Cover photo:
Control room of the Low Emittance Gun test stand, where critical components for XFEL's electron source are being tested.
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The year 2008 marked the 20th anniversary of the Paul Scherrer Institute, PSI, and my colleagues seized the opportunity to organise and run several special events during the year, with the ultimate goal of giving the Institute a higher visibility in the neighbourhood, among critical non-scientific stakeholders and within Switzerland in general. At the same time, important scientific and technological results have been obtained, of which you will learn more in this report. Finally, 2008 was also a special year for me, as I was honoured with the Directorship of the Institute.

20 years Paul Scherrer Institute

In 1988, PSI was founded by the merger of the Swiss Institute for Nuclear Research and the Federal Institute for Reactor Research. The cultures of both institutes were very different at that time, making a new, joint beginning quite difficult. However, from today’s point of view, the amalgamation was the right decision: With the focus on the research areas of solid-state research and materials sciences, particle physics, life sciences, energy research and environmental research, a sagacious decision can be judged to have been made. Nowadays, PSI’s concept of focusing on its large-scale facilities – the neutron and muon sources around the proton accelerator and the Swiss Light Source SLS – is considered a success. The Institute focuses, on the one hand, on providing service for external research groups, which receive the support they need as they use the facilities, beamlines and research instruments, whereby it is our strategy to excel in a number of selected disciplines, rather than trying to serve the needs of all users. On the other hand, PSI’s own research concentrates on those research topics where an advantage in terms of international competition can be gained by employing our own in-house large-scale and complex research equipments.

In addition, PSI’s own research on the complex research equipment itself results in the acquisition of experience that can be used to develop our facilities still further, maintaining the latter’s ability to compete internationally.

Three requirements that are essential for success

PSI serves as a successful example of how a research institute can continue to be an internationally acknowledged scientific hub by simply remaining flexible and thus safeguarding its own existence. Three prerequisites are essential for this: Firstly, a well-defined scientific goal and a clear understanding of the Institute’s role in the Swiss research landscape, especially its relationship with the universities; secondly, political decision-makers who understand the importance of basic and applied research for the progress of society, and consequently support us; thirdly, excellent staff. Only with highly qualified, experienced and motivated personnel is success in performing cutting-edge research possible.

Based on these three factors, within the course of the last 20 years PSI has been able on the one hand to generate outstanding fundamental research results and on the other hand to develop key technologies and introduce them successfully to the market. To give you two examples:

Firstly, the development of compact accelerators for the proton therapy of tumours. PSI is a technology leader in this area, and recent developments can be seen on page 56. Several
hospitals have already expressed their intention to establish this technology on their own sites.
And secondly, we have developed detectors that are orders of magnitude more sensitive than those existing previously.
One such example is the MYTHEN X-ray detector, which is presented on page 26. In combination with recent developments at the SLS, MYTHEN is opening up wholly new perspectives for diffraction experiments.
Both products have already been successfully introduced to the market. It should, however, not go unmentioned that both technologies are the belated offspring of the basic research undertaken in the field of particle physics. As such, they are the results of a development phase of more than 20 years. Where else would such a long-term endeavour be possible, if not at a publicly funded research institute?

Interesting and surprising findings

As to our scientific achievements in 2008, let me just highlight a couple, details of which you will find in the individual chapters in this report: Interesting and even surprising findings around superconductivity and magnetism revealed using neutron scattering and muon spin resonance accompanied us throughout the year (p. 28–31); using the high spatial resolution of synchrotron light at the SLS it was possible on the one hand to create new nano-structures (p. 42–45) and on the other hand to reveal microscopic details of the functioning of photo-catalysts (p. 20), fuel cells (p. 68) and bio-molecules (p. 23) with unprecedented accuracy. To complement the work performed at our large-scale facilities, various complementary methods are currently developed in Biology, Energy, or Environmental Sciences. For example, by using selected isotopes it is now possible to date glacier ice with unequaled precision (p. 40), to enhance the NMR sensitivity for potential medical diagnosis (p. 32), to develop efficient SPECT tracers (p. 50), or to assess the long-term safety of radioactive waste repositories (p. 82). On the operational side of the PSI accelerators, two world records were achieved: The proton facility surpassed its own world record, with a new beam power of 1.3 MW, and the SLS operating team announced a significant improvement of beam quality, resulting in a world-record low vertical emittance of 2.5 pm rad.

For the time being, PSI fulfils all the criteria necessary for remaining amongst the world’s top research institutes for the next 20 years. For us, one such criterion is the development and construction of a novel and ambitious large-scale research installation for dynamical studies with femtosecond and atomic resolution: the free electron laser PSI-XFEL, whose commissioning is planned for 2016 (p. 7).

As a good and longstanding tradition, I shall end this foreword with my sincere thanks: Thanks to the PSI staff, who have made everything possible on which we proudly report in this volume, and “Thank you” to our research and development partners in academia and industry worldwide, to our home canton of Aargau for its manifold support, and to the Board of the ETH and the Swiss Federal Government for their continued support.

Joël Mesot, Director
The PSI-XFEL is planned to be the next large-scale facility at the Paul Scherrer Institute and will contribute to the vitality of the laboratory during the coming decades. The project represents a continuation of PSI’s excellence in the field of synchrotron radiation research, established through the outstanding performance of the Swiss Light Source (SLS), which began operation in 2001.

The PSI-XFEL will complement the SLS by being ideally suited for experiments where the combination of atomic spatial resolution and femtosecond temporal resolution is required – detailed images of atoms and molecules in motion will be captured for the first time.

The PSI-XFEL will be one of the first national free-electron laser facilities worldwide that aims to produce coherent light with wavelengths down to 1 Ångström. It will hopefully serve as a model for other national sources, since further projects of this type are a long-term necessity, given the limited number of experiments that can be installed at any one such facility.

With the PSI-XFEL, Swiss and external users will have an excellent scientific instrument with which to perform novel investigations in the fields of chemistry, biochemistry, condensed matter physics and materials science.

New concepts and innovative technical solutions have been incorporated into the facility design to optimize performance and minimize cost. The low-charge concept, combined with an ultra-small electron-beam emittance, is the essence of this design. The higher longitudinal pulse compression required is realized with a newly-developed dual-frequency accelerating cavity. High-gradient and high-voltage acceleration systems are being developed to reduce space charge effects and to guarantee the required electron beam characteristics for the lasing process.
The exciting features of this novel light source will, for example, allow users to unravel the molecular structure of a protein and to effectively take a motion picture of a chemical process on the scale of femtoseconds (fs). X-ray light of unprecedented quality is needed to guarantee the accomplishment of these ambitious goals. This, in turn, requires an electron beam with high performance and sophisticated beam-handling. In the past year, important steps towards the technical realization of the facility were made, and the XFEL concept was further improved.

Project overview

In a Free Electron Laser (FEL), electrons are not bound to an atom, as in a conventional laser, and light is created by transverse acceleration of a relativistic electron beam in an undulator. In a conventional laser, coherence is created by a stimulated transition of the electrons from an excited state of the atom to the ground state, with a corresponding emission of light that forms a narrow bandwidth around a single wavelength (the shortest wavelength possible is in the VUV). In a FEL, coherence arises from the interaction of the emitted electromagnetic wave with the electron beam, and lasing wavelengths can be achieved continuously down to the hard X-ray regime.

The generic elements of a FEL are a linear accelerator, a radiator constructed from several undulators, with beam focusing devices positioned between the undulator sections, and the photon beam distribution lines that house the experiments at their ends.

Acceleration to high energies is necessary for two reasons. Firstly, the resonance wavelength of an undulator for a given (minimum feasible) period length is reduced with the square of the energy, i.e. short wavelengths require higher energies. Secondly, the electrons can only emit in the fundamental radiation mode if the beam size and divergence (expressed by their product, the emittance) are small. Fortunately, the transverse beam size (and emittance) of the electron beam in a linear accelerator decreases with increasing energy (adiabatic damping). However, the latter condition requires high electron energies (and costly, long linear accelerators) for short lasing wavelengths.

In addition to the requirement of a small electron beam cross-section, there is also the pre-condition that many particles are to be involved in the process, i.e. the charge density must be high. This is achieved by compressing the length of the electron bunch in the linear accelerator by a sequence of bunch compressors.

In the PSI-XFEL, the acceleration process starts at the cathode of the electron gun. Two different electron guns are foreseen for the three undulator lines (Figure 1, Athos: 7 nm – 3 nm; Porthos: 3 nm – 0.7 nm; Aramis: 0.7 nm – 0.1 nm). Since the quality requirements are less stringent for the longer wavelengths, a more conventional gun, based on photoemission, can be used here. For the baseline design incorporating the CERN CTF3 gun, an electron pulse (bunch) of 10 ps duration (fwhm) and a peak current of 22 A is extracted from a metallic...
or semiconductor surface by means of a laser beam. The cathode is placed on the axis of a 2½ cell, 3 GHz accelerating cavity, which immediately accelerates the electron bunch after extraction from the cathode. Solenoid and quadrupole magnets in the subsequent structure focus the beam, to minimize the emittance at the exit of the gun complex.

For the second gun, several options are possible. The decision on which will be based on the success of ongoing R&D work. It will either be a newly-developed photo-electron gun or an alternative gun based on field emission arrays, where electrons are extracted from a surface by means of high electric field gradients (~ 5 V/m). Such high gradients can be easily achieved if the field is applied to micro- or nano-structured surfaces where the field is strongly enhanced around tips with small apex radii. In order to mitigate space charge effects, the energy of the beam is rapidly increased by passing the beam through a high-voltage and high-gradient diode configuration, before entering the first RF accelerating structure. A newly-developed high voltage pulser is currently being tested and further developed. Different surface materials are being explored, to discover those which can sustain high surface gradients without breakdown. Since this concept relies on a longer initial pulse (60 ps fwhm with 5.5 A peak current), a higher compression is required to reach a sufficiently high peak current at the entrance to the undulator. This compression starts in the first accelerating cavity, which is fed by two frequencies (1.5 GHz and 4.5 GHz). In this way, the longitudinal energy distribution in the beam can be suitably shaped to reach a very effective velocity compression. In the low relativistic regime, particles with different energies still have a notable difference in velocities. If they are arranged properly in energy along the bunch, they move towards the bunch centre, and the length is reduced.

After the gun complex, the bunch can be directed into a diagnostic line for complete characterization. A more conventional accelerating structure follows the gun and comprises four S-band structures of 4 m length, surrounded by focusing solenoids. The maximum accelerating gradient is 20 MV/m. In the test setup for this injector presently under construction, a bunch compressor will be placed at the end (250 MeV) for test purposes. In the final layout, an additional accelerating section will be added (Linac 1) in front of the bunch compressor, boosting the energy to 450 MeV. The higher energy will alleviate the risk of emittance dilution due to space charge effects in the bunch compressor. Linac 1 comprises two FODO cells, each of 10 m length, with two accelerating structures of 2 m length between adjacent quadrupoles. One cell will provide an energy increase of 120 MeV on crest, corresponding to an accelerating gradient of 30 MV/m.

During the acceleration process prior to the bunch compressor, an energy chirp will be introduced in the beam. Particles with higher energies will be arranged at the tail of the bunch and particles with lower energies at the head of the bunch. Due to the nonlinearity of the 3 GHz accelerating field, the energy chirp is slightly too large in the head of the bunch and too small in the tail. Therefore an X-band (12 GHz) cavity is introduced before the bunch compressor to compensate for these deviations.

The bunch compressor (BC1) consists of a sequence of four bending magnets, which create an orbit bump around the straight motion path in the linac. Since particles with higher energies are subject to a smaller deflection in the magnets, their orbit lengths are shortened. They are consequently moved from the tail towards the centre of the bunch. Similarly, the lower-energy particles at the head of the bunch experience larger deflections that result in a lengthening of the orbit and a transition towards the bunch centre. The net effect after BC1 is that the length of the bunch is reduced from 10 ps (for the 200 pC mode) to 450 fs.

The subsequent Linac 2 (with the same cell structure as Linac 1) raises the energy to 2.1 GeV. At this point, the second magnetic bunch compressor (BC2) is introduced, which reduces the bunch duration to 30 fs, with a corresponding increase of the peak current to 2.7 kA. For the succeeding Linac 3, the transverse beam dimensions are already considerably smaller, due to the increased beam energy, permitting the distance between the focusing quadrupoles to be increased. One cell here is constructed from four two-metre-long accelerating sections between two adjacent quadrupoles, and has a total length of 19 m.

After Linac 3, the electron beam is extracted for the longer-wavelength FEL lines Athos and Porthos. The nominal energy at this point is 3.4 GeV, but will be reduced to 2.1 GeV for Athos by not powering Linac 3. It remains to be verified by simulations whether the focusing lattice can remain unchanged, since the quadrupole strengths are matched to a higher energy, otherwise a second extraction point after Linac 2 will need to be inserted.

Only for the 1 Ångstrom wavelength of Aramis is an additional boost to 5.8 GeV required, provided by Linac 4, which uses the same cell structure as Linac 3.

The electron beam quality is now sufficient for the lasing process as the beam enters the undulators. The emittance is reduced by adiabatic damping, and the beam is longitudinally compressed. In principle, an electron transversally accelerated in a magnetic field emits a broad spectrum of radiation. However, in an undulator the only wavelengths not to be eliminated by interference effects are those for which the electron beam lags behind the photon beam by one wavelength (or an odd integer multiple). Due to the long undulator structure, the intensity of the radiation steadily increases and becomes sufficiently
strong to act back on the electron bunch. The transverse electric field of the emitted wave causes acceleration and deceleration of particles within the transversally moving electron bunch in the undulator, which imprints a micro-bunch structure onto the whole. The more this structure is enhanced, the more coherent the radiation becomes. At saturation, the waves emitted from the different micro-bunches are summed up in phase, leading to a tremendous increase in intensity of the transversally, fully coherent light.

At the end of the undulator, a photon beam with 2.9 GW power is extracted from Aramis, with a pulse duration of 40 fs at 1 Ångström wavelength. The photon beam is then distributed to the various experiments. At the exit of the undulator, no material can withstand the high power density, necessitating long expansion lines before optical elements can be positioned in regions of acceptable heat load. Since X-ray mirrors have useful reflectivity only at very small grazing angles, long optical lines with refocusing are required to guide the photon beam to the experiments.

Project progress

The PSI-XFEL project is being executed in three parallel developments. Major emphasis is given to the realization of a low-emittance gun by exploring the ultimate limits of conventional photo-cathodes and investigating new options based on field-emission from needles and field-emitter arrays (FEA). Simultaneously, the injector of the XFEL facility is being built, which will integrate the major critical R&D elements of the project and allow their verification and optimization at an early stage. Finally, the configuration of the final XFEL facility is being developed and the civil engineering requirements are being specified.

High-brightness electron beams

Operation of the PSI-XFEL will start with a conventional photo-gun for the electron source. Simulations have confirmed satisfactory performance for both the hard and soft X-ray undulator beamlines. Eventually, after successful completion of the R&D, the driver system for the hard X-ray line will be equipped with a cathode based on field-emission from a needle or an FEA, embedded in a diode configuration for high-gradient and high-voltage acceleration. For the needle cathode, two independent emittance measurement methods have confirmed the target value of 0.2 µm. Further work is needed to reach the required charge and emission current. A major step forward was made for FEAs by controlling the tip apex for homogeneous emission, and a production process for double-gated arrays (Figure 2) has been developed [1]. It could be demonstrated that the focusing gate has little effect on the emitted current, compared to the single-gated array. So far, the current is limited by the available accelerating voltage. A new test setup is being installed to overcome this limitation.

XFEL injector

Construction of the 250 MeV injector for the FEL facility will allow the testing of critical technical developments, and the verification and optimization of their performance, at an early stage. For optimum performance, two complementary electron guns will feed the linear accelerator. Both gun concepts can be tested in the 250 MeV injector facility. Operation will start with the “CTF” photo gun (Figure 3) [2]. Emission from the cathode is driven by a Ti-Sapphire laser system, which allows longitudinal pulse-shaping and wavelength-tuning for the generation of minimum emittance.
Construction of the 250 MeV injector is currently in progress and the procurement of magnets, accelerating structures, klystrons, modulators and laser systems has begun. Building construction is well underway (Figure 4) and will be completed early in 2010.

**XFEL facility**

Extensive start-to-end simulations have been performed in order to consolidate the basic parameters and the configuration of the XFEL facility. Figure 5 shows the simulation results for Self Amplified Spontaneous Emission (SASE) at 1 Ångström wavelength.

![Spectrum at saturation for SASE operation.](image)

The three XFEL beamlines have been re-optimized to allow independent operation. For the soft X-ray undulator line, seeded operation is foreseen, possibly based on high-harmonic generation from a Ti-Sapphire laser [3]. This will enhance the longitudinal coherence of the XFEL pulse, even at wavelengths down to 1 nm, and render the XFEL operation more stable in both frequency and time. Provisions for short-pulse operation have been made, based on either laser-slicing or low-charge, “single spike” operation (Figure 6).

![“Single spike” spectrum at saturation for 2 pC operation.](image)

The consolidation of the XFEL configuration has allowed the preparation of a conceptual design of the building with experimental hall and technical infrastructure. The orientation of the building has been slightly modified to increase the available space (Figure 7).

The accelerator and the experimental hall will be completely below ground, with an underground supply area on top of the accelerator tunnel (Figure 8).

![Design study of the XFEL tunnel, with accelerator and technical gallery.](image)

For further information see: [http://fel.web.psi.ch](http://fel.web.psi.ch)

**References**

[1] S. Tsujino et al., to be published.


Novel science at the PSI-XFEL

Scientific strengths of the PSI-XFEL

The photon energies of the PSI X-ray Free Electron Laser (XFEL) [1] will allow a wide range of investigations of matter at the molecular and atomic level (see Figure 1). Furthermore, the extremely short X-ray pulses (<20 fs = 2 × 10⁻¹⁴ s) and high peak flux (10¹¹ photons/pulse) will permit the study of ultra-fast dynamics, either as equilibrium fluctuations or in “pump-probe” experiments. XFEL-radiation has 100% transverse coherence, allowing “lensless imaging” of nanostructures, down to atomic resolution. Although a focused XFEL pulse will locally destroy the sample, the short pulse duration will ensure that the scattered photons reaching the detector arise from undamaged material. Variable-polarization undulators at the PSI-XFEL will allow observation of magnetization dynamics, using the magnetic contrast of the L absorption features of, for example, Fe, Co and Ni. Interesting magnetic processes may be efficiently initiated at the PSI-XFEL with picosecond, half-cycle pulses of intense terahertz (THz) radiation, produced by a dedicated source, synchronized with the XFEL. The same THz source may also initiate surface catalytic reactions. It is also planned that the PSI-XFEL will deliver highly uniform, “transform-limited” X-ray pulses, suitable for novel “quantum optics” techniques, such as heterodyne spectroscopy. Finally, the maximum photon energy of the PSI-XFEL may be sufficiently high to reach the ultra-narrow (10⁻⁸ eV) “Mössbauer resonance” of the ⁵⁷Fe nucleus, yielding the ultimate in high-coherence X-rays. In what follows, we briefly present three proposed XFEL experiments of particular interest to PSI research divisions.

Nanoscale magnetic processes

Very stable “magnetic vortices” in planar magnetic nanostructures may in the future be used for high-density information storage. Field-induced switching of the core of such a vortex is predicted to occur on the nm and ps length and time scales [2](see Figure 2). With the high transverse coherence and the circular polarization of the PSI-XFEL beam, and at photon energies close to the magnetically-sensitive L₂ and L₃ edges of, for example, cobalt (at 793 and 778 eV, respectively), it...
will be possible to take “snapshots” of the instantaneous magnetization distribution in thin-film nanostructures, and hence to follow this process in detail.

Unstable intermediates in surface catalysis

Surface catalytic reactions play a central role in many industrial chemical processes, in clean energy production and in eliminating environmental pollutants. A typical reaction is shown schematically in Figure 3. In the presence of a heated substrate, reactant species go through a series of short-lived intermediate states, finally emerging as the desired product. Figure 3 illustrates a possible “THz pump / X-ray absorption spectroscopy probe” XFEL measurement, which will elucidate the chemical nature of intermediate states on a ps-ns timescale [3].

Protein structure from 2D-crystals

Protein structure determines the function of the building blocks of life, and its knowledge permits the intelligent design of drugs to treat genetic diseases. Many clinically relevant proteins are membrane bound. Their 3D crystallization is difficult and requires tedious optimization to yield well-diffracting crystals. With the PSI-XFEL, it should be possible to extract high-resolution structural data from diffraction experiments on two-dimensional crystals (see Figure 4), complementing the techniques of electron diffraction/microscopy [4]. Although each XFEL shot will locally destroy the sample, with a focus spot size of 100 nm and the 100 Hz repetition rate of the PSI-XFEL, it will be possible to reposition the sample between shots.

References

The PSI-LEG test stand


The PSI-LEG test stand is PSI’s test bed for the development of an ultra-bright electron gun based on a high-voltage pulser configuration. This is one of several promising candidate designs for the electron source to be used at the PSI X-ray Free-Electron Laser. Since the start of operation at the end of 2007, the test stand has provided important information on relevant materials and geometries. The facility was recently upgraded with the addition of a radio-frequency cavity to accelerate electrons up to 4 MeV.

Introduction

Operating an X-ray free electron laser at relatively low electron energy requires an electron beam of unprecedented brightness: the electrons must be as densely packed as possible yet still propagate on highly parallel trajectories. Since any irregularities in the electron beam from the source cannot be corrected further downstream, the quality of the electron source is of paramount importance. To explore and evaluate new concepts for the generation of ultra-bright electron beams, such as field-emitter arrays or needle cathodes, PSI initiated the Low Emittance Gun (LEG) project. (The emittance of a beam is a measure for how well it can be focused – the lower the emittance, the brighter the beam.) The centre-piece of this effort is the PSI-LEG test stand, located in the OBLA building. The installation was implemented in two phases, with electrons reaching energies of 500 keV and 4 MeV, respectively.

Phase I: From 0 to 500 keV in 50 ps

In its initial form, the PSI-LEG test stand consisted of a high-voltage pulser followed by a short diagnostic beamline. In this configuration, the test stand was in operation from December 2007 until October 2008. The pulser generates a “diode” electric field between two metal electrodes (typically copper or stainless steel) separated by a variable gap of several millimetres. The electric field can reach up to 120 MV/m for the duration of about 250 ns. It accelerates electrons emitted at the cathode to a kinetic energy of approximately 500 keV in a few tens of picoseconds. At this energy, the influence of repulsive space-charge forces...
The broadening of the electron distribution emerging from each hole is a direct measure of the local, uncorrelated divergence of the beam (Figure 2).

Operation of the test stand during Phase I resulted in a wealth of information important to the further development of the programme. In particular, a wide range of cathode materials was investigated with regard to quantum efficiency and highest field gradient achievable with and without laser irradiation. Electrodes made from diamond-like carbon were shown to withstand up to 240 MV/m without, and 100 MV/m with, laser irradiation. The maximum extracted charge was 200 pC, when using a powerful Nd:YAG laser of 262 nm wavelength. The setup also allowed an accurate measurement of the so-called thermal emittance of the electron beam emerging from a metal cathode. This is the residual emittance arising from the thermal motion of the electrons inside the cathode prior to emission.

Phase II: Surfing to 4 MeV

To increase the beam energy into the MeV range, a radiofrequency cavity was added to the test stand during a major upgrade (Figure 4). The beamline now measures some five metres in length and includes a dispersive branch for momentum measurements (Figure 3). Installation was completed in December 2008, and first beam was observed in early January 2009. The new setup will give valuable insights as to how the emittance of the generated electrons can be preserved up to higher energy.

An entirely re-designed laser system will provide laser pulses of tuneable wavelength, thus allowing the study of beam emittance as a function of photon energy. Last but not least, the experience gained by operating the PSI-LEG will be of great value for the commissioning of the much larger future facilities that are planned in the context of the PSI-XFEL project.
Examples from PSI’s research portfolio in 2008 are presented on the following pages, but this is only a very small sample of the cutting-edge research being performed at the Institute.

A large number of results in various fields of science have been obtained at PSI’s large-scale facilities; for example, research at SLS provided insights into the structures of novel nanomaterials, the inner workings of photocatalysts and processes in biomolecules. The fascinating interactions between superconductivity and magnetism were among the topics investigated with muons and neutrons.

The development of a new process for turning wet biomass into methane, and thus making the solar energy stored in these materials available for use in households and vehicles, is but one example of PSI’s activities towards a sustainable energy supply. In the field of nuclear energy and safety, current research projects include the investigation of the geological conditions required for the storage of nuclear waste and the development of methods for monitoring material fatigue in nuclear power plants.

In environmental research, information gained from an ice core drilled in the Siberian Altai Mountains showed the influence of solar activity and greenhouse gases on the local climate, and a new method developed by researchers from PSI and ETHZ will allow even more precise dating of ice cores in the future.

Activities in the medical field covered a very broad range, from fundamental research into the origins of various diseases to the treatment of actual patients at the proton therapy facility. The year 2008 was the first year of continuous patient treatment at Gantry 1, as well as a year of considerable progress in the development of future facilities and technologies for proton therapy at PSI.
The physical properties of the isoelectronic, two-dimensional structures of graphene and hexagonal boron-nitride are complementary and may also in combination become technologically useful. On solid supports, both deviate from a perfectly flat honeycomb structure and provide the possibility to functionalize them as templates for nanoscaled arrays among other applications. Structural and electronic studies of these systems performed at the Swiss Light Source have provided new insights for their potential use in areas as diverse as molecular recognition, nanoarrays, and novel electronic device fabrication.

Graphene and hexagonal boron-nitride (h-BN) are honeycomb structures that can be grown as single layers, or “sheets”, on crystalline substrates. The bonding between these sp²-hybridised, two-dimensional structures and the substrate varies periodically, due to a moiré-like interference caused by differences in their respective in-plane lattice constants. As a consequence, the atomic sheets become corrugated, resulting in features with periods of a few tens of Ångströms. They are characterised by pronounced and separated triangular elevations on a hexagonal network in the case of graphene, but in h-BN the elevations are more hexagonal with wire-like connected rings, and is thus referred to as a “nanomesh”. Their future use as nanotemplates for molecular arrays and in recognition of macromolecules is a tantalizing prospect that can be better assessed only by a deeper understanding of their structures and electronic properties. With this in mind, studies of these systems have been performed at the Surface Diffraction Station and Surface and Interface Spectroscopy Beamline of the Swiss Light Source.

Graphene on Ruthenium

Initial studies of graphene on Ru(0001) (g/Ru) using techniques such as scanning tunneling microscopy and low-energy electron-diffraction produced mutually contradictory results: two different structures were proposed – one in which (12×12) graphene hexagons lie on (11×11) Ru unit cells (denoted henceforth as 12-on-11) [1], and another suggesting an 11-on-10 structure [2]. None of these studies, however, had the necessary spatial sensitivity to unambiguously resolve this inconsistency. Only surface X-ray diffraction (SXRD) has the necessary resolution (approximately two parts in ten-thousand of an in-plane reciprocal lattice unit), and hence SXRD studies were performed on g/Ru at the Materials Science beamline of the SLS. Surprisingly, in-plane SXRD measurements showed that the moiré structure agrees with neither of those previously proposed, but is in fact unambiguously 25-on-23, having a pe-
Riordicity of over 60 Å [3]. This superstructure comprises four translationally inequivalent (but nonetheless nearly identical) subunits [see Figure 1(a)] with chemistries very similar to that of the initially proposed 12-on-11 structure. Out-of-plane measurements along superstructure rods showed pronounced oscillations and indicated both strong out-of-plane corrugation of the graphene with an amplitude of 1.4 Å, and also a weaker corrugation of the Ru. More recent analysis of the data using a parametric approach implemented in GenX, which uses a genetic algorithm [4], shows that the corrugation of the Ru is 180° out of phase with that of the graphene [Figure 1(b) and [5]].

Dipole rings in the h-BN nanomesh

h-BN nanomeshes on Rh(111) and on Ru(0001) were also studied using SXRD and showed registries of 13-on-12 [6] and 14-on-13, respectively [7]. Strong modulations of the superstructure rods also indicate significant modulations of the h-BN and substrate. This corresponds well to STM studies of h-BN on Rh, where a clear corrugation of the surface was observed [8].

In contrast to graphene, the h-BN nanomesh is not a metal [9] and a difference in the electronic and electrostatic landscape between the regions close to the substrate (holes) and those further away (wires) is expected. These differences can be measured by angle-resolved photoemission-spectroscopy (ARPES). The difference in electronic structure between the holes and wires is reflected in a splitting of the σ bands [Figure 2(a)], but because of the absence of any states at the Fermi level this has no immediate effect on the lateral electrical resistance. However, this splitting reflects the different electrostatic potentials in the holes and on the wires. This difference in the local work function can also be probed through the adsorption of a closed shell species such as xenon, as is visible from the different core-level lines for adsorbed Xe in the holes and on the wires [H and W in Figure 2(a)].

The difference of 300 meV in electrostatic energy at the Xe atom sites indicates a lateral local electrostatic field on the rims of the holes. This dipole field locally enhances the bonding of atoms or molecules that may be polarized. In order to test this hypothesis, we performed thermal-desorption spectroscopy measurements on adsorbed Xe. Detailed analysis of the respective Xe core-level intensities on the holes and wires as a function of temperature [Figure 2(a)] indicates that the Xe bond energy on the holes and the wires is almost the same, except for the last 12 Xe atoms in every hole. These Xe atoms form a ring at the rim of the holes, where the dipole field is strongest, and are trapped there up to significantly higher temperatures [10].

These results indicate that every hole of the nanomesh has a dipole ring which significantly enhances its trapping potential. This is further illustrated by the ability to trap Cu-phthalocyanine (Cu-Pc) molecules at room temperature, as shown in Figure 2(b). As on most other substrates, the molecules can move within the holes, resulting in the diffuse shapes. However, they cannot cross the dipole ring once they are trapped. Similar trapping mechanisms are expected for all molecules and atoms, where the maximum trapping temperature depends on their size and polarizability.

The h-BN nanomesh is robust in air and even water, thus with the regular spacing of the dipole rings and the relatively easy preparation of large-scale samples the technological relevance of more than $10^{11}$ molecular traps per square mm is self-evident.

References

X-ray absorption spectroscopy (XAS) has long been established as a precise method of measuring local structure in disordered systems such as molecular systems in solution. This technique has recently been introduced into the domain of ultrafast science where the electronic and nuclear dynamics of molecules and crystals are examined on the time scales of atomic motion [1, 2]. In the present investigation, ultrafast XAS has been used to examine the photocatalytic excited state of the \( \text{[Pt}_2\text{(P}_2\text{O}_5\text{H}_2)_4]^{4–} \) (PtPOP) anion (see Figure 1) dissolved in ethanol.

Time-resolved X-ray absorption spectroscopy

An X-ray absorption spectrum is obtained by measuring either the transmission or total fluorescence of a sample as a function of incident X-ray photon energy. A typical measurement allows the reconstruction of atomic distances on the scale of <0.01 Å. Using this technique, the structure of the ground state of PtPOP was measured for the molecule in solution, indicating a Pt-Pt distance of 2.876(28) Å and a Pt-P bond length of 2.32(4) Å [3]. These values are in agreement with previous spectroscopically derived values as well as DFT calculations [4], and represent a small difference from those measured using crystallographic techniques. In the ground electronic state, this molecule has two electrons in the Pt-Pt \( \sigma^* \) (dz\(^2\)) antibonding molecular orbital. Upon excitation with 350–390 nm ultraviolet light, PtPOP can be excited into the \( \sigma(p_x) \) bonding orbital, resulting in the formation of a transient Pt-Pt bond and a predicted decrease in the Pt-Pt distance.

Exciting heavy metal retrieving structures in photocatalysis

Photocatalysts play an important role in a broad range of applications, from photochemical conversion of light energy into chemical energy to initiating novel chemical reactions. One family of compounds that has attracted much attention are the dinuclear d\(^8\)-d\(^8\) platinum, rhodium and iridium complexes that have a highly reactive electronic excited state. When photo-excited with light, these systems have been shown to abstract H-atoms from a variety of substrates and initiate electron transfer processes. In this work, the structure of the triplet excited state of a diplatinum member of this photocatalyst family is examined.

Figure 1: Structure of the \( \text{[Pt}_2\text{(P}_2\text{O}_5\text{H}_2)_4]^{4–} \) (PtPOP) anion.
Measurements were performed at the MicroXAS beamline at the Swiss Light Source by exciting a 10 mM PtPOP solution in ethanol with 100 fs laser pulses at 390 nm and probing at the Pt L₃ absorption edge (11.56 keV). The transient XAS spectrum (excited minus unexcited), shown in Figure 2a, directly reflects the electronic and structural changes that occur 150 ns after excitation. In this study, the EXAFS region of the XAS spectrum has been exploited to determine the excited-state structure of PtPOP.

Retrieving excited-state structures

The ability to retrieve photoinduced structural changes with high accuracy is based on a rigorous model-based fitting approach. By including prior knowledge in the form of physically reasonable distortion models, the number of free fitting parameters can be reduced considerably, allowing the introduction of additional parameters, such as the photoexcited population and the energy shift between excited and ground-state XAS spectra, which are typical for time-resolved XAS analyses and often difficult to obtain by independent methods. The general procedure followed is to first obtain accurate structural values for the ground state of the system, then to use these values as a starting point for the excited-state structure. By making physically reasonable changes to the ground state structure according to a specific distortion model, then simulating the EXAFS spectrum for the new structures, the resulting transient EXAFS spectra can be calculated by subtracting the ground-state fit. For each excited-state structure, the difference between the experimental and simulated transient spectra can be minimized by introducing fitting parameters such as the energy shift and the photoexcited population. This procedure can then be repeated with various realistic structural distortion models that all involve a contraction along the Pt-Pt axis, allowing the result to converge to the smallest difference between experiment and calculation.

In this way, the best fit was obtained for a Pt-Pt contraction of 0.31(6) Å and a Pt-ligand elongation of 0.013(5) Å (see Figure 2) [5]. The latter is larger than just resulting from the Pt-Pt contraction, which indicates that the coordination bonds are weakened upon the Pt-Pt bond formation in the excited state. This small Pt-P elongation has been predicted by DFT calculations [4], but this represents the first experimental confirmation of such a structural change and illustrates the sensitivity of both time-resolved XAS as a technique to resolve excited-state structures and the analysis procedure used. Remarkably, the bridging P-O-P ligands do not follow the Pt atoms in the contraction movement, which supports the weakening of the Pt-P bonds and the rigidity of these bidentate ligands. In addition, the analysis indicates an excitation population of 7% and a zero energy shift. Both of these conclusions seem accurate: optical measurements indicate an excited-state contribution of approximately 8%, and no energy shift of the excited-state X-ray absorption spectrum is expected as the photoexcitation does not affect the charge density on the Pt atoms.

It should be emphasized that the present transient EXAFS analysis goes beyond the simple determination of nearest-neighbour distances. By using a model-based fitting approach, a more global picture of the excited molecule can be obtained. Application of this analysis technique to other photocatalytic systems should provide a wealth of information not directly available through other methods.

References

Transfer of information is a basic property of biological systems, with common examples including the transfer of genetic information or nerve impulses. The transmission of signals occurs at an even more fundamental level and is mediated by signaling molecules, which bear a phosphate or a sulfate group. Since these processes are of supreme importance, they have been extensively studied and a number of mechanisms and related protein structures have been revealed. ASST is unusual amongst sulfuryl transfer enzymes in that it exhibits a previously unknown three-dimensional structure. This novel topography was revealed by X-ray crystallography at the SLS [1].

The crystal structure of ASST, at 2 Ångström resolution, revealed that ASST contains an extremely unusual disulfide bond. In ASST, this bond is characterised by an extremely short distance between the two linked cysteine residues and a high steric strain, which we believe can only be efficiently formed by the action of the disulfide bond formation machinery genetically associated with ASST [2]. This disulfide bridge is a prerequisite for proper folding of this protein and could also play a role in regulating its catalytic activity. More striking than this unusual disulfide bond geometry, however, was the overall structure of ASST. This consisted of two equal propeller-like parts which contain active sites in the central funnel formed by the beta-sheet ‘blades’ of each of the propellers. Such a fold has never before been observed for a sulfotransferase, leading to fundamental questions regarding the structure-function relationship of ASST.

In order to answer these questions, two complementary approaches were adopted: we replaced individual amino acids and probed the biophysical properties of these mutant forms of ASST, while concomitantly treating the native form of ASST with molecules acting as sulfuryl-donors and solving the crystal structure of these native intermediates. Mutations of ASST showed five nitrogen-containing amino-acids to be essential for function. These residues build a reaction cage which accommodates both the donor and the acceptor of the sulfuryl group. Furthermore, during sulfotransfer, the sulfuryl group is directly (covalently) bound to a histidine side chain of ASST. Thus, the signal is first transferred from the donor to ASST and subsequently from ASST to the acceptor. Such a ping-pong mechanism is unique in the processes of sulfuryl transfer.

As a number of histidine residues surround the active site of ASST, in order to clarify the catalytic role of each residue,
Electrospray ionization mass spectrometry was performed on both the native and sulfurylated forms of the enzyme. Together with the crystal structure of native ASST, results from these experiments clearly demonstrated that His-436 is the residue that undergoes transient covalent sulfurylation during catalysis. Structural analysis of the two intermediate forms of ASST showed, for the first time, this high-energy sulfuryl-histidine intermediate state, confirming the proposed ping-pong reaction pathway.

The experiments summarised here provide a basis for understanding sulfuryl transfer in a manner independent of the universal sulfuryl donor (adenosine 3'-phosphate-5'-phosphosulfate, PAPS) in mammals, opening up medically interesting perspectives. ASST is a promising target for antibacterial drugs, and together the crystal structures and biochemical data provide a basis for drug design targeting this virulence factor.

It is also interesting to note that these insights were only made possible by combining crystallographic, spectroscopic [3], and other biochemical methods. An advanced form of mass spectrometry, combined with multiple crystallographic models enabled us to understand the architecture of the active site and thus elucidate the catalytic pathway of the enzyme. The complete account of the work described here can be found in reference [1].

References
During lung development, the airways and an extensive gas exchange area have to be formed. The development usually starts with the appearance of two lung buds. At the terminal ends of the buds, a repetitive process starts where elongation of the future airways alternates with branching. After approx. 20 rounds of outgrowth and branching, the ducts and parts of the respiratory airways are formed. During alveolarization, the gas exchange area is further enlarged by a subdivision of the terminal air spaces by the formation of new septa. One leaflet of the double-layered capillary network inside the existing septa folds up and gives rise to a new double-layered capillary network within the newly forming septa (Figure 1, A–C). Later, during microvascular maturation, the double-layered capillary network of the alveolar septa is reduced to a single-layered one (Figure 1D). Currently, it is believed that after this phase the lifting off of new septa from preexisting ones is excluded due to the missing second capillary layer. Consequently, after microvascular maturation is completed, the enlargement of the gas exchange area will be achieved by lung growth and not by addition of new alveolar septa. By the same token, a mature alveolar septum, once lost, will most likely not be reformed. Therefore, a noteworthy amount of lung regeneration is excluded, according to this view. The time when alveolarization in humans stops is not well-defined and has been discussed for decades. Currently, many agree on an age of 2–3 yr[1] whereas older data suggested that the formation of new alveoli ceases at ca. 8 yr or even at 16–18 yr of age[2]. Nevertheless, one question remained open: how may new alveoli be formed at a later time point? It has been proposed that (i) late alveolarization may take place in subpleural areas where a double-layered capillary network is not required or (ii) late alveolarization may follow a different, unknown mechanism. So far, alveolarization after the phase of microvascular maturation is on debate, and the question on how any form of “late” alveolarization may take place remains open.

The large clinical relevance of late alveolarization inspired us to follow two directions. First, we applied a stereological method by estimating the length density of the alveolar entrance rings and developed a novel approach to follow the formation of new alveolar septa throughout lung development and growth. Second, we were wondering how the requirement...
of a double-layered capillary network inside the existing alveolar septa may be overcome. For this purpose, we studied 3D tomographic data sets of vascular casts of rat lungs obtained at the TOMCAT beamline of the SLS. Figure 2 shows the lumen of the capillaries. Inside the cavity of an alveolus, the up-folding of the single-layered capillary network is observed (blue dashed lines in A, C, and E). The folding is indicative of the formation of a new septum. The 3-D visualization enabled us, for the first time, to look at the reverse side of the same septum (B, D, and F). At the basis of the folding, we detected a local duplication of the existing capillary network (covering of the blue dashed line in B, D, and F). Whereas most duplications are already formed in these examples (arrowhead), one is most likely just forming by sprouting angiogenesis (arrow in B). In addition, (forming) tissue posts inside the capillary network (holes in the vascular cast, green asterisk) are indicative for intussusceptive angiogenesis (the growth of the capillary network to allow the up-folding).

We were able to show that the requirement of a double-layered capillary network at the site of septation is still valid; however, the two layers do not have to be preexisting as currently postulated, but they may be formed rapidly and locally by angiogenesis when needed. Because microvascular maturation takes place during alveolarization, we defined the entire time when new septa/alveoli are formed during lung development and growth as “developmental alveolarization”. This term distinguishes the developmental processes from any kind of lung regeneration, which we called “regenerative alveolarization”.

Synchrotron-radiation tomographic microscopy was essential for the structural understanding on how new alveoli are formed throughout lung development and growth. We could show that new alveoli are formed not only before, but also after, the maturation of the alveolar microvasculature. During the latter, the requirement of a double-layered capillary network at the site where a new septum will be formed is overcome by a local duplication found at the sides of septation. Most likely, many of these duplications were not preexisting. We defined the classically described alveolarization “phase one of developmental alveolarization” and the newly described form “phase two”. Until now, the understanding of phase two is based on structural evidence only. However, due to its clinical significance, we believe that these structural findings will be the starting point for investigations of the molecular mechanisms involved. The description of phase two will most likely force us to rethink our views of (i) lung regeneration and of (ii) side effects on the structure of the lungs during the treatment of children and adolescents with glucocorticoids and retinoids.

References
MYTHEN: The fastest high-resolution solid-state X-ray detector for powder diffraction

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MYTHEN is a 1-D detector designed for powder diffraction that is capable of acquiring 120° (in 2θ) diffraction patterns with sub-sec time resolution. It is, therefore, optimal for time-resolved and dose-critical measurements. Thanks to its outstanding performance and the calibration procedure developed at SLS, data quality is now comparable with that of traditional high-resolution detectors, with the further advantage of very fast data acquisition or, equivalently, very high counting statistics, with acquisition times of the order of tens of seconds. MYTHEN is therefore also ideal for the analysis of pair distribution functions (PDFs).

Synchrotron radiation X-Ray powder diffraction (SR-XRPD) experiments require detection systems with low noise, high dynamic range and high angular (FWHM) and d-spacing resolution. These requirements can only be fulfilled by single-photon counting systems with high granularity [1]. The MYTHEN detector (Microstrip sYstem for Time reSolved expeRimeNts) has been designed to fulfill all these demands and, furthermore, to perform time-resolved measurements. High-resolution powder diffraction patterns acquiring 120° in 2θ can be collected in a fraction of a second.

Detector description

The MYTHEN detector consists of more than 30,000 independent channels (µstrips) working in parallel and positioned at 760 mm from the centre of the diffractometer, with a pitch of 50 µm. This results in an intrinsic detector angular resolution of 0.004° [2]. The detector is based on a silicon micro-strip sensor absorbing the diffracted X-rays and coupled to a custom-made integrated circuit [3].

Thanks to its single-photon counting capability, the detector is virtually noiseless and has a dynamic range of up to 24 bits. The fluctuation in the number of detected photons is purely Poisson-like, and thus the data quality is maximized, with low statistics. The low noise of the front-end electronics allows the detection of photons of energy down to 5 keV, while the short shaping time of the analogue signal permits counting rates of up to 1 MHz/channel. The channels are read out in parallel, with an inter-frame dead time of 0.3 ms. The maximum frame rate of the whole detector is limited by the data transfer rate and is about 10 Hz for the whole detector (increasing to 300 Hz for a 5° partial readout and 16 bits dynamic range). Acquisition times down to 100 ns are possible and can be synchronized to users’ experiments using external signals. A small on-board memory can store 4 to 32 frames in real time, depending on the dynamic range. Data acquisition with MYTHEN is possible through a user-friendly graphical interface and is completely integrated in the beamline control system.

An upgraded version of MYTHEN was installed at the SLS powder diffraction station in July 2007 and has been available for users since the beginning of 2008, providing excellent data quality.

Applications

Some examples of experiments showing the outstanding performance of the MYTHEN detector are:

1) Bragg crystallography

MYTHEN has worked remarkably well, not only for time-resolved applications but also for structural solution and refinement. Here, time resolution is usually not relevant and, therefore, the intensity of the incoming photon beam is generally sacrificed to achieve an optically aberration-free beam. This results in optimal Gaussian/Voigtian instrumental line-shape functions and, therefore, the diffraction patterns are easily processed by any refining program. Thanks to the exceptional efficiency and fast acquisition of the MYTHEN detector, it is also possible to acquire full diffraction patterns of organic compounds within a few seconds, without any radiation damage, and to solve and refine their crystal structure [5].
PDF studies

The PDF [6] and Debye [7] methods are total scattering techniques, in which the whole powder pattern is taken into account. This is especially useful when Bragg peaks alone do not contain the desired information, either because samples are disordered or have small particle size, or because the research focuses on disorder of some kind which exists apart from a trivial average crystal order. Of course, all contributions to the total pattern that do not stem from the sample need to be either measured separately or sufficiently well modelled. Multiple exposures and long counting times are normally necessary in order to acquire sufficient statistics at high scattering angles and at relatively high X-ray energies, where the photon flux is small.

The need for comparing and subtracting multiple patterns puts further demands on detector stability and linearity. MYTHEN also stands out in this field, thanks to its large dynamic range, that allows both high-intensity and low-intensity regions to be accessed, and to its high counting efficiency, that allows the acquisition of all relevant data sets within a short time. A PDF experiment can now be performed in times comparable to a classical diffraction experiment using a point detector.

Time-resolved experiments

Pioneering in situ microwave heating experiments have been performed by a group from EMPA Thun [9] at the SLS-MS beamline since 2006.

The fast frame rate of the MYTHEN detector enables experiments to be carried out in which the structural and microstructural evolution of solids under microwave application can be accurately followed in near-to-real time, while monitoring the microwave heating processes [8] and eventually fine-tuning the microwave application for processing for a broad variety of materials.

An excellent example of this is the efficient microwave-assisted carbothermal reduction of magnetite Fe₃O₄ to iron, a process of high interest for the steel industry. A transient iron oxide phase was found which intermediates the transition from magnetite, Fe₃O₄, to wüstite, FeO (see Figure 1). The kinetics of this phase transformation provides a deeper understanding of volumetric heating by microwaves [10].

Conclusions

The MYTHEN detector shows outstanding performance, not only for time-resolved experiments but also for structural determination and refinement, and for PDF measurements. The quality of the data acquired with the micro-strip detector is comparable with that obtained by using a crystal analyzer detector, with the further advantage of measurement times that are 5000 – 15000 times faster, depending on the X-ray energy and d-spacing resolution required. Time-resolved studies impossible with any other powder diffraction detector can be performed, opening up new perspectives for in situ measurements.

References

First results on iron-based superconductors

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In 2008, the Laboratory for Muon-Spin Spectroscopy (LMU) was at the forefront of research on the recently discovered iron-based high-temperature superconductors. In view of the vicinity of the magnetic and superconducting states and of their possible interplay in these compounds, muon spin rotation (μSR) has been widely recognized as one of the key techniques to test for possible microscopic coexistence between different ground states. In addition, μSR has been used to provide fundamental results about the nature of the magnetic and superconducting states.

The observation of high-temperature superconductivity in layered iron pnictides \([1]\) early in 2008 triggered the second gold rush among solid state scientists, after the discovery of high-\(T_c\) cuprates. As in the well-studied cuprates, superconductivity in these new compounds takes place mainly in crystal layers (in this case FeAs), with the rest of the structure acting as a charge reservoir. Moreover, a remarkable parallel with the cuprates can be drawn from the observation that superconductivity appears when doping away from an antiferromagnetically ordered mother compound, suggesting the importance of magnetic fluctuations in the mechanism of Cooper pair formation. At the same time, in contrast to the cuprates, the magnetic parent compound is not a Mott-Hubbard insulator but a metal. Therefore, it is believed that, after 20 years of research on high-\(T_c\) superconductors, the Fe-pnictides may finally provide insight into the superconducting coupling mechanism. From the beginning, muon-spin spectroscopy (μSR) research at PSI has been playing a key role in the investigation of Fe-pnictides, on the one hand by providing fundamental results about the nature of the magnetic and the superconducting states, and on the other hand by investigating the interplay between these two ground states (see e.g. \([2–6]\)).

Diverse studies were conducted on various families of the Fe-pnictides by different research groups at the PSI μSR facilities in 2008. As examples, we present some results on the magnetic and superconducting properties of the first discovered \(\text{LaO}_{1-x}\text{F}_x\text{FeAs}\) system.

Magnetic properties

Muon-spin relaxation measurements and \(^{57}\text{Fe}\) Mössbauer spectroscopy were used to determine the magnetic properties of \(\text{LaOF}_{\text{As}}\), a mother compound of the newly discovered iron-based superconductors \([3]\).

These studies prove a static magnetic order below \(T_N = 138\) K with a clearly commensurate spin structure and a strongly reduced ordered moment at the Fe site in the ordered phase. The data provide a high-precision measurement of the temperature dependence of the sublattice magnetization. As shown in the inset of Figure 1, the muon thermalizes at an interstitial lattice site in the vicinity of the iron moments, which generate a dipole field at the muon site. Therefore, the μSR technique allows the Fe sublattice magnetization to be determined via the muon spin precession in the local field. In combination with Mössbauer spectroscopy measurement, the absolute value of the Fe moments can also be estimated, even without knowledge of the actual spin structure. In Figure 1, the estimated Fe magnetic moment, as measured via the μSR precession frequency, is shown as a function of temperature.

![Figure 1: Iron magnetic moment measured via the μSR precession frequency as a function of temperature \([3]\).](image-url)
The quick saturation below $T_n$ markedly differs from conventional mean field behaviour. Theoretical calculations can reproduce the size of the order parameter as well as its approximate temperature dependence only by invoking a multi-band spin density wave model [3].

Superconducting properties

Muon-spin rotation experiments in applied magnetic fields have been carried out on a series of differently doped LaO$_{1-x}$F$_x$FeAs samples. In such experiments on polycrystalline type-II superconductors, bulk superconductivity is revealed by an additional Gaussian relaxation of the muon precession signal below $T_C$. This additional relaxation arises from the inhomogeneous internal field distribution in the vortex phase of type-II superconductors, see inset of Figure 2. In an anisotropic superconductor, the observed relaxation rate can be converted into $\lambda_{ab}$, the in-plane magnetic penetration depth. The expression $1/\lambda_{ab}^2$ is proportional to the superfluid density $\eta_s$ divided by the effective mass $m^*$ of the charge carriers. The temperature dependence of $1/\lambda_{ab}^2$ for an LaO$_{0.8}$F$_{0.2}$FeAs sample is depicted in Figure 2. A nearly temperature-independent behaviour below $T_c/3$ is found, which is indicative for a low density of states in the superconducting gap and excludes superconducting symmetries with nodes in the gap function.

Phase diagram of LaO$_{1-x}$F$_x$FeAs

The competition of magnetic order and superconductivity is a key element in the electronic phase diagram of all unconventional superconductors, such as, for example, the high-$T_c$ cuprates, heavy fermions and organic superconductors. In these systems, superconductivity is often found close to a quantum critical point where long-range antiferromagnetic order is gradually suppressed as a function of a control parameter, e.g. charge carrier doping or pressure. It is widely believed that dynamic spin fluctuations associated with this quantum critical behaviour are crucial for the mechanism of superconductivity. In Figure 3, the structural and electronic phase diagram of LaO$_{1-x}$F$_x$FeAs that has been determined by $\mu$SR, Mössbauer spectroscopy and X-ray diffraction is shown. The $\mu$SR experiments yield information on both the doping dependence of the transition temperatures and the respective order parameters. A discontinuous first-order-like change from the spin density wave magnetic state to superconductivity upon doping is found. While these results strongly question the relevance of quantum critical behaviour in iron pnictides, they prove the strong coupling of the structural orthorhombic distortion and the magnetic order with both disappearing exactly at the phase boundary to the superconducting state.

References

Superconductors conduct electric current without resistive loss, and thus hold great promise for technological applications. Superconducting materials serve already now in a number of industrial and device applications, but many of them are only marginally understood at best. At the heart of superconductivity are electron pairs, the so-called Cooper pairs, which are quantum-entangled electrons. Electric current in superconductors is transported by Cooper pairs, and not by single electrons as in metallic materials.

Probably the most intriguing question in the field of superconductivity concerns the coupling of electrons into Cooper pairs. While this is understood in phonon-mediated superconductors, it is still a mystery in various classes of materials, such as organic, heavy-fermion and doped Mott-insulator superconductors.

The existence of Cooper pairs depends on the preservation of electron entanglement of their wave-functions. External magnetic fields or the ordering of the electrons in charge or spin structures generally perturbs the entanglement. In fact, in order to qualify as a superconductor, a material has to be a perfect diamagnet, which means that all magnetic fields are completely shielded from the inside of the material at sufficiently low field strength.

A similar antagonism also exists between magnetic and superconducting order, which often compete and rarely co-exist. The reason for this is that an ordered spin loses its quantum character and becomes more classical. The loss of the electron’s spin quantum nature inhibits superconductivity.

There are a number of examples where magnetic order and superconductivity do co-exist. In these cases, magnetic order and superconductivity arise from different species of electrons, thus preserving the quantum nature of the electrons that contribute to superconductivity. In such materials, magnetic order and superconductivity thus merely tolerate each other.

Magnetic order and superconductivity have been found to coexist in a number of magnetically mediated superconductors, but these phenomena generally compete. We report that, close to the upper critical field, CeCoIn$_5$ adopts a multicomponent ground state that simultaneously carries cooperating magnetic and superconducting orders. Suppressing superconductivity leads to the simultaneous collapse of the magnetic order, showing that the material needs to be superconducting in order to adopt magnetic order. A symmetry analysis suggests a form of superconductivity that is associated with a non-vanishing momentum.

Conspiring magnetic and superconducting order

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We have studied the heavy-fermion superconductor CeCoIn$_5$ using neutron diffraction at very low temperatures and high magnetic fields. CeCoIn$_5$ features d-wave superconductivity which is believed to be magnetically induced [1]. The material features strong electronic hybridization between localized f-electrons and itinerant d-electrons, which leads to charge carriers of composite nature and high mass [2]. CeCoIn$_5$ is believed to be close to a critical point at zero temperature that separates phases of different symmetry. This type of criticality is often also referred to as a quantum critical transition.

The field–temperature (H-T) phase diagram of the superconducting phase features two phases that are separated by a second-order phase transition (see Figure 1), indicating they are of different symmetry. It has long been suggested that this additional phase, which we call Q-phase and which can only be reached with high fields, features superconducting order arising from Cooper pairs that carry a finite momentum [3]. The key result of our experiment is that the Q-phase features a long-range ordered spin-density wave which is modulated in an incommensurate manner perpendicular to the magnetic field direction [4]. The magnetic moments point perpendicular to the magnetic field and modulation vector. Most importantly, the spin-density wave is stabilized only in the superconducting phase, and it collapses abruptly when the material becomes metallic above $H \sim 11$ T (see Figure 2). This is the first example of superconductivity induced magnetic order that has been observed in nature.

The origin of magnetic order in the Q-phase came as a surprise, and it is currently not understood. Small-angle neutron scattering revealed an anomalous flux line form factor [5], which indicates fluctuating magnetism in the flux line cores. Our results suggest that this fluctuating magnetism becomes static at low temperatures. However, the magnetic fluctuations in the superconducting and metallic phases must be fundamentally different, as no magnetic order is observed in the normal phase.

Cooper pairs carrying momentum

The direct coupling of magnetic and superconducting order in CeCoIn$_5$ allows conclusions to be drawn about the symmetry of the superconducting order. A symmetry analysis shows [4] that possible magneto-superconducting terms include terms where magnetic order couples directly to superconducting order that is associated with momentum. This is indirect evidence that the Cooper pairs could indeed carry a finite momentum, as has been suggested. Our experiment illustrates a novel way of how magnetism and superconductivity can conspire rather than compete, and, as a result, form a novel state of solid matter.

References


Dynamic nuclear polarization, from polarized targets to metabolic imaging

The methods of dynamically polarizing nuclei (DNP) have led to the development of increasingly sophisticated polarized targets used in investigations of the role spin plays in nuclear and particle interactions. Only very recently, DNP has been recognized in the Nuclear Magnetic Resonance (NMR) community as the most promising technique for enhancing the nuclear spin polarization of organic molecules. The tremendous sensitivity enhancement of up to 10,000 potentially obtainable opens a wealth of new applications, with metabolic imaging being a prominent example. The techniques developed in polarized target research need now to be adapted to the new applications.

Dynamic Nuclear Polarization methods were developed during the past decades for applications in nuclear and particle physics research. Continued improvements in DNP, however, are being pursued not only for the development of increasingly sophisticated polarized targets used to investigate the role of spin in nuclear and particle interactions, but also in order to open up new fields in neutron science exploiting the strong spin dependence of neutron scattering [1] or develop transmission polarizers for neutron beams [2].

Recently, a unique enthusiasm for the DNP technique has developed in the magnetic resonance (MR) community, most prominently in the biomedical field. Researchers at Amersham (now part of GE Healthcare) have demonstrated that it is possible to transform a dynamically polarized organic sample from its initial frozen state (such as used in polarized targets) into a liquid solution at room temperature, while retaining a large part of the nuclear polarization by rapidly dissolving it in superheated water [3]. The nuclear relaxation times in such polarized liquid solutions are long enough to open the possibility of injecting them into biological subjects, in order to investigate in vivo metabolic processes in a nearby MR installation (see Figure 1) [4].

Figure 1: Dissolution DNP machine (left) connected to the 9.4 T rodent scanner (right) installed at the CIBM Lausanne. The sample is polarized in the solid state at around 1 K at 3.35 T and subsequently rapidly dissolved and blown via a thin tube to an injection pump delivering the polarized room temperature solution to the animal in the imager [7].
A consortium of Swiss researchers, now well-known as the Swiss DNP Initiative (sdnpi.epfl.ch), was formed very soon after this “dissolution DNP” method had become known. It combines the unique know-how of the polarized-target group at PSI with the advanced spectroscopic and imaging methods available at two leading MR institutes sited at EPFL: the Center for Biomedical Imaging (CIBM) and the Laboratory for Biological MR (LRMB) [5]. The DNP techniques developed for building polarized targets had to be adapted to the requirements of magnetic resonance spectroscopy (MRS) and magnetic resonance imaging (MRI). A versatile continuous-flow cryostat system was designed that fits into a standard wide-bore NMR magnet and constitutes the basis of a DNP prepolarizer system which can be coupled to a rodent MRI scanner [6] or an NMR spectrometer.

A main challenge was finding biologically compatible solutions with low concentration of an efficient paramagnetic centre well suited for DNP in which the labelled metabolic precursors could be easily dissolved. The polarization mechanism is based on the transfer of polarization from the electron spins of the paramagnetic centres to the nuclei of the solvent and dissolved molecules, by continuous irradiation with microwaves close to the ESR frequency of the paramagnetic centres. The efficiency of DNP relies on the fact that, at a temperature of about 1 K, the electron spin polarization is close to 100%, even in a moderate magnetic field (3.35 T in a standard polarizer).

Extensive DNP studies have been performed on substances which may well be regarded as model systems for “hyperpolarization” applications [7]. In these studies, compounds of biological interest containing $^{13}$C (Na acetate, Na pyruvate, Na bicarbonate, urea, glycine, glucose), $^{15}$N (urea, choline chloride) or $^4$Li (Li chloride) nuclei were dissolved at a typical concentration of a few moles per litre in water-ethanol and water-glycerol doped with TEMPO free radicals. Instead of a proprietary triarylmethyl (TAM) radical, the readily available TEMPO free radical had been chosen as paramagnetic centre, because it has very low toxicity, it dissolves well in water-alcohol mixtures and its DNP characteristics have been studied in various polarized target applications. A $^{13}$C polarization of up to 12% was achieved at 1.2 K in a magnetic field of 3.5 T under irradiation with 97 GHz microwaves. This corresponds to an enhancement of 14,000 with respect to the thermal equilibrium polarization in a 9.4 T magnet at room temperature. It is even possible to gain another 50% in polarization by increasing the field from 3.5 T to 5 T [8]. Most importantly, it was found that the DNP properties of the solute compounds are mainly determined by the solvent matrix, which suggests that this approach can generally be used to polarize molecules of metabolic interest.

A hardware characteristic is that the DNP and the MRS and MRI applications are performed in separate magnets, at different fields. The crucial step is an efficient dissolution of the solid-state sample (typically by a factor 10 to 80) to obtain the “hyperpolarized” solution and a rapid transfer from the polarizer to the MR equipment (usually by blowing it through a thin plastic tube), because an intrinsic limitation of the technique is the finite lifetime of the hyperpolarized state. The signal is very intense, but only available for a limited length of time (see Figure 2).

Fast dissolution experiments have shown that 70% to 80% of the initial solid-state polarization level can be retained for all nuclei studied ($^{13}$C, $^4$Li, $^{15}$N), while the liquid state NMR amplification factor reached (up to 10,000) mainly depends on the relaxation time T1 of the specific nuclei after dissolution. Optimum samples are now routinely used in metabolic/MRI experiments at CIBM Lausanne employing the developed DNP and dissolution apparatus (see Figure 1).

![Figure 2: $^{13}$C NMR signal enhancement of labelled glycine compared to its thermal equilibrium value in a 9.4 T field. After the dissolution, the polarization starts to decay rapidly. The inset illustrates the tremendous gain in NMR signal obtained [6].](image-url)

References

Many of the phenomena in solid-state physics that still lack a profound conceptual understanding comprise mechanisms with a coupling between two order parameters. Unconventional superconductivity as well as spin- and charge-order coupled to conduction electrons in intermetallic materials are some of the most prominent examples.

Another class of materials with similar high technological potential are multiferroics. These exhibit simultaneous magnetic and ferroelectric orders that are directly coupled. Several classes of applications have been suggested, including next-generation electronic devices in which the magnetic properties may be controlled by an electric field, magnetically-controlled ferroelectric memory devices for instant boot-up computers, or magnetically-tuned dielectric capacitor devices [1].

Simultaneous magnetic and ferroelectric order – a rare phenomenon

Until a few years ago, only a small group of materials exhibiting coupled magnetization and electrical polarization had been identified since – quite generally – the ordering of the magnetic moments and cooperative atomic displacements responsible for ferroelectricity occur at distinctly different temperatures. Recently, however, an increasing number of multiferroics have been discovered that are magnetically frustrated magnets, suggesting that competing magnetic interactions play a crucial role in these materials.

It is thought that magnetic frustration naturally leaves the system with some degree of freedom at low temperatures and hence does not allow its entropy to reduce upon cooling. According to the third law of thermodynamics, however, entropy has to be zero at zero temperature, requiring a massive entropy reduction at low temperature. In multiferroics, this is achieved through the coupling to an additional order parameter – ferroelectricity – that, in the process, reduces the magnetic entropy. Ferroelectricity is thus magnetically driven.

Pressure – a powerful stimulus

Experimental studies probing the effects of perturbations on such complex interacting systems have often been proved to be indispensable for validating proposed theoretical models. Application of pressure is particularly powerful since, on the one hand, pressure alters atomic distances and hence directly changes the magnetic interactions between the atoms, making it thus possible to change the degree of magnetic frustration in a material. On the other hand, theory may predict pressure effects relatively simply.
Suppressing frustration with pressure

One of the simplest spin-spiral multiferroic materials, namely Ni$_3$V$_2$O$_8$, has been studied, in which magnetic frustration results from the specific geometric arrangement of spins on a so-called Kagome lattice, in which the interactions between neighbouring spins compete with those between next-neighbouring spins. As a result, the compound displays a complex magnetic phase diagram, with at least three different magnetic phases. Ferroelectricity emerges in one of these phases and is magnetically driven [2, 3].

Our neutron diffraction measurements on Ni$_3$V$_2$O$_8$ show that pressure removes magnetic frustration and thus suppresses ferroelectricity. The ferroelectric phase (denoted LTI in Figure 1 (top)) gradually becomes suppressed by a phase with a simple commensurate magnetic structure that is typical for unfrustrated magnets and eventually disappears at pressures above 1.5 GPa. At even higher pressures (beyond 3.5 GPa) a remnant incommensurate phase at higher temperature (denoted HTI in Figure 1 (top)) is also fully suppressed, thus removing the last signs of magnetic frustration from our data. The transition between the two incommensurate magnetic phases (denoted LTI and HTI in Figure 1) changes in nature from being continuous at ambient pressure to being discontinuous at pressures above 0.5 GPa. This feature is evidenced by the discontinuous jump of the magnetic wave-vector shown in the Figure. A small temperature range exhibiting phase-coexistence between the two phases further hints at the first-order (discontinuous) nature of this magnetic phase transition. This clearly shows that magnetically-induced ferroelectricity can occur in a first-order transition, and might thus be switched in principle with relatively small temperature changes.

References
Muon lifetime measurement with FAST

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The Fibre Active Scintillator Target (FAST) detector at PSI is designed to measure the lifetime of a positive muon to better than 2 ppm statistical precision. After including theoretical and experimental systematic uncertainties, this will determine the Fermi constant, $G_F$, to 1 ppm precision. $G_F$ is one of the three free parameters of the Standard Model in the bosonic sector, and the uncertainty in its determination is currently dominated by the muon lifetime [1].

The measurement of the lifetime of a positive muon is a difficult challenge, involving the dual requirements of increasing the event sample by a factor of 100 relative to earlier measurements, while, at the same time, reducing the systematic errors by an order of magnitude. The concept of the FAST experiment is to suppress the systematic effects at the detector level, as far as possible. In this way, only small systematic corrections to the raw measurement are required to reach the final value of the $\mu^+$ lifetime.

Set-up

The FAST detector is an imaging plastic scintillator target comprising $32 \times 48$ pixels (Figure 1, [2]). Each pixel corresponds to a plastic scintillator of dimension $4 \times 4 \times 200$ mm$^3$. A $\pi^+$ beam from the PSI proton accelerator facility (nM1 beamline) is stopped in the target. A wedge-shaped degrader distributes the stopping positions through the target depth. The system identifies the $\pi^+ \rightarrow \mu^+ \nu$ decay chains and registers the time and space coordinates of each particle. Time-to-Digital converters (TDCs) record a time window from $10 \mu$s preceding the beam particle arrival time to $20 \mu$s afterwards. The wide positive decay region allows the muon decay time to be observed over a period of about 9 muon lifetimes. The negative decay time region is used to calibrate accidental backgrounds. In order to reach the desired precision in the measurement, a data sample of about $5 \times 10^{11}$ events is required.

This is achieved in FAST by running at an LV2 (i.e. tagged $\pi^+ \rightarrow \mu^+$) trigger rate of about 80 kHz and handling several muon events, with overlapping time windows, in parallel. At this rate, the required statistics can be reached in about 200 days of data taking. Achieving this performance requires a dedicated second-level (LV2) trigger and a highly segmented data acquisition (DAQ) system (Figure 2).

The first part of the DAQ system comprises 8 chains, each consisting of a fast PC attached to a VME crate containing 2 CAEN V767 TDCs and a VME-to-PCI interface. The LV2 trigger

Figure 1: Schematic drawing of the FAST detector: a) top view, and b) side view. A representative event shows a $\pi^+$ beam particle stopping in the target followed by a $\pi^+ \rightarrow \mu^+ \nu$ decay and finally a $\mu^+ \rightarrow e^+ \nu \nu$ decay. This sequence is imaged by the target in the xy projection and the pixel times are recorded.
recognizes a π⁺→μ⁺ decay chain and selectively triggers only those TDCs in the 7×7 pixels surrounding the muon stop pixel. This reduces the data bandwidth by a factor of 2.5. The LV2 trigger also encodes the muon stop pixel and records the information in the TDCs. The huge throughput of data (about 80 MB/s) requires that events are analysed in real time; only lifetime histograms are recorded on disk, together with monitoring information and around 1% of raw events for later analysis of systematic effects. The on-line analysis farm comprises 4 fast PCs, which are supplied with time-slices of data in round-robin fashion. The time-slices are assembled from the 8 DAQ/VME chains with a collector PC, and routed via a Gigabit ethernet switch.

Operation and results

A pilot physics run of FAST in December 2006 allowed a measurement of GF with 8 ppm precision (Figure 3, [3]). The average LV2 trigger rate was 30 kHz, and a total of $1.1 \times 10^{10}$ events were recorded. In spring 2008, the FAST detector was prepared for a long data-taking run at an LV2 trigger rate of about 70kHz. By the end of the 2008 run, FAST had taken data for 140 days and recorded a sample of $3 \times 10^{11}$ events. During this period, the detector was operated in a fully automated mode. All hardware functions were under the supervision of a slow-control program. The read-out and analysis processes were controlled by watch-dog programs. A web-based online monitoring program controlled the data quality. This allowed remote operation of the experiment by a small experimental group. The overall operation efficiency was of the order of 80%, including unexpected beam down-time and detector stops. For a typical day, without any hardware failure, FAST was active for 96% of beam time. In conclusion, FAST had a very successful data taking period in 2008. The muon lifetime measurement from the 2008 data sample has a statistical precision of about 3 ppm, which allows a determination of GF to 1.5 ppm. During 2009, FAST will record an additional data sample of about $3 \times 10^{11}$ events, taken under different conditions, in order to calibrate the systematic errors and accumulate the remaining statistics for a 1 ppm measurement of GF.

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The first experiment to search for the neutron electric dipole moment (nEDM) was performed more than 50 years ago [1]. A non-zero nEDM would violate both parity (P) and time reversal (T) symmetry. Assuming the conservation of CPT, T symmetry is equivalent to CP symmetry. P, T and CP symmetries are violated in weak interactions [2], and all related particle physics observations are so far successfully described within the Standard Model (SM) of particle physics via a phase in the Cabibbo-Kobayashi-Maskawa quark mixing matrix [3]. CP violation is also needed to explain the matter-antimatter asymmetry of the universe [4]. However, the CP violation of the SM is not sufficient. While the electro-weak SM predicts only unobservably small particle EDM values, extensions of the SM often provide extra CP violation and generate sizeable EDM values.

Up to now, no permanent particle EDM has been found. Figure 1 displays the history of experimental results setting upper limits on the neutron EDM, presently less than $2.9 \times 10^{-26} \text{e cm}$ (90% confidence level) [5]. This constrains many theories beyond the SM, e.g. Supersymmetry [6]. Today, several collaborations around the world are trying to measure the nEDM with 1–2 orders of magnitude improved sensitivity. This might allow CP violation to be discovered beyond the SM.

Experimental approach

This nEDM collaboration (http://nedm.web.psi.ch) follows a three-phase programme: During Phase I, the existing experimental apparatus [5] was operated at the Institute Laue-Langevin in Grenoble. This phase ended with the transfer of the apparatus to PSI in March 2009. Phase II foresees the operation of the upgraded apparatus at the new Ultracold Neutron Facility at PSI. The setup should be ready by the end of 2009 and the collaboration plans on a 2-year operation during 2010 and 2011. The sensitivity of the setup will be about a factor of 5 better than that of [5]. At the same time, a new experiment is being designed and constructed to come online in Phase III, starting in 2012. Its goal is to improve the sensitivity by another order of magnitude, to $5 \times 10^{-28} \text{e cm}$ or better.
Phase I – Operation at ILL

Phase I at ILL in 2005–2008 delivered various important results, including the first direct limit on neutron–mirror-neutron oscillations [7], a search for exotic spin-dependent interactions, and systematic studies of the influence of magnetic field gradients on the measurement of the neutron to Hg atom precession frequencies.

The most important experimental issue was a severe deterioration of the transverse polarization decay time $T_2$ of the ultra cold neutrons (UCN) after 2003. Although much work was done to resolve this issue, major progress was achieved only after finding and removing some magnetic components towards the end of 2008. The $T_2$ times came back up to about 400 s and further progress can be expected. Hunting magnetic impurities is a continuing effort and part of the necessary quality control. The R&D work in Phase I included the adaption and development of highly sensitive laser pumped Cs magnetometers [8], the development of a new insulator ring using DPS (deuterated polystyrene) coated PS [9], the development of high-rate UCN detectors [10], as well as studies on high voltage, leakage current measurements, field mapping, and data acquisition.

Phase II – Running at PSI

Figure 2 shows the experiment [5] located in a thermally stabilized room on the UCN beam in area South of the UCN facility at PSI. The setup will be fully operational and ready for UCN by the end of 2009. The beamline is 3.3 m above the floor, leaving space for the counting house below. A superconducting polarizer magnet is used to polarize the UCN beam upstream of the EDM apparatus. A horizontal beamline will allow test measurements to be made downstream of the EDM ‘house’. A UCN switch below the EDM apparatus will allow the experiment to be filled, monitoring the incoming flux and emptying the UCN into the detection system. Detailed Monte Carlo simulations have confirmed the expectations of an increase in UCN density inside the experiment of 30–50 times that obtained previously at the ILL PF2 beam.

Phase III – A new device

The design of the new experiment started with the evaluation of various conceptual ideas over the past 3 years. It converged on a double UCN chamber inside a 5-layer mu-metal shield using co-magnetometry as well as external $^3$He and Cs magnetometers. The year 2009 will see more detailed design as well as progress with ordering the magnetic shield. R&D will concentrate on issues with the magnetic shield, such as demagnetization, magnetometry (R&D on $^{129}$Xe, $^{199}$Hg, readout of $^3$He via Cs or SQUID magnetometers), the development of non-magnetic equipment, neutron detection, and new neutron-compatible surface coatings.

Acknowledgements

We are grateful to our technicians and engineers and acknowledge the continued support and hospitality received at ILL during Phase I. We thank our colleagues of the Sussex-RAL-ILL collaboration [5] for the loan of equipment and for their constructive comments.

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The most common method used for ice core dating is annual layer counting, which relies on seasonally varying signals and is supported by the identification of reference horizons such as volcanic layers. For ice cores from high-altitude glaciers, strong ice flow induced layer thinning limits counting of annual layers in the best case to a couple of centuries, and is not suitable for the oldest and deepest part, where individual years can no longer be distinguished. Glacier flow is dominated by the small-scale geometry of bedrock, resulting in a strongly non-linear depth-age relationship over time, which cannot be resolved using physical ice flow models.

The lack of an appropriate dating tool for this lowermost section could be overcome in certain cases by wiggle matching of the stable isotope records, using the strong variation during the glacial-interglacial transition (ca. 14,000–9,000 yrs BP) observed in polar ice cores. However, it is evident that a record reaching at least that far back in time is required for this indirect dating method.

For longer timescales, radiocarbon analysis can provide an absolute date. Radiocarbon ($^{14}$C) dating has been successfully applied to several ice cores, where enough carbon-containing material was incorporated. Suitable material included wood fragments or insects, although it is emphasized that macrofossils in ice cores appear rather seldom – a fact limiting the wider application of this technique.

To overcome this problem, we have recently developed a novel radiocarbon method, using carbonaceous aerosols contained in the ice for dating. Carbonaceous particles are a major component of naturally occurring aerosols that are emitted ubiquitously, or formed in the atmosphere, and that reach potential ice core sites. The particles are classified as organic carbon (OC, light polycyclic hydrocarbons) and elemental carbon (EC, highly polymerized hydrocarbons), which have different sources. OC is predominantly emitted from the terrestrial biosphere as primary aerosol, or formed in the atmosphere as secondary aerosol from gaseous precursors, whereas the main source of EC is pyrolysis during combustion. By determining the $^{14}$C/$^{12}$C ratios of OC samples from a well-dated ice core from the Swiss Alps (Fiescherhorn, 3,900 m asl), it was shown that the OC incorporated in ice is almost of purely biogenic origin before around 1800 AD, making this fraction a valuable target for age determination. However, the very small amounts of OC incorporated in ice core samples (3–30 µg of carbon) make the usual treatment for radiocarbon dating impossible. This would typically require

Ice cores from high-alpine glaciers provide regional information about past climatic and environmental conditions. However, a precise chronology is a prime requirement for each natural archive, to allow a precise interpretation of the information recorded. Due to complex ice flow, there is a lack of appropriate dating tools for the deeper ice sections. To overcome this problem, a new dating method has been developed using radiocarbon in carbonaceous aerosol particles included in the ice. This required major technical improvements in AMS technologies allowing samples with sizes in the microgram range to be measured.
about 1 mg of material. However, a large step forward has recently been taken to overcome this limitation by exploiting the possibilities of directly analyzing gaseous CO₂ samples using accelerator mass spectrometry (AMS). The novel Mini Carbon Dating System (MICADAS) at PSI/ETH Zurich [5] is equipped with a gas ion source and is able to accept tiny amounts of CO₂ for ¹⁴C/¹²C analyses. A dedicated miniaturized gas-handling system (Figure 1) was constructed for continuous sample introduction into the ion source [6]. The system is designed to handle CO₂ amounts of only 6–60 µl (3–30 µg carbon). Particular emphasis has been taken to reduce possible contamination of the sample material with contemporary CO₂ from ambient air by minimizing the volume and thus the internal surface of the equipment. Using CO₂ directly has, in addition, the great advantage that the final reduction step to solid graphite in the sample preparation procedure can be omitted and the related contamination is avoided. Typically, the carbon contamination introduced in this step is of the order of only a few micrograms. This can be neglected for samples in the milligram range, but would influence the analysis of the OC fraction as it can be extracted from the ice cores.

To extract the OC fraction, the aerosols were filtered off the ice and combusted in a two-step heating system. CO₂ from the OC fraction was collected in a first, low-temperature step at 340°C and sealed in a silica glass tube. In a second step, the EC fraction was released at a high temperature of 650°C [7]. The glass tubes containing the CO₂ from the OC fraction were introduced into the ampoule cracker of the gas handling system and the CO₂ gas was released into the syringe and subsequently mixed with He to a ratio 1:20. This gas mixture was directly fed into the ion source at a typical flow rate of 1 µl CO₂/min. Inside the ion source, the gas mixture was flashed over a titanium catalyst exposed to a high-intensity caesium beam. Due to interaction with energetic caesium ions, negatively charged carbon ions were formed and extracted as an ion beam from the source, and its isotopic composition measured with the downstream accelerator mass spectrometer. From the resulting ¹⁴C/¹²C ratios, radiocarbon ages were calculated and related calendar ages derived from the tree ring calibration record intcal04.

This new ¹⁴C dating technique was applied to two ice cores, from Illimani (Andes, 6,300 m asl) and Colle Gnifetti (Alps, 4,450 m asl) (Figure 2). For both ice cores, the ages cover a time span from 1,000 to more than 10,000 years. A strongly non-linear age-depth relationship is prominent in the lowermost part of the cores, in agreement with the expected strong annual layer thinning gradients. Samples close to bedrock are of Late Pleistocene age. Additional, independent dating methods have corroborated these findings and confirmed the accuracy of the method.

References
We have fabricated 50 nm-period perpendicular magnetic nanoislands by depositing Co/Pd multilayer films onto arrays of SiO$_x$ pillars created with extreme ultraviolet interference lithography at the XIL beamline, Swiss Light Source. A direct comparison of the island diameters with the magnetic switching fields indicated that island-to-island anisotropy variations are likely to be responsible for the observed switching field distribution (SFD) of 11.5%. Recently we have been able to create magnetic islands with sub-30 nm periods corresponding to data storage densities close to 1 Tbit/in$^2$.

We are all familiar with the use of computer hard drives for storage of information, from simple text documents and data files through to images and movies. Since the first IBM hard drives in the mid 50s, there has been a phenomenal increase in the data storage density in the magnetic thin-film media, which is now about 10$^4$ times higher than it was 20 years ago. This tremendous increase has been spurred on by new discoveries, such as the Nobel Prize winning giant magnetoresistive (GMR) effect implemented in the read elements of magnetic recording heads and improvements in the magnetic layers. However, the train of innovation in magnetic data storage faces derailment due to the thermal stability of the written information. This issue is set to change the course of magnetic data storage history.

Current devices record bits of information in continuous magnetic films in the form of magnetised areas which are presently made up of about 100 crystal grains. In order to increase the magnetic storage density, both the magnetic bit size and the grain diameter must be decreased, and at a certain volume limit the grains are no longer stable against thermal fluctuations. Information can therefore no longer be stored below this so-called superparamagnetic limit. One solution to this problem is to replace the continuous grainy magnetic media with a magnetic film patterned into nanoscale magnetic islands, where each island corresponds to a single bit of information [1]. Currently industry is searching for a viable method to fabricate arrays of islands, and extreme ultraviolet interference lithography (EUV-IL), which has been developed at the XIL beamline at the Swiss Light Source since 2003, provides a highly promising fabrication method, with its ability to create high-resolution periodic island structures over large areas and with a high throughput [2].

Towards the beginning of last year we published a method to create 50 nm-period magnetic islands on a square array [3], which are to our knowledge the smallest magnetic islands created by a photolithography rather than an electron-beam lithography method. We succeeded in doing this by first creating an array of SiO$_x$ pillars on a silicon substrate (see Figure 1a) and depositing a Co/Pd multilayer film with perpendicular
anisotropy on top (see Figure 1b). This resulted in single-domain perpendicular magnetic islands on top of the pillars, which were isolated from the material in the valleys due to the serendipitous negative profile of the SiO$_x$ pillars. These 50 nm-period magnetic nanoislands covered an area of 20 by 20 µm$^2$.

In order to determine whether such islands are suitable for magnetic data storage, it is vital to determine the magnetic switching behaviour [4]. For this we wanted to make a direct correlation between the switching field and dot size, so we chose to look at an inhomogeneous area at the edge of an array (see Figure 2) which allowed us to measure for each and every island both its size with scanning electron microscopy and its switching field with magnetic force microscopy.

The mean switching field of the island array was 7200 Oe with a switching field distribution (SFD = σ/mean) of 11.5%, which compares well with values for islands fabricated by electron beam lithography. Looking at the switching field distribution as a function of island size, we were able to deduce that the key cause of the SFD is not a variable island size nor the inter-island magnetic stray field coupling, but rather is linked to a variation in the island-to-island anisotropy. This falls in line with the current thinking in the patterned media community. We are working hard to make the magnetic islands even smaller [5] and have had first success in creating sub-30 nm period arrays. This opens up the possibility of creating patterned media with EUV-IL at densities greater than 1 Tbit/in$^2$, corresponding to a bit period of less than 25 nm, so answering the call from industry to beat the superparamagnetic limit at higher densities.

References
Dots and stripes: Nanofabrication enables new science

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Micro- and nanofabrication technology enables the creation of well-defined structures and patterns in various forms and shapes, down to the size of a few nanometres. Interesting phenomena are expected and observed when small objects, such as colloidal particles and molecules, interact with such structures. In periodic structures it is often easier to observe collective phenomena, since tiny signals originating from well-localized nanoscale objects can sum up to yield a better signal-to-noise ratio.

Pushing the resolution limit of photon-based lithography

The extreme ultraviolet interference lithography (EUV-IL) set-up established a few years ago at the SLS produces periodic structures in the range from micrometers down to a few tens of nanometers [1], a size range not only interesting for future integrated electronic devices, but also for looking at interactions with immobilised biomolecules such as proteins, which are typically a few nanometers in size. Figure 1 shows a recent result with a 22 nm-period structure exposed in hydrogen silesquioxane (HSQ) resist. The lines are only about 11 nm wide, which is the highest resolution achieved with a photolithography technique to date. Unique to this technology is the narrow size distribution of the periodic surface features (lines or, for the case of multiple beam interference, dots) which can be of the order of 0.5 nm (1σ), i.e. the size of one resist molecule. Field sizes up to 2×2 mm² can be exposed in a few seconds. Controlled nanofabrication on a length scale approaching the size of single molecules allows exciting new science.

Periodic nanostructures at the size of biomolecules.

In addition to being of potential use in bio-analytics, arrays of immobilized single protein molecules are of interest as substrates for cell growth studies, since interactions of single molecules or molecule ensembles with living cells are not

Figure 1: 11 nm-wide lines in HSQ on a silicon surface exposed by EUV-IL. This is the best resolution ever achieved with photon-based lithography.

Figure 2: Process scheme for the fabrication of gold dot arrays (explanations in the main text).
necessarily the same. Here the crucial resolution is reached when the sites for biomolecule immobilization is so small that they can only host single molecules. The process schematically shown in Figure 2 has been developed to reduce the size of structures produced with EUV-IL towards these dimensions. (A) A layer of chromium is evaporated under a shallow angle and sample rotation onto an array of nanoscale holes produced with EUV-IL in a photoresist leading to minimization of the hole size. (B) A gold layer is evaporated through the holes. (C) Removal of the photoresist and annealing yielded arrays of 12–15 nm gold islands (Figure 3). After deposition of a protein-resistant layer, proteins are specifically bound to the gold islands. Such arrangements provide the basis for protein detection at the single-cell level using scanning-force microscopy techniques [2].

Particle ordering in nanochannels

Confinement-induced ordering of particles in nanofluidic devices depends on the ionic charges on the particle and container surfaces as well as in the surrounding solution. However, direct experimental observation is challenging, due to the restrictions imposed on the probe.

A recently developed technique relies on using a nanofabricated array of channels (Figure 4) for confinement, allowing the fluid density profile across the channel to be determined by means of X-ray diffraction [3]. The method was demonstrated on a charge-stabilized colloid, in which the colloidal particles were observed to move from the center of the channel (left panel of Figure 5) to the channel walls (right panel of Figure 5) upon adding a small amount of salt. The observation of the effective channel width depending on the ion concentration should prove useful for future nanofluidic devices. The present fabrication technique, based on electron-beam lithography, allows structural studies on confined fluids with particle diameters of about 30 nm or larger. However, the application of EUV-IL should make studies on smaller particles, such as macromolecules, feasible.

References

Molecular insight into amyloid fibril formation from a de novo design

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Amyloid fibrils are protein structures that occur in a number of human pathologies, including Alzheimer's and Parkinson's disease. In the present article, methods are presented that allow the study of amyloid fibril formation in the test tube.

Amyloid fibrils are filamentous, insoluble protein aggregates deposited in vivo in more than 20 different amyloid diseases or formed in vitro from soluble proteins [1]. Although fibril-forming proteins often lack sequence and structural similarity, amyloid fibrils share some common properties which make it feasible to use simple model systems to systematically assess the factors that predispose a native protein to form amyloid fibrils. For this purpose, a 17-residue peptide model system has been generated de novo, referred to as ccβ-Met, which can be converted into amyloid fibrils [2, 3]. The simplicity of this peptide system makes it suitable for probing the molecular details of amyloid assembly.

Analysis by electron microscopy

The structure of ccβ-Met fibrils was analyzed by transmission electron microscopy. Electron micrographs of unidirectional metal-shadowed samples revealed single and frequently twisted fibrils, with uniform morphology and with widths ranging from ~5 to 8 nm (Figure 1). Closer inspection of several electron micrographs indicated the presence of at least two polymorphic fibril forms, with a lower (repeat lengths of ~60 nm) and a higher (repeat lengths of ~30 nm) degree of left-handed twist, referred to as Type 1 and Type 2 fibrils, respectively.

Analysis by X-ray fibre diffraction

The packing of the ccβ-Met peptide chains within the fibrils was investigated by fibre diffraction. Diffraction patterns recorded with the X-ray beam perpendicular to the major axis of the fibril revealed signals at 4.7 Å on the meridian and 12.3 Å on the equator (Figure 2). This pattern is consistent with a laminated cross-β structure and is characteristic for amyloid structures. In this structure, the polypeptide chains are organized in laminated layers of β-sheets and run perpendicular to the long fibre axis. All the reflection positions were measured and the unit cell was determined to be: a = 9.4 Å, b = 23 Å, c = 58 Å, α = β = γ = 90°, where a is the hydrogen bonding direction along the major fibril axis, b is the inter-sheet direction, and c is the peptide chain direction.

Figure 1: Electron micrograph of unidirectional metal-shadowed ccβ-Met. The direction of metal shadowing is indicated by the white arrow. Type 1 and Type 2 fibrils are labelled. Scale bar: 70 nm.
Atomic models and molecular dynamics simulations

To obtain a detailed molecular description of the ccβ-Met amyloid fibril, atomic models were constructed, representing Type 1 and Type 2 fibrils (Figure 3), based on all present experimental restraints (see [4]). To gain insight into the side chain interactions within the ccβ-Met amyloid fibril, molecular dynamics simulations were performed (see [4]). Analysis of structures at the end of the simulation revealed that compatible side chains interdigitate and appear like the teeth of a zipper. Previous experiments showed that chemical oxidation of the sulfur atom of the methionone side chain to a polar sulfoxide (denoted ccβ-MetO) completely abolished amyloid fibril formation of the derivatized ccβ-Met peptide [4]. Calculations indicate that, compared to ccβ-Met, ccβ-MetO strands are more stable in water than in an amyloid fibril. This effect can be explained by the stronger solvation of the methionine sulfoxides compared with methionines and by a perturbation of the packing of the hydrophobic core residues in the fibril.

Conclusions

The simplicity of the ccβ-Met system makes it suitable for probing the molecular origin of amyloid fibril assembly. The detailed structural information presented for the ccβ-Met amyloid fibril provides a basis for understanding the influence of single site-specific hydrophobic interactions on native-state stability, the kinetics as well as the packing and polymorphism of fibril formation and the evaluation of their relative importance.

References

The analysis of cellular processes is of crucial importance for the understanding of human diseases. The use of genetically engineered fluorescent probes allows the monitoring of biological processes in living cells. A new expression vector system has been developed which makes it possible to modify and study multiple cellular parameters simultaneously.

In contrast to bacteria, mammalian cells contain many different compartments. This allows the assignment of specific cellular functions to defined regions of the cell. Examples of such compartments are the nucleus, mitochondria or endosomes. The nucleus stores genetic information (DNA) and transcribes it to a working copy (mRNA), which is then exported to the cytoplasm. Mitochondria are the major sites of cellular energy production. Endosomes are cytoplasmic transport vesicles, which transfer membrane proteins from the plasma membrane to intracellular sites for sorting, signalling, and degradation. Unfortunately, most of these organelles are too small to be identified by classical light microscopy. In addition, they are intermingled within cells and are highly motile. The identification of interesting cellular structures therefore resembles the search for a “needle in a haystack”.

Fluorescence microscopy in cell biology

August Köhler observed at the beginning of the last century that certain structures of plant cells show autofluorescence when they are illuminated with ultraviolet light. In the middle of the century, it became possible to specifically label cellular compartments and to monitor simultaneously several different colours using optical filters. However, the analysis was still limited to fixed material. The analysis of living cells became possible with the introduction of fluorescent proteins. This technology was awarded with the Nobel Prize for Chemistry in 2008. Genetic engineering made it possible for the natural fluorescent proteins from a jelly fish and a coral to be available today in many different colours. Specific targeting signals for subcellular compartments are then added to the genetic information of these fluorescent proteins, and the resulting expression vector is transfected into mammalian cells. The cells translate this information into a new protein, which labels a particular cellular compartment (Figure 1).

The insertion of expression vectors into mammalian cells by transfection is well established, but there are limitations in this approach: (1) Co-transfection with individual vectors leads to cells with different expression ratios, since only small amounts of each plasmid are taken up. This becomes very pronounced when more than two plasmids are transfected simultaneously, or if a cell line is difficult to transfect; (2) The stable integration of expression vectors in a host cell genome works mainly sequentially, meaning that it is a time-consuming process. An expression system has therefore been developed in our Lab that allows the flexible expression of several proteins in a mammalian cell from a single vector.

Figure 1: COS cell transiently transfected with three vectors encoding a blue fluorescent protein with a nuclear localization signal, a green fluorescent protein with endosomal targeting, and a red fluorescent protein with mitochondrial targeting. A phase-contrast picture is shown on the left; the overlay of the three fluorescent pictures is shown on the right. The cell border of the transfected cell is marked with a dashed line.

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Multi-protein expression systems

Our group was previously involved in the development of a recombination-based system (cre/LoxP) for the expression of multi-protein complexes in insect cells and bacteria [1,2]. This system allowed the assembly of up to four plasmids, each containing the genetic information for a particular protein, in a recombination-based reaction followed by selection with appropriate antibiotics. It was used exclusively for the production of protein complexes for structural studies. To develop a similar mammalian expression system, unnecessary elements were removed from these vectors and replaced with regulatory elements for mammalian expression. In addition, the system was kept modular so that it is compatible with our robotics-based high-throughput cloning platform. It is currently possible to integrate the information for five different fluorescent proteins into one expression vector. Figure 2 clearly shows that the system has the expected benefits. Transfected cells express all proteins and it is now possible to efficiently generate stable cell lines with several expression units at once.

Conclusions and outlook

It has been shown in this work that a recombination-based assembly of expression cassettes is a successful strategy for expressing numerous proteins in mammalian cells. So far, work has focused on the expression of fluorescent probes for the analysis of cellular processes. The system also allows the expression of several proteins to reprogram cells, which is extremely important in stem cell research, where pluripotent stem cells are transformed into differentiated cells for clinical applications.

References


Figure 2: (A) Expression from a single plasmid leads to the simultaneous expression of several proteins in a cell. The cells were transfected with a plasmid encoding a cyan (mTFP1), a yellow (mCitrine), and a red fluorescent protein (mCherry). (B) The coding sequences for the same fluorescent proteins were located on independent plasmids and cotransfected. Note that not all transfected cells express all fluorescent proteins. The cell borders of the transfected cells are marked with a dashed line.
Human thymidine kinase type 1 (hTK1) is a cytosolic enzyme which catalyzes the Mg\(^{2+}\)-dependent \(\gamma\)-phosphate transfer from ATP to the 5\(^\prime\)-hydroxyl group of thymidine (dT). hTK1 is significantly overexpressed in rapidly proliferating and malignant cells and has proven to be a suitable target for non-invasive imaging of cancer cell proliferation using radioactively labeled thymidine and deoxyuridine derivatives. For this reason, there is considerable interest in the development of a thymidine tracer for single photon emission tomography (SPECT) based on the inexpensive radionuclide technetium-99m (\(^{99m}\)Tc). \(^{99m}\)Tc is readily available at low cost and possesses excellent decay properties (\(T_{1/2} = 6\) h, 140keV \(\gamma\)-radiation) for in vivo diagnosis. However, when we started our studies no such tracer was known, and no technetium-labelled thymidine derivative which retained substrate activity, that is phosphorylation at position C\(^{5\prime}\) by hTK1, had been synthesized. Retaining substrate activity is a prerequisite for in vivo application.

**Synthesis and radiolabelling**

We identified two potential sites of thymidine (namely C\(^{3\prime}\) and N3) for modification with a bifunctional metal chelating system (Figure 1). It is well known that subtle changes to the lead structure and the metal complex can have a decisive impact on substrate activity. Often such effects can only be identified if larger series of derivatives are synthesized, which in the case of metal complexes is typically associated with multi-step syntheses requiring the use of protecting groups to avoid unwanted side reactions. To speed up this often laborious approach, we employed the “click-to-chelate” strategy, which was recently developed by our group, and which uses the Cu(I) catalyzed cycloaddition of alkynes and azides [1, 2]. This efficient strategy enabled us to assemble and radiolabel thymidine derivatives in a single step using a one-pot procedure, which spares the isolation of the clicked ligands before in vitro screening and assessment.

Commercially available C\(^{3\prime}\) azido-3\(^\prime\)-deoxythymidine and an N3 azido-thymidine derivative were reacted with a set of suitable alkynes (Figure 2). The thymidine derivatives were subsequently reacted in situ with the organometallic \(^{99m}\)Tc precursor \([^{99m}\text{Tc}(\text{H}_2\text{O})_3(\text{CO})_3]^+\) [3]. Using this strategy, ten novel thymidine derivatives with varying structures, hydrophilicity and overall charge were prepared in a matter of a few hours.

The site-specific conjugation of metal chelating systems to biologically relevant molecules is an important contemporary topic in bioinorganic and bioorganometallic chemistry. The “click-to-chelate” approach describes the use of the Cu(I) catalyzed cycloaddition of azides and terminal alkynes to synthesize 1,2,3-triazole-containing metal chelating systems, and their simultaneous incorporation into biologically relevant molecules. Using this strategy, a series of thymidine derivatives were prepared, radiolabelled in situ with technetium-99m and evaluated as potential tracers for single photon emission tomography.

![Chemical structures of thymidine (dT), C\(^{3\prime}\)-azido thymidine and N3-azido thymidine, and general reaction scheme for the “click-to-chelate” approach [2].](image)
which would have taken several weeks using “classical” synthetic procedures \[4\]. In parallel, the non-radioactive rhenium (Re) complexes were also prepared.

Identification of substrates for hTK1

\[^{99m\text{Tc}/\text{Re(CO)}_3}\] complexes 1–10 were incubated with ATP in the presence of hTK1. The time-dependent formation of the monophosphorylated complexes was monitored by HPLC. We observed that all complexes were substrates for hTK1. This was corroborated by mass spectroscopic analyses. The hTK1 substrate activities of \[^{99m\text{Tc}/\text{Re(CO)}_3}\] complexes 1–10 were measured quantitatively relative to the natural substrate thymidine using a coupled hTK1-PK-LDH assay.

As the data in Table 1 show, the overall charge of the thymidine complexes had a pronounced influence on the substrate activity. The neutral and anionic C3’-functionalized complexes were similarly good substrates, whereas the cationic complexes were much less readily phosphorylated. On the other hand, for the N3-functionalized derivatives, we observed that anionic complexes were the worst substrates.

Table 1: Phosphorylation rates of C3’- and N3- functionalized thymidine derivatives.

<table>
<thead>
<tr>
<th>C3’ Complex</th>
<th>[%]*</th>
<th>N3 Complex</th>
<th>[%]*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>20.3 ± 0.8</td>
<td>6*</td>
<td>17.9 ± 0.1</td>
</tr>
<tr>
<td>2*</td>
<td>27.6 ± 1.9</td>
<td>7*</td>
<td>14.1 ± 0.2</td>
</tr>
<tr>
<td>3*</td>
<td>23.1 ± 1.8</td>
<td>8*</td>
<td>9.0 ± 0.4</td>
</tr>
<tr>
<td>4*</td>
<td>14.2 ± 0.2</td>
<td>9*</td>
<td>16.8 ± 0.2</td>
</tr>
<tr>
<td>5*</td>
<td>12.5 ± 0.5</td>
<td>10*</td>
<td>10.9 ± 0.4</td>
</tr>
</tbody>
</table>

* The phosphorylation rate for dT was arbitrarily set to 100%.

Conclusions

Using the “click-to-chelate” strategy we were able to identify the first metal-containing substrates for hTK1. Furthermore, the approach allowed the fast identification of structure-activity relationships in a matter of a few hours. Thus, we could demonstrate that neither the synthesis or incorporation of different metal chelating systems, nor the subsequent radio-labelling, need to be the rate-determining steps in the development of radiopharmaceuticals. It is important to recognize that the same approach can be used to functionalize any azide-containing biomolecule and in situ (radio)labelling provides rapid access to a set of conjugates for preliminary screening. By making functionalization of targeting molecules fast, efficient and predictable, click chemistry could play a crucial role in expediting the development of potential SPECT tracers.

References

Improved imaging of prostate cancer with bombesin analogues functionalized by “click”-chemistry

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“Click”-chemistry offers a powerful tool for the incorporation of chelating systems and other moieties (e.g. glucose) into biomolecules. Using this strategy, new analogues of the tumour-affine peptide bombesin were synthesized which showed higher tumour uptake and lower radioactivity at the abdominal area. This resulted in a better delineation of tumours by Single Photon Emission Computed Tomography/Computed Tomography (SPECT/CT). Moreover, radioactivity wash-out was faster from normal tissues, including receptor-positive organs, than from tumours, which would be advantageous for therapeutic purposes.

A variety of human tumours, including prostate and breast cancers, overexpress bombesin (BBS) receptors on the cell membrane and, thus, BBS analogues are interesting molecules to selectively deliver radionuclides into tumour cells for imaging and therapy [1, 2]. The main drawback of most reported radiolabelled BBS derivatives is their high liver uptake and strong hepatobiliary excretion, which may obscure the detection of tumours or metastases localized at the abdominal cavity. Introduction of carbohydrates in the molecule increases the hydrophilicity and may favour a renal excretion. “Click”-chemistry (the Cu(I)-assisted [2+3] cycloaddition of an alkyne and an azide) offers a convenient way of functionalizing bimolecules [3, 4]. This technique was used to attach glucose to the peptide molecule (BBS-2) as well as a new chelating system (BBS-3). Presented here is the comparison of two glycated BBS analogues as potential radiopharmaceuticals for tumour targeting (Figure 1).

Biodistribution

The presence of glucose neither affected the affinity for the BBS receptors nor the internalization into tumour cells in vitro [5]. The biodistribution of the new 99mTc-labelled BBS analogues was tested in mice with tumour xenografts of PC-3 cells, a human prostate carcinoma cell line that overexpresses BBS receptors. The “click”-glycated analogues BBS-2 and BBS-3 showed significantly higher tumour uptake than the non-glycated analogue BBS-1 (Figure 2). Uptake in the tumour and in the receptor-positive organs pancreas (data not shown) and colon was very specific, and could be significantly inhibited after co-injection with a high concentration of natural BBS. The glycated 99mTc-BBS-2 and 99mTc-BBS-3 were preferentially excreted through the kidneys and, thus, their liver uptake was substantially reduced compared to the non-glycated

Figure 1: Schematic presentation of the Cu(I)-assisted [2+3] cycloaddition of an alkyne and an azide, called a “click” reaction. Structure of the analogues BBS-1 (“non-clicked” reference); BBS-2 and BBS-3 (“clicked” carbohydrates in red and “clicked” chelator in green).
99mTc-BBS-1. In spite of a higher kidney uptake at earlier post-injection times for the “click”-glycated analogues, the activity was rapidly cleared and similar low renal uptake was observed for all the analogues at later times. Moreover, residence times of labelled BBS-2 and BBS-3 in the tumour were longer, whereas activity wash-out was rapid from normal organs, which resulted in much higher tumour-to-tissue ratios.

SPECT/CT imaging

SPECT/CT (Single Photon Emission Computed Tomography / Computed Tomography) is a nuclear medicine imaging technique which combines gamma rays and X-rays. The imaging depicts both the distribution of radioactivity in the body (SPECT) and its anatomic localization (CT). SPECT/CT imaging was performed in mice with PC-3 tumour xenografts 1.5 h after i.v. injection of the radiolabelled BBS analogues. The images corroborated the results obtained in the biodistribution studies. A better delineation of the tumour xenografts was observed with the “click”-glycated analogues, which also showed lower activity at the abdominal area in agreement with their preferential renal excretion (Figure 3).

In conclusion, the insertion of carbohydrates increased the potential of BBS analogues as radiopharmaceuticals for both imaging and therapy of BBS receptor-positive tumours, and “click”-chemistry showed itself to be an elegant method for the glycation of peptides.

References


Figure 2: Biodistribution of 99mTc-labelled BBS analogues in mice with prostate tumours at 1.5 h p.i. Comparison in selected tissues. High uptake in colon is due to the normal expression of receptors in this tissue in mice.

Figure 3: SPECT/CT images in mice with prostate tumour xenografts (1.5 h p.i.). The glycated analogues BBS-2 and BBS-3 gave better visualisation of the tumours, as well as a much lower accumulation of radioactivity in the abdominal cavity.
The quest for a perfect optics correction and highest brightness at the Swiss Light Source

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The storage ring of the Swiss Light Source (SLS) was designed to obtain the highest brightness possible within the constraints of machine size, beam energy and available straight sections for undulators. Imperfections of the tense magnet structure, leading to deterioration of brightness, beam lifetime and injection efficiency, were cured progressively by several beam-based means during the years 2000–2008. These efforts resulted in a world-record low vertical emittance of $2.5 \text{ pm rad}$ and excellent agreement of measured beam lifetime with data obtained from simulations, confirming successful beam optics correction.

Brightness, emittance and acceptance

Brightness (photons per time, area at the source and solid angle of the beam) is the key measure of light source performance. High brightness requires small transverse emittances (product of beam size and divergence) of the stored beam. Horizontal emittance is determined by the layout of the storage ring lattice, i.e. the magnet structure. A small value is obtained by using a large number (SLS: 36) of dipole magnets for the lattice and by providing a horizontal beam focus in all dipole centres by means of strong quadrupole magnets. The quadrupole chromaticity, i.e. the dependency of focusing strength on particle energy, however, is a cause for beam instability and requires compensation by means of sextupole magnets. The non-linear sextupole field, however, leads to a degradation of the lattice acceptance, i.e. its ability to also store particles which deviate from ideal coordinates, due to the onset of chaotic motion beyond some amplitude. In particular, efficient injection into the storage ring requires a large horizontal acceptance, and long beam lifetime requires large energy acceptance, which basically translates to horizontal acceptance for off-energy particles. Thus it became a crucial issue of the SLS design to find an arrangement of sextupoles which minimizes their adverse effects while delivering the indispensable chromaticity compensation \cite{1}. It took several iterations of the lattice layout to simultaneously fulfil the requirements for beam energy ($2.4 \text{ GeV}$), number and size of straight sections ($6 \times 4 \text{ m}, 3 \times 7 \text{ m}, 3 \times 11.5 \text{ m}$), horizontal emittance ($5 \text{ nm rad}$) and suitable acceptances ($25 \text{ mm mrad horizontal, } \pm 3\% \text{ in energy}$) within a limited circumference ($288 \text{ m}$).

The vertical emittance of an ideal, flat lattice, as given by the quantum emission nature of synchrotron radiation, is very small, $\sim 0.5 \text{ pm rad}$ for the SLS, and is usually dominated in a real lattice by two contributions due to imperfections, i.e. magnet misalignments: direct generation of vertical emittance due to spurious vertical dispersion (i.e. vertical orbit excursions due to energy deviations) and transfer of horizontal to vertical emittance due to coupling between the transverse planes.

Acceptance breakdown and recovery

The vertical acceptance in a light source is rather small, due to the narrow gaps of the undulators. In the presence of coupling, particles at large horizontal amplitudes, as they occur in the injection process or due to intrabeam scattering events (Touschek effect), may be deflected vertically and subsequently get lost. Furthermore, any distortion of the sextupole cancellation obtained for the ideal lattice due to asymmetries in the optics will drive additional nonlinear resonances, leading to a direct deterioration of horizontal and energy acceptance. During the commissioning phase, and later on in parallel with user operation, the lattice imperfections were cured progressively in the following ways:

1. The linear optics is corrected by measurements of the average beta function, i.e. beam size normalized to emittance, in each quadrupole, and subsequent application of individual correction currents to each of the 177 quadrupoles.

2. Transverse displacements between the magnetic centres of the quadrupoles and the centres of the adjacent beam position monitors, i.e. the beam position for zero readings, is measured using the beam itself (beam-based alignment). This allows the beam to be centred in the quadrupoles. Displacements of girders revealed in the process are corrected by careful mechanical realignment utilizing the unique remote girder alignment capability of the SLS \cite{2}.
Recent activities employ small skew quadrupole and auxiliary sextupole magnets, installed as additional coils on the main sextupole magnets, to optimize the lattice in the following ways:

- Twenty-four skew quadrupoles in dispersion-free regions globally suppress the betatron coupling and are also used to locally compensate coupling introduced by vertical beam excursions in sextupoles, if users require orbit bumps.
- Twelve skew quadrupoles in dispersive regions (six installed to date) control the vertical dispersion, and with it the vertical emittance, without introducing coupling.
- Twelve auxiliary sextupoles (six installed to date) restore the symmetry of the sextupole patterns, which is not possible with the 120 main sextupoles since they do not have individual power supplies.

The auxiliary sextupole settings are obtained empirically, whereas the skew quadrupoles settings are derived from orbit response measurements with little further empirical adjustment. The ratio of beam lifetime to beam height was chosen as figure of merit for optimization, where lifetime, dominated by the Touschek effect, ideally scales with the beam height and has to be maximized. Beam height, which depends on vertical emittance, has to be minimized for highest brightness.

A unique high-resolution monitor developed at the SLS was extensively used to observe the beam size [3]: Figure 1 depicts an image of the vertically polarized light emitted by the storage ring dipole which is used by the monitor.

**Performance results**

Excellent agreement of measured beam lifetime with data from simulations of the ideal lattice was obtained, as shown in Figure 2, indicating the success of the optics correction. An injection efficiency of virtually 100% has been achieved, enabling the storage ring to be filled to 400 mA within seven minutes and largely avoiding any radiation background during top-up operation.

An ultralow vertical emittance of 2.5 pm rad has been achieved, just a factor of five away from the ultimate radiation limit set by the quantum nature of the photon emission. The corresponding ratio of vertical to horizontal emittance of 0.05% sets a world record (Figure 1).

In user operation, lifetime may be increased at the expense of vertical emittance or brightness in a controlled way, since the ideal scaling of lifetime with emittance has been largely achieved; for example, 10 hrs of lifetime can be achieved with 7.5 pm rad vertical emittance in 400 mA top-up operation.

**References**


Converging missions on cancer treatment at the Center for Proton Therapy (CPT)

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2008 marked the first year of continuous patient treatment operation using Gantry 1 at the CPT. The primary mission of providing proton therapy for adults and children with difficult-to-treat tumours is paralleled by a continued commitment to particle research and technical developments, notably Gantry 2 and the next-generation spot-scanning system.

Summary

In 2008, the CPT completed its first full year of continuous patient treatment operation. One hundred and six patients were treated, thereby almost doubling the highest number of patients ever treated per year. Over the entire treatment system, throughout the chain of events from accelerating protons to actual delivery in the patient, availability was exceedingly high, essentially providing patient treatment for more than 97% of the time possible. Sources of patient treatment delay, either scheduled or unscheduled, are depicted in Figure 1. In practice, this meant that there were occasional delays during the day, but very rarely was patient treatment cancelled. This high availability is unprecedented for a prototype and was certainly only achievable due to the remarkable expertise in accelerator physics, beam controls and beam delivery at PSI. The model of integrating technical service, maintenance and system upgrades into the clinical operation without any major shut-downs proved to be manageable by introducing only six long weekends over the course of the year. The reasons for limiting the number of patients treated per day is entirely due to the needs of competing beamtime to complete the OPTIS2 commissioning process and the development and commissioning of Gantry 2. The present clinical programme was continued, with strong emphasis on the treatment of children, while preparing to evaluate new indications, once Gantry 2 becomes operational.

Childhood malignancies treated at PSI

After initiating the paediatric project at PSI, over 100 children have so far been treated. Since 2004, the treatment of very young children under deep sedation has also been offered, in cooperation with the children’s hospital of the University of Zurich. In addition, the prospective investigation of late effects and quality of life was started in 2004. During 2008, an analysis was performed of all children prospectively investigated at the Institute from 2004 until the end of 2007. Fifty-one children were evaluable for this analysis, with the aim of investigating local tumour control rates and the incidence of acute and late side-effects of treatment. The median age of the children at the time of diagnosis was 2.6 years, ranging from 4 months to 20 years. Twenty-two of these were girls and 29 were boys, sent from 33 hospitals in 8 different countries (Switzerland, Germany, the Netherlands, Denmark, France, the United Kingdom, Spain and Austria). The diagnoses indicated bone or soft-tissue tumours in 24 children, brain tumours in 19 children, chordomas/chondrosarcomas in 5 children, and 3 miscellaneous tumours. The predominant tumour site in 41 children was the head and neck. In 8 children, the tumour was located in the spine, and in 2 in the pelvis. The total median dose of radiation therapy was 54 Gy (range, 45–79.4 Gy). In 46 children, only proton therapy was administered. In 5 children, the radiation therapy was partially given with
In 34 children, proton therapy at PSI was administered under deep sedation, reflecting the very young age of the cohort. In 41 children, chemotherapy had been administered before radiotherapy, and in 26 patients chemotherapy was given in parallel to irradiation, in the children's hospital, University of Zurich. In 49 children, only incomplete resection or biopsy was achieved before starting radiotherapy. After median follow-up time of 29.4 months (range, 5–62.3 months), 7 children experienced local recurrence. All local recurrences were found to be located in the high-dose area of the radiotherapy. No systemic dissemination occurred. 44 children (86.3%) are free of disease after proton therapy. Regarding acute side effects, major adverse events (scored according to international standards) were observed only for skin/mucosa (n=5) and bone marrow (n=19) in children having parallel chemotherapy. Regarding late effects, 35 children were evaluable as follow-up time exceeded 6 months. In 5 children, major late effects were observed for skin (n=1), central nervous system (n=1), eye (n=1) or ear (n=2). Quality-of-life analysis data are not yet available. So far, 76 children have entered this study and completed forms on their quality of life status. Early results suggest that, in general, parents consider the status of their child more negative compared with the perception of the child.

Initial commissioning of the Gantry 2 beam line

During the first half of 2008, the beam line on Gantry 2 was completed and the proton beam could be transmitted to the gantry iso-centre. The initial experimental phase was used to demonstrate the new concepts of the system. New and outstanding features are the very fast changes of the beam energy, the parallelism of the 2D scanned beam and the small size of the proton beam, due to a sophisticated nozzle design. The much faster 2D scanning (compared with Gantry 1), with invariant spot shape, is the precondition for delivering the dose with repainting, one of the promising strategies for treating mobile tumours on Gantry 2.

The PROSCAN project – the expansion of the proton therapy facility at PSI – comprises a new treatment station for deep-seated tumours. Gantry 2 is based on long-term experience with a scanned proton beam on Gantry 1. It incorporates many improvements and will be the system for performing further developments of the scanning technique [1]. The mechanical structure of Gantry 2 was finished during 2007 and the beam line was completed during the first half of 2008. First beam at the gantry iso-centre was detected on 9 May. This was the starting point of a new phase of commissioning, to demonstrate the new features of Gantry 2.

Fast energy selection

In contrast to Gantry 1, where the proton beam energy is modulated on the gantry itself, the degrader system in the beam line of PROSCAN is used to set the correct energy for Gantry 2. This has advantages in the design of the nozzle and allows a continuous set of beam energies to be produced. On the other hand, the complete beam line must be set in the shortest time for each new energy. This becomes an even more critical issue in the case of volumetric repainting, where the dose of the complete volume is applied several times. Therefore, beam lines were constructed with laminated magnets, to reduce eddy currents. As shown in Figure 2, typical energy steps corresponding to 5 mm in water can be performed in less than 80 ms.

![Sequence of spots with an energy change in between. The currents of the kicker magnet and the 90° bending magnet are shown.](image)

This time was measured for the 90° bending magnet, which is the slowest, and also the largest, magnet in the beam line. The degrader system has a highly energy-dependent transmission, of the order of two magnitudes, but for precise dose monitoring an energy-independent proton current at the iso-centre is advantageous. The problem cannot be solved with a set of different collimators, since the mechanical switch between different energies would slow down the energy selection. This was solved by introducing additional beam losses for higher energies, which help to equilibrate the proton current. They are controlled by defocusing the beam with quadruple magnets on a fixed collimator. Since these magnets are part of the beam tune, the intensity compensation is solved intrinsically, as shown in Figure 3. Additionally, an energy parameterization of the beam tunes was found which allows the settings of the complete beam line to be calculated for all possible energies.
Spot shape and size

An invariant and small proton spot at the iso-centre is of large importance for good quality of treatment planning. Therefore a lot of attention was paid to the design of the beam exit region, the so-called nozzle. Without dose monitors and collision protection, the standard deviation of the Gaussian spot form at iso-centre is about $0.3 \text{ cm}$, as shown in Figure 4.

By installing all required material into the nozzle, the beam is broadened due to multiple scattering, especially for low energies. To reduce this effect, the nozzle is designed with a movable snout, containing all affecting material, which can be moved closer to the iso-centre. A further improvement can be achieved if the patient is placed closer to the nozzle. This reduces the air gap, and the spot size approaches the limit of an undisturbed beam.

Gantry 2 is equipped with two sweeper magnets, allowing fast 2D beam scanning. Due to upstream scanning and sophisticated design of the $90^\circ$ bending magnet, the scanned beam is parallel. It was expected that the spot form would change along the x scan axis. To correct for this deformation, a quadruple corrector was installed at the middle of the first doublet on the gantry. With a static corrector value, the spot shape can be optimized for one specific x deflection. To achieve the goal of an invariant spot shape in the complete scan region, the quadruple corrector must be changed dynamically with the x sweeper magnet. Therefore the corrector magnet was connected in series with the power supply of the x sweeper magnet. The resulting spot shapes are shown in Figure 5.

Conclusions

The feasibility of some important concepts of Gantry 2 has been demonstrated and fundamental parameters of the beam delivery system measured. We believe that the new gantry has the necessary potential to become the best performing system in this field. This is a solid basis for further development towards the treatment of moving tumours. The areas which are still awaiting completion are the mechanical system, the finishing of the treatment area, the electronics and the software for patient safety, the steering system for the patient table and the diagnostic equipment for patient positioning.

First patient treatment with static tumours is planned for 2010.

Reference:

Strategy and highlights of General Energy Research

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The year 2008, the year of PSI's 20th anniversary, was a year of infrastructure and knowledge build-up for future research in General Energy. A process development unit (1 MW) for the production of methane from synthesis gas was completed, so new experience can be gained with this avenue of biomass utilization. Test stands for combustion and hydrothermal gasification have been installed in the new laboratory hall of CCEM. Solar technology and atmospheric research have embarked on several important EU projects, and Electrochemistry laid the groundwork for future avenues in electric mobility, comprising both advanced batteries and fuel cells.

Turmoil in the energy market, concern about a changing global climate, and discussion about the future energy supply for Switzerland have drawn attention to the importance of energy efficiency and renewable energies. The mission of the General Energy Department is responding to these challenges as it targets the generation of low-CO₂ energy carriers from renewables, the efficient provision of energy services, and minimizing material flows from and into the natural environment. Demonstrating their engagement for these issues, researchers from the five Laboratories of the Department have responded to members of the parliament, to interested audiences, and to the general public during the various events of this anniversary year, culminating with the “Open Day” in October 2008.

Energy carriers from renewables

General Energy at PSI is deliberately focusing on the two renewable primary energies of biomass and solar energy, and targeting energy storage in both cases. For solar energy, PSI's specialty is applying concentrated solar irradiation to drive endothermic chemical reactions, thereby producing chemical energy carriers or upgrading low-quality waste streams. For biomass, which represents solar energy stored by photosynthesis, the emphasis is on the production of fuels or electricity, to maximize work rather than heat.

In this context, energy carriers for transportation are of international interest. Which fuels – liquids, gases, or electricity – will be used as oil availability decreases, or as greenhouse gas emission reductions become even more pressing? The project “Transition to hydrogen-based transportation” is taking a comprehensive, unbiased view on the role hydrogen might play in a future transportation system.

Energy and Material Cycles

The project “Methane from Wood” took a big step forward in 2008, with the commissioning and first successful operation of the 1 MW process development unit installed at Güssing, Austria (Figure 1). In the PSI process, raw synthesis gas from the gasifier is converted into methane in a single catalytic step, followed by conditioning to gas grid quality. This development is supported by advanced on-line diagnostic tools for the gasification process.

For waste biomass with high water content, such as agricultural residues or sludges, hydrothermal gasification is being pursued as an alternative route. A Ruthenium catalyst is added to convert organics completely into CH₄ and CO₂, while
the nutrients precipitate as the medium is heated above the critical point of water, and can be recycled. For the first time, X-ray absorption spectroscopy at the super-XAS beam-line of the SLS has been successfully applied to look at the catalyst in situ under supercritical conditions.

Solar Technology
The solar thermal ZnO/Zn cycle, in which water is split into oxygen and solar hydrogen in two steps, has advanced, and construction and planning are ongoing for a demonstration at the 100 kW scale in 2010. In addition, a variety of novel ideas for high-temperature solar processes is being investigated. In one of these, CO₂ rather than H₂O is reduced by the solar Zn auxiliary medium. Several processes are advancing in which a low-quality feedstock, such as petcoke, is upgraded by solar energy, thereby halving associated CO₂ emissions.

Efficient energy conversion
Efficiency is recognized internationally as one of the most important measures needed to make our energy system more sustainable. The Combustion Research Laboratory devotes itself to efficient, clean combustion of fossil and biogenic fuels. The Electrochemistry Laboratory focuses on advancing efficient electric drive trains in transportation, be they hybrids with internal combustion engines, plug-in hybrids, fuel cell hybrids, or electric vehicles.

New infrastructure created by the CCEM
Several of the projects targeting energy carriers from renewables and their efficient conversion are embedded within the Competence Center Energy and Mobility (CCEM), a joint endeavour of the ETH domain facilitated by PSI. In 2008, important new facilities have been commissioned, in particular a test stand for large (ship) diesel engines (see image on page 71), and a laboratory hall hosting installations for biomass conversion and test stands for combustion research.

Combustion Research
Completion of the CCEM hall enabled the upgrading of two large test rigs for lean premix and catalytic combustion, representing key experimental facilities for research on low-emission gas turbines. This is supported by advanced laser diagnostics and by theoretical modelling, and was presented at the 7th International Workshop on Catalytic Combustion, organized by the Laboratory. The portfolio further includes important activities in exhaust gas after-treatment, targeting in particular the simultaneous removal of NO, and particulates from diesel exhausts.

Electrochemistry
The Battery Group is improving high-energy, high-power batteries for electrochemical energy storage by means of novel electrode materials, notably nanoparticulate oxides produced by flame spray pyrolysis.

In fuel cell research, development continues on stable, potentially low-cost polymer electrolyte membranes. Novel simplified stack concepts are being developed in collaboration with an industrial partner, Belenos Clean Power, with the goal of building a fuel cell car operated on hydrogen and oxygen produced by solar energy. The key for progress in 2008 was the intensive use of in situ diagnostic methods, including using the unique analytical capabilities available at PSI’s large facilities, such as neutron radiography of operating fuel-cell stacks, microtomography of porous materials, and locally resolved impedance spectroscopy.

Energy, environment and society
The Laboratory of Atmospheric Chemistry has focused on atmospheric particles, their sources, atmospheric transformation, and climatic impact. In particular, the generation of secondary organic aerosol particles from anthropogenic and biogenic precursors is not only of scientific interest, but also of high political relevance for source attribution of particulate air pollution. These activities, including experimentation at the smog chamber, are being pursued within a network of European projects, in several of which PSI is a leading contributor.

Energy system analysis has gained importance in creating scenarios for developing a sustainable energy system, while respecting global climate protection goals. In particular, important contributions have been made to the Energie Trialog Schweiz, in which stakeholders from politics, industry, and academia seek solutions for the Swiss energy system consistent with security of supply, environmental goals, and economic growth.

Outlook for 2009
The activities of the CCEM during the past three years will be evaluated early in 2009, and directions for its future development given. The launching of a major initiative for electromobility is under discussion. In May, PSI will invite major European players to an international conference on 2nd generation biofuels. The seminal projects of solar fuels, “zero emission” power plants and atmospheric ecosystem quality will be pursued in the context of international consortia.
Hydrothermal gasification of wet biomass – results from SLS

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Wet biomass (e.g. algae, sewage sludge, manure, food wastes) can contribute significantly to a sustainable energy supply if converted efficiently into synthetic natural gas. PSI is developing a novel process that allows wet biomass to be converted into methane with a net efficiency of 65–70 %. Understanding the key steps of the gasification and methanation is of paramount importance for improving the process. The catalytically active sites involved in the gasification were investigated for the first time by applying in-situ X-ray absorption spectroscopy (XAS) in supercritical water at 25 MPa.

Biomass may be converted into a variety of energy forms, including heat, electricity and mechanical work in the form of traction power. Today, most of the biomass used for energy purposes is combusted to produce electricity and/or heat. Biomass conversion to transportation fuels has been the subject of many studies. Among all options, biogenic synthetic natural gas (Bio-SNG) is particularly attractive because its combustion produces much less atmospheric pollution than fossil fuels. Furthermore, it can be distributed using an existing natural gas grid.

Bio-SNG can be synthesized directly from biomass in water at supercritical conditions ($T = 400{\,}^\circ\text{C}$, $p = 30$ MPa) using a catalyst. This is described in Eqs. 1–3 for the hydrothermal gasification of ethanol, as an example. Ruthenium catalysts have been found to be very active and selective in this process [1,2].

\[
\begin{align*}
\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O} & \rightarrow \text{CH}_4 + \text{CO}_2 + 2 \text{H}_2 \quad (1) \\
0.5 \text{CO}_2 + 2 \text{H}_2 & \rightarrow 0.5 \text{CH}_4 + \text{H}_2\text{O} \quad (2) \\
\text{net: C}_2\text{H}_5\text{OH} & \rightarrow 1.5 \text{CH}_4 + 0.5 \text{CO}_2 \quad (3)
\end{align*}
\]

The main advantage of supercritical water gasification over conventional gasification processes is that it allows wet biomass (i.e. manure, crop residues, algae) to be converted efficiently into fuels, since the energy-intensive drying of wet biomass feedstocks is eliminated.

In-situ X-ray absorption spectroscopy

In-situ X-ray absorption spectroscopy (XAS) of a working catalyst was performed, in order to obtain representative in-formation about its active sites responsible for the transformation of organic constituents into the desired product methane [3]. Due to the demanding reaction conditions applied during the supercritical water gasification, a dedicated setup was designed for operation up to 400°C and 25 MPa (Figure 1). The key part of this setup is the sapphire reactor. Sapphire has a high mechanical strength, which is needed to withstand the high pressure, while still showing sufficient transparency for hard X-rays.

The experiments were conducted with a commercialized ruthenium catalyst (2 wt% Ru on carbon, supplied by Engelhard Corp.). A solution of 5 wt% ethanol in water was used as a simple model feed for wet biomass. Experiments were conducted at the SuperXAS beamline of the Swiss Light Source (SLS), at a total pressure of 25 MPa and temperatures up to 390°C, and spectra were recorded at the Ru K-edge ($E_0 = 22118$ eV).
Active sites of the ruthenium catalyst

Figure 2 displays ethanol conversion as a function of the reaction temperature. The conversion of ethanol increased sharply above 300°C, and complete conversion was observed at 370°C.

The corresponding in-situ XANES spectra recorded at 25 MPa are shown in Figure 4. For comparison, reference spectra of the fully oxidized and fully reduced catalyst are displayed in Figure 3.

Comparison of the reference spectra (fully oxidized and fully reduced catalyst, Figure 3) with those recorded at different reaction temperatures (Figure 4; 100–250°C and 250–370°C) revealed that a reduction of the catalyst took place between 125°C and 150°C. Metallic ruthenium was formed, as indicated by the appearance of the typical double-peak structure in the XANES spectra. The double-peak structure remained in the spectra at higher temperatures (up to 370°C). The position of the absorption edge did not change. A systematic decrease of the peak intensities with increasing temperature was observed, which was most likely related to surface reactions and/or adsorption of small molecules on the ruthenium surface.

The results obtained clearly indicate that ruthenium metal sites (Ru⁰) are catalyzing the hydrothermal gasification of ethanol [3]. These findings do not support the commonly cited reaction mechanism published by Park et al., who proposed a redox-type reaction involving Ru⁰ and Ru⁴ species [4].

Acknowledgements

We thank E. De Boni and M. Hottiger for their support during the construction of the experimental setup and would also like to thank M. Schubert, T.-B. Truong and J. Müller for their help during the measuring campaign.

References

Stabilizing atmospheric CO$_2$ concentration is of major concern today. Considerable effort is currently underway to attain a zero-emission energy production scenario involving the development of more efficient energy systems and renewable energy utilization, as well as CO$_2$ capture, sequestration and/or utilization. CO$_2$ capture, either by means of fuel decarbonization prior to combustion, by separation from combustion flue gas, or directly from air, produces a stream of pure CO$_2$ that is stored long-term or utilized as feedstock for the synthesis of chemical commodities. A promising and sustainable alternative to CO$_2$ sequestration is the decomposition of CO$_2$ into C, CO, and O$_2$. Solid carbon can be safely stored, and both C and CO can be used as combustion fuels or further processed to synthetic liquid fuels for transportation. O$_2$ is needed for oxy-combustion and gasification technologies. Direct thermal decomposition of CO$_2$ at atmospheric pressure occurs at ultra-high temperatures, i.e. 30% dissociation is theoretically obtained above 2700 K. Further complication arises from the need to separate the product gases at these high temperatures, in order to avoid recombination. The operating temperature can be reduced and the separation problem bypassed by making use of thermochemical cycles. Of special interest is the two-step cycle based on metal-oxide redox reactions, shown schematically in Figure 1.

### Chemical thermodynamic equilibrium

Thermochemical equilibrium calculations for Zn(s) at 1 bar indicate three temperature regimes: below 700 K, C is produced; between 700 and 1000 K, C and CO are produced; and above 1000 K, CO$_2$ is the only product, which can be reduced to C and CO with Zn(s) at below 1000 and above 700 K, respectively, and with FeO at below 550 K and above 800 K, respectively. In the case of stoichiometric Zn+CO$_2$ and 3FeO+CO$_2$ reactions, C(s) formation reaches maxima below 700 K and 300 K, respectively. For all cycles, higher pressures favour the formation of C, according to Le Chatelier’s principle. Note that the reduction of CO$_2$ to C(s) requires double the amount of ZnO or Fe$_3$O$_4$ compared with the reduction of CO$_2$ to CO.

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**Figure 1:** Scheme of the two-step solar thermochemical cycle for CO$_2$ reduction via M/M$_x$O$_y$ redox reactions (M denotes metal).
Second-Law analysis

A Second-Law (exergy) analysis has been performed to determine the theoretical maximum energy conversion efficiency of the CO\textsubscript{2}-splitting solar thermochemical cycle using the proposed two-step Zn/ZnO and FeO/Fe\textsubscript{3}O\textsubscript{4} redox reactions. A flow diagram for a general CO\textsubscript{2}-splitting cycle is shown schematically in Figure 2, composed of a solar reactor, a quench unit, and a reducer. Readily available CO\textsubscript{2} is assumed, i.e. after capture. The molar flow rate of CO\textsubscript{2} to the CO\textsubscript{2} reducer is set to 1 mol/s, to produce either CO or C, which implies different molar flow rates of the metal oxide to the solar reactor according to the given reactions. The complete process is assumed to be carried out at steady-state and at a constant pressure of 1 bar. In practice, pressure loss will occur throughout the system and pumping work will be required. Heat exchangers for recovering sensible latent heat are not considered. Additional assumptions are that the solar reactor is a blackbody absorber, all products separate naturally without expending energy, kinetic and potential energies are neglected, and all reactions reach completion. The solar-to-chemical energy conversion efficiency is defined as the portion of solar energy that is converted into chemical energy, given by the Gibbs free energy of the products, i.e. the maximum possible amount of work that can be extracted from the products when transformed back to the reactants at 298 K in a reversible, ideal fuel cell:

\[ \eta_{\text{solar-to-chemical}} = \frac{\dot{W}_{\text{FC,ideal}}}{Q_{\text{solar}}} = \frac{-\dot{n} \Delta G_{\text{products}}|_{298 \text{ K}}}{Q_{\text{solar}}} \]

The baseline parameters are: molar flow rate of CO\textsubscript{2} = 1 mol/s, normal beam solar isolation = 1 kW/m\textsuperscript{2}, solar flux concentration ratio = 5000 suns, nominal reactor temperature = 2000 K, and ambient temperature = 298 K. For Zn/ZnO cycles, \( \eta_{\text{solar-to-chemical}} \) reaches 30% and 39% for C and CO production, respectively. For FeO/Fe\textsubscript{3}O\textsubscript{4} cycles, \( \eta_{\text{solar-to-chemical}} \) reaches 22% and 29% for C and CO production, respectively. Higher efficiencies for Zn/ZnO than for FeO/Fe\textsubscript{3}O\textsubscript{4} are attributed to two factors: 1) the lower enthalpy change of ZnO-dissociation, resulting in 25% lower solar input, and 2) the lower heat capacities (on a molar basis) for Zn and ZnO compared to FeO and Fe\textsubscript{3}O\textsubscript{4}, resulting in a reduction of heat lost from quenching by a factor of more than 2. Major sources of irreversibility are associated with the re-radiation losses of a solar reactor operating at 2000 K and the quenching of products exiting the solar reactor.

In general, the Second-Law analysis indicates that a favourable aspect of using solar energy at high temperatures is the potential of achieving high solar-to-chemical conversion efficiencies. High efficiencies directly translate to lower solar collection area and associated costs of the heliostat field, which amount to 40–50% of the capital cost for the entire solar CO\textsubscript{2}-splitting plant.

Conclusions

Two-step thermochemical cycles for CO\textsubscript{2} splitting via Zn/ZnO and FeO/Fe\textsubscript{3}O\textsubscript{4} redox reactions have been thermodynamically examined. The results provide a foundation for pursuing an experimental study for reducing CO\textsubscript{2} with Zn and FeO. Additional measures could be applied in a real system to increase the overall efficiencies that were not considered in these analyses. For example, waste heat may be recovered from the quenching process and from the exothermic \( xM + CO_2 \rightarrow CO + xM \) reaction. An in-depth description of the thermodynamics analysis is described in Ref. [1], the reaction kinetics is described in Ref. [2], and the solar reactor technology for thermally reducing ZnO to Zn is described in Ref. [3].

References

Molecular dynamics of combustion species

Molecular states and energy barrier levels have to be known exactly when assessing reaction processes. Knowing the energy and configuration maps of a single molecule alone is an invaluable contribution to combustion modelling, as dynamical models primarily depend on energy levels and the number of possible states. As the overall progress of a chemical reaction is determined by single discrete rearrangements and the exchange of atoms between two colliding molecules, the kind and state of the resulting species, and the speed at which they form, are strongly dependent on such mechanisms.

Using formaldehyde as an example, the dissociation of molecules along two channels into two possible products was investigated: H + HCO and H$_2$ + CO. For both channels to proceed, formaldehyde has to be activated to relatively high, and only slightly different, energies (Figure 1). The goal was to understand the underlying mechanisms leading to either molecular or radical products. Currently, an approach to the even more complicated multi-channel dissociation of alkyl peroxy radicals is being made. Better knowledge of the peroxy chemistry in a flame will allow the ignition processes of a flame to be described more accurately than is possible today.

With femtosecond spectroscopy, the intra-molecular energy transfer in formaldehyde was monitored [1], beginning with measurements on the dissociation of di-tert-butylperoxide. Using the experimental facilities at the SLS/VUV beamline, urgently needed data will be added to the peroxy spectroscopy in the domain below 200 nm, in order to obtain highly resolved multi-photon [2] spectroscopic measurements in the laser lab.

Figure 1: Energy levels and potential of states of H$_2$CO relevant for the description of the dissociation reaction channels to H + HCO and H$_2$ + CO.

Chemical reactions in micro-scale devices

Flows in complex geometries and with flow regimes of Kn > 0.1 (ratio of mean free path to characteristic geometric dimension), e.g. porous media in catalytic modules and fuel cells, are being investigated by the Lattice Boltzmann (LB) method. A model consistent with kinetic theory that accounts for multi-component, surface-reacting and complex-geometry flows has been
established for the first time [3]. This model is able to capture non-trivial microscopic effects, such as velocity slip on rigid boundaries, which depends on the channel dimensions as well as the mixture composition. The model is being applied to transient reacting flow through catalytic pellets (Figure 2). An extension of the current formulation is underway, that will account for flows with temperature and density gradients, e.g. in (partial) oxidation catalysts. The thermal Lattice Boltzmann model [4] will be used as a platform for deriving a new thermal, multicomponent and reacting Lattice Boltzmann model.

Figure 2: Catalytic pellet bed reactor (pellets shown in blue). 2D distribution of methane mole fraction (dark red = max. conc.) and flow streamlines.

Dynamics of flames in meso-scale channel flows

Direct numerical simulation with detailed chemistry and transport is being used to map the dynamics of lean, premixed hydrogen/air flames in planar mesoscale (mm-sized) channels. Different burning modes have been observed, depending on inlet velocity, such as steady and oscillating flames, as well as the chaotic behaviour of cellular flame structures. Stability maps delineating the regions of different flame types have been constructed showing their dependence on channel geometry and inflow conditions [5]. It has also been shown that all intrinsic flame dynamics (Figure 3) can be suppressed by an appropriate catalytic reactivity of the channel walls. Thus, it is possible to eliminate undesirable unsteady combustion modes in practical small-scale combustors by applying a predetermined catalyst loading to the channel walls.

Figure 3: Flame stability diagram as a function of the inlet velocity (channel height: h = 4 mm).

Flame dynamics near the lean extinction limit

Homogeneously mixed, ultra-lean flames are favoured for their low-emission performance in stationary gas turbines. Exploiting this combustion technique to its limit (lean extinction) leads to dynamic extinction/re-ignition behaviour. OH chemiluminescence spectra are indicative of the resulting heat release fluctuations. Power spectra derived from OH-CL data (Figure 4) highlight the dynamic behaviour of lean premixed flames when approaching the lean blow-out limit. While system-specific resonance frequencies (see peaks at around 200 Hz) are observed for “stable” operating conditions, low-frequency pulsations (<10 Hz) dominate at lean blow-out [6].

References

Examples from the Swiss Light Source

Materials
Fundamental understanding of the interaction of highly porous carbon electrodes with electrolyte ions is of great importance for the optimization of energy storage processes in the electrochemical double layer of supercapacitor electrodes. In situ X-ray diffraction (XRD) and small-angle X-ray scattering (SAXS) were performed at the MS and cSAXS beamlines of the SLS, respectively. In situ XRD enabled changes in lattice spacing of graphitic materials to be characterized as ions are intercalated. The formation of staged phases was observed for different electrolytes, and the effective size of intercalated ions could be estimated [1]. Experiments with ionic liquids under similar conditions indicate that staging is hindered in these electrolytes, demonstrating that the presence of solvent molecules can have a significant effect on the intercalation mechanism. For the first time, activated carbons for supercapacitors were investigated by in situ SAXS during electrochemical charging (see Figure 1). Changes in the scattered intensity were observed, predominantly on the length scale of the microporosity (<2 nm) of the activated carbon, implying a change in composition of the electrolyte within the pores (double-layer charging) and indicating that dimensional changes on these length scales are likely to occur. Structural changes accompanied frequently with oxygen evolution are among the major failure mechanisms of positive electrode materials used in lithium-ion batteries [2]. The combined use of in situ X-ray synchrotron powder diffraction (Figure 2), ex situ X-ray powder diffraction, and in situ neutron diffraction is efficient when studying ageing effects of materials in lithium-ion batteries. The goal is understanding the long-term reversibility characteristics of, e.g., Li1.1(Ni1/3Mn1/3Co1/3)0.9O2 by investigating the phase transitions the material might undergo when subjected to high potential (>4.5 V vs. Li+/Li). The changes in the crystal structure after first cycle charge, extended galvanostatic cycling, and potentiostatic stresses were examined by X-ray powder diffraction. It was found that Li1.1(Ni1/3Mn1/3Co1/3)0.9O2 did not undergo any phase transition when deeply delithiated, because of a lithium-nickel exchange degree of about 4% in the present sample. The latter property is believed to be the reason for improved structural stability as nickel ions present in the interslab space keep the (MO6)n slabs in place, thus preventing the O3 phase
from converting into the O1 phase. The Li1.1(Ni1/3Mn1/3Co1/3)0.9O2 material class is therefore a good candidate as a low cobalt electroactive oxide suitable for high-potential window operation.

**Ex situ** X-ray micro-tomography at the Tomcat beamline allows the bulk material and interfaces in complex structures to be visualized (Figure 3), e.g. in components of polymer electrolyte fuel cells (PEFCs) [3]. Ultrathin platinum layers serving as electrocatalysts can be displayed down to a typical loading of 25 μg/cm². Hence, this technique offers the chance of visualizing post-mortem morphological changes occurring in these layers during different operating conditions, e.g. steady-state, potential or relative humidity cycling.

**Processes**

In the case of PEFCs, a detailed and fundamental understanding of the transport processes – in particular in the microporous gas diffusion layer (GDL) – is important, because these processes contribute to polarization losses and degradation. Research is focused on the role of liquid water in the porous structure. At a given energy (10–40 keV), X-rays are attenuated by both carbon and water. Thus, X-ray micro-tomography allows the microporous structure of the carbon-fibre-based GDL materials to be determined simultaneously with the distribution of liquid water contained in parts of the void [4] – with a resolution of 1 μm at the Tomcat beamline. Figure 4 shows a 3-dimensional view of a GDL filled with water from the bottom. “Fingering” of water through the path with largest connecting pores is observed.

![Figure 4: X-ray micro-tomogram of a gas diffusion layer partially filled with water (blue: water; white: solid phase of GDL; black: void).](image)

**Example from SINQ**

Earlier successful work on Neutron Imaging at SINQ was continued and extended to novel aspects of liquid water visualization in PEFCs. Optimizations in the detector system allowed exposure times of less than 10 s to be achieved, while keeping the high spatial resolution required for observing the different layers of a GDL. This opens the way to **in situ** studies of water accumulation and removal dynamics. Additionally, advantage was taken of the isotopic sensitivity of neutrons for **in situ** study of exchange processes at fuel cell electrodes, by labelling either the fuel or external water humidification with heavy hydrogen atoms (2H) [5].

**References**


In the third year of operation of the Competence Center Energy and Mobility CCEM, several infrastructural investments have been realized, which now offer important opportunities to the research community. In the fields of Heat and Buildings, Electricity, Mobility, and Renewable Fuels, the networks among the involved groups started to generate fruitful benefits. The first joint Master's programme between ETH Zurich and EPFL, Lausanne has started and is in its initial year. The interdisciplinary approach has clearly increased the exchange and collaboration beyond the borders of the separate institutions.

In 2008, the Competence Center Energy and Mobility CCEM complemented its project portfolio. The scope of this was fully covered by available funds, which in the reporting period of expansion were lower than in years before.

The flexibility of CCEM's structure, which refrained from creating strict boundaries between the research fields as proposed in the business-plan (technologies for mobility, electricity production, and heat and buildings) has proved itself to be very powerful. In the meantime, a cross-cutting field (the generation of fuels based on renewable primary energies) has emerged which is linked to almost all the other fields. Interactions are quite easy to establish and are very effective.

In 2008, several of the infrastructure enhancements were completed, and now offer additional opportunities for interested research groups. Examples include the new experimental hall and the large-engine research facility at PSI, the engine test-bench at ETH Zurich and the test-stand at EMPA, all of which are now in operation.

In 2008, CCEM succeeded in strengthening its relations with the Universities of Applied Sciences (UAS). To date, the Fachhochschule Nordwestschweiz, Fachhochschule Zentral-schweiz, Zürcher Hochschule für Angewandte Wissenschaft, and Berner Fachhochschule have signed agreements of common understanding, which secure, at least partially, the funding of participating research groups of the UAS.

From PSI's internal perspective, activities are well connected with the research activities of the departments of General Energy Research and Nuclear Energy and Safety. The new experimental hall has opened new opportunities within CCEM projects, as well as outside the Center.

Results of collaborative projects

An educational project, the first joint Master’s course between ETH Zurich and EPFL, Lausanne, was started in 2008 with 12 students: Both schools and PSI are collaborating in the ‘Master’s programme of Nuclear Engineering’ supported by CCEM, and large interest has been shown in the second term of this course.

In the field of electricity, the platform for high-temperature materials (PHITEM) has seen the investigation of advanced high-temperature materials with the support of a new nano-indentation device and the FIB multiscale characterization tool. These tests included irradiated, i.e. radioactive, samples. The project is described in more detail in a dedicated article within this scientific report (see page 80).
In the NEADS (Next Generation Exhaust gas After-treatment for Diesel Systems), new SCR catalyst materials are being investigated in order to achieve high reactivity and conversion with low exhaust gas temperature. In addition, a ceramic-foam-based substrate is under development to replace the conventional diesel oxidation catalyst, improving the performance and lifetime of the subsequent after-treatment system (particulate filter and/or SCR system). This project is organised in three sub-projects: Sub-project I develops zeolite-based catalytic materials; Sub-project II concerns the development of the micro reactor; while Sub-project III investigates emission formation and reduction paths from the combustion through the after-treatment systems. The sub-projects in turn make use of tools and knowledge developed and acquired in the three tasks “new instrumentation for particle characterisation”, “numerical simulation” and “atmospheric interactions”.

One particular tool is the use of X-ray transmission microscopy for imaging phase-separated nanostructured organic material, to obtain a microscopic picture of soot particle properties at the nanoscale. After having designed, constructed and tested a novel environmental cell at the X-ray scanning transmission microscope (POLLUX) at the Swiss Light Source (SLS) at PSI, the tool was used to investigate the morphology, chemical composition and water uptake of diesel soot particles. Samples were taken from a smog chamber into which diesel soot from a EURO III diesel passenger car had been injected. In a first experiment, particles were studied as they underwent photochemical aging in the smog chamber. The main result was a unique spatially resolved picture of how water interacts with soot particles (see Figure 1). Detailed spectral analysis at the O K-edge allows water strongly bound to hydrophilic functional groups at low humidity to be differentiated from capillary water at high humidity.

The results and activities of other projects, covering the fields of mobility, electricity, heat and buildings, as well as fuels from renewable primary energy sources, can be found in [1].

New facilities available

A range of new infrastructure became available during 2008. After the indentation devices and focussed ion beam that are already being intensively used this year, the test stand at ETH Zurich was commissioned, with a single-cylinder engine for specific research on combustion and emissions from new fuels and injection strategies.

At EMPA, the construction of a dynamic test bench for large Diesel engines has made good progress and will be inaugurated in 2009.

Reference

The debate over the benefits and risks of nuclear energy has certainly not ended, but it can be seen in the international press that the tide of opinion is changing. The turbulence in the oil and gas markets, and the now obvious need to restrict the emission of greenhouse gases, compel today’s governments to look with new eyes at their nuclear options. A growing number of European governments are starting to invigorate their civilian nuclear programmes, and present them as the most pragmatic option for fighting greenhouse gas emissions. Sweden and Italy are the most spectacular examples as their governments have very recently announced a phase-out of the previous nuclear phase-out policy.

In Switzerland too, nuclear energy is making the headlines. During 2008, three requests for general site permits for nuclear power plants have been submitted: for Beznau, Mühleberg and Niederamt. In addition, the national nuclear waste cooperative, Nagra, has disclosed six potential sites for underground waste repositories.

For us researchers, geared towards the safe and sustainable use of nuclear energy, this confirms our basic conviction: that nuclear electricity generation is an asset to life in Switzerland today, and will remain one tomorrow. Our goal is to integrate nuclear energy in the sustainable energy mix even more comprehensively.

Strategic collaborations and tools

The Nuclear Energy and Safety Department (NES) is an active partner in the overall Swiss energy scene. It is NES’s duty on the national level to deliver objective judgments and rational methods to the stakeholders involved in the decision-making processes. The Department is also strongly embedded in the international nuclear energy research community, where it collaborates formally or informally with its contemporaries in other countries. Examples of this engagement are, for example, its active presence in the EU-based Sustainable Nuclear Energy Technology Platform; its formal engagement in support of the VHTR and GFR systems within the Generation IV International Forum; and its membership in the numerous working groups and committees of the IAEA and the OECD Nuclear Energy Agency.

Last but not least, NES is fully integrated in PSI’s research portfolio. For example, the use of the large facilities at PSI for addressing basic though far-reaching problems regarding the structure of matter is combined with application to practical, present-day issues, such as the sorption mechanism of radionuclides on specific clays or cements, and the ageing process of the metals used in current reactors. The state-of-the-art analytical, experimental and computer-supported tools available at PSI are an asset to the technologies of today, and will serve future applications in the decades to come.

Fundamental and applied research

In nuclear research, the focus on practical applications can be seen in NES’s involvement in the safety and operational issues relevant to present-day operating plants (Generation II), as well as its drive to a deeper understanding of plants offering even higher safety and reliability standards, such as those (Generation III plants) now being constructed worldwide,
and also envisaged for Switzerland. The development of the next generation of nuclear plants, for which increased sustainability is a central issue, is NES’s contribution to the long-term nuclear perspective. Furthermore, it is participating in the advancement of Generation IV designs, which aim to maintain the advantages of safety and cost-effectiveness of today's plants, while decreasing dramatically the consumption of the planet’s fissile resources and recycling a significant share of the radioactive waste.

Six laboratories and a common strategy

NES’s portfolio concentrates on selected topics of nuclear science and technology and is organised in six units. The Laboratory of Reactor Systems (LRS) focuses on the high-fidelity numerical simulation of nuclear reactor systems under normal operational conditions, and their transition to abnormal situations. As a counterpoint, an experimental platform on reactor physics is maintained, providing hands-on experience of neutronic behaviour for various reactor concepts. LRS is also involved in developing better understanding of advanced reactor cores operating with fast neutrons.

The Laboratory for Thermal Hydraulics (LTH) addresses the reactor cooling issues. For Generation II reactors, the coolant is water at high pressure and temperature. Both single- and two-phase flows are studied, the latter including mixtures containing water and steam bubbles, and steam with water droplets, and the related heat transfer phenomena. The long-term goal of the research is to link instrumentation of high spatial and time resolution with solutions of the basic equations of fluid motion, not only for water-cooled reactors, but for the variety of coolants which feature in future design concepts, such as gases, liquid-metals and (possibly) molten salt.

Materials, either in the form of oxide or ceramic fuels, or as metallic structural components, determine both the reliability and lifetimes of nuclear reactors, and thereby their overall economic viability. Material behaviour also determines the ultimate operational limits for reactors. The Laboratory for Nuclear Materials (LNM) has a long tradition in the study of nuclear fuels, and in the ageing of structural components under the hostile conditions that exist over decades in a nuclear power plant. With an eye to the future, LNM has recently developed experimental and modelling skills in advanced ceramics and metals for high-temperature environments.

Examination of materials following irradiation is the main focus of the Hot Laboratory at PSI. The Hot Lab (AHL) serves the users of the PSI irradiation facilities, both in regard to their industrial operational needs and in the context of advanced materials research. Dedicated measurement points for the safe handling of radioactive samples are also installed in other large, less-specific facilities at PSI, such as SINQ and SLS.

Nuclear reactions produce fission products as waste, but with an associated risk of radioactive contamination of the biosphere. The Laboratory for Nuclear Waste (LES) investigates the retention capabilities of certain geological layers to isolate the waste from the biosphere over the long time periods commensurate with the longest decay times of the radionuclides present: that is, from tens of thousands to millions of years. The responsibility of the Laboratory of Energy Systems Analysis (LEA), which is common to both Energy Departments at PSI, is to offer a global perspective over all sustainable energy technologies of interest to Switzerland. The technologies are considered over their entire life-cycles, including their ecological, economic and social implications.

Highlights

The following pages present a selection of highlights of the activities of NES during the past year. The articles aim to give a representative view of the variety of tasks needed to further the understanding of nuclear reactors, both present and future, and of the nuclear fuel cycle.
Coupling classical thermal hydraulics with computational fluid dynamics for nuclear reactor systems

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The use of computational fluid dynamics (CFD) codes to address nuclear safety issues and to improve the accuracy of nuclear system transient analysis has grown significantly in recent years. However, the large computational costs involved in a CFD simulation limit its use to local areas of the nuclear plant system. As a consequence, best-estimate 1-D thermal-hydraulics codes still represent the main workhorse for system analysis. PSI’s STARS project is developing a tool capable of performing detailed CFD component analyses, while retaining the full feedback from, and to, the plant 1-D simulation through coupling with a system code.

Introduction

As part of the safety assessment and licensing procedure for nuclear power plants (NPPs), a wide range of analyses are carried out using best-estimate codes. These have been developed and validated to analyze system response during a wide variety of accident scenarios and transients. In these codes, the conservation equations (mass, momentum and energy) that describe the two-phase flow and the heat transfer are usually based on 1-D approximations. The thermal-hydraulics modelling employs an appropriate set of correlations and physical models (closure relationships). The model for a specific nuclear power plant is then built up by connecting 1-D modular components (pipes, tees, pumps, valves, etc.). There are, however, certain accident scenarios foreseen for NPPs in which strong asymmetries exist in the properties (e.g. boron concentration or temperature) of the coolant entering the reactor pressure vessel (RPV). These asymmetries depend largely on the coolant mixing taking place in the downcomer and in the lower plenum of the RPV. Such mixing phenomena are strongly 3-D and are influenced by turbulence, so that 1-D approximations are unsuitable for this class of problem.

On the other hand, in the context of single-phase mixing applications, CFD codes have reached a satisfactory level of maturity to be able to provide a complementary capability to system codes for accurately dealing with multidimensional flows. The coupling of system codes and CFD is therefore a logical step for nuclear safety applications, especially when applied to the analysis of transients in which 3-D flows play an important role in the evolution of a given accident scenario.

Coupling

A coupling [1] has been developed between the US NRC (Nuclear Regulatory Commission) best-estimate system code TRACE and the commercial CFD code ANSYS-CFX. The PVM (Parallel Virtual Machines) environment has been used to manage the information traffic between the two codes. Exchange of variables occurs at the boundary elements of each code. The conversion from 1-D to 3-D boundaries is crucial, since additional information on the flow is required (e.g. inlet velocity profile, which is not necessary in 1-D approximations). Another critical point is the numerical stability of the coupling, since it is developed following an explicit or semi-implicit scheme. This limits the choice of the temporal and spatial discretization adopted.

The currently implemented coupling has been verified, firstly against simple numerical tests, and then against an experiment involving 3-D mixing effects.

Figure 1: Simplified scheme of the double T-junction experiment.
Double T-junction experiment

The experimental set-up used consisted of two loops connected by means of a double T-junction, with a recirculation loop connecting the two branches (Figure 1). The operating fluid was tap water and the mass flow ratio between inlet and recirculated mass flow rates was 1:1. The loop was instrumented with three wire-mesh sensors [2] to measure the cross-sectional distribution of a tracer, injected at the location WM1 indicated in Figure 1. During the transient, the tracer was partially recirculated (to location WM2) and partially ejected (WM3) from the system at each recirculation, until it was completely expelled from the facility. For the coupling involved in the simulation, the double T-junction was modelled with CFX, while the recirculation loop was modelled with TRACE.

Results

The velocity field inside the double T-junction is strongly multidimensional (Figure 2), and therefore a TRACE simulation alone cannot capture the correct amount of tracer which is recirculated in the side loop (a 1-D code will partition the tracer according to the mass flow ratio between the junctions themselves). A clear improvement of the computational results was obtained when the coupled tool CFX-TRACE was employed (Figure 3), with some small discrepancies due to the unstable velocity field in the proximity of the outlet boundary WM3. Parametric studies have shown a clear influence of the inlet velocity profile on the simulation results [1]. In the currently presented results, a fully developed turbulent profile has been used, since this is representative of the actual experimental conditions.

Conclusions

A coupling between the 1-D system code TRACE and the CFD code ANSYS-CFX has been developed and verified. A first validation experiment, in which 3-D effects in the flow are important, has been carried out and comparison between experimental and simulation results indicate definite advantages of the coupled tool, relative to the use of a stand-alone system code.

References

In T-junctions, particularly in the regions where hot and cold streams are not completely mixed, significant temperature fluctuations can occur near the walls. Such fluctuations may induce cyclic thermal stresses in the walls and may eventually lead to fatigue cracking. These problems were first considered in the context of Liquid-Metal Fast Breeder Reactors (LMFBRs) in the 1980s. Although the problem is particularly pronounced in a liquid-metal reactor, due to the high thermal conductivity of the liquid-metal coolant, thermal striping is an issue in Light Water Reactors (LWRs) as well. A few instances of high-cycle fatigue have been observed in T-junctions, such as the one at Civaux. Recent research activity in this area includes the experiments and benchmarks undertaken by Vattenfall and the comprehensive, European 5th Framework Program THERFAT. Present research is undertaken as a part of the Plant Life Management (PLiM) project in Switzerland.

Experiments

The high cyclic nature of these phenomena makes them difficult to monitor with conventional thermocouple instrumentation, due to the limited sensor response time. Yet reliable prediction of thermal fatigue loads is an important part of managing the risk. The temperature fluctuations at frequencies up to several Hz caused by the turbulent thermal mixing, present the highest risk of wall thermal fatigue. Significantly higher frequencies than these appear not to pose a risk, as they are strongly attenuated by the thermal inertia of the pipe wall. Using the analogy between turbulent mass and thermal transport and mixing, isothermal experiments have been performed using regular tap water and demineralised water. The setup consists of a horizontal T-junction geometry of Plexiglas pipes of 50 mm inner diameter. Regular tap water flows in the longer pipe (1.5 m) and demineralised water in the shorter, branch pipe (0.5 m).

A photograph of the test section is given in Figure 1. The two streams join and mix at and after the T-junction, and the mixture is drained through a flexible hose shown on the right side (green). Close to the inlets of both pipes, honeycombs are placed to straighten the flow. Both pipes are sufficiently long to ensure a developed flow profile as the fluids arrive at the T-junction, giving well-defined boundary conditions for the CFD simulations. In the arrangement used in this work, the instrumentation consists of two wire-mesh sensors (WMS) placed one behind the other, 51 mm downstream of the junction. The wire-mesh sensors used for this study have 16 × 16 wires constituting a grid of 236 measurement points (from the 256 combinations, a few points are missing in the corners due to the circular pipe geometry). The pitch of the measurement grid, which also defines the spatial resolution of the measurements, is 3 mm. The time resolution of the measurement is 600 frames per second.
Calculations

The calculations presented here were based on the Large Eddy Simulation (LES) approach and were carried out using the FLUENT 6.3 commercial CFD package. Previous studies \[2,3\] on mixing showed the higher suitability of LES with respect to Reynolds-Averaged Navier-Stokes (RANS) and Scale-Adaptive Simulation (SAS) of turbulence. As a drawback, LES is an order of magnitude more expensive than SAS and two orders of magnitude more expensive than RANS \[3\].

Results

Figure 2 shows a comparison of the conductivity distribution in the pipe cross-section at \(x/D = 1\) distance downstream of the T. Apparently, LES is able to qualitatively predict conductivity distribution very well. At \(x/D = 1.0\), the high conductivity region has quite similar half-moon shape for both WMS and LES. The most obvious difference is a slight anti-clockwise tilt visible in the experiments, which is due to the buoyancy of the side flow, but not accounted for by LES. The recirculation region (blue in Figure 2) is also well predicted by LES. Recirculation transports tap water back to the measurement plane, thus leading to a slight increase in conductivity. Distribution of RMS of conductivity at \(x/D = 1.0\) is shown in Figure 3. As with conductivity distributions, LES predicts its RMS very accurately.

The sharp interface region (red) shows high RMS values and results from a strong shear between the two streams. RMS of conductivity reaches a minimum in both high-velocity and recirculation regions, since they are not yet mixed at this position. The interface region (sickle-shaped) is thin for both WMS and LES and has similar thickness. Figure 4 gives comparison of conductivity and its RMS at the midline of the measuring plane. The accuracy of LES is striking for both quantities.

Conclusions

Mixing studies are being performed at PSI’s Laboratory for Thermal Hydraulics with the final aim of finding the most suitable experimental technique, as well as to improve modelling aspects to predict these phenomena. WMS is particularly suited for examining such flows, thanks to its spatial resolution and high frequency. From the numerical viewpoint, LES offers the most accurate answer, but as a drawback is very expensive. The striking accuracy of LES in predicting conductivity and its RMS is encouraging but not surprising, since LES is most suitable for predicting phenomena governed by large coherent structures, such as the one featured in the mixing part of the flow in the T-junction. Future experimental and numerical investigations should focus on the near-wall region, which is responsible for generating thermally-induced cyclic stresses, and on prediction of characteristic mixing frequencies.

References

The Hot Laboratory (HOTLAB) of the Paul Scherrer Institute (PSI) started its activity in 1963 (at that time in the Eidgenössisches Institut für Reaktorforschung/EIR). Since then, it has been extended with so-called Pu-Laboratories, which allow the production, study and storage of advanced nonirradiated nuclear fuel for future generations of nuclear reactors. Its infrastructure has been steadily upgraded, to ensure the required safety for such infrastructure and the safe containment of the hazardous materials.

A major effort has been made throughout these years to keep the available analytical infrastructure up to the needs and expectations of the users and also offer new possibilities for detailed analysis of radioactive materials.

Most of the research activities realized in the HOTLAB start with the delivery of heavily radioactive batches of materials to the large concrete hot-cell chain and continue with detailed and often sophisticated analytical analysis.

The concrete hot-cell chain

Heavy transport casks used for the international transport of radioactive goods are unloaded in one of the five large concrete hot cells. Cell number 1 can accept full-length Light Water Reactor (LWR) fuel rods for detailed non-destructive examination. Visual inspection of the rod surface and measurement of the oxide layer thickness and variation of rod diameter and rod length, with regard to their nominal values, allow a detailed analysis of the rod state to be made. This allows the first characterization of flaws resulting from the service life of a rod in a reactor, which is essential for the prediction of the lifetime of new rod design for nuclear power plants.

Smaller batches of material irradiated in accelerator facilities in PSI itself, as well as in research reactors around the world, are unloaded in smaller concrete cells. For example, irradiated test materials for future neutron sources, based on liquid metal technology, are delivered, sorted and cleaned in these cells for the target development group of PSI, as well as irradiated materials developed for future fusion nuclear reactors by the fusion technology group of EPFL. After delivery, subsamples must very often be cut up for further detailed investigation. The HOTLAB had to adapt commercially available equipment, such as the Electrical Discharge Machine (EDM), for their remote handling in the cells. This allows small specimens with complex shape (as seen in Figure 1) to be produced.

After cutting, these samples are dispatched to the many shielded analytical facilities available in the laboratory, where observation of the material structure is often needed.
Solid-surface analytical tools

Irradiation induces changes in material structures through nuclear reactions, as well as thermal or chemical processes. These modifications can be observed at the micron and sub-micron length scale on polished specimens with an Optical Microscope (OM), Scanning Electron Microscope (SEM) or Electronic Probe Micro-Analysis (EPMA). The Hot Laboratory has two shielded cells dedicated to the preparation of such specimens, to allow the detection of structural modification in a material, such as in the case of the nuclear fuel restructuring occurring at very high burn-up (Figure 2 – left). These observations are often the starting point for more sophisticated analysis to understand the degradation processes resulting from the irradiation.

Elemental and isotopic analytical tools

Irradiation also induces modification of element distribution. EPMA allows the distribution of the major elements in a sample to be determined. This helps to understand the thermal and nuclear processes that occurred during reactor operation. For example, observation of the Uranium distribution at the fuel/cladding interface (Figure 2 – right) gives information on the corrosion processes at this critical interface relevant to the integrity of an LWR fuel rod.

Often the elemental information is not sufficient and isotopic details are needed to comprehend properly the irradiation effects. This is often critical for the validation of the very sophisticated modelling software available today. The HOTLAB is a leader in the development of the Secondary Ion Mass Spectrometer (SIMS) as well as in Inductively Coupled Plasma Mass Spectrometry (ICP-MS) techniques for the isotopic analysis of highly radioactive materials. The ICP-MS coupled with High Performance Liquid Chromatography (HPLC) allows, for example, the separation of different neighbouring elements that suffer from isobaric interferences, as shown in Figure 3 for the analysis of fission products in nuclear fuel.

Mechanical properties

Finally, structural and chemical modification of materials can have a critical effect (often degrading) on the mechanical properties of samples. The HOTLAB offers the basic infrastructure for investigating irradiated specimens in shielded environments, including the transfer, loading and unloading of specimens in dedicated test facilities. Different machines have been developed, and are operated, by PSI and EPFL research groups for the shielded boxes to allow detailed investigation of the mechanical properties of irradiated materials at different temperatures and in different environments (Figure 4).

Summary

The PSI Hot Laboratory offers state-of-the-art infrastructure for experimental studies of radioactive material behaviour and is being successfully used by many PSI and external research groups. Further information on current Hot Laboratory tasks, operators and users can be found on: http://ahl.web.psi.ch.
Advanced reactors will be exposed to high temperatures, non-aqueous environments and high dose levels. Also, reactor materials are expected to differ considerably from those used in current plants (coarse-grained materials, nickel-based alloys, etc.). These facts suggest a need for non-destructive evaluation (NDE). The major challenge for this is the envisaged plant design lifetime of 60 years, with possible extension. Information about the actual condition of components becomes extremely important, as there is no long-term experience with such plants. Complementary to conventional NDE techniques, the analysis of very small samples taken from significant locations can provide more detailed information concerning damage.

Stress-strain information can be obtained from punch tests. Discs of 3 mm diameter and about 200 µm thickness are deformed either with a small ball (1 mm diameter) or a cylindrical punch of similar diameter. The resulting load-displacement curves can be converted into stress-strain curves with finite element analysis – a method well established for the determination of irradiation hardening in the laboratory. Thin strips, i.e. 100–200 µm-thick dog-bone-shaped samples, can be used for tensile and creep tests. Even less sample material than for thin strips and punch tests is needed for nano indentation and micro/nano-sized samples, such as micro bend bars or micro pillars. Nano-indentation and micro-sample testing will be described in the present article. Figure 1 shows the load-displacement response of a ferritic oxide dispersion strengthened (ODS) steel which was tested before and after He-implantation. The implantation creates irradiation damage (point defect clusters), leading to hardening of the material, which can be clearly seen.

Samples of micrometre dimensions can be manufactured with a focused ion beam (FIB) and these samples deformed using the head of the nano-indenter for the application of deformations and loads. Figure 2 shows a small pillar which was tested under compression. The material is again the ferritic ODS steel. This alloy has very large grains and therefore the pillar consists of a single crystal. The shear plane is clearly visible and a correlation with the critical shear stress can be made. Comparison of the shear stress measured with dog-bone samples in tension compare very well with the results obtained from micro-pillar compression. This is not necessarily always the case, and considerable size effects can be found in micro-pillar tests, particularly for single-phase materials [1]. Most important for condition monitoring is the relative
change of mechanical properties as a result of damage. Figure 3 shows results from compression tests of the ferritic ODS steel before and after helium implantation. The sample material was the same as that for which the nano-indentner results were shown in Figure 1. Irradiation hardening of about 20% was found for the indenter tests as well as for the micro-pillar tests.

Important additions to the micro-mechanical investigations are micro-characterization with electron microscope and advanced beamline techniques such as extended X-ray absorption fine structure (EXAFS). These techniques allow quantitative assessments of damage to be made, such as the analysis of point defect clusters or coordination analysis.

Another important issue concerns the quantitative understanding of damage with respect to component life. Constitutive equations and other parameterizations of material properties are usually applied with time-independent coefficients and exponents using the properties of virgin material. These can change as microstructure changes. Conversion of these changes into mechanical response could provide a possibility for better assessments of the development of mechanical properties with time. The inclusion of multiscale modelling tools for describing materials through several length (and time) scales, starting at the atomic level up to the level of finite element analysis, is expected to enhance the current modelling schemes used. A detailed discussion of these methods is given in [3].

Figure 3: Stress-strain curve of a ferritic ODS steel before and after helium implantation determined by micro-pillar compression.

Mechanical testing of small samples, together with advanced analytical methods and materials modelling, provide a very promising option for the determination of damage in nuclear plants. It is proposed to use these combined tools for the assessment of the residual life of components with an expected lifetime of 60 years or more. Even very small samples (not affecting the integrity of a component) could be investigated. Taking such a “fingerprint” of the condition at scheduled time intervals would provide an improvement in relevant material parameters and design rules. Using these fingerprints in synergy with a multiscale modelling scheme would bring a more fundamental understanding of the mechanisms causing material aging. Information from such methods of condition monitoring goes far beyond the possibilities of current NDE. Micro-sample/micro-scale modelling for condition monitoring should be used complementarily to conventional non-destructive methods, to provide a sound picture of the status of a component, which can be used for safety considerations and reliable risk assessment.

This work was essentially supported by the Swiss Competence Center Energy and Mobility (CCEM).

References:
Assessing the long-term safety of a radioactive waste repository can be greatly assisted by a molecular-level understanding of the behaviour of radionuclides in the geosphere. This knowledge is needed in order to establish reliable thermodynamic data to quantify the retention and transport of radionuclides in deep groundwaters. The fate of released radionuclides in geological environments is primarily controlled by sorption/desorption processes onto mineral surfaces. Clay minerals are major constituents of the potential host rock formations considered in the design of a high-level radioactive waste repository.

The sorption of metal ions is strongly dependent, amongst other things, on ionic strength, pH and the presence of organic or inorganic ligands in solution. A detailed understanding of the sorption mechanisms occurring at the mineral surface over a representative range of relevant conditions is essential for performance assessment.

Carbonate is ubiquitous in deep groundwaters and has a great complexation affinity for actinides. Such complexes in the aqueous phase can potentially lead to a decrease in sorption and thus an increase in the migration rates of actinides. Thermodynamic and structural data for lanthanide/actinide-carbonate-mineral systems are sparse. However, such data are absolutely essential, since clay rock porewaters often contain quite high carbonate concentrations. For trivalent actinides and U(VI) it has been reported that the formation of ternary (hydroxo)carbonate surface complexes may contribute to surface sorption reactions [1–3] (Figure 1). Taking the latter into account requires unambiguous identification of the mixed surface species. The objectives of the current study are to investigate with a combination of wet chemistry, geochemical modelling and spectroscopic studies whether or not ternary Ln(III)/An(III)-carbonate complexes form at the surface of clay minerals.

Macroscopic and microscopic investigations

Macroscopic sorption experiments have been carried out in the absence and presence of carbonate, to quantify the influence of inorganic carbon on the sorption of trivalent actinides/lanthanides on different clay minerals. Sorption measurements were carried out as a function of pH in the presence of various carbonate concentrations. The measurements show that a pronounced decrease of sorption is observed in the presence of carbonate (Figure 2).

Modelling with the 2-Site Protolysis Non-Electrostatic Surface Complexation and Cation Exchange (2SPNE SC/CE) sorption model [4], under the assumption that carbonate complexes
do not sorb, largely under-predicts the experimental data (red dashed line in Figure 2). Consequently, other surface sorption reactions involving carbonate complexes must be considered. The experimental data for Ln(III)/An(III) could only be successfully modelled with the 2SPNE SC/CE sorption model by including two additional surface complexation reactions, forming $≡$SSOAnCO$_3$ and $≡$SSOAnOHCO$_3$ surface species [3].

Time Resolved Laser Fluorescence Spectroscopy (TRLFS) has proven to be a versatile tool for Cm(III) speciation studies and for sorption studies on various solids [5, 6]. The TRLFS measurements were carried out on Cm(III)-loaded clay pastes at T < 20 K. In a preliminary step, an iron-poor clay mineral, kaolinite, was chosen in order to avoid any fluorescence quenching by iron. The excitation spectra of the Cm(III) kaolinite samples were measured by scanning the excitation wavelength in the range of the $[^4D_{7/2} \rightarrow ^6S_{7/2}]$ transition [595–625 nm], recording simultaneously the corresponding Cm(III) emission spectra.

Figure 3a shows the excitation spectra of Cm(III)/kaolinite samples prepared in the absence (black line) and in the presence (red line) of 20 mM NaHCO$_3$. Figure 3b shows the fluorescence emission decay curves of Cm(III) obtained for both systems by exciting at two different wavelength. The fluorescence features (shift to higher wavelength and shape of the excitation spectra, bi-exponential decay and increase of the fluorescence lifetime) of the Cm(III)-carbonate-mineral systems differ strongly from those of the carbonate-free systems, indicating different coordination environments for Cm(III). This is clear evidence that ternary An(III)/(hydroxy)-carbonate surface complexes form on the clay edge surface, as postulated in the macroscopic study.

References

Secondary organic aerosol (SOA) is formed by the chemical transformation of gaseous precursors in the atmosphere and comprises a substantial fraction of the organic mass of atmospheric aerosols. At present, the global formation of SOA is poorly constrained, with estimates ranging from 12–70 Tg/year. Such estimates rely critically on laboratory measurements of the amount of SOA produced by individual SOA precursors, typically carried out in large environmental (“smog”) chambers. The global emission of isoprene (2-methyl-1,3-butadiene, C5H8), estimated at ~500 Tg/year, is far higher than that of biogenic terpenes and anthropogenic hydrocarbons. Thus, even if only a small fraction of the isoprene oxidation products partitions to the atmospheric aerosol, this may result in a very large contribution to the global aerosol. This necessitates careful investigation of the fate of isoprene oxidation products on a global scale, in order to reduce the associated uncertainties. Recent laboratory-chamber studies of isoprene photo-oxidation reported SOA yields that varied by a factor of 5 ([1] and references therein). The discrimination between the oxidation products of a specific precursor and the organic matrix of the pre-existing aerosol can be achieved by isotopic labelling.

For the production of 13C-labelled isoprene, six potted velvet bean plants (Mucuna pruriens) were placed in a 184 L Plexiglas chamber and irradiated with xenon lamps after the addition of 600–700 ppm of 13CO2 (Figure 1). The isoprene concentration and its degree of labelling were checked regularly with a proton transfer reaction mass spectrometry (PTR-MS) instrument (Ionicon). Figure 2 shows that 70–80% of carbon was already labelled after one hour, and on average a final labelling of 81±2% was obtained [1]. When the concentration of isoprene in the plant chamber became sufficient (~2200–4100 ppb), the air mixture was
transferred to the large smog chamber. Two glass traps cooled to \(-131^\circ C\) were used in the transfer line, resulting in negligible quantities of any impurities also produced by the plants (such as monoterpenes), as shown by PTR-MS. Varying amounts of (non-labelled) \(\alpha\)-pinene were added, then nitrous acid (HONO) was continuously injected into the smog chamber as an OH radical source. Thereafter photo-oxidation of the mixture was started by turning on the lamps of the chamber. All experiments were performed at \(20^\circ C\) and 50% relative humidity.

Since the photo-oxidation of \(\alpha\)-pinene produces SOA much faster than that of isoprene, \(\alpha\)-pinene SOA serves as organic seed for the isoprene oxidation products. The amount of organic seed was varied by the addition of different amounts of \(\alpha\)-pinene. SOA was then sampled by three different methods for \(^{13}\)C analysis, i.e. an impactor, a filter and electrostatic deposition, with all three sampling techniques providing very similar results. The sampled aerosol was burnt with oxygen in an elemental analyzer coupled to the inlet of the isotope ratio mass spectrometer. From the \(^{13}\)C content, the amount of isoprene SOA as well as the yield (formed isoprene SOA normalized by the amount of reacted isoprene) were determined.

Results

The yield of isoprene as a function of SOA mass is presented in Figure 3. The measured yields are shown, as well as the values after correction for incomplete reaction of the first products of isoprene. The data show a strong increase of the aerosol yield with pre-existing aerosol mass concentration, increasing from 0.02 at 10 \(\mu g\) m\(^{-3}\) to 0.1 at 100 \(\mu g\) m\(^{-3}\) of SOA. This is explained by the partitioning theory: with a higher aerosol load, more semi-volatile compounds are driven into the aerosol. Figure 3 also depicts isoprene SOA yields used in the literature for modelling studies [2, 3]. Results described here fall somewhere between these two studies. The application of the upper line of Figure 3 in global models could result in an increase of the total SOA burden in the atmosphere by a factor of 2–3, with major increases in the free troposphere [4].

These model results underline the importance of studies of this kind. As the data in Figure 3 show, these studies need to be performed under conditions that are as close to the ambient atmosphere as possible. Here, experiments that take advantage of labelling techniques offer a high potential.

References


Direct radiative forcing due to increase in total solar irradiance since 1750 is estimated to be only +0.12 (−0.06, +0.18) W/m² [1]. Nevertheless, a number of climate records show a significant response to variations in solar activity [2–4], providing evidence for a solar forcing effect. The underlying physical processes, however, are still not fully understood. Here, we report on a 10–30-year lag between solar forcing and temperature response in the continental Altai, pointing to an indirect sun-climate mechanism in this region.

Temperature record

The Altai Mountains lie on the border between Russia, Kazakhstan, Mongolia, and China. In 2001, a Swiss-Russian research team drilled an ice core from the Belukha glacier in the Siberian Altai (Figures 1 and 2) that provides information about the climate and atmospheric pollution during the past 750 years in this region with a pronounced continental climate [5]. Temperatures in the Altai were reconstructed using the ice-core oxygen isotope (δ¹⁸O) record. It was demonstrated that the δ¹⁸O record followed closely the atmospheric temperatures at a nearby weather station over the past 130 years, and can therefore be used as a temperature proxy [5].

Temperature response lags behind solar forcing

The established temperature record was directly compared with proxy records of solar activity (solar modulation derived
The Altai temperature record correlated significantly with the solar activity proxies in the period 1250–1850 (Figure 3), suggesting that the sun was the main driving force for the temperature variation during the preindustrial period. The influence of solar activity on the Altai temperatures is corroborated by a spectral analysis of the temperature record, showing significant periods at 205, 86, and 10.8 years [5], which can be related to the solar Suess, Gleissberg, and Schwabe cycles, respectively. Interestingly, the regional temperatures followed the solar forcing with a time lag of 10 to 30 years (Figure 4). Since the influence of solar activity on climate has not yet been fully resolved, such observations provide an important contribution to its understanding. One possible mechanism, which might explain this average lag of 20 years, is the indirect effect of the solar activity on temperature changes involving ocean-induced changes in atmospheric circulation [7]. Ocean water warms up more when the solar radiation is most powerful, i.e. in the sub-tropics and the tropics. The heat energy absorbed is carried from lower to higher latitudes by the ocean, then released back into the atmosphere. Because of the high thermal capacity of the oceans and the variable velocities of their currents, these processes are subject to considerable delay. Changes in the North Atlantic atmospheric circulation system, which is responsible for temperature changes in the Altai, may be initiated 20 years earlier by changes of solar radiation in the tropical oceans.

Industrial period 1850–2000

The reconstructed temperatures are significantly correlated with the $^{10}$Be-based and $^{14}$C-based solar activity reconstructions in the period 1250–1850, but not with the greenhouse gas CO$_2$ (Figure 3). This indicates that solar activity changes are a main driver for the temperature variation in the Altai region during the pre-industrial period. However, during the industrial period (1850–2000), solar forcing became less important and only the CO$_2$ concentrations show a significant correlation with the temperature.

Acknowledgements

This work was supported by the SNF, Marie Heim-Vögtlin programme. We would like to thank Patrick Ginot and Beat Rufibach for drilling, and Martin Lüthi, Henrik Rhyn, Dimitrii N. Kozlov, Sergej Derewstschikow, Vladimir Vashenzev, Andrej Jerjomin, Veronica Morozova, Alexander Chebotkin, and Igor Karakulko for their help during the expedition.

References


Figure 3: a) Reconstructed Altai temperature (deviation from mean, orange) and solar activity inferred from $^{10}$Be (blue) and $^{14}$C (green). The solar modulation curves were shifted by 20 years (average value of the lag between solar forcing and temperature response); b) Reconstructed temperature (orange) and CO$_2$ concentration (black). Given are 10-year means smoothed with a 5-point moving average. The vertical line divides the pre-industrial era (1250–1850) from the last 150 years. Significant $r^2$ ($p<0.05$) are marked (*, bold).

Figure 4: Cross correlation ($r$) between Altai temperature reconstruction and $^{10}$Be-based solar activity. A window of 200 years was moved through the data in steps of 10 years to obtain the temporal changes of the correlation coefficient.
Power generation based on fossil fuels will substantially contribute to the world’s growing electricity demand over the next few decades. However, considering the ambitious goals set for climate change mitigation and the increasing scarcity of resources, fossil technology improvement is essential. Life Cycle Assessment (LCA) shows that it can significantly reduce Greenhouse Gas (GHG) emissions, but only the application of Carbon Capture and Storage (CCS) will allow renewable technology GHG levels to be reached by 2050. However, CCS will at the same time substantially increase costs and consumption of fossil resources.

The recently finalized EU project NEEDS (New Energy Externalities Developments for Sustainability; 2004–2009) included a comprehensive environmental and economic assessment of a wide spectrum of current and future power generation technologies. This evaluation will support the further development of a sound European energy strategy. Among other tasks, PSI was – in collaboration with IER – responsible for the assessment of advanced fossil systems, including CCS technologies [1].

Scope and methods

This analysis covered hard coal, lignite (both as pulverized coal (PC) and IGCC units) and natural gas combined cycle (CC) power plants, with and without CCS, as well as natural-gas-fuelled plants for decentralized combined heat and power generation. Three different scenarios were established for the time frame of the study: the estimation of pessimistic, realistic-optimistic, and very optimistic technology developments, which could reflect the possible spectrum of evolutionary technological progress until 2050. The three most promising options for CO₂ capture – post-, pre-, and oxyfuel-combustion – were considered, along with CO₂ storage in saline aquifers (at a depth of 800 m) or depleted gas fields (2500 m), representing the two types of storage sites most likely to be implemented in Europe on a large scale [2]. The environmental assessment was based on LCA methodology, taking into account complete energy chains, including not only the operation of power plants but all steps in the energy chain, e.g. the extraction and processing of resources, construction of infrastructure, transport and waste disposal. Cumulative environmental burdens (emissions to air, water and soil, land use and consumption of resources) were calculated per kWh electricity at the busbar of a power plant, using...
Selected results and conclusions

The LCA results in Figures 1 and 2 show the “worst case” and “best case” scenarios for hard coal: the former assumes CCS with post-combustion capture and depleted gas field storage of CO₂, while the (very) optimistic scenario considers CCS with oxyfuel-combustion capture and saline aquifer storage. Advanced power plants, with higher efficiencies due to new Ni-based alloys which can withstand combustion temperatures up to 750°C, will allow GHG emissions to be reduced from about 840 g(CO₂-eq.)/kWh today to around 650 g(CO₂-eq.)/kWh in 2050, in the best case, but still exceeding the emission levels of natural gas chains by almost 100%. Application of CCS leads to a more substantial reduction, with about 30–40 g(CO₂-eq.)/kWh of cumulative emissions (red lines in Figures 1 and 2). While hard-coal supply alone is responsible for about 100 g(CO₂-eq.)/kWh, lignite with CCS, due to minor emissions from mining and transport, and natural gas chains with CCS, could reach GHG levels of 30–40 g(CO₂-eq.)/kWh. The rate of CO₂ capture (90% for post- and 100% for oxyfuel-combustion), energy demand for CO₂ injection depending on the depth of the reservoir, and contributions from fuel supply are the factors dominating the GHG performance of fossil energy chains with CCS.

Using Life Cycle Impact Assessment (LCIA) methods and external costs, aggregating a wider spectrum of environmental impacts reduces the advantages of CCS (Figures 3 and 4). Carbon dioxide capture considerably decreases power plant efficiency and, therefore, more fuel is required for the same power generation, which in turn results in higher environmental burdens from the fuel supply. Coal chains with IGCC and PC plants perform similarly in terms of environmental burdens. Due to the high weighting of the scarcer natural gas (compared with hard coal and, especially, lignite), gas chains perform worse using this LCIA method. However, the external costs (not including the monetization of resource consumption) of natural gas chains, emitting less CO₂ and fewer pollutants, are lower.

The economic assessment shows a reduction of capital costs of the order of a few percent for fossil plants, by 2050. However, CCS will increase electricity generation costs significantly: for hard coal and lignite by approximately 35%, resulting in production costs of about 4 €cents/kWh, and for natural gas by almost 50%, resulting in 8.7 €cents/kWh, in 2050.

References

The Paul Scherrer Institute runs Switzerland’s Large-Scale research facilities for users from the national and international scientific community, in particular for condensed matter, materials science and biology research. PSI is one of only two locations in the world providing the three complementary probes of synchrotron X-rays, neutrons and muons at one site.

Synchrotron X-rays are available at the Swiss Light Source (SLS) – a third-generation synchrotron light source based on a 2.4 GeV electron ring and providing photon beams of high brightness at 14 beamlines. Neutrons are produced at the continuous spallation source SINQ – the only one of its kind worldwide. SINQ is a state-of-the-art user facility for neutron scattering and imaging with a suite of 13 instruments. The Swiss Muon Source (SµS) is the world’s most intense continuous muon source, with 6 beamlines available for experiments using muons as sensitive local magnetic probes. High-precision particle physics experiments use these unique beams to complement the LHC high-energy frontier experiments at CERN in investigating the limits of the Standard Model of particle physics.

Both SINQ and SµS are powered by a 590 MeV cyclotron that delivers a 1.3 MW proton beam (the world’s most powerful proton accelerator). In 2010, the suite of User Facilities will be extended by the Ultra-Cold Neutron Source (UCN), and a few years later by the X-Ray Free-Electron Laser (XFEL), a new large-scale facility that will provide ultrashort, intense X-ray pulses for the investigation of fast processes and the determination of molecular structures.

In addition to the User Facilities at the accelerators, other PSI laboratories are also open to external users, for example the Hot Laboratory operated by the Nuclear Energy and Safety Department that allows experiments to be performed on highly radioactive samples.
Operation and development of the high-intensity 590 MeV proton accelerator complex

During the 2008 shutdown, the upgrade programme for the Ring Cyclotron was completed, with the installation of the remaining two copper resonators (Figure 1). Operation with the new resonators has several beneficial effects: Because of better electrical conductivity of the cavity walls, the unwanted conversion of microwave power into heat is reduced and, in practice, approximately 600 kW of electrical power is saved under the same operating conditions; the much better properties of the vacuum sealing surfaces lead to a lower leak rate; but the most important benefit is the possibility of generating higher fields in the new resonators. By raising the gap voltage per resonator from 780 kV to 850 kV, the number of turns in the Ring Cyclotron was reduced from 202 to 186. This resulted in a reduction of residual beam losses at extraction by a factor of 2. Consequently, the Ring Cyclotron is now capable of accelerating higher beam currents while keeping losses to acceptable levels.

The present licence allows operation at 2.0 mA under standard conditions. In addition, a temporary licence was granted to PSI that foresees operation at 2.2 mA for a maximum time fraction of 10%. In total, 12 runs were performed at this elevated current and it was possible to demonstrate smooth operation without exceeding the loss limits. With the help of the experience gained, a request has been made to the Swiss authorities to raise the licensed current limit to 2.6 mA. It is planned to approach this value in small steps over several years and, as a first goal, standard operation at 2.2 mA is envisaged for 2009.
Accelerator reliability has been improved substantially thanks to the reduced losses in the new setup. During the second half of the year, when the new setup was in operation, availability reached the unprecedented level of 94%, whereas the average over the whole year was 90%. The integrated charge was 9.2 Ah on Target E and 5.5 Ah on the SINQ Target (Table 1).

In preparation for the start-up of the new ultracold neutron source (UCN) in autumn 2009, many short-pulse beam tests were performed on a beam dump in the UCN beamline. These tests represent a first commissioning step for the new mode of operation with UCN.

In the following, accelerator operation and the most important incidents that occurred during the year are described. After completion of the yearly shutdown in Week 16, some delay was caused by the necessity to re-optimize the Ring Cyclotron settings, since the radial voltage distribution of the new resonators deviated from that of the original cavities. One-and-a-half weeks later, frequent high-voltage trips in both electrostatic elements necessitated their exchange in Weeks 18/19.

The extraction element had breakdowns in the oil-insulated, high-voltage feed-through, and the injection element suffered from in-vacuum breakdowns. After these incidents, beam current was continuously increased and the production current of 2000 µA was reached in Week 23. In Week 31, the beam could not be restored for 15h after a regular service. The cause was finally identified as a distortion of the bending field of the Injector II Cyclotron by an inappropriately parked crane hook. In Week 51, a failure of the site power occurred and resulted in a beam interruption of 12 hours followed by 4 hours to reach stable operation. The various relative contributions to the downtimes in 2008 are shown in Figure 3. The longest break was caused by the replacement of the electrostatic devices already mentioned. The other two major contributions were vacuum problems in both cyclotrons and failures of the control system. A prominent control system problem was caused by sporadic failures of the very large CAMAC field-bus system in the experimental hall. Another class of control-system failures is related to start-up problems of new VME hardware that replaces older CAMAC systems. Both problems are expected to vanish when the ongoing CAMAC/VME transition is completed. The above contributions accounted for over 50% of the downtime; the magnitude of other items is similar to past experience. In comparison with recent years, the new category “Setup” was introduced. This accounts for unplanned setup times during scheduled production periods.

Continuous patient treatment with Proscan

Since February 2007, the PSI cancer therapy facility using protons has been operated using a dedicated superconducting cyclotron. This allows, typically, 15 patients to be treated per day on Gantry 1 continuously throughout the year. In the evenings and on weekends, cyclotron and beamlines are used.
for further development of Gantry 2, the commissioning of the new eye treatment facility OPTIS2, and the proton irradiation facility PIF. Compared with 2007, 2008 showed a doubling of the operational time, to 4690 hours per year, of which 2071 hours were devoted to patient treatment.

The unscheduled downtime of approximately 4% (Figure 7) is defined as the time during which the cyclotron or beam lines were not operational, although scheduled, and it includes unforeseen, but nevertheless “planned”, repairs that affected the patient schedule. The inner region of the cyclotron contains a specially shaped copper electrode, called a puller, that extracts protons from the ion source (chimney) and applies the first acceleration to the initial proton beam. Major problems were due to sputtering of the puller by beam particles, and overheating of RF contact springs in the cavity. The latter necessitated the replacement of two stems (Figure 5), and caused a shutdown of five days, including a weekend. The sputtering of the puller is well understood, using tracking simulations (see Figure 6), and developments are in progress to increase the puller lifetime. The stability of the beam intensity is now well under control. The relative variation amounts to $(\Delta I/I)_{\text{rms}} < 5\%$. The stability of the beam intensity is of major importance for fast three-dimensional scanning of tumours, as it is planned for operation with Gantry 2. The extraction efficiency has been steadily above 80\%, giving a typical dose rate of 300–500 $\mu$Sv/h within the cyclotron and allowing a routine intensity of 800 nA for OPTIS2.

Operation of Injector I

An important part of the Injector I programme consists of the operation of the OPTIS facility for treatment of eye cancer. This facility, which has been in operation since 1983, is used for approximately 250 patients per year, in periods of one week per month. During the first months of 2008, several major repairs were needed to the pressure springs in the RF-vacuum feed-through. Despite these difficult repairs, only one OPTIS-week had to be cancelled. Since June, the Injector I cyclotron has run without major problems. In the present shutdown, a limited refurbishing programme is in progress to ensure smooth OPTIS operation in 2009.
Operation and development of SLS

A significant improvement of SLS beam quality was achieved in 2008 by better control of local coupling and spurious dispersion, and the design energy acceptance level was finally reached. These improvements are described in a dedicated article within this report [1].

Two beamlines ended their operation this year: LUCIA and SIS/XIL. LUCIA was shipped to the French light source SOLEIL, and its replacement PHOENIX will start operation in March 2009. The two experimental stations SIS and XIL shared one beamline until the end of 2008. The rebuilding of their long, straight section will allow the simultaneous operation of both as two independent beamlines. The new SIS beamline will start operation in March 2009.

Total beam downtime in 2008 was 218 hours. This rather high value, compared with the previous year, was mainly due to a small number of severe incidents. If the downtime is split up into events longer or shorter than 5 hours, as shown in Figure 8, it is recognized that the number of shorter outages has remained nearly constant in the past, while the contribution from major incidents has fluctuated strongly from year to year.

The longest interruption had a duration of 82 hours and was caused by a water leak in the cooling circuit of the RF coupler of a cavity. As a first measure, the risk of further leakages was decreased by reducing the water flow in those cooling circuits, but the replacement of those couplers by newer types is under investigation. A total interruption of 30 hours was directly and indirectly caused by the scheduled repair of a 50kV mains transformer. A 10-hour scheduled interruption was planned, but afterwards the Helium cryostat system of the 3rd harmonic cavity became unstable and this required a longer beam interruption to restart the system. Figure 9 shows the outage time assignment to individual systems. More than half of the downtime was caused by RF problems. The operational data is summarized in Table 2.

Table 2: SLS Operation Statistics.

In 2009, further steps will be undertaken to optimize the SLS for highest brightness. New correction magnets will be used to further reduce the vertical beam size while maintaining the beam lifetime.

The beamlines PHOENIX, SIS and XIL will start operation in 2009. The latter will be upgraded later to XIL II, with new X-ray optics. Only then will the two beamlines be able to operate independently. The installation of a new type of cryo-cooled permanent magnet undulator (CPMU) is in preparation, as a replacement for the wiggler W61 of the Materials Sciences Beamline. This measure will allow the maximum photon energy of this beamline to be increased to 30 keV. After this, only one new beamline is planned: a dipole beamline to serve the Photo-Emission and Atomic Resolution Laboratory (PEARL), which will start operation in 2010.

References

[1] Michael Böge, Andreas Lüdeke, Andreas Streun, The quest for a perfect optics correction and highest brightness at the Swiss Light Source (this report p. 54).
SLS facility in 2008
Great instrumentation for excellent science

Over the year, SLS continuously increased the number of beamlines up to 16 at the end of 2008. With this expansion of the facility, the SLS now covers practically the whole spectrum of synchrotron radiation applications. In the reporting year, a broad scientific programme was carried through by a large number of teams – many of them international and multidisciplinary. Public activities at SLS during the reporting period include a number of high-level scientific conferences, seminars and workshops, as well as the two-day public visitor event carried out in the framework of PSI's 20th anniversary.

More than 1000 experiments in 2008

Compared with 2007, the year 2008 showed a significant increase in the number of experiments performed. More than 1600 individual users carried out a total of 1036 experiments, visiting the facility 1.8 times on average. Figure 1 shows the number of proposals submitted per beamline. While the IR and VUV beamlines operated in the pilot phase, all other beamlines were fully operational. Overbooking was in the range of 1.5 – 3 for the non-PX beamlines and 6.5 for PX I. To cope with this high demand for protein crystallography, the proposals were partly redirected to the new PX III beamline. Figure 2 illustrates the distribution of granted shifts by scientific area and also shows the extent of the programmes in condensed matter research (47%) and in life-science and protein crystallography (24%). However, many attractive new opportunities for environmental and energy-related research activities are arising with the new beamlines VUV, SuperXAS and IR.

Open access and European Support

The geographic distribution of the SLS users remained relatively constant over the last year, showing a 60:40 ratio of international to Swiss users (Figure 3). Within Switzerland, half of the users were hosted by PSI, followed by ETH Zurich (20%), EPFL, Lausanne (10%), the University of Basel (6%) and EMPA (4%). Approximately half of the SLS users came from EU countries, with the largest numbers coming from Germany (36%), France (19%) and the UK (19%); 9% of the beam time was used by groups from outside the EU.

Access to the SLS is supported through the European integrated infrastructure project IA-SFS for users from EU member or associated states. In 2008, 500 projects were supported through IA-SFS. Out of these users, 75% are between 20 and 40 years of age and 30% are women. This shows that SLS has a user base with a high potential for the future. In addition,
the IA-SFS project supports joint research activities (JRAs), with the purpose of enhancing the effectiveness of the facilities in serving users.

International conference (XRM2008) and public awareness

In the period 21–25 July 2008, the 9th International Conference on X-Ray Microscopy XRM2008, organized by SLS, brought together almost 300 participants from the international community developing new instrumentation and applications of X-ray microscopy. The Werner Meyer-Ilse Memorial Award went to Pierre Thibault (PSI) and Anne Sakdinawat (Lawrence Berkeley National Lab., USA) for pioneering work in coherent diffraction imaging and for the development of optimized Fresnel zone plates, respectively.

Another highlight was the 20th anniversary of PSI, which was celebrated with many different events. Among the highlights of the celebrations were two days when PSI opened its doors to the public, allowing more than 10,000 visitors to experience the broad range of multidisciplinary research performed at the Institute. The visitors enjoyed the fascinating world of science and took a close look at the neutron, muon and X-ray sources here. At SLS, they were allowed to circumnavigate the whole building on a guided round-trip, with detailed information on the instrumentation and research available at each beamline. In addition, a set of educational movies was shown, presented by scientists.

Committees

As a sign of the maturity achieved at the SLS, which has now been operating for more than 7 years as a user facility, the year 2008 saw the appointment of several new members to the SLS Scientific Advisory Committee (SAC), while the retiring members were thanked for their valuable work. The committee is now chaired by Prof. Dr. Gerhard Materlik from the Diamond Light Source.

The non-PX Proposal Review Committee (PRC) met twice, to elaborate on dedicated proposal evaluations. The four sub-committees (HardXAS, SoftXAS, Photoemission/Infrared and Diffraction/Tomography) evaluated a total of 520 proposals during the year. Since the autumn, this committee is being chaired by Prof. Dr. Philippe Aebi (Univ. Neuchâtel). The SLS Users Association SUUSA has been extended to represent the users of all three PSI User Facilities (SLS, SINQ, SpS). The mission of SUUSA is to promote research at the PSI user laboratories, and the SUUSA board is newly chaired by Prof. Dr. Bernd Schönfeld, ETH Zurich. The first joint Users’ Meeting (JUM@P09) will be held in the period 12–13 October 2009, at PSI.

New beamlines

The IR beamline started operation in 2008 and provides a service to an exceptionally wide range of experiments, from bone research to catalysis to the electronic structure of graphene to in-situ gain experiments on quantum cascade lasers. The synchrotron beam exceeds any other source in terms of brightness. The VUV beamline, which is jointly operated by staff from the General Energy and Synchrotron Light departments, produced its first spectra, and interesting programmes in combustion and atmospheric research lie ahead. During its first year of operation, the super-XAS beamline, running in 'quick-EXAFS' mode, demonstrated its capability to monitor oxidation/reduction reactions on catalysts under working conditions in sub-second steps. This beamline also runs in partnership with the General Energy department at PSI, and a further increase in energy-related projects at the SLS are awaited.

Highlights

The SLS highlights presented in this report represent just a few selected out of many. In 2008, a remarkably high number of user publications (41 in total) appeared in the leading journals Science, Nature, Cell and Phys. Rev. Letters. This illustrates the excellence of our user community and our in-house staff. Breakthroughs have been achieved, for example, in high-resolution resonant inelastic X-ray scattering and angle-resolved photoemission studies of correlated electron systems, in ptychographic X-ray imaging and 3D tomography, and in various applications of our PILATUS and MYTHEN detectors in biocrystallography and materials science.

All users are sincerely thanked for the excellent science they have brought to the SLS in 2008.
The year 2008 was the 11th year of full user operation of SINQ, and another very successful one, with a record-high number of user visits and experiments demonstrating the strength of the national and international user programmes at Switzerland's unique neutron facility.

Protons and Neutrons

The performance of both the proton accelerator and the SINQ neutron target was outstanding in 2008. The availability of the PSI proton source was 90% and exceeded even slightly the very good values of the year 2007. The new operational schedule, with 3 weeks of proton production interrupted by 3–4 days of maintenance, service or beam development, has now proven to be very successful and well accepted by users, those responsible for the instruments, and facility operation staff. SINQ itself ran very stably and reliably: With an availability between 98% and 99%, SINQ was able to deliver neutrons almost as reliably as Swiss clockwork. Between 12 May and 23 December, the target received a total charge of 5390 mAh (2007: 3885 mAh; 2006: 2796 mAh; 2005: 5822 mAh).

During the winter shutdown of 2008, the SINQ operation staff installed an additional intermediate cooling circuit, to provide an additional barrier between PSI's secondary cooling circuits, operated with normal water, and SINQ's D2O moderator. This guarantees additional safety and reliability.

User Operation statistics

In 2008, 15 instruments for neutron scattering experiments and imaging applications were in operation. Two of them (‘MORPHEUS’ and ‘NARZISS’) were mainly used for in-house activities, whereas 13 instruments were fully available to users. On those instruments, almost 450 experiments were performed in 2008, with an average duration of approximately 4 days. As usual, most of the experiments were used for academic research, but on the two imaging instruments ‘NEUTRA’ and ‘ICON’ a total of 18 experiments were performed in cooperation with, or even ordered by, industry.

The number of user visits was higher than ever before, and the user office counted a total of 677 visits by 447 different individuals. These numbers clearly exceed those from 2007 and 2006, with their reduced operation times of SINQ, but also those from ordinary fully operational years, such as 2005 and earlier.

As previously, SINQ was strongly used by Swiss user groups and clearly served as home base for the Swiss neutron scattering community, with more than 50% of the beam time being used by Swiss groups. Another 37% was used by foreign groups from EU countries and 10% by groups from countries outside Europe (Figure 1). The largest foreign national communities came from Germany (10%), followed by the United Kingdom (8%), Denmark and France (both 6%).

Looking closer at Swiss use of SINQ (Figure 2), PSI (44%) again provided most of the Swiss groups, followed by ETH Zurich (35%). The remaining share was almost equally distributed between the Universities of Bern, Fribourg and Geneva, EPFL, Lausanne and EMPA in Dübendorf.

The scientific impact of SINQ is documented in more than 120 publications in peer reviewed journals which appeared in 2008, based on data obtained at the SINQ instruments. Thirteen of these articles were in high-impact journals, such as Science, Nature Materials, PRL and JACS.
The SINQ instruments are also being heavily requested by the user community for the future, as 275 new proposals were submitted during 2008 and the average overbooking factor of the instruments was 2.2.

Complementary use of X-rays and neutrons

PSI can offer three probes for condensed matter research on one site: muons, synchrotron X-rays and neutrons. To enhance the complementary use of these facilities, a new proposal submission channel was opened in 2008. For the first time, users could submit proposals requesting beam time for both synchrotron X-rays and neutrons. This first call was dedicated to experiments in the field of powder diffraction and included the MS-powder beamline ‘X04SA’ of the SLS and the high-resolution powder diffractometer ‘HRPT’ at SINQ. The experiments allocated were then performed directly after each other at SINQ and SLS, to reduce travel demands on the users. Because of the positive resonance to this initiative, it will be continued and a second call will be made in 2009.

Twenty years of partnership with ILL

2008 was not only the year of PSI’s 20th anniversary. In 1988, the year when PSI was founded, the contract was signed that made Switzerland a full member country of the Institut Laue-Langevin (ILL) in Grenoble. Since then, a very fruitful partnership with manifold collaborations has been established, including the Cryopad/Mupad development, the collaborations on Time-of-Flight spectrometers (INE/FOCUS), and the PSI development of supermirrors, now also routinely used at ILL. Between 1988 and 2007, 939 Swiss proposals were submitted to ILL, with a success rate of 80%. This is the highest national success rate of all ILL member countries, and the complementary use of SINQ and the ILL neutron source is definitely one of the reasons for this success. A total of 682 publications have appeared from Swiss experiments at ILL, which makes an average of 45 per year (R. Wagner, ILL Grenoble, private communication, 28 November 2008).

The 20th anniversary of Swiss membership of ILL was celebrated in a dedicated symposium on 28 November 2008 at PSI, jointly sponsored by the Swiss State Secretariate for Education and Research and PSI.

Highlights

In 2008, the impressive number of 125 papers based on experiments performed at SINQ were published in peer reviewed journals – many of them in highly ranked journals such as Science or Physical Review Letters. Results from two of these papers are described in the Highlight section of the present report. In one of them (p. 30) the authors report on a superconductor in which superconductivity and magnetism are intimately connected: the material shows magnetic order only as long as it is superconducting. In the second article (p. 34), new results on multiferroics are presented. These materials exhibit spontaneous coupling between magnetization and ferroelectricity and show great promise as components in new electronic devices.

Goodbye Walter Fischer

For PSI and the Swiss neutron scattering community, 2008 started on a sad note: On 17 March, Walter E. Fischer, one of the pioneers in establishing SINQ, passed away after half a year’s battle with cancer. Walter’s major contributions to the Swiss spallation neutron source will never be forgotten and his colleagues will greatly miss him.
PSI offers three major probes for condensed matter research on one campus. Next to SLS and SINQ, the Swiss Muon Source, SμS, provides unique possibilities for muon spin spectroscopy. The facility is highly attractive for the user community, and never before was the number of new proposals as high as in 2008.

User Laboratory SμS

The Swiss Muon Source, SμS, is one of the large PSI user facilities and can look back on 2008 as a very successful year: The six SμS instruments delivered a total of 655 instrument days, and 168 experiments were completed successfully during the operational period between April and December. Two-thirds of the user groups came from abroad, with the largest foreign user community coming from the United Kingdom (19%), followed by Germany and Japan (both 13%). The experiments were carried out by 151 different researchers during 185 visits. In 2008, SμS for the first time launched two calls for proposals instead of one. In addition to the usual December deadline for all instruments, it was possible to submit proposals for the three instruments ‘GPS’, ‘GPD’ and ‘LTF’ in summer 2008. Having two calls instead of one per year provides higher flexibility and significantly reduces the time between proposal submission and allocation of beam-time. The new scheme was well accepted by the user community and will be continued in the future. A total of 156 proposals were submitted in 2008, which represents a new record for the facility. Several instrumental improvements were realized in 2008. In particular, to cope with the increasing number of proposals, the GPS instrument was provided with a port for an additional cryostat (Figure 1).

SμS reveals secrets of the new superconductors

The year 2008 was also outstanding for SμS regarding publications: A total of 54 publications appeared, based on data obtained at the Swiss Muon Source (39 with an LMU author). Even more than the pure number, the impact of the publications is significant: To give an example, μSR at PSI has been at the forefront in rapidly providing essential information about the phase diagram and the superconducting and magnetic properties of the newly discovered iron-based superconductors. Overall, the journal publication record contains one ‘Science’ and one ‘Nature Materials’ article, 13 papers appeared in ‘Physical Review Letters’ and another 24 were published in ‘Physical Review B’. Finally, it should be mentioned that 2008 marked the retirement of Dierk Herlach, Head of Laboratory, and Ueli Zimmermann, GPD instrument scientist. We wish to thank these two esteemed μSR scientists for their long-standing commitment to μSR and to the user programme at PSI, and wish them all the best for the future.
The PSI Ultra-Cold Neutron Source

Bertrand Blau, Manfred Daum, Klaus Kirch, Knud Thomsen, Werner Wagner
for the PSI UCN project team and the PSI UCN collaboration

The construction of the Ultra-Cold Neutron Source (UCN) at PSI is under way. In the beginning, it will be mainly used for extremely precise measurements of the neutron’s electric dipole moment. Those are important tests of the Standard Model of particle physics. Source commissioning is planned to start in autumn 2009. A density of 1000 UCN/cm$^3$ is expected in typical experiments – an increase of almost two orders of magnitude over the best source currently available (PF2 at ILL Grenoble). User operation will start in 2010.

Prominent milestone

The most important milestone in 2008 was the delivery of the UCN tank system to PSI. All main components of the UCN source, i.e. the spallation target for neutron production, the 3.5 m$^3$ heavy water moderator, the solid deuterium cold source and UCN converter at 5 K, and the UCN storage volume (∼2 m$^3$), will be embedded in the 6.5 m-high tank (Figure 1).

Proton beam and spallation target

Tests with kicking the proton beam onto the test beam dump have been successfully performed at full intensity (2 mA, 600 MeV; 10 ms pulse duration). All beam elements worked perfectly well. The spallation target for neutron production, made of 760 lead-filled reactor-grade zircaloy tubes, is also ready for operation.

The heart of the UCN source...

... is the cold moderator: 30 litres of solid deuterium at 5 K will cool neutrons and produce UCN. The moderator vessel must withstand 3 bar overpressure. A peculiarity of this vessel is the top lid (Figure 2), that must be penetrable for UCN and, thus, as thin as possible. Production of the optimal toroidal shape was a formidable challenge.

The UCN flagship

The search for the electric dipole moment of the neutron (nEDM, see page 38 in this report) is the flagship experiment in physics with ultra-cold neutrons. A large international collaboration aims at an improved measurement at PSI. The experiment will be ready for data taking in area south at the end of 2009.

For more information, visit: http://ucn.web.psi.ch
In April 2008, the analysis of radiocarbon samples was moved from the EN Tandem accelerator to the MICADAS AMS spectrometer. This was a big step forward, because a major fraction of the external financial resources of the laboratory are related to these measurements. From the operational point of view, the new measurement procedure has the great advantage that the efforts of radiocarbon measurements are significantly reduced, and analyses can be performed unattended and fully automated. Moreover, the quality of the analyses has improved. The PSI/ETH MICADAS system is based in its design more on a conventional mass spectrometer than a traditional AMS system. This is a good qualification for achieving more precise $^{14}\text{C}/^{12}\text{C}$ and $^{13}\text{C}/^{12}\text{C}$ measurements. During the first year of routine operation, precision limits could be improved and measurements approaching the $1\%$ level became possible. The BioMICADAS project has been successfully accomplished. On 25 June, the instrument was shipped to the USA and only 14 days later became operational. Rigid performance tests followed, and final acceptance was achieved on 21 July. Since then, the instrument has been operated at Vitalea Science under commercial conditions, and more than 5000 analyses of biomedical samples were conducted by the end of the year. At the 6 MV Tandem-based AMS system, a total of 2868 $^{10}\text{Be}$, $^{26}\text{Al}$, $^{36}\text{Cl}$ samples were measured. The Tandy AMS system was predominantly used for $^{129}\text{I}$, Pu and Pa measurements as well as for experimental AMS work. The reduced burden of routine measurements at the EN Tandem left freedom for experiments in material sciences. In a new materials science project, the possibility of using micro-capillaries for the focusing of MeV ion beams is being investigated. The transmission of proton and helium ion beams through capillaries of approximately 1 micron tip size has been observed. The technique has large potential for simplified micro analysis of surfaces and small objects.

**2008 was a year of change for the PSI/ETH Laboratory of Ion Beam Physics (LIP).** After the retirement of Martin Suter and Georges Bonani, a new structure for the laboratory had to be found and the tracks were laid for the integration of the laboratory into the ETH structure from 1 January 2009. A fruitful and successful relationship of more than 24 years has come to an end, but the connection between PSI and the new ETH Laboratory of Ion Beam Physics will not terminate completely, and PSI will continue to support the activities of the Laboratory and benefit from its analytic capabilities.
The design and construction of the large research facilities at the Paul Scherrer Institute require new and innovative solutions at the limit of current technologies. Scientists and engineers are successfully pushing the limits in various technological fields, from power electronics to precision machining to nanotechnology. Combined with achievements in various research fields being investigated at PSI, these accomplishments offer outstanding opportunities for commercialization by industrial partners.

The Technology Transfer Office at PSI is ready to assist partners from industrial companies with their search for sources of innovation at PSI or to prepare the way for solutions to their technological challenges.

The following pages explain the various options for technology transfer models and illustrate a selection of successful commercialization projects, as well as some promising technologies still to be tapped by our industrial partners.
Technology transfer projects rely on the quality of the relationships between the persons involved in different aspects with both partners. A major factor shaping this relationship is the layout of the contractual framework and collaboration concept, which is adapted to each transfer project. The greatest task within these boundary conditions is the alignment of the needs and expectations of the industrial and scientific partners.

The most effective way to transfer competencies in technologies and know-how is the “transfer” of persons, who take along not only additional intangible knowledge to the company but also the enthusiasm to transform their research into industry-standard applications. PSI has experienced successful “person transfer” of PhD graduates as well as senior scientists.

A very useful way of supporting industrial research and development activities is to make available the instruments and methods used at our large research facilities. As a User Lab, PSI develops and operates instruments and equipment for a wide range of applications, from material and structure analysis to imaging. The following sections showcase a variety of the opportunities present at our particle beam facilities. The services offered by PSI include the evaluation of the appropriate measurement configuration, support with data acquisition and expertise in data analysis.

From the economical point of view, the most significant model for technology transfer is with projects involving intellectual property rights (IPR) generated at PSI. If the right is granted to use PSI-owned IPR, or to transfer patents, industrial partners expect a direct economic advantage from applying such protected IPR in their products and are ready to compensate PSI for this advantage.

Research collaborations enable companies to tap PSI’s know-how and technologies early in the innovation process. Depending on the technological situation and requirements, a collaboration framework will be set up that equally suits the interests of the industrial partner and PSI. An agreement which includes the project plan, provisions on intellectual property and confidentiality is the basis for such collaboration. A long-term collaboration project for an energy and mobility concept was launched in 2008 together with Belenos Clean Power Holding (see article on page 111).

If you are interested in one of the technology transfer models described above, or if you are looking for advice or consultation on a specific topic, the Technology Transfer Office is ready to connect you with the matching centre of expertise at PSI.

The following pages give a selection of opportunities and success stories in technology transfer, as motivation to contact PSI concerning a technological solution that is challenging your own R&D department.

X-ray microscopy of active samples: The micro-XAS instrument

The availability of high-performance light sources – such as the Swiss Light Source (SLS) – and remarkable advancements in the field of X-ray optics have enabled the design of efficient hard X-ray microscopes. Recently, such a high-resolution microscope was completed at the SLS: the microXAS beamline.
This analytical facility allows materials and matter to be investigated with a high spatial resolution of approximately 1\( \mu \)m - providing microscopic insights into their structure. A synchrotron-based X-ray microscope comprises a suite of powerful analytical methods, such as molecular structure analysis (X-ray absorption spectroscopy, XAS), chemical compositional analysis (X-ray fluorescence, XRF) and structural analysis (X-ray diffraction, XRD). These three techniques represent key analytical techniques in many fields of basic and applied science, and now have a major impact on the exploration of chemical reactivity and structural analysis of both engineered and natural systems. Furthermore, micro-XAS is capable of providing chemical information from within single micro-domains and at the same time providing local structural analysis of such domains.

Among other things, one particular unique characteristic of the micro-XAS is that it enables radioactive materials to be investigated. Consequently, after starting user operation, micro-XAS became widely used for investigations in close collaboration with, or relevant to, the nuclear industry. Active samples analyzed so far include solidified radioactive waste, such as glasses or cement materials, irradiated alloys, activated corrosion products (crud), and analogues of next-generation fuel materials.

In most cases, elemental distribution maps (chemical images) were recorded by collecting two-dimensional micro-XRF data, followed by molecular-scale chemical information gained by collecting the micro-XAS spectra at specific locations within the radioactive specimen. Most recently, the capability of collecting structural images was added to the facility through the generation of two-dimensional X-ray micro-diffraction images.

A tool for non-destructive residual stress characterization: POLDI

The time-of-flight (TOF) diffractometer POLDI (Pulse-Overlap Diffractometer) is the dedicated instrument at the SINQ neutron source at PSI for the study of residual stresses and the mechanical behaviour of industrial materials. POLDI uses a beam of thermal neutrons with a range of wavelengths which satisfy the diffraction condition for many crystal lattice spacings. Consequently, the recorded diffraction pattern consists of many crystal reflections (Figure 2), which allow multi-phase and composite materials to be studied, as well as intergranular stresses in single-phase materials.

Residual stresses are of great concern in industry, since they can lead to premature failure of industrial materials and structures if they are not detected. Such stresses can be studied in crystalline materials using neutron diffraction, where the crystal lattice is used as an atomic strain gauge. The penetration of neutrons in many engineering materials allows for the non-destructive determination of residual stresses from the near surface to deep within the bulk. Examples of residual stress experiments that have been conducted include residual stress in pump cases for aerospace, railway wheels, mechanical surface treatments (i.e. laser peening) and welded structures.

Residual stress distribution can be non-destructively mapped in three dimensions by translating the sample through a sampling volume established where the incident beam and diffracted beam intersect. Concomitantly, the mechanical deformation of industrial materials can be studied by in-situ straining, providing phase-specific information during specific loading regimes. In-situ neutron diffraction during mechanical testing is among the most advanced research methods, providing details of micro-structural evolution under service-like conditions, input that is needed for the development of new predictive engineer-
ing models. An example of in-situ mechanical deformation studies concerns high-field (>80 T) pulsed magnets, which are subject to large forces during operation. Such loads require conductor materials with a very high elastic limit. In-situ neutron diffraction during tensile deformation of the Cu-Nb-based nanocomposite system is an ideal tool for investigating the evolution of the lattice strain of each component. These observations allow conclusions to be drawn about possible deformation mechanisms in Cu-Nb nanocomposite wires, and reveal the build-up of large internal stresses during deformation.

Pushing the limits in microscopic tomography: TOMCAT

Synchrotron-light-based Tomographic Microscopy is a powerful technique for fast, non-destructive, high-resolution quantitative volumetric investigations on samples of diverse nature. At the SLS, a beamline for TOmographic Microscopy and Coherent rAdiology experiments (TOMCAT) has been recently put into operation. TOMCAT covers an X-ray energy range between 8 and 45 keV. The standard TOMCAT detector offers field of views ranging from $0.75 \times 0.75$ mm$^2$ up to $15 \times 15$ mm$^2$, with a theoretical pixel size from 0.37 µm to 7.4 µm, respectively. The beamline design and flexible endstation setup make a large range of investigations possible. In addition to routine measurements which exploit the absorption contrast, the high coherence of the source also enables phase contrast tomography, implemented with two complementary techniques, based on a modification of the ‘Transport of Intensity’ method and grating interferometry. In-situ experiments are also routinely conducted. Typical acquisition times for a tomogram are of the order of a few minutes, ensuring high throughput and allowing semi-dynamic study. Raw data are automatically post-processed online, and full reconstructed volumes are available shortly after a scan, with minimal user intervention. Quantitative evaluation of the tomographic scans is available on site, see Figure 3.

TOMCAT is offering its services to applications in the materials and life-sciences area. Examples of these range from the visualization of cellular structures in bone samples to the micro-structure in selected concrete applications. Other applications range from high-resolution, non-destructive investigation of defects in metallic and non-metallic prototype components to the quantitative analysis of pore networks in diverse rock types – for instance, for improving oil recovery, understanding element mobilization by hydrothermal fluids, studying the dynamics of volcanic eruptions, or refining current contaminant diffusion models.

Microspectroscopy of nano-scale materials: PoLux

The PoLux facility at the SLS operates a scanning transmis-

Figure 3: 3D visualization of the pore structure of a sandstone. Data have been obtained at the TOMCAT beamline, with a theoretical voxel size of 740 nm$^3$.
magnetic states. Usually, the characteristic properties vary across the sample, and the spatial distribution of these variations has to be investigated at sufficiently high spatial resolution. Soft X-ray absorption spectroscopy, combined with high spatial resolution, is an ideal tool for such tasks, since it provides the necessary information with high sensitivity and minimum sample preparation. In particular, near-edge X-ray absorption fine structure (NEXAFS) shows superior sensitivity in organic materials.

In order to achieve high spatial resolution in scanning transmission soft X-ray microspectroscopy, Fresnel zone plates are commonly used to focus the X-rays to a point focus. Images are formed from raster-scanning the sample through the focal point while measuring the transmitted intensity using an X-ray detector.

Because of its flexible sample environment, which includes heating, cooling, gas and liquid cells, and electrical connections to the outside, the PolLux-STXM offers a very wide variety of experiments, from hard- and soft-condensed matter as well as in environmental science and biology.

Methane from wood: Pilot Plant is operational

In 2008, the demonstrator plant for the catalytic conversion of wood gas to methane was built and commissioned by our industrial partners in Güssing (Burgenland, Austria). The core component and real innovation of the plant is the catalytic fluidized bed reactor, which is responsible for the chemical conversion to methane. This reactor has been developed and built based on experience gained over the past few years with a 10 kW laboratory plant at PSI. In an ambitious scale-up step, the capacity of the reactor was increased by a factor of 100. The team achieved an important milestone in December 2008, when the 1 MW catalytic fluidized bed reactor first started operation, and achieved the expected performance level right from the start.

The project 'Methane from Wood' overcame a crucial technical hurdle on the way to its successful implementation in practice. This achievement was recognised in January 2009 with the "Watt d’Or" prize of the Swiss Federal Office of Energy, for outstanding accomplishments in energy technologies, awarded to the consortia comprising the industrial partners CTU and Repotec, the scientific partners PSI and the TU Vienna, and the biomass power plant in Güssing. For more information on the technology, see http://tpe.web.psi.ch

Improving the design of exhaust-gas after-treatment systems

Commercial vehicles have been increasingly equipped with urea-SCR systems for the reduction of NOx emissions over the past few years. To achieve high NOx conversions, it is important to mix the reactant urea homogeneously with the exhaust gas before it reaches the catalyst. As the constructed space in vehicles is usually very limited, computational fluid dynamics (CFD), as offered by Swenox, has been used as a design tool to achieve this goal. A specific feature of the Swenox software is its ability to calculate dynamic processes, which is crucial for the realistic modelling of urea-SCR systems in vehicles. Within this collaboration, PSI has contributed significant know-how for the implementation of the SCR chemistry and generated the data used in the models of commercially available vanadium- and zeolite-SCR catalytic converters. In an experimental programme at PSI, samples were cut from such commercial catalytic modules and measured in steady and dynamic states, using laboratory test equipment. The experiments included varying temperature, velocity, concentration and the NO/NO2 ratio over large ranges. The acquired data were used to successfully parameterise the Swenox model, consequently helping the efficient design of exhaust-gas after-treatment systems. Such improved systems help to further reduce NOx emissions, for the benefit of human health and nature.

Regulatory support tasks on the human factor

The human factor is an important element of nuclear power plant safety. Methods for treating this element in safety studies, known as Human Reliability Analysis (HRA), are a subject of research within NES. NES’s expertise in this area is also used to support the regulatory activities of the Swiss Federal
Nuclear Safety Inspectorate, ENSI. Tasks include reviews of the HRAs within the Probabilistic Safety Assessments (PSAs) of the Swiss nuclear power plants, evaluations of the plants’ procedures for emergency operations, and analyses of the implications of new developments in human factors for regulatory activities and guidelines.

The reviews of HRAs address the methods and assumptions used in the analyses, and the failure probabilities obtained for the personnel actions included in the safety studies. These analyses and their results are examined in the light of developments in methods, as well as in safety analysis practice. When a study uses a widely applied method, the implementation is considered in the light of international practice, otherwise comparisons with accepted methods are performed. This review work bases NES’s HRA research in actual practices, providing the impulse for research and motivating efforts to enhance current HRA methods.

The personnel actions required in plant emergencies are planned thoroughly and described in formal procedures, e.g. the ‘Emergency Operating Procedures’, which guide the actions required by, as well as the assessment of, the actual plant situation, and the actions that the operators will need to take in these situations. Tasks in this area evaluate the usability of the procedures, focusing on the most significant accident scenarios postulated in the PSAs. At its most basic level, usability is based on criteria ranging from readability to the technical clarity and specificity of the procedures. A broader assessment of usability is performed by “walking through” the procedures and anticipating the plant indications that will be presented to the operators as they assess the evolving plant situation and perform the actions required by the procedures. The actions are also assessed in terms of the time needed to perform the required assessments of, and actions on, the plant’s systems, and of the systems available in the scenario. Such evaluations complement the verification and validation of the procedures by examining the beyond-design-basis scenarios included in PSAs.

Reference
A new way of cooperation for big challenges

Philipp Dietrich, Competence Center Energy and Mobility CCEM, PSI

On the way to a more de-carbonized system for individual mobility, several elements have to be adapted. The whole chain is affected, starting with fuel production, followed by the whole supply logistics of the fuel, including delivery to the customer, and finally its application in transport vehicles. This process creates opportunities as well as threats to several industrial sectors. Even society itself may be influenced by the availability of new mobility concepts. To contribute within this arena, the Belenos Clean Power Holding and PSI are collaborating with a new business model.

The idea behind the concept of Belenos Clean Power (BCP) is to substitute a part of the fossil fuels used in the mobility sector with available renewable energy. Since an alternative fuel will be only used on a large scale if the fuel supply and the fuel converter are already in the vehicle, BCP is involved along the whole energy chain. The concept is visualized in Figure 1.

The business model consists of creating joint venture companies along the complete value chain, from the capture of the primary energy all the way to its use to generate mechanical power to propel passenger cars.

The shareholders in the BCP are, to date, The Swatch Group, Hayek Engineering, Deutsche Bank, group e and the Ammann Group. It is intended that the ETH domain, through PSI, also becomes a shareholder. The share capital is initially CHF 21 million.

The holding company, together with other partners, is interested in creating joint ventures in specific areas of this clean energy chain.

The first joint venture is ‘Swiss Hydrogen Power’, which is developing the stationary conversion of electricity to hydrogen and oxygen, and the safe decentralized storage of these gases. PSI is mainly involved in the second joint venture, in which the development of a fuel cell system is envisaged, to be used to supply passenger cars with electricity. The integration of the fuel cell system in a car will be carried out in collaboration with a car manufacturer.

A further joint venture is concerned with increasing the efficiency of photo-voltaic cells and systems, mainly through the application of thin-film technologies.

Another joint venture is dedicated to the development of advanced batteries. This technology also strengthens the application of fuel cells, since their combination in a car helps to improve the overall efficiency and use of energy.

The structure of the holding company is designed to be a very flexible way of integrating stakeholders willing to contribute towards the realisation of one form of cleaner mobility, based on lower fossil fuel consumption.

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The essential statistical data for the Paul Scherrer Institute for 2008 is presented on the following pages, giving the most important information about the Institute in a concise form. The largest proportion of the Institute's budget of CHF 300 million is provided by the Swiss federal government. However, the contribution of third-party revenue is of increasing importance. As a particular example of third-party support for the past year, the sum of 10 million Swiss Francs was donated by the Canton of Aargau as a contribution to the further development of the Proton Therapy facility.

In the field of education, a new figure has emerged to supplement the impressive numbers of PhD students and apprentices shown in previous years, as more than 1600 pupils visited iLab, PSI's newly founded school laboratory, during its first nine months of operation. The increasing number of external scientists performing experiments at PSI proves the institute's continued attractiveness as a multifarious User Facility. The rapidly growing number of publications in high-profile journals based on research performed at PSI shows that many of the most creative scientists choose the Institute when looking for a place to carry out their experiments.

The large number of users from abroad, and the majority of foreign members on PSI's scientific advisory bodies, are clear signs of the Institute's firm integration in the international scientific community. To illustrate this, complete lists of members of the PSI Research Commission and the Research Committees of the particular departments are included in this chapter.
The year 2008 in numbers

Finances

The total expenditure of PSI in 2008 amounted to CHF 300.4 million, with the Swiss government providing 80.4% of this amount, i.e. CHF 241.5 million. Investments totalled CHF 73.2 million (24.35% of the total expenditure). Third-party funding amounted to CHF 73.1 million, with 38.3% coming from private industry, 14.77% from Swiss federal research programmes and 9.85% from EU programmes. The Canton of Aargau made a once-off supporting contribution of CHF 10 million to the Proton Therapy facility.

### PSI Financial Statement (in CHF millions)

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<tr>
<th>Expenditure</th>
<th>2008</th>
<th>%</th>
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<tbody>
<tr>
<td>Operations¹</td>
<td>227.2</td>
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<tr>
<td>Investments¹,²</td>
<td>73.2</td>
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<td>Total</td>
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<table>
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<th>Expenditure according to source of income</th>
<th>2008</th>
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<tbody>
<tr>
<td>Federal government funding</td>
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<tr>
<td>Third-party</td>
<td>58.9</td>
<td>19.6%</td>
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<table>
<thead>
<tr>
<th>Third-party revenue</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Private industry</td>
<td>28.0</td>
<td>38.30%</td>
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<tr>
<td>Federal research funding</td>
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<td>14.77%</td>
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<tr>
<td>EU programmes</td>
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<td>9.85%</td>
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<tr>
<td>Support by the Canton of Aargau for Proton Therapy</td>
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<td>13.68%</td>
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<tr>
<td>Other</td>
<td>17.1</td>
<td>23.39%</td>
</tr>
<tr>
<td>Total</td>
<td>73.1</td>
<td>100%</td>
</tr>
</tbody>
</table>

1 Including personnel costs. Total personnel costs of CHF 181.5 million corresponded to 60.40% of total expenditure
2 Including CHF 18.4 million investment in buildings

### Total budget distribution for 2008 across PSI Departments.

Research facilities allocated to the various departments. (Values for 2007 in brackets)

- Solid-State Research and Materials Science: 39% (35%)
- General Energy: 12% (14%)
- Nuclear Energy: 17% (15%)
- Particle Physics: 14% (18%)
- Life Sciences: 18% (20%)
- Technical and Engineering: 53.3%
- Information Technology: 7%
- Research: 33%
- Administration: 6.7%

The staffing structure reflects the importance of technical staff for successful research at large-scale facilities.

Employment

At the end of 2008, employment at PSI corresponded to 1300 full time equivalents; 22.3% of the employees were women and 42% were non-Swiss citizens.

Education

In addition to scientific research, the Paul Scherrer Institute sees education as one of its main tasks. Many PSI scientists give courses at the Swiss Federal Institutes of Technology, the Universities and the Universities of Applied Sciences. About 300 graduate students from the ETH and other universities are working at PSI for their degree. Out of those, 166 PhD students, including 44 women, were employed by PSI. Seventy-seven young people were undergoing vocational training in 13 different professions. In addition, PSI offered courses in radiation protection and reactor technology.

A particularly important event for educational activities was the opening of the iLAB – PSI’s school laboratory – on 4 April
At iLAB, pupils from secondary schools get the opportunity to perform a variety of physics experiments. The idea of the school lab is to spread interest in the natural sciences among the youth. In its first nine months of operation, iLAB hosted 75 classes, with 1600 young people attending from Switzerland and southern Germany.

User Service

In 2008, PSI kept its position as an attractive User Lab to scientists from all over the world. More than 2300 users visited the Institute and performed more than 1600 experiments at the 40 beamlines available at the large-scale facilities. The high demand is reflected by the overbooking that occurred, that was somewhere between 2 and 3 for most beamlines, and reached a value of 6.5 for the PXI beamline at SLS. The number of publications in high-profile journals, based on research within the departments Synchrotron Radiation and Nanotechnology (SYN) and Condensed Matter Research with Neutrons and Muons (NUM), reached a new high. SYN research produced 41 papers in Nature, Science, PRL or Cell, and research at NUM 33 papers.
Commission and committees
(status at the end of 2008)

Research Commission

**External Members**
- Prof. Dr. H.-R. Ott, President Laboratory for Solid-State Physics, ETH Zurich, CH
- Prof. Dr. G. Aeppli University College, London, UK
- Prof. Dr. F. Carré CEA, Gif-sur-Yvette, FR
- Prof. Dr. H.H. Coenen Institute for Nuclear Chemistry, Forschungszentrum Jülich, DE
- Prof. Dr. R.W. Falcone ALS, Lawrence Berkeley National Laboratory, Berkeley, USA
- Prof. Dr. Ø. Fischer Department of Condensed Matter, University of Geneva, CH
- Prof. Dr. R. Klanner Institute for Experimental Physics, University of Hamburg, DE
- Prof. Dr. S. Larsen European Synchrotron Radiation Facility, Grenoble, FR
- Prof. Dr. E. Leppävuori VTT Technical Research Centre of Finland, FI
- Prof. Dr. T. Mason Oak Ridge National Laboratory, USA
- Prof. Dr. J. Rossbach Institute for Experimental Physics, University of Hamburg, DE
- Prof. Dr. Th. Sattelmayer Chair of Thermodynamics, TU München, Garching, DE

**Internal Members**
- Prof. Dr. R. Horisberger, President Particles and Matter (TEM)
- Dr. M. Ammann Particles and Matter (TEM)
- Prof. Dr. K. Ballmer-Hofer Life Sciences (BIO)
- Dr. B. Delley Condensed Matter Research with Neutrons and Muons (NUM)
- Dr. R. Eichler Particles and Matter (TEM)
- Dr. P. Hasler, Secretary Life Sciences (BIO)
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- Dr. W. Pfingsten Nuclear Energy and Safety (NES)
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Dr. R. Schmitz
Swiss Federal Office of Energy, Berne, CH
Where to find what

On CD and online
The publication lists for all PSI departments can be found on the CD version of this report, which can be ordered at www.psi.ch (Media/Info Material) or by phone +41 (0)56 310 21 11.

The lists include the following:
• Peer-reviewed publications
• Invited talks
• Dissertations
• Conference Proceedings
• Lectures

Also included on the CD is the Annual Report (Jahresbericht) in German.

Links to other research not featured here can be found on our website: www.psi.ch (Research at PSI).

Elena Mengotti, PhD student at the Laboratory for Micro- and Nanotechnology, at the electron writer she uses to prepare nanosamples for her investigations.


CONFERENCE AND WORKSHOP CONTRIBUTIONS

Albertini F, Lomax A. Intensity Modulated Proton Therapy: influence of starting conditions on the optimized dose distribution. (SGSMP, Chur 2008)


Invited Talks:

E. Hug.  
*Particle Therapy in Europe: Present State and Near Future*  

E. Hug.  
*Technische Innovationen in der Strahlentherapie.*  

E. Hug.  
*Proton Therapy – What could be possible*
E. Hug.
Proton Therapy in Switzerland
Ospedale Regionale Bellinzona e Valli, San Giovanni, April, 2008

E. Hug.
Protonen Therapie für Weichteilsarkome.

E. Hug.
Long Term Patient Outcomes Following Proton Beam Therapy for Skull Base Tumors.

E. Hug.
Spot Scanning based proton therapy – the next generation.
Jahreskongress, Children’s Oncology Group, Denver, USA, Oktober 2008

E. Hug.
Protontherapy: The Gold Standard for next Generation Clinical Trials?
18. Jahreskongress, AIRO Italienische Gesellschaft für Radioonkologie, Mailand, November 2008

E. Hug.
Technische Innovationen in der Strahlentherapie – Protonen.

E. Hug.
Proton Therapy – What could be possible.
5th Engadin Prostate Cancer Winter Symposium, März, 2008

E. Hug.
Neurologische Indikationen für die Protonen-Radiotherapie.
KSA, Neurozentrum, März 2008.

E. Hug.
Proton Therapy in Neurooncology: Indications and Results.
USZ, Klinik für Neurochirurgie, Mai 2008.

E. Hug and Manser, P. (2008),
Vorsitz: Principles and Perspectives.
6. Zuppinger Symposium der Bernischen Radium-Stiftung: Im Technorama der Radioonkologie, Bern, 25.06.08.

E. Hug.
Grundlagen der Protonentherapie und Fragen an den Radiologen.

E. Hug.
Protonentherapie von der Forschungseinklave zu akzeptierter Behandlungsmodalität.

E. Hug.
Protonentherapie für Patienten mit Sarkomen.
A.J. Lomax

Importance of starting conditions for optimising IMPT: Giving power to the planner?
Huangguoshu International workshop on Biomedical Mathematics, Huangguoshu, China, November, 2008

A.J. Lomax.

Clinical proton therapy: Planning, positioning and patients.
Invited seminar, Kantonsspital Aarau, October 2008

A.J. Lomax.

Range and robustness: The good and bad of proton therapy
Invited seminar, Varian Ltd, Daetwil, October 2008

A.J. Lomax.

Potential and challenges of Intensity Modulated Proton Therapy.
Invited Seminar, Institute for Bio-medical Technology, ETH, Zurich, October 2008

A.J. Lomax.

Future directions and current challenges of proton therapy.
European Science Foundation workshop, Oxford, UK, September 2008

A.J. Lomax.

Current challenges in hadron therapy.

A.J. Lomax.

Is there still a role for proton therapy?
BIR/IPEM Spring meeting, London, UK, June 2008

A.J. Lomax

Clinical aspects of proton therapy.
MD Anderson Hospital, Houston, USA, May 2008

A.J. Lomax

Practical aspects of proton therapy with scanned beams.
Invited seminar, MD Anderson Hospital, Houston, USA, May 2008

A.J. Lomax

Treatment planning for scanned proton beams and IMPT
PTCOG teaching course, Jacksonville, USA, May 2008

A.J. Lomax.

State-of-the-art Proton Therapy: The physicist’s perspective.
Keynote lecture, PTCOG, Jacksonville, USA, May 2008

A.J. Lomax

Current status of proton therapy at the Paul Scherrer Institute.
Radiation Biology Program Retreat, Stanford University, April 2008

A.J. Lomax

Strahlentherapie mit Protonen: Aktuelle Technik und neue Entwicklungen.
Physikalische Gesellschaft Zurich, Zurich, February 2008.
A.J. Lomax
State-of-the-art in proton therapy: modern delivery techniques and current challenges
MASSTRO, Maastricht, Holland, January 2008.

E. Pedroni
Hadrontherapy facilities worldwide
European Particle Accelerator Conference - EPAC
Genoa 24.06.2008

E. Pedroni.
Proton Beam Delivery Techniques and Commissioning Issues: Scanning
BeamsEducational Pre-Meeting – 19.05.2008
PTCOG 47  Jacksonville Florida, USA

Timmermann B.
Protonentherapie von Malignomen im Kindesalter am Paul Scherrer Institut: eine prospektive Untersuchung.
Wien, DEGRO 2008, Mai

Timmermann B., Maier S., Lomax A., Hug E.
Proton Beam Radiation Therapy of Childhood Malignancies at the Paul Scherrer Institute: A prospective Analysis.
Göteborg, ESTRO 2008, September

Timmermann B., Maier S., Grotzer M., Weiss, M., Bolsi A., Hug E.
Spot-Scanning Proton Therapy for Malignant Brain Tumours in early Childhood: First Experiences at PSI.

Timmermann B.: Maier S., Stadelmann O., Hug E.
Proton Radiation Therap for Childhood Cancer at PSI.

Timmermann B.
Modern Radiotherapy in Brain Tumours: techniques and Concepts.
SYRAD Workshop, ESFR, Grenoble 6/08

Timmermann B.
State of the Art lecture dedicated to Radiotherapy approaches in CNS tumours.
SIOP 2008, Berlin, 3. Oktober

Timmermann B.
Radiation Therapy for Childhood Malignancies.
Curso de Neuro-Oncologia Pediatrica. Barcelona 10/08

Teaching activities

E. Hug:

Co-Director and lecturer:
ESTRO Teaching Course on Protons and Ions, Heidelberg, 2008
T. Lomax:

Lecturer - ESTRO teaching course on Proton and Heavy-Ion Therapy
Co-director and Lecturer – PSI Winter School on Scanned Proton Therapy

Physics Option at ETH – ‘Physics in Medical Research – from Humans to Cells’
Physics Option at ETH – ‘Medical Physics III – New Trends in Radiotherapy’
UNIVERSITY LEVEL AND OTHER TEACHING

B.P. Andreasson
Physik für Informatiker, 402-0038-00 U
Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland 19.02-27.05.2008

B.P. Andreasson
Advanced Solid State Physics, 402-0257-00 U
Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland 02.10-11.12.2008

H. Dil
Electron Spectroscopy
Universität Zürich, Physik 1, FS 2008

J. Gobrecht, H. Schift
Nanotechnologie für Ingenieure
Fachhochschule Nordwestschweiz, Windisch, HS 2008

F. Gozzo
Non-conventional sources: X-ray powder diffraction using Synchrotron Radiation

L.J. Heyderman
Magnetic Imaging Techniques
Seminar in Lecture Series ‘Magnetism and Spin Dependent Transport’ (Prof. Rüdiger), Universität Konstanz, 7.7.2008

L.J. Heyderman
Magnetic Nanostructures and X-rays
Lecture at the Summer School on Condensed Matter Research (Probing the Nanometre Scale with Neutrons, Protons and Muons), Zuoz 16-22.08.2008

L.J. Heyderman
Magnetic Nanostructures and X-rays

M. Nachtegaal, M. Janousch
Cook and look: Synchrotron techniques
Eidgenössische Technische Hochschule Zürich, Zürich, Switzerland, Kursnr. 701-1336-00L, FS 2008

C. Padeste
Preparation of Bio-Active Model Systems using Micro- and Nanolithographic Tools
Nanobiomat Workshop, Middle East Technical University, Ankara, Turkey 1-2.9.2008

S. A. Pauli
Physik-Kolloquium für Mediziner
University of Zürich, Switzerland, HS 2008

B. Patterson, C. Weyer, H. Sigg,
SLS Student ‘Praktikum’
Paul Scherrer Institut, Villigen, Switzerland, 24-27.8.2008

F. Pfeiffer
Coherent Imaging with X-rays and neutrons
PSI Summer School, Zuoz, 08.2008

F. Pfeiffer
Coherent Imaging with X-Rays and Neutrons

F. Pfeiffer
Coherent X-Ray Imaging for Life Science Applications
Graduate School for Laser Physics, DESY, Hamburg, Germany, 12.2008
F. Pfeiffer
_X-Ray Imaging and Tomography_
CIBM lecture, EPFL, 12.2008

C. Schulze-Briese
_Protein Crystallography_
CIMST Summer School on Biomedical Imaging, Zurich, Switzerland, 10.09.2008

H. Schift
_LIGA technology_
Seminar for Master of Micro- and Nanotechnology (MNT), Dornbirn, Austria 11.01.2008

H. Schift
_Nanoreplication technology_
Master of Engineering in Packaging Technology, International Packaging Institute (IPI), Neuenhausen, Switzerland 13.09.2008

M. Stampanoni
_Micro and Nano-Tomography of Biological Tissues_
ETHZ-Lecture: 227-0965-00G

M. Stampanoni
_Aktuelle Forschung in der biomedizinischen Technik_
ETHZ-Lecture: 227-0970-00L

M. Stampanoni
_X-ray Tomographic imaging: a fascinating trip from macro to nano_
CIMST: Interdisciplinary Summer School on Biomedical Imaging, 2-12.9.2008

M. Stampanoni
_X-ray Tomographic Microscopy_
7th PSI Summer School on Condensed Matter Research, 17-23.8.2008

J.F. van der Veen
_Physik_
Bachelorstudiengang Informatik, ETH Zürich, FS 2008

J.F. van der Veen
_Materials research using synchrotron radiation_
Masters course ETH Zürich, HS 2008

P. R. Willmott
_Introduction to Synchrotron Radiation and Synchrotron Techniques_
University of Zürich, Switzerland, Course No. CHE822, HS 2008

P. R. Willmott
_Surface and Interface Analysis of In-situ Grown Thin Films_
7th PSI Summer School on Condensed Matter Research, Zuoz, Switzerland, 16-22.08.2008

P. R. Willmott
_Physik mit Photonen_
ETHZ-Studenten Colloquium, PSI, Villigen, Switzerland, 21.05.2008

**PUBLICATIONS WITH SYN AUTHOR(S) AND DESCRIBING AN SLS EXPERIMENT**

Arenholz E, van der Laan G, Nolting F
_Magnetic structure near the Co/NiO(001) interface_
APPLIED PHYSICS LETTERS 93, 162506 (2008)

_Large area arrays of metal nanowires_
MICROELECTRONIC ENGINEERING 85, 1131 (2008)

_Spatiotemporal stability of a femtosecond hard-x-ray undulator source studied by control of coherent optical phonons (vol 99, art no 174801, 2007)_
PHYSICAL REVIEW LETTERS 100, 099901 (2008)
Bjorck M, Schleputz CM, Pauli SA, Martoccia D, Herger R, Willmott PR
Atomic imaging of thin films with surface x-ray diffraction: introducing DCAF
JOURNAL OF PHYSICS-CONDENSED MATTER 20, 445006 (2008)

Manipulating the magnetic structure with electric fields in multiferroic ErMn2O5
PHYSICAL REVIEW LETTERS 100, 027201 (2008)

Boero G, Mouaziz S, Rusponi S, Bencok P, Notling F, Stepanow S, Gambardella P
Element-resolved x-ray ferrimagnetic and ferromagnetic resonance spectroscopy
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Thin Cr2O3 films for magnetoelectric data storage deposited by reactive e-beam evaporation
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JOURNAL OF POWER SOURCES 183, 564 (2008)

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PHYSICAL REVIEW B 78, 205103 (2008)

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Johnson I, Jefimovs K, Bunk O, David C, Dierolf M, Gray J, Renker D, Pfeiffer F
Coherent diffractive imaging using phase front modifications
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Spatial resolution limits for synchrotron-based spectromicroscopy in the mid- and near-infrared
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L.J. Heyderman
*Patterned Magnetic Thin Films*
Seminar at Sun Microsystems, Boulder, USA, 17.11.2008

L.J. Heyderman
*Patterned Magnetic Thin Films*
IEEE Chapter Seminar, Boulder, USA, 17.11.2008

T. Huthwelker
*Keynote lecture: New experimental approached to the study of ices and aerosols*

G. Ingold
*Towards Pump-Probe Resonant Diffraction at Femtosecond Undulator Sources*
Colloquium SPP 1134, Max-Born-Institut, Berlin, Germany, 22-23.10.2008

M. Janousch
*Basic Principles and Recent Applications of XAS*
Workshop on X-ray absorption spectroscopy and advanced XAS techniques, Paul Scherrer Institut, Switzerland, 6-10.10.2008

I. Johnson
*Coherent X-rays for Imaging and Correlation Spectroscopy*
38th Winter Colloquium on the Physics of Quantum Electronics; Snowbird, Utah, USA, 06.01.2008
S. L. Johnson
Femtosecond X-Ray Crystallography of Bismuth and Tellurium: Dynamics on the Time Scale of an Optical Phonon Period
Seminar, Photon Factory, Tsukuba, Japan, 01.09.2008

S. L. Johnson
Femtosecond X-Ray Crystallography of Elemental Solids: Coherent Dynamics in Bismuth and Tellurium
XXI Congress and General Assembly of the International Union of Crystallography, Osaka, Japan, 23-31.08.2008

S. L. Johnson
Femtosecond Diffraction in Bismuth and Tellurium: Dynamics on the Time Scale of an Optical Phonon Period

S. L. Johnson
Ultrafast X-ray Science
Lecture, PhD Workshop Photons and Matter, Hollum, The Netherlands, 29.06.-04.07.2008

S. L. Johnson
Structural Dynamics in Bismuth and Tellurium Studied by Femtosecond X-Ray Diffraction
Seminar, Advanced Photon Source, Argonne National Laboratory, Argonne, IL, USA, 21.03.2008

S. L. Johnson
Ultrafast Solid State Dynamics
Second European XFEL User's Meeting, Hamburg, Germany 23.01.2008

T. A. Jung, A. Kaufmann, H. Burkard, H. Schifft
Bruchexperimente an Nanostrukturen mit dem Rasterkraftmikroskop
Nano-Argovia Industrie Tag, Muttenz, Switzerland, 26.2.2008

Addressable supramolecular assemblies at surfaces: from switches to rotors and devices
International Conference on Nanosciences and Technology, Keystone, USA, 07.2008

Supra-Molecular Self Assembly at Surfaces: Rational Architectures for Addressable Molecular Switches with Increased Complexity and Novel Functionality
International Conference on Nano-Molecular Electronics (INME), Kobe, Japan, 16–18.12.2008

Dry Supra-Molecular Self Assembly at Surfaces: Rational Architectures for Addressable Molecular Switches
Institute of Solid State Physics (ISSSP), Tokyo University, Japan, 16.12.2008

Supra-Molecular Self Assembly at Surfaces: Rational Architectures for Addressable Molecular Switches
National Institute of Metals, MANA, Tsukuba, Japan, 15.12.2008

Controlling structure and properties of surface supported functional materials by synergetic use of local and non-local probes
NFFA Workshop held at PSI, Villigen, Switzerland, 11.11.2008

Bio-Inspired (soft) condensed matter: Functional surfaces and Novel Materials
Workshop on "Ab initio Modelling in Applied Bio-Sciences: Structure, Dynamics & Function"
Uppsala University, Uppsala, Sweden, 11-12.12.2008


Supra-Molecular Self Assembly at Surfaces: Rational Architectures for Addressable Molecular Switches with Increased Complexity and Novel Functionality
25th European Conference on Surface Science (ECOSS), Liverpool, UK, 08.2008


Supra-Molecular Self Assembly at Surfaces: Biophysics in a Nutshell
From Solid State Physics to Biophysics, Cavtat, Kroatio, 6–13.06.2008


Molecular and Supra-Molecular Self Assembly at Surfaces: Towards Adressable Multi-stable Devices with Novel Functions
MONET, Autumn School on Molecular Organisation and Function at Surfaces, Fuglsøcentret, Denmark, 8–12.09.2008


‘Dry’ Molecular and Supra-Molecular Self Assembly at Surfaces: Towards Adressable Multi-stable Devices
University of Leuven, Belgium, 23.04.2008


Molecular and Supra-Molecular Self Assembly at Surfaces: Combining Physics and Chemistry towards Adressable Multi-stable Devices
Midterm Meeting of the EU Marie Curie RTN PRAIRIES, Stresa, Italy, 03.04.2008


Supra-molecular chemistry beyond the solution phase: Adressable, surface mounted supra-molecular architectures and their characterisation in view of future multistable devices
NANOMATCH Workshop, Supramolecular Nanostructured Organic/Inorganic Hybrid Systems, Nanomatch University of Zurich, Switzerland, 13.02.2008

T. A. Jung, M. Stoehr, N. Wintjes, M. Matena, J. Lobo-Checa, S. Boz, T. Samuely, M. Enache, S. Schintke, A. Baratoff, D. Bonifazi, L.H. Gade, F. Diederich,

Molecular and Supra-Molecular Self Assembly at Surfaces: Towards Adressable Multi-stable Devices
Science Department of the University of Fribouer, Switzerland, 29.02.2008


Supra-Molecular Self Assembly at Surfaces and Interfaces: Rational Architectures with Increased Complexity and Novel Functionality
2008 Swiss Workshop on Basic Research in Nanoscience, Davos, Switzerland, 04-06.06.2008

A. Kaufmann
Nano fracture mechanics for studying adhesion and corrosion on interfaces and grain boundaries
EMPA Seminar talk, Thun, Switzerland, 04.11.200

C.M. Kewish
2-D Membrane Protein Crystallography at Future XFELs
C.M. Kewish  
2-D Membrane Protein Crystallography at Future XFELs  
PSI-XFEL Science Workshop on Coherent Diffraction by Nanostructures, Schweizerischer Nationalfonds, Bern, Switzerland, 27.11.2008

Molecular Layers on the Nanometer Scale Explored by Photons and Local Probes  
2008 Swiss Workshop on Basic Research in Nanoscience, Davos, Switzerland, 04-06.06.2008

F. Luo, L. J. Heyderman, H. H. Solak  
Patterned Nanoscale Perpendicular Magnetic Dot Arrays  
Seminar at Bochum University, Bochum, Germany, 16.05.2008

F. Marone  
Synchrotron-based X-ray Microtomography in the Geosciences  

S. A. McDonald  
Phase contrast activities at TOMCAT  
CIBM Research Day, Université de Lausanne, Lausanne, Switzerland, 26.11.2008

A. Menzel  
Imaging, Scattering, and Diffraction at the Swiss Light Source  
Seminar, BESSY, Berlin, Germany, 04.08.2008

A. Menzel  
Scanning X-Ray Diffraction Microscopy  
Materials Science Seminar, Argonne National Laboratory, USA, 08.08.2008

K. Müller, A. Scheybal, R. Bertschinger, T. Kim, A. Bendounan, M. Wahl, P. Aebi, T.A. Jung  
Molecular Self-Assembly and Electronic Coupling of Pentacene on Cu(110)  
SLS Symposium on low dimension systems, PSI, Villigen, Switzerland, 01.07.2008

F. Nolting  
Magnetic Imaging  
5th International School on Magnetism and Synchrotron Radiation, Mittelwirr, France, 19-24.10.2008

F. Nolting  
Seeing the "invisible" with X-rays – A close look at magnetic multilayers and individual nanocrystals with spectromicroscopy  
Symposium, Physics Institute, University Basel, Switzerland, 10.-11.09.2008

F. Nolting  
A close Look at Nanomagnets Using Spectromicroscopy  
Seminar, Physics Institute, University Basel, Switzerland, 05.05.2008

F. Nolting  
Seeing the "invisible" with X-rays – Probing antiferromagnets and individual nanoclusters with spectromicroscopy  
Colloquium, Max-Planck-Institut für Metallforschung, Stuttgart, Germany, 28.04.2008

F. Nolting  
A close Look at Nanomagnets Using Spectromicroscopy  

V. Olieric  
Specific and global radiation damage in nucleic acid crystals at 90K and 5K  
Fifth International Workshop on X-ray Damage to Biological Crystalline Samples, Villigen PSI, Switzerland, 03-05.03.2008

V. Olieric  
Advantages of the PILATUS 6M pixel detector  
2008 Meeting of the American Crystallographic Association, 31.05-05.06.2008
C. Padeste
*Functionalization of polymer surfaces with nanoscale resolution by EUV radiation induced polymer grafting.*
4th International Symposium on Nanostructured and Polymer-Based Materials and Nanocomposites. Rome, Italy, 16-18.04.2008

C. Padeste
*Surface nanopatterning and functionalization using extreme ultraviolet interference lithography.*
Bilkent University, Ankara, Turkey, 04.09.2008

L. Patthey
*ARRES and RIXS spectroscopies at Swiss Light Source*
IBM, Rüschlikon, Switzerland, 08.09.2008

S. A. Pauli, P. R. Willmott, C. M. Schlepütz, D. Martoccia, M. Björck
*Surface X-Ray Diffraction of Complex Metal Oxide Interfaces and Surfaces - A New Era*
SXNS-10, 10th International Conference on Surface X-ray and Neutron Scattering, Paris, France, 02-05.07.2008

S. A. Pauli, C. M. Schlepütz, M. Björck, D. Martoccia, P. R. Willmott
*Structural Studies of the Interfaces between Insulating Metal Oxides*
Villa Conference on Complex Oxide Heterostructures, Clermont, USA, 02-06.11.2008

S. A. Pauli, C. M. Schlepütz, M. Björck, D. Martoccia, P. R. Willmott
*Structural Studies of the Interfaces between Insulating Metal Oxides*
53rd Annual Conference on Magnetism and Magnetic Materials, Austin, USA, 10-14.11.2008

F. Pfeiffer
*Biomedical X-Ray Phase Contrast Imaging*
International Interdisciplinary Conference on Biomedical Mathematics, Anshun City, Guizhou Province, China, 2008

F. Pfeiffer
*Coherent X-ray Imaging at Future Hard X-Ray FEL Sources*
International Workshop: Application of Coherent X-rays at the LCLS, Stanford Linear Accelerator, Stanford University, USA, 2008

F. Pfeiffer
*Super-Resolution' Coherent Scanning X-Ray Microscopy*
9th Biannual Conference on High Resolution X-Ray Diffraction and Imaging (XTOP 2008), Linz, Austria, 2008

F. Pfeiffer
*Super-Resolution' Coherent Scanning X-Ray Microscopy*
Congress of the International Union of Crystallography, Osaka, Japan, 2008

F. Pfeiffer
*Super-Resolution' Coherent Scanning X-Ray Microscopy*
Advanced Light Source User Meeting, Berkeley, USA, 2008

F. Pfeiffer
*Coherent X-Ray Imaging and Microscopy for Life Science Applications*
The Zurich Physics Colloquium, ETH Zurich, Switzerland, 2008

F. Pfeiffer
*X-Ray Phase Contrast Imaging for Life Science Applications*
Colloquium, University of Goettingen, Germany, 2008

F. Pfeiffer
*Coherent X-Ray Imaging for Life Science Applications*
Colloquium for Laser Physics, DESY, Hamburg, Germany, 2008

F. Pfeiffer
*X-Ray Phase Contrast Imaging for Life Science Applications*
ANKA Seminar, Forschungszentrum Karlsruhe, Germany, 2008

F. Pfeiffer
*Phase-Contrast and Dark-Field Imaging with X-Ray Synchrotron and Tube Sources*
SPIE International Symposium on Optical Engineering + Applications, San Diego, USA, 2008
F. Pfeiffer
*Introduction to X-ray Focusing*
SPIE International Symposium on Optical Engineering + Applications, San Diego, USA, 2008

F. Pfeiffer
*Coherent X-ray Scanning Diffraction Microscopy*
Heraeus-Seminar ‘Matter in Coherent Light’, Bad Honnef, Germany, 2008

F. Pfeiffer
*Coherent Diffractive Imaging and future Free-Electron Laser Sources*
2nd European X-ray Free-Elektron Laser Users’ Meeting, DESY, Hamburg, Germany, 2008

C. Piamonteze
*X-ray absorption spectroscopy at the Swiss Light Source*
Group Of Inorganic Chemistry and Catalysis, University Of Utrecht, Utrecht, The Netherlands, 04.11.2008

C. Piamonteze
*Absorption Spectroscopy by use of polarized X-rays*
Workshop on X-ray absorption spectroscopy and advanced XAS techniques, 08.10.2008

C. Quitmann
*NanoScience with Synchrotron Radiation*
CCMX Industry Day, EMPA Dübendorf, Switzerland, 02.10.08

C. Quitmann
*The Dance of the Domains*
Colloquium, Univ. Würzburg, Germany, 26.05.2008

C. Quitmann
*Doing Science with Light*
Summer school of the MaMaSelf Programm, Rigi, Switzerland, 15.05.2008

C. Quitmann
*PEEM - Photo Emission Electron Microscopy*
Maxlab summer school, Lund, Sweden, 01.06.2008

C. Quitmann
*Dynamics of mesoscopic magnetic structures*
International Workshop on Time-Resolved X-Ray Dynamics, Dresden, Germany, 05.08.2008

C. Quitmann
*Time resolved X-Ray Microscopy*
Vth International School on Magnetism and Synchrotron Radiation, Mittelwihr, France, 23.10.2008

H. Schift
*Nanofabrication with polymers at PSI – from grafting to molding*
University of Michigan, Ann Arbor, MI, USA, 07.08.2008

H. Schift
*Nanoimprint lithography – stamps (templates), processes and applications*
Workshop on Nanoimprint Lithography, Osaka Prefecture University, Osaka, Japan, 16.10.2008

H. Schift
*3D visualization of mold filling stages in thermal nanoimprint*

H. Schift
*Visualization of mold filling in thermal nanoimprint*
Nanolith08, Second Spanish Workshop on Nanolithography, Bellaterra, Barcelona, Spain, 10-12.11.2008

C. M. Schleputz
*Surface X-Ray Diffraction of Complex Metal Oxide Surfaces and Interfaces - A New Era*
SRMS-6, 6th International Conference on Synchrotron Radiation in Materials Science, Campinas, Brazil, 21-23.07.2008
T. Schmitt, V. Strocov, L. Patthey

Construction and First Results of the ADRESS beamline for Resonant Inelastic X-Ray Scattering and Angular Resolved Photoemission Experiments at the Swiss Light Source
SOLEIL, Paris, France, 06.06.2008

T. Schmitt, V. Strocov, L. Patthey

Construction and First Results of the ADRESS beamline for Resonant Inelastic X-Ray Scattering and Angular Resolved Photoemission Experiments at the Swiss Light Source
Laboratoire de Chimie Physique Matière et Rayonnement, Université Pierre et Marie Curie, Paris, France, 09.06.2008

T. Schmitt

New Opportunities and Perspectives in Soft X-Ray RIXS

T. Schmitt

Scientific opportunities for the new soft X-ray beamline at ESRF – Example: Low dimensional magnetic materials

C. Schulze-Briese

The PILATUS 6M pixel detector - The first year of regular user operation

C. Schulze-Briese

The PILATUS 6M - Protein Crystallography with 6 millions detectors
Annual meeting of the Swiss Society for Crystallography, Zurich, Switzerland, 09.09.2008

C. Schulze-Briese

Fine data from SLS - the PILATUS 6M
9th international school on the crystallography of macromolecular biomolecules, Como, Italy, 30.09.2008

C. Schulze-Briese

Current limitations on Synchrotron based Protein Crystallography
PSI-XFEL Science Workshop on Coherent Diffraction by Nanostructures, Bern, Switzerland, 27.11.2008

M. Shi, J. Mesot

Various Energy Scales in the Electronic Excitation Spectra of HTS as studies by ARPES
Internal Workshop on Superconductivity, unconventional mechanisms and novel materials, Neuchâtel, Switzerland, 15.01.2008

M. Shi, J. Mesot

Electronic and Magnetic Excitations of HTCs Probed by ARPES and Neutron Scattering
22nd General Conference of the Condensed Matter Division of the European Physical Society, Roma, Italy, 25–29.08.2008

H. Sigg

Prospects of Si-based opto electronics exploring interband and intersubband transitions in strained Ge/SiGe/Si quantum structures
4th. Int. SiGe technology and Device Meeting, ISTDM-2008, Hsinchu, Taiwan, 11–14.05.2008

H. Sigg

Si-based opto using strained Ge/SiGe/Si quantum structures
Department of Electrical Engineering, National Taiwan University, Taiwan, 16.05.2008

H. H. Solak

Extreme ultraviolet interference lithography - a tool for extreme nanostructuring
Nano Europe 2008, St Gallen Switzerland, 16-17.09.2008

M. Stampanoni

TOMCAT goes nano nano:broadband phase contrast imaging at a broadband phase contrast imaging at a superbend
Second International Symposium on X-ray Phase Contrast Imaging, Yellow Mountain, Anhui, China, 24-28.03.2008
M. Stampanoni
*X-ray Tomographic Imaging at the Swiss Light Source*
Shanghai Synchrotron Radiation Facility Seminar, Shanghai, China, 31.03.2008

M. Stampanoni
*TOMCAT at SLS: a high-throughput X-ray Tomographic Microscopy beamline*
IMAGE Workshop Forschungszentrum Karlsruhe, Germany 28.04.2008

M. Stampanoni
*High resolution, sensitivity and throughput X-ray Tomographic Microscopy: can we make it?*
SCANCO Users Meeting 2008 - SCANCO'S 20th Birthday, Appenzell, Switzerland, 15–18.05.2008

M. Stampanoni
*Phase contrast imaging at TOMCAT*
SOLEIL 's Tomography Advisory Meeting, Gif sur Yvette, France, 03.09.2008

M. Stampanoni
*Novel approaches towards High-sensitivity and High-resolution X-ray Tomographic Microscopy*
2008 Annual Meeting Swiss Society for Biomedical Engineering, Muttenz, Switzerland, 05.09.2008

M. Stampanoni
*Cutting-edge synchrotron-based tomographic imaging: the TOMCAT experience*
NINA & MIA Brainstorming, ESRF, Grenoble, France, 13-14.11.2008

M. Stampanoni
*Inside-Out: what can synchrotron-based tomographic microscopy do for you*
Seminar Series on Advances in Materials, EPFL, Lausanne, Switzerland, 17.11.2008

M. Stampanoni
*The TOMCAT beamline of the Swiss Light Source*
CIBM Research Day, Université de Lausanne, Lausanne, Switzerland, 26.11.2008

P. Thibault
*High-resolution scanning X-ray diffraction microscopy*
Swiss Federal Institute of Technology (ETHZ) Zurich, Switzerland, 25.11.2008

P. Thibault
*Ptychography at XFEL sources: wavefront and focal spot characterization*
International Workshop on Diffraction Imaging at the European XFEL. Uppsala, Sweden, 21.11.2008

P. Thibault
*High-resolution scanning X-ray diffraction microscopy*
European Synchrotron Radiation Facility, France, 17.11.2008

P. Thibault
*High-resolution scanning X-ray diffraction microscopy*
SOLEIL Synchrotron, France, 07.11.2008

P. Thibault
*Microscopie à balayage par diffraction de rayons X*
9ème Colloque sur les Sources Cohérentes et Incohérentes UV, VUV et X. Dourdan, France, 08.10.2008

P. Thibault
*High-resolution scanning X-ray diffraction microscopy*
9th International Conference on X-ray Microscopy. ETH, Zurich, Switzerland, 22.07.2008

P. Thibault
*Problème des phases et algorithmes itératifs*
Université de Montréal, Canada, 07.06.2008

P. Thibault
*Phase problem and iterative algorithms*
McGill University, Canada, 06.06.2008

P. Thibault
*Scanning X-ray diffraction microscopy*
2nd Symposium on X-ray phase contrast imaging. Huangshan, China, 25.03.2008
P. Thibault  
*Scanning X-ray diffraction microscopy*  
École polytechnique de Lausanne, Switzerland, 03.03.2008

P. Thibault  
*Récents développements en algorithmes de reconstruction*  
Journée d'étude sur la recherche en rayons X cohérents en France. ESRF, Grenoble, France, 23.01.2008

J. F. van der Veen  
*Fluids in confinement – how fluid are they?*  
Oesterreichische Akademie der Wissenschaften, Graz, Austria, 12-14.2.2008

J. F. van der Veen  
*Confined fluids – structure and dynamics*  
Research course ,new materials in new light, Hasylab DESY, Hamburg, Germany, 05-07.3.2008

P. R. Willmott, S. A. Pauli, C. M. Schlepütz, M. Björck  
*Structural basis for the conducting interface between SrTiO$_3$ and LaAlO$_3*  
Swiss Physics Society and MaNEP Meeting, Geneva, Switzerland, 26-27.03.2008

P. R. Willmott, S. A. Pauli, C. M. Schlepütz, D. Martoccia, M. Björck  
*Surface X-Ray Diffraction of Complex Metal Oxide Interfaces and Surfaces - A New Era*  
ICSOS-9, 9th International Conference on the Structure of Surfaces, Salvador, Brazil, 03-08.08.2008

**ORAL PRESENTATIONS**

B. P. Andreasson, M. Janousch, U. Staub, G. I. Meijer  
*Spatial evolution of oxygen vacancies in Cr-doped SrTiO$_3$ during the insulator-to-metal transition in electric fields*  
Annual Meeting of the Swiss Physical Society, Geneva, Switzerland, 26-27.03.2008

B. P. Andreasson, M. Janousch, U. Staub, G. I. Meijer  
*In situ defect microscopy during the electric-field-driven insulator-to-metal transition in Cr: SrTiO$_3$*  
33rd European Conference on X-Ray Spectrometry, Cavtat, Dubrovnik, Croatia, 16-20.06.2008

V. Azelyte, P. Sahoo, M. Saidani, A. Weber, H.H. Solak  
*Advances in resist testing at PSI EUV-IL exposure tool*  
2008 International EUVL Symposium, Lake Tahoe, California, USA, 28.09.–01.10.2008

P. Beaud, S. L. Johnson, C. J. Milne, F. Krasniqi, E. Vorobeva, G. Ingold  
*Atomic Motion in Laser Excited Bismuth Studied with Femtosecond X-ray Diffraction*  
XVI International Conference on Ultrafast Phenomena, Stresa, Italy, 9-13.06.2008

A. Bergamaschi, A. Cervellino, R. Dinapoli, F. Gozzo, B. Henrich, I. Johnson, P. Kraft, A. Mozzanica, B. Schmitt, X. Shi  
*Photon counting microstrip detector for time resolved powder diffraction experiments*  
8th International Conference on Position Sensitive Detectors PSD8, University of Glasgow, Scotland, 01-05.09.2008

M. Björck  
*A new direct method for surface x-ray diffraction*  
“Scattering weekend in the Rhine Valley”, St. Goarshausen, Germany, 24-25.05.2008

Y. Bodenthin, U. Staub, M. García-Fernández  
*Exciting magnetic moments by an electric field in multiferroic ErMn$_2$O$_5*  
XRMOS 2008 Workshop, Hamburg, Germany, 23.-24.01.2008

*Manipulating the magnetic structure by electric fields in multiferroic ErMn$_2$O$_5*  
Highly Frustrated Magnetism 2008, Braunschweig, Germany, 07-12.09.2008

Controlled engineering of patterned surfaces via self-assembly of organic building blocks in UHV

Midterm Meeting of the EU Marie Curie RTN PRAIRIES, Stresa, Italy, 04.2008

O. Brunke, K. Brockdorf, S. Drews, B. Müller, T. Donath, J. Herzen, F. Beckmann

Comparison between x-ray tube-based and synchrotron radiation-based μCT

SPIE 7078 - Developments in X-Ray Tomography VI, San Diego, USA 12-14.08.2008

J. Chang, M. Shi

Study of low- and high-electronic responses in high-temperature superconductors

Annual Meeting of the Swiss Physical Society, Geneva, Switzerland, 26–27.03.2008


Photoluminescence studies of SiGe quantum dot arrays prepared by templated self assembly

Nanoelectronic Days, Aachen, Germany, 13-16.05.2008

C. David, K. Jefimovs, J. Vila-Comamala, T. Pilvi, M. Ritala, G. Tzvetkov, J. Raabe, R. Fink

Fabrication of line-doubled optics for ultra-high resolution x-ray microscopy


C. David, K. Jefimovs, J. Vila-Comamala, T. Pilvi, M. Ritala, G. Tzvetkov, J. Raabe

Towards 10 nm resolution in x-ray microscopy


A. Diaz, C. Mocuta, J. Stangl, V. Chamard, J. Vila-Comamala, C. David, T. H. Metzger, G. Bauer

Towards coherent diffraction imaging of single epitaxial nanostructures


A. Diaz, C. Mocuta, J. Stangl, V. Chamard, J. Vila-Comamala, C. David, T. H. Metzger, G. Bauer

Applications of Coherent Diffraction to Semiconductor Nanostructures

PSI-XFEL Science Workshop on Coherent Diffraction by Nanostructures, Bern, Switzerland, 27.11.2008

H. Dil, F. Meier, J. Lobo-Checa, L. Patthey and J. Osterwalder

Understanding and tuning the electron spin at surfaces

3S08 - SYMPOSIUM ON SURFACE SCIENCE 2008, St. Christoph, Austria, 07.03.2008

H. Dil

Measuring the local electrostatic potential in nanostructures with PAX

tolCHsurf Ill, Bern, Switzerland, 10.06.2008

H. Dil, F. Meier, J. Lobo-Checa, L. Patthey, G. Bihlmayer and J. Osterwalder

Rashba type spin orbit splitting in Pb QWS

ECOSS 25 Liverpool, UK, 28.07.2008

T. Donath, F. Pfeiffer, O. Bunk, W. Groot, M. Bednarzik, C. Grünzweig, E. Hempel, S. Popescu, M. Hoheisel, C. David

Phase-contrast imaging and tomography at 60 keV using a conventional x-ray tube

SPIE 7078 - Developments in X-Ray Tomography VI, San Diego, USA 12-14.08.2008


Control over supramolecular assemblies by rational modification of alkoxy substituents on phthalocyanine derivatives

SAOG meeting, Fribourg, Switzerland, 01.2008


Ordered 2D assemblies of phenoxy substituted phthalocyanines as hosts for further guest molecules

25th European Conference on Surface Science (ECOSS), Liverpool, UK, 08.2008

M. Enache, N. Wintjes, J. Lobo-Checa, J. Hornung, T. Samuely, F. Diederich, T.A. Jung

Bimolecular porphyrin systems on metallic substrates

Workshop of the EU Marie Curie RTN PRAIRIES, Ciudad Real, Spain, 09.2008

*Nanoscale Observation of Order Parameter Coupling in Multiferroic BiFeO3 Thin Films*

Annual Meeting of the Swiss Physical Society 2008, Genève, Switzerland, 26-27.03.2008

A. Fraile Rodríguez, F. Nolting, A. Kleibert, J. Bansmann

*Application of x-ray spectromicroscopy to the study of magnetic properties of single nanoparticles*

6th International Workshop on LEEM-PEEM (LEEMPEEM6), Trieste, Italy, 07-11.09.2008

A. Fraile Rodríguez, A. Kleibert, F. Nolting, J. Bansmann

*Application of x-ray spectromicroscopy to the study of magnetic properties of single nanoparticles*


M. R. Fuchs

*The SLS experience with cryogenic sample mounting and in-situ screening with the CATS sample changer*


*Photo-field emission source for free electron laser applications*

The 7th International Vacuum Electron Sources Conference, London, UK, 03-06.08.2008


*Three dimensional Si/Ge quantum dot crystals with small periodicities*

International conference on superlattices, nanostructures and nanodevices, Natal, Brazil, 03-08.08.2008

S. M. Gutmann

*Optimal data collection temperature for macromolecular crystallography*

RD5: Fifth International Workshop on X-ray Damage to Biological Crystalline Samples, PSI, Villigen, Switzerland, 03-05.03.08


*SRT study of crack propagation within laser-welded aluminum-alloy T-joints*

SPIE 7078 - Developments in X-Ray Tomography VI, San Diego, USA 12-14.08.2008

L.J. Heyderman, E. Mengottia, A. Fraile Rodríguez, Frithjof Nolting, A. Bisig, H.-B. Braun

*Magnetic configurations in artificial kagome ice structures*

53rd Annual Conference on Magnetism and Magnetic Materials, MMM 2008, Austin, USA, 10-14.11.2008


*The XAS beamlines at the SLS. XAS workshop*

PSI, Villigen, Switzerland, 07-08.10.2008

S.L. Johnson, P. Beaud, G. Ingold, U. Staub

*Pump-Probe Resonant X-ray Diffraction: Possibilities for FLASH*

FLASH User Workshop, Hamburg, Germany, 08-10.09.2008

M. Kerbrat, T. Huthwelker, M. Ammann

*Interaction de l’acide nitreux (HONO) avec la glace : Adsorption à la surface et diffusion dans le volume*

Conférence annuelle de cinétique et de Photochimie, Strasbourg, France, 09-10.06.2008

M. Kerbrat, T. Huthwelker, M. Ammann

*Co-adsorption of nitrous and acetic acid on ice*

M. Kerbrat, T. Huthwelker and M. Ammann
*Co-Adsorption of gaseous acids on ice: nitrous and acetic acid*
AICI-HiT Workshop "Ice and Halogens: Laboratory Studies to Improve the Modelling of Field Data". British Antarctic Survey, Cambridge, UK, 16-18.06.2008

M. Kerbrat, M. Pinzer, T. Huthwelker, M. Schneebeili, M. Ammann
*Laboratory studies of the diffusivity of NOx and HONO in Snow*
Atmospheric Chemical Mechanisms, University of California, Davis, USA, 10-12.12.2008

M. Kerbrat, M. Pinzer, B., T. Huthwelker, T. Schneebeili, M. Ammann
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C. Pradervand  
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J.F. van der Veen
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Visit ETH Ratspräsident Schiesser, PSI, Villigen Switzerland, 04.02.2008

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J.F. van der Veen
Introduction to the SLS
Visit Mr. M. van der Rest, CEO of French Synchrotron SOLEIL, PSI, Villigen, Switzerland, 28.04.2008

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SAAB (Prof. Dr. Billy Fredriksson, Dr. Magnus Ahlström), PSI, Villigen, Switzerland, 26.05.2008

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IBM (Scientific Director Paul Seidler and Science and Technology managers), PSI, Villigen, Switzerland, 04.06.2008

J.F. van der Veen
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Seminar Institute for Atmosphere and Climate, ETH, Zürich, Switzerland, 14.03.2008

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Seminar PSI/Uni Bern, PSI, Villigen, Switzerland, 09.05.2008

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AICl-HiT Workshop "Ice and Halogens: Laboratory Studies to Improve the Modelling of Field Data". British Antarctic Survey, Cambridge, UK, 16-18.06.2008
T. Bartels-Rausch, T. Huthwelker, I.T. Zimmermann, M. Ammann

*Interaction of peroxynitrile acid with ice surfaces*


M. Bednarzlik, M. Saidani, B. Keusch, H. H. Solak, H. Schift, C. Spreu, J. Gobrecht

*Stitching Free High Resolution Stamps for Molding Techniques with EUV Interference Lithography*


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*Doping of few monolayers thin film transistors: charge carrier density and injection properties*

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*Determination of Liquid Water Distribution in Porous Transport Layers*

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A. Fraile Rodríguez, F. Nolting, A. Kleibert, J. Bansmann
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*Pilatus: a single photon counting Pixel detector for x-ray applications*
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*Differential phase contrast – new imaging method for HARWI-II beamline at DESY using hard x-ray grating interferometer*
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L. Holzer, B. Muench, P. Tritik, F. Marone, M. Stampanoni
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T. Huthwelker, A. Krepelová, V. Zelenay, M. Janousch, M. Ammann
Is NaCl in a frozen solution in a solid or liquid state?
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Development of metallic field emitter arrays with individual focusing electrodes for high-brightness, low-emittance cathode

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Workshop on X-ray absorption spectroscopy and advanced XAS techniques, Paul Scherrer Institut, Villigen, Switzerland, 06-10.10.2008

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K. Mader, R. Müller, J.P. Thiran, M. Stampanoni
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A. Retolaza, S. Merino, V. Trabadelo, P. Heredia, C. Morales, J.A. Alduncín, D. Mecerreyes, H. Schift, C. Padeste
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J. Vila-Comamala, K. Jefimovs, M. Stampanoni, B. Kaulich, C. David

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*Molecular recognition on surfaces: controlling dimensionality and periodicity of supramolecular tetraarylporphyrin assemblies by the interplay of cyano and alkoxy substituents*

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V. Zelenay, A. Křepelová, M. Birrer, M.G.C. Vernooij, M. Ammann, G. Tzvetkov, J. Raabe, T. Huthwelker

*A new device for the Study of water uptake and release in aerosol particles using x-ray microspectroscopy*

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V. Zelenay, A. Křepelová, M. Ammann, M.G.C. Vernooij, M. Birrer, R. Chirico, G. Tritschler, G. Tzvetkov, J. Raabe, T. Huthwelker

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3rd International Workshop on Approaches to Single-Cell Analysis, Zürich, Switzerland, 11-12.09.2008

**WORKSHOPS AND CONFERENCES**

A. Fraile Rodríguez

*Co-organization of a Special Session on Multiferroics at the Annual meeting of the Swiss Physical Society 2008*

Genève, Switzerland, 26-27.03.2008

F. Gozzo

*Structure Determination from Powder Diffraction Data: A Hands-on Workshop on X-Rays, Synchrotron Radiation and Neutron Techniques*

Paul Scherrer Institute, Switzerland, 18-22.06.2008

F. Gozzo

*MS-12 Mycrosymposium “Instrumentation: synchrotron, neutron and Laboratory”*

11th European Powder Diffraction International Conference (EPDIC-11)

Warsaw, Poland, 21-23.09.2008

C. Quitmann, C. David, F. Nolting, M. Stampanoni, F. Pfeiffer

*9th International Conference on X-Ray Microscopy (XRM2008)*

Zürich, Switzerland, 21-25.07.2008

C. Schulze-Briese

*Workshop on X-ray Damage to Biological Crystalline Samples*

Paul Scherrer Institut, Villigen, Switzerland, 03-05.03.2008
U. Staub  
*Co-organization of a Special Session on Multiferroics at the Annual meeting of the Swiss Physical Society 2008*  
Genève, Switzerland, 26-27.03.2008

**PUBLIC RELATIONS**

R. Abela  
- SLS - Ein riesiges Mikroskop: Wie funktioniert die SLS: brillantes Licht aus beschleunigten Elektronen, Oral Presentation for the 20 years of PSI, Baden, Switzerland, 22.08.2008

A. Fraile Rodriguez  
- Presentation at the "Showstation 1 Bühne" during the "Tage der offenen Türe", Paul Scherrer Institut, Villigen, Switzerland, 25.-26.10.2008

J. Gobrecht  
- Project reports on applied nanoscience, Industry day 2008, Swiss Nanoscience Institute, Mutteln, Switzerland, 26.02.2008  
- Physik zwischen Atomen und Alltagswelt, Forscher im Zelt, Waldshut, Germany, 27–31.08.2008  
- Science Fiction wird Realität – dank Nanotechnologie?, TecDay@Kanti Baden, Kantonsschule, Baden, Switzerland, 09.10.2008  
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T.A. Jung  
- “Stoff für Forscher und Science-Fiction-Autoren”, Beate Peiseler Sutter, Beitrag über das Swiss Nanoscience Institute in der Chemischen Rundschau, Ausgabe Nr. 10, 10.2008

F. Marone  
- Nanostrukturen: Physik zwischen Atomen und Alltagswelt, Forschende im Zelt, Aarau, Switzerland, 22.08.2008  
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L. Patthey  
- SLS - Ein riesiges Mikroskop: Wie funktioniert die SLS: brillantes Licht aus beschleunigten Elektronen, Oral Presentation for the 20 years of PSI, Aarau, Switzerland, 22.08.2008

F. Pfeiffer  
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C. Quitmann
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H. Schift
- *A precious envelope for budding scientists - an educational film on new fabrication techniques at the nanometric scale*, Animation movie in the framework of the European NaPa project, duration 16 min, director F. Grimal, author C. Cartaillec, production Héladon (Toulouse, France), Multilingual DVD (French, English, German), compiled by H. Schift; available in PSI Forum

M. Stampanoni
- Un viaggio al Paul Scherrer Institut, Live guest at the “Il giardino di Albert”, Televizione della Svizzera Italiana, 07.01.2008

**DISSERTATIONS**

L.J. Heyderman
- Spin structure of domain walls and their behaviour in applied fields and currents
  D. Backes, University of Konstanz, Germany, (2008)

C. Padeste
- Synchrotron Radiation Grafting: a lithographic method to create polymer micro- and nanostuctures.
  P. Farquett, ETH Zürich, Switzerland, (2008)

L. Patthey
- Angle- and spin-resolved photoemission on La23Sr10MnO3
  J. Krempasky, Université de Cergy-Pontoise, France, (2008)

**AWARDS**


F. Pfeiffer, National Latsis Award of Switzerland, 2008

P. Thibault, Werner Meyer-Ilse Memorial Award, X-ray Microscopy Conference, 23.07.2008

**MEMBERSHIPS IN EXTERNAL COMMITTEES**

R. Abela
- Chairman of the Scientific Advisory Committee, ESRF, France
- Chairman of the Council of the Swiss Norwegian Foundation for Research with X-Rays
- Member of the Scientific Advisory Committee of Diamond, UK

C. David
- Member of the International Program Committee of the Micro- and Nano-Engineering Conference 2007
- Member of the International Consortium for Coherent X-ray Diffractive Imaging (ICCDXI)
- Member of the Scientific Advisory Board of the Courant Research Centre "Nano-Spectroscopy and X-ray Imaging", University of Göttingen, Germany
- Member of the Editorial Board of the Journal of X-ray Optics and Instrumentation
- Member of the International Program Committee of the X-Ray Microscopy Conference Series
- Member of the International Advisory Committee of the Photon Conference Series

J. Gobrecht
- Head of the Institute of Polymer Nanotechnology, University of Applied Sciences Nordwestschweiz, Brugg/Windisch, Switzerland
- Vice Director Technology of the Swiss Nanoscience Institute at the University of Basel
- Member of the board of the Swiss Micro- and Nanotechnology Network
- Member of the nomination committee for the Nano Argovia professorship on quantum optics at the University of Basel
- Member of the management team of the Matlife ERU, CCMX Program of the ETH domain
- Member of the Scientific Advisory Board, HeiQ Materials AG, Bad Zurzach, Switzerland
- External thesis reviewer and member of the board of examiners for the PhD of Dirk Backes, Physics dept., University of Konstanz, 2008
- External thesis reviewer and member of the board of examiners for the PhD of Jean Baptiste Orhan, Microtechnology dept., EPFL Lausanne, 2008
- Member of the advisory board of the Nano-Europe Conference, St. Gallen, Switzerland, Sept. 16-17, 2008
- Member of the board of directors, Eulitha AG, 5232 Villigen PSI
- Member of the jury for the “Nano-Prize 2008” of the “Erwin Schrödinger Gesellschaft für Nanowissenschaften”, Vienna, Austria
- Member of the jury for the “Förderpreis für Jungunternehmen” of the “W. A. de Vigier Foundation”, Solothurn, Switzerland

F. Gozzo
- Powder Diffraction beamline Expert – Beamlines Coordinator Meeting, SESAME (Synchrotron light for Experimental Sci. & Appl. in the Middle East) Project, c/o UNESCO Amman Office, Amman, Jordan
- Member of the Commission of Instrumentation and Computing, Italian Crystallography Association

L.J. Heyderman
- Intermag 2008 Program Committee
- Member of the Technical Committee of the IEEE Magnetics Society
- MNE2008, International Program Committee

T.A. Jung
- Jung Zukunft Bildung Schweiz Thinktank der Akademien Schweiz, 2008

F. Nolting
- Member of the Proposal Review Committee of Soleil, France
- Member of DEIMOS beamline review committee, Soleil, France
- Scientific Committee of the 5th International school on Synchrotron Radiation and Magnetism 2008, Mittelwirh (France)
- Member of the organisation team for the 9th International Conference on X-ray Microscopy, Zürich, 21-25.7.2008
- Member of the PhD Thesis committee, Loic Le Guyader, University of Nijmegen, The Netherlands, 2.4.2008

L. Patthey
- Chairman of the Local Organisation Committee, CORPES-09 workshop
- Member of the International Program Committee, CORPES-09 workshop

F. Pfeiffer
- Member of the scientific advisory committee for the first International Workshop on Single Particle Diffractive Imaging at the future EU-XFEL sources, Uppsala, Sweden, November 2008
- Member of the scientific proposal review committee for the European Synchrotron Radiation Facility (Grenoble/ France), the National Synchrotron Light Source in Taiwan, and the Spallation Neutron Source (Oak Ridge/US)

C. Quitmann
- Member of the Diamond Scientific Advisory Committee
- Member of the Editorial Board, Journal of Physics Condensed Matter, Surface and Interface section
- Member Nanoscience Beamline Review Panel, Diamond

H. Schift
- AVS American Vacuum Society, NSTD Nanometer-scale Science and Technology Division, elected board and executive committee member

C. Schulze-Briese
- APS Renewal Workshop, APS, ANL, USA
- ESRF Upgrade Programme - UPBL brainstorming session, Grenoble, France
- ESRF Beamline Review Committee (ID11), Grenoble, France
- ESRF Methods & Instrumentation Proposal Review Committee, Grenoble, France
- EMBL@PETRA3 Scientific Advisory Board, Hamburg, Germany
- IUCR 2008, Chairman of ‘Recent Progress in Data Collection Session, Osaka, Japan

U. Staub
- Member of the Executive Committee of the Swiss Physical Society representing condensed Matter

M. Stamparoni
- Member of the steering committee of the Zurich Center for Imaging Science and Technology (CIMST)

J. F. van der Veen
- Science Advisory Committee of Elettra, Trieste
- Scientific Committee for Inorganic and Analytical Chemistry, Science Foundation, Flanders, Belgium
- Chairman of Programme Committee of PSI Summer School on Condensed Matter Research, Zuoz, Switzerland
- Scientific Advisory Committee of HERCULES, Grenoble.
- Chairman of Science Advisory Committee of the Advanced Light Source, Berkeley, USA
- International Advisory Committee of the International Conference Series on Synchrotron Radiation Instrumentation
- Science Advisory Committee of Synchrotron SOLEIL, Gif-sur-Yvette, France
- Advisory Committee of the International Conference Series on Surface X-Ray and Neutron Scattering
- Steering Committee CCMX, Competence Centre for Materials Science and Technology, ETH, Switzerland
- Steering Committee NCCBI, National Competence Center in Biomedical Imagine, ETH, Switzerland
- Science Advisory Committee for the Van der Waals-Zeeman Instituut, University of Amsterdam, The Netherlands
- Advisory Board ‘Structure of Matter’, Forschungszentrum Karlsruhe, Germany
- Member of Committee advising the Bundesministerium für Bildung und Forschung (BMBF) on research with photons in Germany
- Science Advisory Committee of National Synchrotron Radiation Research Center, Hsinchu, Taiwan

P. R. Willmott
- Member of the Committee of the Future of the SNBL Beamline, ESRF

PATENTS

C. David, T. Donath, E. Hempel, M. Hoheisel, F. Pfeiffer, S. Popescu
*Röntgen CT-System zur Röntgen Phasenkontrast- und/oder Röntgen-Dunkelfeld-Bildgebung*
European Patent Application No. 08017240.6

D. Chrastina, H. Sigg, T. Soichiro, H. von Känel
*Semiconductor quantum well structure for optoelectronic device*
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K. Clausen
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Todorova T, Delley B
The Creutz-Taube Complex Revisited: DFT Study of the Infrared Frequencies
INORGANIC CHEMISTRY 47, 11269 (2008)

Vernay F, Moritz B, Elfimov IS, Geck J, Hawthorn D, Devereaux TP, Sawatzky GA
CuK-edge resonant inelastic x-ray scattering in edge-sharing cuprates
PHYSICAL REVIEW B 77, 104519 (2008)

Zhang H, Soon A, Delley B, Stampfl C
Aluminium adsorption on Ir(111) at a quarter monolayer coverage: A first-principles study
APPLIED SURFACE SCIENCE 254, 7655 (2008)

Zhang H, Soon A, Delley B, Stampfl C
Stability, structure, and electronic properties of chemisorbed oxygen and thin surface oxides on Ir(111)
PHYSICAL REVIEW B 78, 045436 (2008)
CONFERENCE, WORKSHOP AND SEMINAR CONTRIBUTIONS

Chr. Mudry
*Delocalization Transitions and Multifractality*
A Satellite Meeting at Gregynog Hall, University of Wales, November 2-6, 2008.

Chr. Mudry
*Mathematics and Physics of Anderson localization: 50 Years After Delocalization Transitions and Multifractality,*

Chr. Mudry
*Exact Results in Low-Dimensional Quantum Systems:*
2nd INSTANS Summer Conference, Galileo Galilei Institute for Theoretical Physics, University of Florence, September 08 - 12, 2008.

Chr. Mudry
*Probing the Nanometer Scale with Neutrons, Photons and Muons*
7th PSI Summer School on Condensed Matter Research, 16-22 August 2008, Lyceum Alpinum Zuoz, Switzerland.

Chr. Mudry

PROCEEDINGS

*The Cu/ZnO(0001) Surface under Oxidative and Reducing Conditions: A First-principles Study*
APS March meeting New Orleans Mar 12
BAPS: P21.00007

B. Delley and T. Todorova
*Molecular Crystals, a Test System for Weak Bonding*
APS March meeting New Orleans Mar 12
BAPS: Q13.00005

INVITED TALKS

Kurt Clausen
*Fission, Spallation or Fusion-based neutron sources*
International symposium of Neutron scattering, Mumbai, India, 15-18 January 2008

Kurt Clausen
*Neutron scattering: properties, status and perspectives*

B. Delley
*Quantum mechanics for molecules, surfaces and solids*
Feb 5 Chemisches Colloquium Uni. Hamburg

B. Delley
*An overview of electronic structure calculations with DMol³*
Apr 3 Colloquium Nanotek Institute, Bangkok
B. Delley
*DMol³ applications from molecules to surfaces and solids*
Aug 26  FPLO-Workshop Dresden

B. Delley
*An overview of electronic structure calculations with DMol³*
Mar 30 Thailand Electronic Structure Workshop, at University Ubon Rachathani

B. Delley
*An overview of electronic structure calculations with DMol³*
Apr 15 ETHZ

Chr. Mudry
*Quantum transport of 2D Dirac fermions: The case for a topological metal, Delocalization Transitions and Multifractality*
Satellite Meeting at Gregynog Hall, University of Wales, 2008

Chr. Mudry
*Electron fractionalization in two-dimensional graphene-like structures*
National Seminar Condensed Matter Physics, Dutch Research School of Theoretical Physics, 2008

Chr. Mudry
*Electron fractionalization in two-dimensional graphene-like structures*
Workshop on Exact Results in Low-Dimensional Quantum Systems: 2nd INSTANS Summer Conference, Galileo Galilei Institute for Theoretical Physics, University of Florence, 2008

Chr. Mudry
*Introduction to the physics of graphene*
7th PSI Summer School on Condensed Matter Research, 16-22 August 2008 Lyceum alpinum Zuoz, Switzerland

Chr. Mudry
*Quantum transport of 2D Dirac fermions: The case for a topological metal*
WE Heraeus Seminar: Network Models in Quantum Physics, at Jacobs University Bremen, 2008

Chr. Mudry
*Quantum transport of 2D Dirac fermions: The case for a topological metal*

Chr. Mudry
*Electron fractionalization in two-dimensional graphene-like structures*
University of Warwick, October 2008.

Chr. Mudry
*Freezing transition in a problem of Anderson localization*
Cambridge University, October 2008

Chr. Mudry
*Electron fractionalization in two-dimensional graphene-like structures*
Instituto de Ciencia de Materiales de Madrid (ICMM), March 2008.

**LECTURES AND COURSES**

Dr. Christopher Mudry
- Visiting Fellowship, Isaac Newton Institute for Mathematical Sciences, University of Cambridge, UK.
- Visiting Research Scholar, Boston University, USA.
MEMBERSHIP IN EXTERNAL COMMITTEES

Dr. K. Clausen
- Member of the ESS-Scandinavia Science Group (since 2004)
- Member of the Board of NMI3 (since 2004)
- Member of the Scientific Selection Panel of the Berlin Neutron Scattering Centre (since 2005)
- Member of the Science Program Advisory Council for Condensed Matter Physics and Nanoelectronics at Research Centre Jülich, Germany (since 2006)
- Chairman of the BENSC Instrument Committee (since 2006)
- International Advisory Committee for The RIKEN-RAL Muon Facility

Dr. B. Delley
- Advisory Board Electronic Structure Theory, EMRS conference series
- Psi-K network local orbital topical group
- PSI-Forschungs Komission
Condensed Matter Research with Neutrons and Muons

Spallation Neutron Source Division (ASQ)

LIST OF PUBLICATIONS (PEER REVIEWED)

Prediction of capillary hysteresis in a porous material using lattice-Boltzmann methods and
comparison to experimental data and a morphological pore network model
ADVANCES IN WATER RESOURCES 31, 1151 (2008)

Appleby GA, Vontobel P
Optimisation of lithium borate-barium chloride glass-ceramic thermal neutron imaging plates
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-
ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 594,
253 (2008)

Aswal VK, Van den Brandt B, Hautle P, Kohlbrecher J, Konter JA, Michels A, Piegsa FM,
Stahn J, Van Petegem S, Zimmer O
Characterisation of the polarised neutron beam at the small angle scattering instrument
SANS-I with a polarised proton target
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-
ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 586,
86 (2008)

Bitzek E, Brandl C, Derlet PM, Van Swygenhoven H
Dislocation cross-slip in nanocrystalline fcc metals
PHYSICAL REVIEW LETTERS 100, 235501 (2008)

Bitzek E, Derlet PM, Anderson PM, Van Swygenhoven H
The stress-strain response of nanocrystalline metals: A statistical analysis of atomistic
simulations
ACTA MATERIALIA 56, 4846 (2008)

A, Shin Y, Tortorella D, Wohlmuther M, Young AR, Zejma J, Zsigmond G
Cold Neutron Energy Dependent Production of Ultracold Neutrons in Solid Deuterium
(vol 99, art no 262502, 2007).
PHYSICAL REVIEW LETTERS 101, 189902 (2008)

Tasaki Y, Shinohara K
In situ observation of the water distribution across a PEFC using high resolution neutron
radiography
ELECTROCHEMISTRY COMMUNICATIONS 10, 546 (2008)

Transient observation of H-2 labeled species in an operating PEFC using neutron radiography
ELECTROCHEMISTRY COMMUNICATIONS 10, 1311 (2008)
Brandstetter S, Derlet PM, Van Petegem S, Van Swygenhoven H
*Williamson-Hall anisotropy in nanocrystalline metals: X-ray diffraction experiments and atomistic simulations*
ACTA MATERIALIA **56**, 165 (2008)

Brandstetter S, Zhang K, Escuadro A, Weertman JR, Van Swygenhoven H
*Grain coarsening during compression of bulk nanocrystalline nickel and copper*
SCRIPTA MATERIALIA **58**, 61 (2008)

*Unsaturated water flow across soil aggregate contacts*
ADVANCES IN WATER RESOURCES **31**, 1221 (2008)

Cnudde V, Dierick M, Vlassenbroeck J, Masschaele B, Lehmann E, Jacobs P, Van Hoorebeke L
*High-speed neutron radiography for monitoring the water absorption by capillarity in porous materials*
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION B-BEAM INTERACTIONS WITH MATERIALS AND ATOMS **266**, 155 (2008)

Conesa HM, Moradi AB, Robinson BH, Kuehne G, Lehmann E, Schulin R
*Response of native grasses and Cicer arietinum to soil polluted with mining wastes: Implications for the management of land adjacent to mine sites*
ENVIRONMENTAL AND EXPERIMENTAL BOTANY in press, - (2008)

Dai Y, Egeland GW, Long B
*Tensile properties of EC316LN irradiated in SINQ to 20 dpa*

Dai Y, Gavillet D, Restani R
*Stressed capsules of austenitic and martensitic steels irradiated in SINQ Target-4 in contact with liquid lead-bismuth eutectic*

Dai Y, Long B, Tong ZF
*Tensile properties of ferritic/martensitic steels irradiated in STIP-I*

Dementjev S, Groeschel F, Jekabsons N
*MEGAPIE project, experience of electromagnetic pumps operation in the swiss spallation neutron source.*
MAGNETOHYDRODYNAMICS **44**, 97 (2008)

Diaconis P, Lehmann E
*On Student's 1908 article - "The Probable Error of a Mean" - Comment*

Dudarev SL, Bullough R, Derlet PM
*Effect of the alpha-gamma phase transition on the stability of dislocation loops in bcc iron*
PHYSICAL REVIEW LETTERS **100**, 135503 (2008)

Elsener A, Politano O, Derlet PM, Van Swygenhoven H
*A local chemical potential approach within the variable charge method formalism*
MODELLING AND SIMULATION IN MATERIALS SCIENCE AND ENGINEERING **16**, 025006 (2008)

Grotzbach G, Milenkovic R, Latge C, Knebel JU
*The MEGAPIE-TEST project: Supporting research and lessons learned in first-of-a-kind spallation target technology*
NUCLEAR ENGINEERING AND DESIGN 238, 1471 (2008)

Gavillet D, Martin M, Dai Y
*SIMS investigation of the spallation and transmutation products production in lead*

Gilbert MR, Dudarev SL, Derlet PM, Pettifor DG
*Structure and metastability of mesoscopic vacancy and interstitial loop defects in iron and tungsten*
JOURNAL OF PHYSICS-CONDENSED MATTER 20, 345214 (2008)

Giller L, Filges U, Kuehne G, Wohlmuther M, Zanini L
*Validation of Monte-Carlo simulations with measurements at the ICON beam-line at SINQ*
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 586, 59 (2008)

*Quantification of hydrogen uptake of steam-oxidized zirconium alloys by means of neutron radiography*
JOURNAL OF PHYSICS-CONDENSED MATTER 20, 104263 (2008)

Grosse M, Steinbrueck M, Lehmann E, Vontobel P
*Kinetics of hydrogen absorption and release in zirconium alloys during steam oxidation*
OXIDATION OF METALS 70, 149 (2008)

*Neutron decoherence imaging for visualizing bulk magnetic domain structures*
PHYSICAL REVIEW LETTERS 101, 025504 (2008)

*Bulk magnetic domain structures visualized by neutron dark-field imaging*
APPLIED PHYSICS LETTERS 93, 112504 (2008)

Grunzweig C, Pfeiffer F, Bunk O, Donath T, Kuhne G, Frei G, Dierolf M, David C
*Design, fabrication, and characterization of diffraction gratings for neutron phase contrast imaging*
REVIEW OF SCIENTIFIC INSTRUMENTS 79, 053703 (2008)

Henry J, Averty X, Dai Y, Pizzanelli JP
*Tensile behaviour of 9Cr-1Mo tempered martensitic steels irradiated up to 20 dpa in a spallation environment*
JOURNAL OF NUCLEAR MATERIALS 377, 80 (2008)

Kaestner A, Lehmann E, Stampanoni M
*Imaging and image processing in porous media research*
ADVANCES IN WATER RESOURCES 31, 1174 (2008)

*Assessment of structural evolution of aggregated soil using neutron tomography*
WATER RESOURCES RESEARCH 44, W00C07 (2008)

Kurizlach J, Melikhova O, Hou M, Van Petegem S, Zhurkin E, Sob M
*Positron annihilation in vacancies at grain boundaries in metals*
APPLIED SURFACE SCIENCE 255, 128 (2008)

Lehmann E
Recent improvements in the methodology of neutron imaging
PRAMANA-JOURNAL OF PHYSICS 71, 653 (2008)

Impact of geometrical properties on permeability and fluid phase distribution in porous media
ADVANCES IN WATER RESOURCES 31, 1188 (2008)

Long B, Dai Y
Investigation of LBE embrittlement effects on the fracture properties of T91
JOURNAL OF NUCLEAR MATERIALS 376, 341 (2008)

Long B, Tong Z, Groschel F, Dai Y
Liquid Pb-Bi embrittlement effects on the T91 steel after different heat treatments

Maass R, Van Petegem S, Grolimund D, Van Swygenhoven H, Kiener D, Dehm G
Crystal rotation in Cu single crystal micropillars: In situ Laue and electron backscatter diffraction
APPLIED PHYSICS LETTERS 92, 071905 (2008)

Maass R, Van Petegem S, Zimmermann J, Borca CN, Van Swygenhoven H
On the initial microstructure of metallic micropillars
SCRIPTA MATERIALIA 59, 471 (2008)

Direct TEM observation of nanometric-sized defects in neutron-irradiated MgB2 bulk and their effect on pinning mechanisms
SUPERCONDUCTOR SCIENCE & TECHNOLOGY 21, 012001 (2008)

Probing the electron-phonon coupling in MgB2 through magnetoresistance measurements in neutron irradiated thin films
EPL 81, 67006 (2008)

Moradi AB, Conesa HM, Robinson BH, Lehmann E, Kuehne G, Kaestner A, Schulin R
Neutron radiography as a tool for revealing root development in soil: capabilities and limitations
PLANT AND SOIL in press, - (2008)

Oswald SE, Menon M, Carminati A, Vontobel P, Lehmann E, Schulin R
Quantitative imaging of infiltration, root growth, and root water uptake via neutron radiography
VADOSE ZONE JOURNAL 7, 1035 (2008)

From the pore scale to the lab scale: 3-D lab experiment and numerical simulation of drainage in heterogeneous porous media
ADVANCES IN WATER RESOURCES 31, 1253 (2008)

Peterson AA, Vontobel P, Vogel F, Tester JW
In situ visualization of the performance of a supercritical-water salt separator using neutron radiography
JOURNAL OF SUPERCRITICAL FLUIDS 43, 490 (2008)

Podofillini L, Dang VN, Thomsen K
Scoping-level Probabilistic Safety Assessment of a complex experimental facility: Challenges and first results from the application to a neutron source facility (MEGAPIE)
NUCLEAR ENGINEERING AND DESIGN 238, 2726 (2008)
Measuring the effect of structural connectivity on the water dynamics in heterogeneous porous media using speedy neutron tomography
ADVANCES IN WATER RESOURCES 31, 1233 (2008)

Robin Schäublin, Jean Henry, Yong Dai
Helium and point defect accumulation: (i) microstructure and mechanical behaviour
C. R. Physique 9 (2008) 389

Sevillano JG, Alkorta J, Gonzalez D, Van Petegem S, Stuhr U, Van Swygenhoven H
In situ Neutron Diffraction Study of Internal Micro-Stresses Developed by Plastic Elongation in < 110 > Textured BCC Wires
ADVANCED ENGINEERING MATERIALS 10, 951 (2008)

Shokri N, Lehmann P, Vontobel P, Or D
Drying front and water content dynamics during evaporation from sand delineated by neutron radiography
WATER RESOURCES RESEARCH 44, W06418 (2008)

Magnetization decay in neutron irradiated MgB2 bulk samples
JOURNAL OF APPLIED PHYSICS 104, 013903 (2008)

Thomsen K
Liquid metal leak detection for spallation neutron sources
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 592, 476 (2008)

Knud Thomsen
Advanced on-target beam monitoring for spallation sources
NIM (2008) in press

Van Swygenhoven H
Footprints of plastic deformation in nanocrystalline metals

Drainage in heterogeneous sand columns with different geometric structures
ADVANCES IN WATER RESOURCES 31, 1205 (2008)

Wagner W, Groschel F, Thomsen K, Heyck H
MEGAPIE at SINQ - The first liquid metal target driven by a megawatt class proton beam

Wagner W, Seidel M, Morenzoni E, Groschel F, Wohlmuther M, Daum M
PSI status 2008 - Development at the 590 MeV proton accelerator facility
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 11, 18 (2008)

Yoshizawa K, Ikezoe K, Tsubaki Y, Kramer D, Lehmann EH, Scherer GG
Analysis of gas diffusion layer and flow-field design in a PEMFC using neutron radiography

Zhang H, Long B, Dai Y
Metallography studies and hardness measurements on ferritic/martensitic steels irradiated in STIP
LIST OF PUBLICATIONS


The UCN Source at PSI
Proc. of the 18th Meeting of the International collaboration on Advanced Neutron Sources, ICANS-XVIII, April 2007 (printed 2008)


Measurements of Ultracold Neutron Production and Cold Neutron Transmission for Deuterium, Oxygen and Heavy Methane
Proc. of the 18th Meeting of the International collaboration on Advanced Neutron Sources, ICANS-XVIII, April 2007 (printed 2008)

B. Blau

Cryogenic System of the Swiss Ultra-cold neutron source

K. Thomsen

Experience with VIMOS during the Irradiation Phase of MEGAPIE
Proc. of the 18th Meeting of the International collaboration on Advanced Neutron Sources, ICANS-XVIII, April 2007 (printed 2008)

K. Thomsen

Heat Exchange and Operating Gas Flow Influence on Radiation Resistant Pressure Sensor Properties

W. Wagner, G. Kühne, P. Tregenna-Piggott, M. Wohlmuther

Status and Development of the Swiss Spallation Neutron Source SINQ
Proc. of the 18th Meeting of the International collaboration on Advanced Neutron Sources, ICANS-XVIII, April 2007 (printed 2008)

INVITED TALKS

C. Brandl

Dislocation activity within nanocrystalline metals: A molecular dynamics study

C. Brandl

Atomistic Simulations of Interface Dominated Metals
Technology Aperitif, CCMX, Competence Centre for Materials Science and Technology, 3rd December, Bern, Switzerland

Y. Dai, F. Gröschel, W. Wagner

Materials research at the Paul Scherrer Institute for developing high-power spallation targets
P. M. Derlet
Atomistic simulations of nanocrystalline metals: dislocation, activity in confined volumes
International Workshop on the Plasticity of Nanocrystalline Metals, Lake Bostal, Germany, September 28-October 1 2008

P. M. Derlet
Plasticity in Nanocrystalline Metals: A Molecular Dynamics Study
8th World Congress on Computational Mechanics, Venice, Italy, 2008

E. H. Lehmann
Neutron Imaging in the conflict between neutron physics, applied research and industrial utilization
Seminar Talk at HMI Berlin, 12 March 2008

E. H. Lehmann
Neutron imaging methods for studies of soil-water-plant interactions
Seminar Talk, Helmholtz Centre Leipzig for Environmental Studies, 14 July 2008


Helena Van Swygenhoven
Nano- and micro-scale materials: mechanical behaviour under extreme conditions
MRS Fall meeting Boston, November 2008

Helena Van Swygenhoven
Small scale plasticity using X-rays and neutrons
Max-Planck Institut für Eisenforschung (MPIE) Duesseldorf, October 2008

Helena Van Swygenhoven
Laboratoire de PHYsique des MATériaux (PHYMAT), Université de Poitiers UMR CNRS 6630, France, June 2008

Helena Van Swygenhoven
Modelling and Simulation (Keynote lecture)
Materials Science and Engineering, symposium, 1 – 4 September 2008, Nürnberg, Germany

Helena Van Swygenhoven
Grenzflächen und Grenzflächendominierte Prozesse

Helena Van Swygenhoven
A different view on microcompression

Helena Van Swygenhoven
Contractors' Meeting of the "Mechanical Behavior and Radiation Effects" Core Research Area (CRA) of the Office of Basic Energy Sciences (DOE), Washington, April 13th, 2008 (Plenary opening lecture)

Helena Van Swygenhoven
Invited discussion leader in the International Workshop on the Plasticity of Nanocrystalline Metals held at Lake Bostal, Germany, September 28 to October 1, 2008
S. Van Petegem
*Mechanical behavior and deformation mechanisms of nanocrystalline f.c.c. metals*
2nd Workshop on Nanomaterials: microstructural and mechanical characterizations, simulations (December 11-12, 2008)

S. Van Petegem
*Deformation mechanisms in nanocrystalline Ni and NiFe studied by in-situ x-ray diffraction’*
Nanoplasticity 2008, Lake Bostal, Germany (September 28 - October 1 2008)

S. Van Petegem
*In-situ Laue diffraction and two-dimensional mapping during compression of micron-sized pillars (Keynote lecture)*
MSE08, Materials Science and Engineering, Nuernberg, Germany (September 1-4, 2008)

W. Wagner
*The PSI large scale accelerator facilities: Techniques and applications in materials science*

W. Wagner
*PSI Status – Operation and Utilization of the Proton Accelerator Facility*
IPS08: International Symposium on Pulsed Neutron and Muon Sciences, Mito, Japan, March 5-8, 2008

W. Wagner
*Status and Developments of the Swiss Spallation Neutron Source SINQ*
IAEA Consultants Meeting on Applications of accelerators in real time studies of materials Vienna, A, April 28-30, 2008

W. Wagner
*Post-MEGAPIE developments at SINQ – PSI’s strategy towards an optimized MW(+)*

**CONFERENCE, WORKSHOP AND SEMINAR CONTRIBUTIONS**

G. Frei, E. H. Lehmann, P. Boillat
*The neutron micro-tomography stub at PSI and its use for research purposes and engineering applications*
Int. Topical Meeting on Neutron Radiography, Kobe, Sept. 2008

G. Frei, E. Lehmann, L. Josic, P. Vontobel
*Investigations of welding joints by means of energy resolved imaging*
NEUWAVE-1 Workshop on energy selective neutron imaging, Munich-Garching, April 2008

G. Frei, E. H. Lehmann
*Zerstörungsfreie Materialuntersuchung mittels Neutronen am Paul Scherrer Institut- Lösungen und Schweißungen*
Industrie-Workshop Böhler-Welding, Nov. 2008

*Cold neutron imaging near Bragg edges as tool for material research*
Int. Topical Meeting on Neutron Radiography, Kobe, Sept. 2008

L. Josic, P. Vontobel, E. Lehmann
*Nuclear data for neutron interaction with structural materials verification (and improvement) with neutron transmission measurements*
NEUWAVE-1 Workshop on energy selective neutron imaging, Munich-Garching, April 2008
E. H. Lehmann
Non-destructive testing with neutrons (and X-rays) for industrial and scientific use at the imaging beam lines at PSI
Consultancy Meeting IAEA, Vienna, 26-28 Nov. 2008

E. H. Lehmann
Recent improvements in the methodology of neutron imaging: higher spatial resolution, energy selective investigations
Int. Conf. on Neutron Scattering, Mumbay, Jan. 2008

E. H. Lehmann, P. Boillat, G. Scherrer, G. Frei
Fuel cell studies with neutrons at the imaging facilities at PSI
Int. Topical Meeting on Neutron Radiography, Kobe, Sept. 2008

E. H. Lehmann, G. Frei, L. Josic, P. Vontobel
The energy selective option in neutron imaging
NEUWAVE-1 Workshop on energy selective neutron imaging, Munich-Garching, April 2008

E. H. Lehmann, D. Mannes, P. Cerubini, P. Niemz
Neutron transmission imaging with imaging plates detectors as competitive method for tree ring determination
EURODENDRO, Hallstadt, May 2008

D. Mannes, M. Grabner, E. H. Lehmann, P. Niemz
Imaging with cold neutrons for the determination of tree rings in deteriorated wood
EURODENDRO, Hallstadt, May 2008

S. Van Petegem
In-situ x-ray diffraction study of nanocrystalline metals
ICRS-8 - DXC2008, The eight International Conference on Residual Stress - Denver X-ray Conference, Denver, USA (August 4-8, 2008)

S. Van Petegem
From microstructures to mechanical behaviour - neutrons and x-rays
Metallurgy day, Lausanne, Switzerland (September 11, 2008)

S. Van Petegem
In-situ mechanical testing at the time-of-flight neutron diffractometer POLDI
DN2008, Deutsche Neutronentagung, Garching

LECTURES AND COURSES

P. M. Derlet
Defects, dynamics and diffraction patterns: a computational synergy
7th PSI Summer School on Condensed Matter Research, Probing the Nanometer Scale with Neutrons, Photons and Muons, Zuoz, Switzerland, August 16-22 2008

H. Van Swygenoven
Small scale plasticity using in-situ mechanical techniques
7th PSI Summer School on Condensed Matter Research, Probing the Nanometer Scale with Neutrons, Photons and Muons, Zuoz, Switzerland, August 16-22 2008

H. Van Swygenoven
Five research lectures at the International Centre for Mechanical Sciences (CISM) on „Mechanical Size-Effects of Materials: Processing, Characterizing and Modelling”, May 12-16, 2008, Udine, Italy.
"Grains and deformation" a research course on "New Materials in New Light" is the 7th course in a series on "New X-Ray Sciences" organized by Prof. Prof. Robert Feidenhans', Niels Bohr Institute, University of Copenhagen at DESY, Hamburg, March 5-7, 2008.

MEMBERSHIP IN EXTERNAL COMMITTEES

Dr. W. Wagner
- Technical Advisory Group, ESS Scandinavia
- International Advisory Committee of ICANS: International Collaboration on Advanced Neutron Sources
- International Technical Committee of the "Fifth edition of the International Workshop on Materials for Heavy Liquid Metal Cooled Reactors and Related Technologies"
- Technical Programme Committee of the "International Topical Meeting on Nuclear Research Applications and Utilization of Accelerators"

Dr. H. Van Swygenhoven
- Member of the reviewing commission of the proposals for beam time at the instruments at FRM II
- Member of the hiring commission for the Professor in Experimental Condensed Matter Physics at ETHZ and Head of Laboratory for Neutron Scattering at PSI (2008)
- Elected by the EC-commission as an expert and member of the External Advisory Group (EAG) of the NMP program (FP7)
- Elected member of the PSI research commission (FOKO).
- Elected member of the International Advisory Committee of the International Risø Symposium on Materials Science
- Vice chair of the International Committee of Strength of Materials (organization of ICSMA conferences).

Dr. E. Lehmann
- COST-IE0601 "Wood research for cultural heritage", Member of Steering Committees und Deputy Working Group Leader, Swiss Representative of the Action
- ILL: Mitglied des Subcommittees 1 für die Proposal Evaluation (until end of 2008)
- FRM-2: Member of Advisory Committee for Proposal Evaluation (since end of 2008)
LIST OF PUBLICATIONS (PEER REVIEWED)

*Nature of the Magnetic Order in Ca$_3$Co$_2$O$_6*  
PHYSICAL REVIEW LETTERS 101, 097207 (2008)

Altissimo M, Petrillo C, Sacchetti F, Sani L, Stahn J
*Neutron diffraction from macroscopic objects and transverse coherence of the wavefunction: The Fresnel zone plates*  
NUCLEAR INSTRUMENTS AND METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 586, 68 (2008)

Aswal VK, Chodankar S, Kohlbrecher J, Vavrin R, Wagh AG
*Small-angle neutron scattering study of structural evolution of different phases in protein solution*  

Aswal VK, Chodankar SN, Kohlbrecher J, Vavrin R, Wagh AG
*SANS and DLS Studies of Protein Unfolding in Presence of Urea and Surfactant*  
AIP CONFERENCE PROCEEDINGS 989, 53 (2008)

*Characterisation of the polarised neutron beam at the small angle scattering instrument SANS-I with a polarised proton target*  
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 586, 86 (2008)

Aswal VK, Vavrin R, Kohlbrecher J, Wagh AG
*Pressure-induced structural transition of nonionic micelles*  
PRAMANA-JOURNAL OF PHYSICS 71, 1051 (2008)

Balagurov AM, Bobrikov IA, Karpisky DV, Troyanchuk IO, Pomjakushin VY, Sheptyakov DV
*Successive Structural Phase Transitions in Pr0.5 Sr0.5 CoO3 in the Range 10-1120K*  
JETP LETTERS 88, 531 (2008)

Balagurov AM, Bobrikov IA, Pomjakushin VY, Sheptyakov DV, Babushkina NA, Gorbenko OY, Kartavtseva MS, Kaul AR
*Effect of isotopic composition and microstructure on the crystalline and magnetic phase states in R0.5Sr0.5MnO3*  
JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS 106, 528 (2008)

Barilo SN, Shiryaev SV, Bychkov GL, Shestak AS, Flavell WR, Thomas AG, Rafique HM, Chernenkov YP, Plakhty VP, Pomjakushina E, Conder K, Allenspach P
*Large single crystals of LnBaCo(2)O(5.5): Initial nucleation, growth and study*
Bende A, Almasy L

Weak intermolecular bonding in N,N'-dimethylethyleneurea dimers and N,N'-dimethylethyleneurea-water systems: The role of the dispersion effects in intermolecular interaction

CHEMICAL PHYSICS 354, 202 (2008)


Superconducting vortices in CeCoIn5: Toward the Pauli-limiting field

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Storage of ultracold neutrons in high resistivity, non-magnetic materials with high Fermi potential

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M. Kenzelmann
*Electric control and switching frequency of magnetism in thin films of Ni₃V₂O₈*
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J.C.E. Rasch
*Magnetism in Pb₃Mn₁₋ₓO₁₅*
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INVITED TALKS

R. Ackermann
Magnonen und polarisierte Neutronen
Universität des Saarlandes, Saarbrücken Germany June 20, 2008

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Phononen und inelastische Neutronenstreuung
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A. Cervellino
Analysis of partially ordered (nano)materials through the Debye function method.

A. Cervellino
Debye function: nella cassetta degli attrezzi.
Powder Diffraction Software Workshop „In the Toolchest“ Warsaw Poland September 18, 2008

A. Cervellino
The Debye equation: Powder diffraction patterns directly from atom clusters. What we can really do and when it is convenient.

J. Chang
Electronic structure of La-based cuprates near the 1/8-anomaly
UMD CNAM/ICAM Workshop on Cuprate Fermiology University of Maryland USA Nov. 14-15, 2008
J. Chang  
*Magnetic and Electronic properties of the high-temperature superconductor La2-xSrxCuO4.*  
Seminar Universite Sherbrooke Canada Mar. 15th, 2008

J.P. Embs  
*Dynamics of Ionic Liquids (ILs) by menas of QENS*  
13th International Conference on Neutron Scattering Investigation in Condensed Matter  
Universität Poznan Poland May 8-10, 2008

J.P. Embs  
*QENS - a method to probe dynamics in liquids on a molecular scale*  
Winterschool DFG - SPP 1191 priority program Universität Leipzig Germany Feb., 20-23, 2008

A. Furrer  
*Admixture of an s-wave component to the d-wave gap symmetry in high temperature superconductors*  
22nd General Conference of the Condensed Matter Division of the EPS Rome Italy August 25-29, 2008

A. Furrer  
*Bose-Einstein Condensation in Magnetic Materials*  

A. Furrer  
*Towards establishing a Swiss partnership with the ILL*  
Symposium 20 Years Partnership Villigen PSI Switzerland Nov. 28, 2008

C. Garcia  
*TEM and WAXS complementarity to analyze nanopowder*  
Laboratory for Neutron Scattering PSI Villigen Switzerland Sept. 22, 2008

U. Gasser  
*Non-central forces in crystals of charged colloids*  
GaTech Atlanta USA Sept. 15-25, 2008

S.N.Gvasaliya  
*Phase Transitions in Relaxors: Neutron Scattering Studies*  
SNSF Scopes Workshop Tashkent Uzbekistan Sept. 11- Sept 14 2008

S.N.Gvasaliya, G.M. Rotaru, B. Roessli, R.A. Cowley, S. Kojima  
*Phase Transitions and Lattice Dynamics of Relaxors*  
Frontiers in Ferroelectricity St. Petersburg Russia June 12 - June 14, 2008

J. Hoppler  
*Stress induced modulation of the magnetic profile in Y0.6Pr0.4Ba2Cu3O7 / La2/3Ca1/3MnO3 superlattices*  
Seminar MPI fuer Festkörperfoerschung, Stuttgart Germany March 14, 2008

L. Keller  
*Upgrade Of The Cold Neutron Powder Diffractometer DMC At SINQ*  

G. M. Kenzelmann  
*Coupled magnetic and superconducting order in CeColn5*  
M. Kenzelmann
*Ferroelectricity from magnetic order*
International Conference on Highly Frustrated Magnetism Braunschweig Germany Sept. 8-12, 2008

M. Kenzelmann
*Ferroelectricity from magnetic order*

M. Kenzelmann
*Magnetically-induced ferroelectricity in frustrated quantum magnets*
American Crystallographic Association Oak Ridge USA Mai 31 - June 5, 2008

M. Kenzelmann
*Multiferroic Materials*
Dept of Materials, ETH Zürich Zürich Switzerland October 1, 2008

M. Kenzelmann
*Multiferroic Materials*
7th PSI Summer School on Condensed Matter Research Zuoz Switzerland Aug 20-22, 2008

M. Kenzelmann
*Nanoscale Magnetization Dynamics*
XFEL Bern Switzerland June 5, 2008

M. Kenzelmann
*Quantum magnetism, multiferroics and heavy-fermion superconductivity*
Dept. of Physics, University of Karlsruhe Karlsruhe Germany April 14, 2008

M. Kenzelmann
*Superconducting Vortices in CeCoIn5: Toward the Pauli-Limiting Field*
MANEP Review Geneva Switzerland Mai 20, 2008

M. Kenzelmann
*Unconventional magnetism in an unconventional superconductor*

M. Kenzelmann
*Unconventional magnetism in an unconventional superconductor*
Annual Meeting of the Swiss Physical Society/MANEP Meeting Geneva Switzerland March 26-27, 2008

J. Kohlbrecher
*How scattering techniques can probe the nanometer scale: An introduction to SAS and PCS*
PSI Zuoz Switzerland 16.-22. August 2008

J. Kohlbrecher
*real-time small-angle neutron scattering techniques probing sub-millisecond dynamics in magnetic nanomaterials*
NFFA Symposium PSI Villigen Switzerland August 16-22, 2008

J. Kohlbrecher
*Small-Angle Scattering (SAS)*
ETHZ-LMVT Switzerland 1.5.08

*Quantum Phasetransition of a Magnet in a Spinbath*
Departement of Physik, Neutron-Seminar TU München, Garching Germany January 19, 2008
J. Mesot
*Doping Dependent Anisotropic Electronic Scattering Rate in La$_{2-x}$Sr$_x$CuO$_4*
American Physical Society (APS) March meeting New Orleans USA March 10-14, 2008

J. Mesot
*Electronic and magnetic excitations of high-temperature cuprate superconductors probed by ARPES and neutron scattering*
Condensed Matter Colloquium, University Fribourg Fribourg Switzerland April 15, 2008

J. Mesot
*Multiple Energy Scales and FS pockets : Neutron and ARPES Studies*
CIFAR QM workshop Toronto Canada April 7-11, 2008

J. Mesot
*Neutron and ARPES evidences for two energy scales in La(2-x)Sr(x)CuO(4)*

J. Mesot
*Neutron Scattering Investigation of High-Temperature Superconductors*
International Symposium on Neutron Scattering, Mumbai India Jan. 15-18, 2008

M. Shi, J. Mesot
*Electronic and Magnetic Excitations of High-Temperature Cuprate Superconductors Probed by ARPES and Neutron Scattering*
22nd General Conference of the Condensed Matter Division of the European Physical Society Rome Italy August 25-29, 2008

C. Niedermaier
*Tuning competing orders in cuprate superconductors by the application of an external magnetic field*
Manep Internal Workshop Neuchâtel Switzerland January 15, 2008

C. Niedermaier
*Tuning competing orders in La$_{2-x}$Sr$_x$CuO$_4$ cuprate superconductors by the application of an external magnetic field*
Stripes 08: Quantum Phenomena in Complex Matter Erice Italy July 26 - August 1, 2008

V. Pomjakushin
*Determination of the magnetic structure from powder neutron diffraction*
Structure Determination from Powder Diffraction Data Villigen PSI Switzerland June 18-22, 2008

*Layered and cubic cobaltites grown by floating zone, structural and magnetic properties study*

J.C.E. Rasch
*Layered compounds for spintronics*
Metal Physics and Technology Winter Colloquium Stoos Switzerland January 15-18, 2008

J.C.E. Rasch
*Magnetism induced lattice distortion in CuCrS$_2$*
16$^{th}$ SCTE Dresden Germany July 26-31, 2008

J.C.E. Rasch
*Neutron and synchrotron X-ray diffraction on Pb$_3$Mn$_7$O$_{15}$*
INTAS Workshop, New Layered 3d-Materials for Spintronics Villigen PSI Switzerland March 31 to April 1, 2008
J.C.E. Rasch
*Neutron scattering on magnetoelastic CuCrS₂*
ETH Zurich Advanced Materials Science Seminar Zürich Switzerland October 13, 2008

*Magnetic and Structural Properties of Pb₃Mn₇O₁₅*

*Magnetism in Pb₃Mn₇O₁₅*
Annual Meeting of the Swiss Physical Society/MANEP Meeting Geneva Switzerland March 26-27, 2008

B. Roessli
*Neutron Polarimetry in Ferroic NdFe₃(11BO₃)₄*
Int. Seminar on Ferroelectricity St-Petersburg Russia June 12 - June 14, 2008

B. Roessli
*Neutron Polarimetry in Ferroic NdFe₃(11BO₃)₄*
PNCMI2008 Tokai Switzerland Sept. 1-5, 2008

B. Roessli
*Three-dimensional polarimetry: from ILL to PSI Symposium 20 Years Partnership Villigen PSI*
Switzerland Nov. 28, 2008

J. Schefer
*Neutron Diffraction at the Swiss Neutron Spallation Source SINQ*
1st Status Meeting of MaMaSELF Rigi Kulm Switzerland May 6-10, 2008

J. Schefer
Neutron Scattering at the Swiss Neutron Spallation Source SINQ
*Department of Materials Engineering and Industrial Technologies University of Trento Italy*
May 26, 2008

J. Schefer
*Neutron Scattering at the Swiss Neutron Spallation Source SINQ*

J. Schefer
*SINQ and selected Applications: Metastable states, oxygen transport in perioviskites and other applications using novel materials*
Institut für Experimentalphysik Universität Wien Austria Oct. 20, 2008

D. Sheptyakov
*Crystal And Magnetic Structures Of The New Mixed Oxides: Pb₂₋ₓBaₓFe₂O₅ And Sr₃Y(Co,Fe)₄O₁₀₊ₓ*
SNSF Scopes Workshop Tashkent Uzbekistan Sept. 11-13, 2008

D. Sheptyakov
*Powder Diffraction Using Neutrons And Its Complementarity To The X-Ray Powder Diffraction Structure Determination from Powder Diffraction Data*
Villigen PSI Switzerland June 18-22, 2008
D. Sheptyakov  
*Tutorial On Powder Diffraction Techniques In Application To The Analysis Of The Particle Sizes And Microstrains In Materials*

7th PSI Summer School on Condensed Matter Research Zuoz Switzerland  
August 16-22, 2008

V.V. Sikolenko  
*Phase separation and Co spin state in cobaltites with perovskite-type structure*

Hasylab DESY seminar, 23.05.2008 Hamburg Germany Mai 23, 2008

V.V. Sikolenko  
*Triple-Axis Spectroscopy. Experimental training.*


J. Stahn  
*Elliptic neutron guides from the idea to the implementation*

NMI3 annual meeting 2008 Corse France June 25-28, 2008

J. Stahn  
*Laterally graded and complex multilayers for neutron optical elements*

NMI3 annual meeting 2008 Corse France June 25-28, 2008

Th. Strässle  
*Neutron spectroscopy under high pressure: a vibrational study on the amorphization process of ice*

11ème Journee de la Matiere Condensee Strasbourg France August 25-29

Ph. Tregenna-Piggott  
*Experimental and Theoretical Study of Cyano-bridged trimers incorporating [Mn(5-Brsalen)]+
Units*

Seminar Freiburg Germany December 5, 2008

R. Vavrin  
*Probing the phase diagram of a colloidal suspension under high pressure by neutron and light scattering*

Conference of the European Colloid and Interface Society (ECIS) Cracow Poland Aug. 31 - Sept. 5, 2008

O. Zaharko  
*Isolated tetrahedra system Cu4OCi6L4:magnetic exchange against cluster plasticity*

seminar in Lab. of Crystallography Lausanne Switzerland February 25, 2008

O. Zaharko  
*Magnetic structure determination combining nonpolarized and polarized neutron diffraction*


M. Zayed  
*Pressure induced phase transitions in the Shastry-Sutherland compound SrCu$_2$(BO$_3$)$_2$.*


**BOOK CHAPTERS**

*Magnetic and Structural Properties of Pb3Mn7O15*  
INTAS Workshop: New layerd 3d-Materials for Spintronics, PSI Villigen, Switzerland
LECTURES AND COURSES

M. Kenzelmann
- Introduction to multiferroics + Ferroelectricity from magnetic order, 2nd European School on Multiferroics, Girona, 1.9.2008-5.9.2008, European school
- Multiferroic Materials, 7th PSI Summer School on Condensed Matter Research, Zuoz

J. Mesot
- Neutronenstreuung in der Festkörperphysik I, ETH Zürich
- Neutronenstreuung in der Festkörperphysik II, ETH Zürich
- Seminarreihe Neutronenstreuung I, ETH Zürich
- Seminarreihe Neutronenstreuung II, ETH Zürich

J. Schefer
- Magnetic scattering with neutron diffractions, MaMaSELF, Erasmus Mundus Sommer School, University of Rennes, cycle of seminars

V.V. Sikolenko
- Triple-Axis Spectroscopy, Experimental training 20th Berlin School on Neutron Scattering, Hahn Meitner Insitut Berlin, cycle of seminars

T. Strässle
- Neutronenstreuung in der Festkörperphysik I, ETH Zürich
- Neutronenstreuung in der Festkörperphysik II, ETH Zürich

Ph. Tregenna-Piggott
- Magnetism and Transition Metal Compounds, Department of Chemistry, University of Bern, cycle of seminars

MEMBERSHIP IN EXTERNAL COMMITTEES

A. Furrer
- Science Advisory Committee, EU Infrastructure Initiative NMI3 (2002)
- Gutachter-Ausschuss Sonderforschungsbereich 463 DFG (2005)
- Programme Committee, 2008 Latsis Symposium (2007)

T. Geue
- Scientific Advisory Committee Budapest Neutron Center, BNC, Budapest, Hungary (2008)

S. Gvasaliya
- Program Committee, RCBJSF-10, TITech, Yokohama, Japan (2008)
M. Kenzelmann
- Executive Committee of the NIST Center for Neutron Research User Group, NCNR, NIST, United States (2008)

J. Kohlbrecher
- Scientific Advisory Committee ILL, ILL Grenoble, France (2008)
- Scientific Advisory Committee NCNR, NIST Center for Neutron Research (2007)

J. Mesot
- Forum of the CH-NCCR/NSF Materials with Novel Electronic Properties (MaNEP), Swiss National Science Foundation (since 2005)
- Member of the organizing committee, Summer School on Condensed Matter Research, Zuoz, Switzerland (2005-2008)
- Member of the International Advisory Committee, Conference on Dynamical Properties of Solids (DYPROSO): International Advisory Committee (since 2002)
- Member of the International Advisory Committee, International Workshop on Polarized Neutrons in Condensed Matter Investigations (PNCMI) (since 2005)
- Member of the International Advisory Board, Workshop on Inelastic Neutron Spectrometers (WINS) International Advisory Board (since 2006)
- Member of the Board, European Association of Research Facilities (since 2008)
- Member of the council, European Physical Society (since 2008)

V. Pomjakushin
- Scientific Advisory Committee ILL, Magnetism, ILL Grenoble, France (2009)

B. Roessli
- Scientific Advisory Committee ILL, Dynamics and Magnetism, ILL Grenoble, France (2006)

J. Schefer
- Scientific Advisory Committee FRM-II, structure, FRM-II, Munich, Germany (since 2008)
- Editor Newsletter of the Swiss Society for Crystallography, SGK/SSCr, Swiss Society for Crystallography (since 2006)
- Member of the Organizing Committee, Summer School on Condensed Matter Research, yearly (since 2008)
- Board Member, Swiss Society for Crystallography (since 2006)

Ph. Tregenna Piggott
- Scientific Advisory Committee for the DNA Backscattering Spectrometer, J-PARC, Japan (2008)

AWARDS

J. Chang
- ETH Medaille for outstanding thesis work Physics Departement ETH Zürich, October 2008
LIST OF PUBLICATIONS (PEER REVIEWED)

Acosta-Alejandro M, de Leon JM, Medarde M, Lacorre P, Konder K, Montano PA
Local lattice structure change in PrNiO₃ across the metal-insulator transition: X-ray absorption near-edge structure spectroscopy and ab initio calculations
PHYSICAL REVIEW B 77, 085107 (2008)

Characterisation of the polarised neutron beam at the small angle scattering instrument SANS-I with a polarised proton target
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 586, 86 (2008)

Barilo SN, Shiryaev SV, Bychkov GL, Shestak AS, Flavell WR, Thomas AG, Rafique HM, Chernenkov YP, Plakhty VP, Pomjakushina E, Conder K, Allenspach P
Large single crystals of LnBaCo(2)O(5.5): Initial nucleation, growth and study
JOURNAL OF CRYSTAL GROWTH 310, 1867 (2008)

Superconducting vortices in CeCoIn₅: Toward the Pauli-limiting field
SCIENCE 319, 177 (2008)

Resonant x-ray scattering study of layered TbBaCo₂O₅.5
PHYSICAL REVIEW B 78, 054123 (2008)

Chernyshov D, Dmitriev V, Pomjakushina E, Conder K, Stingaciu M, Pomjakushin V, Podlesnyak A, Taskin AA, Ando Y
Superstructure formation at the metal-insulator transition in RBaCo₂O₅.5 (R=Nd, Tb) as seen from reciprocal space mapping
PHYSICAL REVIEW B 78, 024105 (2008)

Producing over 100 ml of highly concentrated hyperpolarized solution by means of dissolution DNP
JOURNAL OF MAGNETIC RESONANCE 194, 152 (2008)

Principles of Operation of a DNP Prepolarizer Coupled to a Rodent MRI Scanner
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Conder K, Stingaciu M, Pomjakushina E
Point defect chemistry of YBa₂Cu₃O₆.5+delta
MATERIALS RESEARCH BULLETIN 43, 1195 (2008)
Magnetic and electronic Co states in the layered cobaltate GdBaCo$_2$O$_{5.5-x}$
PHYSICAL REVIEW B 78, 054424 (2008)

Garcia-Fernandez M, Staub U, Bodenthin Y, Lawrence SM, Mulders AM, Buckley CE, Weyeneth S, Pomjakushina E, Conder K
Resonant soft x-ray powder diffraction study to determine the orbital ordering in A-site-ordered SmBaMn$_2$O$_6$
PHYSICAL REVIEW B 77, 060402 (2008)

Giller L, Filges U, Kuehne G, Wohlmuther M, Zanini L
Validation of Monte-Carlo simulations with measurements at the ICON beam-line at SINQ
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 586, 59 (2008)

Gironnet J, Mikhailik VB, Kraus H, De Marcillac P, Coron N
Scintillation studies of Bi$_4$Ge$_3$O$_{12}$ (BGO) down to a temperature of 6K
NUCLEAR INSTRUMENTS AND METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 594, 358 (2008)

Grimmer H
Elastic properties of two-dimensional quasicrystals
ACTA CRYSTALLOGRAPHICA SECTION A 64, 459 (2008)

Harris AB, Kenzelmann M, Aharony A, Entin-Wohlman O
Effect of inversion symmetry on the incommensurate order in multiferroic RMn$_2$O$_5$ (R=rare earth)
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Kawasaki Y, Gavilano JL, Roessli B, Andreica D, Baines CH, Pomjakushina E, Conder K, Ott HR
muSR studies of CePd$_2$In at low temperatures
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PHYSICAL REVIEW LETTERS 100, 089701 (2008)

Coupled superconducting and magnetic order in CeCoIn$_5$
SCIENCE 321, 1652 (2008)

Evidence of nodeless superconductivity in FeSe$_{0.85}$ from a muon-spin-rotation study of the in-plane magnetic penetration depth
PHYSICAL REVIEW B 78, 220510 (2008)

Oxygen isotope effects on the superconducting transition and magnetic states within the phase diagram of Y$_1$-xPr$_x$Ba$_2$Cu$_3$O$_{7-\delta}$
PHYSICAL REVIEW LETTERS 101, 077001 (2008)
Universal correlations of isotope effects in Y1-xPrxBa2Cu3O7-delta
PHYSICAL REVIEW B 77, 104530 (2008)

Kim JH, Lee SH, Park SI, Kenzelmann M, Harris AB, Schefer J, Chung JH, Majkrzak CF,
Takeda M, Wakimoto S, Park SY, Cheong SW, Matsuda M, Kimura H, Noda Y, Kakurai K
Spiral spin structures and origin of the magnetoelectric coupling in YMn2O5
PHYSICAL REVIEW B 78, 245115 (2008)

Kurdzesau F, van den Brandt B, Comment A, Hautle P, Jannin S, van der Klink JJ, Konter JA
Dynamic nuclear polarization of small labelled molecules in frozen water-alcohol solutions
JOURNAL OF PHYSICS D-APPLIED PHYSICS 41, 155506 (2008)

Lawes G, Kenzelmann M, Broholm C
Magnetically induced ferroelectricity in the buckled Kagome antiferromagnet Ni3V2O8
JOURNAL OF PHYSICS-CONDENSED MATTER 434205, 434205 (2008)

Lierke EG, Holitzner L
Perspectives of an acoustic-electrostatic-electrodynamic hybrid levitator for small fluid and
solid samples
MEASUREMENT SCIENCE AND TECHNOLOGY 19, 115803 (2008)

Luetkens H, Stingaciu M, Pashkevich YG, Conder K, Pomjakushina E, Gusev AA, Lamonova
KV, Lemmens P, Klaus HH
Microscopic evidence of spin state order and spin state phase separation in layered cobaltites
RBaCo2O5.5 with R = Y, Tb, Dy, and Ho
PHYSICAL REVIEW LETTERS 101, 017601 (2008)

Marini C, Arcangeletti E, Di Castro D, Baldassare L, Perucchi A, Lupi S, Malavasi L, Boeri L,
Pomjakushina E, Conder K, Postorino P
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PHYSICAL REVIEW B 77, 235111 (2008)

Medarde M, Fernandez-Diaz MT, Lacorre P
Long-range charge order in the low-temperature insulating phase of PrNiO3
PHYSICAL REVIEW B 77, 212101 (2008)

Piegsa FM, Schneider M
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NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-
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Piegsa FM, van den Brandt B, Glaettli H, Hautle P, Kohlbrecher J, Konter JA, Schlimme BS,
Zimmer O
A Ramsey apparatus for the measurement of the incoherent neutron scattering length of the
deuteron
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Spin-State Polaron in Lightly-Hole-Doped LaCoO3
PHYSICAL REVIEW LETTERS 101, 247603 (2008)

Polarization analysis in soft X-ray diffraction to study magnetic and orbital ordering

JOURNAL OF SYNCHROTRON RADIATION 15, 469 (2008)

Stingaciu M, Pomjakushina E, Grimmer H, Trottmann M, Conder K

Crystal growth of Tb0.9Dy0.1BaCO2O5+delta using travelling solvent floating zone method

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Van den Brandt B, Hautle P, Konter JA, Kurdzesau F

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F. Kurdzesau, P. Hautle, J. van der Klink, B. van den Brandt, J.A. Konter, S. Jannin, A.
Comment
Study of the DNP Build-up Time versus Applied Microwave Frequency in a Frozen Solution of Na Acetate in Ethanol/Water Doped with TEMPO
EUROMAR-2008, St. Petersburg, Russia, July 6-11, 2008

F. Kurdzesau, A. Comment, S. Jannin, P. Hautle, J.A. Konter, J. van der Klink, B. van den Brandt
Preparation of polarized solutions on 13C, 15N and 6Li labeled compounds for MRI/metabolic experiments
EUROMAR-2008, St. Petersburg, Russia, July 6-11, 2008

E.G. Lierke and L. Holitzner
Perspectives of an acoustic-electrostatic / electrodynamic hybrid levitator for small fluid and solid samples

S. Mayer and U. Filges
Uncertainty Assessment of a Photon Irradiation Facility
Workshop Proceedings, 8-10 October 2007, Bologna, Italy, ISBN 978-3-9805741-9-8

J. P. Urrego-Blanco, C.R. Bingham, B. van den Brandt, A. Galindo-Uribarri, P. Hautle, J. A. Konter, E. Padilla-Rodal, P. Schmelzbach
Development of Polarized Proton Targets for Reactions with Radioactive Ion Beams
SPIN2008, The 18th International Symposium on Spin Physics, Virginia, USA, October 6-11 2008

F.M. Piegsa et al.
Polarized Solid Targets at PSI: Recent Developments and Novel Applications in DNP
SPIN2008, The 18th International Symposium on Spin Physics, Virginia, USA, October 6-11 2008

B. van den Brandt, P. Hautle, J.A. Konter, F.M. Piegsa, J.P. Urregro-Blanco
Dilution refrigerators for particle physics experiments: two variants with sample cooling by helium-4
25th International Conference on Low Temperature Physics (LT25), Amsterdam, The Netherlands, August 6-13, 2008
CONFERENCE, WORKSHOP AND SEMINAR CONTRIBUTIONS

R. Ackermann, U. Filges, J. P. Embs, R. Hempelmann
*Ray-trace simulations of polarizing components for the cold neutron TOF spectrometer FOCUS*
Bunsentagung, 1-3 May, 2008, Saarbrücken, Germany

K. Conder, M. Stingaciu, E. Pomjakushina, A. Podlesnyak
*Layered cobaltites: synthesis, crystal growth, transport and magnetic properties*

K. Conder
Oxygen nonstoichiometry in perovskites: origin, control and determination
Perovskite meeting (ETHZ, EMPA, PSI) 26.05.2008, PSI West

U. Filges
*Validation of the RNR11-SINQ beamline and FOCUS instrument with different Monte Carlo packages*
MCNSI meeting, 25-28 June, 2008, Ajaccio, France

Th. Gahl, R. Hempelmann, F. Jurányi, J. Mesot, W.-C. Pilgrim, Th. Straessle
*BRISP and FOCUS-2D – Two similar Large Area Position Sensitive Detector Projects for TOF applications at the ILL and the PSI*
Poster, Deutschen Neutronenstreuungstagung 15.-17.9.2008, München:

F. Gallmeier, M. Wohlmuther and U. Filges
*Implementation of Neutron Mirror Effects into MCNPX and its Validation*
11th International Conference on Radiation Shielding, April 13-18. 2008, Pine Mountain, Georgia, USA

Johann Gironnet, Noël Coron, Pierre de Marcillac, Hans Kraus, Vitalii Mikhalik
Scintillation properties of Bi4Ge3O12 (BGO) down to a temperature of 20mK
Cryoscint, IPNL, Lyon, June 6th, 2008

M. Koennecke, M. Zolliker, PSI, N. Hauser, T. Lam, F. Fransecini
*Treepath Based Instrument Control*
ANSTO NOBUGS 2008, November 3-5, Sydney, Australia

M. Koennecke
*PSD 4 Circle Data Processing at SINQ*
PSD4C Workshop, November 13, Paris

*Combining neutron diffraction and XAS: gap opening through charge disproportionation in RNI03 perovskites*

*Gap opening through charge disproportionation in RNI03 perovskites (R = rare earth): new neutron diffraction and x-ray absorption results*

F. M. Piegsa
*Spin Phase Neutron Spin Phase Imaging*
Workshop on Neutron Wavelength dependent Imaging (TUM), München, April 21-24, 2008
F.M. Piegsa et al.
An accurate measurement of the spin-dependent neutron-deuteron scattering length

F.M. Piegsa, B. van den Brandt, P. Hautle, J.A. Konter
First results of the Neutron Spin Phase Imaging-Technique
Sixth International Topical Meeting on Neutron Radiography, ITMNR-6, Kobe, Japan, 14-18 September, 2008

Ekaterina V. Pomjakushina, Kazimierz Conder, Marian Stingaciu, Andrey Podlesnyak
Layered and cubic cobaltites grown by floating zone, structural and magnetic properties study

J.P. Urrego-Blanco, C.R. Bingham, B. van den Brandt, A. Galindo-Uribarri, P. Hautle, J.A. Konter, E. Padilla-Rodal, P.A. Schmelzbach
Development of Polarized Proton Targets for Reactions with Radioactive Ion Beams at Low and Intermediate Energies
Nuclear Structure 2008, National Superconducting Cyclotron Laboratory, East Lansing, MI, June 3-6, 2008

B. van den Brandt, P. Hautle, J.A. Konter, F.M. Piegsa, J.P. Urrego-Blanco
Polarised nuclei: From fundamental nuclear physics to applications in neutron scattering and magnetic resonance scattering AIP Proc. 980 (2008) 312
12th International Workshop Polarized Ion Sources, Targets and Polarimetry - PSTP2007, September 10-14, 2007, Brookhaven National Laboratory (BNL)

INVITED TALKS 2008

K. Conder
Crystal growth of oxides by Optical Floating Zone technique
MaMaSELF Status Meeting RIGI KULM, SWITZERLAND, 6-9 Mai 2008

M. Medarde
Neutron scattering instrumentation at the SINQ
IV Reunión de la Sociedad Española de Técnicas Neutrónicas, Sant Feliu de Guixols, (Spain), (8-10)-9-2008.

F.M. Piegsa et al.
Polarized Solid Targets at PSI: Recent Developments and Novel Applications in DNP
2. SPIN2008, The 18th International Symposium on Spin Physics, Virginia, USA, October 6-11 2008

F.M. Piegsa, B. van den Brandt, P. Hautle, J.A. Konter,
First results of the Neutron Spin Phase Imaging-Technique
Sixth International Topical Meeting on Neutron Radiography, ITMNR-6, Kobe, Japan, 14-18 September, 2008

J. P. Urrego-Blanco, C.R. Bingham, B. van den Brandt, A. Galindo-Uribarri, P. Hautle, J. A. Konter, E. Padilla-Rodal, P. Schmelzbach
Development of Polarized Proton Targets for Reactions with Radioactive Ion Beams
SPIN2008, The 18th International Symposium on Spin Physics, Virginia, USA, October 6-11 2008
COMMITTEES

M. Medarde
Member of College 5b (magnetism). Institut Laue-Langevin, France (until April 2008).

LECTURES AND COURSES 2008

K.Conder Keramik II (Semesterprogramm 327-0603-00), Fakultät Werkstoffe ETH Zürich, (together with Prof. L. Gauckler)
LIST OF PUBLICATIONS (PEER REVIEWED)

Bonda M, Holzapfel M, de Brion S, Darie C, Feher T, Baker PJ, Lancaster T, Blundell SJ, Pratt FL
*Effect of magnesium doping on the orbital and magnetic order in LiNiO₂*
PHYSICAL REVIEW B 78, 109903 (2008)

*Tuning competing orders in La₂₋ₓSrₓCuO₄ cuprate superconductors by the application of an external magnetic field*
PHYSICAL REVIEW B 78, 104525 (2008)

*Two-step magnetic ordering in quasi-one-dimensional helimagnets: Possible experimental validation of Villain’s conjecture about a chiral spin liquid phase*
PHYSICAL REVIEW LETTERS 100, 057203 (2008)

Deac IG, Tetean R, Andreica D, Burzo E
*Magnetic and magnetoresistive properties of Pr₁₋ₓCaₓCoO₃ (x=0.3, 0.5) cobaltites*
IEEE TRANSACTIONS ON MAGNETICS 44, 2922 (2008)

*Pressure effects on the magnetic transition temperature in ordered double perovskites*
PHYSICAL REVIEW B 78, 184416 (2008)

*Direct measurement of the electronic spin diffusion length in a fully functional organic spin valve by low-energy muon spin rotation*
NATURE MATERIALS doi:10.1038/nmat2333 (2008)

*Intrinsic mobility limit for anisotropic electron transport in Alq(3)*
PHYSICAL REVIEW LETTERS 100, 116601 (2008)

Fan I, Chow KH, Hitti B, Scheuermann R, MacFarlane WA, Mansour AI, Schultz BE, Egilmez M, Jung J, Lichti RL
*Optically induced dynamics of muonium centers in Si studied via their precession signatures*
PHYSICAL REVIEW B 77, 035203 (2008)

*Influence of photoexcitation on the diamagnetic muonium states in Ge studied via their precession signatures*
PHYSICAL REVIEW B 78, 153203 (2008)

Electronic Liquid Crystal State in the High-Temperature Superconductor YBa$_2$Cu$_3$O$_{6.45}$
Science 319, 597 (2008)

Strong coupling between magnetic and structural order parameters in SrFe$_2$As$_2$
PHYSICAL REVIEW B 78, 180504 (2008)

Kawasaki Y, Gavilano JL, Roessli B, Andreica D, Baines CH, Pomjakushina E, Conder K, Ott HR
muSR studies of CePd$_3$In at low temperatures
JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS 69, 3149 (2008)

Evidence of nodeless superconductivity in FeSe0.85 from a muon-spin-rotation study of the in-plane magnetic penetration depth
PHYSICAL REVIEW B 78, 220510 (2008)

Khasanov R, Klamut PW, Shengelaya A, Bukowski Z, Savic IM, Baines C, Keller H
Muon-spin rotation measurements of the penetration depth of the Mo$_3$Sb$_7$ superconductor
PHYSICAL REVIEW B 78, 014502 (2008)

Evidence for a Competition between the Superconducting State and the Pseudogap State of (BiPb)$_2$(SrLa)$_2$CuO$_{6.86}$ from Muon Spin Rotation Experiments
PHYSICAL REVIEW LETTERS 101, 227002 (2008)

Khasanov R, Luetkens H, Amato A, Klaus HH, Ren ZA, Yang J, Lu W, Zhao ZX
Muon spin rotation studies of SmFeAsO$_{0.85}$ and NdFeAsO$_{0.85}$ superconductors
PHYSICAL REVIEW B 78, 092506 (2008)

Oxygen isotope effects on the superconducting transition and magnetic states within the phase diagram of Y$_{1-x}$Pr$_x$Ba$_2$Cu$_3$O$_{7-\delta}$
PHYSICAL REVIEW LETTERS 101, 077001 (2008)

s-wave symmetry along the c-axis and s+d in-plane superconductivity in bulk YBa$_2$Cu$_3$O$_{6.86}$
JOURNAL OF SUPERCONDUCTIVITY AND NOVEL MAGNETISM 21, 81 (2008)

Correlation between the transition temperature and the superfluid density in BCS superconductor NbB$_{2+x}$
PHYSICAL REVIEW B 77, 064506 (2008)

Nodeless superconductivity in the infinite-layer electron-doped cuprate superconductor Sr$_{0.5}$La$_{0.5}$CuO$_2$
PHYSICAL REVIEW B 77, 184512 (2008)

Universal correlations of isotope effects in Y$_{1-x}$Pr$_x$Ba$_2$Cu$_3$O$_{7-\delta}$
PHYSICAL REVIEW B 77, 104530 (2008)

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PHYSICAL REVIEW LETTERS 101, 077005 (2008)
Komissarov I, Zhang Y, Nieuwenhuys GJ, Morenzoni E, Prokscha T, Suter A, Aarts J
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muon spin relaxation
EPL 83, 47013 (2008)

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Jansen M
Anomalous temperature evolution of the internal magnetic field distribution in the charge-
ordered triangular antiferromagnet AgNiO$_2$
PHYSICAL REVIEW LETTERS 100, 017206 (2008)

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Hess C, Kohler A, Behr G, Werner J, Buchner B
Field and temperature dependence of the superfluid density in LaFeAsO$_{1-x}$F$_x$
superconductors: A muon spin relaxation study
PHYSICAL REVIEW LETTERS 101, 097009 (2008)

Luetkens H, Stingaciu M, Pashkevich YG, Conder K, Pomjakushina E, Gusev AA, Lamonova
KV, Lemmens P, Klauss HH
Microscopic evidence of spin state order and spin state phase separation in layered cobaltites
RBa$_2$Co$_{3-x}$O$_{5.5}$ with R = Y, Tb, Dy, and Ho
PHYSICAL REVIEW LETTERS 101, 017601 (2008)

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Ralchenko V, Stoykov A, Terentiev S, Zhukov V, Zimmermann U
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DIAMOND AND RELATED MATERIALS 17, 1221 (2008)

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Solvation of a hydrogen isotope in aqueous methanol, NaCl, and KCl solutions
JOURNAL OF PHYSICAL CHEMISTRY B 112, 3070 (2008)

Morenzoni E, Luetkens H, Prokscha T, Suter A, Vongtragool S, Galli F, Hesselberth MBS,
Garifianov N, Khasanov R
Depth-dependent spin dynamics of canonical spin-glass films: A low-energy muon-spin-
rotation study
PHYSICAL REVIEW LETTERS 100, 147205 (2008)

Mukai K, Sugiyama J, Ikedo Y, Andreica D, Amato A, Brewer JH, Ansaldo EJ, Russo PL,
Chow KH, Aiyoshi K, Ohzuku T
Micro- and macroscopic magnetism on layered cobalt dioxide Li$_x$CoO$_2$ (0.1 <= x <= 1)
JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS 69, 1479 (2008)

Ofer R, Keren A, Chmaissem O, Amato A
Universal doping dependence of the ground-state staggered magnetization of cuprate
superconductors
PHYSICAL REVIEW B 78, 140508 (2008)

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Bendounan A, Sassa Y, Fedorov A, Palles H, Santander-Syro AF, Chang J, Shi M, Mesot J,
Fretwell HM, Kaminski A
Origins of large critical temperature variations in single-layer cuprates
PHYSICAL REVIEW B 78, 054523 (2008)
The new $\mu$E4 beam at PSI: A hybrid-type large acceptance channel for the generation of a high intensity surface-muon beam

Ricco M, Gianferrari F, Pontiroli D, Belli M, Bucci C, Shiroka T
Unconventional isotope effects in superconducting fullerides
EPL 81, 57002 (2008)

Saoudi M, Fritzschke H, Nieuwenhuys GJ, Hesselberth MBS
Size effect in the spin glass magnetization of thin AuFe films as studied by polarized neutron reflectometry
PHYSICAL REVIEW LETTERS 100, 057204 (2008)

Shiroka T, Scheuermann R, Morenzoni E, Stoykov A, Prokscha T
Exploring the performance of $\mu$SR position-sensitive detectors through numerical simulations

Solt G, Zimmermann U, Herlach D
Dynamics of implanted muons at low temperatures in white tin
PHYSICA B-CONDENSED MATTER 403, 3351 (2008)

Direct observation of a Fermi surface and superconducting gap in LuNi$_2$B$_2$C
PHYSICAL REVIEW B 77, 134520 (2008)

Storchak VG, Brewer JH, Eshchenko DG, Stubbs SL, Cottrell SP, Nikonov AA, Parfenov OE, Marenkin SF
Weak High-Temperature Bulk Ferromagnetism in Mn-Doped CdGeAs$_2$ Semiconductors

Storchak VG, Eshchenko DG, Morenzoni E, Prokscha T, Suter A, Liu XY, Furdyna JK
Spatially resolved inhomogeneous ferromagnetism in (Ga,Mn)As diluted magnetic semiconductors: A microscopic study by muon spin relaxation
PHYSICAL REVIEW LETTERS 101, 027202 (2008)

Comparative $\mu$SR investigation of static magnetic order and anisotropy of the pure and Pb-doped Bi$_2$Sr$_2$Co$_2$O$_y$ layered cobalt dioxides
PHYSICAL REVIEW B 78, 094422 (2008)

Electronic and magnetic properties of novel layered cobalt dioxides $A_x$CoO$_2$ with $A = Li, Na, and K$

Static magnetic order in the triangular lattice of Li$_x$NiO$_2$ (x <= 1): Muon-spin spectroscopy measurements
PHYSICAL REVIEW B 78, 144412 (2008)
Static magnetic order in metallic triangular antiferromagnet Ag$_2$MnO$_2$ detected by muon-spin spectroscopy
PHYSICAL REVIEW B 78, 104427 (2008)

Muon-spin rotation and relaxation study on the quasi-one-dimensional compounds Ca$_3$CoRhO$_6$, Sr$_3$CoRh$_2$O$_9$, and Sr$_3$CoRh$_3$O$_{12}$
PHYSICAL REVIEW B 77, 092409 (2008)

Wagner W, Seidel M, Morenzoni E, Groeschel F, Wohlmuther M, Daum M
PSI status 2008 - Development at the 590 MeV proton accelerator facility
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT 11, 18 (2008)

Finite gap behaviour in the superconductivity of the ‘infinite layer’ n-doped high-T-c superconductor Sr$_{0.9}$La$_{0.1}$CuO$_2$
JOURNAL OF PHYSICS-CONDENSED MATTER 20, 104237 (2008)

Yaouanc A, de Reotier PD, Chapuis Y, Marin C, Lapertot G, Cervellino A, Amato A
Short-range magnetic ordering process for the triangular-lattice compound NiGa$_2$S$_4$: A positive muon spin rotation and relaxation study
PHYSICAL REVIEW B 77, 092403 (2008)

LIST OF PUBLICATIONS

D.G. Eshchenko, V.G. Storchak and S.P Cottrell
Muon track induced current measurements in semi-insulating GaAs (poster)
μSR 2008 - 11th International Conerence on Muon Spin Rotation, Relaxation, Resonance, Tsukuba, Japan, July 21-25, 2008

D.G. Eshchenko, V.G. Storchak and S.P Cottrell
RF-μSR in electric fields studies of GaP (poster)
μSR 2008 - 11th International Conerence on Muon Spin Rotation, Relaxation, Resonance, Tsukuba, Japan, July 21-25, 2008

D.G. Eshchenko, V.G. Storchak, E. Morenzoni, T. Prokscha, A. Suter, X. Liu and J.K. Furdyna
Low Energy Muon studies of semiconductor interfaces (poster)
μSR 2008 - 11th International Conerence on Muon Spin Rotation, Relaxation, Resonance, Tsukuba, Japan, July 21-25, 2008

D.G. Eshchenko, V.G. Storchak, E. Morenzoni and D. Andreica
High-pressure Muon Spin Rotation studies of magnetic semiconductors: EuS (poster)
μSR 2008 - 11th International Conerence on Muon Spin Rotation, Relaxation, Resonance, Tsukuba, Japan, July 21-25, 2008

E. Morenzoni,
Yamazaki Prize Lecture
A (closer) look below surfaces and at heterostructures with muons
To appear in Physica B
T. Prokscha, E. Morenzoni, D.G. Eshchenko, H. Luetkens, G.J. Nieuwenhuys, A. Suter
Near surface muonium states in germanium

A novel VME based muSR data acquisition system at PSI
Proceedings of the 11th International Conference on muSR, Tsukuba (Japan), July 21-25.

Magnetic Polarons in Magnetic Semiconductors
Proceedings of the 11th International Conference on muSR, Tsukuba (Japan), July 21-25.

B.M. Wojek, E. Morenzoni, D.G. Eshchenko, A. Suter, T. Prokscha, E. Koller, E. Treboux, Ø. Fischer, H. Keller
Magnetism and superconductivity in cuprate heterostructures studied by low energy muSR
Proceedings of the 11th International Conference on muSR, Tsukuba (Japan), July 21-25.
Physica B (2009), DOI:10.1016/j.physb.2008.11.189

H.V. Alberto, J. Piroto Duarte, A. Weidinger, R.C. Vilão, J.M. Gil, N. Ayres de Campos, K. Fostiropoulos, T. Prokscha, A. Suter, E. Morenzoni
Low-energy-muon [LEM] study of Znphthalocyanine and ZnO thin films
Proceedings of the 11th International Conference on muSR, Tsukuba (Japan), July 21-25.

T. Shiroka, T. Prokscha, E. Morenzoni, K. Sedlak
GEANT4 as a simulation framework in muSR
Proceedings of the 11th International Conference on muSR, Tsukuba (Japan), July 21-25.

CONFERENCE, WORKSHOP AND SEMINAR CONTRIBUTIONS

A. Amato,
Interplay Magnetism-Superconductivity in UCoGe
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

T.C. Duan, T. Nakano, J. Matsumoto, I. Watanabe, T. Suzuki, T. Kawamata, A. Amato, F.L. Pratt and Y. Nozue
µSR Study on Ferromagnetic Properties of Rb Clusters Incorporated into Zeolite A
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

Itinerant and localized magnetic correlations in URhGe and UGe2
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

Paramagnetic nature of the layered cobalt dioxide with a double rocksalt-type block
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

High pressure µSR study on cobalt oxide spinel
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008


\textit{\mu SR study on CuC}_{1-x}\textit{Mg}_{x}\text{O}_2}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

T.U. Ito, W. Higemoto, K. Ohishi, N. Nishida, R.H. Heffner, Y. Aoki, T. Onimaru, H.S. Suzuki, A. Amato

\textit{Observation of Quantized Muon Spin Precession Frequencies in Paramagnetic PrPb}_3

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008


\textit{Magnetism and Superconductivity in LaO}_{1-x}\textit{FxFeAs}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

E. Morenzoni

\textit{Investigation of proximity effects in high and low T}_C\textit{ heterostructures}

MaNEP Forum workshop, Neuchatel,15.1.2008

T. Nakano, J. Matsumoto, T.C. Duan, I. Watanabe, T. Suzuki, T. Kawamata, A. Amato, F.L. Pratt, Y. Nozue

\textit{Fast Muon Spin Relaxation in Ferromagnetism of Potassium Clusters in Zeolite A}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008


\textit{Magnetism and Superconductivity in Heavy Fermion Superconductor CeCo(In}_{1-x}\textit{Cd}_x}_5

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008


\textit{A novel VME based \mu SR data acquisition system at PSI}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

K. Sedlak, R. Scheuermann, A. Stoykov, A. Amato

\textit{Simulation and Optimisation of the High-Field \mu SR Spectrometer Design}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

K. Sedlak, R. Scheuermann, A. Stoykov, A. Amato

\textit{Geant 4 simulation and optimisation of the high-field muSR spectrometer}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

K. Sedlak, T. Shiroka, A. Stoykov, R. Scheuermann

\textit{Geant 4 simulation of the upgraded ALC spectrometer}

11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008
A. Stoykov, R. Scheuermann, K. Sedlak, T. Shiroka, V. Zhuk:  
First experience with G-APDs in muSR instrumentation  

A. Stoykov, R. Scheuermann, K. Sedlak  
Fast timing detectors for the high field muSR spectrometers  
Poster Prize at the 11th International Conference on Muon Spin Rotation, Relaxation, and Resonance, Tsukuba, Japan, 21-25 July, 2008.

Static magnetic order on the triangular antiferromagnet Li$_x$NiO$_2$ with $x \leq 1$  
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

Static magnetic order and anisotropy of the layered cobalt dioxides Bi(1.6)Pb(0.4)Sr2Co2Oy and Bi$_2$SrCoO$_4$  
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

J. Sugiyama, Y. Ikedo, H. Nozaki, K. Mukai, D. Andreica, A. Amato, M. Ménétrier, D. Carlier, and C. Delmas  
Annihilation of antiferromagnetic order in LiCoO$_2$ by excess Li  
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

J. Sugiyama, H. Nozaki, Y. Ikedo, K. Mukai, D. Andreica, A. Amato, H. Yoshida, and Z. Hiroi  
Static magnetic order in metallic triangular antiferromagnet Ag$_2$MnO$_2$  
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

A. Suter  
Search for Magnetism in HfO$_2$ Thin Films  

A. Suter  
The Thin Film Phase Diagram of La$_{2-x}$Sr$_x$CuO$_4$  

A. Suter  
Superconductivity in La$_2$CuO$_4$/La$_{1.56}$Sr$_{0.44}$CuO$_4$ Superlattices  

μSR study of thiospinel CuCrZrS$_4$  
11th International Conference on Muon Spin Relaxation, Rotation and Resonance, Tsukuba, Japan, 21-25th July 2008

B. M. Wojek, E. Morenzoni, D. G. Eshchenko, T. Prokscha, A. Suter, E. Koller, E. Treboux, O. Fischer, and H. Keller  
Superconductivity and Magnetism in Cuprate Multi-layers (poster)  
Annual meeting of the Swiss Physical Society, Genève, March 26-27, 2008
B.M. Wojek, E. Morenzoni, D.G. Eshchenko, T. Prokscha, A. Suter, E. Koller, E. Treboux, O. Fischer, and H. Keller

*Magnetism and Superconductivity in Cuprate Heterostructures Studied by Low Energy muSR (poster)*

muSR 2008 – 11th International Conerence on Muon Spin Rotation, Relaxation, & Resonance, Tsukuba, Japan, July 21-25, 2008

B.M. Wojek, E. Morenzoni, D.G. Eshchenko, A. Suter, T. Prokscha, E. Koller, E. Treboux, O. Fischer, and H. Keller

*Magnetism and Superconductivity in Cuprate Heterostructures Studied by Low Energy muSR (poster)*

7th PSI Summer School on Condensed Matter Research, Zuoz, August 16-22, 2008

**INVITED TALKS**

A. Amato,
*Bulk μSR Facilities at PSI,*
μSR User Meeting BVRA 2008, January 2008, Paul Scherrer Institute, Villigen Switzerland

A. Amato
*Bulk MuSR: a tool to investigate nanometer scale phenomena - Introduction and selected examples*
7th PSI Summer School on Condensed Matter Research, Zuoz, August 16-22, 2008

R. Khasanov
*Two energy scales in the superconducting state of high-temperature cuprate superconductors: μSR and ARPES studies*
Workshop on Metal Insulator transition in Cuprates (MICuO), 18 March 2008, Parma, Italy

R. Khasanov
*Muon spin rotation study of the ternary non-centrosymmetric superconductors Li$_2$Pd,Pt$_{3-x}$B*
Workshop on Non-Centrosymmetric Superconductors, 30-31 May, ETH Zurich

R. Khasanov
*Magnetism and Superconductivity in RO$_{1-x}$FxFeAs and RFeAsO$_{1-x}$: A Local Probe Study*
International Symposium on Fe-oxipnictide Superconductors, 28-29 June, Tokyo, Japan

R. Khasanov
*Evidence for complex order parameters in cuprate superconductors*
The 22nd General Conference of the Condensed Matter Division of the European Physical Society, 25-29 August, Rome, Italy

R. Khasanov
*Partially superconducting "Fermi surface" in Bi2201: evidence for competition between superconductivity and pseudogap from superfluid density studies*
Second CoMePhS Workshop in Controlling Phase Separation in Electronic Systems, 30 September - 4 October, Nafplion, Greece

R. Khasanov
*μSR study of the superfluid response of Fe-based superconductors*
LMU seminar, 11 November, PSI, Villigen

R. Khasanov
*μSR study of the superfluid response of Fe-based superconductors*
Zurich University seminar, 17 December

H. Luetkens,
*Electronic Phase Diagram of LaO$_{1-x}$F$_x$FeAs:A Muon Spin Rotation Study (invited talk),*
LMU Seminar on Fe-based Superconductors, 4.11.2008
E. Morenzoni  
*Depth dependent μSR on nanometer scale*  
International Symposium on Pulsed Neutron and Muon Sciences (IPS 08)  
March 5-7, 2008, Mito, Japan

E. Morenzoni  
*A (closer) look below surfaces and at heterostructures with muons*  
(Yamazaki Prize Lecture)  
International Conference on Muon Spin Rotation, Relaxation and Resonance, 21-25th July 2008, Tsukuba, Japan.

E. Morenzoni  
*Superconductivity and Magnetism in Cuprate Heterostructures*  
6th International Conference on Low Temperature Physics, 6.8-13.8.2008, Amsterdam

E. Morenzoni  
*Introduction to polarized low energy muons as depth dependent probes of thin films and heterostructures*  
7th PSI Summer School on Condensed Matter Research, Zuoz 17.8.2008

A. Maisuradze  
*Analysis of μSR spectra in the vortex state of type-II superconductor*  
Paul Scherrer Institut, 28 Feb. 2008

T. Prokscha  
*PSI Fast and Slow Muons*  
ISIS Muon Training Course, April 21-25, 2008

T. Prokscha  
*Thin-film investigations with low-energy muons (Non-locality and spintronics: what can low-energy muons tell us?)*  
PSI, Oct-24, 2008

A. Suter  
*Induced Superconductivity in La$_2$CuO$_4$/La$_{1.56}$Sr$_{0.44}$CuO$_4$ Superlattices*  
BVRA, Jan. 29, 2008, PSI, Switzerland

A. Suter  
*Supraleitung und Magnetismus in nominal nicht supraleitenden La$_{2.4}$Sr$_6$CuO$_4$ Übergittern*  
Nov. 10, 2008, Institute for Material Science, Darmstadt University of Technology, Germany

T. Shiroka  
*Computer Modelling and Simulations of Future Muon Sources*  
International Workshop on Next Generation Muon Sources, Cockcroft Institute, Daresbury Lab, UK, 8-9 April 2008.

B.M. Wojek  
*Superconductivity and Magnetism in Cuprate Heterostructures*  
Studied by Low Energy muSR Seminar in Festkörperphysik, Universität Zürich, May 14, 2008

**LECTURES AND COURSES**

H. Luetkens  
20 Jahre PSI, "Neue Phänomene in mikroskopischen Dimensionen - Bausteine einer Zukunftstechnologie", Baden und Aarau, Germany, August, 2008,
E. Morenzoni  
ETH Zürich, FS-2008  
Physik mit Myonen: von der Atomphysik zur Festkörperphysik, Vorlesungen und Übungen

E. Morenzoni  
ETH Zürich, FS-2008  
Praktikum: Myon Spin Rotationsspektroskopie

A. Suter  
20 Jahre PSI, "Neue Phänomene in mikroskopischen Dimensionen - Bausteine einer Zukunftstechnologie", Waldshut, Germany, August, 2008,

MEMBERSHIP IN EXTERNAL COMMITTEES

A. Amato  
- Swiss Representative COST – Action P16, "Emergent Behaviour in Correlated Matter"  
- Facility Subcommittee of the International Society for μSR Spectroscopy (ISMS)  
- International Advisory Committee, 11th International Conference on Muon Spin Relaxation, Rotation and Resonance

D. Herlach  
- Secretary, PSI μSR International Research Committee  
- Swiss Delegate, International Society for μSR Spectroscopy (ISMS) Europe

H. Luetkens  
- Executive committee member of the International Society for μSR Spectroscopy (ISMS)

E. Morenzoni  
- Program Committee for muSR2008 (Tsukuba, Japan) International Advisory Committee for muSR2008 (Tsukuba, Japan)  
- Program Committee for IPS08 (Mito, Japan)  
- Program Committee of 7th PSI Summer School on Condensed Matter Research, Zuoz, Switzerland

AWARDS

E. Morenzoni  
- Yamazaki Prize awarded by the International Society for μSR spin spectroscopy
LIST OF PUBLICATIONS IN 2008

*A vertex trigger based on cylindrical multiwire proportional chambers*

*Wavelength shifter strips and G-APD arrays for the read-out of the z-coordinate in axial PET modules*

I. Johnson, K. Jefimovs, O. Bunk, C. David, M. Dierolf, J. Gray, D. Renker and F. Pfeiffer
*Coherent diffractive imaging using phase front modifications*

P. Lecomte, D. Luckey, F. Nessi-Tedaldi, F. Pauss and D. Renker
*Comparison between high-energy proton and charged pion induced damage in PbWO₄ calorimeter crystals*

R-89-01 (PIBETA Collaboration), R-05-01 (PEN Collaboration)

W. Bertl
*Form factors for radiative pion and kaon decays*
in: C. Amsler et al., Review of Particle Physics,

E. Friež, M. Bychkov, and D. Počanić
*The automatic gain-matching in the PIBETA CsI calorimeter*

R-97-05 (MuCap Collaboration), R-08-01 (MuSun Collaboration)

C. Petitjean
*Muon capture experiments in hydrogen and deuterium*
R-98-01 (Pionic Hydrogen)


*Accurate miscut angle determination for spherically bent Bragg crystals*

R-99-05 (MEG Collaboration)


*Development of a large volume zero boil-off liquid xenon storage system for muon rare decay experiment (MEG)*

R-99-06 (FAST Collaboration)

A. Barczyk et al. (PSI: K. Deiters, C. Petitjean)

*Measurement of the Fermi constant by FAST*

R-00-03 (UCN Source Project), R-05-03 (nEDM Collaboration)


*Direct experimental verification of neutron acceleration by the material optical potential of solid deuterium*


*Neutron velocity distribution from a superthermal solid $^2$H$_2$ ultracold neutron source*


*Surface characterization of diamond-like carbon for ultracold neutron storage*
*Storage of ultracold neutrons in high resistivity non-magnetic materials with high Fermi potential*

*Tailored instrumentation for long-pulse neutron spallation sources*

P.-N. Seo *et al.* (PSI: B. Lauss)
*High-efficiency resonant RF spin rotator with broad phase space acceptance for pulsed polarized cold neutrons*

**R-03-01**

F.M. Piegsa, B. van den Brandt, H. Glättli, P. Hautle, J. Kohlbrecher, J.A. Konter, B.S. Schlimme and O. Zimmer
*A Ramsey apparatus for the measurement of the incoherent neutron scattering length of the deuteron*

**CMS Collaboration**

*Design and performance of the silicon sensors for the CMS barrel pixel detector*

P. Adzic *et al.* (CMS Electromagnetic Calorimeter Group, PSI : K. Deiters, Q. Ingram, C. Marchica, D. Renker)
*Intercalibration of the barrel electromagnetic calorimeter of the CMS experiment at start-up*
JINST **3**, P10007 (2008)

*The CMS experiment at the CERN LHC*
JINST **3**, S08004 (2008)
H1 Collaboration

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*Multi-lepton production at high transverse momenta in ep collisions at HERA*  

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*Search for excited electrons in ep collisions at HERA*  

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*Measurement of the proton structure function \( F_2(x,Q^2) \) at low x*  

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*A search for excited neutrinos in e-p collisions at HERA*  

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*Three- and four-jet production at low x at HERA*  

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*Measurement of isolated photon production in deep-inelastic scattering at HERA*  

F.D.Aaron et al. (PSI: S. Egli, R. Eichler, M. Hildebrandt, R. Horisberger)  
*Measurement of deeply virtual Compton scattering and its t-dependence at HERA*  

L3 Collaboration

P. Achard et al. (PSI: K. Deiters)  
*Study of the solar anisotropy for cosmic ray primaries of about 200- GeV energy with the L3 + C muon detector*  

Theory Group

A. Bredenstein, A. Denner, S. Dittmaier and S. Pozzorini  
*NLO QCD corrections to \( t^t b^b \) production at the LHC: 1. quark-antiquark annihilation*  
S. Brensing, S. Dittmaier, M. Krämer and A. Mück
Radiative corrections to W-boson hadroproduction: Higher-order electroweak and supersymmetric effects

J. Brod, F. Fugel and B. A. Kniehl
Dominant two-loop electroweak corrections to the hadroproduction of a pseudoscalar Higgs boson and its photonic decay

M. Ciccolini, A. Denner and S. Dittmaier
Electroweak and QCD corrections to Higgs production via vector-boson fusion at the LHC

A. Denner, B. Jantzen and S. Pozzorini
Two-loop electroweak next-to leading logarithms for processes involving heavy quarks
JHEP 0811, 062 (2008)

R. Horsky, M. Krämer, A. Mück and P. Zerwas
Squark cascade decays to charginos/neutralinos: Gluon radiation

M. Mühlleitner and M. Spira
Higgs boson production via gluon fusion: Squark loops at NLO QCD

D. Noth and M. Spira
Higgs boson couplings to bottom quarks: Two-loop supersymmetry-QCD corrections

CONTRIBUTIONS TO CONFERENCES AND WORKSHOPS

PEN collaboration

M. Bychkov
Muon radiative decay and limits on non-(V-A) weak interaction
American Physical Society, Division of Nuclear Physics Fall Meeting, Oakland, CA, 23-26 October 2008
E. Frlež
Central particle tracking in the PEN experiment
American Physical Society, Division of Nuclear Physics Fall
Meeting, Oakland, CA, 23-26 October 2008

E. Frlež et al. (PSI: W. Bertl)
Precise measurement of $\pi^+\rightarrow e^+\nu$ branching ratio
Contribution to New Trends in High Energy Physics:
Experiment, phenomenology, theory,
Yalta, Crimea, (Ukraine), 27 September - 4 October 2008
arXiv:0812.2829 [hep-ex]

A. Palladino
Waveform analysis for a precision pion decay measurement
American Physical Society, Division of Nuclear Physics Fall
Meeting, Oakland, CA, 23-26 October 2008

MEG Collaboration

B. Keil, S. Lehner and S. Ritt
Application of a 5 GSPS analogue ring sampling chip for low-cost single-shot BPM systems
Proceedings of 11th European Particle Accelerator Conference (EPAC 08), Magazzini del
Cotone, Genoa (Italy) 23 - 27 June 2008, pp TUPC048.

S. Ritt
Design and performance of the 6 GHz waveform digitizing chip DRS4
Proceedings of the 2008 Nuclear Science Symposium (NSS/MIC 2008), Dresden (Germany),
19 - 25 October 2008

Pionic Hydrogen

D. Gotta, F. Amaro, D. F. Anagnostopoulos, S. Biri, D. S. Covita, H. Gorke, A. Gruber,
M. Hennebach, A. Hirtl, T. Ishiwatari, P. Indelicato, Th. Jensen, E.-O. Le Bigot, J. Marton,
M. Nikipelov, J.M.F. dos Santos, S. Schlesser, Ph. Schmid, L. M. Simons, Th. Strauch,
M. Trassinelli, J. F. C. A. Veloso and J. Zmeskal
Conclusions from recent pionic-atom experiments
Proceedings of the International Workshop on Cold Antimatter Plasmas and Application to
Fundamental Physics (PBAR 2008), eds. Y. Kanai and Y. Yamazaki, 20 - 22 February 2008,
Naha, Okinawa (Japan)
Muonic Hydrogen

T. Nebel
*News from the muonic hydrogen Lamb shift experiment*
Poster at the Int. Conf. on Precision Physics of Simple Atomic Systems (PSAS2008),
Windsor, Ontario (Canada), 21 - 26 July 2008

T. Nebel
*News from the muonic hydrogen Lamb shift experiment*
Poster at the 21st Int. Conf. Atomic Physics (ICAP2008),

UCN Collaboration

J. Krempel *et al.*
*Progress on the GAMS-6 double crystal gamma-spectrometer*
Proceedings of the Conference on Precision Electromagnetic Measurements,
Broomfield, Colorado (USA), 8 - 13 June 2008

B. Lauss
*UCN guides for the ultra-cold neutron source at PSI*
Poster at the International Workshop on Particle Physics with Slow Neutrons,
Grenoble (France), 29 - 31 May 2008

B. Lauss
*Fundamentale Physik mit ultrakalten Neutronen am Paul Scherrer Institut*
Poster at the Jahrestagung der "Osterreichischen Physikalischen Gesellschaft,
Leoben (Austria), 22 - 26 September 2008

G. Zsigmond
*Monte Carlo optimization of the polarized beamlines of the ultracold neutron source at PSI*
Poster at the International Workshop on Particle Physics with Slow Neutrons,
Grenoble (France), 29 - 31 May 2008

CMS Collaboration

W. Erdmann
*Vertex reconstruction at the CMS experiment*
Theory Group

N.E. Adam et al. (PSI: M. Ciccolini, A. Denner, M. Spira)
*Higgs working group summary report*

Z. Bern et al. (PSI: A. Denner)
The NLO multileg working group: Summary report

A. Bredenstein, A. Denner, S. Dittmaier and S. Pozzorini
NLO QCD corrections to $pp \rightarrow t \bar{t} b \bar{b}$ via quark anti-quark annihilation
Proceedings of 9th Workshop on Elementary Particle Theory:
Loops and Legs in Quantum Field Theory, Sondershausen (Germany), 20 - 25 April 2008

C. Buttar et al. (PSI: B. Jantzen)
Standard Model handles and candles working group: Tools and jets summary report
Report of SMHC working group for the Workshop "Physics at TeV Colliders",
Les Houches (France), 11 - 29 June, 2007

M. Ciccolini, A. Denner and S. Dittmaier
Strong and electroweak NLO corrections to Higgs-boson production in vector-boson fusion at the LHC
Proceedings of 9th Workshop on Elementary Particle Theory:
Loops and Legs in Quantum Field Theory, Sondershausen (Germany), 20 - 25 April 2008

A. Denner, B. Jantzen and S. Pozzorini
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Proceedings of the 8th International Symposium on Radiative Corrections (RADCOR07), Florence (Italy), 1 - 5 October 2007

T. Hahn, S. Heinemeyer, W. Hollik, H. Rzehak and G. Weiglein
FeynHiggs and more
Proceedings of the 9th DESY Workshop on Elementary Particle Theory,
Sondershausen (Germany), 20 - 25 April 2008
T. Hahn, S. Heinemeyer, W. Hollik, H. Rzehak and G. Weiglein
Two-loop corrections to the charged Higgs-boson mass in the MSSM
Proceedings of the 9th DESY Workshop on Elementary Particle Theory,
Sondershausen (Germany), 20 - 25 April 2008

K. Kampf, J. Novotny and J. Trnka
Renormalization of tensor self-energy in resonance chiral theory
Contribution to Hadron structure 07, Slovakia

K. Kampf, M. Knecht, J. Novotny and M. Zdrahal
Dispersive representation of $K \to 3\pi$ amplitudes and cusps
Contribution to QCD 08, Montpellier (France)

K. Kampf, J. Novotny and J. Trnka
Renormalization of the antisymmetric tensor field propagator and dynamical generation of the $1^+$-mesons in resonance chiral theory
Contribution to QCD 08, Montpellier (France)

R. Rosenfelder
Stochastic evaluation of high-energy potential scattering
Poster at PANIC08 - International Conference on Particles And Nuclei, Eilat (Israel), 9 - 14 November 2008, abstract no. 82-288.

PUBLISHED PROCEEDINGS (from previous conferences)

F. del Aguila et al. (PSI: M. Spira)
Collider aspects of flavour physics at high Q
Report of Working Group 1 of the CERN Workshop Flavor in the Era of the LHC:
A Workshop on the Interplay of Flavor and Collider Physics,
Geneva (Switzerland), 7 - 10 November 2005

M. Artuso (ed.) et al. (PSI: R. Horisberger)
Vertex detectors
Proceedings of the 16th International Workshop (Vertex 2007),
Lake Placid (USA), 23 - 28 September 2007
SISSA , Trieste (Italy), (2008) nonconsec. pag.
A. Biland, I. Britvich, E. Lorenz, N. Otte, F. Pauss, D. Renker, S. Ritt, U. Roesner and M. Scheebeli
*First detection of air shower Cherenkov light by Geigermode avalanche photodiodes*
Proceedings of the Sixth International Workshop on Ring Imaging Cherenkov Detectors (RICH 2007)

B. van den Brandt, P. Hautle, J.A. Konter, F.M. Piegsa and J.P. Urrego-Blanco
*Polarised nuclei: From fundamental nuclear physics to applications in neutron scattering and magnetic resonance imaging*
12th Int. Workshop on Polarized Sources, Targets \& Polarimetry
Brookhaven, NY (USA), 10 - 14 September 2007

*Pionic hydrogen*

U. Langenegger, A. Starodumov and D. Wiesmann
*Topological reconstruction of decays with missing particles*
18th Hadron Collider Physics Symposium 2007 (HCP 2007),
La Biodola, Isola d’Elba (Italy), 20 - 26 May 2007

S. Mayer, G. Zsigmond and P. Allenspach
*Monte-Carlo simulation of phase space transformation of ultra-cold neutrons*
Proceedings of the European Workshop on Neutron Optics (NOP07),
Paul Scherrer Institut, Villigen (Switzerland), 5 - 7 March 2007

M. Raidal et al. (PSI: K. Kirch)
*Flavor physics of leptons and dipole moments*
R. Fleischer, T. Hurth and M. L. Mangano

R. Rosenfelder
*Perturbative results without diagrams*
Proceedings of he 9th International Conference ``Path Integrals - New Trends and Perspectives``,
Dresden, Germany (2007), eds. W. Janke and A. Pelster,
World Scientific, Singapore, 2008
S. Santra et al.
Parity-violating gamma asymmetry in $\eta + p \to d + \gamma$
Proceedings of the DAE Symposium on Nuclear Physics,
Sambalpur, Burla, Orissa (India), 11-15 December 2007

A. Starodumov
Rare heavy flavor decays at ATLAS and CMS
18th Hadron Collider Physics Symposium 2007 (HCP 2007),
La Biodola, Isola d'Elba (Italy), 20-26 May 2007

A. Starodumov
Missing particle reconstruction using vertexing
Proceedings of the CERN Workshop on Flavor in the Era of the LHC, October 2006, CERN
(Switzerland),
ed. M. Artuso et al.

INVITED TALKS

M. Hildebrandt
The drift chamber system of the MEG experiment
Seminar f. Teilchen- und Astrophysik,
Universität Zürich, 19 November 2008

F.M. Piegsa,
An accurate measurement of the spin-dependent neutron-deuteron scattering length
International Workshop on Particle Physics with Slow Neutrons,
Grenoble (France), 29-31 May 2008

F.M. Piegsa
Neutron spin precession in samples of polarised nuclei and neutron spin phase imaging
Excellence-Cluster Seminar, Garching (Germany), 26 August 2008

F.M. Piegsa
Polarised solid targets at PSI
18th International Spin Physics Symposium, Charlottesville, VA (USA), 6-11 October 2008

F.M. Piegsa
Neutron spin precession in samples of polarised nuclei and neutron spin phase imaging
Group Seminar of Prof. G. Gratta, Stanford University, Stanford, CA (USA), 13 October 2008
D. Renker  
*New developments on photosensors for particle physics instrumentation for colliding beam physics*  
INSTR08, Novosibirsk (Russia), 28 February - 5 March 2008

D. Renker  
*Progress in the development of Geiger-mode avalanche photodiodes*  
IEEE Nuclear Science Symposium, Dresden (Germany), 19 - 25 October 2008

**UCN Collaboration**

R. Henneck  
*The new high-intensity ultracold neutron source at PSI*  
PANIC08, Eilat (Israel), 9 - 14 November 2008

K. Kirch  
*Towards a new measurement of the neutron electric dipole moment*  
Int. Workshop on Particle Physics with Slow Neutrons, Grenoble (France), 29 - 31 May 2008

K. Kirch  
*Betazerfall: R-Parameter*  
39. Arbeitstreffen Kernphysik Schleching, Schleching (Austria), 21 - 28 February 2008

K. Kirch  
*FUN with UCN*  
Universität Bern, 23 April 2008

K. Kirch  
*The quest for new physics: Neutrons and muons*  
ETH Zürich, 3 June 2008

K. Kirch  
*Neutron EDM experiments*  
Workshop on *P and T Violation at Low Energies and Related Phenomena*, Heidelberg (Germany), 9 - 11 June 2008

K. Kirch  
*Muon electric dipole moment*  
10th International Workshop on Neutrino Factories, Superbeams and Betabeams (NuFact08), Valencia (Spain), 30 June - 5 July 2008

K. Kirch  
*FUN with UCN*  
Universität Münster, 4 July 2008
K. Kirch
Low energy precision experiments (2 lectures)
ZuoZ Summer School on New Ideas in Particle Physics,
ZuoZ, Engadine (Switzerland), 13 - 19 July 2008

K. Kirch
Ultrakalte Neutronen
Universität Wuppertal, 24 November 2008

K. Kirch
Ultracold neutrons at ILL and PSI
Symposium on the Occasion of 20 Years Partnership between Switzerland and
the Institut Laue-Langevin ILL Grenoble, PSI, 28 November 2008

A. Knecht
A direct experimental limit on neutron - mirror neutron oscillations
SPG Jahrestagung, Geneva (Switzerland), 26 - 27 March 2008

A. Knecht
A direct experimental limit on neutron - mirror neutron oscillations
Talk and poster at International Workshop on Particle Physics with Slow Neutrons,
Grenoble (France), 29 - 31 May 2008

M. Kuzniak
An improved electric dipole moment experiment
FCPC08, Taipei (Taiwan), 5 - 9 May 2008.

B. Lauss
Status of the ultra-cold neutron source and the neutron EDM experiment at the
Paul Scherrer Institut
4th International Workshop on Nuclear and Particle Physics at J-PARC (NP08),
Ibaraki (Japan), 5 - 7 March 2008

B. Lauss
Experiments on muon capture and muon lifetime: Latest results and future goals
Annual Meeting of the Swiss Physical Society, Geneva (Switzerland), 27 - 28 March 2008

B. Lauss
Fundamentale Physik mit ultrakalten Neutronen am Paul Scherrer Institut
Fachausschusstagung Kern- und Teilchenphysik der Österreichischen Physikalischen
Gesellschaft, Aflenz (Austria), 21 - 23 September 2008

B. Lauss
Fundamental measurements with muons - View from PSI
International Conference on Particles And Nuclei (PANIC08),
Eilat (Israel), 9 - 14 November 2008
G. Zsigmond
The UCN source at PSI
Workshop on tailored neutron beams & neutron anti-bunching, ATI
Wien (Austria), 6 - 8 March 2008

PEN Collaboration

D. Počanić
Rare pion and muon decays: Summary of results and prospects
"Low Energy Precision Electroweak Physics in the LHC Era,"
Institute for Nuclear Theory, University of Washington,
Seattle, 21 November 2008

D. Počanić
PEN Experiment: A sensitive search for non-(V-A) weak processes
18th International Conference on Particles and Nuclei (PANIC08),
Eilat, Israel, 9--14 November 2008

MEG Collaboration

F. Cei
The MEG experiment
Neutrino Oscillation Workshop (NOE 2008), Conca Specchiulla Otranto,
Lecce (Italy), 6 - 13 September 2008.

L. Galli
An FPGA-based trigger for the search of $\mu \rightarrow e + \gamma$ in the MEG experiment

O. Kiselev
Status of MEG experiment
10th International Workshop on Tau Lepton Physics, Budker Institute of Nuclear Physics,
Novosibirsk, 22 - 25 September 2008

O. Kiselev
Positron spectrometer of MEG experiment at PSI
8th International Conference on Position Sensitive Detectors (PSD8),
Glasgow, Scotland, 1- 5 September 2008

W. Ootani
Status of MEG at PSI & prospects
3rd CHIPP Neutrino Meeting, ETHZ, Zürich, 17 - 18 November 2008
A. Papa
Search for lepton flavour violation with the MEG experiment
New Trends in High Energy Physics (Crimea 2008),
Yalta (Ukraine), 27 September - 4 October 2008

S. Ritt
Tackling the search for Lepton flavour violation with GHz waveform digitizing using the DRS chip
Seminar at Fermilab, Batavia, Illinois (USA), 26 February 2008

G. Signorelli
The MEG experiment at PSI: Status and prospects
PANIC 2008, Eilat (Israel), 11 - 16 November 2008

G. Signorelli
Status of MEG: An experiment to search for the $\mu \to e\gamma$ decay
Symposium on Muon Physics during the Workshop "Low Energy Precision Electroweak Physics in the LHC Era",
Institute of Nuclear Theory & University of Washington,
Seattle, WA (USA), 27-30 October 2008

Pionic Hydrogen

D. Gotta
X-ray spectroscopy of light hadronic atoms
International Conference on Exotic Atoms (EXA08),
Vienna (Austria), 15 - 19 September 2008

MuLan Collaboration

K. Lynch
The MuLan experiment: Measuring the muon lifetime to 1ppm
10th International Workshop on Tau Lepton Physics (Tau08),
Budker Institute for Nuclear Physics, Novosibirsk (Russia), 22 - 25 September 2008

MuCap Collaboration

C. Petitjean
Muon capture in hydrogen and deuterium
Int. Conference on Exotic Atoms & related topics (EXA08),
Vienna (Austria), 15 - 18 September 2008
*Deuterium removal unit for the Mucap experiment*  
NHA Annual Hydrogen Conference 2008, Sacramento, CA (USA), 30 March - 3 April 2008

**Muonic Hydrogen**

A. Antognini  
*The thin-disk laser for the muonic hydrogen Lamb shift experiment*  
International Workshop on Laserspectroscopy,  
Ringberg-Tegernsee (Germany), 8 - 12 September 2008

T. Nebel  
*Lamb shift in muonic hydrogen: Experiment and results from the 2007 campaign*  
International Workshop on Laserspectroscopy,  
Ringberg-Tegernsee (Germany), 8 - 12 September 2008

R. Pohl  
*2S state and Lamb shift in muonic hydrogen*  
International Workshop on Laserspectroscopy,  
Ringberg-Tegernsee (Germany), 8 - 12 September 2008.

R. Pohl  
*2S state and Lamb shift in muonic hydrogen*  
Int. Conf. on Exotic Atoms and Related  
Topics (EXA08), Vienna (Austria), 15 - 19 September 2008

**CMS Collaboration**

L. Caminda and A. Starodumov  
*Building and commissioning of the CMS pixel barrel detector*  

L. Caminda  
*Topics in heavy quark physics at CMS*  
18th International Conference On Particles and Nuclei (PANIC08),  
Eilat (Israel), 9 - 14 November 2008

W. Erdmann  
*Beam spot and primary vertices*  
CMS b-tagging workshop, CERN, 29 October 2008

W. Erdmann  
*Tracking in high energy physics*  
University of Kansas, Kansas (USA), 17 September 2008
R. Horisberger
Conference summary talk of VERTEX 2008
17th International Workshop on Vertex detectors (Vertex2008), Utö Island (Sweden), 28 July - 1 August 2008

H.-C. Kästli
Integration and installation of the CMS pixel barrel detector
17th International Workshop on Vertex detectors (Vertex2008), Utö Island (Sweden), 28 July - 1 August 2008

S. König
Building the detector modules for the barrel part of the CMS pixel detector
Vertical Integration Technologies for HEP and Imaging Sensors, Ringberg Castle, Lake Tegernsee (Germany), 7 April 2008

D. Kottlinski
Status of the CMS pixel detector
Pixel 2008 International Workshop, Fermilab, Batavia (USA), 23 - 26 September 2008

B. Meier
Design studies of a low power serial data link for a possible upgrade of the CMS pixel detector
Topical Workshop on Electronics for Particle Physics Search (TWEPP-08), Naxos (Greece), 15 - 19 September 2008

T. Rohe
Signal height in silicon pixel detectors irradiated with pions and protons
7th International Conference on Radiation Effects on Semiconductor Materials Detectors and Devices, Florence (Italy), 15 - 17 October 2008

A. Starodumov
Building the CMS pixel barrel detector: Assembling, testing and integration
Pixel 2008 International Workshop, Fermilab, Batavia (USA), 23 - 26 September 2008

A. Starodumov
Flavor physics with CMS at LHC
2nd International Workshop on Theory, Phenomenology and Experiments in Heavy Flavor Physics, Capri (Italy), 16 - 18 June 2008

**Theory Group**

A. Denner
Reduction of multiparticle one-loop integrals and amplitudes (5 lectures)
Third Graduate School in Physics at Colliders: from Twistors to Monte Carlos, Turin (Italy), 7 - 11 January 2008
A. Denner
*Electroweak and QCD corrections to Higgs production in vector-boson fusion at the LHC*
8th DESY Workshop: Loops and Legs in Quantum Field Theory, Sondershausen (Germany), 20 - 25 April 2008

A. Denner
*Towards reliable predictions for multiparticle processes at the LHC*
Seminar Elementarteilchentheorie, Würzburg (Germany), 5 June 2008

A. Mück
*Squark decay chains at NLO SUSY-QCD*
Theory Seminar, MPI München (Germany), 28 January 2008

A. Mück
*Electroweak precision at the LHC*
Frühjahrstagung der Deutschen Physikalischen Gesellschaft, Freiburg (Germany), 4 March 2008

A. Mück
*Electroweak precision for W-boson production at the LHC*
Swiss Physical Society Annual Meeting, Geneva (Switzerland), 26 March 2008

A. Mück
*Squark decay chains at NLO SUSY-QCD*
CMS SUSY Meeting, CERN, 30 April 2008

A. Mück
*Squark decay chains at NLO SUSY-QCD*
ATLAS SUSY Meeting, CERN, 21 May 2008

A. Mück
*Squark decay chains at NLO SUSY-QCD*
Particle Physics Seminar, ETH Zürich, 27 May 2008

A. Mück
*Electroweak corrections to W hadroproduction*
LHC-D workshop on QCD and EW Physics, Zürich, 3 June 2008

A. Mück
*Precise prediction for MSSM Higgs-boson production in bottom quark fusion*
MSSM Higgs Physics at the LHC: Theory meets Experiment, Santander (Spain), 8 October 2008

M. Spira
*Associated MSSM Higgs production with heavy quarks: SUSY-QCD corrections*
SUSY08 conference, Seoul (Korea), 16 - 21 June 2008
M. Spira
*Recent progress in Higgs cross section (and branching ratios) calculations*
CMS-Meeting, CERN, 4 July 2008

M. Spira
*Associated MSSM Higgs production with heavy quarks: SUSY-QCD corrections*
SUSY08 conference, Seoul (Korea), 16 - 21 June 2008

M. Spira
*Higgs & ILC: Reality or wishful thinking?*
LC08 School, Frascati (Italy), 22 - 25 September 2008

**OUTREACH AND OTHER SCIENTIFIC ACTIVITIES**

P.-R. Kettle
*New COMET brings a promising future to proton therapy*

A. Knecht and M. Kuzniak
*Mirror matter - Experimental search for neutron to mirror neutron oscillations*
SPG Mitteilungen **22**, 6 2008

A. Knecht and M. Kuzniak
*Mirror matter - experimental search for neutron to mirror neutron oscillations*

R. Rosenfelder and M. Spira (organizers)
*New ideas in particle physics*
Summer School, Lyceum Alpinum, Zuoz, Engadine (Switzerland), 13 - 19 July 2008

**LECTURES AND COURSES**

A. Denner
*Das Standardmodell der elektroschwachen Wechselwirkung und dessen Erweiterungen*
ETH Zürich, HS 08

R. Horisberger
*Elektronik für Physiker I, Analog*
ETH Zürich, HS 08
R. Rosenfelder  
*Pfadintegrale in der Quantenphysik*  
ETH Zürich, HS 08

M. Spira and A. Mück  
*LTP-Colloquium*  
PSI, FS 08, HS 08

M. Spira  
*Einführung in die Quantenchromodynamik*  
ETH Zürich, FS 08

M. Spira (with F. Moortgat)  
*Jenseits des Standardmodells*  
ETH Zürich, HS 08

**THESES**

S. Heule  
*Production, characterization and reflectivity measurements of diamond-like carbon and other ultracold neutron guide materials*  

M. Kasprzak  
*Ultracold neutron converters*  

M. Kuzniak  
*The neutron electric dipole moment experiment: Research and development for the new spectrometer*  
Doctoral thesis, Jagiellonian University, Krakow (Poland), 2008

H. Nishiguchi  
*An innovative positron spectrometer to search for the lepton flavour violating muon decay with a sensitivity of 10^{-13}*  
Doctoral Thesis, University of Tokyo, 2008  
Advisors: T. Mori (Tokyo), J. Egger (PSI)

D. Noth  
*Supersymmetric precision calculations of bottom Yukawa couplings*  
Doctoral thesis, Universität Zürich, December 2008  
Advisors: M. Spira (PSI), D. Wyler (U. Zürich)
COMMITTEES

R. Horisberger
- President of the Internal PSI Forschungskommission (FOKO),
- Member of the Photon Science Committee at HASYLAB, DESY Hamburg,
- Member of the Advisory Committee of VERTEX-Conferences

K. Kirch
- Member of the Committee of the Swiss Physical Society,
- Swiss Correspondent for Nuclear Physics News

S. Ritt
- Elected member of the IEEE Nuclear & Plasma Sciences Society Administrative Committee (AdCom)

R. Rosenfelder
- Member of the Research Committee BVR at PSI

M. Spira
- Convenor of the working group 'Electroweak Gauge Theories and Alternative Theories' of the 'ECFA Study of Physics and Detectors for a Linear Collider'
Radio- and Environmental Chemistry
LIST OF PUBLICATIONS

HEAVY ELEMENTS

D. Piguet, P. Rasmussen, A. Serov, S.V. Shishkin, A.V. Shutov, A.I. Srivikhin, E.E. Tereshatov, G.K. Vostokin,
M. Wegrzecki, A.V. Yeremin
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D. Piguet, P. Rasmussen, A. Serov, S.V. Shishkin, A.V. Shutov, A.I. Srivikhin, E.E. Tereshatov, G.K. Vostokin,
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Angew. Chem. 120(17), 3306-3310 (2008).

J.M. Gates, M.A. Garcia, K.E. Gregorich, Ch.E. Dullmann, I. Dragojevic’, J. Dvorak, R. Eichler, C.M. Folden,
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S.L. Nelson, C.M. Folden III, K.E. Gregorich, I. Dragojevic’, Ch.E. Dullmann, R. Eichler, M.A. Garcia, J.M. Gates,
R. Sudowe, H. Nitsche
Comparison of complementary reactions for the production of $^{261,262\text{Bh}}$

SURFACE CHEMISTRY

J. Abbatt, T. Bartels-Rausch, M. Ullerstam, T. Ye
Uptake of acetone, ethanol and benzene to snow and ice: Effects of surface area and temperature

T. Bartels-Rausch, T. Huthwelker, M. Jöri, H.W. Gąggele, M. Ammann
Interaction of gaseous elemental mercury with snow surfaces: Laboratory investigation

M. Kerbrat, B. Pinzer, T. Huthwelker, H.W. Gąggele, M. Ammann, M. Schneebeli
Measuring the specific surface area of snow with x-ray tomography and gas adsorption: Comparison and implications for
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M. Ndour, B. D’Anna, C. George, O. Ka, Y. Balkansi, J. Kleffmann, K. Stemmler, M. Ammann
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K. Stemmler, A. Vlasenko, C. Guimbaud, M. Ammann
The effect of fatty acid surfactants on the uptake of nitric acid to deliquesced NaCl aerosol

O. Vesna, S. Sjogren, E. Weingartner, V. Samburova, M. Kalberer, H.W. Gąggele, M. Ammann
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ANALYTICAL CHEMISTRY

E. Dietze, A. Kleber, M. Schwikowski

S. Kaspari, R. Hooke, P.A. Mayewski, S. Kang, S. Hou, D. Qin

F. Vimeux, P. Ginot, M. Schwikowski, M. Vuille, G. Hoffmann, L.G. Thompson, U. Schotterer

RADWASTE ANALYTICS

S. Chiriki, J. Fachinger, R. Mormann
Decommissioning and safety issues of liquidmercury waste generated from high power spallation sources with particle accelerators
11th International Conference on Radiation Shielding (ICRS-11) of American Nuclear Society, Pine Mountain, Georgia, USA.

J. Neuhausen, S. Horn, B. Eichler, D. Schumann, T. Stora, M. Eller
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Results from the ESA SREM monitors and comparison with existing radiation belt models

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J. Řipa, A. Mészáros, R. Hudec, C. Wigger, W. Hajdas
The RHESSI Satellite and Classes of Gamma-ray Bursts

J. Řipa, D. Huja, A. Mészáros, R. Hudec, W. Hajdas, C. Wigger
A Search for Gamma-ray Burst Subgroups in the SWIFT and RHESSI Databases

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C. Wigger, O. Wigger, E. Bellm, W. Hajdas
Prompt spectrum of GRB 021206 supports the Cannonball Model

C. Wigger, O. Wigger, E. Bellm, W. Hajdas
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N. Homazava, A. Shkabko, D. Logvinovich, U. Krähenbühl, A. Ulrich
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*Determination of biogenic and fossil CO₂ emitted by waste incineration based on ¹³C CO₂ and mass balances*

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**TECHNICAL REPORTS**

Y. Dai, J. Neuhausen, D. Schumann
*Specimen extraction plan for MEGAPIE PIE*

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HEAVY ELEMENTS

R. Dressler, D. Schumann, R. Eichler, S.V. Shishkin
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R. Eichler for a PSI-University of Bern-FLNR-LLNL-ITE collaboration
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**SURFACE CHEMISTRY**

M. Ammann
*Effects of fatty acids on $\text{HNO}_3$ uptake to deliquesced NaCl particles*
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M. Ammann
*Phase transfer properties, ozonolysis and photochemistry of organic films of atmospheric relevance*
Seminar, Brookhaven National Laboratory, Long Island, NY, USA, 11 April 2008.

M. Ammann
*Tracing phase transfer at the interface between chemistry and climate*
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M. Ammann
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M. Ammann
*Can a XFEL shed light on atmospheric particles?*
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M. Ammann
*Mechanisms and kinetics of heterogeneous reactions of nitrogen oxides with tropospheric aerosol particles*
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T. Bartels-Rausch, M. Ammann, J. Kleffmann, Y. Elshorbany, M. Brigante, B. D’Anna, C. George
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Invited Eurochamp HONO Workshop, Bergische Universität Wuppertal, Wuppertal, Germany, 1-3 March 2008.

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Recent results on the uptake of HNO2 and HNO3 on ice surfaces from laboratory studies
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A. Křepelová, M. Ammann, J.T. Newberg, H. Bluhm, T. Huthwelker
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A. Rouviere, M. Ammann
Heterogeneous reactions of ozone on inorganic aerosol particles. Influence of fatty acid coating.
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A. Rouvière, M. Ammann
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A. Rouvière, M. Ammann
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A. Schlierf
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A. Ciric
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A. Eichler, S. Olivier, H. Henderson, A. Laube, J. Beer, T. Papina, M. Schwikowski
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S. Kaspari, M. Schwikowski, P. Mayewski, S. Kang, S. Hou
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Kathmandu, Nepal, 4-7 December 2008.

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_Holocene climatic fluctuations including Medieval Warm Period and Little Ice Age type events in tropical South America deduced from Illimani ice core_

M. Schläppi, T. Jenk, B. Rufibach, A. Rivera, M. Rodriguez, G. Casassa, M. Schwikowski
_Results of the ice core from Pio XI, Southern Patagonian ice field_
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M. Schwikowski
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M. Schwikowski
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M. Schwikowski
_Chemistry of glacier ice: Frozen archive of past environmental conditions_

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M. Schwikowski
_Ice cores from the Alps: Challenges in reconstructing paleo climate_

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M. Sigl
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*Anwendung der (Continuous Ice Melting) CIM-ICP-SF-MS zur Bestimmung von Spurenelementen in Eiskernen aus den Südamerikanischen Anden*

**RADWASTE ANALYTICS**

S. Chiriki, N. Prolingheur, R. Moormann
*A simplified method for estimation of groundwater contamination surrounding accelerators and high power targets*

S. Chiriki, K. Bongardt, J. Fachinger, M. Herbst, B. Heuel-Fabianek, R. Moormann, R. Nabb, N.Prolingheuer, B.Schlögl
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J. Neuhausen

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PIE-samples for radiochemical analysis

J. Neuhausen

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Radiochemical analysis in MEGAPIE PIE

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Radiochemical analysis in MEGAPIE PIE

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Abschätzung der Aktivitätsfreisetzung beim Ausschmelzen der Proben im Megapie-Target
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Villigen

G. Korschinek, G. Rugel, Th. Faestermann, I. Dillmann, C. Domingo Pardo, F. Käppeler, J. Marganiec, F. Voss, S. Walter, M. Heil,
R. Reifarth, J. Goerres6, E. Uberseder, M. Wiescher
Radionuclides of astrophysical interest from accelerator waste

D. Schumann, J. Neuhausen, I. Dillmann, C. Domingo Pardo, F. Käppeler, J. Marganiec, F. Voss, S. Walter, M. Heil,
R. Reifarth, J. Goerres, E. Uberseder, M. Wiescher, M. Pignatari
Preparation of a 60Fe target for nuclear astrophysics experiments

D. Schumann
The ERAWASTInitiative - a new approach for isotope production

D. Schumann
ERAWAST - A status report
SARAF workshop, Jerusalem, Israel, 26-29 October 2008.

D. Schumann
Wässrige Chemie von Transaktiniden
Succession Professorship J.V. Kratz, University of Mainz, Germany, 24/25 November 2008.

PROTON IRRADIATION FACILITY

U. Grossner, W. Hajdas, K. Egli, R. Brun, R. Harboe-Sorensen
New proton irradiation facility at Paul Scherrer Institute
NUCLEAR AND SPACE RADIATION EFFECTS CONFERENCE NSREC 2008

U. Grossner, W. Hajdas, K. Egli, R. Brun, R. Harboe-Sorensen
Proton irradiation facility at the PROSCAN project of the Paul Scherrer Institute
8th European Workshop on Radiation Effects on Components and Systems RADECS2008, Jyvaskyla,
10-12 September 2008.
W. Hajdas, C. Eggel, D. Kotlinski, B. Schmitt, St. Scherrner, N. Schlumpf, A. Mohammadzadeh, P. Nieminen
Development of the low energy electron detector
Seminar in the Swiss Space Office, Bern, Switzerland, 12 March 2008.

W. Hajdas
PIF activities: from ground tests to space weather monitoring and biggest cosmic explosions
Seminar in the Physics Institute of the Bern University, Bern, Switzerland, 12 March 2008.

W. Hajdas, St. Scherrner, K. Egli, N. Schlumpf, B. Schmitt, A. Mohammadzadeh, P. Nieminen, C. Eggel, D. Kotlinski
Current status of the low energy electron detector

W. Hajdas
POLAR - novel hard X-ray polarimeter for gamma ray bursts
37th COSPAR Scientific Assembly, Montréal, Canada, 13-20 July 2008.

W. Hajdas
Low energy electron detector for space radiation measurements
37th COSPAR Scientific Assembly, Montréal, Canada, 13-20 July 2008.

H. Evans, E.J. Daly, P. Nieminen, W. Hajdas, A. Mohammadzadeh, D. Rodgers, G. Mandorlo, K. Ryden
Use of radiation Monitor data for validation of radiation environment specifications based on the NASA AE8 Models
37th COSPAR Scientific Assembly, Montréal, Canada, 13-20 July 2008.

W. Hajdas
SREM data base and calibration meeting
ESA-ESTEC, Nordwijk, 6-7 October 2008.

W. Hajdas, E. Daly, L. Desorgher, C. Eggel, K. Egli, H. Evans, D. Kotlinski, D. Marinov, A. Mohammadzadeh,
P. Nieminen, G. Santin, St. Scherrner, N. Schlumpf, B. Schmitt
Space radiation monitoring activities at PSI

St. Scherrner, W. Hajdas, U. Grossner, N. Schlumpf
Proton radiation test of DC/DC converter with high voltage output

ENVIRONMENTAL RADIONUCLIDES UNIVERSITÄT BERN

A.C. Aiken, C. Wiedinmyer, B. de Foy, D. Salcedo, M. Cubison, I. Ulbrich, P. DeCarlo, J.A. Huffman, K. Docherty,
Organic aerosols in Mexico City: urban and biomass burning contributions during MILAGRO / MCMA-2006 at the urban supersite (T0)

S. Fahrni
Towards compound-specific radiocarbon analysis of carbonaceous aerosols
Seminar Radio- und Umweltchemie, University of Berne, Switzerland, 4 April 2008.

S. Fahrni
Towards compound-specific radiocarbon analysis of carbonaceous aerosols
First Year Graduate Student Symposium, University of Berne, Switzerland, 8 September 2008.

S. Fahrni, H.W. Gäggeler, I. Hajdas, M. Ruff, S. Szidat, L. Wacker
A direct combination of CuO oxidation with a gas ion source for small 14C samples
N. Perron, L. Besnier, S. Szidat, A.S.H. Prévôt, U. Baltensperger
EC and OC separation for $^{14}$C analysis: a challenge
Seminar Laboratory of Atmospheric Chemistry, Paul Scherrer Institut, Switzerland, 19 May 2008.

N. Perron, L. Besnier, S. Szidat, A.S.H. Prévôt, U. Baltensperger
EC and OC separation for $^{14}$C analysis

Optimised separation of OC and EC for radiocarbon-based source apportionment of carbonaceous aerosol
9th International Conference on Carbonaceous Particles in the Atmosphere, Berkeley, CA, USA, 12-14 August 2008.

N. Perron, S. Szidat, A. S. H. Prévôt, U. Baltensperger
Carbonaceous aerosol: OC and EC separation for radiocarbon-based source apportionment

N. Perron, S. Szidat, A.S.H. Prévôt, U. Baltensperger
Carbonaceous aerosol: OC and EC separation for radiocarbon-based source apportionment
Seminar Laboratory of Atmospheric Chemistry, Paul Scherrer Institut, Switzerland, 10 November 2008.

Improved separation of OC and EC for radiocarbon-based source apportionment of carbonaceous aerosol
EUCAARI annual meeting, Helsinki, Finland, 17-21 November 2008.

A comparison of new and classic methods to estimate the wood smoke contribution to particulate matter for several field campaigns
European Aerosol Conference, Thessaloniki, Greece, 24-29 August, 2008.

Comparison of different wood smoke markers in ambient aerosol

Fully automated radiocarbon AMS measurements with elemental analyser and gas ion source

Radiocarbon dating of small samples
5th International Symposium on Radiocarbon and Archaeology, Zürich, Switzerland, 26-28 March 2008.

Radiocarbon measurements with the MICADAS gas ion source

S. Schmoker
Compound-specific radiocarbon dating of various soil components
Seminar Radio- und Umweltchemie, University of Berne, Switzerland, 12 December 2008.

Recent developments in accelerator mass spectrometry and its impact to archaeology
5th International Symposium on Radiocarbon and Archaeology, Zürich, Switzerland, 26-28 March 2008.

S. Szidat
$^{14}$C-Analysen von Feinstaubproben
Refined $^{14}$C source apportionment of organic carbon
9th International Conference on Carbonaceous Particles in the Atmosphere, Berkeley, CA, USA, 12-14 August 2008.

L. Wacker, M. Němec, J. Bourquin
A revolutionary graphitisation system: fully automated, compact and simple
PUBLIC RELATIONS

Analytical Chemistry
Printed media

- Die Botschaft
  *Menschliche Einflüsse unbestreitbar*

- Argauer Zeitung
  *In Zukunft recht unbeständig, Leibstadt Vortragsreihe „Klima und Atmosphäre“ im Kernkraftwerk*

- PSI media release
  *Temperatur im Altai folgt Sonne mit Verzögerung*
  19 December 2008.

- Tagesanzeiger
  *Sonne beeinflusst die Temperatur Sibiriens*
  23 December 2008.

Demonstration
Tage der Offenen Tür am PSI
*Klimasignale im Gletschereis und in Bäumen*

Proton Irradiation Facility
Demonstration
Tage der Offenen Tür am PSI
*Radiation detectors for space weather monitoring*

Environmental Radionuclides Universität Bern

- Homepage Department of Chemistry and Biochemistry, Uni Bern
  *Device of the month: Radiocarbon dating of small samples using on-line combustion*
  http://www.dcb-server.unibe.ch/dcbneu/mom/mom0408.html
  April 2008.

- PSI Scientific report 2007
  *New findings on the sources of fine particles in ambient air in Switzerland*
  June 2008.

- PSI, Energie-Spiegel Nr.19
  *Vorsicht Feinstaub*
  July 2008.

- Senioren-Universität, Uni Bern
  *Vortrag U. Krähenbühl: Auf Meteoritensuche in kalten und heissen Wüstengebieten (Antarktis und Oman)*
  2 December 2008.
MEMBERS OF SCIENTIFIC COMMITTEES
EXTERNAL ACTIVITIES

Dr. Markus Ammann:
- Air-Ice Chemical Interactions (AICI), Member of Steering Committee
- Atmospheric Chemistry and Physics: member of editorial board
- Member of the IUPAC Subcommittee on gas kinetic data evaluation
- PSI internal research commission (FoKo), member

Dr. Robert Eichler:
- PSI internal research commission (FoKo), member

Prof. Dr. Heinz W. Gäggeler:
- Nuklearforum Schweiz, Member of the Executive Board and Member of the Science Board
- Schweizerische Kommission für die hochalpine Forschungsstation Jungfraujoch der SANW (Mitglied)
- Astronomische Kommission der Stiftung Jungfraujoch und Gornergrat (Member)
- Joint IUPAC/IUPAP Working Party (JWP) on the discovery of new elements (Member)
- International Union of Pure and Applied Chemistry (IUPAC) (Fellow)
- Steering Committee of EURISOL (Member)
- Division of Nuclear and Radiochemistry, European Association for Chemical and Molecular Sciences (EuCheMS) (Chairman)
- Oeschger Centre for Climate Change Research, Member of the Scientific Board

Dr. Wojtek Hajdas:
- Official Reviewer for the 8th European Workshop on Radiation Effects on Components and Systems RADECS2008, Jyvaskyla, 10-12 September 2008
- Session Chair for the session “dosimetry and facilities” of the 8th European Workshop on Radiation Effects on Components and Systems RADECS2008, Jyvaskyla, 10-12 September 2008
- International Technical Committee of the 8th European Workshop on Radiation Effects on Components and Systems RADECS2008, Jyvaskyla, 10-12 September 2008
- Organizing Committee for 9th ESA Final Presentation Days and RADECS Thematoc Workshop, 27-29 January, PSI Villigen

Dr. Dorothea Schumann:
- Member of the Nuklearforum Schweiz
- Member of the Schweizerische Gesellschaft der Kernfachleute
- Member of the PSI internal Neutron Source Development Group

PD Dr. Margit Schwikowski:
- Expert of the Matura Examination of Kantonsschule Baden
- Member of the Coordinating Committee of the Pages/IGBP initiative LOTRED SA
  (Long-Term climate Reconstruction and Diagnosis of (southern) South America)
- Schweizerische Gesellschaft für Schnee, Eis und Permafrost (SEP), board member
- Member of the Oeschger Centre for Climate Change Research

Leonhard Tobler:
BACHELOR THESIS
Stephan Keller
Anionenbestimmungen von Aerosolfiltern
Dr. S. Szidat / Uni Bern
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
May 2008

MASTER THESIS
Beat Muther
Chemische Modellstudien für die Elemente 113 und 114
Dr. R. Eichler / PSI
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
January 2008

Stephan Heinitz
Extraction of polonium from lead-bismuth eutectic
Dr. D. Schumann / PSI
Prof. Dr. H. Morgner / University Leipzig
November 2008

Andreas M. Bernhard
Photo-induced reduction of mercury in ice
PD Dr. M. Schwikowski / PSI & Uni Bern
Dr. M. Ammann / PSI, Dr. T. Bartels-Rausch / PSI
December 2008

Stéphane Schmoker
Isolierung einzelner Bodenkomponenten aus Bodenproben für die Radiokohlenstoffdatierung
Dr. S. Szidat / Uni Bern
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
December 2008

David Wittwer
Stopping force measurements of $^{40}$Ca induced reaction products in Mylar and argon
Dr. R. Eichler / PSI
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
December 2008
DOCTORAL THESIS

Olga Vesna

Ozonolysis of unsaturated organic acids in aerosol particles: products, secondary chemistry and hygroscopicity studies

Dr. M. Ammann / PSI
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
February 2008

Kaizhen Li

On the investigation of I-129 in the environment by ICP-MS: possibilities and limitations

Prof. Dr. U. Krähenbühl / Uni Bern
April 2008

Hanna Franberg

Production of exotic, short-lived carbon isotopes at ISOL-type facilities

Dr. M. Ammann / PSI
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
October 2008

Thomas Kellerhals

Holocene climate fluctuations in tropical South America deduced from an Illimani ice core

PD Dr. M. Schwikowski / PSI & Uni Bern
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
December 2008

Matthias Ruff

Radiocarbon measurement of micro-scale samples – a carbon dioxide inlet system for AMS

Dr. S. Szidat / Uni Bern
Prof. Dr. H.W. Gäggeler / PSI & Uni Bern
December 2008
Publikationen 2008
Labor für Ionenstrahlyphysik

M.H. Aguirre, S. Canulescu, R. Robert, N. Homazava, D. Logvinovich, L. Bocher, T. Lippert, M. Döbeli and A. Weidenkaff
Structure, microstructure, and high-temperature transport properties of La(1-x)CaxMnO(3-delta) thin films and polycrystalline bulk materials

A case for a downwasting mountain glacier during Termination I, Verçenik valley, northeastern Turkey

Surface characterization of diamond-like carbon for ultracold neutron storage

Comparison of exposure ages and spectral properties of rock surfaces in steep, high alpine rock walls of Aiguille du Midi, France

Plutonium measurements on the 1 MV AMS system at the Centro Nacional de Aceleradores (CNA)

Isolation of Pu-isotopes from environmental samples using ion chromatography for accelerator mass spectrometry and alpha spectrometry

Status of the compact 1 MV AMS facility at the Centro Nacional de Aceleradores (Spain)
Nuclear Instruments and Methods B 266, 2217-2220 (2008).

M. Döbeli
Characterization of oxide films by MeV ion beam techniques
Detection of trace deuterium in depleted protium by MeV ion beam techniques

M. Dühnforth, A.L. Densmore, S. Ivy-Ochs and P.A. Allen
Controls on sediment evacuation from glacially modified and unmodified catchments in
the eastern Sierra Nevada, California

F.G. Fedele, B. Giaccio and I. Hajdas
Timescales and cultural process at 40,000 BP in the light of the Campanian Ignimbrite
eruption, Western Eurasia

The chronology, climate, and confusion of the Moorhead Phase of glacial Lake Agassiz:
new results from the Ojata Beach, North Dakota, USA
Quaternary Science Reviews 27, 1124-1135 (2008).

M. Frank, J. Backman, M. Jakobsson, K. Moran, M. O'Regan, J. King, B.A. Haley, P.W.
Kubik and D. Garbe-Schönberg
Beryllium isotopes in central Arctic Ocean sediments over the past 12.3 million years:
Stratigraphic and paleoclimatic implications

F. Gianotti, M.G. Forno, S. Ivy-Ochs and P.W. Kubik
New chronological and stratigraphical data on the Ivrea amphitheatre (Piedmont, NW
Italy)

I. Hajdas
The Radiocarbon dating method and its applications in Quaternary studies

I. Hajdas, S. Ivy-Ochs, R. Pickering and F. Preusser
Recent developments in Quaternary dating methods

U. Heikkilä, J. Beer and V. Alfimov
Beryllium-10 and beryllium-7 in precipitation in Dübendorf (440 m) and at Jungfraujoch
(3580 m), Switzerland (1998–2005)
10Be measured in a GRIP snow pit and modeled using the ECHAM5-HAM general circulation model

S. Heiroth, T. Lippert, A. Wokaun and M. Döbeli
Microstructure and electrical conductivity of YSZ thin films prepared by pulsed laser deposition

R. Herger, P.R. Willmott, C.M. Schleputz, M. Bjorck, S.A. Pauli, D. Martoccia, B.D. Patterson, D. Kumah, R. Clarke, Y. Yacoby and M. Döbeli
Structure determination of monolayer-by-monolayer grown La(1-x)SrₓMnO₃ thin films and the onset of magnetoresistance

A. Hormes, S. Ivy-Ochs, P.W. Kubik, L. Ferreli and A. Maria Michetti
10Be exposure ages of a rock avalanche and a late glacial moraine in Alta Valtellina, Italian Alps

S. Ivy-Ochs and F. Kober
Surface exposure dating with cosmogenic nuclides

Chronology of the last glacial cycle in the European Alps

Southern Patagonian glacial chronology for the Last Glacial period and implications for Southern Ocean climate

H. Kerschner and S. Ivy-Ochs
Palaeoclimate from glaciers: Examples from the Eastern Alps during the Alpine Lateglacial and early Holocene

M.F. Knudsen, G.M. Henderson, M. Frank, C. Mac Niocaill and P.W. Kubik
In-phase anomalies in Beryllium-10 production and palaeomagnetic field behaviour during the Iceland Basin geomagnetic excursion


**Publikationen 2008**

**Labor für Ionenstrahlphysik**

*Complex multiple cosmogenic nuclide concentration and histories in the arid Rio Lluta catchment, northern Chile*

J. Kuhlemann, E.J. Rohling, I. Krumrei, P.W. Kubik, S. Ivy-Ochs and M. Kucera
*Regional Synthesis of Mediterranean Atmospheric Circulation During the Last Glacial Maximum*

G. Kuri, D. Gavillet, M. Döbeli and D. Novikov
*Structural changes in helium implanted Zr0.8Y0.2O1.9 single crystals characterized by atomic force microscopy and EXAFS spectroscopy*

*Source attribution of submicron organic aerosols during wintertime inversions by advanced factor analysis of aerosol mass spectra*

D. Levchuk, H. Bolt, M. Döbeli, S. Eggenberger, B. Widrig and J. Ramm
*Al-Cr-O thin films as an efficient hydrogen barrier*

I. Marozau, A. Shkabko, G. Dinescu, M. Döbeli, T. Lippert, D. Logvinovich, M. Mallepell, A. Weidenkaff and A. Wokaun
*RF-plasma assisted pulsed laser deposition of nitrogen-doped SrTiO3 thin films*

*Towards more precise 10Be and 36Cl data from measurements at the 10-14 level: Influence of sample preparation*

*10Be AMS measurements at low energies (E < 1 MeV)*

N. Akçar, S. Ivy-Ochs, C. Schlüchter
*Application of in-situ produced terrestrial cosmogenic nuclides to archaeology: A schematic review*
Publikationen 2008
Labor für Ionenstrahlphysik

Cosmogenic nuclide-based investigation of spatial erosion and hillslope channel coupling in the transient foreland of the Swiss Alps

A. Oron, G. Hadas, N. Liphschitz and G. Bonani
A New Type of Composite Anchor Dated to the Fatimid-Crusader Period from the Dead Sea, Israel

Extent of the last ice sheet in northern Scotland tested with cosmogenic 10Be exposure ages

Thermoelectric properties of LaCo(1-x)NiO3 polycrystalline samples and epitaxial thin films

Cosmogenic beryllium-10 and neon-21 dating of late Pleistocene glaciations in Nyalam, monsoonal Himalayas

F. Simmen, T. Lippert, P. Novak, B. Neuenschwander, M. Döbeli, M. Mallepell and A. Wokaun
The influence of lithium excess in the target on the properties and compositions of Li(1+x)Mn2O(4-delta) thin films prepared by PLD

Natural and anthropogenic 236U in environmental samples
Nuclear Instruments and Methods B 266, 2246-2250 (2008).

Z.C. Yu, K.N. Walker, E.B. Evenson and I. Hajdas
Lateglacial and early Holocene climate oscillations in the Matanuska Valley, south-central Alaska

*Timing of the late Quaternary glaciation in the Andes from similar to 15 to 40 degrees S*

LIST OF PUBLICATIONS 2008

BIOMOLECULAR RESEARCH

UNIVERSITY LEVEL AND OTHER TEACHING

K. Ballmer-Hofer
Cellular signalling
Biozentrum, University of Basel, Switzerland, HS 2008

K. Ballmer-Hofer
Hypoxia signaling in angiogenesis, applications in tumor therapy
Cancer Network, ETH Zurich and University of Zurich, Switzerland, March 2008

R. Jaussi
„Gentechnik“ for students in medicine
University of Zurich, FS 2008

R. Jaussi
"Molekulare Zellbiologie“ for students in life sciences
University of Zurich, HS 2008

Ch. Kambach
EMBO Practical Course on the Structural Characterization of Macromolecular Complexes
EMBL Grenoble, France, June 2 – 7, 2008

X.-D. Li
Membrane protein purification
7th NCCR Practical Course and EMBN Summer School "Practical Course 2D Membrane Protein Crystallization and Observation", Basel, Switzerland, October 20 – 24, 2008

F.K. Winkler
Grundlagen der Biologie I
ETH Zurich, FS 2008

F.K. Winkler
Molecular Biology and Biophysics III: Proteins: Structure, Function and Engineering
ETH Zurich, HS 2008

PUBLICATIONS

A. Akhmanova, M.O. Steinmetz
Tracking the ends: a dynamic protein network controls the fate of microtubule tips

O. Azzaroni, M. Mir, L. Tiefenauer, W. Knoll
Electrochemical rectification with redox-labeled supramolecular bioconjugates: Molecular building blocks for the construction of biodiodes
*Orf virus VEGF-E NZ2 promotes paracellular NRP-1/VEGFR-2 coreceptor assembly via the peptide RPPR*

J. Dolenc, R. Baron, J.H. Missimer, M.O. Steinmetz, W.F. van Gunsteren
*Exploring the conserved water sites and hydration of a coiled-coil trimerization motif: A MD simulation study*

O. Eidam, F.S. Dworkowski, R. Glockshuber, M.G. Grütter, G. Capitani
*Crystal structure of the ternary FimC–FimF–FimD complex indicates conserved pilus chaperone–subunit complex recognition by the usher FimD*

*STIM1 is a MT-plus-end-tracking protein involved in remodeling of the ER*

*DsbL and DsbI form a specific dithiol oxidase system for periplasmic arylsulfate sulfotransferase in uropathogenic Escherichia coli*

*Functional connectivity in tactile object discrimination – A principal component analysis of an event related fMRI-study*

S.J. Hwang, S.H. Kim, H.Z. Kim, M.O. Steinmetz, G.Y. Koh, G.M. Lee
*High-level expression and purification of a designed angiopoietin-1 chimeric protein, COMP-Ang1, produced in chinese hamster ovary cells*

A. Javelle, D. Lupo, P. Ripoche, T. Fulford, M. Merrick, F.K. Winkler
*Substrate binding, deprotonation, and selectivity at the periplasmic entrance of the Escherichia coli ammonia channel AmtB*

*Neuropilin-1 in regulation of VEGF-induced activation of p38MAPK and endothelial cell organization*

K. Licht, J. Medenbach, R. Lührmann, Ch. Kambach, A. Bindereif
*3'-cyclic phosphorylation of U6 snRNA leads to recruitment of recycling factor p110 through LSm proteins*
RNA 14, 1532 – 1538 (2008)
T. Manna, S. Honnappa, M.O. Steinmetz, L. Wilson
Suppression of microtubule dynamic instability by the +TIP protein EB1 and its modulation by the CAP-Gly domain of p150<sup>glued</sup>
Biochemistry 47, 779 – 786 (2008)

M. Mir, M. Álvarez, O. Azzaroni, L. Tiefenauer, W. Knoll
Molecular architectures for electrocatalytic amplification of oligonucleotide hybridization

D. Mukhopadhyay, K.S. Howell, H. Riezman, G. Capitani
Identifying key residues of sphinganine-1-phosphate lyase for function in vivo and in vitro

Evidence for proton shuffling in a thioredoxin-like protein during catalysis

On the neural networks of empathy: A principal component analysis of an fMRI study
Behavioral and Brain Functions 4, 41 - 53 (2008)

C. Puorger, O. Eidam, G. Capitani, D. Erilov, M.G. Grütter, R. Glockshuber
Infinite kinetic stability against dissociation of supramolecular protein complexes through donor strand complementation

Recombinant human VEGF<sub>165b</sub> protein is an effective anti-cancer agent in mice

A proangiogenic peptide derived from vascular endothelial growth factor receptor-1 acts through α5β1 integrin

Atomic models of de novo designed ccβ-Met amyloid-like fibrils

M.O. Steinmetz, A. Akhmanova
Capturing protein tails by CAP-Gly domains

L. Tiefenauer, A. Studer
Nano for bio: Nanopore arrays for stable and functional lipid bilayer membranes
R.A. Vacca, S. Giannattasio, G. Capitani, E. Marra, P. Christen
Molecular evolution of B6 enzymes: binding of pyridoxal-5'-phosphate and Lys41Arg substitution turn ribonuclease A into a model B6 protoenzyme
BMC Biochem. 9, 17 (2008)

R. Verel, I.T. Tomka, C. Bertozzi, R. Cadalbert, R.A. Kammerer, M.O. Steinmetz, B.H. Meier
Polymorphism in an amyloid-like fibril forming model peptide

M. Weichel, R. Jaussi, C. Rhyner, R. Crameri
Display of E. coli alkaline phosphatase pIII or pVIII fusions on phagemid surfaces reveals monovalent decoration with active molecules

INVITED TALKS

K. Ballmer-Hofer
Structure/function analysis of the activation of VEGF receptor tyrosine kinases and how coreceptors modulate signal output
University of Manchester, Manchester, United Kingdom, March 10, 2008

K. Ballmer-Hofer
Structure/function analysis of the activation of VEGF receptor tyrosine kinases and how coreceptors modulate signal output
University of Bristol, Bristol, United Kingdom, March 11, 2008

K. Ballmer-Hofer
Signaling in angiogenesis; structural and mechanistic insights into activation of VEGF receptor tyrosine kinases
ESH Conference on Angiogenesis, Paris, France, May 9 – 12, 2008

K. Ballmer-Hofer
Signaling in angiogenesis; structural and mechanistic insights into activation of VEGF receptor tyrosine kinases
7th D-BIOL Symposium ETH Zurich, Davos, Switzerland, June 2 – 4, 2008

K. Ballmer-Hofer
Structure/function analysis of the activation of VEGF receptor tyrosine kinases and how coreceptors modulate signal output
Gordon Conference on Growth Factors and Signalling, Oxford, United Kingdom, August 3 – 8, 2008

K. Ballmer-Hofer
Activation of receptor tyrosine kinases: VEGFR-2/Neuropilin-1 co-receptor complex formation by distinct VEGF isoforms
K. Ballmer-Hofer
Structure/function analysis of the activation of VEGF receptor tyrosine kinases and how coreceptors modulate signal output
Novartis, Basel, Switzerland, November 17, 2008

K. Ballmer-Hofer
Structure/function analysis of the activation of VEGF receptor tyrosine kinases and how coreceptors modulate signal output
Basilea Pharmaceutica, Basel, Switzerland, December 15, 2008

X.-D. Li
Ammonium transported by Amt/Mep/Rh proteins
First Chinese Conference on Life Sciences in Switzerland, ETHZ, Zurich, Switzerland, May 17, 2008

X.-D. Li
AmtB-GlnK complex and nitrogen regulation in bacteria
Symposium “Micromechanics”, Institute of Microbiology, ETH Zurich, July 18, 2008

X.-D. Li
Ammonium transported by Amt/Mep/Rh proteins
First CAS-SSSTC Joint Workshop, ETH, Zurich, Switzerland, November 18, 2008

X.-D. Li
Understanding membrane protein function: present and future
PSI-XFEL Science Workshop on “Coherent Diffraction by Nanostructures”, Swiss National Science Foundation, Bern, Switzerland, November 27, 2008

M.O. Steinmetz
Key interaction modes of dynamic +TIP networks
EMBL Heidelberg, Cell Biology and Biophysics Unit, Heidelberg, Germany, January 17, 2008

M.O. Steinmetz
Key interaction modes of dynamic +TIP networks
3D Repertoire Annual Meeting, Milan, Italy, February 14 – 15, 2008

M.O. Steinmetz
Key interaction modes of dynamic +TIP networks
Canceropôle PACA “Cytosquelette Microtubulaire & Cancer”, Marseille, France, February 26, 2008

M.O. Steinmetz
Key interaction modes of dynamic +TIP networks
INSERM U836, Institut des Neurosciences, Université Joseph Fourier, Grenoble, France, March 2, 2008

M.O. Steinmetz
Key interaction modes of dynamic +TIP networks
Microtubule Dynamics Workshop 2008, Treverevex Hill Oxted, Surrey, United Kingdom, May 11 – 12, 2008

M.O. Steinmetz
Key interaction modes of dynamic +TIP networks
University of Manchester, Wellcome Trust Centre for Cell-Matrix Research, Manchester, United Kingdom, July 2, 2008
M.O. Steinmetz
*Key interaction modes of dynamic +TIP networks*
CNRS, Centre de Recherche de Biochimie Macromoléculaire, Montpellier, France, July 10, 2008

M.O. Steinmetz
*Key interaction modes of dynamic +TIP networks*
FOM Institute for Atomic and Molecular Physics, Cytoskeleton-based Force Generation, Amsterdam, The Netherlands, September 2, 2008

M.O. Steinmetz
*Tracking the ends: A dynamic protein network controls the fate of microtubule tips*
Institute of Pharmaceutical Sciences, ETH Zurich, Switzerland, October 29, 2008

M.O. Steinmetz
*Tracking the ends: A dynamic protein network controls the fate of microtubule tips*
Institute of Biochemistry, ETH Zurich, Switzerland, November 13, 2008

M.O. Steinmetz
*Tracking the ends: A dynamic protein network controls the fate of microtubule tips*
Institute of Structural and Molecular Biology, University of London, United Kingdom, November 17, 2008

M.O. Steinmetz
*Molecular mechanism of EB1-dependent microtubule tip tracking*

A. Studer, M. Di Berardino, L. Tiefenauer
*Measuring membrane protein-mediated transport across lipid bilayers*
The 10th World Congress on Biosensors, Shanghai, China, May 14 – 16, 2008

L. Tiefenauer
*AFM and nanopores in service for biosciences*
Indo-US Workshop on Science and Technology at the Nano-Bio Interface, Bhubaneswar, India, February 19 – 22, 2008

**BOOK CHAPTERS**

B.L. Zaric, Ch. Kambach
*Reconstitution of recombinant human LSmi complexes for biochemical, biophysical, and cell biological studies*
CENTER FOR RADIOPHARMACEUTICAL SCIENCE

UNIVERSITY LEVEL AND OTHER TEACHING

S.M. Ametamey  
*Einführung in die pharmazeutischen Wissenschaften I*  
ETH Zurich, HS08

R. Schibli  
*Metal Based Drug and Drug Development*  
ETH Zurich, FS08

R. Schibli  
*Practicum Medicinal Chemistry*  
ETH Zurich, HS08

P.A. Schubiger, S.M. Ametamey, R. Schibli  
*Einführung in die pharmazeutischen Wissenschaften II*  
ETH Zurich HS08

P.A. Schubiger, S.M. Ametamey, R. Schibli  
*Radiopharmazeutische Chemie*  
ETH Zurich HS08

P.A. Schubiger  
*CIMST Interdisciplinary Summer School*  
ETH Zurich, 2008

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S.M. Ametamey, M. Honer, P.A. Schubiger  
*Molecular imaging with PET*  

W.H. Bisson, G. Westera, P.A. Schubiger, L. Scapozza  
*Homology modeling and dynamics of the extracellular domain of rat and human neuronal nicotinic acetylcholine receptor subtypes α4β2 and α7*  

*Glycation methods for bombesin analogs containing the (N\(^2\)His) Ac chelator for \(^{99m}\)Tc(CO)\(_3\) radiolabeling*  
E. García Garayoa, Ch. Schweinsberg, V. Maes, L. Brans, P. Bläuenstein, D.A. Tourwé, R. Schibli, P.A. Schubiger

*Influence of the molecular charge on the biodistribution of bombesin analogues labeled with the $[^{99m}Tc(CO)_3]$-core*

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*Synthesis, $^{18}$F-labelling, and in vitro and in vivo studies of bombesin peptides modified with silicon-based building blocks*


*Modification of different IgG1 antibodies via glutamine and lysine using bacterial and human tissue transglutaminase*


Th.L. Mindt, C. Müller, M. Melis, M. DeJong, R. Schibli

*“Click-to-chelate”: In vitro and in vivo comparison of a $^{99m}$Tc(CO)$_3$-labeled N($\tau$)-histidine folate derivative with its isostructural, clicked 1,2,3-triazole analogue*


*Siliciumbausteine für die einstufige $^{18}$F-Radiomarkierung von Peptiden für die PET-Bildgebung*

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C. Müller, F. Forrer, R. Schibli, E. P. Krenning, M. DeJong

*SPECT study of folate receptor-positive malignant and normal tissues in mice using a novel $^{99m}$Tc-radiofolate*


C. Müller, R. Schibli, E. P. Krenning, M. DeJong

*Pemetrexed improves tumor selectivity of $^{111}$In-DTPA-folate in mice with folate receptor–positive ovarian cancer*


I. Novak-Hofer, S. Cohrs, J. Grünberg, A. Friedli, M. C. Schlatter, M. Pfeiffer, P. Altevogt, P. A. Schubiger

*Antibodies directed against L1-CAM synergize with genistein in inhibition growth and survival pathways in SKOV3ip human ovarian cancer cells*


T. L. Ross, M. Honer, Ph. Lam, T. L. Mindt, V. Groehn, R. Schibli, S. M. Ametamey, P. A. Schubiger

*Fluorine-18 “click” radiosynthesis and preclinical evaluation of a new $^{18}$F-labelled folic acid derivative*


H. Struthers, B. Spingler, Th. L. Mindt, R. Schibli

*“Click-to-chelate”: Design and incorporation of triazole-containing metal-chelating systems into biomolecules of diagnostic and therapeutic interest*

CONFERENCE PROCEEDINGS

J. Grünberg
*Radioimmunotherapy of ovarian cancer metastasis with Lu-177-labeled antibody chCE7agl directed against L1-CAM*
Annual Congress of the European Association of Nuclear Medicine, Munich, Germany, October 11 – 15, 2008

S. Jeger
*Enzymatic functionalization of the tumor targeting antibody chCE7agl produces single species radioimmunoconjugates*
Annual Meeting of the Swiss Society of Nuclear Medicine, St. Gallen, Switzerland, May 29 – 31, 2008

Th. L. Mindt
*Click-to-chelate: Expedited development of metal-based imaging probes and therapeutic agents by click chemistry*
Symposium on Medicinal Organometallic Chemistry, St. Martin, Germany, April 2 – 5, 2008

Th. L. Mindt
*Expedited development of imaging probes by click chemistry*
Center for Imaging Science and Technology Symposium, Zurich, Switzerland, May 2008

Th. L. Mindt
*New strategies for the development of molecular imaging probes*
236th National Meeting of the American Chemical Society, Philadelphia, USA, August 17 – 21, 2008

Th. L. Mindt
*Click-to-Image: Application of Click Chemistry to the Design of Novel Imaging Probes and Therapeutic Agents*
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*Application of click chemistry to the design of novel imaging probes and therapeutic agents*
World Molecular Imaging Congress, Nice, France, September 10 – 13, 2008
H.R. Struthers
"Click to chelate": Functionalization of thymidine with chelating systems for rhenium and technetium and their evaluation as substrates for human thymidine kinase type 1

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Wasserstoffperoxid in Pharma Isolatoren
Eidgenössische Technische Hochschule ETH Zurich, Nr. 17’857, 2008

A. Friedli
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K. Hajdin
Phage display selected peptides identify furin as therapeutic target on pediatric rhabdomyosarcoma
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A. Höhne
Development of new proprietary F-18 radiolabeling methods
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U. Künzle
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M. Martic
Development of new nucleoside analogues as PET imaging agents for monitoring gene expression
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Ch. Schweinsberg
Novel 99mTc-labeled bombesin analogues with improved pharmacokinetics and targeting of gastrin-releasing-peptide receptor-positive tumors
Eidgenössische Technische Hochschule ETH Zurich, Nr. 17’952, 2008

M. Zimmermann
Cell death in keratinocytes induced by IFN-gamma and ligands of the tumor necrosis factor receptor superfamily
Eidgenössische Technische Hochschule ETH Zurich, Nr. 18’006, 2008
INVITED TALKS

S.M. Ametamey
PET radioligand development for the imaging of a CNS target
CIMST Summer School Zurich, Switzerland, June 25 – July 6, 2008

S.M. Ametamey
Functional brain imaging with PET
Swiss Society for Experimental Pharmacology Zurich, Switzerland, August 29, 2008

S.M. Ametamey
Hypoxia tracers
Annual Congress of the European Association of Nuclear Medicine, Munich, Germany, October 11 – 15, 2008

S.M. Ametamey
PET chemistry and radiopharmaceuticals, modul III: Radiation protection course for the medical application of radioactive substances to men
ETH Zurich, Switzerland, October 23, 2008

E. García Garayoa
Tumour targeting with $^{64/67}$Cu-labelled neurotensin analogues
14th European Symposium on Radiopharmacy and Radiopharmaceuticals, Skopje, Macedonia (former Yugoslav Republic of Macedonia), April 24 – 27, 2008

J. Grünberg
Lutetium-177 radioimmunotherapy of ovarian cancer metastasis in nude mice with anti-L1CAM antibody chCE7 in combination with genistein
28th International Symposium Radioactive Isotopes in Clinical Medicine and Research, Bad Hofgastein, Austria, January 9 – 12, 2008

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New strategies for the development of tracer for non-invasive imaging

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Seminar at the University of Oxford, Dept. of Chemistry, Oxford, United Kingdom, February 2008

R. Schibli
Site-specific radiolabelling of recombinant proteins for imaging and quantitative in vivo studies
2nd World Immune Regulation Meeting, Davos, Switzerland, March 22 – 25, 2008

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Targeting of cancerous diseases with radioactive vitamin derivative
Seminar at the Dept. of Chemistry, University of Trieste, Trieste, Italy, April 2008

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*Transglutaminases allow site-specific modification of anti L1CAM antibody chCE7 with a defined number of metal chelating systems for radiometal labeling*
The 25th International Conference Advances in the Application of Monoclonal Antibodies in Clinical Oncology, Island of Rhodes, Greece, June 16 – 18, 2008

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*Molecular radiodiagnostics and therapy: What can chemistry and radiopharmacy contribute?*
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R. Schibli
*New folate tracers for non-invasive imaging of folate receptors*
2nd International Meeting on Folate Receptors and Carriers, Como, Italy, October 26 – 30, 2008

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*PET-tracers for imaging of the glutaminergic pathway*
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P.A. Schubiger
*PET molecular imaging in research and development - exemplified on a glutamatergic tracer*
The Basel Seminar on Peptides, Proteins and Proteomics, Pharmacenter Basel, Switzerland, April 9, 2008

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*Molecular Imaging of Biochemical Functions using (Small Animal) PET*
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*Targeting of tumors with radiolabeled vitamins*
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“Comparative Irradiation Test of Mixed Carbide Fuel in the US Fast Flux Test Facility with Focus on Sphere-Pac Fuel Behaviour; Summary of a Joint USA-Swiss Experiment”, J. Nucl. Mater. (ISSN 0022-3115), 376(1), 47-59 (2008)
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1 FZK, Karlsruhe, DE
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ALAM A.
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1 FZD, Rossendorf, DE

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1 EMPA, Dübendorf, CH
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CHAWLA R. “PHYSOR’08: Nose, Palate and Finish”, 27 November 2008

MIKITYUK K. “Analytical studies related to liquid-metal flow phenomena in the frame of the FAST project”, 13 March 2008

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DEGUELDORE C. “Comportement des radionucléides dans l'environnement, impact des reacteurs dans l'environnement”, Centre universitaire d'étude des problèmes de l'énergie, Lecture Course, University of Geneva, Switzerland, Spring Semester, 2008


GIMMI T. “Determination of Transport Parameters at the Laboratory Scale”, “Determination of Transport Parameters at the Field Scale”, “Natural Tracers: Transport at Very Large Scales”; Lectures given in Training Course, Okayama University, Japan, 14-18 January 2008


GIMMI T. “Fluids in the Crust”, Masters Course in Environmental and Resource Geochemistry, University of Berne, Switzerland, Autumn Semester, 2008
GIRARDIN G.
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GROLIMUND D.
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KOLBE E.
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KOSAKOWSKI G.

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1 Innovative Systems Software, LLC, US
2 FSUE EDO “Gidropress”, Podolsk, RU
3 IAEA, Vienna, AT
4 JAEA, Tokyo, JP

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1 JRC, Petten, NL
2 Russian Academy of Sciences, Moscow, RU
3 GRS, Garching, DE
4 IRSN, Cadarache, FR
5 JRC/ITU, Karlsruhe, DE
6 FZK, Karlsruhe, DE
7 CEA, Cadarache, FR
8 ENEA, Bologna, IT
9 AEA Technology, Winfrith, UK

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\(^1\) UNU-MERIT, Maastricht, NL

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\(^1\) UNIPI, Pisa, IT

KYPREOS S., BLES M.\(^1\), COSMI C.\(^2\), KANUDIA A.\(^3\), LOULOU R.\(^4\), SMEKENS K.\(^5\), SALVIA M.\(^2\), VAN REGEUMSORT ER D.\(^6\), CUOMO V.\(^2\)
\(^1\) University of Stuttgart, DE
\(^2\) Istituto di Metodologie Avanzate di Analisi Ambientale, Tito Scala, IT
\(^3\) KANLO Sarl, Lyon, FR
\(^4\) McGill University, Montreal, CA
\(^5\) Energy Research Centre, Petten, NL
\(^6\) University of Leuven, BE

LAFORCUE G.\(^1\), MAGNÉ B., MOREAUX M.\(^2\)
\(^1\) Toulouse Business School, FR
\(^2\) University of Toulouse, FR

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\(^1\) Polytechnic of Milan, IT

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RAFAY P.\(^1\), KYPREOS S.
\(^1\) IIASA, Laxenburg, AT

REEE B.

REEE B.
SCHULZ T., KYPREOS S., BARRETO L., WOKAUN A.

TURTON H.

TURTON H., MOURA F.¹
¹ Technical University of Lisbon, PT

Publications in Books

BURGHELL P., HIRSCHBERG S.

LAFORQUE G.¹, MAGNÉ B., MOREAUX M.²
¹ Toulouse Business School, FR
² University of Toulouse, FR

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¹ Centro E. Piaggio, University of Pisa, IT
² University of Rome Tor Vergata, Italy

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¹ University of Maryland, College Park, US

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1 US NRC, Bethesda, US
2 OECD/NEA, Paris, FR

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1 SNL, Albuquerque, US
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1 University of Pisa, IT

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1 MIT, Cambridge, US
2 University of Waterloo, CA

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BAUER C.
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1 EMPA Dübendorf

AXPO NATURSTROMFONDS

Projektleiter: S.M.A. Biollaz
Holz - Brennstoffzelle

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Projektleiter: T. Gerber  
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Projektleiter: L. Gubler, I.A. Schneider  
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Partner: Berner Fachhochschule Technik und Informatik (BFH-TI, Biel BE), CEKA Elektrowerkzeuge AG & Co. KG (Wattwil SG), MES-DEA SA. (Stabio TI)

Projektleiter: W. Hubenschmid  
*Laserdiagnostik in sehr mageren Flammen*

Projektleiter: P. Jansohn  
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Projektleiter: Ch. Ludwig  
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Projektleiter: A. Meier  
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Projektleiter: A. Meier  
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Projektleiter: O. Kröcher, Ch. Gerhart  
*N₂O-Reduzierung im motorischen Abgas mit Guanidinsalzen*  
Prof. Dr. Th. Sattelmayer, Lehrstuhl für Thermodynamik, TU München, Germany  
Prof. Dr. G. Wachtmeister, Lehrstuhl für Verbrennungskraftmaschinen, TU München, Germany

¹ AlzChem Trostberg GmbH, Germany

NIGU Chemie GmbH, Germany

**CCEEM**

Projekt:  
*Woodgas SOFC (Integrated Biomass - Solid Oxide Fuel Cell Cogeneration):*  
WP2: Gas Analysis (Projektleiter: J. Wochele)  
WP4: Development of GC/SCD for S- and N-species measurement (Projektleiter: S.M.A. Biollaz)  
(Pilot Demonstration)

Projektleiter: F.N. Büchi  
*hy muve: Development of hydrogen powered municipal vehicle*  
with EMPA Dübendorf and Industrial Partners
Projektleiter: P. Dimopoulos¹, M. Ammann, U. Baltensperger, K. Boulouchos², H. Burtscher³, N. Heeb¹, O. Kröcher, M. Mohr¹

NEADS (Next Generation Exhaust Aftertreatment for Diesel Propulsion Systems)

¹ EMPA Dübendorf
² ETH Zürich
³ FHNW Windisch

Projektleiter: P. Jansohn

Clean and Efficient Large Diesel Engines (CELaDE)

Projektleiter: U. Lohmann¹, Th. Peter¹, U. Baltensperger, Th. Heck, Ch. Hüglin², H. Burtscher³, I. Bey⁴

IMBALANCE (IMpact of Biomass burning Aerosol on Air quality aNd Climate)

¹ ETH Zürich
² EMPA Dübendorf
³ FHNW Windisch
⁴ EPF Lausanne

Projektleiter: I. Mantzaras

Computational engineering of multiscale transport in small-scale surface based energy conversion

Projektleiter: S. Stucki

Second generation biogas

Projektleiter: S. Ulli-Beer, F. Büchi

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Projektleiter: A. Wokaun

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Project Part: Dynamics of transportation technology development and diffusion (Projektleiter: S. Ulli-Beer)

in collaboration with MIT (Alliance for Global Sustainability)

Projektleiter: A. Wokaun, S. Ulli-Beer

Transition to Hydrogen Based Transportation – Challenges and Opportunities

with MIT (Alliance for Global Sustainability)

Projektleiter: M. Zimmermann, S. Ulli-Beer

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(Project Part: Diffusion dynamics of energy efficient renovations)

with IEA, SNF, BFE, Stadt Zürich, Novatlantis

CompactGTL

Projektleiter: I. Mantzaras

Gas-to-liquid catalytic technologies

Energie Trialog Schweiz

Projektleiter: A. Wokaun, Ph. Dietrich, S. Hirschberg

Studies on Energy Efficiency, Renewable Electricity, Scenarios, Multi-Criteria Decision Analysis

ETH

Projektleiter: D. Cziczo¹, U. Lohmann¹, E. Weingartner, U. Baltensperger

The relationship between aerosol chemical composition and hygroscopic growth

¹ ETH Zürich
ETH-Rat

Projektleiter: A. Wokaun, S. Ulli-Beer  
- Erdgas-/ Biogasfahrzeuge  
- Wasserstoff-Fahrzeuge  
Erlebnisraum Nachhaltige Mobilität Basel  
novatlantis – Nachhaltigkeit im ETH Bereich

EU

Projektleiter: U. Baltensperger, J. Dommen  
EUROCHAMP (Integration of European Simulation Chambers for Investigating Atmospheric Processes)

Projektleiter: U. Baltensperger, E. Weingartner, M. Gysel  
EUSAAR (European Supersites for Atmospheric Aerosol Research)

Projektleiter: U. Baltensperger, J. Dommen  
POLYSOA (Polymers in secondary organic aerosols)

Projektleiter: U. Baltensperger, A.S.H. Prévôt, E. Weingartner  
EUCAARI (European Integrated project on Aerosol Cloud Climate and Air Quality Interactions)

Projektleiter: U. Baltensperger, E. Weingartner  
CLOUD-ITN (Cosmos Leving Outdoor Droplets, Initial Training Network)

Projektleiter: U. Baltensperger, A.S.H. Prévôt, E. Weingartner  
MEGAPOLI (Emissions, urban, regional and Global Atmospheric POLLution and climate effects, and Integrated tools for assessment and mitigation)

Projektleiter: P. Jansohn  
HERCULES (High efficiency engine R&D on combustion with ultra low emissions for ships)

Projektleiter: A. Meier  
SOLHYCARB (Hydrogen from Solar Thermal Energy: High Temperature Solar Chemical Reactor for Co-production of Hydrogen and Carbon Black from Natural Gas Cracking)

Projektleiter: A.S.H. Prévôt  
CIRCE (Climate change and Impact Research: The Mediterranean Environment)

Projektleiter: M. Saurer  
MILLENNIUM, (European climate of the last millennium)

Projektleiter: G.G. Scherer  
CARISMA

Projektleiter: I.A. Schneider  
Nanoglowa (Diagnostics workpackage)

Projektleiter: E. Weingartner, M. Gysel  
QUANTIFY (Hygroscopic properties of ship exhaust particles)

Projektleiter: E. Weingartner, U. Baltensperger  
GeoMon (Global Earth Observation and Monitoring of the atmosphere)

EU-PROJECTS (6. FWP)

Projektleiter: S.M.A. Biollaz  
BIOCELLUS

Projektleiter: T. Schildhauer  
AER-Gas II
Projectleiter: S. Stucki  
Bio-SNG

HSK

Projectleiter: F. Gassmann  
ADPIC- Aktualisierung

Industry

Projectleiter: P. Boillat, G.G. Scherer  
Diagnostics of polymer electrolyte fuel cells  
Automotive industry

Projectleiter: P. Boillat, G.G. Scherer  
Diagnostics of polymer electrolyte fuel cells  
Nissan Motor Co. Ltd., Yokohama, Japan

Projectleiter: F.N. Büchi  
Diagnostics of polymer electrolyte fuel cells  
Automotive Industry

Projectleiter: J.-L. Hersener, S. Bioillaz  
Verfügbarkeit von Gras für Kombikraftwerke in der Schweiz  
Ingenieurbüro Hersener, Ernst Basler und Partner AG

Projectleiter: O. Kröcher, A. Johansson\(^1\)  
Development and parameterization of a catalyst model for NO/NO\(_2\) SCR  
\(^1\) Sweno AB, Schweden

Projectleiter: O. Kröcher  
Development of a TG-FTIR system for exhaust gas aftertreatment  
Mettler-Toledo AG  
Thermo Fisher AG

Projectleiter: O. Kröcher, R. Althoff\(^1\)  
Development of new metal-exchanged zeolites for NH\(_3\)/urea-SCR  
\(^1\) Süd-Chemie AG, Germany

Projectleiter: O. Kröcher  
Investigation of the decomposition of urea in the SCR process  
Anonymous industry partners, France

Projectleiter: O. Kröcher, P. Hirth\(^1\)  
Investigation of the influence of ammonia on the soot oxidation in Diesel particulate filters  
\(^1\) Emitec GmbH, Germany

Projectleiter: O. Kröcher  
Thermoanalytic investigation of the urea decomposition  
Abgaszentrum der Automobilindustrie (ADA), Germany

Projectleiter: P. Maire  
Electrochemical characterization of polymeric organic active materials  
Ciba, Basel

Projectleiter: W. Märkle  
Graphite für Lithiumionen-Batterien  
TIMCAL SA, Bodio

Projectleiter: S. Rabe  
Confidential  
Methanol Casale
Projektleiter: F. Vogel  
Gasoline reforming kinetics  
Toyota Central Research and Development Laboratories, Inc.

Projektleiter: F. Vogel  
Kinetik der präferentiellen Oxidation von CO  
Umicore AG

KTI

Projektleiter: I. Mantzaras  
Sequential combustion technology for gas turbine power generation with CO₂ mitigation

METEO SCHWEIZ

Projektleiter: U. Baltensperger, E. Weingartner, M. Gysel  
GAW-CH (Aerosol Monitoring Programm auf dem Jungfraujoch)

Projektleiter: U. Baltensperger, E. Weingartner, M. Gysel  
Cloud Condensation Nuclei and Carbonaceous Aerosol Characterisation at the Jungfraujoch Research Station

MIT

Projektleiter: F. Vogel  
Ecogas: Nutrient salt recovery during conversion of wet biomass into methane

NATIONALFONDS

Projektleiter: U. Baltensperger  
Investigation of Secondary Organic Aerosol Formation in the PSI Smog Chamber

Projektleiter: A. Foelske-Schmitz  
Degradation mechanisms of electro-catalysts used in Polymer electrolyte fuel cells  
PSI

Projektleiter: M. Geiser Kamber¹, M. Kalberer², J. Ricka¹, J. Dommen  
From aerosol to health effects: Mobile system for controlled, standardized studies of health-effects by inhaled (nano)particles and gases  
¹ University of Bern  
² University of Cambridge, UK

Projektleiter: Ch. Körner¹, R.T.W. Siegwolf  
Swiss Canopy Crane Project: CO₂—enrichment  
¹ University of Basel

Projektleiter: P. Novák, R. Kötz, T. Lippert, R. Nesper¹  
Advanced materials for efficient portable energy supplies  
PSI und ETHZ  
¹ ETH Zürich

Projektleiter: F. Nüesch, M. Nagel¹, T. Lippert, A. Wokaun  
Fabrication of patterned organic multilayer devices using dynamic release layer assisted Laser Induced Forward Transfer  
¹ EMPA Dübendorf

Projektleiter (CCMX): J. Rupp¹, L. Gauckler¹, T. Lippert, K. Conder, T. Graule², S. Pratsinis¹  
NANCER (Nanocrystalline ceramic thin film coating without sintering)  
¹ ETH Zürich  
² EMPA Dübendorf
Projektleiter: M. Saurer, R.T.W. Siegwolf
Climatic changes, tree-ring growth and C- and O-isotope variations along longitudinal transects in Siberia and in the Urals

Projektleiter (MaNEP): L. Schlapbach¹, A. Weidenkaff¹, T. Lippert, A. Wokaun
Plasma enhanced anionic substitution (PEAS) for the generation of perovskite phases with different properties
¹ EMPA Dübendorf

Projektleiter: F. Vogel
Salt particle formation in near- and supercritical water

Projektleiter: A. Wokaun, T. Lippert
Laser ablation of inorganic materials and thin film deposition studied by mass spectrometry and in-situ surface analysis

Projektleiter: A. Wokaun, T. Lippert
Thin Metal Oxide Films by PLD: “Tracing” the oxygen and understanding its role

NATO

Projektleiter: M. Dinescu¹, E. Verona², T. Lippert
Polymers based piezoelectric sensor array for chemical warfare agents detection
¹ National Institute for Lasers, Plasma and Radiation Physics, Romania
² CNR-IDAC Rome, Italy

NOVATLANTIS

Projektleiter: A. Wokaun, S.F. Lienin, S. Ulli-Beer, C. Bach
Erlebnisraum Mobilität: Aufbau einer sozio-technologischen Feldversuchsumgebung
Nachhaltigkeit im ETH Bereich

Projektleiter: S. Ulli-Beer
Innovative Fahrzeugflotte Basel
Nachhaltigkeit im ETH Bereich

OSTLUFT

Projektleiter: A.S.H. Prévôt
Mobile Aerosolmassenpektrometer-Messungen im Rheintal und in Zürich

SBF

Projektleiter: U. Baltensperger, A.S.H. Prévôt
ACCENT (Atmospheric Composition Change, the European Network of Excellence)

Projektleiter: J. Keller
COST 728: Linking meteorological and photo-chemical dispersion models: development and tests of an interface with improved turbulence schemes

Projektleiter: R.T.W. Siegwolf
COST 639 (Carbon cycling in alpine soils in a warmer world)

SNF

Projektleiter: R. Kaufmann¹, S. Ulli-Beer, S. Brüppacher¹
Diffusions dynamics of energy efficient buildings
¹ Uni Bern

Projektleiter: I. Mantzaras
Direct Numerical Simulation of Catalytic Combustion
Projektleiter: A. Wokaun, Th. Lippert
*Thin oxide films by PLD: "Tracing" the oxygen and understanding its role*

Projektleiter: A. Wokaun
*NCCR-Climate*
Project Task 4.1: Energy Technology Strategies

**STIFTUNG AUTO RECYCLING SCHWEIZ SARS**

Projektleiter: Ch. Ludwig, S. Stucki
*KVA plus*

**Swisselectric (CCEM)**

Projektleiter: I. Mantzaras, P. Jansohn
*Technologies for Gas Turbine Power Generation with CO₂ Mitigation*

**Swisselectric Research**

Projektleiter: S.M.A. Biollaz
*Methan aus Holz*

Projektleiter: J. Wochele, Ch. Ludwig
*TREPGAS: Trace Elements in Product Gases*

**UGZ**

Projektleiter: E. Weingartner, J. Brunner
*Entwicklung eines SMPS-Systems für den kontinuierlichen Einsatz*

1 Amt für Umwelt- und Gesundheitsschutz, Zürich

**Universities**

Projektleiter: Ch. Ludwig
*Hydrothermal methane from microalgae (the SunChem process)*

Projektleiter: P.P. Radi
*Detection of Weak Overtone and Combination Bands of Methane*
Dr. D. Kozlov, General Physics Institute, Moscow, Russia

Projektleiter: P.P. Radi
*DFWM and TC-RFWM Spectroscopy on Transient Molecules and Radicals*
Prof. J.P. Maier, Universität Basel

Projektleiter: P.P. Radi
*REMPI and Photoelectron-Spectroscopy on Formaldehyde*
Prof. F. Merkt, ETH Zürich

Projektleiter: P.P. Radi
*Unimolecular Dissociation of Formaldehyde*
Prof. R. Marquardt, Laboratoire de Chimie Quantique, Institut de Chimie - Université Louis Pasteur 4, Strasbourg, France

Projektleiter: E. Weingartner, P. Villani
*Development of new Differential Mobility Analyzers*
VELUX STIFTUNG

1 Laboratoire de Météorologie Physique, University of Clermont-Ferrand (France)
TEACHING ACTIVITIES (LECTURES)

University Level Teaching

Prof. Dr. U. Baltensperger, Prof. Dr. H. Burtscher, Dr. C. Marcolli
*Aerosole II*
ETH Zürich, FS 2008.

Prof. Dr. U. Baltensperger, Prof. Dr. H. Burtscher, Dr. C. Marcolli
*Aerosole I*
ETH Zürich, HS 2008.

Prof. Dr. U. Baltensperger
*European Research Courses on Atmospheres*
- *Sources, sinks and global distribution of aerosols*
- *Direct and indirect aerosol effect on climate*
- *Smog chamber activities and other new directions of research*
ERCA, Grenoble, France, January 7 – February 8, 2008.

Prof. Dr. K. Boulouchos¹, Dr. O. Kröcher
*IC-Engines and Propulsion Systems II*
ETH Zürich, FS 2008.
¹ ETH Zürich

Dr. F. Gassmann, Prof. Dr. F. Stähli²
*Wege zu einer nachhaltigen Energiezukunft*
² FHA, Brugg-Windisch

Dr. P. Jansohn
*Verbrennung in Gasturbinen*
ETH Zürich, FS 2008.

PD Dr. T. Lippert
*Mikro- und Nanostrukturen: Laseranwendungen in Industrie und Forschung*
ETH Zürich, HS 2008.

Prof. Dr. Ch. Ludwig
*Advanced Solid Waste Treatment*
Master 7th and 9th semester
EPF Lausanne, FS 2008.

Prof. Dr. Ch. Ludwig, Dr. Felippe de Alencastro¹
*Analyse des polluants dans l'environnement*
Bachelor 5th semester
EPF Lausanne, FS 2008.
¹ EPFL

PD Dr. I. Mantzaras and Dr. C. Frouzakis
*Theoretical and Numerical Combustion*
ETH Zürich, HS 2008.

PD Dr. P. Novák, Prof. Dr. A. Wokaun
*Technische Elektrochemie*
ETH Zürich, HS 2008.

Dr. A.S.H. Prévôt, Prof. J. Staehelin
*Tropospheric Chemistry*
ETH Zürich, FS 2008.
Dr. R.T.W. Siegwolf, Dr. M. Saurer
*Einsatz stabiler Isotope in der Ökologie und Physiologie der Pflanzen I*
University of Basel, HS 2008.

Dr. R.T.W. Siegwolf, Dr. M. Saurer
*Stabile Isotope in der Ökologie*
University of Zürich, WS 2007/2008.

Prof. Dr. A. Steinfeld, Prof. Dr. R. Abhari
*Energy Systems and Power Engineering*
ETH Zürich, FS 2008.

Prof. Dr. A. Steinfeld, Prof. Dr. R. Abhari
*Thermodynamics III*
ETH Zürich, HS 2008.

Prof. Dr. A. Steinfeld, Dr. W. Lipinski
*Energieübertragung durch Wärmestrahlung*
ETH Zürich, HS 2008.

Prof. Dr. A. Steinfeld, Prof. Dr. A. Wokaun
*Renewable Energy Technologies I*
ETH Zürich, HS 2008.

Dr. F. Vogel (gemeinsam mit Prof. Dr. Ph. Rudolf von Rohr)
*Einführung in die Verfahrenstechnik / Vorlesung 5. Semester Maschinenbau und Verfahrenstechnik*
ETH Zürich, HS 2008.

Prof. Dr. A. Wokaun, Dr. G.G. Scherer, Prof. Dr. K. Boulouchos
*Renewable Energy Technologies II*
ETH Zürich, FS 2008.
Contributions to Courses at Universities, FH, and Other Institutes

Dr. S.M.A. Biollaz
*Renewable Energy Technologies I (lectures on biomass, biofuels)*
ETH Zürich, WS 2007/08.

M. Brandenberger
*Biological Gas Treatment*
*Master in environmental engineering, environmental sciences and engineering, SSIE, EPFL*
EPF Lausanne, HS 2008/09.

Dr. P.F. DeCarlo
*Online measurement of Organic Aerosols - Summer School on Organic Aerosols*
University of Gothenburg, Sweden, June 24, 2008.

Dr. W. Durisch
*Photovoltaik - Strom aus Sonnenlicht*

Dr. W. Durisch
*Photovoltaik - Strom aus Sonnenlicht*

Dr. F. Gassmann
*Die Physik des Fliegens für Kinder von 6-12 Jahren*
Kinderuniverstität Waldshut, Dogern, Germany, November 8, 2008.

Dr. F. Gassmann
*Realität des Klimawandels*

PD Dr. T. Lippert
*Inorganic Thin Films: Processing, Properties and Applications*
Contributions (4 lectures on the topic: *Vacuum thin film deposition techniques* and *Thin film industrial applications*) to the lecture: by L. Gauckler, J. Rupp, A. Bieberle.
ETH Zürich, FS 2008.

PD Dr. T. Lippert
*Der Laser – vom Kuriosum zum Werkzeug: Anwendungen aus Industrie und Forschung*
Senioren Universität Zürich, October 2008.

Prof. Dr. Ch. Ludwig (joint course with Prof. Dr. J.-L. Scartezzini, Dr. D. Robinson, Prof. Dr. A.G. Dumont, Dr. J.-J. Heftl, Prof. Dr. A. Mermoud, Prof. Dr. R. Schlaepfer, Dr. M. Soutter)
*Quartiers urbains, infrastructures et aménagements durables*
Bachelor 6th semester
EPF Lausanne, HS 2008.

A.S.H. Prévôt, M. Hallquist
*Summer school on organic aerosols*
University of Gothenburg, June 23-27, 2008.

Dr. S. Ulli-Beer
*Systeme, Komplexität – und wie Menschen damit umgehen können*

Dr. S. Ulli-Beer
*Methodological issues on “Diffusion dynamics of energy efficient buildings” (DeER)*
Seminar of the Geographical Department of the University of Zürich, December 12, 2008.
PUBLICATIONS

Books and Reviewed Book Chapters

S. Alkan-Gürsel, L. Gubler, B. Gupta, G.G. Scherer
Radiation grafted membranes
In Fuel Cells I
doi: 10.1007/12_2008_153

Contribution of biogenic emissions on carbonaceous aerosols in summer and winter in Switzerland:
A modelling study
29th NATO/CCMS International Technical Meeting on Air Pollution Modelling and its Application, Aveiro,

U. Baltensperger, M. Furger
Aerosol chemistry in remote locations
(2008).

K.A. Friedrich, F.N. Büchi
Fuel cells using hydrogen
Edited by A. Züttel, A. Borgschulte, L. Schlapbach, Wiley VCH, Weinheim, Germany,
ISBN: 978-3-527-30817-0.

L. Gubler, G.G. Scherer
A proton-conducting polymer membrane as solid electrolyte – Function and required properties
In Fuel Cells I
doi: 10.1007/12_2008_156

B. Mishra, Ch. Ludwig, S. Das (Eds.)
Proceedings of the global symposium on recycling, waste treatment and clean technology

G.G. Scherer, Ed.
Fuel Cells I,

G.G. Scherer, Ed.
Fuel Cells II,

M. Schwaninger, S. Ulli-Beer, R. Kaufmann-Hayoz
Transdisciplinary Modelling, Policy Analysis and Design: A System Dynamics Approach
Germany (2008).

A. Steinfield
Editor-in-Chief
Peert Revieved Papers

M.H. Aguirre¹, S. Canulescu, R. Robert¹, N. Homazava¹, D. Logvinovich¹, L. Bocher¹, T. Lippert, M. Döbeli², A. Weidenkaff¹
*Structure, microstructure and high temperature transport properties of La₁₋₄CaₓMnO₃₋₅ thin films and polycrystalline bulk materials*
¹ EMPA Dübendorf
² ETH Zürich and PSI

*O/C and OM/OC ratios of primary, secondary, and ambient organic aerosols with high resolution time-of-flight aerosol mass spectrometer*

S. Alkan Gürsel, J. Schneider¹, H. Ben youcef, A. Wokaun, G.G. Scherer
*Thermal properties of proton-conducting radiation grafted membranes*
¹ ETH Zürich

*Clouds and aerosols in Puerto Rico - a new evaluation*

I. Alxneit
*Assessing the feasibility of separating a stoichiometric mixture of zinc vapor and oxygen by a fast quench – Model calculations*

*Influence of various emission scenarios on ozone in Europe*

*Secondary aerosols in Switzerland and northern Italy: Modeling and sensitivity studies for summer 2003*

S. Arcidiacono, J. Mantzaras, I. Karlin¹
*Lattice Boltzmann simulation of catalytic reactions*
¹ ETH Zürich

A.R. Armstrong¹, D.W. Tee¹, F. La Mantia, P. Novák, P.G. Bruce¹
*Synthesis of tetrahedral LiFeO₂ and its behavior as cathode in rechargeable lithium batteries*
¹ University of St. Andrews, UK

F. Atchison, A. Bergmaier¹, M. Daum, M. Döbeli, G. Dollinger¹, P. Fierlinger, A. Foelske, R. Henneck, S. Heule, M. Kasprzak², K. Kirch, A. Knecht, M. Kuzniak³, A. Pichilmaier, R. Schelldorfer, G. Zsigmond
*Surface characterization of diamond-like carbon for ultracold neutron storage*
¹ Universität der Bundeswehr München, Germany
² Stefan Meyer Institute, Vienna, Austria
³ Jagiellonian University, Cracow, Poland
S. Brandenberger, O. Kröcher, A. Tissler¹, R. Althoff¹
The state of the art in selective catalytic reduction of NOx by ammonia using metal-exchanged zeolite catalysts
¹ Süd-Chemie AG, Bruckmühl, Germany

F.N. Büchi, M. Reum
Measuring the local membrane resistance in PEFC on the sub-mm scale

X-ray fluorescence spectrometry for high throughput analysis of atmospheric aerosol samples: The benefits of synchrotron X-rays

E.C. Buriana¹, L. Hahui¹, T. Buriana¹, L. Urech, T. Lippert
New polyacrylates with photosensitive triazene groups designed for laser ablation. Synthesis, structure and properties
¹ Petru Poni Institute of Macromolecular Chemistry, Romania

F.P. Campana, H. Buqa, P. Novák, R. Kötz, H. Siegenthaler¹
In situ atomic force microscopy study of exfoliation phenomena on graphite basal planes
¹ University of Bern

S. Canulescu, T. Lippert, A. Wokaun
Mass and kinetic energy distribution of the species generated by laser ablation from a manganate target

X.Chen¹, T.B. Settersten¹, P.P. Radi, A.P. Kouzov²
Two-color resonant four-wave mixing spectroscopy: New perspectives for direct studies of collisional state-to-state transfer
¹ Sandia National Laboratories, Livermore, California, USA
² Saint-Petersburg State University, Peterhof, Russia

The influence of small aerosol particles on the properties of water and ice clouds

J. Cozic, S. Mertes, B. Verheggen, D.J. Cziczo, S.J. Gallavardin, S. Walter, U. Baltensperger, E. Weingartner
Black carbon enrichment in atmospheric ice particle residuals observed in lower tropospheric mixed phase clouds

Chemical composition of free tropospheric aerosol for PM1 and coarse mode at the high alpine site Jungfraujoch

I. Czekaj, O. Kröcher, G. Piazzesi
DFT calculations, DRIFT spectroscopy and kinetic studies on the hydrolysis of isocyanic acid on the TiO₂-anatase (101) surface
*Fast airborne aerosol size and chemistry measurements above Mexico City and Central Mexico during the MILAGRO campaign*

*Apportionment of primary and secondary organic aerosols in Southern California during the study of organic aerosols in Riverside (SOAR-1)*

*Cloud forming potential of secondary organic aerosol under near atmospheric conditions*

P.E. Dyer¹, M. Pervolaraki¹, C.D. Walton¹, T. Lippert, M. Kuhnke, A. Wokaun
*Ionization in vacuum ultraviolet F₂ laser ablated polymer plumes*
¹University of Hull, UK

M. Epstein¹, G. Olalde², S. Santén³, A. Seinfeld, C. Wieckert
*Towards the industrial solar carbothermal production of zinc*
¹The Weizmann Institute of Science, Rehovot, Israel
²PROMES-CNRS, Odeillo, France
³ScanArc Plasma Technologies AG, Hofors, Sweden

R. Fardel¹, M. Nageli², T. Lippert, F. Nüesch², A. Wokaun, B. Luk'yanchuk³
*Influence of thermal diffusion on the laser ablation of thin polymer films*
¹EMPA Dübendorf and PSI
²EMPA Dübendorf
³Data Storage Institute, Singapore, Malaysia

P. Farquet, C. Pedaste, H.H. Solak, S.A. Gürsel, G.G. Scherer, A. Wokaun
*Extreme UV-radiation grafting of glycidyl methacrylate nanostructures onto fluoropolymer foils by RAFT-mediated polymerization*

P. Farquet, C. Pedaste, M. Börner¹, H. Ben youcef, S. Alkan-Gürsel, G.G. Scherer, H.H. Solak, V. Saile³, A. Wokaun
*Microstructured proton conducting membranes by synchrotron radiation induced grafting*
¹Forschungszentrum Karlsruhe, Germany

R. Felder, A. Meier
*Well-to-wheel analysis of solar hydrogen production and utilization for passenger car transportation*

*Anisotropic, effective diffusivity of porous gas diffusion layer materials for PEFC*

S.A. Freunberger, I.A. Schneider, P.-C. Sui¹, A. Wokaun, N. Djilali¹, F.N. Büchi
*Cell interaction phenomena in polymer electrolyte fuel cell stacks*
¹University of Victoria, Victoria BC, Canada

R. Gadiou¹, A. Didion¹, R.I. Gearba¹, D.A. Ivanov¹, I. Czekaj, R. Kötz, C. Vix-Guterl¹
*Synthesis and properties of new nitrogen-doped nanostructured carbon materials obtained by templating of mesoporous silicas with aminosurgars*
1 CNRS, Mulhouse, France

Residential wood burning in an Alpine valley as a source for oxygenated volatile organic compounds, hydrocarbons and organic acids

E. Gálvez1, I. Hischier1, A. Frei, A. Steinfeld
Ammonia production via a 2-step Al2O3/AlN thermochemical cycle – III. Influence of the carbon reducing agent and cyclability
1 ETH Zürich

E. Gálvez1, A. Frei, G. Albisetti1, G. Lunardi1, A. Steinfeld
Solar hydrogen production via a 2-step thermochemical process based on MgO/Mg redox reactions – thermodynamic and kinetic analyses
1 ETH Zürich

E. Gálvez1, P.G. Louzenhiser, I. Hischier1, A. Steinfeld
CO2 splitting via 2-step solar thermochemical cycles with Zn/ZnO and FeO/Fe2O4 redox reactions – Thermodynamic analysis
1 ETH Zürich

J.K. Gietl, T. Tritscher, O. Klemm
Size-segregated analysis of PM10 at two sites, urban and rural, in Münster (Germany) using five-stage Berner type impactors

D. Gstoehl, A. Brambilla, L.O. Schunk, A. Steinfeld
A quenching apparatus for the gaseous products of the solar thermal dissociation of ZnO

L. Gubler, H. Ben Youcef, S. Alkan Gürsel, A. Wokaun, G.G. Scherer
Crosslinker effect in ETFE based radiation grafted proton conducting membranes I. Properties and fuel cell performance characteristics

U. Gurudus1, E. Brooks1, D.M. Bubb1, S. Heiroth, T. Lippert, A. Wokaun
Saturable and reverse saturable absorption in silver nanodots at 532 nm using picoseconds laser pulses
1 Rutgers – The State University of New Jersey, USA

M. Hahn, H. Buqa, P.W. Ruch, D. Goers1, M.E. Spahr1, J. Ufheil, P. Novák, R. Kötz
A dilatometric study of lithium intercalation into powder-type graphite electrodes
1 TIMCALS A, Bodio

M. Halmann1, A. Frei, A. Steinfeld
Magnesium production by the pidgeon process involving dolomite calcination and MgO silicothermic reduction: Thermodynamic and environmental analyses
1 Weizmann Institute of Science, Rehovot, Israel

L.J. Hardwick, P.W. Ruch, M. Hahn, W. Scheifele, R. Kötz, P. Novák
In situ Raman spectroscopy of insertion electrodes for lithium-ion batteries and supercapacitors: First cycle effects

R.M. Healy, J.C. Wenger, A. Metzger, J. Duplissy, M. Kalberer, J. Dommen
Gas/particle partitioning of carbonyls in the photooxidation of isoprene and 1,3,5-trimethylbenzene
S. Heiroth, T. Lippert, A. Wokaun, M. Döbeli
Microstructure and electrical conductivity of YSZ thin films prepared by pulsed laser deposition

Using proton transfer reaction mass spectrometry for online analysis of secondary organic aerosols

H. Herich, L. Kammermann, M. Gysel, E. Weingartner, U. Baltensperger, U. Lohmann, D.J. Cziczo
In situ determination of atmospheric aerosol composition as a function of hygroscopic growth

C. Hoose, U. Lohmann, P. Stier, B. Verheggen, E. Weingartner
Aerosol processing in mixed-phase clouds in ECHAM5-HAM: Model description and comparison to observations

W. Hubschmid, R. Bombach, A. Inauen, F. Güthe, S. Schenker, N. Tylli, W. Kreutner
Thermoacoustically driven flame motion and heat release variation in a swirl-stabilized gas turbine burner investigated by LIF and chemiluminescence

Can we use CO₂ concentrations determined with IRMS from small samples for the Keeling plot approach? Comparison of LICOR 8100 and IRMS measurements.

Effects of environmental parameters, leaf physiological properties and leaf water relations on leaf water δ18O enrichment in different Eucalyptus species

The impact of reducing the maximum speed limit on motorways in Switzerland to 80 km h⁻¹ on emissions and peak ozone

Temporal dynamics of the carbon isotope composition in a Pinus sylvestris stand: from newly assimilated organic carbon to respired carbon dioxide

R. Kötz, M. Hahn, P.W. Ruch, R. Gallay
Comparison of pressure evolution in supercapacitor devices using different aprotic solvents

G. Kopitkovas, V. Deckert, T. Lippert, F. Raimondi, C.W. Schneider, A. Wokaun
Chemical and structural changes of quartz surfaces due to structuring by laser-induced backside wet etching

D.N. Kozlov, P.P. Radi
Detection of vibrational overtone excitation in methane by laser-induced grating spectroscopy

D. Kramer, S.A. Freunberger, R. Flückiger, I.A. Schneider, A. Wokaun, F.N. Büchi, G.G. Scherer
Electrochemical diffusimetry of fuel cell gas diffusion layers
O. Kröcher, M. Elsener
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N. Badawi  
*Analysis of pollutants emissions from a landfill in soil and water, Cali, Colombia: Heavy metals*
PSI Villigen, EPF Lausanne and Uni Valle, Cali, Colombia, June 2008.

M. Burger  
*Steady-state fuel processor modeling for the on-board production of hydrogen-enriched fuel blend from gasoline*
PSI Villigen and ETH Zürich, 2008.

C. Caprez  
*Wood burning emission and diesel exhaust experiments at the smog chamber: PTR-MS results*
University of Zürich, 2008.

D. Douçot  
*Municipal waste and recycled material flow analysis of Ho Chi Minh City*
PSI Villigen, EPF Lausanne and National University of HCMC, Vietnam, June 2008.

A. Evans  
*In situ colorimetric analysis of lithium intercalation into graphite electrodes of lithium-ion batteries*
ETH Zürich, February 2008.

A. Fleischer  
*Experimental study of solar steam gasification of cabonaceous materials*
PSI and ETH Zürich, September 2008.

C. Good  
*Source apportionment of a highly time and spatially resolved organic aerosol dataset from the Rhine valley by the use of positive matrix factorization*
ETH Zürich, August 2008.

V. Klass  
*AMS/MAN copolymerization onto ETFE base film using DIPB as crosslinking agent*
ETH Zürich, April 2008.

A. Maric  
*Identification of As-Cu-FA complexes in Laboratory samples and characterization of association between arsenic and dissolved organic matter in China’s groundwater*
PSI Villigen and EPF Lausanne and Chinese Academy of Sciences, Beijing, China, 2008.

M. Nso  
*Assessment of high-temperature electrolysis for solar hydrogen production*
PSI and ETH Zürich, October 2008.

D. Rätz  
*Sub-mm Membranwiderstand in PEFC – Methodenentwicklung und Bestimmung des Einflusses der Gaszusammensetzung an der Kathode*
ETH Zürich, February 2008.

J. Regler  
*Untersuchungen zur kontinuierlichen Salztrennung aus wässrigen Lösungen unter Bedingungen der hydrothermalen Vergasung von Biomasse*
PSI Villigen and Fachhochschule Weihenstephan, Abteilung Triesdorf, Germany, May 2008.

V. Silberstein  
*Prédiction des flux des éléments traces au cours de la réaction des mâchefers avec les poussières de climent enrichies en chlore*
PSI Villigen and EPF Lausanne, January 2008.
M. Steiger  
An overview of diesel and wood burning soot smog chamber experiments and a loading effect correction for aethalometer measurements  
ETH Zürich, July 2008.

C. Suter  
Development and experimental investigation of quench unit for a solar thermal rotary reactor  
PSI and ETH Zürich, May 2008.

D. Tehlar  
Investigation of the cross-convection in PEFC serpentine flow-fields  
ETH Zürich, March 2008.

M. Uldry  
Elektrochemische Charakterisierung von gesputterten Pt/C-Katalysatoren  

T. Ulrich  
An in-situ XAFS investigation of a ruthenium on carbon catalyst during the gasification of ethanol in supercritical water  
PSI Villigen and ETH Zürich, October 2008.

K. Volkart  
Test von Katalysatoren für die Methanisierung, die Umsetzung von Schwefelspezies, die Wassergaskonvertierung und die Ethylenhydriderung in einem Teilstrom eines Holzvergasers  
PSI Villigen and ETH Zürich, 2008.
BACHELOR THESES

J. Aubert
Untersuchungen zur kontinuierlichen Salzabtrennung aus wässrigen Lösungen unter Bedingungen der hydrothermalen Vergasung von Biomasse
PSI Villigen and ETH Zürich, June 2008.

S. Möllencamp
CO2 reduction via a solar thermochemical cycle based on metal oxide redox reactions
PSI and ETH Zürich, October 2008.

T. Müller
Simulation of the hydrolysis and pyrolysis of a wood particle under hydrothermal conditions
PSI Villigen and ETH Zürich, June 2008.

M. Wirz
Solar steam gasification: Characterization and study of thermal behaviour/kinetics of industrial sludges
PSI and ETH Zürich, July 2008.

G. Zanganah
Solar thermal cracking of methane - experimental campaign at the PSI solar furnace
PSI and ETH Zürich, December 2008.
SEMESTER THESES

L. Besnier
*Characterisation of carbonaceous particles with an ECOC instrument*
PSI Villigen, 2008.

J. Gaabab
*Characterization of a packed bed of carbonaceous materials during gasification*
PSI Villigen and ETH Zürich, September 2008.

A. Kirstopuryan
*Fluorite-type solid electrolyte layers by aerosol assisted CVD & PLD*
PSI Villigen and ETH Zürich, April 2008.

A. Paillet
*Contribution to the production of improved iron-exchanged zeolite SCR catalysts*
Université d’Orléans, April 1 – August 31, 2008.

N. Rizwan Farid
*Chemical simulation of syngas flames*
PSI Villigen and ETH Zürich, March 2008.

H. Wallimann
*Experimental investigation of the aerodynamic protection of a solar reactor’s window*
PSI Villigen and ETH Zürich, June 2008.
TALKS

Invited Talks

U. Baltensperger
*Atmospheric aerosols - recent development in elucidating their sources*
4th Aarhaus Winter Meeting, Trends in Modern Chemistry, Aarhus, Denmark, February 1, 2008.

U. Baltensperger
*Sources of organic aerosols in the atmosphere - recent results from lab and field experiments*
University of Copenhagen, Sweden, January 31, 2008.

U. Baltensperger
*Feinstaub in der Schweiz - Zusammensetzung, Quellen, Auswirkungen*
Forum Medizin und Energie, Aarau, March 6, 2008.

U. Baltensperger
*Aerosole - winzige Teilchen beeinflussen globales Klima*
Klimasonntag, PSI Villigen, April 13, 2008.

U. Baltensperger
*Chemical and physical properties of organic aerosols*
EGU, Vienna, Austria, April 13-18, 2008.

U. Baltensperger
*Aerosol research at the high-alpine site Jungfraujoch*
Grosses Physikalisches Kolloquium an der Universität zu Köln, Germany, May 6, 2008.

U. Baltensperger
*Sekundärorganisches Aerosol, HULIS, Polysäuren, hochmolekulare Verbindungen: Eine Wanderung durch den Terminologie-Dschungel und erste Einblicke in Bildungsprozesse und Eigenschaften*

U. Baltensperger
*Atmospheric aerosols - sources, transformation, processes and impact*

U. Baltensperger
*Das CLOUD-Projekt am CERN*

U. Baltensperger
*Primary and secondary organic aerosol from Diesel engines*
12th ETH-Conference on Combustion Generated Nanoparticles, Zürich, June 23-25, 2008.

U. Baltensperger
*Formation and transformation of secondary organic aerosols*
University of Colorado, Boulder, USA, August 1, 2008.

U. Baltensperger
*Nucleation, growth, and aging of secondary organic aerosol*
Workshop on Organic Aerosols, Telluride, USA, August 4-8, 2008.

U. Baltensperger
*Secondary organic aerosols: formation, transformation, and source apportionment*
University of California, Berkeley, CA, USA, August 11, 2008.

U. Baltensperger
*Feinstaub: Kleine Teilchen mit grossen Auswirkungen*
Forschung im Zelt, PSI, Aarau, August 20, 2008.
U. Baltensperger  
*New Frontiers on Organic Aerosols*  

U. Baltensperger  
*Der Beitrag der Holzfeuerungen zum Feinstaub-Hintergrund und Forschung am PSI*  
Medienkonferenz Feinstaub aus Holzeizungen, Balsthal, October 2, 2008.

U. Baltensperger  
*Aerosole und ihre abkühlende Wirkung auf das Klima*  
Lokal messen, Global verstehen. Schweizer Klimabechobtung als globaler Beitrag, Swiss GCOS, Zürich, October 21, 2008.

U. Baltensperger, E. Weingartner  
*Aerosol measurements in the context of the global atmosphere watch programme and several EC projects*  

U. Baltensperger, E. Weingartner  
*Aerosol Measurements at the High-Alpine Station Jungfraujoch, Switzerland*  
CANDAC Workshop, Toronto, Canada, November 27-29, 2008.

S.M.A. Biollaz  
*Vergasung von Biomasse*  

S.M.A. Biollaz  
*Biomasse im Erdgasnetz - SNG für die KWK -*  
OTI Profiforum, KWK mit Biomasse, Regenstauf bei Regensburg, Germany, April 7-8, 2008.

S.M.A. Biollaz  
*Erzeugung von Erdgassubstituten (SNG) aus Vergasungsgasen*  

A. Bodi  
*Imaging photoelectron photoion coincidence spectroscopy at the Swiss Light Source*  
Group Seminar (Prof. John P. Meier) University of Basel, October 27, 2008.

M. Brandenberger  
*BrandenbergerSunCHEM: A 3rd generation biofuel technology to produce methane from algae*  
36th Discussion Forum LCA of Future Biofuels, EMPA Dübendorf, November 17, 2008.

F.N. Büchi  
*Hydrogen based mobility: Developments in Europe*  

F.N. Büchi  
*Sizing of fuel cell powertrains for mobile applications*  

I. Czekaj  
*How can combination of experimental and theoretical methods contribute to the development of catalysts at macroscopic scale?*  

P.F. DeCarlo  
*Characterizing Submicron Aerosols with the High Resolution Time-of-Flight Aerosol Mass Spectrometer*  

W. Durisch  
*Fuel-fired TPV at PSI*  
7th FULLSPECTRUM Meeting, Freiburg, Germany, May 28, 2008.
W. Durisch  
*Fuel-fired TPV Activity Report*  

M. Furger  
*Feinstaub: Kleine Teilchen mit grossen Auswirkungen*  
Forschung im Zelt, PSI, Waldshut, Germany, August 27, 2008.

F. Gassmann  
*Erneuerbare Energie – 2000 Watt Gesellschaft*  
Aargauische Naturforschende Gesellschaft, Naturama Aarau, January 9, 2008.

F. Gassmann  
*Unser Klima im Wandel*  
– Electra Schneisingen, March 27, 2008.

F. Gassmann  
*Klimawandel – Ursachen und Auswirkungen auf unser Leben*  

F. Gassmann  
*Der Klimawandel ist voll im Gang*  

F. Gassmann  
*Treibhauseffekt und Klimawandel*  
Delegation der Axpo, PSI, November 15, 2008.

F. Gassmann  
*Wellen als zentrales Thema der Physik – Experimente mit Schallwellen*  
Volkshochschule der Region Zürach, PSI, November 20, 27, 2008.

F. Gassmann  
*Erneuerbare Energie*  
Thurgauische Naturforschende Gesellschaft, Frauenfeld, December 9, 2008.

F. Gassmann  
*Klimaveränderungen und Auswirkungen auf den Wasserkreislauf*  
Axporama, Böttstein, December 12, 2008.

F. Gassmann  
*Erneuerbare Energie – wie weit reicht sie?*  
Ringvorlesung "Energie" der Zürcher Hochschule der Künste (ZHDK), Zürich, December 16, 2008.

L. Gubler  
*Trends for fuel cell membrane development*  
12th Aachener Membran Kolloquium, Aachen, Germany, October 29, 2008.

M. Gysel  
*Hygroscopic properties of laboratory generated and atmospheric aerosol particles and their interaction with clouds*  
Johann Wolfgang Goethe Universität, Frankfurt (Main), Germany, June 26, 2008.

M.P. Hofer, M. Papra, F.N. Buechi, T. Gloor  
*Freezing of PEFC*  

P. Jansoh  
*Perspektiven in der Energieversorgung*  
Manfred Eigen Nachwuchswissenschaftler Gespräche, Deutsche Bunsen-Gesellschaft für Physikalische Chemie, Bad Herrenalb, Germany, April 24, 2008.
P. Jansohn
*Kraftwerk 2020 – An option for swiss power generation in a carbon constrained world*
ABB Corporate Research Lunch Talk, Baden-Dättwil, November 17, 2008.

G. Knopp
*Prospective experiments on catalytic surfaces*
PSI-XFEL Science Workshop on Sub-ps Solution Chemistry and Surface Catalysis, EPF Lausanne, October 10, 2008.

R. Kötz
*SuperCaps basics*

R. Kötz
*Applications of SuperCaps*

O. Kröcher
*Chemical challenges in the development of urea-SCR systems*
Seminar for Caterpillar, USA, January 14, 2008.

O. Kröcher
*Ein neues TG-FTIR-System für die Abgasnachbehandlung*
Forschungsvereinigung Verbrennungskraftmaschinen (FVV), Frankfurt (Main), Germany, August 19, 2008.

O. Kröcher
*Guanidinium formate as new reductant for the low NOx-SCR technique*

O. Kröcher, M. Casapu
*Katalysatormaterialien für die NOX-Reduktion*
VDI forum, Nürnberg, Germany, December 11, 2008.

O. Kröcher
*New reducing agents for the low-NO, SCR technology*

O. Kröcher
*Zukunft der Mobilität: Das Auto von morgen*
Am Puls der Forschung, Waldshut, Germany, August 23, 2008.

T. Lippert
*Der Laser – vom Kuriosum zum Werkzeug: Anwendungen aus Industrie und Forschung*

T. Lippert
*Excimer laser for the deposition/transfer of thin films and structuring: Applications for fuel cells and OLEDs*

T. Lippert
*Thin films prepared by pulsed laser deposition for renewable energy applications*
FZ Karlsruhe, Germany, November 2008.

T. Lippert
*Laser-induced forward transfer (LIFT) of polymers using a sacrificial layer*
– University of Southampton, Optoelectronics Research Centre, UK, February 2008.

T. Lippert
*Laser interaction with materials: From structuring to thin film deposition*
RIKEN, Wako, Japan, August 2008.
T. Lippert
*From laser ablation to laser transfer techniques – experiences and current developments*
IMM Mainz, Germany, June 2008.

T. Lippert
*Materials for laser propulsion*
7th International conference on High Power Laser Ablation, Taos, USA, April 2008.

T. Lippert
*Thin film deposition by laser based methods*
University of Vienna, Physical Chemistry Department, Austria, April 2008.

Ch. Ludwig
*RESH Behandlung mit KVA*\(^\text{Plus}\)

Ch. Ludwig
*Understanding the fate of elements in industrial processes and the environment*
IMX seminar series on Advances in Materials, EPF Lausanne, November 10, 2008.

A. Meier
*Concentrating solar power – present status and future prospects*

C. Mohr
*Analyse primärer organicher Feinstaub-Emissionen aus Grillaktivitäten*
Bundesamt für Umwelt BAFU, Bern, November 4, 2008.

C. Mohr
*Partikelzusammensetzung im Rheintal und in der Stadt Zürich*

*Commissioning of the QEXAFS monochromator at the Swiss Light Source*

F.P. Nagel
*Verstromung von Holz über die Hochtemperaturbrennstoffzelle*
SAH Statusseminar, EMPA, Akademie, Zürich, March 19, 2008.

P. Novák
*Beyond the conventional approach: An in situ look at battery materials*
– Seminar in the Laboratory for Inorganic Chemistry, ETH Zürich, February 19, 2008.
– Seminar at Toyota Central R&D Labs., Inc., Nagoya, Japan, June 20, 2008.
– 49th Battery Symposium in Japan, Sakai, Japan, November 6, 2008.

P. Novák
*Oxygen loss from NMC materials*
BASF SE, Ludwigshafen, Germany, July 18, 2008.

P. Novák
*In situ investigations of battery materials*
Seminar at the State Key Laboratory of Physical Chemistry of Solid Surfaces, Xiamen University, Xiamen, China, July 9, 2008.

P. Novák
*Materials for lithium-ion batteries*
Seminar at the Department of Chemistry, Zhejiang University, Hangzhou, China, July 3, 2008.
P. Novák
*In situ characterization methods - the scientific key to battery materials*
14th Int. Meeting on Lithium Batteries, Tianjin, China, June 22-28, 2008.

P. Novák
*Energy storage in advanced batteries*
Seminar “A Physics Perspective on Climate Change and Energy Supply” of the German Physical Society, Bad Honnef, Germany, May 29, 2008.

T.J. Patey
*Nanoparticles in lithium-ion batteries – opportunities and challenges*
Particle Formation Symposium, Vitznau, July 5, 2008.

A.S.H. Prévôt
*Organic carbon source analysis in aerosols*
Organics in the Atmosphere, Vienna, Austria, October 6-8, 2008.

A.S.H. Prévôt
*Source apportionment of particulate organics in ambient air and secondary organic aerosol formation studies in the smogchamber at the Paul Scherrer Institute in Switzerland*
University of Stockholm, Sweden, September 26, 2008.

A.S.H. Prévôt
*Fine and ultrafine particle measurements in Central Europe in ambient air*
International Workshop on Environmental Nanoparticles, Tsukuba, Japan, January 18, 2008.

A.S.H. Prévôt
*Fine and ultrafine particle measurements in Switzerland in ambient air*
University of Tokyo, Japan, January 21, 2008.

A.S.H. Prévôt
*Aerosolmassepektrometer*

M. Saurer
*The climatic content of carbon and oxygen isotope ratios in tree-rings from northern Eurasia*
Barnaul, Russia, June 1-6, 2008.

M. Saurer
*The use of isotopes in ecosystem studies*

G.G. Scherer
*Radiation grafted membranes as solid electrolyte in fuel cell applications*
Advances in Polymer Science and Technology, plenary lecture, New Delhi, India, January 28-31, 2008.

G.G. Scherer
*Fuel cells for transportation - an overview on European activities*
Nissan Motor Company, Research Center, Kanagawa, Japan, February 6, 2008.

G.G. Scherer
*The lithium-ion battery - activities at PSI's Electrochemistry Laboratory*
Dainippon Screen, Kyoto, Japan, February 7, 2008.

G.G. Scherer
*Fuel Cells I*
*Fuel Cells II*

G.G. Scherer
*Die Funktionsweise der Polymer Elektrolyt Brennstoffzelle*
G.G. Scherer  
*Radiation grafted polymer membranes for fuel cell applications achievements and challenges*  

G.G. Scherer  
*Radiation grafted fuel cell membranes*  
IPEN, Centro de Química e Meio Ambiente, Sao Paulo, Brazil, October 23, 2008.

G.G. Scherer  
*Polymer electrolyte fuel cells: In situ diagnostic methods & materials development*  
IPEN, Centro de Células a Combustível, Sao Paulo, Brazil, October 24, 2008.

G.G. Scherer  
*Electrochemical energy conversion and storage - R & D at Paul Scherrer Institut*  
IPEN, Centro de Química e Meio Ambiente, Sao Paulo, Brazil, October 25, 2008.

T. Schildhauer  
*Methane from wood: Reducing deactivation by carbon “management” on nickel catalysts*  

I.A. Schneider, M.H. Bayer, A. Wokaun, G.G. Scherer  
*Impedance response of the proton exchange membrane in polymer electrolyte fuel cells*  
5*th* Symposium on FC Modelling and Validation, Winterthur, March 12, 2008.

I.A. Schneider, M.H. Bayer, P. Boillat, A. Wokaun, G.G. Scherer  
*Recent insights obtained from local in situ diagnostics in polymer electrolyte fuel cells*  

M. Schubert, J.W. Regler, F. Vogel  
*Effiziente Salzabscheidung als ein wichtiger Schritt bei der katalytischen, hydrothermalen Vergasung nasser Biomasse*  

L.O. Schunk  
*Erneuerbare Energien – heute und morgen*  
– TecDay@KME, Kantonale Maturitätsschule für Erwachsene, Zürich, November 13, 2008.  
– TecDay@KantiBaden, Kantonsschule Baden, November 26, 2008.

B.C. Seyfang  
*Micro polymer electrolyte fuel cells – simple, small, but still sophisticated enough*  
Catalysis Group Seminar, University of Cape Town, South Africa, February 14, 2008.

A. Steinfeld  
*High-temperature thermochemical processing of fuels using concentrated solar energy*  

A. Steinfeld  
*Solar Hydrogen – Present and Future*  
Int. Conf. Renewable Energy and Beyond, Tel Aviv, Israel, May 22, 2008.

A. Steinfeld  
*In-situ formation and hydrolysis of Zn nanoparticles for H₂ production via a 2-step solar thermochemical cycle*  

A. Steinfeld  
*Die Versorgungssicherheit – Potenzial erneuerbarer Energien*  
Climate Forum, Thun, October 9, 2008.
A. Steinfeld
Concentrated solar power & fuels – early pioneering research, present status, and future prospects
Symposium honoring the 90th birthday of Prof. Dostovsky “Outward Bound; From Nuclear Chemistry to Solar Neutrinos”, Weizmann Institute, Rehovot, Israel, October 26, 2008.

A. Steinfeld
Global potential of renewable energy technologies
Ringvorlesung Energie, University of Zürich, October 30, 2008.

R.P.W.J. Struis
Studying sulfur deactivation of Ni-based methanation catalysts using X-ray absorption spectroscopy

S. Sticki
Neue Technologien im Bereich Holzenergie

S. Sticki
Biotreibstoffe: Aktuelle Möglichkeiten, künftige Bedürfnisse
AWEL Werkstatt, Zürich, October 21, 2008.

S. Sticki
New pathways to efficient use of biomass for power and transportation
CEEM Project 2nd Generation Biogas, SVGW Arbeitsgruppe „Koordination Biogas“, Zürich, June 6, 2008.

S. Ulli-Beer
Wege zu sparsameren Autos: Die Autowahl vor dem Hintergrund sich verändernder Technologie-Landschaften
Mitgliederversammlung der Gruppe Energieperspektiven, Baden, March 27, 2008.

S. Ulli-Beer
Die gelebte Erlebnisraum-Mobilität Strategie. Was macht uns aus, wie können wir uns erhalten und verbessern

S. Ulli-Beer
Nachhaltigkeitsmanagement im Fuhrpark: Energieeffiziente und umweltfreundliche Flotten
Event für Schweizer Fuhrparkmanager, organisiert von aboutFleet, Zürich, November 26, 2008.

F. Vogel
Catalytic Process Engineering at PSI

F. Vogel
Technologien und Perspektiven der Energiegewinnung aus Biomasse – Hydrothermale Vergasung von nasser Biomasse
ETH Alumni - Process Alumni event, Zürich, April 3, 2008.

F. Vogel, M. Schubert, M. Brandenberger, J.W. Regler
Recent advances in catalytic hydrothermal gasification of biomass to synthetic natural gas

F. Vogel
Katalytische Aspekte der hydrothermalen Vergasung nasser Biomasse zu Methan
Kolloquium am Institut für Technische Chemie, Forschungszentrum Karlsruhe, Germany, July 8, 2008.

E. Weingartner
Study of Aerosol from Wood Burning Versus Other Sources (AEROWOOD) Using a Multiwavelength Aethalometer
E. Weingartner
*Current Aerosol Mesurement at the Jungfraujoch*
Air Pollution and Climate Change at Contrasting Altitude and Latitude, Murten, September 11, 2008.

E. Weingartner
*CPC, SMPS, APS im Messbetrieb*

E. Weingartner
*Feinstaub: Kleine Teilchen mit grossen Auswirkungen*
Forschung im Zelt, PSI, Baden, August 13, 2008.

A. Wokaun
*Erneuerbare Energien in der Schweiz – Stand der Forschung und aktuelle Beispiele*

A. Wokaun
*Energie – Perspektiven und Optionen für die Zukunft*
Departement Bau, Verkehr und Umwelt, Aarau "Klimawandel im Aargau: Folgen, Chancen und Risiken",
Baden, September 8, 2008.

A. Wokaun
*Klimaprognosen versus Energieprognosen*
Energie Schweiz, Energie Apéro, Baden and Lenzburg, October 14 and 16, 2008.

A. Wokaun
*Alternative Fuels and Propulsion Concepts for a Sustainable Mobility*

A. Wokaun
*Mobilität und Energie*
Ringvorlesung "Energie", ETH Zürich, December 11, 2008.
Contributions to Media

U. Baltensperger
Feinstaub aus Holzhierzungen: Heute agieren, nicht morgen reagieren

U. Baltensperger
Mögliche wenig Staub aufwirbeln

U. Baltensperger
Holzfönenbauer gehen gegen den Feinstaubausstoss vor

U. Baltensperger
Forschung für saubere Öfen
Zeitungsartikel: Solothurner Tagblatt, October 4, 2008.

U. Baltensperger
Schadstoffärmere Holzfeuerungen
Zeitschriftenartikel: TEC21, October 27, 2008.

U. Baltensperger
Fortschritte dank oberem Abbrand und Blähglimmer

U. Baltensperger
Organische Aerosole als wichtiger Schadstoff

U. Baltensperger
Milliarden Tonnen von Mineralstaub belasten jährlich die Atmosphäre

U. Baltensperger
Auf höchstem Niveau, Klimaforschung auf dem Jungfraujoch

P. Jansohn
CO₂: ausfiltern und speichern – oder vermeiden?
Automobil Revue, Salon Genf Special, Nr. 10s, March 2008.

P. Jansohn
Schweiz forsch für saubere Gaskraftwerke
energia, Ausgabe 4, Juli 2008.

P. Jansohn
Vollbremsung bei den Gaskraftwerken
Handelszeitung, Nr. 38, September 2008.

A. Prévôt
Jetzt handeln ist wichtig

Vorsicht Feinstaub

S. Stucki
Holz in die Gasleitung
S. Ulli-Beer, M. Bosshardt, W. Alexander
Der Weg zum emissionsarmen Fahrzeugfuhrpark: Emissionsarme Flottenfahrzeuge - Erfolgsfaktoren und Stolpersteine bei der Umstellung
aboutFleet (Flottenmagazin der Schweiz), September/Oktober 4, 2008.

E. Weingartner
Die Partei befiehlt Sonne

A. Wokaun
Möglichkeiten und Grenzen des Energiesystems – Energiebereitstellung, Anwendung, energetisches Recycling

A. Wokaun
Visionen Elektrizitätsversorgung 2030 Schweiz / Europa / Global
ClimateForum, Breakout-Session zum Thema "Versorgungssicherheit", October 9, 2008.
Other Talks

S. Andreani-Aksoyoglu
_Ergebnisse eines regionalen Modells für schweizerische Ozonveränderungen im Mittelland_
Ozon und Sommersmog, Fachtagung zum Stand der Forschung und zur Reduktionsstrategie, Bern, October 30, 2008.

_An aerosol modelling study of winter and summer periods in Switzerland_

_Sezonal variability of aerosol composition in Switzerland: A modeling study_
GLOREAM/ACCENT Workshop, Antwerp, Belgium, October 29-31 2008.

U. Baltensperger
_Neue Ergebnisse zur sommerlichen Partikelbildung_
Ozon und Sommersmog, Fachtagung zum Stand der Forschung und zur Reduktionsstrategie, Bern, October 30, 2008.

U. Baltensperger
_Secondary organic aerosol formation in a smog chamber and its link to source apportionment in the real atmosphere_
39th Int. Conf. on Carbonaceous Particles in the Atmosphere, Berkeley, CA, USA, August 12-14, 2008.

U. Baltensperger
_Umweltforschung am PSI_
Besuch UWIS Department, Villigen, May 29, 2008.

U. Baltensperger
_Astrophärentchmie am PSI_

_A comparison of new and classic methods to estimate the wood smoke contribution to particulate matter for several field campaigns_
European Aerosol Conference, Thessaloniki, Greece, August 24-29, 2008.

_Refined 14C source apportionment of organic carbon_
39th Int. Conf. on Carbonaceous Particles in the Atmosphere, Berkeley, CA, USA, August 12-14, 2008.

_Micro-structured proton conducting membranes by synchrotron radiation induced grafting for fuel cell applications_
Europolymer Conference, Gargnano, Italy, June 1-5, 2008.

S.M.A. Biolaz
- _Successful demonstration of long term catalyst stability in the methane from wood process_
- _Long term Tests on a Complete Biomass Integrated Gasification Fuel Cell System (B-IGFC)_
16th European Biomass Conference and Exhibition, Valencia, Spain, June 2-6, 2008.

P. Bornhauser, P.P. Radi
_Depturbation of the d^3T_1g Electronic State (v’ = 0, 1, 2) of C2 by Two-Color Resonant Four-Wave Mixing_
Swiss Chemical Society – Fall Meeting, University of Zürich, September 11, 2008.

F.N. Büchi
_Determination of liquid water distribution in porous transport layers_
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P. Jansohn
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P. Jansohn
Combustion of hydrogen (en-)rich(ed) fuel gases in gas turbines

S. Karagiannidis
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Spectral effects in dispersed off-resonant fs-transient gratings

R. Kötz, P.W. Ruch, D. Cericola, S.H. Ng, A. Foelske
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W. Lipinski, A. Steinfeld
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*In situ colorimetric determination of lithium content in graphite anodes of lithium-ion batteries*

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1 ETH Zürich
2 University of Wollongong, Australia

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A new approach to in situ neutron diffraction applied to lithium-ion batteries

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In situ studies of single-walled carbon nanotubes and activated carbon in non-aqueous supercapacitor electrolytes
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I.A. Schneider, M.H. Bayer, A. Wokaun, G.G. Scherer
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¹ ETH Zürich

I. Barmpadimos
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A. Bodi, Z. Gengeliczki¹, B. Hornung¹, B. Sztáray¹,², T. Baer²
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¹ Institute of Chemistry, Eötvös University, Budapest, Hungary
² Department of Chemistry, University of North Carolina, Chapel Hill, NC, USA

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LiMn₂O₄ thin films synthesized via an in situ annealing-assisted flame spray deposition method
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¹ ETH Zürich
² University of Wollongong, Australia

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¹ University of Hong Kong, China
² Enecolo AG, Mönchaltorf

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1 TIMCAL SA, Bodio

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*Aging phenomena in radiation grafted fuel cell membranes*

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*Hygroscopic growth and cloud condensation nuclei activity of secondary organic aerosol formed through photo-oxidation of alpha-pinene*

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*New approach for inversion of tandem differential mobility analyser measurements*

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1 ETH Zürich

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*Microstructural and compositional control in thin film deposition of oxide ion conductors by laser ablation*
1 ETH Zürich and PSI
2 ETH Zürich

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1 ETH Zürich and PSI
2 EMPA Dübendorf

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1 University of Southampton, UK
2 EMPA Dübendorf and PSI
3 EMPA Dübendorf

J. Keller, A. Prévôt, A.F. Béguin, V. Jutzi, C. Ordonez
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A. Kress, M. Saurer, R. Siegwolf, H. Bugmann
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O. Kröcher, M. Elsener, D. Nicosia, I. Czekaj
*Chemical deactivation of V₂O₅/WO₃–TiO₂ SCR catalysts by additives and impurities from fuels, lubrication oils, and urea solution*
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*New insights into the reactions between NH₃, NO and NO₂ over Fe-ZSM5*
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W. Märkle, J.-F. Colin, D. Goers¹, M.E. Spahr¹, P. Novák
*Investigation of graphites at high potentials with synchrotron based in situ XRD*
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*Pulsed laser deposition and characterisation of nitrogen-substituted SrTiO₃ thin films*
¹ EMPA Dübendorf
² National Institute for Lasers, Plasma and Radiation Physics, Romania
³ ETH Zürich and PSI

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*Pulsed laser deposition of nitrogen-doped SrTiO₃:N thin films*
¹ EMPA Dübendorf
² National Institute for Lasers, Plasma and Radiation Physics, Romania
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M. Mehring, O. Kröcher, M. Elsener, A. Wokaun
*Development of a TGA-FTIR system as R&D tool in exhaust gas aftertreatment*
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M. Meisinger, A. Schulenburg¹, F. Merkt¹, P. Radi
*Coriolis coupling in the 1A2(3px) Rydberg State of Formaldehyde*
Latsis-Symposium "Intramolecular Dynamics, Symmetry and Spectroscopy.", ETH Zürich, September 6-10, 2008.
¹ ETH Zürich

S.H. Ng, Ph. Bernardo, N. Tran, M.E. Spahr¹, D. Goers, C. Vix-Guterl², P. Novák
*Correlations between surface properties of graphite and the first cycle irreversible capacity in lithium-ion batteries*
¹ TIMCAL SA, Bodio
² CNRS UPR, Mulhouse, France
S.H. Ng, F. La Mantia, W. Märkle, M.E. Spahr1, C. Vix-Guterl2, P. Novák
The influence of electrode density on the electrochemical performance of highly crystalline graphites in Li-ion batteries
1 TIMCA SA, Bodio
2 CNRS UPR, Mulhouse, France

T.J. Patey, A. Hintennach, P. Novák
How to make electrodes with nanoparticles better
14th Int. Meeting on Lithium Batteries, Tianjin, China, June 22-28, 2008.

T.J. Patey, R. Büchel1, S.E. Pratsinis1, P. Novák
Flame co-synthesis of nano-LiMn2O4 and carbon black
14th Int. Meeting on Lithium Batteries, Tianjin, China, June 22-28, 2008.
1 ETH Zürich

Optimised separation of OC and EC for radiocarbon-based source apportionment of carbonaceous aerosol

N. Perron, S. Szidat, A.H.S. Prévôt, M. Ruff, S. Fahrni, U. Baltensperger
Improved separation of OC and EC for radiocarbon-based source apportionment of carbonaceous aerosol
EUCAARI annual meeting, Helsinki, Finland, November 17-21, 2008.

P. Radi, M. Tulej, M. Meisinger, P. Bornhauser, A. Walser, T. Gerber, D. Kozlov1
Single and double-resonance spectroscopy by applying four-wave mixing techniques
Latsis-Symposium "Intramolecular Dynamics, Symmetry and Spectroscopy." ETH Zürich,
September 6-10, 2008.
1 General Physics Institute, Moscow, Russia

Elemental analysis of ambient aerosol samples with synchrotron XRF
Workshop on X-ray absorption spectroscopy and advanced XAS techniques, PSI Villigen, October 7-8, 2008.

A. Savouchkina, A. Foelske-Schmitz, R. Kötz, G.G. Scherer, A. Wokaun
Degradation mechanisms of electro-catalysts used in polymer electrolyte fuel cells

Aerosol light scattering at high relative humidity

C.W. Schneider, S. Thiel1, C. Chen2, G. Hammerl1, B. Kießig1, C. Richter1, J. Levy2, J. Mannhart1
Micro- and nanolithography of highly mobile electron-gases formed at interfaces in oxide heterostructures
1 Uni Augsburg, Germany
2 University of Pittsburgh, PA, USA

M. Schubert, M. Brandenberger, Ch. Ludwig, F. Vogel
Methangewinnung durch heterogen katalysierte, hydrothermale Vergasung nasser Biomasse

M. Schubert, J. W. Regler, M. Brandenberger, Ch. Ludwig, F. Vogel
Salt Separation as a crucial step in continuous catalytic hydrothermal gasification of wet biomass to SNG
16th European Biomass Conference and Exhibition, Valencia, Spain, June 2-6, 2008.

H. Schulenberg, E. Müller1, G. Kheshlashvili2, T. Roser, H. Bönnemann2, A. Wokaun, G.G. Scherer
Heat-treated PCl2O3 nanoparticles as catalyst for oxygen reduction
Faraday Discussion 140: Electrocatlysis – Theory and Experiment at the Interface
University of Southampton, UK, July 7-9 2008.
1 FZK, Eggenstein-Leopoldshafen, Germany
2 ETH Zürich
L.O. Schunk, D. Gstoehl, A. Meier, A. Steinfeld  
**Solar thermal dissociation of ZnO for H₂ production via a 2-step water splitting cycle**  

B. Schwanitz, H. Schulenburg, A. Wokaun, G.G. Scherer  
**Characterization of Pt and Pt/C (co)-sputtered electrodes for polymer electrolyte fuel cells**  

B.C. Seyfang, P. Boillat, G.G. Scherer, T. Lippert, A. Wokaun  
**Micro-structuring of glassy carbon for micro polymer electrolyte fuel cells: Ns-shadowgraphy during laser ablation**  

O. Sidorova, R. Siegwolf, M. Saurer, A.V. Kirdyanov, A. Shashkin  
**Climatic changes in Central Siberia inferred from tree ring width and stable isotope data for the last century**  

O.V. Sidorova, R.T.W. Siegwolf, M. Saurer, E.A. Vaganov  
**Response of Siberian larch trees to major volcanic eruptions reflected in tree ring and isotope data**  

**Properties of aged combustion aerosols. First results from smog chamber experiments**  
12th ETH-Conference on Combustion Generated Nanoparticles, Zürich, June 23-25, 2008.

**Hygroscopic growth of pure secondary organic aerosols (SOA) and aged diesel soot particles**  
European Aerosol Conference, Thessaloniki, Greece, August 24-29, 2008.

M. Tulej, M. Meisinger, G. Knopp, A.M. Walser, T. Gerber, P.P. Radi  
**Degenerate and two-color resonant four-wave mixing of C₂ in a molecular beam**  

**SunChem – A smart strategy to produce biofuels and capture CO₂ using an algae-based process**  
Smart Energy Strategies, Meeting the Climate Change Challenge, ETH Zürich, September 8-10, 2008.

F. Wallasch, L. Gubler, M. Slaski, G.G. Scherer, A. Wokaun  
**Advanced fuel cell membranes: Graft copolymerization of AMS and MAN**  
Advances in Polymer Science and Technology, New Delhi, India, January 28-31, 2008.

F. Wallasch, L. Gubler, M. Slaski, G.G. Scherer, A. Wokaun  
**Advanced fuel cell membranes: Graft copolymerization of AMS and MAN**  
Europolymer Conference, Gargnano, Italy, June 1-5, 2008.

F. Wallasch, L. Gubler, G.G. Scherer, A. Wokaun  
**Fuel cell test results of membranes prepared via a pre-irradiation / graft polymerization / sulfonation sequence**  
Europolymer Conference, Gargnano, Italy, June 1-5, 2008.

F. Wallasch, L. Gubler, M. Slaski, G.G. Scherer, A. Wokaun  
**Membranes for polymer electrolyte fuel cells: The pre-irradiation / graft polymerization / sulfonation sequence**  
7th PSI Summer School on Condensed Matter Research, Zuoz, August 16-22, 2008.

F. Wallasch, L. Gubler, M. Slaski, G.G. Scherer, A. Wokaun  
**Advanced fuel cell membranes: Graft copolymerization of AMS and MAN**  
59th Annual Meeting of the International Society of Electrochemistry, Seville, Spain, September 7-12, 2008.
F. Wallasch, H. Ben youcef, M. Slaski, L. Gubler, D. Henkensmeier, A. Wokaun, G.G. Scherer
*Improved radiation grafted membranes for PEFC*

F. Wallasch, L. Gubler, M. Slaski, A. Wokaun, G.G. Scherer
*Advanced polymer electrolyte fuel cell membranes prepared by graft copolymerization of AMS and MAN*
IRAP2008, 8th International Symposium on Ionizing Irradiation and Polymers
Angra Dos Reis, Brasil, October 12-17, 2008.

F. Wallasch, L. Gubler, M. Slaski, A. Wokaun, G.G. Scherer
*Advanced polymer electrolyte fuel cell membranes: Fuel cell tests and post mortem analysis*
IRAP2008, 8th International Symposium on Ionizing Irradiation and Polymers
Angra Dos Reis, Brasil, October 12-17, 2008.

E. Weingartner, R. Schmidhauser
*Aerosol Light Scattering at High Relative Humidity*

H.C. Zellweger, A. Wokaun, G.G. Scherer, I.A. Schneider
*AC impedance based characterization of CO₂ separation membranes*
Europolymer Conference, Gargnano, Italy, June 1-5, 2008.

P. Ziegler, R. Schmidhauser, M. Gysel, L. Kammermann, E. Weingartner, U. Baltensperger
*Effects of relative humidity on aerosol light scattering*
\- EGU General Assembly, Vienna, Austria, April 14-19, 2008.
\- Light Scattering: Mie and More - Commemorating 100 Years Mie’s 1908 Publications, Forschungszentrum Karlsruhe, Germany, July 3-4, 2008.
PATENT APPLICATIONS

O. Kröcher, M. Elsener
A method and a system for a treatment of a NO₂-containing exhaust gas

CONFERENCES, WORKSHOPS & EXHIBITIONS

S. Andreani-Aksoyoglu
*International Symposium on Air Quality Management at Urban, Regional and Global Scales*
Scientific Advisor

W. Dürisch
*World Renewable Energy Congress*
Steering Committee Member

M. Furger
*Jahrestagung der Schweizerischen Gesellschaft für Meteorologie*

P. Jansohn
*Forschungsprogramm “Kraftwerk 2020” (Jahrestagung)*
Bundesamt für Energie (BFE), Bern, Juni 26, 2008.
Organisator/Programmeiter

R. Kötz
*59th Annual Meeting of the International Society of Electrochemistry*
Seville, Spain, September 7-12, 2008.
Co-Organizer and Chair of Symposium 8b, Electrochemical Energy Conversion and Storage

R. Kötz
*ESSCAP 2008, 3rd European Symposium on Supercapacitors and Applications*
Roma, Italy, November 6-7, 2008.
Member of Scientific Committee

S. Lienin, S. Perret, S. Ulli-Beer
*Strategie-Workshop*
Erlebnisraum Mobilität, Basel, September 17, 2008.
Organizers

Ch. Ludwig
*REWAS 2008, Global Symposium on Recycling, Waste Treatment and Clean Technology*
Cancun, Mexico, 2008.
Co-chair

I. Mantzaras, P. Jansohn, A. Wokaun
*IWCC7 – 7th International Workshop on Catalytic Combustion*
Seedamm Plaza, Pfäffikon, September 29 – October 1, 2008.
Veranstalter/Gastgeber

J. Mantzaras
*Int. Symposium on Combustion*
Chairman of committee in heterogeneous combustion and materials synthesis section

A. Meier
*European Energy Research Alliance (EEA) Workshop on Concentrated Solar Power (CSP)*
PSI Villigen, December 4, 2008.
Organizer
M. Nachttegaal
*Workshop on X-ray absorption spectroscopy and advanced techniques*
PSI Villigen, October 6-10, 2008.
Organiser

P. Novák
*59th Annual Meeting of the International Society of Electrochemistry*
Seville, Spain, September 14-19, 2008.
Organizing Committee

P. Novák
*IMLB-14, 14th Int. Meeting on Lithium Batteries*
Tianjin, China, June 22-28, 2008.
Int. Scientific Committee

A.S.H. Prévôt, J. Staehelin, M. Sosonkin
*Summer school on Atmospheric Chemistry*
Kiev, Ukraine, September 16-18, 2008.
Organizing Committee

A.S.H. Prévôt, J. Staehelin, O. Tarasova
*Summer school on Atmospheric Chemistry*
Borok, Russia, May 19-21, 2008.
Organizing Committee

A.S.H. Prévôt, H. Gygax, J. Staehelin
*Ozon und Sommersmog, Fachtagung zum Stand der Forschung und zur Reduktionsstrategie*
Bern, October 30, 2008.
Organizing Committee

P.P. Radi
*European Conference on Nonlinear Optical Spectroscopy*
Steering Committee

G.G. Scherer
*Advances in Polymer Science and Technology - Asian Polymer Association*
New Delhi, India, January 28-31, 2008.
Int. Advisory Board

G.G. Scherer
*59th Annual Meeting of the International Society of Electrochemistry*
Seville, Spain, September 7–12, 2008.
Co-Organizer and Chair of Symposium 8b, Electrochemical Energy Conversion and Storage

G.G. Scherer, R. Kötz
*Electrochemical Materials Processing*
24th One-Day-Symposium, PSI Villigen, May 7, 2008.
Organizers

A. Steinfeld
*2nd IASTED Africa Conference on Power and Energy Systems, Botswana*
Scientific Committee

A. Steinfeld
*Smart Energy Strategies, Zürich*
Scientific Committee

S. Ulli-Beer, M. Müller
*Projekt-Workshop DeeR - Diffusionsdynamik energieeffizienter Renovationen*
Aktiersanalyse inkl. Workshop Bericht, Zürich, Juni 20, 2008.
Organizers
S. Ulli-Beer, S. Grösser, S. Bruppacher
*Projekt-Workshop DeeB – Diffusionsdynamik energieeffizienter Bauten. Entwicklung Effizienzsteigerung im Neubau*
Organizers

A. Wokaun
*iamf EET-2008, Forum focused on the mobility of the future, Geneva, March 11-13, 2008*
Member of Scientific Committee

A. Wokaun
*Energy Com: Conference Moderation*
Swiss Re Centre for Global Dialogue, Rüschlikon, December 5, 2008.
MEMBERSHIPS IN EXTERNAL COMMITTEES

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*Umweltforschung der Forschungszentrum Jülich GmbH*
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*COST633, Particulate matter: Properties related to health effects*
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*Prüfungskommission für die Lehrlinge des Laborantenberufes des Kantons Zürich*
Prüfungsexperte

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*International Energy Foundation, IEF*
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*Schweizerische Gesellschaft für Meteorologie*
President

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*SNC-IUSS - Swiss National Committee of the International Union of Geodesy and Geophysics*
National Correspondent of the International Association of Meteorology and Atmospheric Sciences (IAMAS), 2008.
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*Naturama, Aarau*  
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*Naturforschende Gesellschaft in Zürich*  
Member of editing committee of Vierteljährsschrift, Neujahrsblatt and treasurer of the Society

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*Prüfungskommission Physiklaboranten, Kanton Zürich*  
Experte

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*European Turbine Network (ETN): Conference Advisory Committee*  
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*International Energy Agency (IEA), Implementing Agreement on Energy Conservation and Emission Reduction in Combustion*  
Collaborative Task Leader “Gas Turbine Combustion”

P. Jansohn  
*ProcessNet Fachgemeinschaft „Sustainable Production, Energy and Resources“, Fachausschuss „Hochtemperaturtechnik“*  
berufenes Mitglied

P. Jansohn  
*European Technology Platform – Zero Emission Fossil Fuel Power Plants (ETP-ZEP), Taskforce Technology and Government Group*  
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*Electrochimica Acta*  
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*E-MRS*  
Member of the Executive Committee

T. Lippert  
*Journal of Laser Micro/Nanoengineering (JLMN)*  
Co-Editor

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*Laser Chemistry*  
Associate Editor

T. Lippert  
*Materials*  
Editorial Board
Ch. Ludwig
*BFE-Projekt: Bewertungsmethode für Technologien zur Nutzung von biogenen Abfällen*
Experte und Mitglied der Begleitgruppe

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*International Energy Agency SolarPACES*
Operating Agent

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*SOLLAB – Alliance of European Laboratories on Solar Thermal Concentrating Systems*
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*International Society of Electrochemistry*
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*The Electrochemical Society, Inc.*
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*Atmospheric Chemistry and Physics*
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*Atmospheric Measurement Techniques*
Editorial Board

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*Journal of Raman Spectroscopy*
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*Association for Tree-Ring Research*
Advisory Council

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*Dendrochronologia*
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*Fuel Cell Handbook*
Advisory Board

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*European Fuel Cell Forum*
Advisory Board

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*Tree Physiology*
Editorial Review Board

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Department of Mechanical and Process Engineering, ETH Zürich
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Scientific Council  

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Member – Energy Committee  

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DGM Fachausschuss Strahllinien  
Member  

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BMBF Programm BioEnergie 2020  
Gutachter  

S. Stucki  
EU Technology Platform Biofuels, WG4, Sustainability  
Member  

S. Ulli-Beer  
System Dynamics Review  
Associated editor  

E. Weingartner  
Fachgruppe zum Thema: Partikelzählung / Partikelgrössenanalyse  
Ziel: Erarbeiten von Empfehlung zum Einsatz von Partikelzählern und Partikelgrössenanalysatoren bei Aerosolen  
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Schweiz. Akademie der Technischen Wissenschaften (SATW)  
Einzelmitglied  

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Helmholtz-Gemeinschaft deutscher Forschungszentren  
Mitglied der Senatskommission  

A. Wokaun  
European Climate Forum  
Member of Council  

A. Wokaun  
novatlantis – Nachhaltigkeit im ETH-Bereich  
Mitglied des Leitungsausschusses  

A. Wokaun  
Studiengruppe Energieperspektiven  
Präsident
A. Wokaun  
CORE  
Mitglied

A. Wokaun  
Advisory Group on Energy (AGE), European Union  
Mitglied

A. Wokaun  
Competence Center Energy and Mobility (CCEM)  
Chairman of Steering Committee
AWARDS

D. Cericola  
*Master Thesis*  
*Materiali carboniosi e liquidi ionici per supercapacitori a doppio strato*  
Premio di Laurea "PhotoAnalytical srl " of the Divisione di Elettrochimica della Societa’ Chimica Italiana

I. Czekaj, F. Loviat, J. Wambach, A. Wokaun  
*Nickel deposition on γ-Al₂O₃: modelling of metal particles behaviour at the support*  
SCS Swiss Chemical Society Fall Meeting, University of Zürich, September 11, 2008.  
Best Poster Award

P. Jansohn  
*Member of the Year*  
European Turbine Network (ETN), Brussels, Belgium, September 2008

M. Kalberer  
*Marian Smoluchowski Award 2008*

H. Kuhn  
*PhD-Thesis*  
*In situ Charakterisierung von Polymer-Elektrolyt Brennstoffzellen mittels elektrochemischer Impedanzspektroskopie*  
ABB Forschungspreis 2008

P. Ruch  
*In situ X-ray diffraction of the intercalation of (C₂H₅)₄N⁺ and BF₄⁻ into graphite from acetonitrile and propylene carbonate based supercapacitor electrolytes*  
The Oronzio and Niccolò De Nora Foundation Young Author Prize 2008 of the International Society of Electrochemistry

M. Schubert, J.W. Regler, M. Brandenberger, Ch. Ludwig, F. Vogel  
*Salt Separation as a crucial step in continuous catalytic hydrothermal gasification of wet biomass to SNG*  
Poster Award in the topic Biofuels, 16th European Biomass Conference and Exhibition, Valencia, Spain, June 2-6, 2008.

B.C. Seyfang, P. Boillat, G.G. Scherer, T. Lippert, A. Wokaun  
*Micro-structuring of glassy carbon for micro polymer electrolyte fuel cells: Ns-shadowgraphy during laser ablation*  
Best Poster Award
LIST OF PUBLICATIONS 2008

Large Research Facilities and PSI-XFEL Project

UNIVERSITY LEVEL AND OTHER TEACHING

A. Adelmann
Statistics and Probability theory
University of Technology Economics and Business Administration Zürich, Switzerland
Spring Semester 2008

M. Böge
Closed Orbit Correction
CERN Accelerator School on Beam Diagnostics, Dourdan, France
28 May - 6 June 2008

M. Böge
Closed Orbit Feedback
CERN Accelerator School on Beam Diagnostics, Dourdan, France
28 May - 6 June 2008

D. Kiselev
Aktuelle Experimente am Beschleuniger zur Kern- und Nukleonensruktur
University of Basel, Switzerland
Spring Semester 2008

D. Kiselev, B. Krusche
Einführung in die Kern- und Teilchenphysik
University of Basel, Switzerland
Autumn Semester 2008

J.A. Patorski
Thermographische Temperaturmessung
Paul Scherrer Institut, PSI Lehrlingsausbildung, Villigen, Switzerland
November 2008

L. Rivkin
Introduction to Particle Accelerators
EPFL Lausanne, Switzerland
Autumn Semester 2008

L. Rivkin
Synchrotron Light, Electron Dynamics with Radiation and Synchrotron Light Sources
CERN Accelerator School, Frascati, Italy
2-14 November 2008

L. Rivkin
Accelerator Physics (emphasis on LHC and ILC/CLIC)
CHIPP PhD Winter School, Näfels, Switzerland
13-20 January 2008
J.M. Schippers  
*Accelerators for proton therapy*  
PSI Winterschool on proton therapy, Bad Zurzach, Switzerland  
January 2008

J.M. Schippers  
*The SC-cyclotron at PSI and other accelerators for proton therapy*  
Joint university Accelerator school (JUAS), PSI, Villigen, Switzerland  
6 March 2008

V. Schlott  
*Femto-Second Diagnostics*  
CERN Accelerator School on Beam Diagnostics, Dourdan, France  
28 May - 6 June 2008

M. Schneider  
*Grundlagen der Elektronik*  
Technikerschule HF, Zürich, Switzerland  
Autumn Semester 2007/08, Spring Semester 2008

*Experimental Methods of Particle Physics*  
Joint lecture University and ETH Zürich, Switzerland  
Autumn Semester 2008/09

**PEER REVIEWED PAPERS**

A. Andersson, M. Böge, A. Lüdeke, V. Schlott, A. Streun  
*Determination of a small vertical electron beam profile and emittance at the Swiss Light Source*  

M. Calviani, P. Cennini, D. Karadimos, V. Ketlerov, V. Konovalov, W. Furman, A. Goverdowski, V. Vlachoudis, L. Zanini, the n_TOF Collaboration  
A fast ionization chamber for fission cross section measurements at n_TOF  

J. Chrin, T. Schmidt, A. Streun, D. Zimoch  
*Local correction schemes to counteract insertion device effects*  

S. Dementjev, F. Groeschel, N. Jekabsons  
*Experience of Electromagnetic pumps Operation in Swiss Spallation Neutron Source*  
Magnetohydrodynamics, 44, No. 3, 279 (2008)

*The MEGAPIE-TEST project: Supporting research and lessons learned in first-of-a-kind spallation target technology*  
Nuclear Engineering and Design, 238, Issue 6, 1471, Copyright © Elsevier B.V. (2008)
*Laser-Photofield Emission from Needle Cathodes for Low-Emittance Electron Beams*

Validation of Monte-Carlo simulations with measurements at the ICON beam line at SINQ

B. Kalantari, T. Korhonen, A. Schiper
*Tightly Synchronized Distributed Measurement and Event Triggers*

B. Oswald, P. Leidenberger, C. Hafner
*3-Dimensional Finite Element Time Domain Analysis of an Asymmetric Near Field Optical Probe.*

J.A. Patorski, F. Groeschel
*Measurement of Heat Transfer Coefficient for a Proton Beam Entry Window of a Liquid Metal Target*

M.T.F. Pivi, F.K. King, R.E. Kirby, T.O. Raubenheimer, G. Stupakov, F. Le Pimpec
*Sharp Reduction of the Secondary Electron Emission Yield from Grooved Surfaces*

J.-Y. Raguin, K. Li, R. Bakker, A. Oppelt, M. Pedrozzi
*A two-frequency RF cavity for the PSI-XFEL: Design and beam dynamics simulations*
Nucl. Instr. and Meth., A 593, 125 (2008)

M. Seidel, K. Zapfe
*Particle Accelerators*

E. Seravalli, M. de Boer, F. Geurink, J.Huizenga, R. Kreuger, J.M Schippers, C.W.E. van Eijk, B. Vos
*A scintillating gas detector for 2-D dosimetry in clinical carbon beams*

E. Seravalli, M. de Boer, F. Geurink, J.Huizenga, R. Kreuger, J.M Schippers, C.W.E. van Eijk
*Characterization of a scintillating GEM detector with low energy X-rays*

*Dispersion Characteristics of Arbitrary Periodic Structures with Rectangular Grooves*

S. Tsujino, P. Beaud, E. Kirk, T. Vogel, H. Sehr, J. Gobrecht, A. Wrulich
*Ultrafast electron emission from metallic nanotip arrays induced by near infrared femtosecond laser pulses*

*High-order harmonic wave fronts generated with controlled astigmatic infrared laser*

**JOSA B 25, 161 (2008)**

P. van Luijk, J.M. Schippers

*We need to bridge the gap between current practice in mathematical modeling and new insights obtained from radiobiology: comment on Zhou et al.*


**PSI Status 2008 — Developments at the 590MeV Proton Accelerator Facility**


**OTHER PAPERS**


*Large-Scale Computation at PSI, Scientific Achievements and future Requirements*

**PSI-Bericht 08-02, ISSN 1019-0643** (2008)

M. Dehler

*Real Time Control of Beam Parameters*


M. Dehler

*Requirements for Tune, Coupling and Chromaticity Feedbacks for Light Sources*


*MEGAPIE – Irradiation Experience of the First Megawatt Liquid Metal Spallation Target*


M. Humbel, A. Mezger, M. Schneider

*Beam Intensity Dependent Ramping of the Amplitudes in the RF Flattop System of the PSI 590 MeV Ringcyclotron*


T. Schlicher

*RF Applications in Digital Signal Processing*


F. Stulle, A. Adelmann, M. Pedrozzi

*Conceptual Design of Bunch Compressors and Turn Around Loops for a Multi-TeV Linear Collider*

L. Zanini, J.C. David, A. Yu. Konobeyev, S. Panebianco, N. Thiollière
*Neutronic and Nuclear Post-Test Analysis of MEGAPIE*
PSI-Bericht Nr. 08-04, ISSN 1019-0643 (2008)

L. Zanini, Y. Dai
*MCNPX calculations for the STIP-IV irradiation program at PSI*

**CONFERENCE PROCEEDINGS**

A. Andersson, M. Böge, A. Lüdeke, A. Streun
*Coupling control at the SLS*

A. Anghel, B. Blau, M. Daum, K. Kirch, S. Grigoriev
*Cryogenic System of the Swiss Ultra-Cold Neutron Source, Refrigeration Science and Technology*
Proc. 10th Cryogenic Conference, Int. Institute of Refrigeration, Prague, Czech Republic, 107 (2008)

*Simultaneous extraction of two stable beams for ISAC*

M. Eriksson, A. Hansson, S. Leemann, L.-J. Lindgren, M. Sjöström, E. Wallén, L. Rivkin, A. Streun
*Using multi-bend achromats in synchrotron radiation sources*

S. Hakobyan, L. Hovhannisyan, D. Kalantaryan, V. Tsakanov, A. Streun
*The acceptance and photon beam formation in SLS FEMTO*

D. Kalantaryan, G. Amatuni, V. Tsakanov, P. Beaud, G. Ingold, A. Streun
*Laser–beam interaction and calculation of the sliced bunch radiation spectra for the SLS FEMTO beam line*

B. Keil, S. Lehner, S. Ritt
*Application of a 5 GSPS Analogue Ring Sampling Chip For Low-cost Single-shot BPM Systems*

B. Keil, R. Kramert, G. Marinkovic, P. Pollet, M. Roggli
*The PSI DSP Carrier (PDC) Board – a Digital Back-end For Bunch-to-bunch and Global Feedbacks In Linear Accelerators and Storage Rings*

*The Multi MegaWatt target station, integration of the MAFF/PIAFE fission target design*
Proc. of the 3rd High-Power Targetry Workshop 2007, Bad Zurzach, Switzerland, PSI Proceedings 07-01, ISSN 1019-0643, 85 (2008)
*Linear Accelerator for the PSI-XFEL FEL3 Beamline*

Y. Kim, A. Andersson, M. Dach, R. Ganter, T. Garvey, C. Gough, C. Hauri, R. Ischebeck
F. Le Pimpec, M. Paralieiev, M. Pedrozzi, T. Schietinger, V. Schlott, B. Steffen, A.F. Wruilich
*Low thermal emittance measurements at the PSI-XFEL low emittance gun test facility*

*Start-to-End simulations of the PSI 250 MeV Injector Test Facility*

D. Kiselev
*Activation of Targets and Accelerator Components at PSI - a Comparison of Simulation and Measurement*
42nd ICFA Advanced Beam Dynamics Workshop on High-Intensity, High-Brightness Hadron Beams, Nashville, USA (2008)

F. Le Pimpec, R. Ganter, C. Gough, C. Hauri, M. Paralieiev
*Comparison of high gradient achievement for different metals in dc and pulsed dc mode*

A. Lüdeke
*The Operation Event Logging System of the SLS*

M. Paralieiev, C. Gough, S. Ivkovic
*Status of 500kV Low Emittance Electron Gun Test Facility for a Compact X-ray Free Electron Laser at Paul Scherrer Institute*
IEEE Power Modulator Conference, Las Vegas, NV, USA, 532 (2008)

J.A. Patorski
*Planning of the COOLWETT Experiment*

*First measurement results of the PSI 500 kV low emittance electron source*

*Measurements and modeling at the PSI-XFEL 500-kV Low Emittance Electron Source*

*First year of operation of PSI’s new SC cyclotron and beam lines for proton therapy*

Beam intensity stability of a 250 MeV SC cyclotron equipped with an internal cold cathode ion source.

M. Seidel

Operation of the High Intensity Proton Beam Facility at PSI


Influence of beam foot print on neutron production in SINQ
Proc. 3rd High-Power Targetry Workshop, Bad Zurzach, Switzerland (2007), PSI Proceedings 07-01, ISSN 1019-0643, 101 (2008)

T. Wehrli, M. Böge, E. van Garderen, J. Krempasky

Properties of X-ray beam position monitors at the Swiss Light Source

J.J. Yang, A. Adelmann, M. Humbel, M. Seidel, T.J. Zhang

Numerical study of beam dynamics in high intensity cyclotrons including neighboring bunch effects

L. Zanini, Y. Dai

MCNPX calculations for the STIP-IV irradiation program at PSI
Proc. ANS annual meeting, Nuclear Science and Technology, Anaheim, USA (2008)

L. Zanini

Synthesis, Applications to ADS and Feedback to other Tasks

L. Zanini

Activation & Radiation Damage Calculations for PIE

L. Zanini

Neutronics of a tungsten target as a future option for SINQ
Proc. 3rd High-Power Targetry Workshop, Bad Zurzach, Switzerland (2007), PSI Proc. 07-01, ISSN 1019-0643, 33 (2008)

INVITED TALKS

A. Adelmann

State of the art of high intensity simulation codes: new algorithms and methods for rings
Accelerator Modeling and Advanced Simulation (AMAS)
HB2008, Nashville, USA, 24-29 August 2008

A. Adelmann

Accelerator Modeling and Advanced Simulation (AMAS) Mission - Projects and Challenges
University of Strasbourg, France, 18 April 2008
A. Adelmann
*The PSI-XFEL Project and related Program Development*
ISR-6, Los Alamos National Laboratory, Los Alamos, USA, 6 August 2008

A. Adelmann
*Challenges and Achievements in Computational Electromagnetics in the Context of Particle Accelerator Modeling*
SIAM PP08 Atlanta, USA, 12 March 2008

M. Dehler
*Low energy beam dynamics simulation for the PSI Free Electron Laser*
Project ACD seminar, Stanford Linear Accelerator Center, Stanford, USA, 9 May 2008

M. Dehler
*Synergies between X-band for Linear Colliders and Light Sources X-Band*
RF Structure and Beam Dynamics Workshop - 44th ICFA Advanced Beam Dynamics Workshop, Daresbury, UK, 1-4 December 2008

J. Duppich
*Swiss Light Source at PSI – Technical Infrastructure, Interfaces to the Building and Installation of Accelerators*
ALBA – Seminar, Barcelona, Spain, 9 April 2008

J. Duppich
*The first year of patient treatments at Paul Scherrer Institute using the new superconducting cyclotron Comet*
Loma Linda University Medical Center, Loma Linda, Los Angeles, California, USA, 17 July 2008

J. Duppich
*The first year of patient treatments at Paul Scherrer Institute using the new superconducting cyclotron Comet and beam lines of the new proton therapy facility PROSCAN*
VARIANT Medical Systems, Palo Alto, California, USA, 24 July 2008

J. Duppich
*The first 1.5 years of clinical operation of the SC cyclotron and the beam lines at PSI – From a parasitic user to a stand-alone facility*
University of Washington, Medical Center, Seattle, Washington, USA, 6 August 2008

J. Duppich
*The first 1.5 years of clinical operation of the SC cyclotron and the beam lines at PSI – From a parasitic user to a stand-alone facility*
TRIUMF, Vancouver, B.C., Canada, 8 August 2008

R. Ganter
*Quantum efficiency from different cathode types*
Mini-Workshop on High Brightness Beam Characterisation, Zeuthen, Germany, 26-30 May 2008

R. Ganter
*Photo-Field emission source for free electron laser applications*
IVESC (International Vacuum Electron Source Conference), London, UK, 3-6 August 2008

M. Gaspar
*Solid State RF PA. Practicality, Cost, Potentials, Feasibility, Trend and Outlook*
5th CW and High Average Power RF Workshop, CERN, Geneva, Switzerland, March 2008
M. Gaspar
500 MHz Solid state Power Amplifier Design – Results of the 4 kW Prototype
12 ESLS-RF Meeting, Diamond Light Source, Didcot, UK, October 2008

C. Gough
Low Emittance Electron Source for the PSI-XFEL Project
Institute of High Current Electronics, Tomsk, Russia, 6 May 2008

R. Ischebeck
The PSI-XFEL
ESLS XVI, Cockcroft Institute, Daresbury, UK, 27 November 2008

Y. Kim
Realistic Thermal Emittance measurements at the Low Emittance Gun test facility for the PSI
XFEL Project
Mini-Workshop on High Brightness Beam Characterisation, Zeuthen, Germany,
26-30 May 2008

Y. Kim
Simple Solutions against COTR in LCLS and Design Concepts of XFEL Driving Linacs
2nd Microbunching Instability Workshop, LBNL, USA, 6-8 October 2008

Y. Kim
Microbunching Instability Experimental Plans at Coming PSI-XFEL Test Facilities
2nd Microbunching Instability Workshop, LBNL, USA, 6-8 October 2008

Y. Kim
Does Ultra-Bright Beam induce OTR Intensity Change During No Compression Periods in LCLS
Injector?
2nd Microbunching Instability Workshop, LBNL, USA, 6-8 October 2008

D. Kiselev
Activation of Targets and Accelerator Components at PSI - a Comparison of Simulation and
Measurement
42nd ICFA Advanced Beam Dynamics Workshop on High-Intensity, High-Brightness Hadron
Beams, Nashville, USA, 25-29 August 2008

B. Oswald
Time Domain Eigenmodal Analysis with the Finite Element Method Including a Surface
Impedance Boundary Condition
EUROEM 2008, European Electromagnetics. EPF Lausanne, Switzerland, 21-25 July 2008

B. Oswald
Electromagnetic fields scattered by subwavelength-sized tip - Finite element time domain (FETD)
model with a dispersive Drude dielectric
4th Workshop on Numerical Methods for Optical Nano Structures, ETH Zürich, Switzerland,
7-8 July 2008

B. Oswald
The portable, open and scalable data storage standard H5Fed - Transparent finite element data
storage for tetrahedral meshes and associated data
37th SPEEDUP Workshop on High-Performance Computing ETH Zürich & EPF Lausanne,
Switzerland, 9 September & 12 September 2008
T. Pal  
*Tasks and Challenges in the TAGS DB Project*  
CERN, Geneva, Switzerland, 17 July 2008

L. Rivkin  
*Engines of Discovery: the role of accelerators in scientific exploration*  
The Zürich Physics Colloquium, Zürich, Switzerland, 1 October 2008

L. Rivkin  
*Evolution of Light Sources*  
Jagiellonian University, Kraków, Poland, 29 May 2008

L. Rivkin  
*X-ray Sources*  
ICFA Seminar, SNAL, USA, 28 October 2008

W. Roser  
*Reduction of radioactive waste production of a proton therapy facility*  
Jahrestagung Schweizerische Gesellschaft für Strahlenbiologie und Medizinische Physik, Chur, Switzerland, 6 November 2008

J.M. Schippers  
*Technical aspects of proton therapy at UMCG*  
University Medical Center Groningen, Groningen, the Netherlands, 10 June 2008

J.M. Schippers  
*Developments for proton therapy at PSI*  
Mastro Clinic, Maastricht, the Netherlands, 19 June 2008

J.M. Schippers  
*New developments in technologies for particle therapy*  
ESTRO-Symposium “All you need to know about hadron therapy”, ESTRO-27, Göteborg, Sweden, 14-18 September 2008

J.M. Schippers  
*Radiotherapie met protonen: doel-gerichte High-Tech*  
Inaugural Lecture at University of Groningen, Groningen, the Netherlands, 16 December 2008

J.M. Schippers  
*A novel design of a cyclotron based accelerator system for multi-ion-therapy*  
Particle Therapy Co-operative Group PTCOG-47, Jacksonville (Fl), USA, 22-24 May 2008

J.M. Schippers  
*A novel design of a cyclotron based accelerator system for multi-ion-therapy*  
European Cyclotron Progress Meeting, Berlin, Germany, 16-18 October 2008

J.M. Schippers  
*The first 1.5 year clinical operation of the SC cyclotron and beam lines at PSI’s new Center for Proton Radiation therapy*  
European Cyclotron Progress Meeting, Berlin, Germany, 16-18 October 2008
V. Schlott  
*PSI Accelerator Activities and Diagnostics Highlights*  
SLAC Advanced Instrumentation Seminar, Menlo Park, CA, USA, 23 July 2008

M. Schneider  
*Status of the RF-system for the proton accelerator facility at PSI*  
CW and High Average Power RF Workshop, CERN, Geneva, Switzerland, 25-28 March 2008

M. Seidel  
*Operation of the High Intensity Proton Beam Facility at PSI*  
ICFA Workshop on High Brightness Hadron Beams, Nashville, USA, 24-29 August 2008

M. Seidel  
*Operational Experience and Recent Achievements with the High Power Proton Accelerator at PSI*  
European Cyclotron Progress Meeting, Berlin, Germany, 16-18 October 2008

A. Streun  
*Latest Results from the Swiss Light Source*  
ESLS XVI, Cockcroft Institute, Daresbury, UK, 27 November 2008

A.F. Wruilich  
*Challenges of Cost Optimized X-Ray Free Electron Lasers*  
14th User Meeting and Workshop, NSRRC, Hsinchu, Taiwan, October 2008

A.F. Wruilich  
*Synchrotron Radiation Light Sources: From the origins to the most advanced sources today*  
National Cheng Kung University, Tainan, Taiwan, October 2008

L. Zanini  
*Les Acquis neutroniques de la cible MEGAPIE*  
Meeting GEDEPEON, Aix-en-Provence, France, 14-15 October 2008

**WORKSHOPS**

A. Adelmann  
Co-Organizer  
*HPC Workshop*  
ETH Zürich, Switzerland, 8-9 September 2008  
EPFL Lausanne, Switzerland, 1 September 2008

B. Keil, V. Schlott  
Organizers  
*European X-Ray FEL BPM and Beam Stability Workshop*  
Schloss Böllstein, Böllstein, Switzerland, 18-19 February 2008

M. Pedrozzi  
Organizer  
*Second Solid State Modulator Workshop*  
Paul Scherrer Institut, Villigen, Switzerland  
19-20 November 2008
R. Ganter
Organizer
Mini-Workshop on Girder, Components Supports and Alignment Concept
Paul Scherrer Institut, Villigen, Switzerland
4 December 2008

Organizers
First International Workshop on Accelerator Radiation Induced Activation (ARIA’08)
Paul Scherrer Institut, Villigen, Switzerland
13-17 October 2008

BACHELOR-/ DIPLOMA-/ MASTER-THESIS

Y. Ineichen
A parallel multigrid solver for beam dynamics
Theses advisors: Prof. Dr. P. Arbenz (ETH Zürich), Dr. A. Adelmann (PSI Villigen), 2008

A. Ichsanov
Modell-Experiment für den zukünftigen X-ray Free Electron Laser mit Anwendung der Photonen
Korrelation
Theses advisors: Prof. Dr. B. Patterson (PSI Villigen), 2008

DISSERTATIONS

K. Li
An Ultra-Low Emittance Electron Gun for the PSI-XFEL Design and Construction
Theses No. 18168 / ETH Zürich, Switzerland, 2008
Theses advisors: Prof. Dr. R. Eichler (ETHZ)
Prof. Dr. M. Ferrario (INFN)
Dr. M. Pedrozzi (PSI)

MEMBERSHIPS IN EXTERNAL COMMITTEES

A. Adelmann
- Speedup Society (treasury)
- CSCS "Horizon Project" Steering Committee
- Program Committee ICFA High Brightness Beam Dynamics Workshop
- Program Committee ICAP International Computational Accelerator Physics Conference
- International Super Computing Conference (ISC), Program Committee
- Member of the Project Group "Swiss National Strategic Plan for High Performance Computing
  and Networking”.
- Expert for Mathematics "Maturitaets Exams"

M. Böge
- TPS Machine Advisory Committee, NSRRC, Taiwan
T. Garvey
- International Linear Accelerator Conference Organising Committee
- UK (STFC) Accelerator Science and Technology Advisory Board
- French (CEA/CNRS) Committee of Experts on Accelerators (ComEA)
- CTF/CLIC Collaboration Board

D. Kiselev
- Auswahlkomitee der Deutschen Studienstiftung

L. Rivkin
- CERN Accelerator School, Advisory Committee
- CERN, CLIC CTF3 Collaboration Board
- DESY, Machine Advisory Committee (Chairman)
- European Physical Society Accelerators Group, Prizes Selection Committee Chairman
- Lund University Research Evaluation, RQ08
- Joint Universities Accelerator School, Program Committee
- PAC2009 Program Committee
- Stanford Synchrotron Radiation Laboratory, Scientific Advisory Committee

W. Roser
- Swiss Society for Radiation Biology and Medical Physics, Board Member
- Comité Electrotechnique Suisse (CES), Member of TC 62

T. Schietinger
- European Committee for Future Accelerators (ECFA)

J.M. Schippers
- Board member of the Groningen Particle Therapy Facility, University Medical Center Groningen, Groningen, the Netherlands
- TRIUMF Accelerator Advisory Committee, Vancouver BC, Canada

V. Schlott
- ALBA Spanish Light Source, Machine Advisory Committee, Bellaterra, Spain
- CARE Governing Board
- CERN Accelerator School on Beam Diagnostics, Program Committee
- DIPAC Scientific Program Committee (Chairman)
- In Kind Review Committee for the European XFEL (Chairman)
- Scientific and Technical Issues Working Group for the European XFEL (XFEL-STI)

L. Schulz
- SESAME, Jordan, Technical Advisory Committee

M. Seidel
- Int. Conferences on Cyclotrons and their Applications: Int. Organizing Committee + Program Committee
- Series ICFA Workshops on High Brightness, High Intensity Hadron Beams, Scientific Advisory Committee
- European Cyclotron Progress Meetings, Scientific Advisory Committee
- OECD/NEA Int. Workshop on Technology and Components of Accelerator Driven Systems (TCADS) Int. Scientific Advisor

A. Streun
- The 12th Hiroshima International Symposium on Synchrotron Radiation, Committee Member
A.F. Wrulich
- CNAO, I, Comitato Tecnico
- MAX-lab, S, Scientific Advisory Committee
- NSLS-II, US, Project Advisory Committee
- SESAME, Jordan, Technical Advisory Committee, Chair
- Co-Editor of ‘Journal of Synchrotron Radiation’

AWARDS

J.M. Schippers
Professorship in “physics of particle therapy” at the University of Groningen, Groningen, the Netherlands
Logistics

LIST OF PUBLICATIONS

Tailored instrumentation for long-pulse neutron spallation sources  
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT,  
Volume: 589, Issue: 1, Pages: 34-46

Monte-Carlo simulation of phase space transformation of ultra-cold neutrons  
Conference Information: European Workshop on Neutron Optics (NOP 07)  
March 05-07, 2007 Paul Scherrer Inst Villigen, Switzerland  
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT,  
Volume: 586, Issue: 1, Pages: 110-115

New Generation of AD-Mesurement Cards for High Accuracy Measurments  
EPAC GENOA 2008

Towards Real-Time Tomography: Fast Reconstruction Algorithms and GPU Implementation  

Experimental determination of Radium partitioning between Leucite and Phonolite melt and 226Ra-disequilibrium crystallization ages of Leucite  
CHEMICAL GEOLOGY, 255, 377 - 387

Kehrwald N., Thompson L., Tandong Y., Mosley-Thompson E., Schotterer U., Beer J.,  
Eikenberg J., Davis M. (2008)  
Mass loss on Himalayan glacier endangers water resources  
GEOPHYSICAL RESEARCH LETTERS, 35, No 22

Wersin P., Soler J.M., Van Loon L., Eikenberg J., Baeyens B., Grolimund D., Gimmi T.,  
Dewonck (2008)  
Diffusion of HTO, Br-, I-, Cs+, 85Sr2+ and 60Co2+ in a clay formation: results and modeling  
from an in situ experiment in Opalinus Clay  
APPLIED GEOCHEMISTRY, 23, 678-691

Field calibration and comparison of personal neutron dosemeter designs based on CR-39 for the use around high energy accelerators  
RADIATION MEASUREMENTS, Volume 43, pp. 1081-1084

Response study of fission track detectors using two different moderator designs in a high-energy radiation field  
RADIATION MEASUREMENTS, Volume 43, pp. 1085-1088
CONFERENCE, WORKSHOP AND SEMINAR CONTRIBUTIONS

JOURNAL OF CRYSTAL GROWTH, Volume: 310, Issue: 7-9, Pages: 1867-1874


Rossetti D., Japichino E., Ellenberger U., Pradervand C., Pauluhn A., Ulmer D., Schulze-Briese C. Novel design and first results for a high precision kappa goniometer to be used with X-ray diffraction analysis Proceedings of the SRI international Conference - Saskatoon (Can) – June 2008


Behind the scenes: the water-cooling facility for some of PSI's large-scale facilities.