**No. I/14 - 28 March 2014**

# PSI photon, neutron and muon user facilities newsletter

## Editorial

Werner Wagner

Dear Colleagues

The celebration of 40 years of HIPA, the High Intensity Proton Accelerator of PSI, gave an impressive insight into the challenging endeavor the pioneers of this accelerator complex were facing. Not less challenging was the SINQ project, a new 'useful beamdump' for the accelerator, or, more appropriately named, a MW class spallation neutron source, using the remaining waste of the proton beam, about 70% of the full (!), to generate neutron beams for scientific research and technical applications.

When I joined PSI and the SINQ project in 1990, ground breaking had just started, and the foundations took form. But there was still a long and winding way to go. The initial concept of a liquid metal target was abandoned in favor of a solid so-called 'lead-cannelloni' target. Since the envisaged MW-power of SINQ exceeded that of existing facilities at that time by factors, most challenging engineering and manufacturing problems had to be overcome.

Nevertheless, the facility was successfully completed, and started operation in 1997. Since then, SINQ looks back to an impressive operation history, highly reliable, with availability values in most years exceeding 97%.

## New calls for proposals

**SLS: PX-beamlines**
deadline: June 15, 2014
**SLS: non-PX beamlines**
deadline: September 15, 2014
**more information**
<http://www.psi.ch/sls/calls>

**SINQ**
deadline: May 15, 2014
**more information**
<http://www.psi.ch/sinq/call-for-proposals>

**SμS**
deadline: June 2014
**more information**
<http://www.psi.ch/smus/calls>

An **overview** about all proposal submission deadlines of the PSI facilities can be obtained **here** <http://www.psi.ch/useroffice/proposal-deadlines> **.**

## Facility news

Since the startup the neutron flux to the users could be improved by a factor of 4, thanks to the power upgrade of HIPA and the successful SINQ target optimization. The user program has lively been accepted, overbooking factors between 2 and 4 are common, and meanwhile 450-500 individual users per year are generally highly satisfied.

Besides that, SINQ hosted important projects. The most prominent one was the MEGAPIE project, a widely recognized experiment of a liquid metal target for SINQ. It was operated successfully in 2006 with a remarkable increase in neutron flux, very enjoyable, but it also taught us the extreme complexity of such a system. It thus confirmed the decision for a solid target, but stimulated the optimization of the 'cannelloni' target with an increase in neutron flux which almost catches up with the MEGAPIE flux.

All these accomplishments were only possible thanks to highly motivated, engaged and skilled teams, for SINQ as well as for the instruments operation and development, and for the technical support from Logistics and Large Scale Facilities departments. I am very proud having been part of all that, which I now leave to retire. I take this opportunity to express my deep appreciation.

Werner Wagner, leaving head of the Spallation Neutron Source Division at PSI

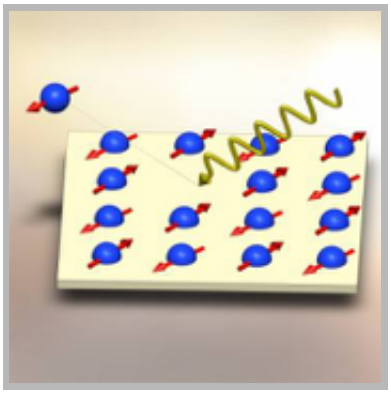
# Research highlights

**SLS, SINQ and SμS - Material Science: Superconductivity in the cuprates**

Comprehensive study of the spin-charge interplay in

**SLS: HERCULES School at Swiss Light Source**

From 10 – 13 March the PSI hosted a group of 20 young physicists, chemists and biologists for practical training at the SLS. The 4.5-week HERCULES course is designed for students, postdoctoral fellows, and senior scientists from European universities and laboratories, in the field of neutron and synchrotron radiation for condensed-matter studies (Biology, Chemistry, Physics, Materials Science, Geosciences, Industrial applications). Emphasis is given to experimental training in small groups of four participants. The training sessions are performed at cutting-edge experimental facilities, e.g., such as those used for research at the cSAXS, microXAS, PolLUX and PXIII beamlines. It also gives the participants the opportunity to become acquainted with the staff scientists of the SLS and, as a highlight before departing, obtain an insight into the inner workings of a synchrotron from a guided tour inside the SLS machine ring, **more information** <http://hercules-school.eu/> .



antiferromagnetic $La_{2-x}Sr_xCuO_4$

**G. Drachuck et al, Nature Communications 5, 3390 (2014), DOI: 10.1038/ncomms4390**

<http://dx.doi.org/10.1038/ncomms4390>

The origin of the pseudogap and its relationship with superconductivity in the cuprates remains vague. In particular, the interplay between the pseudogap and magnetism is mysterious. Here we investigate the newly discovered nodal gap in hole-doped cuprates using a combination of three experimental techniques applied to one, custom made, single crystal. The crystal is an antiferromagnetic $La_{2-x}Sr_xCuO_4$ with x=1.92%. We perform angle- resolved photoemission spectroscopy measurements as a function of temperature and find: quasi-particle peaks, Fermi surface, anti-nodal gap and below 45 K a nodal gap. Muon spin rotation measurements ensure that the sample is indeed antiferromagnetic and that the doping is close, but below, the spin-glass phase boundary. We also perform elastic neutron scattering measurements and determine the thermal evolution of the commensurate and incommensurate magnetic order, where we find that a nodal gap opens well below the commensurate ordering at 140K, and close to the incommensurate spin density wave ordering temperature of 30K.

**Read the full story** <http://www.psi.ch/num/2014#drachuck>

**SLS - Material Science: Magentization of individual Fe nanoparticles**

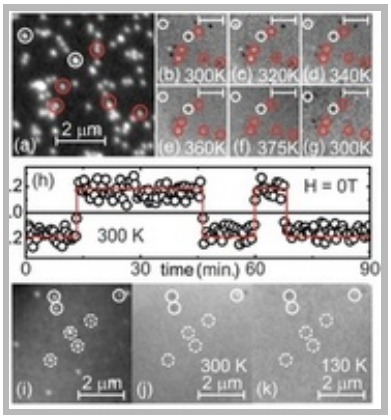
Direct Observation of Magnetic Metastability in

**SINQ: Neutron Microscope**

The goal of the currently running project 'Neutron Microscope' is to extend the spatial resolution of neutron imaging towards the one of the X-ray methods. Following the demands of the user community, the project has been started in December 2012 and includes the design of suitable perfect magnifying optics, novel neutron sensitive micro-structured scintillators, neutron optical devices and suitable cameras. The project is supported by NMI3 (JRA), SNF, PSI-CROSS, and CCMX. The successful pilot experiments using a prototype device were already performed in November 2013. The tests will be continued soon after the end of the shutdown in May 2014. All components mentioned above are under development and their further optimization is planned until the end of 2016, when the 'Neutron Microscope' will be made available for routine user operation.

**SμS: Upcoming μSR Conference**

The 13th International Conference on Muon Spin Rotation, Relaxation and Reso-




## Individual Iron Nanoparticles

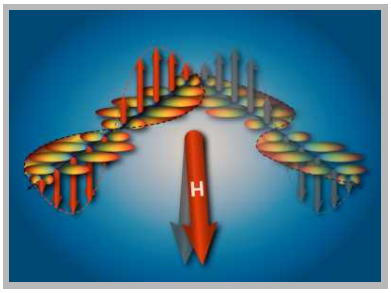
**A. Balan et al, Physical Review Letters 112, 107201 (2014), DOI: 10.1103/PhysRevLett.112.107201**

<http://dx.doi.org/10.1103/PhysRevLett.112.107201>

Studying the magnetization of individual iron (Fe) nanoparticles by magnetic spectromicroscopy reveals that superparamagnetic (SPM) and ferromagnetic blocked (FM) nanoparticles can coexist in the investigated size range of 8-20 nm. Spontaneous transitions from the blocked state to the superparamagnetic state are observed in single particles and suggest that the enhanced magnetic energy barriers in the ferromagnetic particles are due to metastable, structurally excited states with unexpected life times.

**Read the full story** <http://www.psi.ch/sls/scientific-highlights>

**SINQ - Superconductivity switched on by magnetic field**




## Switching of magnetic domains reveals spatially inhomogeneous superconductivity

**S. Gerber et al, Nature Physics 10, 126 (2014), DOI: 10.1038/nphys2833** <http://dx.doi.org/10.1038/nphys2833>

The interplay of magnetic and charge fluctuations can lead to quantum phases with exceptional electronic properties. A case in point is magnetically-driven superconductivity, where magnetic correlations fundamentally affect the underlying symmetry and generate new physical properties. The superconducting wavefunction in

nance (µSR2014) will be held in Grindelwald, Switzerland, from Sunday, June 1st to Friday, June 6th, 2014. It is organized by the Paul Scherrer Institut (PSI), the University of Zurich and the University of Fribourg. The conference provides a forum for researchers from around the world with interests in the applications of µSR to study a wide range of topics including condensed matter physics, materials and molecular sciences, chemistry and biology. More than 200 abstracts have been received and are now under consideration for oral and poster contributions. Therefore, we are looking forward to a scientifically versatile and highly interesting conference at Grindelwald in sight of the famous North Face of the Eiger, the Wetterhorn and First,**more information** <http://www.psi.ch/musr2014> .

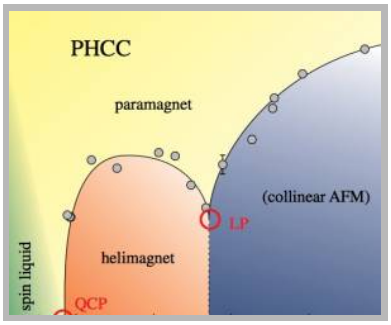
**SwissFEL: Review SwissFEL Experimental Stations**

On the 23rd of January 2014 the technical design review of the SwissFEL Experimental Station A (ESA) took place at PSI. The review committee is consisting of

most known magnetic superconductors does not break translational symmetry. However, it has been predicted that modulated triplet p-wave superconductivity occurs in singlet d-wave superconductors with spin-density-wave (SDW) order. Here we report evidence for the presence of a spatially inhomogeneous p-wave Cooper pair-density wave in CeCoIn5. We show that the SDW domains can be switched completely by a tiny change of the magnetic field direction, which is naturally explained by the presence of triplet superconductivity. Further, the Q-phase emerges in a common magneto-superconducting quantum critical point. The Q-phase of $CeCoIn_5$ thus represents an example where spatially modulated superconductivity is associated with SDW order.

**Read the full story** <http://www.psi.ch/num/2014#gerber>

**SµS - Series of quantum phase transitions induced by pressure**




## Pressure-Induced Quantum Critical and Multicritical Points in a Frustrated Spin Liquid

**M. Thede et al, Physical Review Letters 112, 087204 (2014), DOI: 10.1103/PhysRevLett.112.087204** <http://dx.doi.org/10.1103/PhysRevLett.112.087204>

The quantum spin-liquid compound $(C_4H_{12}N_2)Cu_2Cl_6$ is studied by muon spin relaxation under hydrostatic pressures up to 23.6 kbar. At low temperatures, pressure-induced incommensurate magnetic order is detected beyond a quantum critical point at $P_c \sim 4.3$ kbar. An additional phase transition to a different ordered phase is observed at $P_1 \sim 13.4$ kbar. The data indicate that the high-pressure phase may be a commensurate one. The established (P-T) phase diagram reveals the corresponding pressure-induced multicritical point at $P_1$, $T_1 = 2.0$ K.

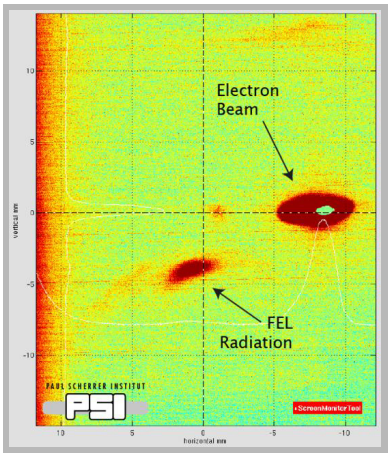
international experts in the field. ESA is envisioned as a pump-probe experimental station, which will focus on investigating photochemical and photobiological systems using combination of X-ray spectroscopy and X-ray scattering, including Serial Femtosecond Crystallography (SFX), from 2 to 12.4 keV. The developments on ESA were judged very positive by the review committee and important feedback was given to the ESA team in order to optimize the technical layout. A first technical review of the SwissFEL Experimental Station B (ESB) will take place, at PSI, from the 20th to the 21st of March 2014. ESA is focusing on condensed matter physics and material science - using time resolved diffraction and scattering techniques.

## Upcoming events

**Computational Structural Biology - From Data to Structure to Function: EMBL-EBI Training Course** <http://www.ebi.ac.uk/training/course/structural-biology-2014>

**Read the full story** <http://www.psi.ch/num/2014#thede>

**SwissFEL - Undulator U15**




## First lasing at the SwissFEL test facility

On the 15th of January 2014, first lasing in the UV wavelength range was achieved at the SwissFEL injector test facility. This is a great success on the way towards SwissFEL, the future hard x-ray free-electron laser that is currently under construction at PSI. It proves the successful functioning of many required key components together in a larger system. Since 2010, PSI has been operating the test facility to study and optimize the electron source for SwissFEL. Over the last years, the test facility has proven many new schemes and techniques, and during the last shutdown end of 2013, a first undulator was installed. This innovative type of undulator is an in-vacuum design with a very small period length of only 15 mm that was specifically developed for SwissFEL. During the very first beam time after the installation of the undulator, the electron beam could be successfully tuned to pass the undulator with low losses - this is very important to prevent radiation damage to the sensitive 1060 permanent magnets. The electrons generate spontaneous radiation when passing the undulator, and this radiation was detected with scintillator screen monitors. In a next step, the electron beam was strongly compressed in a bunch compressor chicane to generate a very large charge density, which is required for the FEL process. This initiated the free-electron lasing process, leading to an exponential increase of the emitted radiation along the undulator. An electron beam with energy 220 MeV and bunch charge 200 pC was used in

April 7-11, 2014, Cambridge, UK

**Polymers in Photovoltaics 2014** <http://www.iucr.org/news/notices/meetings/meeting_2013_399>
April 8-10, 2014, Cologne Germany

**XII School of Neutron Scattering 'Francesco Paolo Ricci': Introduction to the theory and techniques of neutron scattering and applications to Cultural Heritage** <http://www.sonsfpricci.org>
April 30 - May 9, 2014, Erice (Sicily), Italy

**MDANSE2014 – school: Molecular Dynamics (and Lattice Dynamics) to Analyse Neutron Scattering Experiments** <http://www.ill.eu/mdanse2014/>
May 9-10, 2014, Grenoble, France

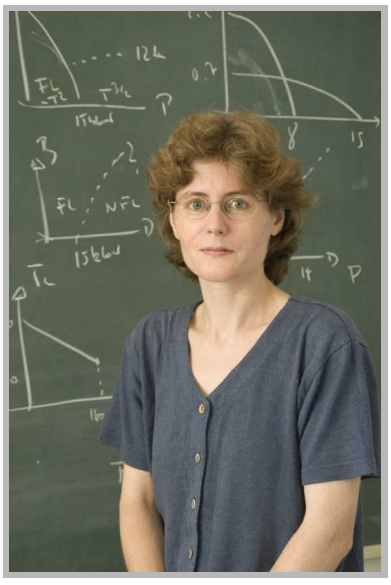
**ACNS 2014: American Conference on Neutron Scattering** <http://www.mrs.org/acns-2014/>
June 1-5, 2014, Knoxville, TN, USA

**µSR2014: 13th International Conference on Muon Spin Rotation, Relaxation and Resonance** <http://www.p-

this process, and first lasing was detected at a wavelength of 80 nm. By adjusting the gap of the undulator, the wavelength of the emitted laser light could be tuned over one octave from around 45 to 90 nm.
After this successful operation the undulator will be taken out from the test facility and final optimization steps will be carried out towards the optimum configuration for the 12 undulators required for the SwissFEL ARAMIS hard X-ray beamline.

# Users Association

**JUSAP - The Joint Users Association**



Sarah Dunsiger, chair of JUSAP

The new European Framework Program **Horizon2020** <http://ec.europa.eu/programmes/horizon2020/> may discontinue the financial support of transnational access to large scale facilities. Previous schemes have been solely based on the scientific merit of beamtime requests submitted by individual researchers.

The European Synchrotron User Organisation **ESUO** <http://www.esuo.org> , representing 25.000 users of European light sources, has expressed enormous concern

si.ch/musr2014>
June 1-6, 2014, Grindelwald, Switzerland

**2014 Annual Meeting of the Swiss Physical Society SPS** <http://www.sps.ch/en/events/sps_annual_meeting_2014/>
June 30 - July 2, 2014, Fribourg, Switzerland

**PSI Powder Diffraction School 2014** <http://www.psi.ch/pds2014>
July 1-4, 2014, PSI Villigen, Switzerland

**SCES 2014: Strongly Correlated Electron Systems 2014** <http://www.sces2014.org>
July 7-11, 2014, Grenoble, France

**Neutrons and Food 2014** <http://www.neutronsandfood.com/>
July 9-11, 2014, Paris, France

**13th PSI Summer School on Condensed Matter Research: Exploring time, energy and length scales in condensed matter** <http://www.psi.ch/summerschool>
August 9-15, 2014, Zug, Switzerland

**FEL 2014** <http://www.fel2014.ch/>
August 25-29, 2014, Basel,

over this development. To date, in the first call 2014 of Horizon2020, no mention has been made of any particular topic which reflects the needs of the broad synchrotron community. The ESUO has thus launched several lobbying initiatives for the second call 2016: (i) a 'letter of concern' accessible via the ESUO website was sent by the ESUO chairman to the European Commission authorities in November 2013; (ii) this letter will also be submitted in April 2014 for publication as a manuscript to the Journal of Synchrotron Radiation and (iii) in the summer of 2014, an eight page brochure focussing on the socio-economic impact of synchrotron radiation research will be finalised and communicated to relevant organisations including political bodies. It is hoped such initiatives will help to promote the continuation of successful integrated pan-European research at synchrotron facilities. The users of neutron and muon facilities are also impacted by this change in financial support and a broad coordinated lobbying initiative is necessary.

Support from the wider community of large scale facility users – via, for example, the ESUO discussion forum, the International Society for µSR Spectroscopy **ISMS** <http://http://musr.org/isms/> and/or the JUSAP chair – is highly welcome.

Sarah Dunsiger (JUSAP chair) and Ullrich Pietsch (ESUO chair)

Switzerland

**18th JCNS Laboratory Course Neutron Scattering** <http://www.neutronlab.de>
September 1-12, 2014, Jülich and Garching, Germany

**Science at FELs** <http://science-at-fels-2014.eurofel.eu/>
September 14-17, 2014, PSI Villigen, Switzerland

**WCNR10: 10th World Conference on Radiography** <http://www.psi.ch/wcnr10>
October 5-10, 2014, Grindelwald, Switzerland

**more events** <http://www.psi.ch/useroffice/conference-calendar>

## Current Openings

**Job opportunities at PSI** <http://www.psi.ch/en/pa/offenestellen/>

# Announcements

## 2014 PSI Summer School on Condensed Matter Physics

The 2014 edition of the PSI Summer School on condensed matter physics is being dedicated to some of the main topics addressed at large-scale user facilities, such as neutron and muon sources or synchrotron photon sources: Exploring time, energy and length scales in condensed matter. In-

ternational experts and PSI staff members will introduce and deepen your knowledge not only about these scientific topics but also about the main methods applied to understanding the phenomena which are presently at the forefront of modern solid-state physics and chemistry. The school will be organised from August 9-15, 2014 on the premises of the Institut Montana Zugerberg (international boarding school), Zug, Switzerland. Following the school, practical training is being offered at PSI to allow a limited number of participants to obtain hands-on experience with state-of-the-art instrumentation using photons, neutrons, and muons. More information can be obtained from the **school's webpage.** <https://indico.psi.ch/conferenceDisplay.py?confId=2672>

## World Congress on Neutron Radiography 2014

The Neutron Imaging group of the NUM department organizes the 10th World Conference on Neutron Radiography in Grindelwald, Switzerland from October 5-10, 2014. WCNR14 will attract scientists active in the field of neutron imaging either as designers and/or operators of facilities or as users of such installations. During the conference the latest methodical developments, instrumentation layout and improvements and new applications will be presented and discussed. More information can be obtained from the **conference website.** <http://www.psi.ch/wcnr10>

## PSI-FELLOW/COFUND – International Fellowship Program for Postdocs at Paul Scherrer Institut

The new EU co-financed funding program PSI-FELLOW addresses international postdocs and offers these researchers the opportunity to perform their innovative scientific project in one of the four attractive scientific fields tackled at PSI: i) materials and matter, ii) life-sciences, iii) energy and environment and iv) accelerator technologies. The application has to be made together with a senior scientist at PSI, who will act as the fellow's mentor. The second call for applications will be launched on June 1, 2014. Project proposal together with CV and two reference letters has to be submitted not later than by **August 4, 2014**. Please keep updated by consulting **PSI-FELLOW webpage** <http://www.psi.ch/psi-fellow/> .

## Imprint

PSI Facility News addresses the users of the PSI large facilities and appears quarterly in English. Any feedback is highly welcome! **More information.** <http://www.psi.ch/imprint>
**Contact:** PSI User Office, Phone: +41-56-310-4666, Email: **useroffice@psi.ch**