

# NES präsentiert: Kompetenzen & Highlights

09:00	Begrüßung und Einführung Neues aus dem NES: Zukünftige Ausrichtung des NES und Gründung eines neuen Labors für Scientific Computing and Modelling	<i>A. Pautz</i>
09:20	Labor für Reaktorphysik und Systemverhalten	<i>H. Ferroukhi</i>
09:40	Labor für Thermohydraulik	<i>H.-M. Prasser</i>
10:00	<i>Kaffeepause</i>	
10:30	Hotlabor	<i>M. Streit</i>
10:50	Labor für Nukleare Materialien	<i>M. Pouchon</i>
11:10	Labor für Endlagersicherheit	<i>S. Churakov</i>
11:30	Labor für Energiesystem-Analysen	<i>V. Dang</i>
11:50	Labor für Radiochemie	<i>R. Eichler</i>
12:10	Schlussbetrachtungen und Verabschiedung	<i>A. Pautz</i>
12:30	Ende der Veranstaltung	

WIR SCHAFFEN WISSEN – HEUTE FÜR MORGEN



Andreas Pautz, Bereichsleiter Nukleare Energie und Sicherheit (NES) :: Paul Scherrer Institut

# NES präsentiert: Kompetenzen und Highlights

Paul Scherrer Institut, 24. Oktober 2017

- NES Mission and Strategy, and Organization
- Projects and Partners of NES
- NES: The New Laboratory LSCM

**NES is the Swiss national center of excellence for nuclear energy:**

NES research focuses on the **safety** of the existing nuclear power plants, **waste management** issues, and **decommissioning of nuclear installations**

NES will continue to address **advanced and innovative nuclear system concepts**, in particular with respect to safe operation and waste minimization strategies

NES recognizes the **multi-disciplinarity** of nuclear engineering and strives to build scientific links to the large-scale facilities at PSI, and to other non-power nuclear applications



## **Contribute to the evolution of the State-of-the-Art in science and technology for thermal and fast reactor systems**

- NES acts as a **Technical Safety Organization (TSO)** for the Swiss Nuclear Regulator, ENSI, and is member of the European TSO Network ETSO
- NES has the mandate of “Technology Monitoring” of Gen-III/Gen-IV reactor developments (*Membership GIF: Generation-IV International Forum*)

## **NES maintains the capability of handling and fostering investigations of radioactive materials in the Hot Laboratory (AHL)**

- The AHL is one of the very few facilities of its kind in Europe, and provides PSI with a decisive advantage over other nuclear research institutions
- It remains mandatory to operate the AHL due to the industrial demand, e.g. PIE of spent fuel rods
- The Hotlab is also an important facility for PSI (waste treatment, target inspection)

## NES Strategic Goals (II)

**NES implements within LES the competence center for geochemistry of disposal systems and transport mechanisms of radionuclides**

– LES delivers significant R&D contributions to the Sectoral Plan (=> Stage 3)

**Contribute to effective decision-making on medium- to long-term technology strategies in energy supply and demand (LEA)**

**Foster Nuclear Education by substantially contributing to the Swiss Nuclear Master Program (PSI / EPFL /ETHZ), and training of PhDs / PostDocs**

**(Only) Joint Master Program of EPFL and ETHZ**

Since its start in 2008 more than **110 Graduates**

Typically **10-15 students per year (2017: 9)**

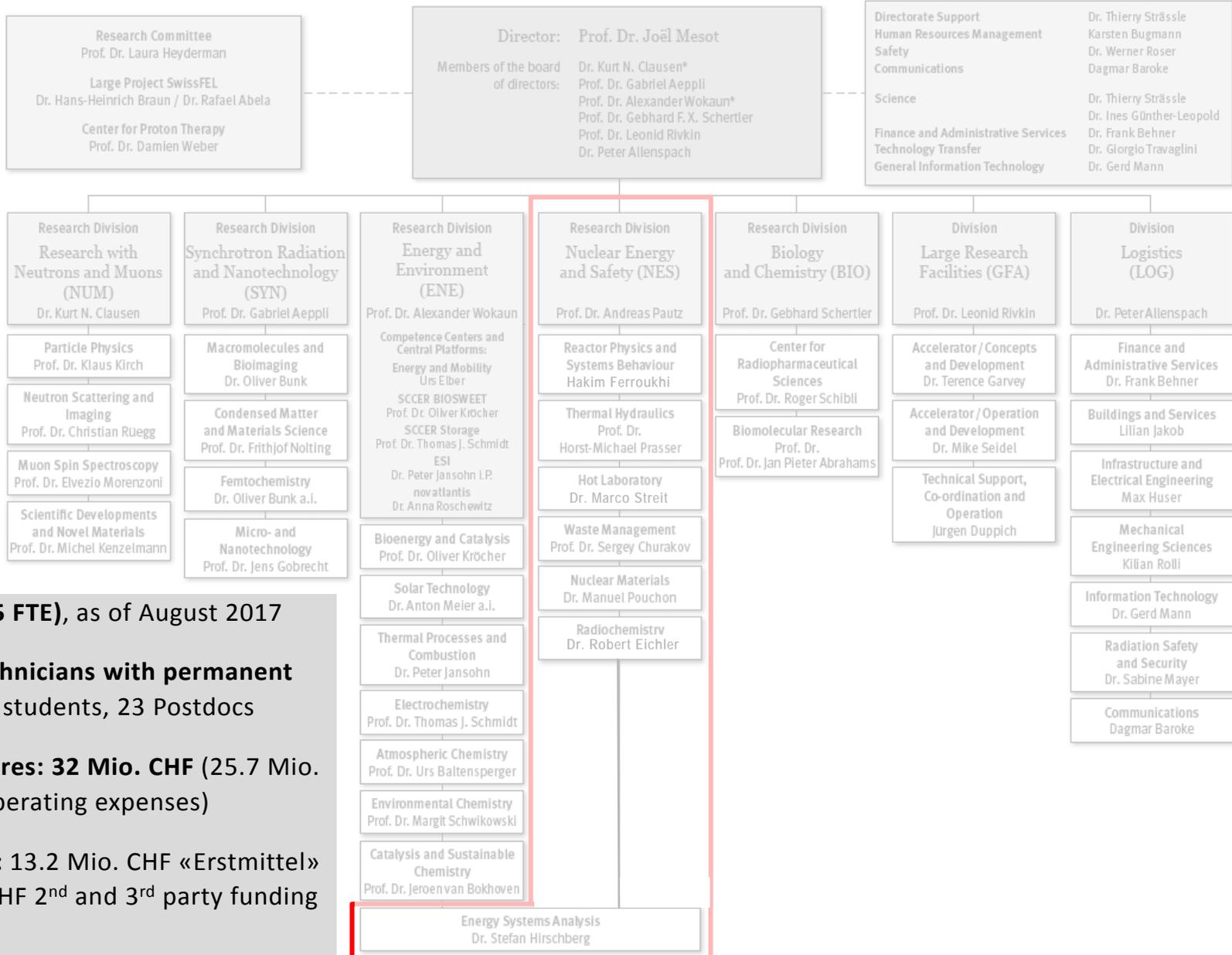
2-year curriculum, 120 ECTS credits

**PSI** contributes significantly to the program:

- Lectures (Nuclear Safety, Severe Accidents, ...)
- Supervision of Master- and semester projects
- Utilization of PSI facilities



# Embedding of NES in the PSI Organization



**201 NES staff (195 FTE), as of August 2017**

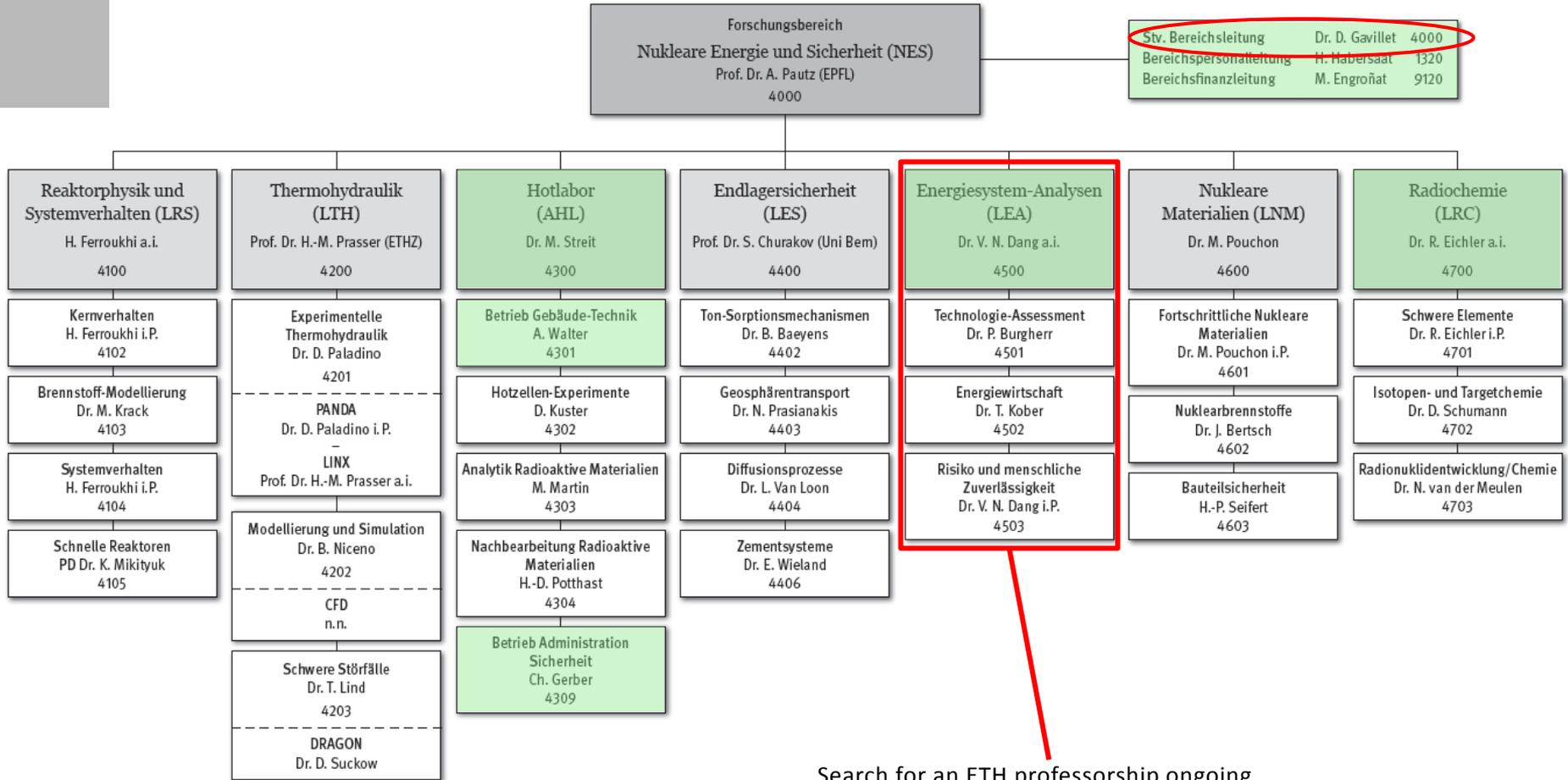
**115 scientists/technicians with permanent positions, 33 PhD students, 23 Postdocs**

**Annual Expenditures: 32 Mio. CHF (25.7 Mio. Salary, 6.3 Mio. operating expenses)**

**Annual Revenues: 13.2 Mio. CHF «Erstmittel» (41%), 18.8 Mio CHF 2<sup>nd</sup> and 3<sup>rd</sup> party funding (59%)**

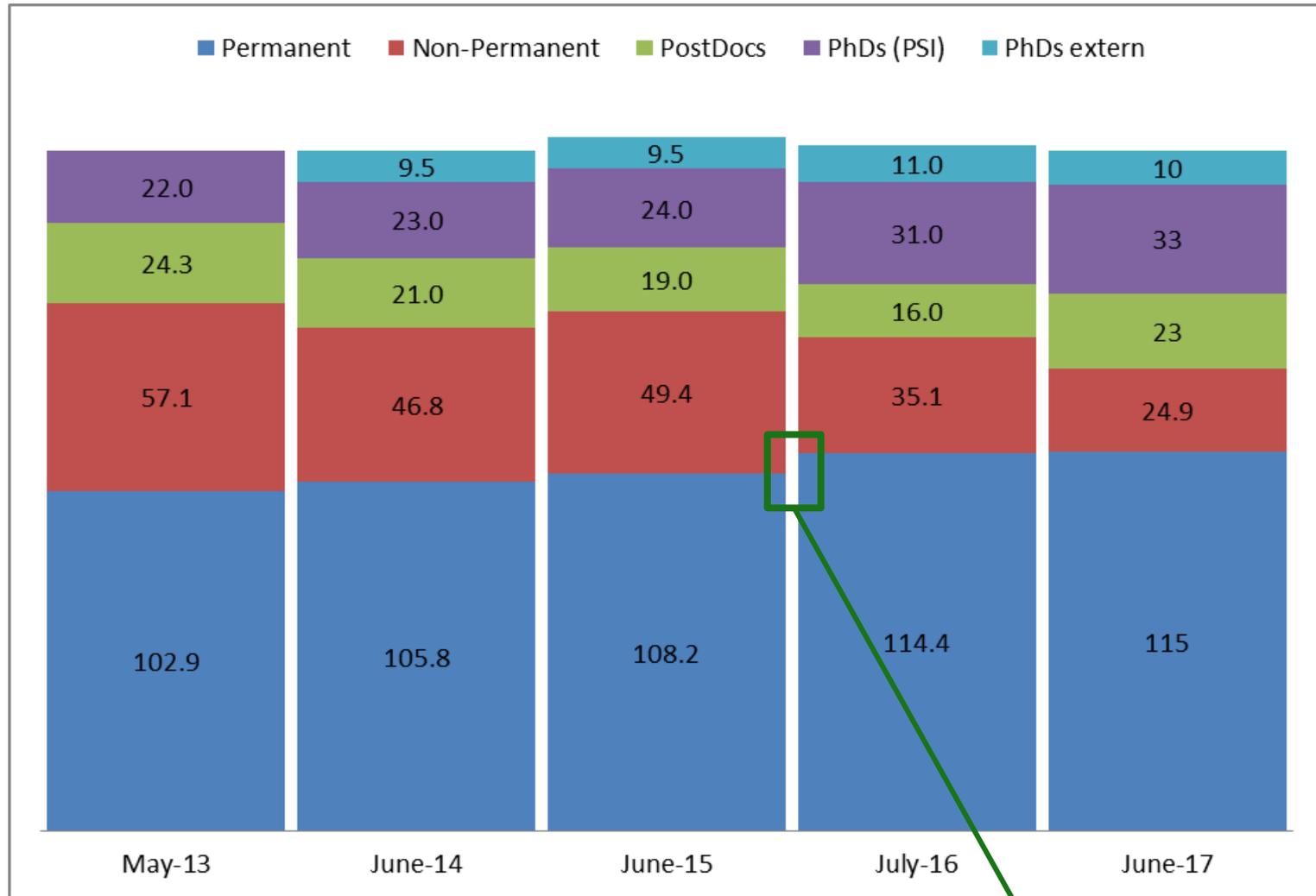


# NES Organization as of October 2017



Search for an ETH professorship ongoing

# Development of NES Staff 2013-2017 (FTE)



LRC joined NES

# NES Projects and Partners

# NES Project Landscape

- NES serves a wide range of clients, however, our most important national partners are:
  - **swissnuclear** (Hotlab Operation + R&D Projects for Maintenance of Competence in Nuclear Engineering”)
    - *13 projects ongoing; Preparations are ongoing for the proposal round 2018/2019; PSI has offered 21 project proposals to swissnuclear*
  - **ENSI** (Reactor Safety Research + On-Calls)
    - *R&D projects in DSA, Material Integrity, Severe Accidents, HRA*
    - **From 2018:** *LEAD, Long-Term Operation Concerns due to Environmentally-Assisted Material Degradation*
  - **NAGRA** (Scientific Support for Sectoral Plan, stage 2 and 3)
- NES has also been successful in acquiring competitive “Zweitmittel”, e.g. via the **Swiss National Science Foundation (SNF) and KTI**
- Besides that, NES is involved in more than 20 **Euratom/Horizon 2020** projects, and participates in numerous OECD/NEA and IAEA activities

# Successful H2020 Project Proposals in 2016 Call

Acronym	Short Description	Project Lead PSI	EU Amount (€)	Labs involved
ESFR-SMART	European Sodium Fast Reactor Safety Measures Assessment and Research Tools	K. Mikityuk	575'000	LRS
CORTEX	Core monitoring techniques and experimental validation and demonstration	M. Hursin, A. Dokhane	1'129'000 (LRS + CROCUS)	LRS, EPFL
INSPYRE	Investigations Supporting MOX Fuel Licensing in ESNII Prototype Reactors	M. Krack	221'000	LRS, LNM
MEACTOS	Mitigation EAC through optimization of surface condition	S. Ritter	151'000	LNM
NOMAD	NDE System for inspection of operation-induced material degradation in NPPs	M. Niffenegger	231'000	LNM
M4F	Multiscale Modelling for Fission and Fusion Materials	J. Chen, P. Spätig	120'000	LNM
DISCO	Modern Spent Fuel DISSolution and Chemistry in Container	E. Curti	202'000	LES
INSIDER	Evaluation of Decommissioning Practices and Strategies in a European Context	S. Nichenko	106'000	AHL, RBE

- **NFRP-2018-1:** Safety assessments to improve **accident management strategies for Generation II & III reactors**
- **NFRP-2018-2:** Model development and **safety assessments** for Generation-IV reactors
- **NFRP-2018-3:** Research on the safety of **Light Water Small Modular Reactors**
  - *Scope: This action should investigate improved safety features of Light Water SMRs and provide a set of fundamental technical specifications, against which compliance of SMRs with Directive 2009/71/Euratom could be tested by safety regulators.*
- **NFRP-2018-4:** **Improved nuclear data** for energy and non-energy modelling applications
- **NFRP-2018-5:** Development of a roadmap for **decommissioning research** aiming at safety improvement, environmental impact minimisation and cost reduction
- **NFRP-2018-6:** European Joint Research Programme in the management and disposal of radioactive waste (**50% of the entire 2018 budget alone!**)

10 OECD/NEA member states will join the **HYMERES-II project** that addresses the understanding of the containment phenomenology during postulated severe accident with release and distribution of hydrogen (=> LTH presentation)

In 2017, OECD/NEA launched the **NEST initiative** (NEA Nuclear Education, Skills and Technology) that shall help to build a new generation of well-trained nuclear engineers

It will support young scientists (Master, PhD, Postdocs) to get **hands-on experience on real-world challenges in a multinational environment**

**HYMERES-II has been selected as the prototype project for this initiative**



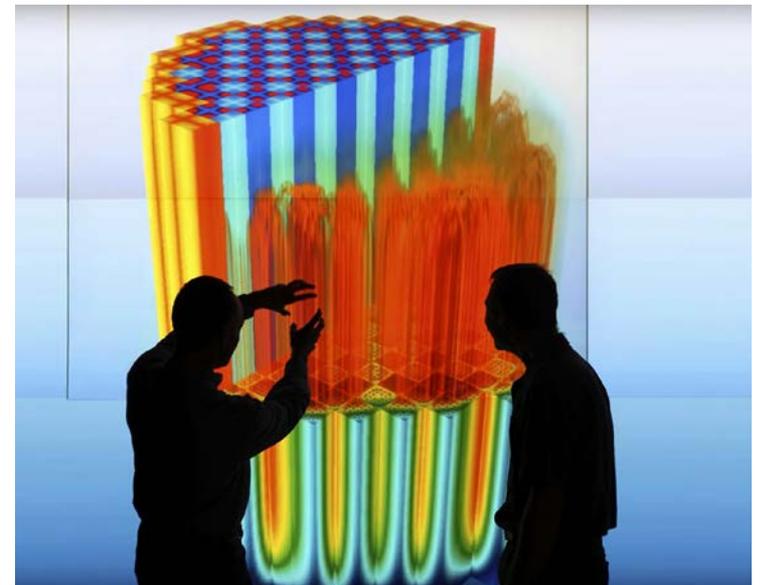
PANDA Facility at PSI will be used for the HYMERES-2 Experiments

# ■ The New NES Laboratory for Scientific Computing (LSCM)



The PSI directorate has decided to bundle **all PSI activities on scientific modelling and computing** in a single laboratory (LSCM):

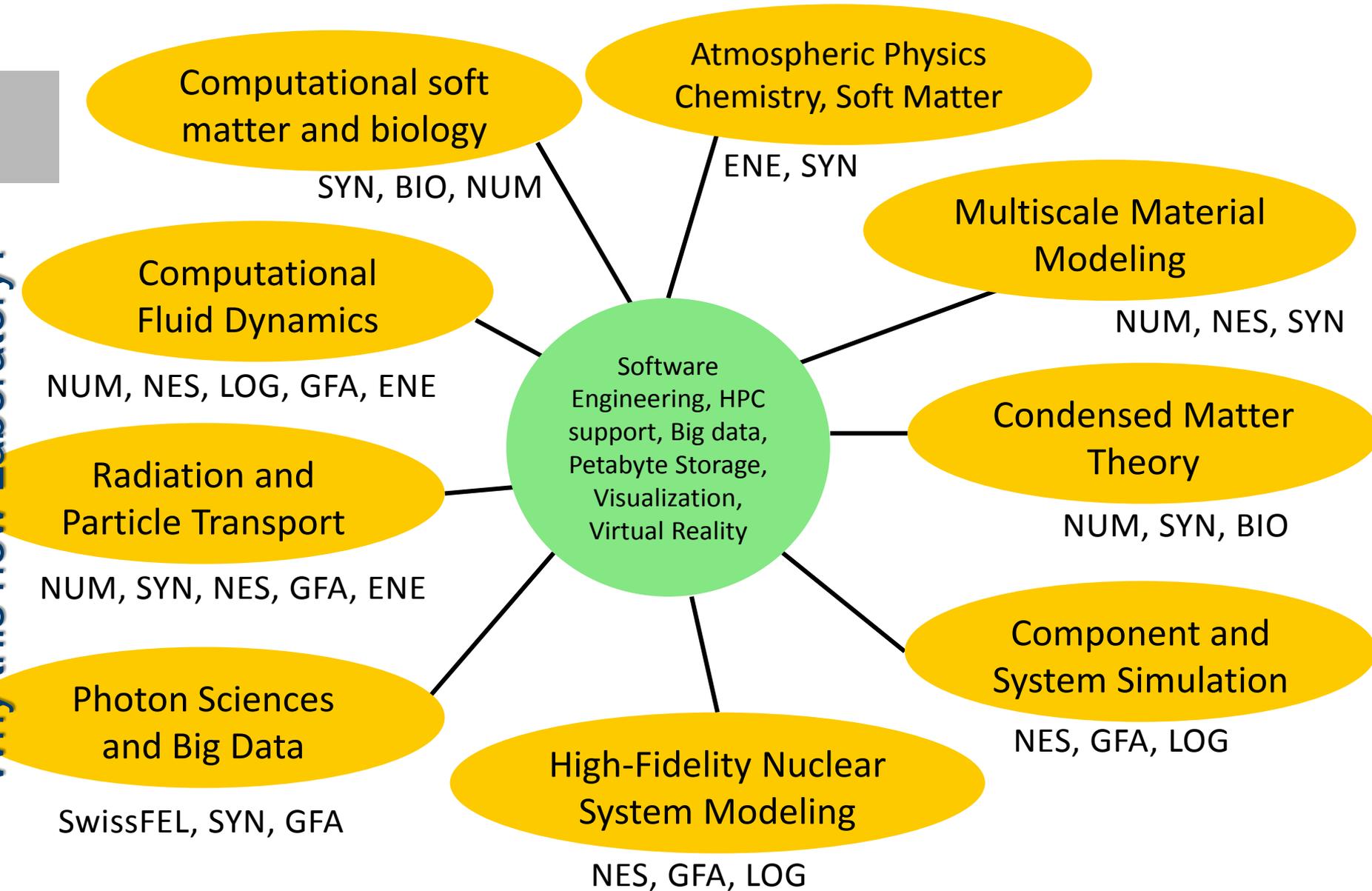
- Recognizes the **importance of computer simulation and modelling** as a third branch of endeavor besides experiment and theory
- Addresses the strategic focus area **“Big Data and Digital Sciences”** of the ETH domain
- Strong cooperation and utilization of the **Swiss Supercomputing Center (CSCS)** is intended
- A new professorship in **Multiscale Materials Modelling** has been created at ETH Zurich, as joint position with the **PSI laboratory lead**



# Scientific Computing and Modeling at PSI

Topical Areas of Scientific Computing and Modeling at PSI (no claim for completeness!)

Why this new Laboratory?



## Mission of the new Laboratory (I):

Shall bring the **simulation/modeling community at PSI closer together**, and foster the scientific interaction and exchange between PSI colleagues

Shall support the definition of **overarching and interdisciplinary science cases** across labs and divisions

Shall become the **centralized PSI location** for all research projects that have a significant simulation component

Shall deliver input for the **definition of new experiments at our large-scale facilities**, and support the evaluation/interpretation of measured data (SwissFEL, ...)

## Mission of the new Laboratory (II):

Shall benefit from a **joint infrastructure**, e.g. common development platforms, pre- and post-processing tools, code parallelization and profiling, ...

Shall **closely cooperate with IT-specialists** that participate in the development and maintenance of simulation software, and the definition of optimal hardware solutions

Shall **foster cooperation** with other units of the ETH domain (and beyond) that have a similar mission (Example: Swiss Data Science Center)

This new laboratory should cover the following areas:

- **Condensed Matter Theory** - (including Analytical modeling)
- **Materials Science** - hard materials, microstructure and microstructural evolution, nuclear materials and structural integrity
- **Computational Fluid Dynamics (CFD)**
- **High-Fidelity Radiation Modeling** - shielding, activation, neutron/photon transport
- **Complex System Simulation:** Reactor simulation, Target simulation/design, «multi-physics» coupling
- **Computational soft matter and biology** - Molecular modeling and simulation of the dynamic properties of biological soft matter.

**The new laboratory in a preliminary structure will start operation on 1<sup>st</sup> of January, 2018.**

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**Large Project SwissFEL**  
Dr. Hans-Heinrich Braun / Dr. Rafael Abela

**Center for Proton Therapy**  
Prof. Dr. Damien Weber

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 Prof. Dr. Alexander Wokaun\*  
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 Prof. Dr. Leonid Rivkin  
 Dr. Peter Allenspach

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 Prof. Dr. Oliver Kröcher  
 SCCER Storage  
 Prof. Dr. Thomas J. Schmidt  
 ESI  
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 novantantis  
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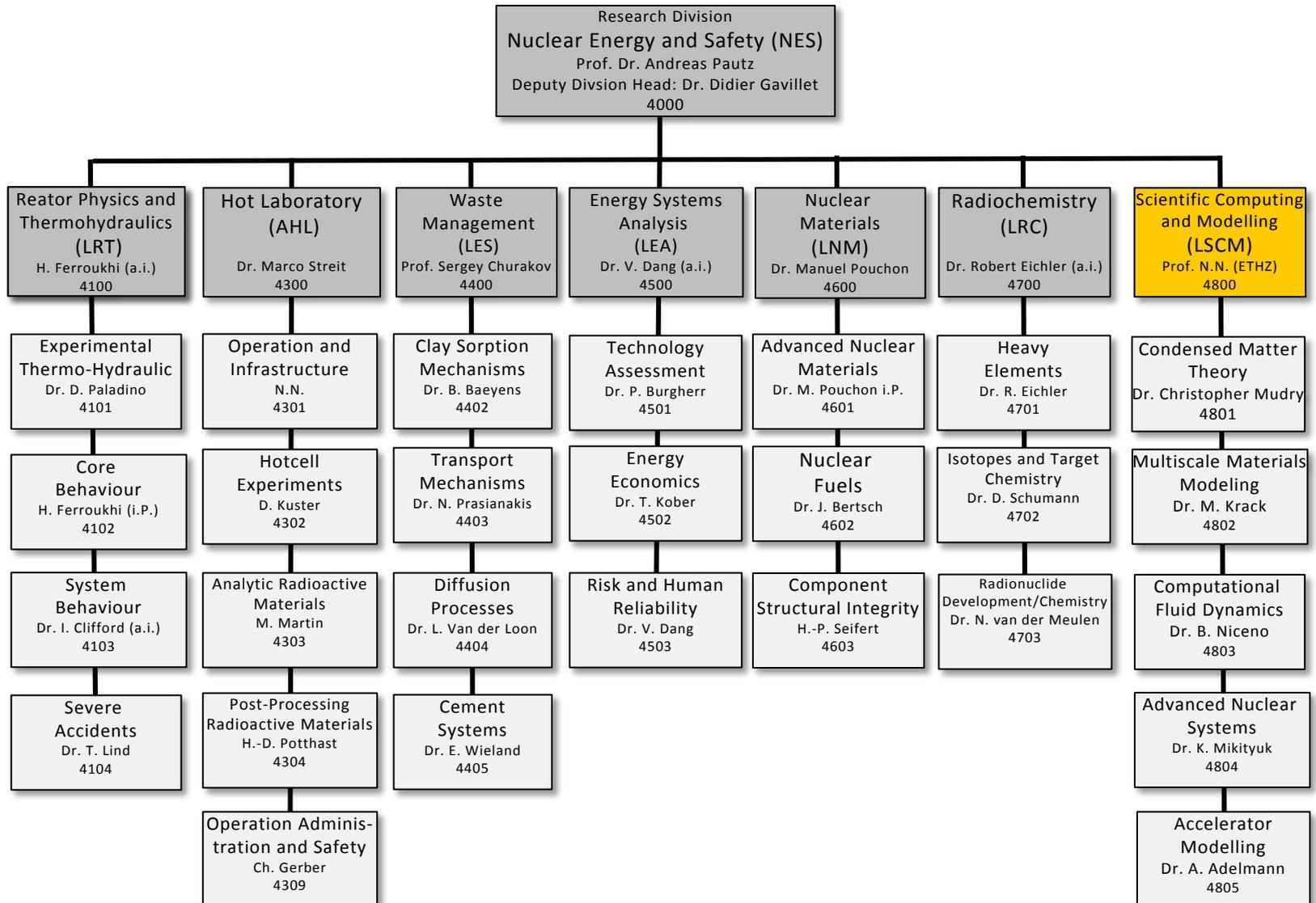
**Mechanical Engineering Sciences**  
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**Information Technology**  
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**Radiation Safety and Security**  
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**Communications**  
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**Scientific Computing and Modelling**  
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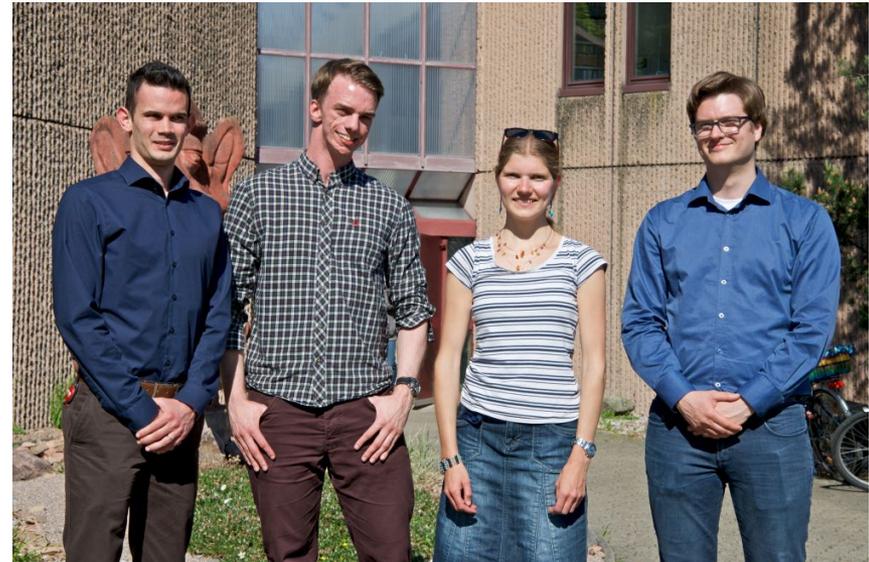
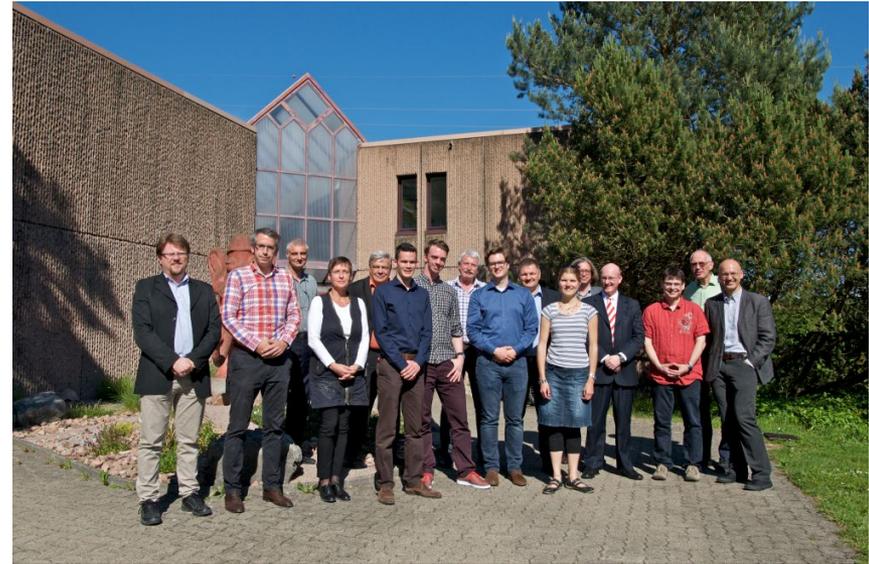


# NES: Some Recent Activities



# The NES PhD Day 2017

- On May 22, 2017, the 9<sup>th</sup> NES PhD day took place at Auditorium West
- The work of 31 PhD students was judged by a 12-member jury in a closed poster session
- From 31 poster contributions, 8 (two 1<sup>st</sup> year, two 2<sup>nd</sup> year, four 3<sup>rd</sup>/4<sup>th</sup> year), were selected for oral presentations in the afternoon
- From those, four winners were selected (one 1<sup>st</sup> year, one 2<sup>nd</sup> year, two 3<sup>rd</sup>/4<sup>th</sup> year)
- The proud winners are:
  - 1st year: Erik Karlsson (LRC)
  - 2nd year: Heiko Kromer(LTH)
  - 3rd year: Dionysios Chionis (LRS)
  - 4th year: Katharina Domnanich (LRC)
- Support from Nuklearforum is greatly acknowledged!



## Nuclear Energy and Safety (NES)

About NES

People

Laboratories

Projects

Facilities

Teaching and Education

Events

Kompetenzen &amp; Highlights 2016

Kompetenzen &amp; Highlights 2015

Kompetenzen &amp; Highlights 2014

Scientific Highlights

Publications

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Hinweis nicht mehr anzeigen.

## Upcoming NES events

24.10.2017 | 09:00 - 12:30 | OSGA/EGo6

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Event

Prof. Andreas Pautz

31.10.2017 | 11:00 | FLG/402

The international High Temperature Reactor landscape

Kolloquium

M. Fütterer, Joint Research Centre, The European Commission's in-house science service

^  
TOP

## General Contact

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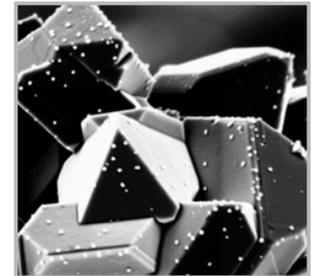
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## Scientific Highlights NES

3 October 2017

### Pt nanoparticles: The key to improved stress corrosion cracking mitigation in boiling water reactors

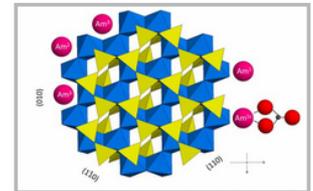
The formation and growth of cracks by stress corrosion cracking (SCC) in external and recirculation pipes due to the highly oxidising environment is a serious problem in boiling water reactors. At first, SCC mitigation was attempted by injecting H<sub>2</sub> into the reactor feed water, where the injected H<sub>2</sub> recombines with the H<sub>2</sub>O<sub>2</sub> and O<sub>2</sub> to water and thereby reduces the electrochemical corrosion potential, and consequently the SCC susceptibility. The disadvantages of the injection of high amounts of H<sub>2</sub>, have led to the development of alternative mitigation strategies. The use of noble metal additions to the reactor feed water. With injection of a much smaller amount of noble metal particles of a few nanometres in size, formed in-situ, work as scavengers for the efficient reduction of the oxidizing species formed by radiolysis, and thus lower the ECP and SCC susceptibility.



15 September 2017

### Sorption of trivalent lanthanides and actinides onto montmorillonite

The credibility of long-term safety assessments of radioactive waste repositories may be greatly enhanced by a molecular level understanding of the sorption processes onto individual minerals present in the near- and far-fields. A study conducted at **LES** in collaboration with the **Helmholtz Zentrum Dresden Rossendorf** used extended X-ray absorption fine structure (EXAFS) and time-resolved laser fluorescence spectroscopies (TRLFS) to elucidate the uptake mechanism of trivalent lanthanides and actinides (Ln/An<sup>III</sup>) by the clay mineral montmorillonite. The excellent agreement between the thermodynamic model parameters obtained by fitting the macroscopic data, and the spectroscopically identified mechanisms, demonstrates the mature state of the 2SPNE SC/CE sorption model developed at **LES** for predicting and quantifying the retention of Ln/An<sup>III</sup> elements by montmorillonite-rich clay rocks.



<https://www.psi.ch/nep/scientific-highlights>

The **NES division of PSI** is adapting its strategy to the situation of nuclear power in Switzerland, and the needs of its major stakeholders

Stronger acquisition of **competitive funding sources**, and diversification to **non-power applications** is well underway

The **research infrastructures** within NES are in good shape and are being extensively used

The NES division delivers an important contribution to **education** and **maintenance of nuclear competence** in Switzerland

Questions ?

