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PSI photon, neutron and muon user facilities newsletter

Editorial



Michel Kenzelmann

Dear Colleagues

Almost 2000 experiments are performed yearly at the PSI user facilities. They cover an impressive range of areas, and include many of the research fields most important for the development of the next generation

medical and materials applications. In the field of materials science and condensed matter physics, what often determines the success of a large facility experiment are two things: high-quality materials, and appropriate sample environment equipment that is reliable.

The progress in the synthesis of high-quality thin films and heterostructures has been astounding: various different functional electronic ground states have been realized in such materials, or their interfaces. These states are high tunable and can often be coupled with other interesting physical properties, offering great promise towards the design of multifunctional devices. Many experiments at large facilities also use bulk materials of advanced quantum materials, which have to be synthesized as high-purity single crystals. While some progress has been made to catch up with competing efforts, also at PSI, clearly more has to be done in Europe to increase the discovery and high-quality synthesis of novel materials.

Cutting-edge reliable sample environment generating

New calls for proposals

SLS: PX-beamlines

deadline: October 15, 2013

SLS: non-PX beamlines

deadline: September 15, 2013

more information

<<http://www.psi.ch/sls/calls>>

SINQ

deadline: November 15, 2013

more information

<<http://www.psi.ch/sinq/call-for-proposals>>

SμS

deadline: December 2013

more information

<http://lmu.web.psi.ch/facilities/next_call.html>

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

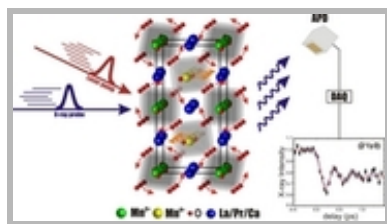
high electric or magnetic fields in a wide range of temperatures are important for many materials of interest today, particularly for the highly-tunable multifunctional materials. I am pleased when I hear that users rate the sample environment at PSI very positively, and we will strive towards improving our tools in this area even more in the future.

The large facilities play an important role in our endeavor to understand materials properties. They will become even more important as we attempt to close the gap between our understanding of the microscopic and macroscopic materials properties. The study of the physics in the mesoscopic length scale has been recognized as an important area for some time, and we will soon be in a position to contribute towards its study with the next-generation instrumentation at PSI.

Michel Kenzelmann, on behalf of the Laboratory for Developments and Methods, PSI

Research highlights

SLS - Material Science: Atomic motions untangled



Identification of coherent lattice modulations coupled to charge and orbital order in a manganite

A. Caviezel et al. Physical Review B 87, 205104

(2013), DOI: 10.1103/PhysRevB.87.205104 <<http://dx.doi.org/10.1103/PhysRevB.87.205104>>

A schematic of the setup employed for the experimental demonstration. X rays are focused and scatter off a test sample that can be displaced laterally with nanometer precision. The diffraction pattern produced by the scattered X rays is collected by a detector. The sample is reconstructed on a computer from the diffraction data (see

Upcoming events

Gordon research conference on Electron Distribution and Chemical Bonding

<<http://www.grc.org/programs.aspx?year=2013&program=elecldist>>

July 2-7, 2013, Les Diablerets, Switzerland

ICNS 2013: International Conference on Neutron Scattering

<<http://www.icns2013.org/home>>

July 7-11, 2013, Edinburgh, UK

2nd International Workshop on Powder and Electron Crystallography

<<http://crystallographypatras.wordpress.com>>

July 8-12, 2013, Patras, Greece

CORPES-13: International Workshop on Strong Correlations and Angle-Resolved Photoemission Spectroscopy

<<http://corpes13.xfel.eu>>

July 29 - August 2, 2013, Hamburg, Germany

SCES'13: International Conference on Strongly Correlated Electron Systems

<<http://www.sces2013.org>>

August 5-9, 2013, Tokyo, Japan

other images). The pursuit of capturing motion in a movie bears an obvious fascination irrespective of the time scales involved. In the atomic and molecular world where the masses are so light and the distances small the relevant time scale shifts to the subpicosecond range and the motions become frantic especially for larger molecular systems. In the material class of strongly correlated electron materials the intricate balance of competing structural, magnetic and charge interactions complicates the picture when it comes down to disentangle the coupled processes. In order to advance the understanding of the underlying correlations in these materials current efforts focus on the interaction of the atomic, electronic, and magnetic subsystems on their relevant time scales. In particular, femtosecond x-ray or electron diffraction received considerable attention in the recent past because they enable direct access to the evolving atomic and electronic structure. Here, we study specific lattice modulations coupled to the melting of charge and orbital order in a manganite by means of femtosecond x-ray diffraction.

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

SINQ and SLS - High Tech meets the Bronze Age



New insights into early bronze age damascene technique north of the alps

D. Berger et al, The Antiquaries Journal 93, 1 (2013), DOI:

10.1017/S0003581513000012 <<http://dx.doi.org/10.1017/S0003581513000012>>

Damascening, defined in this context as the inlay of one metal into a different metal base, is a rare decorative technique in the Early Bronze Age, known only from seven bronze artefacts found north of the Alps. This paper reports on the first thorough scientific examination of

12th PSI Summer School on Condensed Matter Physics

<<http://www.psi.ch/summer-school>>

August 17-25, 2013, Zuz, Switzerland

1st HZB Summer School on Imaging Methods for Industrial Applications

<<http://www.helmholtz-berlin.de/events/ischool/>>

August 26-30, 2013, Berlin, Germany

NINMACH 2013

<<http://www.frm2.tum.de/indico/conferenceDisplay.py?confId=3>>

September 9-12, 2013, Garching, Germany

3rd Joint User Meeting at PSI: JUM@P 2013

<<http://indico.psi.ch/event/jump13>>

September 18-20, 2013, PSI Villigen, Switzerland

BioValley Life Sciences

Week <<http://www.lifesciencesweek.ch>>

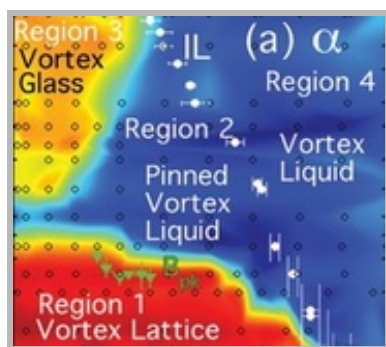
September 24-26, 2013, Basel, Switzerland

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

one such find, the axe from Thun-Renzenbühl grave no. 1. This interdisciplinary project involving several institutions in Germany and Switzerland investigated the axe by means of neutron radiographic imaging and X-ray microprobe methods, supported by microscopic examination. The result is an attempt to reconstruct the fabrication and decoration process and to reconsider the enigmatic question of the origins of the damascene technique north of the Alps.

Read the full story <<http://www.psi.ch/num/2013#berger>>

µS - Superconductivity: Vortex phase diagram revised



Muon-Spin Rotation Measurements of an Unusual Vortex-Glass Phase in the Layered Superconductor $\text{Bi}_{2.15}\text{Sr}_{1.85}\text{CaCu}_2\text{O}_8$

D.O.G. Heron et al, Physical Review Letters 110, 107004 (2013), DOI: 10.1103/Phys-

RevLett.110.107004 <<http://dx.doi.org/10.1103/PhysRevLett.110.107004>>

Muon-spin rotation measurements, performed on the mixed state of the classic anisotropic superconductor $\text{Bi}_{2.15}\text{Sr}_{1.85}\text{CaCu}_2\text{O}_8$, obtain quantities directly related to two- and three-body correlations of vortices in space. A novel phase diagram emerges from such local probe measurements of the bulk, revealing an unusual glassy state at intermediate fields which appears to freeze continuously from the equilibrium vortex liquid but differs both from the lattice and the conventional high-field vortex glass state in its structure.

Read the full story <<http://www.psi.ch/num/2013#heron>>

SwissFEL - X-ray Laser: A novel tool for structural studies of nano-particles

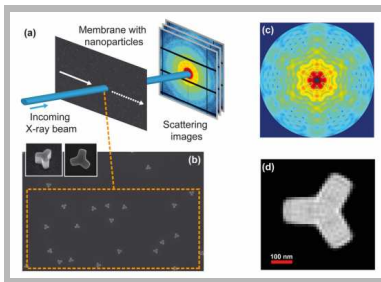
Facility news

SLS: Tomographic nano-imaging towards 10 nm resolution

OMNY (tOMography Nano crYo stage) is an ongoing instrumentation project at the SLS implementing an end-station for tomographic nano-imaging at 10 nm resolution in 3D using ptychography. When complete, OMNY will image biomaterial and materials science samples at cryogenic temperatures in an ultra-high vacuum environment. Cryogenic sample fixation will permit measurements of biological samples such as soft tissue and entire cells close to their native state without chemical fixation. A test-setup operating at room temperature and atmospheric pressure has been built and test measurements demonstrate a resolution of currently 8 nm in 2D and 36 nm in 3D. This test setup is available to users at the cSAXS beamline.

SINQ: Successful restart

On May 13, 2013 the PSI proton accelerator together with SINQ and µS has start-



Two-dimensional structure from random multiparticle X-ray scattering images using cross-correlations.

B. Pedrini et al, Nature Communications 4, 1647 (2013), DOI:

10.1038/ncomms2622 <<http://dx.doi.org/10.1038/ncomms2622>>

Prominent among the planned applications of X-ray free electron laser facilities, such as the future SwissFEL at the Paul Scherrer Institute, PSI, are structural studies of complex nano-particles, down to the scale of individual bio-molecules. A major challenge for such investigations is the mathematical reconstruction of the particle form from the measured scattering data. The experiment consists of exposing the nano-particles to the X-ray laser pulses and of registering the resulting scattered rays. To guarantee sufficient statistical accuracy, many repeated exposures are required – each one on a different collection of identical, but randomly-oriented particles. Researchers at PSI have now demonstrated an optimized mathematical procedure for treating such data, which yields a dramatically improved single-particle structural resolution. The procedure was successfully tested at the Swiss Light Source synchrotron at PSI, with custom-fabricated, two-dimensional nano-structures. With the inclusion of some additional information, such as the particle symmetry, the method can be extended to real three-dimensional objects. The researchers report their results on-line in the current issue of Nature Communications.

Read the full story <<http://www.psi.ch/media/structural-studies-of-nano-particles>>

ed its 2013 campaign successfully. The facilities are now open for user operation as usual until the end of December. At the recent submission deadline in May, almost 180 new proposals have been submitted for the SINQ instruments. The users will be informed by the end of July about the result of the evaluation.

SμS: Permanent Dolly spectrometer successfully commissioned

After a major reconstruction of the secondary beamline in 2012, the permanent installation of the Dolly spectrometer in the PiE1 area has recently been commissioned. Excellent muon rates and beam characteristics have been obtained for longitudinal as well as for transverse polarizations of the muons and user operation started successfully in May 2013. To further enlarge the experimentally available parameter space, a ^3He cryostat has recently been ordered from Oxford instruments.

Current Openings

Job opportunities at PSI

<<http://www.psi.ch/en/pa/offen-estellen/>>

Announcements

Joint User Meeting JUM@P 2013 at PSI

The 3rd edition of the **JUM@P user meeting** <<http://indico.psi.ch/event/jump13>> from **September 18-20, 2013** is still open for registration. The **deadline for abstract submission is approaching soon: July 10**. The aim of the PSI Joint User Meetings is to bring together the three user communities for SLS, SINQ and SμS and to generate new synergies among these scientists driven by common scientific, rather than technical, interests. JUM@P '13 will consist, on the first day, of a plenary session with invited lectures as well as information about PSI and its user facilities. The second day is being reserved for three **topical parallel workshops** <<http://indico.psi.ch/internalPage.py?pagelId=4&confId=2034>> . Poster sessions and the award of the third PSI thesis medal will complete the programme. The 2013 annual meeting of the European Synchrotron User Organisation **ESUO** <<http://www.esuo.org>> will be organized as a JUM@P satellite event.

NINMACH 2013

From September 9-12 the **First International Conference on Neutron Imaging and Neutron Methods in Archaeology and Cultural Heritage Research** will be organized in Garching near Munich, Germany. **NINMACH 2013** <<http://www.frm2.tum.de/indico/conferenceDisplay.py?confId=3>> addresses archaeologists and conservators from museums and universities and aims to illustrate the potential of neutron methods in cultural heritage research. Talks and posters will be presented by physicists and archaeologists who have already employed neutron methods successfully; attendance is explicitly recommended for scientists who are completely new to neutron methods and want to learn about the possibilities at neutron sources throughout the world.

PSI Scientific Report 2012

The **PSI scientific annual report 2012** has recently been published and is available now either as printed or online version. Please download or order your copy **here!**

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>>

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