

Physics at Neutron and Synchrotron Sources

Tuesday, 19.08.2025, Room HS 30

Time	ID	PHYSICS AT NEUTRON AND SYNCHROTRON SOURCES <i>Chair: Herwig Michor, TU Wien</i>
14:00	781	<p>Ramsey GRS (Gravitational Resonance Spectroscopy) with the qBounce setup</p> <p style="text-align: center;"><i>Florian Lachaume, TU Wien - Atominstitut, Austria</i></p> <p>qBOUNCE studies gravitationally bound quantum states of UltraCold Neutrons (UCNs) using Gravitational Resonance Spectroscopy (GRS). This technique offers a way of looking at gravitation at short distances. The qBOUNCE setup uses the Ramsey spectroscopy method, with state transitions driven by mechanical oscillations, to search for possible interactions beyond the Standard Model. The experiment is located at the Institute Laue-Langevin (Grenoble, France) and benefits from the neutrons produced by the High Flux Reactor. These neutrons are slowed down to about 10 m/s. Several measurements with increasing transition frequencies have been made over the last 7 years.</p> <p>In 2024, the pair of transitions $1\rangle \rightarrow 7\rangle$ & $2\rangle \rightarrow 9\rangle$ was measured. These transitions are the ones with the highest frequencies measured so far.</p>
14:15	782	<p>Nano- and Mesoporous Structure Formation Probed with In Situ/In Operando Small and Wide-Angle X-Ray Scattering Analysis during Electrodeposition</p> <p style="text-align: center;"><i>Heinz Amenitsch¹, Philipp A. Wieser^{1,2}</i></p> <p style="text-align: center;">¹ <i>Institute of Inorganic Chemistry, Graz University of Technology, Graz, Austria,</i> ² <i>Electronic Materials, Center for Functional Nanomaterials, Brookhaven National Laboratory, Upton, USA</i></p> <p>Electrochemical formation of nanoporous materials via electrodeposition provides key materials for catalysis, energy storage, and sensing due to their high surface areas and tunable pore sizes. Understanding morphology development is crucial for material design. In situ techniques like Grazing Incidence Small and Wide Angle Scattering (GISWAXS) help reveal structure evolution at meso- and crystalline levels. Using a versatile electrochemical cell developed for GISWAXS studies we have investigated formation hexagonal Pt films using Brij®56 and mesoporous Pt-Ni films with Pluronic P123 based on the method of ref [3]. Additionally recent advances in electrodeposition of ordered materials and the SAXS beamline upgrade at ELETTRA 2.0 will also be discussed.</p>
14:30	783	<p>Phase-Contrast Microtomography Applications in Life Sciences at the BEATS Beamline of the SESAME Synchrotron</p> <p style="text-align: center;"><i>Fareeha Hameed¹, Elizabeth New², Maher Sughayer³, Fatemeh Elmi⁴, Hassan Hoda⁵, Christoforos Odiatis⁶, Charalambos Chrysostomou⁷</i></p> <p style="text-align: center;">¹ <i>SESAME Synchrotron, Allan, Jordan,</i> ² <i>The University of Sydney, Australia,</i> ³ <i>King Hussein Cancer Center, Amman, Jordan,</i> ⁴ <i>University of Mazandaran (UMZ), Babolsar, Iran,</i> ⁵ <i>Iranian Research Institute of Plant Protection (IRIPP), Tehran, Iran,</i> ⁶ <i>University of Cyprus, Nicosia, Cyprus,</i> ⁷ <i>ERATOSTHENES Centre of Excellence, Limassol, Cyprus</i></p> <p>The ID10-BEATS beamline at the SESAME synchrotron in Jordan is the new X-ray microtomography beamline located centrally in the southwest region of Asia. The specifications and capabilities of this beamline are suitable for a wide range of applications in science, engineering, and industry. Recent imaging activities in the field of life sciences are being presented. Phase contrast imaging based on the principle of free space propagation is one of the strengths of this beamline. This technique is especially beneficial for low contrast materials like soft tissues. The studies presented include imaging studies of breast tissue, mice kidneys, and insects-agricultural pests. BEATS offers imaging in a broad range of applications, and, in this presentation, the focus is on biomedical applications research.</p>

14:45	784	<p style="text-align: center;">Study on FeO Nanocubes combining X-ray Scattering Technique with Various Complementary Characterisation Techniques</p> <p style="text-align: center;"><i>Rainer T. Lechner¹, Jerome Deumer³, Christian Gollwitzer³, Sarah-Luise Abram², Ute Resch-Genger²</i></p> <p style="text-align: center;">¹ Montanuniversität Leoben, Austria, ² Bundesanstalt für Materialforschung und -prüfung BAM, Berlin, Germany, ³ Physikalisch-Technische Bundesanstalt - PTB, Berlin, Germany</p> <p>Iron oxide nanocrystals (NCs) were synthesized within a reference material project at the BAM (Berlin) showing very narrow size distribution and a cubic shape with an edge length of 9 nm as derived by TEM.</p> <p>Here, we combine x-ray scattering (SAXS) and diffraction (XRD) to probe a larger NC ensemble as it is possible with TEM alone. These techniques not only allow retrieving the crystal structure and size by XRD, but also the mean 3D shape from SAXS. We compare two SAXS curves, one recorded at a synchrotron beamline and one recorded with a lab source. Both SAXS data were in excellent agreement, revealing cuboid shaped NCs, but with rounded corner and edges, which is known as superball shape.</p>
15:00	785	<p style="text-align: center;">Where are the metals? Analysis of elemental distributions in moss leaflets using synchrotron X-ray experiments</p> <p style="text-align: center;"><i>Matthias Weinberger¹, Luigi Schillaci², Ingeborg Lang², Christoph Rumancev³, Axel Rosenhahn³, Helga Lichtenegger¹</i></p> <p style="text-align: center;">¹ BOKU University, Institute of Physics and Materials Science, Vienna, Austria, ² University of Vienna, Department of Functional and Evolutionary Ecology, Vienna, Austria, ³ Ruhr-University Bochum Faculty of Chemistry and Biochemistry, Bochum, Germany</p> <p>Bryophytes can be used to assess the pollution status of their environment due to their ability to absorb nutrients but also pollutants through their entire surface. In the talk or poster we will discuss our approach to quantifying micro-synchrotron X-ray fluorescence (μ-SRXRF) data measured at the PETRA III P06 beamline at DESY in Hamburg, Germany, and at the NanoMAX beamline at MAXIV in Lund, Sweden. We will focus on Fe, Mn and Cu and housekeeping elements such as Ca and K. We will also include first results from small-angle X-ray scattering (SAXS) experiments performed at NanoMax to study possible changes in cell wall ultrastructure due to heavy metal contamination.</p>
15:15	786	<p style="text-align: center;">Conglomerate screening of 1,1'-binaphthalene by thin film preparation</p> <p style="text-align: center;"><i>Roland Resel¹, Sanjay John¹, Christoph Huber¹, Anmol Andotra¹, Fabian Gasser¹, Tamas Javorfi², Giuliano Siligardi²</i></p> <p style="text-align: center;">¹ Institute of Solid State Physics, Graz University of Technology, Austria, ² beamline B23, synchrotron radiation facility DIAMOND, Ditcot, United Kingdom</p> <p>1,1'-binaphthalene is an axial chiral molecule which has the possibility to change the chirality from R(-) conformation to S(+). A racemic as well as a chiral crystal structure are known. We report on the thin film formation by solution processing starting from a racemic solution. Specific processing parameters are found which favours the formation of chiral phases, the type of chirality is determined by circular dichroism using Müller matrix approach. Both types of chiralities are found within single films, the characteristic extension of enantiopure domains are several tens of μm. The thin film processing parameters together with the thin film morphology suggests that the presence of a surface during the crystallisation process is responsible for the formation of a conglomerate.</p>
15:30		END; Coffee Break
19:00		Public Lecture

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PHYSICS AT NEUTRON AND SYNCHROTRON SOURCES POSTER

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Deep X-ray Lithography for material science: latest results

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The combination of top-down and bottom-up approaches to prepare functional materials has great potential for next generation microdevices. As top-down process we selected Deep X-ray lithography (DXRL) which is based on controlled irradiation of materials using high energy X-rays. In this communication we will present our latest research using DXRL. We will first describe our recent activity on X-ray irradiation of mesoporous materials. After investigating their mechanical properties, we are studying their use as active sample holders able to deliver fluids through the pores. We will then present the direct patterning of Metal Organic Frameworks (MOFs) to obtain a methanol vapor sensor, and of 3D oriented MOFs and MOF templated polymeric films to get micropatterns with anisotropic fluorescent properties.

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Elastic and inelastic neutron scattering studies of magnetism in the heavy fermion system YbPt₅B₂

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YbPt₅B₂ and LuPt₅B₂ were studied by elastic and inelastic neutron scattering experiments. The heavy fermion system YbPt₅B₂ orders antiferromagnetically below $T_{N1} = 7.8$ K and exhibits an incommensurate magnetic structure with a temperature dependent propagation vector, $k_1 = (0.194, 0, -0.045)$ at $T = 6$ K. Below $T_{N2} = 4.7$ K, a transition into a commensurate antiferromagnetic structure, $k_2 = (0, 0, 0)$, takes place. Rather large Yb moments, $m(\text{Yb}) > 3 \mu\text{B}$ can be explained only by an appropriate wave function constituting the CEF ground state doublet as concluded from the present inelastic neutron data. The overall CEF splitting is of the order of 44 meV, while the first excited level is located near 25 meV above the ground state.

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The PERC Beamstop

Johannes Schilberg, Hartmut Abele, Irina Pradler, Alberto Jose Saavedra Garcia, Erwin Jericha, the PERC Collaboration
 Atominstitut - TU Wien, Austria

The PERC (Proton and Electron Radiation Channel) facility, located at the neutron source FRM II of the Technical University of Munich (TUM), serves as a clean source of neutron decay products (protons and electrons). PERC aims to contribute to the determination of the Cabibbo-Kobayashi-Maskawa quark-mixing element (V_{ud}), measure the correlation coefficients of free neutron decay (a, A, b, C) and search for new physics at the TeV scale.

In PERC, the decay products are separated from the neutron beam by a strong magnetic field. To ensure a low background for the detectors as well as to fulfil all radiation protection requirements, the PERC Beamstop has been designed. It consists of B₄C and Pb, which were chosen based on MCNP simulations.

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Upgrading qBounce: Toward New Frontiers in Quantum State Measurements

Christoph Grüner¹, Daniel Aziz¹, Joachim Bosina¹, Tobias Jenke², Florian Lachaume¹, Hartmut Abele¹
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The qBounce collaboration operates a Ramsey-type neutron-based gravitational resonance spectroscopy setup at the Institut Laue-Langevin. Since its commissioning in 2018, the system's sensitivity has improved by a factor of 42 compared to previous implementations. This enhanced precision has enabled, among other achievements, tests of hypothetical modifications to the Newtonian gravitational potential at micrometer scales and the observation of previously unmeasured gravitational quantum state transitions.

The setup is currently undergoing further upgrades to enable longer neutron interaction times, enhanced measurement sensitivity, and a broader range of applications, including fundamental tests of quantum mechanics. We report on the measurement campaign conducted in Spring 2025, present recent scientific findings and technical developments, and provide an outlook on the next phase of planned measurements.

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Exploring Magnetic Field Effects on Quantum States of Ultracold Neutrons in the qBounce Experiment

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The qBounce experiment investigates the quantum states of ultracold neutrons in Earth's gravitational field, offering a unique platform to study gravity at microscopic scales with high precision. Neutrons confined above a horizontal mirror form discrete energy levels arising from the interplay between gravitational and quantum effects. Building upon this system, we have recently begun exploring how external magnetic fields may influence these quantum states. In our latest experimental run, a series of measurements were carried out to examine these interactions. This poster outlines the experimental approach, highlights preliminary observations, and provides a perspective on possible directions for future measurements and experimental techniques.