

School of XFEL, Synchrotron and Neutron Radiation Users – SFEL 2026

Book of Abstracts

Sept 28 - Oct 2, 2026, Stará Lesná, Slovakia



Jozef BEDNARČÍK (ED.)

PAVOL JOZEF ŠAFÁRIK UNIVERSITY IN KOŠICE
ŠAFÁRIKPRESS Publishing
2026



School of XFEL, Synchrotron and Neutron Radiation Users – SFEL 2026

Book of Abstracts

Edited by:

doc. RNDr. Jozef Bednarčík, PhD.

P.J. Šafárik University in Košice, Faculty of Science, Institute of Physics, Park Angelinum 9, 041 54 Košice, Slovakia, jozef.bednarcik@upjs.sk
Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 45, 040 01 Košice, Slovakia

Reviewed by:

prof. Ing. Marcel Miglierini, DrSc.

Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, V Holešovičkách 2, 180 00 Prague 8, Czech Republic, marcel.miglierini@fffi.cvut.cz

prof. RNDr. Vladimír Šepelák, DrSc.

Karlsruhe Institute of Technology (KIT), Institute of Nanotechnology Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany, vladimir.sepelak@kit.edu

Dr. Yuriy Chushkin

ESRF – The European Synchrotron Radiation Facility, 71, avenue des Martyrs, 38043 Grenoble Cedex 9, France, chushkin@esrf.fr

Dr. Gabriel Cuello

ILL – Institut Laue-Langevin, 71, avenue des Martyrs, 38043 Grenoble Cedex 9, France, cuello@ill.fr



This publication is published by Pavol Jozef Šafárik University in Košice under a Creative Commons (CC) licence: CC BY-NC-ND Creative Commons Attribution - NonCommercial - NoDerivatives 4.0. The licence permits the work to be freely shared provided the author is credited, without commercial use and without any modifications or derivative works.

The authors are responsible for the academic and linguistic aspects of the publication. The work was produced at the Pavol Jozef Šafárik University in Košice, Faculty of Science.

Available at: www.unibook.upjs.sk

Publication date: 28.9.2026

DOI: <https://doi.org/10.33542/SOX-0553-5>

ISBN 978-80-574-0553-5 (e-publication)

About the SFEL 2026

Pavol Jozef Šafárik University in Košice, Faculty of Science, together with its National Contact Point for the European XFEL and ERI "NCPXFEL", under the auspices of the Ministry of Education, Research, Development and Youth of the Slovak Republic, in cooperation with the European X-Ray Free-Electron Laser Facility in Hamburg and the Institut Laue-Langevin in Grenoble, is organizing the School of XFEL, Synchrotron and Neutron Radiation Users 2026, "SFEL 2026". The school is a continuation of the Winter Schools of Synchrotron Radiation held in 2011, 2013 and 2014, and the SFEL Schools held in 2017, 2018, 2019, 2022 and 2024.

The aim of SFEL 2026 is to facilitate the growth of a new Slovak research community with high expertise in high-efficiency X-ray lasers, synchrotron and neutron sources. The SFEL school is designed for the efficient transfer of rapidly developing know-how in these areas to the young generation – researchers and university students. A further aim of SFEL 2026 is to strengthen personal connections within the local Slovak research community and to promote the formation of scientific teams of FEL, synchrotron and neutron users. The Slovak research community can thus take advantage of the fact that Slovakia is a shareholder of the European XFEL GmbH company in Hamburg-Schenefeld, while also making more efficient use of other closely related scientific facilities, including the ILL in Grenoble and the European Synchrotron Radiation Facility as well as facilities in Germany, France, Poland, Spain, Sweden and the United Kingdom.

The SFEL 2026 agenda focuses on a thorough introduction to selected experimental techniques that make use of XFEL, synchrotron and neutron radiation. For the first time, the organizers have set aside time for a satellite meeting dedicated to the European Solar Telescope. This dedicated satellite meeting will introduce a next-generation 4-metre-class solar facility designed to advance high-resolution observations of the Sun. As Slovakia is a member country of the EST consortium, the meeting will highlight opportunities for Slovak researchers and students to engage in cutting-edge solar physics, instrumentation development and data-analysis activities.

The School is conducted in the form of invited tutorial lectures (30–45 minutes). Young scientists and PhD students have the opportunity to present their experiences with FEL, synchrotron and neutron sources via short oral presentations (15 minutes) and/or posters. In addition, for the first time, the organizers expand the forms of education and presentation of scientific results (by oral talks and posters) to include hands-on during two evenings. Their goal is to teach students to solve specific real-world examples using real data under the supervision of experienced tutors. The target group mainly consists of the wider Slovak and international scientific community, with an emphasis on young researchers, PhD students and undergraduate students. The content of SFEL 2026 is focused on interdisciplinary research, with an emphasis on physics, materials science, chemistry, biology, pharmacy, medicine and information technology.

Organizers

School of XFEL, Synchrotron and Neutron Radiation Users 2026 – SFEL 2026 is organized by NCPXFEL & ERI at the Pavol Jozef Šafárik University in Košice

NCPXFEL

in cooperation with

- European X-Ray Free-Electron Laser Facility GmbH, Germany
- Pavol Jozef Šafárik University in Košice, Faculty of Science, Slovakia
- Institut Laue-Langevin ILL, Grenoble, France
- Ministry of Education, Research, Development and Youth of the Slovak Republic
- SK ESFRI Commission for Physics, Material Science and Energy Devices



International Advisory Committee

Pavol Sovák (chairman)	NCPXFEL & P.J. Šafárik University in Košice, Slovakia
Karel SaksI	NCPXFEL & Technical University of Košice, Slovakia
Serguei Molodtsov	XFEL GmbH, Hamburg, Germany
Ryszard Sobierajski	Inst. of Physics, Polish Academy of Science, Warsaw, Poland
Mark Robert Johnson	Institut Laue-Langevin, Grenoble, France
Libor Juha	Institute of Physics CAS CR, Prague, Czech Republic
Cyörgy Vankó	HUN-REN Wigner Research Centre for Physics, Budapest, Hungary
Tomáš Michalek	Ministry of Education, Research, Development and Youth of the Slovak Republic

Programme Committee

Pavol Sovák (chairman)	NCPXFEL & P.J. Šafárik University in Košice, Slovakia
Karel SaksI (co-chairman)	NCPXFEL & Technical University of Košice, Slovakia
Jozef Bednarčík (co-chairman)	NCPXFEL & P.J. Šafárik University in Košice, Slovakia
Jozef Uličný	P.J. Šafárik University in Košice, Slovakia
Adriana Zeleňáková	NCPXFEL & P.J. Šafárik University in Košice, Slovakia
Sakura Pascarelli	XFEL GmbH, Hamburg, Germany
Norbert Kučerka	NCPXFEL & Comenius University Bratislava, Slovakia
Daniela Uhríková	NCPXFEL & Comenius University Bratislava, Slovakia
Nad'a Mrkývková	NCPXFEL & Institute of Physics SAS, Bratislava, Slovakia
Imrich Barák	NCPXFEL & IMB SAS, Bratislava, Slovakia
Peter Gömöry	NCPXFEL & Astro. Inst. SAS, Vysoké Tatry, Slovakia
Juraj Krempaský	Paul Scherrer Institute PSI, Switzerland

Local Committee

Adriana Zeleňáková (chairperson)	P.J. Šafárik University in Košice, Slovakia
Dana Kepičová (vice-chairperson)	P.J. Šafárik University in Košice, Slovakia
Jaroslava Szűcssová (secretary)	NCPXFEL & P.J. Šafárik University in Košice, Slovakia
Jana Pivoňková	NCPXFEL & XFEL GmbH, Hamburg, Germany

Location & Venue

Stará Lesná is a picturesque municipality located in the Poprad District of the Prešov Region in northern Slovakia. Nestled at the foothills of the High Tatras (Vysoké Tatry), the highest mountain range in the Carpathian Mountains, the village sits at an elevation of approximately 760 meters above sea level. Its strategic position makes it an ideal gateway for exploring the natural wonders of the Tatra National Park, which was established in 1949 and is home to diverse flora and fauna, including brown bears, chamois, and golden eagles. Stará Lesná represents an ideal combination of traditional Slovak mountain village charm and excellent access to modern tourist infrastructure.

Tourism and Connection to Tatranská Lomnica

Stará Lesná serves as an excellent base for tourists seeking to explore the High Tatras while enjoying a quieter, more authentic mountain village atmosphere compared to larger resort towns. Its proximity to Tatranská Lomnica, one of the most important tourist centers in the Slovak Tatras, makes it particularly attractive for visitors. Tatranská Lomnica, located just 4 kilometers northeast of Stará Lesná, is renowned for its exceptional skiing facilities and year-round mountain attractions. The town features the second-oldest cable car in Slovakia, which transports visitors to Skalnaté pleso (1,754 m), offering breathtaking panoramic views of the surrounding peaks. From Skalnaté pleso, visitors can continue their ascent via the aerial tramway to Lomnický štít (2,634 m), the second-highest peak in the High Tatras and one of the most accessible high peaks in the range.

The ACADEMIA Congress Centre is a modern conference and educational facility operated by the Slovak Academy of Sciences. The centre serves as a prominent venue for scientific conferences, seminars, workshops, and educational programmes, combining professional infrastructure with an exceptional natural setting. Accommodation facilities at ACADEMIA include comfortable rooms for conference participants, typically offering a total capacity of around 80–100 beds. Parking is free in front of the hotel. As part of the Slovak Academy of Sciences, ACADEMIA primarily supports scientific, research, and educational activities.

The centre is easily accessible by road from Poprad (approximately 15 kilometres), which hosts the nearest international airport with regular connections to London and other European cities. Public transport links, including buses and the Tatra Electric Railway, provide convenient connections to neighbouring towns and tourist destinations within the High Tatras region.

Preface

Dear participants

Welcome to Stará Lesná, a small village in the beautiful region of the Slovak Republic, the High Tatras. On behalf of the Organizing Committee, it is a great honor for me to welcome you here as participants of this traditional scientific event – the School of XFEL, Synchrotron and Neutron Radiation Users 2026, “SFEL 2026”. This year it will take place from September 28th to October 2nd, 2026. Pavol Jozef Šafárik University in Košice jointly with and under the auspices of the Ministry of Education, Research, Development and Youth of the Slovak Republic, in cooperation with the European X-Ray Free-Electron Laser Facility GmbH in Hamburg and the Institut Laue-Langevin in Grenoble has prepared SFEL 2026 as an important event for promoting the importance of international cooperation. There are 115 participants from 13 countries registered for SFEL 2026, the majority of them being students, PhD students and young scientists. Together with excellent experts from well-known large-scale facilities, we will do our best to foster a creative community during SFEL 2026. SFEL 2026 is the 9th event of the series, which started in 2011. All previous schools of the series, up to SFEL 2024, were held in Liptovský Ján in the Low Tatras. We hope that this year the new venue located here in Stará Lesná will offer ideal conditions for a friendly and creative atmosphere. The aim of the SFEL 2026 school is to facilitate the growth of a new Slovak research community with high expertise in the area of X-ray laboratory equipment, high-efficiency X-ray lasers, synchrotron and neutron sources. On behalf of the Slovak ES-FRI Commission, it gives me great pleasure to welcome the Slovak community working toward building the European Solar Telescope in the Canary Islands. For the first time, we have set aside time for a satellite meeting dedicated to this unique European infrastructure. We wish to introduce this next-generation 4-metre-class solar facility designed to advance high-resolution observations of the Sun. In addition, for the first time, the organizers expand the forms of education and presentation of scientific results (by oral talks and posters) to include hands-on during two evenings. Their goal is to teach students to solve specific real-world examples using real data under the supervision of experienced tutors. Previous SFEL schools have proved that, thanks to them, the Slovak research community can take advantage of the fact that Slovakia is a shareholder of the European XFEL GmbH company and also make more efficient use of other closely related scientific facilities, including the ILL in Grenoble and the European synchrotron facilities.

Dear colleagues,

I wish you a pleasant stay in Stará Lesná and I hope very much that SFEL 2026 meets all your expectations. I would like to express my thanks to all speakers and to all poster contributors for their active participation. They help us to maintain the scientific level of SFEL. Last but not least, I would like to thank all members of my team from both the programme and local committees for their excellent work.

Stará Lesná, September 28, 2026

Pavol Sovák (chairman)

Contents

About the SFEL 2026	i
Organizers	ii
Committees	iii
Location & Venue	iv
Preface	v
Program	6
September 28, 2026, Monday	7
September 29, 2026, Tuesday	8
September 30, 2026, Wednesday	10
October 1, 2026, Thursday	12
October 2, 2026, Friday	13
EST Satellite Meeting - October 2, 2026, Friday	14
I X-ray techniques	15
X-01 Brief Introduction to Crystallography and Powder Diffraction	16
X-02 From Atomic Structure to Nanostructures: Modern Laboratory X-ray Scat- tering Techniques in Materials Research	17
X-03 Hard Coatings based on Transition Metal Borides analyzed by Labora- tory X-ray	18
X-04 Seeing Beyond Crystallography: an Introduction to Pair Distribution Func- tion Analysis of Complex Materials	19
X-05 Probing Local Atomic Arrangement in Metallic Glasses by High-energy X-ray and Neutron Diffraction	20
II Free Electron Lasers	21
F-01 Recent Scientific Highlights From European XFEL	22
F-02 The HED-HIBEF Instrument at the European XFEL – Scientific Capabil- ities and Instrumentation	23

F-03	XFELs for Investigation of Field-driven Dynamics in Solids	24
F-04	Femto-to-Attosecond Time-resolved Atomic and Molecular Quantum Dynamics using Fluctuating FEL Pulses	25
F-05	Three Movies in a Flash: Electron, Spin, and Atom Dynamics at soft X- ray XFELs	26
F-06	Inertial Fusion Research at X-ray Free Electron Lasers	27
F-07	Ultrafast Structural Transformations of Fe: Time-resolved Studies from Synchrotron to FEL	28
F-08	Sample Delivery Challenges at X-ray Free-electron Lasers	29
F-09	Twisted Light Control of the Ferroelectric GeTe	30
F-10	Radiation Resistance of Materials for Future Inertial Fusion Reactors: Laboratory and Computer Simulations	31
F-11	Effective Representation of Objects for Tomoscopic Experiments - Prepa- ration for Hemodynamic Imaging	32
F-12	Coty Protein Structure and its use for the Development of Novel Nano- biomaterials	33
F-13	Ion Emission from Plasmas produced by Short-wavelength Laser Radi- ation: a Brief Overview	34
F-14	Science Without Borders? – Research Infrastructures and the Role of Scientists in a changing World	35
III Neutron sources		36
N-01	Institute Laue-langevin - Instrument and Infrastructure Upgrades, the Science Strategy and New Research Opportunities for Slovakia . . .	37
N-02	Advanced Materials Characterisation via Neutron Diffraction and Imag- ing at the ISIS Neutron and Muon Source	38
N-03	Lung Surfactant through the Optics of Neutrons	39
N-04	Slovak Neutron Community	40
N-05	Studying Lipid Organization in Model Cell Membranes using Neutron Scattering	41
N-06	Neutron Spectroscopy at the Institut Laue Langevin	42
N-07	Time-resolved Neutron and X-ray Inelastic Scattering	43
N-08	Instrumentation at the Budapest Neutron Centre	44
N-09	Magnetic SANS with Polarized Neutron Beam	45
N-10	Characterization of Core-Shell Nanostructures using SANS	46
IV Synchrotron sources		47
S-01	Introduction to Charged Particle Accelerators and their Applications .	48
S-02	Introduction to Synchrotron Radiation	49
S-03	Recent Advances in X-ray Tomography	50
S-04	ALBA and ALBA II: New Techniques for New Challenges	51

S-05	Research Opportunities at Solaris Synchrotron	52
S-06	Lipid “Duvets” for Antiviral Delivery: SAXS/WAXS Study	53
S-07	Fourth Generation Synchrotron Sources: a Quantum Leap for Matter Ex- ploration. The Example of the ESRF extremely Brilliant Source	54
S-08	Soft X-ray Magnetic Dichroism for Studying Magnetic Materials	55
S-09	Real-time X-ray Scattering and Photoluminescence Insights into Halide Perovskite Vapor Deposition	56
H-01	PDFgui: a Practical Platform for Small-box Modeling and Real-space Structure Refinement of PDF Data	57
H-02	Everything You Wanted to Know About Sex but Were Afraid to Ask . .	58
V	Short talks	59
ST-01	Structural Changes in Lung Surfactant Membranes enriched with Cathe- lidins	60
ST-02	Study of the Surface Structure of Magnetic Nanoparticles using Small- Angle Neutron Scattering	61
ST-03	Instrumental Broadening Correction in X-ray Diffraction Line-profile Anal- ysis by Iterative Forward Convolution	62
ST-04	Time-resolved Synchrotron X-ray Diffraction Study of Stress-induced Anisotropy in VITROPERM 800	63
ST-05	XRD-CT: Applying Tomography Concepts to Diffraction Measurements	64
VI	European Solar Telescope	65
EST-1	Introduction to Plasma Physics and Applications to the Solar Atmosphere	66
EST-2	The European Solar Telescope - EST	67
EST-3	Slovak Participation in the European Solar Telescope	68
EST-4	Realistic Simulations of the Solar Magneto-Convection including Non- ideal Effects	69
EST-5	Radiative Transfer in the Solar Atmosphere: from Spectral Synthesis to Inversions	70
VII	Poster presentations	71
P-01	Study of the Impact of Ligand Exchange on Properties of Thin Films based on Mercury Chalcogenides Colloidal Quantum Dots	72
P-02	Alternative Anode Materials for LIBs based on Hard Carbon	73
P-03	Solvent-directed Synthesis and Structural Stability of HKUST-1 in Aque- ous, Biological, and Organic Media	74
P-04	Structural and Thermal Properties of Melt Spun Fe-Ga-Al-P-C-B Amor- phous Ribbons	75

P-05	Expression, Purification and Preliminary Crystallographic Analysis of U141-gH Complex Presented on HCMV Virion Surface	76
P-06	Structural Signatures of Spin Reorientation in Altermagnetic MnTe . . .	77
P-07	X-ray Diffraction Study of Low Temperature Ferroelectric Phase Transitions in IV-VI Materials	78
P-08	Advanced Soft Magnetic Composites with Ferrite Insulation	79
P-10	BSA-coated Magnetic Nanoparticles for Betulinic Acid Delivery and MRI Contrast Enhancement	80
P-11	Novel High-entropy Materials for Energy Storage	81
P-12	Experimental Capabilities of the Anton Paar XRDynamic500 X-ray Diffractometer for Materials Characterization	82
P-13	Illuminating the Mechanism and Allosteric Behavior of NanoLuc Luciferase	83
P-14	Investigation of Ion Irradiation Damaged of Novel FeCrAl Oxide Dispersion Strengthened Alloys	84
P-15	Biofunctional Surface Engineering of CoFe ₂ O ₄ Nanoparticles for Enhanced Magnetic Particle Hyperthermia	85
P-16	Structural Characteristics of CoFe ₂ O ₄ Nanoparticles with Different Morphologies	86
P-17	Structural, Magnetic, and Magnetocaloric Properties of Ti-substituted GdMnO ₃ Multiferroic Single Crystals	87
P-18	Lattice Dynamics and Electronic Reconstruction in ZrTe ₅	88
P-19	Demultiplexing Generalized Information via Quantum Transmission Lines	89
P-20	Unravelling the Flash Effect: Exploring Early Radiation Chemical Processes with XFEL Radiation	90
P-21	Experimental Phase Diagram and Quantum Monte Carlo Modeling of Cu(pm)(ea) ₂ : a Candidate for a Magnetic Berezinskii – Kosterlitz – Thouless Transition	91
P-22	Study of Magnetic Order in the Quantum Magnet Cu(tn)Cl ₂	92
P-23	Influence of Structure on Heat Capacity and Thermal Conductivity of Dy _x Y _{1-x} (PO ₃) ₃ Phosphate Glasses	93
P-24	Spacer-dependent Self-assembly of Urea-based Gemini Surfactants and their Application in Templating Ordered Mesoporous Silica	94
P-25	Element-specific Local Structural Disorder in (MgCoNiCuZn)O High-entropy and Related Oxides	95
P-26	Structure of Tau Aggregation Promoting Antibody DC11 and of its Oligomeric Tau Targets Studied by X-ray Crystallography and Complementary Methods	96
P-27	X-ray-beam-induced Local Structural Changes in WO ₃ Nanoparticles revealed by RMC-EXAFS	97
P-28	Synchrotron and TEM Study of Wet Mechanically Alloyed Co-Fe-(Ta,W)-B Powders	98

P-29	SAXS and WAXS Study: Effects of Primary N-alcohols on Pulmonary Surfactant Models	99
P-30	Complementary Synchrotron X-ray Diffraction and Mössbauer Investigation of Mechanically Alloyed FeMn-based Amorphous Powders	100
P-31	Tracking Magnetic Nanocarriers within Blood Clots: Toward Multiscale Structural Imaging of Fe ₃ O ₄ @SiO ₂ Drug Delivery Systems	101
P-32	SVT-PINN: a Physics-informed Neural Framework for Disentangling Massive Binaries with Non-linear Phase Variations	102
P-33	Kinematic Fragmentation and Resolution-dependent Fading of Type II Spicules	103
P-34	Quantum Computation of Small Atomic Clusters with Error Mitigation	104
P-35	Photometry and Imaging Polarimetry of Comet C/2012 S1 (ISON) at Heliocentric Distances 4.8 and 0.8 AU	105
P-36	Analysing Possible Precessing Hot Jupiters using Least-squares Deconvolution Technique	106
P-37	Using Pulsed Sources of Energetic Photons for Achieving Extreme Dose Rates: From Compact Plasma-based Devices to Free Electron Lasers	107
P-38	Effect of Thermal Treatment on the Structure and Hydrogen Storage Properties of Arc-melted High-entropy Alloys	108
P-39	SAXSpoint 700 at the MASS-PRAM Laboratory: a Versatile Platform for Multiscale X-ray Structural Characterization	109
P-40	XANES/EXAFS spectrometer at the MASS-PRAM Laboratory	110
Author index		111

SFEL 2026 Program

The table below shows explanation of colors in respective timetables

time	ID	Name	Title
			Opening / Closing
			Laboratory X-rays
			Free Electron Lasers
			Synchrotron sources
			Neutron sources
			European Solar Telescope
			Short Talks
			Poster session
			Hands-On
		Session	
		Coffee Break	
		Breakfast / Lunch / Dinner	

Information for presenters

Oral presentations

Present yourself to the session chair at least 15 minutes before the beginning of the session to upload your presentation to the conference room PC using a USB Key. The beamer and screen are set to a 16:9 aspect ratio. Please prepare your slides accordingly. Presentations will be run from the PC which is having Windows OS installed together with the Office 2021 suite. Presentation can be prepared in Power Point format or in Adobe PDF format.

Poster presentations

Posters must be 120 cm (height) × 80 cm (width) (A0 format, portrait). Presenters must provide their own printout of the poster, including title and authors. Session codes will be displayed on the session boards. Material for hanging posters will be available. Please hang your poster during the morning sessions and remove it at the end of the poster session.

Awards for Best Poster Presentations

Awards for Best Poster Presentations will be selected based on evaluations conducted by a committee composed of session chairs. The committee will assess the presentations and choose the three highest-rated presenters. The winners will be announced during the Farewell Dinner on Oct 1, 2026, Thursday.

September 28, 2026, Monday

09:00–18:00		Registration	
12:00–13:30		Lunch	
		SESSION 1 – LABORATORY X-RAYS – chair: J. Bednarčík	
13:30–13:45		J. Bednarčík UPJŠ Košice, SK	<i>Opening Lab X-ray Session and Information about Hands On</i>
13:45–14:45	X-01	R. Kužel CUNI Prague, CZ	<i>Brief Introduction to Crystallography and Powder Diffraction</i>
14:45–15:30	X-02	M. Dopita CUNI Prague, CZ	<i>From Atomic Structure to Nanostructures: Modern Laboratory X-ray Scattering Techniques in Materials Research</i>
15:30–16:00		Coffee Break	
		SESSION 2 – LABORATORY X-RAYS – chair: R. Kužel	
16:00–16:30	X-03	T. Roch CU Bratislava, SK	<i>Hard Coatings Based on Transition Metal Borides Analyzed by Laboratory X-ray</i>
16:30–17:15	X-04	E. Božin IPB Belgrade, SRB	<i>Seeing Beyond Crystallography: An Introduction to Pair Distribution Function Analysis of Complex Materials</i>
17:15–17:45	X-05	Š. Michalik Diamond, UK	<i>Probing Local Atomic Arrangement in Metallic Glasses by High-Energy X-ray and Neutron diffraction</i>
		OPENING SFEL 2026	
18:15–19:00		P. Sovák T. Michalek S. Molodtsov M. Johnson	<i>Opening SFEL 2026</i>
19:00–22:00		WELCOME DINNER	

September 29, 2026, Tuesday

7:00–9:00		Breakfast	
		SESSION 3 – FREE ELECTRON LASERS – chair: K. SaksI	
9:00–9:45	F-01	S. Molodtsov E-XFEL, DE	<i>Recent Scientific Highlights from European XFEL</i>
9:45–10:30	F-02	U. ZastraU E-XFEL, DE	<i>The HED-HiBEF Instrument at the European XFEL – Scientific Capabilities and Instrumentation</i>
10:30–11:00		Coffee Break	
		SESSION 4 – FREE ELECTRON LASERS – chair: L. Juha	
11:00–11:30	F-03	A. Cavalieri PSI Villigen, CH	<i>XFELs for Investigation of Field-driven Dynamics in Solids</i>
11:30–12:00	F-04	T. Pfeifer MPIK Heidelberg, DE	<i>Femto-To-Attosecond Time-Resolved Atomic and Molecular Quantum Dynamics Using Fluctuating FEL Pulses</i>
12:00–12:30	F-05	K. Rossnagel E-XFEL, DE	<i>Three Movies in a Flash: Electron, Spin, and Atom Dynamics at Soft X-ray XFELs</i>
12:30–14:00		Lunch	
		SESSION 5 – FREE ELECTRON LASERS – chair: U. ZastraU	
14:00–14:30	F-06	D. Kraus UR Rostock, DE	<i>Inertial Fusion Research at X-ray Free Electron Lasers</i>
14:30–15:00	F-07	R. Sobierajski PAS Warszawa, PL	<i>Ultrafast Structural Transformations of Fe: Time-Resolved Studies from Synchrotron to FEL</i>
15:00–15:30	F-08	J. Schulz E-XFEL, DE	<i>Sample Delivery Challenges at X-ray Free-Electron Lasers</i>
15:30–16:00	F-09	J. Krempaský PSI Villigen, CH	<i>Twisted Light Control of the Ferroelectric GeTe</i>
16:00–16:30		Coffee Break	
		SESSION 6 – FREE ELECTRON LASERS – chair: S. Molodtsov	
16:30–17:00	F-10	V. Vozda CAS Prague, CZ	<i>Radiation Resistance of Materials for Future Inertial Fusion Reactors: Laboratory and Computer Simulations</i>
17:00–17:30	F-11	J. Uličný UPJŠ Košice, SK	<i>Effective Representation of Objects for Tomoscopic Experiments - Preparation for Hemodynamic Imaging</i>

17:30–18:00	F-12	I. Barák SAS Bratislava, SK	<i>CotY Protein Structure and its Use for the Development of Novel Nano-Biomaterials</i>
18:00–18:30	F-13	L. Juha CAS Prague, CZ	<i>Ion Emission from Plasmas Produced by Short-Wavelength Laser Radiation: A Brief Overview</i>
18:30–19:00	F-14	N. Elleuche E-XFEL, DE	<i>Science without Borders? – Research Infrastructures and the Role of Scientists in a Changing World</i>
19:00–20:30		DINNER	
20:30–21:30	H-01	E. Božin IPB Belgrade, SRB	<i>PDFgui: A Practical Platform for Small-Box Modeling and Real-Space Structure Refinement of PDF Data</i>

September 30, 2026, Wednesday

7:00–9:00		Breakfast	
		SESSION 7 – NEUTRON SOURCES – chair: N. Kučerka	
9:00–9:30	N-01	M. Johnson ILL Grenoble, FR	<i>Institute Laue-Langevin - Instrument and Infrastructure Upgrades, the Science Strategy and New Research Opportunities for Slovakia</i>
9:30–10:00	N-02	P. Manuel ISIS Oxfordshire, UK	<i>Advanced Materials Characterisation via Neutron Diffraction and Imaging at the ISIS Neutron and Muon Source</i>
10:00–10:30	N-03	D. Uhríková CU Bratislava, SK	<i>Lung Surfactant Through the Optics of Neutrons</i>
10:30–11:00		Coffee Break	
		SESSION 8 – NEUTRON SOURCES – chair: A. Zelenáková	
11:00–11:30	N-04	N. Kučerka CU Bratislava, SK	<i>Slovak Neutron Community</i>
11:30–12:00	N-05	U. Perez-Salas ILL Grenoble, FR	<i>Studying Lipid Organization in Model Cell Membranes Using Neutron Scattering</i>
12:00–12:30	N-06	M. Koza ILL Grenoble, FR	<i>Neutron Spectroscopy at the Institut Laue Langevin</i>
12:30–12:45		Conference Photo	
12:45–14:00		Lunch	
		SESSION 9 – NEUTRON SOURCES – chair: M. Johnson	
14:00–14:30	N-07	J. Kulda ILL Grenoble, FR	<i>Time-Resolved Neutron and X-ray Inelastic Scattering</i>
14:30–15:00	N-08	L. Almasy HUN-REN, HU	<i>Instrumentation at the Budapest Neutron Centre</i>
15:00–15:30	N-09	D. Zákutná ILL Grenoble, FR	<i>Magnetic SANS with Polarized Neutron Beam</i>
15:30–16:00	N-10	P. Hrubovčák UPJŠ Košice, SK	<i>Characterization of Core-Shell Nanostructures Using SANS</i>
16:00–16:30		Coffee Break	
		SESSION 10 – SYNCHROTRON SOURCES – chair: N. Mrkývková	
16:30–17:00	S-01	M. Česnek CTU Prague, CZ	<i>Introduction to Charged Particle Accelerators and their Applications</i>
17:00–18:00	S-02	V. Holý CUNI Prague, CZ	<i>Introduction to Synchrotron Radiation</i>

		SESSION 11 – POSTER PRESENTATIONS – chair: P. Sovák, K. Saksí	
18:00–19:30	P-01 ... P-40	<i>POSTER Session</i>	
19:30–21:00		DINNER	
21:00–22:00	H-02	J. Krempaský, V. Holý PSI Villigen, CH CUNI Prague, CZ	<i>Everything You Wanted to Know about SEX but Were Afraid to Ask</i>

October 1, 2026, Thursday

7:00–9:00		Breakfast	
		SESSION 12 – SYNCHROTRON SOURCES – chair: J. Krempaský	
9:00–9:30	S-03	R. Mokso DTU, DK	<i>Recent Advances in X-ray Tomography</i>
9:30–9:50	S-04	J. C. Martínez ALBA Barcelona, ES	<i>ALBA and ALBA II, New Techniques for New Challenges</i>
9:50–10:10	S-05	E. Partyka- Jankowska Solaris Kraków, PL	<i>Research Opportunities at SOLARIS Synchrotron</i>
10:10–10:30	S-06	M. Klačsová CU Bratislava, SK	<i>Lipid „Duvets“ for Antiviral Delivery: SAXS/WAXS Study</i>
10:30–11:00		Coffee Break	
		SESSION 13 – EUROPEAN SOLAR TELESCOPE – chair: P. Gömöry	
11:00–11:45	EST-1	M. Collados IAC, ES	<i>Introduction to Plasma Physics and Applications to the Solar Atmosphere</i>
11:45–12:15	EST-2	M. Collados IAC, ES	<i>The European Solar telescope - EST</i>
12:15–12:30	EST-3	P. Gömöry AU SAS, SK	<i>Slovak Participation in the European Solar Telescope</i>
12:30–14:00		Lunch	
14:00–18:30		Leisure Time	
18:30–22:00		FAREWELL DINNER	
		Announcing Best Poster Award & Cultural Program	

October 2, 2026, Friday

7:00–9:00		Breakfast	
		SESSION 14 – SYNCHROTRON SOURCES – chair: D. Uhríková	
9:00–9:30	S-07	J. Daillant ESRF Grenoble, FR	<i>Fourth Generation Synchrotron Sources : A Quantum Leap for Matter Exploration. The Example of the ESRF Extremely Brilliant Source</i>
9:30–10:00	S-08	P. Benčok Diamond, UK	<i>Soft X-ray Magnetic Dichroism for Studying Magnetic Materials</i>
10:00–10:30	S-09	V. Held UV, ES	<i>Real-Time X-ray Scattering and Photoluminescence Insights into Halide Perovskite Vapor Deposition</i>
10:30–11:00		Coffee Break	
		SESSION 15 – SHORT TALKS – chair: V. Holý	
11:00–11:15	ST-01	R. Korfanta CU Bratislava, SK	<i>Structural Changes in Lung Surfactant Membranes Enriched with Cathelicidins</i>
11:15–11:30	ST-02	D. Mačáková UPJŠ Košice, SK	<i>Study of the Surface Structure of Magnetic Nanoparticles Using Small-Angle Neutron Scattering</i>
11:30–11:45	ST-03	P. Dubecký UPJŠ Košice, SK	<i>Instrumental Broadening Correction in X-ray Diffraction Line-Profile Analysis by Iterative Forward Convolution</i>
11:45–12:00	ST-04	R. Kaur UPJŠ Košice, SK	<i>Time-Resolved Synchrotron X-Ray Diffraction Study of Stress-Induced Anisotropy in VITROPERM 800</i>
12:00–12:30	ST-05	A. Lipták Diamond, UK	<i>XRD-CT: Applying Tomography Concepts to Diffraction Measurements</i>
		CLOSING SFEL 2026	
12:45–13:00		P. Sovák J. Bednarčík K. Saksl A. Zeleňáková	<i>Closing SFEL 2026</i>
13:00–14:30		Lunch	

EST Satellite Meeting - October 2, 2026, Friday

7:00–9:00		Breakfast	
		SESSION 16 – EST SATELLITE – chair: P. Gömöry	
9:00–10:30	EST-4	E. Khomenko IAC, ES	<i>Realistic Simulations of the Solar Magneto-Convection Including Non-Ideal Effects</i>
10:30–11:00		Coffee Break	
		SESSION 17 – EST SATELLITE – chair: M. Collados	
11:00–12:30	EST-5	S. J. González Manrique IAC, ES	<i>Radiative Transfer in the Solar Atmosphere: From Spectral Synthesis to Inversions</i>
		CLOSING SFEL 2026	
12:45–13:00		P. Sovák J. Bednarčík K. Saksl A. Zeleňáková	<i>Closing SFEL 2026</i>
13:00–14:30		Lunch	

Part I

X-ray techniques



X-01

Brief Introduction to Crystallography and Powder Diffraction

Radomír Kužel^{1,*}

28.09.2026, Monday
13:45 – 14:45

XRAY

X-ray techniques

¹ Department of Condensed Matter Physics, Faculty of Mathematics and Physics, Charles University, Ke Karlovu 5, 12116 Praha, Czech Republic

* presenting author email: radomir.kuzel@matfyz.cuni.cz

THE ELEMENTS of crystallography have been introduced many years ago, perhaps already by the work of Kepler (1611) followed by e.g. Miller (indices of crystal planes), Hessel (32 point groups), Bravais (translation types), Fjodorov, Schoenflies (230 space group types) etc. Symmetry was always the crucial in the description.

Powder diffraction (PD) is used for structural and microstructural characterization of materials. It includes not only the analysis of powder samples but also all kinds of polycrystalline materials. There are several monographies available devoted to this technique. Much has already been described for example in [1] and more recently in [2]. In addition to original Debye-Scherrer method, nowadays mainly the so-called Bragg-Brentano parafo-cusing geometry is used with symmetrical $2\theta - \theta$ or $\theta - \theta$ scan when the information contained in each diffraction peak hkl is related only to the corresponding (hkl) planes parallel to the surface, so that different peaks are related to different crystallite families. Each crystalline phase has its typical PD pattern as a fingerprint. Therefore, by using databases like PDF-5+ we can perform qualitative and quantitative phase analysis (e.g. [1-2]). PD peak positions are also related to the unit cell size, i.e. lattice parameters connected also to possible non-stoichiometry, lattice defects and residual stresses. Integrated intensities are given mainly by the structure factor - i.e. the crystal structure that can be refined or even sometimes solved from the PD XRD pattern (e.g. [3,4]). They are also determined by the irradiated volume of suitably oriented crystallites, so that possible preferred orientation - texture can be estimated. Broadening of diffraction peaks can be influenced by small crystallite sizes and/or microstrains (e.g. due to dislocations) that can also be determined for each phase [e.g. 5, 6]. For detailed analysis of thin films, textures and stresses also asymmetric geometries and often parallel beam techniques are used.

References

- [1] H.P. Klug, L.E. Alexander, X-ray Diffraction Procedures. John Wiley and Sons. 1974. 10.1107/S0021889875011399
- [2] Powder Diffraction: Theory and Practice, R. Dinnebier, S.J.L. Billinge. RCS Publ, 2008. 10.1039/9781847558237
- [3] V.K. Pecharsky and P. Zavalij, Fundamentals of Powder Diffraction and Structural Characterization of Materials, Springer, 2025 10.1007/978-3-031-91504-8
- [4] Structure Determination from Powder Diffraction Data. Edited by W.I.F. David, K. Shankland, L.B. McCusker, Ch. Baerlocher. IUCr. Oxford Publ., 2002. 10.1093/acprof:oso/9780199205530.001.0001
- [5] Modern Diffraction Methods, Edited by E.J. Mittemeijer and U. Welzel, Wiley, 2013. 10.1002/9783527649884
- [6] M.A. Krivoglaz: Theory of X-Ray and Thermal Neutron Scattering by Real Crystals. Springer. 1995. 10.33542/SRU-0350-0



X-02

From Atomic Structure to Nanostructures: Modern Laboratory X-ray Scattering Techniques in Materials Research

Milan Dopita^{1,*}

28.09.2026, Monday
14:45 – 15:30

XRAY

X-ray techniques

¹ Department of Condensed Matter Physics, Faculty of Mathematics and Physics, Charles University, Ke Karlovu 5, 12116 Praha, Czech Republic

* presenting author email: dopita@gmail.com

XRAY SCATTERING and diffraction techniques are indispensable tools in modern materials research, providing complementary information on phase composition, crystal structure, microstructure, morphology, and defects over a broad range of length scales. Continuous advances in laboratory X-ray instrumentation, including high-brilliance X-ray sources, improved X-ray optics, and fast, low-noise area detectors, have significantly expanded the capabilities of laboratory-based experiments. As a result, many studies that previously required access to synchrotron facilities can now be performed using state-of-the-art laboratory instruments.

This lecture presents the experimental capabilities of our X-ray laboratory and illustrates them through selected examples from contemporary materials research, with particular emphasis on advanced and less commonly applied techniques. Our instrumentation covers a reciprocal-space range from $q = 0.003$ to $21 \text{ \AA}^{-1}$, corresponding to real-space dimensions of approximately 0.03–200 nm, enabling structural characterization across multiple length scales. The laboratory supports a wide spectrum of X-ray scattering experiments on single crystals, polycrystalline bulk and powder materials, nanocrystalline and amorphous systems, thin films, multilayers, and epitaxial structures. Measurements can be performed using Co, Cu, Mo, or Ag radiation in Bragg–Brentano, parallel-beam, high-resolution, coplanar, and non-coplanar (in-plane) geometries. A variety of sample environments, including low- and high-temperature stages, tensile and compression devices, and reaction chambers, enable both in-situ and operando investigations.

The available methodologies include crystal structure solution and refinement, qualitative and quantitative phase analysis, texture and residual stress analysis, X-ray reflectivity, rocking-curve measurements, reciprocal-space mapping, total scattering with pair distribution function analysis, small-angle X-ray scattering (SAXS), and grazing-incidence SAXS (GISAXS).

Representative applications include structural characterization of nanocrystalline thin films and coatings, combined XRD/SAXS studies of metallic nanomaterials, investigations of iron-based nanocomposites for pharmaceutical applications, high-pressure X-ray diffraction, in-situ studies at elevated and low temperatures, and in-operando characterization of lithium-ion batteries and fuel cells. These examples demonstrate the versatility of modern laboratory X-ray techniques and their capability to address a broad range of contemporary materials science challenges.



X-03

Hard Coatings based on Transition Metal Borides analyzed by Laboratory X-ray

Tomáš Roch^{1,*}, Branislav Grančič¹, Katarína Viskupová¹, Viktor Šroba¹, Tomáš Fiantok¹, Marek Vidiš¹, Martin Truchlý¹, Leonid Satrapinskyy¹, Marián Mikula¹, Peter Švec¹

¹ CENAM, FMPI, Comenius University Bratislava, Mlynská dolina F1, 842 48 Bratislava, Slovakia

* presenting author email: roch@fmph.uniba.sk

28.09.2026, Monday
16:00 – 16:30

XRAY

X-ray techniques

THIN-FILM MATERIALS research is a highly interdisciplinary field of considerable importance for numerous technological applications. In addition to their chemical composition and electrical, optical, and mechanical properties, a thorough understanding of their structure and morphology is essential for fully exploiting their potential and optimizing fabrication processes. This short lecture provides an overview of the characteristic aspects of laboratory X-ray structural analysis of hard coatings.

Hard layers and coatings are widely used in industry to improve the mechanical and tribological properties of carrier material, for example in manufacturing tools, or as protective barriers against corrosion and oxidation at high temperatures. Recent research showed that boron-based nanostructured hard coatings exhibit very promising thermal and mechanical properties. Our recent research focused on transition metal borides (TMB_x) hard coatings deposited by DC magnetron sputtering and also by its novel development High Power Impulse Magnetron Sputtering. Selected examples include material systems: V-TM-B_x, Zr-Ta-Si-B_x, TiB_x/TaB_x and ZrB_x/TaB_x superlattices.

The several examples of X-ray structural analysis of transition-metal boride around um thick coatings prepared by various sputtering deposition techniques demonstrate the development of pronounced uniaxial texture depending on deposition geometry. The phase composition and phase transformations are also strongly influenced by the deposition conditions and subsequent thermal treatment. In general, the limited thickness of thin films and coatings, typically in the range of a few nanometers to several micrometers, influences the measured diffraction intensities through the product of the X-ray attenuation coefficient and the film thickness. Because the X-ray penetration depth generally exceeds the coatings thickness, grazing-incidence X-ray scattering techniques are commonly used to restrict the probed volume to the thin coating itself, thereby minimizing the contribution from the substrate. Although texture characterization and grazing-incidence X-ray scattering techniques are routinely performed at synchrotron facilities, basic structural characterization can, to a considerable extent, also be carried out using standard laboratory-based X-ray instrumentation.

ACKNOWLEDGEMENT The authors gratefully acknowledge the support by the Slovak Research and Development Agency (Grant No. APVV-24-0038) and support under the Operational Program Integrated Infrastructure for the project: Advancing University Capacity and Competence in Research, Development and Innovation (ACCORD ITMS2014+:313021X329), co-financed by the European Regional Development Fund.



X-04

Seeing Beyond Crystallography: an Introduction to Pair Distribution Function Analysis of Complex Materials

Emil Bozin^{1,*}

28.09.2026, Monday
16:30 – 17:15

XRAY

X-ray techniques

¹ Center for Solid State Physics and New Materials, Institute of Physics Belgrade, Pregrevica 118, P.O.Box 68, 11080 Belgrade, Serbia

* presenting author email: emil.bozin@gmail.com

PAIR DISTRIBUTION FUNCTION (PDF) analysis has become a powerful and widely used approach for investigating the local atomic structure of crystalline, nanostructured, and disordered materials beyond the limits of conventional crystallography. By combining total scattering experiments with real-space structural analysis, PDF methods provide direct insight into short-range order, local distortions, nanoscale heterogeneity, and correlated disorder that are often hidden in average-structure descriptions.

This lecture will introduce the fundamental concepts underlying PDF analysis, beginning with the principles of total scattering and the transformation of reciprocal-space data into real-space structural correlations. The discussion will cover the essential stages of a PDF study, including experimental considerations for X-ray and neutron scattering measurements, data reduction procedures, and approaches to structural modeling and refinement.

Emphasis will be placed on understanding what structural information PDF analysis can reveal, when the method is particularly advantageous, and how it complements conventional diffraction techniques. Representative examples from contemporary materials research - such as nanomaterials, functional oxides, energy materials, and disordered systems - will illustrate the broad applicability of the method and its growing role in modern structural characterization.



X-05

Probing Local Atomic Arrangement in Metallic Glasses by High-energy X-ray and Neutron Diffraction

Stefan Michalik^{1,*}

28.09.2026, Monday
17:15 – 17:45

XRAY

X-ray techniques

¹ Diamond Light Source Ltd., Harwell Science and Innovation Campus, Didcot, Oxfordshire OX11 0DE, UK

* presenting author email: stefan.michalik@diamond.ac.uk

METALLIC GLASSES (MGs) are an advance class of engineering alloys in which the atoms, mainly of metallic elements, are arranged disorderly without creating a crystalline structure. The lack of long-range ordering gives rise to various advantageous mechanical (high yield strength, hardness, large elastic limit), chemical (corrosion and radiation resistance), electronic and/or magnetic (low coercivity, high saturation magnetization, low core loss, high permeability) properties in comparison to their crystalline counterparts. To understand the glass forming ability [1], the temperature stability and devitrification [2], the deformation mechanism [3], radiation resilience [4], the Invar effect in Fe-based MGs [5] and other characteristics, probing the local atomic arrangement and its evolution is essential. High-energy X-ray diffraction (HEXRD) has proven to be a suitable tool to determine the local atomic structure of MGs. Time-resolved in situ HEXRD experiments performed at high-brilliance synchrotron radiation sources can detect subtle modifications of the amorphous structure when it is exposed to a variety of external factors (low and high temperature, tensile and compressive forces, heavy ions, different chemical environments). However, to unambiguously identify the contributions of individual atomic pairs in multicomponent systems, the involvement of other complementary atomic-sensitive techniques is usually crucial. Among them, neutron diffraction has a special position due to its ability to provide scattering contrast that differs from that of HEXRD for various elements [6]. Finally, neutron and diffraction datasets may be employed together in simulation techniques such as the Reverse Monte Carlo method to provide a real-space information at the atomic level [6].

References

- [1] A. Lachová et al., Modification of structural, mechanical, corrosion and biocompatibility properties of Ti₄₀Zr₁₀Cu₃₆Pd₁₄ metallic glass by minor Ga and Sn additions, *J. Alloys Compd.*, vol. 940, p. 168776, Apr. 2023, doi: 10.1016/j.jallcom.2023.168776
- [2] Š. Michalik et al., In situ HEXRD study of a Ca₆₁Al₃₉ metallic glass, *J. Alloys Compd.*, vol. 687, pp. 188–196, Dec. 2016, doi: 10.1016/j.jallcom.2016.06.094
- [3] J. Bednarcik et al., In situ tensile deformation of Fe-rich metallic glass at elevated temperatures using hard X-ray diffraction, *J. Alloys Compd.*, vol. 509, pp. S92–S94, 2011.
- [4] Š. Michalik et al., The effects of swift Xe ion bombardment on the amorphous structure of a VITROPERM type alloy, *J. Alloys Compd.*, vol. 795, pp. 69–78, Jul. 2019, doi: 10.1016/j.jallcom.2019.04.328
- [5] A. Firlus et al., Atomic structure evolution related to the Invar effect in Fe-based bulk metallic glasses, *Nat. Commun.*, vol. 13, no. 1, p. 1082, Dec. 2022, doi: 10.1038/s41467-022-28650-9
- [6] Š. Michalik et al., Short range order and crystallization of Cu–Hf metallic glasses, *J. Alloys Compd.*, vol. 853, p. 156775, Feb. 2021, doi: 10.1016/j.jallcom.2020.156775

Part II

Free Electron Lasers



F-01

Recent Scientific Highlights From European XFEL

Serguei Molodtsov^{1,*}

¹ European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany

* presenting author email: serguei.molodtsov@xfel.eu

29.09.2026, Tuesday
09:00 – 09:45

FEL

Free Electron Lasers

SMALLER, FASTER, MORE INTENSE: The X-Ray Free Electron Lasers (XFEL's) are opening up areas of research that were previously inaccessible. Using the X-ray flashes of XFEL's, scientists are able to map the atomic details of viruses, decipher the molecular composition of cells, take three-dimensional images of the nanoworld, film chemical reactions, and study processes such as those occurring deep inside planets.

To generate the X-ray flashes, bunches of electrons are first accelerated to high energies and then directed through special arrangements of magnets (undulators). In the process, the particles emit radiation that is increasingly amplified until an extremely short and intense X-ray flash is finally created.

The world-unique feature of XFEL's is the possibility to provide up to hundreds of thousands ultra-short flashes (200 as - 100 fs) that makes these facilities particular suitable for time-resolved X-ray absorption, photoemission, (resonance) inelastic X-ray scattering as well as diffraction and imaging studies in the range of moderate and hard X-ray photons.

In this lecture main recent scientific highlight from European XFEL in many areas of its application will be presented.



F-02

The HED-HIBEF Instrument at the European XFEL – Scientific Capabilities and Instrumentation

Ulf Zastrau^{1,*}

¹ European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany

* presenting author email: ulf.zastrau@xfel.eu

29.09.2026, Tuesday
09:45 – 10:30

FEL

Free Electron Lasers

THE ADVENT of the first X-ray free-electron lasers (XFELs), FLASH in 2004 and LCLS in 2009, may prove to be the most profound development since the invention of the laser and, equally, the synchrotron. Sharp improvements in a number of laser parameters, most notably intensity and pulse duration, support this expectation. This brings scientific dreams within reach. Indeed, the unprecedented opportunities and expectations have triggered considerable research activities worldwide. In my talk, I will give an overview of the experimental application of the European XFEL to explore relativistic laser plasma interactions, warm dense matter, materials in extreme conditions, and laboratory astrophysics. Since May 2019, the High Energy Density Science (HED) instrument at the European X-ray Free-Electron Laser Facility in Schenefeld, Germany, allows international users to investigate a wide range of materials and systems at extreme conditions [1]. European XFEL and the HIBEF user consortium [2] form a joint group of more than 30 people for HED research, development and user operation. To drive a sample from ambient conditions to extreme excitations, a variety of high energy drivers are available. Besides a dedicated platform for diamond-anvil cell research [6], we have three separate optical laser systems for warm-to hot-dense-matter creation, dynamic compression [3] and laser-plasma interaction in electron-relativistic regime [4]. These drivers allow studying various phase space parameters with time-resolution down to 10 fs, pressures into the TPa regime [5], and electric field strength up to 1021 W/cm, both at surfaces and in the bulk.

The unique HED instrument allows to study these systems with precise ultrafast x-ray probes including spectroscopy [7], x-ray diffraction, small- and wide-angle scattering as well as phase contrast imaging methods. It is fully tuneable in the photon energy range from 5 to 25 keV at different bandwidths, can be focused to a variety of diameters.

The talk will go into further detail about diagnosing HED plasmas with diffraction, emission and energy-loss spectroscopy (inelastic x-ray scattering) from phonon modes and ion-acoustic waves, and x-ray Talbot imaging.

References

- [1] U. Zastrau, et al., J. Synchrotron Rad. (2021). 28, 1393-1416
- [2] www.hibef.de
- [3] McMahon and Zastrau, DOI: 10.22003/XFEL.EU-TR-2017-001
- [4] Laso Garcia et al., High Power Laser Science and Engineering, 1.5 (2021)
- [5] Descamps et al., Rev. Sci. Instrum. 96 (7), 075206 (2025)
- [6] Liermann et al., J. Synchrotron Rad. (2021). 28, 688-706
- [7] Preston, Goede et al., Journal of Instrumentation, Volume 15 (2020)



F-03

XFELs for Investigation of Field-driven Dynamics in Solids

Adrian Cavalieri^{1,*}

29.09.2026, Tuesday
11:00 – 11:30

¹ Paul Scherrer Institut, Villigen, Switzerland

* presenting author email: adrian.cavalieri@psi.ch

FEL

Free Electron Lasers

COMPREHENSIVE KNOWLEDGE of ultrafast out-of-equilibrium dynamics in materials is essential to identify the microscopic processes that govern their electronic, magnetic and structural properties. Controlling these processes with light may ultimately enable optically driven functional devices that exploit quantum coherence, collective excitations and transient states of matter. Many of the relevant interactions occur on femtosecond and attosecond timescales, including charge redistribution, electronic screening, spin–orbit coupling and the initial transfer of energy among electronic, spin and lattice degrees of freedom. Resolving these processes on their natural length and timescales requires ultra-short, temporally stable, high-photon-energy pulses that can provide element- and orbital-specific sensitivity to evolving electronic and magnetic states.

In principle, X-ray Free-Electron Lasers (XFELs) provide a platform for such studies. Their high brightness and tunable photon energy enable electronic and magnetic states to be probed through element-specific core-level transitions, while their ultrashort pulse duration provides access to the earliest stages of light-induced dynamics. However, although few-femtosecond and attosecond X-ray pulses are increasingly available at XFELs around the world, their practical application presents a major experimental challenge. That is, for field-resolved experiments, both the X-ray probe pulse duration and the relative arrival time and phase of the driving external laser pulse must be determined on a single-shot basis – with a precision comparable to the timescales under investigation. Otherwise, timing uncertainty between the independent sources can obscure the intrinsic material response and the processes involved by limiting the effective temporal resolution in pump–probe experiments.

Here, we present a method for attosecond characterization of ultrashort X-ray pulses generated at SwissFEL using a self-referenced attosecond streaking approach developed for the new Diavolezza endstation. These measurements permit further exploration and development of advanced XFEL emission modes, which include high intensity attosecond pulses, pulse pairs, pulse trains and temporally coherent X-ray emission made possible by external laser seeding. Importantly, the self-referenced streaking measurements also provide a relative measurement of the time of arrival of the XFEL pulse with respect to the external laser, as well as the relative phase with sub-femtosecond resolution. Self-referenced streaking provides a practical route towards reliable waveform-resolved experiments at XFELs. The time-resolution in these studies will range from femtosecond to attosecond resolution, scaling with the wavelength of the external optical laser. This capability opens new opportunities to resolve charge transfer, screening, spin dynamics and light-induced changes of quantum states with element specificity and attosecond temporal resolution.



F-04

Femto-to-Attosecond Time-resolved Atomic and Molecular Quantum Dynamics using Fluctuating FEL Pulses

Thomas Pfeifer^{1,*}

¹ Max-Planck-Institut für Kernphysik, Heidelberg, Germany

* presenting author email: tpfeifer@mpi-hd.mpg.de

29.09.2026, Tuesday
11:30 – 12:00

FEL

Free Electron Lasers

TO RESOLVE ULTRAFAST events, we typically rely on controlled probe pulses that are shorter than the delay between these events. Likewise, to resolve closely-spaced spectral lines, we need to achieve a spectrometer resolution better than their spacing. These statements appear correct, at first. Here, we shed light on this common wisdom, statistically structured light to be more precise. Experiments at the extreme-ultraviolet (XUV) FEL FLASH at DESY taught us that correlations in statistically structured SASE FEL pulses can increase temporal resolution. Molecular wavepacket dynamics on time scales shorter than the FEL pulse duration are resolved in the D_2 molecular ion, observed by ion coincidence spectroscopy with a reaction microscope (ReMi) in an XUV-pump–XUV-probe experiment. Regarding enhanced spectral resolution, we learn from a recent “single-pulse” transmission spectroscopy experiment at EuXFEL. Here, correlations within the physical interaction process itself (X-ray stimulated Raman) can be harnessed (in a manner akin to super-resolution microscopy) to resolve spectral structures (100-meV fine-structure splitting in Ne), beyond the (0.2 eV) x-ray spectrometer resolution. Finally, we turn to our recent attosecond-pump attosecond-probe experiment on electron dynamics in molecules. Making use of a recently established attosecond double-pulse operating regime at EuXFEL we measure spectral interference structures, encoding the time delay of the stochastically varying SASE pulses. Using post sorting based on shot-to-shot spectral diagnostics, we uncover transient changes of characteristic x-ray absorption below the oxygen K edge, encoding the motion of electrons in the vicinity of the two chemically distinct oxygen atoms in the chemically relevant COOH carboxy group found in organic acids.



F-05

Three Movies in a Flash: Electron, Spin, and Atom Dynamics at soft X-ray XFELs

Kai Rossnagel^{1,2,*}

29.09.2026, Tuesday
12:00 – 12:30

FEL

Free Electron Lasers

¹ Deutsches Elektronen Synchrotron DESY, Soft X-ray Spectroscopy of Quantum Materials (FS-SXQM), Notkestraße 85, 22607 Hamburg, Germany,

² Kiel University, Institute of Experimental and Applied Physics (IEAP), Leibnizstr. 19, 24118 Kiel, Germany

* presenting author email: kai.rossnagel@desy.de

ELECTRONS move the world. They drive our electronic devices and every chemical reaction in nature. To understand and control electron motion, we have to catch it in the act inside materials and at their interfaces. But electrons are hard to pin down for two opposite reasons: the mobile electrons at the Fermi level move at velocities of up to a few nm/fs, while the strongly bound electrons sit localized at core levels with binding energies of up to several keV. Filming both therefore demands femtosecond soft x-ray flashes that strip electrons from the material after a short-pulse excitation and capture them frame by frame.

Here, we report on our mission to record and direct electronic films in quantum materials and at functional interfaces. Our approach unites, in a single experiment, the full electronic structure dynamics in energy-momentum space, including spin, via time- and spin-resolved ARPES, with atomic-site-specific chemical and structural dynamics in real space via time-resolved XPS and XPD. We can thus follow electrons, spins, and atoms simultaneously, each on its own natural time scale. Crucially, these three are not independent; their dynamics are intertwined, and capturing them in one experiment lets us disentangle how they drive one another. By shaping the pump pulses, tuning their wavelength and wavefront, we move from observing to directing: this one-stop multimodal technique becomes a tool to discover and even create hidden and transient phases of quantum matter.

This talk surveys both the enabling technology and the scientific frontier it opens: watching, and steering, the electronic life of quantum matter at high-repetition-rate XFELs.



F-06

Inertial Fusion Research at X-ray Free Electron Lasers

Dominik Kraus^{1,*}

29.09.2026, Tuesday
14:00 – 14:30

FEL

Free Electron Lasers

¹ Universität Rostock, Institut für Physik, AG Hochenergiedichtephysik, Albert-Einstein-Str. 23, 18059 Rostock, Germany

* presenting author email: dominik.kraus@uni-rostock.de

RESearch in the field of laser-driven inertial fusion (“laser fusion”) has gained significant momentum following the achievement of the Lawson criterion for fusion ignition at the National Ignition Facility, triggering substantial public and private investment worldwide, including in Germany.

Despite this progress, a detailed understanding of the complex physical processes along the compression pathway toward inertial fusion plasmas remains essential for the realization of laser fusion as a practical energy source. The most widely pursued laser fusion schemes begin with the compression of the ablator and deuterium–tritium fuel to megabar pressures, corresponding to conditions similar to those found in planetary interiors. This stage is followed by a quasi-isentropic compression to gigabar pressures, reaching regimes comparable to stellar interiors. Both phases fall within the regime of so-called warm dense matter, which remains only partially understood.

This talk will review current developments and key challenges in laser fusion research and outline potential contributions from X-ray free electron laser facilities.



F-07

Ultrafast Structural Transformations of Fe: Time-resolved Studies from Synchrotron to FEL

Ryszard Sobierajski^{1,*}

¹ Institute of Physics of the Polish Academy of Sciences, Al. Lotników 32/46 02-668 Warszawa, Poland

* presenting author email: ryszard.sobierajski@ifpan.edu.pl

29.09.2026, Tuesday
14:30 – 15:00

FEL

Free Electron Lasers

THE STRUCTURAL transformations a metal undergoes under intense excitation depend on both the heating rate and the deposited fluence. Femtosecond optical excitation reaches heating rates far beyond those of conventional methods, and how the lattice responds spans a continuum from gentle vibrations to complete structural reordering as the fluence increases. Capturing this full range in a single material requires probing atomic-scale dynamics across (sub)picosecond-to-nanosecond timescales. Here we report a time-resolved diffraction study of thin polycrystalline iron films under femtosecond optical excitation, combining optical-pump / X-ray-probe measurements at a synchrotron and at free-electron-laser sources to follow the structural response as a function of absorbed fluence.

At low intensities, probed at the synchrotron, the excitation launches coherent acoustic deformations: femtosecond heating drives a strain wave that modulates the interplanar spacing, seen as a periodic shift of the Fe Bragg reflections without loss of long-range order. At higher fluences, accessed at the FEL sources, the response crosses into genuine solid–solid transformation, including the formation of a metastable body-centred tetragonal (bct) phase as a non-equilibrium intermediate [1]. At the highest fluences melting occurs, followed on the nanosecond timescale by crystallisation.

Crucially, femtosecond laser heating drives the lattice along a structural pathway distinct from the equilibrium phase diagram. For example the intermediate bcc $\rightarrow$ fcc ($\alpha \rightarrow \gamma$) transition in Fe is kinetically hindered on these timescales and is bypassed entirely, so the system evolves from the bcc phase to the melt and back to bcc-Fe without passing through the close-packed fcc structure. Combining the complementary time and momentum resolution of synchrotron and FEL sources, we assemble a coherent picture of this non-equilibrium excitation ladder in a model metal - Fe, from reversible acoustic strain, through a metastable bct phase, to melting and recrystallisation along a route inaccessible under equilibrium conditions.

ACKNOWLEDGEMENT This work was supported by the grant of the Polish Ministry of Education and Science - decision no. 2022/WK/13 and by the National Science Centre, Poland, grant agreement No 2017/27/B/ST3/02860.

References

- [1] Liubchenko O, Antonowicz J, Sokolowski-Tinten K, et al (2025) Laser-induced ultrafast structural transformations in thin Fe layer revealed by time-resolved X-ray diffraction. DOI 10.48550/arXiv.2506.18730



F-08

Sample Delivery Challenges at X-ray Free-electron Lasers

Joachim Schulz^{1,*}

29.09.2026, Tuesday
15:00 – 15:30

¹ European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany

* presenting author email: joachim.schulz@xfel.eu

FEL

Free Electron Lasers

X-RAY FREE-ELECTRON LASERS (XFELs) provide intense femtosecond X-ray pulses. The peak brightness is often high enough to destroy a sample with a single X-ray pulse. With their short pulse lengths, XFELs are optimal sources for studying ultra-fast processes started by optical laser pumping or by sample mixing. Additionally, high-repetition rate XFELs such as European XFEL or LCLS II require fast sample delivery to avoid double illumination of the same sample or to replenish sample for each X-ray pulse. These unique properties of XFELs give rise to challenges in sample delivery. In this talk, we'll introduce challenges and opportunities at XFELs with an emphasis of sample delivery methods.

An overview of liquid sample delivery will be given, we'll discuss development of drop-on-demand technologies and special sample delivery such as high viscosity injection. For serial femtosecond crystallography (SFX) protein crystals in suspension are prepared and injected into the interaction region of XFELs. Especially for membrane proteins, the sample can be extremely viscous, requiring special high viscosity extruders. Scattering and spectroscopy experiments on solutions, on the other hand, have different demands and need specialized sample delivery methods such as liquid flat sheet injectors. Often, samples are difficult to obtain in large quantities. In this case, highly efficient sample delivery methods like drop-on-demand systems are required.

If samples are in solid state or can be mounted on surfaces or window structures, fixed target sample delivery can be used. This method allows excellent sample efficiency: with good pre-characterization, every target can be hit. However, fixed target sample delivery tends to be slow and can hardly reach megahertz repetition rates. Other sample delivery methods to be discussed include aerosol sample delivery.



F-09

Twisted Light Control of the Ferroelectric GeTe

Juraj Krempaský^{1,*}

¹ Paul Scherrer Institut, Villigen, Switzerland

* presenting author email: juraj.krempasky@psi.ch

29.09.2026, Tuesday
15:30 – 16:00

FEL

Free Electron Lasers

WHAT IS A TWISTED LIGHT, i.e. an X-ray beam carrying orbital angular momentum? Can the “twist” of a light beam move atoms inside a crystal like it can optically tweeze nano-particles [1]? We explore this question in GeTe, a simple ferroelectric in which tiny displacements of Ge and Te atoms determine the direction of the electric polarization [2]. Instead of applying a conventional voltage, we illuminate the material with an X-ray beam carrying orbital angular momentum, an unusual beam whose wavefront twists like a corkscrew around a dark vortex core. To see how the atoms respond, we use X-ray standing waves, which act as an atomic-scale ruler capable of resolving changes in atomic positions deep inside the crystal. The experiment therefore becomes an unusual form of pump–probe measurement: the structured X-ray vortex drives the ferroelectric state, while the coherent X-ray standing wave simultaneously reveals the resulting atomic rearrangement. By changing the handedness of the vortex, we can follow how the Ge and Te atoms move through the ferroelectric energy landscape and how the polarization is switched. The experiment shows how the spatial structure of light, and not just simply its intensity or polarization, can become a new knob for controlling matter at the atomic scale.

References

- [1] Dienerowitz, M. & Dholakia, K. Transfer of orbital angular momentum from an optical vortex beam to a nanoparticle. *Topologica* 2, 008–008 (2009).
- [2] O. Caha, V. Holý, J. Krempaský *et al.*, Optical Vortex Control of Lone-Pair Ferroelectric Order, in preparation



F-10

Radiation Resistance of Materials for Future Inertial Fusion Reactors: Laboratory and Computer Simulations

Vojtěch Vozda^{1,*}

29.09.2026, Tuesday
16:30 – 17:00

FEL

Free Electron Lasers

¹ Department of Radiation and Chemical Physics, Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21 Prague 8, Czech Republic

* presenting author email: vozda@fzu.cz

FUTURE inertial fusion energy (IFE) reactors will require materials capable of surviving repeated exposure to intense X-ray radiation, energetic particles, and debris generated during target implosions. Understanding how these extreme conditions affect reactor materials is essential for the development of reliable fusion power plants.

This contribution presents laboratory and computational studies of radiation damage in candidate materials for future IFE reactors. Topics include EUV laser irradiation of tungsten-based alloys and pyrolytic boron nitride [1], comparison of experiments with XTANT-3 simulations [2], the influence of elevated temperature [3] and pre-existing radiation damage on material performance, and experimental approaches for studying damage caused by debris impacts under fusion-relevant conditions.

References

- [1] J. Bulíčka, et al. J. Nucl. Mater., 616:156069, 10 2025. DOI 10.1016/j.jnucmat.2025.156069
- [2] N. Medvedev, 2024. DOI 10.5281/ZENODO.8392569
- [3] N. Medvedev, et al. Opt. Mater. Express, 13(3):808, February 2023. DOI 10.1364/ome.480936



F-11

Effective Representation of Objects for Tomoscopic Experiments - Preparation for Hemodynamic Imaging

Jozef Uličný^{1,*}

29.09.2026, Tuesday
17:00 – 17:30

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: jozef.ulichny@upjs.sk

FEL

Free Electron Lasers

IN MY PRESENTATION, I will shortly summarize the main outputs of HE EIC project MHz tomography [1] yielding not only the working prototype of apparatus at EuXFEL, but also already interesting examples of applications attracting new user community.

One of the bottlenecks on road to full use of MHz tomography is proper reconstruction of rapid dynamics having only limited number of projections due to hardware limitations. In order to recover 4D (3D plus time) experimental data, apriori information about the physical processes and materials need to be supplied, complementing the insufficient information from projections only. In our case, we are dealing with haemodynamics and interactions of therapeutic ultrasound and vascular system at microscopic level. Using MHz tomography, ultrasound processes such as fractionation of arterial calcifications can be watched at (sub)microscopic scale in near native, optically non-transparent samples, opening opportunity to optimize the intravascular lithotripsy (IVL) protocol and hopefully even more. In our search for proper data representation and processing, we have adapted 3D Gaussian splatting to X-ray phase contrast by giving each splatting primitive absorption and phase-shift values and embedding differentiable Fresnel propagation for scene projection into such compressed representation. Trained on twelve simulated red-blood-cell holograms, it recovers interpretable phase-dominant volumes in 15 minutes on one GPU. The learned fields are physically interpretable: the phase-shift map delineates RBC boundaries and biconcave morphology while the absorption map stays near zero, confirming that the optimisation recovers the correct phase-dominant material distribution without explicit phase retrieval [2].

References

- [1] <https://tomoscopy.eu>
- [2] Moško D., Szeles P., Draci I., Vagovič P., Uličný J., Gaussian Splatting for Sparse-View X-Ray Phase-Contrast Reconstruction in MHz Tomoscopy. In Review July 1, 2026. DOI 10.21203/rs.3.rs-10201845/v1



F-12

Coty Protein Structure and its use for the Development of Novel Nano-biomaterials

Imrich Barak^{1,*}, Andrea Vetráková¹, Daniela Krajčíková¹, Dominik Oberthuer², Ekaterina Round³, Oleksandr Yefanov², Zuzana Chromikova¹

29.09.2026, Tuesday
17:30–18:00

FEL

Free Electron Lasers

¹ Department of Microbial Genetics, Institute of Molecular Biology, Slovak Academy of Sciences, Bratislava,

² Center for Free-Electron Laser Science (CFEL), DESY, Hamburg, Germany,

³ European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany

* presenting author email: imrich.barak@savba.sk

THE BACILLUS SUBTILIS spore coat is an outermost proteinaceous layer that protects spores against a variety of threats, including toxic chemicals and lytic enzymes, as well as predation by unicellular and multicellular eukaryotes. The coat, organised into two major morphologically distinct layers, the outer and inner coats, is composed of at least 70 proteins. The coat assembly process represents a central objective of our research. To gain structural insights into the spore coat of *B. subtilis*, we have attempted to purify several recombinant coat proteins, including CotY, CotE, CotW, CotV, and CotZ. We have discovered several self-assembled structures, including two-dimensional crystals and helical fibres. X-ray free-electron lasers are opening up unique opportunities to image biological materials at high resolution.

We will present our first XFEL-related data on the determination of the structure of CotY 2D crystals. We aim, in a longer-term perspective, to develop a robust technique for the structural determination of 2D crystals by studying a model sample, the CotY coat protein, to overcome the difficulties of obtaining 3D structures of proteins that form 2D crystals, which is likely the case for these proteins. To use these 2D lattices of Cot proteins for suitable fusion with proteins of interest for various applications, their structures must be determined. Highly organized macromolecular protein assemblies are attracting increasing interest as next-generation biomaterials due to their specific structural and functional diversity, offering potential applications in biocatalysis, drug delivery, and vaccine development. Even more possibilities open up if proteins are used as scaffolds to add entirely new functions by attaching enzymes, antigens or foreign proteins. In our work, we attempted to use CotY, a *B. subtilis* spore coat protein, as a scaffold that, when produced in *E. coli*, forms 2D crystalline structures characterized by high stability. However, genetic fusion, as a method for displaying foreign proteins on the surface of CotY crystals, adversely affected the formation of this macromolecular structure. To overcome this limitation, we employed the SpyTag/SpyCatcher bioconjugation system to engineer CotY variants suitable for modular protein attachment.

ACKNOWLEDGEMENT This work was supported by VEGA – Grant No. 2/0016/25 from the Slovak Academy of Sciences and a Grant from the Slovak Research and Development Agency under contract APVV-22-0303 to IB.



F-13

Ion Emission from Plasmas produced by Short-wavelength Laser Radiation: a Brief Overview

Libor Juha^{1,*}

29.09.2026, Tuesday
18:00–18:20

FEL

Free Electron Lasers

¹ Department of Radiation and Chemical Physics, Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21 Prague 8, Czech Republic

* presenting author email: juha@fzu.cz

A BRIEFOVERVIEW of ion emission results obtained in interaction experiments performed with short-wavelength laser pulses of a duration ranging from tens of femtoseconds to tens of nanoseconds will be presented. We compare the basic characteristics of ion emission generated by ultrashort pulses delivered by soft x-ray (FLASH2) and x-ray (European XFEL) free-electron lasers. For further comparison, short pulses from plasma-based XUV/UV lasers provide information on interactions that can no longer be considered isochoric. Finally, we will deal with isotope effects and cascade phenomena that occur during the emission of ions from a plasma generated by a focused beam of short-wavelength laser radiation.

ACKNOWLEDGEMENT The research presented in this contribution was supported by the Czech Republic's Ministry of Education, Youth and Sports (project no. LM2023068).

References

- [1] J. Krása et al., "Ion emission from warm dense matter produced by irradiation with a soft x-ray free-electron laser", *Matter and Radiation at Extremes*, vol. 9, art. nr. 016602, 2024.
- [2] J. Krása et al., "Revealing of hydrodynamic and electrostatic factors in the center-of-mass velocity of an expanding plasma generated by pulsed laser ablation", *Laser and Particle Beams*, vol. 29, pp. 113-119, 2011.
- [3] L. Vyšín et al., "Behavior of poly(methyl methacrylate) exposed to extreme ultraviolet laser radiation: A relationship between the high-energy photo-decomposition of the polymer and the mass spectra of emitted ions", *Polymer Degradation and Stability*, vol. 236, art.nr. 111298, 2025.
- [4] T. Burian et al., "Cascaded ion emissions from copper plasma produced by an X-ray free-electron laser", *Matter and Radiation at Extremes*, vol. 11, art. nr. 057601, 2026.



F-14

Science Without Borders? – Research Infrastructures and the Role of Scientists in a changing World

Nicole Elleuche^{1,*}

29.09.2026, Tuesday
18:20 – 19:00

FEL

Free Electron Lasers

¹ European XFEL GmbH, Holzkoppel 4, 22869 Schenefeld, Germany

* presenting author email: nicole.elleuche@xfel.eu

RESEARCH INFRASTRUCTURES are key players in addressing global societal challenges and strengthening Europe's scientific and technological capabilities. At the same time, the world in which they operate has changed significantly. Geopolitical developments, increasing competition for technologies and critical resources, environmental challenges and changing expectations towards the impact of publicly funded science raise an important question: What does “science without borders” mean in this changing environment?

The talk will discuss the role of international research infrastructures in this context, using European XFEL as an example. It will look at how research infrastructures can contribute to Europe's strategic autonomy and technological sovereignty by providing access to unique cutting-edge infrastructure, technology and know-how. Examples from European XFEL will show how research can contribute to areas such as critical raw materials, energy, digitalization, health and sustainability.

At the same time, the role and impact of research infrastructures go far beyond scientific results. Their contributions to innovation, technological development, international cooperation and education, as well as their socio-economic and environmental impact, are becoming increasingly important when assessing their value for society.

But what does all of this mean for scientists working in and with international research infrastructures? They offer opportunities not only to conduct excellent science, but also to represent scientific communities and countries, build international and trustful partnerships and contribute to keeping science open across borders. In a changing world, science is and remains a bridge – and scientists can play an important role in maintaining and strengthening it.

Part III

Neutron sources



N-01

Institute Laue-Langevin - Instrument and Infrastructure Upgrades, the Science Strategy and New Research Opportunities for Slovakia

Mark Johnson^{1,*}

¹ *Institute Laue-Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble Cedex 9, France*

* presenting author email: johnson@ill.eu

30.09.2026, Wednesday
09:00 – 09:30

NEU
Neutrons

THE COMPREHENSIVE Endurance upgrade programme was completed in 2024. With a budget of 50+ M€, about 30 projects have been delivered, including neutron guide systems, new and upgraded instruments, sample environment and data and software services. More intense neutron beams combined with more efficient detector systems provide major new capability for measuring ever smaller samples, including in extreme sample environments, and weaker signals. In addition, significantly shorter measuring times facilitate parametric studies and increase throughput and, therefore, overall capacity. Thus the upgrade programme as a whole, supported by ongoing and new projects, ensures that research capability at the ILL will continue to be world leading for the next decade, offering new opportunities for cutting-edge science. In this context, the ILL has elaborated a science strategy to optimise the use of its state-of-the-art scientific infrastructure over the next decade and enhance the delivery of societal impact with neutrons.

The Endurance programme, ongoing and new projects, and the science strategy will be presented, including recent science highlights, and set in the context of future reactor operation to 2033 and beyond ...

To complement presentations by other scientists from ILL, this contribution will focus in part on developments in diffraction and corresponding examples of structural studies.



N-02

Advanced Materials Characterisation via Neutron Diffraction and Imaging at the ISIS Neutron and Muon Source

Pascal Manuel^{1,*}

30.09.2026, Wednesday
09:30 – 10:00

NEU
Neutrons

¹ ISIS Neutron and Muon Source STFC Rutherford Appleton Laboratory Harwell Campus Didcot, Oxfordshire, UK

* presenting author email: pascal.manuel@stfc.ac.uk

IN THIS TALK, I will show some recent studies performed at the ISIS neutron and muon source covering a wide range of domains such as quantum materials, location of guest molecules within zeolites and metal organic frameworks, battery materials, geology, engineering applications and archeometry. In the process, we will highlight which neutron characteristics make these measurements unique and describe some special sample environment available at the facility. Finally, the application process (free at the point of use) will be described, including possible source of complementary funding for travel and accommodation.



N-03

Lung Surfactant through the Optics of Neutrons

Daniela Uhríková^{1,*}, Rastislav Korfanta¹, Dalibor Nakládal¹, Norbert Kučerka¹

¹ Department of Physical Chemistry of Drugs, Faculty of Pharmacy, Comenius University Bratislava, Odbojárov 10, 832 32 Bratislava, Slovakia

* presenting author email: uhrikova@fpharm.uniba.sk

30.09.2026, Wednesday
10:00 – 10:30

NEU
Neutrons

THE POPULARITY of small-angle scattering for the study of biologically relevant materials stems from the fact that it provides detailed information on the size, shape, and conformation of molecular assemblies in solutions. Unilamellar vesicles formed by phospholipids serve as models of biological membranes and drug carriers. SANS data treated by using the vesicle model provide information about structural parameters such as the diameter of the vesicle, the thickness of the lipid bilayer (and/or its structural parts), the polydispersity of the system, etc., while knowing neutron scattering length densities (NSLD) of the lipid molecules and the used solvent. The other way to study membrane systems is based on neutron diffraction from a stack of planar lipid bilayers deposited on a silica wafer and hydrated by vapor. Model-free neutron diffraction data analysis provides high-accuracy structural parameters such as the thickness of the lipid bilayer, the head-to-head distance, and the water distribution profile. The advantages and limitations of both approaches will be illustrated with the study of a complex biological system: lung surfactant.

Lung surfactant (LS) is a mixture of lipids (90%) and 10% of specific surfactant-associated proteins. LS lines the interior of the lung alveoli and acts to lower interfacial tension. The absence of LS due to prematurity or its damage is treated with exogenous lung surfactant (ELS) in neonatal medicine and also in ventilated patients with Covid-19 disease in experimental treatment. The clinically used substitute surfactant Curosurf[®], a porcine lung tissue extract, and a protein-free lipid mixture were used as ELS in the study. The effect of selected drugs from the group of antibiotics and corticosteroids on the structure of ELS will be discussed. Molecular dynamics simulation was used to complete the selected experimental findings. The findings will be discussed in the context of medical application. A more recent trend involves the idea that ELS could also be used as a delivery vehicle for pulmonary therapeutics.

ACKNOWLEDGEMENT This work was funded by the VEGA project 1/0305/24. SANS experiments were performed on the PAXY instrument at LLB Saclay. SAND experiments were performed on the D16 instrument, ILL Grenoble, DOI: 10.5291/ILL-DATA.8-02-1032.



N-04

Slovak Neutron Community

Norbert Kučerka^{1,*}

¹ Department of Physical Chemistry of Drugs, Faculty of Pharmacy, Comenius University Bratislava, Odbojárov 10, 832 32 Bratislava, Slovakia

* presenting author email: kucerka1@uniba.sk

30.09.2026, Wednesday
11:00 – 11:30

NEU
Neutrons

SLOVAK RESEARCH community proves continuously a deep interest and high-quality results in condensed matter studies including investigations in both hard and soft matter applications. Scientific research in these areas have always correlated closely with the developments of large-scale scientific infrastructure. The peculiar properties of neutrons, power of synchrotrons, innovations in optical spectroscopy, have their own niche in studies of the chemical composition and structure of condensed matter. The access to the neutron sources by Slovak neutron community is no exception, despite the lack of such sources in Slovakia. Slovak researchers have over the years utilized neutrons from many sources around the world: from Dubna to Chalk River and beyond. Noteworthy is an active participation in research projects at the Laue-Langevin Institute (ILL) in Grenoble for more than 15 years. Thanks to Slovakia's membership in this unique European infrastructure, Slovak scientists have access to the most modern neutron source and scattering instruments in the world, where they carry out cutting-edge experiments in physics, chemistry, biology and pharmacy.



N-05

Studying Lipid Organization in Model Cell Membranes using Neutron Scattering

Ursula Perez-Salas^{1,*}, Yuli Zhu², Lionel Porcar¹, Tera Lavoie³, Thirupathi Ravula⁴, Ying Liu², Krishna Batchu¹

30.09.2026, Wednesday
11:30 – 12:00

NEU
Neutrons

¹ *Institute Laue-Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble Cedex 9, France,*

² *Department of Chemical Engineering, University of Illinois at Chicago, Chicago, Illinois, USA,*

³ *Advanced Electron Microscopy, University of Chicago, Chicago, Illinois,*

⁴ *National Magnetic Resonance Facility at Madison, Department of Biochemistry, University of Wisconsin-Madison, Madison, Wisconsin, USA*

* presenting author email: perez-salas@ill.fr

LIPID COMPOSITIONAL asymmetry across the leaflets of the plasma membrane is a ubiquitous feature in eukaryotic cells. How this asymmetry is attained is thought to be through the sidedness of lipid biosynthesis as well as through active transport of lipids across the membrane. This strategy is helped by the slow diffusion of long tail phospholipids and sphingolipids through the lipid bilayer which takes hours.

Recently, however, we found that lipid compositional asymmetry can occur naturally in model systems consisting of a saturated lipid, an [1]. Our goal is to understand the role of lipid composition in the emergence of lipid composition asymmetry across leaflets. We use small angle neutron scattering (SANS) to track membrane leaflet compositional asymmetry by monitoring the unequal distribution of deuterated and perdeuterated lipids species. In addition to SANS, we support our results with Magic Angle Spinning (MAS) NMR.

References

- [1] Y. Zhu et al., "Unexpected asymmetric distribution of cholesterol and phospholipids in equilibrium model membranes", *Biophysical Journal*, vol. 123, pp. 3923–3934, Nov. 19, 2024. DOI 10.1016/j.bpj.2024.10.004



N-06

Neutron Spectroscopy at the Institut Laue Langevin

Michael Koza^{1,*}

¹ *Institute Laue-Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble Cedex 9, France*

* presenting author email: koza@ill.fr

30.09.2026, Wednesday
12:00 – 12:30

NEU
Neutrons

THE NEUTRON SOURCE Institut Laue Langevin in Grenoble, France, maintains a comprehensive range of spectroscopy instruments, designed and optimised specifically for the study of dynamic processes in condensed matter. As a quantum mechanical particle possessing a magnetic moment, the neutron not only allows the observation of mass fluctuations (vibrational excitations, phonons) and mass transport (diffusion of atoms and molecules), but also the characterisation of magnetic excitations, be they due to localised electric crystal fields, individual spin fluctuations or collective magnetic modes.

The spatial and energy scales that can be investigated using neutrons typically range from 0.1 Angstroms to a micrometre and from about one nano-eV to an electronvolt. In order to characterise this wide range of different dynamic processes in condensed matter and to measure specific excitations in an optimised manner a variety of different techniques and spectrometers is utilized.

We discuss the various neutron spectrometer concepts (time-of-flight, three-axis, back-scattering, spin-echo) and the instruments that the ILL makes available to the scientific community, and present the latest developments and scientific results from the ILL's spectroscopy group.

References

- [1] <https://www.ill.eu/en/science-technology/ill-science-groups/spectroscopy/>



N-07

Time-resolved Neutron and X-ray Inelastic Scattering

Jiří Kulda^{1,*}

¹ *Institute Laue-Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble Cedex 9, France*

* presenting author email: jkulda@free.fr

30.09.2026, Wednesday
14:00 – 14:30

NEU
Neutrons

SINCE DECADES the neutron and, more recently, X-ray spectroscopies have been standard workhorses for investigations of condensed matter dynamics at atomic resolution. Nevertheless, the inherently weak interaction of both probes with matter, accompanied by the tiny flux densities of neutron beams and by the huge X-ray photon energy as compared to the energy scale of elementary excitations in condensed matter, have restricted their implementation to studies of systems in thermodynamic equilibrium.

Experiments using synchronized pulsed X-ray and laser beams to investigate the time evolution of non-equilibrium states of condensed matter, both in the structural and in the magnetic domains, have quickly become routine at XFEL (X-ray Free Electron Lasers) beams exhibiting picosecond time-structures, accompanied by extreme transversal coherence (e.g. [1]). With neutrons the progress in source brilliance is extremely limited and the slow propagation speed is prohibitive for beam time-structures below the microsecond scale, but some compensation comes from the ease of energy transfer analysis. Recently, reports on successful attempts of time-resolved neutron work have appeared [2], demonstrating a very acceptable efficiency when applied to molecular processes on the micro- and millisecond scales [3,4].

In this lecture we shall recall the basic principles of scattering theory based on time-dependent correlation functions and review the present state of neutron experimental techniques addressing transient processes in matter, their principal limitations and emerging opportunities at newly built instruments [5].

References

- [1] M. Trigo et al., *Nat. Phys.* 9, 790 (2013); DOI 10.1038/nphys2788
- [2] C. Hua, D. A. Tennant, A. T. Savici, V. Sedov, G. Sala, and B. Winn, *Rev. Sci. Instrum.* 95, 033902 (2024); DOI 10.1063/5.0181310
- [3] T. R. Reeder et al., *PNAS* 122, 2415300121 (2025); DOI 10.1073/pnas.2415300121
- [4] T. Burankova, T. Hauß, J. Ollivier, R. E. Lechner, N. A. Dencher and J. Pieper, *Biophys. J.* 125, (2026) accepted for publication; DOI 10.1016/j.bpj.2026.02.028
- [5] R. Toft-Petersen et al., *Rev. Sci. Instrum.* 96, 0258847 (2025); DOI 10.1063/5.0258847



N-08

Instrumentation at the Budapest Neutron Centre

László Almásy^{1,*}

30.09.2026, Wednesday
14:30 – 15:00

NEU
Neutrons

¹ Institute for Energy Security and Environmental Safety, Centre for Energy Research, Konkoly Thege Miklós
út 29-33, Budapest 1121, Hungary

* presenting author email: almasy.laszlo@ek.hun-ren.hu

THE LECTURE gives an overview of the research with neutrons at the Budapest Neutron Centre, describing techniques and instruments for neutron scattering, imaging and elemental analysis with neutrons.

Examples of applications of neutron scattering methods in various fields of materials science and cultural heritage science, carried out at BNC, are briefly presented. Future plans for upgrade of the cold neutron source and cold neutron instruments are described.



N-09

Magnetic SANS with Polarized Neutron Beam

Dominika Zákutná^{1,*}

¹ Institut Laue-Langevin, 71 avenue des Martyrs CS 20156, 38042 Grenoble, France

* presenting author email: zakutnad@natur.cuni.cz

30.09.2026, Wednesday

15:00 – 15:30

NEU
Neutrons

SMALL-ANGLE NEUTRON SCATTERING (SANS) is a powerful probe of nanoscale structure, but its full potential in magnetism is unlocked when the incident beam is polarized. This lecture introduces the physical foundations and practical implementation of polarized SANS, demonstrating how the technique provides access to information hidden from other characterization methods. SANS probes real-space structure in the 1-100 nm range. Neutrons carry an intrinsic magnetic moment and therefore scatter not only from nuclear scattering length density but also from the magnetization component perpendicular to the scattering vector Q , giving direct access to nanoscale spin textures and magnetic correlations - something X-ray scattering, electron microscopy, and bulk magnetometry cannot provide. Polarizing the beam allows nuclear and magnetic contributions to be separated; the resulting spin-dependent cross-sections, measured as a function of q and applied field, encode the nanometer-scale spatial distribution of magnetization.

We walk through the key concepts, such as magnetic scattering length density, spin-dependent cross-sections, field-induced moment alignment, and the experimental implementation of polarization analysis, including sample environment, field geometry, and the separation of nuclear and magnetic scattering in a SANSPOL experiment. To ground these concepts, we apply SANSPOL to magnetic nanoparticles (NPs), which are of high interest for data storage, spintronics [1], magnetic hyperthermia, and drug delivery [2,3], and whose nanoscale magnetic morphology remains poorly understood and is inaccessible to conventional probes such as DC magnetometry and AC susceptibility.

Three case studies on chemically and architecturally distinct systems are presented. In CoFe_2O_4 NPs, surface spin disorder is shown to be field-dependent: the magnetically active volume grows as disordered surface spins are progressively polarized, allowing extraction of the spin-disorder energy and surface anisotropy constant across samples from 3.1 to 12.8 nm [4,5]. In core/shell $\epsilon\text{-Fe}_3\text{N}$ NPs, a spatially inhomogeneous magnetic response from the oxidic shell is uncovered, entirely invisible to bulk probes. Together, these results establish polarized SANS as a cornerstone technique in nanomagnetism, making measurable what was previously hidden in plain sight.

References

- [1] P. Bender et al. J. Phys. Chem. C, vol. 122 (2018) 3068.
- [2] A. Lak, S. Disch, P. Bender Adv. Science, vol. 8 (2021) 2002682.
- [3] A. Lappas et al. Phys. Rev. X, vol. 9 (2019) 041044.
- [4] D. Zákutná et al. Phys. Rev. X, vol.10 (2020) 031019.
- [5] M. Gerina et al., Nanoscale Adv., vol. 5 (2023) 4563-4570.



N-10

Characterization of Core-Shell Nanostructures using SANS

Pavol Hrubovčák^{1*}, Adriana Zeleňáková¹, Dominika Zácutná², Žaneta Fabriciová¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

² Institute Laue-Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble Cedex 9, France

* presenting author email: pavol.hrubovcak@upjs.sk

30.09.2026, Wednesday
15:30 – 16:00

NEU
Neutrons

MAGNETIC CORE-SHELL nanoparticles have emerged as highly versatile materials with a wide range of applications spanning biomedicine, catalysis, and sensor technologies. In biomedical fields, the magnetic core responds to external magnetic fields, enabling targeted drug delivery, magnetic hyperthermia, and efficient magnetic separation. To ensure biocompatibility, the magnetic core is typically encapsulated within a biocompatible organic compound or ligand shell. Furthermore, these modifying ligands can exhibit specific therapeutic functions, driving the development of advanced theranostic platforms that combine simultaneous diagnosis and treatment.

Designing these core-shell systems for optimal performance requires a comprehensive understanding of their structural properties. However, precise characterization remains a challenge; conventional methods such as X-ray scattering and electron microscopy lack sufficient sensitivity to light organic matter, making it difficult to accurately resolve the properties of the organic shell coating the core.

To overcome these limitations, small-angle neutron scattering (SANS) serves as a powerful and non-destructive diagnostic tool. Applicable to both powder samples and liquid dispersions, SANS provides the unique capability to determine the internal architecture of core-shell nanoparticles with angstrom-level precision. By utilizing contrast variation techniques (e.g., via isotopic substitution in the liquid medium), specific components of the nanoparticle can be selectively matched out or highlighted, allowing independent visualization of the core and the shell. This approach yields accurate data on the precise size of the magnetic core, the thickness of the organic coating, morphology, and size distribution. Additionally, SANS provides crucial insights into the ligand surface coverage density, interparticle interactions, and the presence, size, and geometry of aggregates within the dispersion. Consequently, SANS represents an indispensable method for the rational design and structural optimization of multifunctional nanocarriers.

Part IV

Synchrotron sources



S-01

Introduction to Charged Particle Accelerators and their Applications

Martin Cesnek^{1,*}

¹ Department of Nuclear Reactors, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, V Holešovičkách 2, 180 00 Prague 8, Czech Republic

* presenting author email: martin.cesnek@fjfi.cvut.cz

30.09.2026, Wednesday
16:30 – 17:00

SYN
Synchrotrons

PARTICLE ACCELERATORS are indispensable tools in both scientific research and various practical applications. They are designed to increase the kinetic energy of charged particles such as electrons, protons, and ions, enabling investigations ranging from fundamental studies of matter to industrial and medical applications.

This lecture introduces the basic principles of charged particle acceleration and beam transport. The main types of accelerators, including electrostatic accelerators, linear accelerators, cyclotrons, and synchrotrons, will be presented together with their operating principles and characteristic features.

The historical development of accelerator technology and its impact on modern science will be briefly discussed. Examples of accelerator applications in nuclear and particle physics, materials research, medicine, industry, and large-scale research infrastructures will be presented, providing participants with a broad overview of the role of accelerators in contemporary science and technology.



S-02

Introduction to Synchrotron Radiation

Václav Holý^{1,*}

¹ Department of Condensed Matter Physics, Faculty of Mathematics and Physics, Charles University, Ke Karlovu 5, 12116 Praha, Czech Republic

* presenting author email: vaclav.holy@matfyz.cuni.cz

30.09.2026, Wednesday

17:00 – 18:00

SYN

Synchrotrons

THE TALK is intended as a first information on synchrotron radiation for beginners. I will present the basics of generation of synchrotron radiation with the emphasis to its physical properties (energy spectrum, time structure, polarization, coherence). In the second part I bring basic information on insertion devices (wigglers, undulators) and on optical elements (monochromators, filters, focusing devices). The third part will be devoted to examples of experimental methods, which use unique properties of synchrotron radiation, especially high coherence, energy tunability and time structure.



S-03

Recent Advances in X-ray Tomography

Rajmund Mokso^{1,*}

01.10.2026, Thursday
09:00 – 09:30

¹ TU Physics, Technical University of Denmark, Richard Petersens Pl. 310, 2800 Lyngby, Denmark

* presenting author email: rajmo@dtu.dk

SYN
Synchrotrons

X-RAY TOMOGRAPHIC micro and nanoimaging at synchrotrons is a versatile method to study materials and biological samples. In my lecture, I will highlight the newest advances in terms of spatial and temporal resolution with special emphasis on imaging complex biological systems in 3D at the micro and nanoscale.



S-04

ALBA and ALBA II: New Techniques for New Challenges

Juan Carlos Martínez^{1,*}

01.10.2026, Thursday
09:30 – 09:50

SYN
Synchrotrons

¹ ALBA Synchrotron, Carrer de la Llum 2-26, 08290 Cerdanyola del Vallès, Barcelona, Spain

* presenting author email: guilmar@cells.es

THE SCIENTIFIC questions addressed at synchrotron facilities are becoming increasingly complex, requiring experiments with higher spatial and temporal resolution, greater sensitivity, and the ability to probe materials under realistic operating conditions. ALBA II, the upgrade of the Spanish synchrotron light source, has been conceived to meet these emerging challenges by providing a substantial increase in source brightness, coherence, and beam stability.

Rather than representing a simple performance upgrade, ALBA II will enable a new generation of experiments that are currently difficult or impossible to perform. The enhanced capabilities will facilitate high-resolution imaging and diffraction, faster in situ and operando studies, multimodal approaches combining complementary techniques, and the investigation of increasingly weak or heterogeneous systems.

This contribution will present an overview of ALBA II from the perspective of the scientific opportunities it will create across multiple research fields, with particular emphasis on advanced scattering and diffraction techniques for soft matter and functional materials. Selected examples will illustrate how the upgraded source will allow researchers to address previously inaccessible scientific questions, highlighting the transition from improved instrumentation to genuinely new experimental capabilities.

Finally, the complementary roles of diffraction-limited synchrotron sources and X-ray free-electron lasers will be discussed, emphasizing how ALBA II will strengthen the experimental ecosystem by providing new opportunities for both standalone synchrotron experiments and XFEL-related research.



S-05

Research Opportunities at Solaris Synchrotron

Ewa Partyka-Jankowska^{1,*}

¹ SOLARIS National Synchrotron Radiation Centre, Jagiellonian University, Krakow, Poland

* presenting author email: ewa.partyka-jankowska@uj.edu.pl

01.10.2026, Thursday
09:50 – 10:10

SYN
Synchrotrons

THE SOLARIS SYNCHROTRON in Kraków is a third-generation light source operating in the medium electron energy range. The first synchrotron light at SOLARIS was observed in 2016, while the first user experiments were performed in 2018. Since then, SOLARIS has continuously expanded its activities by developing new beamlines and experimental end-stations and by providing complementary research infrastructure, including cryo-electron microscopes.

As the only synchrotron light source in Central-Eastern Europe, SOLARIS offers unique research opportunities in both fundamental and applied sciences [1]. Access to the research infrastructure is provided on the basis of the scientific evaluation of beamtime proposals by an international review panel. Additional opportunities for access and financial support for user visits are available through European initiatives such as NEPHEWS and RIANA, as well as through the CERIC-ERIC consortium.

In this lecture, we will present the SOLARIS synchrotron project, its available research infrastructure and current development plans. We will also provide practical information on access to the facility, including the beamtime application procedure and the support offered to users during the preparation and implementation of experiments. Selected examples of research performed at SOLARIS will illustrate the capabilities of the available experimental techniques, with particular emphasis on advanced materials for energy storage and conversion. The presentation will also highlight the opportunities offered by SOLARIS to PhD students and early-career researchers beginning their work with synchrotron-based methods.

ACKNOWLEDGEMENT This work is supported by the Polish Ministry of Science and Higher Education, under contract no. 1/SOL/2021/2.

References

- [1] J. Szlachetko et. al, Eur. Phys. J. Plus, 138 (2023) 10, DOI 10.1140/epjp/s13360-022-03592-9



S-06

Lipid “Duvets” for Antiviral Delivery: SAXS/WAXS Study

Mária Klačsová^{1,*}, Lukáš Hubčík¹, Alexander Búcsi¹, Juan Carlos Martínez², Daniela Uhríková¹

01.10.2026, Thursday
10:10–10:30

SYN
Synchrotrons

¹ Department of Physical Chemistry of Drugs, Faculty of Pharmacy, Comenius University Bratislava, Odbojárov 10, 832 32 Bratislava, Slovakia,

² ALBA Synchrotron, Carrer de la Llum 2-26, 08290 Cerdanyola del Vallès, Barcelona, Spain

* presenting author email: klacsova@fpharm.uniba.sk

CLINICAL EFFICACY of modern antivirals is limited by low stability, solubility and bioavailability. Lipid-based drug delivery systems (DDS) provide a possible solution. Depending on the lipophilicity of the drug, saturation capacity of a lipid bilayer is 0.05 – 0.2 drug-to-lipid molar ratio (mol/mol). Exceeding these limits leads to lateral separation of the drug within the bilayer plane, accompanied by 2D crystallization, or its precipitation out of the bilayer, causing bulk 3D crystallization.

Small- and wide-angle X-ray scattering (SAXS/WAXS) are among the most powerful methods for the analysis of crystallization in lamellar lipid systems. 2D crystallization is coupled to the physical state of the bilayer lipids. Lipids force the embedded drug molecules to orient parallel to the acyl chains, thereby lowering the activation energy for crystallization. Changes in the SAXS d-spacing and splitting of the broad liquid-crystalline WAXS peak into sharp peaks appear. In contrast, 3D crystallization occurs especially for drug molecules bound to the surface of the lipid bilayer and/or for molecules with low lipid-to-water partition coefficient. Unaligned drug molecules in solution lose rotational freedom and form crystal nuclei, detected by a sharp set of fingerprint diffraction peaks in WAXS.

We conducted a SAXS/WAXS study to design an optimal DDS for a papain-like viral protease inhibitor (PLpro), GRL0617. Compared to the hydrophilic main protease (Mpro) inhibitor GC376, which was successfully bound within the dipalmitoylphosphatidylcholine (DPPC) lipid bilayer up to 0.5 mol/mol [1], bulk crystallization of lipophilic GRL0617 was detected already above 0.05 mol/mol in the same system. Therefore, different lipid mixtures, varying in lipid type (ester and ether lipids with phosphatidylcholine and phosphatidylethanolamine headgroups and saturated, mono- or polyunsaturated fatty acyl chains, PUFA) were prepared to alter the rigidity and propensity for non-lamellar DDS. Results suggest that optimizing the lipid composition of the DDS may help to prevent crystallization of the transported drug and maintain the favorable biopharmaceutical performance.

ACKNOWLEDGEMENT Research was supported by VEGA 1/0305/24 and APVV-17-0250 grants. SAXS experiments were performed on the BL11-NCD beamline at ALBA Synchrotron with the collaboration of ALBA staff.

References

- [1] M. Klačsová et al., *Coll Surf B: Biointerfaces* 220, (2022) 112918, DOI 10.1016/j.colsurfb.2022.112918



S-07

Fourth Generation Synchrotron Sources: a Quantum Leap for Matter Exploration. The Example of the ESRF extremely Brilliant Source

Jean Daillant^{1,*}

02.10.2026, Friday
09:00 – 09:30

¹ ESRF – The European Synchrotron Radiation Facility, 71, avenue des Martyrs, 38043 Grenoble Cedex 9, France

* presenting author email: jean.daillant@esrf.fr

SYN
Synchrotrons

THE ESRF-EBS exemplifies how next-generation synchrotron sources open unprecedented avenues for probing the structure and dynamics of matter, driving breakthroughs across physics, chemistry, biology, and materials science.

In 2020, the ESRF, where 19 partner countries join forces to exploit 46 cutting edge beamlines at the forefront of synchrotron technology completed the upgrade of its storage ring. The upgrade boosted the source's brilliance and coherence by two orders of magnitude, enabling experiments that were previously impossible to perform.

New capabilities include:

- Hierarchical imaging spanning from 10 nm up to the meter scale.
- Dynamic-process studies ranging from 100 ps to months, capturing ultrafast phenomena and long-term evolution.
- Elemental-composition sensitivity at the ppb level.
- High-throughput characterization, allowing hundreds of samples to be analysed in minutes.

I will present recent ESRF studies that highlight the transformative impact of fourth-generation synchrotrons. I will also briefly discuss short and longer term plans for the further development of the facility.



S-08

Soft X-ray Magnetic Dichroism for Studying Magnetic Materials

Peter Bencok^{1,*}

¹ Diamond Light Source Ltd., Harwell Science and Innovation Campus, Didcot, Oxfordshire OX11 0DE, UK

* presenting author email: peter.bencok@diamond.ac.uk

02.10.2026, Friday
09:30 – 10:00

SYN
Synchrotrons

THE BEAMLINE for advanced dichroism experiments (BLADE) is a soft X-ray beamline at the UK synchrotron facility Diamond light source. It delivers soft X-ray beam in the energy range from 0.4 to 1.6 keV. This energy range is optimized for the dipolar transitions of 3d transition metals ($L_{2,3}$ edges) and rare earth elements ($M_{4,5}$ edges). So the absorption effect benefits from a strong resonance and directly probes the electronic states responsible for magnetism.

The dichroic effect is measured as difference between circular polarization with opposite handedness in absorption. The absorption is detected by measuring the total electron yield (drain current) and fluorescence signal (photodiode facing the sample) simultaneously. The absorption branch of BLADE is equipped with superconducting split pair coil that can deliver the magnetic field up to 14 T. The sample can be cooled by a variable temperature insert down to 3 K. The set up is complemented with an electromagnet providing the magnetic field up to 1.5 T. This end station is using a Janis cryostat with the base temperature of 20 K.

In several examples, we demonstrate the capabilities of XMCD and how it can be applied to different magnetic systems. As X-ray magnetic circular dichroism (XMCD) is a resonant effect, the technique is element selective. In a system as high entropy alloy with 5 magnetic elements, the use of this technique is essential to separate their contribution. Furthermore, the intensity of the dichroism can be recorded as a function of the external magnetic field. Effectively, this provides element sensitive hysteresis loops that can disentangle elemental contributions to a complex magnetic behavior. We recorded the element specific hysteresis loops in exchange spring multilayers and with help of micromagnetic simulation understood the reversal process of these systems. Spinel ferrites nanoparticles show significant difference in the surface structure compared to the bulk. This modification also manifests in the redistribution of Fe cations in tetrahedral and octahedral sites. XMCD in combination with the semi-empirical quantum many-body program QUANTY has been used to determine the degree of inversion.



S-09

Real-time X-ray Scattering and Photoluminescence Insights into Halide Perovskite Vapor Deposition

Vladimir Held^{1,*}, Sigrid Bernstorff², Yuriy Halahovets³, Matej Jergel³, Martin Ledinský⁴,
Nada Mrkvyňková³, Peter Nádaždy⁵, Stefan Roth⁶, Matthias Schwartzkopf⁶, Peter Šiffalovic³,
Karol Vegso³, Aleš Vlk⁴

02.10.2026, Friday
10:00 – 10:30

SYN
Synchrotrons

¹ Instituto de Ciencia Molecular, University of Valencia, Catedrático José Beltrán Martínez 2, Paterna, 46980, Spain,

² Elettra-Sincrotrone Trieste S.C.p.A., Strada Statale 14 km 163,500 in AREA Science Park, Basovizza/Trieste 34149, Italy,

³ Institute of Physics, Slovak Academy of Sciences, Dúbravská cesta 9, 845 11 Bratislava, Slovakia,

⁴ Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21 Prague 8, Czech Republic,

⁵ Institute of Electrical Engineering, Slovak Academy of Sciences, Dúbravská cesta 9, 845 11 Bratislava, Slovakia,

⁶ Deutsches Elektronen-Synchrotron (DESY), Notkestraße 85, 22607 Hamburg, Germany

* presenting author email: held.vladimir@gmail.com

METAL-HALIDE PEROVSKITES are promising materials for next-generation photovoltaic and optoelectronic devices. Yet, their performance remains strongly affected by structural defects that induce unfavorable charge-carrier recombination, thereby decreasing the overall device efficiency. Vacuum vapor deposition is a scalable, solvent-free fabrication route with precise control over film thickness and composition. However, further optimization of this process requires a detailed understanding of perovskite nucleation, crystal growth, morphology evolution, and defect formation during deposition.

This work focuses on the real-time investigation of halide perovskite thin-film formation during vacuum deposition using in situ grazing-incidence X-ray scattering and photoluminescence spectroscopy. Such a combination of techniques during perovskite deposition reveals the formation of nanoscale perovskite islands, their coalescence, and subsequent steady vertical layer growth. The observed nonmonotonic PL evolution, an initial intensity increase followed by pronounced quenching, does not simply follow the increasing perovskite phase volume, but instead reflects the formation of defect states and enhancement of nonradiative recombination. Furthermore, in situ X-ray scattering enables tracking of lattice strain during growth. The transition from compressive to tensile strain marks the onset of grain coalescence and coincides with PL quenching, directly linking growth stage, strain, and defect formation. Finally, we show how this understanding can be used for targeted defect passivation: introducing potassium salts during perovskite deposition produces an immediate enhancement of PL intensity, indicating efficient suppression of nonradiative recombination and defect passivation without substantial modification of the perovskite crystallographic structure. These results demonstrate that combining X-ray scattering with optical spectroscopy provides a powerful feedback platform for understanding vapor-deposited perovskite film growth, guiding additive selection, defect passivation, and scalable fabrication strategies for high-performance perovskite solar cells.



H-01

PDFgui: a Practical Platform for Small-box Modeling and Real-space Structure Refinement of PDF Data

Emil Bozin^{1,*}

¹ Institute of Physics Belgrade, 118 Pregrevica 11080 Belgrade, Serbia

* presenting author email: emil.bozin@gmail.com

29.09.2026, Tuesday
20:30 – 21:30

SYN
Synchrotrons

SOFTWARE PACKAGE PDFgui is a user-friendly graphical interface built on the PDFfit2 small-box modeling engine for the refinement of neutron and X-ray pair distribution function (PDF) data, enabling the extraction of nanoscale structural information from complex materials. By streamlining the setup, execution, and visualization of PDF refinements, PDFgui provides an accessible environment for organizing fits, performing sequential refinements, and comparing multiple structural models.

At its core, PDFfit2 is a flexible program and library for real-space refinement of crystal structures against PDF data. It enables fitting of three-dimensional structural models to experimental PDFs while accounting for key structural parameters, including lattice constants, atomic positions, anisotropic atomic displacement parameters, and correlated atomic motion. Experimental effects influencing the measured PDF can also be incorporated, and atomic coordinates and thermal parameters can be constrained according to the symmetry of arbitrary space groups, making the approach broadly applicable to both crystalline and nanostructured systems.

In this presentation, the overall PDFgui workflow and interface design will be introduced, along with its essential capabilities for small-box PDF analysis. The utility of the approach for investigating bulk materials with nanoscale heterogeneity will be illustrated through a recent example highlighting the detection of hidden local symmetry breaking in a high-performance thermoelectric material. In addition, typical use cases will be discussed, including co-refinement of multiple datasets, phase analysis, and sequential refinements across variables such as temperature, composition, and real-space fitting range.

PDFfit2 and PDFgui are freely available and continue to serve as widely used tools for real-space PDF analysis in materials research. The PDFgui program and selected tutorial files can be downloaded from the links below

- <https://www.diffpy.org/>
- <https://indico.science.upjs.sk/event/223/attachments/122/>



H-02

Everything You Wanted to Know About Sex but Were Afraid to Ask

Juraj Krempaský^{1,*}, Václav Holý^{2,*}

¹ Paul Scherrer Institut, Villigen, Switzerland,

² Department of Condensed Matter Physics, Faculty of Mathematics and Physics, Charles University, Ke Karlovu 5, 12116 Praha, Czech Republic

* presenting author email: juraj.krempasky@psi.ch, vaclav.holy@matfyz.cuni.cz

30.09.2026, Wednesday

21:00 – 22:00

SYN

Synchrotrons

NO, THIS TUTORIAL is not about what you think! Playing on the famous 1969 book title [1], this session is an almost math-free, highly intuitive guide to Synchrotron Experiments with X-rays (S.E.X), inspired by the legendary 1995 paper by Prof. Giorgio Margaritondo on Synchrotron Emission of X-rays [2]. Think of a synchrotron light source as the ultimate scientific multi-tool for S.E.X. Depending on how light interacts with matter, we can use Absorption to see chemistry, Photoemission to track electronics, or Imaging to peer inside the material. But if you want to unlock the absolute blueprints of matter, the exact 3D arrangement of atoms, you need to understand the S.E.X. with Diffraction.

Because getting beamtime on S.E.X. facilities is rather difficult, in this hands-on tutorial, we will build a virtual synchrotron beamline from scratch right on your laptop PC with ray-tracing. Together, we will simulate S.E.X. with a bending magnet, double-crystal monochromator and focusing optics needed to measure a real diffraction “rocking” curve on a thin ferroelectric GeTe film. By comparing real data directly with dynamical diffraction calculations and related experimental broadening, you will see exactly how close a S.E.X. simulation can get to the real physical world, and what we can learn about it. Almost everything about X-ray dynamical theory can be found in ref. [3]. But be aware, this is not a textbook – it is way too heavy going; it’s practically impossible to get it through, but don’t be afraid to ask, together we will make it. All code, data, and materials for this hands-on session will be provided on the link below

· www.dropbox.com

References

- [1] David Reuben. Everything You Always Wanted to Know About Sex* (*But Were Afraid to Ask), David McKay Company, (1969) isbn:0060192674
- [2] Giorgio Margaritondo. A primer in synchrotron radiation: Everything you wanted to know about SEX (synchrotron emission of x-rays) but were afraid to ask. J. Synchrotron Radiat. 2, 148–154 (1995).
- [3] Andre Authier, Dynamical Theory of X-Ray Diffraction Oxford Univ. Press 2003, isbn:9780198528920

Part V

Short talks



ST-01

Structural Changes in Lung Surfactant Membranes enriched with Cathelicidins

Rastislav Korfanta^{1,*}, Bruno Demé², Daniela Uhríková¹, Norbert Kučerka¹

02.10.2026, Friday
11:00 – 11:15

NEU
Neutrons

¹ Department of Physical Chemistry of Drugs, Faculty of Pharmacy, Comenius University Bratislava, Odbojárov 10, 832 32 Bratislava, Slovakia,

² Institute Laue-Langevin, 71 avenue des Martyrs, CS 20156, 38042 Grenoble Cedex 9, France

* presenting author email: korfanta3@uniba.sk

THE EMERGENCE of highly resistant bacterial strains poses a major threat to patients, driven by extensive global use of antibiotics. In pulmonary infections, antibiotics are widely used, making bacterial resistance a serious risk. Cathelicidins (CATH) are antimicrobial peptides of the innate immune system in various organisms, including humans. CATHs act by interacting with negatively charged bacterial membranes, enabled by their positive net charge. We studied the effect of human cathelicidin, LL-37, and three chicken CATHs on the lipid bilayer. The CATHs selected for the study differ in charge at physiological pH (+6 to +9) and in hydrophobic amino acid content in ascending order, LL-37 < CATH-2 < CATH-1 < CATH-3. The therapeutic use of CATHs in respiratory infections has been explored, but their clinical application is limited by difficulties in delivering sufficient amounts to lung tissues. Therefore, exogenous pulmonary surfactant has been proposed as a drug carrier. Pulmonary surfactant (PS) is a lipid-protein mixture that reduces surface tension at the alveolar air-liquid interface, decreasing the work of breathing. PS is essential for gas exchange, and its deficiency or dysfunction can cause respiratory distress syndrome (RDS), which is treated with exogenous PS, such as porcine Curosurf®.

We used neutron membrane diffraction to examine how CATHs affect the structure of the lung surfactant lipid bilayer. A PS model system composed of diC16:0PC / 16:0–18:1PC / 16:0–18:2PC / 16:0–18:1PG in a 50:24:16:10 wt.% ratio closely reproduces the functional properties of Curosurf®. The oriented lipid bilayers of CATH/PS were deposited on silica wafers and hydrated from vapor at several relative humidities (80% - 99%). To modulate the contrast between the lipid and aqueous phases, four D₂O/H₂O mixtures (100%, 70%, 40%, and 8%) were used. The contrast variation technique enables the solution of the phase problem necessary for the Fourier reconstruction of one-dimensional neutron scattering length density (NSLD) profiles. This model-free approach to the structure of the lipid bilayer allows to determine the thickness of the lipid bilayer, the distribution of water across the membrane, and the width of the bilayer-water interface. The data obtained help us to assess the perturbing effect of CATHs on the membrane of PS.

ACKNOWLEDGEMENT Membrane diffraction experiments were performed at the D16 spectrometer at ILL, Grenoble. DOI: 10.5291/ILL-DATA.8-02-1080. Experiments were supported by the VEGA 1/0305/24 project.



ST-02

Study of the Surface Structure of Magnetic Nanoparticles using Small-Angle Neutron Scattering

Daniela Mačáková^{1,*}, Adriana Zeleňáková¹, Pavol Hrubovčák¹, Ľuboš Nagy¹

02.10.2026, Friday
11:15 – 11:30

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: daniela.macakova@student.upjs.sk

NEU
Neutrons

THE MAIN OBJECTIVE of this work is to analyze the structural properties of cobalt ferrite magnetic nanoparticles using the Small-Angle Neutron Scattering (SANS) technique, which involves neutron scattering at small angles, and to subsequently model and fit the experimental data. A key part of the research was carried out in September 2025 at the Institut Laue–Langevin (ILL) research center in Grenoble, at the D33 instrument. The study utilizes pre-prepared samples of magnetic nanoparticles with different shape morphologies, magnetic properties, and surface modifications using organic ligands (e.g., oleic acid, polyacrylic acid). The SANS method was chosen as a suitable tool for studying the surface layers of magnetic nanoparticles, particularly organic coatings composed of elements with low atomic numbers, such as carbon and hydrogen, which are difficult to distinguish using X-ray or electron-based techniques. During the experiment, the measurement conditions were systematically varied in order to optimize contrast, especially by replacing water and toluene with their deuterated equivalents, as well as by using different sample forms—both powder and dispersed in solvents such as toluene and water. The obtained experimental data were subsequently analyzed using appropriate models, with emphasis placed on the selection of parameters for the most accurate fitting of the model to the experimental data. The modeling enabled the extraction of detailed information about the size, shape, and internal core–shell structure of the magnetic nanoparticles, as well as the nature of their surface layer. The results of this work contribute to a better understanding of the structural properties of functionalized magnetic nanoparticles and provide a basis for optimizing their properties for potential applications in biomedicine, such as magnetic resonance imaging, magnetic hyperthermia, and targeted drug delivery.



ST-03

Instrumental Broadening Correction in X-ray Diffraction Line-profile Analysis by Iterative Forward Convolution

Peter Dubecký^{1,*}, Ravneet Kaur¹, Pavol Sovák¹, Jozef Bednarčík¹

02.10.2026, Friday
11:30 – 11:45

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: peter.dubecky@student.upjs.sk

SYN
Synchrotrons

RELIABLE EXTRACTION of microstructural information from X-ray diffraction (XRD) data requires accurate separation of instrumental broadening from the intrinsic sample response. In this work, we present an iterative forward-convolution method optimized using a genetic algorithm (GA) to recover intrinsic diffraction line profiles from measurements acquired in transmission geometry with a two-dimensional detector.

In contrast to conventional single-peak fitting methods, the proposed approach performs a global optimization over the complete measured 2θ range, improving the stability and robustness of the inverse problem while simultaneously accounting for the instrumental resolution function. The methodology is demonstrated using synchrotron XRD data collected over a wide range of sample-to-detector distances. The proposed analysis substantially reduces systematic variations in the extracted crystallite size caused by changes in the experimental geometry, yielding consistent microstructural parameters that are in good agreement with transmission electron microscopy. The presented framework provides a robust and broadly applicable strategy for quantitative XRD line-profile analysis and instrumental broadening correction in diffraction experiments.

ACKNOWLEDGEMENT The authors express their gratitude to Dr. V. Girman for help with TEM observations. Parts of this research were carried out at the light source PETRA III (beamline P21.2) at DESY, a member of the Helmholtz Association HGF. This study was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034. Support from the project VEGA 1/0638/24 is also acknowledged.



ST-04

Time-resolved Synchrotron X-ray Diffraction Study of Stress-induced Anisotropy in VITROPERM 800

Ravneet Kaur^{1,*}, Daria Striežovská¹, Jozef Bednarčík¹

02.10.2026, Friday
11:45 – 12:00

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: ravneet.kaur@student.upjs.sk

SYN
Synchrotrons

FE-BASED amorphous ribbons can acquire tailored magnetic anisotropy when crystallization occurs under applied tensile stress. However, the accompanying structural evolution and its relationship to stress-induced anisotropy are not yet fully understood. Here, the crystallization behaviour of VITROPERM 800 was investigated in real time using high-energy synchrotron X-ray diffraction. Amorphous ribbons were annealed at 510 °C for 7200 s under tensile stresses of 0 and 1000 MPa, while two-dimensional diffraction patterns were continuously recorded. The emergence and subsequent evolution of Fe₃Si nanocrystals were evaluated through changes in diffraction-peak position and width as a function of time and azimuthal angle. Annealing without external stress produced nearly uniform lattice evolution, whereas tensile loading caused a pronounced directional dependence of the lattice strain. After two hours, the strain components reached approximately 0.92 % along the loading direction and -0.45 % in the transverse direction. The applied stress also altered the peak-width evolution and restricted crystallite growth, resulting in an average crystallite size of approximately 7.5 nm, compared with 9.6 nm in the stress-free sample. These time-resolved observations demonstrate that tensile stress modifies both the crystallization kinetics and elastic response of the emerging Fe₃Si phase. The results provide direct structural insight into the development of stress-induced anisotropy in nanocrystalline soft-magnetic alloys.

ACKNOWLEDGEMENT This study was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034. Support from the project VEGA 1/0638/24 is also acknowledged.



ST-05

XRD-CT: Applying Tomography Concepts to Diffraction Measurements

Alexander Liptak^{1,*}

02.10.2026, Friday
12:00 – 12:30

¹ Diamond Light Source Ltd., Harwell Science and Innovation Campus, Didcot, Oxfordshire OX11 0DE, UK

* presenting author email: alexander.liptak@diamond.ac.uk

SYN
Synchrotrons

X-RAY DIFFRACTION computed tomography (XRD-CT) combines the structural sensitivity of diffraction measurements with the spatial resolution of tomography, enabling the non-destructive mapping of crystalline phases and microstructural properties within heterogeneous materials.

This talk will provide an overview of XRD-CT methodology and its implementation at the I12-JEEP beamline, with emphasis on the experimental considerations and workflows involved in tomographic acquisition and reconstruction of spatially-resolved diffraction datasets. Approaches for constructing sinograms from sparse datasets collected using continuous-rotation (fly-scanning) acquisitions will be discussed; such sparse sampling approaches allow for the recovery of meaningful spatially-resolved information while substantially reducing acquisition times, thus providing a route towards measurements approaching in-situ timescales. Examples of sparse-data acquisition and reconstruction strategies will be presented, discussing how optimisation of sampling and sinogram construction can expand the capabilities of XRD-CT for dynamic and time-resolved studies at synchrotron beamlines.

Part VI

European Solar Telescope



EST-1

Introduction to Plasma Physics and Applications to the Solar Atmosphere

Manuel Collados^{1,*}

¹ Instituto de Astrofísica de Canarias,

* presenting author email: manuel.collados@iac.es

01.10.2026, Thursday
11:00 – 11:45

EST

European Solar Telescope

THE SUN IS A STAR full of charged particles (ions and electrons) everywhere and, as such, behaves as a plasma. The interior and the outer part of its atmosphere (the corona, largely extending into the interplanetary medium) is fully ionized, void of neutral particles. Contrarily, the deeper layers of the solar atmosphere (photosphere and chromosphere) are partly ionized, in which the abundance of neutral particles exceed by a large factor that of charged particles. Despite the large number of neutral particles, the plasma still behaves as a highly-conducting fluid in these layers.

In this talk, the relevant equations governing the evolution of a plasma as a single fluid (interpreted as if a single type of particles were present) will be presented. The main terms in these equations will be interpreted in physical terms and extreme cases with completely different evolutions and properties will be presented, both under a pure academic ideal point of view, as well as with parallel examples in the solar atmosphere. The equations include hydrodynamical terms, as in a neutral fluid, and magnetic terms, derived from the magnetic fields created by the currents generated by the charges and the Lorentz force acting, in turn, on the same particles by those fields. In some situations, the hydrodynamical terms dominate over the magnetic ones, and the plasma evolves and moves as a neutral fluid. In this case, magnetic fields react passively to the motion and evolution of the plasma. This is what happens mostly in the solar interior and in the deep photosphere. From mid-photosphere upwards, the situation changes and the magnetic forces dominate over the hydrodynamical ones. The magnetic field evolves by itself (with the boundary conditions imposed by the field in the underlying layers, because of the continuity of the field lines) and dictates how the plasma particles should behave. In both opposite circumstances, the plasma and magnetic field properties and evolution are completely different.



EST-2

The European Solar Telescope - EST

Manuel Collados^{1,*}

¹ Instituto de Astrofísica de Canarias,

* presenting author email: manuel.collados@iac.es

01.10.2026, Thursday
11:45 – 12:15

EST

European Solar Telescope

EST is the future major infrastructure for ground-based solar physics in Europe. EST will be built in the island of La Palma (Canary Islands, Spain) and is expected to start operations in the next decade. The project is devised to study the solar magnetism of the deepest layers of the solar atmosphere with high spatial, temporal, spectral and polarimetric accuracies, to record how magnetic energy is stored by plasma flows, propagated at large distances and finally released to heat and accelerate the plasma towards the interplanetary space. Understanding these processes is essential to evaluate how the Sun modulates the conditions prevailing in the interplanetary medium and the Earth's environment, needed for space weather forecast.

To achieve its scientific goals, EST has a number of characteristics that, all together, will make it unique in the world. To obtain the best images ever recorded from the Sun, EST will incorporate a primary mirror, M1, with a diameter of 4.2 m. Only the American DKIST, installed in Hawai'i, has a similar size among solar telescopes. The fabrication of M1 represents a fantastic challenge. It will be the mirror with the largest aspect ratio (diameter/thickness ratio, with a value of 560 for the EST M1) ever constructed. With this M1 size, EST will ensure a large collecting power to reduce the intrinsic shot noise of photon measurements together with a spatial resolution of few tens of km on the Sun. To overcome the limitations imposed by the unavoidable turbulence of the Earth's atmosphere existing even at the best observatories, EST will be equipped with the most complete and ambitious set of deformable mirrors to compensate for the wavefront deformation induced by the variations of refractive index as light propagates in the Earth's atmosphere. This compensation will be computed and applied in real time at kHz frequencies.

There will be two observing stations (visible and near-infrared), with room for seven novel powerful instruments whose joint simultaneous use is planned. To maximize efficiency, these instruments will be tuned and optimised for different passbands. Each of these instruments will have polarimetric capabilities. Measuring the polarization of light opens the door to the inference of the solar vector magnetic field. The optical design of EST ensures that the polarimetric performance of the optics in the full optical path from M1 to the instruments is fixed in time, independent of the pointing of the telescope, so that time-consuming calibration and modelling tasks necessary at other telescopes are not required for EST.

The different wavelength regimes of the various instruments make it possible to probe different layers in height in the solar atmosphere. With all this information put together, EST will provide the community with 3D maps of physical quantities (temperature, pressure, density, velocity, magnetic field vector, ionization degree, etc.) and their temporal evolution.



EST-3

Slovak Participation in the European Solar Telescope

Peter Gömöry^{1,*}

¹ *Astronomical Institute, Slovak Academy of Sciences,*

* presenting author email: gomory@astro.sk

01.10.2026, Thursday

12:15 – 12:30

EST

European Solar Telescope

THE EUROPEAN SOLAR TELESCOPE (EST) is a next generation large-aperture (4 meters) solar telescope which will revolutionize observations of our Sun. This will be achieved through the unique and novel post-focus instrumentation. The acquired data will contribute not only to fundamental solar astrophysics research, but will also address and answer questions of direct societal impact, e.g., aspects that concern space safety. EST will also ensure technological sovereignty and help to keep the competitiveness of European industry. In addition, EST will secure the future of solar physics in Europe and will provide an attractive environment to educate the next generation of scientists, engineers and technicians.

In this presentation, we will describe current role of Slovakia within the EST project, which clearly demonstrate that our country is one of the leaders of the project. Slovakia is represented in the project by the Astronomical Institute of the Slovak Academy of Sciences which has been involved in the EST from its very beginning. Our institute is one of the founding organisations of the “Canarian Foundation – EST”, the organisation which is currently covering the EST project. And even more, Slovakia together with Spain and the Czech Republic founded “Board of governmental representatives” for the EST project. It is this body that is to lead the EST project to the creation of an ERIC legal entity, which would subsequently ensure the construction and operation of the EST telescope.



EST-4

Realistic Simulations of the Solar Magneto-Convection including Non-ideal Effects

Elena Khomenko^{1,*}

¹ Instituto de Astrofísica de Canarias,

* presenting author email: khomenko.iac@gmail.com

02.10.2026, Friday
09:00 – 10:30

EST

European Solar Telescope

REALISTIC SIMULATIONS of the solar upper convection zone and its atmospheric layers have become essential tools for unraveling complex magnetohydrodynamic processes in the Sun and complementing observational studies. These simulations also serve as laboratories for testing new ideas. One such idea involves incorporating partial ionization and other non-ideal effects - such as ambipolar diffusion, the Hall effect, and the Biermann battery effect - as potential mechanisms for explaining non-radiative heating in the solar chromosphere and transition region. In this lecture I will review numerical techniques and physical modules needed for producing a realistic simulation of the box-in-a-star style. I will discuss the role of the realistic equation of state, approximations for treatment of interaction of plasma and radiation, and heat conduction. I will review the major numerical codes routinely used for producing realistic solar simulations and will draw possible future lines for their development.



EST-5

Radiative Transfer in the Solar Atmosphere: from Spectral Synthesis to Inversions

Sergio Javier González Manrique ^{1,*}

¹ Instituto de Astrofísica de Canarias,

* presenting author email: smanrique@iac.es

02.10.2026, Friday
11:00 – 12:30

EST

European Solar Telescope

THE INTERPRETATION of solar observations relies critically on our ability to understand how radiation is formed and modified as it propagates through the solar atmosphere. Radiative transfer provides the fundamental framework that connects the physical properties of the plasma such as temperature, velocity, and magnetic field with the observed spectral profiles.

The basic principles of radiative transfer in the solar photosphere and chromosphere are introduced, including the formation of spectral lines under local thermodynamic equilibrium (LTE) and non-LTE conditions. Forward modelling, or spectral synthesis, allows the prediction of observables from atmospheric models, while inversion techniques enable the inference of the underlying physical parameters from spectropolarimetric measurements.

Examples from a variety of solar structures, including the quiet Sun, pores, sunspots, filaments, and arch filament systems, among others, illustrate how radiative transfer techniques are applied in practice. An overview of widely used inversion codes in solar physics is also provided, highlighting their role in the analysis of spectropolarimetric data. This framework provides a coherent view of how radiative transfer techniques are used to extract physical information from the solar atmosphere.

Part VII

Poster presentations



P-01

Study of the Impact of Ligand Exchange on Properties of Thin Films based on Mercury Chalcogenides Colloidal Quantum Dots

Teodora Milenkovich^{1,*}

¹ Center for Solid State Physics and New Materials, Institute of Physics Belgrade, Pregrevica 118, P.O.Box 68, 11080 Belgrade, Serbia

* presenting author email: tmilenkovich@mail.ru

30.09.2026, Wednesday
18:00–19:30

XRAY

X-ray techniques

THE PRESENT WORK reports a series of experiments aimed at the fabrication and investigation of photosensitive thin films operating in the 3–5 μm spectral range based on mercury chalcogenide colloidal quantum dots (CQDs), namely mercury telluride (HgTe) and mercury selenide (HgSe). Particular attention was devoted to the effect of ligand exchange on the structural and electrophysical properties of the resulting photoresistive devices. Thin CQD films were fabricated via spin-coating under an inert argon atmosphere. The morphology and thickness of the deposited layers were characterized using atomic force microscopy (AFM). Photoresistive structures were prepared by sequential deposition of CQDs onto gold interdigitated electrodes followed by layer-by-layer ligand exchange. Their electrophysical characteristics were subsequently investigated. Colloidal quantum dots are semiconductor nanocrystals whose surfaces are passivated by an organic monolayer composed of coordinating ligands. Due to quantum confinement effects, the optical properties of CQDs strongly depend on the size of the semiconductor core.

HgTe CQDs have attracted significant attention over the past decade owing to their unique physical properties. The combination of a large exciton Bohr radius (≈ 30 nm), a near-zero bulk bandgap, and spectral tunability in the infrared region makes these materials highly promising for laser and photodetector applications. In contrast, HgSe CQD-based materials remain relatively underexplored, although their photoresponse extends into the 3–5 μm spectral range. In this study, thin films based on mercury chalcogenide CQDs and photoresistors fabricated from these materials were investigated.

Photosensitive thin films were synthesized from HgTe and HgSe CQD solutions using wet-chemistry approaches. The composition and thickness of the ligand shell were found to strongly affect the photoelectrical properties of the films. Within this work, photosensitive HgTe and HgSe CQD thin films were fabricated on oxidized silicon substrates by layer-by-layer spin-coating performed both in an inert argon atmosphere and under ambient conditions. AFM characterization was employed to analyze surface morphology, roughness, and film thickness as a function of different ligand-exchange procedures. Ethane-1,2-dithiol and iodide ligands were selected as ligand-exchange agents. Photoresistors were fabricated by depositing CQD layers onto gold interdigitated electrodes formed on oxidized silicon substrates. The fabricated photoresistors were investigated under different illumination conditions (980 nm irradiation and blackbody source illumination). Current-voltage (I – V) characteristics of mercury chalcogenide CQD thin films were measured and analyzed following ligand exchange with iodide ions and ethane-1,2-dithiol.



P-02

Alternative Anode Materials for LIBs based on Hard Carbon

Aleksander Adam Krobisz^{1*}, Karel Saks¹, Katarína Gáborová¹

¹ Technical University of Košice, Faculty of Materials, Metallurgy and Recycling, Košice, Slovakia

* presenting author email: aleksander.adam.krobisz@tuke.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

HARD CARBON is a promising alternative anode material for lithium-ion batteries due to its low cost, structural stability, and ability to store Li⁺ ions. However, its electrochemical performance is strongly affected by carbonisation temperature, precursor type, surface chemistry, and the presence of heteroatom dopants. This work compares literature-reported hard carbon materials prepared from various organic precursors, including nanocellulose, lignin, cotton, bacterial cellulose, chitosan, and cotton stalks, with a focus on the relationship between pyrolysis temperature, specific surface area, and specific capacity. The results show that non-doped hard carbons generally exhibit decreasing capacity with increasing carbonisation temperature, mainly due to progressive structural ordering, graphitisation, and loss of active sites. In contrast, heteroatom-doped carbons, especially nitrogen- and sulphur-containing materials, retain higher capacities over a broader temperature range due to increased defect density, modified electronic structure, and improved surface chemistry. The most favourable performance is observed at moderate pyrolysis temperatures of approximately 700–1000 °C, where a balance between structural disorder, heteroatom retention, active sites, and electrical conductivity is achieved. The comparison also indicates that specific surface area alone does not determine electrochemical performance; chemical activation, dopant type, defect structure, and carbon microstructure play equally important roles. These findings highlight the importance of controlled pyrolysis and heteroatom doping in the design of sustainable hard carbon anodes for lithium ion batteries.

ACKNOWLEDGEMENT This work was supported by the Slovak Research and Development Agency under the contract no. VV-MVP-24-0264 and by the research grant for young researchers at the Technical University of Košice, no. 03/TUKE/2025.



P-03

Solvent-directed Synthesis and Structural Stability of HKUST-1 in Aqueous, Biological, and Organic Media

Nikolas Király^{1,*}, Peter Obšatník¹, Daria Striežovská², Vera Meynen³, Vladimír Zelenák¹, Miroslav Almáši¹

¹ Institute of Chemistry, P.J. Šafárik University in Košice, Moyzesova 11, 041 54 Košice, Slovakia,

² Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

³ Department of Chemistry, University of Antwerp, Universiteitsplein 1, 2610 Wilrijk, Belgium

* presenting author email: nikolas.kiraly@upjs.sk

30.09.2026, Wednesday
18:00–19:30

XRAY

X-ray techniques

HKUST-1 is a Cu(II)-based metal–organic framework constructed from copper paddle wheel units interconnected by benzene-1,3,5-tricarboxylate linkers [1]. Its high porosity and accessible coordinatively unsaturated Cu(II) sites support applications in adsorption, heterogeneous catalysis, environmental remediation, and biological or biomedical systems. However, its pronounced affinity toward water and limited hydrolytic stability restrict its use in aqueous and biologically relevant media. Moreover, the conventional synthesis frequently relies on N,N'-dimethylformamide (DMF), a solvent associated with significant toxicological and environmental concerns [2, 3]. This study therefore investigated how replacement or partial substitution of DMF with dimethyl sulfoxide (DMSO), ethanol, and water affects HKUST-1 formation, crystallinity, phase purity, and subsequent structural stability. HKUST-1 materials were prepared solvothermally from copper(II) nitrate trihydrate and benzene-1,3,5-tricarboxylic acid at 120 °C for 20 h using H₂O/EtOH, DMSO/EtOH, DMSO/H₂O, DMSO/DMF, pure DMSO, and pure DMF solvent systems. After controlled cooling, the crystalline products were isolated, washed thoroughly with methanol, dried in air, and characterized primarily by powder X-ray diffraction (PXRD), supported by Fourier-transform infrared (FTIR) spectroscopy. The PXRD patterns of all samples displayed the characteristic reflections of HKUST-1 and agreed closely with the simulated pattern derived from its single-crystal structure, confirming successful framework formation and preservation of the HKUST-1 topology irrespective of solvent composition. The absence of additional diffraction reflections further indicated high phase purity and showed that neither solvent variation nor retained solvent coordination produced a detectable change in the crystalline framework. FTIR spectroscopy confirmed coordination of the benzene-1,3,5-tricarboxylate linker to Cu(II) through the characteristic carboxylate and Cu–O vibrations. In DMSO-containing samples, an additional sulfoxide stretching band revealed the presence of residual DMSO molecules after methanol washing. The structural stability of the prepared materials was subsequently evaluated in aqueous media over a broad pH range, in biologically relevant phosphate-buffered saline, tris(hydroxymethyl) aminomethane and 4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid buffers, physiological saline, and selected organic solvents. These findings demonstrate that solvent modulation, including the use of DMSO-containing systems, enables the preparation of phase-pure HKUST-1 and provides a suitable basis for assessing its applicability in aqueous and biologically relevant environments.



P-04

Structural and Thermal Properties of Melt Spun Fe-Ga-Al-P-C-B Amorphous Ribbons

Nebojša Mitrović^{1,*}, Pavol Sovák², Jozef Bednarčík², Borivoje Nedeljković¹, Vladimír Girmán², Jelena Orelj¹, Peter Dubecký², Ravneet Kaur²

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

¹ University of Kragujevac, Faculty of Technical Sciences Čačak, Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems, 65, Svetog Save St. 32102 Čačak, Serbia,

² Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: nebojsa.mitrovic@ftn.kg.ac.rs

IRON-BASED alloy systems Fe–(Al, Ga)–(P, C, B) rank among the softest magnetic materials obtained through controlled annealing ($H_c \approx 1.3$ A/m annealed at 713 K $\approx 0.97 T_g$) to relieve internal stresses, *i.e.*, after optimum relaxation of the amorphous structure. Low coercivity stems from the suppression of the formation of crystal nuclei of the iron and iron-metalloid compounds. High phosphorus (P) content in the iron-based alloy system inhibits the rapid growth of α -Fe grains during the crystallization process.

Master alloy of chemical compositions $\text{Fe}_{72}\text{Al}_5\text{Ga}_2\text{P}_{11}\text{C}_6\text{B}_4$ was prepared by arc-melting in Ti-gettered argon atmosphere to prevent oxidation and nitrogen contamination. The ribbons produced by a single-roller melt-spinning technique in air exhibit as-cast “XRD-amorphous” state. Elemental SEM-EDS mapping confirmed the presence and homogeneous distributions of all constituent elements of the alloy. Areas of increased roughness were observed on the ribbon’s shiny side, resulting from a large number of gas bubbles trapped between the liquid pool and the copper wheel. During magnetization, these areas act as pinning centers on the magnetic domain walls, thereby disrupting low coercivity and high permeability.

The DSC trace exhibits a glass-transition region followed by an exothermic crystallization process (at a heating rate of 40 K/min, the onset of the glass transition and crystallization is $T_g = 736$ K, $T_x = 802$ K, respectively). The higher heating rate causes a thermal lag and shifts the crystallization peak temperature from 788 K (10 K/min) to 813 K (50 K/min). The observed supercooled liquid region $\Delta T_x = T_x - T_g \approx 66$ K is a metastable temperature interval, where the alloy remains a highly viscous, disordered liquid. After annealing at 973 K, many peaks are present in the XRD pattern. Since they overlap, it is not easy to identify all the phases present. XRD confirmed the formation of the clearly visible bcc-Fe and iron-boron Fe_2B phase.

ACKNOWLEDGEMENT The authors acknowledge the joint support by the Slovak Research and Development Agency and Serbian Ministry for Science, Technological Development, and Innovations (Project: New Perspective in Amorphous and Nanocrystalline Soft Magnetic Alloys – NewAM – Grant No. APVV SK-SRB-25-0003). This study was also funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034. Support from the project VEGA 1/0638/24 is also acknowledged.



P-05

Expression, Purification and Preliminary Crystallographic Analysis of UL141-gH Complex Presented on HCMV Virion Surface

Andrej Bitala^{1,*}, Ivana Nemčovičová²

¹ Biomedical Research Center, Slovak Academy of Sciences, Bratislava, Dúbravská cesta 9, 845 05, Bratislava

* presenting author email: bitalaandrej@gmail.com

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

HUMAN CYTOMEGALOVIRUS (HCMV) employs multiple viral glycoproteins to regulate cell entry, intracellular trafficking and immune evasion. The immunomodulatory glycoprotein UL141 interacts with the viral envelope glycoprotein gH and the cellular death receptor TRAIL-R2. However, the structural basis of these interactions and their potential modulation by synthetic ligands remain poorly understood. This study aimed to establish a platform for the biochemical and structural characterization of the HCMV UL141–gH complex as a prerequisite for investigating the competitive and allosteric interactions of UL141 with gH, TRAIL-R2 and the synthetic glycomimetic TK219.

Soluble ectodomains of Strep-tagged gH and His-tagged UL141 were co-expressed in suspension-adapted HEK293F cells. The complex was isolated using sequential His- and Strep-affinity chromatography, proteolytic tag removal and size-exclusion chromatography. Co-elution during size-exclusion chromatography and the presence of both proteins in the purified fractions confirmed formation of a stable heterodimeric complex. SDS-PAGE revealed bands corresponding to glycosylated gH and UL141 at approximately 78–90 and 38–48 kDa, respectively. Dissociation into individual subunits under non-reducing SDS-PAGE conditions indicated that the complex is stabilized by non-covalent interactions.

Far-UV circular dichroism spectroscopy demonstrated that the purified complex is folded and exhibits a mixed α/β secondary-structure profile. Negative bands near 208 and 222 nm indicated a substantial α -helical contribution, predominantly attributable to gH, whereas UL141 likely contributed to the broader signal within the 215–220 nm region. Initial sitting-drop crystallization screening produced crystals under several conditions. Synchrotron diffraction tests at the ESRF MASSIF-1 beamline yielded diffraction extending to approximately 2.42 Å. However, incomplete low-resolution reflections and ambiguous indexing prevented reliable structure determination. These results establish a reproducible procedure for producing folded UL141–gH complex and provide a foundation for further crystallographic optimization and quantitative competition studies examining whether TK219 modulates the mutually exclusive interactions of UL141 with gH and TRAIL-R2.

ACKNOWLEDGEMENT Financial supports provided by the Slovak Research and Development Agency (APVV-19-0376 and APVV-24-0351) and the Scientific Grant Agency of the Slovak Republic (VEGA-02/0049/26) are gratefully acknowledged.



P-06

Structural Signatures of Spin Reorientation in Altermagnetic MnTe

Marek Ducháň^{1,*}, Jonas Krieger², Ondrej Caha¹

¹ Masaryk University, Kotlářská 2, Brno 602 00, Czech republic,

² Paul Scherrer Institut, Villigen, Switzerland

* presenting author email: 506115@mail.muni.cz

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

MANGANESE TELLURIDE (MnTe) is a prototypical antiferromagnet with a spin-polarised electronic structure, recently classified as an altermagnet, with a critical temperature $T_C \approx 310$ K. In this work, we investigate the structural changes associated with magnetic moment reorientation in the altermagnetic phase using high-resolution X-ray diffraction (HR-XRD). Temperature-dependent diffraction patterns were measured from helium/nitrogen temperatures up to room temperature, enabling precise determination of the lattice parameters a and c .

The extracted temperature dependences $a(T)$, $c(T)$ and the ratio $c/a(T)$ reveal a distinct change in slope at approximately 260 K. This anomaly coincides with the spin reorientation transition, during which the magnetic moments rotate by approximately 30° from alignment along the a^* -axis (below 260 K) toward the a -direction (above 260 K).

Our results demonstrate a coupling between the crystal lattice and the magnetic subsystem, providing evidence of magnetoelastic effects in MnTe. The observed structural signatures offer complementary insight to microscopic magnetic probes and contribute to a more complete understanding of the spin reorientation mechanism in this material.



P-07

X-ray Diffraction Study of Low Temperature Ferroelectric Phase Transitions in IV-VI Materials

Ondrej Caha^{1,*}

¹ Masaryk University, Kotlářská 2, Brno 602 00, Czech republic

* presenting author email: caha@physics.muni.cz

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

FAST, REVERSIBLE, and low-power manipulation of the spin texture is crucial for next generation spintronic devices like non-volatile bipolar memories, switchable spin current injectors or spin field effect transistors. Ferroelectric Rashba semiconductors (FERSC) are the ideal class of materials for the realization of such devices. Their ferroelectric character enables an electronic control of the Rashba-type spin texture by means of the reversible and switchable polarization. The IV-telluride family consists of normal semiconductor PbTe, inverted band gap semiconductor SnTe, and ferroelectric normal semiconductor GeTe. The pseudoternary alloy (Pb,Sn,Ge)Te thus allow for tuning band gap, topological properties, and ferroelectric transition temperature. Similar possibilities are also available in the selenide (Pb,Sn,Ge)Se family.

We will present utilization of a new closed-cycle helium cryostat mounted in a laboratory x-ray diffractometer. The temperature dependent structural properties were studied in thin films of tellurides and selenides. The structural properties results are compared with electronic structure studied by ARPES and other techniques.



P-08

Advanced Soft Magnetic Composites with Ferrite Insulation

Ioannis Tsoukalas^{1,*}, Ján Füzér¹, Samuel Dobák¹, Peter Kollár¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: ioannis.tsoukalas@upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

SOFT MAGNETIC COMPOSITES (SMCs) are a promising class of materials for high-frequency magnetic components in power electronics applications, including electric vehicle on-board chargers, DC-DC converters, and grid-tied inverters. Accomplishing higher operating frequencies than laminated steels and higher saturation flux density than common ferrites, SMCs consist of electrically insulated ferromagnetic particles that suppress eddy currents while enabling 3D flux paths, which provide great flexibility in component design. Despite these advantages, the high-frequency behaviour of SMCs, particularly those with ferrite coatings, remains critically undercharacterised in the literature, especially above 100 kHz.

This work investigates advanced ferro-ferrite SMCs in which a magnetically active ferrite phase is employed as the insulating medium. Iron and iron-alloy (Fe-Si, Fe-Si-Cr) particles will be coated with nickel-zinc or manganese-zinc ferrite. The two ferrites, chosen for their complementary resistivity-permeability trade-offs at high frequencies, are the most industrially applied ferrite materials. Different core materials introduce similar trade-offs, further complicating the selection of the appropriate core-shell material combination. The processing route is crucial in determining the final properties of the material. SMCs are traditionally developed by the conventional two-step method of cold pressing followed by heat treatment to improve material density and relieve stresses. Benefits of more advanced methods, such as hot pressing, spark plasma sintering and cold sintering, will be evaluated, along with combinations of them. The primary characterisation targets are magnetic performance properties, such as volumetric core loss, P_v , over broad frequency and temperature ranges, complex permeability, μ , and coercivity, H_c . Enhancing thermal and mechanical properties is another key demand for the incorporation of the material in real-world power electronic circuits. A physics-based broadband loss model will be developed to account for all relevant loss mechanisms in the dual-phase microstructure: hysteresis losses in both the iron core and the ferrite shell, eddy currents, split between short-range (intra-particle), governed by skin depth, and long-range (inter-particle), propagating through the ferrite insulation, and excess losses. The model will be validated against measurements, so that it can be successfully integrated into power electronics circuit simulation tools. This research is carried out within the Horizon EU Doctoral Network MAGNIFY, which aims to establish the foundation for modern power electronics, covering the whole chain from magnetic material development to power electronic circuit design and system-level modelling, with direct participation of five industrial partners.

ACKNOWLEDGEMENT This research is funded by the HORIZON.1.2 – MSCA programme (Grant agreement ID: 101226760).



P-10

BSA-coated Magnetic Nanoparticles for Betulinic Acid Delivery and MRI Contrast Enhancement

Valentín Jedinák^{1,*}, Alena Jurikova¹, Iryna Antal¹, Iryna Khmara¹, Katarina Dibdiakova², Martina Koneracka¹, Martina Kubovcikova¹, Monika Liskova², Oliver Strbak², Paula Pil-lárová¹, Vlasta Závistová¹

¹ Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovakia,

² Biomedical Center Martin, Slovakia

* presenting author email: 5224090@upjs.sk

30.09.2026, Wednesday
18:00–19:30

XRAY

X-ray techniques

MAGNETIC RESONANCE IMAGING (MRI) is a non-invasive diagnostic technique that provides high-resolution images of internal tissues based on nuclear magnetic resonance. It relies on the interaction between hydrogen nuclei and an external magnetic field to generate contrast between different biological structures. Contrast agents are often used in MRI to enhance image quality and improve diagnostic accuracy. Among these agents, iron oxide nanoparticles, specifically magnetite (Fe_3O_4) and maghemite ($\gamma\text{-Fe}_2\text{O}_3$), are used to shorten mainly the transverse relaxation time (T_2), significantly enhancing image contrast.

BSA-coated magnetite nanoparticles were synthesized and stabilized with HClO_4 ; subsequently, betulinic acid (BA) was conjugated to the resulting carrier. Physicochemical characterization revealed that the hydrodynamic diameter increased from 34.0 nm for the magnetic fluid (MF) to 52.1 nm after BSA coating (MFBSA), and further increased to 89.9 nm following BA binding (MFBSA-BA). Additionally, the observed decrease in zeta potential from +31.0 mV (MF) to +19.8 mV (MFBSA) confirms the successful coating of the positively charged maghemite core with amphiphilic BSA molecules. The MF sample exhibited the highest longitudinal relaxivity ($r_1 = 6.49 \text{ mM}^{-1}\text{s}^{-1}$) together with high transverse relaxivity ($r_2 = 389 \text{ mM}^{-1}\text{s}^{-1}$). Conjugation with BSA resulted in a substantial decrease in r_1 ($1.72 \text{ mM}^{-1}\text{s}^{-1}$), while r_2 remained relatively high ($370 \text{ mM}^{-1}\text{s}^{-1}$). Further functionalization with betulinic acid (BA) led to a slight additional decrease in both r_1 ($1.51 \text{ mM}^{-1}\text{s}^{-1}$) and r_2 ($273 \text{ mM}^{-1}\text{s}^{-1}$). Overall, surface modification reduced both the longitudinal and transverse relaxivities, while significantly increasing the r_2/r_1 ratio ($60 \rightarrow 215 \rightarrow 181$), indicating predominantly T_2 -type contrast behavior.



P-11

Novel High-entropy Materials for Energy Storage

Marianna Hodorová^{1*}, Alena Fedoročková¹, Dana Ivánová¹, Dávid Csík¹, Frantisek Kromka², Gabriel Súčik¹, Karel Saksl¹, Katarína Gáborová¹, Róbert Džunda²

¹ Technical University of Košice, Letná 9, 042 00 Kosice Slovakia,

² Slovak Academy of Sciences, Institute of Materials Research, Watsonova 47, 040 01 Kosice Slovakia

* presenting author email: marianna.hodorova@tuke.sk

30.09.2026, Wednesday

18:00 – 19:30

XRAY

X-ray techniques

THE SUSTAINABLE transformation of industrial sectors and metallurgy is closely linked to the implementation of hydrogen technologies. However, the efficient operation of hydrogen technological systems (such as electrolyzers and fuel cells) relies on secondary energy storage systems capable of balancing dynamic power surges. Lithium-ion batteries (LIBs) integrated into these hybrid hydrogen frameworks require a new generation of electrode materials featuring high capacity and extended lifespan.

This work focuses on the synthesis and electrochemical characterization of single-phase high-entropy perovskite $\text{La}(\text{Co}_{0.2}\text{Mn}_{0.2}\text{Fe}_{0.2}\text{Ni}_{0.2}\text{Cu}_{0.2})\text{O}_3$ (HEP), prepared via spray drying of an aqueous metal nitrate solution followed by calcination at temperatures ranging from 800 to 1100 °C. The study investigates its stability during rate capability testing. Electrochemical testing revealed a unique phenomenon of in-situ electrochemical activation. Following the initial cycles, a progressive increase in specific discharge capacity was observed across all calcination conditions, with the sample calcinated at 1100 °C for 1 hour demonstrating the highest capacity. This mechanism, associated with controlled particle pulverization and the evolution of a stable solid electrolyte interphase (SEI) layer (confirmed by SEM surface analysis), opens new avenues for pseudocapacitive charge storage. This paper provides a detailed analysis of the material's stability over 150 cycles. The findings demonstrate that the entropy-stabilization effect effectively suppresses degradation mechanisms in conversion anodes, making this perovskite a promising candidate for battery subsystems that ensure the stability and operational continuity of advanced hydrogen energy networks.



P-12

Experimental Capabilities of the Anton Paar XRDynamic500 X-ray Diffractometer for Materials Characterization

Daria Striežovská^{1,*}, Jozef Bednárčík¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: daria.yudina@upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

WITHIN THE MASS-PRAM project, a new Anton Paar XRDynamic500 X-ray diffractometer was acquired at the Institute of Physics, Pavol Jozef Šafárik University in Košice for the structural characterization of various materials. The instrument operates with Cu-K α radiation and allows goniometer configurations with radii of 360 mm and 400 mm. The performance of the diffractometer was evaluated using the standard reference material LaB₆. The dependence of angular resolution on the goniometer radius, optical and slit configurations was investigated. The obtained results demonstrated that the choice of experimental configuration significantly affects the diffraction peak width and overall angular resolution of the diffraction patterns. The analysis of the Instrumental Resolution Function (IRF) revealed a systematic increase in the full width at half maximum (FWHM) with increasing diffraction angle for all tested configurations. Configurations employing a slit aperture of 0.025 rad exhibited lower FWHM values throughout the entire measured angular range. The best angular resolution was achieved using the monochromator, 0.025 rad slits, and a 400 mm radius goniometer, where the width of the first diffraction peak of the LaB₆ reference sample reached approximately 0.024°. Furthermore, the IRF analysis demonstrated that the combination of the monochromator and 0.025 rad slits leads to a systematic improvement in angular resolution across the full range of measured diffraction angles.

The capabilities of the instrument were further demonstrated on several materials. Crystalline CeO₂ demonstrated the quality of the diffraction patterns. Fluorescence reduction applied to the amorphous ribbon Fe₂₅Sc₇₅ suppressed the fluorescence background and improved the signal-to-noise ratio. Nanostructured materials exhibited detectable diffraction reflections even at very low crystalline phase content. SAXS measurements of SBA-15 revealed characteristic reflections of its ordered pore structure. The presented results confirm the high flexibility and broad application potential of the Anton Paar XRDynamic 500 diffractometer and demonstrate the new experimental capabilities.

ACKNOWLEDGEMENT This study was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034.



P-13

Illuminating the Mechanism and Allosteric Behavior of NanoLuc Luciferase

Michal Nemergut^{1,*}, Martin Marek²

¹ CIB-TIP, Pavol Jozef Šafárik University in Košice, Slovakia,

² Loschmidt Laboratories, Masaryk University, Czech republic

* presenting author email: michal.nemergut@upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

NANOLUC, a superior β -barrel fold luciferase, was engineered 10 years ago but the nature of its catalysis remains puzzling. Here experimental and computational techniques are combined, revealing that imidazopyrazinone luciferins bind to an intra-barrel catalytic site but also to an allosteric site shaped on the enzyme surface. Structurally, binding to the allosteric site prevents simultaneous binding to the catalytic site, and vice versa, through concerted conformational changes. We demonstrate that restructuring of the allosteric site can boost the luminescent reaction in the remote active site. Mechanistically, an intra-barrel arginine coordinates the imidazopyrazinone component of luciferin, which reacts with O₂ via a radical charge-transfer mechanism, and then it also protonates the resulting excited amide product to form a light-emitting neutral species. Concomitantly, an aspartate, supported by two tyrosines, fine-tunes the blue color emitter to secure a high emission intensity. This information is critical to engineering the next-generation of ultra-sensitive bioluminescent reporters.



P-14

Investigation of Ion Irradiation Damaged of Novel FeCrAl Oxide Dispersion Strengthened Alloys

Tomasz Stasiak^{1,*}

¹ National Centre for Nuclear Research, ul. Soltana 7, 05-400 Otwock, Poland

* presenting author email: tomasz.stasiak@ncbj.gov.pl

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

OXIDE DISPERSION STRENGTHENED (ODS) alloys are composed of a metallic matrix (typically bcc or fcc) containing a uniform distribution of nanoscale oxide particles. These alloys generally exhibit strong mechanical performance, retaining high strength even at elevated temperatures reaching 800°C. In addition, the nanoscale precipitates function as trapping sites for defects generated by irradiation, considerably enhancing the material's resistance to radiation damage. Owing to these characteristics, ODS alloys are considered attractive candidates for use in various components of Generation IV nuclear reactors, such as high-temperature gas-cooled reactors.

In this work, FeCrAl-Y₂O₃ ODS alloys with minor additions (0.5–1.0%) of Ti and V were investigated to assess how chemical composition and processing parameters influence microstructure and properties, including behavior under irradiation. The alloys were produced via mechanical alloying followed by spark plasma sintering under optimized conditions. Microstructural characterization using SEM and EBSD showed a fine, uniform grain size of around 1 μm across all samples, with vanadium addition appearing to produce a slight further refinement in grain size. TEM analysis revealed a dense and homogeneous distribution of nanoscale oxide particles (10–40 nm in size), along with the presence of Ti-rich nanometric carbides. Room-temperature tensile testing showed yield strength up to 900 MPa and ultimate tensile strength up to 1050 MPa, while in-situ high-temperature testing up to 800°C demonstrated encouraging mechanical performance under elevated temperatures. Irradiation resistance was assessed through Fe²⁺ ion implantation at room temperature and 300°C, up to a dose of 5 dpa. Nanoindentation measurements indicated only limited irradiation-induced hardening, while grazing incidence XRD showed increases in both crystallite size and lattice strain following irradiation. Detailed TEM investigations were carried out to characterize irradiation-induced defects and assess the stability of the oxide precipitates. Overall, these findings support the potential of FeCrAl ODS alloys as candidate materials for Generation IV nuclear reactor applications.



P-15

Biofunctional Surface Engineering of CoFe_2O_4 Nanoparticles for Enhanced Magnetic Particle Hyperthermia

Luboš Nagy^{1,*}, Adriana Zelenáková¹, Michael Barutiak¹, Pavol Hrubovčák¹, Žaneta Fabriciová¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: lubos.nagy@student.upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

MONODISPERSE CoFe_2O_4 nanoparticles with an average core size of approximately 9 nm were synthesized by thermal decomposition and surface-engineered for magnetic particle hyperthermia. Polyacrylic acid (PAA) coating was employed to improve aqueous dispersibility and provide reactive groups for subsequent covalent attachment of lysine, tryptophan, and elastin via EDC/NHS coupling. The resulting nanoparticles were characterized using FTIR, DLS, SEM, TEM, XRD, and SQUID magnetometry to evaluate their surface chemistry, colloidal properties, morphology, crystal structure, and magnetic behavior. Magnetothermal performance was assessed through specific absorption rate (SAR) and intrinsic loss power (ILP). The results demonstrate that biomolecular functionalization modifies the interfacial and colloidal properties of CoFe_2O_4 nanoparticles while preserving their magnetic functionality, highlighting their potential as surface-engineered magnetothermal agents for magnetic hyperthermia.



P-16

Structural Characteristics of CoFe_2O_4 Nanoparticles with Different Morphologies

Žaneta Fabriciová^{1,2,*}, Adriana Zeleňáková¹, Ľuboš Nagy¹, Maksym Lisnichuk¹, Michael Barutiak¹, Pavol Hrubovčák¹, Pierfrancesco Maltoni², Davide Peddis²

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

² Department of Chemistry and Industrial Chemistry (DCCI) & INSTM RU, nM2-Lab, University of Genoa, Genoa 14146, Italy

* presenting author email: zaneta.fabriciova@student.upjs.sk

30.09.2026, Wednesday
18:00–19:30

XRAY

X-ray techniques

COBALT FERRITE (CoFe_2O_4) nanoparticles belong to the family of spinel ferrites whose structural properties are strongly influenced by particle size, morphology, and synthesis conditions. A detailed understanding of their crystal structure is therefore important for establishing relationships between synthesis, morphology, and the resulting material properties.

In this work, CoFe_2O_4 nanoparticles with three different morphologies, spherical, cubic, and octopod-like, were synthesized by thermal decomposition. The structural properties of the prepared nanosystems were investigated primarily by X-ray diffraction, with particular emphasis on the influence of particle morphology on the crystalline characteristics of cobalt ferrite. X-ray diffraction analysis confirmed the formation of crystalline CoFe_2O_4 with a spinel-type structure for all investigated samples. The diffraction patterns were analysed to evaluate the structural parameters of the individual morphologies and to identify possible differences related to particle shape. The XRD results were complemented by morphological characterization, confirming the formation of well-defined spherical, cubic, and octopod-like nanoparticles with narrow size distributions. The comparison of nanoparticles with different morphologies provides insight into the relationship between particle shape and the structural characteristics of CoFe_2O_4 nanomaterials. These findings underline the importance of controlled morphology and detailed structural analysis in the design and optimization of spinel ferrite nanoparticles.



P-17

Structural, Magnetic, and Magnetocaloric Properties of Ti-substituted GdMnO_3 Multiferroic Single Crystals

Muhammad Faisal Ashraf^{1,*}, Jiří Pospíšil², Marián Mihálik¹, Zuzana Molčanová³

¹ Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovakia,

² Department of Condensed Matter Physics, Faculty of Mathematics and Physics, Charles University, Ke Karlovu 5, 12116 Praha, Czech Republic,

³ Institute of Materials Research, Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovakia

* presenting author email: ashraf@saske.sk

30.09.2026, Wednesday
18:00–19:30

XRAY

X-ray techniques

SINGLE crystalline GdMnO_3 came to the attention of the scientists due to the discovery of multiferroicity in this compound. It crystallizes in the orthorhombically distorted perovskite structure; space group Pnma ; Gd ions are located on $4c$; Mn ions on $4b$ and oxygen anions are located on $4c$ and $8d$ crystallographic sites. The compound orders into antiferromagnetic phase below $T_N \sim 40$ K [1] and then undergoes order-to-order magnetic phase transition into low temperature canted magnetic phase at $T_{\text{lock}} (\sim 20\text{K})$. $\text{GdMn}_{1-x}\text{Ti}_x\text{O}_3$ ($0 \leq x \leq 0.1$) compounds were synthesized by the floating zone method to understand the role of Ti substitution on structural, magnetic, and magnetocaloric properties. Raman spectroscopy and X-ray diffraction, along with Rietveld refinement, confirm the pure phase of all compositions having an orthorhombic perovskite structure (space group; Pnma). The Neel temperature T_N is not visible on magnetization measurements; however, from the combination of zero-field-cooled; field-cooled magnetization data and hysteresis loops $M(B)$, we concluded the decrease of T_N from 42 K ($x=0$) to roughly 30 K ($x=0.1$). T_{lock} has been also shifted from ~ 20 K ($x=0$) to ~ 2 K ($x=0.1$). In the temperature interval $T_{\text{lock}} < T < T_N$ the $M(B)$ curves show simple antiferromagnetic behavior, however, below T_{lock} the character of $M(B)$ curves changed from complicated butterfly-type ($x=0$) to simple ferromagnetic one ($x=0.1$). This suggests that Ti destabilizes the magnetic structure or at least prevents the Gd sublattice from ordering. Magnetic entropy change (ΔS_M) is extremely sensitive to the direction of the applied field and can be negative (normal MCE) or positive (inverse MCE). The Gd ordering induces an inverse MC effect along c and b axes, whereas it's not seen along the a axis, revealing complex anisotropic magnetic ordering. The magnetic entropy change displays a broad peak at $T_1 \sim 13$ K with $-\Delta S_M = 11.35, 8.05, \text{ and } 7.77 \text{ J/kg-K}$ and corresponding relative cooling power (RCP) = 197.72, 164.70, and 166.78 J/kg for $x = 0.0, 0.05, \text{ and } 0.1$, respectively, under 5 T. A sharp $-\Delta S_M = 0.55 \text{ J/kg-K}$ (0.5 T) appears at $T_{\text{lock}} = 20$ K ($x = 0.0$), which is shifted to higher temperatures with a magnetic field.

ACKNOWLEDGEMENT This publication is the result of the project implementation: VEGA 2/0004/25.

References

- [1] N. Pavan Kumar et al., Phys. Scr., Vol. 83, p.045701 (2011)



P-18

Lattice Dynamics and Electronic Reconstruction in ZrTe_5

Ana Kanjevac^{1,*}, Ana Milosavljević¹, Jovan Blagojević¹, Qiang Li², Emil Bozin¹, Nenad Lazarević¹

¹ Center for Solid State Physics and New Materials, Institute of Physics Belgrade, Pregrevica 118, P.O.Box 68, 11080 Belgrade, Serbia,

² Brookhaven National Laboratory, USA

* presenting author email: kanje@ipb.ac.rs

30.09.2026, Wednesday
18:00 – 19:30

FEL

Free Electron Lasers

TOPOLOGICAL material ZrTe_5 exhibits a pronounced resistivity anomaly and a sequence of temperature-dependent electronic reconstructions whose microscopic origin remains under active debate [1,2]. Here, we present a symmetry-resolved Raman scattering study of ZrTe_5 single crystals in the ac plane over the temperature range 40–300 K. All symmetry-allowed Raman active phonons accessible in the employed polarization configurations were observed, corresponding to six A_g and two B_{2g} modes. While the phonon energies and linewidths exhibit the expected anharmonic evolution over most of the investigated temperature range, clear deviations from this behaviour emerge near 60 K and 200 K. Several A_g modes and both B_{2g} modes display pronounced Fano asymmetry, indicating coupling between lattice vibrations and the electronic continuum. The evolution of phonon energies, linewidths, and Fano parameters reveals two distinct temperature scales that coincide with previously reported transport anomalies. The observed response demonstrates a strong interplay between lattice dynamics and the temperature-dependent electronic structure of ZrTe_5 and identifies phonon modes that are particularly sensitive to electronic reconstruction in this material.

ACKNOWLEDGEMENT This research is financed by HIP-2D-QM Project. This project received funding from the European Union's Horizon Europe research and innovation programme under grant agreement NO 101185375.

References

- [1] Hang Chi et al, "Lifshitz transition mediated electronic transport anomaly in bulk ZrTe_5 ", New J. Phys. 19 015005 (2017). DOI: 10.1103/PhysRevB.106.L081124.
- [2] Mohelsky I. et al, "Temperature dependence of the energy band gap in ZrTe_5 : Implications for the topological phase", Phys. Rev. B 107, L041202 (2023), DOI: 10.1103/PhysRevB.107.L041202.



P-19

Demultiplexing Generalized Information via Quantum Transmission Lines

Soham Sau^{1,*}, Anna Jenčová¹, Tamal Guha¹

¹ RCQI, Institute of Physics, Slovak Academy of Sciences, Dúbravská cesta 9, Bratislava, Slovakia

* presenting author email: soham.sau@savba.sk

30.09.2026, Wednesday
18:00 – 19:30

EST

European Solar Telescope

DEMULTIPLEXERS are the fundamental primitives of network architecture, enabling perfect routing of an input classical signal to a designated one, among multiple output ports. Quantum transmission lines, having access to the quantum systems directly, are able to transmit both the classical and quantum information encoded in quantum systems. A natural question therefore emerges that whether the scrambled classical and quantum information in a quantum system can be perfectly demultiplexed in the designated classical and quantum output ports? Here we answer this question by introducing a quantum to quantum-classical device, namely the quantum demultiplexer (Q-DEMUX). We characterize the class of Q-DEMUXs enabling perfect routing of both the classical and the quantum information along with their simple circuit realizations. Our results highlight an explicit connection between the strength of a Q-DEMUX with the incompatibility of quantum instruments. Finally, we extend the notion in a stronger variant where the sender is oblivious regarding the nature of the data to be transmitted through the Q-DEMUX.



P-20

Unravelling the Flash Effect: Exploring Early Radiation Chemical Processes with XFEL Radiation

Barbora Sedmidubská^{1,*}, Libor Juha¹, Luděk Vyšín¹

¹ Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21 Prague 8, Czech Republic

* presenting author email: sedmidubskab@fzu.cz

30.09.2026, Wednesday
18:00–19:30

FEL

Free Electron Lasers

RADIOTHERAPY delivered at ultra-high dose-rates (UHDR, > 40 Gy/s) can preserve tumour-control efficacy while reducing normal-tissue toxicity, a phenomenon known as the FLASH effect. Despite intense research efforts, the underlying mechanisms remain poorly understood and the conditions required for the occurrence of the FLASH effect are still under debate. Recent studies suggest that not only the average dose rate, but also the temporal beam structure and pulse characteristics may play a crucial role in determining the biological response [1].

The European X-ray Free-Electron Laser (EuXFEL) provides unique irradiation conditions, enabling dose rates exceeding TGy/s and exploration of ultrafast (physico-)chemical processes inaccessible with conventional radiation sources. The unique pulse structure of the EuXFEL beam enables investigation of whether temporal irradiation patterns contribute to radiation-chemical responses relevant to the FLASH effect. In this work, we propose the development of an experimental platform for studying radiation chemistry as a function of absorbed dose, dose-rate, and beam structure. Key components include the implementation of validated fluorescence and chemical dosimetry, as well as the design of temperature-control and chemically inert sample cells compatible with EuXFEL operation and safety requirements. Representative radiosensitizers and plasmid DNA will be investigated in solution using an unfocused XFEL beam providing homogeneous dose deposition. By systematically varying irradiation conditions, we aim to identify radiation-chemical pathways sensitive to dose, dose rate, and pulse structure, and to establish their potential relevance to the FLASH effect using absorption and fluorescence spectroscopies and spin traps. Among the investigated systems, plasmid DNA will be used to assess radiation-induced damage, while Nibrozetone (RRx-001) will be used to determine whether radiosensitizing properties are retained or modified under UHDR irradiation conditions. The present work establishes the methodological and experimental framework for future XFEL irradiation studies. These experiments will provide insights into the early stages of radiation action under extreme irradiation conditions and contribute to a mechanistic understanding of the FLASH effect, ultimately supporting the development and clinical implementation of FLASH radiotherapy.

References

- [1] Y. Yang and F.-F. Yin, "Understanding of FLASH radiotherapy through physical to biological interpretation," *Radiation Medicine and Protection*, vol. 6 (2025) pp. 187-195, DOI: 10.1016/j.radmp.2025.07.002.



P-21

Experimental Phase Diagram and Quantum Monte Carlo Modeling of $\text{Cu}(\text{pm})(\text{ea})_2$: a Candidate for a Magnetic Berezinskii – Kosterlitz – Thouless Transition

Illia Kozin^{1,*}, Robert Tarasenko¹, Alžbeta Orendáčová¹, Erik Čižmár¹, Vladimír Tkáč¹, Martin Orendáč¹,

¹ Institute of Physics, P. J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: illia.kozin@student.upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

NEU
Neutrons

LOW-DIMENSIONAL spin-1/2 Heisenberg antiferromagnets provide an ideal platform for studying topological magnetic phases, including a magnetic Berezinskii–Kosterlitz–Thouless (BKT) transition. The previously well-studied metal-organic complex $\text{Cu}(\text{pm})(\text{ea})_2$ (pm = pyromellitic acid anion, $[\text{C}_6\text{H}_2(\text{COO})_4]^{4-}$; ea = ethylamine cation, $[\text{C}_2\text{H}_5\text{NH}_3]^+$) represents a quasi-two-dimensional antiferromagnet with anisotropic interactions forming a rectangular lattice with dominant exchange $J_1/k_B \approx 10$ K, and anisotropy parameter $R = J_2/J_1 \approx 0.7$, while no long-range magnetic ordering has been observed down to 1.8 K [1]. We extended heat capacity measurements down to 0.4 K in magnetic fields up to 9 T. While no magnetic phase transition was detected in zero field, the field behavior of the heat-capacity anomaly enabled construction of the magnetic field–temperature phase diagram. The resulting phase boundary is characterized by a small initial increase followed by the expected suppression of the BKT transition temperature with increasing magnetic field. Furthermore, the magnetic entropy released across the transition was analyzed and compared with theoretical predictions for a two-dimensional Heisenberg antiferromagnet on a isotropic lattice.

Based on the established microscopic magnetic model, the experimental phase diagram is compared with Quantum Monte Carlo simulations performed for different values of the exchange anisotropy parameter R . The resulting phase diagram provides a roadmap for future neutron scattering experiments aimed at probing short-range magnetic correlations across the field-induced BKT magnetic phase in $\text{Cu}(\text{pm})(\text{ea})_2$.

ACKNOWLEDGEMENT The work was supported by the projects VVGS-2026-3893, APVV-23-0006 and APVV-22-0172.

References

- [1] R. Nath, M. Padmanabhan, S. Baby, A. Thirumurugan, D. Ehlers, M. Hemmida, H.-A. Krug von Nidda, and A. A. Tsirlin, "Quasi-two-dimensional $S = 1/2$ magnetism of $\text{Cu}[\text{C}_6\text{H}_2(\text{COO})_4][\text{C}_2\text{H}_5\text{NH}_3]_2$ ", *Physical Review B*, vol. 91, no. 5 (2025) Art. no. 054409, DOI: 10.1103/PhysRevB.91.054409.



P-22

Study of Magnetic Order in the Quantum Magnet $\text{Cu}(\text{tn})\text{Cl}_2$

Ali Darwich^{1,*}, Robert Tarasenko¹, Erik Čižmár¹, Martin Orendáč¹, Alžbeta Orendáčová¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: ali.darwich@student.upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

NEU
Neutrons

PREVIOUS studies [1] of $\text{Cu}(\text{tn})\text{Cl}_2$ ($\text{tn}=\text{C}_3\text{H}_{10}\text{N}_2$) proved that the system is an excellent realization of a spin-1/2 two-dimensional (2D) quantum magnet. While previous work was unable to specify the type of 2D magnetic lattice, re-analysis of the thermodynamics data within the current theories suggests realization of a spatially anisotropic square lattice (SASL) with $R = J_1/J_2 \approx 0.5$ and $J_1/k_B = 4.5\text{K}$. However, a clear quadratic temperature dependence of specific heat observed far below 0.4 K indicates the presence of 2D magnetic correlations. Magnetic two-dimensionality of $\text{Cu}(\text{tn})\text{Cl}_2$ can be also demonstrated by the response on the applied magnetic field, typical for the field-induced Berezinskii-Kosterlitz-Thouless (BKT) phase transition theoretically predicted for HAF on the square lattice.

The existence of long-range magnetic order (LRO) is another important issue. Previous powder studies in zero field ($B=0$) were not able to indicate LRO down to 50 mK. The existence of LRO in $B=0$ was further examined on powdered sample in the muon spin relaxation (μSR) experiment performed down to 50 mK. The absence of oscillations typical for magnetic ordered phase seems to indicate the absence of conventional LRO. It could, however, be as well due to the weakness of the local fields in the vicinity of the Cl ions, at the sites where muons are expected to stop. The fact that a sharp increase of the relaxation rate is observed at about 0.5-0.6 K may suggest the onset of LRO. It should be noted that the field induced specific heat anomalies start to form just around these temperatures. What is more, recent single crystal specific heat measurements indicated nearly negligible round hump in this temperature region [1].

We believe that elastic neutron scattering in zero magnetic field should definitely decide about the character of a magnetic long-range order which should differ from a conventional Néel order due to the presence of structural modulation introducing potential splitting of magnetic system into a few different competing 2D domains. On the other hand, the potential elimination of LRO via weakened interlayer interactions would make the compound attractive for the studies of the interplay of magnetic field and 2D quantum states, investigated within the bulk material.

References

- [1] R. Tarasenko et al, Phys Rev. B 108 (2023) 214432, DOI: 10.1103/PhysRevB.108.214432.



P-23

Influence of Structure on Heat Capacity and Thermal Conductivity of $\text{Dy}_x\text{Y}_{1-x}(\text{PO}_3)_3$ Phosphate Glasses

Vladyslav Stadnyk^{1,*}, Vladimír Tkáč¹, Martin Tokarčík¹, Pavlo Baloh², Robert Tarasenko¹, Erik Čižmár¹, Martin Orendáč¹, Alžbeta Orendáčová¹, Jana Holubová³, Eva Černošková³, Zdeněk Černošek³, Alexander Feher¹

30.09.2026, Wednesday
18:00–19:30

NEU
Neutrons

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

² International Institute for Carbon-Neutral Energy Research, Kyushu University (I2CNER), 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan,

³ Department of General and Inorganic Chemistry, Faculty of Chemical Technology, University of Pardubice, Studentská 573, 532 10 Pardubice, Czech Republic

* presenting author email: vladyslav.stadnyk@student.upjs.sk

THIS STUDY is devoted to the investigation of low-temperature thermal properties of phosphate glasses $\text{Dy}_x\text{Y}_{1-x}(\text{PO}_3)_3$ containing different concentrations of rare-earth Dy^{3+} ions. The gradual substitution of Y^{3+} by Dy^{3+} is expected to modify the local structure of the glass network and influence its thermal properties. A series of $\text{Dy}_x\text{Y}_{1-x}(\text{PO}_3)_3$ samples with Dy^{3+} content ($x = 0, 0.0001, 0.001, 0.01, 0.1, 1$) was studied by means of heat capacity and thermal conductivity measurements. The heat capacity C_p was measured using the relaxation technique in the temperature range from 0.4 to 20 K under magnetic fields up to 9 T. Thermal conductivity $\kappa(T)$ was determined by the two-probe method between 1.8 and 300 K. The heat capacity data reveal a pronounced boson peak in the C_p/T^3 representation for all investigated compositions, confirming the presence of universal low-energy excitations typical of glassy systems. In Dy-doped samples, an additional Schottky-type anomaly is observed due to the splitting of the Dy^{3+} energy levels. The thermal conductivity exhibits characteristic glass-like behavior, including a plateau between approximately 5 and 20 K. Below 5 K, $\kappa(T)$ follows an approximately quadratic temperature dependence, while above 15 K it gradually increases. The incorporation of Dy^{3+} ions modifies phonon transport and changes the absolute values of thermal conductivity in a nontrivial way depending on concentration x . The observed behavior suggests that structural modifications induced by Dy^{3+} incorporation, together with magnetic scattering and spin-phonon interactions, play an important role in determining the thermal transport of Dy^{3+} -doped phosphate glasses.



P-24

Spacer-dependent Self-assembly of Urea-based Gemini Surfactants and their Application in Templating Ordered Mesoporous Silica

László Almásy^{1,*}, Ana-Maria Lacrămă², Gergely Nagy³, Manfred Kriechbaum⁴, Martin Písárčik⁵, Miloš Lukáč⁵, Sarvarjon Kurbonov¹, Vasyl Ryukhtin⁶, Zsolt Czígány¹

¹ HUN-REN Centre for Energy Research, Budapest, Hungary,

² “Coriolan Drăgulescu” Institute of Chemistry, Bv. Mihai Viteazul, No. 24, 300223 Timisoara, Romania,

³ Neutron Scattering Division, Oak Ridge National Laboratory, Oak Ridge, TN, 37831, USA,

⁴ Institute of Inorganic Chemistry, Graz University of Technology, Stremayrgasse 9/5, A-8010 Graz, Austria,

⁵ Faculty of Pharmacy, Comenius University, SK-83232 Bratislava, Slovakia

⁶ Nuclear Physics Institute, Czech Academy of Sciences, 250 68 Husinec-Řež, Czech republic,

* presenting author email: almasy.laszlo@ek.hun-ren.hu

30.09.2026, Wednesday
18:00 – 19:30

NEU
Neutrons

UREA-BASED cationic gemini surfactants with polymethylene spacers containing 2 to 10 methylene units were investigated with respect to their micellization behavior and their role as pore-forming agents in the synthesis of mesoporous silica nanoparticles. Micellar structures were characterized using small-angle neutron scattering (SANS) with various form-factor of core-shell and homogeneous ellipsoid models [1].

Using the same surfactants as structure-directing agents, mesoporous silica nanoparticles were synthesized by a sol-gel process under basic conditions [2]. Particle morphology and pore structure was investigated using nitrogen porosimetry, SAXS, USANS, SEM and TEM. All materials exhibited 2D hexagonal pore structure of MCM-41. The spacer length influenced the lattice spacing and the size of the ordered domains. TEM analysis revealed a 10–20% variation in lattice spacing across crystalline domains. The finite domain size was the dominant contribution, whereas the lattice-spacing variation gave a smaller contribution to the diffraction line broadening. Surfactants exhibiting weaker intermicellar interactions, produced predominantly spherical silica particles, suggesting a possible influence of intermicellar interactions on particle morphology. While this trend was not systematic across the entire series, a possible connection between spacer-controlled molecular architecture, micellar structure, and the structural characteristics of the resulting mesoporous silica could be established.

ACKNOWLEDGEMENT This research was supported by grants no. APVV SK-HU-24-0023 and APVV-23-0349 of the Slovak Research and Development Agency and grant no. TÉT-1.2.5-2024-00068 of the Hungarian National Research, Development and Innovation Fund.

References

- [1] S. Kurbonov et al., “Quantitative SANS and multi-model analysis of spacer-dependent micellization of urea-based gemini surfactants” *JCIS Open*, vol. 23, 100189, 2026. DOI:10.1016/j.jciso.2026.100189.
- [2] S. Kurbonov et al., “Structural Characterization of Ordered Mesoporous Silica Prepared by a Sol–Gel Process Using Urea-Based Cationic Gemini Surfactants” *Gels*, vol. 11, 804, 2025. DOI:10.3390/gels11100804.



P-25

Element-specific Local Structural Disorder in (MgCoNiCuZn)O High-entropy and Related Oxides

Julija Lukaševiča^{1,*}, Alexei Kuzmin¹, Edmund Welter², Aleksandr Kalinko²

¹ Institute of Solid State Physics, University of Latvia, Riga, Latvia,

² Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

* presenting author email: julija.lukasevica@cfi.lu.lv

30.09.2026, Wednesday

18:00–19:30

SYN
Synchrotrons

HIGH-ENTROPY OXIDES (HEOs) are materials in which five or more cations share a common crystallographic lattice that is stabilized by high configurational disorder [1]. The presence of multiple principal elements allows their deliberate selection, thus tuning or fundamentally altering the properties of the compound. Despite often crystallizing in simple average structures, HEOs exhibit significant local distortions due to differences in the ionic radii, electronic configurations, and bonding preferences of the constituent cations. Understanding these distortions is essential for establishing structure-property relationships in HEOs. In this work, the local atomic structure of the prototypical rock-salt HEO (MgCoNiCuZn)O [2] was investigated and compared with two related compounds, (MgCoNiZn)O and (MgCo_{0.3}NiCu_{0.1}Zn)O, to determine the effect of Jahn-Teller distortions at Cu sites on the overall lattice. To probe the local environment of individual cations, extended X-ray absorption fine structure (EXAFS) spectroscopy measurements were carried out at the Co, Ni, Cu, and Zn K-edges at the P65 [3] and P64 [4] beamlines of the PETRA III synchrotron facility. The experimental spectra were analysed using reverse Monte Carlo simulations [5], allowing the simultaneous fitting of multiple absorption edges while accounting for contributions from distant coordination shells. Significant distortions of the first coordination shell around both Co and Cu ions were observed in (MgCoNiCuZn)O. However, no distortions around Co were found in samples with lower Cu content, namely (MgCoNiZn)O and (MgCo_{0.3}NiCu_{0.1}Zn)O. The distortion of the local environment around Cu is consistent with the first-order Jahn-Teller effect, as previously reported by Rost et al. [2]. The distortion of the local environment around Co may be induced by the Cu Jahn-Teller distortions; however, the exact mechanism underlying this effect requires further investigation.

ACKNOWLEDGEMENT This study was supported by the Latvian Council of Science project No. LZP-2023/1-0476. Beamtimes were allocated under proposals I-20240967 EC and I-20250904 EC.

References

- [1] J. Ren et al., Adv Compos Hybrid Mater, vol. 8 (2025) p. 195, DOI: 10.1007/s42114-025-01275-4.
- [2] C. M. Rost et al., Nat Commun, vol. 6 (2015) p. 8485, DOI: 10.1038/ncomms9485.
- [3] E. Welter et al., AIP Conf. Proc., vol. 2054 (2019) p. 040002, DOI: 10.1063/1.5084603.
- [4] W. A. Caliebe et al., AIP Conf. Proc., vol. 2054. (2019) p. 060031, DOI: 10.1063/1.5084662.
- [5] J. Timoshenko et al., J. Phys.: Condens. Matter, vol. 26 (2014) p. 055401, DOI: 10.1088/0953-8984/26/5/055401.



P-26

Structure of Tau Aggregation Promoting Antibody DC11 and of its Oligomeric Tau Targets Studied by X-ray Crystallography and Complementary Methods

Ondrej Cehlár^{1,*}, Adam Polák¹, Branislav Kovačech¹, Petra Majerová¹, Rostislav Škrabana¹, Stefana Njemoga¹, Tomáš Sádecký², Vladimír Garaj²

¹ Neuroimunologický ústav SAV, v.v.i., Dúbravská cesta 9, 845 10 Bratislava,

² Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Comenius University in Bratislava, Slovakia

* presenting author email: ondrej.cehlar@savba.sk

30.09.2026, Wednesday
18:00 – 19:30

SYN
Synchrotrons

A KEY YET UNRESOLVED question of the pathogenesis of Alzheimer's disease (AD) and other tauopathies is the mechanism of the transition from the unstructured monomeric tau protein to the insoluble filaments. In the physiological state, tau protein exists as a conformational ensemble of interconverting structures and on the scale of transition from monomeric through oligomeric and filamentous species we can observe conformations reacting with specific antibodies, mainly with DC11, which is able to specifically discriminate between tau proteins isolated from healthy brain and tau proteins isolated from the brain of AD patient. The antibody recognizes also the recombinant truncated tau proteins up to the shortest fragment tau321-391. It was found that conformational antibody DC11 has a catalytic pro-aggregatory effects in tau aggregation assay. This may imply possible mechanism of induction of pathological tau conformation, in which the antibody prepared against pathological tau imprints the pathological conformation into the physiological tau proteins in solution and therefore speeds up the tau aggregation.

We have solved the X-ray structure of DC11 Fab fragment to a resolution of 1.33 Å crystallized in a space group P-1-21-1 and deposited it into the PDB database with PDB ID 9H8H. We have also obtained crystals of DC11 Fab and crystals of tentative complexes between DC11 and either tau321-391 or tau peptide tau371-387 in different space groups. We have further measured the synchrotron SAXS data to characterize the conformational ensembles of tau297-391 (dGAE), tau316-391 and tau321-391 and in both batch and SEC-SAXS modes and of dGAE oligomers. We have also attempted to characterize the complexes between tau proteins and DC11 Fab fragment. DC11 binds also oligomeric and fibrillar tau forms. Tau oligomers are thought to be the most toxic species in the pathogenesis of AD, however, intermediate fibrils were observed early in the course of aggregation reaction of truncated tau dGAE by cryo-EM. We have performed docking and MD simulation of DC11 Fab fragment with tau peptide, tau oligomer and tau protofibril to further uncover the binding mode of DC11 antibody and shed light on the tau pre-aggregation conformation. We have also docked a set of 27 previously described tau aggregation inhibitors into the structures of coarse-grained MD obtained dimers of tau321-391.

ACKNOWLEDGEMENT This research was funded by APVV SK-BG-25-0031, VEGA 2/0125/23, 1/0825/25 and Horizon Europe 101087124.



P-27

X-ray-beam-induced Local Structural Changes in WO₃ Nanoparticles revealed by RMC-EXAFS

Vitalijs Dimitrijevs^{1,*}, Aleksandr Kalinko², Alexei Kuzmin¹

¹ Institute of Solid State Physics, University of Latvia, Riga, Latvia,

² Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

* presenting author email: dimitrijevs@cfi.lu.lv

30.09.2026, Wednesday
18:00 – 19:30

SYN
Synchrotrons

TUNGSTEN (VI) oxide (WO₃) is widely studied for photochromic and solar-energy-related applications, where its functional properties are strongly connected with changes in electronic structure and local atomic arrangement [1]. In nanocrystalline WO₃, the local structure can be sensitive not only to chemical modification, such as protonation, but also to synchrotron X-ray exposure during characterization. Therefore, understanding beam-induced structural changes is important for the correct interpretation of X-ray absorption spectroscopy data. WO₃ nanoparticles were synthesized using a modified polyol process [2]. X-ray diffraction measurements indicated an average crystallite size of 3-5 nm. Part of the sample was additionally protonated through hydrogen spillover on metallic indium in an acidic environment, resulting in H_xWO₃ nanoparticles. X-ray absorption spectroscopy at the W-L₃ edge was performed at 300 K at the DESY PETRA III P64 beamline in Hamburg, Germany [3]. EXAFS spectra were collected for both as-prepared WO₃ and protonated H_xWO₃ nanoparticles during exposure to the synchrotron X-ray beam. The EXAFS spectra were analyzed using the reverse Monte Carlo method combined with an evolutionary algorithm [4]. This approach allowed the reconstruction of three-dimensional atomic configurations consistent with the experimental spectra and enabled detailed analysis of W-O and W-W radial distribution functions, as well as W-O-W bond-angle distribution functions. The RMC-EXAFS results reveal beam-induced changes in the local structure of both as-prepared and protonated WO₃ nanoparticles. The effect is more pronounced for the protonated H_xWO₃ sample, where changes in the W-O and W-W radial distribution functions and in the W-O-W angular distribution indicate partial bleaching, corresponding to a structural evolution back toward the initial WO₃-like state. In the as-prepared WO₃ nanoparticles, the observed changes are smaller and may be related to the formation or rearrangement of W⁵⁺ color centers under X-ray exposure. These results demonstrate that synchrotron X-ray irradiation can modify the local structure of WO₃ nanoparticles during the XAS experiment and should be considered when interpreting EXAFS data for radiation-sensitive nanoscale oxides.

References

- [1] X. Dong et al., J. Photochem. Photobiol. C Photochem. Rev. 53 (2022) 100555.
- [2] Y. Badour et al., J. Electron. Mater. 51 (2022) 1555.
- [3] W. A. Caliebe et al., AIP Conf. Proc. 2054 (2019) 060031.
- [4] J. Timoshenko et al., J. Phys.: Condens. Matter 26 (2014) 055401.



P-28

Synchrotron and TEM Study of Wet Mechanically Alloyed Co-Fe-(Ta,W)-B Powders

Dominika Hrehová¹, Vladimír Girman^{1,*}, Daria Striežovská¹, Maksym Lisnichuk¹, Pavol Sovák¹, Nebojša Mitrović², Jelena Orelj², Jozef Bednarčík¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

² University of Kragujevac, Faculty of Technical Sciences Čačak, Joint Laboratory for Advanced Materials of SASA, Section for Amorphous Systems, Serbia,

* presenting author email: vladimir.girman@upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

SYN
Synchrotrons

CO-BASED amorphous alloys combine high strength, favorable magnetic properties and chemical stability. Co-Fe-Ta-B alloys show excellent glass-forming ability and a supercooled liquid region near 70 K [1], with compressive yield strength exceeding 5000 MPa [2]. Their potential is also enhanced by high magnetic permeability, nearly zero magnetostriction and coercivity as low as 0.25 A/m [3]. Giant magnetoimpedance and high corrosion resistance [4] make them promising for magnetic and structural applications.

This work compares the structural transformations of $\text{Co}_{43}\text{Fe}_{20}\text{Ta}_{5.5}\text{B}_{31.5}$ (at.%) and $\text{Co}_{43}\text{Fe}_{20}\text{W}_{5.5}\text{B}_{31.5}$ (at.%) powders induced by wet mechanical alloying in hexane for up to 100 h. Their evolution was examined by synchrotron high-energy X-ray diffraction, pair distribution function analysis, X-ray absorption spectroscopy and high-resolution transmission electron microscopy, complemented by room-temperature magnetic and thermomagnetic measurements. Prolonged milling caused crystallite refinement, increasing structural disorder and progressive loss of long-range atomic correlations in both alloys, but their amorphization pathways differed markedly. The Ta-containing alloy transformed through intermediate nanocrystalline phases and became fully amorphous after 100 h. Replacing Ta with W prevented complete amorphization under identical processing conditions. The final W-containing powder instead consisted of an amorphous Co-Fe-B matrix with residual nanocrystalline bcc-W. Element-specific analysis revealed extensive atomic scale mixing in the Ta-based material, whereas W retained a local coordination resembling crystalline bcc-W. This remaining crystalline fraction was associated with higher saturation magnetization and coercivity of the W-containing powder. The results highlight the decisive role of elemental interactions in controlling amorphization kinetics and support the design of powder precursors for consolidation or additive manufacturing.

References

- [1] Taghvaei, A.H. et al. J.; Mater. Lett. 2013, 93, 322–325.
- [2] Shen, B.; Inoue, A.; J. Phys. Condens. Matter 2005, 17, 5647–5653.
- [3] Shen, B.; Pang, S.; Zhang, T.; Kimura, H.; Inoue, A.; J. Alloy. Compd. 2008, 460, L11–L13.
- [4] Nicula, R.; Stir, M.; Ishizaki, K.; Catalá-Civera, J.M.; Vaucher, S.; J. Phys. Conf. Ser. 2009, 144, 012109.

ACKNOWLEDGEMENT Support from the project VEGA 1/0638/24 is also acknowledged.



P-29

SAXS and WAXS Study: Effects of Primary N-alcohols on Pulmonary Surfactant Models

Denisa Sádecká^{1,*}, Mária Klacsová¹, Juan Carlos Martínez², Daniela Uhríková¹

¹ Department of Physical Chemistry of Drugs, Faculty of Pharmacy, Comenius University Bratislava, Odbojárov 10, 832 32 Bratislava, Slovakia,

² ALBA Synchrotron, Carrer de la Llum 2-26, 08290 Cerdanyola del Vallès, Barcelona, Spain

* presenting author email: fujasova5@uniba.sk

30.09.2026, Wednesday
18:00 – 19:30

SYN
Synchrotrons

WHEN INHALED general anaesthetics are administered, pulmonary surfactant represents the first biological barrier they interact with. We investigated effects of primary aliphatic n-alcohols (CnOH, n = 8–18, 0.4 mol/mol), as simple models of inhaled general anaesthetics, incorporated into synthetic pulmonary surfactant models. Two lipid mixtures were used as model systems: S-model, consisting of dipalmitoylphosphatidylcholine : palmitoyloleoylphosphatidylcholine : palmitoylinooleoylphosphatidylcholine : palmitoyloleoylphosphatidylglycerol (DPPC : POPC : PLPC : POPG = 50 : 24 : 16 : 10 wt.%), and a simpler P-model, containing POPC : POPG = 9:1 wt.%. Each mixture was enriched with 0–20 wt.% polymyxin B (PxB), mimicking the properties of the surfactant protein SP-B. Structural properties of bilayers were characterised by small- and wide-angle X-ray scattering (SAXS/WAXS) at 20–50 °C. Diffraction peaks were fitted using Lorentzian functions. Lattice parameter of the lamellar phase (bilayer repeat distance, *d*), including the thickness of the lipid bilayer and the water layer, was calculated from the position of the first SAXS reflection. The structural organisation of lipid acyl chains was evaluated from WAXS. For both models, diffractograms showed lamellar phase with equidistant low-resolution reflections superimposed on a wide diffuse reflection from uni- or oligolamellar liposomes. Negatively charged POPG disrupted the regularity of the lamellar arrangement, resulting in higher *d*-values. C₁₂OH reversed this effect most. Adding PxB (>5 wt.%) into the P model + C₁₂OH system markedly stabilized the lamellar structure, whereas in S-model + C₁₂OH, PxB led to phase separation, especially at 20 °C. WAXS diffractograms at 20 °C showed a diffuse signal for P model, but a peak at $q \sim 15 \text{ nm}^{-1}$, corresponding to acyl chains in gel phase, for S model. At 50 °C, this peak became less pronounced and with PxB <5 wt.% disappeared. In homologous series of CnOHs at 20 °C systems showed gel-phase chain organization for C₁₄OH – C₁₈OH in the P-model and for C₈OH – C₁₈OH in the S-model, at 50 °C only for C₁₆OH – C₁₈OH. These results suggest that positively charged PxB (>5 wt.%) increases the gel to liquid-crystalline phase transition in the complex S-model and stabilizes negatively charged bilayers via electrostatic interactions with PG headgroups, despite leading to laterally separated domains. In the two-lipid P-model, prevalent unsaturated chains grant the liquid-crystalline phase across 20–50 °C, facilitating even PxB distribution.

ACKNOWLEDGEMENT Research was supported by VEGA 1/0305/24 project. SAXS experiments were performed on the BL11-NCD beamline at ALBA Synchrotron with the collaboration of ALBA staff.



P-30

Complementary Synchrotron X-ray Diffraction and Mössbauer Investigation of Mechanically Alloyed FeMn-based Amorphous Powders

Ravneet Kaur^{1,*}, Martin Cesnek², Stefan Michalik³, Jozef Bednarčík¹

30.09.2026, Wednesday
18:00 – 19:30

SYN
Synchrotrons

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

² Department of Nuclear Reactors, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, V Holešovičkách 2, 180 00 Prague 8, Czech Republic,

³ Diamond Light Source Ltd., Harwell Science and Innovation Campus, Didcot, Oxfordshire OX11 0DE, UK

* presenting author email: ravneet.kaur@student.upjs.sk

HIGH-ENERGY SYNCHROTRON X-ray diffraction and ⁵⁷Fe Mössbauer spectroscopy were combined to resolve the phase evolution and local magnetic environments in mechanically alloyed Fe_{73.5-x}Mn_xCu₁Nb₃Si_{13.5}B₉ with ($x = 2, 4, 6, 8, 10$ at.%) powders. Elemental mixtures were dry-milled for 30 h in a RETSCH PM400 planetary ball mill at 250 rpm using a ball-to-powder ratio of 40:1. High-energy diffraction measurements were performed at the I12 beamline of Diamond Light Source, and room-temperature Mössbauer spectra were evaluated using hyperfine magnetic-field distributions. Synchrotron diffraction revealed progressive suppression of the bcc-Fe reflections with increasing Mn content. The powders with $x \leq 6$ consist of nanocrystalline bcc Fe embedded in an amorphous matrix, whereas the $x = 10$ composition exhibits a fully amorphous diffraction pattern. Consistently, the Mössbauer spectra are dominated by broad magnetic-field distributions characteristic of structurally disordered Fe environments. A relatively narrow Fe-rich high-field contribution with a mean hyperfine field close to 30 T is present for $x = 2, 4, 6$ and becomes nearly negligible at $x = 8$ and is absent at $x = 10$. A pure α -Fe component could be fitted only for $x = 2$, with a relative spectral area below approximately 1%, preventing its unambiguous identification. The mean hyperfine field of the amorphous contribution decreases from 2.5 T at $x = 2$ to 7.9 T at $x = 10$, with the largest change occurring between $x = 6$ and $x = 8$. The accompanying decrease in the mean isomer shift from 0.08 to 0.02 mm/s demonstrates a systematic modification of the local electronic environment of Fe. The bimodal field distributions indicate the coexistence of Fe-rich regions and Mn-enriched or more strongly disordered environments. Together, these complementary local and long-range probes demonstrate that Mn simultaneously stabilizes the amorphous structure and weakens local magnetic ordering, identifying the $x = 10$ alloy as the most completely amorphous composition within the investigated series.

ACKNOWLEDGEMENT This study was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034. Support from the project VEGA 1/0638/24 is also acknowledged.



P-31

Tracking Magnetic Nanocarriers within Blood Clots: Toward Multiscale Structural Imaging of $\text{Fe}_3\text{O}_4@\text{SiO}_2$ Drug Delivery Systems

Eva Beňová^{1,*}, Nikolas Király¹, Pavol Hrubovčák², Ľuboš Nagy², Adriana Zelenáková², Vladimír Zelenák¹

30.09.2026, Wednesday
18:00–19:30

SYN
Synchrotrons

¹ Institute of Chemistry, P.J. Šafárik University in Košice, Moyzesova 11, 041 54 Košice, Slovakia,

² Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: eva.benova@upjs.sk

THROMBOTIC DISORDERS remain a major cause of morbidity and mortality worldwide, while conventional antithrombotic therapy is limited by systemic drug exposure and associated bleeding risks. Magnetic drug delivery systems offer a strategy for increasing the local concentration of therapeutic agents at a thrombotic site through external magnetic guidance. In this work, $\text{Fe}_3\text{O}_4@\text{SiO}_2$ -based nanocarriers were investigated as a platform for localized delivery of the anticoagulant apixaban and for their interaction with the fibrin network of blood clots.

Magnetic silica nanoparticles were prepared using Fe_3O_4 cores coated with silica and characterized with respect to morphology, porous structure and magnetic properties. Electron microscopy confirmed the core-shell architecture, while nitrogen adsorption measurements demonstrated a porous silica structure suitable for drug incorporation. Magnetic measurements showed superparamagnetic behaviour at room temperature, enabling manipulation of the particles by an external magnetic field. The interaction of the nanocarriers with blood clots was subsequently investigated under dynamic conditions using an experimental circulation model. Apixaban-loaded $\text{Fe}_3\text{O}_4@\text{SiO}_2$ nanoparticles were circulated in the presence of a blood clot and an external magnetic field. Macroscopic observations demonstrated magnetic accumulation of the nanoparticles in the vicinity of the clot. SEM examination revealed nanoparticle aggregates associated with the clot surface and partially entrapped within the fibrin network.

These results demonstrate the feasibility of magnetic localization of silica-based nanocarriers under dynamic conditions but also reveal an important unresolved question: whether magnetic targeting primarily promotes surface retention or enables penetration of the nanocarriers into the three-dimensional fibrin network. Conventional surface imaging cannot fully resolve their spatial distribution within the clot. Advanced X-ray scattering and imaging approaches could therefore provide complementary information on nanocarrier localization, penetration depth and nanoparticle-induced structural changes in the fibrin network. Such insight may contribute to the rational development of magnetically targeted systems for localized antithrombotic drug delivery.



P-32

SVT-PINN: a Physics-informed Neural Framework for Disentangling Massive Binaries with Non-linear Phase Variations

Reddy Charan Reddy Munagala^{1,*}

¹ Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, 059 60 Vysoké Tatry, Slovakia

* presenting author email: charan2025m@gmail.com

30.09.2026, Wednesday
18:00 – 19:30

EST
European Solar Telescope

THE DETERMINATION of stellar and orbital parameters in massive binaries is often complicated by phase-dependent variability in the line profiles. Classical spectral disentangling represents time-series spectra as contributions from Doppler-shifted, phase-invariant components [1, 2]. However, this approximation can be inadequate in systems affected by tidal deformation, gravity darkening, pulsations, winds or extreme light ratios. In such cases, atmospheric, orbital, and variability signatures become coupled, creating an identifiability issue in which non-rigid profile changes may be misinterpreted as orbital motion or as incorrect stellar parameters. We present SVT-PINN, a physics-informed framework currently under development, designed to separate these contributions through an ordered scalar-vector-tensor inference scheme. The scalar mode uses a library of 33,075 ATLAS9 and TLUSTY synthetic models, parameterised by effective temperature, surface gravity, metallicity, and projected rotational velocity, to constrain phase-independent component spectra. Given this atmospheric solution, the vector mode infers coherent orbital Doppler transport in logarithmic wavelength ($x = \log \lambda$) and Fourier space using Markov chain Monte Carlo sampling. The tensor mode is then introduced to model the remaining phase-dependent deformation, $\tau_a(x, \phi)$, using a physics-informed neural network [3]. Spectral smoothness, phase coherence, amplitude control and geometry-dependent penalties are incorporated to limit this flexible mode's ability to absorb errors from the atmospheric or orbital solutions. The framework is designed so that its atmospheric, orbital and variability components can be inspected separately. The dimensionless ratios R_{VS} and R_{TS} are introduced to characterise orbital transport and phase-dependent deformation relative to the phase-independent spectral baseline. Multi-epoch, high-resolution spectroscopy of HD 2913, HD 199892 and HD 138527, supported by space-based photometry, will provide the first observational stress tests. The present contribution describes the physical formulation, ordered inference strategy, diagnostic quantities, and validation plan for SVT-PINN, a developing, variability-aware extension of spectral disentangling.

ACKNOWLEDGEMENT This work was supported by the Slovak Research and Development Agency under contract No. APVV-24-0160, and by the VEGA grant No. 2/0033/26.

References

- [1] P. Hadrava, *Astrophysics and Space Science*, 304 (2003) pp. 337-339, DOI: 10.1007/s10509-006-9153-5.
- [2] K. Pavlovski and H. Hensberge, *Astronomy and Astrophysics*, 439 (2005) pp. 309-321, DOI: 10.1051/0004-6361:20042139.
- [3] M. Raissi et al., *Journal of Computational Physics*, 378 (2019) pp. 686-707, DOI: 10.1016/j.jcp.2018.10.045.



P-33

Kinematic Fragmentation and Resolution-dependent Fading of Type II Spicules

Elene Midelashvili^{1,*}, Peter Gömöry¹, Teimuraz Zaqarashvili², Zurab Vashalomidze¹

30.09.2026, Wednesday
18:00 – 19:30

EST

European Solar Telescope

¹ Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, 059 60 Vysoké Tatry, Slovakia,

² Space Research Centre, Ilia State University, AG-Institute of Physics, University of Graz, Austria

* presenting author email: emidelashvili@astro.sk

TYPE II SPICULES often fade rapidly from cool chromospheric lines, commonly interpreted as their heating to transition-region temperatures. Here, we test whether apparent fading can also arise from a primarily kinematic visibility effect. Using high-resolution 2.5D ideal-MHD simulations, we show that transverse oscillations of a super-Alfvénic magnetized jet trigger the Kelvin-Helmholtz instability (KHI), which fragments the initially coherent jet into fine-scale strands. The internal-energy evolution is used only as a control diagnostic; the thermal-energy gain remains small ($\Delta E_{\text{th}}/E_{\text{kin},0} \simeq 5.18\%$), indicating that the modeled fading is not produced by imposed thermodynamic heating. Forward modeling with an optically thin emission proxy ($I \propto \rho^2$) shows that the finite spatial resolution of observations strongly affects detectability. It is found that KHI begins at the jet boundary before the emission-dominating core is sufficiently fragmented to fade observationally. This leads to a visibility delay, $\Delta t = t_{\text{obs}} - t_{\text{phys}}$, where the coherent transverse motion weakens while unresolved line-of-sight velocity dispersion increases. Non-thermal line broadening (v_{rms}) peaks at $\simeq 2.65 \text{ km s}^{-1}$ during the simulations, while σ_{nonth} reaches $\simeq 3.20 \text{ km s}^{-1}$. We predict that DKIST-like diffraction-limited spatial resolution might recover some apparently faded events as fragmented fine-scale strands, whereas IRIS-like resolution will fail to resolve them.



P-34

Quantum Computation of Small Atomic Clusters with Error Mitigation

Kaushik Das^{1,*}

¹ Research Centre for Quantum Information, Dúbravská cesta 5808, 841 04 Bratislava, Slovakia

* presenting author email: kd733585@gmail.com

30.09.2026, Wednesday
18:00 – 19:30

EST

European Solar Telescope

THE SUBSPACE-SEARCH variational quantum eigensolver (SSVQE) algorithm is used on various atomic clusters of Be, B and C atoms to find their ground state and 1st excited state energy values. Various approximations such as active space and freeze core have been used to reduce the quantum qubit in the computation. The approximations affect the energy values for quantum mechanically big clusters (C4, B4, etc.)

This work also shows the use of the application of Single Excitation and Double Excitation to build the ansatz. The final calculated energy values are compared with those calculated by the Hartree-Fock and DFT methods. The findings show that, when the ansatz and optimization are properly customized to the given situation, the SSVQE algorithm can consistently and accurately find both ground and excited state energies. This research highlights SSVQE's potential as a formidable tool for quantum simulations on upcoming quantum technology, providing a mechanism to achieve more accurate and thorough quantum chemistry and material science computations. In this research we are not only calculating the energy values of molecules, but using various error mitigation techniques to show the ability of the existing techniques. Here we are using various methods like ZNE, PEC, TEM, and some more error mitigation techniques. Here we are showing why error mitigation is important till we get useful error correction.



P-35

Photometry and Imaging Polarimetry of Comet C/2012 S1 (ISON) at Heliocentric Distances 4.8 and 0.8 AU

Leonid Shakun^{1,*}, Oleksandra Ivanova¹, Igor Lukyanyk²

30.09.2026, Wednesday
18:00–19:30

EST

European Solar Telescope

¹ Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, 059 60 Vysoké Tatry, Slovakia,

² Astronomical Observatory of Taras Shevchenko, National University of Kyiv, Ukraine

* presenting author email: lshakun@astro.sk

COMETARY DUST provides a unique record of the primitive material from which the Solar System formed. Observations of the brightness, color, and polarization of cometary comae can be used to constrain the physical and compositional properties of their dust particles. Comet C/2012 S1 (ISON) was classified as a dynamically new comet arriving from the Oort Cloud on a near-parabolic orbit and was expected to retain relatively unprocessed primordial material. Since the comet disintegrated during its perihelion passage, observations obtained before perihelion are especially important. Moreover, only a small amount of polarimetric information was available for this comet. We report photometric and imaging polarimetric observations of C/2012 S1 (ISON) carried out with the 6-m BTA telescope at heliocentric distances of 4.81, 0.89, and 0.76 au, corresponding to phase angles of 7.3°, 57.6°, and 66.8°. The observations included broadband photometry and imaging measurements of both linear and circular polarization in several spectral bands. Long-slit spectroscopy obtained at 4.81 AU revealed no detectable gaseous emission, indicating that the coma was dominated by dust at large heliocentric distances.

We investigate dust activity using the $Af\rho$ parameter, study the spectral color of the coma, and examine the spatial distribution of polarization. $Af\rho$ decreased from approximately 1000 cm⁻¹ at a distance of 4.8 AU to approximately 300 cm⁻¹ closer to the Sun. Spatially resolved color measurements revealed variations in dust properties throughout the coma, including an increase in the spectral gradient with increasing distance from the core. The coma was found to remain predominantly dusty at heliocentric distances of approximately 3.8–6.0 AU and exhibit a moderately red continuum with a normalized reflectivity gradient of approximately 6–10% per 1000 Å. At a geocentric distance of 0.76 AU, we detected a significant spatial variation in the degree of polarization from 7% to 14%. The spatial structure of these variations is similar to the spatial structures revealed by photometric observations.

ACKNOWLEDGEMENT The research of Leonid Shakun and Oleksandra Ivanova is supported by the Slovak Research and Development Agency under Contract No. APVV-24-0076 and the grant of the Slovak Academy of Sciences (grant VEGA No. 2/0067/26).



P-36

Analysing Possible Precessing Hot Jupiters using Least-squares Deconvolution Technique

Dmytro Orikhovskiy^{1,*}

30.09.2026, Wednesday
18:00–19:30

¹ Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, 059 60 Vysoké Tatry, Slovakia

* presenting author email: orekhovskiy.math@gmail.com

EST

European Solar Telescope

HOT JUPITERS are a unique group of planets that cannot be found in our Solar system. They are placed closer than 0.1 AU from their parent stars, which often results in transits that can be detected by photometric observations. Interiors of hot stars are able to conserve their angular momentum for longer time, keeping rotational velocities high for whole lifetime. If there is a planet orbiting such star, its orbit may change significantly over time. The planet may become highly eccentric, misaligned with respect to the rotational axis of the star or even undergo tidally-induced precession. Up to date, only 4 exoplanets are confirmed to be nodally precessing, but their number may grow with more long-term observations. We present the analysis of spectroscopy of hot Jupiters KELT-7b, WASP-167b and MASCARA-1b. Using its Doppler shadow, we provide updated values for its projected misalignment.



P-37

Using Pulsed Sources of Energetic Photons for Achieving Extreme Dose Rates: From Compact Plasma-based Devices to Free Electron Lasers

Luděk Vyšín^{1,*}, Barbora Sedmidubská¹, Libor Juha¹, Przemysław Wachulak²,
Henryk Fiedorowicz², Andrzej Bartnik²

¹ Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21 Prague 8, Czech Republic,

² Military University of Technology, ul. gen. Sylwestra Kaliskiego 2, 00-908 Warszawa, Poland

* presenting author email: vysin@fzu.cz

30.09.2026, Wednesday
18:00–19:30

FEL

Free Electron Lasers

RECENT INTEREST in ultra-high-dose-rate (UHDR) irradiation and FLASH radiotherapy has stimulated the development of experimental platforms capable of delivering radiation under increasingly extreme temporal conditions. Short-wavelength photon sources are particularly attractive because they combine highly localized energy deposition with pulse structures spanning from nanoseconds to femtoseconds. Such sources provide unique opportunities for exploring radiation action beyond the regimes accessible with conventional irradiation technologies.

Using a compact laser-plasma source operating in the water-window spectral range, we have investigated a broad range of irradiation scenarios including aqueous chemical dosimetry, DNA irradiation in liquid and dry environments, and microbial spore inactivation. By modifying sample geometry and irradiation conditions while maintaining the same source architecture, a wide spectrum of dose-rate regimes and biological endpoints can be addressed. The source provides a versatile laboratory-scale platform for studies of radiation chemistry, radiobiology, and UHDR effects under highly localized irradiation conditions. To further extend these capabilities, a microfluidic irradiation cell is currently being developed for controlled exposure of liquid samples and biological systems. The approach enables precise sample handling, continuous replenishment of irradiated volumes, reduced sample consumption, and improved compatibility with strongly absorbed soft X-ray radiation. In addition, microfluidic platforms offer a promising route toward time-resolved studies that connect the physical, chemical, and biological stages of radiation action. Beyond laser-plasma sources, free-electron lasers and related short wavelength facilities provide access to femtosecond pulse durations and correspondingly extreme instantaneous dose rates. These instruments enable investigation of irradiation regimes where the temporal structure of the radiation approaches the timescales of primary ionization and early physicochemical processes. Combining compact laser-plasma sources, advanced microfluidic irradiation technologies, and large-scale FEL facilities therefore creates a complementary experimental toolbox spanning many orders of magnitude in pulse duration and dose rate. This framework opens new opportunities for systematic studies of UHDR and FLASH-relevant radiation effects and for understanding how temporal dose delivery influences radiation action from the earliest physicochemical events to complex biological responses.



P-38

Effect of Thermal Treatment on the Structure and Hydrogen Storage Properties of Arc-melted High-entropy Alloys

Maksym Lisnichuk^{1*}, Daria Striežovská¹, Serhii Vorobiov¹, Oleksandr Onufriienko², František Onderko¹, Lubomír Král³, Pavol Sovák¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia,

² Institute of Experimental Physics, Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovakia,

³ Institute of Physics of Materials, Czech Academy of Sciences, Žitkova 513/22, Brno, 61600, Czech Republic

* presenting author email: maksym.lisnichuk@upjs.sk

30.09.2026, Wednesday
18:00–19:30

XRAY

X-ray techniques

HIGH-ENTROPY ALLOYS based on Ti, V, Nb, Cr and Mn have attracted interest as potential hydrogen storage materials due to the possibility of tailoring their structural and hydrogen sorption properties through compositional and processing modifications. In this study, the phase composition, microstructure and hydrogen absorption behaviour of TiVNbCrMn and TiVNbCrMnFe alloys prepared by arc melting were investigated using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), X-ray diffraction (XRD), and transmission electron microscopy (TEM) combined with selected-area electron diffraction (SAED). The TiVNbCrMn alloy exhibited a predominantly body-centred cubic (bcc) structure with the Im-3m space group, confirmed by XRD and TEM-SAED. Its microstructure showed a pronounced dendritic morphology with a relatively homogeneous elemental distribution. In contrast, TiVNbCrMnFe exhibited a multiphase structure dominated by a hexagonal phase (P6₃/mmc) accompanied by a minor bcc phase (Im-3m). TEM-SAED confirmed the coexistence of these phases, with the dendritic regions associated mainly with the hexagonal phase and the interdendritic regions with the bcc phase and Ti-V enrichment.

Hydrogen absorption measurements at 35 °C revealed substantially different behaviour. TiVNbCrMn showed rapid initial hydrogen uptake, reaching approximately 1.9 wt.% within 100 min, followed by slower absorption and a final hydrogen content of approximately 2.55–2.6 wt.%. TiVNbCrMnFe exhibited lower hydrogen uptake, reaching approximately 0.9 wt.% within the investigated pressure range, without a distinct plateau region. The results demonstrate a strong relationship between phase composition, microstructure and hydrogen absorption behaviour. The predominantly bcc TiVNbCrMn alloy exhibited substantially higher hydrogen uptake than the multiphase TiVNbCrMnFe alloy. The obtained results provide a basis for further investigation of thermal treatment as a means of modifying the structural state and hydrogen storage properties of high-entropy alloys.

ACKNOWLEDGEMENT This work has been supported by the grants EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V04-00264.



P-39

SAXSpoint 700 at the MASS-PRAM Laboratory: a Versatile Platform for Multiscale X-ray Structural Characterization

Peter Dubecký^{1,*}, Jozef Bednárčík¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: peter.dubecky@student.upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

UNDERSTANDING structure–property relationships in advanced materials requires complementary experimental techniques capable of probing structural organization across different length scales. The newly established MASS-PRAM laboratory at Pavol Jozef Šafárik University in Košice is being developed as a multimodal X-ray characterization platform integrating X-ray diffraction, X-ray scattering, and X-ray absorption spectroscopy. Within this framework, the Anton Paar SAXSpoint 700 provides dedicated capabilities for structural characterization across a broad range of length scales. The SAXSpoint 700 is configured for small-angle X-ray scattering (SAXS), wide-angle X-ray scattering (WAXS), and grazing-incidence small-angle X-ray scattering (GISAXS). The instrument is equipped with interchangeable Cu and Mo X-ray sources and a DECTRIS EIGER2 R 1M hybrid photon-counting detector. Its modular configuration includes dedicated stages for transmission and grazing-incidence measurements, temperature-controlled environments for both geometries, an automated sampler compatible with quartz cuvettes and a flow cell, and a broad range of sample holders. This flexibility enables the investigation of powders, bulk solids, liquids, thin films, and nanostructured materials. The combination of flexible scattering geometries and sample environments enables studies of particle size and morphology, nanoscale organization, interfaces, orientation, and structural evolution under varying experimental conditions. Together with complementary X-ray diffraction and X-ray absorption spectroscopy capabilities available within MASS-PRAM, the SAXSpoint 700 contributes to a comprehensive approach to material characterization, linking nanoscale morphology with crystallographic, local atomic, and electronic structure. The laboratory thus provides a versatile platform for advanced materials research and opens new possibilities for interdisciplinary and collaborative studies.

ACKNOWLEDGEMENT This study was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034. Support from the project VEGA 1/0638/24 is also acknowledged.



P-40

XANES/EXAFS spectrometer at the MASS-PRAM Laboratory

Zuzana Mikulková^{1*}, Jozef Bednárčík¹

¹ Institute of Physics, P.J. Šafárik University in Košice, Park Angelinum 9, 040 01 Košice, Slovakia

* presenting author email: zuzana.mikulkova@student.upjs.sk

30.09.2026, Wednesday
18:00 – 19:30

XRAY

X-ray techniques

WITHIN the recently completed MASS-PRAM project (Multimodal Approach to Study Structure-Property Relationships in Advanced Materials) at Pavol Jozef Šafárik University in Košice (UPJS) an in-house laboratory X-ray Absorption Spectroscopy (XAS) system was successfully procured. The newly operational instrument brings synchrotron quality X-ray Absorption Near Edge Structure (XANES) and Extended X-ray Absorption Fine Structure (EXAFS) capabilities directly into a standard university laboratory environment. This acquisition democratizes access to advanced local structural characterization and optimizes the allocation of precious synchrotron beamtime.

The acquired instrument is a turn-key hiXAS integrated XAS spectrometer manufactured by HP-Spectroscopy. Built upon an optimized HAPG (Highly Annealed Pyrolytic Graphite) von Hamos spectrometer architecture, the system integrates an X-ray tube source, a high-resolution HAPG optics assembly, and a hybrid 2D detector (DECTRIS 500k). It operates over a broad photon energy range of 4.5 to 25 keV, covering the K absorption edges of 3d transition metals as well as higher-energy edges. Technical specifications feature a high spectral resolving power of up to $E/\Delta E = 4000$, a wide bandpass of up to 1 keV, and an extremely high signal-to-noise ratio. These performance characteristics enable high-precision measurements on diluted samples with analyte concentrations as low as a few weight percent.

At the MASS-PRAM Laboratory, the spectrometer provides essential element-specific insights across characteristic correlation length scales. XANES delivers detailed information on elemental oxidation states and local electronic structures, while EXAFS determines the local atomic arrangement, exact bond lengths, bond angles, and coordination numbers around absorbing atoms. Ultimately, the procurement and integration of this hiXAS system complete a major infrastructure milestone, establishing the School for Structural Analysis at UPJS as a national competence center in Košice, Slovakia.

ACKNOWLEDGEMENT This study was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00034. Support from the project VEGA 1/0638/24 is also acknowledged.

Author index

- Almásy László, 44, 94
Almási Miroslav, 74
Antal Iryna, 80
Ashraf Muhammad Faisal, 87
- Baloh Pavlo, 93
Barak Imrich, 33
Bartnik Andrzej, 107
Barutiak Michael, 85, 86
Batchu Krishna, 41
Bednarčík Jozef, 62, 63, 75, 82, 98, 100, 109, 110
Bencok Peter, 55
Bernstorff Sigrid, 56
Beňová Eva, 101
Bitala Andrej, 76
Blagojević Jovan, 88
Bozin Emil, 19, 57, 88
Búcsi Alexander, 53
- Caha Ondrej, 77, 78
Cavalieri Adrian, 24
Cehlár Ondrej, 96
Cesnek Martin, 48, 100
Chromikova Zuzana, 33
Collados Manuel, 66, 67
Csík Dávid, 81
Czigány Zsolt, 94
- Daillant Jean, 54
Darwich Ali, 92
Das Kaushik, 104
Demé Bruno, 60
- Dibdiakova Katarina, 80
Dimitrijevs Vitalijs, 97
Dobák Samuel, 79
Dopita Milan, 17
Dubecký Peter, 62, 75, 109
Duchaň Marek, 77
Džunda Róbert, 81
- Elleuche Nicole, 35
- Fabriciová Žaneta, 46, 85, 86
Fedoročková Alena, 81
Feher Alexander, 93
Fiantok Tomáš, 18
Fiedorowicz Henryk, 107
Füzer Ján, 79
- Garaj Vladimír, 96
Girman Vladimír, 75, 98
González Manrique Sergio Javier, 70
Grančíč Branislav, 18
Guha Tamal, 89
Gáborová Katarína, 73, 81
Gömöry Peter, 68, 103
- Halahovets Yuriy, 56
Held Vladimir, 56
Hodorová Marianna, 81
Holubová Jana, 93
Holý Václav, 49, 58
Hrehová Dominika, 98
Hrubovčák Pavol, 46, 61, 85, 86, 101
Hubčík Lukáš, 53

- Ivanova Oleksandra, 105
Ivánová Dana, 81
- Jedinák Valentín, 80
Jenčová Anna, 89
Jergel Matej, 56
Johnson Mark, 37
Juha Libor, 34, 90, 107
Jurikova Alena, 80
- Kalinko Aleksandr, 95, 97
Kanjevac Ana, 88
Kaur Ravneet, 62, 63, 75, 100
Khmara Iryna, 80
Khomenko Elena, 69
Király Nikolas, 74, 101
Klacsová Mária, 53, 99
Kollár Peter, 79
Koneracka Martina, 80
Korfanta Rastislav, 39, 60
Kovačech Branislav, 96
Koza Michael, 42
Kozin Illia, 91
Krajčíková Daniela, 33
Kraus Dominik, 27
Krempaský Juraj, 30, 58
Kriechbaum Manfred, 94
Krieger Jonas, 77
Krobisz Aleksander Adam, 73
Kromka Frantisek, 81
Král Lubomír, 108
Kubovcikova Martina, 80
Kulda Jiří, 43
Kurbanov Sarvarjon, 94
Kuzmin Alexei, 95, 97
Kučerka Norbert, 39, 40, 60
Kužel Radomír, 16
- Lacrămă Ana-Maria, 94
Lavoie Tera, 41
Lazarević Nenad, 88
Ledinský Martin, 56
Li Qiang, 88
- Liptak Alexander, 64
Liskova Monika, 80
Lisnichuk Maksym, 86, 98, 108
Liu Ying, 41
Lukaševiča Julija, 95
Lukyanyk Igor, 105
Lukáč Miloš, 94
- Majerová Petra, 96
Maltoni Pierfrancesco, 86
Manuel Pascal, 38
Marek Martin, 83
Martínez Juan Carlos, 51, 53, 99
Mačáková Daniela, 61
Meynen Vera, 74
Michalik Stefan, 20, 100
Midelashvili Elene, 103
Mihálik Marián, 87
Mikula Marián, 18
Mikulková Zuzana, 110
Milenkovich Teodora, 72
Milosavljević Ana, 88
Mitrović Nebojša, 75, 98
Mokso Rajmund, 50
Molodtsov Serguei, 22
Molčanová Zuzana, 87
Mrkývková Naďa, 56
Munagala Reddy Charan Reddy, 102
- Nagy Gergely, 94
Nagy Luboš, 61, 85, 86, 101
Nakládal Dalibor, 39
Nedeljković Borivoje, 75
Nemergut Michal, 83
Nemčovičová Ivana, 76
Njemoga Stefana, 96
Nádaždy Peter, 56
- Oberthuer Dominik, 33
Obšatník Peter, 74
Onderko František, 108
Onufriienko Oleksandr, 108
Orelj Jelena, 75, 98

- Orendáč Martin, 91–93
 Orendáčová Alžbeta, 91–93
 Orikhovskiy Dmytro, 106
- Partyka-Jankowska Ewa, 52
 Peddis Davide, 86
 Perez-Salas Ursula, 41
 Pfeifer Thomas, 25
 Pillárová Paula, 80
 Pisárčík Martin, 94
 Polák Adam, 96
 Porcar Lionel, 41
 Pospíšil Jiří, 87
- Ravula Thirupathi, 41
 Roch Tomáš, 18
 Rossnagel Kai, 26
 Roth Stefan, 56
 Round Ekaterina, 33
 Ryukhtin Vasyi, 94
- Saksl Karel, 73, 81
 Satrapinskyy Leonid, 18
 Sau Soham, 89
 Schulz Joachim, 29
 Schwartzkopf Matthias, 56
 Sedmidubská Barbora, 90, 107
 Shakun Leonid, 105
 Sobierajski Ryszard, 28
 Sovák Pavol, 62, 75, 98, 108
 Stadnyk Vladyslav, 93
 Stasiak Tomasz, 84
 Strbak Oliver, 80
 Striežovská Daria, 63, 74, 82, 98, 108
 Sádecká Denisa, 99
 Sádecký Tomáš, 96
 Súčík Gabriel, 81
- Tarasenko Robert, 91–93
 Tkáč Vladimír, 91, 93
 Tokarčík Martin, 93
 Truchlý Martin, 18
 Tsoukalas Ioannis, 79
- Uhríková Daniela, 39, 53, 60, 99
 Uličný Jozef, 32
- Vashalomidze Zurab, 103
 Vegso Karol, 56
 Vetráková Andrea, 33
 Vidiš Marek, 18
 Viskupová Katarína, 18
 Vlk Aleš, 56
 Vorobiov Serhii, 108
 Vozda Vojtěch, 31
 Vyšín Luděk, 90, 107
- Wachulak Przemyslaw, 107
 Welter Edmund, 95
- Yefanov Oleksandr, 33
- Zaqarashvili Teimuraz, 103
 Zastrau Ulf, 23
 Zeleňák Vladimír, 74, 101
 Zeleňáková Adriana, 46, 61, 85, 86, 101
 Zhu Yuli, 41
 Zákutná Dominika, 45, 46
 Závíšová Vlasta, 80
- Černošek Zdeněk, 93
 Černošková Eva, 93
 Čižmár Erik, 91–93
- Šiffalovic Peter, 56
 Škrabana Rostislav, 96
 Šroba Viktor, 18
 Švec Peter, 18

School of XFEL, Synchrotron and Neutron Radiation Users – SFEL 2026

Book of Abstracts

Editor: Jozef Bednarčík

Publisher: Pavol Jozef Šafárik University in Košice
published by **ŠAFÁRIKPRESS**

Year: 2026

Edition: 1st

Pages: 121

Author's sheets: 5.8 (only text)

Design and typesetting: Jozef Bednarčík



DOI: <https://doi.org/10.33542/SOX-0553-5>

ISBN 978-80-574-0553-5 (e-publication)