Ministry of Science and ICT

27th LINC Workshop

Leaders Workshop for Research and Innovation Collaboration

3rd Korea/Sweden Advanced X-ray Symposium

Science at the diffraction limit: Opportunities for Sweden/Korea Collaborations

Abstract book

KNTEC

SOGANG UNIVERSITY

MAX IV

Joachim Schnadt

Science Director, Professor
MAX IV Laboratory, Lund University
http://www.maxiv.lu.se
e-mail : joachim.schnadt@maxiv.lu.se

Joachim Schnadt is the Science Director of MAX IV since March 2024. He brings along a background within Physics and Chemical Physics, and he has not only been a long-standing user of synchrotron radiation, but also contributed to the development of former MAX-lab and present MAX IV by building up the first synchrotron-based ambient pressure x-ray photoelectron spectroscopy (APXPS) instrument at what today is the SPECIES beamline and by acting as the spokesperson for the HIPPIE beamline for APXPS. He is a professor at the Department of Physics, Lund University, to which he moved in 2005 after a postdoctoral sojourn at Aarhus University, Denmark, and a PhD from Uppsala University.

Dr. Aymeric ROBERT

Senior Advisor / Deputy Science Director for MAX 4^U
MAX IV Laboratory
http://maxiv.lu.se
e-mail : Aymeric.ROBERT@maxiv.lu.se
Research Areas : X-ray science, X-ray Coherence, Amorphous and disordered matter, Dynamics

Aymeric ROBERT is Senior Advisor at MAX IV Laboratory, Sweden. He is also Deputy Science Director for MAX 4^U. He received his Ph.D. in physics at Joseph Fourier University with a fellowship from the European Synchrotron Radiation Facility (Grenoble, France) in 2001. He was among the team that pioneered the use of X-ray coherence to develop X-ray Photon Correlation Spectroscopy (XPCS) at the ESRF, the world's first third-generation synchrotron source (from 1998 to 2007). XPCS has since matured as a robust technique to probe the equilibrium and out-of-equilibrium dynamics of ordered and disordered matter. From 2007 to 2012, he built the third instrument at the Linac Coherent Light Source (Stanford University, Menlo Park, USA): the X-ray Correlation Spectroscopy instrument (https://lcls.slac.stanford.edu/instruments/xcs). LCLS is the world's first hard X-ray-Free Electron Laser. He was hard X-ray Department head (2012), then Deputy Director of the LCLS Science Division (2015) until moving to MAX IV Laboratory in 2021 as Scientific Director for Physical Sciences. MAX IV hosts the first fourth-generation synchrotron source. He was appointed Senior Advisor in 2024 and leads the science case for MAX 4U, an upgrade program of our 3GeVstorage ring. He continues to advocate for the use of X-ray coherence in X-ray science at MAX IV and beyond.

MAX 4U – Our vision for MAX IV

Aymeric ROBERT

MAX IV laboratory, Lund University, Fotongatan 2, Lund SE-211 00, Sweden

In 2016, MAX IV inaugurated the first fourth-generation storage ring in the world. With unprecedented performance, this new accelerator paved the way for a new era of X-ray science. Currently, four more fourth-generation light sources are in operation, with many more to come online by 2040. Overall, the accelerator community is making considerable advancements in Multi-Bend Achromat (MBA)-type lattices. This is to such an extent that, whereas MAX IV paved the way for fourth-generation light sources, we will have difficulties competing with other synchrotrons in the future.
With this in mind, we developed our vision for the laboratory to ensure the excellence, relevance, and leadership of Swedish academic and industrial research with X-rays for the next decades.
This is called **MAX 4^U**, and is our proposal to upgrade our 3GeV storage ring [1]. MAX 4^U will reduce the 3GeV ring horizontal emittance further from the current of 328pm×rad to better than 100pm×rad on the horizon of the early 2030s. Beyond an accelerator upgrade, MAX 4^U provides opportunities for beamline performance improvements that will keep MAX IV a leading platform for accelerating science, discovery, and innovation.
[1] https://maxiv.lu.se/max4u

Funding
MAX IV laboratory, the Swedish synchrotron lightsource, is funded principally by Vetenskapsrådet / Swedish Research Council.

Kyung-Tae Ko

Beamline Division,
Multi-purpose Synchrotron Construction Project
Korea Basic Science Institute
https:
e-mail : kkt0706@kbsi.re.kr
Research Areas : X-ray Spectroscopy, Condensed Matter Physics

Dr. Kyung-Tae Ko is currently the Head of the Beamline Division for the Multipurpose Synchrotron Construction Project at the Korea Basic Science Institute (KBSI). He received his BS and Ph.D. in experimental physics from POSTECH, South Korea. After completing a two-year postdoctoral fellowship at POSTECH, he joined the Max Planck POSTECH Center as a junior research group leader and worked as a guest scientist at MPI-CPfS in Dresden, Germany, until October 2015. Upon returning to Korea, he served as a senior scientist at the Max Planck-POSTECH Center and as an affiliate professor in the Department of Physics at POSTECH. In 2020, he moved to KBSI to participate in the new synchrotron project and has been serving in his current role since July 2025. As an X-ray spectroscopist utilizing synchrotron radiation sources, his main research focuses on the electronic structure and correlated phenomena in various transition metal-based complex materials. Currently, he seeks to expand his research scope to encompass next-generation X-ray photon science, including advanced measurement techniques and AI-driven data science.

Selected recent publications

[1] J.-S. Lee *et al.*, Cooperative Charge Ordering Signature of Trimer Molecules in Infinite-Layer $CaCoO_2$, Physical Review X 16, 011064 (2026; contribution)

[2] J.-K. Kim *et al.*, Electronic origin of ferroelectricity in multiferroic $Lu_{0.5}Sc_{0.5}FeO3$, Physical Review B 108, 155152 (2023; corresponding)

[3] S.-R. Kim *et al.*, Role of Orbital Bond and Local Magnetism in Fe_3GeTe_2 and Fe_4GeTe_2: Implication for Ultrathin Nano Devices, ACS Applied Nano Materials 5, 10341 (2022; corresponding)

[4] Y.-J. Kim *et al.*, Orbital Order Melting at Reduced Dimensions, Nano Letters 22, 1059 (2022; contribution)

[5] J.-H. Ryu *et al.*, Direct Observation of Orbital Driven Strong Interlayer Coupling in Puckered Two-Dimensional $PdSe_2$, Small 18, 2106053 (2022; corresponding)

Current Status and Perspective of Beamlines in K-4GSR

Kyung-Tae Ko

Beamline Division, Multi-purpose Synchrotron Construction Project
Korea Basic Science Institute

The multi-purpose synchrotron construction project aims to build a new 4 GeV, 800 m-scale storage ring in Korea. The target electron beam emittance is below 100 pm·rad, achieving a diffraction-limited photon energy of up to 1.5 keV. Building construction commenced in May 2026 and is scheduled for completion in 2029, with beamline commissioning anticipated to begin in 2030. In parallel with the construction, we have been updating the optical layouts and refining the science programs to maximize facility performance and utilization. Here, we introduce the key modifications to the updated beamline program and present the future development schedule, along with recent activities from our science working groups. Furthermore, to align with the ongoing AI transformation, a new physical AI R&D program is being established for both the accelerator and beamlines. We expect this parallel R&D initiative to significantly enhance the productivity of the upcoming facility.

Kajsa G. V. Sigfridsson Clauss

Group manager Science Division, Beamline
Scientist Balder
e-mail : kajsa.sigfridsson_clauss@maxiv.lu.se
Research Areas : Hard X-ray spectroscopy, Life
Science, Environmental Science, Chemistry

Kajsa Sigfridsson Clauss is Balder Beamline Scientist and Group Manager in the Science Division at the MAX IV Laboratory in Sweden. She earned her PhD in Chemistry from Uppsala University in 2009, focusing on EPR spectroscopy of Photosystem II in the Styring lab. Her postdoctoral work at Freie Universität Berlin in the Haumann/Dau group expanded her expertise to hard X-ray spectroscopy, where she investigated metalloproteins using XAS and XES techniques. After returning to Sweden in 2012 for a postdoc at the I811 XAFS beamline at MAX-lab, she joined MAX IV in 2016 as a beamline scientist for the Balder hard X-ray spectroscopy beamline, where she has developed sample environments for liquid and sensitive samples in life and environmental sciences. Presently she is leading the science case for MAX 4U in Environmental and Earth sciences.

Selected recent publications

Applications of X-ray fluorescence microscopy with synchrotron radiation: From biology to materials science DOI: 10.1016/j.radphyschem.2024.112491

Nanoparticles of iridium and other platinum group elements identified in Chicxulub asteroid impact spherules – Implications for impact winter and profound climate change
DOI: 10.1016/j.gloplacha.2024.104659

Fabrication and characterisation of a silicon-borosilicate glass microfluidic device for synchrotron-based hard X-ray spectroscopy studies DOI: 10.1039/d1ra05270e

Environmental and earth sciences with MAX4U and Balder

Kajsa G.V. Sigfridsson Clauss

MAX IV Laboratory, Lund University

Environmental and earth sciences is a broad and active area of research at MAX IV where user science can have direct societal impact in areas of mining critical raw materials, waste handling and recycling, pollution mitigations and more. This is therefore an important part of the science case for the MAX 4U upgrade of the 3 GeV storage ring and its beamlines. Scientific questions in this area are probing real life samples with large natural variation. The anticipated higher flux and better spatial resolution and increased coherence especially at higher energies will allow us to see lower trace amounts and finer details and speed up measurements to probe statistically relevant number/area of samples. Examples will be shown.

Balder is a wiggler source beamline at MAX IV for hard X-ray spectroscopy (XAS and XES) and will as such do not gain anything from the MAX 4U upgrade. However, it will continue to do good science in the field of environmental science. User examples will be shown.

Mira Viljanen

Scientist
MAX IV Laboratory – Lund University
e-mail : mira.viljanen@maxiv.lu.se
Research Areas : Combined X-ray imaging techniques, X-ray Scattering, X-ray tomography, Cellulosic materials

Mira Viljanen is a beamline scientist working on the ForMAX beamline at MAX IV Laboratory in Lund, Sweden. She earned a degree in physics from the University of Helsinki in 2023. Following the completion of her doctoral studies, Dr. Viljanen pursued postdoctoral research at ForMAX beamline, focusing on the development of combined X-ray scattering and imaging on hierarchical materials at the beamline. After a period of postdoctoral research, Dr. Viljanen transitioned to the role of beamline scientist at ForMAX beamline, where she is working on beamline development, user support and collaborative research projects with industrial and academic users.

Multiscale & -modal characterisation of renewable materials

Mira Viljanen

ForMAX beamline,
MAX IV Laboratory – Lund University

With the ever-increasing demand for sustainable and renewable materials, forest-derived resources such as wood have become key candidates for future material solutions. Wood and many other renewable materials are naturally hierarchical, consisting of structural elements that extend from the atomistic and nanoscales to micrometre level organisation. Understanding the structural features at multiple length scales is essential for tailoring material performance and enabling the development of advanced biodegradable products.

Addressing such multiscale complexity requires advanced characterisation techniques capable of resolving structural information in both space and time. Fourth-generation synchrotron sources, characterised by their extremely high photon flux density, enable X-ray imaging with unprecedented temporal resolution and sensitivity. At the ForMAX beamline of the MAX IV Laboratory [1], these capabilities are harnessed through the combination of time-resolved full-field X-ray (uCT) imaging and small- and wide-angle scattering (SWAXS). This multimodal approach allows spatiotemporal characterisation across more than eight orders of magnitude in length and time, bridging real-space imaging with reciprocal-space analysis within a single experimental platform. We will present how this multimodal approach provides unique insights into the multiscale structure of renewable and sustainable materials, highlighting its potential to advance the understanding and design if sustainable material systems.

References

[1]. K. Nygård et al., *J. Synchrotron Rad.* 31 (2024) 363.

Calle Preger

Low Density Matter (LDM) Scientist, MAX IV Laboratory
e-mail : calle.preger@maxiv.lu.se
Research Areas : Aerosols, Photoelectron spectroscopy, Low Density Matter (LDM)

Dr. Calle Preger is a Low Density Matter (LDM) Scientist with expertise in aerosol studies at synchrotron facilities. Calle received his M.S degrees in Engineering Nanoscience from Lund University and earned a Ph. D in solid state physics and aerosol science in 2020. The title of his thesis was Magnetic-field-directed Self-assembly of Multifunctional Aerosol Nanoparticles. Between 2021 and 2024 Calle conducted postdoctoral research at MAX IV Laboratory, where he developed and commissioned a novel aerosol sample delivery system for in-flight photoelectron spectroscopy studies of aerosols. Since 2025 Calle has been employed permanently at MAX IV Laboratory to lead the development of aerosol research development at MAX IV, with key focus on the aerosol sample delivery system.

Selected recent publications

i. *A versatile sample delivery system for x-ray photoelectron spectroscopy of in-flight aerosols and free nanoparticles at MAX IV Laboratory,* **C. Preger,** J. Rissler, A. Kivimäki, A. C. Eriksson, N. Walsh, *J. Synchrotron Rad.* (2004), 31, 1382-1392

ii. *In-Flight Observation and Surface Oxidation Modification of Tin Oxide Nanoparticles for Gas Sensing Applications,* **C. Preger**, L. Jonsson, P. Ternero, M. Sedrpooshan, M. Bermeo, A. Kivimaki, N. Walsh, M. E. Messing, A. C. Eriksson, J. Rissler. *ACS Applied Nano Materials. (2025)* 8 (12), 6004-6013

iii. *Minor components in natural inorganic aerosols dominate surface composition: a contrast between surface and bulk,* X. Kong, N .Fauré, **C. Preger**, A. C. Eriksson, J. Rissler, J. B. C. Pettersson, *Environmental Science & Technology Letters* (2025), 12 (10), 1347-1353

iv. *Magnetic field-assisted nanochains formation of intermixed catalytic Co-Pd nanoparticles* **C Preger**, L Rämisch, J Zetterberg, S Blomberg, ME Messing, *Nanoscale* (2025), 17 (2), 955-964

v. *Surface properties of spark-ablated metal oxide nanoparticles studied in-flight* L. Jönsson, **C. Preger,** T. Krinke, M. Bermeo, M. Sedrpooshan, H. Jalili, M. Pourhossein, B. O. Meuller, A. C. Eriksson, J. Rissler, K. Deppert, M. E. Messing, *Powder Technology* (2026), 122363

In-flight surface characterization of aerosol particles at the MAX IV synchrotron radiation facility

C. Preger
MAX IV Laboratory, Lund University, Box 118, 221 00 Lund, Sweden
corresponding author: calle.preger@maxiv.lu.se

The chemical surface properties of aerosol particles are of utmost importance, as they govern their reactivity and toxicology. Thus, the surface properties of aerosol particles are relevant for their health effects, their impact on climate, and development of new materials. To enable direct surface investigation of aerosols, a dedicated aerosol sample-delivery system (ASDS) has been developed at the MAX IV synchrotron radiation facility in Lund, Sweden [1]. The ASDS combines an aerodynamic lens with differential pumping stages and is optimized for in-flight X-ray photoelectron spectroscopy (XPS). It continuously transports aerosols from atmospheric pressure into vacuum, enabling their analysis only seconds after formation. This rapid, substrate-free approach minimizes radiation damage, avoids artefacts associated with particle collection, and allows characterization of truly unsupported aerosols. Additionally, gas molecules propagating with the particle beam can be exploited for energy calibration and gas–particle studies. Since its inclusion into standard user calls in spring 2023, the ASDS has been applied to a wide range of aerosol types, including soot, sea salt, secondary organic aerosol, and engineered nanoparticles. MAX IV provides basic instrumentation for aerosol generation and characterization, and users have the option of bringing their own unique aerosol generation systems to enable comprehensive in-flight XPS of lab-generated aerosols.

[1] C. Preger *et al.*, *J. Synchrotron Rad.* 31 (2024) 1382.

Karina Thånell

Group manager for Imaging, and beamline scientist SoftiMAX
MAX IV Laboratory, Lund University

https://www.maxiv.lu.se/beamlines-accelerators/beamlines/softimax/

e-mail : karina.thanell@maxiv.lu.se

Research Areas: X-ray microscopy techniques, environmental, biomedical and heritage science

Karina Thånell received her PhD (2002) from Groningen University, the Netherlands, working on electron spectroscopies of correlated systems, such as layered bismuth superconductors and giant magnetoresistance oxides. Her M.Sc. is from the same university, involving FT-IR spectroscopy on Transition Metal silicides. At Nottingham University (UK) she completed a postdoc position and an Anne McLaren Fellowship, working on encapsulated fullerenes, and phthalocyanines using synchrotron techniques, STM and AFM. In 2008 she made the move to Max-lab, as the beamline responsible for I311, a soft X-ray beamline for XAS and XPS. When MAX IV came on the horizon, she switched to lead the SoftiMAX project – a soft X-ray beamline for STXM/ptychography and Coherent X-ray Imaging. Since 2019 she is also the Group Manager for Imaging beamlines, nowadays comprising SoftiMAX and NanoMAX. She has co-authored more than 90 international journal articles, and was the main host for XRM2024.

Selected recent publications

Nanoscale Characterization of Fungal-Induced CaCO3 Precipitation: Implications for Self-Healing Concrete – M. Tuyishime, E. C. Hammer, M. Pla-Ferriol, **K. Thånell**, C. Alwmark, S. van Velzen, D. Floudas, R. Platakyte, M. Obst & H. Zou –
ACS Appl. Materials & Interfaces **17**, 37648 (2025) – https://doi.org/10.1021/acsami.5c07137

Rapid, In Situ and Non-Destructive Analysis for the Evaluation of Microplastics Degradation in Water Via Haze Measurement – R. Greco, L. Baxauli-Marin, J. Fernández-Catalá, V. Pankratova, C. Bulbucan, **K. Thånell** & W. Cao – Chemistry Methods **5**, e202400047 (2025) – https://doi.org/10.1002/cmtd.202400047

Phosphorus Storage in Microalgae: STXM and XAS P K-Edge Investigation –
M. Plouviez, B. Guieysse, O. Buwalda, K. Wolmarans, **K. Thånell**, I. Beinik, JRM Tuyishime, V. Mitchell, P. Kappen, RG. Haverkamp – ACS Sust. Res. Managem. **1**, 1270 (2024) – https://doi.org/10.1021/acssusresmgt.4c00130

Microalgae for the Extraction and Separation of Rare Earths: An STXM Study of Ce, Gd & P
M. Plouviez, B. Guieysse, K. Wolmarans, A. M. E. Matinong, O. Buwalda, **K. Thånell**, I. Beinik, M. Tuyishime, V. Mitchell, P. Kappen, D. Flynn, T. Jauffrais & R. G. Haverkamp –
ACS Sust. Res. Managem. **1**, 2225 (2024) – https://doi.org/10.1021/acssusresmgt.4c00237

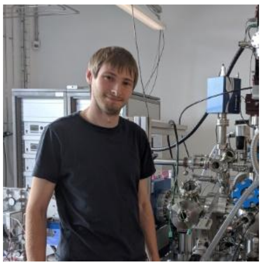
Environmental Science at SoftiMAX

Karina Thånell

MAX IV Laboratory, Lund University

I will present examples from ‘space, air, water, and earth’ research conducted at SoftiMAX outlining the many possibilities for environmental research at the beamline.

Robert Temperton



APXPS Group Manager
Beamline Scientist, HIPPIE Beamline
MAX IV Laboratory, Lund University

e-mail : robert.temperton@maxiv.lu.se
Research Areas : Soft X-ray spectrosopy, electrochemical interfaces, charge transfer materials

Robert is a scientist at the HIPPIE beamline at the MAX IV Laboratory. He is a specialist in applying advanced Xray spectroscopies to complex systems, with a specific focus on energy materials, batteries and electrochemical interfaces. He is also the manager of the APXPS group, which operates 4 instruments at two beamlines (SPECIES and HIPPIE). Recently he has been working on the development of the MAX 4U project by coordinating and contributing to the "whitepaper" and the energy materials section of the science-case.

Selected recent publications

Multimodal Ambient Pressure Sample Environment for the HIPPIE Solid-Gas Endstation at MAX IV Laboratory. Rosemary Jones et al. Photon Sci. 2026, 1, 2, 111–120

MAX 4U, Energy Materials and photoemission at a 4th generation synchrotron

Robert Temperton

MAX IV Laboratory
Lund University

MAX IV has a thriving energy materials program that will be significantly enhanced by the proposed MAX 4U upgrade. The first half of talk will highlight some of these opportunities, with a focused examples in the areas of batteries, catalysts and photovoltaics.

The second half of the talk will present an update of ambient pressure spectroscopy activities at the HIPPIE beamline. This will include ideas of how we could develop the beamline, including how the beamline may benefit from the reduced emittance delivered by MAX 4U. We will also provide a progress update on our operando time-resolved activities, which was introduced in detail in the 2025 meeting.

Hyunjung Kim

Director, Center for Ultrafast Phase Transformation
Professor, Department of Physics
Sogang University
http://cupt.sogang.ac.kr
e-mail: hkim@sogang.ac.kr
Research Areas: X-ray Scattering, Coherent X-ray Diffraction Imaging, X-ray Photon Correlation Spectroscopy, Phase Transformation, Energy Materials, Catalysis, Nanoparticles

Hyunjung Kim is the Director of the Center for Phase Transformation and a professor at the Department of Physics, Sogang University, Korea. She served on the Presidential Advisory Council on Science and Technology (PACST) in Korea from 2023 to 2026. She received her B.S. and M.S. degrees in physics from Sogang in 1987 and 1989, respectively, and her Ph.D. in Physics from Purdue University, USA, in 1998. She was a Postdoctoral Fellow at Purdue University, the Advanced Photon Source at Argonne National Laboratory, and the University of California, San Diego in the USA prior to joining Sogang University in 2002. Her research focuses on investigating ultrafast phenomena related to the phase transformation (e.g., phase transition, order-disorder transition, atomic diffusion, defect migration, nucleation) of materials and develops innovative methods for probing with the use of X-ray Free Electron Lasers and synchrotrons, emphasizing quantum materials, energy materials, and catalytic nanoparticles in situ and operando conditions. She has authored more than 130 international journal articles.

Selected recent publications

1. S. Choi, et.al., Dynamics of dislocation formations and their impacts on exsolution in Ru-doped perovskite oxide, Nature Commun. (2026).
2. F. Zhou, et.al., Atomically Resolved Acoustic Dynamics Coupled with Magnetic Order in a Van der Waals Antiferromagnet, Advanced Materials **38**, e22280 (2026).
3. K. Yun, et.al., Enhancing resolution with the extended image restoration method: Strain field energy and correlation length analysis in Bragg coherent X-ray diffraction imaging, Journal of Synchrotron Radiation **32**, 743-749, (2025).
4. D. Kim, et.al., Nonmelting Disordering Facilitated by Electron Delocalization, ACS Nano **1**9, 9317-9326 (2025).
5. T. Tran, et.al., Augmented Extraction Efficiency of a Hot D Exciton in MoS_2 via Intervalley Scattering, Nano Letters **36**, 11163-11169 (2024).
6. S. Choi, et.al., Strain and crystallographic identification of the helically concaved gap surfaces of chiral nanoparticles, Nature Communications **14**, 3615-3624 (2023).
7. A. Johnson, et.al., Ultrafast X-ray imaging of the light-induced phase transition in VO2, Nature Physics **19**. 215-220 (2022).

Unveiling Ultrafast Phase-Transition Dynamics in Perovskite Oxides through Time-resolved Bragg Coherent X-ray Diffraction Imaging

Hyunjung Kim

Center for Ultrafast Phase Transformation
Department of Physics
Sogang University

In perovskite oxides, the coupling between photoexcited carriers and the crystal lattice on femtosecond-to-picosecond timescales plays a decisive role in determining both the fundamental physics and the functional performance of these materials. This electron–lattice interaction governs how the lattice deforms and how charge carriers migrate through the structure. Capturing the moment when such distortions emerge and begin to propagate—prior to their eventual evolution into fully developed phonon modes—is essential to unlocking the full potential of these systems. To date, however, neither direct experimental observations nor a satisfactory mechanistic picture of how these distortions arise and travel has been established.

Recent developments in X-ray free-electron lasers (XFELs) have pushed the temporal resolution of structural dynamics experiments into the few- to tens-of-femtosecond regime, taking advantage of the distinctive properties of X-ray pulses. Unlike conventional approaches that typically capture only the starting and ending configurations, XFELs provide access to transient states and intermediate pathways that are traversed during a phase transformation.

In this talk, I will report direct visualization of the earliest stages of carrier-driven lattice deformation, together with the subsequent strain evolution, in perovskite-oxide nanocrystals. Photoinduced ultrafast structural changes were probed using time-resolved Bragg coherent X-ray diffraction imaging in an optical-pump/X-ray-probe configuration at PAL-XFEL and LCLS. Our measurements reveal a distinctive form of lattice distortion, generated by photoexcited carriers and extending throughout the whole nanocrystal on picosecond timescales. The atomic-scale displacements associated with these transient internal deformations are resolved and linked to a short-lived phase transition mediated by electron–lattice coupling.

This research was supported by the National Research Foundation of Korea (RS-2021-NR059920).

Bongjin Simon Mun

Professor at the Department of Physics and Photon Science
Gwangju Institute of Science and Technology
http:// https://physics.gist.ac.kr
e-mail : bsmun@gist.ac.kr
Research Areas : Surface Science, Electronic Structure, X-ray Photoelectron Spectroscopy

Bongjin Simon Mun is a professor in Department of Physics and Photon Science, Gwangju Institute of Science and Technology (GIST), Korea. He received his BS degree in physics at Univ. of Maryland College Park, USA in 1993, and continued his MS and PhD study in Physics at Univ. of California Davis, USA. Upon his PhD in 2001, he worked briefly as a postdoctor fellow at Lawrence Berkeley National Lab. (LBNL), USA before joining Intel Corp. USA. In 2002, he returned to LBNL and worked as a staff scientist for next 5 years. In 2007, Prof. Mun started his academic career at Hanyang Univ. ERICA, Korea and later moved to GIST. Since 2016, he is a full professor at GIST. The main research area of his group is to find the correlation between electronic structures and surface chemical reaction using synchrotron-based X-ray science.

Selected recent publications

1. Investigations on the Origin of Topotactic Phase Transition of $LaCoO_3$ Thin Films with In Situ XRD and Ambient Pressure Hard X-ray Photoelectron Spectroscopy, Hyunsuk Shin, Youngmin Yun, Okkyun Seo, Seongeun Kim, Minsik Seo, Dongwoo Kim, Hojoon Lim, Hojun Oh, Subin Jang, Kyungmin Kim, Sae Hyun Kang, Adrian Hunt, Iradwikanari Waluyo, Do Young Noh, **Bongjin Simon Mun**, Hyon Chol Kang, *ACS Applied Materials & Interfaces*, 17 (1), 1499-1508 (2025)
2. Study of CO_2 Adsorption Properties on the $SrTiO_3$(001) Surface with Ambient Pressure XPS, Dongwoo Kim, Hojoon Lim, Minsik Seo, Hyunsuk Shin, Kyungmin Kim, Moonjung Jung, Subin Jang, Byunghyun Chae, Buseung Park, Jungwoo Lee, Yongseok Choi, Ki-jeong Kim, Jeongjin Kim, Xiao Tong, Adrian Hunt, Iradwikanari Waluyo, **Bongjin Simon Mun**, *ACS Applied Materials & Interfaces*, 16 (29), 38679-38689 (2024)
3. Revealing CO_2 dissociation pathways at vicinal copper (997) interfaces, J. Kim, Y. Yu, T.W. Go, J.-J. Gallet, F. Bournel, **B.S. Mun**, J.Y. Park, *Nature Comm.* 14 (1), 3273 (2023)
4. Understanding the role of electronic effect in CO on Pt-Sn alloy surface via band structure measurements, Jongkeun Jung, Sungwoo Kang, Laurent Nicolaï, Jisook Hong, Ján Minár, Inkyung Song, Wonshik Kyung, Soohyun Cho, Beomseo Kim, Jonathan D Denlinger, Francisco José Cadete Santos Aires, Eric Ehret, Philip Ross, Jihoon Shim, Slavomir Nemsă ḱ , Doyoung Noh, Seungwu Han, Changyoung Kim, **Bongjin Simon Mun**, *ACS Catalysis*, 12, 219 (2022)
5. Jeongjin Kim, Hyunwoo Ha, Won Hui Doh, Kohei Ueda, Kazuhiko Mase, Hiroshi Kondoh, **Bongjin Simon Mun**, Hyun You Kim, Jeong Young Park, *Nature Comm.* 11 (1), 1-9 (2020)

Probing buried interface of heterostructure of transition metal oxides using tender X-ray spectroscopies

Bongjin Simon Mun

Department of Physics and Photon Science, Gwangju Institute of Science and Technology, Gwangju 61005, Korea

In heterostructures of complex oxides, "intertwined" charge, spin, orbital, and lattice degrees of freedom give rise to entirely new quantum states that do not exist in the bulk. Especially, at buried heterointerfaces, the breakdown of interfacial symmetry and the mutual reconfiguration of these charge, spin, orbital, and lattice become critically important. In this presentation, using various tender X-ray spectroscopies, including a grazing-incidence ambient-pressure photoelectron spectroscopy, X-ray scattering, and X-ray diffraction, we explored the physical and chemical properties of buried interfaces as a topotactic phase transition, an ion-migration-driven structural phase transition, takes places on heterostructures of transition metal oxides system, $LaMnO_3/SrTiO_3$. During the topotactic phase transition, the structure and chemical states of interfacial layers display unique signatures of the phase transition. The correlation between interfacial properties and its onset of topotactic phase transition will be discussed.

Kyuseok Yun

Post Doc., Center for ultrafast phase transformation,
Department of Physics
Sogang University
e-mail : xristus@naver.com
Research Areas : X-ray science

Kyuseok Yun is a Post Doc at Center for ultrafast phase transformation, Department of Physics at Sogang University, Korea. He received his B.S. degree and Ph. D. from Sogang University in 2016 and 2025, respectively. He has been working as a postdoctoral researcher at the Center for Ultrafast Phase Transformation, Department of Physics, Sogang University. His main research focuses on structural analysis of materials using Bragg Coherent Diffraction Imaging (BCDI).

Selected recent publications

1. Dongjin Kim, Myungwoo Chung, Jerome Carnis, Sungwon Kim, **Kyuseok Yun**, Jinback Kang, Wonsuk Cha, Mathew J. Cherukara, Evan Maxey, Ross Harder, Kiran Sasikumar, Subramanian K. R. S. Sankaranarayanan, Alexey Zozulya, Michael Sprung, Dohhyung Riu & Hyunjung Kim, "Active site localization of methane oxidation on Pt nanocrystals", Nature communications, 9, 3422 (2018)

2. **Kyuseok Yun**, Sungwon Kim, Dongjin Kim, Myungwoo Chung, Wonhyuk Jo, Hyerim Hwang, Daewoong Nam, Sangsoo Kim, Jangwoo Kim, Sang-Youn Park, Kyung Sook Kim, Changyong Song, Sooheyong Lee & Hyunjung Kim, "Coherence and pulse duration characterization of the PAL-XFEL in the hard X-ray regime", Scientific reports, 9, 3300 (2019)

3. Dongjin Kim, Myungwoo Chung, Sungwon Kim, **Kyuseok Yun**, Wonsuk Cha, Ross Harder, and Hyunjung Kim*, "Defect Dynamics at a Single Pt Nanoparticle during Catalytic Oxidation", Nano Letters, 19(8) 5044-5052 (2019)

4. Sungwook Choi, Myungwoo Chung, Dongjin Kim, Sungwon Kim, **Kyuseok Yun**, Wonsuk Cha, Ross Harder, Tomoya Kawaguchi, Yihua Liu, Andrew Ulvestad, Hoydoo You, Mee Kyung Song, and Hyunjung Kim*, "In Situ Strain Evolution on Pt Nanoparticles during Hydrogen Peroxide Decomposition", Nano Letters, 8541-8548 (2020)

5. Jinback Kang, Jerome Carnis, Dongjin Kim, Myungwoo Chung, Jaeseung Kim, **Kyuseok Yun**, Gukil An, Wonsuk Cha, Ross Harder, Sanghoon Song, Marcin Sikorski, Aymeric Robert, Nguyen Huu Thanh, Heeju Lee, Yong Nam Choi, Xiaojing Huang, Yong S. Chu, Jesse N. Clark, Mee Kyung Song, Kyung Byung Yoon, Ian K. Robinson & Hyunjung Kim, "Time-resolved in situ visualization of the structural response of zeolites during catalysis", Nature communications, 11, 5901 (2020)

6. **Kyuseok Yun**, Sungwook Choi & Hyunjung Kim. "Enhancing resolution with the extended image restoration method: strain field energy and correlation length analysis in Bragg coherent X-ray diffraction imaging." Journal of Synchrotron Radiation 32.3 (2025).

Hidden interfaces direct ferroelastic variant selection in $BiVO_4$ nanoparticles

Kyuseok Yun, Muhammad Mahmood Nawaz, Sung Soo Ha, Sungwook Choi, Jiseong Oh, Hieu Minh Ngo, Dongchan Kim, Jinhwan Jang, Su Yong Lee, Wojciech Roseker, Dina Sheyfer, Ross Harder, Hyunjung Kim

Center for Ultrafast Phase Transformation, Department of Physics, Sogang University, Seoul Korea
Pohang Accelerator Laboratory, POSTECH, Pohang, Korea.
Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany.
Advanced Photon Source, Argonne National Laboratory, Argonne, IL, USA.

Twin walls in ferroelastic oxides concentrate strain gradients that steer transformation pathways, but their buried evolution remains elusive. Here, we use in situ Bragg coherent diffraction imaging to track 3D lattice displacement and strain in $BiVO_4$ bipyramidal nanoparticles across the tetragonal-monoclinic transition. Above the transition, we uncover a reproducible, sharp diagonal phase-discontinuity sheet and, from a non-collinear reflection in a morphologically matched particle, a core-centered axial strain partition. On cooling, reciprocal-space shoulders emerge and reconstructed amplitude collapses first near the internal interface, consistent with variant-formation onset. Both reciprocal and real-space motifs recover on reheating. Combining the two projections under the tetragonal constraint yields a 3D strain-topology map of intersecting diagonal sheets and axial partitions, consistent with an eight-variant twin-network architecture. Hidden internal interfaces, therefore, direct variant emergence by providing preferred nucleation sites where pre-existing strain gradients preferentially drive symmetry breaking, enabling engineering of strain-textured domain networks in ferroic nanoparticles.

This work was supported by the National Research Foundation of Korea grant RS-2021-NR059920.

Heejong Shin

Assistant Professor, Department of Chemical and Biomolecular Engineering
Sogang University
http://hshin-lab.com
e-mail : hshin@sogang.ac.kr
Research Areas : Electrocatalysis and Electrochemical Energy Conversion

Heejong Shin is an Assistant Professor in the Department of Chemical and Biomolecular Engineering at Sogang University, Republic of Korea. He received his B.S. degree in Chemical and Biological Engineering from Seoul National University in 2014 and earned his Ph.D. from the same department in 2020 under the supervision of Prof. Yung-Eun Sung. Following his doctoral studies, he conducted postdoctoral research at the Institute for Basic Science (IBS) Center for Nanoparticle Research and later at Northwestern University in the group of Prof. Edward H. Sargent.

Prof. Shin's research focuses on the design of nanostructured catalyst materials, electrochemical interfaces, and integrated reaction systems for sustainable energy and chemical production. His group develops advanced electrocatalysts and reactor platforms for CO_2 capture and conversion, hydrogen peroxide electrosynthesis, water electrolysis, and renewable chemical manufacturing. A major emphasis of his work is the mechanistic understanding of electrochemical reactions through in situ and operando characterization techniques, including X-ray spectroscopy, Raman spectroscopy, infrared spectroscopy, and electrochemical mass spectrometry.

He has authored more than 50 international journal publications, including papers in Nature Energy, Nature Catalysis, Nature Materials, Joule, and Energy & Environmental Science. His research aims to bridge fundamental catalyst science with practical electrochemical systems, accelerating the electrification of chemical processes for a sustainable future.

Selected recent publications

1) Tandem amine scrubbing and CO_2 electrolysis via direct piperazine carbamate reduction. *Nature Energy* **2025**, 10, 1262-1273.

2) Electrolysis of ethylene to ethylene glycol paired with acidic CO_2-to-CO conversion. *Energy & Environmental Science* **2025**, 18, 8600-8607.

3) Hierarchically porous carbon supports enable efficient syngas production in electrified reactive capture. *Energy & Environmental Science* **2025**, 18, 6628-6640.

4) Electrochemically generated electrophilic peroxo species accelerates alkaline oxygen evolution reaction. *Joule* **2023**, 7, 1902-1919.

5) Supramolecular tuning of supported metal phthalocyanine catalysts for hydrogen peroxide electrosynthesis. *Nature Catalysis* **2023**, 6, 234-243.

6) Atomic-level Tuning of Co-N-C Catalyst for High-Performance Electrochemical H_2O_2 Production. *Nature Materials* **2020**, 19, 436-442.

Mechanistic Understanding of Electrocatalyst Degradation via In Situ/Operando Analysis

Heejong Shin

Department of Chemical and Biomolecular Engineering,
Sogang University

Electrochemical energy conversion technologies, including CO_2 capture and conversion, water electrolysis, electrosynthesis, and hydrogen fuel cells are promising pathways toward sustainable chemical production and carbon neutrality. Despite significant advances in catalyst and reactor design, the long-term stability of electrocatalysts remains a critical challenge, largely due to the dynamic structural and chemical evolution occurring at "electrode-electrolyte interfaces" under operating conditions.

In this presentation, I will introduce our recent efforts to elucidate degradation mechanisms in electrochemical systems through in situ and operando characterization techniques. Particular emphasis will be placed on studies employing synchrotron-based X-ray methods, which enable direct observation of catalyst reconstruction, oxidation-state changes, and interfacial transformations during electrochemical operation. These insights have provided a deeper understanding of the relationship between catalyst dynamics and performance degradation.

Finally, I will discuss several outstanding challenges in the field, including the time-resolved tracking of short-lived reaction intermediates, operando visualization of local interfacial phenomena at working electrodes, and the development of multimodal characterization platforms capable of correlating structural, chemical, and kinetic information across multiple length and time scales. Addressing these challenges will be essential for establishing mechanistic design principles for next-generation electrochemical energy conversion systems.

Thorbjørn Erik Køppen Christensen

PhD in Nanoscience
Researcher at MAX IV and DTU compute
e-mail : thorbjorn_erik.koppen_christensen@maxiv.lu.se
Research Areas : Biomineralization, Tomography, XRD and XRF mapping, Bone research.

Thorbjørn Erik Køppen Christensen is a researcher at the DanMAX beamline. His research is focused on biomineralization, and he utilizes both diffraction, fluorescence, and tomography in his work.

Furthermore, Thorbjørn has a strong focus on developing data pipeline for TiB size datasets, and has been part of multiple pipeline developments at MAX IV.

At the DanMAX beamline, Thorbjørn has been part of the development of the reconstruction pipeline, along with daily operations, and user support.

Selected recent publications

A. Rodriguez-Palomo, M. S. B. Jacobsen, Thorbjørn Erik Køppen Christensen, M. R. V. Jørgensen, I. Kantor, G. Willan, A. Herrel, A. Marghoub, M. Moazen, S. Evans, M. Vickaryous, C. J. Williams, H. Birkedal, Acta Biomaterialia 2025, 204, 457–469

Thorbjørn Erik Køppen Christensen, T. Moriishi, T. Komori, Faraday Discussions 2025, 261, 446–460

N. Schenz-Spisic, Thorbjørn Erik Køppen Christensen, J. Palle, M. Østergaard, M. Berglund, J. Hubner, H. Huber, I. Artioli, V. Offermanns, C. Chen, M. Foss, A. G. Crismani, H. Birkedal, Materialia 2025, 102385

Thorbjørn Erik Køppen Christensen, M. Østergaard, O. Gutowski, A.-C. Dippel, H. Birkedal, Journal of Structural Biology 2024, 108136

C. Li, N. K. Wittig, Thorbjørn Erik Køppen Christensen, M. Østergaard, J. Garrevoet, H. Birkedal, E. Amstad, Chemistry of Materials 2024, 36, 6038–6046

N. K. Wittig, C. Pedersen, J. Palle, M. Østergaard, Thorbjørn Erik Køppen Christensen, M. Kahnt, A. Sadetskaia, J. S. Thomsen, A. Brüel, H. Birkedal, Tomography of Materials and Structures 2024, 5, 100027

J. Q. I. Chua, Thorbjørn Erik Køppen Christensen, J. Palle, N. K. Wittig, T. A. Grünewald, J. Garrevoet, K. M. Spiers, H. Castillo-Michel, A. Schramm, W. L. Chien, R. M. Sobota, H. Birkedal, A. Miserez, Acta Biomaterialia 2023, 170, 479–495

Thorbjørn Erik Køppen Christensen, J. Q. I. Chua, N. K. Wittig, M. R. V. Jørgensen, I. Kantor, J. S. Thomsen, A. Miserez, H. Birkedal, IUCrJ 2023, 10, 288–296

A. B. Jensen, Thorbjørn Erik Køppen Christensen, C. Weninger, H. Birkedal, Journal of Synchrotron Radiation 2022, 29, 1420–1428

Thorbjørn Erik Køppen Christensen, M. B. Davidsen, S. V. Malderen, J. Garrevoet, V. Offermanns, O. Z. Andersen, M. Foss, H. Birkedal, ACS Biomaterials Science & Engineering 2022, 8, 620–625

Batteries at DanMAX

Thorbjørn Erik Køppen Christensen

Department of Applied Mathematics and Computer Science, Technical University of Denmark.
DanMAX, MAX IV, Lund, Sweden

DanMAX is a materials beamline at the MAX IV synchrotron, with at 50/50 time split between full field tomographic imaging and PXRD techniques. Both methods can prove invaluable for the study of batteries, as they both can provide unique insight into the changes in battery structure during cycling of batteries. With the *operando* techniques available at DanMAX, it is possible to follow changes in the chemistries of batteries with XRD during cycling. And with tomography, it is possible to see how the microstructure of the batteries change in the cycling process. Furthermore, at DanMAX these techniques can uniquely be combined to provide a multimodal view of both crystal and chemical structure.

Justus Just

Scientist, Beamline Lead
MAX IV Laboratory, Lund University
e-mail : justus.just@maxiv.lu.se
Research Areas :

Justus got his PhD at the University of Wuppertal and Helmholtz-Zentrum Berlin on the topic of structure-property relations in complex compound semiconductors for energy applications. Fascinated by the amount of complementary insight generated through simultaneous multimodal approaches, he developed instrumentation and methodologies to follow the real-time evolution of structure-property relations during formation of inorganic and hybrid semiconductors in his postdoctoral studies. As beamline lead of Balder at MAX IV, he now uses the exceptional properties of the world's first 4th generation synchrotron, to push the boundaries in time-resolution and data quality for uncompromised combinations of real-time spectroscopy and diffraction. In close collaboration with a diverse user community, he exploits these capabilities to investigate formation- and transformation processes in-situ and operando in various energy materials for solar cells, batteries and catalysis. Striving to accelerate material and process discovery with in-situ characterisation, he recently led the development of a beamline integrated robotic material processing platform for wet-film coating in-FORM.

Selected recent publications

Surajit Ghosh

Postdoctoral Fellow,
LDM-RIXS group,
MAX IV Laboratory, Lund *https://sites.google.com/view/surajitg15/*
e-mail: surajit.ghosh@maxiv.lu.se
Research Areas: RIXS, XAS, XMCD, Strongly Correlated Electron Systems, Battery and Energy Materials

Surajit Ghosh is a postdoctoral fellow working at the Veritas beamline of MAX IV Laboratory, Lund since August 2025. He received his B.Sc. and M.Sc. in Physics from the university of Calcutta and Banaras Hindu University, India in 2009 and 2011 respectively. He earned her Ph.D. in Physics at the Banaras Hindu University in India in 2016. From 2017 to 2022, he conducted postdoctoral research at the Indian Institute of Technology, Varanasi and Kharagpur, India. He joined as the postdoctoral fellow at Tamang university, Taipei city, Taiwan in 2022 and worked till July 2025 as the beamline local contact for the TPS 45A2 beamline TKU endstation of the Taiwan Photon Source (TPS), Hsinchu City, Taiwan as a part of the job. His current research interests include low-energy excitations in quantum materials, spin–orbital–lattice coupling, emergent magnetic phases, and spectroscopic studies of energy materials using synchrotron techniques. He has authored more than 30 peer-reviewed publications in international journals

Selected recent publications

[1] ***Correlation between non-collinear spin orientation and lattice distortion in $Ni_{0.4}Mn_{0.6}TiO_3$,*** S.-H. Hsieh*, **Surajit Ghosh***, Y.-H. Liang, , H.-T. Wang, C.- H. Du, J-W. Chiou, C.-M. Wu, C.-W. Wang, Y.-C. Shao, J.-L. Chen, C.-W. Pao, H.-M. Tsai, T.-S. Chan, W.-B. Wu, H.-J. Lin, J. F. Lee, A. Kandasami and W. F. Pong, **Physical Review Materials, 8**, 124410 (2024).
DOI: https://doi.org/10.1103/PhysRevMaterials.8.124410

[2] ***Structural Instability and Charge Transfer mediated Transition in $Pr_3Co_4Sn_{13}$: A Synchrotron Radiation Spectroscopy Based Study,*** **Surajit Ghosh*,** C.-W. Li*, H.-T. Wang, K. H. Chen, W. X. Lin, J.-W. Chiou, Y. H. Liang, C.-H. Du, C.-E. Hsu, H.-C. Hsueh, C.-N. Kuo, C. S. Lue, M. Tsai, T.- S. Chan, W.-B. Wu, H.-J. Lin, J.-F. Lee, S. C. Ray and W. F. Pong, Physical Review B, **111**, 165119 (2025).
DOI: https://doi.org/10.1103/PhysRevB.111.165119

RIXS for Battery Materials at MAX IV

Surajit Ghosh

MAX IV Laboratory
Lund University

Resonant Inelastic X-ray Scattering (RIXS) is a powerful photon-in photon-out spectroscopic technique for probing the electronic structure and low-energy excitations of quantum and energy materials. This presentation will introduce the fundamental RIXS process and discuss how RIXS can provide unique insights into a wide range of battery systems, including Li-ion, solid-state, and aqueous batteries. Particular emphasis will be placed on understanding transition-metal redox, oxygen activity, charge-transfer processes, and lattice dynamics in advanced electrode materials. The talk will further highlight major challenges in modern battery research, such as irreversible redox reactions, structural degradation, interfacial instability, capacity fading, and energy-loss mechanisms. The capability of RIXS to investigate oxygen redox chemistry, trapped molecular oxygen, and low-energy excitations in battery cathodes will also be discussed. Finally, future opportunities for operando and next-generation RIXS studies will be presented, demonstrating the growing importance of advanced synchrotron spectroscopy in the development of safer, high-performance, and sustainable energy-storage technologies.

Kim Nygård

ForMAX Beamline Lead
MAX IV Laboratory, Lund University, Sweden

e-mail : kim.nygard@maxiv.lu.se
Research Areas : Method Development, Soft Matter, Rheology

Kim Nygård is the Beamline Lead for the ForMAX beamline of the MAX IV Laboratory. He earned his Ph.D. in Physics at the University of Helsinki, Finland in 2007. From 2007 to 2011 he conducted postdoctoral research at the Paul Scherrrer Institut, Switzerland, and the European Synchrotron Radiation Facility. After an assistant professorship at the University of Gothenburg, Sweden, he joined MAX IV in 2017 to lead the construction of the ForMAX beamline. Currently he also serves as the Science Case Lead for the 'Advanced Materials' section of the Science Case for the proposed MAX 4U upgrade programme.

Advanced materials @ MAX 4U

Kim Nygård

MAX IV Laboratory,
Lund University

The MAX IV Laboratory is currently developing a science case for the proposed upgrade programme for its 3 GeV storage ring [1]. One of the highlighted areas is advanced materials, which encompasses a large user community at MAX IX. While MAX IV already today offers a broad portfolio of x-ray techniques to probe these structurally, chemically and 'dynamically' complex materials, tools for probing the connection between the processing of advanced materials and their ensuing structure across lengthscales, function, and degradation are less well developed. Here we will discuss how the MAX 4U upgrade programme would facilitate in-situ and operando processing of advanced materials.

[1] https://www.maxiv.lu.se/beamlines-accelerators/max-4u/

Do Young Noh

Professor, Department of Physics and Photon Science
Gwangju Institute of Science and Technology, Korea
http://x-ray.gist.ac.kr
e-mail : dynoh@gist.ac.kr
Research Areas : X-ray Science, Condensed Matter Physics

Do Young Noh is a Professor in the Department of Physics and Photon Science at Gwangju Institute of Science and Technology (GIST), Korea. He received his B.S. degree in Physics from Seoul National University in 1985. He earned his Ph.D. in Physics at Massachusetts Institute of Technology (MIT), United States in 1991, where he continued to work as a post-doctoral associate until 1992. From 1993 to 1995, he worked at Exxon Research & Engineering Company, United States. Since joining GIST in 1995, Prof. Noh has studied structural problems of various condensed matter and materials science systems using synchrotron x-ray radiation including x-ray free electron lasers leading x-ray science in Korea. He received an Honorary doctoral degree in 2010 at Nara Advanced Institute of Science and Technology (NAIST), Japan. He also served as the president of Institute for Basic Science (IBS), Korea from 2019 to 2025. He has authored more than 200 international journal articles.

Selected recent publications

1. X-ray-scattering studies of the interfacial structure of Au/GaAs, Physical Review B 51 (7), 4441 (1995)
2. Kinetic Roughening of Ion-Sputtered Pd(001) Surface: Beyond the Kuramoto-Sivashinsky Model, Phys. Rev. Lett. 92. 246104 (2004)
3. Coarsening Kinetics of a Spinodally Decomposed Vicinal Si(111) Surface, Phys. Rev. Lett. 102, 156103 (2009)
4. Coherent diffraction surface imaging in reflection geometry, Optics Express Vol.18 No. 7 7253 (2010)
5. Single-pulse coherent diffraction imaging using soft x-ray laser, Optics Letter 5. 37. 1688 (2012)
6. Enhancing resolution in coherent x-ray diffraction imaging Journal of Physics: Condensed Matter 28 (49), 493001 (2016)
7. Direct observation of picosecond melting and disintegration of metallic nanoparticles, Nature communications 10 (1), 2411 (2019)

Behavior of the monoclinic order in VO_2 thin films near the metal-insulator transition

Do Young Noh

Department of Physics and Photon Science, Gwangju Institute of Science and Technology, Gwangju, Korea

The interplay between structural defects, chemical composition and electrical properties of VO_2 thin films was investigated by using three-dimensional X-ray reciprocal space mapping, hard X-ray photoelectron spectroscopy, and electrical resistance measurements. In VO_2 films grown on c-plane Al_2O_3, both the monoclinic order parameter and correlation length significantly affect the metal-insulator transition (MIT). Pronounced x-ray diffuse scattering was observed in the film plane, the origin of which was attributed to the rutile-like planar defects separating ordered monoclinic domains. The monoclinic-to-rutile structural phase transition accompanying the MIT progresses in two stages. In the pre-transitional stage, the rutile-like defect boundaries separating monoclinic domains are nucleated and grow progressively, which crosses over to the transitional stage where the rutile phase grows rapidly within the domains leading to the transition. Meanwhile, in the VO_2 films grown on $LaAlO_3$, La-enriched and La-deficient VO2 grains were generated, leading to the stabilization of an intermediate triclinic phase that coexists with the monoclinic phase. In this case, cation interdiffusion significantly influences the formation of VO_2 polymorphs and their structural phase transition pathways.

Mads Ry Jørgensen

Senior Researcher, Department of Chemistry, Aarhus University (DK)
Beamline manager, DanMAX, MAX IV Laboratory, Lund University (SE)
http://maxiv.lu.se/danmax
e-mail : mads.jorgensen@maxiv.lu.se
Research Areas : Powder X-ray Diffraction, µXRD imaging, instrument development

Mads Ry Jørgensen is a Senior Researcher at the Department of Chemistry at Aarhus University (Denmark) and beamline manager for the DanMAX beamline at the MAX IV Laboratory. He received a PhD in Nanoscience from Aarhus University in 2012. In 2012 – 2013, he was a postdoc at the Spallation Neutron Source at the Oak Ridge National Laboratory in the US. Since 2014, he has been part of the DanMAX project and has led it from conceptual design through funding acquisition, construction, and commissioning to user operation. Today, Dr. Jørgensen is leading not only the DanMAX project but also the SINCRYS side-branch beamline and is the lead project partner for the Heimdal neutron diffraction instrument at the European Spallation Source.

Selected recent publications

T. E. K. Christensen, F. H. Gjørup, M. R. V. Jørgensen, A. Rodriguez-Palomo, I. Kantor: Distributed Computing for the Reconstruction of Multi-terabyte Tomographic X-ray Imaging Datasets. 2026, Accepted in *Journal of Synchrotron Radiation.*

M. R. V. Jørgensen, F. H. Gjørup, M. Yazdi-Rizi, Z. Matej, W. De Nolf, P. Bell: Why do we need a(nother) new data format? A standardized data format for azimuthally integrated area detector data. *Journal of Synchrotron Radiation.* 2026, **33**, 896-898.

M. Mobin, C. Abdurrahmanoglu, O. V. Mishin, F. H. Gjørup, M. R. V. Jørgensen, V. Esposito, A. B. Haugen: Tailoring crystallographic texture through 3D printing of piezoelectric ceramics. *Journal of the American Ceramic Society.* 2026, **109**, e70687.

A. S. Anker, J. H. Jensen, M. González-Duque, R. Moreno, A. Smolska, M. Juelsholt, V. Hardion, M. R. V. Jørgensen, A. Faiña, J. Quinson, K. Støy, T. Vegge: Autonomous Synthesis of Nanoparticles with Target Scattering Patterns. *ACS Nano.* 2026, **20**, 6767-6782.

A. Pramanick, C. Babori, F. Albertini, F. H. Gjørup, A. Kumar, M. R. V. Jørgensen, L. Daniel: Tuning functional properties of 3-D printed ferroelectric ceramics using different architectures. *Journal of the European Ceramic Society.* 2026, **46**, 118025.

A. Rodriguez-Palomo, M. Didziokas, M. S. B. Jacobsen, T. E. K. Christensen, I. Kantor, M. R. V. Jørgensen, K. P. Almtoft, A. Herrel, C. J. A. Williams, H. Birkedal: Micro and nanostructural diversity in lizard osteoderm capping tissue. *Advanced Functional Materials.* **2025**, e26169.

Autonomous nanoparticle synthesis at DanMAX

Mads Ry Jørgensen

Department of Chemistry, Aarhus University (DK)
DanMAX, MAX IV Laboratory, Lund University (SE)

Sharp Bragg peaks indicate long-range order and crystallite sizes of 100s of nm or larger. For small nanoparticles, Bragg peaks broaden and overlap, hindering the analysis of normal powder diffraction (PXRD) data. By collecting high-quality total scattering data to very high momentum transfer values and subsequently Fourier transforming said data, it is possible to obtain the Pair Distribution Function (PDF) – essentially a histogram over atomic distances weighted by their scattering power – yielding structural information. Crucially, this works even for very small nanoparticles and amorphous materials.

Total scattering (TS) is traditionally performed at high-energy beamlines, but can also be done at lower energies, such as on the DanMAX beamline, where it is performed at 35 keV. Lower energies do lead to some trade-offs, such as limiting resolution in real space, but they do allow for better time resolution [1]. DanMAX has been used in numerous TS experiments exploring nanoparticle synthesis [e.g., 2-3]; however, in these studies, the chemist determined the synthesis conditions, and the reaction was followed in situ to study the reaction mechanism and potential intermediates.

Another approach to nanoparticle synthesis is to operate an autonomous laboratory guided by direct experimental feedback. At DanMAX, we have worked with the group of Andy Anker (Technical University of Denmark) to operate a robotic synthesis robot, an automated data reduction pipeline, and a Bayesian Optimization engine to control the data acquisition. This setup demonstrated that the concept worked and that it could synthesize the target materials [4].

In this presentation, I will introduce the TS/PDF technique. I will show examples of both the in situ and autonomous experiments and discuss their applications. Finally, I will discuss the benefits the MAX 4^U upgrade could bring to this type of experiment at MAX IV and how to realize it in practice.

References

[1]. M. Roelsgaard, M. Kløve, R. Christensen, A. D. Bertelsen, N. L. N. Broge, I. Kantor, D. R. Sørensen, A.-C. Dippel, S. Banerjee, M. v. Zimmermann, P. Glaevecke, O. Gutowski, M. R. V. Jørgensen, B. B. Iversen. *Journal of Applied Crystallography.* 2023, **56**, 581-588.
[2]. A. B. Borup, A. D. Bertelsen, M. Kløve, R. S. Christensen, N. L. N. Broge, A.-C. Dippel, M. R. V. Jørgensen, B. B. Iversen. *Nanoscale.* 2023, **15**, 18481.
[3]. A. D. Bertelsen, M. Kløve, N. L. N. Broge, M. Bondesgaard, R. Christensen, A.-C. Dippel, Q. Li, R. Tilley, M. R. V. Jørgensen, B. B. Iversen. *Journal of the American Chemical Society.* 2024, **146**, 23729-23740.
[4]. A. S. Anker, J. H. Jensen, M. González-Duque, R. Moreno, A. Smolska, M. Juelsholt, V. Hardion, M. R. V. Jørgensen, A. Faiña, J. Quinson, K. Støy, T. Vegge: Autonomous Synthesis of Nanoparticles with Target Scattering Patterns. *ACS Nano.* 2026, **20**, 6767-6782.

Sukjune Choi

Senior Researcher, Beamline Engineering Office, Beamline Department, Multipurpose Synchrotron Radiation Construction Project
Korea Basic Science Institute
e-mail: sukjune6.choi@kbsi.re.kr
Research Areas: Beamline DAQ and software development, LLM-integrated autonomous experimental control, synchrotron data acquisition systems; previously, materials characterization and thin film research

Sukjune Choi is a Senior Researcher in the Beamline Engineering Office of the Multipurpose Synchrotron Radiation Construction Project at the Korea Basic Science Institute (KBSI). He received his B.S. in Physics Concentration from the Gwangju Institute of Science and Technology (GIST), Korea, in 2016, and his M.S. and Ph.D. degrees in Physics and Photon Science from the same institution in 2018 and 2025, respectively. Following his doctorate, he worked as a postdoctoral researcher at the Pohang Accelerator Laboratory (PAL), where he was based at the PLS-II 5D beamline. He joined KBSI in March 2026. His current research focuses on beamline DAQ and software development, synchrotron data acquisition systems, and LLM-integrated autonomous experiment control for next-generation synchrotron facilities.

Selected recent publications

1. Su Yeon Cha, **Sukjune Choi**, Dongwoo Kim, Okkyun Seo, Bongjin Simon Mun, Do Young Noh, and Hyon Chol Kang, “Short-range positional order in phase separated indium gallium oxide islands deposited in a reducing atmosphere”, Appl. Surf. Sci. 637, 157943 (2023).
2. **Sukjune Choi**, Daseul Ham, Sae Hyun Kang, Su Yong Lee, Do Young Noh, and Hyon Chol Kang, “Polymorphic solid phase epitaxy of amorphous SnO_2 thin films deposited on sapphire(0001) substrates”, Ceram. Int. 51, 20475-20481 (2025).
3. **Sukjune Choi**, Chel-Jong Choi, Do Young Noh, and Hyon Chol Kang, “Identification of polymorphs in epitaxial SnO_2 thin films deposited on sapphire (0001) substrates”, J. Cryst. Growth 670, 128349 (2025).
4. Daseul Ham, Su Yong Lee, **Sukjune Choi**, Ho Jun Oh, Do Young Noh, and Hyon Chol Kang, “Multimodal X-ray probe station at 9C beamline of Pohang Light Source-II”, J. Synchrotron Radiat. 29, 1114-1121 (2022).

Building and Proving AI-Ready DAQ Infrastructure for Korea-4GSR

Sukjune Choi

Beamline Engineering Office, Beamline Department, Multipurpose Synchrotron Radiation Construction Project
Korea Basic Science Institute

The Construction of Korea-4GSR, a 4^{th} generation multipurpose synchrotron radiation facility, presents both a significant challenge and a unique opportunity for beamline DAQ development. With 10 beamlines commissioned simultaneously under a fixed deadline, a unified DAQ framework must be designed from the ground up – enabling cross-beamline consistency while preserving beamline-specific independence.

This presentation describes our approach to building an AI-ready DAQ infrastructure for Korea-4GSR, centered on a control stack based on EPICS 7, Ophyd, and the Bluesky platform. We demonstrate that this infrastructure is ready for AI integration through a closed-loop autonomous experiment combining Bluesky with a large language model via Model Context Protocol. We also present complementary AI-driven experimental results from colleagues at Brookhaven National Laboratory [1] and NanoMAX, MAX-IV, illustrating the broader potential of AI-assisted decision-making in synchrotron science.

References

[1]. Kim et al., “Autonomous Nanoparticle Synthesis Guided by In Situ Multiscale Structural Characterization”, J. Am. Chem. Soc., 148, 162-174 (2026)

Dean Lang

Researcher, MicroMAX, Macromolecular Crystallography
MAX IV Laboratory, Lund University, Sweden
https://orcid.org/0000-0002-0272-1296
e-mail : dean.lang@maxiv.lu.se
Research Areas : protein crystallography, biophysics, time-resolved synchrotron methods

Dean Lang is a research scientist at the MicroMAX beamtime, specializing in sample delivery methods for time-resolved serial protein crystallography. He received his B.Sc and PhD degrees in biochemistry (structural biology) from the University of Calgary, Canada. He worked as beamline scientist at the Canadian Lightsource for 2 years, prior to joining the Macromolecular Crystallography group at MAX IV Laboratory in 2024. Dean's primary developments focus on developing crystal delivery using tape-drive, droplet, and microfluidic sample handling techniques.

Selected recent publications

Ana Gonzalez, Tobias Krojer, Jie Nan, Monika Bjelčić, Swati Aggarwal, Ishkan Gorgisyan, Mirko Milas, Mikel Eguiraun, Cecilia Casadei, Manoop Chenchiliyan, Andrius Jurgilaitis, David Kroon, Byungnam Ahn, John Carl Ekström, Oskar Aurelius, Dean Lang, Thomas Ursby and Marjolein M. G. M. Thunnissen "Status and perspective of protein crystallography at the first multi-bend achromat based synchrotron MAX IV." *Synchrotron Radiation* 32.3 (2025). https://doi.org/10.1107/S1600577525002255

Health and Life Sciences at MAX IV and MAX4U

Dean Lang

MAX IV Laboratory,
Lund University, Sweden

Health and life sciences research represents one of the largest and most diverse user communities at MAX IV. The suite of imaging, diffraction, and spectroscopy techniques allows investigations from the millimetre to Ångstrom scale. The complementarity between x-ray techniques often enables studying the structure, chemical identity, and evolution of living materials with very high precision. Incorporating time further extends measurement to an additional dimension, with potential for microsecond (and lower) resolution. Beyond x-ray measurement, the lab supports various microscopies including IR and cryo-EM, and fragment-based screening, and in the future *in vivo* tomography.

The proposed MAX4^{U} upgrade [1] to the 3 GeV storage ring promises significant advancement at the forefronts of health and life sciences synchrotron research. High-resolution imaging (tomography and ptychography, and scanning SAXS) and time-resolved techniques (SAXS, MX) which take advantage of the increased coherence and flux densities, albeit with consideration of radiation damage and heating effects, from a more brilliant source.

In this talk, I present an overview of health and life science research at MAX IV. I will emphasize high-impact publications which highlight the capabilities of MAX IV's today. Further, I will present how health and life science research community can most benefit from MAX4^{U}.

References
[1]. A. Robert et al., Eur. Phys. J. Plus 138, 495 (2023)

Suk-Youl Park

Senior Researcher, Pohang Accelerator Laboratory (PAL), POSTECH
https://pal.postech.ac.kr/en/index.do
E-mail: navypsy@postech.ac.kr

Research Areas
1. Beamline Science for Protein Structural Analysis
2. Type I Restriction–Modification Systems
3. Histone Deacetylases
4. Centriole Biogenesis

Suk-Youl Park is a Beamline Scientist at the Pohang Accelerator Laboratory (PAL), POSTECH, South Korea. He received his Ph.D. in Chemistry from Chonnam National University in 2012 and worked as a Postdoctoral Fellow at the National Cancer Institute (NIH), USA, from 2013 to 2015. Since joining PAL in 2015, he has been involved in the operation and development of the 11C Micro-MX beamline and synchrotron serial crystallography systems. In 2023, he also collaborated with the MX3 beamline at the Australian Synchrotron, ANSTO, Australia.

Dr. Park's research focuses on structural biology and beamline science using X-ray crystallography and serial crystallography techniques. In parallel, he has conducted structural studies on type I restriction-modification systems, histone deacetylases, human centrosome kinase Plk4 complexes, and key metabolic enzymes in fermentative bacteria.

Selected recent publications

1. Novel fixed-target serial crystallography flip-holder for macromolecular crystallography beamlines at synchrotron radiation sources. *J. Synchrotron Radiat.* 2025;32(Pt 2):315–320.

2. Structural Mimicry Without Glyoxalase I Functional Convergence: A Homogentisate 1,2-Dioxygenase from Acinetobacter. *Proteins*. 2025 Dec;93(12):2150-2157.

3. Structural features of a minimal intact methyltransferase of a Type I restriction–modification system. *Int. J. Biol. Macromol.* 2022; 208:381–389.

4. BL-11C Micro-MX: a high-flux microfocus macromolecular crystallography beamline for micrometre-sized protein crystals at Pohang Light Source II. *J. Synchrotron Radiat*. 2021;28(Pt 4):1210–1215.

5. A short guide to histone deacetylases including recent progress on class II enzymes. *Exp. Mol. Med*. 2020;52(2):204–212.

6. Structural basis of the specific interaction of SMRT corepressor with histone deacetylase 4. *Nucleic Acids Res.* 2018;46(22):11776–11788.

7. Molecular basis for unidirectional scaffold switching of human Plk4 in centriole biogenesis. *Nat. Struct. Mol. Biol.* 2014;21(8):696–703.

Accelerating Drug Development: Current Status and Advancement Plans for PAL MX Beamlines

Suk-Youl Park

Pohang Accelerator Laboratory, POSTECH, Pohang, Gyeongbuk, Korea.

The Pohang Accelerator Laboratory (PAL) at PLS-II operates three macromolecular crystallography (MX) beamlines—5C, 7A, and 11C—supporting protein structure determination and structure-based drug discovery. Beamlines 5C and 11C are equipped with robotic sample mounting systems, enabling efficient high-throughput and remote experiments. In particular, the 5C beamline provides a dedicated Fragment-Based Drug Discovery (FBDD) platform, facilitating early-stage therapeutic development.

The 7A beamline is currently undergoing major upgrades, including the installation of an EIGER2 detector, robotic system, and advanced goniometer to enhance throughput and data quality. The 11C beamline, optimized for microcrystals (<50 μm) and synchrotron serial crystallography (SSX), is being expanded from 90 to 1,332 sample capacity through a high-throughput automation system. In addition, a compound refractive lens (CRL) transfocator will enable flexible beam size control, significantly broadening experimental capabilities.

Furthermore, a novel flip-type fixed-target holder has been developed to address key challenges in SSX, enabling reliable room-temperature data collection.

Together, these developments position PAL's MX beamlines as advanced platforms for high-throughput structural biology, further accelerating structure-based drug discovery.

References

[1]. Novel fixed-target serial crystallography flip-holder for macromolecular crystallography beamlines at synchrotron radiation sources. J Synchrotron Radiat. 2025 Mar 1;32(Pt 2):315-320.

[2]. BL-11C Micro-MX: a high-flux microfocus macromolecular-crystallography beamline for micrometre-sized protein crystals at Pohang Light Source II. J Synchrotron Radiat. 2021 Jul 1;28(Pt 4):1210-1215.

[3]. Upgrade of BL-5C as a highly automated macromolecular crystallography beamline at Pohang Light Source II. J Synchrotron Radiat. 2021 Mar 1;28(Pt 2):602-608.

Jie Nan

Beamline scientist, Beamline Lead of MicroMAX
MAXIV Laboratory, Sweden
https://www.maxiv.lu.se/
e-mail : jie.nan@maxiv.lu.se
Research Areas : protein crystallography, time-resolved protein crystallography, ptychography

Jie Nan is the beamline lead of the MicroMAX beamline at MAXIV Laboratory. As a beamline scientist, her work focuses on beamline development and supporting users in time-resolved crystallography, serial crystallography, and crystallographic automation, with additional interests in X-ray ptychography imaging technique.

Tobias Krojer

FragMAX team lead, MAX IV Laboratory
Lund University
https://www.maxiv.lu.se/fragmax
e-mail : tobias.krojer@maxiv.lu.se
Research Areas : structural biology, drug discovery

Tobias Krojer leads the FragMAX platform for crystallographic fragment and ligand screening at MAX IV Laboratory in Lund, Sweden. The platform provides extensive user support, from protein crystallization through to data analysis, and has so far facilitated more than 50 screening campaigns for academic and industrial research groups. Tobias also holds a group leader position at Science for Life Laboratory (SciLifeLab). His research centers on structural chemical biology, experimental method development, and laboratory automation.

Tobias trained as a protein crystallographer at the Max Planck Institute of Biochemistry and earned his PhD from Cardiff University. He completed postdoctoral studies at the Institute of Molecular Pathology in Vienna. In 2009, he became a Team Leader at the Structural Genomics Consortium (SGC) at the University of Oxford where he contributed to a wide range of initiatives. During his time in Oxford, he also supported development of Diamond Light Source's XChem facility as a visiting scientist.

Selected recent publications

Kanchugal P., S. et al. FragMAX Facility for Crystallographic Fragment and Ligand Screening at MAX IV. Applied Research 4, e202400263 (2025).

Kozielski, F. et al. Structural basis for small molecule binding to the SARS-CoV-2 nsp10–nsp14 ExoN complex. Nucleic Acids Res 53, gkaf753 (2025).

Wilk, P. et al. Crystallographic fragment screening supports tool compound discovery and reveals conformational flexibility in human deoxyhypusine synthase. Commun Chem 9, 66 (2026).

Macromolecular crystallography at MAX IV: from drug discovery to time-resolved studies

Jie Nan & Tobias Krojer

MAXIV Laboratory, Lund University

MAX IV Laboratory hosts two beamlines for macromolecular crystallography (MX), BioMAX and MicroMAX, which together with the FragMAX platform provide integrated support for a broad range of structural biology applications, from routine diffraction experiments to time-resolved studies and early-stage drug discovery.

BioMAX was the first operational beamline at MAX IV Laboratory and is a versatile MX instrument offering tunable energy and variable beam sizes for a wide range of crystallographic applications. Equipped for highly automated high-throughput experiments, it is closely integrated with FragMAX, a platform for crystallographic fragment and ligand screening. FragMAX combines high-throughput crystal preparation, fragment libraries, automated data collection at BioMAX, and data-processing pipelines, supporting both academic and industrial users in structure-guided drug discovery and chemical biology.

MicroMAX expands the possibilities of macromolecular crystallography by combining a highly focused X-ray beam with advanced experimental methods for serial crystallography and time-resolved studies. The beamline supports a wide range of sample-delivery systems and sample environments, including light triggering and mixing for time-resolved experiments. Equipped with an X-ray chopper and a Jungfrau integrating detector, MicroMAX enables measurements on sub-100 microsecond timescales. More recently, its capabilities have been extended to include ptychographic imaging of biological samples under cryogenic conditions.

In this talk, we will present the current capabilities and design principles of the MX infrastructure at MAX IV, discuss ongoing developments and experimental opportunities, and outline future challenges and strategic priorities.

References

[1] Ursby, T. et al. BioMAX – the first macromolecular crystallography beamline at MAX IV Laboratory. J Synchrotron Rad 27, (2020).

[2] Gonzalez, A. et al. Status and perspective of protein crystallography at the first multi-bend achromat based synchrotron MAX IV. J Synchrotron Rad 32, 779–791 (2025).

[3] Kanchugal P., S. et al. FragMAX Facility for Crystallographic Fragment and Ligand Screening at MAX IV. Applied Research 4, e202400263 (2025).

Valeriia Skoryk

Associate Researcher, Faculty of Medicine
Postdoctoral fellow, NanoMax, MaxIV Laboratory
Lund University, Sweden

http:// https://portal.research.lu.se/en/persons/valeriia-skoryk/
e-mail : Valeriia.skoryk@med.lu.se
Research Areas : histopathology, oncomorphology, XRF, IR spectroscopy (OPTIR, AFM-IR, ATR-FTIR).

Valeriia Skoryk is an Associate Researcher/Postdoctoral Researcher at Lund University, Faculty of Medicine, and MAX IV Laboratory, Sweden. She holds an MD and a Ph.D. in Medical Science, with doctoral research focused on the pathogenetic and immunohistochemical features of gastrointestinal stromal tumors. From 2011 to 2022, she worked as a pathologist and academic researcher, with experience in diagnostic histopathology, FFPE tissue handling, and pathological interpretation of complex biological tissues. Since joining Lund University, Dr. Skoryk has developed her research at the interface of pathology, biomedical imaging, and large-scale research infrastructure. Her current work focuses on histology-based tissue preparation, correlative multimodal imaging, synchrotron nano-XRF, infrared microspectroscopy/O-PTIR, and quantitative image analysis of biological tissue architecture, with the aim of linking tissue morphology, molecular composition, and elemental distributions in biological samples.

Selected recent publications

1. da Silva IAN, Paulus A, **Skoryk V,** Su KY, Herranz-Trillo F, Klementieva O. Polystyrene nanoplastic exposure promotes amyloid misfolding and metabolic impairment at sub-lethal doses: a subcellular infrared imaging study. Environmental Science: Nano. 2026.
2. Thakore R, Aldén M, Gustavsson N, Danielson L, Lins L, Sánchez JD, Rosenthal Arensburg A, Paulus A, da Silva IAN, **Skoryk V,** Kayed R, Gouras GK, Deierborg T, Heuer A, Konings SC, Klementieva O. Early amyloid formation and neuroinflammatory response in a bigenic mouse model expressing human α-synuclein and Aβ. Parkinson's Disease. Accepted 2026; Article ID 7303965. In press.
3. Gvazava N, Konings SC, Cepeda-Prado E**, Skoryk V,** Umeano CH, Dong J, Silva IAN, Ottosson DR, Leigh ND, Wagner DE, Klementieva O. Label-free high-resolution photothermal optical infrared spectroscopy for spatiotemporal chemical analysis in fresh, hydrated living tissues and embryos. J Am Chem Soc. 2023;145(45):24796–24808.
4. Savchenko O, Shponka I, **Skoryk V,** Savchenko P. Histological and immunohistochemical features of malignant epithelial and granulosa cell tumors of the ovaries. Pathologia. 2019;16(2):155–163. doi:10.14739/2310-1237.2019.2.177078
5. Shponka I, Hrytsenko P, **Skoryk V.** Extramammary Paget's disease of the perianal area: a case report and summarizing review of the last 5 years of literature. Morphologia. 2019;13(3):156–161. doi:10.26641/1997-9665.2019.3.156-161

Abstract title

Valeriia Skoryk

Associate Researcher, Faculty of Medicine
Postdoctoral fellow, NanoMax, MaxIV Laboratory

Multimodal Synchrotron Imaging at MAX IV: New Perspectives for Cell and Tissue Research

Multimodal synchrotron imaging at MAX IV offers new perspectives for cell and tissue research in Life & Health Science by connecting morphology, elemental composition, molecular structure, chemical state, and 3D architecture across different spatial scales. In this presentation, multimodality is considered in several complementary ways: as a combination of different synchrotron techniques, as integration of synchrotron and offline methods, as analysis of the same sample or directly adjacent sections, and as a question-driven workflow where the selected methods depend on the biological problem. By combining complementary structural, elemental, chemical, and molecular readouts, these workflows can support studies of metal accumulation, drug localization, organoid architecture, biomaterial integration, and tissue heterogeneity.

References:

[1] Pushie MJ, Sylvain NJ, Hou H, Hackett MJ, Kelly ME, Webb SM. X-ray fluorescence microscopy methods for biological tissues. *Metallomics*. 2022;14(6).
[2] Roudeau S, Carmona A, Ortega R. Multimodal and multiscale correlative elemental imaging: from whole tissues down to organelles. *Current Opinion in Chemical Biology*. 2023;76:102372.

Leonardo Oliveira

Postdoctoral researcher
Lund University, MAX IV laboratory – NanoMAX beamline
https://www.linkedin.com/in/leonardosoliveira/
e-mail : leonardo.oliveira@fysik.lu.se
Research Areas : X-ray diffraction microscopy, functional and quantum materials

Leonardo Oliveira is a Materials Physicist and shared Postdoctoral Fellow between the Department of Synchrotron Radiation Physics at Lund University and the NanoMAX beamline at MAX IV Laboratory. His research uses synchrotron X-ray diffraction microscopy to study how structural heterogeneities influence functional electronics, ferroics, and quantum materials.

He earned his Ph.D. in Physics from the Technical University of Denmark in 2024, where he used Dark-Field X-ray Microscopy to investigate structural heterogeneity in lead-free dielectric materials. Key findings included how solid solutions improve mesostructural ordering in antiferroelectrics, shear stress as the driver of a polar transition in $NaNbO_3$ — recognized as a 2024 ESRF Highlight of the Year — and how chemical disorder limits energy-storage performance in $BiFeO_3$–$SrTiO_3$ relaxors.

At NanoMAX, his work has expanded to nanoscale imaging of low dimensional structural, such as thin films and quantum wells, combining nano-focused X-ray probes with multimodal approaches to study ferroelectric domain-wall dynamics and emission losses in nanoLED devices. He also contributes to the Quantum Materials and Technologies science case for the MAX IV upgrade program.

He has authored 16 peer-reviewed publications, with 188+ citations and an h-index of 10.

Selected recent publications

Bergne, A., Alikin, D., Vasiljevic, M., Buratto Tinti, V., Zamudio-García, J., Oliveira, L., et al. Electro-Chemo-Mechanical Coupling in $Hf_{0.5}Zr_{0.5}O_2$ Ferroionic Heterostructures. Advanced Functional Materials, e30176, 2026

Oliveira, L., et al. Coupled Local Residual Shear and Compressive Strain in $NaNbO_3$ Ceramics Under Cooling. Acta Materialia, 266, 119640, 2024.

Oliveira, L., et al. Heterogeneous Antiferroelectric Ordering in $NaNbO_3$–$SrSnO_3$ Ceramics Revealed by Direct Superstructure Imaging. ACS Materials Letters, 6(8), 3745–3749, 2024.

Oliveira, L., et al. Electric-field-induced non-ergodic relaxor to ferroelectric transition in $BiFeO_3$–$SrTiO_3$ ceramics. Journal of Materials Chemistry C, 11(21), 6902–6911, 2023.

Oliveira, L., et al. Insulator–metal transition in the Nd2CoFeO6 disordered double perovskite. The Journal of Physical Chemistry C, 124(41), 22733-22742, 2020.

Quantum Materials and Technology with MAX 4U

Leonardo Oliveira

NanoMAX beamline, MAX IV laboratory
Synchrotron Radiation Research and NanoLund, Department of Physics, Lund University

Quantum phenomena give rise to a new class of materials whose emergent properties hold transformative potential across technology and science. However, harnessing these properties in real devices remains challenging, as quantum states must be controlled and preserved within complex engineered geometries.

A critical bottleneck is understanding how structural heterogeneities govern structure-function relationships, where strain gradients can locally tune, suppress, or generate entirely new quantum phases [1,2]. Probing these effects under realistic operating conditions is non-trivial, requiring simultaneous high sensitivity to buried layers, structural contrast, and nanoscale spatial resolution [3,4].

In this talk, I will discuss how the forthcoming MAX 4U upgrade, through a substantial increase in transverse coherent flux, will directly address these demands for hard X-ray imaging beamlines and significantly advance in-operando characterization of quantum devices.

References

[1] Du, D.; Hu, J.; Kawasaki, J.K. Strain and Strain Gradient Engineering in Membranes of Quantum Materials. *Applied Physics Letters* ***122***, 170501, 2023, 10.1063/5.0146553.

[2] Ko, W.; Gai, Z.; Puretzky, A.A.; et al. Understanding Heterogeneities in Quantum Materials. *Advanced Materials* ***35***, 2106909, 2023, 10.1002/adma.202106909.

[3] Corley-Wiciak, C.; Richter, C.; Zoellner, M.H.; et al. Nanoscale Mapping of the 3D Strain Tensor in a Germanium Quantum Well Hosting a Functional Spin Qubit Device. *ACS Appl. Mater. Interfaces* ***15***, 3119–3130, 2023, 10.1021/acsami.2c17395.

[4] Hill Landberg, M.O.; Yan, B.; Chen, H.; et al. Direct Imaging of Nanoscale Ferroelectric Domains and Polarization Reversal in Ferroelectric Capacitors. *Nano Lett.* ***25***, 16304–16310, 2025, 10.1021/acs.nanolett.5c05032.

Evangelos Golias

Beamline scientist
MAXPEEM Beamline Scientist
MAX IV Laboratory, Lund University
https://www.maxiv.lu.se/beamlines-accelerators/beamlines/maxpeem/
e-mail : evangelos.golias@maxiv.lu.se
Research Areas : Magnetism, low-dimensional materials

I am a beamline scientist at the photoemission microscopy beamline MAXPEEM at the MAX IV synchrotron facility. My research focuses on magnetism materials (mainly altermagnets and antiferromagnets), low dimensional materials and method developments for the study of quantum materials using synchrotron radiation.

Selected recent publications

See: https://scholar.google.com/citations?user=crfg8vQAAAAJ&hl=en

Altermagnetic research at MAXIV

Evangelos Golias

MAX IV Laboratory, Lund, Sweden

We will present recent results from the MAXIV beamlines MAXPEEM and Bloch on the study of the prototypical altermagnetic material MnTe. We will show how we can use photoelectron microscopy to map the altermagnetic domain structure and control the formation of vortices and single domains [1]. The using spin- and angle-resolved photoemission spectroscopy we verified a theoretical prediction for an unconventional relativistic spin-polarization state in MnTe [2].

[1] Amin, O.J., Dal Din, A., Golias, E. *et al.* Nanoscale imaging and control of altermagnetism in MnTe. *Nature* **636**, 348–353 (2024). https://doi.org/10.1038/s41586-024-08234-x

[2]. A. Dal Din et al., arXiv:2511.01690 (2025)

Sae Hee Ryu

Staff Scientist, Beamline Photon Science Office
Korea Basic Science Institute
http://
e-mail : sryu7@kbsi.re.kr
Research Areas : Angle-Resolved Photoemission Spectroscopy

Sae Hee Ryu is a Staff Scientist in the Beamline Photon Science Office at the Korea Basic Science Institute (KBSI). His research focuses on advanced ARPES methodologies for quantum materials, with particular interest in in-operando, device-compatible, and field-controlled photoemission experiments. He has worked on the development of magnetoARPES, electronic-structure studies of low-dimensional materials, kagome metals, black phosphorus, and van der Waals heterostructures. He is currently involved in the development of a nanoARPES beamline for Korea's new fourth-generation synchrotron facility. His current direction is to connect beamline design with emerging experimental needs, including operando device environments, external-field control, nano-focused soft X-ray beams, and spatially resolved electronic-structure measurements.

Selected recent publications

- **S. H. Ryu**, G. Reichenbach, C. M. Jozwiak, A. Bostwick, P. Richter, T. Seyller, and E. Rotenberg,
"magnetoARPES: Angle Resolved Photoemission Spectroscopy with Magnetic Field Control,"
Journal of Electron Spectroscopy and Related Phenomena **2023**.

- **S. H. Ryu**, M. Huh, D. Park, C. Jozwiak, E. Rotenberg, A. Bostwick, and K. S. Kim,
"Pseudogap in a crystalline insulator doped by disordered metals,"
Nature **2021**.

- Y. Li, F. Zhang, V.-A. Ha, Y.-C. Lin, C. Dong, Q. Gao, Z. Liu, X. Liu, **S. H. Ryu**, et al.,
"Tuning commensurability in twisted van der Waals bilayers,"
Nature **2024**.

- M. Kang, S. Fang, J. Yoo, B. R. Ortiz, Y. M. Oey, J. Choi, **S. H. Ryu**, et al.,
"Charge order landscape and competition with superconductivity in kagome metals,"
Nature Materials **2022**.

- S. Husremović, O. Gonzalez, B. H. Goodge, L. S. Xie, Z. Kong, W. Zhang, **S. H. Ryu**, et al.,
"Tailored topotactic chemistry unlocks heterostructures of magnetic intercalation compounds,"
Nature Communications **2025**.

Toward In-Operando nanoARPES: Active Control of Electronic Structures in Quantum Materials Devices

Sae Hee Ryu

Beamline Photon Science Office,
Korea Basic Science Institute

Angle-resolved photoemission spectroscopy (ARPES) has been one of the most direct tools for measuring the electronic structure of quantum materials. However, many emerging materials and device systems cannot be fully understood from static measurements on pristine surfaces alone. Electronic phases in van der Waals materials, heterostructures, and low-dimensional semiconductors are often controlled by external fields, interfaces, strain, carrier density, local inhomogeneity, and device geometry.

In this presentation, I will discuss how ARPES can be extended from passive band mapping toward active control of electronic states in device-like environments. Representative directions include gate-controlled[1], magnetic-field-controlled[2, 3, 4], strain-controlled[5], and current-driven[6] ARPES. These approaches may enable targeted electronic structures, such as flat bands or van Hove singularities, to be placed near the Fermi level and directly probed. I will also discuss why nanoARPES is essential for this direction, since active device regions are often limited to micrometer-scale gates, junctions, strained areas, or current paths. The combination of nano-focused soft X-rays, external-field control, and device-compatible sample environments offers a practical route toward in-operando ARPES of quantum materials devices.

References
[1]. Nguyen, P.V. et al. Visualizing electrostatic gating effects in two-dimensional heterostructures. Nature 572, 220–223 (2019).
[2]. Ryu, S. H. et al. magnetoARPES: Angle Resolved Photoemission Spectroscopy with magnetic field control. J. Electron Spectrosc. Relat. Phenom. 266, 147357 (2023)
[3]. Huang, J. et al. Magnetic field-induced momentum-dependent symmetry breaking in a kagome superconductor. Nat. Phys. 22, 550–558 (2026).
[4]. Huang, J. et al. Angle-resolved photoemission spectroscopy with an in situ tunable magnetic field. Rev. Sci. Instrum.94 (9) 093902 (2023).
[5]. Jo, N. H. et al. Phys. Rev. B 109, 235122 (2024)
[6]. Suen, C.T. et al. Electronic response of a Mott insulator at a current-induced insulator-to-metal transition. Nat. Phys. 20, 1757–1763 (2024).

Balasubramanian Thiagarajan

Beamline Scientist at Bloch beamline
MAX IV Laboratory, Lund, Sweden
http://maxiv.lu.se
e-mail : balasubramanian.thiagarajan@maxiv.lu.se
Research Areas : Electronic band structure 2D materials using ARPES and Spin ARPES

Balasubramanian Thiagarajan is a beamline scientist at the Bloch beamline at the Swedish synchrotron facility MAX IV Laboratory. He received her M.S. degrees in Physics from University of Hyderabad, India in 1983 and worked as a staff scientist at the Indira Gandhi Center for Atomic Energy in Kalpakkan, India from 1993-1999. He received his second Maters from University of Rochester, USA in 1991 and his PhD from Brandies university in 1997. He conducted his postdoctoral research at MAX-lab from 1997-1999 at MAX-lab. Since 1999 he is working as a beamline scientist at the MAX-lab/MAX IV laboratory. His main expertise is studying 2D materials with Spin and Angle Resolved Photoemission Spectroscopy. He was also the project manager for the build-up of the i3 beamline at MAX III (MAX-lab) and the Bloch beamline at the MAX IV 1.5 GeV ring. He is also involved as one of the lead for the science case for MAX4U.

Quantum Materials research at the Bloch beamline

Balasubramanian Thiagarajan

Beamline Scientist at Bloch beamline
MAX IV Laboratory, Lund, Sweden

I will talk about the Bloch beamline, some recent developments and future outlook. I will also present a couple of science highlights from our user community and some recent work of my colleague Sungosoo Hahn. Lastly, will give my take on possibilities of complementary research on quantum materials using the 3GeV ring beamlines and the use of X-ray coherence.

References
[1].
[2].