Report of the 2025 Workshop on Frontiers in Ultrafast Scattering of Electrons

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1 Introduction

Ultrafast electron diffraction (UED) is a powerful tool for exploring material properties on ultrafast and ultrasmall scales, revealing information about structural properties of the sample. Material studies using UED have included all three phases of matter: solid, liquid, and gas. In a typical pump-probe arrangement, dual or split laser pulses are used both to generate the electron beam and to deposit energy into a sample. Systematically varying the delay between the two pulses allows for time resolved measurement of ultrafast material dynamics, such as the motion of atoms and molecules during a chemical reaction or a phase transition. The use of MeV electrons has particular advantages, including reduced velocity slippage with respect to the pump laser in thicker samples, high penetration depth with minimal damage to materials, and reduced space charge repulsion allowing for higher charge density and shorter (10s of femtosecond) bunch durations. The use of MeV-UED as an experimental tool constitutes an active and growing field with facilities coming online now in multiple laboratories and universities around the world. Growing interest and competition also provide motivation for improvements in technical capabilities. **Key areas of rapidly evolving technical improvements include spatial resolution, coherence length, temporal resolution, signal to noise, stability, and versitility of pump laser wavelengths and energies.**

The first workshop on Frontiers in Ultrafast Scattering of Electrons (FUSE) was held August 27-29, 2025 at SLAC National Accelerator Laboratory in Menlo Park, California. The primary goals of the workshop were to enhance the visibility of relativistic electron scattering as a critical research tool, foster collaboration across the broader ultrafast electron diffraction (UED) community (including both relativistic and nonrelativistic UED instruments), and serve as a platform for practitioners to exchange ideas, share breakthroughs, and address emerging challenges. The workshop was open to the global UED science and instrument development community to attend. Invited talks were arranged from international leaders, particularly those from regions with significant UED investments, to relate recent scientific developments, share capabilities and progress from emerging UED facilities, and identify opportunities for innovation. An auxilliary goal was to inform SLAC's MeV-UED program so that it will remain user-driven while adapting to evolving trends in ultrafast science. Such engagement will be vital for maintaining the value of MeV-UED as a research tool and maximizing its scientific impact.

The workshop was organized with emphasis on relativistic (MeV) electron scattering experiments under the following eight session topics: (1) Historical Overview and Perspectives, (2) MeV-UED Facilities, (3) Gas and Liquid Phase Science, (4) Solid State and Quantum Materials, (5) Electron Sources & Beam Optics, (6) Supporting Technologies, (7) Materials in Extreme Conditions, and (8) Cross-Cutting UED Science. The authors of this report were the chairs of the workshop sessions, who were invited to summarize the state of the art and future directions identified from talks and discussions within their respective sessions. Rather than summarizing the outcome of each session, we have synthesized the results from different fields of study into a cohesive set of conclusions, covering the science drivers (Section 2), current and future facilities (Section 3), and forward-looking priorities (Section 4), followed by a summary (Section 5). A list of all speakers and talks is provided at the end.

2 Science Drivers and Enablers

2.1 Stochastic Dynamics and Material Extremes

Ultrafast electron diffraction (UED) is rapidly evolving into a quantitative tool for probing transport and structural dynamics under extreme conditions. A notable advance is the integration of UED with THz spectroscopy, enabling direct measurements of DC conductivity in warm dense matter and providing critical benchmarks for Density Functional Theory - Molecular Dynamics (DFT-MD) simulations [1]. Studies of diffuse scattering in tungsten and helium-implanted tungsten have revealed new insights into non-equilibrium phonon dynamics and irradiation-induced modifications of energy relaxation pathways [2,3], processes that are central to the performance and longevity of tungsten as a plasma-facing material in fusion reactors. The UED pump-probe technique has also allowed researchers to capture ultrafast melting and phase transformations in fusion-relevant materials [4,5], as well as fragmentation processes in solvated nanoparticles [6], extending its applicability across solid, liquid, and nanoscale systems. These developments underscore the power of combining UED with complementary probes and modeling to directly link atomistic dynamics—such as electron–ion coupling, phonon relaxation, and structural disorder—to measurable quantities including electrical conductivity, thermal conductivity, and transient phase changes. Collectively, the field is moving beyond static structural snapshots toward predictive capabilities, enabling studies of increasingly complex materials and environments relevant to fusion energy systems.

Technical advancements in beam delivery and detection are critical for realizing these scientific opportunities. High bunch charges (10–100 fC) with sub-picosecond duration permit single-shot measurements of irreversible ultrafast processes, while high-repetition-rate operation improves statistical reliability for weak diffuse scattering signals. Enhanced momentum resolution ($< 0.1\ \mathring{A}^{-1}$) allows precise characterization of defect structures through diffuse scattering near Bragg peaks. The adoption of direct electron detectors further increases signal-to-noise ratio [7], improving sensitivity to both Bragg and diffuse scattering. Integration of a keV ion source into the UED system was identified as a direction of interest for future research. In-situ ion irradiation coupled with the ultrafast electron probe would enable direct observation of highly transient defect dynamics including defect formation and evolution under controlled conditions, providing critical insight into radiation damage processes in nuclear and fusion-relevant materials. Together, these developments could significantly expand the capability of UED to probe fast, complex processes in extreme environments with high temporal and structural fidelity.

Key Science Drivers: *Transport properties in warm dense matter • Ultrafast phase transitions and structural disorders • Non-equilibrium phonon and energy relaxation dynamics • In-situ ion irradiation studies in fusion materials*

Key Needs: *High-bunch-charge, sub-picosecond, high-rep-rate UED beams • Single-shot capability with enhanced momentum resolution ($< 0.1\ \mathring{A}^{-1}$) • Direct electron detectors with improved SNR for diffuse scattering • keV ion beam delivery for extreme-environment studies*

2.2 Material Science and Quantum Materials

The materials science session of the workshop highlighted cutting-edge research on structural dynamics and their critical role in determining functional properties across diverse solid-state systems. Materials science and quantum materials are a central area of research for electron-based techniques. MeV-UED is used to explore the structural dynamics of quantum-ordered phases and observe materials' order across phase transitions. Relativistic electrons serve as an ideal probe due to their high scattering cross sections, penetration depths of tens of nanometers, access to high momentum transfers, and minimal energy deposition. The workshop highlighted a number of cutting-edge research examples that point to the future needs of this field. Topical areas discussed included the methods application to structural and quantum phase changes and to the investigation of energy transport in low dimensional materials. In particular, the discussions showed how going beyond simple thermal interpretations of structural dynamics could lead to new understanding.

It was highlighted that understanding the dynamics of structural phase transitions can require data beyond the average lattice structure. The metal-to-insulator transition in VO_2 serves as an example where researchers have demonstrated the key role of disorder, which has been shown to play a key role in how the transition occurs. Such signatures can be revealed in diffraction via the weak diffuse scattering which appears between lattice reflections due to structural deviations from the crystal period. It was further highlighted how such diffuse scattering can also be a direct insight into phonon dynamics in materials. It was shown how the specific vibrational modes that facilitate enhanced charge and thermal transport between WSe_2 and WS_2 2D heterostructures could be measured using ultrafast electron diffuse scattering. In this case, these phonons enabled fast charge and thermal transport across the Van der Waals between the two atomically thin layers [8]. In another example of the application of UED to quantum materials, researchers employed UED to quantify the amplitude of specific coherent phonons in Ta_2NiSe_5 [9]. The motion was shown to drive gap suppression in the exitonic insulator phase transition. Here, the essential element was to have sufficient structural information to determine the quantitative retrieval of the dynamic atomic positions. This was enabled by the large field of view in momentum transfer, where close to a hundred lattice reflections could be observed simultaneously, greatly constraining the retrieval problem. A recurring theme across the talks was the importance of moving beyond average structural information towards probes of specific dynamic excitations. By pinpointing the motions that govern electronic or thermal responses, these studies establish causal links between lattice dynamics and other degrees of freedom. This approach opens the door to future strategies for control and tunability of material properties via targeted excitations.

The talks also underscored several key requirements for structural probes. Lattice dynamics extend into the multi-THz regime and it is essential to capture these fast dynamics. Advanced MeV-UED facilities with sub 100 fs instrument resolutions now make this feasible. Another requirement is the precise control of the sample and its environment. Experiments frequently aim to isolate effects under specific temperatures, stimuli, or other well-defined conditions. Sensitivity to small changes or weak signals is increasingly important in distinguishing subtle energy pathways from competing effects. Instruments need to maximize sensitivity using direct electron detection schemes, and high brightnesses beams, but also balance these against energy deposition and damage concerns. It is noted that recent research further demonstrates the value of information-rich measurements: in Zong's work, phonon amplitudes could only be extracted through fitting a large number of diffraction peaks [9], while Raja's study showed how angular displacements of atomic layers enabled simultaneous observation of multiple layers in stacked heterostructures [8]. Collectively, these studies illustrate the power of ultrafast structural probes to unravel complex, material-specific dynamics, and to guide the design of quantum materials with tailored properties.

Key Science Drivers: *Ultrafast structural and quantum phase transitions in complex materials • Phonon-mediated charge and thermal transport in low-dimensional and heterostructure systems • Disorder, diffuse scattering, and non-thermal pathways in phase-change dynamics • Causal links between lattice excitations and electronic/thermal functionalities*

Key Needs: *Improved temporal resolution (<100 fs) with wide momentum-transfer coverage • High-sensitivity, low-dose detection (electron counting, low damage) for weak diffuse signals • Precise sample/environmental control for material-specific and stimulus-defined studies • High-brightness beams enabling quantitative retrieval of dynamic atomic motion*

2.3 Structural Dynamics in Photochemistry

Probing photoinduced dynamics in small organic systems, both in the gas and liquid phases, on their natural timescales is critical for understanding fundamental molecular processes [10–13]. Sensitivity to transient structural changes is essential to disentangle competing dynamical pathways, identify distinct signal contributions, and resolve their associated time scales. Such detailed insight is key for building accurate theoretical models of molecular behavior [14]. Across experiments, achieving a balance between detection sensitivity and sufficient statistical sampling remains a persistent challenge, particularly when attempting to capture ultrafast processes with high fidelity.

The MeV-UED technique provides unique observables for directly tracking transient structural dynamics in isolated gas-phase systems as well as in soft condensed-phase liquid environments. Scattering measurements are sensitive to both intra- and intermolecular distance changes, which are captured through differences in the pair distribution function. Resolving these structural changes requires sub-Ångström spatial sensitivity and sub-picosecond—often few-hundred-femtosecond—temporal resolution. In this context, relativistic MeV electrons serve as a compelling structural probe, as they provide access to a wide momentum-transfer range exceeding 10 inverse Ångström, offering complementary and, in some cases, enhanced structural sensitivity compared to hard X-ray photons.

The workshop session consisted of five presentations that showcased cutting-edge results on photoinduced chemical and physical processes in gas- and liquid-phase systems on their natural timescales, with MeV electrons serving as a unique probing medium. One example focuses on excited-state dynamics in the deep-UV photochemistry of oxazole and isoxazole, demonstrating how MeV-UED observables can track bond-cleavage pathways and subsequent structural rearrangements in isolated molecular systems with intramolecular resolution. With direct structural sensitivity at the sub-Ångström level, the strengths of UED are further illustrated through comparative studies of bromoform in the gas and liquid phases, highlighting differences in dynamics arising from solvent–solute interactions in the condensed phase. Beyond photoinduced chemical dynamics, MeV electrons have also been employed to probe laser-induced streaking effects in liquid environments. In addition to emphasizing the unique capabilities of electron-based probes, the session addresses current limitations and potential improvements by reviewing published work and performing cross-comparisons between electron and hard X-ray scattering approaches. In particular, discussions focused on temporal resolution in resolving internal dynamics and the need for higher signal-to-noise ratios, informed by comparisons with hard X-ray scattering experiments at LCLS.

Advancing temporal resolution to the sub-50 fs regime is a high-priority goal. This improvement would enable the differentiation of ultrafast nuclear–nuclear and electron–nuclear correlations, avoiding time-averaged signals that obscure the underlying dynamics. Achieving this requires further compression of electron bunches, expanded laser capabilities, and the development of higher-efficiency electron detection systems, including single-electron detection. Complementary improvements in sample delivery—such as stable high-density gas sources and liquid-jet systems—are also essential to maximize signal quality and reproducibility.

Realizing these capabilities will also demand innovations in electron gun design and corresponding diagnostic infrastructure. Optimized beamline instrumentation, combined with advanced detection and sample delivery protocols, will allow researchers to probe complex chemical dynamics with unprecedented temporal and structural resolution. Collectively, these developments will significantly enhance the ability of gas- and liquid-phase UED experiments to provide quantitative, high-resolution insight into fundamental photochemical and photoinduced processes.

Key Science Drivers: *Ultrafast photochemical pathways in gas- and liquid-phase molecular systems • Transient structural dynamics for disentangling competing reaction channels • Nuclear–nuclear and electron–nuclear correlation dynamics on* ≤ 50 *fs timescales • Quantitative benchmarks for molecular theory and reaction modeling*

Key Needs: *Sub-50 fs temporal resolution • High-efficiency, single-electron–counting detection for weak transient signals • Robust, high-density sample delivery (gas targets, liquid jets) with high stability • Innovative electron gun and beamline designs with improved diagnostics*

2.4 Cross-cutting Themes

MeV-UED provides unique opportunities for in-situ and operando spectroscopy, using electric and laser pulses to excite structural dynamics in materials which are then probed by the electron beam. This approach can also be used to understand phenomena such as thermal energy transfer across nanometer-scale samples, providing quantitative values for interfacial thermal conductance to optimize device thermal management. Time-resolved electron energy loss spectroscopy (EELS) offers complementary insight into the spatial distribution of charge carriers [15], though current experiments at keV-scale facilities show that signals can be noisy even at high pump fluences. Implementing EELS in MeV-UED could open new avenues for exploring ultrafast electronic and structural processes with higher temporal and momentum resolution.

Advancing temporal resolution through shorter pump pulses, combined with in-situ control of strain and electric fields [16], can provide additional dimensions for studying material dynamics. High-resolution measurements of diffuse scattering and Debye-Waller factors further enhance the understanding of energy transport and structural evolution [17]. These developments will allow UED to capture early-time structural dynamics and energy redistribution processes, extending its capability beyond conventional structural snapshots and enabling quantitative investigation of complex, functional materials.

Future capabilities of interest include the development of compatible high-resolution electron energy spectrometers capable of simultaneously measuring nuclear and inelastic energy transfer with elemental sensitivity. Such instrumentation would enable comprehensive characterization of energy flow within and between materials, supporting studies of quantum materials and other advanced systems. Prototype design, testing, and iterative development of these spectrometers, combined with exploration of optimized pump-probe schemes, will be essential to fully realize the scientific potential of MeV-UED for cross-cutting studies in materials science, energy transport, and functional device characterization.

Key Science Drivers: *Ultrafast energy transport and interfacial thermal conductance in functional materials • In-situ and operando probing of field-driven structural dynamics • Quantitative insight into coupled electronic, vibrational, and thermal pathways*

Key Needs: *High-resolution EELS integrated with MeV-UED for element-sensitive dynamics • Short-pulse pump sources with in-situ strain and electric-field control • Enhanced diffuse-scattering sensitivity • Next-generation spectrometers and optimized pump–probe instrumentation*

3 Current and Future MeV-UED Facilities

The workshop highlighted significant progress in MeV-UED facilities worldwide, with speakers presenting both advances in current capabilities and plans for next-generation systems. Facility updates—including REGGAE (DESY, Germany), the planned RUEDI facility (UK), STJU (China), KAERI (Korea), FORTRESS (Tsinghua, China), and SLAC (USA)—emphasized improvements in electron guns, detector performance, and sample preparation, while also addressing challenges such as gating out dark current and managing low damage thresholds for biological targets. A selection of key parameters for several facilities are summarized in Table 1. A common theme across facilities was enhanced magnetic compression strategies and jitter reduction, including methods utilizing chirped beams and isochronous bunch compression. Further R&D efforts are leveraging high-power OPCPA pump lasers, digital twin simulations for virtual experiment design, and the integration of secondary beamlines for ultrafast electron microscopy. Experimental results showcased dynamic space-charge manipulation, micro-beam delivery of multiple short bunches to micron-scale focal spots, and increased repetition rates. Novel diagnostics for quantifying jitter and bunch length—particularly those employing THz radiation—demonstrated improved characterization capabilities, including visualization of THz pulses using electrons [18]. International collaboration is accelerating progress, exemplified by joint funding of the new user facility in the UK. Collectively, these advances are pushing UED performance toward user-driven milestones: sub-10 fs electron probe durations (with current limitations dominated by pump-laser timing), micrometer-scale spatial resolution, and sub-nanometer emittance. It is worth noting that to realize 10 fs or better overall instrument time resolution additionally requires similar short-pulse laser systems for pumping of samples. As higher-repetition-rate operation matures, the community is poised to transition these achievements from R&D testbeds to user facilities. In particular, at SLAC there is strong motivation to elevate magnetic compression and jitter-correction efforts—building on established expertise in beamline design—while pursuing parallel improvements in pump-laser pulse duration to fully realize the next leap in temporal resolution.

Table 1: Existing and planned MeV-UED facilities presenting at the workshop, including compression method (Compressor), gun electron exit energy (E) and bunch charge, bunch length (BL), pulse repetition rate (Rep), and year of facility start of operation.

Country	Facility	Compressor	E (MeV)	Charge (fC)	BL (fs)	Rep (Hz)	Start Year
Germany	DESY-REGAE [19]	RF comp.	2.4–5	100	<50	12.5/50	2011
China	FORTRESS [20]	Alpha magnet	3	300	<10	50	2024
China	SJTU-UED [21]	Dogleg	3	20	<50	400	2020
UK	RUEDI [22]	TBA	4	400	<10	100	2032
Korea	KAERI [23]	DBA	3.1	1.12	<50	50	2031
USA	SLAC [24]	None	3.6 / 2.3	10–100	<150	360/1080	2014

Key Science Drivers: *Ultrafast probes with sub-10 fs temporal resolution • Micron-scale spatial resolution and sub-nanometer emittance for advanced materials studies • High-repetition-rate UED for statistically robust measurements • Integrated multimodal capabilities (UED + ultrafast microscopy + THz diagnostics)*

Key Needs: *Advanced magnetic compression and jitter-correction (chirped beams, isochronous compression) • High-performance electron guns, detectors, and low-damage sample environments • High-power OPCPA pump lasers and improved pump–probe timing stability with ultrashort pulse durations • Digital twin simulation tools and next-generation diagnostics (THz-based bunch-length/jitter monitors)*

4 Priorities for Future Development

Advancing relativistic-energy UED facilities requires coordinated development across electron sources, compression systems, detectors, sample handling, and supporting technologies. Across all sessions, the highest-priority technical drivers were identified as achieving short electron bunch durations (temporal resolution), low emittance (spatial and momentum resolution), and high electron flux (signal quality). **Realizing these goals necessitates high-brightness electron sources and photocathode innovations, combined with compact, stable bunch compression systems and robust jitter suppression.** Candidate designs demonstrated at FORTRESS (Tsinghua), SJTU-UED (Shanghai), and KAERI (Korea) are informing plans for the RUEDI facility in the UK, while SLAC MeV-UED would benefit from focused implementation of magnetic compression and jitter correction alongside shorter pump-laser pulses. Novel electron gun designs with high flux, low emittance, and support for in-situ cathode testing remain essential for pushing the state-of-the-art, alongside supporting RF, laser, and diagnostic systems.

Instrument sensitivity, probe size, and momentum resolution were highlighted as critical priorities for enabling advanced science. **To fully exploit the capabilities of MeV-UED, facilities should target sub-50 fs FWHM temporal resolution, increase electron flux and detection efficiency by at least an order of magnitude, and achieve transverse coherence of >10 nm.** Reducing electron probe sizes toward the micron scale will unlock new insights into heterogeneous materials, while improved momentum resolution and high-resolution energy analysis will enable studies of quantum order, Moiré reconstructions, and element-specific energy transfer. Multiple beamlines dedicated to both R&D and user science, alongside strategic infrastructure planning for personnel and budgets, will maximize facility flexibility and scientific output. Novel sample delivery methods and enhanced electron-laser coupling are essential for maintaining signal quality and statistical reliability.

Several sessions emphasized longer-term developments and cross-cutting technologies. The use of AI and machine learning techniques [25] should be further developed for real-time facility tuning, and automated analysis, including anomaly detection and efficient high-repetition-rate data processing. Single-electron direct detectors, such as the ePix10k, combined with advanced hit-finding algorithms, will improve signal-to-noise and resolution [26]. **Alternative source technologies should be evaluated to further enhance 5D brightness and enable sub-10 fs electron pulses with sub-10 μm spot sizes and high momentum resolution.** These may include developments of high gradient, low jitter S-band gun, ultrahigh-gradient C-band gun, and CW electron sources such as superconducting and hybrid guns. Supporting technologies such as high-power pump lasers, integrated ion guns for in-situ irradiation studies, and high-resolution electron energy spectrometers will extend experimental regimes, enabling dynamic studies of warm dense matter, radiation damage, and energy transfer processes in quantum and extreme-condition materials. Collectively, these developments provide a path for maintaining global advances in MeV-UED science and for delivering transformative capabilities to the user community over the next 5–10 years.

5 Summary

The first FUSE Workshop brought together the scientific user and instrument communities to address a diverse range of science cases—including solid-state and quantum materials, gas-phase chemistry, and extreme-condition systems—highlighting MeV-UED as a powerful tool to probe ultrafast structural and energy dynamics across these domains. Discussions emphasized the critical need for ultrahigh-brightness electron sources, femtosecond scale temporal resolution, low-emittance beams, high-flux detection, and precise jitter suppression to enable transformative experiments. Complementary developments in sample delivery, in-situ and operando measurements, and integration with techniques such as THz spectroscopy and EELS were recognized as important for connecting atomistic dynamics to observable material properties. Emerging AI/ML methods were highlighted for their potential to optimize beamlines, automate high-repetition-rate data analysis, and enable predictive facility operation. These advances and cross-cutting priorities point the way forward for SLAC and other international MeV-UED facilities to deliver quantitative, high-impact insights into complex materials and molecular dynamics over the next decade, while reinforcing the value of sustained interaction between instrument developers and scientific users.

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Workshop Talks

Day 1 (Aug 27, 2025)

Session 1A - Opening Session (Chair: Joel England)

- Alex Reid — *Welcoming Remarks*
- Pietro Musumeci — *Perspectives and outlook for MeV ultrafast electron diffraction*

Session 1B - UED Facilities (Chair: Stephen Weathersby)

- Alke Meents — *3D atomic structure determination with MeV electron diffraction*
- Julian McKenzie — *The Future RUEDI UK Facility*
- Dao Xiang — *MeV-UED Facility at STJU*
- Jun Heo — *KAERI MeV-UED: Setup and Applications to Ultrafast Chemical Dynamics*
- Joel England — *SLAC MeV-UED Plans and R&D Upgrades*

Session 1C - Gas and Liquid Phase Science (Chair: Yusong Liu)

- Pedro Nunes — *Gas phase ultrafast electron diffraction: achievements, challenges, and opportunities*
- Daniel Rolles — *Studying the UV-induced isomerization and dissociation dynamics of gas-phase oxazole and isoxazole*
- Oliver Gessner — *UED studies of the UV photochemistry of isolated and solvated bromoform*
- Elisa Biasin — *Capturing Chemical Motion in Solution: Insights from Femtosecond X-ray and Electron Scattering*
- Jie Yang — *Laser-Induced Streaking in Liquid-Phase Ultrafast Electron Diffraction*

Day 2 (Aug 28, 2025)

Session 2A - Solid State and Quantum Materials (Chair: Alexander Reid)

- Archana Raja — *Visualizing Energy Transfer and Phonons During Charge Transfer at 2D van der Waals Heterojunctions Using Ultrafast Electron Diffraction*
- Alfred Zong — *Structural contribution to light-induced gap suppression in Ta2NiSe5*
- Mariano Trigo — *X-ray diffuse scattering studies of structural dynamics in quantum materials*

Session 2B - Electron Sources and Beam Optics (Chair: Fuhao Ji)

- Renkai Li — *Pushing the limits of Ultrafast Electron Diffraction and Imaging at Tsinghua University*
- Tianhuan Luo — *Novel Cathodes for Dark Current Mitigation in LCLS-II Injector Gun*
- Haoran Xu — *C-band high-gradient photoinjector R&D at LANL CARIE facility*
- Ben Hounsell — *Design of the RUEDI ultrafast electron diffraction beamline at Daresbury Laboratory*

Session 2C - Supporting Technologies and Diagnostics (Chair: Cameron Duncan)

- Sergio Carbajo — *Towards programmable XFELs: linking adaptable photoinjector laser shaping to tailored X-ray production*
- Steven Zeltmann — *Direct electron detectors for robust structural characterization with four-dimensional STEM*
- Mohamed Othman — *Advanced THz structures for accelerator timing diagnostics*
- Michael Kaemingk — *Versatile Photoelectron Sources for Ultra-low Intrinsic Emittance Electron Beams*

Day 3 (Aug 29, 2025)

Session 3A - Materials at Extreme Conditions (Chair: Mianzhen Mo)

- Benjamin Ofori-Okai — *Ultrafast structural evolution of warm dense matter*
- Artur Tamm — *Radiation induced damage in nuclear materials studied with UED and modeling*
- Mianzhen Mo — *Ultrafast electron-diffraction studies of materials under extreme conditions*

Session 3B - Cross-Cutting UED Science (Chair: Ming-Fu Lin)

- Aditya Sood — *Probing in-operatindo device dynamics and atomic-scale energy flows with UED*
- Scott Cushing — *Imaging photoexcited carriers and heat transport in nanoscale materials using ultrafast EELS*