The 1st Workshop for Future Science in Next Generation Synchrotron

THE 1ST WORKSHOP FOR FUTURE SCIENCE IN NEXT GENERATION SYNCHROTRON JUNE 23TH 0 27TH 0 SONG CONVENTION COLEMANCOREA HIGHLAND STATE ST

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Seeing Disorder through Coherence: Extreme Light on Complex Matter

Thursday 26 June 2025 17:00 (40 minutes)

The emergence of enhanced transverse coherence in X-rays has significantly expanded their applicability to structural investigations beyond well-ordered systems. When coherent X-rays scatter from disordered or random specimens, they produce characteristic speckle patterns in the diffraction images. These speckles encode rich information about structural disorder and fluctuations. By utilizing short-wavelength X-rays, finer structural features—down to the atomic scale—can be resolved through speckle analysis.

Coherent diffraction imaging (CDI) techniques, combined with advanced phase retrieval algorithms, enable the reconstruction of real-space images or charge density distributions directly from these speckle patterns, without the need for image-forming lenses. Since their initial demonstration at second-generation synchrotron sources, coherent imaging methods have undergone rapid development, now capable of resolving nanoscale structural details and capturing ultrafast dynamics on femtosecond timescales.

The arrival of fourth-generation synchrotron sources, with significantly enhanced brightness and coherence, is expected to usher in a new era of coherent X-ray science—one focused on disordered systems and far-from-equilibrium phenomena. In this talk, we will review the fundamental principles of coherent X-rays, present recent advances in coherent imaging techniques, and discuss emerging perspectives and opportunities in the study of structural disorder and ultrafast dynamics.

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Session Classification: Session 6: Advanced Coherent X-ray Scattering (Chair: Seo Hyoung Chang)