APS WK #6: Multi-modal X-ray Techniques for Emergent Quantum Materials

Time: Full-day
Date: Wednesday, April 22
Workshop location: Building 446, APCF Conference Room
Organizers: Philip J. Ryan (APS), Mingda Li (APS), and Gilberto Fabbris (APS)

Description: Multi-modal experiments represent an exciting frontier in condensed matter physics (CMP) as it enables a thorough investigation of emergent phenomena under complex and often difficult to exactly reproduce environments. The penetration depth of hard x-rays makes it particularly suited to multi-modality; it can be used in conjunction with a broad temperature range, external fields, electrical transport, optical pump, strain, micro-to-nano beam size or high beam coherence, etc. In this way, multi-modal hard x-ray techniques greatly expand the power of a sole scattering probe by directly extracting structure-property relation in emergent quantum materials, such as multiferroicity, topological materials, spintronics, unconventional superconductivity, and quantum criticality. We see this approach as highly beneficial to the US CMP community, providing complete access to the underlying physical phenomena that will drive future device engineering forward. However, multi-model experiments also lead to a wealth and variety of data that needs to be concomitantly analyzed. To this end, artificial intelligence (AI) has recently emerged as a promising avenue to enhance and accelerate data modelling. Understanding how to best implement multi-modal probes to best operate between large data methods and AI remains a mostly unexplored area.

This workshop will bring together leading experimentalists, theorists, and computational material scientists to introduce their latest progress on how a multi-modal metrology may benefit their own in-house research, driving CMP phenomena and microelectronic device functionality that will take advantage of such methodology employing brilliant x-rays with micron size beams. The confluence of those designing experiments, who will need to appreciate how large data sets will be analyzed, and those experts designing future intelligent analysis and modelling tools, who need to understand the realities of emerging experimentation capabilities, will enable a powerful shift of how we investigate phenomena that is currently beyond our capabilities.