NSLS-II: Enabling new tools to study electron dynamics in quantum materials

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In this talk, I report on several world-leading tools that are now operational at NSLS-II, the recently commissioned synchrotron at BNL. The high brightness of NSLS-II – it is one of the brightest synchrotrons in the world - enables new world-leading beamlines optimized for the study of electron dynamics in quantum materials. These include the ability to study quasi-particle dynamics and collective excitations with meV resolution (in ARPES and RIXS experiments) and to study charge and magnetic domain dynamics over time scales ranging from seconds to hours (in coherent scattering experiments). To illustrate the new capabilities, I will discuss the first ever coherent x-ray scattering studies of stripe domain dynamics in cuprate superconductors and the potential advances enabled by inelastic x-ray scattering studies with meV resolution. Further, two of these beamlines, the ARPES beamline and the coherent scattering beamline, have sub-micron spatial resolution, allowing such studies to also be carried out on inhomogeneous quantum materials. Together these beamlines provide the capabilities for a powerful assault on understanding the behavior of electrons in quantum materials. Finally, I will conclude by discussing two extremely exciting potential additional beamlines; the first would provide the ability to measure the single-particle excitation spectrum and the collective excitation spectrum simultaneously from the same spot on the sample with nanoscale resolution. The second beamline would provide IR spectroscopies with unprecedented nanoscale resolution. These capabilities would provide a complete picture of electron dynamics in heterogeneous quantum materials and should enable dramatic advances in our understanding of the emergent phenomena hosted in these fascinating materials.