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Ultrafast Electron Scattering & Imaging Using MeV Electrons

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Going higher electron beam energy had been one of the major factors improving electron microscope performance. The 'holy grail'of electron microscope –1 Å resolution was first demonstrated in 1990s with a 1.2 MeV electron microscope. The introduction of aberration-correction electron optics and cold field-emission electron source led to the demise of MV electron microscope. To meet the challenge of ultrafast science & imaging bio-samples in physiological environments, there is renewed interest in going higher electron beam energy. The MeV ultrafast electron diffraction (MeV-UED) is the first step of the renaissance of MeV electron scattering. MeV-UED opened a new paradigm due to its capability of following dynamics on femtoseconds scale with the high spatial resolution and sensitivity. MeV-UED had broad and transformative impact to ultrafast science, such as the first ultrafast structure dynamics of 2-D materials, light-induced transient states, and the first direct imaging of fundamental chemical processes: canonical interception & ring-opening. In this talk, I will first discuss the latest advancements of MeV-UED technology and science, such as hydrogen bond structure dynamics in liquid water and simultaneous observation of both electronic and nuclear dynamics. the advanced accelerator technologies needed to enable MeV-UEM will be explored.

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