Explore the horizons of 4D imaging using ultrafast Electron Microscope

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The phrase “seeing is believing” is a good descriptor of the powerful impact atomic-scale static structure determination has had on our understanding of matter, as demonstrated by the number of Nobel Prizes awarded for works that focused and relied on the use of such techniques. While structure determination is undeniably powerful, the multitude of pathways available to a complex system on its potential energy surface, due to the enormous number of degrees of freedom, prevents the formulation of a complete description of its function from such static images.

The key advantage afforded by ultrafast electron pulses for the study of nanoscale materials is the combination of real-space imaging with time resolution. The base capability that would be provided by this source, with of order femtosecond time resolution and 10 nm spatial resolution would open up very new possibilities for imaging phonon transport at the nanoscale and single shot nanoscale nucleation events associated with phase transitions. At higher spatial resolution, the impact would be even greater, essentially opening up new means of visualizing not just the structure but the functionality and dynamical processes that underlie nanoscale materials transformations.

The lecture will present a demonstration of the idea of temporal imaging as well as the stages of its development. Before discussing the applications of UEM, a description of some defining principles of the method will be delivered, in order to resolve the fleeting structures associated with transient phenomena.