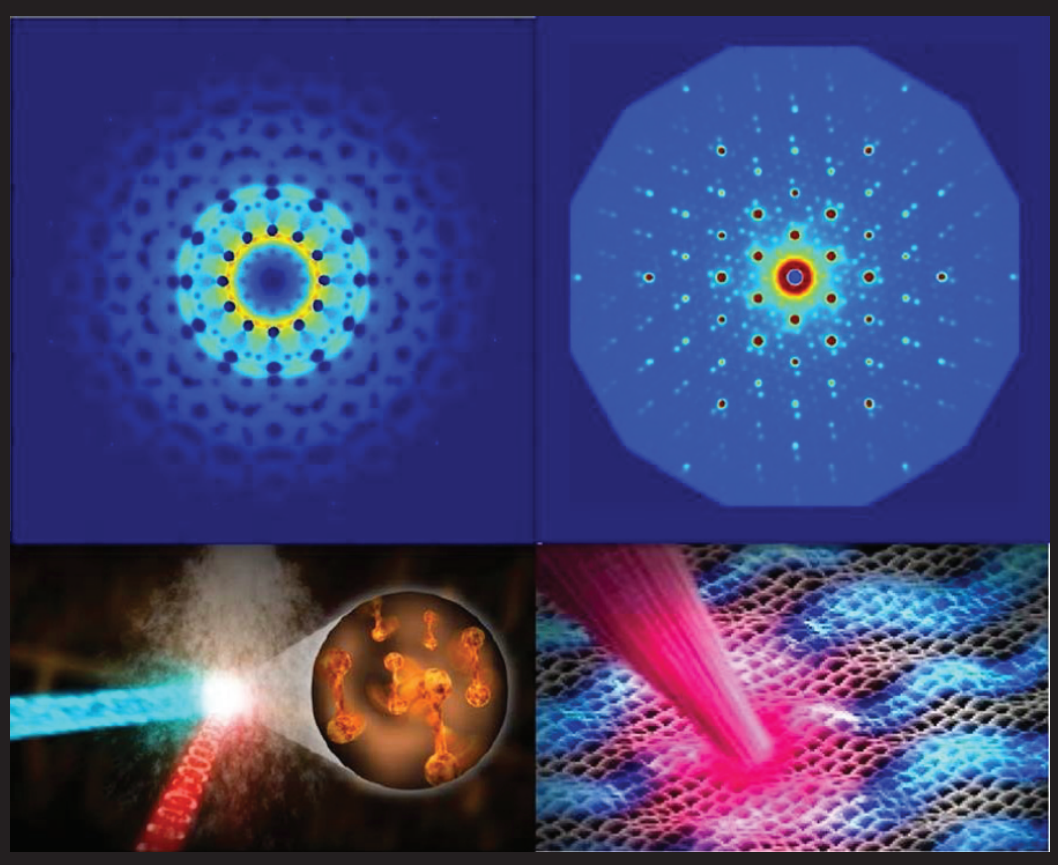
APS/NST Joint Colloquium

Argonne NATIONAL LABORATORY

X.J. Wang

Making Atomic and Molecular Movies with MeV Electrons



To achieve atomic spatial and temporal resolution simultaneously, MeV high-brightness beam generated by a photocathode radio-frequency gun was proposed for ultrafast electron diffraction (UED) and microscopy (UEM) applications. Recent development in MeV-UED has enabled broad scientific opportunities in ultrafast materials science and chemical dynamics. The ripples of monolayer MoS_2 and atomic movies of light-induced structural reorganizations in the perovskites solar cell were captured for the first time by MeV-UED. The rotational wave-packet dynamics of non-adiabatically laser-aligned nitrogen molecules and atomically resolved movies of coherent nuclear motion in iodine molecules were imaged using MeV-UED. Recently, molecular movies of chemical bond breaking, ring-opening, and nuclear wave-packet passing through conical intersections were successfully recorded at SLAC MeV-UED.

Dr. Xijie Wang is the principal investigator of the Ultrafast Electron Diffraction and Microscopy (UED/UEM) initiative at SLAC National Accelerator Laboratory. He obtained his undergraduate degree from Shaanxi Normal University, Xian, China, then joined Brookhaven National Laboratory (BNL) after earning a Ph.D. in physics from UCLA in 1992. Xijie Wang was awarded a tenure position at BNL in 2001 based on his leadership in developing the BNL Accelerator Test Facility (ATF) and seminal work on ultra-short electron generation and characterization. He joined the SLAC National Accelerator Laboratory in December 2013. Dr. Wang's research covers a wide range of topics in accelerator physics and ultrafast science and technology. He has made major contributions to the science and technologies enabling the x-ray free-electron laser (X-FEL) and ultrafast electron diffraction. Dr. Wang developed the photoinector that drove the first saturation of both the high-gain harmonic generation FEL at BNL ATF and the self-amplified spontaneous emission (SASE) FEL at the APS. Dr. Wang and his collaborators carried out a series of pioneering FEL experiments in the early 2000s: VISA SASE FEL; nonlinear harmonic generation; superradiance FEL; and detuning and tapering for FEL efficiency improvements. The MeV-UED pioneered by Dr. Wang has demonstrated atomic spatial and temporal resolutions required to make atomic and molecular movies. He is an inaugural recipient of SLAC Director's Award.

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