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Ultrafast strong field AMO Physics[1]

PHILIP BUCKSBAUM, Stanford PULSE Institute, Stanford University and SLAC

Quantum Electron-electron and electron-ion dynamics drive all processes in molecular physics, yet for many years these elemental motions were difficult to capture in experiments because of the ultra-short time scales and distances involved. Two advances in laser technology have enabled ultrafast imaging and ultrafast quantum control of molecules. The first was the development 30 years ago of powerful ultrafast lasers with focused optical fields comparable to the binding fields in chemical bonds, exceeding one volt per Angstrom. These lasers led to new ways to control the the interactions of electrons in atoms on their natural time scales. The second advance was the development in the last decade of ultrafast x-ray lasers with Angstrom-wavelengths and even higher focused fields. X-ray laser diffraction from molecular gases can be used to produce movies of molecules undergoing bond re-arrangements in tens to hundreds of femtoseconds. Recent improvements in the x-ray source will soon enable measurements that can resolve attosecond-scale electron motion in x-ray-atom interactions.

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