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Probing Ultrafast Processes in Intense Laser–Matter Interactions[1]

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This talk reports on computational studies of using sub-femtosecond/attosecond extreme ultraviolet and soft-x-ray pulses to probe ultrafast processes in intense laser interactions with atoms, molecules, and plasmas. By developing and optimizing the finite-element discrete-variable-representation (FEDVR) combined with the real-space product (RSP) algorithm, a powerful computational method is generated, enabling one to explore transient processes in quantum, few-body systems non-perturbatively driven by strong electromagnetic fields. These studies include attosecond photoelectron microscopy of molecular structures, ultrafast probing ion–atom collisions, as well as exploring electron correlations in single-/double-ionization of helium in intense laser fields. Detailed discussions on what has been learned and what can be done in experiments will be presented. This work was partially supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302, the University of Rochester, and the New York State Energy Research and Development Authority. The support of DOE does not constitute an endorsement by DOE of the views expressed in this article. Computations have been conducted utilizing the Kraken Supercomputer of the National Institute of Computational Sciences (NICS) at Oak Ridge National Laboratory.

[1]In collaboration with L. A. Collins, B. Schneider, A. F. Starace, V. N. Goncharov, and S. Skupsky.