Coincidence Experiments with Atoms and Molecules in Intense XUV and IR Laser Fields

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The fragmentation dynamics of single atoms and molecules in femtosecond IR and/or XUV laser pulses is studied using many-particle coincidence-spectrometers (COLTRIMS or Reaction-Microscopes) that enable kinematically-complete and time-resolved studies with ultimate completeness. In combination with modern short-pulse IR and XUV radiation sources like high-power table-top lasers, high-harmonic sources, or free-electron lasers, they are ideally suited to unravel the correlated multi-particle dynamics in ultrafast processes occurring in atoms and molecules. For example, pump-probe experiments allow the observation of moving electronic wave-packets in bound sates of atoms, and in case of molecules vibrational and electronic excitations can be imaged with unprecedented resolution and in real time. The data provide insights into the ionization and fragmentation dynamics and, by comparison with theoretical calculations, they help in unravelling physical mechanisms.