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Imaging ultrafast processes in nanometer sized clusters

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Free-electron lasers deliver extremely intense, coherent x-ray flashes with femtosecond pulse length. With the intense x-ray pulses single nanoscale objects can be imaged wirth single shots, opening the door for spatially and time resolved investigations of transient states and dynamic processes. Imaging of individual He droplets allows the unambiguous identification of quantum vortices. Ultrafast scattering of small highly excited nanoplasma carries information about their transient electronic states. With pump-probe techniques the electronic and structural evolution of highly excited clusters and nanoplasmas far from equilibrium can be investigated with femtosecond time and nanometer spatial resolution. These examples showcase that there are exciting new opportunities for Atomic, Molecular and Cluster Physics using ultrafast and ultraintense x-ray pulses.