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Clusters in XUV Radiation Fields[1]

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The behavior of weakly bound clusters exposed to XUV radiation in two different regimes of intensity is discussed. At the intensities currently provided by synchrotron radiation sources, only one-photon absorption plays a role. A cluster is singly ionized and a hole in the valence shell is formed. In atoms and small molecules, an inner valence hole is electronically stable, but in clusters an ultrafast, Auger-like decay process can occur. This process, referred to as Interatomic Coulombic Decay (ICD), is characterized by an efficient Coulombic energy transfer mechanism between monomers in the cluster. The talk provides a basic overview of the phenomenon of ICD. The most important theoretical predictions are presented, together with recent experimental evidence for ICD in neon clusters. In the second part of the talk, motivated by a recent experiment using the new free-electron laser at DESY in Hamburg, the interaction of xenon clusters with intense VUV radiation is analyzed. In the experiment, xenon clusters were found to absorb a very large number of VUV photons, many more than had been anticipated—based on the experience with long-wavelength lasers. The theoretical description developed accounts for the experimental observation. Key aspects are the rapid formation of a dense nanoplasma and the efficiency of photon absorption in electron–ion collisions, a process known as Inverse Bremsstrahlung.

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