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Rare Gas Clusters under an Intense Laser Pulse and Analytical Ion Kinetic Energy Spectra

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We will give an overview over the different mechanisms which emerge for the coupling of short light pulses into rare gas clusters when the laser frequency is increased from roughly 1 eV (∼800 nm) over 12 eV (∼100 nm) to 350 eV (∼3 nm). In the second part of the talk I will present a simple analytic approach to quantitatively compare ion spectra of Coulomb exploding clusters under experimental conditions (spatial laser intensity distribution, cluster size distribution) to ideal single cluster results from theory. We will explain, how the kinetic energy distribution of ions emerging from a cluster irradiated by an intense laser pulse differs qualitatively from the distribution of a single cluster illuminated by a spatially homogeneous laser beam. This is due to three main effects: (i) the spatial profile of the laser beam, (ii) the cluster size distribution in the experiment, and (iii) possible saturation effects in the cluster ionization. Each of these effects leaves a characteristic fingerprint in the ion kinetic energy spectrum and is easily identifiable in the spectrum. All three effects together fully account for the shape of a typical spectrum. The simple model provides a quantitative link between observable ion spectra under experimental conditions and the ideal single cluster result of a typical calculation.