ULTRAFAST FORMATION OF A RESONANT NANOPLASMA IN DOPED HELIUM DROPLETS

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Doping a helium nanodroplet with a tiny xenon cluster of a few atoms only, sparks complete ionization of the droplet at laser intensities below the ionization threshold of helium atoms. As a result, the intrinsically inert and transparent droplet turns into a fast and strong absorber of infrared light. Microscopic calculations reveal a two-step mechanism to be responsible for the dramatic change: Avalanche-like ionization of the helium atoms on a femtosecond time scale, driven by field ionization due to the quickly charged xenon core is followed by resonant absorption enabled by an unusual non-spherical nanoplasma within the droplet [1]. In contrast to the well known resonant absorption during the Coulomb explosion of both homogeneous [2] and composite [3] clusters, the resonance here occurs on an electronic time scale. The effect occurs for an arbitrary elliptical laser polarization. The ellipticity parameter controls the shape of the resulting nanoplasma. Linearly polarized pulses produce a cigar-shaped nanoplasma, while a circular laser polarization gives rise to a pancake-like nanoplasma. Time-dependent observation of the transient nanoplasma shape may be possible with the help of a IR-UV pump-probe scheme.

References

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