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Institut für Ionenphysik
und Angewandte Physik

Institutsseminar

Charged Nanoparticles in Helium Nanodroplets: Controlled Growth, Particle Fusion, and Thomson Configurations

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Helium nanodroplets (HNDs) provide an ultracold, weakly interacting environment for studying nanoscale growth and charge-mediated self-assembly. Multiply charged droplets, generated by electron impact and doped with gold atoms from a heated crucible, produce highly uniform nanoparticles as dopants migrate toward charge centers and nucleate. Since both ionization and pickup probabilities scale with the droplet's surface area, particle size remains largely independent of droplet size, enabling precise, reproducible control.

During formation, the released binding energy drives helium evaporation and droplet shrinkage, forcing singly charged nanoparticles into close proximity, ultimately overcoming the Coulomb repulsion, thereby leading to the fusion of individual particles into nanowires.

The surface arrangement of charged nanoparticles constitutes an experimental realization of the Thomson problem, where charges minimize their Coulomb energy on a sphere. Transmission electron microscopy reveals two-dimensional projections of these configurations, confirming theoretical Thomson minima and providing insight into droplet splashing and structural preservation upon impact.

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