

**Dr Stefan Kuhn**

*Cooling and manipulating the ro-translational motion of dielectric particles in high vacuum*

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Abstract:

Future matter-wave interferometers, which are targeted at probing the quantum superposition principle with objects of increasing mass and complexity, will require coherent sources of slow particles. I discuss the possibilities of manipulating, controlling, and cooling dielectric nanoparticles in optical dipole potentials and high-finesse cavities. For this purpose I present laser-based launch methods for particles of various sizes and shapes in ultra-high vacuum and the detection and manipulation of nanoparticles in intense cavity fields.

These launch methods also enable novel studies with non-spherical nanoparticles, opening up the field of rotational optomechanics. I present the detection of the free rotation of silicon nanorods in high vacuum, and their optical levitation at millibar gas pressures. I discuss how their orientation dependent polarizability can be exploited in order to control and cool their rotational motion with the goal in mind to enable quantum experiments in the orientational degrees of freedom.