Levitated Solids in the Quantum Regime

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The quantum optical control of solid-state mechanical devices, quantum optomechanics, has emerged as a new frontier of light-matter interactions. Objects currently under investigation cover a mass range of more than 17 orders of magnitude -– from nanomechanical waveguides to macroscopic, kilogram-weight mirrors of gravitational wave detectors. Extending this approach to levitated solids opens up complete new ways of coherently controlling the motion of massive quantum objects in engineerable potential landscapes. I will discuss recent experimental advances in quantum controlling levitated solids, including demonstrations of the motional quantum ground state of optically trapped nanoparticles in a room temperature environment using either optical cavities or quantum Kalman filtering. I will also discuss the perspective to explore new regimes of macroscopic quantum physics, in particular ones that include quantum systems as sources of gravity.