Levitated Quantum Nanophotonics

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I discuss our experiments with optically levitated nanoparticles in ultrahigh vacuum. Using active parametric feedback we cool the particle's center-of-mass temperature to $T \sim 100\mu$K and reach mean quantum occupation numbers of $n \sim 15$. I show that mechanical quality factors of $Q = 10^9$ can be reached and that damping is dominated by photon recoil heating. The vacuum-trapped nanoparticle forms an ideal model system for studying non-equilibrium processes, nonlinear interactions, and ultrasmall forces.

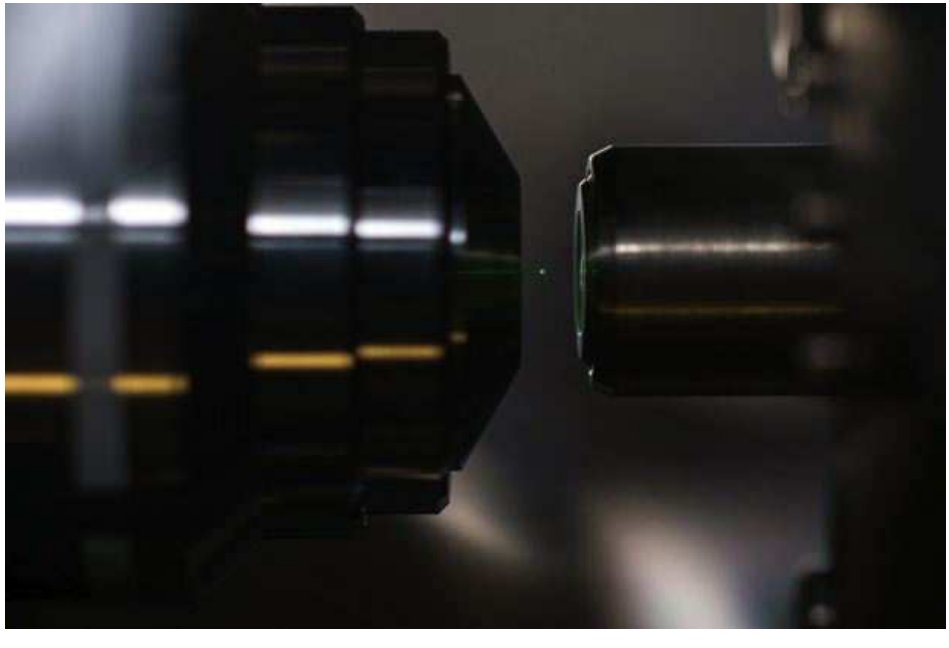

Figure 1: Photograph of light scattered from a laser-trapped diamond nanoparticle.