Abstract Submitted
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Cooling optically levitated dielectric nanoparticles via parametric feedback[1] LEVI NEUKIRCH, Department of Physics and Astronomy, University of Rochester, Rochester, NY 14627, BRANDON RODENBURG, MISHKATUL BHATTACHARYA, School of Physics and Astronomy, Rochester Institute of Technology, Rochester, NY 14623, NICK VAMIVAKAS, Institute of Optics, University of Rochester, Rochester, NY 14627 — The inability to leverage resonant scattering processes involving internal degrees of freedom differentiates optical cooling experiments performed with levitated dielectric nanoparticles, from similar atomic and molecular traps. Trapping in optical cavities or the application of active feedback techniques have proven to be effective ways to circumvent this limitation. We present our nanoparticle optical cooling apparatus, which is based on parametric feedback modulation of a single-beam gradient force optical trap. This scheme allows us to achieve effective center-of-mass temperatures well below 1 kelvin for our $\sim 1 \times 10^{-18}$ kg particles, at modest vacuum pressures. The method provides a versatile platform, with parameter tunability not found in conventional tethered nanomechanical systems. Potential applications include investigations of nonequilibrium nanoscale thermodynamics, ultra-sensitive force metrology, and mesoscale quantum mechanics and hybrid systems.

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