Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Shot-noise dominant regime of a nanoparticle in a laser beam

CHANGCHUN ZHONG, FRANCIS ROBICHEAUX, Purdue — The technique of laser levitation of nanoparticles has become increasingly promising in the study of cooling and controlling mesoscopic quantum systems. Unlike a mechanical system, the levitated nanoparticle is less exposed to thermalization and decoherence due to the absence of direct contact with a thermal environment. In ultrahigh vacuum, the dominant source of decoherence comes from the unavoidable photon recoil from the optical trap which sets an ultimate bound for the control of levitated systems. In this paper, we study the shot noise heating and the parametric feedback cooling of an optically trapped anisotropic nanoparticle in the laser shot noise dominant regime. The rotational trapping frequency and shot noise heating rate have a dependence on the shape of the trapped particle. For an ellipsoidal particle, the ratio of the axis lengths and the overall size controls the shot noise heating rate relative to the rotational frequency. For a near spherical nanoparticle, the effective heating rate for the rotational degrees of freedom is smaller than that for translation suggesting that the librational ground state may be easier to achieve than the vibrational ground state.

Changchun Zhong
Purdue

Date submitted: 25 Jan 2017 Electronic form version 1.4