Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Optically levitated nanoscale torsion balance for detecting Casimir torque and beyond.[1] TONGCANG LI, Purdue Univ — The virtual photons of quantum vacuum fluctuations will not only have linear momentums that lead to the well-known Casimir force, but also have angular momentums which can induce the Casimir torque for anisotropic materials and structures. We propose to optically levitate a nonspherical nanoparticle in vacuum to detect the Casimir torque due to the angular momentum of vacuum fluctuations. We have experimentally levitated nonspherical nanoparticles in vacuum, observed their torsional vibration, and driven them to rotate at several hundred MHz. A nonspherical nanoparticle levitated in high vacuum will have a remarkable torque detection sensitivity on the order of 10^{-28} Nm/sqrt(Hz), which will be sufficient to detect the Casimir torque.

[1]This work is partially supported by the National Science Foundation under grant no.1555035-PHY.

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Date submitted: 26 Jan 2018 Electronic form version 1.4