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Rotational cavity optomechanics WYATT WETZEL, B. RODENBURG, B. EK, Rochester Inst of Tech, A. K. JHA, Indian Inst of Tech, M. BHATTACHARYA, Rochester Inst of Tech — We consider optomechanics based on the exchange of orbital angular momentum between light and matter. Specifically we consider a nanoparticle levitated in an optical ring trap in a cavity. The motion of this particle is probed by an angular lattice created by two co-propagating beams carrying equal but opposite angular momenta. Firstwe consider the case where the lattice is weak, so the nanoparticle can execute complete rotations about the cavity axis. We establishanalytically the existence of a linear regime where accurate Doppler velocimetry can be performed on the nanoparticle, and also describe numerically the dynamics in the nonlinear regime where the velocimetry is no longer accurate. Second, we consider the case where the lattice is strong and the nanoparticle executes torsional motion about the cavity axis. We find the presence of an external torque introduces an instability, but can also be used to tune continuously the linear optomechanical coupling whose strength can be measured by homodyning the cavity output field. This research was supported by the National Science Foundation (NSF) (1454931), the Office of Naval Research (N00014-14-1-0803), and the Research Corporation for Science Advancement (20966).

Wyatt Wetzel
Rochester Inst of Tech

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