Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Hybrid optomechanical systems in the strong coupling regime[1]
YOGESH PATIL, JOHN LOMBARD, KRISTINA COLLADAY, MUKUND VENGALATTORE, Cornell University — We present our progress toward the realization of a hybrid optomechanical system consisting of an ultracold atomic gas parameterically coupled to the optomechanical whispering gallery modes of a microtoroidal resonator. These resonators admit both high-Q mechanical modes as well as optical modes that exhibit very low loss. The strong coupling between the optical and mechanical degrees of freedom has been exploited for the optical cooling and quantum-limited detection of the mechanical micromotion [1]. In addition, the small optical mode volume of the evanescent wave optical fields allows for strong optical coupling to proximally confined atoms [2]. We are constructing a hybrid quantum system wherein a gas of ultracold atoms is confined near the microtoroid in a two-color evanescent wave optical dipole trap. The atomic coupling to the microtoroid allows for atom-mediated optomechanical interactions and the control of the mechanical motion of the microtoroid using the atomic medium.

[1] G. Anetsberger *et al*, Nature Phys. **5**, 909 (2009).
[2] T. Aoki *et al*, Nature **443**, 671 (2006).

[1]This work is funded by the NSF and the Cornell Center for Materials Research

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Date submitted: 29 Jan 2013 Electronic form version 1.4