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Testing gravity at the micro-scale with laser-cooled trapped microspheres DAVID ATHERTON, MELANIE BECK, CHRIS THOMAS, ANDREW GERACI, University of Nevada, Reno — In ultra-high vacuum, optically-trapped and cooled dielectric microspheres show great promise as force sensors. The environmental decoupling of their center-of-mass motion enables sub-attonewton sensitivity. Hence, they can be used to investigate Casimir forces or for testing non-Newtonian gravity [1]. We are developing an apparatus to trap and cool silica spheres in a combined optical dipole-cavity trap. The cavity will be filled with two laser fields to trap and cool the sphere center of mass motion, respectively. We describe our experimental results on optical trapping and cooling and our progress towards demonstrating the sensitivity of the technique. Ultimately, with a sphere trapped in an anti-node close to an end-mirror of the cavity, Casimir forces due to the end-mirror will be measured as a frequency shift of the oscillator. Non-Newtonian gravity-like forces will be tested by monitoring the displacement of the sphere as a mass is brought behind the cavity mirror.

[1] A.A.Geraci, S.B.Papp, and J.Kitching, Phys. Rev. Lett. 105, 101101 (2010).

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