All-Optical Optomechanics: An Optical Spring Mirror\textsuperscript{1} SWATI
SINGH, Department of Physics, College of Optical Sciences and B2 Institute, Uni-
versity of Arizona, GREGORY PHELPS, Department of Physics, College of Optical
Sciences and B2 Institute, University of Arizona, DAN GOLDBAUM, Department of
Physics, College of Optical Sciences and B2 Institute, University of Arizona, EWAN
WRIGHT, College of Optical Sciences, University of Arizona, PIERRE MEYSTRE,
Department of Physics, College of Optical Sciences and B2 Institute, University of
Arizona — The dominant hurdle to the operation of optomechanical systems in the
quantum regime is the coupling of the vibrating element to a thermal reservoir via
mechanical supports. Here we propose a scheme that uses an optical spring to re-
place the mechanical support. We show that the resolved-sideband regime of cooling
can be reached in a configuration using a high-reflectivity disk mirror held by an
optical tweezer as one of the end mirrors of a Fabry-Perot cavity. We find a final
phonon occupation number of the trapped mirror $\bar{n} = 0.56$ for reasonable parame-
ters, the limit being set by our approximations, and not any fundamental physics.
This demonstrates the promise of dielectric disks attached to optical springs for the
observation of quantum effects in macroscopic objects.

\textsuperscript{1}This work was supported by the US Office of Naval Research, the US National Sci-
ence Foundation, the US Army Research Office and the DARPA ORCHID program
through a grant from AFOSR.

Swati Singh
Dept of Physics, University of Arizona

Date submitted: 02 Feb 2011

Electronic form version 1.4