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Feedback Control and Characterization of a Microcantilever Using Optical Radiation Pressure DAVID WELD, AHARON KAPITULNIK, Stanford University — We describe a simple method for feedback-regulation of the response of a microcantilever using the radiation pressure of a laser. A modified fiber-optic interferometer uses one laser to read out the position of the cantilever and another laser of a different wavelength to apply a force that is a phase-shifted function of that position. The method does not require a high-finesse cavity, and the feedback force is due solely to the momentum of the photons in the second laser. The feedback phase can be adjusted to increase or decrease the microcantilever's effective quality factor $Q_{\rm eff}$ and effective temperature $T_{\rm eff}$. We demonstrate a reduction of both $Q_{\rm eff}$ and $T_{\rm eff}$ of a silicon nitride microcantilever by more than a factor of 15 using a root-mean-square optical power variation of $\sim$2 μW. This technique was developed to control the response of a cantilever used as a force sensor in a next-generation test of Newtonian gravity at length scales of 20 μm. Additionally, we suggest a method for determination of the spring constant of a cantilever using the known force exerted on it by radiation pressure.

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