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Characterization of an oscillator's mechanical impedance using photon pressure PAUL WILKINSON, GORDON SHAW, JON PRATT, NIST Physical Measurements Lab — In recent years, there has been much progress in coupling optical cavities to mechanical oscillators, especially in the pursuit of the quantum ground state of a macroscopic oscillator. Photon pressure due to reflection is of particular interest, and such experiments must be carefully designed to minimize competing contributions. Typically, such unwanted contributions are estimated or modeled. We describe an experimental approach to place an upper bound on unwanted contributions. A fiber coupled superluminous light emitting diode is modulated at an optical power of 6.5 mW rms, driving a highly reflective cantilever at a displacement of over 10 nm rms at resonance (Q=4900) in vacuum (10-5 Torr). The optomechanical transfer function is measured and fit to a simple harmonic oscillator model. The stiffness of the oscillator determined from the fit (k=16.6 +/- 1.3 N/m) is found to be in good agreement with that obtained by calibration against our SI-traceable nanoindenter (k=17.4 +/- 0.5 N/m). We characterize the modal stiffness, mass, and dissipation of the first two eigenmodes of our oscillator with SI traceability. The quantitative agreement in our experiment indicates that our oscillator is actuated by photon pressure, and that all other contributions to the force must sum to less than 11%.

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