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Observation of a Stable Optical Spring Without a Cavity[1] BENJAMIN LANE, JONATHAN CRIPE, Department of Physics Astronomy, Louisiana State University, Baton Rouge, Louisiana, BAYLEE DANZ, Department of Physics, Brigham Young University-Idaho, Rexburg, Idaho, THOMAS CORBITT, Department of Physics Astronomy, Louisiana State University, Baton Rouge, Louisiana
— The current generation of gravitational wave detectors utilize high power lasers to reduce the shot noise within an interferometer. This high power creates a significant radiation pressure that couples the laser fields and the mechanical motion of the test masses opto-mechanically. This opto-mechanical coupling gives rise to an optical spring that changes the resonance of the interferometer, and thus should be studied. In this experiment, we present the observation of a stable optical spring without the use of an optical cavity. We use a Michelson-Sagnac interferometer with a GaAs microresonator as a common/end mirror. Our measurements were done using input powers of 50 mW, 100 mW, 200 mW, and 363 mW and show that the shift of the optical spring frequency as a function of input power is in excellent agreement with theoretical predictions. We also show that the optical spring can keep the interferometer stable and locked without the use of external feedback.

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