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High-frequency search for mass-coupled mesoscopic forces HAIYANG YAN, HANS OTTO, EVAN WEISMAN, RAKSHYA KHATIWADA, JOSH LONG, Indiana Univ - Bloomington, G-EXP TEAM — The possible existence of unobserved interactions of nature with ranges of mesoscopic scale (microns to millimeters) and very weak couplings to matter has attracted a great deal of scientific attention. We report on an experimental search for exotic mass-coupled in this range. Our technique uses a planar, double-torsional tungsten oscillator as a test mass, a similar oscillator as a source mass, and a stiff conducting shield in between them to suppress backgrounds. This method affords operation at the limit of instrumental thermal noise, which we have we have recently demonstrated with a measurement of the noise kinetic energy of a detector prototype in thermal equilibrium at room temperature. The fluctuations of the oscillator in a high-Q torsional mode with a resonant frequency near 1 kHz are detected with capacitive transducers coupled to a sensitive differential amplifier. The apparatus is calibrated by means of a known electrostatic force and input from a finite-element model of the selected mode. The measured kinetic energy is in agreement with the expected value of 1/2 kT.

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