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Spin-Dependent Fifth-Force Search Using 1 kHz Mechanical Oscillators CALEB HUGHES, JOSH LONG, Indiana University - Bloomington — Exotic interactions arise in many theoretical frameworks attempting to unify General Relativity and quantum mechanics. We describe an experimental search with sensitivity to fifteen exotic spin-dependent potentials in the sub-millimeter range, using planar resonant test masses with operational frequencies near 1 kHz. The test masses have been augmented with a polarized ferrimagnetic material which exhibits temperature-dependent orbital cancellation of the magnetism associated with the electron spins, substantially reducing the magnetic backgrounds. Cancellation is maximal (ideally perfect) at the compensation temperature near 225 K. A complete apparatus, designed to make optimal use of the ferrimagnet, has been tested. The apparatus has been surrounded with a radiative shield containing a liquid nitrogen reservoir for cooling. To assess the remnant magnetization during cooldown and locate the compensation temperature, the apparatus contains a set of coils to drive the detector with a resonant magnetic gradient. At 223.7 K, the magnetic driving force is reduced by at least a factor of 240 relative to its room temperature value. We describe this operation and discuss the projected sensitivity to exotic potentials.

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