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Test Mass Development for Sub-Millimeter Searches for New Forces of Nature EVAN WEISMAN, SIMON KELLEY, HANS-OTTO MEYER, ANDREW PECKET, JOSH LONG, Department of Physics, Indiana University, Bloomington — Experimental searches for new forces of nature at short range have attracted a great deal of attention over the last decade. We describe test mass development for two new force searches below 1 mm. Both experiments use 1 kHz mechanical oscillators as test masses with a stiff conducting shield in between them to suppress backgrounds, a technique showing promise for probing exceptionally small distances and operation at the limit of instrumental thermal noise. For one experiment, which will be operated at cryogenic temperature to further reduce the thermal noise, pure metallic test masses have been shown to have mechanical quality factors large enough so that the measurement will be dominated by the Newtonian backgrounds, leading to studies with plated silicon masses. In addition, a currently operational room temperature experiment is being modified to test for spin-dependent interactions by applying spin-polarized materials to the test mass surfaces. We report investigations of our initial candidate material, a ferrimagnetic DyFe compound used in previous torsion-pendulum experiments, that exhibits orbital compensation of the magnetism associated with the intrinsic electron spins.

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