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Search for non-Newtonian gravity with optically-levitated microspheres[1] AKIO KAWASAKI, CHARLES P BLAKEMORE, ALEXANDER FIEGUTH, DENZAL MARTIN, NADAV PRIEL, ALEXANDER D RIDER, GIORGIO GRATTA, Stanford University — The universal law of gravitation has undergone stringent tests for a long time over a significant range of length scale, from an atomic scale to a planetary scale. Of particular interest is the short distance regime, where modifications to Newtonian gravity may arise from axion-like particles and extra dimensions. We have constructed an ultra-sensitive force sensor based on optically-levitated microspheres with a force sensitivity of 10^{-17} N/$\sqrt{\text{Hz}}$ for the purpose of investigating non-Newtonian forces in the 1-100 μm range. Microspheres interact with a variable-density attractor mass made by alternating silicon and gold segments with periodicity of 50 μm. The attractor can be located as close as 10 μm to a microsphere. I describe the characterization of this system, its sensitivity, and some preliminary results. Further technological developments to reduce background are expected to provide orders of magnitude improvement in the sensitivity, going beyond current constraints on non-Newtonian interactions.

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