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New Experimental Limits on Non-Newtonian Forces in the Micrometer range

ALEXANDER SUSHKOV, Harvard University

Using a torsion balance, we measure forces between macroscopic bodies at separations on the order of a micron. Measurements with Au-coated plates detect the Casimir effect due to quantum fluctuations of the electromagnetic field, as well as the thermal Casimir effect, due to thermal fluctuations, and confirm the validity of the Drude model of permittivity dispersion used in Casimir force calculations. We use our measurements to place new upper bounds on short-range (distance scales 0.4 - 4 micrometers) exotic forces, arising, for example, in quantum gravity theories with extra dimensions.