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Experimental Search for a Violation of Einstein's Equivalence Principle MICHAEL ABERCROMBIE, ADAM ARCHIBALD, TSITSI MADZIWA-NUSSINOV, KASEY WAGONER, RAMANATH COWSIK, Washington University in St. Louis — The Equivalence Principle (EP) states that a gravitational field is locally equivalent to a uniformly accelerated reference frame, and it is this idea that Einstein's Theory of General Relativity (GR) is largely based upon. A direct consequence of the EP is the universality of free fall; that is, all objects, regardless of their composition, fall at the same rate in a given gravitational field. Motivated by theoretical attempts to unify GR with the Standard Model that predict possible violations of the universality of free fall, we have developed an Eötvös-type torsion balance experiment capable of testing the EP at unprecedented sensitivities. Using a balance configured as a composition dipole with an azimuthally symmetric mass distribution, a violation of the EP would cause a diurnal modulation of the balance orientation in response to the gravitational field produced by the Sun. To monitor the torsion balance we use a multi-slit auto-collimating optical level capable of measuring angular displacements on the scale of nanoradians. The recent relocation of our experiment to an isolated bunker built into a hillside at the Tyson Research Facility reduces the seismic and thermal noise in our measurements.

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