Abstract Submitted
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New search for a spin-gravity interaction DEREK KIMBALL, California State University - East Bay — We are beginning an experiment to search for a new long-range coupling between nuclear spins and the mass of the Earth. If interpreted as a limit on a spin-gravity interaction of the form $\mathbf{S}\cdot\mathbf{g}$ between nuclear spins $\mathbf{S}$ and the gravitational field of the Earth $\mathbf{g}$, the experiment would improve present experimental limits by over two orders of magnitude. The presence of such an interaction would be evidence that gravity violated parity and time-reversal symmetries to a small degree, as well as being a breakdown of the equivalence principle which underlies the theory of general relativity. The experiment would set new experimental limits on hypothetical scalar and vector components of gravitational fields. This new experimental search is motivated by recently developed techniques in the field of atomic magnetometry enabling significant improvement in sensitivity to atomic spin precession. The experiment will use nonlinear optical rotation of near-resonant laser light to measure the spin-precession frequency of alkali atoms in the presence of a magnetic field $\mathbf{B}$. The difference between the precession frequencies for the two different ground state hyperfine levels yields a signal proportional only to anomalous interactions that do not scale with the magnetic moments of the atoms. The sum of the precession frequencies enables ultra-precise determination of $\mathbf{B}$ to correct for associated systematic errors.

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