

Abstract Submitted
for the DAMOP16 Meeting of
The American Physical Society

Search for a coupling of the proton spin to gravity¹ DEREK JACKSON KIMBALL, California State University - East Bay, JORDAN DUDLEY, University of California at Berkeley, YAN LI, DILAN PATEL, California State University - East Bay — We present an overview of progress in our search for a long-range coupling between rubidium (Rb) nuclear spins and the mass of the Earth [D. F. Jackson Kimball et al., *Annalen der Physik* **525**(7), 514528 (2013)], which can be interpreted as a search for a long-range monopole-dipole interaction or a spin-gravity coupling. The experiment consists of simultaneous measurement of the spin precession frequencies of overlapping ensembles of Rb-85 and Rb-87 atoms contained within an evacuated, antirelaxation-coated vapor cell. Because of the nuclear structure of Rb-85 and Rb-87, the experiment is particularly sensitive to anomalous spin-dependent interactions of the proton [D. F. Jackson Kimball, *New J. Phys.* **17**, 073008 (2015)]. We have studied a number of important systematic effects related to vector and tensor light shifts, optical pumping effects, the ac and nonlinear Zeeman effects, and magnetic field gradients. We anticipate that our experiment can improve sensitivity to anomalous long-range spin-mass couplings of the proton compared to previous experiments by more than an order of magnitude.

¹Supported by the National Science Foundation under grant PHY-1307507.

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Date submitted: 01 Feb 2016

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