

Abstract Submitted  
for the CAL11 Meeting of  
The American Physical Society

**Progress toward a search for spin-mass couplings of the proton**<sup>1</sup> JERLYN SWIATLOWSKI, JULIAN VALDEZ, IAN LACEY, CAITLIN MONTCRIEFFE, DEREK JACKSON KIMBALL, California State University - East Bay — We report progress in our development of a dual-isotope rubidium magnetometer to be used to search for a long-range coupling between proton spins and the mass of the Earth. The valence electron dominates magnetic interactions and serves as a precise co-magnetometer for the nuclei in a simultaneous measurement of Rb-85 and Rb-87 spin precession frequencies, enabling accurate subtraction of magnetic perturbations. Both Rb nuclei have valence protons, but in Rb-87 the proton spin is parallel to the nuclear spin and magnetic moment while for Rb-85 the proton spin is anti-parallel to the nuclear spin and magnetic moment. Thus anomalous interactions of the proton spin produce a differential shift between the Rb spin-precession frequencies, whereas many sources of systematic error produce common-mode shifts of the spin-precession frequencies which can be controlled through auxiliary measurements. We discuss our optimization of the magnetometer sensitivity and methods to control systematic effects due to light shifts, collisions, and the gyro-compass effect.

<sup>1</sup>This work was supported in part by the National Science Foundation under grants PHY-0652824 and PHY-0969666.

Derek Kimball  
California State University - East Bay

Date submitted: 30 Sep 2011

Electronic form version 1.4