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A Test of CPT and Lorentz Violation Using a Compact, Rotating Co-Magnetometer[1] JUSTIN BROWN, SYLVIA SMULLIN, THOMAS KORNACK, MICHAEL ROMALIS, Princeton University — The K-^{3}He co-magnetometer contains overlapping, coupled ensembles of high-density polarized K vapor and ^{3}He nuclei that cancel external magnetic fields by a factor of $10^3 - 10^4$, but remain sensitive to anomalous electron and neutron spin couplings. A compact three-layer μ-metal and inner ferrite shield further reduce magnetic interactions by a factor of 10^8. The co-magnetometer, including lasers and a vibration isolation platform, are operated in a 1 Torr vacuum to achieve equivalent sensitivity of 2 $\mathrm{fT}/\sqrt{\mathrm{Hz}}$ at 0.02 Hz. We mount the vacuum bell jar and control electronics on a rotating platform allowing 180° reversals of the apparatus every 22 seconds. Since the co-magnetometer is also a sensitive gyroscope, Earth's rotation contributes significantly to our signal. We collect data in the North-South and East-West orientations, corresponding to the maximum and zero of the gyroscopic signal which are susceptible to different systematic effects. A sidereal, out-of-phase modulation in the two signals would provide evidence for a Lorentz violating field. We have automated the experiment to run 24 hours a day and achieved uninterrupted operation over several weeks. We have achieved more than an order of magnitude improvement in sensitivity to anomalous neutron coupling relative to existing limits.

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