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**Weak Interactions with Neutral Atom Traps: new observables using beta-decay daughter momenta**[1]

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We use modern atomic physics techniques to trap localized samples of atoms with polarization known to high accuracy. The low-energy daughter nuclei escape the trap, and their detection permits a variety of new observables. We have placed the best general limits on first generation scalar interactions by measuring the $\beta$-$\nu$ correlation in $^{38m}$K decay [Gorelov, PRL 94 (2005) 142501], and we have also made a 3% measurement of the $\nu$ spin asymmetry in $^{37}$K decay [Melconian DNP 2005]. We plan upgrades of both. Here we concentrate on measurements of the daughter nucleus momentum by time-of-flight with respect to the atomic shakeoff electrons, a technique demonstrated by LBL researchers [Scielzo, Nucl.Phys.A 746 (2004) 677c]. The spin asymmetry of daughter nuclei in singles in a pure Gamow-Teller decay vanishes in the standard model [Treiman, Phys. Rev. 110 (1958) 448], so it is a very sensitive probe for new interactions. We have measured the daughter spin asymmetry in $^{80}$Rb decay, achieving statistical accuracy that would complement the best existing limits on tensor interactions in beta decay. The same observable in $^{37}$K decay would be sensitive to right-handed currents with statistics competitive with $\mu$ decay experiments. We also plan a search for the admixture of keV-mass $\nu$'s with the electron $\nu$ in the electron capture decay of $^{131}$Cs. Our goal is sensitivity to $<10^{-5}$ admixtures at mass $<$30 keV. Such a $\nu$ would be a warm dark matter candidiate and would have other astrophysics implications.

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