Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Optical pumping for nuclear beta decay[1] J.A. BEHR, S. SMALE, I. CRAICIU, A. VANTYGHEM, A. GORELOV, TRIUMF, M. ANHOLM, U. British Columbia, R.S. BEHLING, B. FENKER, D. MELCONIAN, Texas A&M, G. GWINNER, D. FRIESEN, U. Manitoba — For nuclear beta decay experiments to test the standard model, we must produce laser-cooled, polarized atoms with vector polarization of at least 99.9%, with knowledge of the polarization from atomic observables at 0.1% accuracy. We cycle on and off an AC MOT, and optically pump ^{37}K atoms for 2 ms with trap off. We use circularly polarized light on the $4S_{1/2} \rightarrow 4P_{1/2}$ transition, using RF sidebands on a diode laser to excite transitions from both F=1 and F=2 ground states. We test techniques with stable ^{41}K atoms, which have very similar hyperfine splitting to ^{37}K. Optical pumping techniques include flipping spin state with liquid crystal variable retarders, 0.25 mm thick SiC substrate mirrors in front of the beta detectors, combining 769.9 D1 and 766.5 nm D2 with an angle-tuned narrow bandpass filter, relieving stress from conflat-compatible windows to minimize birefringence, and shifting the frequency of the light with the spin flips to compensate for Zeeman shifts. We must avoid coherent population trapping effects. The polarization is measured by the time dependence of the excited state population after optical pumping light is applied, probed by measuring fluorescence and by nonresonant photoionization.

[1]Supported by NSERC, NRC through TRIUMF

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Date submitted: 30 Jan 2013 Electronic form version 1.4