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Optical Pumping Methods for Nuclear β Decay[1] JOHN BEHR, TRIUMF, ERIN BROATCH, Queen's University, ANYA FORESTELL, University of Waterloo, JAMES MCNEIL, University of British Columbia, ALEXANDRE GORELOV, TRIUMF — Having completed a nuclear β decay asymmetry experiment with the best percentage accuracy ever achieved (0.35%) [B. Fenker et al., accepted by Phys. Rev. Lett.], we are trying to improve the vector polarization of our laser-cooled atoms from our present 99.1 $\pm$ 0.1%. We cycle on and off a MOT, and optically pump ^{37}K atoms 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. Upgrades to improve our systematic uncertainties include: preparing the initial atomic state before optical pumping with faster liquid crystal variable retarders, replacing 0.25 mm thick SiC substrate mirrors in front of the beta detectors with 0.012 mm mylar to minimize β straggling, and using a 50 μs exposure CMOS camera to explore polarization changes across the trapped atom cloud. We must avoid coherent population trapping effects. Diagnostics of the polarization include the time dependence of the excited state population after optical pumping light is applied, probed by measuring fluorescence and by nonresonant photoionization.

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