First observation of Beta Decay from ^{82}Rb in a TOP trap

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Recent progress in trapping radioactive atoms at Los Alamos have resulted in the first observation of parity violation from the nuclear beta decay of polarized ^{82}Rb ($t_{1/2}$ = 75 s) atoms confined in a pure magnetic, Time-averaged Orbiting Potential (TOP) trap. The ^{82}Rb atoms were first trapped in a SC-77 coated, 3 inch cubic quartz cell using a magneto-optical trap (MOT1) with a trapping efficiency of $\sim$ 1%, then transferred to a second MOT (MOT2) using the laser push beam / hexapole guide approach. Temporal and energy dependence of the beta signal from MOT2 were analyzed and compared with the optical signal to determine events originating from trapped atoms versus those due to background. The ^{82}Rb atoms were then further cooled by optical molasses, optically pumped into the stretched spin state (F=3/2, m_F=3/2) and loaded into the TOP magnetic trap with an efficiency approaching 50%. The m states population in the TOP trap was further purified by taking advantage of gravity cleaning in that the more weakly confined non-stretch states (3/2,1/2) and (1/2,-1/2) fall out of trap due to gravity at lower quadrapole trapping fields. With a detection solid angle of 0.8%, the beta decay count rate ranged as high as 40 Hz corresponding to 0.5 million ^{82}Rb atoms in the TOP trap. The beta decay signal was recorded in an event-by-event mode where the beta energy, nuclear-spin orientation, and time of each event can be extracted to map out completely and continuously all degrees of freedom relevant to the nuclear beta decay. Background effects were studied by changing the TOP lifetime and dropping the TOP trap immediately after the atoms were loaded. We have observed the parity violating angular correlation and positron energy spectrum consistent with expectations for the pure Gamov-Teller decay of ^{82}Rb. This is the first time that polarized radioactive atoms have been magnetically trapped and their beta-decay detected. Analysis of some 0.5 million beta decay is presently underway and these proof-of-principle experiments serve as the data base necessary to design a first generation physics experiment.