Improved β branching ratios in ^{34}Ar

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As part of our program to test the Standard Model *via* the unitarity of the Cabibbo-Kobayashi-Maskawa (CKM) matrix [1] we are re-measuring the branching ratios in the β decay of ^{34}Ar. The experiment has two important motivations: (1) to test our upgraded acquisition system and (2) to increase the precision of the extracted branching ratios.

In this experiment, a ^{35}Cl beam at 30*A* MeV impinged on a hydrogen gas target, which had a pressure of 2 atm, and was cooled to liquid nitrogen temperature. The ^{34}Ar ejectiles were then separated in the MARS recoil separator, extracted into air, detected by a thin 0.3-mm plastic scintillator and eventually implanted into a 76-μm-thick mylar tape. The implanted ^{34}Ar activity had a purity of better then 99.7%. The average ^{34}Ar beam intensity was about 1.5×10^4 particles per second. We implanted the ^{34}Ar ions for 2 s, then the beam was turned off and the collected activity was moved in 0.2 s to the center of a counting station, which consisted of a HPGe detector and a plastic scintillator on opposite sides of the tape. We recorded all β-γ coincident events and the total number of β singles. The 2 s /0.2 s /2 s collect/move/detect cycle was repeated until sufficient statistics had been acquired. In a one-week experiment we recorded more than 9.5×10^6 β-γ coincident events for 1.3×10^9 implanted ^{34}Ar ions.

Although we already reported a rather precise branching ratio for the superallowed decay of ^{34}Ar in last year's annual report [2], this new experiment should allow us to increase the precision to its ultimate limit, since we now have much better control over the source-to-detector distance at the counting station [3]. The analysis of the experiment is in progress and preliminary values agree with the previously reported value. Even if the final value for the superallowed branching ratio in ^{34}Ar is not significantly improved, this experiment is an effective test of the upgraded experimental system. If all the tests are passed, we will be able to extend our measurements of accurate branching ratios to nuclei where the ground-state-to-ground-state superallowed branch isn't as favorable as it is in ^{34}Ar, where it represents about 95% of the total decay strength. In such a case, even a modest 2% error in the sum over the non-superallowed branches is good enough to yield 0.1% precision for the superallowed branch. No other T_Z = -1 superallowed emitter has such a favorable configuration.

[1] I. S. Towner and J. C.Hardy, Phys. Rev. C **77**, 025501 (2008).

[2] V. E. Iacob, *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2005-2006), p. I-31.

[3] V. E. Iacob, *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2007-2008), p. V-19.