High precision half-life measurement in ^{38}Ca

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It has been recently argued that the nuclear-structure-dependent corrections can be tested against experiment in the context of the unitarity test of the Cabibbo-Kobayashi-Maskawa (CKM) matrix [1]. The test is based on how well the calculated corrections convert the scatter in the uncorrected *ft* values for many transitions into a consistent set of corrected $\mathscr{F}$t values for all transitions, as required by CVC. The decay of ^{38}Ca is a good case to investigate for this purpose since, for the superallowed transitions, the calculated nuclear-structure-dependent correction is larger than that of any of the nine well-known nuclei (^{10}C, ^{14}O, ^{26m}Al, ^{34}Cl, ^{38m}K, ^{42}Sc, ^{46}V, ^{50}Mn, ^{54}Co) [2]. If the measured *ft* value with large calculated nuclear-structure-dependent corrections converts into the average $\mathscr{F}$t value established from these well-known cases, then it further demonstrates the calculation's reliability for the smaller corrections. For the *ft* value to be useful for this purpose, it is necessary to measure the half-life with a high precision of 0.1%.

The half-life of ^{38}Ca was measured via the ^{1}H (^{39}K, 2*n*) reaction at a primary beam energy of 30*A* MeV. The MARS spectrometer provided a pure ^{38}Ca beam from the fully stripped reaction products at the extraction slits in the focal plane. This beam exited the vacuum system through a 50μm-thick Kapton window, passed through a 0.3-mm-thick BC-404 scintillator and a stack of aluminum degraders, and finally stopped in the 76μm-thick aluminized Mylar tape of a fast tape-transport system. We collected the activity of ^{38}Ca on the tape for 0.5 s. At the end of the collection time, the beam was interrupted and the collected sample was moved in 196 ms to the center of a 4π proportional gas counter. Signals from the counter were multiscaled for 15 s, and separate decay spectra were recorded. For the measurement of a highly precise half-life, this "collect-move-count" cycle must be repeated until high statistics are obtained. In a preliminary test run, over 18 million β events were recorded under various detecting conditions, with different settings for dominant dead time, bias voltage of the detector, and threshold of the discriminator. The data analysis is currently underway.

[1] I. S. Towner and J. C. Hardy, Phys. Rev. C **66**, 035501 (2002).
[2] J. C. Hardy, Nucl. Phys. **A752**, 101c (2005).