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High-Precision Half-Life Measurement for the Superallowed β^+ Emitter ^{22}Mg (G)*

Monday 11 June 2018 14:30 (15 minutes)

High precision measurements of the $\mathcal{F}t$ values for superallowed Fermi beta transitions between $J^\pi = 0^+$ and isospin $T = 1$ isobaric analogue states allow for stringent tests of the electroweak interaction described by the Standard Model. These transitions provide an experimental probe of the Conserved-Vector-Current hypothesis, the most precise determination of the up-down element of the Cabibbo-Kobayashi-Maskawa quark-mixing matrix, V_{ud}, and set stringent limits on the existence of scalar currents in the weak interaction. In order to use the superallowed decays to perform such tests, however, several theoretical corrections must be applied to the experimental data. In particular, many studies of the isospin symmetry breaking correction, δ_C, have been performed with large model dependent variations. Precise experimental determinations of the ft values can be used to help constrain the different models used in the calculation of δ_C.

The uncertainty in the ^{22}Mg superallowed $\mathcal{F}t$ value is dominated by the uncertainty in the experimental ft value. Prior to this work, the adopted half-life of ^{22}Mg was dominated by a single high-precision measurement ($T_{1/2} = 3.8755 \pm 0.0012$ s [1]) which disagrees with the only other, and less precise, measurement ($T_{1/2} = 3.857 \pm 0.009$ s [2]) which yielded a $\chi^2/\nu = 4.0$ and resulted in the inflation of the weighted-average half-life by a factor of 2. The discrepancy between these two measurements was addressed through a high-precision half-life measurement for ^{22}Mg which was carried out at TRIUMF's Isotope Separator and Accelerator (ISAC) facility. This experiment was performed using a 4π continuous-flow gas proportional counter to detect the β particles with near 100\% efficiency. The result of $T_{1/2} = 3.87400 \pm 0.00079$ s is a factor of 3 more precise than the previously adopted world average and resolves a discrepancy between the two previously published ^{22}Mg half-life measurements [3]. In this presentation, the new high-precision half-life measurement for ^{22}Mg and its implications for testing the isospin symmetry breaking corrections in superallowed Fermi β decays will be discussed.

[1] J. C. Hardy *et al.*, Phys. Rev. Lett. **91**, 082501 (2003).
[2] J. C. Hardy *et al.*, Nucl. Phys. A **246**, 61 (1975).
[3] M. R. Dunlop *et al.*, Phys. Rev. C **96**, 045502 (2017).

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