ft value of the superallowed β-delayed proton decay of ^{32}Ar

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The T=2 superallowed decay of ^{32}Ar is an interesting case to study because the isospin breaking correction, δ_C, is predicted [1] to be 3× larger than the cases where the *ft* value has already been measured to the best precision [2]. By measuring this theoretical correction in a case where it is large enough to observe, we will be able to provide experimental confirmation of the calculations applied to the other cases when testing fundamental physics (confirming the conserved vector current hypothesis, unitarity of the CKM mass-mixing matrix, weak scalar and right-handed currents, etc.).

We counted the number of ^{32}Ar ions produced at NSCL by implanting them in the middle of a 500 mm thick Si detector (D_3 in Fig. 1). The β-delayed protons were observed in the same detector, and γs were detected by the surrounding HPGe detectors. Fig. 2 shows our proton spectrum as well as a fit to a Monte Carlo simulation based on an R-matrix parameterization of the decay. Our result for the total superallowed branch is b^{β}_{SA} = (22.71±0.16)%. Combining this with the known ^{32}Ar half-life [3] and energy release [3, 4], we find the *ft* value of the superallowed decay is *ft* = 1552±12 s. If we use the corrected $\mathcal{F}t$ value extracted from the nine precisely known T=1 superallowed decays, we find δ_c^{exp} = (2.1±0.8)% [5] which can be compared to a theoretical calculation δ_C = (2.0±0.4)% [1]. In order to produce a stringent test of the theory, an improved version of the experiment is being considered and we hope more detailed calculations of δ_C and δ_{NS} will be performed.

As by-products of this work, we determined the γ and proton branches for the decay of the lowest T=2 state of ^{32}Cl, made a precise determination of the total proton branch and relative intensities of proton groups

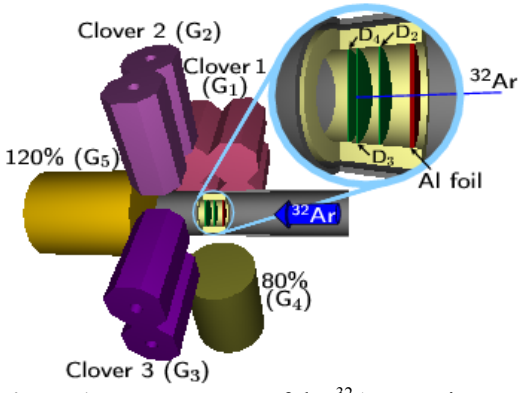

Figure 1. Detector setup of the ^{32}Ar experiment.

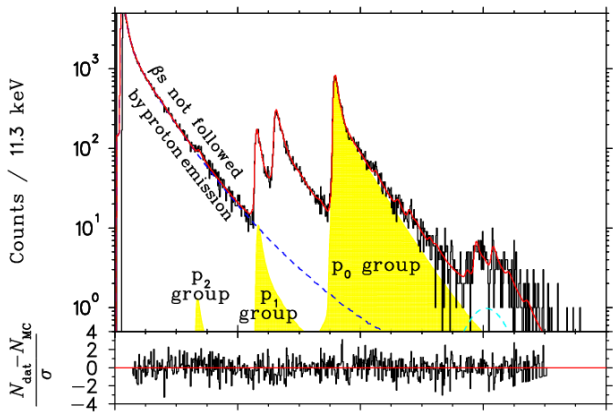

Figure 2. β-delayed proton spectrum of ^{32}Ar (top) and residuals of the fit (bottom). The filled areas represent the proton groups following the superallowed β decay; other peaks arise from Gamow-Teller transitions.

that leave ^{31}S in its first excited state, and deduced a value for the ^{32}Cl mass with 1.6 keV uncertainty.

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[2] J. C. Hardy, *Progress in Research*, Cyclotron Institute, Texas A&M University (2007-2008), p.I-24.
[3] A. García *et al.* (to be published).
[4] K. Blaum *et al.*, Phys. Rev. Lett. **91**, 260801 (2003).
[5] M. Bhattacharya *et al.*, Phys. Rev. C (in press).