Contribution ID: **121** Type: **Invited Speaker / Conférencier invité**

High-Precision Half-Life and Branching Ratio Measurements For The Superallowed β^+ Emitter ^{26}Al^m

Monday 16 June 2014 16:15 (30 minutes)

High-precision half-life and branching-ratio measurements for the superallowed β^+ emitter ^{26}Al^m were performed at the TRIUMF-ISAC radioactive ion beam facility located in Vancouver, Canada. The branching ratio measurement was performed with the 8π Spectrometer, an array of 20 high-purity germanium detectors, in conjunction with SCEPTAR, a plastic scintillator array used to detect the emitted beta particles. An upper limit of $\leq$ 12 ppm at 90% confidence level was found for the second forbidden β^+ decay of ^{26}Al^m to the state at 1809 keV in ^{26}Mg. An inclusive upper limit of $\leq$ 15 ppm at 90% confidence level was found when considering all possible non-analogue β^+/EC decay branches of ^{26}Al^m, resulting in a superallowed branching ratio of $100.0000^{+0}_{-0.0015}$%.

The half-life measurement was performed using a 4π continuous-flow gas proportional counter and fast tape transport system. The resulting value for the ^{26}Al^m half-life, $T_{1/2} = 6.34654(76)$ s, is consistent with, but 2.5 times more precise than, the previous world average, and represents the single most precisely measured half-life of any superallowed emitting nucleus to date.

Combining these results with world-average Q-value measurements yields a superallowed β-decay ft value of 3037.58(60) s, the most precisely determined ft value for any superallowed emitting nucleus to date. Combined with the small, and precisely quoted, theoretical isospin-symmetry-breaking corrections for this nucleus, the corrected $\mathcal{F}t$ value for ^{26}Al^m of 3073.1(12) s is also the most precisely determined for any superallowed emitter by nearly a factor of two and now rivals the precision of all the other 12 precisely measured superallowed β decays combined. The high-precision experimental ft value for ^{26}Al^m superallowed decay reported here provides a new benchmark to refine theoretical models of isospin-symmetry-breaking effects in superallowed Fermi β decays.

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Session Classification: (M2-10) Testing Fundamental Symmetries II - PPD-DTP-DNP / Tests de symétries fondamentales II - PPD/DPT/DPN

Track Classification: Particle Physics / Physique des particules (PPD)