Advances in Radioactive Isotope Science

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From Tensor Currents to Solar Neutrinos: Precision Beta-Decay Studies of ^{8}Li and ^{8}B

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The β-decays of ^{8}Li and ^{8}B provide an important playground to search for physics beyond the Standard Model, and, additionally, a detailed study of ^{8}B β-delayed α-particles provides key insights needed to constrain the spectrum of high energy neutrinos emitted by the Sun. To accomplish both these aims, the β-decays of ^{8}Li and ^{8}B were studied with the Beta-decay Paul Trap (BPT) at the ATLAS facility of Argonne National Laboratory. The BPT traps a cloud of ions at rest in a volume of ~1 mm^3 for extended periods of time, allowing for a backing-free measurement of the emitted particles. The trapping volume is surrounded by segmented, 1 mm thick DSSDs, from which the decay kinematics can be fully constrained by a β-α-α triple coincidence measurement. This enables both a nearly background-free measurement of the β-ν angular correlation coefficient $a_{\beta\nu}$, while a α-α double coincidence measurement enables a determination of the ^{8}B neutrino energy spectrum.

We will present (1) recent results in ^{8}Li, showing the most precise measurement of $a_{\beta\nu}$ in a GT decay and highlighting both the possibility of a ~9 MeV 2^{+} "intruder state"in ^{8}Be and the importance of accurate values for the recoil-order terms, (2) the first measurement of $a_{\beta\nu}$ in ^{8}B and a method to constrain C_T and C'_T in the decay of mirror systems, and (3) the preliminary analysis of a high statistics ^{8}B dataset to determine $a_{\beta\nu}$, and a new determination of the neutrino spectrum following ^{8}B β-decay, which is important for the next generation of solar neutrino experiments.

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