Half-life of the superallowed $\beta$-emitter $^{46}$V

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After making concerted efforts over several years to develop a useful $^{47}$Ti beam [1], we completed a successful measurement of the half-life of $^{46}$V with up to 50 nA of beam in June 2009. We used the $^1$H($^{47}$Ti, $2n$)$^{46}$V reaction at a primary beam energy of 32A MeV. Our experimental arrangement was the same as described before [1].

The main contaminant for this measurement was $^{42}$Sc, another superallowed $\beta$-emitter with $t_{1/2} = 680.72$ ms, which is rather similar to the 422.50 ms half-life of $^{46}$V. Because of this potentially serious problem, we carefully adjusted the distribution of implanted $^{46}$V in the mylar tape by setting the thickness of Al degraders to minimize the number of $^{42}$Sc ions stopping in the tape; and then we routinely measured the purity of the beam with a position-sensitive silicon detector inserted at the focal plane of the Momentum Achromat Recoil Separator (MARS) on a daily basis throughout the whole experiment. Finally, the subsequent data analysis has included a detailed impurity analysis based on the range differences among all possible impurities, including $^{42}$Sc, in the collected $^{46}$V samples. The amount of $^{42}$Sc present in the samples relative to that of $^{46}$V was determined to be 0.1%, an amount for which we can satisfactorily correct.

Approximately 95 million $\beta$ events were recorded under the various combinations of different bias voltages for the $4\pi$ proportional gas counter, discriminator thresholds, and dominant dead times. Currently, we are finalizing our analysis to extract the precise half-life for $^{46}$V with an associated error budget.