

## High precision half-life measurement of the superallowed $\beta$ -emitter $^{38}\text{Ca}$

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Previously we made two measurements of the half-life of  $^{38}\text{Ca}$  [1,2], the first an exploratory one and the second a higher-statistics one that suffered from an unusually unstable – and high (up to ~3%) – contamination from  $^{35}\text{Ar}$  ( $t_{1/2} = 1.77$  s) in the  $^{38}\text{Ca}$  beam at the focal plane of MARS. Since the range difference between  $^{38}\text{Ca}$  and  $^{35}\text{Ar}$  is less than half the thickness of our mylar collection tape, our positioning of the stopped  $^{38}\text{Ca}$  ions mid-way through the tape resulted in the simultaneous deposit of some  $^{35}\text{Ar}$  near the back of the tape. Although the contribution of  $^{35}\text{Ar}$  could be accounted for when we extracted the half-life of  $^{38}\text{Ca}$ , we believed that the precision of our result could be further improved by better control of the impurities and optimized positioning of the collected sample in the tape.

We performed the final half-life measurement of  $^{38}\text{Ca}$  in September 2009 using the same  $^1\text{H}(^{39}\text{K}, 2n)^{38}\text{Ca}$  reaction at a primary beam energy of 30A MeV. Our experimental arrangement was the same as described before [1]. The Momentum Achromat Recoil Separator (MARS) produced a secondary  $^{38}\text{Ca}$  beam that was better than 99% pure. Moreover, we further minimized the  $^{35}\text{Ar}$  contaminant by depositing  $^{38}\text{Ca}$  near the back of the mylar tape, thus ensuring that much of the  $^{35}\text{Ar}$  passed entirely through it. During a daily routine check of MARS beam, no change was observed this time in the amount of  $^{35}\text{Ar}$  relative to  $^{38}\text{Ca}$ . Approximately, 200 million  $\beta$  events were recorded under various different settings of the experimental parameters – bias voltage of the  $4\pi$  proportional gas counter, discriminator threshold, and dominant dead times – in order to check for possible systematic effects. The analysis is close to completion. This will lead to our final result for the half-life of  $^{38}\text{Ca}$  and its associated error budget.

- [1] H. I. Park *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2006- 2007), p. I-58; H. I. Park *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2007- 2008), p. I-30.
- [2] H. I. Park *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2008- 2009), p. I-33.