^{34}Ar half-life

V.E. Iacob and J.C. Hardy

Our recent work on the half-life of ^{30}S [1] gave us a unique opportunity to test the data reduction techniques and the corrections we use in parent-daughter decaying systems. In contrast to the ^{34}Ar-^{34}Cl pair with half-lives in a ratio very close to 1:2, the ^{30}S-^{30}P pair has half-lives that differ from one another by 2 orders of magnitude. This allows for fits that treat the combined parent-daughter decays either as two independent components or as a parent-daughter linked system. Making use of this feature, we proved that the use of a small rate-dependent correction makes a small but not negligible improvement in the fit. This prompted us to revisit the half-life analysis of ^{34}Ar reported in [2].

To understand the origin of the rate-dependent correction, consider how the detection efficiency of our gas proportional counter varies as a function of the applied anode voltage. We measured this before and after the ^{34}Ar run using a ^{90}Sr-^{90}Y β source. Fig. 1 presents the relevant part of the response function for the three discriminator thresholds used in the experiment: 150 mV, 200 mV and 250 mV. The region where the counting rate is almost constant, the "plateau", is centered on 2600 V and extends for about 150 V above and below this value.

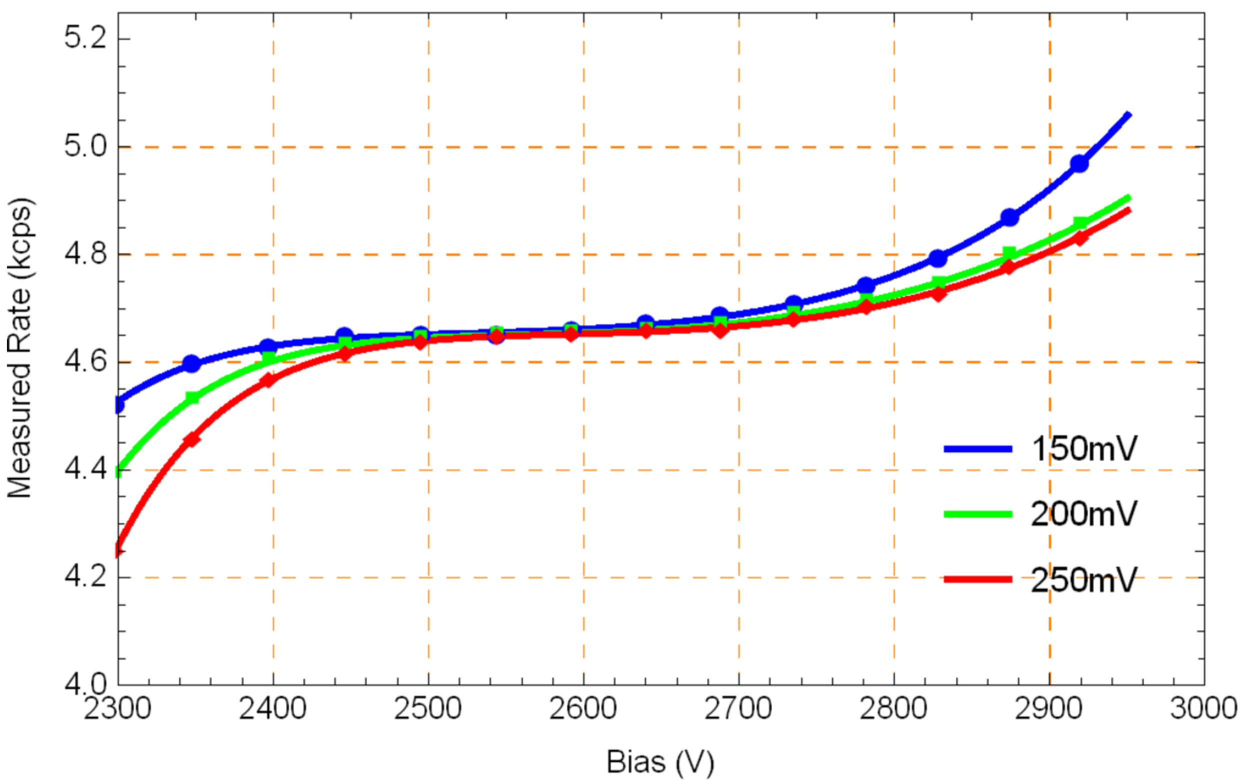

FIG. 1. The "plateau" of the 4π gas counter, for the three discriminator thresholds used in the ^{34}Ar run.

While the slope of the counting-rate versus anode voltage is small (a change of less than ~0.5% per 100 V), it is not zero. As the counting rate decreases during the decay of the measured sample, the current through the detector decreases as well. This in turn leads to a decreased voltage across the resistor that biases the anode wires (100 MΩ), leaving a slightly higher voltage on the anode. Thus, as the counting rate decreases, the anode voltage increases, making the detector (slightly) more efficient.

Currently we are re-fitting the ^{34}Ar data with the inclusion of this correction.

[1] J.C. Hardy, I.S. Towner, V. E. Iacob, H.I. Park, N. Nica, M. Bencomo, V. Horvat, and L. Chen, *Progress in Research*, Cyclotron Institute, Texas A&M University (2017-2018) p.I-20; V.E. Iacob *et al*., Phys. Rev. C **97**, 035501 (2018).

[2] V.E. Iacob, J.C. Hardy, M. Bencomo, L. Chen, V. Horvat, N. Nica, H.I. Park, B.T. Roeder, and A. Saastamoinen, *Progress in Research,* Cyclotron Institute, Texas A&M University (2015-2016) p. I-14.