Improved determination of the gamma branching ratios from the decay of ^{37}K

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As part of the TRIUMF Neutral Atom Trap (TRINAT) collaboration, our goal is to search for physics beyond the standard model via precision measurements of the (polarized) angular correlations of the β^+ decay of ^{37}K. In order to achieve the requisite precision in the standard model predictions of the parameter values (<0.1%), it is essential that the *ft* value of ^{37}K be as precise as possible [1-3]. At the moment, the precision of the *ft* value is limited by the uncertainty in the branching ratio to the ground state; Ref. [3] from 1997 had plenty of statistics to see small branches, but the HPGe was not precisely calibrated so the ground state branch was not determined precisely. We will improve this with data we have taken at the Cyclotron Institute using the fast-tape transport system in conjunction with the world's most precisely calibrated HPGe. We are currently in the process of completing the branching ratio analysis.

We have filtered the data to obtain a clean data set (e.g. vetoing bad cycles where the tape does not stop between the HPGe γ detector and the plastic scintillator β detector) and minimized accidental coincidences via the E_γ vs β-γ timing 2D spectrum. We have completed calibrating the HPGe energy using four known prominent peaks at 1184, 1611, 2796 and 3602 keV [3]. In order to optimize the reduction of backgrounds and random coincidences, we iteratively optimized our cuts in both the γ energy and β-γ timing.

Our fits to the areas of the γ photopeaks now account for the random coincidences and background, and include small effects such as incomplete charge collection, as shown in the left panel of Fig. 1. Preliminary comparison to the published work is shown in right panel of the same figure, where

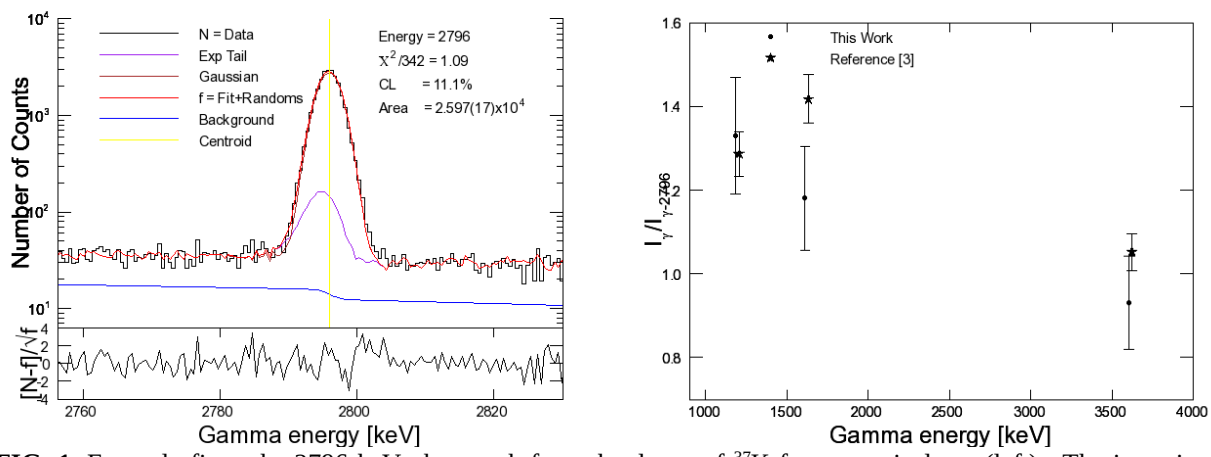

FIG. 1. Example fit to the 2796-keV photopeak from the decay of ^{37}K from a typical run (left). The intensity of 3 other γ rays compared to the dominant 2796-keV branch is plotted on the right, as well as the results from Ref. [3], showing reasonable agreement at this preliminary stage.

our ratio of photopeak areas is compared to the results of Ref. [3]. The comparison is already quite reasonable.

Currently, we are at the stage of making corrections to account for dead times and pile-up as outlined and discussed in detail in Ref. [4]. We expect to arrive at a publishable result before the end of the year.

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[2] B. Fenker *et al.*, Phys. Rev. Letts. **120**, 062502 (2018).

[3] E. Hagberg *et al.*, Phys. Rev. C **56**, 135 (1997).

[4] M. Bencomo, Ph.D. Thesis, Texas A&M University (2019); URL: http://oaktrust.library.tamu.edu/-handle/1969.1/174335.