Progress in the calibration Kr+C with FAUST-QTS

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Fusion-evaporation residues have for reactions of ^{78,86}Kr+C @ 15,25,35 MeV/nucleon been measured with the Quadrupole Triplet Spectrometer (QTS) in coincidence with the evaporated charged particles in the FAUST array. This report describes progress on the calibration of the data from FAUST. The calibration procedure for this data set is conceptually the same as that of Heilborn [1], and is similar in implementation.

In this experiment, the position-sensitive silicon detectors (DADLs) [2] of FAUST were used. The amplitude of the signals measured by them depends slightly (~5%) on the position of the detector. As a means of observing and correcting for this, data was taken with a ^{228}Th alpha source. Fig. 1 (left panel) shows the sum of the two front signals (F2+F1) from the DADL on detector 21 as a function of their difference (F2-F1). Since the alphas from the ^{228}Th are emitted at discrete and known energies, the data should fall on bands of constant energy (F2+F1). We parameterize the bands with parabolas. Though the curvature and linear coefficients of the parabolas are different for each band, they do vary nearly linearly with the constant coefficient (i.e. F2+F1). Thus the curvature and linear coefficient can be obtained for any arbitrary value of (F2+F1) and subtracted from the sum to obtain the corrected sum, which is shown in Fig. 1 (right panel) as a function of (F2-F1). Though there are exceptions, this is representative of the

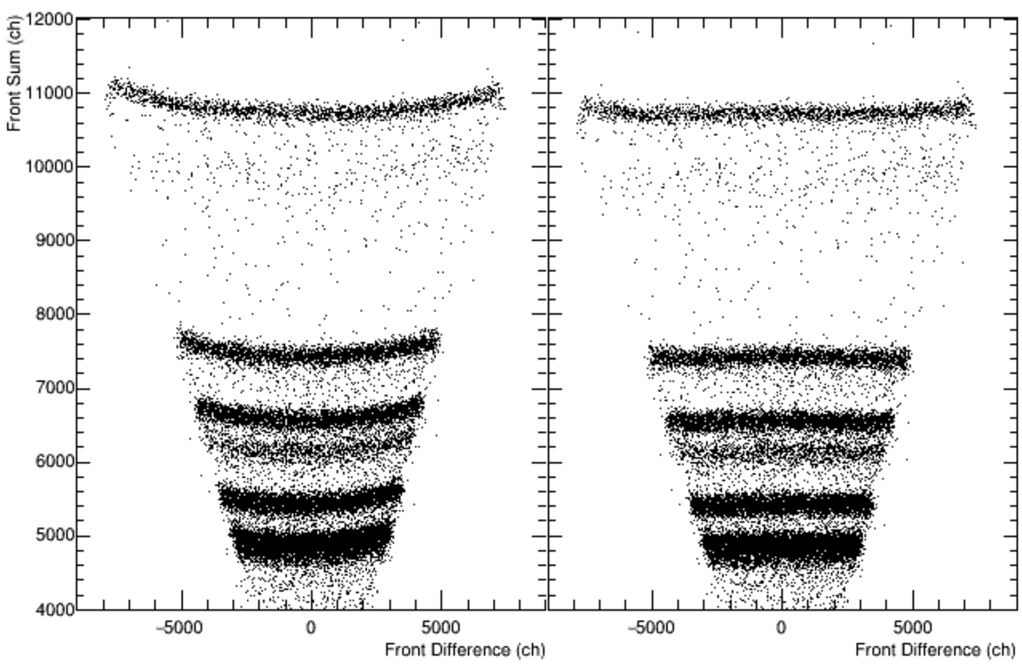

FIG. 1. Measured energy (F2+F1) vs position (F2-F1) before (left) and after (right) the position correction.

correction procedure for the array. The same procedure is applied to the back signals B2 & B1 with similar results.

The next step is to find the correlation from corrected sum to energy deposited in the silicon detector. This is done using the ^{228}Th data as well as beam calibration data. In Fig. 2, the corrected sum is plotted on the x-axis. The corresponding energy calculated, given the known incident energy energy corrected for loss in the target and mylar delta-ray shields as well as punch-through from the silicon detector when appropriate, is plotted on the y-axis. The upper two points correspond to beam calibration; the remainder are thorium peaks. The linear correlation is good to 1.5% for this detector, which is typical of the array. From thorium data and beam calibration data taken at various times throughout the experiment, the calibration appears to be stable in time for all detectors in rings C, D, and E. This remains to be settled for rings A and B.

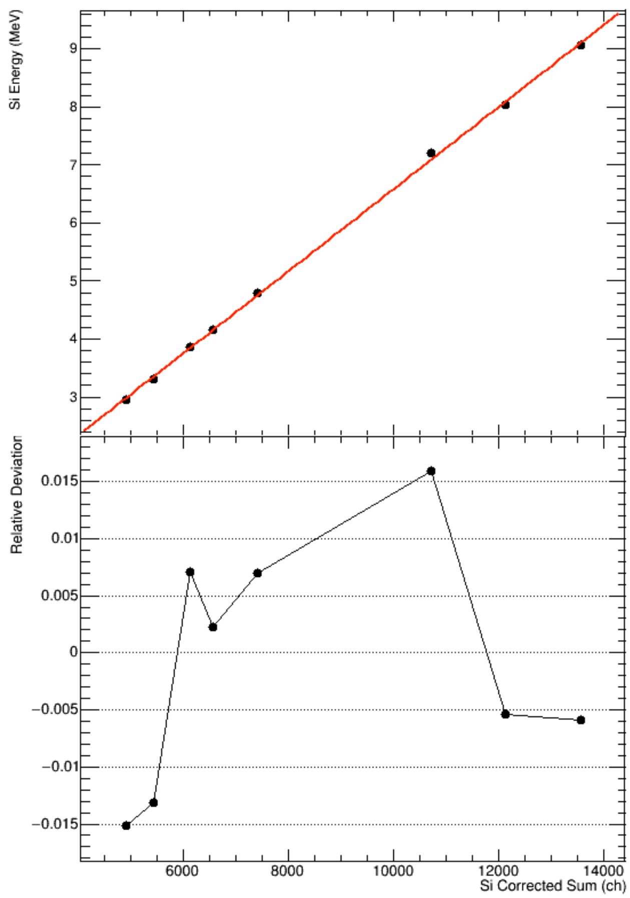

FIG. 2. Top: energy vs measured ADC channel with the linear fit that defines the energy calibration. Bottom: relative deviation of the data points from the linear fit as a function of the ADC channel.

Having corrected the silicon signals, it is also possible to perform the particle identification (PID). The ΔE-E technique is used in FAUST. Since the dynamic range in this experiment is small, covering hydrogen, helium, much of lithium and a sliver of beryllium, it is possible to use a parameterization of the shape of the PID bands (based on the Bethe-Bloch formula) to linearize the PID bands. The formula used is the same as Youngs [3] used, with the addition of independent calibration parameters as Heilborn did [1]. By varying the parameters somewhat, it is possible to obtain the spectrum shown in Fig. 3 where the PID bands for detector 21 have been (nearly) straightened (x-axis) against the raw CsI value. Atomic number and mass number increase from right to left. The data shown corresponds to runs 223-285 (^{86}Kr+C @ 35MeV/nucleon), but the same parameterization works for all other detectors in rings C, D, and E for all five other beam isotope and energy combinations. The PID for the back silicon signals and for rings A and B is underway.

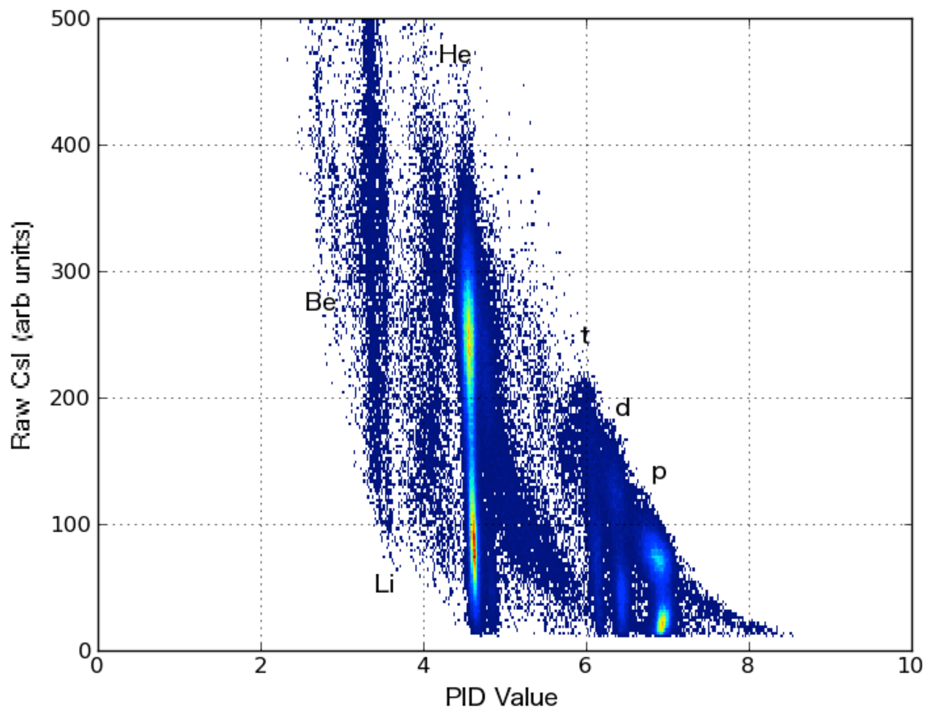

FIG. 3. Particle ID in FAUST.

[1] L.A. Heilborn, Ph.D. Thesis, Texas A&M University,in preparation.

[2] S. Soisson *et al.*, Nucl. Instrum. Methods Phys. Res. **A613**, 240 (2010).

[3] M.D. Youngs, Ph.D. Thesis, University of Michigan, 2013.