Progress in the calibration of Kr+C with the FAUST-QTS

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To investigate the previously reported asymmetry dependence of the caloric curve [1-3], reactions of ^{78,86}Kr + C @ 15,25,35MeV/u were measured with the FAUST array and the Quadrupole Triplet Spectrometer. Progress in the FAUST calibration and particle identification is discussed in this report.

The particle ID in FAUST [4] is achieved with the ΔE-E technique in Si-CsI. A representative spectrum is shown in the upper panel of Fig. 1 (note the log-log scale). The spectrum shown is for detector 21 for the ^{86}Kr+C @ 25MeV/u. As discussed in [5], the particle ID loci are linearized according to a simple parameterization [You2013]. The linearized distribution is shown in the lower panel of Fig. 1. Here, peaks are seen for ^{1,2,3}H, ^{3,4,6}He, ^{6,7}Li, and ^{7,9,10}Be; gates are set around each of these peaks as indicated by the coloring. In the upper panel, particles inside each cut are redrawn with the corresponding color to illustrate the efficacy of the particle ID. This identification procedure is effective for the majority of detectors, but improvements remain to be made (predominantly for rings A and B).

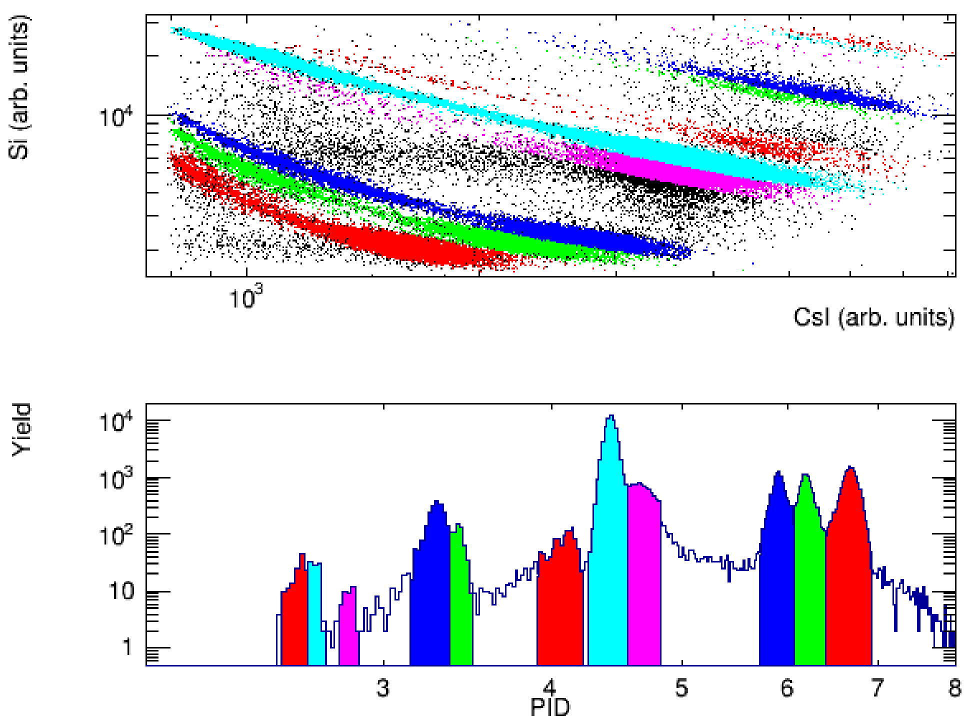

FIG. 1. Particle ID using ΔE-E method. Upper panel: Energy in ΔE(Si) vs energy in E(CsI). Particles are colored according to their extracted ID. Note the log-log scale. Lower panel: linearized PID value. Coloring is the same as in the upper panel. From right to left, isotopes of hydrogen, helium, lithium and beryllium are observed.

The energy calibration of the silicon detectors was previously described [McI17]. To verify the consistency of the calibration, the distribution of energies deposited by a single particle type in silicon detectors is examined. Fig. 2 shows the energy deposited in the silicon by alpha particles in detectors 21, 23, 25, 27, 29, 31, 33, and 35, which are all at the same polar angle in the laboratory. The coloring shifts from yellow (det 21) to red (det 35). The solid lines correspond to the neutron-poor ^{78}Kr @25MeV/u beam; the dashed lines correspond to the neutron-rich ^{86}Kr @25MeV/u beam. The distributions are generally the same shape, scale, and yield, suggesting that the energy calibration is consistent across detectors and across time. This is generally true for detectors in rings C, D, and E; improvements are generally necessary in rings A&B.

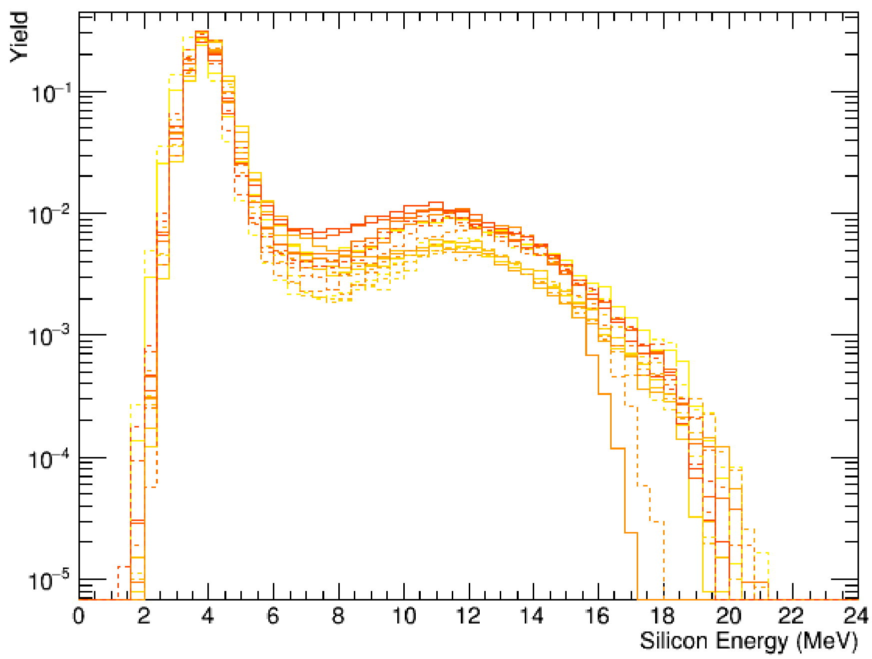

FIG. 2. Calibrated energy deposited in some of the ~300um Si detectors by alpha particles. Detectors shown are all at the same polar angle. Solid lines show spectra for ^{78}Kr beam and dashed for the ^{86}Kr beam; all are at E_{beam}=25MeV/u.

The calibration of the CsI is based on the calibration of the silicon, the particle ID, and energy loss calculations. This is illustrated in Fig. 3 for alpha particles produced in ^{86}Kr+C @ 35MeV/u measured in detector 21. In the upper panel, the measured digitized signal ("light output") in the CsI is plotted on the vertical axis. The measured energy in MeV in the silicon detector is used by CycSrim to calculate the energy the alpha particle deposited in the CsI detector; this latter quantity is plotted on the horizontal axis. The yield is indicated by the color in linear scale; the closed black circles correspond to the mean light output as a function of the energy. This is fit (red curve) according to the parameterization of Parlog et al. (eqn7) [Par02]. In the lower panel the relative deviation from the fit is shown. This illustrates the procedure, which is in progress.

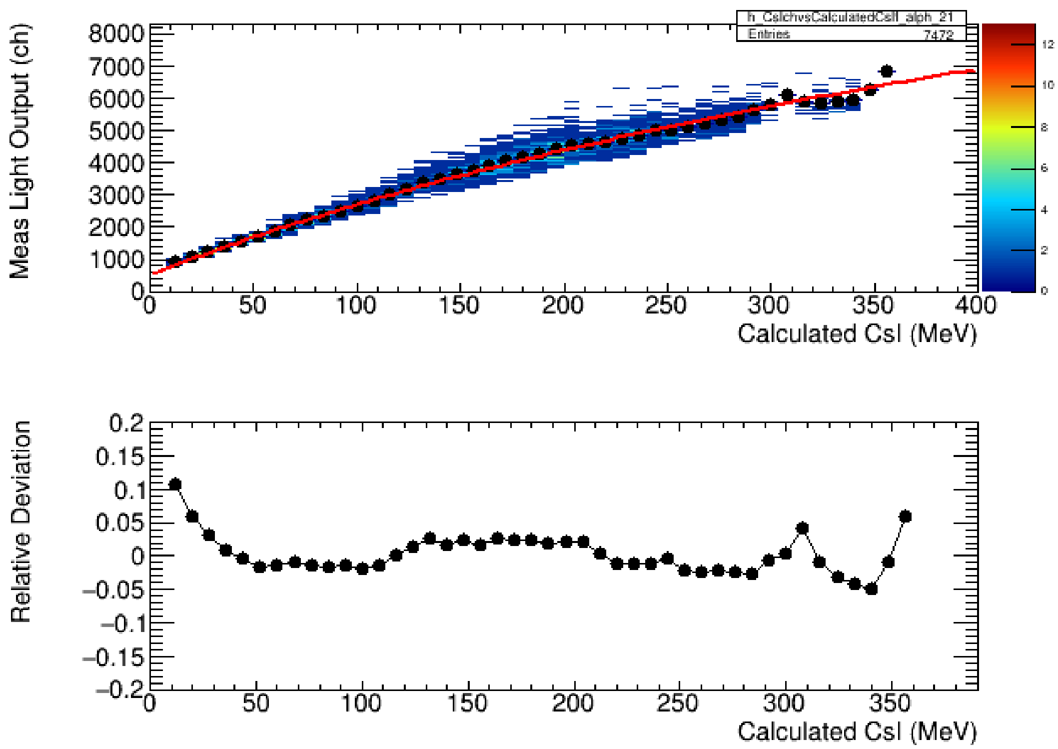

FIG. 3. Method of calibrating the CsI(Tl) detectors based on the calibrated silicon detector and the particle ID. Upper panel: measured (digitized) light output in channels vs energy deposited in the CsI calculated using the silicon energy event by event. The red line shows the result of a fit of the form from Parlog et al. [Par02]. Lower panel: relative deviation describing the accuracy of the fit to the mean light output vs energy.

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