Measurement of Kr+C @ 15, 25, 35 A MeV

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Previous research [1-3] has observed an asymmetry dependence of the nuclear caloric curve: increasing the neutron composition of an excited nucleus at a given excitation energy lowers its temperature. To independently verify this and to investigate this further, a new measurement was made. Beams of ^{78}Kr and ^{86}Kr impinged on a ^{12}C target at beam energies of 15, 25, and 35 A MeV. Incomplete fusion of the entire Kr beam with a fraction of the carbon target dominates the cross section at these energies, though at the lowest energy there should be a measureable amount of complete fusion. The excited compound nucleus (CN) de-excites often by emitting light charged particles. The temperature of the emitting source is reflected in the emission patterns such as the kinetic energy spectra, momentum distributions and fluctuations, and yield ratios. The light charged particles are measured with the FAUST array between 1.6° and 45° relative to the beam axis. The position sensitive DADL detectors of the FAUST upgrade are used for this measurement. The CN evaporation residues are measured in the Quadrupole Triplet Spectrometer (QTS) where their time of flight (TOF), energy loss (ΔE), and total energy (E) is measured.

Fig. 1 shows the ΔE vs TOF distribution for heavy residues produced in reactions of ^{86}Kr + ^{12}C @ 25A MeV. Since the energy loss (ΔE) of a particle is proportional to Z^2/v^2, the bands of data observed

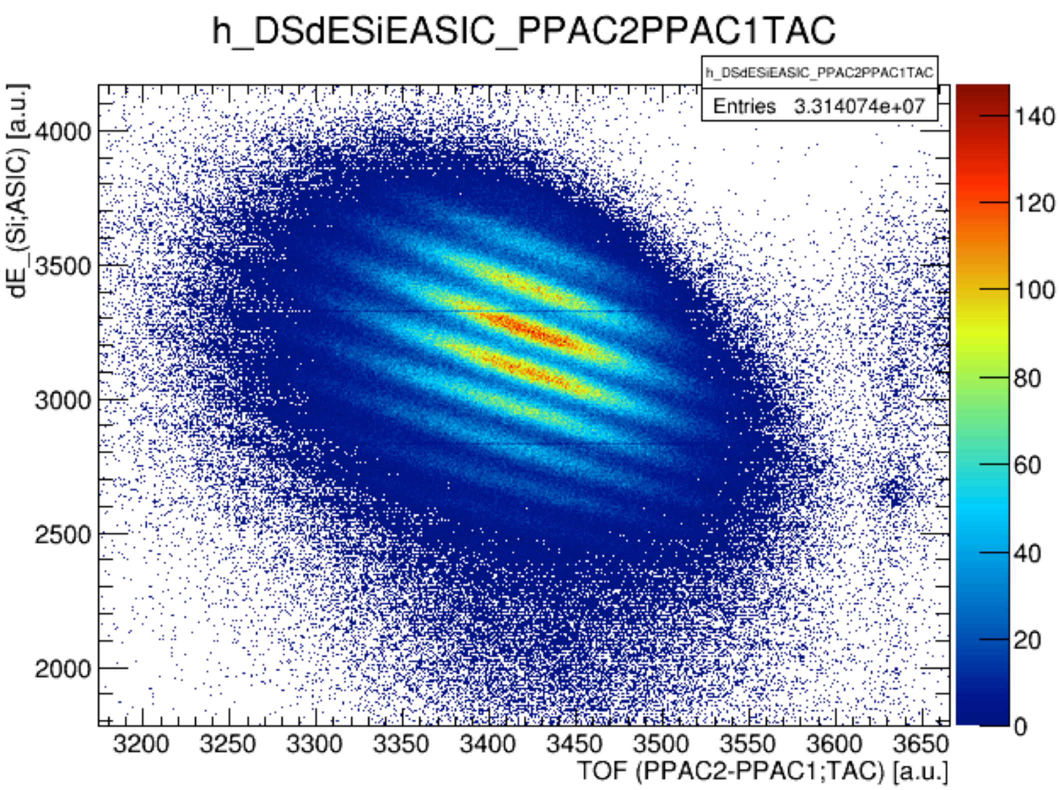

FIG. 1. Energy loss vs time of flight spectrum for evaporation residues measured in the QTS. Z resolution is obtained.

here correspond to different atomic numbers. Clearly unit Z resolution is obtained. Similarly, by correlating the total energy with the time of flight, mass information may be obtained. However, the single most important piece of data that can be obtained is the velocity, or more specifically the velocity damping. This contains information of how much of the carbon target fused with the projectile, which then determines the excitation energy and composition. The QTS was tuned significantly below the rigidity of the beam in the region where production cross-section for residues of interest maximized. The trigger for these events was at least one charged particle in FAUST, and with this trigger the yield of elastically scattered beam particles in the data stream is hugely suppressed. A small contribution of spurious events with a particle in FAUST and a beam particle in the QTS are observed (E=2640,ΔE=2700).

Fig. 2 shows a typical ΔE vs E distribution from FAUST. Isotopes of light charged particles can clearly be resolved.

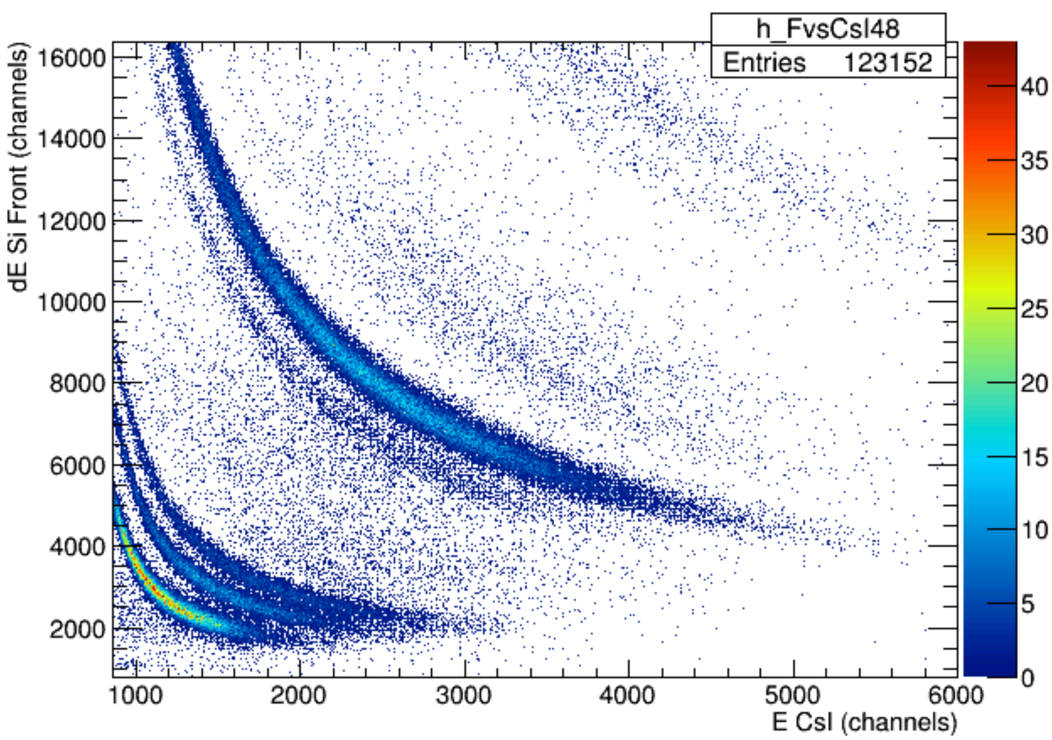

FIG. 2. ΔE (Si) vs E (CsI) in FAUST. Isotopes of Z=1 and Z=2 are clearly separable, and some Z=3 resolution can be seen as well.

The calibration of this data set is underway. Once complete, the data will be useful for other analyses in addition to that mentioned above. Correlation functions exploring the space-time properties of emitting source can be examined. These correlation functions may also allow us to study Coulomb and nuclear tidal forces acting on short-lived clusters. The evolution of the reaction mechanism with the incident beam energy may also be interesting and addressable in this data set.

This work is supported by the Department of Energy (DE-FG02-93ER40773) and the Welch Foundation (A-1266).

[1] A.B. McIntosh *et al.*, Phys. Lett. B **719**, 337 (2012).
[2] A.B. McIntosh *et al.*, Phys. Rev. C **87**, 034617 (2013).
[3] A.B. McIntosh *et al.*, Eur. Phys. J. A **50**, 35 (2014).