Projectile Fragmentation of Mass 40 Isobars Using FAUST

A. L. Keksis, M. Veselsky, G. A. Souliotis, E. Martin, A. Ruangma, D. Shetty,
E. M. Winchester, and S. J. Yennello

Projectile fragmentation resulting from heavy-ion reactions has been the topic of many studies [1-5]. To investigate the influence of isospin, rare ion beams that have very large or very small N/Z are especially interesting [5-6]. So far the following reactions have been studied: 45 MeV/u ^{40}Ca and 32 MeV/u ^{40}Ca and ^{40}Ar beams on ^{112,124}Sn targets. The tin targets were chosen due to their large difference in N/Z of 1.24 and 1.48, respectively. ^{40}Ca has N/Z of 1.00 and ^{40}Ar has N/Z of 1.22.

This work was performed at Texas A&M University's Cyclotron Institute using the FAUST array. To reconstruct the fragmenting projectile in these reactions, the forward angles need good coverage to intercept and identify all the fragments. FAUST, described in [7, 8] accomplishes this goal. The geometry of FAUST is shown in Figure 1. FAUST is composed of 68

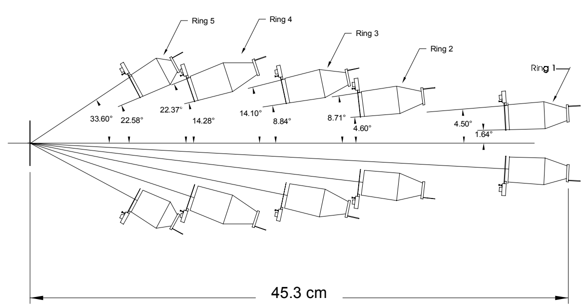

Figure 1: Diagram showing cross section of the geometry of FAUST.

ΔE-E telescopes comprising a 300μm silicon followed by a CsI(Tl) crystal. Of the 68 telescopes, only 49 were appropriately working during the run with these current reactions.

An uncalibrated spectrum of E vs. ΔE from the reaction 32MeV/u ^{40}Ar on ^{112}Sn is shown in Figure 2. One can see that isotopic identification can be achieved up to Carbon.

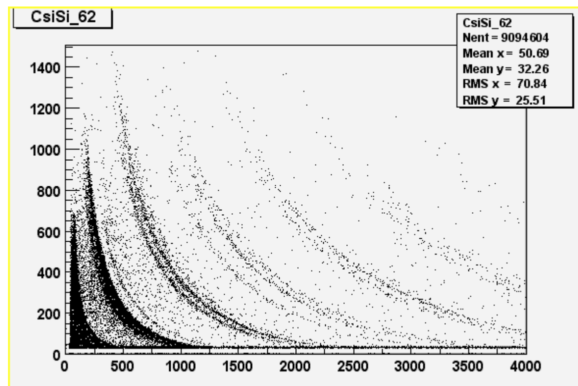

Figure 2: Uncalibrated E versus ΔE spectrum from 32MeV/u ^{40}Ar on ^{112}Sn.

Using alphas from a ^{228}Th source, the silicon for telescope 62 was calibrated with a linear fit for converting signal to energy. Then, as shown in Figure 3, lines were visually drawn on top of the isotopes: ^{4}He, ^{7}Li, and ^{9}Be. These isotopes were chosen because they are readily identifiable in all the spectra. Then these lines were fitted using a minimization program. Finally, gates were drawn to select specific isotopes.

At this point, the silicon calibration parameters, the CsI calibration parameters and the gating parameters have been extracted for telescope 62. Calibrations are underway with the rest of the working telescopes and work is progressing on extracting energy spectra. Then event characterization can be made and the quasi-projectiles can be reconstructed.

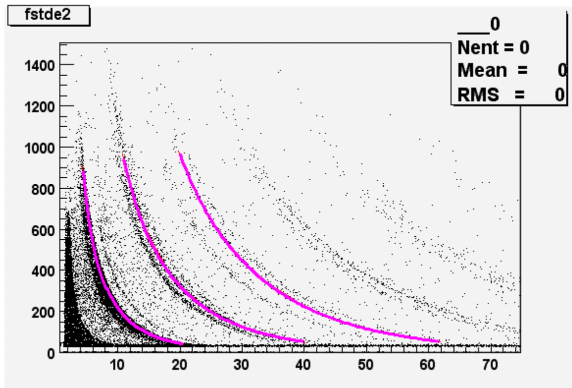

Figure 3: Calibrated ΔE spectra from 32MeV/u ^{40}Ar on ^{112}Sn.

To compare the experimental results to theory, a deep inelastic transfer model by Tassan-Got/Stephan [9], will be used to simulate the interactions between the target and projectile. Then the quasi-projectile formed will be de-excited by both GEMINI [10], a statistical evaporation model using Monte Carlo techniques and the Hauser-Feshbach formalism, and SMM, a Statistical Multi-fragmentation Model [11].

Future plans include systematic measurements with stable beams of ^{40}Ca, ^{40}Ar and ^{48}Ca with the full array working. Then the nearly completed Superconducting Solenoid Rare Isotope Beam Line will be used for producing and selecting rare ion beams such as ^{40}Sc ($t_{1/2}$ 0.1823 sec.), ^{40}Cl ($t_{1/2}$ 1.35 min.) and possibly ^{40}S ($t_{1/2}$ 8.8 sec.). The two main constituents of this line are the University of Michigan's 7-Tesla superconducting solenoid magnet 'BigSol' [12, 13] followed by a time of flight (TOF) line consisting of a large bore quadrupole triplet.

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