TOTAL Z, A, ENERGY AND ANGULAR DISTRIBUTIONS OF FRAGMENTS PRODUCED REACTIONS OF 100- AND 200-MeV ^{4}He WITH ^{28}Si

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In order to test intermediate-energy models for description of the total reaction cross section in nucleus-nucleus collisions, complete energy and angular distributions have been measured with discrete nuclidic resolution for all fragments emitted in the reaction of 100- and 200-MeV ^{4}He ions with ^{28}Si. Self-supporting targets of separated ^{28}Si were bombarded with ~200 nA beams from IUCF in these experiments.

Two detector telescope systems were employed. One of these was designed for complete definition of the mass and energy yields for all fragments with energies > 0.05 MeV/nucleon. This detector consisted of a channel-plate fast timing start detector followed 60 cm downstream by a stack of silicon detectors of thicknesses 48-, 400-, 2000- and 2000-μm, respectively. The 48-μm detector served as a stop signal for time-of-flight determination. In Fig. 1 a plot of Et^2 (mass parameter) versus fragment energy is shown, indicating the on-line mass resolution attainable with this system. Also shown in Fig. 1 is a projection of the mass spectrum with an energy gate from 8-10 MeV.

The second detector system was designed to yield discrete nuclidic Z and A information for the fragments down to as low an energy as possible. This system employed two channel-plate fast-timing units for time-of-flight measurement, followed by a gas-ionization detector operating at 7.5 torr of isobutane for ΔE information, and a silicon detector stack of 50-, 500- and 5000-μm thickness, respectively. Discrete resolution for all fragments with energies > 0.2 MeV/nucleon was achieved with this system.

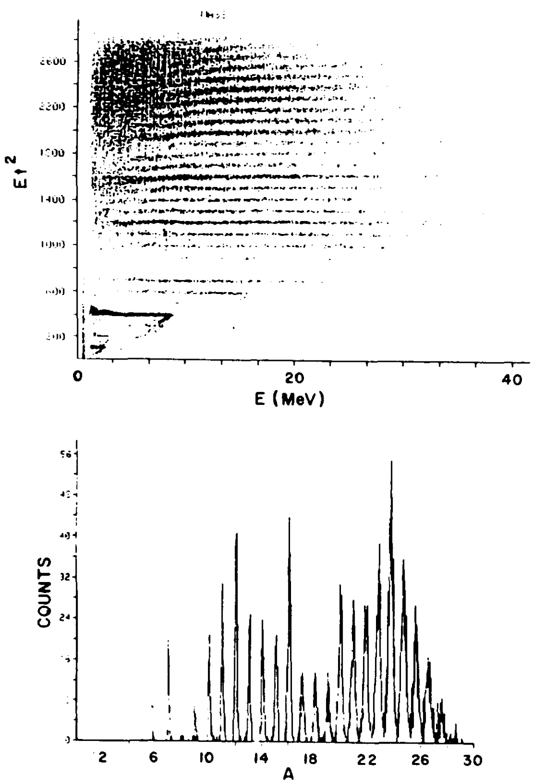

Figure 1. Mass spectra observed at 30 deg in the reaction of 200-MeV ^{4}He ions with ^{28}Si. Upper curve plots mass parameter Et^2 versus fragment energy; lower curve shows a projection of the above mass spectrum in an energy window from 8-10 MeV.

Based upon preliminary analysis of the data, the mass and charge distributions from this reaction are observed to populate a broad range of residual nuclei, which emerge with significant amounts of kinetic energy, as observed in proton-induced reactions.[1] However, in contrast with the proton-induced reactions the yields of fragments with $4 < Z < 8$ at backward angles are suppressed. Analysis of these data is

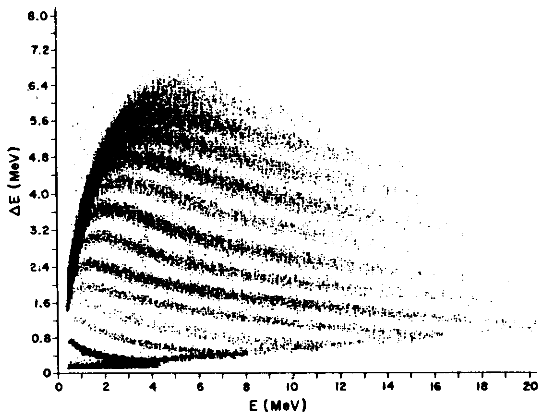

Figure 2. ΔE-E spectrum for fragments emitted in 200-MeV ^{4}He + ^{28}Si reaction.

currently in progress. The results will be examined both with intranuclear cascade and pre-equilibrium calculations.

1) K. Kwiatkowski et al., Phys. Rev. Lett, 50, 1648 1983).

INTERMEDIATE MASS FRAGMENT EMISSION IN 200 MeV ^{3}He-INDUCED REACTIONS ON Ag AND Au TARGETS

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The charge distributions and energy spectra of intermediate-mass fragments (IMF's: $3<Z<14$) from the reaction of 198.6- and 270-MeV ^{3}He with Ag and Au targets have been measured at IUCF. Self-supporting targets of thickness ≈2 mg/cm^{2} were bombarded with ^{3}He beams of 100 nA in the 64-inch diameter scattering chamber. Fragment atomic numbers were identified with a ΔE-E telescope consisting of a gridded gas ion-chamber element (ΔE), operated at 8.4 torr of isobutane, and a 165- μm partially depleted silicon surface barrier stopping detector. Differential cross sections were measured over the angular range $15° < \Theta_{lab} < 161°$.

The angular distributions and energy spectra suggest that at least two separate mechanisms are responsible for the production of IMF's. The first is consistent with a statistical emission mechanism, as evidenced by approximately isotropic angular distributions from 80-160 deg and associated energy spectra peaked near the Coulomb energy predicted by fission systematics, assuming a binary process. These can be described rather well by the statistical model of Moretto.[1] The peaks of the spectra correspond to a separation distance of the charge centers of about 1.8 $(A_1^{1/3}+A_2^{1/3})$fm, implying a highly stretched configuration for the emitting system at the scission point. A rapidity analysis of these energy spectra is consistent with statistical emission from a source moving with the compound nucleus velocity.

The second IMF mechanism is evidenced by strongly forward peaked angular distributions which exhibit an increasingly pronounced high-energy component as one