

Figure 2. ΔE -E spectrum for fragments emitted in 200-MeV $^4\text{He} + ^{28}\text{Si}$ 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 ^3He -INDUCED REACTIONS ON Ag AND Au TARGETS

J.S. Bashkin, K. Kwiatkowski, M. Fatyga, H.J. Karwowski⁺ and V.E. Viola
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

The charge distributions and energy spectra of intermediate-mass fragments (IMF's: $3 < Z < 14$) from the reaction of 198.6- and 270-MeV ^3He with Ag and Au targets have been measured at IUFC. Self-supporting targets of thickness $\approx 2 \text{ mg/cm}^2$ were bombarded with ^3He 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 $15^\circ < \theta_{\text{lab}} < 161^\circ$.

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 $1.8 (A_1^{1/3} + A_2^{1/3}) \text{ fm}$, 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

approaches zero degrees. Parameterization of the forward-angle spectra in terms of a Maxwellian function superimposed on the equilibrium spectrum, yields temperatures well in excess of the compound nucleus temperature. For the most forward angle studied here heavy fragments ($Z \sim 6-10$) are observed with momenta up to 1.5 times the beam momentum (Fig. 1). The origin of these fragments is especially interesting in that their momenta imply a very unusual acceleration mechanism - simplistically corresponding to quasi-free knockout of the heavy fragment with ${}^3\text{He}$ scattered at 180 deg.

Differential cross sections for the backward angle data (140°) as a function of fragment mass have been compared with calculations based on the Friedman-Lynch model² which assumes statistical emission from a highly

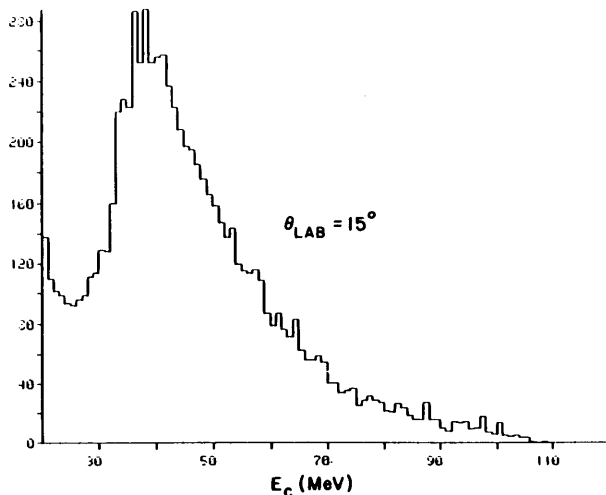


Figure 1. Energy spectra as a function of angle for carbon fragments emitted from 198.6-MeV ${}^3\text{He}$ reaction with Ag.

excited source. Whereas good agreement is found for the backward angle differential cross sections, comparison with total cross section data yields a significant underprediction of the data, especially for $Z < 6$. Finally in Fig. 2 we show excitation functions for backward angle fragment production, which includes lower energy ${}^3\text{He}$ data from LBL.

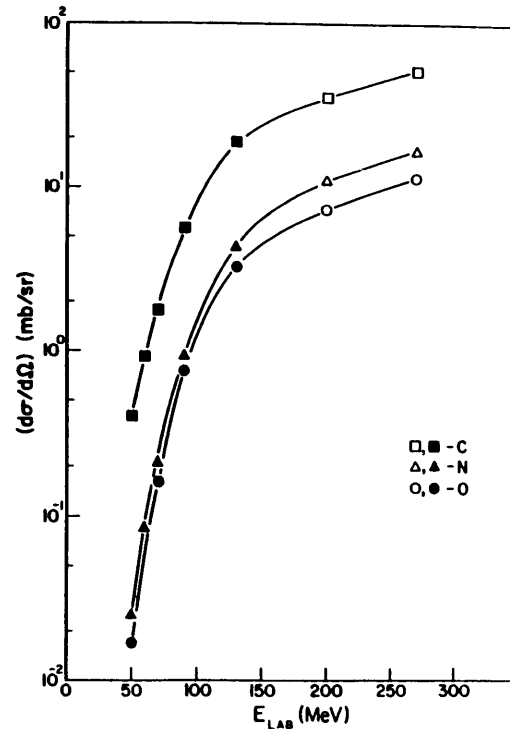


Figure 2. Excitation function for carbon fragments emitted in ${}^3\text{He} + \text{Ag}$ reaction at 140° . Closed \bullet refer to Ref. 3; open \circ are from this work.

[†]Present address: Physics Department, University of North Carolina, Chapel Hill, NC 27514

- 1) L.G. Moretto, Nucl. Phys. A247 (1975).
- 2) W.A. Friedman and W.G. Lynch, Phys. Rev. C 28, 950 (1983).
- 3) L.G. Sobotka et al., Phys. Rev. Lett. 51, 2187 (1983), and private communication.