FURTHER STUDIES OF UNUSUAL FISSION MASS DISTRIBUTIONS USING 190 MeV PROTONS

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We have continued our study of symmetric and asymmetric fission of intermediate-mass nuclei using 190 MeV protons. A three-detector ΔE-E counter telescope, consisting of a common-anode ΔE ion chamber (~12.6 torr isobutane) and three large area, 300 mm^2, Si(SB) detectors (in gas) in coincidence with a three-detector Si(SB) array was used to provide approximate fragment Z identification as well as fragment energies (TKE). This, together with fragment TOF relative to the beam r.f. (Δt~0.5 ns) provides Z and A identification. The TKE is used to separate contaminants.

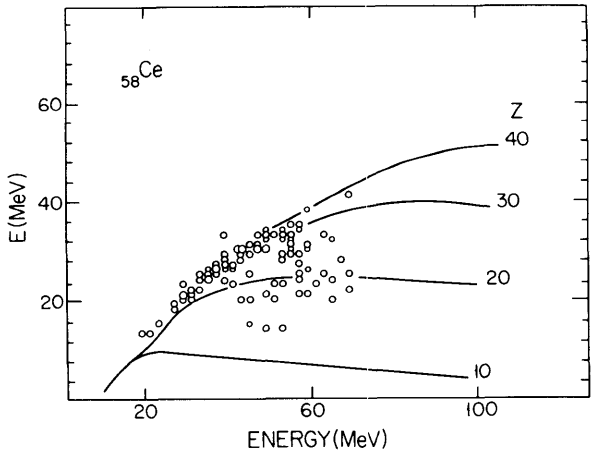

Figure 1. Ion-chamber - Si(SB) detector spectrum of ΔE-E for coincident p+Ce fission fragments (E_p = 190 MeV) gated on the fission peak in TKE. The calculated contours for various fragment Z values are indicated.

Two new elements were studied (Nd and Dy), together with new targets of masses (Ce and Er) studied previously without the ΔE-E detector.[1] A ΔE-E spectrum for Ce is shown in Fig. 1. This appears to be consistent with the unusually symmetric fission mass distribution 140 → 50(Z≈20) + 80(Z≈35) + ... deduced previously.[1,3] Likewise mass (and Z) distributions for other targets near A = 140 (Nd and Dy) exhibit broad and/or double-peaked mass distributions (Fig. 2). This is indicative of a trend towards broad, asymmetric fission as A → 100 which is predicted by the liquid drop model (BG point). Recent studies[4] at Ep=1 GeV also indicate such behavior (Fig. 3).

We have also obtained angular correlations (using the coincidence data) and angular distributions (using singles data and plastic track detectors). Further studies using a 200 MeV ^{3}He beam have been approved, which will permit investigation of the region A < 140, yet still with relatively low angular momentum and mass transfer.

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1) F.D. Becchetti et al., Phys. Rev. C 28, 276 (1983).

2) P. Lister et al., Proc. 4th Intl. Conf. on Clustering Aspects of Nuclear Reactions and Nuclear Structure. Chester, GB, July 1984.

3) G. Anderson et al., Z. Phys. A293, 241 (1979).

4) L.N. Andronenko et al., Z. Phys. A318, 97 (1984).

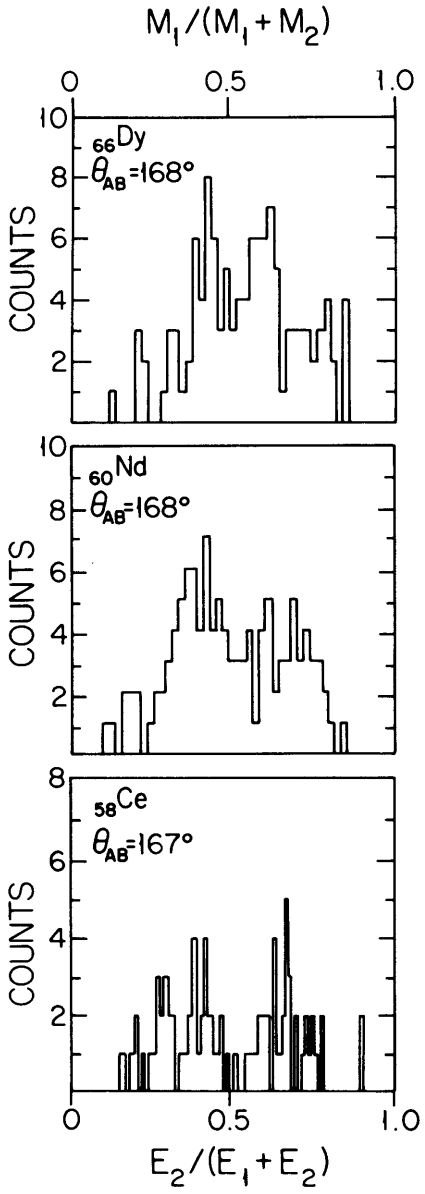

Figure 2. Inferred mass spectra $[M_1/(M_1+M_2) \approx E_2/(E_1+E_2)]$ for coincident fission fragments $[(\Theta_1-\Theta_2) \approx 168°]$ gated on the peak in the TKE spectrum corresponding to binary fission for the masses indicated (TKE $\approx 0.107\ Z^2/A^{1/3} + 22.2$ MeV).

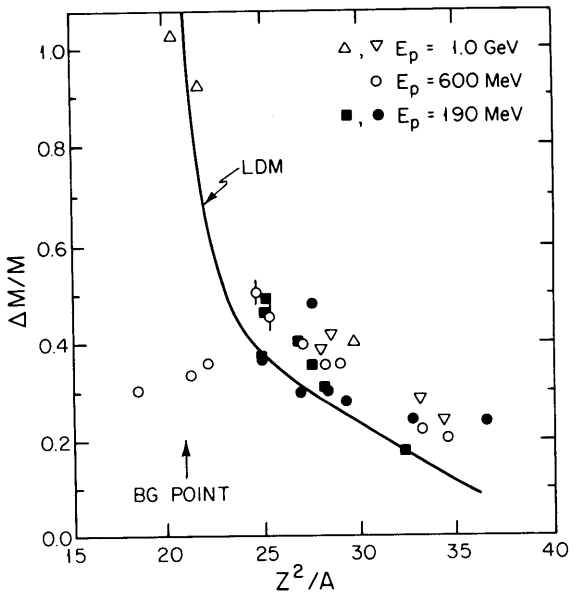

Figure 3. Fission mass widths (deduced from $M_1/M_1+M_2) \approx E_2/(E_1+E_2)$ or directly measured with TOF) for proton-induced fission (1 GeV: Ref. 4; 600 MeV: Ref. 3; 190 MeV: this work and Ref. 1).