SEARCH FOR ASYMMETRIC MASS DIVISION IN THE FISSION OF ^{182}W*

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The deformed scission point model[1] has been rather successful in providing a comprehensive description of mass, charge and kinetic energy distributions in nuclear fission. This model predicts that in the vicinity of ^{182}W an asymmetric mass split may occur due to the influence of deformed nuclear shells at the scission point. In order to search for this effect we have studied the fission of ^{178}Hf with 50-MeV ^{4}He ions at IUCF. The bombarding energy was chosen to provide as low an excitation energy as possible and at the same time maintain an acceptable counting rate. (This tradeoff resulted in an excitation energy above the barrier of ≈ 20 MeV at a cross section of ≈ 4 μb). An array of semiconductor detectors arranged to detect binary fragment coincidence events was used to detect fragment energies. Approximately 1850 events were recorded and from the E_1-E_2 contours a mass resolution of about ± 4μ was obtained.

Fig. 1 presents a plot of fragment yield versus heavy fragment mass for these results. These are compared with the predictions of the deformed scission point model for various shell strengths (one expects

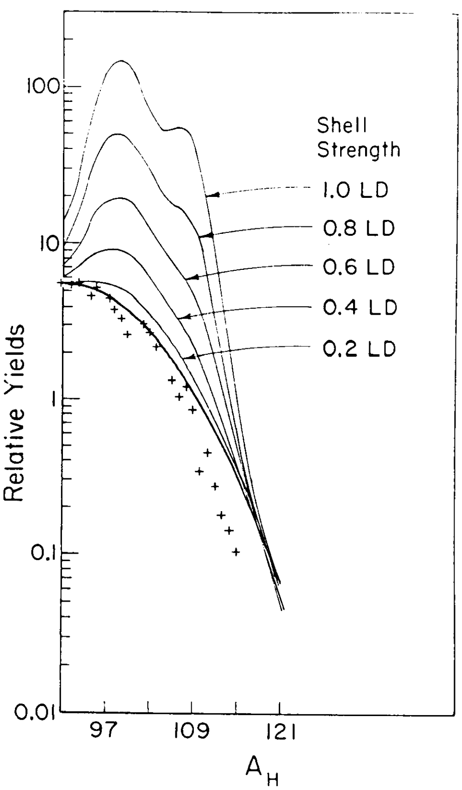

Figure 1. Fragment yield versus heavy fragment mass for fission of ^{178}Hf with 50-MeV ^{4}He ions. Data are compared with deformed scission point model for various shell strengths.

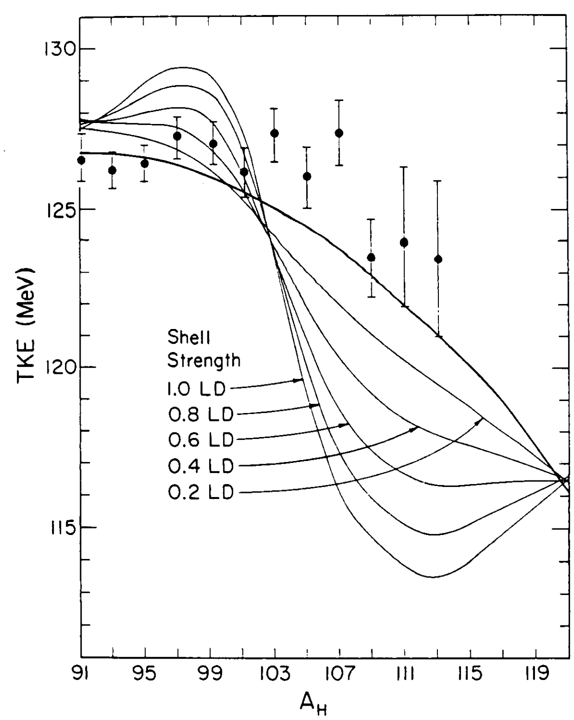

Figure 2. Plot of total kinetic energy release versus heavy fragment mass. Data are compared with deformed scission point model for various shell strengths.

shell strengths of ~0.3-0.5 at this excitation energy). Fig. 2 shows a plot of total kinetic energy release versus fragment mass, again compared with model predictions. Although the data indicate the possibility of some anomalous behavior in the region of $A_H \approx 103$, the best fit to the data is given by the liquid drop calculation with zero shell strength.

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1) B.D. Wilkins, et al., Phys. Rev. C 14, 1832 (1978).

CALCULATIONS OF HIGH-SPIN FISSION FOR A≈200

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One of the long term hopes of heavy-ion studies has been the use of heavy-ion induced fusion-fission processes to extract information on the evolution of fission barriers (B_f) with increasing angular momentum (J). Existing results[1-6] have produced a wide range of conclusions concerning the comparison between values of $B_f(J)$ deduced from experiment and barrier heights obtained from rotating liquid drop model (RLDM) predictions. The differences in conclusions in Refs. 1-6 may reflect in part a real mass-dependence in the validity of the RLDM (specifically in the importance of corrections associated[7] with surface diffuseness and the finite range of the nuclear force), as stressed recently by Blann and Komoto.[5] Nevertheless, nagging discrepancies persist between the conclusions of different workers for selected similar-mass systems, and these cast doubt on the general significance of nuclear properties deduced from fusion-fission studies.

Recently, results have become available for three quite different systems, all leading to compound nuclei (CN) around ^{200}Pb: our own measurements and analysis[6] for ^{6}Li + ^{197}Au,[6] and those of Hinde et al.[8] for ^{19}F + ^{181}Ta and ^{30}Si + ^{170}Er. The data for these different entrance channels provide a useful "case history" in which to probe the origin of discrepancies between different studies. The results for ^{6}Li-induced fusion in the bombarding energy range from 75 to 95 MeV (for ^{181}Ta, ^{194,198}Pt, and ^{208}Pb targets as well as ^{197}Au) were interpreted[6] as completely consistent (to within ~5%) with nuclear structure predictions of the RLDM and noninteracting Fermi gas (NIFG) model; in contrast, Hinde et al.[8] claim that the data for heavier projectiles appear to require ~20% reductions to RLDM fission barrier heights. It should be noted that the corrections to RLDM structure arising from diffuse-surface and finite-range effects are expected[7] to be negligible for A≈200.

The differences in conclusions between the two studies[6,8] might arise in principle from a variety of sources: e.g., different experimental techniques for defining the total fusion cross section σ_{fus}; contributions to fission from mechanisms other than complete fusion, which would yield an effective entrance-channel dependence of the extracted nuclear structure parameters; different underlying assumptions and philosophy in the statistical model analysis. In order to explore the latter possibility, we have recently performed statistical model calculations under a variety of assumptions for all three systems above. We have previously urged[9] the comparison of fission results for such widely differing entrance channels to