GEF calculations for the Mass distribution in ^{238}U(^{18}O,f) reaction

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Introduction

Nuclear fission is a complex process involving large scale collective rearrangement of nuclear matter. The modelling of the re-ordering of the nucleons from an excited mono-nucleus into two (or eventually more) fragments is still a challenge for nuclear theory. The distribution of fragment masses formed in the nuclear fission is one of the most striking feature of the process. New experimental studies has enabled full identification of all fission products in A and Z for various fissioning systems [1, 2]. The systematics of available data gives a more comprehensive view on the influence of shell effects and pairing correlations on the fission-fragment mass and nuclear-charge distributions. The fission fragment mass distribution and isotopic yield were obtained in for the ^{238}U(^{18}O,f) system in an earlier work [1]. In the present work the results from this investigation are compared with GEneral Fission model (GEF model). The GEF model describes the observables for spontaneous fission, neutron-induced fission and, more generally, for fission of a compound nucleus from any other entrance channel, with given excitation energy and angular momentum. It is applicable for a wide range of isotopes from Z = 80 to Z = 112 and beyond, up to excitation energies of about 100 MeV. A comprehensive documentation of the model can be found elsewhere [3].

GEF calculations

The fission fragment mass distribution for the ^{238}U(^{18}O,f) reaction is shown in Fig. 1 The experimental value is shown by the filled symbol. The GEF calculations for the primary and the secondary fragments yields is shown by the dashed and the solid line. The term primary fission fragment refers to the nuclear species formed just after the scission. These primary fission fragments are highly-excited and they de-excited by the emission of prompt neutrons resulting in secondary fission fragments. A normalization factor obtained as 11000 is used to compare the experimental data and the GEF calculations.

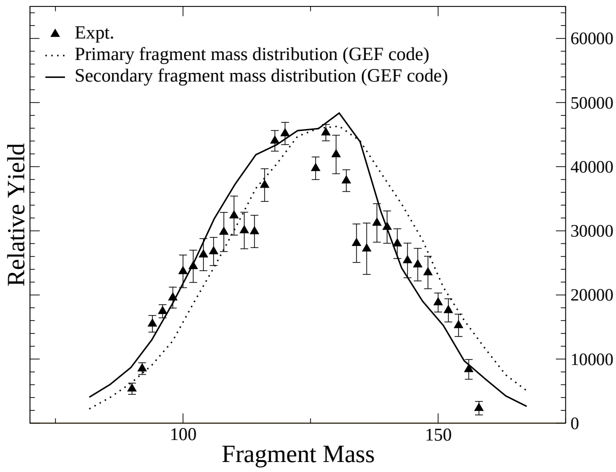

FIG. 1: Fission fragment mass distribution in ^{238}U(^{18}O,f) reaction (see text for detail).

The fission fragment distribution for the ^{238}U(^{18}O,f) reaction was obtained by employing the γ-γ coincidence technique, thus it represents the distribution of the secondary fission fragments. The GEF calculation for the primary fragment yield results in a smooth bell shaped distribution and it is towards higher mass number in comparing to the experimental mass distribution as shown in Fig. 1. The distribution of the secondary fragments obtained from the GEF calcula-

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tions agree reasonably with the experiment. The fine structure dips observed experimentally [1], however are not reproduced by the GEF calculations.

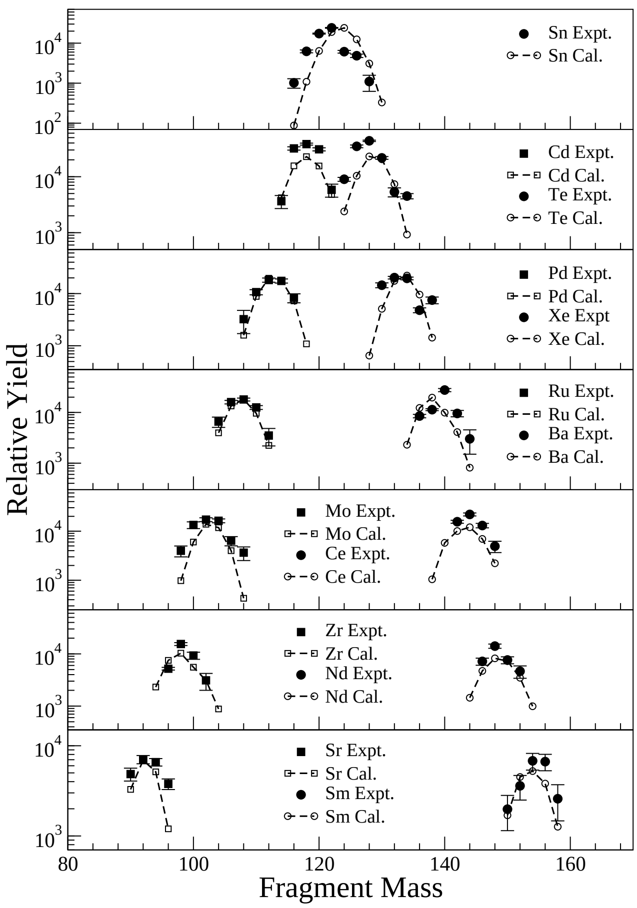

FIG. 2: Relative yield distribution of various isotopes in ^{238}U(^{18}O,f) reaction (see text for detail).

The isotopic yield distribution extracted from the ^{238}U(^{18}O,f) reaction [1], along with the GEF calculations are shown in Fig. 2. The filled symbols represent the experimental values and the GEF calculations are shown by the open symbol. The dashed line joining the open symbols is drawn to guide the eye for the distribution of the calculated yield. The GEF calculations are in agreement with the experimental values for most of the charge splits. As it can be seen in Fig. 2 the calculations reproduce the distribution of Pd and Ru isotopes very well. However for the Cd-Te split there is a difference between the experimental yield and the GEF calculations. It may be noted that the atomic number of Cd and Te is close to Z=50 shell closure. Detailed analysis is in progress and will be presented during the symposium.

Acknowledgments

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