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Effects of neutron emission during fission on fragment mass distribution calculated with dynamical model

Fission is one of the most complex reactions. The mass asymmetry of the fission fragments depends on the shell structure of the fissioning nucleus. It is generally believed that mass-asymmetric fission disappeared due to the annihilation of the shell structure in high excitation energy. Recently, however, fissioning over a wide range of excitation energies has been experimentally observed by producing fissioning nuclei through multi-nucleon transfer reactions [1,2]. In that experiment, it was found that the fission fragment mass distributions (FFMDs) maintain a double-humped structure even at high excitation energies such as 50 MeV. It can be explained by using the concept of multi-chance fission. In the general concept of multi-chance fission, fissioning nuclides changes by multiple emissions of neutrons before fission. The neutron emission lowers the excitation energy of fissioning nucleus, which restores the shell structure, thus reviving mass-asymmetric fission.
The purpose of this study is to introduce neutron emission during fission in the dynamical model, in contrast to the general approach that neutron can be emitted at the compound nucleus shape. In our model the shell structure can revive at any step of nuclear shape evolution. We observed the effect of neutron emission in FFMDs also in this approach. Effects of neutron emission, such as isotope dependence of pre-scission neutron multiplicity for fissioning nuclides, are discussed.

Reference
[1] K. Hirose et al., Phys. Rev. Lett. 119, 222501 (2017).
[2] M. J. Vermeulen et al., Phys. Rev. C. 102, 054610 (2020).

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