Calculation of the fission fragment characteristics in the three-body model of binary fission

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The experimental yields of fragment mass and charge distributions for the neutron-induced fission of 30 actinide nuclei are well described in the model [1,2], which considers the fissioning scission system consisting of two heavy fragments and α-particle between them. The α-particle has its origin in the neck nucleons. The yield of fission fragments in the model is linked to the number of states over the barrier of the saddle point, which is between the contacting and well-separated fission fragments. The quadrupole deformations of heavy fragments are taken into account in the model. The correlation between the values of the equilibrium quadrupole deformation parameter of the fragments and the yield of these fragments is shown. The yields of 9020 fission fragment data points produced in 30 neutron-induced fission reactions considered in our model are described up to a factor of ~7.8. The values of the averaged total kinetic energy for the neutron-induced fission of considered nuclei are well agreed with the available experimental data.

The values of the ground-state deformation parameters play important role in the description of the nuclide, mass, and charge distributions because the deformation energy gives contribution to the total potential energy of the three-body system. Due to this, it is possible to define the values of the ground-state deformation parameters in neutron-rich fragment nuclei by using the sensitivity of the fragment yield on the values of these parameters. The mass, charge, and nuclide yields are described by fitting the values of the equilibrium quadrupole deformation of nuclei related to the fission fragments in the model.

The fragment mass distribution is considered without division on symmetric and different asymmetric fission modes. In contrast to this, there is the three-body configuration in the scission point, which is responsible for the characteristics of the fission fragments yields. The fission fragment yields depend on the heights of corresponding saddle points and the values of the equilibrium quadrupole deformation of fragment nuclei.

[1] V.Yu. Denisov, I.Yu. Sedykh, Eur. Phys. J. A 57, 129 (2021).
[2] V.Yu. Denisov, Eur. Phys. J. A 58, 188 (2022) (2022).

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