Self-consistent approach to tripartition of heavy and superheavy nuclei

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Tripartition is a rare outcome of actinide fission. Most frequently the additional fragment is an alpha particle, but sometimes it can be a heavier light fragment. Evidence accumulated over the years suggests the existence of a genuine tripartition mode in the spontaneous fission of ^{252}Cf and in the neutron-induced fission of ^{235}U (see Refs. [1,2]). With ^{68,72}Ni and Sn close to ^{132}Sn as the two detected products, the third one, undetected (supposedly due to its small velocity), should be Ca (or Si for ^{235}U). The frequency of this channel deduced from data is 2-5$\times10^{-4}$ per binary decay. Various calculations, including the microscopic-macroscopic (MM) three-center model, e.g. [3], suggest that the observations result from a collinear tripartition process.

Apart from its experimental evidence in actinides, a possible tripartition of superheavy nuclei is an open problem which deserves to be investigated. Up to now, as it has been the case for the actinides, the process was mostly studied within the MM or even more restricted models.

Here, we present an approach based on the Hartree-Fock+BCS method with Skyrme-type interactions. In application to tripartition, it seems to present a few advantages over the MM method. In a first step, we focus on the energy barrier preventing the tripartition process. Creation of suitably constrained energy surfaces, for both collinear and equatorial configurations, is a nontrivial practical problem in self-consistent calculations. Obtained results for nuclei in the actinide and superheavy regions show that genuine tripartition should be one of the detectable fission modes. Our ultimate aim is an estimate of the tripartition probability.

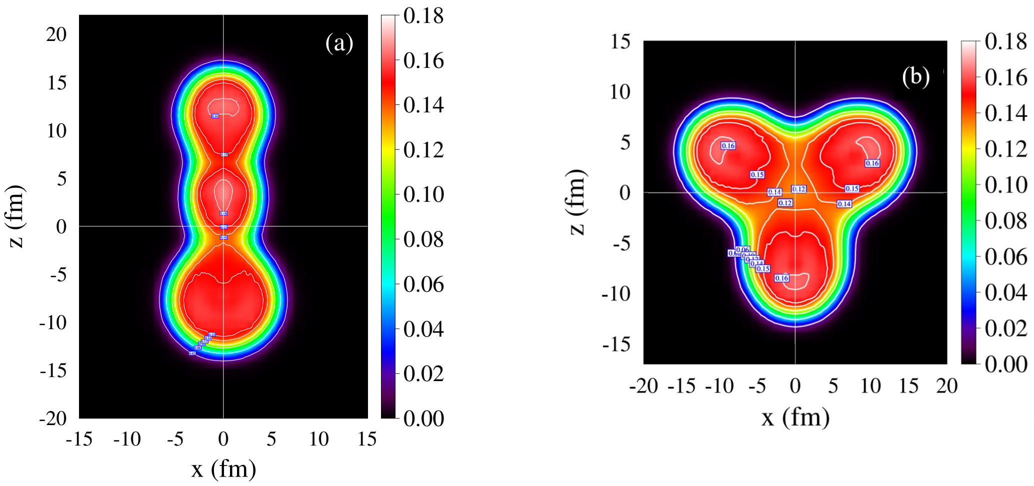

FIG. 1: Nucleon density of tripartite configurations of (a) ^{252}Cf in the collinear case and (b) ^{288}120 in the equatorial case.

[1] Yu. V. Pyatkov *et al.*, Phys. Rev. C **96** (2017) 064606
[2] W. von Oertzen, and A. K. Nasirov, Eur. J. Phys. A **56** (2020) 299
[3] A. V. Karpov, Phys. Rev. C **94** (2016) 064615