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Validation of the mechanism in reaching the island of stability

The existence of ^{298}Fl, the center of the island of stability, has been predicted [1]. To synthesize this nucleus, it is necessary to produce a more neutron-rich compound nucleus than ^{298}Fl, since the excited compound nucleus cools down by emitting neutrons.
According to this paper [2], the compound nucleus ^{304}Fl exhibits some interesting mechanisms. One of them is the effect of neutron emissions. Due to neutron emissions, the neutron number in this nucleus approaches the doubly closed shell, increasing the fission barrier height. This results in the survival probability of ^{304}Fl decreasing quite slowly even at high excitation energy. However, a combination of projectile and target nuclei that can synthesize this nucleus has not yet been found. Therefore, confirming this effect in experiments has been considered difficult.
Recently, experiments were conducted on ^{40}Ar + ^{238}U and ^{48}Ca + ^{232}Th reactions at JINR [3]. We realized that the compound nuclei of these reactions exhibit the same mechanism as ^{304}Fl in terms of the effect of neutron emissions. According to the mass table [4], the shell correction energy, which can be approximated as the fission barrier height, of ^{278,280}Ds increases due to neutron emissions. Therefore, we expect the survival probability of ^{278,280}Ds to decrease quite slowly even at high excitation energy. In fact, the experimental values of the evaporation residue cross sections do not show large differences between the peak excitation energy (about 40 MeV) and the high excitation energy (over 55 MeV) [3].
We calculate the whole fusion-fission process in the superheavy-mass region in three stages: the projectile-target contact process, the competition between fusion and quasi-fission, and the subsequent decay process. We estimated the evaporation residue cross sections by combining the probabilities of these three processes. We used the coupled-channel method [5, 6] for the first stage, the dynamical model with the multidimensional Langevin approach [6] for the second stage, and the statistical model [7] for the third stage.
In this presentation, we primarily discuss the effect of neutron emissions and the associated increase in the fission barrier height in known fusion reactions. This effect plays a crucial role in reaching the island of stability.

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