FISSION AND QUASIFISSION IN THE REACTIONS WITH WELL-DEFORMED NUCLEI

Itkis I.M.[1], Knyazheva G.N.[1], Kozulin E.M.[1], Kozulina N.I.[1], Novikov K.V.[1], Gikal K.B.[1], Diatlov I.N.[1], Pchelintsev I.V.[1], Vorobiev I.V.[1], Pan A.N.[1,2], Singh P.P.[3]

[1] Joint Institute for Nuclear Research, Dubna, Russia; [2] Institute of Nuclear Physics, Almaty, Kazakhstan; [3] Indian Institute of Technology Ropar, Ruipnagar, Punjab, India

E-mail: jitkis@jinr.ru

It is known that in the reactions with well-deformed nuclei their mutual orientation affects considerably the reaction dynamics. The analysis of mass-energy and angular distributions of fragments obtained in the reactions of ^{40,48}Ca with well-deformed ^{152,154}Sm isotopes at energies near and below the Coulomb barrier has shown that the quasifission process contributes significantly in the capture cross section, whereas in the case of the spherical ^{144}Sm target no evidence of quasifission has been found.

The evidence of quasifission caused by the orientation effects was observed in the reactions of light ions like F, O, Ne, with actinide targets (well-deformed nuclei) at energies near and below the Coulomb barrier. The conclusion about the presence of quasifission for these systems was derived from the anomalous large anisotropies and increase of the dispersion of mass distributions. However, the quasifission process is rather unexpected for the reactions with such light projectiles. Moreover, the measurement of the evaporation residues cross sections for the ^{16}O + ^{238}U reaction at near- and sub-barrier energies have shown that the complete fusion is the main process for this system. The large angular anisotropies obtained for these reactions are well described in the framework of the dynamic model of fission-fragment angular distributions which takes into account thermal fluctuations of the orientation degree of freedom and stochastic aspects of nuclear fission. The width of mass distributions can be explained within the multimodal concept of the compound nucleus fission.

To study the role of the multimodal fission the mass and energy distributions of fission fragments formed in the reactions ^{16,18}O + ^{232}Th, ^{238}U, and ^{22}Ne + ^{232}Th, ^{238}U at energies around the Coulomb barrier have been measured. It was found that at these energies the mass and energy distributions of fragments exhibit the multimodal structure, which results in the larger variance of the mass distributions.

The experiments have been carried out at the U400 cyclotron of the Flerov Laboratory of Nuclear Reactions (JINR, Dubna, Russia) using the double-arm time-of-flight spectrometer CORSET.

This work was supported by the Indian Department of Science and Technology (DST) and the Russian Science Foundation (RSF) (Project No. 19-42-02014).