MANIFESTATION OF SHELL EFFECTS IN QUASI-FISSION REACTIONS

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Nucleon transfer between the nuclei in a DNS is statistical in nature [1,2], and there is a possibility that the system may reach and overcome the B.G. point, and thus a compound nucleus will be formed. An alternative to that process is the break-up of the system into two fragments (quasi-fission). In order to calculate the probability of proton transfer from one nucleus to another in a di-nuclear system we used an expression from ref. [3] and assumed that the macroscopic nucleon transfer probability can be expressed in terms of the microscopic probability and the level density.

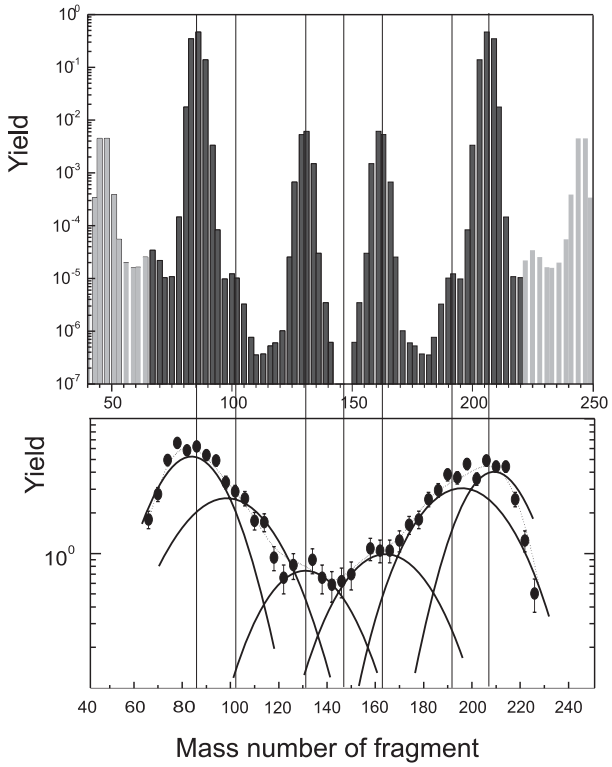

Fig.1 Calculations of the QF mass distribution in the reaction $^{48}Ca + ^{244}Pu = ^{292}114$ (upper), the fragment mass distribution for the same reaction measured experimentally (bottom) [4].

Knowing relative $(P^+ + P^- = 1)$ probabilities and using a random value uniformly distributed over the interval between 0 and 1, we randomly chose the direction for the DNS to move: either the direction to a symmetric system or the direction to the compound nucleus. The procedure may be repeated as many times as necessary for obtaining the necessary statistics. Fig.1 presents the calculation of the mass distribution of quasi-fission products in the reaction $^{244}Pu + ^{48}Ca$.

From Fig.1 it can be seen, that our model reproduces an enhanced yield of fragments with mass numbers 208 and 132 observed in the experiment. However, the yield of nuclei with closed shells appeared to be rather high in the model. During the DNS evolution to the symmetric form its excitation energy grows substantially. It leads to the weakening of the influence of shells effects and accordingly to decreasing the maxima in the mass spectrum.

In reactions of warm synthesis of SHE there are indications for the influence of the nuclear structure of the DNS nuclei on the probability of the system disintegration observed in the mass distribution of quasi-fission products - nuclear fragments with closed shells have the greatest yield. Our model offers a clear and realistic interpretation of the quasi-fission process and occurrence of shell effects in the mass distributions. The model based on this concept allows one to reproduce the shell effects in experimental mass distributions of quasi-fission products.

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