Contribution ID: **49** Type: **not specified**

A new mechanism of incomplete fusion of nuclei.

Wednesday, 18 October 2023 14:30 (20 minutes)

A study of the complete fusion mechanism of nuclei in nucleus-nucleus collisions is an actual task to find an unambiguous answer how fusion takes place: by nucleon transfer through the window between nuclei or as two droplets merge with each other.
The uncertainties in the experimental and theoretical estimations of the cross sections of complete fusion are related mainly with the $\sigma_{\rm fus.fiss}(E_{\rm c.m.})$ term of fusion-fission products in the fusion formula [1,2]:
\begin{equation}
\sigma_{\rm fus}(E_{\rm c.m.})=\sigma_{\rm ER}(E_{\rm c.m.})+
\sigma_{\rm fus.fiss}(E_{\rm c.m.})
\end{equation}
It is related with ambiguity in the identification of the fusion-fission products when they mix with the quasi-fission products in the measured data.

The analysis of the overlap of the mass and charge distribution of the binary reaction products by the dinuclear system (DNS) approaches have demonstrated that fusion of nuclei takes place by nucleon transfer through the window between nuclei. The possibility to describe incomplete fusion by the DNS model as a function of the orbital angular momentum of the entrance channel shows that yield of the α particle is the appearance of the intrinsic fusion barrier at the last stage of complete fusion [3]. At this moment the centrifugal force arising at the large values of the angular momentum pushes out the α particle from the other part of the DNS which has come to the very mass asymmetric shape as a result its evolution by the nucleon transfer. The hindrance to complete fusion of the α particle with the heavy part of the dinuclear system is caused by the increasing the centrifugal forces for the α particle for the large orbital angular momentum ($L > 30\hbar$) [3]. Indeed this is one of channels of the quasifission of the DNS.
This fact is confirmed by our calculations. The angular momentum distribution of the DNS and compound nucleus is calculated by the DNS model taking into account the possibility of the collisions of the nuclei with different orientation angles relative to the beam direction.
The excitation energy E^*_Z of the DNS with the charge asymmetry Z, which is generated from the total kinetic energy loss at the capture of the projectile by the target nucleus. Another reason causing decrease of the excitation energy of the residual nucleus
is kinetic energy of the α particle emitted at large values of the DNS angular momentum.

Therefore, the residue nucleus formed in the incomplete fusion is less heated than the compound nucleus formed in the complete fusion. The observed yield of the ^{194}Au in the α0nchannel of the ^{22}Ne+^{176}Lu reaction occurs only in collisions with the large orbital angular momentum. The measured cross sections of evaporation residues formed in the incomplete fusion and complete fusion channels have been reproduced well by the DNS model and the statistical model implanted in KEWPIE2 [4].

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Session Classification: Section 3