Study of angular momentum variation due to entrance channel effect in heavy ion fusion reactions

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A systematic investigation of the properties of hot nuclei may be studied by detecting the evaporated particles. These emissions reflect the behavior of the nucleus at various stages of the deexcitation cascade. When the nucleus is formed by the collision of a heavy nucleus with a light particle, the statistical model has done a good job of predicting the distribution of evaporated particles when reasonable choices were made for the level densities and yrast lines. Comparison to more specific measurements could, of course, provide a more severe test of the model and enable one to identify the deviations from the statistical model as the signature of other effects not included in the model. Some papers have claimed [1-4] that experimental evaporation spectra from heavy-ion fusion reactions at higher excitation energies and angular momenta are no longer consistent with the predictions of the standard statistical model.

In order to confirm this prediction we have employed two systems, a mass-symmetric (^{31}P+^{45}Sc) and a mass-asymmetric channel (^{12}C+^{64}Zn), leading to the same compound nucleus ^{76}Kr* at the excitation energy of 75 MeV and angular momentum of 39 $\hbar$. Neutron energy spectra of the asymmetric system (^{12}C+^{64}Zn) at different angles are well described by the statistical model predictions using the normal value of the level density parameter **a** = A/8 MeV^{-1}. However, in the case of the symmetric system (^{31}P+^{45}Sc), the statistical model interpretation of the data requires the change in the value of **a** = A/10 MeV^{-1}. The delayed evolution of the compound system in case of the symmetric ^{31}P+^{45}Sc system may lead to the formation of a temperature equilibrated dinuclear complex, which may be responsible for the neutron emission at higher temperature, while the protons and alpha particles are evaporated after neutron emission when the system is sufficiently cooled down and the higher ℓ-values do not contribute in the formation of the compound nucleus for the symmetric entrance channel in case of charged particle emission.

References

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