To study the effect of variation of mass and energy in the dissipative evolution of the system for ^{122}Ba* in heavy-ion fusion dynamics

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1. Introduction

Dissipation plays a crucial role in the heavy-ion fusion-fission reaction dynamics [1–3]. During the collision process energy of the projectile couples with the intrinsic degree of freedom of the target due to the dissipation. Here we have focused on the dissipative behaviour of the fusing nuclei which is based on the variation of mass region as well as variation in the incident energy. In our earlier studies [4–10],in the mass region A≤80, we learned that the symmetric systems evolve slower than asymmetric systems. In asymmetric systems, formation time is significantly less than decay time whereas, in symmetric systems, both formation and decay time have very close values. The presence of dissipation in the entrance channel affects the particle evaporation spectra. However, when we focus on mass region A≥100, we obseve totaly different scenario comparative to what was observed in our earlier studies.

2. Theoretical Studies

In the present study, we have used two reactions, out of which one is symmetric ^{56}Fe+^{66}Zn, and the other is asymmetric ^{28}Si+^{94}Mo forming the same compound nucleus (CN) ^{122}Ba* at the same excitation energy. Here, we have done statistical calculations using code CASCADE, and dynamical calculations done by us using code HICOL.

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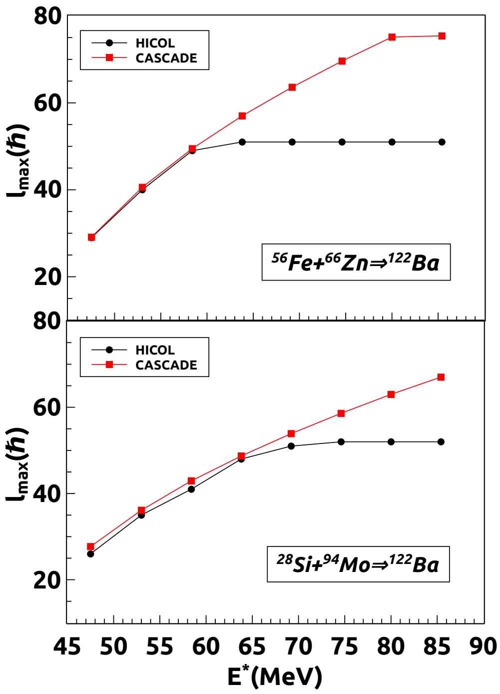

FIG. 1: A plot between $l_{max}(\hbar)$ w.r.t Excitation energy for compound nucleus ^{122}Ba*, symmetric and asymmetric reactions.

From figure 1, we can observe that the angular momentum contribution in the higher energy range is more in CASCADE as compared to HICOL. But at the low energy range, both the codes give close values for symmetric and asymmetric systems. The angular momentum predicted by dynamical model code HICOL contributes to fusion, while CAS-

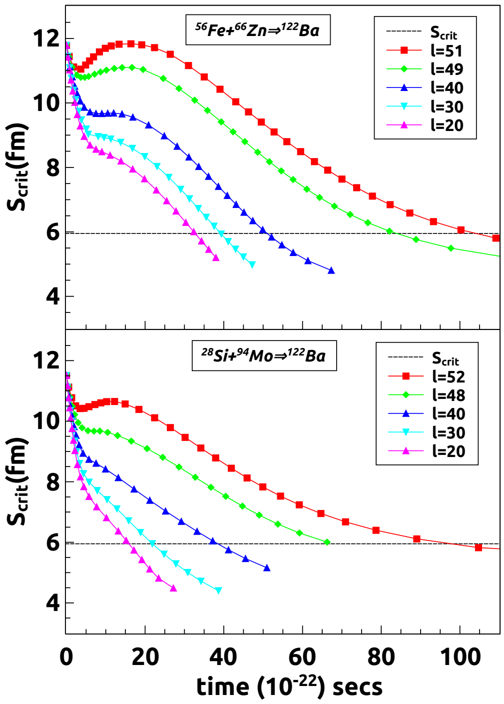

FIG. 2: A plot between S_{crit} (fm) w.r.t time (10^{-22} secs) for compound nucleus $^{122}Ba^{*}$, symmetric and asymmetric reactions.

CADE provides the CN angular momentum. So, we can say that angular momentum predicted by CASCADE does not contribute to fusion. This is due to presence of dissipation in the system which is found by HICOL, that indicates the increase in hindrance directly depends on the E/A of the projectile and mass of the CN for that particular reaction. If we increase the excitation energy and choose a more heavy compound nucleus ($^{122}Ba^{*}$) comparative to previous studies, it is found that the statistical model prediction about the asymmetric systems also shows deviations. We have calculated this for symmetric, i.e. $^{56}Fe+^{66}Zn$ and asymmetric, i.e. $^{28}Si+^{94}Mo$ systems, as shown in figure 2. From the figure, we can say that dynamical effects play their role in the symmetric and asymmetric reactions and at high angular momentum ($l \geq 50$) formation time of both the systems are near by equal.

3. Conclusion

From the present work, we can obseve that dissipation was observed in both symmetric and asymmetric entrance channels at high incident energy as well as high mass region ($A \geq 100$). Very few experimental data are found till now in this mass region and accordingly, we are planning to perform experiment on this problem at IUAC, New Delhi.

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