Effect of mass asymmetry on the mass dependence of balance energy*

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The effect of system size on the reaction dynamics from low to ultra-relativistic energies has been studied a lot in the literature [1]. In heavy-ion collisions at intermediate energies the phenomenon of collective transverse flow and its disappearance has attracted a lot of interest in last two decades [2]. The collective flow is found to disappear at a fixed value of energy (termed as balance energy E_{bal}) where the attractive mean field (dominant at low energies) balances the repulsive field due to nucleon-nucleon collisions (dominant at high energies). The E_{bal} is found to depend on the mass, impact parameter, asymmetry of the reaction, and incident energy of the projectile [2]. The dependence of E_{bal} for the symmetric systems on the system size has been investigated extensively. It has been found to follow a simple power law scaling (= cA^{τ}) with τ close to -0.33 [3]. But till now no study has been done to see the effect of mass asymmetry on the mass dependence of balance energy.
The asymmetry of a reaction is given by $\eta = (A_T-A_P)/(A_T+A_P)$, where A_T is the mass of the target and A_P is the mass of projectile. The value of $\eta = 0$ corresponds to symmetric reactions and $\eta \neq 0$ corresponds to asymmetric reactions. It is known that asymmetric reactions will not follow the same power law behavior as shown by symmetric reactions in the first place. But our studies has shown that the mass dependence of E_{bal} show mass asymmetry independent behavior and it follows the know trend of power law scaling i.e. $\tau \approx -0.33$. This is due the fact that with increase in asymmetry, the number of nucleon-nucleon collisions and repulsive Coulomb interactions decreases, therefore E_{bal} increases. The increase in E_{bal} with asymmetry is more for lighter nuclei as compared to heavier nuclei due to the further less magnitude of Coulomb repulsions in lighter nuclei as compared to heavier ones. The results are displayed for η = 0.1-0.7 and for momentum dependent soft equation of state at semi-peripheral geometry [4].

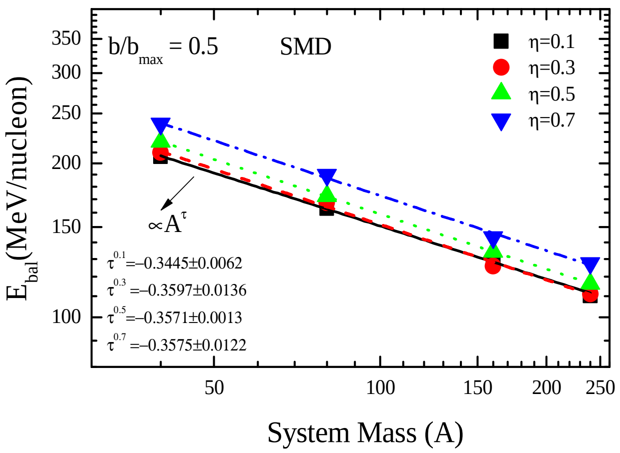

Fig. 1. E_{bal} as a function of combined mass of the system. Lines represent the power law fitting and different symbols are explained in the figure.

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