Optimization of the value of isospin dependent spatial constraints for fragment production.

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1. Introduction

The most interesting phenomenon in heavy ion reaction is the multifragmentation of nuclei accompanied by the production of free nucleons (FN's), light fragments (LMF's), and intermediate mass fragments (IMF's). Study of nuclear multifragmentation provide important and unique information about nuclear matter equation of state(EOS)[1]. Interpretation of experimental results require comparison of data to prediction from transport models that take into account reaction dynamics. Transport models track the time evolution of a nuclear reaction and separately treat the nuclear EOS through the mean field part and the nucleon-nucleon (NN) cross section through collisions[1]. The influence of mean field and NN collision have been studied by using the dynamical model in which one is constrained to stop the reaction at time where the fragment saturates i.e. there is no variation in yield of fragments and identify the fragments using cluster recognition technique.
Recently developed algorithm to identify the fragments is based on spatial correlation among nucleons and has been dubbed as iso-MST method[2]. In this algorithm, nucleons with relative distance of coordinate and momentum of $|r_i - r_j| \leq R_0$ and $|p_i - p_j| \leq p_0$ belong to a fragment. We choose different R_0 values for nn,np, and pp to find that which value of R_0 give largest effect on heavy ion collision observable in this study.
The present study is carried within the framework of isospin-dependent quantum molecular dynamics(IQMD)model [3].

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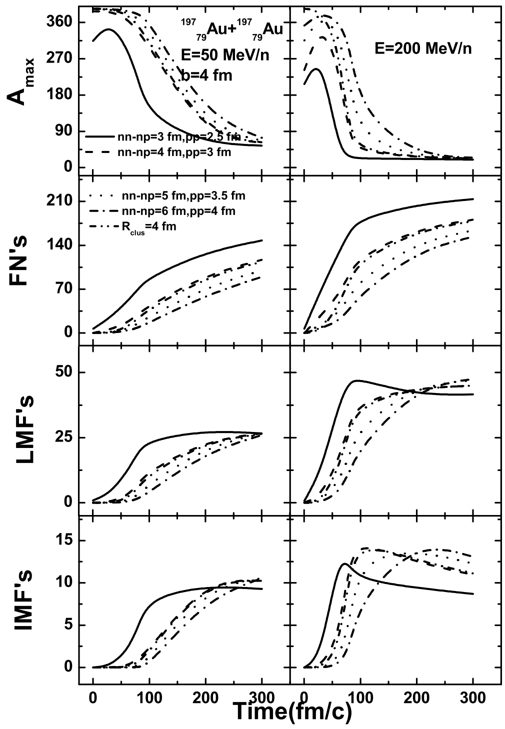

FIG. 1: The time evolution of different fragments for the reaction of $^{197}_{79}Au +^{197}_{79} Au$ at 50 and 200 MeV/nucleon (right panels) at an impact parameter of 4 fm and for the different values of iso-spatial constraints

2. Results and Discussion

We present the analysis for reaction of $^{197}_{79}Au +^{197}_{79} Au$ for different values of R_0 for nn,np, and pp using a soft equation of state along with an isospin-dependent reduced cross-section ($\sigma = 0.9\sigma_{NN}$)[4]. The above reaction is simulated between 50 and 1000 MeV/nucleon, over the full impact parame-

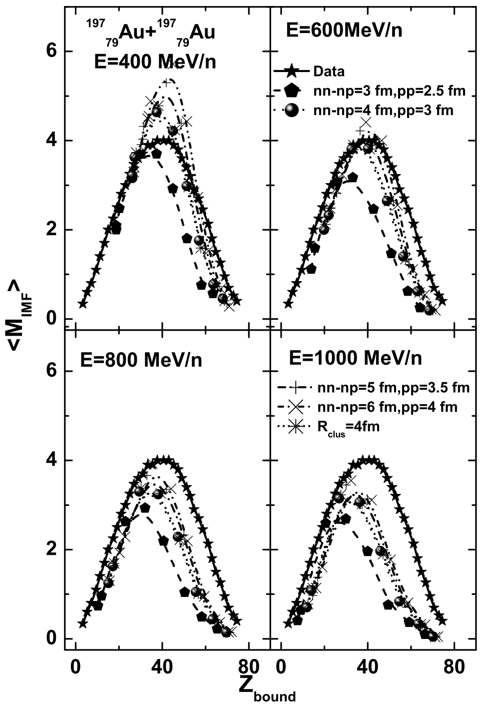

FIG. 2: Mean multiplicity of IMF's as a function of Z_{bound} for $^{197}_{79}Au +^{197}_{79} Au$ system at different incident enrgies.

ter range. The reaction dynamics are followed until 200 fm/c and then clusterization is performed with the iso-MST method. In the Fig. 1, we display the time evolution of different fragments at incident energy of 50 and 200 MeV/n for $^{197}Au +^{197} Au$ system. The different lines in the figure shows the variation with different isospin dependent constraints. Maximum number of heaviest fragments obtained when the distance between two nucleon is large, so it is suppose to be most stable. The excitation energy stored in system during collision decay this single big fragment into FN's, LMF's, and IMF's. When the energy is 200 MeV/n the frequent nucleon-nucleon collision leads to more number of FN's, LMF's, and IMF's. In Fig. 2, we plot the multiplicity of IMF's as a function of Z_{bound} for $^{197}Au +^{197} Au$ system at incident energies of 400, 600, 800, and 1000 MeV/nucleon. When the distance between two nucleon is less, then small energy transfer to spectator part so, very few IMF's are produced.
Also, in central collision colliding nuclei break into free nucleons, light particles that results into very few IMF's. Maximum number of IMF's can only be seen at $Z_{bound} \approx 40$. When the energy is 600 MeV/nucleon and relative distance is R_0^{nn} $=R_0^{np}$ $= 6$ fm and R_0^{pp} $= 4$ fm, theoretical data agree well with the experimental data. Further study in this direction is in progress.

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