Coalescence Model Analysis for Reactions with Entrance Channel Mass about 150

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Studying the process of multifragmentation in excited nuclei has been significant interest in recent years. Some signals for phase transition and critical phenomena have been presented but some controversy remains [1]. In the last two years, a lot of experiments have been done in the TAMU Cyclotron Institute using NIMROD, our 4π detector system, in order to investigate the properties and dynamic evolution of excited nuclei in heavy ion collisions. Projectile masses from proton to ^{64}Zn and incident energies from 15A MeV to 55A MeV have been used. Recently, the coalescence model analysis of light particle emission has been developed in to study the evolution of temperature and nuclear density [2, 3].

The calibrations have been done for most of these reactions. An extensive investigation of the nuclear dynamic evolution and the caloric curves are being carried out for all the measured reactions. The preliminary results of a coalescence analysis of light particle emission are shown for four reactions with entrance channel mass 150, 47A MeV ^{64}Zn + ^{92}Mo, 35A MeV ^{64}Zn + ^{92}Mo, 40A MeV ^{40}Ar + ^{112}Sn and 55A MeV ^{27}Al + ^{125}Sn.

The 10% most central collision events are selected using calorimetric methods. Then moving source fits are applied to extract the Nucleon-Nucleon (NN) source component. Three sources, Projectile-Like Fragment (PLF) source, Target-Like fragment (TLF) source and NN source are assumed in moving source fitting and the Coulomb energy is fixed in order to reduce the free parameters. Fig. 1. shows P_0 extracted by a coalescence model analysis as the

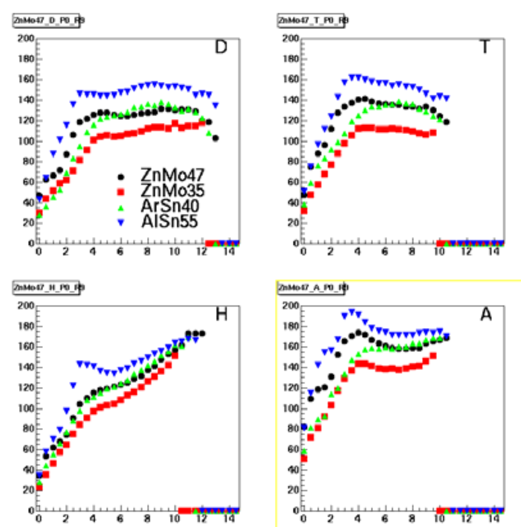

Figure 1: P_0 as function of surface velocity for d, t, ^{3}He and alpha. TLF contribution is removed.

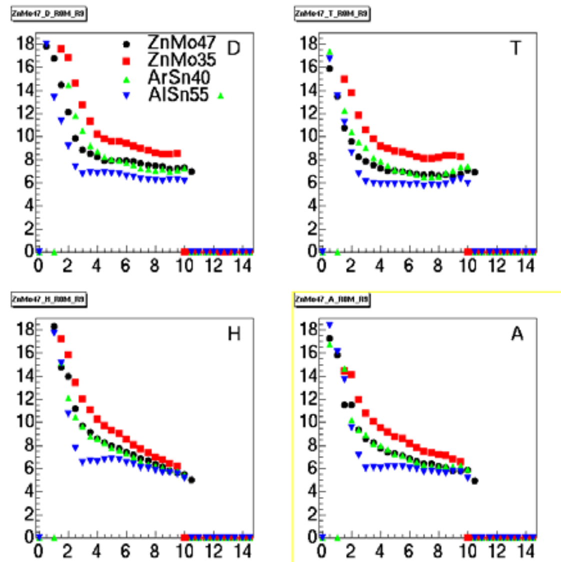

Figure 2: R_0 as function of surface velocity for d, t, ^{3}He and alpha. TLF contribution is removed.

function of surface velocity at the angle of 40.4 degrees. The TLF component contribution has been subtracted. The system sizes derived using Mekjian's thermal model are shown in Fig. 2. Fig. 3 shows the sizes obtained after removing the TLF and PLF source contributions. The behaviors of the coalescence parameter P_0 and

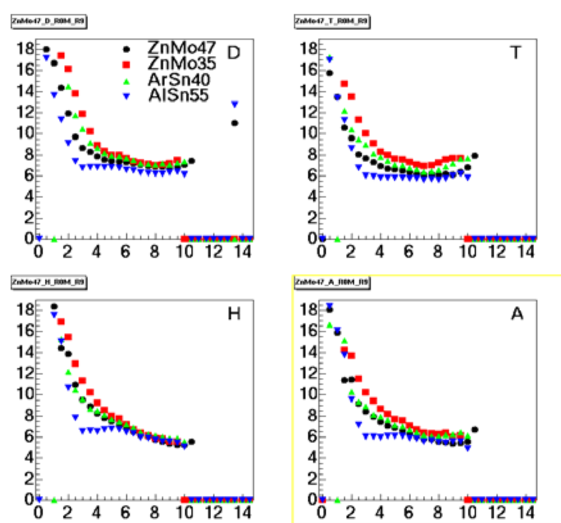

Figure 3: P_0 as function of surface velocity for d,t,^{3}He and alpha. TLF and PLF contributions are removed.

system size R_0 versus surface velocity agree with previous analyses of 47AMeV reactions [2, 3]. Comparing Fig. 2 and Fig. 3, we can see that the apparent dependence of system sizes on the mass of the projectiles disappears when the PLF source contribution is subtracted. This indicates that the sizes of PLF sources are strongly dependent on the mass of projectiles while the NN source sizes are very similar for similar entrance channel mass. Further analyses are underway, such as determining excitation energy and temperature and extracting the density at freeze out.

Most of the light particles and more than 40% of the intermediate mass fragments in the forward angles are measured with NIMROD. Fig. 4 represents the correlation of measured charge multiplicity and total charge for the

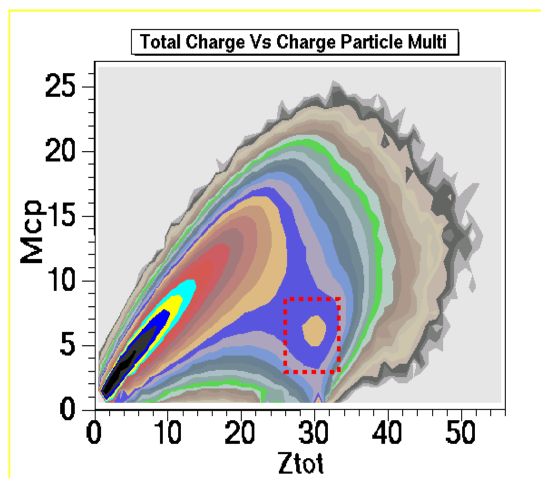

Figure 4: The correlation between measured charge multiplicity and total charge.

reaction of 47A MeV ^{64}Zn + ^{92}Mo. The box shows the events for which the projectile-like fragment and most of light charged particles emitted from thermodynamic initial projectile fragments are completely measured in the experiment [4]. With this selected events, the initial projectile-like fragment can be reconstructed, many properties of de-excitation of this initial excited projectile-like fragment can be explored. For these PLF components, coalescence model analyses will also be performed.

References

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