An Alternative Method of Source Reconstruction and Identification

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Intermediate energy heavy ion collisions are complicated processes where the roles of the mean field and nucleon-nucleon interactions interplay. Many reactions manifest the mixed features of the low energy deep inelastic scattering mechanism and a high energy participant-spectator scenario. In the Fermi energy domain, most reactions reveal a quasi-binary mechanism with mid-rapidity particle emission. Usually, the laboratory frame kinetic energy spectra can be reproduced by three source fits: Projectile- like fragments (PLF), Nucleon-Nucleon (NN) source (mid-rapidity) and Target-like Fragments (TLF) source. To better understand the reaction dynamics, the origins of the emitted particles origins would be ideally attributed on an event-by-event basis. Where source distributions overlap, that is not possible. Thus, many studies such as HBT, caloric curve, collective flow, etc., rely on momentum cuts or windows in other parameter spaces to trace evolution of particular observables. We are investigating an alternative method to assign the light charged particles (LCP) to the different sources with the help of three source fits and Monte-Carlo sampling techniques.

The method is based on three source fits. First, we obtain the laboratory energy spectra for different LCP at different laboratory angles and reproduce them using the three source fits. In this case, we obtain the relative contribution from PLF, NN, and TLF sources. The probability that particles in a spectrum belong to a particular source can be obtained. Second, we run the data analysis program again and use Monte Carlo sampling method to assign the origin of each LCP, i.e., to PLF, or NN, or TLF source using the probabilities determined from the three source fit.

Fig. 1 shows an example of velocity contour plots

for α particles from 47 MeV/nucleon ^{40}Ar + ^{58}Ni reactions. From top to bottom, it represents the

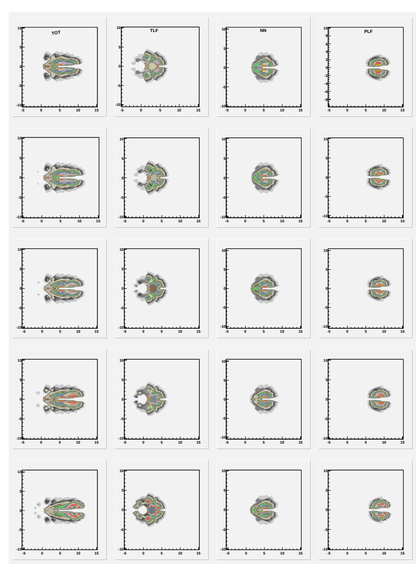

Figure 1: Velocity plots of α particle emission for 47 MeV/nucleon ^{40}Ar + ^{58}Ni. From the top to bottom panel, it

presents results for five impact parameter zones from the most central collisions (B1) to the most peripheral collisions (B5). From left to right, it presents the velocity contour plot (1) before the source identification, (2) for the TLF source, (3) for the Nucleon-nucleon source and (4) for the PLF source after event-by-event assignment of particle emission sources.

particles associated with five impact parameter zones from the most central collisions (B1) to the most peripheral collisions (B5). From the left to right panel, it shows the velocity contour plot (1) before the source identification, (2) for the TLF source, (3) for the Nucleon-nucleon source and (4) for the PLF source after event-by-event assignment of particle emission sources.

The parallel velocity distribution is plotted in Fig. 2. Again, from top to bottom, it corresponds to five impact parameter zones from the most central to the most peripheral. The histograms with the dots are the total distribution. The dashed line, solid line and crosses show the parallel velocity distribution of α's from the TLF, NN and PLF sources using the source separation technique as stated above.

Using this source assignment and separation technique, the event-by-event analysis for HBT, coalescence, collective flow, caloric curves and the dynamical and thermal features of the different sources, can be explored. We are currently carrying out such analyses and comparing results obtained with the more common selection technique.

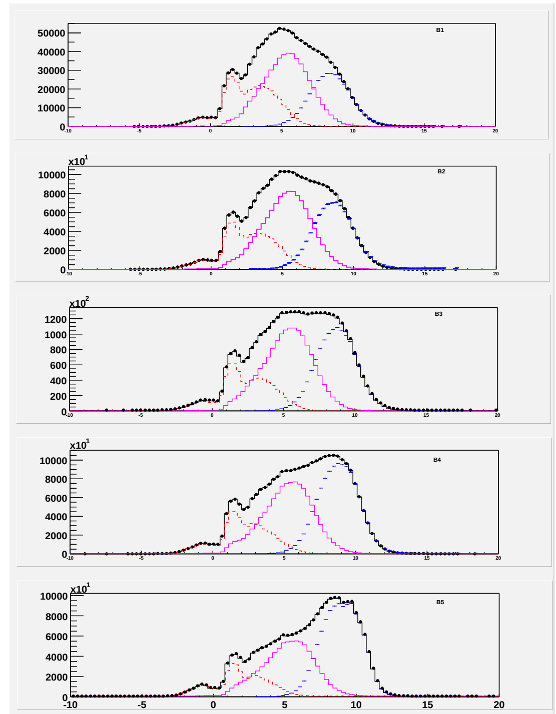

Figure 2: The parallel velocity distributions for different emission components of α particle emission from 47 MeV/nucleon ^{40}Ar + ^{58}Ni for five different impact parameter zones from the most central (top) to the most peripheral (bottom). The histograms with the dots show the total distributions, the dashed line, solid line and crosses show the parallel velocity distribution of TLF, NN and PLF sources, respectively.

References

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