Multifragmentation and Isospin Dependence of Reaction Mechanism at Intermediate Energy

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Studies leading to formation, equilibration and disintegration (multifragmentation) of a hot composite nuclei formed in a heavy ion collision at intermediate energies provide a rich source of information for understanding the nuclear equation of state and compressibility. While statistical multifragmentation models simulate the disintegration process well, once equilibrium has been established, the role of entrance channel dynamics and isospin asymmetry in determining conditions leading to formation and equilibration is still far from being understood. Theoretical calculations based on various microscopic models, such as BUU, VUU and QMD, which simulate the entrance channel dynamics, predict a variety of effects which are sensitive to the isospin dependence of the symmetry potential of the mean field and the in-medium NN cross section [1]. Experimentally, these effects can be elucidated by studying the effect of the neutron to proton ratio of the colliding system on the nuclear collective flow, preequilibrium nucleon emission, nuclear stopping and, separation of nuclear material into a gas phase that is more neutron rich and a liquid phase that is less neutron rich. These studies could aid in understanding better the dynamics of multifragmentation.

In order to investigate some of the above issues, measurements of ^{124}Sn + ^{124}Sn, ^{112}Sn and ^{124}Xe + ^{124}Sn, ^{112}Sn reactions were carried out using the NIMROD 4π charged particle detector array [2]. These systems populate different isospin (N/Z) enabling one to study their influence on the entrance channel collision dynamics and their sensitivity to the multifragmentation process.

We report here some preliminary results on energy spectra for the ^{124}Sn + ^{124}Sn reaction at 28 MeV/A, and its angular evolution. The energy calibration for the spectra were done using the procedures described in an earlier report [3]. Fig.1 shows the calibrated energy spectra for the ^{4}He, ^{9}Be and ^{12}C from different rings in the NIMROD array. The different symbols in the figure corresponds to different detectors in the same ring. All spectra shown in the figure come from the super telescopes in the NIMROD array. As seen in the figure, the laboratory energy spectra for the alpha particles show a gradual change in their slopes with the emission angle. The spectra at the forward most angle indicate two sources of emission, possibly

from a slow moving target-like and a fast projectile like source. The peak on the high-energy side of the spectra is observed to shift towards lower energies with an increase in the emission angle, due to forward kinematic focusing of the reaction products. In general, the spectra evolve with detection angle to become softer. A similar feature is observed for all the intermediate mass fragments (IMF) up to Z = 7 (only ^{9}Be and ^{12}C are shown in the figure). Further analysis to extract the isotopic and the isobaric yield ratios and investigation into various global variables is in progress.

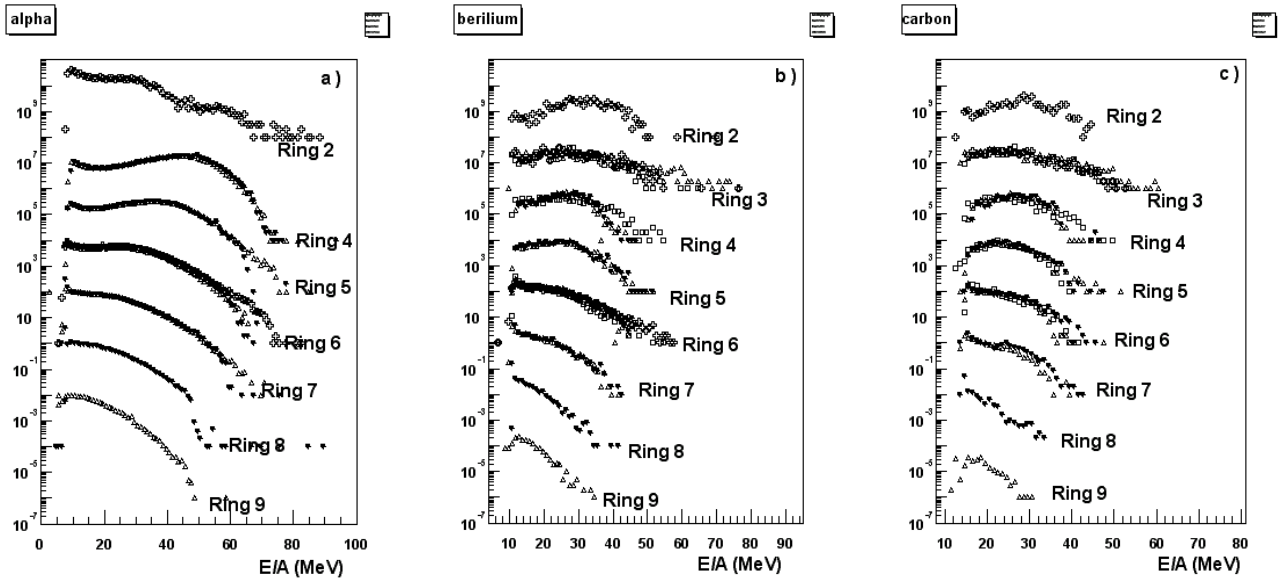

Figure 1: ^{4}He, ^{9}Be and ^{12}C energy spectra for the 28 MeV/A ^{124}Sn + ^{124}Sn reaction. Different symbols correspond to different detectors in the same ring.

References

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