Effect of Nucleon Exchange on Projectile Multifragmentation in the Reactions of $^{28}\text{Si} + ^{112}\text{Sn}$ and $^{124}\text{Sn}$ at 30 and 50 MeV/nucleon


We use the projectile multifragmentation events reconstructed using isotopically identified fragments for the study of the nucleon exchange between the projectile and target. The experiment was done with a beam of $^{28}\text{Si}$ impinging on $\sim 1 \text{ mg/cm}^2$ self supporting $^{112,124}\text{Sn}$ targets. The beam was delivered at 30 and 50 MeV/nucleon by the K500 superconducting cyclotron. The detector array FAUST [1] was composed of an arrangement of 68 silicon - CsI(Tl) telescopes covering polar angles from 2.3° to 33.6° in the laboratory system. The total charge of quasiprojectiles used in analysis is restricted to the values near to the charge of the projectile $Z_{\text{tot}} = 12 - 15$. For the events with $Z_{\text{tot}} = 14$ we define the principal neutron exchange observable as the mass change by subtracting the sum of the neutrons bound in the detected fragments from the neutron number of the beam

$$\Delta A = N_{\text{proj}} - \sum_{f} N_{f}$$  \hspace{1cm} (1)

where $N_{\text{proj}} = 14$ for $^{28}\text{Si}$ beam. The apparent charged particle excitation of the quasiprojectile is reconstructed for every projectile fragmentation event using the formula

$$E_{\text{app}} = \sum_{f} (T_{f}^{QP} + \Delta m_{f}) - \Delta m_{QP}$$  \hspace{1cm} (2)

where $T_{f}^{QP}$ is the kinetic energy of the fragment in the reference frame of the quasiprojectile and $\Delta m_{f}$ and $\Delta m_{QP}$ are the mass excesses of the fragment and quasiprojectile.

We carried out a comparison of the experimental observables to the results of the simulations. For a description of the production of excited quasiprojectiles we used the Monte Carlo code of Tassan-Got et al. [2]. This code implements a version of the model of deep inelastic transfer suitable for simulations using a Monte Carlo technique. We simulated the deexcitation of highly excited quasiprojectile using the statistical model of multifragmentation (SMM) [3]. The target deexcitation was not taken into account as a contributing source of the charged particles at the forward angles. The simulated events were filtered by the FAUST software replica.

The results of the simulation are shown in Figs. 1, 2. Simulated distributions of the mass change for fully isotopically resolved events with $Z_{\text{tot}} = 14$ (lines) are plotted in Fig. 1 (circles represent experimental data). In Fig. 2 are shown simulated distributions of the apparent quasiprojectile excitation energy for both $Z_{\text{tot}} = 14$ and $Z_{\text{tot}} = 12 - 15$ (histograms labeled as A and B) along with experimental data (circles.
emitted neutrons imply that the N/Z ratio of the reconstructed quasiprojectiles gives realistic estimate of true isospin of the fragmenting system.

References

