

Production of light nuclei in collisions of $^{124,136}\text{Xe}$ with CsI target

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The difference between the numbers of neutrons and protons in atomic nuclei defines the isospin asymmetry of nuclei. The squared relative difference between the local densities of neutrons and protons contributes to the density-dependent symmetry energy term in the equation of state of nuclear matter. In particular, this contribution makes the nuclei with a large neutron excess unstable and defines the parameters of neutron stars [1]. Comparative studies of nuclear reactions induced by projectiles with similar mass numbers but differing neutron and proton numbers on the same target allow for systematic investigations of isospin asymmetry effects [2]. As found in Ref. [2], the cross sections for the production of heavy isotopes are particularly sensitive to the isospin content of projectile nuclei.

In this work, the Abrasion-Ablation Monte Carlo for Colliders model with pre-equilibrium clustering based on the Minimum Spanning Tree algorithm (AAMCC-MST) [3,4] was used to study the production of light spectator fragments. In AAMCC-MST, the Glauber Monte Carlo model [5] is used to calculate the numbers of participant and spectator nucleons. The latter are assumed to form spectator prefragments. In particular, in peripheral collisions such prefragments consist of multiple excited nuclear clusters defined by the MST clustering algorithm [3]. Depending on their excitation energy, the clusters undergo various secondary decays simulated with de-excitation models from the Geant4 library [6].

Fragmentation of relativistic nuclei can be investigated using forward detectors in the Baryonic Matter at Nuclotron (BM@N) experiment [7] at the NICA accelerator complex. Specifically, light spectator fragments with charges $Z = 1-5$ from the fragmentation of $3.8\text{A GeV } ^{124}\text{Xe}$ on a CsI target can be measured by the scintillation wall [8]. The potential use of a ^{136}Xe beam is currently under discussion. Here, we present a comparative study of light spectator fragment emission in collisions of ^{124}Xe and ^{136}Xe with ^{130}Xe representing the CsI target. Production cross sections for fragments with $Z = 1-5$ were calculated as a function of collision centrality. In addition, the relative yields of spectator protons, ^2H , ^3H , and ^3He in the 10 % of most central collisions were calculated to probe the isospin content of the fragmenting systems.

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