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Systematic investigation on momentum distributions of projectile-like fragments at $E/A = 290$ MeV/u

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Abstract

The systematic investigation on the longitudinal and transverse momentum (P_L and P_T) distributions of projectile-like fragments (PLFs) produced at the intermediate energy is performed experimentally. The momentum distributions of PLFs in a broad range of mass and charge produced from Ar- and Kr-beams with various targets (C, Al, Nb, Tb, Au) at $E = 290$ MeV/u were observed and analyzed. This type of measurements has been usually performed at lower (≤ 100 MeV/u) or higher (≥ 500 MeV/u) energies. The analysis of P_L distributions by the asymmetric Gaussian functions provides the shift and the width of the distributions with a good precision. The broader width obtained at the lower momentum side indicates the contribution of multistep processes at this energy region. The width and the shift are independent on the target. Compiling with previous results, the incident energy dependence will be discussed. The analysis of P_T distributions by the off-center Gaussian functions provides not only the width but also the contribution of the deflection effect. In principle, the width is independent on the target. In contrast, the deflection effect depends on the target, and is remarkable for heavier fragments produced with heavier targets. In case of one-nucleon removed fragments, the main part of deflection effect can be reproduced by the coulomb repulsion. The deflection effect is analyzed and represented by the empirical formulation. The systematics of momentum distributions, shown in the present studies, is important to evaluate production cross sections of PLFs. Especially, P_T distribution is crucial to deduce production cross sections from production rates of PLFs, which are observed at the forward angle within the limited angular acceptance. The present results will also contribute to the simulation of the transport phenomena of heavy ions through matter.