

Projectile Fragmentation Between ^{40}Ar And ^9Be : Isotopic And Energetic Distribution-Comparison Between GEANT4 and EPAX at FRIB

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Abstract. The Facility for Rare Isotope Beams (FRIB) uses mainly the Empirical Parametrized cross-section (EPAX) formula and GEANT4 Monte Carlo tool to model experimental setups or to predict the production of rare isotopes via fragmentation process. GEANT4 is a prime tool in the simulation of the interaction between particle and matter and EPAX, is a powerful formula to calculate the fragmenting projectile cross section down to a few milli or nano-barn. However, there is so far no comprehensive and systematic validation of these two methods against each other.

In this communication, we will first present the GEANT4 hadronic models, which are able to describe the fragmentation reaction and to highlight the difference between them. We will also dedicate a section to the energetic distribution to assess the impact of energy on the total cross section values. The latter is constant with the energy variation when using EPAX formula. Secondly, we will present a comparative study of the total cross section distributions of the fragment nuclei between GEANT4 models and EPAX formula.

To perform this study, a 140 MeV/u beam of ^{40}Ar was used to impinge on a ^9Be target. Six GEANT4 physics models (e.g., Shielding, QGSP_BERT, QGSP_BIC, FTFP_BERT, QGSP_INCL⁺⁺ and QBBC) have been identified as adequate to describe these reactions. Their predictions are compared to those from EPAX.

The identification of the discrepancies (or strength and weakness) between GEANT4 and EPAX for rare isotopes will lead to the development of a systematic validation suite to benchmark each code for their future release versions.

Keywords: rare isotopes-total cross section-projectile fragmentation reaction-GEANT4-EPAX