



Contribution ID : 154

Type : Oral talk

Simulation-Based Feasibility Study of Isospin Effects with the HGND at BM@N

Wednesday, 28 October 2026 16:35 (15)

The Baryonic Matter at Nuclotron (BM@N) is a fixed-target experiment (JINR, Dubna) aimed at studying heavy ion collisions at beam energies up to 4 A GeV. To extend its capabilities, the Highly Granular Neutron Detector (HGND) [1] has been developed. This detector will enable unique measurements of neutrons in the kinetic energy range of 0.3–4.0 GeV. These measurements will make it possible to explore the isospin term of the equation of state (EOS) of baryonic matter. The HGND comprises two arms, each consisting of 8 layers of plastic scintillator with copper absorber plates in between. Each scintillation layer is assembled from an 11×11 matrix of individual cells, providing high spatial granularity and a time resolution of ~ 150 ps.

As an observable sensitive to the isospin-dependent term of the EOS, the ratio of neutron and proton spectra was proposed [2]. To determine the experimental sensitivity, Monte Carlo simulations of Xe+Cs collisions were performed. The simulations were done using the SMASH [3] model at a beam kinetic energy of 2.5 A GeV. A set of isospin symmetry potentials was used to study the difference in the spectra. The proton spectrum reconstruction procedure is already developed [4]. In this work, the neutron spectrum reconstruction procedure from HGND data is discussed. Special attention is paid to the neutron spectrum reconstruction using a plastic absorber for background removal.

References: 1. S. Morozov et al., Nucl. Instrum. Meth. A 1072, 170152 (2025) 2. Bao-An Li, C. M. Ko, Zhong-zhou Ren, Phys. Rev. Lett. 78 (1997), 1644 3. <https://github.com/smash-transport/smash> 4. BM@N Collaboration • S. Afanasiev (Dubna, JINR) et al., JHEP 08 (2025), 095

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Session Classification : High energy physics: experiment

Track Classification : High energy physics: experiment