Nuclear Stopping at SIS Energies by using Isospin Asymmetric Nuclear Collisions

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The FOPI collaboration at the heavy-ion synchrotron SIS at GSI/Darmstadt is devoted to study hot and dense nuclear matter at beam energy below 2 GeV per nucleon. The FOPI detector covers a large portion of phase-space for charged hadrons.

The degree of nuclear stopping in heavy-ion collisions is one of the essential parameters which are necessary to understand the basic reaction dynamics. In many cases, nuclear stopping has been studied by baryon rapidity distributions at various beam energies [1,2]. Experimental data shows that baryon rapidity distributions are wider than the isotropic source for beam energy larger than 1 GeV per nucleon. The origin of this observation has become one of the most disputable topics, as very similar rapidity distributions can be produced by transparency, rebound, or longitudinal expansion after equilibrium. In order to shed more light on this subject, we have designed and performed a new precision experiment utilizing the N/Z (proton-to-neutron ratio) method, which will give us a direct experimental evidence for nuclear stopping phenomenon, at $400A$ MeV and $1.5A$ GeV [3,4].

In this presentation, we will first present the centrality dependence of proton and deuteron rapidity distributions in ^{96}Ru + ^{96}Ru collisions. Data are compared with the IQMD calculations for various assumptions on the NN collision cross-section in medium. Then we will show the results for the ratio of baryon rapidity distributions in isospin asymmetric collision systems (^{96}Ru + ^{96}Zr and ^{96}Zr + ^{96}Ru), which will clearly demonstrate incomplete mixing and partial transparency of the projectile and target nuclei at SIS energies.

References

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