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EPJA Featured Poster: How much angular momentum is stopped at midrapidity in collisions from O(1) to O(1000) GeV energies?

The spin polarization of hadrons emitted from heavy-ion collisions can serve as a probe of the angular momentum contained within the colliding system. Recent measurements of hyperon global spin polarization at midrapidity from ALICE, STAR, and HADES, spanning a collisional beam energy range from O(1000) to O(1) GeV, have shown a monotonic trend of continually increasing signal with decreasing energy even in the region extremely close to the two-nucleon-mass threshold. This appears surprising, as the angular momentum stopped at midrapidity depends on two competing factors: with decreasing beam energy, the total angular momentum drops quickly while a bigger fraction of the total angular momentum gets stopped in midrapidity. As such, a non-monotonic dependence on beam energy is expected for midrapidity angular momentum, which should first increase with decreasing beam energy and then decrease, approaching zero when beam energy comes down to the threshold.

In this work, we present a quantitative model (dubbed "Glauber+") of initial nucleon stopping based on general requirements of energy-momentum conservation in binary collisions. We further use measurements of midrapidity net proton numbers to constrain the key model parameter that characterizes the inelasticity of binary collisions. This allows us to predict the initial angular momentum at midrapidity across a wide range of beam energies, which indeed shows a non-monotonic behavior with a peak around 5 GeV. The discord in the beam energy dependence between initial angular momentum and the observed global spin polarization casts intriguing questions on conventional interpretations assuming a strong positive correlation between them, especially in the very low energy region. The corresponding rapidity distributions of initial angular momentum are also obtained across beam energies, which could provide valuable initial conditions for spin hydrodynamics simulations.

Category

Theory

Collaboration (if applicable)

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