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Measurement of system size dependence of directed flow of protons (anti-protons) at RHIC

The directed flow (v_1) is a sensitive probe of the initial state conditions in heavy-ion collisions. One key initial condition is the presence of a strong electromagnetic field, which induces charge splitting between particles and antiparticles and has important implications for the QCD phase transition and the properties of the Quark-Gluon Plasma (QGP) [1]. Another crucial aspect of the initial state is the deposition of baryon charge, which can be specifically probed through the directed flow of baryons, offering insights into baryon transport within the QGP [2].

In this poster, we shall present measurements of directed flow (v_1) for π^\pm , K^\pm , and $p(\bar{p})$ in Au+Au, isobar (Ru+Ru, Zr+Zr) collisions at $\sqrt{s_{NN}} = 200$ GeV, and U+U collisions at $\sqrt{s_{NN}} = 193$ GeV, as recorded by the STAR experiment at RHIC. For the first time, we observe a clear system size dependence in the slope, dv_1/dy , for $p(\bar{p})$ and the difference in slope between particle and antiparticle, $\Delta(dv_1/dy)$, while the sum of the slopes for baryons ($p + \bar{p}$) shows no such dependence. In contrast, neither the difference nor the sum of the v_1 slopes for mesons (π^\pm and K^\pm) shows system size dependence [3]. This behavior is qualitatively reproduced by a hydrodynamic model, providing insights into baryon deposition and transport. Additionally, the observed $\Delta(dv_1/dy)$ pattern across different systems may also help constrain the strength of electromagnetic fields and the conductivity of the medium.

[1] STAR Collaboration, Phys. Rev. X 14, 011028

[2] T. Parida and S. Chatterjee, arXiv: 2305.08806

[3] STAR Collaboration, Phys. Rev. Lett. 101, 252301

Category

Experiment

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STAR Collaboration

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