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Measurement of charge-dependent directed flow in STAR Beam Energy Scan (BES-II) Au+Au and U+U Collisions

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An ultra-strong magnetic field (B ≈ 10^{18} Gauss) is anticipated during the early stages of heavy ion collisions. Such a strong magnetic field holds significant importance in QCD, including understanding topology of QCD vacuum, QCD phase transition, and nucleon structure. The directed flow or the first harmonic flow coefficient (v_1), serves as a powerful tool not only for detecting the magnetic field but also for understanding its effects in the Quark-Gluon Plasma (QGP) medium (such as electrical conductivity). Additionally, v_1 can capture information from the initial geometry of the system and also offer means to understand baryon transport. Recently, the STAR collaboration reported a substantial splitting of directed flow between positively and negatively charged identified particles in peripheral Au+Au and isobar (Ru+Ru and Zr+Zr) collisions. These results are consistent with the dominance of Faraday induction and Coulomb effect from the initial strong magnetic field [1].

In this presentation, we shall discuss the rapidity dependence of v_1 and dv_1/dy for $\pi^{\pm}$, $K^{\pm}$ and p ($\bar{p}$) in Au+Au collisions at 7.7, 11.5, 14.6, and 19.6 GeV from Beam Energy Scan Phase-II, as well as in U+U collisions at 193 GeV measured by the STAR experiment. The v_1 values will be reported as a function of transverse momentum, rapidity, and centrality. Additionally, the dv_1/dy and the charge dependent difference, $\Delta dv_1/dy$, of identified particles in U+U collisions will be compared to those in Au+Au and isobar (Ru+Ru and Zr+Zr) collisions. These findings will offer further insights into the initial electromagnetic field as well as baryon transport at various system sizes and beam energies.

[1]. STAR Collaboration, arXiv: 2304.03430

Auteurs principaux: M. TASEER, Muhammad Farhan (Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, China); FARHAN TASEER, Muhammad; RADHAKRISHNAN, Sooraj (Kent State University/Lawrence Berkeley National Laboratory)

Orateurs: M. TASEER, Muhammad Farhan (Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, China); FARHAN TASEER, Muhammad

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