Study of electromagnetic effect by charge-dependent directed flow in isobar collisions at $\sqrt{s_{NN}} = 200$ GeV using STAR at RHIC

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In non-central heavy-ion collisions, it is predicted that an initial strong but transient magnetic field ($\sim 10^{18}$ Gauss) can be generated. The charge-dependent directed flow (v_1) can serve as the probe to detect this initial magnetic field [1, 2]. In addition, v_1 of several identified hadron species with different constituent quarks will help to disentangle the role of produced and transported quarks.

In this talk, we will present the measurements of v_1 for $\pi^{\pm}$, $K^{\pm}$, p($\bar{\text{p}}$) in Ru+Ru and Zr+Zr collisions at $\sqrt{s_{NN}} = 200$ GeV as a function of transverse momentum, rapidity, and centrality. The difference of v_1 slope ($\Delta \mathrm{d}v_1/\mathrm{dy}$) between proton and anti-proton as a function of rapidity is observed and it changes sign from positive to negative when going from central to peripheral collisions. While the contribution from transported quarks can give positive $\Delta \mathrm{d}v_1/\mathrm{dy}$, the electromagnetic field is predicted to give negative $\Delta \mathrm{d}v_1/\mathrm{dy}$. The significant negative $\Delta \mathrm{d}v_1/\mathrm{dy}$ of proton in peripheral collisions is consistent with the prediction from the initial strong electromagnetic field in heavy-ion collisions. The results from isobar collisions will be compared to those in Au+Au collisions and transport model calculations.

References

[1] U. Gürsoy, D. Kharzeev, E. Marcus, K. Rajagopal and C. Shen, "Charge-dependent Flow Induced by Magnetic and Electric Fields in Heavy Ion Collisions," Phys. Rev. C **98** (2018), 055201

[2] U. Gursoy, D. Kharzeev and K. Rajagopal, "Magnetohydrodynamics, charged currents and directed flow in heavy ion collisions," Phys. Rev. C **89** (2014), 054905