Hyperon Polarization in isobar Collisions and Correlation of Global Polarization with Directed Flow from STAR

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Abstract

The observation of hyperons polarization has revealed the existence of large vorticities in the medium created by heavy-ion collisions. Global polarization indicates vorticities perpendicular to the reaction plane due to the system's orbital angular momentum. Previous measurements have shown a similar trend in the energy dependence between the global polarization and the slope of directed flow, suggesting a strong correlation between the initial tilt of the system and the vorticity[1]. For the first time, this correlation is investigated, and the dependence of the Λ global polarization as well as directed flow on the first-order flow vector (q_1) is presented in Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6 GeV.

Global polarization

➤ In non-central collisions :

- The created matter should exhibit rotation motion [2].
- Particles and anti-particle spins are aligned with angular momentum.
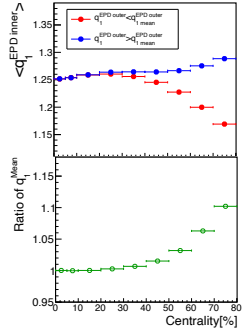
$\vec{B}$ ⊗ $\vec{L}$ ⊗
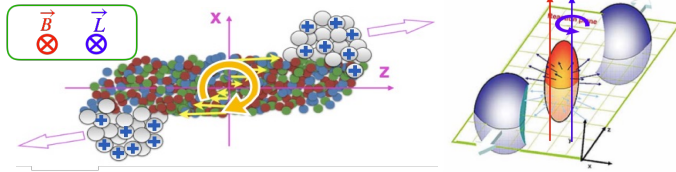
First order flow vector q_1

- q_1 is calculated by EPD most inner 5 rings and outer 5 rings.

$$q_1 = \sqrt{Q_{x,1}^2 + Q_{y,1}^2}$$

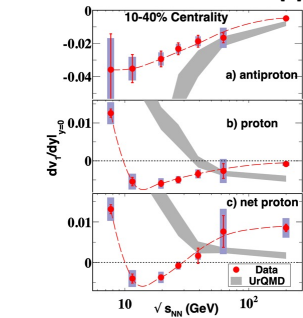$$Q_{x,1} = \sum_i w_i \cos(\phi_i) \Big/ \sqrt{\sum_i w_i}$$

$$Q_{x,1} = \sum_i w_i \sin(\phi_i) \Big/ \sqrt{\sum_i w_i}$$

w_i = nMip

- $\langle q_1^{EPD\ inner} \rangle$ is calculated each $q_1^{EPD\ outer}$ regions.
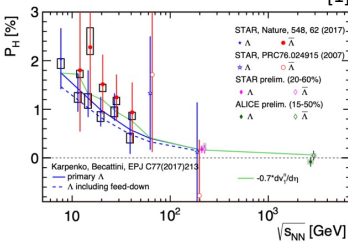

Motivation

[3]

- Similar trend between the global polarization and the slope of the directed flow[1].
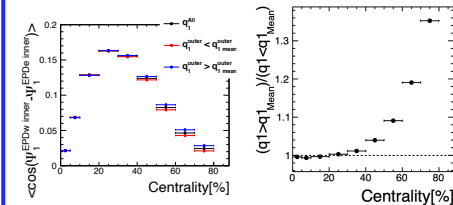
- Suggesting a strong correlation between the initial tilt of the system and the vorticity.

- Plan to examine polarization selecting on directed flow vector q_1.

[1]

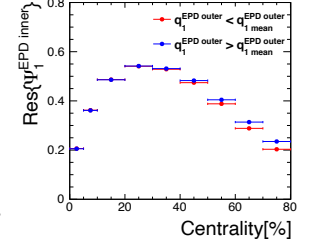## Event plane correlation and resolution

➤ **Event Plane correlation**

- The ratio of the event plane correlation (blue/red) is larger than 1 in 20 to 80%.
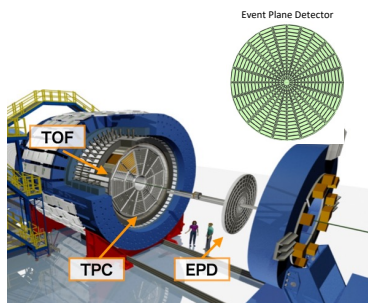
➤ **Event Plane resolution**

- 2subevent method

$$Res_A = Res_B = \sqrt{\langle \cos(\Psi_A - \Psi_B) \rangle}$$

- q_1 dependence of event plane resolution is observed.

The STAR detector

- TPC is the main tracking detector.
- EPD has 16 rings and covers wide rapidity region ($2.1 < \eta < 5.1$).
- 1st order event plane is reconstructed by EPD.

Summary & outlook

➤ q_1 and event plane is measured using EPD in Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6 GeV.

- q_1 dependence of event plane resolution is observed.

➤ q_1 dependence of directed flow and global polarization will be measured.

Reference

[1] S.A. Voloshin, EPJ Web Conf.171 (2018) 07002.

[2] Z-T.Liang and X.N.Wang,Phys.Rev.L94,102301(2005).

[3] L.Adamczyk (STAR), Phys.Rev.L122,262301 (2014).