Beam-Energy Dependence of Baryon Directed Flow in Au + Au Collisions at RHIC-STAR

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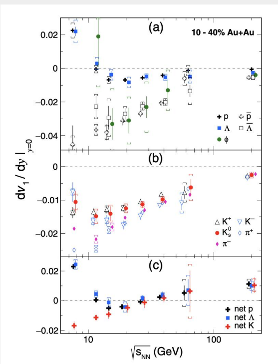
Abstract

Anisotropic collective flow provides valuable information about the evolution of nuclear matter in the early stages of collisions and is one of the commonly used observables in high-energy heavy ion collisions. The final-state momentum-space angular distribution of the first harmonic coefficient in the Fourier expansion, relative to the reaction plane, is referred to as directed flow v_1. The results of BES-I show that the directed flow of baryons exhibits a extremum at around 20 GeV, which may serve as a signal of a phase transition. The results from BES-II, with improved statistics, can improve the precision of these measurements. In this poster, we will present the energy dependence of p and Λ v_1 in Au + Au collisions at $\sqrt{s_{NN}}$ =7.7, 9.2, 11.5, 14.5, 17.3, and 19.6 GeV.

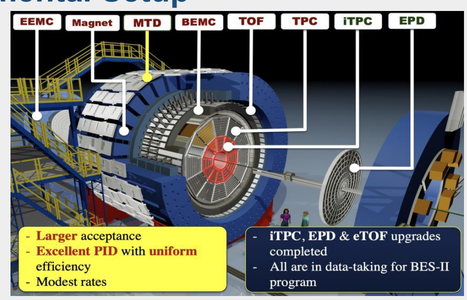
Motivation



- v_1 slope of net-proton and net-Λ show a minimum value when collision energy is around 10-20 GeV.
- The slope of proton and Λ shows a sign change between 11.5 and 14.5 GeV.

Ref : L. Adamczyk et al.(STAR Collaboration), Phys. Rev. Lett. 120, 062301 (2018)

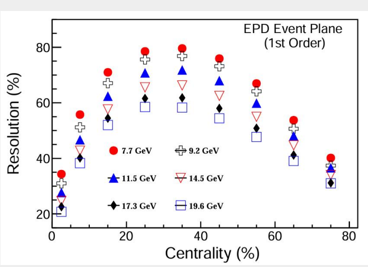
Experimental Setup



- The TPC and TOF are used for particle identification; EPD is used for event plane reconstruction.

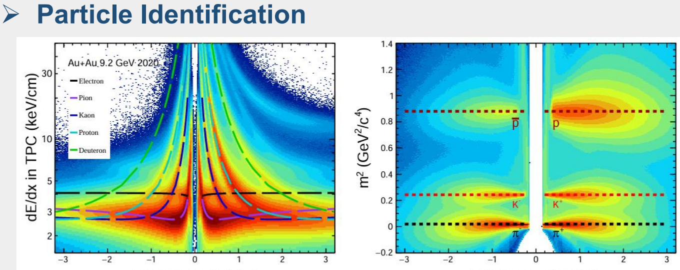
Event plane and PID

Event Plane Resolution

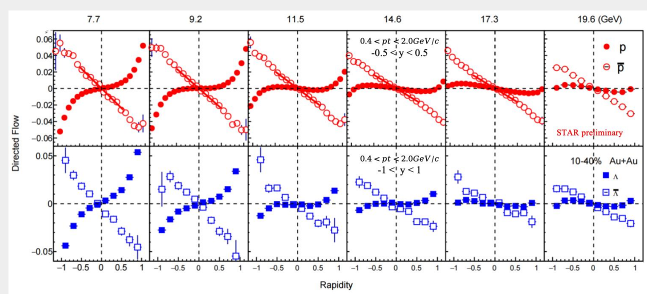


- At the same centrality, the resolution of the first-order event plane decreases as the energy increases.
- The combination of TPC and TOF provide excellent particle identification capability.

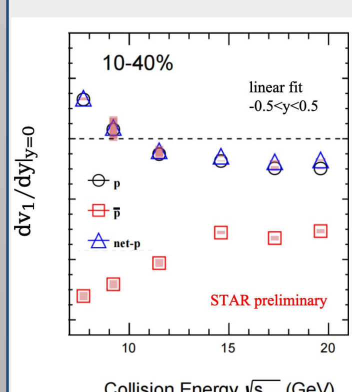
Particle Identification

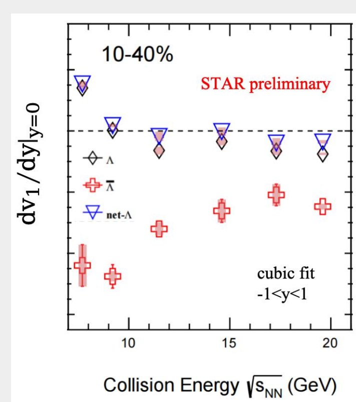


Results



- The directed flow decreases as the energy increases.





- The v_1 slope of both the proton and the Λ varies non-monotonically with energy.

Conclusions

- Proton and net-proton v_1 slopes show sign inversion between 7.7-9.2 GeV and a minimum near 15 GeV at 10-40% centrality.
- Λ and net-Λ exhibit similar v_1 slope trends to protons, with sign change occurring between 9.2-11.5 GeV.

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