Triangular Flow of Identified Particles in Au +Au Collisions at $\sqrt{s_{NN}}$ = 200 GeV from the STAR Experiment

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Abstract

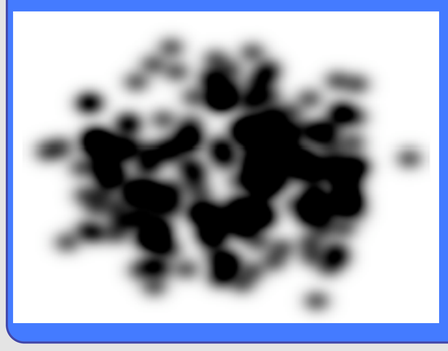
The study of azimuthal anisotropy, characterized by Fourier coefficients, is widely recognized as an important tool to probe the hot, dense matter created in heavy ion collisions. The third harmonic flow (v_3), also called triangular flow, can shed light on the initial geometry and its fluctuations, and on the hydrodynamic expansion of the medium. We report v_3 of identified charged particles proton, pion and kaon v_3 as a function of transverse momentum at $\sqrt{s_{NN}}$ =200 GeV Au + Au collisions measured by the STAR collaboration. Results are compared with available model predictions.

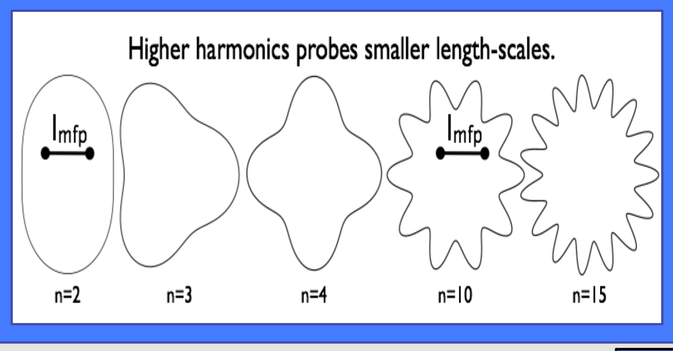
Introduction

Higher Harmonics :

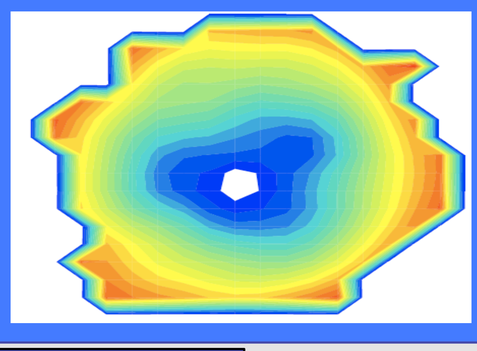
$$N_{pairs} \propto 1+2v_1^2\cos\Delta\varphi+2v_2^2\cos2\Delta\varphi+2v_3^2\cos3\Delta\varphi+2v_4^2\cos4\Delta\varphi+\ldots$$

Kowalski, Lappi and Venugopalan, Phys. Rev. Lett. 100:022303





K. Werner, Iu. Karpenko, K. Mikhailov, T. Pierog, arXiv:11043269

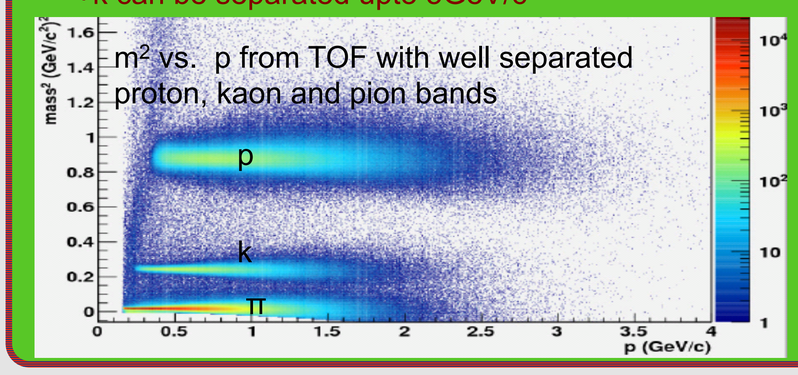


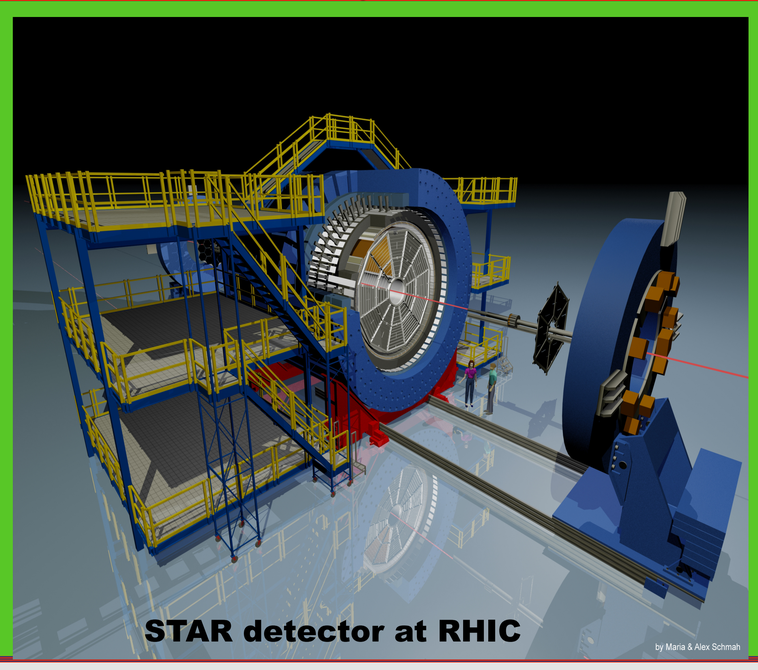
Motivation :

- Fluctuations imply odd terms aren't necessarily zero
- Some models predict that third harmonic component at central collisions are similar in magnitude to elliptic flow
- Higher harmonic term may be more sensative to viscosity and they may help to constrain initial geometry fluctuations in the models.

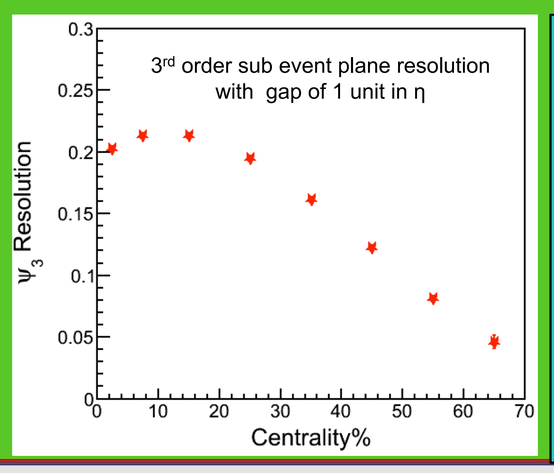
Experiment

- Time Projection Chamber(TPC) is main tracking detector at STAR. In this analysis we use TPC tracks for event plane reconstruction along with particle identification
- Time of Flight(TOF) detector provides excellent particle identification p_T < 1.6 GeV/c for pions and kaons and p_T<2.8 GeV/c for protons. Protons and π +k can be separated upto 5GeV/c





- For triangular flow analysis we used event plane method .We used eta sub event reconstructed from the charged particles from 0.5< η<1.0 (-0.5>η>-1.0) to correlate the particles from η<0 (η> 0). Gap of at least 0.5 units in η mostly suppresses the short range near side correlations

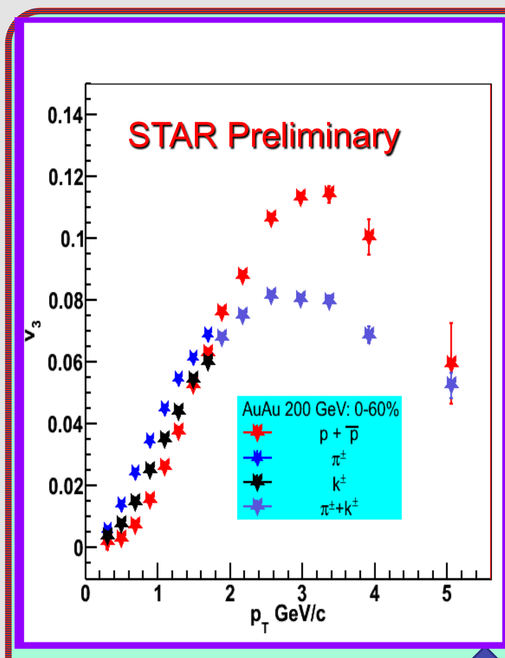


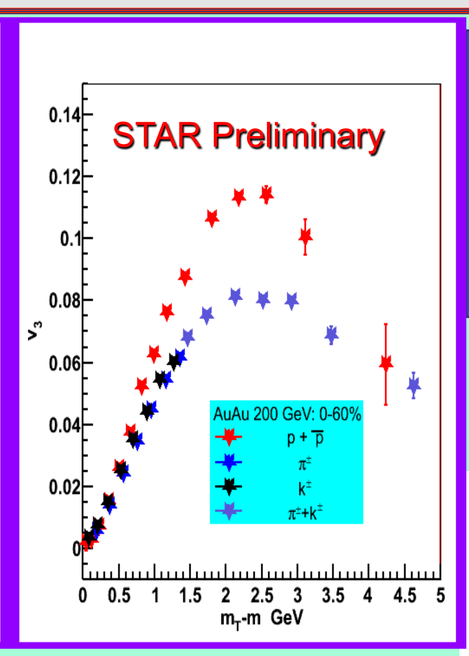
System: Au +Au Collisions
Energy: $\sqrt{s_{NN}}$ = 200 GeV
Event Selections
- $|v_z|$ < 30 cm, $|v_r|$<2 cm

Track Selections
- p_T > 0.20 GeV/c
- |η| < 1.0
- fit points > 15
- fit pts / max. pts > 0.52
- dca < 3.0 cm

PID cuts:
- Proton: 0.8 <m^2 <1.0 $(GeV)^2$
- Pion: -0.1<m^2<0.10$(GeV)^2$
- Kaon: o.2<m^2<0.35$(GeV)^2$

Results





Model comparison

Fig 2. Proton and pion v_3 as a function of pt for 0-5% central collisions compared with hydro model prediction with η/s=0.16. Model result is in reasonable agreement with data.

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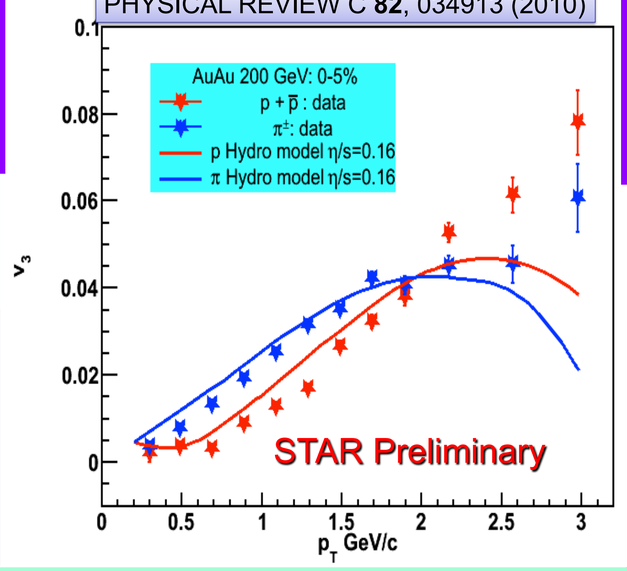

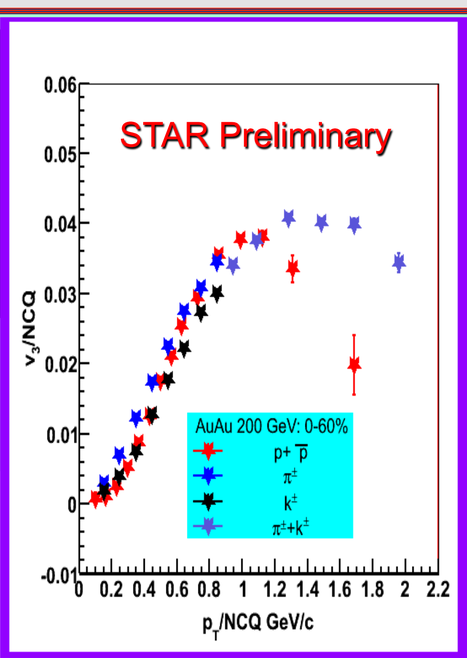

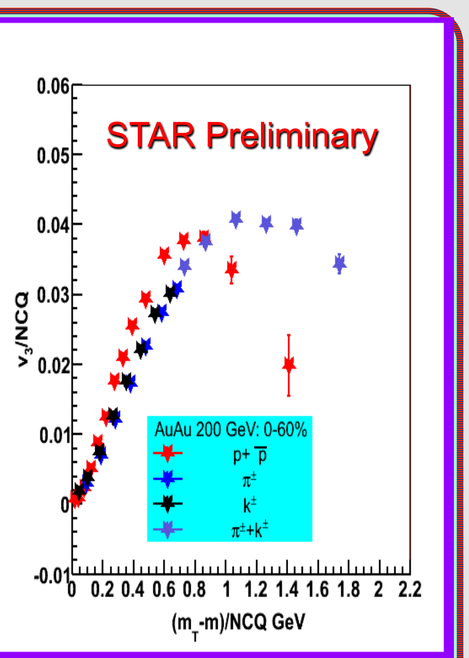

π, k, p v_3 as a function of p_T

Fig 1: π, k p v_3 as a function of p_T on left panel and function of Kinetic Energy (m_T-m) of right panel. At p_T<2GeV we observe mass scaling and at p_T>2GeV baryon v_3 is larger than that of meson

Test of NCQ Scaling

Fig 3: π, k p v_3/ncq as a function of p_T/ncq on left penal and (m_T-m)/ncq on right panel. Deviations from NCQ scaling is observed for v_3.However higher p_T analysis is necessary to make final conclusions

Summary and outlook

- Triangular flow v_3 as a function of transverse momentum for proton, pion and kaon (π and k combined at higher p_T) is presented at Au +Au Collisions at 200GeV
- Hydro model results with initial fluctuations is in reasonable agreement with data.
- For proton, pion and kaon , at low p_T we observe hydro type mass scaling, at high p_T we observe deviations from NCQ scaling .
- Plan to extend analysis to higher p_T for π and p and analysis for strange hadrons K0s and Lambda to make a final conclusion on NCQ scaling.

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