Energy dependence of longitudinal flow decorrelation from STAR

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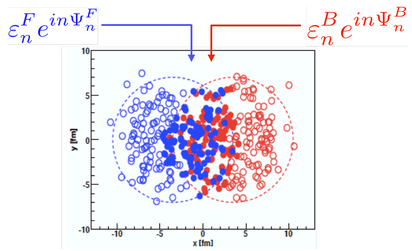
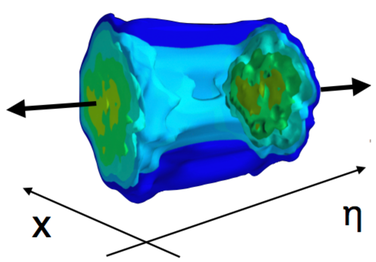
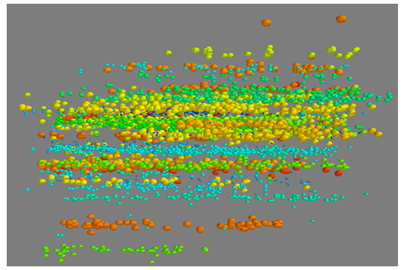
Motivation





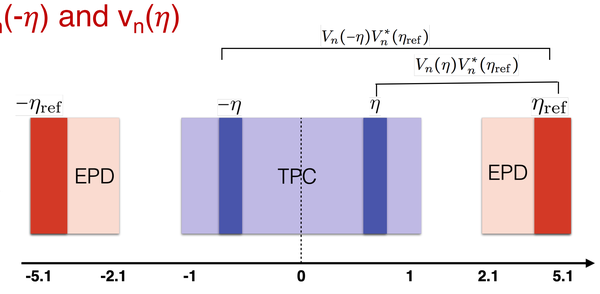


- Longitudinal dynamics can provide the full space-time evolution of the fireball.
- Longitudinal flow decorrelation is mostly sensitive to the initial fluctuation.
- Energy dependence needs to be measured at lower energies.

Flow decorrelation observables

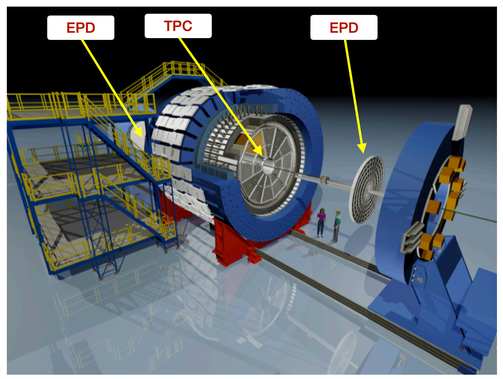
r_n measures relative fluctuation between $v_n(-\eta)$ and $v_n(\eta)$

$$r_n(\eta) = \frac{\langle V_n(-\eta)V_n^*(\eta_{\rm ref})\rangle}{\langle V_n(\ \eta)V_n^*(\eta_{\rm ref})\rangle} = \frac{\langle v_n(-\eta)v_n(\eta_{\rm ref})\cos n(\Psi_n(-\eta)-\Psi_n(\eta_{\rm ref}))\rangle}{\langle v_n(\ \eta)v_n(\eta_{\rm ref})\cos n(\Psi_n(\ \eta)-\Psi_n(\eta_{\rm ref}))\rangle}$$

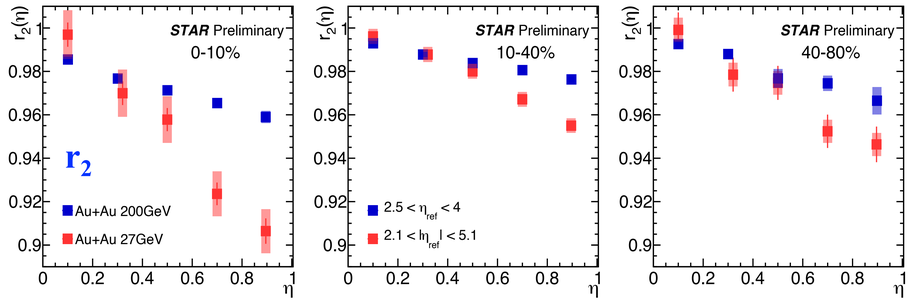


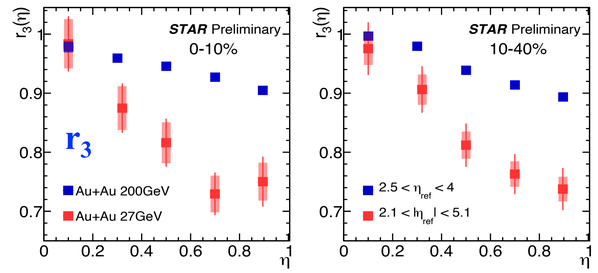
The STAR detectors

- Time Projection Chamber
  - Charge particle tracking and identification
  - Full azimuthal coverage
  - $|\eta| < 1$
- Event Plane Detector
  - Full azimuthal coverage
  - $2.1 < |\eta| < 5.1$



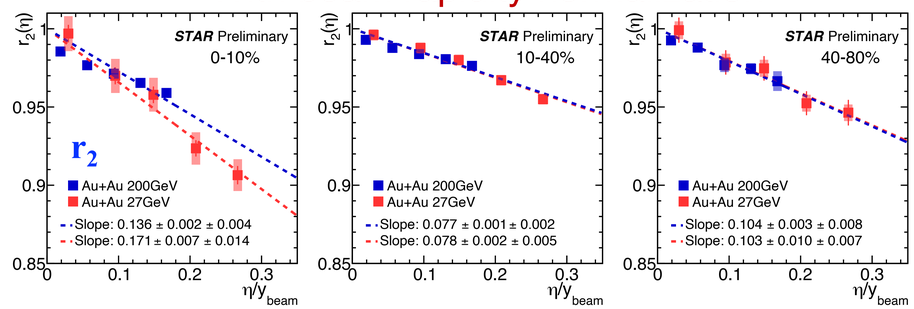
Results and discussions

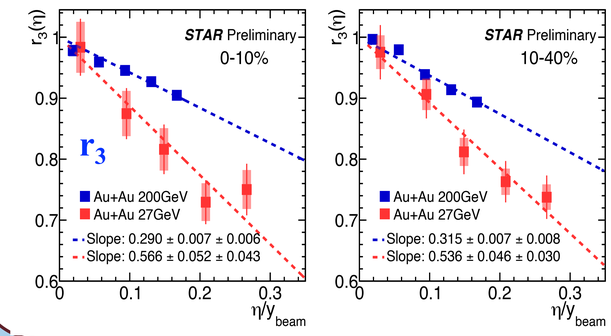




- Direct comparison: stronger v_2 and v_3 decorrelation at 27 GeV is observed for all shown centralities.

With beam rapidity normalization





- After $y_{\rm beam}$ normalization, r_2 shows:
  - 0-10%: weak energy dependence
  - 10-40% & 40-80%: no energy dependence.
- Still stronger v_3 decorrelation at 27 GeV after $y_{\rm beam}$ normalization.

Summary

- Longitudinal flow decorrelation measurements at 27 GeV at RHIC provide new constraints on longitudinal dynamics of heavy-ion collisions.
- After beam rapidity normalization, r_2 shows no clear energy dependence, while r_3 shows clear energy dependence.
- Energy dependence can be further studied using STAR BES-II data.

Reference

[1] L.-G. Pang, H.Petersen, G.-Y.Qin, V.Roy, X.-N.Wang, Eur. Phys. J. A 52 (2016) 97.
[2] CMS Collaboration, Phys. Rev. C 92 (2015) 034911.
[3] ATLAS Collaboration, Eur. Phys. J. C 78 (2018) 142.

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