Flow and Non–flow correlations

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The Anisotropic Flow

Anisotropic Flow is any correlation with respect to the reaction plane.

In practice, since the orientation of the reaction plane is not known *a priori*, flow measurements are usually extracted from azimuthal correlations between particles.

The conventional method

$$v_n = \langle \cos n(\phi - \psi_n) \rangle$$

- Based on the study of 2 particle correlations.
- Is biased by non–flow effects like:

  resonance decay

  dijets

  HBT or Coulomb effects

  momentum conservation

  etc.

The multi–particle correlation method

- Partition each event into four subevents and study the cumulant of Q vectors from subevents:

$$\langle Q_1 Q_2^* Q_3 Q_4^* \rangle - 2\langle Q_1 Q_2^* \rangle^2 = \langle v^4 \rangle - 2\langle v^2 \rangle^2$$

,

where

$$Q_j = \sum_k e^{in\phi_k} / M_j$$, for a subevent j.

The cumulant turns out to be:

$$-v_n^{\ 4} + O(\ldots)$$

- Works fast but gives big statistical error.

The multi–particle correlation method

- This method studies the 2 and 4 particle correlations together :

$$\langle\langle e^{in(\phi_1+\phi_2-\phi_3-\phi_4)}\rangle\rangle \equiv \langle e^{in(\phi_1+\phi_2-\phi_3-\phi_4)}\rangle$$

$$-\langle e^{in(\phi_1-\phi_3)}\rangle\langle e^{in(\phi_2-\phi_4)}\rangle - \langle e^{in(\phi_1-\phi_4)}\rangle\langle e^{in(\phi_2-\phi_3)}\rangle$$

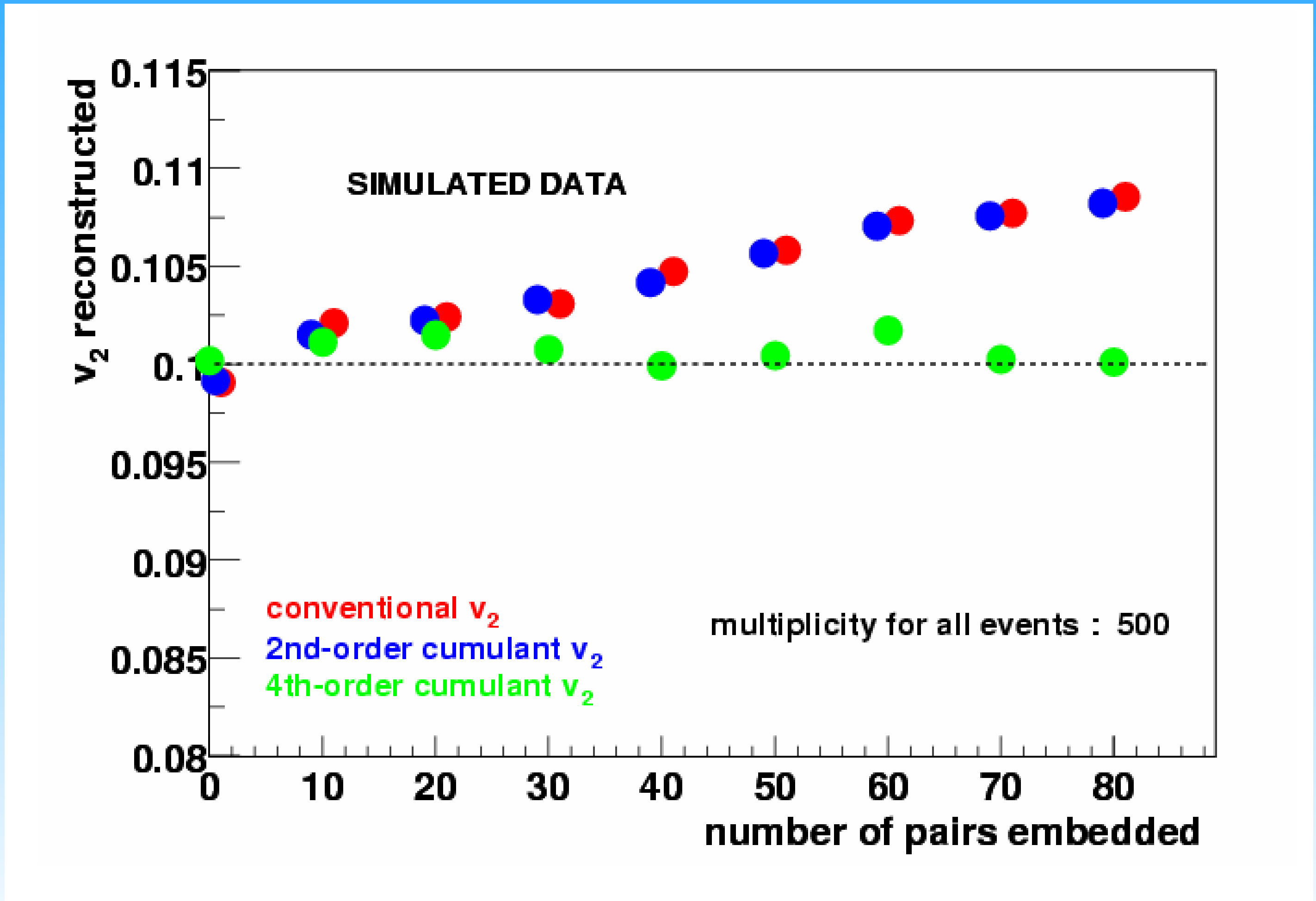
which turns out to be:

$$-v_n^4 + O\left(\frac{1}{N^3} + \frac{v_{2n}^2}{N^2}\right)$$

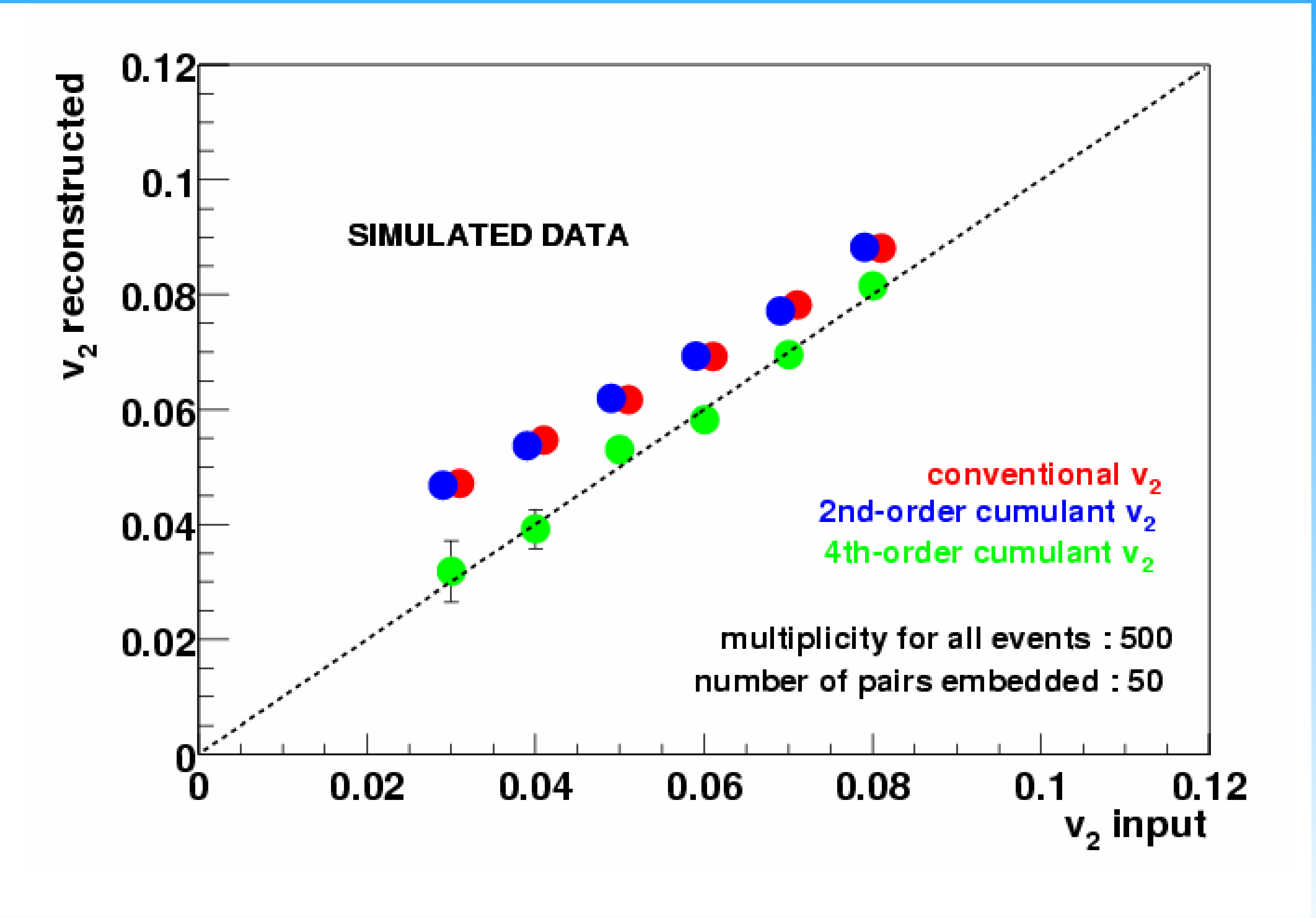
- The generating function is used in this method to make the complicated calculation possible.

For details, see Borghini, Dinh and Ollitrault Phys. Rev. C63 (2001) 054906

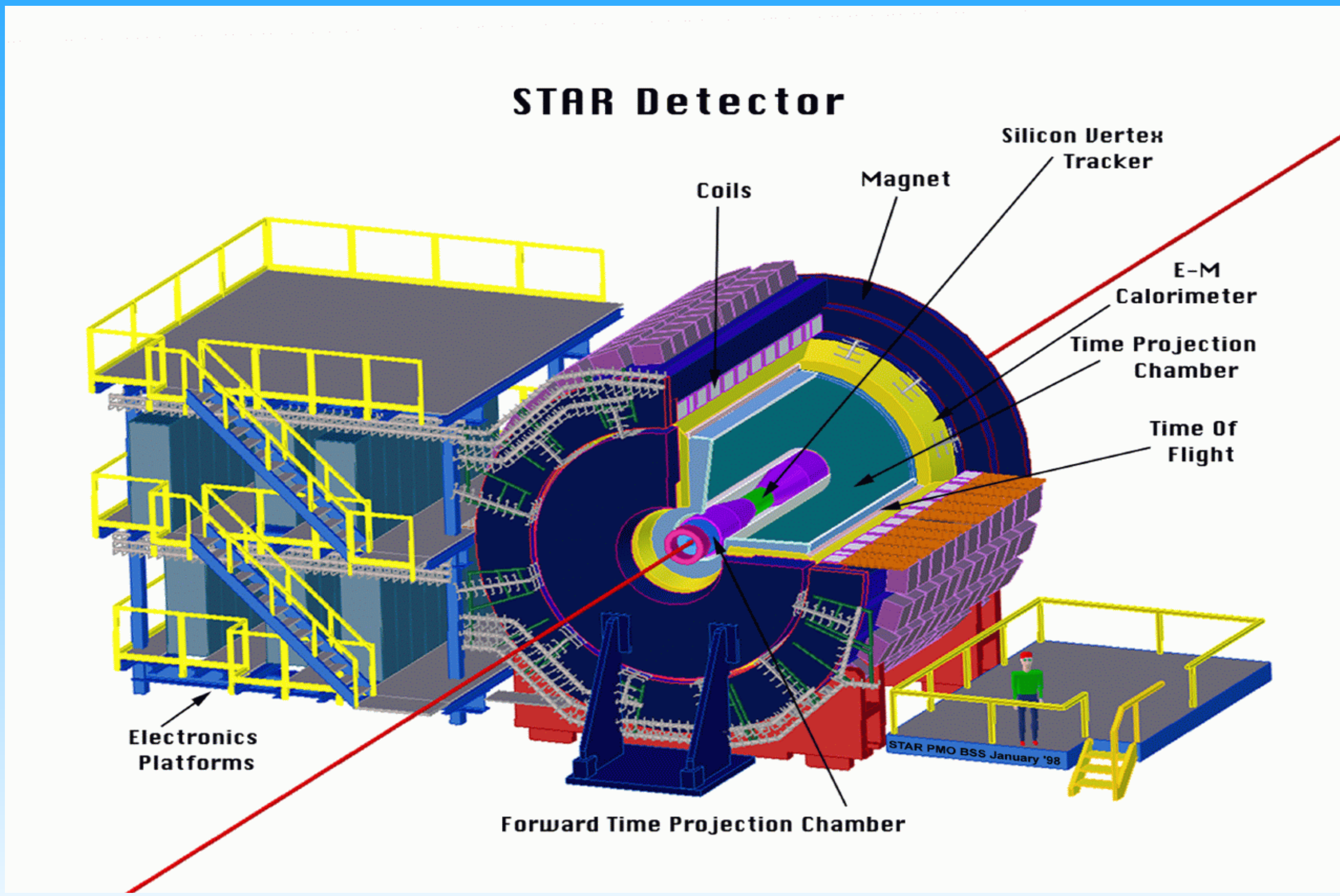
Quality Assurance



Quality Assurance (cont.)



STAR TPC

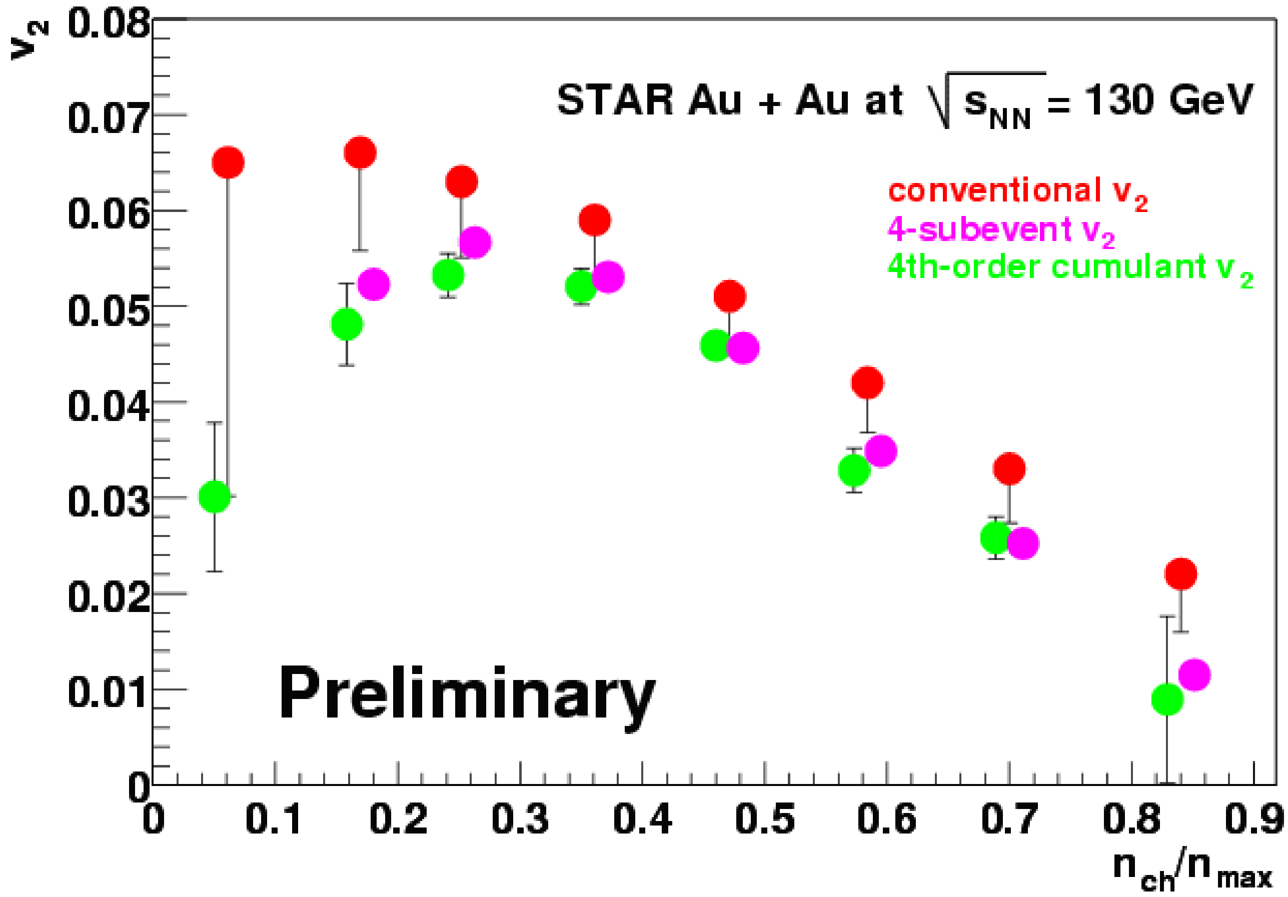


STAR Detector
Silicon Vertex Tracker
Magnet
Coils
E-M Calorimeter
Time Projection Chamber
Time Of Flight
Electronics Platforms
Forward Time Projection Chamber
STAR PMO BSS January '98

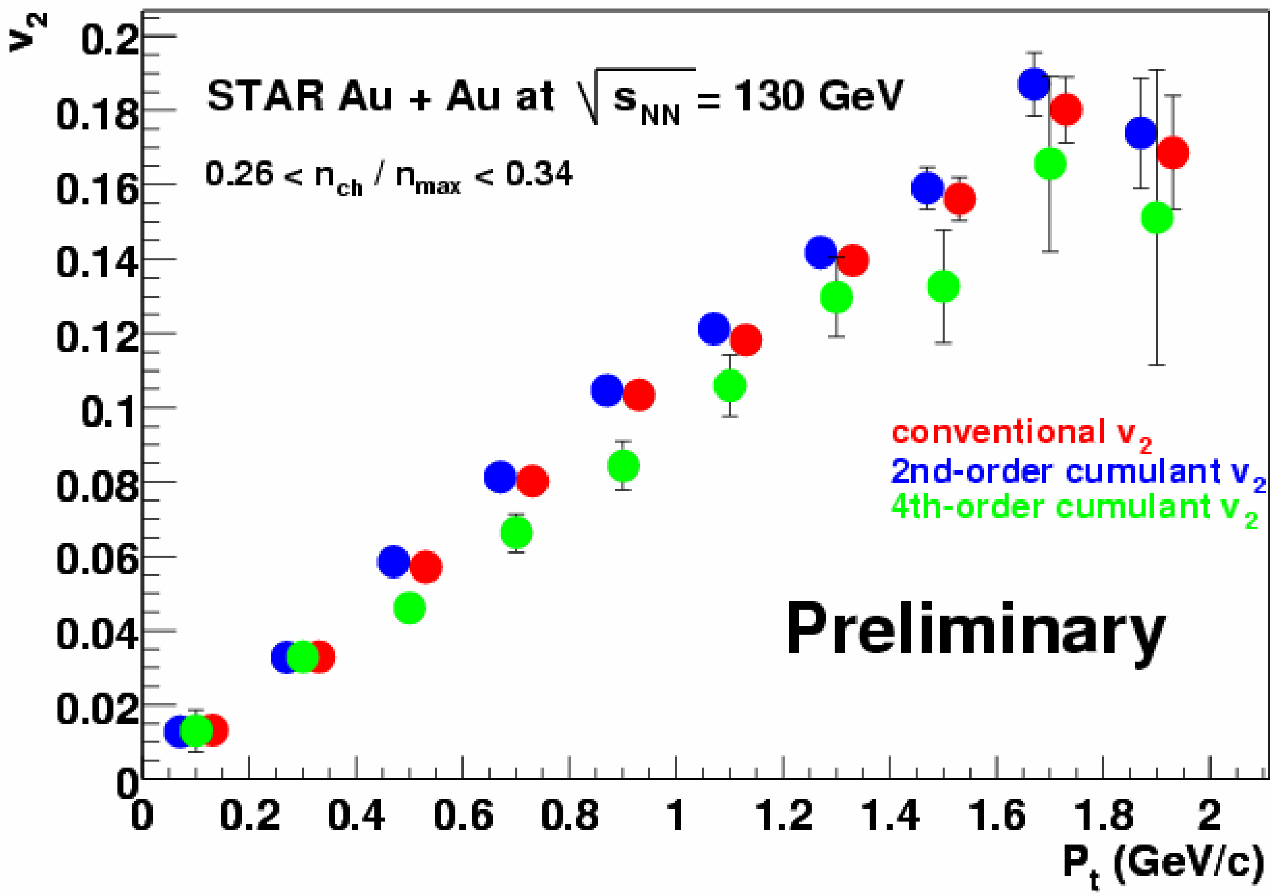
Cuts for this analysis

- 0.1 GeV/c < Pt < 2. GeV/c
- 0.15 GeV/c < P < 2. GeV/c
- –1.3 < eta < 1.3
- 15 < fit points < 45
- 0.52 < fit points / maximum points < 1.
- 0. cm < global dca < 2. cm

V2 versus centrality

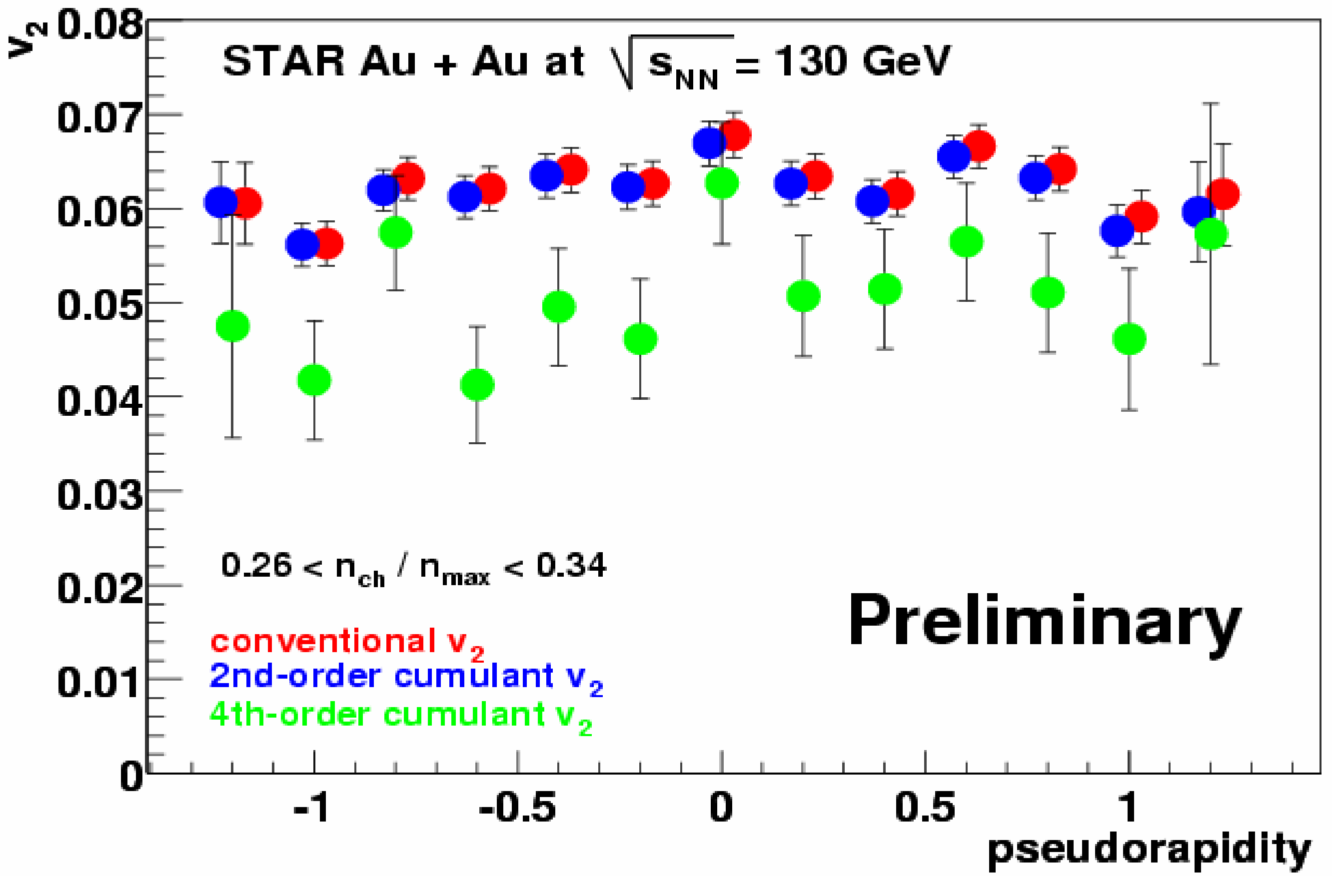


V2 versus Pt



STAR Au + Au at √s_NN = 130 GeV
0.26 < n_ch / n_max < 0.34
v_2
P_t (GeV/c)
conventional v_2
2nd-order cumulant v_2
4th-order cumulant v_2
Preliminary

V2 versus pseudorapidity



Conclusions

· Quadruplet correlation analysis can reliably separate flow and non−flow correlation signals but gives larger statistical errors than two particle correlation analyses.

· In earlier STAR analyses, the non−flow contribution was partly removed and partly quantified by the reported systematic uncertainties. Now we present v2 measurements corrected for non−flow effects.

· Non−flow correlations are present in $\sqrt{S_{NN}} = 130\,GeV$ **Au+Au events throughout the studied region** $|\eta| < 1.3$ **and** $0.1 < p_t < 2.0\,GeV/c$**, and are present at all centralities.**

·The largest contribution from non−flow correlations is found in peripheral collisions, however the v2 from central collisions still fits in hydrodynamic picture.

Thanks Note

- Thanks to

Jean–Yves Ollitrault

for his help on the cumulant method.