

# Triangular Flow of Identified Hadrons in Au+Au Collisions

at  $\sqrt{s_{NN}} = 39$  and 200 GeV

Xu Sun\*

for the STAR Collaboration

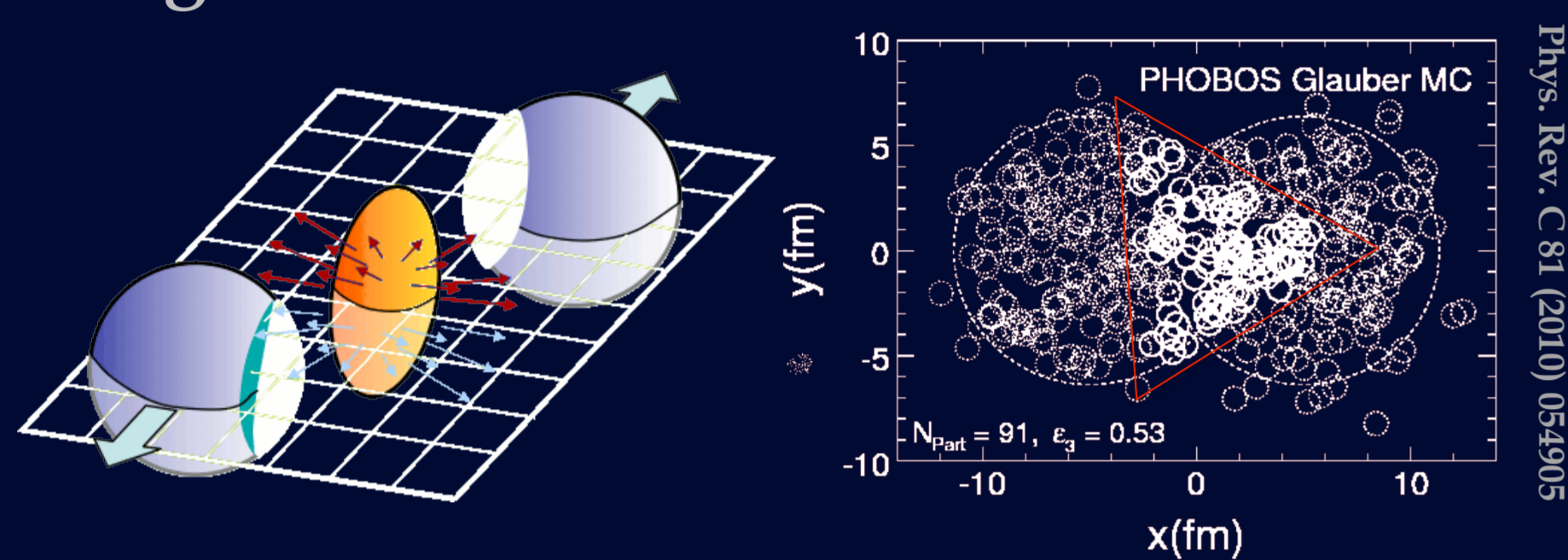
\*Harbin Institute of Technology

\*Lawrence Berkeley National Laboratory



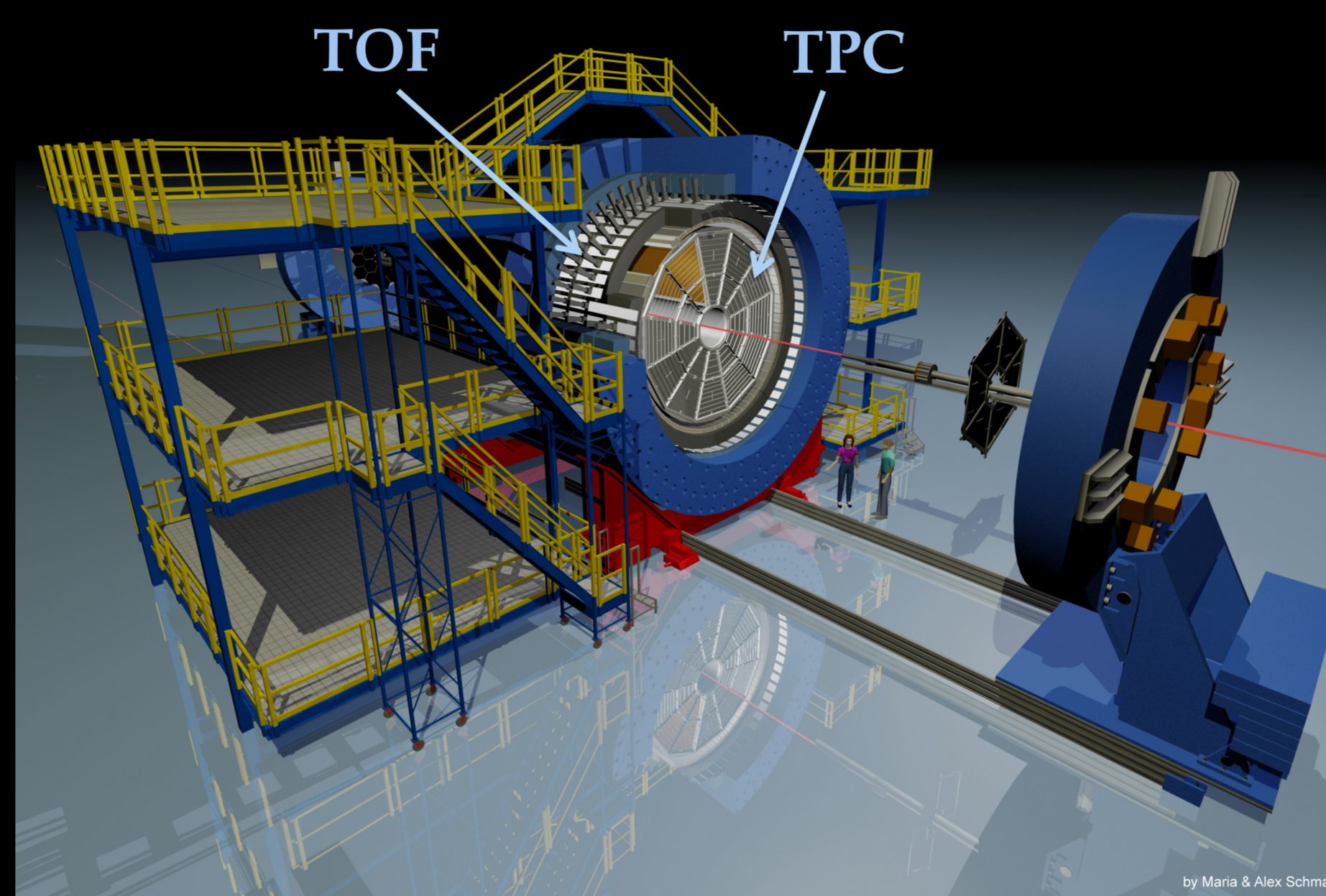
## Motivation

- Beam Energy Scan (BES) at STAR:
  - Signatures for QCD phase transition
- Triangular flow  $v_3$  sensitive to initial state fluctuations
- Number-of-Constituent-Quark (NCQ) scaling of  $v_3$  might be sensitive to partonic degree of freedom



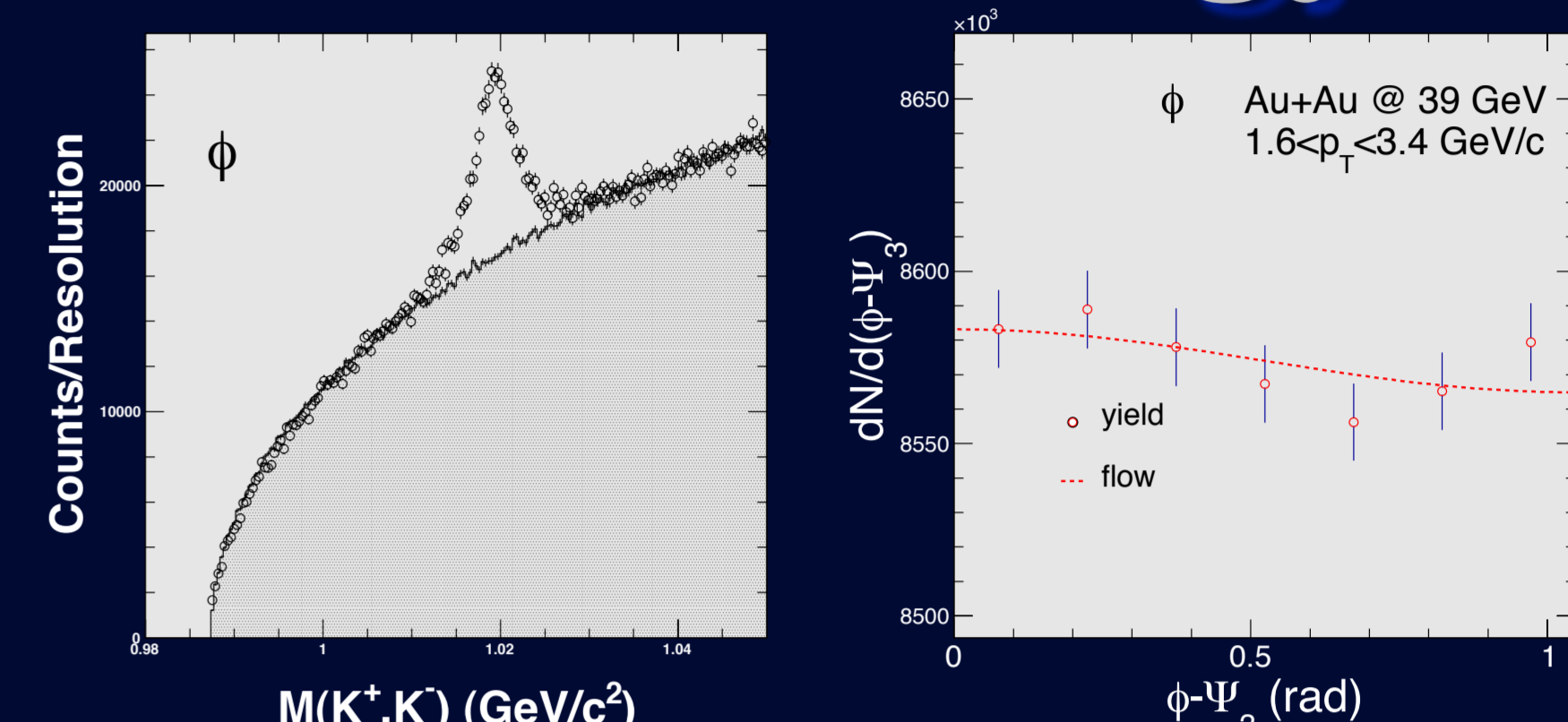
Initial state fluctuation

## The Experiment



Solenoidal Tracker At RHIC

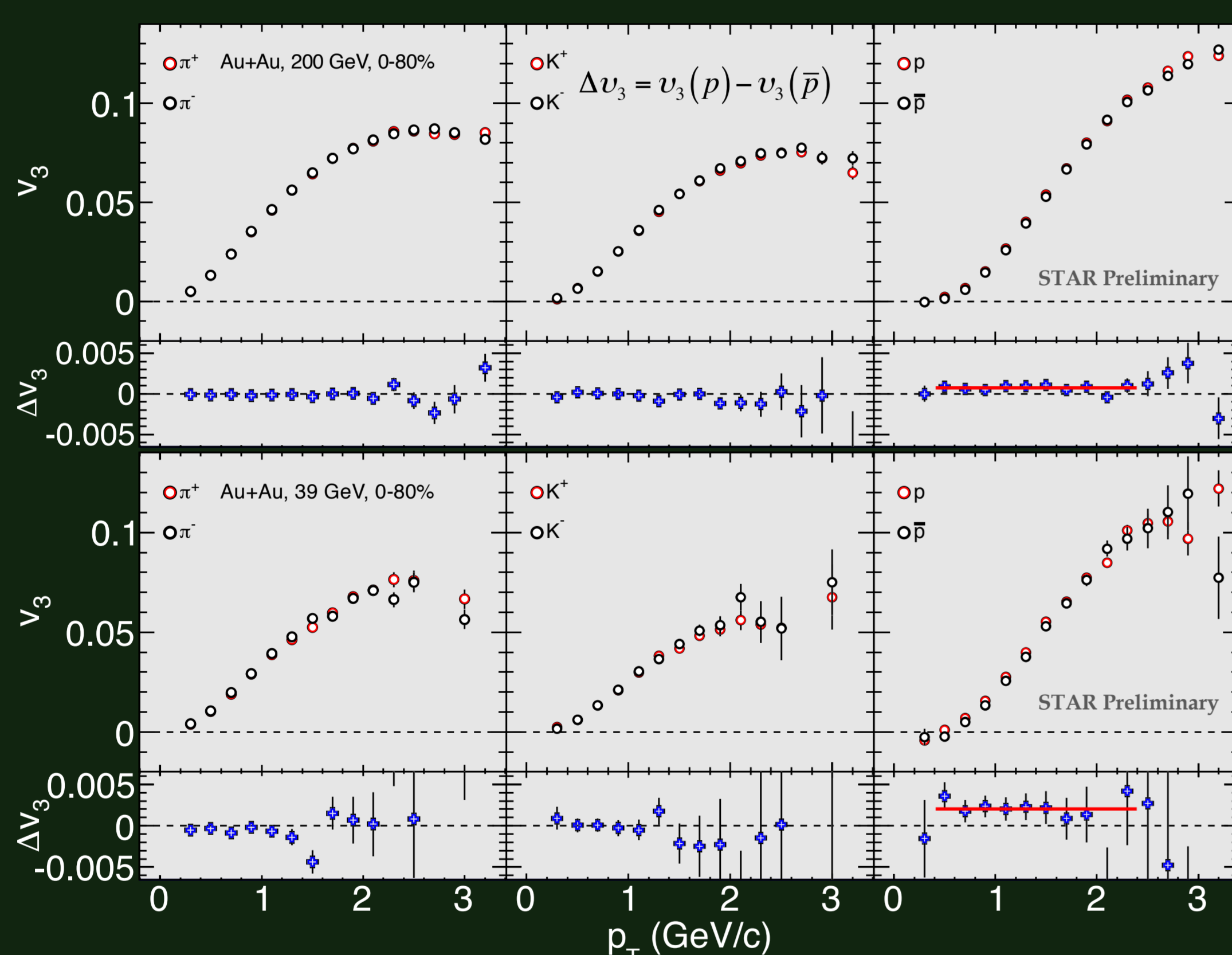
## Methodology



- PID based on  $dE/dx$  and TOF
- $\Phi$  meson reconstructed with invariant mass
- 3<sup>rd</sup>-order event plane reconstructed ( $|\eta| < 1$ )
- $\eta$ -gap method used to suppress non-flow
- Event plane method used to extract  $v_3$

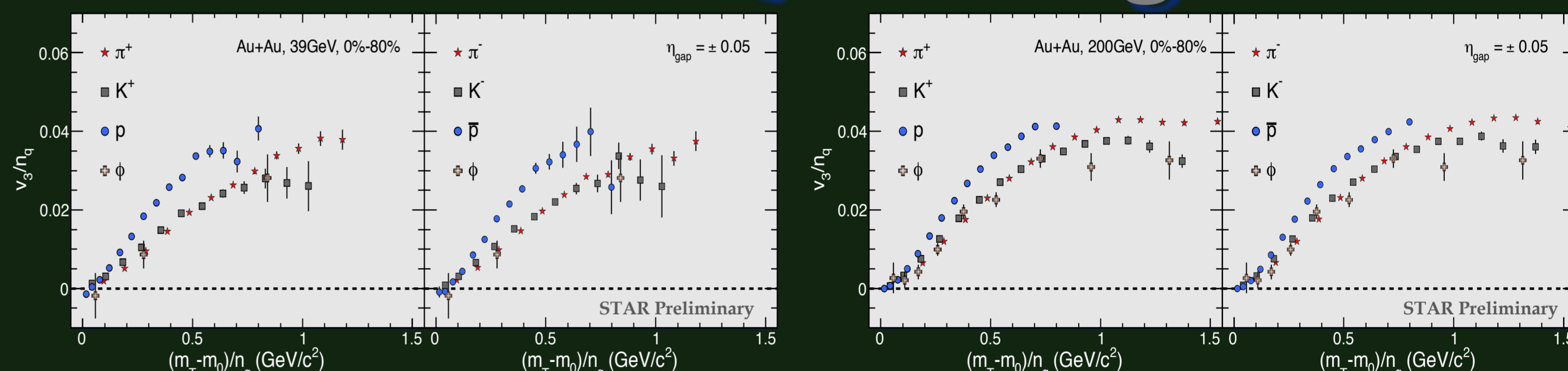
$$\frac{dN}{d(\phi - \Psi_3)} \approx 1 + 2v_3 \cos[3(\phi - \Psi_3)]$$

## Particle $\leftrightarrow$ anti-Particle

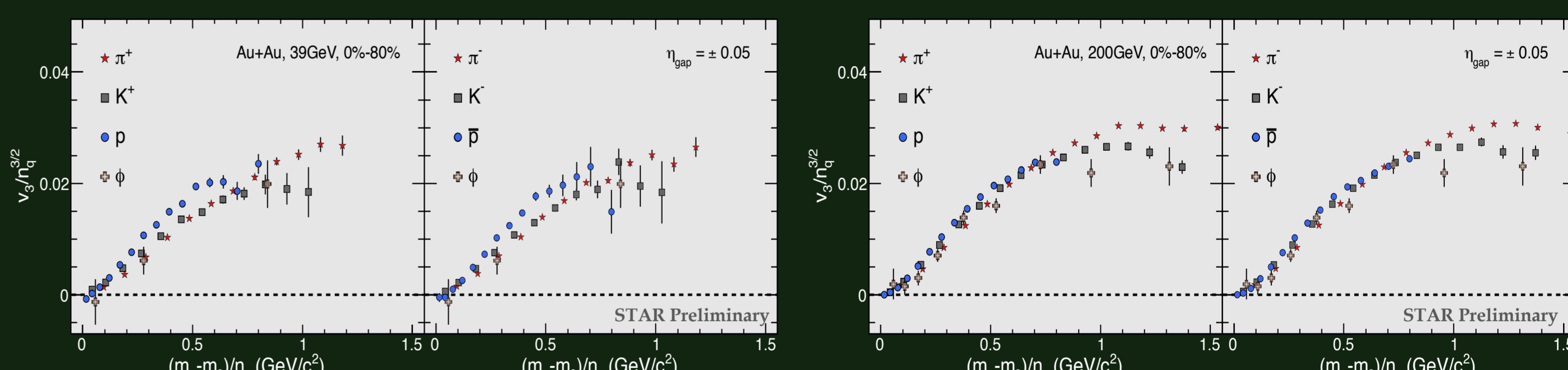


- Observed difference in  $v_3$  between protons and anti-protons
- $\Delta v_3$  is constant in the measured  $p_T$  range and the difference is larger at the lower energy
- $\Delta v_3$  (proton/antiproton) =  $(7.4 \pm 1.2) \cdot 10^{-4}$  at 200 GeV
- $\Delta v_3$  (proton/antiproton) =  $(2.1 \pm 0.6) \cdot 10^{-3}$  at 39 GeV
- $\Delta v_3 / \Delta v_2 = 0.34 \pm 0.10$  at 39 GeV

## NCQ Scaling

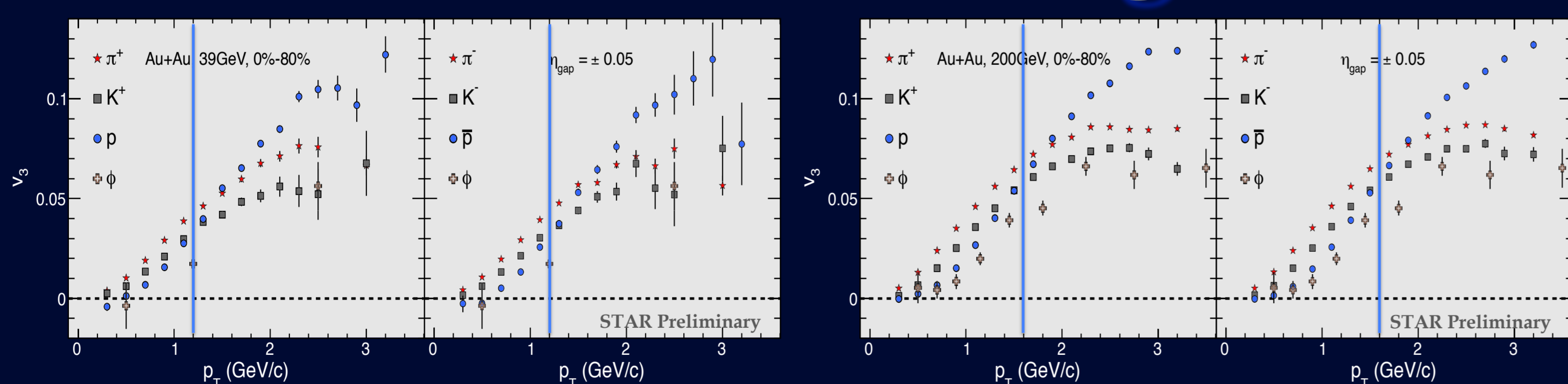


- NCQ scaling failed at 39 GeV (up to 0.8 GeV/c<sup>2</sup>) and 200 GeV (up to 0.8 GeV/c<sup>2</sup>) by using scaling factor  $n_q$



- Better NCQ scaling achieved at 39 GeV (up to 0.8 GeV/c<sup>2</sup>) and 200 GeV (up to 0.8 GeV/c<sup>2</sup>) by using scaling factor  $n_q^{3/2}$

## Mass Ordering



- Mass ordering extends for larger  $p_T$  range at 200 GeV than 39 GeV
- Larger radial flow at 200 GeV than 39 GeV ?

## Summary

- $\Delta v_3$  of protons and anti-protons are bigger at 39 GeV than 200 GeV
- Mass ordering for all particle species observed at low  $p_T$
- Radial flow is larger at 200 GeV than 39 GeV ?
- Baryon - meson splitting is observed at intermediate  $p_T$
- Better NCQ scaling achieved by using scaling factor  $n_q^{3/2}$