K/π Fluctuations at 2.76 TeV in Pb+Pb Collisions

Zubayer Ahammed , VECC, Kolkata

Introduction

M. Cheng et al., Phys. Rev. D 79 (2009) 074505
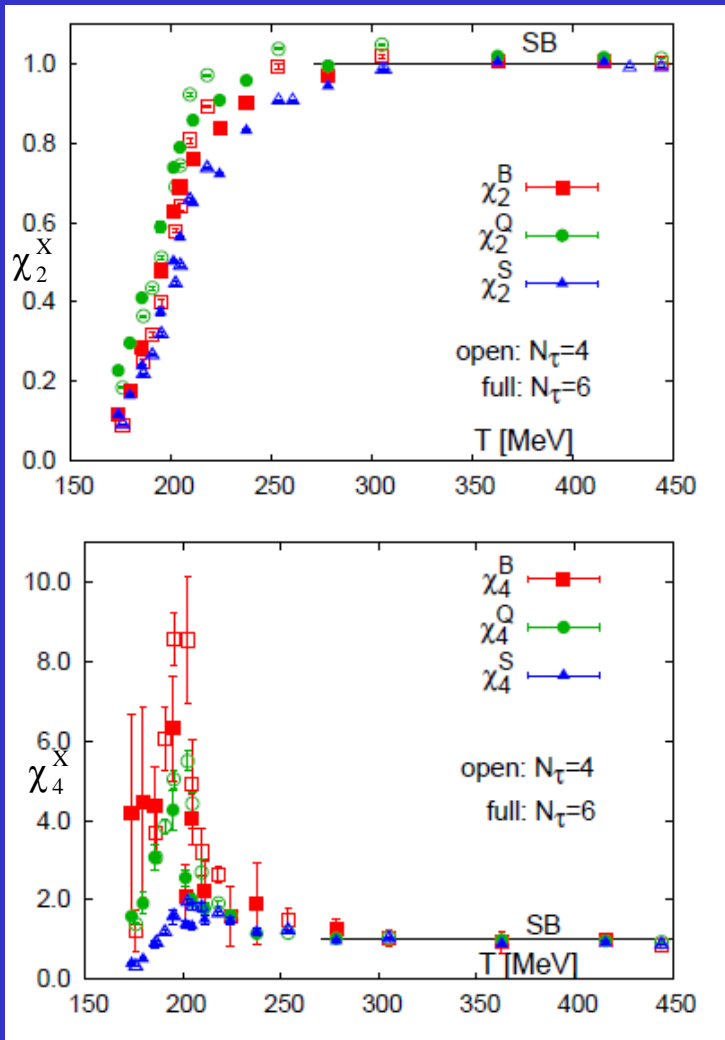
- Large fluctuation is expected in a phase transition near QCD critical point.

- Finite system size effects may influence fluctuation measurements.

- There may be change in behavior of quark susceptibilities in the vicinity of the QCD critical point.
Aoki, Endrodi, Fodor, Katz and Szabo,
Nature **443**, 675-678(2006)

K/π Fluctuations measurement

Measure the K/π ratio event-by-event.

  K = K$^+$ + K$^-$

  π= π^+ + π^-

Produce histogram of the K/π ratio.

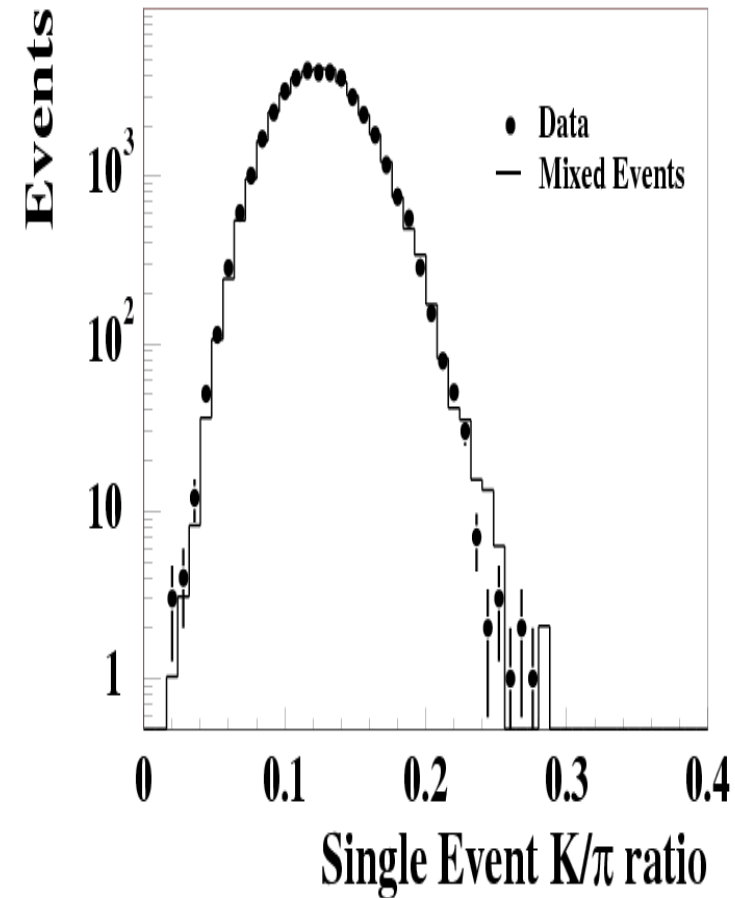Extract the width of K/π histogram to get σ_{real}

Do the same for mixed event to get σ_{mixed}

K/π Fluctuations at SPS

- Define the dynamical fluctuations in terms of σ_{dyn}

$$\sigma_{dyn} = \sqrt{\sigma_{real}^2 - \sigma_{mixed}^2}$$

- Divide by the mean and multiply by 100

  to get %

Measure, ν_{dyn}

Used in STAR Experiment(RHIC)

$$\nu_{dyn,K\pi} = \frac{\left\langle N_K \left(N_K - 1\right)\right\rangle}{\left\langle N_K \right\rangle^2} + \frac{\left\langle N_\pi \left(N_\pi - 1\right)\right\rangle}{\left\langle N_\pi \right\rangle^2} - 2\frac{\left\langle N_K N_\pi \right\rangle}{\left\langle N_K \right\rangle\left\langle N_\pi \right\rangle}$$

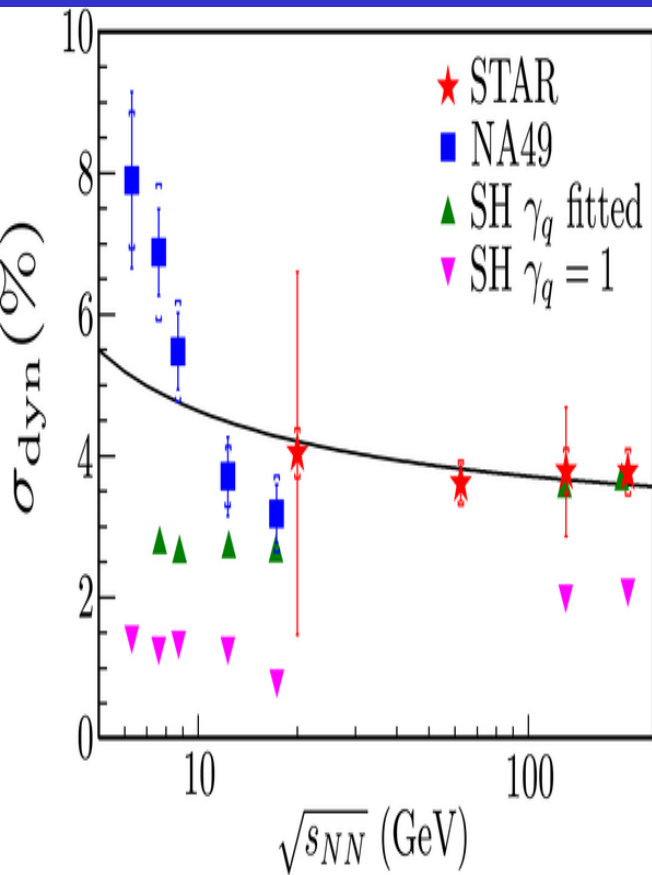ν_{dyn} introduced to study net charge fluctuations.
(PRC **68**, 044905 [2003])
$\nu_{dyn,K\pi}$ is insensitive to efficiency.
$\nu_{dyn,K\pi}$ properly deals with small multiplicities.
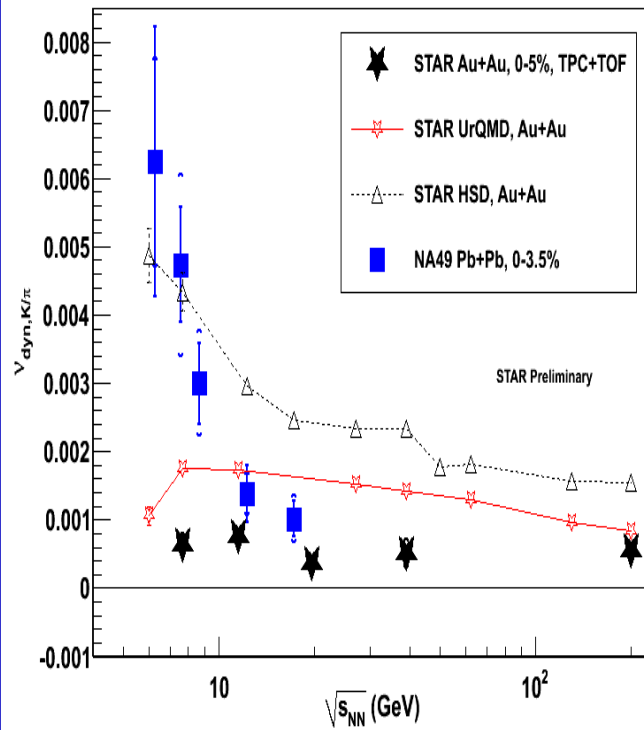
Excitation Function for $\nu_{\mathrm{dyn},K/\pi}$

NA49 $s_{\mathrm{dyn},K/p}$ converted to $n_{\mathrm{dyn},K/p}$ using $\sigma^2_{\mathrm{dyn}} = n_{\mathrm{dyn}}$.

TPC+TOF (GeV/c): STAR, QM'12
p : $0.2 < p_T < 1.4$
K : $0.2 < p_T < 1.4$

NA49, QM'12

New results

Phys. Rev. Lett. **103** (2009) 92301
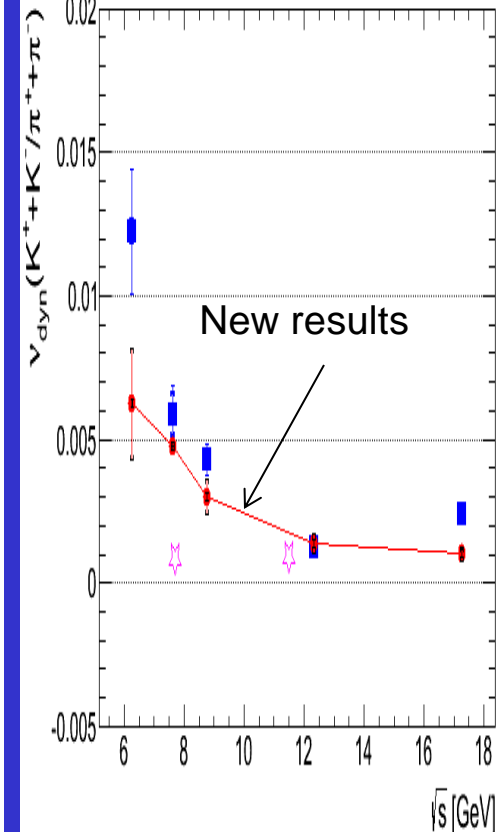
Analysis in ALICE

Data Sample:

Period   : LHC10h
Run Number   : All Runs in the Period
Event Selection Cuts   : Value
Physics Selection   : Min.bias, only collision candidates
Primary vertex   : >= 1 contributor (tracks/SPD)
Centrality   : V0(M)
Z-vertex   : (-10.0, 10.0) cm

   Data Type Analysed: AOD

   CF_PbPb train used

Centrality bins: 0-5 %, 5-10%, 10-20%,20-30%, 30-40%, 40-50%, 50-60%
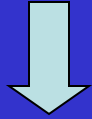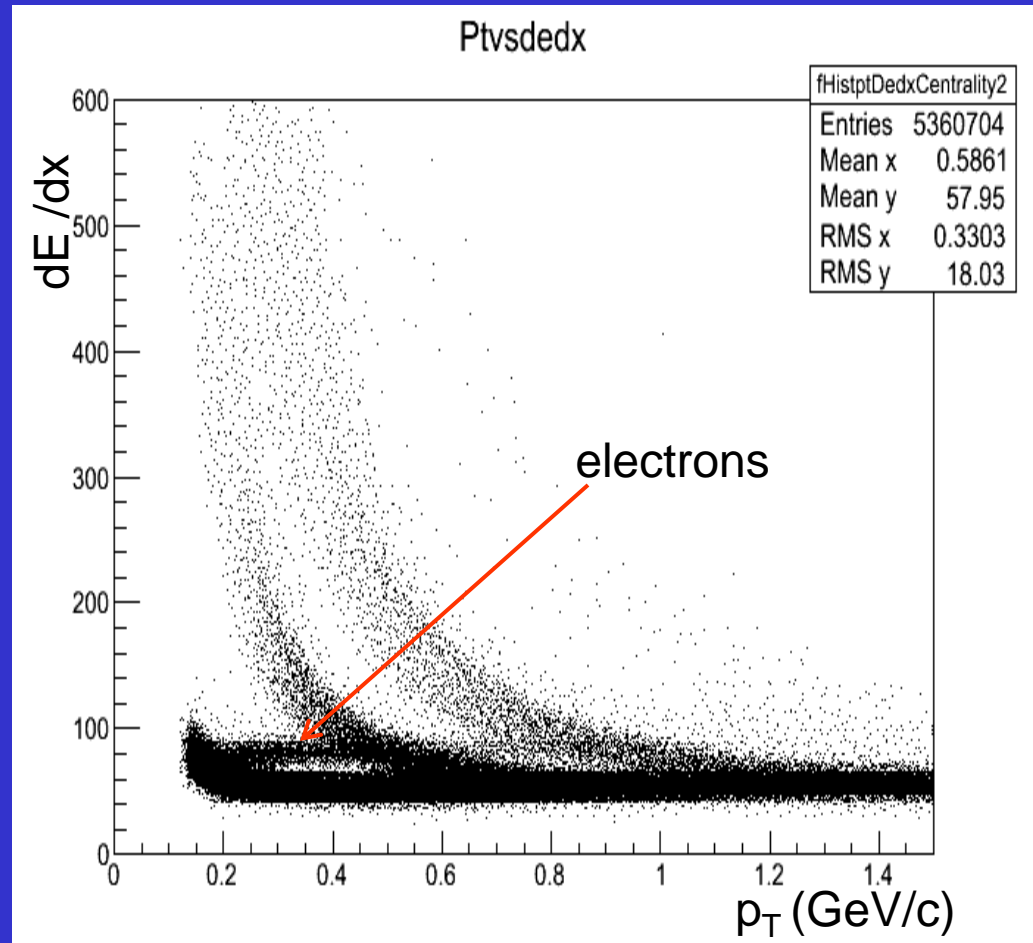   60-70%,70-80%
Track Cuts:
$0.3 < pT < 1.5$ GeV/c
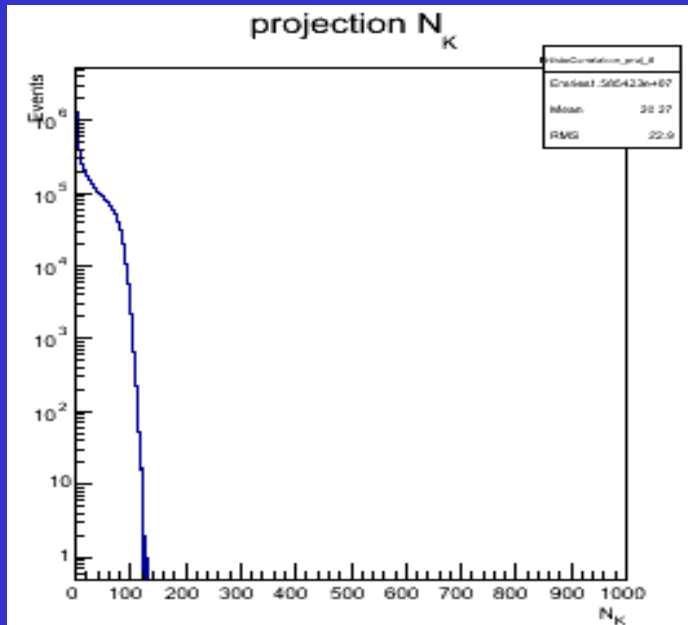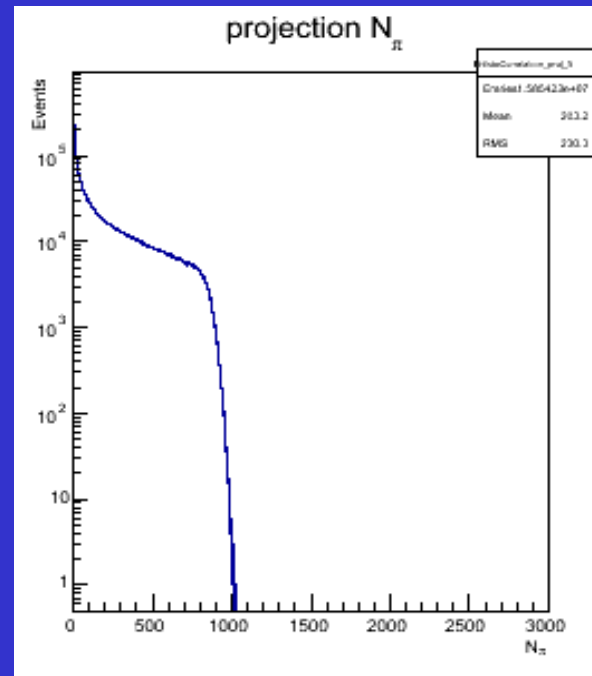$- 0.8 < \eta < 0.8$
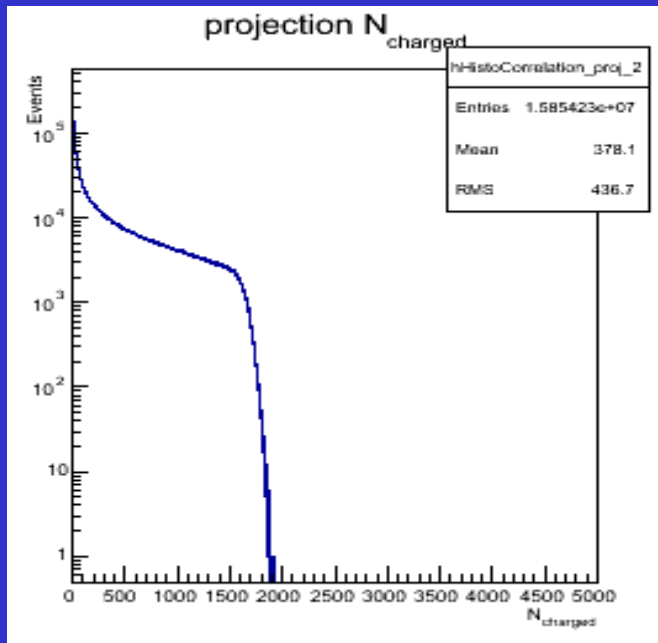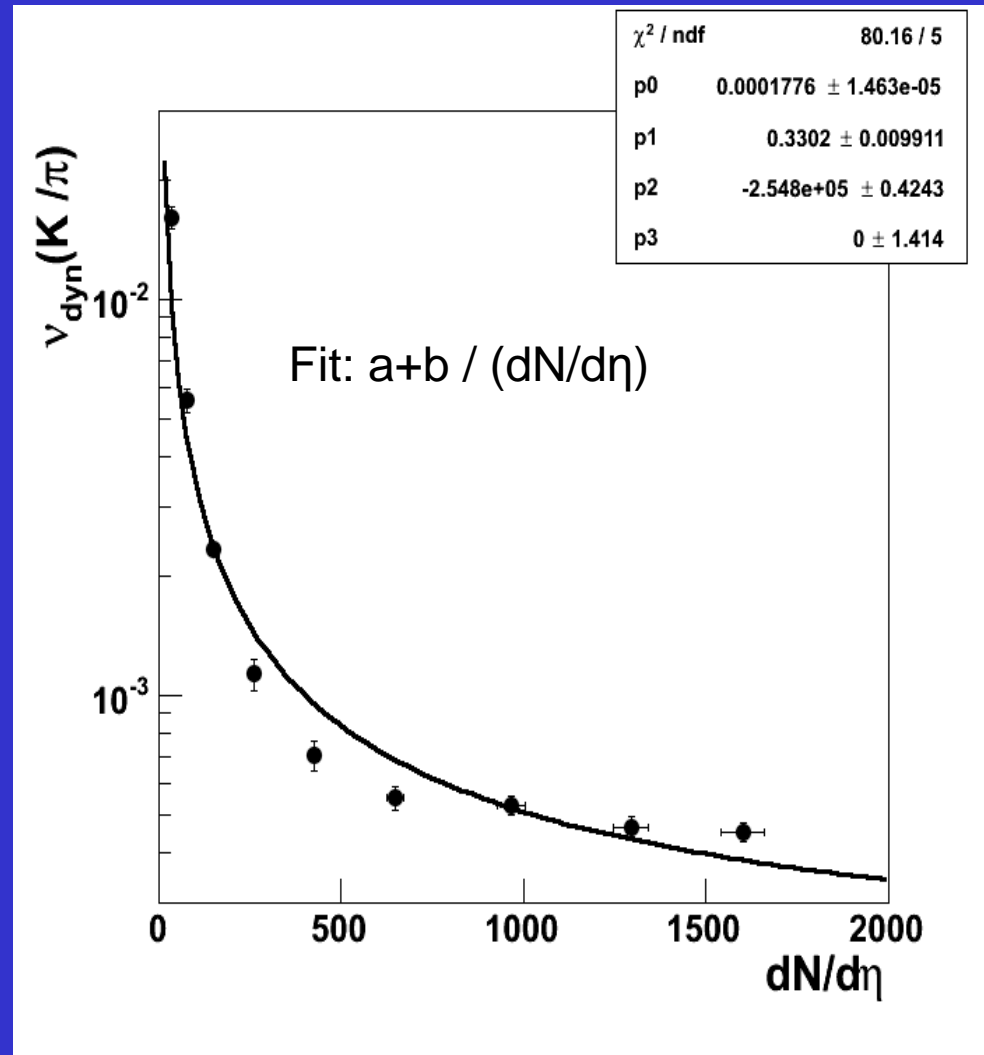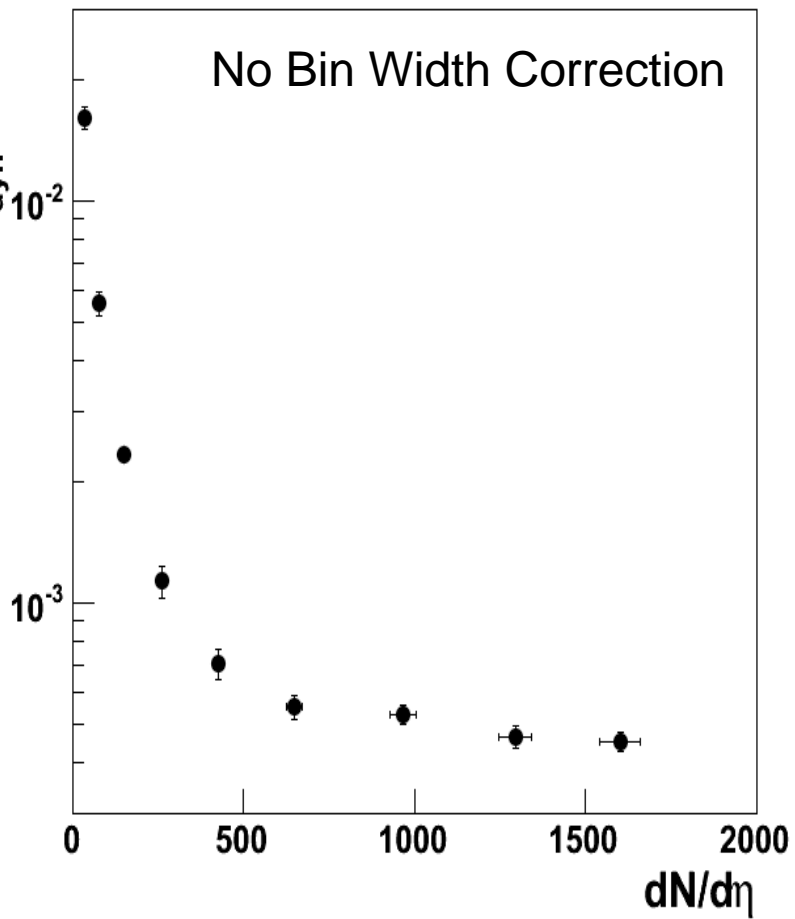
K,π identification

TPC

- Extract the number of $K^+ + K^-$ and $\pi^+ + \pi^-$ event-by-event using dE/dX curvature in the TPC

- Select kaons and pions with $0.3 < p_T < 0.6$ GeV/c and

  $|\eta| < 0.8$

  - kaons: $N_{\sigma,K} < 2$, $N_{\sigma,\pi} > 2$
  - pions: $N_{\sigma,\pi} < 2$, $N_{\sigma,K} > 2$
  - electrons: $N_{\sigma,e} < 1$

Ptvsdedx

fHistptDedxCentrality2	
Entries	5360704
Mean x	0.5861
Mean y	57.95
RMS x	0.3303
RMS y	18.03

dE /dx

electrons

p_T (GeV/c)

8

Some QA Plots

9

Results

No Bin Width Correction

χ^2 / ndf   80.16 / 5

p0   0.0001776 $\pm$ 1.463e-05

p1   0.3302 $\pm$ 0.009911

p2   -2.548e+05 $\pm$ 0.4243

p3   0 $\pm$ 1.414

Fit: a+b / (dN/dη)

$\nu_{dyn}(K/\pi)$

dN/dη

No Bin Width Correction

Fit: $a+b / (N_{Part})$

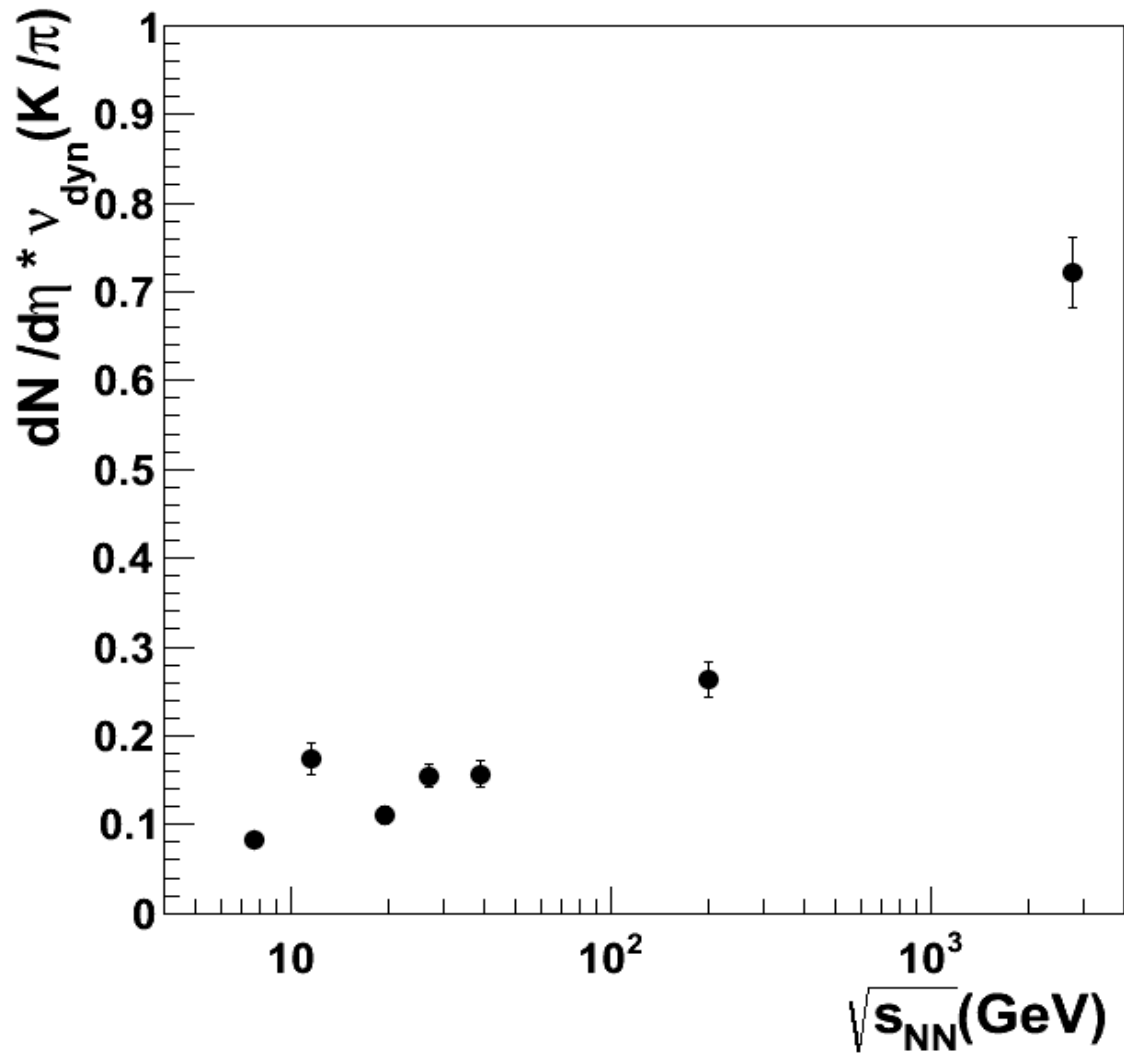| χ^2 / ndf	136.9 / 5
p0	6.183e-05 ± 1.399e-05
p1	0.1205 ± 0.002998
p2	-3.321e+05 ± 0.4243
p3	0 ± 1.414
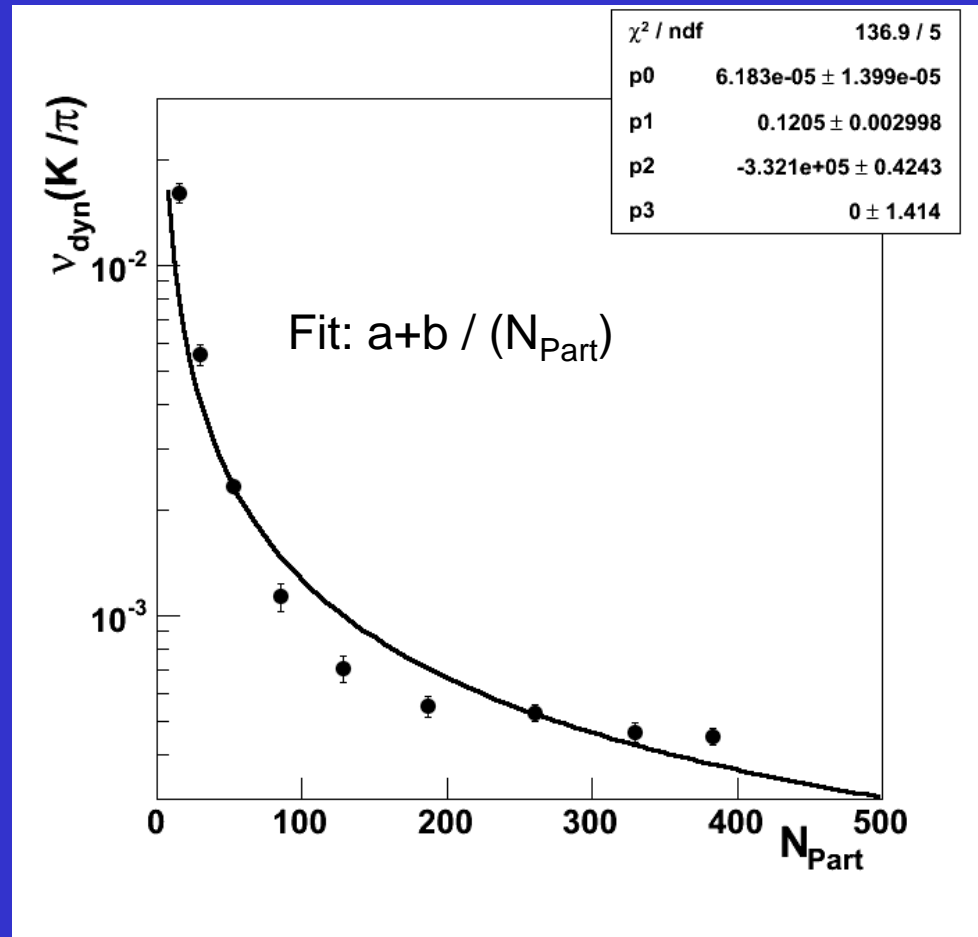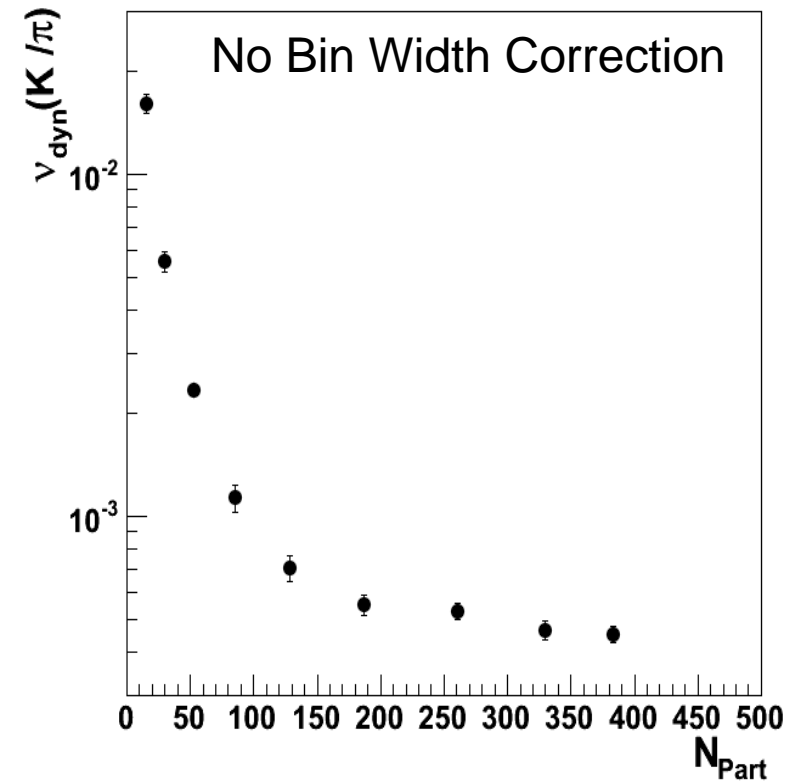
Scaled Fluctuation Strength
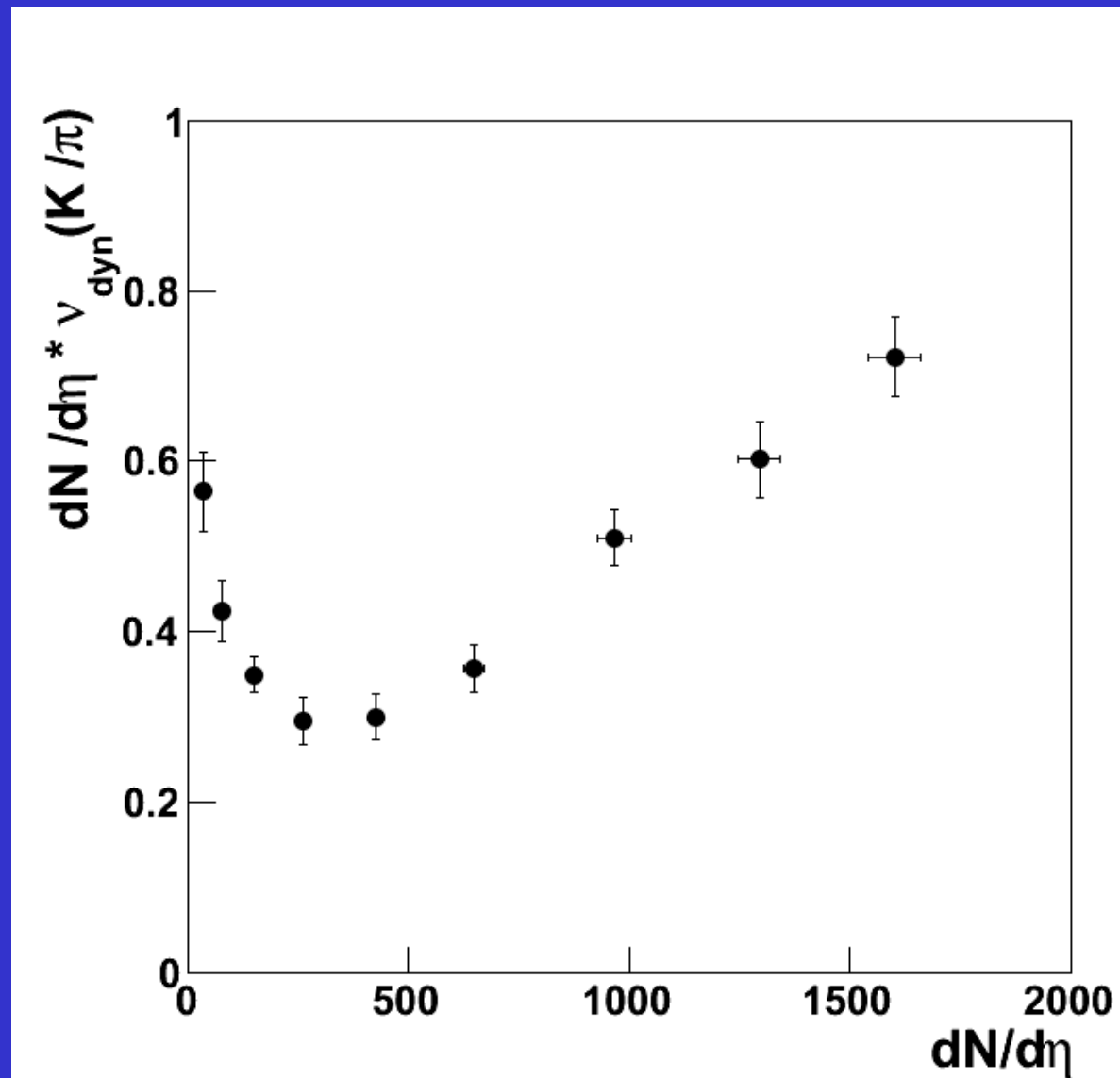
Comparison with STAR

0-5% central events

STAR dN / dη
uncorrected
(QM'2012)

Summary and Future Outlook

• Preliminary results for K/pi ratio fluctuation is presented

• ν_{dyn} decreases towards higher centrality(1/N dependence) which is expected.

• Scaled ν_{dyn} shows increased trend.

•Further checks, analysis, MC simulations ongoing.