Reconstruction of ϕ Mesons in K^+K^- Channel for Au-Au Collisions at $\sqrt{s_{NN}}$=200 GeV by the PHENIX Experiment at RHIC

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For

PHENIX Collaboration

Outline

PHENIX

- Motivation
- Detector Setup
- Particle Identification
- Data Sample Selection
- ϕ Invariant Mass Reconstruction
- Transverse Mass Spectra of ϕ
- ϕ Yield and Slope Parameter

Motivation

- An enhanced ϕ-meson production has been suggested as a signature for the formation of a deconfined phase.

- Chiral symmetry restoration expected in heavy ion collisions may lead to medium modifications of ϕ-meson properties.

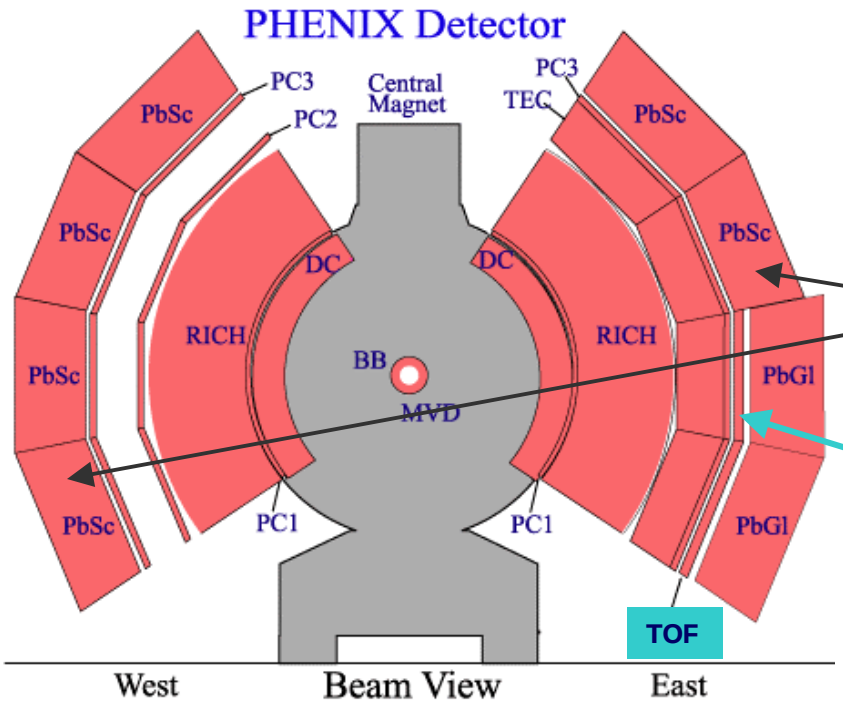
R. Rapp nucl-th/0204003

- The change in the branching ratio in leptonic and hadronic channels may point to the chiral symmetry restoration.

- The measurement of ϕ in K^+K^- channel combined with the measurement in the e^+e^- channel may be a good diagnostic tool of the new phase created in the heavy ion collisions.

PHENIX in Run-II

- PHENIX Central Arm
  - Capable of Measuring hadrons, electrons and photons



Tracking:

Drift Chamber
Pad Chamber1
Pad Chamber3

Kaon Identification

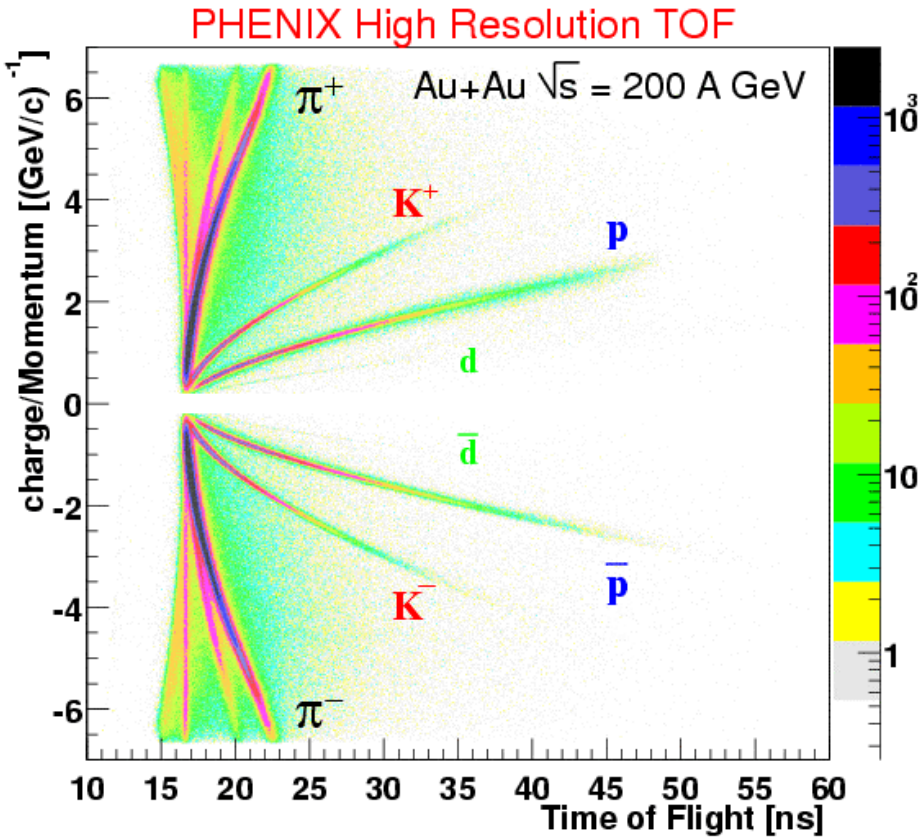
Electromagnetic Calorimeter

Time-of-Flight Detector

Excellent Particle Identification Capability

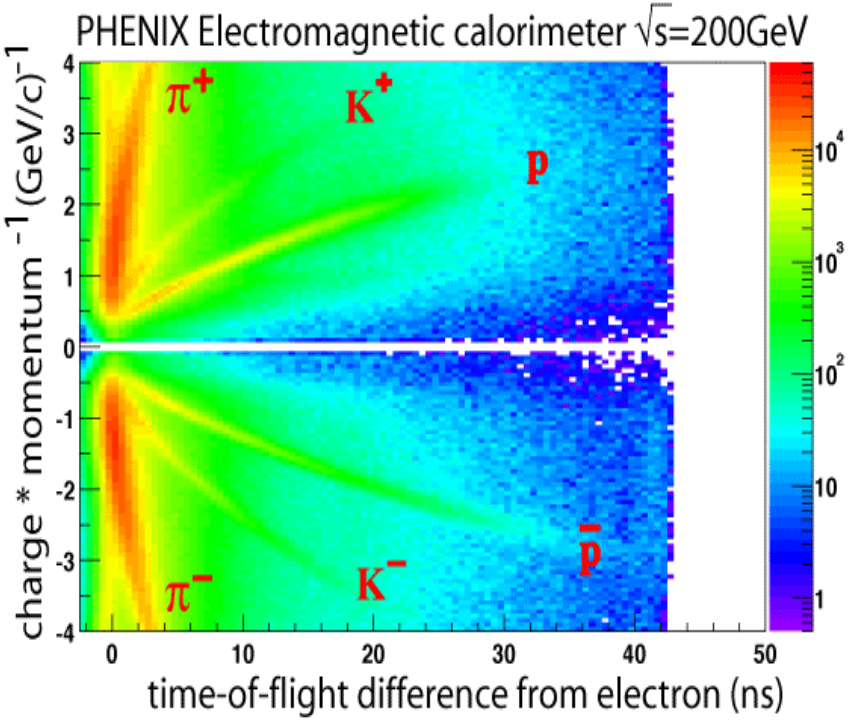
Particle Identification

Particle Identified through High Resolution Time-of-Flight Detector



Timing resolution ~ 120ps

Particle Identified through Electromagnetic Calorimeter



Timing resolution ~ 480ps

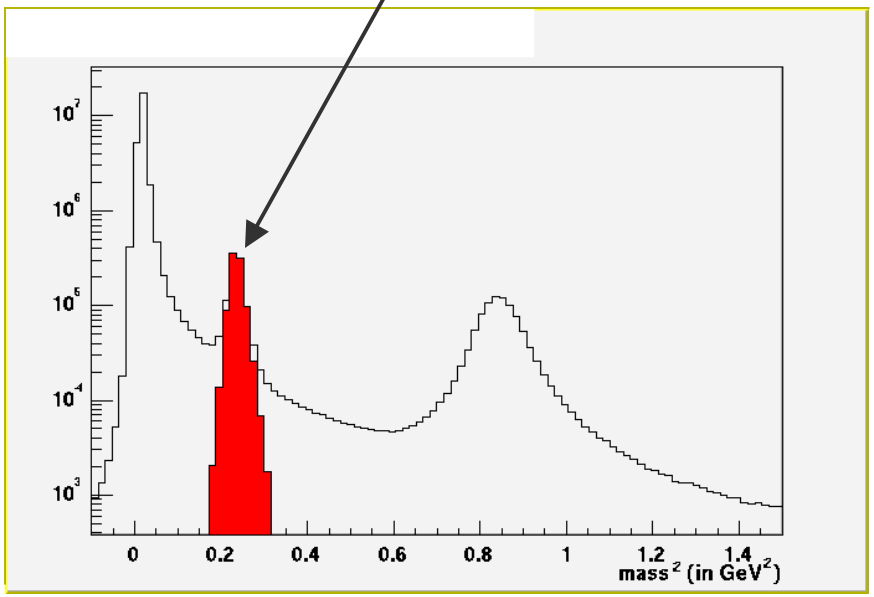
Data Sample

Particles identified in TOF are used for this analysis

- **27.94 Million Minimum Bias Au+Au events.**
- **Track Selection**
  - **3σ track projection matching.**
- **Momentum between 300MeV/c and 2.0 GeV/c.**
- **2σ cut on the calibrated mass^2 of kaon at TOF.**

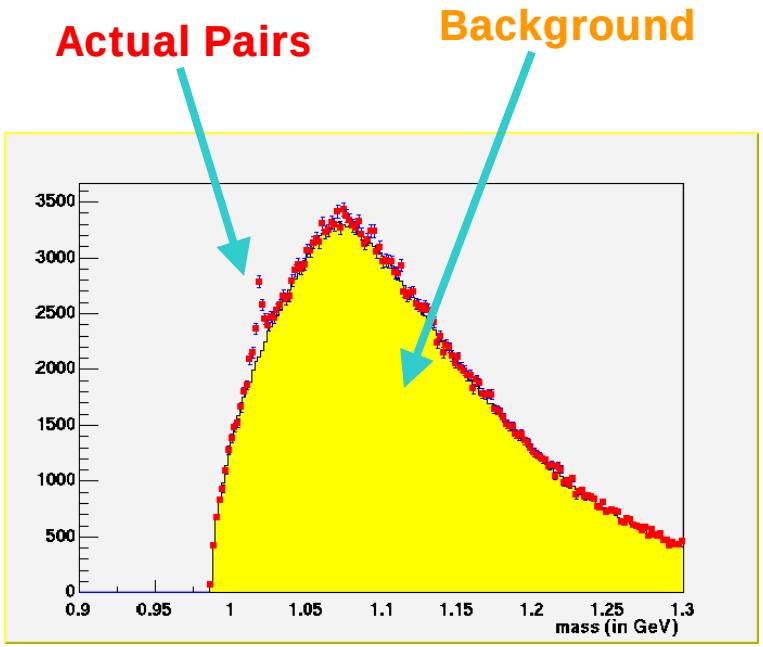
Mass squared of Particles are Calculated. Sample is selected on its mass^2 Distribution

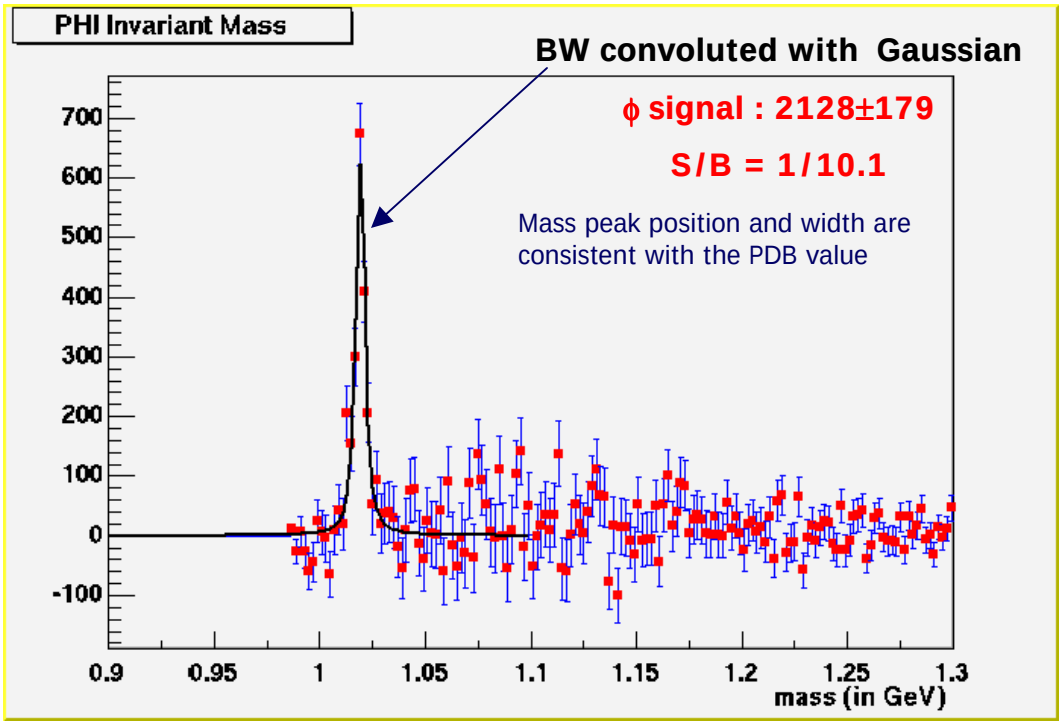
2σ around the peak of mass^2



$\phi \longrightarrow K^+K^-$ Signal in the TOF

- K^+ and K^- from same event are paired together to give Actual N_{+-}
- K^+ and K^- from different events, but from same centrality and vertex class, are paired together to give Mixed N_{+-}
- Mixed N_{+-} Normalized by Actual Pair N_{++} and N_{--}as $CB = 2\sqrt{(N_{++}.N_{--})}$,where CB stands for the combinatorial background
- Signal = Actual N_{+-} - CB





m_t Distribution : Analysis Procedure

3 Centrality Classes : 0%-10%, 10%-40%, 40%-92%

9 m_t bins : 1.2-1.6, 1.6-1.8, 1.8-2.0, 2.0-2.2, 2.2-2.4, 2.4-2.6, 2.6-2.8, 2.8-3.0, 3.0-4.0 GeV

$$\frac{d^2N}{dm_t dy} = N_\phi \frac{MC_{thrown}}{MC_{accepted}} \frac{1}{evt} \frac{1}{\varepsilon^2_{embed}} \frac{1}{\frac{cf}{0.92}} \frac{1}{BR} \frac{1}{\Delta m_t}$$

where

N_ϕ = ϕ signal, the number of counts in $\pm 2\Gamma$ window in the invariant mass plot

MC = Monte-Carlo ϕ

ε_{embed} = 1 - efficiency loss due to high occupancy

cf = Centrality fraction of the cross-section

BR = Branching Ratio (0.49 for ϕ decaying into K^+K^-)

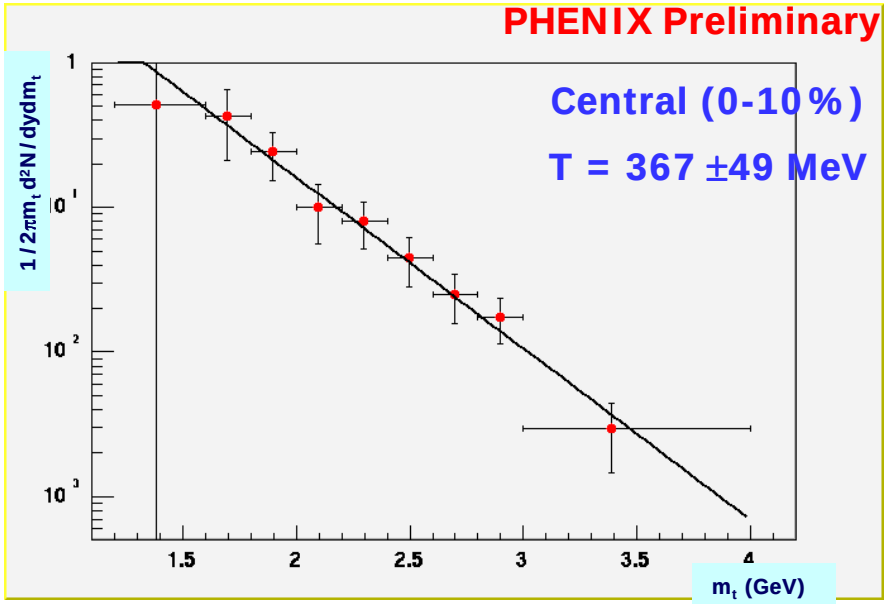
Δm_t = width of the m_t bin

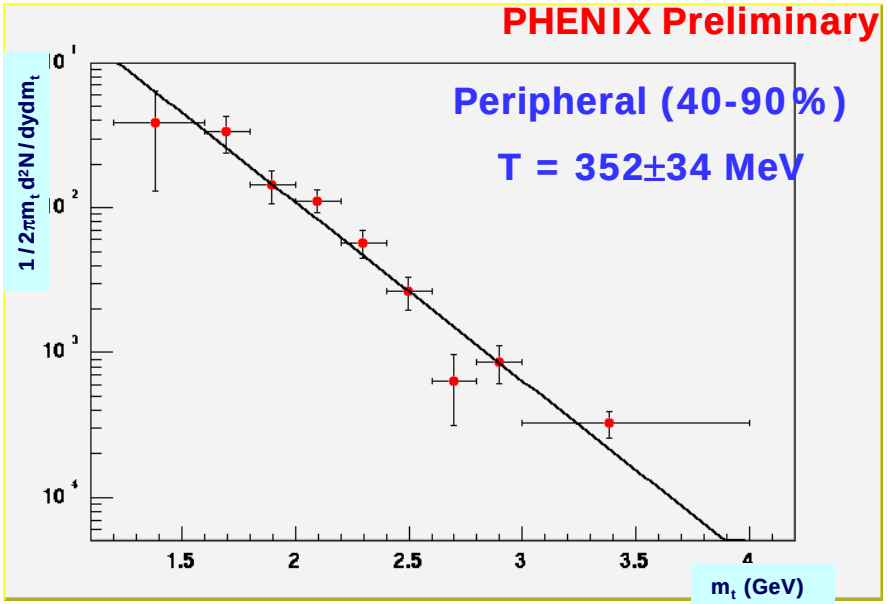
Fitting Function:

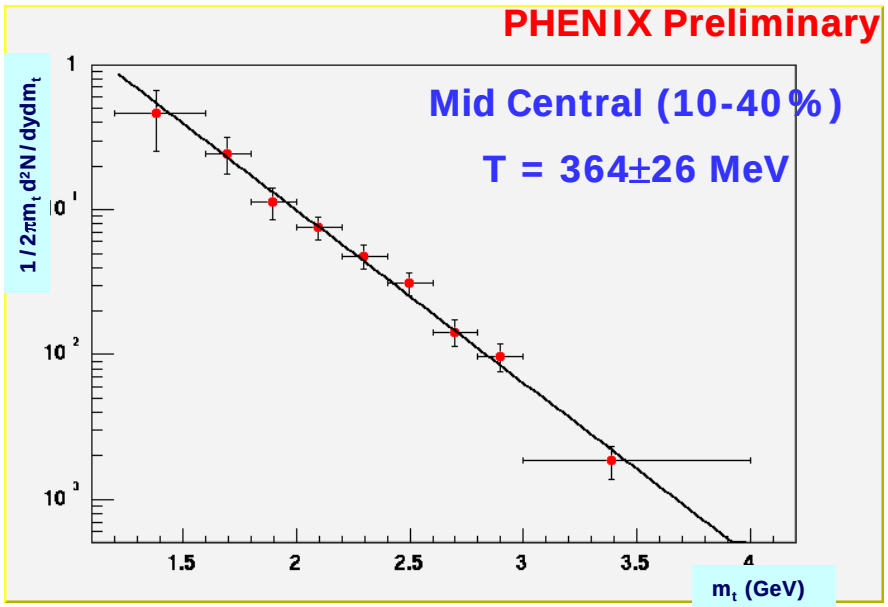
$$\frac{1}{2\pi m_t} \frac{d^2N}{dm_t dy} = \frac{dN/dy}{2\pi T(m_\phi + T)} e^{-(m_T - m_\phi)/T}$$

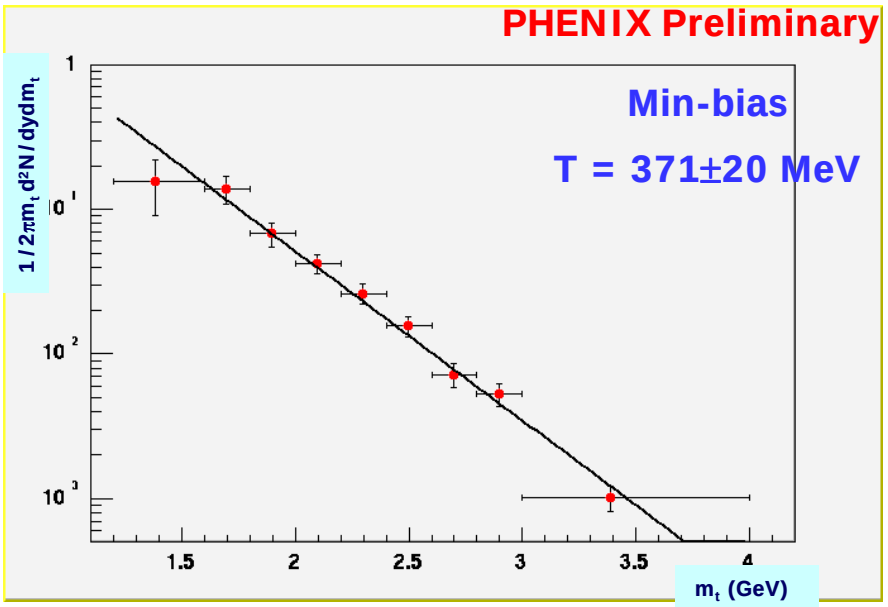
ϕ m_t Distribution

PHENIX

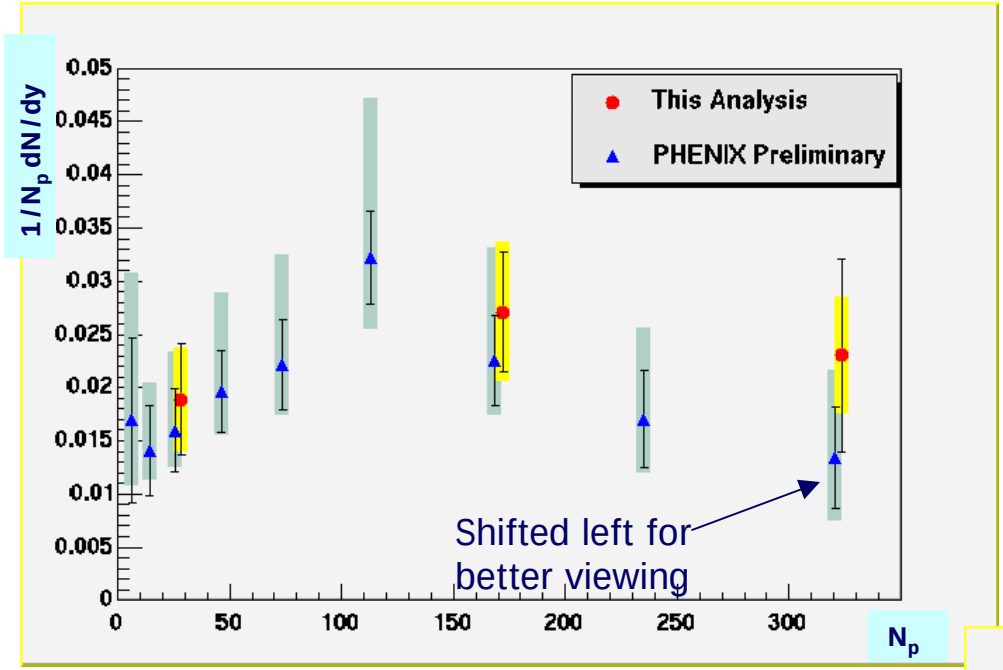


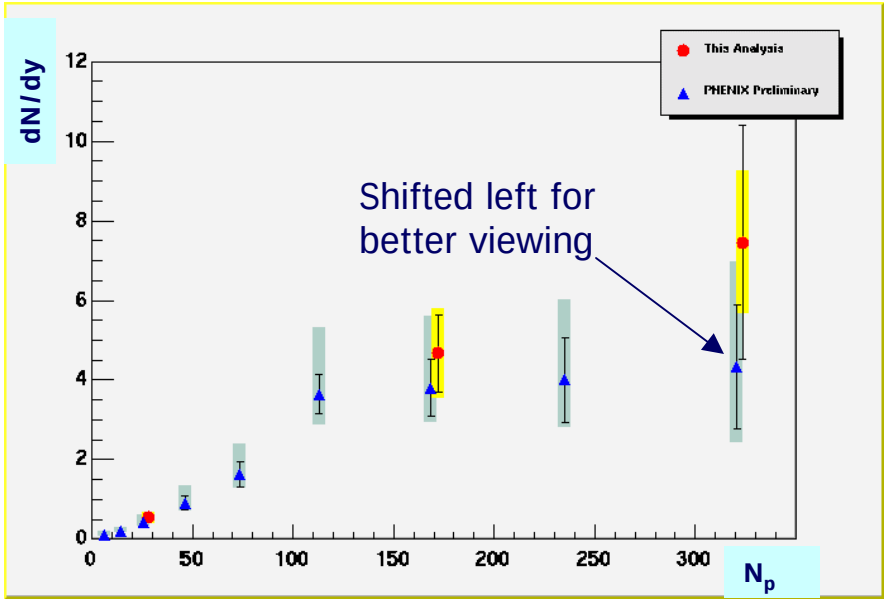




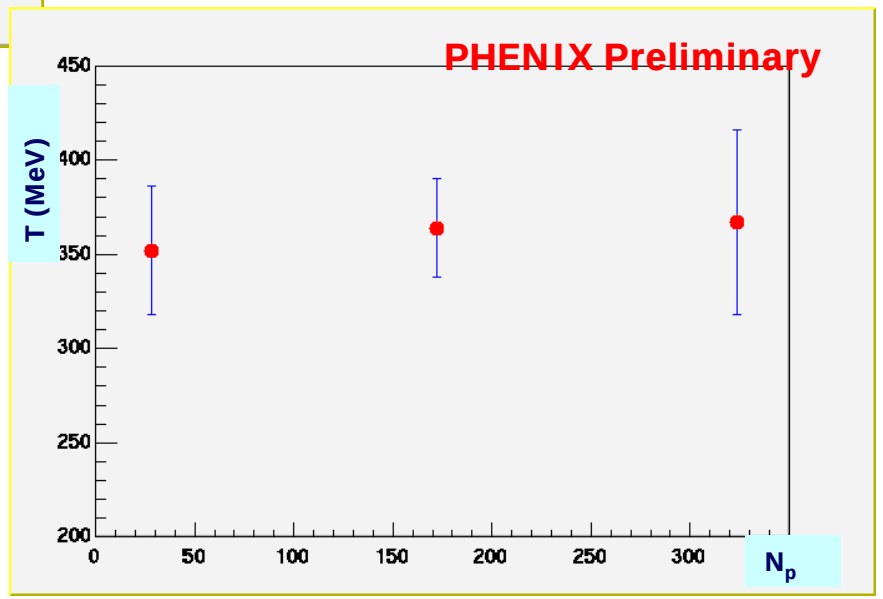


Summary on dN/dy and Inverse Slope Parameter





Centrality	dN/dy±(stat) ±(syst) (This Analysis)	T (MeV)
0%-10%	7.46± 2.94±1.79	367 ±49
10%-40%	4.67±0.96±1.12	364±26
40%-92%	0.54±0.15±0.14	352±34
Min bias	2.35±0.38 ±0.54	371±20



Summary

- ϕ mesons are reconstructed via K^+K^- channel for the Au-Au Collisions at $\sqrt{S_{NN}}$=200GeV.
- m_t spectra of ϕ are studied for three centralities.
  - The spectra were fitted with an exponential and the ϕ yield and inverse slope parameters were extracted from the fit.
- Centrality dependence of yield is studied.
- The inverse slope parameters appear to be unaffected with the centrality.
  - The systematic error on the slope parameters are still under investigation.
- Inclusion of the higher statistics Electromagnetic Calorimeter is underway.