Reconstruction of K*(892) Resonance in Au+Au Collisions at 200 GeV at STAR

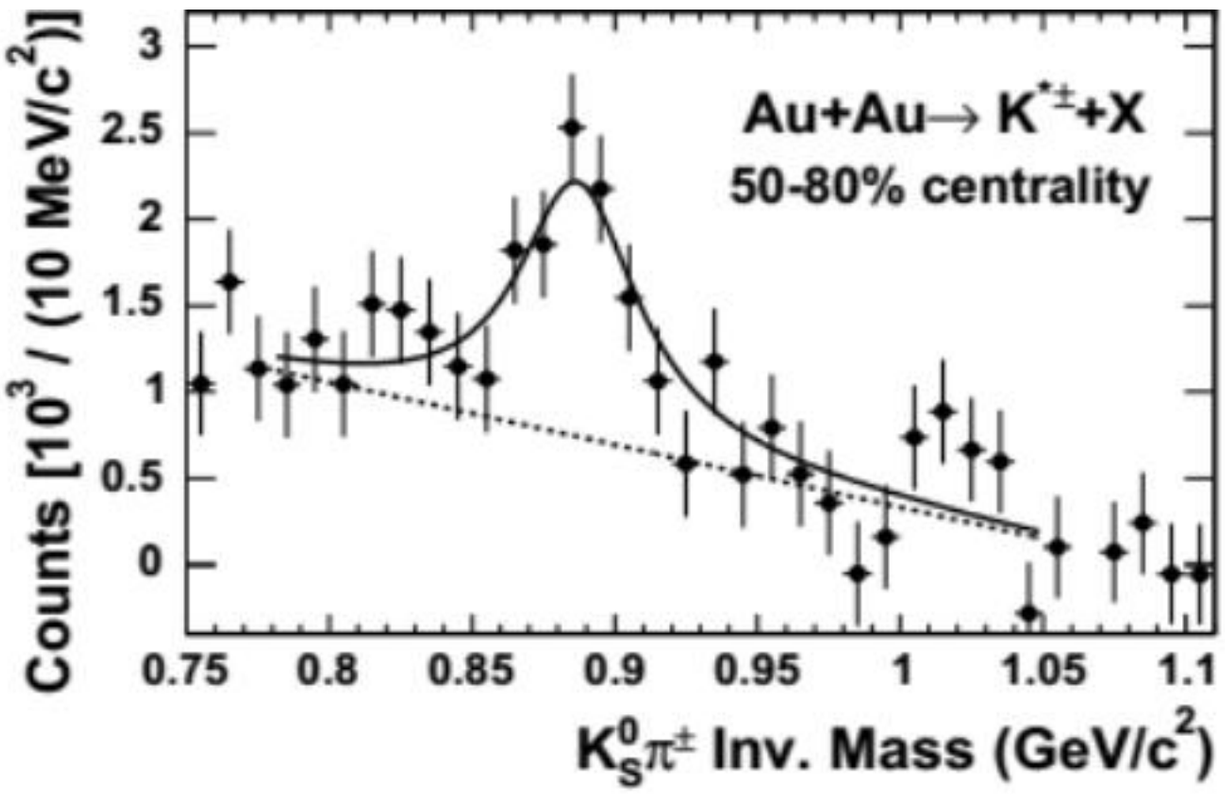
Peter He Zheng
University of California, Los Angeles
for the STAR Collaboration

Outline

- Motivations
- Data and Cuts
- K_s^0 Signals
- $K^{*\pm}$Signals
- Summary and Outlook

Motivations

- K* is not previously well studied at RHIC:
  - vector meson with a lifetime of 4 fm/c.
  - Decay Channel: $K^{*\pm}(892) \rightarrow K_s^0\pi^{\pm}$, $K_s^0 \rightarrow \pi^+\pi^-$
- Previous results from the second RHIC run (2001-2002) with Au+Au collisions at √sNN = 200 GeV.
- With current statistics and PID capability, we can do much better.



Reference: arXiv:nucl-ex/0412019v2
22 Apr 2005

Data

- The data used in this analysis were the Run 2011, minimum bias trigger Au+Au collisions at √sNN = 200 GeV at STAR.

- The centrality is defined using the standard STAR definition.

- In this report, charged K* invariant mass spectra for centrality 50%~80% and 20%~50%, reconstructed with transverse momentum less than 3 GeV/c are presented respectively.

Track Cuts, Event Cuts and Particle Identification

NFitPnts is the number of fit points of a track in the TPC, NTpcHits is the number of hits of a track in the TPC, MaxPnts is the number of maximum possible points of a track in the TPC, and DCA is the distance of closest approach to the primary interaction point. Tof is the time of flight, pVtxz is the primary vertex Z, pVtxr is the primary vertex radial, vzVpd is the vertex position detector Z, β is the velocity, η is the pseudorapidity.

Event cuts

pVtxz < 30cm

pVtxr < 2cm

|pVtxz – vzVpd|< 3cm

Trigger = minimum bias

Cut for K* :

Dip angle > 0.04

(Dip angle is the angle between K^0 and pion momentum vectors)

Track cuts for K^0 reconstruction :

nHitsFit > 15

p > 0.2 GeV/c

TOF flag > 0

$|\beta-\beta_\pi| < 0.04$

$|n\sigma_\pi| < 3.0$

$dca\_\pi^+\_\pi^- < 0.8$ cm

decay length > 4.0 cm

dca_to_vtx (for K^0) < 0.85 cm

dca_to_π^+ & dca_to_π^- > 0.5 cm

mass of K^0 = (0.48, 0.51) GeV/c^2

Track cuts for pion:

$|n\sigma_\pi| < 2.0$

$0.2 < p_T < 10.0$ GeV/c

p < 10.0 GeV/c

$|\eta| < 0.8$

dca < 3.0 cm

NFitPnts > 15

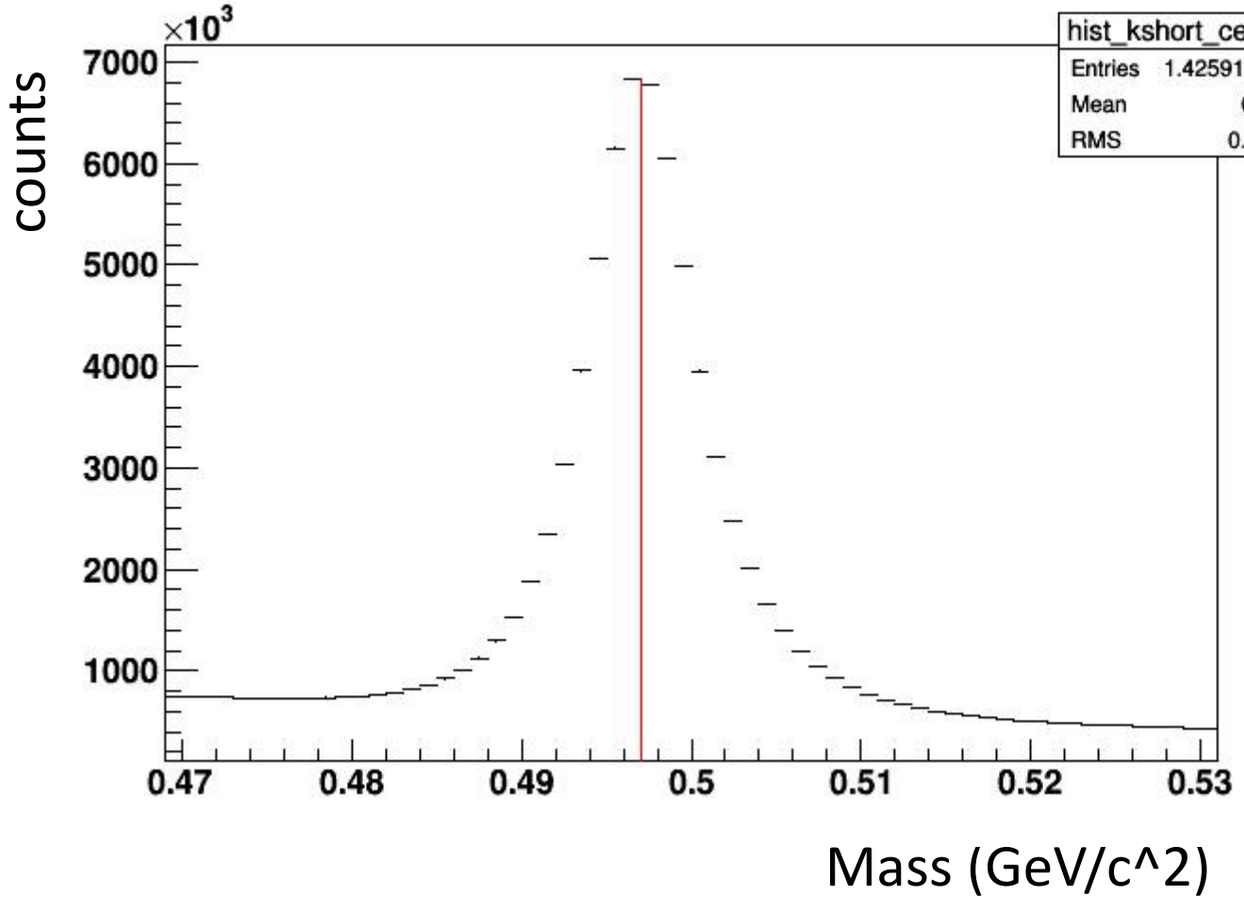
NTpcHits > 15

nHitsFit/nHitsTotal > 0.55

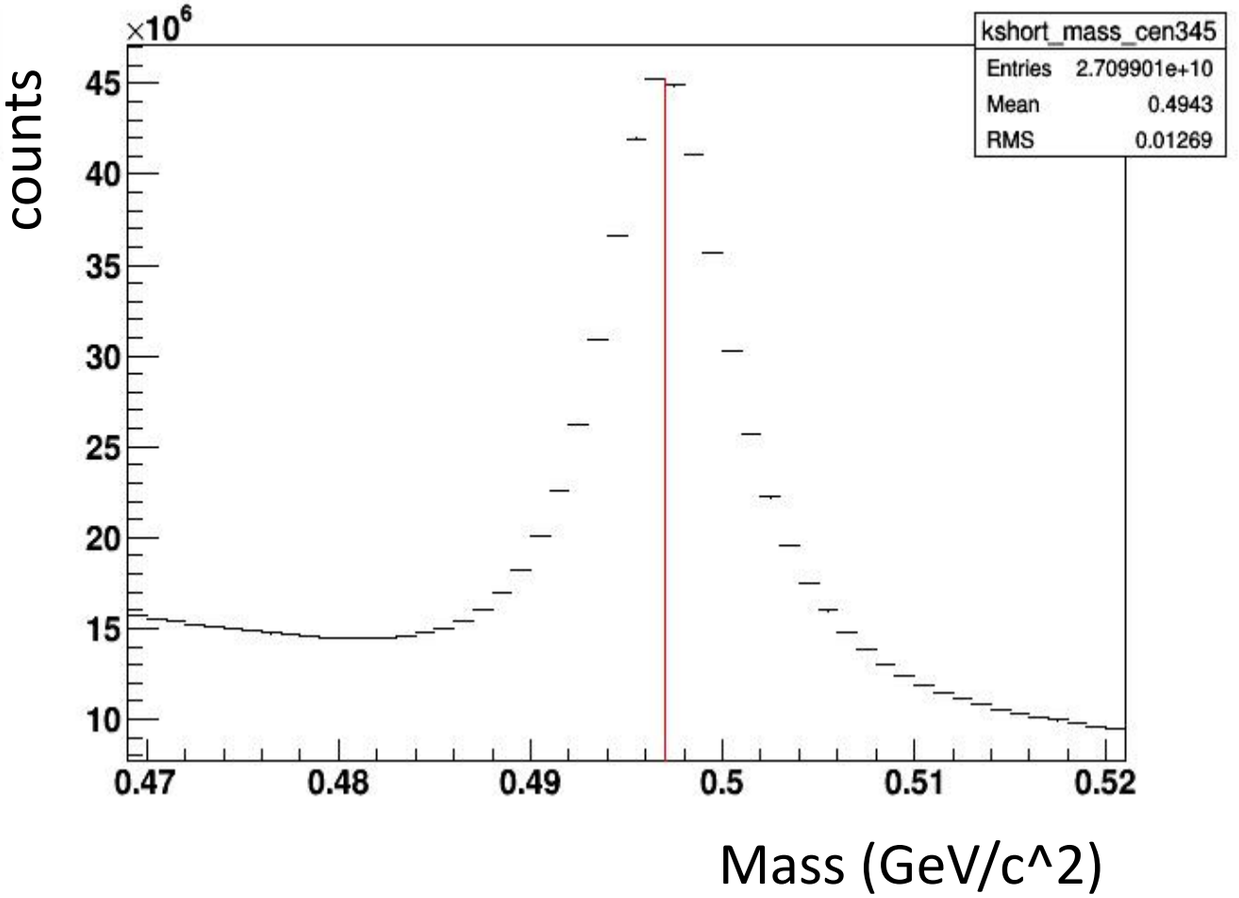
K_s^0 Signals

- Observed in the $\pi+\pi-$ invariant mass distribution reconstructed from the decay topology method.

K_s^0 Signals for Centrality 50%-80%



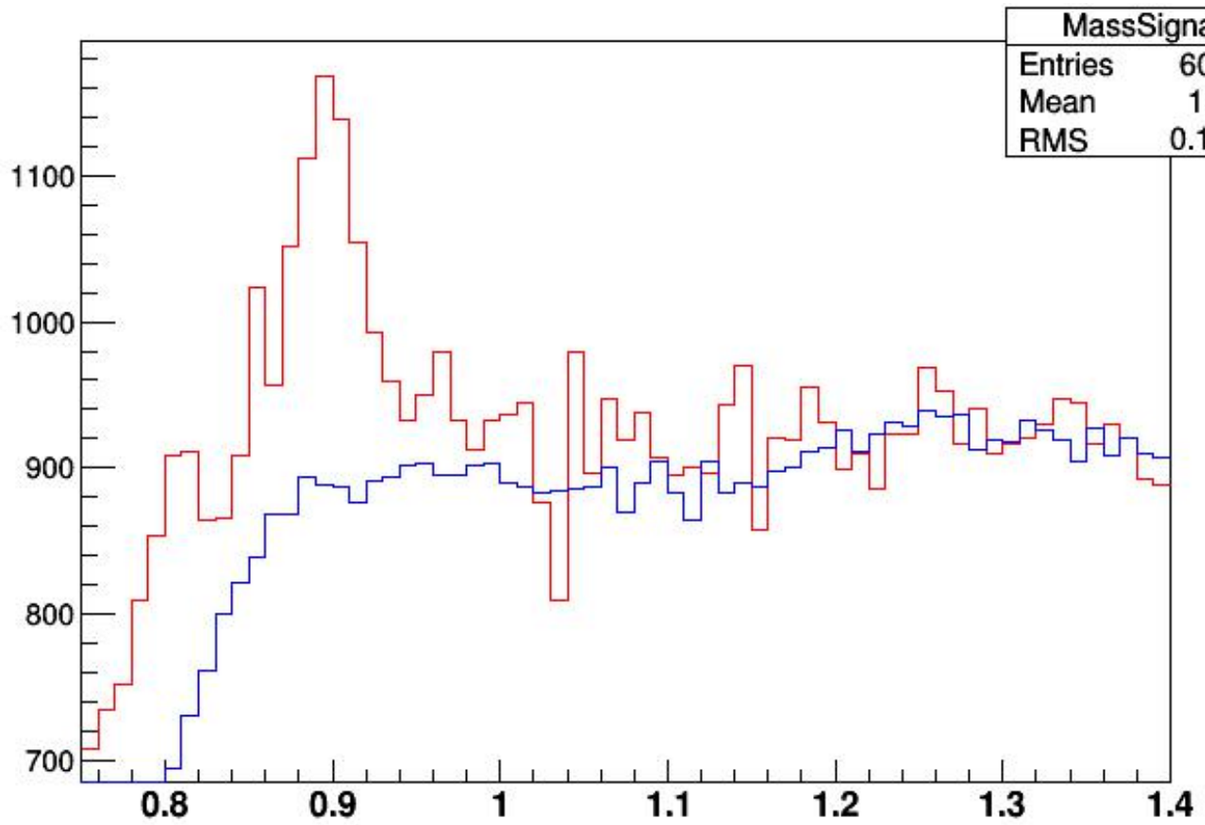
K_s^0 Signals for Centrality 20%-50%



- PDG value: $\mathrm{m} = 497.614 \pm 0.024\ MeV$

Event Mixing Background

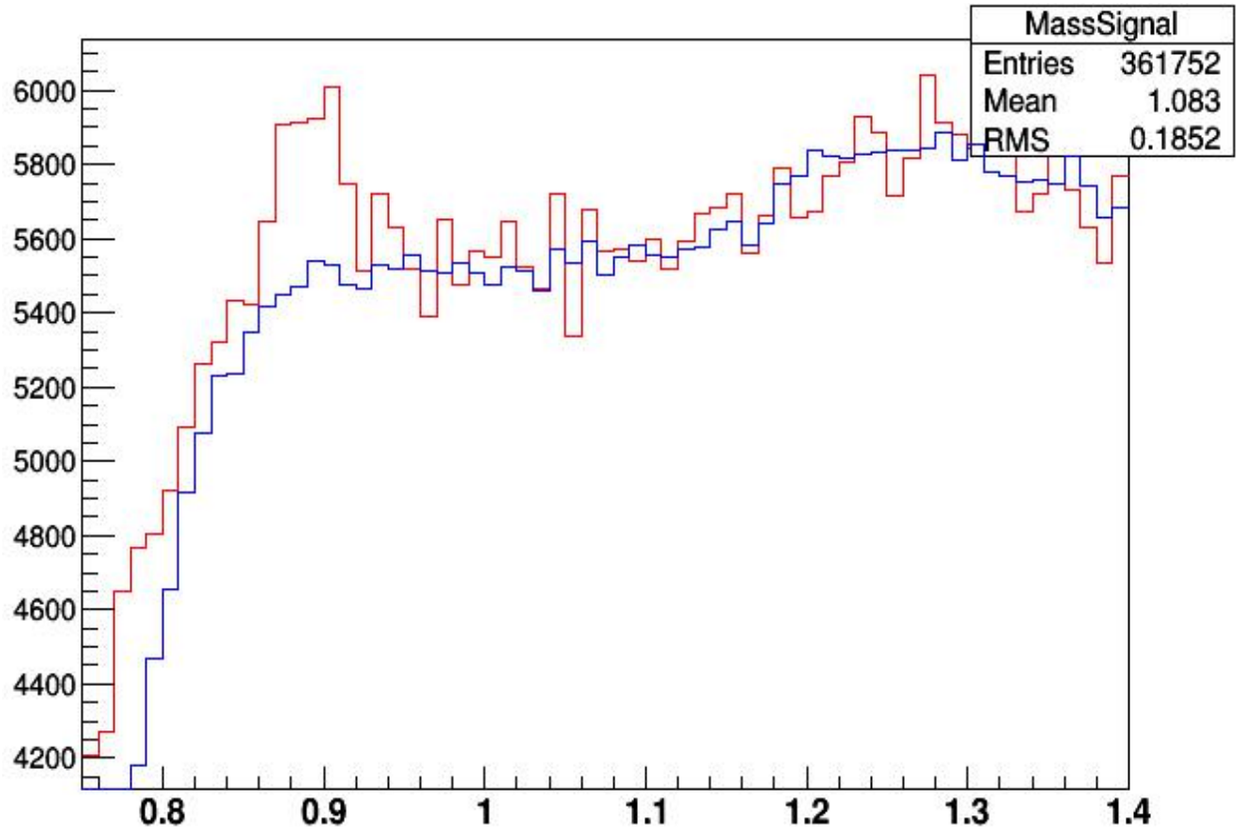
Red: same event



Centrality 70%~80%

$p_T = 4{\sim}5\ GeV/c$

Blue: Mixed Event



Centrality 60%~70%

$p_T = 4{\sim}5\ GeV/c$

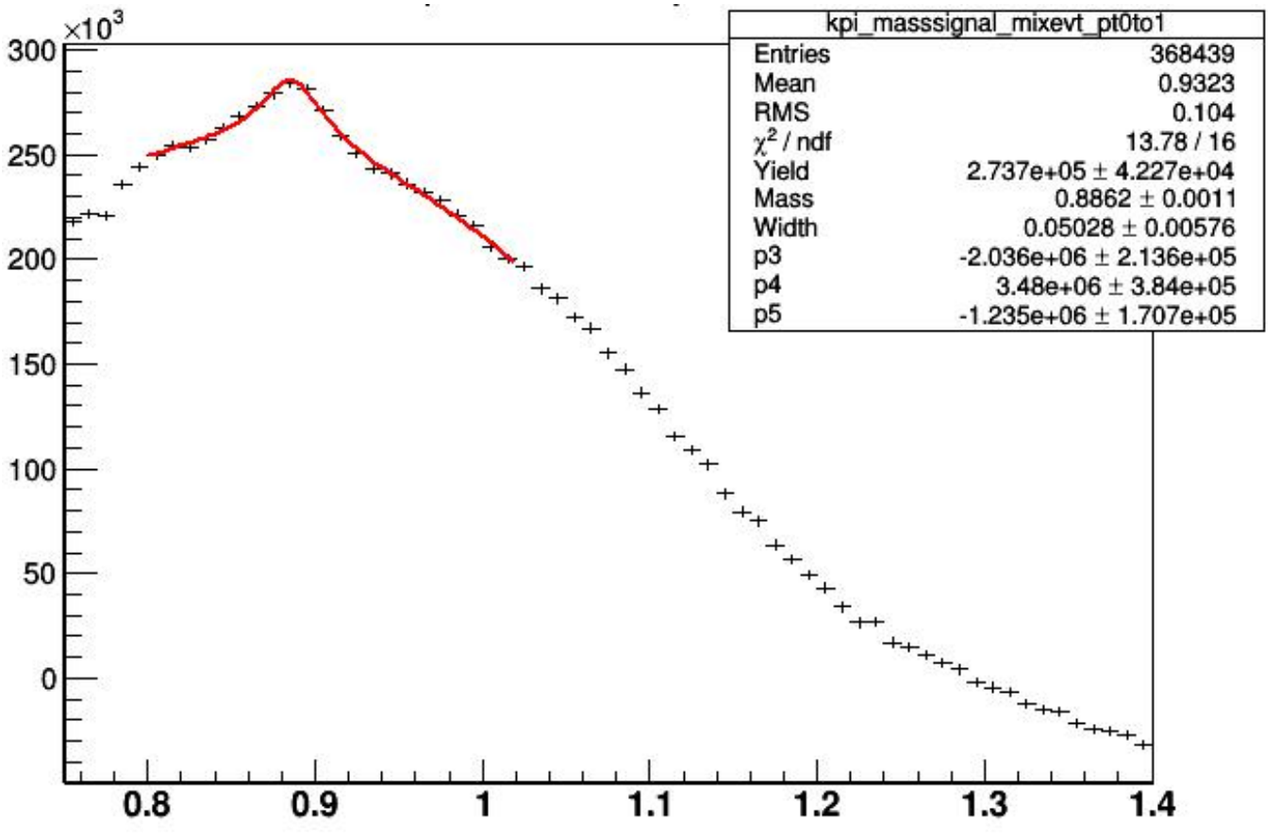
$K^{*\pm}$ Signals for Centrality 50%-80%

Fitting: the Breit-Wigner function with background fitted by a second order polynomial

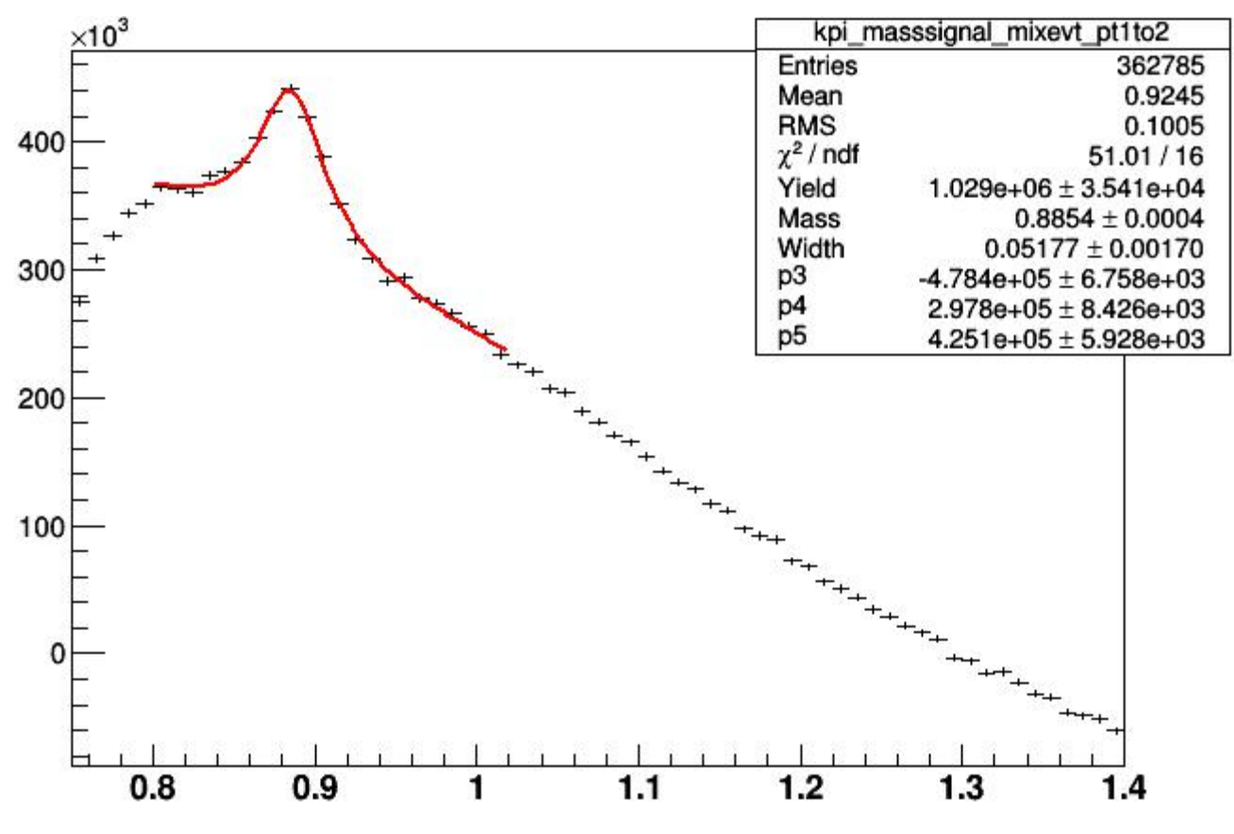
$$\frac{Y * 0.01 * W}{2\pi((x-M)^2 + W^2/4)} + ax^2 + bx + c$$

where Y = Yield, W = Width, M = Mass.

Mixed-event bg has been subtracted.

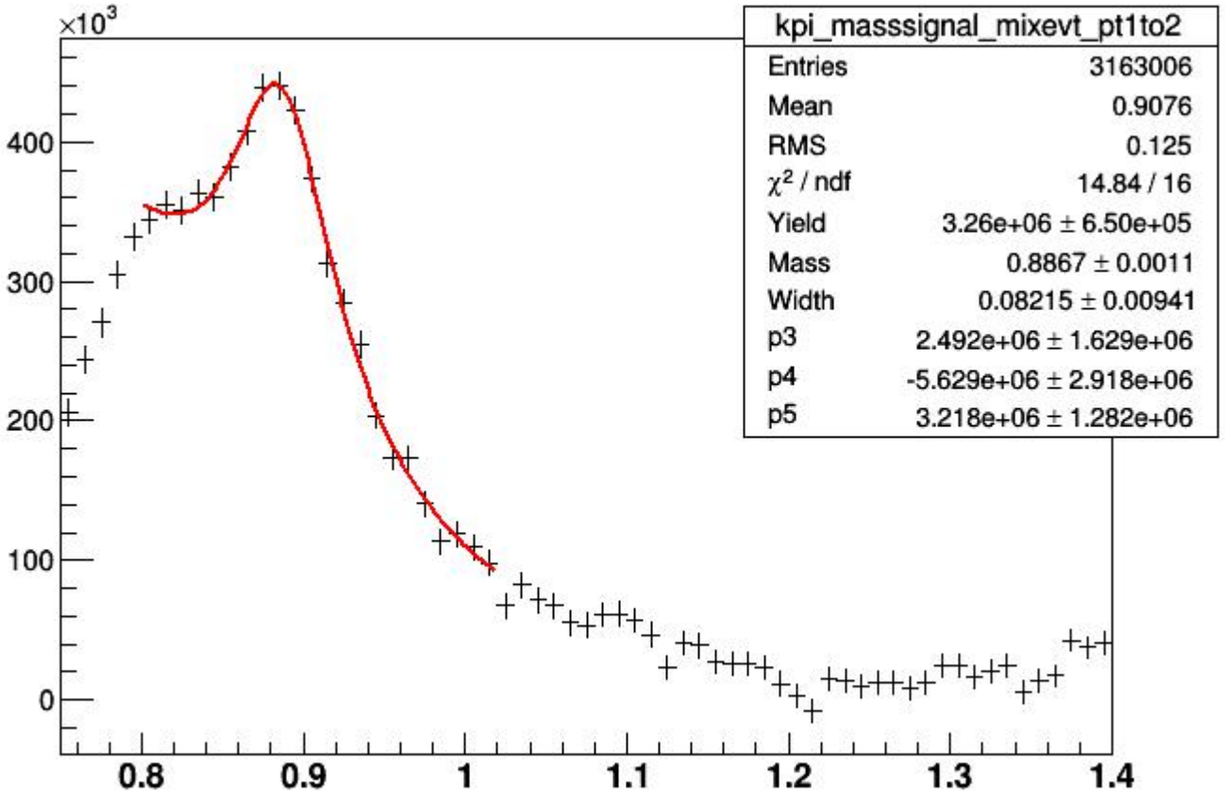


$p_T = 0\sim1$ GeV/c



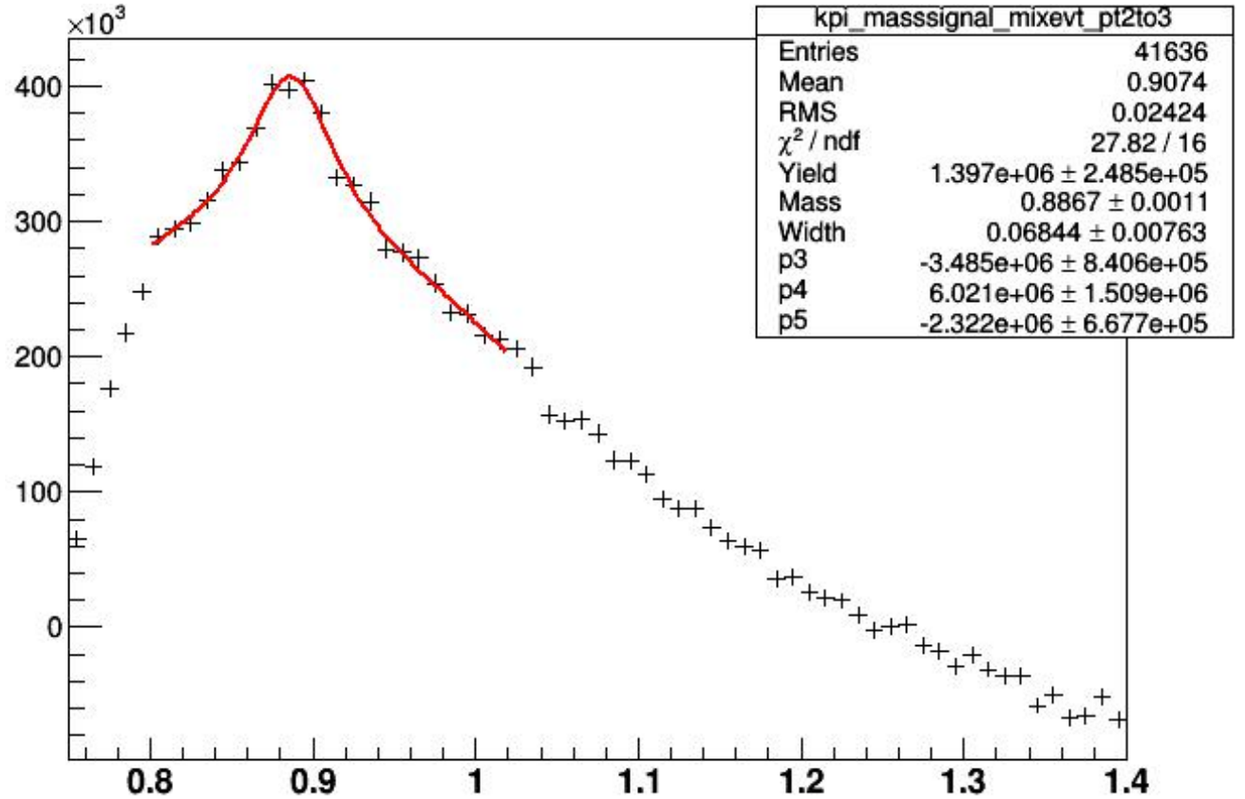
$p_T = 1\sim2$ GeV/c

$K^{*\pm}$ Signals for Centrality 20%-50%



Mass (GeV/c^2)

$p_T = 1{\sim}2$ GeV/c



Mass (GeV/c^2)

$p_T = 2{\sim}3$ GeV/c

Mass vs. p_T

- PDG value: $\mathrm{m} = 891.66 \pm 0.26\ MeV$
  - Width = $50.8 \pm 0.9\ MeV$

Centrality & p_T Range	K* Mass (MeV/c^2)	Width (MeV/c^2)
50%~80%, 0~1 GeV/c	886.2±1.1	50.28±5.76
50%~80%, 1~2 GeV/c	885.4±0.4	51.77±1.70
30%~50%, 1~2 GeV/c	886.7±1.1	82.15±9.41
30%~50%, 2~3 GeV/c	886.7±1.1	68.44±7.63

- *Summary*

The signal for K*(892) resonance produced in Au-Au collisions at 200 GeV at STAR is significant. The data analysis confirms the existence of a measurable amount of K*, which allows further study of its properties.

- *Outlook*
  - More investigation of the background.
  - Study of new physics if possible, such as resonance decays in strong magnetic field. For example, how K* mass changes with the magnetic field.

- Submit a poster abstract for the Conference Experience for Undergraduates (CEU) opportunity at 2016 DNP Fall Meeting.