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

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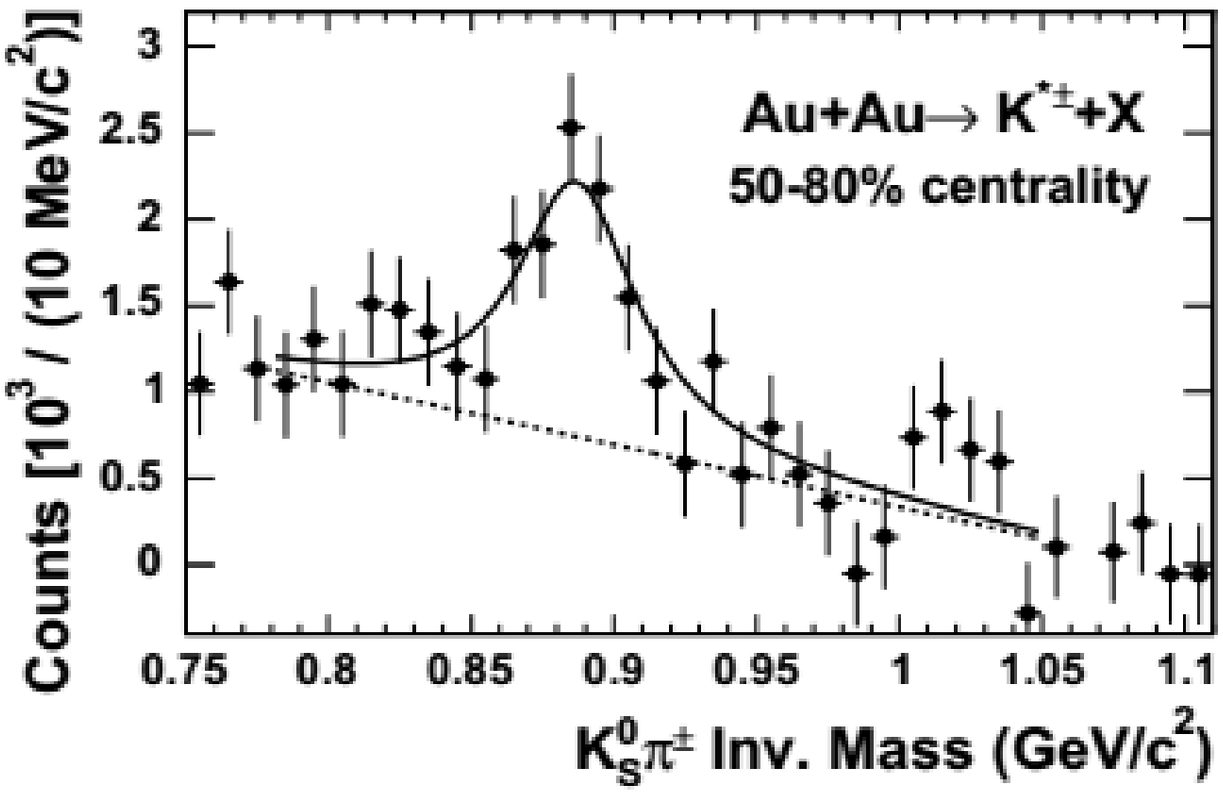
# Outline

- 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: Phys.Rev.C 71, 064902 (2005)

# Data

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

- Particle Identification: TPC (Time Projection Chamber) dE/dx and TOF (Time of Flight) are used for pion identification.

- 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 5 GeV/c are presented respectively.

- Background method: Mixed event background – Build reference background distribution by pairing decay daughters from different collision events to eliminate possible correlation dependence.

# 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, $\beta$ is the velocity, $\eta$ 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 K0 and pion momentum vectors)

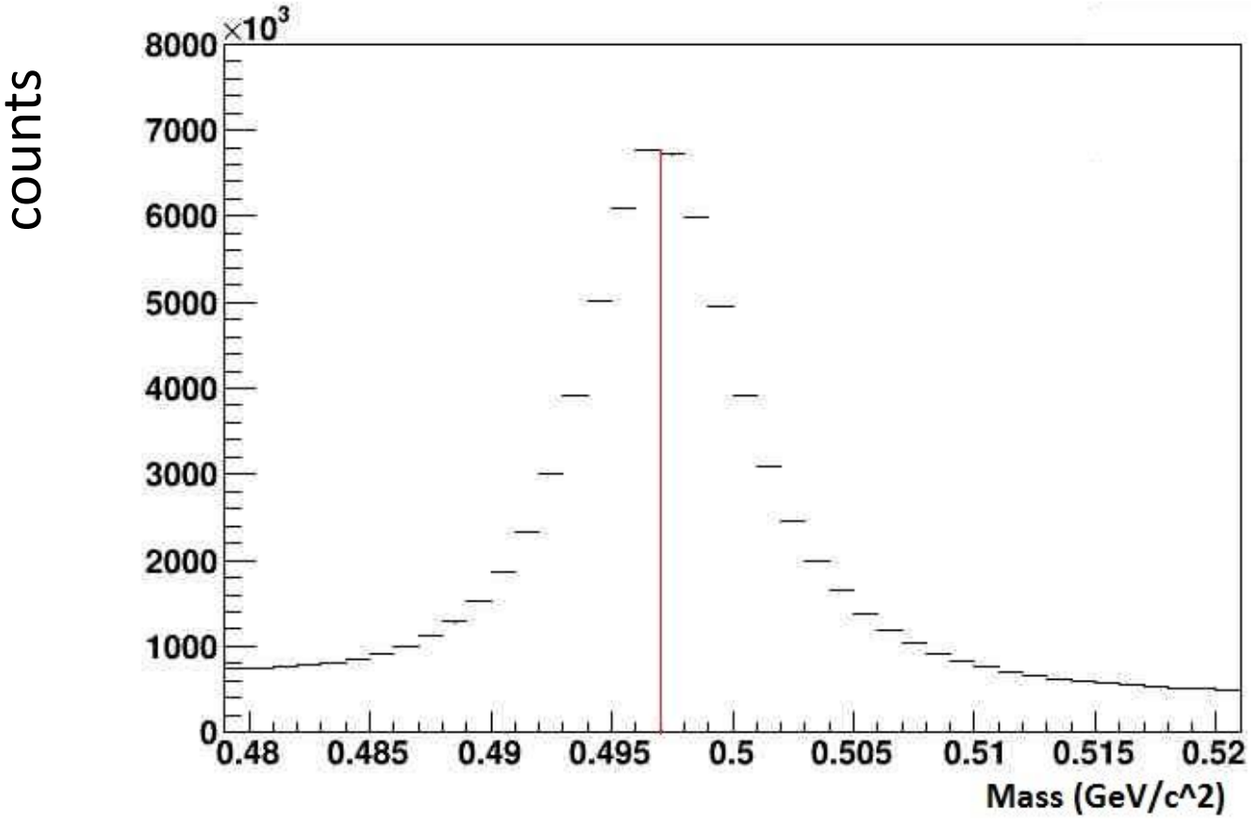
Track cuts for K0 reconstruction :
nHitsFit > 15
p > 0.2 GeV/c
TOF flag > 0
|β-βπ| < 0.04
|nσπ|< 3.0
dca_π+_π- < 0.8 cm
decay length > 4.0 cm
dca_to_vtx (for K0) < 0.85 cm
dca_to_π+ & dca_to_π- > 0.5 cm
mass of K0 = (0.48, 0.51) GeV/c2

Track cuts for pion:
|nσπ| < 2.0
0.2 < pT < 10.0 GeV/c
p < 10.0 GeV/c
|η| < 0.8
dca < 3.0 cm
NFitPnts > 15
NTpcHits > 15
nHitsFit/nHitsTotal > 0.55

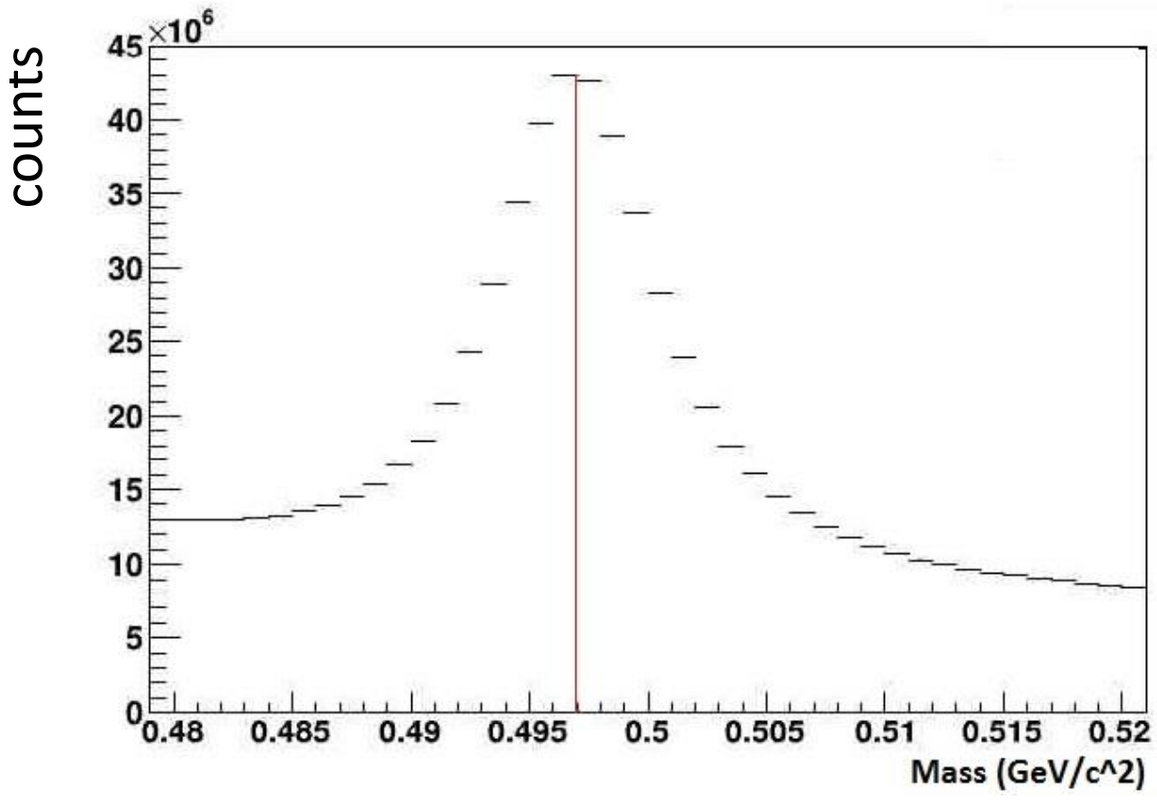
# $K_s^0$ Signals

- Observed in the π+π− invariant mass distribution reconstructed from the decay topology method.

$K_s^0$ Signals for Centrality 50%-80%



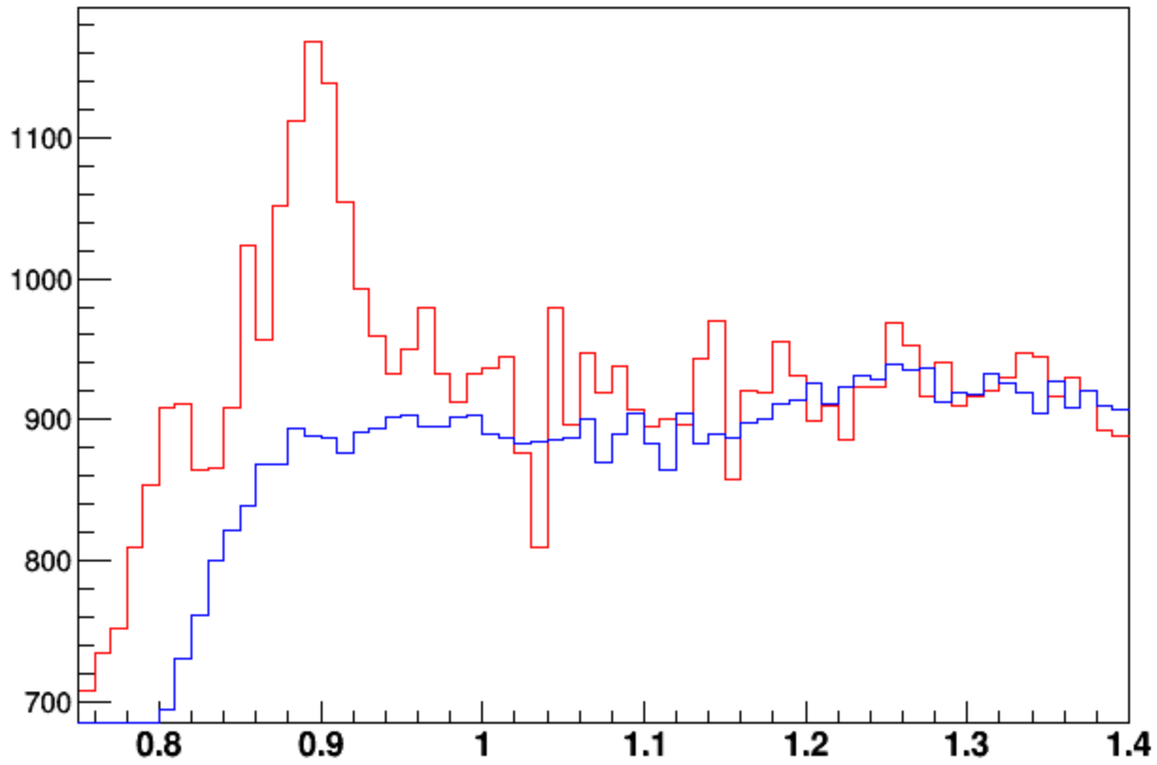

$K_s^0$ Signals for Centrality 20%-50%




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

# Event Mixing Background

Red: same event

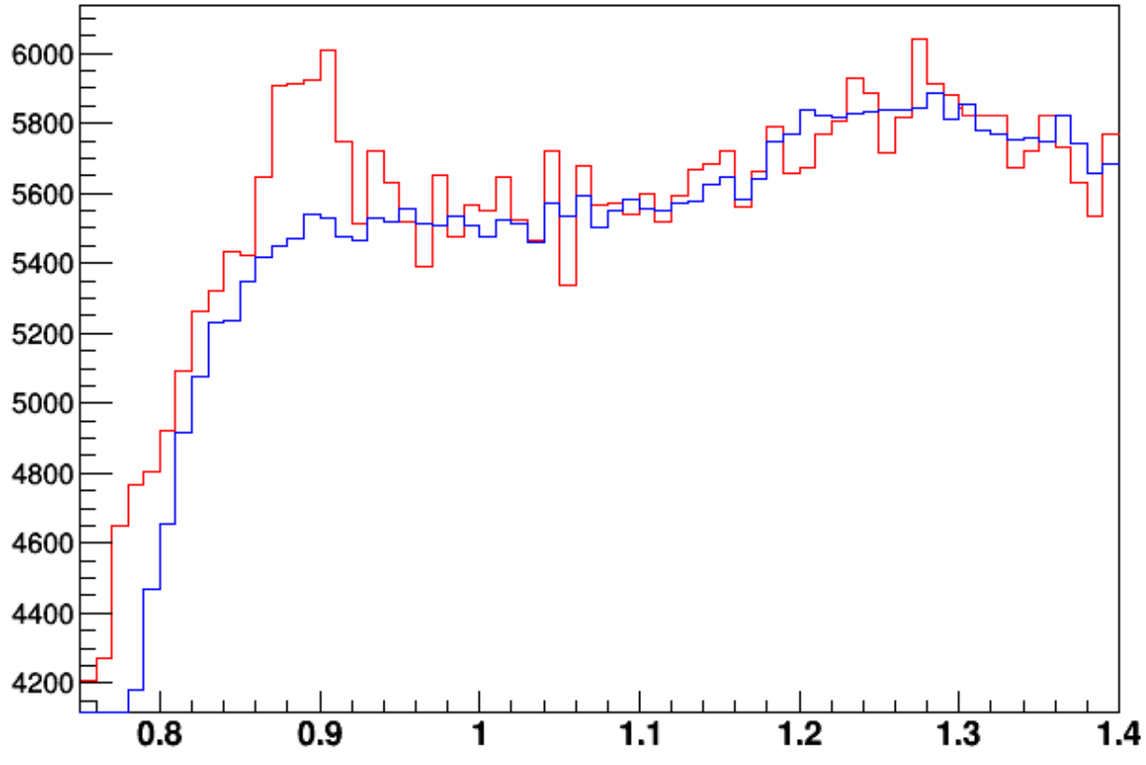



Mass (GeV/c^2)

Centrality 70%~80%

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

Blue: Mixed Event



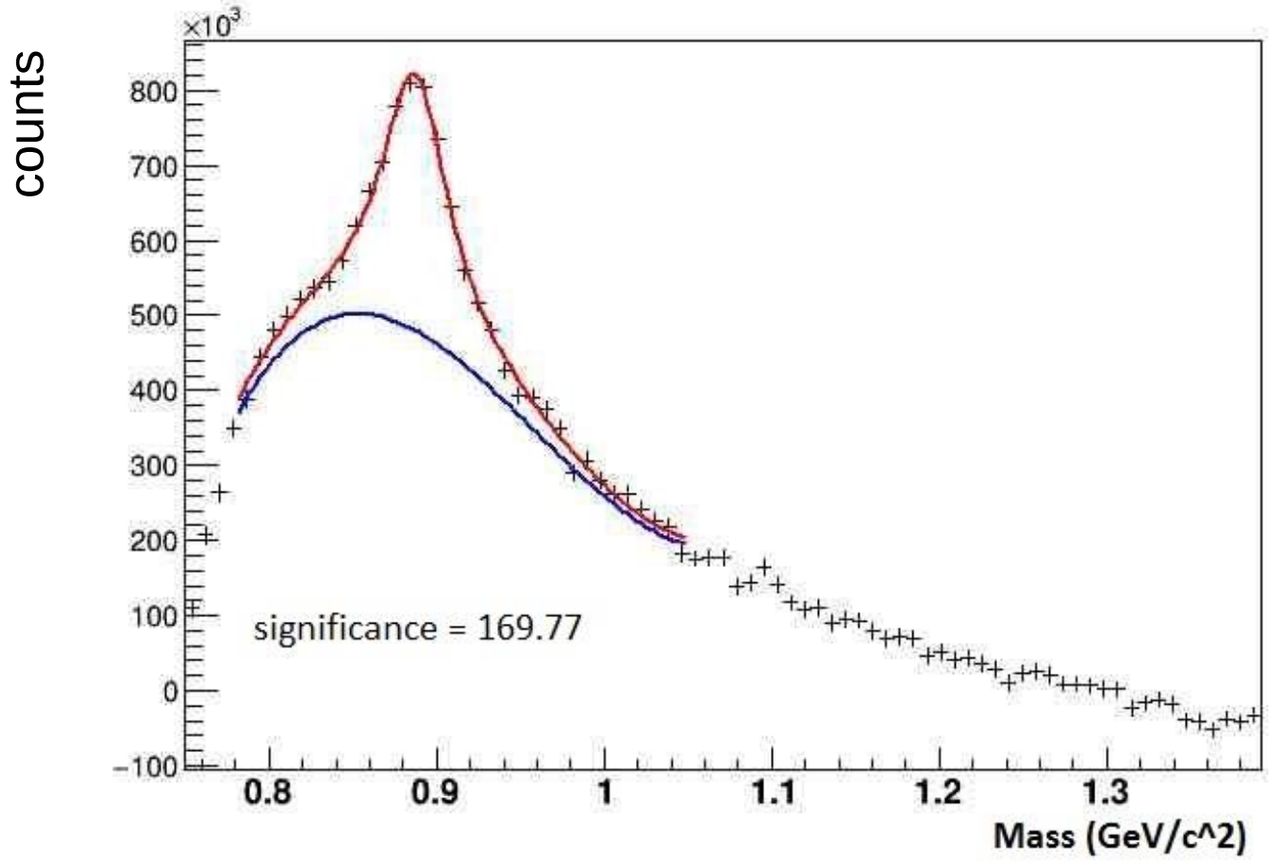

Mass (GeV/c^2)

Centrality 60%~70%

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

# $K^{+-}$ signals for all centrality combined

Mixed event background has been subtracted.



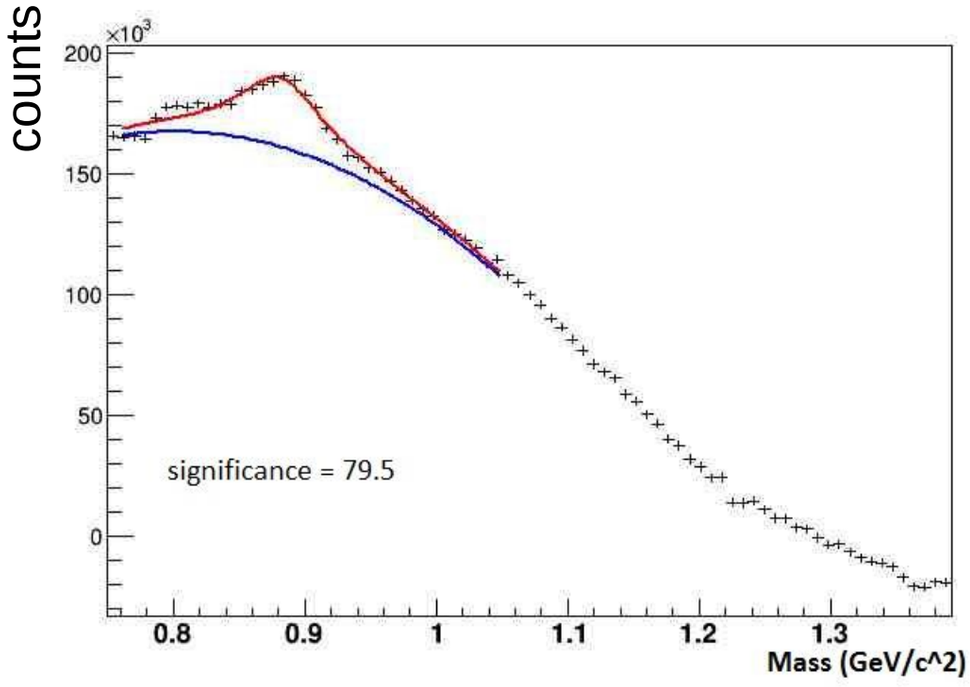

$$p_T = 0.5\sim3\ GeV/c$$

Fitting: the relativistic Breit Wigner function with background fitted by a 3rd order polynomial.

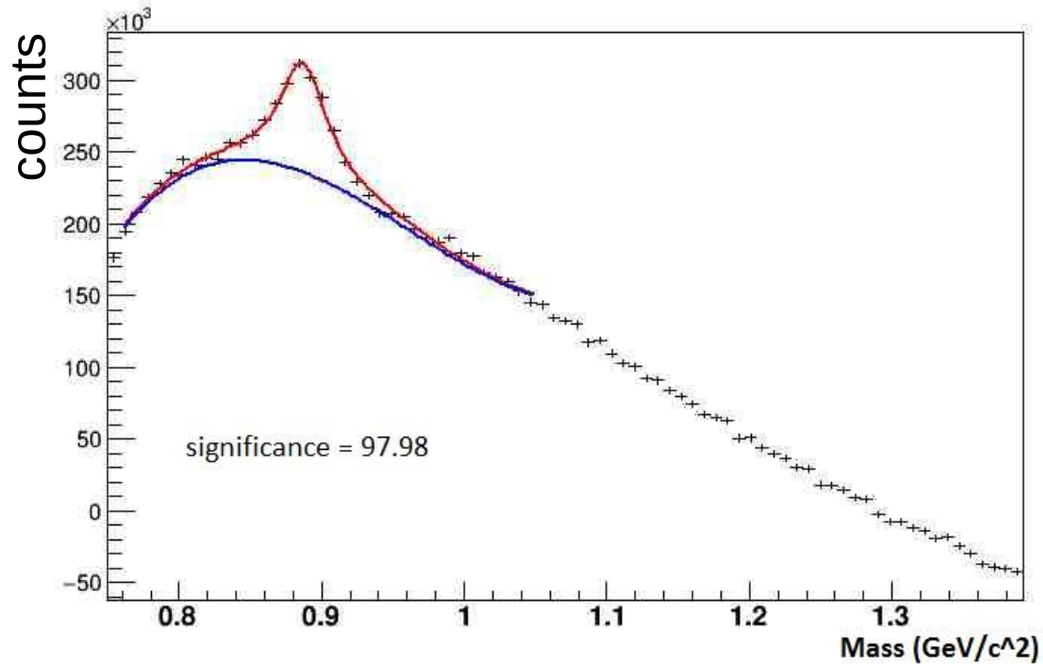
$$\frac{2\sqrt{2}YMW\sqrt{M^2(M^2+W^2)}}{\pi\sqrt{M^2+\sqrt{M^2(M^2+W^2)}}(M^2W^2+(x^2-M^2)^2)} + \mathrm{a}x^3 + \mathrm{b}x^2 + \mathrm{c}x + \mathrm{d}$$

where Y = yield, W = width, M = mass.

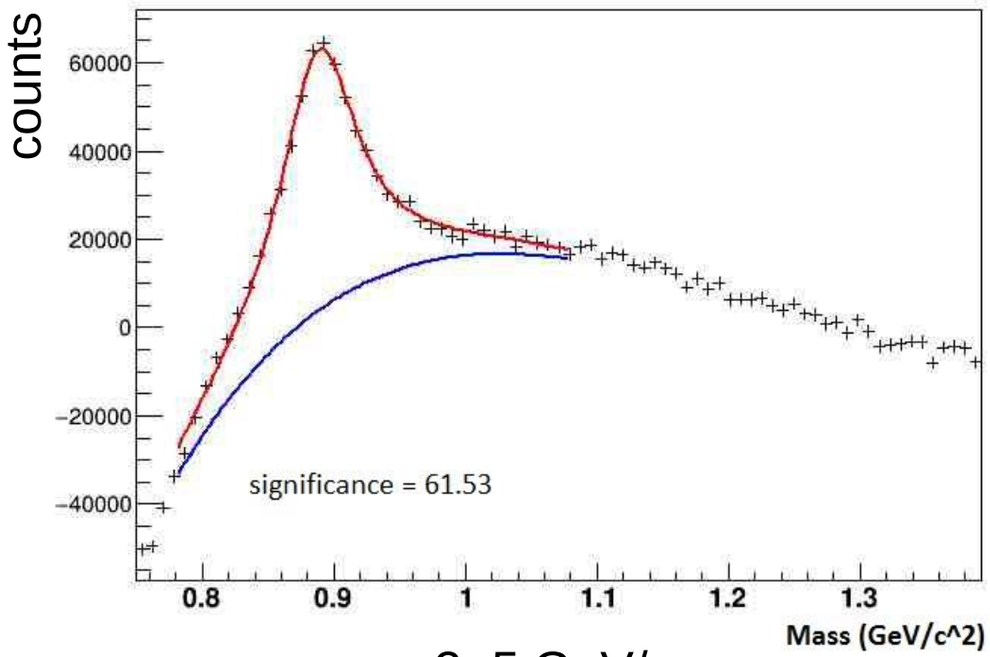
# $K^{*\pm}$ Signals for Centrality 50%~80%




$p_T$ = 0.5~1 GeV/c

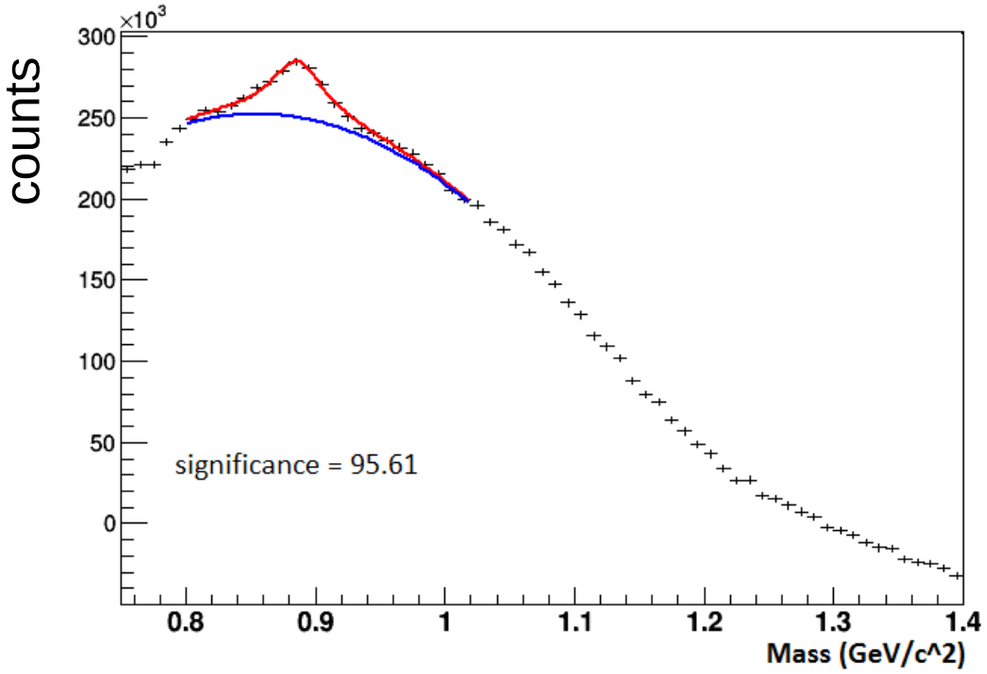



$p_T$ = 1~2 GeV/c

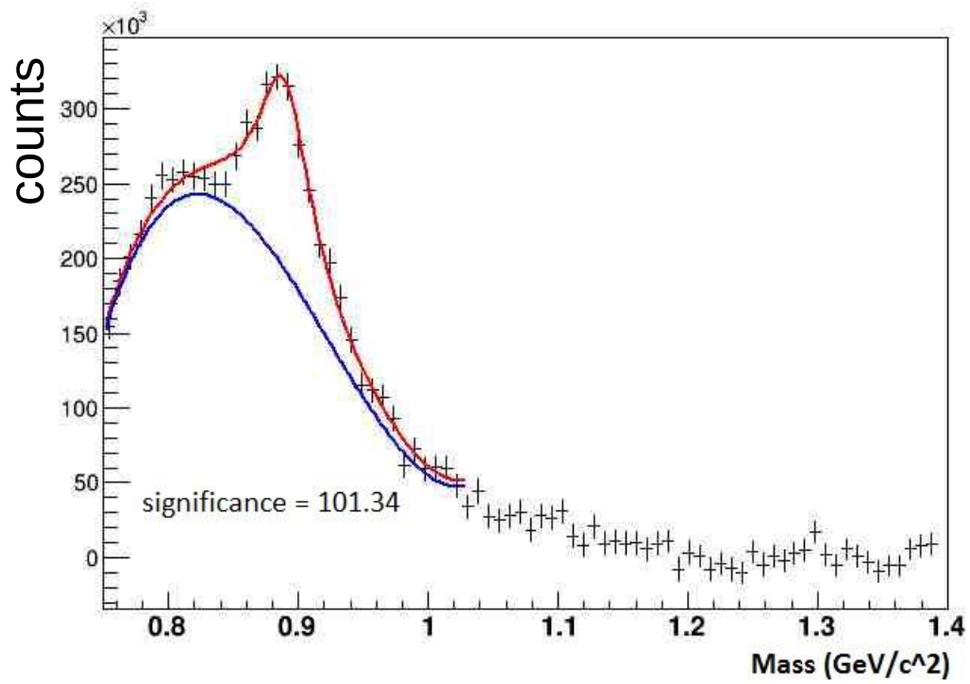



$p_T$ = 2~5 GeV/c

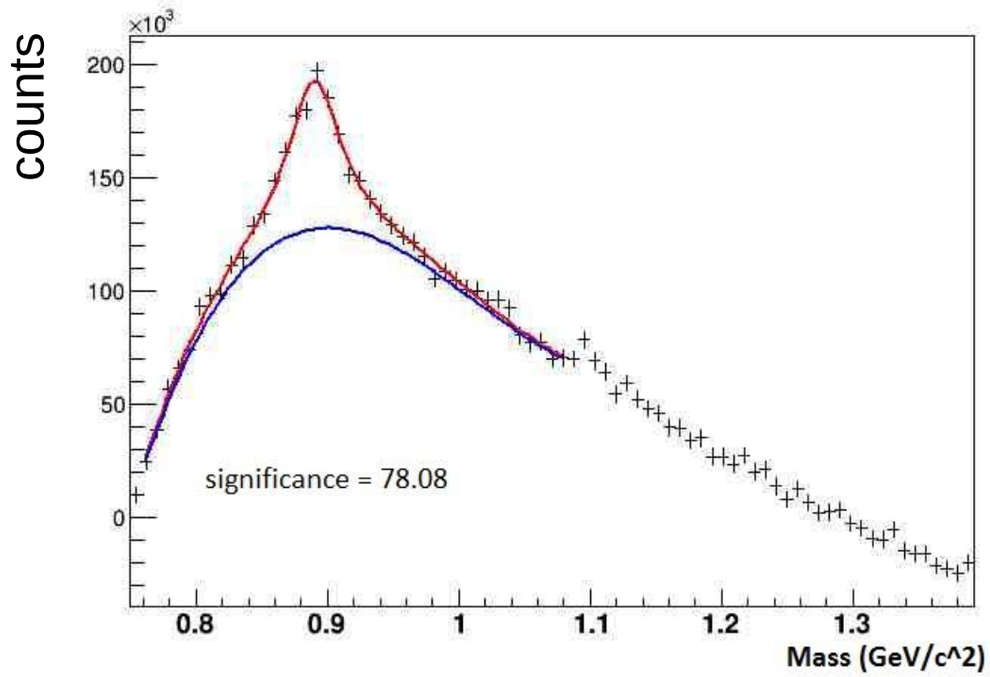
# $K^{*\pm}$ Signals for Centrality 20%~50%




$p_T$ = 0.5~1 GeV/c



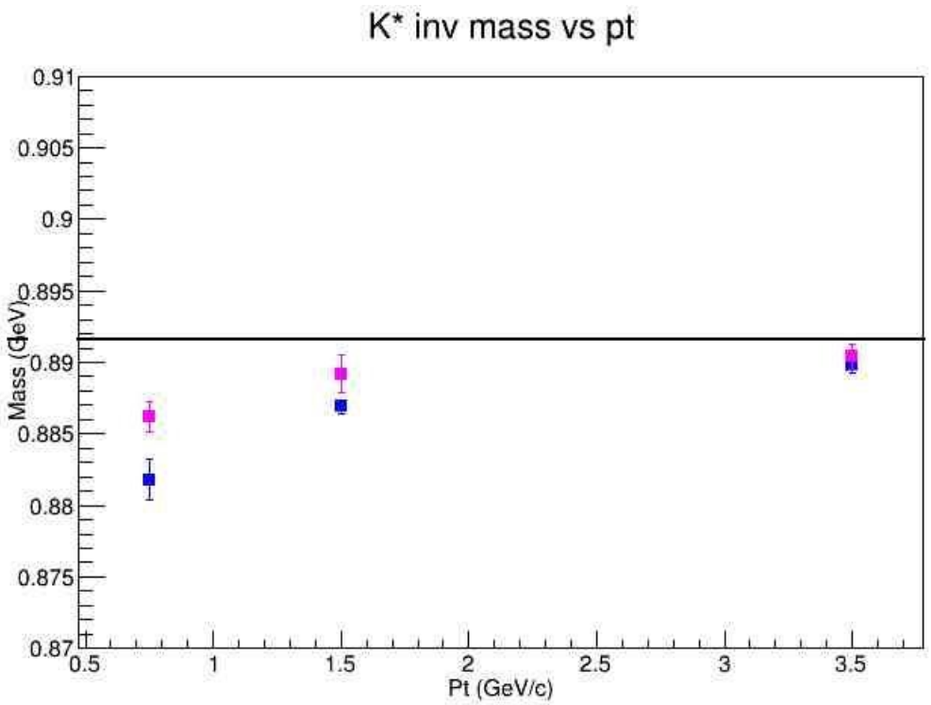

$p_T$ = 1~2 GeV/c,

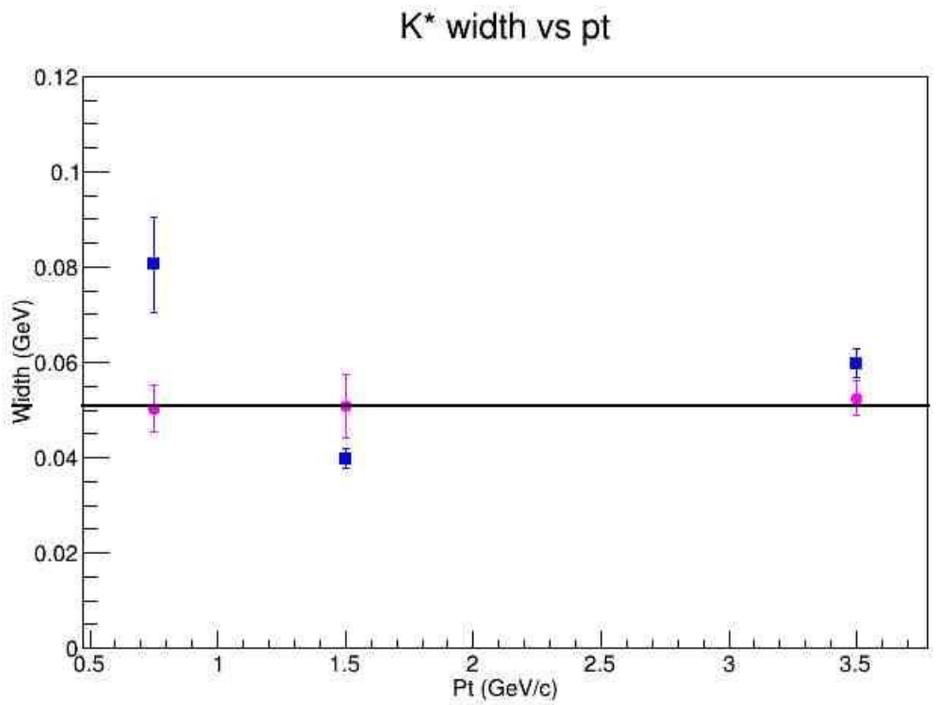



$p_T$ = 2~5 GeV/c,

# Mass/Width vs $p_T$

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




- Centrality 20%~50%
- Centrality 50%~80%

Possible sources of the differences from the PDG values may include the uncorrected efficiency and the effect of strong magnetic field created.

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