



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

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The Relativistic Heavy Ion Collider (RHIC) produces a hot, dense and de-confined Quantum Chromodynamics (QCD) medium, called the quark-gluon plasma (QGP), with Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV. The $K^*(892)$ resonance is a short-lived vector meson with a life-time of 4 fm/c, shorter than the expected life-time of the QGP. The decay of the K^* and its properties may provide an effective tool to probe the evolution of the QGP produced. Experimentally, K^* is not a well-studied particle at STAR previously because of its fast decay and large combinatorial background. In recent years, improvements in data sample statistics and particle identification capability promise better K^* measurements. In this poster, we report the reconstruction of invariant mass of K^* resonance via the hadronic decay channel $K^*(892) \rightarrow K_S^0 \pi^\pm$ as a function of transverse momentum (p_T) up to 5 GeV/c for various collision centrality classes. Physics implications of our measurements will also be discussed.

Introduction

$K^*(892)$ candidates are reconstructed by inverting the decay mode to obtain the distribution of invariant mass of the decay parent.

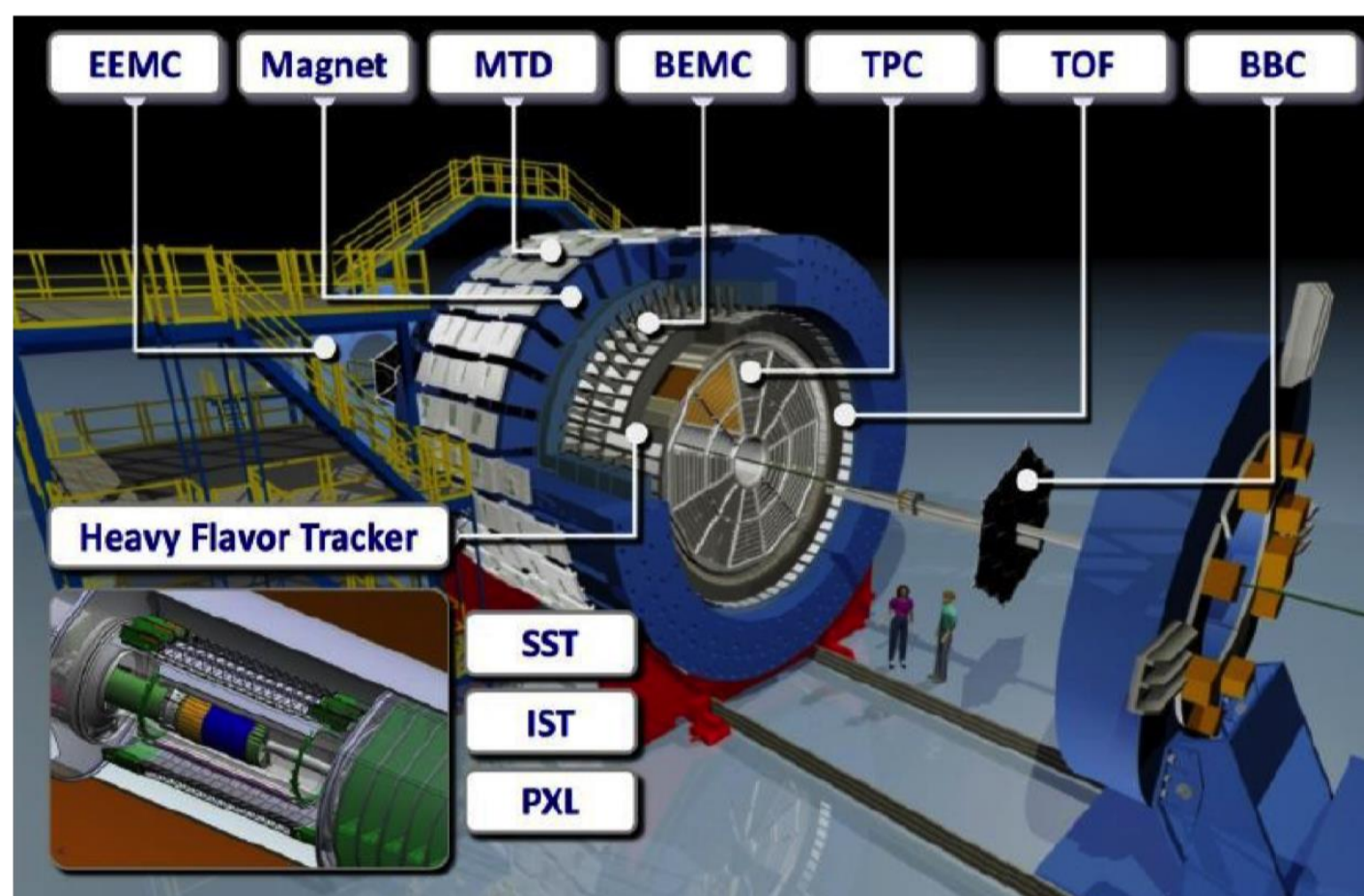
By special relativity,

$$m_{K^*} = \sqrt{E_{K^*}^2 - \vec{p}_{K^*}^2} = \sqrt{(E_{K_S} + E_\pi)^2 - (\vec{p}_{K_S} + \vec{p}_\pi)^2} \quad (c = 1)$$

So we should expect to observe a resonance peak around 0.892 GeV/c².

Background Method:

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



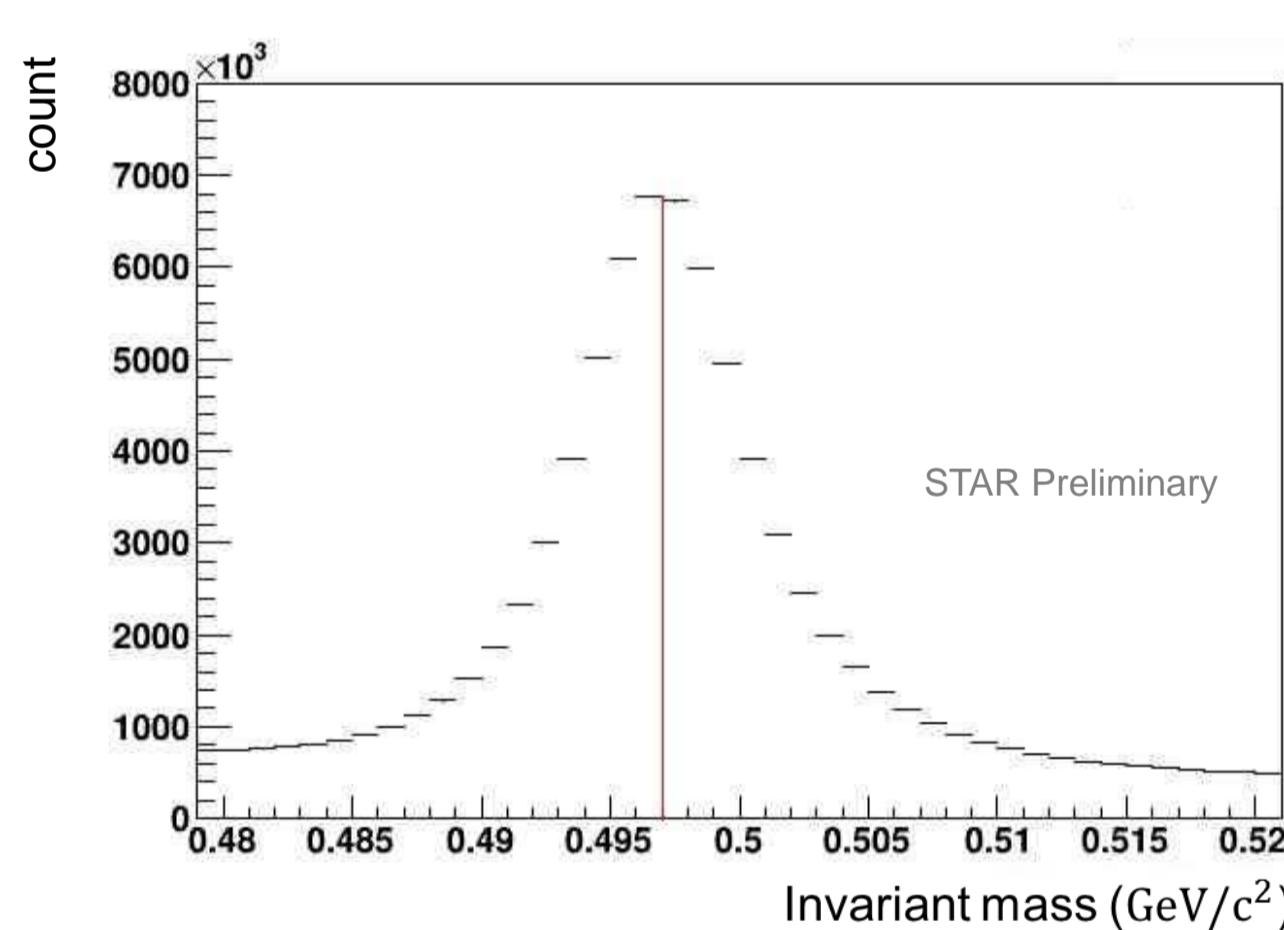
The STAR Detector

- The data used in this analysis were minimum bias trigger Au+Au collisions at 200 GeV collected in the Run 2011 from the STAR experiment.
- Particle Identification: TPC (Time Projection Chamber) dE/dx and TOF (Time of Flight) are used for pion identification.

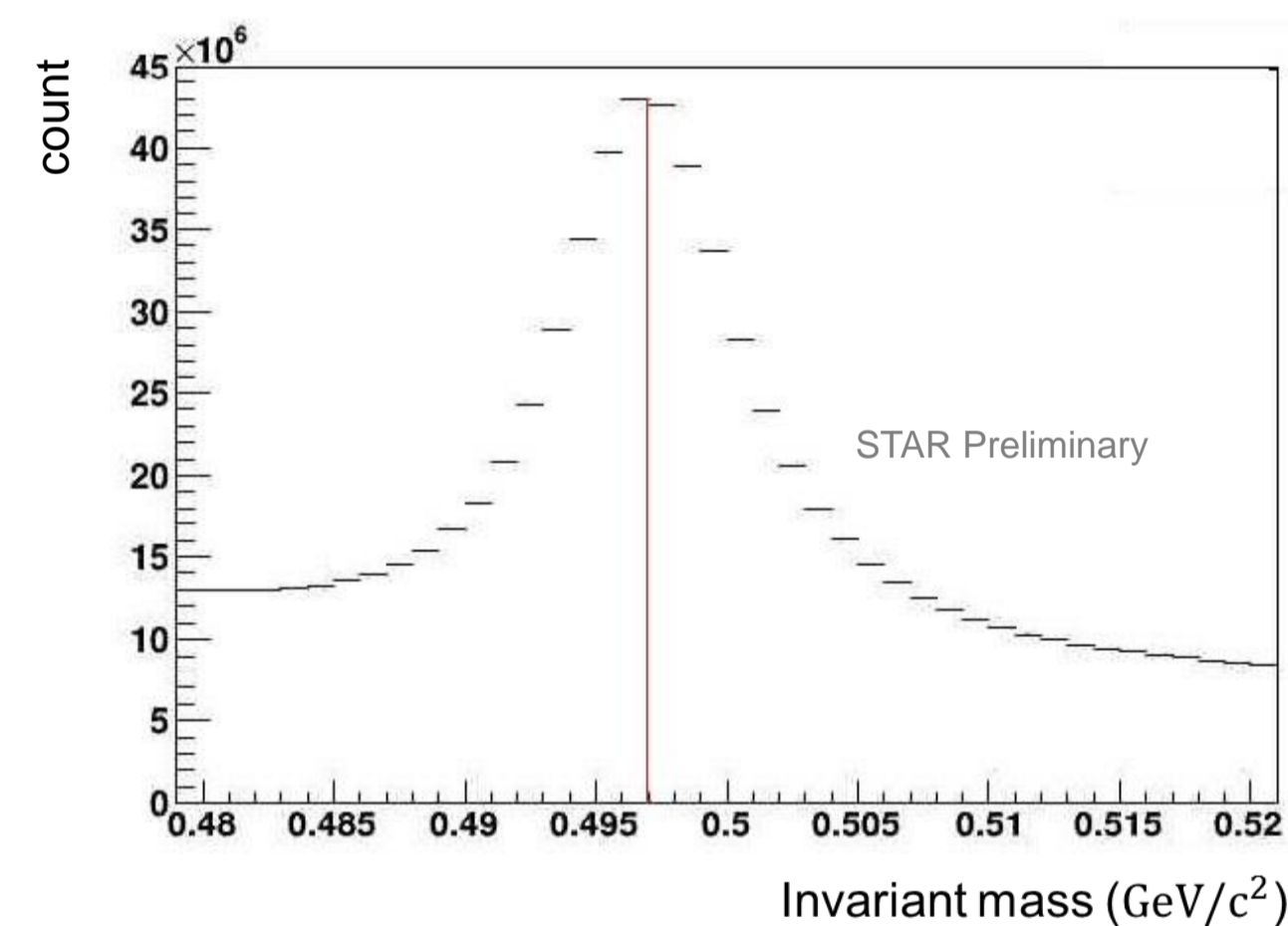
K_S^0 signals

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

K_S^0 signals for centrality 50%~80%



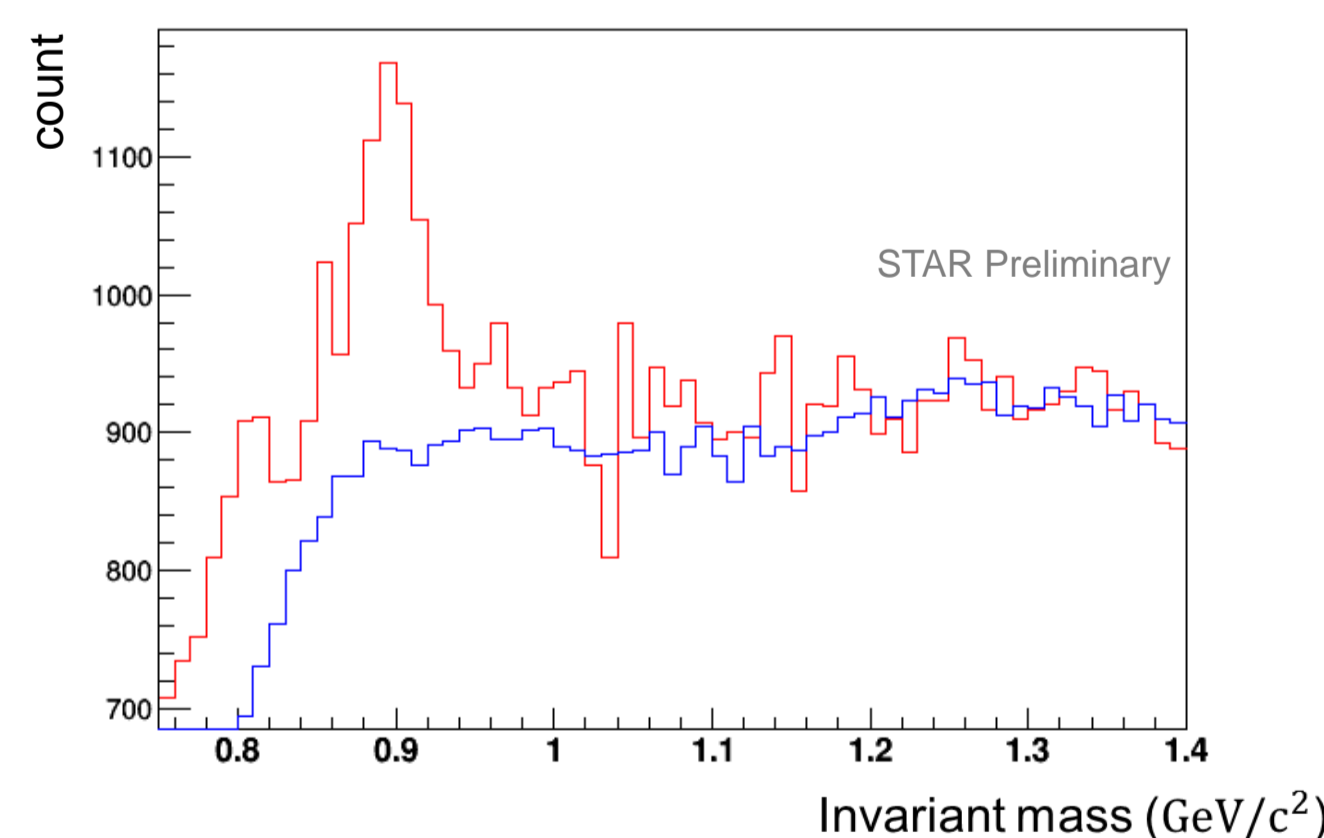
K_S^0 signals for centrality 20%~50%



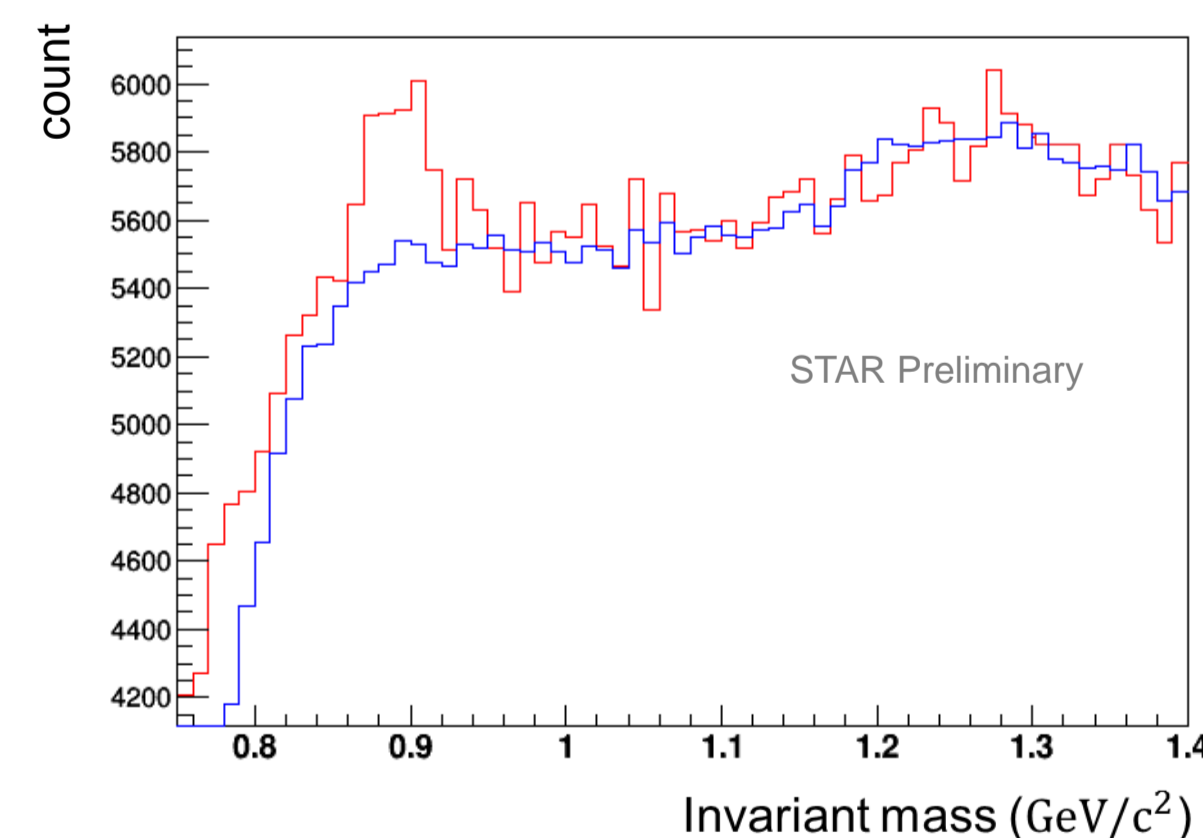
PDG value: 497.614 ± 0.024 MeV

Examples of signal (red) and event mixing background (blue):

Centrality 70%~80%, $p_T = 4\text{--}5$ GeV/c



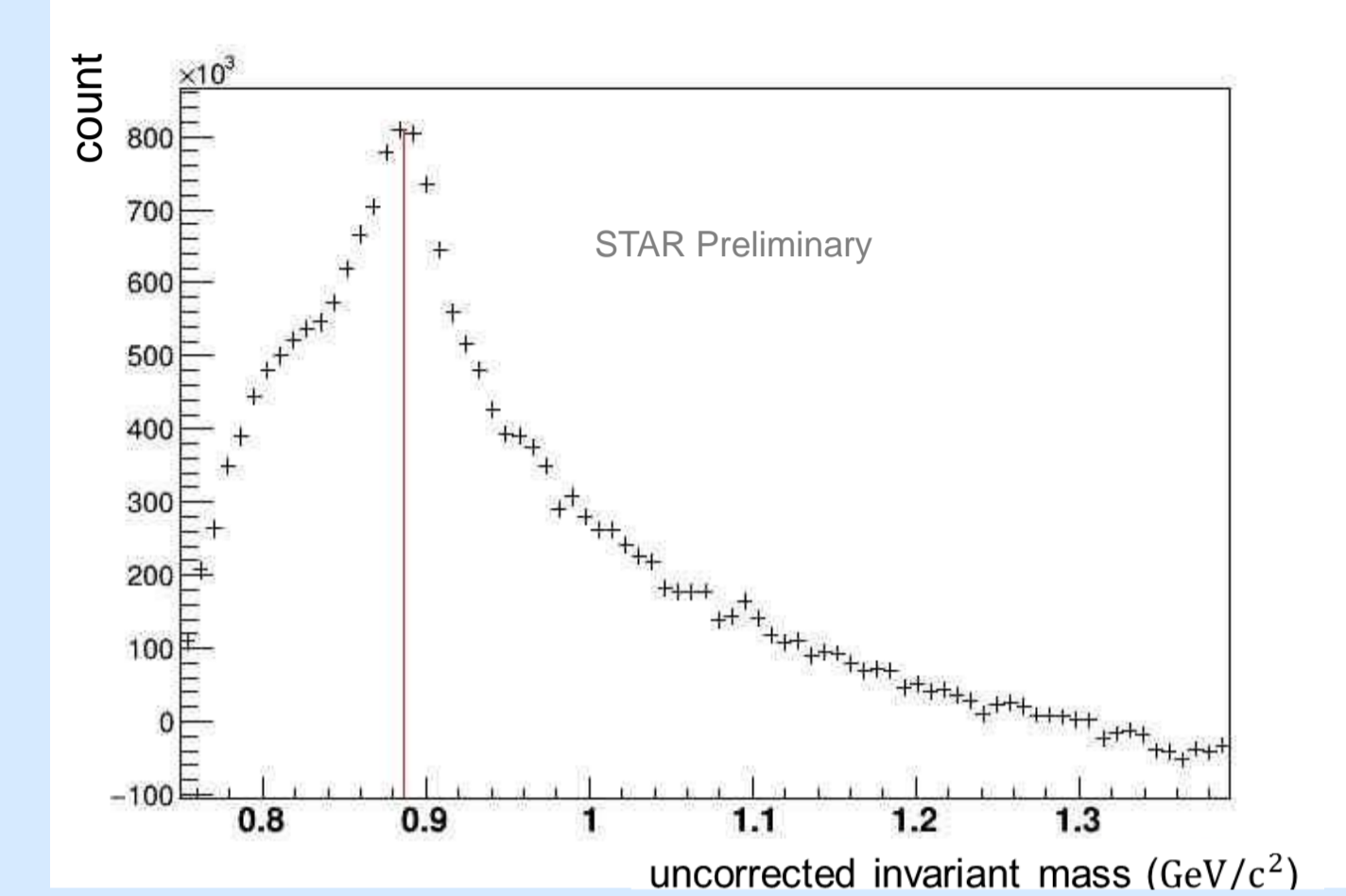
Centrality 60%~70%, $p_T = 4\text{--}5$ GeV/c



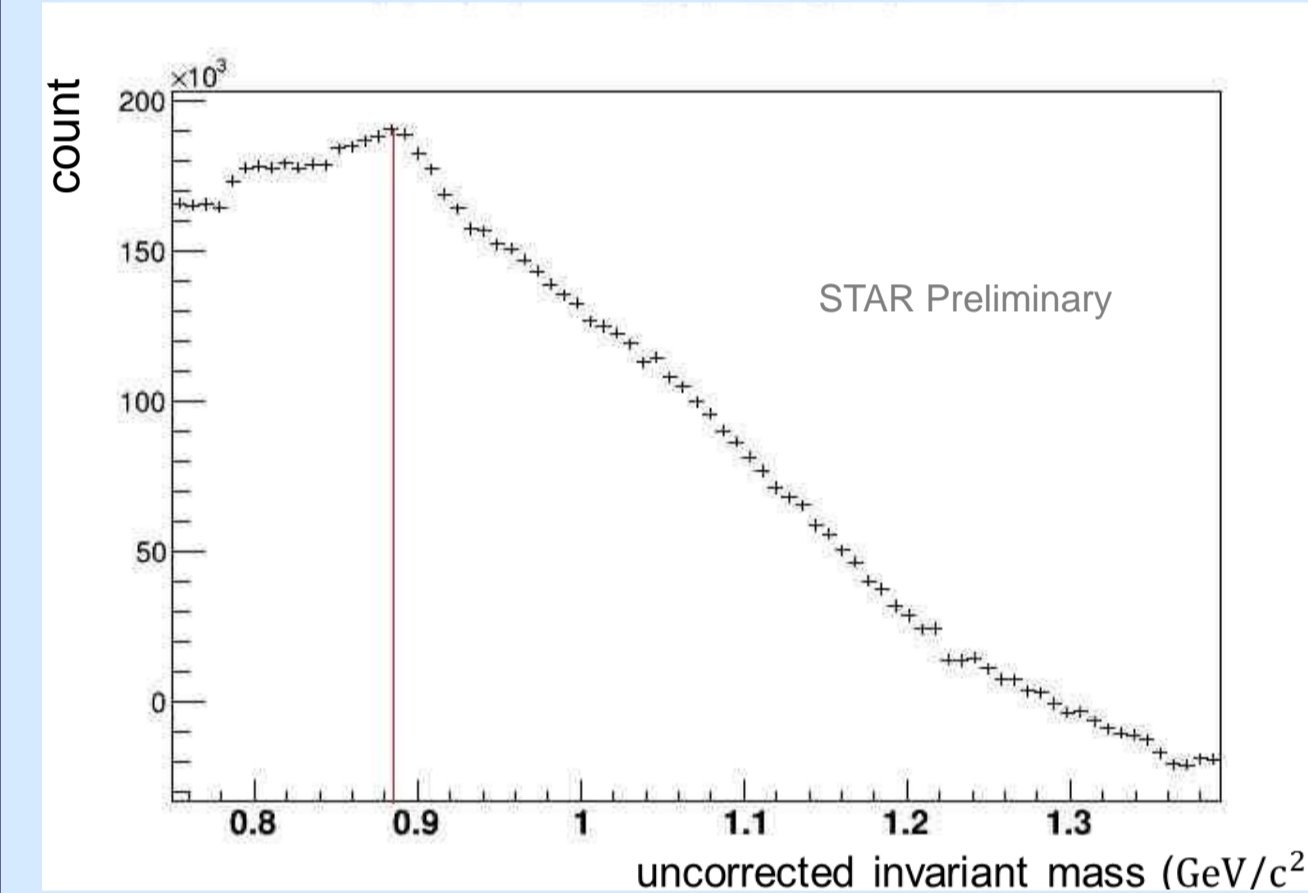
Results

- $K^*(892)$ signals: Mixed-event background has been subtracted.

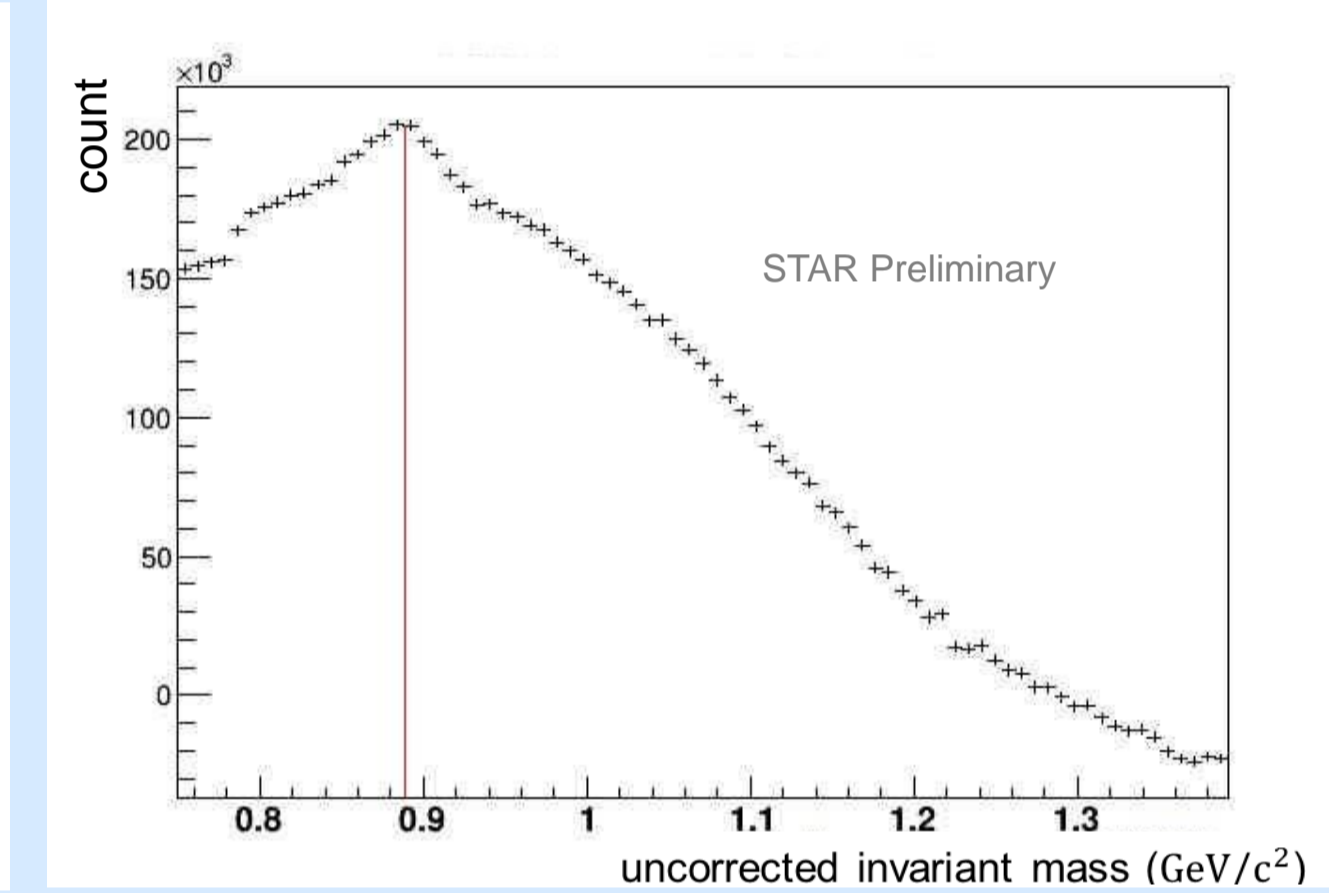
K^* signals for $p_T = 0.5\text{--}3$ GeV/c, all centrality combined



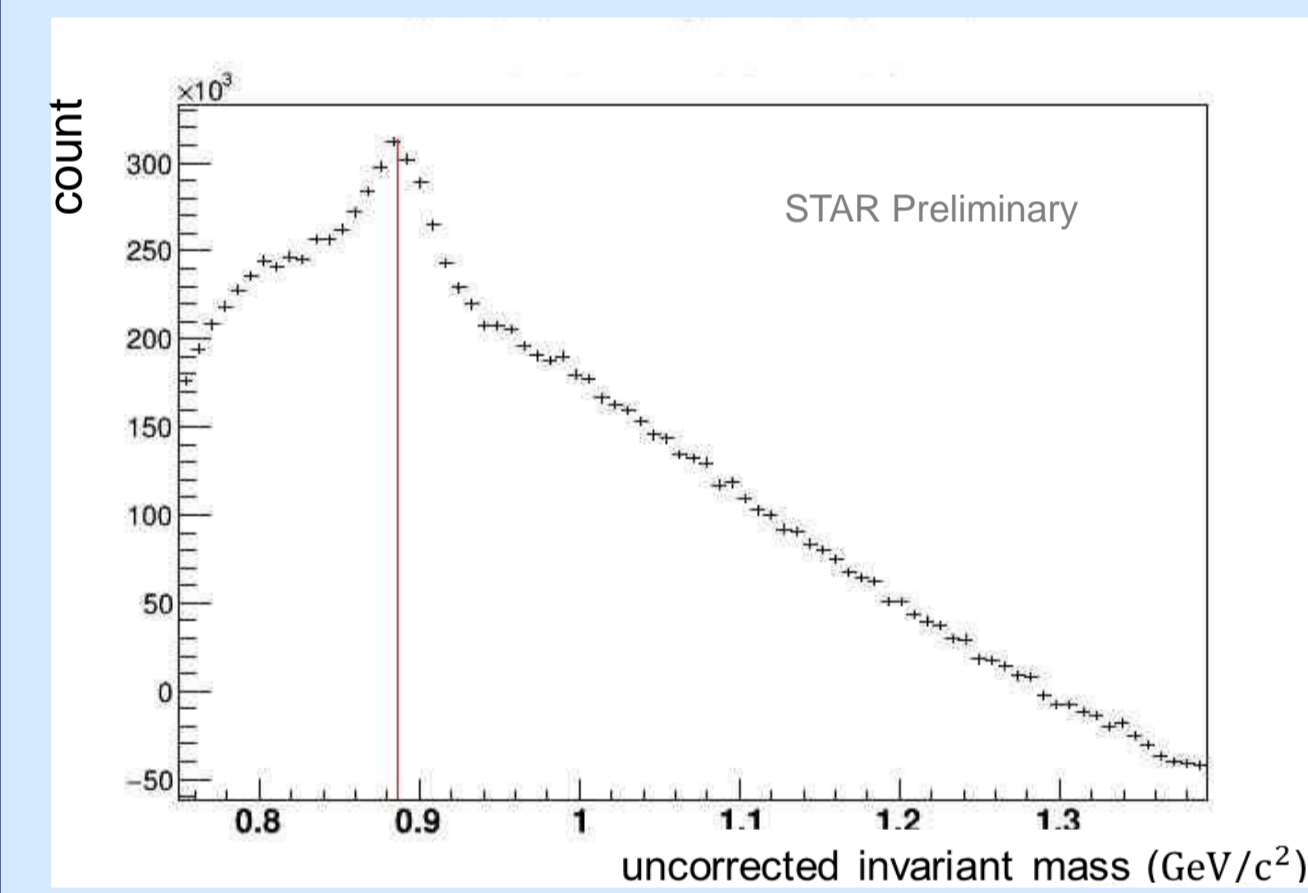
$p_T = 0.5\text{--}1$ GeV/c, centrality 50%~80%



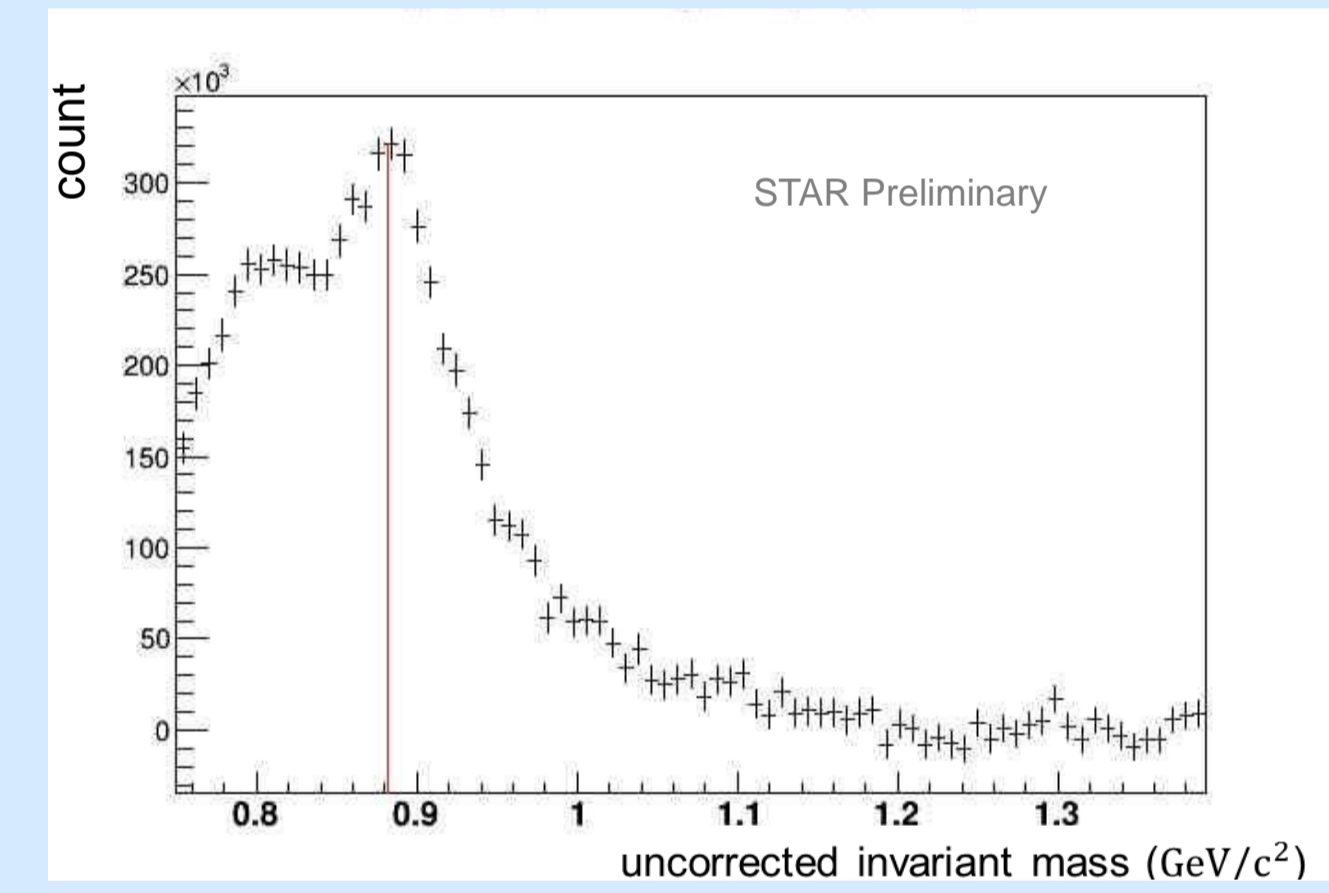
$p_T = 0.5\text{--}1$ GeV/c, centrality 20%~50%



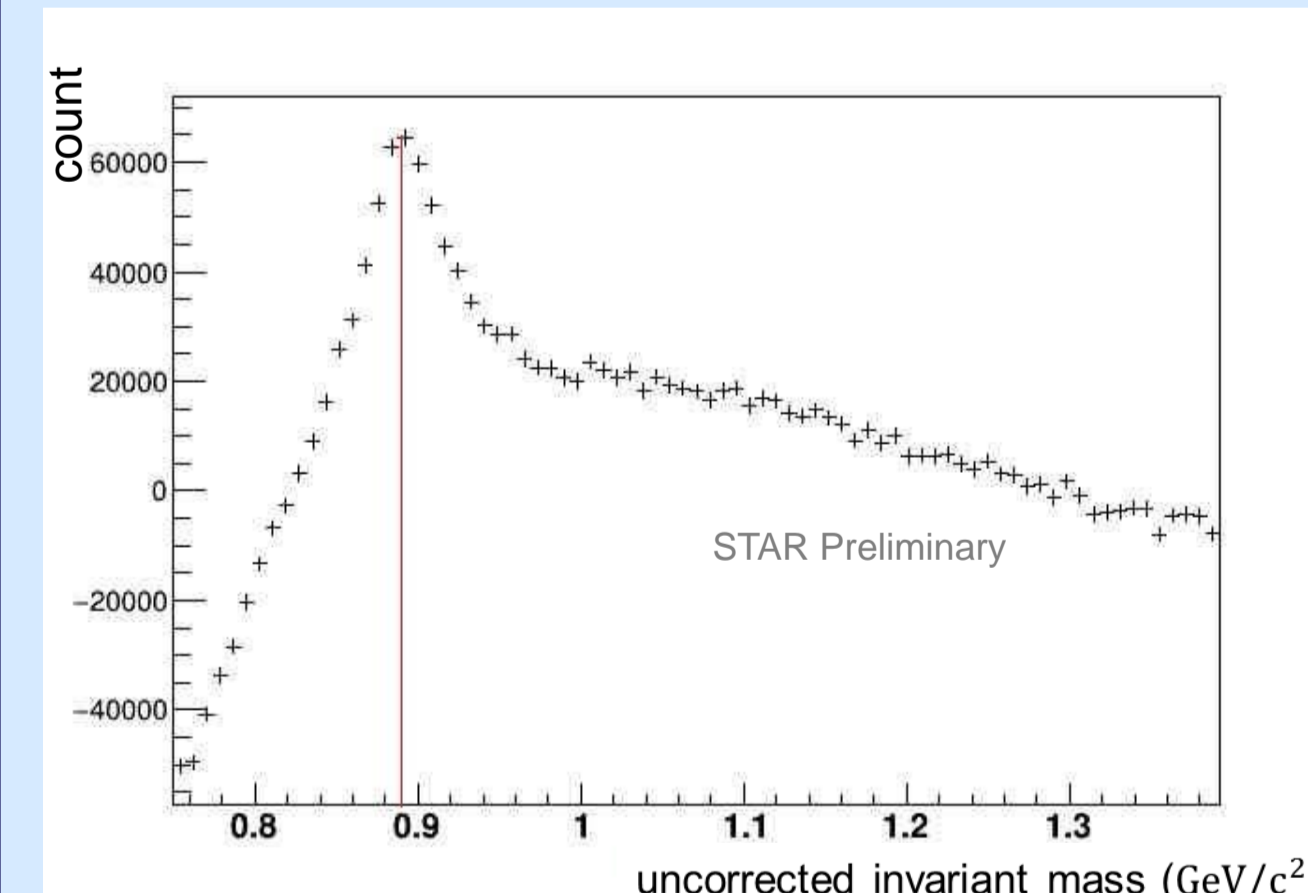
$p_T = 1\text{--}2$ GeV/c, centrality 50%~80%



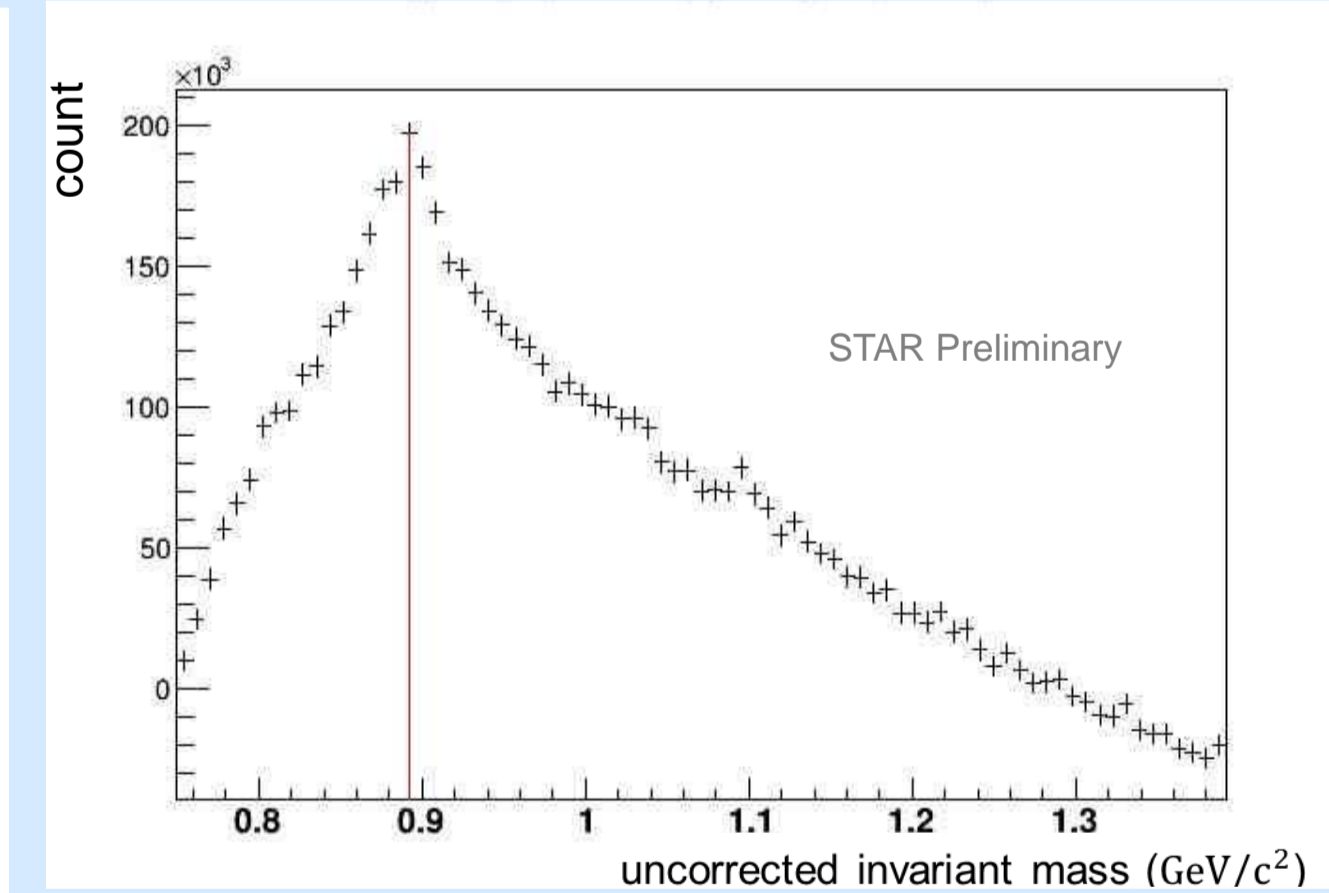
$p_T = 1\text{--}2$ GeV/c, centrality 20%~50%



$p_T = 2\text{--}5$ GeV/c, centrality 50%~80%



$p_T = 2\text{--}5$ GeV/c, centrality 20%~50%



PDG value: 891.66 ± 0.26 MeV

Summary and Outlook

- The signals for $K^*(892)$ resonance produced in Au+Au collisions at 200 GeV at STAR are significant. The data analysis confirms the existence of a measurable amount of K^* , which allows further study of its properties.
- Future study of new physics if possible, includes resonance decays in strong magnetic field. For example, how K^* mass changes with the magnetic field.

Acknowledgement

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Reference

[1]. STAR Collaboration, arXiv:nucl-ex/0412019v2, 22 Apr 2005

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