J/Ψ PRODUCTION IN U+U COLLISIONS IN THE STAR EXPERIMENT

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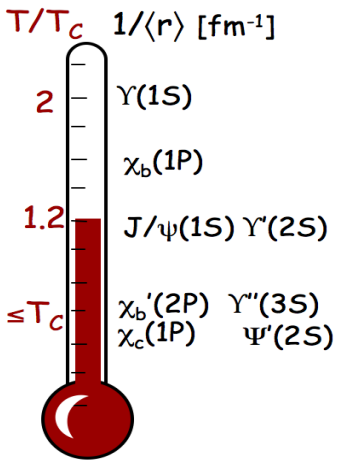
Outline

- Motivation
- STAR Experiment
- Analysis
  - Electron identification
  - J/ψ signal
- Summary and outlook

Motivation

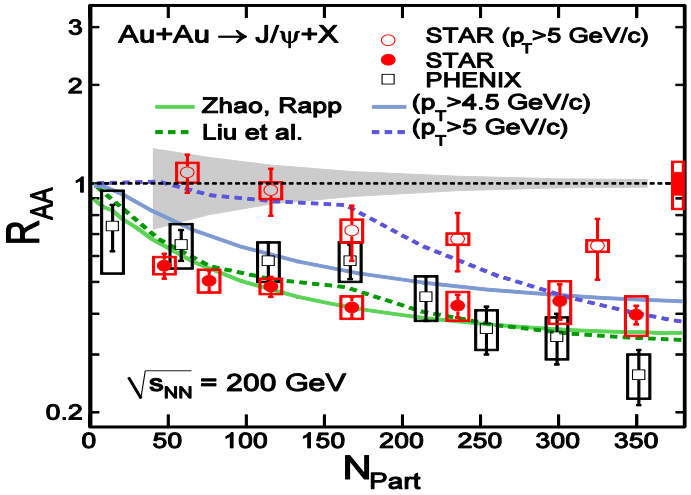
- Since 2000 the properties of hot and dense nuclear matter, Quark Gluon Plasma, are studied at RHIC in BNL by means of heavy ion collisions
- Mass of charm quark is high (~1.3 GeV/c^2)
  - Production can be described by pQCD
  - Produced early in hard processes
- J/ψ should be suppressed in QGP
  - In-medium screening of color charge
  - Different states suppressed at different temperature
  - Use as a thermometer



- Nuclear modification factor $$R_{AA} = \frac{dN_{AA}^2/dP_T dy(y)}{\langle N_{bin} \rangle \, dN_{pp}^2/dP_T dy}$$
- Good understanding of p+p baseline and cold nuclear effects (d+Au) necessary

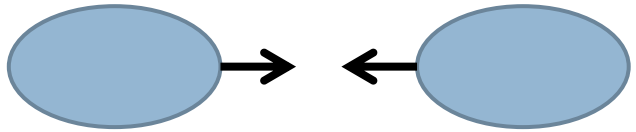
Motivation

- STAR Measurements:
  - J/ψ measured in Au+Au, d+Au, p+p and Cu+Cu (various energies)
  - R_{AA} decreases with number of participants – size of the system



H.Qiu: J. Phys. Conf. Ser. 422, 012013 (2013)

- Our analysis:
  - U+U collisions at 193 GeV per nucleon (2012)
  - Uranium nucleus is non-spherical → higher initial energy density (highest tip-to-tip) → higher track multiplicity
  - $J/\psi \rightarrow e^- e^+$ (B.R. 5.9 %)



Tip-to-tip collision

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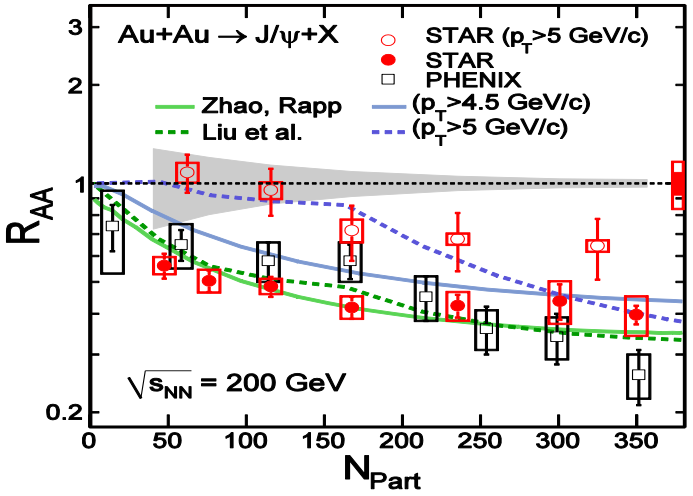

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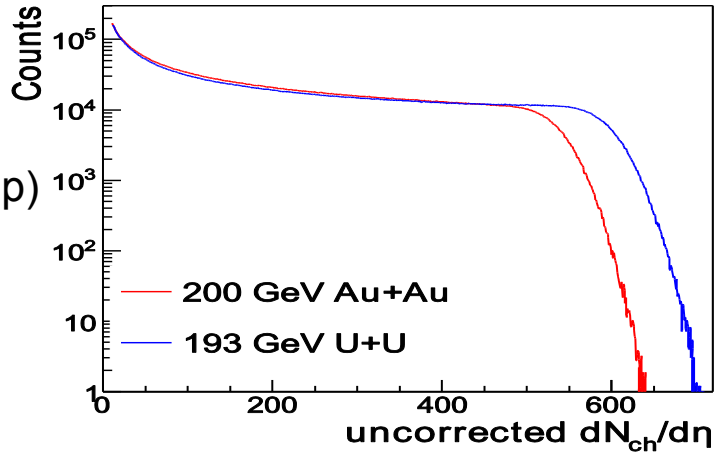
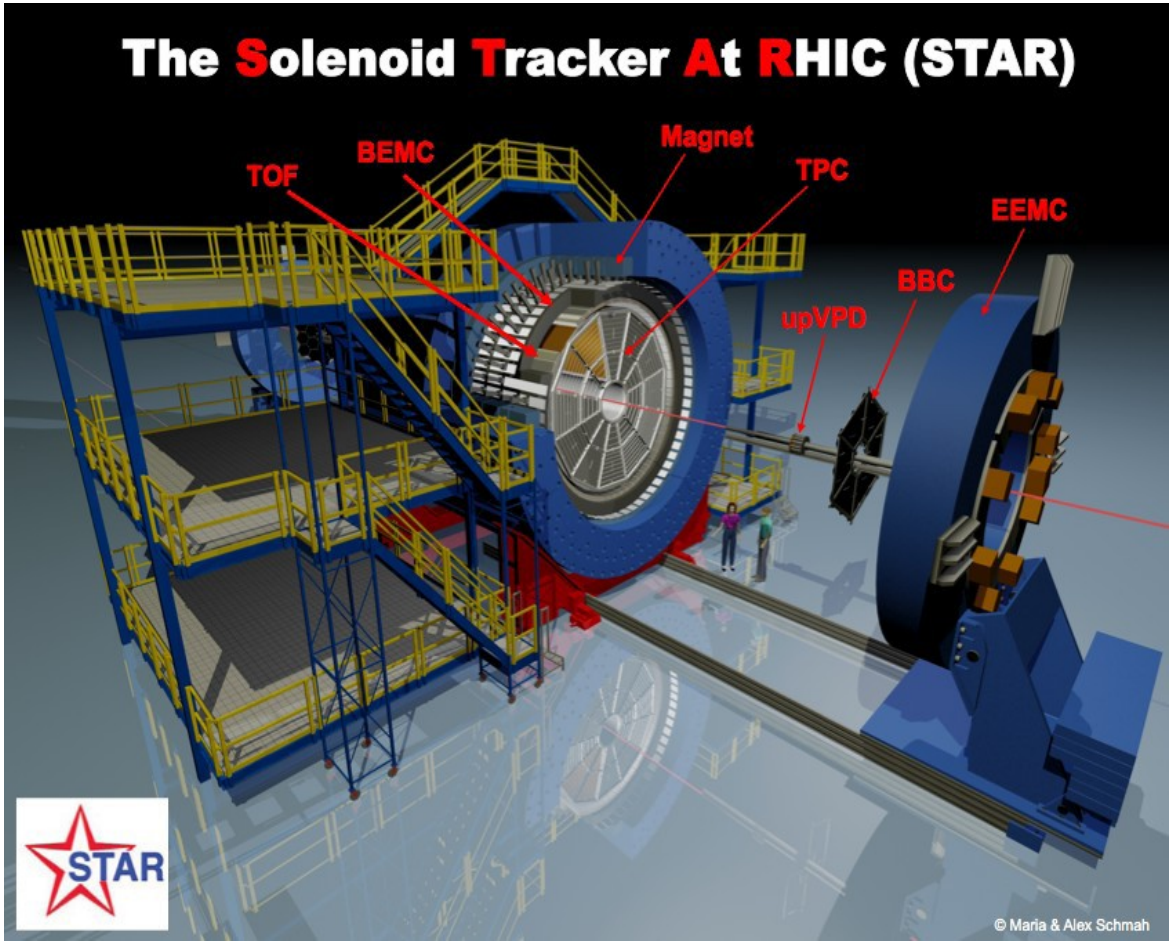


STAR Experiment



- Brookhaven National Laboratory, USA
- Time Projection Chamber (TPC)
  - Particle momentum, dE/dx
- Time Of Flight (TOF)
  - Particle velocity (1/β)
- Barrel Electromagnetic Calorimetr (BEMC)
  - Particle energy

Analysis overview

- U+U at 193 GeV per nucleon, $J/\psi \rightarrow e^- e^+$ (B.R. 5.9 %)

- Minimum bias events
- Event cuts
- Trajectory cuts
- Electron selection
- Invariant mass

Event cuts

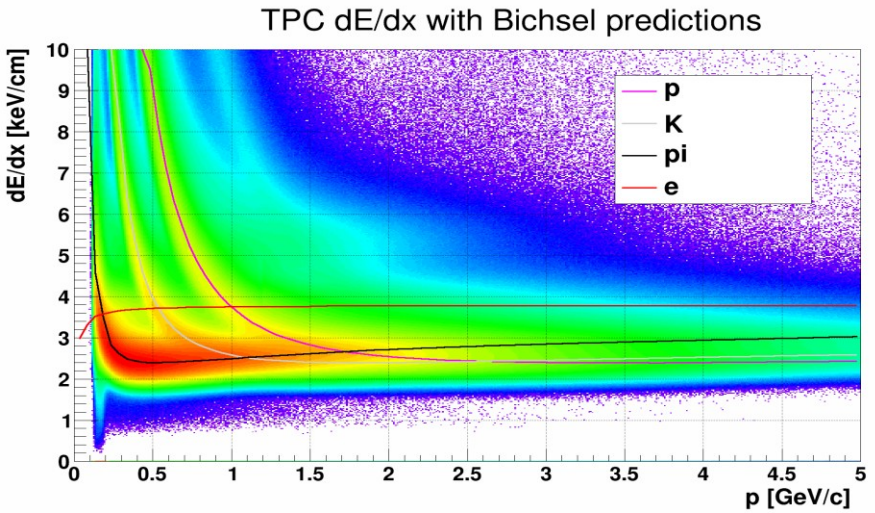
- *Reference Multiplicity > 10 (0-80%)*
- *Primary Vertex Z: -30 cm < Pz < 30 cm*
- *Difference of TPC and VPD Primary Vertex Z < 3 cm*
- *Signal in BEMC required*

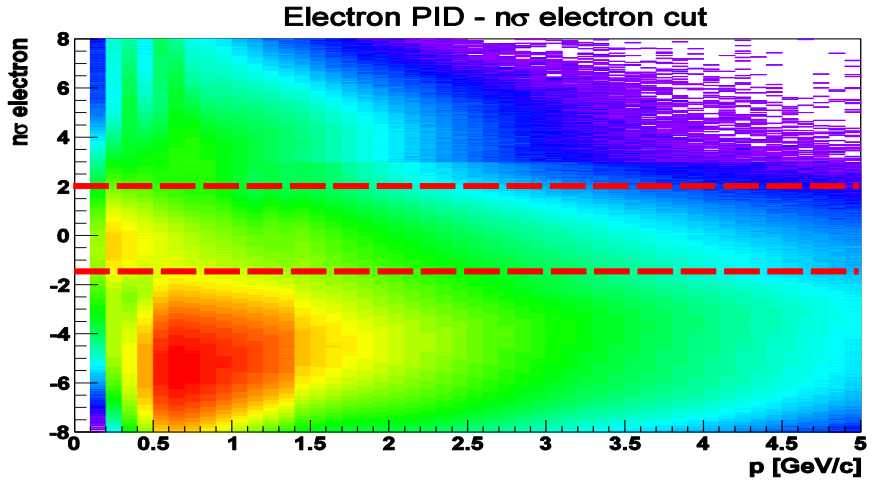
Trajectory cuts

- *Number of fitted hits > 19*
- *Ratio of fitted to possible TPC hits > 0.51*
- *DCA to primary vertex < 3 cm*
- *Pseudorapidity -1<η<1*

Electron Identification

- TPC, BEMC and TOF used
- TPC:
  - $-1.5 < n\sigma_{elektron} < 2$
  - $|n\sigma_{pion}| > 2.5$
- BEMC:
  - Used only for $p \geq 1.4$ GeV/c
  - $0.3 < p/E < 2.0$
  - $E > 0.1$ GeV
- TOF:
  - $p < 1.4$ GeV/c required,
  - $p \geq 1.4$ GeV/c used only if signal exists
  - $0.97 < 1/\beta < 1.03$





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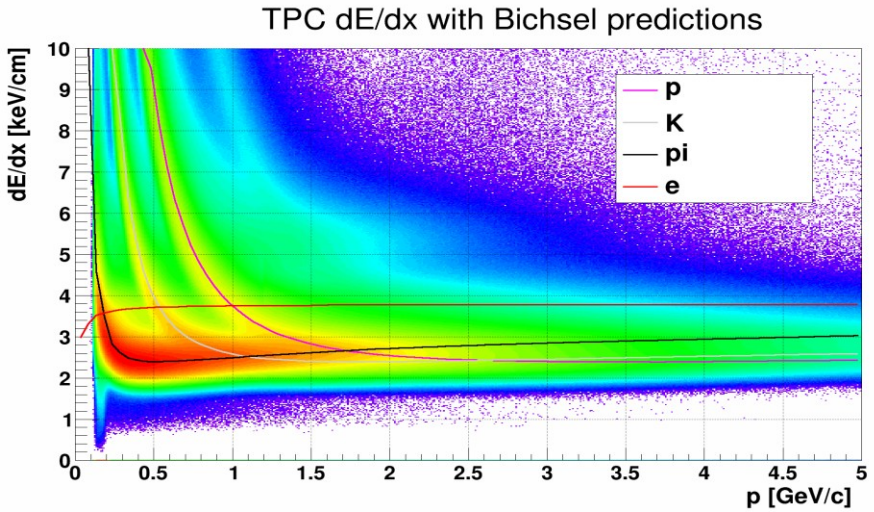
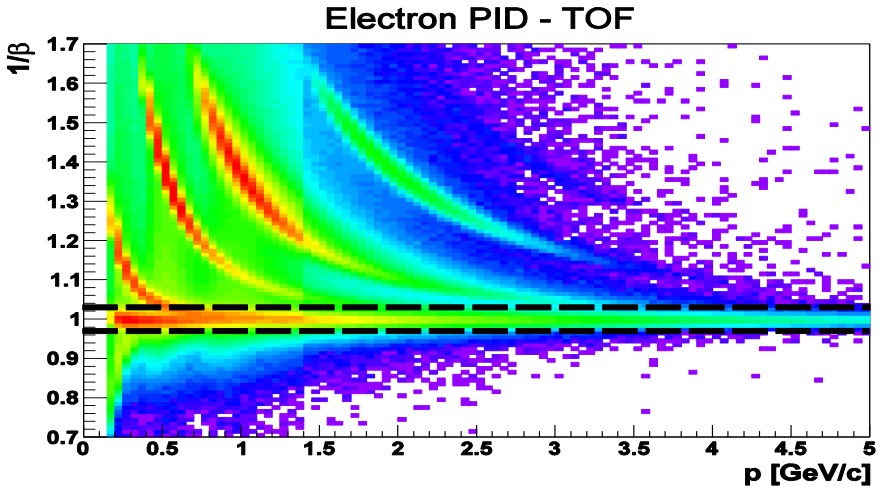
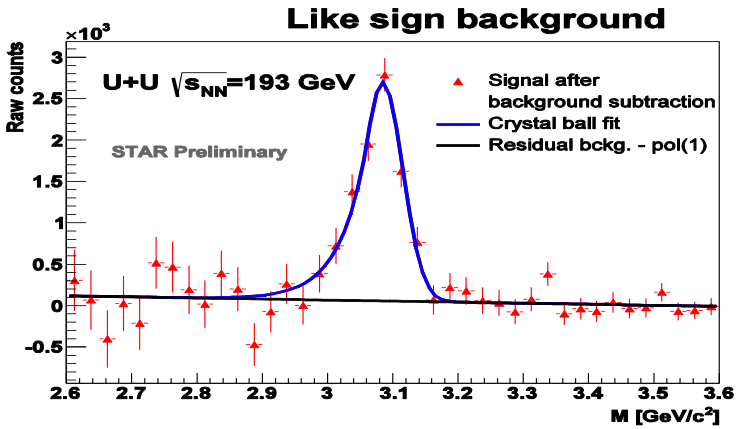
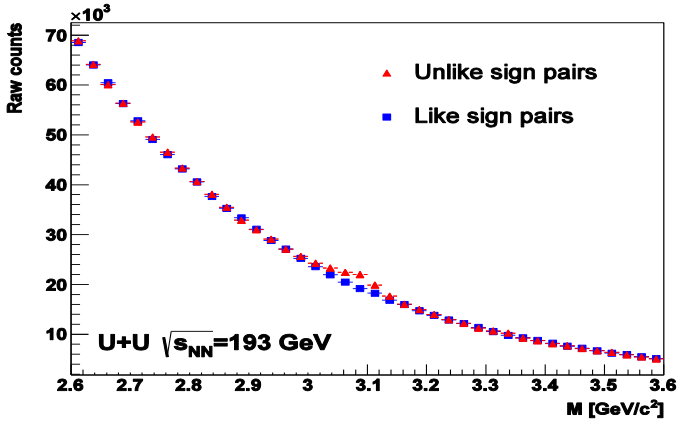


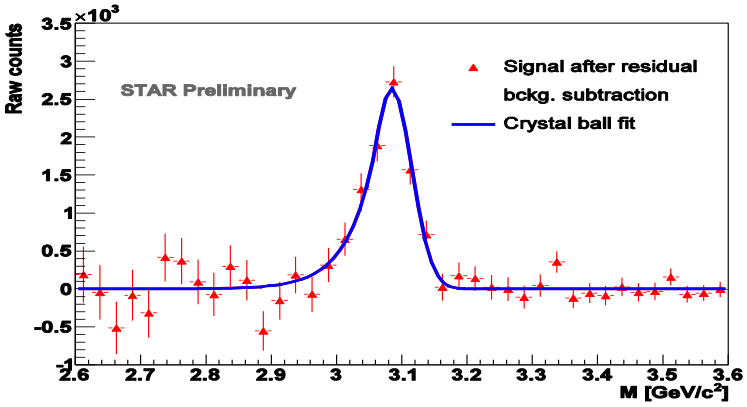


Signal

- Like-sign background reconstruction ($e^+e^+ + e^-e^-$):
- Crystal ball fit (Gaussian with tail)
- Significance $$Sg = \frac{S}{\sqrt{S + 2B}}$$
- S = 9440 ± 640 in (2.9-3.2) GeV/c^2
- Sg = 12.9



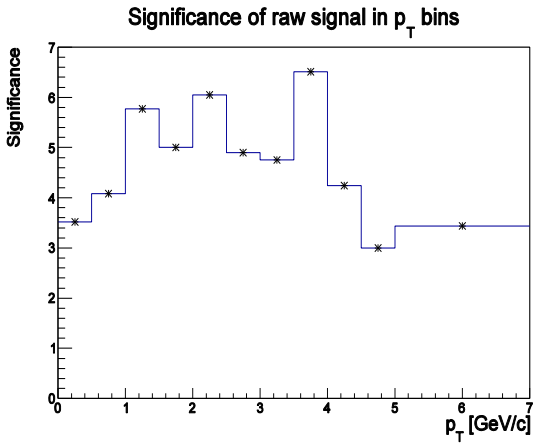


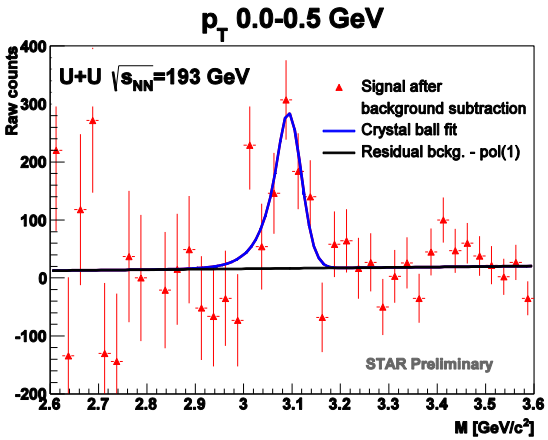


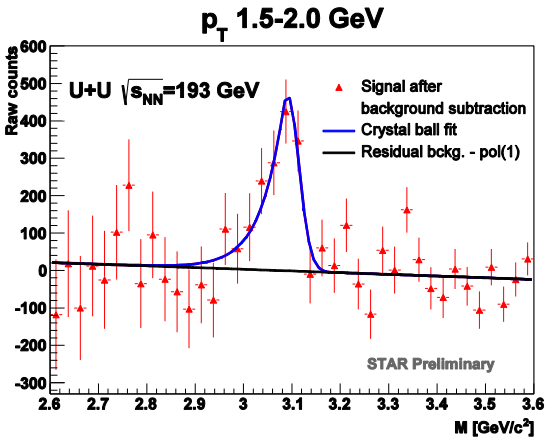
Signal for different p_T bins

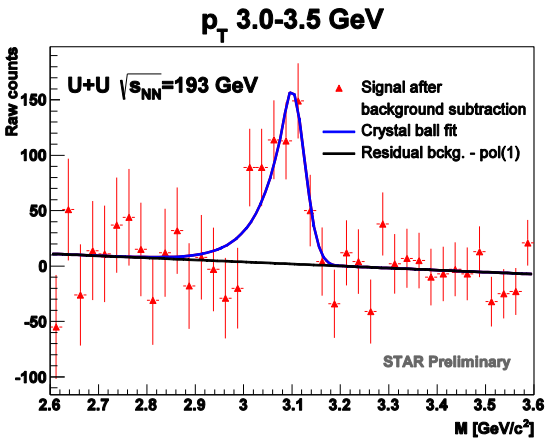
- 11 p_T bins up to 6 GeV/c
- Linear fit to residual background
- Significance

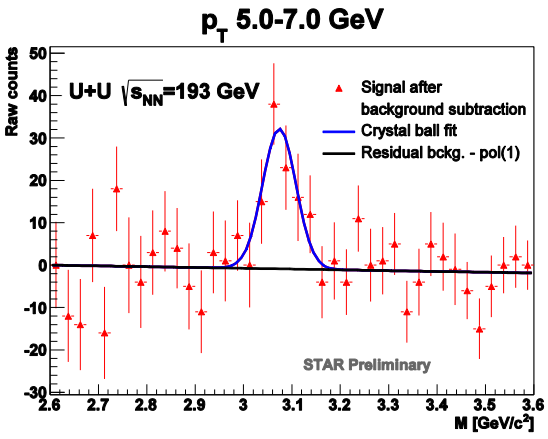
$$Sg = \frac{S}{\sqrt{S+2B}}$$







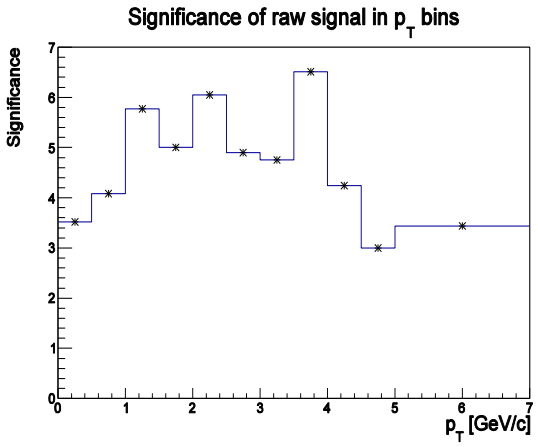


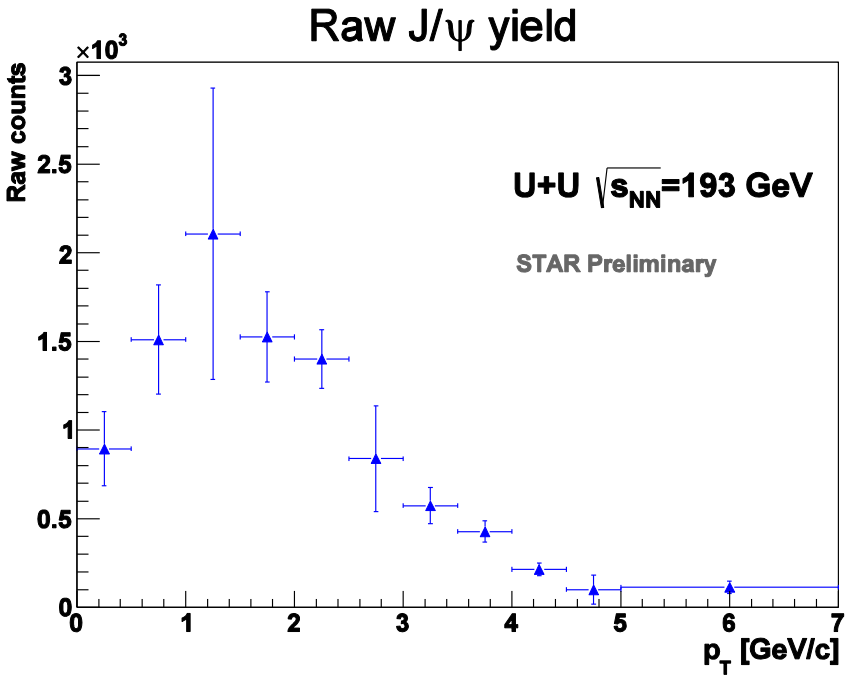


Uncorrected spectra

- 11 p_T bins up to 6 GeV/c
- Linear fit to residual background
- Significance

$$Sg = \frac{S}{\sqrt{S+2B}}$$





Summary

- J/ψ signal observed in U+U collisions
  - Significance 12.9
  - 11 p_T bins

- Outlook
  - Signal corrections
  - Embedding under way
  - Cross section and R_{AA}