Production of J/ψ in min-bias p+p collisions at 200GeV in STAR

Leszek Kosarzewski

for the STAR collaboration

Warsaw University of Technology /

Lawrence Berkeley National Laboratory

SQM
Cracow 2011

Strangeness in Quark Matter

18-24 September 2011
Polish Academy of Arts and Sciences
Cracow, Poland

Outline

. Introduction

. STAR 2009 run setup

. Signal extraction

. Cross section

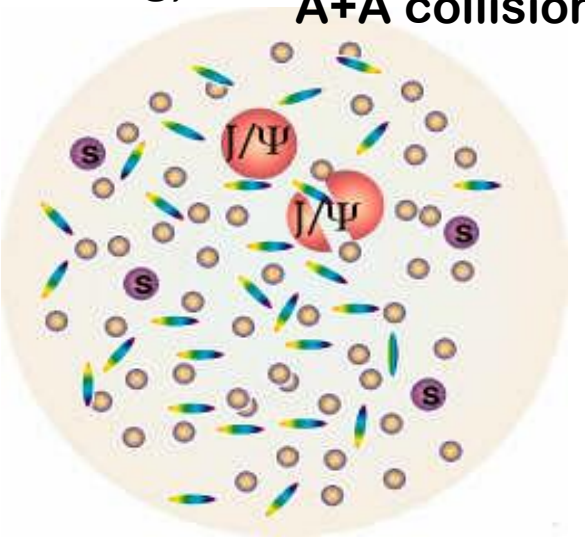
. Summary

Introduction - J/ψ

J/Ψ suppression as a signature of QGP formation (color screening)

T.Matsui and H.Satz 1986 Phys. Lett. B 178:416, 1986

A+A collision

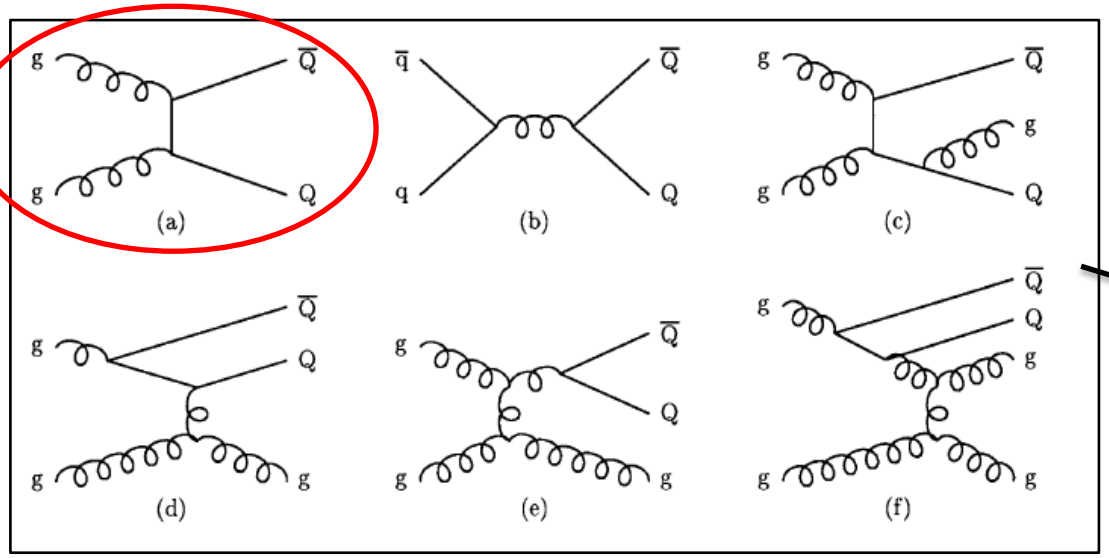


Nuclear modification factor – measures suppression

$$R_{AA} = \frac{1}{N_{coll}} \frac{(\text{invariant yield})_{AA}}{(\text{invariant yield})_{pp}}$$

J/Ψ production in elementary collision

Dominant process at RHIC



$c\bar{c}$

99% → **D mesons c+light quark**

1% → **J/ψ** *hep-ph*/0803.1611

J/ψ suppression in A+A

Sequential suppression of quarkonia. The higher the temperature of QGP the more quarkonia states are dissociated.

Other processes contribute:

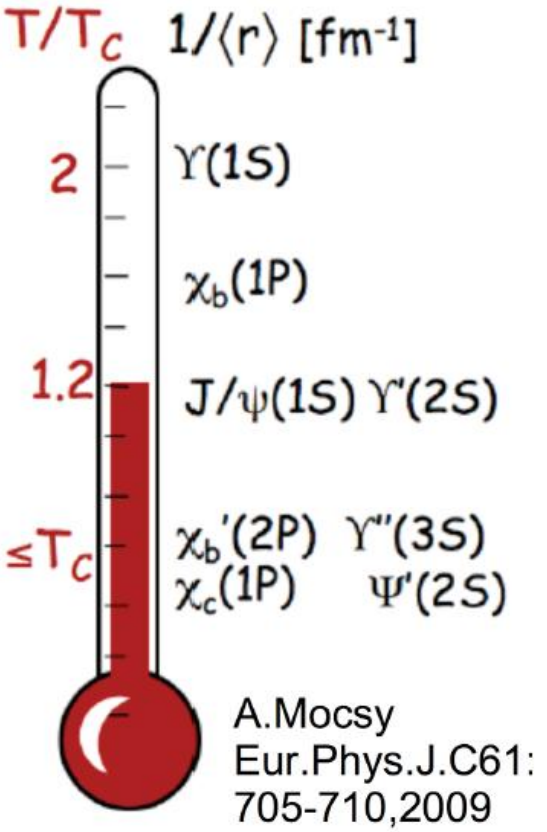
- feed down from excited states (and B mesons)

$$\chi_c \rightarrow J/\psi + X$$

$$\psi' \rightarrow J/\psi + X$$

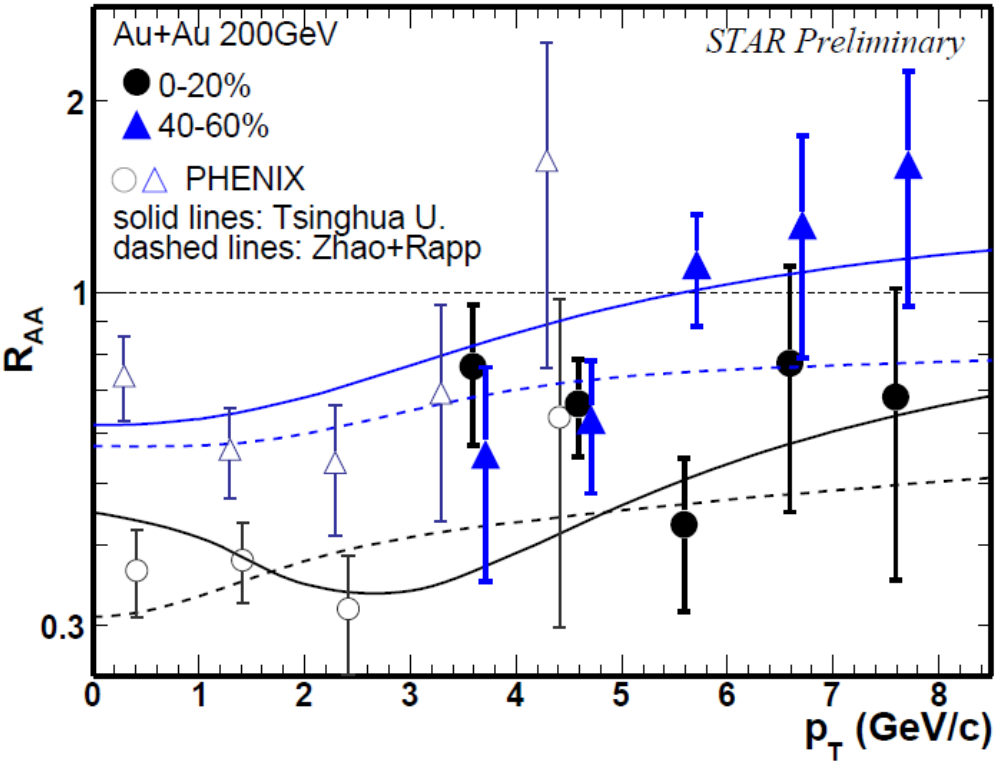
- regeneration

- cold nuclear matter effects



Low p_T J/ψ in p+p

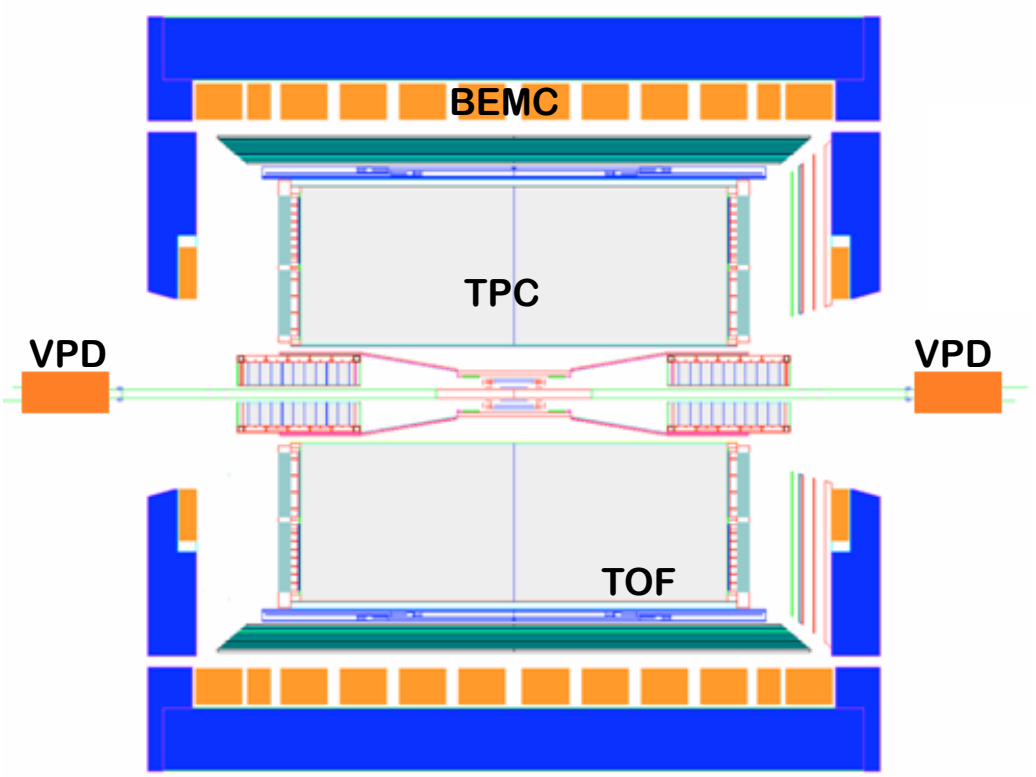
p+p baseline for J/Ψ production in Au+Au. Required for nuclear modification factor measurement.



arXiv:1107.0532v1 [hep-ex]
arXiv:0901.2757v2 [nucl-th]
arXiv:1008.5328v1 [hep-ph]

STAR 2009 run setup

High luminosity run (~1MHz collision rate)



- **Large acceptance:** $0<\varphi<2\pi$, $-1<\eta<1$
- **Time Projection Chamber (TPC)**
- **Time of Flight (TOF) detector**
- **Min-bias data collected with Vertex Position Detector (VPD) as a trigger. VPD east-west coincidence required.**
- **Barrel Electromagnetic Calorimeter (BEMC)**

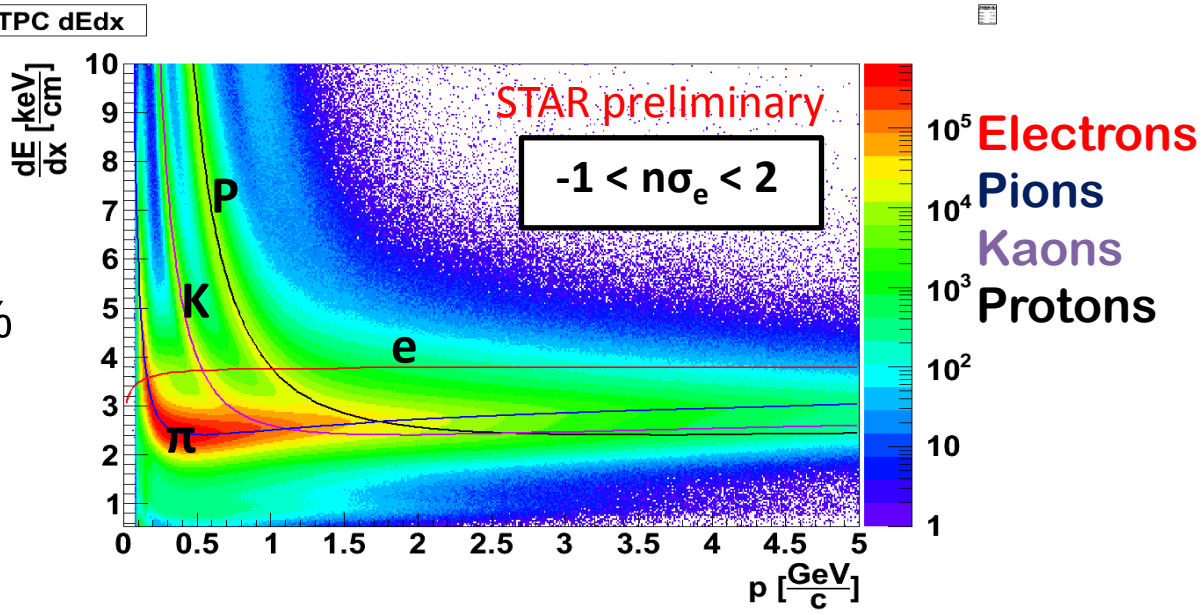
J/ψ reconstruction

74M p+p 200GeV min-bias events.

Di-electron decay channel:

$J/\psi \rightarrow e^+e^-$ BR 5.94+/-0.06%

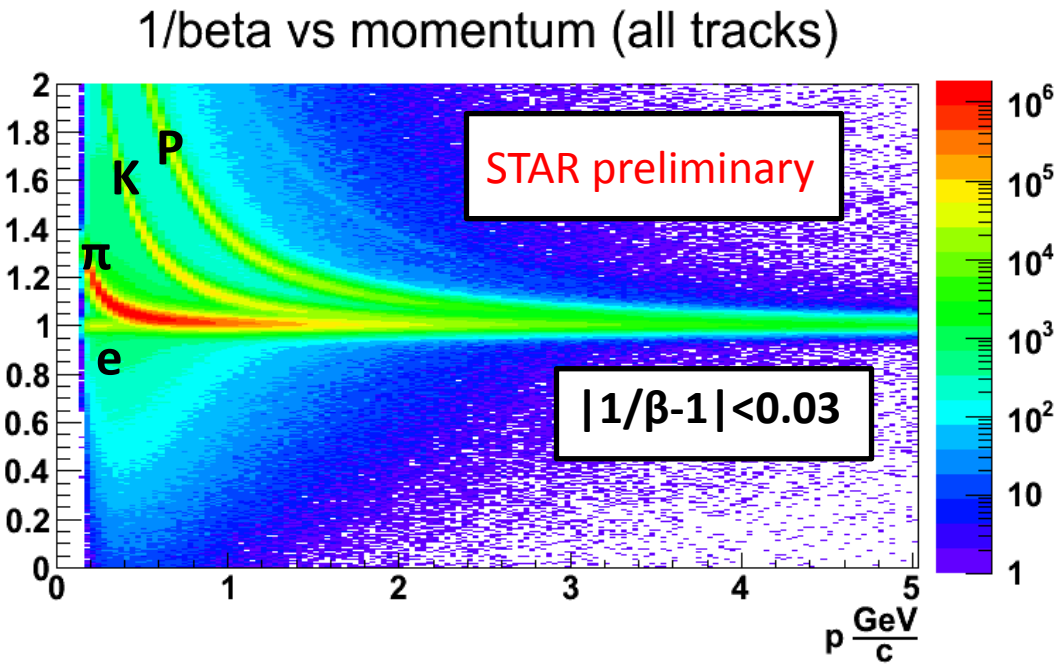
PDG, July 2010



Electron identification:

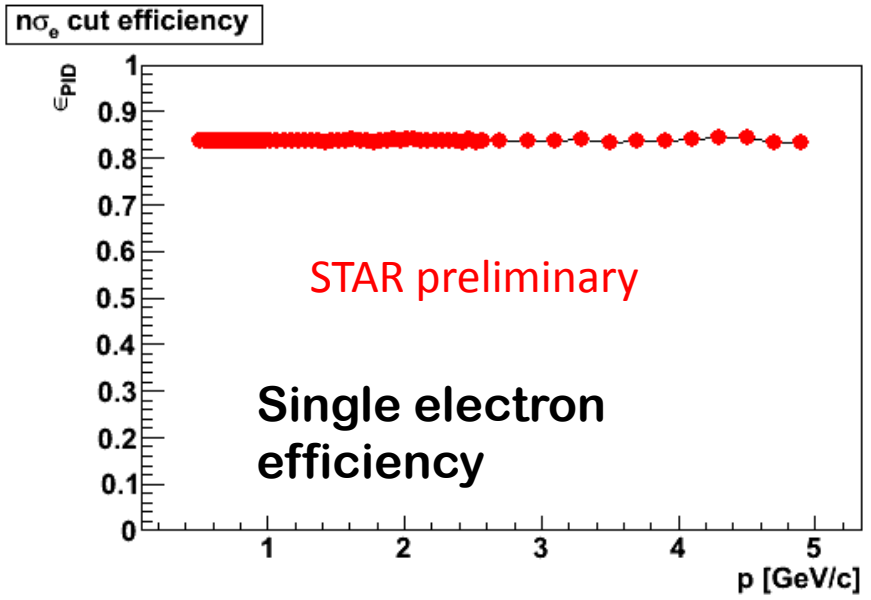
TPC (dE/dx) +TOF p<1.4GeV
TPC (dE/dx) 1.4<p<2.0GeV
TPC (dE/dx) +BEMC(E/p) p>2.0GeV

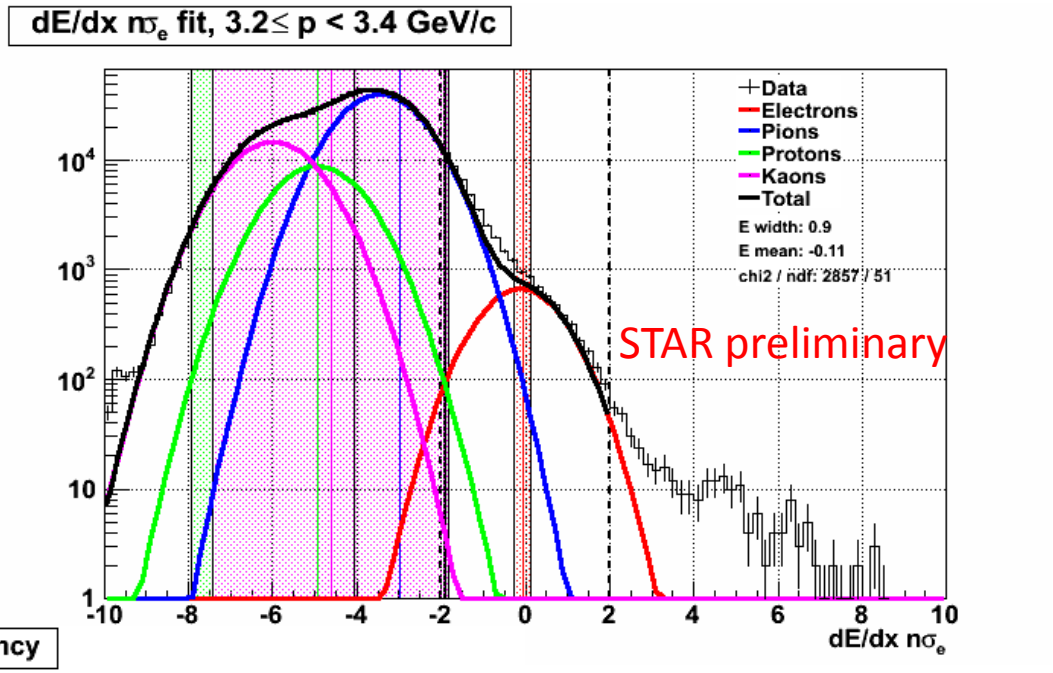
$$n\sigma_e = \log\left(\frac{dE/dx_e}{dE/dx|_{Bichsel}}\right)/\sigma$$



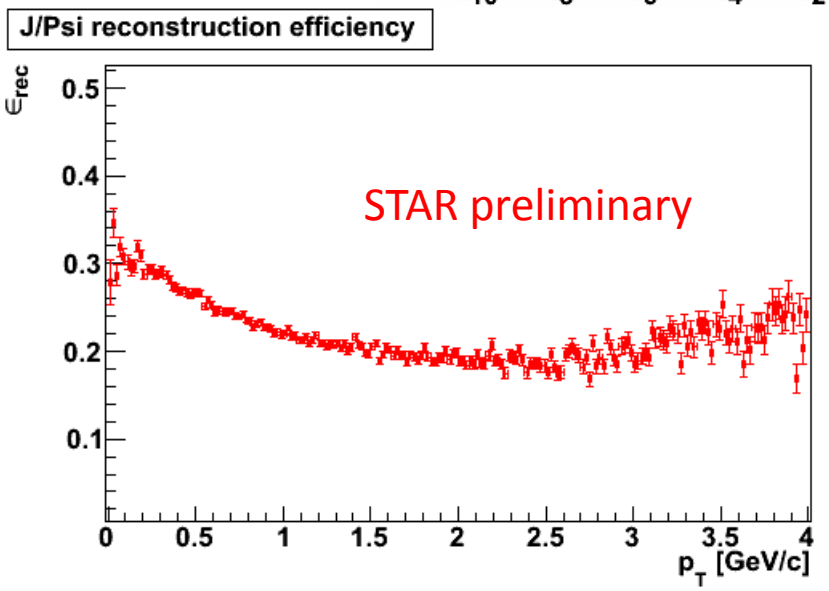
Efficiency

$n\sigma_e$ cut efficiency obtained from gaussian fits to the data





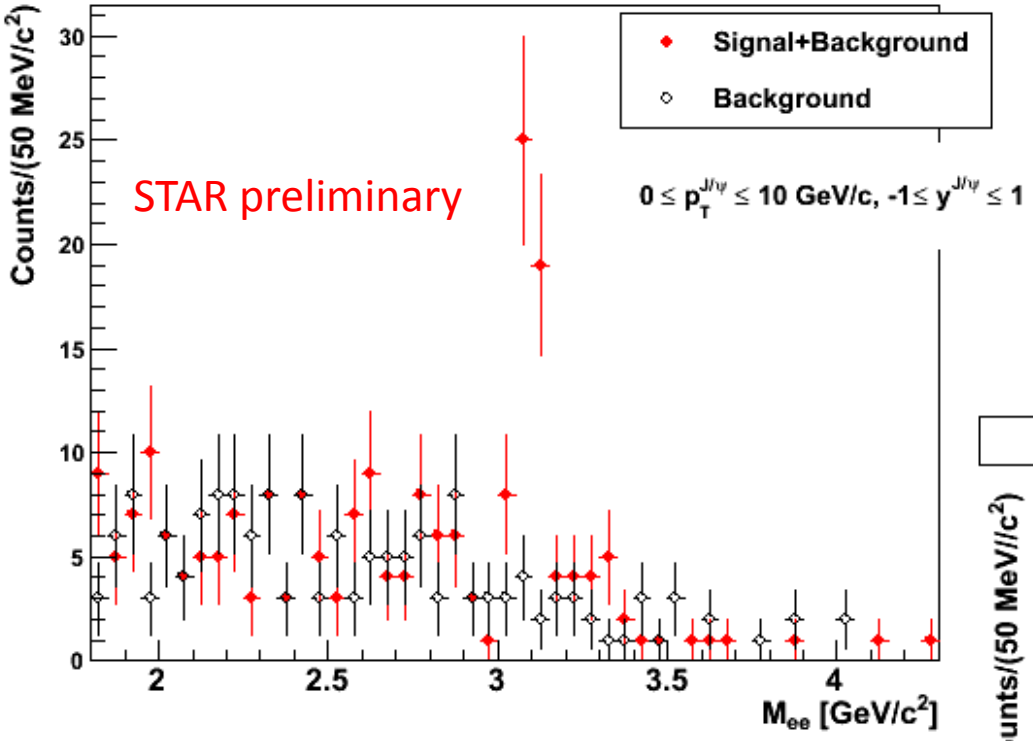
J/ψ reconstruction efficiency



Includes:

- **tracking efficiency and acceptance**
- **PID efficiency**
- **detector matching effficiencies**

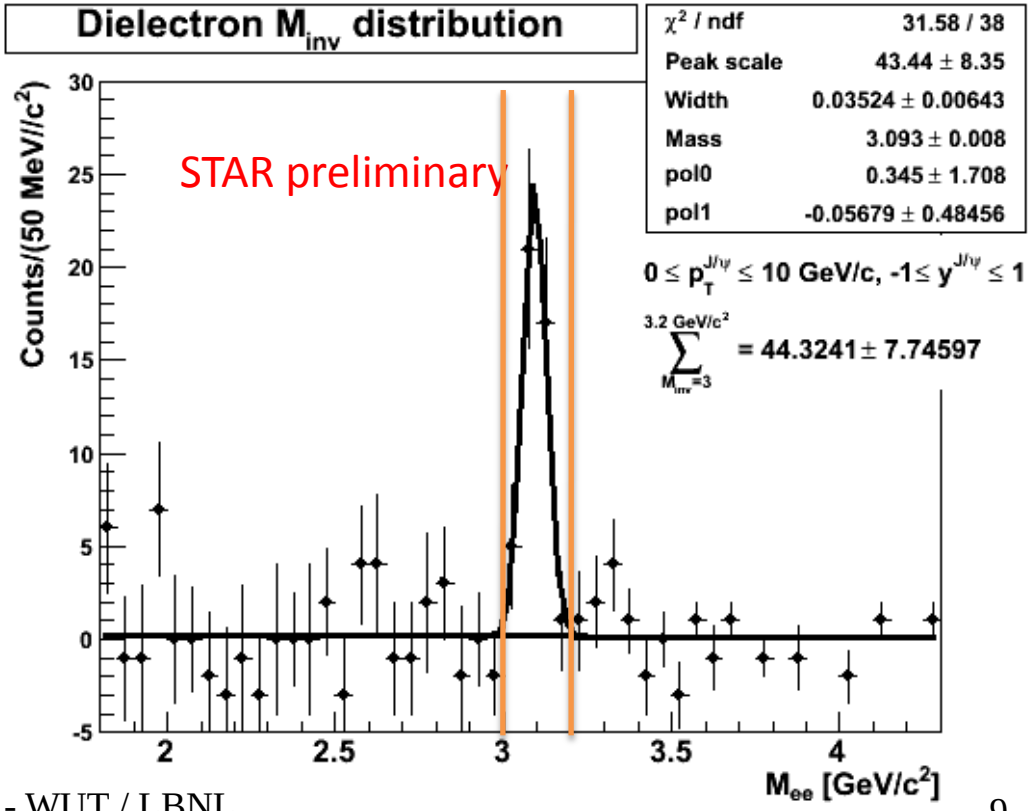
J/ψ Signal in p+p 200GeV



Signal after like-sign sum background subtraction

$$S = N_{e+e-} - \left(N_{e+e+} + N_{e-e-}\right) - N_{residual\ \ bkg}(fit)$$

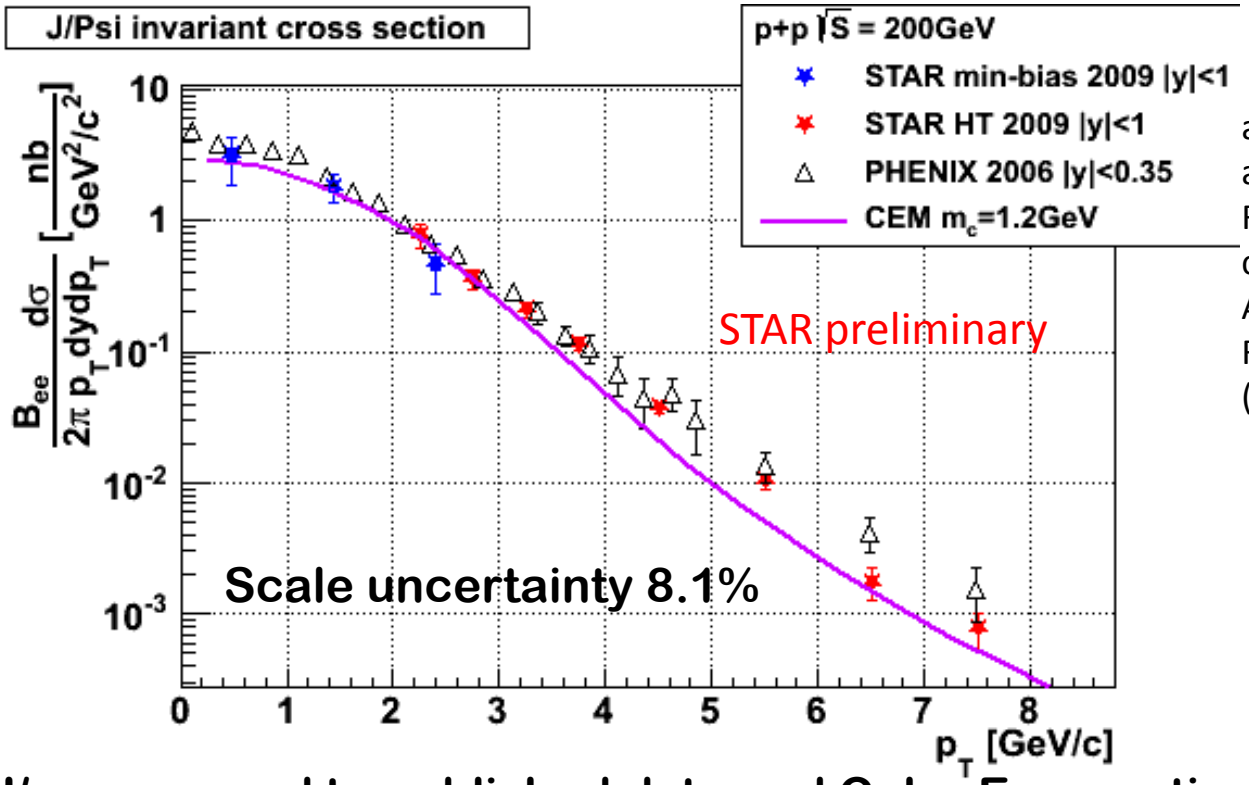
Fitted gaussian signal+linear residual background (subtracted)



44 J/ψ
5.7σ signal
Signal/Background = 2.82

|y|<1
Most signal in: p_T<3GeV

J/ψ p_T spectrum



arXiv:1107.0532v1 [hep-ex]
arXiv:1107.0532v1 [hep-ex]
R. Vogt – private communication
A.D. Frawley, T. Ullrich and R. Vogt, Phys. Rept. 462 (2008) 125

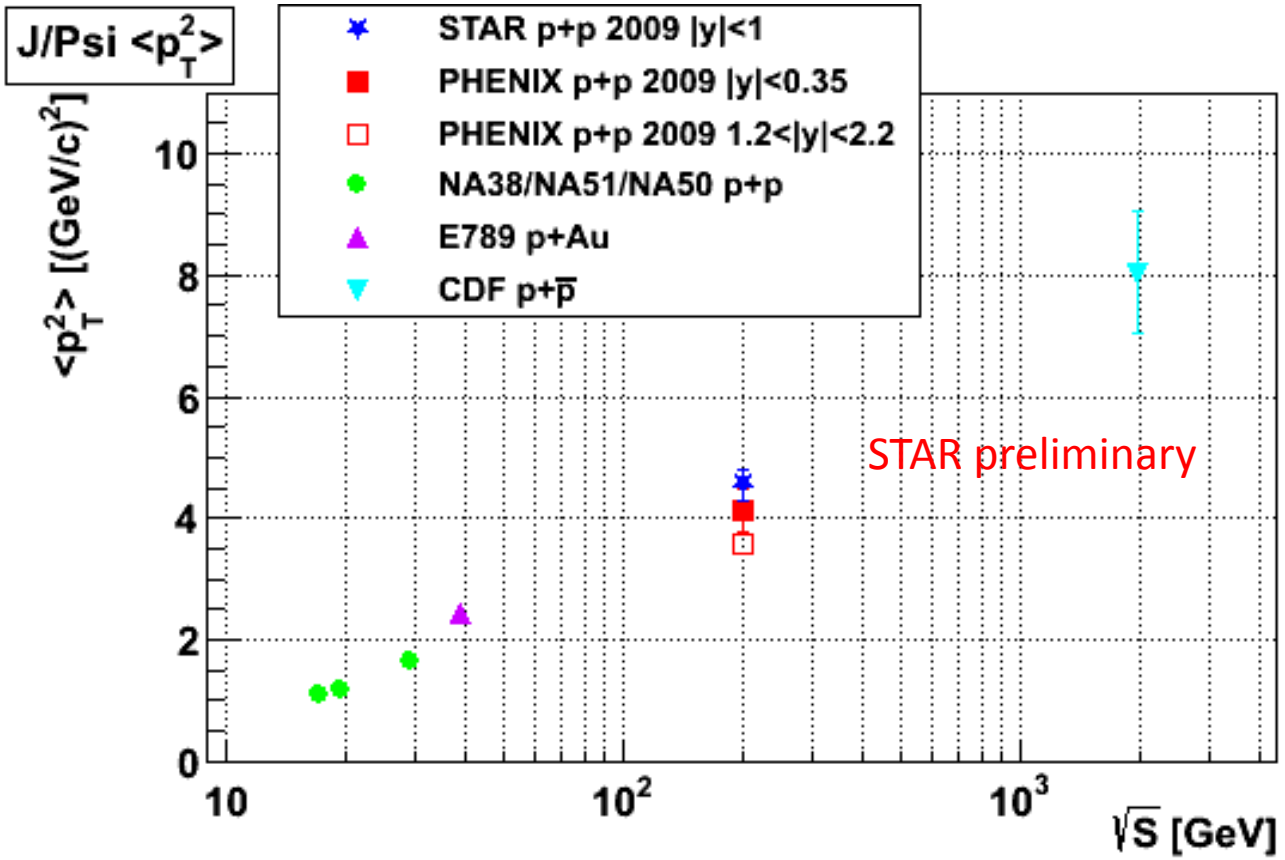
STAR min-bias J/ψ compared to published data and Color Evaporation Model prediction.

Agreement between experiments. Agreement with CEM model up to 3GeV.

J/ψ production cross section calculated from HT+min-bias data (0-8GeV):

$$B_{ee}\left.\frac{d\sigma_{J/\psi}}{dy}\right|_{|y|<1} = 40.6 \pm 6.0(\text{stat})[nb]$$

J/ψ <p_T^2>



Comparison of J/ψ <p_T^2> with the results of other experiments (arXiv:1107.0532v1 [hep-ex]).

$$\left\langle p_T^2 \right\rangle = 4.5 \pm 0.3 \left[\frac{GeV^2}{c^2} \right]$$

Summary

- First 2009 p+p 200GeV min-bias J/ψ results from STAR in 0-3GeV p_T range reported. Signal of 5.7σ found.

- J/ψ production cross section calculated in 0-8GeV 2009 run data is:

$$B_{ee}\left.\frac{d\sigma_{J/\psi}}{dy}\right|_{|y|<1} = 40.6 \pm 6.0(\text{stat})[nb]$$

- J/ψ production cross section p_T dependence compared to Color Evaporation Model, agreement at low p_T up to 3GeV. Agreement with PHENIX.

Thank you!!