J/ψ production in p+p collisions at STAR

Work in progress report

Leszek Kosarzewski

Warsaw University of Technology / Lawrence Berkeley National Lab

Outline

- Introduction – J/ψ suppression
- Datasets: p+p 200GeV Run09 minBias & JetPatch
- Track cuts
- Particle Identification
- Signal
- Plans for the future

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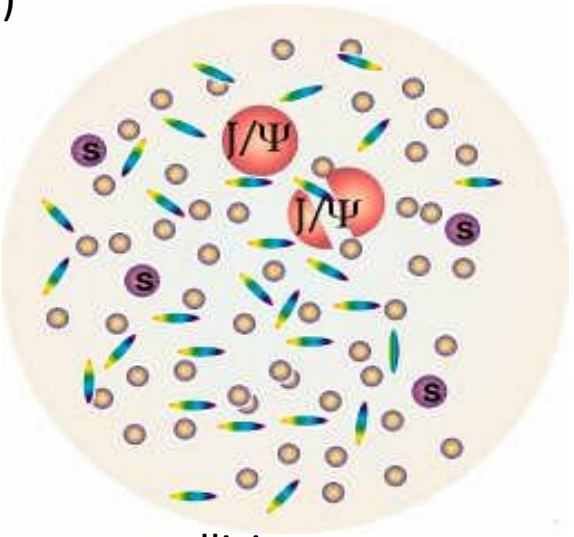
J/Psi suppression

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

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

A+A collision



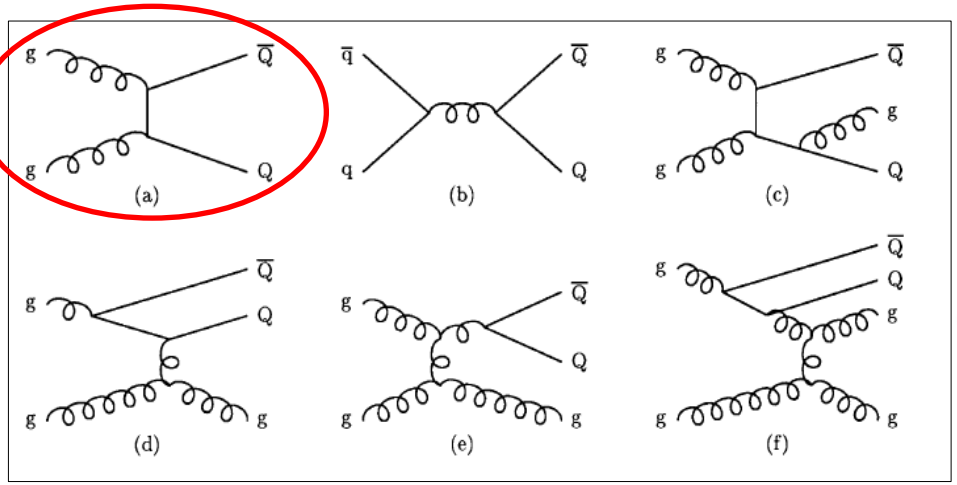
Nuclear modification factor – measures suppression

$$R_{AA/pp} = \frac{N_{coll,pp}}{N_{coll,AA}} \frac{(Invariant\ yield)_{AA}}{(Invariant\ yield)_{pp}}$$

J/Psi production in elementary collision for reference

Cross section from p+p collisions (calculable within pQCD)

$$\left(\frac{\mathrm{d}N_{J/\psi}}{\mathrm{d}y} \; and \; \frac{\mathrm{d}^2 N_{J/\psi}}{\mathrm{d}p_T \mathrm{d}y} \right)$$



$c\bar{c}$ → 99% D mesons c+light quark

$c\bar{c}$ → 1% J/ψ

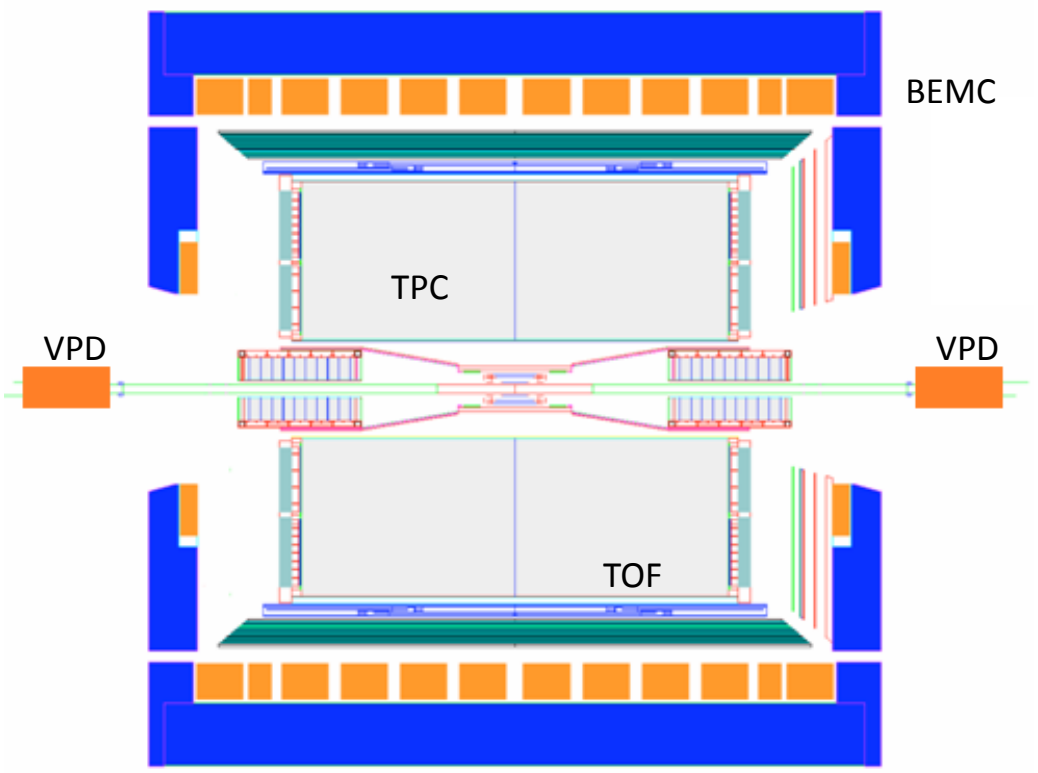
hep-ph/0803.1611

STAR p+p 200GeV Run09

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

PDG Booklet, July 2010

High luminosity run (10x design luminosity)
=> issues with pile-up



VPD – start for the TOF, requires coincidence, fast => can remove pile-up

vpdMB

300M events triggered by VPD

Event cuts:
Rank(id=0) > 0
|Vz| < 30cm
|Vz-VpdVz| < 6cm

jetPatch

132M events triggered by VPD and large spatial patch of energy in BEMC

Event cuts:
Rank(id=0) > 0
|Vz| < 100cm
|Vz-VpdVz| < 6cm

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vpdMB track cuts

Track quality cuts:

|q| = 1
|η| < 1
0<Flag<1000
FitHitRatio > 0.52
NfitPts > 15
DCA < 3.0cm
DipAngleDifference > 0.04

Pile-up track rejection

PID cuts:
|nσ_electron| < 2.0

TOF PID p < 1.4 GeV
|TOF_nSigma_e| < 2.0
|1/beta-1| < 0.03

TPC PID p > 1.4 GeV:
|nSigma_pi| > 3.0
|nSigma_k| > 2.0
|nSigma_p| > 2.0

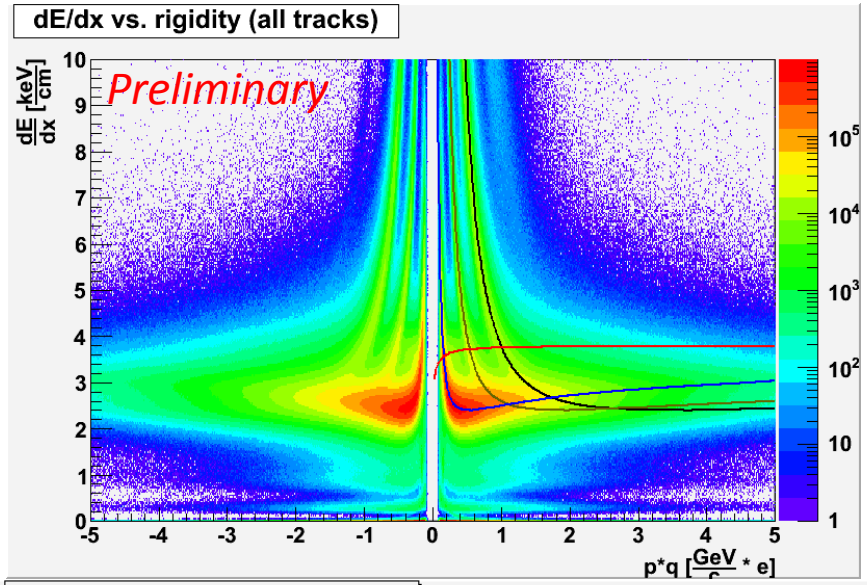
Kinematic cut:

pT > 0.5 GeV

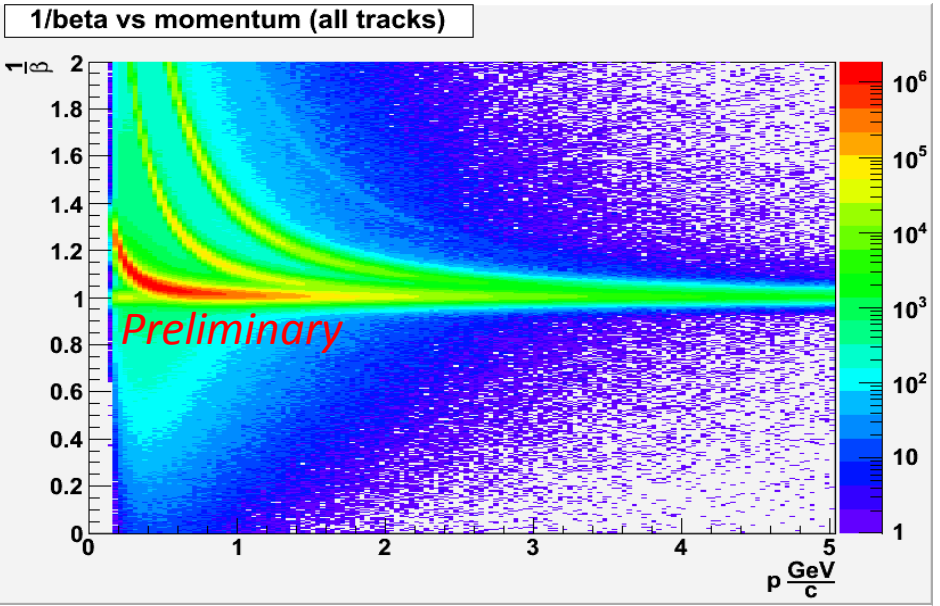
Very low kinematic cut!!

Particle Identification

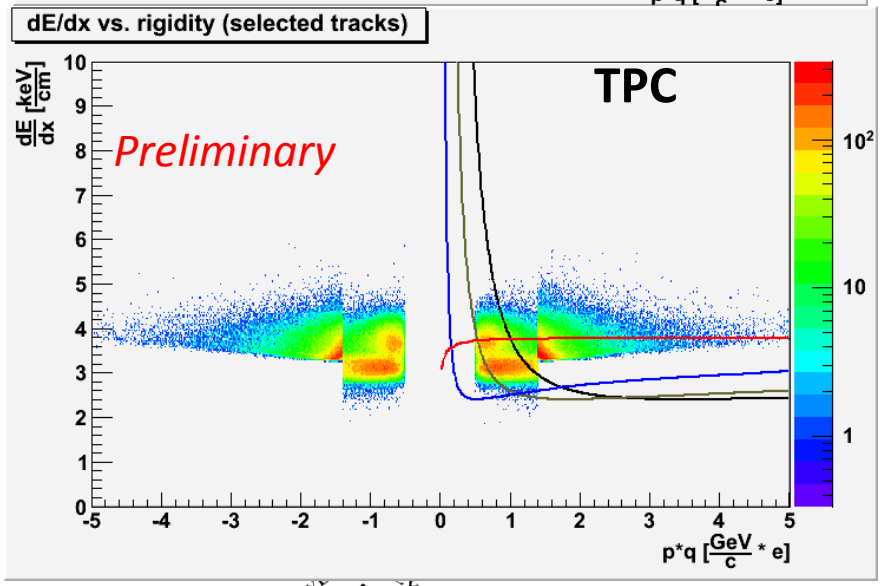
$$n\sigma_i = \log\left(\frac{\mathrm{d}E/\mathrm{d}x}{\mathrm{d}E/\mathrm{d}x_{\mathrm{Bichsel}}}\right)/\sigma_i$$



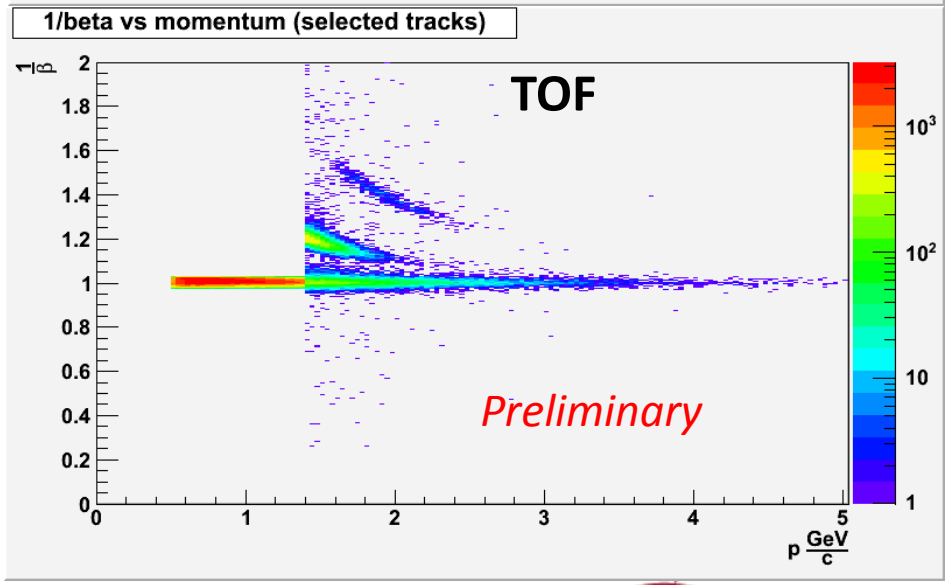
Electrons
Pions
Kaons
Protons



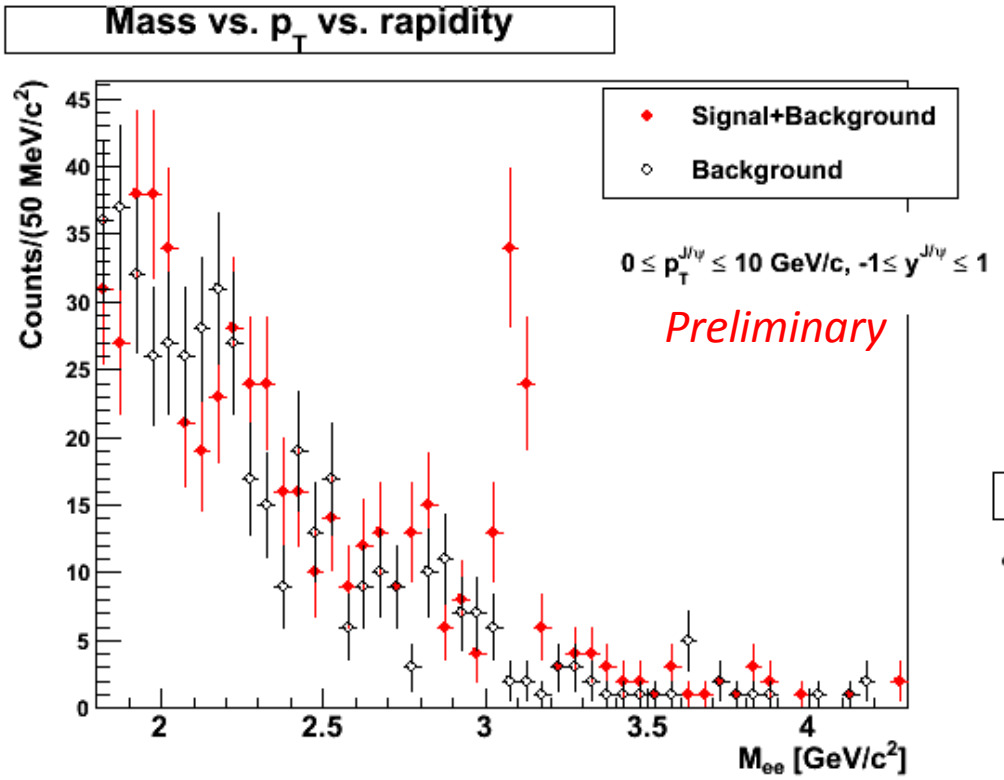
pre cuts



after cuts



VPD Min-bias – signal in 3.0-3.2 GeV

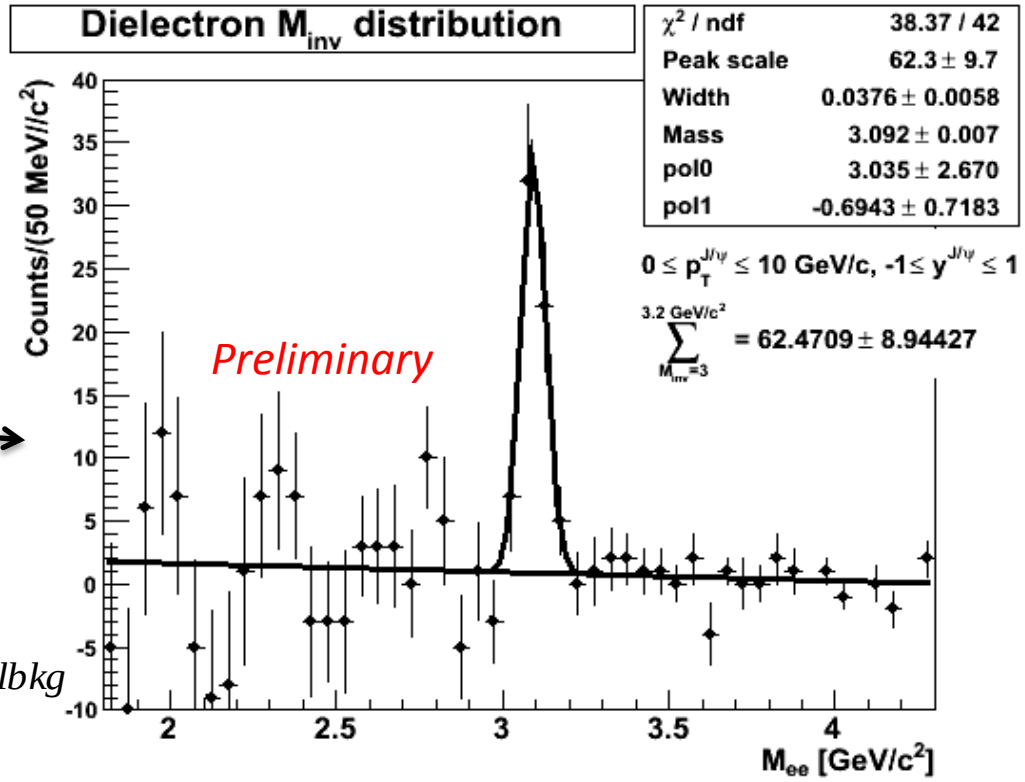


Significance = 6.99!!
S/B = 1:0.28 (3.56)
Signal
= 62.5+/-8.9
Background in
= 17.5+/- 3.7

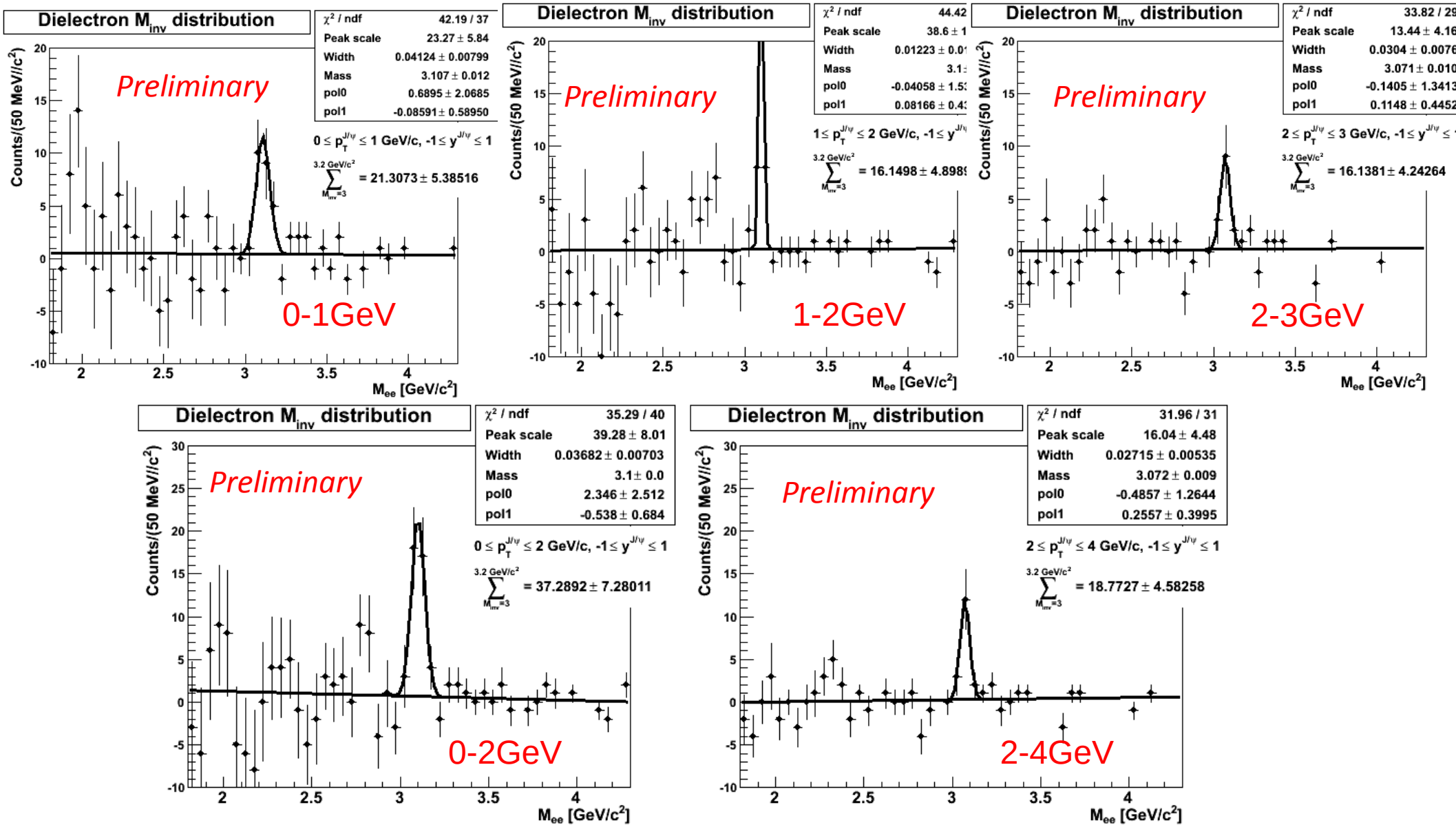
Linear residual background + gaussian signal fit

After background subtraction
- Like sign sum

$$S = N_{e+e-} - \left(N_{e+e+} + N_{e-e-}\right) - N_{residualbkg}$$



vpdMB J/Psi pT dependence



jetPatch track cuts

Track quality cuts:

|q| = 1
|η| < 1
FitHitRatio > 0.52
NfitPts > 15
DCA < 3.0cm
DipAngleDifference > 0.04

PID cuts:
|nσ_electron| < 2.0
|nSigma_pi| > 3.0
|nSigma_k| > 2.0
|nSigma_p| > 2.0

Kinematic cut:

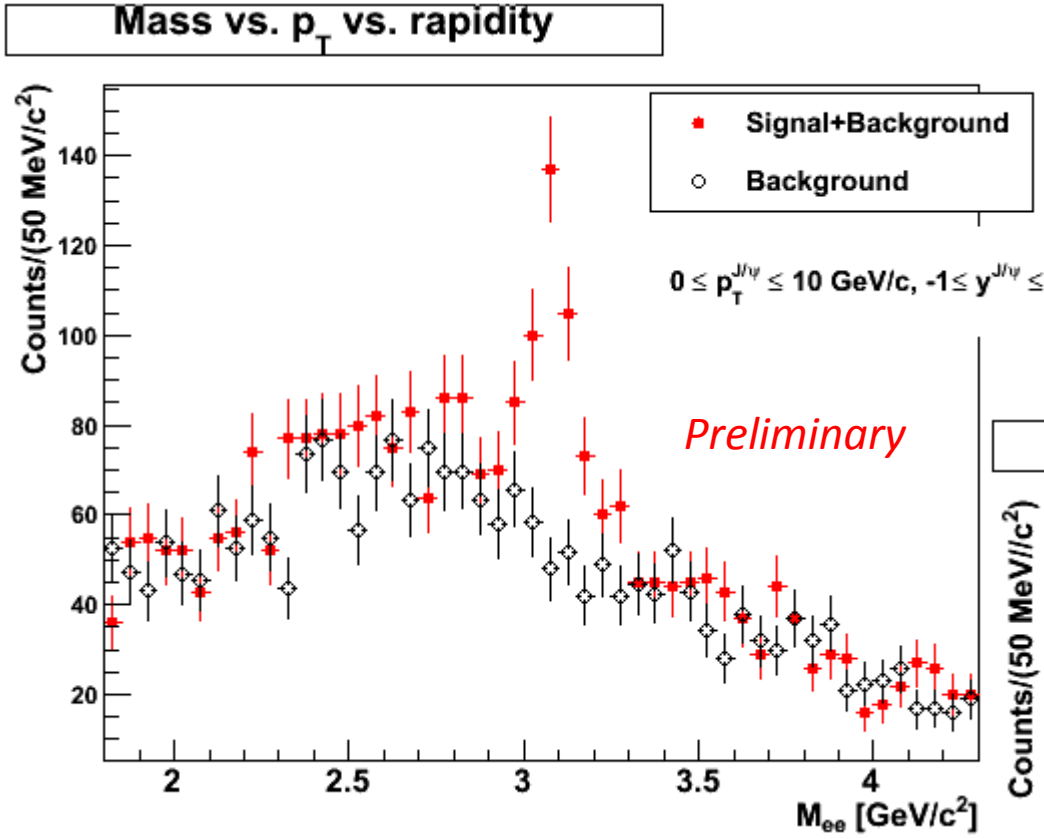
pT > 0.5 GeV

Very low kinematic cut!!

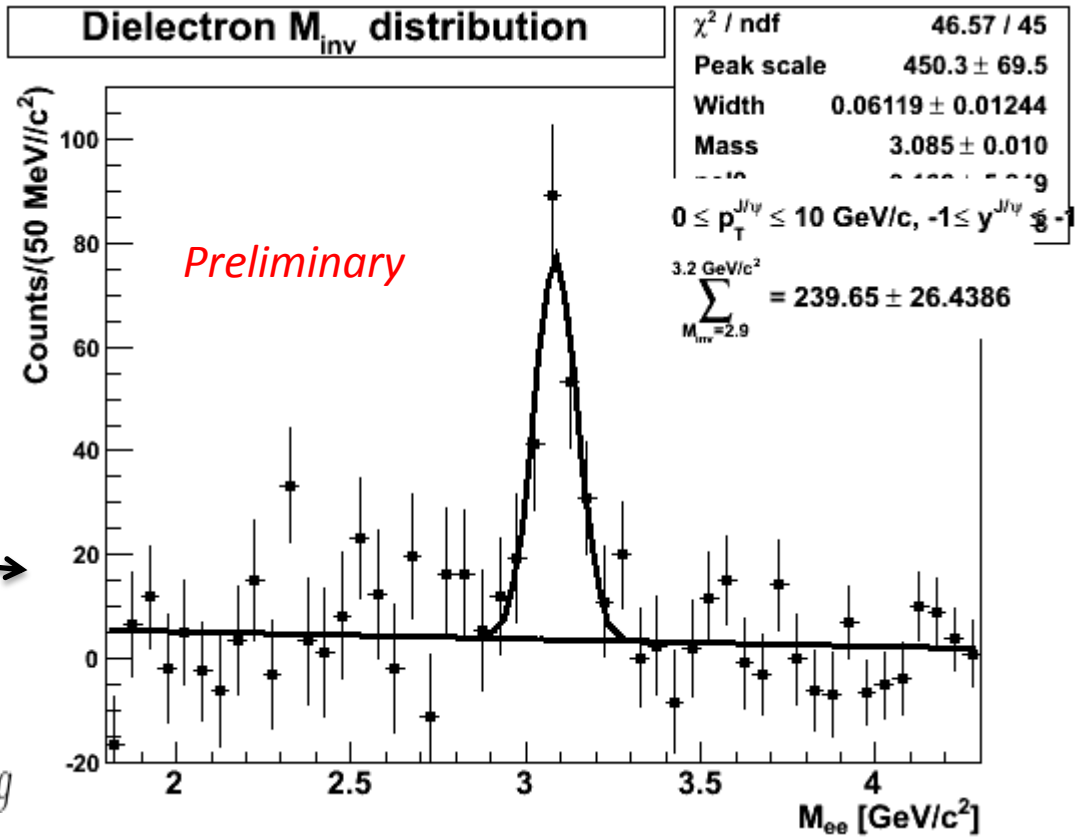
Different than vpdMB – didn`t optimize these

WARNING: No pile-up track rejection cut!!

JetPatch – signal yield in 2.9-3.2 GeV



Significance = 7.18!!
S/B = 1:0.719
Signal
= 239.7+/-26.4
Background
= 436.5+/-20.9

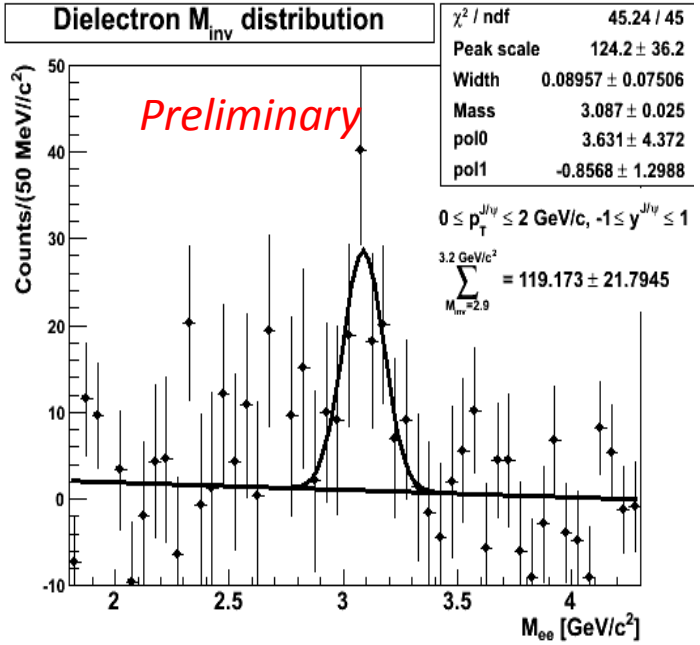


Linear residual background + gaussian signal fit

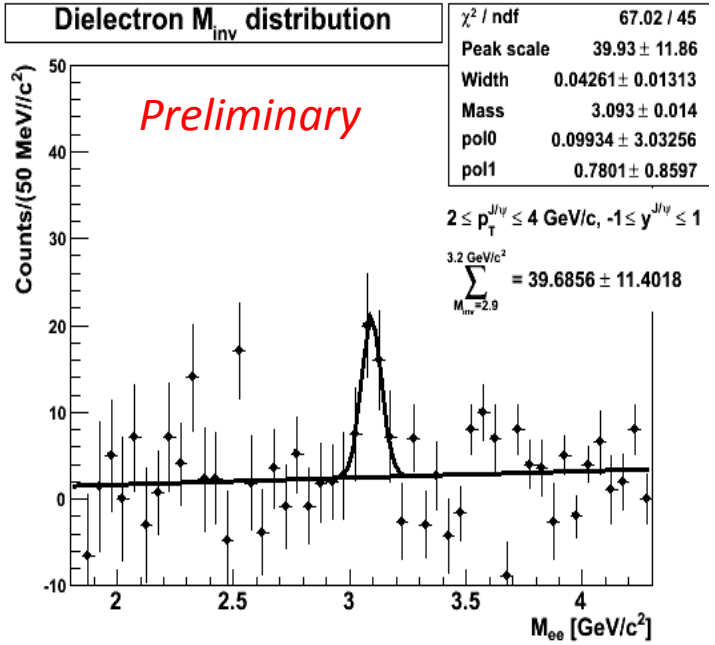
After background subtraction
- like sign geometric mean

$$S = N_{e+e-} - 2\sqrt{N_{e+e+}N_{e-e-}} - N_{residual\ bkg}$$

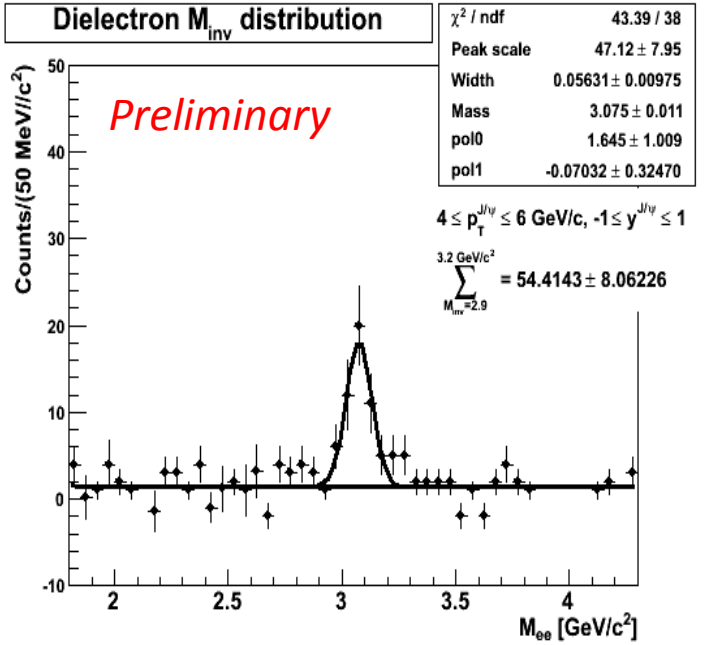
J/ψ p_T dependence in JetPatch, M_{inv} = 2.9-3.2GeV



0-2GeV



2-4GeV



4-6GeV

- Large background
- No optimized cuts
- Didn`t use TOF

To do:

PID cuts efficiency

Kinematic cuts study using Pythia

Systematic uncertainty studies

PID cuts with BEMC (E/p)

Calculate cross section (first estimates in agreement with previous results)

Thank you!!