

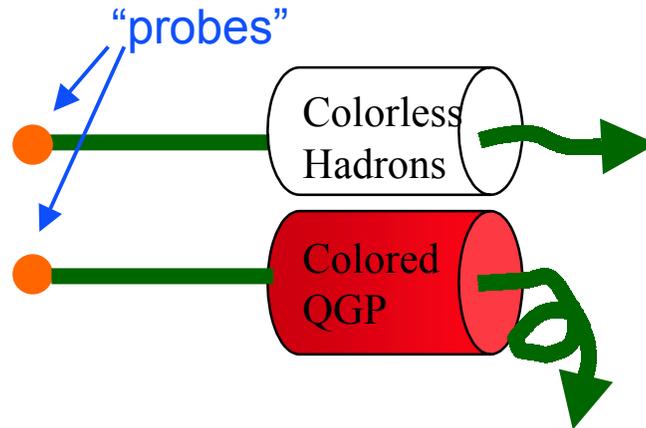
$J/\psi \rightarrow e^+e^-$ in PHENIX

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for the PHENIX Collaboration

First joint meeting of the Nuclear
Physics Divisions of APS and JPS
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QGP Probes

We expect quarks and quarkonium states to respond differently to a plasma compared to ordinary nuclear matter

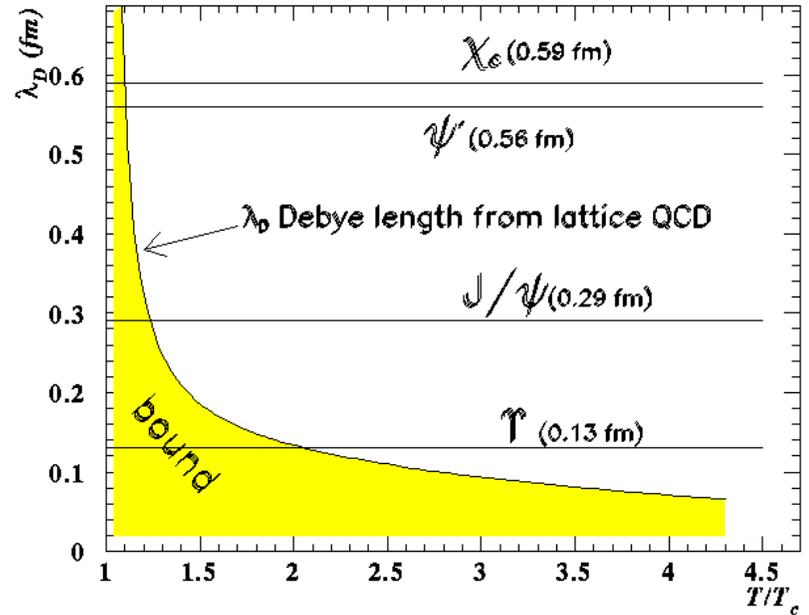
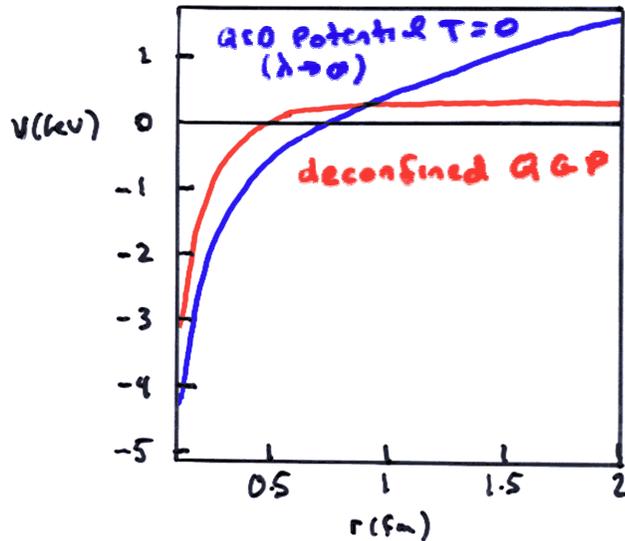


In year-1 we got our first glimpse at hard probes.
In year-2 we will get our first glimpse of "onium" probes.

Quarkonium in Deconfined Media

In deconfined media

» QCD potential modified



» Gluons are hardened

☞ They are distributed

thermally: $\langle P_g \rangle_{\text{deconf}} = 3T$

($T=200\text{MeV}$, $\langle P_g \rangle_{\text{deconf}} = 0.6 \text{ GeV}$)

In confined media gluons are thermally distributed in π 's:

☞ $\langle P_g \rangle = 1/5 \langle P_\pi \rangle = 3/5 T$

(For $T=200\text{MeV}$, $\langle P_g \rangle = 0.1 \text{ GeV}$)



Need for a Central Arm Trigger

✓ Estimate 750 $J/\psi \rightarrow e^+e^-$ /week into central arms

➤ Assumptions

→ RHIC at design luminosity ($\mathcal{L}=2.0 \times 10^{26} \text{ cm}^{-2}\text{s}^{-1}$)

→ RHIC/PHENIX duty factor: 0.25

→ $\sigma(\text{pp} \rightarrow J/\psi) = 3.3 \times 10^{-6} \text{ barns}$

➤ DAQ/triggering input:

→ Design interaction rate: 1.44 kHz events

→ J/ψ triggered event size: 390kB (200kB for minbias)

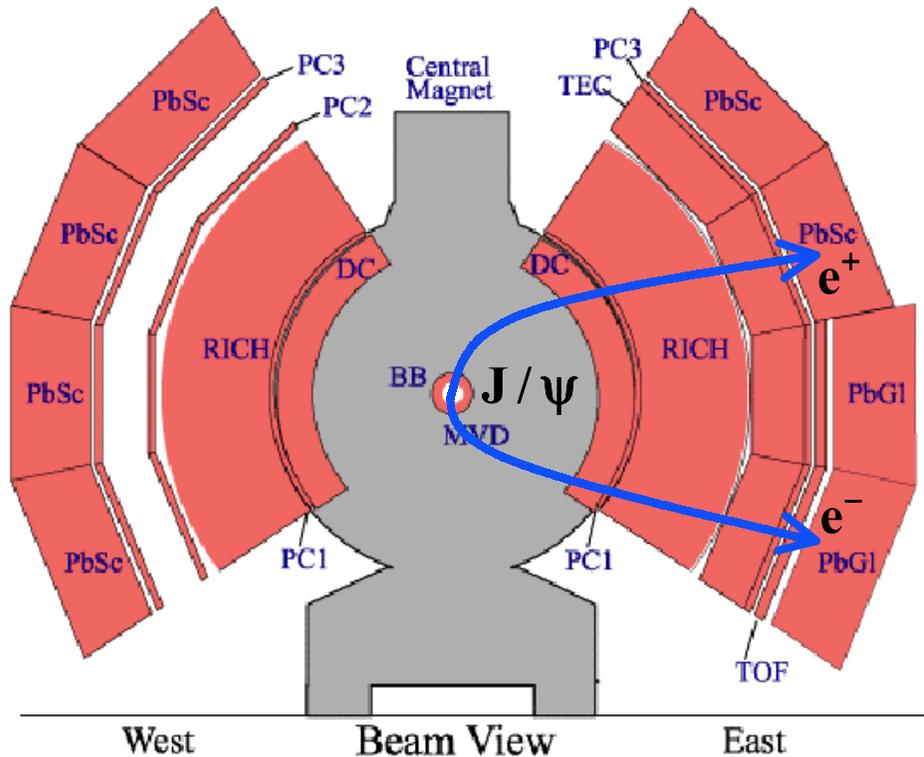
→ Current DAQ rate to tape: 30MB/sec

→ Assume 30% of trigger bandwidth to this trigger

➤ **Trigger rejection of 60 required to sample all events-**



The PHENIX Central Arm Detector

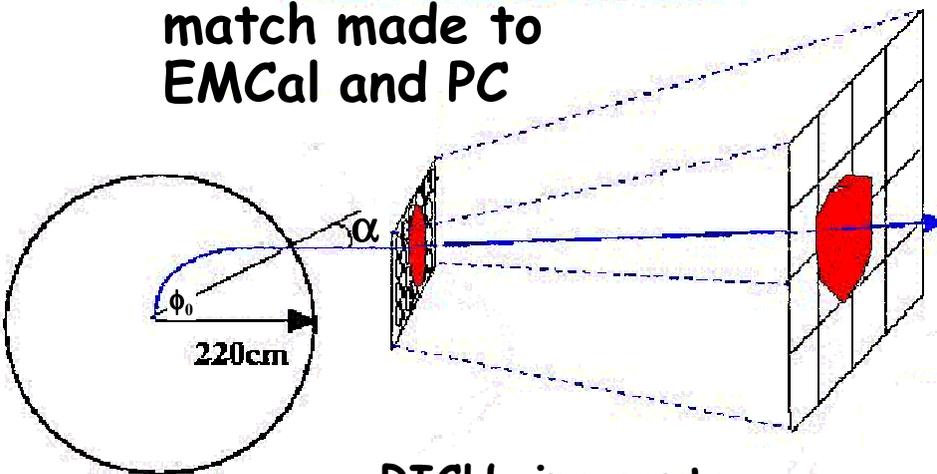


- Use BB, RICH, EMCal, and PC in a Level-2 trigger
- Make rough invariant mass selection
- Accept events above mass cut

The Trigger Algorithm

- Reconstruct all RICH rings and get track direction
- Do EMCAL clustering in area correlated to RICH rings
- Remove fake candidates via PC and α cuts
- Reconstruct kinematics using look-up table
- Pair all the candidates and reconstruct the invariant mass

match made to
EMCAL and PC



RICH ring center
 \Rightarrow track direction $\rightarrow \alpha$

$$\mathbf{E}_{\text{cluster}} \rightarrow \mathbf{p}_{\text{tot}}, \theta_0$$

$$\mathbf{p}_T = \mathbf{p}_{\text{tot}} \sin(\theta_0)$$

$$\mathbf{p}_T, \theta_0, \mathbf{z}_{\text{vtx}}, \phi_{\text{dc}}, \mathbf{Z} \Rightarrow \phi_0$$

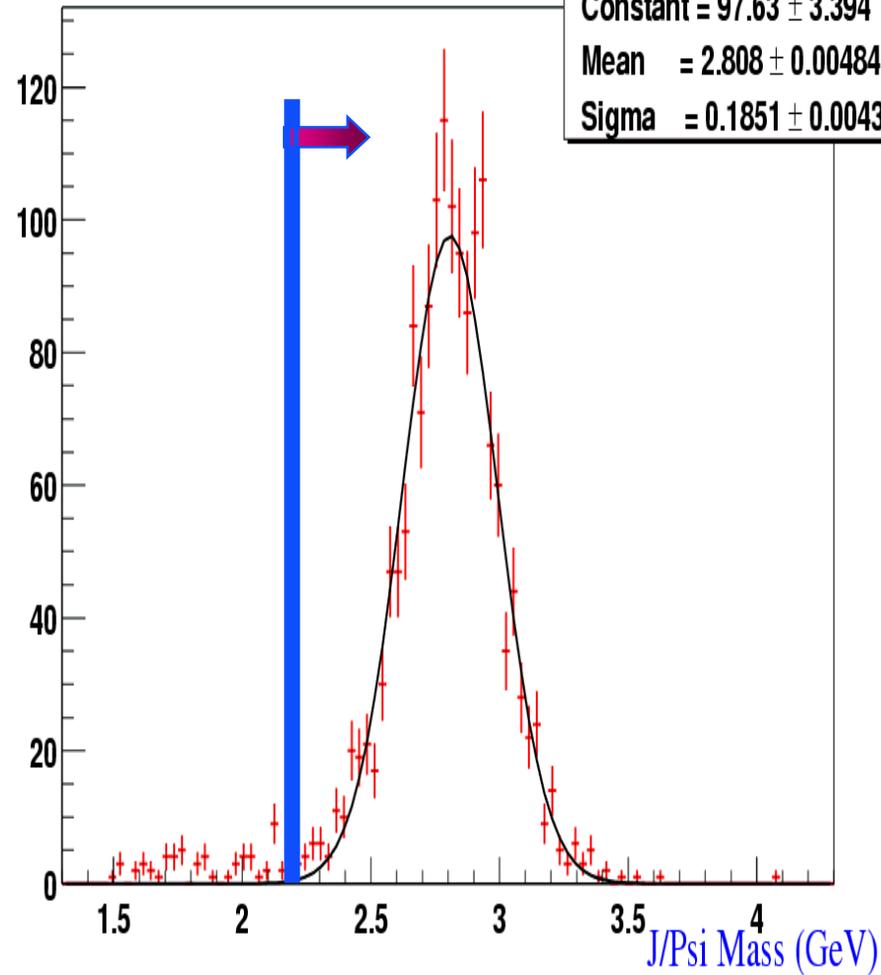
$$\theta_0, \phi_0 \Rightarrow \theta_{12} \left(\begin{array}{l} \text{angle between} \\ \text{two candidates} \end{array} \right)$$

$$\mathbf{M} = \sqrt{2\mathbf{p}_{\text{tot}1}\mathbf{p}_{\text{tot}2}(1 - \cos\theta_{12})}$$

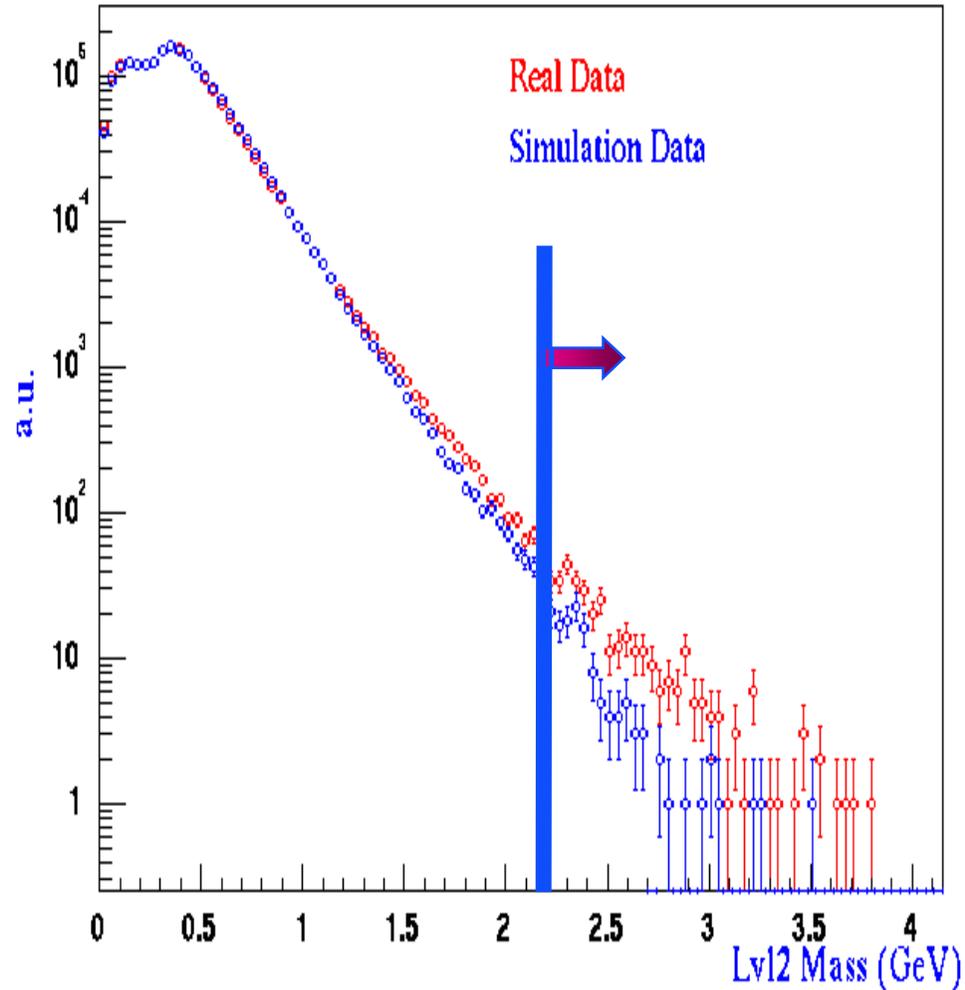
Mass Reconstruction

Single J/ψ

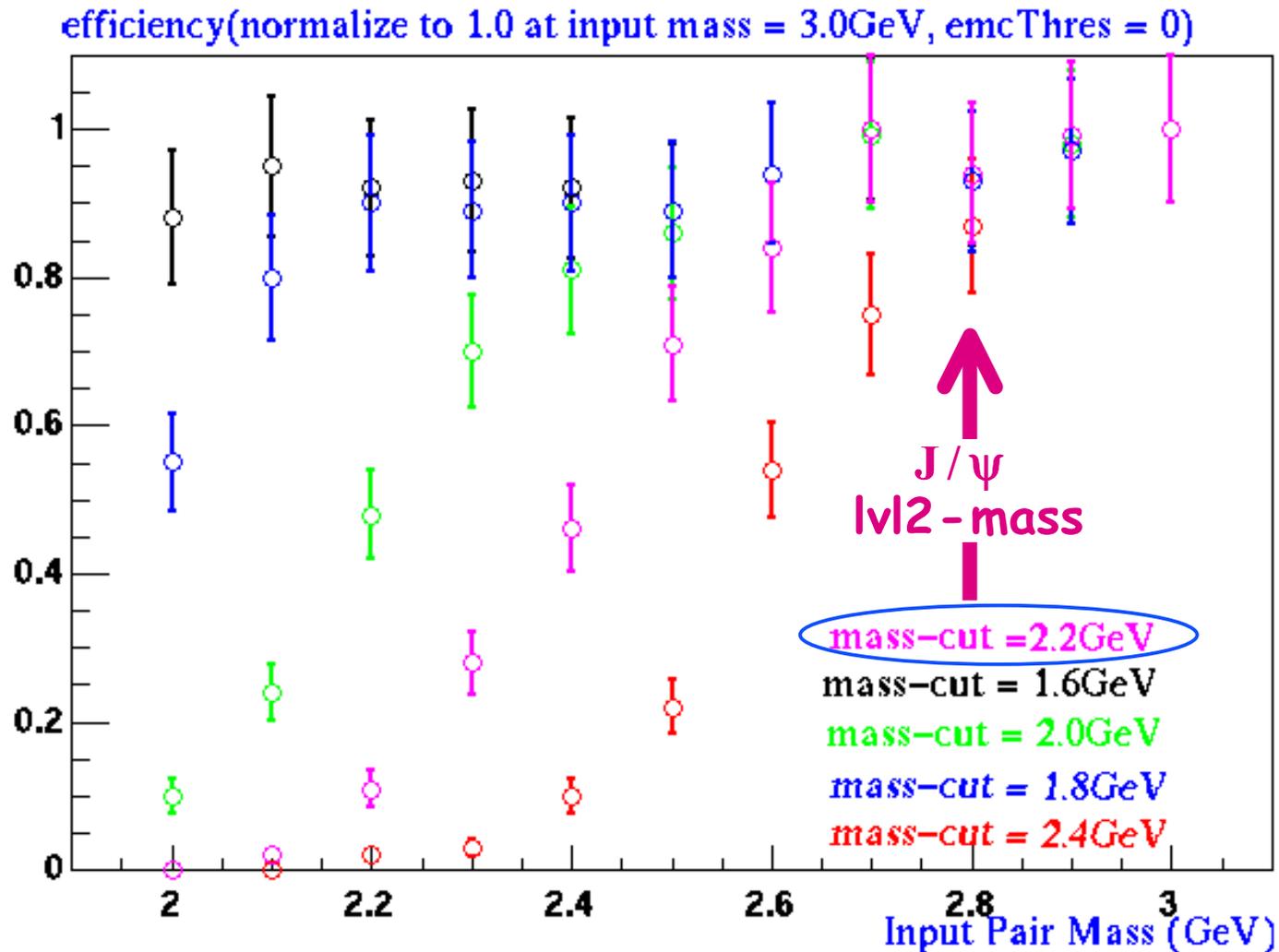
Chi2 / ndf = 128.2 / 63
Constant = 97.63 ± 3.394
Mean = 2.808 ± 0.004846
Sigma = 0.1851 ± 0.004337



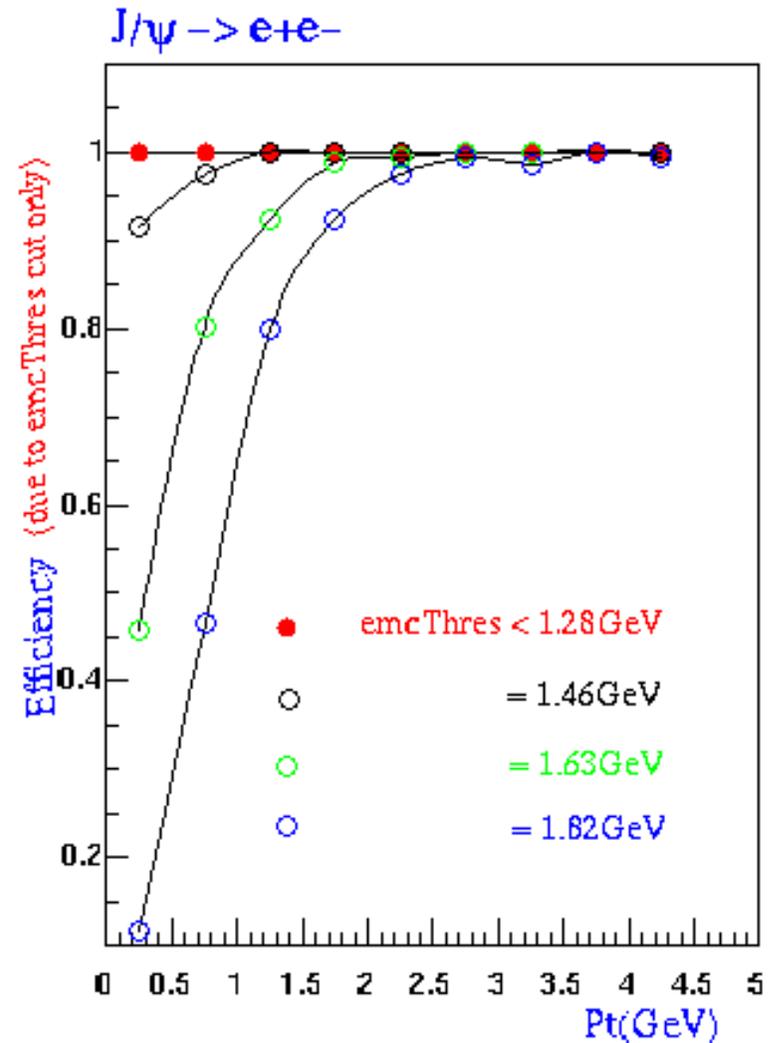
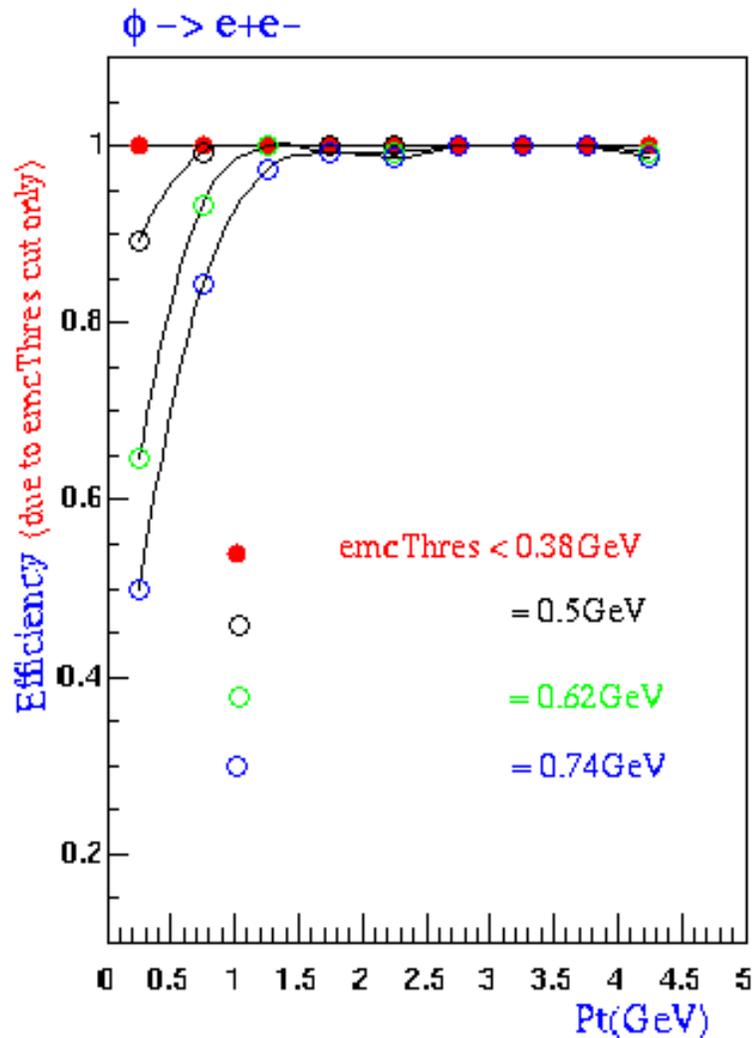
Minbias Events



Simulation Efficiencies vs. Mass Cut

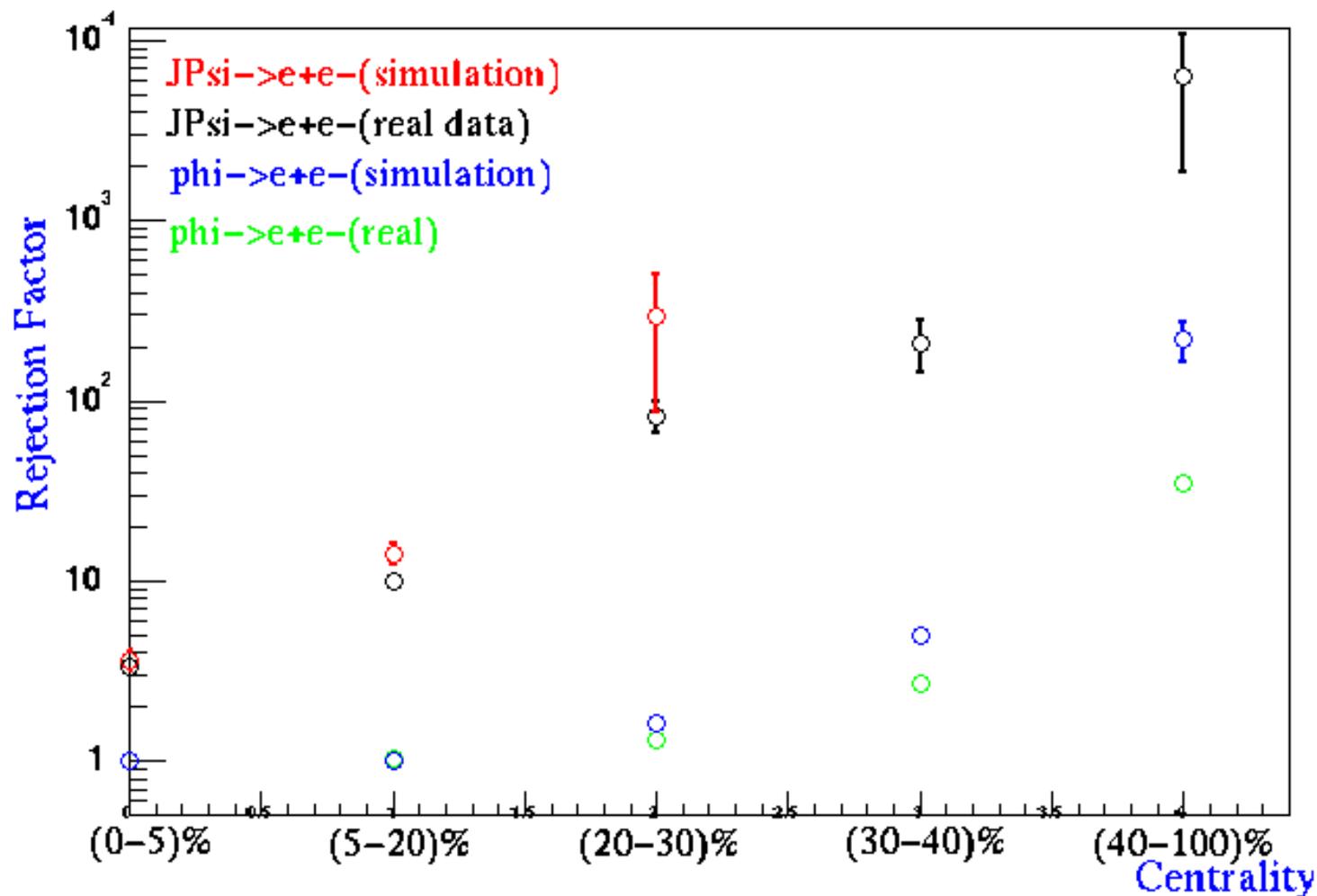


Simulation Efficiencies vs P_T



Rejections (Simulation and Data)

Minbias Rejection: Simulation 40, Data 31



Outlook/Conclusions

- ✓ Trigger scheme in place to sample all $J/\psi \rightarrow e^+e^-$ in the PHENIX central arm acceptance at RHIC design luminosity.
 - ✓ With current algorithm cuts the rejection is 30
 - ✓ Once calibrations and alignments are understood cuts can be tightened to achieve a rejection of 60
 - ✓ Offline trigger efficiency studies using data is underway
- Biggest uncertainty: integrated luminosity
- » Original goal for run: 5000 $J/\psi \rightarrow e^+e^-$ events collected

