

J/ψ Analysis Update

Update on Presentation of 2/23/13

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Outline

1. Introduction & Motivation
2. Monte-Carlo Data Generation
3. Cuts on the Data
4. Preliminary Results

Motivation

1. Study J/ψ production
2. Search for pentaquark production

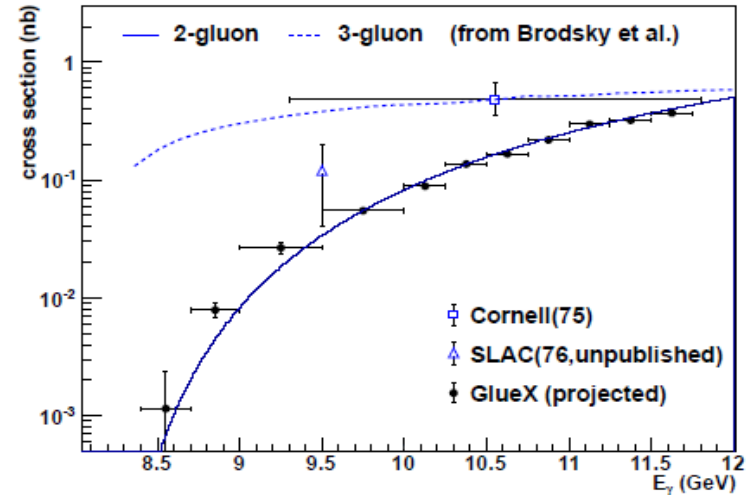
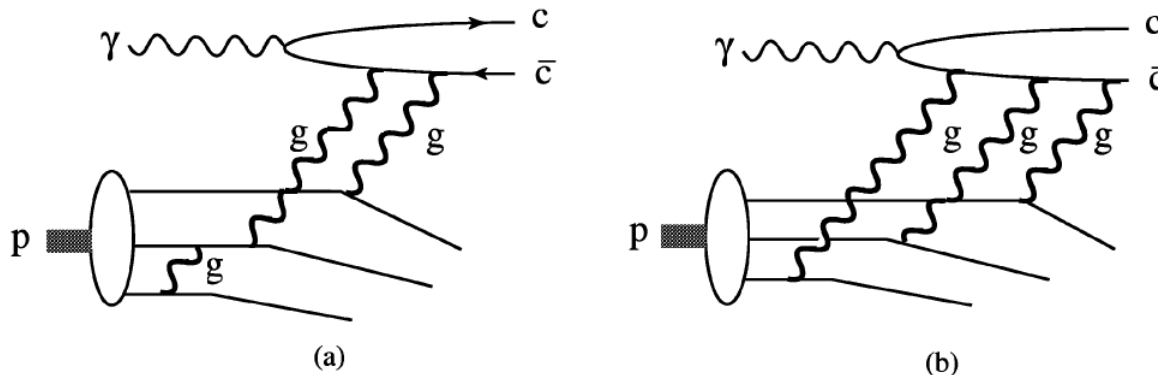


Illustration of two and three gluon photoproduction of J/ψ



J/ψ Analysis

J/ψ Signal:

$$\gamma p \rightarrow J/\psi p$$

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

Branching ratio to e^+e^- : 6%
Cross section: ~ 0.1 nb near 10 GeV.

Main Background:

$$\gamma p \rightarrow \pi^+ \pi^- p$$

Cross section: ~ 14.5 μb
(mostly due to ρ production).

Monte-Carlo Generation

$J/\psi \rightarrow e^+e^-$ events:

1. Generate 120k J/ψ events with a t-slope of 1, assuming the 2-gluon photoproduction model.
2. Run this data through *hdgeant* and *mcsmeas*.
3. Run the output through my JANA plugin and then *TSelector*.

$\pi^+\pi^-$ events:

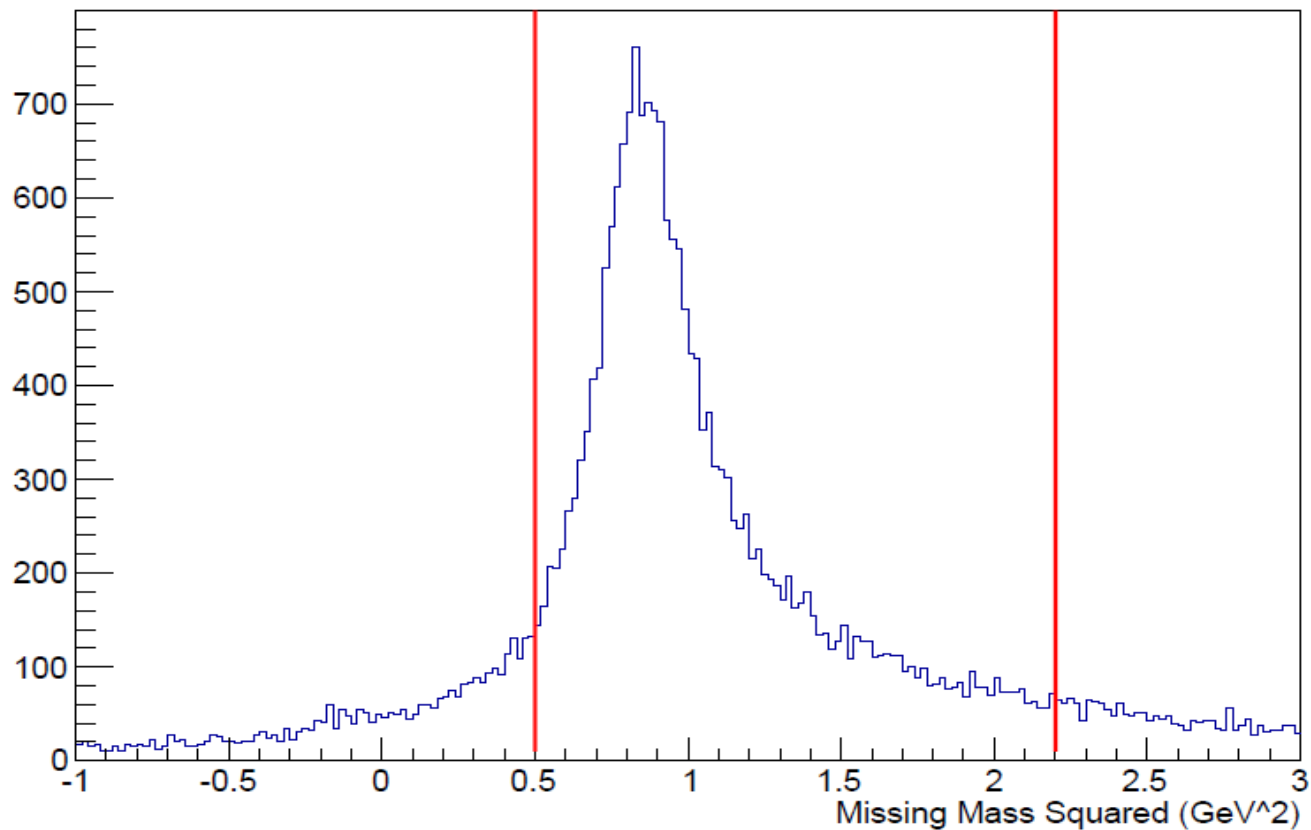
1. Generate ≥ 1 million background events, courtesy of Sean.
2. Run this data through *hdgeant* and *mcsmeas*.
3. Run the output through my JANA plugin and then *TSelector*.

Basic Selection Cuts

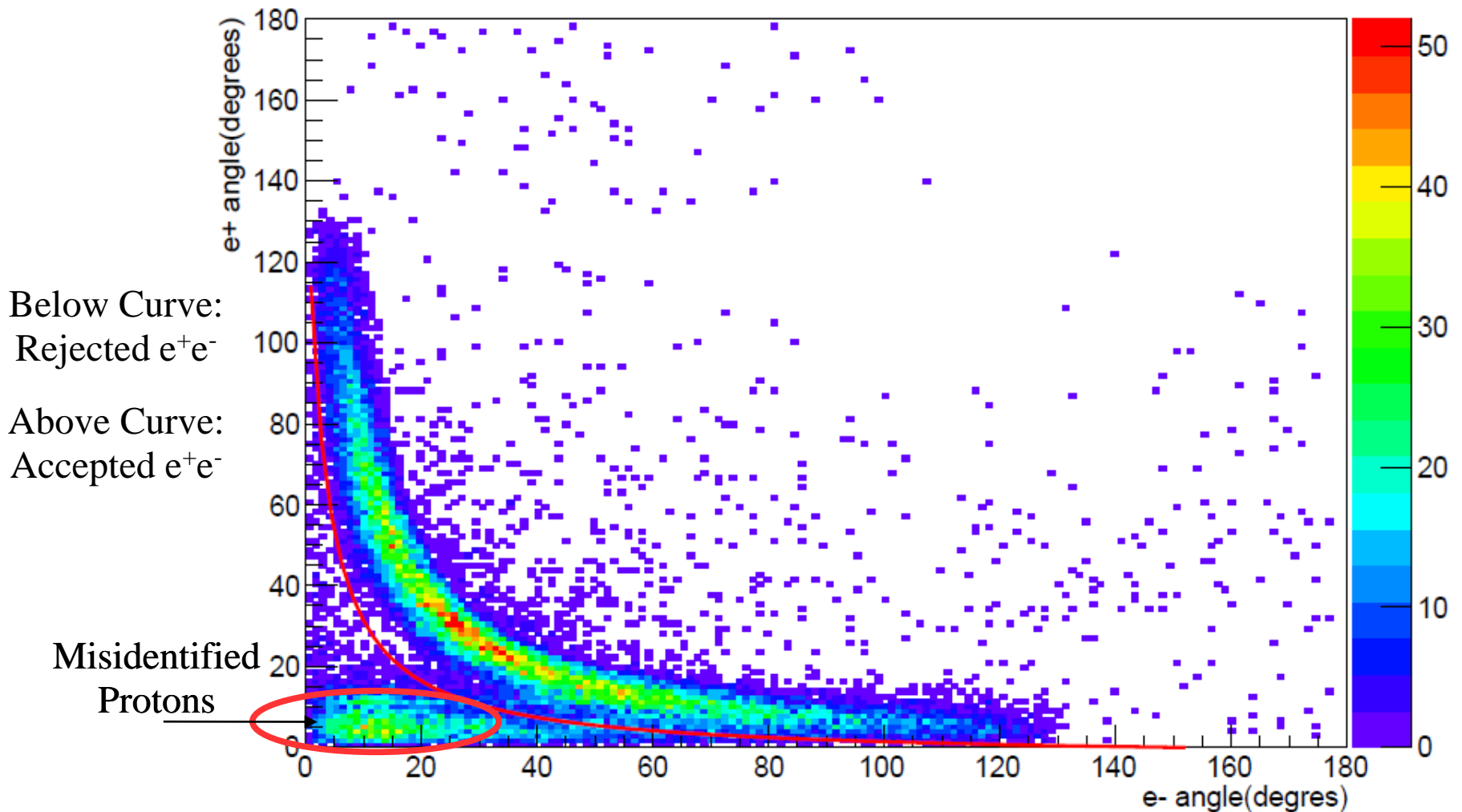
1. Both the $J/\psi \rightarrow e^+e^-$ and $\pi^+\pi^-$ events are reconstructed in JANA, with the proton missing.
2. Various suggested cuts in JANA are made:
 - Maximum Photon RF to the correct beam bunch. (1.002 ns cut)
 - Maximum Extra Good Tracks (4).
3. A loose invariant missing mass cut is made in the TSelector
 $0.5 \text{ GeV} < \text{Squared Missing Mass} < 2.2 \text{ GeV}$

TSelector Cuts- Missing Mass

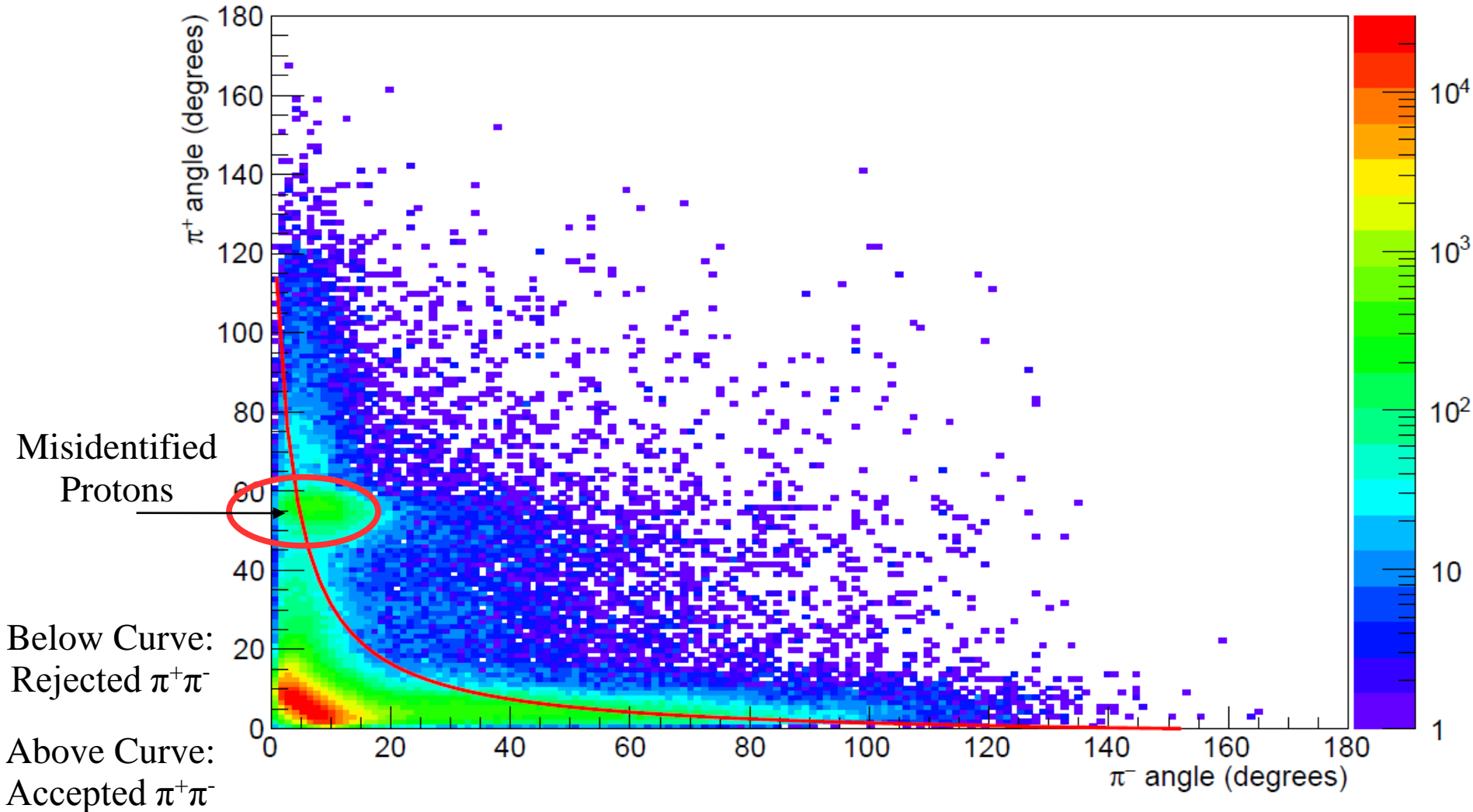
Missing Mass for e^+e^- events



TSelector Cuts- e^+e^- Angles



TSelector Cuts- $\pi^+\pi^-$ Angles



TSelector Cuts- E/p

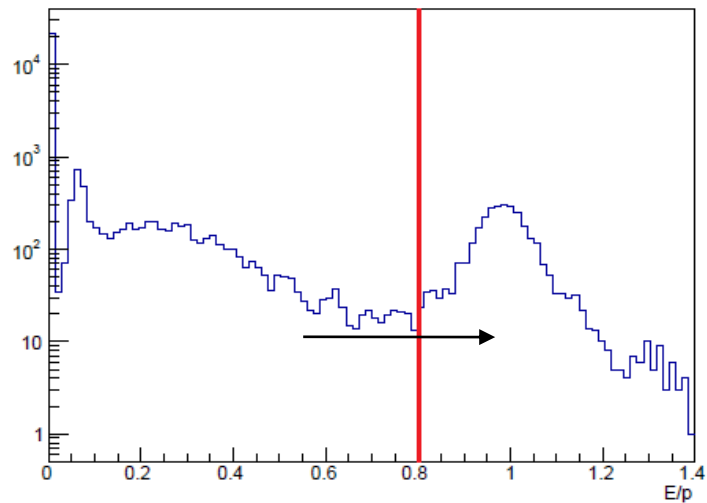
E/p Cut	Purity	E/p Efficiency
0	0.013	1
0.5	0.396	0.741
0.6	0.672	0.710
0.65	0.776	0.683
0.7	0.889	0.650
0.75	0.938	0.610
0.8	0.965	0.561
0.85	>0.97	0.508

Selected Cut
→

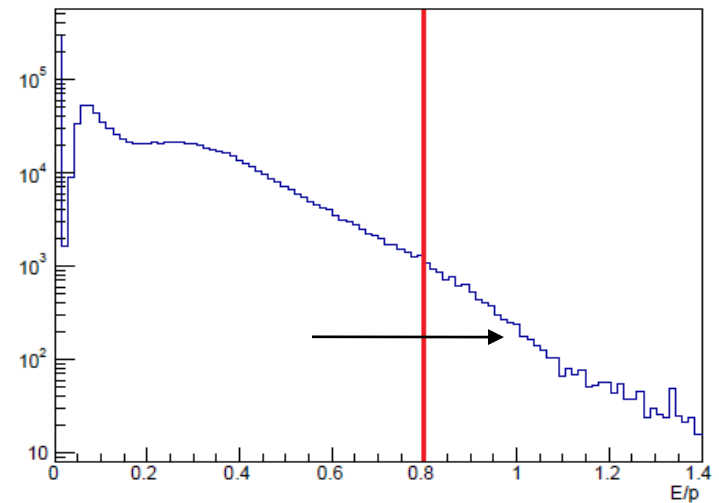
Choosing an E/p cut of >0.8 gives an overall efficiency of 6.5%.

E/p Distributions

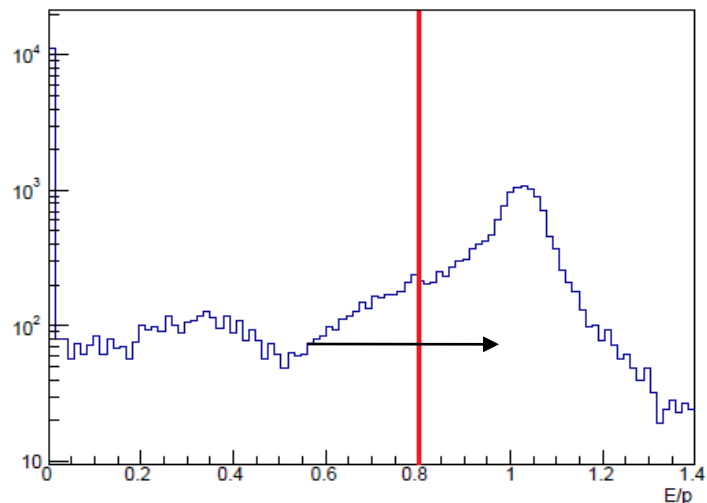
E/p for J/psi events in the FCAL



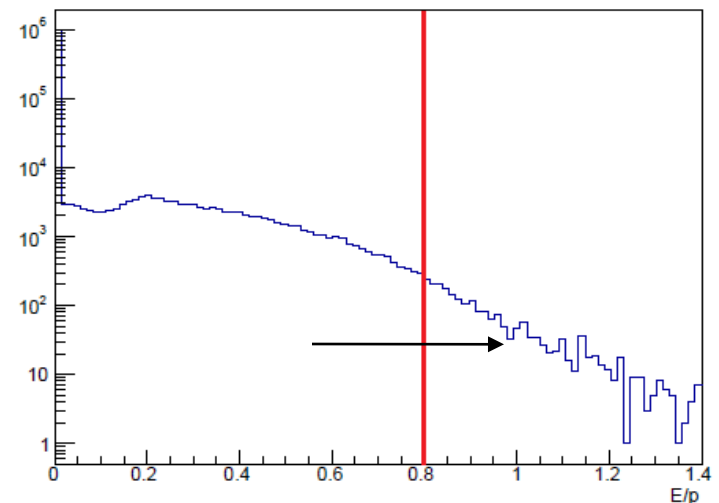
E/p for pions in the FCAL



E/p for J/psi events in the BCAL

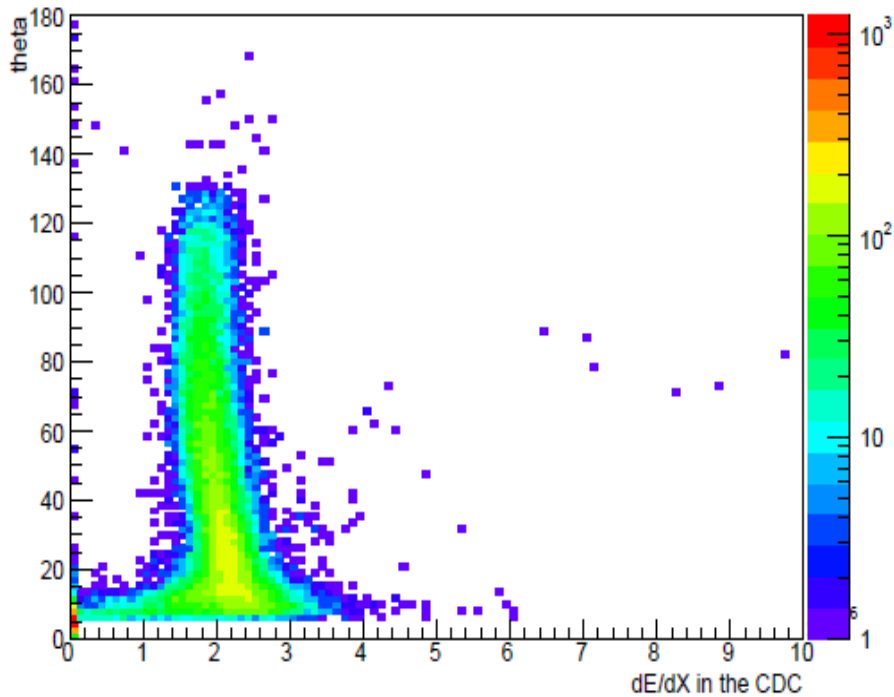


E/p for pions in the BCAL

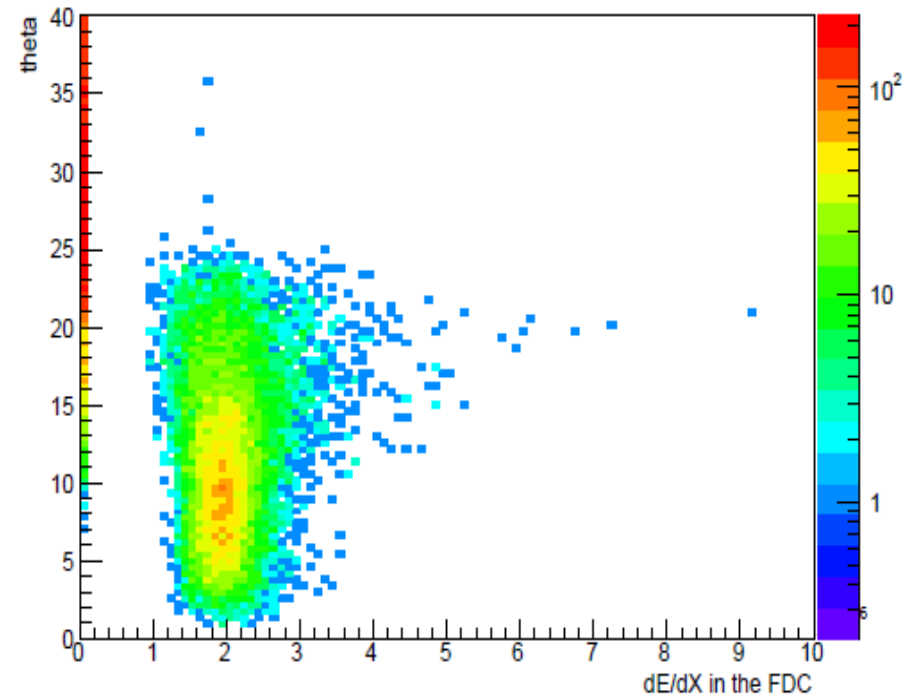


dE/dx from e^+e^- Events

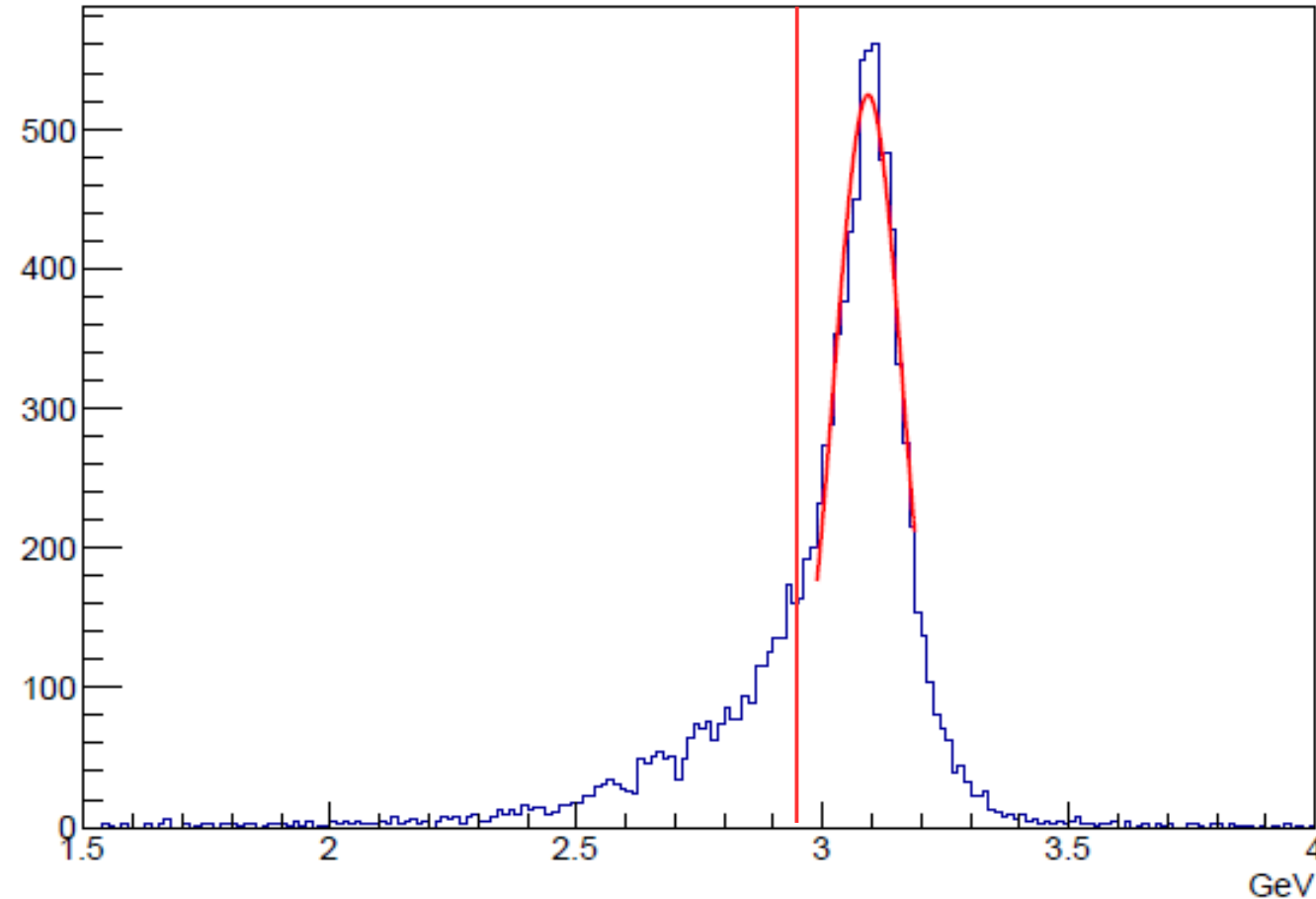
e^+e^- events in the CDC



e^+e^- events in the FDC



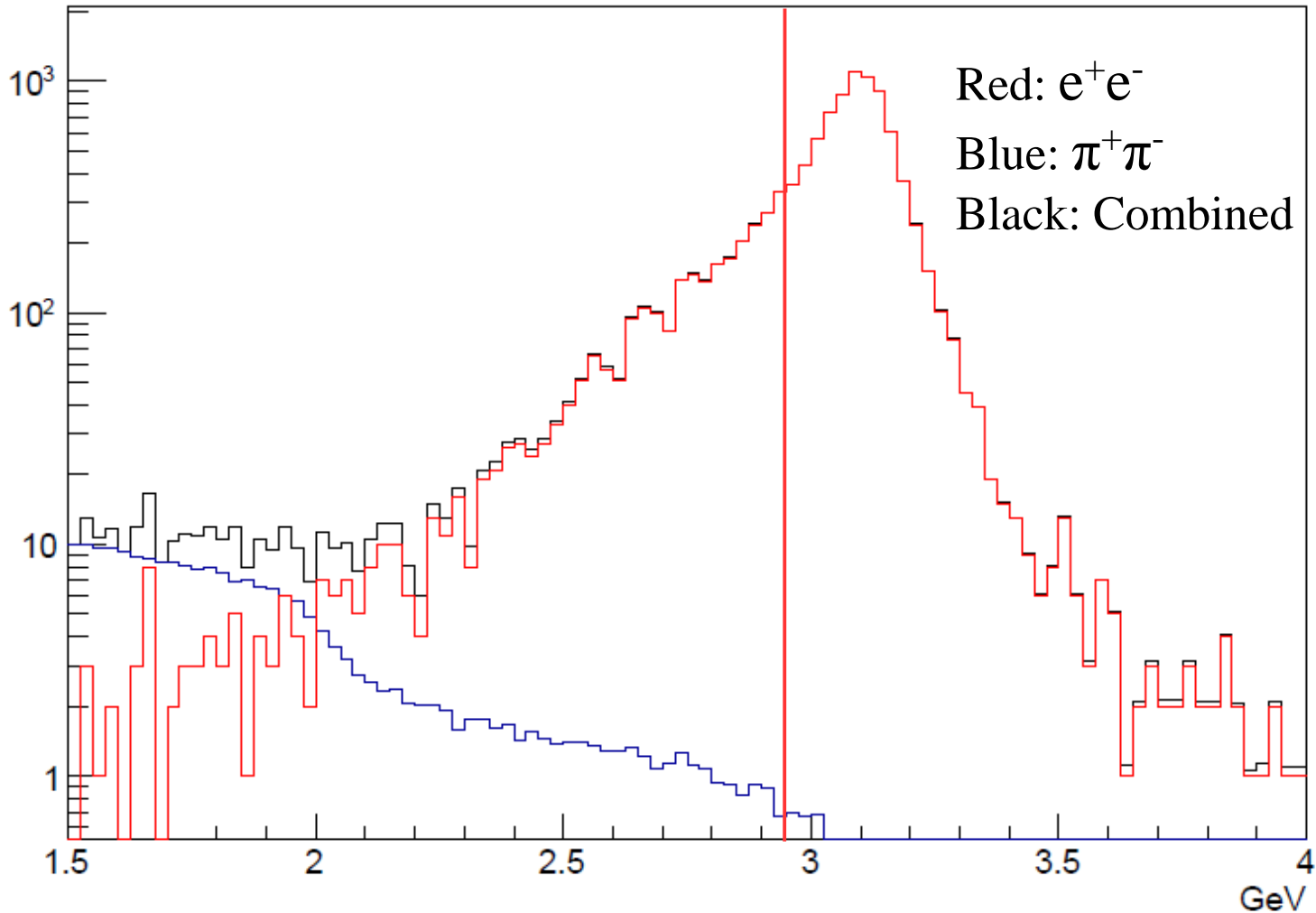
e^+e^- Invariant Mass



Mean: 3.09 GeV
Sigma: 70 MeV

Overall Efficiency
(>2.9 GeV): 6.5 %

Combined Invariant Mass



Overall Efficiency
(>2.9 GeV): $>99.9\%$

Future Plans

- Re-do the analysis, but with the Proton reconstructed.
- Compare the response of the FCAL and BCAL to electrons and pions between simulation and data.
- Continue to add other useful cuts & plots (comparing reconstructed distributions to thrown ones, for example).
- Investigate low efficiencies from JANA
- Look into adding in tagger information
- Continue working on TRD development