

# 宇宙史拠点実習最終報告

～EMCALによるJ/ψの測定～

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High energy nuclear physics group

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# Outline

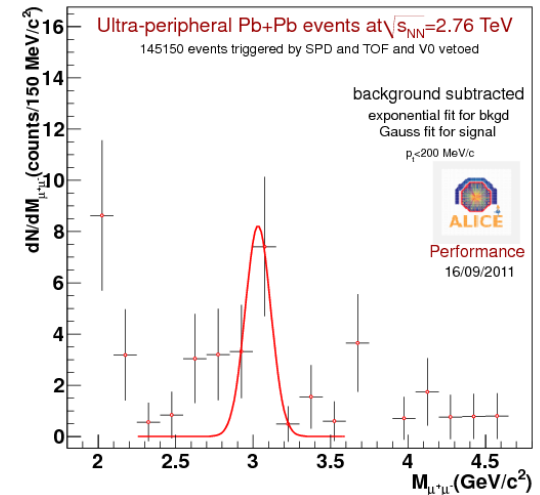
- Introduction
- Motivation
- ALICE Detector (EMCal & TPC )
- How to find  $J/\Psi$  decayed  $e^+e^-$  pair
- Track matching

# Introduction

- What's  $J/\psi$  ?

Quark composition :  $c\bar{c}$

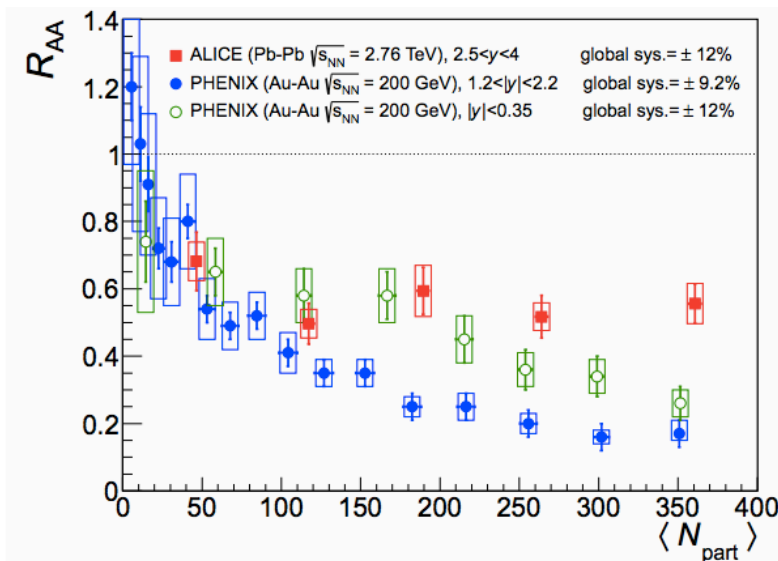
Mass(Mev/c<sup>2</sup>) : 3096.916±0.011



$J/\psi(1S)$ DECAY MODES	Fraction ( $\Gamma_i/\Gamma$ )	Scale factor/ Confidence level (MeV/c)	$p$
hadrons	(87.7 ±0.5 ) %	—	—
virtual $\gamma \rightarrow$ hadrons	(13.50 ±0.30 ) %	—	—
$g g g$	(64.1 ±1.0 ) %	—	—
$\gamma g g$	( 8.8 ±1.1 ) %	—	—
$e^+ e^-$	( 5.94 ±0.06 ) %	1548	—
$e^+ e^- \gamma$	[a] ( 8.8 ±1.4 ) × 10 <sup>-3</sup>	1548	—
$\mu^+ \mu^-$	( 5.93 ±0.06 ) %	1545	—

# Motivation

- **J/Ψ suppression occur in QGP**
  - Because of Debye shielding came from color charge



$R_{AA}$ (nuclear modification factor)

$$R_{AA} = \frac{1}{\langle N_{coll} \rangle} \frac{(1/N_{event}^{AA}) d^2 N_{\pi^0}^{AA} / dy dp_T}{(1/N_{event}^{pp}) d^2 N_{\pi^0}^{pp} / dy dp_T}$$

☆ if A-A collision yield is represented superposition of p-p collision yield...

$$R_{AA} \cong 1$$

It's considered proof of QGP's existence

# ALICE Detector

- In the present analysis...

- Time Projection Chamber (TPC)

- main tracking device

$$\Delta\eta = 1.8 \quad \Delta\varphi = 360^\circ$$

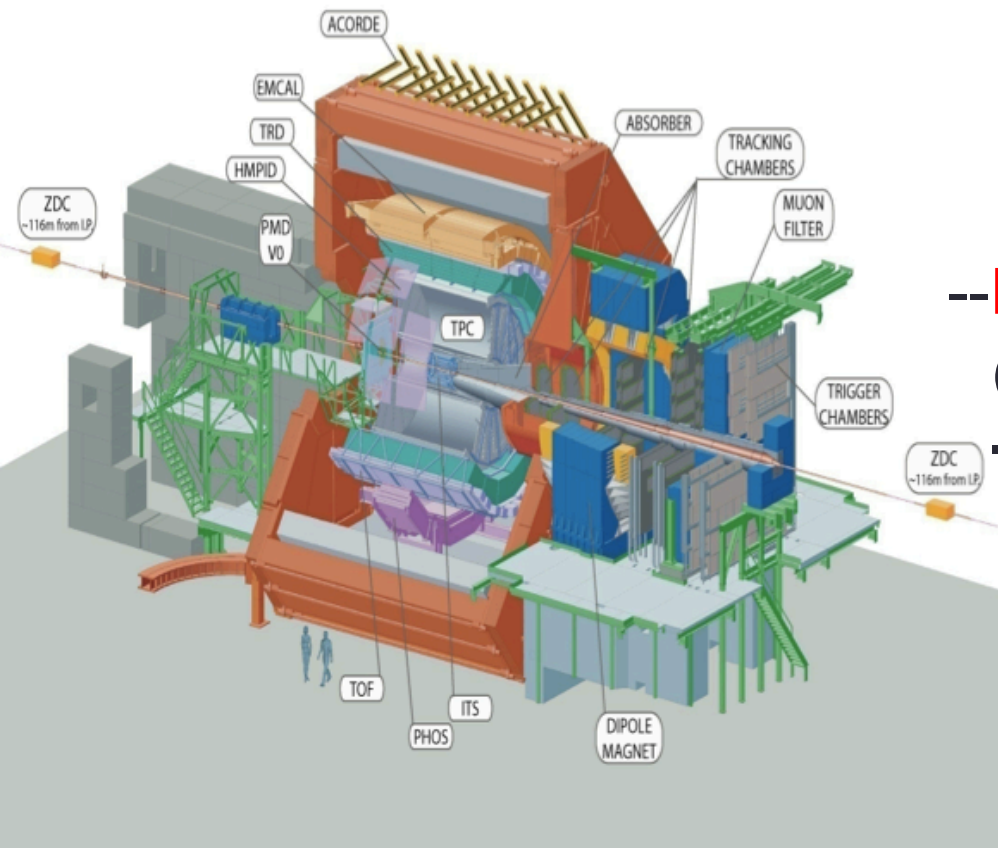
- ▶ tracking
- ▶ PID (energy loss)

- Electromagnetic Calorimeter (EMCal)

- Lead-scintillator sampling calorimeter

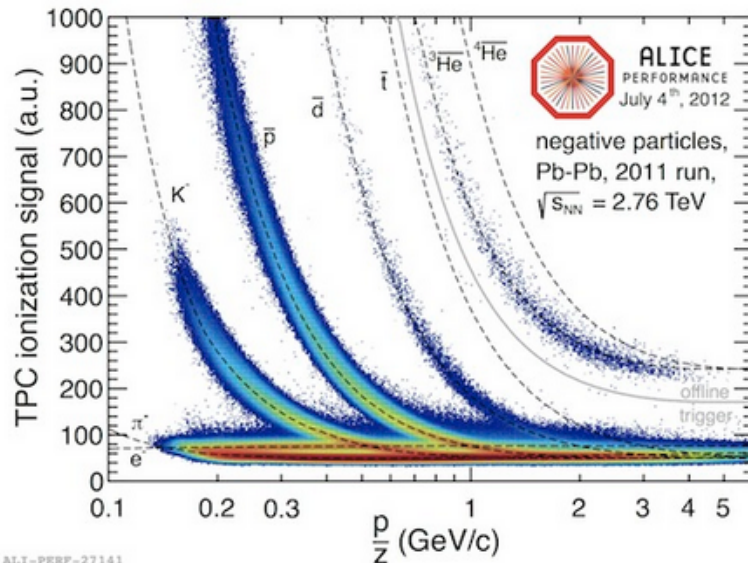
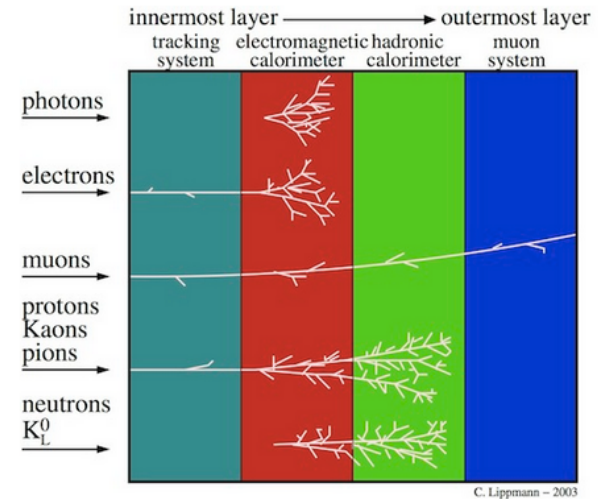
$$\Delta\eta = 1.4 \quad \Delta\varphi = 110^\circ$$

- ▶ PID (cluster energy)



# How to find $J/\psi$ decayed $e^+e^-$ pair

- Electron selection  
electron makes shower on EMCal  
select cluster with track
  - reject photon



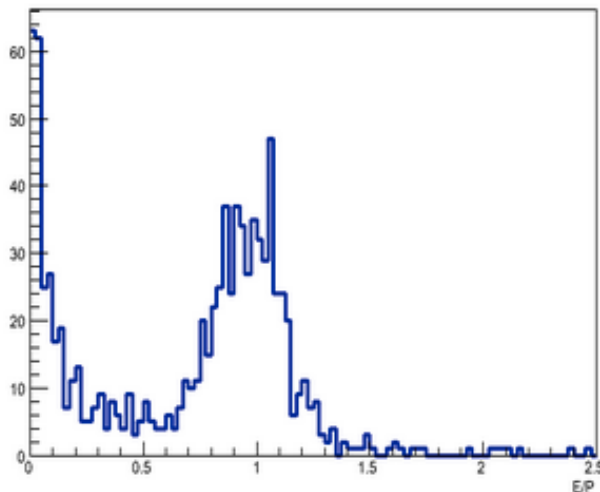
- TPC signals  
Ionization loss is represented
  - Bethe-Bloch formula

# How to find J/ψ decayed e<sup>+</sup>e<sup>-</sup> pair

- Sigma selection  
dE/dx in nσ's around the  
electron Bethe-Bloch

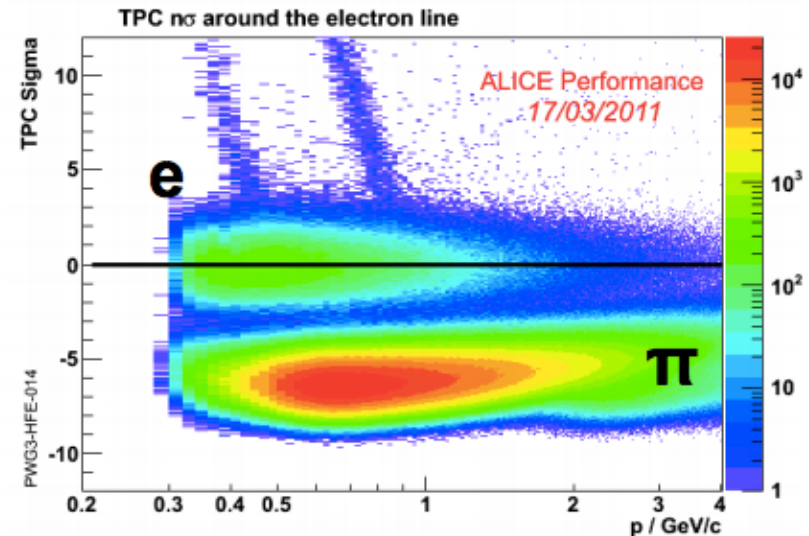
$$n\sigma = \frac{dEdx_{signal} - dEdx_{electron}}{\sigma_{electron}}$$

EoverP e(MC) for Pt(1.0,3.0)GeV/c



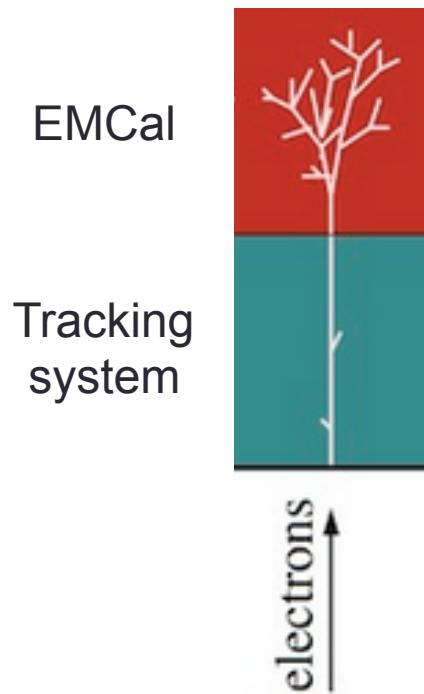
- E/p  
cluster energy “E” and track momentum “p”  
►PID parameter

$$\frac{E}{p} = \frac{Energy_{cluster}}{Momentum_{track}}$$



# Track matching

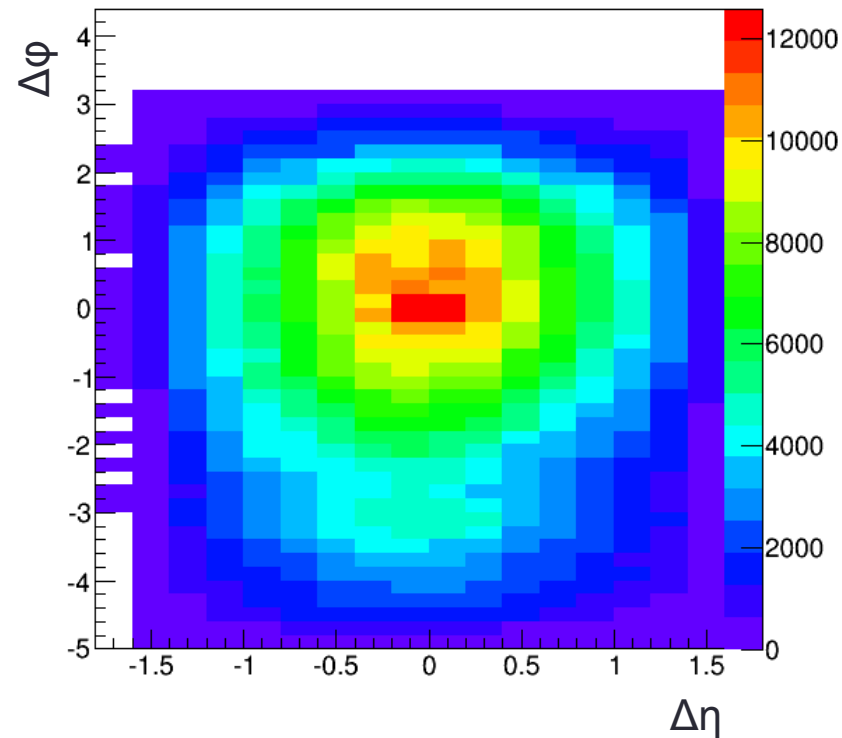
- クラスターの位置とトラックの差



$$\Delta R = \sqrt{\Delta \eta^2 + \Delta \varphi^2}$$

$$\Delta \eta = \eta_{cluster} - \eta_{track}$$

$$\Delta \varphi = \varphi_{cluster} - \varphi_{track}$$



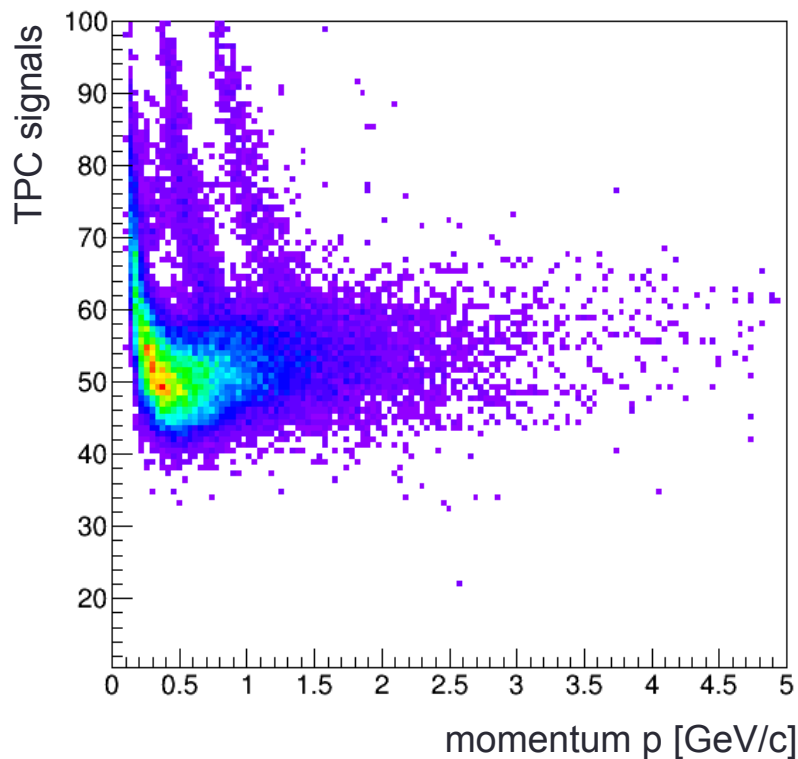
cut :  $\Delta R < 10$



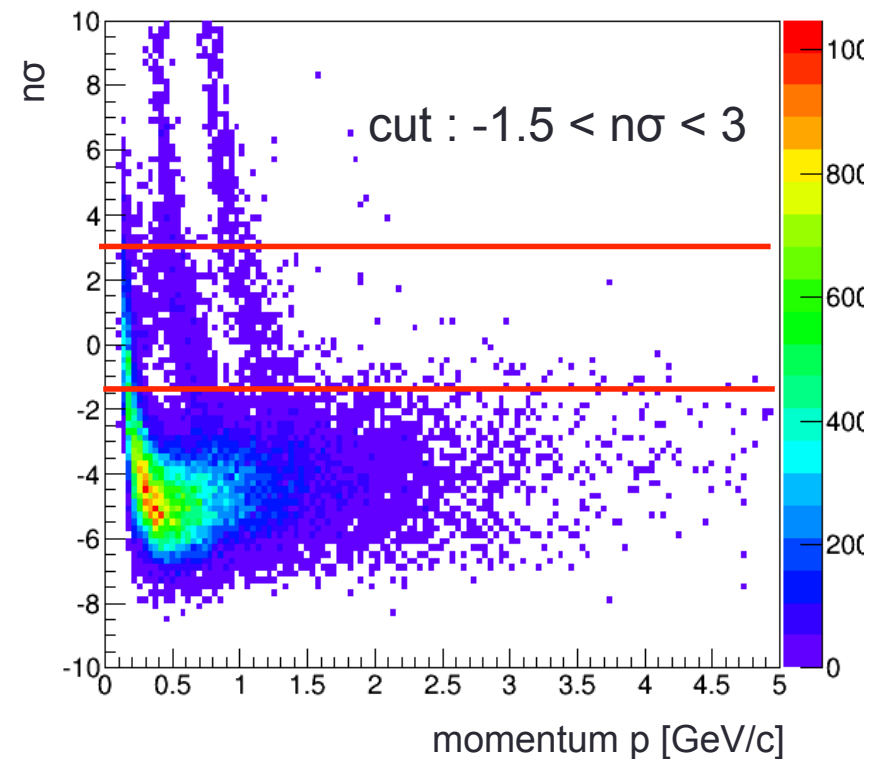
# TPC signals

- centrality 50-100%

Track p vs TPC signal

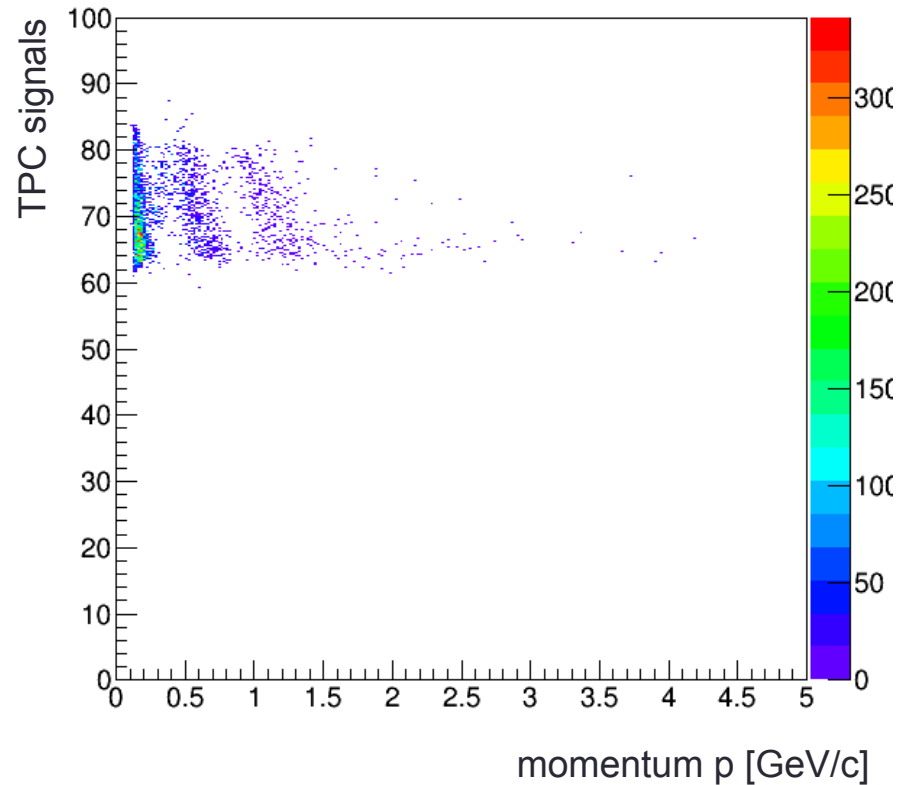
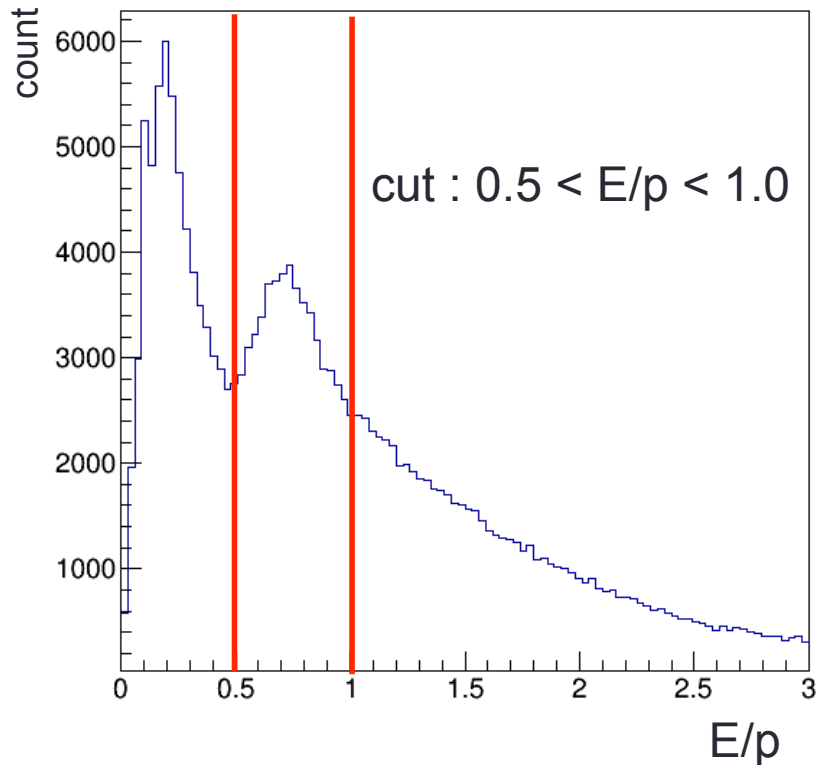


Track p vs sigma



# E over p and cut TPC signal

- centrality 50-100%



# Future plan

- Use TOF and PID electrons
- $J/\psi$  reconstruction

Additional Slides

# J/ψ (particle data group)

**J/ψ(1S)**

$$J^{PC} = 0^{-}(1^{-}-)$$

Mass  $m = 3096.916 \pm 0.011$  MeV

Full width  $\Gamma = 92.9 \pm 2.8$  keV (S = 1.1)

$\Gamma_{ee} = 5.55 \pm 0.14 \pm 0.02$  keV

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