Work Progress

J/ψ mass reconstruction and eID(EOP)

Xinbai Li, Wangmei Zha
USTC ECCE HF working group
31/8/21

Outline

- Update the mass spectrum plots
- eID(EOP)
- TOF(fast simulation)
- Gap between unlikesign and likesign
- Cut to improve J/ψ significance
- Summary and Plan

Update some plots

Files:

- fast simulation: similar input comfiguration files with /gpfs02/eic/DATA/YR_SIDIS/ep_18×275/inputcards/, only change the ep energy
- smear: Add tof in Matrix02_B1_5T, set the paraments as:

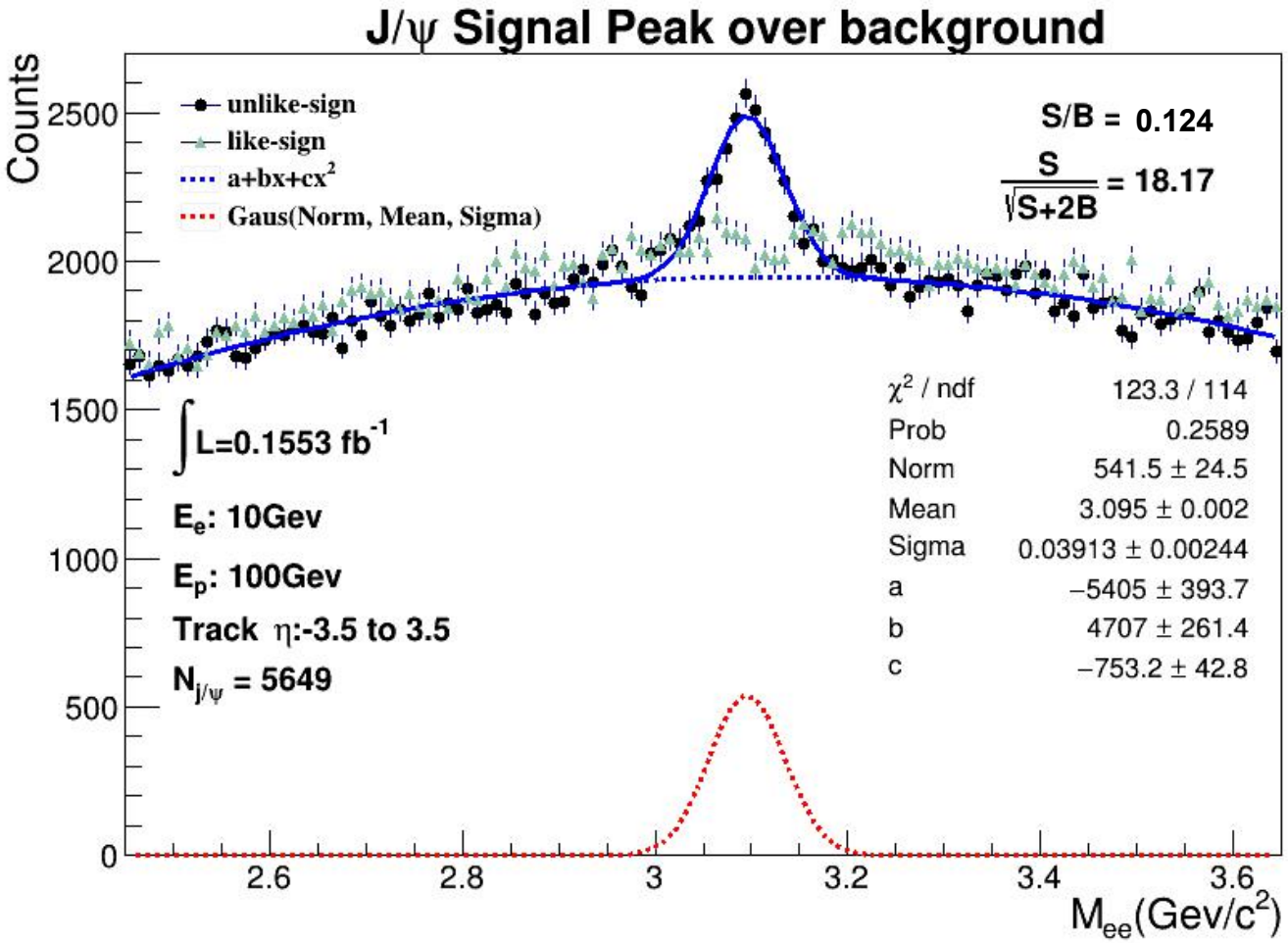
	η range	path length	time resolution
forward	-1.5>η>-3.5	|250(cm) / cos(Θ)|	20 (ps)
barrel	1.5>η>-1.5	50 / sin(Θ)	20
end	3.5>η>1.5	|150 / cos(Θ)|	20

- full simulation:

/gpfs02/eic/DATA/ECCE_Productions/MC/prop.2/c131177/SIDIS/pythia6/ep-10x100/eval_00000/*.g4tracking_eval.root

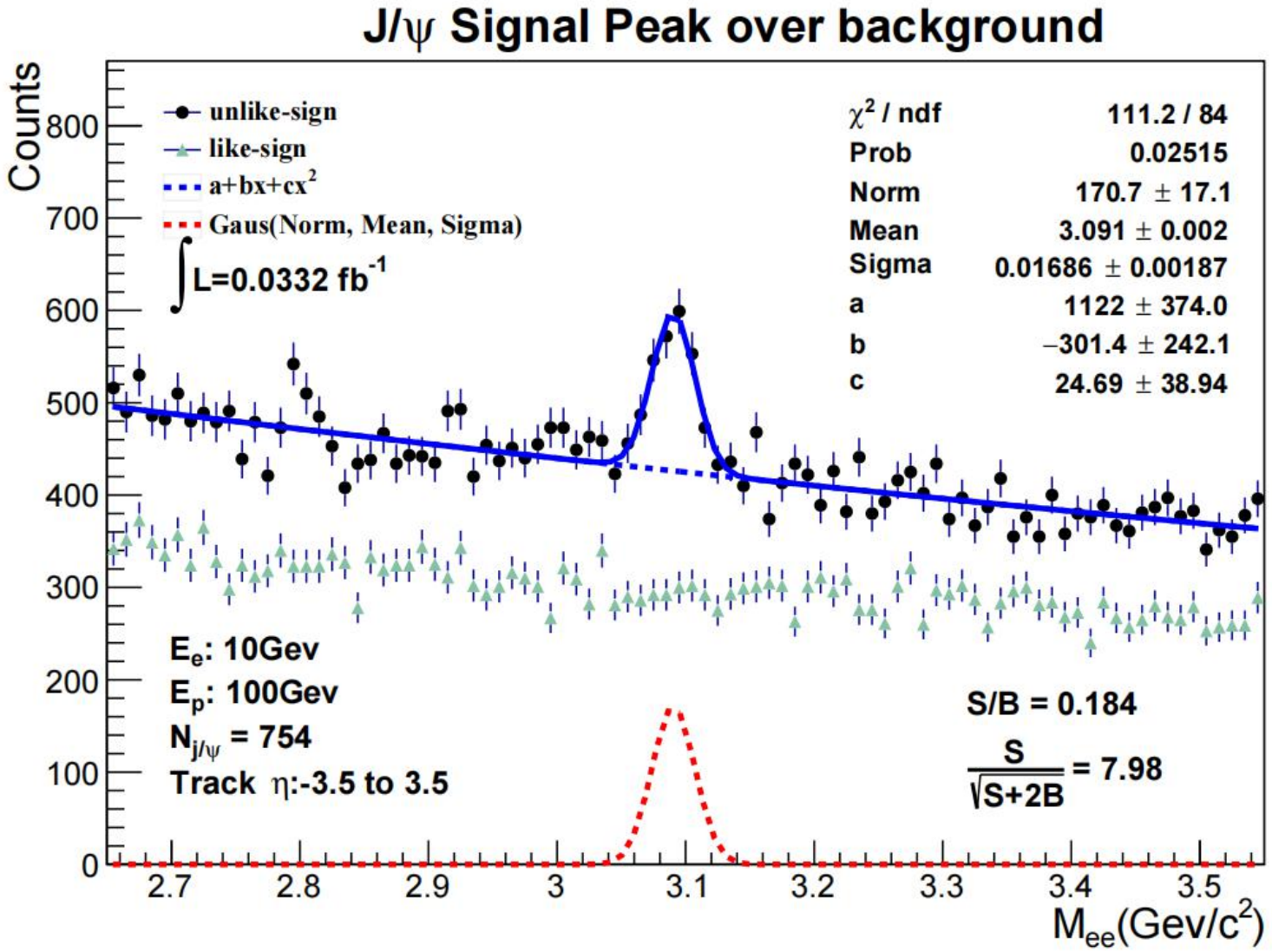
and /gpfs02/eic/DATA/ECCE_Productions/MC/prop.2/c131177/SIDIS/pythia6/ep-10x100/eval_00001/*.g4event_eval.root

Update some plots



fast-simulation
matrix2-B1_5T

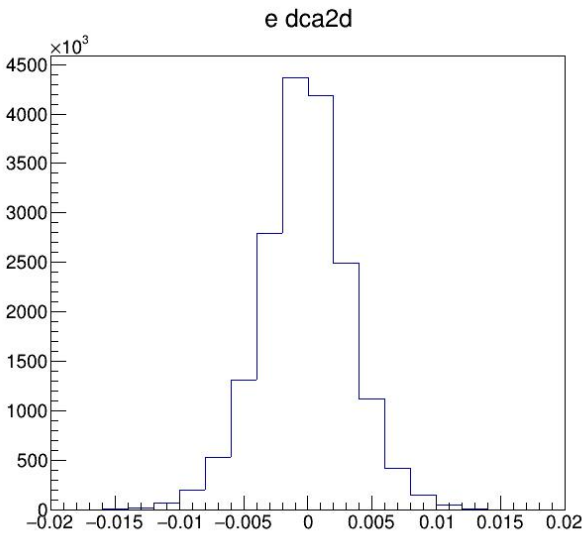
Update some plots

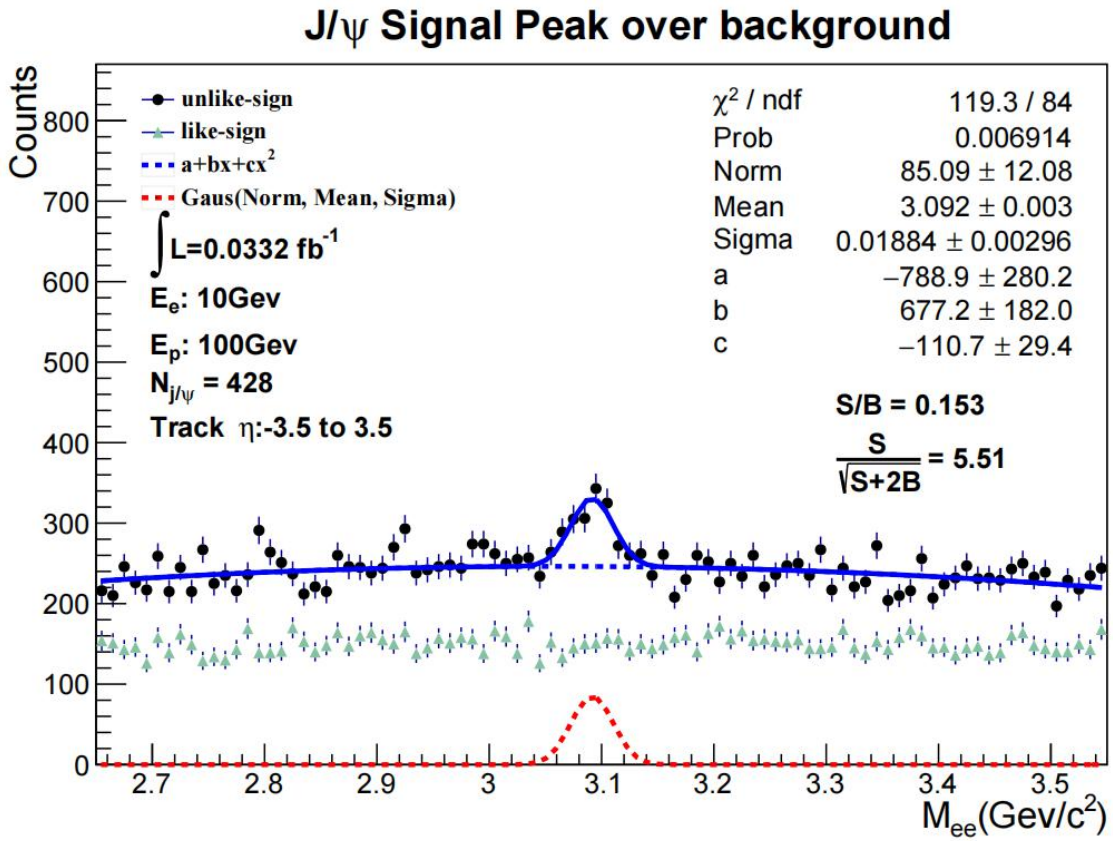


1. full-simulation
2. perfect eID
3. using track evaluator files
4. not good S/B

problem:
gap between unlike-sign and like-sign

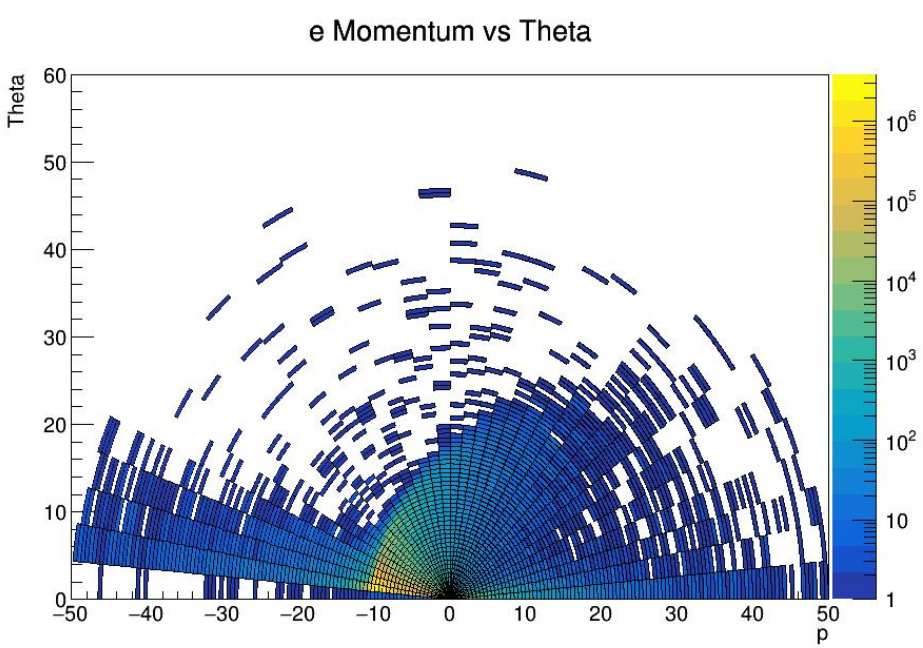
Update some plots

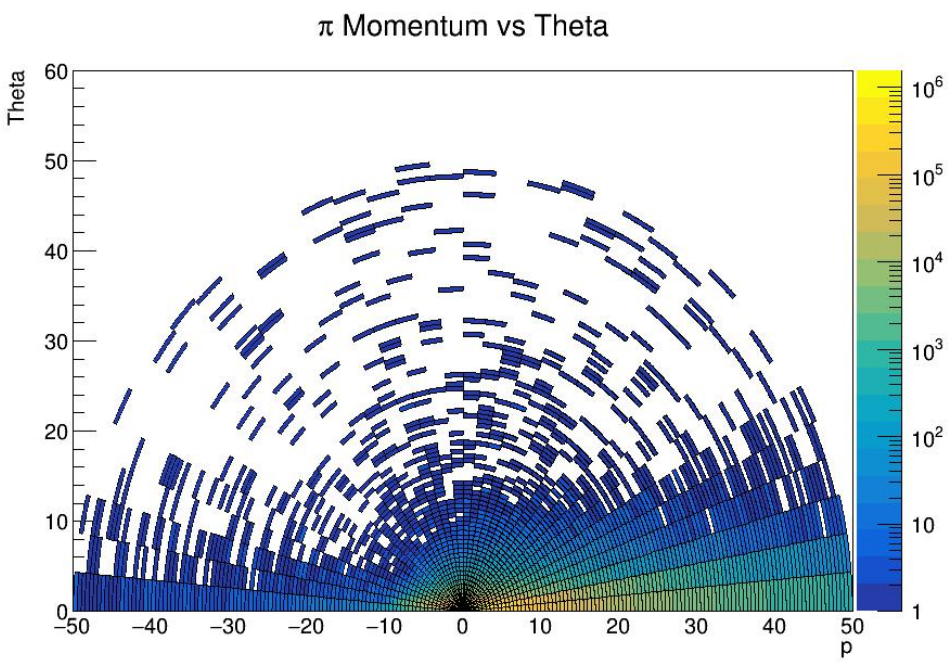




with dca2d cut |dca2d|<0.005

eID(EOP)

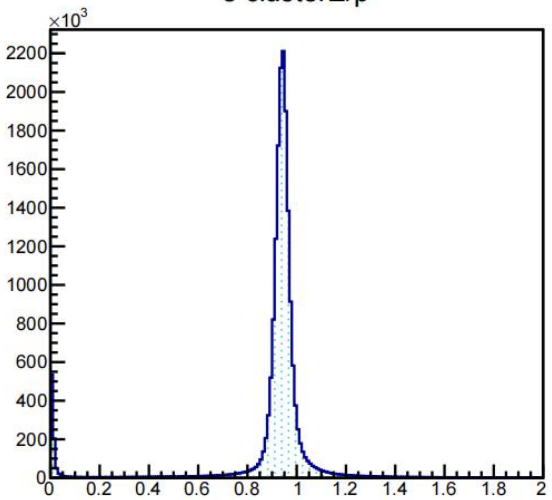




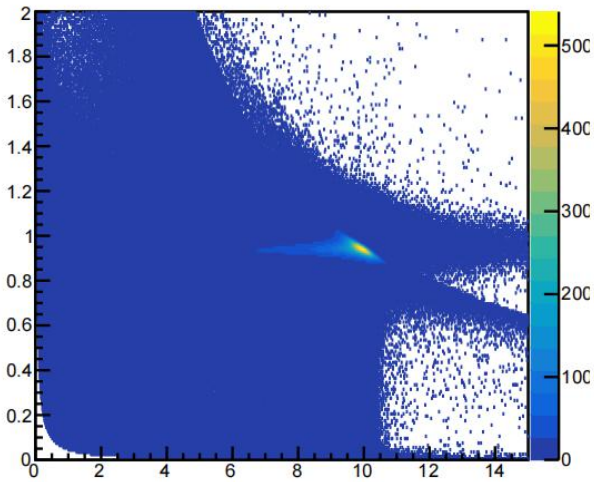
electron and pion dynamic distribution
momentum vs theta (polar plots)

eID(EOP)

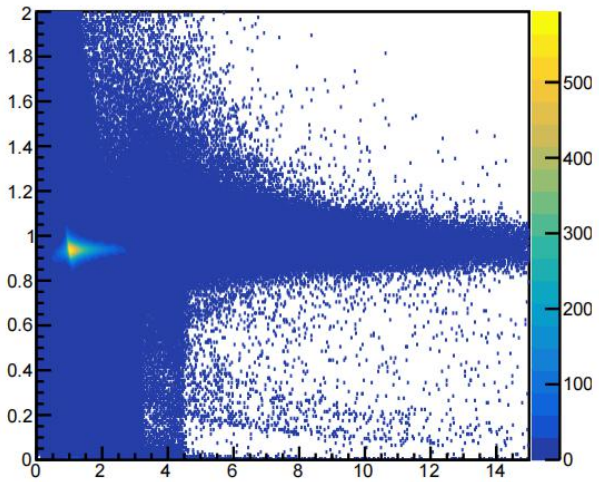
e clusterE/p



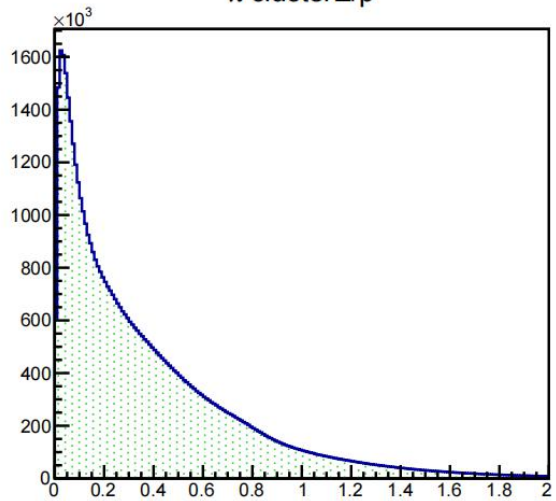
e clusterE/p vs p



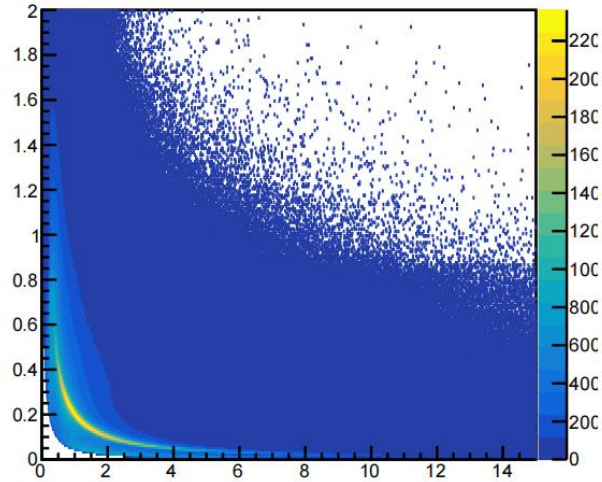
e clusterE/p vs pt



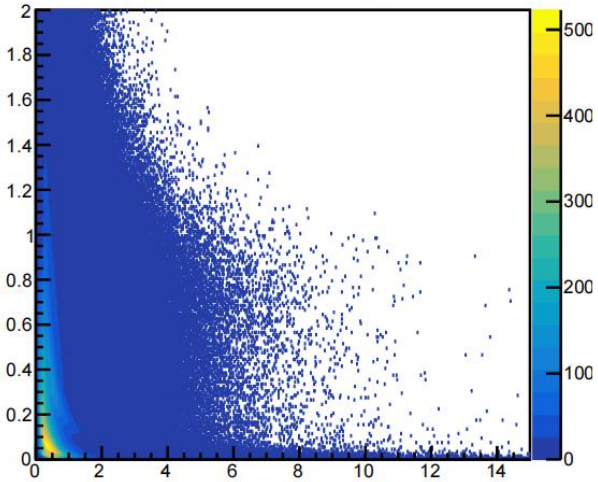
π clusterE/p



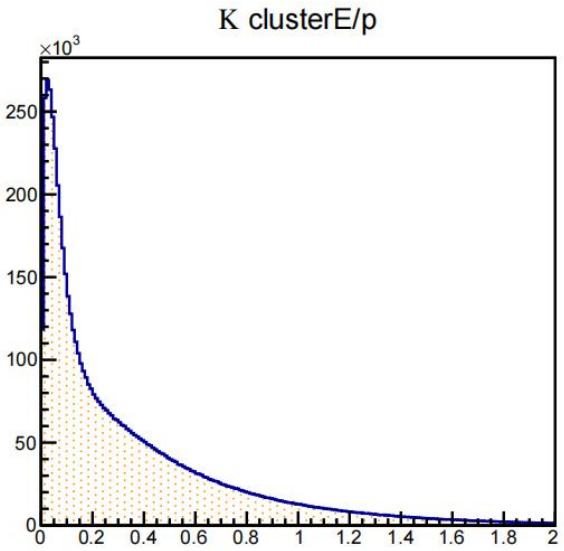
π clusterE/p vs p

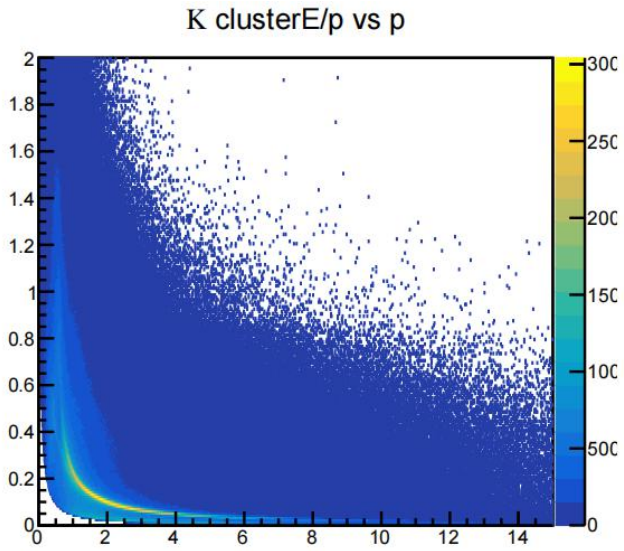


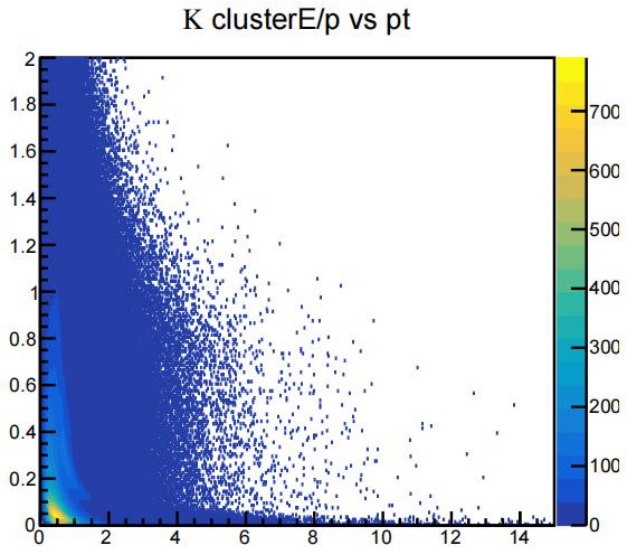
π clusterE/p vs pt

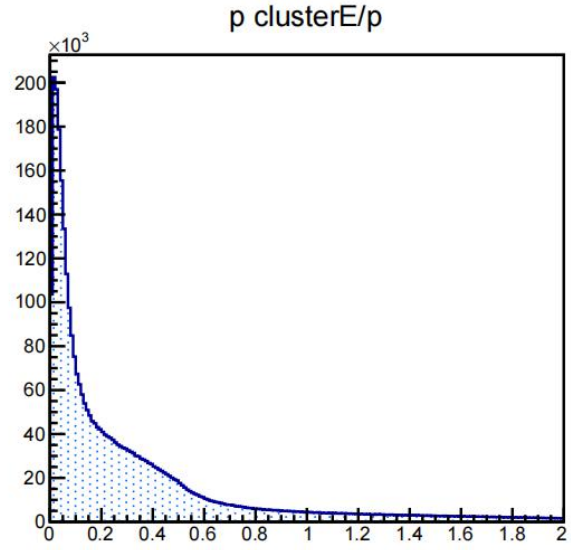


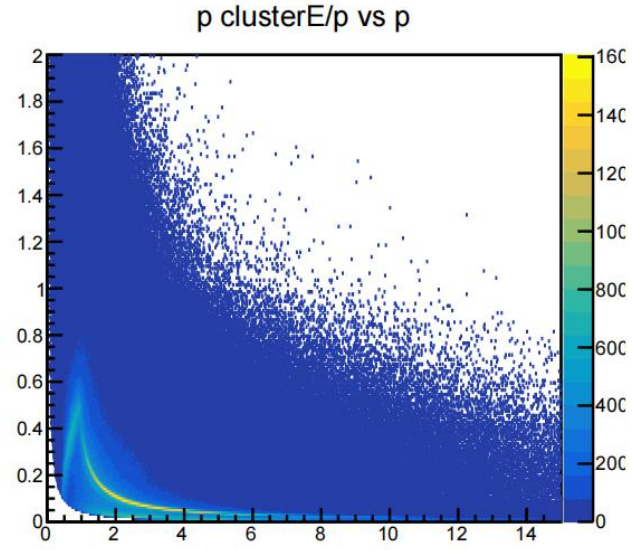
eID(EOP)

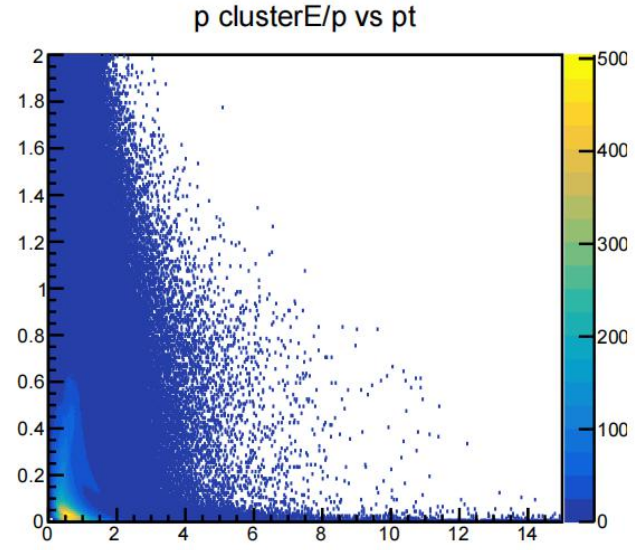

K clusterE/p
×10^3


K clusterE/p vs p


K clusterE/p vs pt

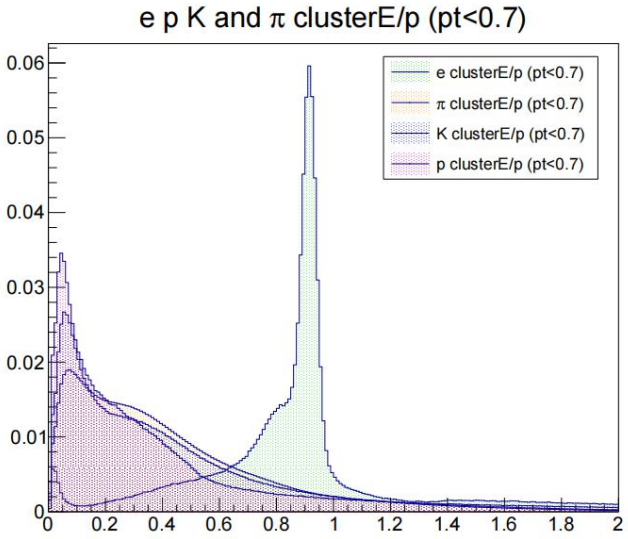

p clusterE/p
×10^3

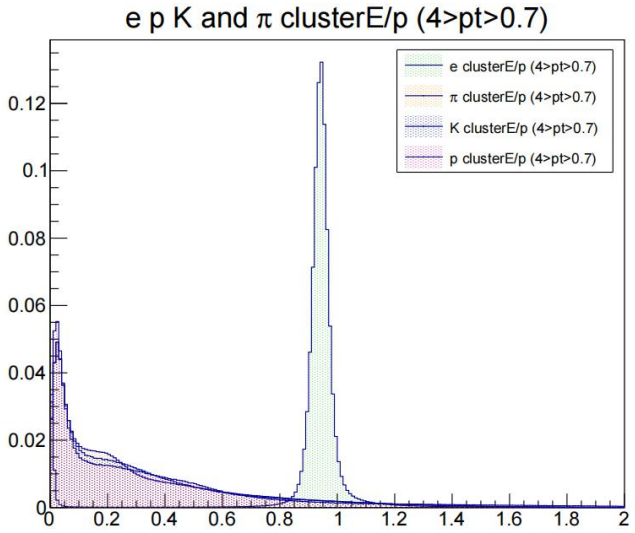

p clusterE/p vs p

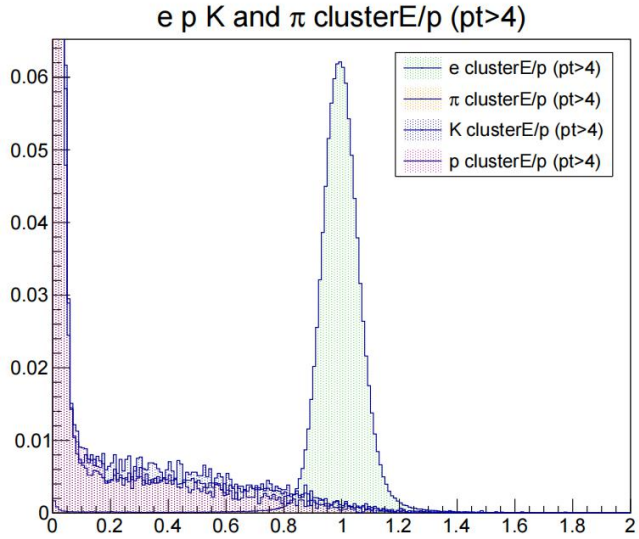

p clusterE/p vs pt

eID(EOP)

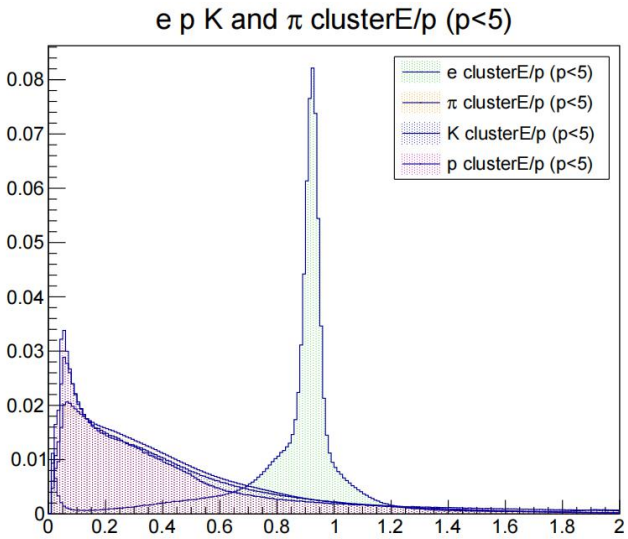
EOP distribution in different tranverse momentum regions（Normalization）

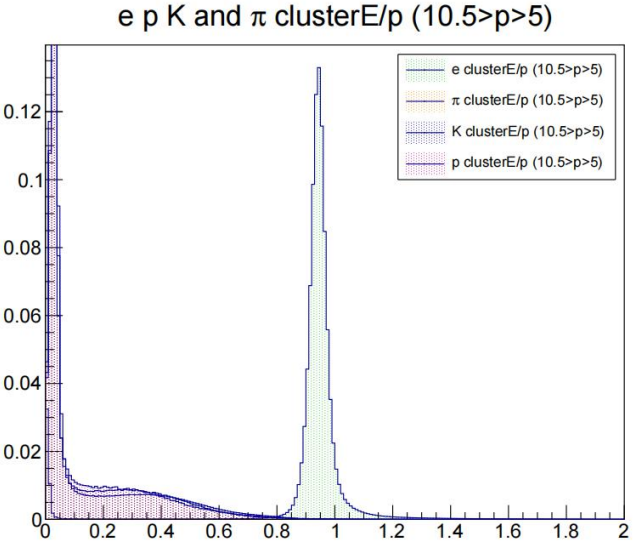


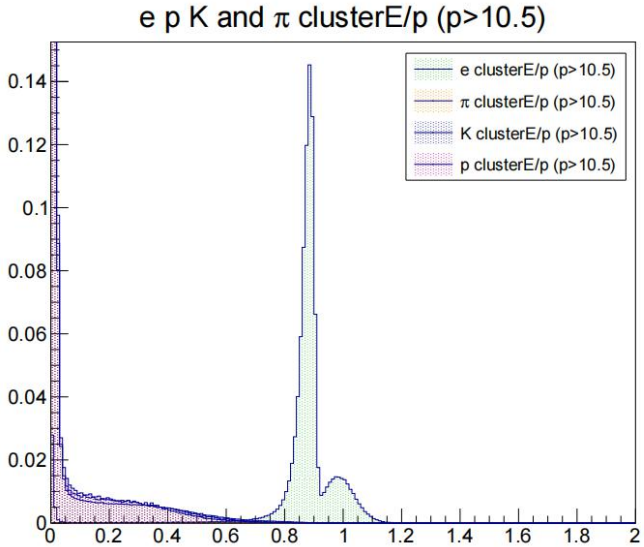




EOP distribution in different momentum regions（Normalization）







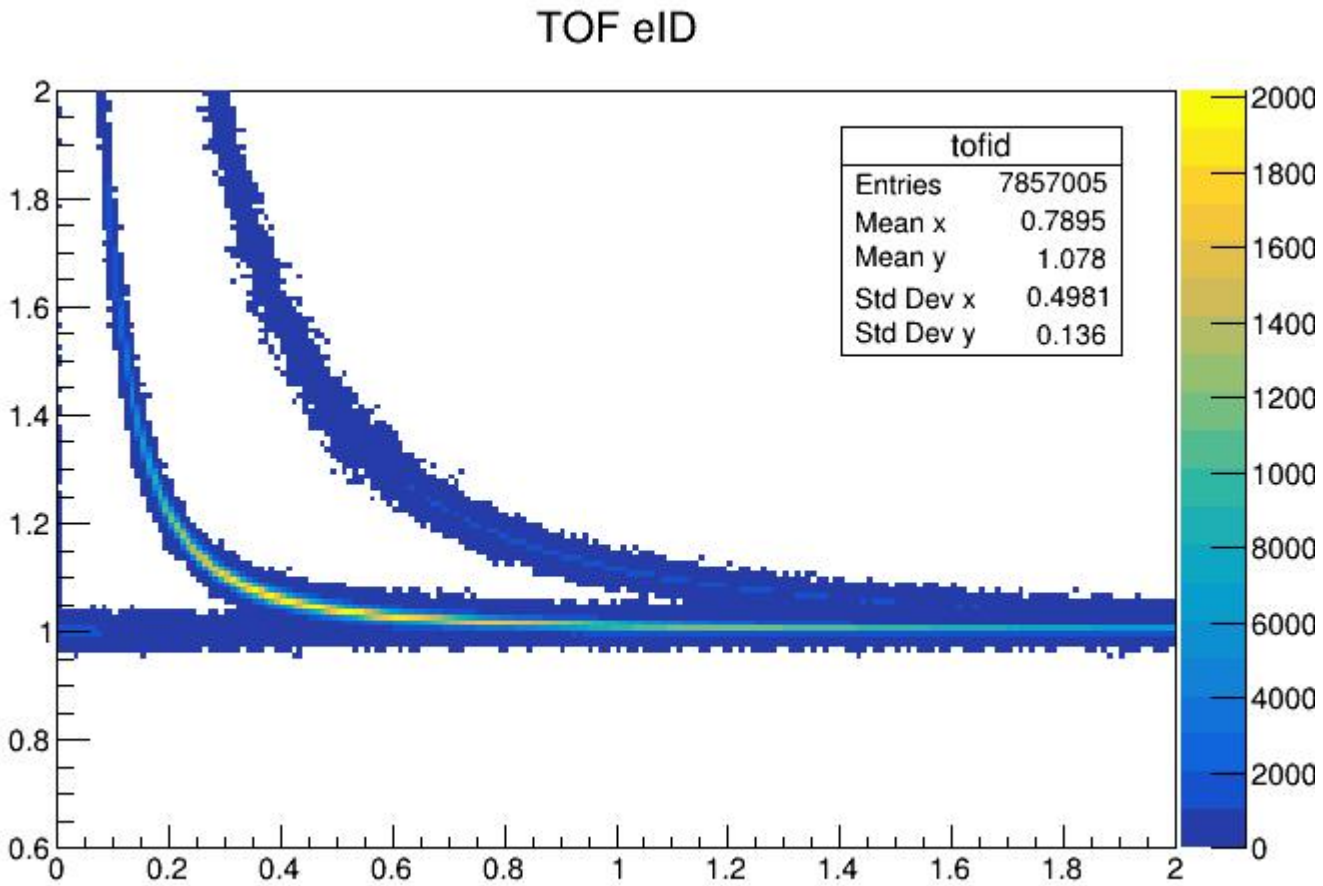
eID(EOP)

define purity = nume / (nume + numpi + numk + nump)
where nume, numpi, numk, nump means number of electron, pion, kaon, proton

momentum range	eop cut	purity
$p < 5(GeV/c)$	$0.86 < eop < 1$	0.34
$5 < p < 10.5$	$0.7 < eop < 1.4$	0.99
$10.5 < p$	$0.82 < eop < 1.2$	0.99

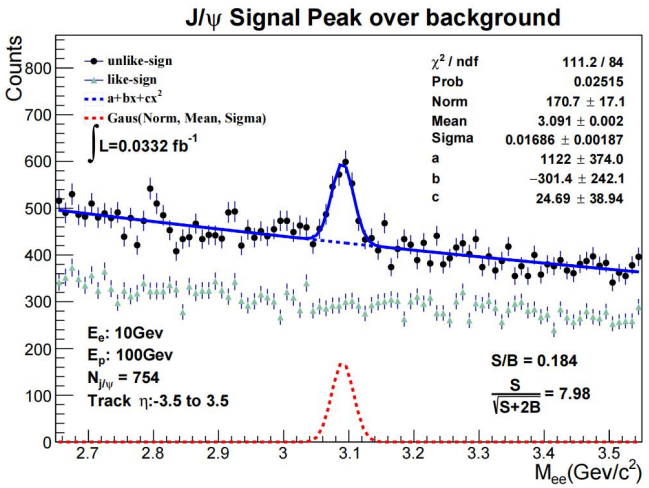
p_T range	eop cut	purity
$p_T < 0.7(GeV/c)$	$0.85 < eop < 0.95$	0.24
$0.7 < p_T < 4$	$0.85 < eop < 1.2$	0.95
$4 < p_T$	$0.7 < eop < 1.4$	0.99

TOF(fastsimulation)



p < 0.4(GeV/c)
|1/β-1|<0.04
survival possibility:
e: 99.5%
π: 0.1%
purity: 98.3%

Gap between unlikesign and likesign



perfect eID

Why there is a gap?
How can we eliminate it?

see mother particle of the pair around J/ψ peak

find same track in mcpart with tracker, get its bcid, find same bcid in hepmc with mcpart, get its mother's bcid, and get its mother's pdg.

most backround comes from a(an) e^+/ e^- of π^0 decay pairs with a scattering e^-

mothers of pair:
111 (π^0)
11 (e^-)

hypothesis: gap comes from inequlity of e^+/ e^- of π^0 decay
unlikesign is more than likesign ==> number of e^+> e^-

production
π^0 —> e^+ + e^- + γ
✗

tracker acceptance (and efficiency?)
need to prove it

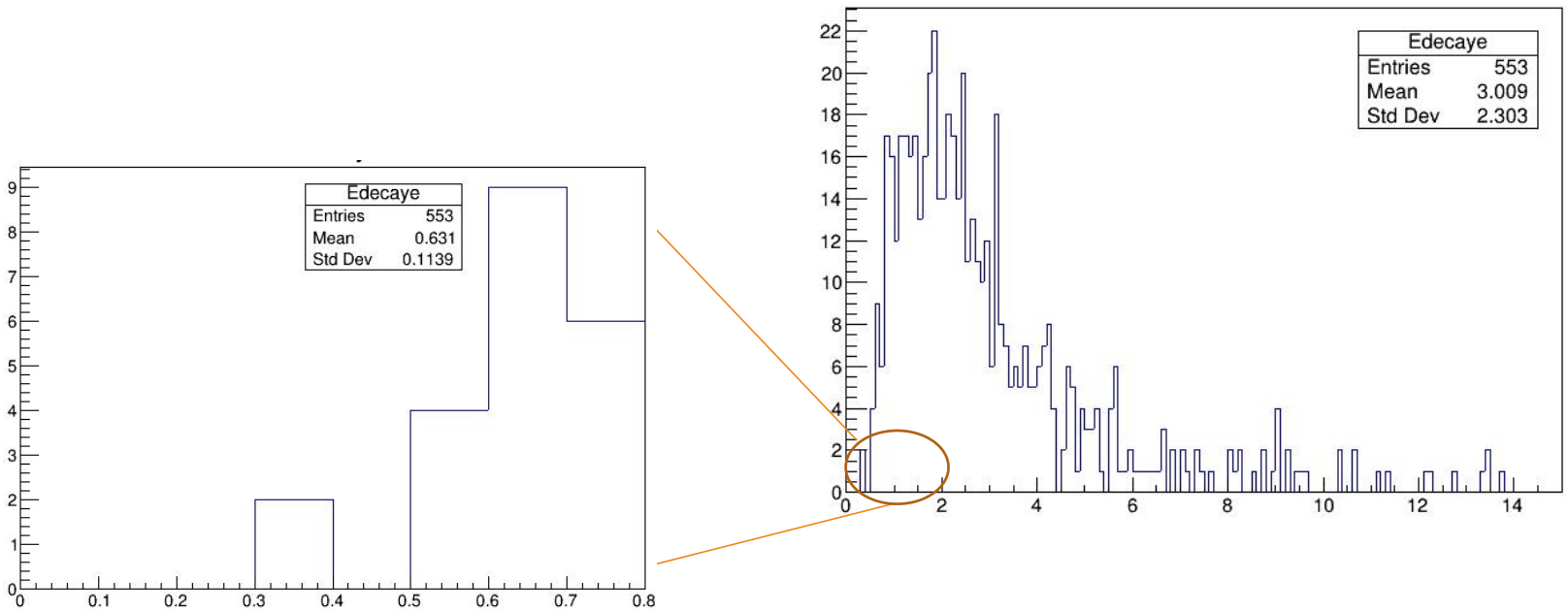
Cut to improve J/ψ significance

① cut e^+/ e^- of π^0 decay, π^0 has a small mass 0.135(GeV), so I think most e^+/ e^- of π^0 decay may have a lower energy than which of J/ψ decay.

② cut scattering beam e^- , I use a forward light cone variables to do it.

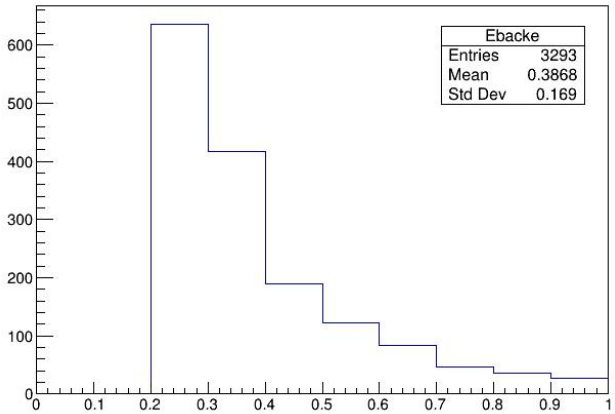
$x_+ = \frac{b_0+(-b_z)}{a_0+(-a_z)}$ (cause beam e^- moves along negative z axis), b is beam e^-.

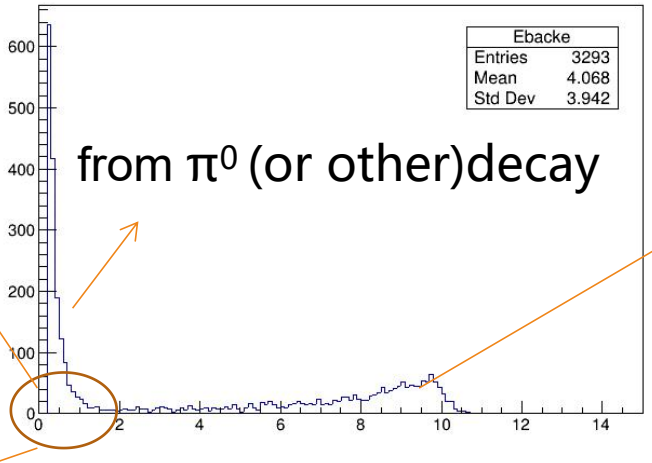
① if the invariant mass of a unlikesign di-electron pair is in ±3σ region of J/ψ mean, we select the e^+ and e^- of J/ψ decay, their energy distribution :



Cut to improve J/ψ significance

other e^+ and e^- energy distribution:

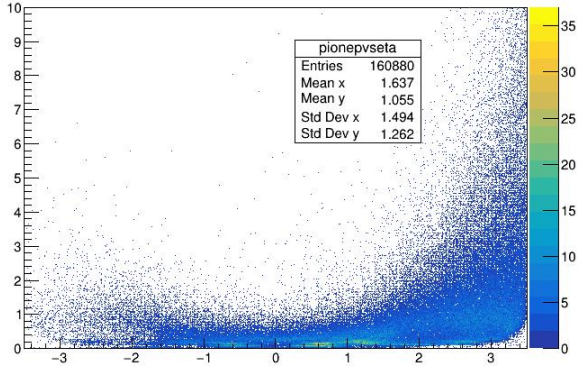




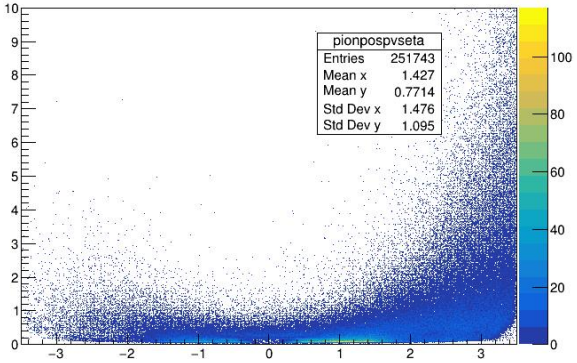
cut: E>0.6

another way to do ① is VETO: sign the e^+ and e^- in π^0 peak in mass spectrum and cut them off when you reconstructe J/ψ. (not do yet, it should perform better).

** about track acceptance: (need more analysis)



0.16million

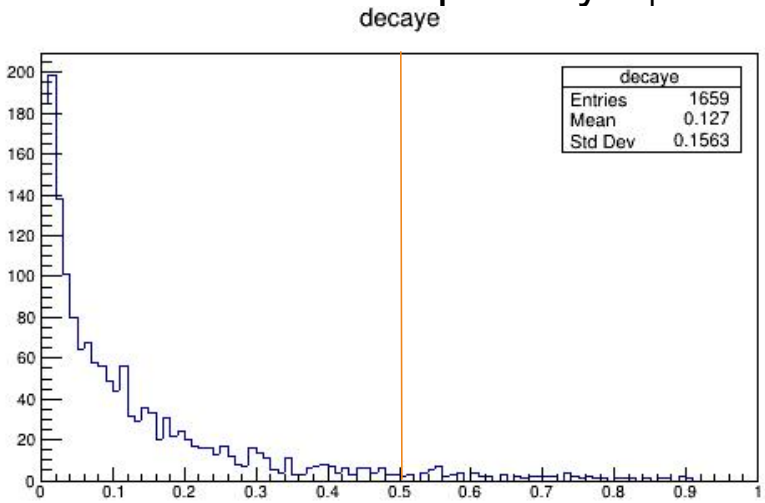


0.25million

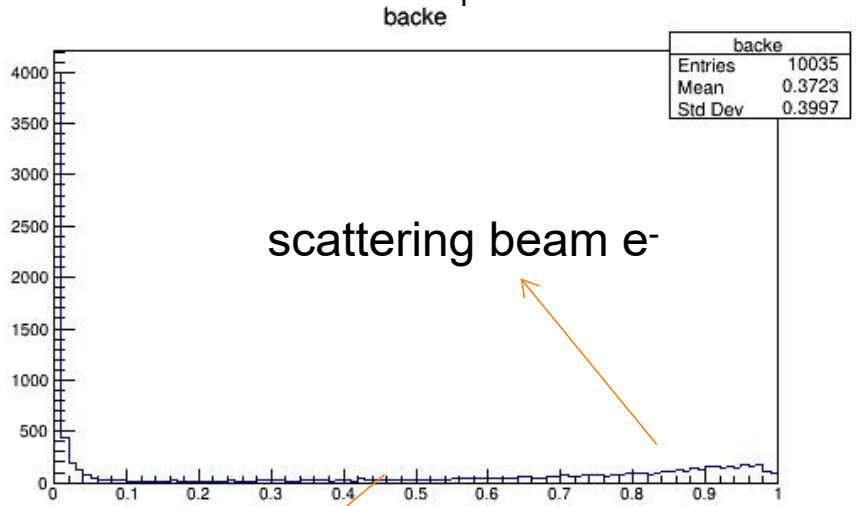
Cut to improve J/ψ significance

② a forward light cone variables cut:

e^+ and e^- of J/ψ decay x_+ distribution :

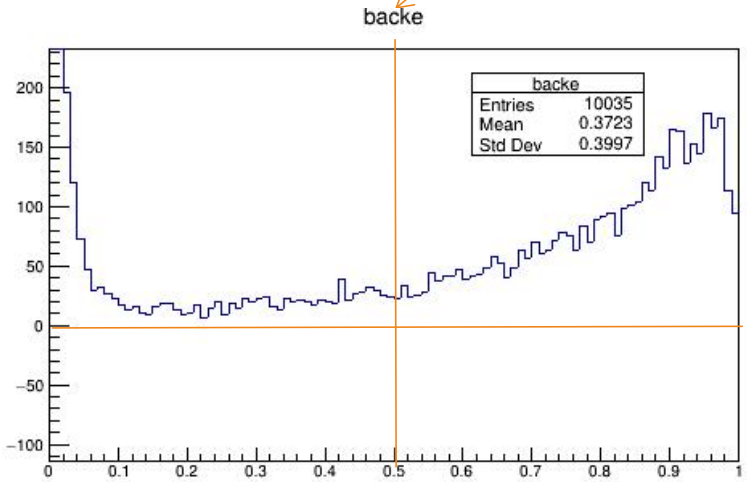


other e^+ and e^- x_+ distribution :

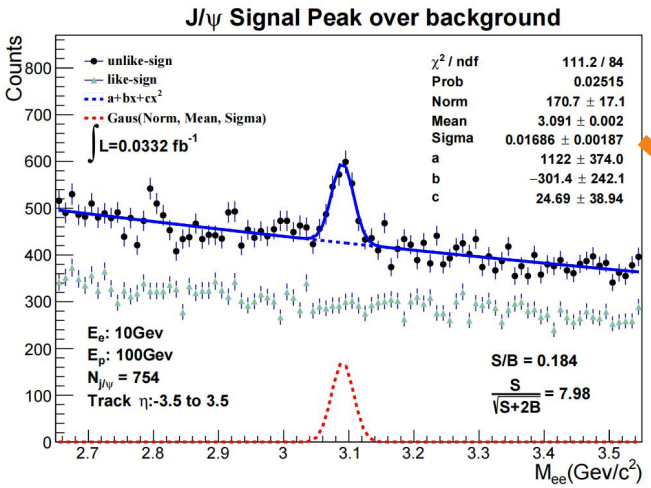


scale

cut: $x_+ < 0.5$



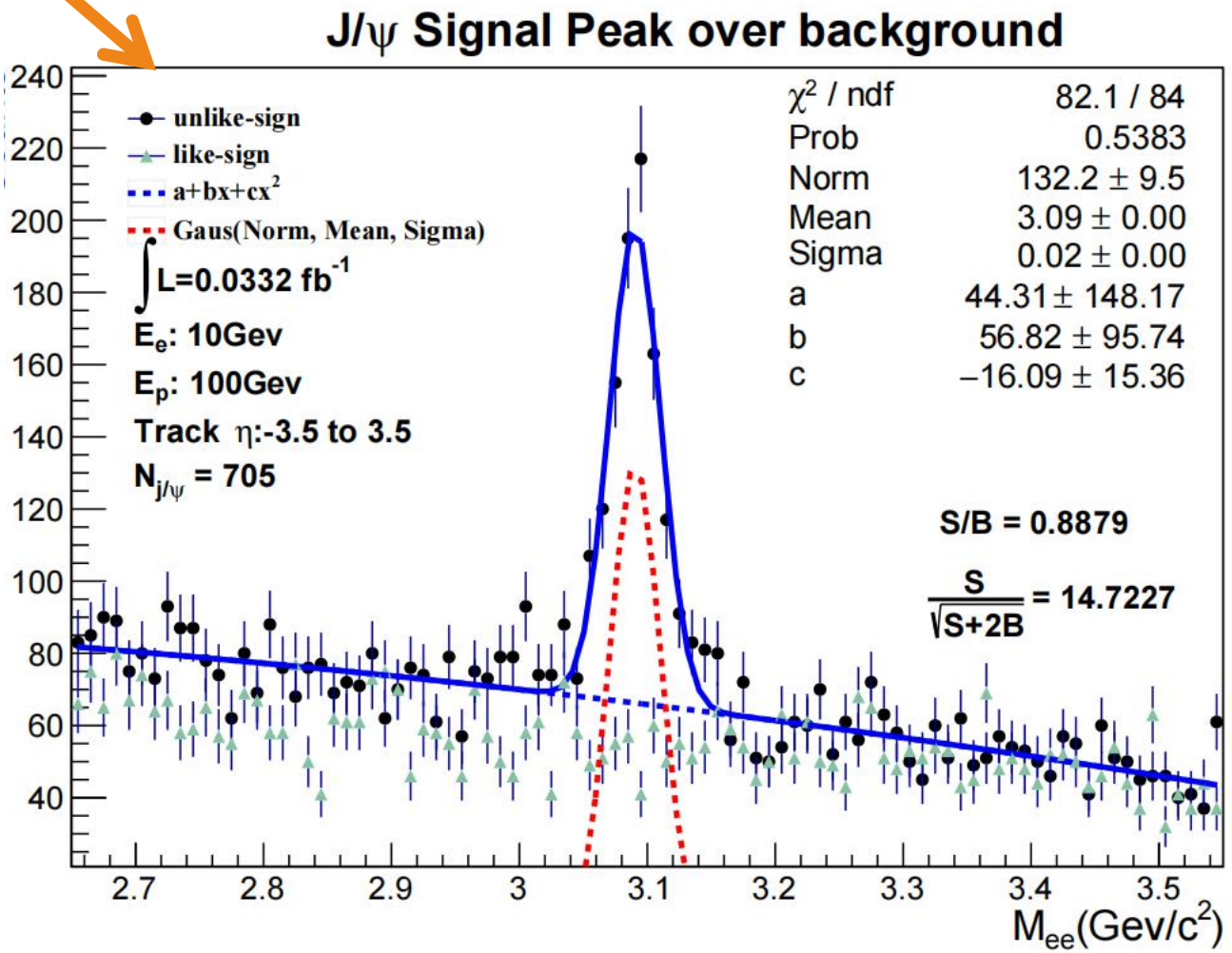
Cut to improve J/ψ significance



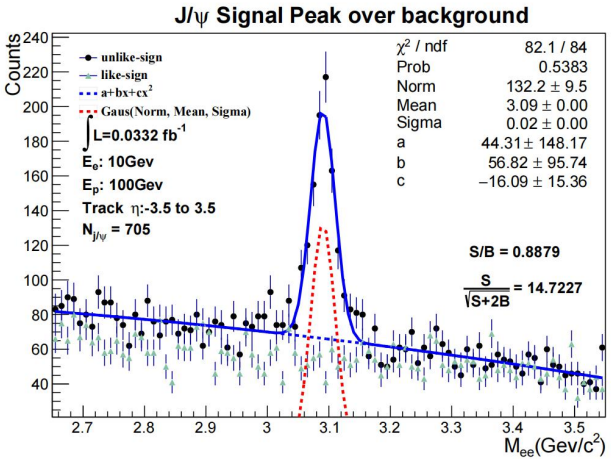
cut: $x_+ < 0.5$

S/B: 0.184 —> 0.888

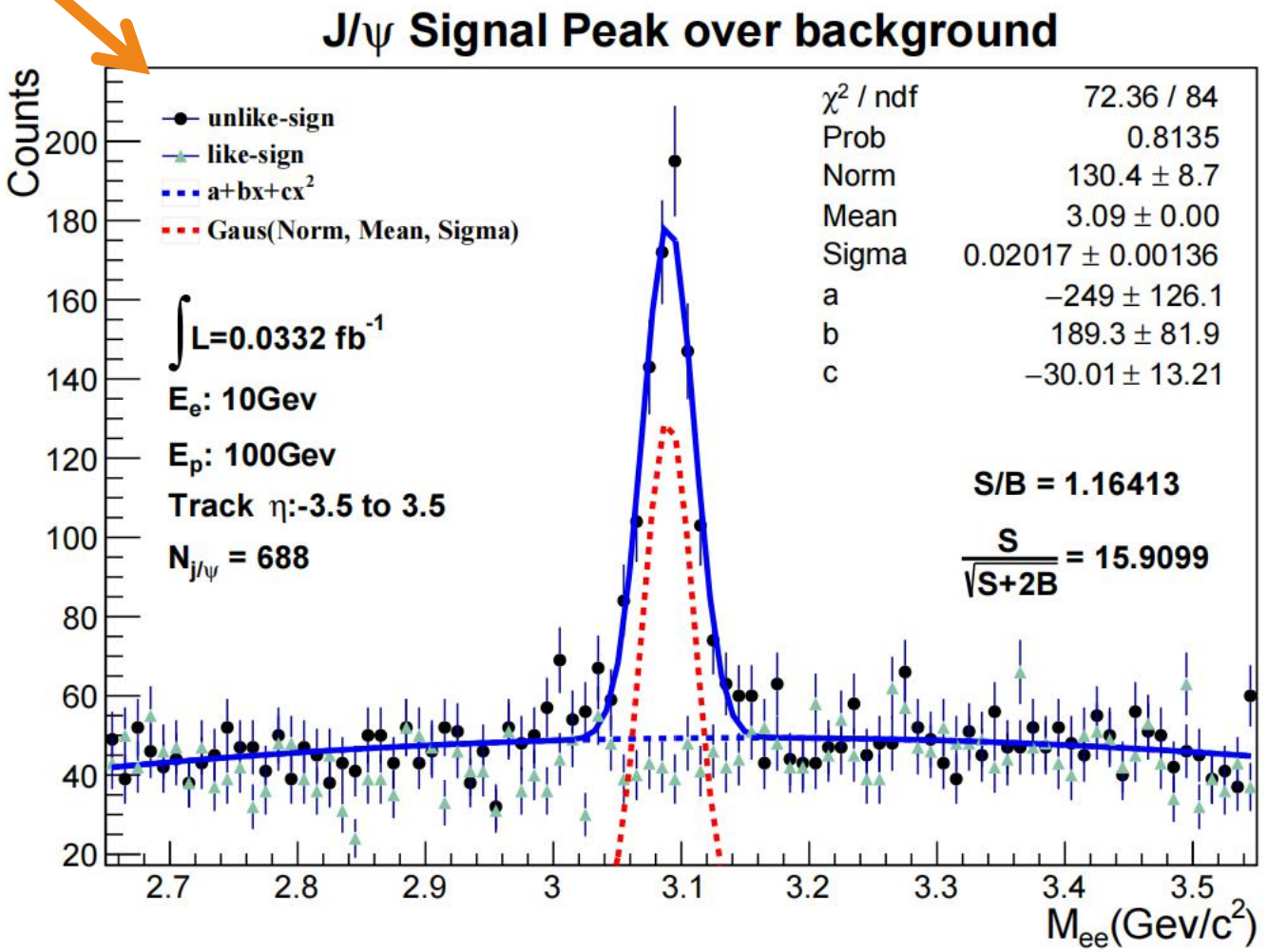
only cut the beam scattering electron



Cut to improve J/ψ significance



cut: E>0.6
S/B: 0.888 —> 1.164



also cut some e^+ and e^- of low mass hardon decay

Summary and Plan

- ✓ J/ψ mass spectrum
- ✓ find out the source of the gap
- ✓ do an eID using EOP
- ✓ see the TOF performance in eID in fast simulation
- ✓ find a good cut to improve the significance

need to do:

- find the reason of more e^+ than e^- of π^0 decay in tracker
- wait the tpc and cherenkov data in evaluator files to do eID in low momentum
- more study of the backround
- try to add the dca_3d cut in reconstruction