Simulations for ECCE

Produce X,Y,Ψ(2S) based on jpacPhoto & elSpectro

11 days at 10^{34}

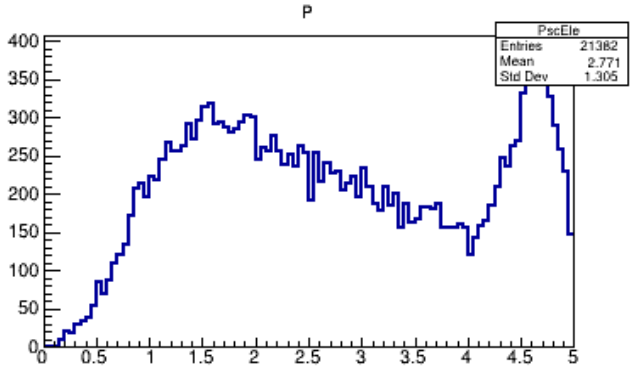
5 Gev e- and 100 GeV proton beams

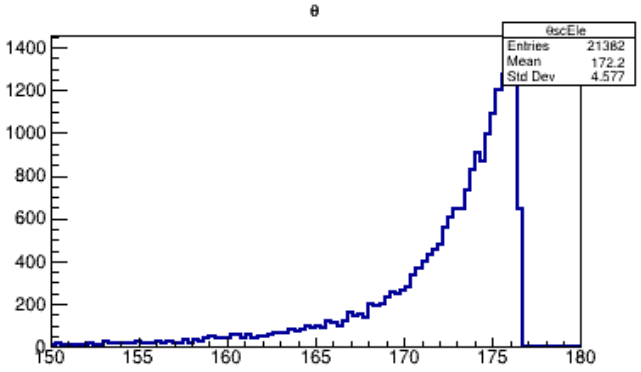
Approximately 300k events

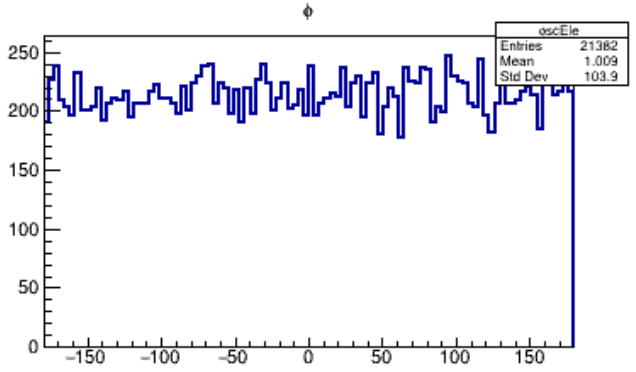
Passed through ECCE detector simulation/reconstruction
(Wenliang Le, William and Mary U.)

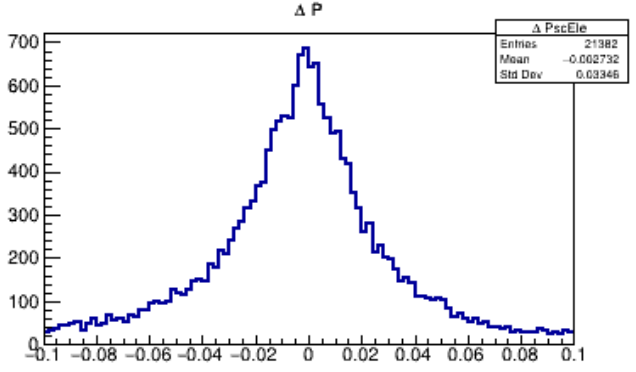
Plot results :
- Just using track momentum
- Take PID from truth (100% efficient)
- Calculate Energy from momentum

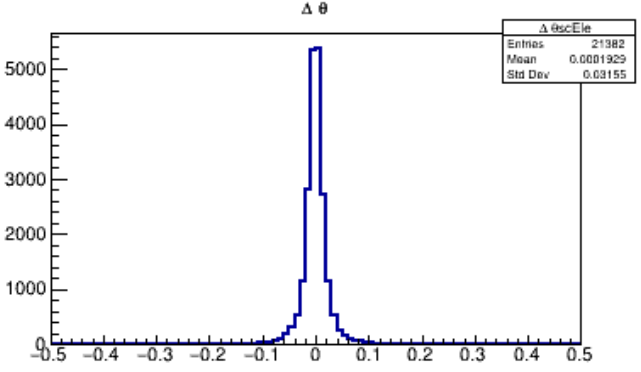
e−′

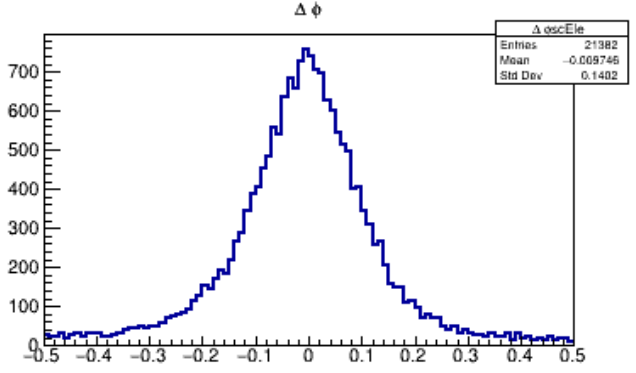

P
PscEle
Entries 21382
Mean 2.771
Std Dev 1.305


θ
θscEle
Entries 21382
Mean 172.2
Std Dev 4.577

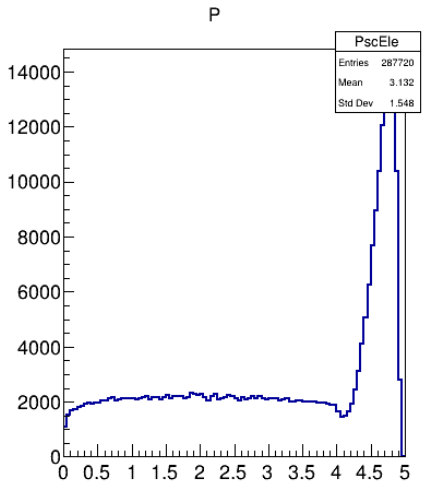

ϕ
ϕscEle
Entries 21382
Mean 1.009
Std Dev 103.9

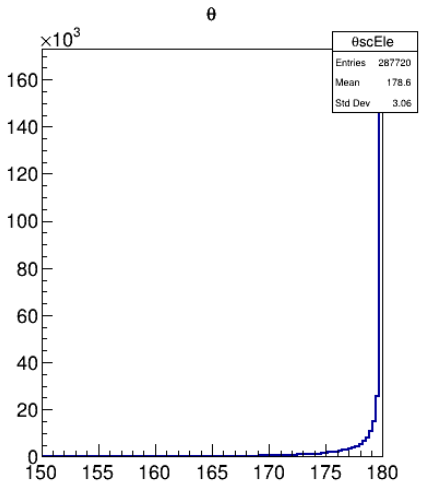

Δ P
Δ PscEle
Entries 21382
Mean −0.002732
Std Dev 0.03346

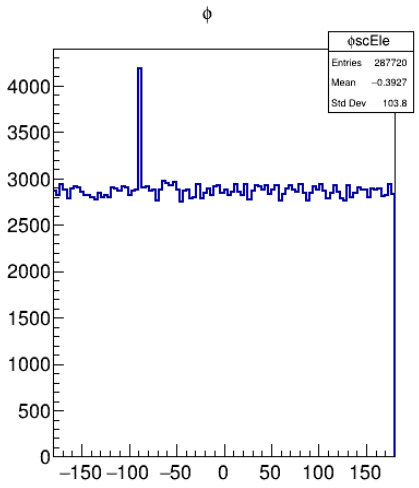

Δ θ
Δ θscEle
Entries 21382
Mean 0.0001929
Std Dev 0.03155


Δ ϕ
Δ ϕscEle
Entries 21382
Mean −0.009746
Std Dev 0.1402

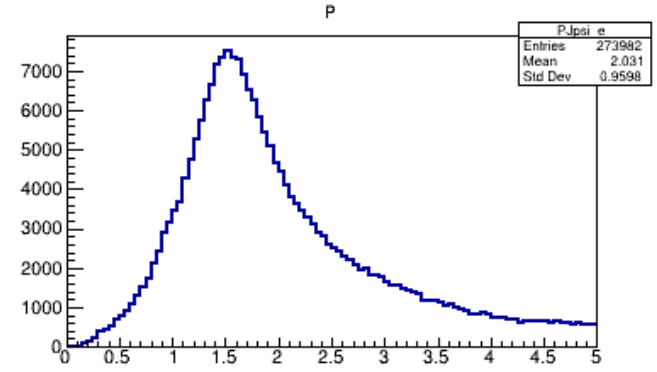
Truth e-’

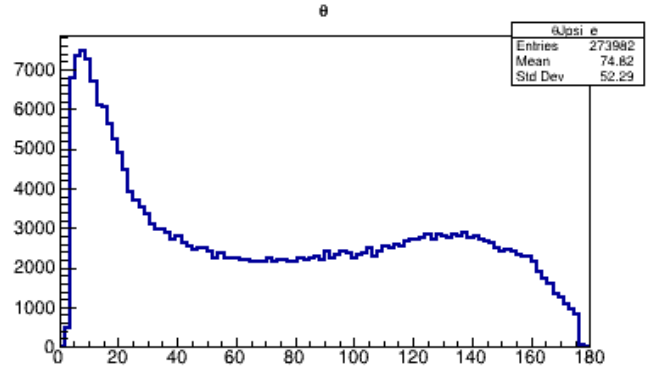

P
PscEle
Entries 287720
Mean 3.132
Std Dev 1.548
14000
12000
10000
8000
6000
4000
2000
0
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5

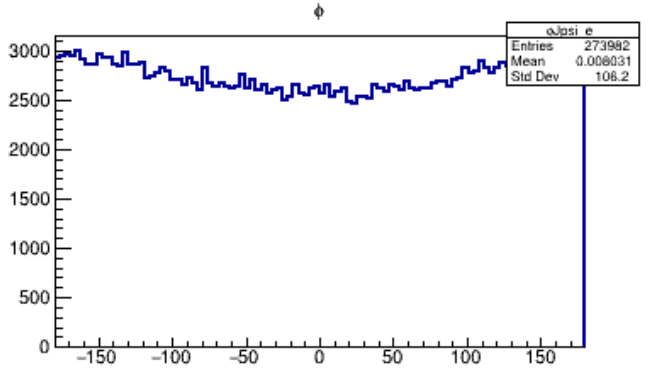

θ
×10^3
θscEle
Entries 287720
Mean 178.6
Std Dev 3.06
160
140
120
100
80
60
40
20
0
150 155 160 165 170 175 180

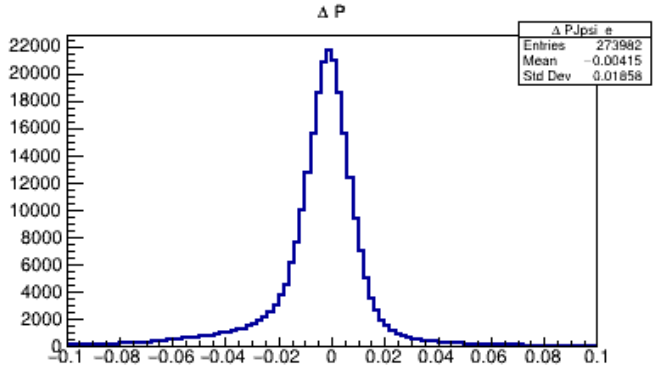

ϕ
ϕscEle
Entries 287720
Mean −0.3927
Std Dev 103.8
4000
3500
3000
2500
2000
1500
1000
500
0
−150 −100 −50 0 50 100 150

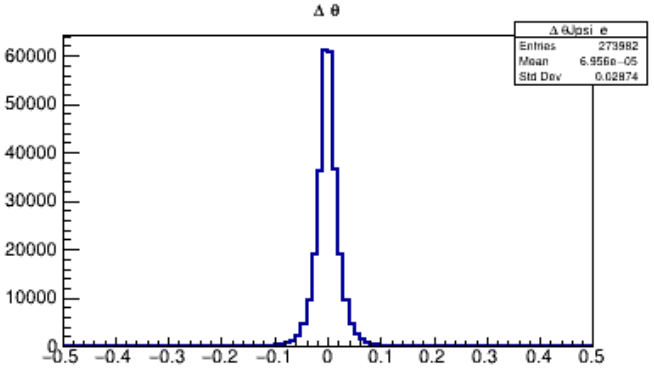
J/ψ e-

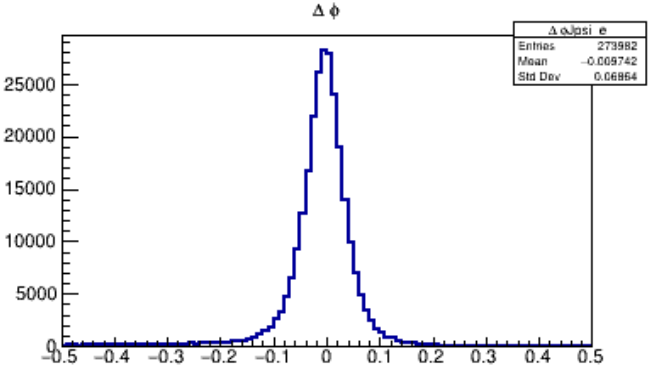

P
PJpsi_e
Entries 273982
Mean 2.031
Std Dev 0.9598


θ
θJpsi_e
Entries 273982
Mean 74.82
Std Dev 52.29

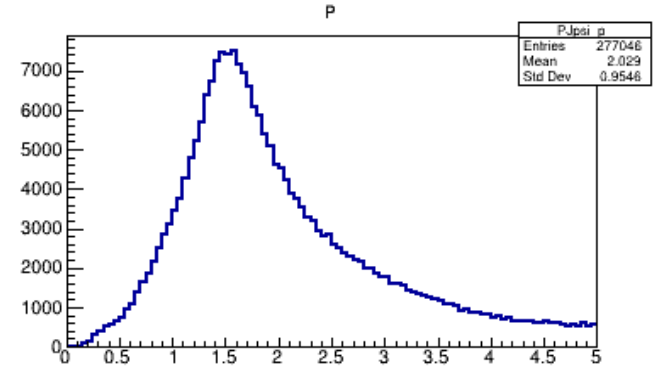

ϕ
ϕJpsi_e
Entries 273982
Mean 0.008031
Std Dev 106.2

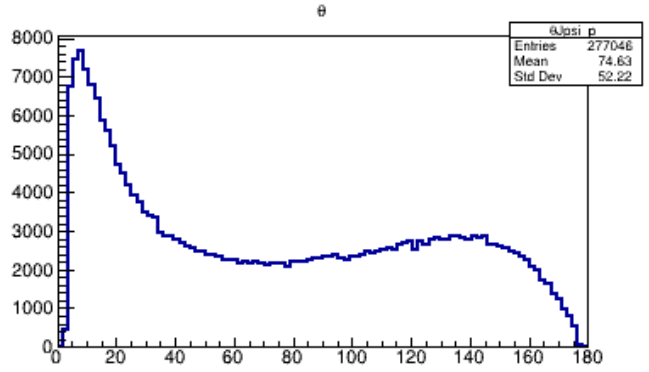

Δ P
Δ PJpsi_e
Entries 273982
Mean −0.00415
Std Dev 0.01858

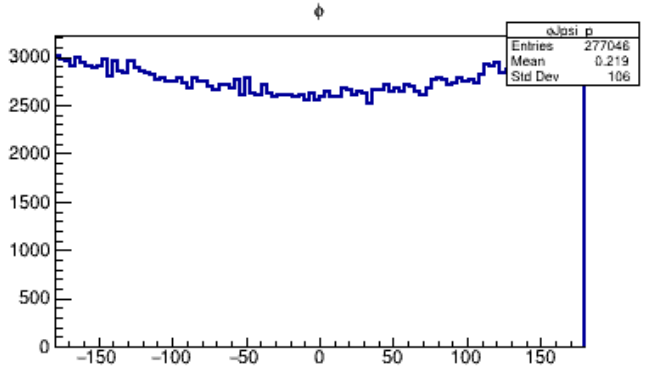

Δ θ
Δ θJpsi_e
Entries 273982
Mean 6.956e−05
Std Dev 0.02874

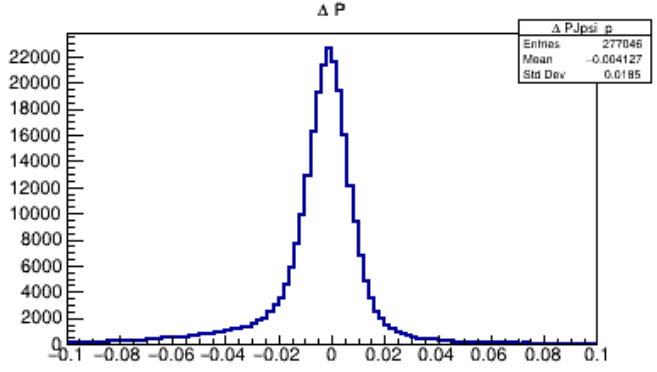

Δ ϕ
Δ ϕJpsi_e
Entries 273982
Mean −0.009742
Std Dev 0.06864

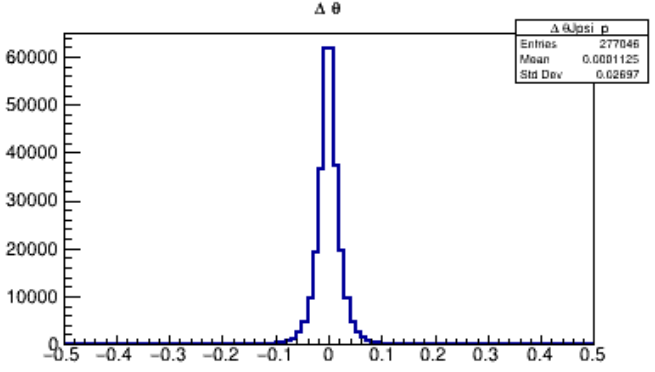
J/ψ e+

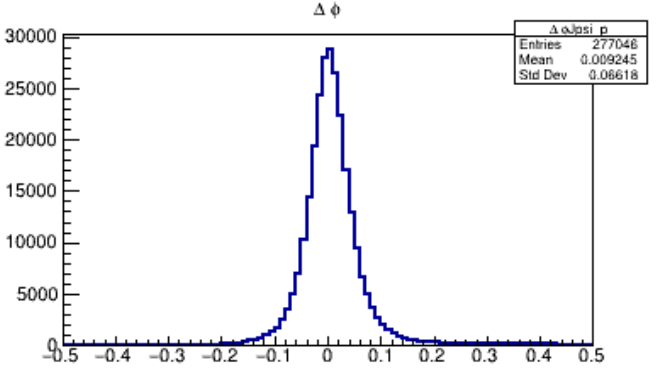

P
PJpsi_p
Entries 277046
Mean 2.029
Std Dev 0.9546


θ
θJpsi_p
Entries 277046
Mean 74.63
Std Dev 52.22

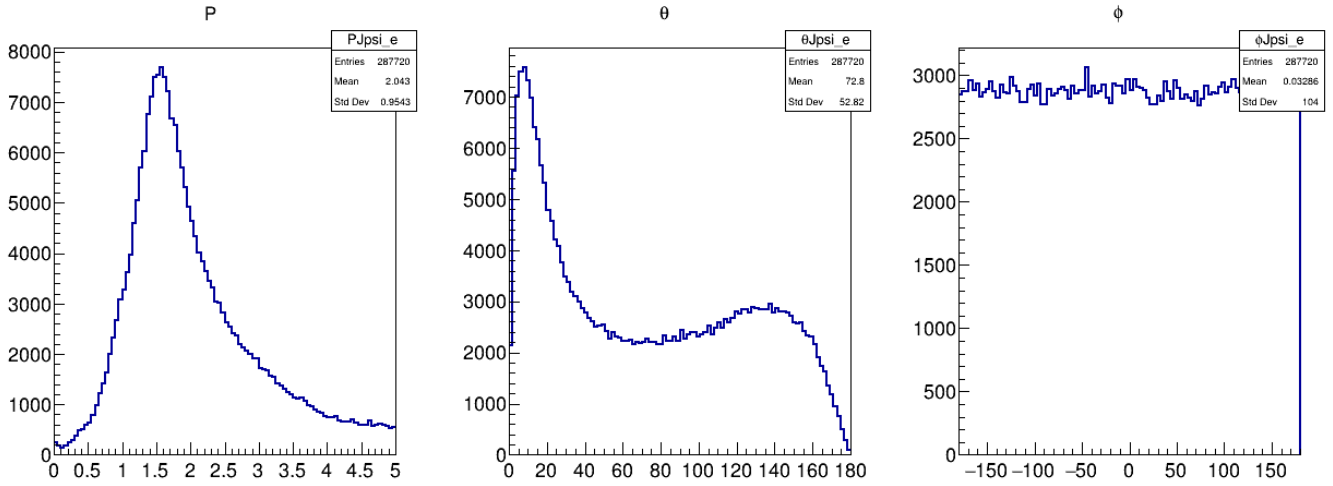

ϕ
ϕJpsi_p
Entries 277046
Mean 0.219
Std Dev 106


Δ P
Δ PJpsi_p
Entries 277046
Mean -0.004127
Std Dev 0.0185

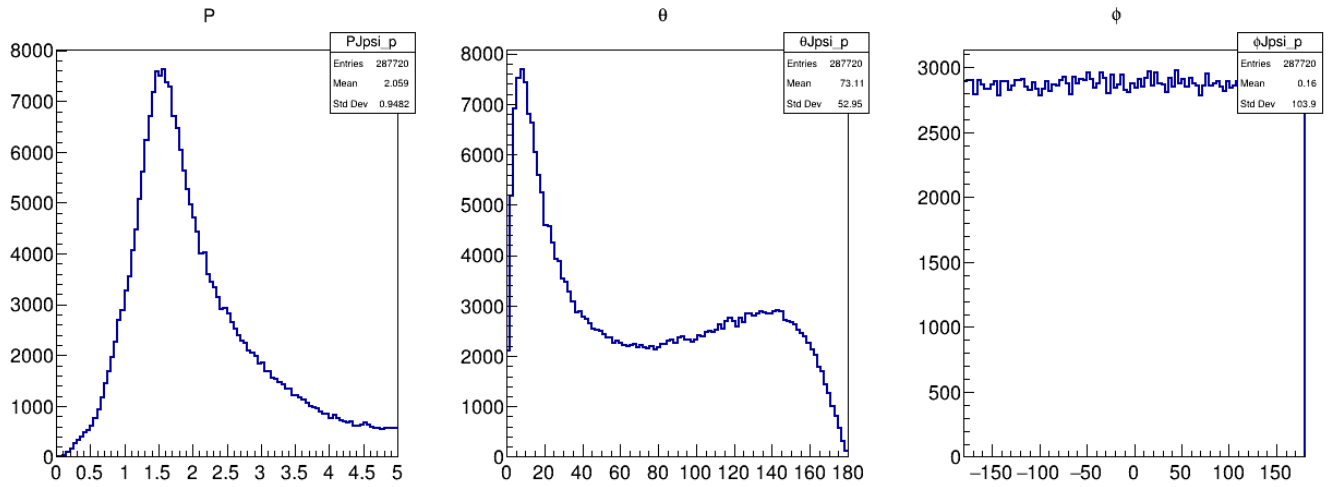

Δ θ
Δ θJpsi_p
Entries 277046
Mean 0.0001125
Std Dev 0.02697


Δ ϕ
Δ ϕJpsi_p
Entries 277046
Mean 0.009245
Std Dev 0.08618

Truth J/ψ

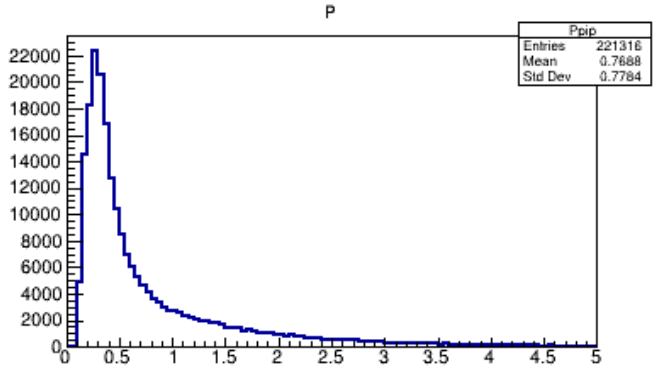

P
PJpsi_e
Entries 287720
Mean 2.043
Std Dev 0.9543
θ
θJpsi_e
Entries 287720
Mean 72.8
Std Dev 52.82
ϕ
ϕJpsi_e
Entries 287720
Mean 0.03286
Std Dev 104

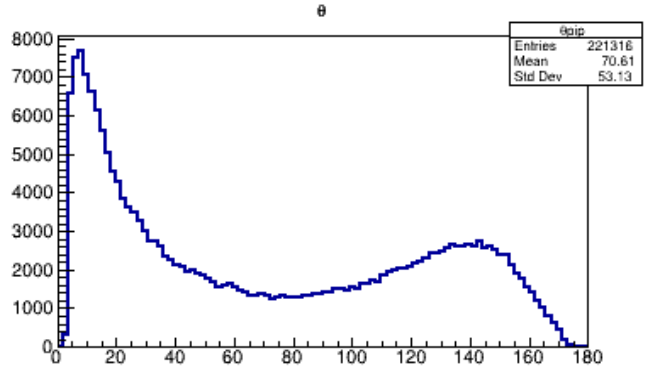
e−

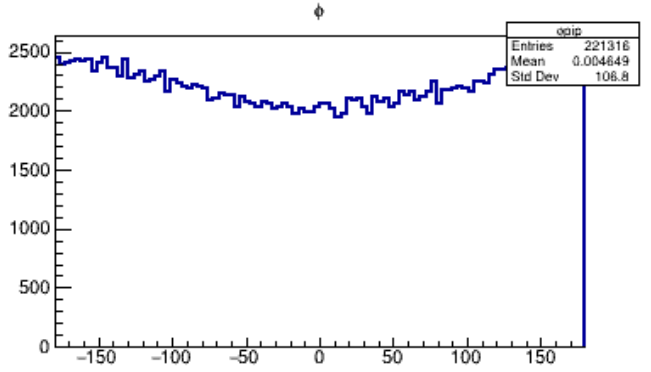

P
PJpsi_p
Entries 287720
Mean 2.059
Std Dev 0.9482
θ
θJpsi_p
Entries 287720
Mean 73.11
Std Dev 52.95
ϕ
ϕJpsi_p
Entries 287720
Mean 0.16
Std Dev 103.9

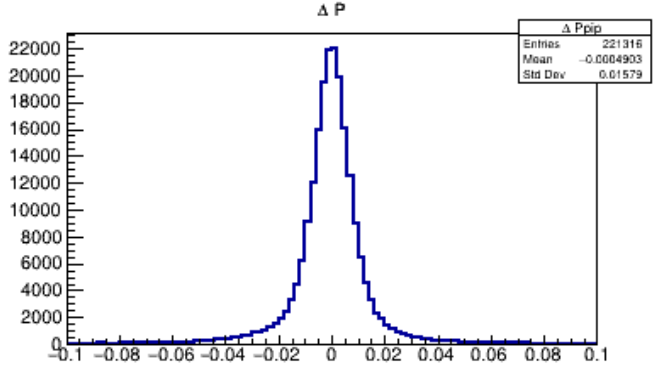
e+

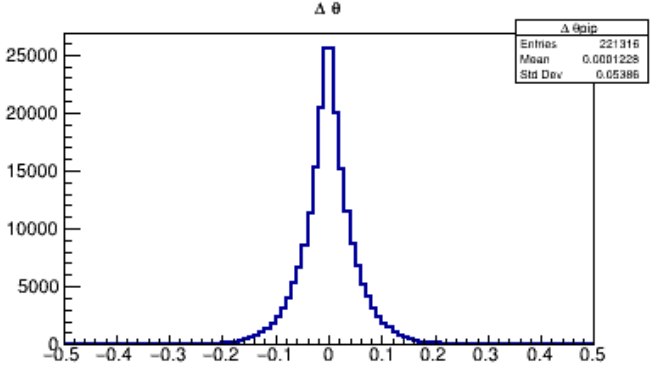
π+

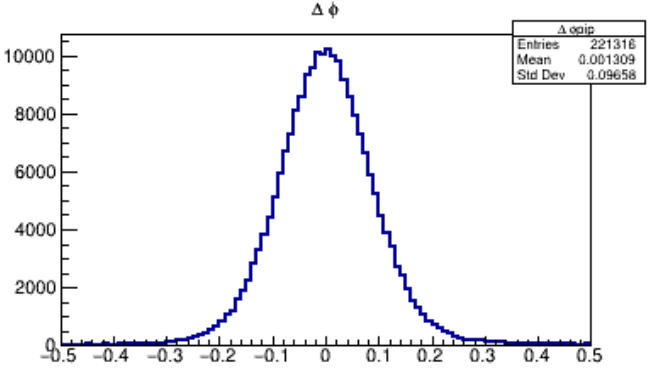

P
Ppip
Entries 221316
Mean 0.7688
Std Dev 0.7784


θ
θpip
Entries 221316
Mean 70.61
Std Dev 53.13

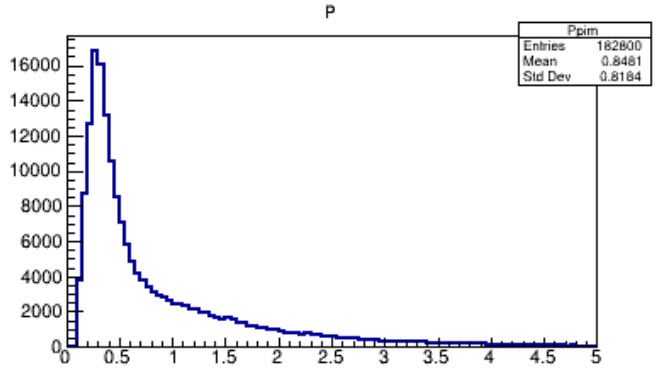

ϕ
ϕpip
Entries 221316
Mean 0.004649
Std Dev 106.8

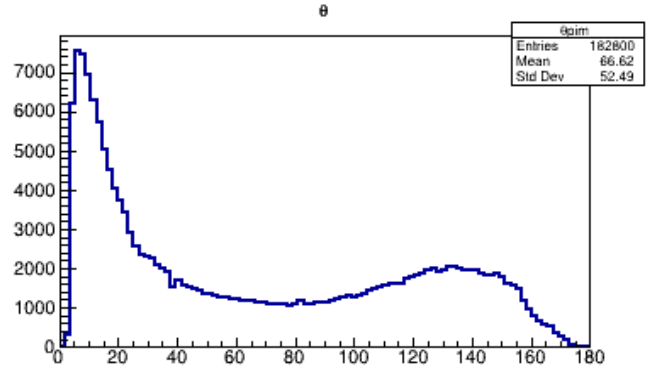

Δ P
Δ Ppip
Entries 221316
Mean -0.0004903
Std Dev 0.01579

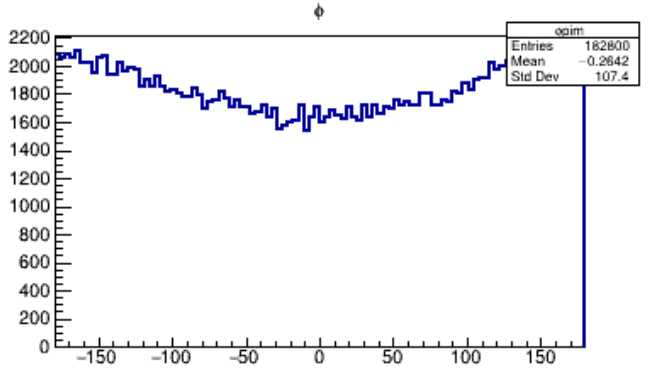

Δ θ
Δ θpip
Entries 221316
Mean 0.0001228
Std Dev 0.05386

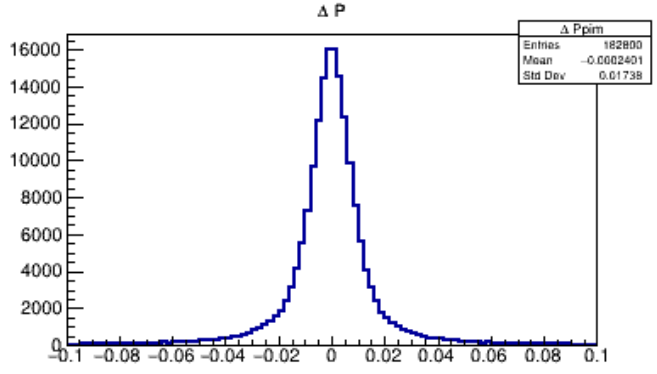

Δ ϕ
Δ ϕpip
Entries 221316
Mean 0.001309
Std Dev 0.09658

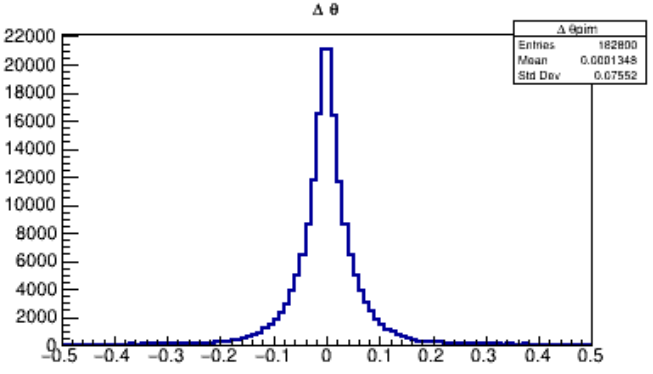
π^-

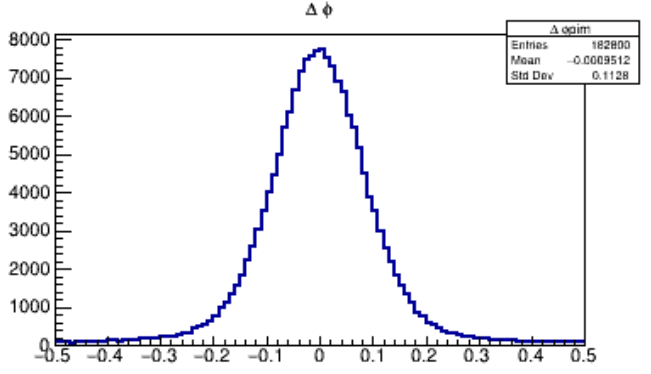

P
Ppim
Entries 182800
Mean 0.8481
Std Dev 0.8184


θ
θpim
Entries 182800
Mean 66.62
Std Dev 52.49

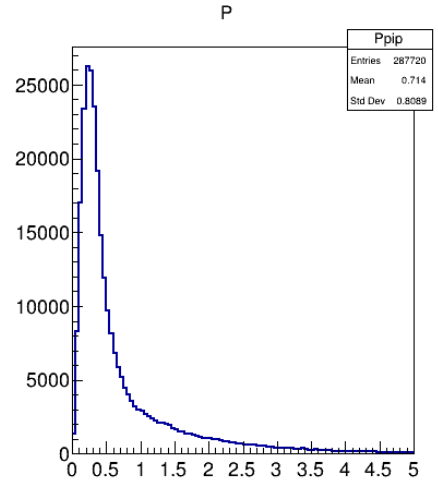

ϕ
ϕpim
Entries 182800
Mean −0.2642
Std Dev 107.4

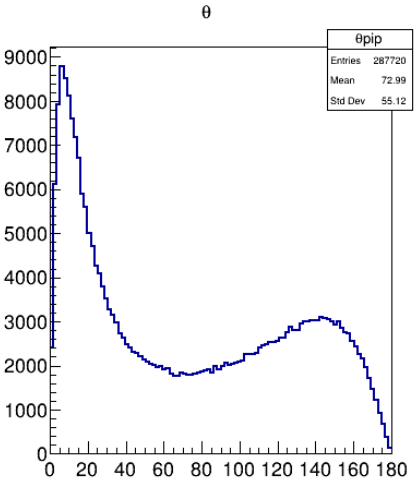

Δ P
Δ Ppim
Entries 182800
Mean −0.0002401
Std Dev 0.01738

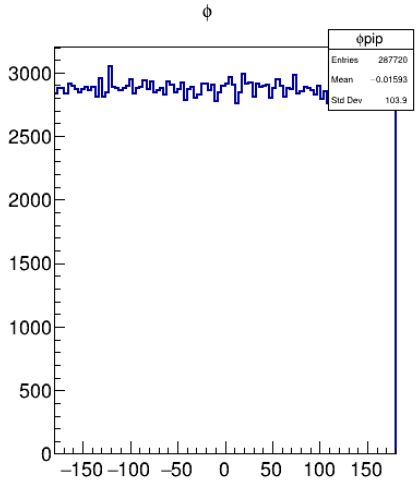

Δ θ
Δ θpim
Entries 182800
Mean 0.0001348
Std Dev 0.07552


Δ ϕ
Δ ϕpim
Entries 182800
Mean −0.0009512
Std Dev 0.1128

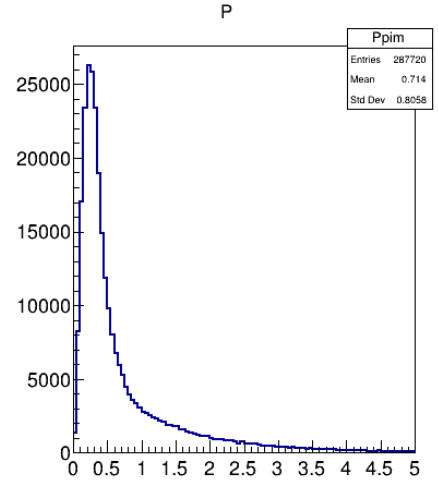
Truth pions

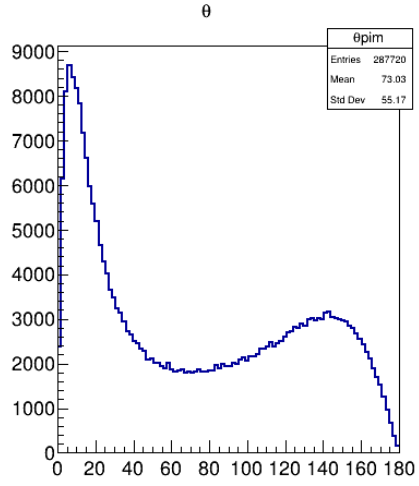


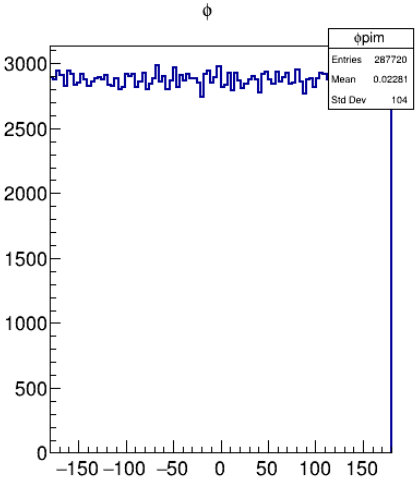




π+



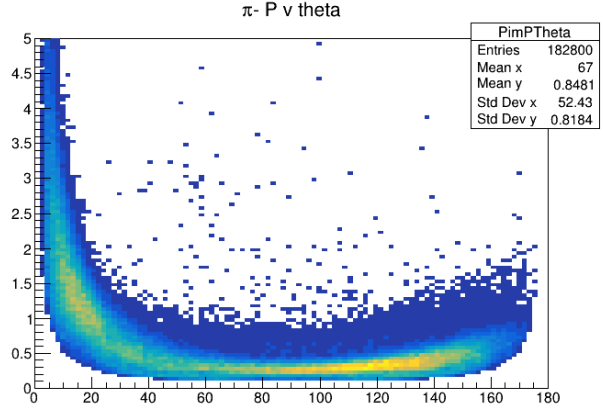




π−

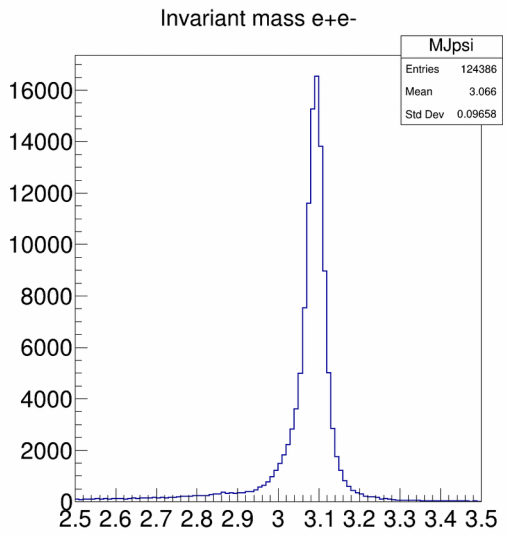
Low momentum pions
Are lost ~0.1-0.5GeV

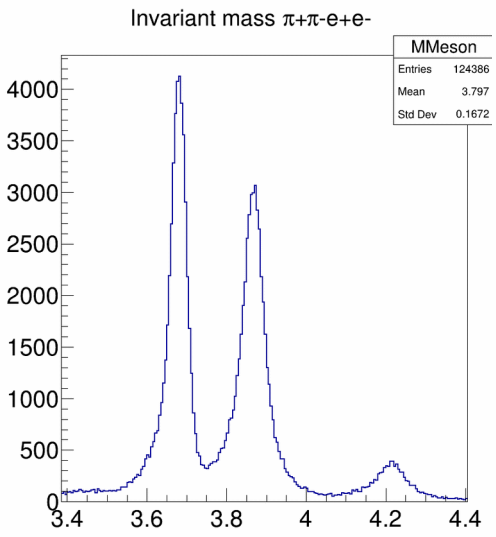
*note there is a
Pt>0.1 threshold applied in
my code
Pt>0.2 might be more
realistic



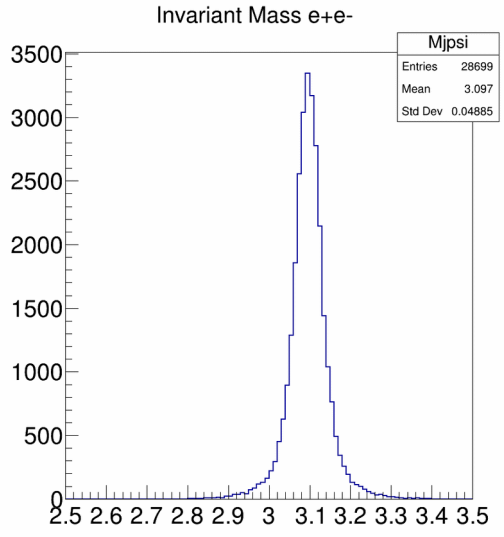
Invariant Masses

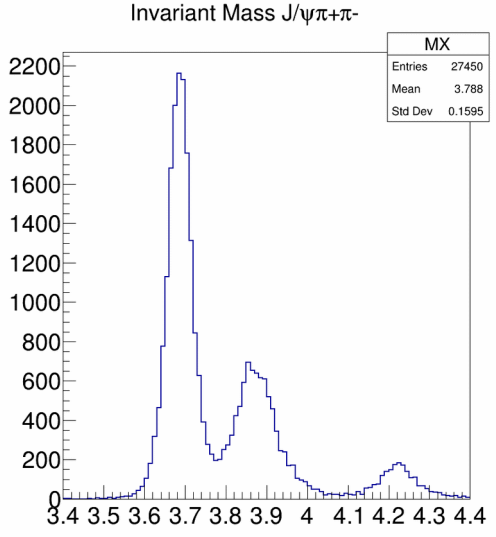
ECCE Simulation





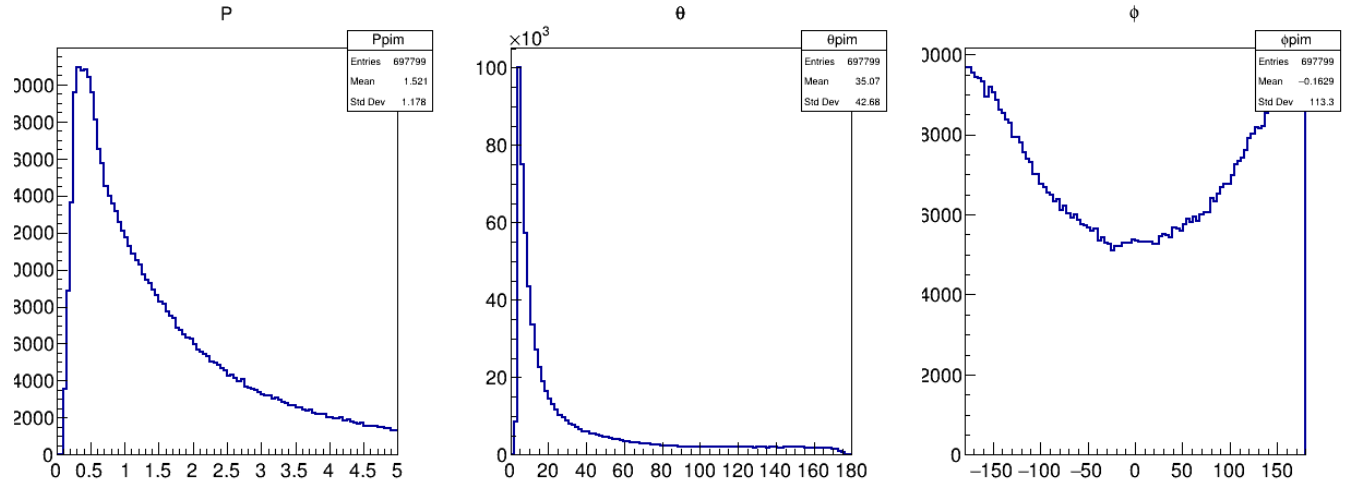
EIC SMEAR Yellow Report 1.5T

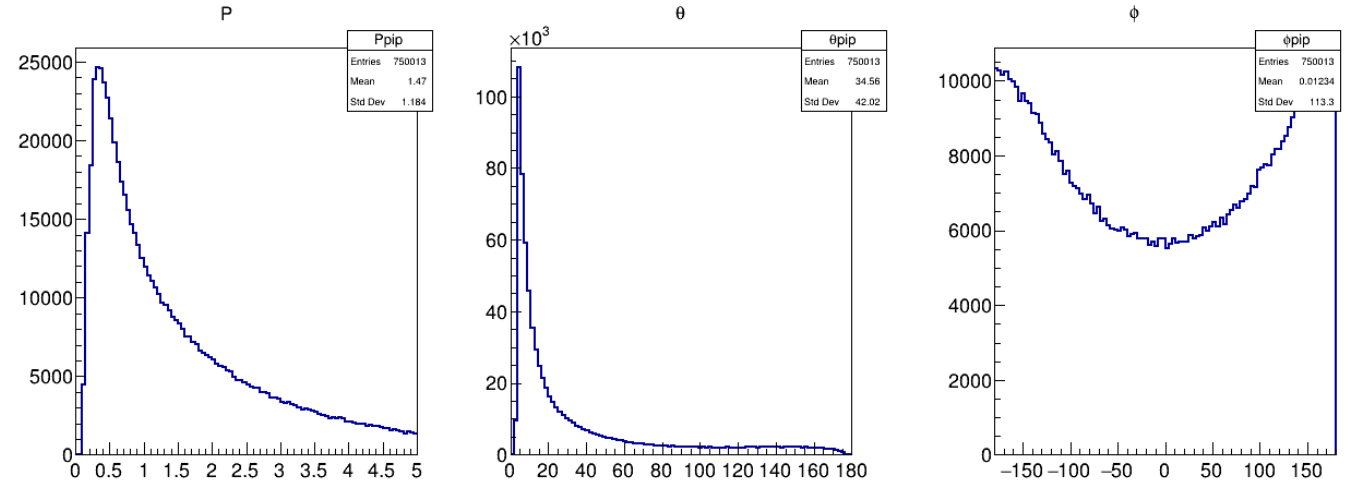




Low momentum pion acceptance worse for Ψ(2S) (X are higher momentum)
Resolution looks better in ECCE simulation

Pythia Background



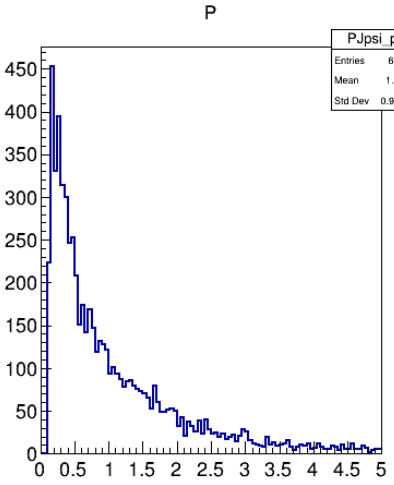


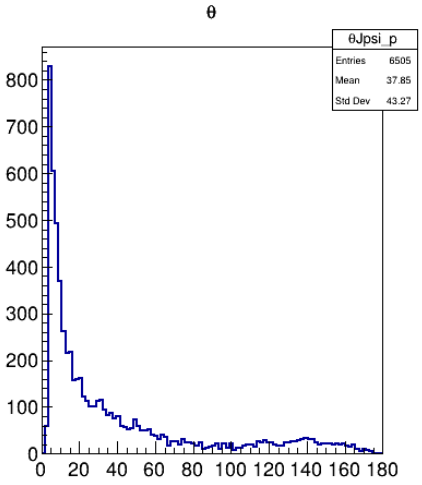
10^6 low Q2 Pythia events
Cameron Dean (LANL)

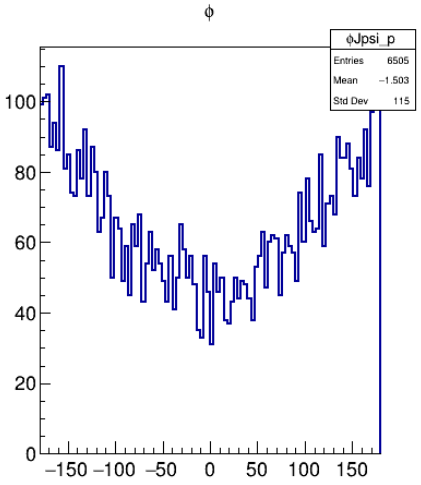
$\pi+$

$\pi-$

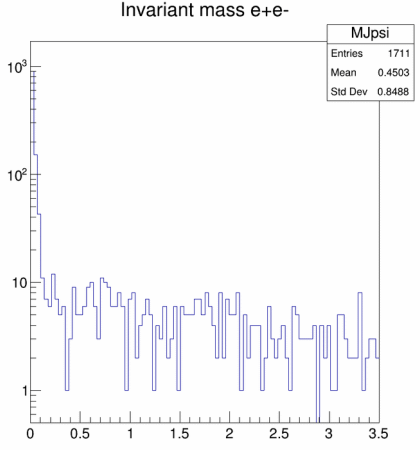
Pythia Background for J/ψ2π

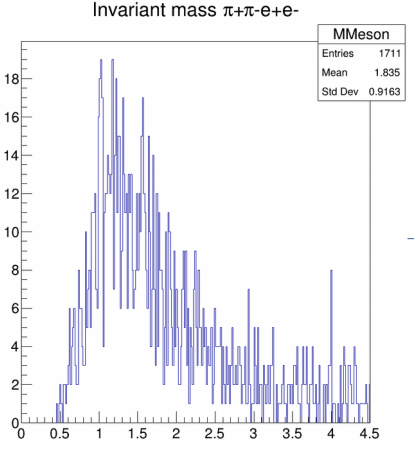




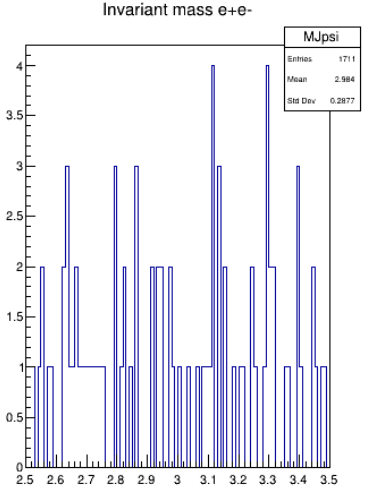


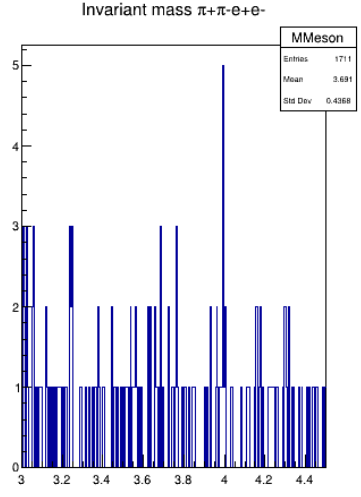
e+





Region of interest





What Next ?

Do I need to do anything else with particle 4-momentum ?

What about calorimeters, PID, … ?

What about far forward/backward regions ?

Should I simulate for other CM configutations?

Should I try and produce more Pythia background ?

Should this reaction go in the dedector proposal
and if so what exactly should be the focus ?

Yellow Report Detector Matrix

η	θ	Nomenclature			Tracking						Electrons and Photons			π/K/p		HCAL		Muons
					Resolution	Relative Momentum	Allowed X/X_0	Minimum-pT	Transverse Pointing Res.	Longitudinal Pointing Res.	Resolution σ_E/E	PID	Min E Photon	p-Range (GeV/c)	Separation	Resolution σ_E/E	Energy	
< -4.6		↓ p/A	Far Backward Detectors	low-Q2 tagger														
-4.6 to -4.0					Not Accessible													
-4.0 to -3.5						Reduced Performance												
-3.5 to -3.0			Central Detector	Backward Detector		σ_p/p ~0.2%×p⊕5%	~5% or less X	70-150 MeV/c (B=1.5 T)			1%/E ⊕ 2.5%/√E ⊕ 1%	π suppression up to 1:1E-4	20 MeV	≤ 10 GeV/c	≥ 3 σ	50%/ √E⊕10%	~500MeV	Muons useful for bkg, improve resolution
-3.0 to -2.5																		
-2.5 to -2.0						σ_p/p~ 0.04%×p⊕2%			dca(xy) ~ 40/pT μm ⊕ 10 μm	dca(z) ~ 100/pT μm ⊕ 20 μm	2%/E ⊕(4-8)%/ √E ⊕ 2%	π suppression up to 1:(1E-3 - 1E-2)	50 MeV					
-2.0 to -1.5																		
-1.5 to -1.0																		
-1.0 to -0.5				Barrel		σ_p/p ~0.04%×p⊕1%		200 MeV/c	dca(xy) ~ 30/pT μm ⊕ 5 μm	dca(z) ~ 30/pT μm ⊕ 5 μm	2%/E ⊕(12-14)%/√E ⊕ (2-3)%	π suppression up to 1:1E-2	100 MeV	≤ 6 GeV/c		100%/ √E+10%		
-0.5 to 0.0																		
0.0 to 0.5																		
0.5 to 1.0																		
1.0 to 1.5				Forward Detectors		σ_p/p ~0.04%×p⊕2%		70 - 150 MeV/c (B = 1.5 T)	dca(xy) ~ 40/pT μm ⊕ 10 μm	dca(z) ~ 100/pT μm ⊕ 20 μm	2%/E ⊕ (4°-12)%/√E ⊕ 2%	3σ e/π up to 15 GeV/c	50 MeV	≤ 50 GeV/c		50%/ √E+10%		
1.5 to 2.0																		
2.0 to 2.5																		
2.5 to 3.0						σ_p/p ~0.2%×p⊕5%												
3.0 to 3.5																		
3.5 to 4.0		↑ e		Instrumentation to separate charged particles from photons		Reduced Performance												
4.0 to 4.5					Not Accessible													
> 4.6			Far Forward Detectors	Proton Spectrometer														
				Zero Degree Neutral Detection														