ECal Simulation and PVDIS Rate Update

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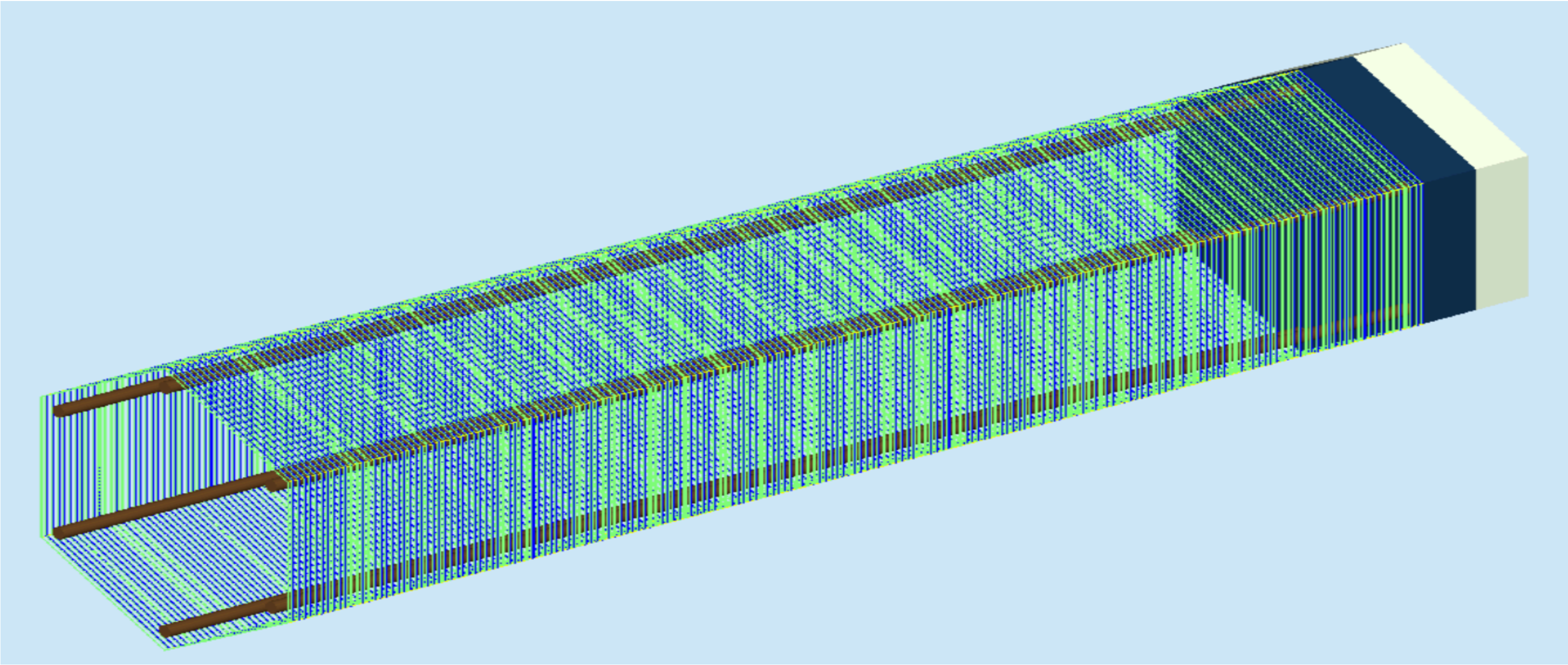
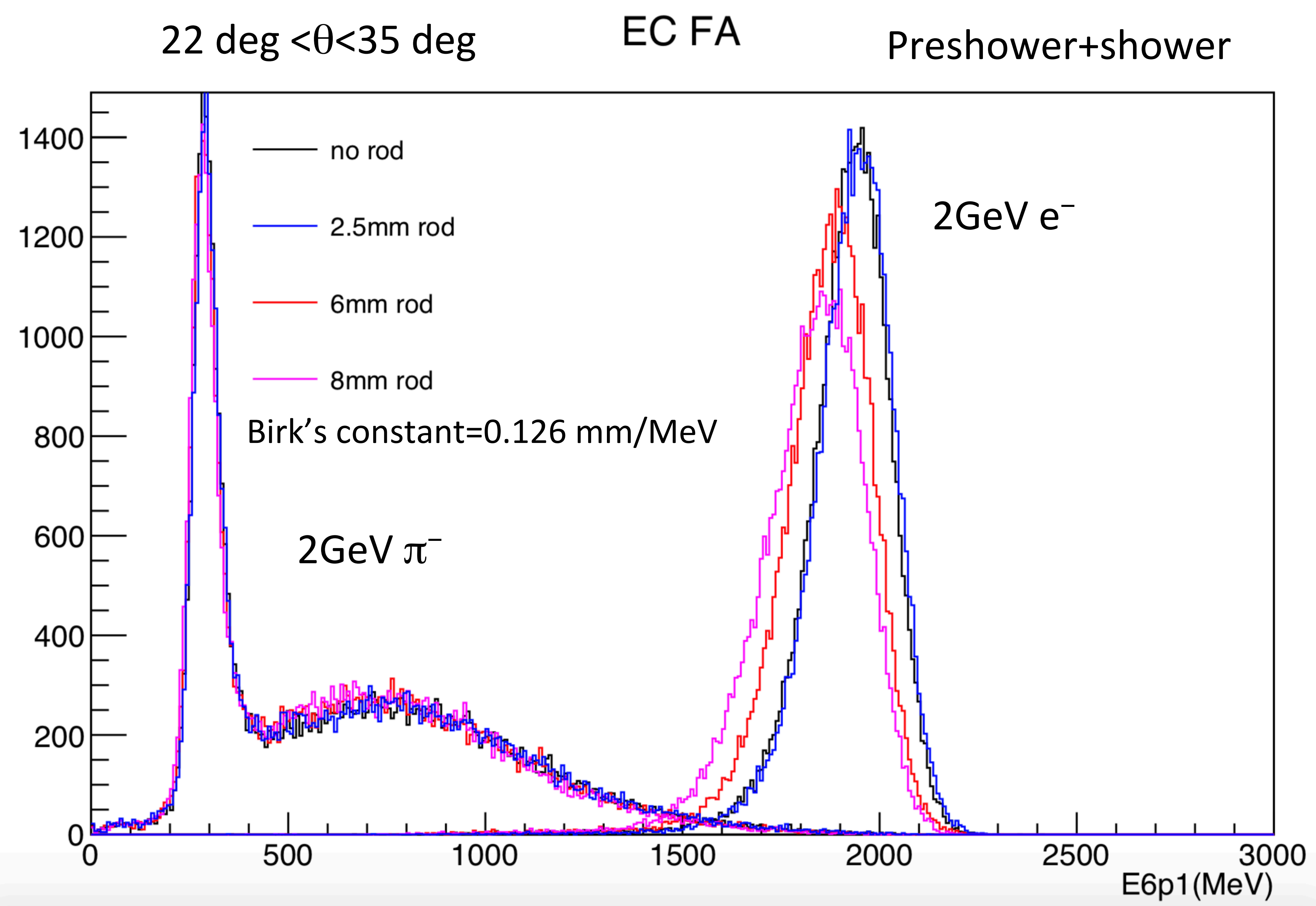
ECal Module Configuration

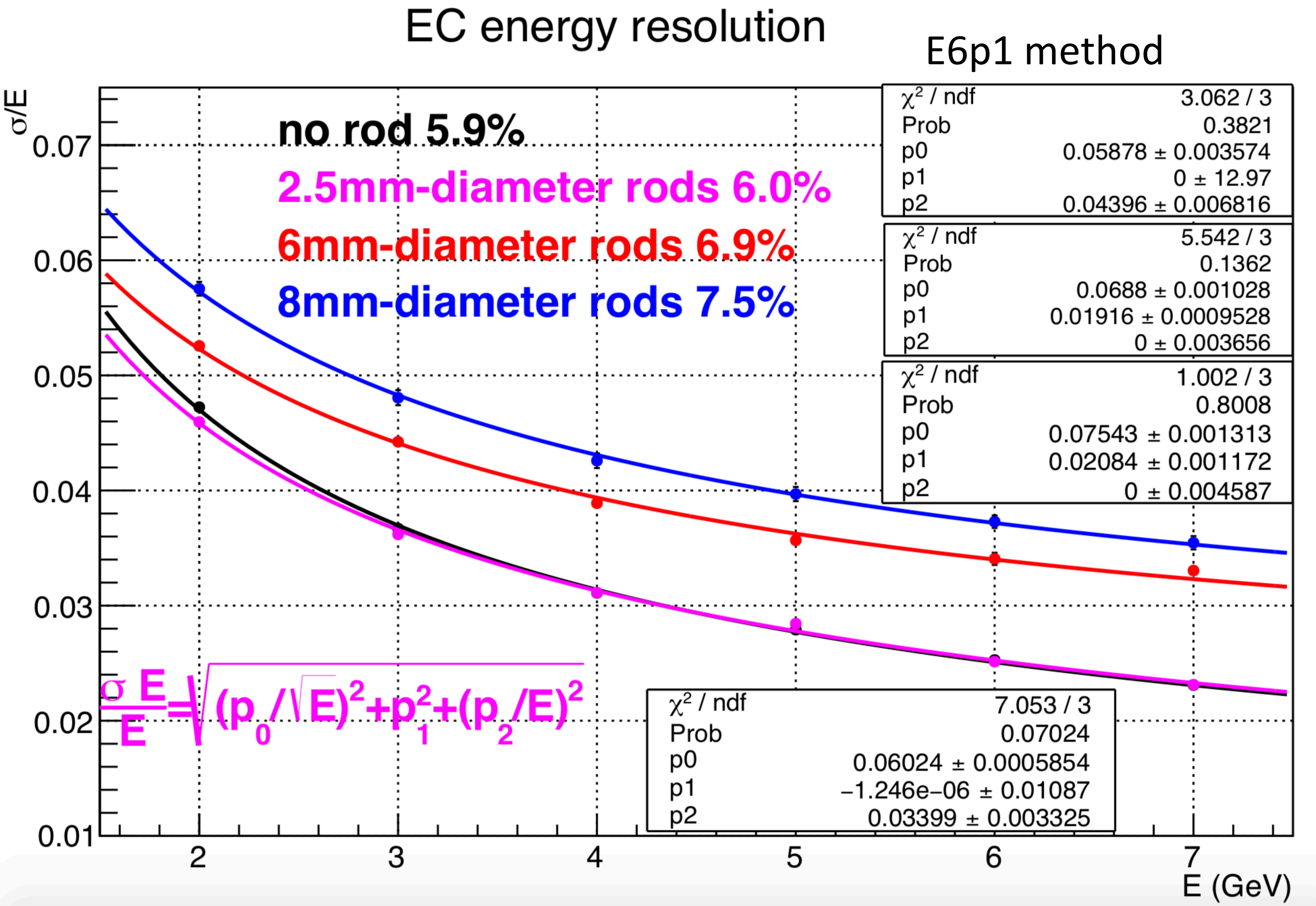


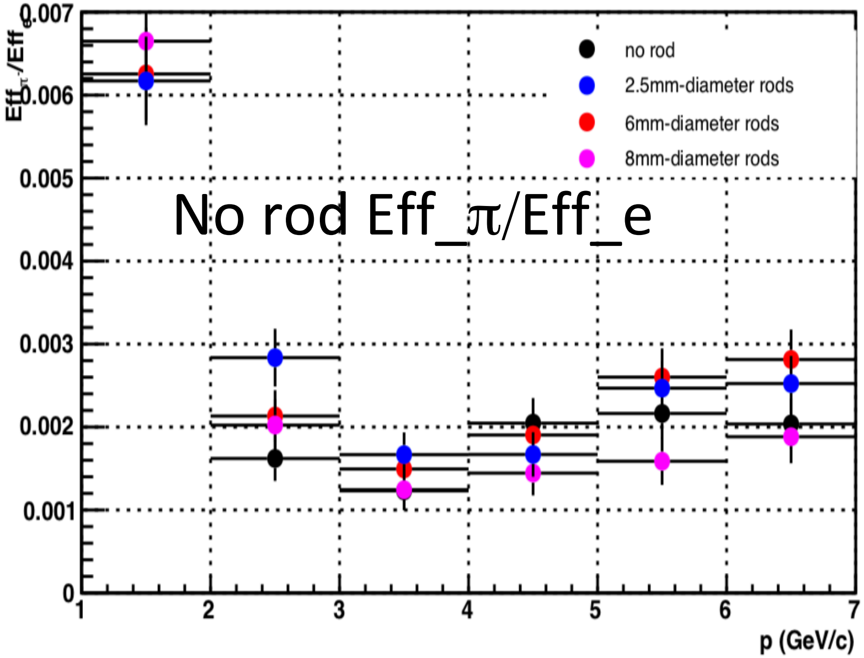
6 stainless steel rods have been added in the simulation configuration

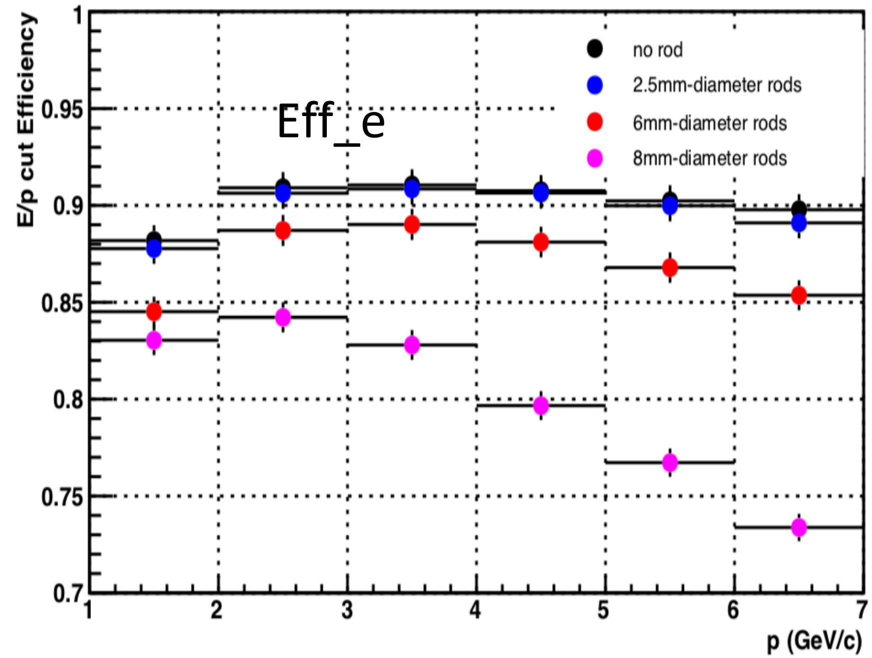
- 2.5mm-diameter------beam test modules
- 6mm-diameter-----prototype
- 8mm-diameter

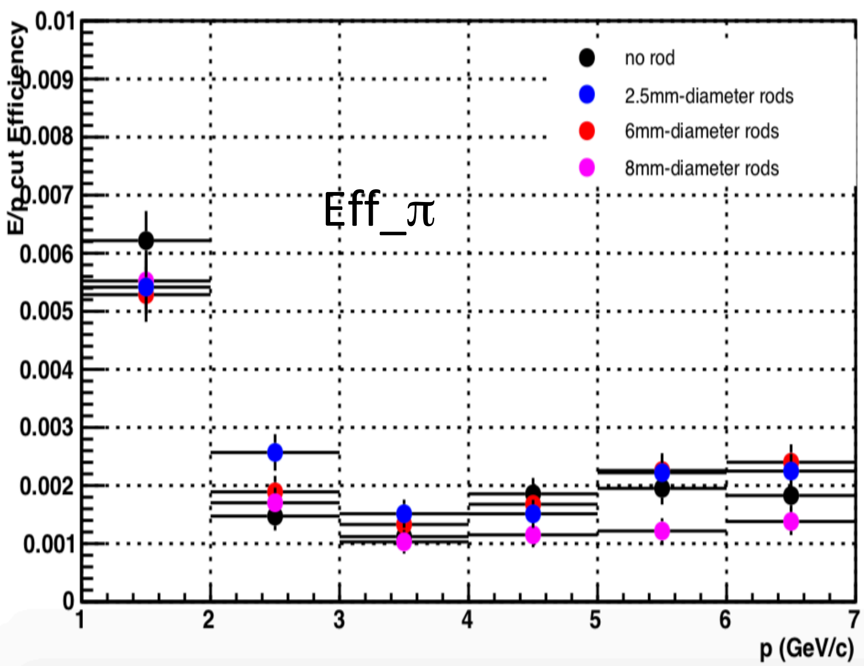


22 deg <θ<35 deg
EC FA
Preshower+shower
no rod
2.5mm rod
6mm rod
8mm rod
Birk's constant=0.126 mm/MeV
2GeV e⁻
2GeV π⁻
1400
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
3000
E6p1(MeV)


EC energy resolution
E6p1 method
σ/E
no rod 5.9%
2.5mm-diameter rods 6.0%
6mm-diameter rods 6.9%
8mm-diameter rods 7.5%
χ2 / ndf 3.062 / 3
Prob 0.3821
p0 0.05878 ± 0.003574
p1 0 ± 12.97
p2 0.04396 ± 0.006816
χ2 / ndf 5.542 / 3
Prob 0.1362
p0 0.0688 ± 0.001028
p1 0.01916 ± 0.0009528
p2 0 ± 0.003656
χ2 / ndf 1.002 / 3
Prob 0.8008
p0 0.07543 ± 0.001313
p1 0.02084 ± 0.001172
p2 0 ± 0.004587
χ2 / ndf 7.053 / 3
Prob 0.07024
p0 0.06024 ± 0.0005854
p1 −1.246e−06 ± 0.01087
p2 0.03399 ± 0.003325
σ/E = √((p0/√E)^2 + p1^2 + (p2/E)^2)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
2
3
4
5
6
7
E (GeV)







PID cuts

- preshower E>10MeV
- 3σ<E6p1/p ----no rod
- 2σ<E6p1/p ----6mm-diameter
- 2σ<E6p1/p----8mm-diameter

ECal Simulation Parameters Update

Nlayer	194	counts	Nlayer	-	-	-	-	-	-
Thickness_lead	0.05	cm	Thickness_lead	-	-	-	-	-	-
Thickness_scint	0.15	cm	Thickness_scint	-	-	-	-	-	-
Thickness_gap	0.024	cm	Thickness_gap	-	-	-	-	-	-
Thickness_shield	1.12	cm	Thickness_shield	-	-	-	-	-	-
Thickness_paint	0.01	cm	Thickness_paint	-	-	-	-	-	-
Thickness_prescint	2	cm	Thickness_prescint	-	-	-	-	-	-
Thickness_support	2	cm	Thickness_support	-	-	-	-	-	-
Angle_module	30	deg	Angle_module	-	-	-	-	-	-
Radius_shower	5.413	cm	Radius_shower	-	-	-	-	-	-
Radius_rod	5.6255	cm	Radius_rod	-	-	-	-	-	-
R_rod	0.3	cm	R_rod	-	-	-	-	-	-

//assume 50% light goes forward, 50% goes backward, assume 60% loss from reflection at front fiber end Shower

double attlength_D=3000;

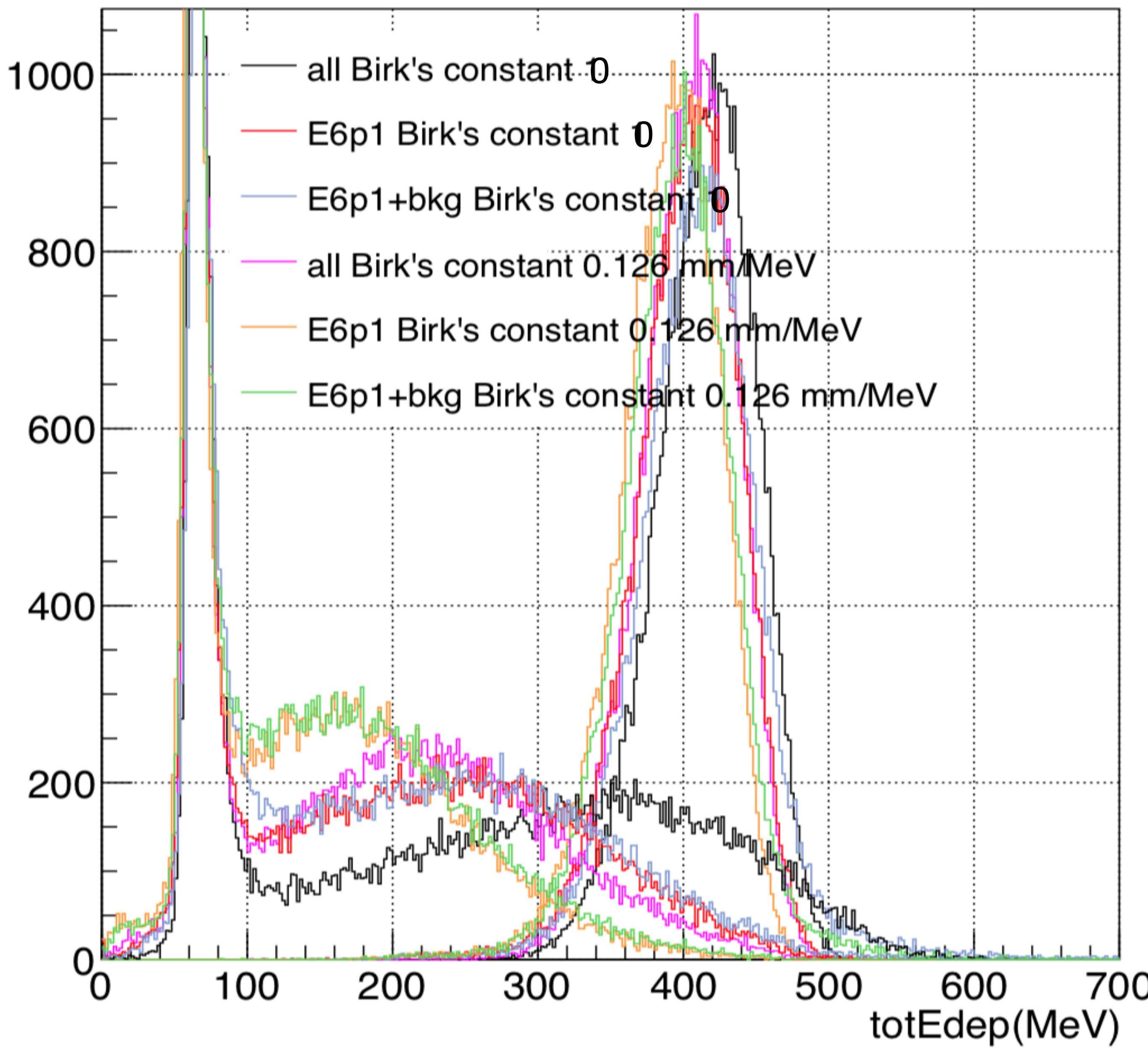
$$\textbf{Eend} = 0.5 * \text{EdepB} * \exp(-\text{dz1}/\text{attlength\_D}) + 0.3 * \text{EdepB} * \exp(-\text{dz2}/\text{attlength\_D});$$

// Calculate attenuated energy which reach module end Preshower

double attlength_D=2000; dz1=dz2= 400

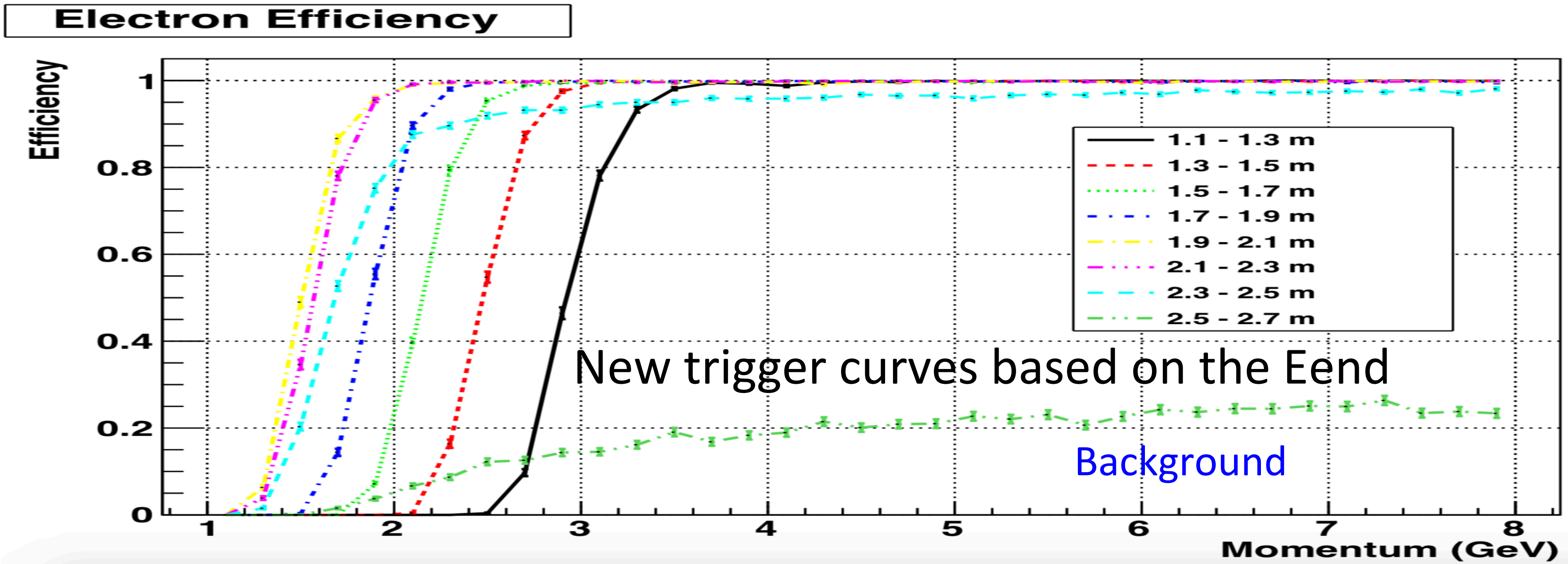
$$\textbf{Eend} = 0.5 * \text{EdepB} * \exp(-\text{dz1}/\text{attlength\_D}) + 0.5 * \text{EdepB} * \exp(-\text{dz2}/\text{attlength\_D});$$

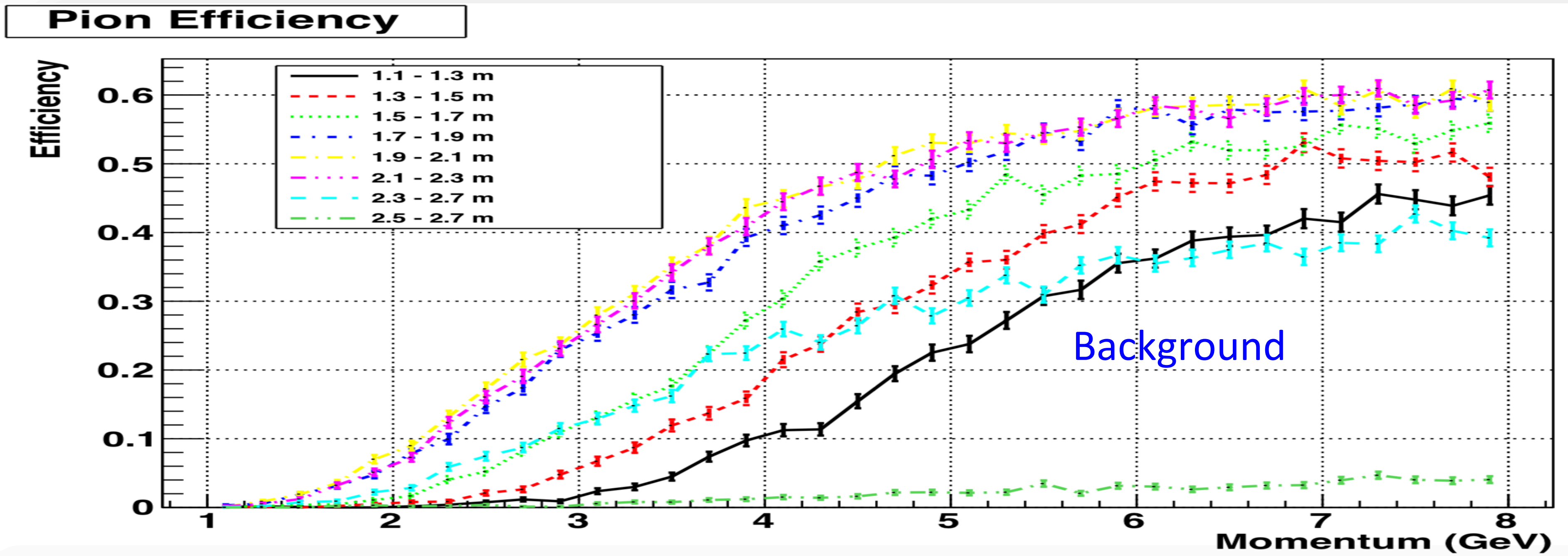
22<θ<35 deg, shower, no rod



Should use Eend !

ECAL Trigger Response Curves for PVDIS configuration

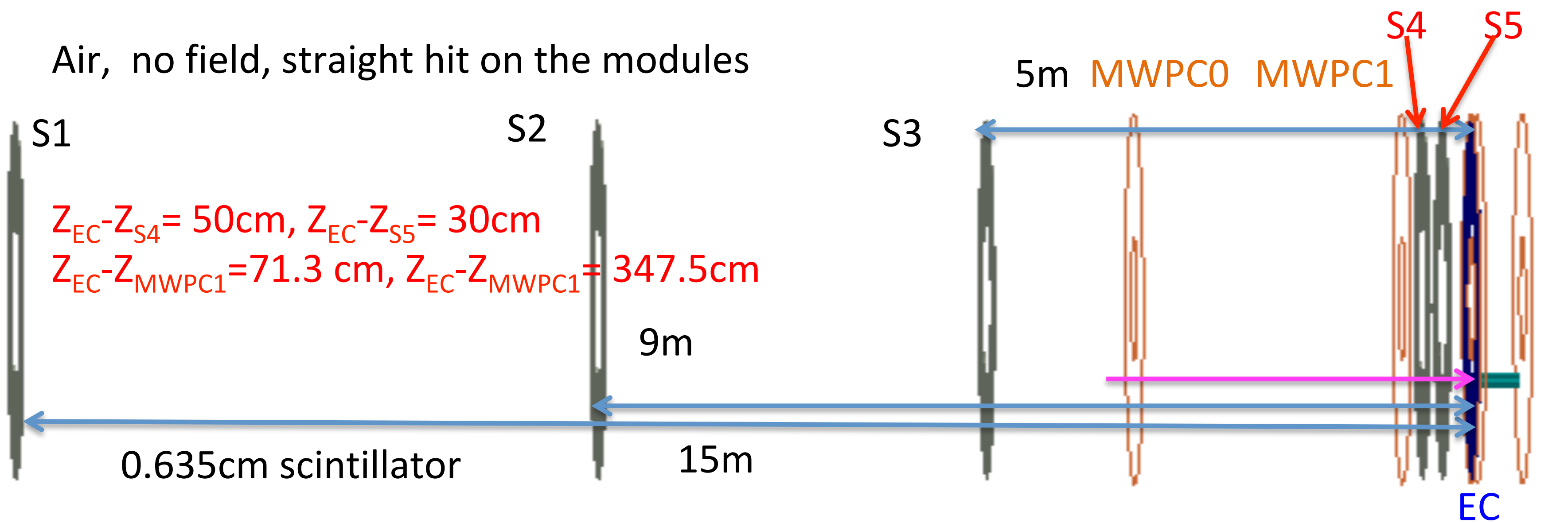




PVDIS Trigger Rate EC only (MHz)				
	Without pile-up	**With pile-up 30ns**	**Without pile-up New trigger**	**With pile-up 30ns New trigger**
e^-	0.366	0.367	0.395	0.396
π^-	21.615	31.01	5.916	12.51
π^+	0.663	0.739	0.224	0.306
π^0	0.061	0.071	0.114	0.166
All pions	22.339	31.821	6.26	12.98

ECal
FTBF Beam Test Simulation Update

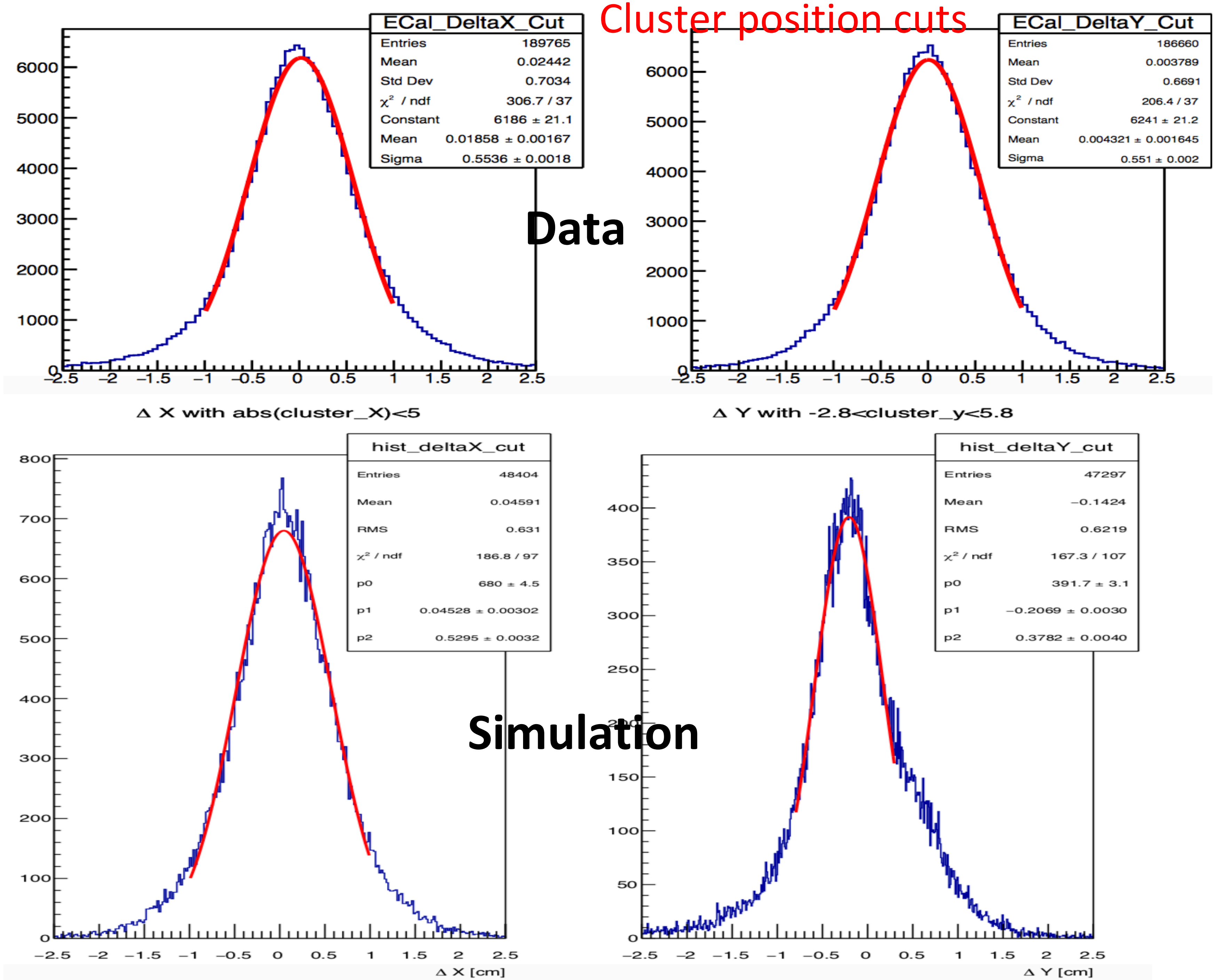
FTBF Beam Test Simulation Setup



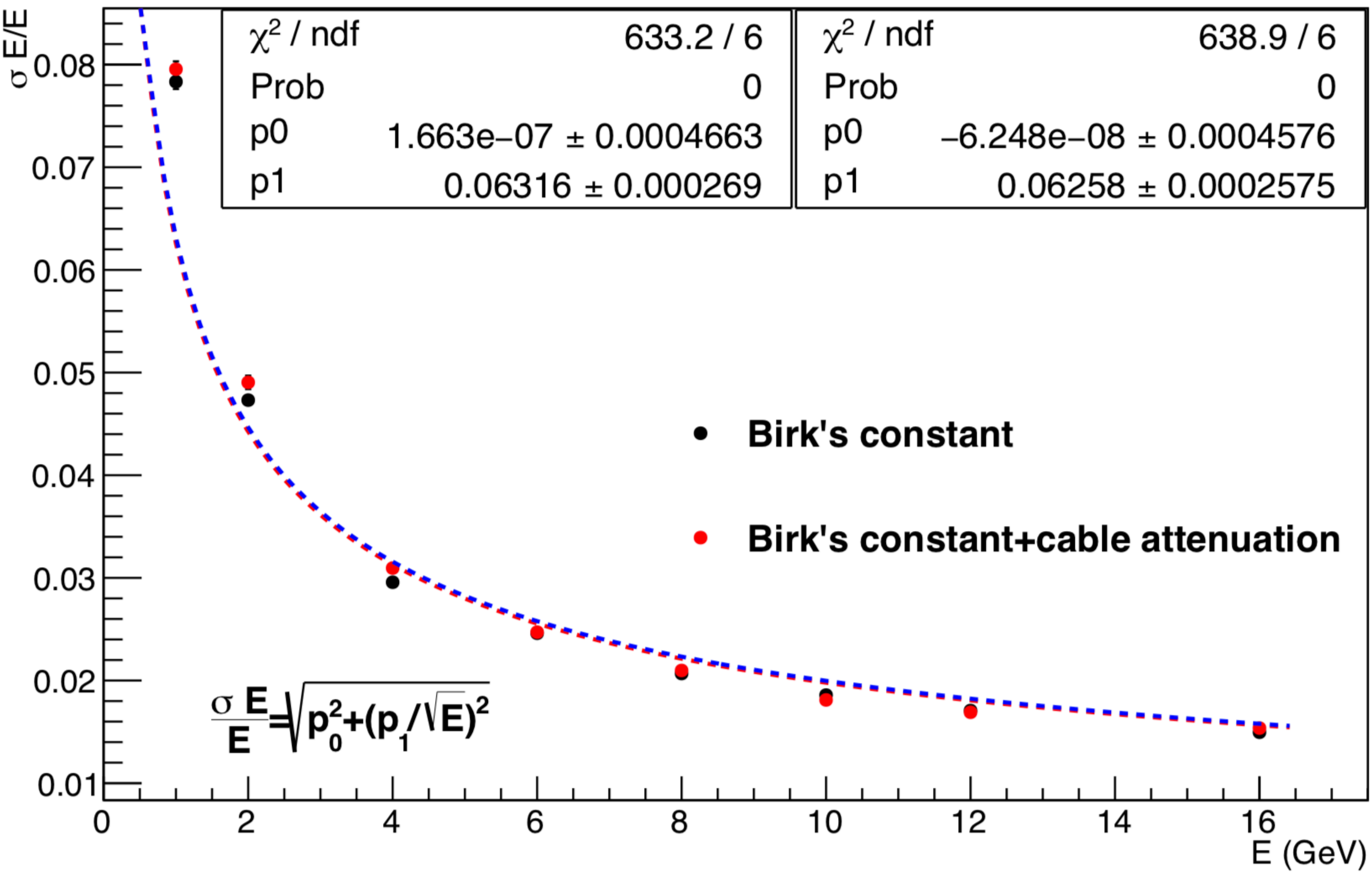
Simulation setting:

- **10 GeV e- beam**
- Beam profile **(X,Y, θ, ϕ)** based on the **MWPC0 and MWPC1** information from data. https://userweb.jlab.org/~jixie/SOLID/BeamTest/FTBFBeamProf/
- Add **1.5%** momentum resolution.

Cluster position cuts

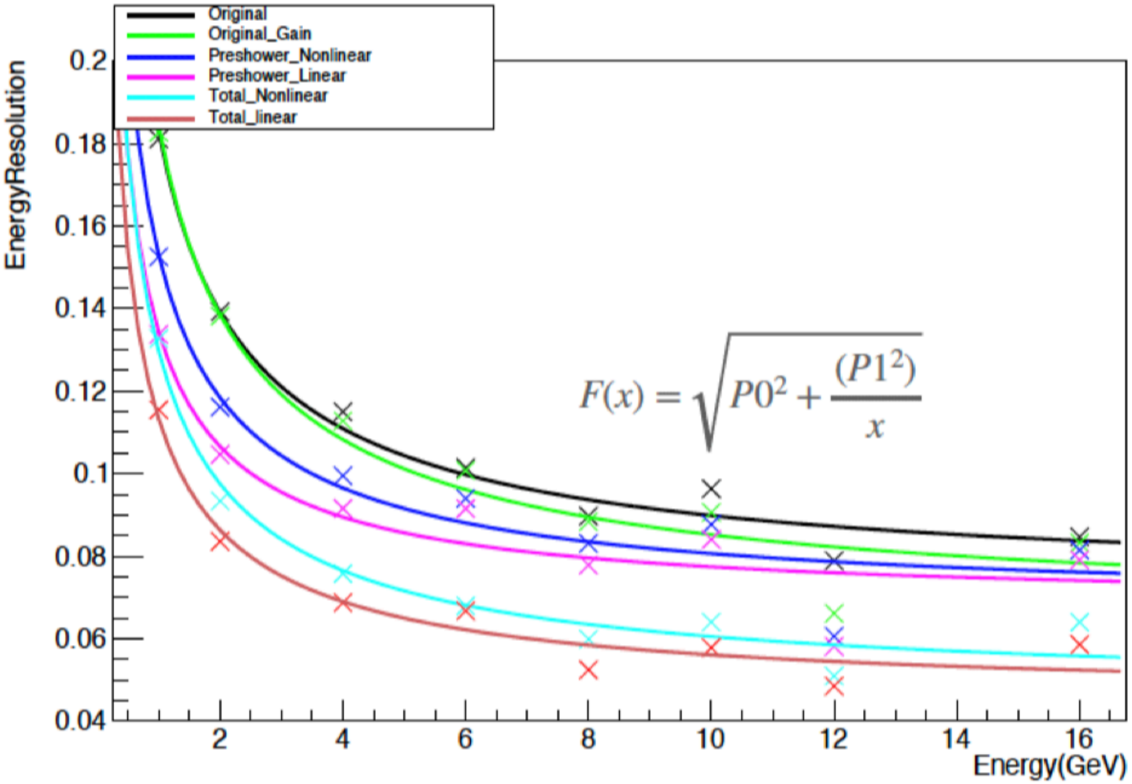


EC Energy Resolution based on FTBF Simulation



From Jixie

Ecal Energy Resolution

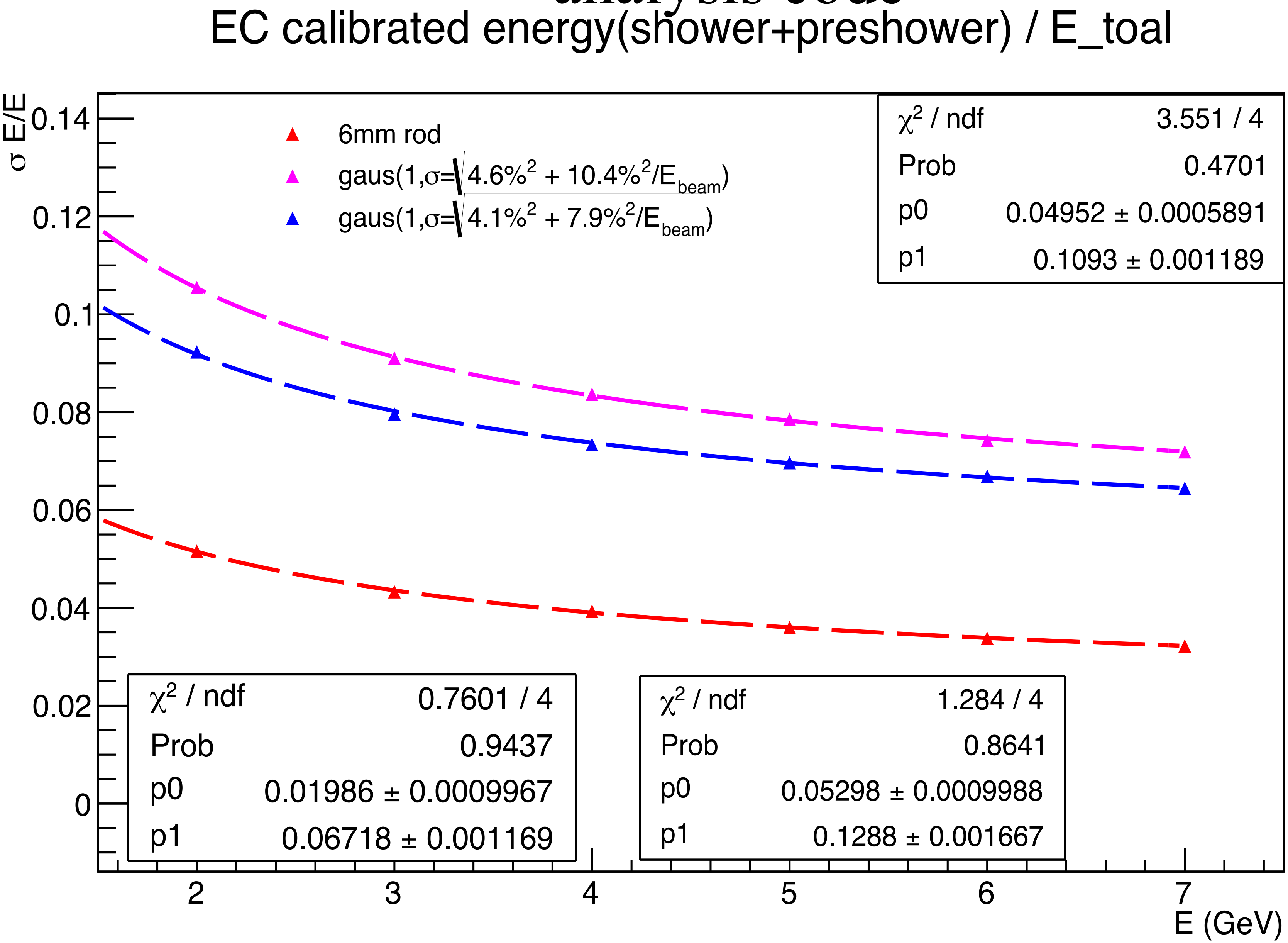


	P0	P1
Original	**0.072±0.003**	**0.168±0.005**
Gain	0.065±0.006	0.173±0.008
Preshower (nonlinear)	0.068±0.006	0.137±0.009
Position	0.047±0.004	0.121±0.006

	P0	P1
Original	**0.072±0.003**	**0.168±0.005**
Gain	0.065±0.006	0.173±0.008
Preshower (linear)	0.068±0.005	0.116±0.005
Position	**0.046±0.003**	**0.104±0.005**

FTBF data

Add Beam Test Energy Resolution to ECal analysis code



Summary and Outlook

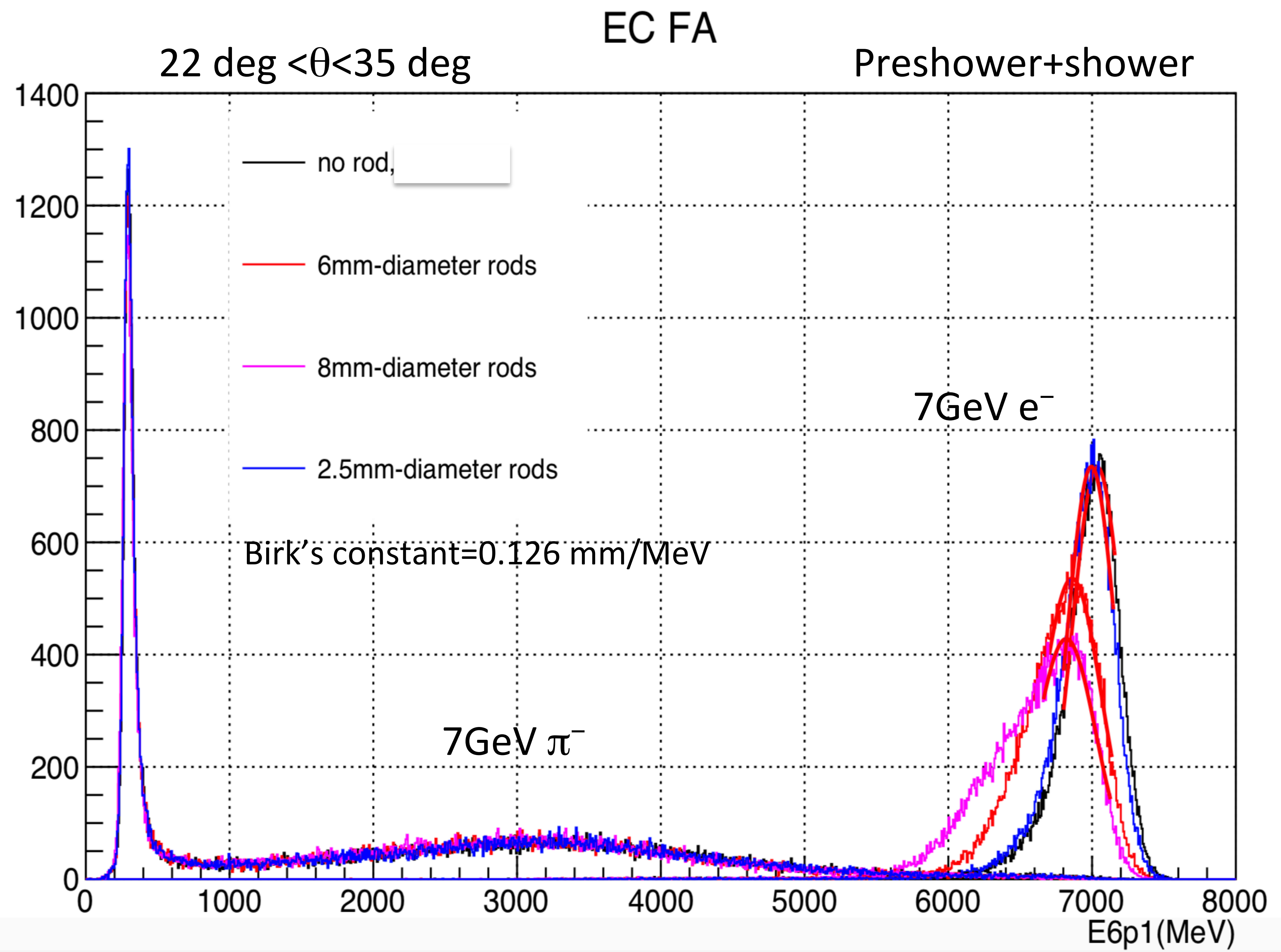
- Based on the simulation study, Ecal rods with 6mm-diameter and 8mm-diameter have different effects on the ECal energy resolution and PID efficiency.

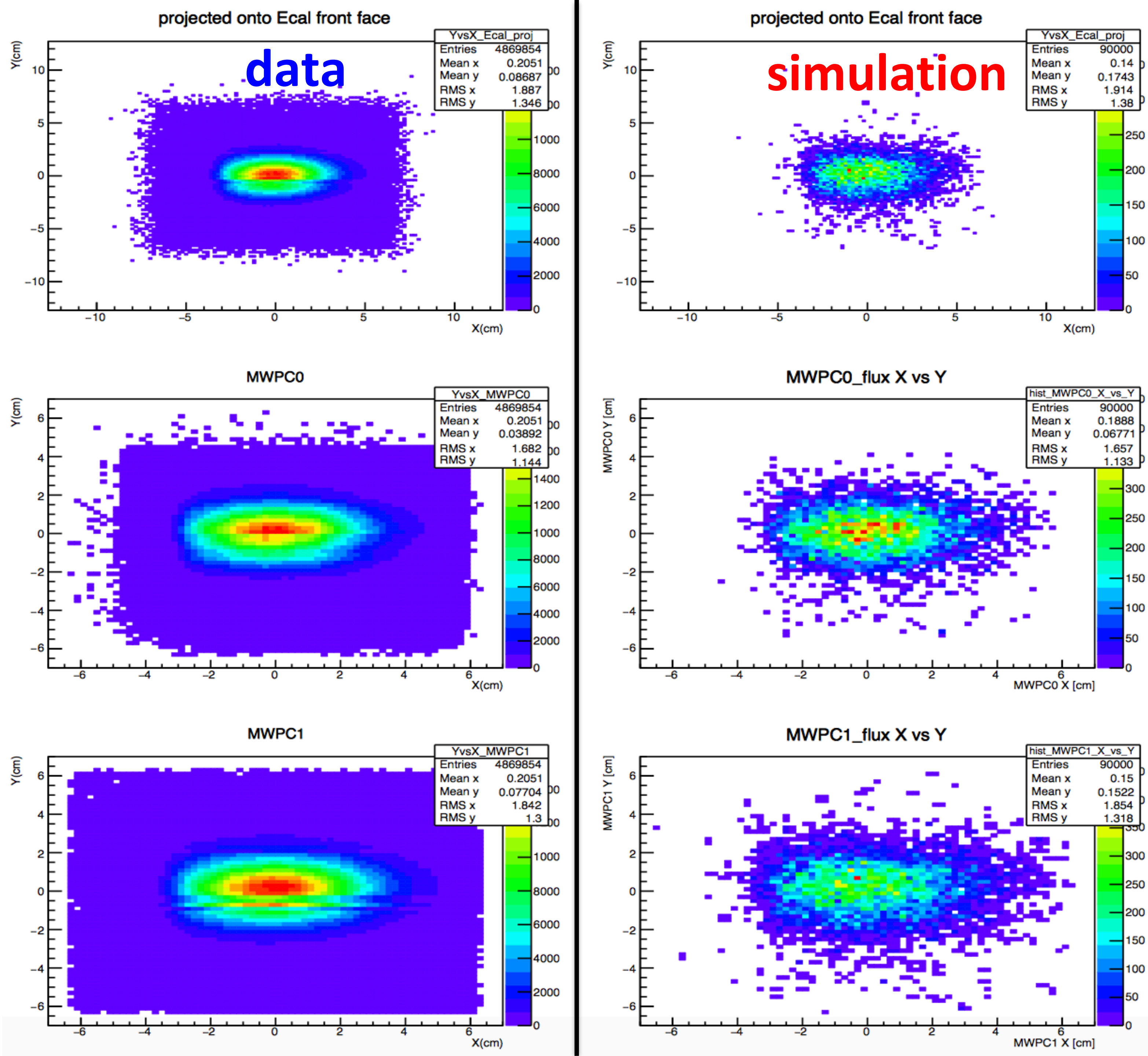
- PVDIS trigger curves and rates are updated based on Eend.

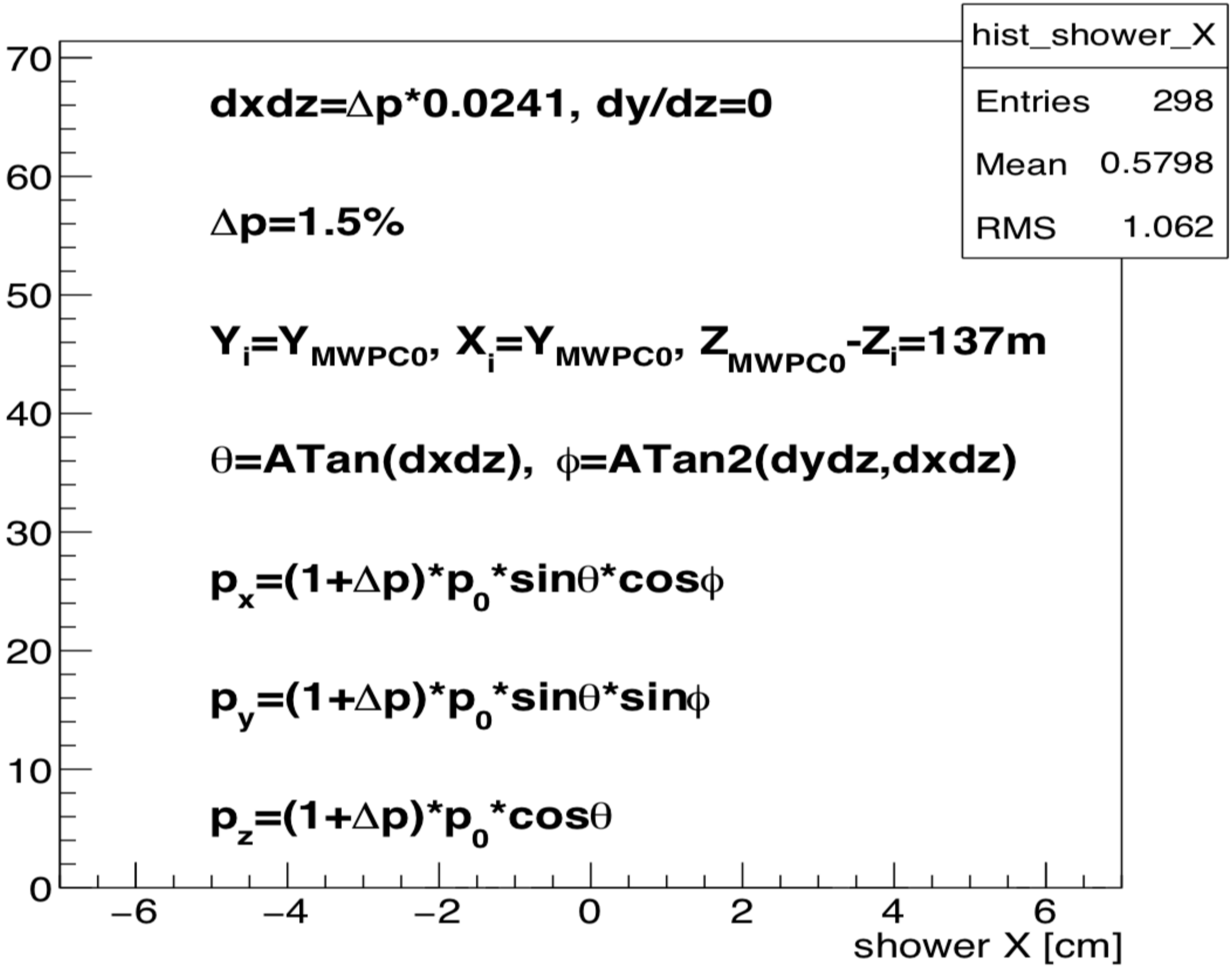
- ECal FTBF beam test energy resolution was applied to simulation code.

- To do: Review SIDIS trigger rates and PID cuts.

Backup


EC FA
22 deg <θ<35 deg
Preshower+shower
no rod,
6mm-diameter rods
8mm-diameter rods
2.5mm-diameter rods
7GeV e⁻
Birk's constant=0.126 mm/MeV
7GeV π⁻
0
200
400
600
800
1000
1200
1400
0
1000
2000
3000
4000
5000
6000
7000
8000
E6p1(MeV)


data
simulation
projected onto Ecal front face
YvsX_Ecal_proj
Entries 4869854
Mean x 0.2051
Mean y 0.08687
RMS x 1.887
RMS y 1.346
Y(cm)
X(cm)
projected onto Ecal front face
YvsX_Ecal_proj
Entries 90000
Mean x 0.14
Mean y 0.1743
RMS x 1.914
RMS y 1.38
MWPC0
YvsX_MWPC0
Entries 4869854
Mean x 0.2051
Mean y 0.03892
RMS x 1.682
RMS y 1.144
MWPC0_flux X vs Y
hist_MWPC0_X_vs_Y
Entries 90000
Mean x 0.1888
Mean y 0.06771
RMS x 1.657
RMS y 1.133
MWPC0 Y [cm]
MWPC0 X [cm]
MWPC1
YvsX_MWPC1
Entries 4869854
Mean x 0.2051
Mean y 0.07704
RMS x 1.842
RMS y 1.3
MWPC1_flux X vs Y
hist_MWPC1_X_vs_Y
Entries 90000
Mean x 0.15
Mean y 0.1522
RMS x 1.854
RMS y 1.318
MWPC1 Y [cm]
MWPC1 X [cm]


hist_shower_X
Entries 298
Mean 0.5798
RMS 1.062
dxdz=Δp*0.0241, dy/dz=0
Δp=1.5%
Y_i=Y_MWPC0, X_i=Y_MWPC0, Z_MWPC0-Z_i=137m
θ=ATan(dxdz), ϕ=ATan2(dydz,dxdz)
p_x=(1+Δp)*p_0*sinθ*cosϕ
p_y=(1+Δp)*p_0*sinθ*sinϕ
p_z=(1+Δp)*p_0*cosθ
70
60
50
40
30
20
10
0
−6
−4
−2
0
2
4
6
shower X [cm]