ECAL Updates

- ECAL energy calibration
- The dependence of ECAL energy resolution on the beam polar angle for different pre-lead width ($0X_0$, $0.5X_0$, $1X_0$, $1.5X_0$, $1.83X_0$, and $2.0X_0$)
- 3-D PID cuts (π^- rejection) for different pre-lead width on the SIDIS configuration

ECAL Energy Calibration Updates

$$\frac{E}{p} = \frac{E_{shower}^{total} + E_{preshower}^{total}}{P_{flux}}$$

$$= \frac{aE_{shower}^{scin} + bE_{preshower}^{scin}}{p_{flux}} \simeq 1$$

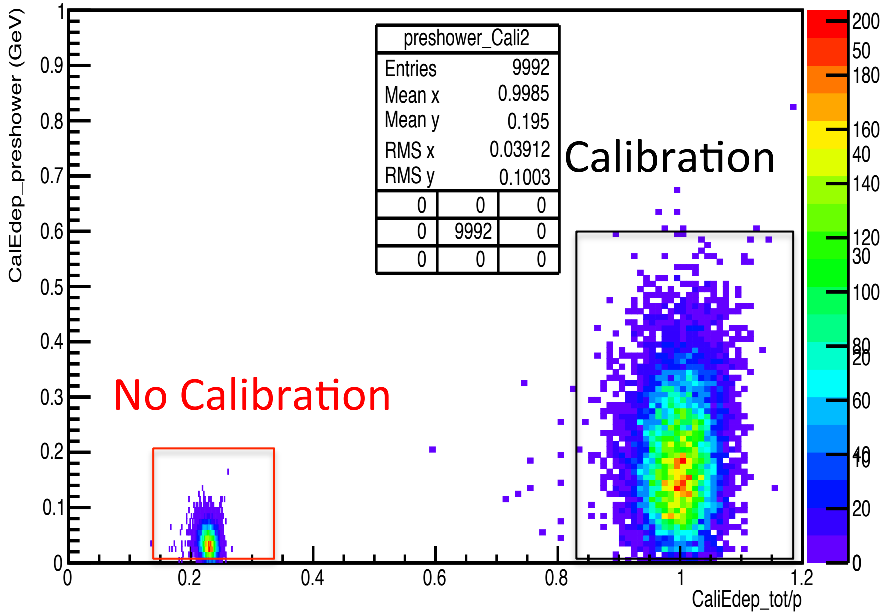
$$p_i = aX_i + bY_i + \varepsilon_i$$

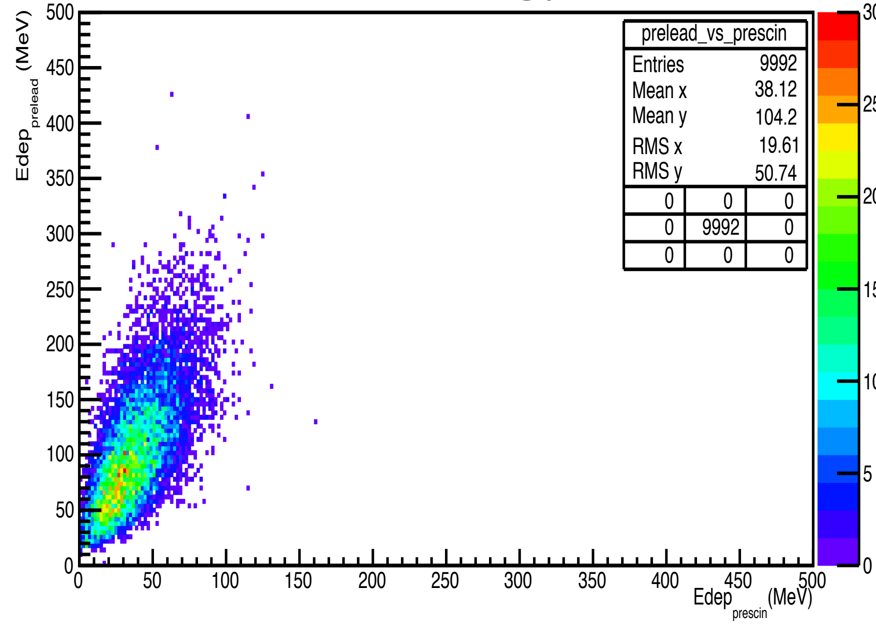
Calibration paramters

$$\mathrm{f} = \sum_{i=1}^{N} \varepsilon_i^2 = \sum_{i=1}^{N} (p_i - aX_i - bY_i)^2$$

$$\frac{\partial f}{\partial a} = 0 \qquad \frac{\partial f}{\partial b} = 0$$

2 GeV e- beam, θe=0°, and vertex (-39.116, -120.984,10)cm Energy Calibration





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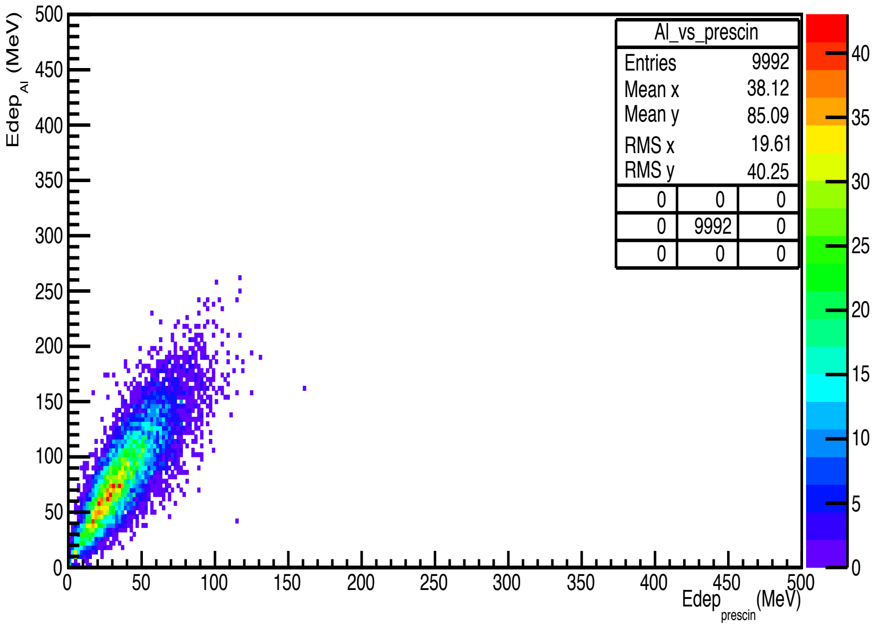
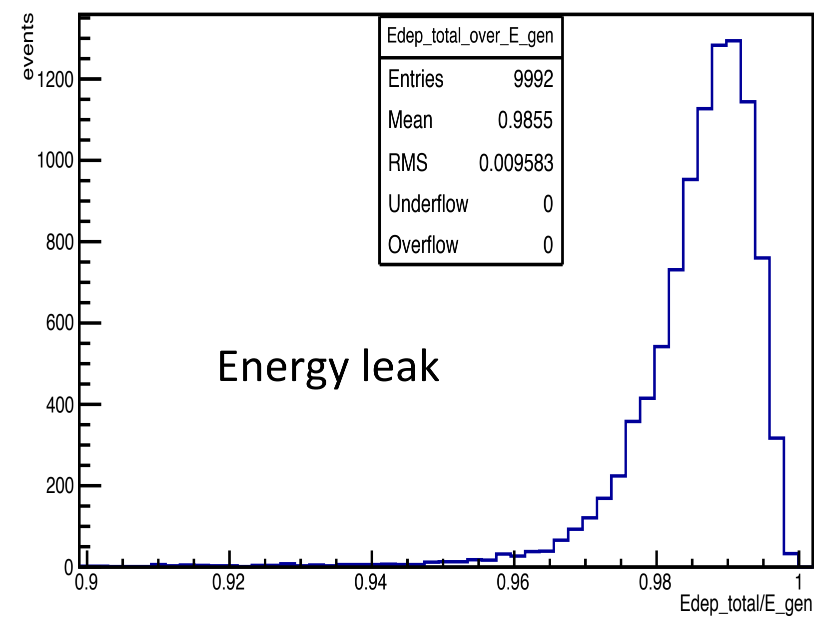
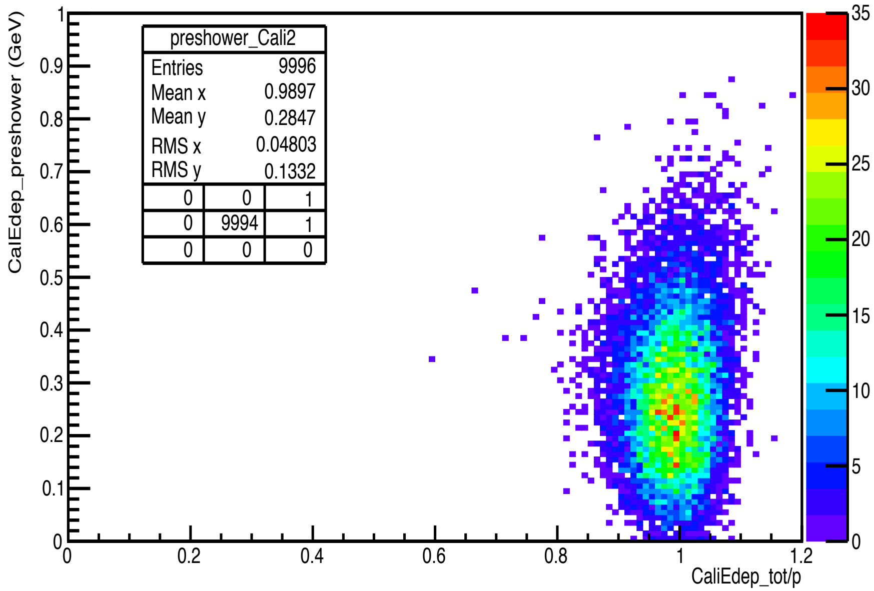
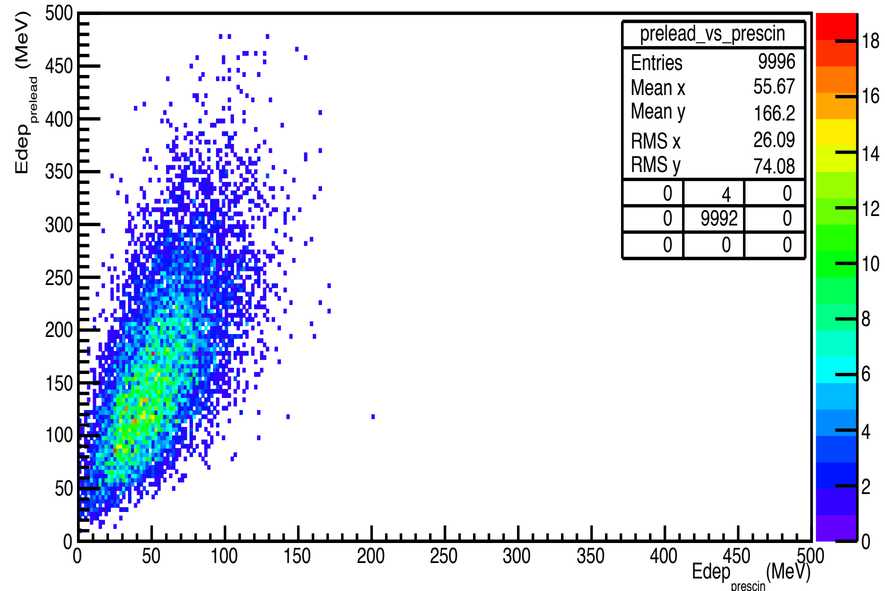




2 GeV e- beam, θe=35°, and vertex (-39.116, -120.984,10)cm Energy Calibration





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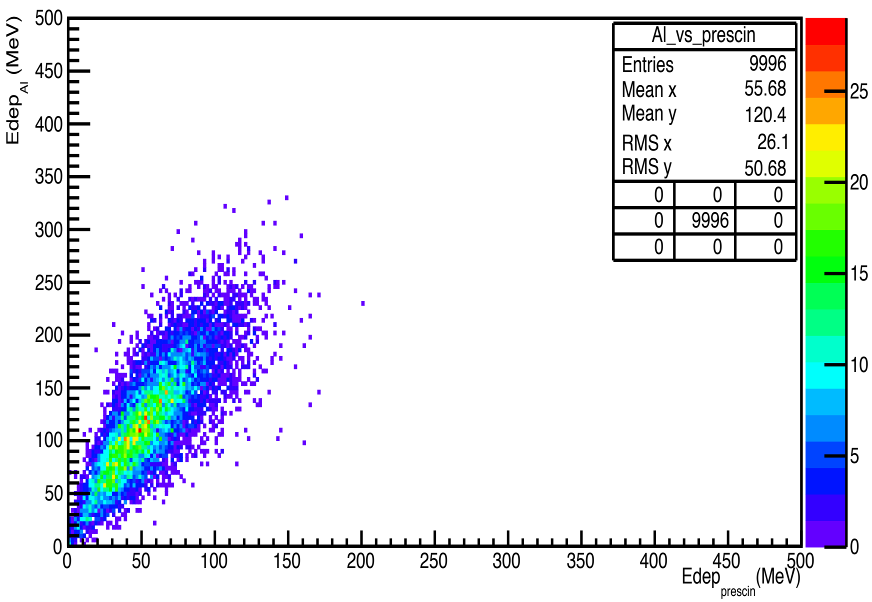
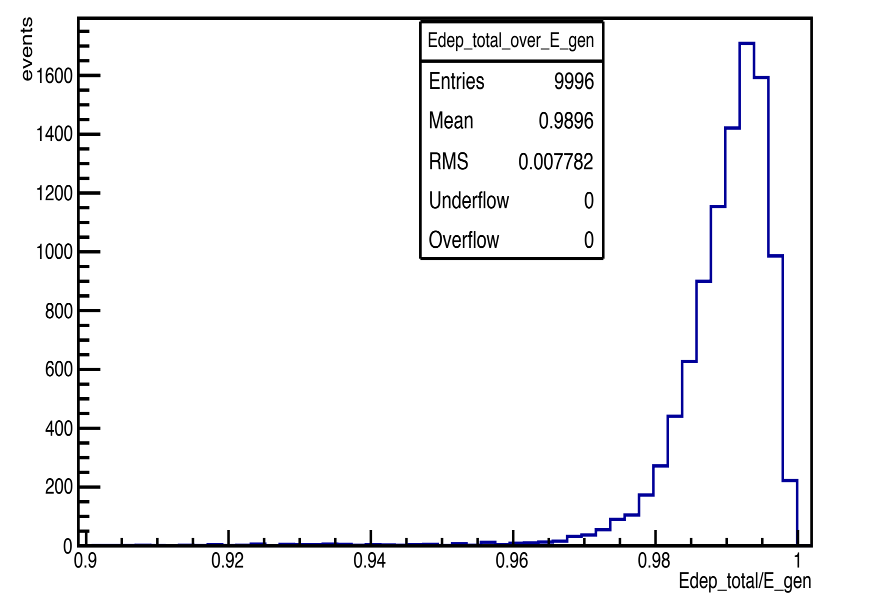
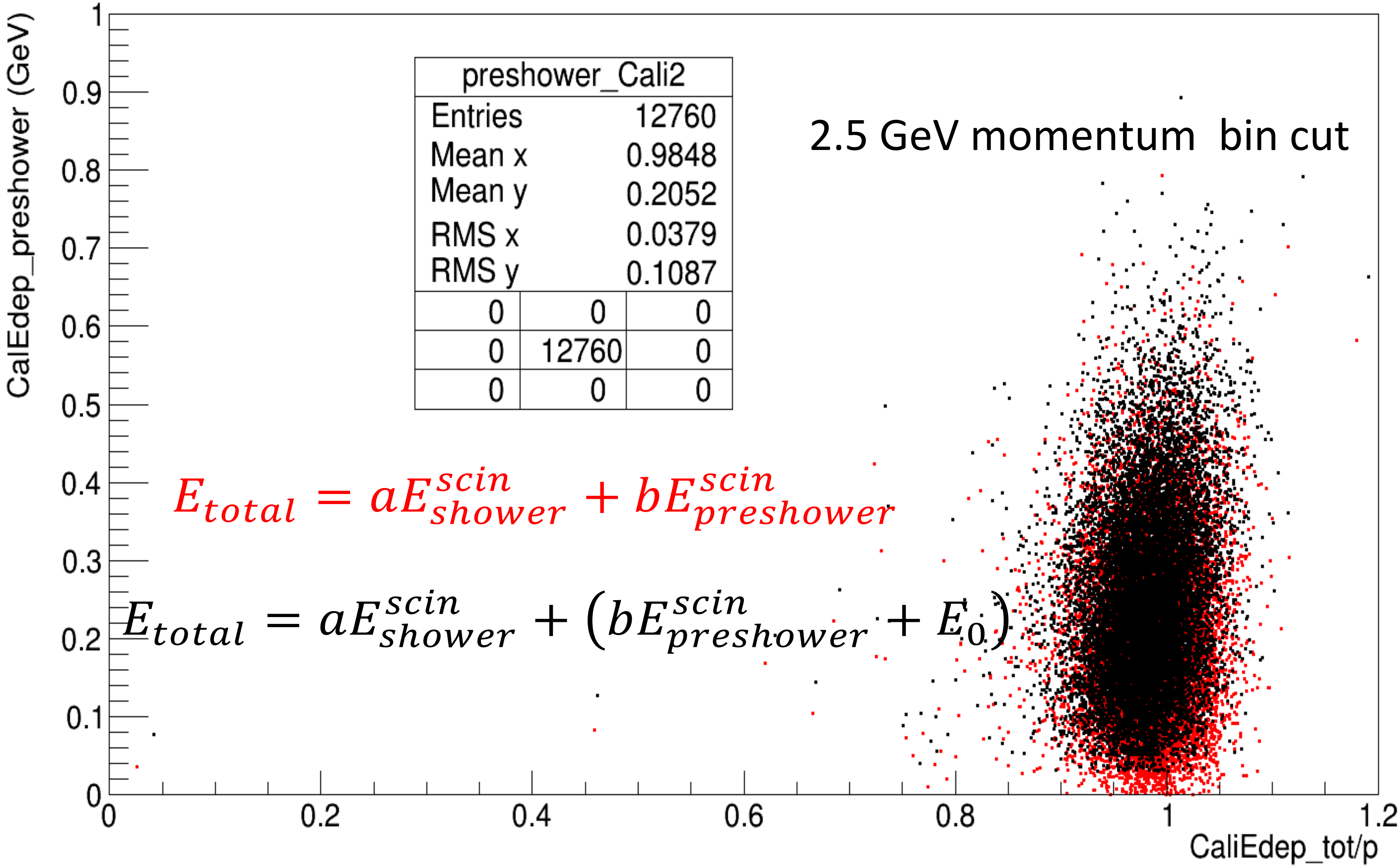




Two Different Calibration Methods Comparison



$$E_{total} = aE_{shower}^{scin} + bE_{preshower}^{scin}$$

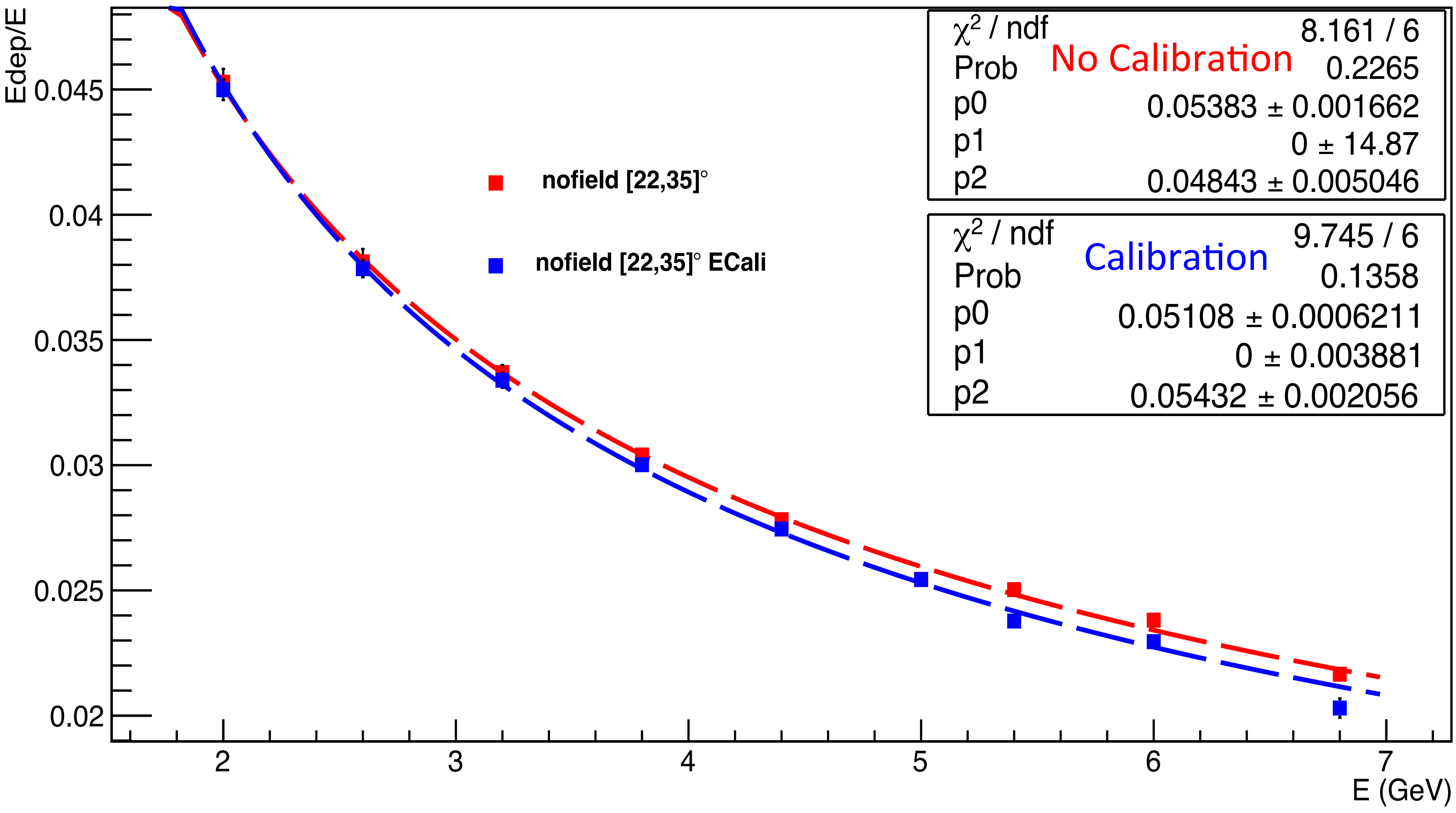
$$E_{total} = aE_{shower}^{scin} + \left(bE_{preshower}^{scin} + E_0\right)$$

e^- beam: E_e=[0,11] GeV, θ_e= [22°,35°], and ϕ= [−180°,180°]

PVDIS Energy Resolution Study

No field e^- beam: all angles: θ_e= [22°,35°], and ϕ= [−180°, 180°] , vertex=(0,0,10 cm), and vertex_spread=(0.21,20).

EC calibrated energy(shower+preshower) / E_toal



ECAL Energy Resolution Dependence Table

e^- beam nofield	Epolar angle (o)	1GeV σE/E (σ/μ)%	2GeV σE/E(σ/μ)%	5GeV σE/E (σ/μ) %
1748 modules prelead+Al 2 X_0	0	5.87±0.046	3.74±0.028	2.19±0.017
	10	5.96±0.046	3.77±0.030	2.24±0.017
	20	6.11±0.048	3.85±0.03	2.25±0.017
	35	7.38±0.058	4.70±0.039	2.56±0.019
1748 modules no prelead (PVDIS) No angle dependence for shower	0	3.98±0.029	2.91±0.021	1.94±0.022
	10	4.00±0.029	2.90±0.025	1.95±0.021
	20	3.98±0.029	2.87±0.021	1.93±0.015
	35	4.03±0.029	2.89±0.020	1.92±0.014

26% worse

ECAL Energy Resolution Dependence Table

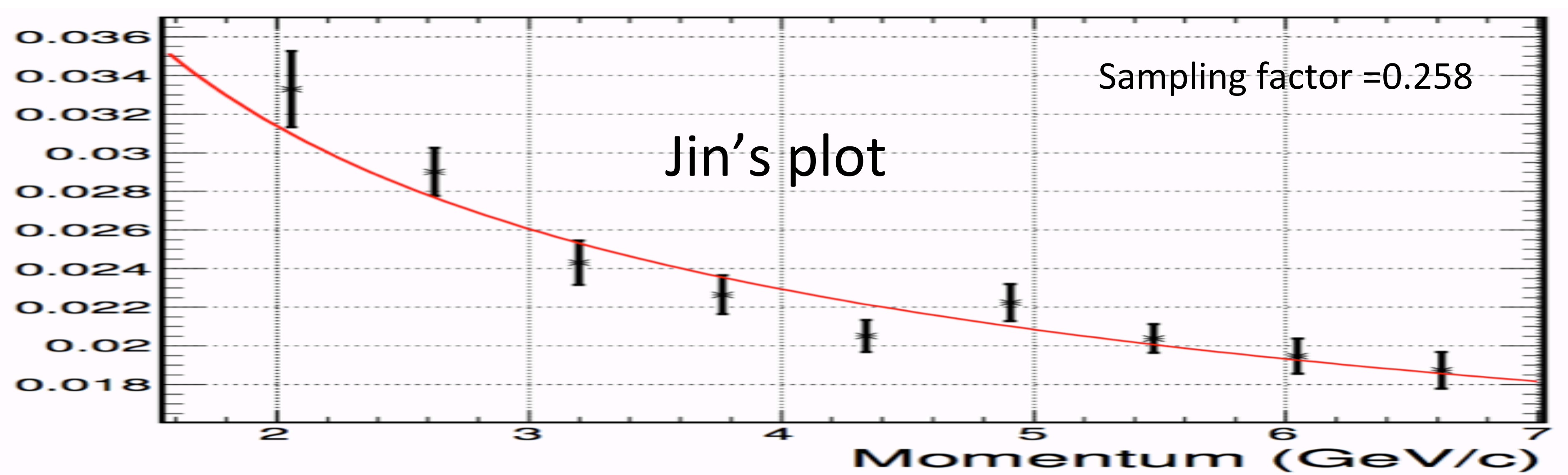
e^- beam nofield	Epolar angle (o)	1GeV $\sigma E/E$ (σ/μ)%	2GeV $\sigma E/E$(σ/μ)%	5GeV $\sigma E/E$ (σ/μ) %
1748 modules prelead $1.5X_0$	0	4.83±0.036	3.21±0.024	1.99±0.015
	10	4.88±0.038	3.29±0.024	2.03±0.015
	20	5.09±0.038	3.33±0.024	2.04±0.016
	35	5.84±0.044	3.74±0.028	2.16±0.016
1748 modules prelead $1.0\ X_0$	0	4.33±0.031	3.03±0.023	1.92±0.015
	10	4.34±0.032	3.05±0.023	1.928±0.015
	20	4.43±0.033	3.03±0.023	1.93±0.014
	35	4.68±0.036	3.19±0.024	1.96±0.014

ECAL Energy Resolution Dependence Table

e^- beam nofield	Epolar angle (o)	1GeV $\sigma E/E$ (σ/μ)%	2GeV $\sigma E/E$(σ/μ)%	5GeV $\sigma E/E$ (σ/μ) %
1748 modules prelead $0.5X_0$	0	4.09±0.030	2.94±0.024	1.93±0.015
	10	4.15±0.031	2.95±0.023	1.94±0.022
	20	4.15±0.031	2.94±0.022	1.94±0.022
	35	4.29±0.031	3.00±0.022	1.95±0.015

e^- beam nofield	Epolar angle (o)	1GeV σE/E (σ/μ)%	2GeV σE/E(σ/μ)%	5GeV σE/E (σ/μ) %
SOLID GEMC 1.83X_0	0	5.40±0.040	3.56±0.027	2.13±0.016
	10	5.48±0.041	3.58±0.028	2.17±0.017
	20	5.77±0.44	3.72±0.028	2.18±0.017
	35	6.77±0.053	4.36±0.035	2.39±0.018

Preshower(20mm Scin+10.274mm Pb+15mm Scin)+18X_0 shashlyk(0.24mm+0.5mm Pb+1.5mm Scin)+Al?



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	10	5.96±0.046	3.77±0.030	2.24±0.017
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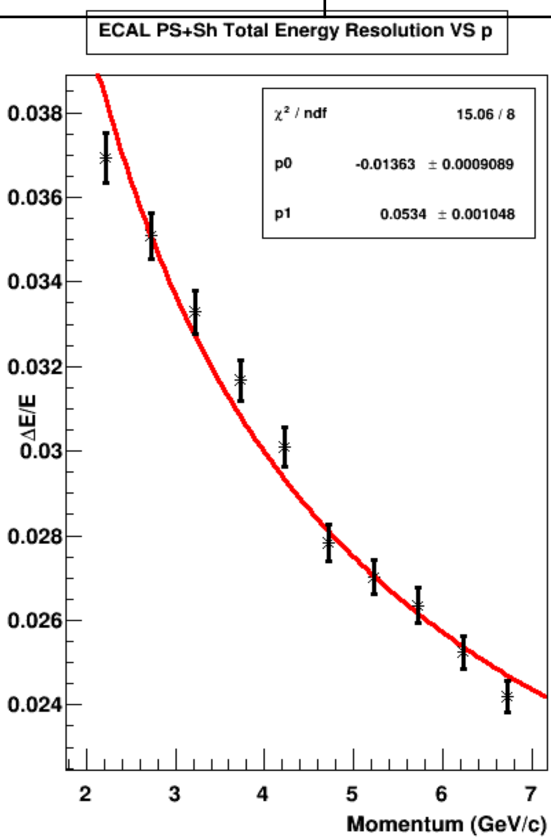
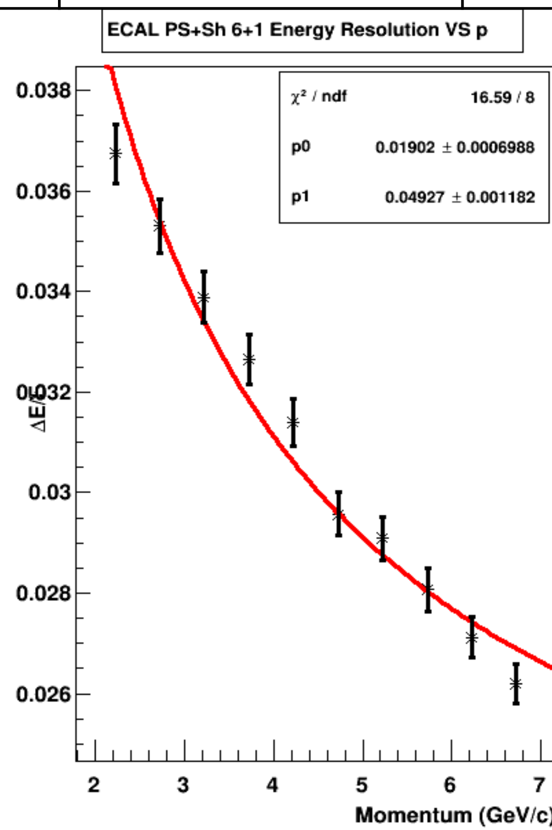
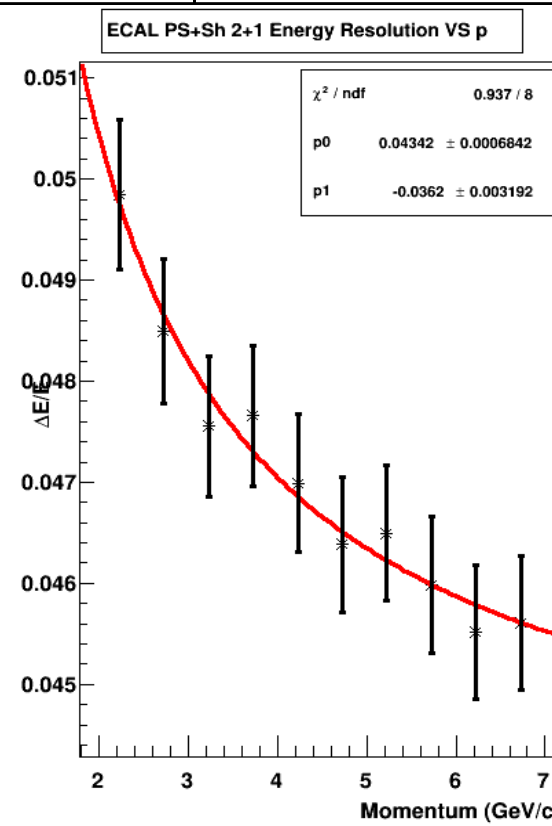
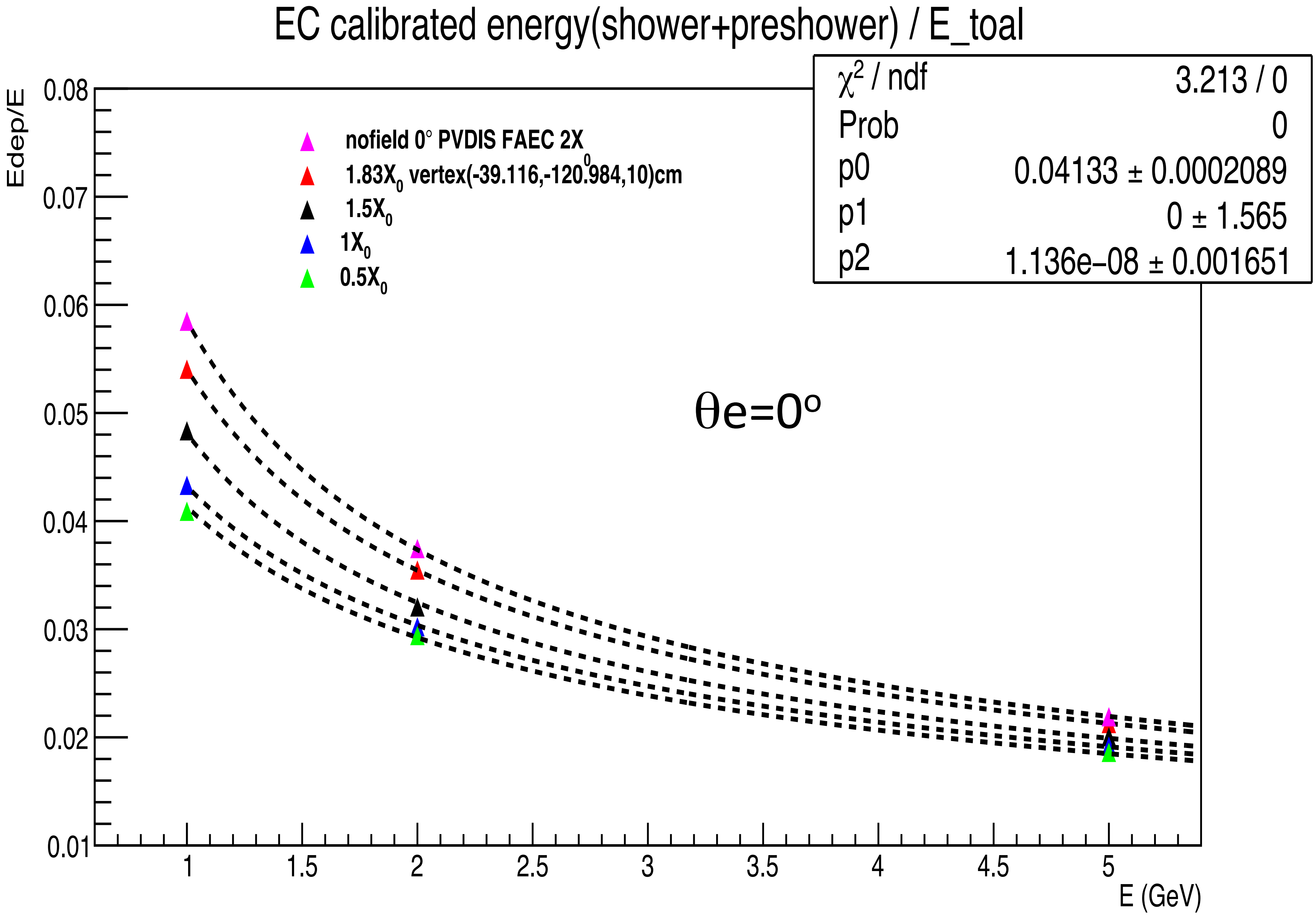


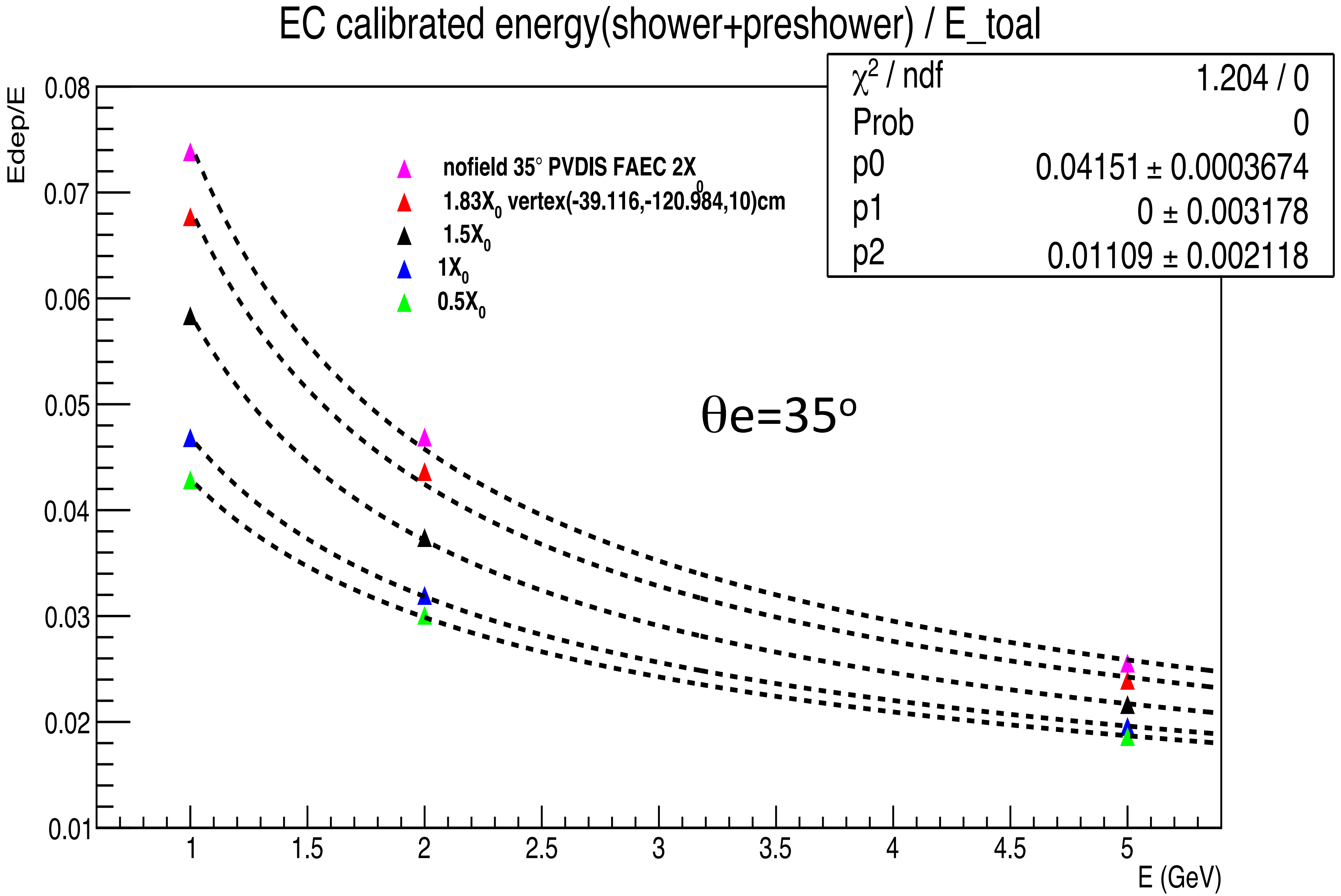




The Dependence of Prelead Width on ECAL Energy Resolution

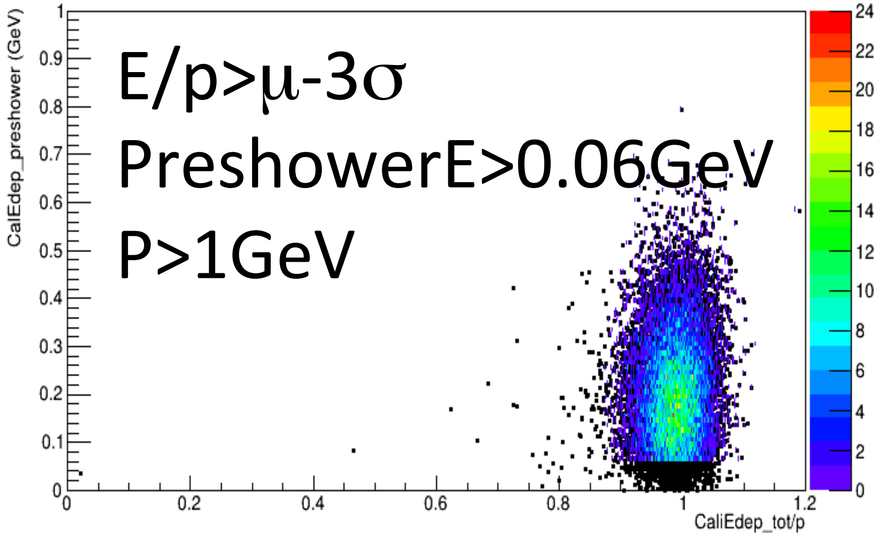


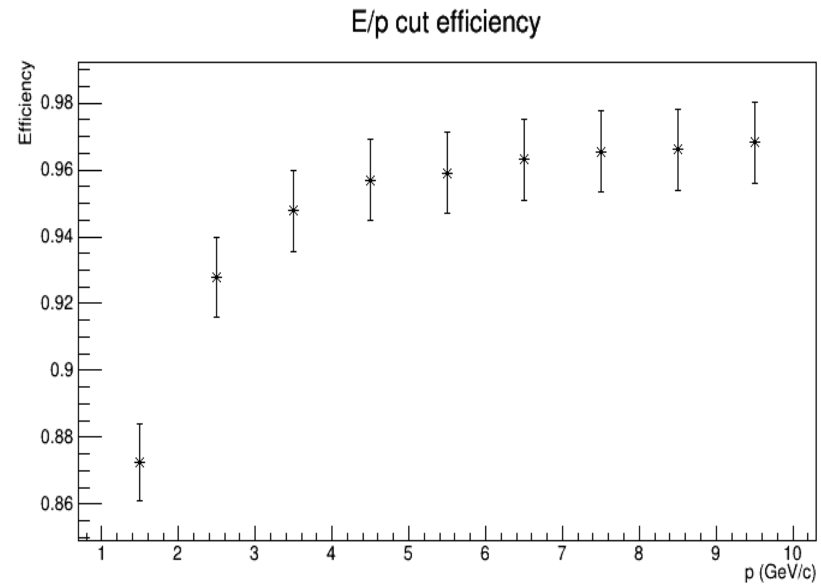
The Dependence of Prelead Width on ECAL Energy Resolution

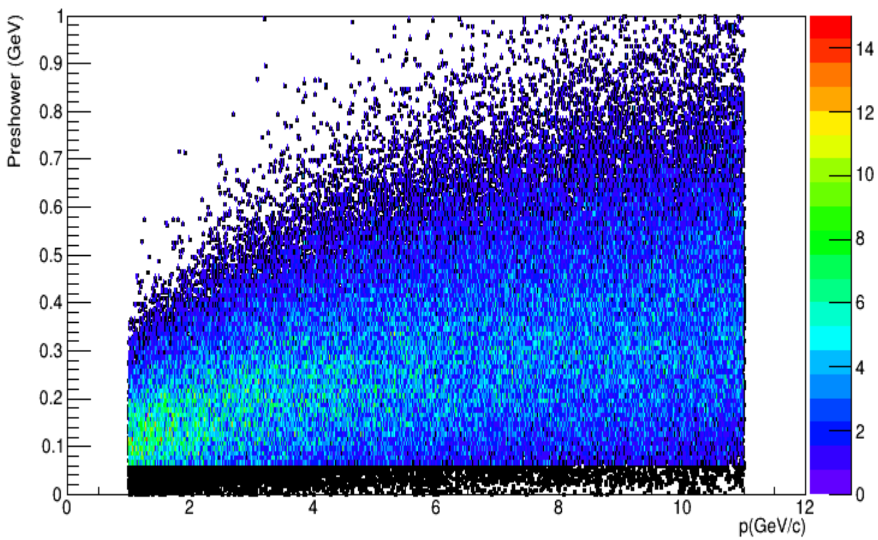


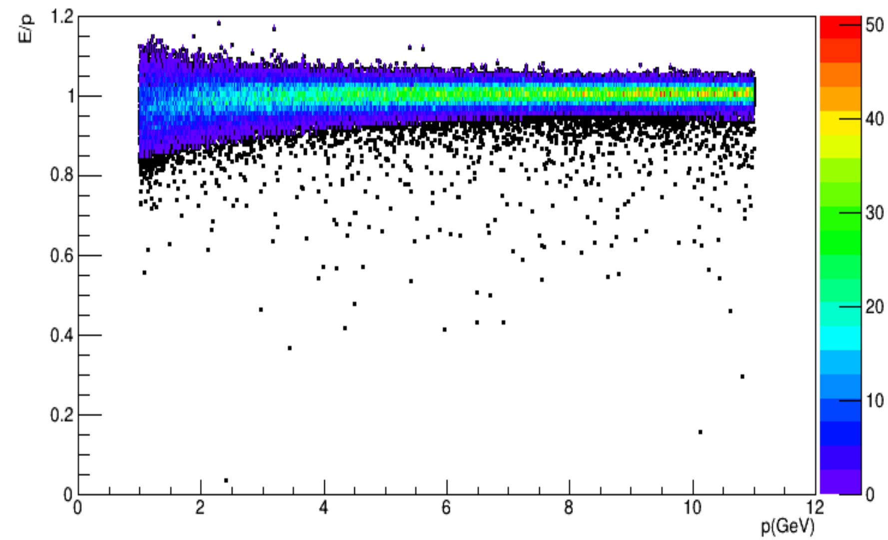
0-11 GeV e- beam, θe [7.5°,14.85°] Energy Calibration SIDIS configuration

Prelead: 2.0X0





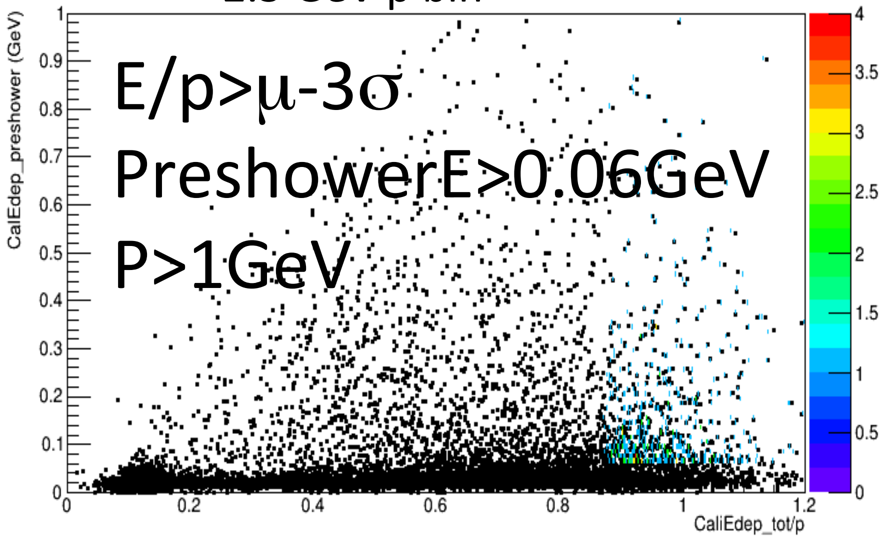


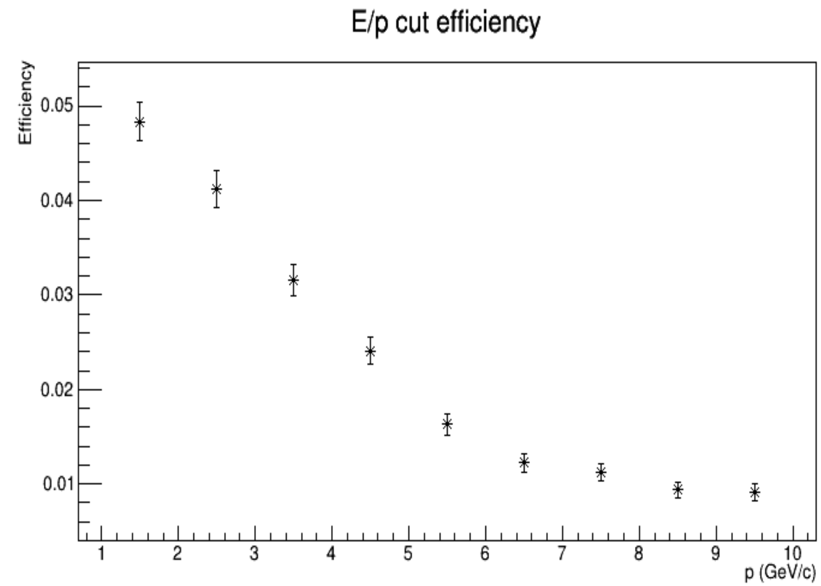


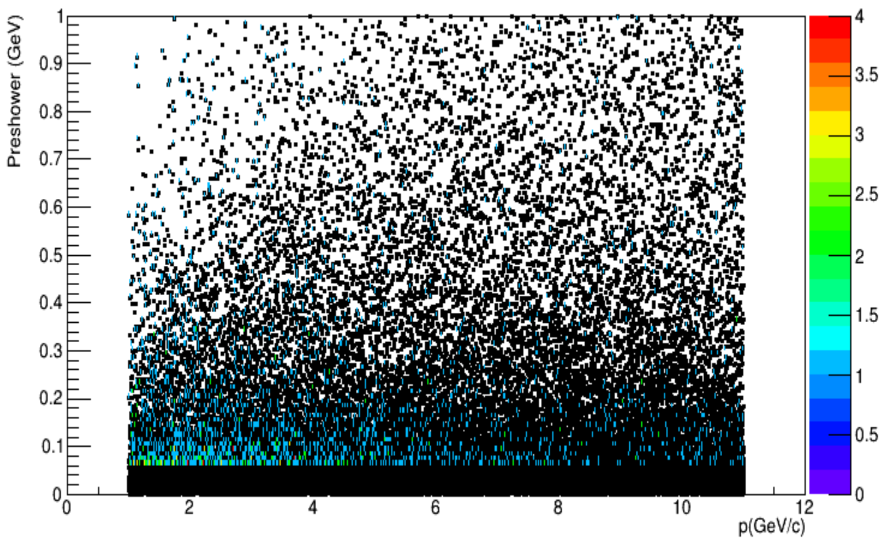
0-11 GeV e- beam, θe [7.5°,14.85°] Energy Calibration SIDIS Configuration

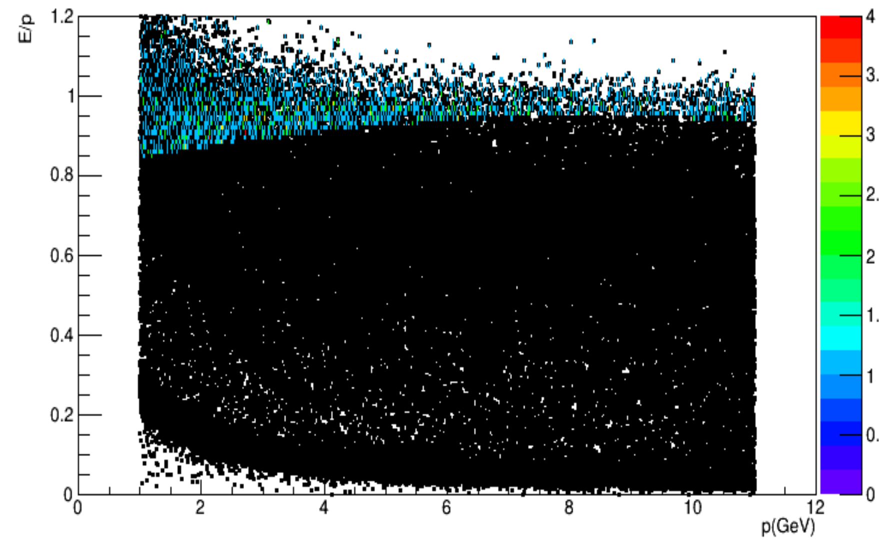
Prelead: 2.0X0

2.5 GeV p bin

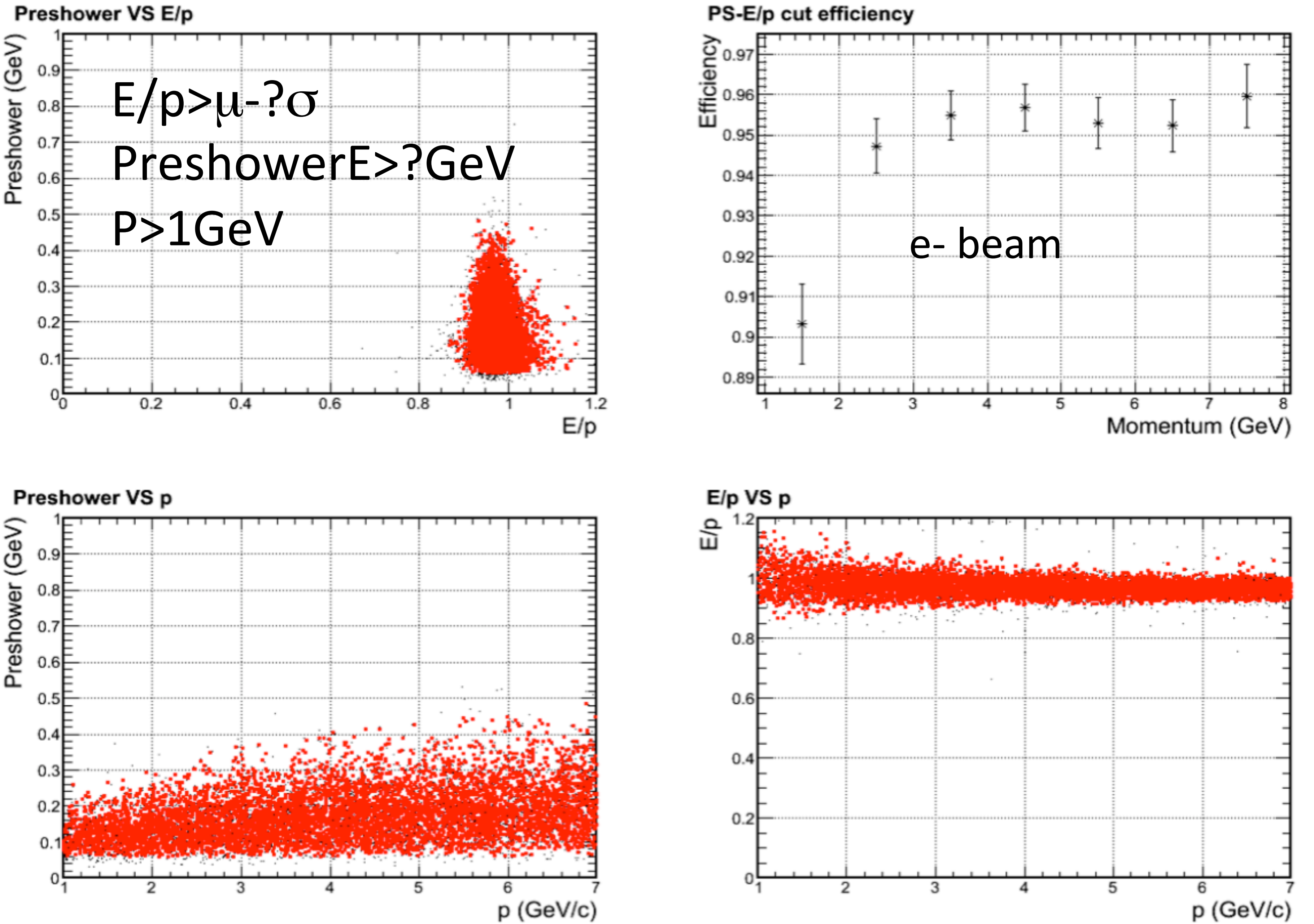




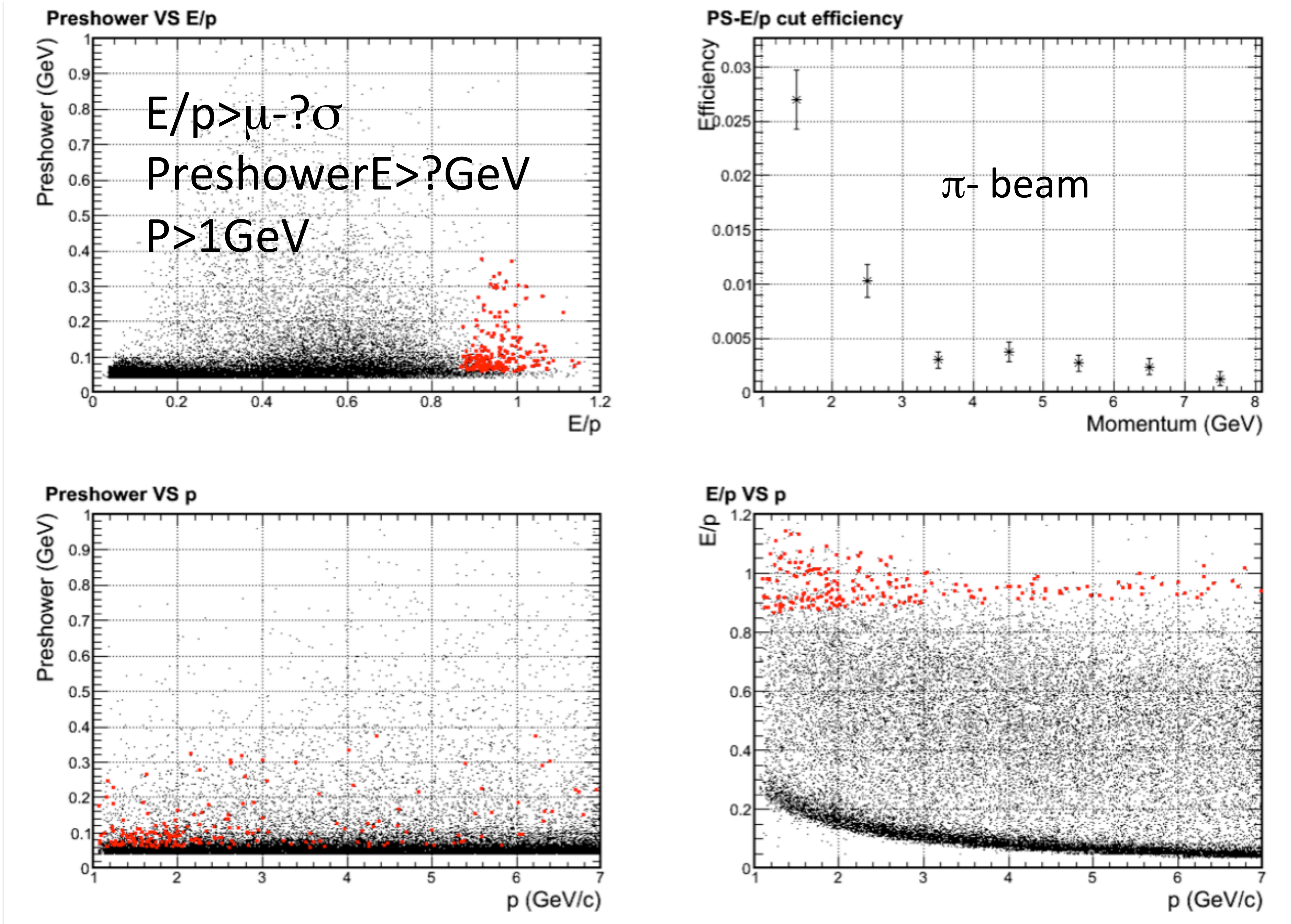




PcDR Jin's Plots

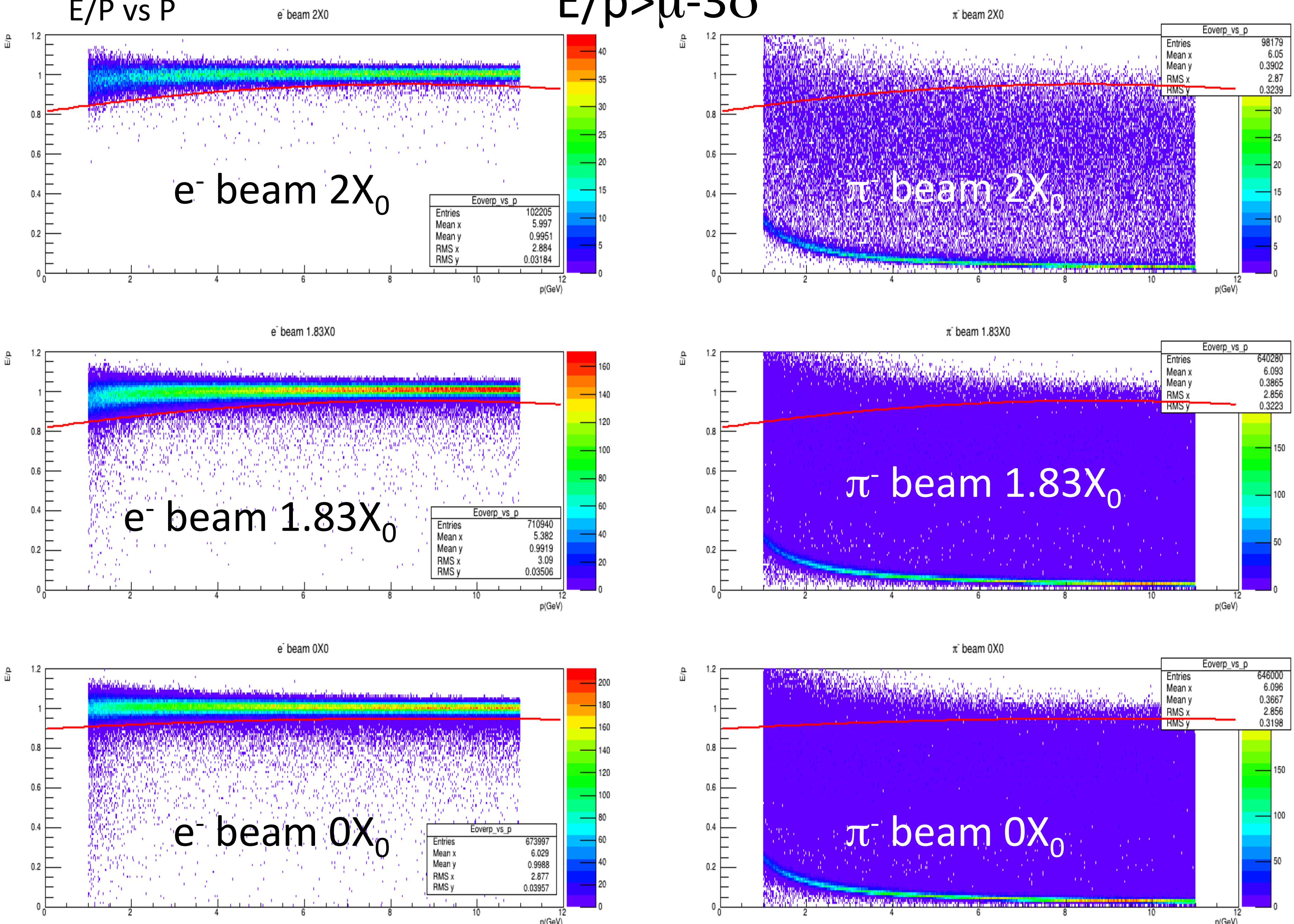


PcDR Jin's Plots

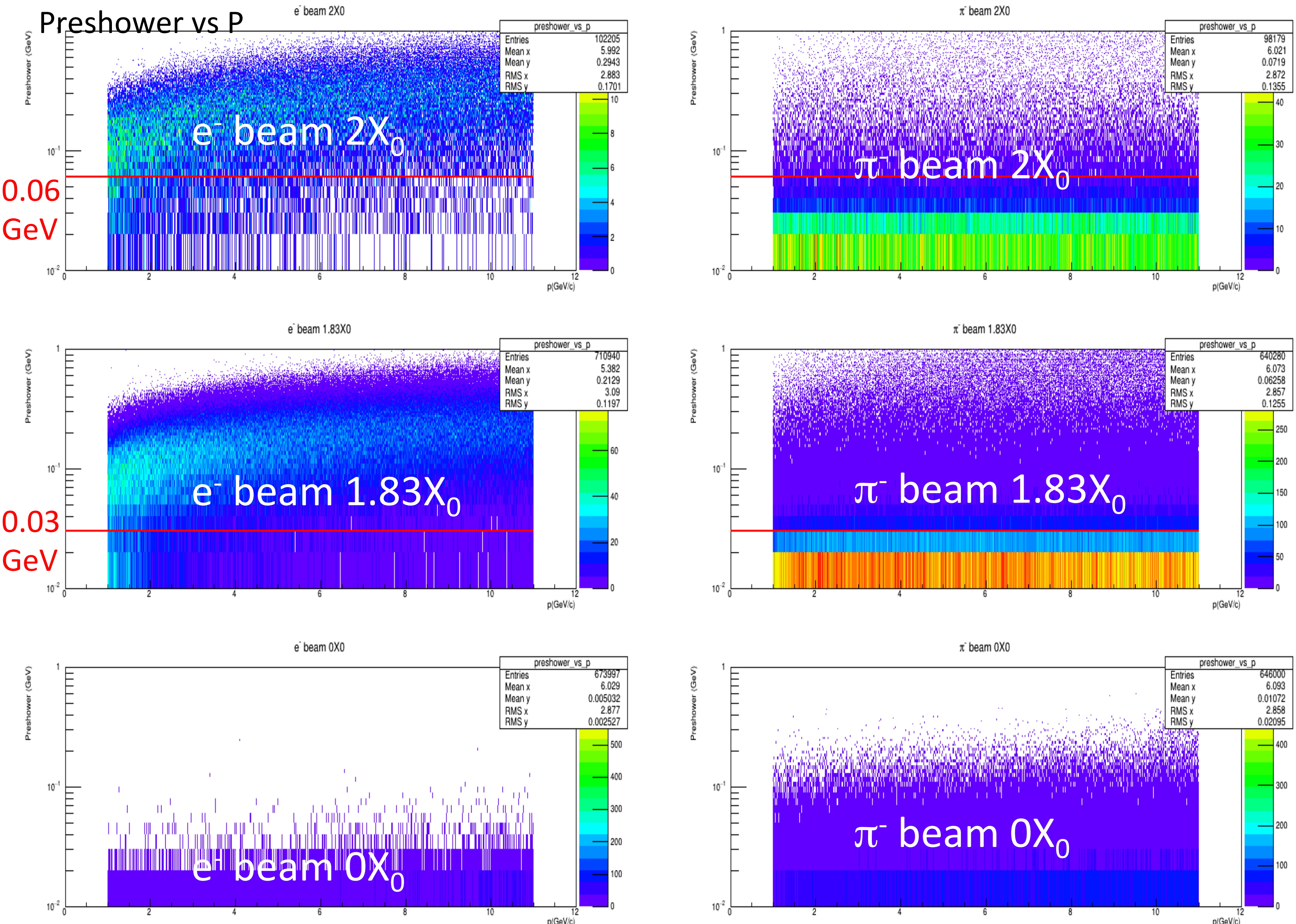


0-11 GeV e- beam, θe [7.5°,14.85°] Calibrated E/P Cuts

$E/p > \mu - 3\sigma$

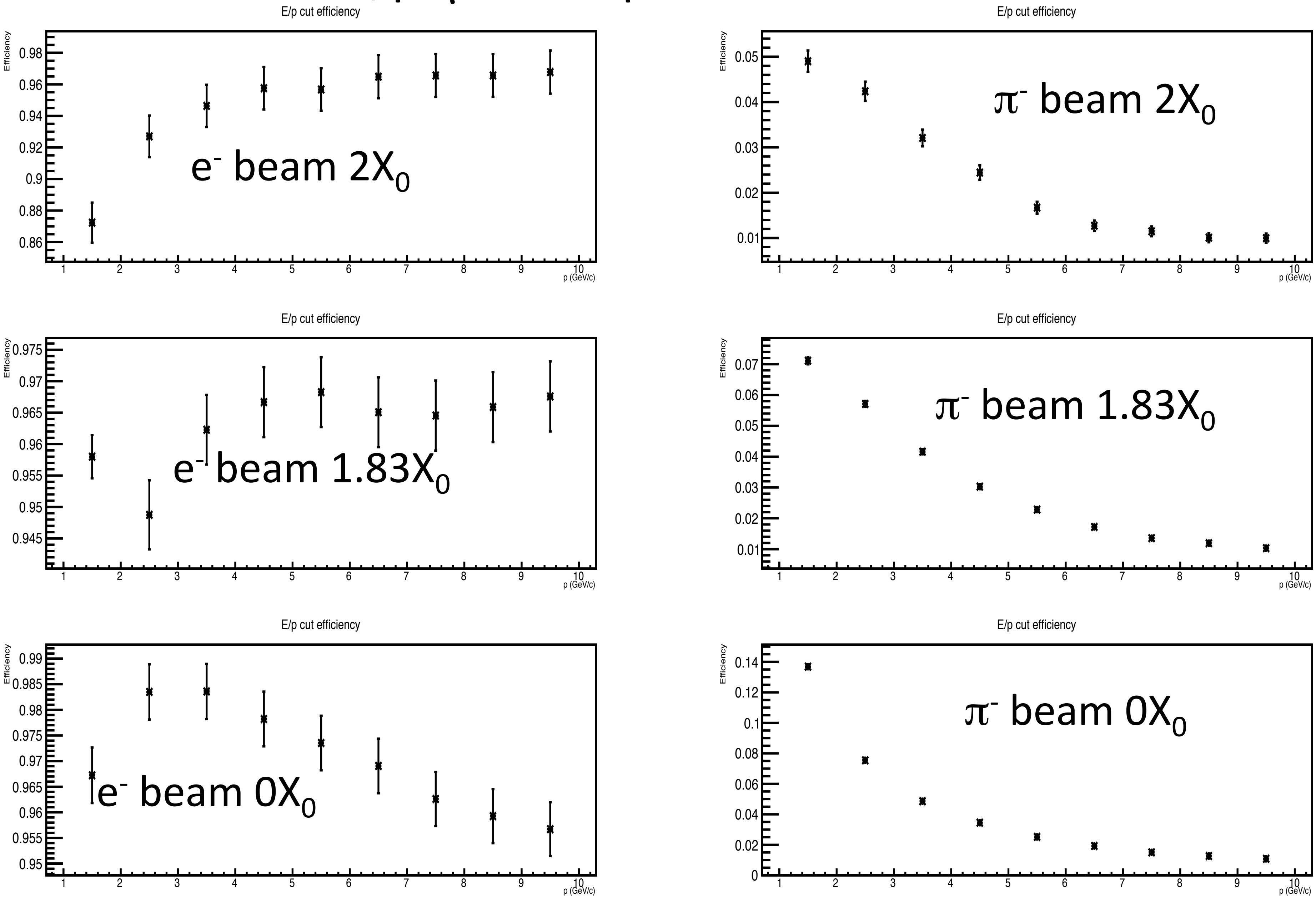


0-11 GeV e- beam, θe [7.5°,14.85°] Calibrated Preshower E Cuts



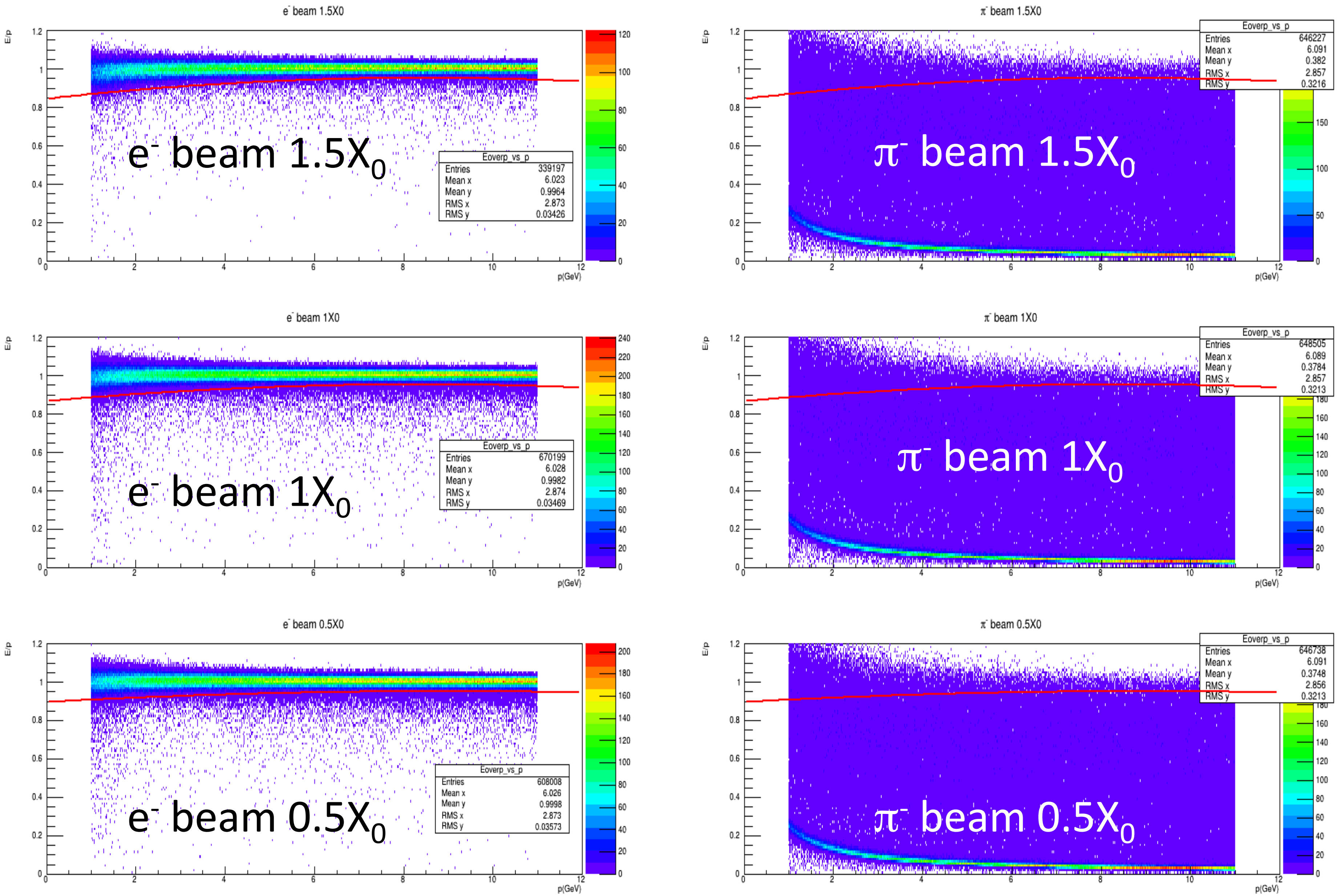
0-11 GeV e- beam, θe [7.5°,14.85°]

E/p>μ-3σ + preshower E cuts

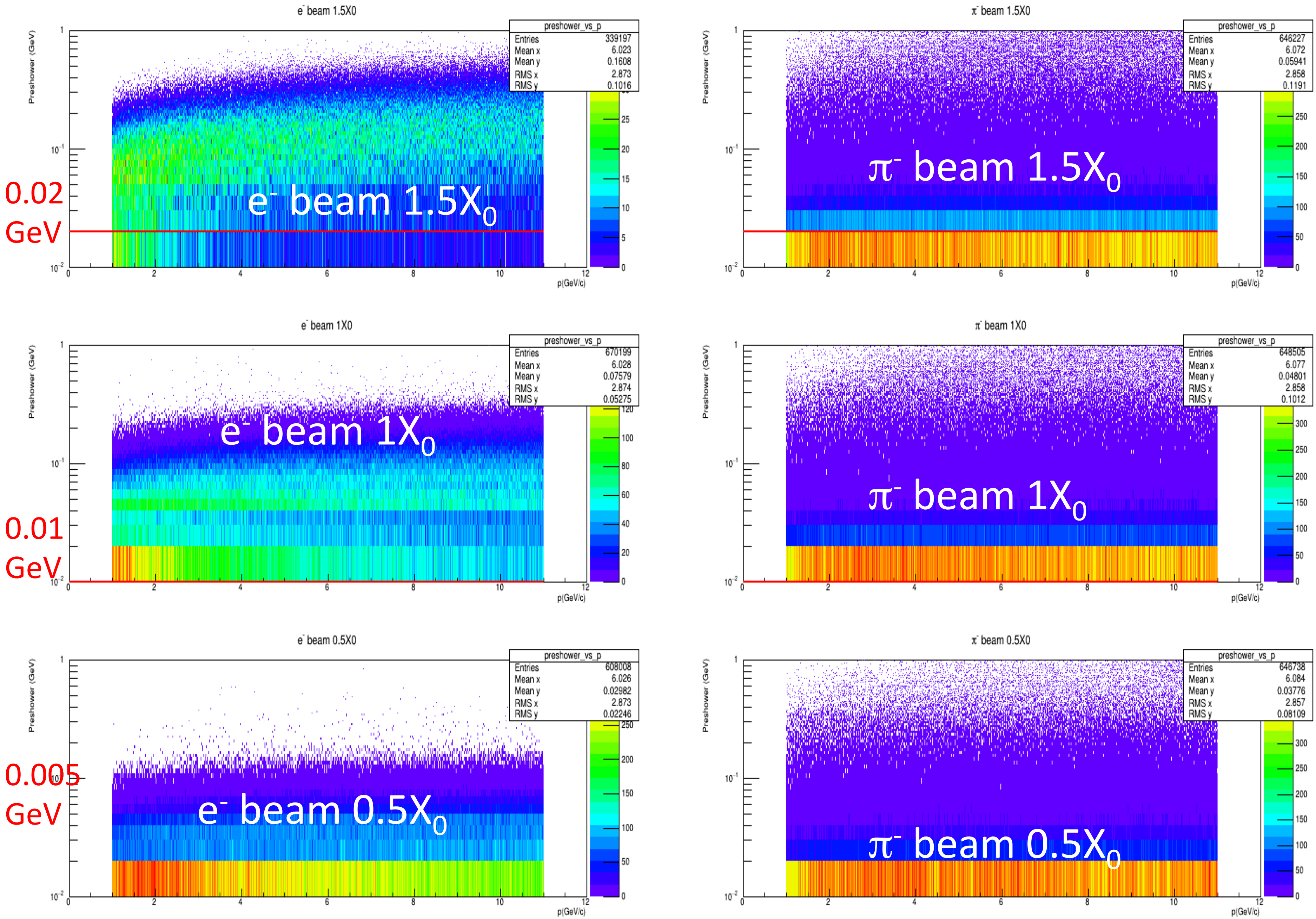


0-11 GeV e- beam, θe [7.5°,14.85°] Calibrated E/P Cuts

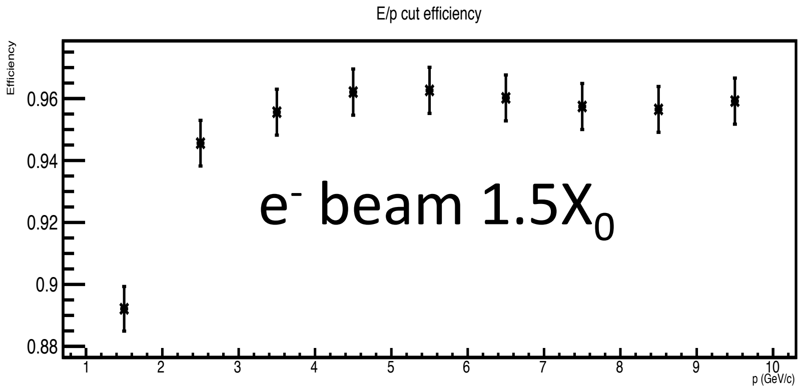
E/p>μ-3σ

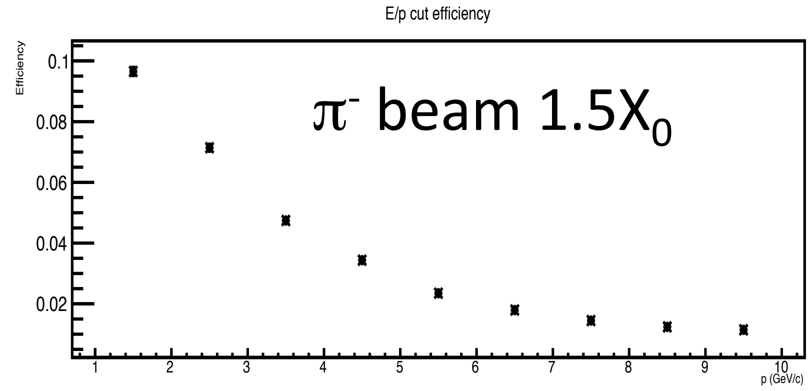


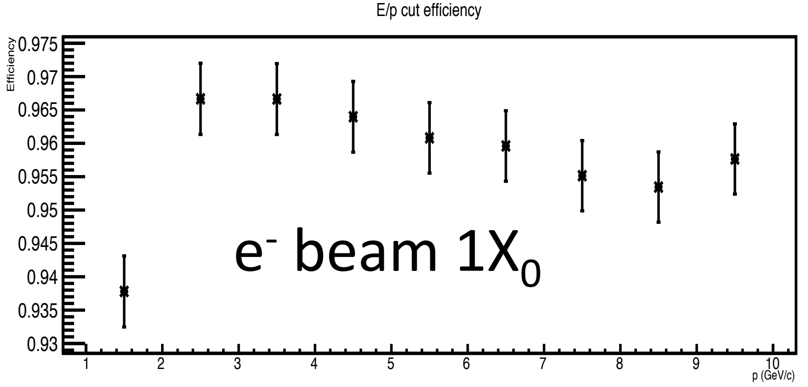
0-11 GeV e- beam, θe [7.5°,14.85°] Calibrated Preshower E Cuts

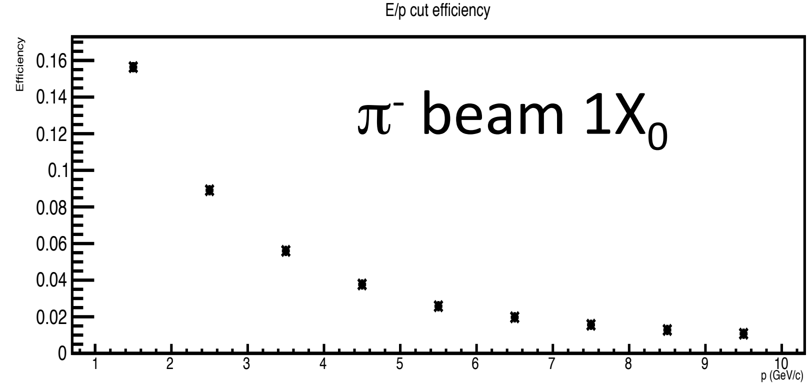


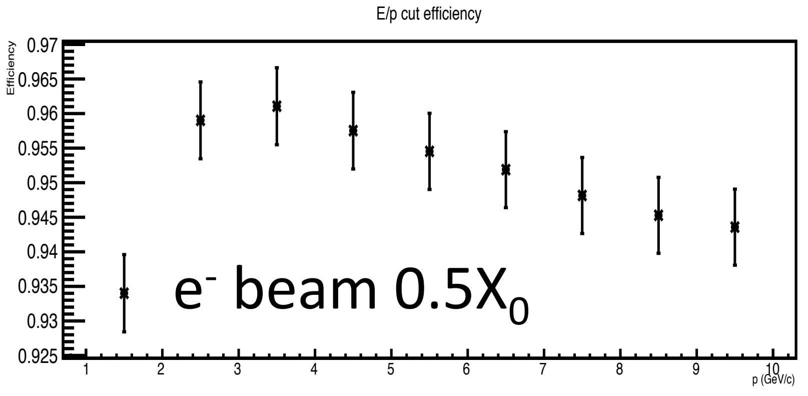
0-11 GeV e- beam, θe [7.5°,14.85°]
E/p>μ-3σ + preshower E cuts

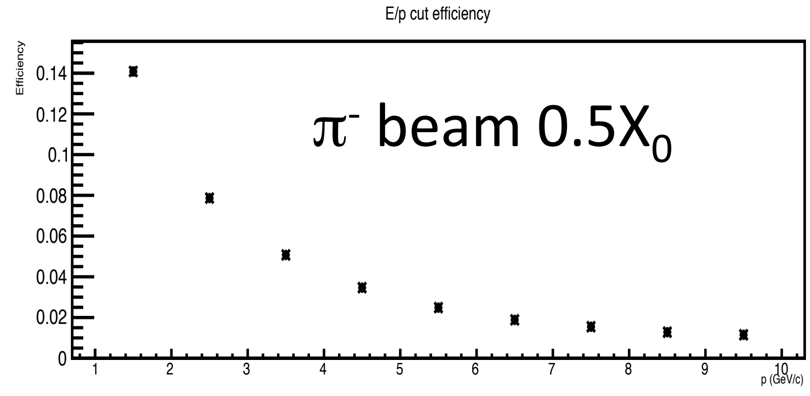












Summary and Outlook

- Without the pre-lead, the ECAL energy resolution is independent of the beam polar angle.

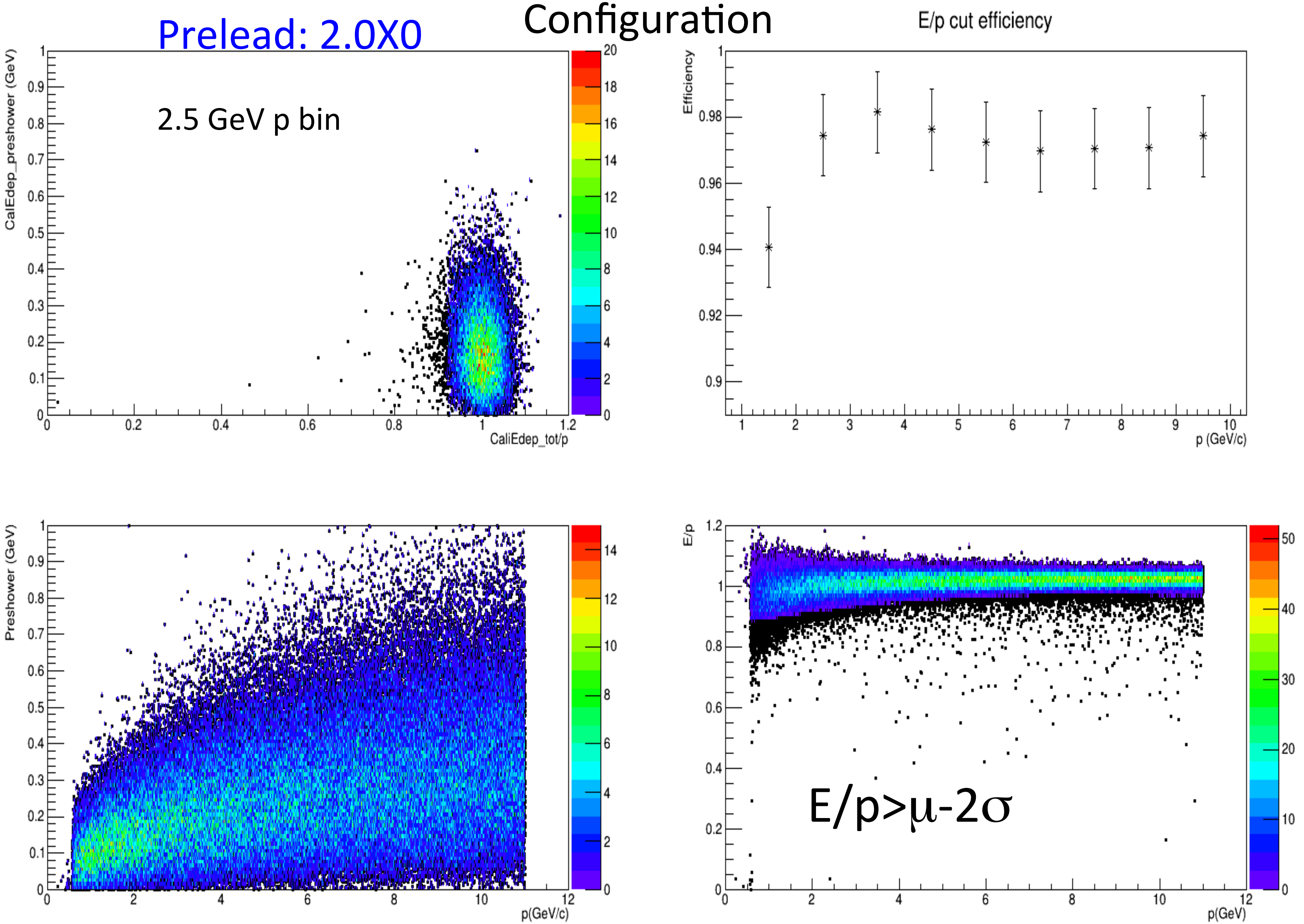
- With the pre-lead, the ECAL energy resolution is worse for the large polar angle, which is more pronounced for increasing the pre-lead width especially at low energy region (1 GeV).

- In order to maximize the π^- rejection, the off-line 3-D PID cuts show that the pre-lead width >1.5X_0 could get better e^-/π^- separation.

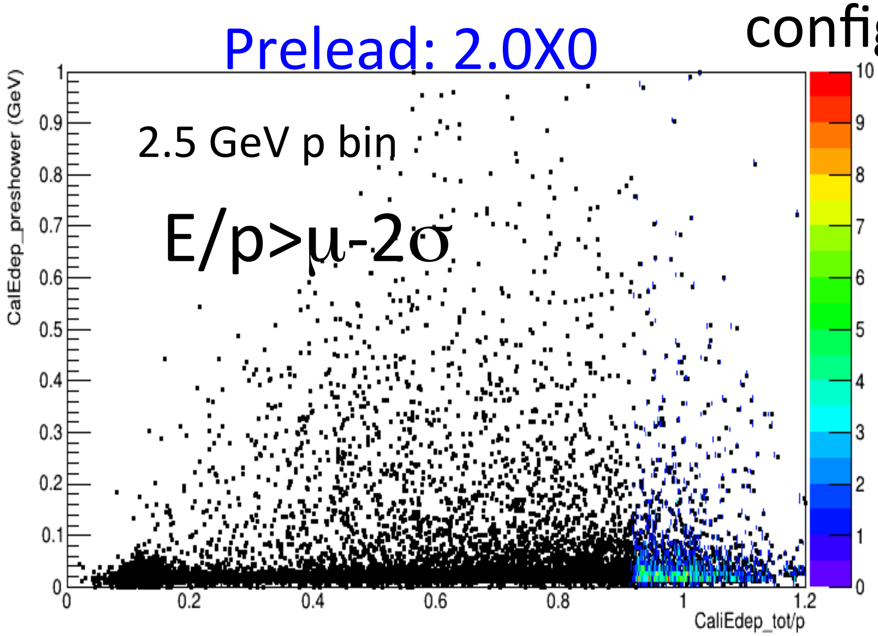
Any comments and suggestions ?

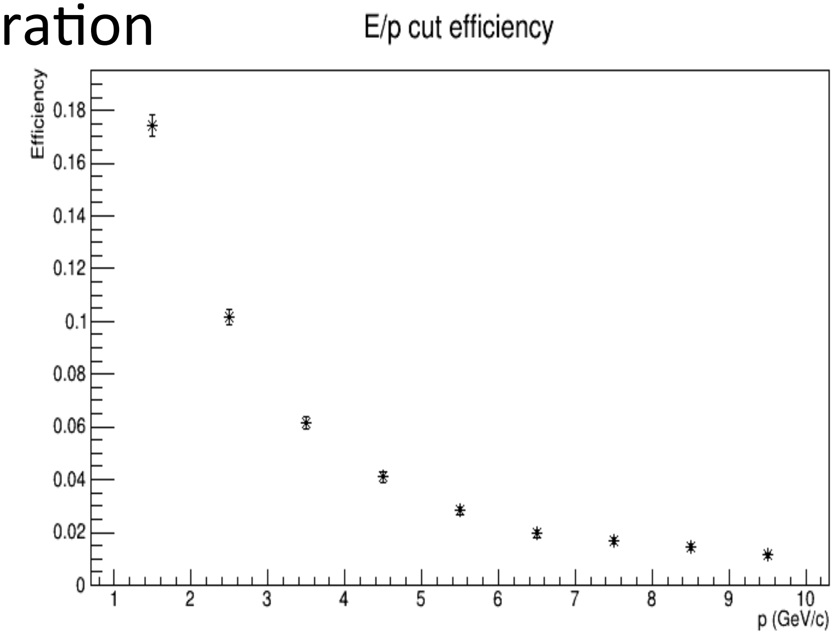
Backup

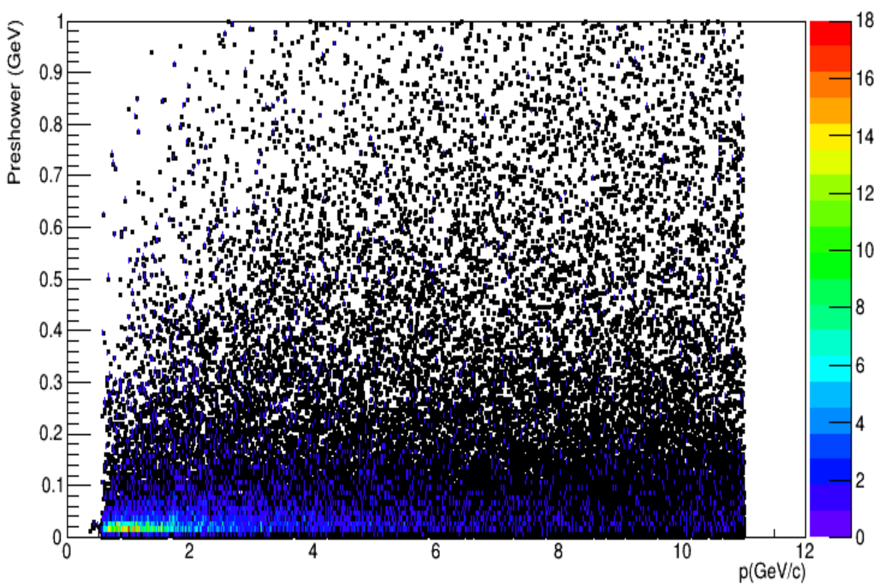
0-11 GeV e- beam, θe [7.5°,14.85°] Energy Calibration SIDIS Configuration

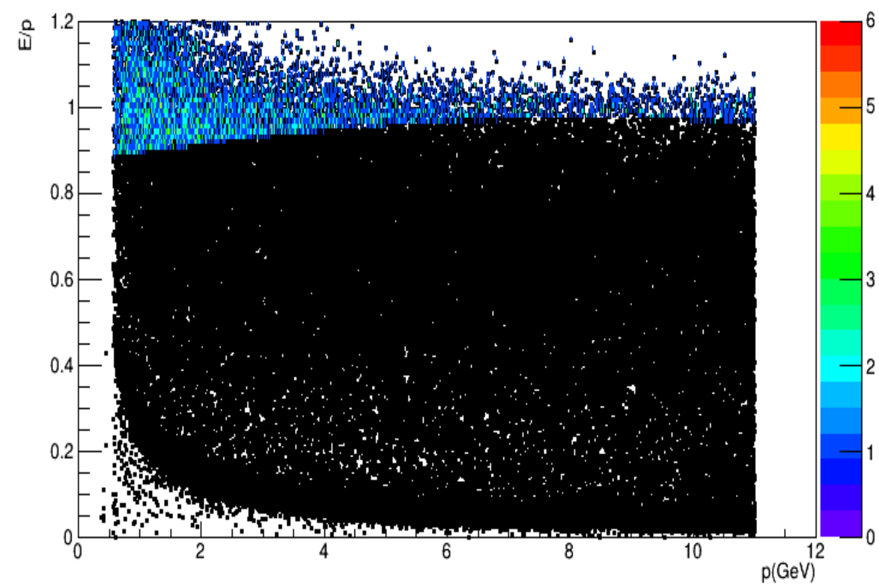


0-11 GeV π- beam, θe [7.5°,14.85°] Energy Calibration SIDIS configuration

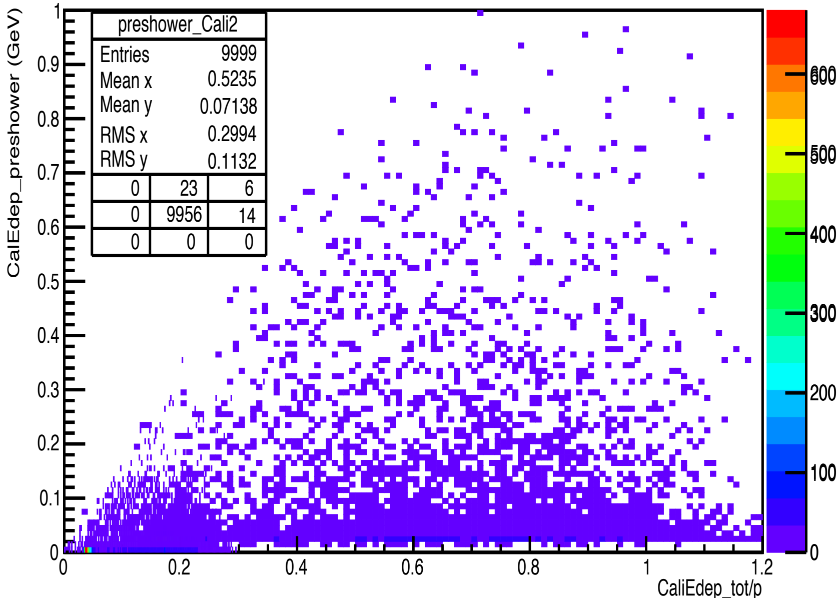


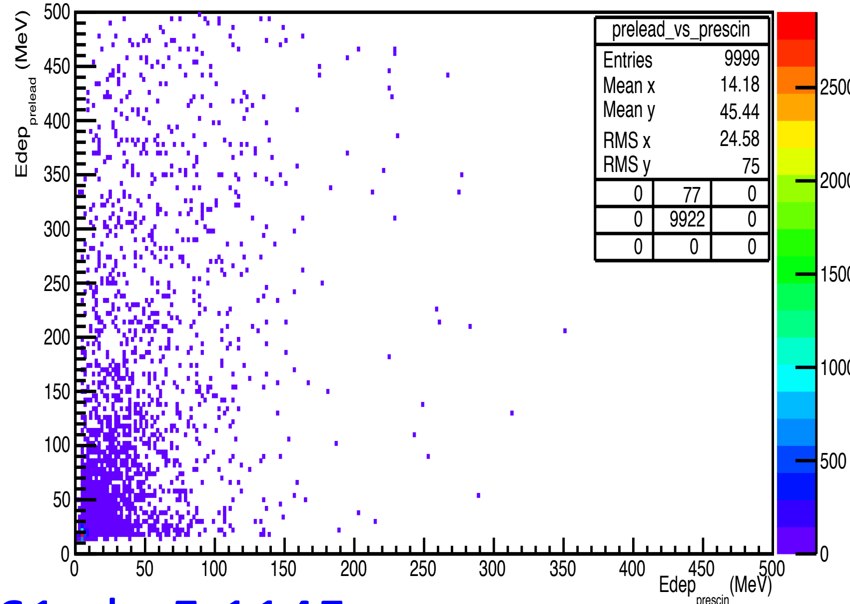






2 GeV π- beam, θe=35°, and vertex (-39.116, -120.984,10)cm Energy Calibration





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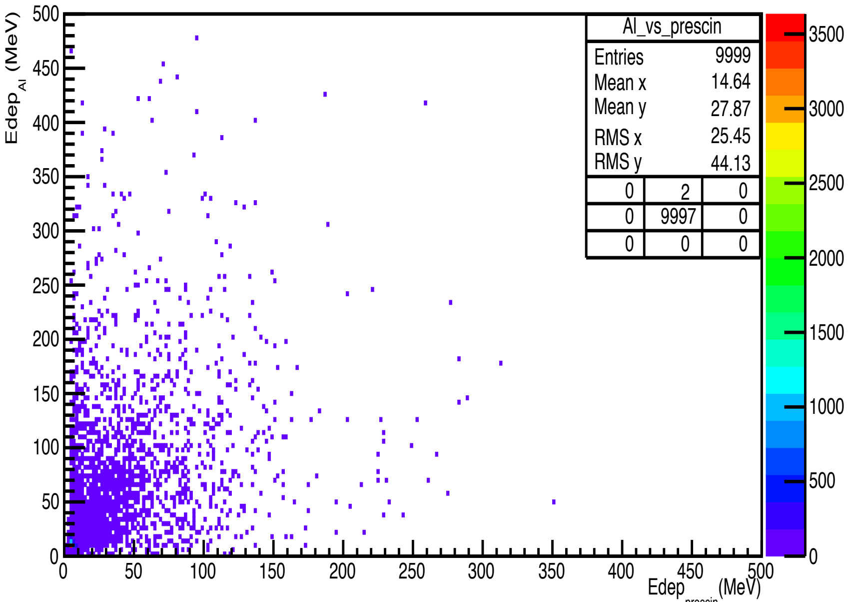
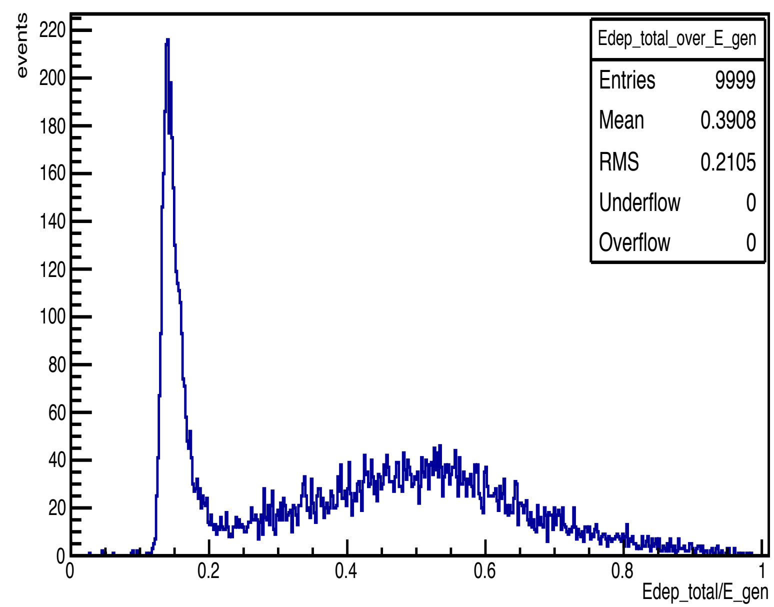
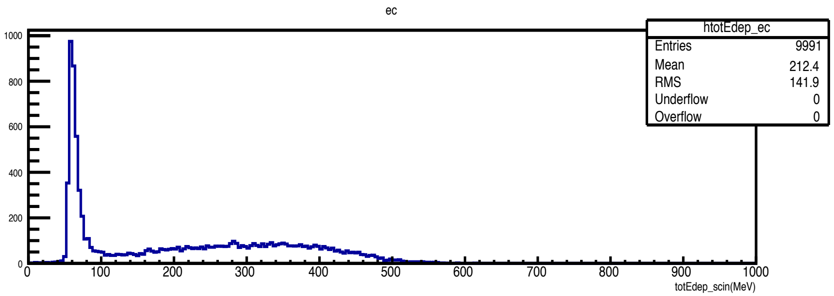
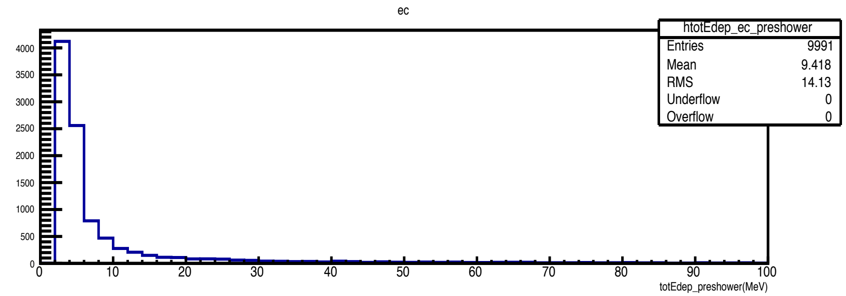
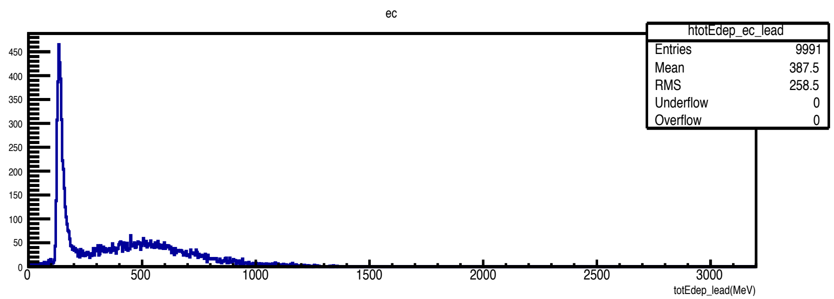


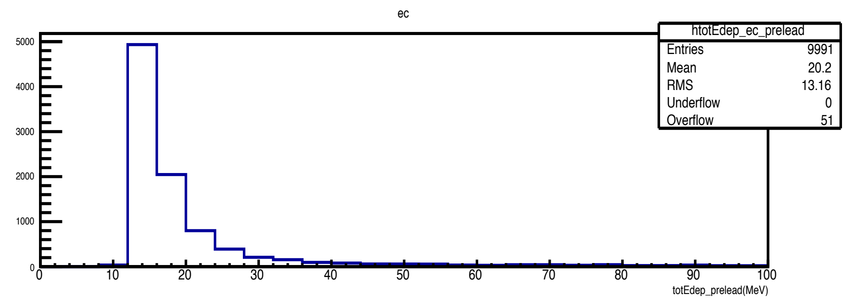


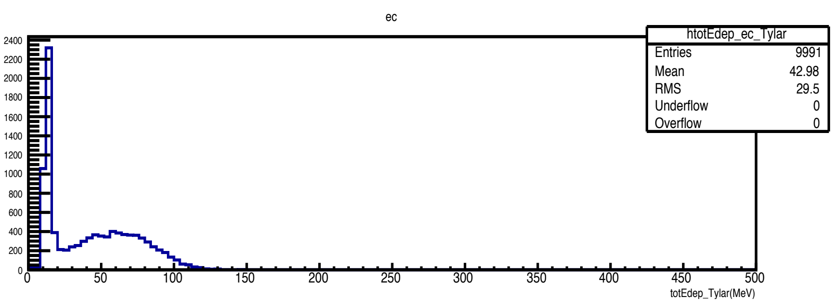
2 GeV π- beam, θe=35°, and vertex (-39.116, -120.984,10)cm Energy Distribution

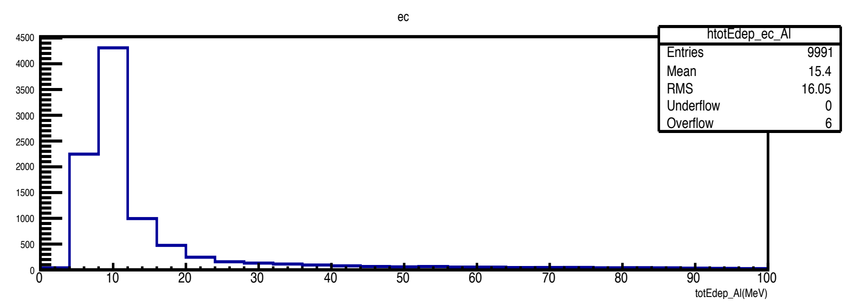


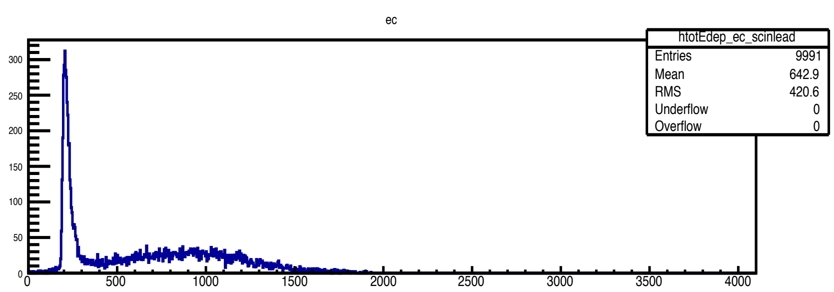


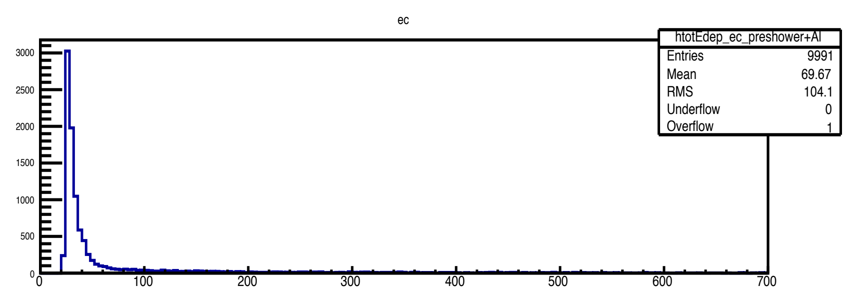




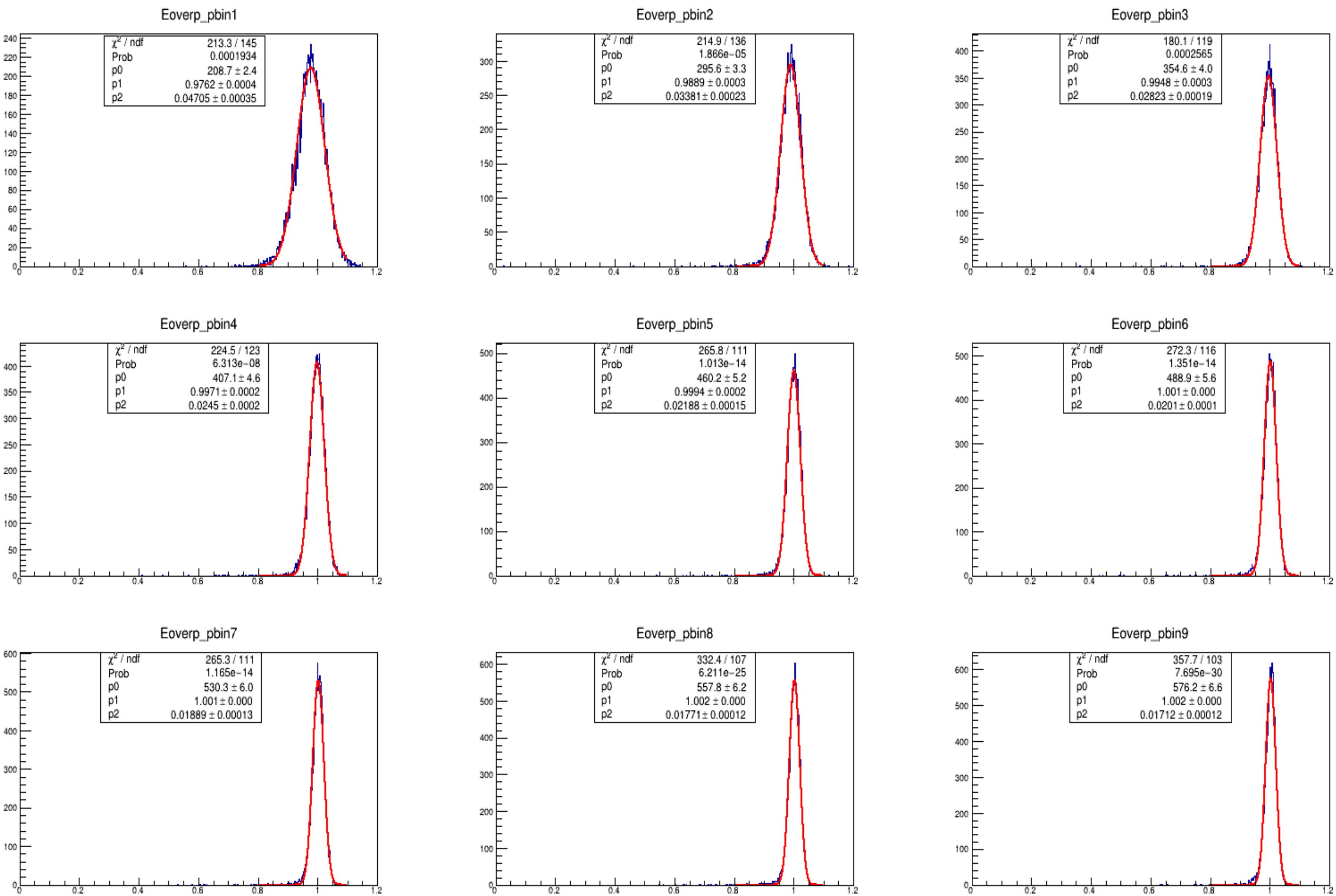






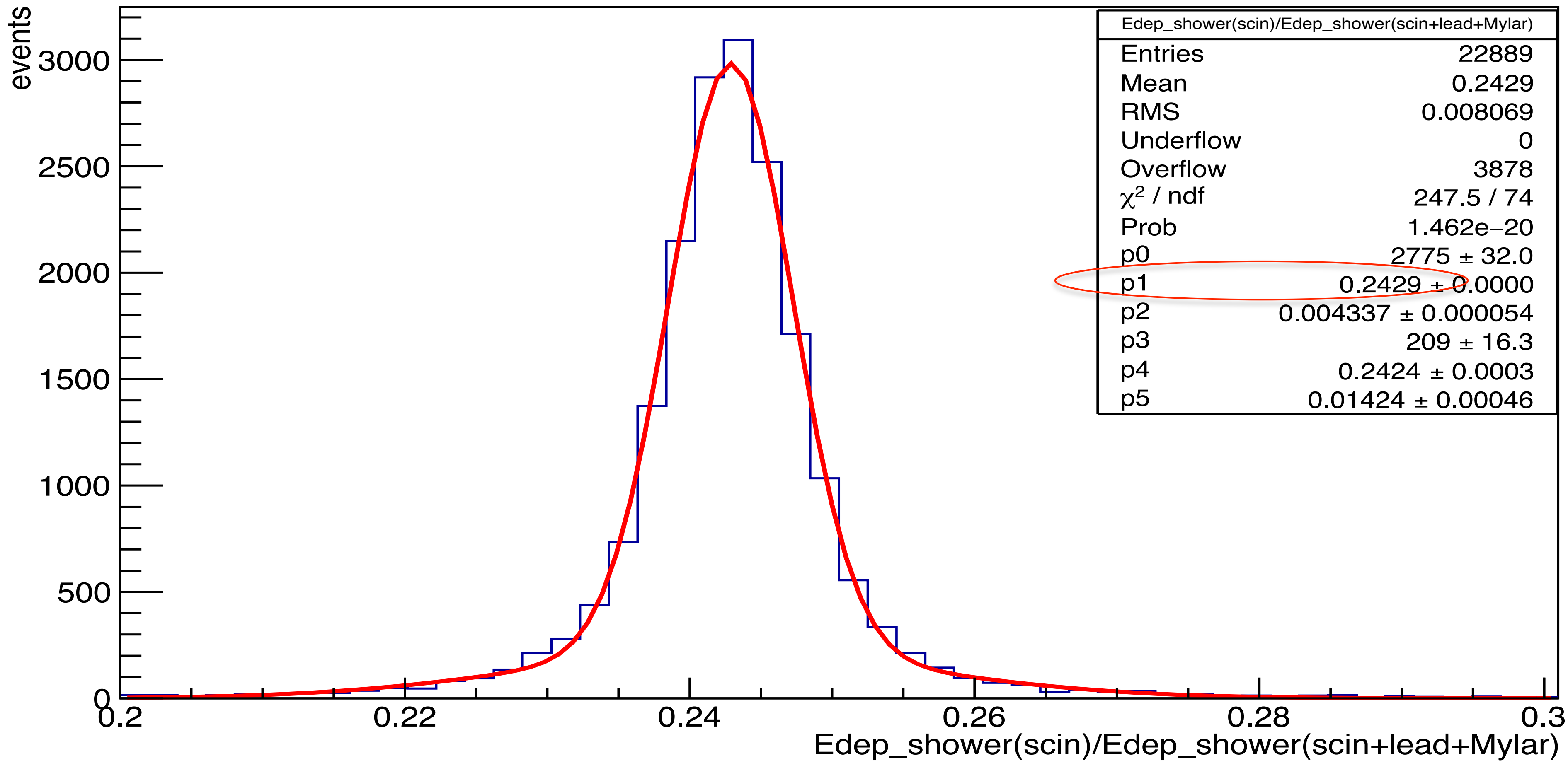


Nine momentum bin Total Calibrated E/p Fit



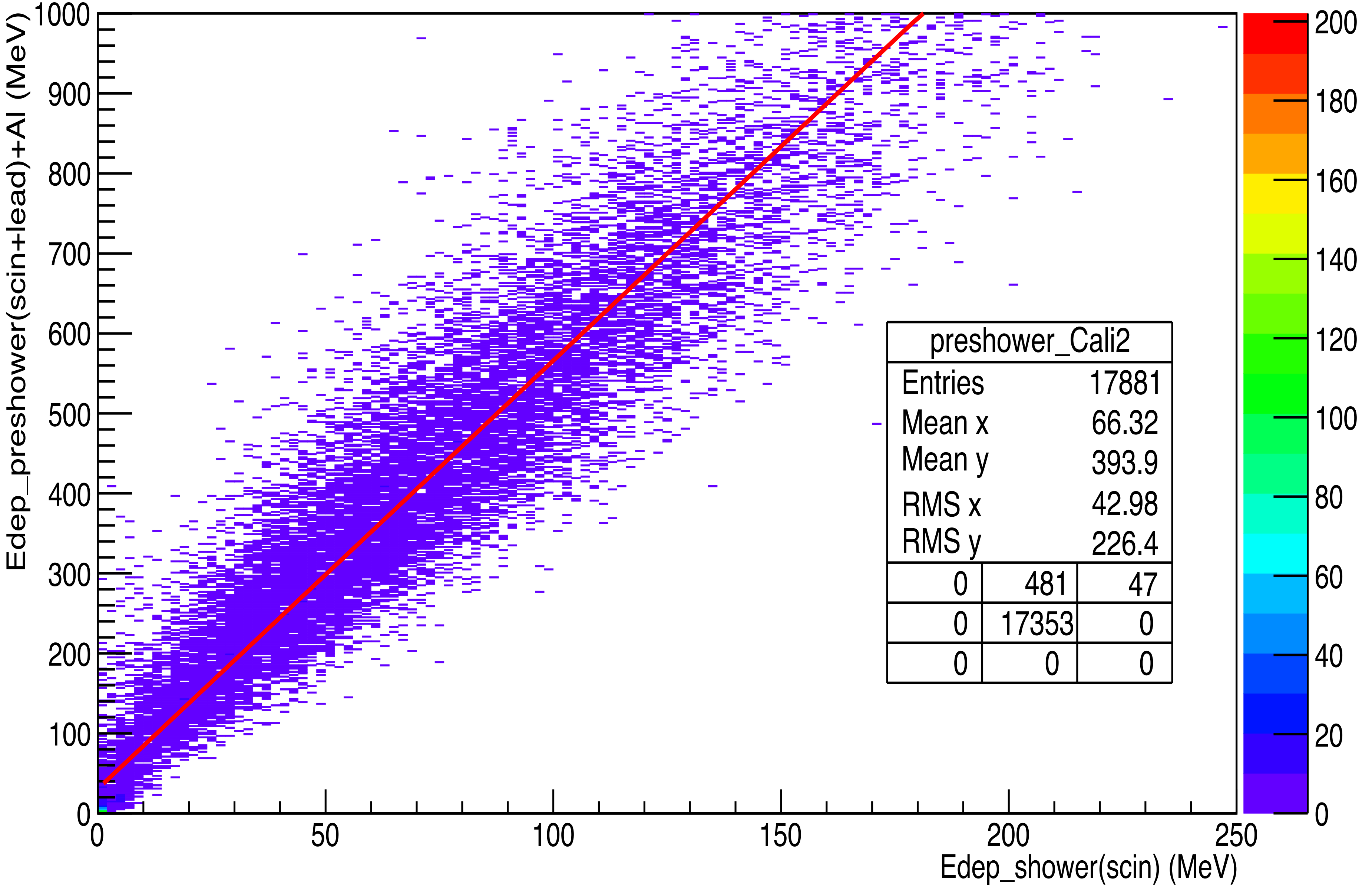
Shower Energy Calibration Old Method

$$E_{shower}^{Correct} = \frac{E_{scint}^{dep}}{0.2429} = 4.117 E_{scint}^{dep}$$

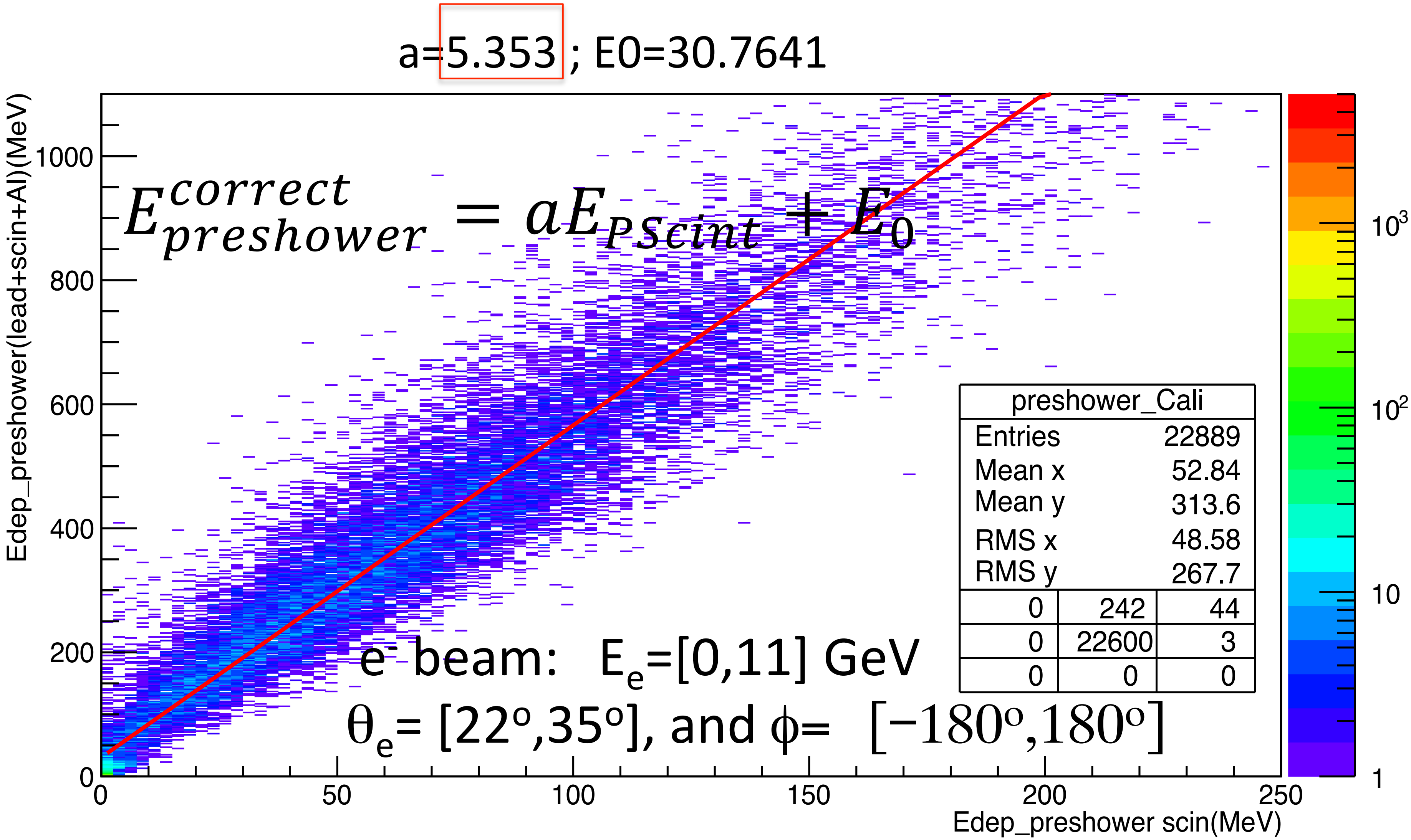


The sampling factor is slightly dependent on the energy, here the factor used to do the following calibration is got from over all energy [0, 11] GeV simulation.

e^- beam: E_e=[0,11] GeV, θ_e= [22°,35°], and ϕ= [−180°,180°]

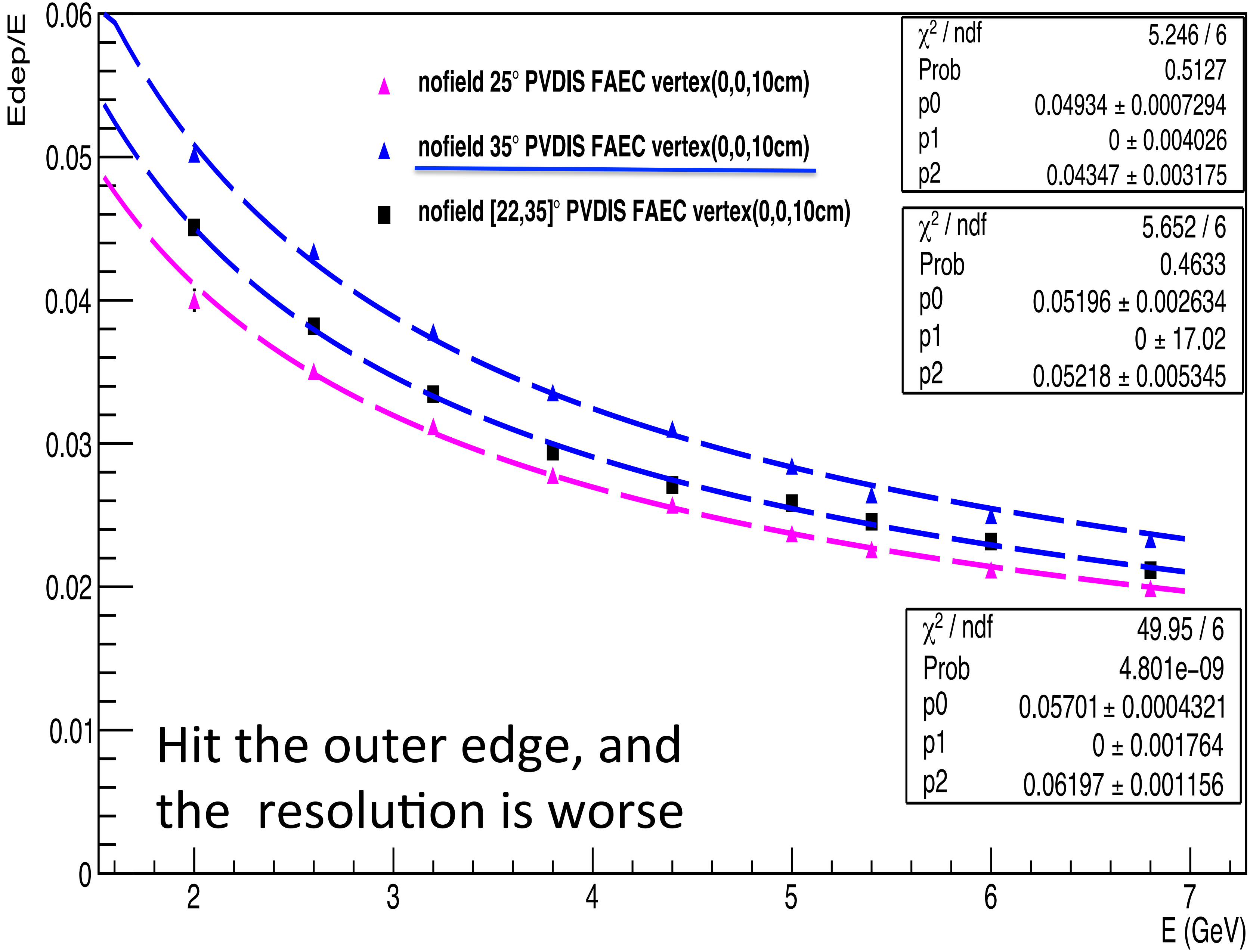


Preshower Energy Calibration Old Method



The coefficients E0 and a of linear correction for given value of absorber thickness in the first approximation are not dependent on the energy

EC calibrated energy(shower+preshower) / E_toal



Energy Leak comparison