ECAL Summary 5
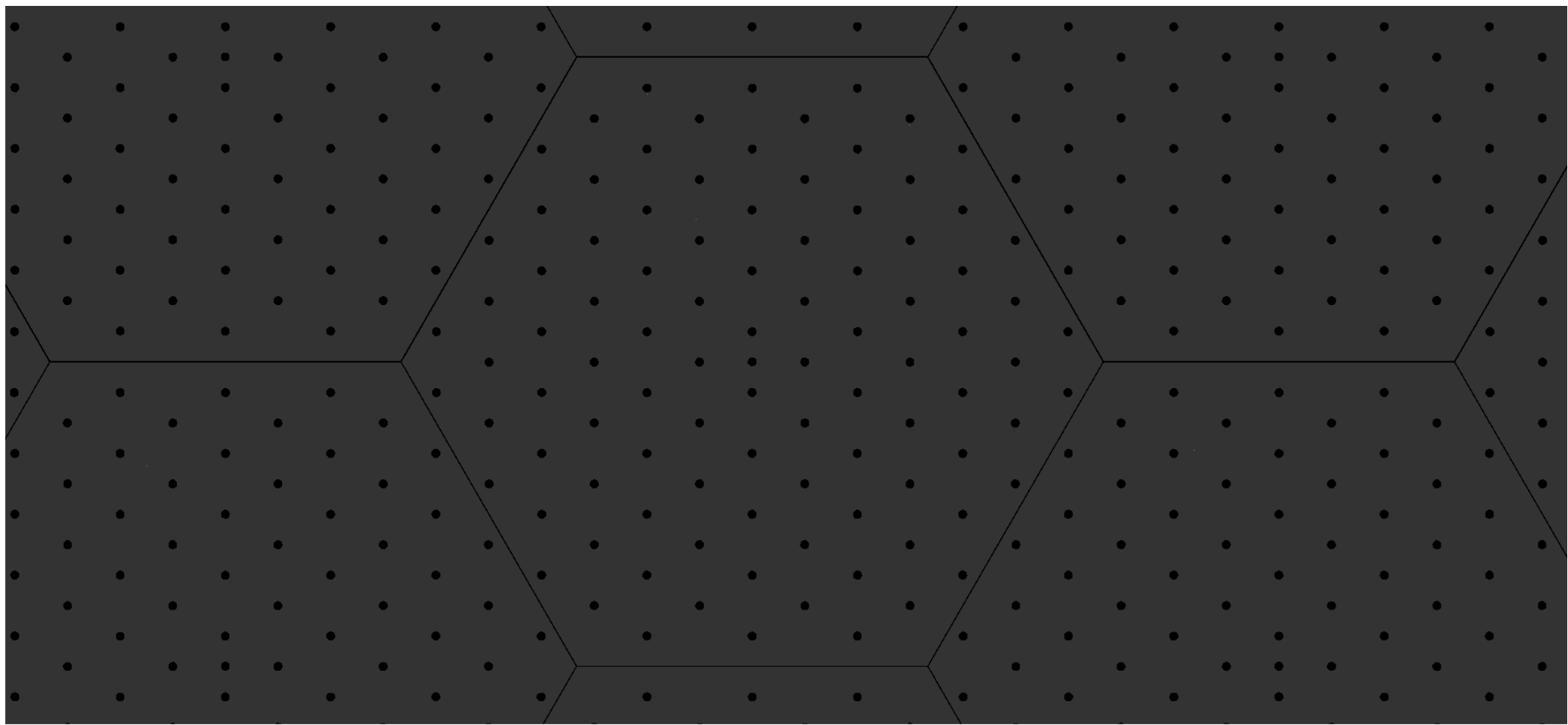
ECAL Energy Resolution Update

Fiber Holes in the G4 Geometry
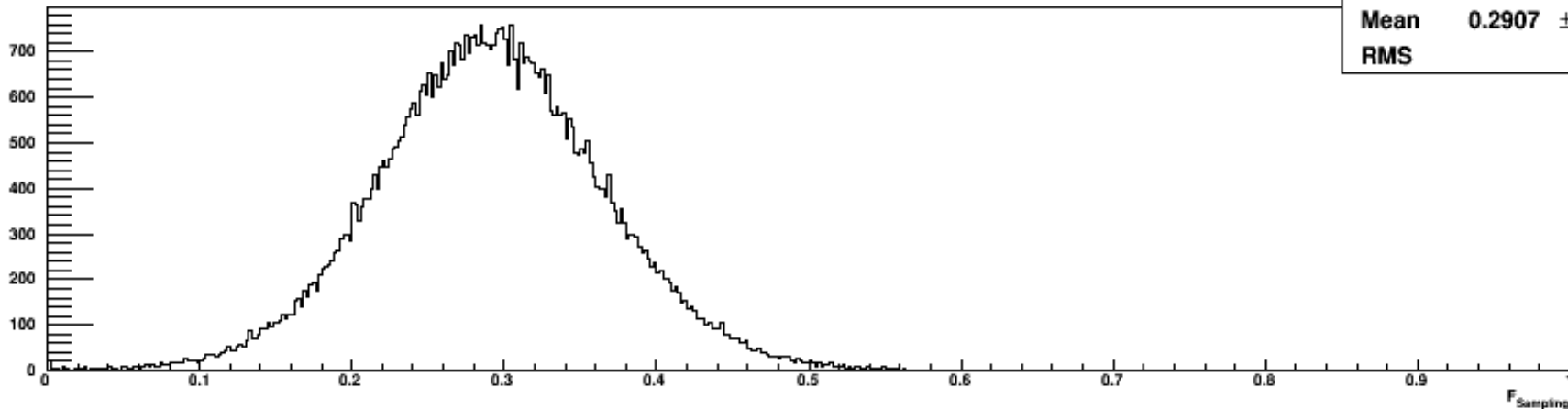
With No Holes : Sampling Fraction

Rakitha Beminiwattha

Update to Analysis

9% Increase in shower sampling fraction
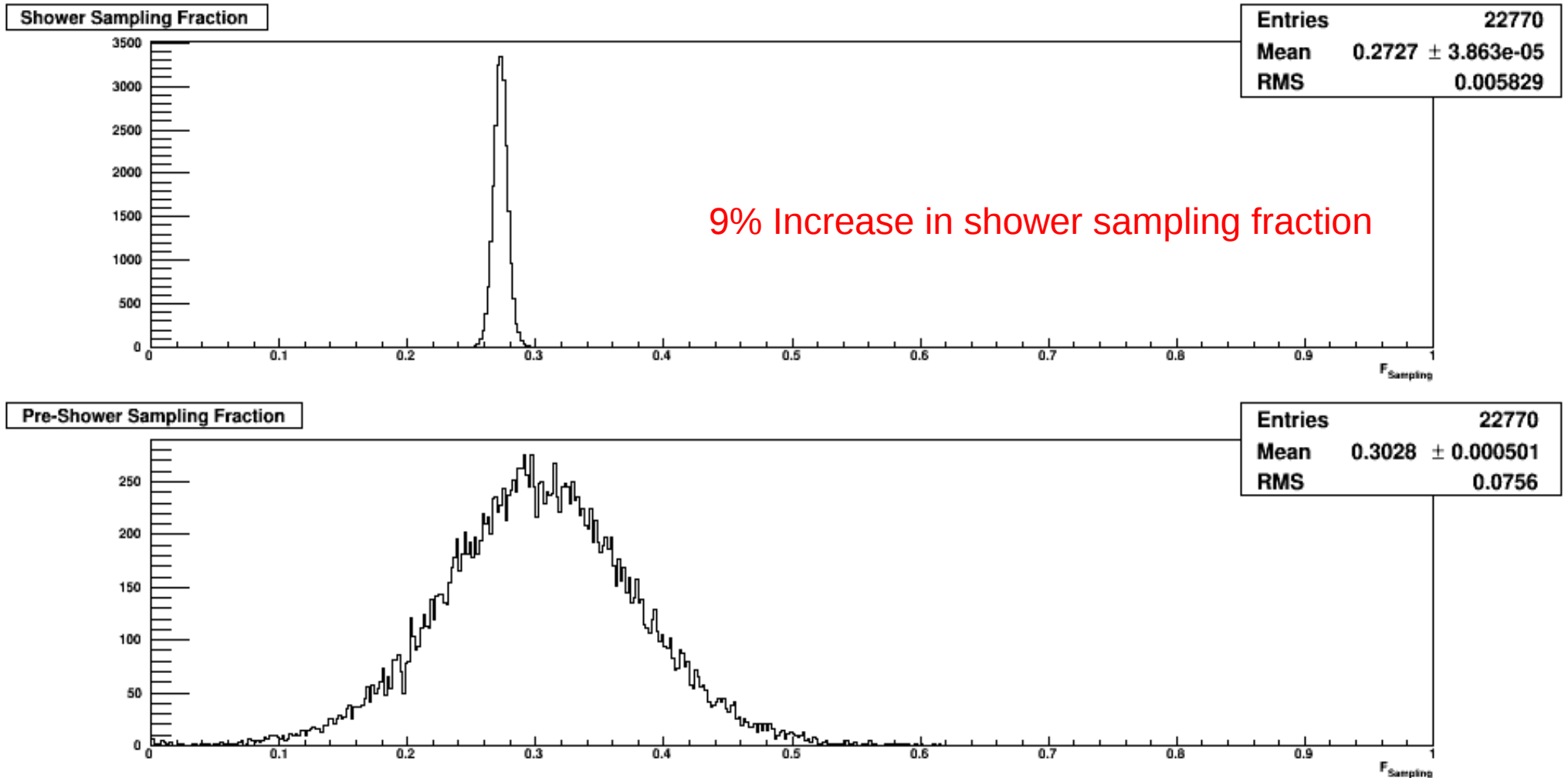
Intrinsic ECAL Energy Resolution : No Holes

Based on calibrated energy deposit in the ECAL
using sampling fractions for Shower and Pre-Shower

Rakitha Beminiwattha

Intrinsic ECAL Energy Resolution : No Holes

From Total Energy on ECAL		
Pf (GeV)	Resolution	Error
2.23	0.037	0.001
2.73	0.035	0.001
3.23	0.033	0.001
3.73	0.032	0.0005
4.23	0.030	0.0005
4.73	0.028	0.0004
5.23	0.027	0.0004
5.73	0.026	0.0004
6.23	0.025	0.0004
6.73	0.024	0.0004

From 6+1 Clusters		
Pf (GeV)	Resolution	Error
2.23	0.037	0.0006
2.73	0.035	0.0005
3.23	0.034	0.0005
3.73	0.033	0.0005
4.23	0.031	0.0005
4.73	0.030	0.0004
5.23	0.029	0.0004
5.73	0.028	0.0004
6.23	0.027	0.0004
6.73	0.026	0.0004

From 2+1 Clusters		
Pf (GeV)	Resolution	Error
2.23	0.050	0.001
2.73	0.048	0.001
3.23	0.048	0.001
3.73	0.048	0.001
4.23	0.047	0.001
4.73	0.046	0.001
5.23	0.046	0.001
5.73	0.046	0.001
6.23	0.046	0.001
6.73	0.046	0.001

Intrinsic ECAL Energy Resolution : With Fiber Holes

Based on calibrated energy deposit in the ECAL
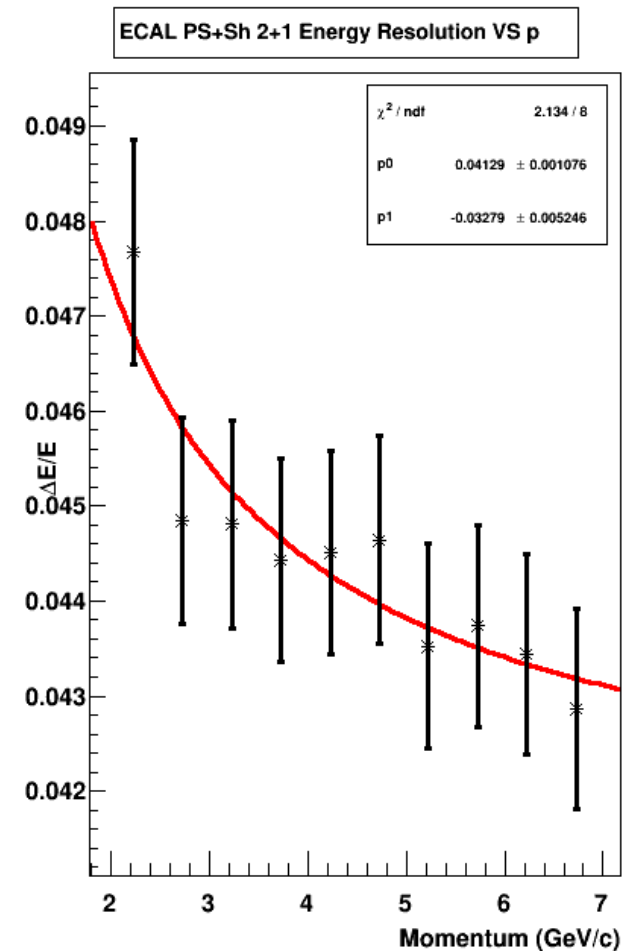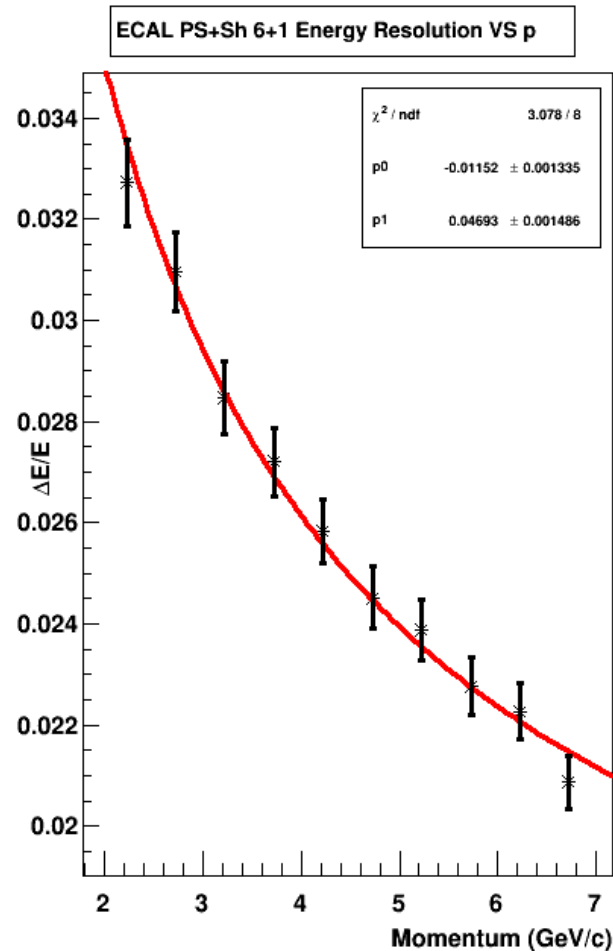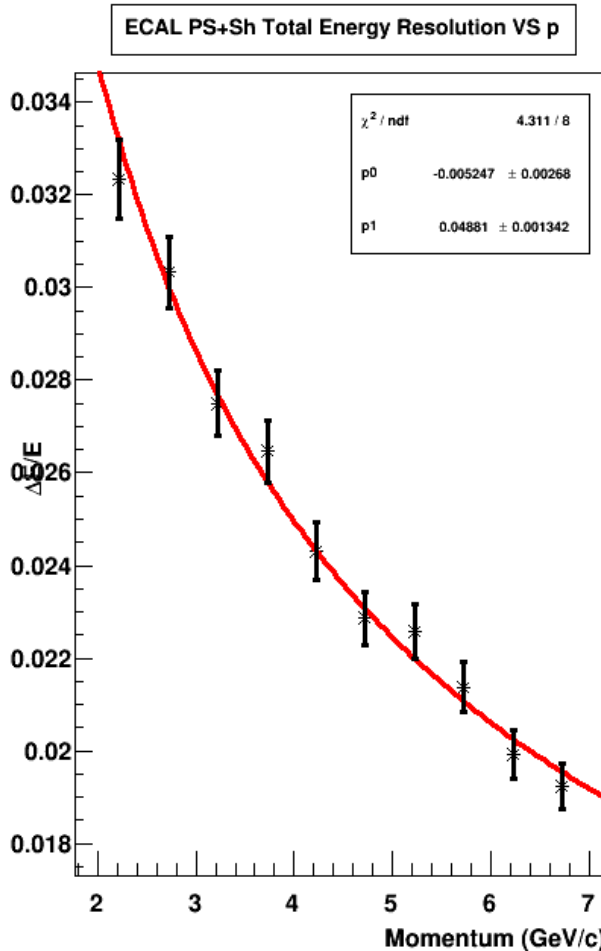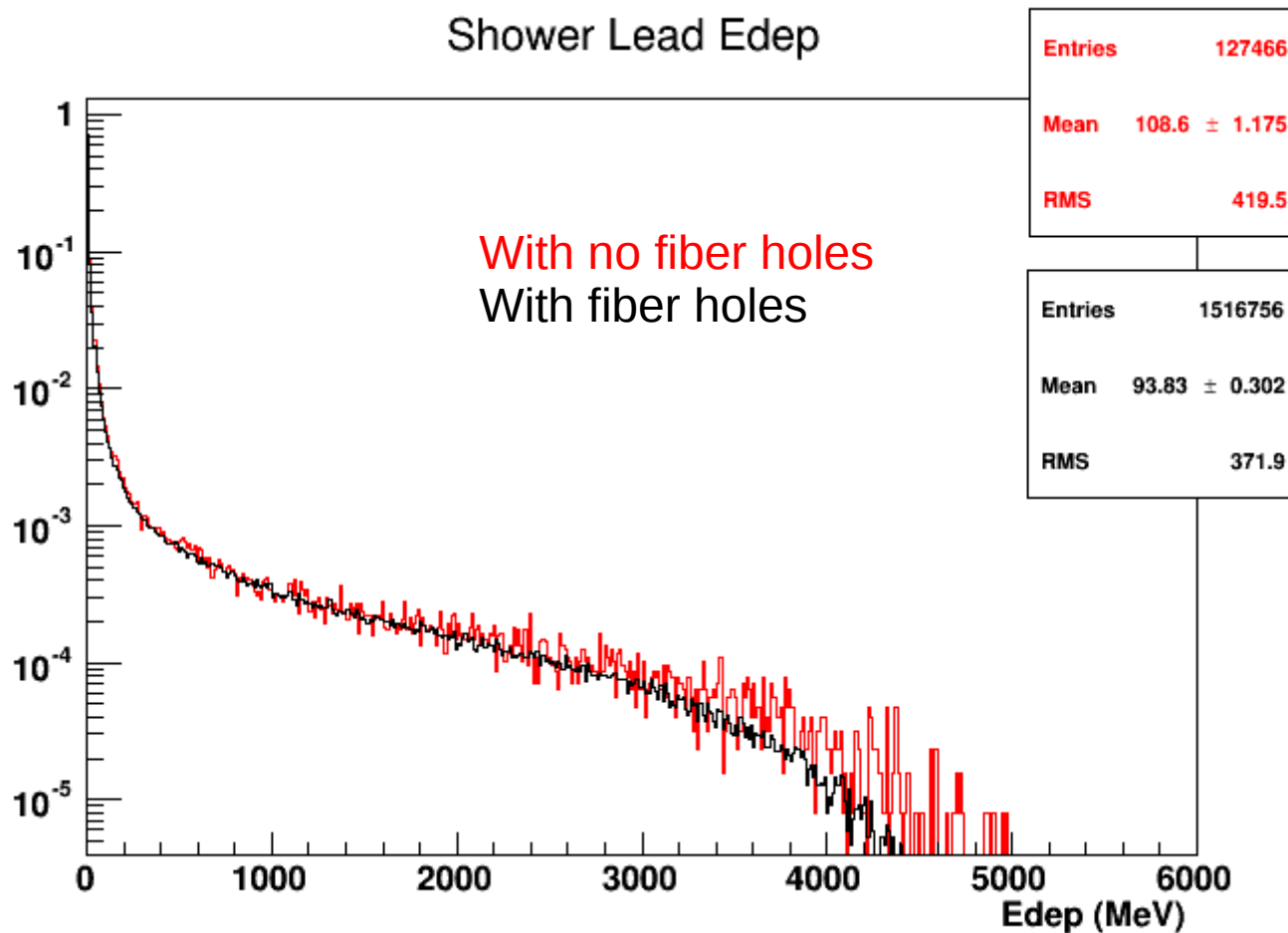using sampling fractions for Shower and Pre-Shower

Intrinsic ECAL Energy Resolution : With Fiber Holes

From Total Energy on ECAL		
Pf (GeV)	Resolution	Error
2.23	0.032	0.001
2.73	0.030	0.001
3.23	0.028	0.001
3.73	0.026	0.001
4.23	0.024	0.001
4.73	0.023	0.001
5.23	0.023	0.001
5.73	0.021	0.001
6.23	0.020	0.001
6.73	0.019	0.0005

From 6+1 Clusters		
Pf (GeV)	Resolution	Error
2.23	0.033	0.001
2.73	0.031	0.001
3.23	0.028	0.001
3.73	0.027	0.001
4.23	0.026	0.001
4.73	0.025	0.001
5.23	0.024	0.001
5.73	0.023	0.001
6.23	0.022	0.001
6.73	0.021	0.001

From 2+1 Clusters		
Pf (GeV)	Resolution	Error
2.23	0.048	0.001
2.73	0.045	0.001
3.23	0.045	0.001
3.73	0.044	0.001
4.23	0.045	0.001
4.73	0.045	0.001
5.23	0.044	0.001
5.73	0.044	0.001
6.23	0.043	0.001
6.73	0.043	0.001

Energy Deposit in Lead

Rakitha Beminiwattha

Energy Deposit in Scintillator

Shower Scint Edep

With no fiber holes
With fiber holes

Entries	2031
Mean	835.2 ± 6.313
RMS	284.5

Entries	22770
Mean	1137 ± 2.534
RMS	382.3
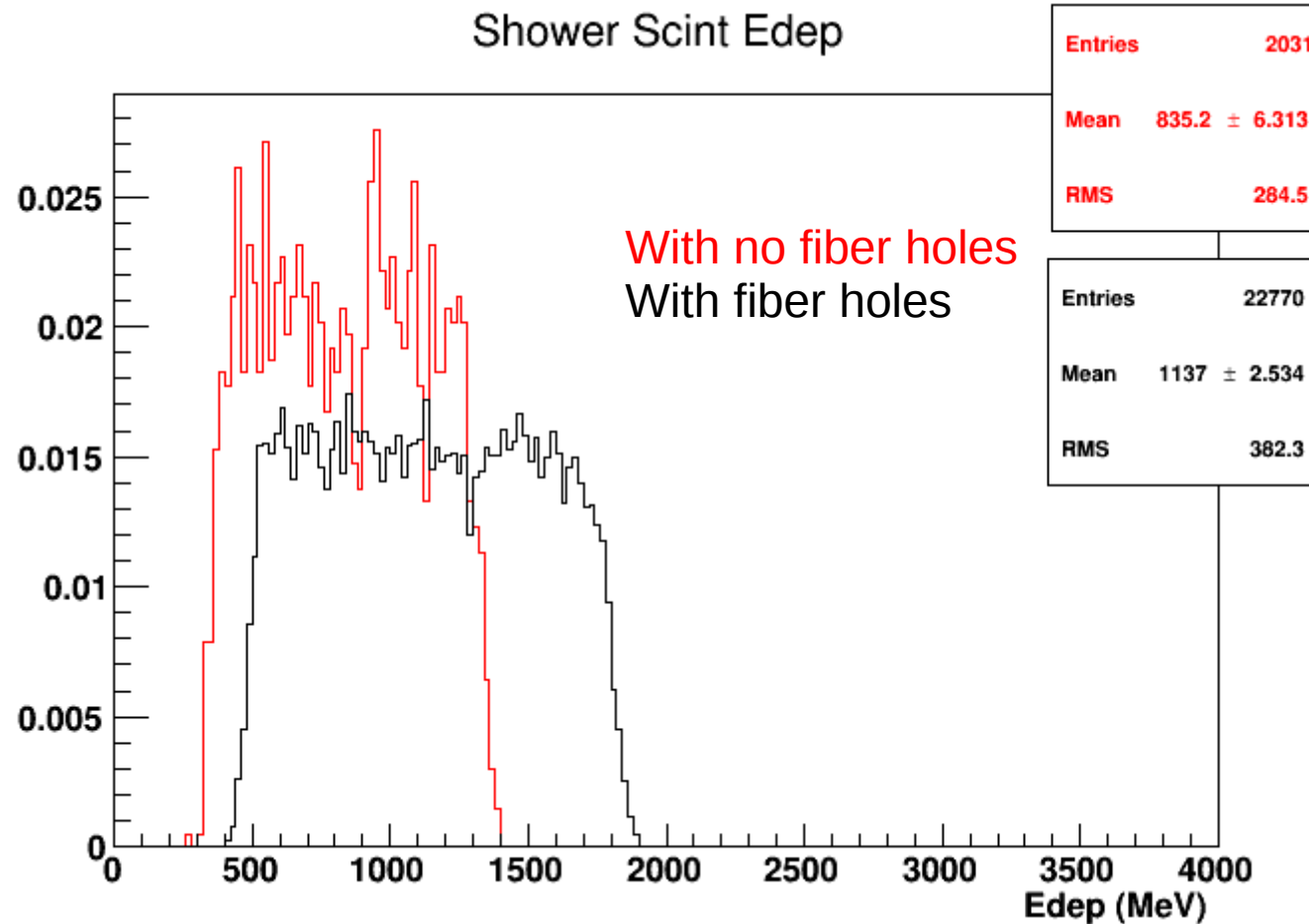
Average Energy Deposit

	No Holes Avg. Energy Dep. Per track (MeV)	Holes Avg. Energy Dep. Per track (MeV)
Shower (Lead + Scint)	4168	4168
Shower (Lead)	3334	3031
Shower (Scint)	834	1137

- With holes shower lead had 303 MeV less energy deposited

  - This 303 MeV energy is now deposited in the Scint

Energy Loss Fraction in Shower

Momentum Fraction Deposit in ECAL (Calibrated E/Pf)

With no fiber holes
With fiber holes

Entries 22770
Mean 0.9897 ± 5.855e-05
RMS 0.008835
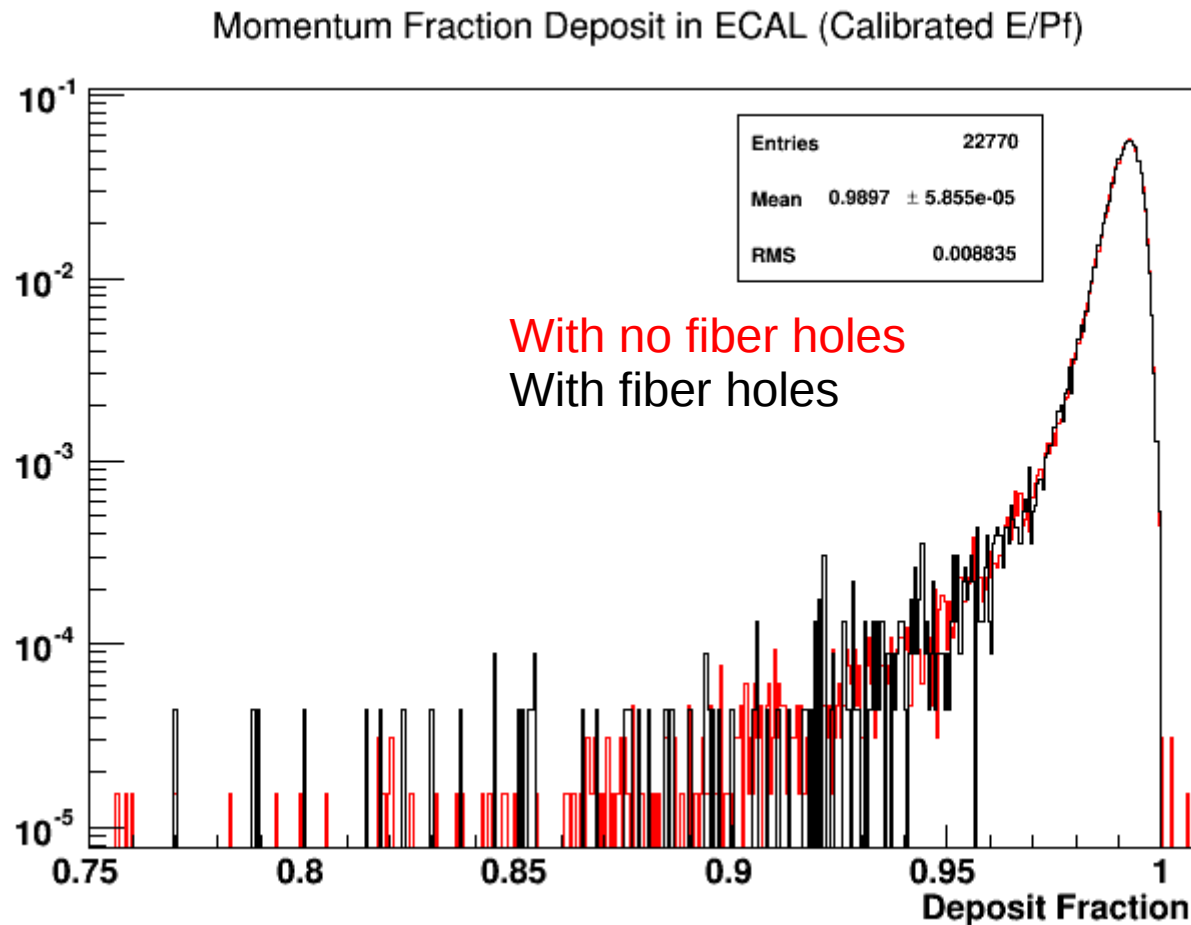
Scint. Energy Deposit Z Profile

Shower Scint Edep Z

Entries	398845
Mean	-4.595 ± 0.0156
RMS	9.85

Entries	5593229
Mean	-4.056 ± 0.004263
RMS	10.08

With no fiber holes
With fiber holes
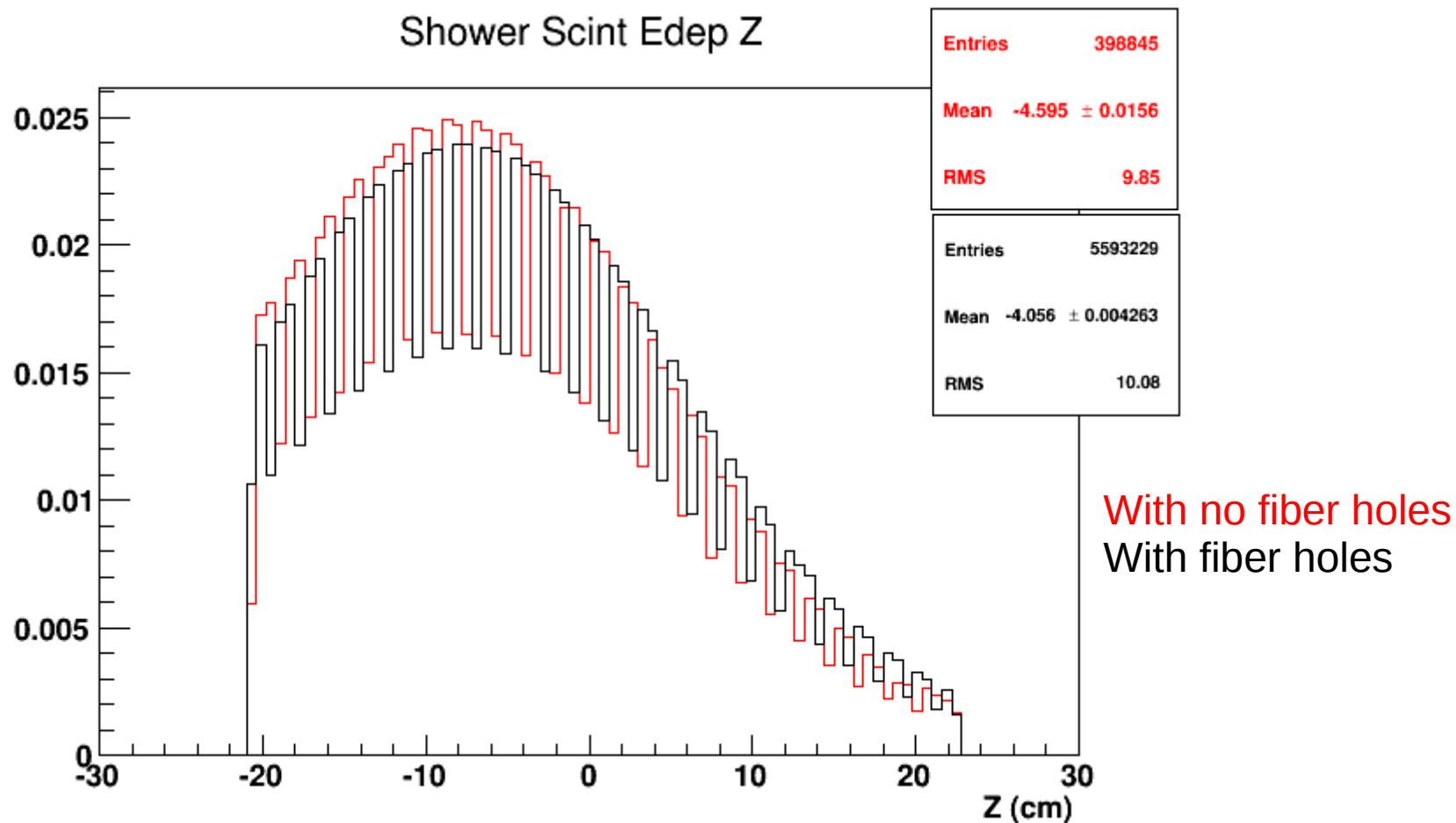
Summary

- Adding holes is equivalent to thin lead plates
  - Less energy is contained in Lead and transfer more energy to scintillator pads
- Intrinsic energy resolution with fiber holes is better than no fiber holes
- the sampling fraction has increased
  - Total energy deposit in the shower is about same
  - More energy is transferred from Lead to Scintillator with fiber holes
- Next : Following will be tested in order,

1) Add six larger holes to above geometry

2) Add front and back support plates

3) Add supporting aluminum wrap (this may require increasing the spacing between hex block.

Rakitha Beminiwattha

Energy Leakage in ECAL

Definition,

- Leakage = (total edep in PS + toal edep in SH)/ (incident electron energy)

    - Where total edep in PS and Sh are total energy deposit in the active and passive layers

- If all the energy is deposited in the ECAL ratio would be close to unity

Energy Leakage in ECAL with thin Lead

Momentum Fraction Deposit in ECAL (Calibrated E/Pf)

With no fiber holes

With fiber holes

Deposit Fraction

Rakitha Beminiwattha