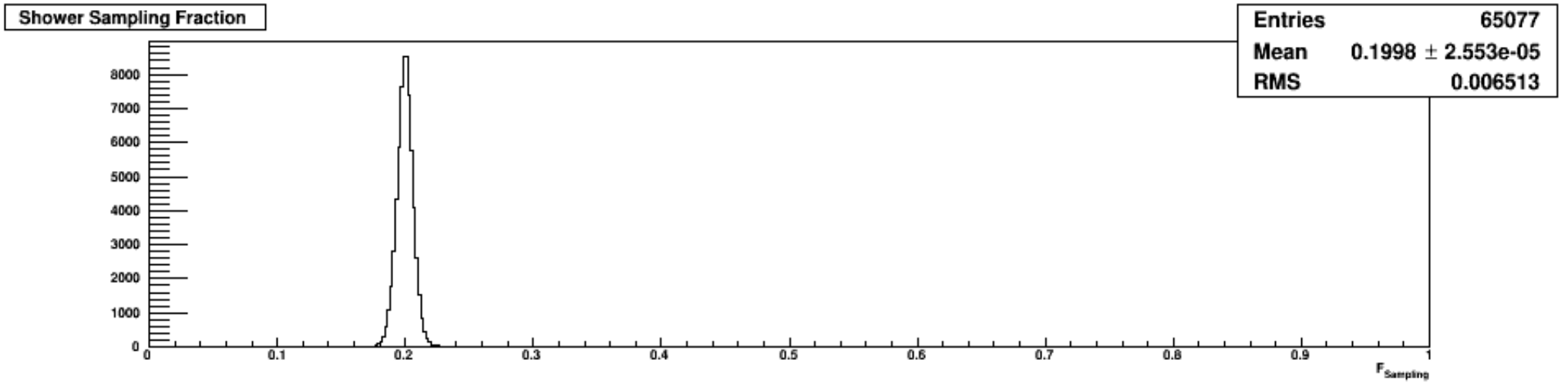
ECAL Summary 5

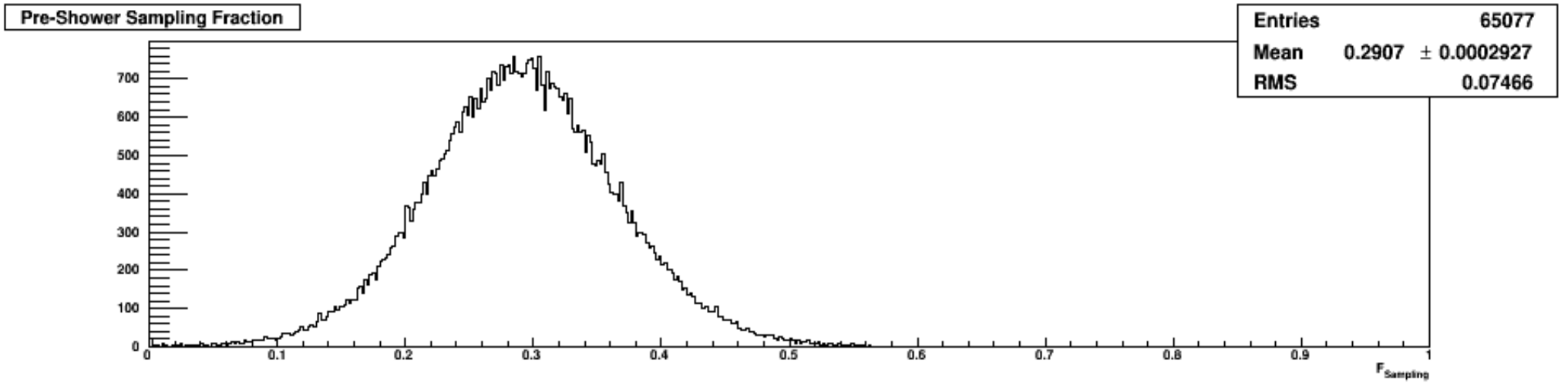
ECAL Energy Resolution Update

Update

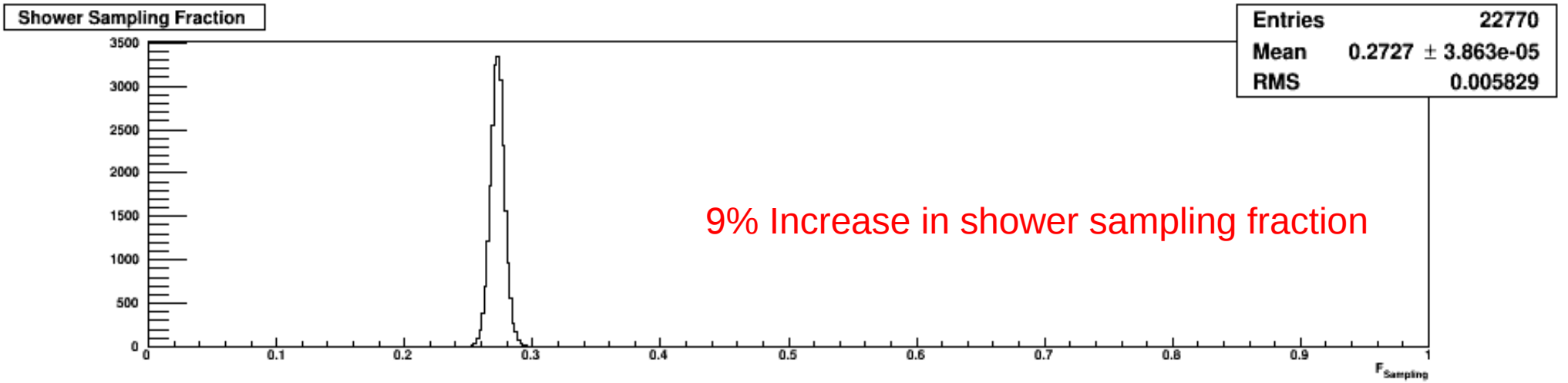
- Added fiber holes to all the ecal blocks
- Earlier analysis used thinner lead absorbers for the shower layers
  - Correct thickness is 0.05 cm (For Lead)
  - I was using 0.034 cm (For Tungsten)
- It is interesting to note that with 0.034 cm lead, there is more energy deposit in the scintillator
  - But more energy leakage in the shower

With No Holes : Sampling Fraction

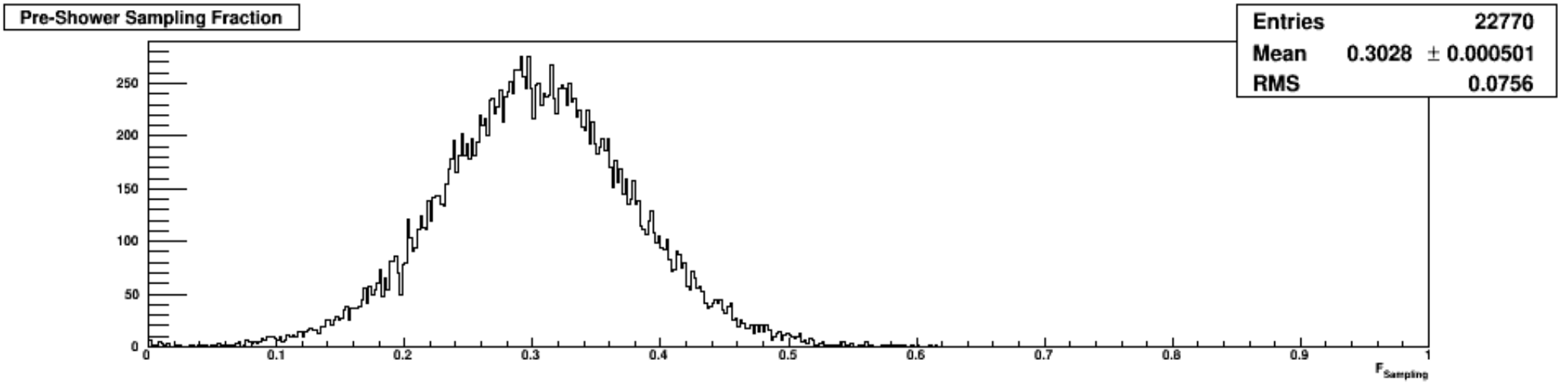




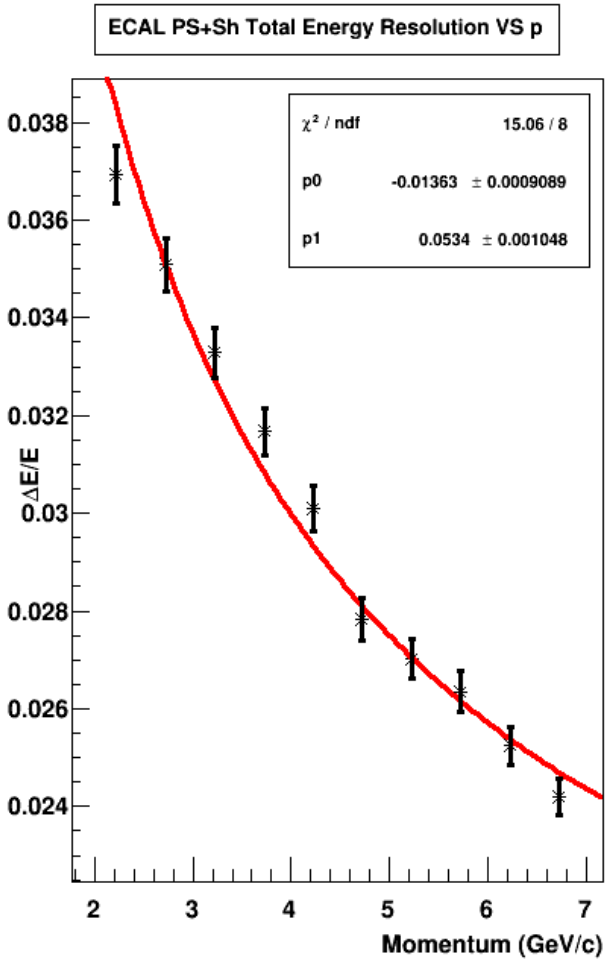
Update to Analysis

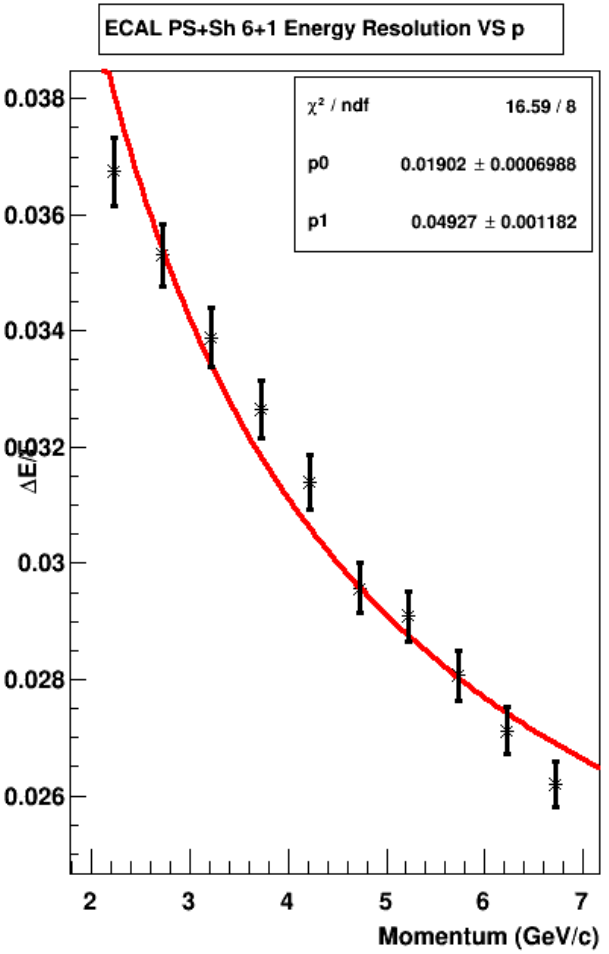


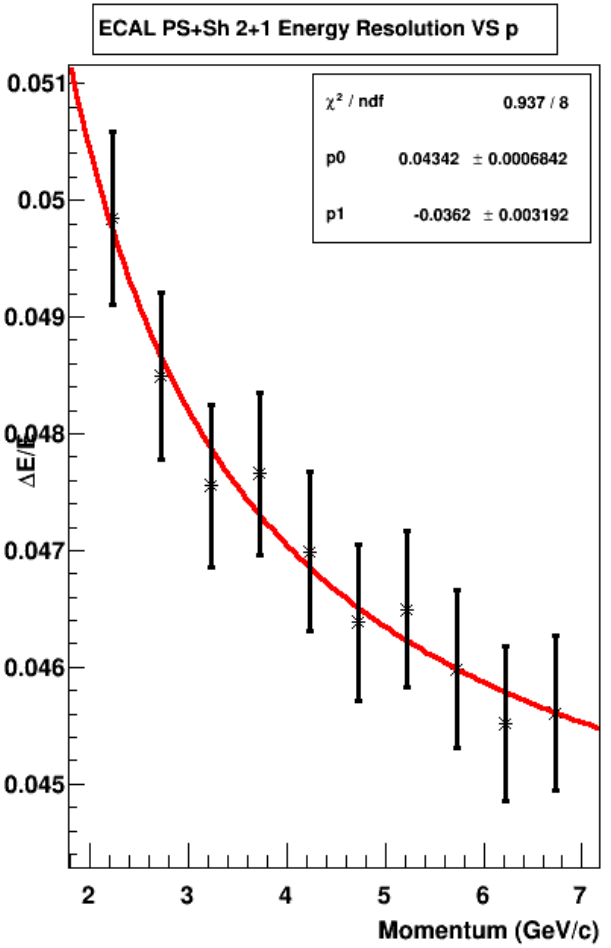
9% Increase in shower sampling fraction



Intrinsic ECAL Energy Resolution : No Holes







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

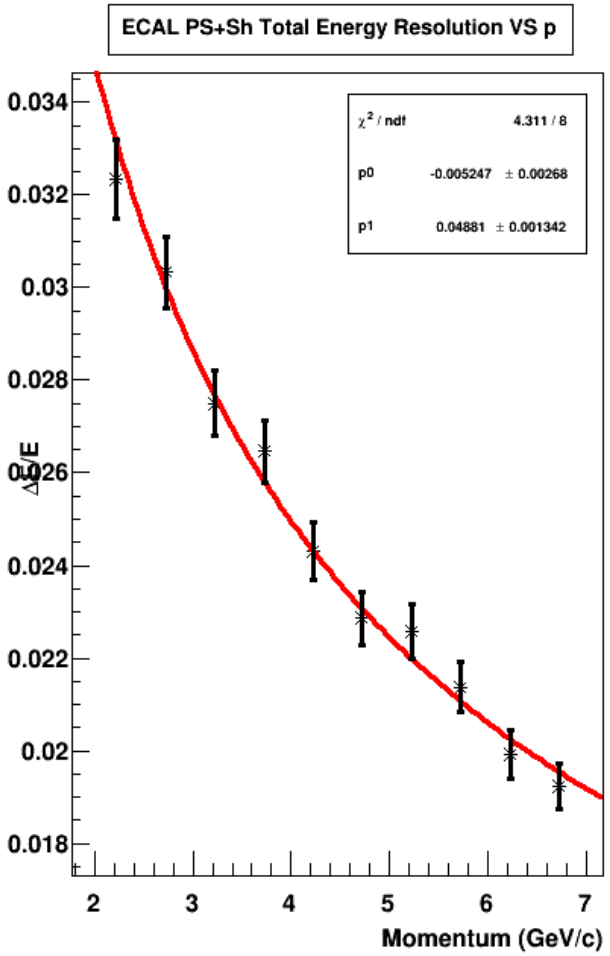
Intrinsic ECAL Energy Resolution : No Holes

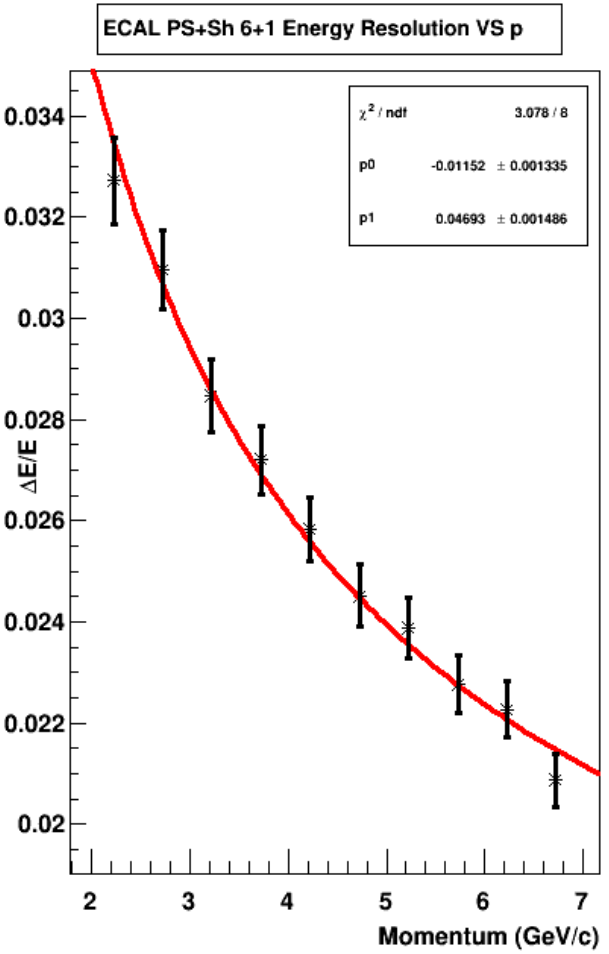
From Total Energy on ECAL		
Pf (GeV)	Resolution	Error
2.23	0.037	0.001
2.73	0.035	0.001
3.23	0.033	0.001
3.73	0.032	0.0005
4.23	0.030	0.0005
4.73	0.028	0.0004
5.23	0.027	0.0004
5.73	0.026	0.0004
6.23	0.025	0.0004
6.73	0.024	0.0004

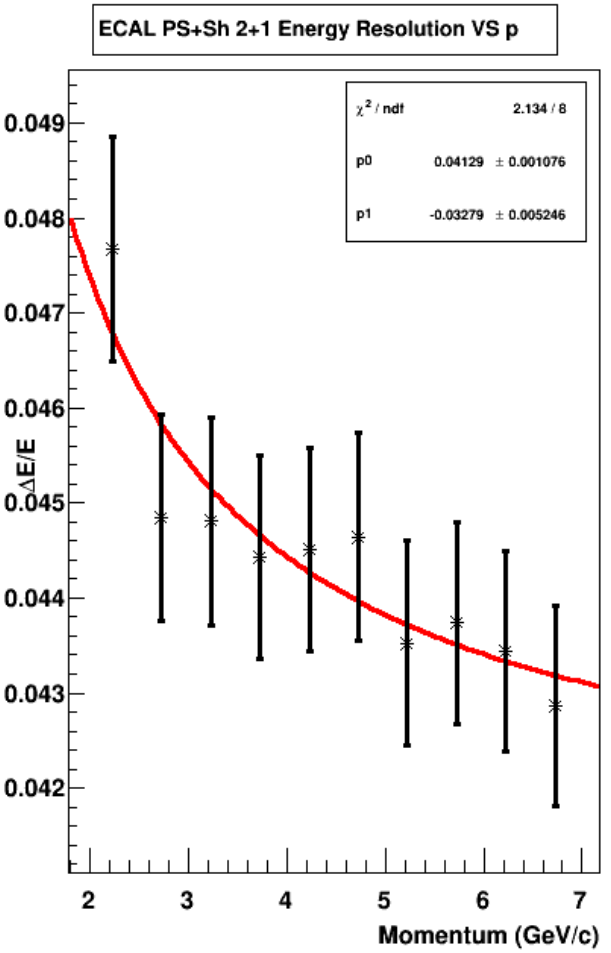
From 6+1 Clusters		
Pf (GeV)	Resolution	Error
2.23	0.037	0.0006
2.73	0.035	0.0005
3.23	0.034	0.0005
3.73	0.033	0.0005
4.23	0.031	0.0005
4.73	0.030	0.0004
5.23	0.029	0.0004
5.73	0.028	0.0004
6.23	0.027	0.0004
6.73	0.026	0.0004

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

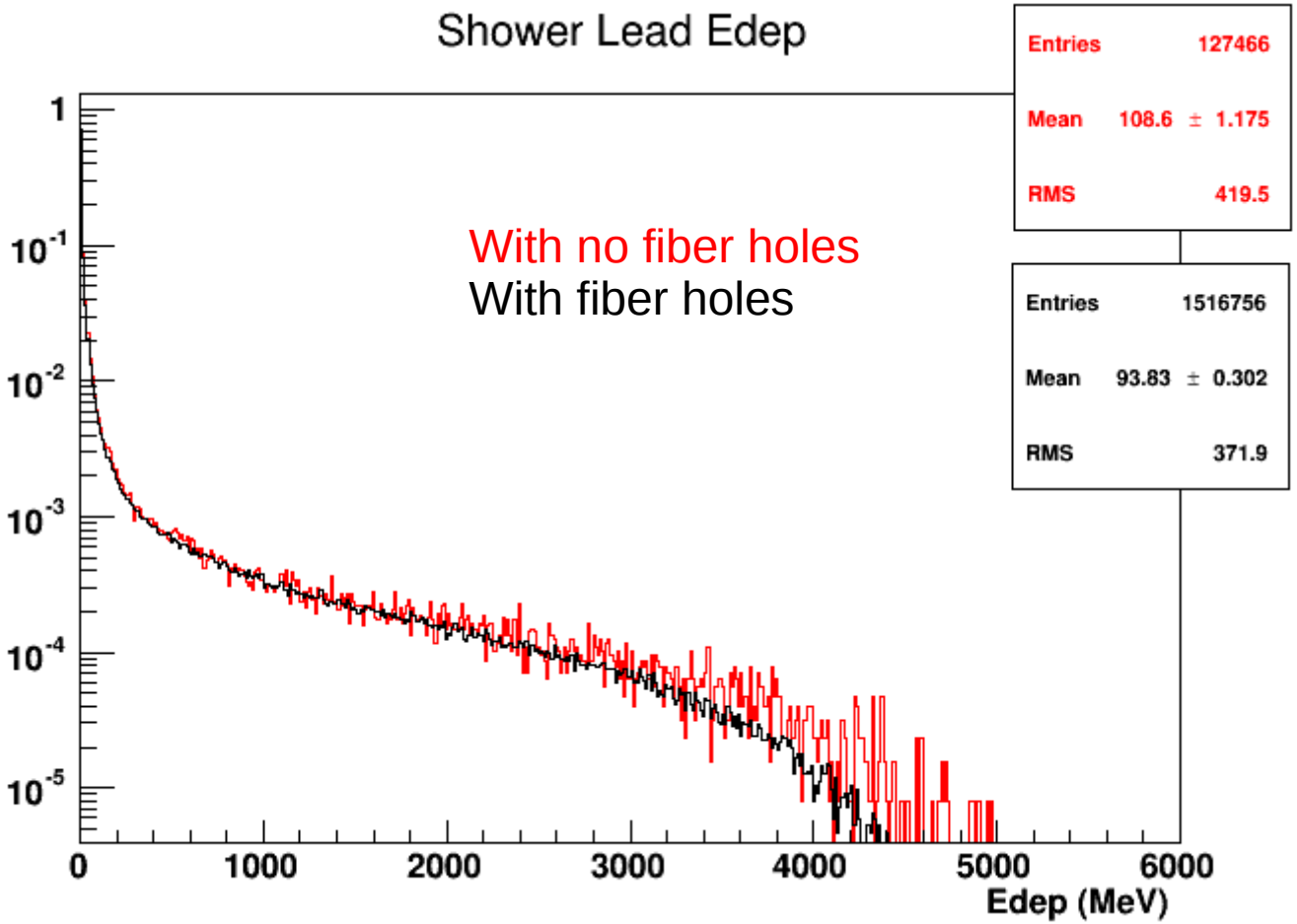
Intrinsic ECAL Energy Resolution : With Fiber Holes

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

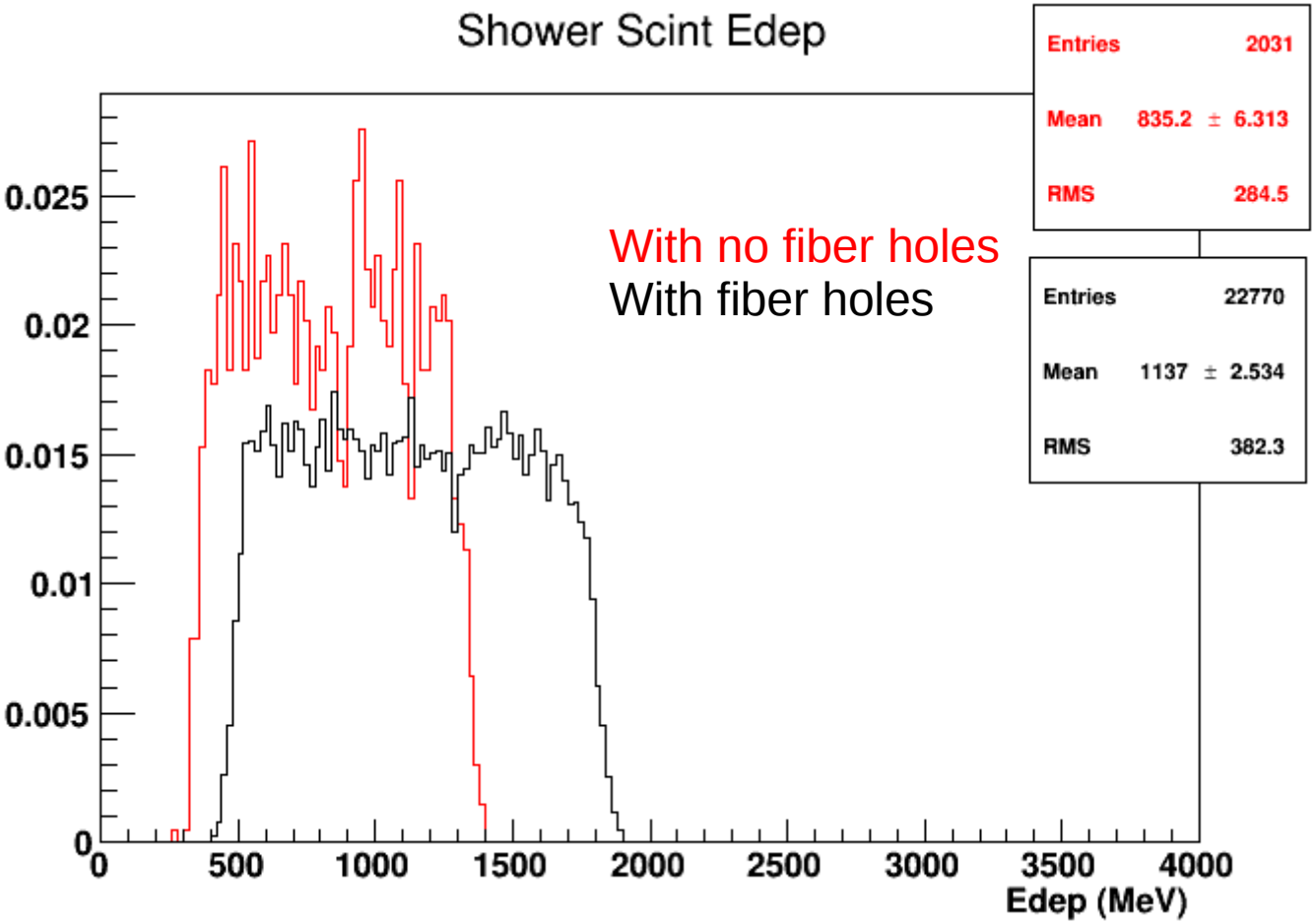
From 6+1 Clusters		
Pf (GeV)	Resolution	Error
2.23	0.033	0.001
2.73	0.031	0.001
3.23	0.028	0.001
3.73	0.027	0.001
4.23	0.026	0.001
4.73	0.025	0.001
5.23	0.024	0.001
5.73	0.023	0.001
6.23	0.022	0.001
6.73	0.021	0.001

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



Energy Deposit in Scintillator

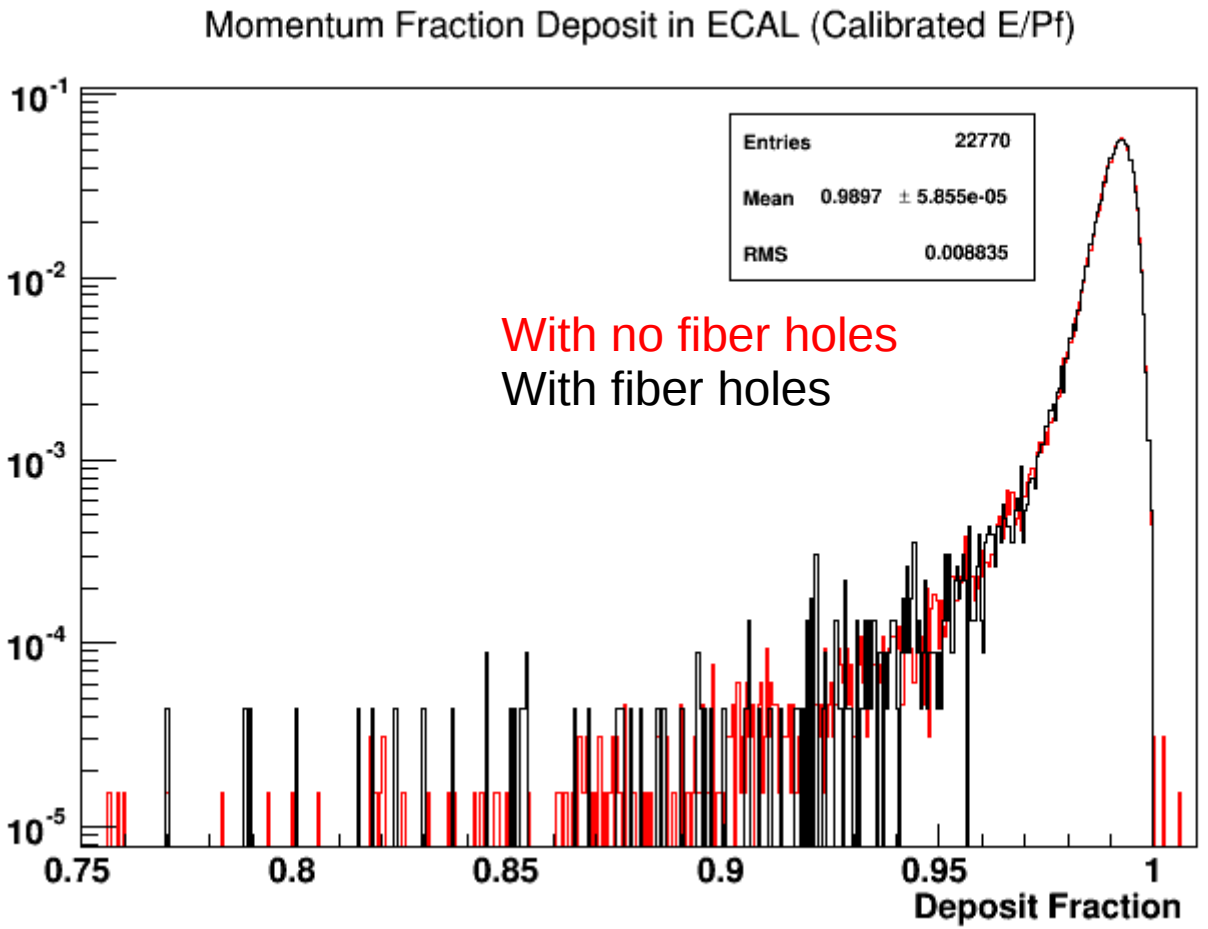


Average Energy Deposit

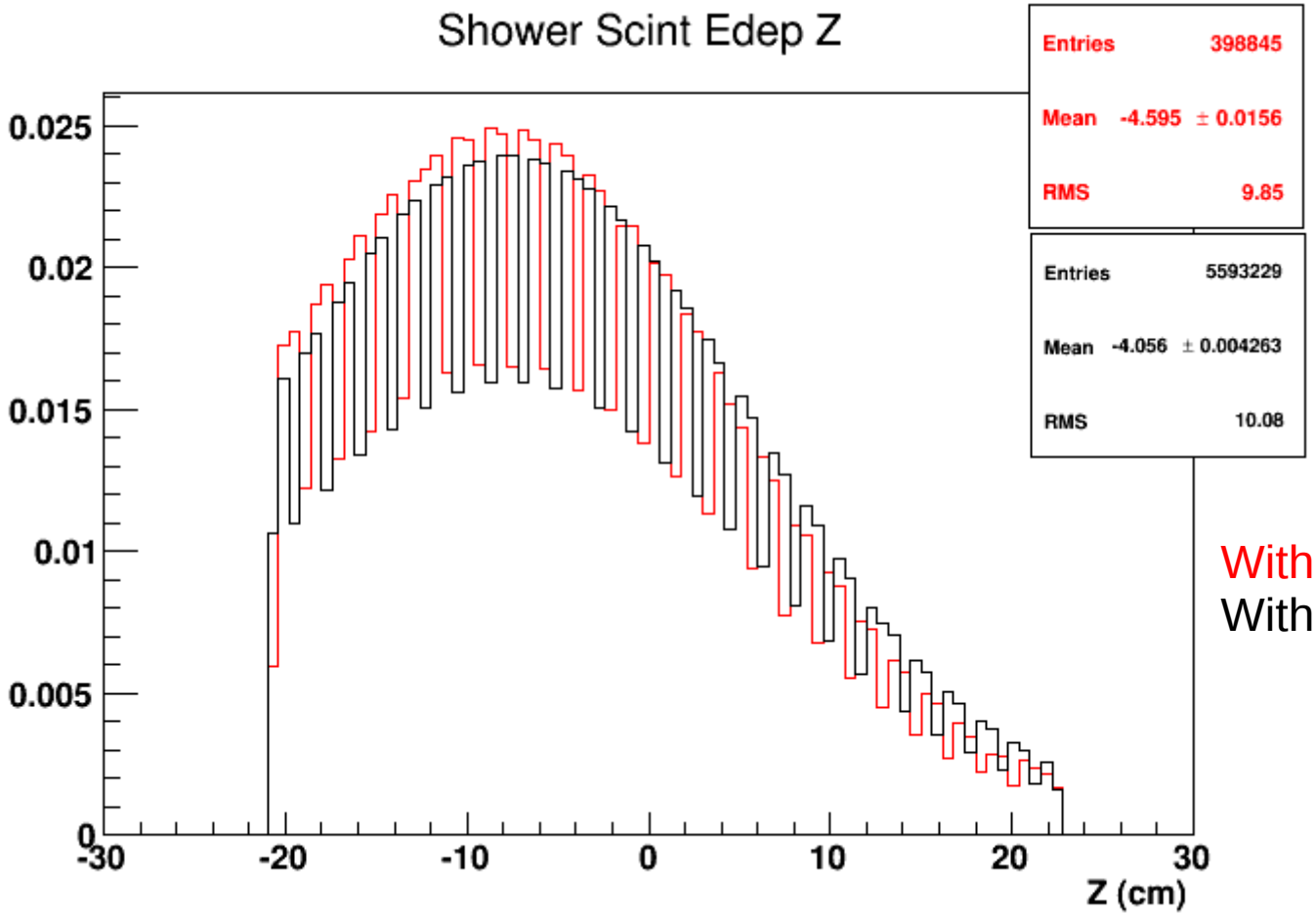
	No Holes Avg. Energy Dep. Per track (MeV)	Holes Avg. Energy Dep. Per track (MeV)
Shower (Lead + Scint)	4168	4168
Shower (Lead)	3334	3031
Shower (Scint)	834	1137

- 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



Scint. Energy Deposit Z Profile



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.

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