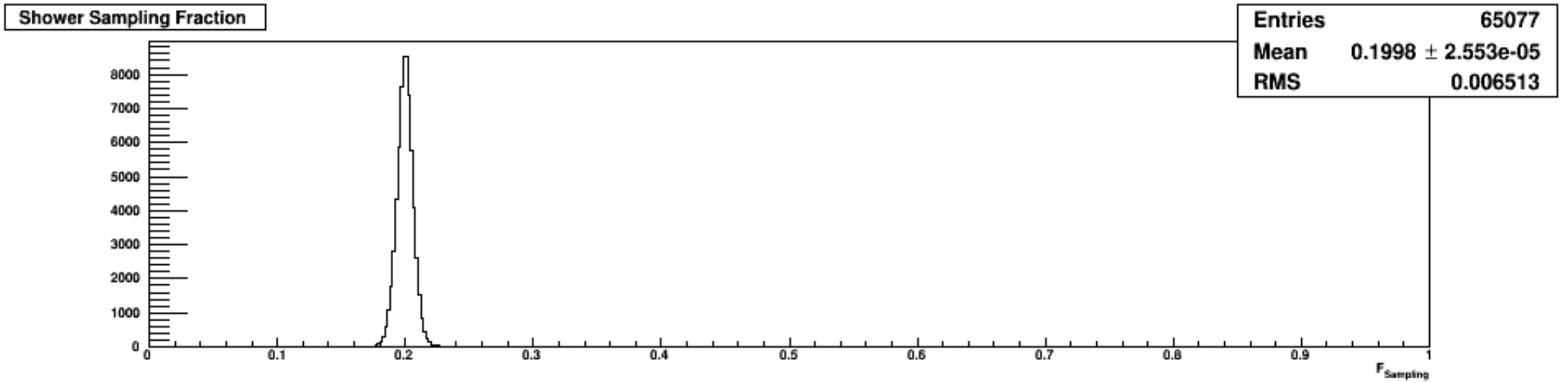
ECAL Summary 8

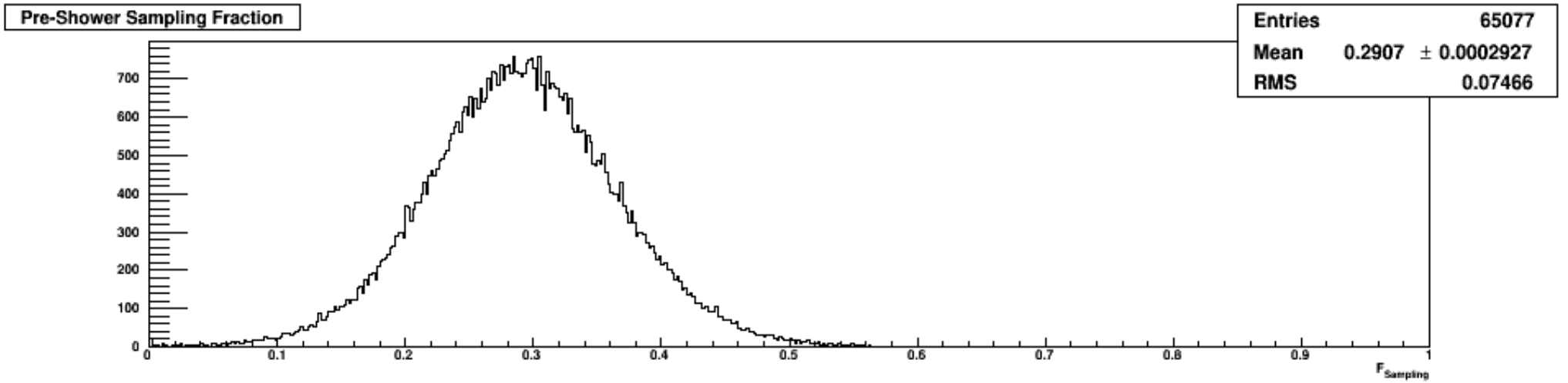
ECAL Update

Update

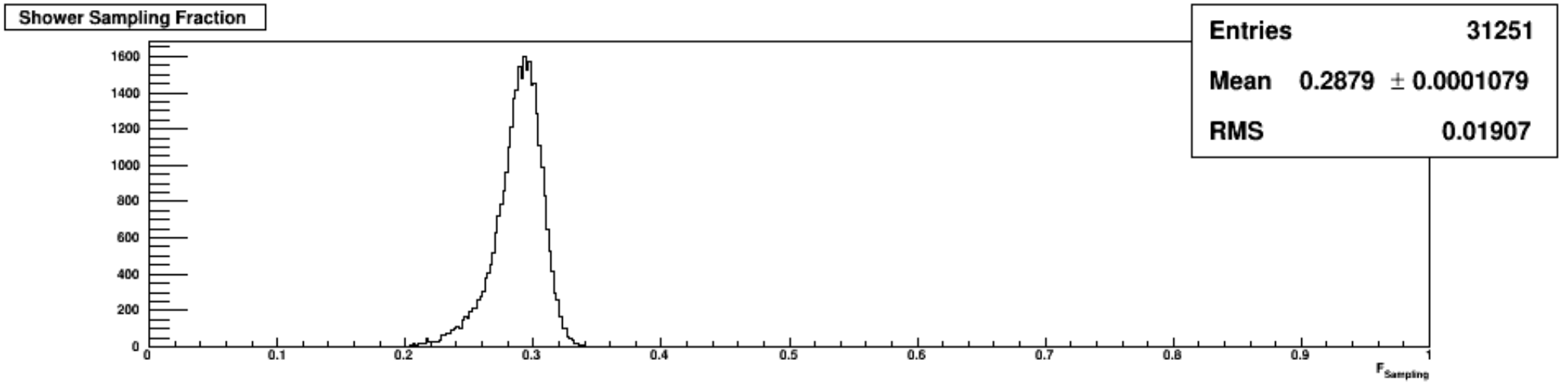
- Compare sampling fractions between 10 – 11 GeV muons and 2-4 GeV electrons
  - High energy muons produce less soft-energy charge particles (due to the EM shower)
    - Act as MIP
  - Electrons deposit energy mainly by EM shower
- Compare energy deposited only from muons to understand ECAL energy deposit

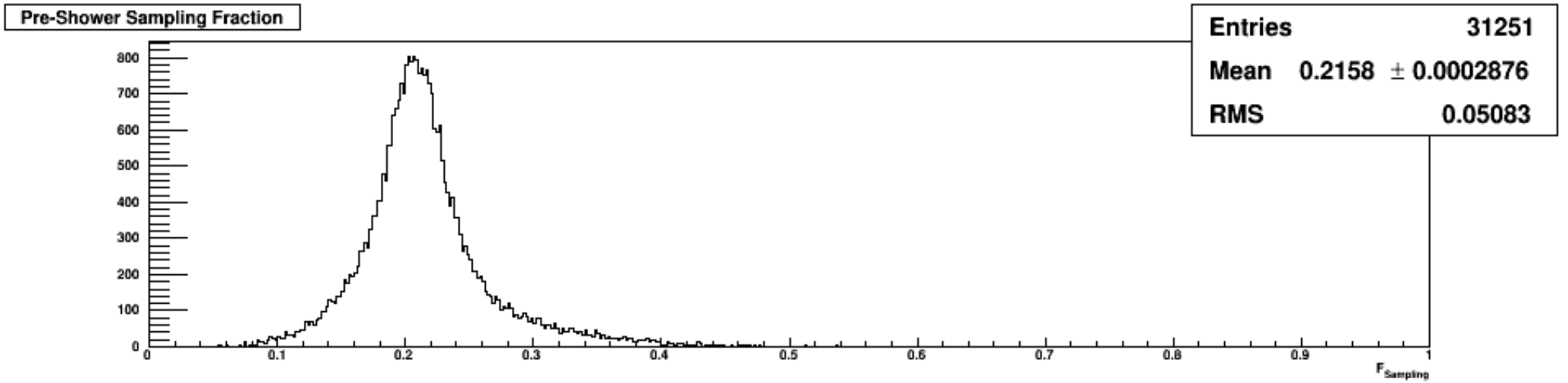
Electrons: Sampling Fraction F_s(edep)



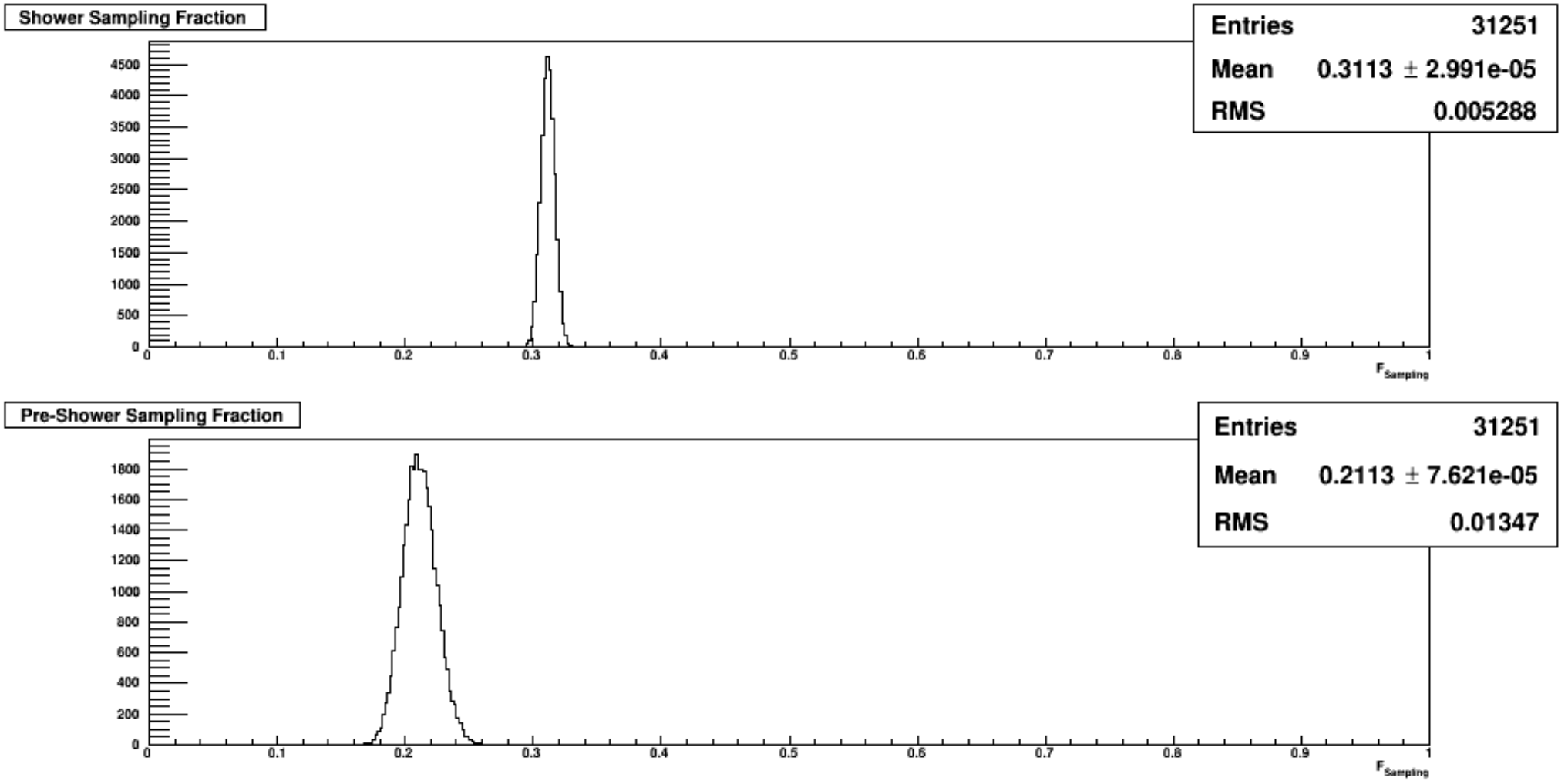


Muons : Sampling Fraction F_s(edep)





Only Edep from Muons : Sampling Fraction F_s(edep)



Sampling fraction for MIP type energy loss in the material

- The sampling fraction for MIP

$$\frac{2\ \mathrm{MeV/cm} \times 0.15\ \mathrm{cm}}{(2\ \mathrm{MeV/cm} \times 0.15\ \mathrm{cm} + 12.8\ \mathrm{MeV/cm} \times 0.05\ \mathrm{cm})} = 0.319$$

- This agrees with what we see from Muon simulations

Material	Z	A	Z/A	dE/dx min (MeVcm²/g)	Density (g/cm³)
H_2 (liquid)	1	1.008	0.992	4.034	0.0708
He	2	4.002	0.500	1.937	0.125
C	6	12.01	0.500	1.745	2.27
Al	13	26.98	0.482	1.615	2.70
Cu	29	63.55	0.456	1.403	8.96
Pb	82	207.2	0.396	1.123	11.4
W	74	183.8	0.403	1.145	19.3
U	92	238.0	0.387	1.082	19.0
Scint.			0.538	1.936	1.03
BGO			0.421	1.251	7.10
CsI			0.416	1.243	4.53
NaI			0.427	1.305	3.67

Lead $dE/dx|_{min}$ = 1.123 MeV.cm2/g and density is 11.4 g/cm3
Scint $dE/dx|_{min}$ = 1.936 MeV.cm2/g and density is 1.03 g/cm3
Lead $dE/dx|_{min}$ = 12.8 MeV/cm and layer thickness is 0.05 cm
Scintillator $dE/dx|_{min}$ = 2 MeV/cm and layer thickness is 0.15 cm

Sampling fraction MIP vs. EDEP

- From electron simulation, we see that sampling fraction F_s(edep) is significantly smaller than F_s(MIP)
  - $F_s(edep)/F_s(MIP) \sim 0.64 \rightarrow e^-$/mip ratio
- The dominant part of the electron edep in the scintillator is not produced by minimum ionizing particles (MIP), but rather by the EM shower (low-energy electrons/positrons) reaching the scintillator