ECAL PID Efficiency with Light Yield

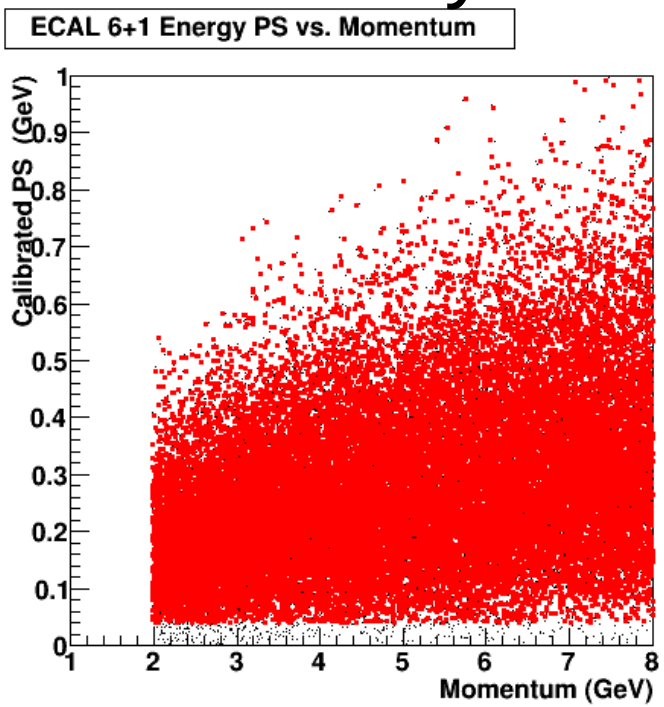
Update 6

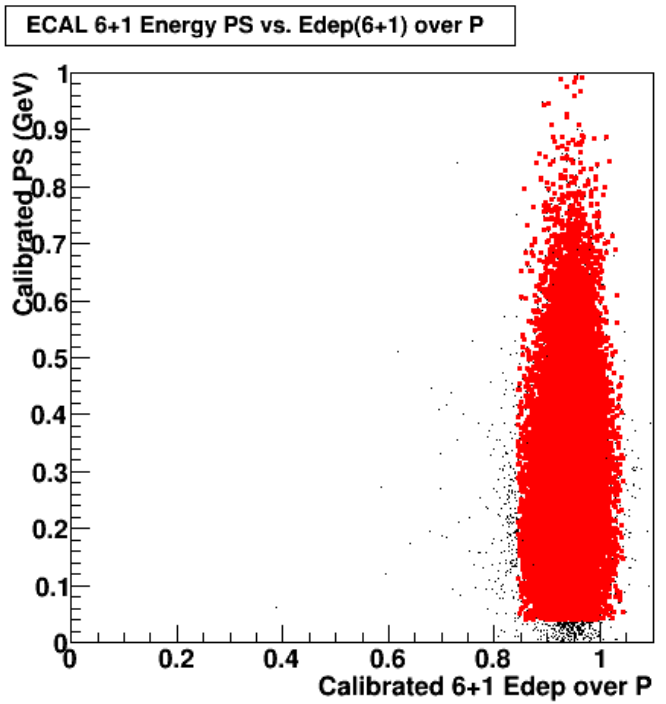
Simulation Overview

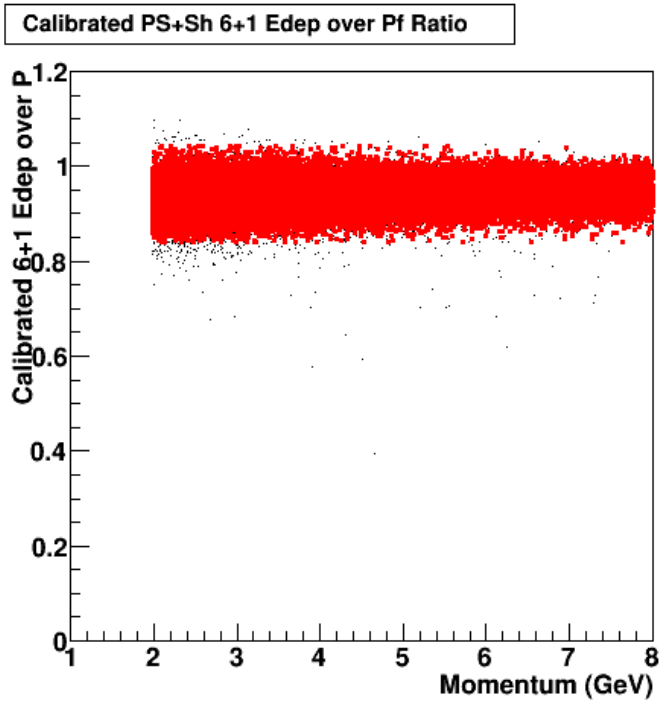
- Uniform electrons and Pions distributions incident on ECAL
- Photo-electron (PE) yield added to the shower
  - 400 PE per GeV and no PE fluctuations in PS
    - PS and shower cuts are relaxed to improve electron efficiency
- Started implementing light yield for scintillator material
  - Birk's attenuation : The quenching effect in scintillators where light output saturates when the energy loss density is large
  - For the scintillator used for ECAL : Birk's constant is 0.126 mm/MeV

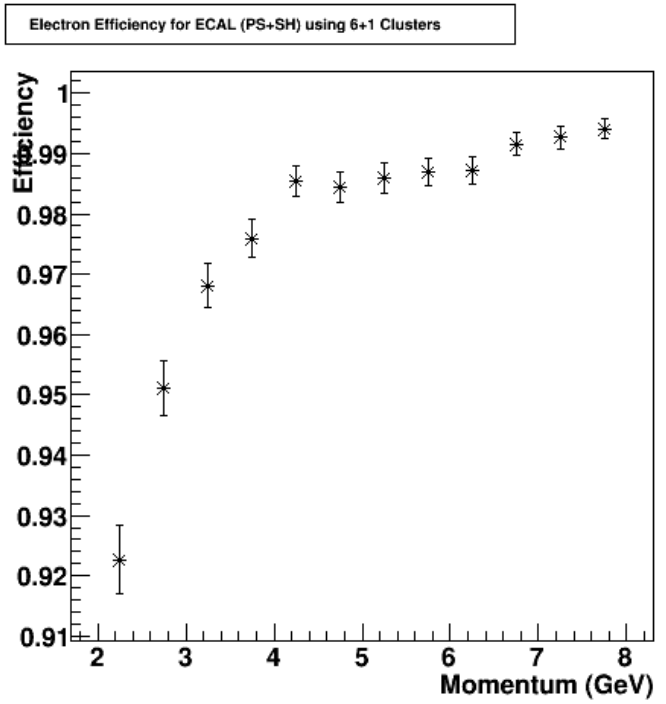
```
G4Material* Sci =
new G4Material("Scintillator", density= 1.032*g/cm3, ncomponents=2);
Sci->AddElement(C, natoms=9);
Sci->AddElement(H, natoms=10);
```

Electron Efficiency: with Birk's Attenuation No PE

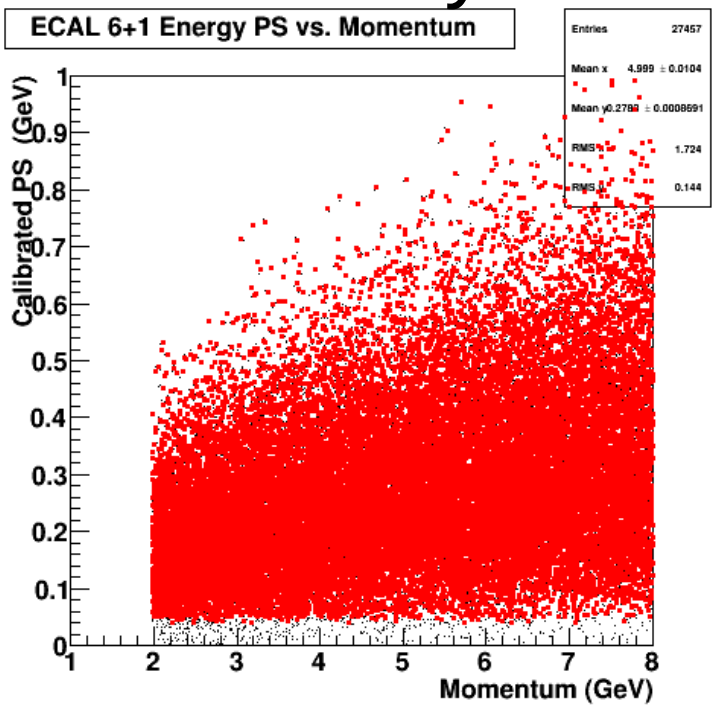


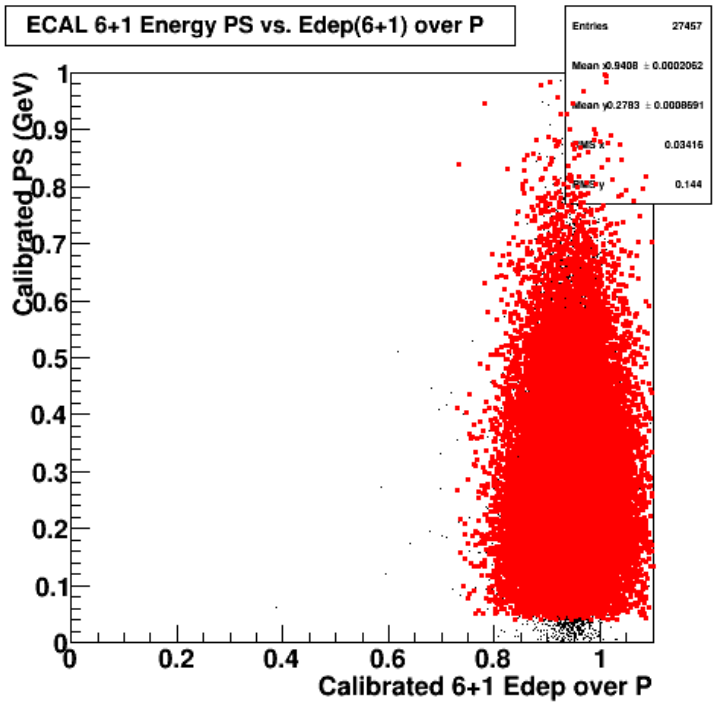


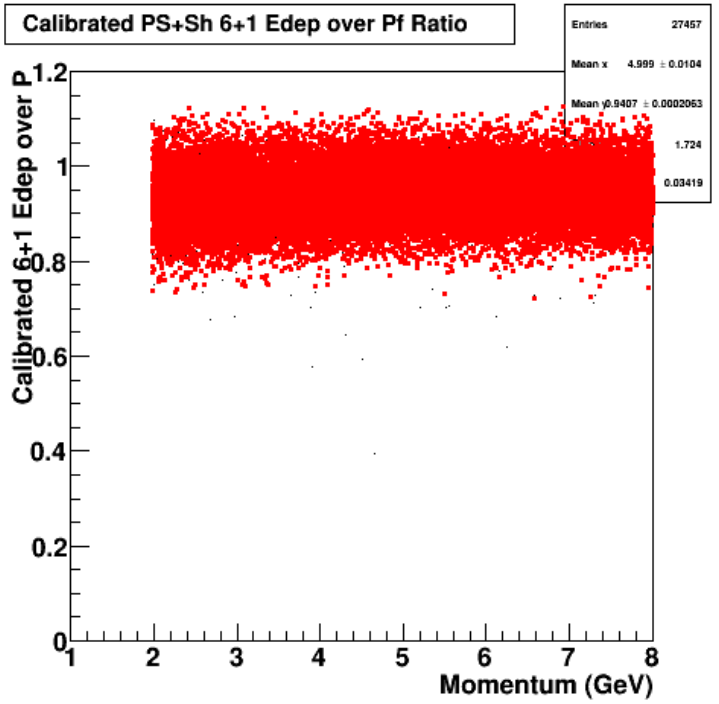


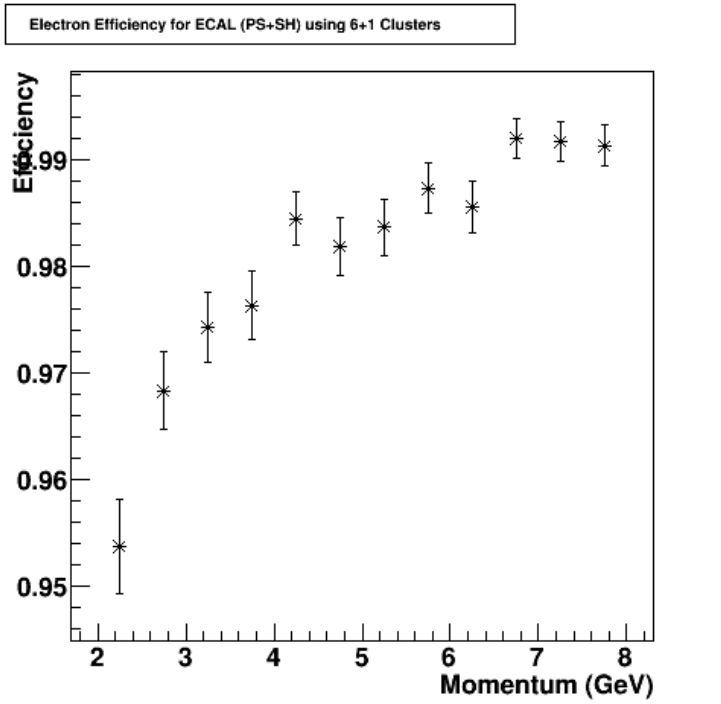


Electron Efficiency: with Birk's Attenuation 400 PE

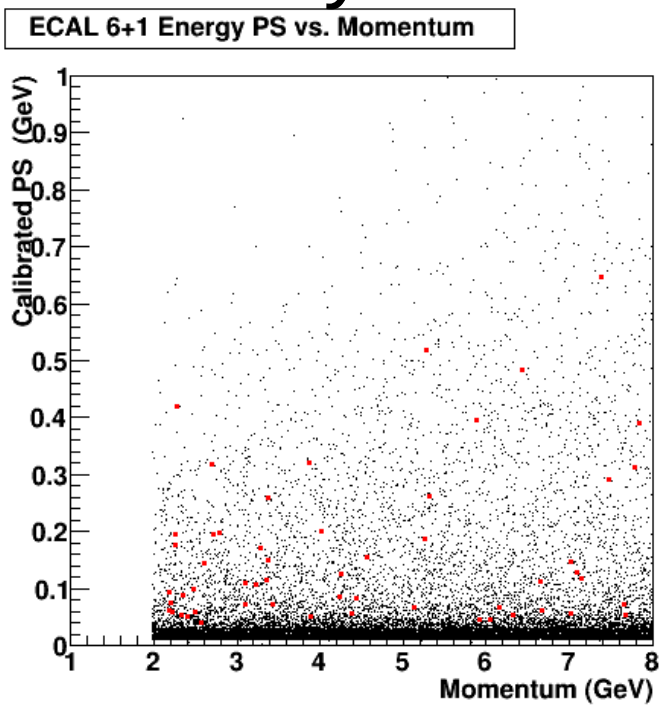


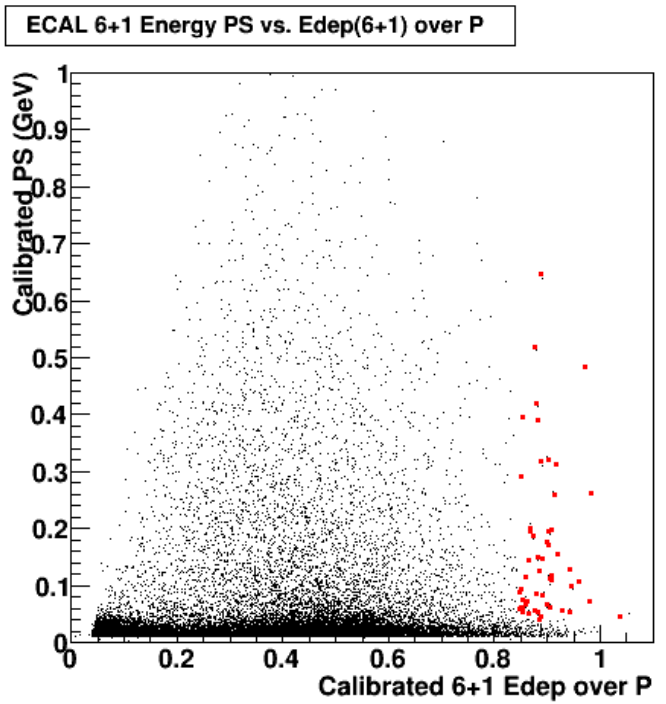


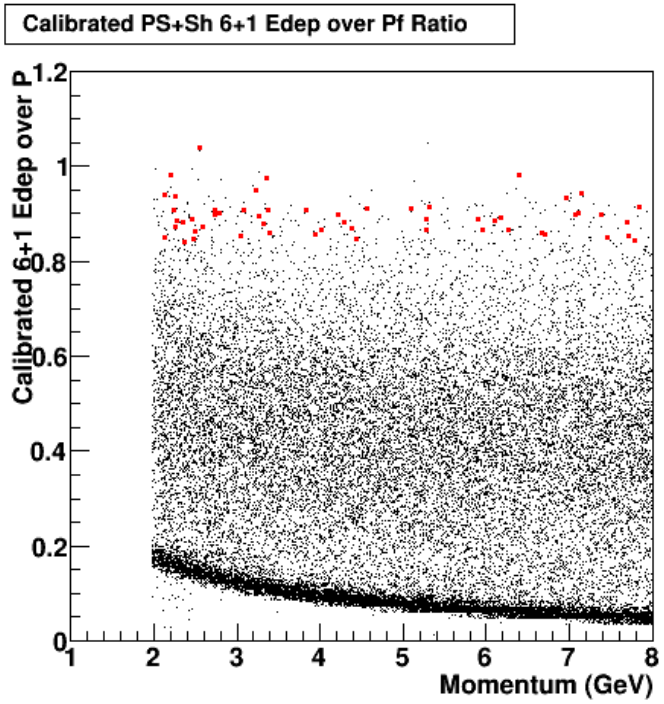


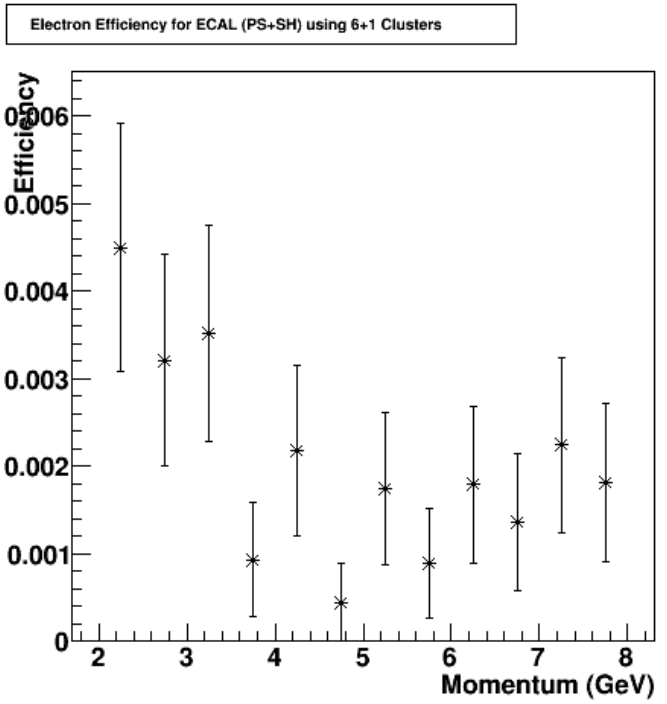


Pion Efficiency: with Birk's Attenuation No PE

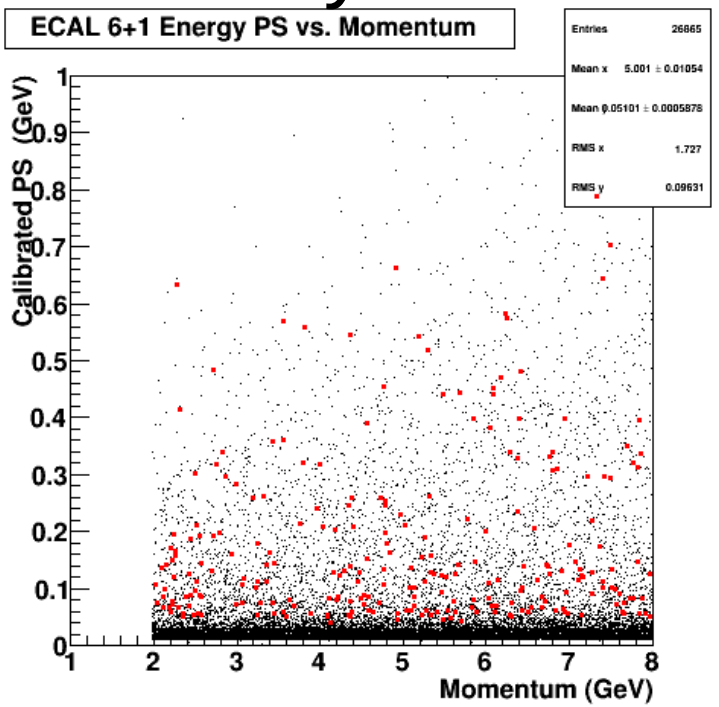


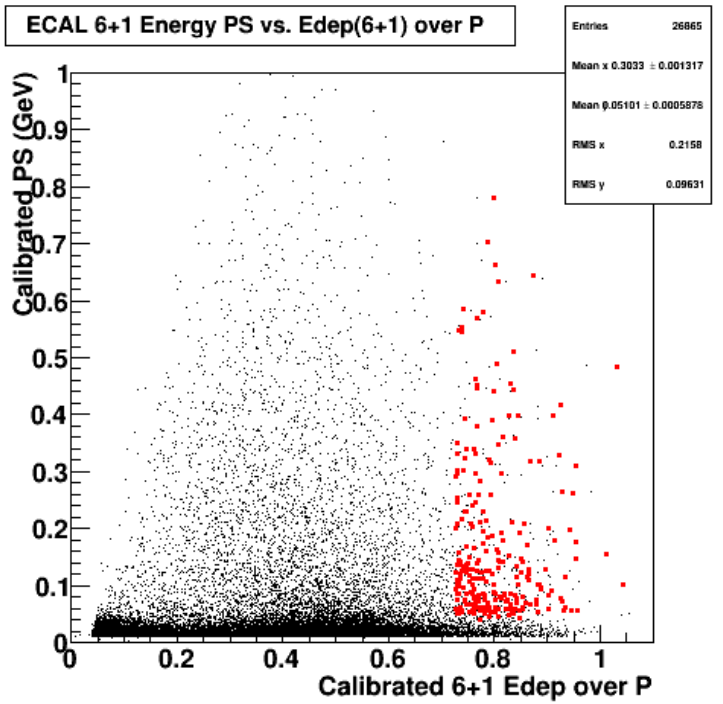


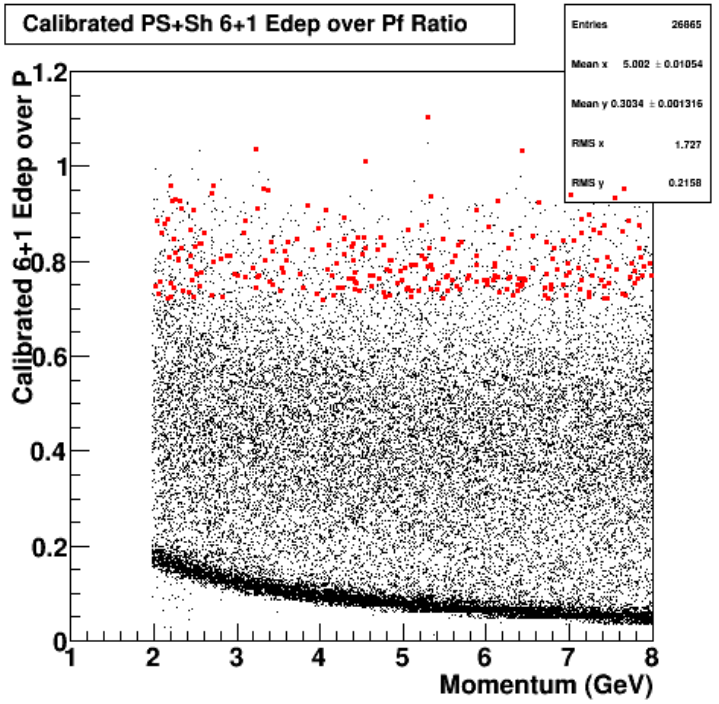


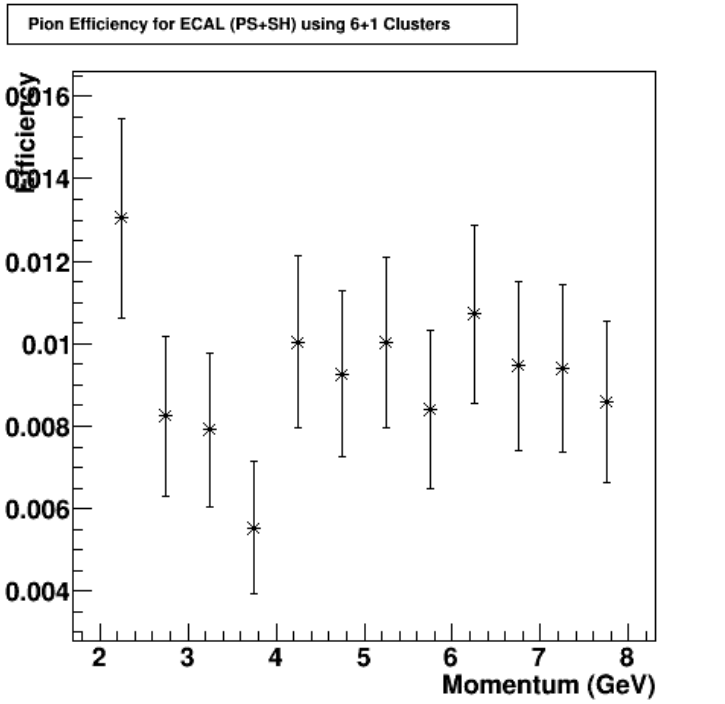


Pion Efficiency: with Birk's Attenuation 400 PE









PID Efficiency : with Birk Effect No PE

	Electron		Pion	
Momentum	Efficiency	Error	Efficiency	Error
2.25	0.923	0.006	0.004	0.001
2.75	0.951	0.004	0.003	0.001
3.25	0.968	0.004	0.004	0.001
3.75	0.976	0.003	0.001	0.001
4.25	0.985	0.002	0.002	0.001
4.75	0.984	0.003	0.0001	0.0001
5.25	0.986	0.002	0.002	0.001
5.75	0.987	0.002	0.001	0.001
6.25	0.987	0.002	0.002	0.001
6.75	0.992	0.002	0.001	0.001
7.25	0.993	0.002	0.002	0.001
7.75	0.994	0.002	0.002	0.001

PID Efficiency : with Birk Effect 400 PE

	Electron		Pion	
Momentum	Efficiency	Error	Efficiency	Error
2.25	0.954	0.004	0.013	0.002
2.75	0.968	0.004	0.008	0.002
3.25	0.974	0.003	0.008	0.002
3.75	0.976	0.003	0.006	0.002
4.25	0.985	0.003	0.01	0.002
4.75	0.982	0.003	0.009	0.002
5.25	0.984	0.003	0.01	0.002
5.75	0.987	0.002	0.008	0.002
6.25	0.986	0.002	0.011	0.002
6.75	0.992	0.002	0.009	0.002
7.25	0.992	0.002	0.009	0.002
7.75	0.991	0.002	0.009	0.002

Note : Shower and PS cuts are relaxed

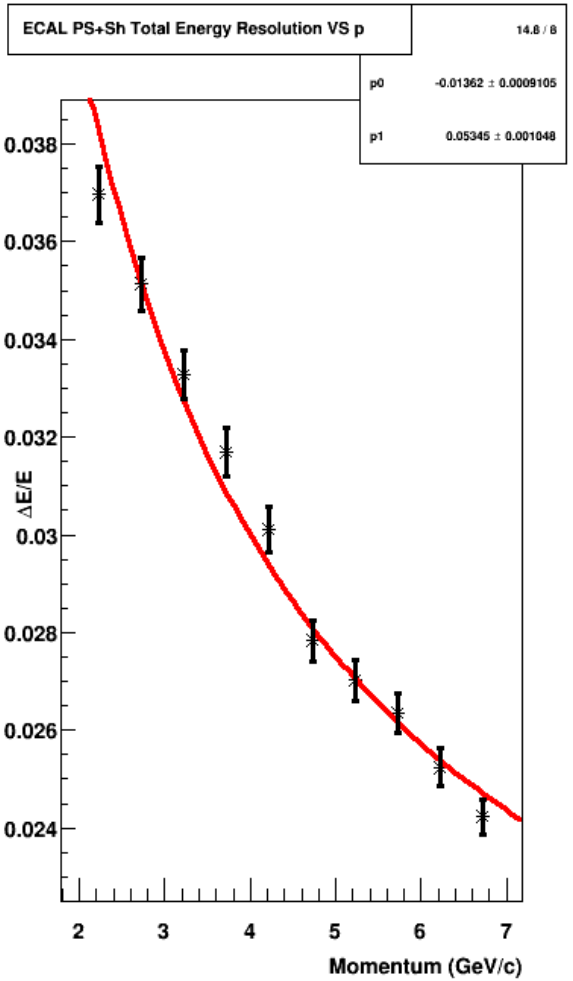
Energy Resolution

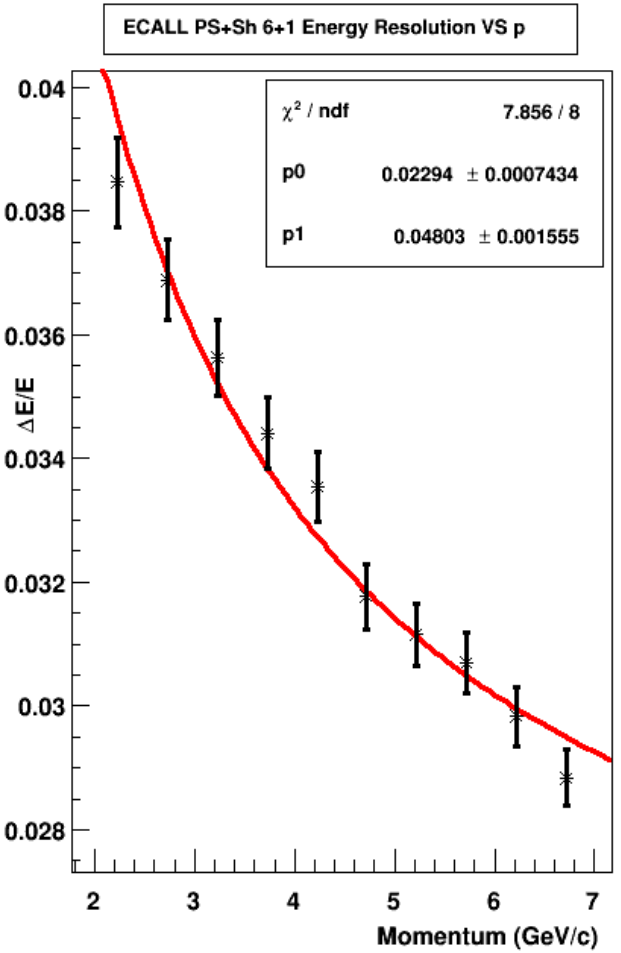
- Electron energy resolution after including PE fluctuations

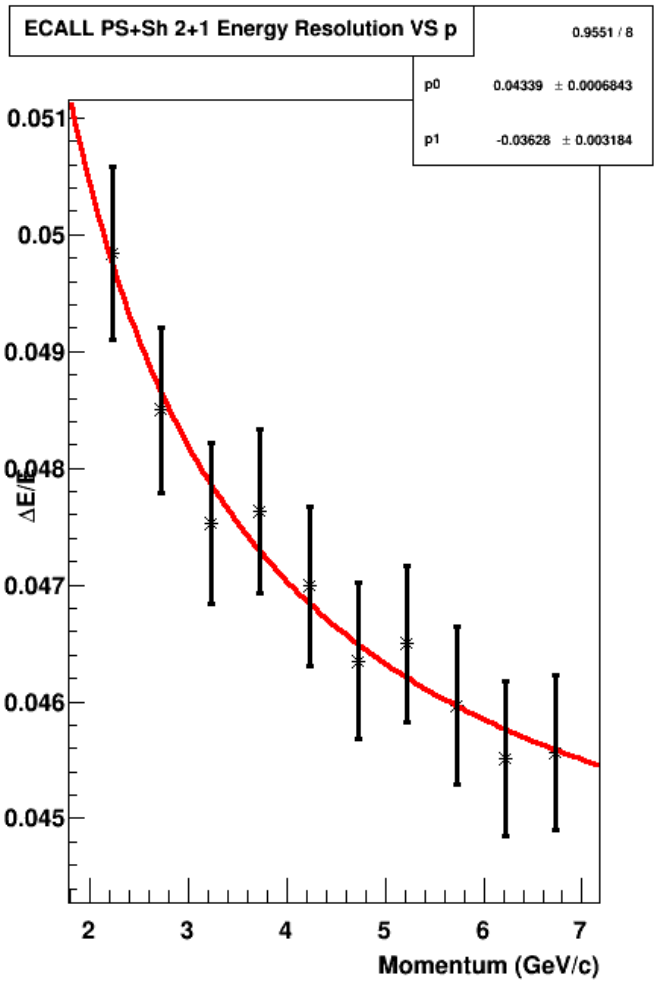
	No PE		Shower PE 900		Shower PE 200	
Momentum	Total Res	Error	Total Res	Error	Total Res	Error
2.23	0.037	0.0006	0.039	0.0006	0.080	0.0012
2.73	0.035	0.0005	0.038	0.0006	0.077	0.0012
3.23	0.033	0.0005	0.037	0.0006	0.077	0.0011
3.73	0.032	0.0005	0.036	0.0006	0.075	0.0011
4.23	0.030	0.0005	0.036	0.0006	0.073	0.0011
4.73	0.028	0.0004	0.035	0.0006	0.072	0.0011
5.23	0.027	0.0004	0.034	0.0005	0.074	0.0011
5.73	0.026	0.0004	0.034	0.0006	0.072	0.0011
6.23	0.025	0.0004	0.034	0.0005	0.072	0.0011
6.73	0.024	0.0004	0.033	0.0005	0.071	0.0011
7.23	0.023	0.0003	0.033	0.0004	0.071	0.0008

	No PE		Shower PE 900		Shower PE 200	
Momentum	6+1 Res	Error	6+1 Res	Error	6+1 Res	Error
2.23	0.037	0.0006	0.039	0.00064	0.081	0.0012
2.73	0.035	0.0005	0.039	0.00062	0.080	0.0012
3.23	0.034	0.0005	0.038	0.00059	0.077	0.0011
3.73	0.033	0.0005	0.037	0.00058	0.075	0.0011
4.23	0.031	0.0005	0.036	0.00056	0.073	0.0011
4.73	0.030	0.0004	0.036	0.00056	0.073	0.0011
5.23	0.029	0.0004	0.036	0.00055	0.074	0.0011
5.73	0.028	0.0004	0.036	0.00056	0.073	0.0011
6.23	0.027	0.0004	0.035	0.00055	0.073	0.0011
6.73	0.026	0.0004	0.035	0.00053	0.073	0.0011
7.23	0.025	0.0003	0.035	0.00037	0.072	0.0008

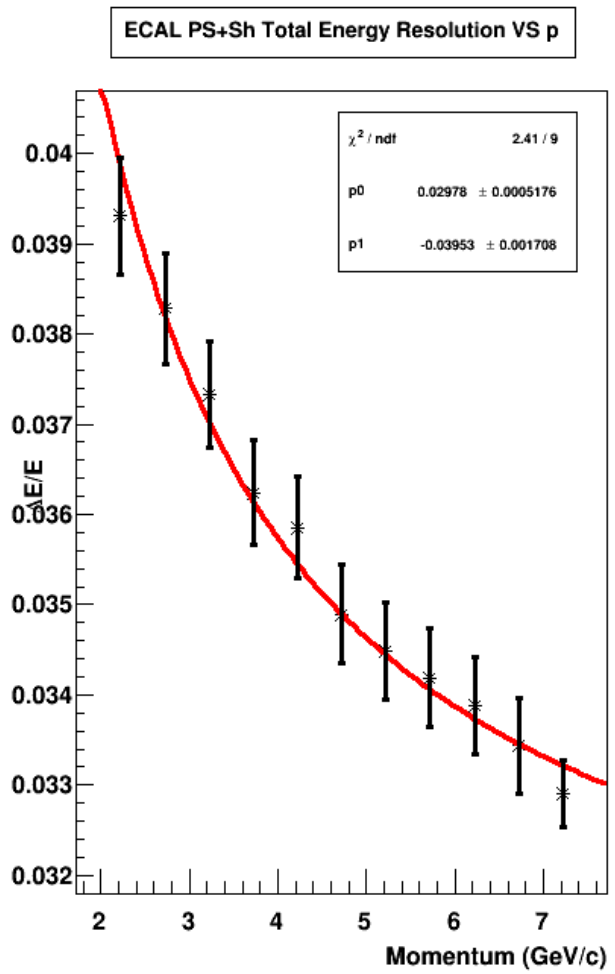
Energy Resolution : No PE

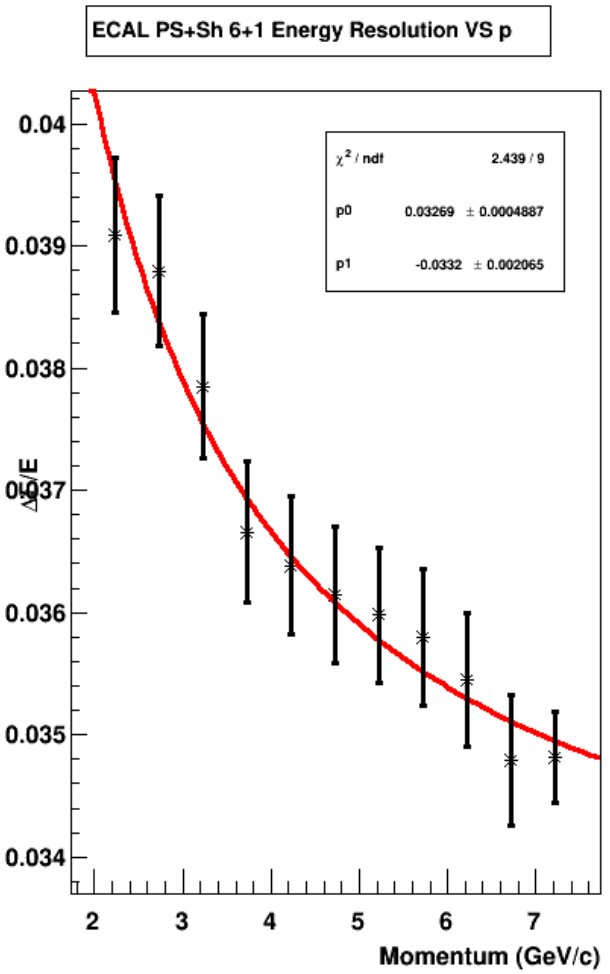


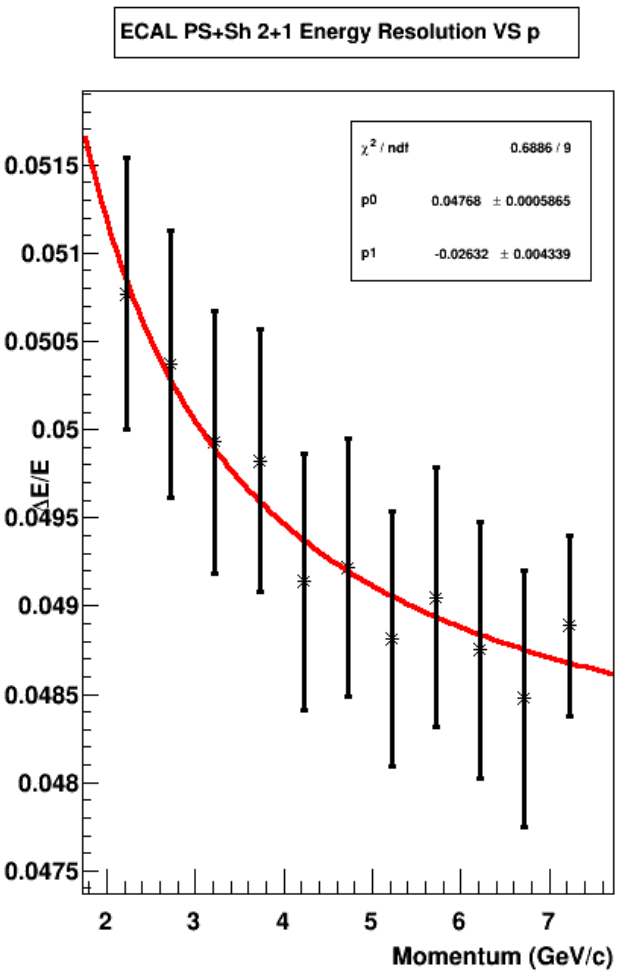




Energy Resolution : 900 PE







Energy Resolution : 200 PE