

TPC Endplate Studies concerning PFA Jet Energy Resolution

Steve Aplin

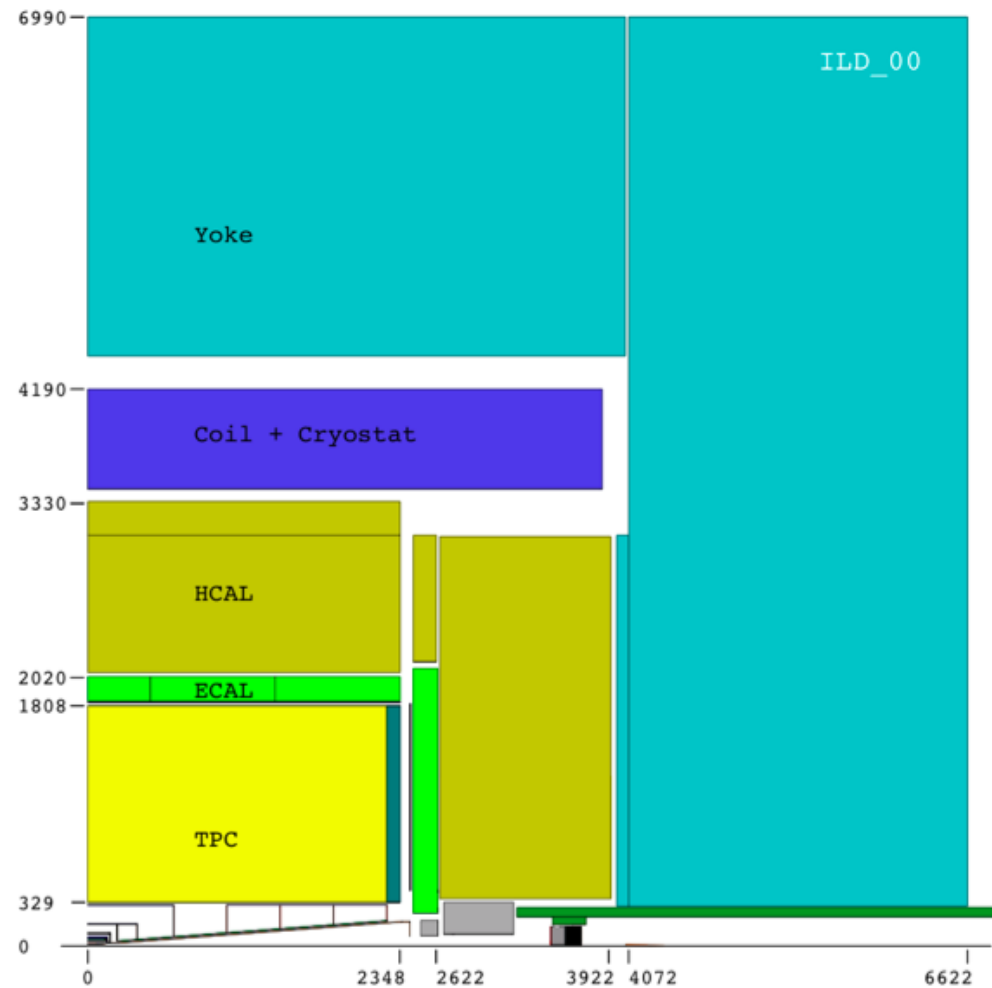
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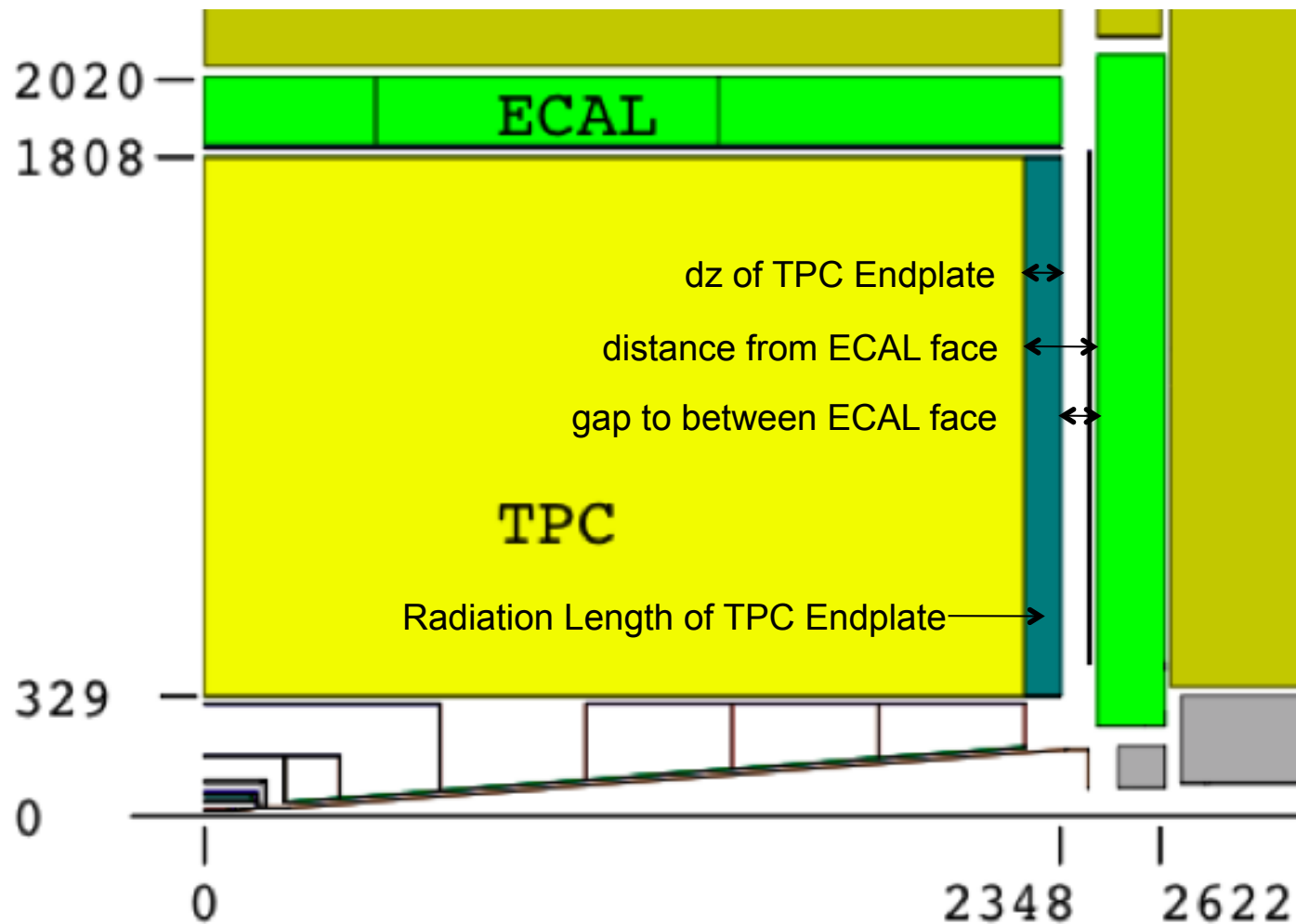
Overview

- Motivation: How much material can we **afford** in the TPC Endplate?
- Difficult to answer ...
- Attempt to provide input by studying the PFA Jet Energy Resolution for various TPC Endplate configurations in the ILD detector

Simulation Model



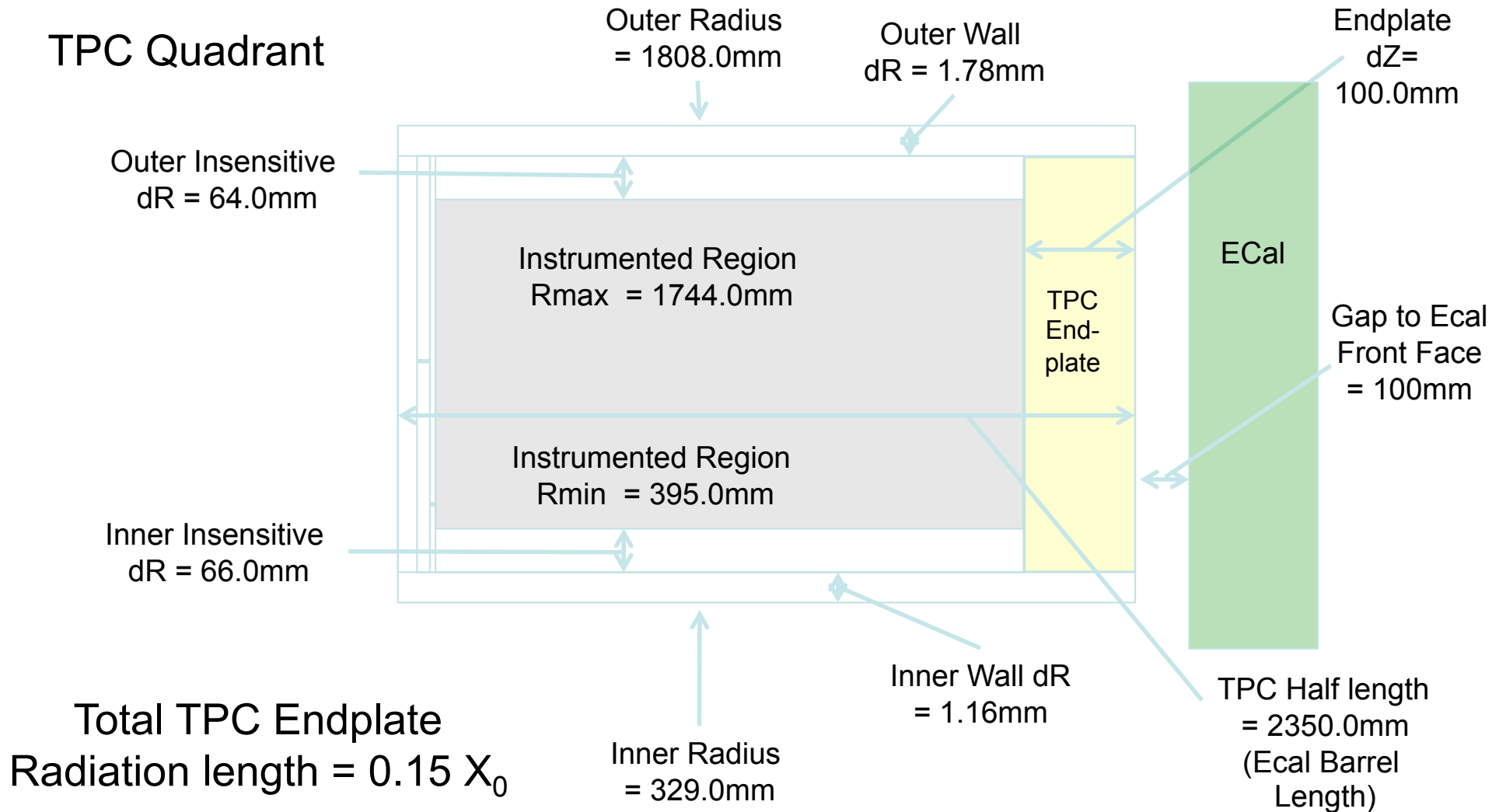
Simulation Model Variation



Simulation and Reconstruction

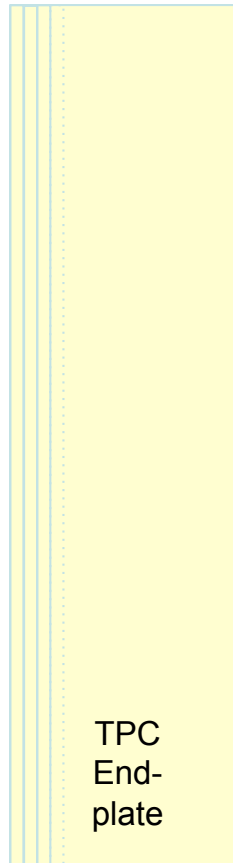
- Jet Energy Resolution determined for qqbar (uds) events at 91, 200, 500 GeV Center of Mass.
- Simulation performed using Mokka v01-07 with the ILD_00 detector model which was used for the Lol, making modifications to the TPC detector driver.
- Reconstruction performed using Standard Marlin based full reconstruction, including MarlinPandora (PandoraPFANew).

TPC Description in ILD_00 Model



TPC End-Plate configurations

- In simulation the TPC Endplate material description is represented by consecutive discs of homogenous material:

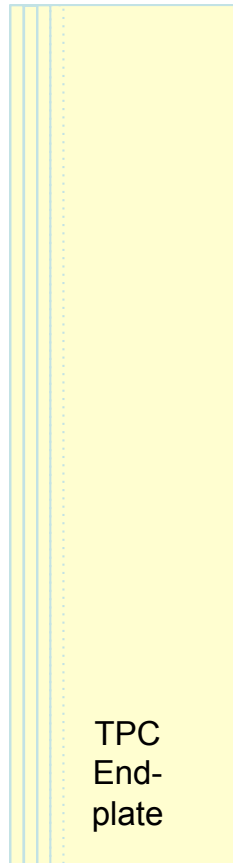


```
dz (mm) % X_0 Material
0.003 0.020 copper ( gating )
0.030 0.010 kapton
0.003 0.020 copper
1.964 0.002 TPC_gas
0.003 0.020 copper ( mpgd )
0.030 0.010 kapton
0.003 0.020 copper
1.964 0.002 TPC_gas
0.003 0.020 copper ( mpgd )
0.030 0.010 kapton
0.003 0.020 copper
3.964 0.004 TPC_gas
0.050 0.350 copper ( pads )
2.000 1.030 g10
0.500 0.530 silicon_2.33gccm ( R/O Electronics )
2.000 1.932 epoxy,etc
1.000 0.350 kapton
2.000 2.240 aluminium ( Cooling )
1.000 0.350 kapton
3.000 1.590 carbonfibre ( Stiffness )
80.450 6.240 Air(0.85)+G10(0.15) (space+R/O boards )

Total 14.770
```

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Material list adjusted to produce increasing total material X_0 while keeping to the overall Endplate thickness:

15% X_0
 30% X_0
 45% X_0
 60% X_0

Jet Energy Resolution vs EP X_0

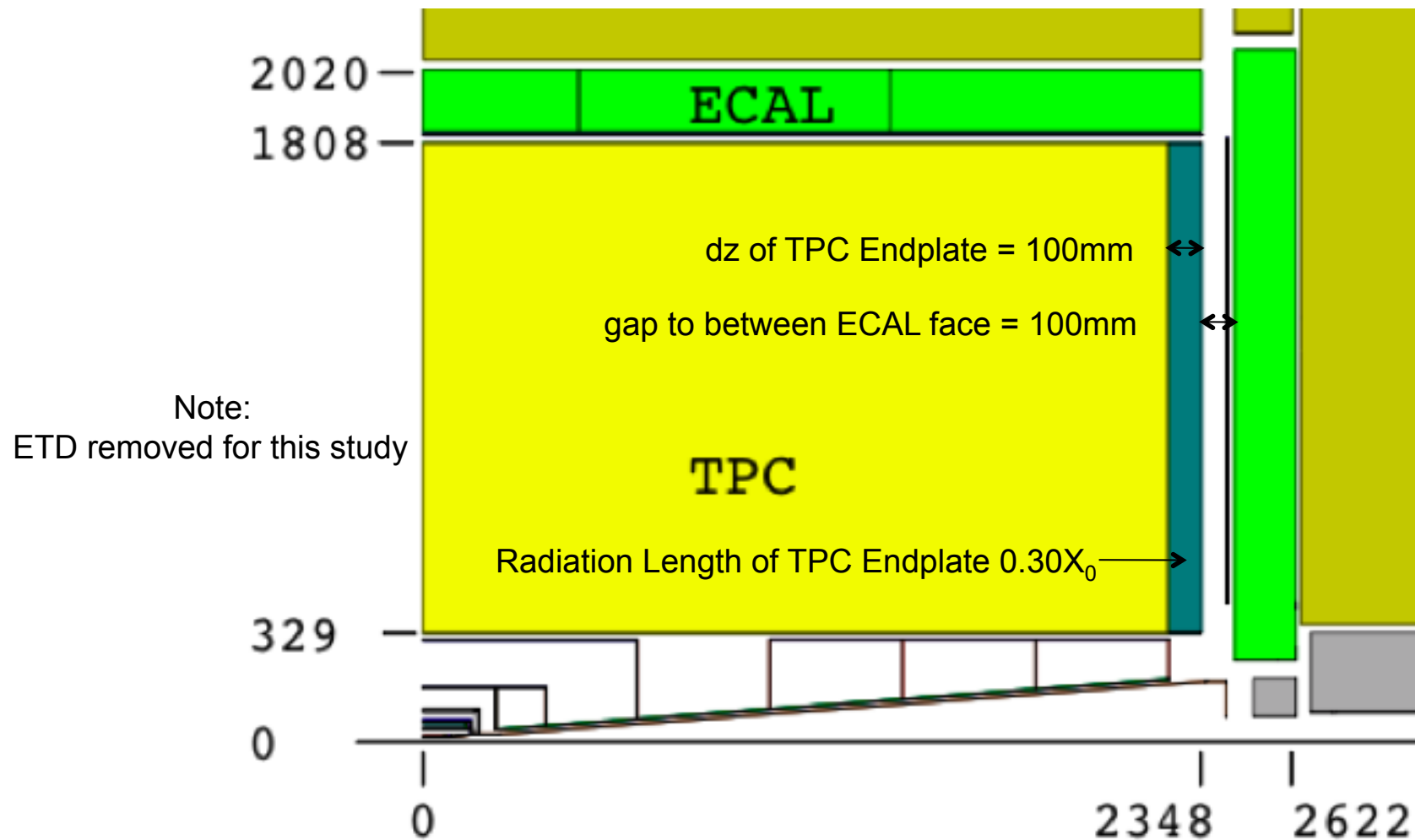
Jet Energy Resolution ($\sigma E/E$) in $0.8 < |\cos(\theta)| < 0.9$

	45 GeV	100 GeV	250 GeV
15 %	4.1 \pm 0.1	3.2 \pm 0.1	3.0 \pm 0.1
30 %	4.4 \pm 0.1	3.1 \pm 0.1	3.0 \pm 0.1
45 %	4.5 \pm 0.1	3.2 \pm 0.1	3.3 \pm 0.1
60 %	4.8 \pm 0.1	3.3 \pm 0.1	

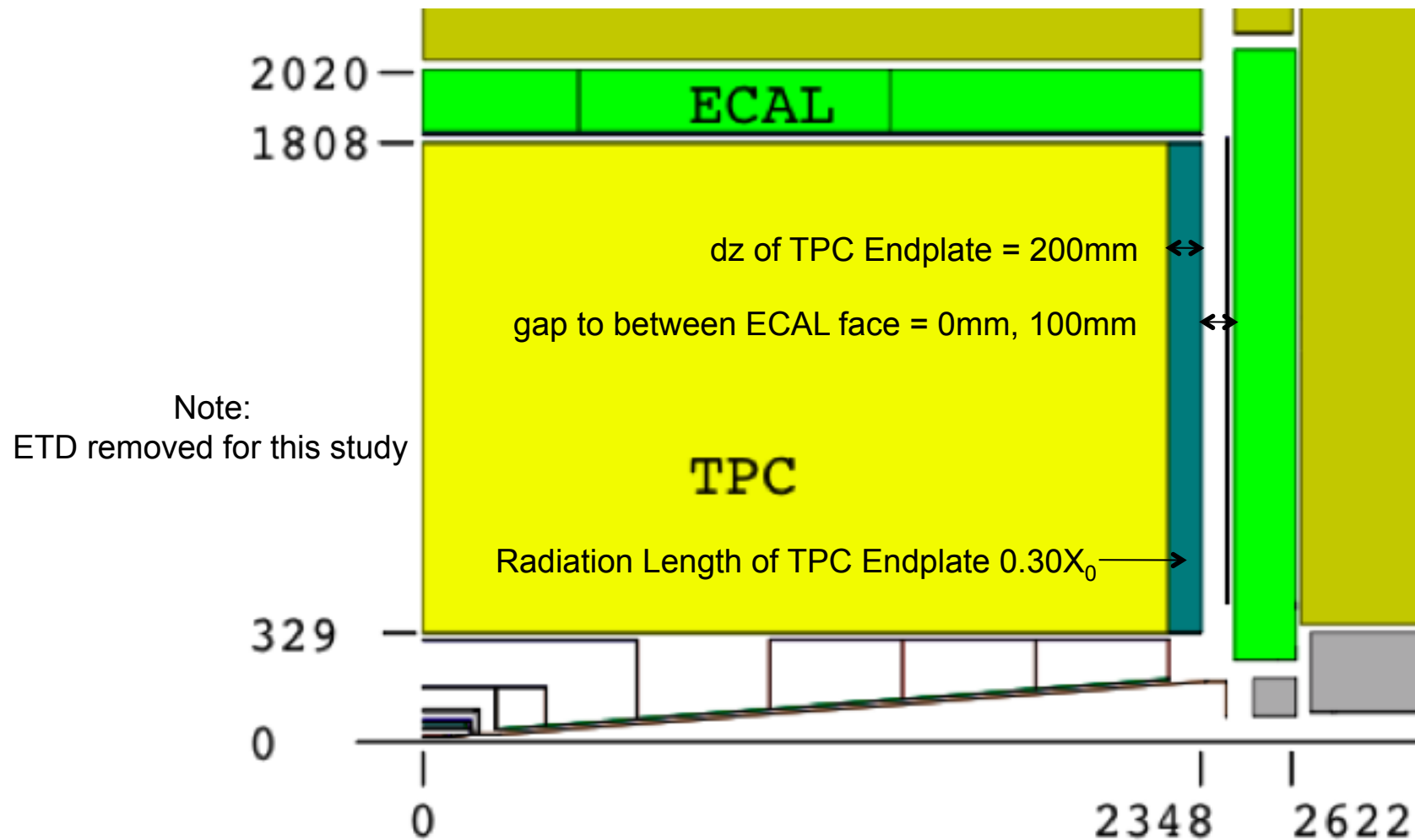
The difference is largest for low energy jets - perhaps not surprising since this is where PFlow is working very effectively, i.e. nominally a small confusion term.

Mark Thomson

Simulation Model Variation

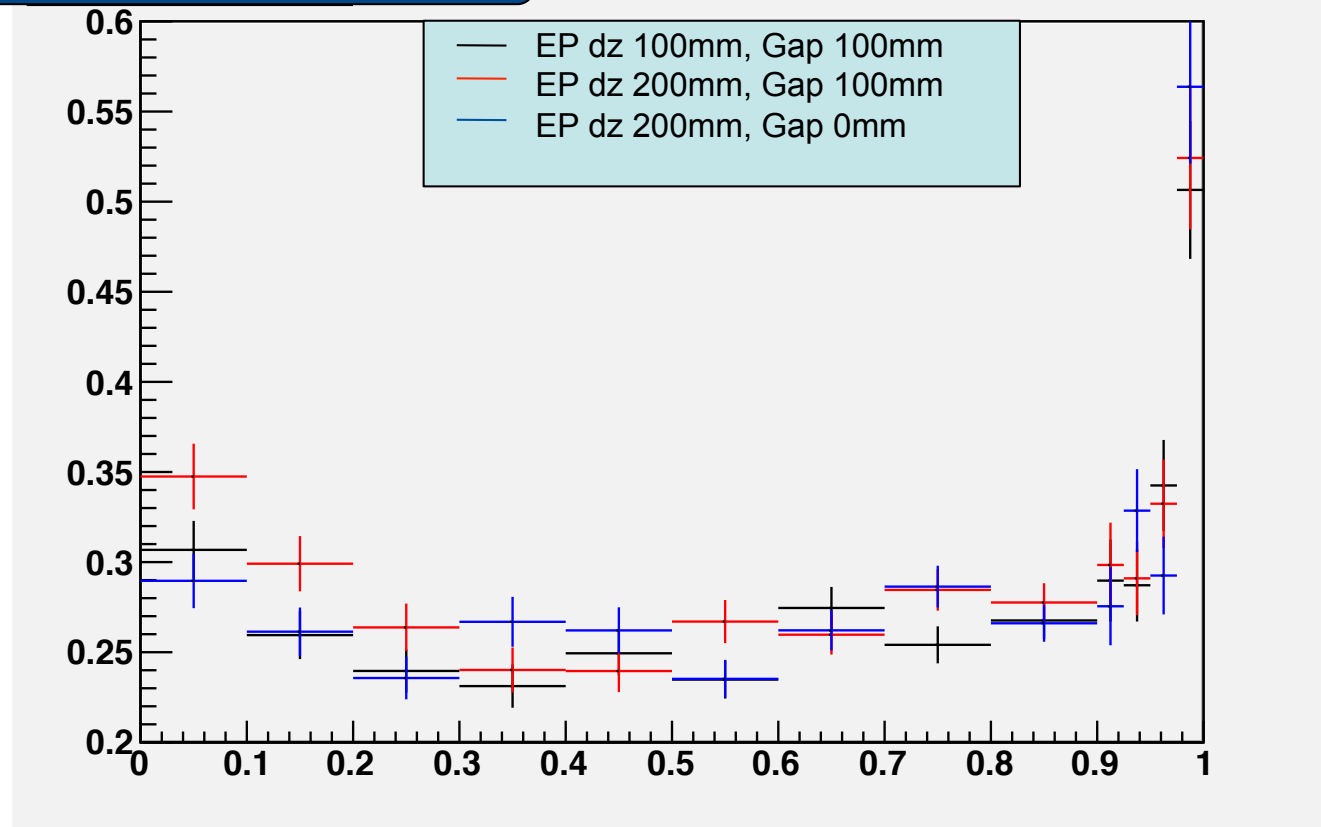


Simulation Model Variation



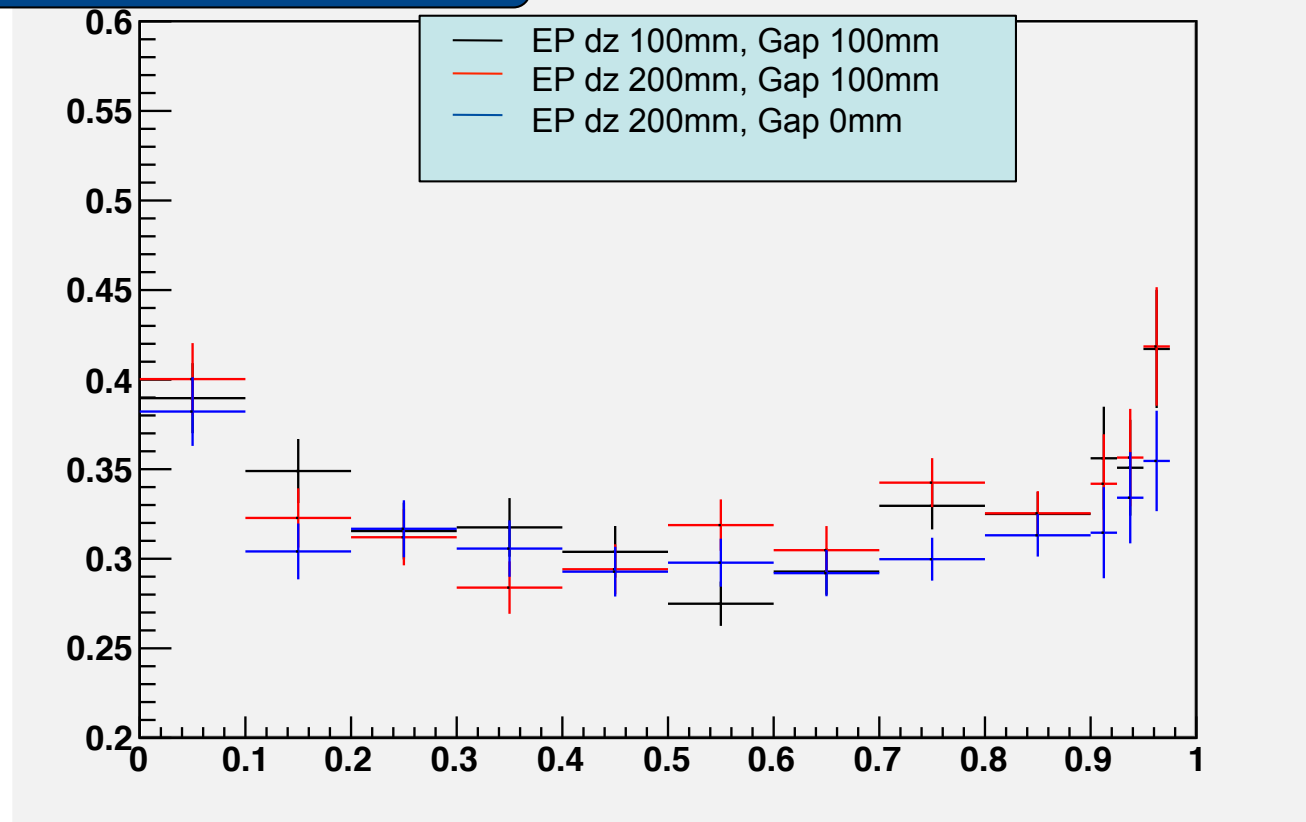
91 GeV

sigmaE vs |cos theta|



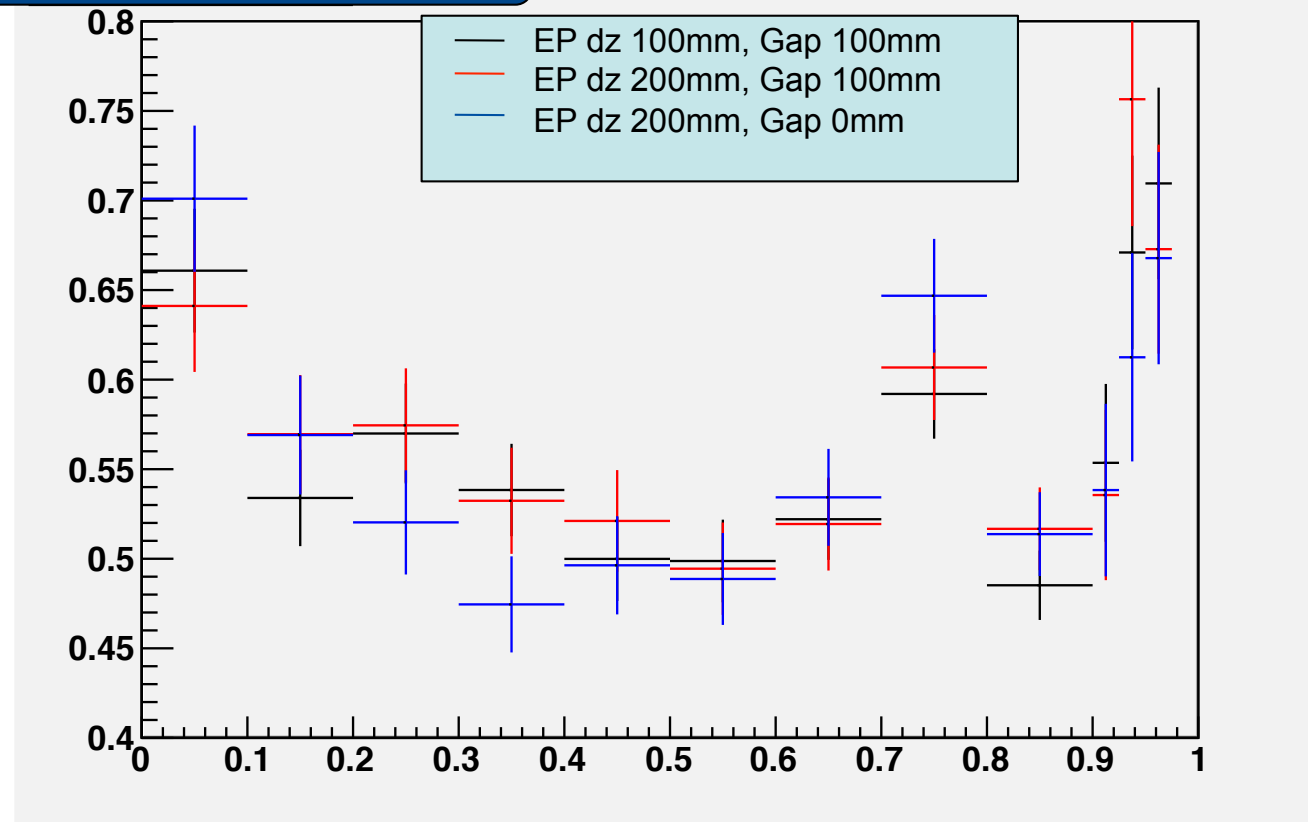
200 GeV

sigmaE vs |cos theta|



500 GeV

sigmaE vs |cos theta|



Summary

- For increasing material budget in the TPC endplate the trend in Jet Energy Resolution is as expected, although the differences are not large, the difference is largest for low energy jets.
- No significant effect seen in the Jet Energy Resolution when increasing the length of the TPC endplate to 200mm and removing the gap to the ECal face for a total radiation length of the endplate = $0.3 X_0$.
- For the new ILD simulation model ILD_01, the TPC model with use an endplate total radiation length of $0.23 X_0$.