LDC Detector Optimisation Results using PandoraPFA

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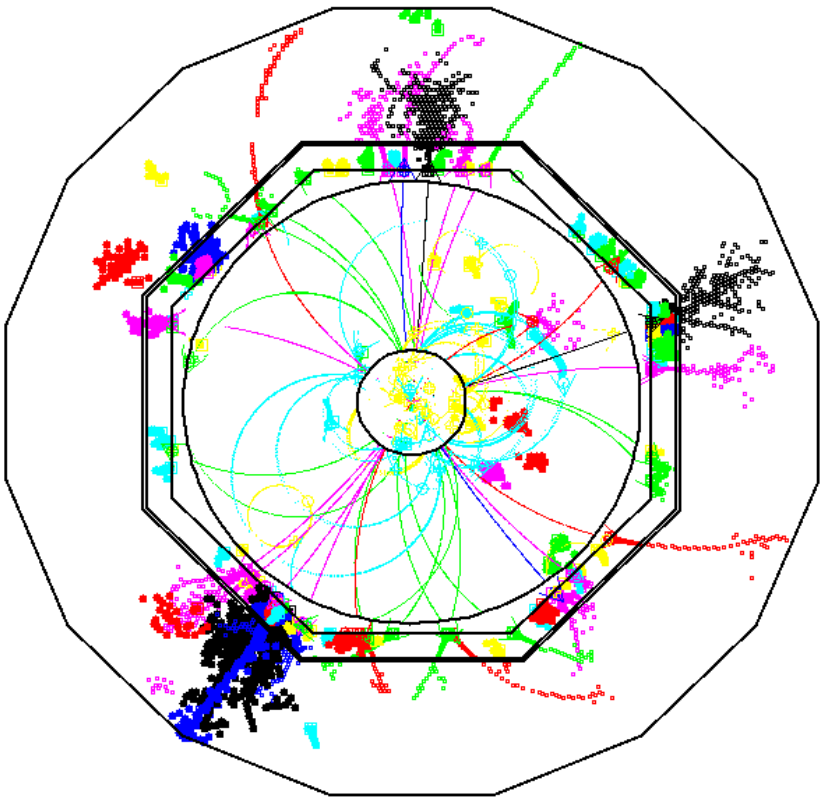


This Talk:

Brief summary of recent results from PandoraPFA:
- **HCAL granularity**
- **HCAL depth**
- **Detector Size**
- **B-field**

Limitations of PandoraPFA

- Before discussion performance - a few words about the limitations of the current algorithm….

Limitations:

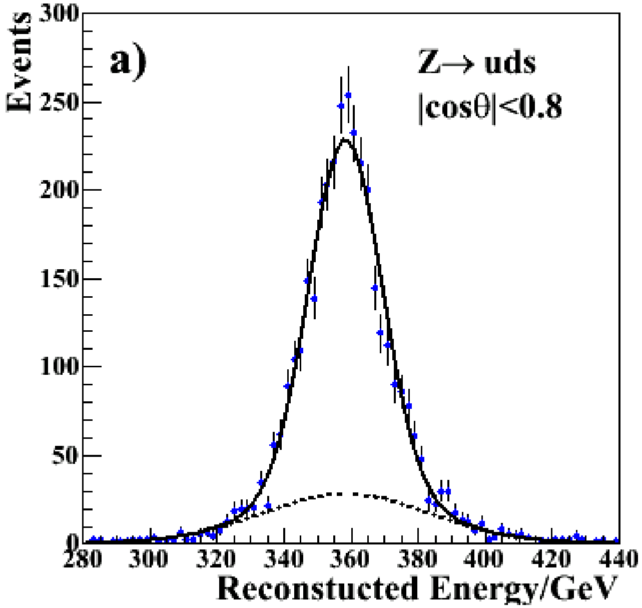
★ Currently only tested/tuned for TrackCheater tracks
★ Track extrapolation from TPC to Calorimeters uses simple Helix fit which doesn't account for energy loss. For looping tracks this is an issue.
★ Still too many "fragment" clusters from hadron showers – to date no real effort to identify these. This needs to be improved.
★ No treatment of muon chambers as a tail catcher or attempt to correct energy of leaking hadronic showers
★ No treatment of energy in FCAL
★ Photon ID is OK – but is very simple and could be improved.

Performance : Z→ uds jets

Figures of Merit:

σ_{75}

- Fit sum of two Gaussians with same mean. The narrower one is constrained to contain 75% of events
- Quote s of narrow Gaussian



rms_{90}

- Find smallest region containing 90 % of events
- Determine rms in this region

E_{JET}	$\sigma_E/E = \alpha\sqrt{(E/GeV)}$ $\lvert\cos\theta\rvert<0.8$
45 GeV	0.30
100 GeV	0.37
180 GeV	0.57
250 GeV	0.75

ILC GOAL OF 30 % ACHIEVED !

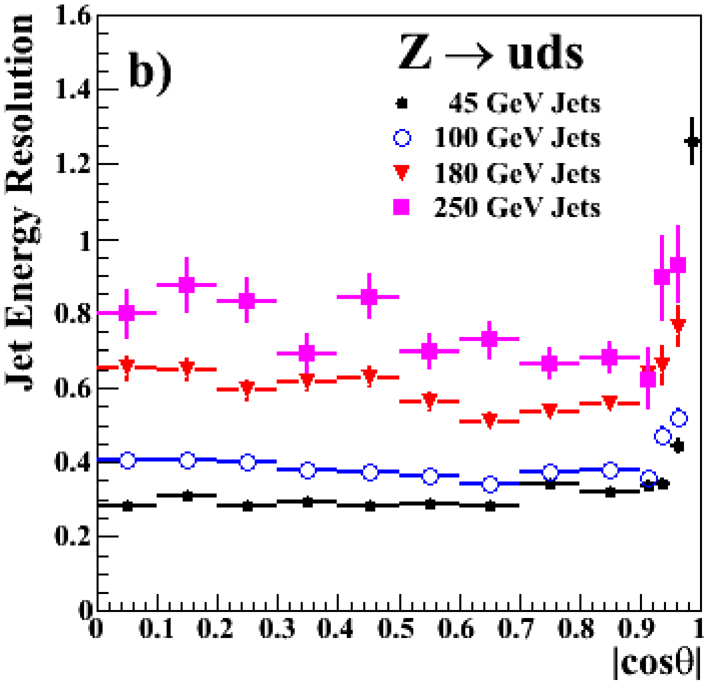
- BUT only for Z at 91.2 GeV
- Need to look at performance at higher energies

It is found that $rms_{90} \approx \sigma_{75}$

★ **The current performance of the algorithm is well described by the EMPIRICAL expression:**

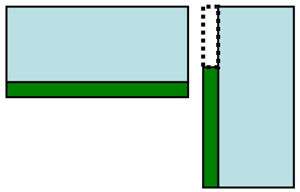
$$\frac{\sigma_E}{E} = \frac{0.265}{\sqrt{E(\mathrm{GeV})}} + 1.2 \times 10^{-4} E(\mathrm{GeV})$$

Angular Dependence



- **Jet energy resolution depends on polar angle**
- **Degradation in endcap : nuclear interactions in TPC endplate have some impact + longer track extrapolation**

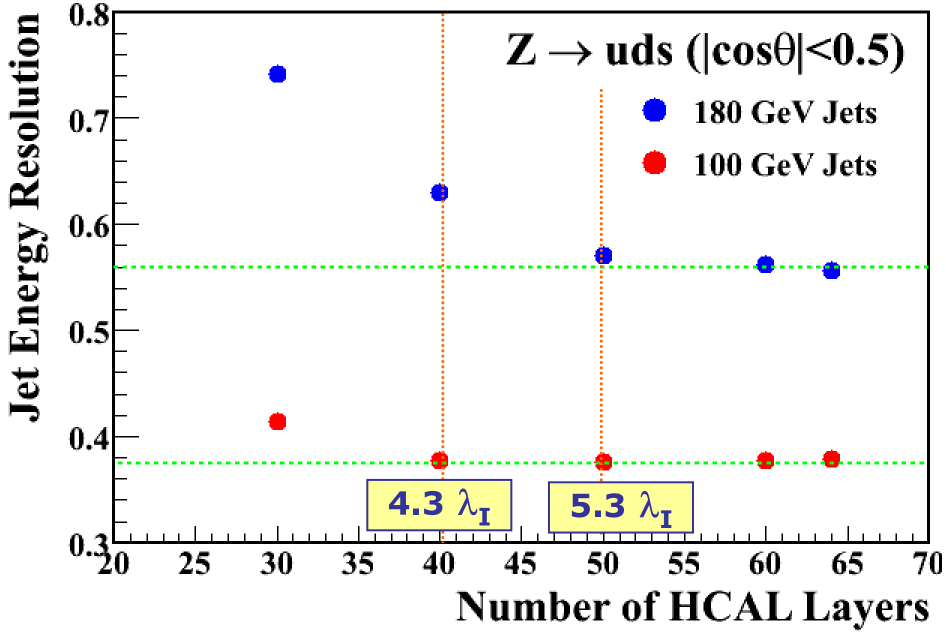
+ HCAL ring not currently simulated in Mokka



- **For high energy jets performance in barrel region worse at low values of |cosθ|**

HCAL Depth

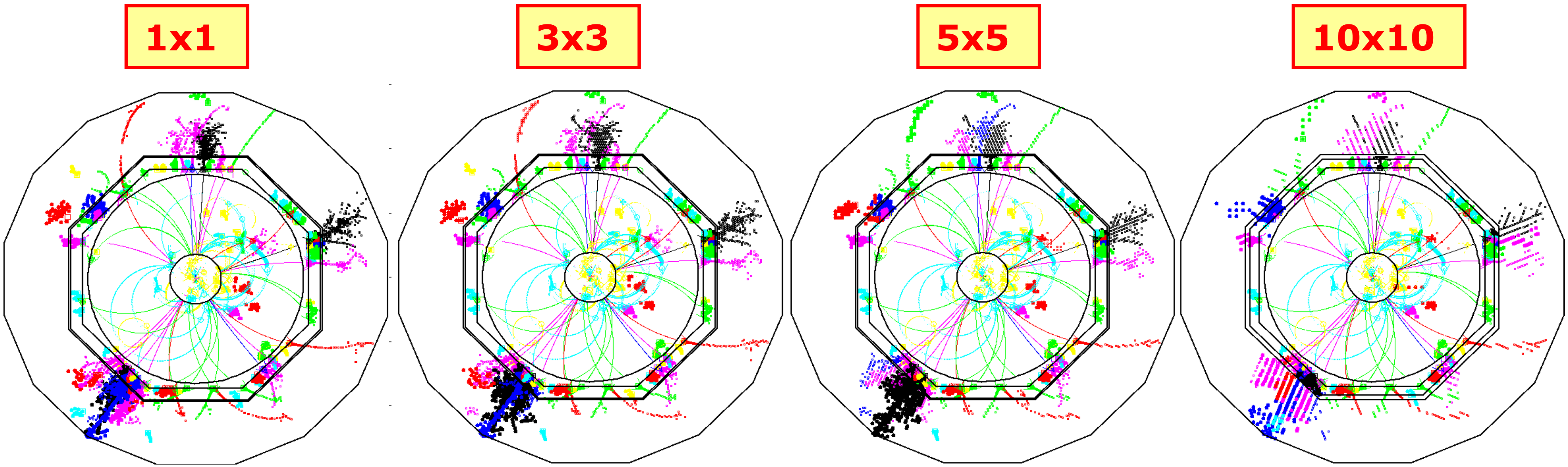
★ Recently investigated this hypothesis
- Generated some **Z→uds** events with a large HCAL (63 layers)
- In PandoraPFA introduced a configuration variable to truncate the HCAL
- Took account of hexadecagonal geometry



- For **100 GeV** Jets no advantage in going to larger HCAL !

- For **180 GeV** Jets HCAL leakage degrades PFA performance

e.g. HCAL Transverse Granularity

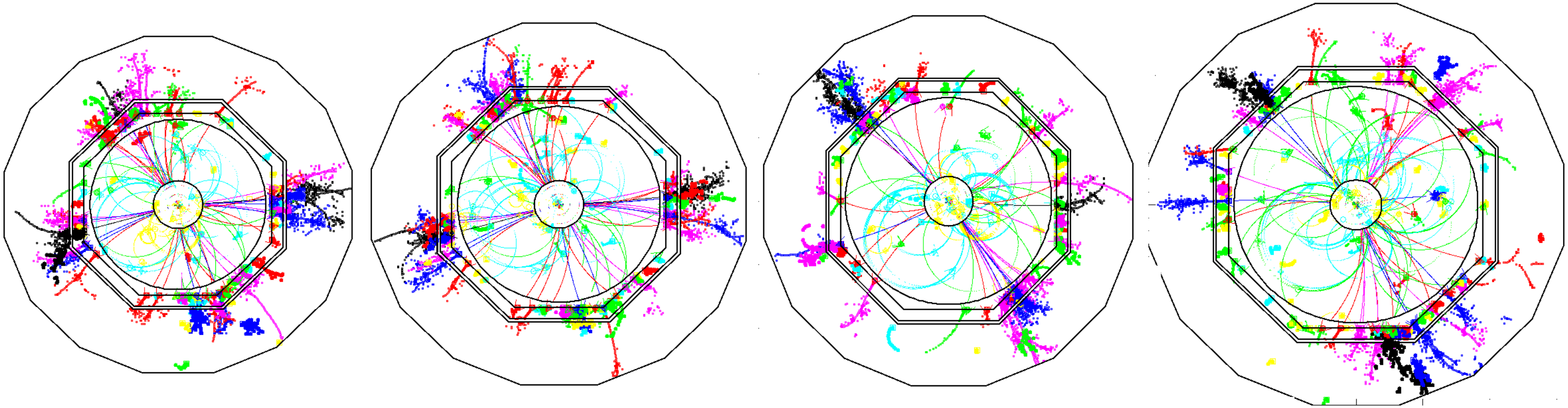


Detector Model	$\sigma_{Evis}/E = \alpha\sqrt{(E/GeV)}$	
	Z @91 GeV	tt@500 GeV
LDC00Sc 1cm x 1cm	31.4 ± 0.3 %	42 ± 1 %
LDC00Sc 3cm x 3cm	30.6 ± 0.3 %	45 ± 1 %
LDC00Sc 5cm x 5cm	31.3 ± 0.3 %	48 ± 1 %
LDC00Sc 10cm x 10cm	33.7 ± 0.3 %	56 ± 1 %

- ★ 10x10 too coarse (can be seen clearly from display)
- ★ Finer granularity helps somewhat at higher energies
- ★ Not yet considered DIGITAL HCAL

Radius and Magnetic Field

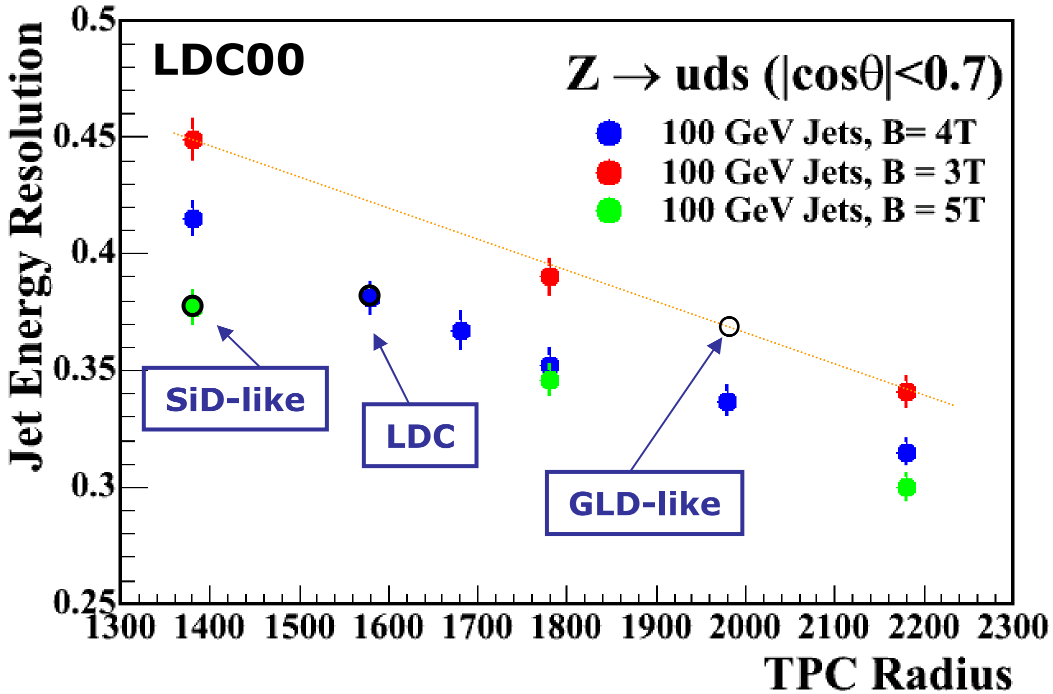
r_{TPC} = 1380 mm | r_{TPC} = 1580 mm | r_{TPC} = 1690 mm | r_{TPC} = 1890 mm

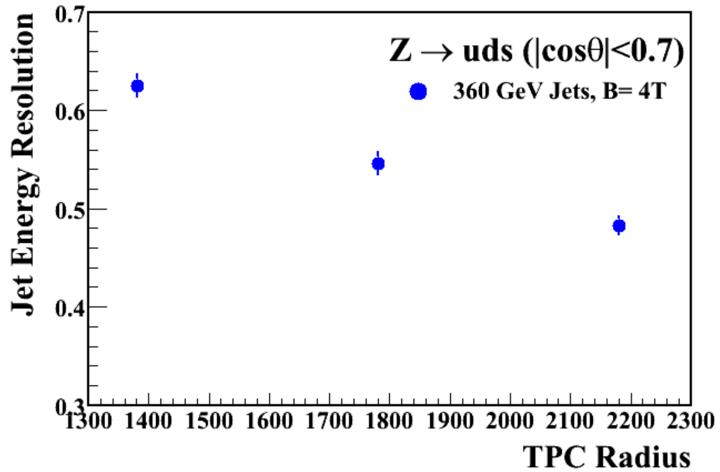


Look at jet energy performance for 100 GeV Jets in Barrel

- ★ Used LDC00 detector model
- ★ LDC01 gives very similar results
- ★ Look at jets from Z→uds at rest
- ★ Vary field from 3-5 T
- ★ Vary radius of TPC from 1380-2180 mm
- ★ No retuning of algorithm (don't believe this is necessary)

Results





★ **Results consistent with:**

$$\frac{\sigma_E}{E} \propto \frac{1}{B^{0.24} R^{0.6}}$$

★ **As expected large radius/ large field does best**

★ **How much due to "intrinsic detector" resolution and how much due to software deficiencies ?**

No Conclusions / What Next

- ★ Starting to be able to perform (useful?) studies
- ★ Next intend to look at ECAL transverse granularity
  - ★ does finer granularity help ?
- ★ <u>Any other suggestions ?</u>

+Starting to look at physics performance…..