Detector Optimzation using particle flow

- Slides taken from talk by Mark Thompson
- Based on work done with LDC detector model in the framework of MOKKA/ MARLIN
- Try to gain some insight into the relation between particle flow and detector size

② Current Performance

Figures of Merit:

rms_{90}

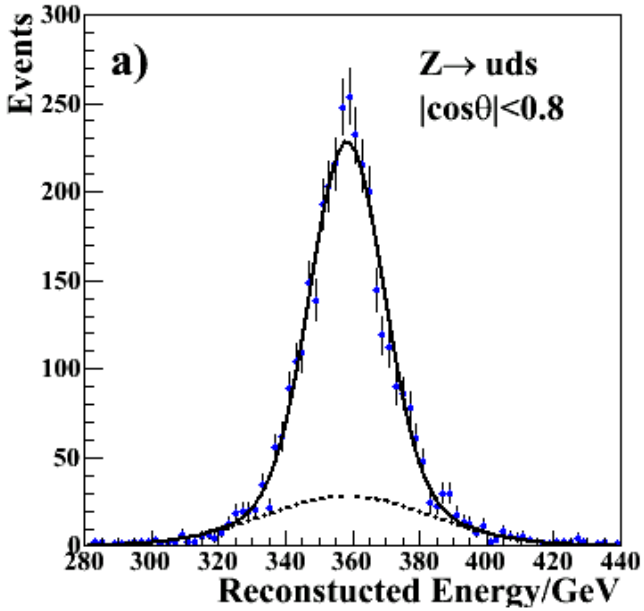
- ★Find smallest region containing 90 % of events
- ★Determine rms in this region

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

For jet energies < 100 GeV performance is probably good enough for physics studies

σ_{75}

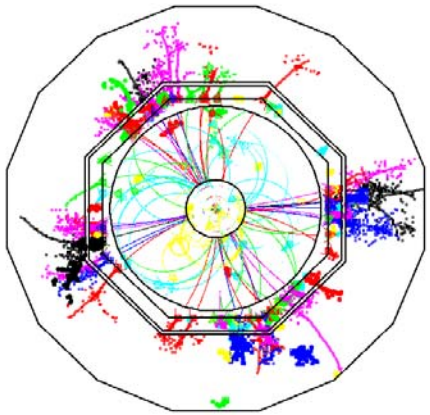
- ★Fit sum of two Gaussians with same mean. The narrower one is constrained to contain 75% of events
- ★Quote σ of narrow Gaussian



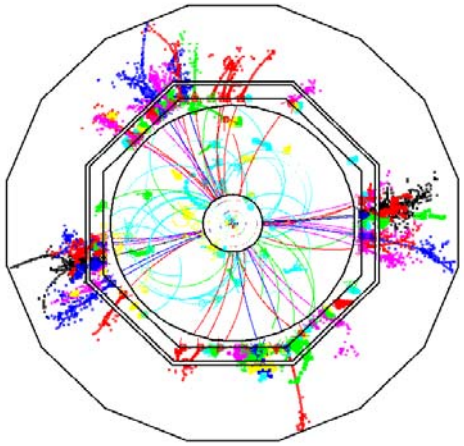
It is found that $rms_{90} \approx \sigma_{75}$

e.g. Radius/Field

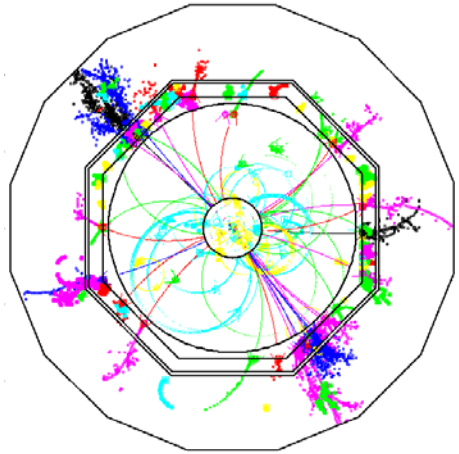
r_{TPC} = 1380 mm



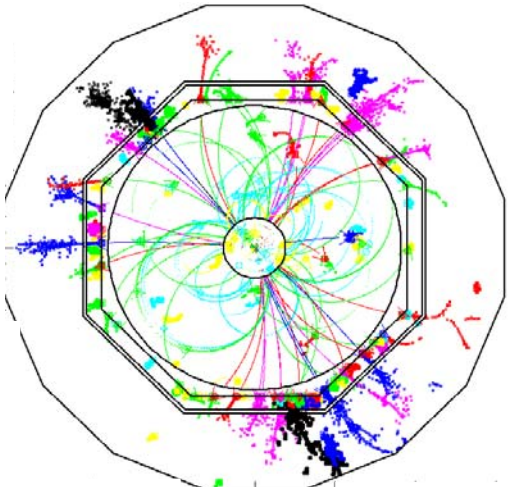
r_{TPC} = 1580 mm



r_{TPC} = 1690 mm

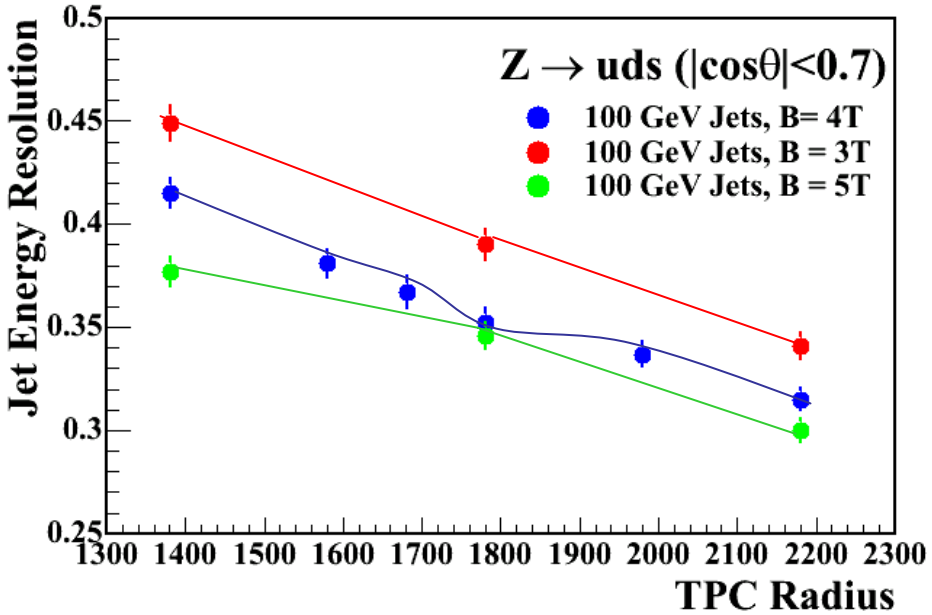


r_{TPC} = 1890 mm

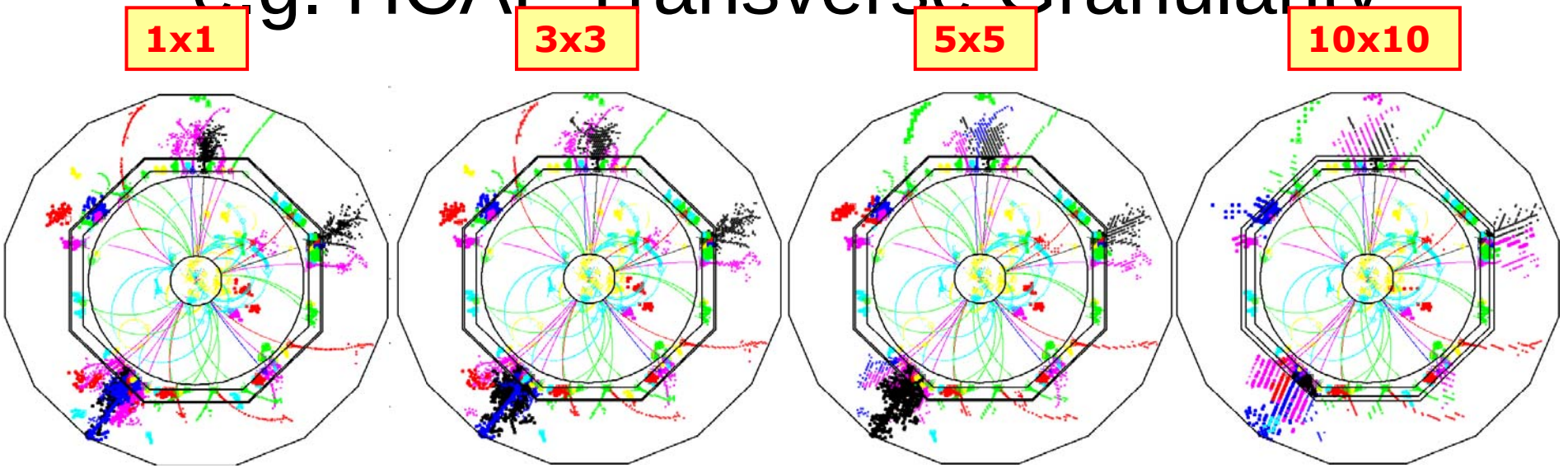


e.g. 100 GeV uds Jets in Barrel

- ★ Performance vs. radius/B (Tesla TDR detector)
- ★ Argues for large high field
- ★ With a reasonable cost model for ECAL+HCAL and Solenoid could identify "optimal" parameters



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 %

Visible energy resolution

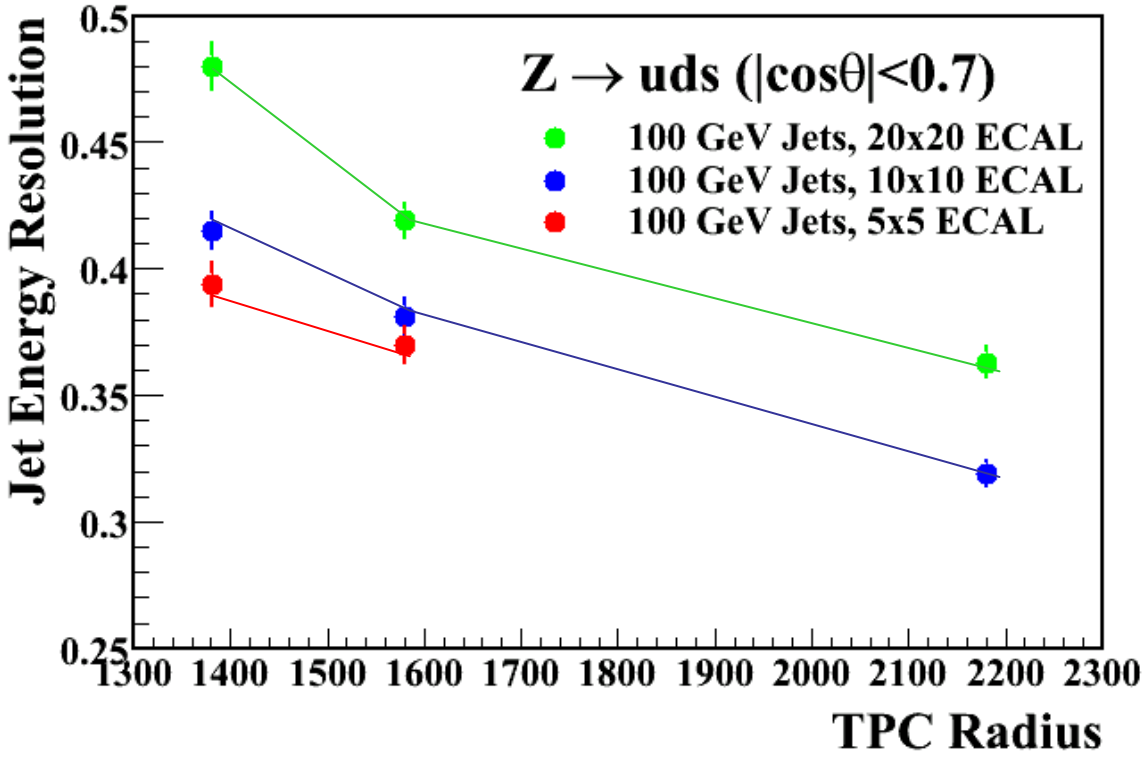
★ 10x10 too coarse (can be seen clearly from display)

★ Finer granularity helps(?) somewhat at higher energies

e.g. ECAL Transverse Granularity

- **Use Mokka to generate Z → uds events @ 200 GeV with different ECAL segmentation: 5x5, 10x10, 20x20 [mm²]**

- **Detector model: LDC00Sc (~Tesla TDR)**
- **B = 4 Tesla**
- **30x30mm² HCAL**



With PandoraPFA

- **20x20 segmentation looks too coarse**
- **For 100 GeV jets, not a big gain going from 10x10 → 5x5mm²**

[for these jet energies the contributions from confusion inside the ECAL is relatively small]

④ “Physics Studies”

- ★ **PandoraPFA is not perfect, but does a reasonable job**
- ★ **Can start to use it for full simulation physics studies**
- ★ **Using Marlin jet finders + reconstructed PandoraPFA reconstructed PFOs, it took me about 1 hour to produce the “classic” PFA plot**

$e^+e^- \to \nu\nu WW \to \nu\nu qqqq$, $e^+e^- \to \nu\nu ZZ \to \nu\nu qqqq$