Studies with PandoraPFA

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Physics Signatures II

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Studies with PandoraPFA

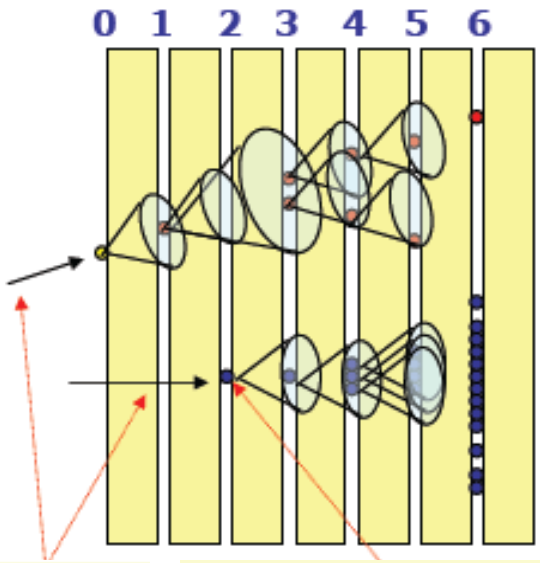
- **Consider both LDC and SiD-like detectors**
  - **Use LDC00Sc parameters**
    - B-field 4T, tracker radius 1.7 m, detector length 2.7 m
    - SiW 40 layer ECAL 10x10 mm pads
    - HCAL 40 layer analog scintillator, 3x3 cm pads
  - **Scale to SiD-like parameters**
    - Vary B-field (4, 5, 6 T)
    - Reduce tracker radius (1.27 m)
    - ECAL layers (40 → 30)
  - **Impact of tracking technology (TPC vs. silicon)**
    - Minimal effect due to use of track cheating
- **Longer-term**
  - **Implement full SiD-like design**
  - **Main bottleneck**
    - Need description of SiD-like detector with HCAL digital readout for gear/marlin
  - **HCAL: 1x1 cm RPC digital**

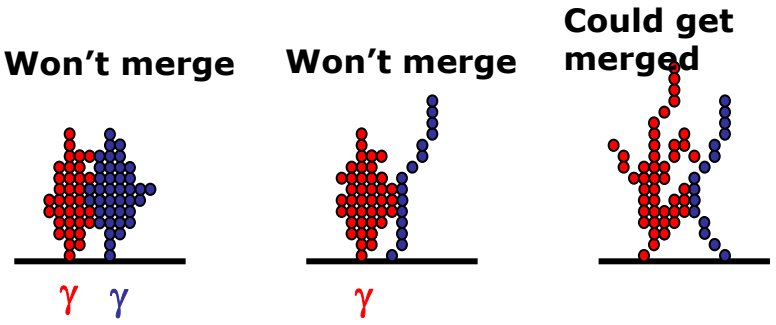
Overview of PandoraPFA

- **Performs ECAL & HCAL reconstruction and particle-flow analysis**
  - ♦ **Preparation: classify hits by**
    - Depth into calorimeter
    - Isolation from other hits
    - Is it MIP-like?
  - ♦ **Cluster non-isolated hits using cone algorithm**
    - Use tracking information to seed new clusters
    - Associate hits with clusters
    - Unused hits form new clusters
  - ♦ **Associate clusters**
    - ♦ Based on topology
    - ♦ Allow for photons, merged tracks, backscatters, MIP segments
    - Perform iterative reclustering as needed, using track momentum

The core of PandoraPFA

Mark Thomson



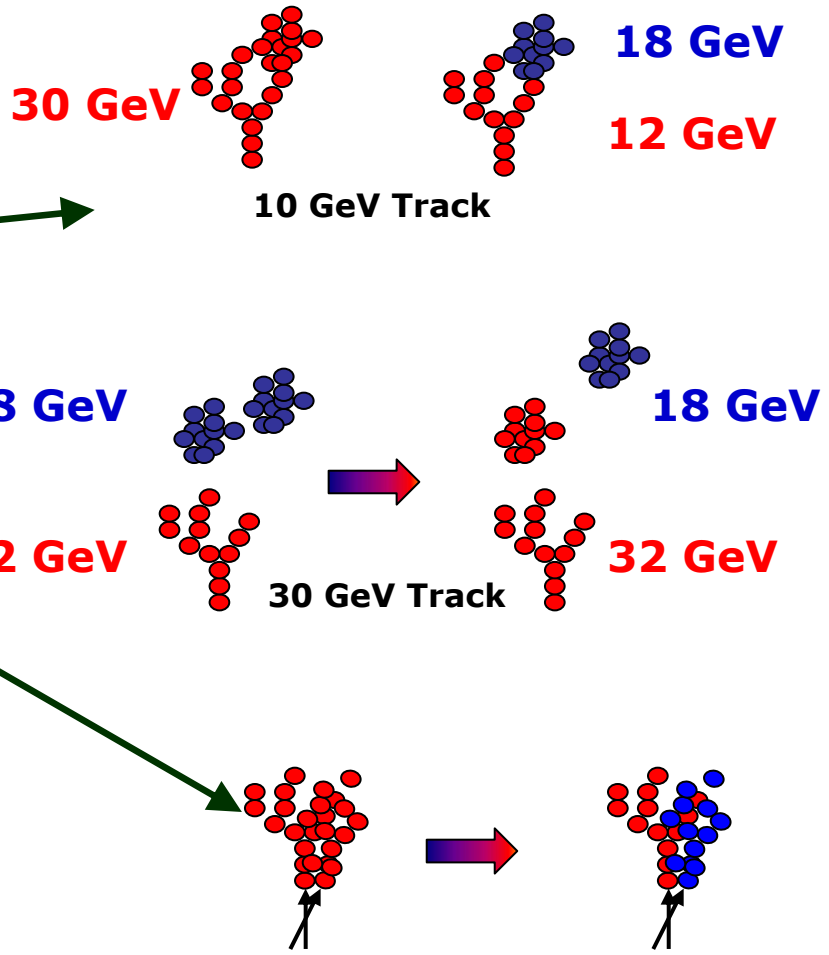


Iterative reclustering

Mark Thomson

When p_{track} is inconsistent with $E_{cluster}$, adjust clustering parameters until cluster splits in a reasonable way

- Important for higher-energy jets
- Cluster splitting
  - Re-apply clustering algorithm, reducing cone angle until energy matches track
- Cluster merging
  - Merge nearby clusters, possibly splitting them as needed to achieve energy match
- Track association disambiguation
  - If multiple tracks associated with a cluster, apply above until acceptable matches are found
- Last resort if nothing works
  - Ignore track information, use cluster information only



PandoraPFA and LDC00Sc

Recent studies using LDC00Sc detector and PandoraPFA

- Use rms90
  - RMS of smallest region containing 90% of the events
- Shows acceptable jet energy resolution up to E_{jet} < 100 GeV
- Continuing development by Mark Thomson
  - Expects adequate performance will be achieved at higher energies
  - Biggest problem will be confusion at higher energies

rms90

E_{JET}	$\sigma_E/E = \alpha\sqrt{(E/GeV)}$ $\lvert\cos\theta\rvert<0.7$
45 GeV	0.295
100 GeV	0.305
180 GeV	0.418
250 GeV	0.534

Mark Thomson
August 2007

Initial results

Errors ± 0.2–0.3

Configuration	n/sqrt(E)	Jet energy
LDC00Sc	30.5	45
LDC00Sc 5T	31.2	45
LDC00Sc 30 layer ECAL	32.4	45
LDC00Sc Sid-ish 4T	32.6	45
LDC00Sc Sid-ish 5T	32.0	45
LDC00Sc Sid-ish 6T	33.8	45
LDC00Sc	36.7	100
LDC00Sc Sid-ish 4T	42.7	100
LDC00Sc Sid-ish 5T	41.0	100
LDC00Sc Sid-ish 6T	39.8	100

M. Stanitzki

- **100 GeV numbers are very preliminary**

Items to be studied

Questions to address

- Can we reproduce Mark's numbers?
  - Yes, at least at lower energies
- Jet energy resolution as function of
  - Radius
  - B-field
  - ECAL layers
  - HCAL layers, depth
    - ILD development: studying 4.5–5 λ_I?
    - Analog scintillator vs. digital RPC
  - Detector length
- Comparison of LHep and LCPhys physics lists
  - Recently discovered not all datasets we're using use LCPhys (it's not the Mokka default)
- Dependence of PFA on hadronic cascade code
  - Need some indication of sensitivity of PFA to cascade shower models
  - Effect of different models handling of statistical fluctuations may be important
- Conversion to real tracking from cheated tracks
- Implementation of full SiD concept in marlin
  - Need full detector description for use with Mokka
  - Requires new code for digital readout simulation