

# Status of PFA @ NIU

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ALCPG LCSim meeting  
May 23<sup>rd</sup>, 2006

# PFA development choices

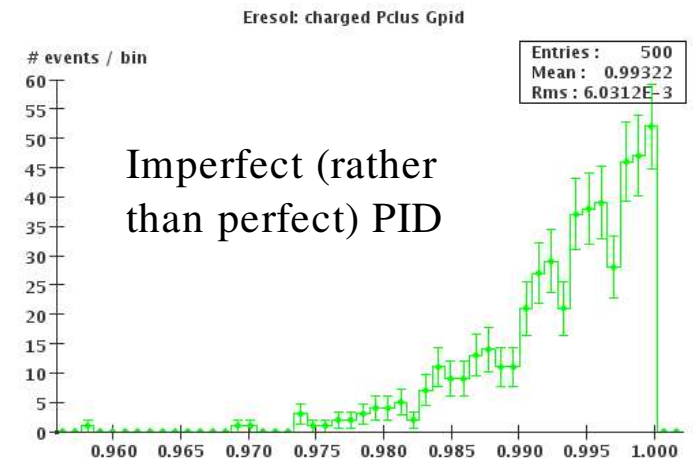
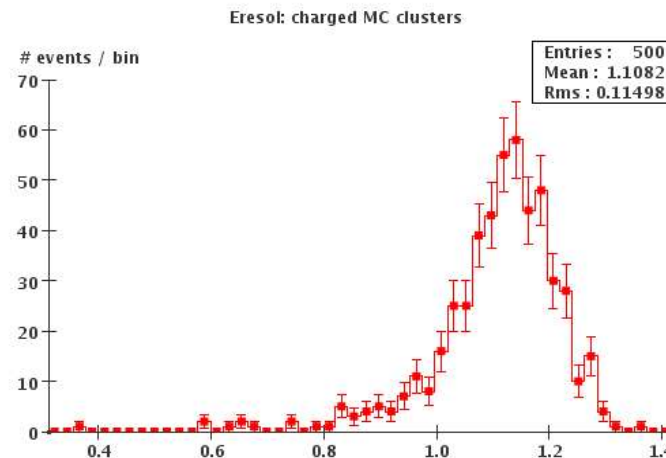
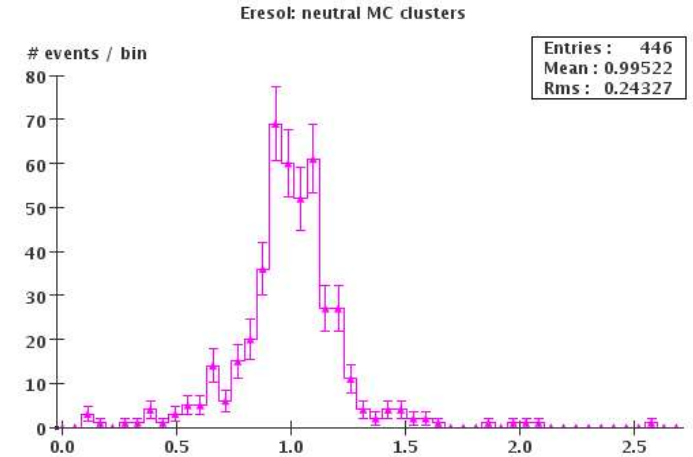
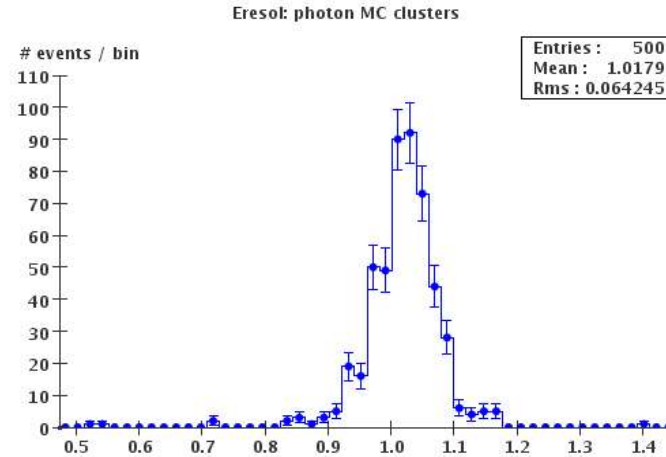
- Based on directed tree clusters
- Compliance with the org.lcsim + template scheme (Boulder)
- Geometry: sidaug05\_tcmt

Sidaug05 + scintillator-based, non-projective HCal and muon system (TCMT)

- ECal: 30 3.75mm layers, non-projective Si/W 5x5mm<sup>2</sup>
- HCal: 34 28mm layers, non-projective Sci/Steel 10x10mm<sup>2</sup>
- TCMT: 48 28mm layers, non-projective Sci/Steel 30x30mm<sup>2</sup>
- Hit selection:  $E < E_{\text{MIP}}/4$ , time < 10ns (DigiSim)
- Energy reconstruction: digital for hadrons, analog for photons

# Perfect PFA

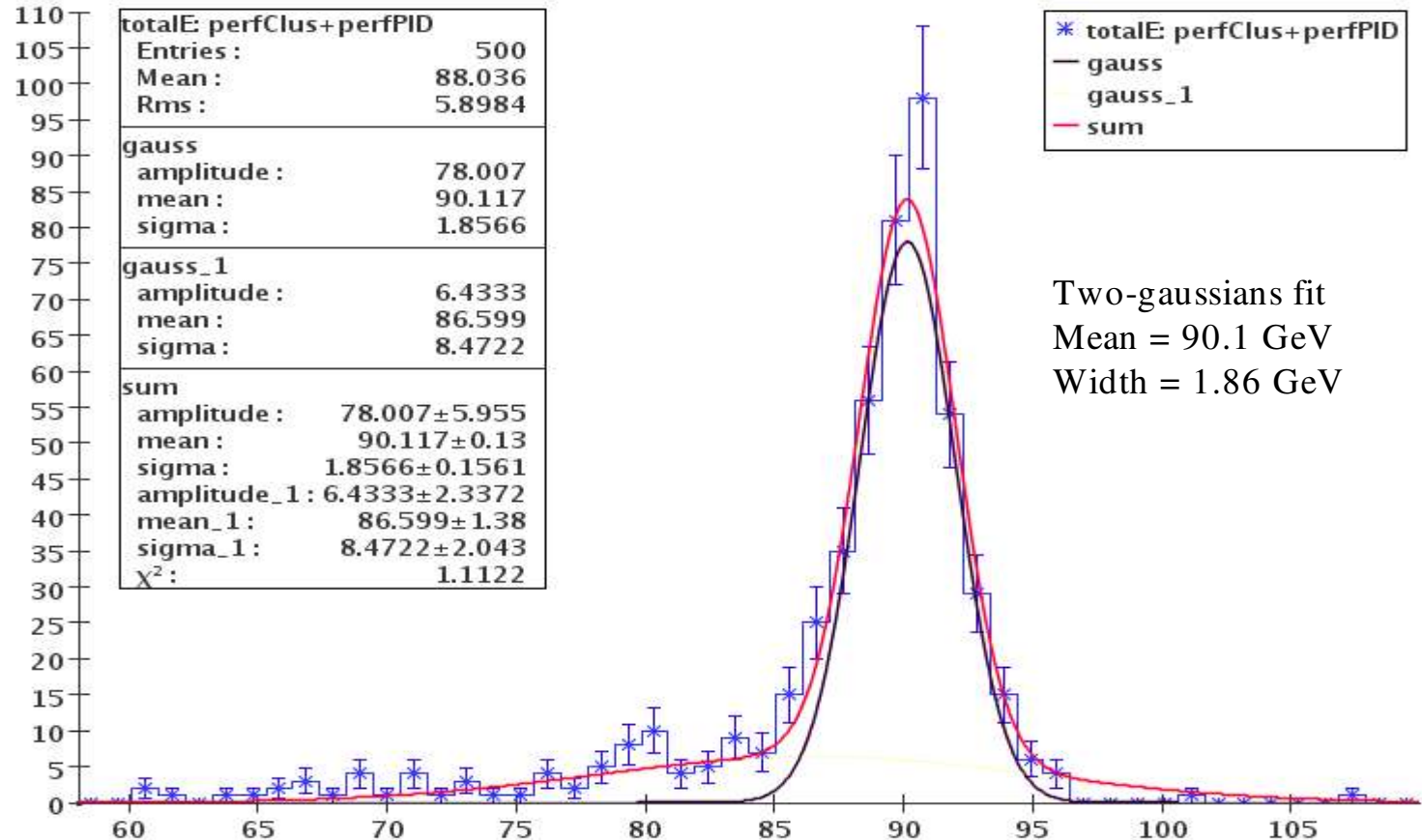
- Perfect clusters: all hits coming from each generated Final State particle
- Perfect PID: use real hadron masses rather than pion masses
- Calibrated by global particle type contributions



# Perfect PFA

- Perfect clusters: all hits coming from each generated Final State particle
- Perfect PID: use real hadron masses rather than pion masses
- Calibrated by global particle type contributions
- Still a long low-energy tail which affects the RMS
- No angular or missing energy corrections yet (further improvements?)
- Improvements probably due to Geant4 fix to EM showers

Z --> Hadrons, perfect PFA, perf. clustering, perf. PID



# Real PFA

- Under development (no Z-mass plots yet...)
- Main missing part: shower patrec (cluster merging)

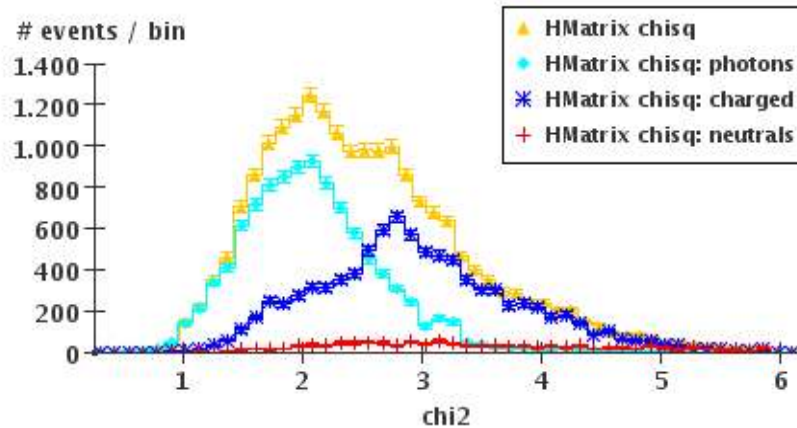
Directed tree clusters (fragmented) --> final showers

Vishnu's code exists, worked fine using (inefficient) AIDA Ntuples + hep.lcd directed tree clustering  
It is currently being ported to the org.lcsim + template framework

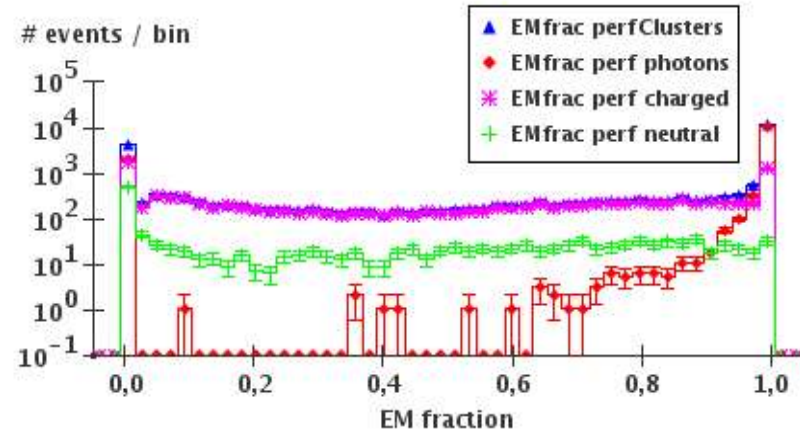
- ClusterID:
  - charged: combination of track matching and MIP stubs (also E/p?)
    - Both swimmer-based (5x5 in ECal, 2x2 in Hcal) and stepper-based track matching tools implemented
    - MIP stubs: using a DirectedTreeClusterer tuned for finding MIPs
  - photonID: EMfraction seems better than HMatrix for perfect clusters
  - ... both studies to be repeated for final reco clusters (pending on shower patrec)

# First look at photon-ID

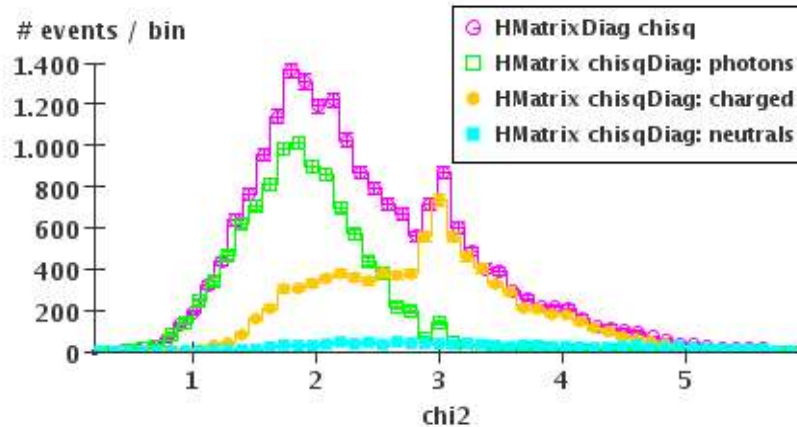
HMatrix chisquare



EMFrac

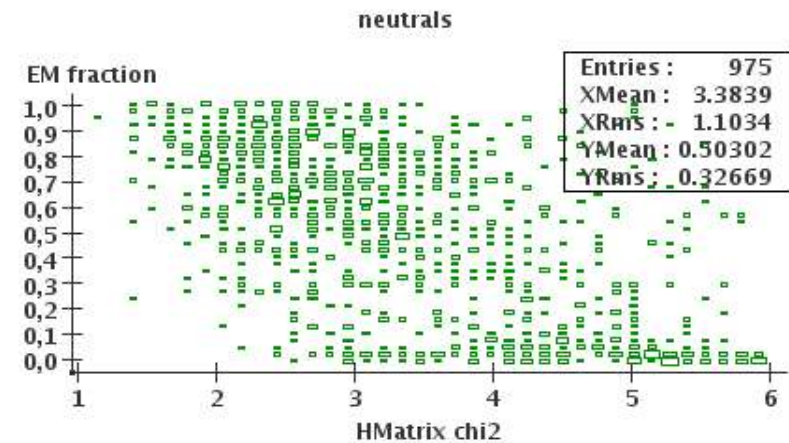
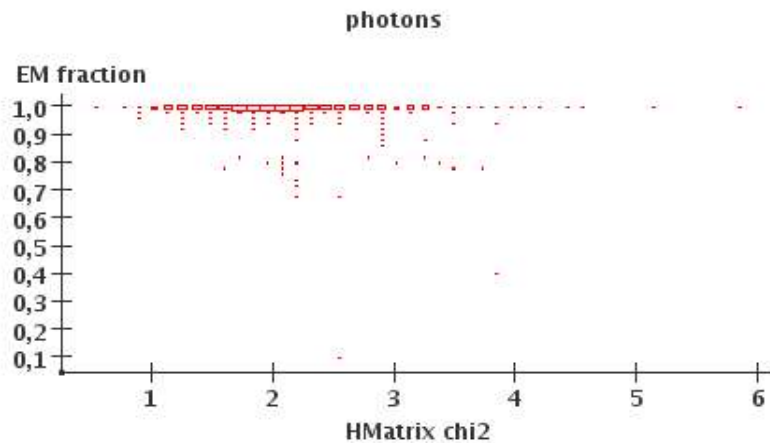
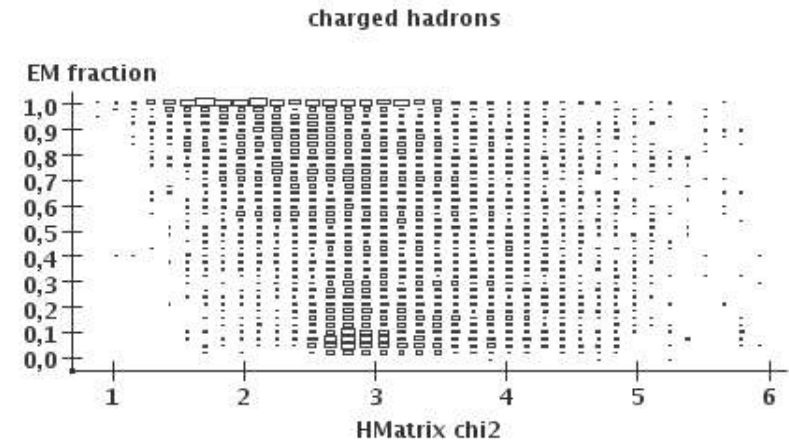
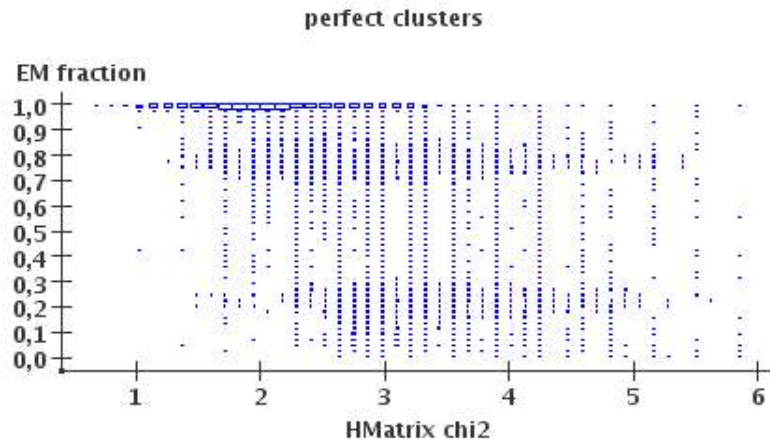


HMatrix diagonal chisquare

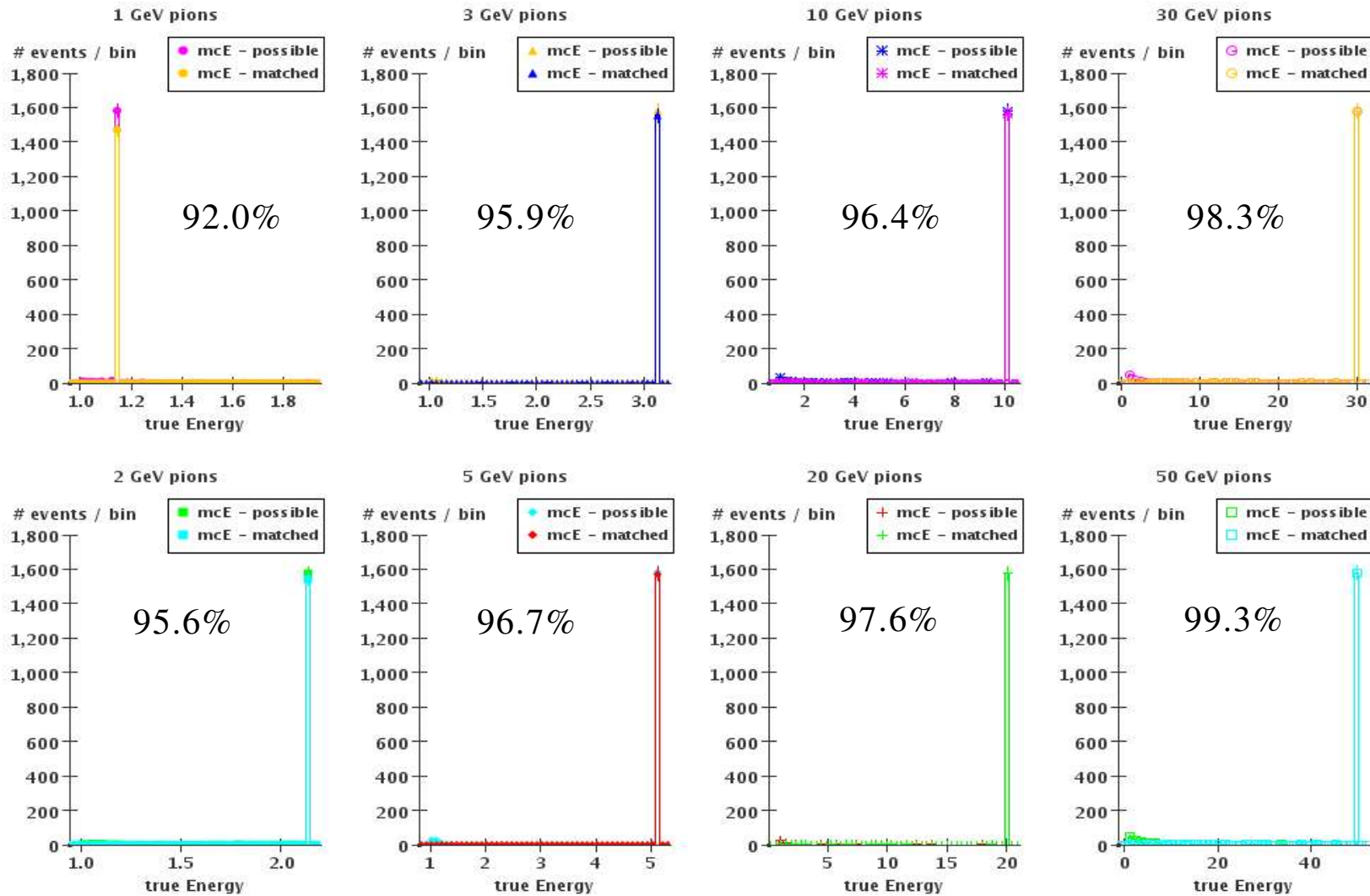


- ✓ Look at Hmatrix available in org.lcsim
- ✓ Available variables: full  $\chi^2$  and diagonal  $\chi^2$
- ✓ Used EMfrac for cross-check

# Perfect clusters: Diagonal chi2 vs. EMfrac



# Pions at 90°: track matching efficiency with energy





# Summary

- **Most of the tools needed are in place** (org.lcsim + template framework)  
missing is the shower pattern recognition algorithm
- **DigiSim has been incorporated, and used to apply energy and timing cuts**  
several digitization effects can also be studied
- **Reconstructed clusters can be made persistent for faster analysis development**  
new: unnecessary collections can be dropped (Thanks, Tony!)
- **Things to do:**
  - Shower patt.reco. code being ported from tuple-based to org.lcsim + template
  - Evaluate performance of clusterID options with reconstructed clusters
  - Further calibration corrections (dependences on E, incidence angle, interaction layer)
  - Comparisons to other people's results (standard geometries)
  - Comparisons for different geometries, B-fields and technologies