

Thoughts on Energy Flow

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- Toy MC studies.
- REPLIC.
- Properties of typical showers.
- Possible approach to pattern recognition?
- Just preliminary studies at this stage.

Toy MC study of jet energy resolution

PYTHIA Z^0 MC; smear tracks and clusters by expected resolution functions and evaluate visible energy. Exclude neutrinos.

Tracks $\Delta p_T/p_T = (0.5 \oplus 2.6/p_T) \times 10^{-4}$

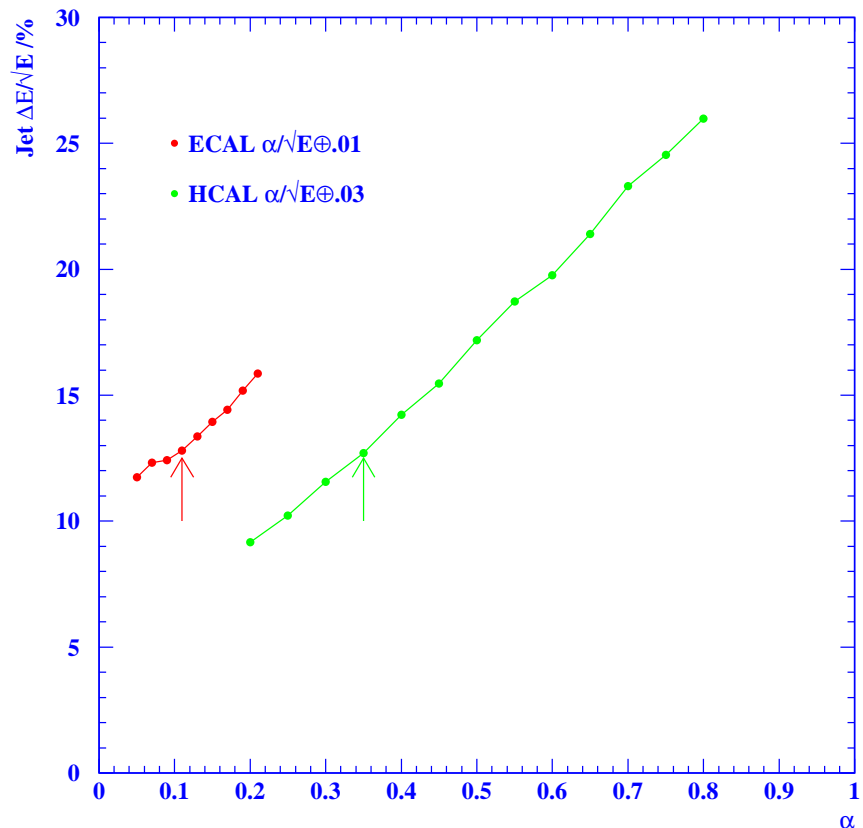
ECAL $\Delta E/E = \alpha/\sqrt{E} \oplus 0.01$

HCAL $\Delta E/E = \beta/\sqrt{E} \oplus 0.03$

Look at jet energy resolution (excluding neutrinos)

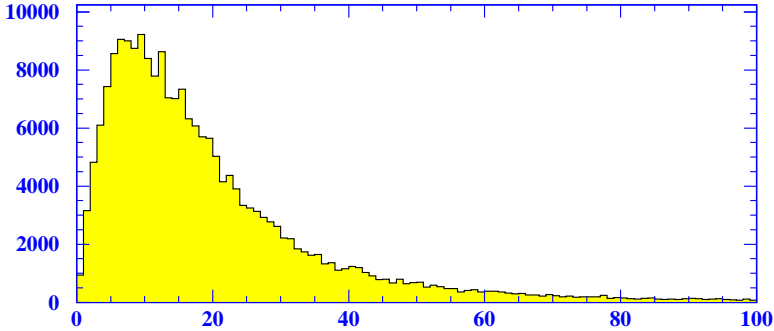
Arrows denote default resolution values
 $\Rightarrow \Delta E/E = 13\%/\sqrt{E}$.

\Rightarrow Intrinsic energy resolution not very important (especially ECAL).

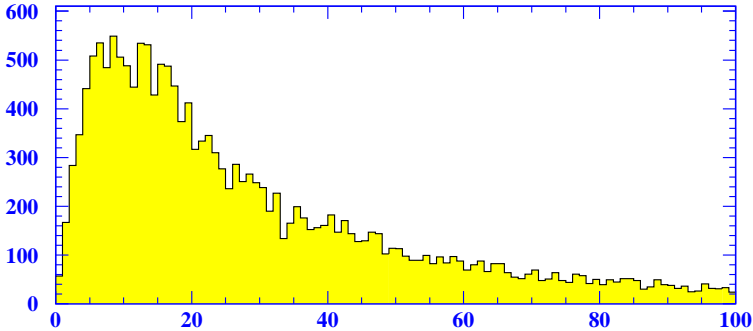


Toy MC study of jet energy resolution

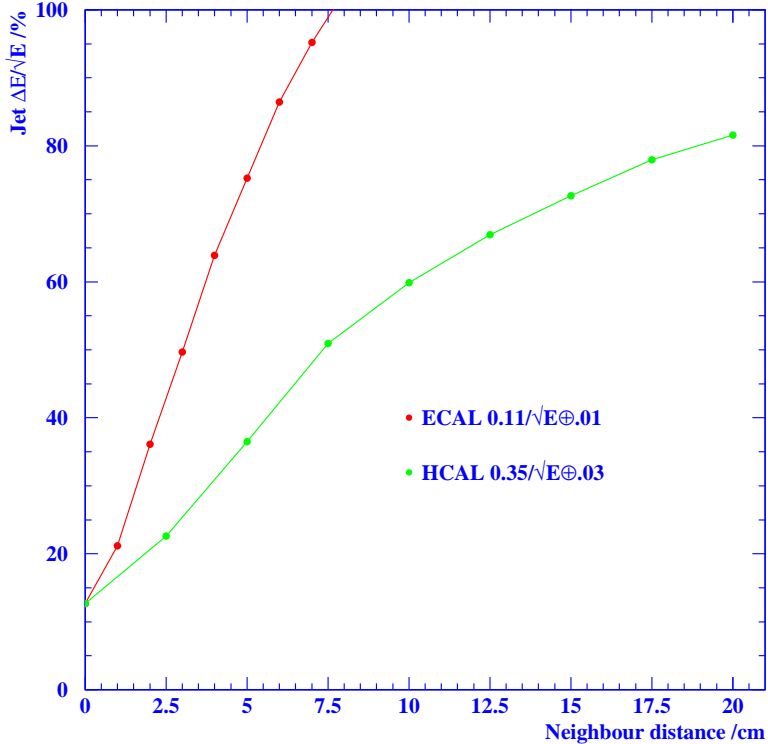
Extrapolate particles to surface of calorimeter; assume particles within some distance cannot be resolved and are lost.



Photon - distance to nearest hadron



Neutral hadron - distance to nearest charged



Distance to relevant neighbour

Effect on resolution.

⇒ Spatial resolution crucial.

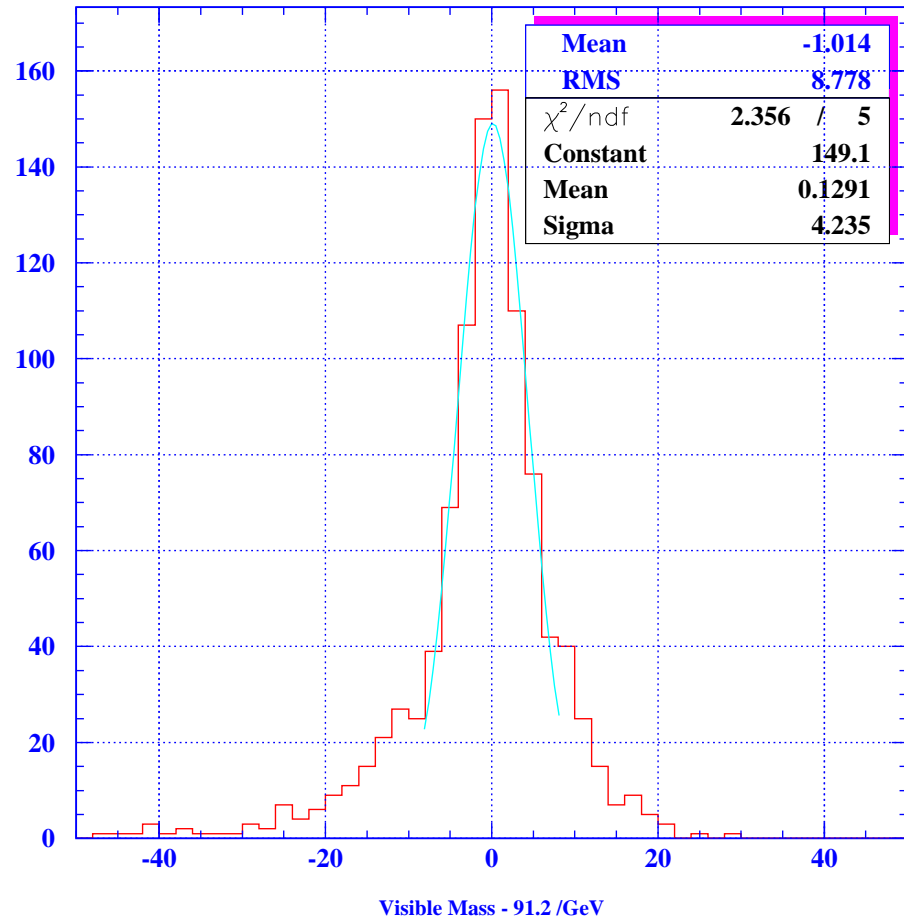
REPLIC

Chris A has installed Replic 0.2;
processed 1000 $Z^0 \rightarrow q\bar{q}$ Mokka
events.

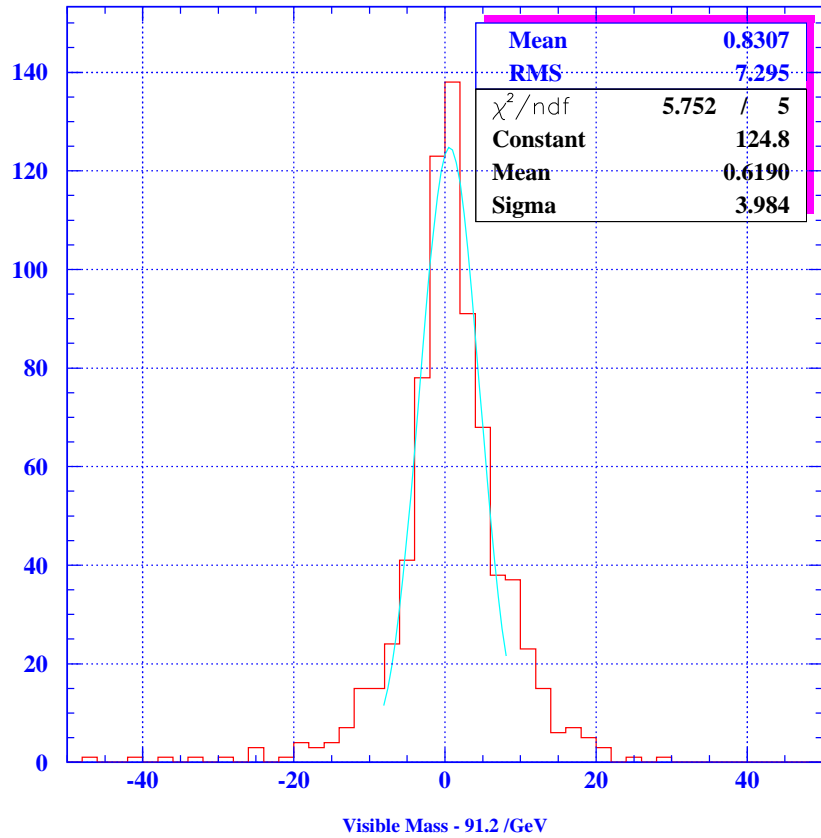
Look at standard Ntuple created by
Replic.

In Tesla TDR, a resolution of
3.1 GeV on the visible mass was
seen (i.e. approximately $30\%/\sqrt{E}$);
can we reproduce this?

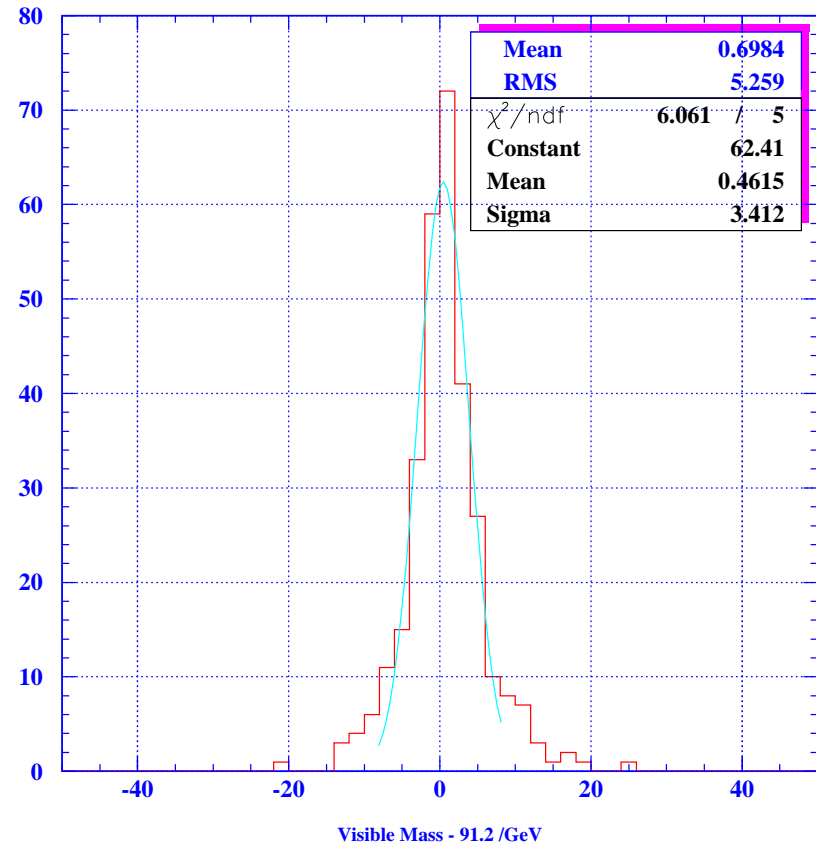
Use this as a basis for comparison
with anything we write ourselves.



Replic contd...

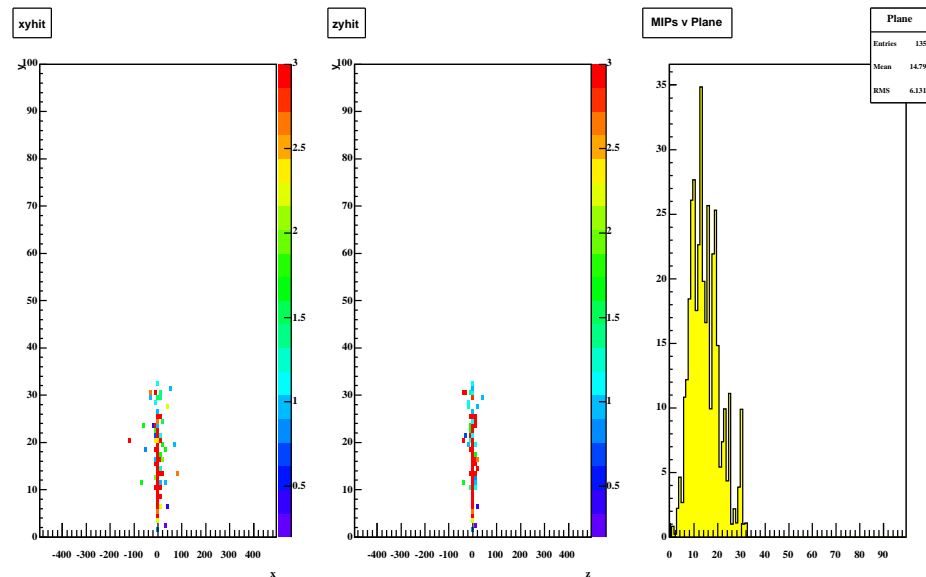
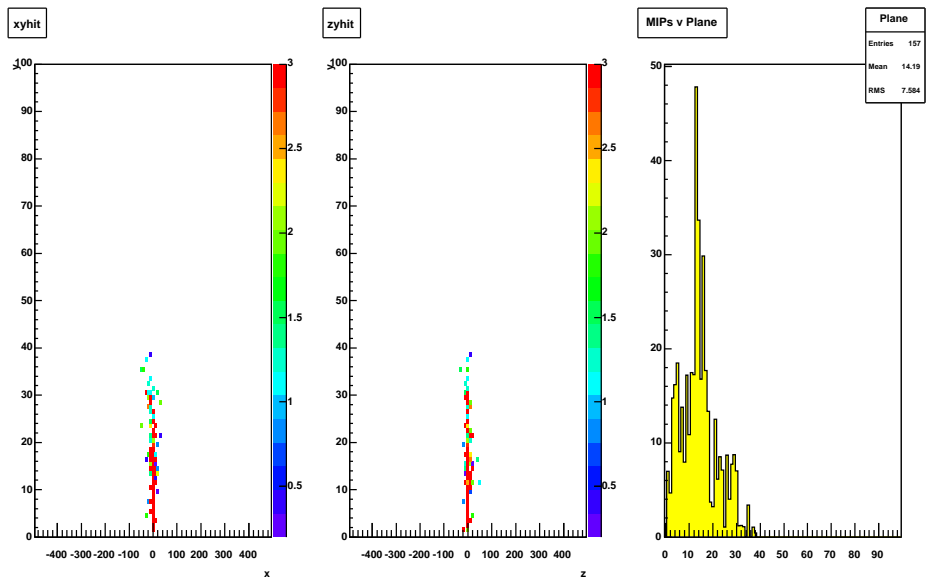
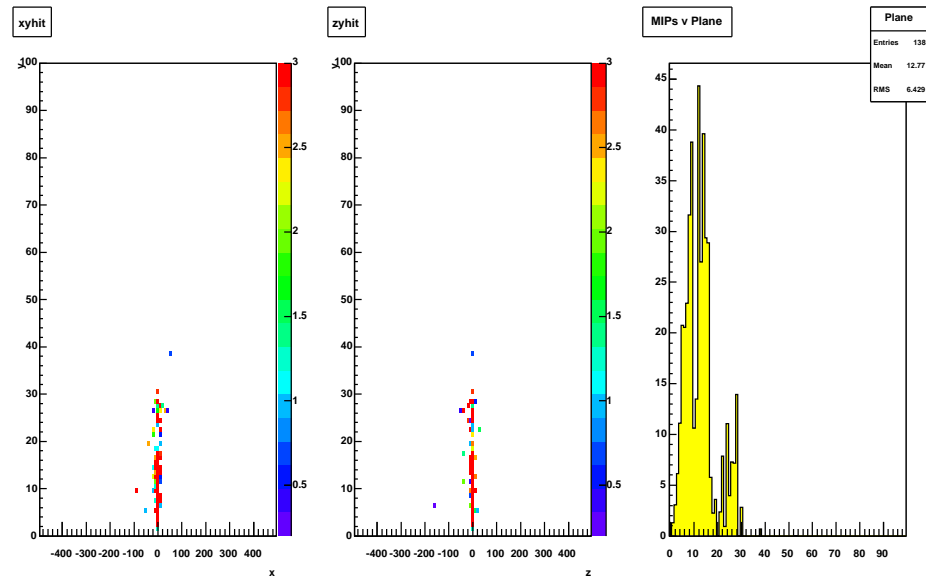
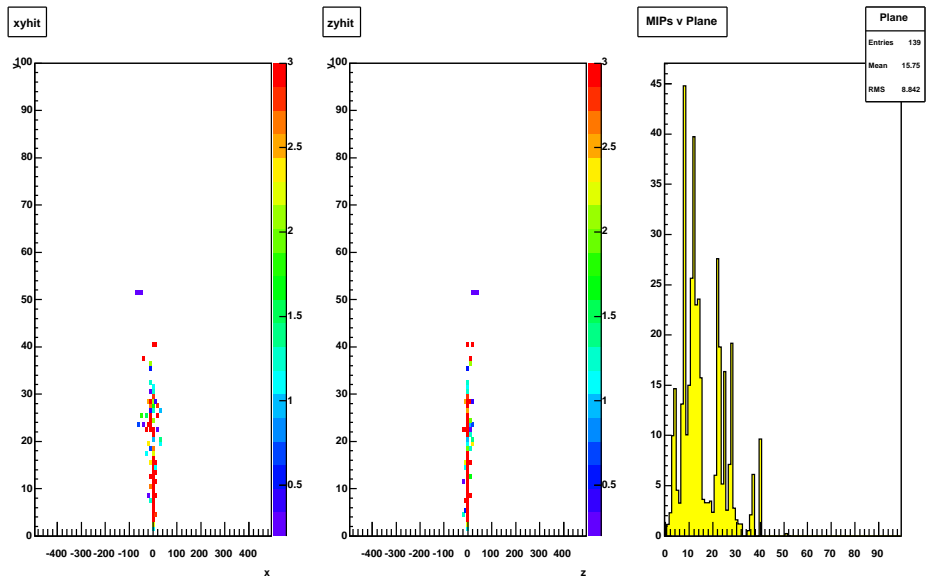


Cut out events with neutrinos.

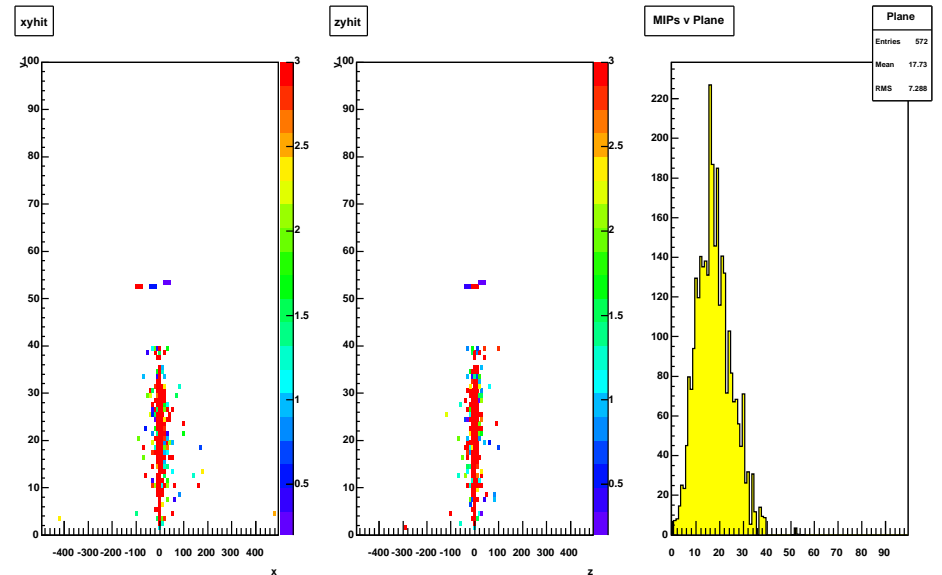
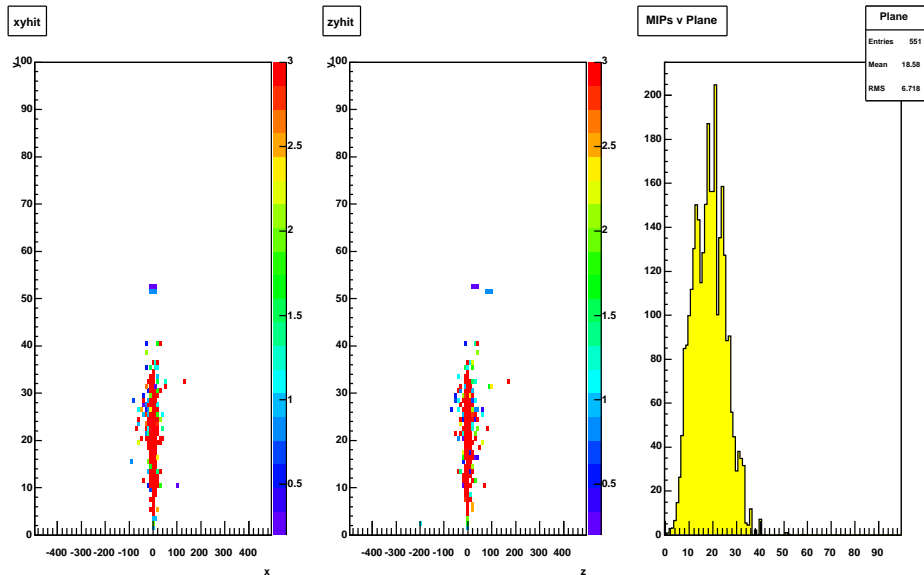
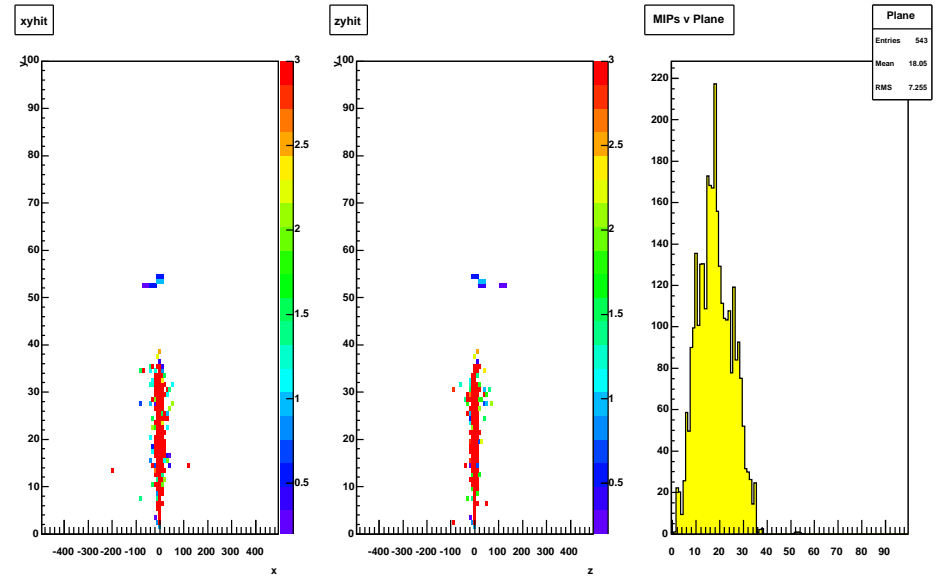
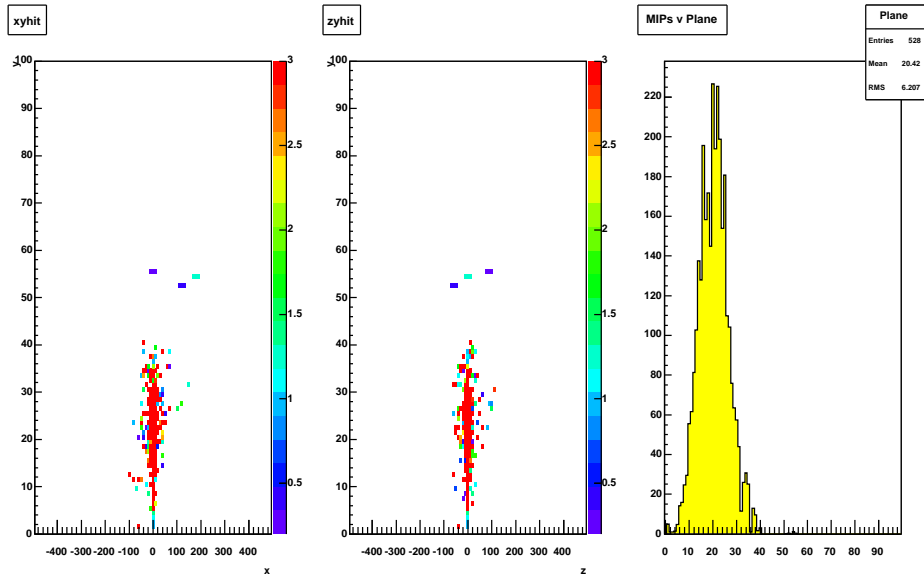


Restrict to barrel ($|\cos \theta_T| < 0.5$).

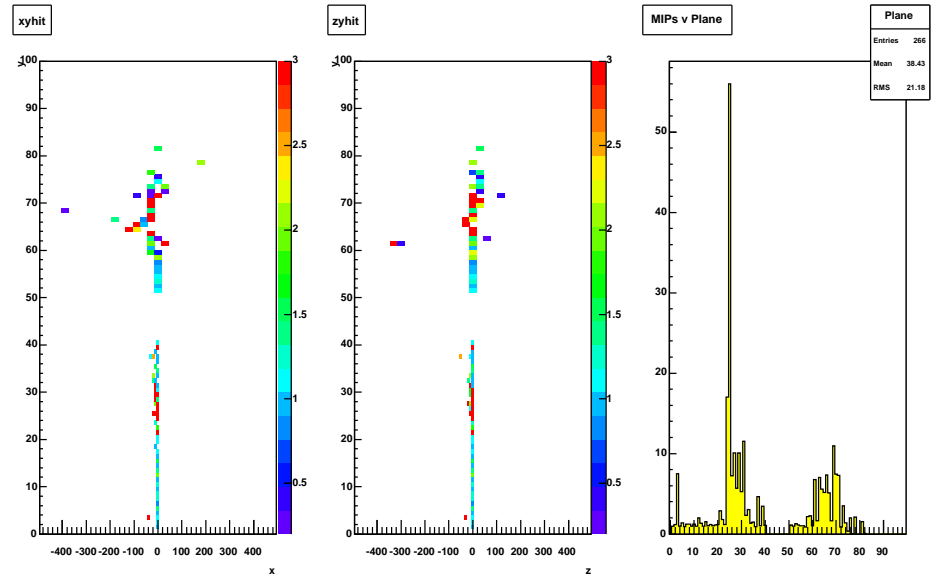
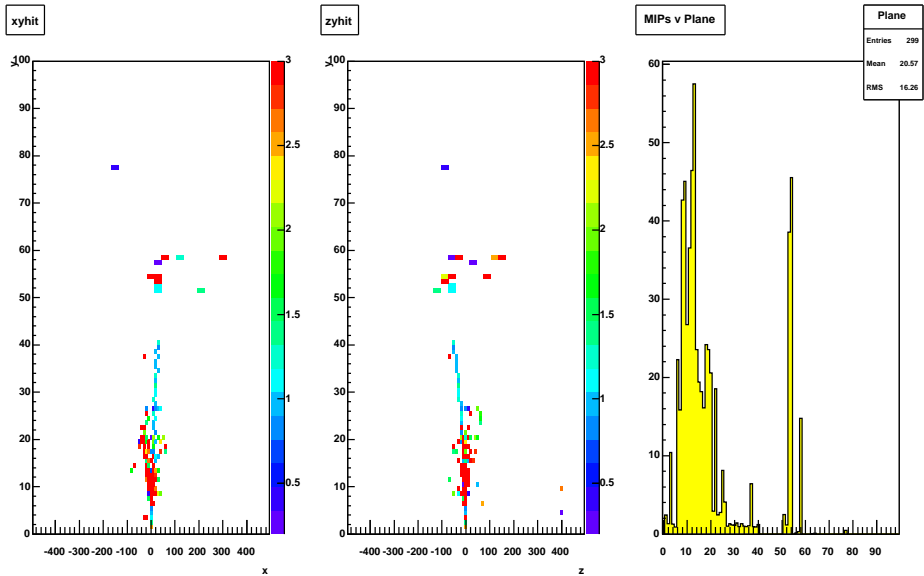
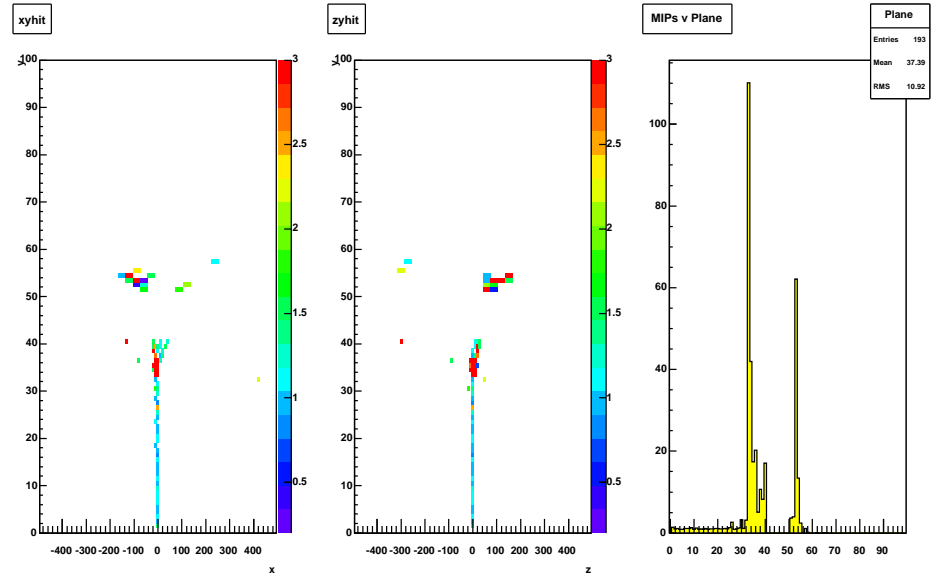
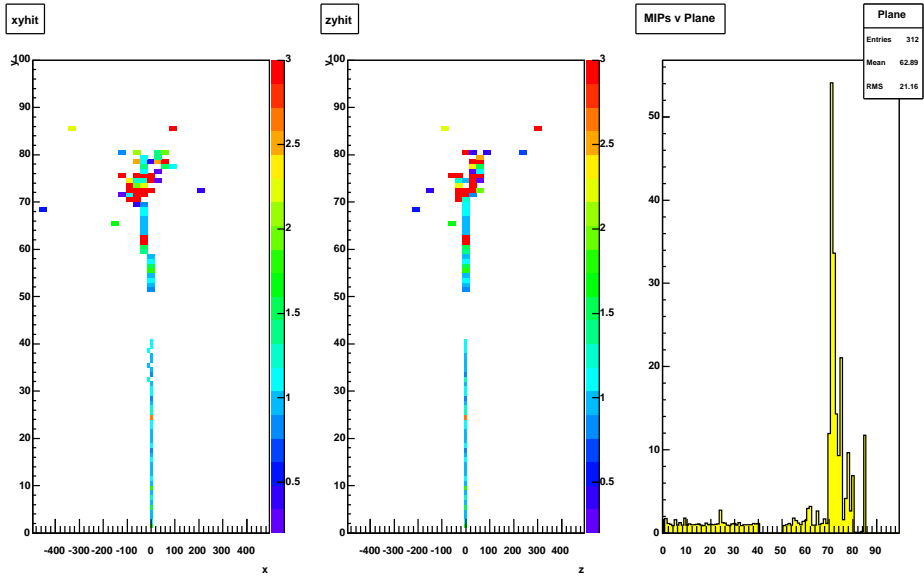
Display some showers : 5 GeV e⁻



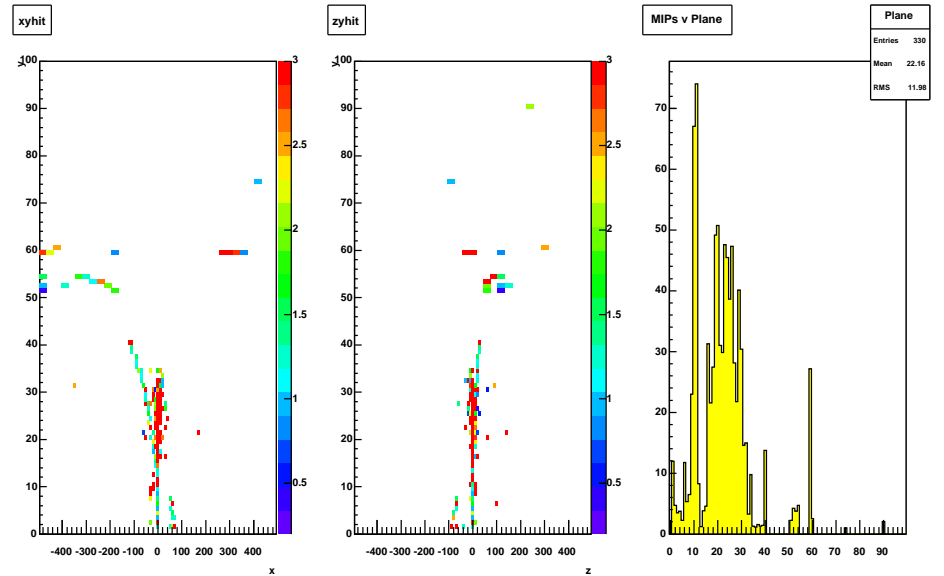
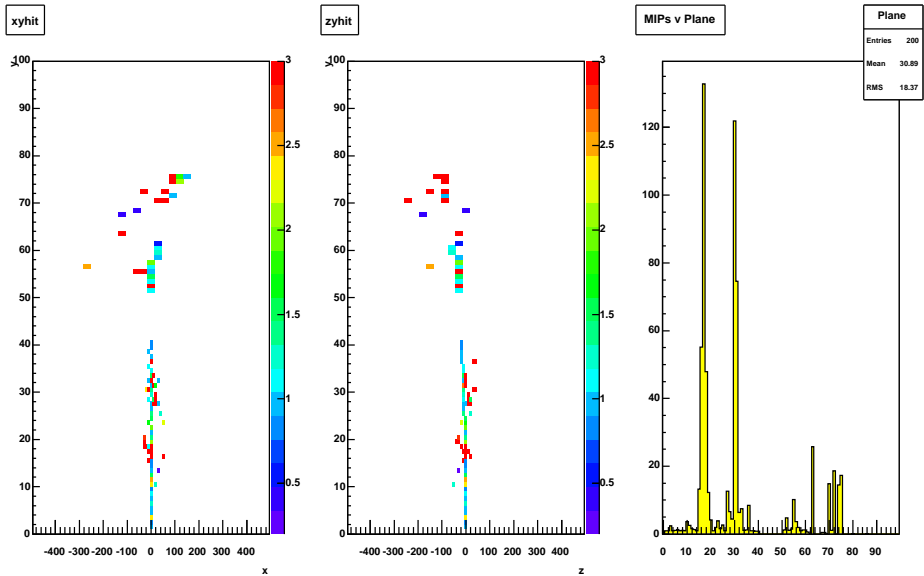
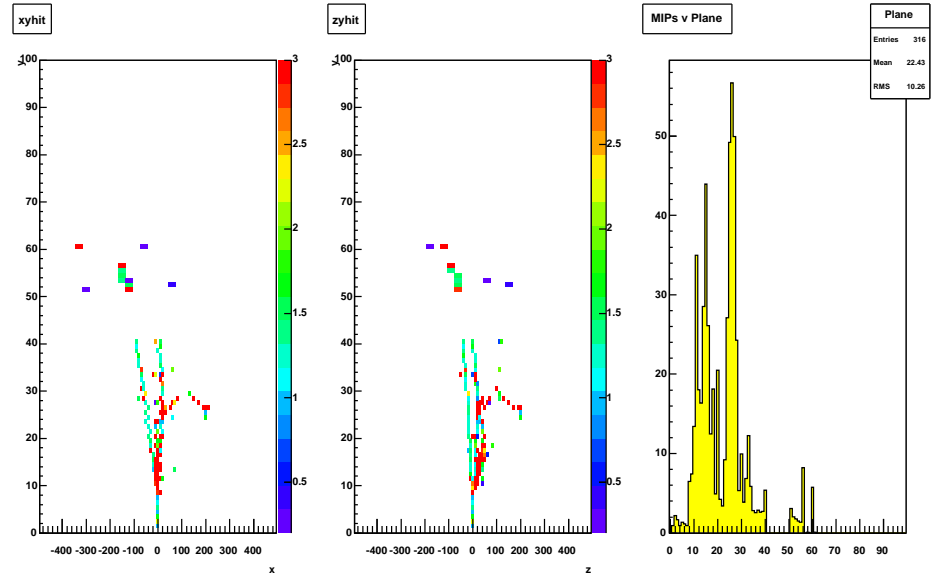
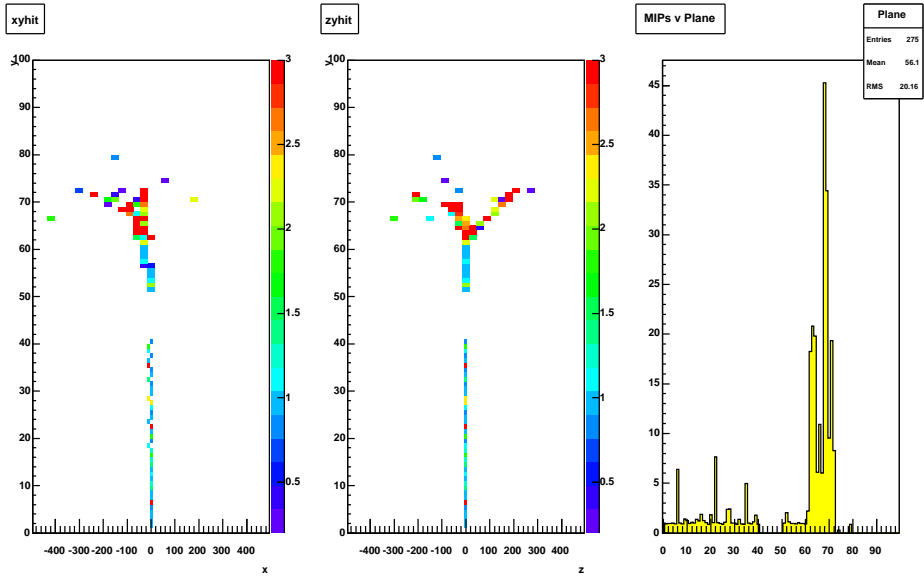
Display some showers : 15 GeV e^-



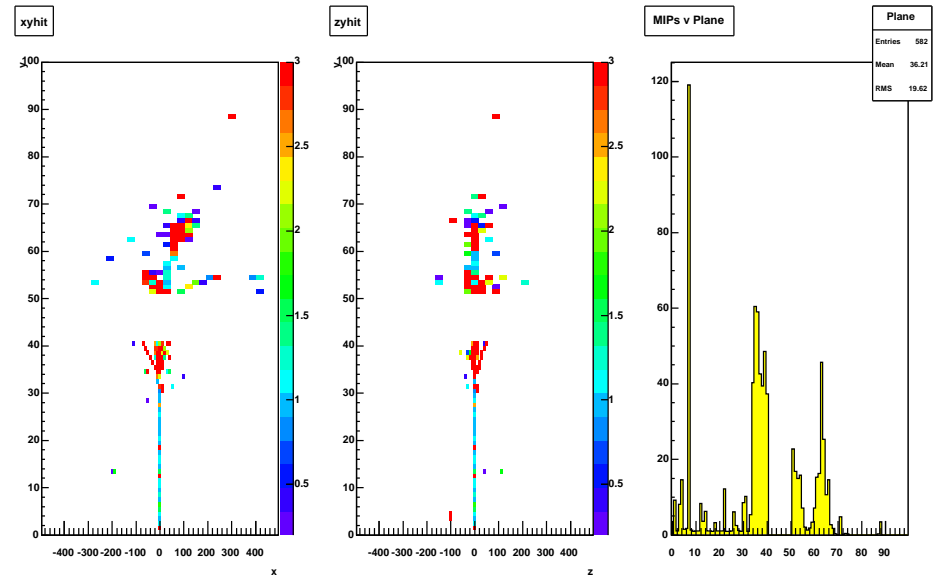
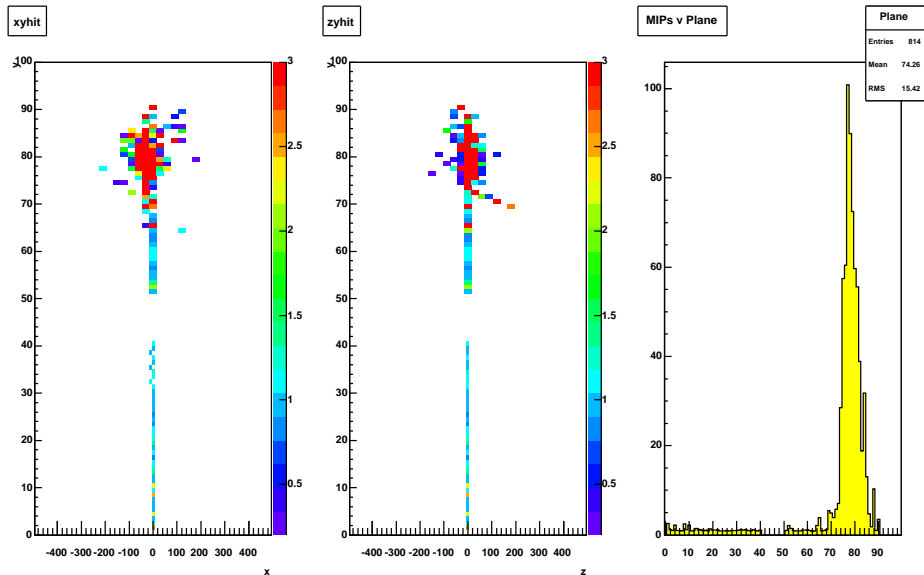
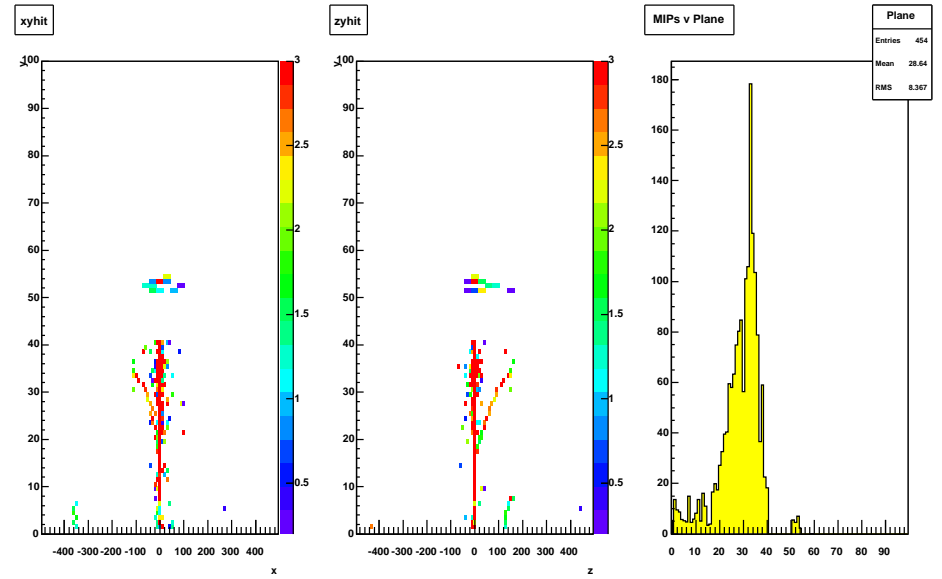
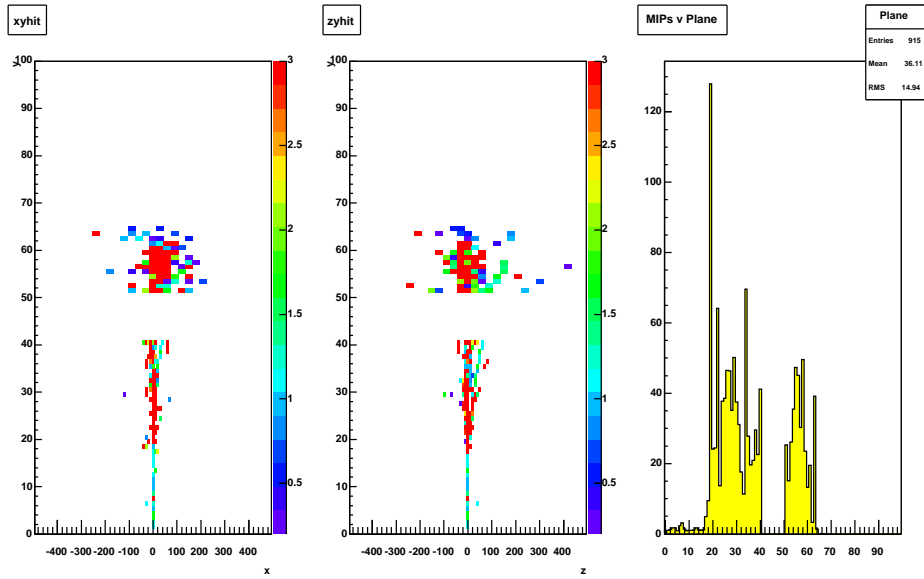
Display some showers : 5 GeV π^-



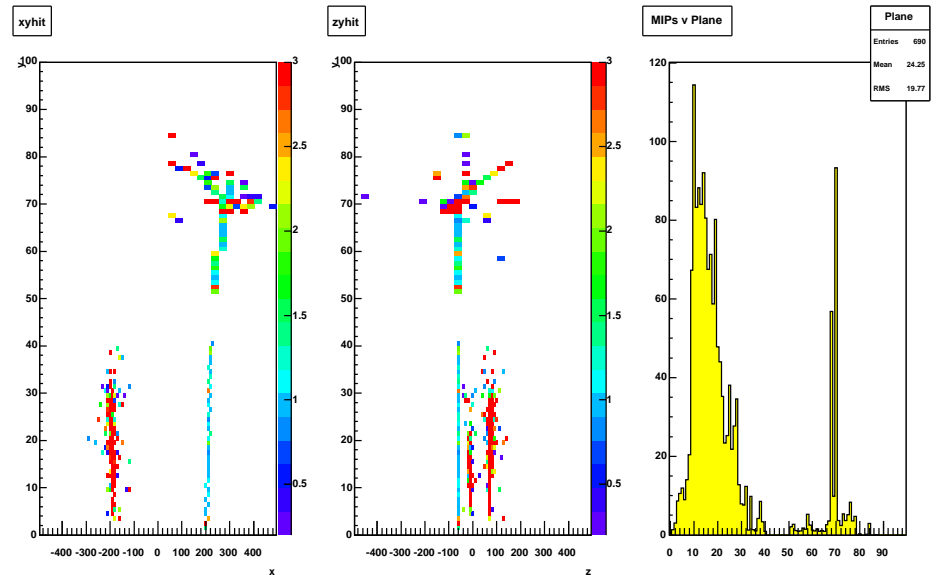
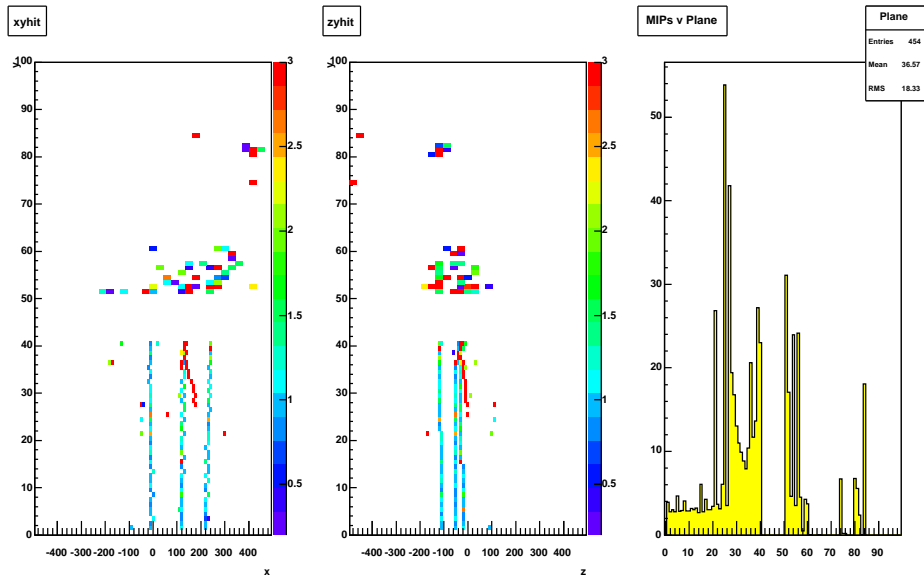
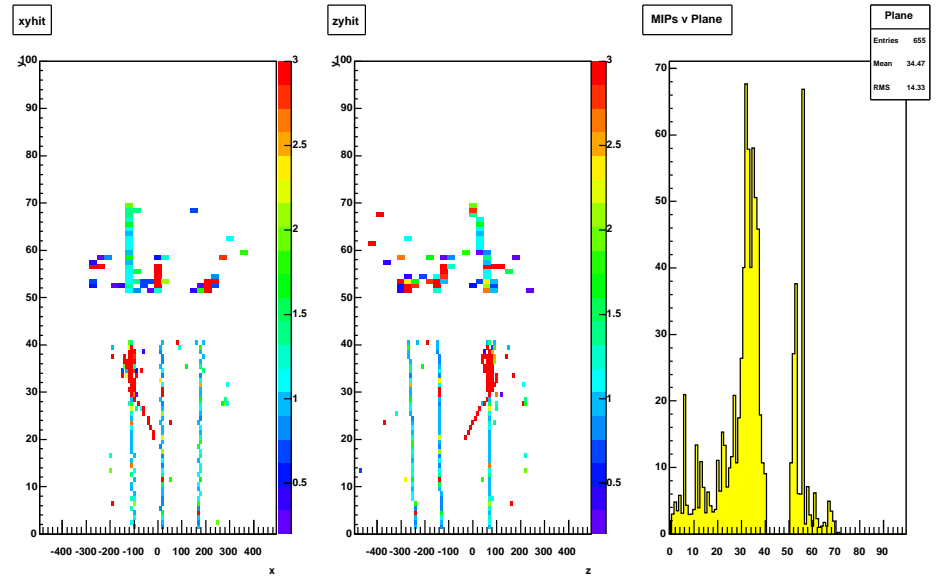
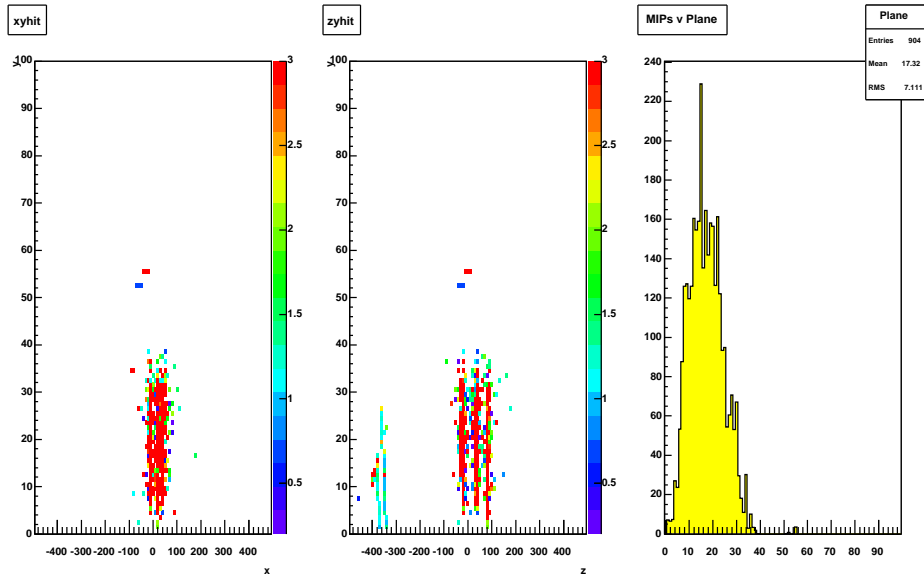
Display some showers : 5 GeV π^-



Display some showers : 15 GeV π^-



Display some showers : 15 GeV τ^-

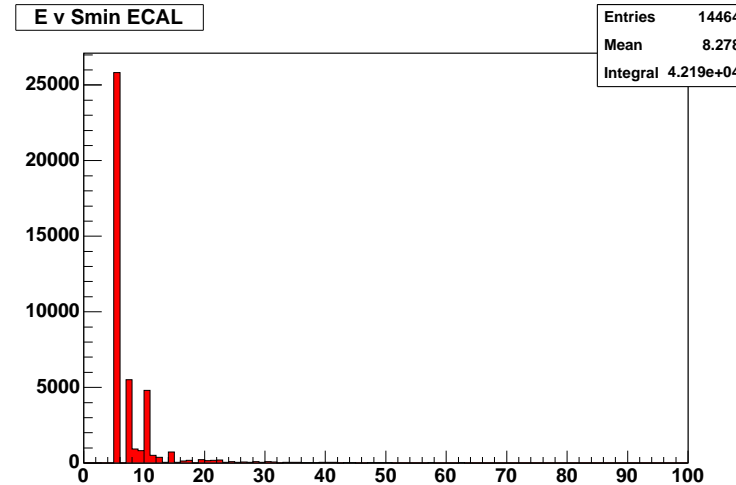


Towards a pattern recognition algorithm?

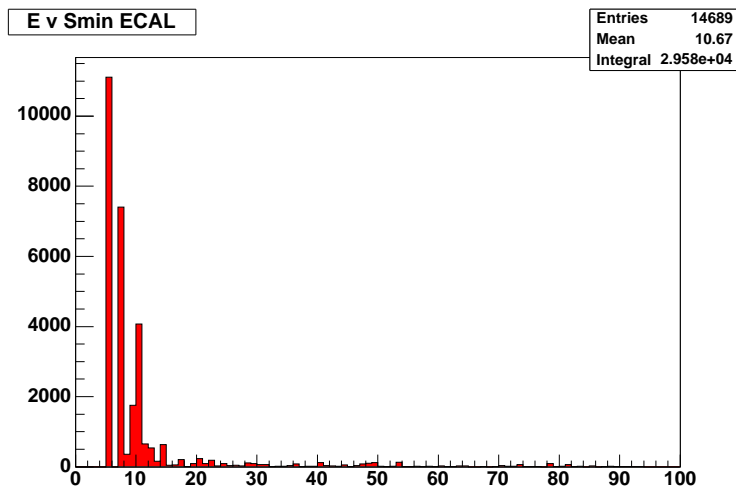
Tracking-style clustering algorithm?
e.g. associate each hit to nearest neighbour in current or earlier planes.

Look at distributions of distance to nearest neighbour.

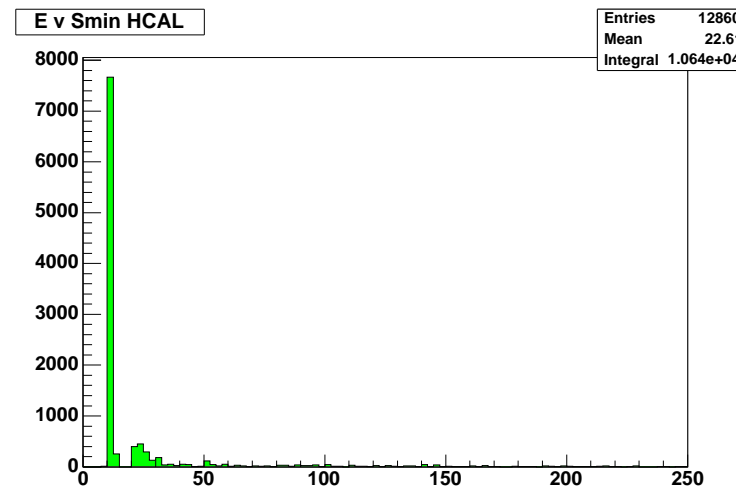
5 GeV e^- in ECAL



5 GeV π^- in ECAL



5 GeV π^- in HCAL



Summary

- Several preliminary studies. Now ready to make a first attempt at coding an algorithm.
- REPLIC available for comparisons. (Also look at SNARK (Brahms)?)
- “Track-like” nature of showers \Rightarrow try to rethink the sort of algorithms needed.