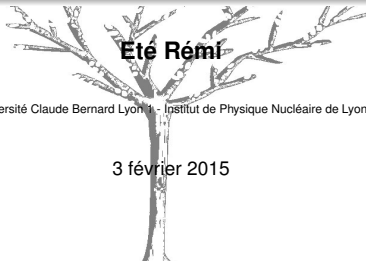


# HGCAL for ILD @ LLR - February 2015

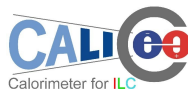
## ArborPFA status at IPNL and future steps



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Lyon 1



## Current status of Arbor (IPNL)

Implementation only in SDHCAL :

- Tree building
- Track association
- Cluster association
- PFO creation

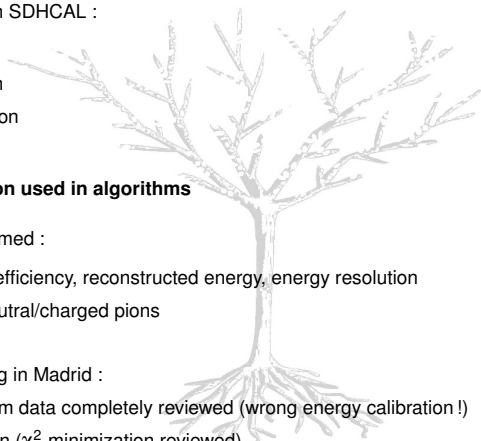
**No energy information used in algorithms**

Current studies performed :

- Single particle : efficiency, reconstructed energy, energy resolution
- Separation of neutral/charged pions

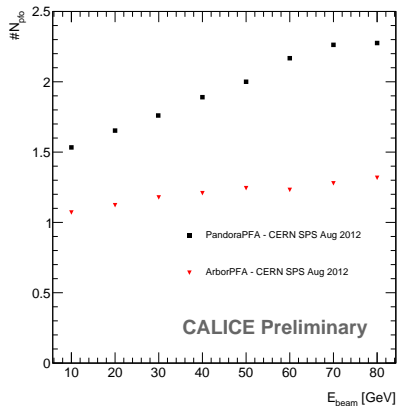
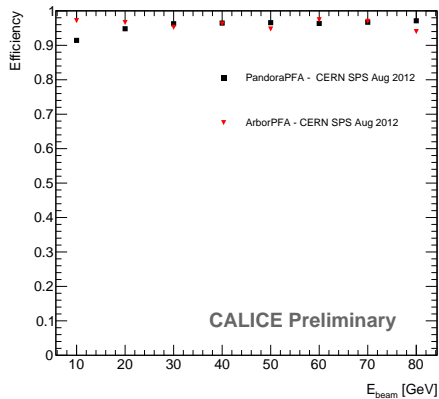
Since CALICE meeting in Madrid :

- Cuts on test-beam data completely reviewed (wrong energy calibration !)
- Energy calibration ( $\chi^2$  minimization reviewed).
- Using only test beam data for studies, no simulation comparison.
- No change in Arbor algorithms



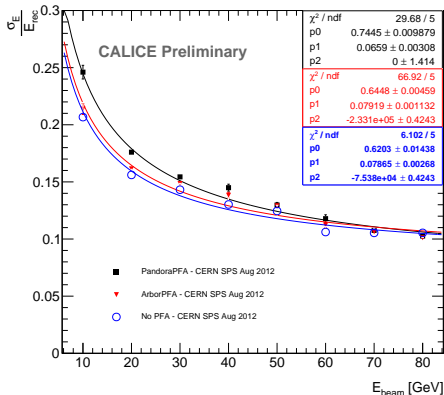
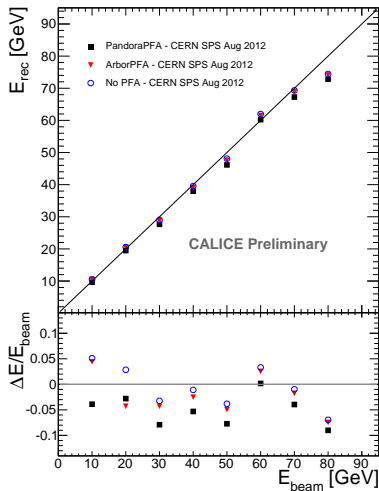
# Single particle study

Efficiency - NPf0



# Single particle study

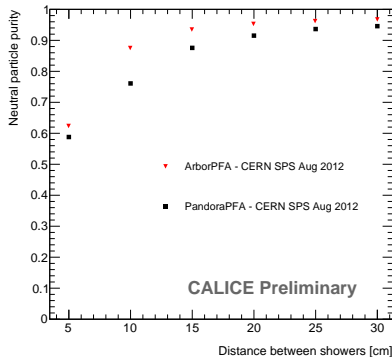
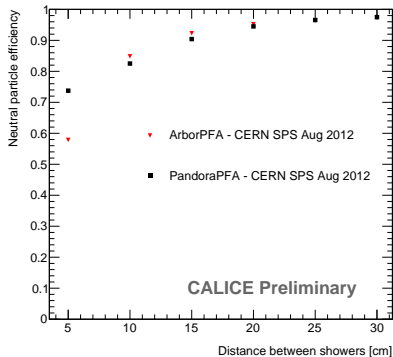
$E_{rec}$  and  $E_{res}$



# Overlay pion showers

10 GeV neutral pi and 10 GeV charged pion

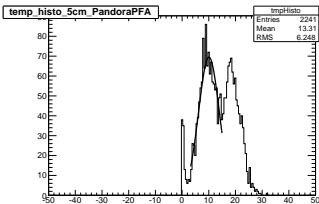
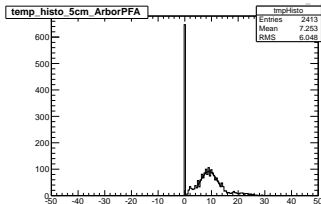
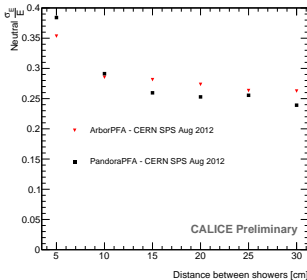
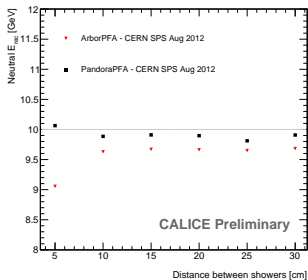
Look at hit per hit level which hit belongs to which shower ...



# Overlay pion showers

10 GeV neutral pi and 10 GeV charged pion

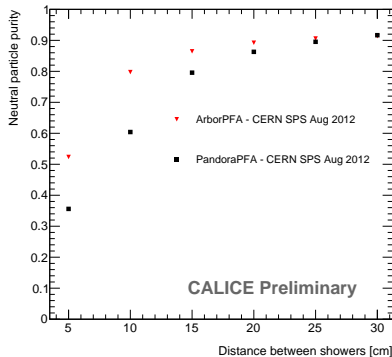
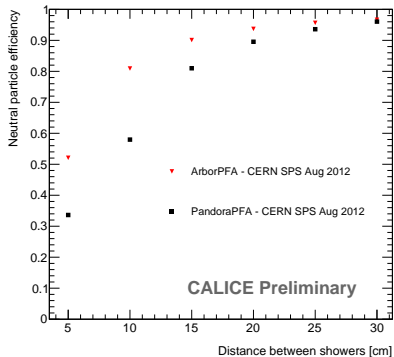
Points extracted from gaussian fit around 10 GeV



# Overlay pion showers

10 GeV neutral pi and 30 GeV charged pion

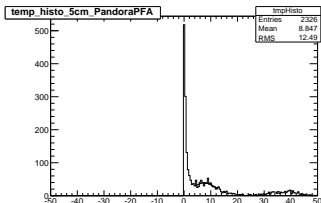
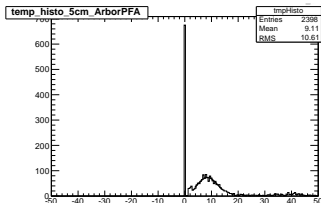
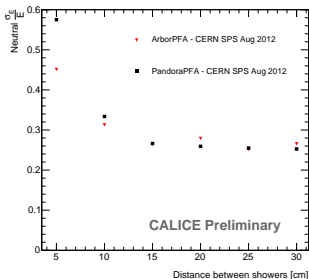
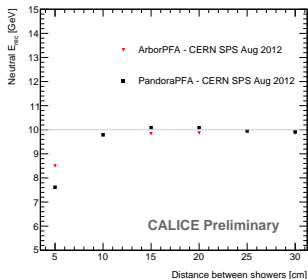
Look at hit per hit level which hit belongs to which shower ...



# Overlay pion showers

10 GeV neutral pi and 30 GeV charged pion

Points extracted from gaussian fit around 10 GeV





# Plans for Arbor

## Reclustering

Next step should be a reclustering procedure.

But has to be carefully done when using energy information!

PandoraPFA uses the energy as an estimator of the *goodness* of the reconstruction

→ Minimization of  $\chi^2 = \left(\frac{p-E}{\sigma_E}\right)^2$

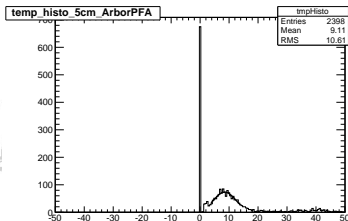
But energy calibration very influent!

Ideas :

- Energy can be used as a first estimator of the track-cluster matching but not only
- Uses of topological arguments to recluster things correctly (symmetry, tree variables ?)
- Minimization → OK. Only energy in  $\chi^2$  → NO!
- Which estimator ?

Varying parameters :

- Connection distance : increase/decrease in case of missing/additional energy
- Lot of neighbors (collimated jet) ? Tighten the order parameter to increase the separation power and then re-associate cluters (split and merge strategy a-la-Arbor)
- Branch switching from one cluster to an other one ? Estimator ?



# Plans for Arbor

Additional algorithms for ILD

For ILD-like detector implementation :

- Implementation in ECAL (for hadronic showers)
- Photons and electrons reconstruction handled by Garlic (D. Jeans)
- Muon reconstruction : Arbor standalone ? Pandora ? External ?
- ECAL - HCAL tree connection (M. Ruan)
- Track association should stay topologically based as much as possible (bias)
- Handling of back-scattering in calorimeter ...

Really need to start a collaboration with the existing ArborPFA implementation for ILD (M. Ruan)  
→ Not only code sharing but **development sharing** (svn or git option ?)

Currently finishing to write a CAN on single particle and separation of overlaid showers ...