

A comparison of the different Tracking Algorithms

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Comparison of existing tracking algorithms for HCal

Tracking algorithms

- Andrea's Track Finder
(used for HCal calib)
- Marina's Primary Track Finder
(used for shower start finding)
- Philippe's MipFinder
(originially used for ECal \Rightarrow geometry problems?)
- Lars' Follow-Your-Nose Tracker
(used for finding tracks in hadronic showers)

Goal

Compare Tracking Algorithms with regard to muon track identification for HCal calibration

How to compare the Algorithms

- Monte Carlo simulation
 - μ^- with 80 GeV
 - enabled tracking layer in front of ECal
- Comparison Processor: HCalTrackingCompareProcessor
 - Takes tracks as LCIO Cluster collections
 - MC based comparison:
 - Calculates the flight path of the MCParticle (μ) and the cells hit by it
 - Compare by event efficiency e_{eff} (no noise hit penalty) or e_{noise} (with noise hit penalty):

$$e_{eff} = \frac{\# \text{ hits correctly identified}}{\# \text{ hits created by } \mu} \quad (1)$$

$$e_{noise} = \frac{\# \text{ hits correctly identified} - \# \text{ noise hits}}{\# \text{ hits created by } \mu} \quad (2)$$

- Fit based comparison:
 - Fit Langau on all cells with enough statistics (> 1000 entries)
 - Compare Langau fit errors (smaller = better)

Preparation

Preparation

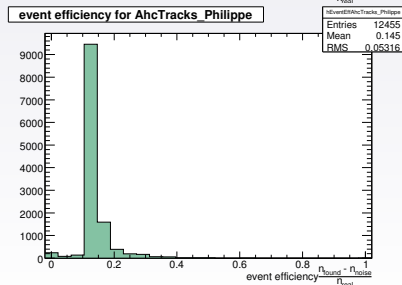
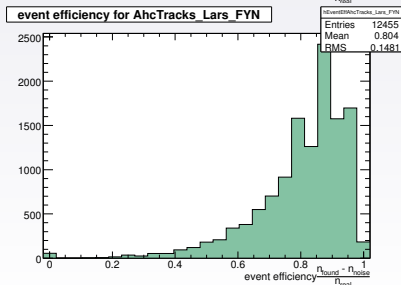
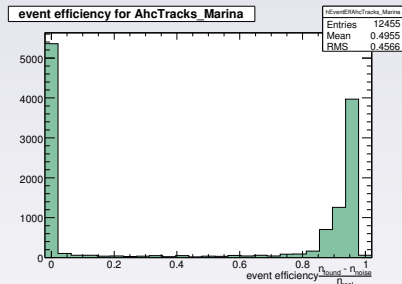
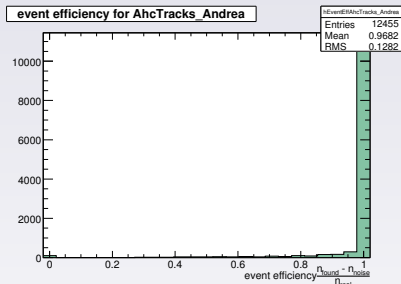
- Change source that the found tracks are saved into a LCIO Cluster.
- Philippe: Change default steering parameter:
MaxDist= 45 instead of 18
- Philippe: Changed max nr layers to 38

Still missing

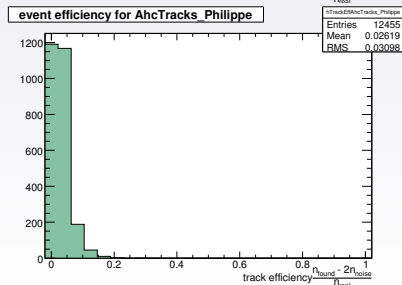
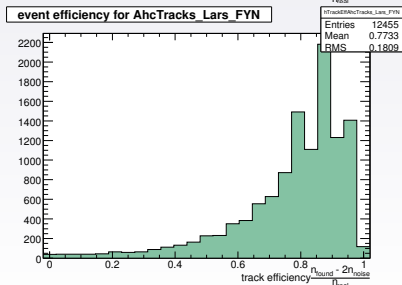
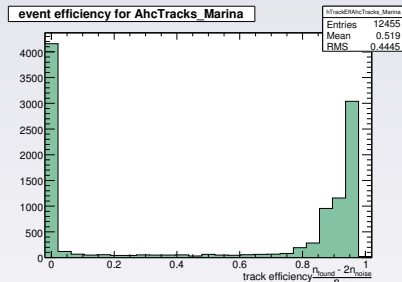
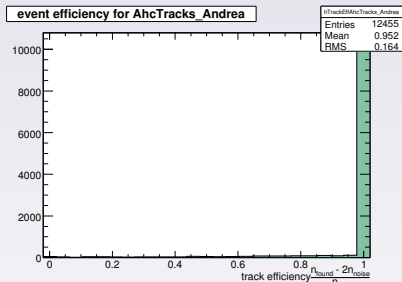
Parameter Scan

⇒ Results are preliminary!

$$\text{MC Comparison: } e_{\text{eff}} = \frac{\# \text{ hits correctly identified}}{\# \text{ hits created by } \mu}$$



$$\text{MC Comparison: } e_{\text{noise}} = \frac{\# \text{ hits correctly identified} - \# \text{ noise hits}}{\# \text{ hits created by } \mu}$$



MC Comparison: event categories

Tag algorithm performance into 5 classes per event:

1 perfect complete:

all μ hits were found, no false/noise hits found

2 perfect incomplete:

found some μ hits, but no false/noise

3 majority:

found μ hits and false/noise hits, but most are from μ (i.e. correct)

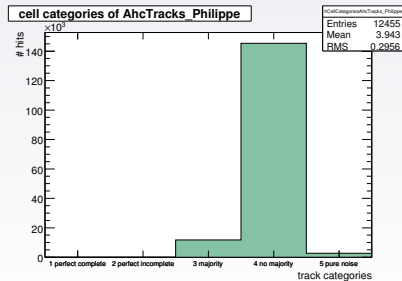
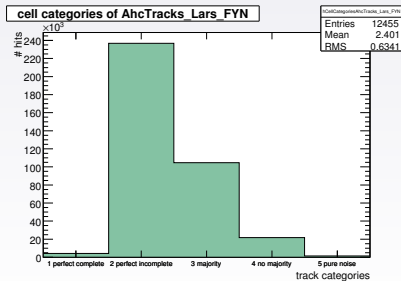
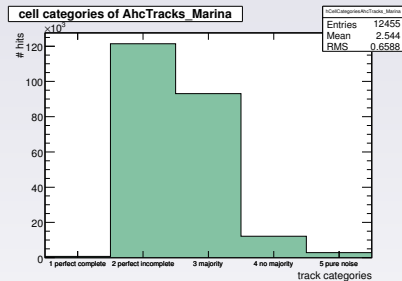
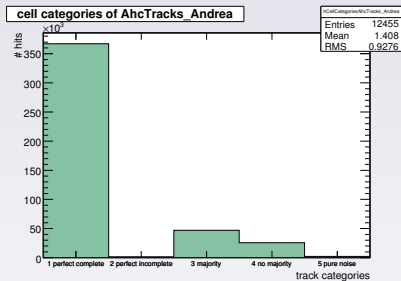
4 non majority:

as above, but most hits come from false/noise

5 pure noise:

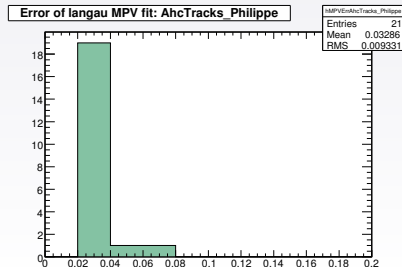
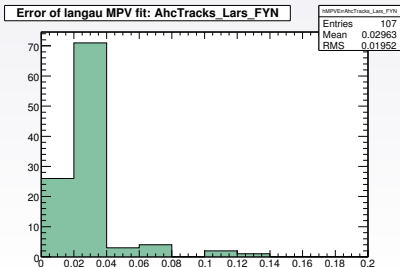
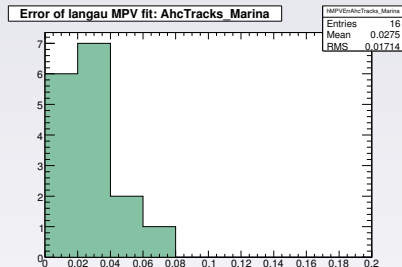
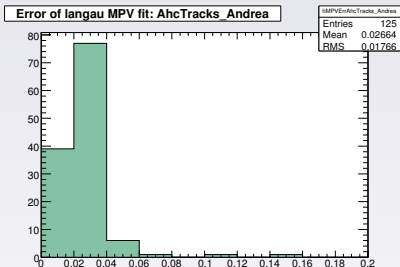
hits found consist entirely of false/noise hits

MC Comparison: event categories



Langau-Fit Errors

Fit all cells with more than 1000 entries. Errors of MPV are:



Conclusion

- With default parameters:

algorithm	Andrea	Lars	Marina	Philippe
e_{eff}	0.97	0.80	0.50	0.15

- Similar results by Langau-Fit comparison
- Andrea's track finder almost perfect ($e_{eff} \approx 97\%$)
- Philippe's MIP finder finds almost noise only
⇒ use different steering parameters!?
- All 4 algorithms were run with default parameters
⇒ Improvement possible
⇒ Parameter Scan necessary