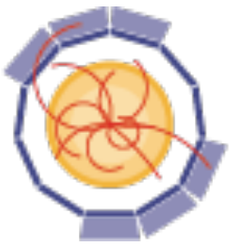


Advanced Particle Flow

- **Development of advanced particle flow and pattern recognition algorithms in PandoraPFA**
- **Application to LHC, LC and neutrino experiments**

J. S. Marshall, 16 December 2016

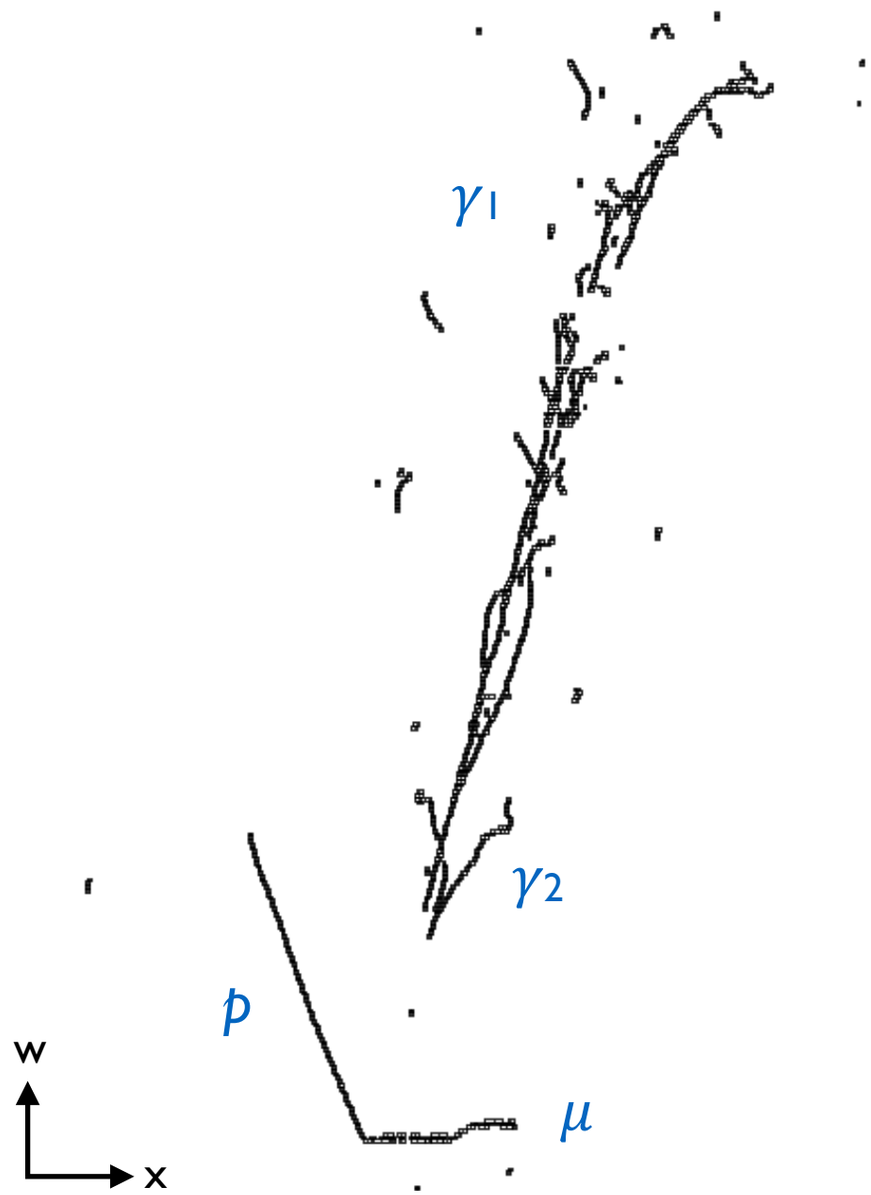
Pandora for MicroBooNE

- **Significant work to improve track vs. shower id in Pandora multi-algorithm approach.**
- Not just characterisation of final output particles for use in downstream analysis…
- … also examine intermediate clusters and particles, using information within Pandora algs.
- Reduces algorithm "tension", allowing for differing treatment for different topologies.

- **Algorithm flow is rather complex and subtle, but yields significant pat-rec improvements.**

1. Characterise output of track cluster-matching algs - true tracks vs. shower spines?
2. Characterise any remaining 2D clusters - are these small tracks vs. shower branches?
3. Characterise the final output particles.

Illustrative event, BNB CC RES:
$\nu_\mu + N \rightarrow X + p + \pi^0 + \mu^-$



Pandora for MicroBooNE

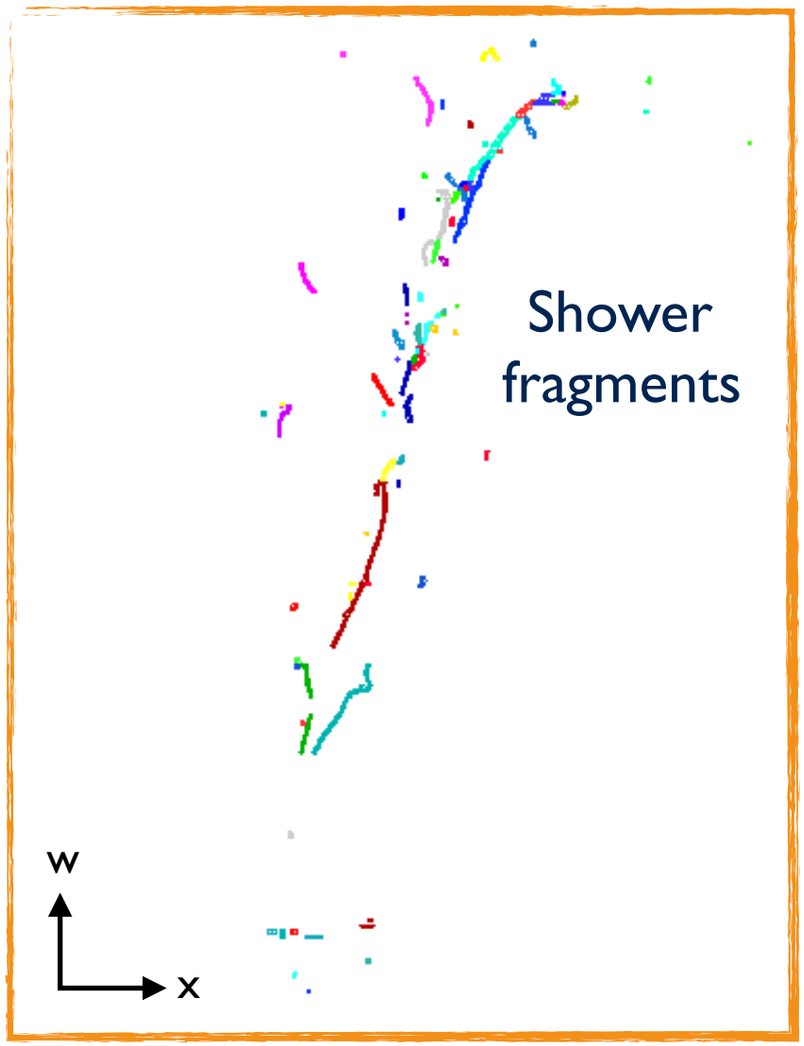
AIDA 2020

1. Examine output of track cluster-matching

Groupings of 3x2D Clusters (Particles), without branches

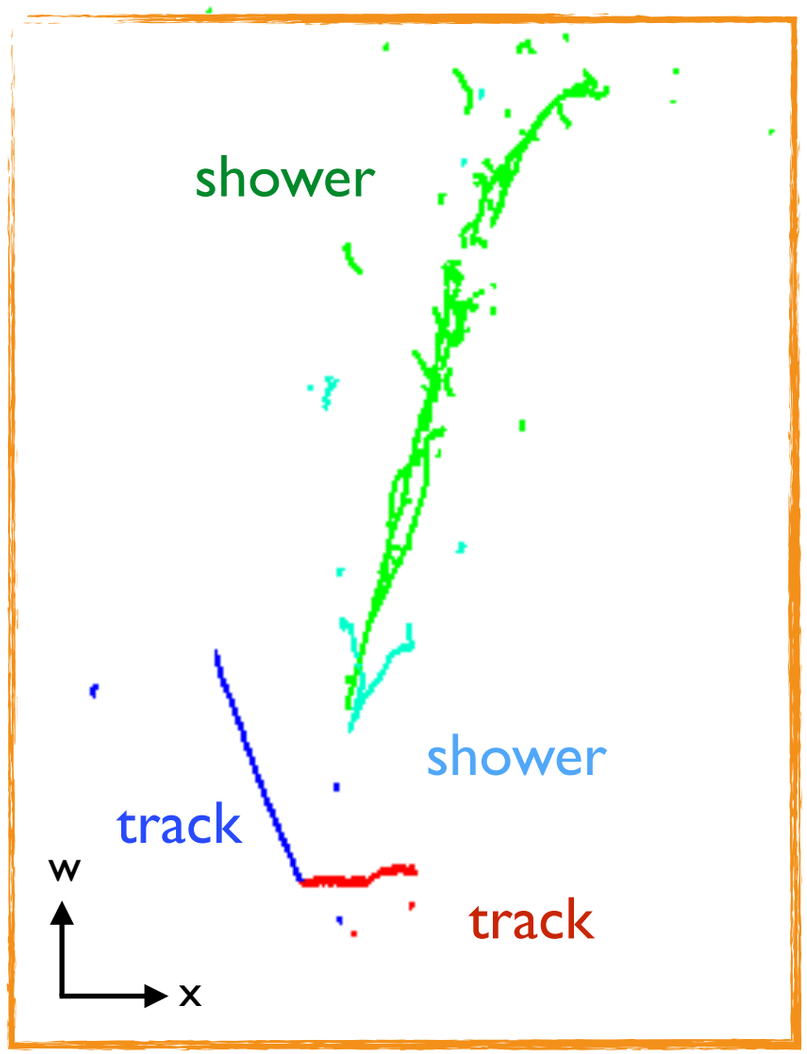
2. Examine remaining 2D Clusters

Individual 2D Clusters, without "branches"



3. Final/output Particle Id

Particles, with "branches", almost final pattern-recognition

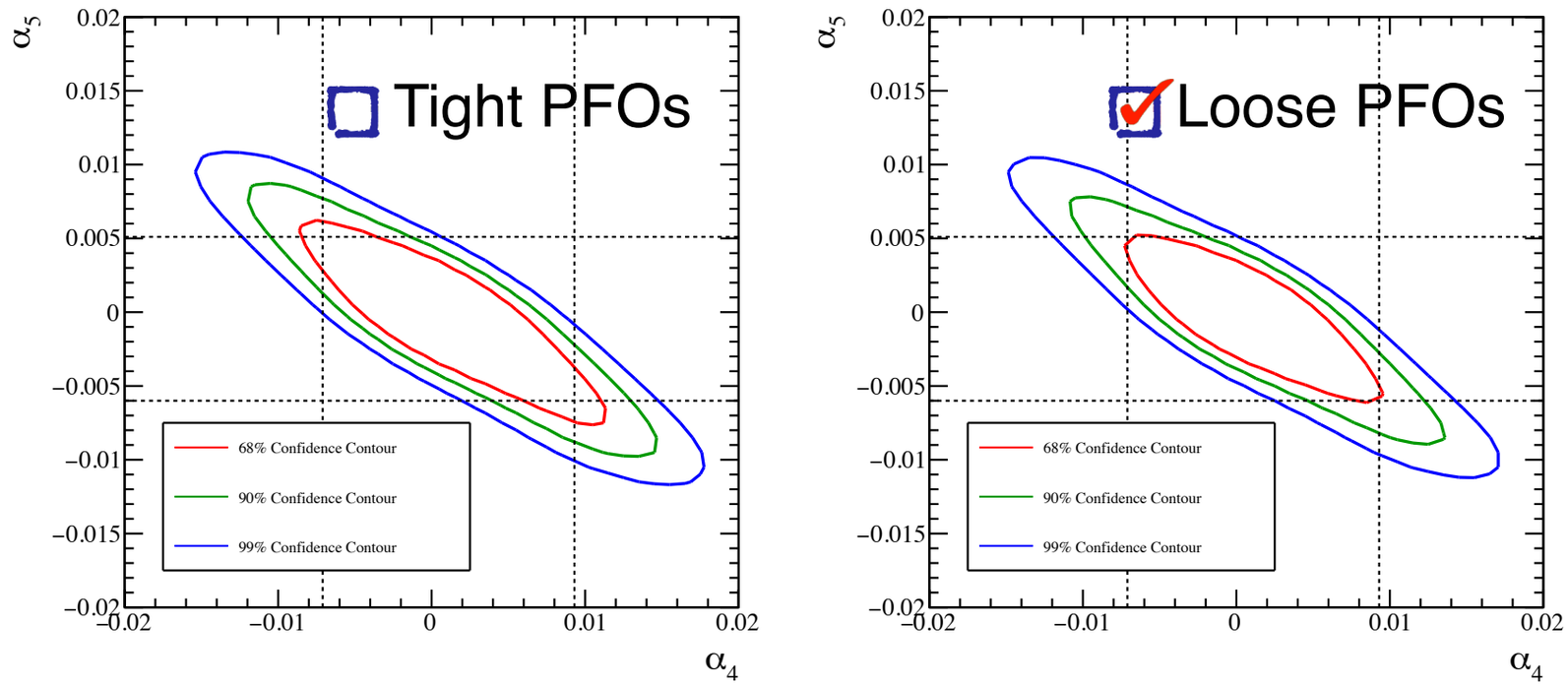


Also, upcoming in AIDA-2020 newsletter "On Track": Jennifer and Barbara (editors) are working on an article on use of the Pandora for MicroBooNE and the presentation at Neutrino 2016.

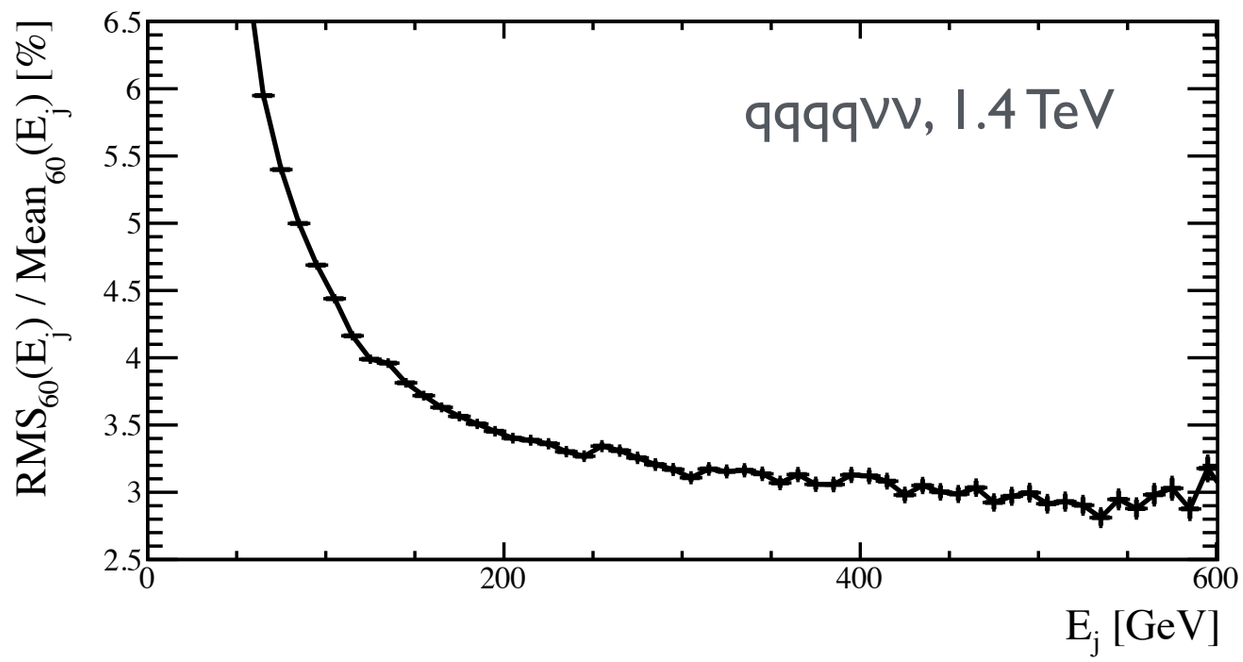
Pandora for ILC and CLIC

S. Green

- Optimisation of jet algorithm used to study sensitivity of CLIC to anomalous gauge couplings, α_4, α_5
- Optimisation performed by considering sensitivity of a pure signal sample, qqqqνν



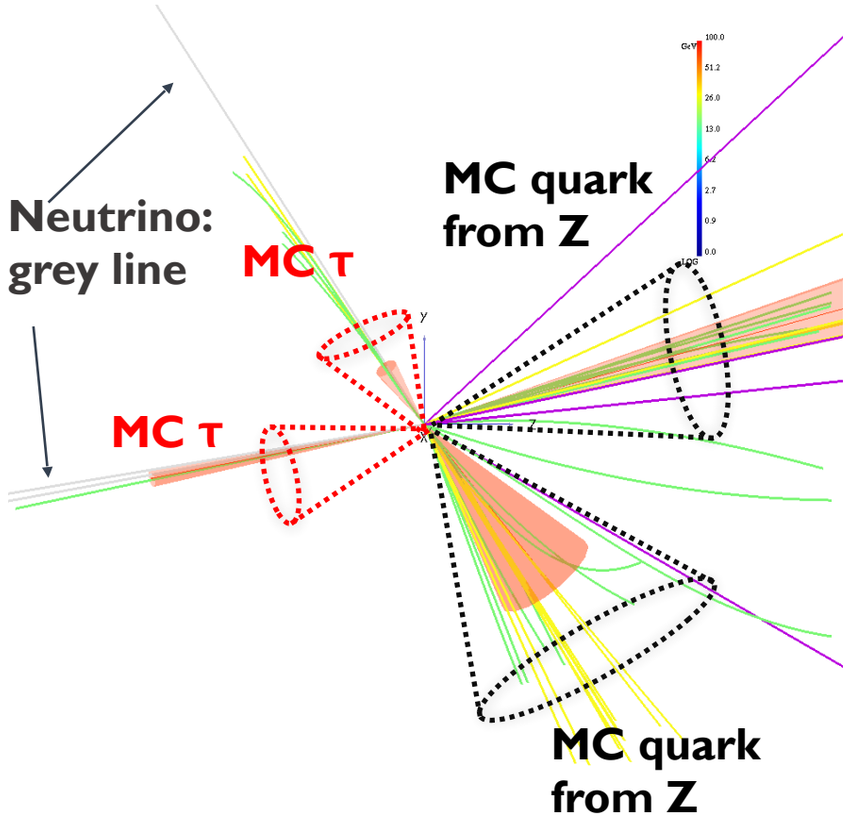
- Analysis of jet energy resolution (as a function of jet energy) for physics samples used in anomalous gauge coupling study.
- Metric adjusted to account for presence of beam-induced backgrounds present at CLIC.

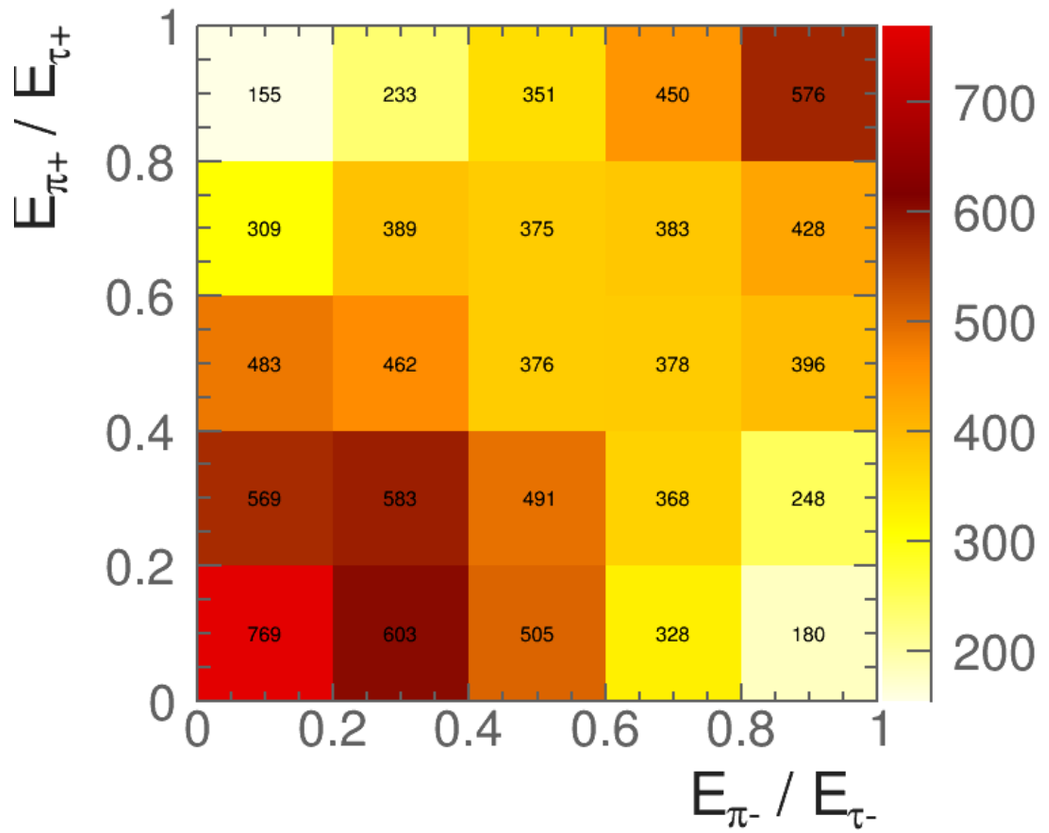


Pandora for ILC and CLIC

B. Xu

- Identify tau decay products in jet environment and select one-prong charged pion final state, using multivariate classifier.
- Aim to demonstrate correlation of ratios $E_{\pi+}/E_{\tau+}$ vs. $E_{\pi-}/E_{\tau-}$ using $ZZ \rightarrow qq\tau\tau$ events.
- Below show display of $ZZ \rightarrow qq\tau\tau$ event and correlation achieved using MC info.





Also, support to resolve issues emerging from move from MarlinPandora → DDMarlinPandora

Advanced Particle Flow

Update from LLR / IHEP:

- Vincent recently spent a week at IHEP (associated to AIDA-2020) working with Manqi on ARBOR: monitoring, documentation and particle ID.
- ARBOR was presented in LCWS by Manqi, and a particle ID module by Dan YU to be used in ARBOR (integration by Bo LI, now working at IPNL, Lyon on the SDHCAL):
  https://agenda.linearcollider.org/event/7371/contributions/37873/attachments/30967/46394/Arbor-Manqi.pdf
  https://agenda.linearcollider.org/event/7371/contributions/37872/attachments/31003/46440/lcws_pid_dan.pdf
- Both will be incorporated to the new iLCSoft git repository:
  https://agenda.linearcollider.org/event/7371/contributions/37868/attachments/30857/46173/gaede_ilcsoft_lcws2016.pdf

Update from CERN:

- Ongoing progress with topics previously discussed, including DDMarlinPandora.