

Near & Far Detector Response Comparison with the MINOS Calibration Detector



Overview:

- The MINOS experiment.
- The Main Aim MINOS.
- Caldet At CERN.
- The Near/Far Comparison.
- Conclusions.

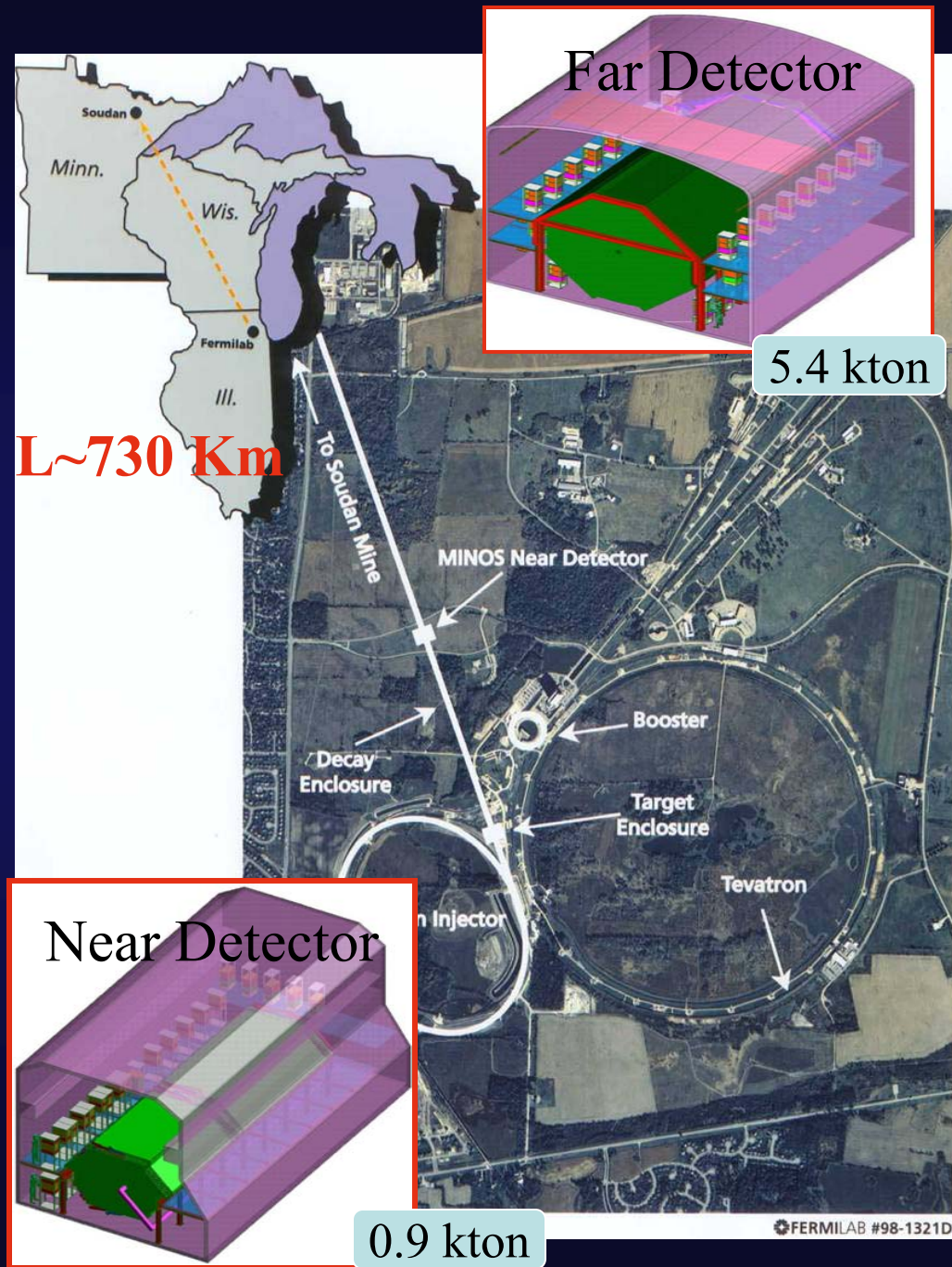
IoP Meeting: Particle Physics 2004

Birmingham - 6th/4/2004

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The MINOS Experiment.

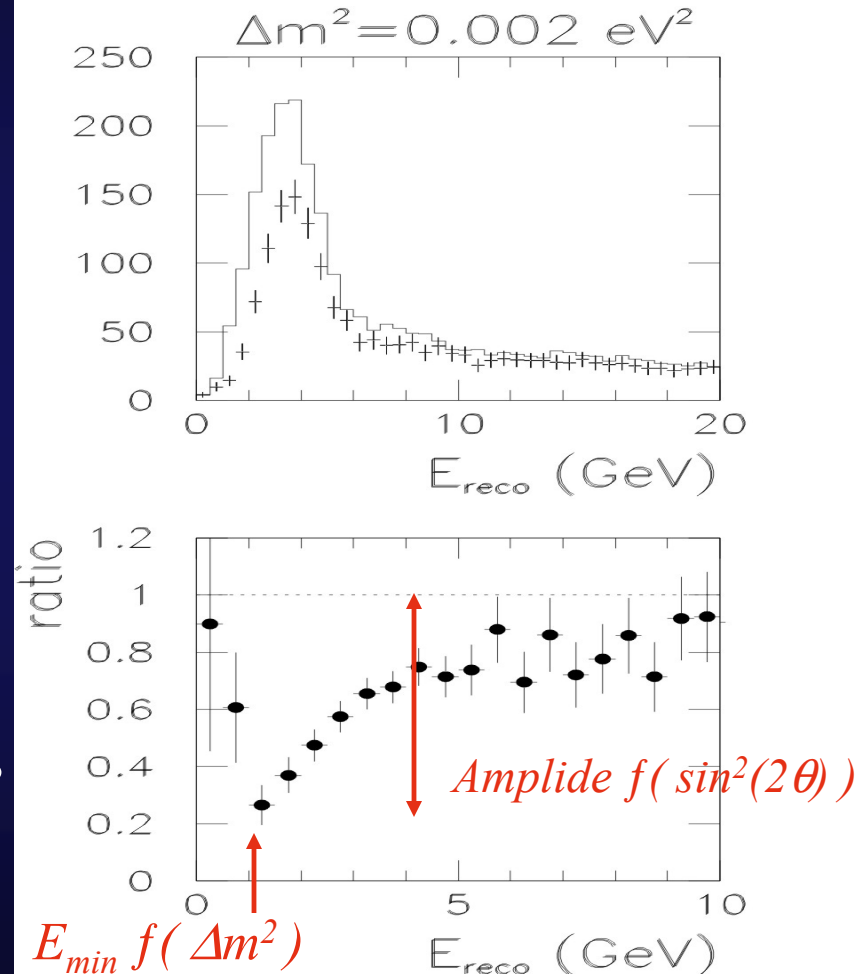
- Neutrino oscillation experiment: Δm^2_{23} & $\sin^2(2\theta_{23})$
- Neutrinos created @ FNAL:
 - p's of MI on a target.
 - Produce π 's, which decay.
$$\pi \rightarrow \mu + \nu_{\mu}$$
 - Some beam contamination from μ 's and k's decays.
- The 3rd detector: *calibration detector*.
- Collaboration: US, UK, Greece, France, Rusia & Brazil.



Main Measurement: ν_μ disappearance.

- Measure spectrum of CC $\nu(\mu)$ at both ND and FD.
- Propagate the un-oscillated ND spectrum using MC and then normalise it to the correct exposure at the FD.
- Ratio of both spectra shows oscillation signal and reduces systematics.

4 years with nominal # of protons

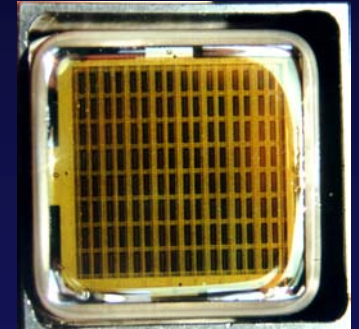


Are we expecting differences between ND and FD?

Scintillator planes are the same in both detectors.

PMTs:

- FD uses multiplexed M16.
- ND uses M64.

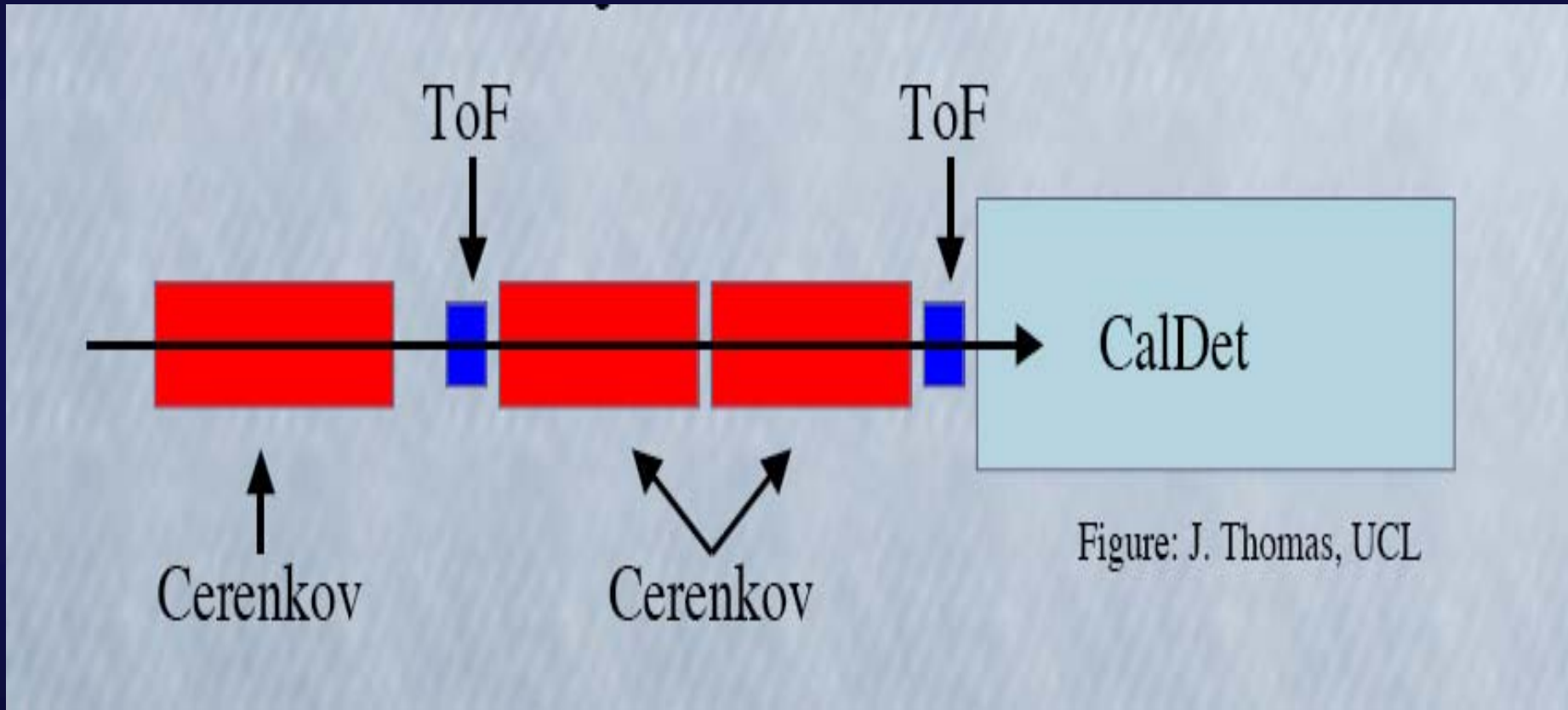


Readout FEE:

- FD FEE:
 - ◆ Time-stamps first hit per PMT only (~ 1.5 ns clock).
 - ◆ Shaper circuitry: 500ns shaping time.
 - ◆ Charge acceptance varies.
- ND FEE:
 - ◆ Time-stamps each hit (~ 19 ns clock).
 - ◆ Integrating circuitry.
 - ◆ Charge acceptance constant while alive.

Let's compare them at Caldet...

Calibration Detector (Caldet) equipped with ND and FD electronics in either side:



CERN Test beams (PS complex) -> samples of e , p , π , μ at energies from 600MeV to 10GeV.

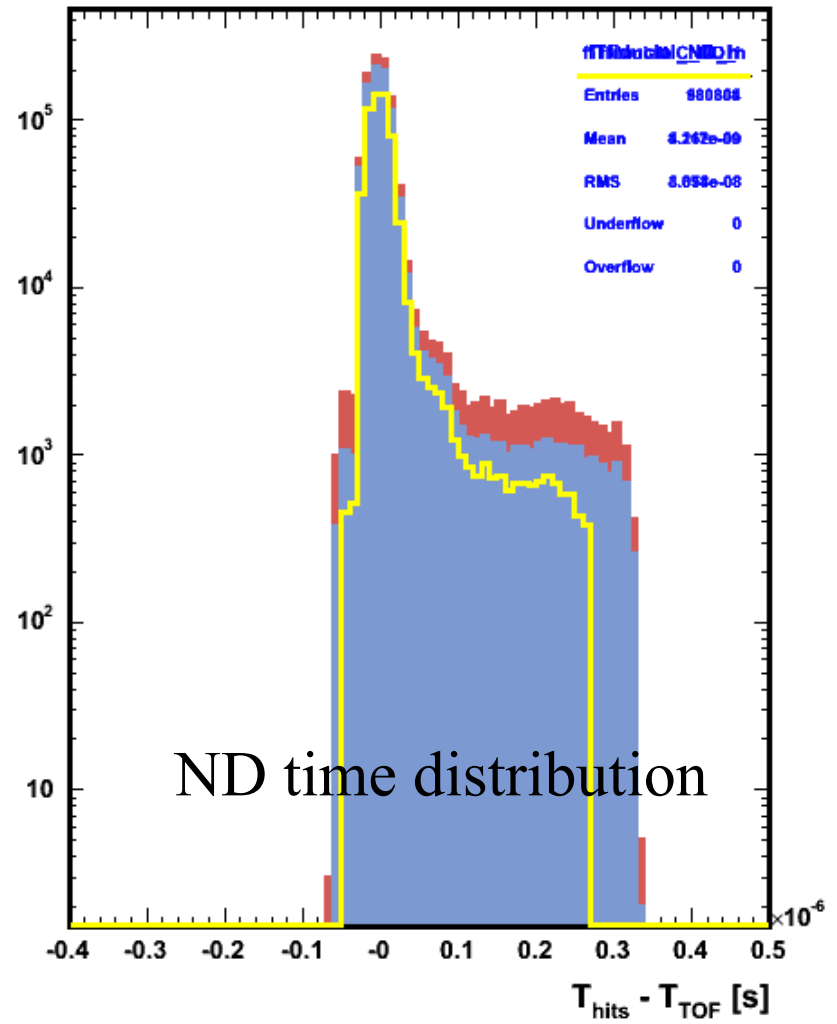
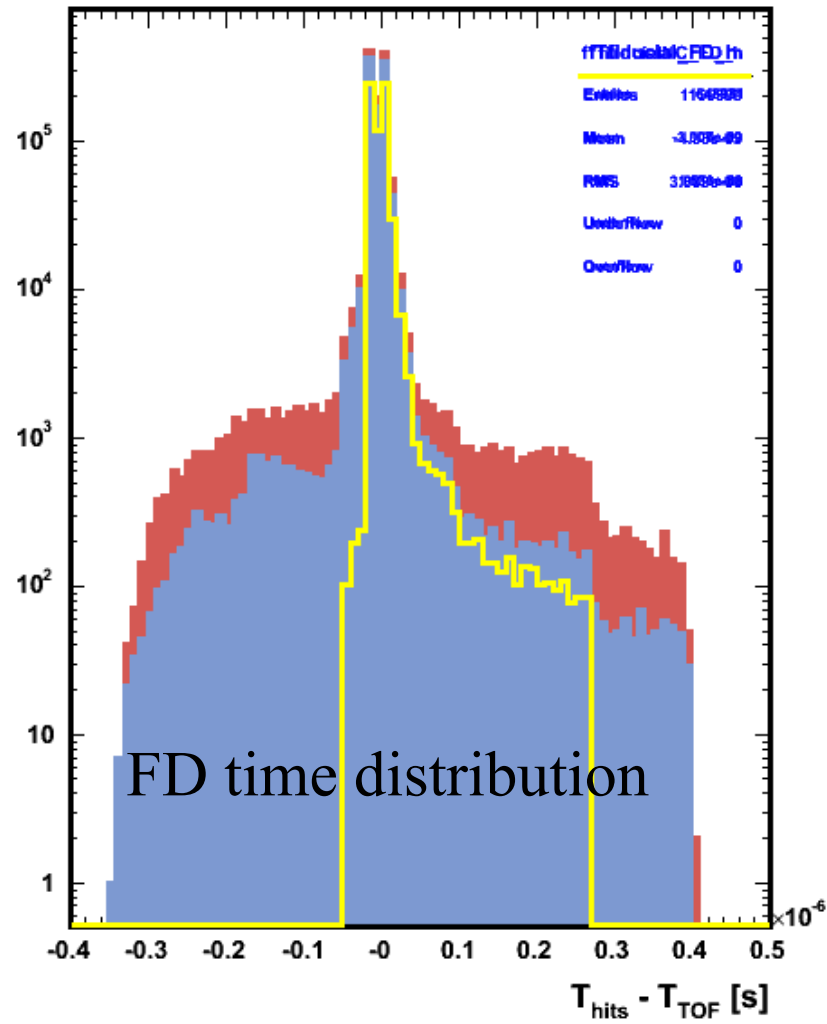
Near & Far Detector comparison at Caldet 2003...

Aims of my analysis:

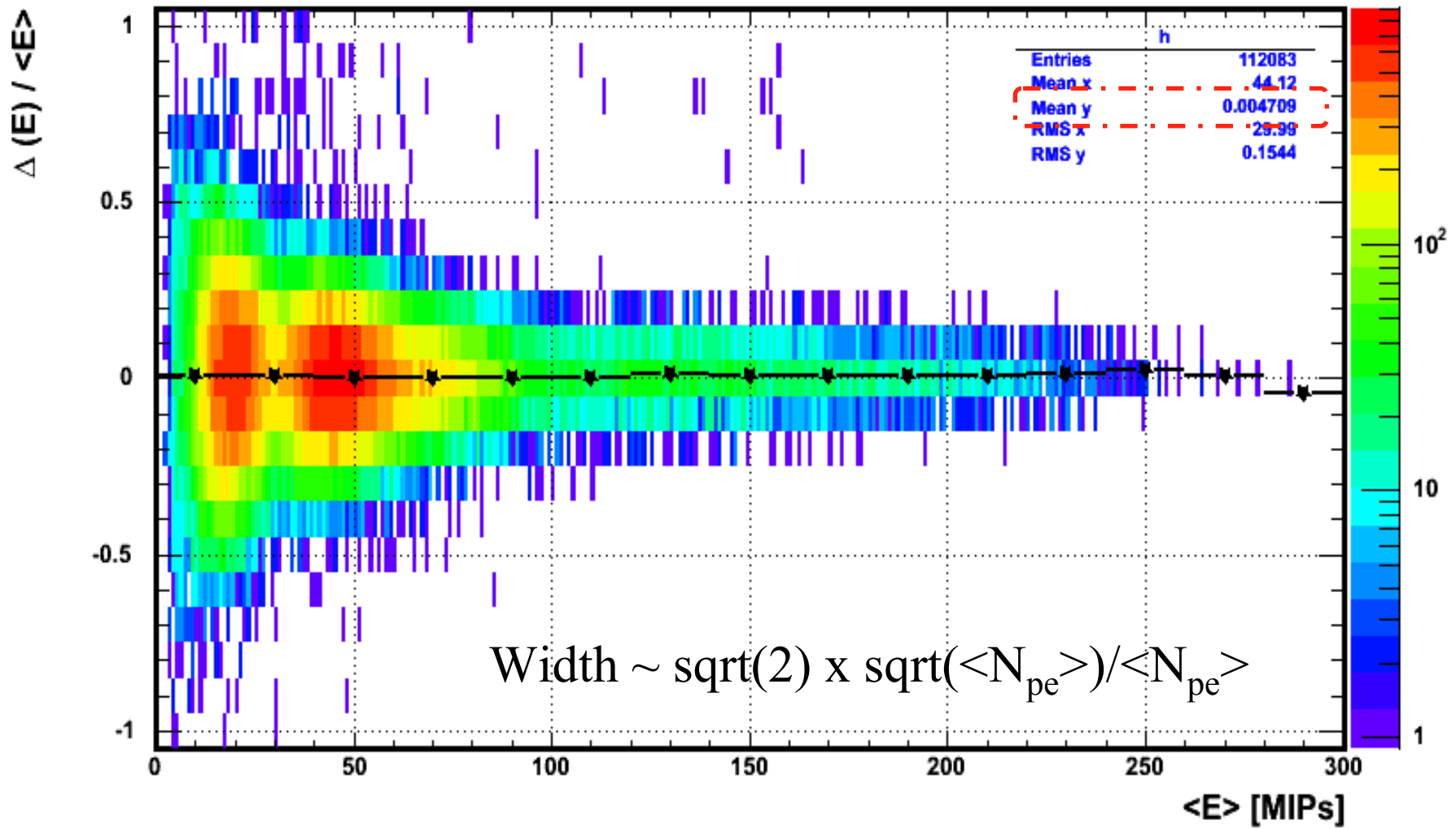
1. Learn how to run the two detectors for an optimal relative response.
2. Characterise differences in response with known particles - expected to be seen in our Far and Near detectors.
3. Identify magnitudes usable for event selection which are at the same time robust ND & FD relative to each other.
4. Tune our MINOS MC and Detector Simulation.

How to get some electrons at Caldet?

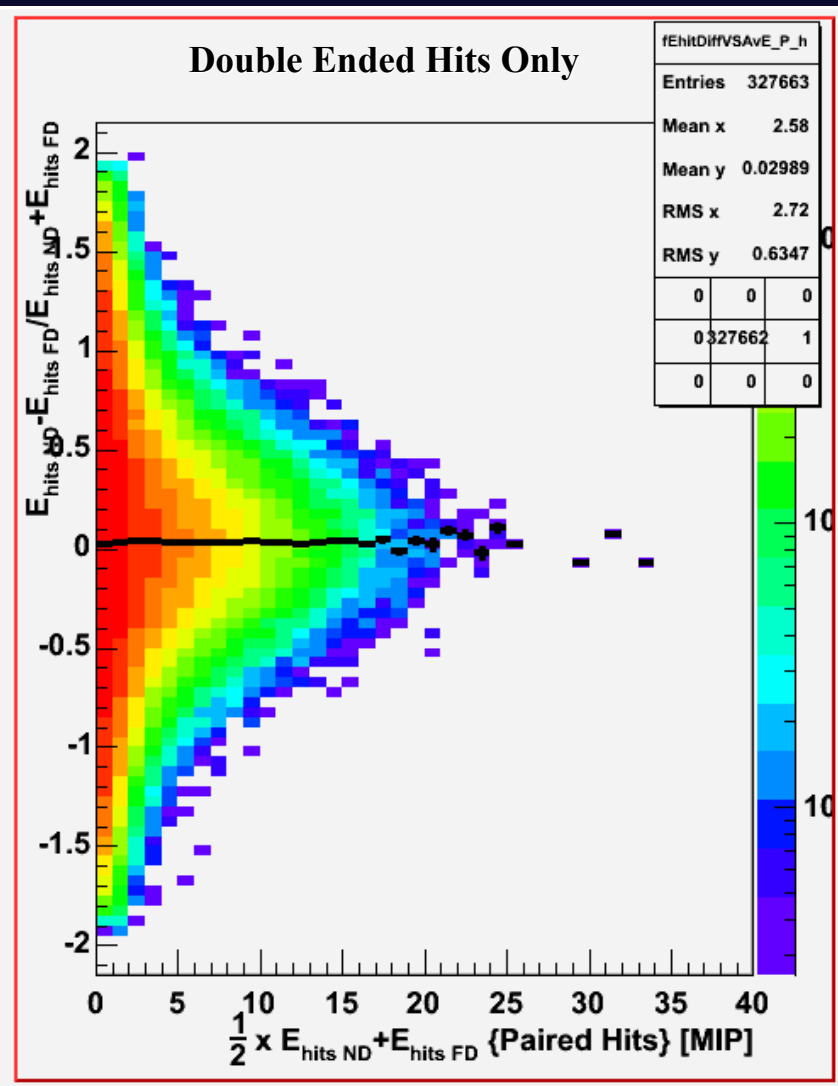
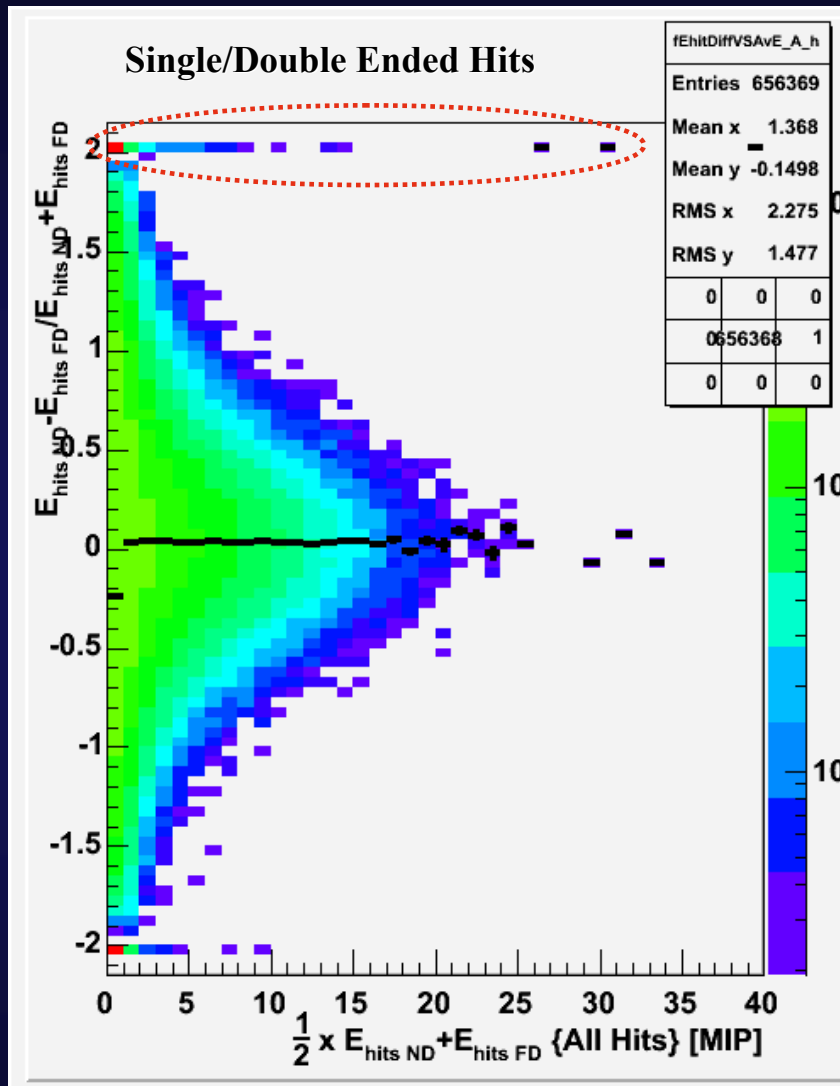
Fiducial cut on time -> compare when both detectors are alive.



Event-by-event comparison.

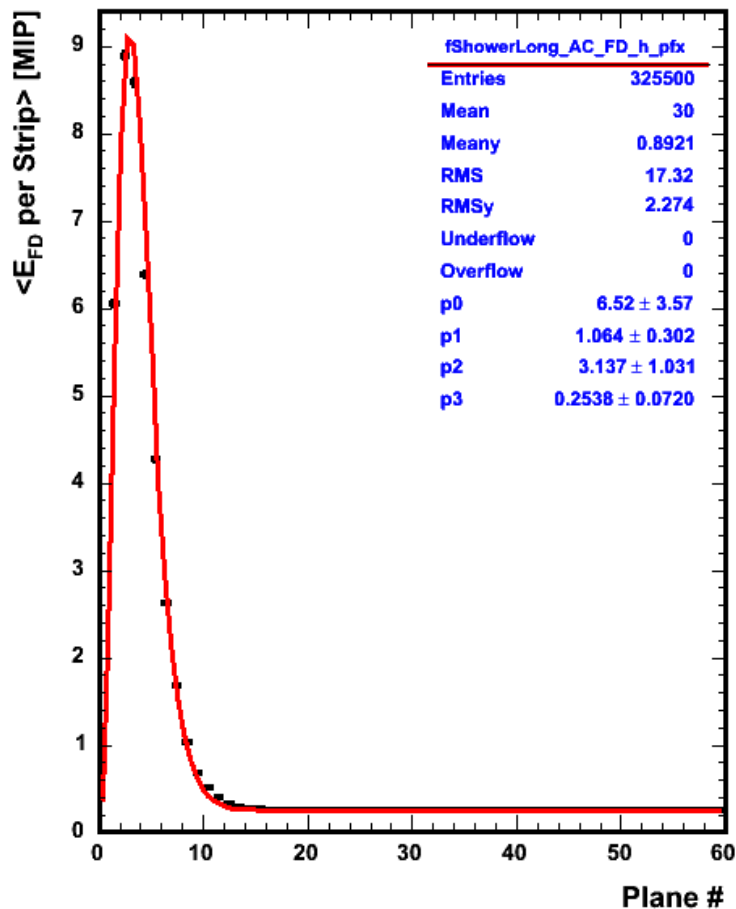


Hit-by-hit comparison.

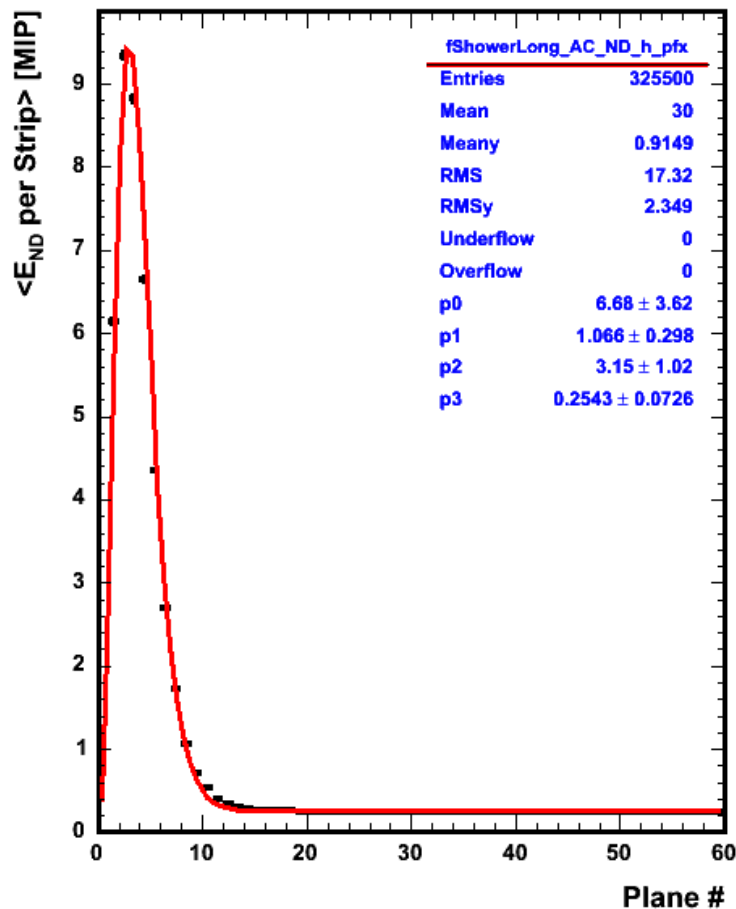


Energy is important but topological differences are too...

Far Detector Side



Near Detector Side



Conclusions & Outlook...

- Preliminary results are looking very promising -> no significant difference on response and topology of events (at all energies).
- All variable for event selection explored so far seem very Near/Far robust.

Future:

- Expanding this analysis to muons and pions - ongoing already.
- Use analysis to tune the MINOS MC and detector simulation.