MAPS — The "No Harm" Physics Study and Early Sensor Tests at Imperial

MAPS Group Meeting, RAL

Jamie Ballin

HEP, Imperial College, London
j.ballin06@ic.ac.uk

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CALICE Calorimeter for ILC

Outline

1. The No Harm Study
2. Sensor tests at IC
   - Scanning thresholds

The “Do No Harm” idea

Just count hits in virtual 1 cm^2 cells

- check we do no harm by applying MAPS: sum hits in virtual 1 cm^2 cells, and apply a factor to convert from the number of hits to MIPs or GeV
- takes output from AM’s MIPFinder and digitisation
- turn off noise, no dead area for now

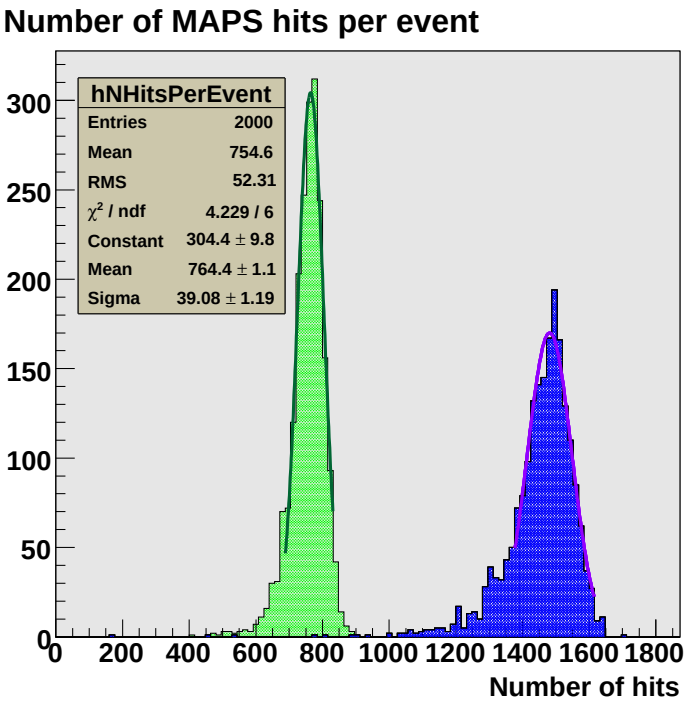
Procedure

Need to create new collections

- For each MAPS `SimCalorimeterHit` from AM's digi, smear the position to the centre of a 1 cm^2 cell. Create a new `SimCalorimeterHit`, `CalorimeterHit` and relationship between them if that cell didn't already exist.
- Set the energy of the new cell equal to the number of hits $\times$ conversion factor
- Compare photons at 10 GeV and 20 GeV to standard ECAL case to determine conversion factors

Number of hits to GeV

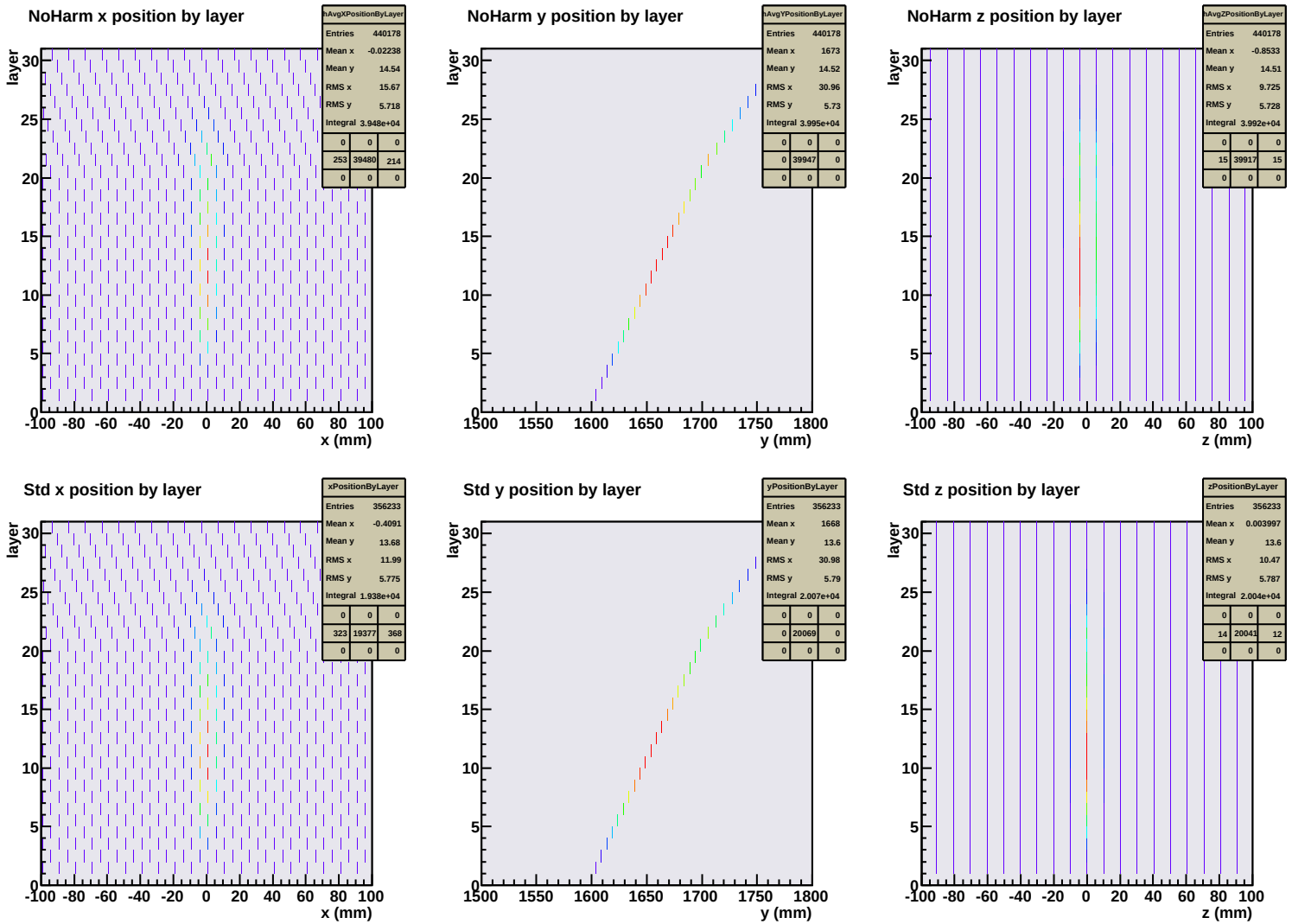
10 and 20 GeV photons



- Fit parameters (gah, ROOT!): 20 GeV has $\mu = 1481$ hits and $\sigma = 66$ hits
- 1481/2 not quite 764.4, but . . .
- Take 1 hit = 0.0135 GeV

NoHarm and standard ECAL- x, y, z distributions

20 GeV photons - average positions, NoHarm ECAL top, Standard ECAL bottom



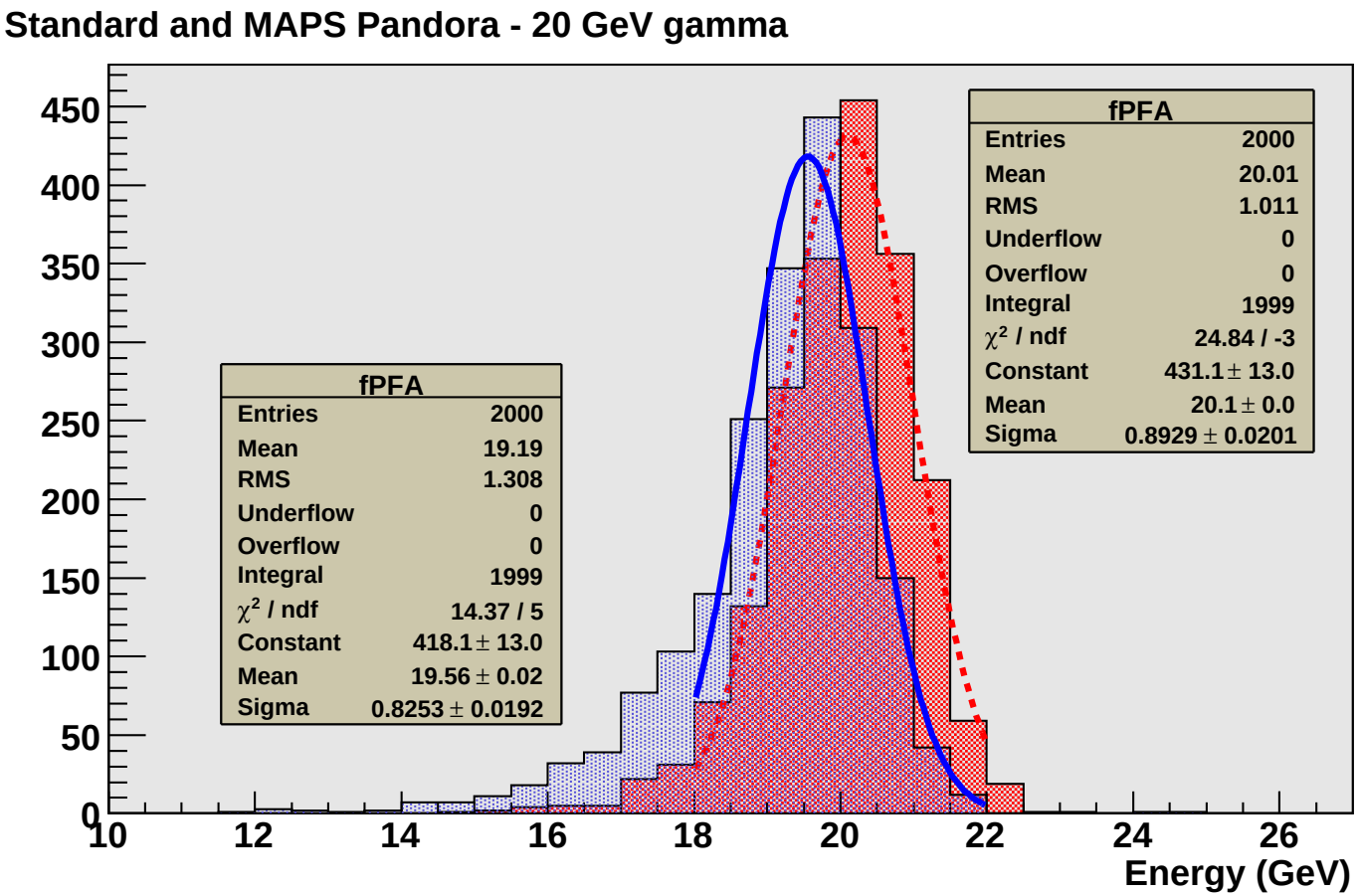
NoHarm and standard ECAL- x, y, z distributions

20 GeV photons - average positions, NoHarm ECAL top, Standard ECAL bottom

- x, y shower development agree in each case
- NoHarm z cells are displaced by 5 mm relative to standard ECAL case $\Rightarrow$ needs a fix

Pandora and NoHarm

What happens when we push NoHarm through Pandora?[1] Std ECAL



[1] Answer: it crashes miserably: I had to hardcode the new collection names into `PandoraPFAProcessor.cc`

Pandora and NoHarm

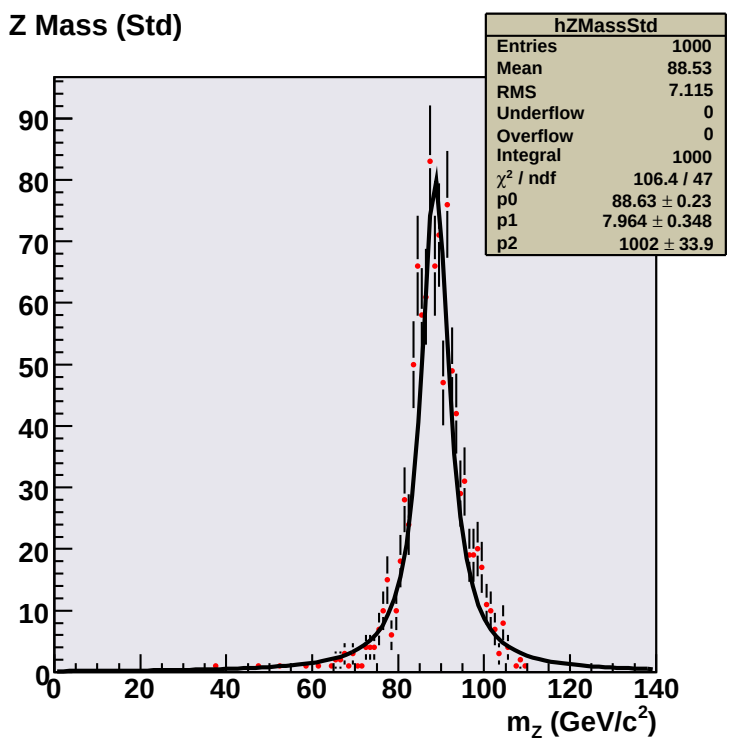
Photons, great, but what of the Z?

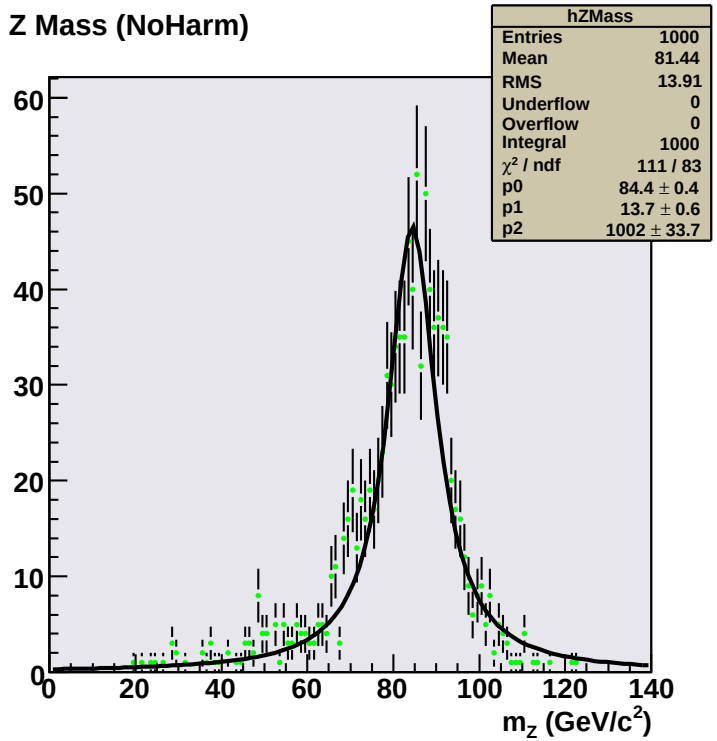
Is the tail on the photon energy distrubution due to Pandora incorrectly clustering the photon shower to two clusters?

- Apparently not.
- Nor does it reconstruct > 1 particle.

Pandora and NoHarm

Oh dear





Mmmm. Discuss.

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Testing end–to–end sensor operation

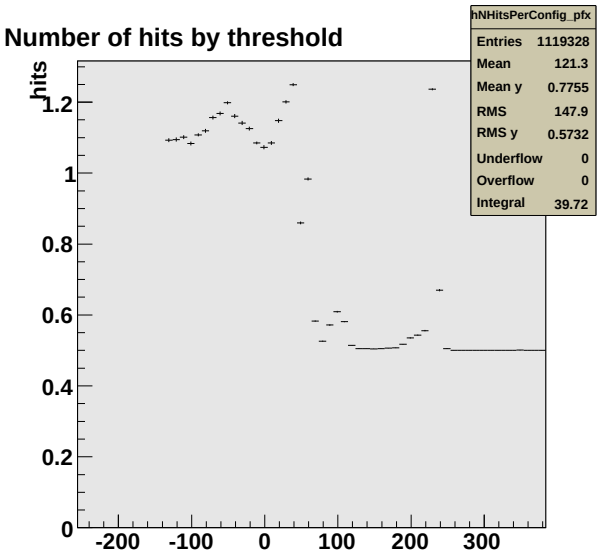
Task Number 1: scan thresholds

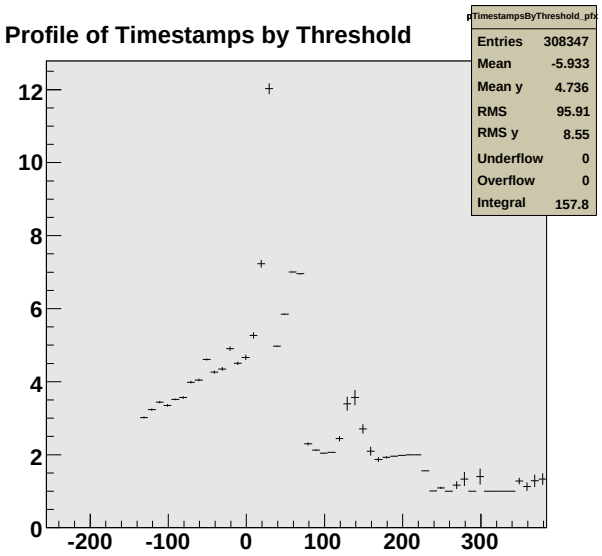
1. Scan thresholds across a range such as 2048 $\pm$ 256 DAC values
2. Measure number of hits for each threshold: expect a monotonically decreasing curve (a reverse 'S') as a function of increasing threshold
3. Hiccup 1: Discover number of hits increases with threshold - i.e. we get peaks!
   - At very low thresholds, memory fills very quickly, within a few timestamps (3, 4, 5) of the 8000 available in a bunch train (BT).
   - At threshold and beyond, memory may not fill during a whole BT $\Rightarrow$ can get more hits in more time
   - $\Rightarrow$ need to normalise the hit curve with the last time stamp in that BT to get correct P(hit) as a function of threshold.
4. Hiccup 2: Peaks still remain! Check threshold is not related to common mode.
5. Hiccup 3: Discriminator was directly coupled to monostable output. This was fixed 2 days ago, but all the same, things aren't pretty...

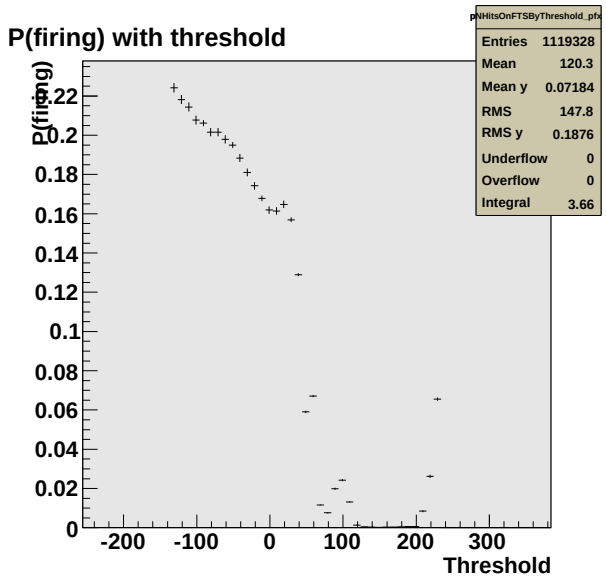
CALICE Calorimeter for ILC

Pixel (35, 64) for example

NHits, Full timestamp and hit probability as a function of threshold

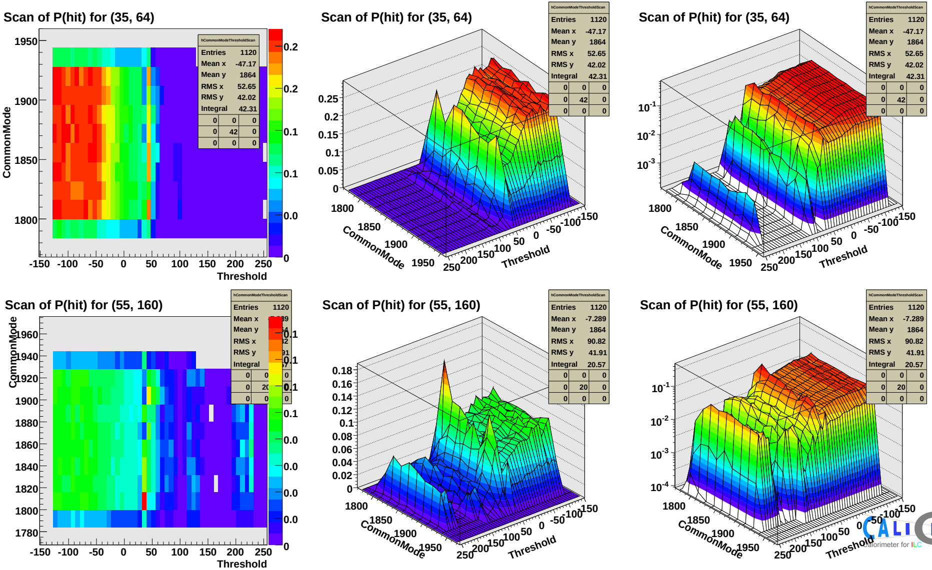






Testing end–to–end sensor operation

Consider pixels (35, 64) and (55, 160)



Fin.