MAPS – Beam Test: preliminary results and book keeping
MAPS Group Meeting, RAL

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CALICE
Calorimeter for ILC

A Christmas Tale

Starring the staff of the DESY House of Pain
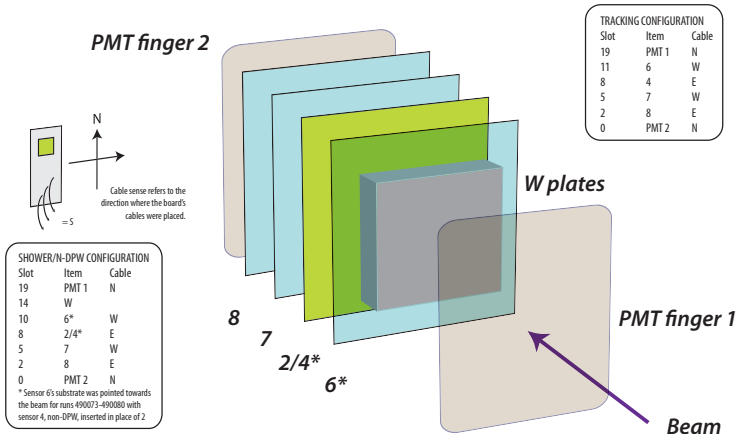Laughter • Tears • Power • SCANDAL

Starring

- ▶ Dr M Stanitzki – Burgermeister
- ▶ Prof P Dauncey – Die Grosse Kase
- ▶ Dr A-M Magnan – Die Kleine Fromage
- ▶ Dr M Noy – Vorschsprung durch Tecknik
- ▶ Moi - Main Goon

Outline

1. Tracking efficiencies

2. Code base

3. Book keeping

Physical configuration

DESY BEAM TEST CONFIGURATION

PMT finger 2

N

Cable sense refers to the
direction where the board's
cables were placed.

= S

TRACKING CONFIGURATION		
Slot	Item	Cable
19	PMT 1	N
11	6	W
8	4	E
5	7	W
2	8	E
0	PMT 2	N

W plates

SHOWER/N-DPW CONFIGURATION		
Slot	Item	Cable
19	PMT 1	N
14		W
10	6*	W
8	2/4*	E
5	7	W
2	8	E
0	PMT 2	N

* Sensor 6's substrate was pointed towards
the beam for runs 490073–490080 with
sensor 4, non-DPW, inserted in place of 2

8

7

2/4*

6*

PMT finger 1

Beam

Finding a tracking efficiency
Concepts

- For each bunch crossing, count how many hits each sensor has.
- For the sensors held at nominal, make a track when each of the 3 sensors has at least one hit. Get N tracks.
- Ask whether the threshold-scanned sensor confirms this. Get i confirmations, and $N - i$ rejections.
- Efficiency ϵ is simply,

$$\epsilon = \frac{i}{N} \times 100\%$$

- (Slight complexity: compute ϵ each bunch train, plot average of ϵ, otherwise you get steps.)

Efficiency ϵ and purity η

But 4th sensor will always incorrectly confirm a track if noise is very high.
So we need purity too. . .

$$\bar{\eta} = \epsilon|_{\text{no beam}}$$

- ▶ Can't rely on PMT data
- ▶ Code base can't support x, y correlations and rejections
- ▶ So either we plot fake "impurity" rate from noise data
- ▶ Or look at whether the 4th sensor confirms a track at some decorrelated time 4096 BXs away (gives results between noise and beam as it happens, not shown today)

Noise vs. beam, all DPW

Beam threshold scan, run 490043
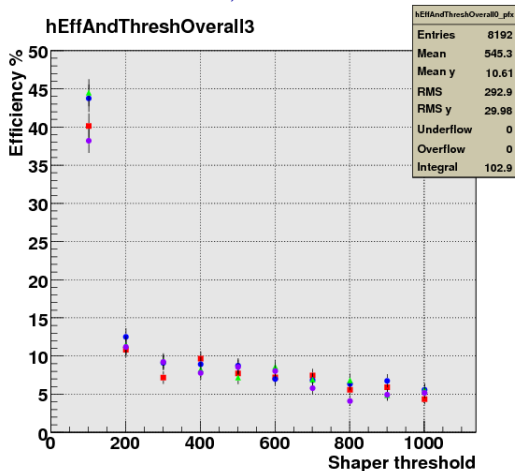
- One colour for each of sensors 2, 6, 7, 8
- All held at "nominal" thresholds (150/500)
- First beam test plot from a working system!
- ...but you get a queezy feeling all the same.
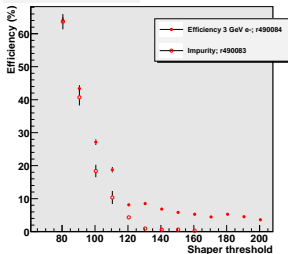
Non-DPW results

Non-DPW vs DPW

Legend:
- Non-DPW with 3 GeV e- beam; r490079
- DPW with 3 GeV e- beam; r490079
- Non-DPW without beam; r490080
- DPW without beam; r490080
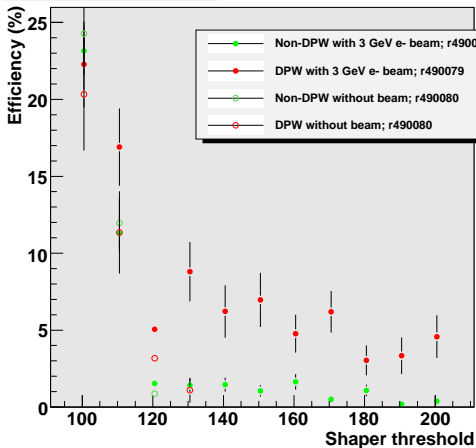
- ▶ Red - DPW (sensor 7), Green Non-DPW (sensor 4)
- ▶ DPW process has boosted efficiency by 7x! (To all of 7%).

Finer threshold scan
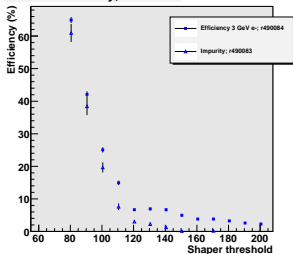Nominal thresholds lowered

Finer threshold scan
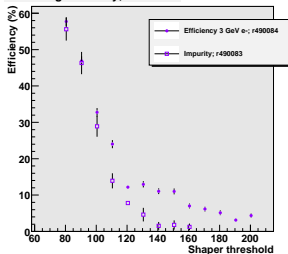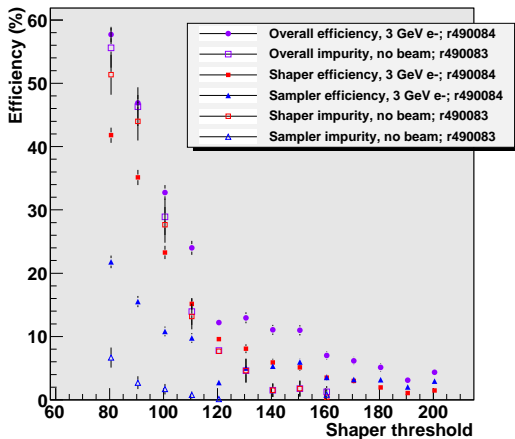Shapers or samplers?

Ask for track confirmation in shapers and samplers seperately

Sensor 8 - shapers/samplers

- Overall efficiency, 3 GeV e-; r490084
- Overall impurity, no beam; r490083
- Shaper efficiency, 3 GeV e-; r490084
- Sampler efficiency, 3 GeV e-; r490084
- Shaper impurity, no beam; r490083
- Sampler impurity, no beam; r490083

$\Rightarrow$ normalisation of 50%. Sensor stack arrangement made for alternating sampler/shaper layers $\Rightarrow$ impossible to get a simple answer.
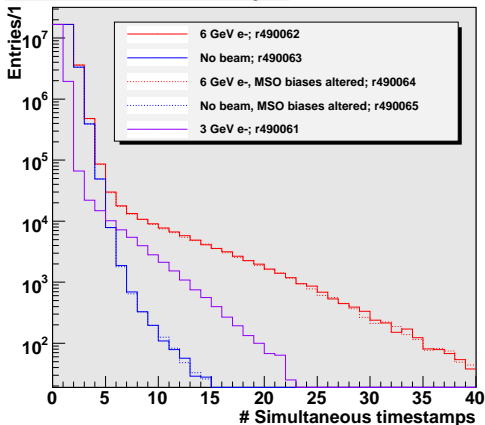
10%!?

- ▶ Why is this? We need a systematic and coordinated plan to tackle this question.
    - ▶ Laser
    - ▶ Priority list for DAC scanning and optimisation
    - ▶ Software hot channel masking
- ▶ Can it be fixed? If not, why not?
- ▶ What is this slowly decreasing tail in the source and beam scans? Can we be sure the thresholds are working? (Recall that the trims perturbed the response in an unexpected way.)
- ▶ I'm not convinced we're at a good WP - samplers continue to produce erratic behaviour (viz. peaks)

</rant>

How many simultaneous hits are there in showers?
3 layers of tungsten

Simultaneous timestamps

Legend:
- 6 GeV e-; r490062
- No beam; r490063
- 6 GeV e-, MSO biases altered; r490064
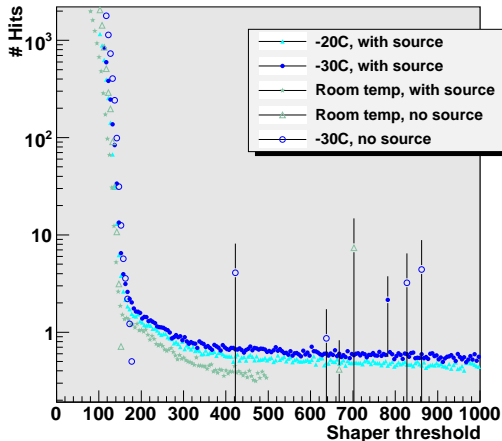- No beam, MSO biases altered; r490065
- 3 GeV e-; r490061

- ▶ Red (6 GeV) and purple are different since we sample different parts of the shower.
- ▶ Purple (3 GeV) has highest particle flux
- ▶ Red and blue are close for values 0, 1, 2... since some 6 GeV particles zip through without showering.

Temperature dependence

Use environmental chamber at IC ($-40°$C to $120°$C) to see if working point is temperature dependent

Temperature Dependence, (S7, R0)

- -20C, with source
- -30C, with source
- Room temp, with source
- Room temp, no source
- -30C, no source

► S & N both increase with cooling
► DAQ bombs out after $\sim 185/200$ configs at $T < 0°$C
► Continue to see long tail from source
► Sensor's not working at $40°$C, but may be due to condensation?

Plans for an analysis framework

Desperately need to convert to a more user–friendly format for data analysis!

- Convert `.bin` to a ROOT file with a physics–driven structure of `TTree`s and the like
- Integrate appropriate book keeping information
- Design and implement a new analysis framework
  - Facilitate tracking
  - Shower objects
  - Geometry and alignment
  - Software channel masking

An attempt to find sensible runs
All useful runs have sequence numbers 470043+ . . .

- ▶ Please find a list organised by physics programme at, `https://twiki.cern.ch/twiki/bin/view/CALICE/DesyTBRuns`
- ▶ Cleaned spreadsheet of eLog data will soon be available
- ▶ Let's use this resource!

The End.

Hey, what's this CALICE logo doing here?

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