Flightlike CalDigi

Some History

The old version of CalDigi digitised the data using parameters stored in xmlGeoDbs.

Primary Category CALResponse

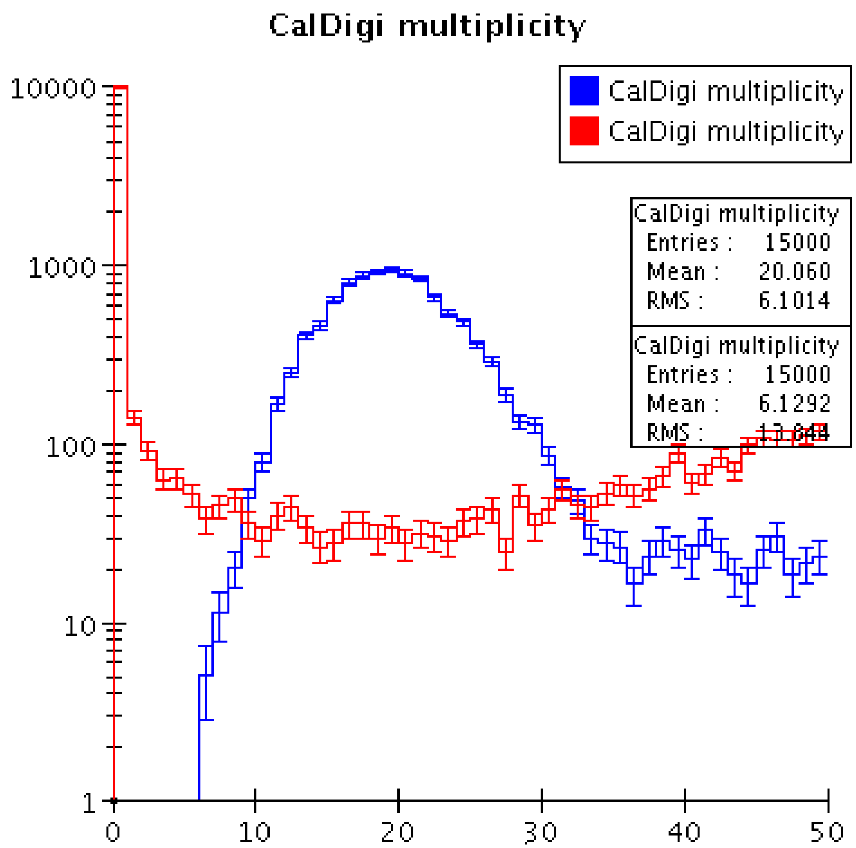
Overview: Fundamental parameters concerning response and configuration of CAL electronics and crystals.

Name	Value	Description
cal.maxResponse0	200 MeV	Max response for readout channel 0
cal.maxResponse1	1600 MeV	Max response for readout channel 1
cal.maxResponse2	12800 MeV	Max response for readout channel 2
cal.maxResponse3	102400 MeV	Max response for readout channel 3
cal.noiseSmall	2000	Noise (in electrons) for small diode
cal.noiseLarge	2000	Noise (in electrons) for large diode
cal.ePerMeVSmall	833	Electrons per MeV for small diode
cal.ePerMevLarge	5000	Electrons per MeV for large diode
cal.pedestal	100	Pedestal in adc units
cal.maxAdcValue	4095	Max possible adc value
cal.zeroSuppressEnergy	2 MeV	Zero suppression threshold
cal.lightAtt	0.65	Light attenuation in CsI crystal (= far/near)

All channels have the same zero suppression threshold and pedestal width.
Noise sigma is set to 2000 electrons (0.4 MeV), zero suppression threshold is 2 MeV (5 sigma).

Threshold lowered to 1 MeV

Threshold now 2.5 sigma, many more noise hits.



New Caldigi

CalDigi was rewritten and can now make digi's using real calibration files.
Also has an ideal mode, which does not require access to the calibration database.
Ideal mode – treat all xtals the same using parameters based on “real” calibrations.

HISTORY OF VALUES

This documents the history of CalXtalReponse ideal calibration effective gain & noise for versions <= v0r3 at which point documentation will be included in the header of each xml file.

```
NEWIDEAL_FLIGHT (CalXtalReponse v0r2p8 -> v0r2p7, GlastRelease v6r6 -> v6r6p1)
RANGE MeV/ADC MAX_ADC SATURATION(MEV)  PED(ADC) NOISE(ADC,MeV) LAC(ADC,MeV)
LEX8  0.03    3400    109              510      5.1, 0.153     30, 0.9
LEX1  0.27    3400    941              210      2.1, 0.567
HEX8  1.73    3400    5913             510      5.1, 8.823
HEX1  15.38   3400    52,000           210      2.1, 32.30

NEWIDEAL_MUON2 ( CalXtalReponse v0r2p6, GlastRelease v6r4 -> v6r5)
RANGE MeV/ADC MAX_ADC SATURATION(MEV)  PED(ADC) NOISE(ADC,MeV) LAC(ADC,MeV)
LEX8  0.03    3400    109              510      5.1, 0.153     30, 0.9
LEX1  0.27    3400    941              210      2.1, 0.567
HEX8  0.17    3400    591              510      5.1, 0.867
HEX1  1.53    3400    5,200            210      2.1, 3.213

NEWIDEAL_MUON1 ( CalXtalReponse v0r2 -> v0r2p5, GlastRelease <= v6r3p2 )
RANGE MeV/ADC MAX_ADC SATURATION(MEV) PED(ADC)  NOISE(ADC,MeV) LAC(ADC,MeV)
LEX8  0.03    3500    112             510       5.1, 0.153     30, 0.9
LEX1  0.27    3500    968             210       2.1, 0.567
HEX8  0.17    3500    608             510       5.1, 0.867
HEX1  1.53    3500    5,352           210       2.1, 3.213
```

Ideal Mode Digitization

CURRENT VALUES - Ideal flight mode

Ideal mode calibrations are based on measured means of cal Flight Models.

They are not well suited to real data as they treat all crystals as equal, while the varying pedestals in real data could cause some ideal calibrations to be out of range.

'flight' mode calibrations are intended for simulating flight energy levels.

The effective reponse of the current configuration is as follows

```
NEWIDEAL_FLIGHT2
RANGE MeV/ADC MAX_ADC SATURATION(MEV)  PED(ADC) NOISE(ADC,MeV) LAC(ADC,MeV)
LEX8  0.03    3550    109              510      6.0, 0.18      43, 1.29
LEX1  0.27    3850    941              210      0.6, 0.162
HEX8  2.16    3550    7676             510      6.0, 8.823
HEX1  19.23   3850    74,016           210      2.1, 32.30
```

Zero suppression threshold is at 1.29 MeV.

The noise (relative to the old Caldigi) has been reduced to 6 ADC counts (0.18 MeV), consistent with what is measured on the ground (but see next slides). This is not expected to be representative of what we will see in orbit.

Using the calibrations

Can also use the calibration constants to generate the digis.

Currently points to $LATCalibRoot/CAL/16Towers/peds6grid_v0.xml for pedestal values and widths.

- Pedestal width is 7-8 ADC counts for the 6 towers.
- Pedestal width is 5.5-6 ADC counts for the other 10 towers (from the preship calibration).

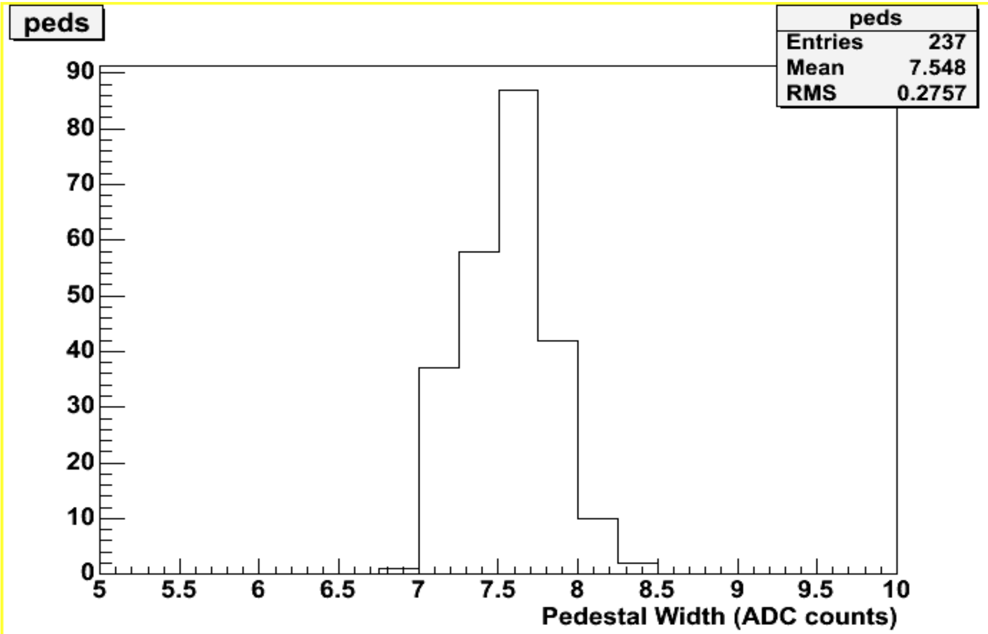
(why are they different?)

$LATCalibRoot/CAL/16Towers/16TowerFakeTholdCI.xml for thresholds (prod).

- LAC thresholds are all the same and are set to 30 ADC counts (~0.9 MeV).

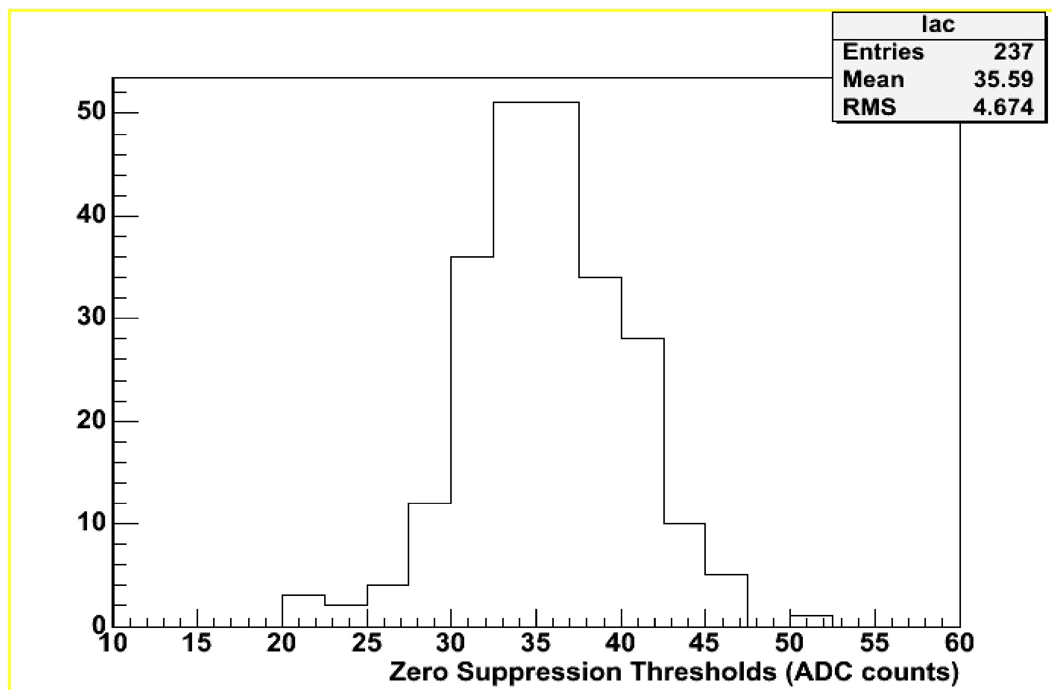
There is also a dev thresholds calibration for the 4 tower configuration which has variable LAC thresholds.

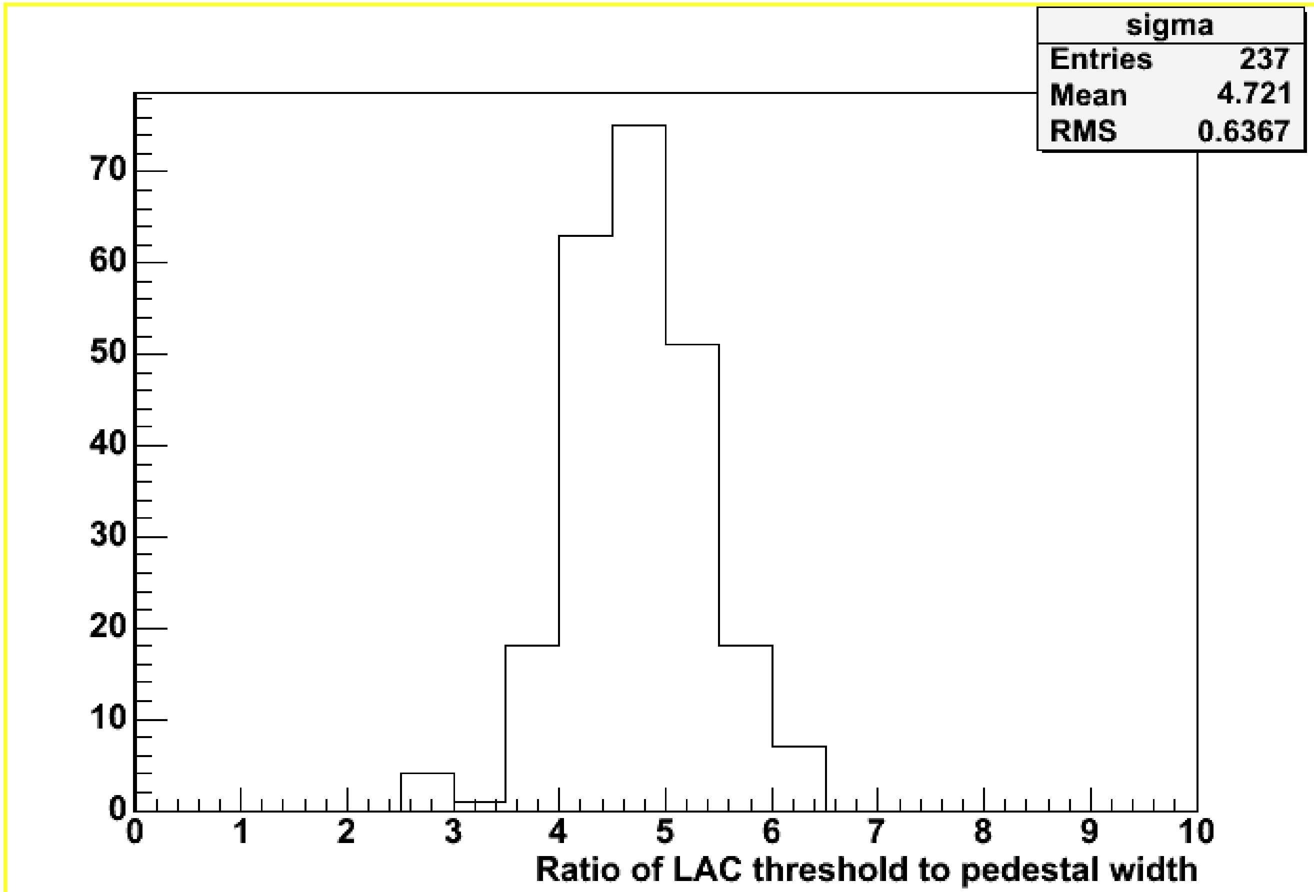
Some plots



Distribution of pedestal widths from 4 towers. 7.5 counts*0.03 =~0.23MeV This is larger than the "average" value used in ideal mode calibrations.

Distribution of LAC thresholds from 4 tower calibration file.





The LAC threshold is at around 5 sigma with this configuration. However it is important to note that the pedestal widths are much smaller than we expect to see in orbit.

What to do

Ideal flight mode:
With the rewrite of CalDigi, the pedestal width was reduced from 0.4 to 0.18 MeV for ideal mode digitization. 0.18 MeV, while reasonable for data taking on the ground, is not representative of what we will see on orbit. Sasha and Neil suggest that the value will need to be a factor of 2-3 higher.

- The noise for ideal flight mode should probably be put back to 0.4 MeV or even higher. How can we estimate what the noise level should be?
- Increasing the noise will (obviously) increase the number of noise hits, so should possibly also increase the LAC threshold (to 2 MeV?). How many noise hits/event can we tolerate (i.e. where should we set the threshold)?

Using Calibration Constants

It would be better to use the full capabilities of the new CalDigi and perform the digitisation on an xtal by xtal basis.

- Allow for variable LAC thresholds and noise levels.

We would need to come up with a distribution of LAC thresholds consistent with a 2 MeV setting and a distribution of flight like noise levels and create a set of “fake” flightlike calibration files.

Summary

At the moment none of the CalDigi methods produce flight like Cal data.

- Ideal flight mode (treating all xtals in the same way) has noise values set too low.
- 16 Tower calibration files can also be used, but again, the noise is too low and LAC threshold is also set too low (at 0.9 MeV).

Suggest that we 1) increase the noise in ideal flight mode.
2) generate a set of "fake" flightlike calibration files.

How do we decide on (and justify) a choice of flightlike noise level?