Cal Peds and Gains

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CAL monitoring: what do we have?

- Pedestals (DigiLong end of run):
  - Cal pedestal distributions (12288 histograms);
  - Mean and RMS of the pedestal distributions (4 ranges, with two different methods, fit and truncated average).
  - Deviation of the mean and RMS with respect to the reference (with the truncated average only).
  - Some additional information (dof, χ^2) for the fitting method.
- Gain ratios (DigiLong end of run):
  - PM, Pp, Mm ratios for all crystals (1536×3 histograms).
  - Mean and RMS of those distributions (two different methods, fit and truncated average).
  - Same additional stuff for the fitting method.
- Trending (DigiLong trending, within each run):
  - Pedestal value in 5 min time bins (12288 trending plots);
  - Pedestal deviations in 5 min time bins (12288 trending plots);
  - Gain ratios in 5 min time bins (1536×3 trending plots).
- A whole bunch of *regular* plots (FastMon, Digi, Recon).

What is this presentation about

- Decide whether what we have is appropriate:
  - Do we have all we need?
  - Do we have too much?
  - Do we have it too often?
- Identify the sensible quantities to put alarms on;
  - Eventually data will tell us;
  - But need input from the CAL group for setting the limits.
- Decide whether we want the (same) quantities from both the truncated average and the fitting method;
  - Detailed comparison follows (run 0238071573);
  - Need to do it on a series of runs and quantify the variations, but this is a first step.

A few remarks on the fitting procedure

- We have quite a few handles to try and make sure the fit is done properly:
  - The fitting function (a gaussian, unless something different is specified).
  - The number of iterations (mean and RMS from the previous iteration used in the next one);
  - The rebin factor for each histogram (when we're absolutely sure we can change the binning in the histograms at the creation time);
  - The number of RMS around the mean for defining the fitting sub-range (separate for left and right).
- All those handles have been fine-tuned by hand, essentially.

A few remarks on the fitting procedure (continued)

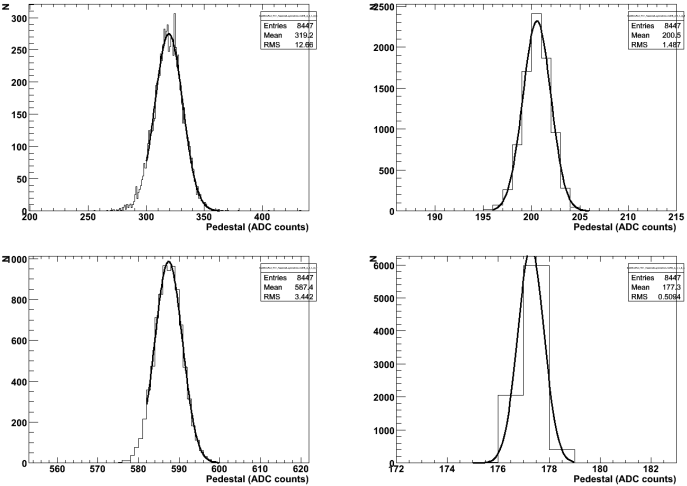
Data type	Function	Iter.	Rebin	Range L	Range R
Ped LEX8	gaussian	1	1	1.5	3.5
Ped LEX1	gaussian	1	1	3.0	3.0
Ped HEX8	gaussian	1	1	1.5	3.5
Ped HEX1	gaussian	1	1	3.0	3.0
Gain RPM	mod. gauss*	2	2	3.0	3.0
Gain RPp	gaussian	2	10	2.0	1.0
Gain RMm	gaussian	2	10	2.0	1.0

*The functional form is:

$$f(x) = \frac{p_0}{\sqrt{2\pi}p_2}\, e^{-\left|\left(\frac{x-p_1}{p_2}\right)^{p_3}\right|} \tag{1}$$

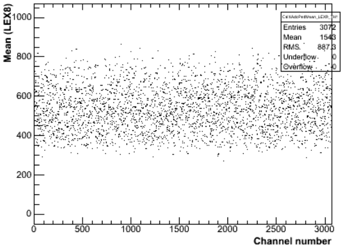
which reduces to a gaussian for $p_3 = 2$ and to a *square* function when $p_3 \rightarrow \infty$. $p_3 = 8$ is chosen for fitting RPM ratios.

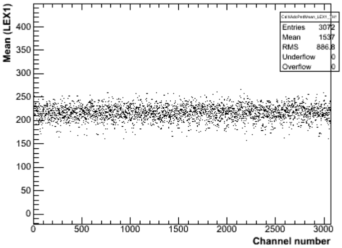
Pedestals: methodology

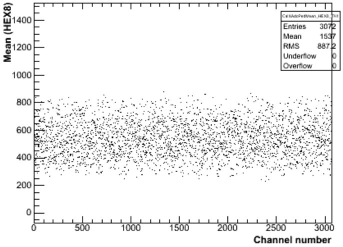


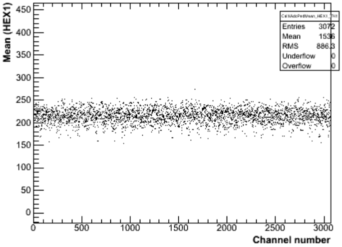
- Gaussian fit on a suitable sub-range (one or more iterations):
  - Get mean and RMS, along with χ^2 and some other things.

Pedestals: mean values

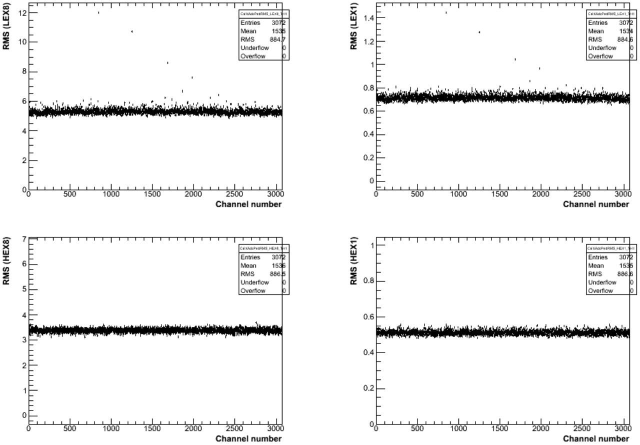






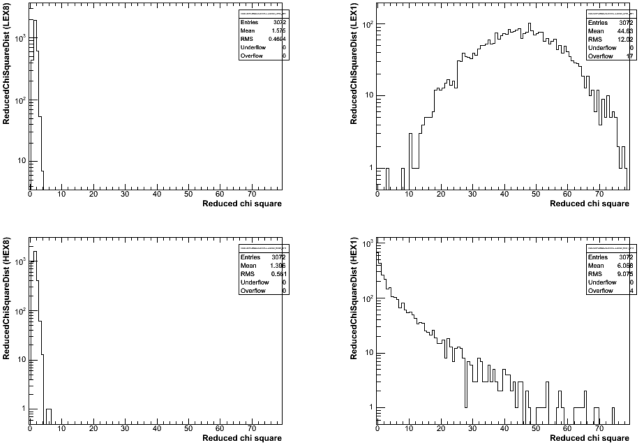


Pedestals: RMS values



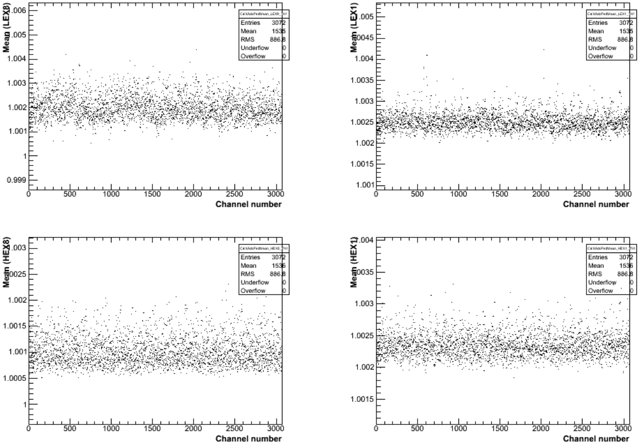
- The *outliers* are real and *not* results of problematic fits:
  - χ^2 is ok when RMS is large.
  - Slide 6 refers to channel 848 (RMS is $\simeq 12$ in LEX8).

Pedestals: reduced χ^2 distributions



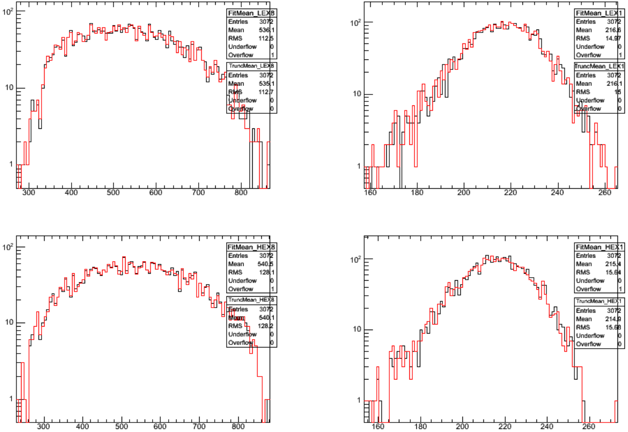
- LEX1 and HEX1 suffer from the fact that the pedestal distributions are only a few bins wide;
  - But the fit *always* converges correctly (looking by eye).

Pedestals: comparison with the truncated average (mean)



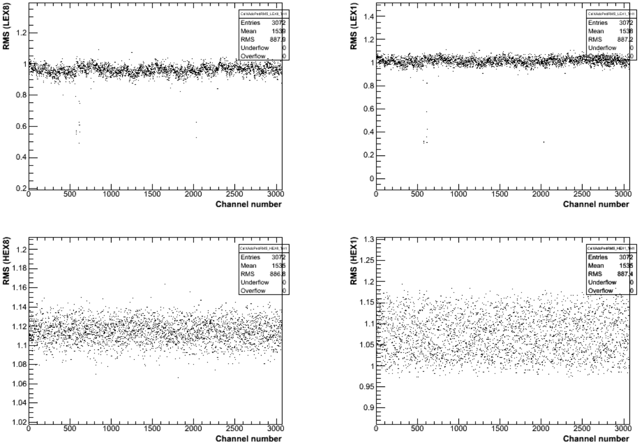
- Agreement on the average values at a fraction of % level;
  - Plots show the ratio between the fitting method and the truncated average method;
  - Small bias (0.1–0.2 %, who cares?)

Pedestals: comparison with the truncated average (mean)



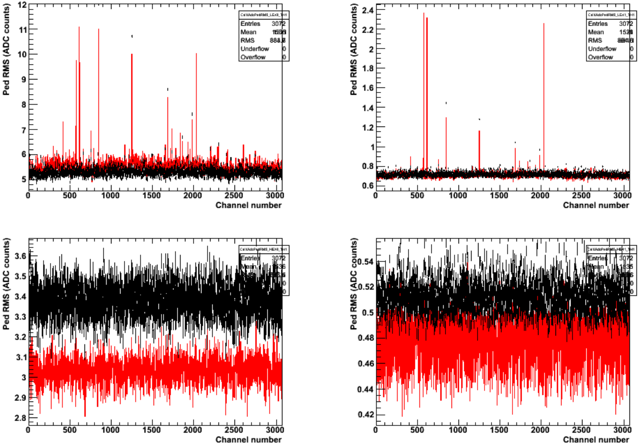
- A different view: distribution of the values.

Pedestals: comparison with the truncated average (RMS)



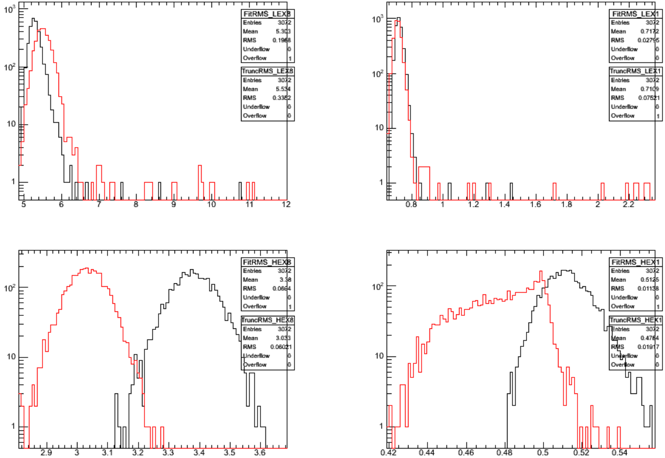
- Agreement of the RMS values is generally good (not always);
  - The truncated average method gives a few more spikes (cfr. channels 576–578). Real or not (see following slides)?

Pedestals: comparison with the truncated average (RMS)



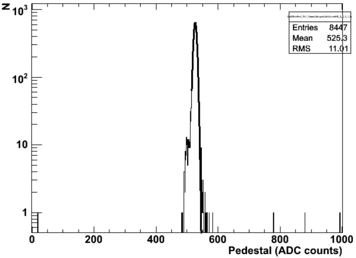
- A different view on the comparison;
  - Black is the fitting method, red is the truncated average.

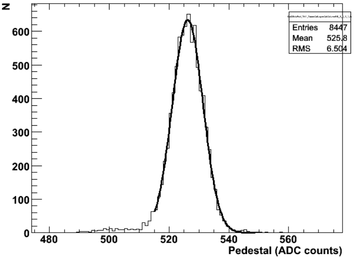
Pedestals: comparison with the truncated average (RMS)



- Another different view: distribution of the values.

Pedestals: channel 577 LEX8



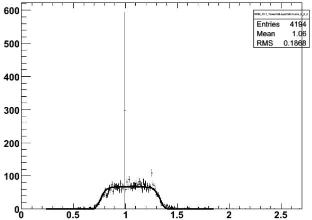


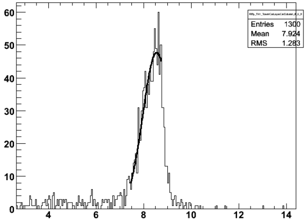
- The plot on the right is the zoomed version of the one on the left (channel 577 LEX8);
  - The fitting method gives RMS $= 5.13$;
  - The truncated average gives RMS $\simeq 9$.
- Need to assess which one is correct and which one is wrong;
  - If the truncated average excludes the few bins below 100 and above 700 I don't understand how it can return $\simeq 9$. The *raw* RMS on the zooomed plot is only 6.5 or so.

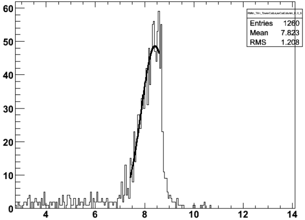
Pedestals: comments

- Mean values:
  - Fitting and truncated average are really the same thing, no noticeable difference.
- RMS values:
  - There are occasional differences for a few channels;
  - The fit converges correctly in those cases;
  - Need to understand why the truncated average does *not* agree and whether this difference is telling us something interesting or not.
- The subtraction of the pedestal values (in the CAL db) is not yet implemented with the fitting method;
  - If we want to use this tool we need to do it (probably need some help from David).
- Trending the pedestal-related quantities with sub-run resolution is not implemented with the fitting method—and may be problematic.

Gain ratios: methodology

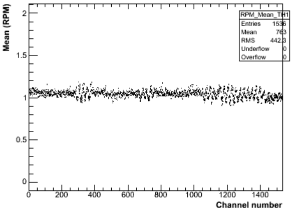


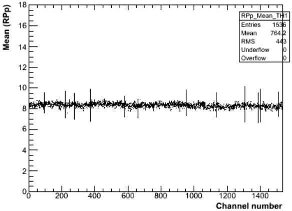


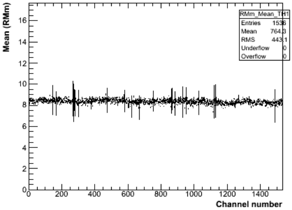


- Unphysical spike at $\simeq 1$ now fixed—I was assigning a large error in the meantime to neglect it in the fit.

Gain ratios: mean values

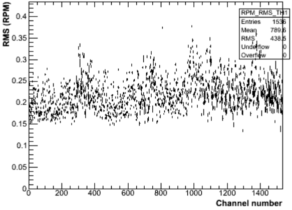


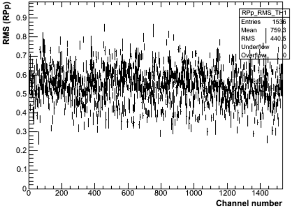


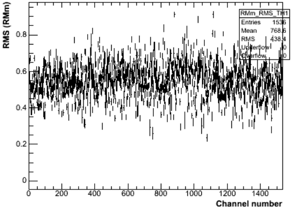


- In some cases the error associated with the fit is large;
  - But the fit parameter still look *correct*;
  - Reasonably uniform across the detector.

Gain ratios: RMS values

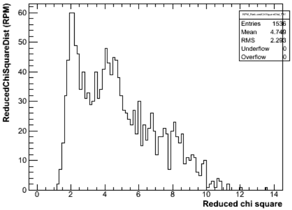


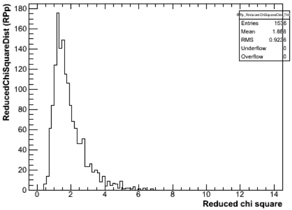


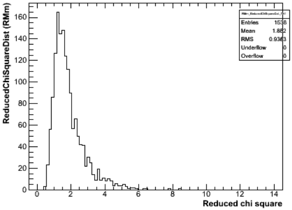


- Again the fit seems to converge in all cases.

Gain ratios: reduced χ^2 distributions

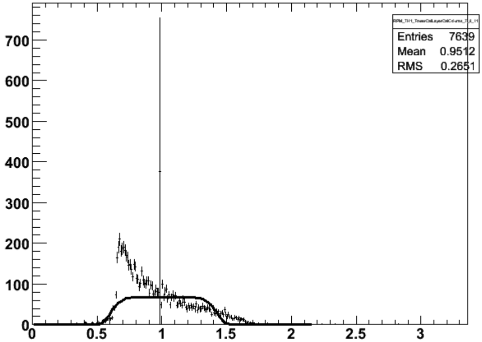






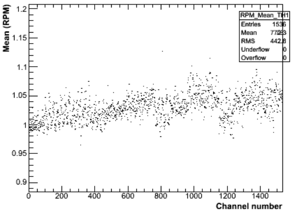
- The reduced χ^2 distribution looks poor for the PM ratios:
  - Clearly the fit function is not *right*—at least in some cases;
  - But still the fit parameters are reasonable.

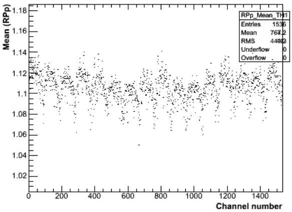
A *problematic* channel: 755 (PM)

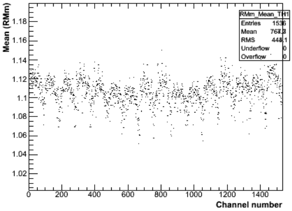


- The fit for this one has a reduced $\chi^2 \simeq 12$;
  - The fitting tool gives mean = 1.01, RMS = 0.23
  - The truncated average gives mean = 0.95, RMS = 0.24
- Even questionable what we are trying to measure, here. . .

Gains: comparison with the truncated average (mean)

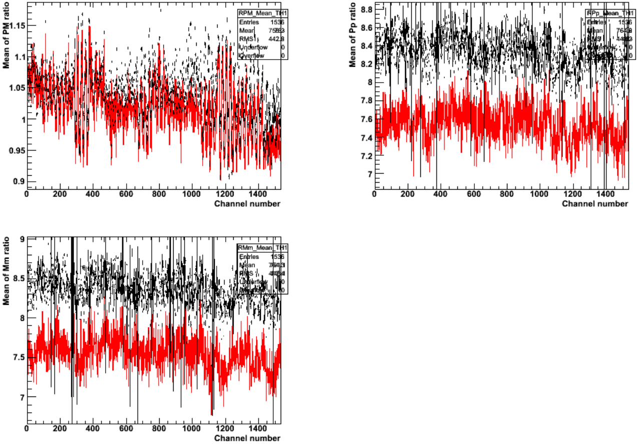






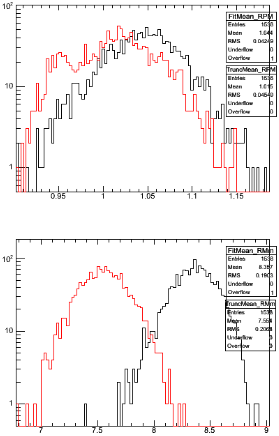
- Good agreement (at the level of 10%);
  - Clear (irrelevant) bias due the shape of the distributions (cfr. slide 17);
  - Probably both are good enough to put alarms on.

Gains: comparison with the truncated average (mean)



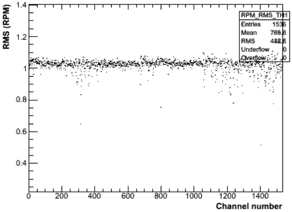
- The fitting method seems slightly more uniform across the detector.

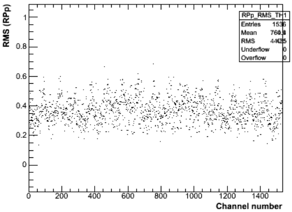
Gains: comparison with the truncated average (mean)

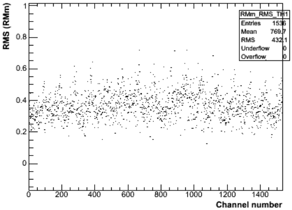


- Another different view: distribution of the values.

Gains: comparison with the truncated average (RMS)

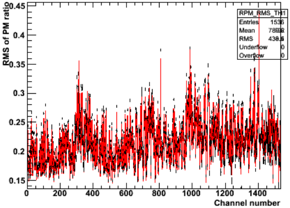


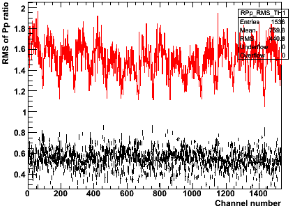


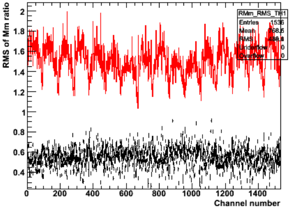


- Numbers for Pp and Mm are different;
  - Reasonable, given how the distributions look like (cfr. slide 17—there's a lot of stuff outside the peak).

Gains: comparison with the truncated average (RMS)

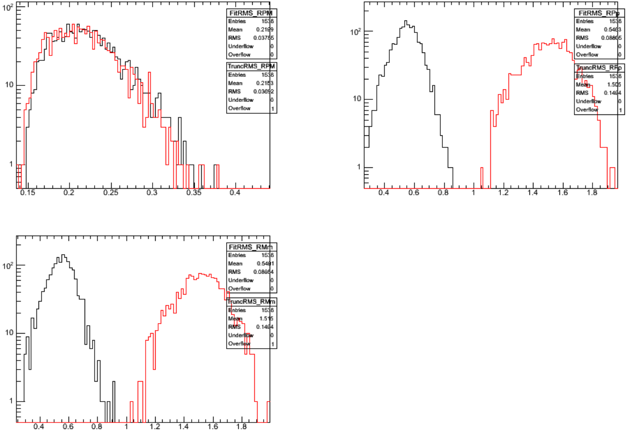






- Again the fitting method seems slightly more uniform across the detector.

Gains: comparison with the truncated average (RMS)

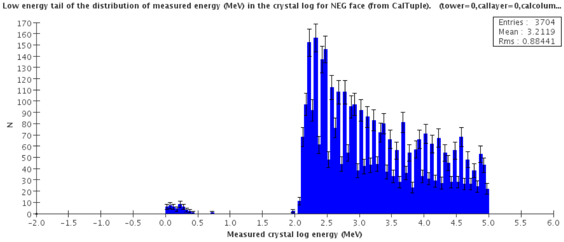


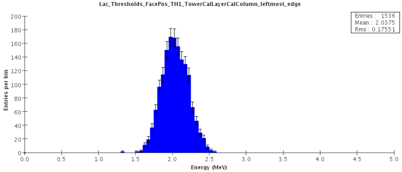
- Another different view: distribution of the values.

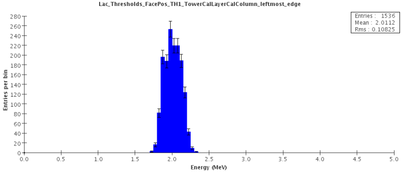
Gain ratios: comments

- The gain distributions are highly non gaussian and not particularly well behaved;
  - Fitting and truncated average give *different* numbers.
  - The difference is mainly an overall (irrelevant) multiplicative factor;
  - The ratio between the two methods is reasonably uniform across the detector—probably they're both good enough for putting alarms on.
  - Results from the fitting procedure seem slightly more uniform across the detector (distributions of the values are narrower).

LAC thresholds







- Left: distribution of the LAC values over all the crystal *before* the first in-flight calibration;
- Right: same thing after the calibration.

Conclusions

- Which plots are useless ?
- Which plots are missing ?
- What method shall we use for pedestal monitoring ?
- Which alarms shall we put for pedestal monitoring ?
- What method shall we use for ratios monitoring ?
- Which alarms shall we put for ratios monitoring ?
- About fitting vs. truncated average:
  - Truncated average allows trending with sub-run granularity.
  - Truncated average already provides deviations wrt. reference.
  - Distributions of the output values from the fitting are generally narrower and more *well behaved*—easier to put alarms on but do the outliers in the truncated average tell us something?