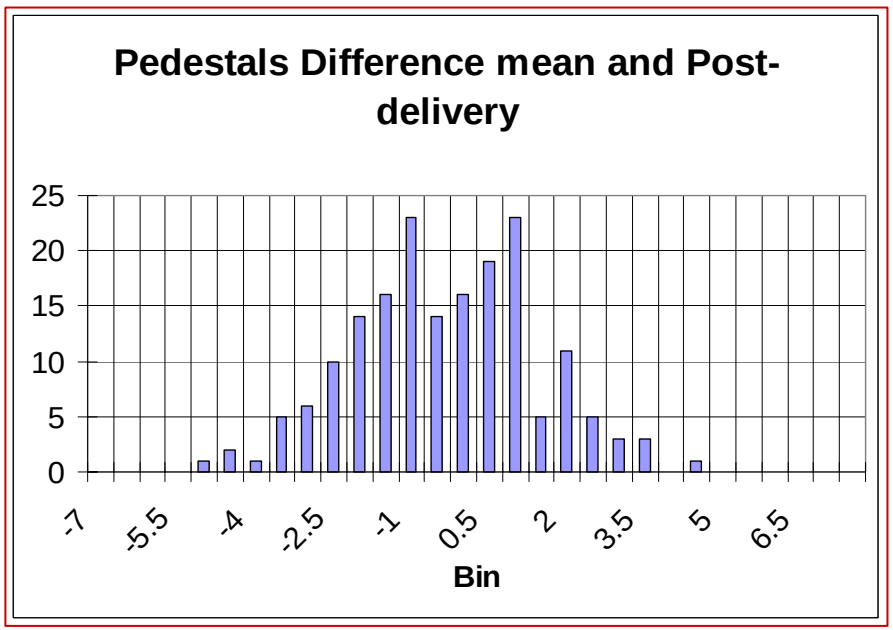
ACD MIP PEAK AND PEDESTAL "INSTABILITY"

The problem is that we regularly observe changes in ACD pedestals and mip peak positions during tests at SLAC

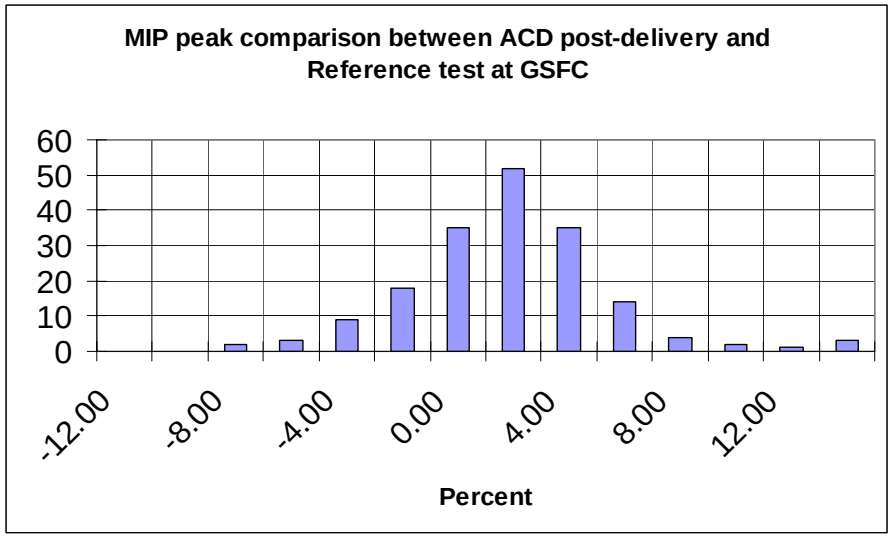
Let's look at some data.

1. ACD tests at Goddard, May-August 2005



This is a comparison plot of pedestals between ACD post-delivery test at SLAC (August 2005) and one of the first runs at Goddard (May 23, 2005).

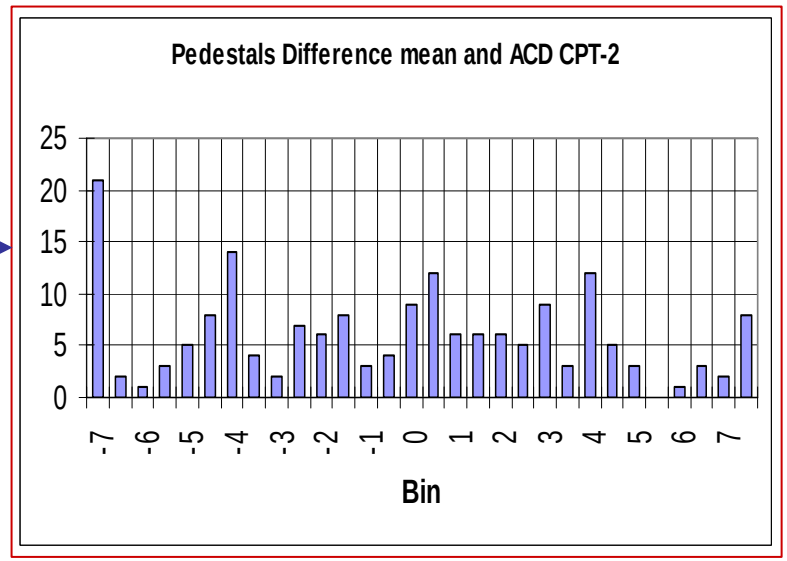
- **there were numerous ACD tests between that two, including full program of mechanical (vibration, acoustic) and environmental (thermal, 8 times up and down from -25C to +35C) and transportation from GSFC to SLAC. But still – pedestals are stable within a few ADC bins!**
- **if we look at intermediate pedestal comparison plots, they look even better**
- **Conclusion – ACD pedestals are stable within ±4 ADC bins**



This plot compares MIP peak positions between ACD post-delivery at SLAC and Reference test at GSFC (June 2005) – very nice distribution!

Conclusion – ACD parameters demonstrated required stability during tests at Goddard

- In the tests performed after ACD post-delivery test we started seeing changes in pedestals and mip peak positions.
- The first impact was caused by new GASU. It was understood and accepted
- In the next tests we started seeing more changes. Some of them were (per our guess) caused by changed "Hold Delay". One thing left unexplained – simultaneous change of all pedestals in **channels 17 by up to 30 ADC bins** – see my presentation at I&T VRVS 02/03/2006

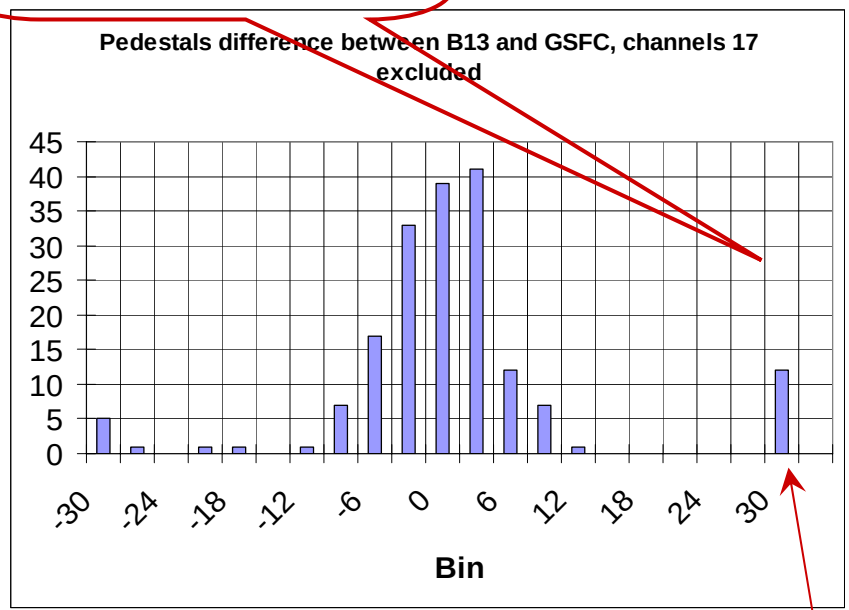


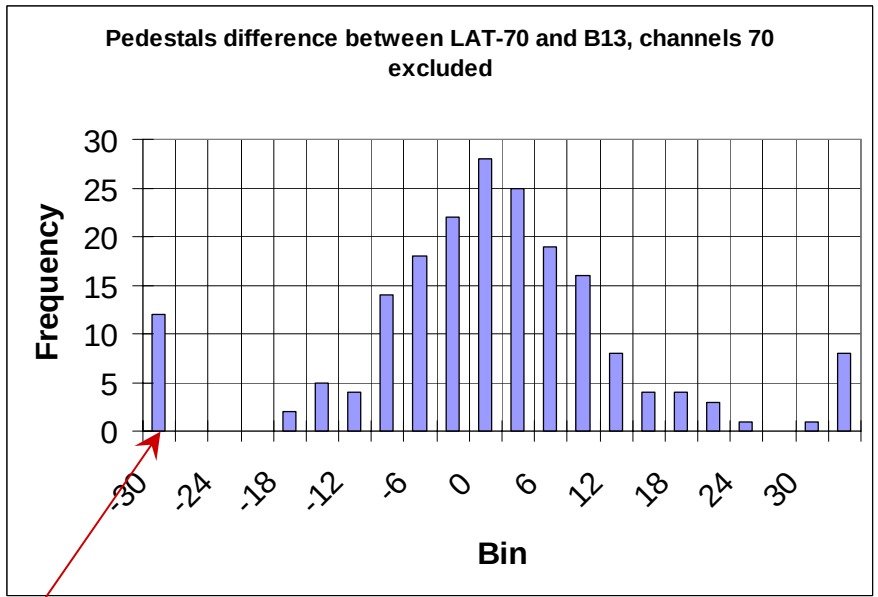
- Since first LAT muon runs (B2/B30, mid-January) we regularly saw changes in ACD pedestals and MIP peak positions, which were caused by different LAT settings
- We still do not have a clear understanding about all affects of LAT settings on ACD parameters. We (ACD Goddard team) requested several times to generate the list of LAT settings with some (temporary) default values, to clearly and promptly see what could cause the ACD performance change

I artificially moved all pedestal values belonging to FREE channels 17 to the bin 30

More Pedestal changes examples:

GSFC → B13 → LAT-70 Big Differences!



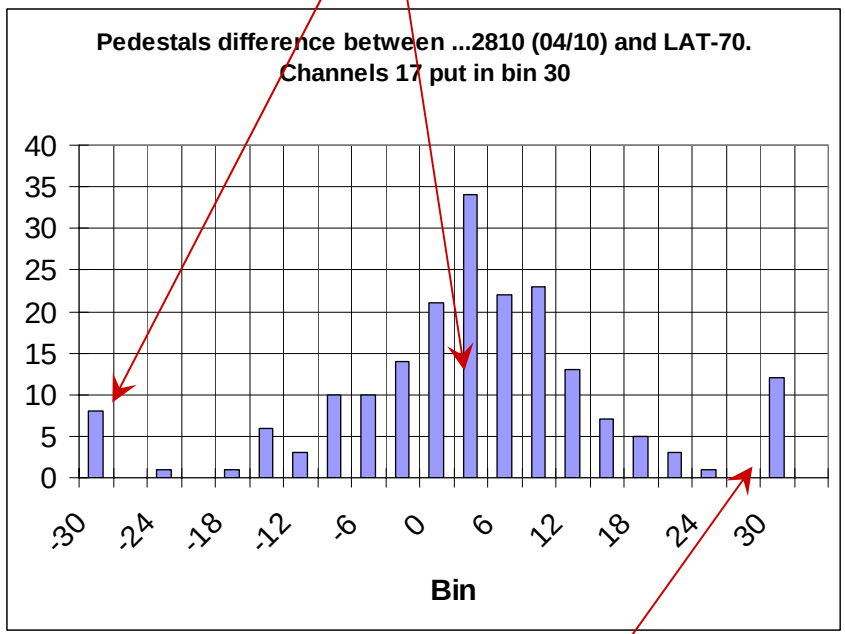


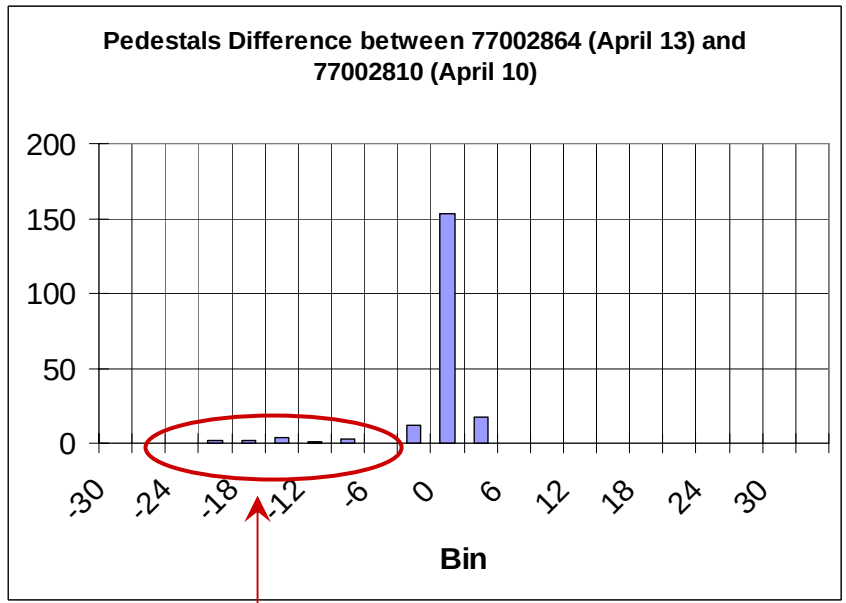
These are channels 17, artificially placed here

More pedestals monitoring

LAT-70 → ..2810 (04/10) → ..2864 (04/13)

Lots of changes!





Channels 17, artificially moved in bin 30

All these are channels 17! I did not remove them here

• Before showing the examples of ACD Mip peak positions change, I'd like to state some **very important points**:

- pedestals determination is approach independent
- there are two sorts of ACD calibration (in both ground tests and in space) – mip peak ***calibration*** and mip peak ***monitoring.*** The ***calibration*** is needed to be performed in the initial phase of the mission, and with strictly normal incidence events to calibrate proper Veto threshold settings. After that the ***monitoring*** will be regularly performed to monitor the stability of mip peak, in order to make necessary adjustments in Veto threshold settings. This test, generally saying, does NOT require normal incidence events, but does require the same run conditions, instrument settings and analysis approach

Effect of different mip peak determination

In addition to the effect of LAT settings, the mip peak position depends on how to do the analysis.

Having a muon sample, the muon peak can be obtained by three ways:

1. selecting the events by the angle between the track and the plane of the tile. This approach reduces the range of pulse height variations due to the different path lengths in the tile. ***Here we will select events within ±30^0***
2. correcting the pulse height from the ACD tile by the track path length in the tile. This approach scales all pulse heights to that would be produced by normal incidence events
3. use external trigger, such as coincidence between two opposite tiles, and use all events which were triggered by this coincidence

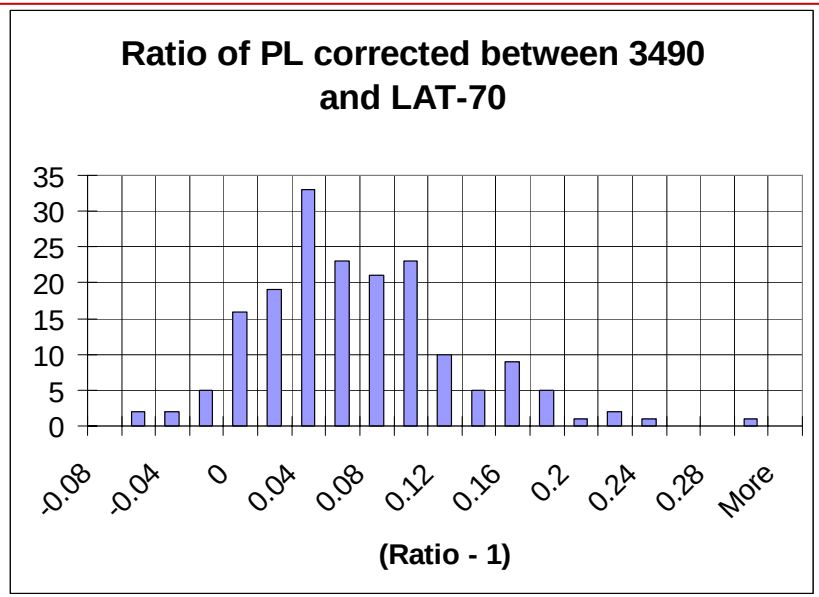
Now let's look at what is happening with ACD Mip peaks along the tests. **Take 4 sets of runs:**

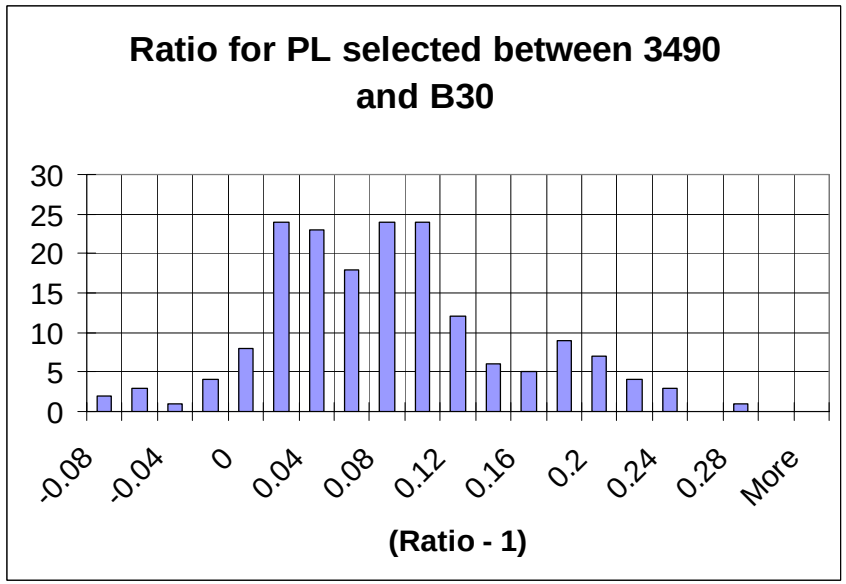
Muon runs B2/B30 **Mid-January** **Mip peak analyzed by Method 1 (angle selection)**	**LAT-70 runs** **End of March** **Mip peak analyzed by Method 2 (path length correction)**	**Runs 77002810 (April 10) and 77002864 (April 13)**	**Runs 77003490-77003504 (April 25). Mip peaks analyzed by both methods:**
			Method 1 / **Method 2**

I. Difference between runs, using the same Mip peak determination method

Take Runs …3490-3504 (April 25) and compare them with earlier runs

..3490-3504 with LAT-70	..3490-3504 with B2/B30
Used Method 2 (path length correction	Used Method 1 (path length selection)

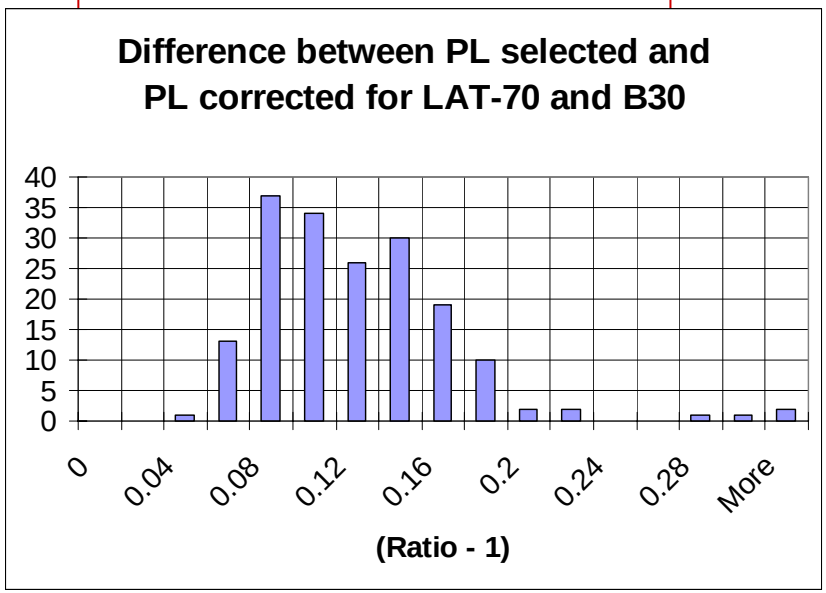




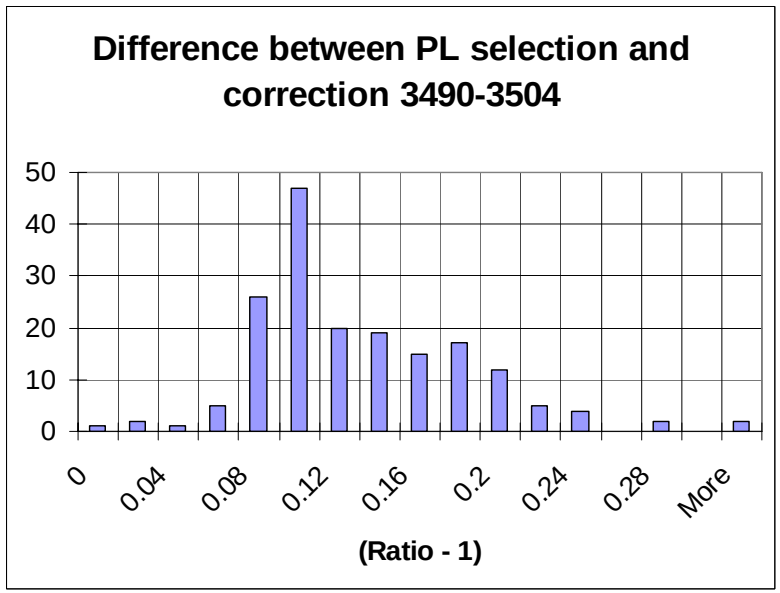
ALL PULSE-HEIGHTS INCREASED BY ~10%. POSSIBLE EXPLANATION – THERE WAS WRONG TACK TIMING IN EARLIER LAT-70 AND B30 RUNS, WHICH CAUSED UNDER-MEASUREMENT OF ACD PULSE HEIGHT. IS IT CORRECT NOW, OR STILL CAN BE IMPROVED?

II. Difference between Mip peak determination Method 1 (angle selection) and Method 2 (path length correction)

LAT-70 (Method 2) and B30 (Method 1)



..3490-..3504 Both Methods are applied to the same data



It is seen that Method 1 (angle selection) gives ~10% higher mip peak position than if Method 2 (path length correction) is used. Let's see what Monte Carlo will predict…..

Monte Carlo simulation of Mip peak determination

Normal incidence events	**1.76** MeV in 1cm plastic	
Isotropic illumination:		
Path length corrected for events within $\pm 50^0$	**1.77**	Good
Angle selected for events within $\pm 30^0$	1.91	
Angle selected for events within $\pm 25^0$	1.84	
ACD self-trigger*, no events selection	**1.76**	Good

* **Events were triggered by the coincidence in two ACD tiles, 30cm by 30cm each, illuminated by isotropic flux, and distanced by 160 cm – real situation for ACD tiles on opposite ACD sides**

Conclusions

1. **ACD does Not have yet the baseline (reference) run**
2. Very much needed: list of LAT settings which affect ACD performance, with estimates what is their effect. Have “default” settings
3. Agreement on the approach in ACD Mip peak calibration and monitoring

Suggestions based on Eric Charles data analysis and my simulations:

- for **ground Mip calibration and monitoring** use **path-length correction** method (Method 2) for events angle within $\pm 50^0$. Vertical position of LAT is fine for this. **Reason** – we cannot run ACD trigger for side tiles when LAT is in vertical position
- for **on-orbit Mip calibration** use **ACD trigger** for calibration of side tiles (tile-to-tile coincidence), and **path-length selection** (maybe correction) for top tiles using events within $\pm 18^0$ (1.05 of normal path length)
- For **on-orbit Mip monitoring** use **path-length correction** for all tiles, using events with the angle within $\pm 50^0$