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WP3: Muon g-2 Calibration System Update

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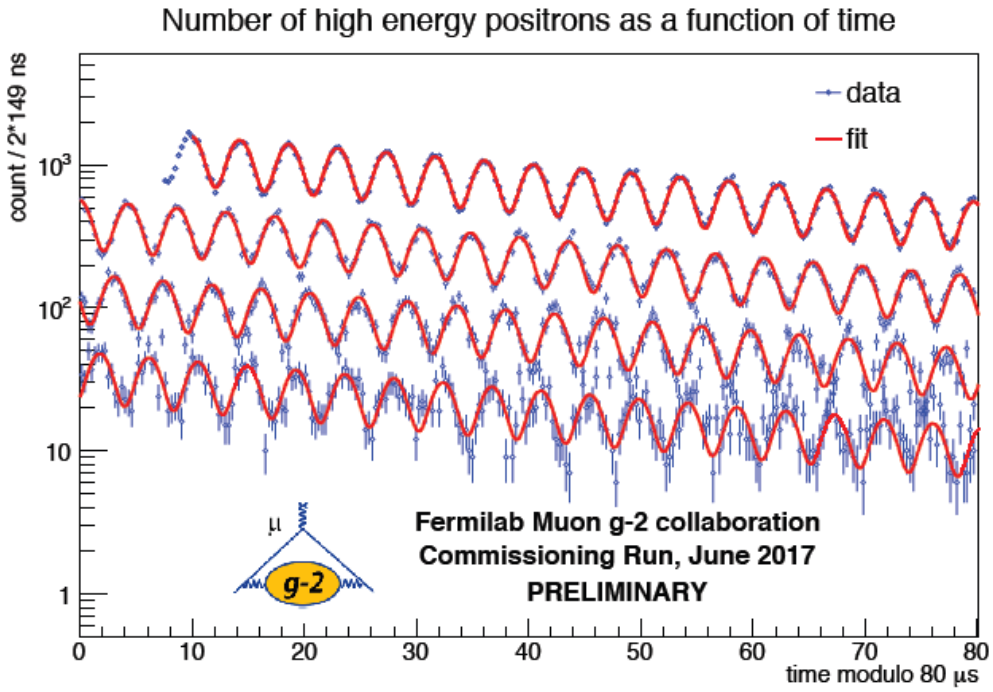
Outline

- Summer 2017 muon g–2 run (23/05/2017 – 7/7/2017)
- Filter wheel calibration
- Preliminary monitor signals analysis
- System upgrade

June run: Milestones & Highlights

- May 23rd: first particle delivered to the ring; particle splashes observed in calos
- May 31st: first particle injection and revolution
- June 5th: first particle stored for 100's of turns
- June 11th: first wiggle plot
- June 15th: first field map
- July 7th: end of run

Laser system used 24/7 for the entire commissioning run

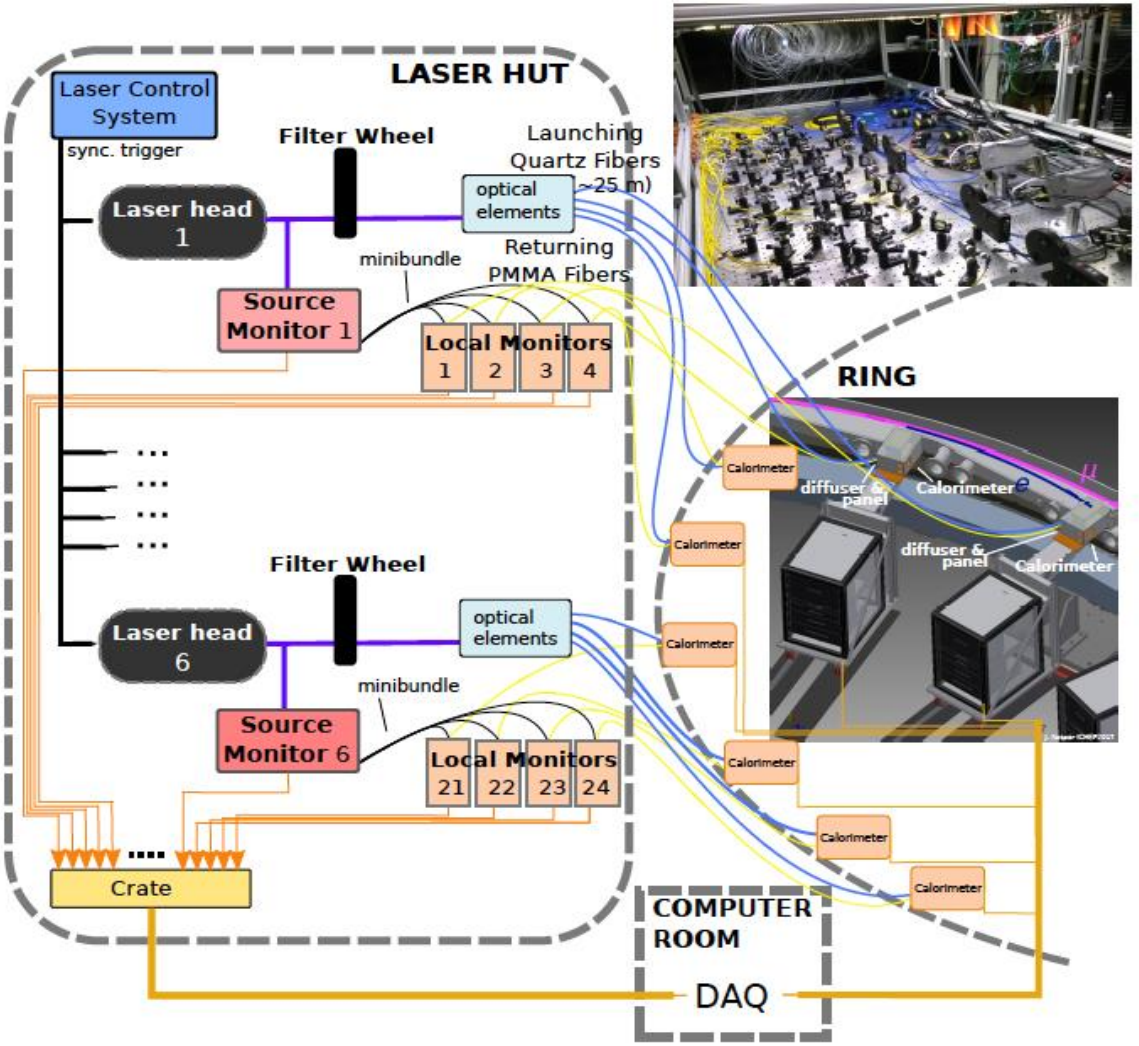


Laser system performances

- End of may: all calorimeters connected. Hardware for the laser calibration system completed. Adjusted all HV, equalized LM light, system frozen

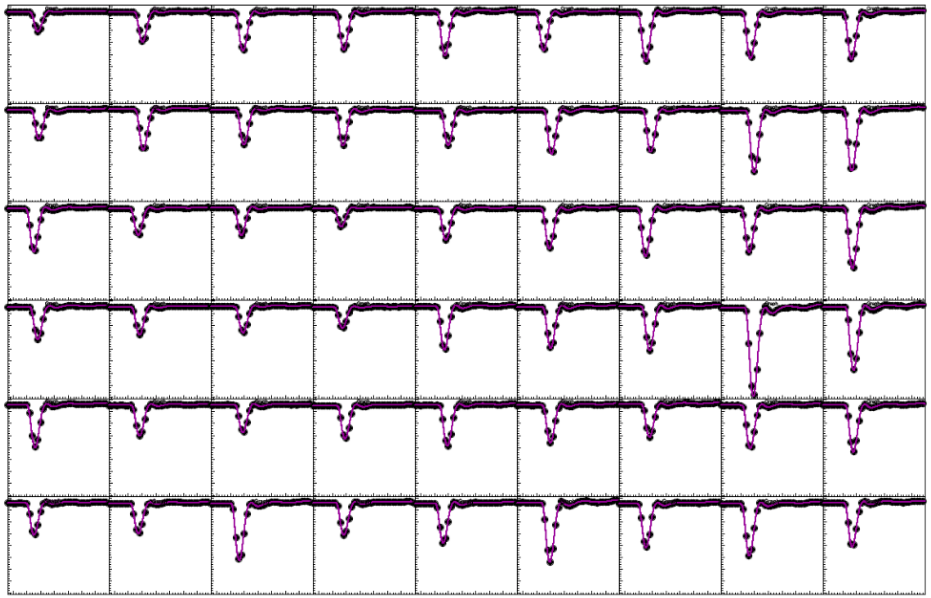
- 17/06/2017: first test of in-fill and out-of-fill calibration modes

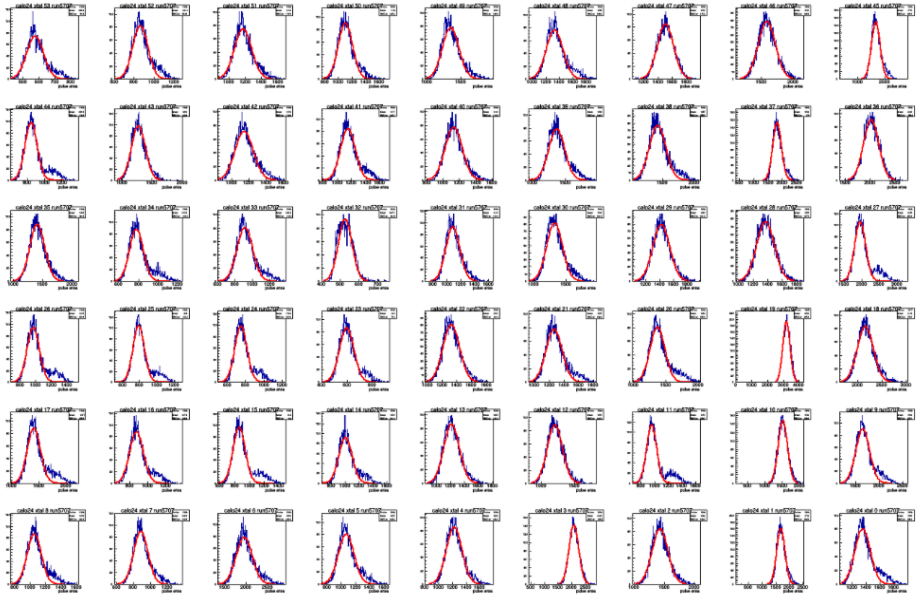
- The laser system has run continuously providing calorimeter calibration, time synchronization, and in-fill and out-of-fill calibration
- Few interventions were done and few anomalies were observe
- Data analysis is ongoing

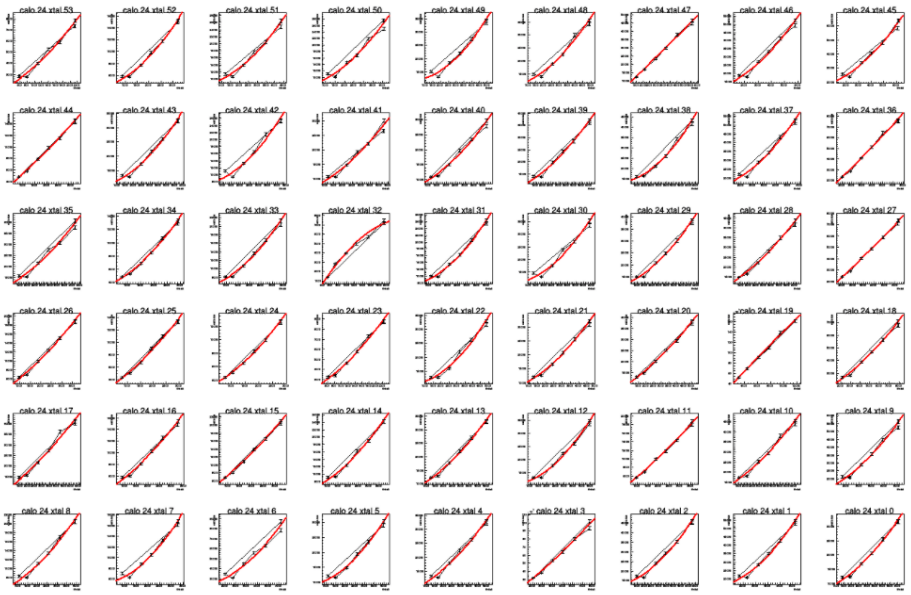


Example of filter wheel calibration for one calo

- ✓ Laser pulses seen by the 54 SiPM in a calorimeter are fitted with a template.
- ✓ 5000 pulses collected for each FW position and charge distribution fitted with a gaussian.
- ✓ Calibration curve for each crystal permits to measure the pulse-to-n.p.e conversion factor.

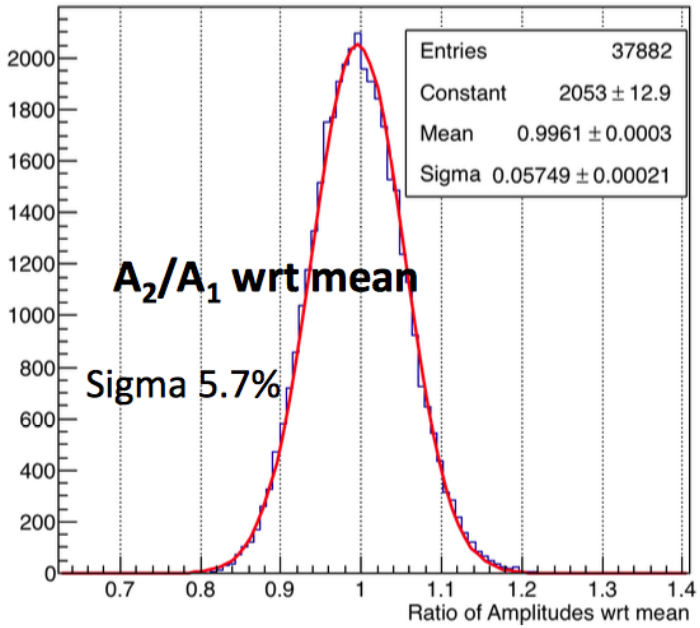




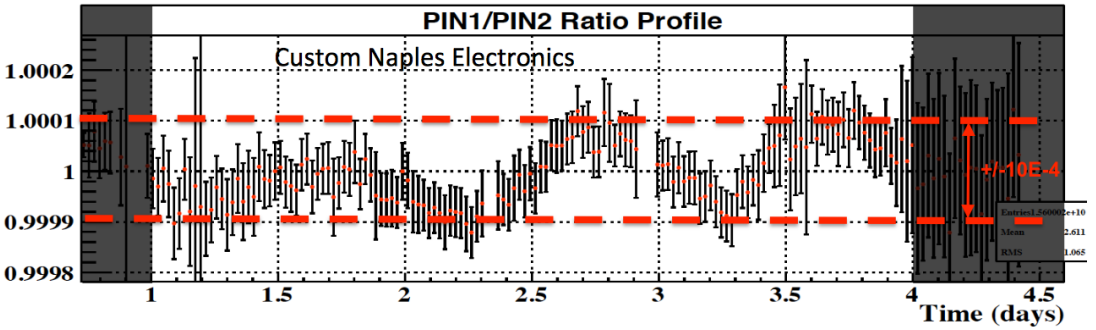


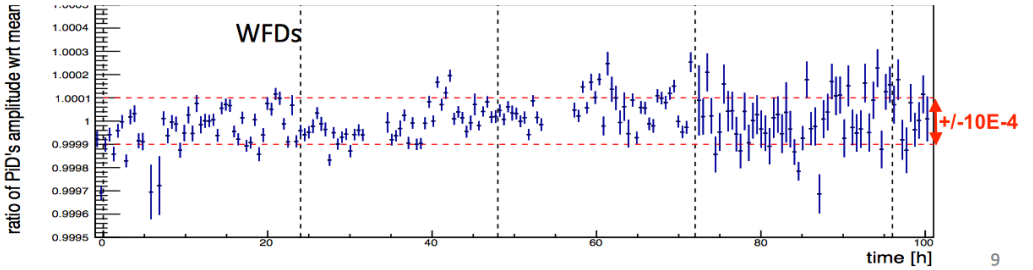
Offline monitor signals analysis

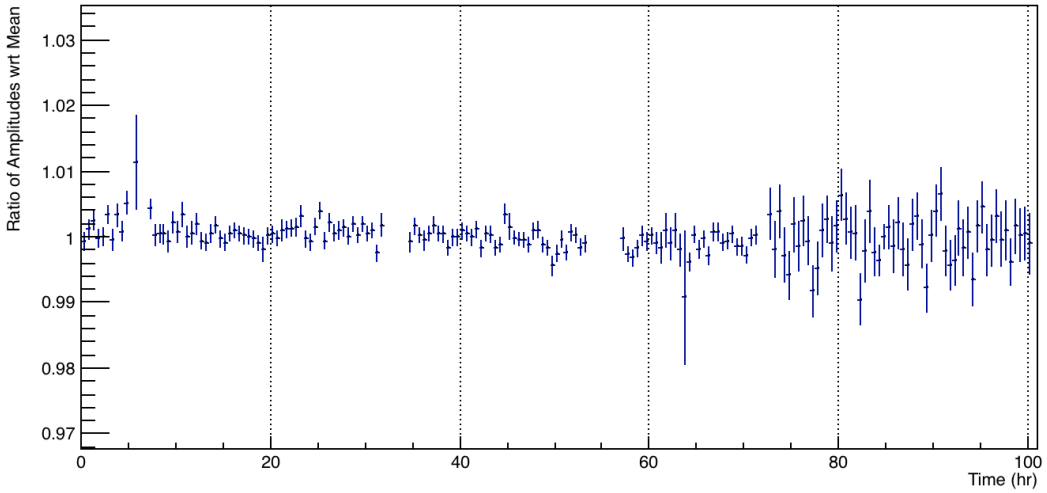
The comparison of the SMs' stability (*i.e.* ratio of the PiN diodes) between data acquired by the WFDs and by the custom electronics showed good agreement and stability close to 10^{-4} (our final goal)



Distribution light stability measured as ratio of the LM's pulse amplitude







Laser pulse intensity equivalent to 1 GeV (-> 2 GeV)

Calibration software

ONLINE

DAQ collects data from FWDs, slow control, etc.

FTS transfers data to the Fermilab tape storage

TOOLS

Grid submission script + FHiCL file + SAM dataset

OFFLINE

Raw Data

Midas file from DAQ. Data from laser monitors crate are stored in bank 25. There is a bank for each acquisition mode *i.e.* muon fill (C), laser out-of-fill (L), asynchronous data (A).

Unpacked Data

Each bank has his own unpacker. For the laser monitors data we use the same unpackers used by the calorimeters for the C and L banks but a new unpacker was written for the A bank and is under debugging/testing. This step returns an ART file.

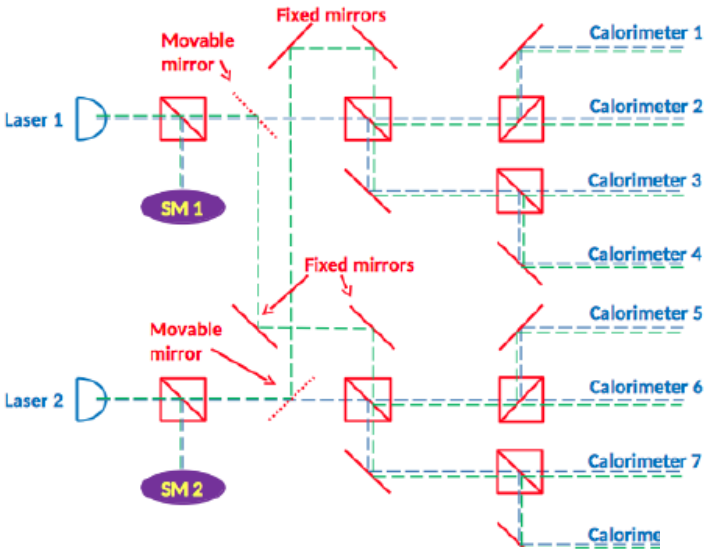
Reconstructed Data

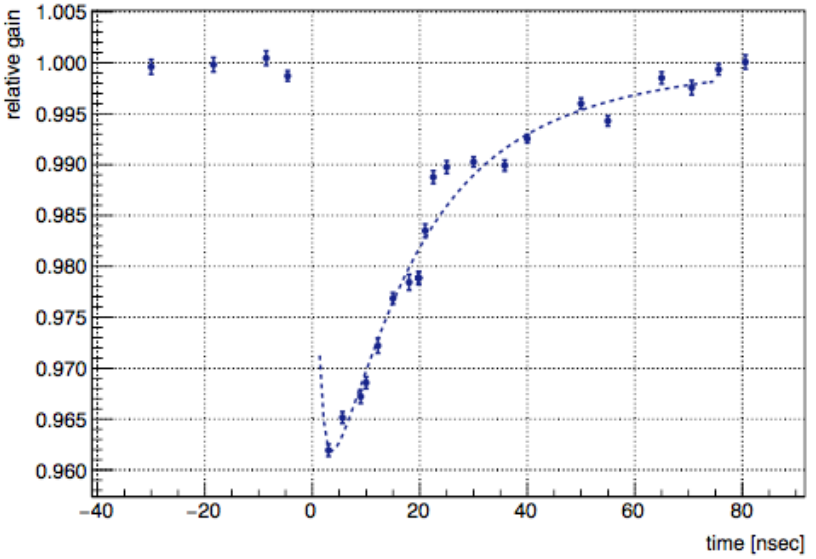
Unpacked data are the input of the reconstruction modules. In this stage the information regarding the laser monitors pulses (e.g. amplitude, time, etc.) are extracted and saved in an ART file (new).

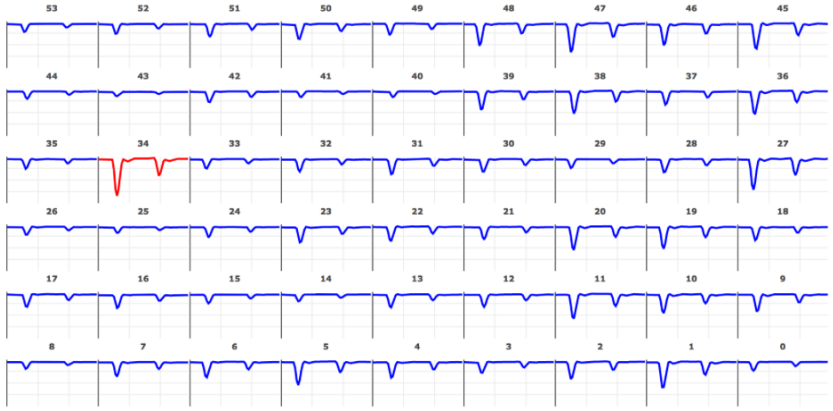
Users analysis

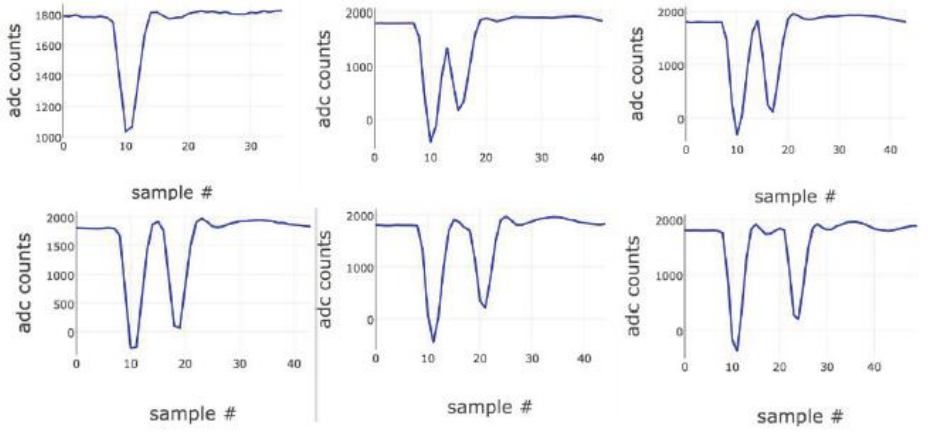
Upgrade - double pulse

- schemes for double-pulsing mode are under development for detail study of the in-fill gain variations.









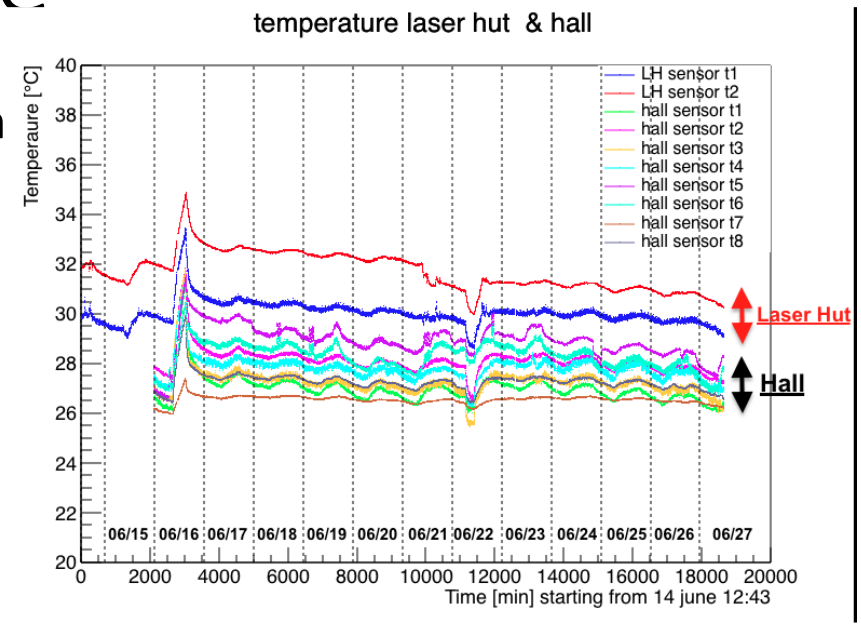
Upgrade

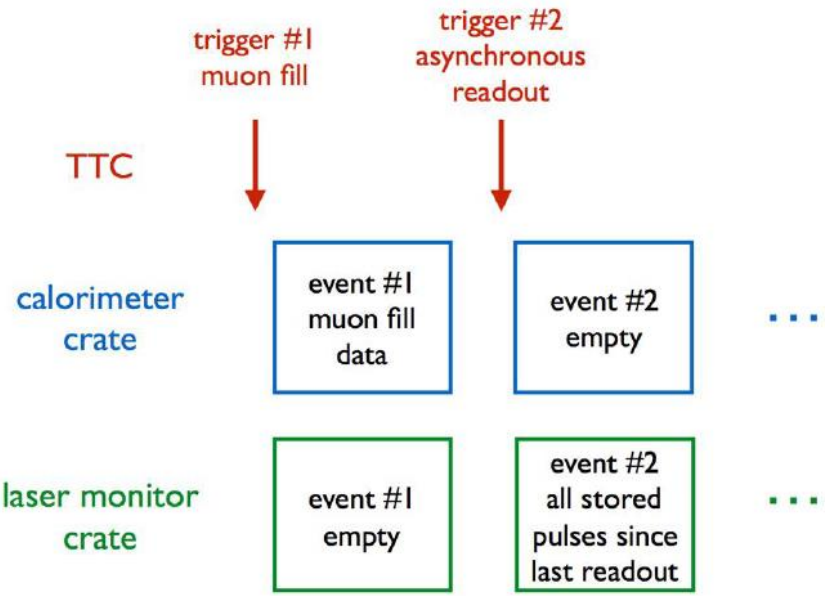
- Temperatures exceeding (30C) were recorded in the laser hut (systematically higher by 2C than those in the hall): we will install A/C

- Asyncronous trigger for Americium has been tested

  tests have been performed using NIM logic to build the trigger. In the future, the Naples boards will send the trigger to the readout boards

- The data structure is different from the standard one
  - DAQ has been made compatible with new structure (DAQ group)
  - new *data unpackers* had to be written for reconstruction (A. Driutti)





Conclusions

- The laser system has been used 24/7 during the 5-week engineering run with proton beam

- The laser calibration system operated adequately (close to the 10^{-4} technical specifications) in its first implementation; temperature dependences were revealed and few anomalies (noise) were observed

- Some upgrade is scheduled by October
  - Setup of double pulse configuration (for pile-up and SiPM gain sagging studies)
  - Installation of the new LM PMTs
  - Installation of the HV power supply for all LM PMTs
  - Async trigger for Americium