WP3: Muon g-2 Calibration System Update

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MUSE Scientific Board Meeting

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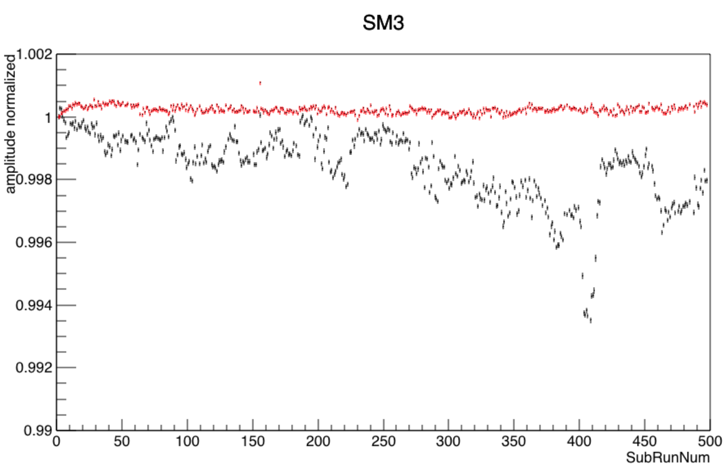
Outline

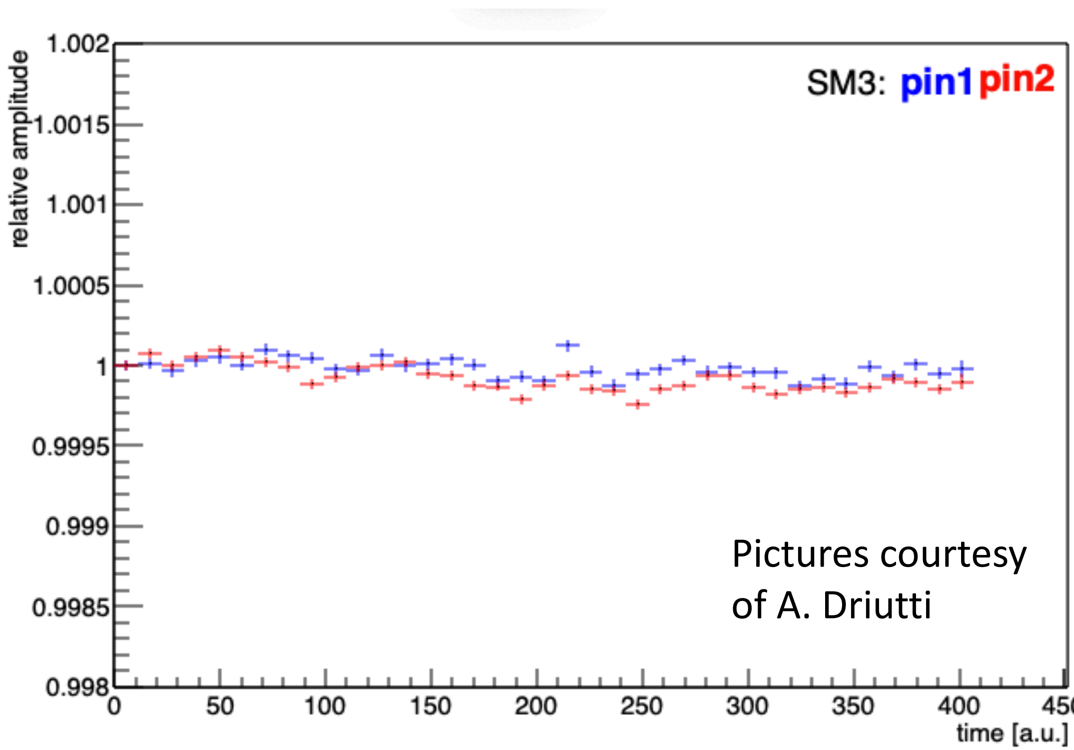
- SM, LM, CCC
- Asynchronous trigger
- Laser studies and corrections: STDP, LTDP, IFGF
- Laser monitor SW

SM

- Substitution of defective SM3 board (NA electronics)
- The SM system is back to operation
- This action has cleared the problem with PIN1 instability



Demonstration of SM3
PIN1 stability
after intervention
over 2 hours of data



LM

- Doubling LM installed
- 24 new PMTs in two boxes with cooling fans
- HV set for all PMTs
- The trailing edge of the signals negatively affects energy reconstruction: readout electronics needs an HV fix

CCC

- Optical-to-electrical transducer installed to trigger the laser control board, which needs an electrical TTL input
- Set optical path from the computer room → the middle of the ring → the laser hut
- Set prescale for laser triggering: CCC is the master and the Laser Control board is the slave
- Trigger width and delay adjusted
- InFill and OoF pulses are on time and correctly recorded
- Prescaling works fine

Asynchronous trigger check

- Already done in the past, but done again after MIDAS upgrade to make sure it works
- Two raiders (11 and 12) were successfully read out in async mode to record the signals from the Am/NaI source
- Needed for the absolute calibration of SM PMTs

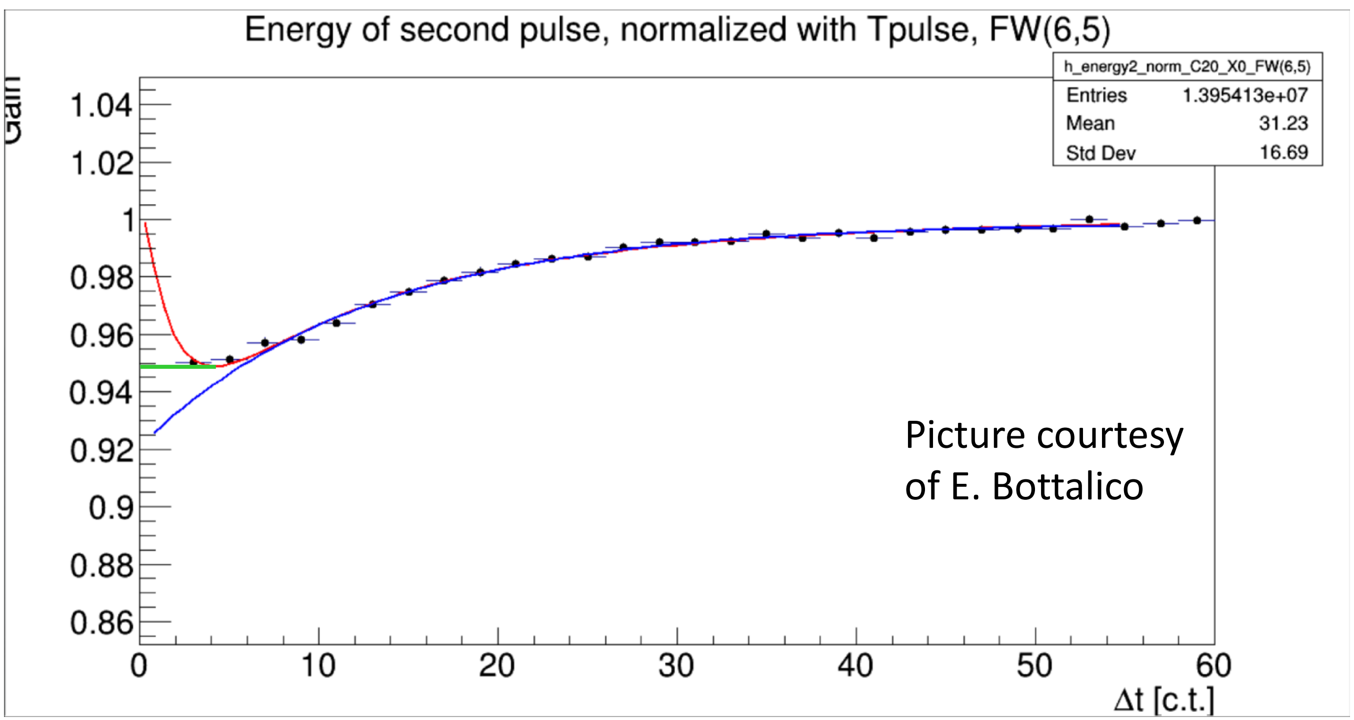
Temperature control

- Laser hut temperature control still pending

STDP corrections

- Short-term gain sag, due to previous nearest events, is now parametrized with a truncated *logn* function
- *g* meant to be used to correct SiPM signals for the STDP effect

$$g(\Delta t) = \begin{cases} \Delta t = t_M \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \Delta t < t_M \\ 1 - a \exp\left(\dfrac{1}{2} \dfrac{\log^2(\Delta t/\tau)}{\log^2(t_M/\tau)} \right) \ldots\ldots \Delta t > t_M \end{cases}$$



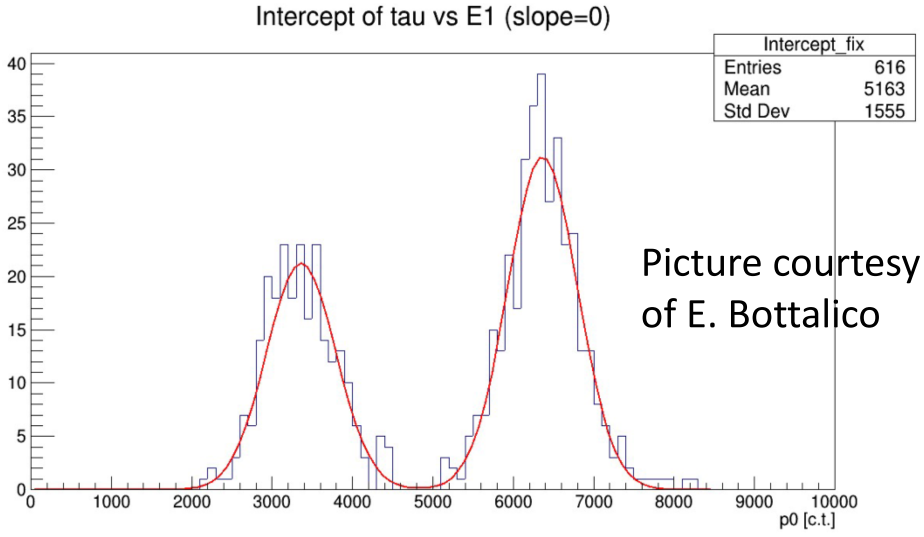
Picture courtesy of E. Bottalico

LTDP Studies

- Studies of the SiPM signals over 'long' time intervals (due to muon splash at injection) with a burst of laser flashes
- Fit of *A* (gain drop) and τ (recovery time) for each crystal as a function of the total energy of the burst

$$g(t) = \frac{G(t)}{G(0)} = 1 - A\exp(-t/\tau)$$

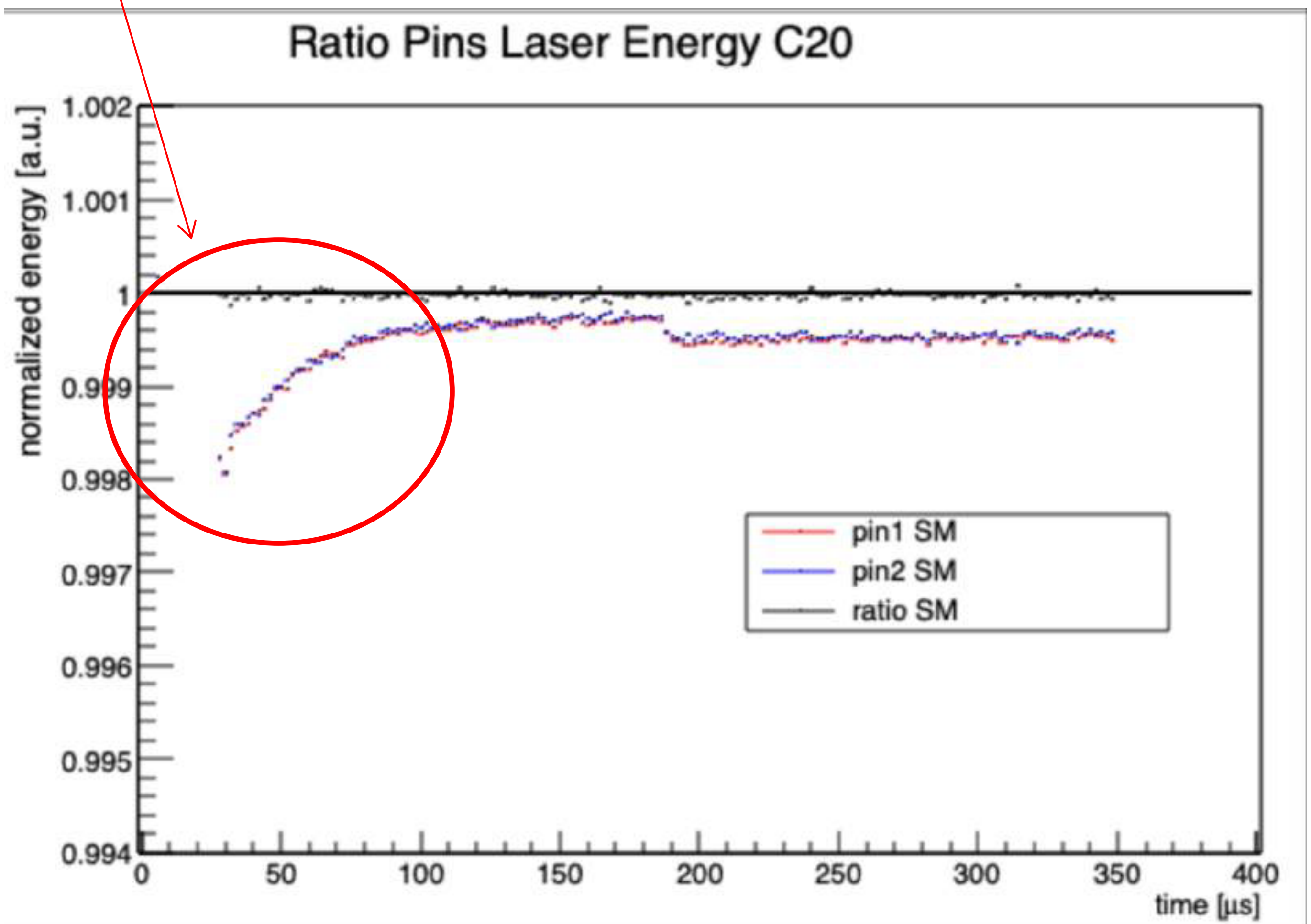
- *A* varies linearly: $A = m \cdot E$ with $m = (4.3 \pm 0.9) \cdot 10^{-4}\, GeV^{-1}$
- so for each GeV of deposited energy there is a gain drop of 0.04%
- τ remains constant but has a bimodal distribution over the crystals (due to different channel behavior)



Picture courtesy of E. Bottalico

SM gain sag

- Sag observed in PINs (and PMT) signals at early times (<50 μs)
- Not observed in PIN signals ratio



Picture courtesy of A. Driutti

SM gain sag

- The Sync pulse is very near to the first InFill pulse (30 μs) and the electronics does not properly handle it
- Data taken without the Sync pulse show no such gain sag
- Sag is due to the interference of the Sync pulse with the first InFill pulse...
- ... and presently prevents us from correcting InFill gain functions with the SM, lest we introduce an overcorrection at short times
- Studies are underway to fix the problem

Laser monitor SW

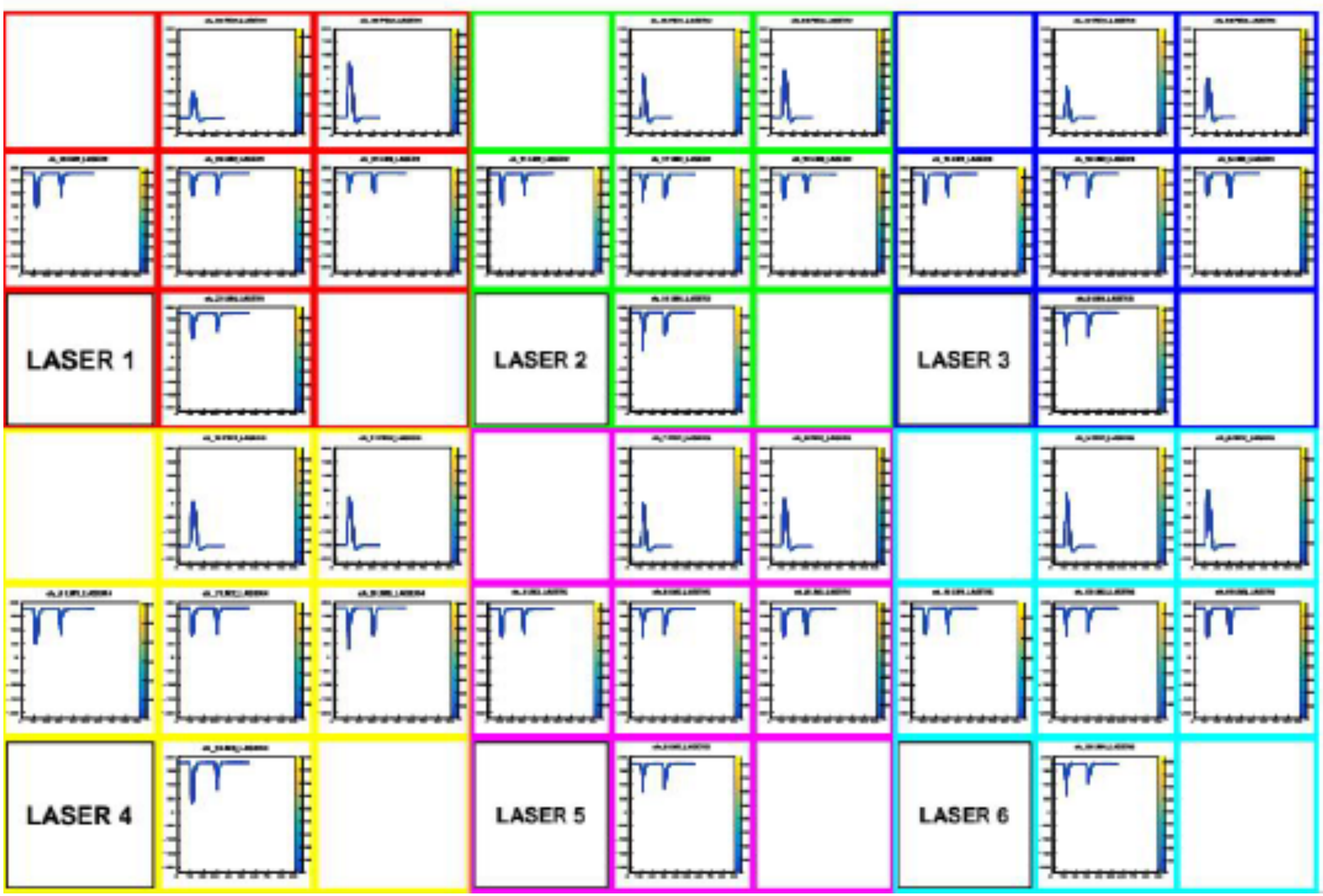
- Meant to view the laser system signals (SM and LM) acqured by MIDAS
- Very useful for debugging and data quality check
- To run the SW:
  - ./laserMonitor_run2.sh <run n.>

Laser monitor SW Output

- Laser monitor individual traces:
  - SM InFill , OoF
  - LM InFill , OoF
- Synoptic traces:
  - SM+LM InFill
  - SM+LM OoF
- SM PINs:
  - PIN1, PIN2 amplitudes InFill , OoF
  - PIN1, PIN2 amplitudes ratio InFill , OoF

Laser monitor SW

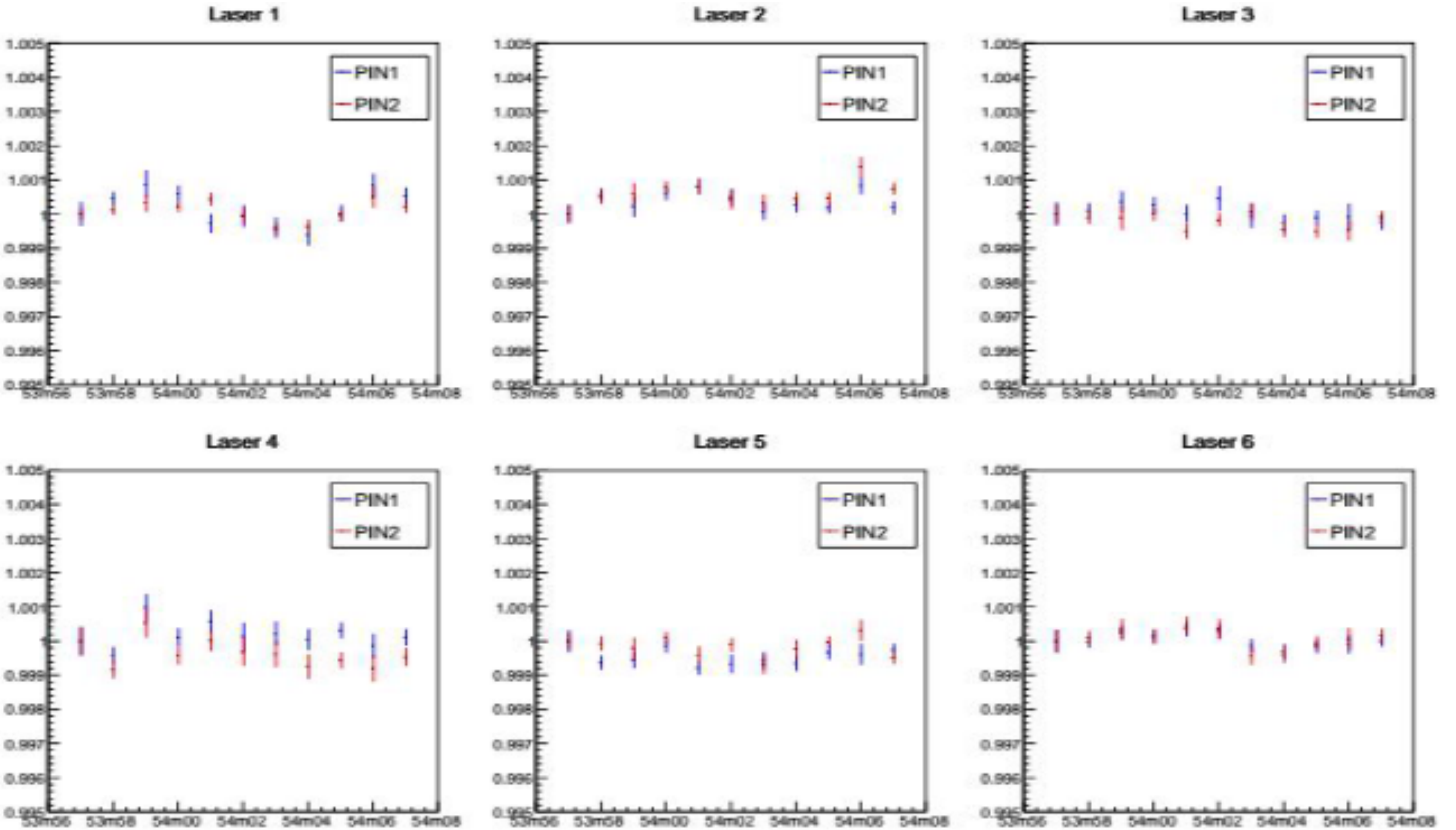
- Example: Synoptic SM+LM InFill traces



Picture courtesy of A. Gioiosa

Laser monitor SW

- Example: SM pin1, pin2 normalized InFill amplitudes vs time



Picture courtesy of A. Gioiosa