Laser Source Performance in 2004 at H4

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Test Beam Meeting - CMS Week
9. June 2004 - CERN

Laser Source Beam Test Preparation

- Laser switched off during winter - Internal cooling water drained - Replaced faulty main transformer - Check functionality with ‘bricolage’ cooling in March - All Lasers functional.
- Switch on lasers in April after North Area Cooling back - Check functionality of all three systems - One blue laser showed problem and could not be operated.
- After identifying the cause and in view of the upcoming beam test it was decided to call in service instead of attempting self-repair.
  (Non-typical YLF crystal mount damage - Manufacturer claims ~7 years lifetime for this part)
- Service visit 17.- 19. May - all three lasers ready after that. Performance (peak energy, pulse width, time jitter) similar to 2003.

2004 E0' Beam Test Issues

- VPTs can't see 700nm/800nm ⇒ Don't use Red Laser.
  (only quick look with red laser - maybe some tests should be done to get a better feeling for signal size - in 2003 we ran 800 nm at less than 10% intensity and with 10 dB filter)

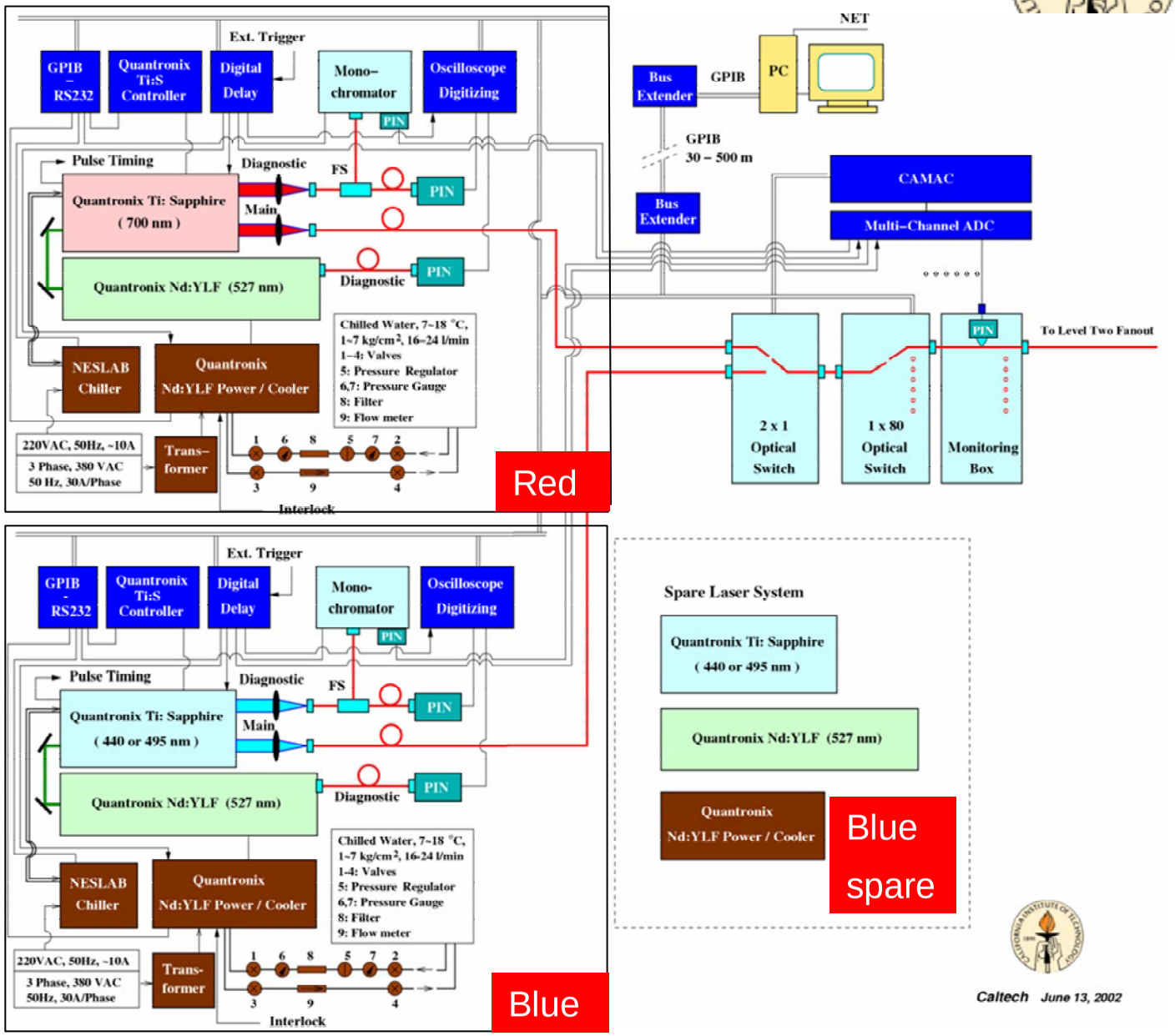
- VPTs need more light than APDs ⇒ Run at higher intensity
  (to be taken into account for CMS running ?)

- It appears that there is a 10 dB light loss as seen by the MEM boxes compared to 2003. (somewhere after the 1x80 switch)
  ⇒ to be checked after the beam test

Laser source layout at H4

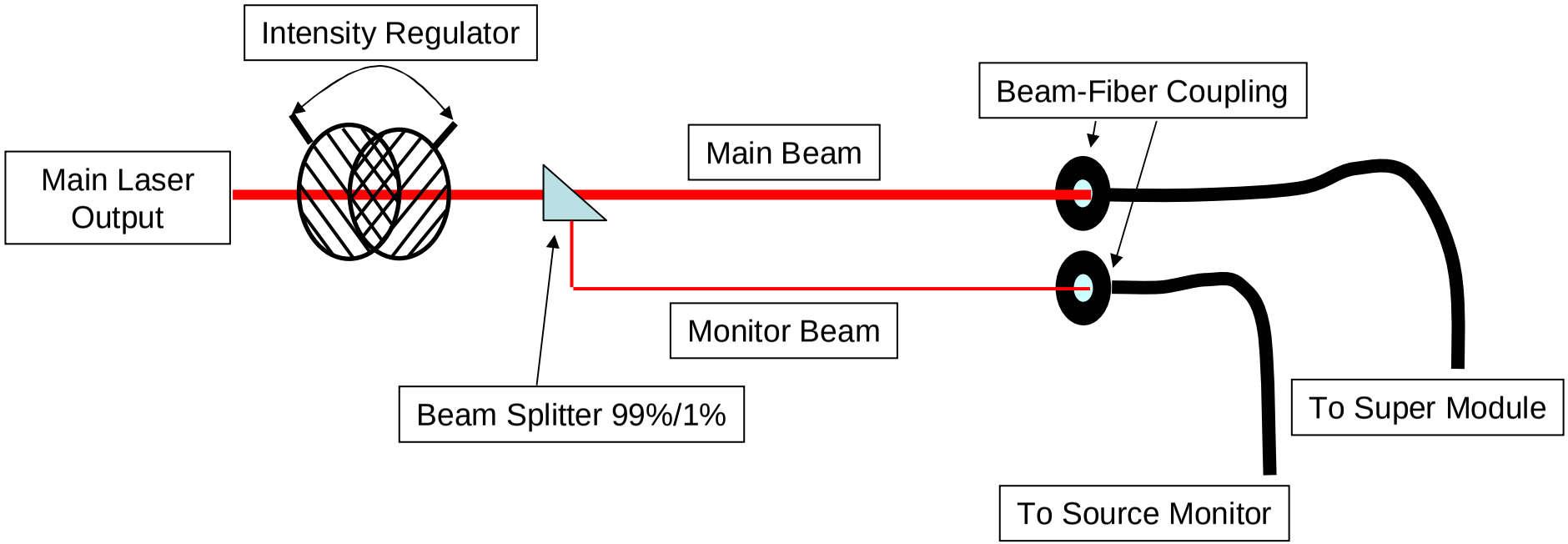
RED Laser:
700 nm / **800 nm** not visible to VPTs

BLUE :
Use ‘Laser 2’ to run at
440 nm
and set up ‘Laser 1’ to run at
495 nm



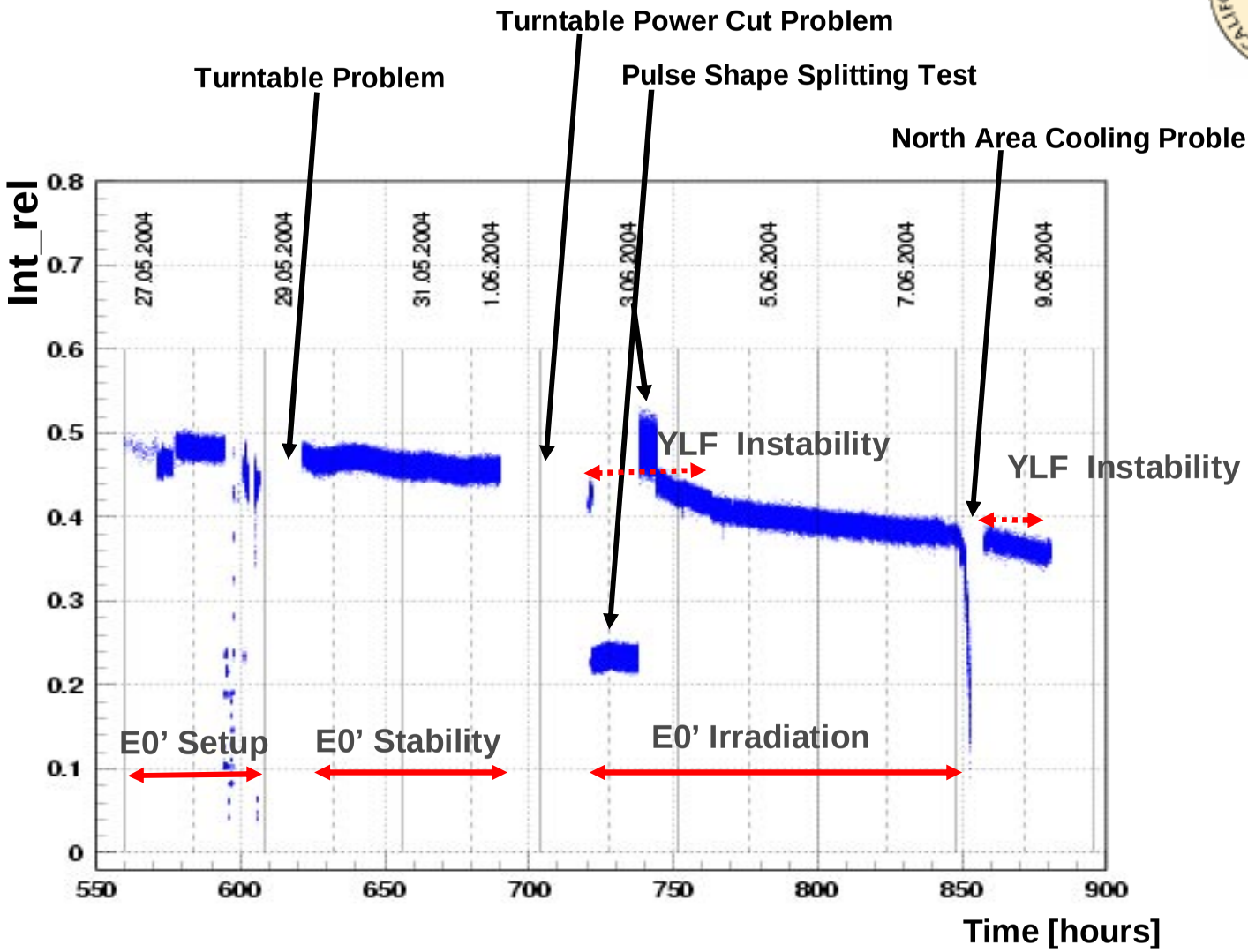
Caltech June 13, 2002

Few Details on the Source Monitor



Few Notes :
Laser max pulse rate is 100 Hz, Laser source monitor DAQ runs at 1Hz.
Laser Source Monitor integrates the laser pulse signal from a diode with a digital scope.
Laser source monitor is meant to help to adjust and monitor laser performance.
Intensity regulator is not a high precision (sub %) device, at very low intensity settings.
The intensity measurement of the source monitor is (can be) calibrated with a photometer.

Overview Laser Performance 2004

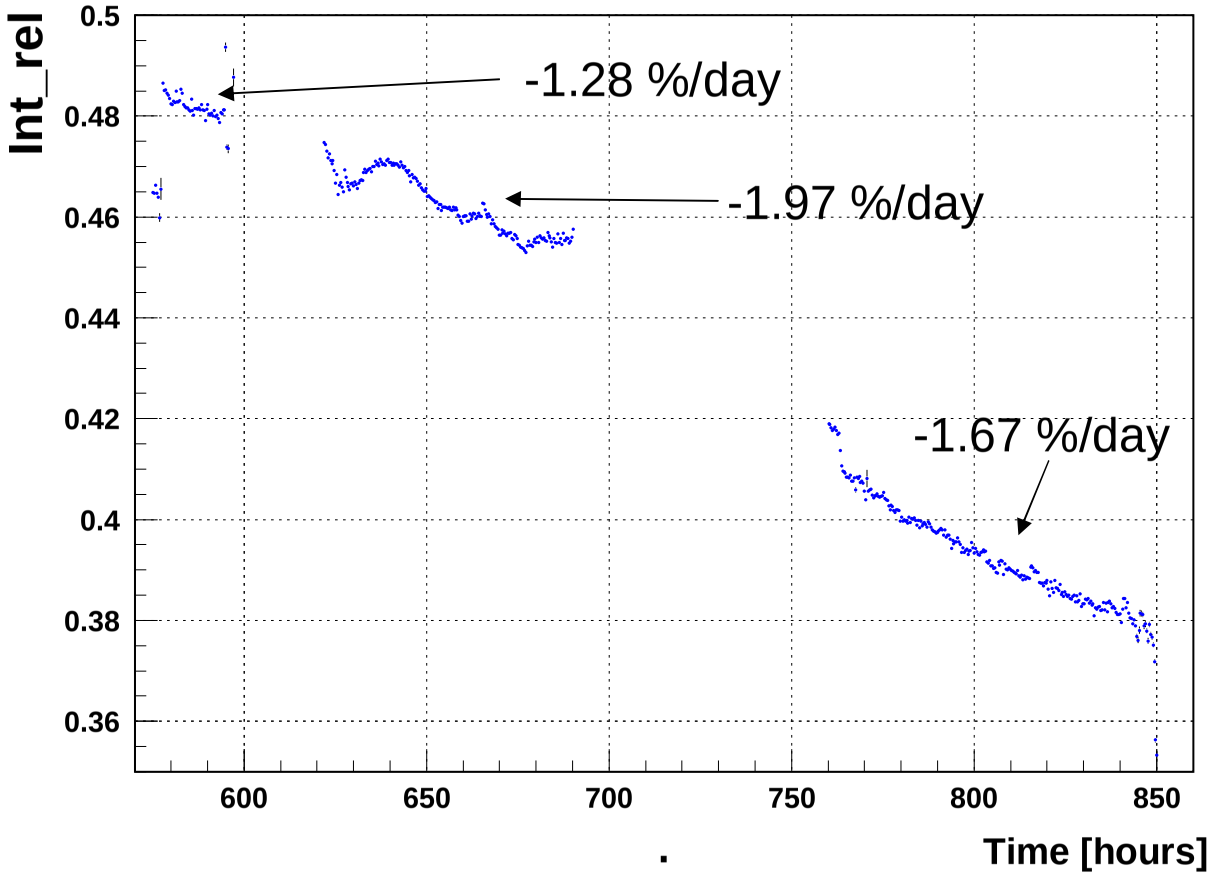


⇒ **Short term stability good (slightly better than 2003) - Long term stability worse than 2003.**

⇒ **Performance sufficient for radiation monitoring (See Patrice's talk).**

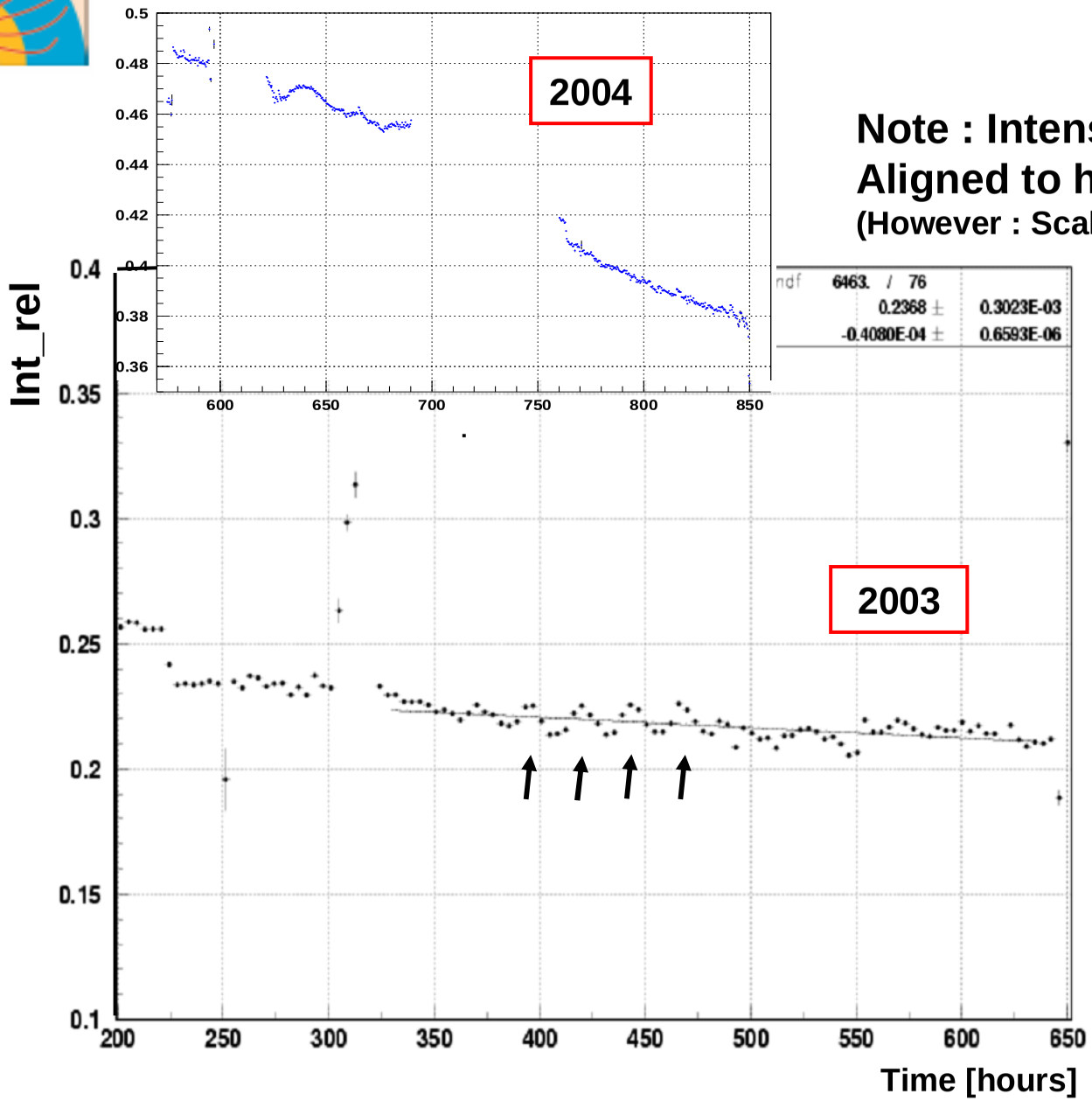
Note : Laser DAQ records much more events in 2004 than in 2003 due to additional random triggers send to laser ! Plots thus look different !

Long Term Degradation of Laser 2 at 440 nm



Degradation ~constant over ~300 h.
Caused by YLF pump lamp ('standard degradation') (?)
Continues during 'power off'.
Degradation is 'real' (seen in E0'/MEM).
⇒ No attempt was made to fix this !
Investigation difficult without interrupting Laser - Radiation monitoring works.

Comparison Degradation 2003 / 2004

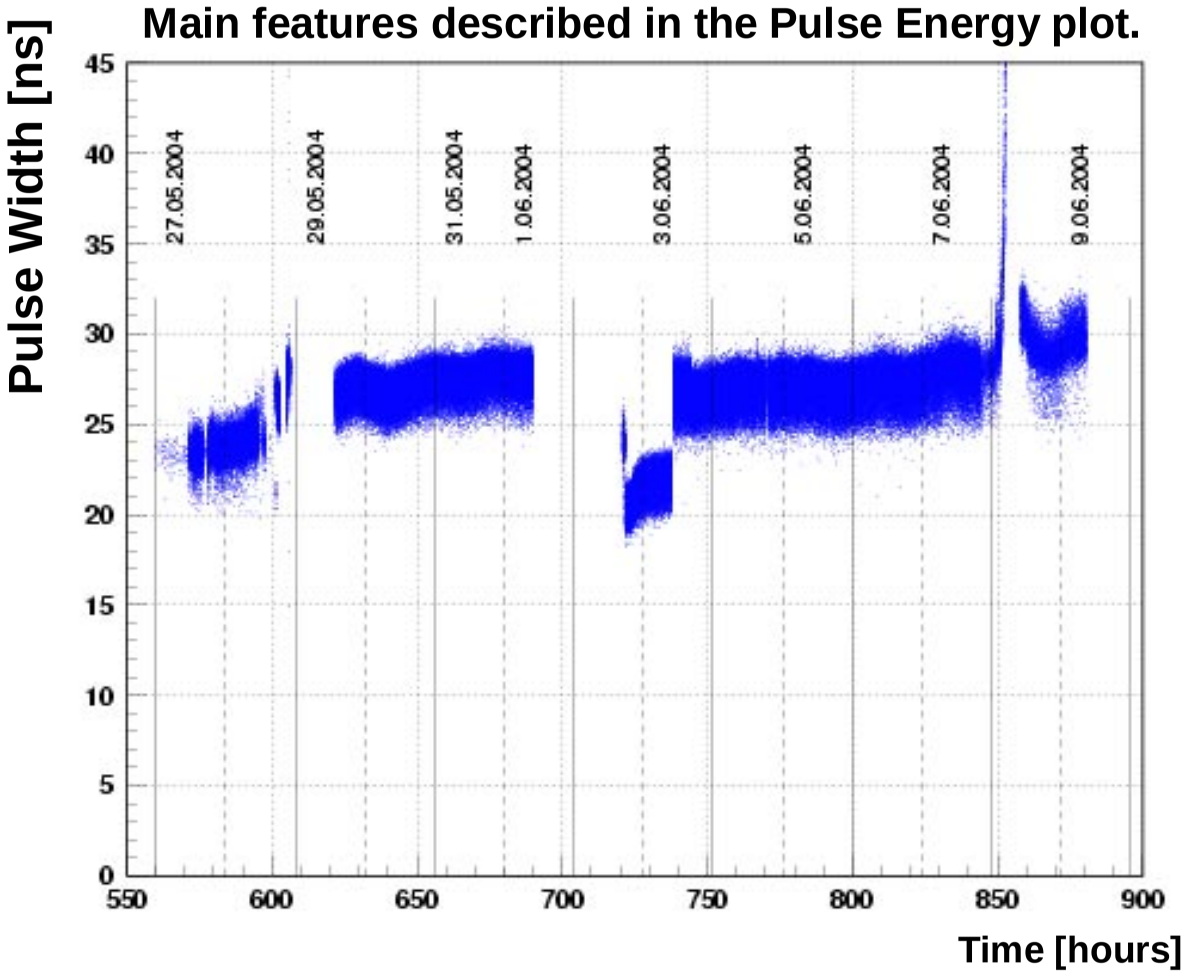


Note : Intensity Scale Arbitrary !!!
Aligned to have common '0'.
(However : Scale agrees with power settings)

2004 : ~ -1.6% (w.r.t. 0.5)
2003 : ~ -0.4% (w.r.t. 0.28)

But : Does this matter ??

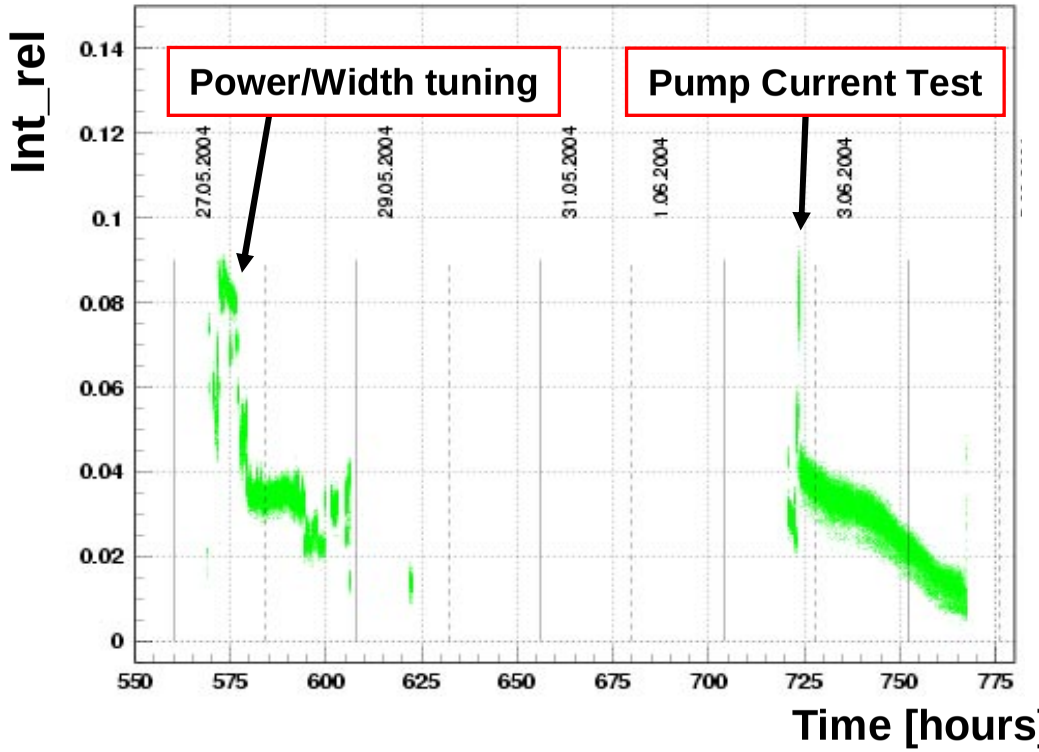
Pulse width history 2004



⇒ **Pulse width seems to be not affected as much as pulse energy - Below 30 ns.**

Green Laser (495 nm) Performance

495 nm operation is meant for systematic cross checks of the radiation monitoring.
Producing 495 nm light with a TiS Laser is very difficult.
Optimal tuning provides light within specs : <10% pulse energy variation, <40 ns pulse duration



Initial tuning OK - similar to 2003.

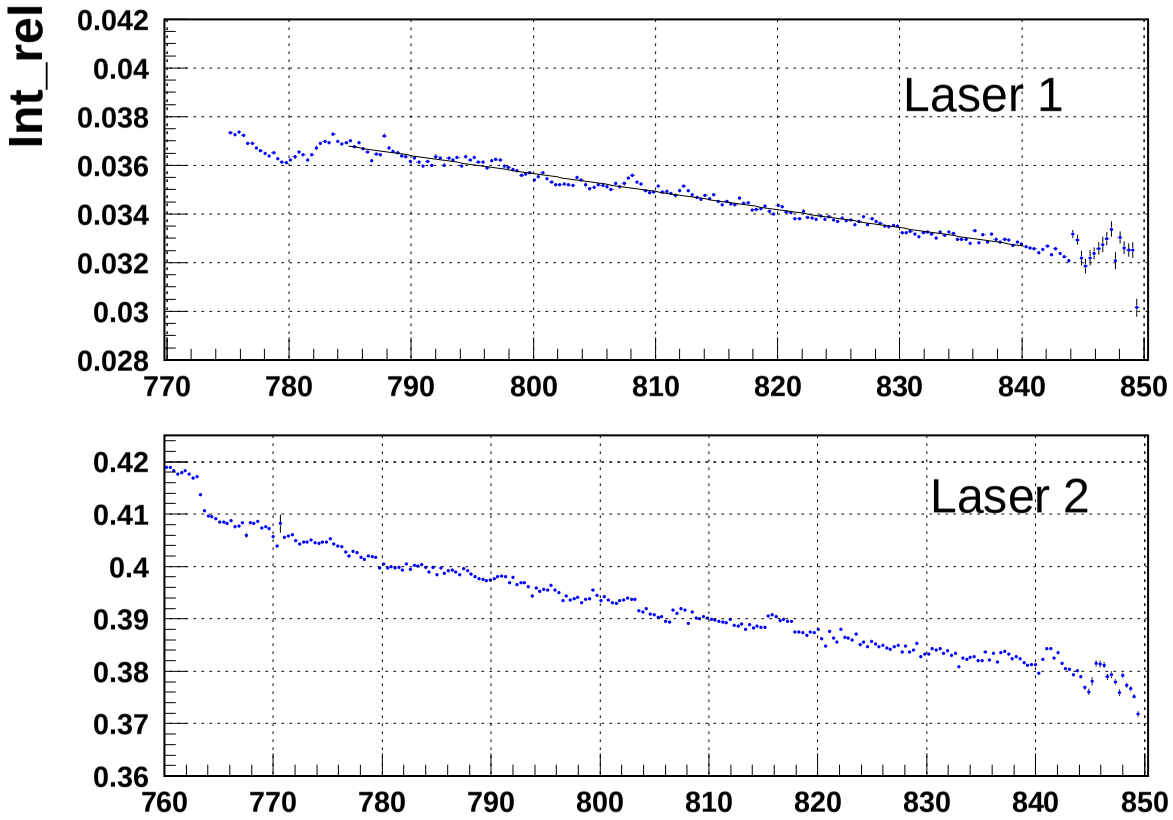
⇒ Fast degradation at 495 nm.
495 nm dropped out of spec soon.
Removed from data taking.

Same reason as 440 nm degradation ?

APD/PN depends on pulse energy and pulse width ⇒ Systematics
How different will the radiation damage measured at 440/495 be ?
Some green data has been taken in 2003 and in 2004 ⇒ to be studied ?

Laser Intensity Degradation

Note : Intensity Scale Arbitrary !!! Apparent similar slope accidental !!



-4.7%/day

-2.0%/day

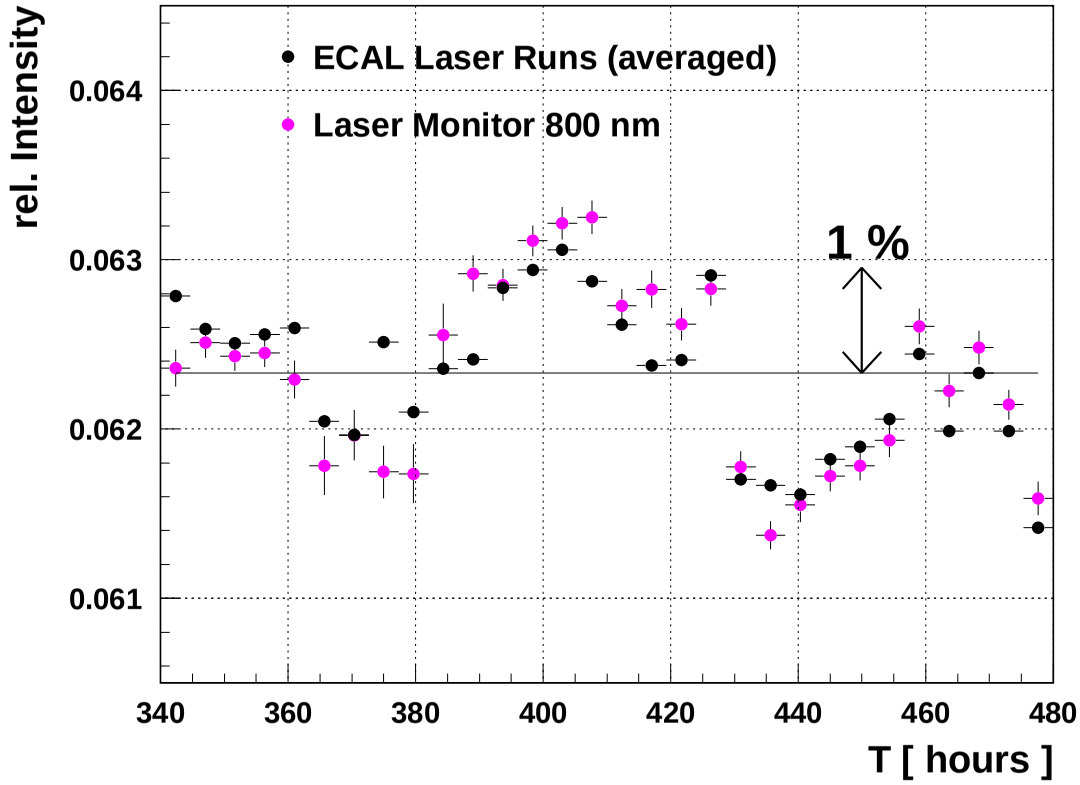
Both lasers show much faster degradation than Laser 2 in 2003.

A few general remarks

- Laser monitoring has to measure LHC induced radiation damage - which has a ~12 h time scale.
- Precise in-situ calibration methods have time scales of days - weeks - month.
- ECAL stability has to be ensured on these time scales.
- What is the best strategy with respect to different wavelength - intensity - long and short term stability … ?

InfraRed (800nm) Monitoring in 2003 Beam Test

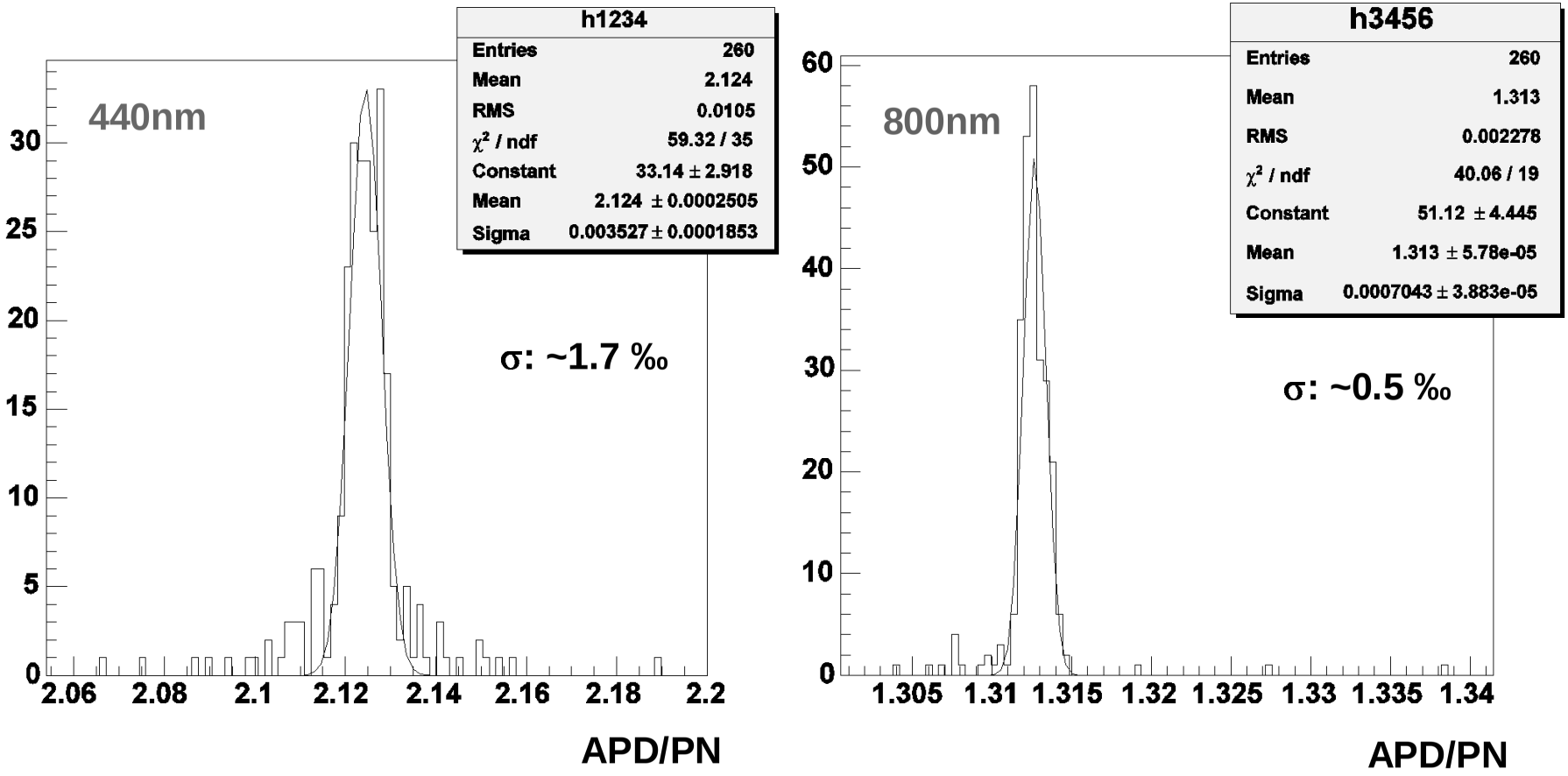
Raw signals - mean values per run (ECAL) - averaged over time bins - scale arbitrary, adjusted to mean value - no corrections (non-lin etc.)



Monitors entire LDS chain from the 1x2 switch on - Valuable cross systematic check !

Long Term Stability from 2003 Test Beam

Compare stability (ECAL Laser runs APD(mean)/PN(mean) as seen with 440 nm and 800nm :



2004 data to come …

Summary

- **Laser Performance 2004 sufficient - so far ..**
  ⇒ See Patrice's talk for a more quantitative statement ..
- **Long term stability worse than 2003 - seemingly caused by a 'global effect' (Laser 2 and Laser 1).**
  ⇒ under investigation …
- **EndCap Beam Test raises several issues - Red vs Green - Light intensity needs - ..**
- **Beam Test very valuable - Even without beam !**

To Do :

Investigate signal decrease.

Investigate 10 dB light loss.

Try 495 again ! Try 800/700 again after 10 dB solved !

Some modifications to Laser DAQ in the works.

Need to improve Laser Barrack environment !!