# Laser Monitoring System

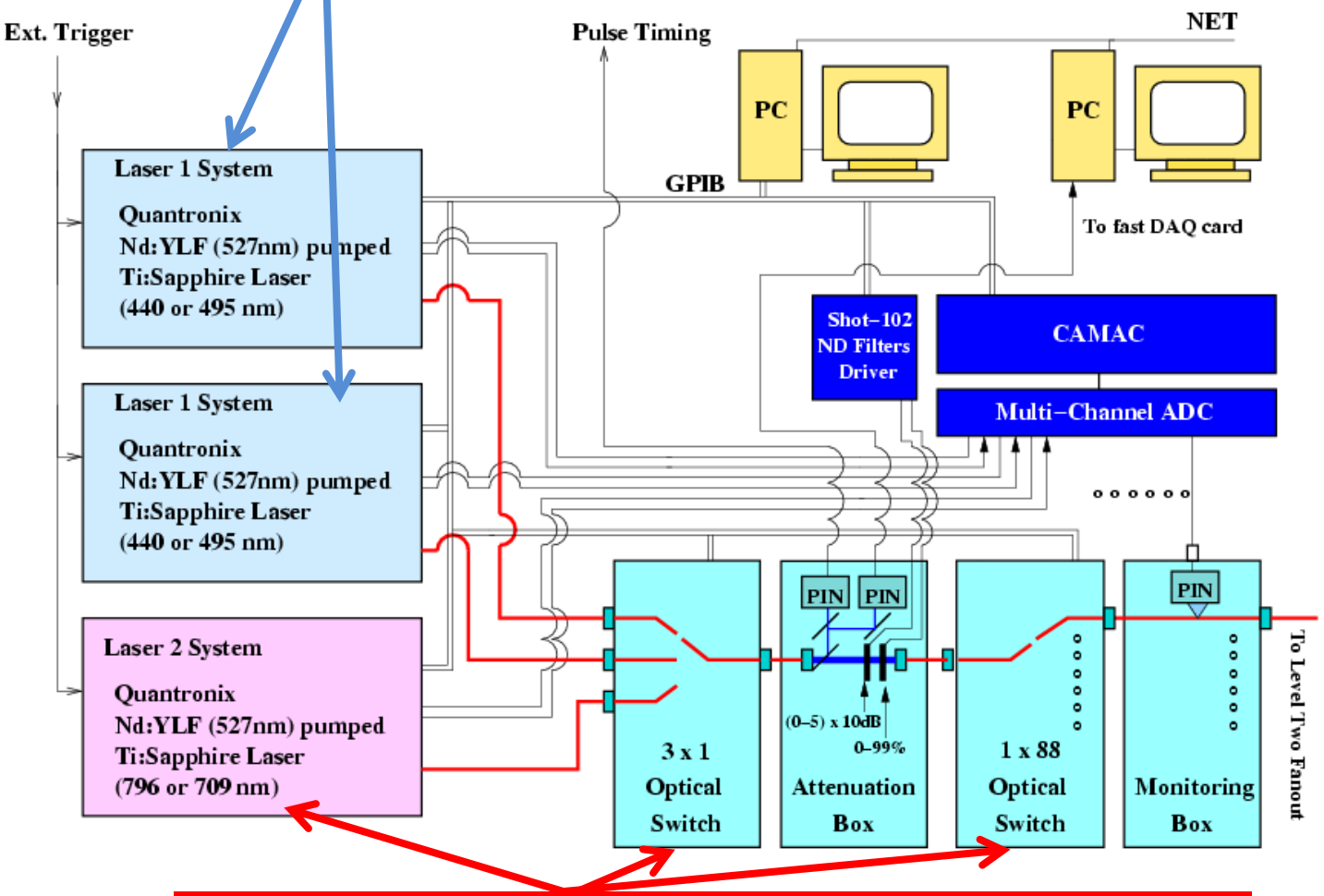
**Lasers plots**
**Lasers interventions**
**System improvements**

***- ECAL days Sept 2010-***

David BAILLEUX
*On behalf of the Caltech group*

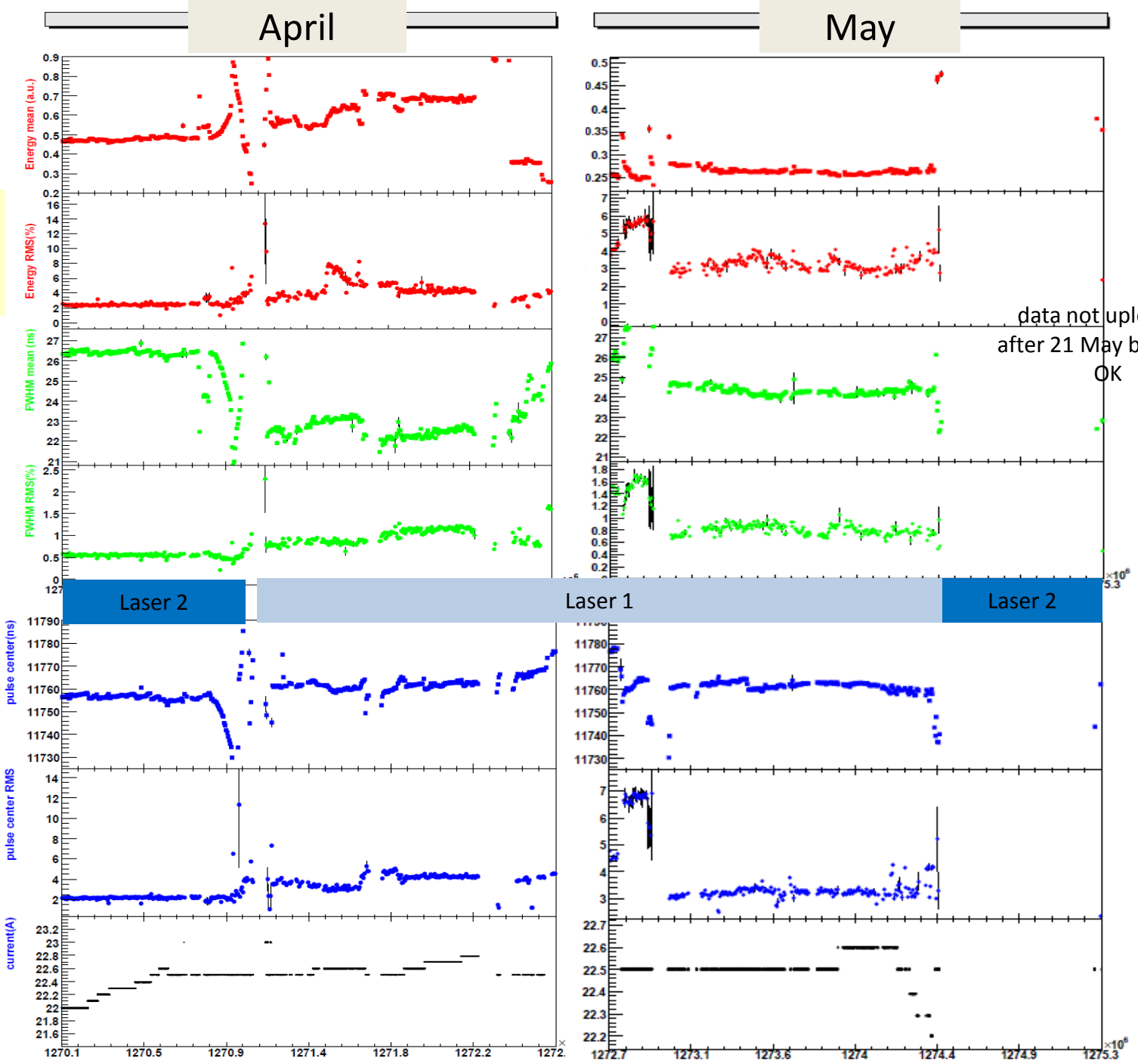
# The monitoring Laser System

With Spare: Two blue lasers for almost 100% availability

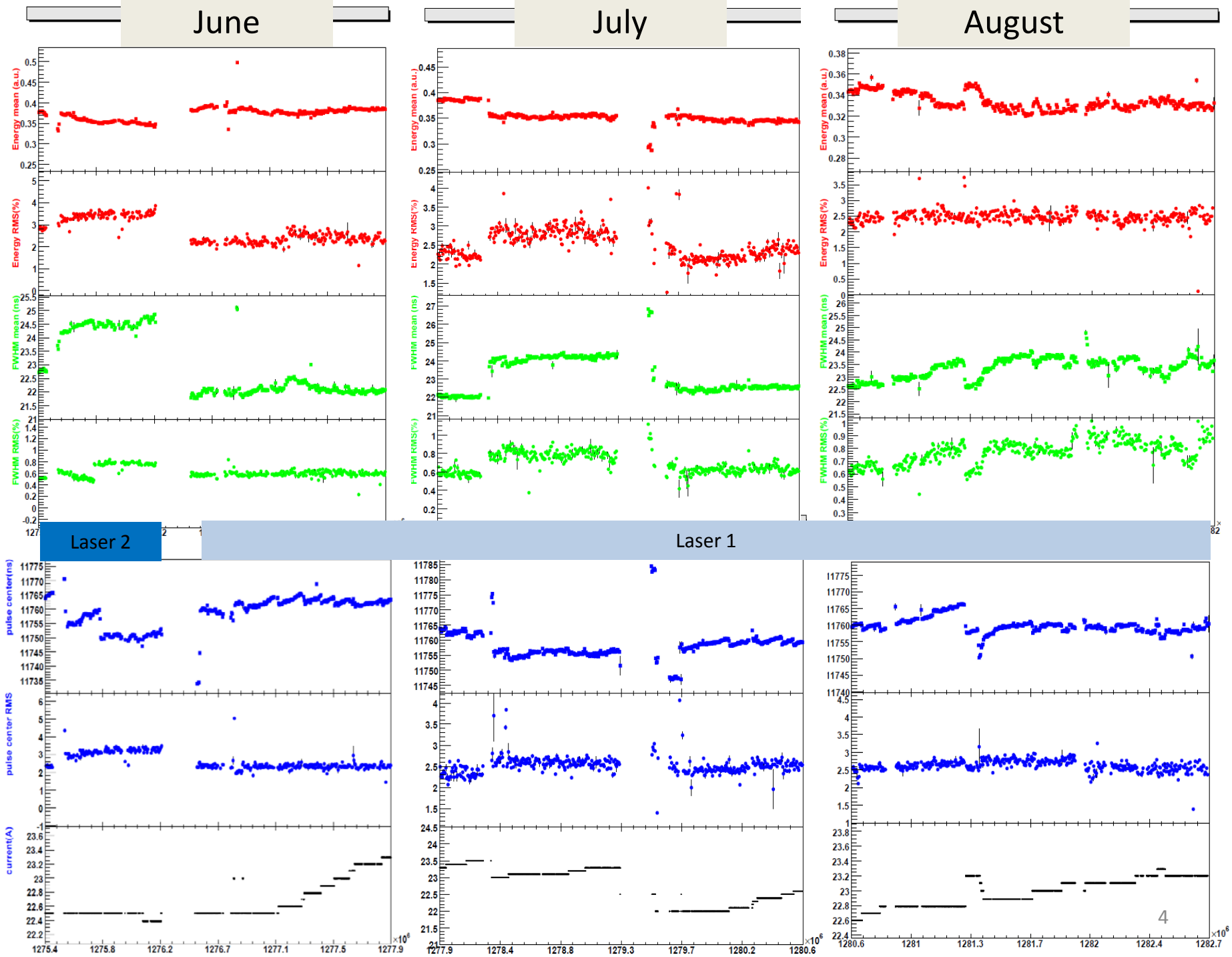



No Spare: IR laser, 5 x 1 switch and 1 x 88 switch
Not available if in service. Long lead time for spare.

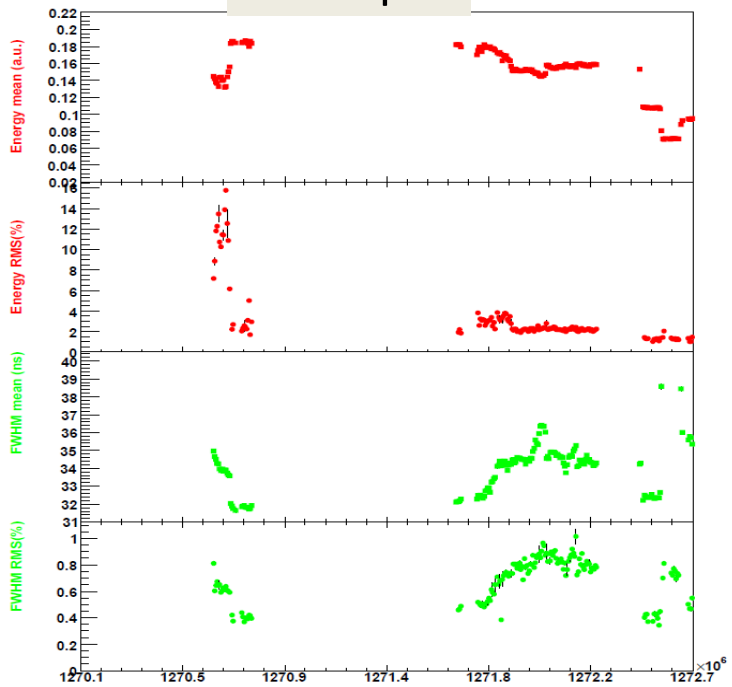
**Data from slow monitoring (get laser current evolution)**



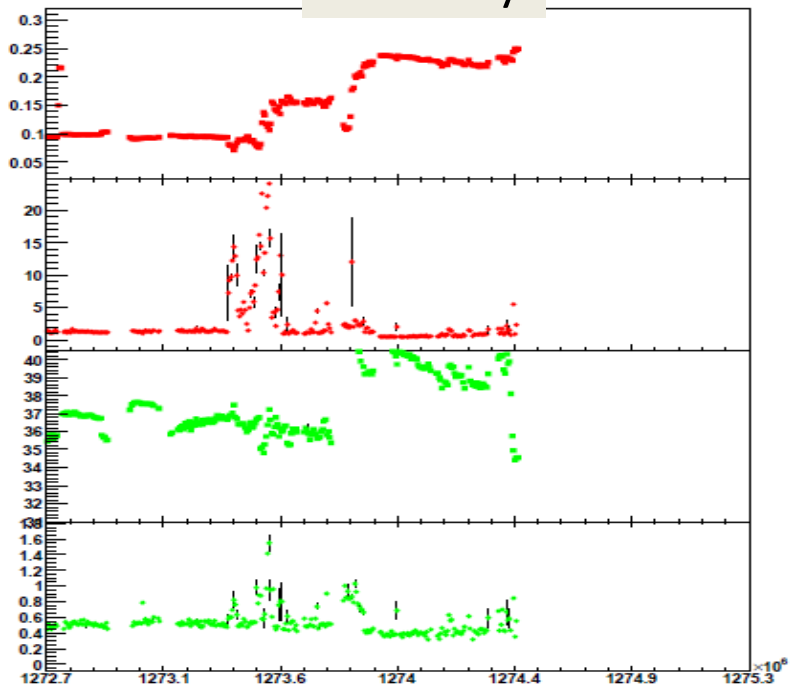

data not uploaded after 21 May but Laser OK

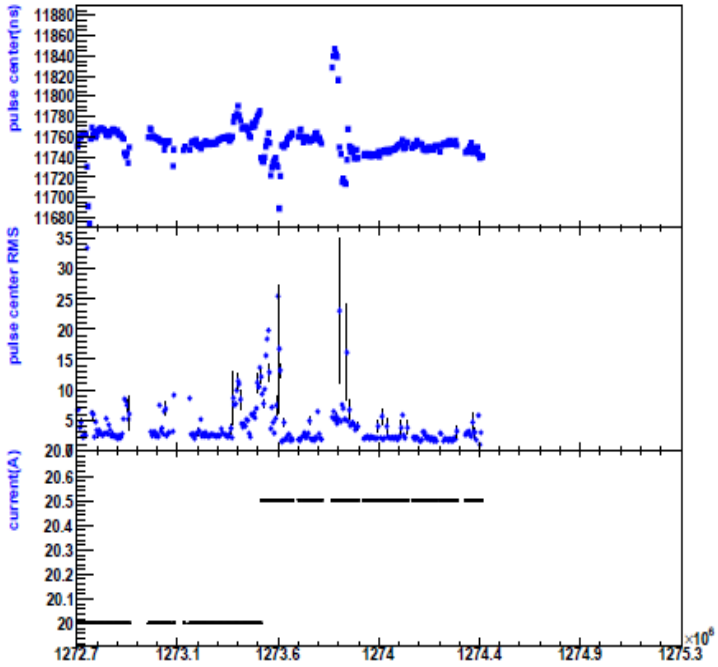

June
July
August
Energy mean (a.u.)
Energy RMS(%)
FWHM mean (ns)
FWHM RMS(%)
Laser 2
Laser 1
pulse center(ns)
pulse center RMS
current(A)

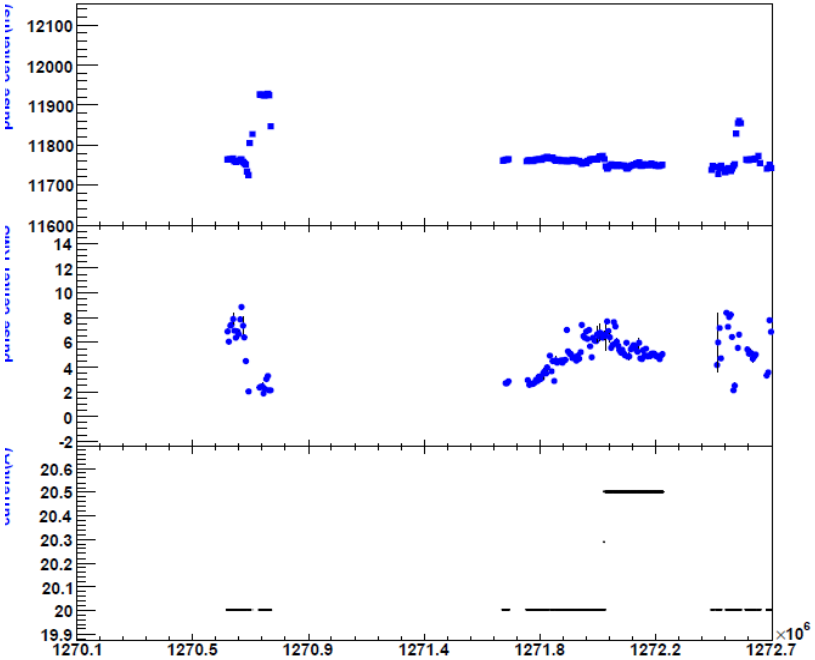
## RED April

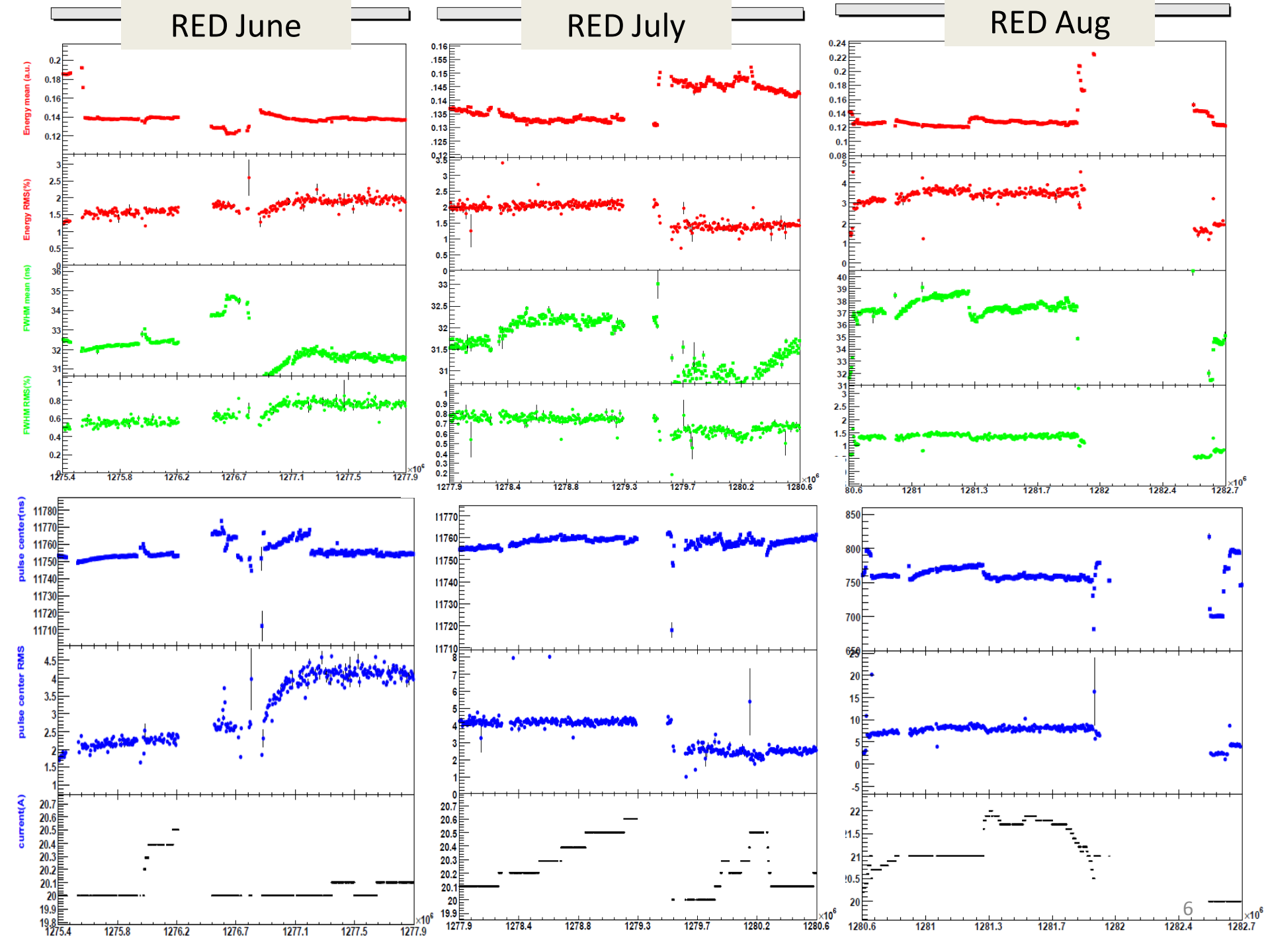



## RED May




RED June
RED July
RED Aug
Energy mean (a.u.)
Energy RMS(%)
FWHM mean (ns)
FWHM RMS(%)
pulse center(ns)
pulse center RMS
current(A)

## April 2010

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 |
| | | | Laser2 online | | | |
| 5 | 6 | 7 **Laser1**: new crystal (spots) | 8 | 9 | 10 | 11 |
| Laser2 online | | | | | | |
| 12 Scan ECAL with different laser attenuation | 13 **Laser2**: new lamp, broken after 450 hrs. **Laser1**: New HV pulser | 14 | 15 | 16 | 17 | 18 |
| Laser2 online | Laser1 online | | | | | |
| 19 **Laser1**: small tuning because of RMS power 5% | 20 Scan ECAL with different laser attenuation | 21 | 22 | 23 | 24 | 25 |
| Laser1 online | | | | | | |
| 26 | 27 | 28 | 29 | 30 | Notes: | |
| Laser1 online | | | | | | |

## May 2010

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|
| Notes: | | | | | 1 | 2 |
| | | | | | Laser1 online | |
| 3 | 4 **Laser1**: tuning **Laser3**: lost control of TiS box | | 6 | 7 | 8 | 9 |
| Laser1 online | | | | | | |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Laser1 online | | | | | | |
| 17 | 18 | 19 | 20 | 21 **Laser1**: water leak , flow tube broken. | 22 | 23 |
| Laser1 online | | | | Laser2 online | | |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 **Laser3**: lamp broken. New parker valve | Notes: | | | | | |
| Laser2 online | | | | | | |

## http://laser-caltech.web.cern.ch/laser-caltech/

## June 2010

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|
| Notes: | 1 | 2 | 3 | 4 | 5 | 6 |
| | Laser2 online | | | | | |
| 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Laser2 online | | | | | | |
| 14 **Laser2**: flow tube broken | 15 | 16 | 17 | 18 **Laser3**: change lamp, water inside | 19 | 20 |
| Laser1 online | | | | | | |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| Laser1 online | | | | | | |
| 28 | 29 | 30 | Notes: | | | |
| Laser1 online | | | | | | |

## July 2010

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|
| Notes: | | | 1 | 2 | 3 | 4 |
| | | | Laser1 online | | | |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Laser1 online | | | | | | |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Laser1 online | | | | | | |
| 19 **Laser1-3**: change lamp as usual maintenance | 20 **Laser3**: change ICS box controller (GPIB trouble) | 21 | 22 | 23 | 24 | 25 |
| Laser1 online | | | | | | |
| 26 | 27 | 28 | 29 | 30 | 31 | Notes: |
| Laser1 online | | | | | | |

# August 2010

| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|
| Notes: | | | | | | 1 Laser1 online |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Laser1 online | | | | | | |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Laser1 online | | | | | | |
| 16 | 17 **Laser3**: Impossible to restart after B field ramp. | 18 | 19 | 20 | 21 | 22 |
| Laser1 online | | | | | | |
| 23 | 24 | 25 **Laser3**: Back Online. **Issue with laser sequence up to 30 August** | 26 | 27 | 28 | 29 |
| Laser1 online | | | | | | |
| 30 **Laser1-2-3**: maintenance | 31 **TEST Gain200: change attenuation** | | | | | |

| Months | Usual maintenance or laser failures | Number of switching time with spare laser |
|---|---|---|
| April | 3 | 1 |
| May | 3 | 1 |
| June | 2 | 1 |
| July | 1 | 0 |
| August | 2 | 0 |

| Replacement parts Since April | Nb. of items |
|---|---|
| Lamp | 9 |
| Flow tube | 3 |
| YLF Crystal | 1 |
| Solenoid valve (cooling) | 1 |
| ICS box (RS232/GPIB) | 1 |
| Blue HV Pulser | 1 |

***January:*** *Main intervention laser1: the power supply connector burned suddenly.* ***changed the power supply unit and the cooler assembly.***

# Laser Interventions

- **April to August:**

**Blue laser** was switched three times during regular maintenance making 440 nm available all the time.

- **Mid-August to end-August:**

On August 17, the **RED laser** was taken offline. It was instable for a while after a B field ramping, and was completely dead on August 17. There was no error from laser side, but it seems impossible to put it back online for some unknown reason.

On August 24, the RED laser went back online - but calibration troubles appears after few hours:

1. Missing quite all the time first LM region of the sequence moving from EB to EE or from blue to red.
2. Lost blue and red laser after few hours of data taking.

**Investigation:** Rebooting the laser program remotely help to restart the sequence but same problem appeared after a while. No error on log files.
Finally found hardware issue with RS232/GPIB interface box from laser3: I suspect a B field effect on the small power supply convertor (24Vdc to this interface box) which caused similar problem back in March.

- **18-20 Sept:**

RED laser died suddenly on Saturday, September 18. Repaired on Monday, September 20, morning in regular maintenance and reparation. Flow tube was found broken.
This problem has been raised because we lost RED laser the weekend.

# Laser Interventions

**TWiki page done by Laser shifters:**
https://twiki.cern.ch/twiki/bin/view/CMS/EcalLaserMonitoringOnCallShiftIncidents

## Incidents and Interventions

This list contains incidents and interventions during the CMS Ecal Laser Monitoring On-Call Shifts since 19-Oct-2009.

| ID | Date | Laser Expert | Symptoms - ECAL P5 Shifter | Symptomps - Laser Expert | Actions Taken | Result | Hindsight | Elog |
|---|---|---|---|---|---|---|---|---|
| 34 | 2010-08-04 20:14 | Vladlen Timciuc | Laser sequence disappeared form laser fast checker | Lasers are fine and accepting trigger | Check laser application | It was a glitch in DAQ system as confirmed by DAQ expert | | elog |
| 33 | 2010-08-03 22:21 | Vladlen Timciuc | Leser sequence red, laser amplitude "0" | After magnet ramp, lasers were switched off by the interlock mechanism. Can't connect to ecal-laser-room-02, neither via vncviewer not simple ssh. | At P5, restarted laser application. used last valid values for laser currents (laser-1.ps, laser-3.ps). Laser successfully recovered. Put laser back online. | Laser recovered, lightchecker shows green sequence. Other parameters also Ok. | Follow magnet status | elog |
| 32 | 2010-07-04 | Yousi Ma (not really an expert) | laser supervisor/control timeout | laser seems okay on ecal-laser-room, commands also working via ./client. send1: command has 50% errors | tried remote restart of laser client, cause pc freeze, did physical restart in laser barracks | laser okay after reconfigure of calibration sequence at the end of the run | not sure if it is a long run issue (build up of delay, or memory leak, or? | |
| 31 | 2010-06-06 9:44 | Vladlen Timciuc | A sector in EE-9 appears red in DQM for laser | In light checker laser looks ok | No action | Problem disappeared for the next run, probably was a DAQ problem | | elog |
| 30 | 2010-05-01 17:30 | Vladlen Timciuc | While in control room observe that laser2 amplitude went to 0. | Laser 2 seams fine, but no signal at ecal-laser-room-01 | Switch back to laser1. Adjust delay A | Laser back online | | elog |
| 29 | 2010-05-01 12:40 | Vladlen Timciuc | Received Call from ECAL P5 Shifter. Laser sequence went red and the amplitude for red laser 0. | Confirm, laser amplitude fro laser3 is 0. Problem with GPIB or communication. Shutter for laser3 can't be closed, stuck in position 88. Laser 1 also went off | Reboot DG535 for laser1 and laser3. Hard reboot of laser3 including power box for the laser (box on the shelve above the laser). Restart laser application. Switch to laser 2 and Laser 3 configuration | Laser back online ready for data taking | | elog |
| 28 | 2010-04-29 18:30 | Vladlen Timciuc | Received Call from David. One of the laser boxes was down | Need to reboot the laser box for laser 1 | Lasr box for laser 1 reboot | Everything ok | | none |
| 27 | 2010-04-21 13:15 | DavidBailleux | Betev. During good health check: laser light only on half of EB each time. | None | Looking log file on ecal-laser-room-04#tmp/LaserSup-ecalPro/LaserSupervisorLog_RUns133662_133695 and see error: missing Laser trigger because of switching time. | A. Thea and P. Gras called to change/check this configuration: maybe time is left to 5sec instead of 8sec. Unsolved. | None | |
| 26 | 2010-03-20 14:50 | JanVeverka | None | None | Tested taking laser off-line and back on-line during data-taking. See elog and the description of the procedure for details. | Laser came back to live alright, global run was not disturbed. | | link |
| 25 | 2010-03-17 | JanVeverka | Laser amplitude on the light checker and DQM is 0. | Confirmed. | None. | Laser self-recovered during investigation at | Reason unknown. | elog |

# Improvements

## From ECAL presentation, *Calibration and monitoring review,Oct 2009:*

***1) Reducing switching time:***

***Aim:***

- *Reduce the time needed for the monitoring region scan. Currently, it's average is 3 sec/region with tail.* ☑

***Idea:***

- *Remove two protective Ti:S shutter operations for each step (close and open), so that the average switching time needed will be reduced to 1 sec/region, well below the 4 sec allocation.*
- *Separate laser control from DSO data taking by using two GPIB cards, so that the tail will be eliminated. (See below for the details)*
- *EMTC will guarantee no trigger sent to lasers before confirming switch position, otherwise the switch may be damaged.*

***2) Modify GPIB control:***

***Aim:***

- *Avoid DSO causing GPIB crashing.*

***Idea:*** *Separate GPIB tasks to avoid crash:* ☑

1) *3 scopes on 1st PCI-GPIB, ecal-laser-room-02.*
2) *All other lasers devices on 2nd PCI_GPIB, ecal-laser-room-02 or another P.C*

# Improvements

**From March CMS week 2010,**
**laser presentation with Caltech team**

## Summary

1) ***The period requiring daily intervention to reboot GPIB is over.*** *Long time operation is need to see how the system goes and what can be further improved.*
   ***Stop laser control regularly to avoid the accumulation of too many commands, for example.***

2) ***Laser2 and Laser3 are very stable since 2010.*** *No interruption due to laser failure;*

3) ***B field effect under control:*** *DCS interlock, shielding box, new digital DSO, new power meter, new IR viewer ;*

4) ***2 GPIB board****: - new DSOs are OK now (failed last year)*
   *- Issue of the switching time not solved: average/channel goes from 3 to 5 sec.*
   ***To be understood.***

# Improvements

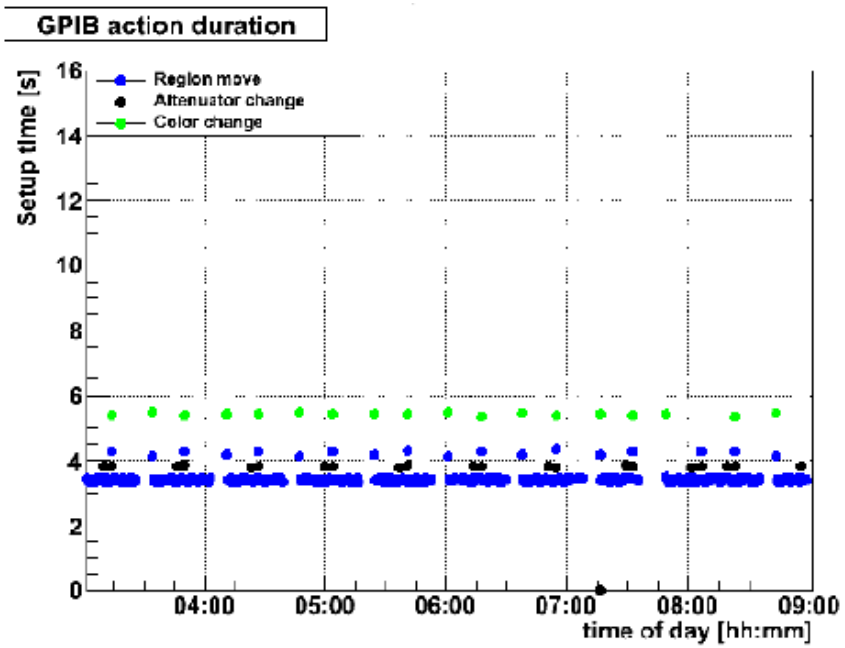
### 3.1 Reducing Laser Scan Time

A road-map is defined to reduce the overall switch time. Small modifications regarding laser supervisor, e.g. the **handshake removal** and **allocated switching time** have been implemented first last week (Philippe). The mechanical interlock, which protects the switch, is planned to be replaced by electronic one by the Caltech team. Now full laser sequence is reduced from ~48 to 38min. *Cf. OM meeting 22 Sept.*

From 26 Sept, switching from blue to red is also optimized from laser software, removing the intermediate **switch position 0** in between.

**Plan established with Renyan, David, Marc, Adi, Patrick, Kejun, Liyuan and Philippe.**

- Remove acknowledgement of laser setting change and trigger veto during setting (a.k.a. "handshake"). DONE
  *This protection was causing an uncontrolled delay not understood and was redundant with shutter-based protection.*
- Reduce time allocated to region switching from 8 seconds to 4 seconds. *Savings: 11min.* DONE
- Caltech team will explore the possibility of inhibiting trigger electronically instead of mechanically during the switch operations.
- If successful we may remove the shutter operations, and reduce the waiting time to 2 seconds. *Savings: 5 min.*




Time from laser log file now, based directly on hardware.

# Improvements

### 3.2 A bug in laser DAQ fixed:

The issue of the occasional laser PC (ecal-laser-room-02 ) freeze is understood. A bug related to the new version of GPIB device driver was fixed late August. Since then no PC freeze was observed.

### 3.3 Additional Laser Hardware Expert:

Having a second expert is under discussion: One expert is not sufficient for a long term data taking, e.g. vacation.
The RED laser and switches (3 x 1 and 1 x 88) are critical with no spare. Off-time is expected when they need service (as during last vacations). Additional hardware expert will help to reduce the off-time.
One year (+/-1 ☺) experience is needed for someone to be efficient, which can only be gained by actually working on the laser system during maintenance.

# Summary

- The laser system operates **as expected** during this period. After the main service last Fall, the laser pulses from all lasers arrive at the same time with consistent energy and width for monitoring.
- A road-map is defined to accelerate the switch time, and to reduce the overall monitoring scan time: already time sequence goes from **48 to 38 min**.
- Because of **no spare the RED** laser was offline some times this Summer. An additional expert would help, but will not eliminate entirely the off time. To make it 100% available a spare RED laser is needed.

***From Oct 2009 review:***

•*No spare for :*
*- 5 x 1 and 1 x 100 switches, DSO, Ti:S crystal, Ti:S LBO assembly, laser power meter, power detector, IR camera*
*- Red laser ; Orange laser for encaps.*

• *Pump laser upgrade: The YLF:Nd pump laser may be replaced by* ***diode pumped model*** *with high stability, reliability and much less maintenance requirement.*

# ECAL safety

## *As new ECAL safety Officer (June 2010)*

**Principal duties as linkmen are:**

1. on behalf of their Group Leader, to monitor the Safety of working methods, equipment and premises, so as to advise members of the Group and the Group Leader on dangerous situations and on actions to be taken to improve Safety;
2. to provide information and arrange for Safety training for all members of the group, and in particular for newcomers and people temporarily attached to it;
3. to provide liaison in matters of Safety between their Group, the Divisional and other Safety Officers and the TIS Division.

Near future:

- Learn more regarding IP5 safety . Ex: be awarded of safety aspect for next CMS opening;
- Help the new safety training officer to elaborate CMS L4 safety regarding laser;
- Follow the H4/H2 test beam;
- Write a paper to describe ECAL safe operation with actions matrix;
- Web page : ECAL Safety on Twiki and ECAL main web page

https://twiki.cern.ch/twiki/bin/view/CMS/EcalSafety

For all ECAL activities at CERN where there is a potential risk, information to the safety link person is welcome !
Feel free to contact me for any safety questions or comments