

Status Report of the ECAL Laser Committee

W. Zeuner

Members: Brad Cox, Marc Dejardin, Roger Russack, W.Z., Ren Yuan Zhu

Task – review modifications/upgrades of the laser system

Benefits, risks, integration, time schedule, costs

-→ Recommendations

Proposal

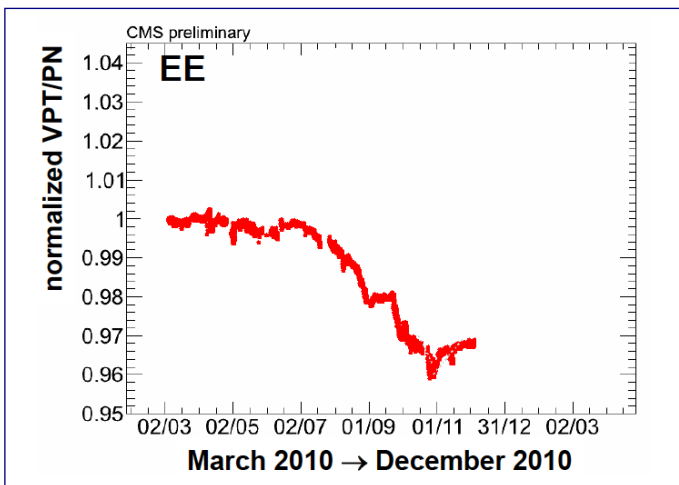
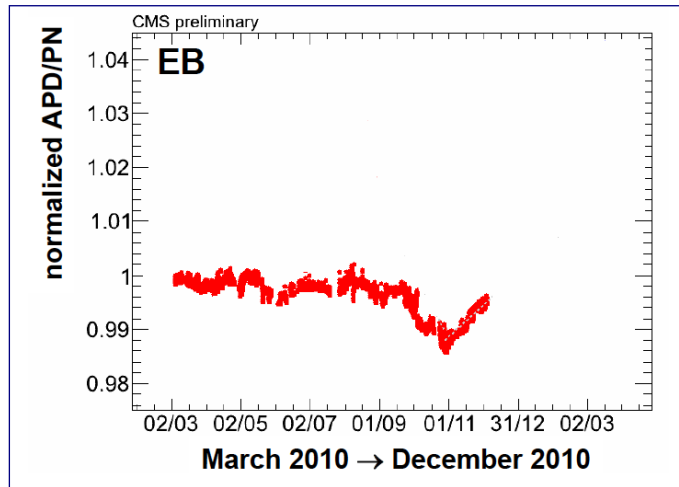
- New optical switches
- New solid state pump laser for Ti:Sapphire laser to replace Kr-lamp
- New orange laser for the EE to replace the LED system
- Spares for IR/orange lasers in EB and EE

Two long EVO-Meetings and extensive E-Mail exchanges

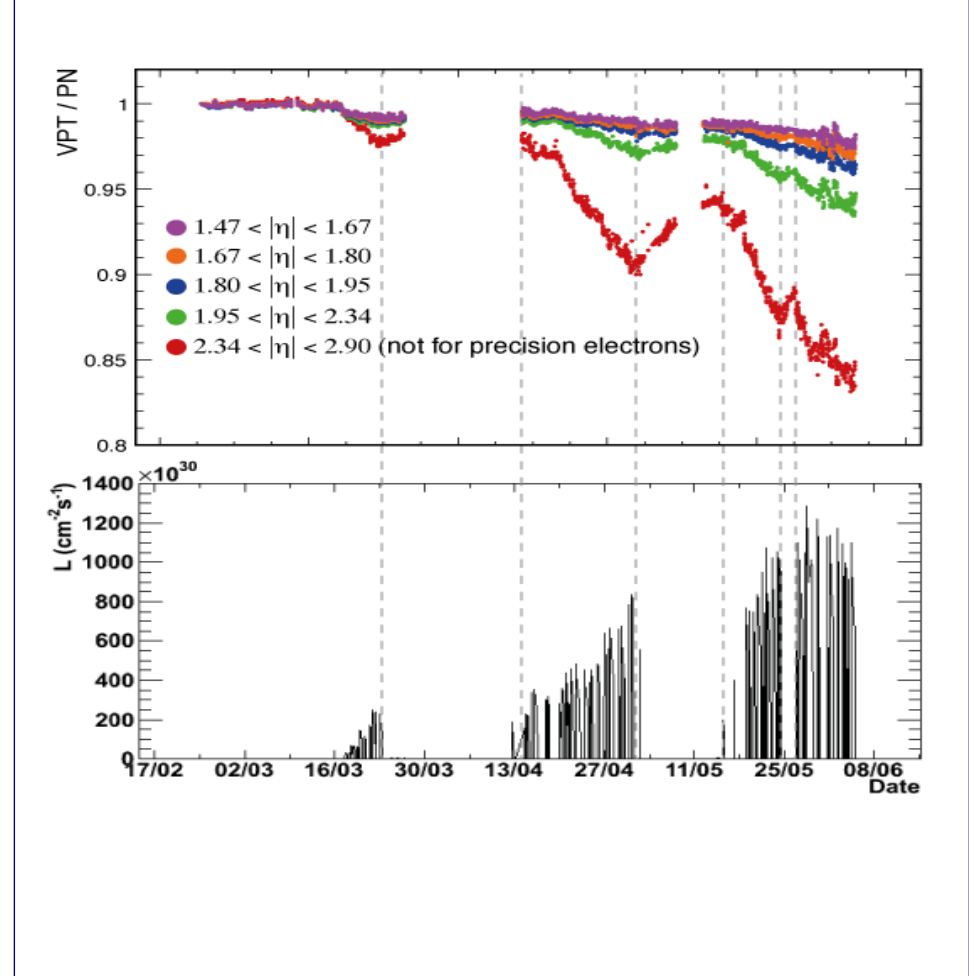
The laser system is a working system and it is essential for ECAL operation
The transparency of the crystals changes throughout a fill.
For a correct energy measurement this must be corrected.

D. Barney

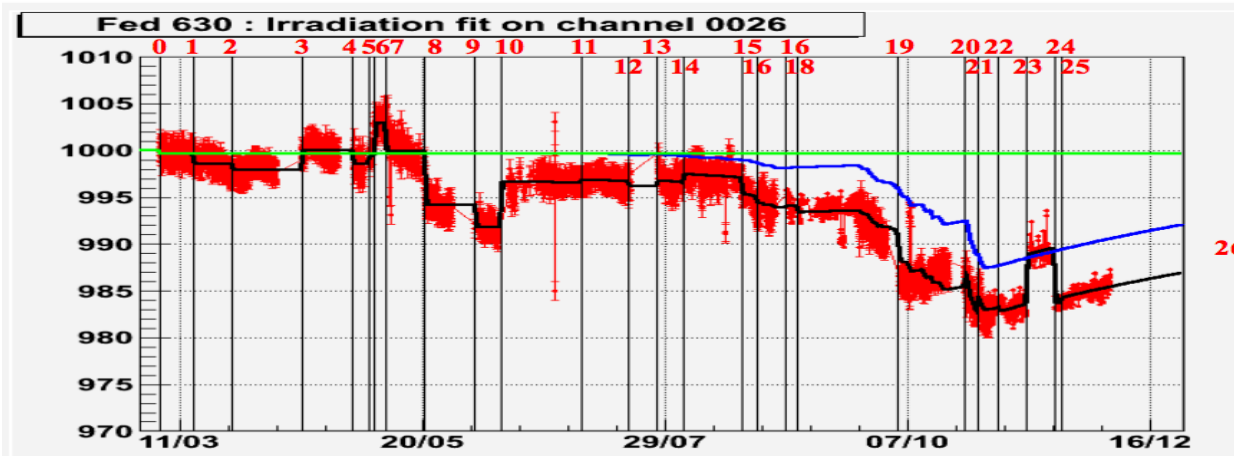
Some losses seen in **2010**
at expected magnitude –
Measured by laser system



Larger losses (as expected) in **2011** due
to much increased luminosity



Transparency model



Vertical lines
indicates where
steps are allowed
26 steps in 2010

Black = fit
Blue = correction

M. Dejardin

■ Residual instabilities observed:

- CMS Magnet, ECAL on/off cycles, laser tuning/maintenance

← Not understood

■ Smoothed by a model describing the transparency evolution with luminosity (CMS Note 1998/013)

- Model parameters constrained to data
 - Colour center creation/annihilation dynamics (3 parameters)
 - VPT response evolution (only EE and in 2010)
- Steps of unconstrained size allowed at each laser 'incident'

← Parametrizing
the unknown

■ Crystal dynamics not at saturation yet

- Model possibly OK at interpolating, less so at extrapolating
- Use of plain monitoring data being addressed (for Prompt Reco at least!)

Summary from Dave Barney in his LHCC Talk

- **Inter-calibration**

- $\sim 0.5\%$ in $|\eta| < 1.0$; better than 1.0% in all EB
- Better than 2% in region covered by ES; 3-4% elsewhere
- E/p will provide ultimate inter-calibration precision with few fb^{-1}

- **Scale/stability**

- Laser monitoring system fully operational in prompt calibration loop \rightarrow follows transparency
- π^0/η , $W \rightarrow e\nu$, $Z \rightarrow ee$ all used as “standard candles” for sanity checks and to monitor energy scale and stability

Technical Problems

Blue Ti:S lasers are pumped by a laser pumped by a Kr-lamp

Kr-lamp is a very sensitive consumable – causes large maintenance effort

Pump laser is not available any more – spares are running out soon

The interruptions to maintain the pump laser causes the large majority of “jumps” in the APD/PN ratio

Blue Ti:S lasers show first signs of aging, long term availability not clear

Blue Ti:S lasers show some not understood pre-pulses

There is no spare optical switch of the correct size to feed all channels in parallel

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Liyuan Zhang will arrive next week and further investigate the jumps and pre-pulses

Preliminary Conclusions

- The system must be kept running in today's configuration until LS1 (this might be as long as until spring 2013 !)
Therefore enough spares must be procured now
- A second large optical switch must be procured a.s.a.p.
- In view of the long term operation, it is not sufficient to replace only the pumping laser of the blue laser system.
- The entire blue laser system must be replaced.
It can be expected that the new system will show much less jumps in the APD/PN ratio
A market survey should be performed before purchasing
One laser should be procured in FY12 to perform tests of long term stability
The general parameters (wavelength, pulse length, shape and stability, jitter....) can be used from the current system
The energy of the current laser is an advantage, but not absolutely mandatory depending on the chosen technology it might come as by product of the required stability.
- There is no need for yet another frequency laser (green)

Preliminary Conclusions con't

- The decision on the final system should be made in 2012 with data of the test laser
- Procurement of the final system should be FY13 (maybe split and spread into FY14)
- Installation at PT5 – end of 2013 or spring 2014

Open questions

Does the endcap system needs a an orange laser to replace the LED system ?

Will the available lasers lead to an performance increase worth the price ?

How should the financial load of the proposed changes shared between M&OA/B and upgrade funds ?

Time line – my proposal

Try to find a slot this week to meet and hopefully conclude on the open questions

Make a proposal for the FY12 negotiations for Brad this week.

Final report to ECAL management second week of August (after my vacation)