



Monitoring system 2011-2012: status and plans

ECAL General Meeting

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Adi Bornheim California Institute of Technology





Focus on light sources

- > Intro : Historic evolution of the monitoring system.
- Summary of of operational experience 2011 & 2012
 - > Quantronix
 - Photonics
 - Other light sources
- > Evolution of light sources
 - > 2nd Photonics



ECAL Laser Monitoring History





First transpareny change First corrected physics data ⇒ Proof-of-principle Photonics Laser Alpha dynamics Increased APD noise Additional effects in EE ?





Federico Ferri & Saclay team



More dynamic evolution of the transparency change in 2011.
Saturation becoming visible as luminosity levels of in 2012.
Final equilibrium not yet reached.







- First laser in CERN 1999, 2nd and 3rd (red) in 2003.
- Used in test beam, P5 comissioning and CMS physics until now (backup only since 2012)
- Main issue : Wear and tear, requiring regular maintenance interventions, affecting optical path and hence pulse properties.
- Very sensitive to environmental conditions and non-graceful operation (power & cooling cuts).





Quantronix



David Bailleux

- Operation very man power intense.
- Pulse shape variations make transparency corrections more complicated & man power intense.
- Fundamentally, they worked as expected.







Spring 2011 :

- Stable Quantronix operation
- Renormalise laser corrections to unity at the beginning of data taking
- > Recalibrate with π^0 & phi-sym, adjust scale with Z.
- > Resolution agrees between DATA and MC for high R9, central EB.
- Transparency change has very significant impact on ECAL resolution



May10 2011





- In May 2011 we experienced very unstable laser running.
- Subsequently discovered that MATACQ correction could not recover the resolution performance in case of extreme pulse property changes.
- Summer 2011 :
- ⇒Decided to run with two blue lasers in parallel to calibrate the monitoring system.
- \Rightarrow Started discussions on new lasers, task force.







- After very carefull and extensive maintenance, stable running for 1 months (0.5 fb⁻¹) with two blue lasers.
- While one blue laser was used for production monitoring second was used to perform dedicated linearity scans.







Marc Dejardin & Saclay team

- September exercise has proven that non-linearities in the laser monitoring hardware are not perfectly corrected.
- Traced back to limited bandwidth in the MATACQ readout chain.
- Recalibration of the monitoring system September/October 2011.
- See detailed report from Marc Dejardin :

https://indico.cern.ch/getFile.py/access?subContId=0&contribId=3&resId=0&materialId=slides&confId=163877





92.8

DOLL

2012 : Photonics



- Order placed verbally on 11.11.2011
- > At Caltech February 2012
- > At CERN March 2012, in operation in April 2012
- \Rightarrow 6 months from order to operation.

Photonics Industries





- After some initial operational optimization at P5, very stable operation.
- In Summer, some degradation traced to auxilliary optics.
- ➢ End of summer some degradation suspected to be caused by issues internal to the laser. ⇒ See discussion later.
- \Rightarrow Reduce power from 55 A to 45 A pump current to minimize further degradation.
- \Rightarrow Very stable operation after this.



DP2-447 Slow Monitoring 2012





Emanuele DiMarco & laser team

- Comissioning phase (April 2011) : Cooling, power setting, laser DAQ
- Summer 2012 power degradation :
 - External optics degraded, fixed.
 - Issue internal to the laser suspected, can only be verified by opening cavity (=> warranty). Power reduced, since stable.
- On-call interventions in 2012 :
 - > 24 in total : https://twiki.cern.ch/twiki/bin/viewauth/CMS/EcalLaserMonitoringOnCallShiftIncidents
 - > 11 related to Photonics, 6 in the first weeks (commissioning).
 - Most interventions related to DAQ/communication.
 - On-call service mostly performed by 2 people, more experienced shifter.



More Details on Photonics Operation







2012 Resolution Performance



Shervi Nourbakhsh :

UCD detects DIN 2012 A | D | C mb th

https://indico.cern.ch/getFile.py/access?contribId=11&sessionId=1&resId=0&materialId=slides&confId=215585 https://indico.cern.ch/getFile.py/access?subContId=1&contribId=0&resId=0&materialId=slides&confId=211474

IICI dataset: IICI 2012 A+D+C pho-tunea regression energy				
	ECAL Region	add. smearing $(\%)$		sys.
		fit method	smearing method	
	EB $ \eta < 1 R9 > 0.94 \text{ GAP}$	1.02 ± 0.04	1.10 ± 0.14	±0.22
	EB $ \eta < 1 \ R9 > 0.94 \ noGAP$	1.02 ± 0.04	1.00 ± 0.28	±0.22
	EB $ \eta < 1 R9 < 0.94$	1.04 ± 0.04	1.06 ± 0.08	±0.24
	EB $ \eta > 1 R9 > 0.94$	1.96 ± 0.51	1.86 ± 0.42	±0.60
	EB $ \eta > 1$ $R9 < 0.94$	1.83 ± 0.09	1.96 ± 0.14	±0.59
Ì	EE $ \eta < 2 R9 < 0.94$	2.67 ± 0.12	2.67 ± 0.17	±0.30
	EE $ \eta < 2 \ R9 > 0.94$	3.42 ± 0.23	2.83 ± 0.31	±0.90
	EE $ \eta > 2 R9 < 0.94$	3.58 ± 0.13	3.45 ± 0.18	±0.52
	EE n > 2 B9 > 0.94	3.32 ± 0.07	343 ± 015	+0.34



 \Rightarrow Performance evolution indicates further improvement in stability corrections needed.



May 24th 2

Other light sources



Marc Dejardin : <u>https://indico.cern.ch/getFile.py/access?contribId=0&resId=0&materialId=slides&confId=191786</u>



-0.24 -0.22 -0.2 -0.18 -0.16 -0.14 -0.12 -0.1 -0.08

Log(transparency@527

- Saclay green laser : very short pulses, used for SRP and linearity.
- Wavelength dependency to be studied, full tag in preparation.
- Quantronix red laser : potentially very useful for alpha studies.
- ⇒ Variation of alpha is a significant effect in EE now. Attempts to measure alpha in situ precisely had limited success.



https://indico.cern.ch/getFile.py/access?contribId=1&resId=0&materialId=slides&confId=14444016





- Photonics laser performed as expected.
- Significant reduction in maintenance interventions and reduction of the impact of individual interventions.
- Largely immune to external hazards (power and cooling cuts).
- Long term stability better than Quantronix by a factor 10.
- ⇒ We propose to proceed with the anticipated purchase of a second Photonics laser.





- > Need to clarify reason for power degradation in August :
 - It is suspected that the power degradation is inside the laser.
 - Opening the Photonics laser would void warranty. Warranty expires 10.02.2013.
 - \Rightarrow Send existing Photonics for service.
- Performance requirements as existing Photonics.
- Two possible additional features considered :
 - Active temperature stabilization (heating and cooling) (OK)
 - Fine adjustment of pump current <0.1 A (major upgrade, descoped)</p>
- Quoted price ~equivalent to exisiting Photonics.





Option 1 (negotiations with Photonics ongoing) :

- Order 2nd Photonics by 24.12.2012, Photonics will extend warranty until 10.06.2013, delivery of new Photonics late Spring 2013 (2y warranty, 8000h).
 - If diagnosis reveals connection of power degradation to our specific application may adjust 2nd Photonics accordingly.
 - Both lasers will be at Photonics simulataniously, allowing to profit from anything that may be learned when opening 1st laser.
 - > Delivery and (re)commissioning can be on a relaxed timescale throughout 2013.
 - \Rightarrow Profit from exisiting experience.

Option \mathcal{X} :

- > If we consider not having Photonics for HI running could keep warranty by sending back ~now.
- If we consider waving the warranty we could send back existing Photonics after the end of HI running.
- > For both options may decide of placing order later.
- It is not guaranteed that there is a hardware issue related to how we use the laser and/or if it is a warranty case.





- Need to remove one Quantronix to make space for 2nd Photonics.
- Limited remaining run time on Quantronix without spare parts (order months) :
 - Keep red Quantronix at P5 for alpha studies.
 - Propose to move one blue Quantronix to H4 for testbeam applications.
- May further consolidate laser DAQ and laser barrack infrastructure.





- Laser monitoring achieves its objective, we have corrected the crystal transparency change with good precision and discovered a Higgs like boson.
- Details of the monitoring procedure have been steadily evolving – and will continue to do so.
- \Rightarrow Continued effort crucial !
- > The new Photonics laser has performed well.
- We recommend to proceed with the purchase of a 2nd Photonics laser.















Pi0 Intercalibration Precision









CMS Integrated Luminosity, pp

