

# CMS job matching event

Postdoc position at CEA-Saclay IRFU

ECAL Laser Monitoring system upgrade  
for Phase 2 and the ECAL timing calibration

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24<sup>th</sup> May 2022



## Introduction:

- CMS ECAL Laser Monitoring system as it is now (responsibility of Saclay)
- Performance during run 1 and run 2
- CMS ECAL Laser monitoring upgrade for phase 2: changes foreseen

## Proposed work during the postdoc:

- Proposed work
- Work environment/Saclay group
- Contract conditions/duration

# CMS ECAL Laser Monitoring system

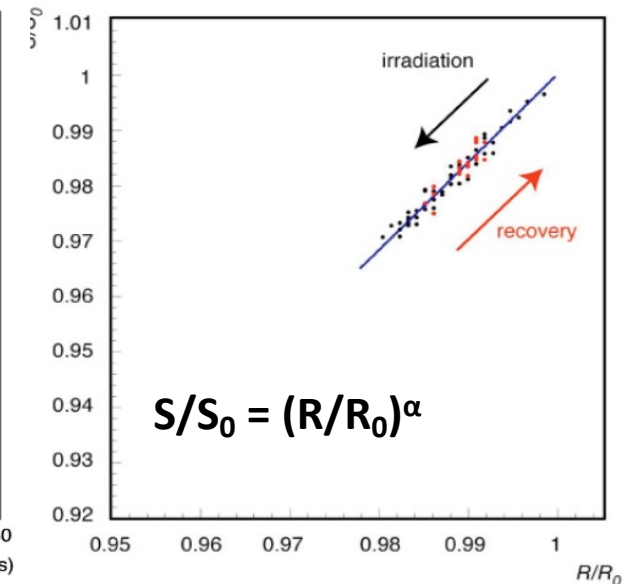
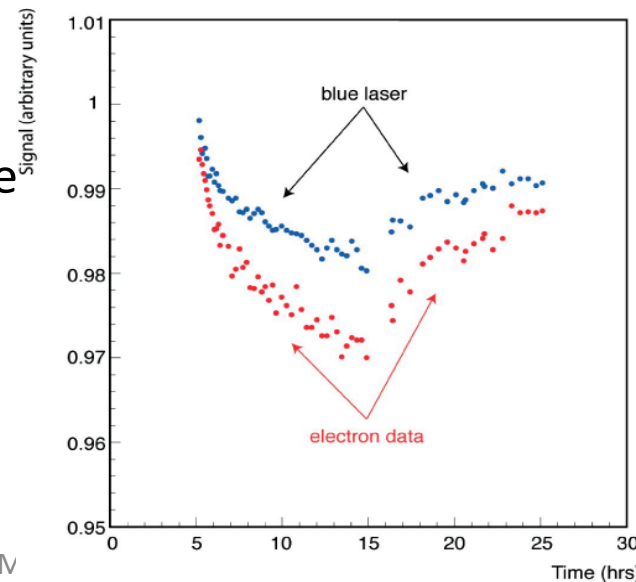
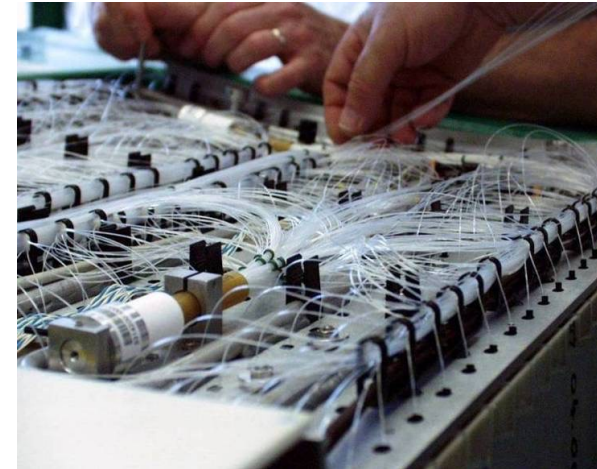
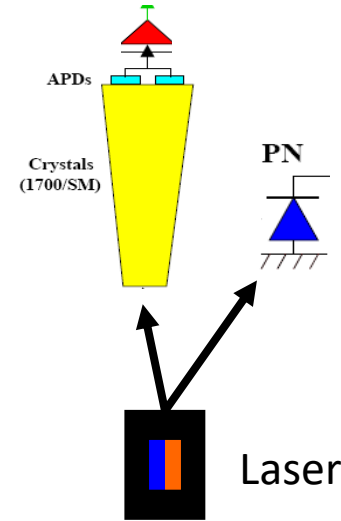


## Monitoring and correcting variations with laser in abort gaps during data taking:

- Laser light injection in each crystal every 40 minutes
- Light also injected in PN diodes
- ECAL signals compared event by event to PN ones
- Energy corrections derived from the ratio, with the relative response to laser light ( $R/R_0$ ) and electromagnetic showers ( $S/S_0$ ) linked  $\alpha$

## Simple in principle but:

- Needs **per mil precision level** in order to preserve the intrinsic excellent energy resolution of ECAL
- **For a large amount of channels** (about 75000)
- Needs to **work permanently and deliver corrections at most 48h after the data taking** (for the “prompt” reconstruction of data)



# CMS ECAL Laser Monitoring system

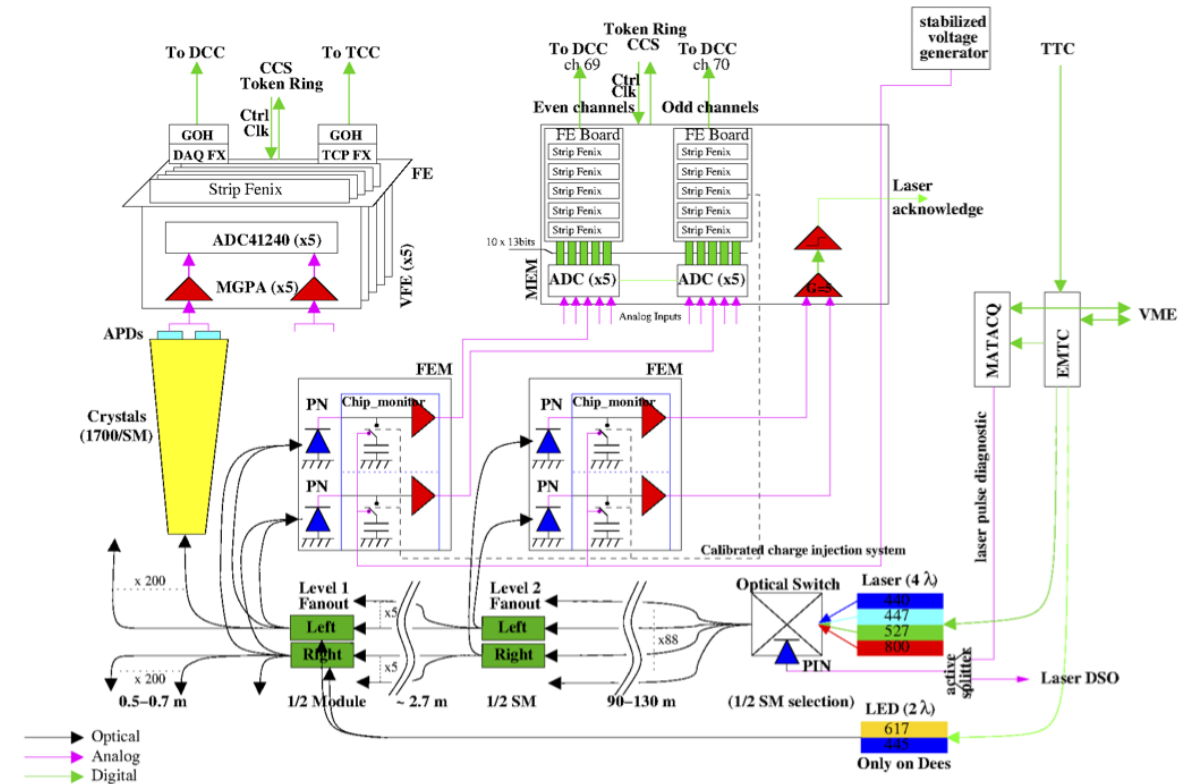


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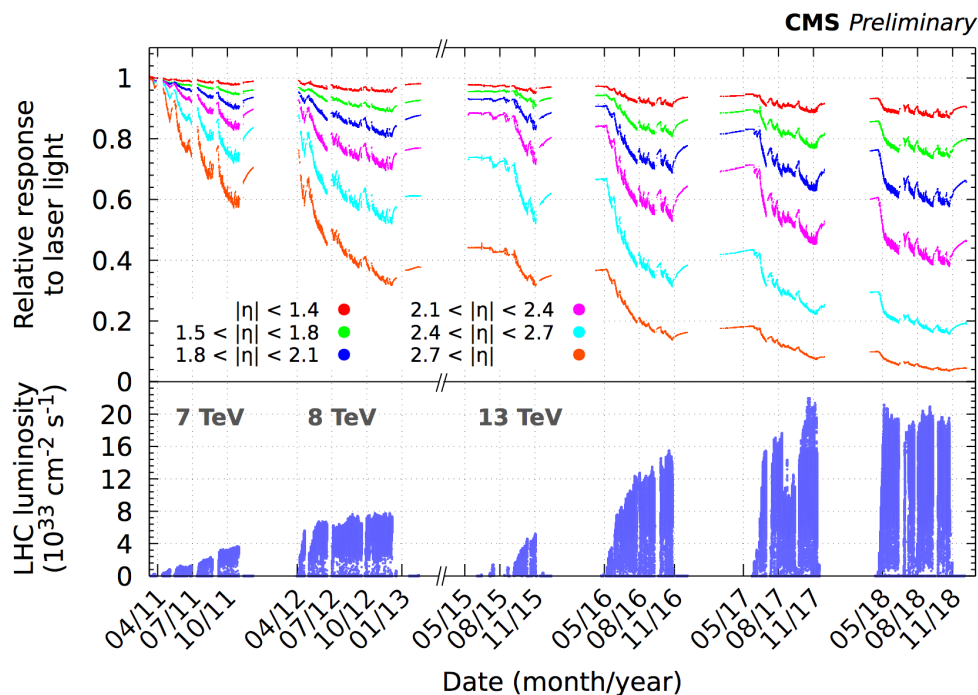


- Light produced by a system of lasers
- Light distribution via a multi-level optical fiber distribution system
- Laser pulse shape monitored by a fast ADC (MATAcq)

# ECAL LM results / performance



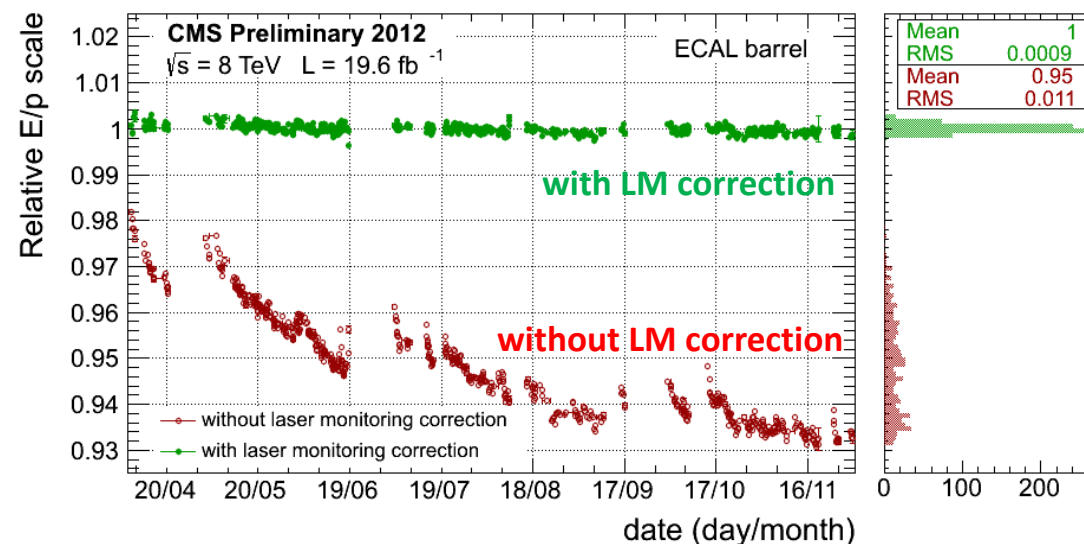
## LM transparency corrections: Run1 + Run 2



- Damage/recovery during LHC cycles evident
- Response change up to 10% in the barrel, up to 50% at  $|\eta| \sim 2.5$

## Applied to physics events:

$E_{\text{ECAL}}/p_{\text{tracker}}$  with electrons in 2012 data



Stable energy scale after corrections  
Expected precision

**Crucial system for Higgs to 2 photons mass resolution**

# CMS ECAL Laser Monitoring system upgrade

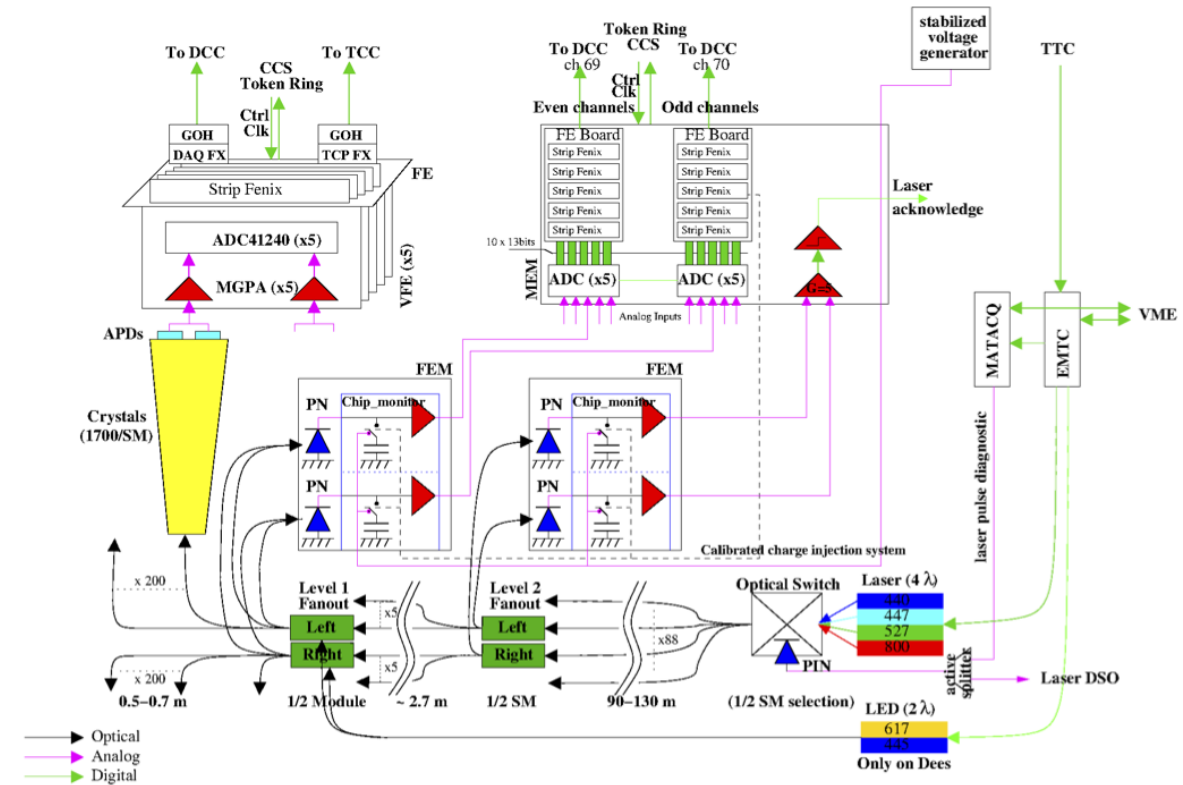


## ECAL phase II:

- Crystals and APD kept
- New readout electronics (VFE card CATIA responsibility of Saclay as well)

## Laser monitoring phase II (Saclay):

- Keep optical fibers
- New PN diodes
- New charge pre-amplifier ASIC (MONACAL)
- New modules (called HL-MEM (sending signals off-detector) and HL-FEM (diode readout)) to read the generated signals and integrate them in the DAQ system
- New board (“LMB”) to control the LASER and monitor the pulses (replaces MATAcq and EMTC)



- Light produced by a system of lasers
- Light distribution via a multi-level optical fiber distribution system
- Laser pulse shape monitored by a fast ADC (MATAcq)

# Proposed work: LM system upgrade



- 1. Definition of the integration of the new LM components** in the existing ECAL super-modules (SM) and LM system. The installation procedure will have to be defined on the spare SM “SM36” (SM36 will be used also to test the integration and performance of other developments like CATIA for example with the upcoming November 2022 test-beam at CERN). This work should take a few months only and will require to interact with the ECAL technical coordination, the ETH group for the installation, and the various actors in Saclay, including the group involved in mechanics and cooling studies. The candidate will acquire a deep knowledge of the ECAL and its LM system as well as the ECAL community, with several trips at CERN.
- 2. Definition of the new LM data acquisition.** The full data acquisition chain will have to be revisited for phase 2: from the data format to the laser monitoring software. This will require software development on one side, and interacting with people responsible of the firmware to define the needs on the other side. Interacting with many groups will thus again be needed, including with the DAQ group at CERN, but also the HLT and the Tier0.
- 3. Definition of the procedure to (inter-)calibrate the ECAL timing with LM data** and its automatization. For phase 2, the timing resolution will be significantly improved (from about 120 ps currently to less than 50 ps) and the timing information from ECAL and from other sub-detectors will allow to reduce the impact of increased PU drastically. The laser data will be used to monitor the timing in the ECAL and to intercalibrate channels. This timing calibration will have to take into account the transparency losses and pulse shape changes. The spare SM36 could be used to take laser data to validate the procedure, once defined, and assess its precision.

# CMS group in Saclay



- CMS group in saclay is currently composed of 11 physicists, 3 PhD students and 1 postdoc: Chiara Amendola, Marc Besancon, Fabrice Couderc, Marc Dejardin, Federico Ferri, Serguei Ganjour, Philippe Gras, Gautier Hamel de Monchenault, Victor Lohezic, Julie Malcles, Jelena Mijuskovic, Andre Rosowsky, Ozgur Sahin, Polina Simkina, Maxim Titov
- The group has been involved in the ECAL design, construction and calibration since the very beginning. In particular, the ECAL laser monitoring system was designed in Saclay. The group had many responsibilities related over the years, including System Manager, Detector Performance Group convenership, ...
- The group is also historically strongly involved in the Higgs to 2 photons decay channel, again with two convenerships
- We do participate to the upgrade for several aspects:
  - ECAL VFE (CATIA chip)
  - ECAL laser monitoring upgrade
  - MTD clock (RAFAEL chip + system tests) and DAQ
  - HGCal clock (RAFAEL chip + system tests) and TDC (HGRoc TOT and TOA)
- The team of physicists is completed by a very strong team of engineers for the detector design





# Work environment



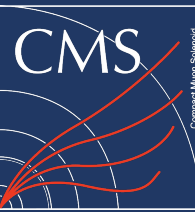
- CEA Saclay is located on the new campus of the Paris-Saclay university
- CEA (“Commissariat à l’énergie atomique”) Saclay was created just after the second world war to for nuclear research
- Big center with several thousands employees working on diverse topics from energy to biology...
- Irfu is an institute of CEA dedicated to fundamental research, including several labs: astrophysics, nuclear physics, particle physics, etc, for a total of about 600 employees.
- The lab you will be working on is called “DPhP” for “Département de physique de particules”. It covers particle physics with for ATLAS, T2K and future long baseline experiment but also other topics like cosmology (DESI) or gravitacionnal waves (LISA).
- CEA is 1 hour from Paris by public transportation approximately (RER-B + Bus). It is in Gif-Sur-Yvette, not far from “Vallée de Chevreuse”, with many natural sites.



19/05/2022



# Contract conditions/duration



## Contract conditions:

- Needs at least a PhD thesis to apply
- Contract is expected to start in 2022
- Two years contract, renewable for one additional year
- The successful candidate will be based at CEA-Saclay with opportunities to visit CERN regularly
- Income will depend on your experience. The monthly salary, with no experience after the PhD at all, is expected to be about 2200 euros /month after taxes are deducted (effective salary) and range up to 2500 euros or more with experience
- For missions at CERN, there is extra money to cover the expenses of the hotel and meals

## How to apply:

Interested candidates should send:

- a CV;
- A cover letter and research statement;
- two recommendation letters;

to the following address: [julie.malcles@cea.fr](mailto:julie.malcles@cea.fr). The review of applications will start on May 15th 2022 and will continue until the position is filled.

Link on inspire:

<https://inspirehep.net/jobs/2070919>

19/05/2022