
CMS
and its upgrades
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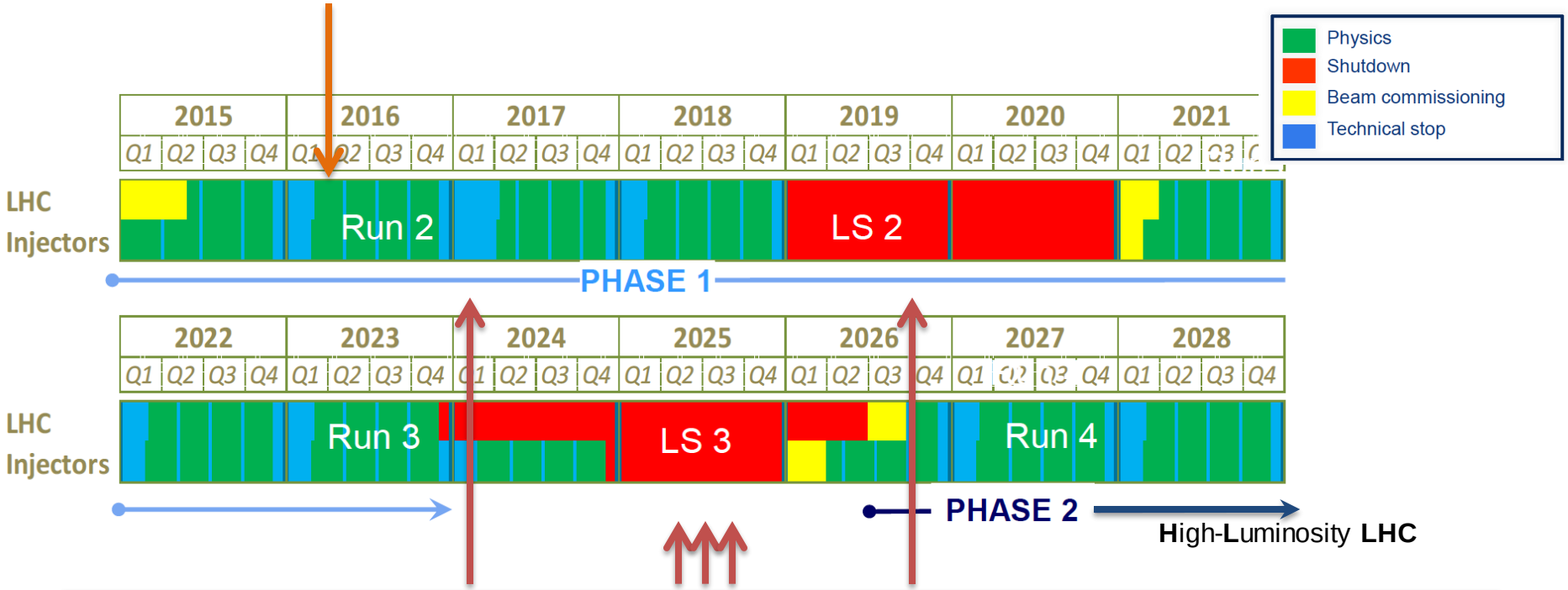
Imminent: take more data at the highest energy ever reached in a collider

… with hopefully more discoveries!

Make sure that the detector is optimized, reconstruction algorithms are ready and well tested….



At the same time: prepare for the future!

Eventually more than 5x design luminosity: most of the present detector unable to operate!
Design and build new subdetectors to ***upgrade*** CMS for the ***high luminosity***.
Take advantage of state-of-the-art technology!

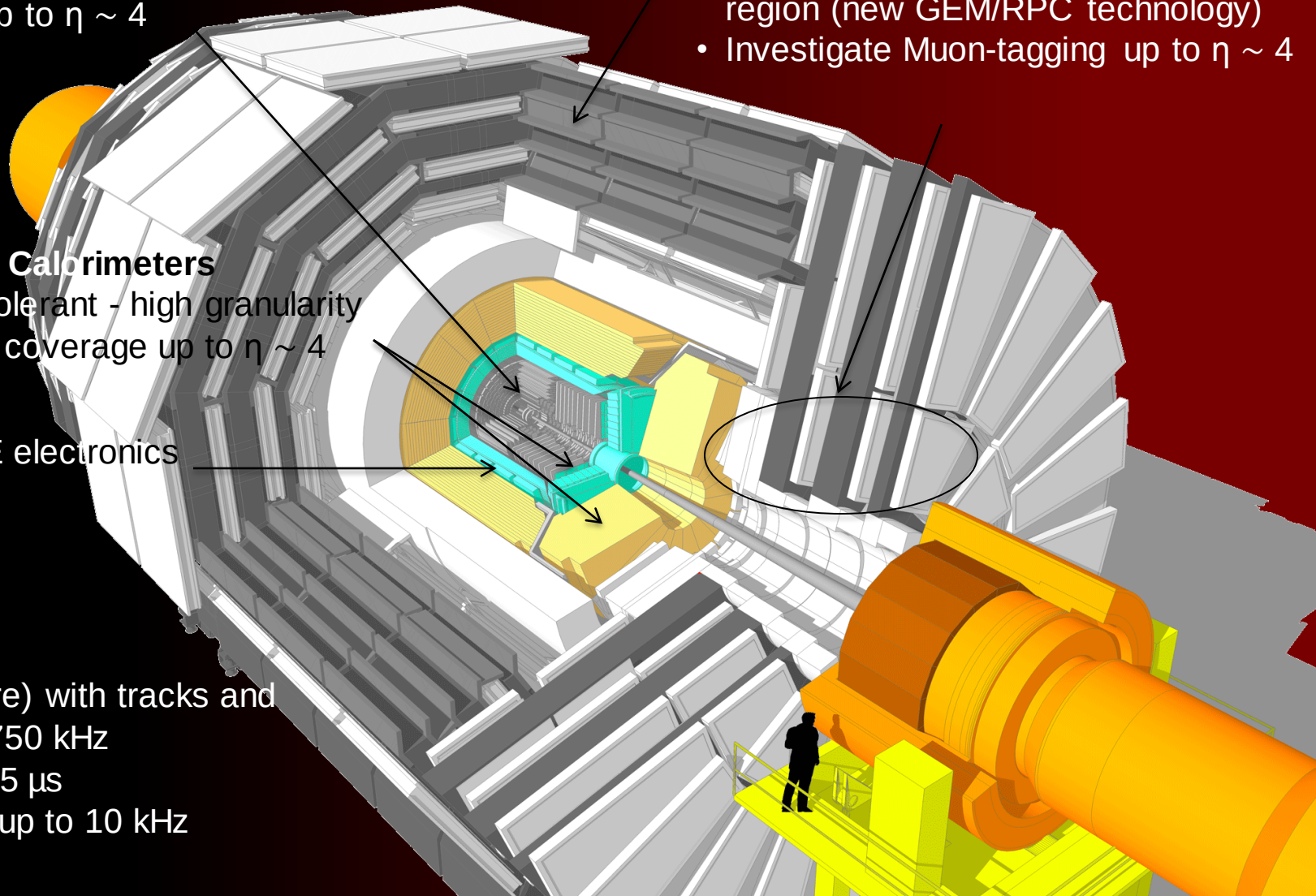
CMS Upgrades for the High Luminosity

New Tracker
- Radiation tolerant - high granularity - less material
- Tracks in hardware trigger (L1)
- Coverage up to η ~ 4

Muons
- Replace DT FE electronics
- Complete RPC coverage in forward region (new GEM/RPC technology)
- Investigate Muon-tagging up to η ~ 4

New Endcap Calorimeters
- Radiation tolerant - high granularity
- Investigate coverage up to η ~ 4

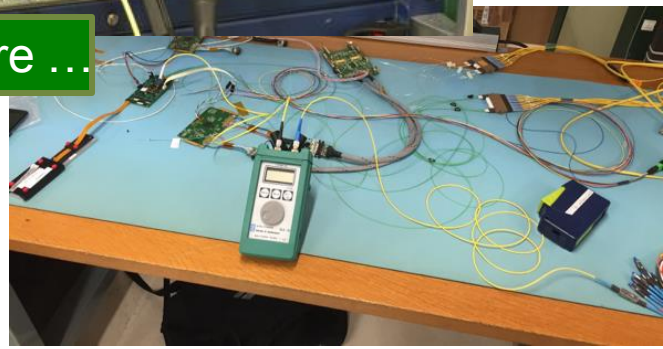
Barrel ECAL
- Replace FE electronics



Trigger/DAQ
- L1 (hardware) with tracks and rate up to 750 kHz
- Latency 12.5 μs
- HLT output up to 10 kHz

Phase 1 Upgrade of the CMS Pixel Detector Data Acquisition System

from here …



The Phase 1 Pixel Detector Upgrade

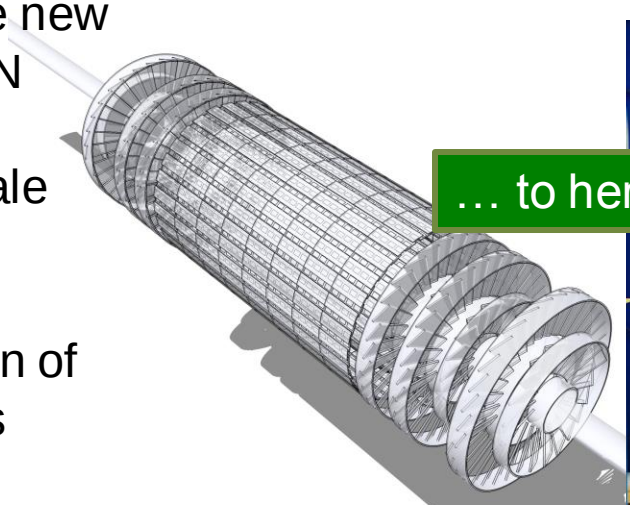
At the end of 2016 the CMS Pixel detector will be replaced and upgraded. The DAQ system will be replaced entirely. The backend electronics are switched to the new CMS wide standard “microTCA”.

Your task

- Systematical test of all new components in the optical readout chain
- Measurements and qualification of optical transceivers and optical fibres
- Test stand operation and development
- Acceptance tests after parts of the new CMS Pixel detector arrive at CERN

What we offer

- Working with a high end, large scale DAQ system made from modular electronic components
- Insight into testing and qualification of optical and electronic components



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Aperture optimization studies for the

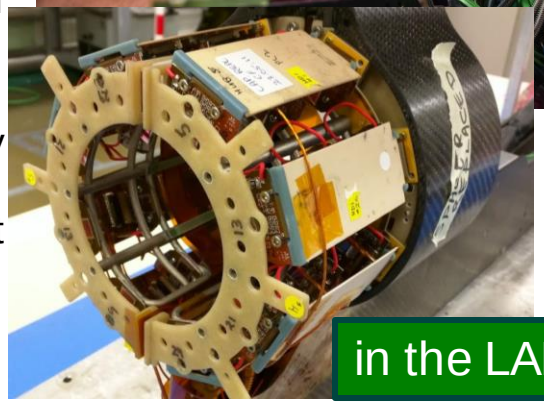
Pixel Luminosity Telescope

under 2016's increased luminosity conditions in CMS

The Pixel Luminosity Telescope (PLT)

16 small angle beam telescopes detect and track the path of collision products from the interaction point to measure the Luminosity provided to CMS.

in CMS



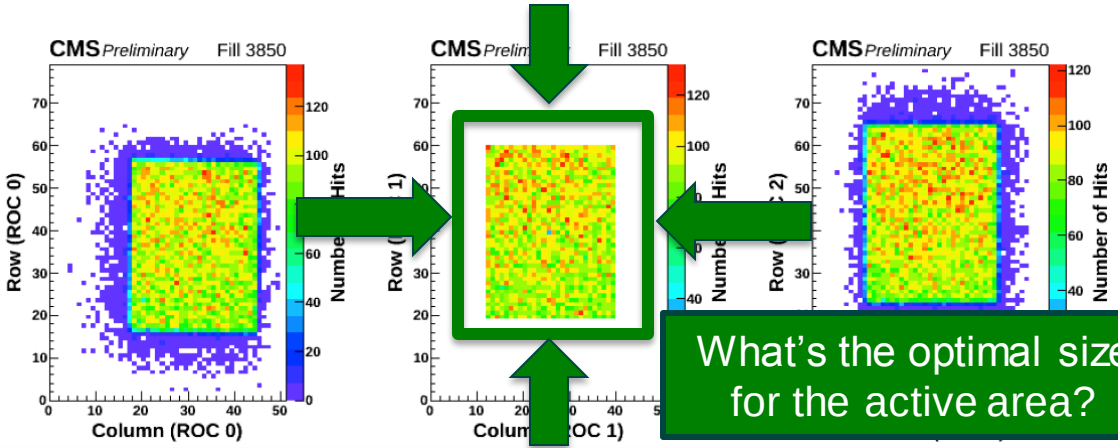
in the LAB

Your Task

- Optimize the active detector acceptance for precision Luminosity measurement in 2016
  - Data Analysis of PLT data taken during 2015
  - Simulation of the expected increase in Luminosity in 2016 by factor 2 by combining data sets from 2015
  - Optimize the active area for precision luminosity measurement before first LHC stable beams (until end of April)
  - Data analysis of linearity and calibration of PLT luminosity measurement using final aperture (until June)

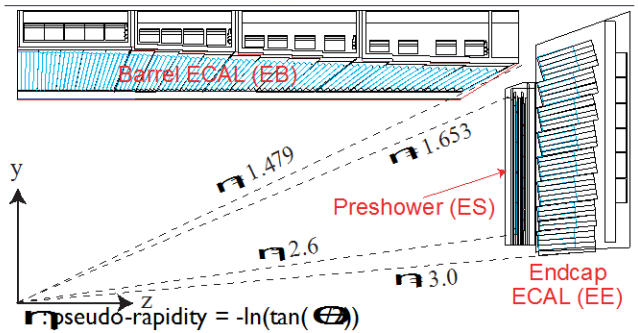
What we offer

- Experience with a small scale pixel tracking detector
- Small, but active working group
- Supervised work on an important and imminent task
- Visibility within the project

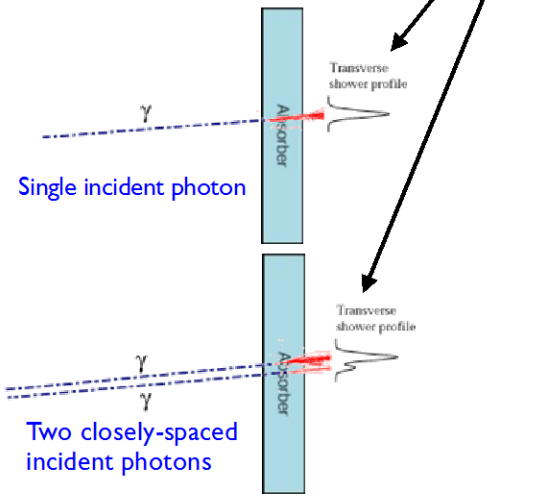


Optimizing the preshower (ES) measurement of position and energy

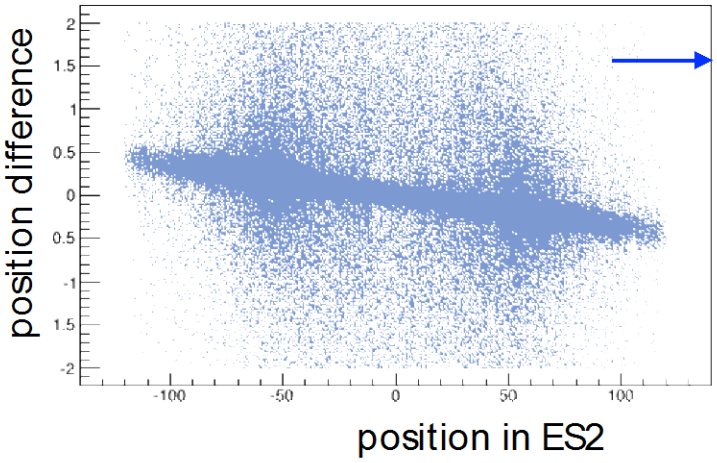
- ES is a pre-sampling detector of CMS Endcap Calorimeter
  - (2X0) Pb layer + Si strips in X ("ES1") +
    (1X0) Pb layer + Si strips in Y ("ES2")
  - Strip dimensions: 1.9 x 61 mm (EE crystals: 28.6 x 28.6 mm)
  - 68k channels per endcap



- Provides energy and position measurement:
  - important for particle ID (e/γ/π0 rejection)
  - requirement: energy resolution ≤ 5%, position resolution < 1mm for 60 GeV e/γ



current indication of problem in the position measurement



difference between measured position in ES2 and the prediction from EE extrapolation
=> impact on particle ID, alignment
=> needs investigation and tuning

- GOALS:
  - Optimize the energy measured in each ES plane, with ad hoc calibration in case of non working regions => important for global energy estimate in the endcap calorimeter (EE+ES)
  - Investigate and optimize the position measurement => important for particle ID, alignment
  - Results will be exploited in current data taking

Timing optimization of the **CMS** Beam Halo Monitor

BHM: A fast Cherenkov detector that measures background induced in CMS by particles straying off the LHC beam.
This detector is extremely sensitive to the precise timing of its signals.

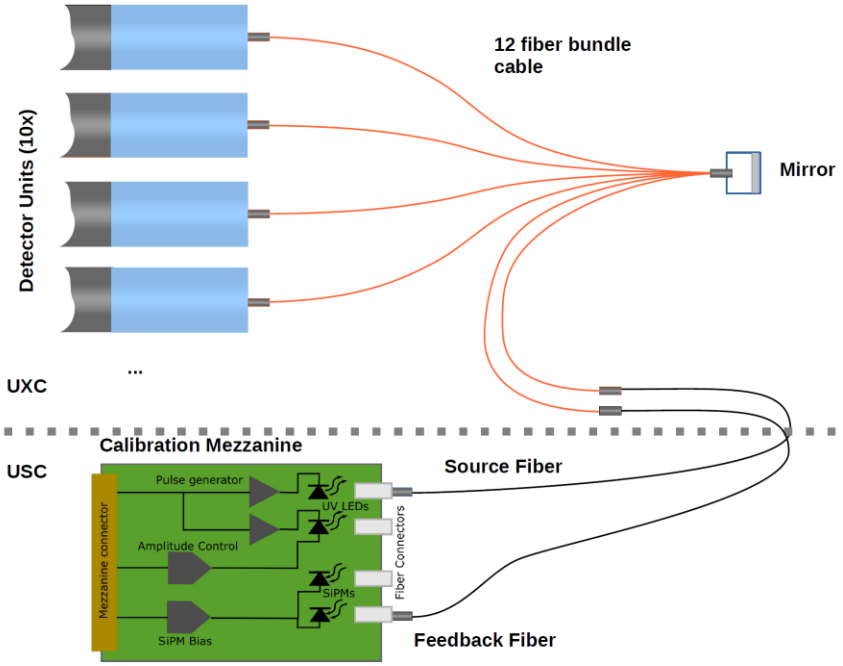
The task: To test, install and use an optical calibration system, which will allow to measure and optimize the timing of BHM signals.

In practice:

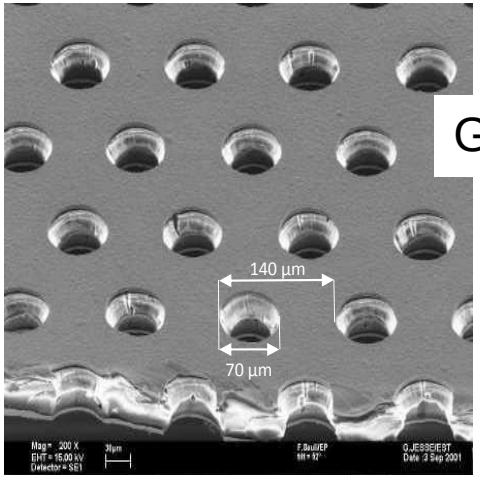
- Lab tests of a new electronic board
- Installation in the CMS service cavern
- Commissioning of the system in time for the upcoming LHC restart
- Measurement and optimization of time delays through the BHM detector

You will be working with:

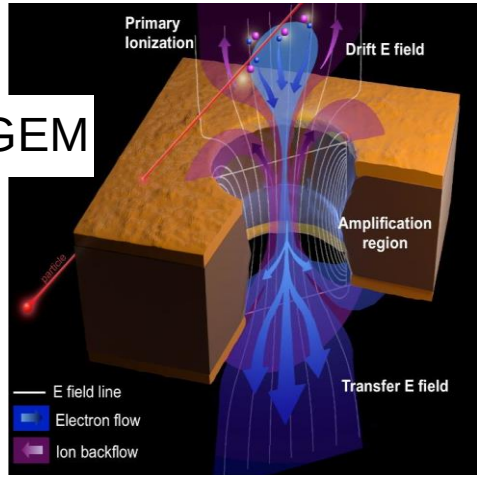
- Custom electronics and software
- Optical fibres carrying UV light
- Both Vacuum and Silicon PhotoMultipliers
- A very small and young team
- A full-time supervisor

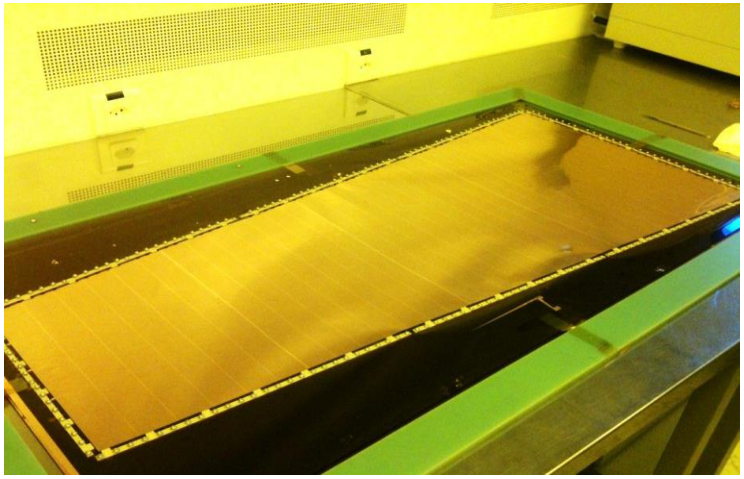


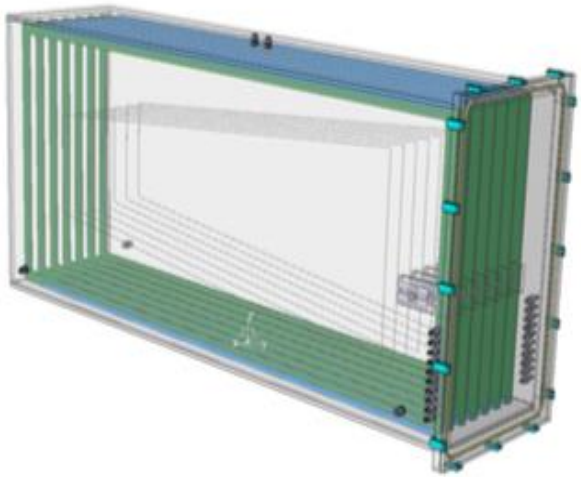
GE1/1 foils HV test



GEM







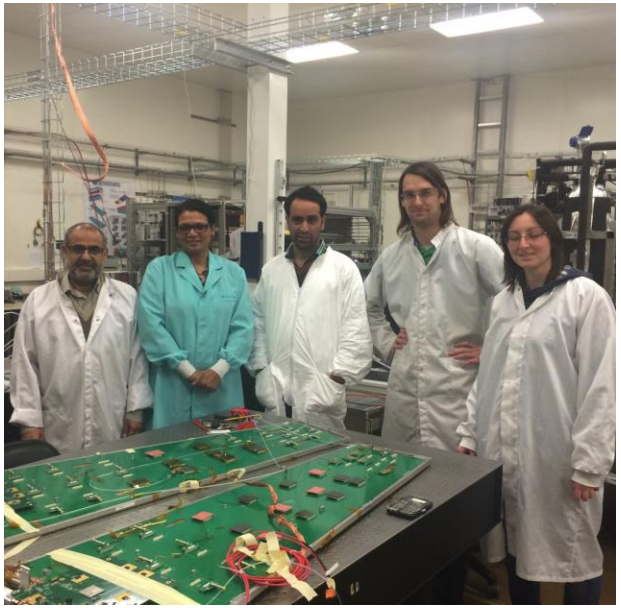
- The student will join the CERN GEM group, he/she will have the unique opportunity to take part in the design/realization/running of qualification test of the main components of the GE1/1 detector components.

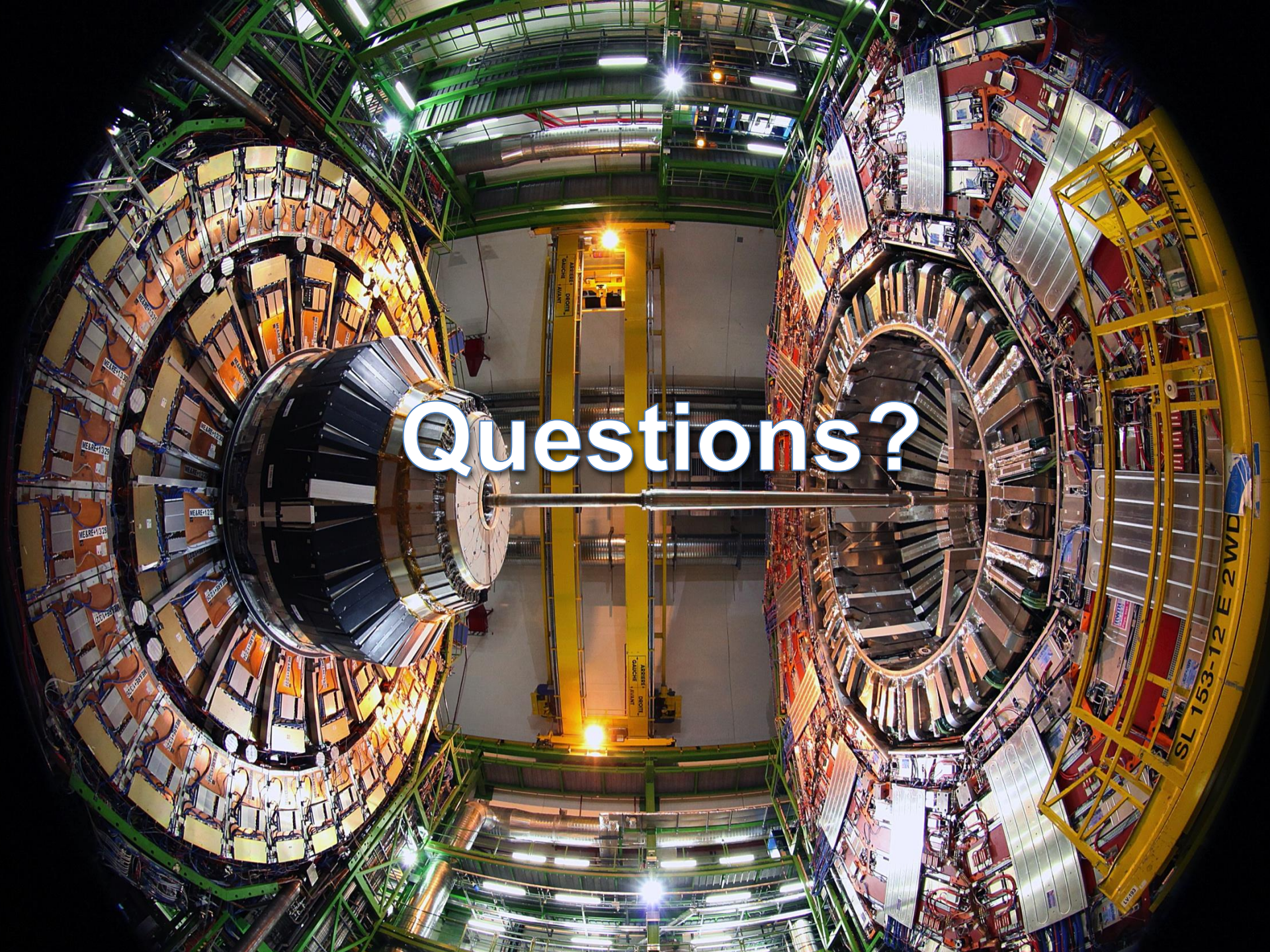
- A leak current test need to be performed on each GEM foils, the student will take care of design and realization of the HV monitor system as well as the the execution of the test and the data analysis, under the supervision of CERN group.

- Tests will be carried out in a Clean Room.

- Interest in hardware and software development are required but no particular experience in HEP

- **We are waiting for you!!!**




Questions?