Measuring the time evolution of the response of the ATLAS Tile Calorimeter

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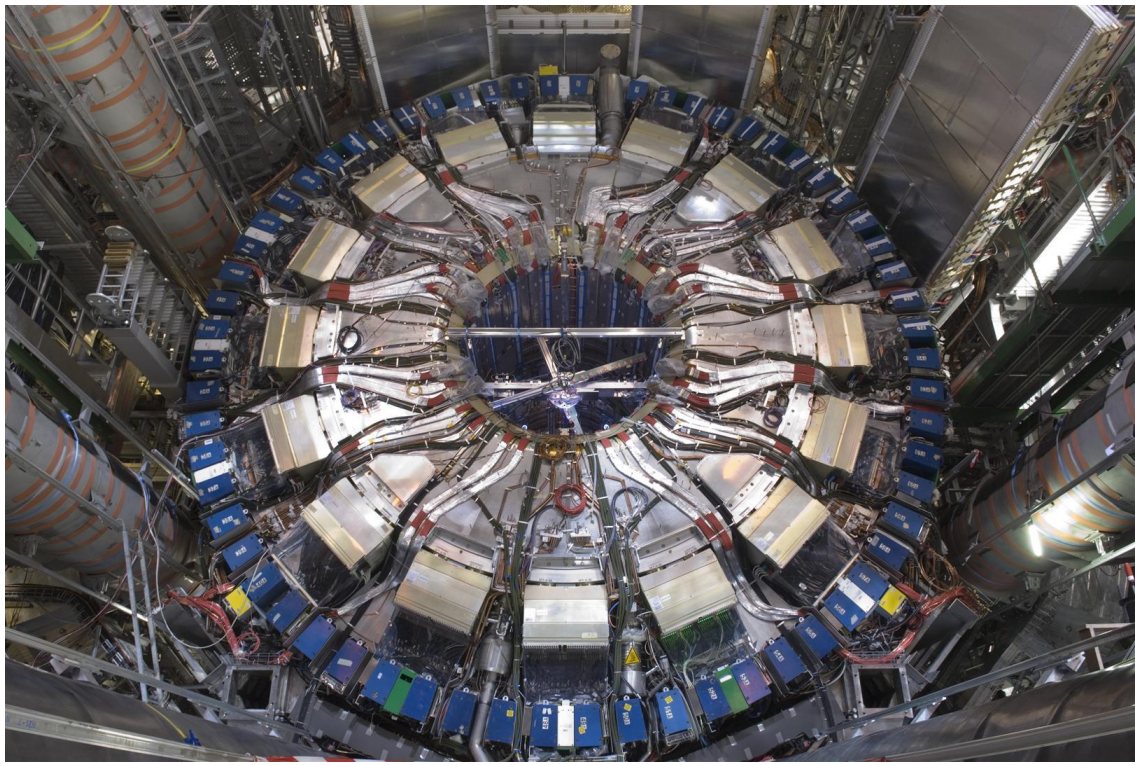
1. The ATLAS detector in short

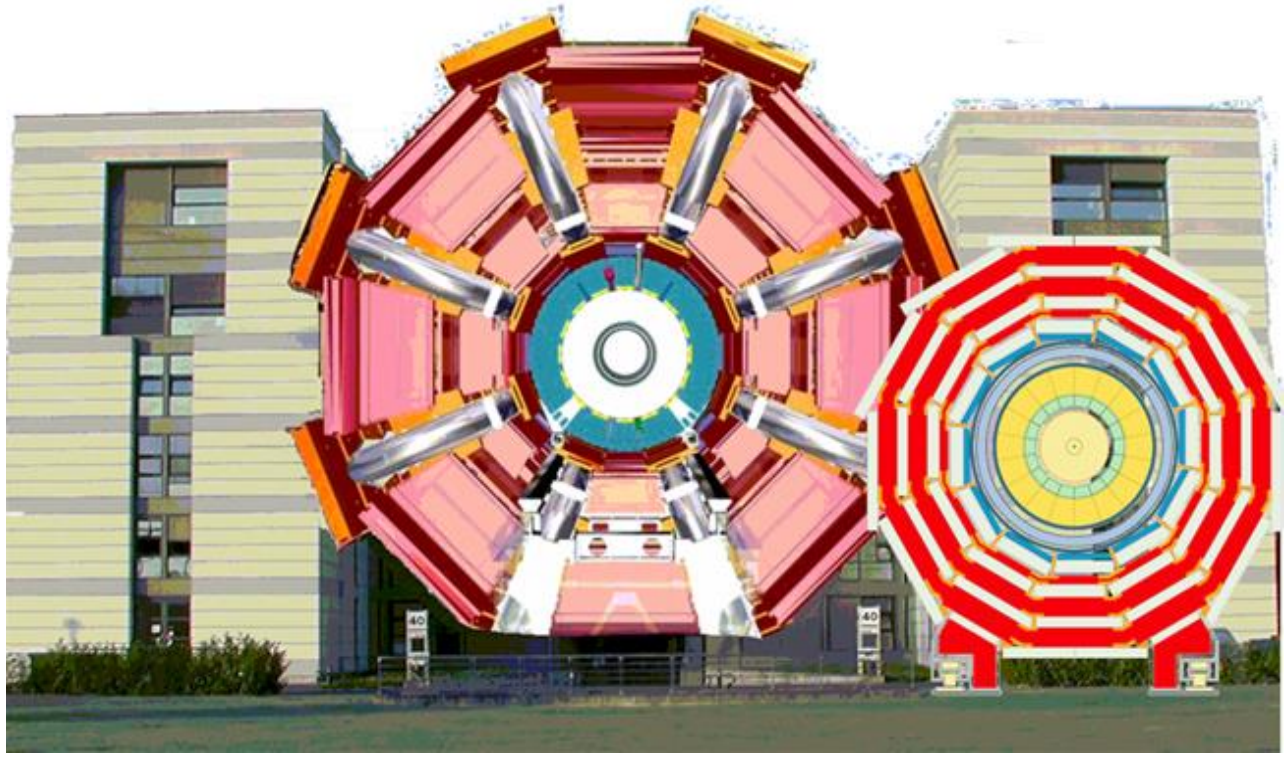
Aim: detect and measure particles created at LHC

46 m long
25 m of diameter

100 m below ground

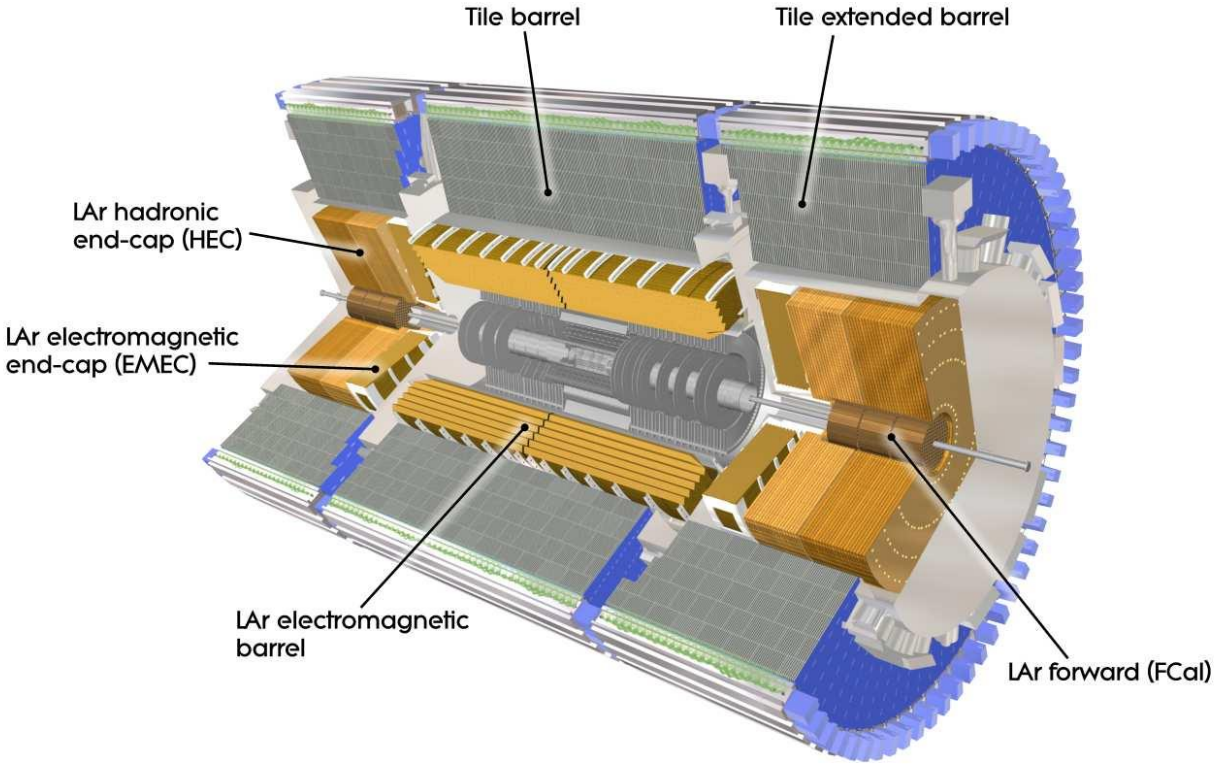
7000 tonnes

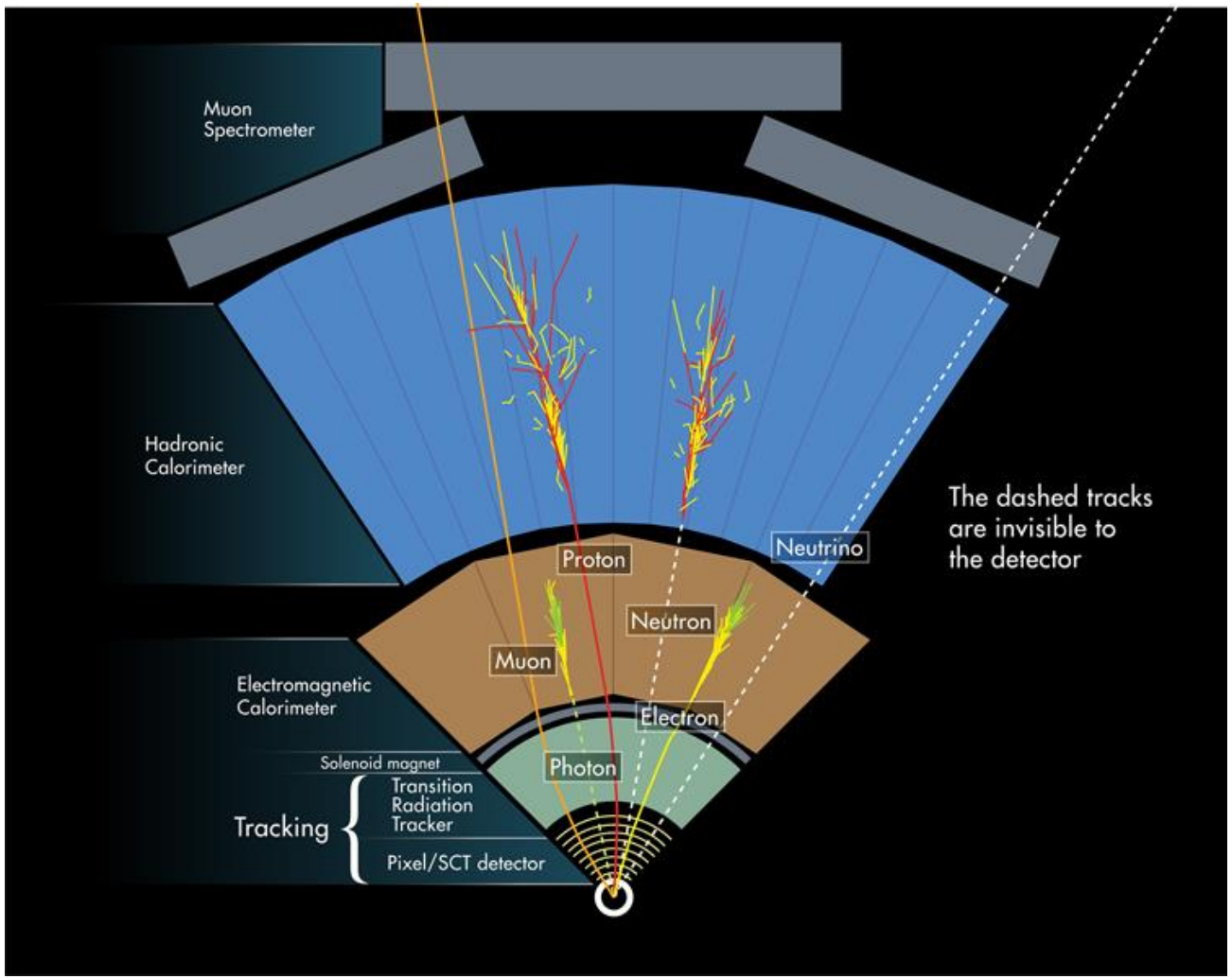




2. Components

- The detector itself is a many-layered instrument designed to detect some of the tiniest yet most energetic particles ever created on earth.





3. The Hadronic Calorimeter

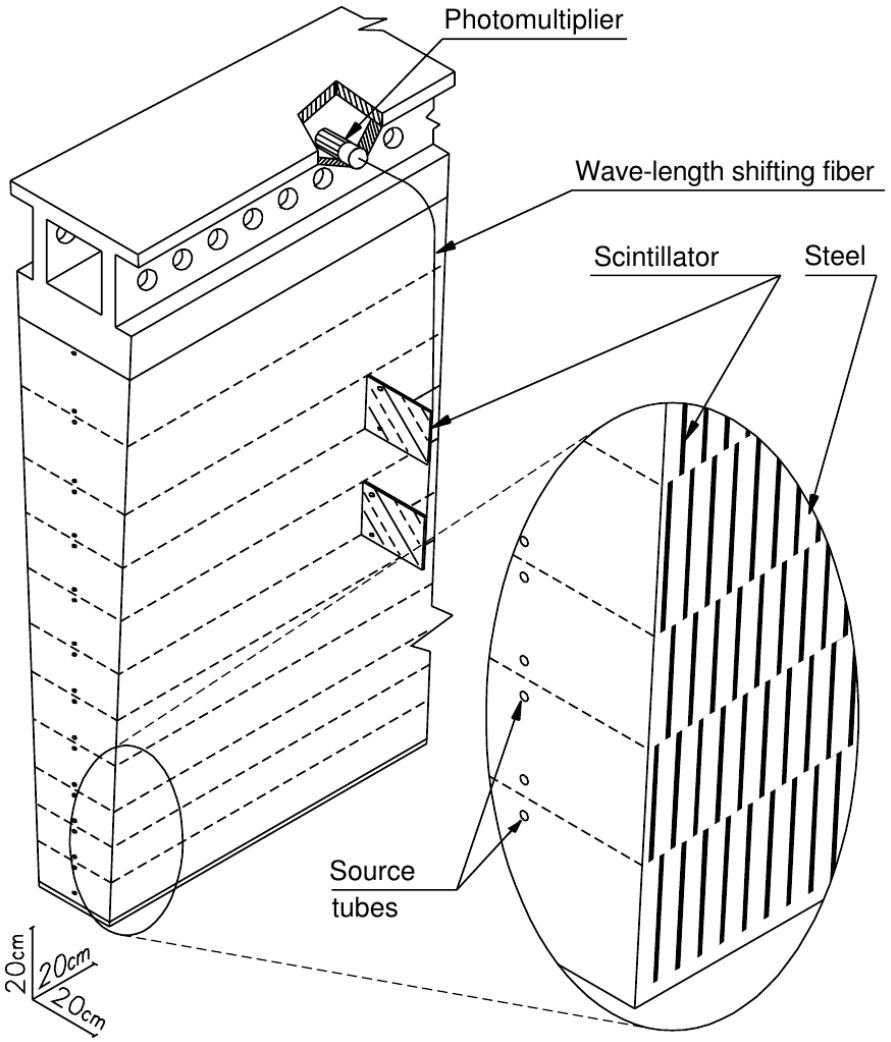
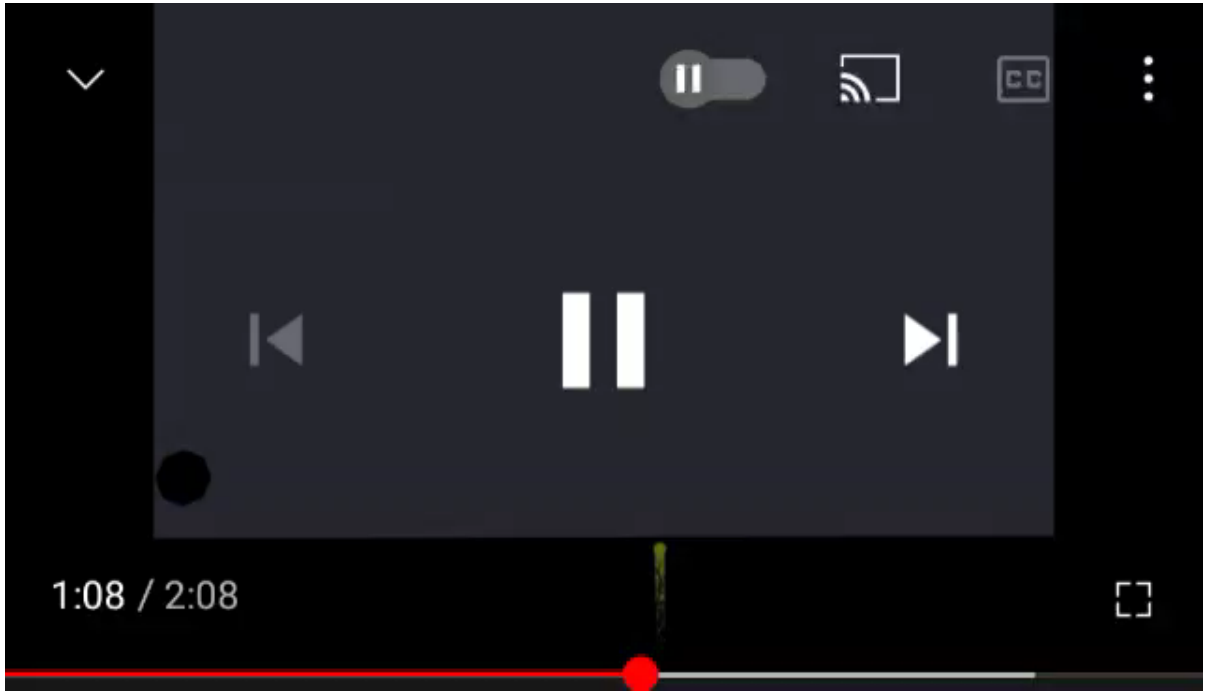


Illustration of a single Tile Calorimeter module

4. How does it work?

- As particles hit the layers of steel, they generate a **shower of new particles.**
- A **scintillator** is a material that produces UV light when exposed to a charged particle.
- The **photons** emitted are collected at the edges of each tile and picked-up by optical fibres, which transport them to the **Photomultiplier Tubes (PMT).**

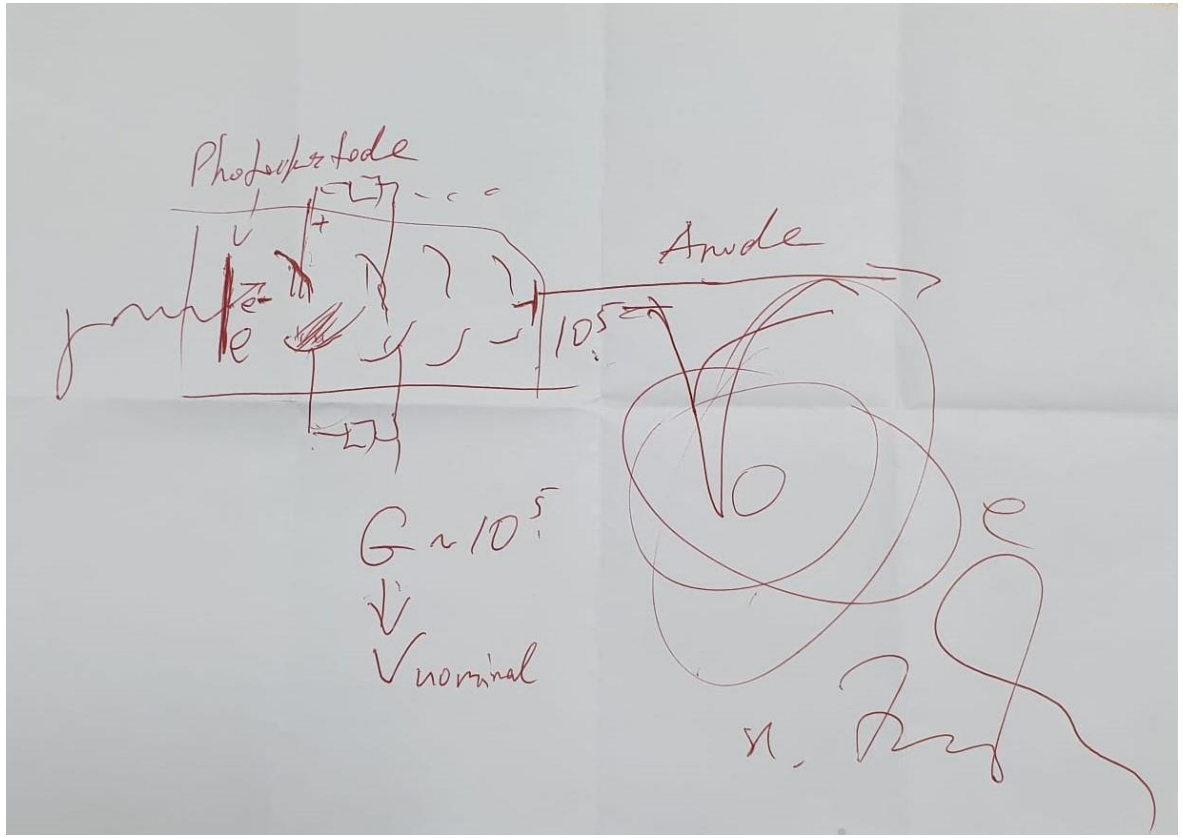
Optical fibre connected to PMTs in the lab



Inside a scintillating tile

5. What did we do?

- We focused on the PMTs, studying their functionality along certain periods of time.

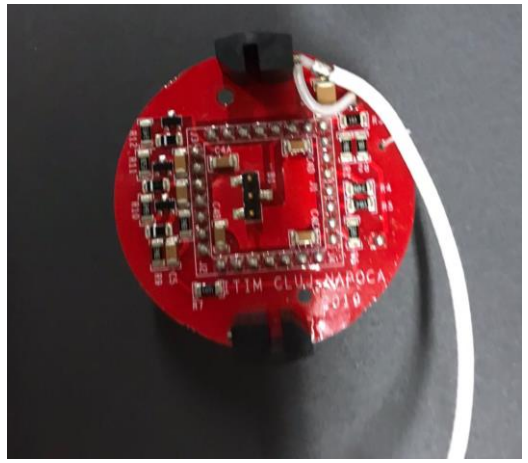


Irakli's drawing of the PMT

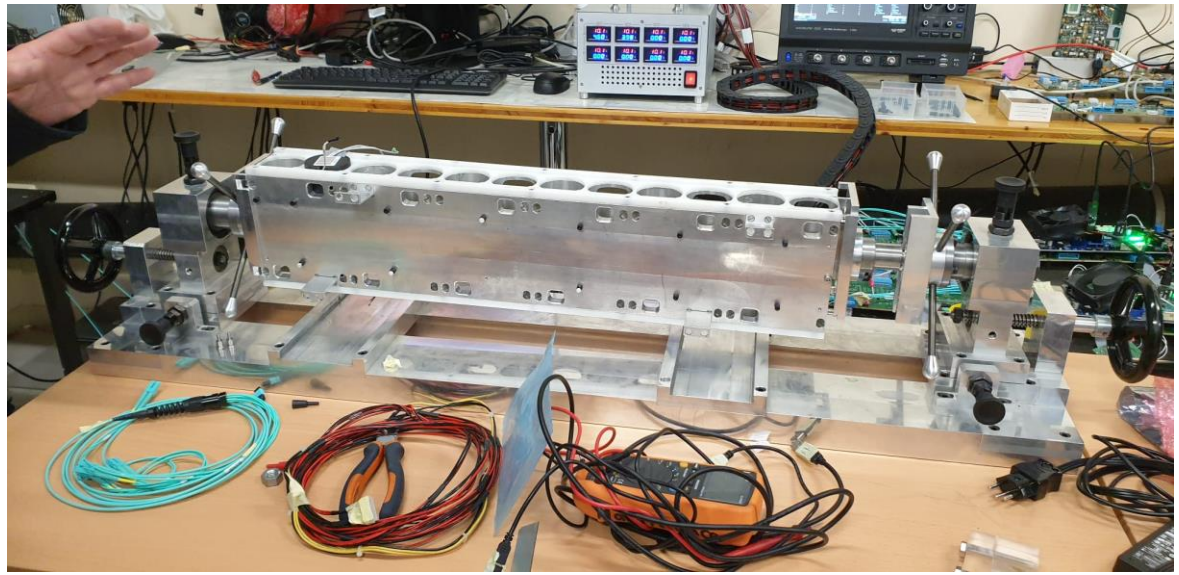
Us in the Tile Calorimeter lab, next to one of the 256 modules that make up the full Tile Calorimeter.

6. The lab

Us in the lab with Pawel and Irakli



Piece of equipment manufactured in Cluj-Napoca, Romania



7. How does the PMT work?

- A photomultiplier tube is a device that converts incident photons into an electrical signal, using the photoelectric effect.
- The **intensity of the electric current** is proportional to the original particle's energy.

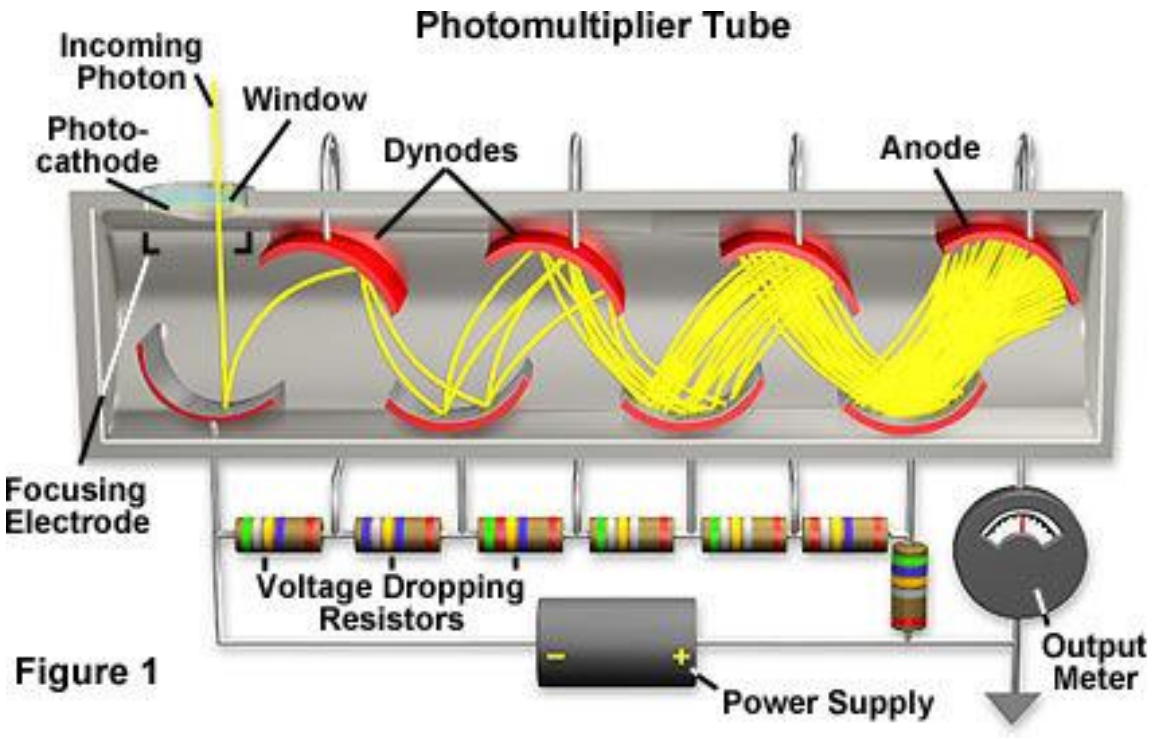


Figure 1

Most Tile Calorimeter cells are read out by two PMTs, corresponding to two electronic read-out channels.

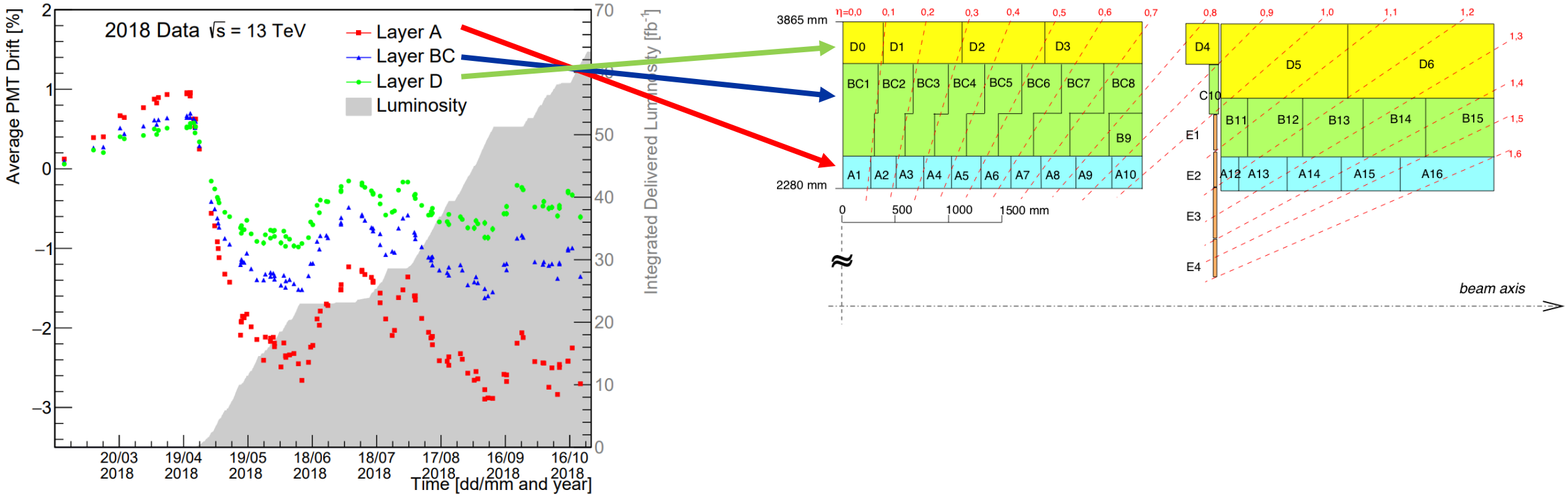
9856 PMTs

5182 cells

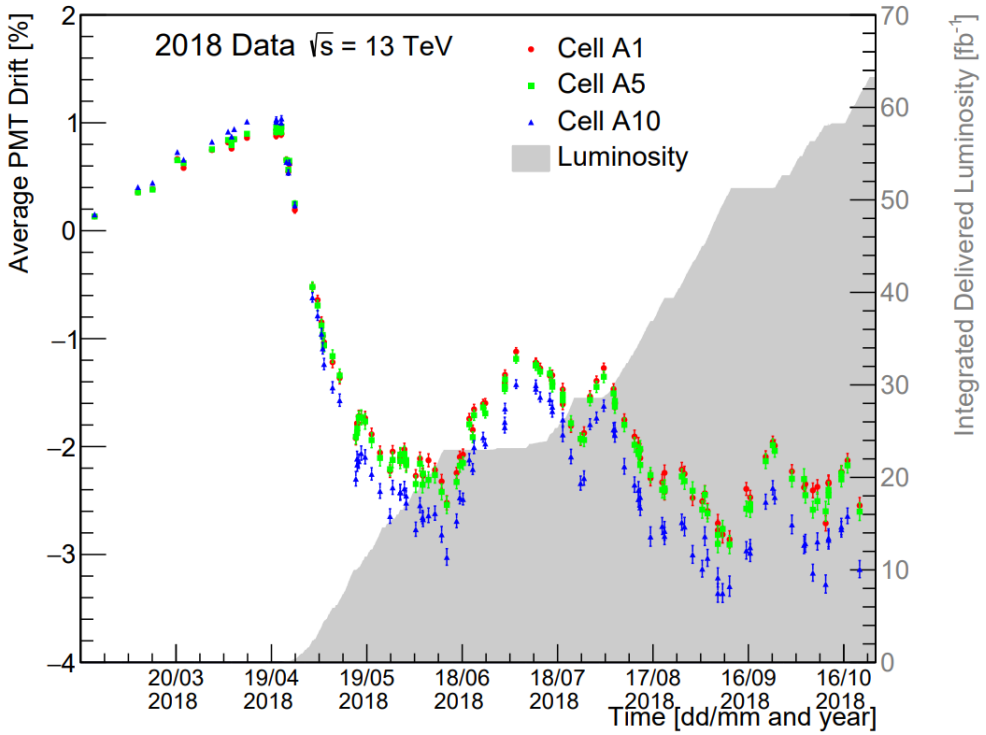
8. Our main focus: calibration of the PMT

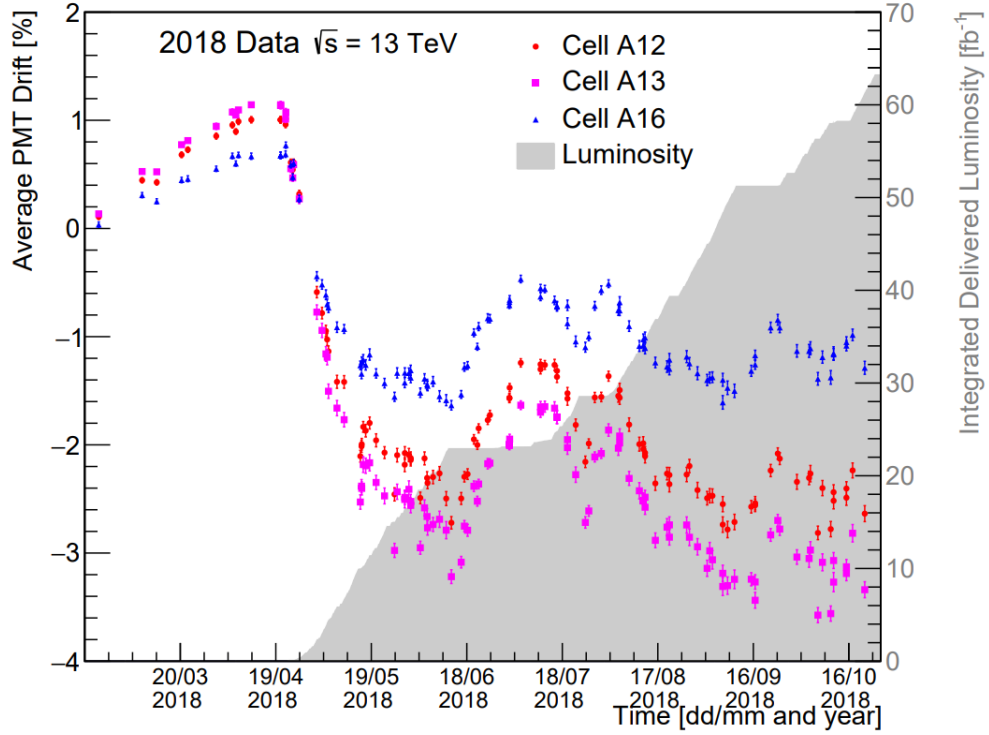
- Regular laser calibration is required because of variations in PMT high-voltage and stress induced on the PMTs by high light flux.

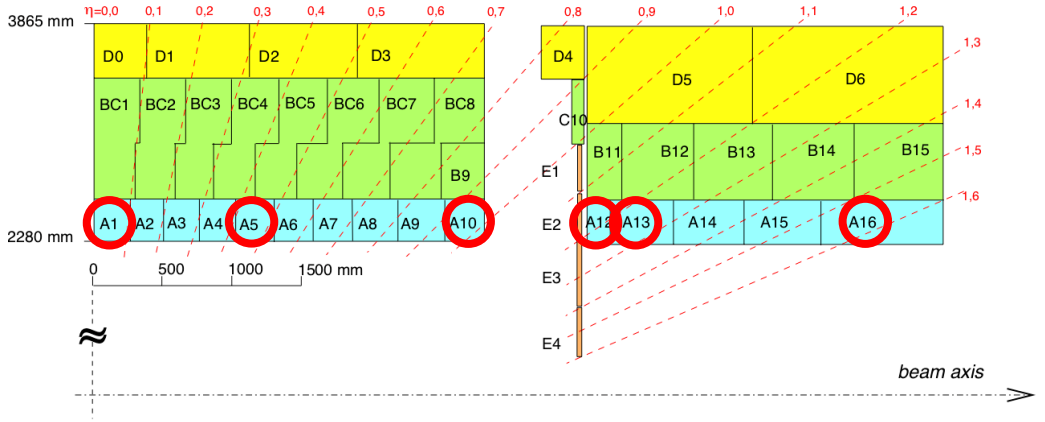
- For this project, we have studied the evolution of the cell response during the Run-2 of the LHC, and we have learned how the true value of the energy of a particle is calculated using the data gathered.



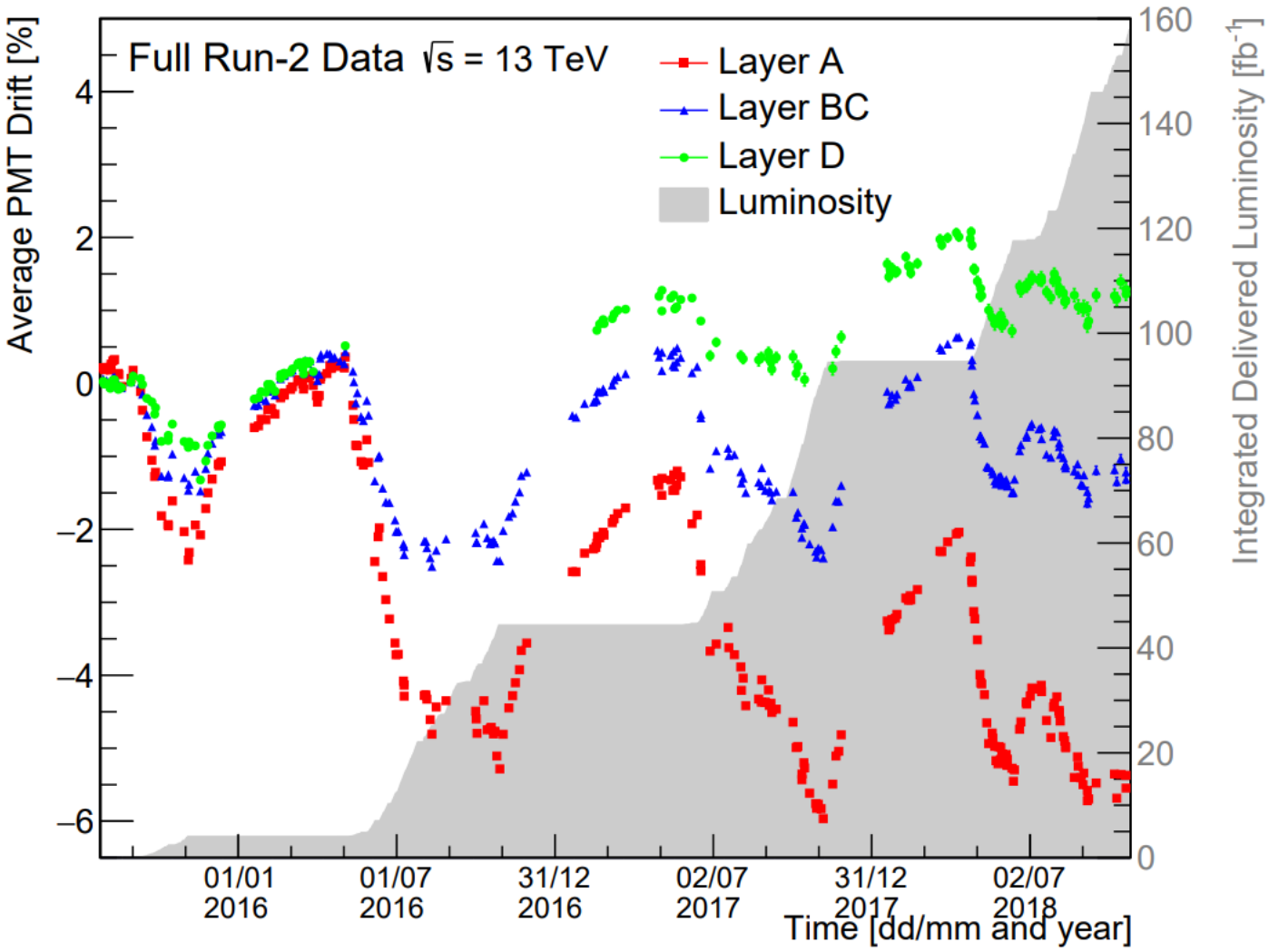
9. PMT response in 2018

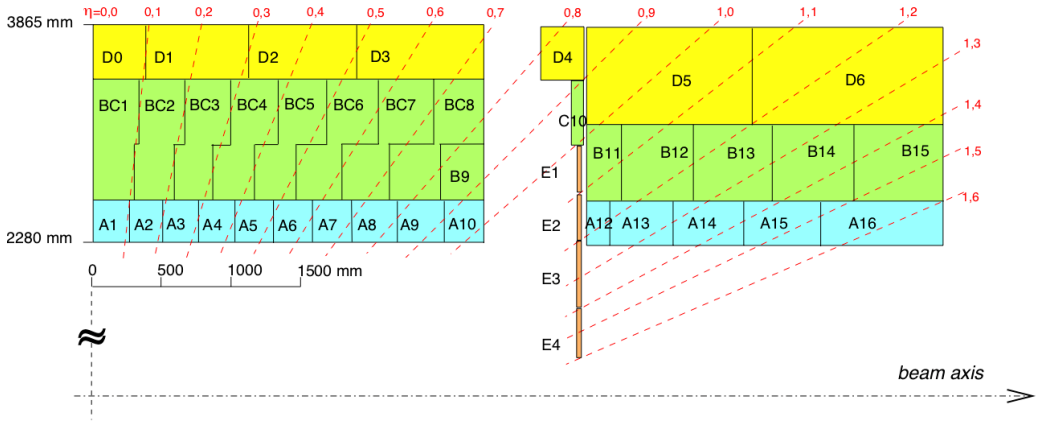






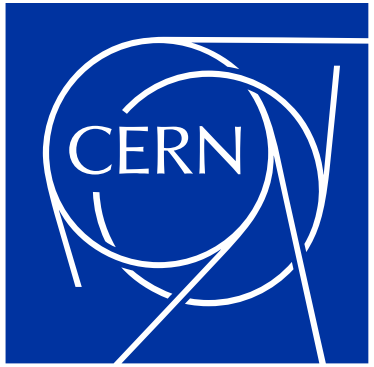
10. PMT response in full Run-2





11. Acknowledgements

We would like to thank our supervisor, Pawel Klimek, for everything he has taught us during the programme, Irakli and all the people in the lab for welcoming us there, and the HSSIP-RO team for giving us the unique opportunity of discovering CERN for two weeks.



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