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HGCAL test beam analysis using Jupyter notebooks

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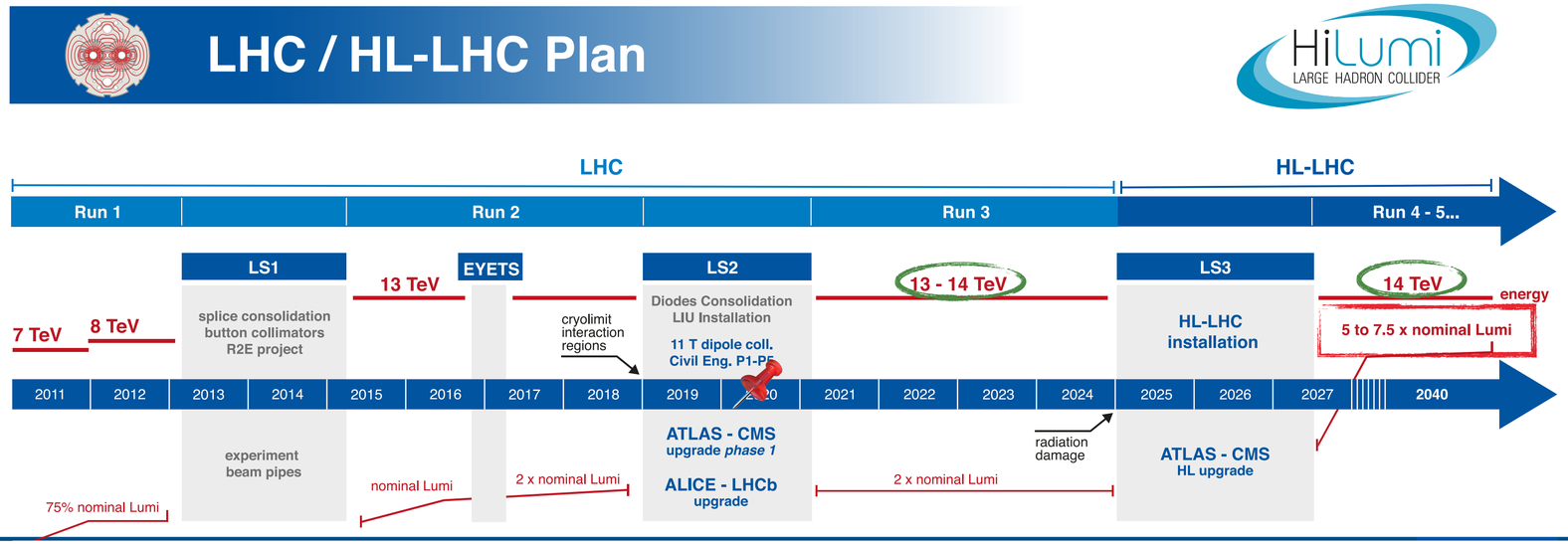
HGCAL in a nutshell

- In **2027** CERN is intended to start the **High-Luminosity LHC** program: **3-5** (10) **times** the **current instantaneous** (integrated) **luminosity**!
  🆙 **High pile up rate**: O(140/200) events per bunch crossing;
  ☢️ **Unprecedented radiation levels**: doses up to 2 MGy;

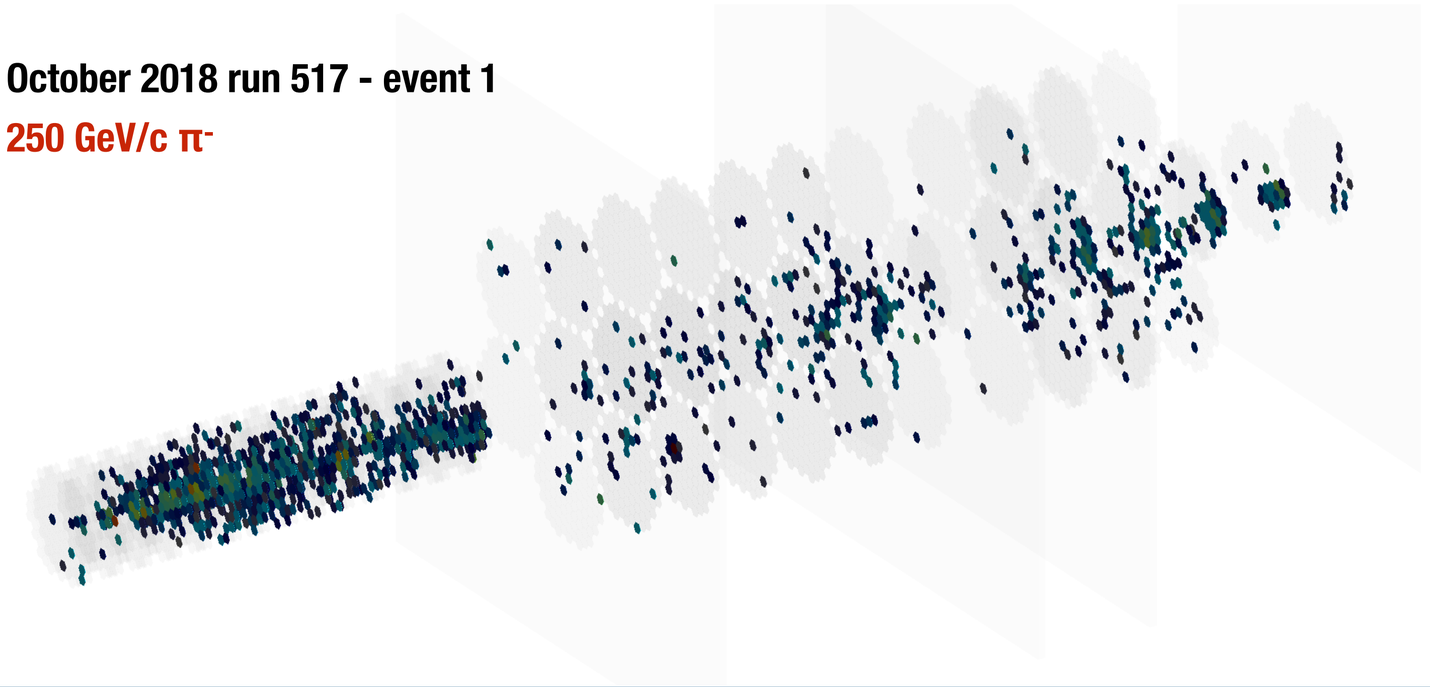
- High Granularity Calorimeter (**HGCAL**): **replacement of CMS endcap calorimeters** for HL-LHC;

- **Beam tests** are fundamental **to validate** the **detector design** and **to study** the **physics performance**



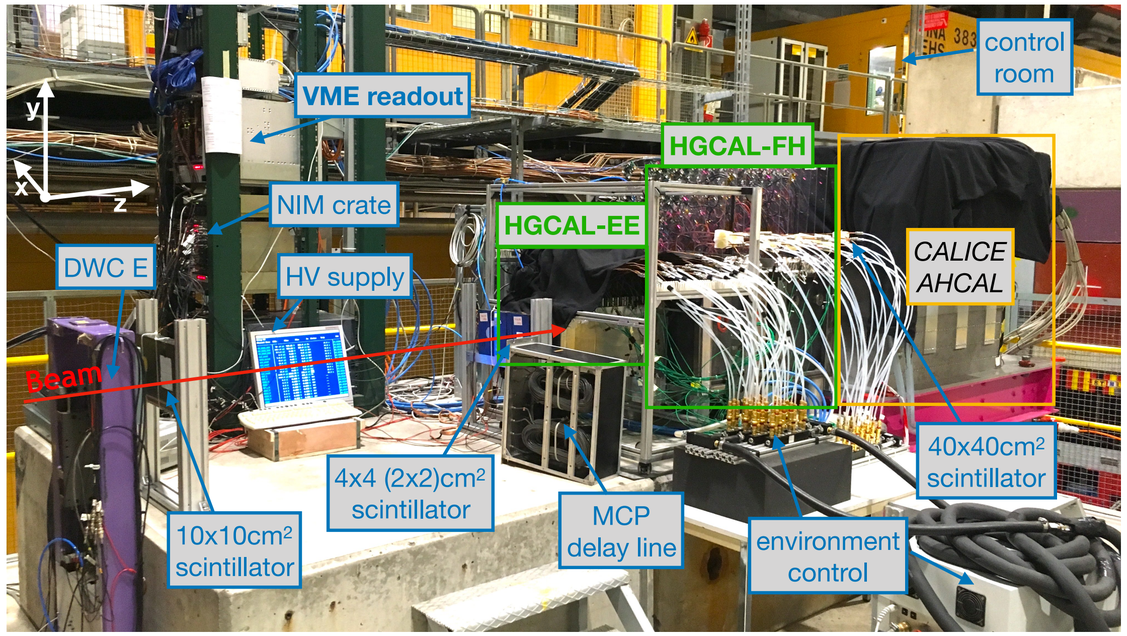
HGCAL test beams

- October 2018: **first large scale beam test of HGCAL prototype**;
- Data with e^+ and π^- over a wide energy range (20-300 GeV), for a **total of O(10⁶) events**;
- **In a test beam** we can profit from a "clean environment" w.r.t. final physics scenario, but still **many challenges** …



Typical challenges of a test beam

- Many variables to keep under control during data acquisition: **online** data quality monitoring (**DQM**);
- Fast access to (remote) data: **several plots to be produced** and compared to **validate** the **reconstruction workflow** and to **check** the main **physics observables** for the analysis;
- Offline analysis: exploit test beam knowledge to **develop preselection** and **cleaning cuts**; run **data/simulation comparisons**; produce results by means of **statistical analysis**.



Jupyter notebooks in test beams

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More and more physicists are exploiting the flexibility of the **python environment** and the advantages of **Jupyter notebooks to tackle these tasks**

A typical test beam notebook

Let's have a look at a typical use case of Jupyter notebooks during a test beam campaign