OCTOBER TEST BEAM: SUMMARY

Artur Lobanov for the TB team

HGCAL System Tests Meeting | 24 October 2018

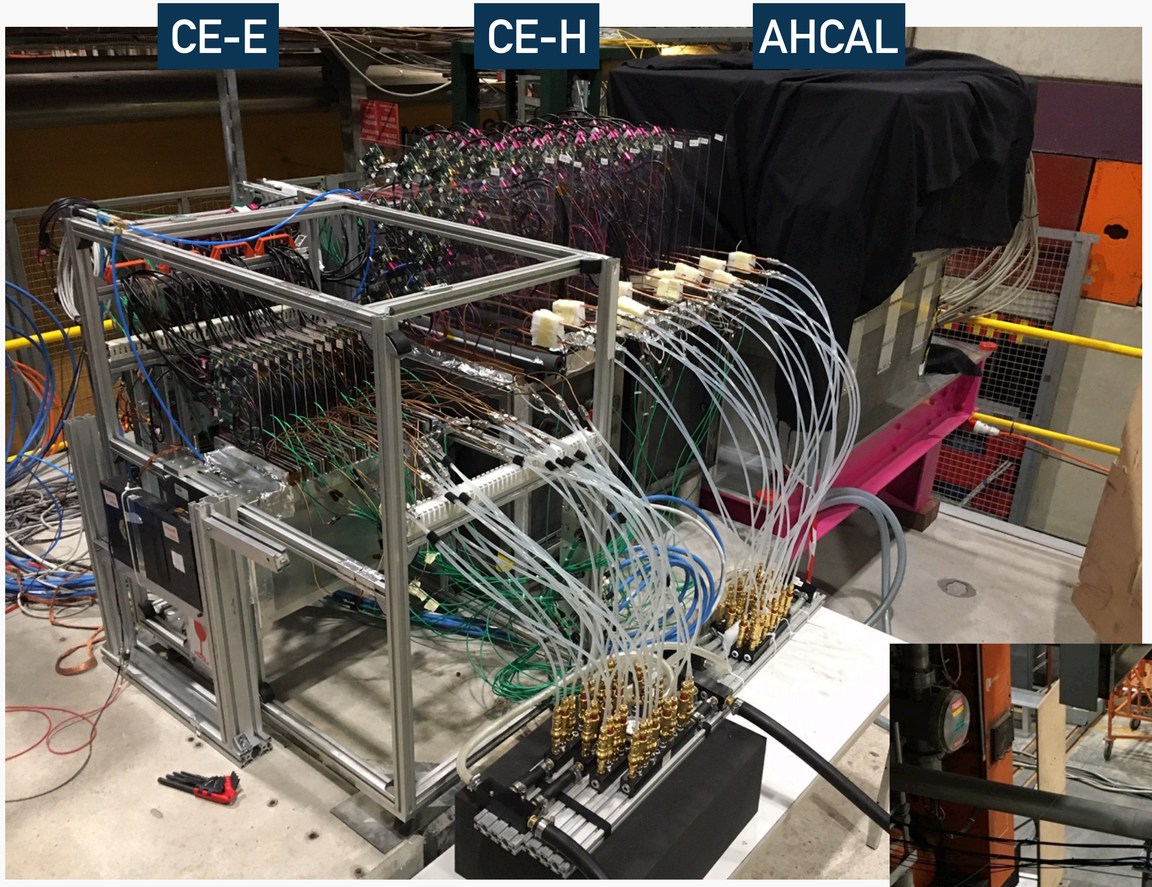
HGCAL TEST BEAM IN OCTOBER

- Previous HGCAL test beams:
  - 2016: up to **16** EE layers with SKIROC2 @ CERN/Fermilab (Paper accepted!)
  - 2017: ~**20** modules with SKIROC2cms in EE & FH + AHCAL @ CERN
  - 2018: full **28** layer EE @ CERN & single modules @ DESY
- October 2018
  - 2 weeks (10 - 24.10) at CERN H2 with mu/e/pi of 20-300 GeV
  - 94 modules in the EE + FH and 39 layer AHCAL (as BH/Scintillator CE-H)
  - Final major test beam before LS2 ...

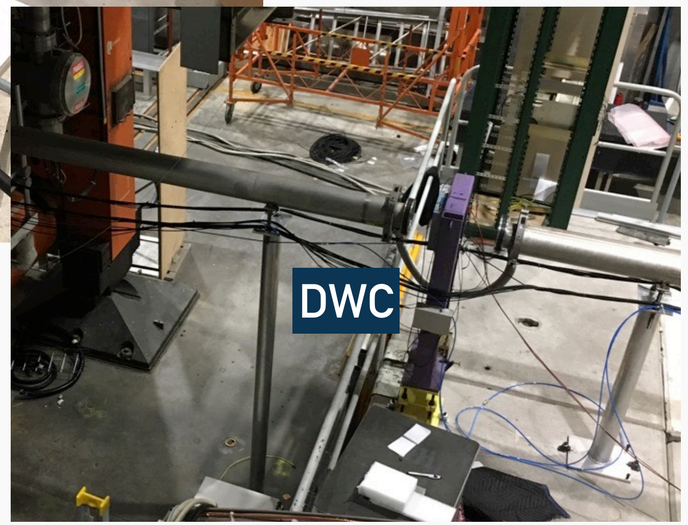
THE SETUP

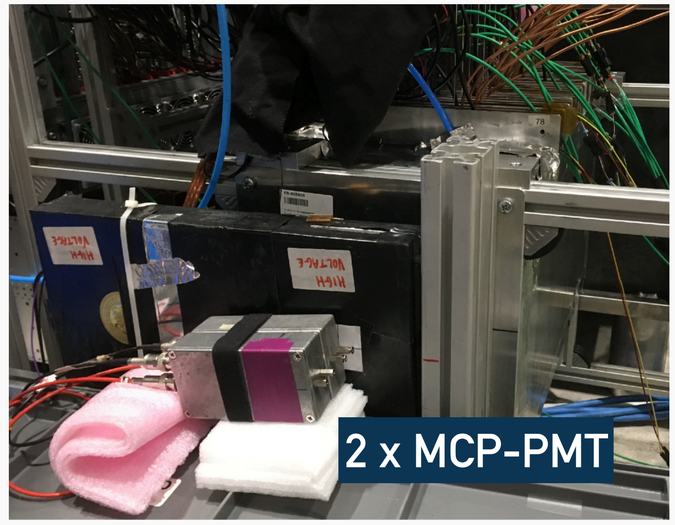
- CMS HGCAL + CALICE AHCAL common test beam at CERN 10-24 October 2018
- Setup placed on the concrete platform behind the M1 magnet in H2

THE DETECTORS



- HGCAL: silicon CE-E (ECAL) and CE-H (HCAL) with 94 modules, up to 40 layers
- AHCAL: SiPM-on-scintillator tile in 39 layers
- DWC: Delay wire chambers for tracking
- XCET: Cherenkov counters for π/p ID
- MCP-PMT: as timing reference (σ ~ 30ps)

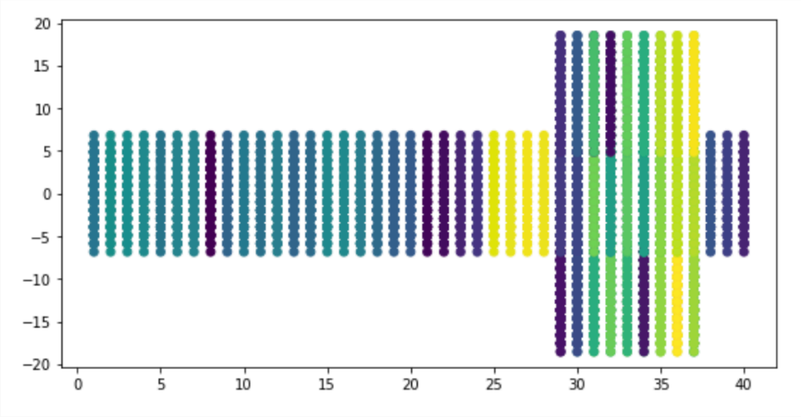




THE HGCAL CONFIGURATIONS

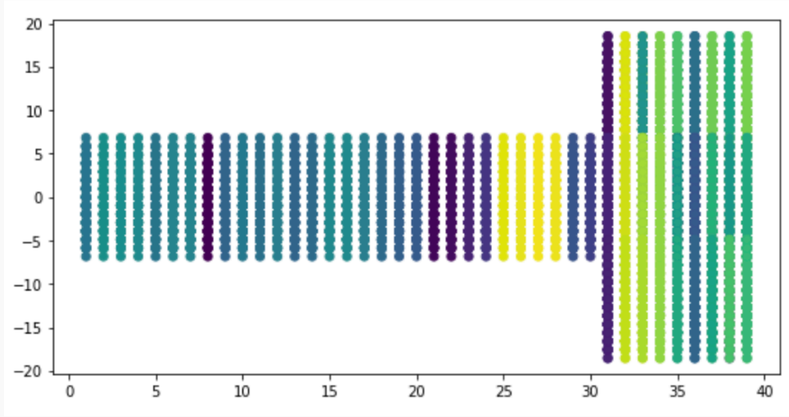
Configuration 1:

- EE: 28 layers x 1 module
- FH: 9 x 7 + 3 x 1
  - FH absorbers between all layers



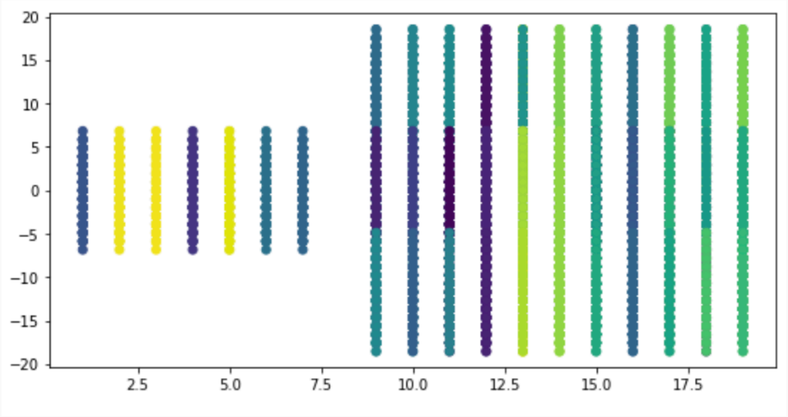
Configuration 2:

- EE: 28 layers x 1 module
- FH: 2 x 1 + 9 x 7
  - No FH absorbers between 2 x 1 layers



Configuration 3:

- EE: 8 layers x 1 module
- FH: 12 layers x 7 modules
  - FH absorbers between all layers

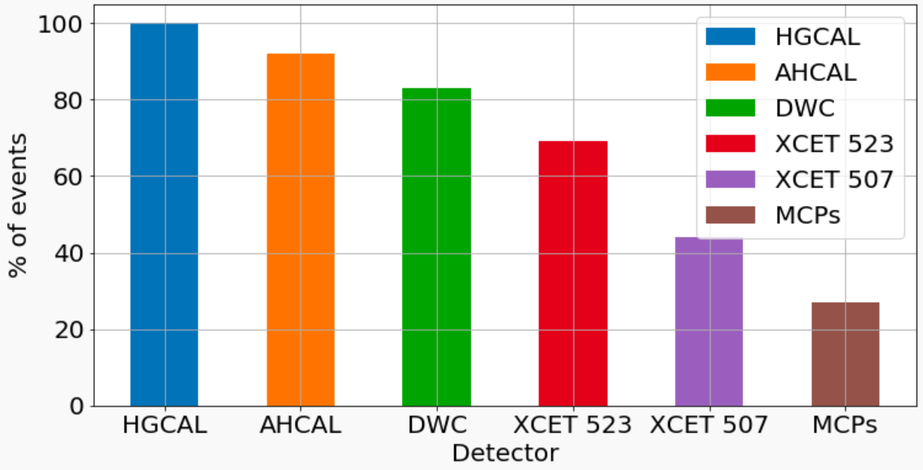


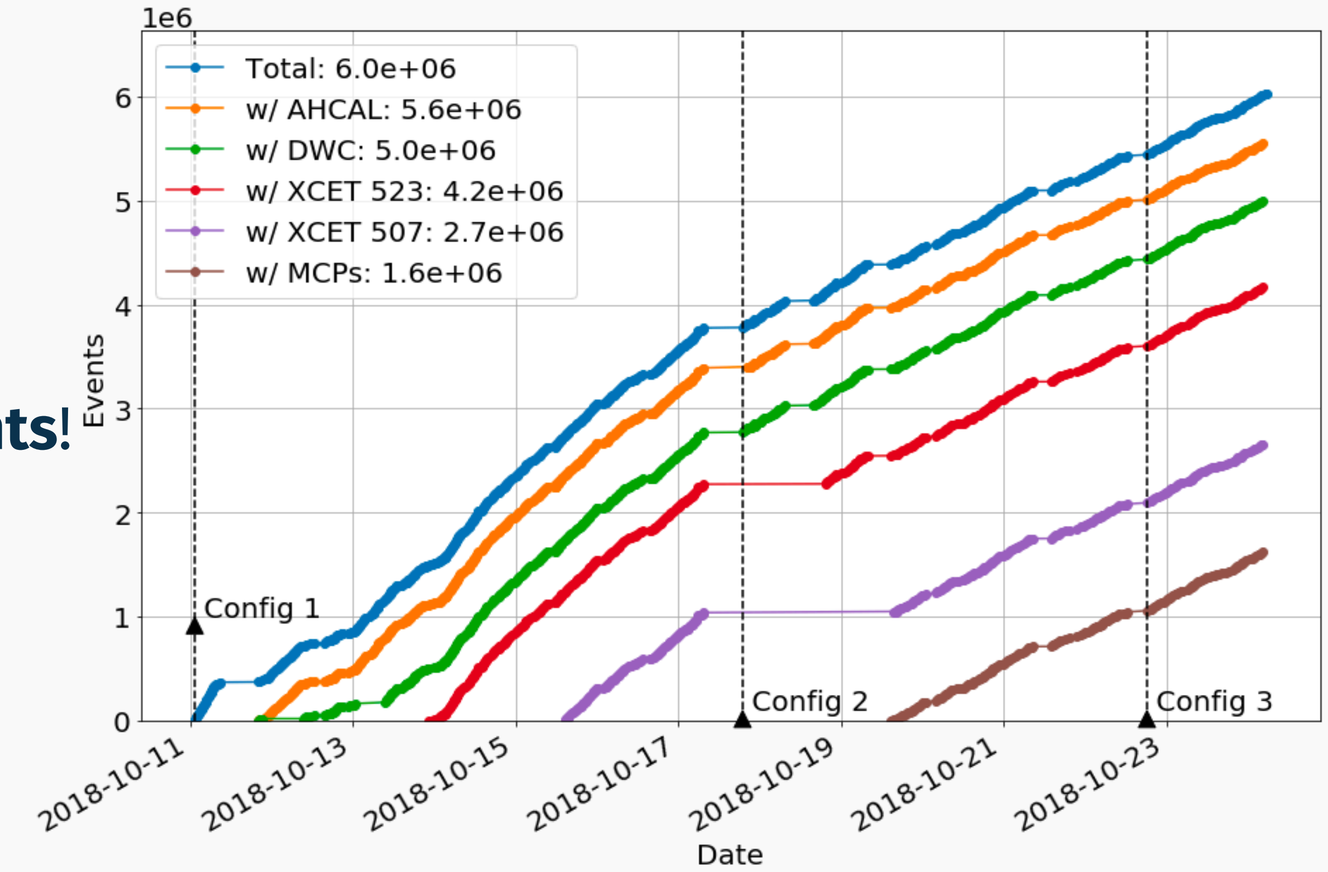
Focus on EM showers

Focus on hadronic showers

THE DATA

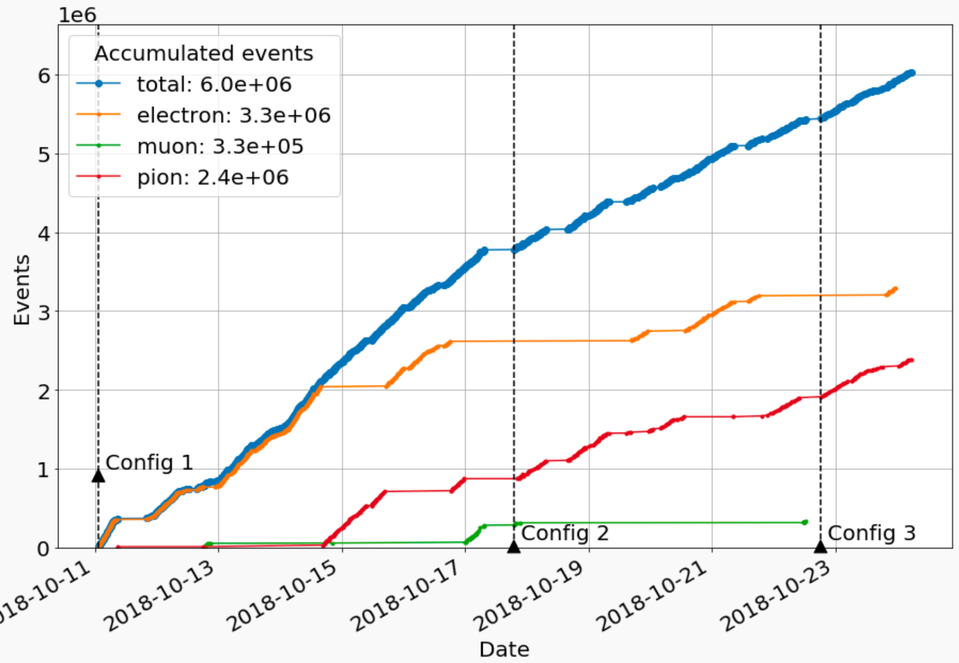
- Pretty ~smooth running over the two week test beam period
- Commissioned additional detector components during the first week
  - Good availability of AHCAL!
- Most down time due to SPS
- Accumulated more than **6 million events**!

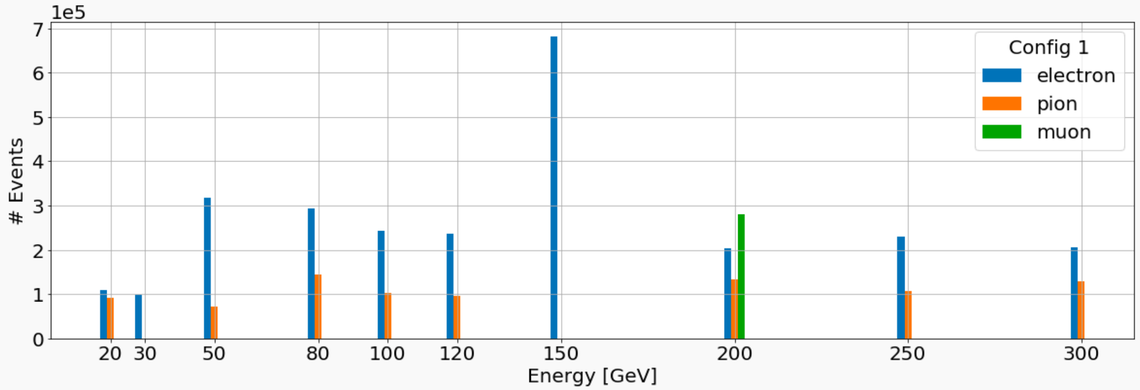


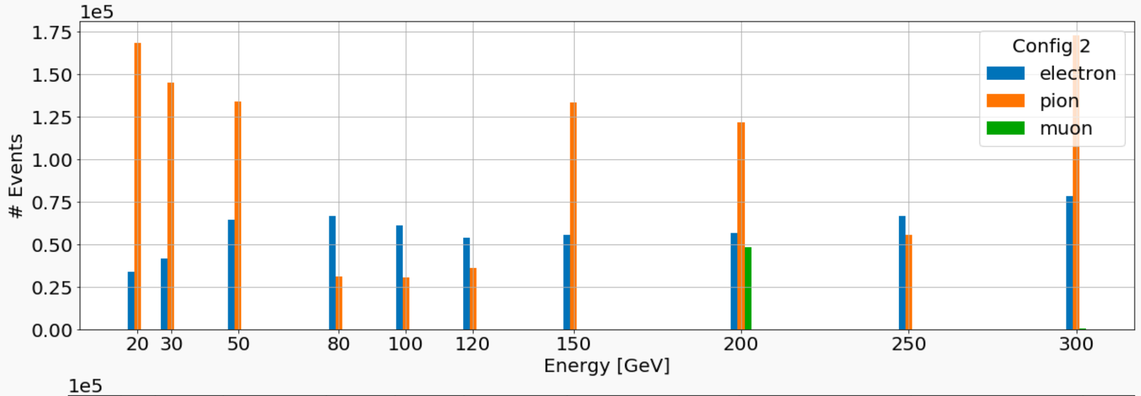


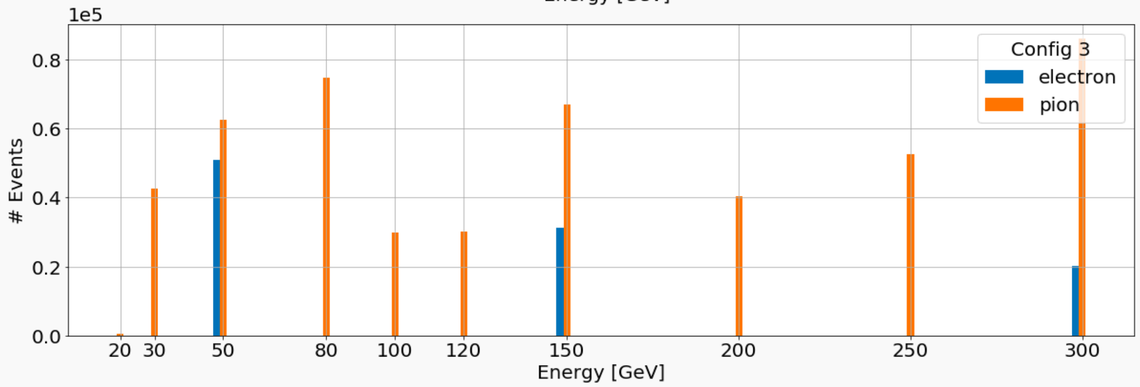
THE DATA

- Beams of electrons, pions and muons:
  - Wide range of energies for electrons and pions: from 20 till 300 GeV
  - Cleaner electrons than in June
  - Negative pion = only muon contamination



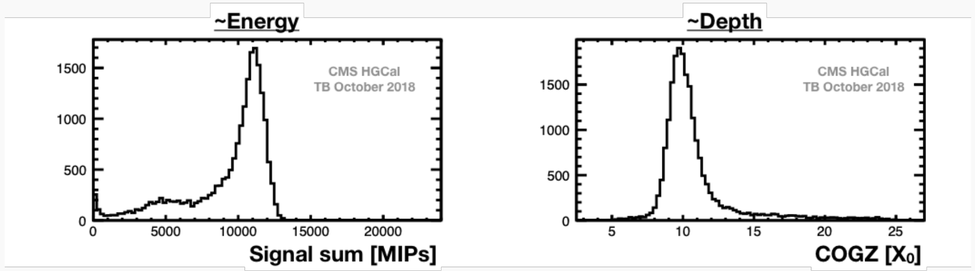






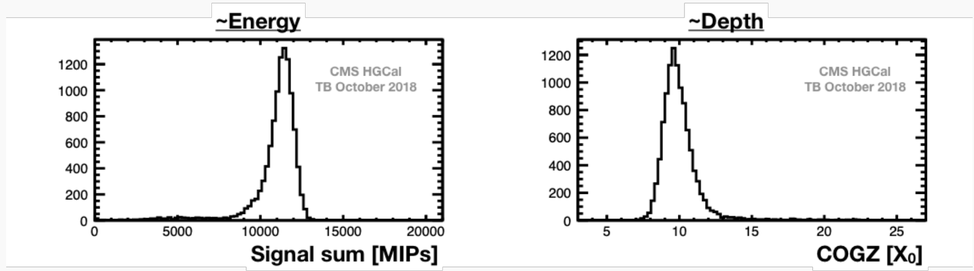
FIRST IMPRESSIONS

150 GeV electrons



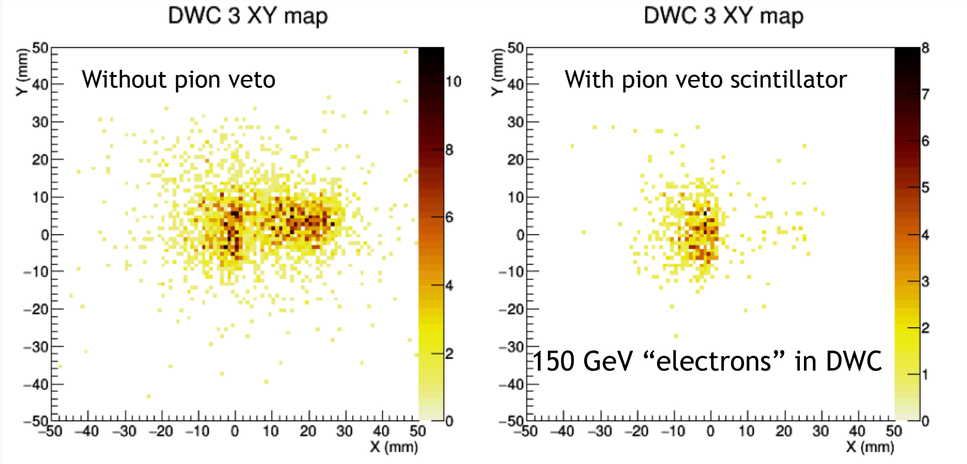
Second population due to the expected pion contamination in the beam

150 GeV electrons – with pion veto scintillator



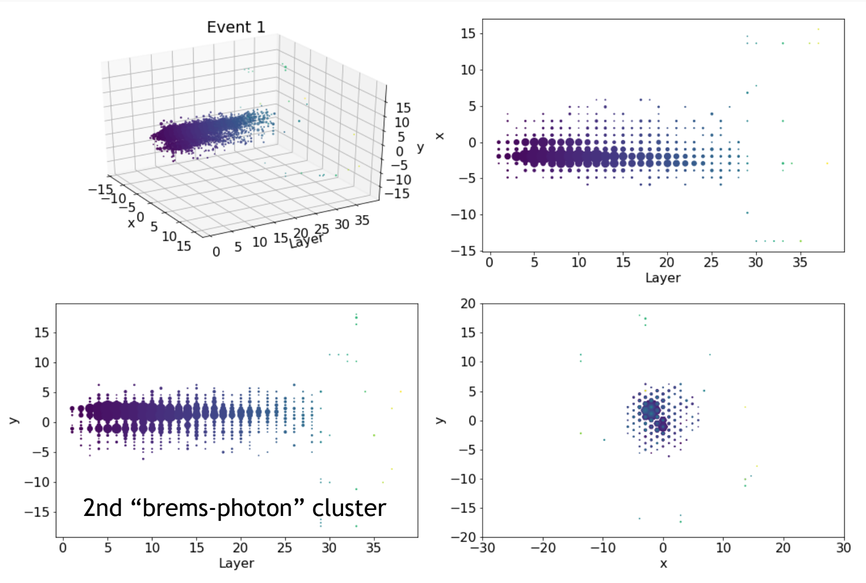
Second pion population disappears with veto after front hadronic part

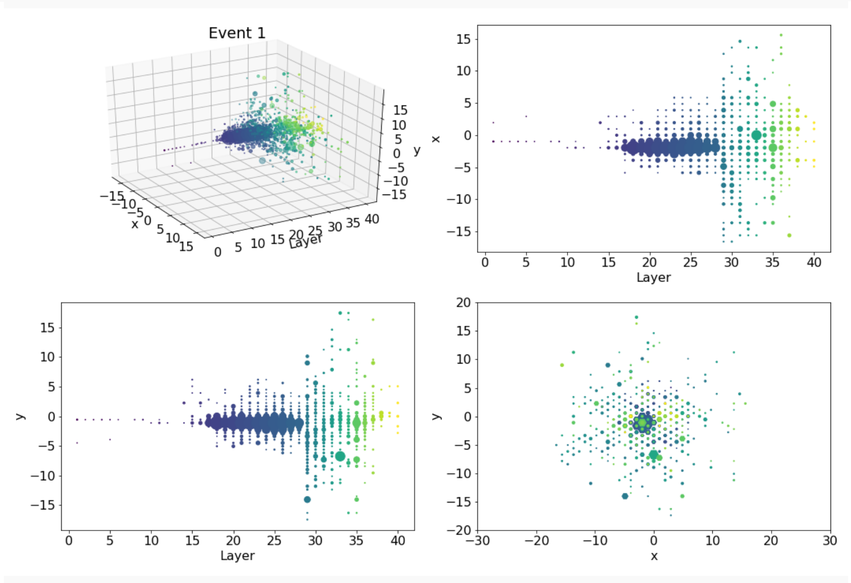
- Very useful to have prompt reconstruction —> almost immediate feedback on the beam quality and detector performance

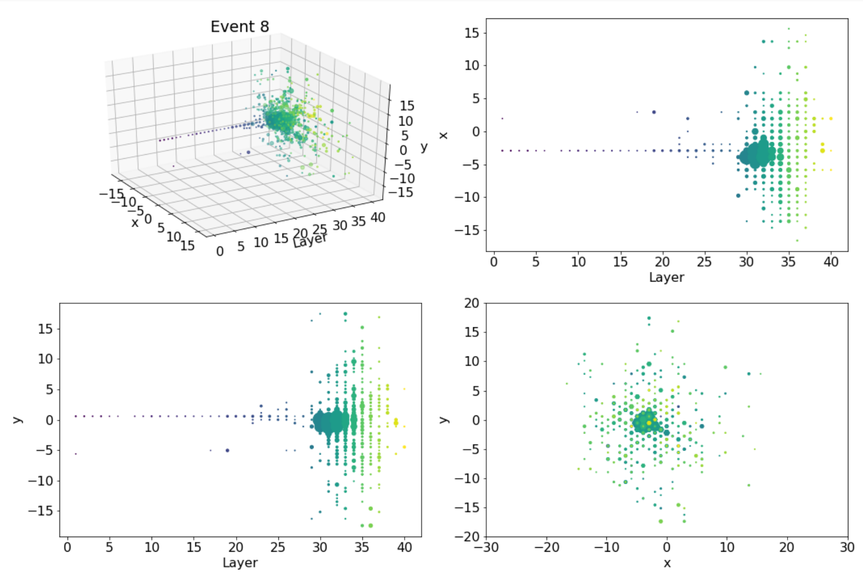


FIRST IMPRESSIONS

- First occupancy plots and event displays from prompt reco look very promising!







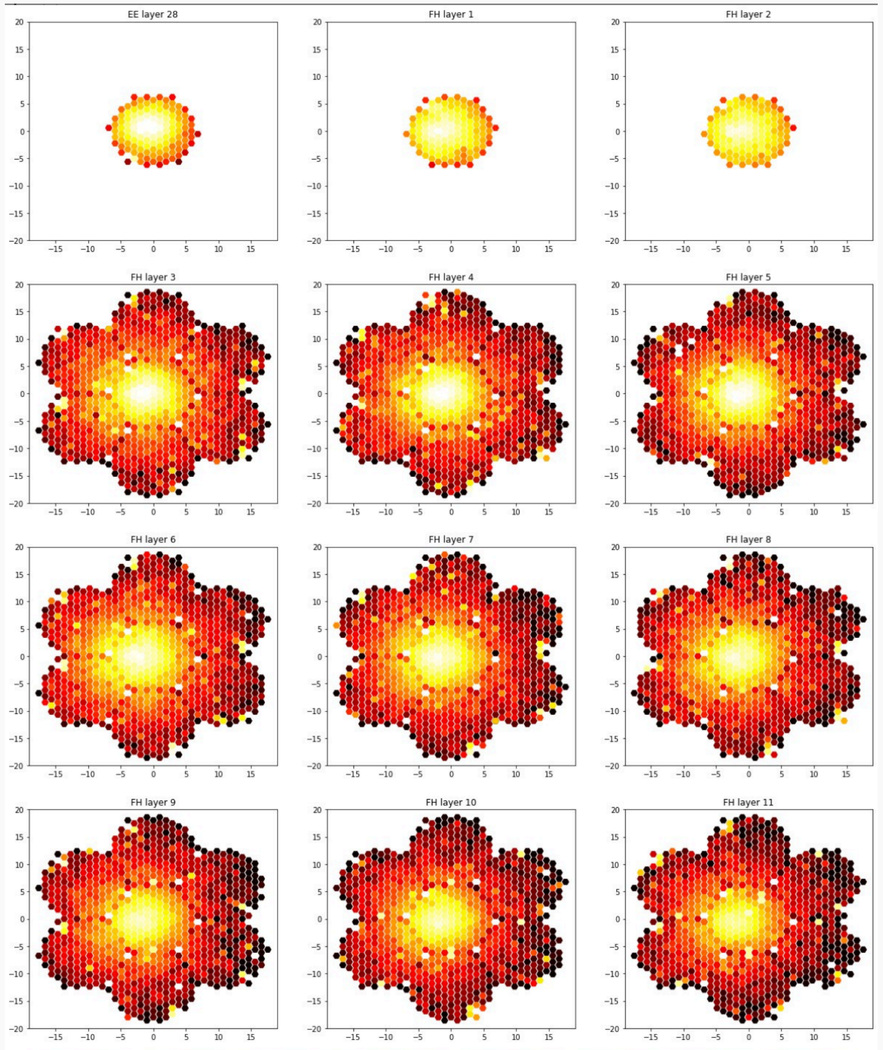
300 GeV electron

Blue = Electromagnetic calorimeter (silicon)
Green = Hadronic calorimeter (silicon)

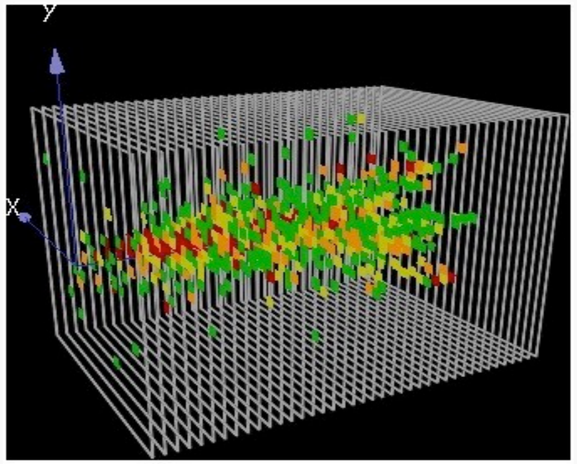
300 GeV pions

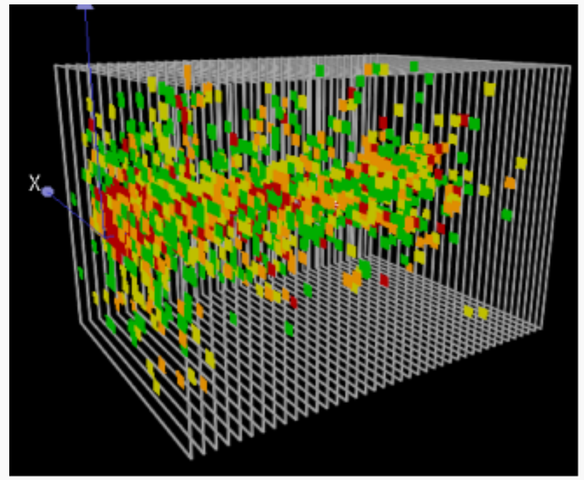
FIRST IMPRESSIONS

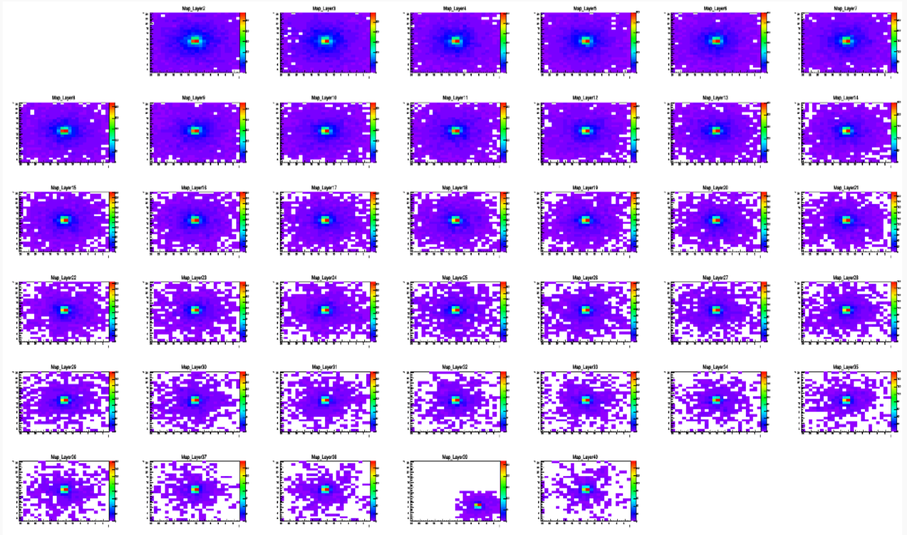
HGCAL EE -> FH



300 GeV pion events in AHCAL

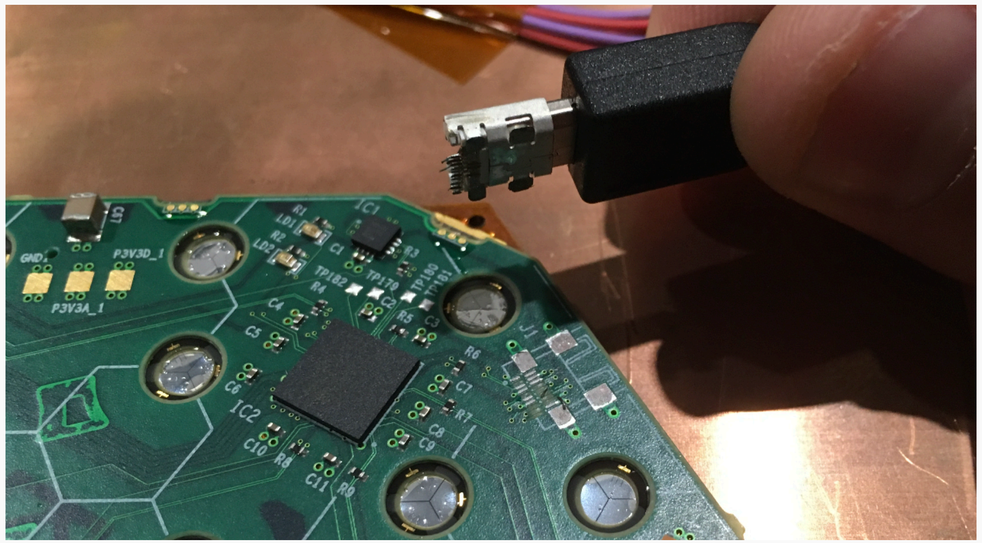


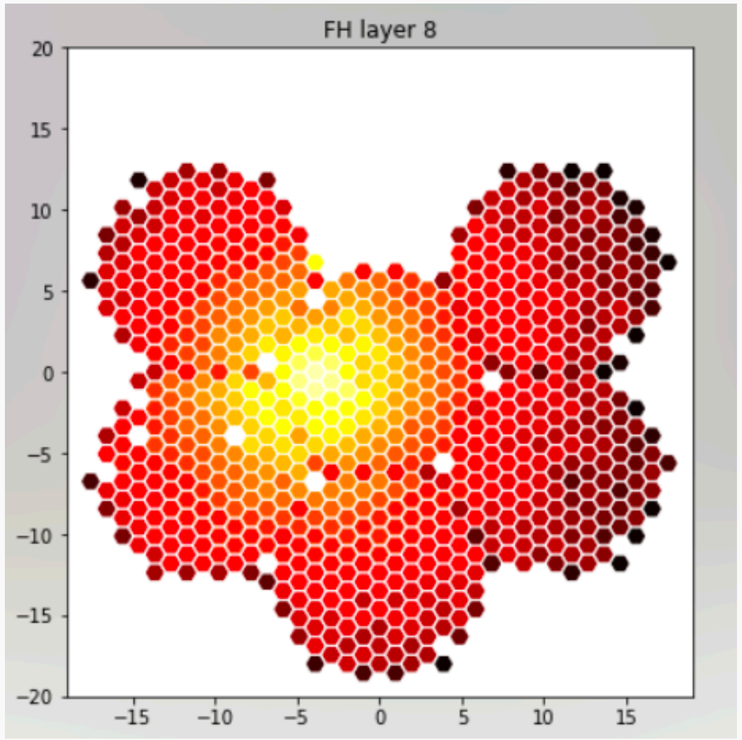




PROBLEMS

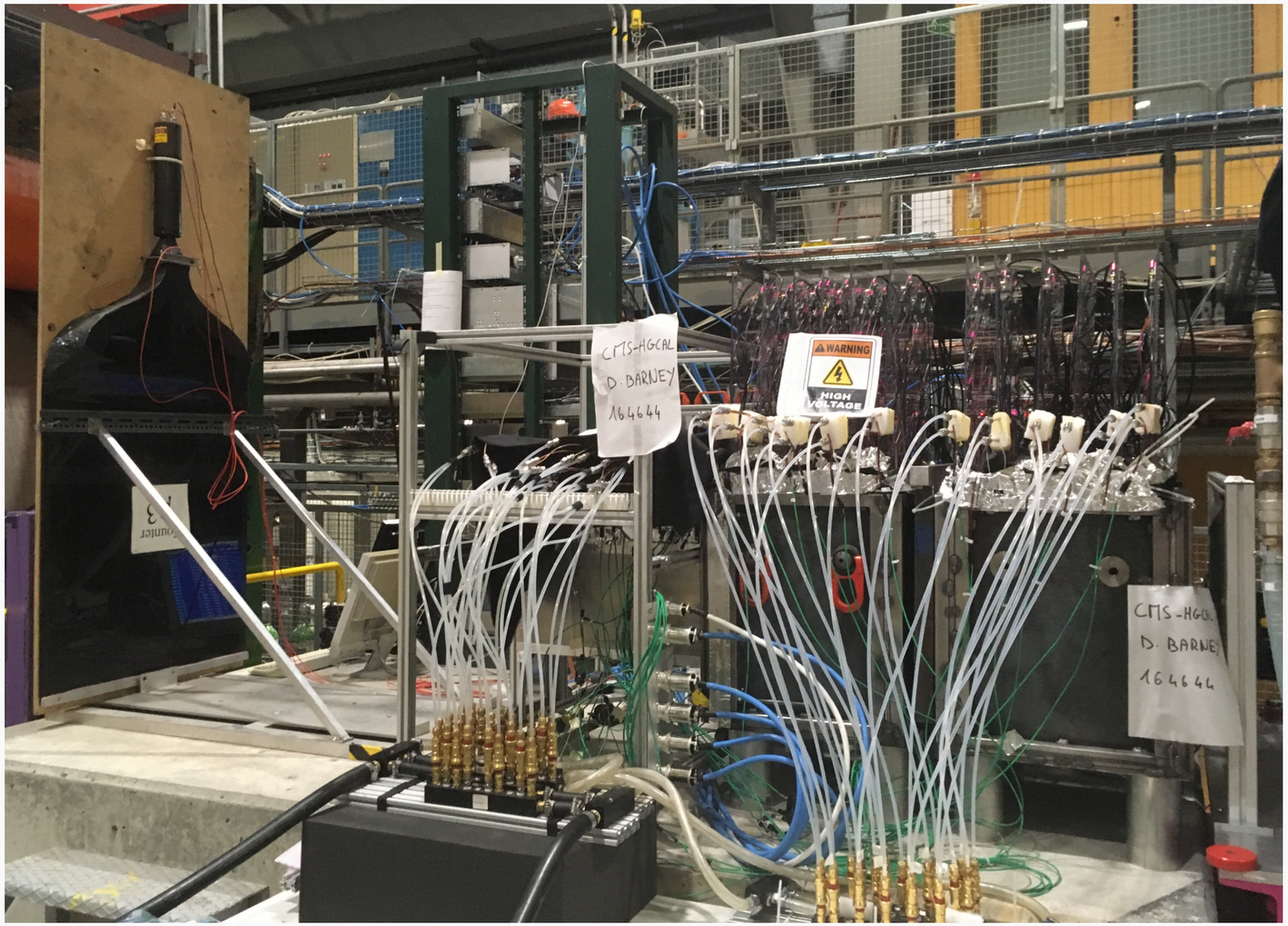
- During the TB the number of active HGCAL modules decreased from 94 to 91…
  - 1 module did not “wake up”
  - 1 module had corrupted data / communication
  - 1 module had the uHDMI breaking off
    - ➤ Careful handling critical!





THE ANALYSIS TASKS

- Reconstruction on individual detector levels:
  - HGC, AHCAL, DWC, MCP, XCET
- Calibration of HG/LG/TOT/TOA
- Electronics performance:
  - Noise/pedestal/stability
- Physics performance:
  - Muons
  - Electrons + timing!
  - Pions + timing!



HGCAL setup for post-TB period for parasitic data taking