ALICE FoCal – first results from 2021 test beam

H. Rytkönen[1], N. Novitzky[2]

[1]University of Jyväskylä
[2]University of Tsukuba

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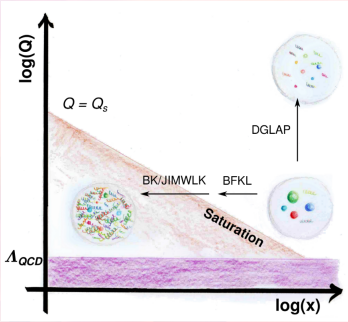
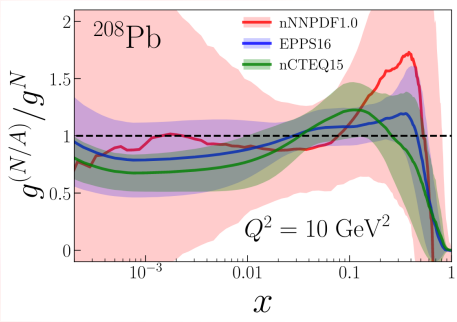
Motivation





The momentum fraction x is linked to partons with p_T at rapidity y

$$x \approx \frac{2p_\mathrm{T}}{\sqrt{s}} \exp(-y)$$

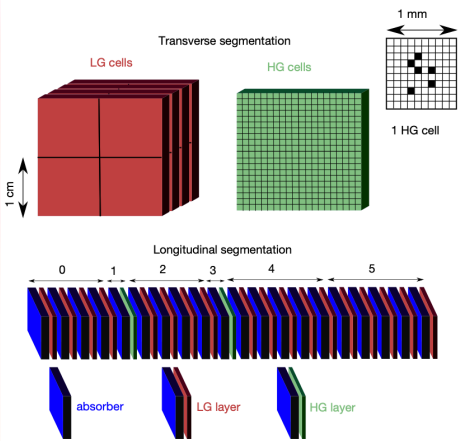
⇒To probe low-x region we need low p_T and high rapidity

To measure prompt photons we also need

- isolation of photons ⇒need for HCal
- good π^0 identification to exclude their decay photons
  - ⇒ identification enables other interesting π^0 physics studies!

FoCal

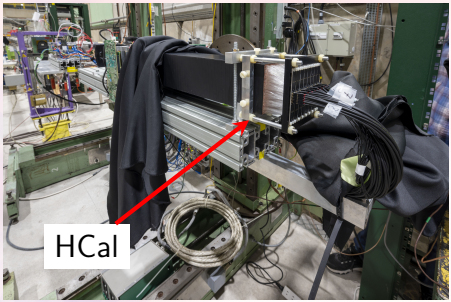
- To answer these needs ALICE will have FoCal at forward rapidity ($3.4 < \eta < 5.8$)
  - FoCal electromagnetic calorimeter (ECal) consists of
    - 18 pad layers ⇒shower energy & profile
    - 2 pixel layers ⇒good two photon separation (**important to identify π^0s!**)
  - HCal behind ECal
    - for photon isolation
    - together with ECal, enables forward jet measurement

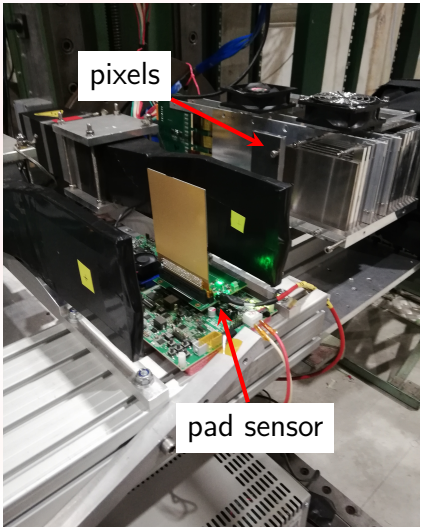


ALICE collaboration, "Letter of Intent: A Forward Calorimeter (FoCal) in the ALICE experiment," CERN-LHCC-2020-009.

Test beam

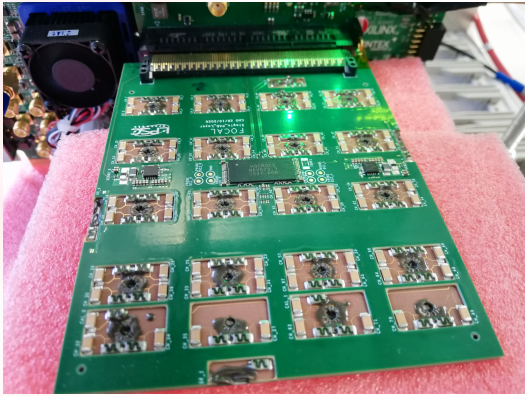
- During September-October a test beam was held for FoCal @ CERN Prévessin
- All the subsystems (ECal pads and pixels, HCal) were measuring during the test beam
- **This presentation concentrates on analysis of the pad sensor**





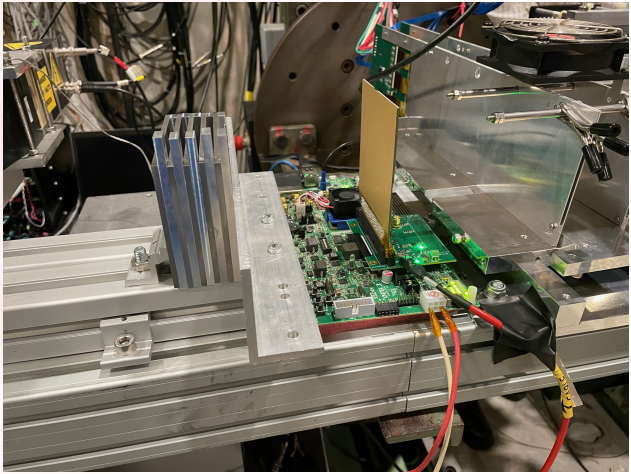
Tested pad sensor

- Silicon sensor that uses HGCROC chip for front-end readout (developed by CMS for HGCal)
- The sensor consist of $8 \times 9 = 72$ $(1\ \mathrm{cm} \times 1\ \mathrm{cm})$ channels



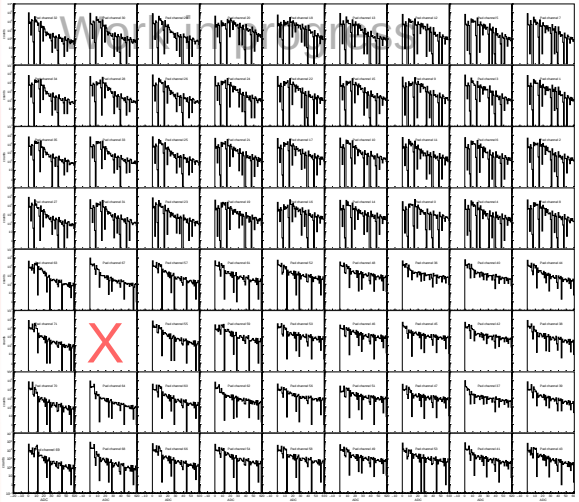
What was measured with the pad sensor

- Collected lots of data to check the MIP peak in the pad channels
  - $\Rightarrow$ energy calibration
- Internal injection
  - $\Rightarrow$ response calibration
- Beam particles at different energies, with 5 and 10 layers of tungsten in front of the sensor
  - $\Rightarrow$ shower distributions



MIP peak

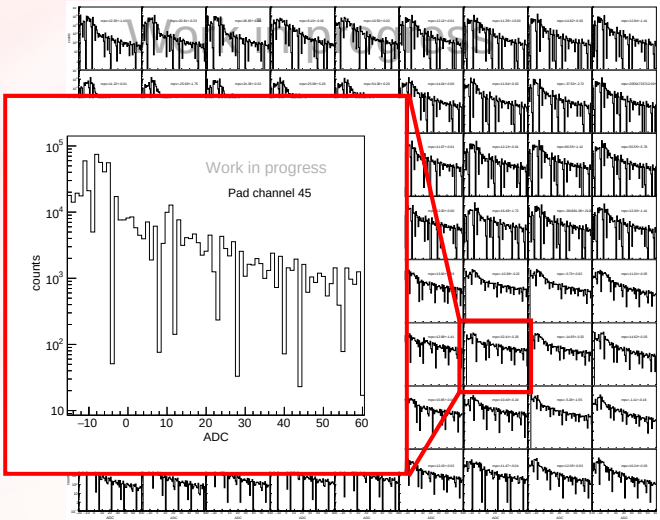
- Figure presents the raw data from the sensor for all 72 channels
- To get the MIP peak from the raw data...



note: channel 65 is dead

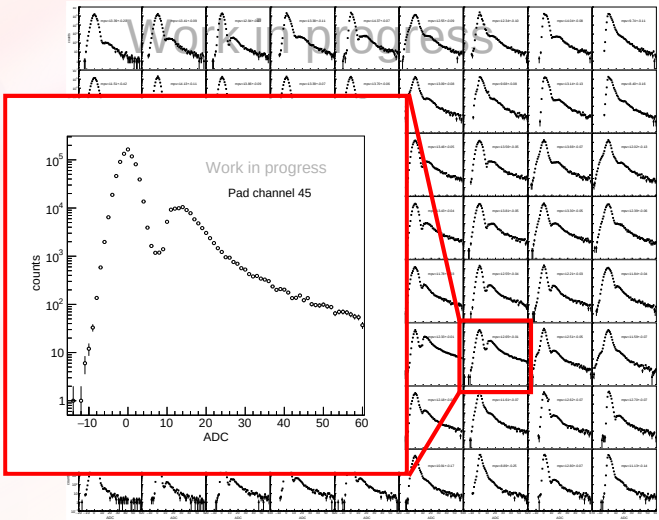
MIP peak

- .. noise pedestal needs to be removed from each channel...



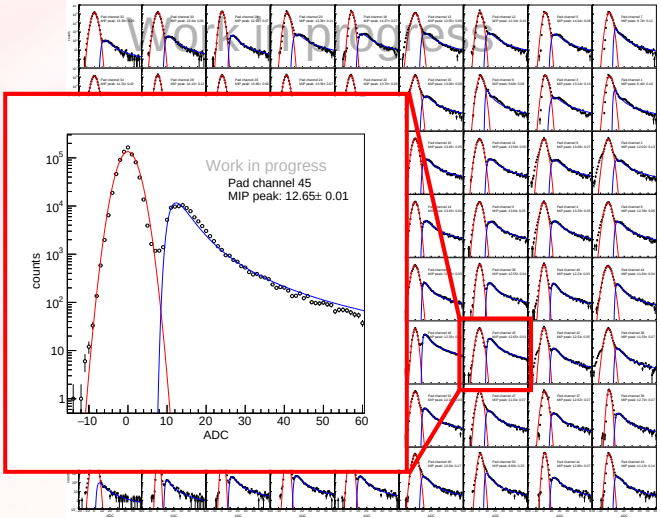
MIP peak

- .. and common noise needs to be removed event by event.



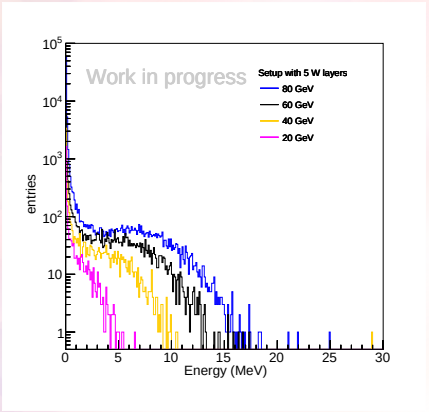
MIP peak

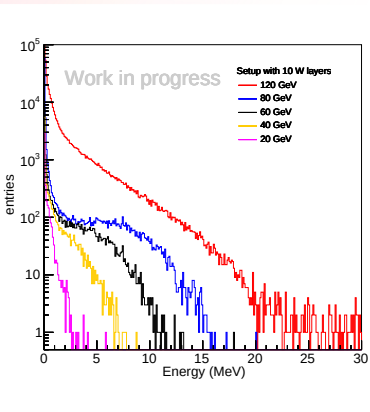
- After cleaning up the data the MIP peak is clearly visible from noise!
  - Gaussian fitted to the noise pedestal (red) and Landau to the MIP peak (blue)
- The peak is visible in most channels to varying degree



Shower distributions

- The beam consist of mixture of electrons and hadrons depending on energy
  - Higher beam energy ⇒larger hadron contamination
- Ideal if hadrons would pass through ECAL but they do shower to some extent ⇒contribution at lower energy of the distribution





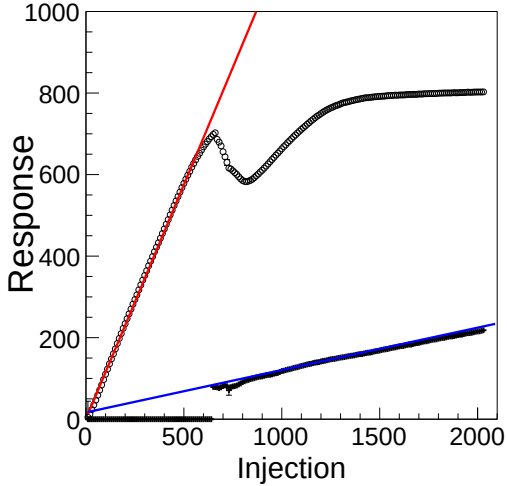
Conclusions & outlook

- All FoCal subsystems were tested at CERN. For the pad sensor
  - MIP peak at 12 ADC counts clearly observed
  - dynamic range measured for this setup (1 MIP $\rightarrow$ 4000 MIP, still tunable)
  - test beam gave insights to the calibration procedure and revealed issues to fix for the following tests
- During summer/autumn next year another test beam under planning: setup with 18 pad + 2 pixel layers
  - common readout so that events can be matched in all sub systems
  - full set of ECal layers allows to study the shower profile & energy resolution
- Before the summer test measurements for pads only in May

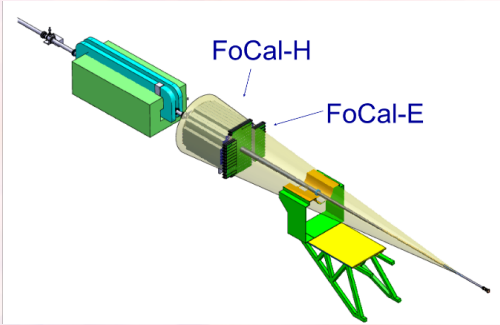
Thank you
for your attention!

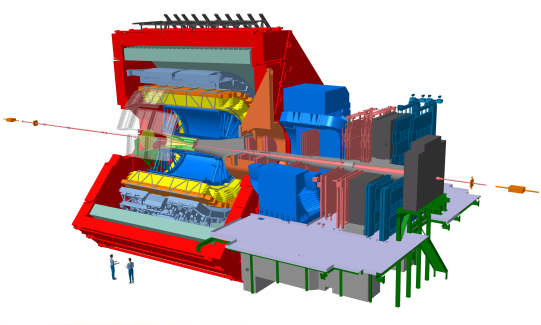
Backup: calibration

- Response of the sensor was studied by injecting charge to the sensor
- ADC dynamic range is not enough ⇒need to switch to ToT after ADC saturates



Backup: FoCal structure





Backup: π^0–π^0 correlations