Status of W-HCAL analyses at CERN

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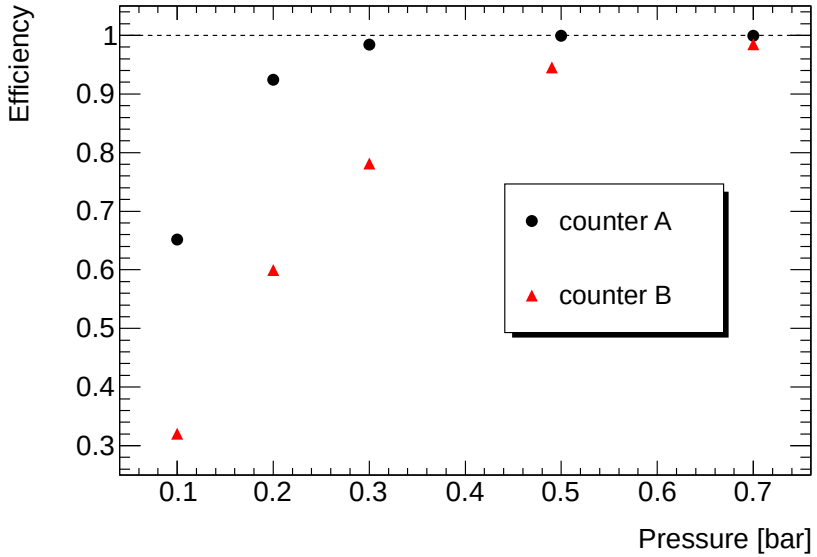
Cherenkov counters

- Analysis started by Wolfgang Klempt and Dominik Dannheim, continued by **Bruno Lenzi** (a post-doc working for a few weeks in our group)

Cherenkov efficiencies

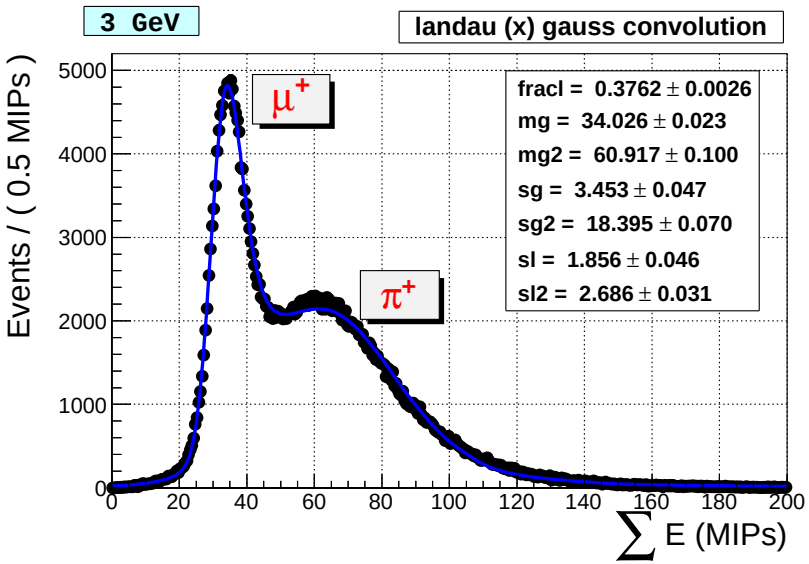
- Studies done on dedicated 1 GeV runs with varying pressures
- Assume Cherenkov signal comes only from electrons (since thresholds for other particles are higher)
- Efficiency calculated as $\epsilon_{A\,B} = N_{A\,\&\,B}/N_{B,\,A}$, with N_A, N_B, $N_{A\,\&\,B}$ the number of particles triggered by counters A, B, A and B

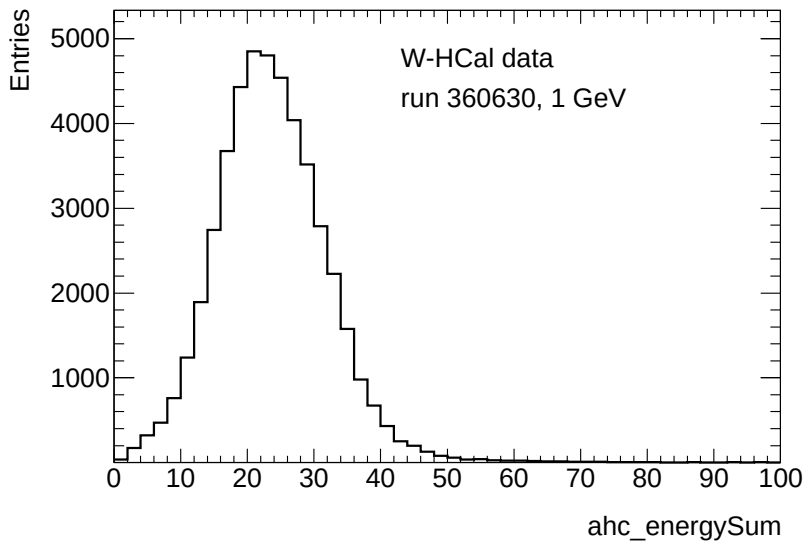
run	Charge	Pressure [bar]	Electron fraction
360583	-1	0.5	**0.58**
360584	-1	0.1	**0.85**
360628	$+1$	0.3	**0.75**
360629	$+1$	0.2	**0.76**
360630	$+1$	0.7	**0.76**



Particle ID in 1 GeV runs

- For $E_{beam} \geq 3$ GeV:
  - Cherenkov to select/veto electrons
  - energy sum in HCAL to separate between muons and pions
- For $E_{beam} = 1$ GeV:
  - Cherenkov to select/veto electrons
  - energy sum in HCAL CANNOT be used to separate between muons and pions
    $\Rightarrow$ need other variables (see next slides)

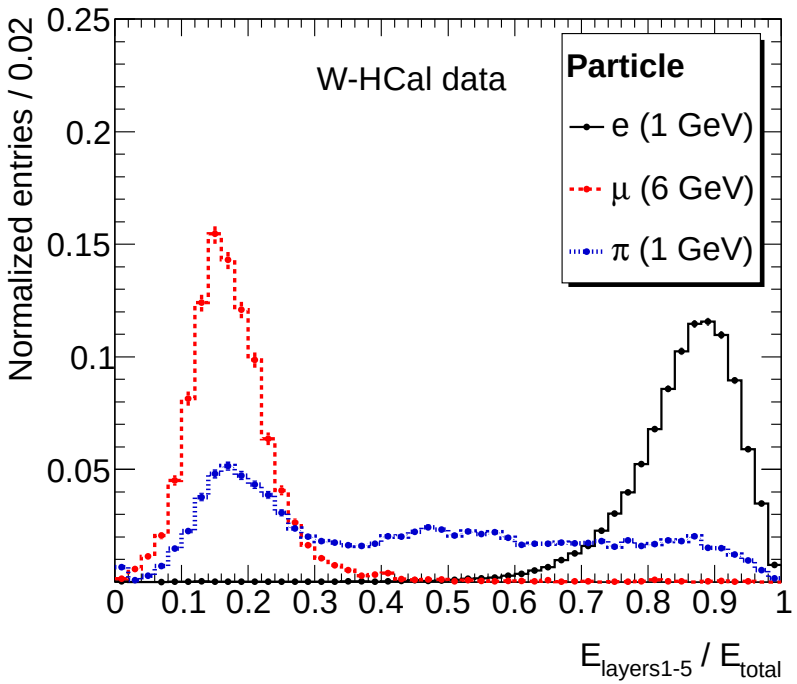


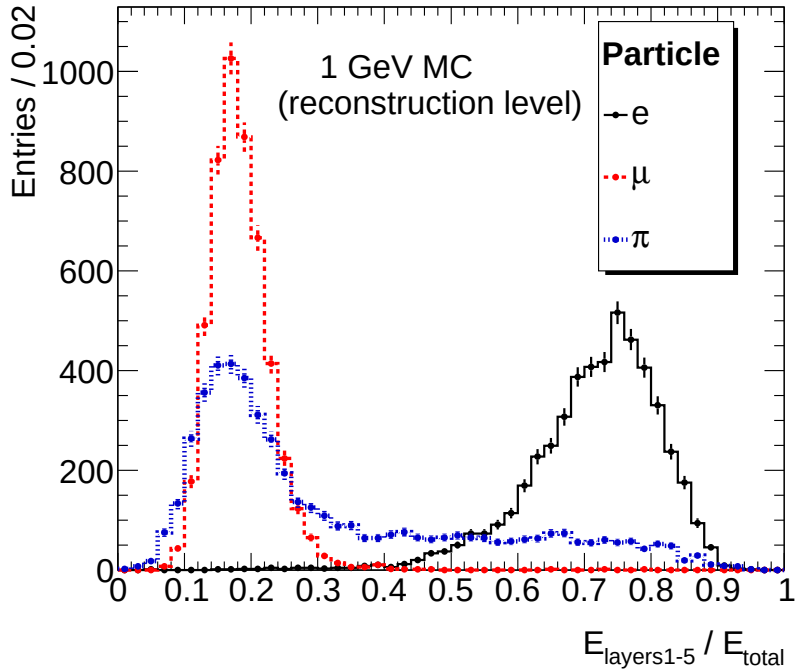


- Next slides: plots with data and Monte Carlo
- **Note**: studies of W-HCAL simulation and digitisation not yet finished, hence no superimposing of data and Monte Carlo (only shape comparison)

Particle ID in 1 GeV runs: 'Shower depth'

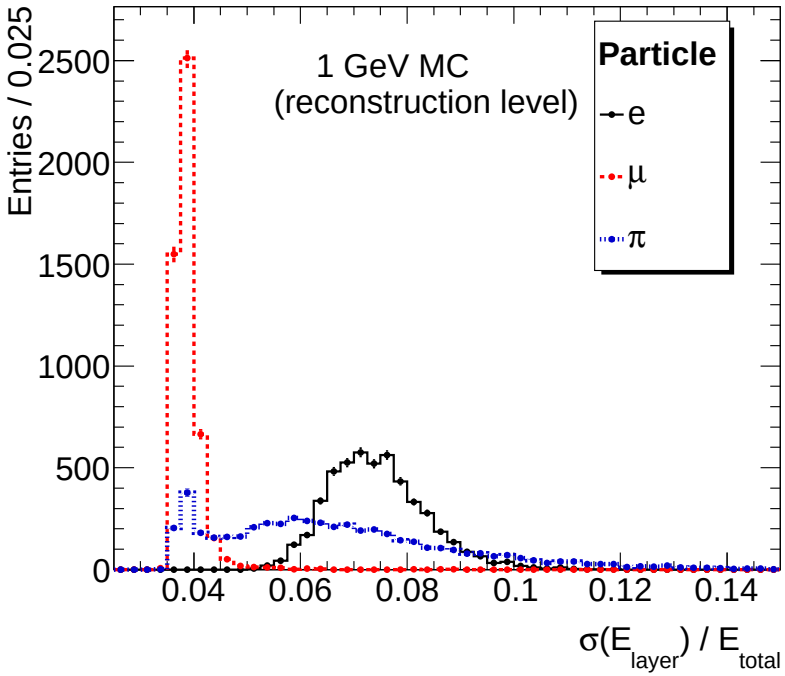
- 'Shower depth': sum of $E_{layers\ 1-5}/E_{layers}$ (initially used by Nils Feege)
- Idea:
  - e: deposit most energy in the first layers
  - μ: constant energy loss (MIPs)
  - π: penetrate more than e

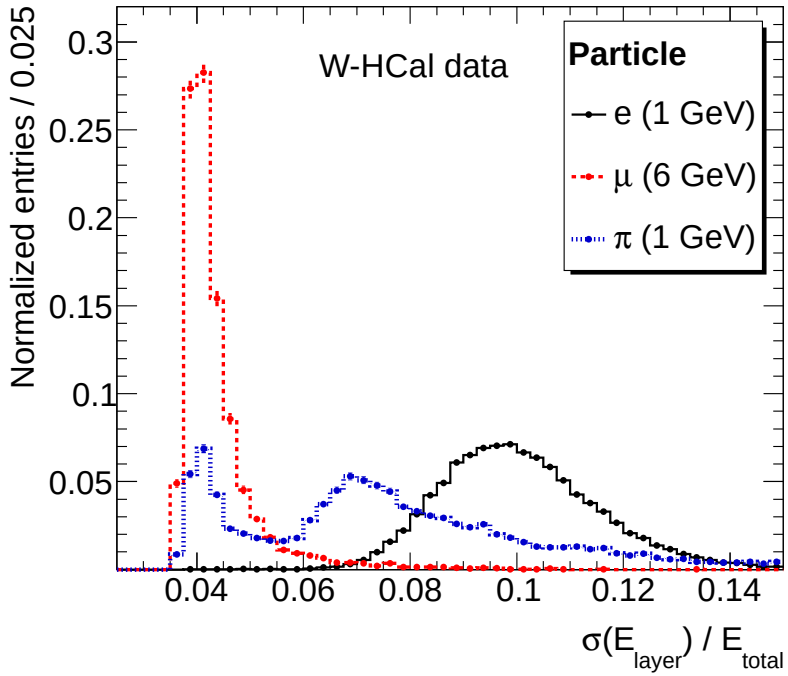




Particle ID in 1 GeV runs: 'Uniformity of energy loss'

- 'Uniformity of energy loss': standard deviation of energy per layers
- Expect small values for muons, large for other particles

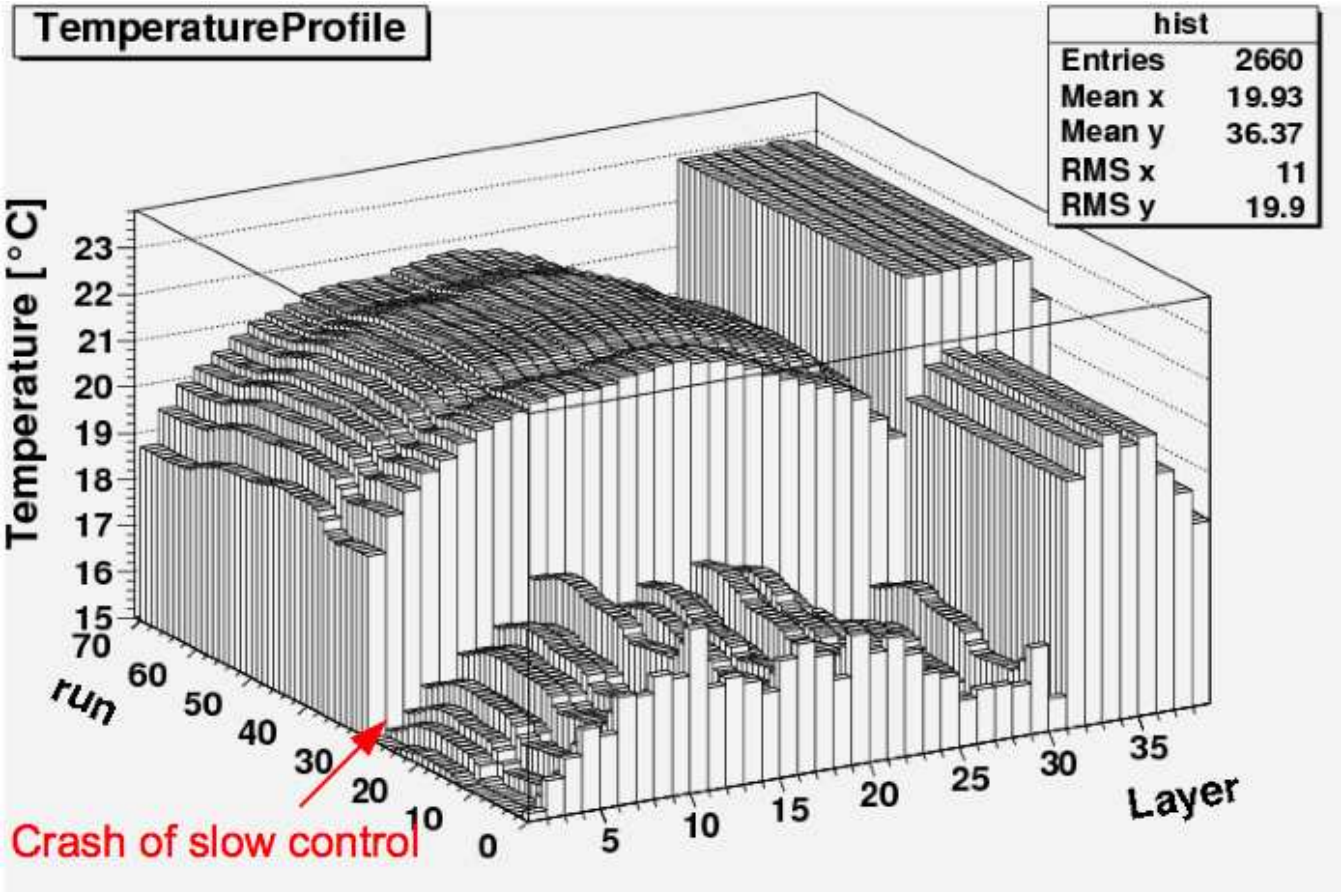




⇒ Can have a handle for particle selection based on Cherenkov triggers and on selected variables ('shower depth', 'uniformity of energy loss') also at low energies

Temperature profiles

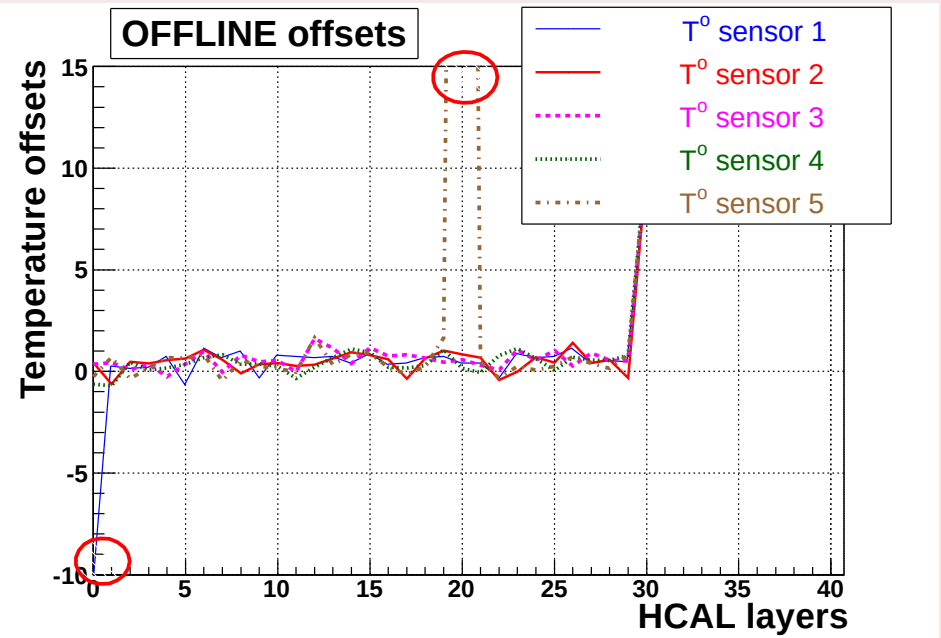
- Problem noticed in the temperature profile: 2 days before the end of the data taking, we had a slow control crash. After this, a sudden increase of about 4 degrees observed in the temperature profiles
- Plot presented by Clemens Günter (DESY) at the HCAL main meeting, end of January



Temperature profiles - continued

- The problem: we forgot to calibrate the temperature sensors for CERN 2010 (wrong offsets, from FNAL period, were used)
- $\Rightarrow$ It was necessary to re-do temperature calibration measurements (Wolfgang and Dominik) - tedious, since needed to wait for the HCAL to be close to thermal equilibrium
- 1-2 weeks spend on development of new tools to write the temperature offsets into the data base, and on the treatment of 'bad' temperature measurements

Treatment of 'bad' temperature measurements



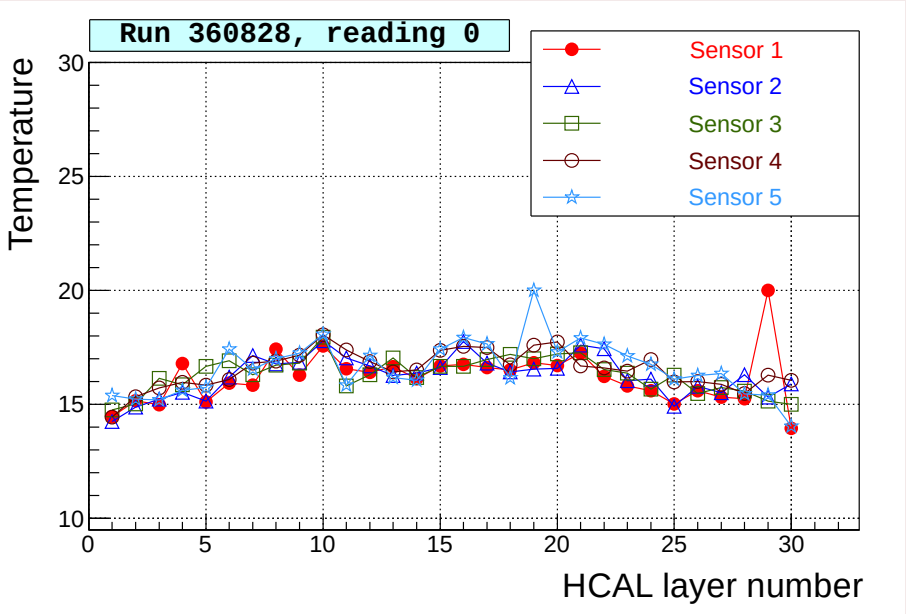
- Decided to use **status** flag to distinguish between good ($status > 0$) and unreliable sensors ($status = 0$)
- Use offsets from $15-Feb-2011-08-48$

Treatment of 'bad' temperature measurements

- Until now:
  - A temperature sanity range was applied: $0^\circ < T^\circ < 45^\circ$
  - For sensors outside range, the **mean temperature per module**, of 'good' sensors, was taken
- New numerical attempt:
  - Use **median** (middle of distribution)
  - 'Good' sensors should be **within 1 degree Celsius** from the median
- Next plots: Done for **run 360828**, run taken just before the slow control crash

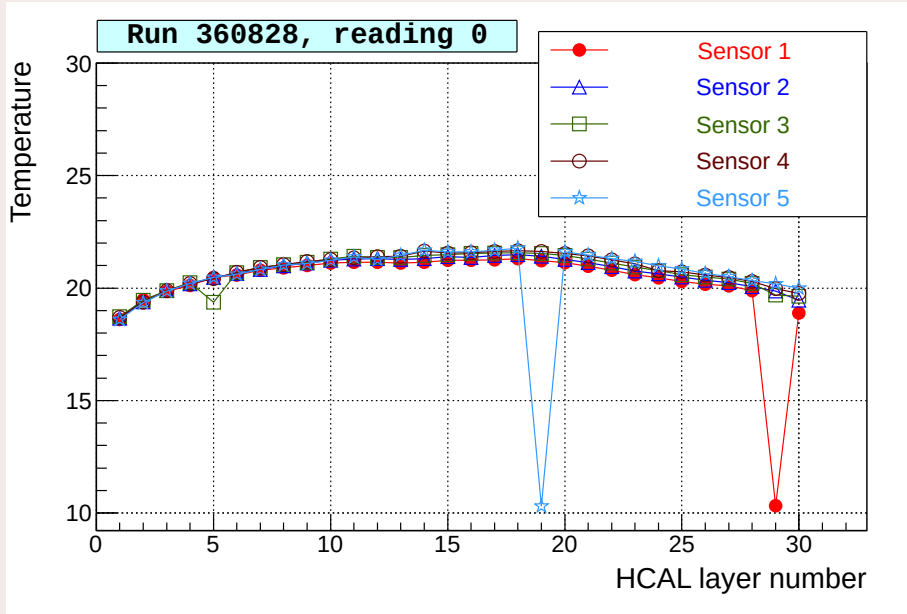
OLD treatment of 'bad' temperature measurements: old vs new offsets

OLD offsets



- Large spread and global shift due to wrong offsets applied
- Problematic sensors forced to 20° (but STILL inside the safety range!)

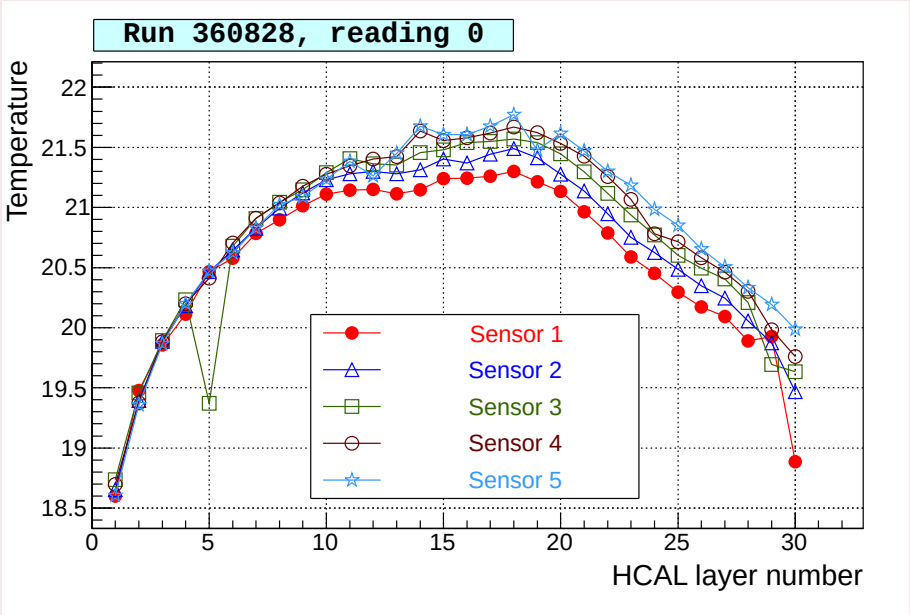
NEW offsets



- Smoother
- Problematic sensors are now at the reference temperature of 10°

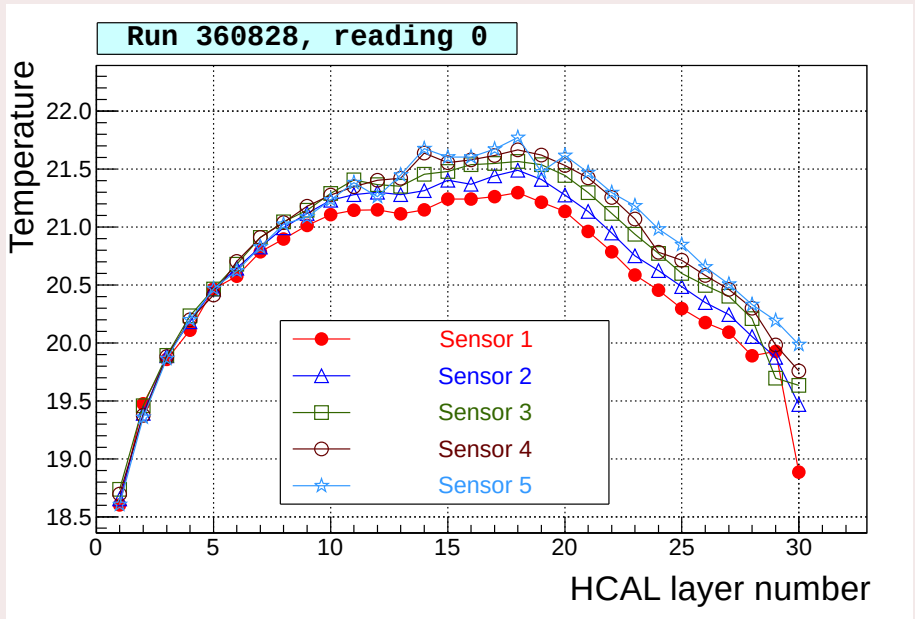
NEW treatment of 'bad' temperature measurements

NEW offsets, with correction for 'bad' status sensors



- Problematic sensors flagged as 'bad' and removed, use median of 'good' sensors instead

NEW offsets, with correction for 'bad' status sensors and for 1 degree variation



- The last outlier removed by the request to be within $\pm 1^\circ$ from the median

Conclusions

- Many bits and pieces already in place:

Intercalibration	✔
Gain	To be rewritten to db with correct T°
MIP	To be written to db with correct T°
Cherenkov counters	✔
Temperature calibration	✔
Tracking	To write db folders used during digitisation
W-HCAL in Mokka	**First version ready, to be checked**
Digitisation	**To be cross-checked**

- Analysis: hopefully soon there...