

First look in SPS Data : Calibration and first results

AHCAL Main Meeting

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Hamburg, 11/12/2015



What is needed before doing physics?

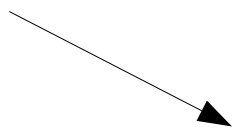
> What is needed?

> Calibration constants :

- MIP Calibration : energy scale
- Gain calibration : saturation effects in EM/Hadronic showers (digitization)
- Pedestal
- Dead / Noisy channels : essential for MC/Data Comparison
- Temperature dependance : Gain & MIP – Small corrections (2nd order)
- Saturation Parameters → Number of effective pixels!

> Software tools

- Digitization chain → Simulation including all detector effects
- Reconstruction chain → Same for Simulation and Data!



Will be presented
by Lan after



Gain Calibration

> Gain calibration using data before Test beam period :

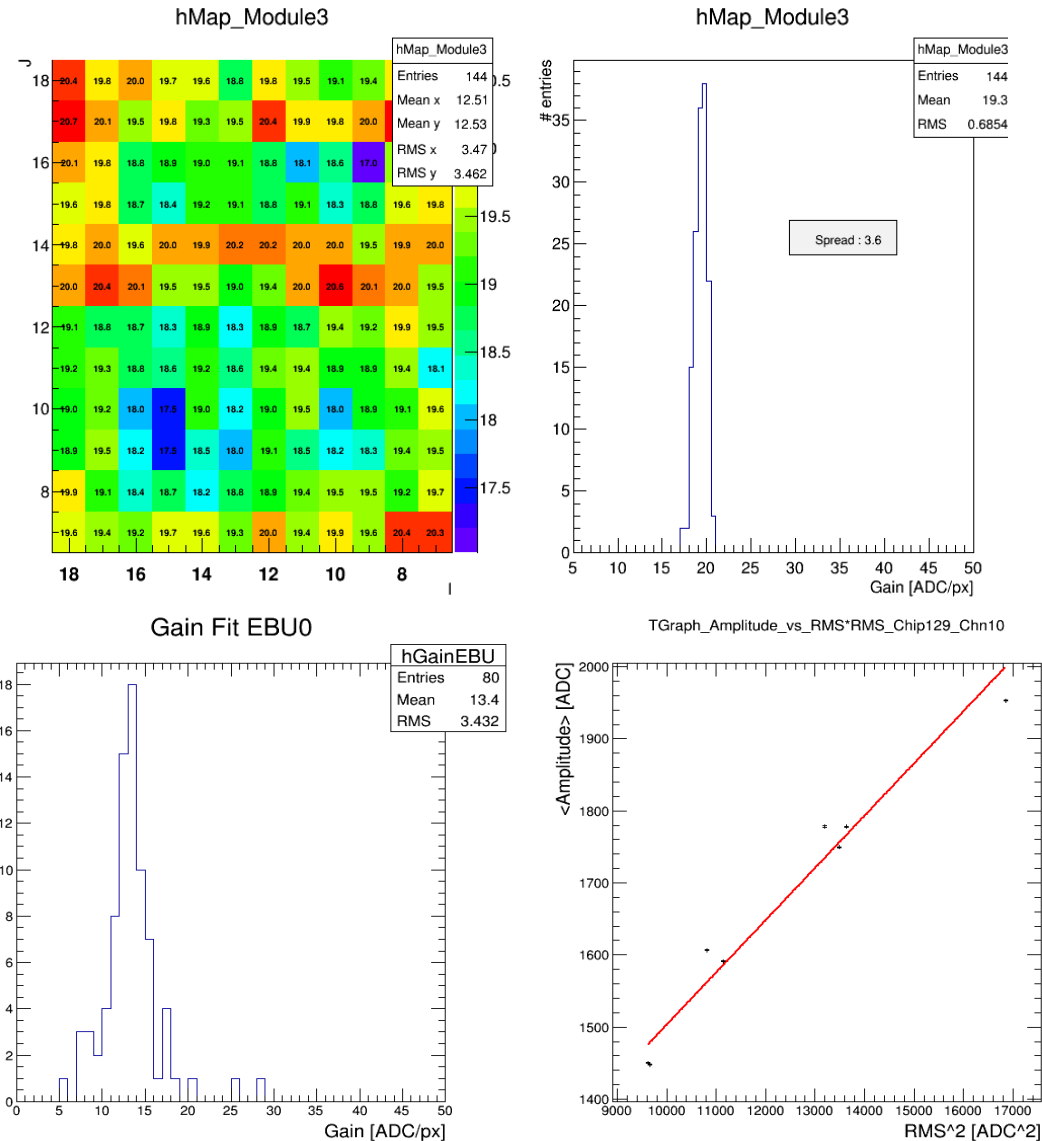
- Combining LED runs from 04/07 to 08/07
- Gaussian fit of the Gain distribution if enough entries otherwise mean of Gain distribution
- EBU0 no SPS visible → extraction by using σ /Amplitude dependence

> Gain Calibration :

- ~ 88.2% of the detector (3303 channels)
- Spread between 3.5% (Mainz) to 25% (bad boards – Layer 6 and 10)

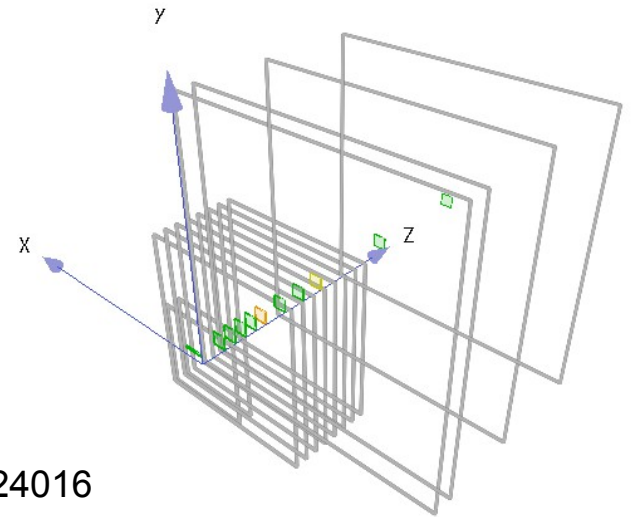
> Still needed :

- Gain Stability crosschecks
- Default values for uncalibrated channels



MIP Calibration

- Redo MIP Calibration from Feb / Apr + July based on the same method
- Data :
 - February / April : Electrons 3 GeV in Airstack
 - July : SPS Muons 80 & 150 GeV in EUDET Absorber
- Several Steps :
 - Use MipTrackFinder (Tower length ≥ 8 hits & nHits/event ≤ 30)
 - First Fit (Chi2 / ML) to get approximate MIP value
 - Iteration (Chi2 / ML) to get best MIP value after 0.5 MIP cut
 - Extract Pedestal from data (AT Pedestal)
 - Get MIP value by subtracting Pedestal
- TrackFinder → calibration of inner area
- Use MIP Calibration from previous periods
 - → Consistency check!



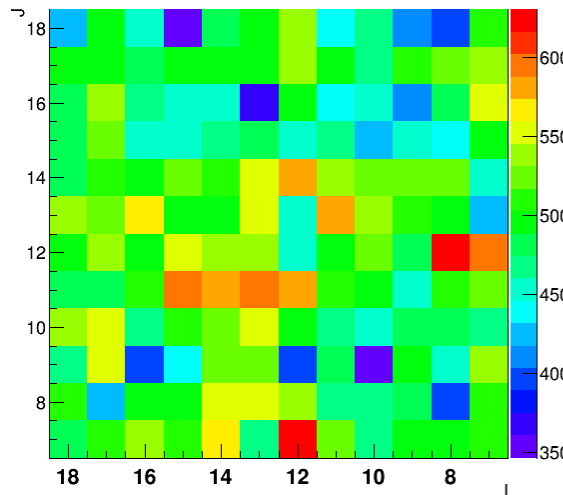
Run 24016

MIP Calibration

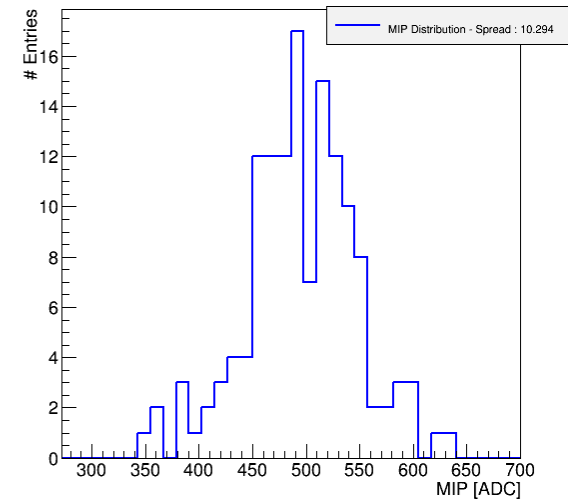
> Performance :

- ~ 87 % of the total detector calibrated (3250 channels)
- ~ 81 % inner part calibrated (1632 channels)
- 10 – 20 % spread
- Mean/RMS of MIP distribution for uncalibrated channels

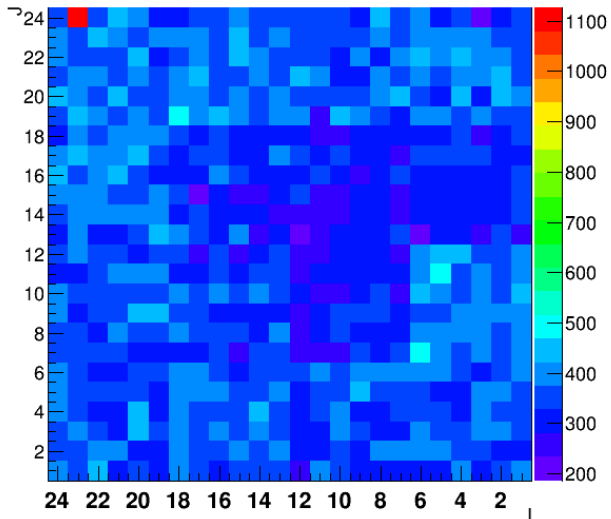
MIP Map Module3



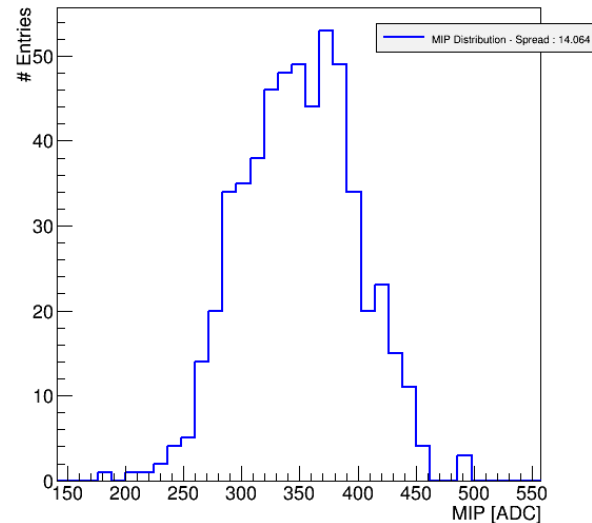
MIP Distribution Module3



MIP Map Module14



MIP Distribution Module14

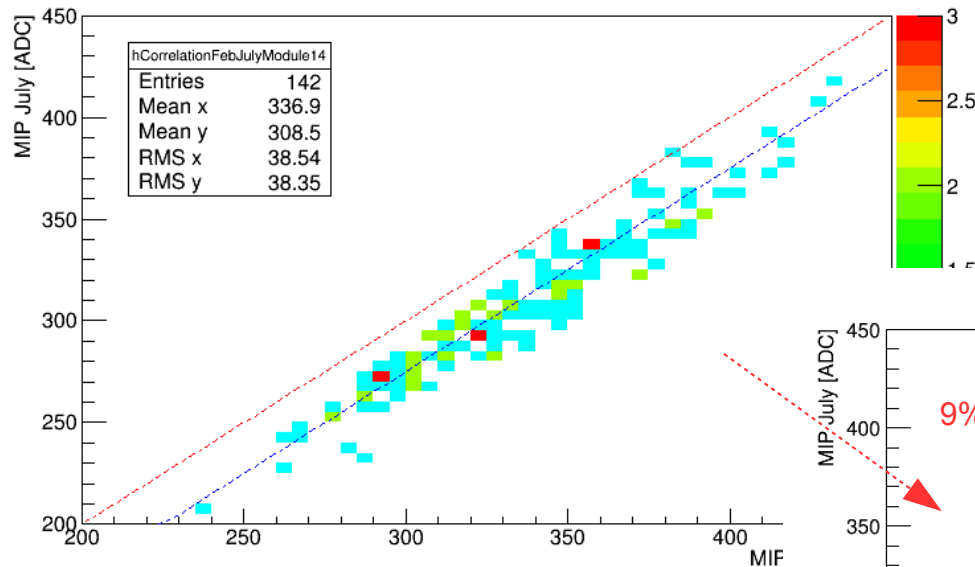


MIP Calibration

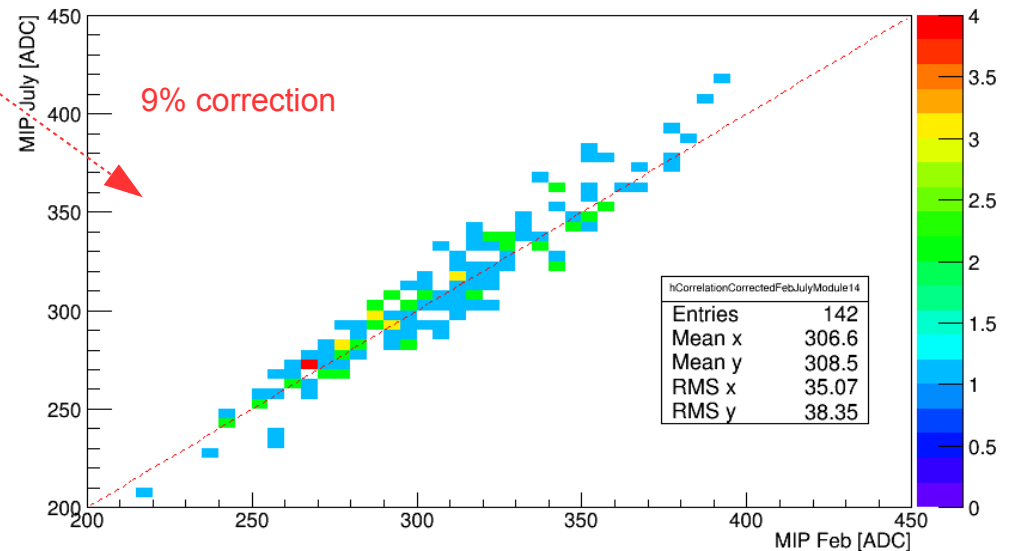
➤ Cross-Check Feb / July :

- Systematic shift $\sim 10\%$ $\rightarrow$ Muons / Electrons (80 GeV Muons $\beta\gamma \sim 800$ – 3 GeV electrons $\beta\gamma \sim 6000$)

Correlation Feb/July Module 14



Correlation Corrected Feb/July Module 14

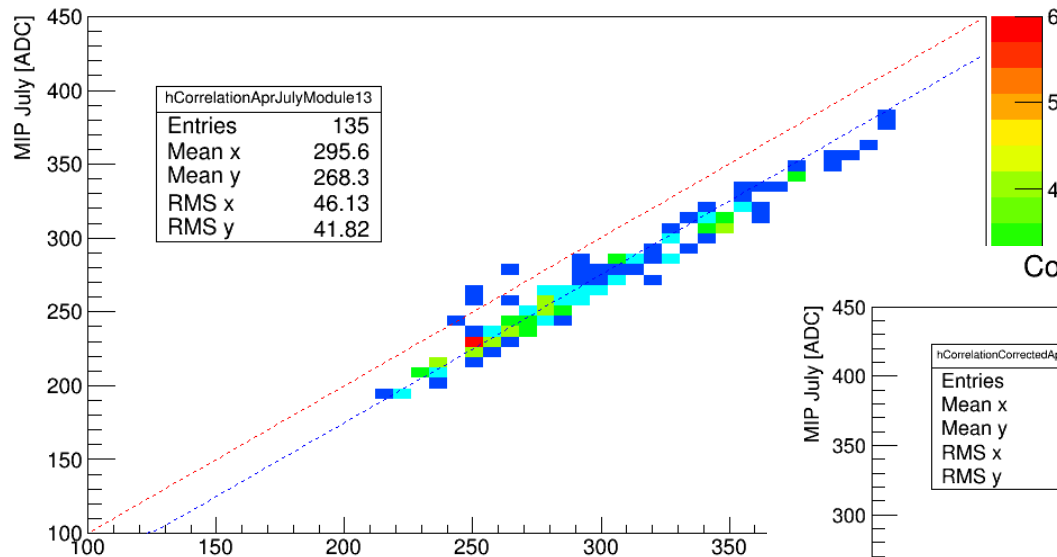


MIP Calibration

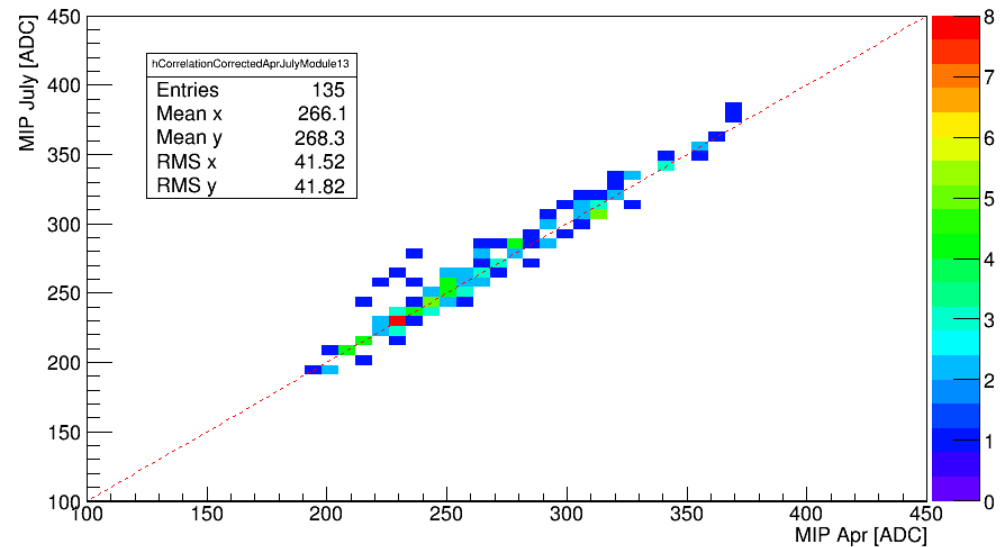
➤ Cross-check Apr / July :

- Same systematic shift $\sim 10\%$

Correlation Apr/July Module 13



Correlation Corrected Apr/July Module 13

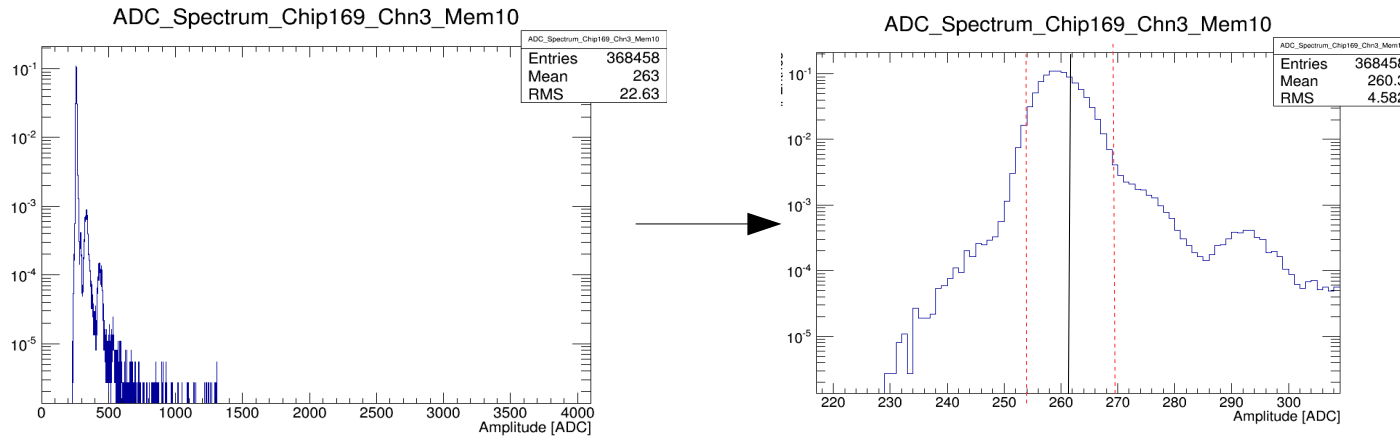


Calibration is transportable!

Pedestal & Dead/Noisy Channels

> Pedestal Extracted from data (need to take into account noise tail!)

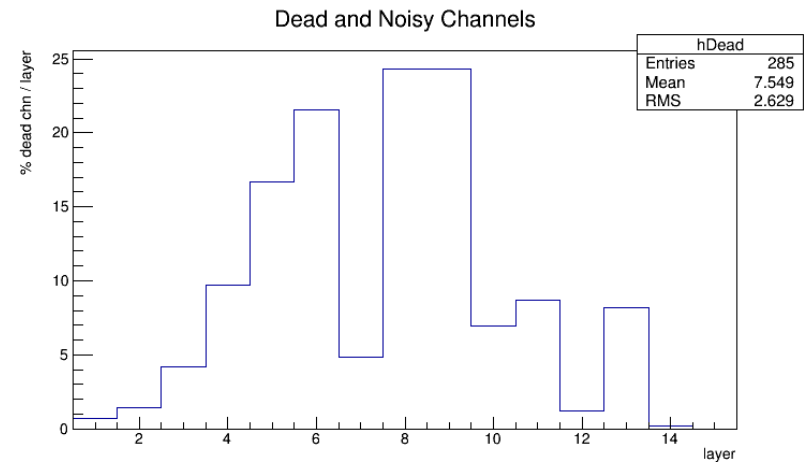
- Fill Histograms for each chip/channel/memory cell (extract between Mean $\pm$ 2 sigma after one iteration)



- Combine all memory cells & cut on RMS per SiPM type $\rightarrow$ defining dead and noisy channels

> Performance :

- ~ 92.8 % Pedestal Extracted (3474 channels)
- ~ 7 % dead/noisy channels $\rightarrow$ need double check



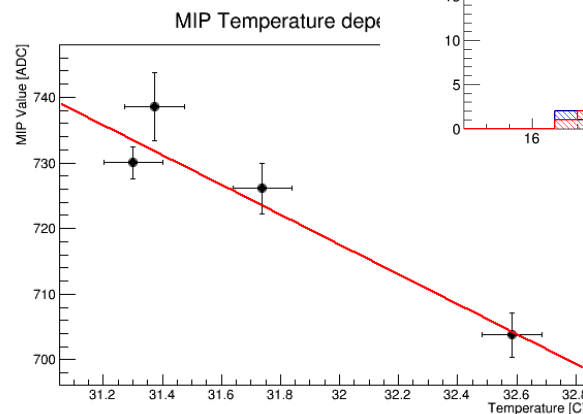
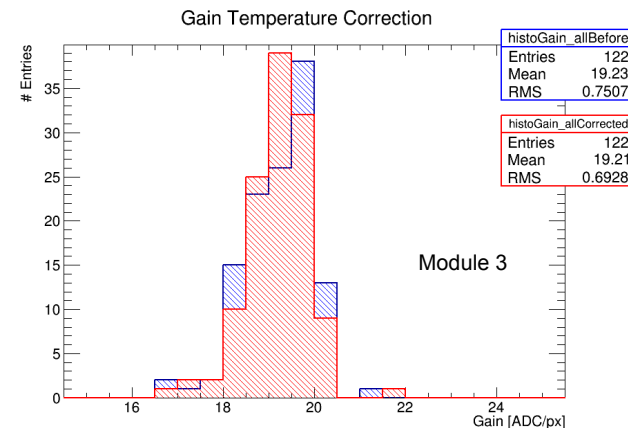
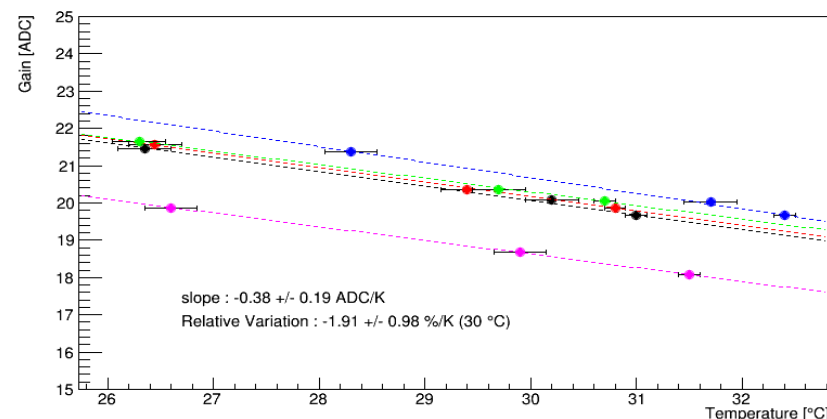
Slopes : Temperature dependance

- > Temperature dependence → small correction
- > First look Gain / MIP → reduction of spread applying correction
- > General expected behavior for Gain

- $\sim -2.1\ \% / \text{K}$: CPTA
- $\sim < -1\ \% / \text{K}$: new Ketek
- $\sim < -1\ \% / \text{K}$: SenSL
- $\sim -0.5\ \% / \text{K}$: new ITEP
- $\sim -1.5\ \% / \text{K}$: Mainz

> MIP :

- Cutting Calibration period in small samples
- $\sim -3\ \%$ for Mainz SiPM (one channel) → need further study



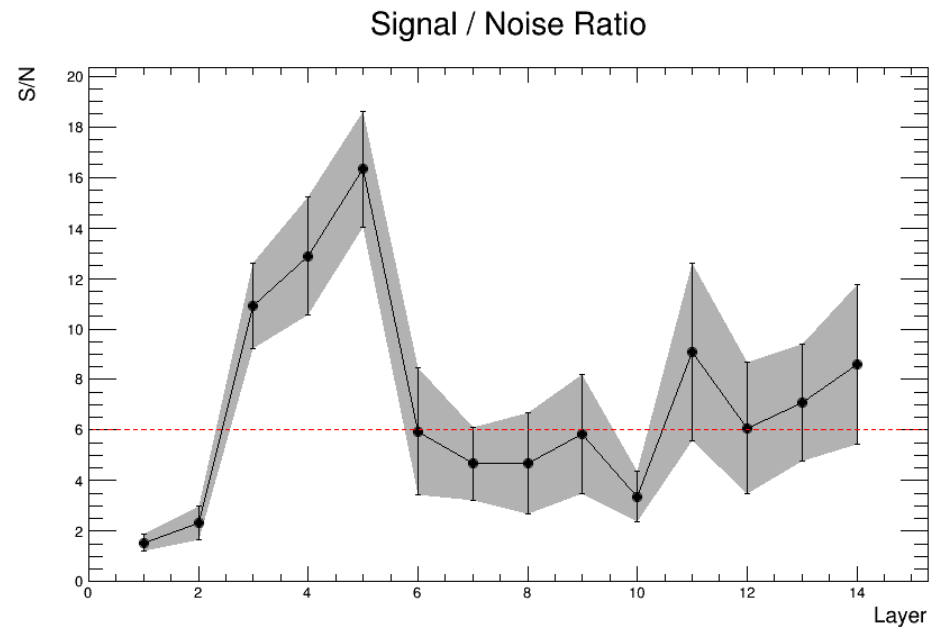
First Results

> Basic Checks :

- Detector Performance : S/N, Light Yield, MIP Efficiency ..

> Signal / Noise ratio :

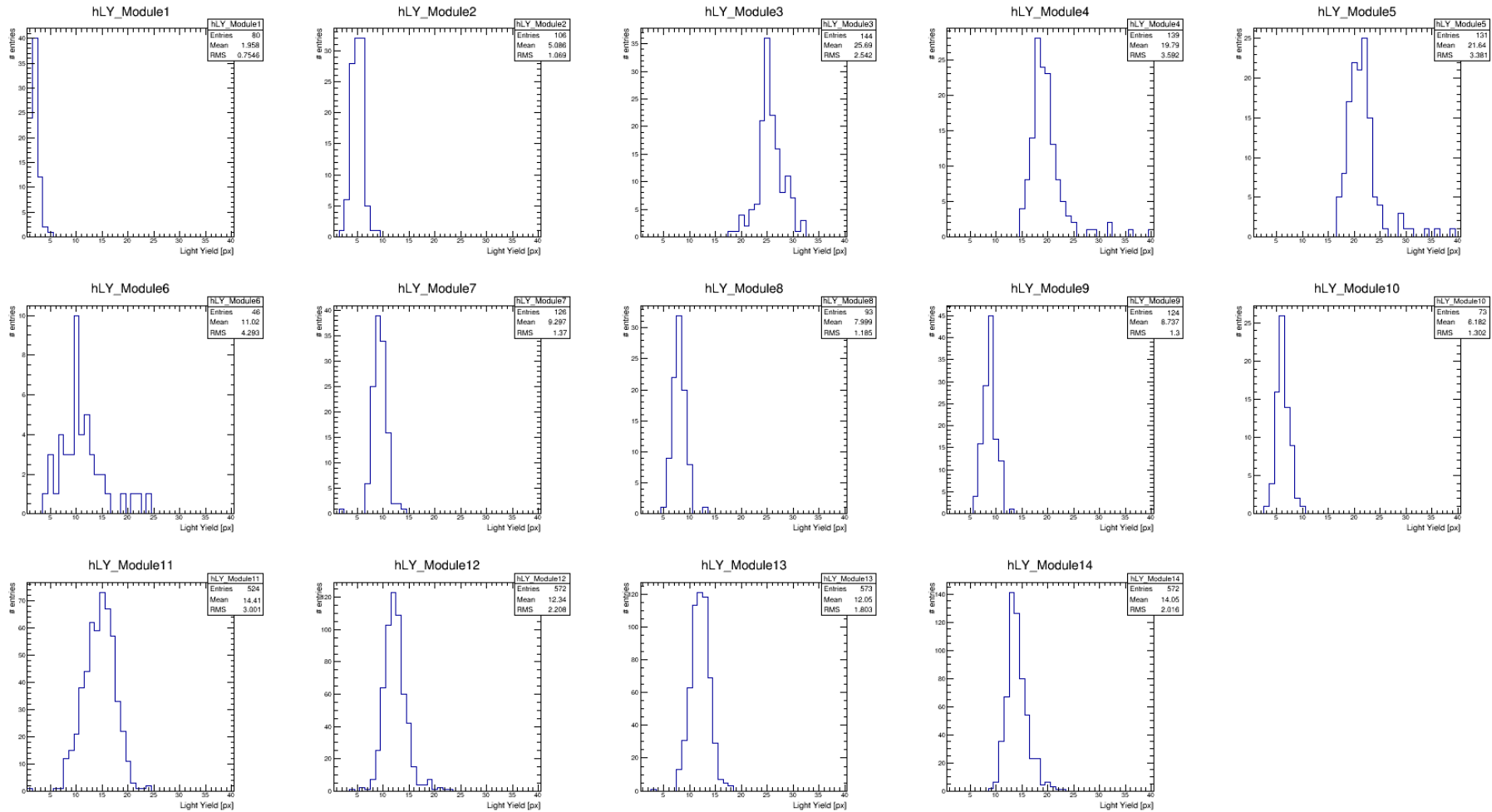
- Clearly see board with high LY
- EBUs → low S/N (low LY)



First Results

➤ Light Yield :

- Expected LY for Mainz, new ITEP and Big Layers
- Quite low LY for old ITEP boards → need investigations



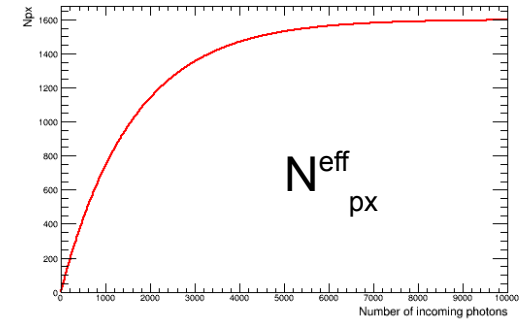
First Results!!

> Checks :

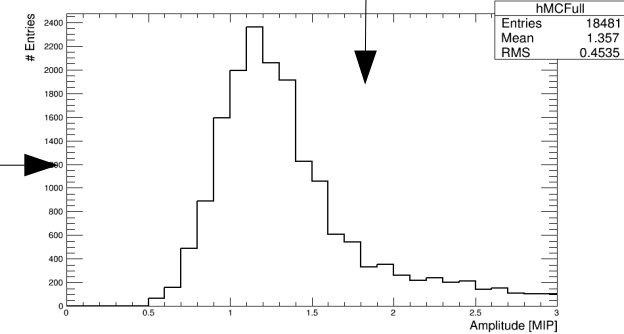
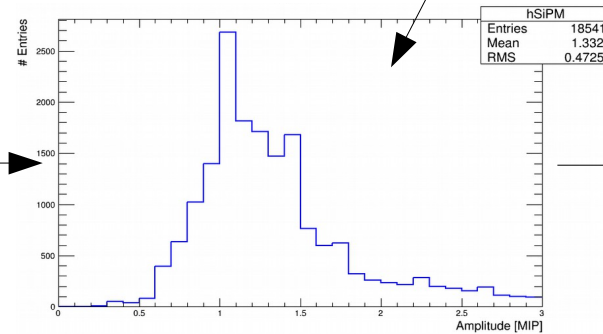
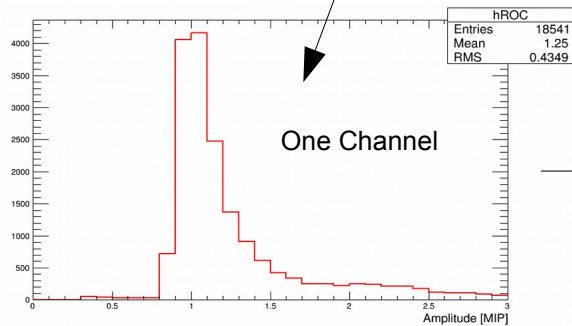
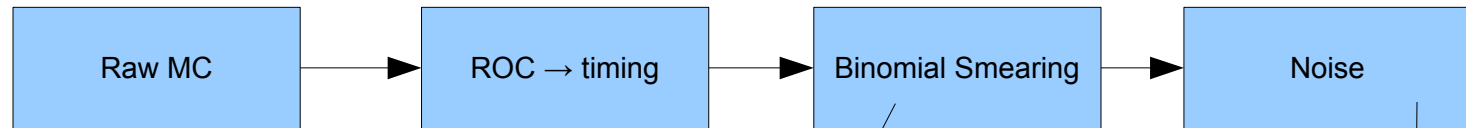
- MC/Digitization chain validation
- Reconstruction chain validation
- First MC/Data Comparison with Muons

> Digitization :

- MIP2GeV : - EBU : 0.00031136 GeV/MIP / HBU : 0.00047714 GeV/MIP



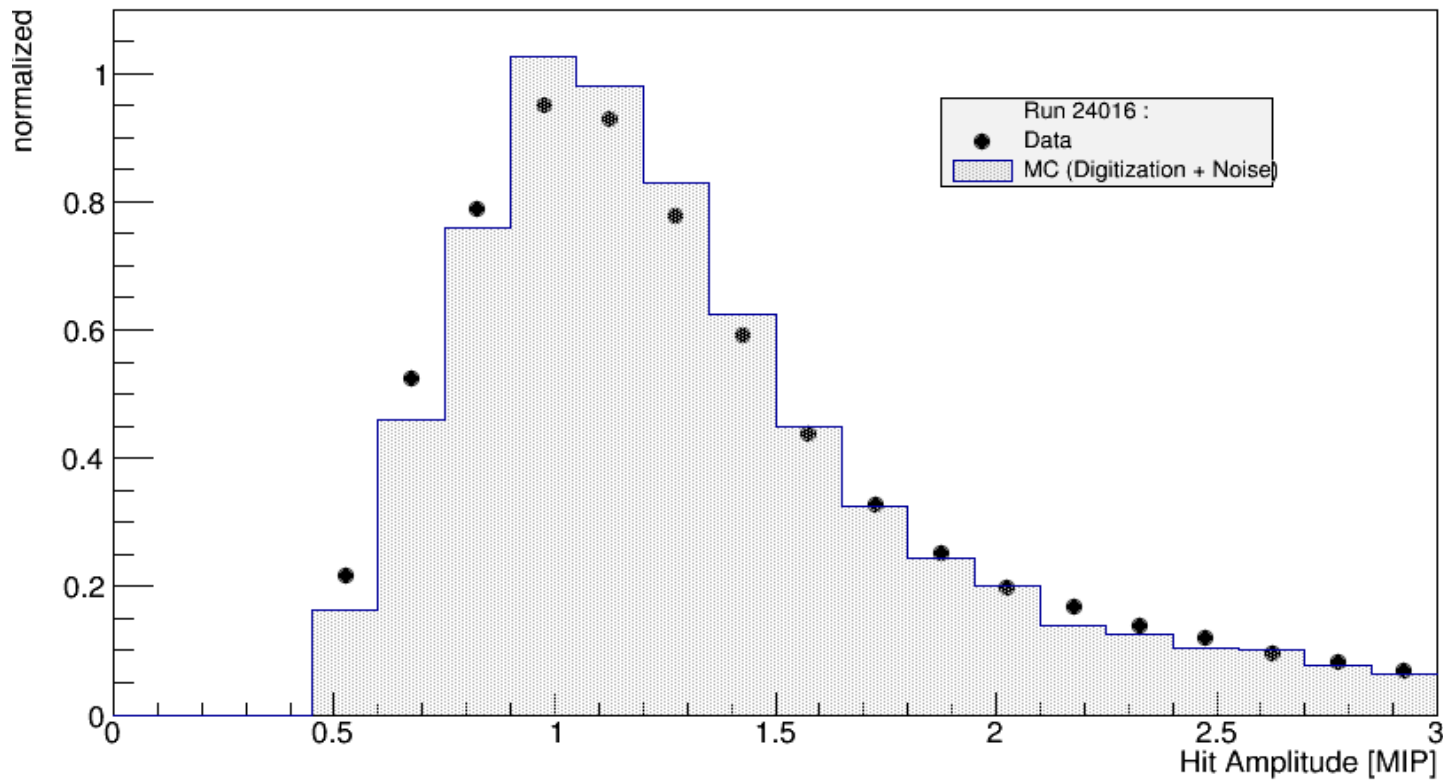
Extract from data



First Results

- Check MIP Calibration + Monte-Carlo chain!
- First Data/MC Comparison for this prototype!!!
- Only one run (Run 24016)

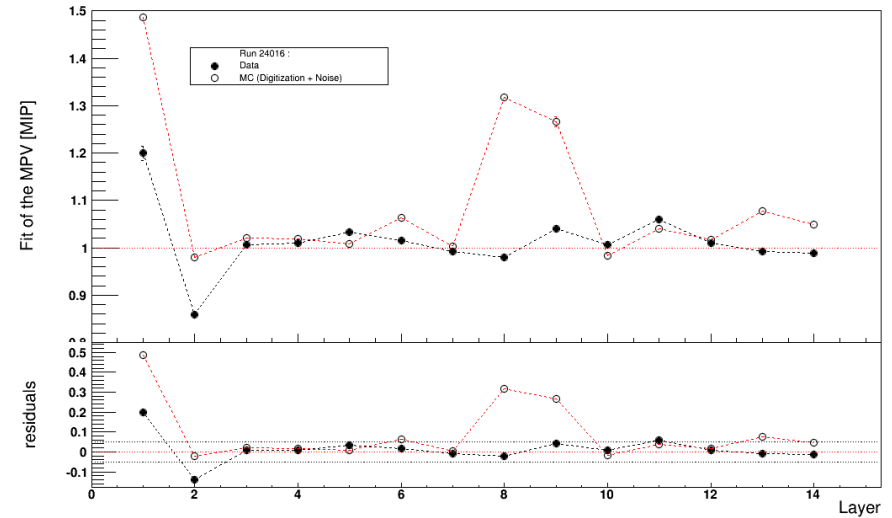
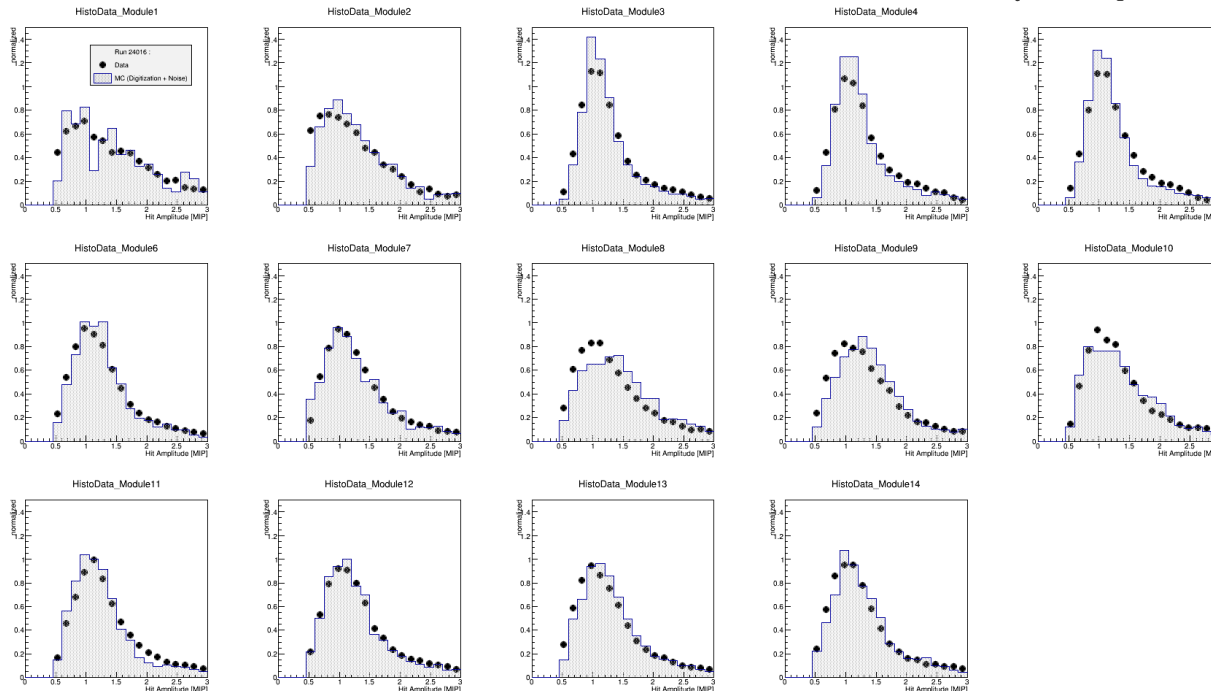
Good agreement !!



Look into details

➤ Spectra per layer :

- General good agreement!
- Few Layers need more investigations → Dead Channel Mapping inconsistent / Mis-calibration

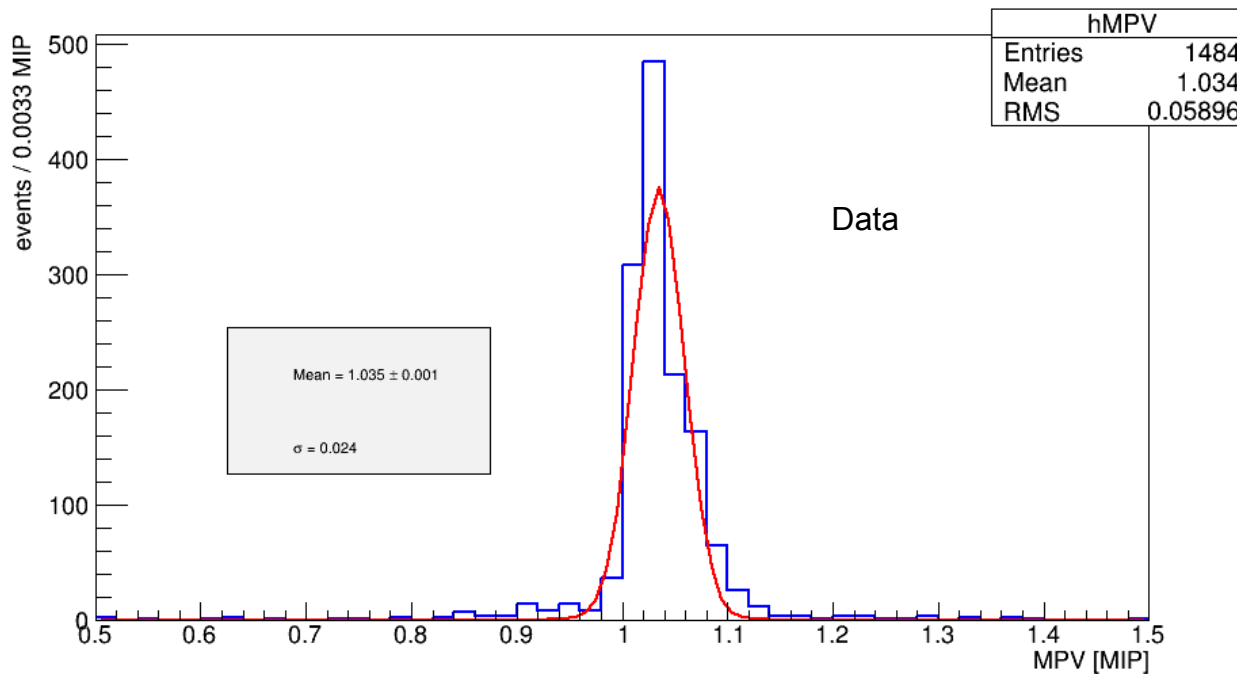


MIP Calibration Check

➤ Check MIP Distribution for each channels

- Rerun on all July Muon data
- Good first calibration
- Outliers → most are default values.

Still need checks for the right tail.



Conclusion

- Most of the software/simulation is ready for starting analysis → see Lan's talk
- Ground Calibration for the period of July done!
 - Will be tagged in the DB soon → check wiki for informations
 - Need to do August Calibration + Cross-Checks!
 - State that we can start analysis (People are welcome to contribute!!!)
- Relative good Gain/MIP Calibration done, few constants/checks still needed (Intercalibration HG/LG, DeadCell Map..)
- Time domain still essentially uncharted and need pioneering minds!
- First MC/Data Comparison!!
 - Need further validation with Electron data → saturation!
- Wait and see!!

