TOB status report

(Mostly) understanding noise

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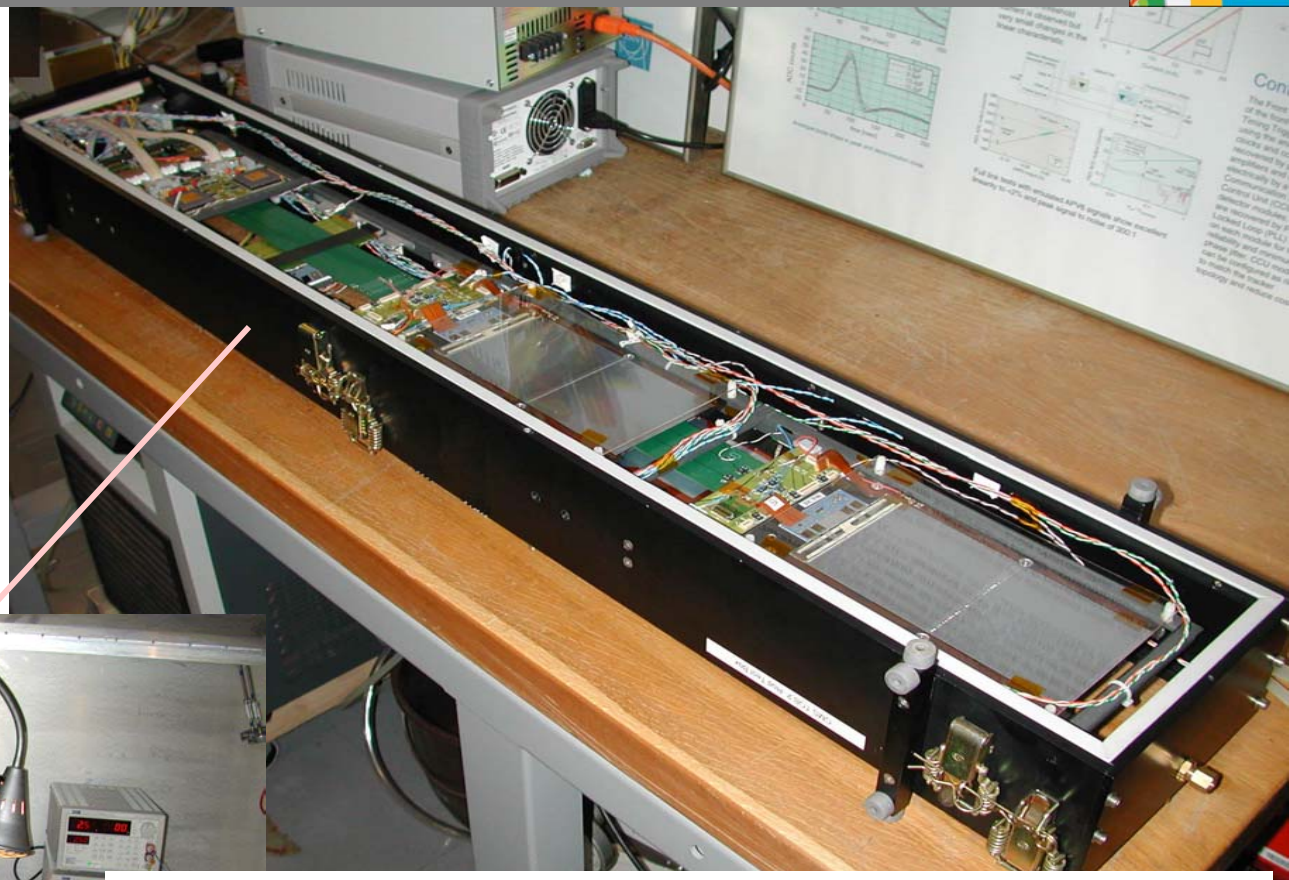
- Noise measurements and consistency checks
- Pedestal drift - temperature dependence
- Open problems and ongoing work

CMS week, tracker general meeting, 25 September 2002

The rod setup

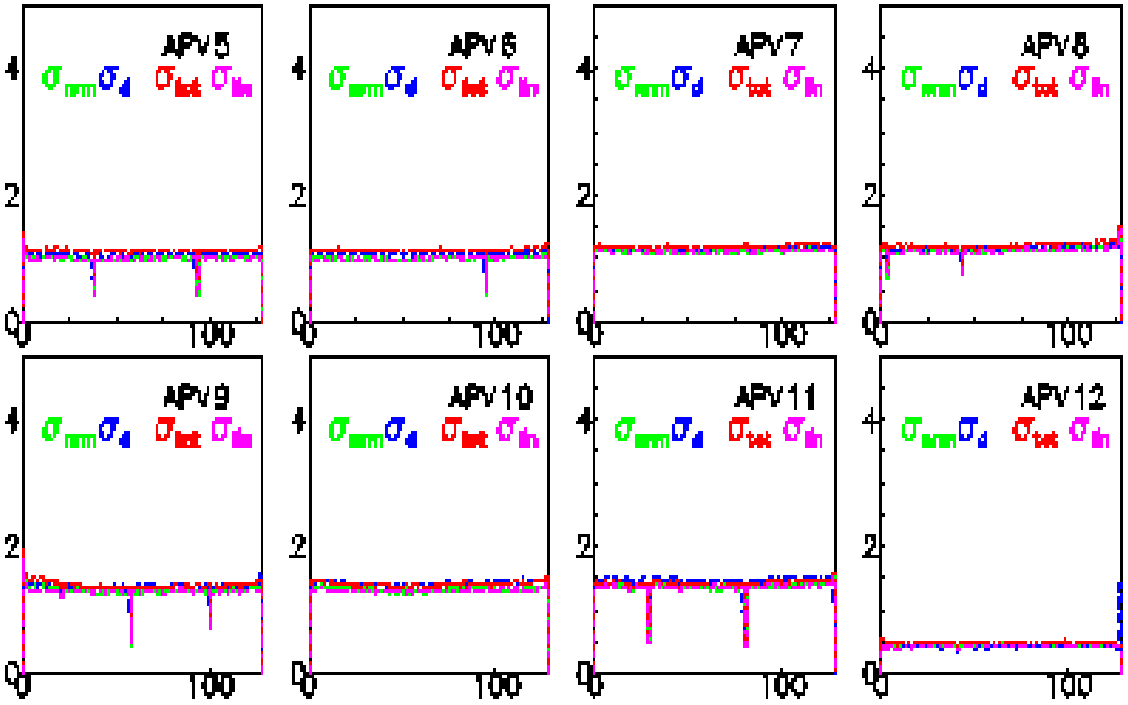
See Paolo's talk at the last tracker week !



Alu box, gas tight, with patch panel for pipes (C_6F_{14} cooling and dry air) and other services
(it can house 2 rods)
External temperature and humidity probes
Modules, optohybrids, CCUM, high voltage
Daq PC with 1 TSC, 1 FEC and 3 FED cards,
DAQ Software

Noise figures

(Very) good noise profile for random triggers or low/high frequency triggers



(deconvolution)

$ped_i = \langle ADC_i \rangle_{ev}$

σ_{tot}: RMS of $ADC_i - ped_i$

σ_d: RMS of $0.5(ADC_i - ADC_{i+1})$

σ_{nrm}: RMS of $ADC_i - ped_i - CMN_0$

σ_{lin}: RMS of $ADC_i - ped_i - CMN_i$

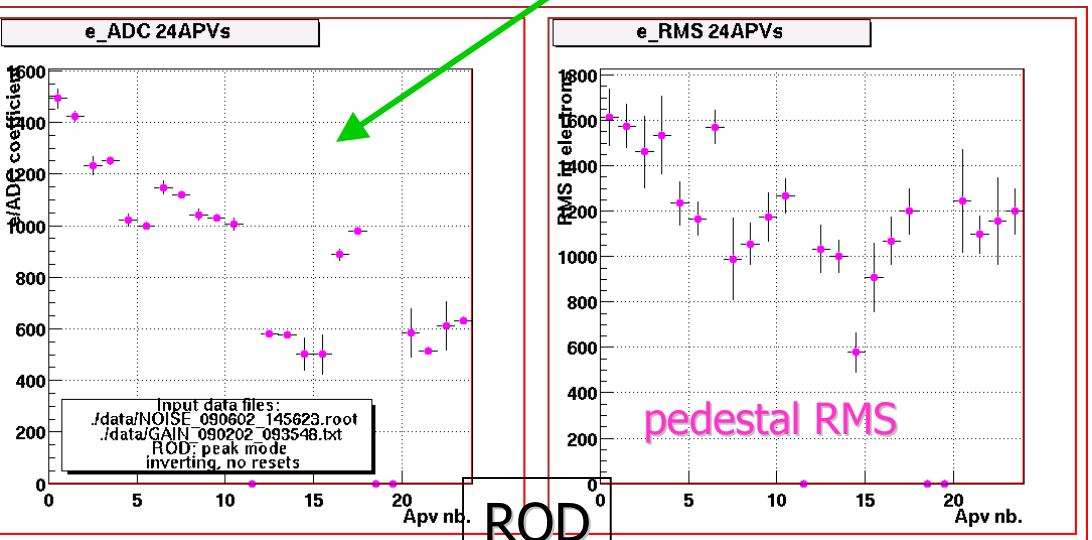
$$CMN_0 = \langle ADC_i - ped_i \rangle_{strip}$$

$$CMN_i = b + a\,i$$

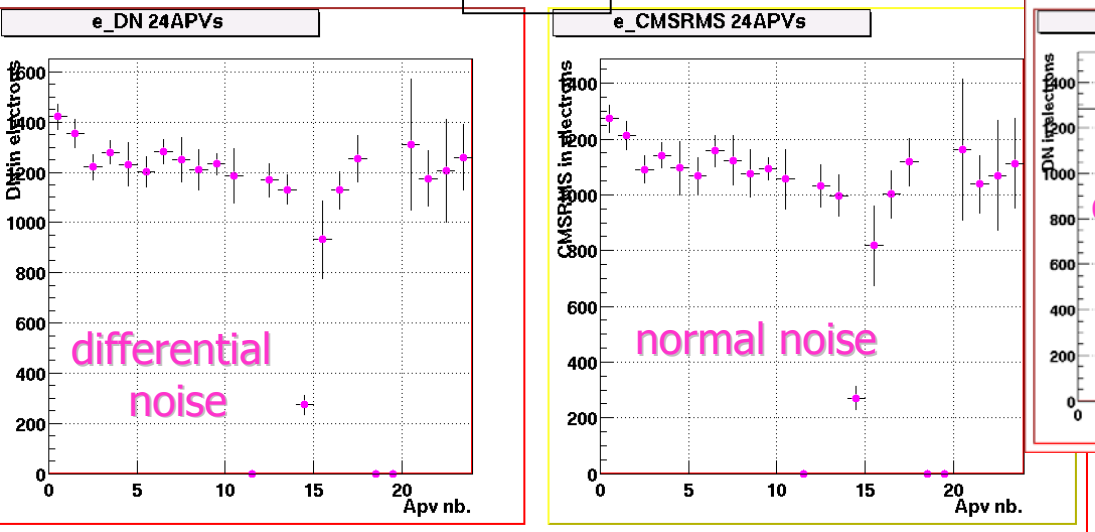
No large contribution from CMN ($\sigma_{tot}=\sigma_d$), noise is flat and gaussian
(both in peak and deconvolution mode)

Understanding the noise

Noise can be translated into ENC from the gain curve in calibration (peak mode)



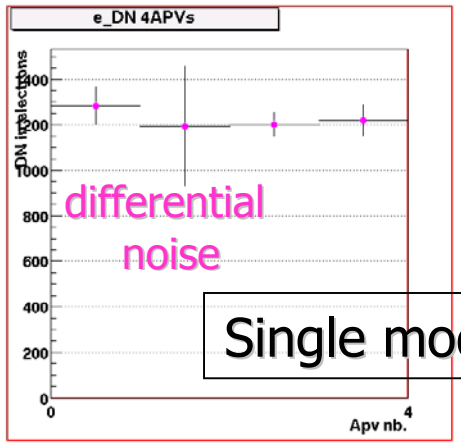
ROD

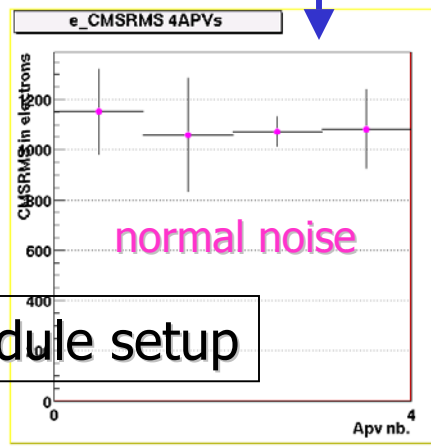


⇒ good stability of noise along the rod

⇒ agreement with expectations and the single module setup (no optical link there)

⇒ noise about 1200 e

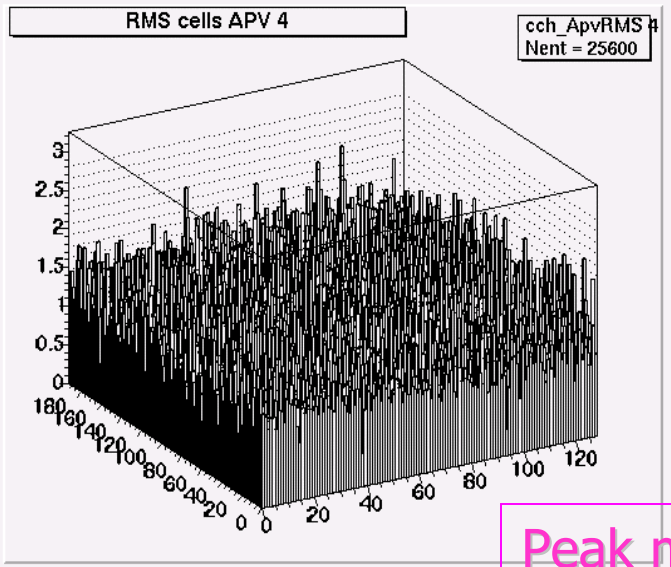


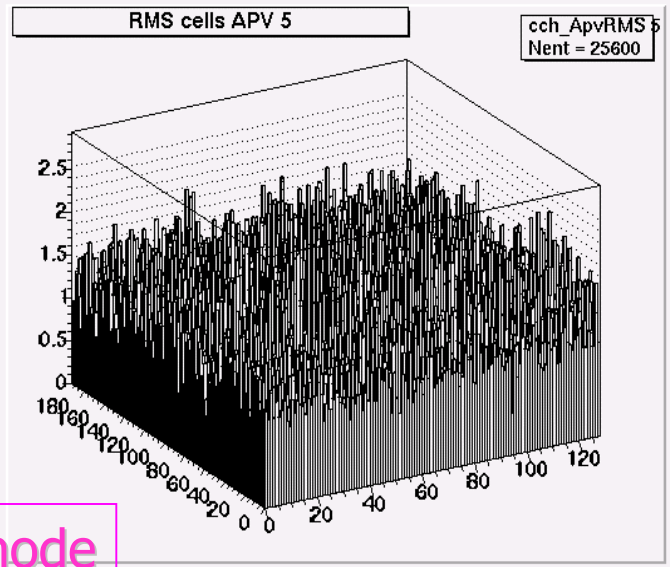


Single module setup

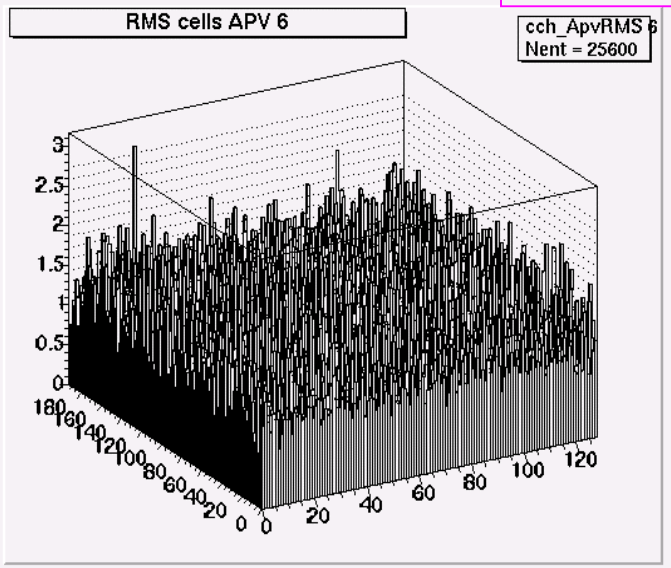
Pipeline cell dependence

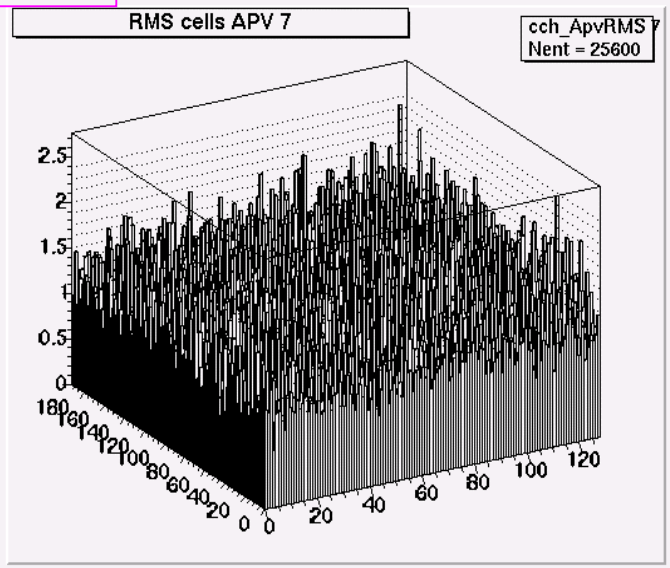
Are noise figures dependent on the position in the chip memory?





Peak mode





Random triggers: noise vs pipeline cell

- stable in peak mode
- studies going on in deconvolution

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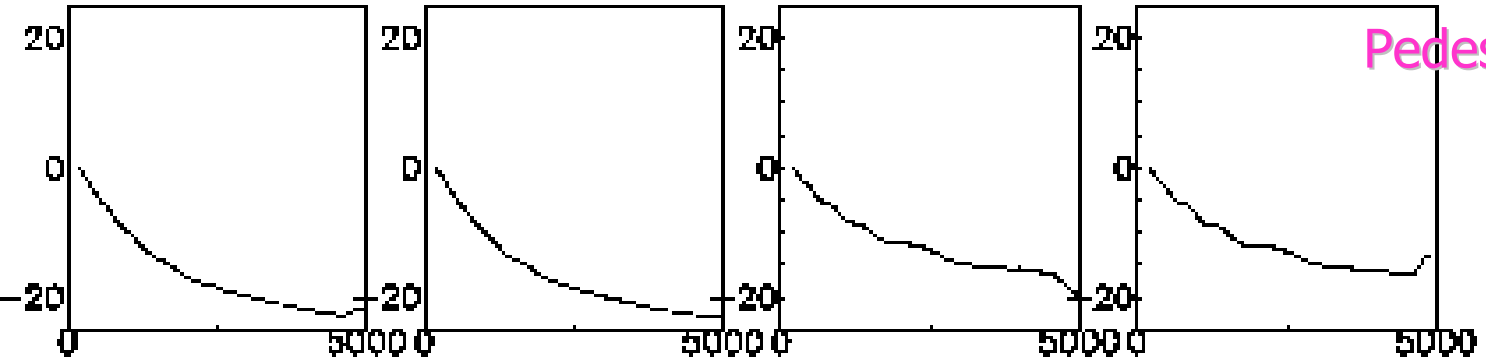
Pedestal drift

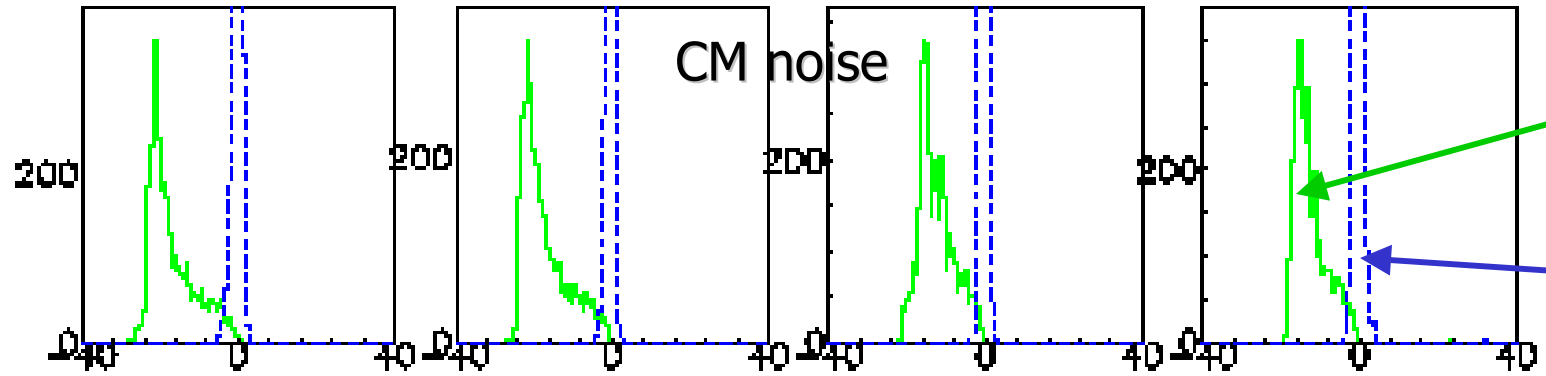
Drift of the pedestals in time at the beginning of a run:



Pedestal updating

5 min.

Temperature increases at the beginning due to the start of run
⇒ change in the threshold of the laser
⇒ manifests itself in huge CM shifts if no updating is performed

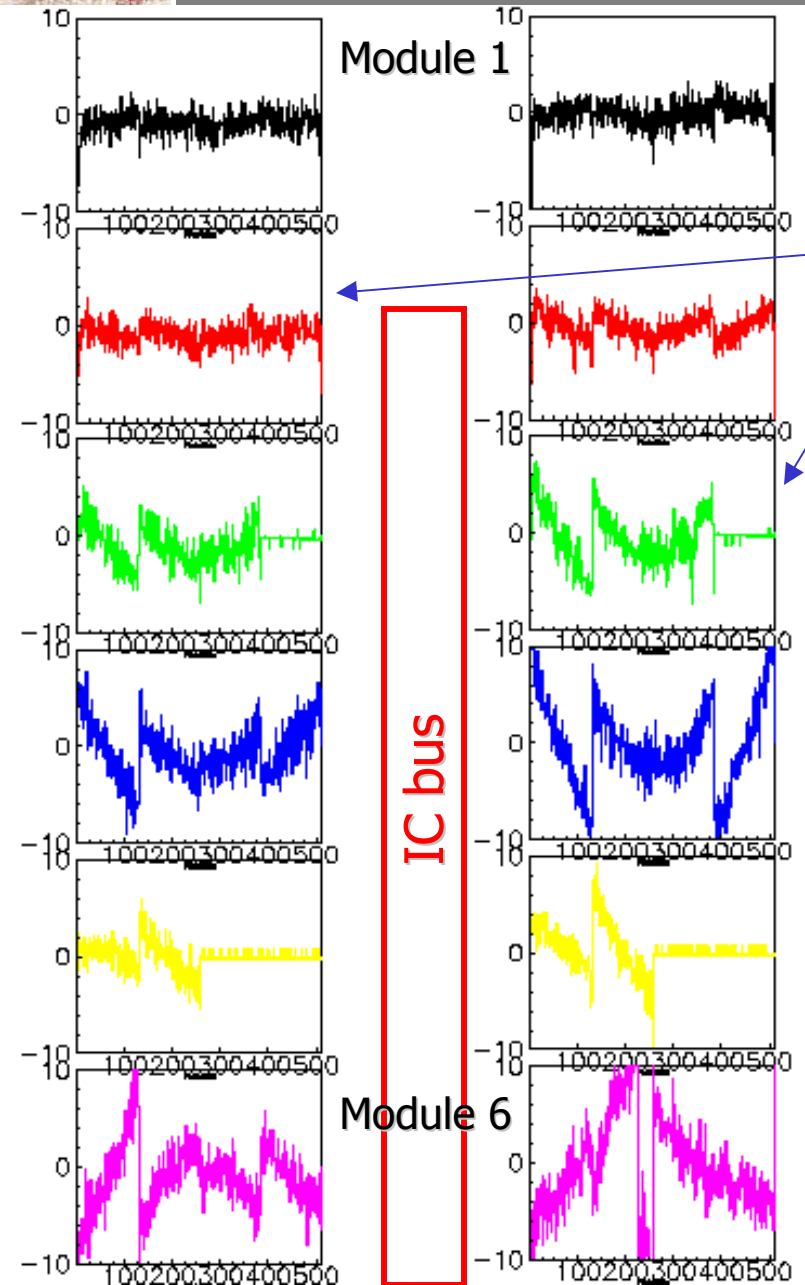


no updating

updating

⇒ updating procedures are very welcome

Nasty events at 2KHz trigger rate



Outstanding problem: noise pick-up still present in our setup

Example of worst events (high 'a')
(Raw-Ped is shown)

⇒ noise is picked up by the module and 'propagates' linearly inside it

⇒ linear NON flat CM noise appears

Correlations per event in the modules are evident. Effect more important for 'external' APVs

⇒ effect is worse for detectors facing the interconnect bus

⇒ effect depends on the trigger frequency!

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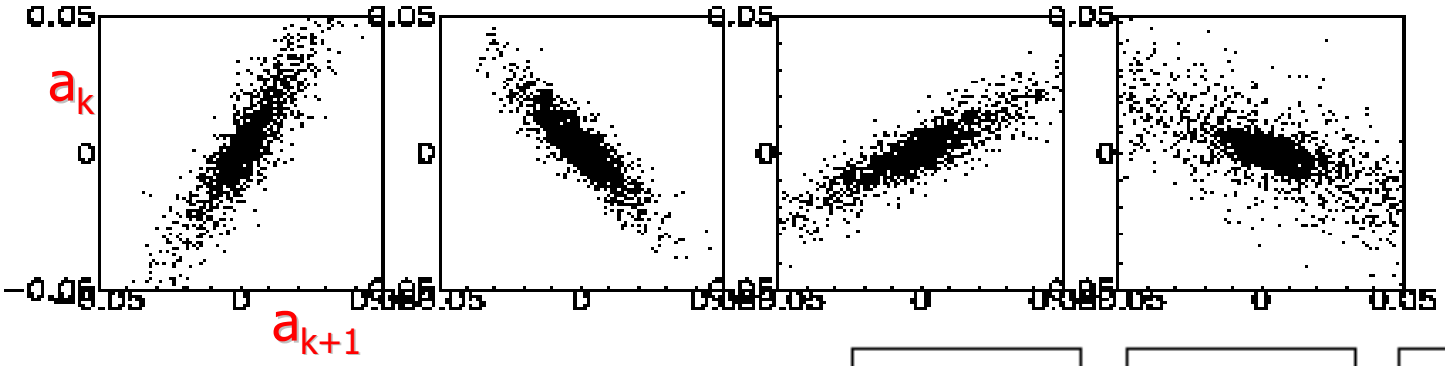
Understanding it...

Noise is correlated in modules and in APV

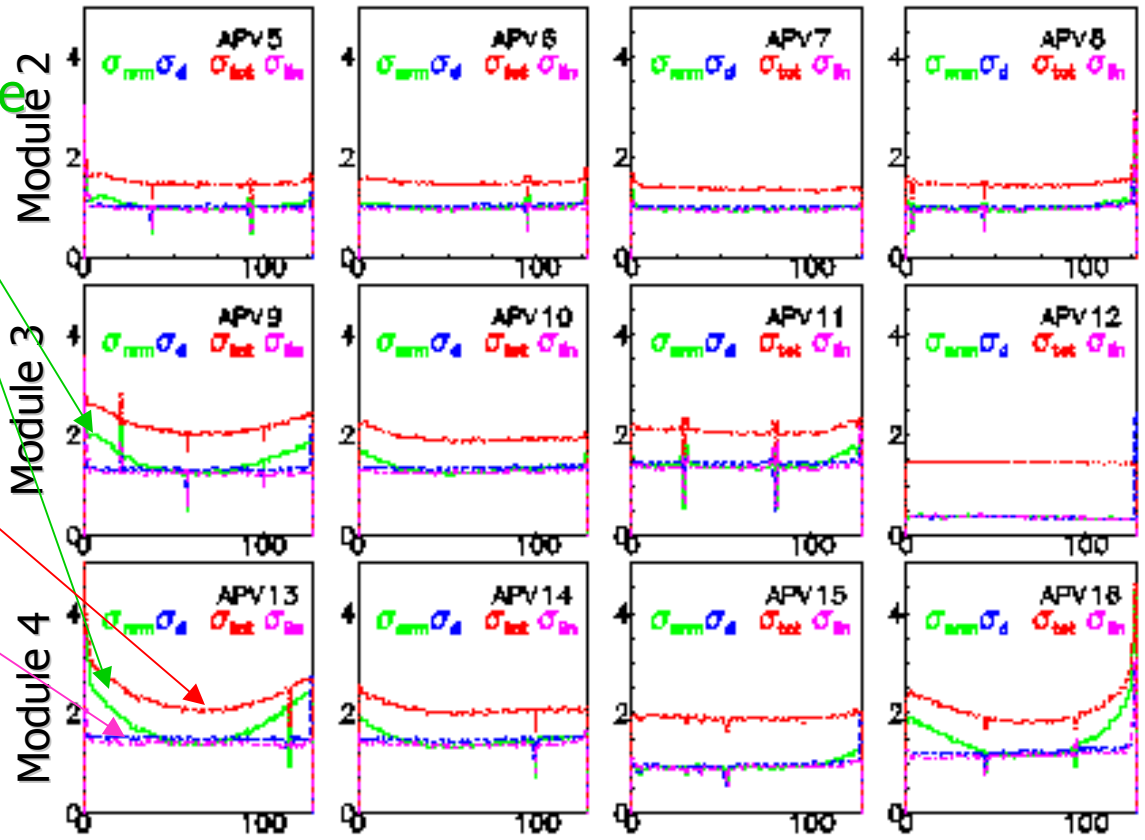


large variation of CMS-like noise at the edges of the chip

the total noise follows consequently

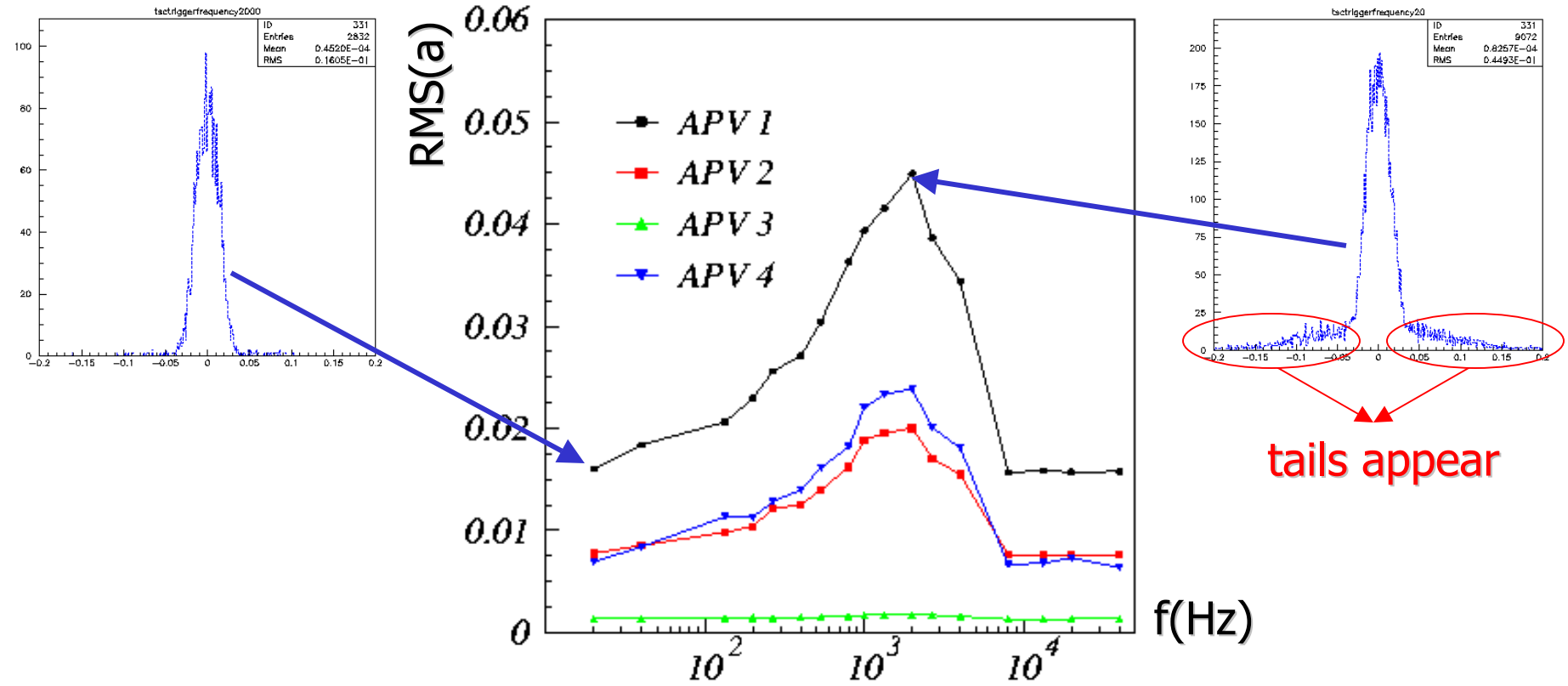
σ_{lin} almost flat

$\Rightarrow$ confirmation of linear CMN



Dependence of noise on trigger frequency

The dispersion of the slope (related to the amount of noise) depends on the frequency of the internal trigger



Worst operating conditions at about 2KHz

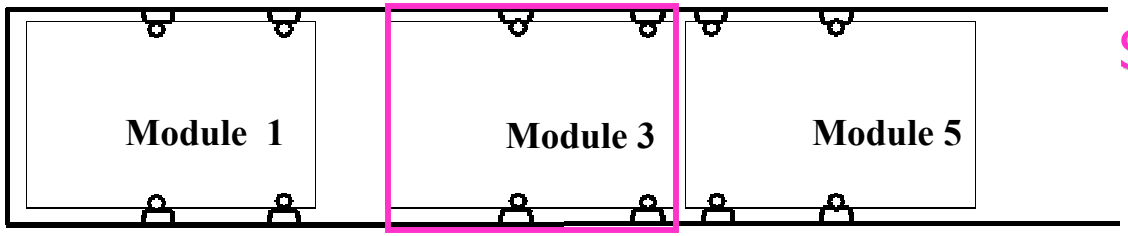
Only in deconvolution mode: negligible the effect in peak

Investigations…

Many different configurations tried to better investigate the problem

- improvements in the grounding scheme
- leave just one module / one side of the rod modules
- capacitors on the LV lines
- insulating the modules from the frame
- shielding of the modules from the rod
- mounting modules at 90° w.r.t the rod -not to be used in CMS- ;)
- injecting noise at different frequencies after shielding

(more are planned…)



Shielding realized by a 1.5 mm copper panel between module and support (+bus, +pipes)

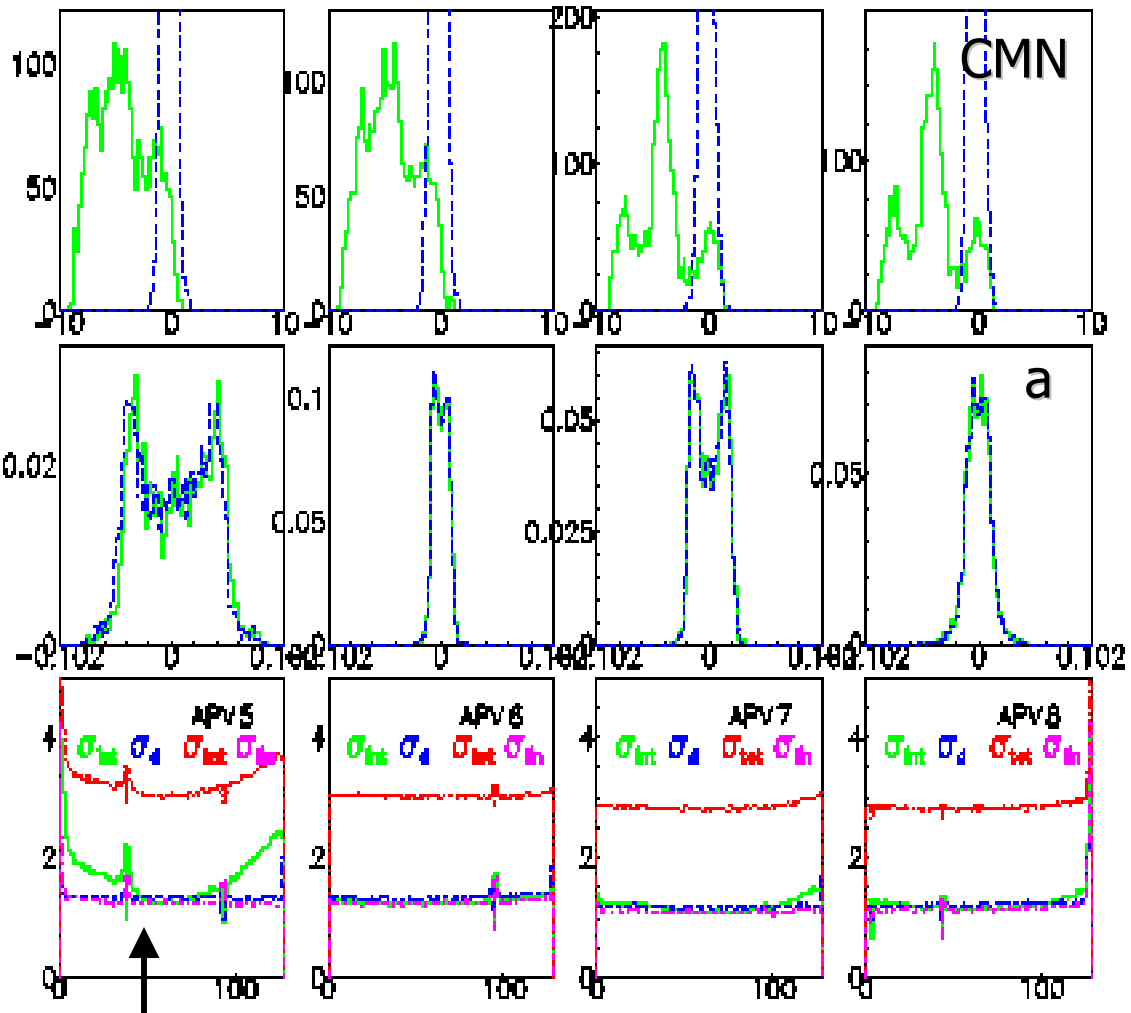
⇒ non-flat noise disappears when far away from the rod, or when shielded:

Noise is brought in by the rod itself, but by what exactly?

- conductive pipes as a perfect solenoid?
- interconnect bus?
- CF support?

can we disentangle between them?

Injecting more noise



APV closest to noise

Noise is injected at different frequencies with an antenna

Module is shielded

Same pattern of the noise is found on the chip closest to the noise source

Indication of worse behaviour for high noise frequencies

A linear CM subtraction restores a perfect (gaussian) noise behaviour

⇒ Cluster finding is more robust !

Conclusions – so far…

Huge amount of work for a detailed understanding of the behaviour of the rod, with particular attention to the noise

- quite important for optimizing the setup and planning of the extended tests

Preliminary results:

- quite satisfactory response with random triggers – or in peak mode
- noise is stable all along the rod and comparable to the single module setup
- pedestal drifts associated to temperature change at the optohybrid level

Side observation:

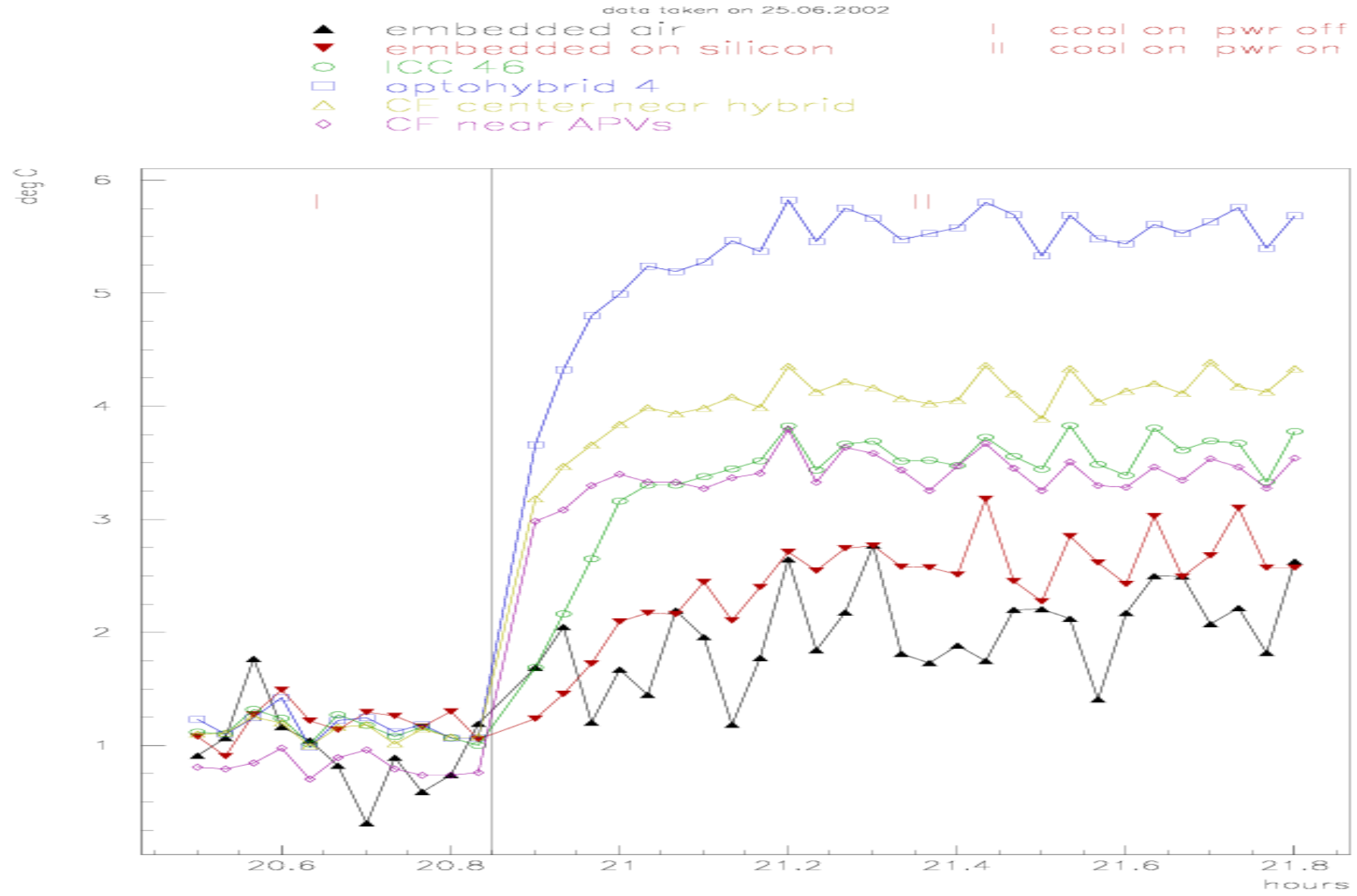
- if external noise is there, evidence for linear propagation in the module
  - totally cured by linear CM subtraction

Outstanding problem:

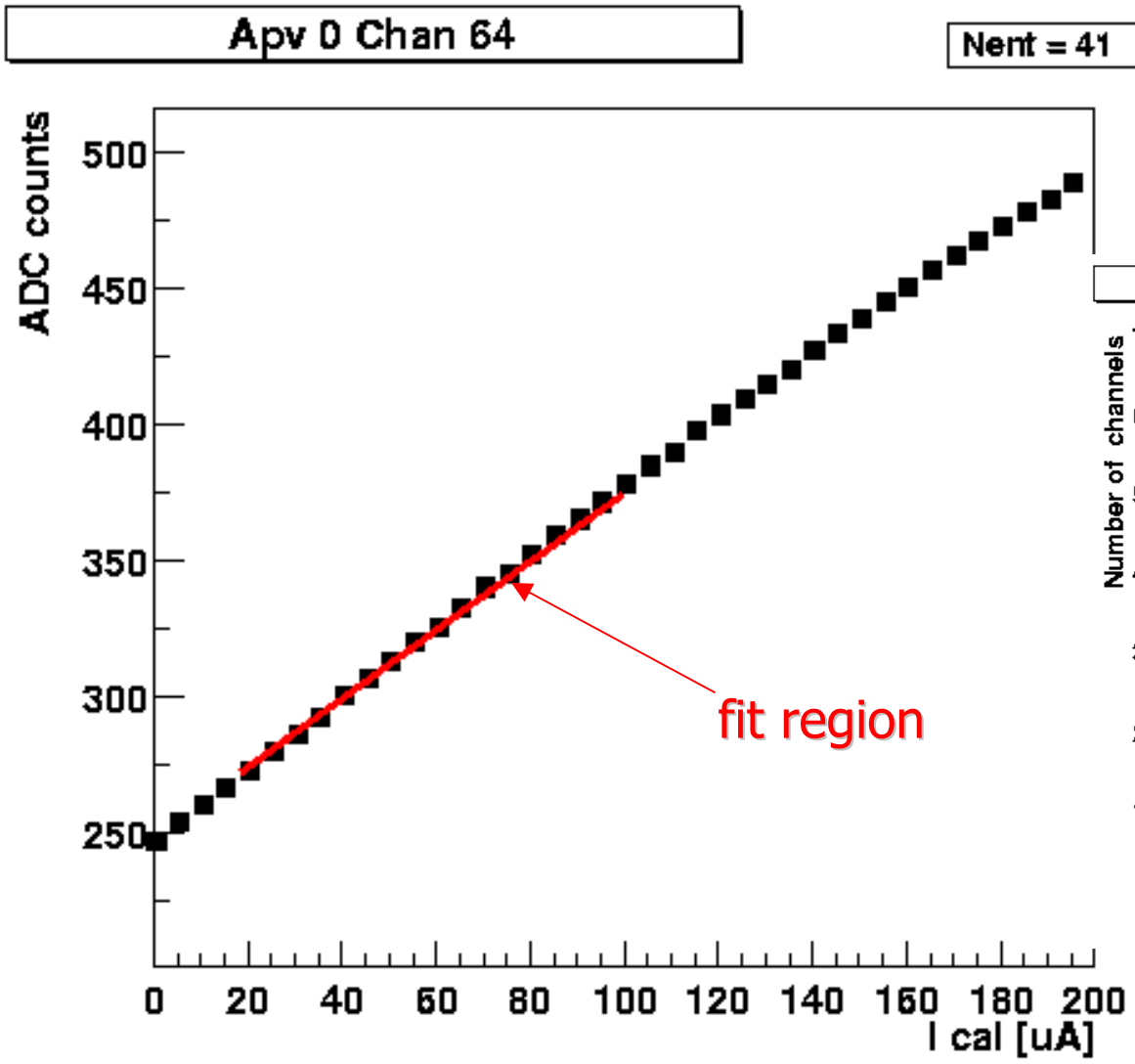
- still external noise in the system, peaking at a certain trigger frequency
- correlated in all modules
- necessity of finding the source
  - brought in by the rod itself (bus? pipes? support frame?)

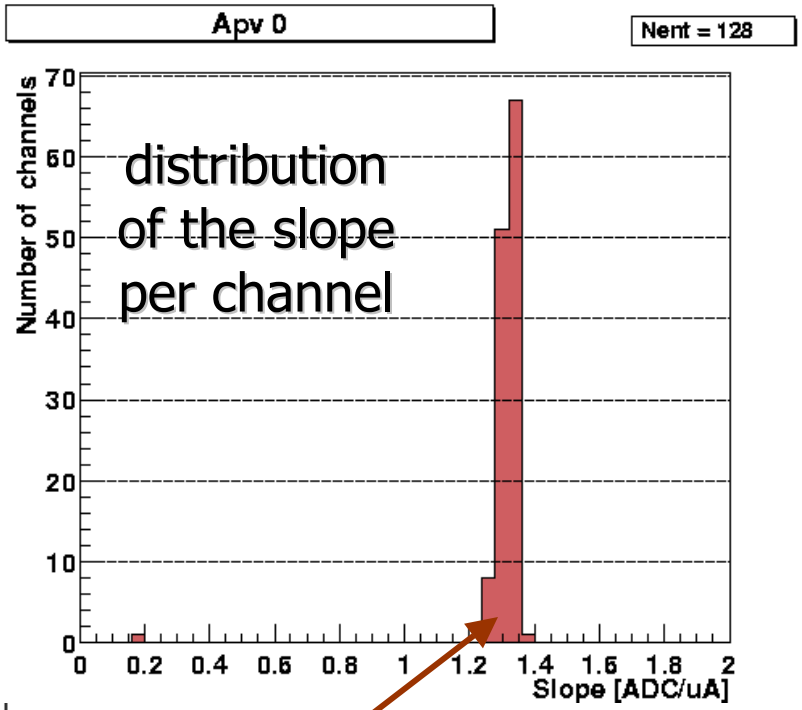
  ⇒ several more tests ongoing…

Thermal measurements



Calibrating with the gain





Average is taken as a calibration factor

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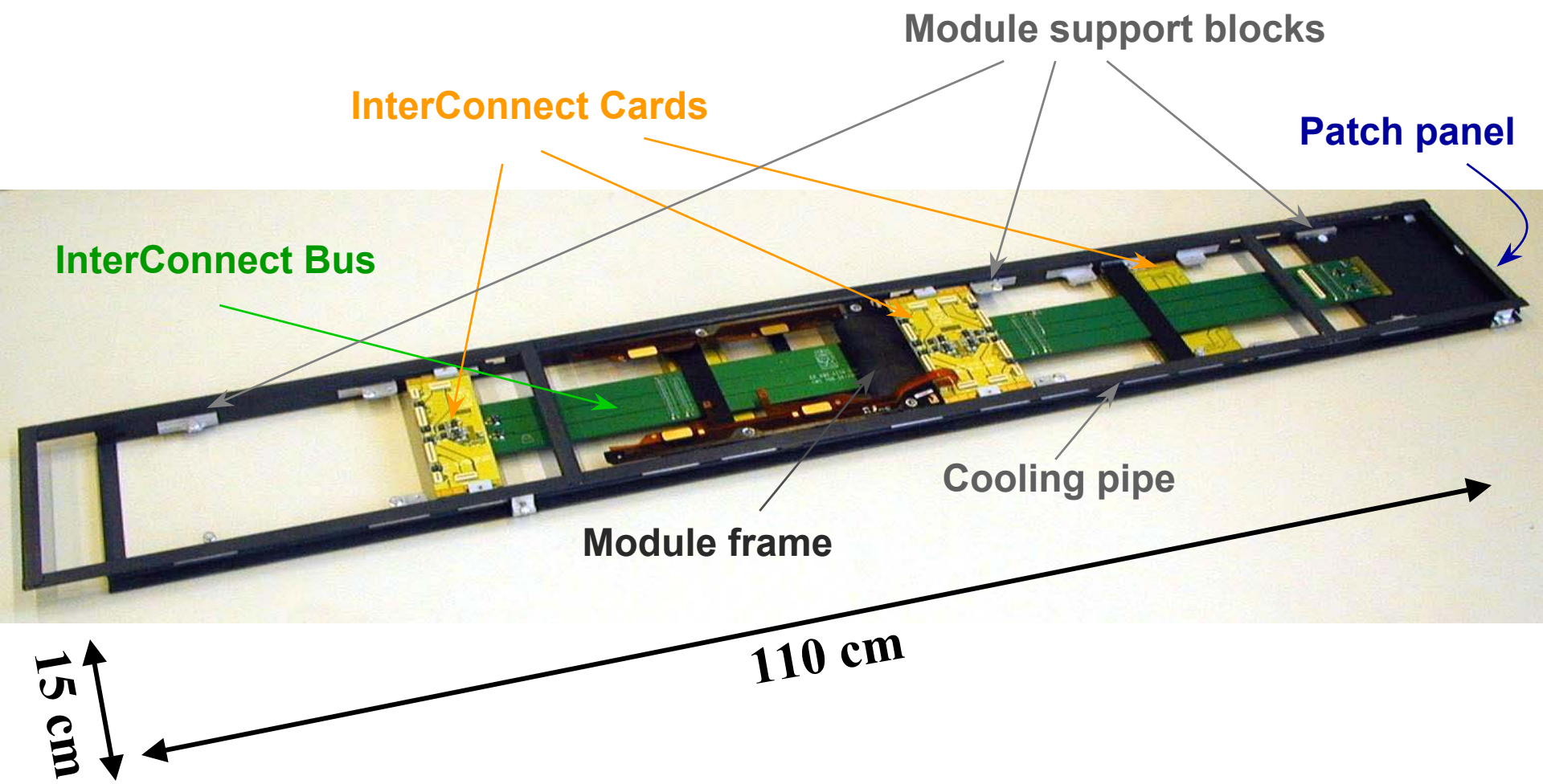
The rod


Module support blocks
InterConnect Cards
Patch panel
InterConnect Bus
Cooling pipe
Module frame
110 cm
15 cm