

Calibration of the gain and measurement of the noise for the apv25 electronics

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From INFN Italy: E. Cisbani, P. Musico

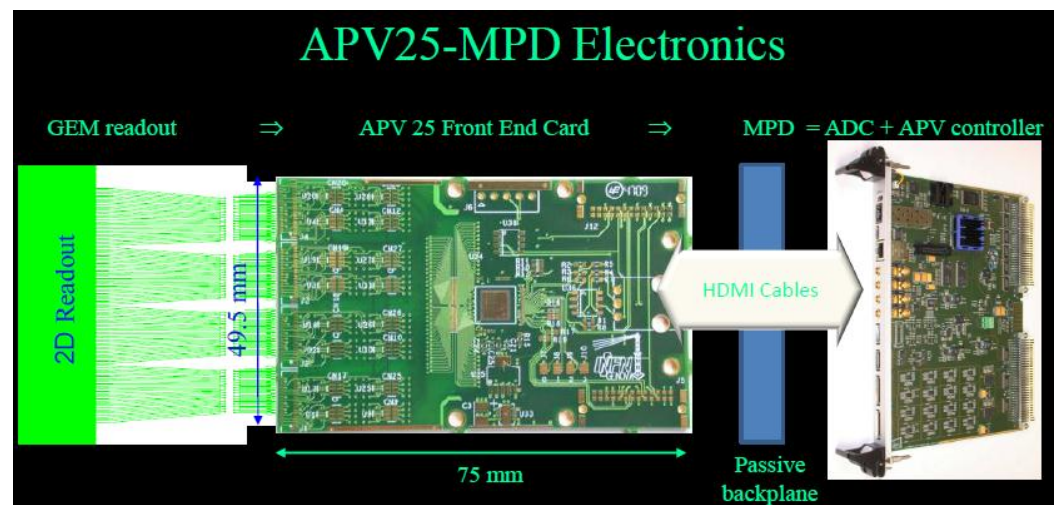
Experimental setup put in place at UVa to

- Measure the gain of two apv25 based readout electronics: Scalable Readout System (CERN, RD51) and MPD (INFN Italy for SBS)
- Measure the apv channels rms noise and estimation of the ENC from the apv gain measurement
- Comparison of the performances of the two systems

APV25 MPD and SRS system

Multi Purpose Digitizer (MPD)

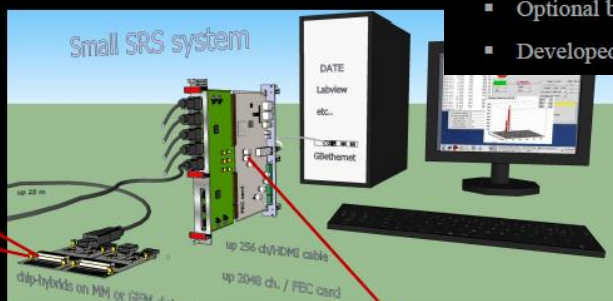
- P. Musico, INFN Italy
- More than 2.5K Channels at UVa



Main features:

- 2 “active” components: Front-End Card and VME64x custom module (MPD=Multi Purpose Digitizer)
- HDMI Copper cables between front-end and VME
- Optional backplane acting as signal bus, electrical shielding, GND distributor and mechanical support
- Developed by INFN, manufactured by a commercial company

APV25-SRS Electronics @ UVa



Scalable Readout System (SRS)

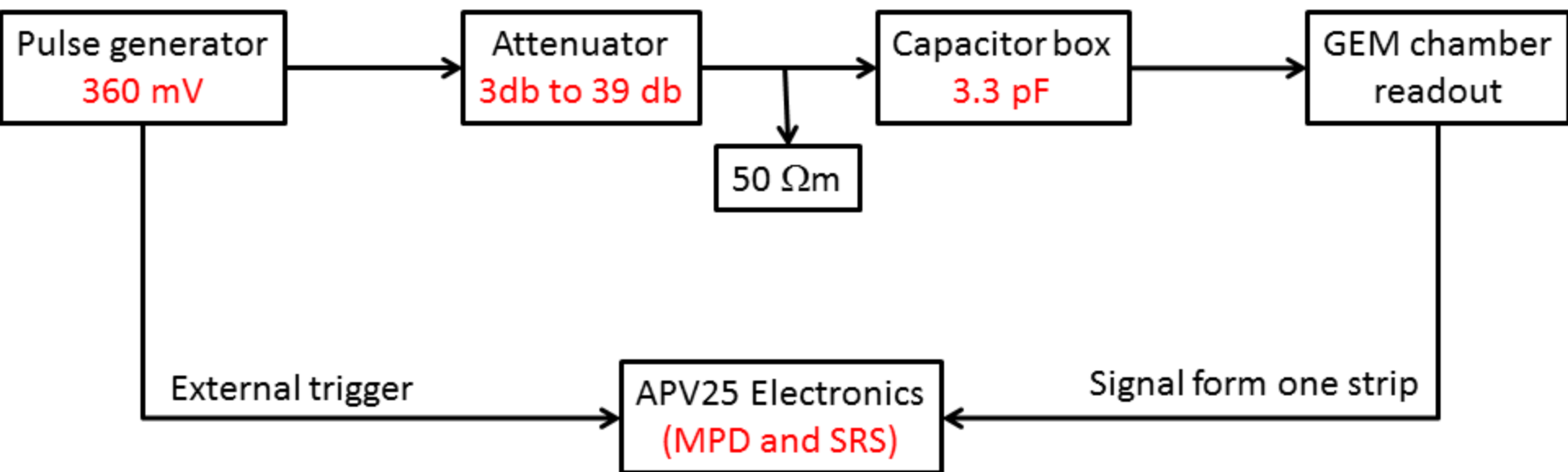
- Portable readout system developed by RD51 Collaboration (CERN)
- Successfully tested with APV25 chip (many users and experiments)
- APV25 cards, 1 ADC board, 1 Data Concentrator board
- Data transferred through Gb Ethernet via UDP (ALICE DAQ)
- Common platform for different chips (Bettle, VFAT, VMM1)



Scalable Readout System (SRS)

- H. Muller, CERN, RD51
- 2048 channels at Uva

APV25 Gain calibration setup

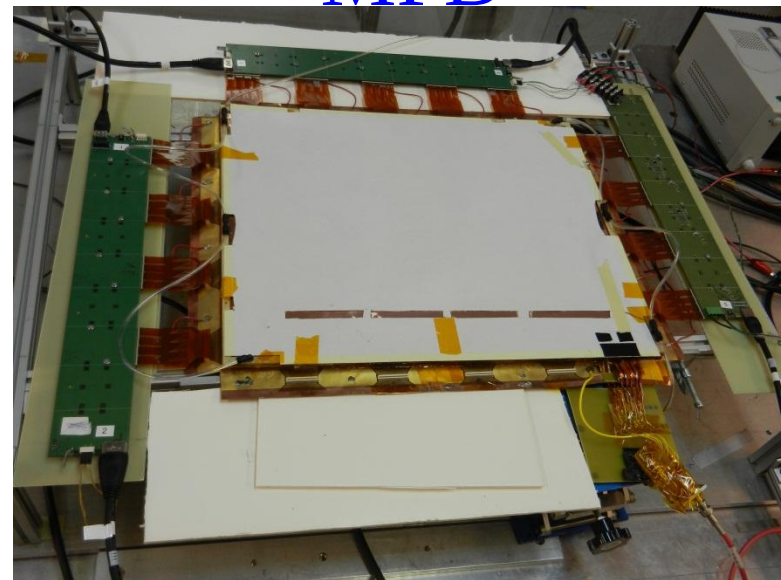
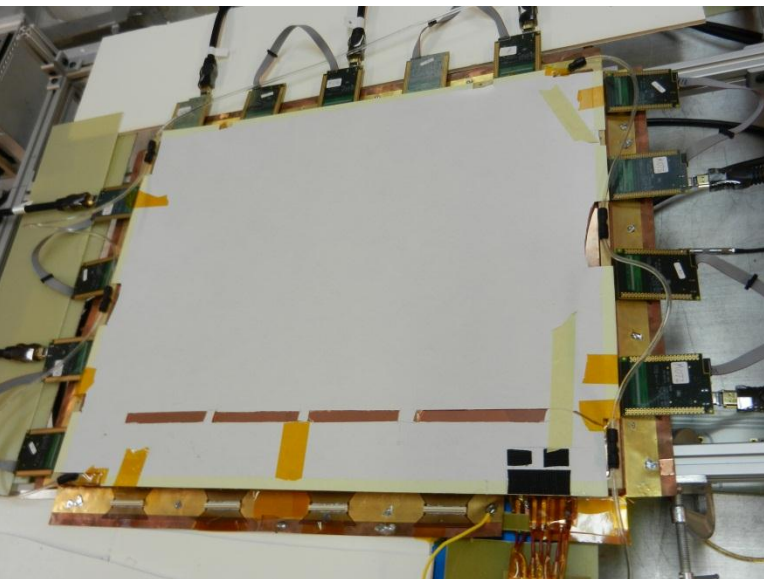


- Test pulse = 360 mV, Capacitor = 3.3 pF → Equivalent charges = 7.2 Million e⁻
- Injected charges = Equivalent charges / Attenuator → attenuation 3dB to 39 db

APV2 on SBS GEM prototype

SRS

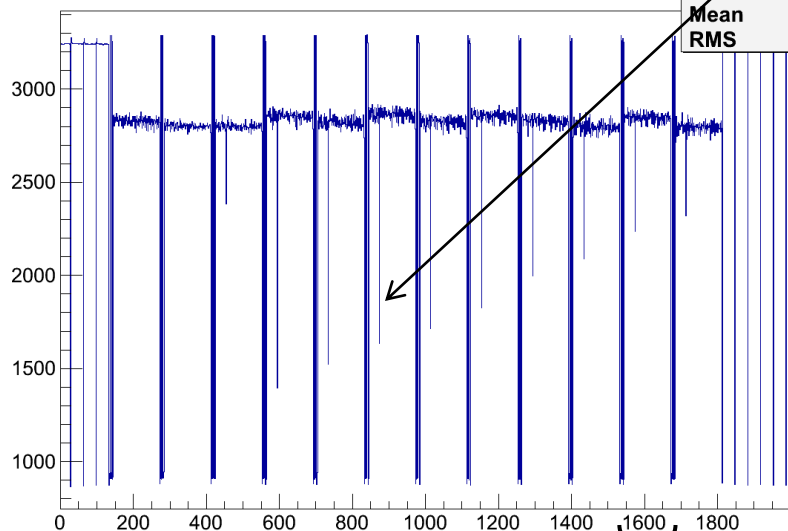
MPD



Analog signal

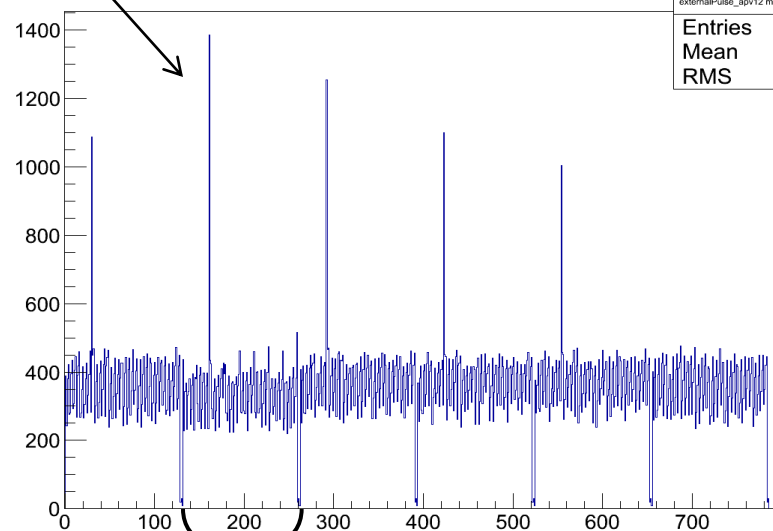
Fec1 ch1 APVn1 eventNo 2524

apvNo1RawData	
Entries	2524
Mean	1006
RMS	587.5



externalPulse_apv12 mpd9 adc3 adcl2C3

externalPulse_apv12 mpd9 adc3 adcl2C3	
Entries	786
Mean	393.6
RMS	225.8

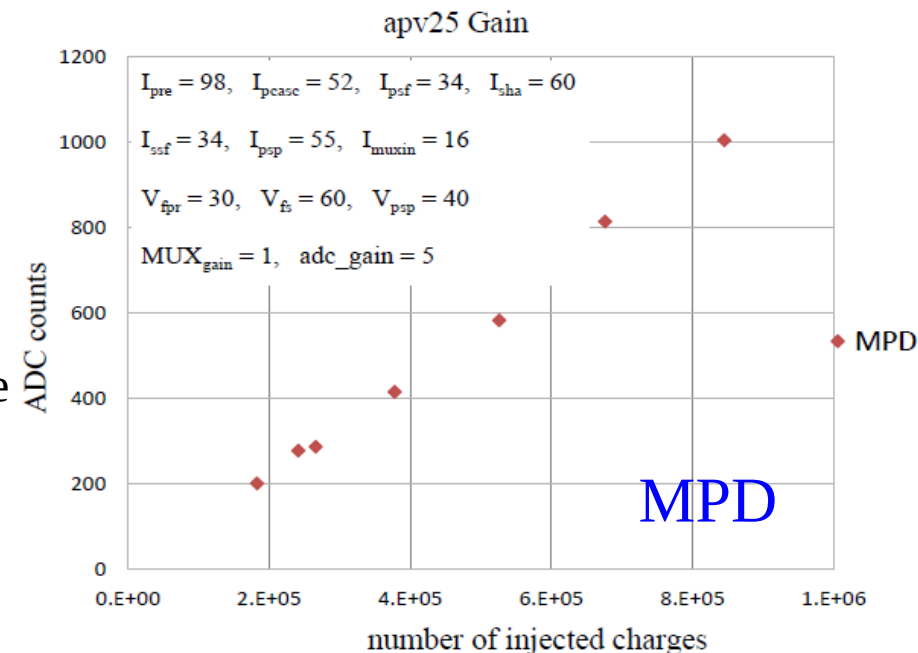
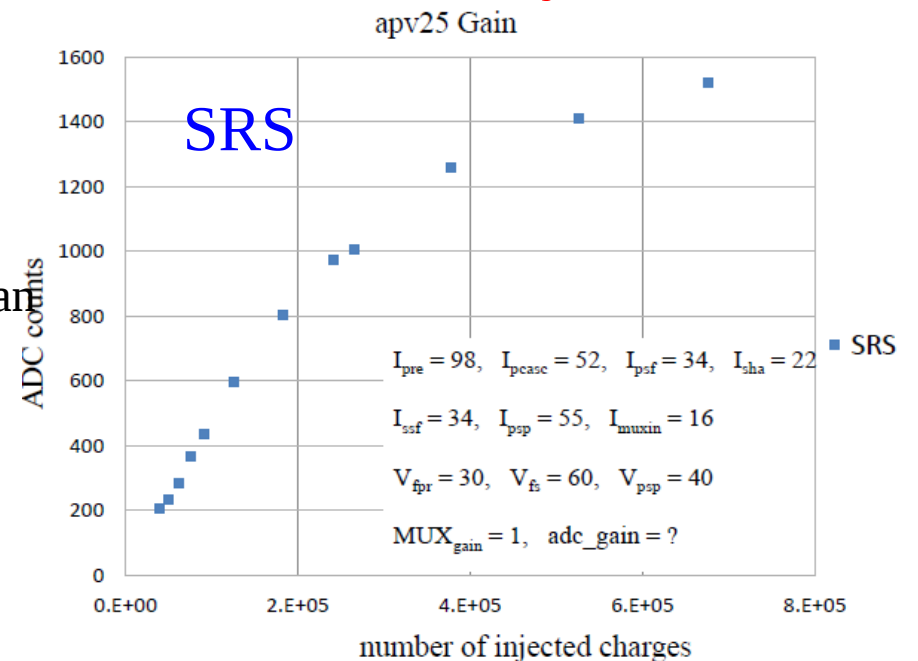


25 ns time frame

APV25 and ADC configuration for MPD and SRS systems

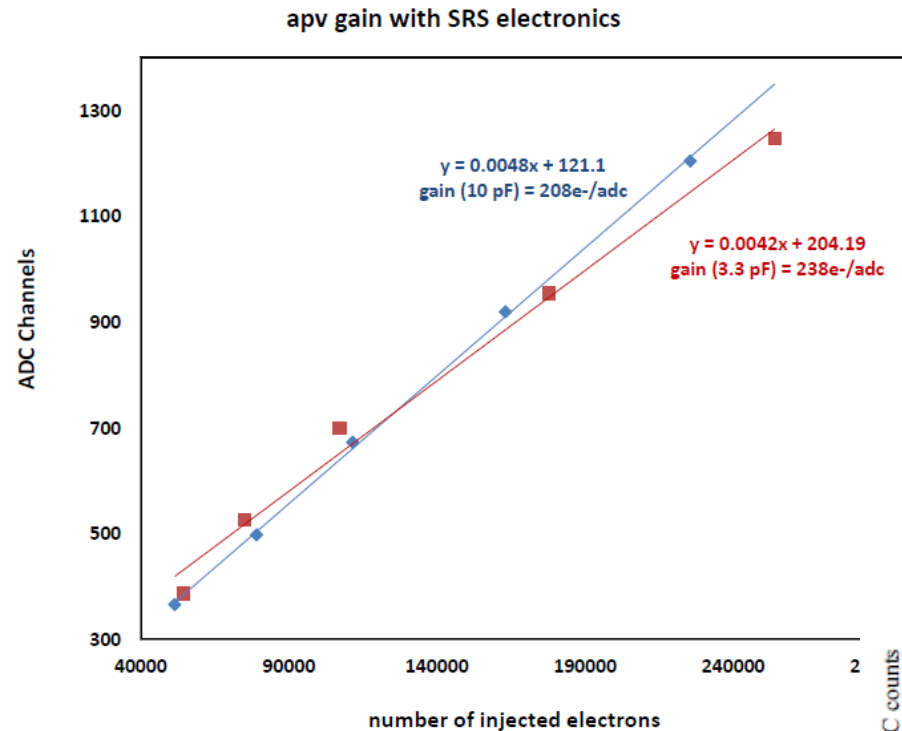
- We have almost the same configuration parameters for the two systems
- Different performances of the two electronics can be related to some differences in hardware that Paolo has identified:

- protecting diode in the VCC line of the INFN card
- input capacitance 47 pF vs. 1 pF in SRS
- 1 M Ω resistor to ground in the SRS input lines
- external biasing in INFN card vs. internal biasing in SRS (this affect the values of the APV parameters for the optimal working point)

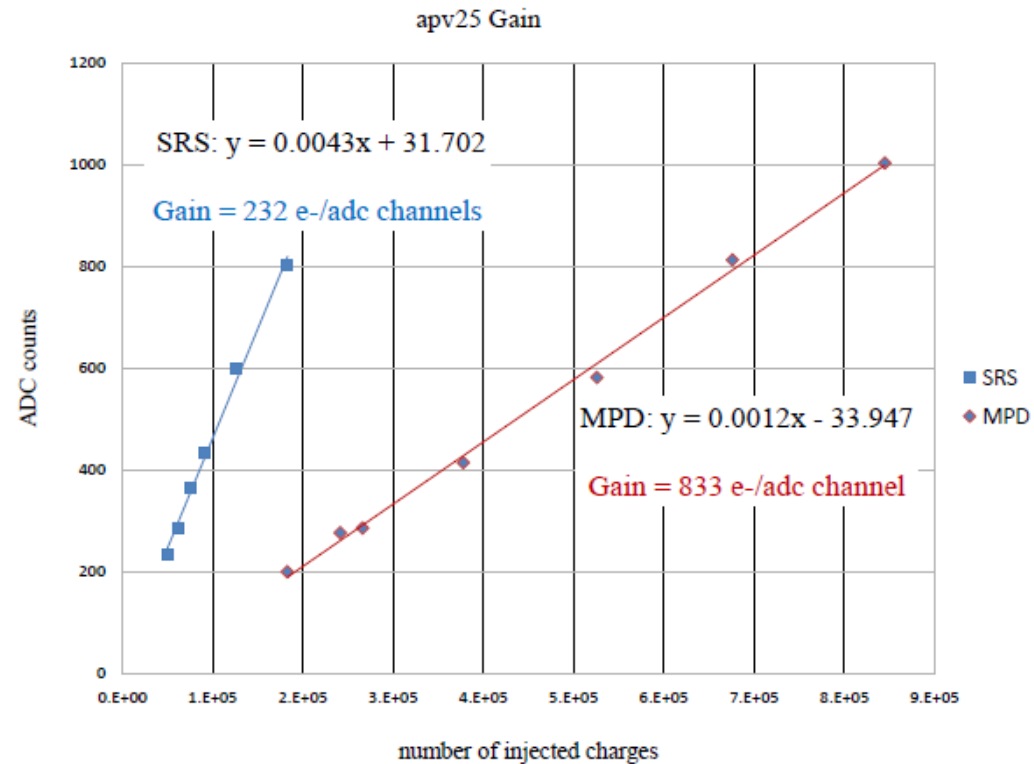


Apv25 Gain: MPD vs SRS

Gain calibration with 3.3pF and 10pF



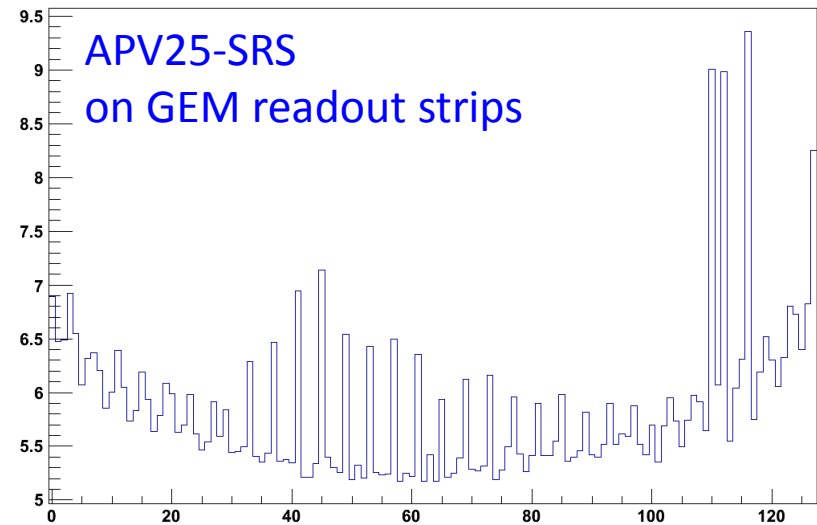
Gain calibration for SRS and MPD



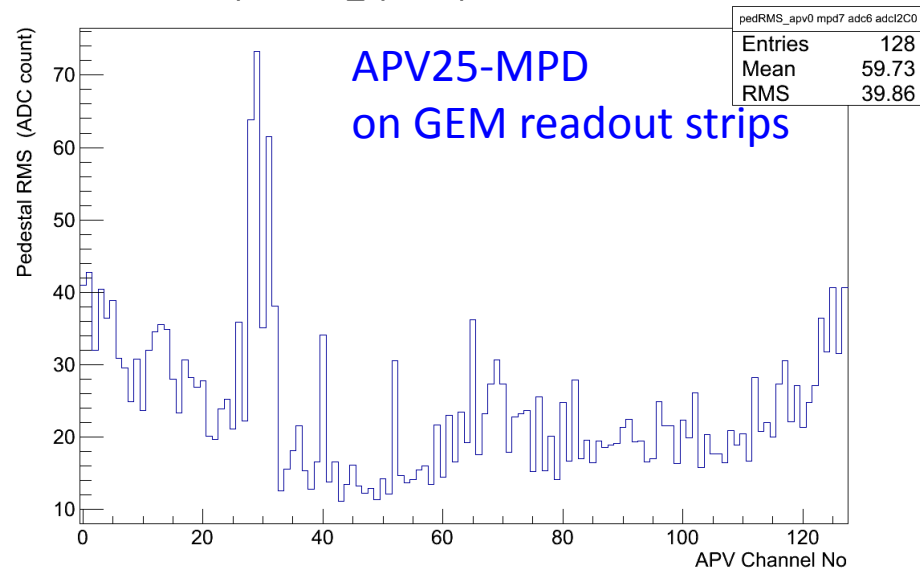
Study of the noise (rms of the apv25 channels)

- Typical rms for each of the 128 channels of a given APV cards from a pedestal run and for both MPD and SRS
- This rms is obtained after common mode correction of the baseline
- The common mode correction reduce the rms by
 - a factor 2 for apv25-MPD (basically from ~ 40 adc counts to ~ 20)
 - A few adc counts for apv25-SRS (from ~ 8 adc counts to 6.5-7)

apvNo0_Noise



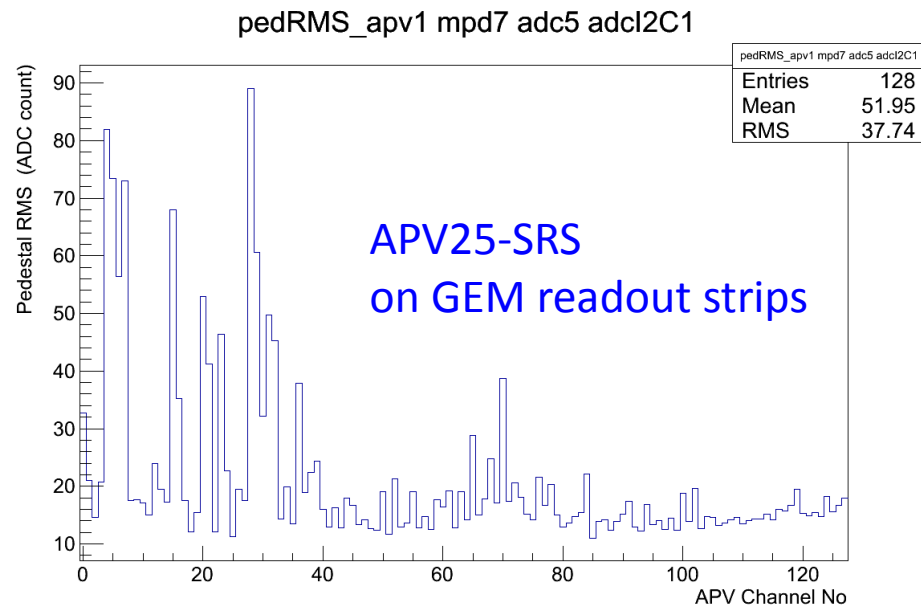
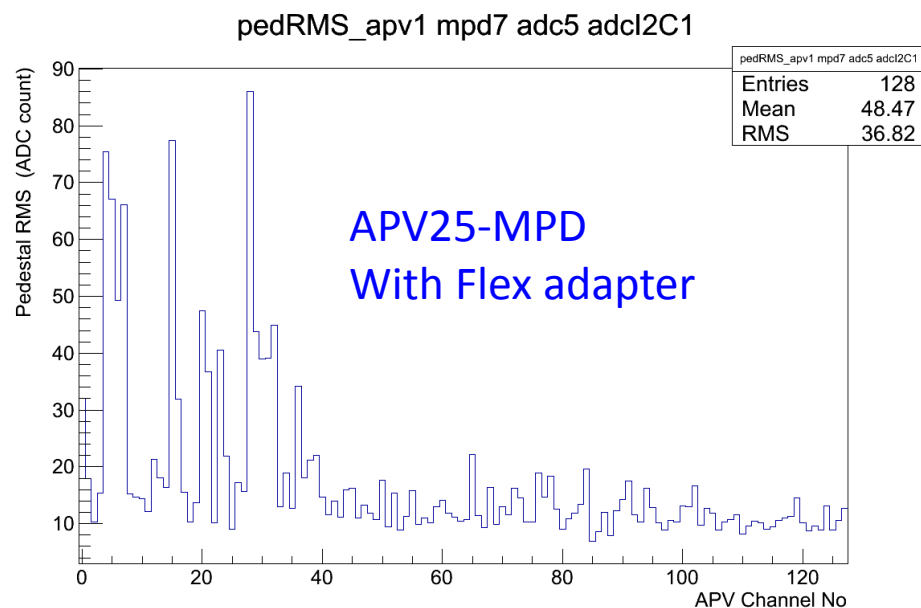
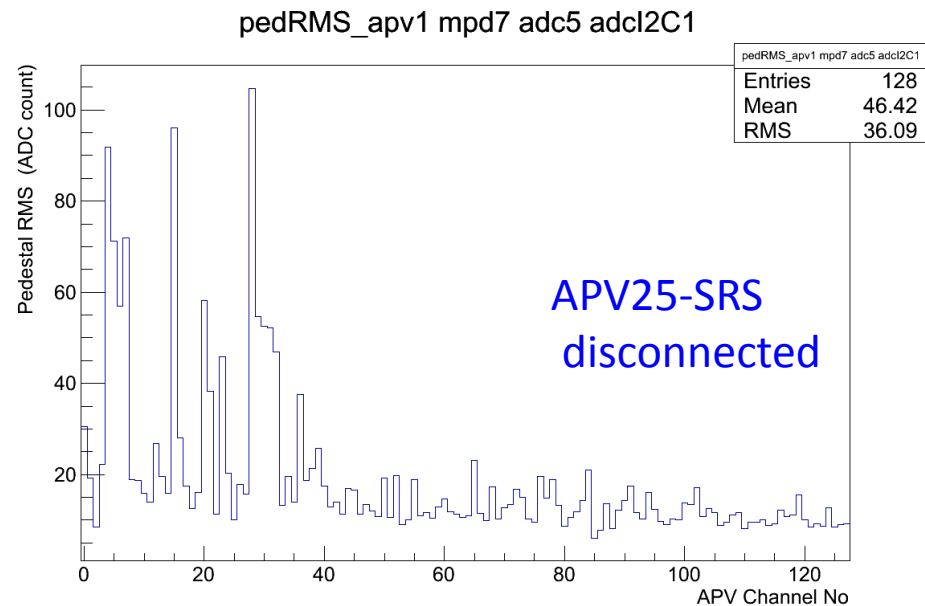
pedRMS_apv0 mpd7 adc6 adcl2C0



Where do the hot channels come from for apv25-MPD electronics

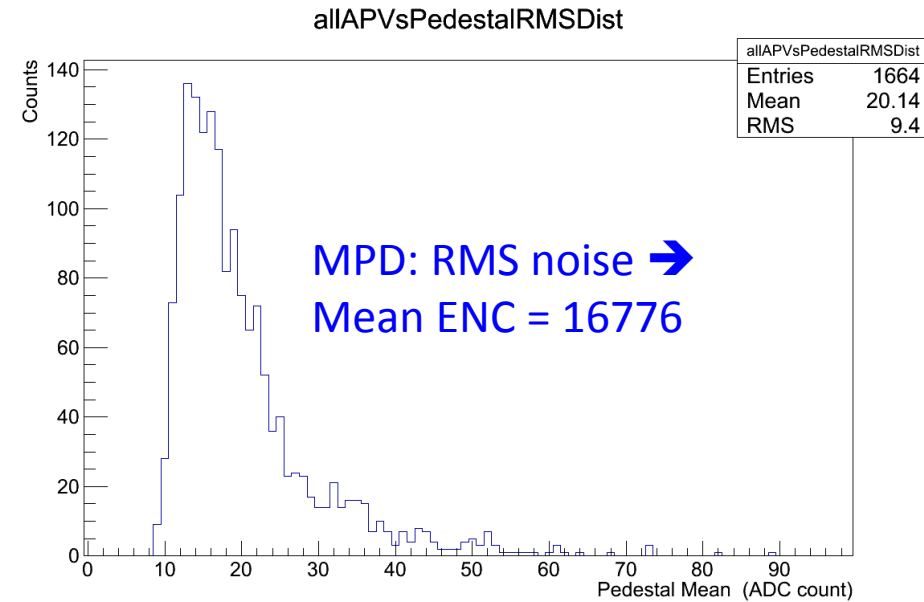
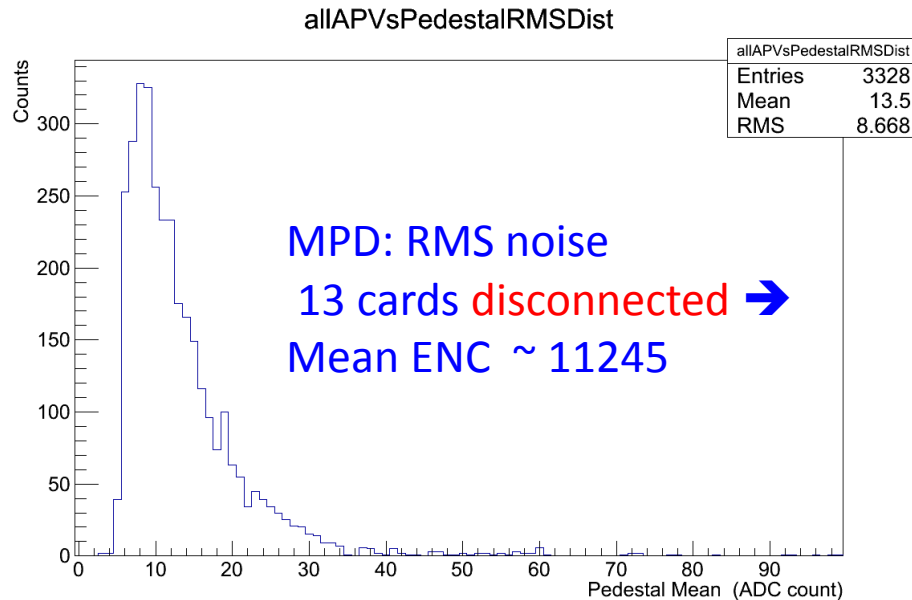
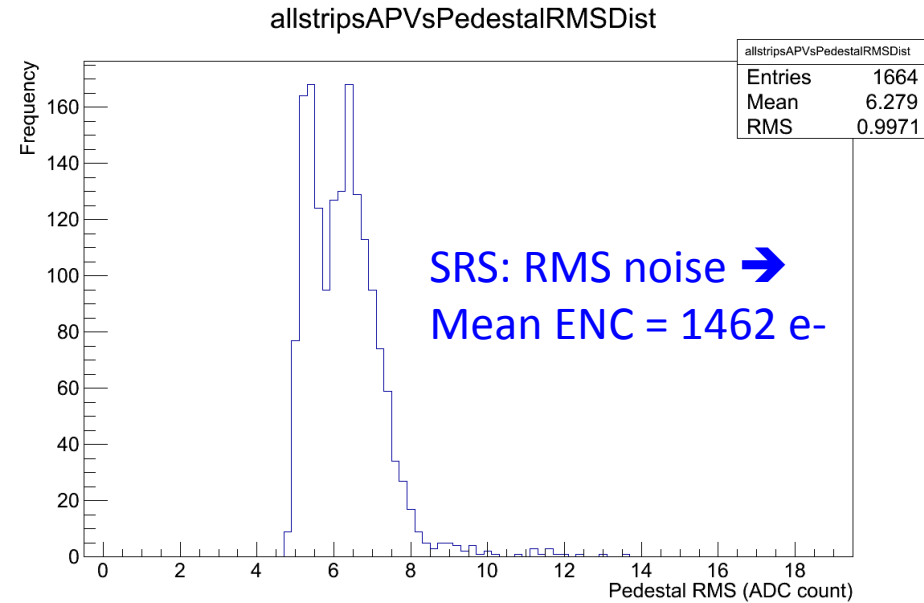
Hot channels appears in some of the apv cards

- Sometimes come from the noisy strips or bad connection with the adapter
- Not always from the GEM strips nor is it always coming from the flex adapter
- We are still studyin this effect

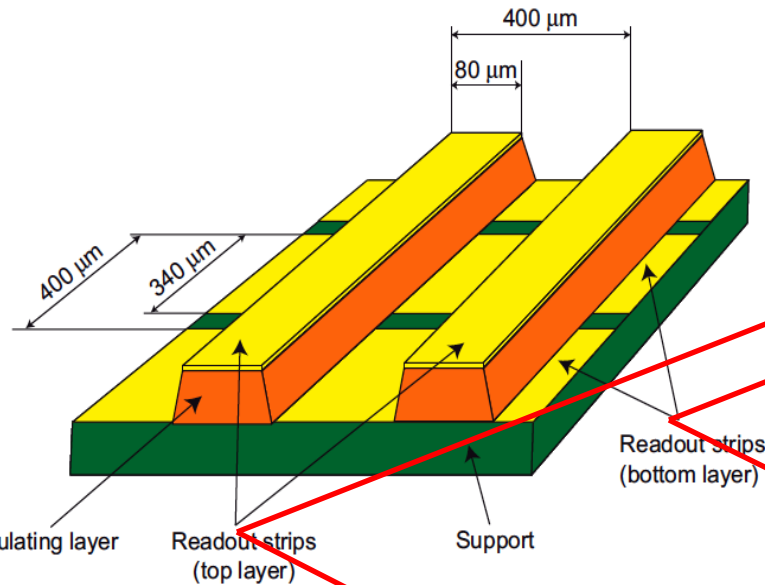


RMS noise and Equivalent Noise Charges for the 13 apv25 FE cards

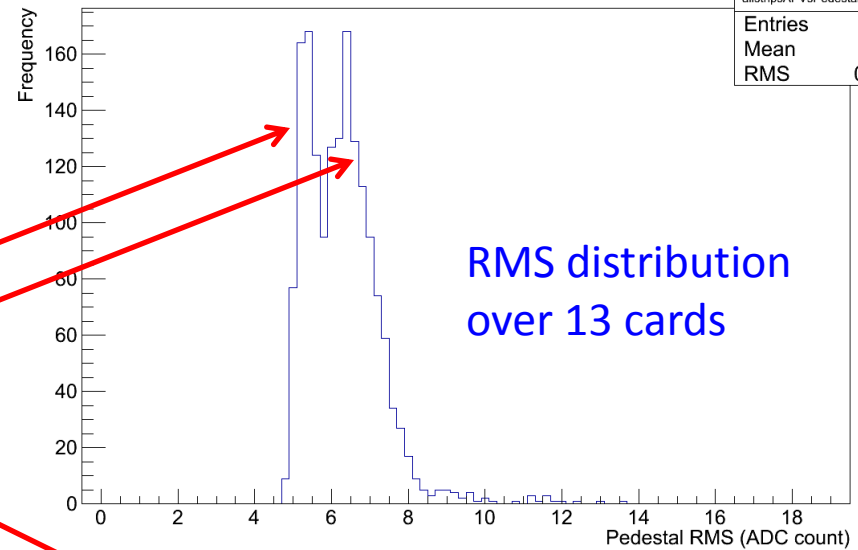
- Noise in ADC counts is $3 \times$ bigger for MPD (~20 ADC channels) than SRS (~7 ADC channels)
- When translated into ENC, it becomes a factor ~ 10 because MPD has a gain 3 to 4 times higher than SRS



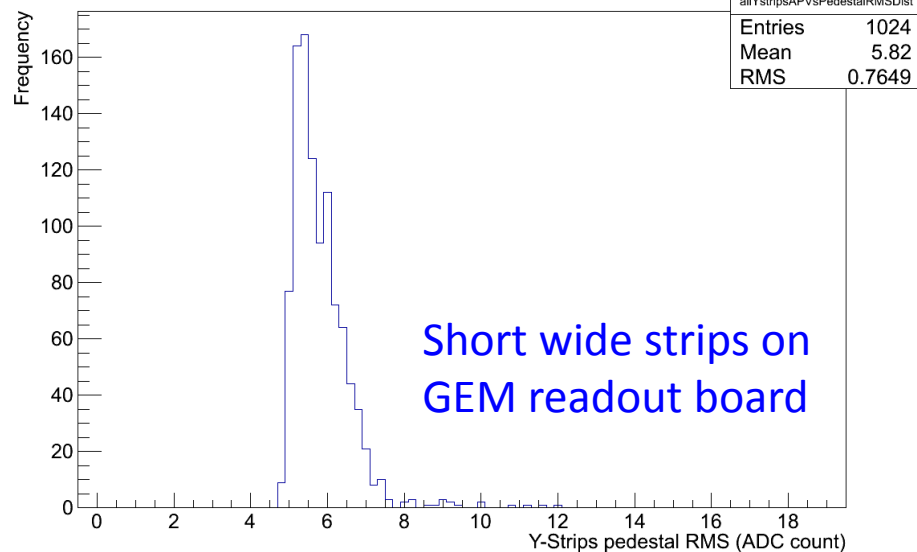
SRS: GEM Readout strip Capacitance effect on the noise



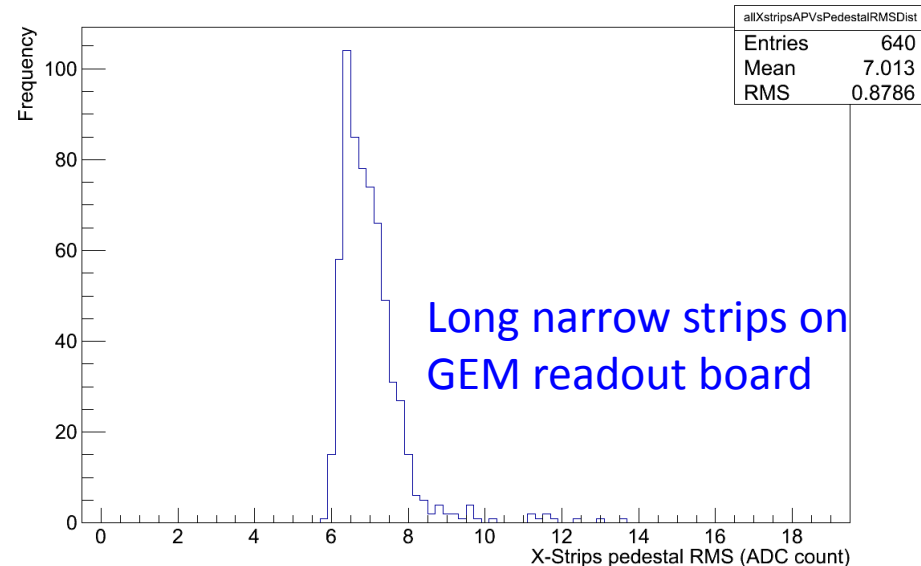
allstripsAPVsPedestalRMSDist



allYstripsAPVsPedestalRMSDist



allXstripsAPVsPedestalRMSDist

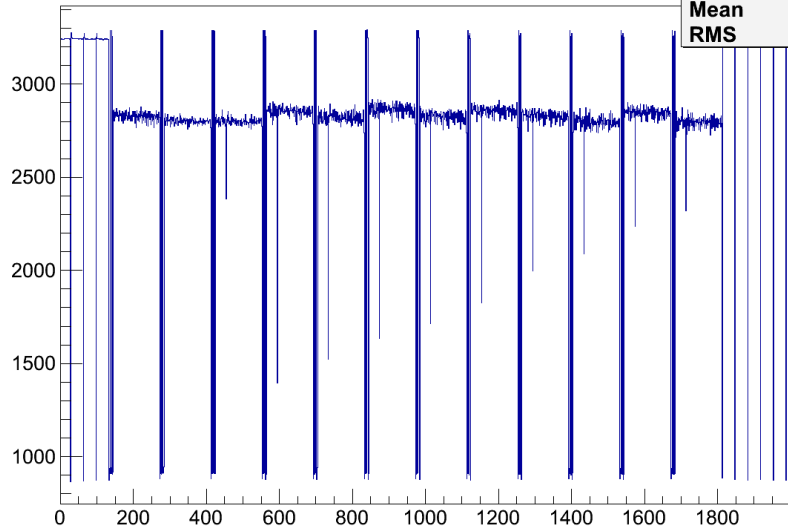


SRS: Effect of the number of apv25 time frames on the noise

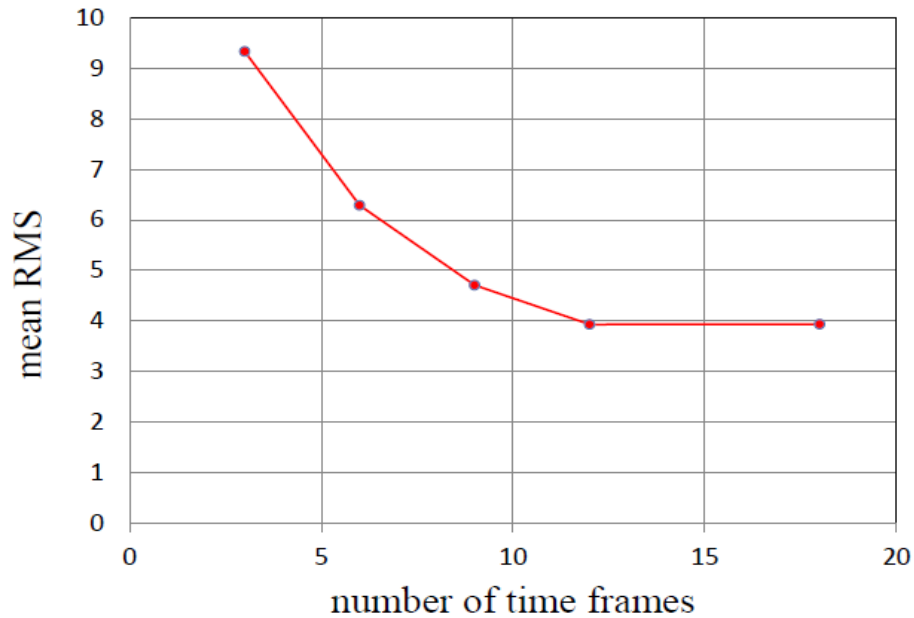
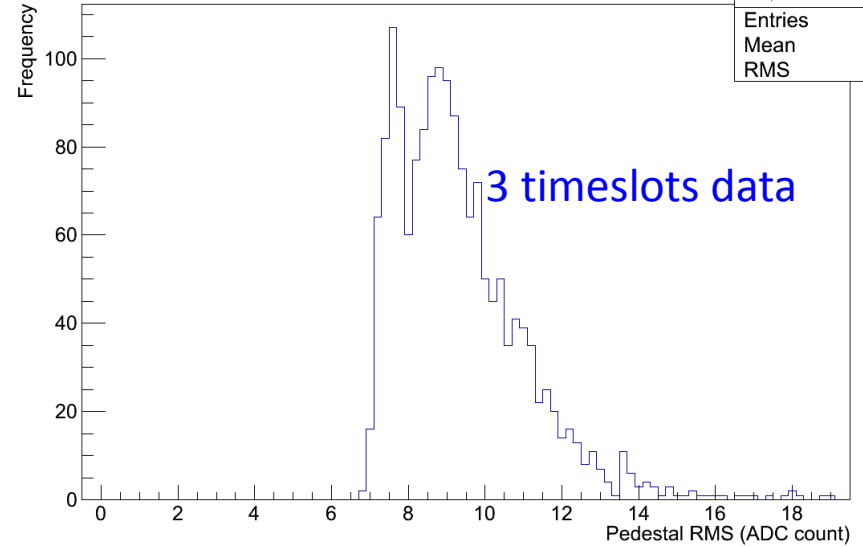
Fec1 ch1 APVn1 eventNo 2524

apvNo1RawData

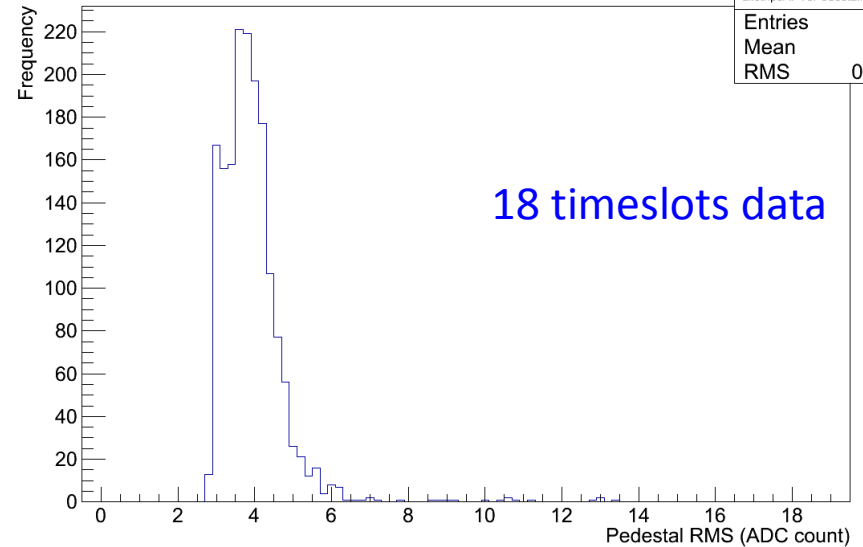
Entries	2524
Mean	1006
RMS	587.5



allstripsAPVsPedestalRMSDist



allstripsAPVsPedestalRMSDist



Backup slides

APV25 Readout time

Buffer length 192 samples : 4.8 us Look back 160 samples

32 samples reserved for event readout

➔ Look back 160 samples ➔ 4 us

APV readout time :

$$t_{\text{APV}} = 141 \times \text{number_of_sample} / 40 \text{ MHz}$$

$$t_{\text{APV}} (1 \text{ sample}) = 3.7 \text{ us.}$$

Max rate APV front end :

270 KHz in 1 sample mode

90 KHz in 3 samples mode

Will be triggered by coincidence trigger around 50 KHz