03/09/2020

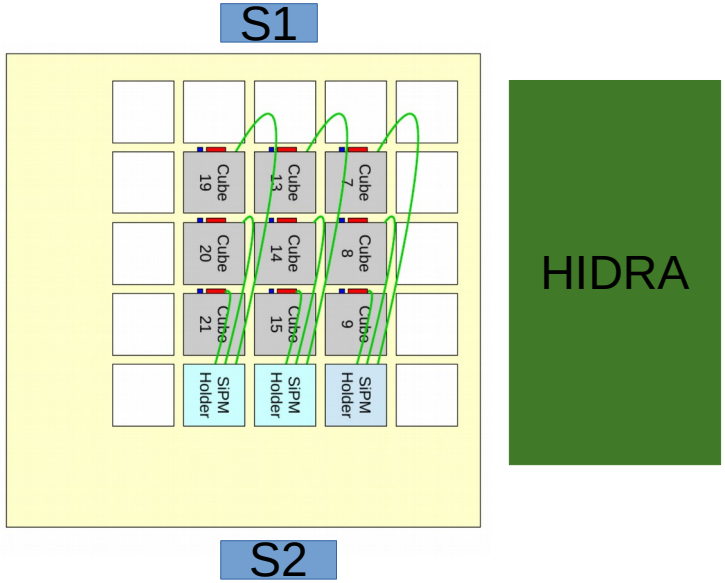
Istituto Nazionale di Fisica Nucleare
SEZIONE DI FIRENZE

MIP test: first layers with all PDs and WLF+SiPM. Quick analysis and comparison with alternative acq mode.

Lorenzo for the Firenze INFN lab. group: Eugenio, Seba, Sasha, Raffaello, Oscar...

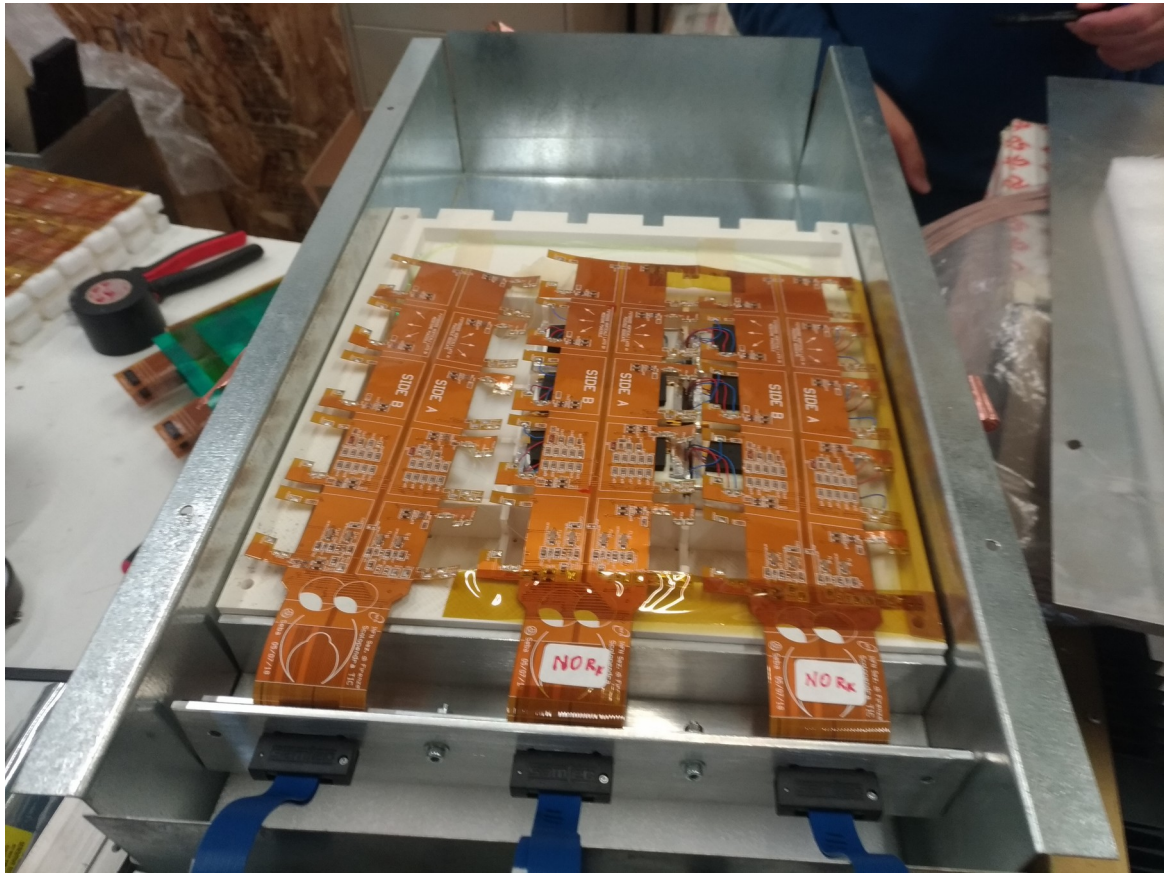
Single layer, metal box

- Now all the PDs and SiPM are connected.
- S1 & S2 used for the trigger.



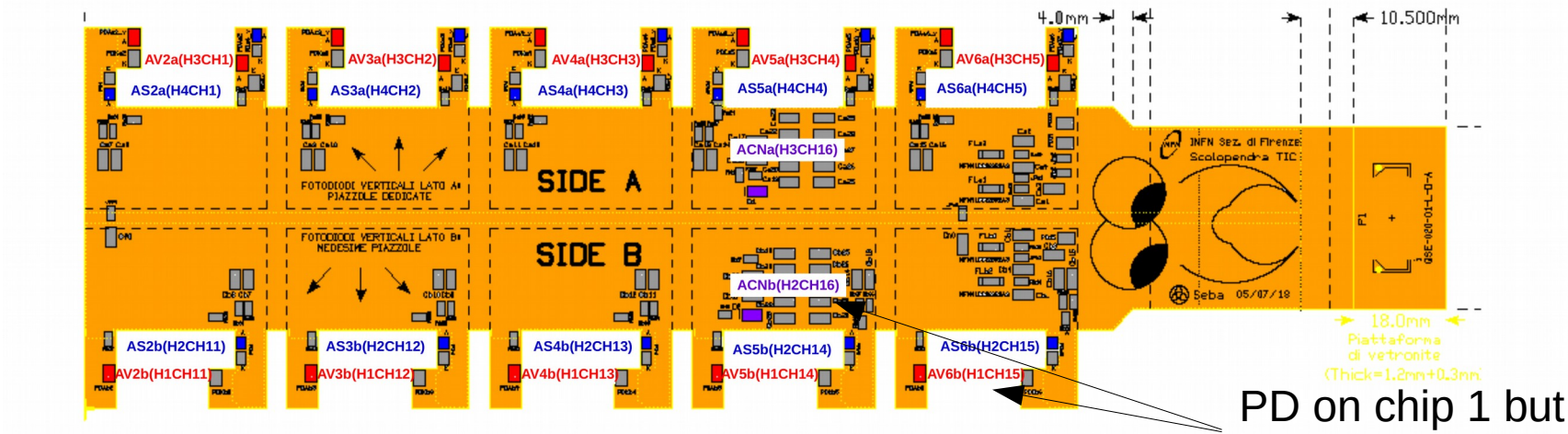
HIDRA

Old picture without SiPM



CN subtraction update

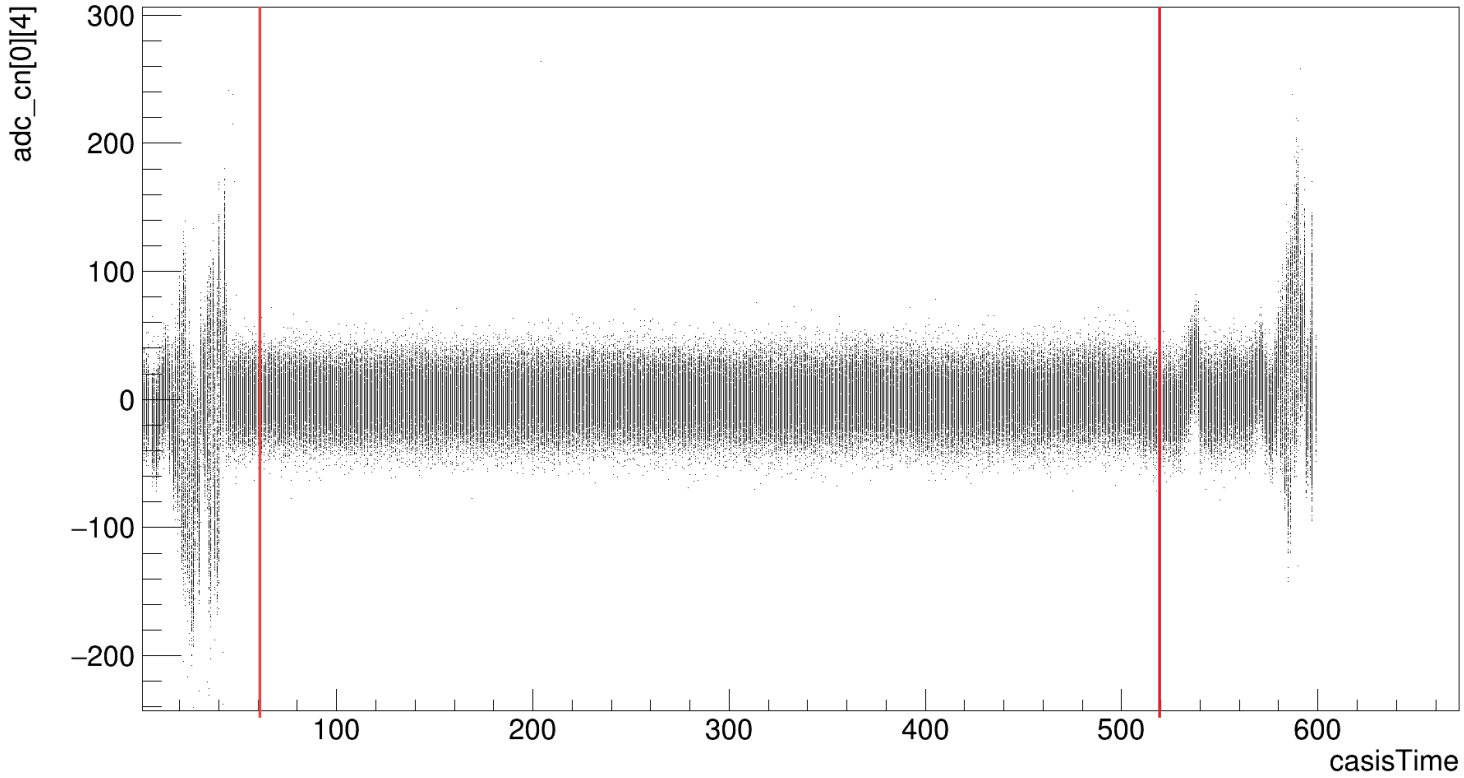
- Previous analysis: a CN diode was used to subtract the CN on all the channels of the same chip
- Now the rooting of the channel are complicated!
  - This is done to separate small and big PDs.
  - A diode which is connected to the chip 1 can be on a kapton cable with the CN diode connected to a different chip.
- A sort of map is needed to properly subtract the CN, and for some channels the CN subtraction works better than for other channels.



PD on chip 1 but CN diode on chip 2.

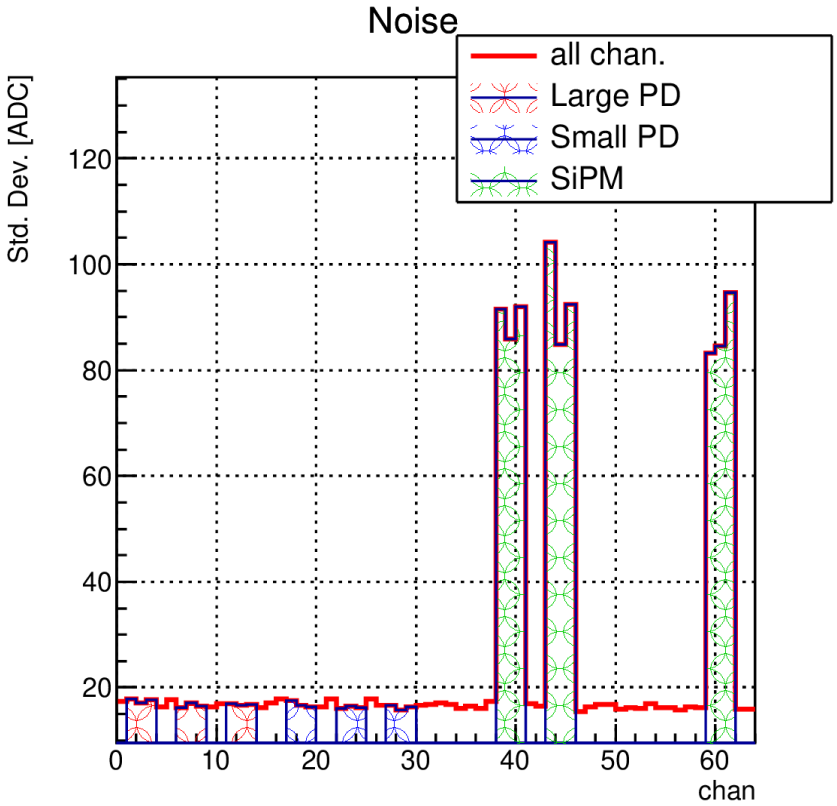
CasisTime windows selection

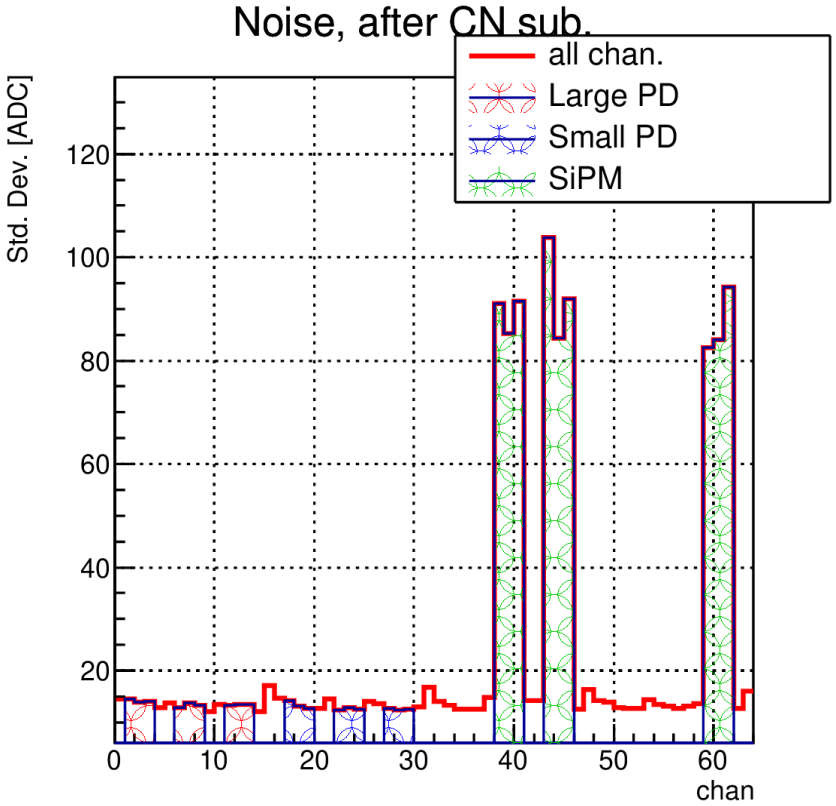
- To study the noise and the MIP signal we removed “bad” casisTime edges.



Noise (RMS) all channels

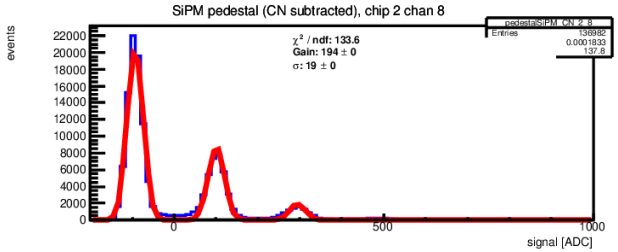
- Nice results but obtained by selecting the casisTime “good” window.

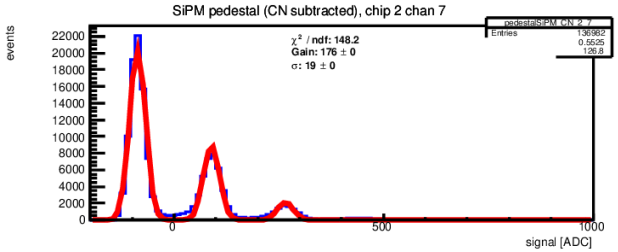


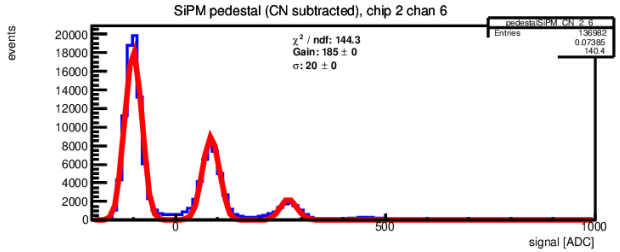


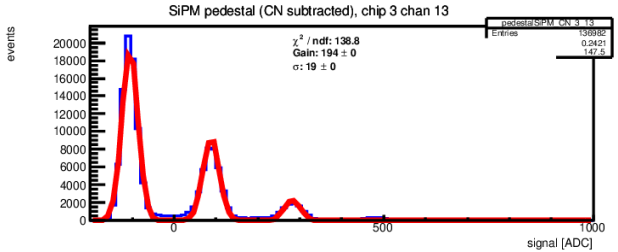
SiPM pedestal.

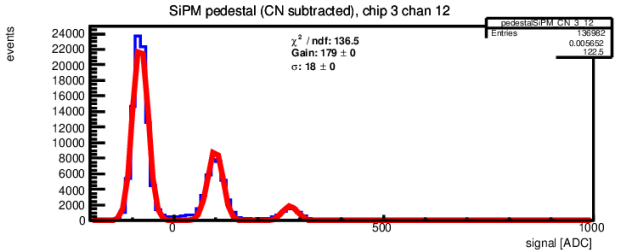
- Using pedestal to get the SiPM gains (i.e. photo-peak distance)

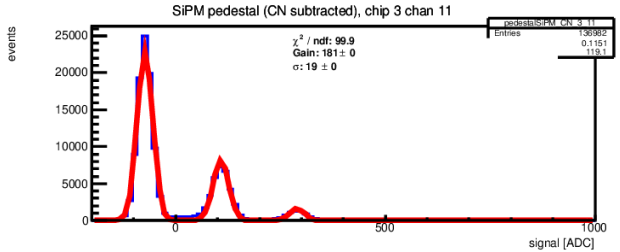


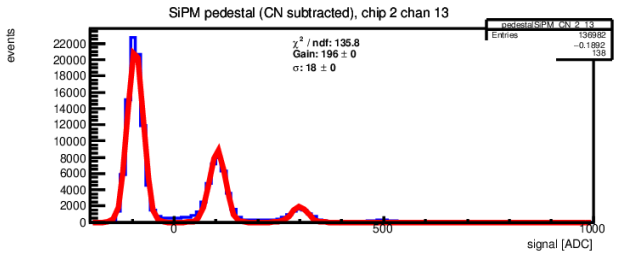


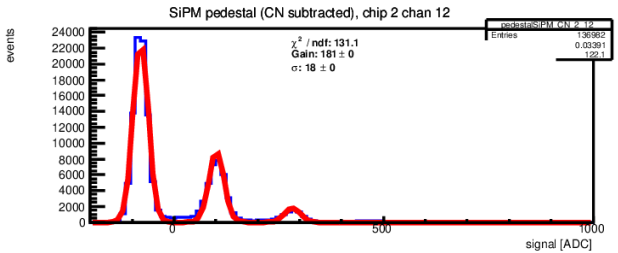


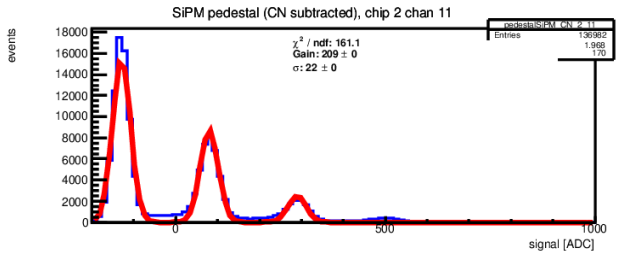






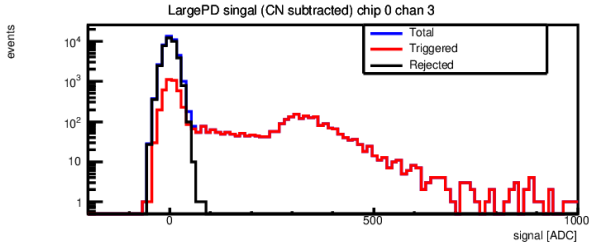


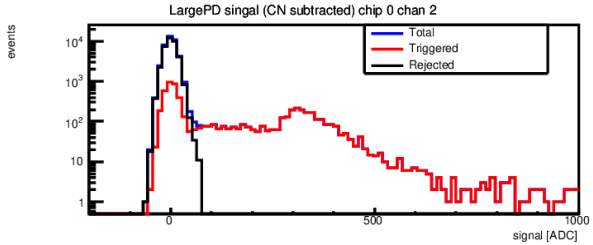


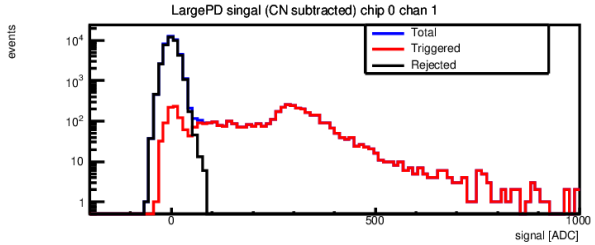


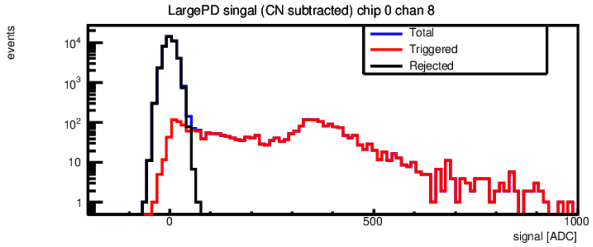
LPDs distributions

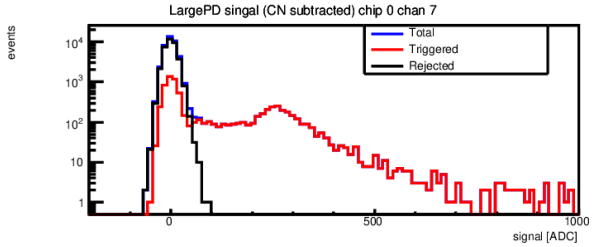
- Self trigger information seems wrong correct for all channels

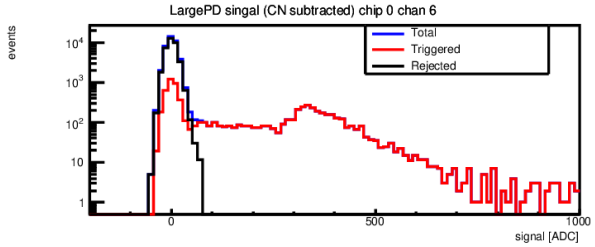


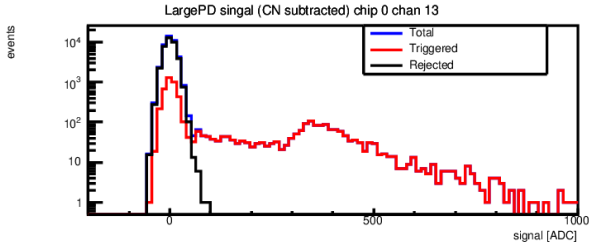


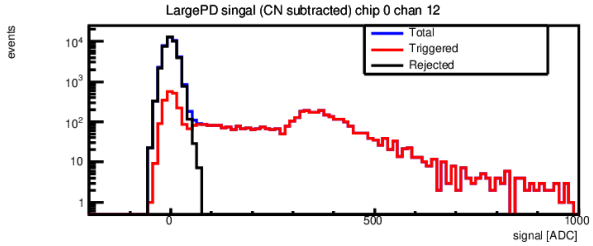


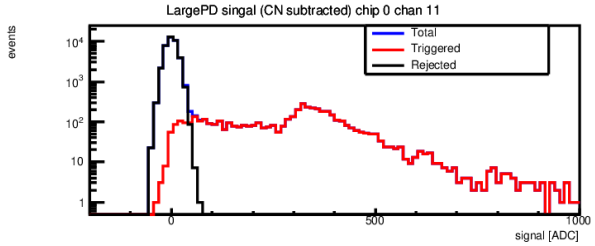






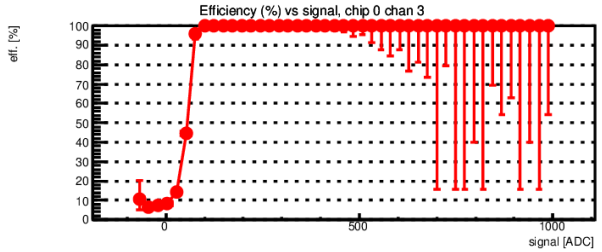


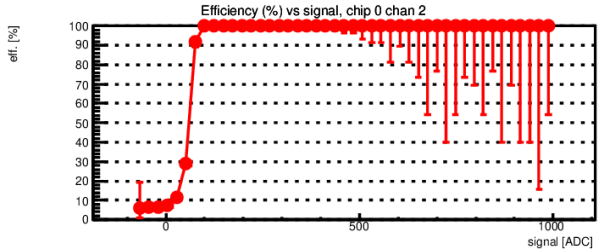


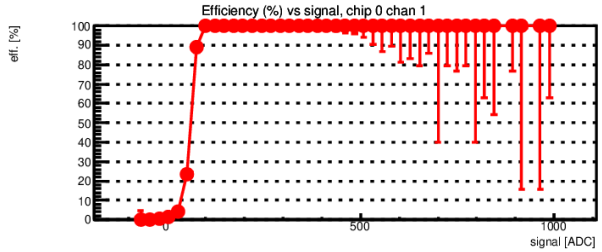


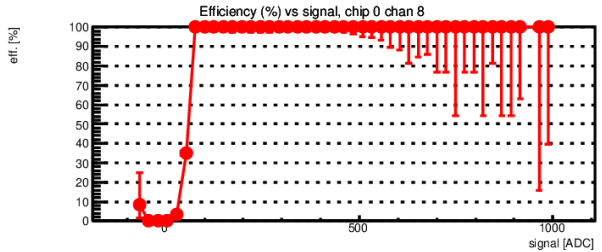
Trigger efficiency

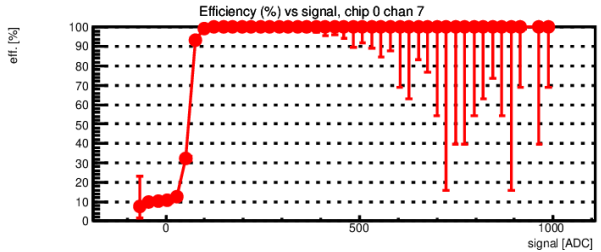
- Trigger thresholds ~ 70 ADC

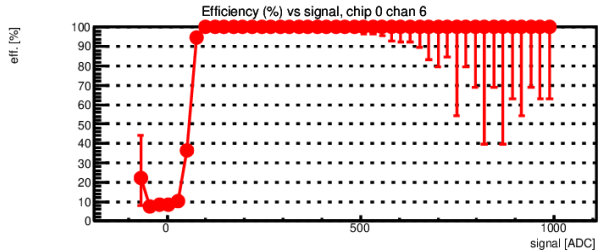


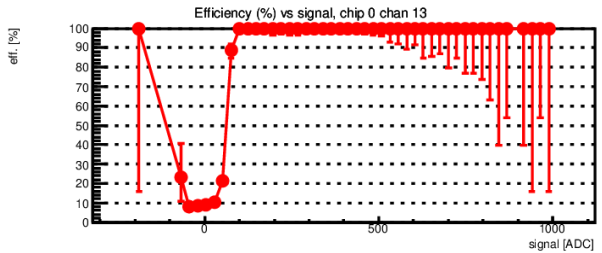


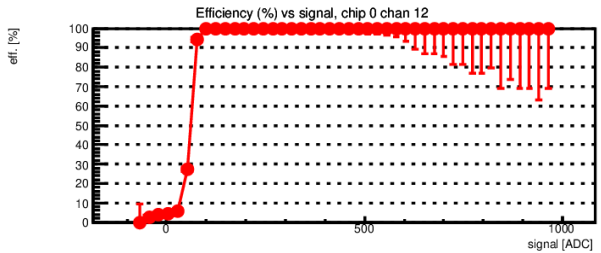


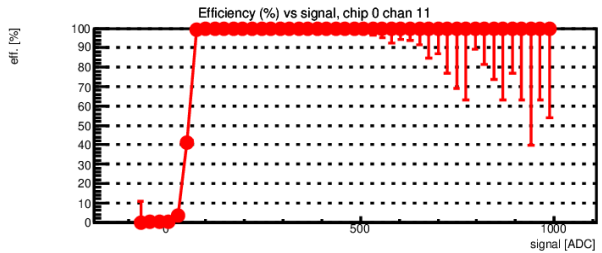






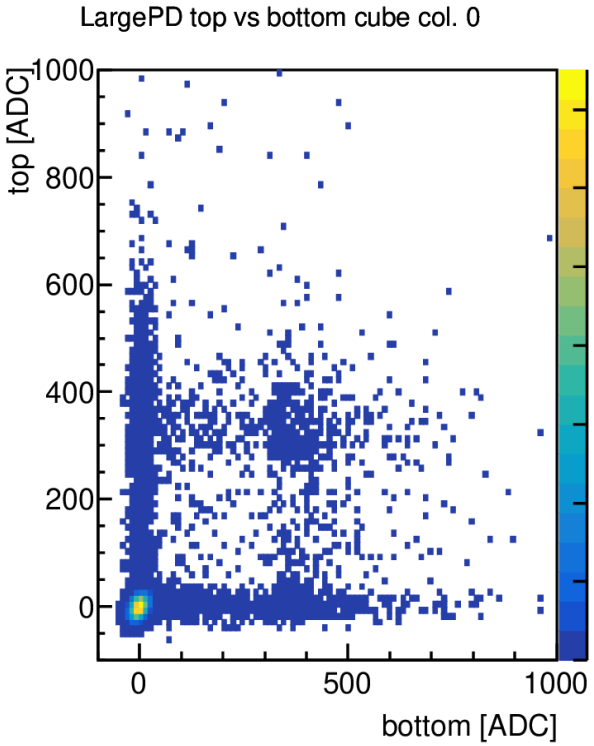


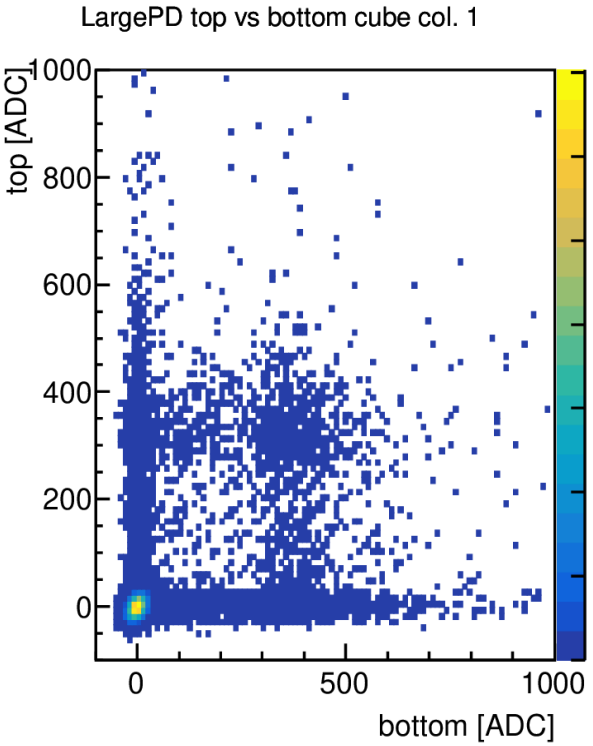


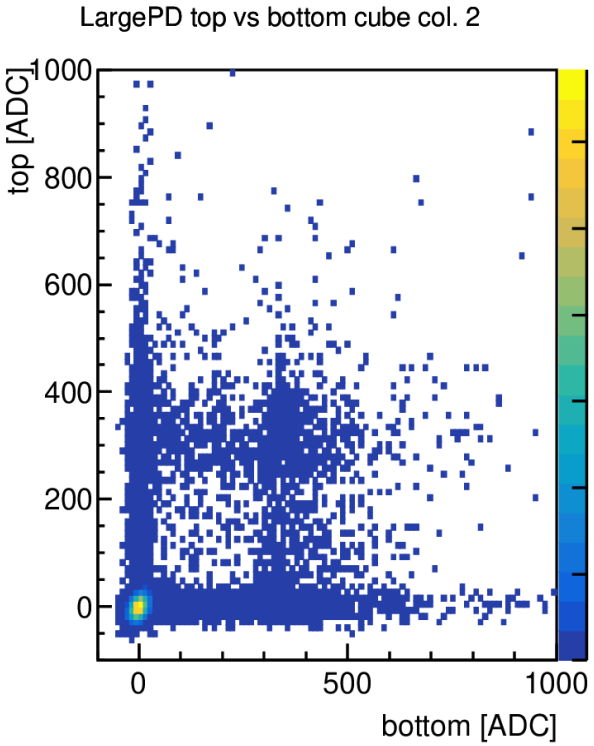


Selecting MIP track

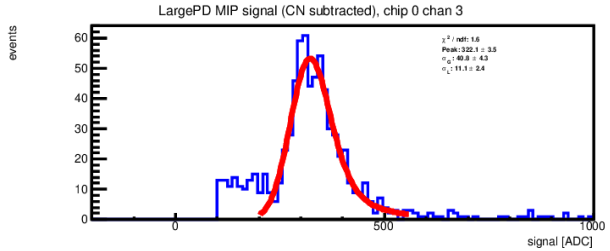
- Looking the top and bottom signals for each column.
- Selection using LPD: MIP if TOP > 150 ADC && MIDDLE > 150 ADC BOTTOM > 150ADC

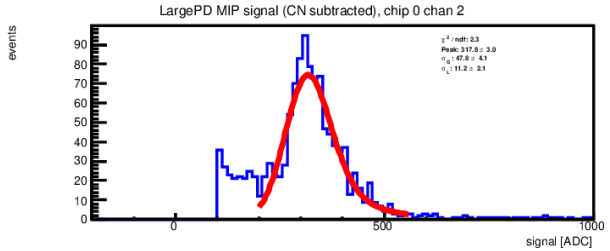


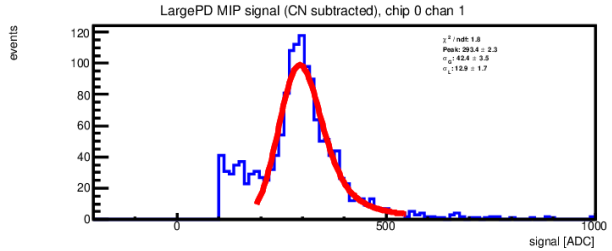


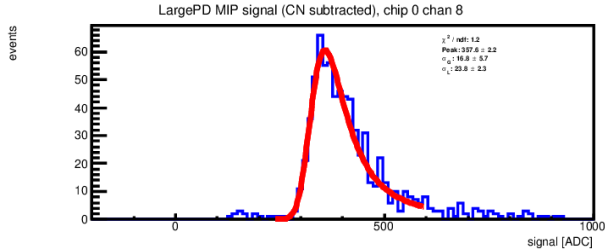


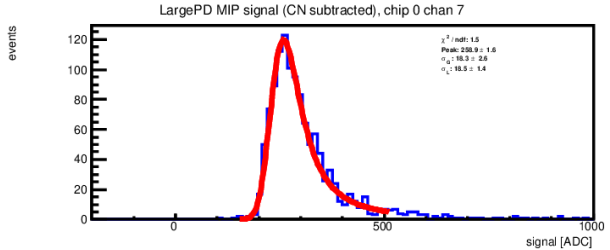
MIP peak Large PD

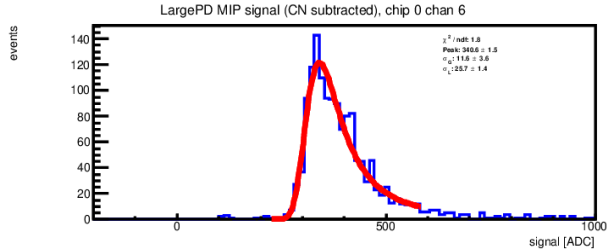


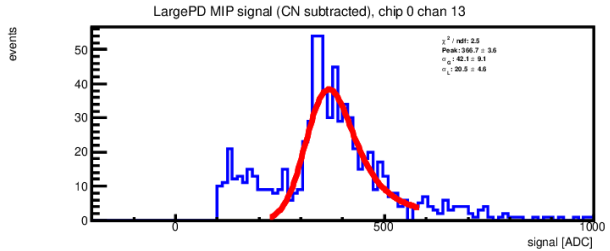


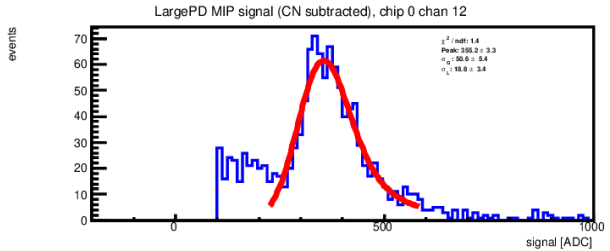


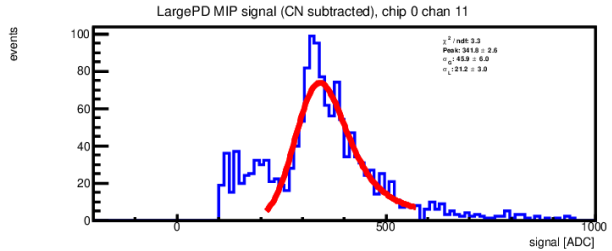




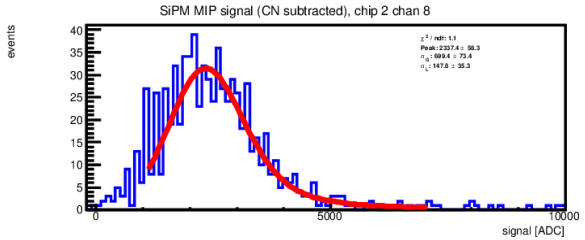


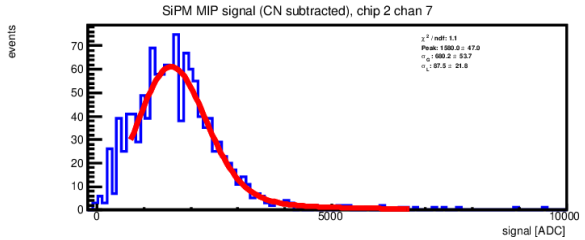


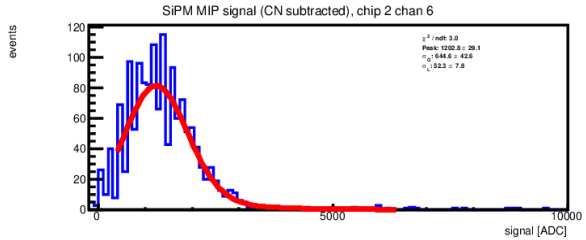


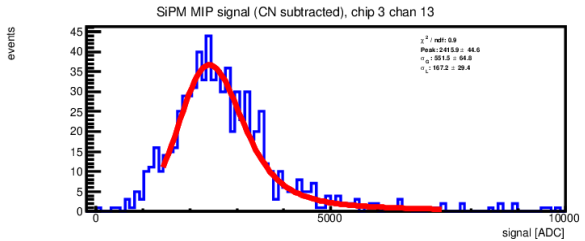


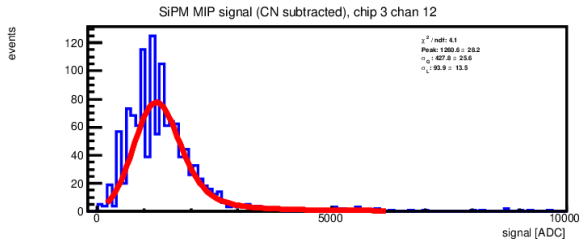
MIP peak SiPM

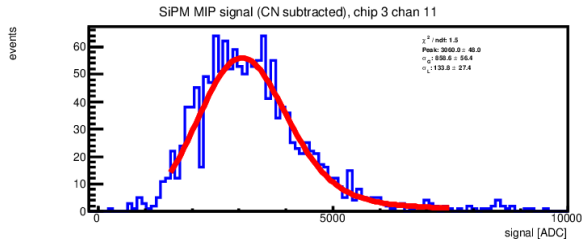


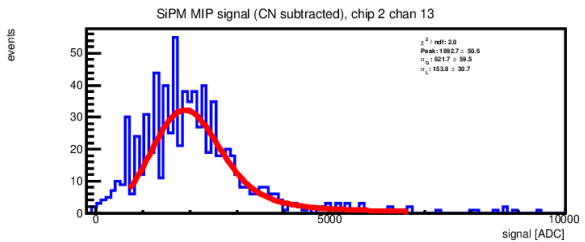


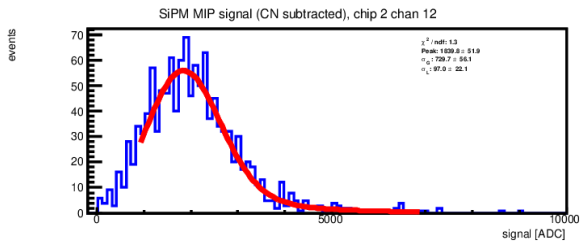


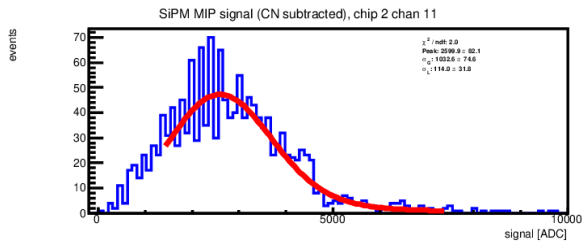




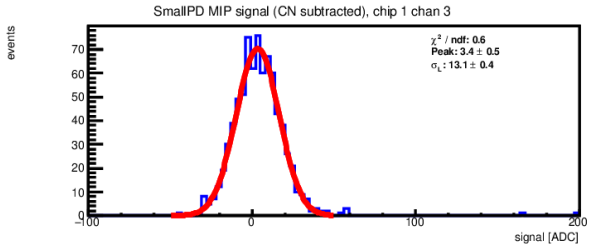


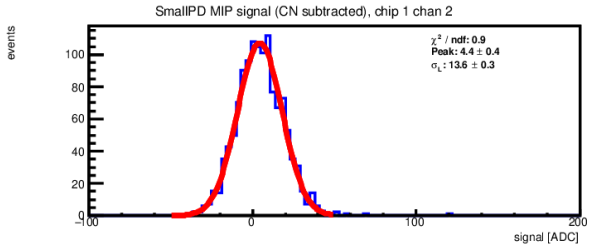


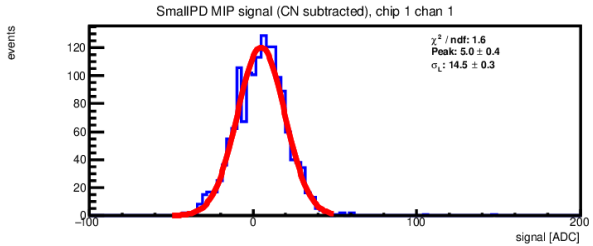


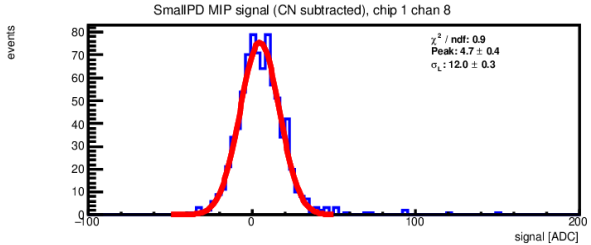


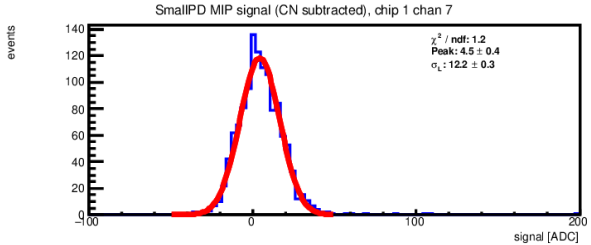
MIP peak Small PD

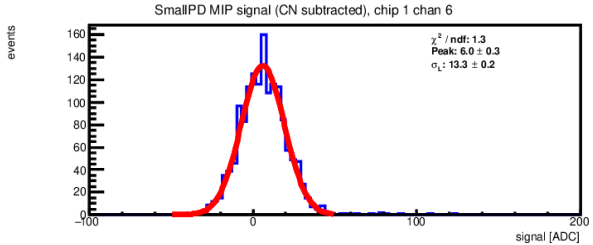


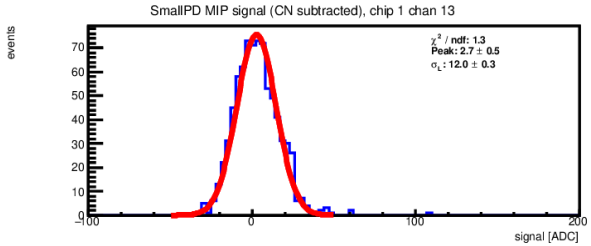


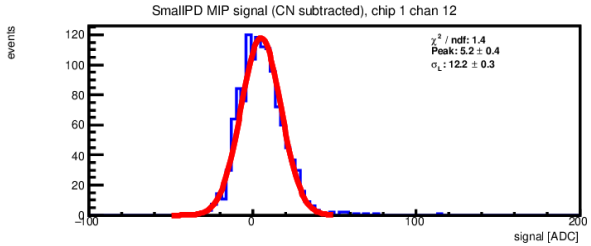


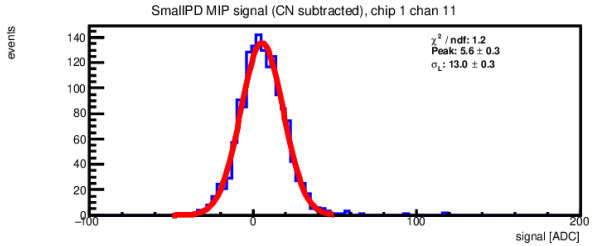




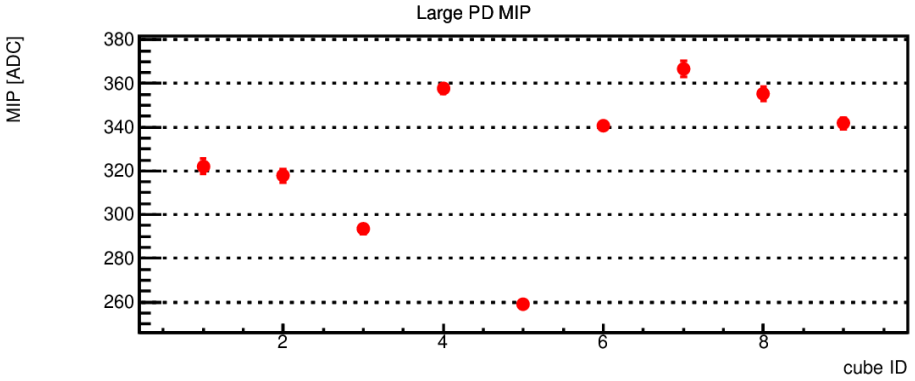


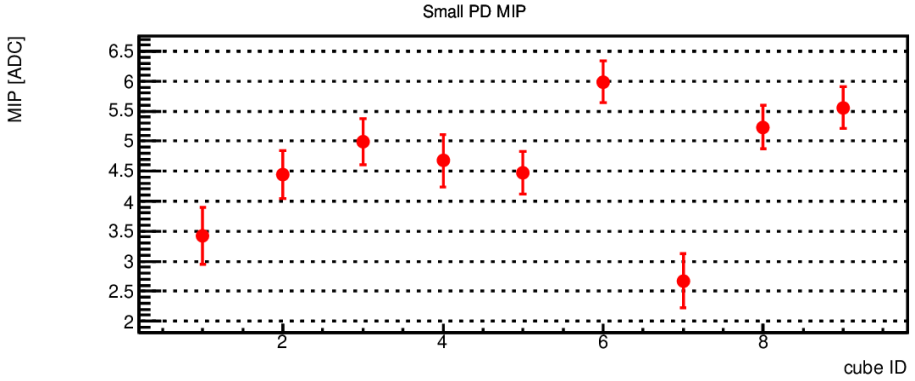


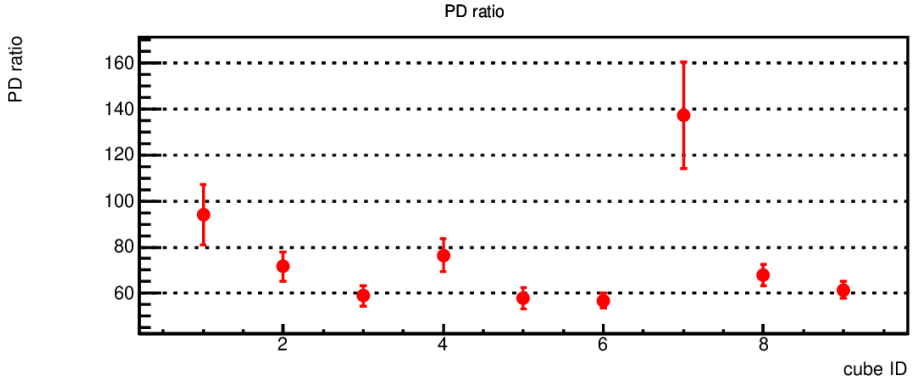


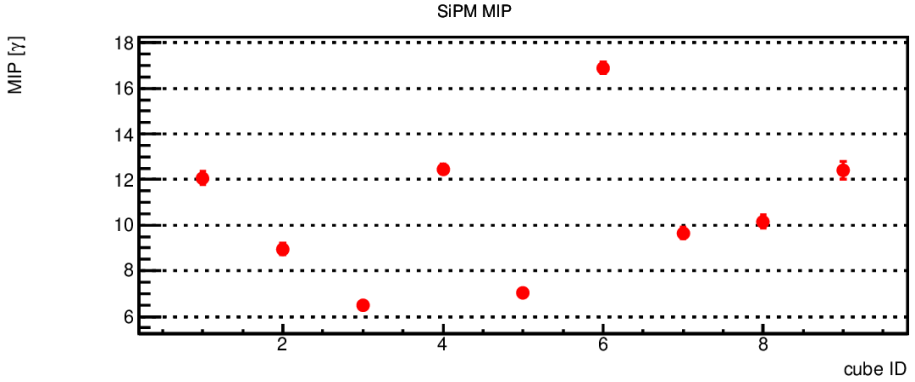


MIP on different channels







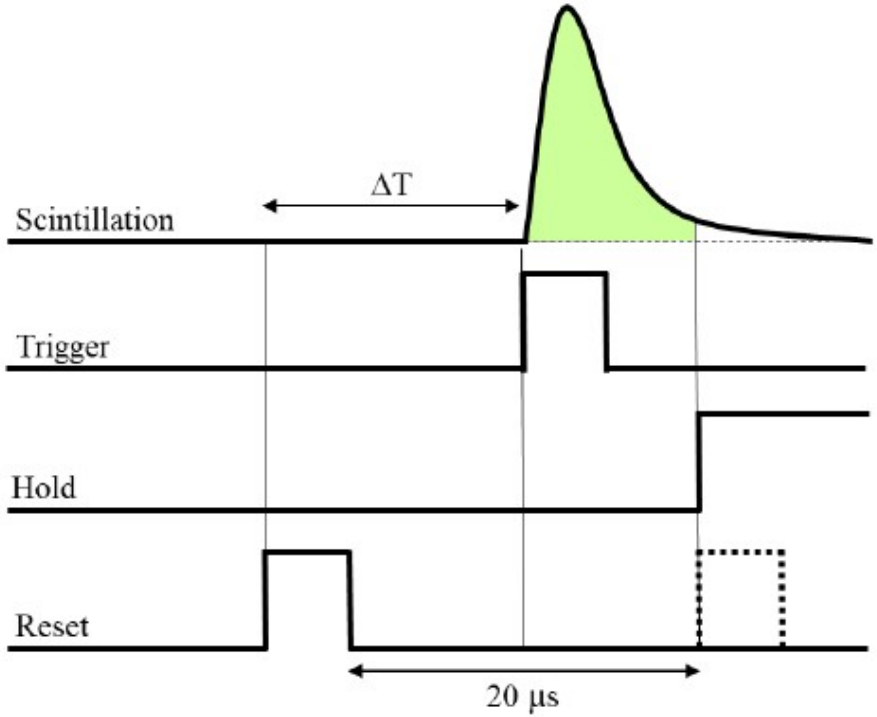


- LPD ~ 320 +- 40 (12%); SPD ~ 4.5 +- 2 (40%); SiPM ~ 12 +- 6 (50%) (photons)
- LPD/SPD ratio: 70 +- 10 with one very large value due to small SPD signal.

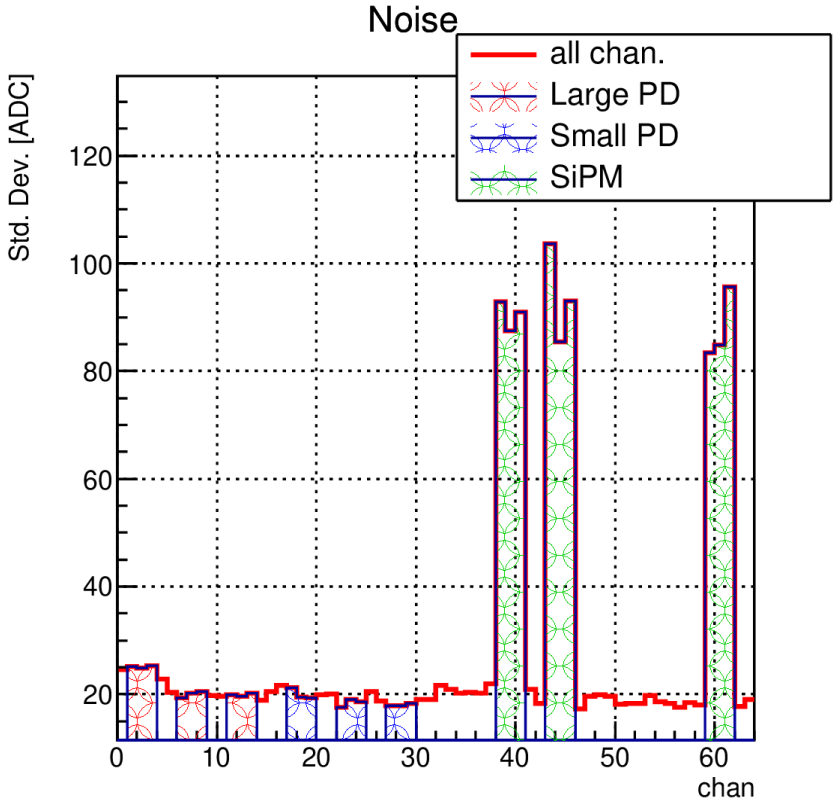
Alternative acq mode

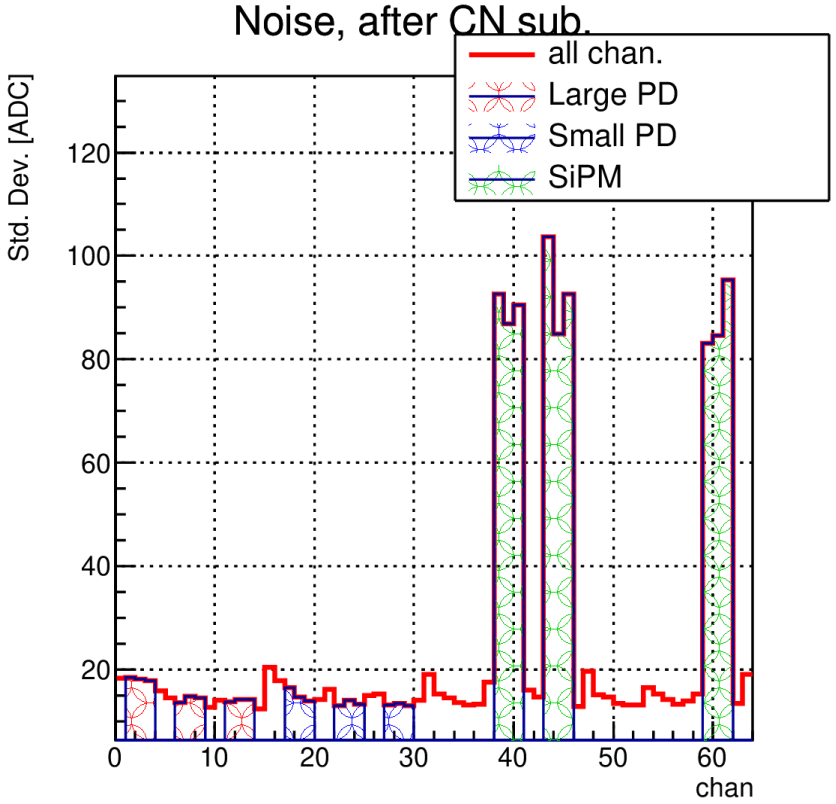
- Standard acq: hold signal replaces the reset
- Standard acq: ntegration window fixed (10 us)
- New mode: hold signal asserted after a fixed time with respect the trigger (5 us).
- New mode: the integration window is depends on trigger: e.g. it is 10 +- 5 us
- Expected features of new mode:
  - Noise will slightly depends on casisTime
  - Particle signal will not depends on casisTime.
  - Pile up problem: it is possible to decrease the input time constant, the signal should not depend on casisTime even with a short time constant

Standard acq mode



Noise obtained with new mode

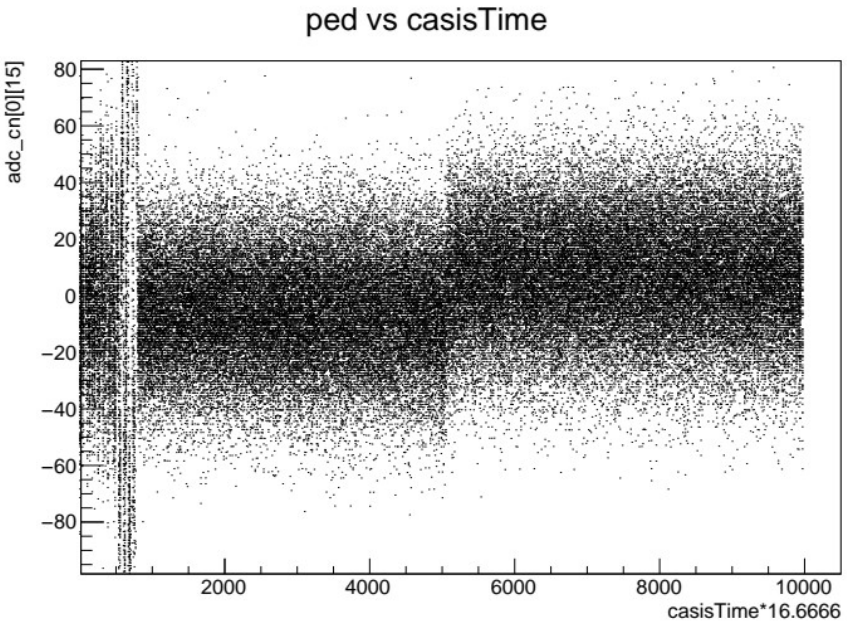




- Noise is bigger with this acq mode (why?).

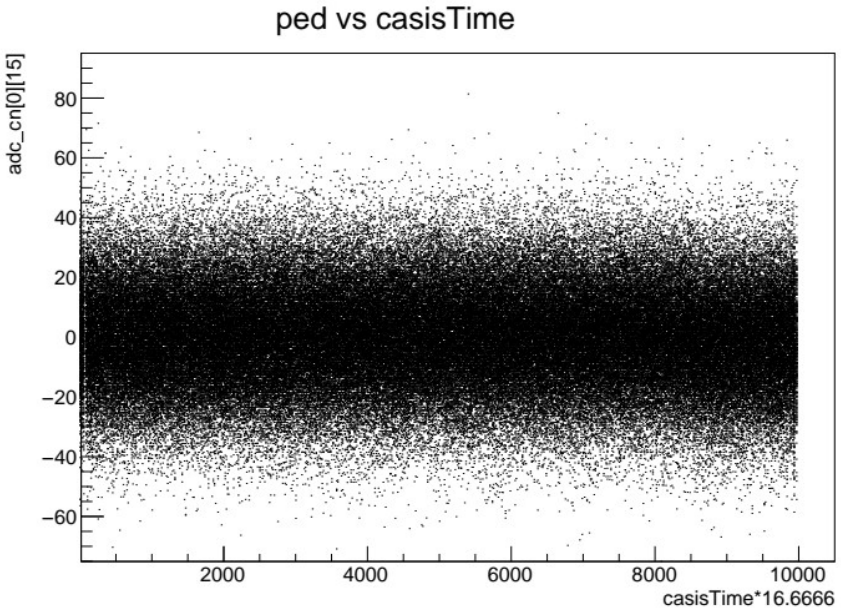
Single channel comparison

New mode CN channel

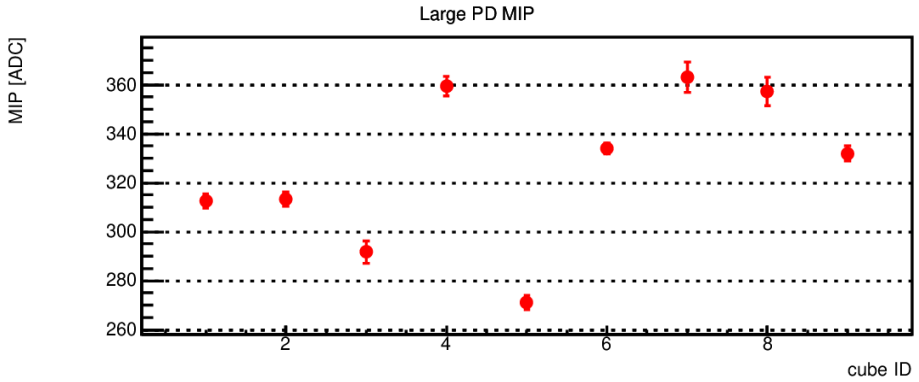


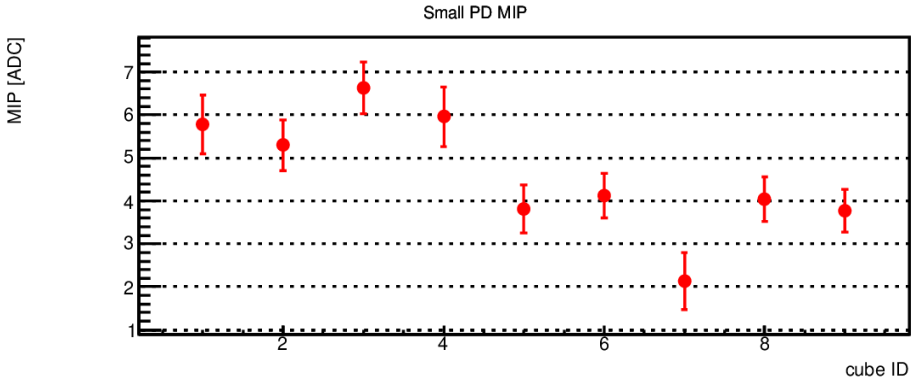
?????????????

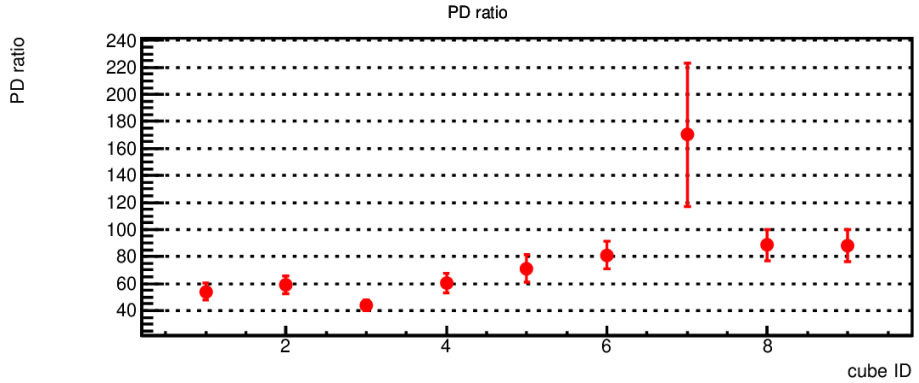
Standard mode CN channel

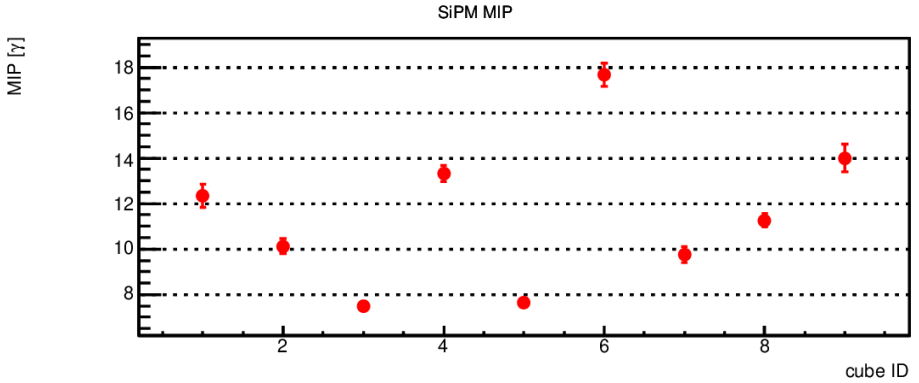


MIP peak with new mode









- Very similar results with respect the standard mode.

Conclusion

- All channels of the first complete layer are “good channels”.
- It seems possible to measure the MIP value even with the small Pds
  - PD ratio is ~70 with big variation, as expected by previous lab measurement, beam test…
- The new acquisition mode feature similar results but the noise is bigger and there are strange features in the pedestals.
- The HIDRA2+TROC system seems work well:
  - All the self-trigger information are presents
  - All the gain information are correct.
- The configuration for the careggi and Frascati beam test seems working.
- We will assemble the other 3 layers (1 layer has only 1 LYSO)
  - Olek: attach the SiPM to the fiber
  - Seba: connect the SiPM to the cable.
  - Eugenio/Lorenzo: test each layer with MIP and check good/bad channels.

Current “HIDRA” problems

- Is new acq mode reliable?
- Trigger efficiency: new PD MIP ~ 70 ADC, noise ~ 25, what is the correct value of the trigger threshold?
- Pedestal drift after big signal: can be attenuated by decreasing the input capacitance and resistor but we will create a increase of the signal with respect the casisTime
- Saturation of a channels affects other channels: when a small PD will saturate can we use the nearby small PDs?
- Signal vs casisTime dependence: depends on PD, LED, electronics??
- Samtec blue cable increase the noise of the system (about 20%).
- Chip 3 broken on a board, fixed ~33000 ADC channels.