First hands-on experience of THGEM/SRS with LabView based DAQ

H. Muller, S. Martoiu,

R. de Asmundis, G. Sekhniaidze,

L. Ropelewski, G. Glonti, M. Van Stenis,

M. Cortesi,

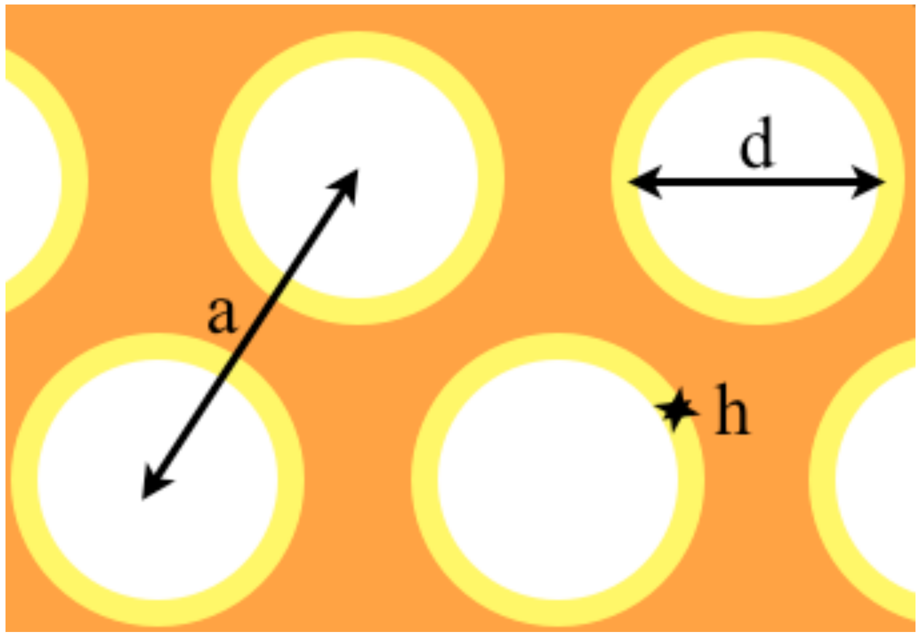
A. Breskin, L. Arazi, L. Moleri, M. Pitt, A. Rubin, S. Bressler

Outline

- First experience with THGEMs and the SRS
- Online analysis tools - a wish list
  - Using preliminary off-line analysis of the data as an illustration
- Future plans

THGEM geometry

- $100 \times 100\ mm^2$ electrodes
- $a = 1mm$, $d = 0.5\ mm$, $t = 0.4\ mm$, $h = 100\ \mu m$



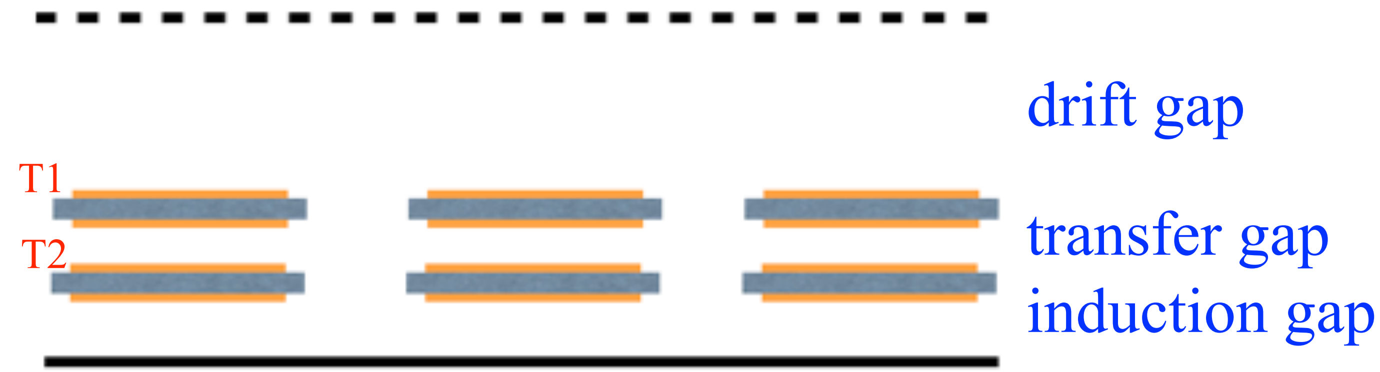
First experience with THGEMs and SRS

- Tests were held at CERN in March 2012

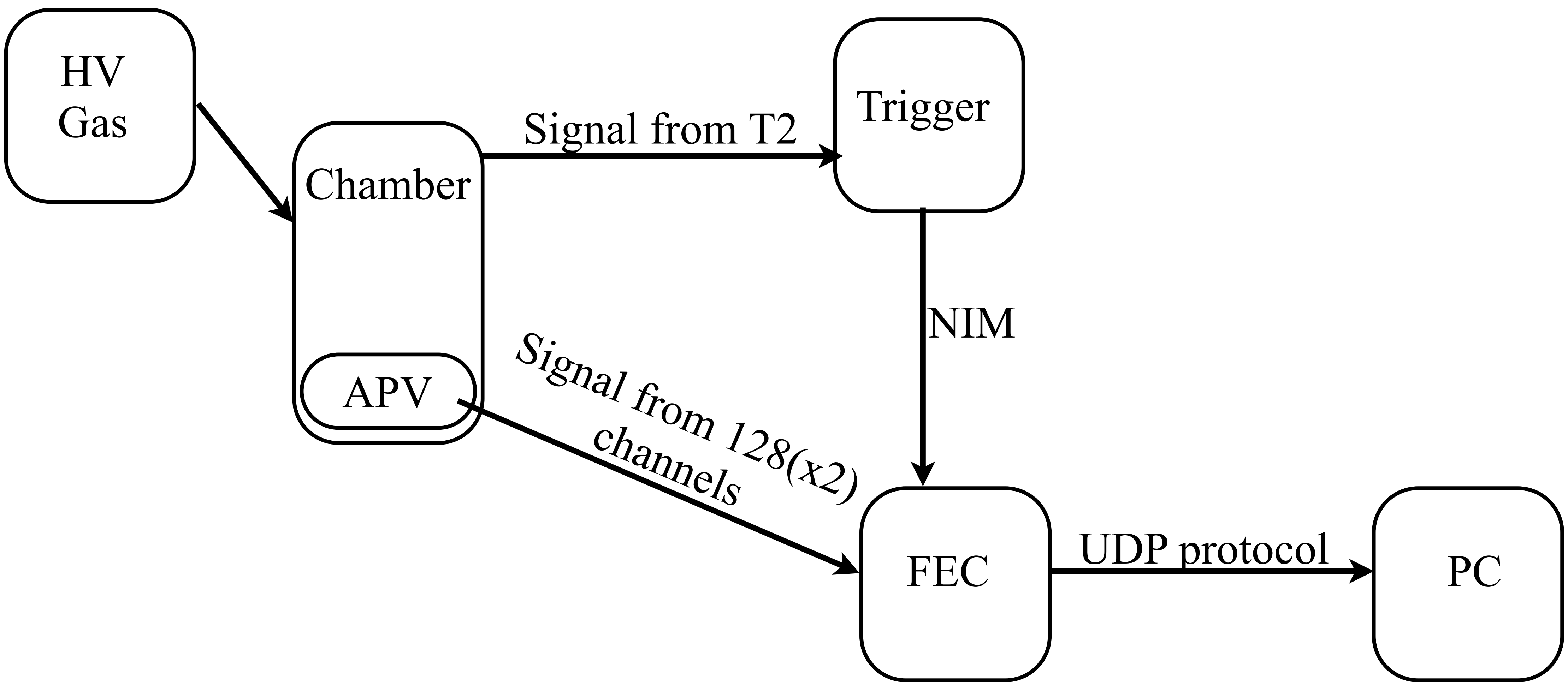
- Goals
  - Confirm that THGEM signal can be read by the SRS
    - With and without resistive layers
    - Before buying an SRS unit
  - Learn to operate the SRS
  - Learn to use the simple LabView DAQ sw developed by Riccardo
    - See Riccardo's talk in the next session
  - Incorporate the SRS in our lab and use it in the next test beams

Experimental setup

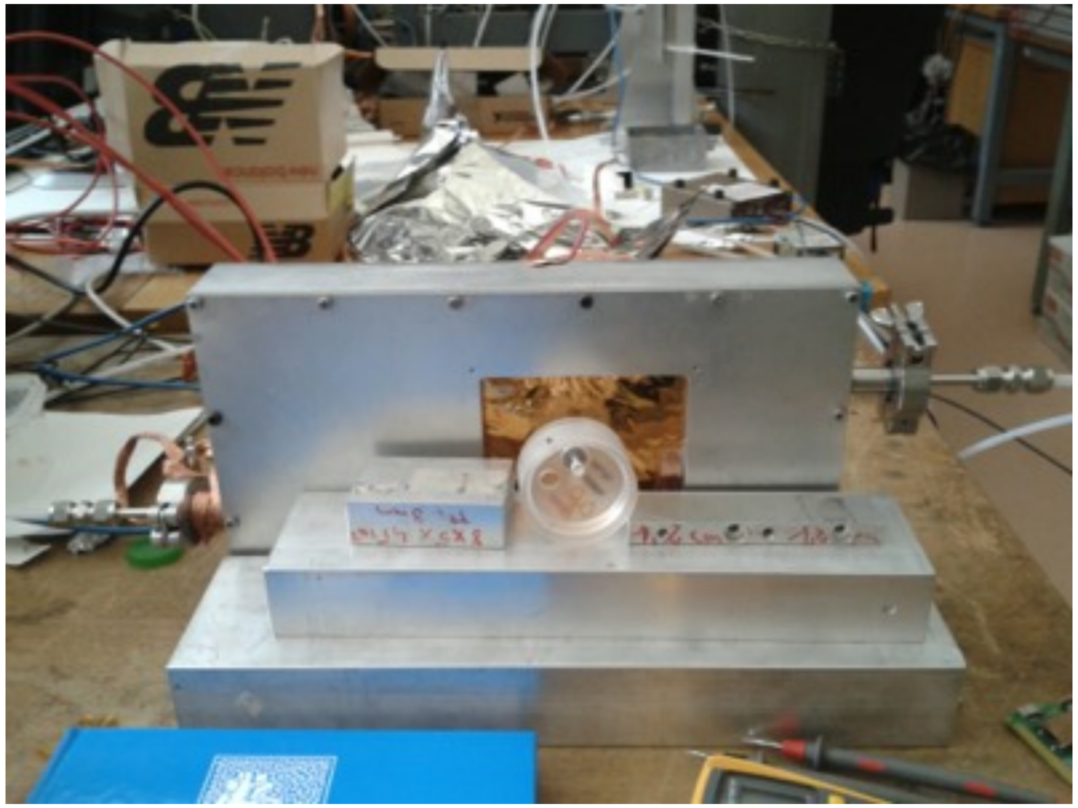
- Double stage 100×100 mm^2 THGEM detector
  - 2 mm induction gap
  - 2mm transfer gap
  - 10 mm drift gap



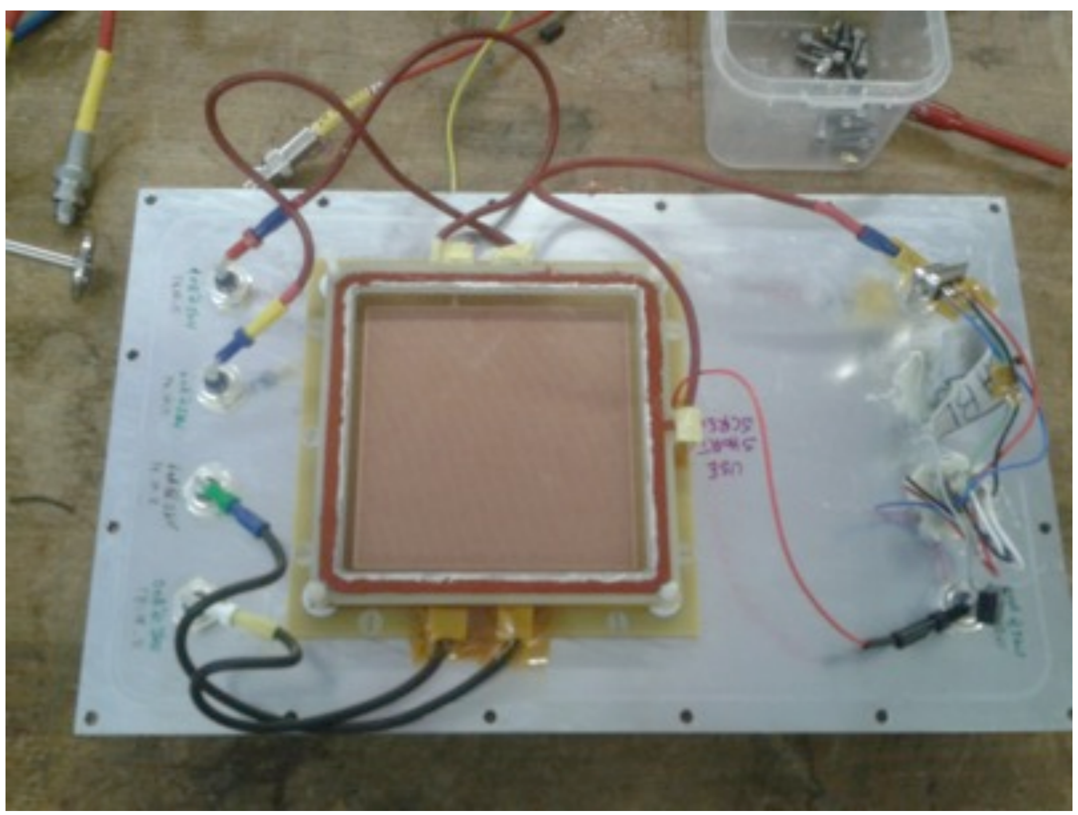
- Self induced trigger using the signal from T2 electrode



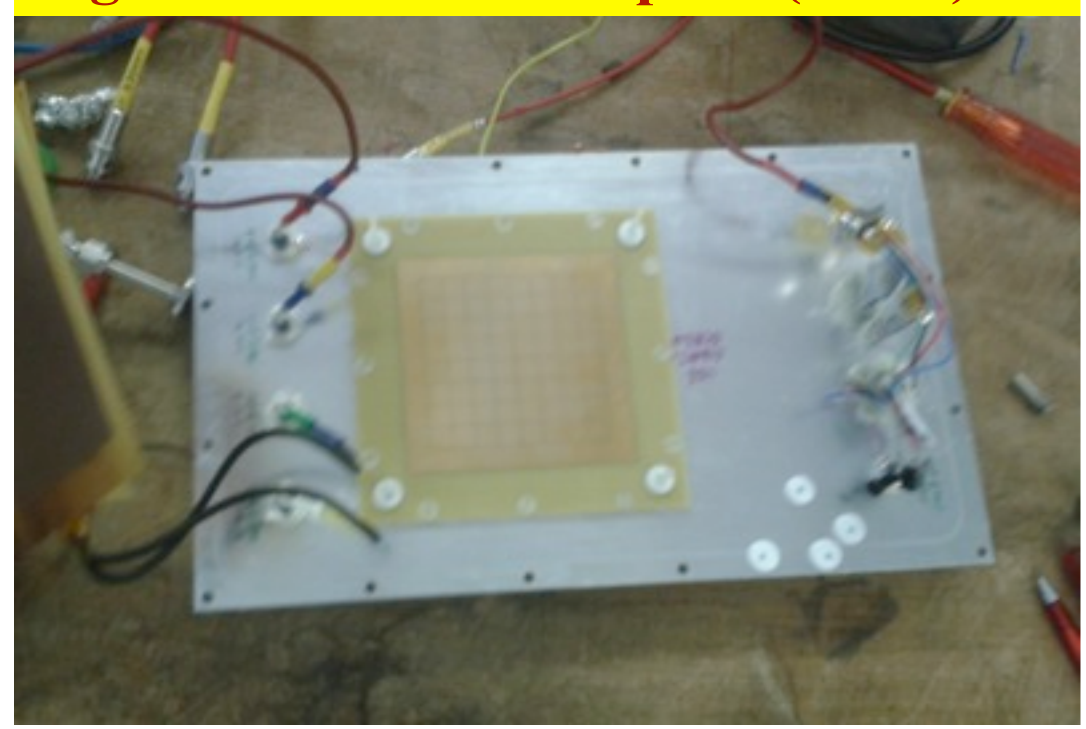
The chamber



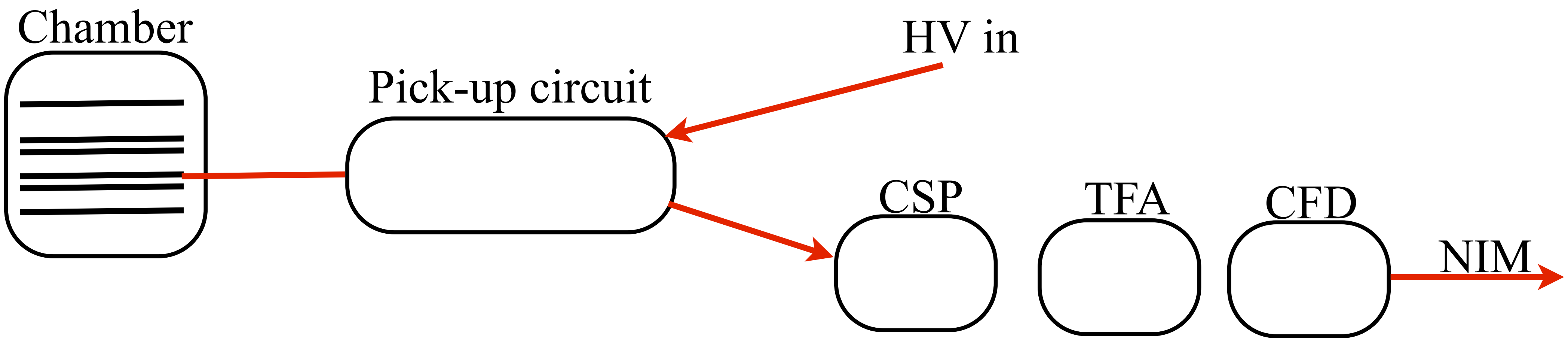
APV mounted on the anode



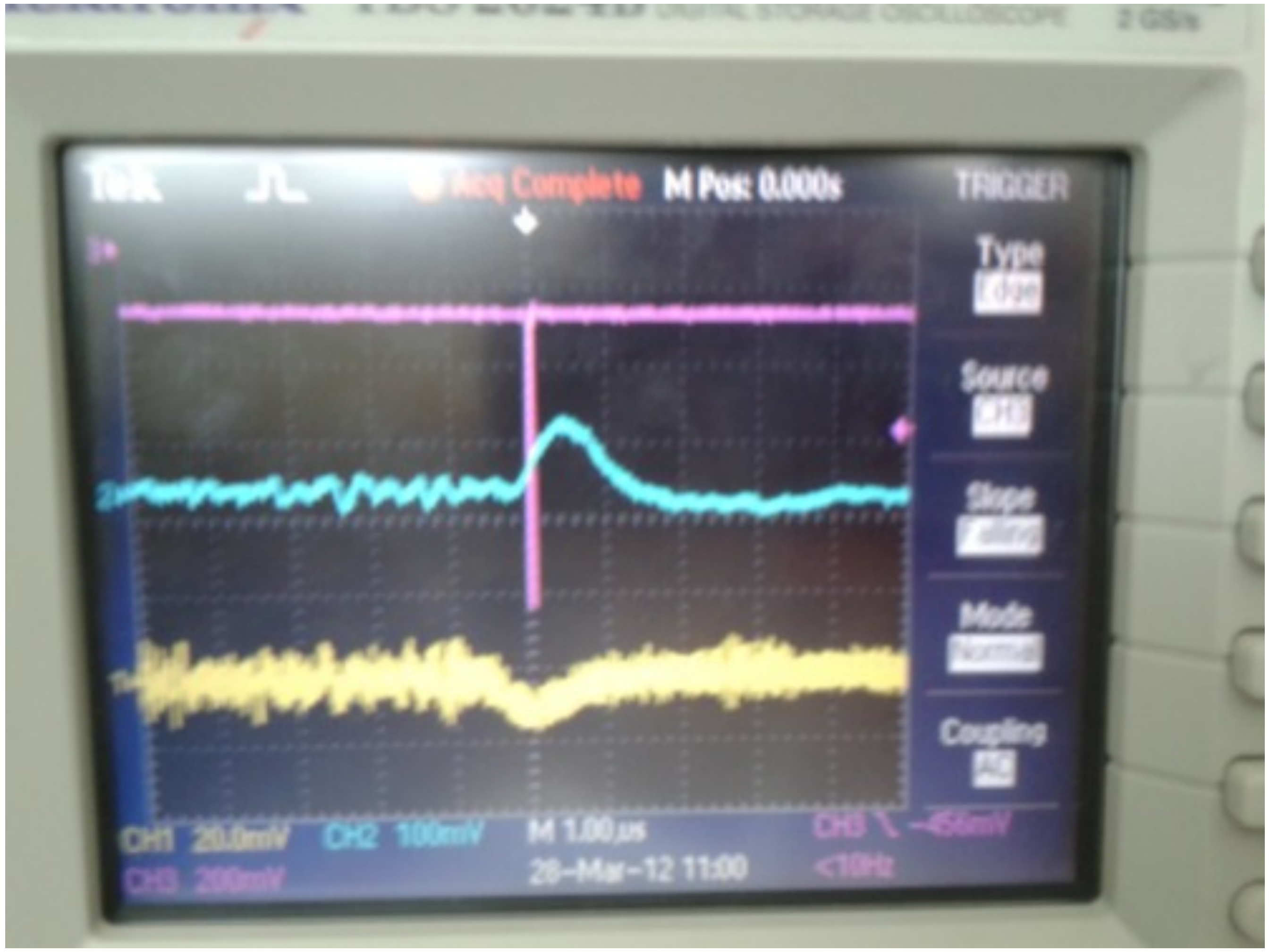
Segmented anode 8×8 pads (1 cm^2)



The trigger system



TFA: Time Filter Amplifier

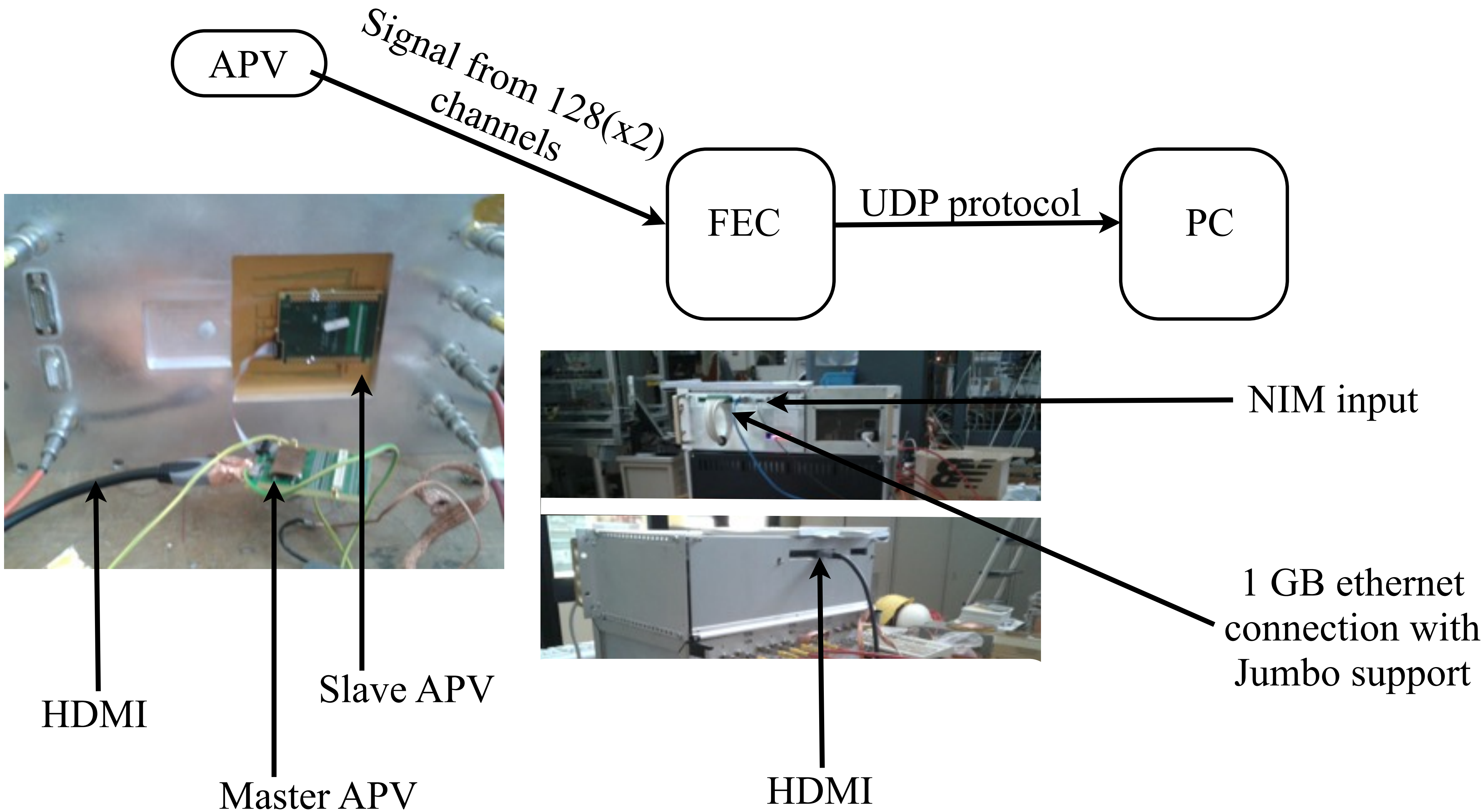


CFD: const. fraction discr. NIM signal

CFD: monitor signal

CSP: Charge sensitive preamplifier signal

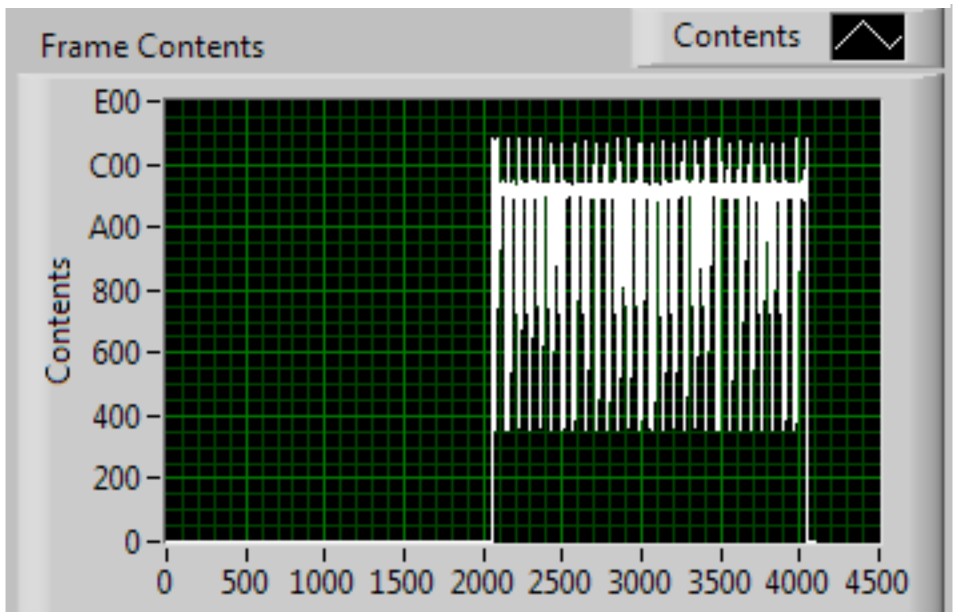
The readout system



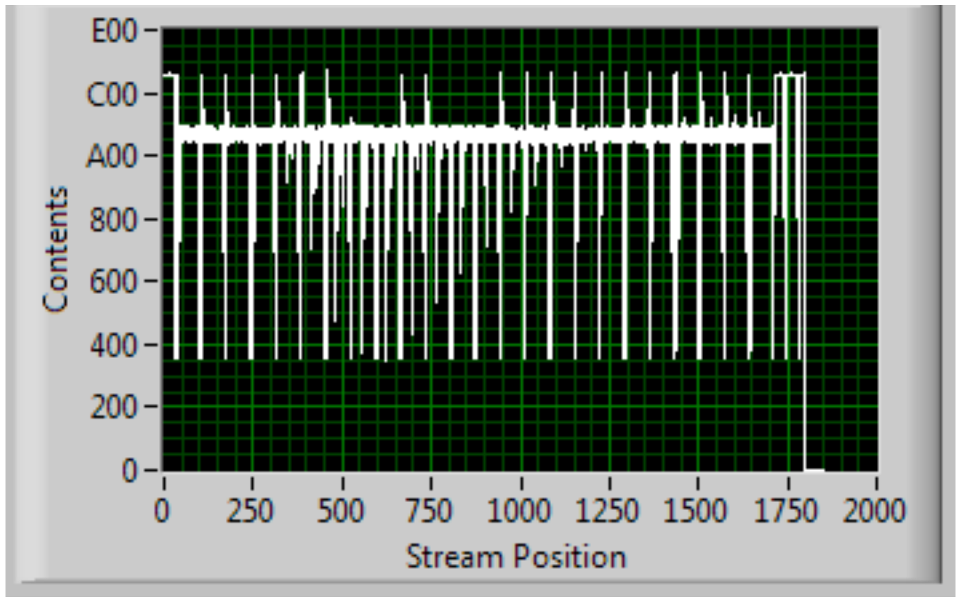
THGEM signals from the SRS

- Using Riccardo's DAQ sw we were able to store THGEM signals in different configurations
  - Pure Ne and NeCH4
  - with and without resistive layer

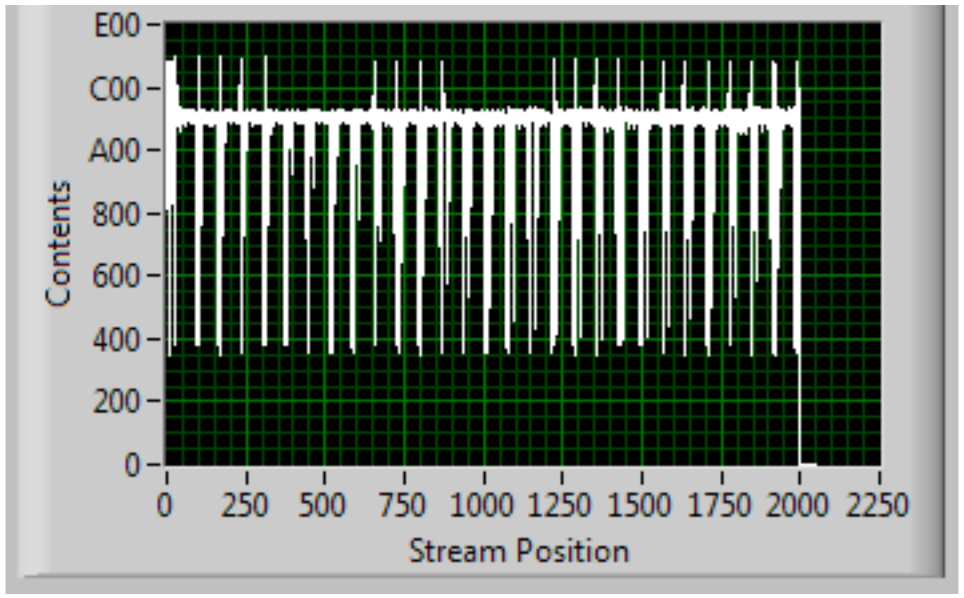
Pure Ne & regular anode



NeCH4(5%) & regular anode



Pure Ne & resistive layer



→ THGEMS can be operated with the SRS

(Well structure will be studied separately)

Problems encountered

- Energetic discharge (when operated with Ar) destroyed an APV
- Due to lack of NeCH4 we had to operate the detector with pure Ne → sparky detector
  - The sparks often required manual initialization of the FEC parameters
  - The fast CSP in the pickup circuit was damaged
  - In order to avoid these problems we operated the detector at low gain, with signal not well separated from the noise
  - Since the same signal was used for triggering we had many false triggers and large jitters

- which brings me to the next topic...

Online analysis tools - our wish list

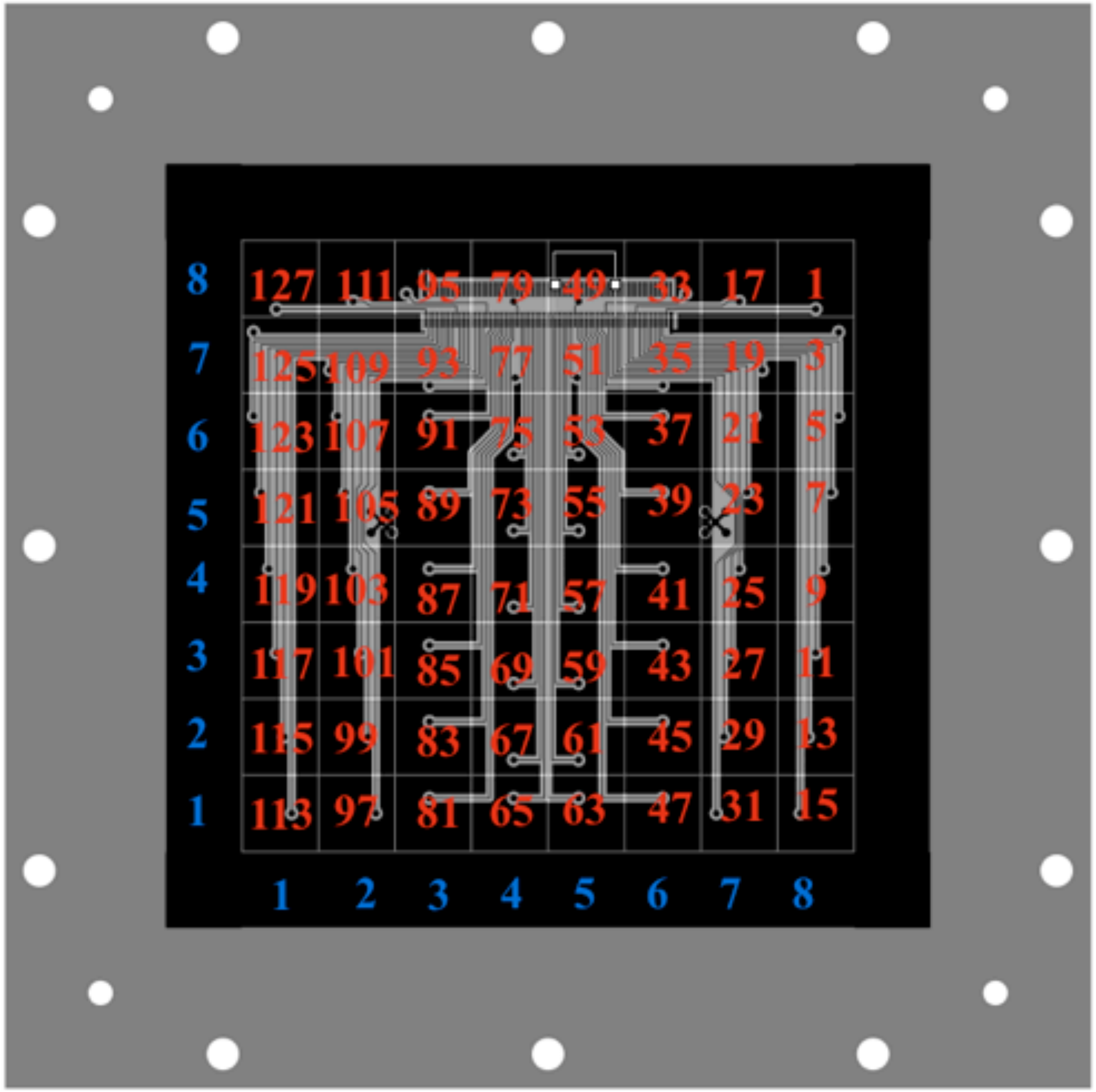
- The immediate consequences from the previous slide
  - An automatic tool that identifies FEC malfunctions and initialize it is needed
  - An online estimation of signal efficiency can also help identifying high false trigger rate

- In the next slides we use an offline analysis sw to **demonstrate** what online analysis tools will be useful
- The analysis is VERY preliminary

2D representation of the readout pads

- So far data is presented in terms of 128 strips for each APV
- This does not reflect correctly the geometry of all the systems
- A tool to translate the strips to different geometries will be useful

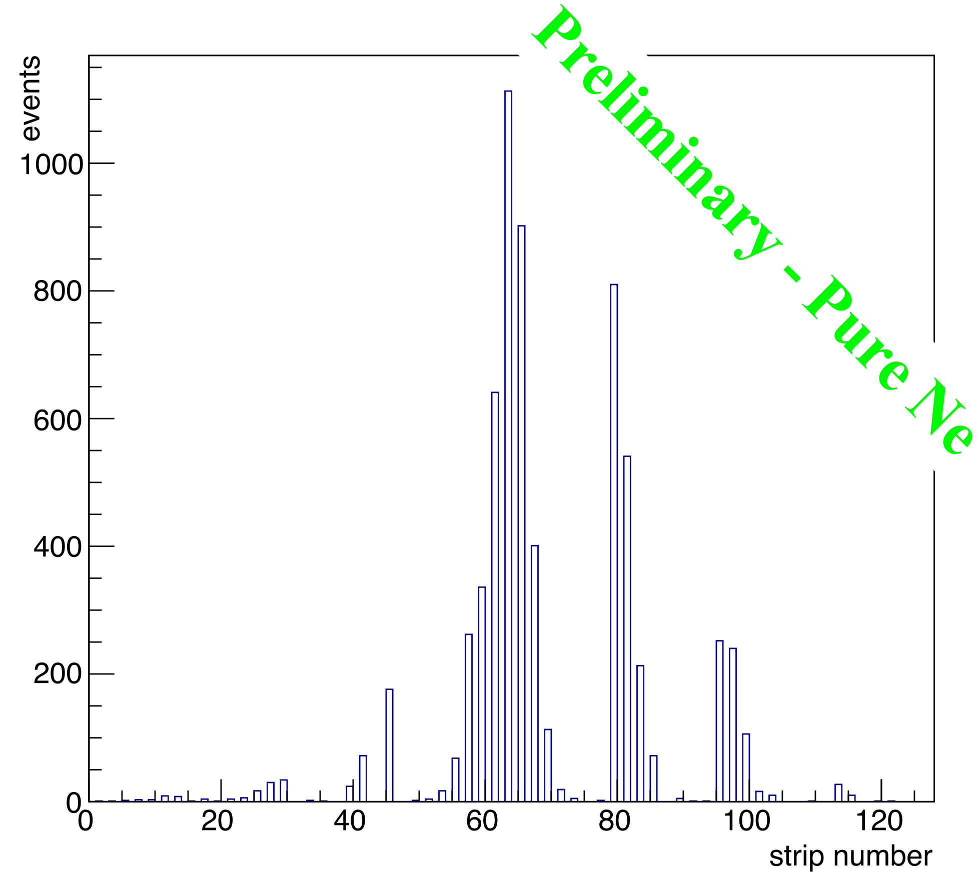
- The translation needed for the anode we used is seen in the plot

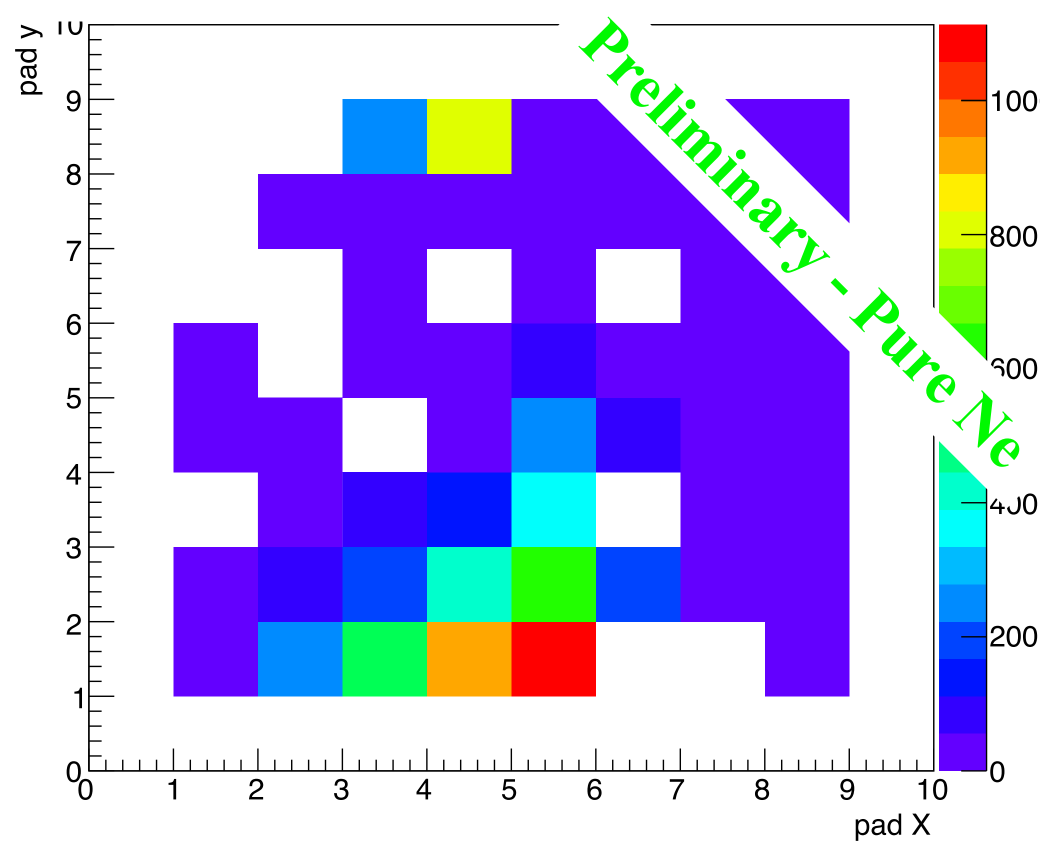


strip number **pad (x,y) indices**

2D cumulative distribution of fired channels

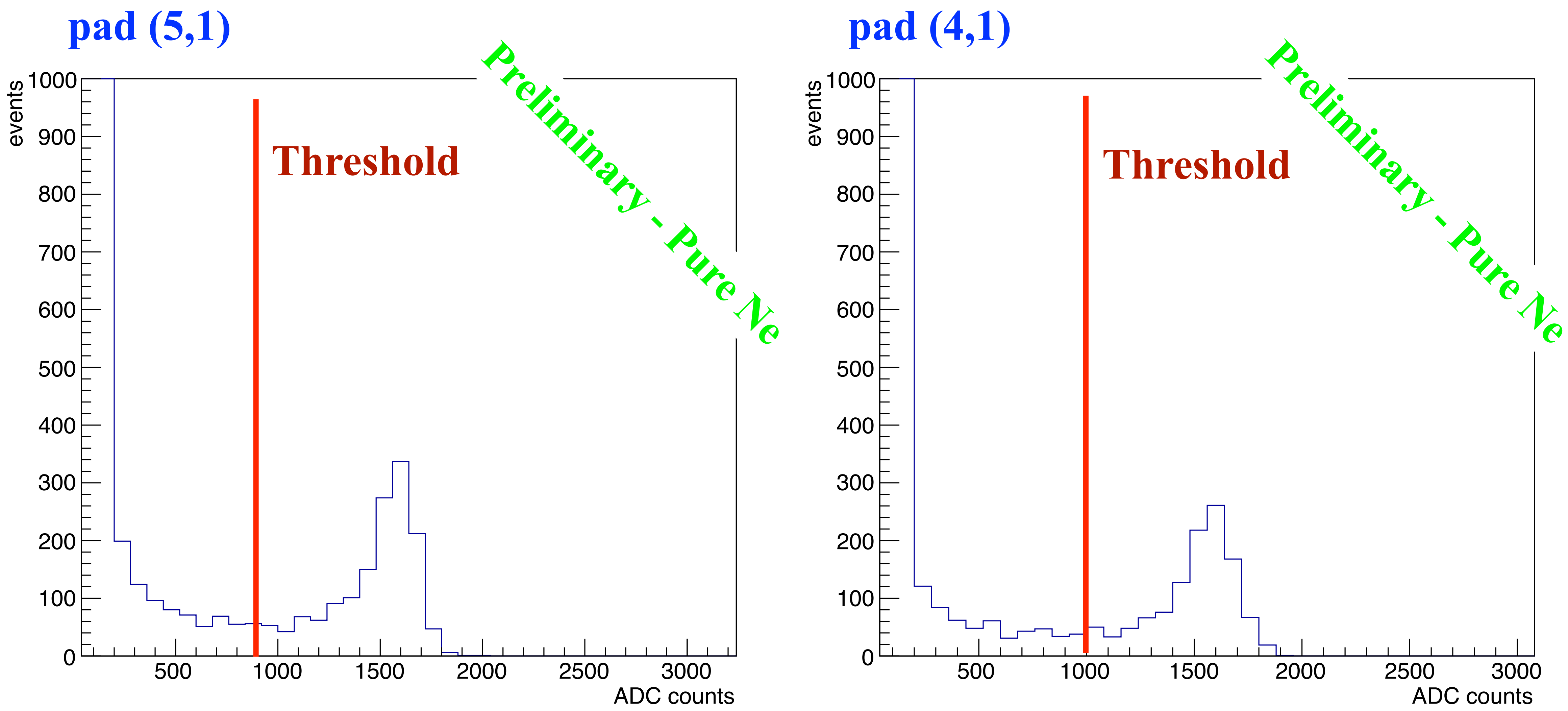
- Perhaps the first thing to test in a start of run is that the signals are read and aligned with the position of the source
- A 2D cumulative distribution of fired channels can give this information
- Shown here for the most energetic channel in terms of strips and pads
- White pads are probably not connected → online analysis tool will allow identify and fix this problem





Pulse height dist. of the individual channels

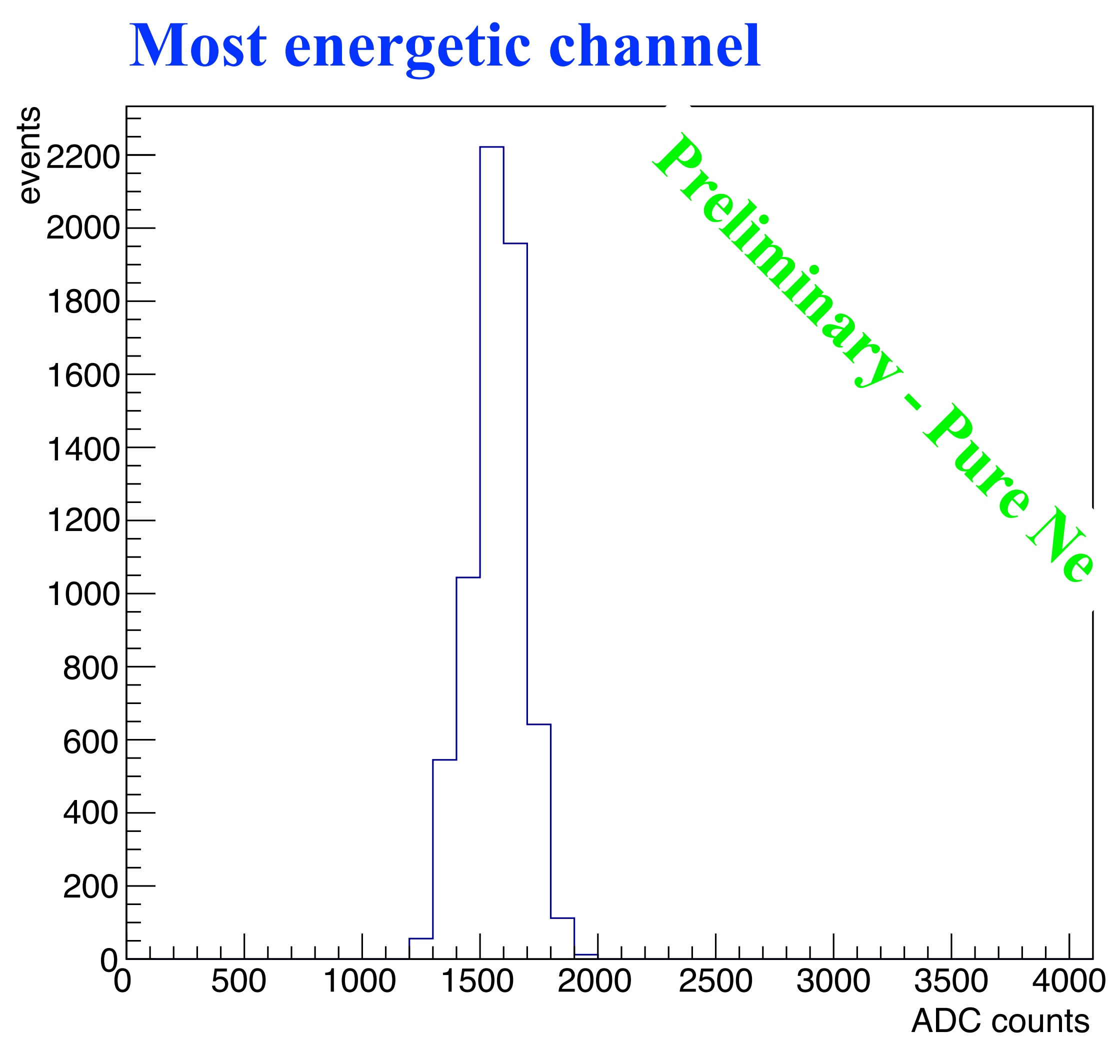
- Provides with a measurement of typical noise level at each channel and determine noise suppression thresholds
- Shown here (with insufficient statistics) for two pads

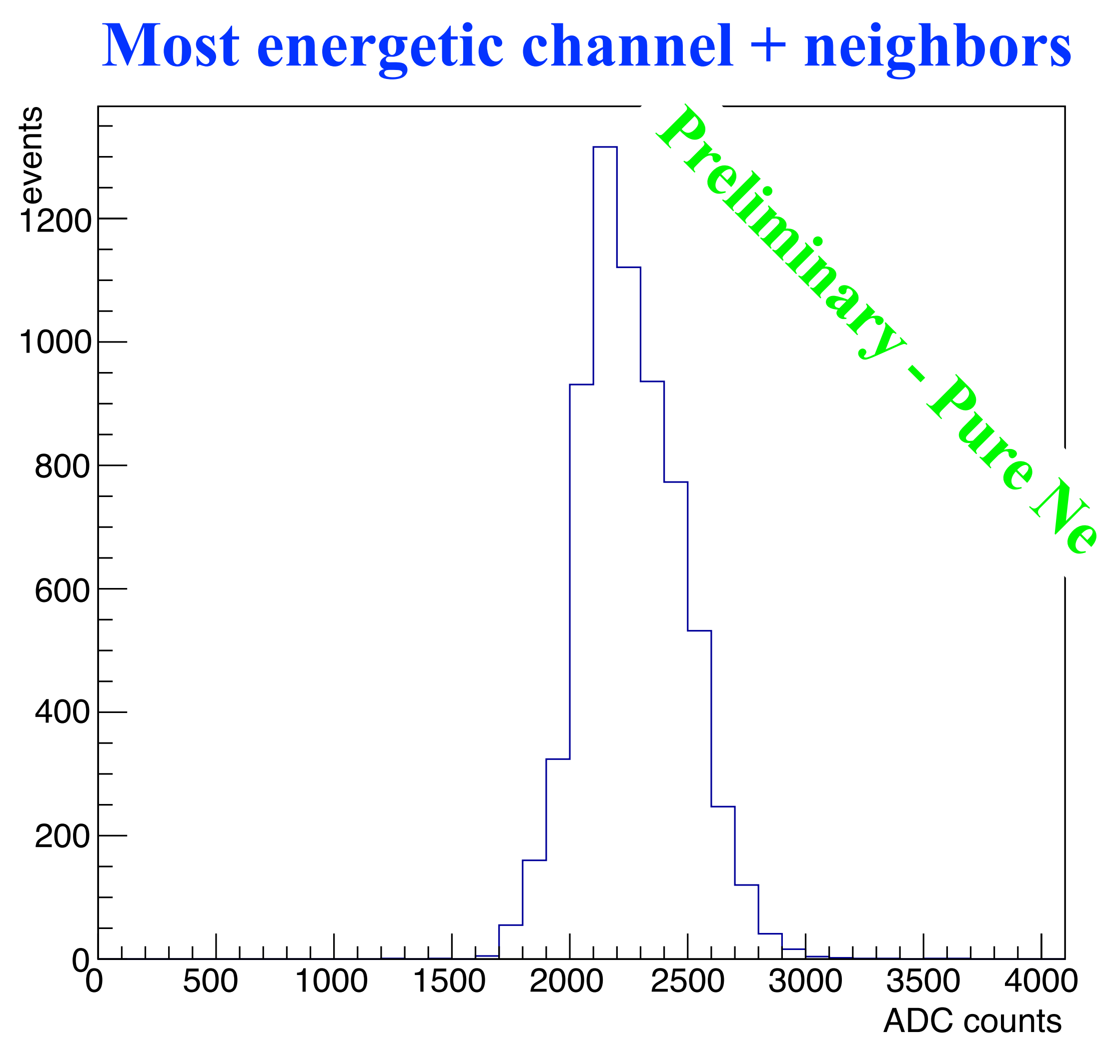


- A <u>channels based thresholds</u> will also be useful

Combined pulse height distribution

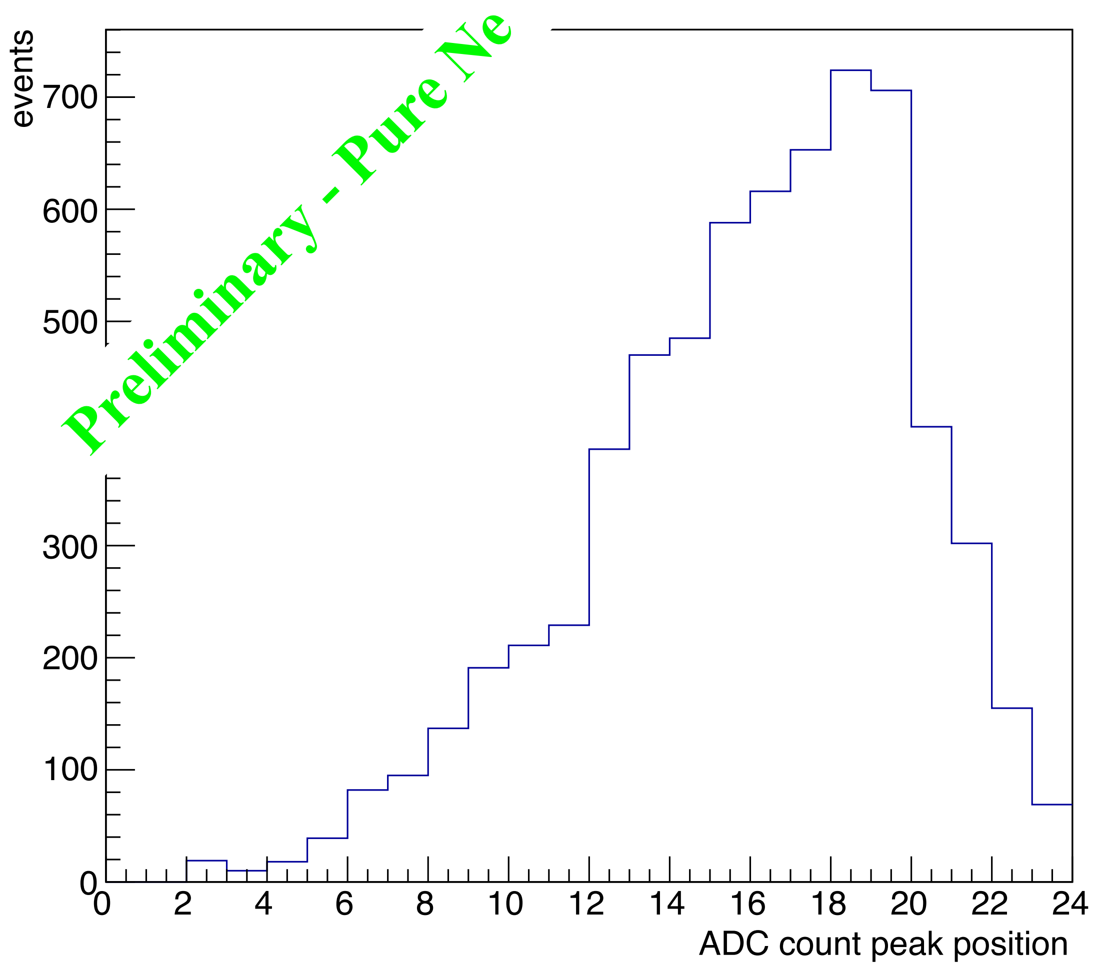
- Three alternatives might be useful
  - The charge of the most energetic channel
  - The charge of the most energetic channels and it's neighbors
  - The charge of all channels above a certain threshold
- The first two options are presented





Efficiency

- Once thresholds are set to the individual and combined channels we can define
  eff = <num selected events>/<num triggers>
- In the previous plot eff = 6600 / 21000 = 31 %
- This is due to high rate of false trigger and not due to low detector efficiency
- The plot shows the jitter in the peak of the signal which is an indication of the bad trigger quality



Multiplicity

- For each event identify the highest channel and count how many neighbors go above a user-defined threshold
- The multiplicity of the event is 1 + number of neighbors above threshold

Additional points

- Gain measurement
  - Not clear (to us?) if and how gains can be measured with the SRS
  - "The APV chip has an internal test charge injection circuit with a variable strength of (0..255) x 0.1fC. Unfortunately there is no internal way to calibrate the calibration circuit, so process variations will influence accuracy."
- Synchronization with RD51 tracker
  - The data from a single FEC card is packed into a single event
  - The LabView DAQ is designed to support these data
  - But (!!) this was never tested
- Output file is too big (157MB / 10K events)
  - Zero order suppression is needed
  - It should be possible to define the zero of the individual channels

Conclusions

- THGEMs can be operated with the SRS
  - With and without resistive layer
  - Well configuration was not tested yet
- More advanced off-line analysis can be implemented
  - Taking into account the pulse shape and not just the highest ADC count

- The LabView DAQ sw is user friendly and allows off-line analysis of the data
- The few on-line tools suggested in the text can improve the quality and the efficiency of the data taking

Future plans: 100×100 mm^2 electrodes

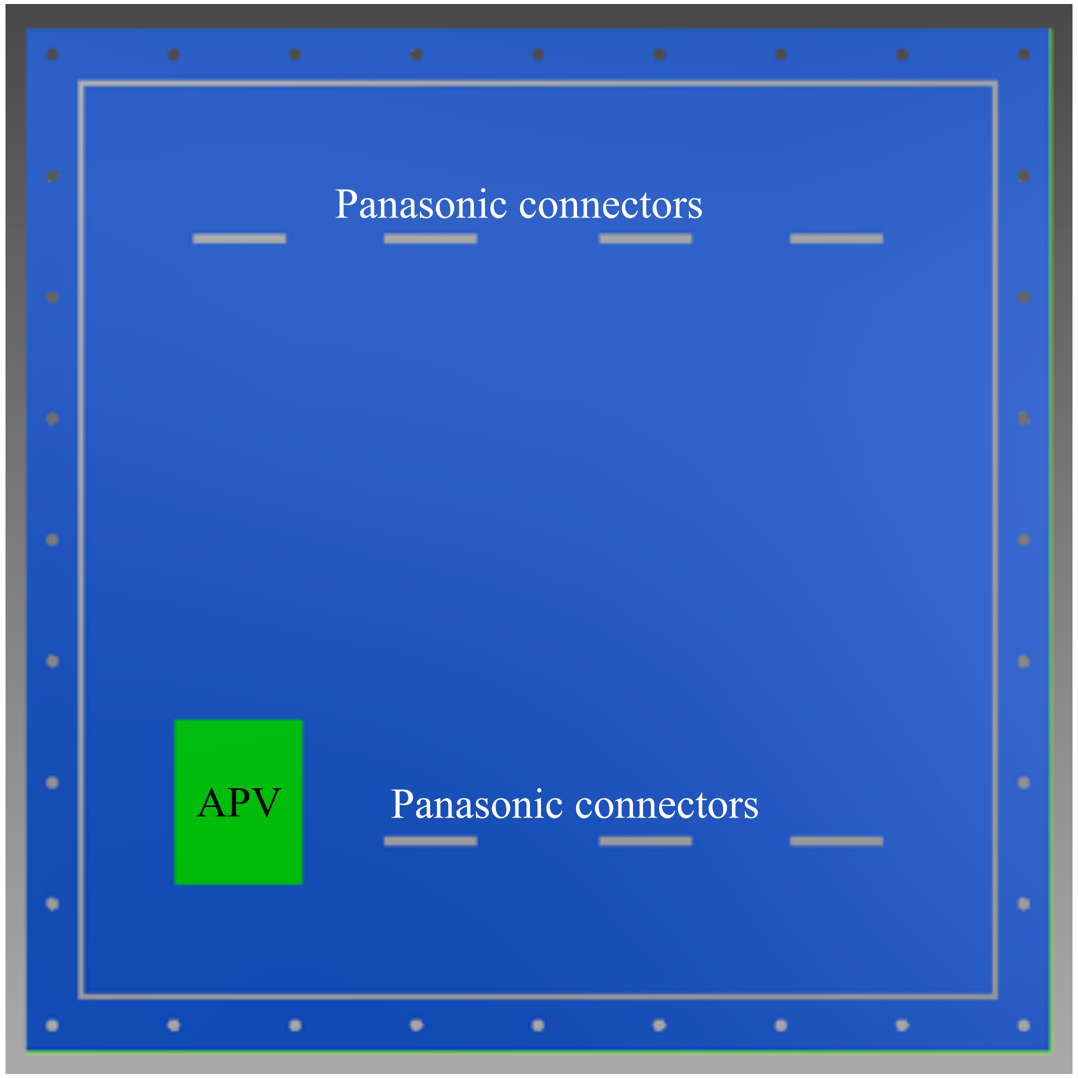
- Test the SRS in the lab at WIS
  - With cosmic-rays and x-ray photons
- Use the SRS with the LabView DAQ in one of the next beam tests

- We must have an SRS in WIS before our next test beam

Future plans: 300×300 mm^2 electrodes

- A step towards large scale THGEMs
  - Present needs: COMPASS RICH, DHCAL for the ILC
- In collaboration with Aviero and Cuimbra
- New vessel
- New segmented electrode (will be produced by PE)
- Fully equipped with SRS electronics

- Suggestions are welcomed



THGEM evaluation with MICROROC

- In collaboration with LAPP
- Possible solution for the DHCAL
- Will allow direct comparison of results obtained with the SRS to results obtained with MICROROC