Tracking setup preparation for test beam 2018

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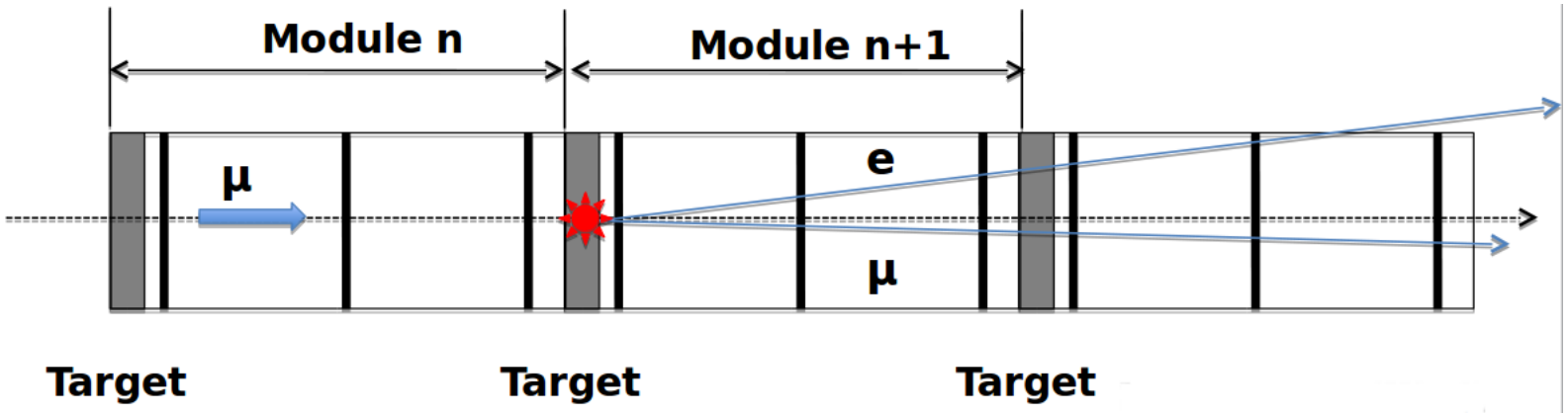
Insubria & INFN-MiB & INFN-TS

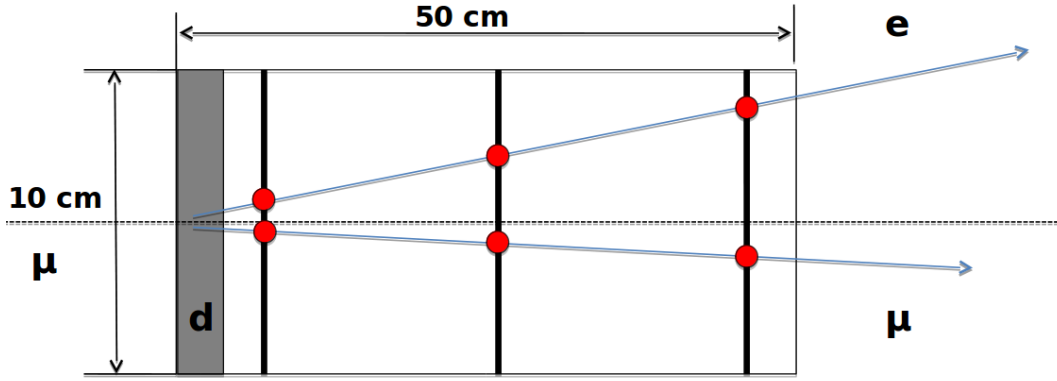
Mainz 19/23 february 2018

Topics

- Experimental setup
- Silicon detectors
- Electronic chain & DAQ
- Ongoing tests in Como
- TB 2018 preparations

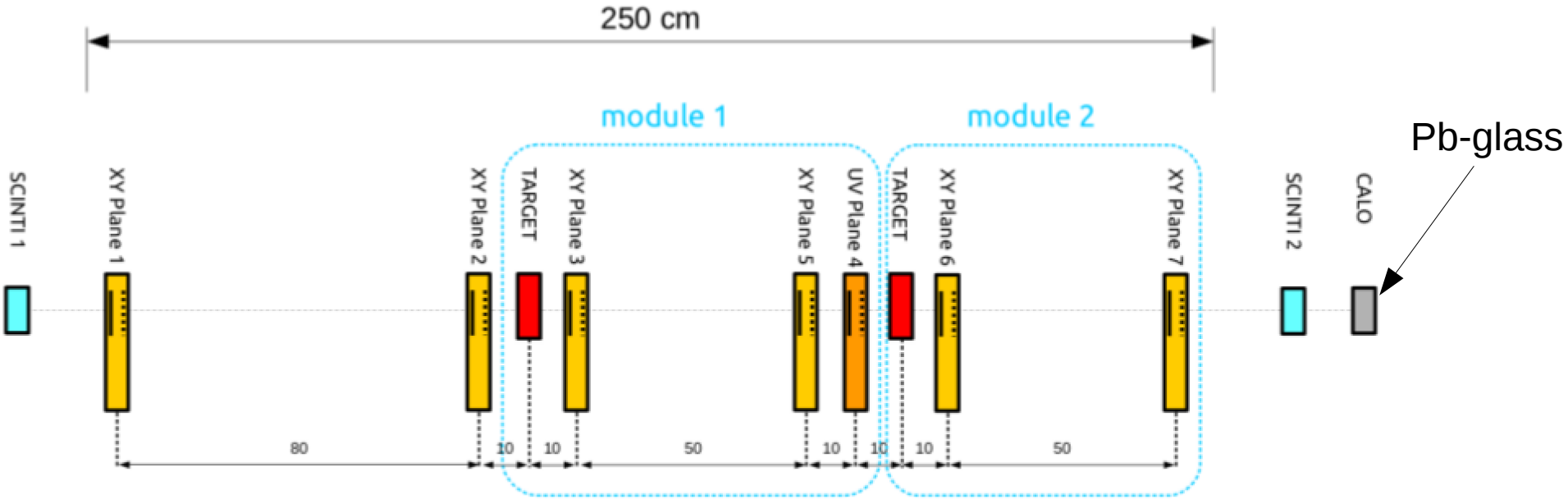
How to measure e and μ scattering angle





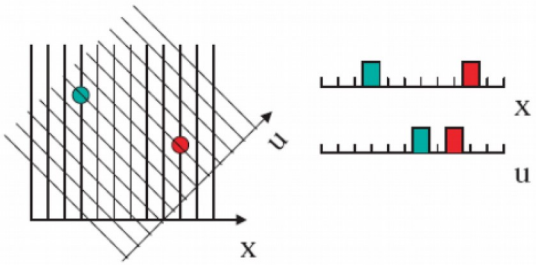
Standalone module scheme

Experimental setup

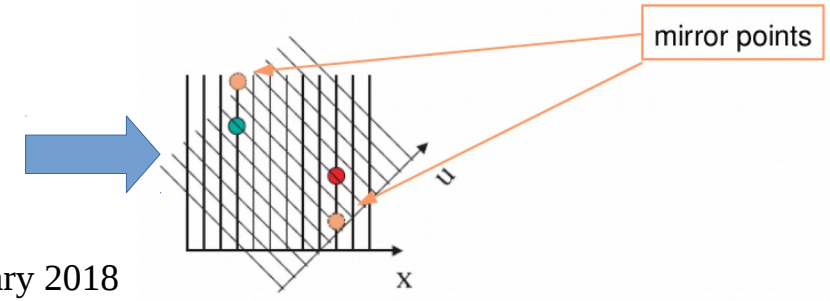


Scintillators: 2 100 x 100 mm^2

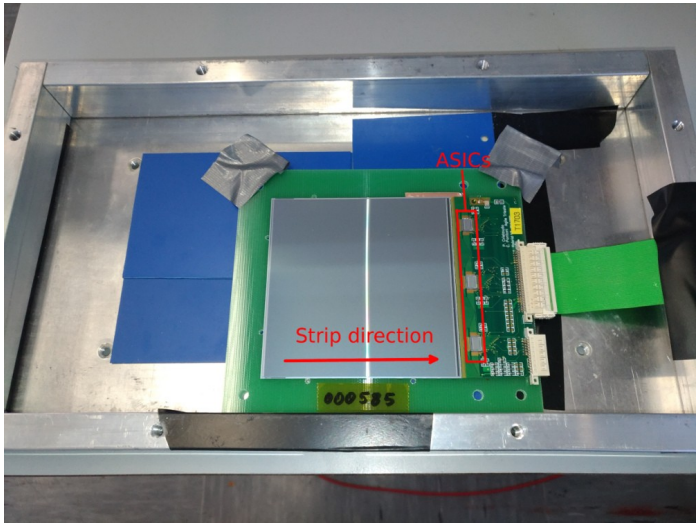
Silicon detectors: 12 XY planes
2 UV plane ±45°



Need 3 stereo views to resolve ambiguities



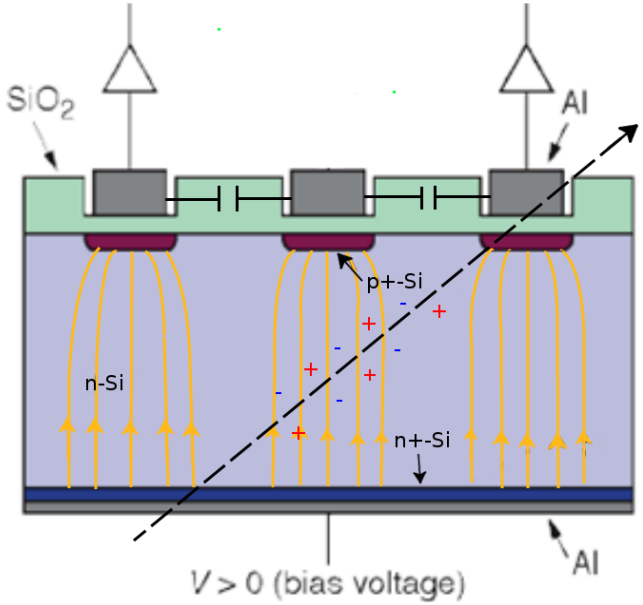
Silicon detectors



Each detector is made of double-side microstrip planes (XY or UV).

Details for each layer:

- Dimensions → 9.5 x 9.5 cm^2
- Thickness → 410 μm
- Readout strips → 384
- Readout pitch → 242 μm
- Physical pitch → 121 μm



Strip floating:

- Analog readout mode
- Capacitive coupling between adjacent strips (charge shared)
- Better resolution
- Not necessary to read all the strips (less channels to read)

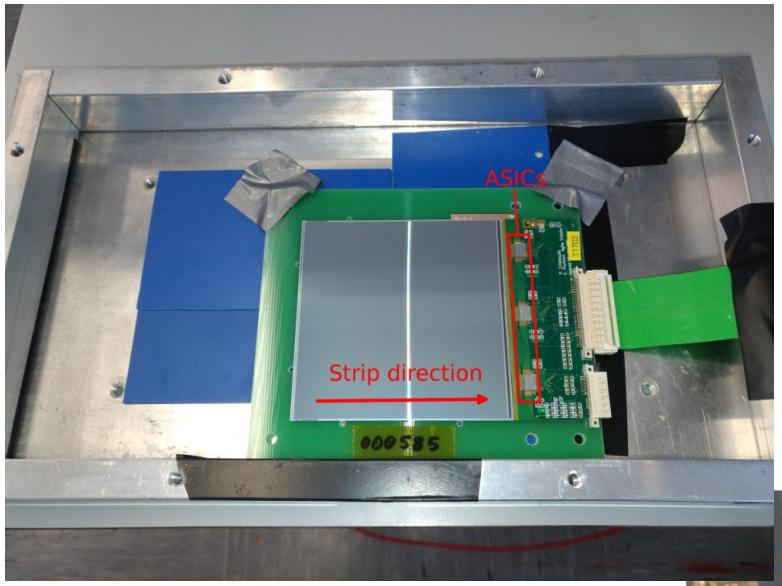
Spatial resolution without floating strip and digital readout mode

$$\sigma = \frac{pitch}{\sqrt{12}} \approx 70\,\mu m$$

Spatial resolution with floating strip and center of gravity calculation

$$\sigma \approx \frac{pitch}{1.5 \cdot SNR} \approx 30 - 40\,\mu m$$

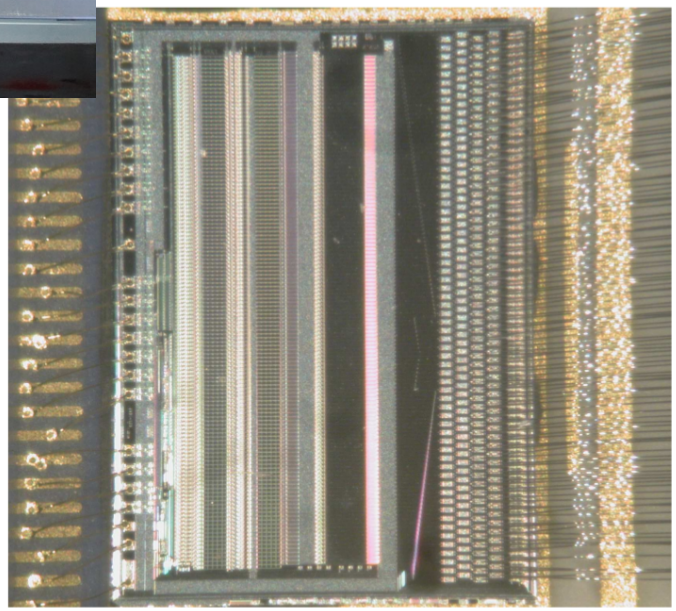
ASIC TAA1 (IdeAS)

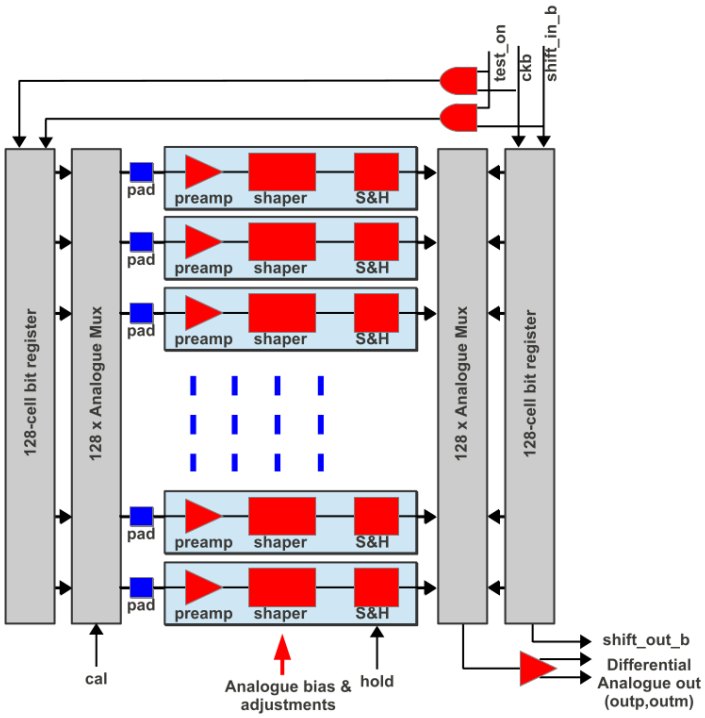


Readout:

- 3 ASICs, 128 strips for ASIC

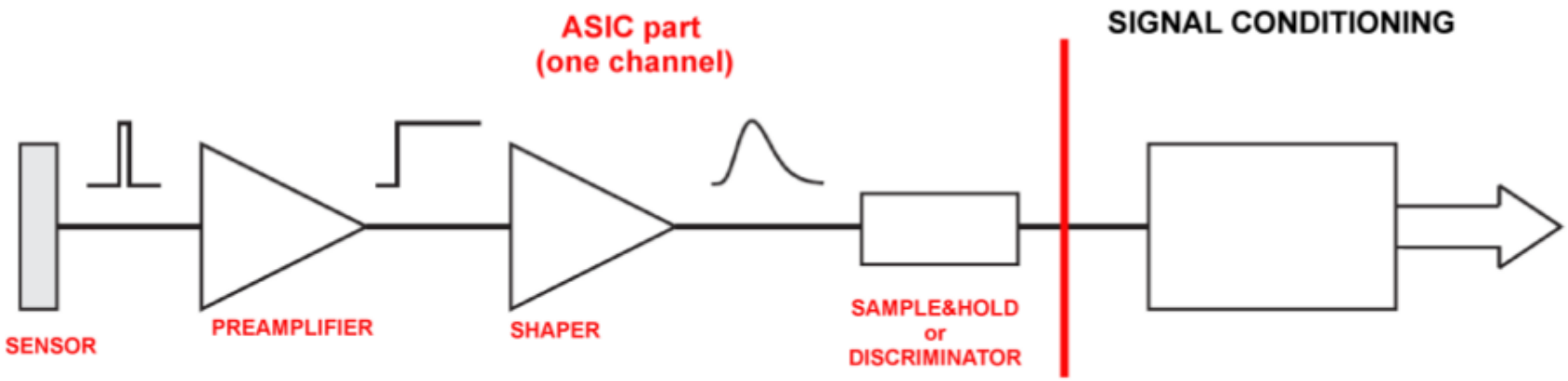
Single ASIC →





Shaping time optimization

Electronic chain (ASIC part)

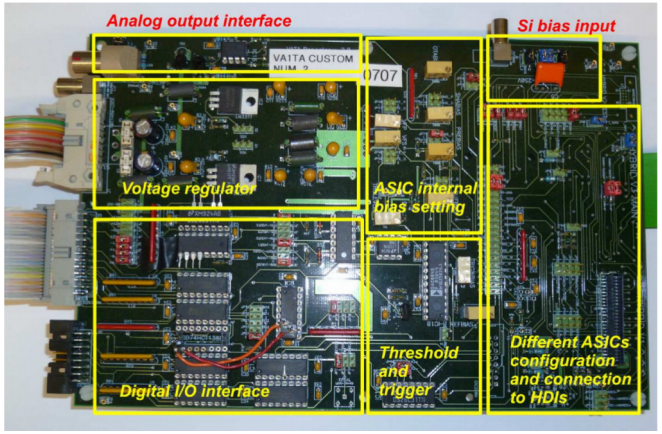


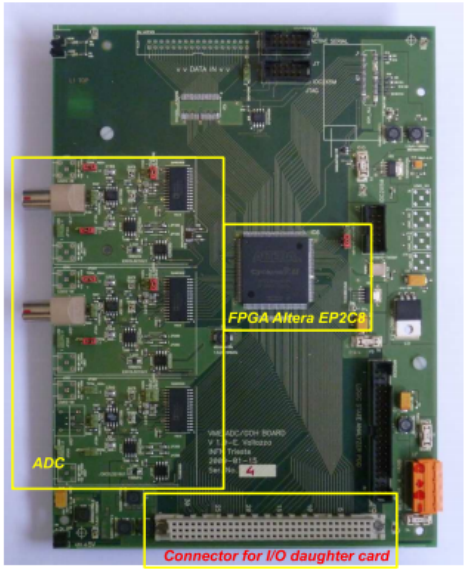
- preamplifier: integrates the total charge and produces a voltage step;
- CR-RC^2 shaper: filters the noise contribution and shapes the signal. Requires analog bias given by repeater
- a Sample&Hold circuit (S&H), in case of the analog readout: the shaper output is stored in a capacitor, which in turn is driven by a dedicated digital signal (the hold one), and readout afterwards.

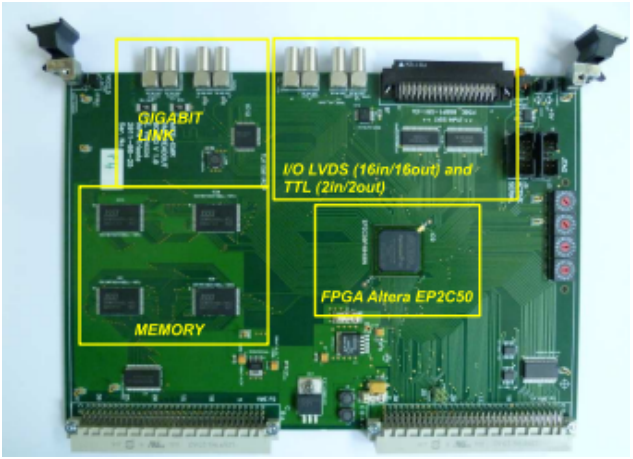
Electronic chain (signal conditioning)

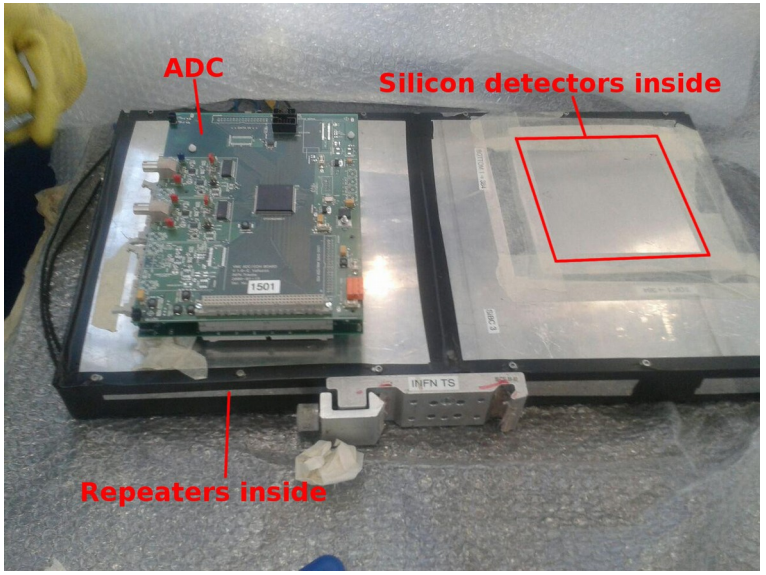
External electronics, connected to the ASICs:

- repeater: configuration settings for detectors and ASICs
- ADC: digitization of the multiplexed signal, data storage, communication with VME readout board

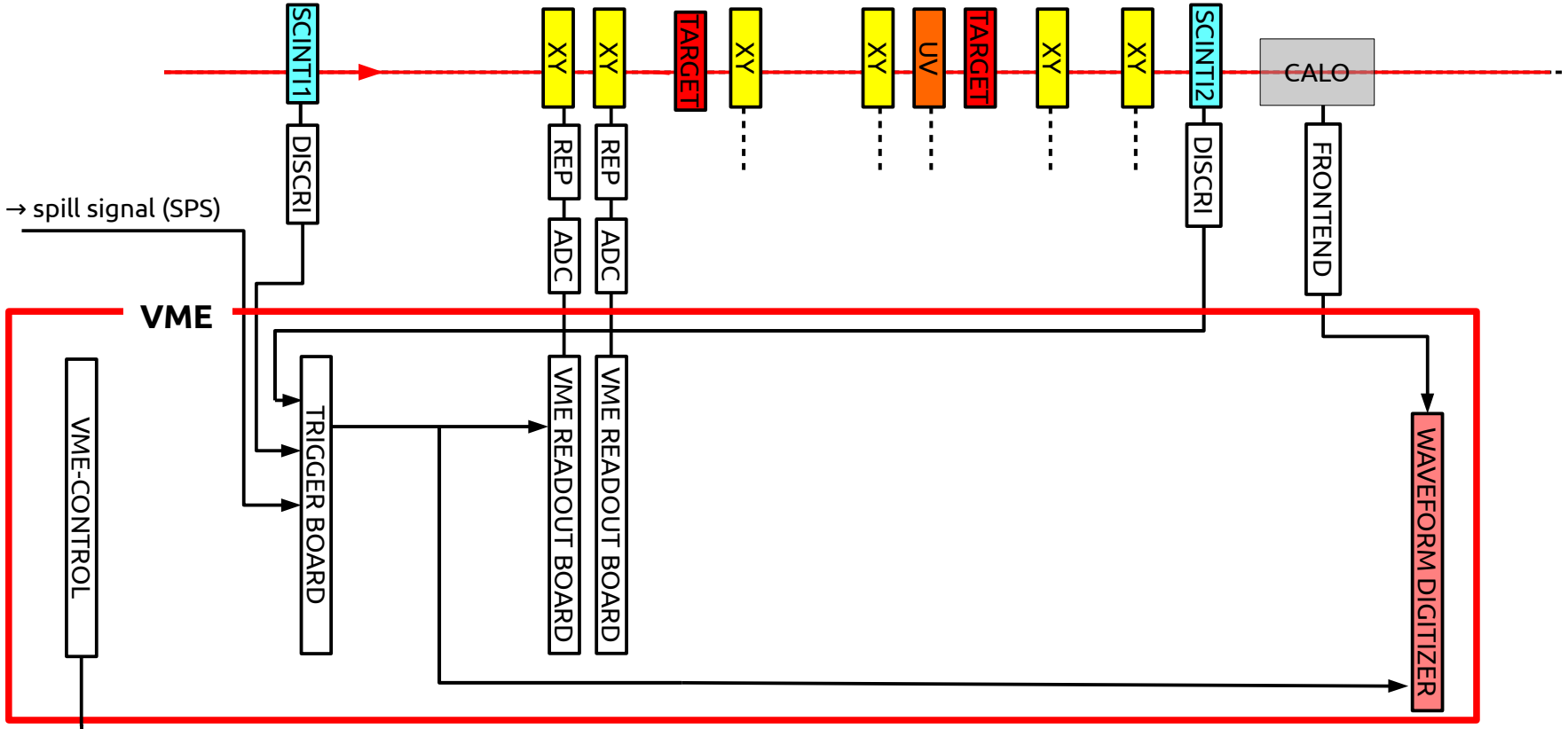






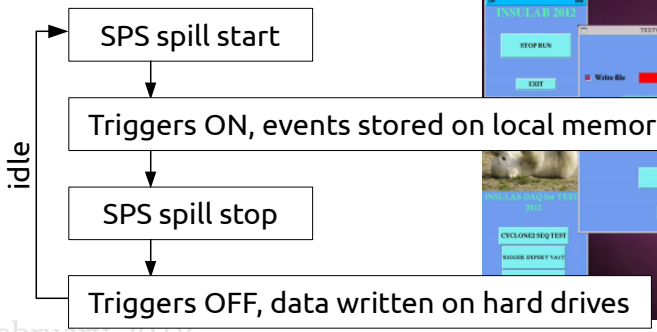


DAQ

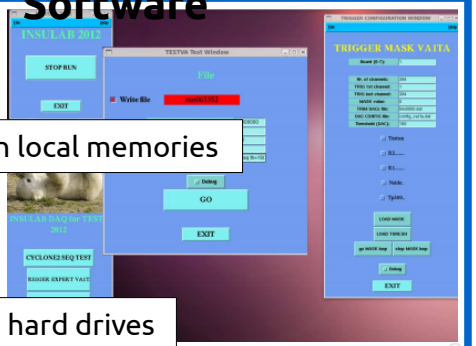


DAQ program (C + Tkl/Tk GUI)
- trigger selection (AND, OR, VETO, ...)
- calibration routines (silicon strips)
- pedestal run

online data processing
- "dst" production
- monitoring tools



Software



Acquisition rate

Max acquisition rate: **10 kHz**

- Readout time for each silicon layer: **78,6 µs**
- Initialization time of the boards: **10 µs**
- A readout rate of 10 kHz is possible

BUT

- Particles in spill follow a Poisson distribution → to approach a rate of 10 kHz we need more than 10k particles/spill (at least 100k) → but this will increase the number of multiple hits
- “good events” acquisition rate will depend on the number of single cluster events on the first two detectors (before the first target)

Expected data size

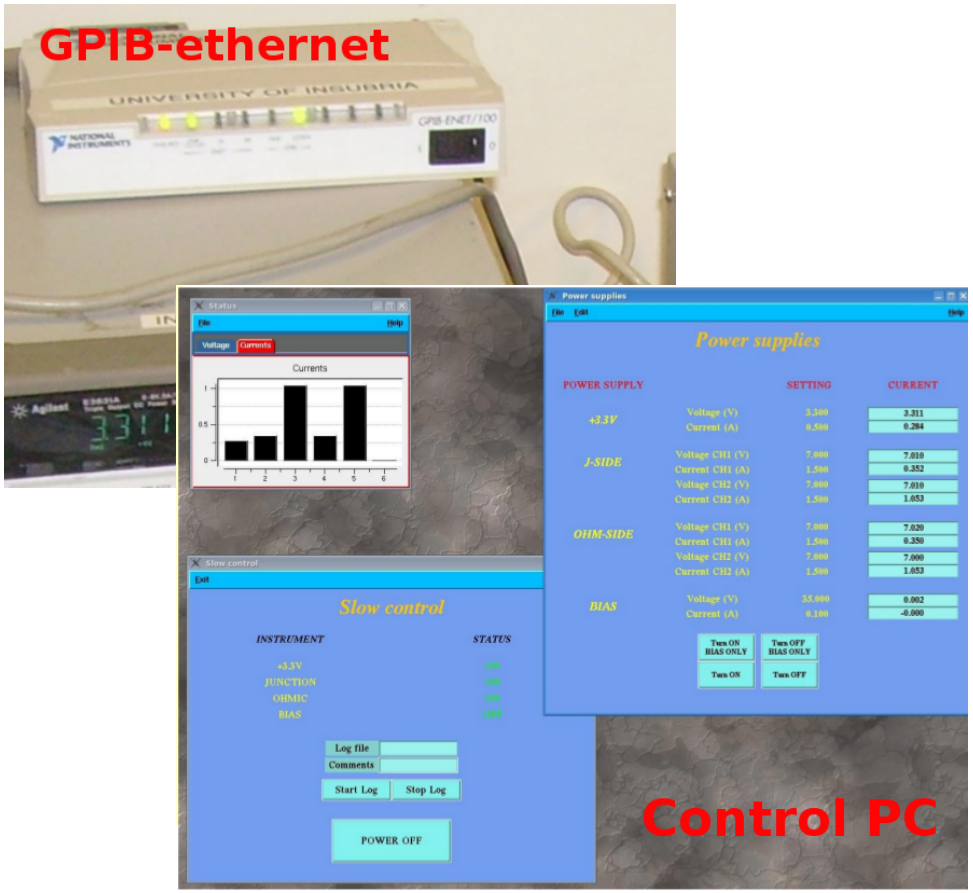
- Event rate = **1.4 Gevents/week**
  - 10k event/s * 14 s/spill* 1 spill/min * 1440 min/day * 7 day/week
- Event size = **430 byte**
  - Microstrips → 24 bit/hit-strip = 3 byte/hit-strip * 10 strips (zero suppression scenario) * 14 planes = 420 byte
  - Digitizer →14 bit/information * 6 informations (3 PH + 3 times) = 10 byte

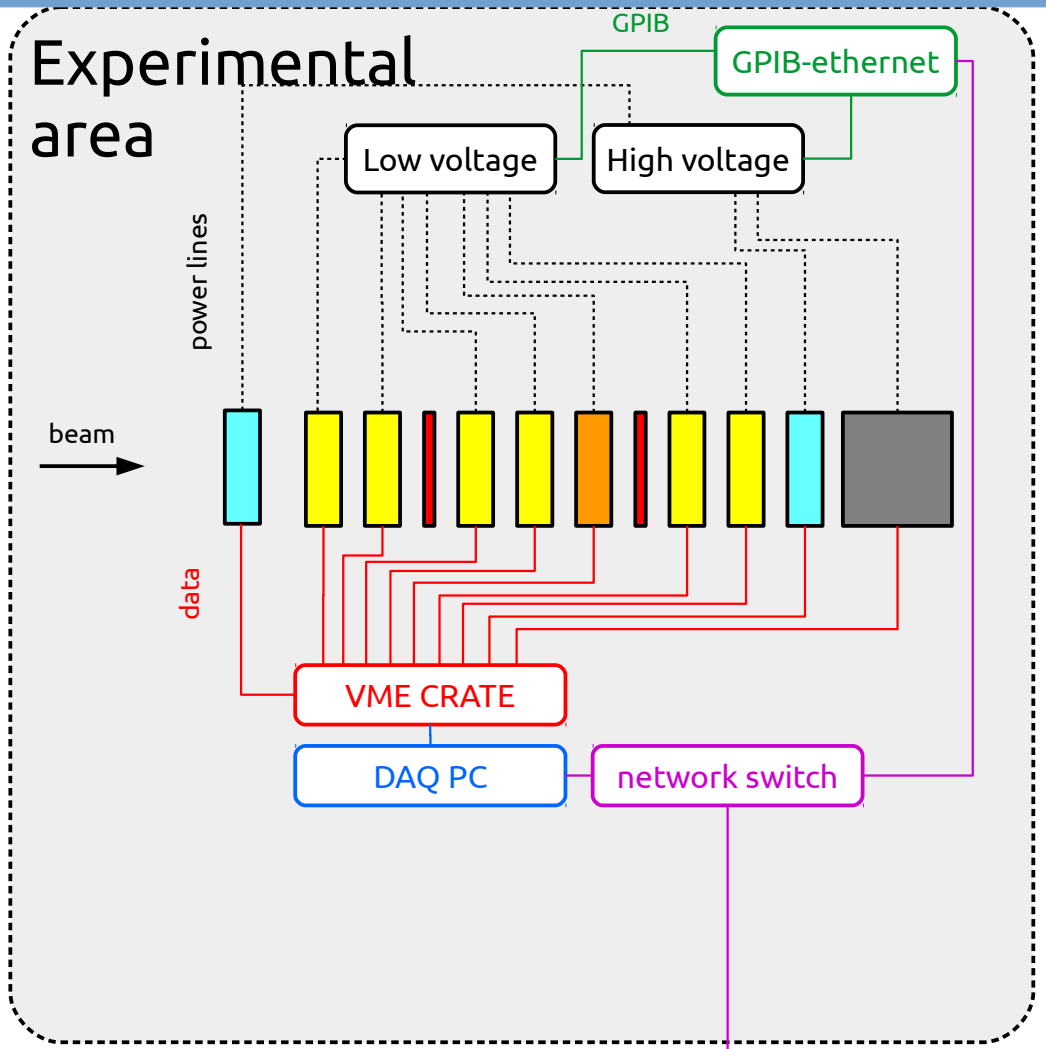
~ 600 GB/week

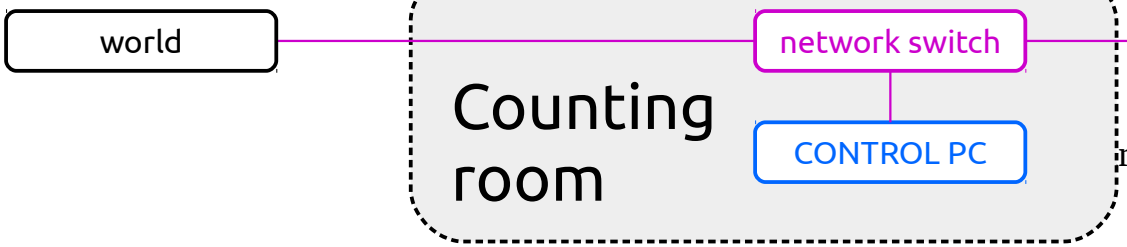
We can work with standard hard drives (monthly replacement at most)

Remote control

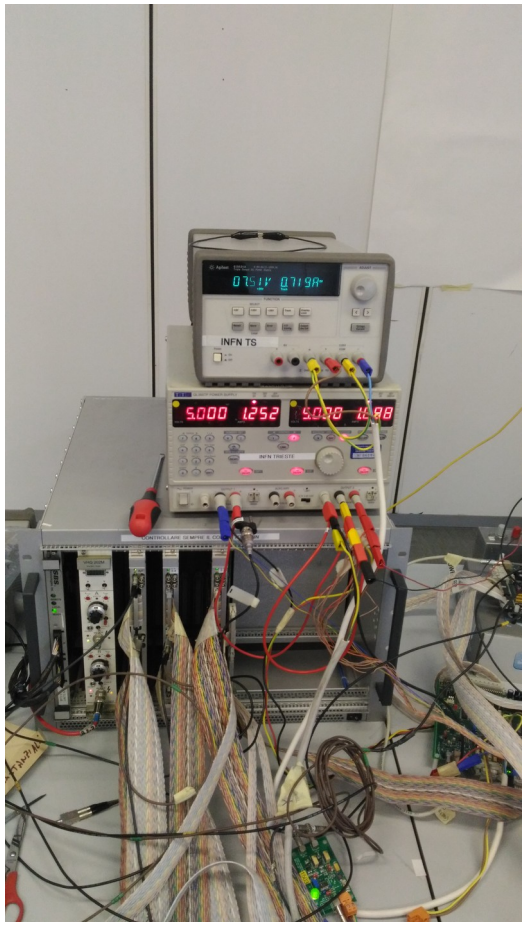
Connections
(power, data, network)

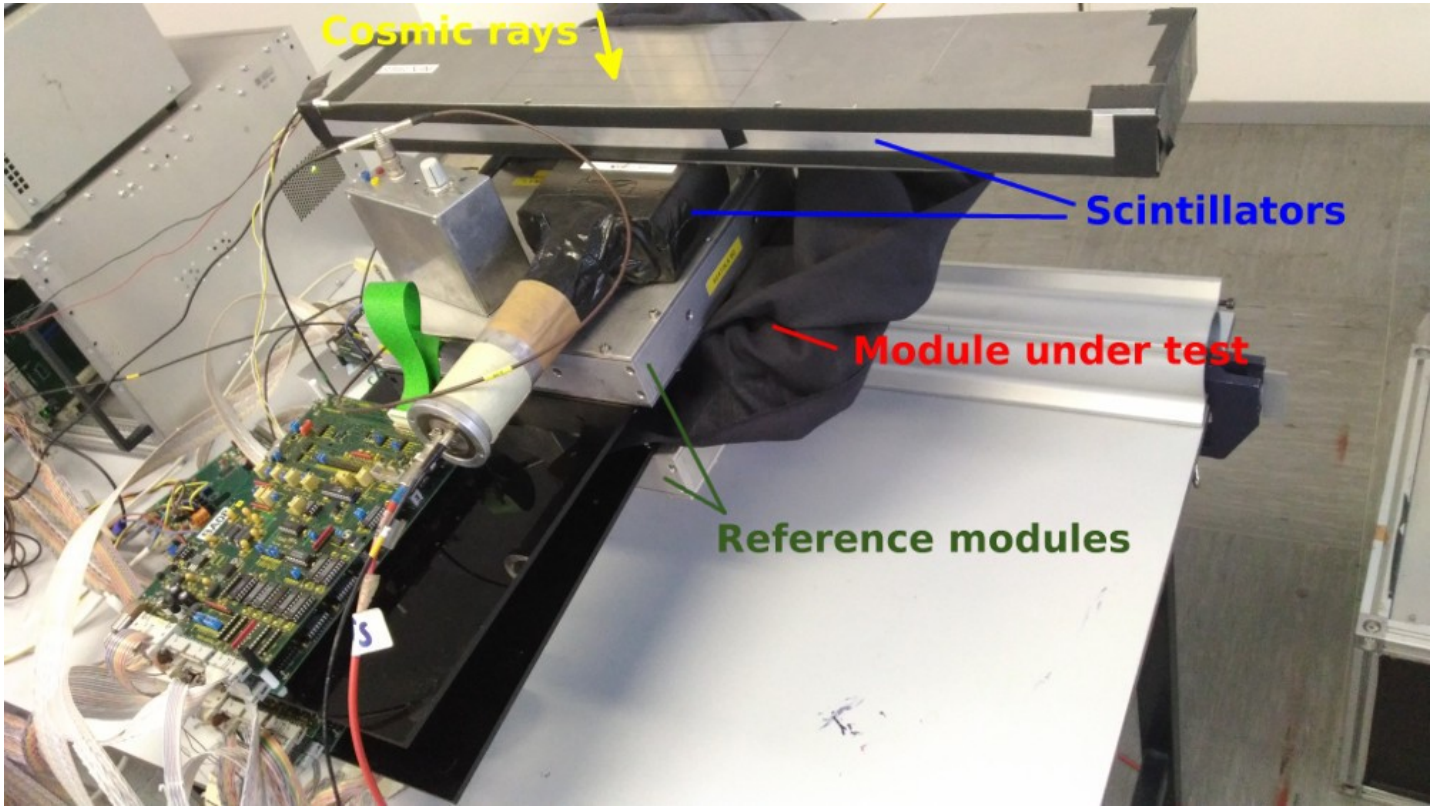






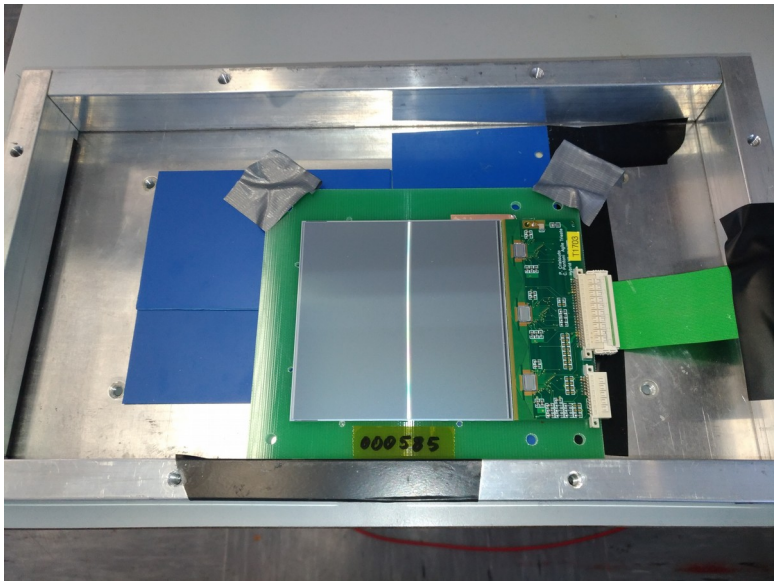
Ongoing tests in Como

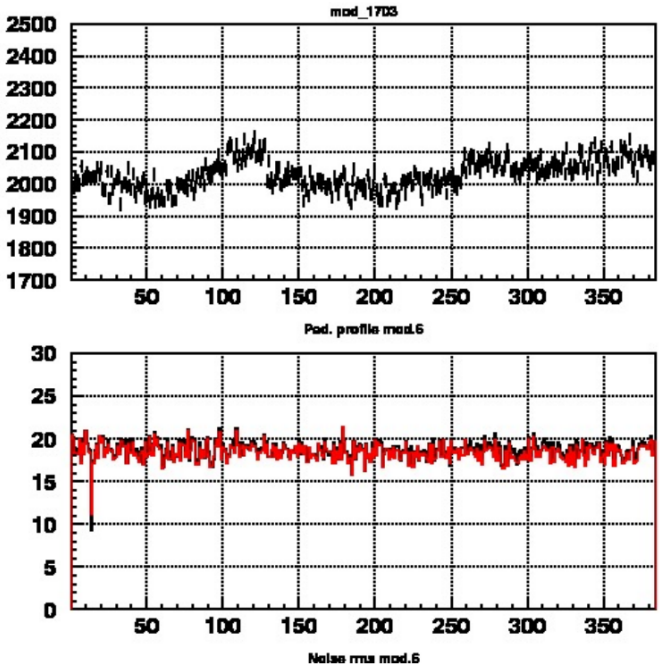




Ongoing tests in Como

Strip uniformity:

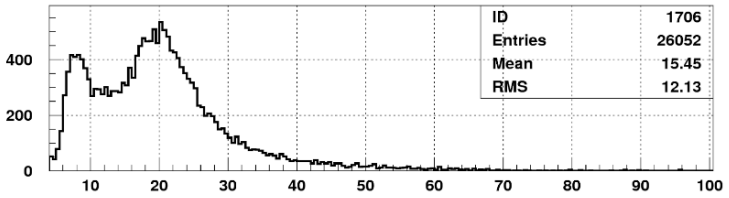




Pedestal (black)

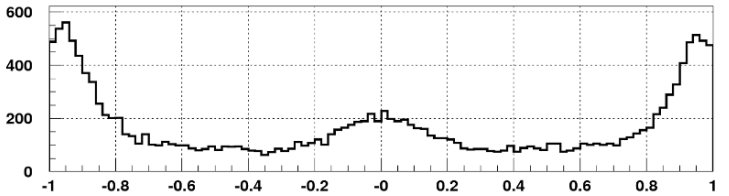
Pedestal-CM (black)
Common Mode (red)

Ongoing tests in Como



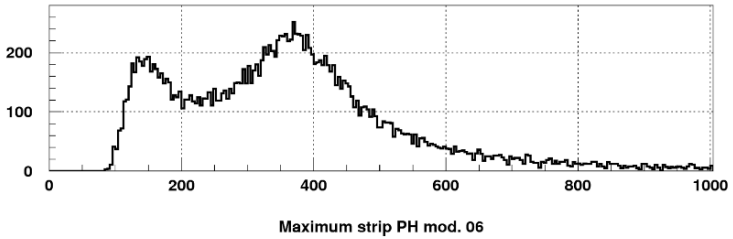
$$pull = \frac{PH}{rms}$$

Defined event by event for each channel

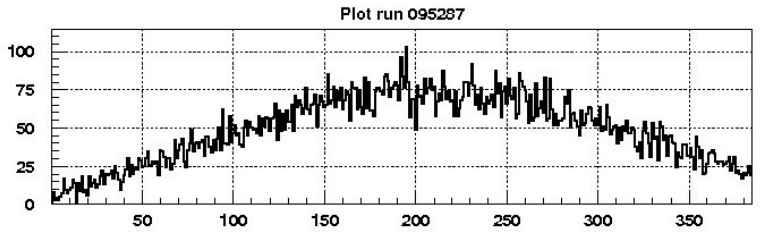


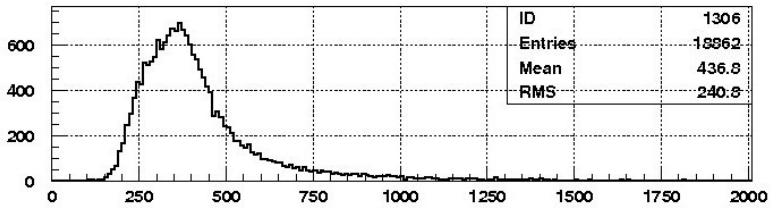
$$\eta_{dx} = \frac{PH_{high} - PH_{dx}}{PH_{high} + PH_{dx}} \qquad \eta_{sx} = \frac{-PH_{high} + PH_{sx}}{PH_{high} + PH_{sx}}$$

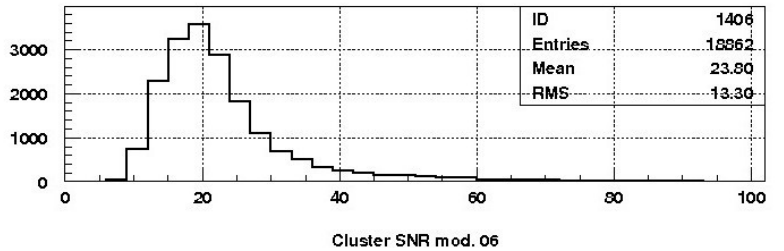
Charge sharing between strips



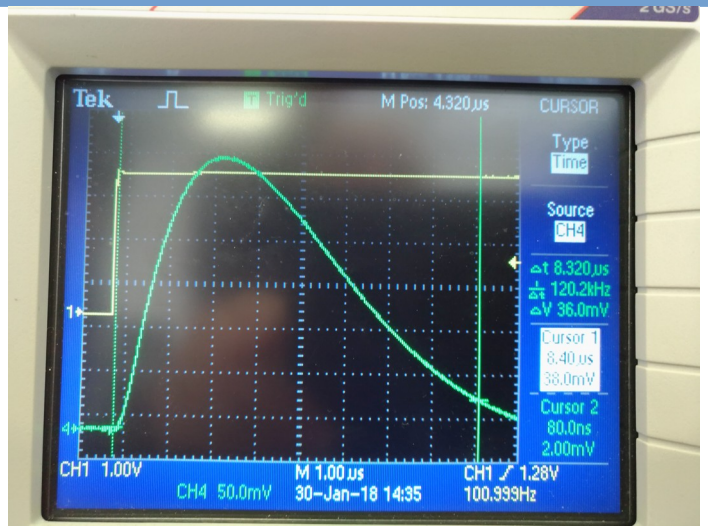
- charge sharing
- readout clock

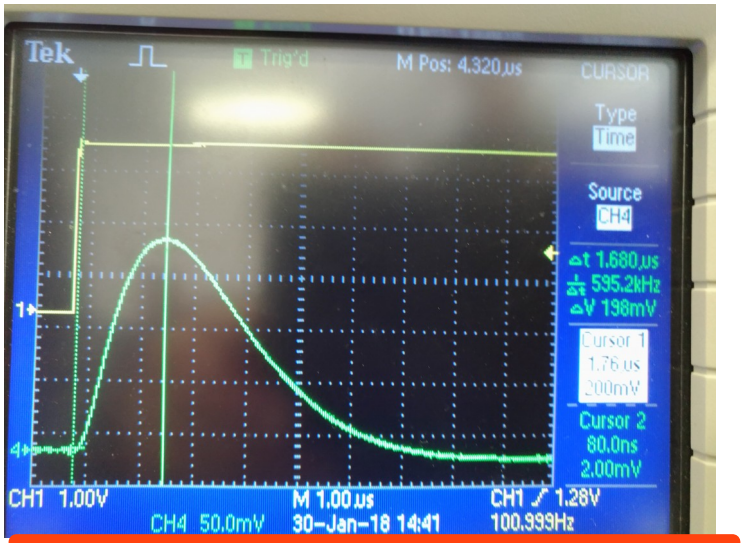


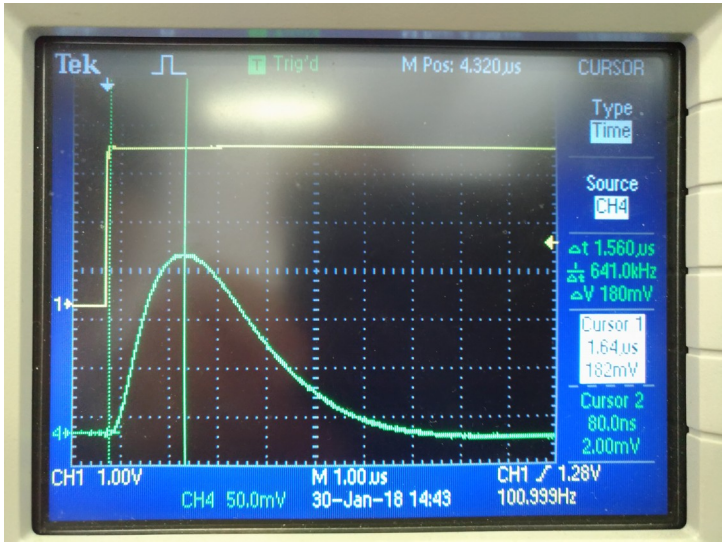




Shaping time optimization





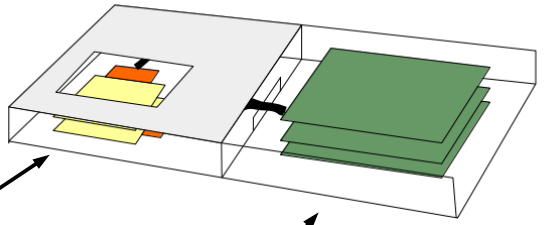


Parameters adjusted via repeater. Improving the signal shape is useful to prevent pile up

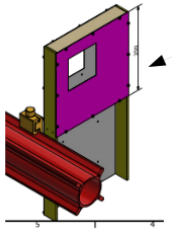
Experimental setup location

Site inspection in COMPASS on 11/10/2017
Counting room quite far from experimental site: DAQ PC near setup → “short” optical fiber from crate VME to DAQ PC, then ethernet cable from DAQ PC to counting room

Test run 2018 preparations



- Detectors (Insubria and INFN-TS):
  1) Silicon strip detectors → 11/14 fully tested
  2) Frontend (2 repeater boards + ADC board) → assembly start this week, ready 05/03



- Mechanics:
  1) Boxes (INFN-MiB) → preliminary drawing ok, final drawing ~ this week
  2) Support:
     I. 2.5 m Newport rail + carriages ordered @CERN, arrived
     II. Main support for the rail (INFN-BO), ok