EUDET TB

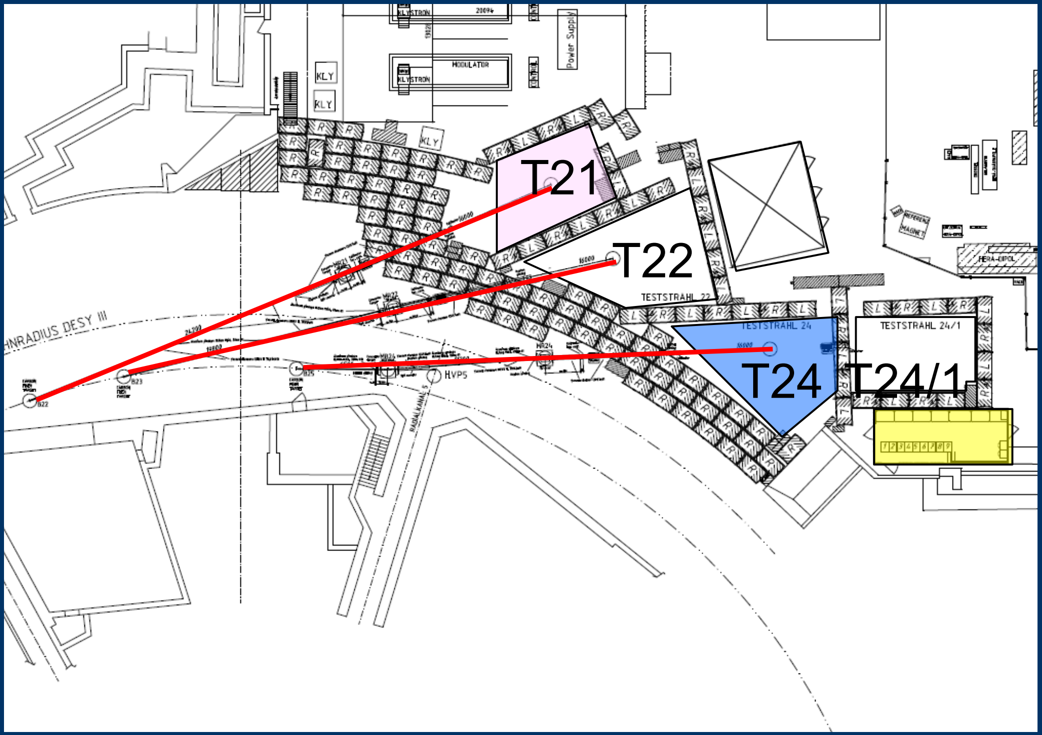
Outline

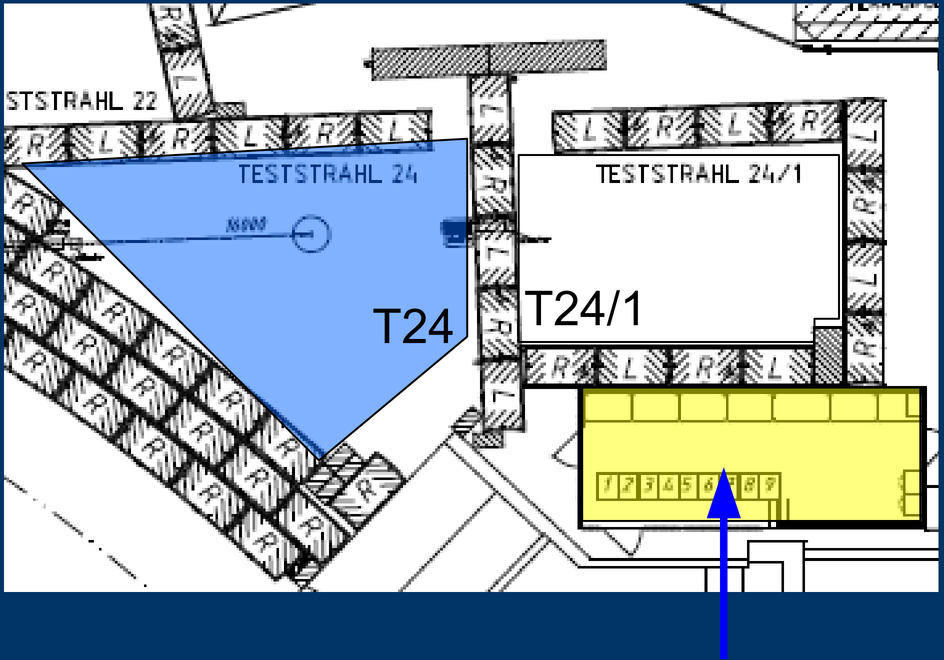
- Where? When? Who?
- Results
- Future perspectives

Where? When? Who? What?

Where?

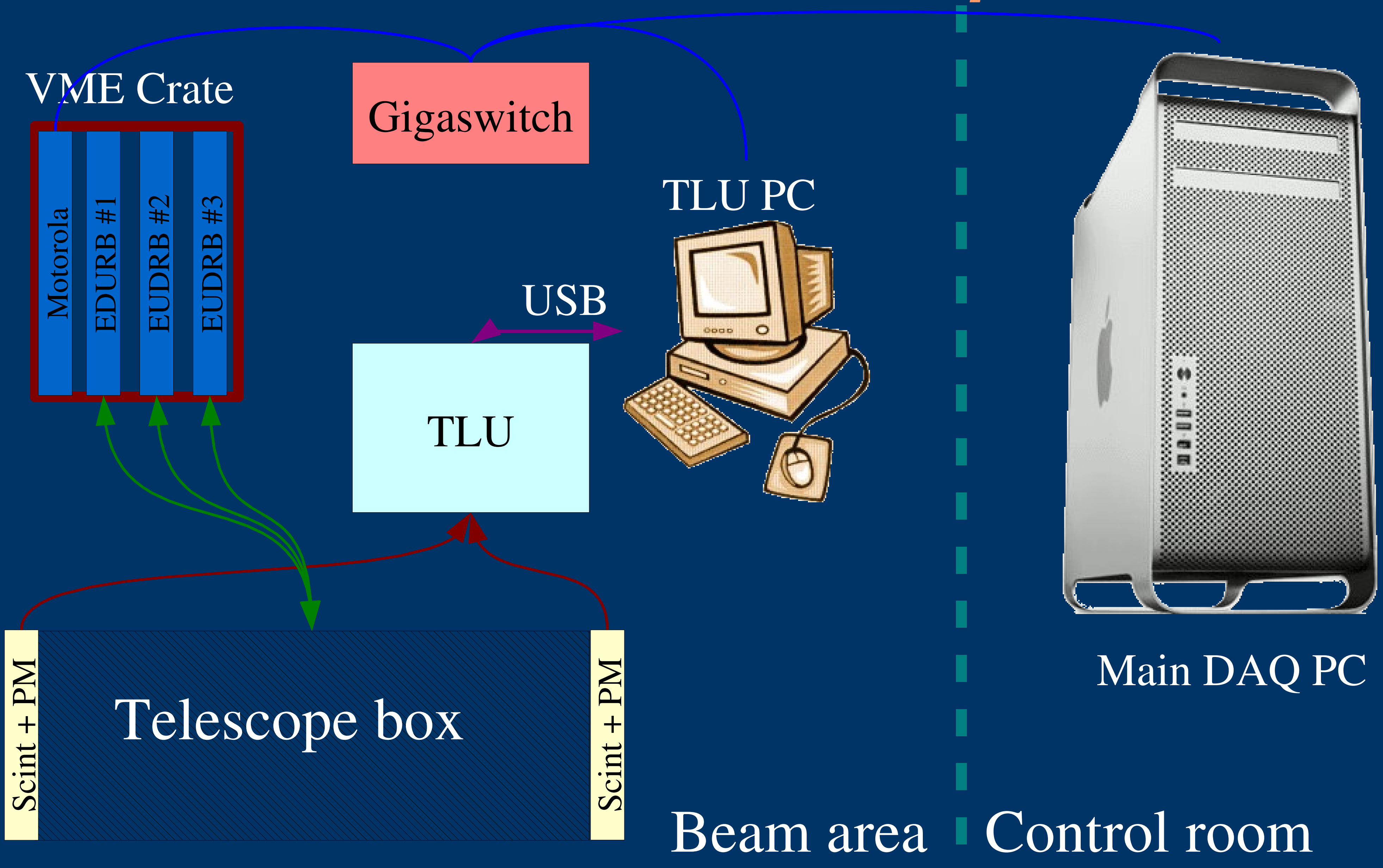
- DESY (Hamburg), test beam area 24.
- Electron beam from 3 to 6 GeV



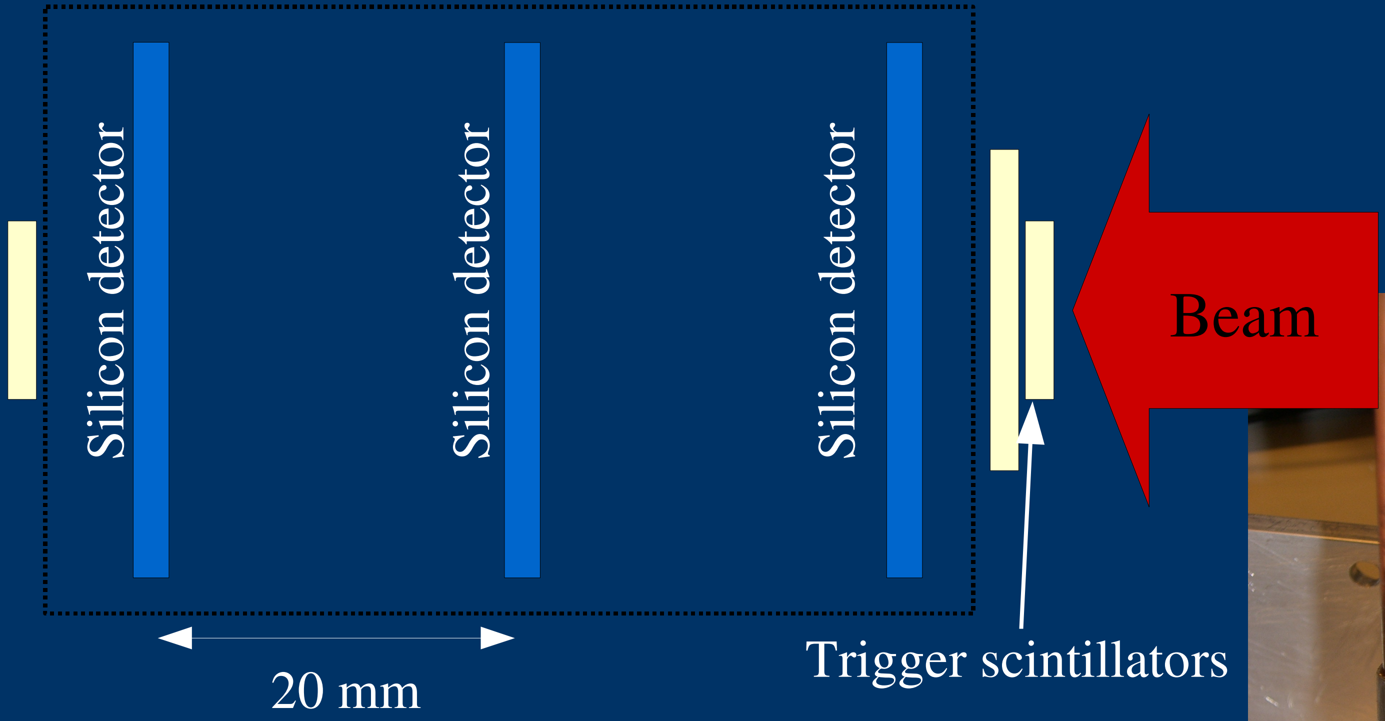


Control room

What? The test beam setup

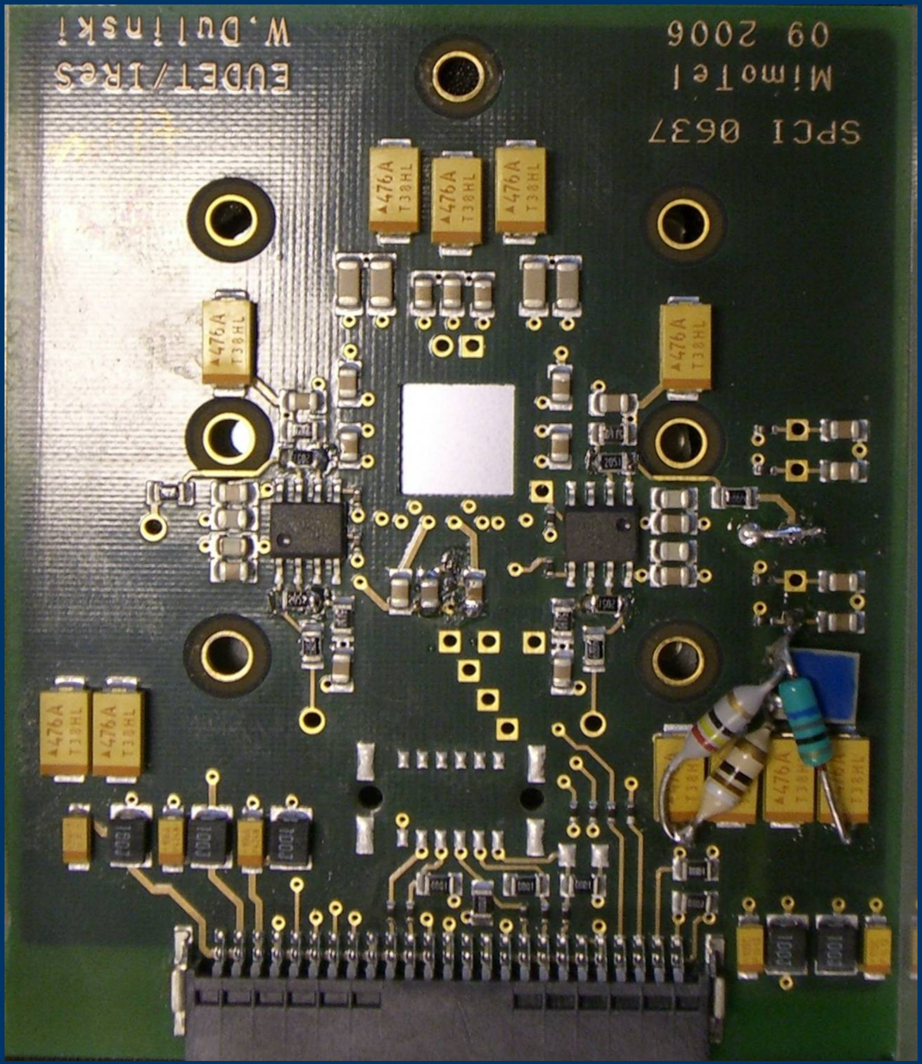


Zoom of the telescope

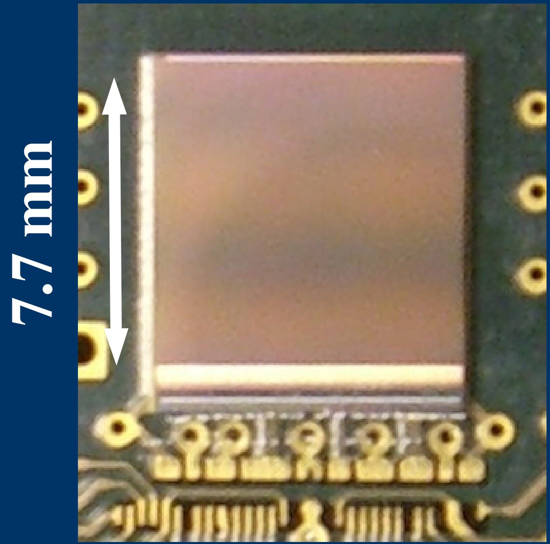


- 3 scintillator planes
- 3 sensor planes (the first two with 20 µm and the last with 14 µm epi) with one EUDRB each

Zoom on the sensor



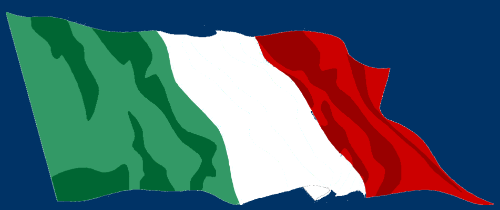
- MimoStar 3M
- 256 * 256 pixels
- 30 µm x 30 µm pitch
- Self biased structure
- 10 MHz clock
- Epi thickness 20 and 14 µm
- Total thickness 700 µm



Who does what?

- Mechanics, cooling and motion control by DESY

- Chip design and production



- Data acquisition boards and analysis software

- DAQ main software

- Trigger logic unit

When and how?

Test beam period organized in two phase:

١. **Integration phase**:
- All data acquisition boards have been installed into the crate and tested to be working.
- The trigger logic unit, the scintillator and PM have been installed and a suitable threshold set.
- The full DAQ system has been integrated and started

➔ Main contribution by **Angelo Cotta Ramusino** (INFN-FE)

٢. **Data taking phase**:
- Test runs where taken using Fe^{55} source
- Beam data acquired at two different energies: 3 and 6 GeV

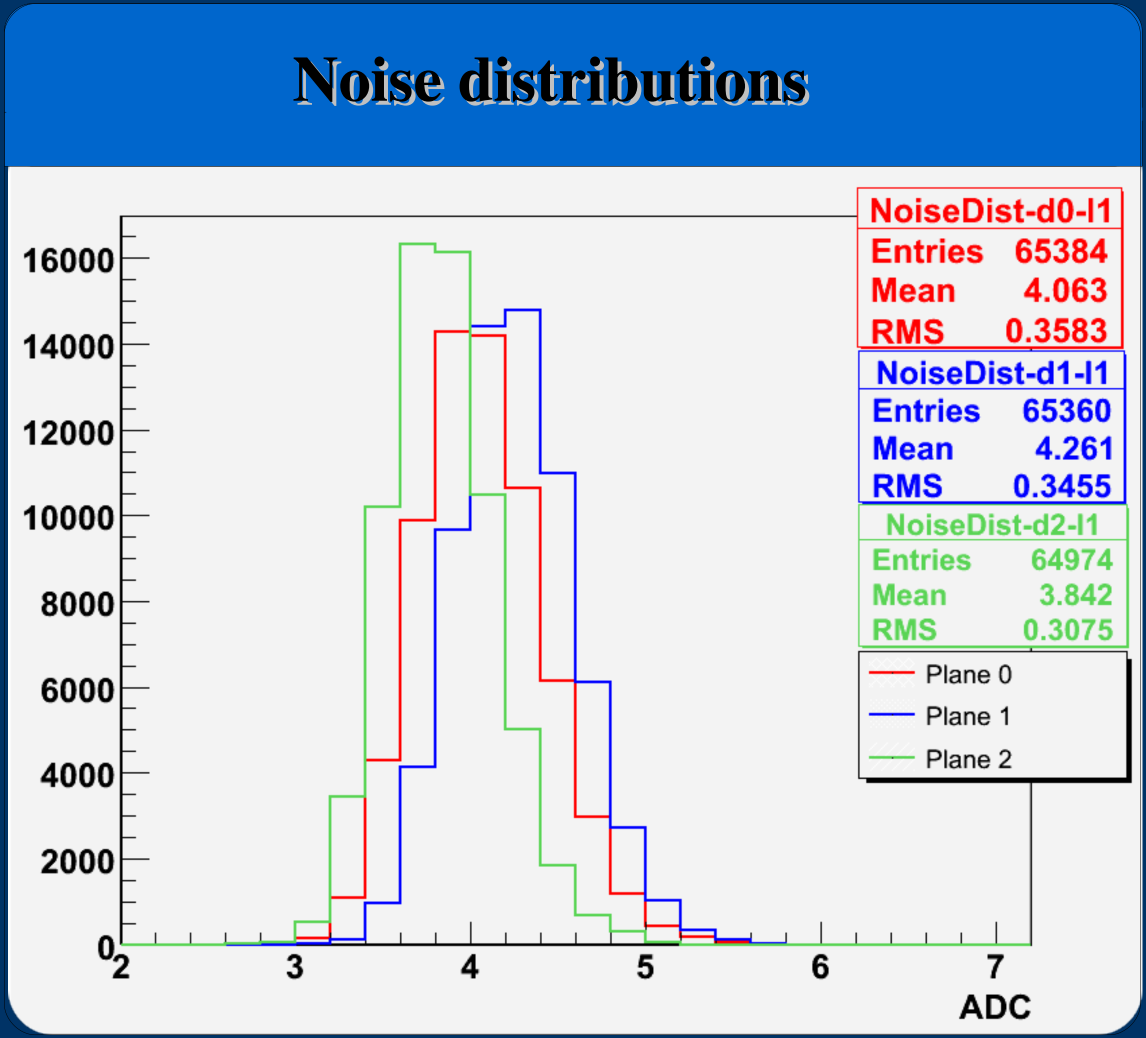
➔ Contribution by **A. Bulgheroni** (INFN-RM3), **D. Spazian** (INFN-FE), **M. Jastrzab** (INFN-MI)

How many?

- Data was taken at ~1 Hz all the time
- ~ 200 GB of raw data on disk
  - 70 beam 3 GeV runs taken with more than 115 kEvts
  - 19 beam 6 GeV runs taken with more than 26 kEvts
  - 45 pedestal and test run with ~ 14 kEvts
- All raw data have been converted to LCIO format, pedestal corrected, scanned for clusters and transformed to space points
- Data have been moved to tapes and are available to ILC virtual organization members through the GRID
- Data processing has been done using the GRID infrastructure as a proof of principle for future and more compelling data challenge

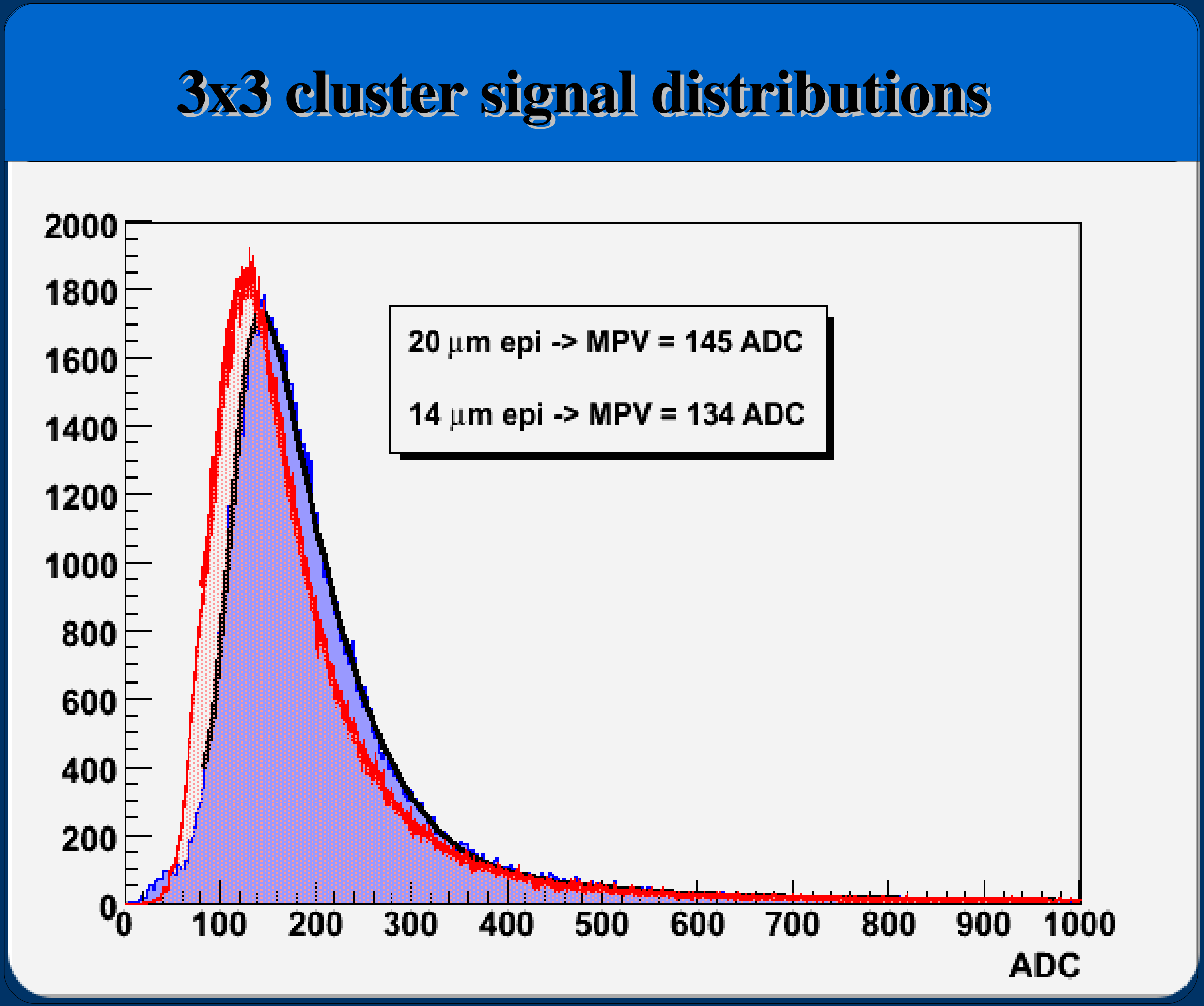
Results

Noise distributions



- Measured noise value in the test beam setup (~ 4 ADC) is twice as much the one measured in the lab.
- System verified against ground loops
- Analogue daughter card is well behaving.
- Other possibilities:
  - Bad Faraday cage
  - Bad thermal coupling with the cooling system
- Room for improvements

Signal distributions (3 GeV)



- Signal amplitude far enough from the noise (MPV SNR = 10)
- The charge signal is NOT scaling according to the epi thickness
  - The thickness might be inaccurate
  - The charge collection efficiency might be different.
- A factor 2 in the SNR may be obtained improving the noise

Eta function correction

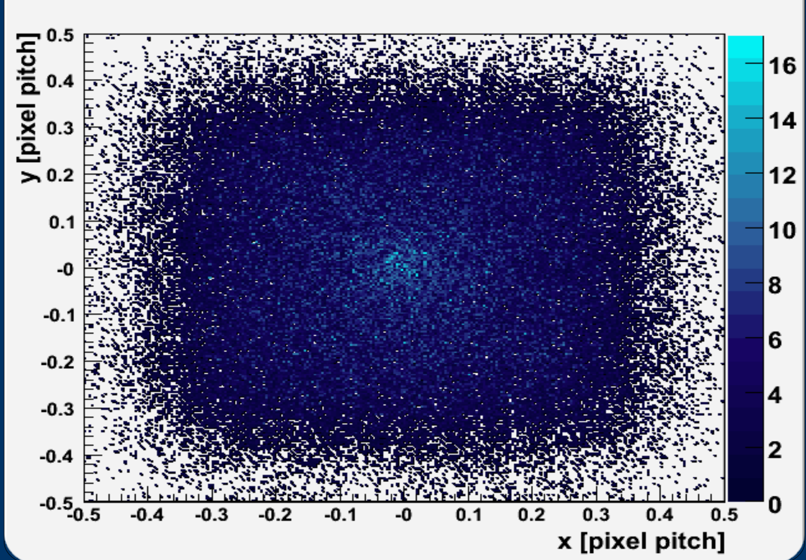
Definition: empirical non-linear weighting function for cluster center calculation.

Physical explanation: the cluster center spatial distribution has to be flat within one pixel. If not, there are other effects to be taken into account like:

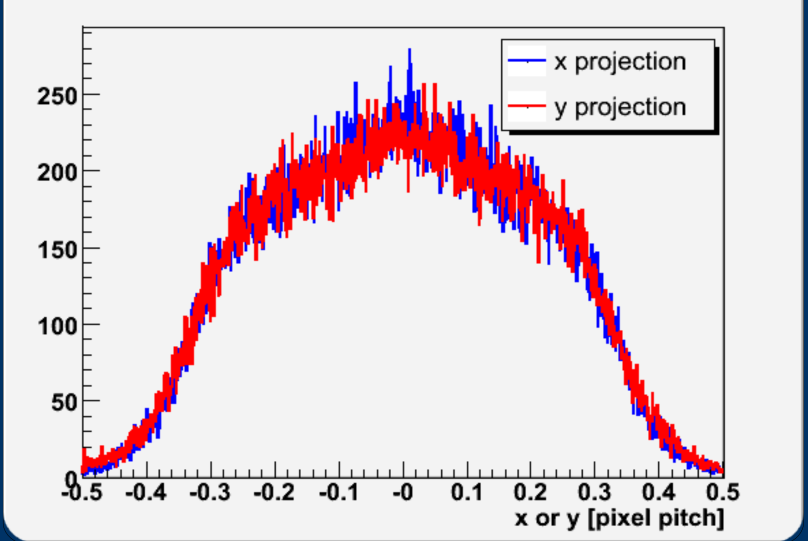
- Clustering algorithm artifacts
- Non-uniform CCE

A good candidate for cluster center is the charge center of gravity, but...

Center of Gravity distribution



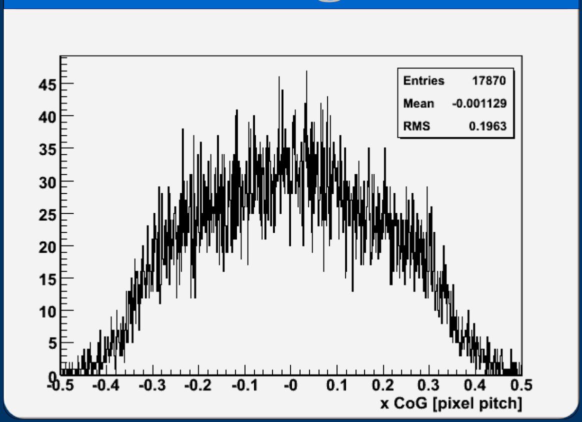
x and y CoG projections



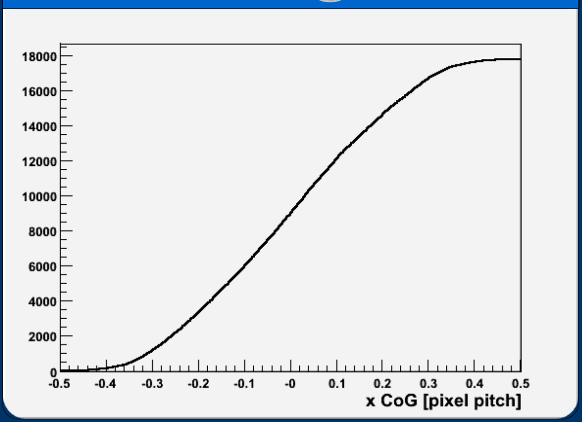
Calculating the η function

- Used a data sample containing more than 15k clusters
- The two directions are threaded independently
- For all clusters, the CoG is calculated and a histogram is filled with the corresponding value (1)
- When the loop is over, histogram (1) is integrated as shown in (2).
- The integral is normalized by the highest value and shifted by half. This is the η function (3)!

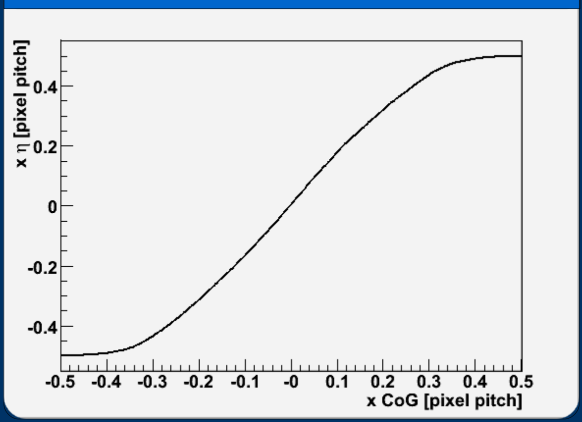
CoG histogram (1)



CoG integral (2)



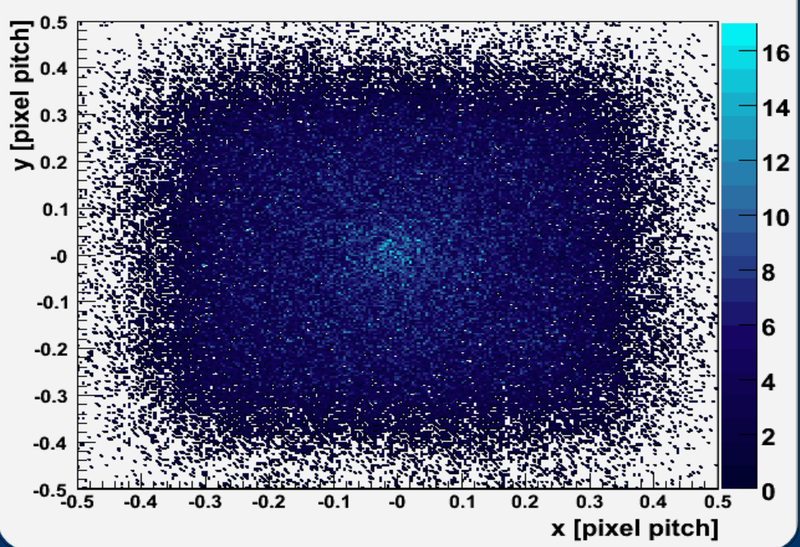
Eta function (3)



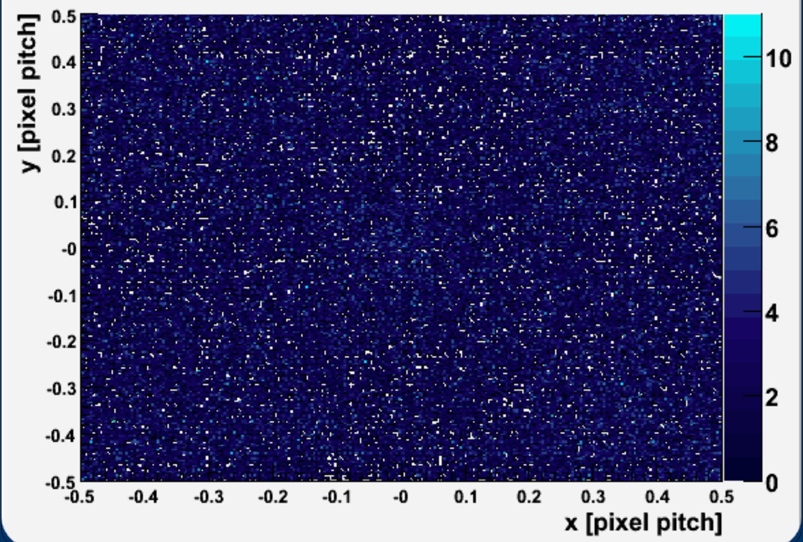
Applying the η function correction

- The goodness of the correction can be easily verify comparing the spatial cluster center distribution before and after the η function correction.

Cluster center before



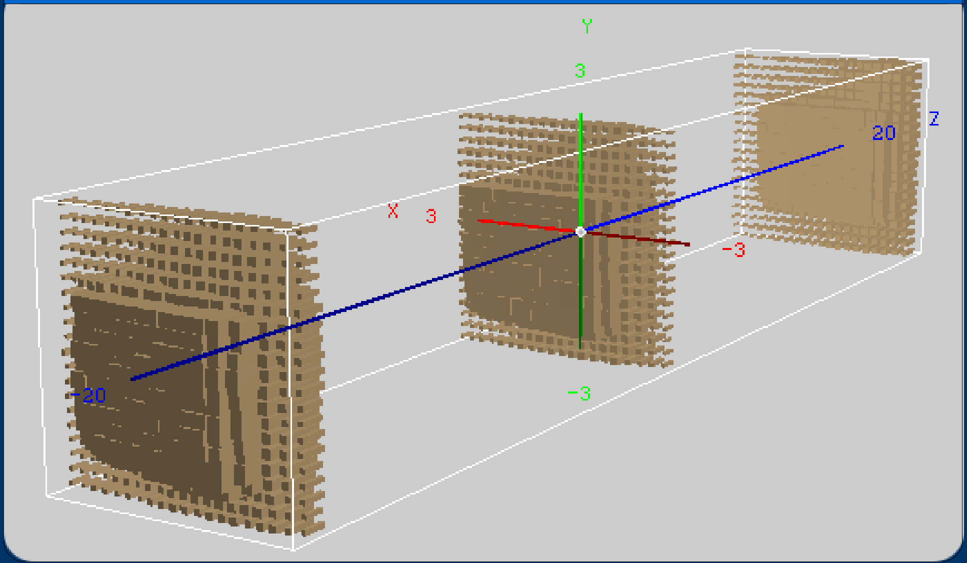
Cluster center after



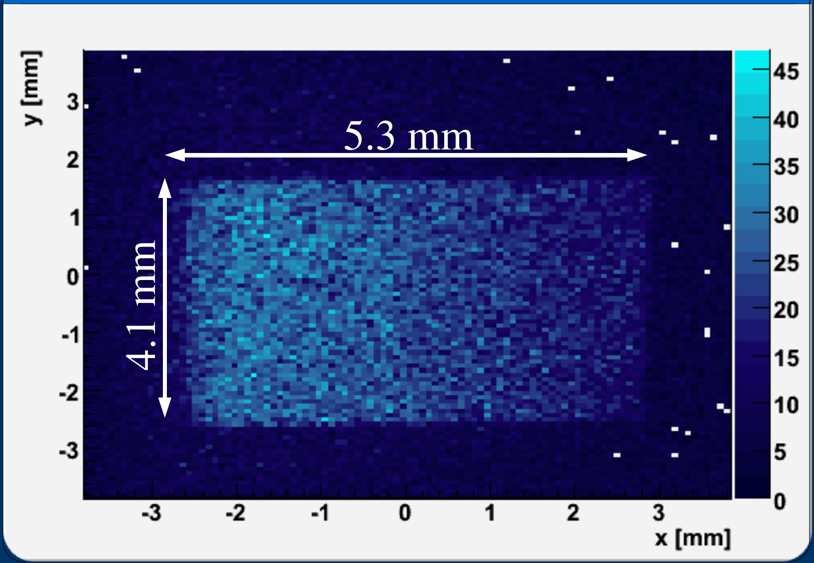
Hit map with full 3GeV statistics

- Integrated over all 3 GeV runs already in the telescope frame of reference.

Full statistics 3D hit map



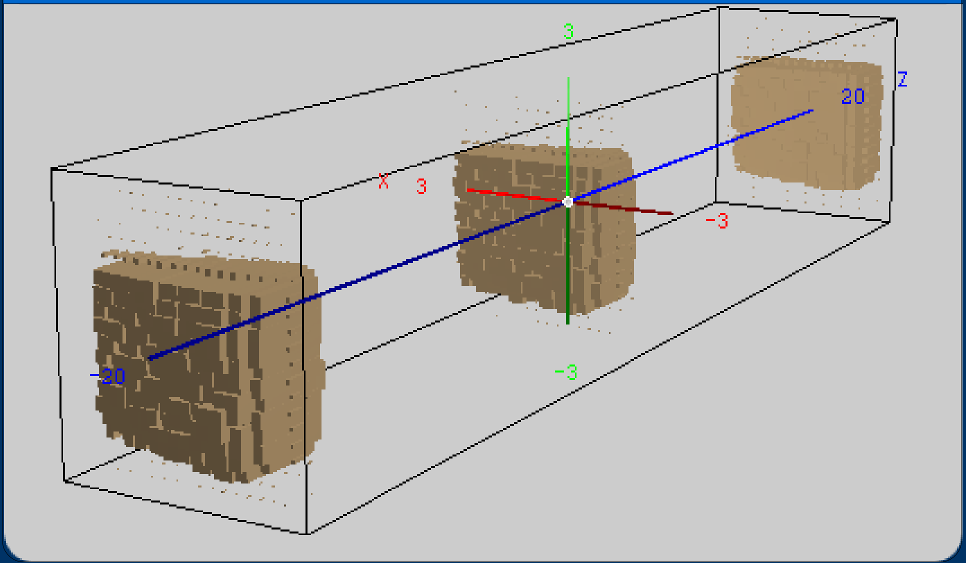
First plane hit map



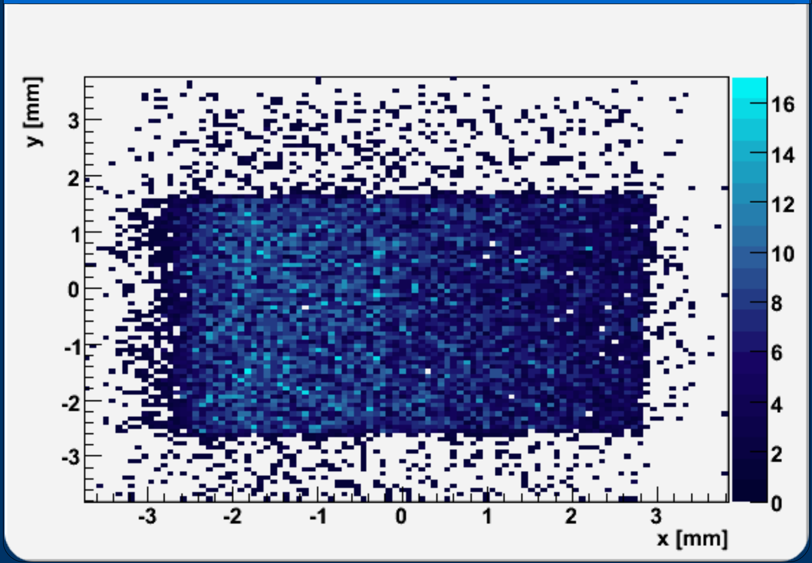
Hit map with single track

- Applying a single track per event filter, the scintillator shadow appears even clearer.

Single track 3D hit map



First plane hit map



Spatial resolution and alignment

- At the time of writing, the spatial resolution and the alignment studies are on going.

Efficiency and purity

- Due to the de-synchronization of the three EUDRB, efficiency and purity studies are more complicated and require track identification first.
- For the next TB, the EUDRB's will run fully synchronized.

Future perspectives

Future (or recently past) test beams (1)

TB-DESY-AUGUST (13/08 → 24/08)

- Increase the number of telescope planes (≥ 4)
- All boards fully synchronized
- Increase the event rate to ~ 10 Hz
- Test zero suppression mode
- Collect enough statistics at different energies (data acquisition on shifts)
- Allow the first DUT user (DEPFET group) to test part of their system

Future (or recently past) test beams (2)

TB-CERN-SEPTEMBER (19/09 → 27/09)

- Full telescope demonstrator installed (6 planes)
- All EUDRB's running in ZS
- The first DUT will be installed in the telescope