

DEPFET Test Beam



Julia Furletova

Bonn University



Outline

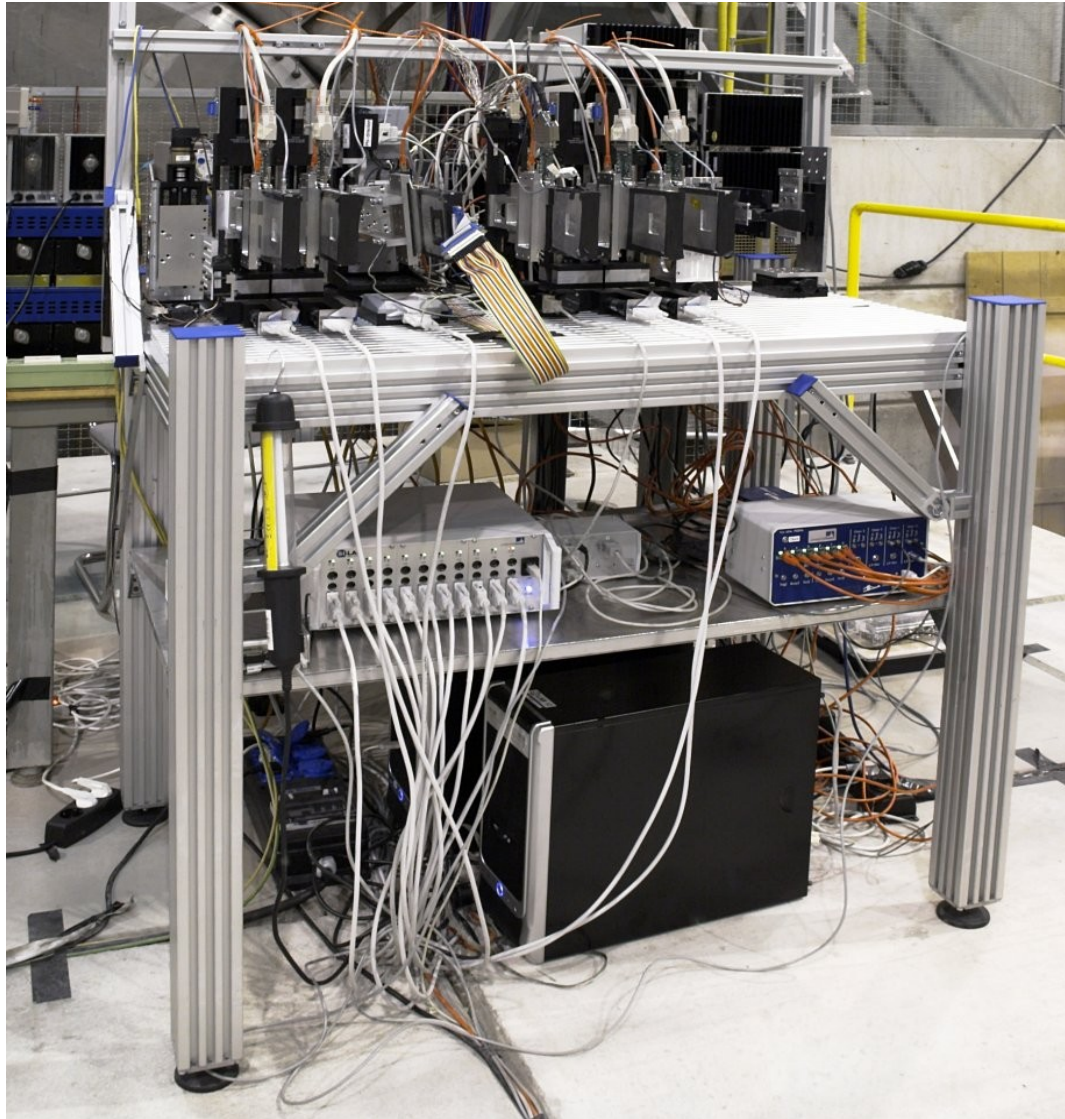
- Setup/DAQ
- Results
- Plans



JRAI Meeting, Strasbourg, 03.03.2009

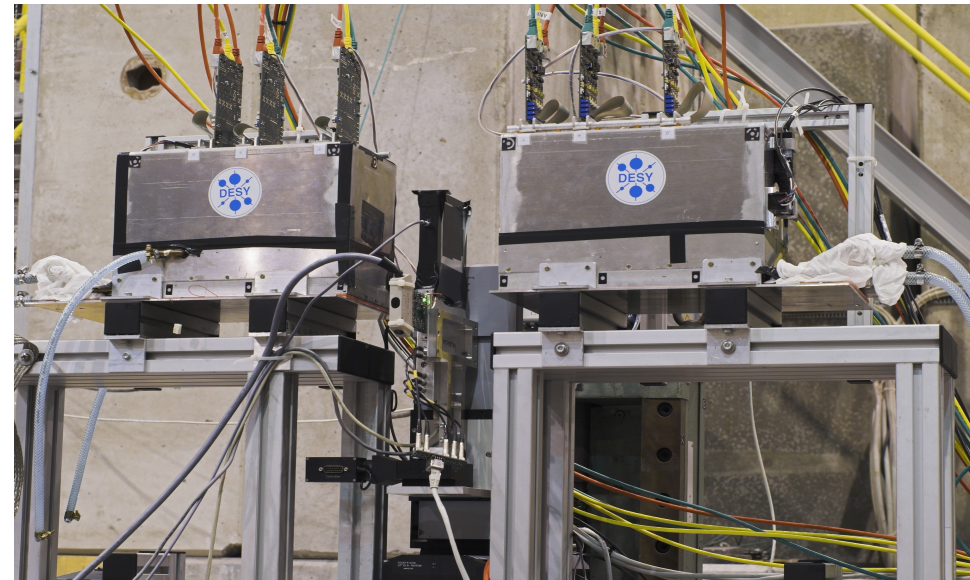
Setup at CERN

DEPFET Telescope



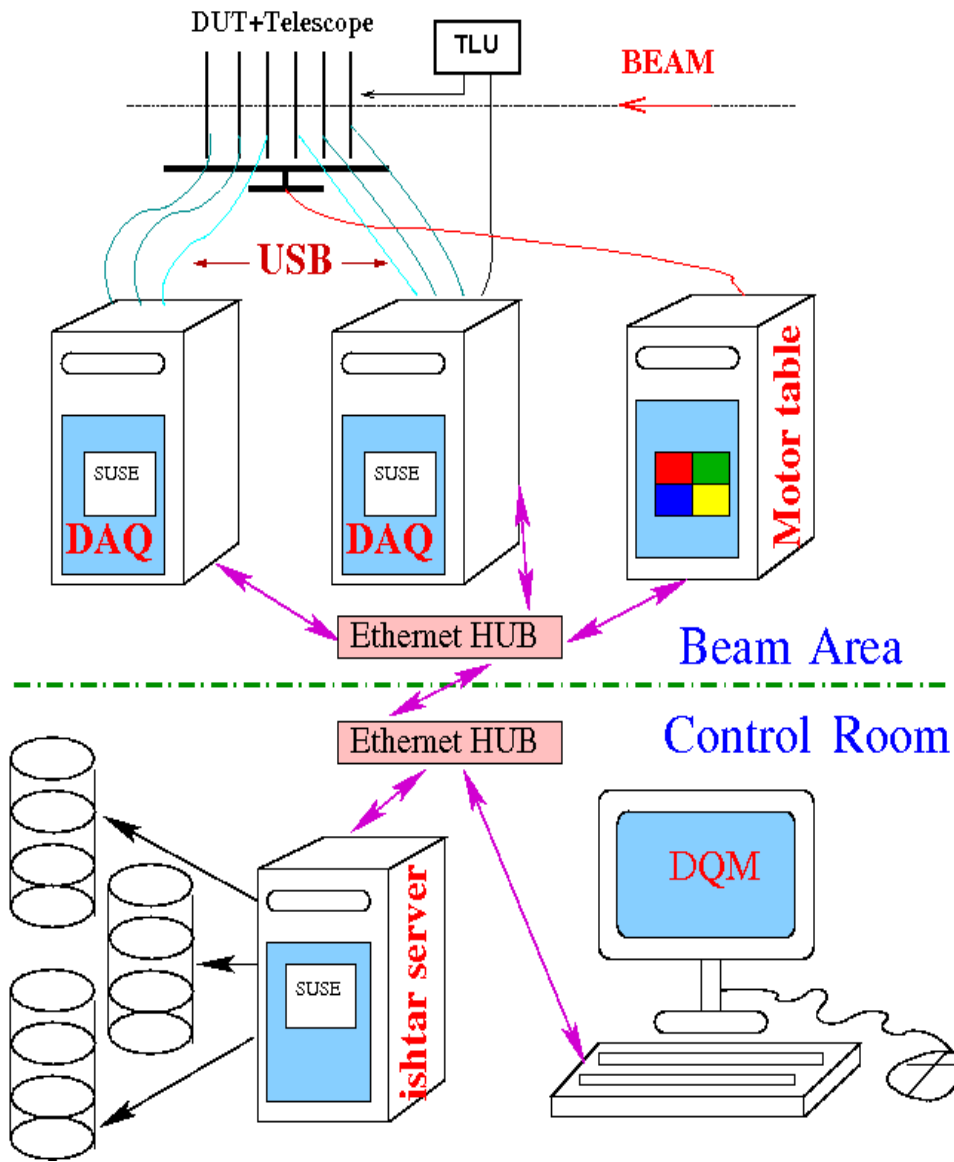
CERN SPS 120 GeV pions

EUDET Telescope + DEPFET DUT



DEPFET Telescope

- Test Beam Area :

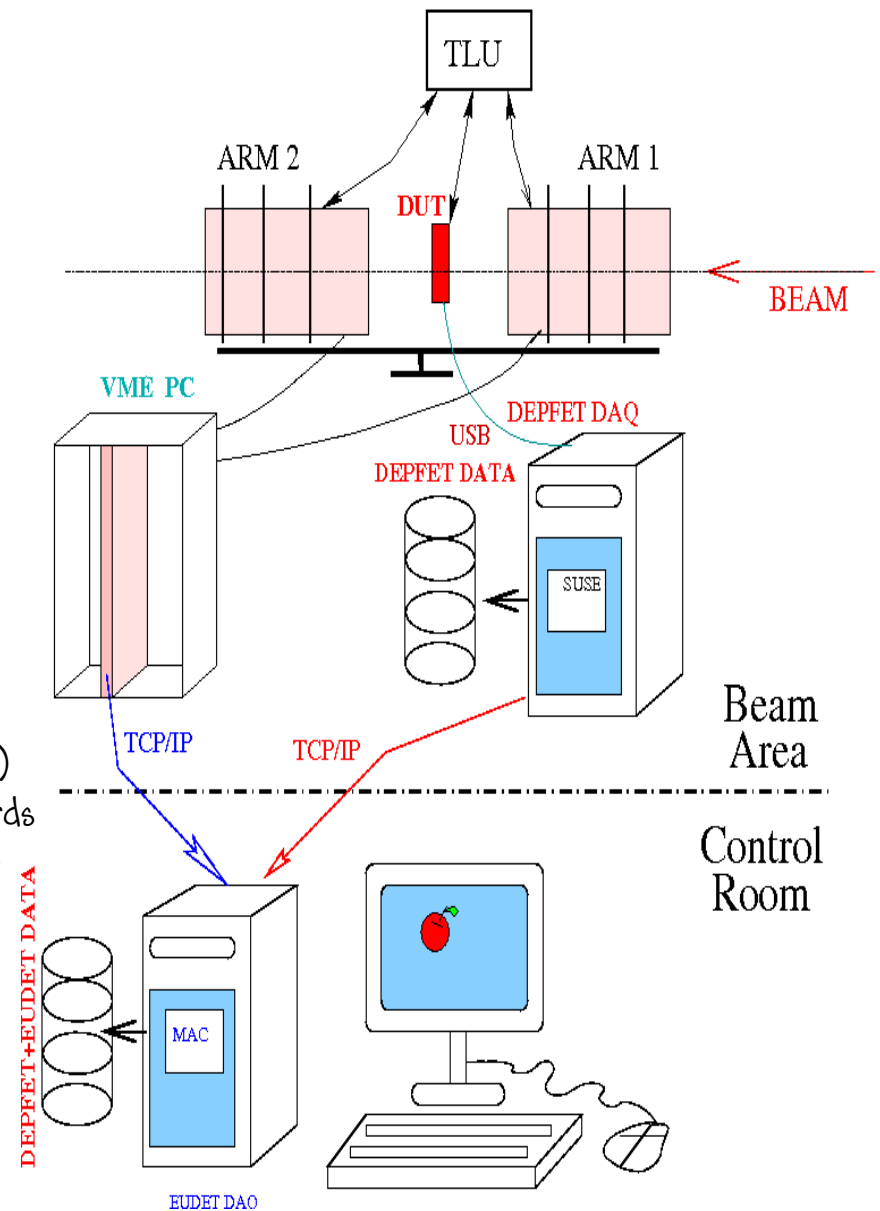
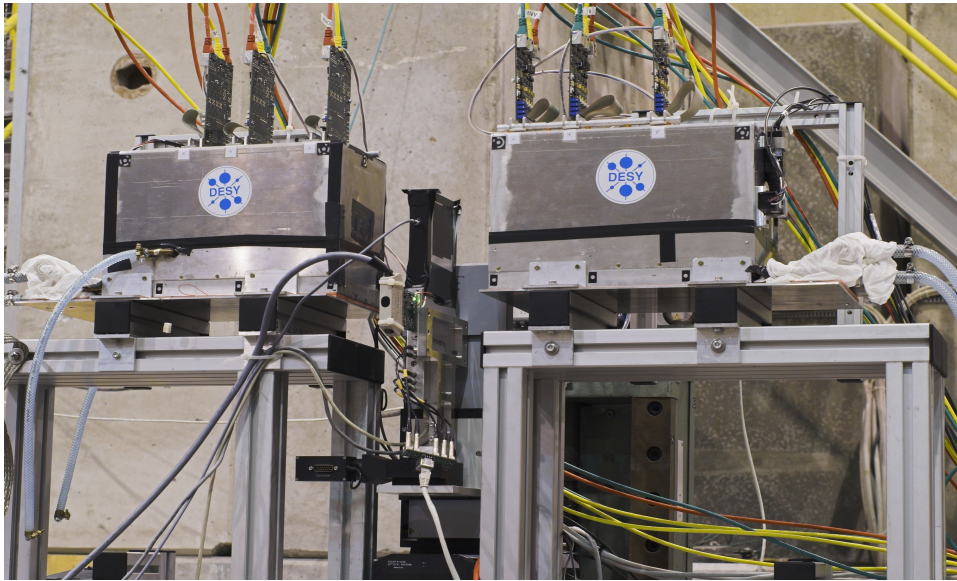


- table with DEPFET telescope consisting of 6 modules, mounted on X-Y motor stages
- 2 readout PC with 3 DEPFET modules per PC, connected via USB2.0 in the test beam area in distance of max. 4 meters from the modules.
- Windows PC to control 6 X-Y motor stages, with USB2.0 connection to controller.
- Trigger Logic Unit (TLU) connected to one of readout PC via USB2.0
- all PC are connected to 1GB ethernet HUB

- Control Room :

- one DAQ server - rack mounted server PC : Intel S5000, 8 CPU, 4GB memory, hot swap SATA RAID with 1.5 TByte disk space - total 6 disks.
- working PC : Run Control, DQM, etc....
- all PC also connected to local ethernet HUB
- both HUBs are connected by 30m ethernet cable, from test beam area to control room

EUNET Telescope



Test Beam Area :

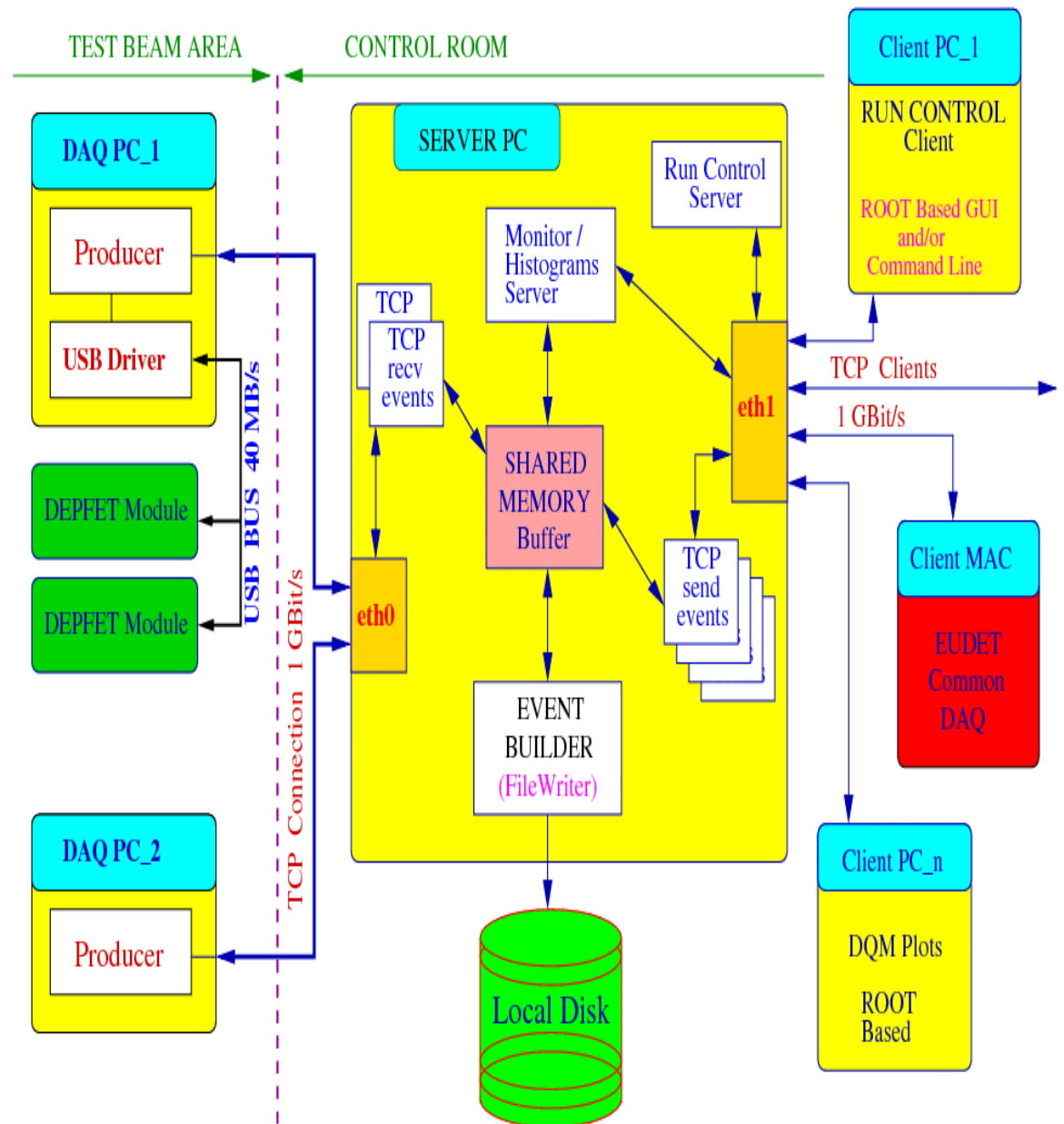
- 6 EUDET Modules (Monolithic active pixel sensors MAPS $7.7 \times 7.7 \text{ mm}^2$)
- MVME6100 PowerPC computer with general purpose acquisition boards (EUDRB) inside the VME64x crate connected to 1Gb ethernet HUB
- Trigger Logic Unit (TLU)
- DEPFET DUT with Readout PC

Control Room :

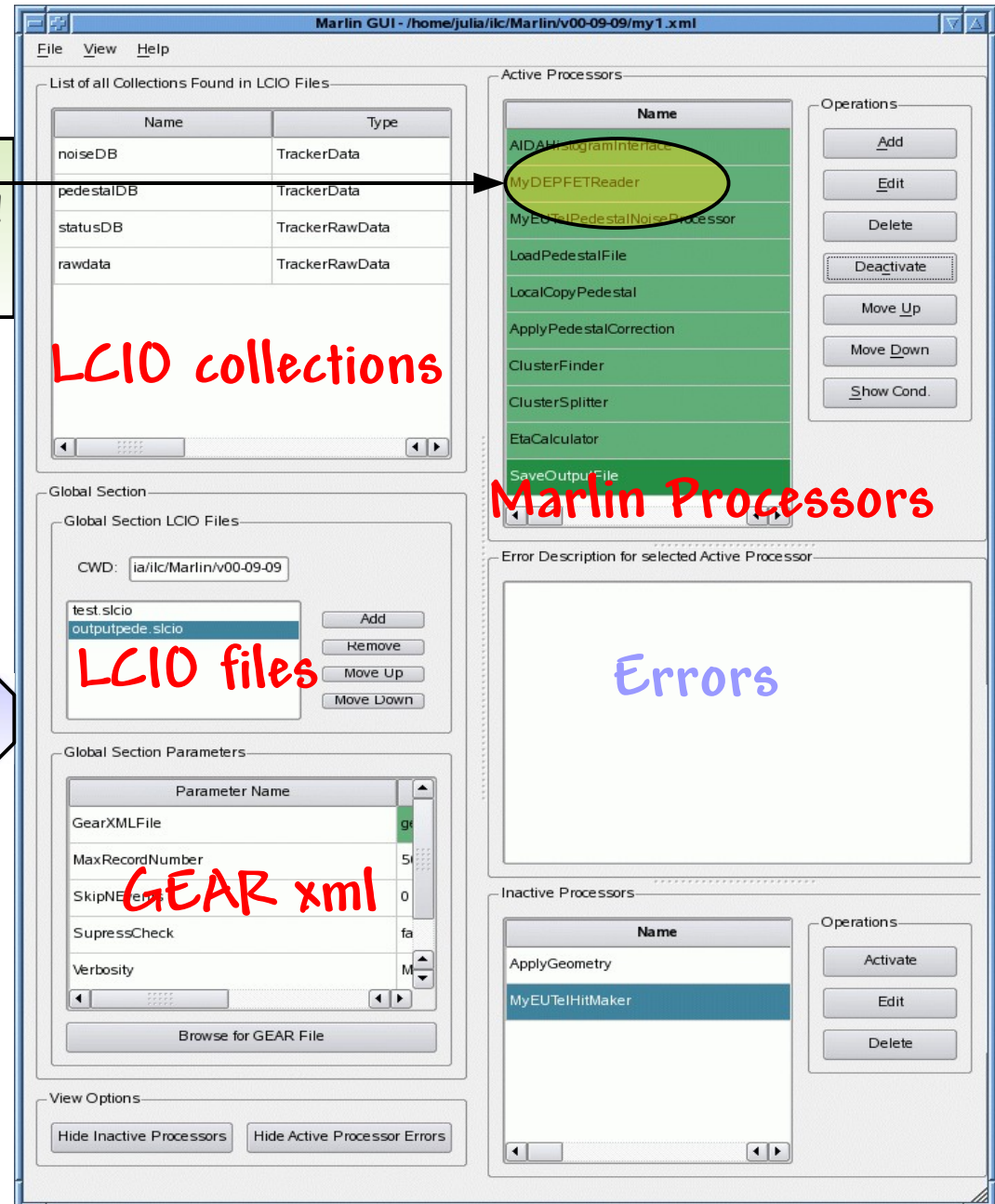
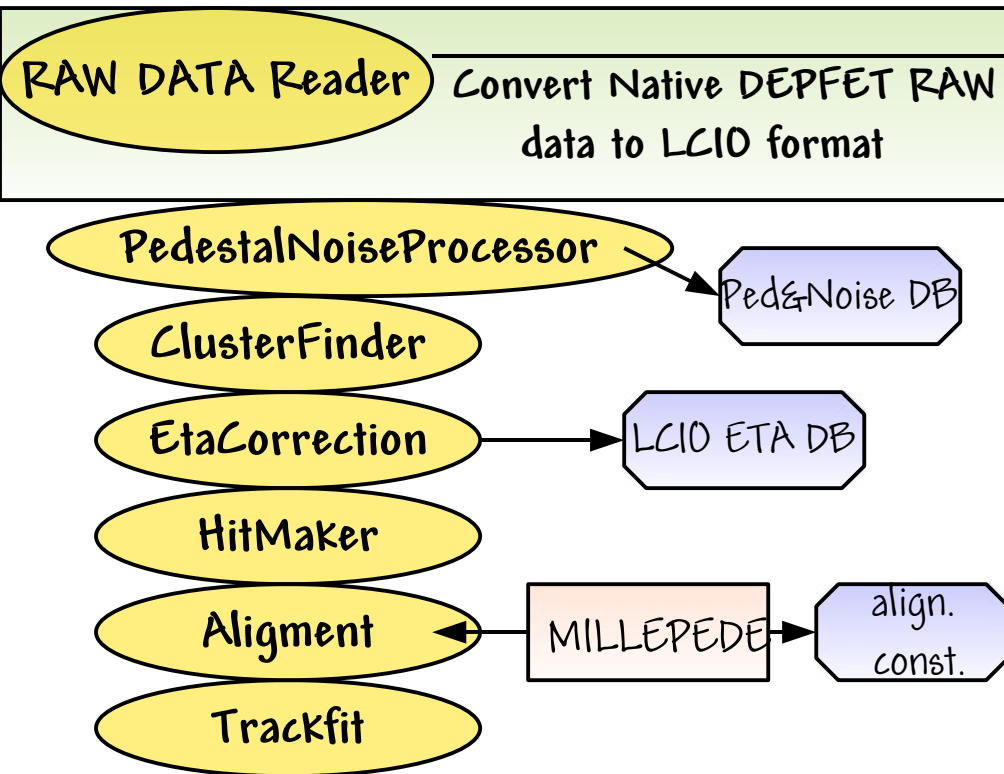
- EUDET DAQ server on MAC PC 1Gb ethernet HUB

DEPFET Data Acquisition System

- original Depfet DAQ is based on Windows[™] and running on a single PC
- in order to improve functionality during the test beam measurements a newer version of the DAQ software was implemented
- new DAQ is based on Linux network distributed client/server architecture which allows :
 - share resources and tasks;
 - easy scale the system;
 - remote control and monitoring;
 - easy integration of other detectors
- DAQ uses **USB 2.0** for data transfer from DEPFET R/O board to PC and **TCP/IP** to send data to **Event Builder**.



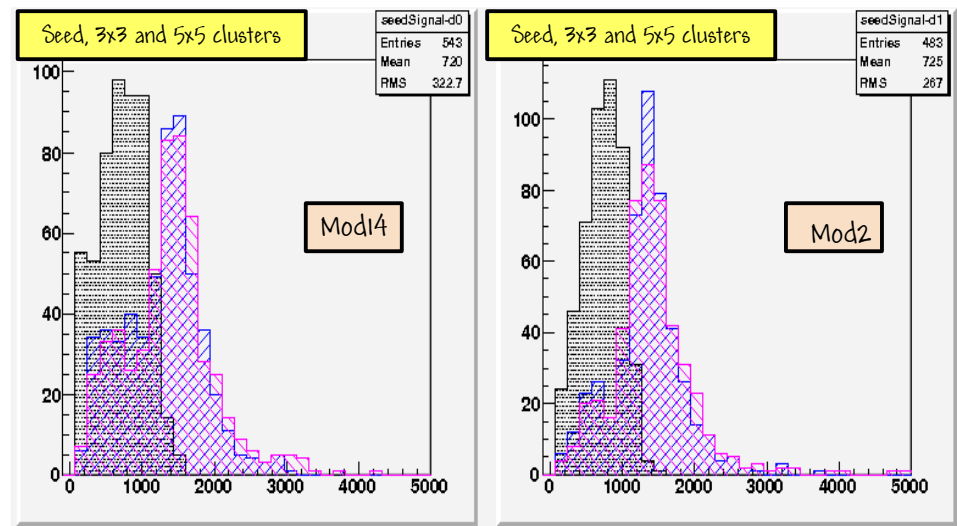
DEPFET data reconstructed with EuTelescope software



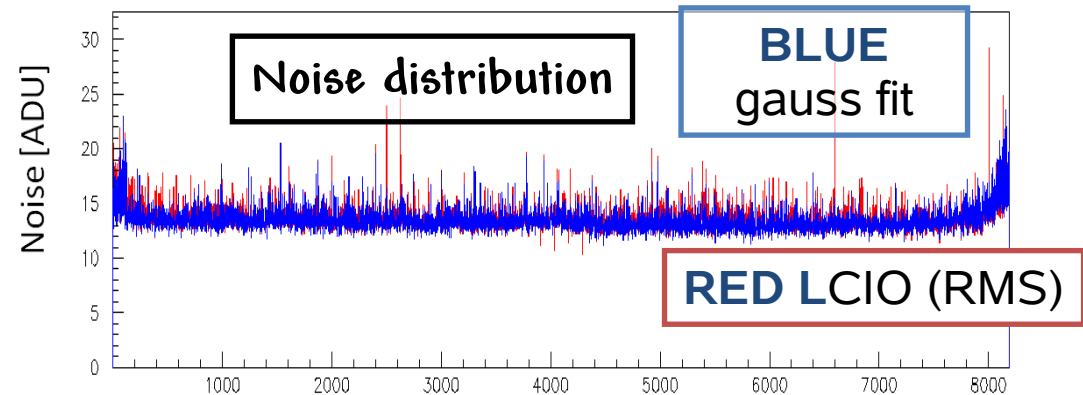
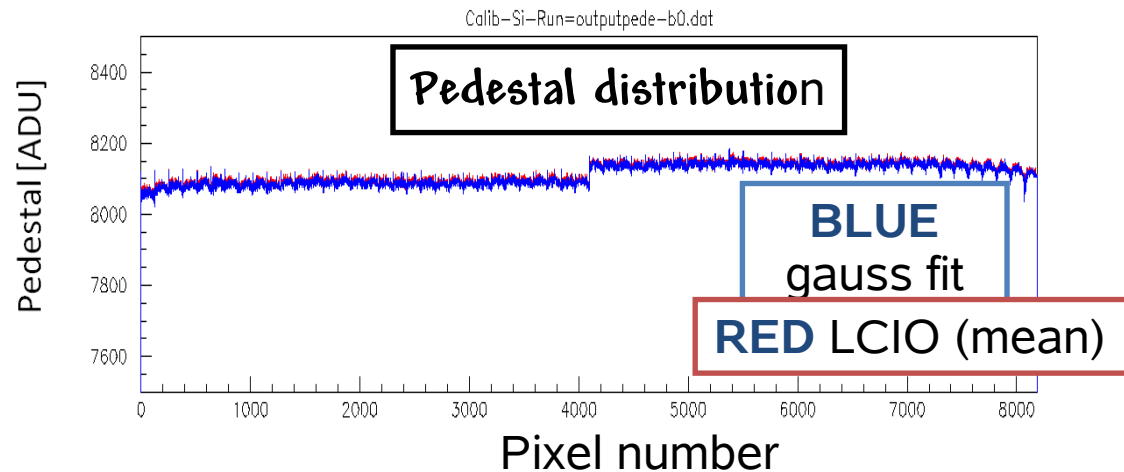
DEPFET data reconstructed with ILC EuTelescope software

- LCIO file
- ROOT file with histograms

Seed and Clusters



Pedestal and Noise



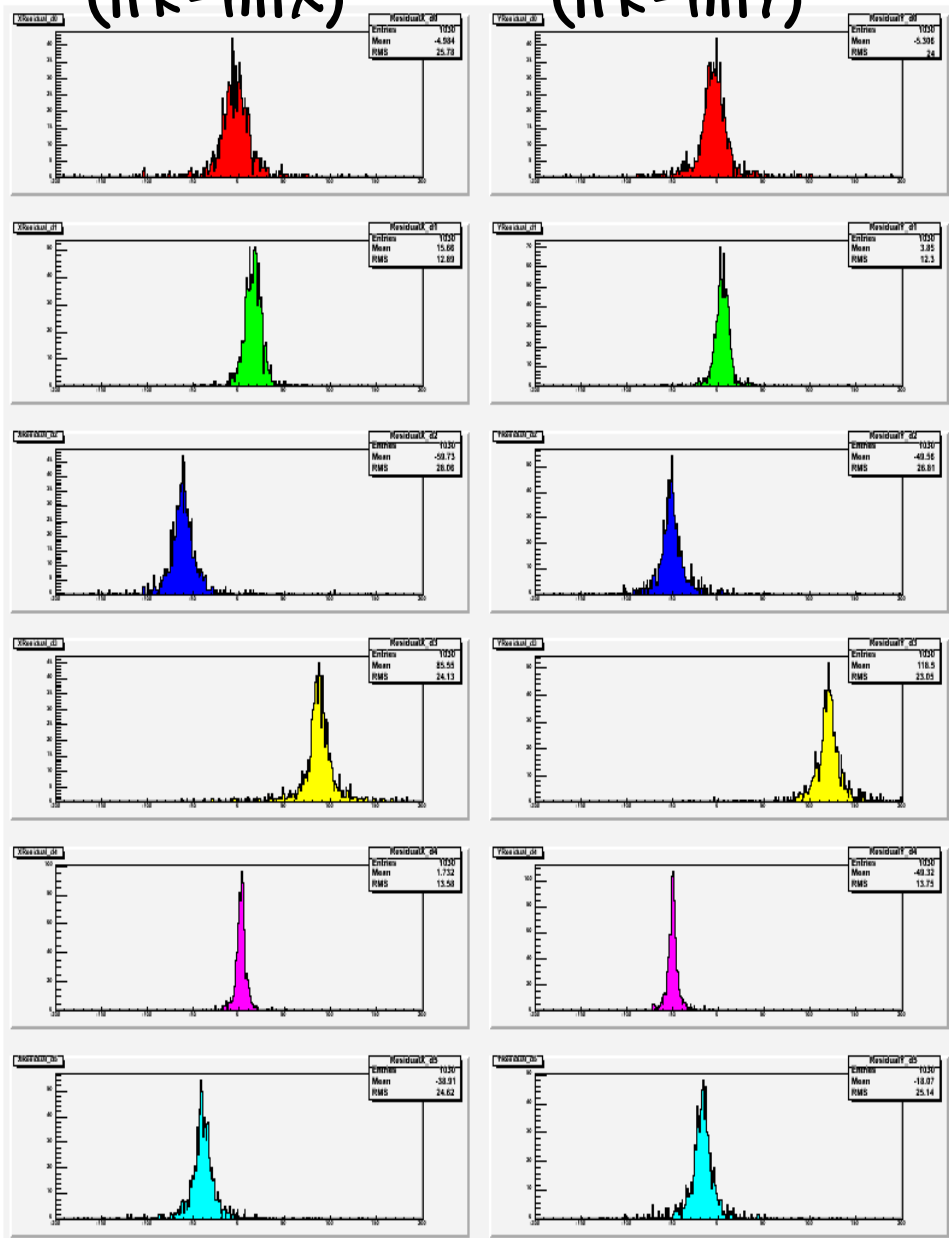
With hit rejection and row wise
common mode correction

Millepede alignment (Run 1277 DEPFET telescope)

Before alignment

(trk - hitX)

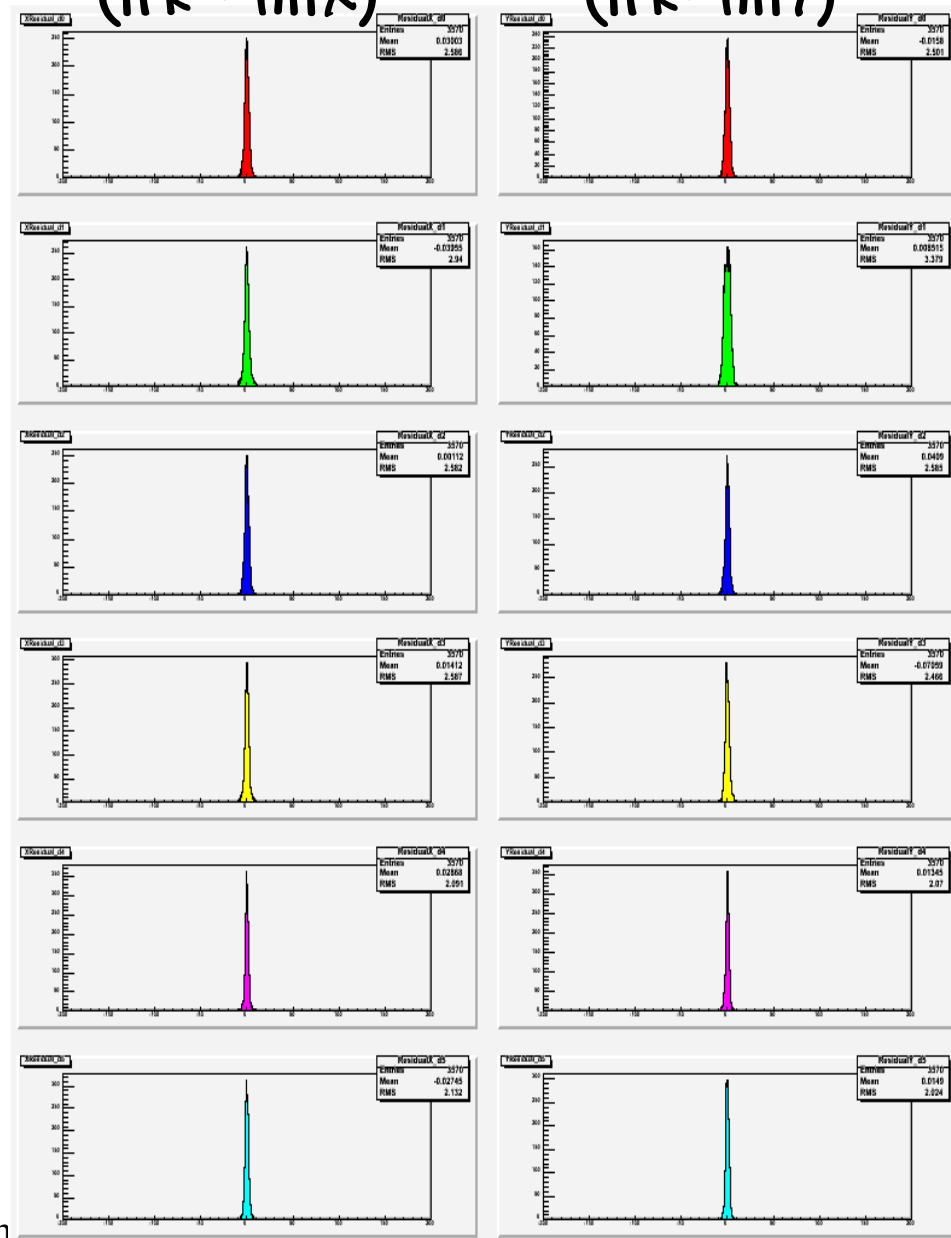
(trk - hitY)



After alignment

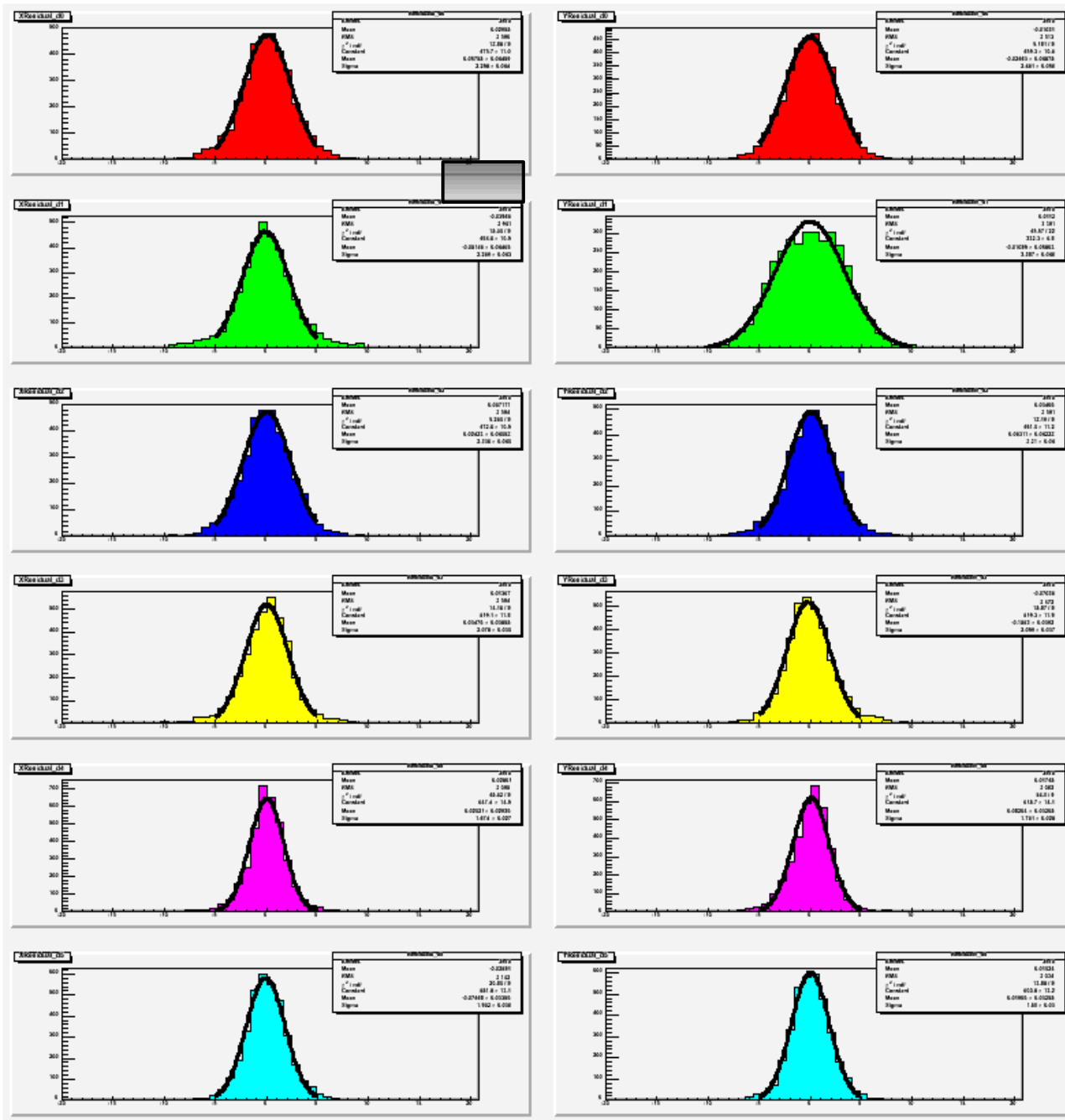
(trk - hitX)

(trk - hitY)



etin

Tracking (run1273) 120GeV (preliminary)



Module 7
X: $2.23 \pm 0.02 \mu\text{m}$ Y: $2.19 \pm 0.02 \mu\text{m}$

Module 5
X: $2.20 \pm 0.02 \mu\text{m}$ Y: $3.07 \pm 0.02 \mu\text{m}$

Module 6 (Prague)
X: $2.43 \pm 0.02 \mu\text{m}$ Y: $2.20 \pm 0.02 \mu\text{m}$

Module 11 (Munich)
X: $2.23 \pm 0.02 \mu\text{m}$ Y: $2.07 \pm 0.02 \mu\text{m}$

Module 14
X: $1.79 \pm 0.02 \mu\text{m}$ Y: $1.76 \pm 0.02 \mu\text{m}$

Module 2
X: $1.91 \pm 0.02 \mu\text{m}$ Y: $1.86 \pm 0.02 \mu\text{m}$

Beam energy scan (first results)

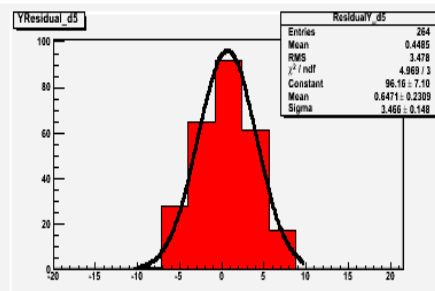
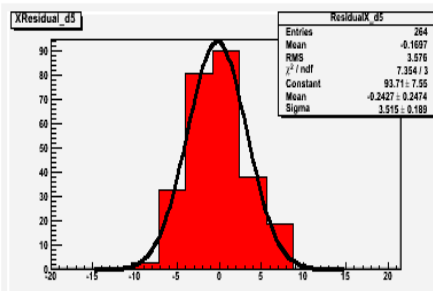
Residual X

Residual Y

20GeV(run1294)

X: $3.5 \pm 0.2 \mu\text{m}$

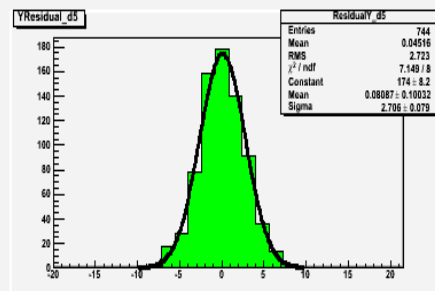
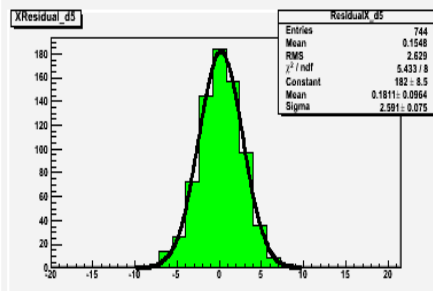
Y: $3.5 \pm 0.2 \mu\text{m}$



60GeV(run1280)

X: $2.59 \pm 0.08 \mu\text{m}$

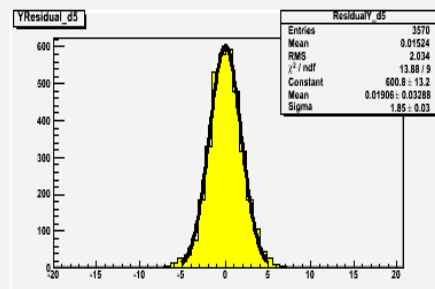
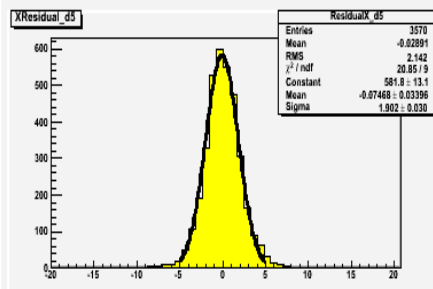
Y: $2.70 \pm 0.08 \mu\text{m}$



80GeV(run1277)

X: $1.90 \pm 0.03 \mu\text{m}$

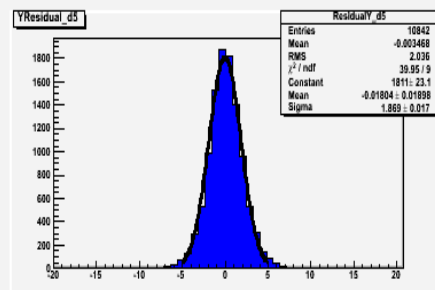
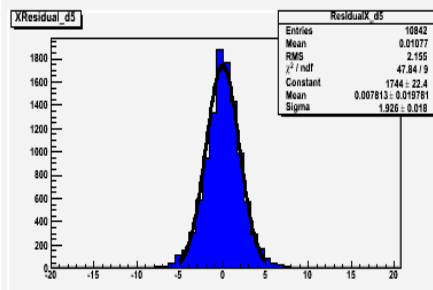
Y: $1.85 \pm 0.03 \mu\text{m}$



120GeV (run1273)

X: $1.91 \pm 0.02 \mu\text{m}$

Y: $1.86 \pm 0.02 \mu\text{m}$

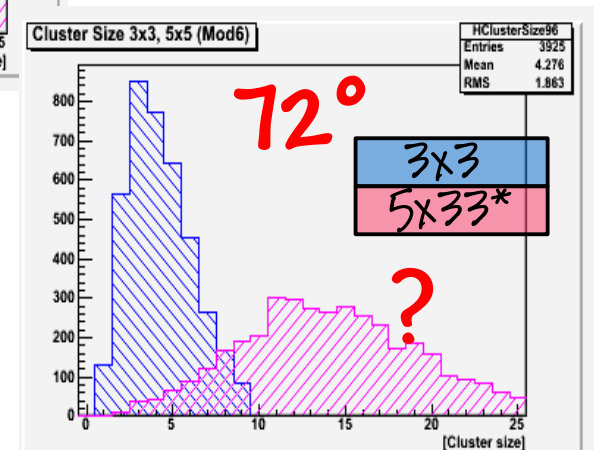
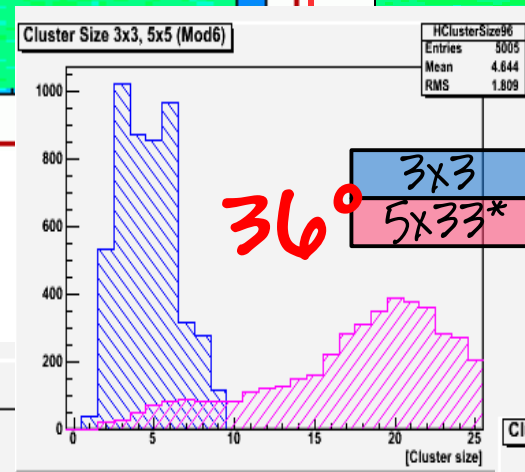
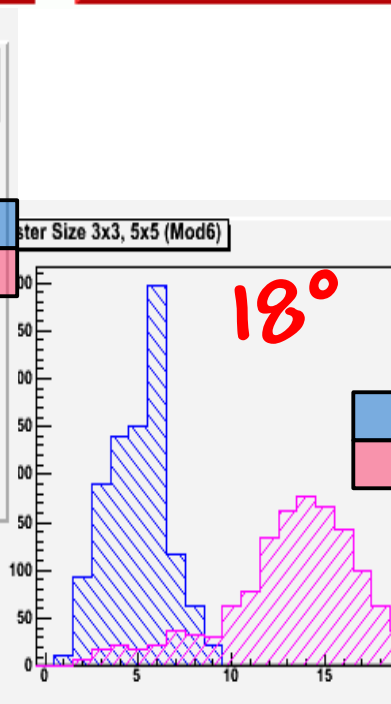
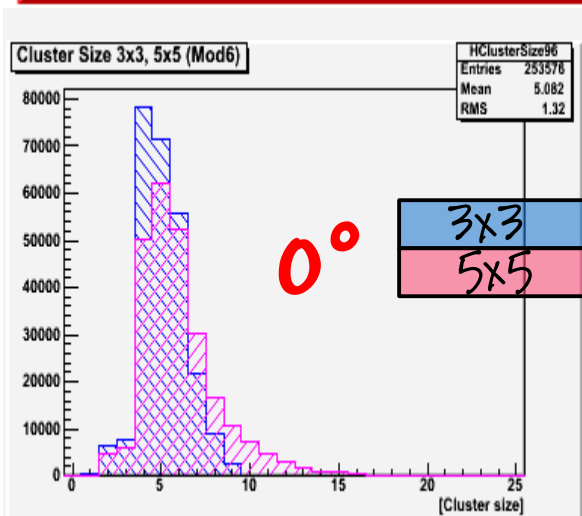
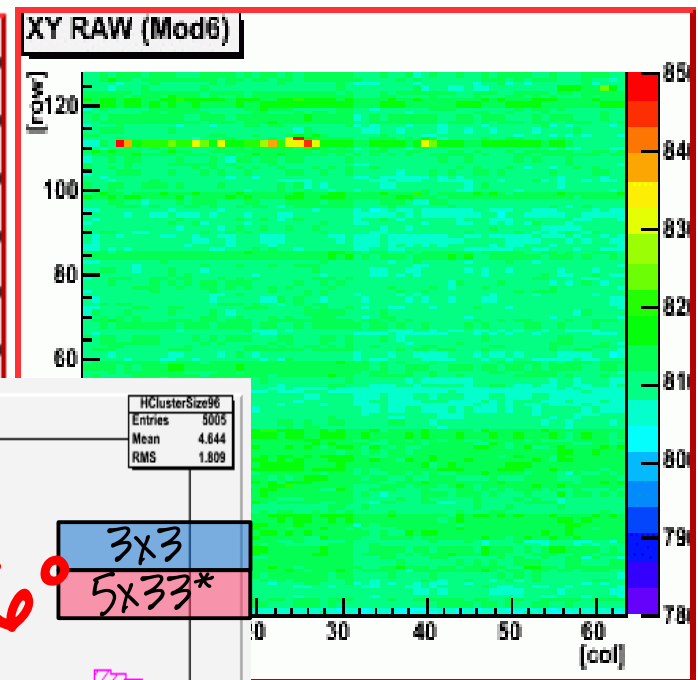
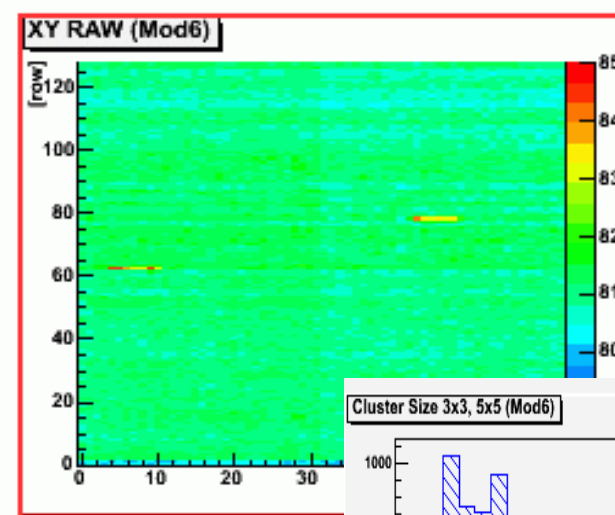
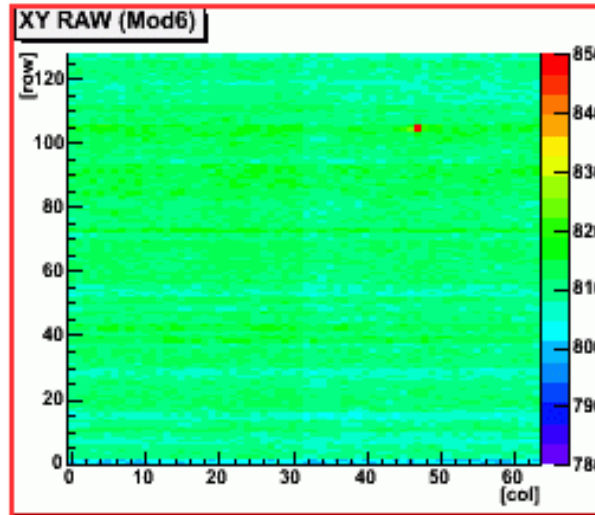


Angular scan (Module 6)

0°

18°

72°



EUDET Telescope +DEPFET DUT

- Compatibility of EUDAQ with 64bit Linux done;
- Marlin+EuTelescope software were compiled on the 64bit Linux server in Bonn

`SET(CMAKE_CXX_FLAGS "${CMAKE_CXX_FLAGS} -m32")`

- EuTelescope (see Antonio's talk):
 - "NativeReader" (processor for reading out a different types of a different detectors raw data) are done;
 - update in "PedestalNoiseProcessor", "CalibrateEventProcessor"
 - DEPFET data are reconstructed upto level of 'hits'

Next Test Beam (summer 2009)

1 Week as DUT with EUDET Telescope + 1 week DEPFET Telescope

DEPFET Matrix :

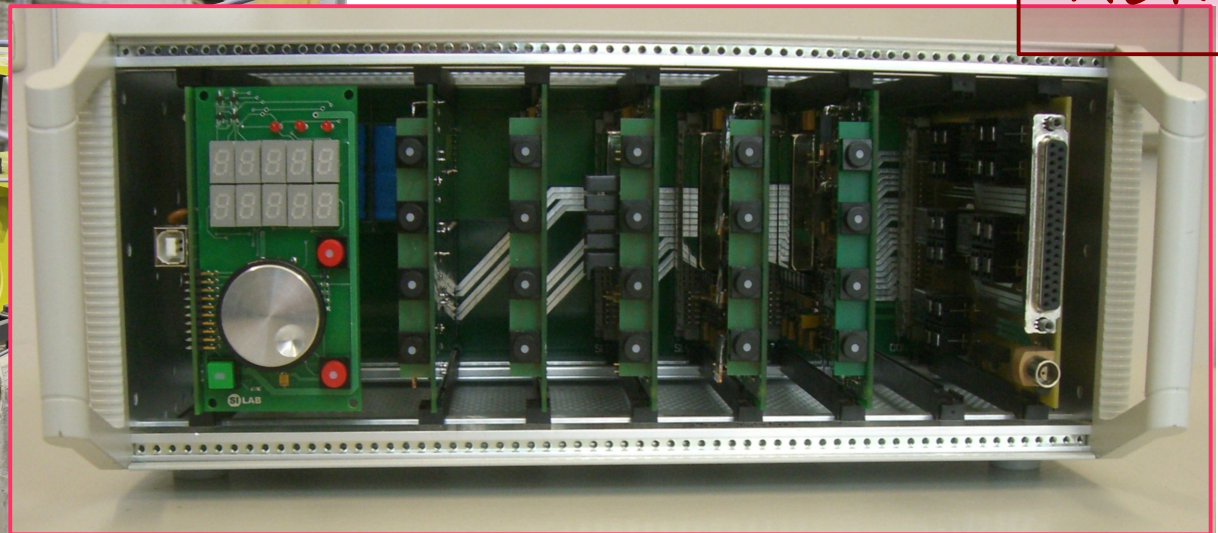
- New S3B System with a new Switcher 3 for matrixes upto 128x128 (old one S3A System with Switcher 2 for 64x128 matrixes)
- update of readout software and Data Quality Monitor for the use of 128x128 matrixes (and also mix of the different types of systems S3A and S3B)
- change of data format (update of the DEPFET producer in EUDET DAQ is required) : reduce twice an event size

New Power Supplies (Johannes Schneider): small, computer controlled.

OLD



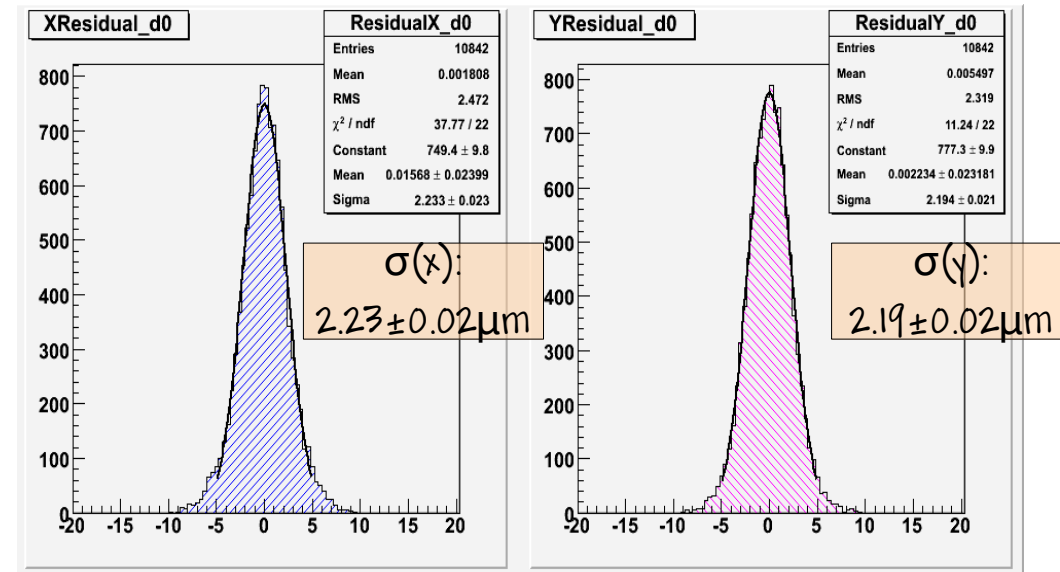
NEW



Conclusion

- DEPFET Telescope Test Beam Setup:

- Operated 6 layers DEPFET telescope
- Stable data taking with new Linux DAQ system (rate ~20 GB/hour with a readout rate ~220Hz)
- Collected ~ 20 millions events for analysis (~4TB raw data)
- preliminary data analysis with ILC/EUDET software:
 - ✓ 6 modules track fit residuals ~ 2 μm
 - ✓ signal to noise ratio ~130



- DEPFET DUT with EUDET Telescope:

- DEPFET DAQ has been successfully integrated to EUDET readout system
- Collected ~ 2 millions events
- Data analysis are ongoing