

# User Report: DEPFET



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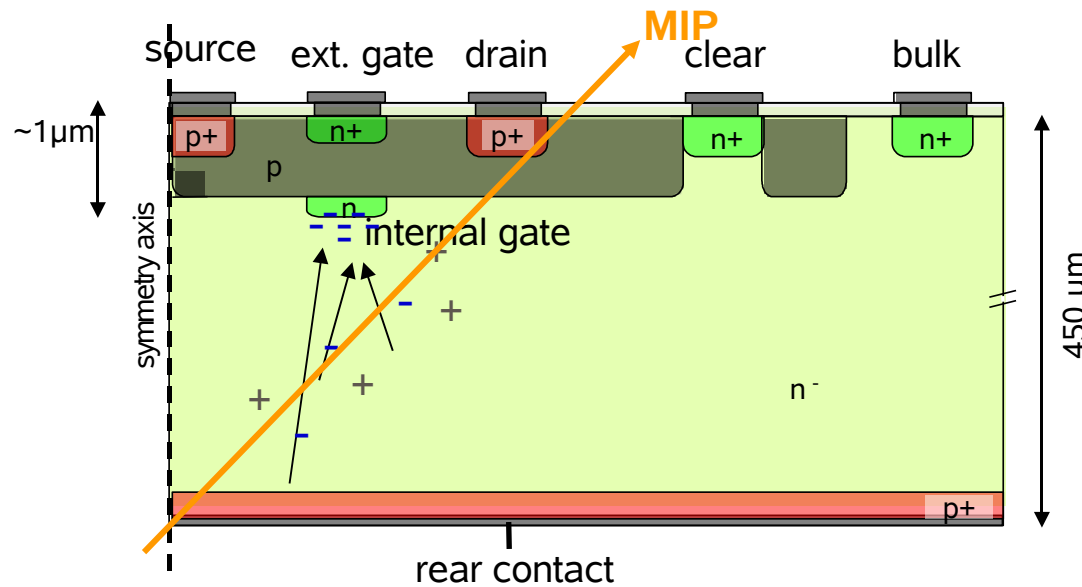


## Outline

- DEPFET system
- DEPFET DAQ (preparation to the Test Beam)
- Test beam 2008: Setup
- DEPFET and EUDET integration
- Measurement Program and First Results

EUDET Meeting, Amsterdam, 6-8 Oct. 2008

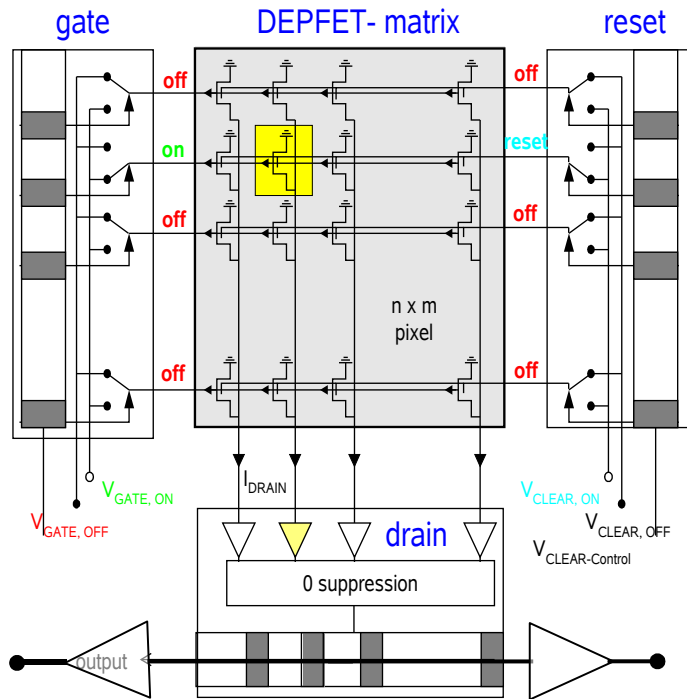
# Operation principle of a DEPFET



The Depleted P-Channel Field Effect Transistor (DEPFET):

- a **p-FET** transistor is integrated in every pixel
  - fully depleted sensitive volume (high negative backplane voltage)
  - charge collection by drift
  - Electrons are collected in the „internal gate“ and **modulate the transistor current**
  - Signal charge is removed via a clear contact
- **Fast** signal collection in **fully depleted** bulk
  - **Low noise** due to small capacitance and first amplification
  - Transistor can be **switched off** by external gate – charge collection is then still active !
  - Readout can be at the source (voltage signal) or at the drain (current signal)

# DEPFET Matrix

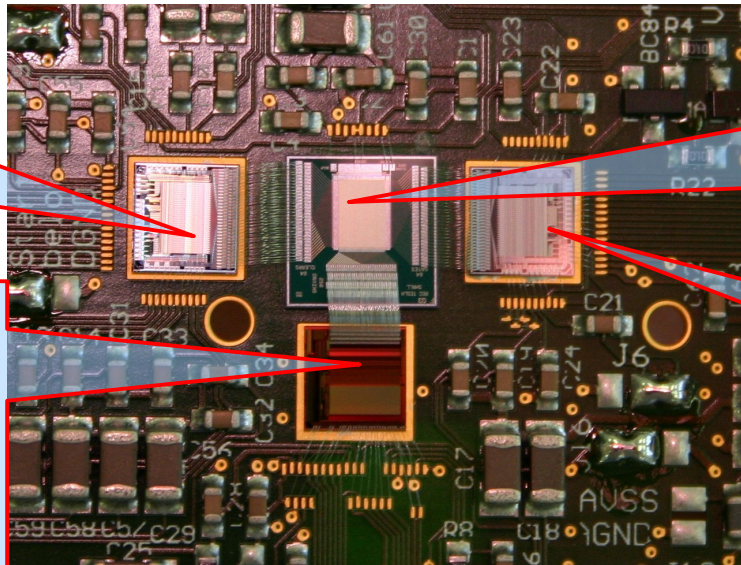


## Row wise read-out ("rolling shutter"):

- select row with external gate  $\rightarrow$
- read current ( $I_{sig} + I_{ped}$ ),  $\rightarrow$
- clear DEPFET,  $\rightarrow$
- read current again ( $I_{ped}$ )  $\rightarrow$  the difference is the signal
- move to the next row

Gate  
Switcher

Current  
Readout  
CUROI1



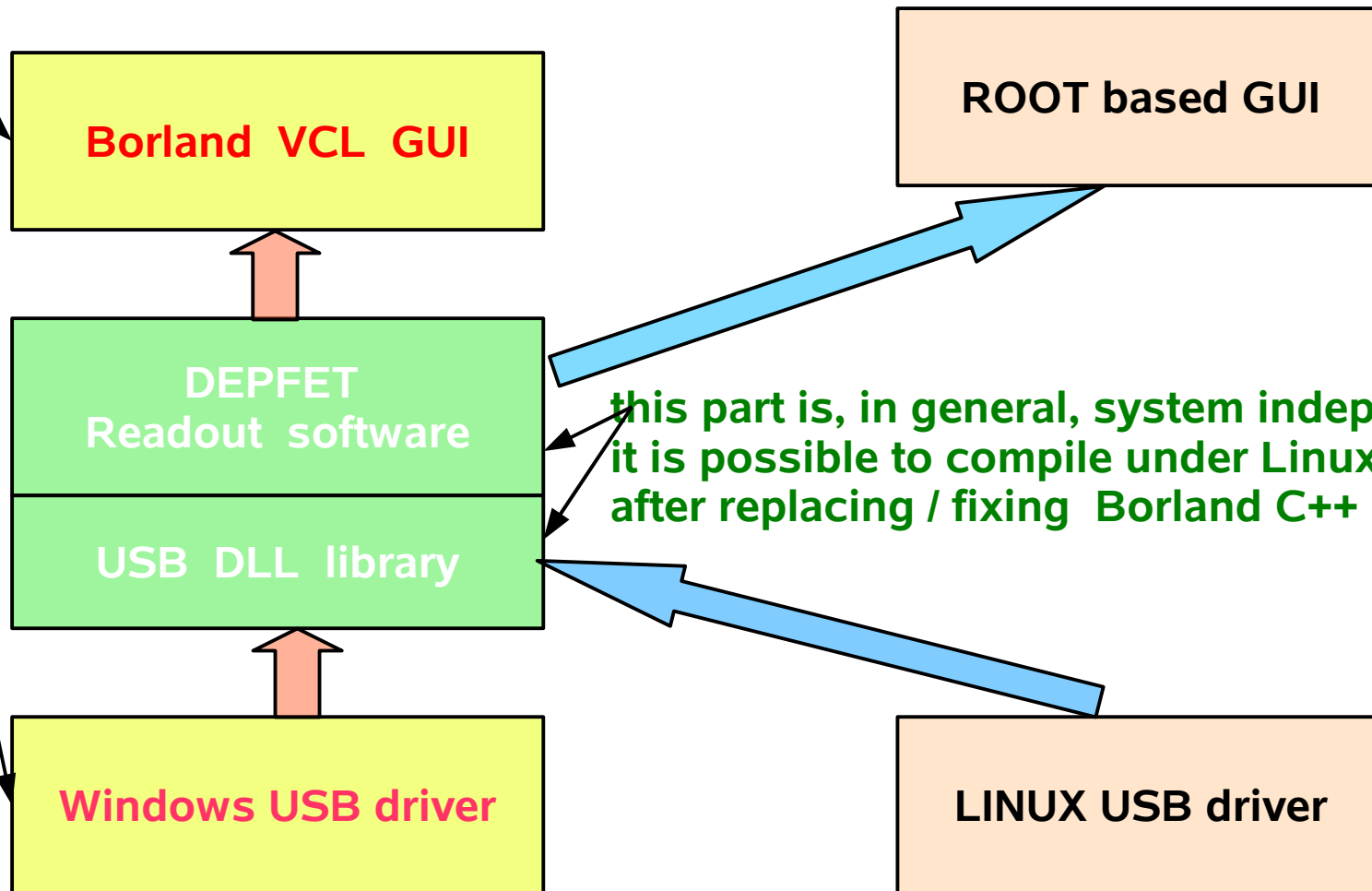
DEPFET Matrix  
64x128 pixels,  $32 \times 24 \mu m^2$

Clear  
Switcher

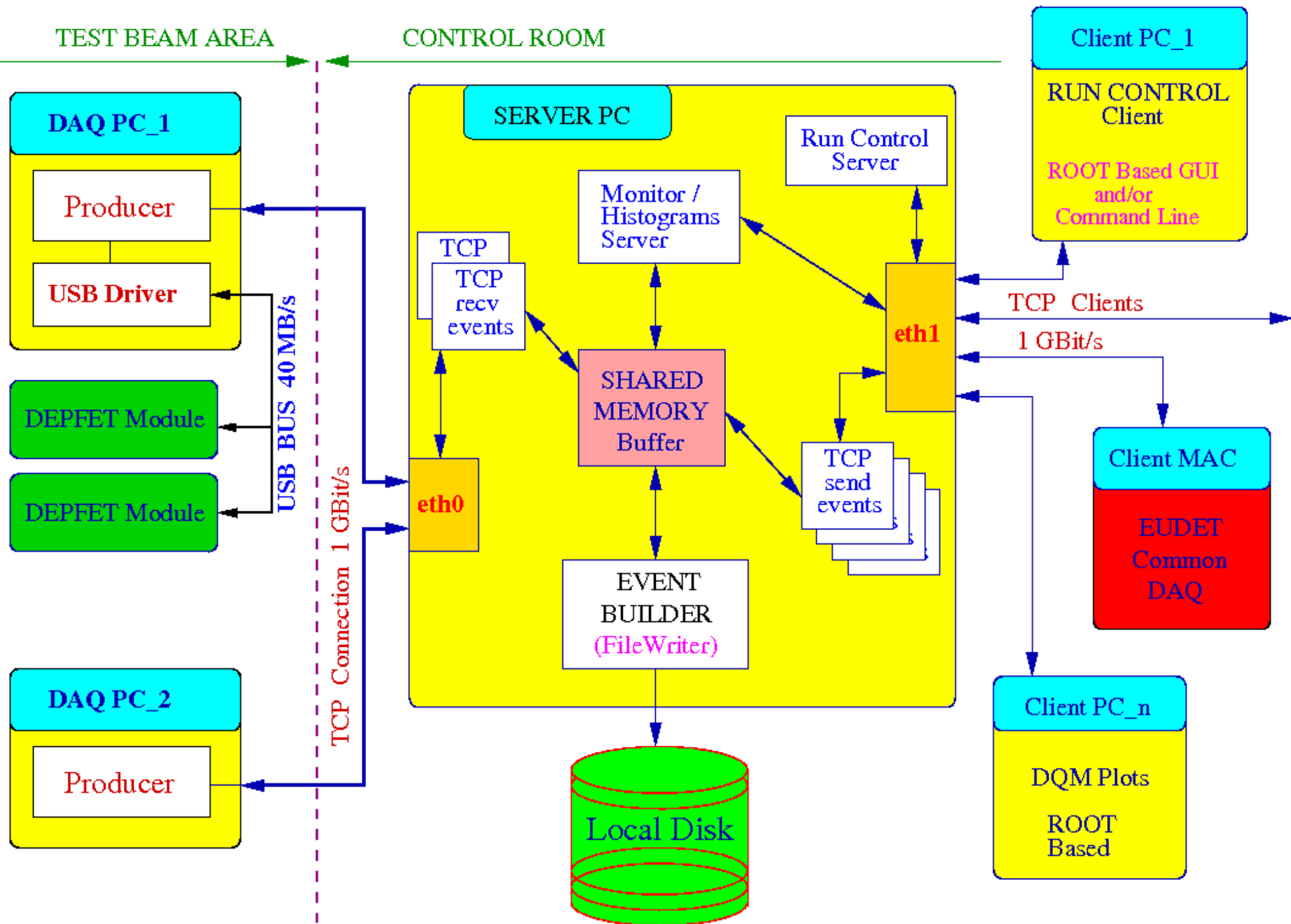
# DEPFET DAQ structure

strong SYSTEM (Windows) dependence

new software for LINUX



# DEPFET DAQ, LINUX version.



# Run Control

Run Control receive and distribute commands via TCP/IP

The diagram illustrates the Run Control system architecture. It shows a **TCL** (Tcl) component and a **Command line** component. The **Command line** is connected to a terminal window showing the execution of the `cmd status` command. The terminal output displays various system parameters and status information, including board details and event counts. The **Run Control Client** window is also shown, displaying a graphical interface with buttons for **Status**, **Init USB**, **Write to File**, **Start**, **Stop**, **Exit PROD**, **RCM Status**, **EVB stat.**, and **HELP**. The **Command** field is empty, and the **Server** is set to `silab11` and **Port** to `32767`. The **Run Control Client** window also displays a list of system parameters and their values, such as **Number\_of\_Boards** (1), **BoardID** (5), **RUN\_Flag** (2), **RUN\_Time** (198 sec), **N\_Events\_Tot** (49873), **N\_timed\_out** (0), **N\_extra\_mod** (0), **shmem\_error** (0), **FILE\_Flag** (0 Format=0), **File\_Name** (empty), **N\_Events\_File** (0), **IN\_Buffer** (9 (0.450000 %)), **EVB\_Buffer** (16 (4.000000 %)), **EVB\_busy** (4166 msec), **N\_Producers** (2), **Mod\_tot** (2 (max=5)), **N\_Musers** (1), **N\_Clients** (3), **N\_BOR** (2 of tot=2), **N\_EOR** (0), **TTL** (100000), and **Rate** (2(2) REQ=0x05 Rate=). The **Run Control Client** window also has **Update** and **Quit** buttons.

**Terminal Output:**

```
fourl@zax:~  
EVB:: N_timed_out=0  
EVB:: N_Events_File=117  
EVB:: File_Name=DATA/run1014.dat  
cmd status  
cmd status  
!BEGIN_STATUS  
!Number_of_Boards=1  
!BoardID=2  
!BoardName=SILAB USB 2.0 Contro  
!FW_Version=5  
!VendorID=0x5312  
!ProductID=0x200  
!DeviceClass=0xff  
!END_STATUS  
EVB:: FILE_Flag=0  
EVB:: N_Events_Tot=1796352  
EVB:: N_timed_out=0  
EVB:: N_Events_File=117  
EVB:: File_Name=DATA/run1014.dat
```

**Run Control Client Parameters:**

Number_of_Boards	1
BoardID	5
RUN_Flag	2
RUN_Time	198 sec
N_Events_Tot	49873
N_timed_out	0
N_extra_mod	0
shmem_error	0
FILE_Flag	0 Format=0
File_Name	
N_Events_File	0
IN_Buffer	9 (0.450000 %)
EVB_Buffer	16 (4.000000 %)
EVB_busy	4166 msec
N_Producers	2
Mod_tot	2 (max=5)
N_Musers	1
N_Clients	3
N_BOR	2 of tot=2
N_EOR	0
TTL	100000
Rate	2(2) REQ=0x05 Rate=

# ROOT based DQM

Mode of operating:

1. from File
2. from Shmem
3. via TCP/IP
4. without graphics, as ROOT TCP/IP histogram server

via TCP/IP:

- plot all events
- adjustable rate

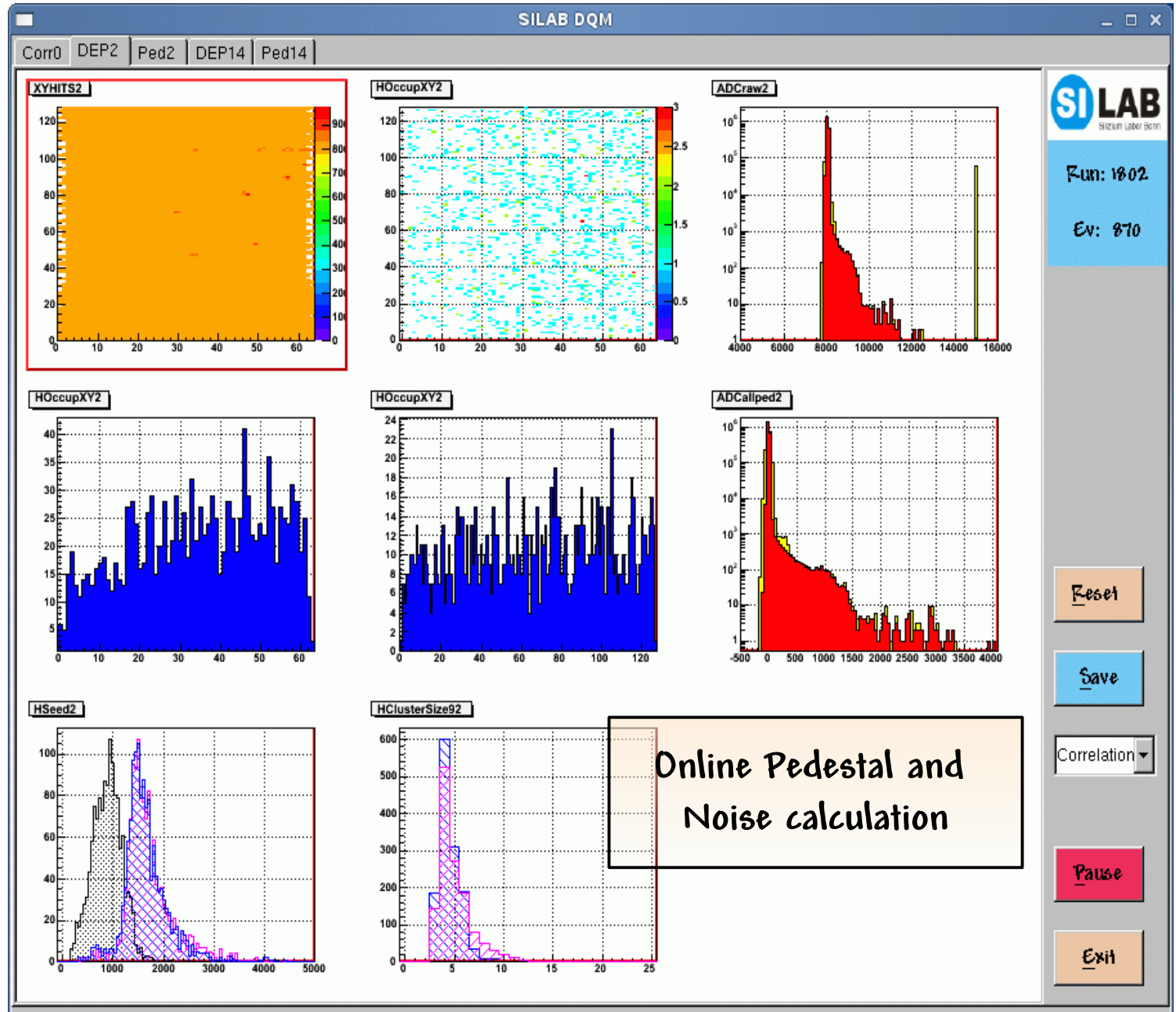
Histogram server:

- Fill histograms
- Send (via TCP) hists on request

Histogram client:

- ROOT script (C++)

Easy to integrate into common DQM





# Test beam 2008

17 July - 30 July PS - T10 DEPFET

5 Aug. - 20 Aug. SPS - H6 B EUDET/DEPFET (first days: MimoRoma)

20 Aug. - 27 Aug. SPS - H6 B DEPFET

Good collaboration and understanding between groups!!!

	19 May 12 Jun	12 Jun 10 Jul	10 Jul 14 Aug	14 Aug 11 Sep
T2 -H2	EA NUCLEON 3 13	CMS CASTOR 15	CMS SIUP 7 13	NA61 CAUCE 7 5 6 4 COMPASS SHASHLIK 13 7 7
T2 -H4	EA 3 8 5 3	UBRAN ECC 7 6 7	DREAM RD22 10 6 10	RD22 CMS ECAL 5 2
T4 -H6	EA SILC R&D 3 5 8	ATLAS BCM 6 7 7 8	ATLAS DIAMOND 4 3 6 7	ATLAS MUMEGA 7 8 6 7 RD42
T4 -H8	EA 3 13	ATLAS MDT 5 10	ATLAS MDT 5 20	ATLAS ROMAN-POT 10 9 4 RD22 CRYSTAL 15

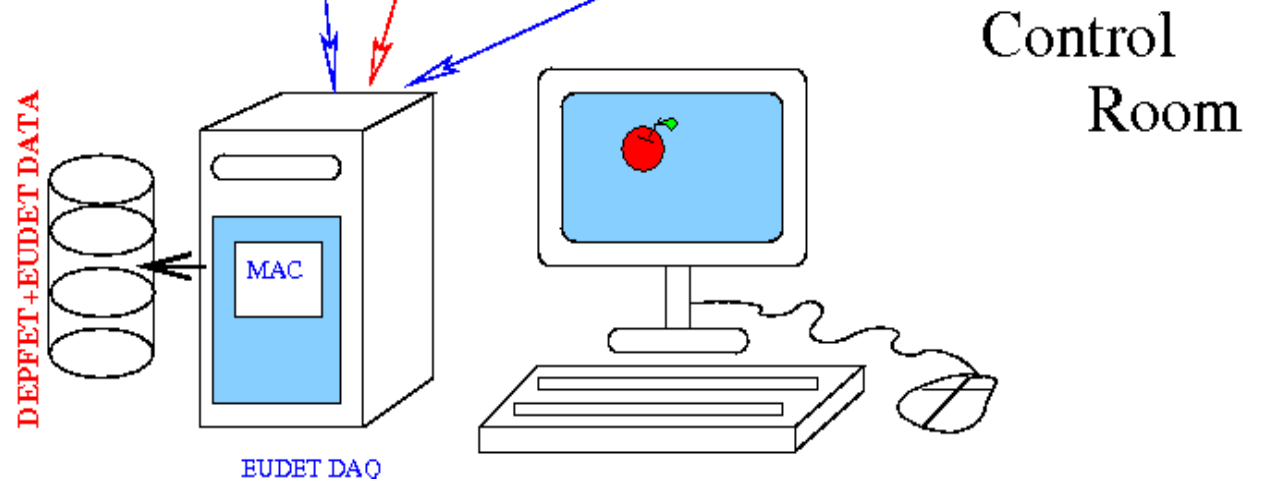
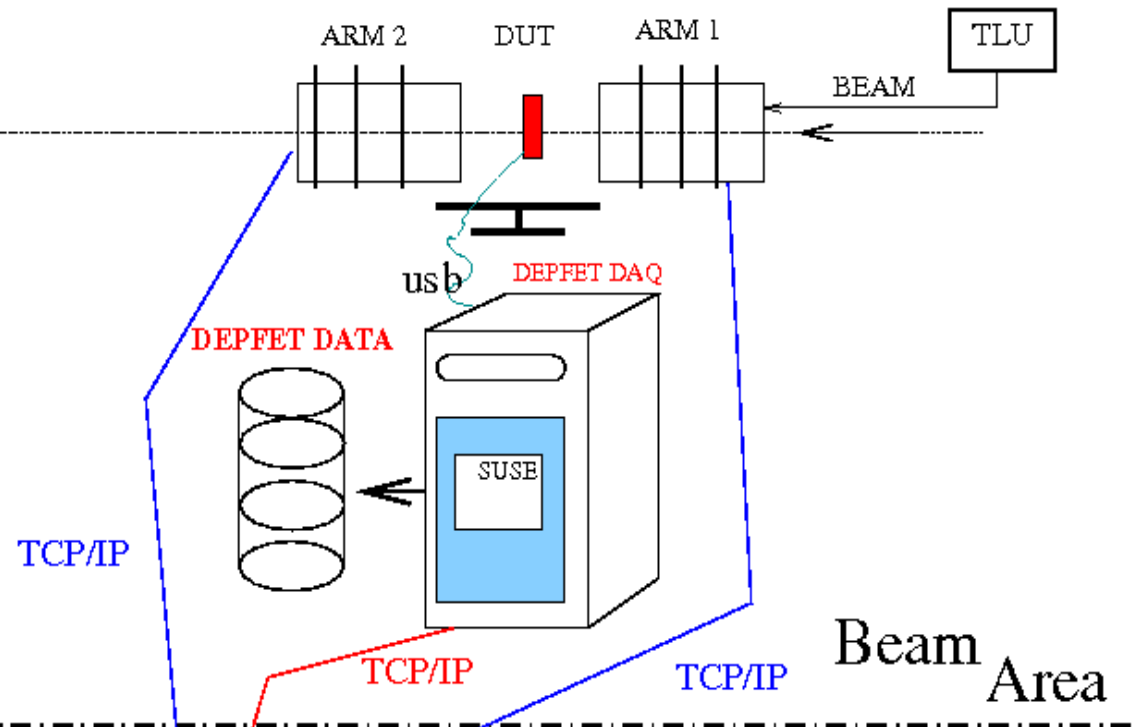
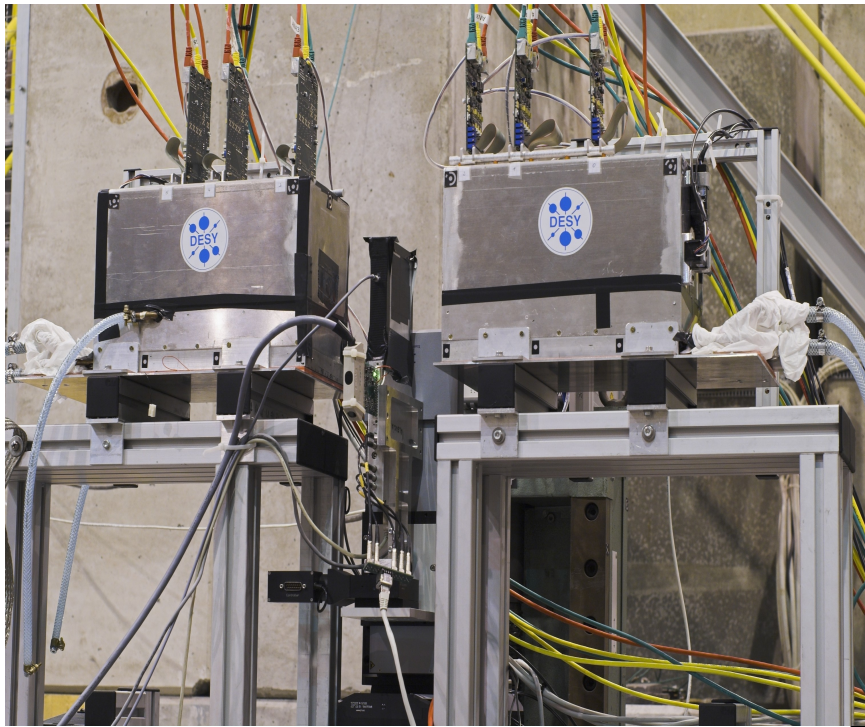
- 5 Days was lost due to problems with beam
- Summer students playing in the afternoon

```

110 CERN SL
SPS-Protons updated: 09-08-08 09:38:38
User: SFTLONG1 400 GeV/c SC: 25012
Flat top: nullms SC length: 40 BP 48.0s
RATE#E10:
  0 0 0 0 0 0
TT2 INJ1 END-FB FTOP SEXT DUMP
Targ I/E11 Mu1 %Sym Expmt
T2 0.0 0 0a H2
H4
H6
H8
T4 0.0 0 0a COMPASS
T6 0.0 0 0a
T10 0.0
T40.1 0.0 0.0 0.0 CNGS
T40.2 0.0 0.0 0.0 CNGS
Comments 09-08-08 08:21 :
CPS Septum problem
more news at 12:00
    
```



# DEPFET & EUDET: Test beam Setup



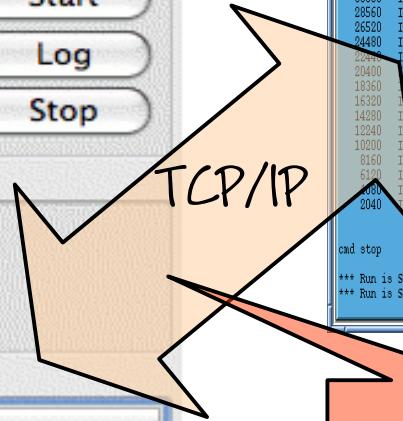
# DEPFET & EUDET: Run Control

During the test beam 2007 integration has been done having the two DAQ system synchronized at the trigger level via TLU

DEPFET Run Control

EUDET Run Control  
Many Thanks to Emlyn for help!

type	name	state	connection
DataCollector		OK	127.0.0.1:53884
LogCollector		OK	127.0.0.1:53881
Monitor	Root	OK	127.0.0.1:53891
Producer	EUDRB	OK	129.194.55.111:32803
Producer	TLU	OK	129.194.55.245:33211
Producer	DEPFET	OK	127.0.0.1:53888



cmd init  
cmd start  
cmd stop

During this 2008 test beam integration has been done having the DEPFET DAQ system steered by the EUDET DAQ software

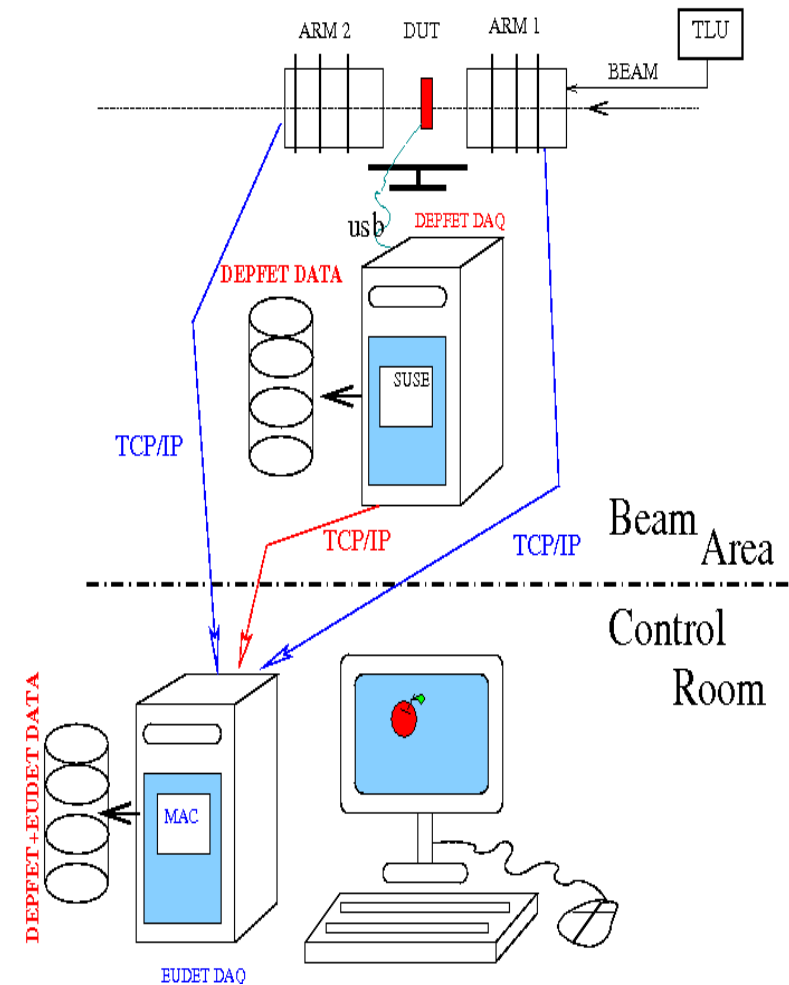


# DEPFET & EUDET: DATA Stream

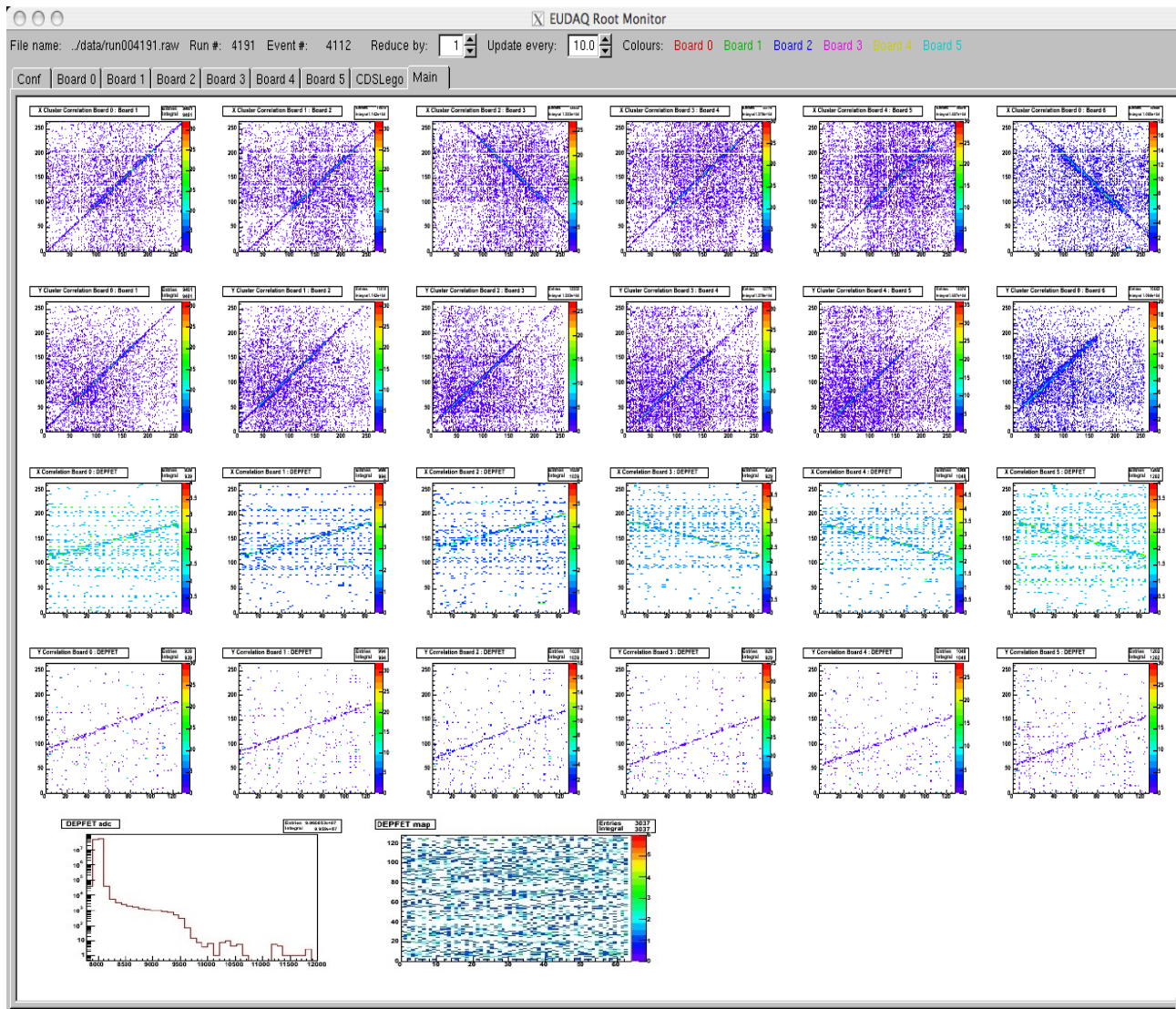
1 Million events as EUDET DUT!

The screenshot shows the 'eudaq Run Control' window. The 'Control' section includes a 'Config' dropdown set to 'depfet\_and\_tel\_zs', and buttons for 'Config', 'Start', 'Log', 'Reset', and 'Stop'. The 'Status' section displays 'Run Number: (4944)', 'Rate:', 'Triggers: 0', 'Mean Rate:', 'Events Built:', and 'File Bytes:'. The 'Connections' table is as follows:

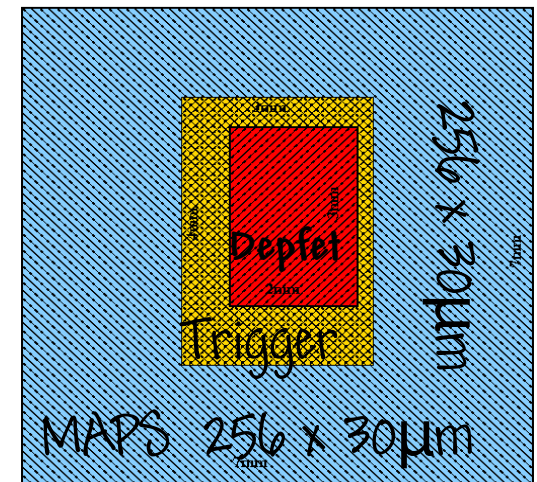
type	name	state	connection
DataCollector		OK	127.0.0.1:53884
LogCollector		OK	127.0.0.1:53881
Monitor	Root	OK	127.0.0.1:53891
Producer	EUDBR	OK	129.194.55.111:32803
Producer	TLU	OK	129.194.55.245:33211
Producer	DEPFET	OK	127.0.0.1:53888



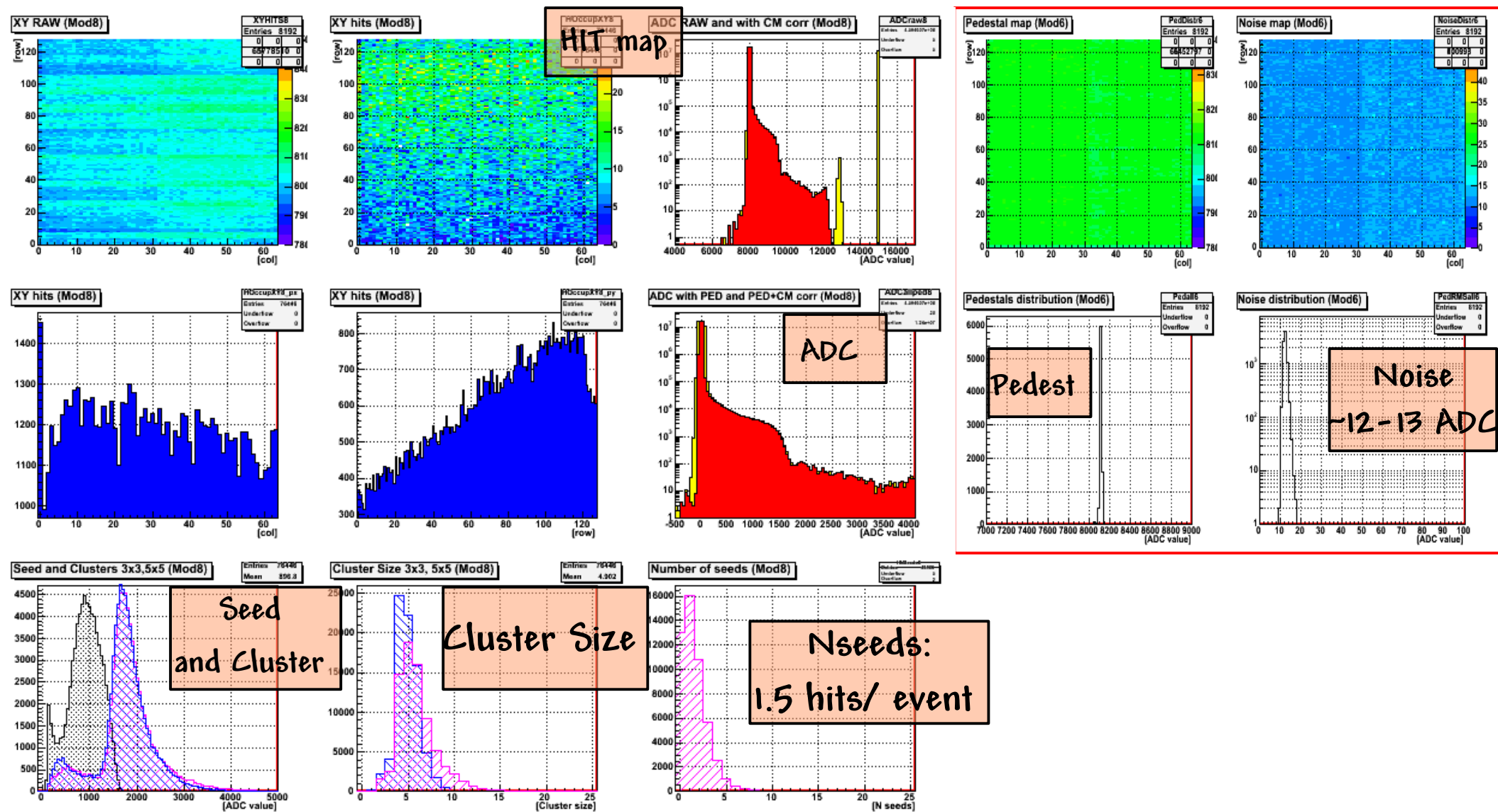
# DEPFET & EUDET: Online Data Quality Monitor



- DEPFET DUTs:  
Bonn 15b, Prague
- Beam energy scan:  
20GeV, 40GeV, 60GeV,  
80GeV, 120GeV
- High statistic run with 120GeV



# DEPFET & EUDET: DQM

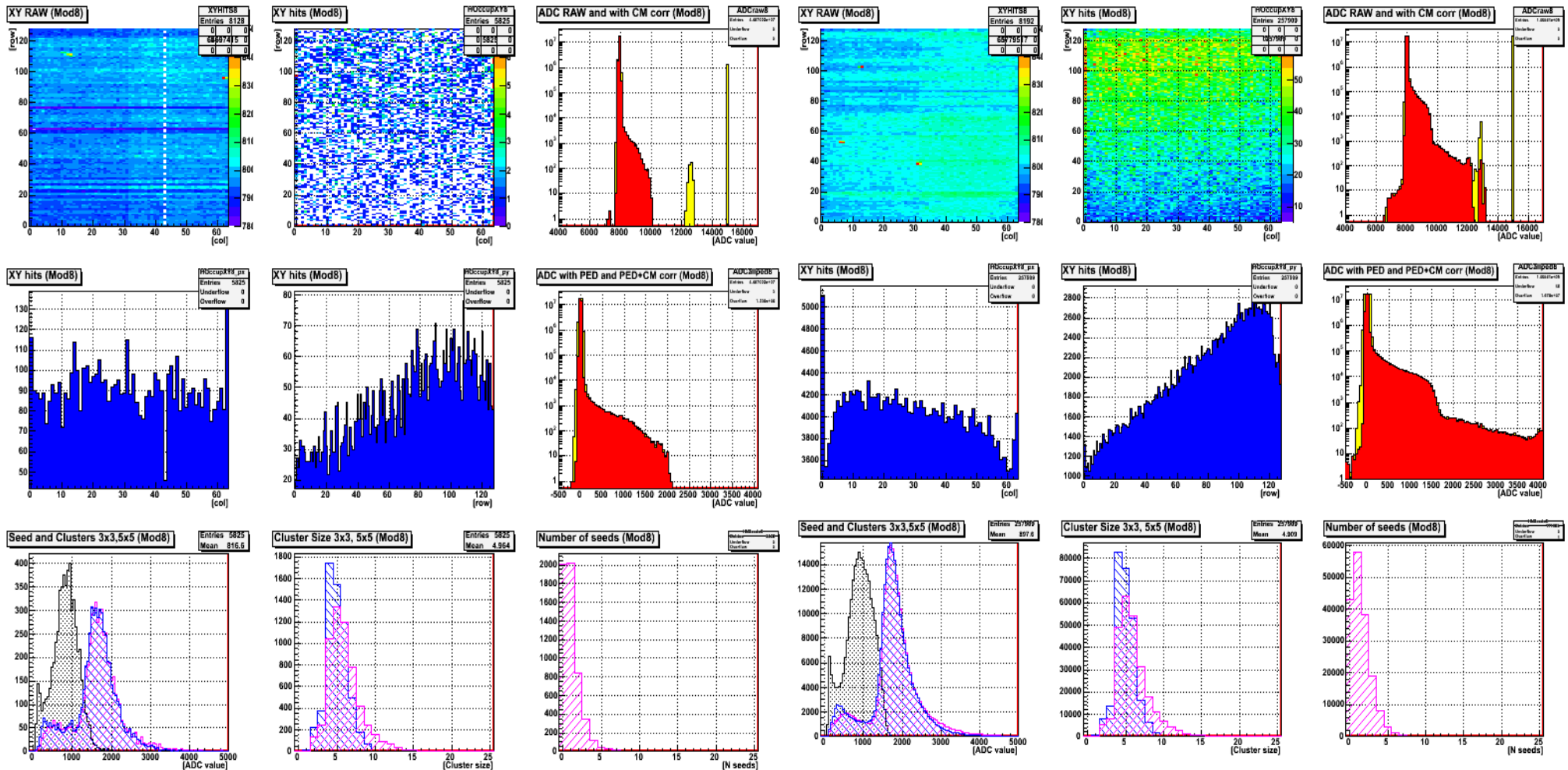




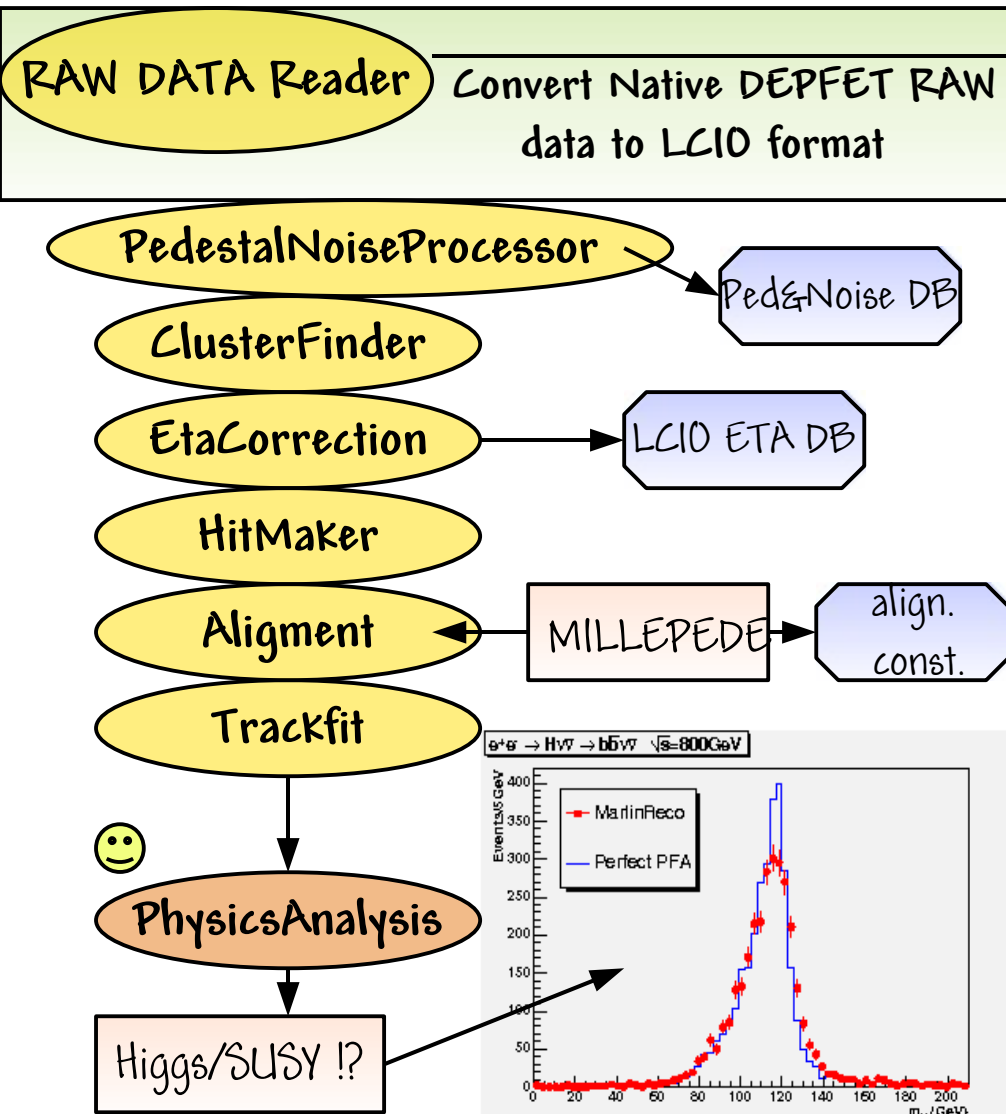
# DEPFET DUTs

DEPFET Prague DUT (24 $\mu$ m x 24  $\mu$ m)

DEPFET Bonn DUT (32 $\mu$ m x 24  $\mu$ m)



# ILC software for DEPFET analysis



The screenshot shows the **Marlin GUI** interface. The title bar indicates the file path: `/home/julia/ilc/Marlin/v00-09-09/my1.xml`. The interface is divided into several sections:

- List of all Collections Found in LCIO Files:** A table with columns 'Name' and 'Type'.
 

Name	Type
noiseDB	TrackerData
pedestalDB	TrackerData
statusDB	TrackerRawData
rawdata	TrackerRawData
- Active Processors:** A list of processors with operations. **MyDEPFETReader** is highlighted.
 

Name	Operations
AIDAHistogramInterface	Add, Edit, Delete, Deactivate, Move Up, Move Down, Show Cond.
<b>MyDEPFETReader</b>	
MyEtelPedestalNoiseProcessor	
LoadPedestalFile	
LocalCopyPedestal	
ApplyPedestalCorrection	
ClusterFinder	
ClusterSplitter	
EtaCalculator	
SaveOutputFile	
- Global Section:**
  - Global Section LCIO Files:** CWD: `ia/ilc/Marlin/v00-09-09`. Files listed: `test.slcio`, `outputpede.slcio`. Buttons: Add, Remove, Move Up, Move Down.
  - Global Section Parameters:** A table of parameters.
 

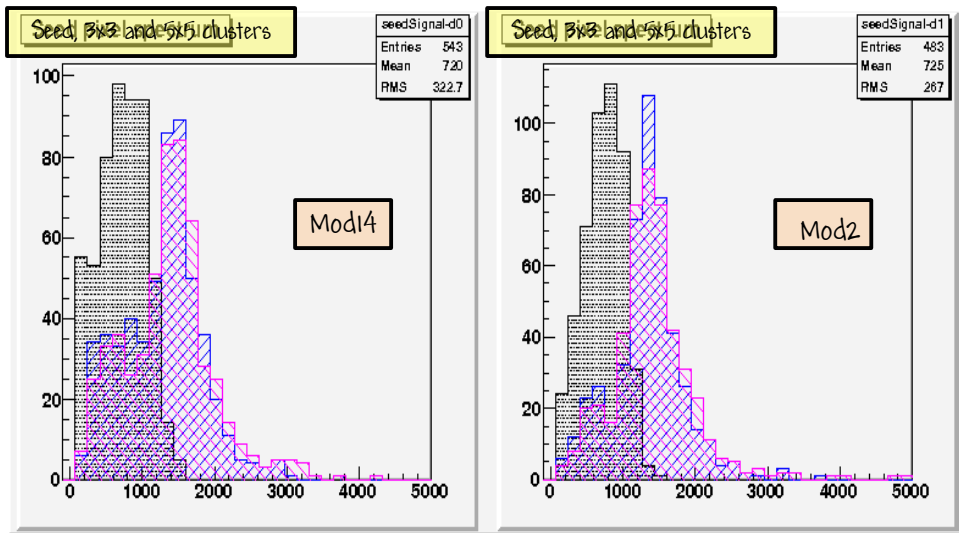
Parameter Name	Value
GearXMLFile	ge...
MaxRecordNumber	5
SkipNEvents	0
SupressCheck	fa
Verbosity	M

 Button: Browse for GEAR File.
  - View Options:** Hide Inactive Processors, Hide Active Processor Errors.
- Inactive Processors:** A list of inactive processors with operations. **MyEtelHitMaker** is highlighted.
 

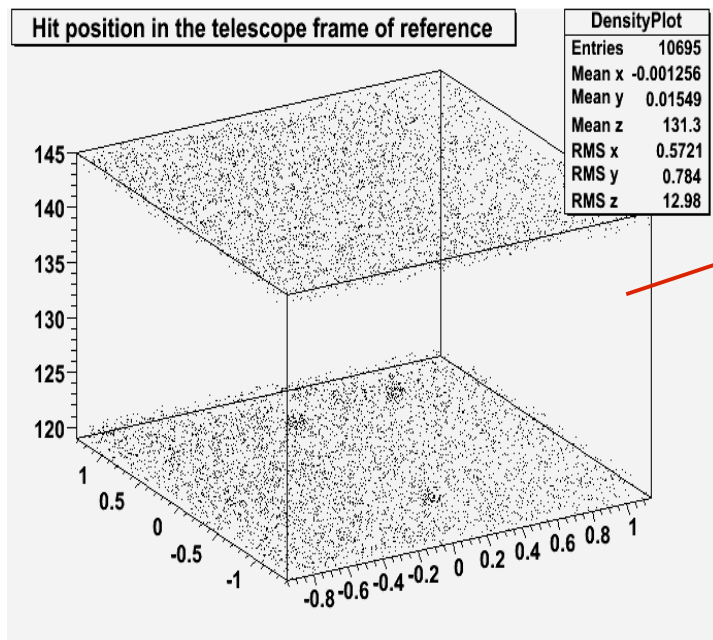
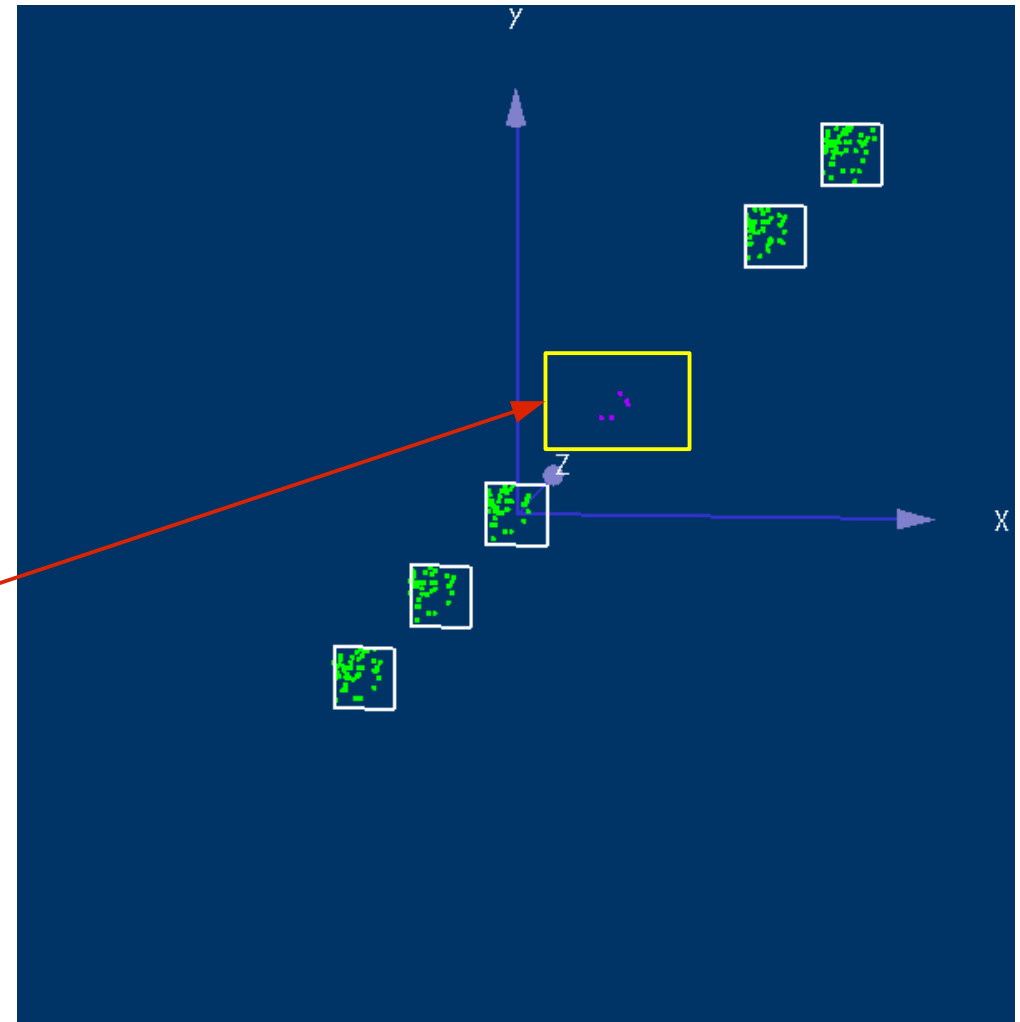
Name	Operations
ApplyGeometry	Activate, Edit, Delete
<b>MyEtelHitMaker</b>	



# EUTelHitMaker & merged DATA



Many Thanks to Antonio for help!



# Conclusions

- Linux version of DEPFET DAQ was tested and showed a **good performance**.
- DAQ integration to EUDET Telescope system (via RunControl, DQM, DATA merging on a DAQ and offline level ) are **done**.

# Plans

- To analyze all events and compare the results with the results from DEPFET Telescope.
- For the next test beam:
  - × DUT stage for the angular scans
  - × Improve a readout rate (DEPFET/EUDET)
  - × Improve a DEPFET power supplies
  - × Share a beam time

Thanks to everybody  
who took part in this (2008)  
test beam!