The EUDET Telescope in 2009 - Summary of Users

Ingrid-Maria Gregor, DESY

Outline

- Overview 2009
- Users Results
- Users Meeting
- Outlook 2010
- Summary

EUDET Annual Meeting 2009
19 – 21 October 2009
Geneva University and CERN

Status JRA1 Telescope

- Telescope currently running at CERN
- Disassembly to go back to DESY first week of December

- Users used Demonstrator in DESY and CERN
- Final Telescope running since September 2009

- Software meeting in spring helped to prepare detailed to–do list to be ready for the season
- "Season" was **very** smooth

- **Extreme good support by CERN, especially Horst Breuker, Henric Wilkens and Edda Gschwendtner**
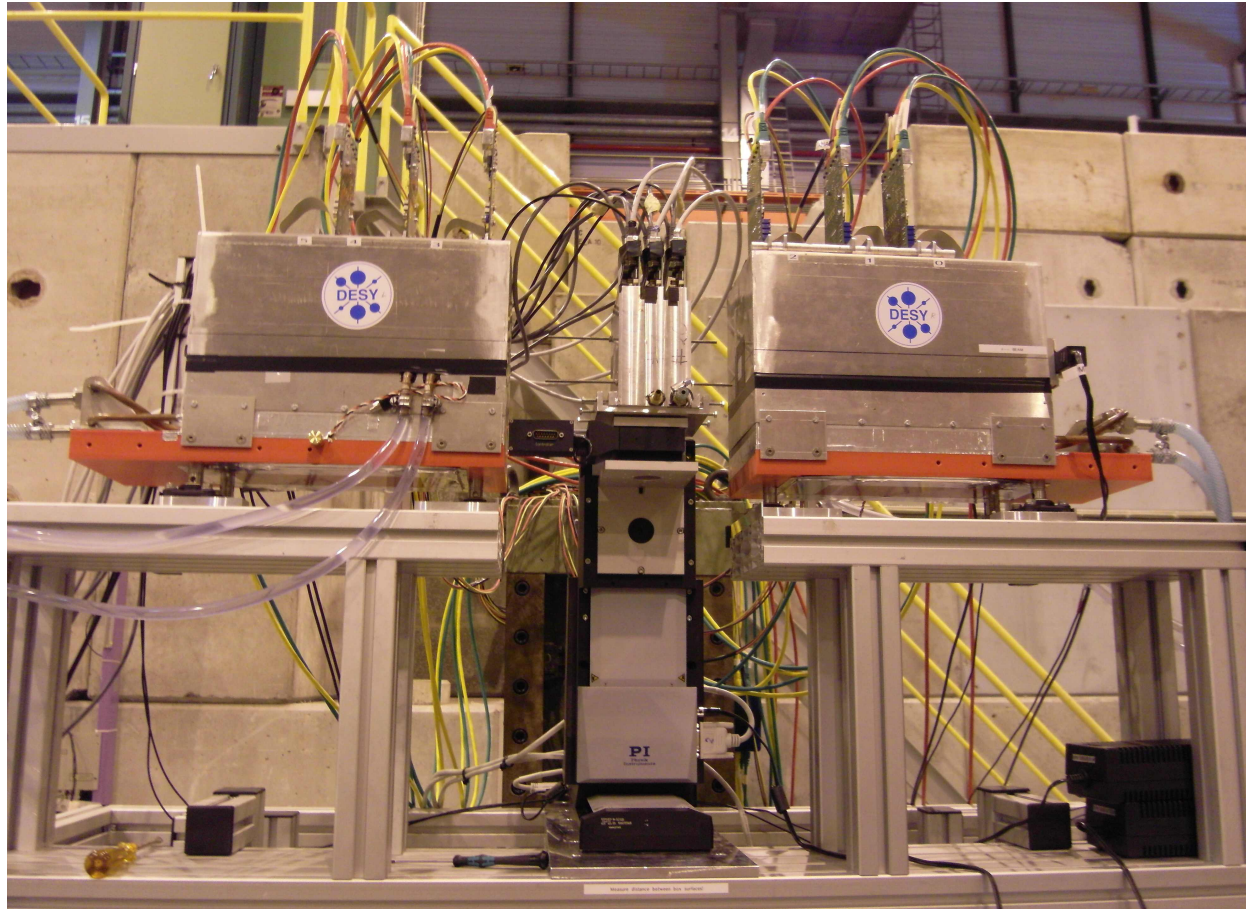
Telescope Users 2009

| Experiment	Area	Date	GRID	events
EUDET	DESY	December 2008	243	2050566
TAKI	DESY	May 2009	124	350000
EUDET	CERN	June 2009	384	3405307
AtlasLucid	CERN	July 2009	222	30000000
AtlasTRT	CERN	July 2009	143	2059613
EUDET Mimosa26	CERN	August 2009	17	1336135
DEPFET	CERN	August 2009	121	2167097
FORTIS	CERN	August 2009	319	192638
FORTIS_SILC	CERN	August 2009	765	184448
TAKI	CERN	September 2009	112	250000
EUDET Mimosa26	CERN	September 2009	25	2787097
ATLAS 3D	CERN	September 2009	-	30000000
ATLAS ALFA	CERN	Oktober 2009	-	
ATLAS PPS	CERN	November 2009	-	
ATLAS 3D	CERN	November 2009	-	

74782901

- According to logbooks about 75Mio events were recorded
- altogether >200Mio tracks (factor 4 more than last year)
- Feed back and first results from users (users meeting yesterday)
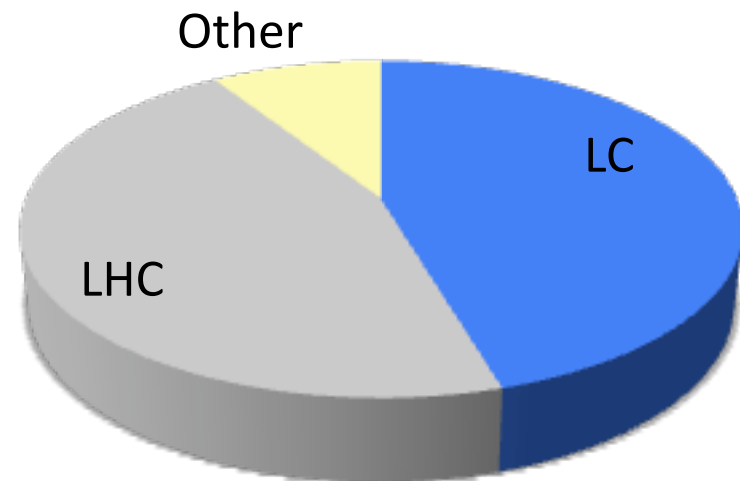
- Not all groups eligible for travel support via TA
- Number of TA2 proposals: 6 (13 out of 20)

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ATLAS TRT

Sample of the segmented straw with 10 segments (straw length – 1.6 m; diameter – 4 mm; spacer length – 8 mm, granularity of the segment is 2 cm^2 - 10 cm^2):
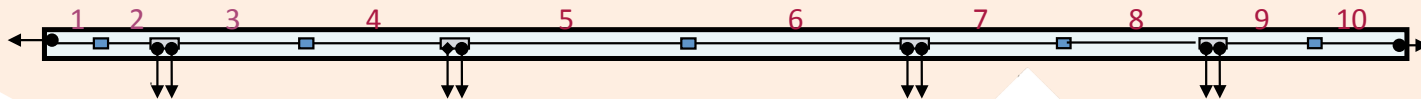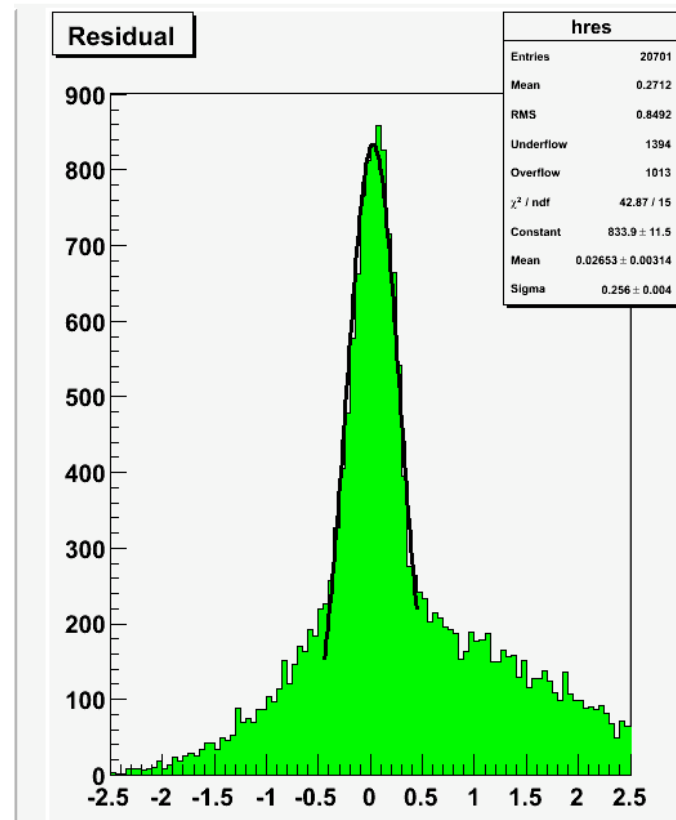
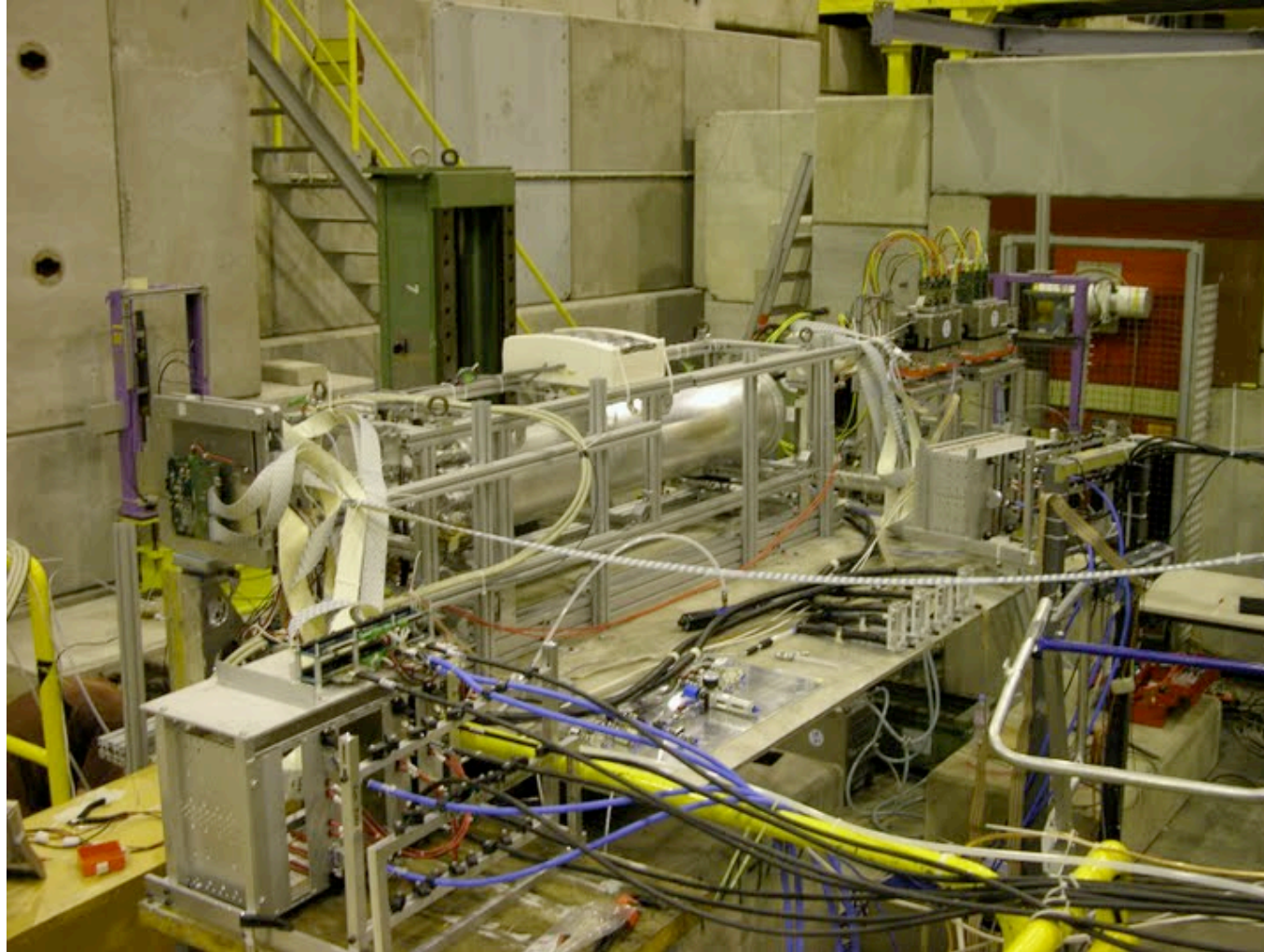Outer – 0.25 mm
Weight – 0.094 mg/mm

Prototype straw contains 4-segmented anode like:

- Double layer segmented straw prototype
- Test beam goals
  - Check of reading by means of the TLs
  - measurement of the spatial resolution
  - study of the Joint and Spacer Unit zones

- Implemented in EUDAQ
- Use EUTelescope for Analysis (still ongoing)

Residual

hres	
Entries	20701
Mean	0.2712
RMS	0.8492
Underflow	1394
Overflow	1013
χ^2 / ndf	42.87 / 15
Constant	833.9 ± 11.5
Mean	0.02653 ± 0.00314
Sigma	0.256 ± 0.004

ATLAS LUCID

- largest user of 2009
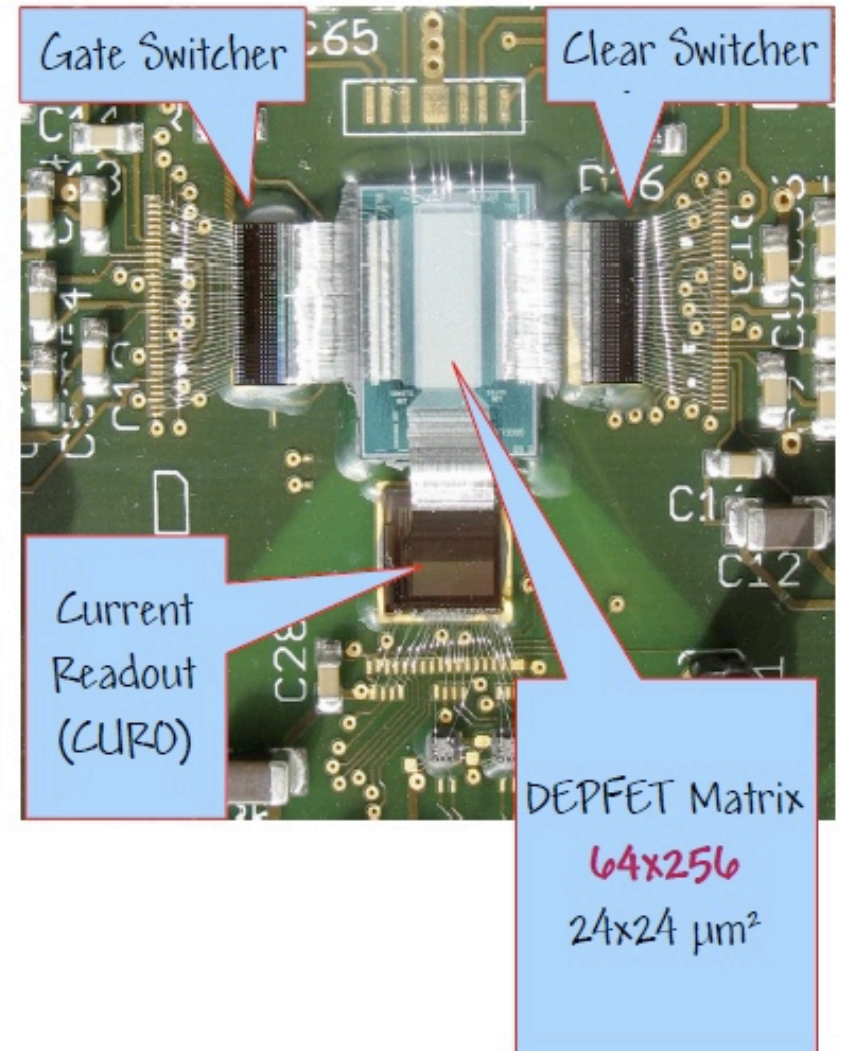- 40Mio events with

ATLAS LUCID
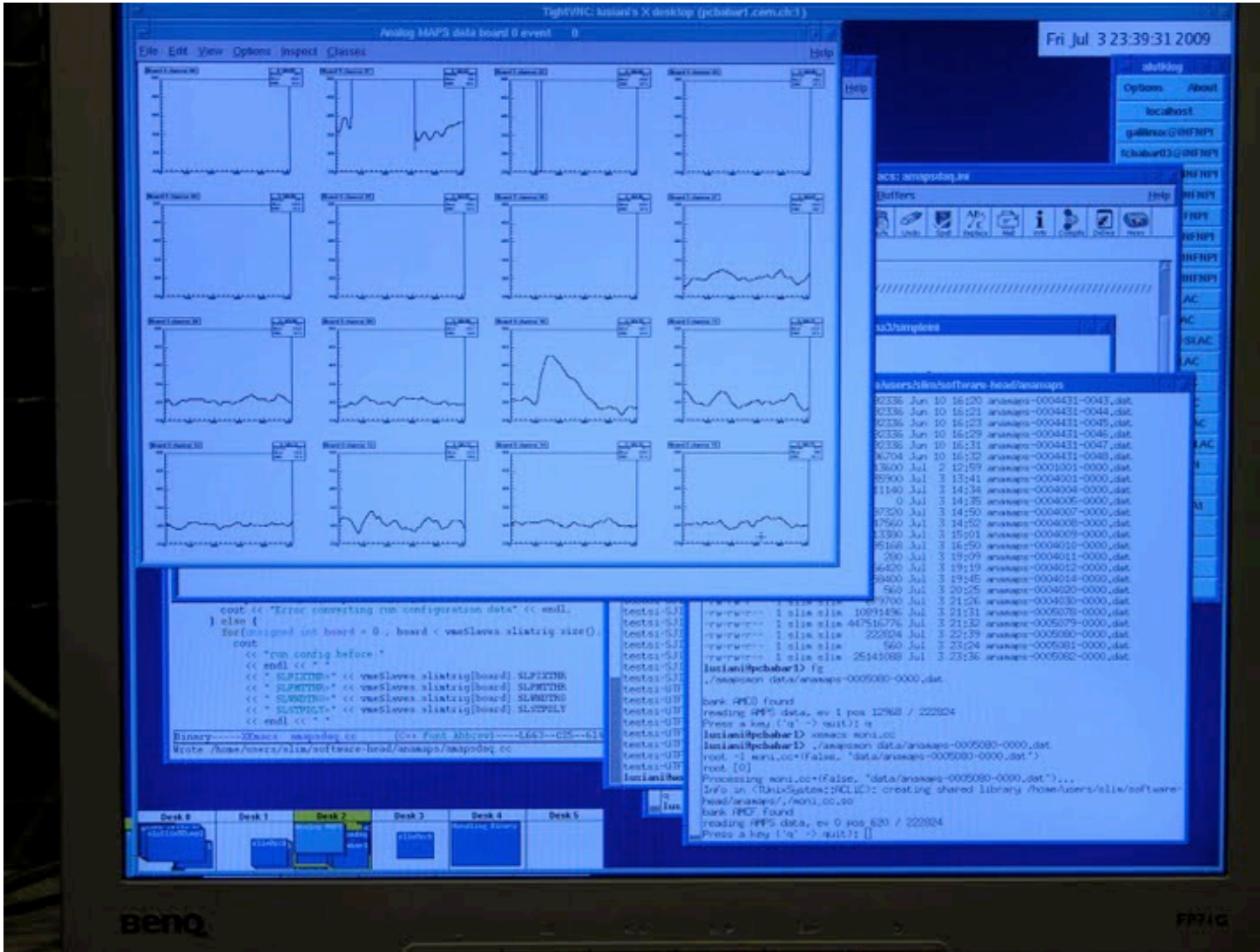
DEPFET Sensor

> * New generation of DEPFET sensors (PXD5)
>
>   with bigger matrices (64x256 pixels).
>
> * New Switcher 3 (350 nm CMOS)
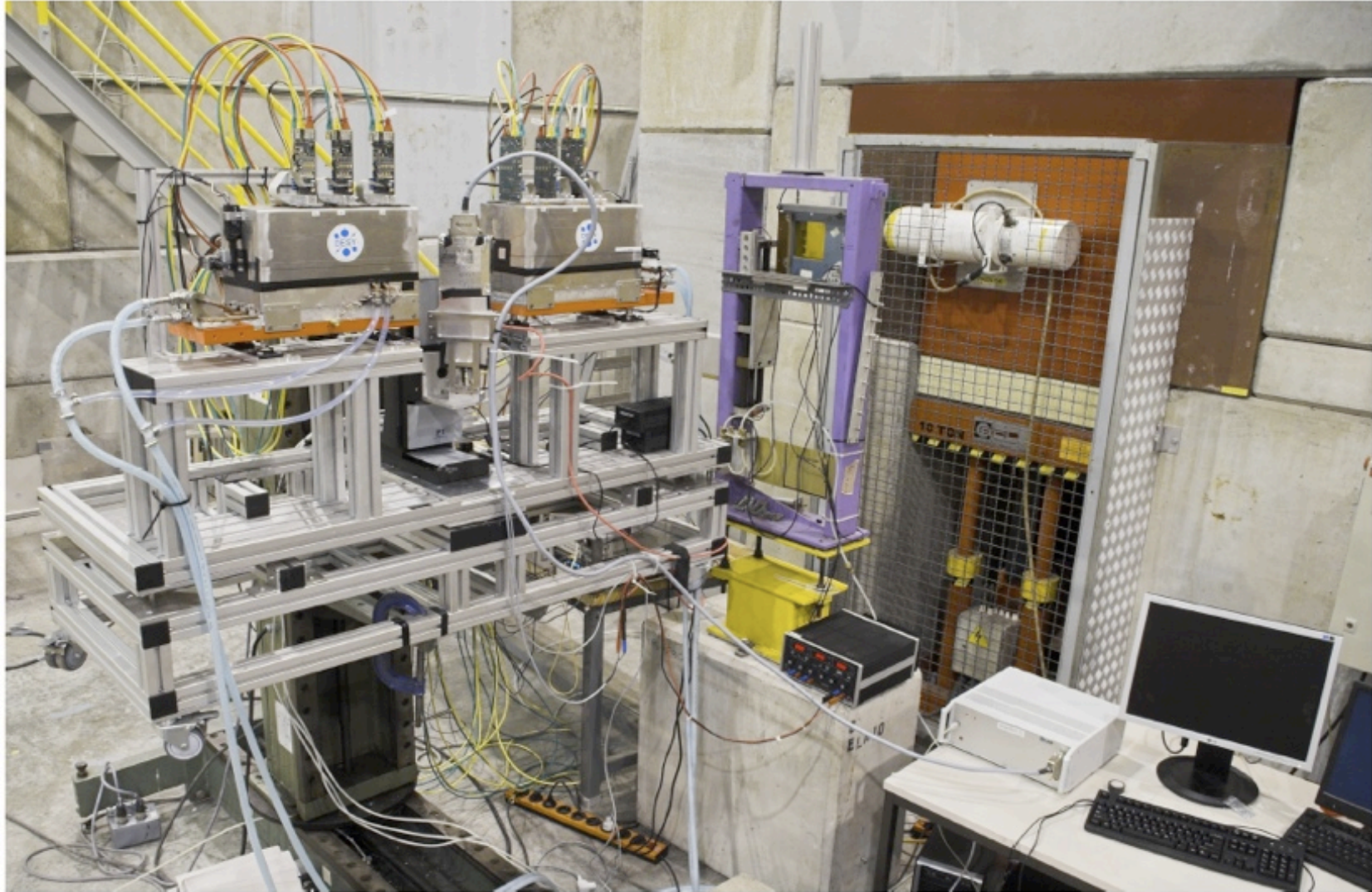>
> * New readout system S3B

- Test of complete new system
- angular scan (0°, 26°, 36°, 41°)
- Energy scan (100,80,60,40GeV electron and 120,100,80 GeV pion)
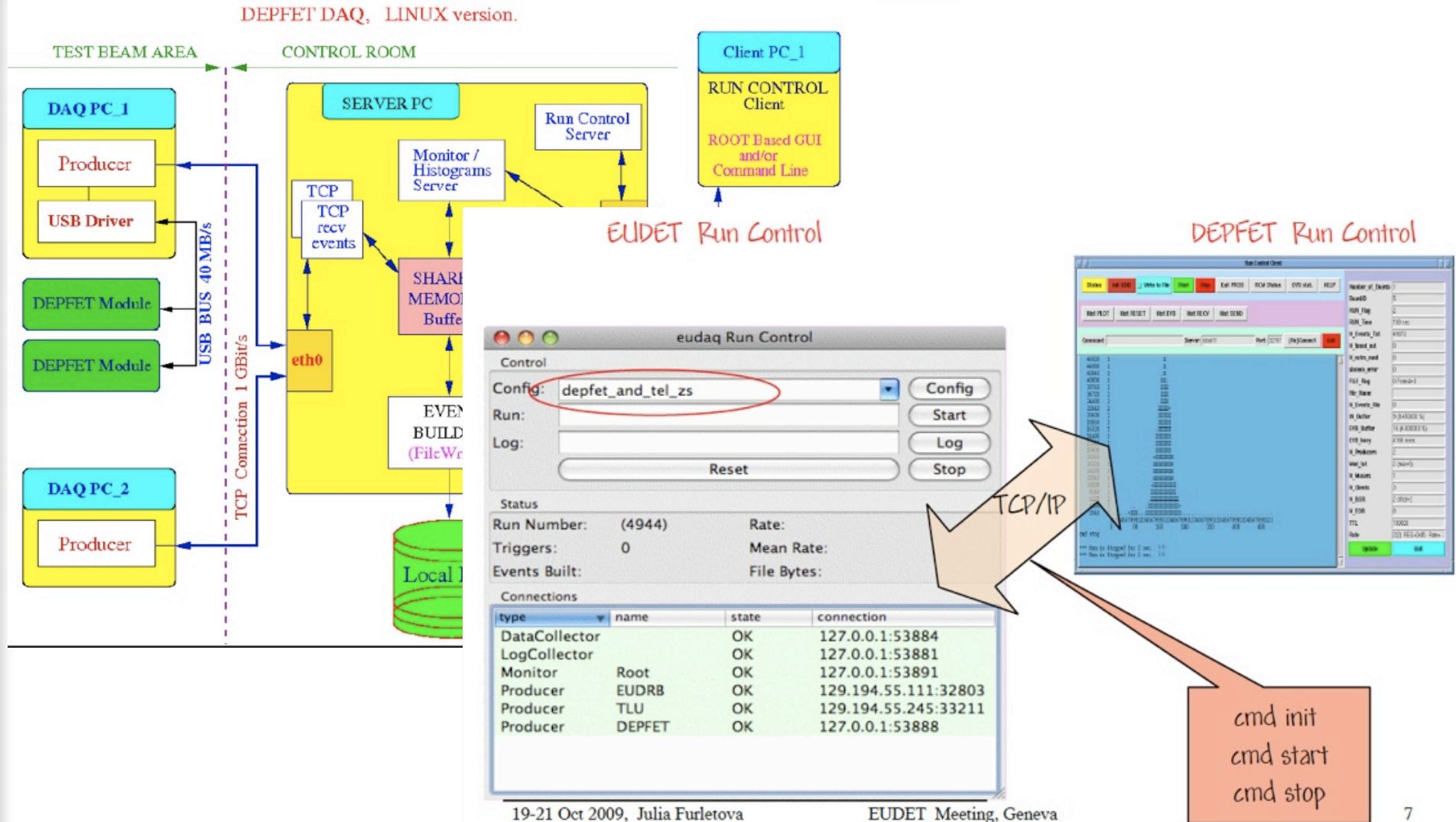- ~2.2Mio events

DEPFET 2009

Gate Switcher

Clear Switcher

Current Readout (CURO)

DEPFET Matrix
64x256
24x24 μm²

DEPFET

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INTEGRATED IN EUDAQ

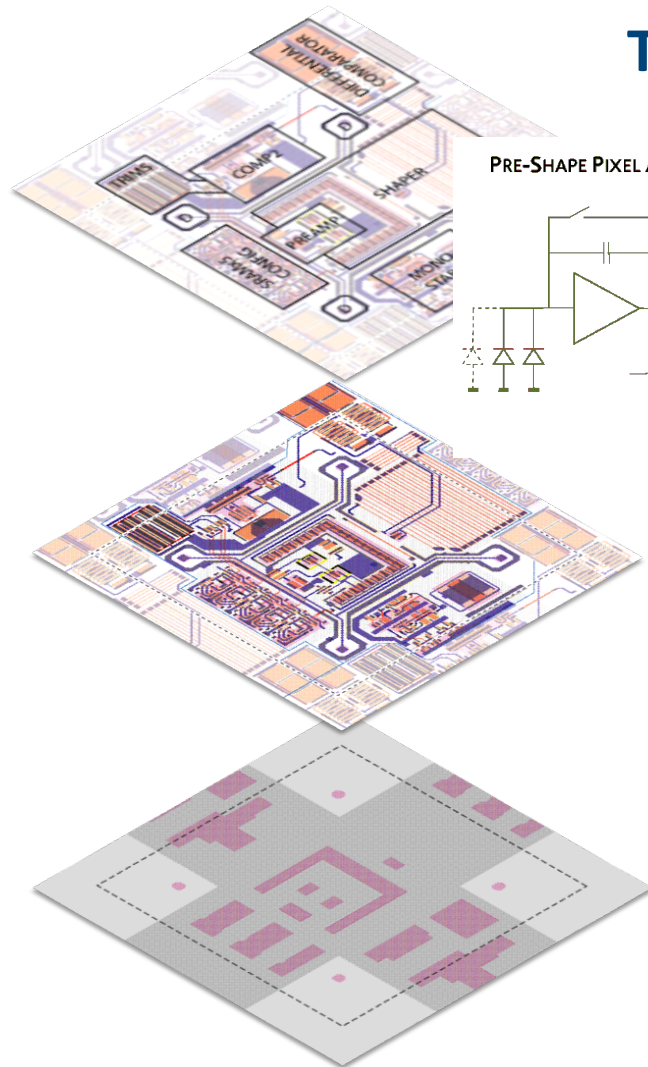Ingrid-Maria Gregor, The EUDET Telescope in 2009 - Users Summary

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Preliminary Results

- DUT resolutions for DEPFET sensor -> still under investigation
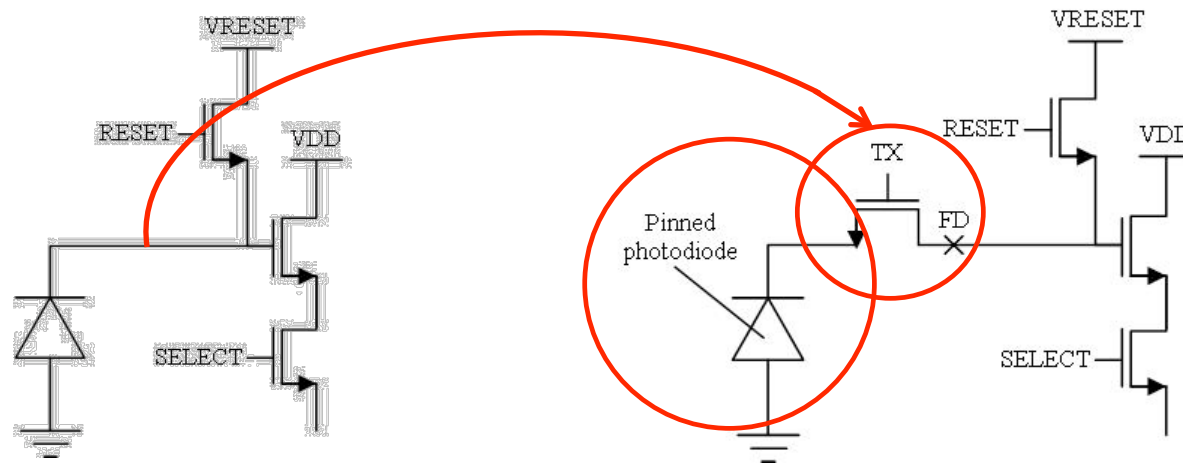- many DEPFET groups are using EUTelescope for analysis

Ingrid-Maria Gregor, The EUDET Telescope in 2009 - Users Summary
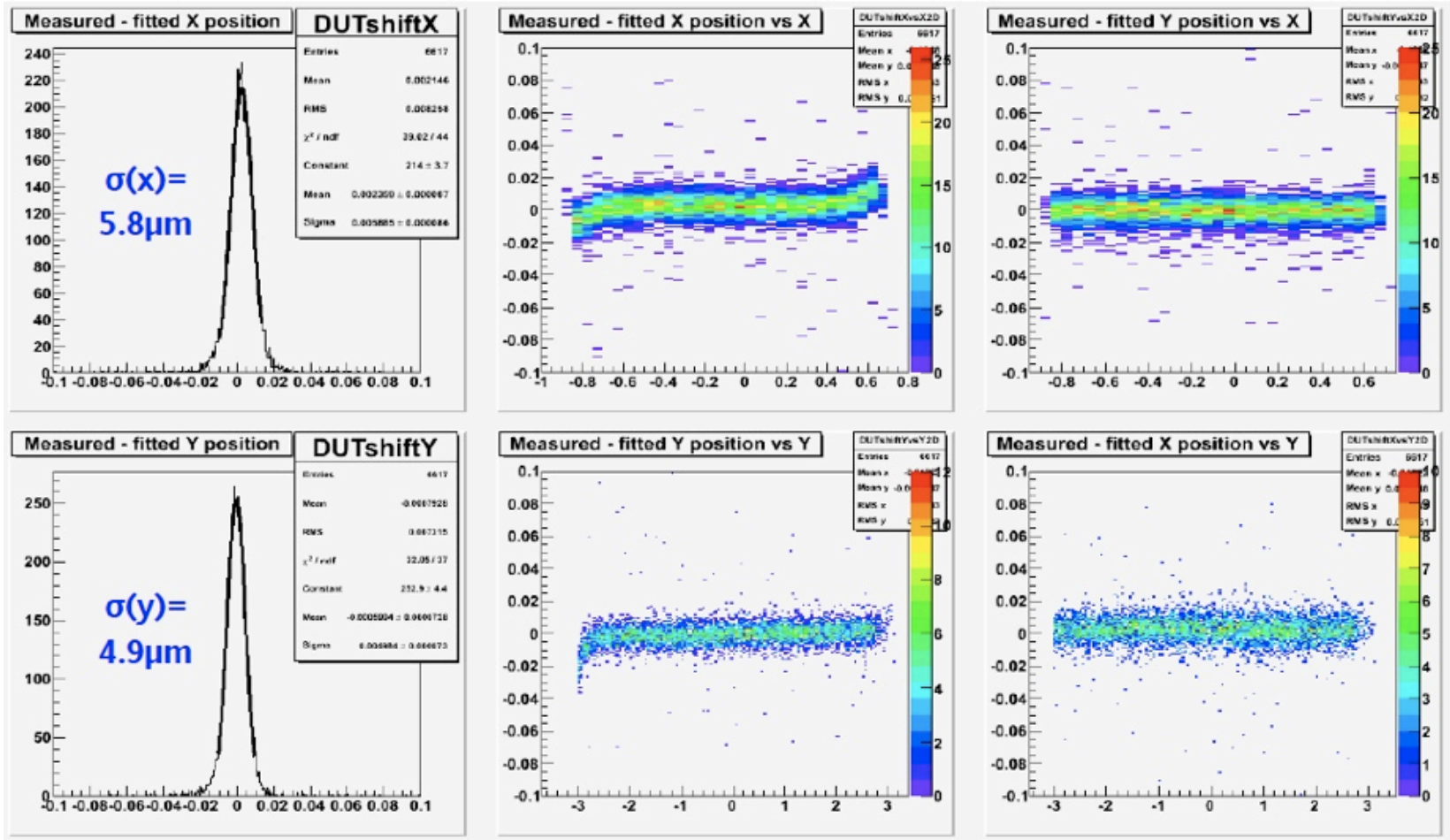
SPiDeR -> two Types of DUTs!!

TPAC pixel for a digital ECAL

PRE-SHAPE PIXEL ANALOG FRONT END   LOW GAIN / HIGH GAIN COMPARATOR   HIT LOGIC

Vth+
Vth−

Hit

Trim&Mask
SRAMx5

- Gain 136uV/e
- Noise 23e−
- Power 8.9uW
- 50um pixel
- 4 diodes
- 160 transistors
- 27 unit capacitors
- 1 resistor (4Mohm)
- ...

Sensor 29/Layer 1 x vs Sensor 43/Layer 0 x pixel correlation

Layer1VsLayer0pXX	
Entries	6787
Mean x	81.28
Mean y	79.67
RMS x	44.05
RMS y	42.19

X–X correlation plot for two layers (back-to-back)
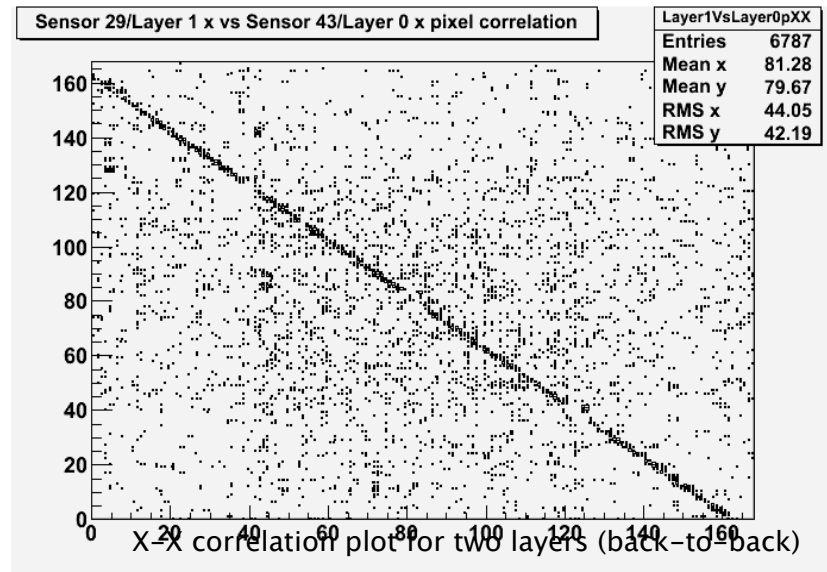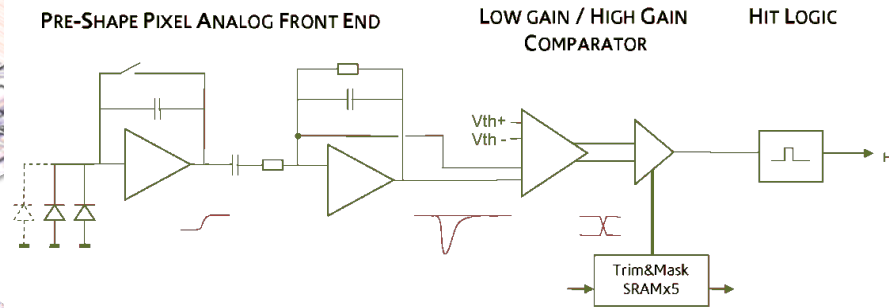
Fortis 4T MAPS

- FORTIS is the first 4T MAPS for Particle Physics
  - 3T CMOS
    - Simple architecture
    - Readout and charge collection area are the same
  - 4T CMOS
    - Three additional elements
    - Readout and charge collection area are at different points

Advantages:
- Low Noise
- High Conversion Gain

Test Beam setup

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Preliminary Results

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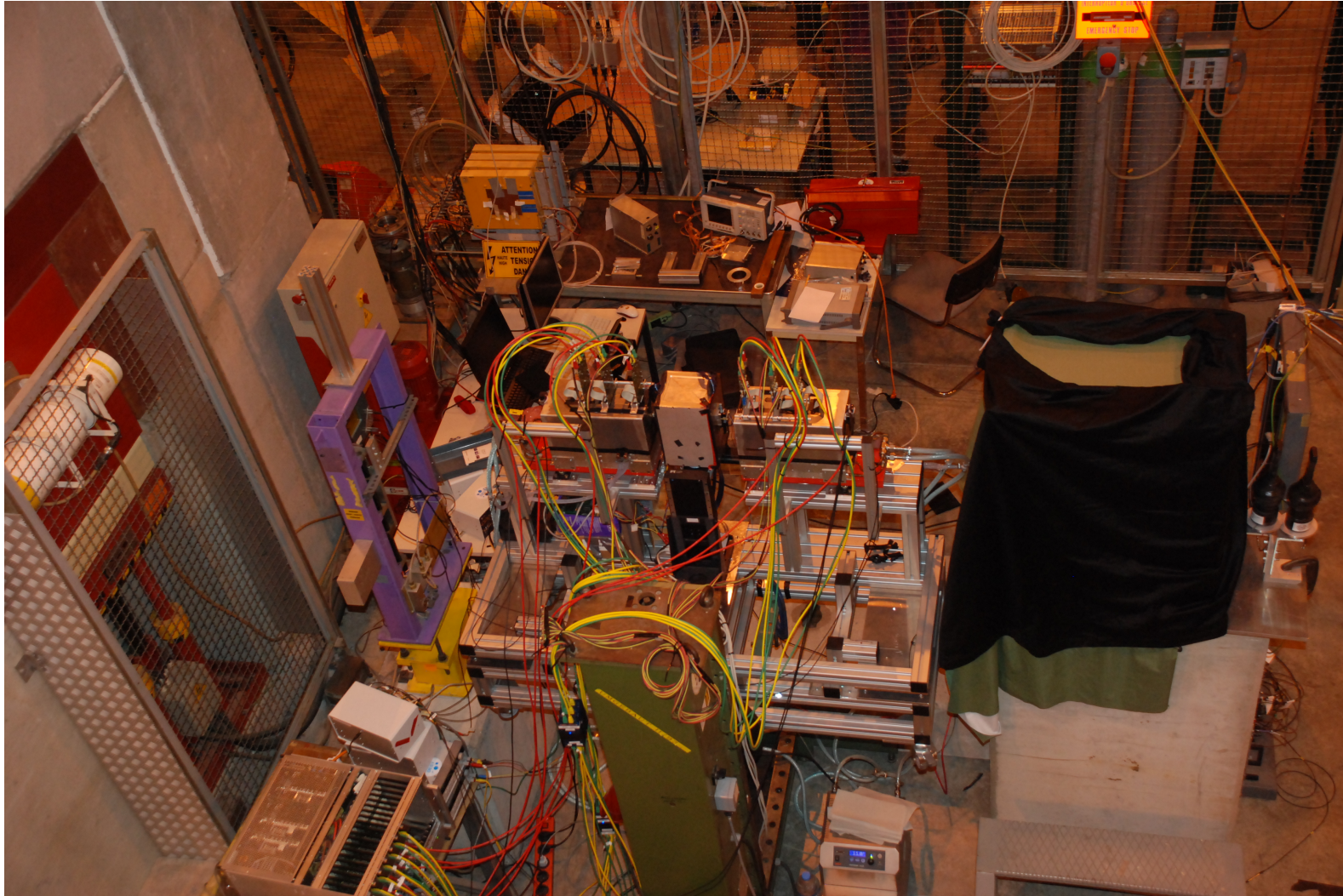
- Very preliminary results
- analysis still ongoing
- Also using EUTelescope software
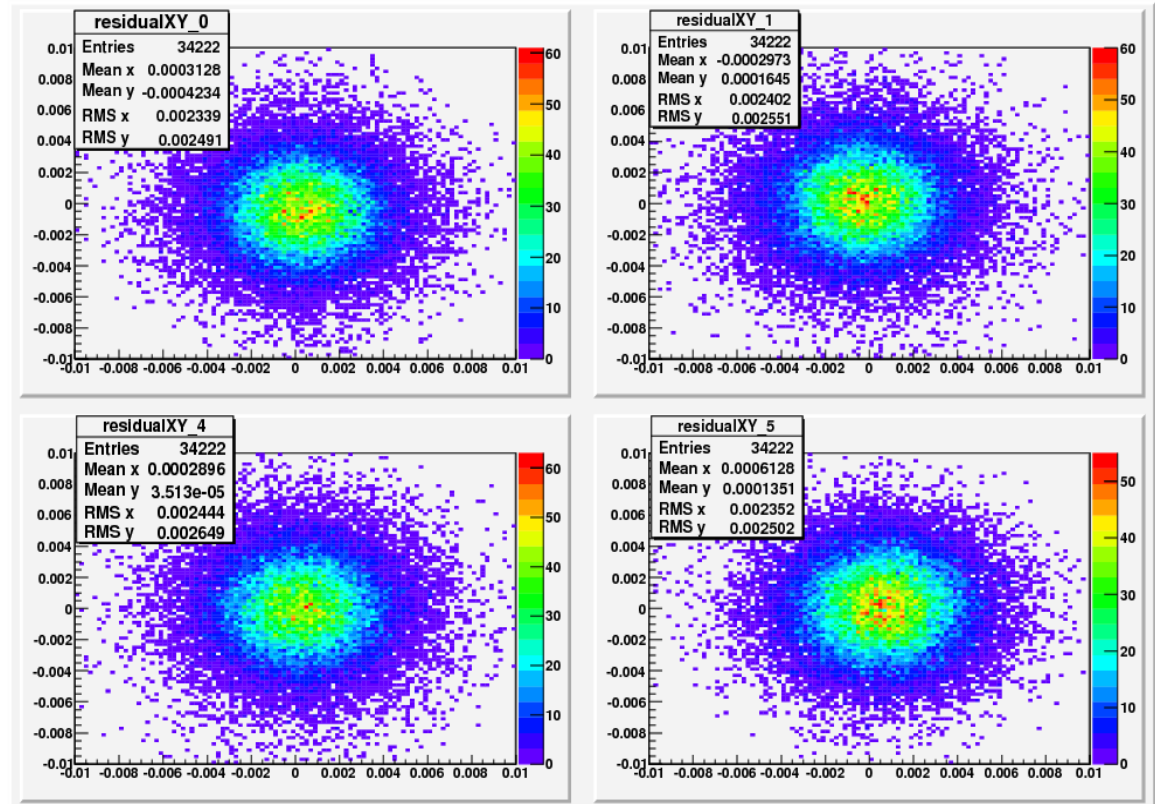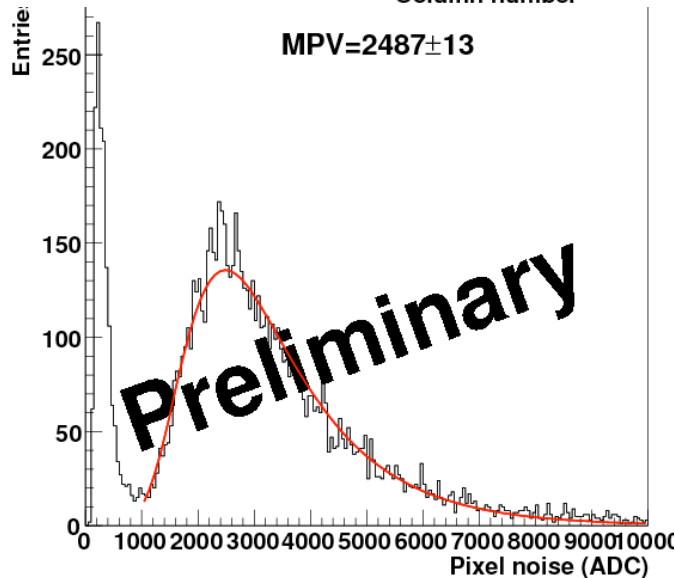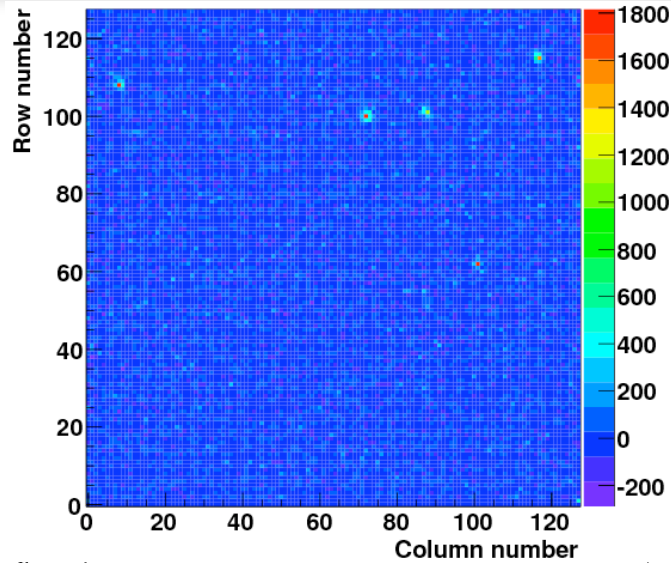
SiLC Test Beam

Testbeam at CERNs SPS

(19. to 26. August 2009)

- CERN SPS North Area: H6B
- Low intensity 120 GeV with
  - Pi+   55.67 %
  - p   38.95 %
  - K+   5.38 %
- Slow control/monitoring: HV, T, RH, Cooling
- Full remote control

Results

- 3.2 Million events
- 1 TB of data
- Full Logbook at
    http://elog.hephy.at/testbeam-SPS09/
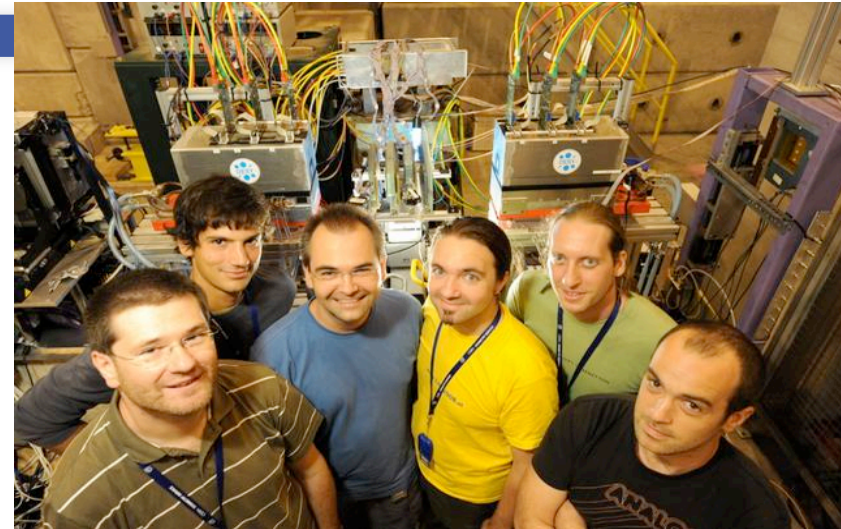
ONE STUDY: SIGNAL LOSS

- Pitch Adapter in first metal layer
- Readout metallization used to route strip to readout pads
- No metallisation over strip in PA region
- Higher capacitance per strip due to routing
- Signal loss due to higher resistivity of p+ compared to aluminium
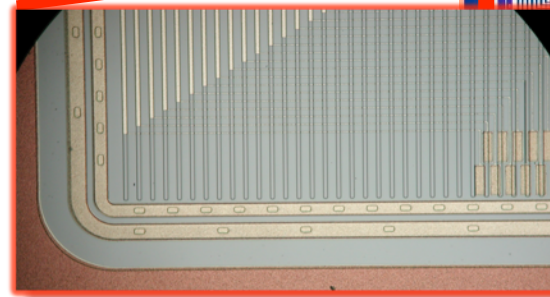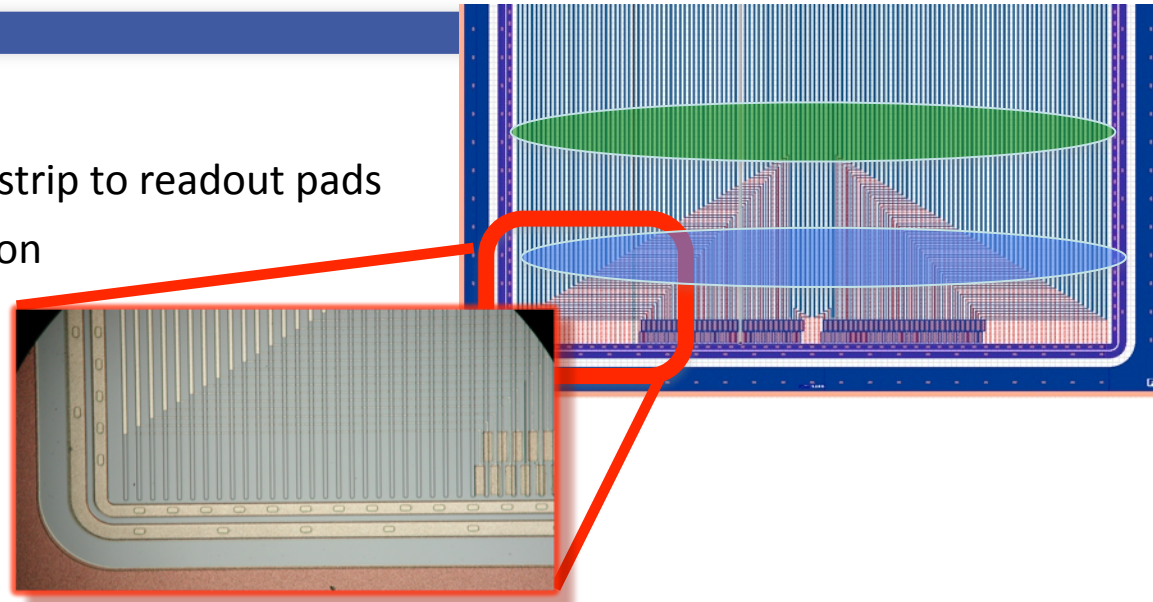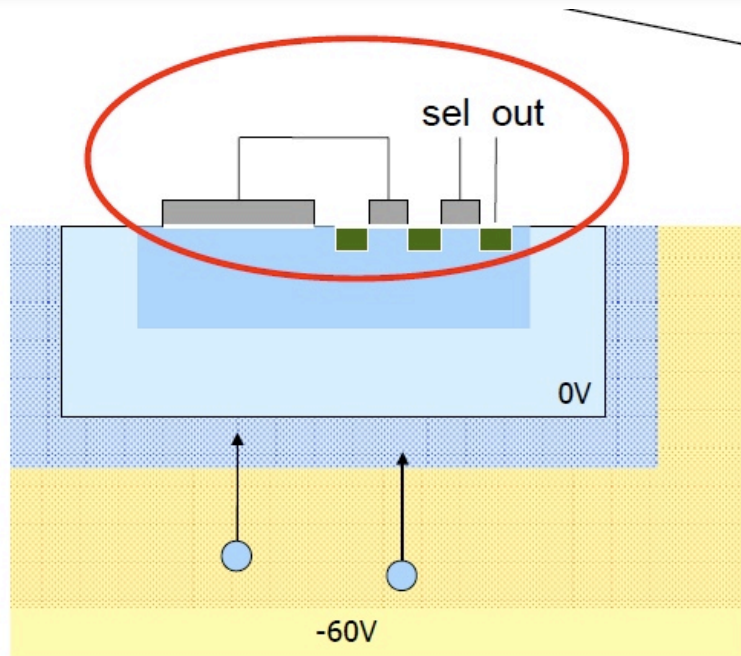
- Data is taken from two runs
- Height information from additional sensor rotated by 90°
- Each hit position represents SNR of a cluster with hit location estimated at the respective strip
- Closer look on signals and noise separately necessary to disentangle effects

HV-Pixel Chip "TAKI"

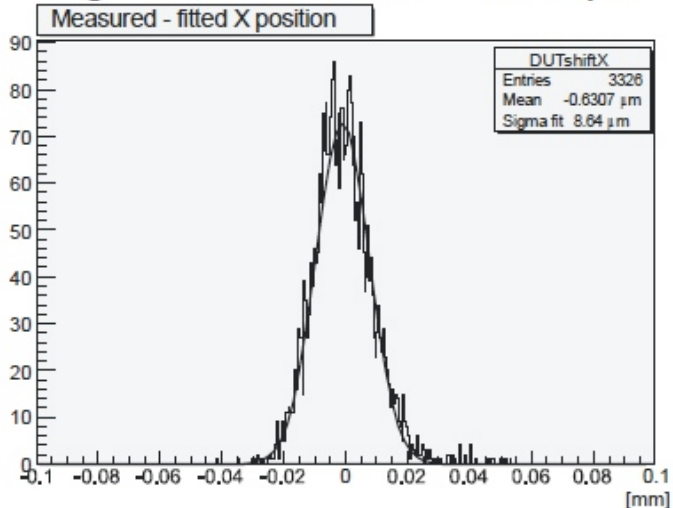Ingrid-Maria Gregor, The EUDET Telescope in 2009 - Users Summary
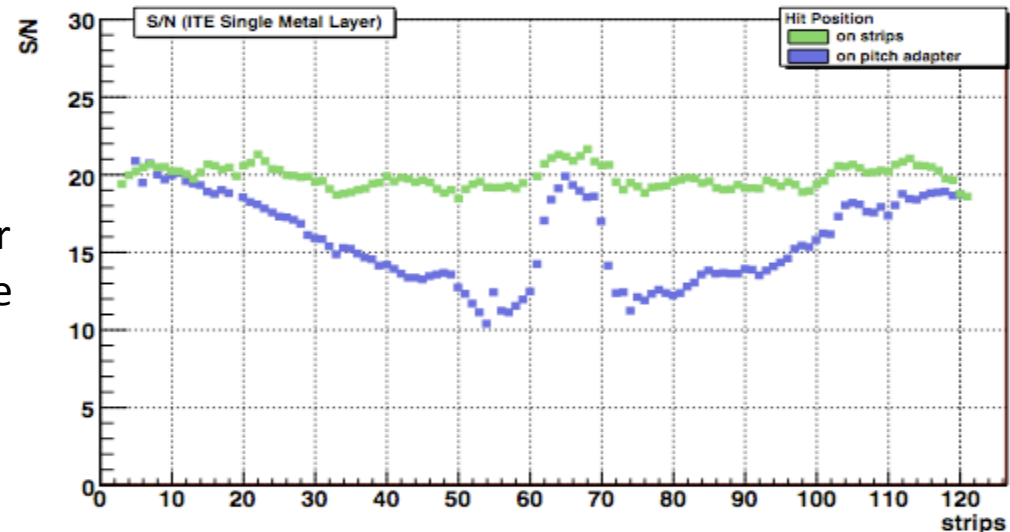
- New pixel sensor (Ivan Peric)
- HV 0,35 um CMOS
- Charges collected by **drift** (rather than diffusion)
- Higher radiation tolerance
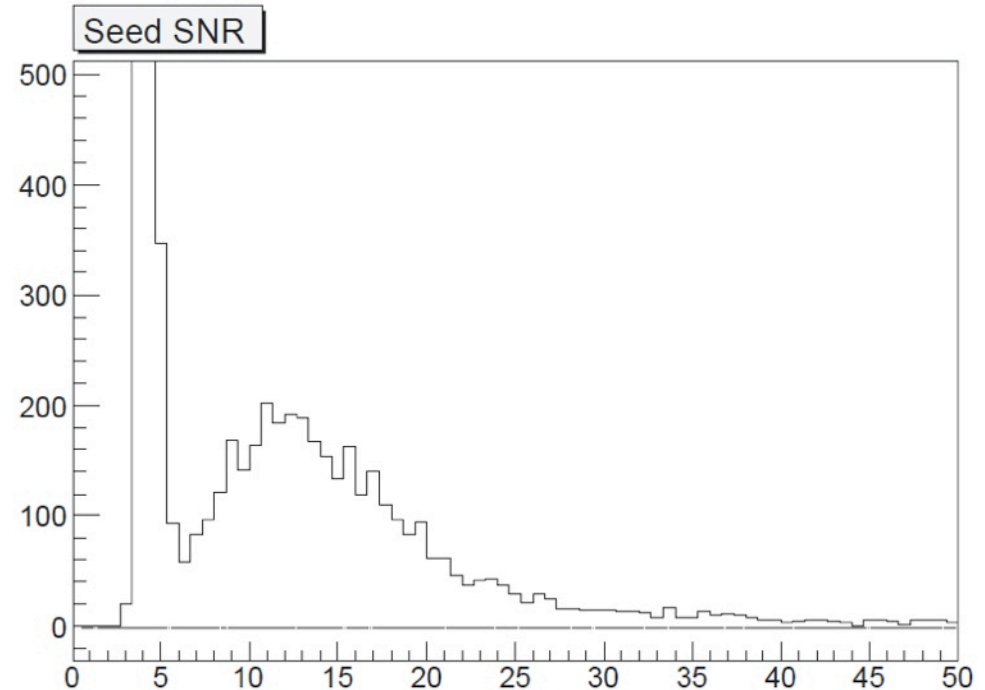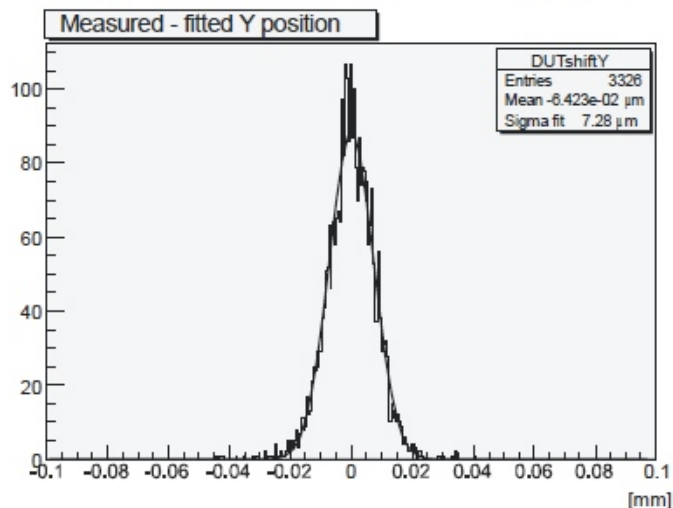- **pmos** intrinsically more radiation tolerant

PRELIMINARY RESULTS

Ingrid-Maria Gregor; The EUDET Telescope in 2009 - Users Summary

Sigma residual X: 8.6 µm

Measured - fitted X position

DUTshiftX	
Entries	3326
Mean	-0.6307 µm
Sigma fit	8.64 µm

Sigma residual Y: 7.3 µm

Measured - fitted Y position

DUTshiftY	
Entries	3326
Mean	-6.423e-02 µm
Sigma fit	7.28 µm

Seed SNR
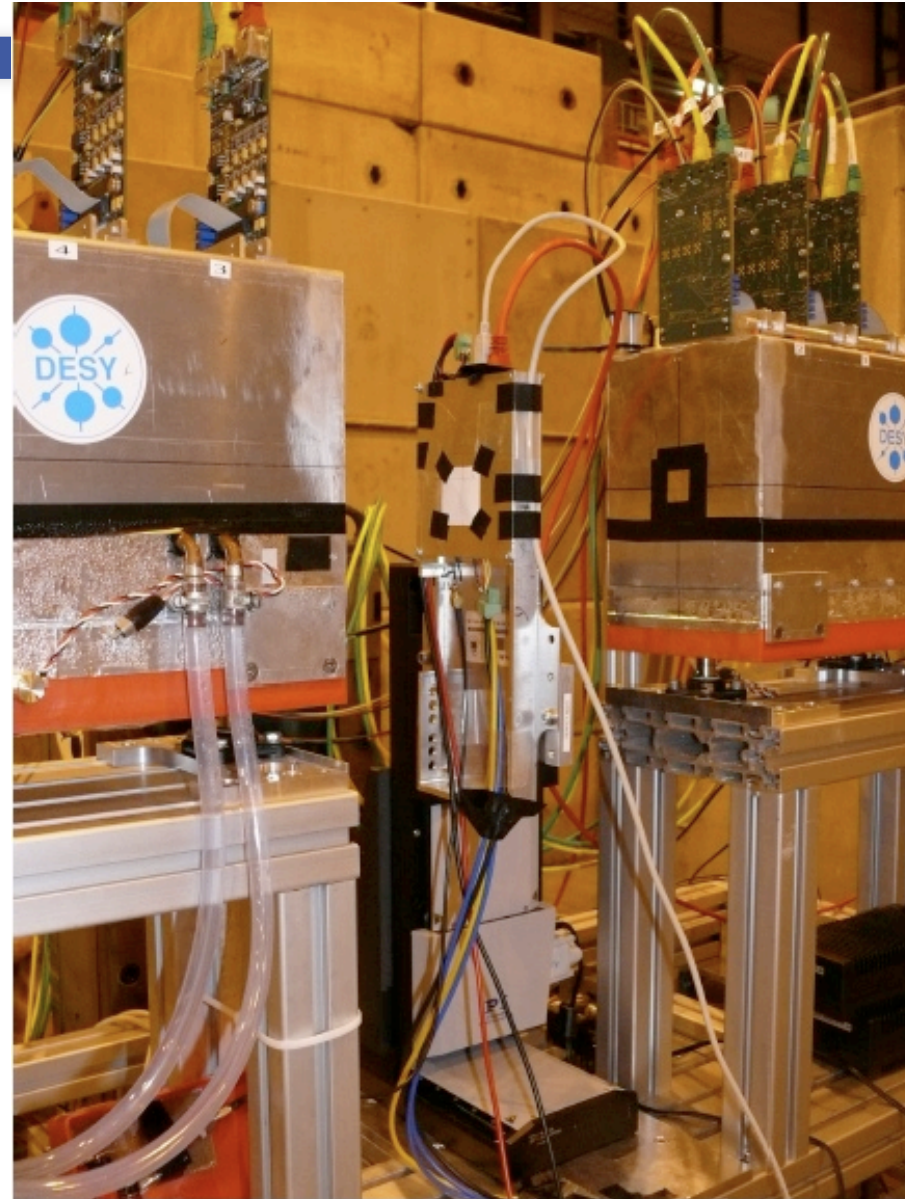
- Readout of HVPix also fully integrated in the EUDAQ (TAKIProducer)
- Analysis completely done with EUTelescope software
- Preparation + Measurement + Analysis < 6 months => idea of EUDET telescope works completely

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ATLAS Pixel

- For ATLAS Insertable B-Layer (~2014) three different sensor technolgies have to be characerised: PPS, 3D, Diamond
- Use of EUDET telescope -> under same conditions
- Integration on EUDAQ level was planned a few months ago

ATLAS pixel readout TPLL


Level Adaptor Board
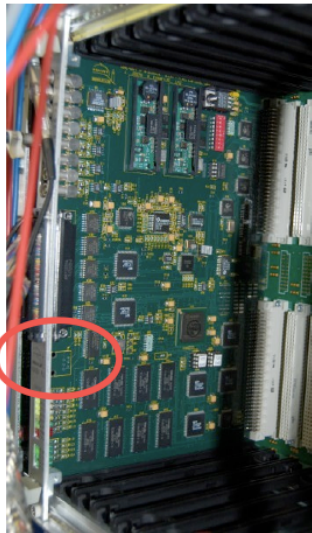
ATLAS modifications

Hardware

- Solder in connector for LVDS TLU signal
- Modify front panel for connector
- Change of PROMS

Software/FPGA Modifications (examples)
- Extension to TPLL VME interface for trigger
- Busy signal
- Added FIFO for storage of trigger info
- EUDET trigger ID
- Trigger ID (normal ATLAS pixel daq)
- Timestamps (UNIX time + 25ns)

Experimental Setup

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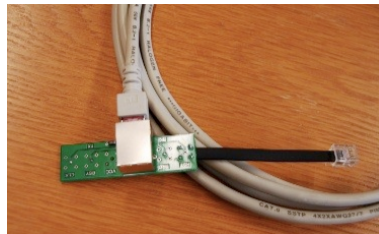
DUT's (8×7.2mm² active area)
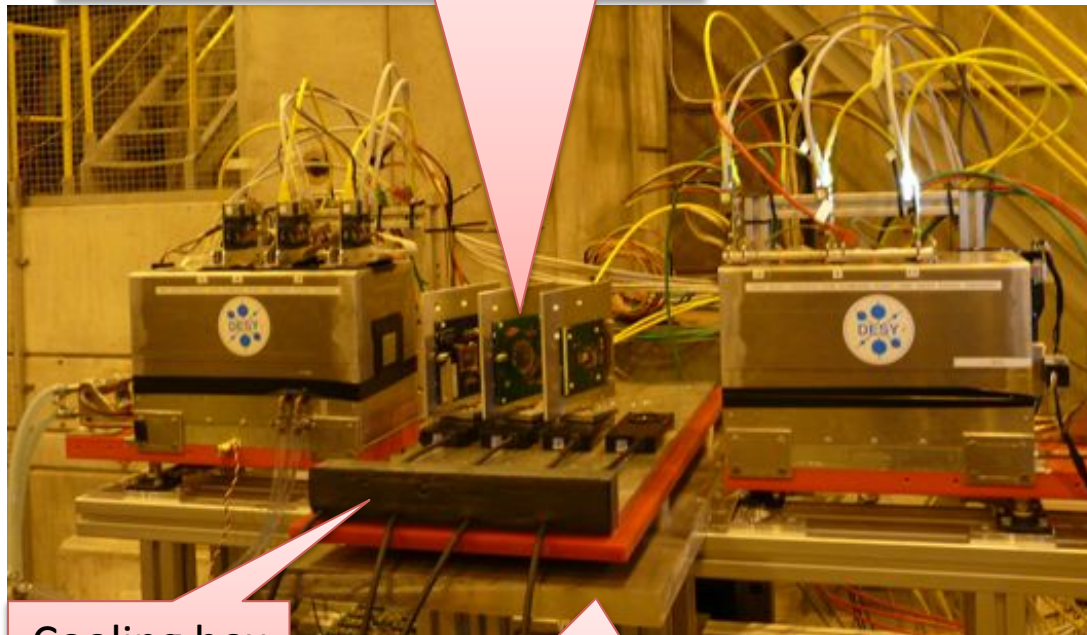
Cooling box base plate

2cm aluminum support plate on existing Bosch profiles

- Four single pixel chips boards on rotating stages
- Removed existing movable stage
- Placed in new cooling box (Peltier)
  - Sensor positions built-in (from EUDET drawings)
  - No cooling used yet
- Simple exercise to move EUDET planes to fit box
- Very quick setup
  - No NIM logic
  - Already aligned telescope

PRELIMINARY RESULTS

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SPS Beam (H6)

120 GeV p+

10s spill every ≈40sec

10^6 p+ /spill

- 5 days of data taking
- Data taking efficiency of system (TurboDAQ+EUDET) ~80%
- Collected around 30 million triggers
  - good fiducial region of scintillators
- Rates around 500Hz during spills
- Implementations of new plots
  - TLU trigger ID sometimes 0?

Triggers	Type
5000	/spill
450k	/hour
~30 M	Total for 3D TB

Time over threshold (~charge)
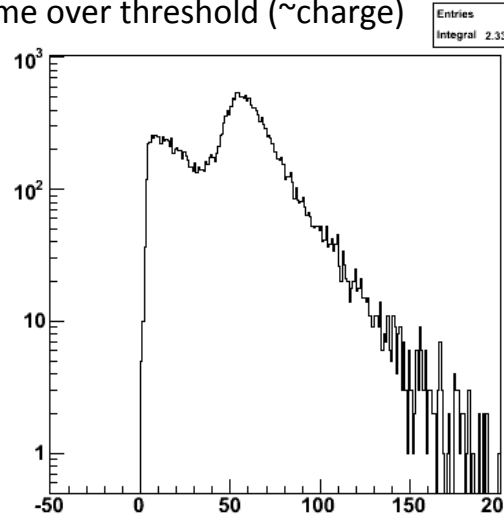
ATLAS pixel hit map
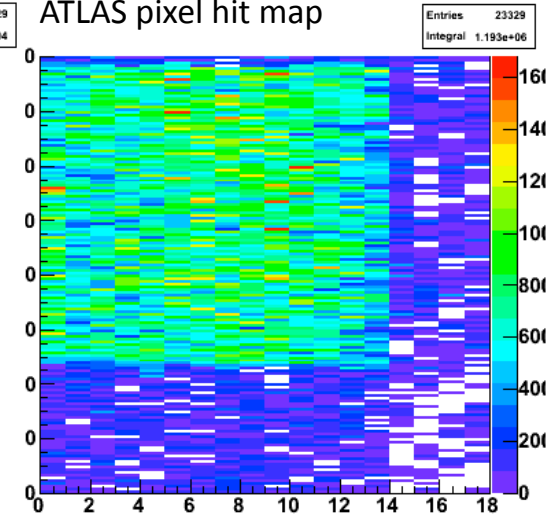
TLU nr cmp. streams (max)

(Synchronization)

Frame index of hits

(ATLAS: time info)

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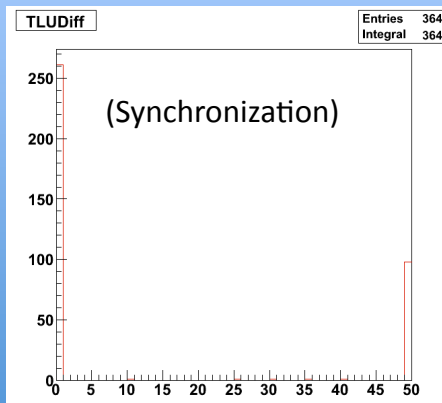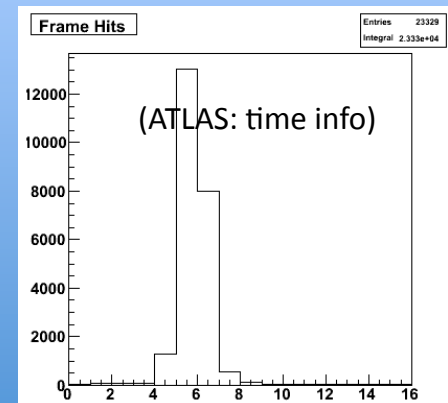
Transnational Access

- Reminders on
  - eligibility for transnational access
  - guidelines on how to apply for TA
  - dummy sample beam time request
  - dummy sample travel reimburstment form
- Available on web
- Natalia is helping with the forms !!

Planning 2010

- Telescope will running at DESY January - ~June, afterwards some time at CERN
- Proposals for use of SPS test beam are due end of the year
- To ease planning all telescope users should "book" the same beam line (H6B) and contact me before submitting to the SPS coordinator

- Survey of work load on JRA1 for users support
- **Daniel + Emlyn + Toto + Joerg + Marie + Julia + Igor + Ingrid => 2FTE!**
- In this number no development work for the latest upgrade is included

- For 2010 we have to see how to keep up this effort -> will try to involve the users

- First inquiries for the use of the telescope (DESY + CERN)
  - DEPFET
  - ATLAS Pixel (3D, PPS, Diamond)
  - SPiDER
  - NA62 ...

Summary Telescope User 2009

- The JRA1 telescope is running successfully with LC **and** LHC users at CERN since May and user runs are still ongoing (season 3).

- Flexible approach in software and mechanics allow to integrate different devices from very small to rather large.

- Users meeting during Annual Meeting -> Feed back and results.

- All users were happy with the outcome and the available hardware.

- Integration on DAQ level allow online plots (good indication for "success" of test beam) as well as the use of the EUTelescope software for analysis

- Some users were able to show first preliminary results within 1-2 weeks!

- Effort to have the telescope running at CERN for 6 months -> 2FTE !!

- First plans for 2010 already ongoing -> DEPFET, ATLAS Pix, NA62 ....