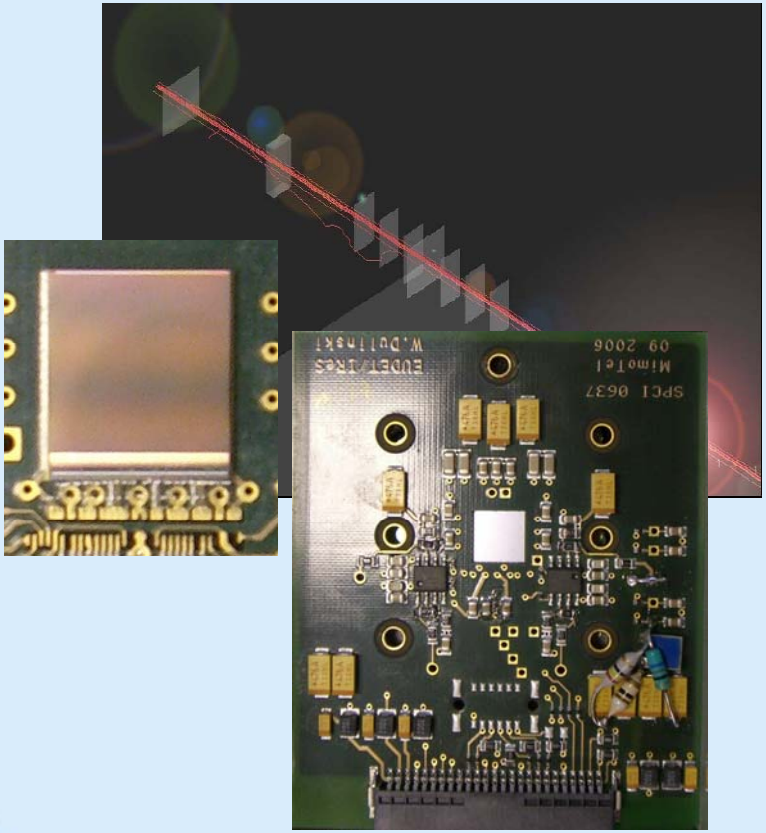
JRA1: Pixel Telescope Test Beam Campaigns

Ingrid-Maria Gregor on behalf of EUDET JRA1



Pixel Telescope:

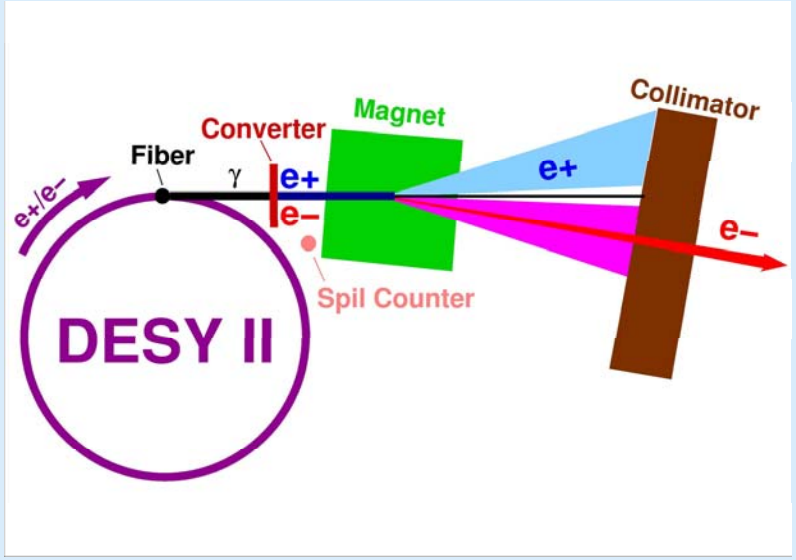
- Status Demonstrator
- Testbeam 1 (DESY)
- Testbeam 2 (DESY)
- Testbeam 3 (CERN)

Summary & Outlook

EUDET
Extended Steering Committee
August 27th 2007

Test Beam Infrastructure JRA1

- Provide test beam telescope with:
  - Very high precision: <3 µm precision even at lower energies
  - High readout speed (frame rate >1kHz)
  - Easy to use: well defined/described interface
  - Large range of conditions: cooling, positioning, magnetic field
- Main use for pixel sensors, large volume tracking devices (TPC)
- Suitable to different test beam environments:
  - construction & initial tests at DESY (E_{e-} up to 6 GeV)
  - exploitation at CERN, FNAL etc. possible



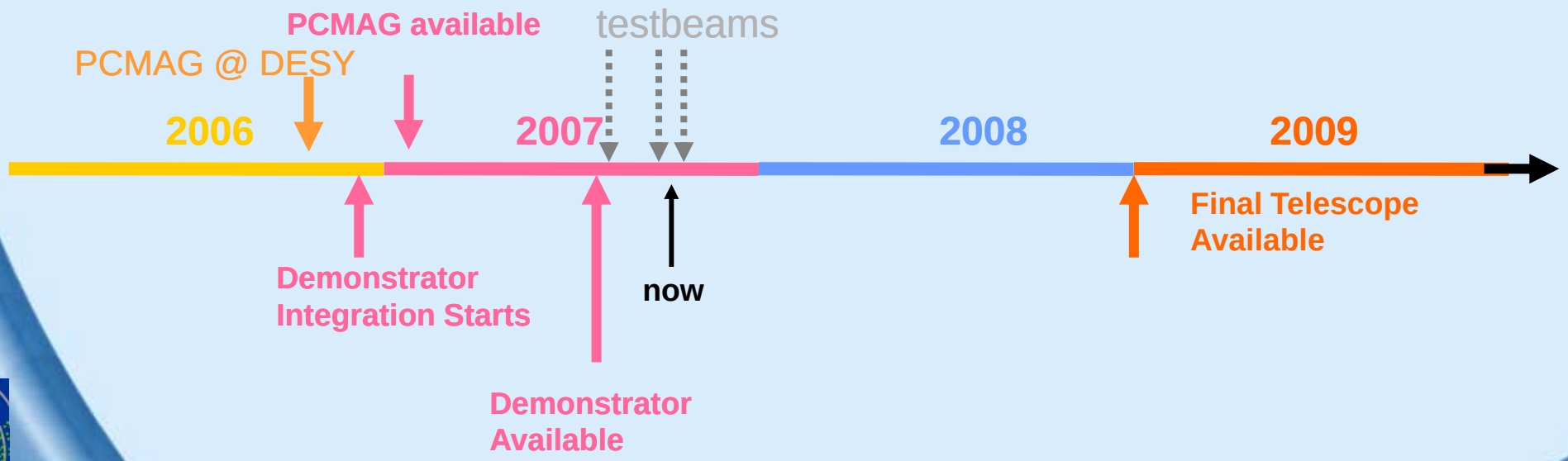
JRA1 Schedule

Phase1: “Demonstrator”

- First test facility will be available quickly for the groups developing pixels
- Use established pixel technology with analogue readout and no data reduction

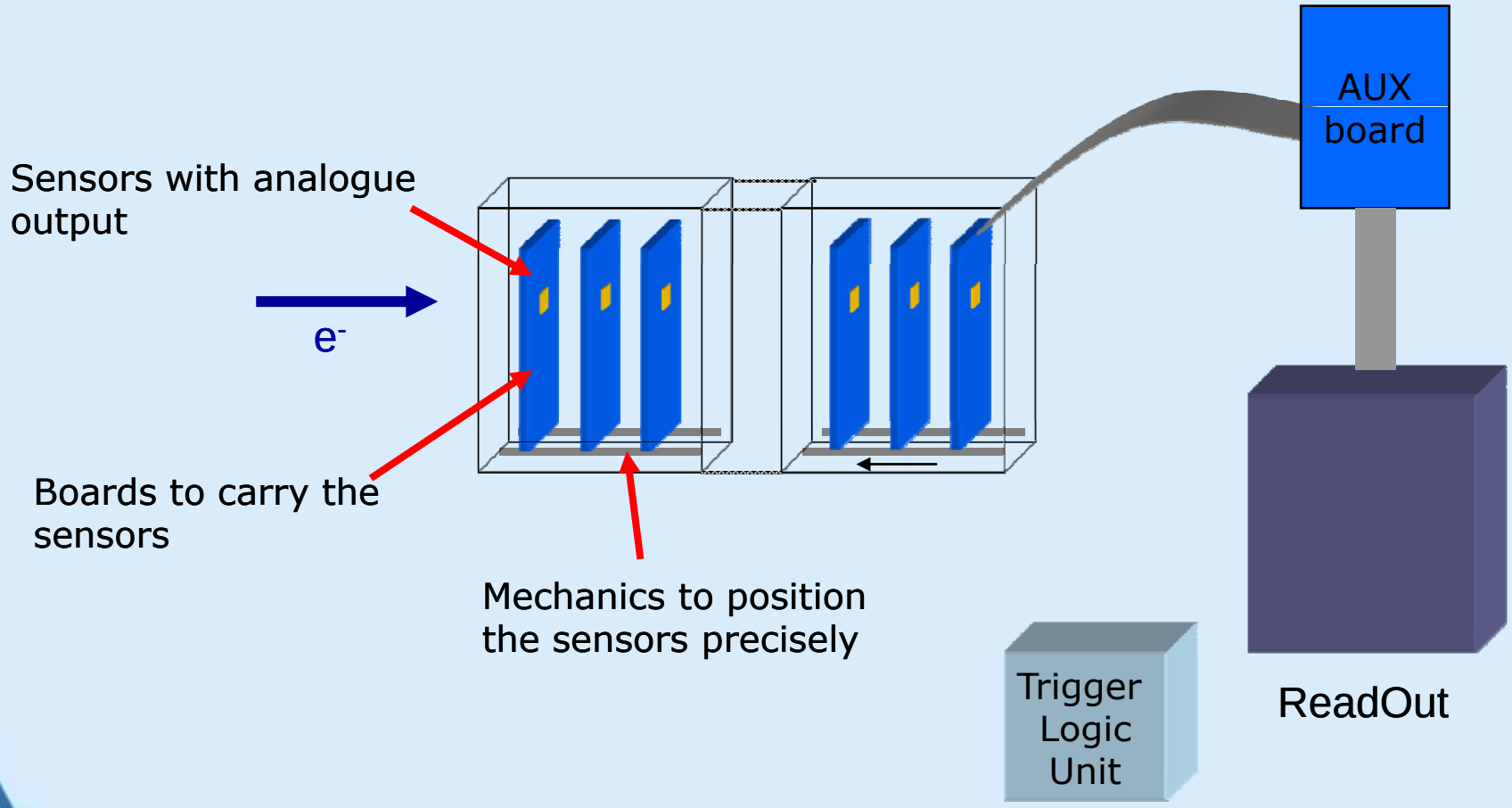
Phase2: Final telescope

- Use pixel sensor with fully digital readout, integrated Correlated Double Sampling (CDS), and data sparsification
- The beam telescope ready at the end of 2008



Demonstrator: Analogue Telescope

Ingredients needed for such a telescope

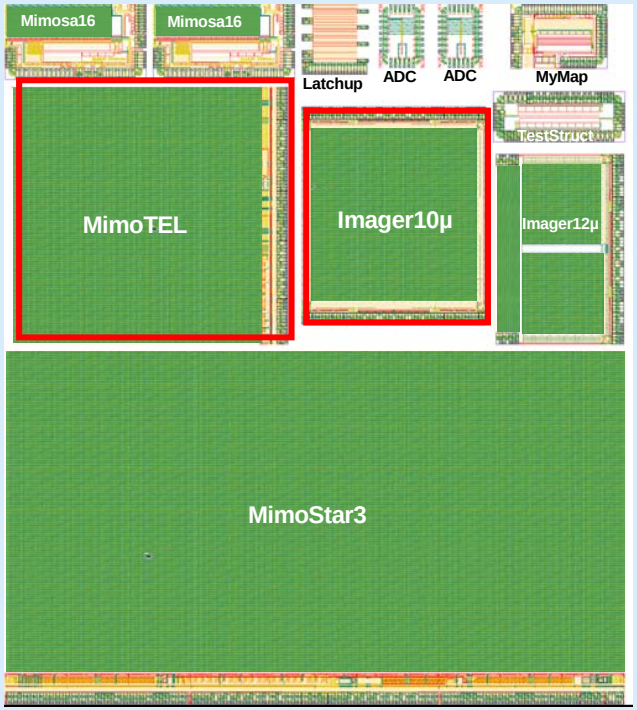


Reference Plane Sensors

IPHC

Demonstrator: MimoTel

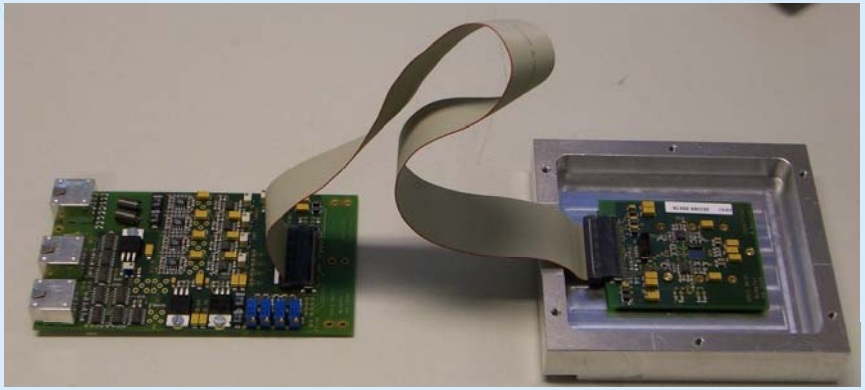
- use MimoTel prototype
- AMS 0.35 OPTO process with 14 and 20µm epitaxial layer
- 4 sub-arrays (64 × 256 pixel)
  - 30 × 30 µm^2 pitch: active area: 7.7 × 7.7 mm^2
  - Readout : 1.6 ms (4 analog output nodes at 25 MHz)
  - engineering run was in summer 06
  - End of October 2006, reception of engineering run
  - Since beginning of 2007 chips are available

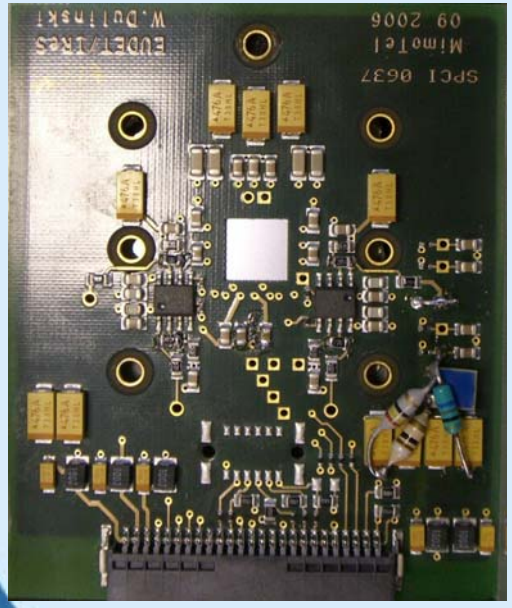


Layout of the reticle of the engineering run AMS-035 OPTO 07/2006 on 14 µm (standard) and 20 µm epi substrate

PCBs and MimoTel sensors

IPHC/DESY

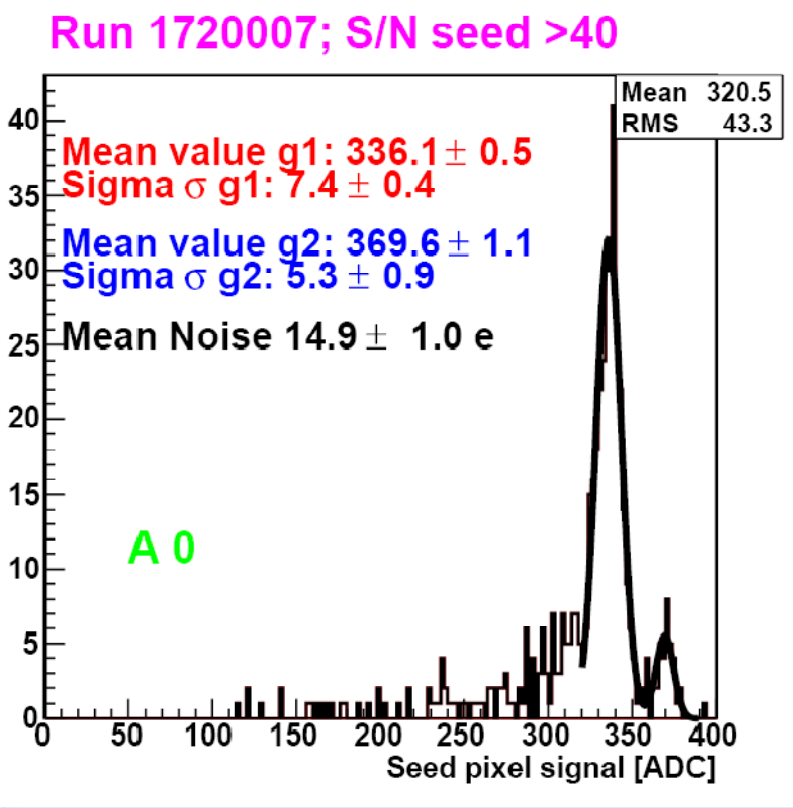


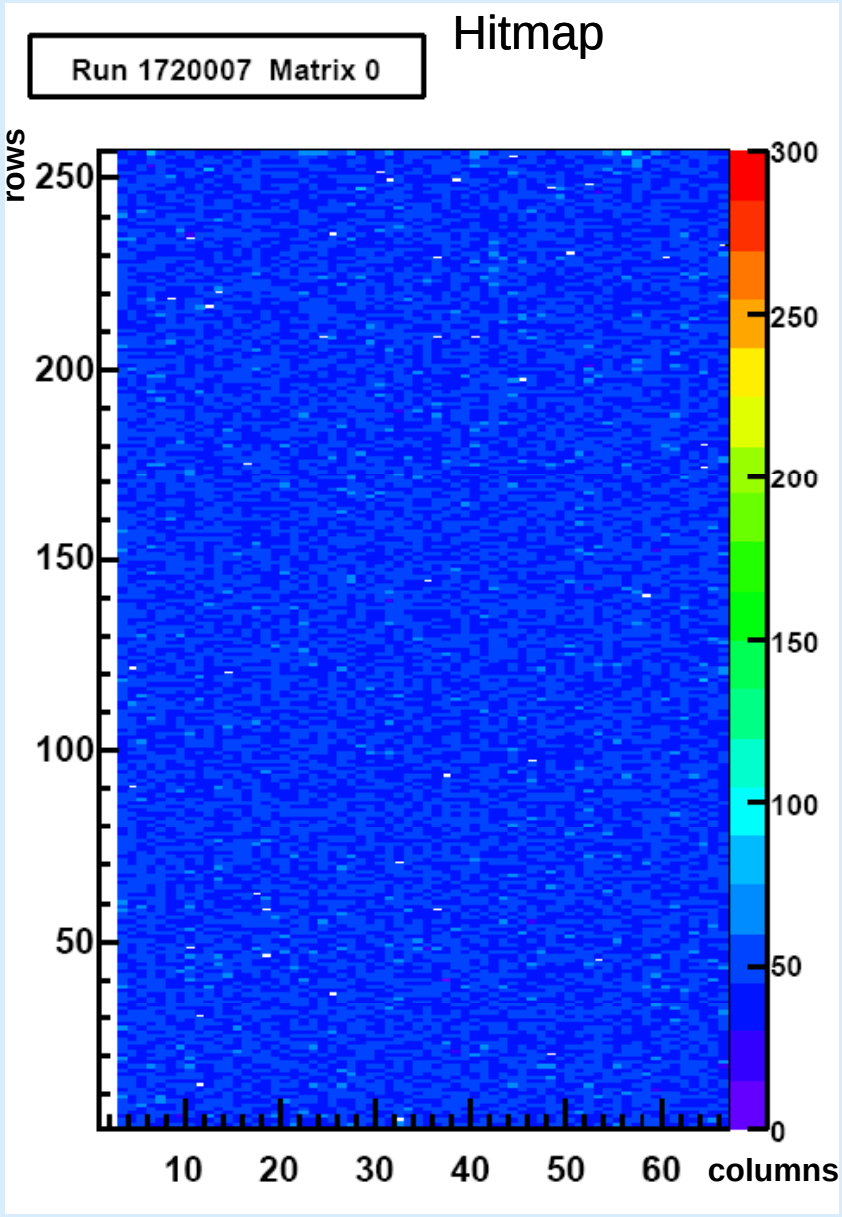


- 20 sets of boards (AUX board, MimoTel proximity. board, Mimosa18 proximity Board)
  - 5 were populated and tested in Strasbourg
  - 15 of these sets populated and tested at DESY
  - 10 sensor boards with wire bonded chips on the way to Hamburg
  - Further 10 sets of sensor boards will be build
- 5 sensors were running in Demonstrator during test beam
- More chips (incl. high resolution sensors) arrived today in Hamburg
- MimoTel chips also thinned (50µm) but not in telescope yet

MimoTel Results

- MimoTel chip#20 (14um EPI layer)
- Response to Fe55 source at 18°C
- Results obtained in Hamburg
- Agreeing with results obtained in Strasbourg





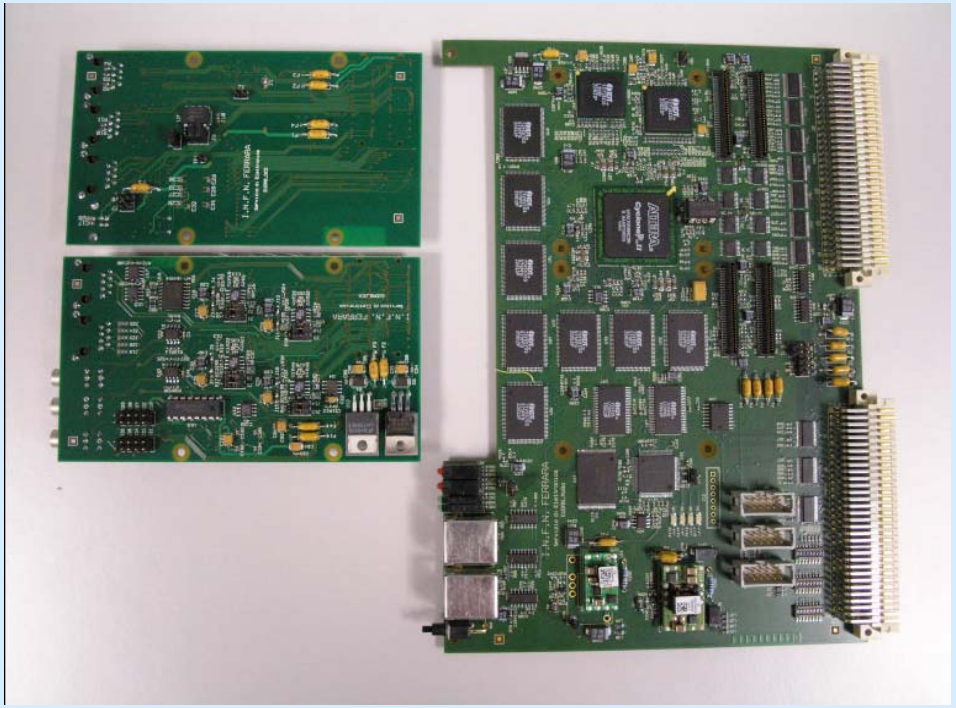
Ingrid-Maria Gregor, DESY, JRA1 Milestone

Readout: EUDET Data Reduction Board

INFN

EUDRB

- Functionality of motherboard
  - on-line calculation of pixel pedestal and noise, cluster finding, ADC
  - remote configuration of the FPGA
  - on-board diagnostics
- 4 independent signal processing and digitizing stages
- Implementation
  - One analogue card -> signal processing
  - One digital card -> USB



- Operational modes
  - Full Frame readout mode for debugging or off-line pedestal and noise measurements
  - Zero Suppression readout to minimize readout dead time while normal data taking

Status EUDRB

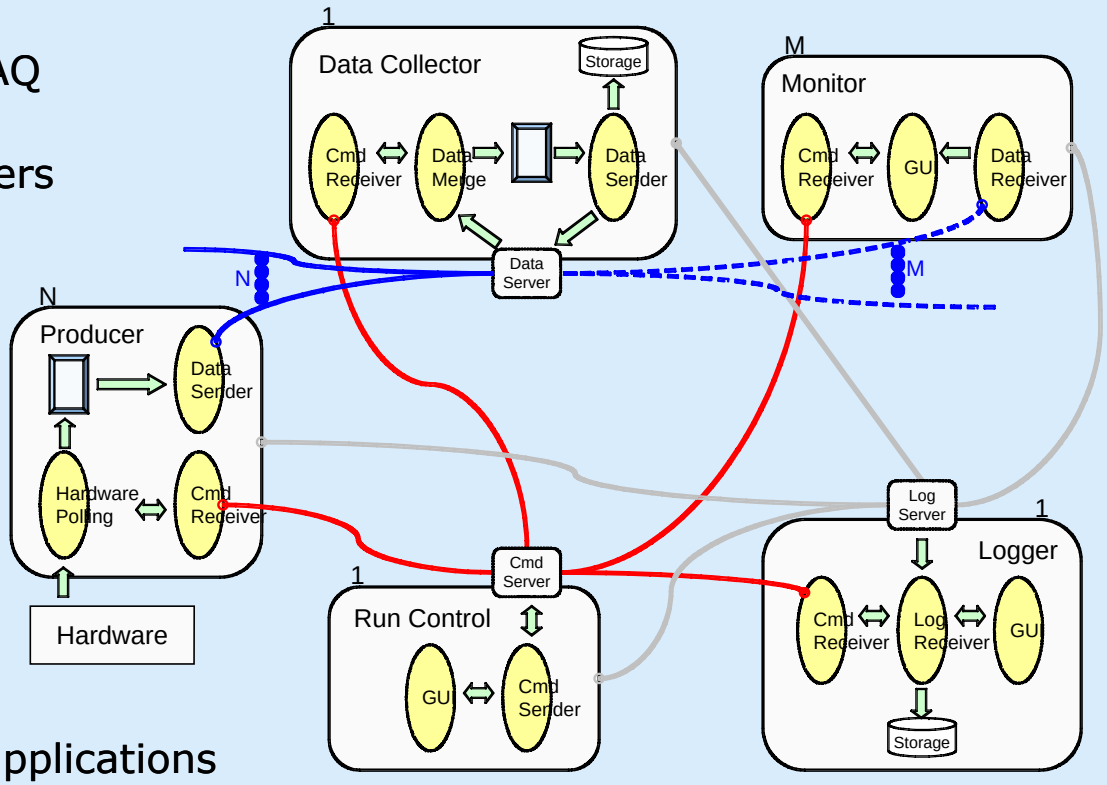
- The boards were delivered end of July 2006

- all tests of hardware were successful
  - Quality of boards not so high -> manual fixing necessary
- testing of operation connected to a sensor (Mimosa V + MimoTel) successfully done
- the USB-2 link is fully working and can be used for diagnostics and debugging.
- both the zero- and the non-zero-suppressed modes are established and the board has been tested with the MimoTel sensor during two test beams at DESY
- TLU interface has been integrated

- Production of more EUDRB boards has started and 8 additional boards will be available at the end of September.

DAQ Status

- Create a simple and easy to use DAQ system for the beam telescope
- Distributed across multiple computers
  - Use sockets for sending data/commands
- Reasonably portable
  - Use mainly standard C++
  - POSIX for sockets and threading



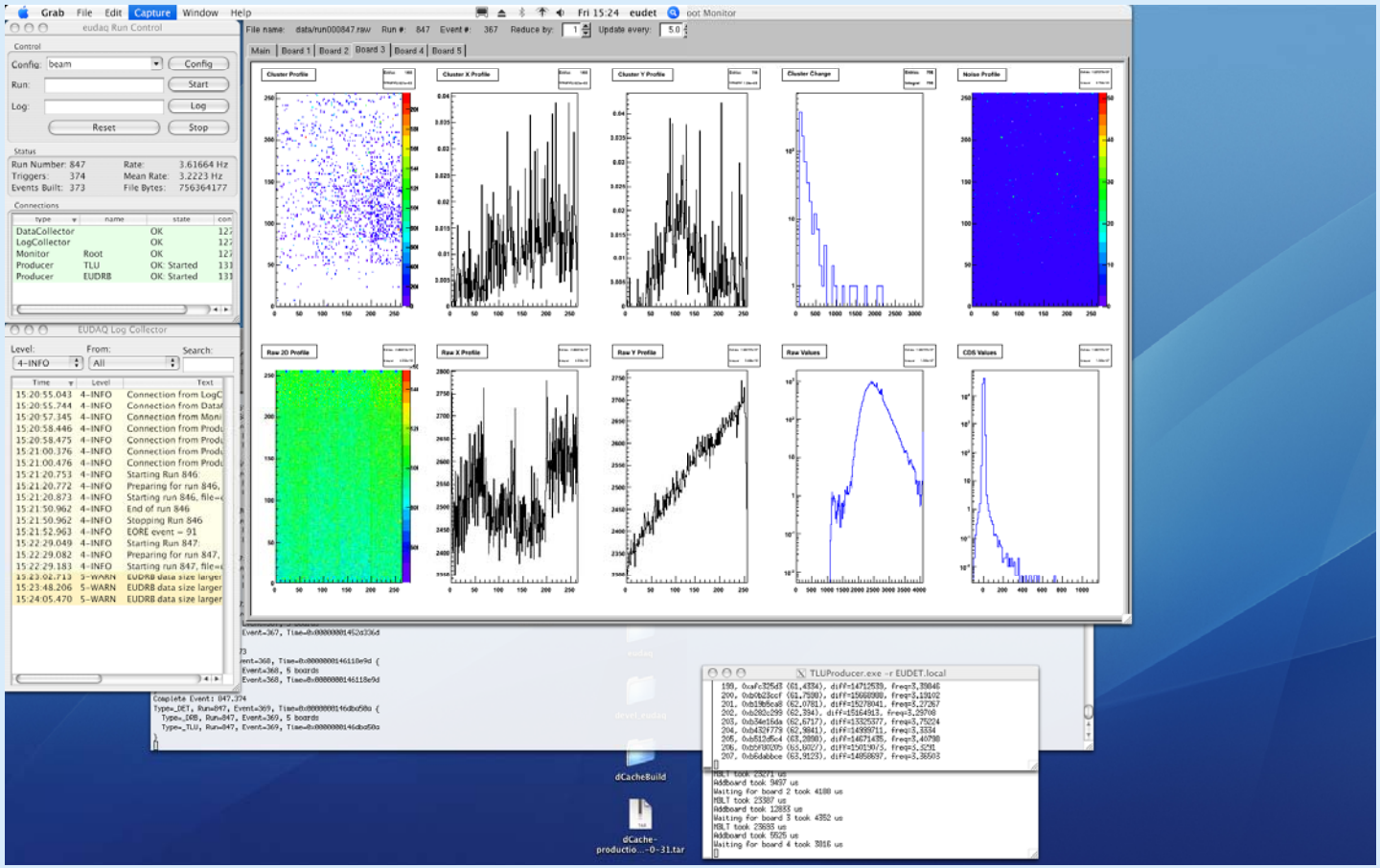
- Run Control
  - Controls all the other applications
- Producer
  - Communicates with hardware and sends data to:
- Data Collector
  - Collects and merges data from all Producers
- Monitor
  - Receives data from Data Collector for display/statistics
- Logger
  - Collects logging messages from other applications

DAQ Status

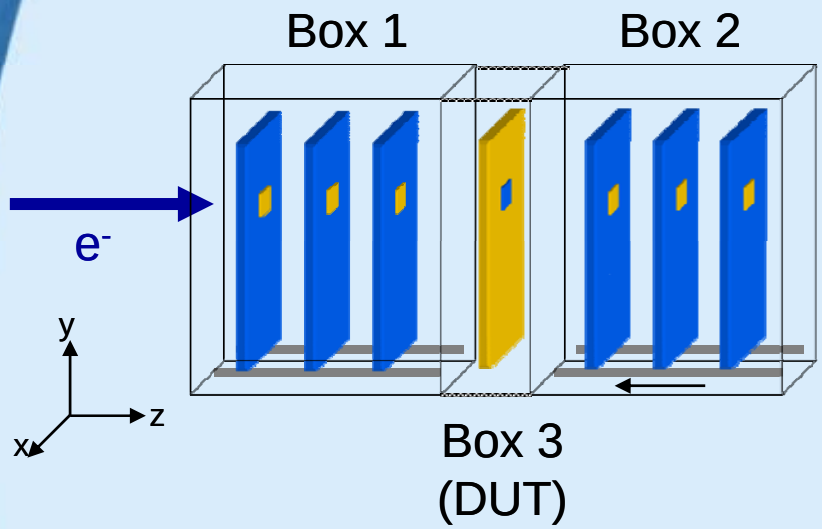
Geneva

- Decision to use LCIO/Marlin for data storage and processing.
- Data will be sent within the DAQ in a simple custom format, and converted to LCIO before being written

- Successfully running at test beam in June and August
- Smaller bugs and problems fixed “on the fly”



Telescope Mechanics

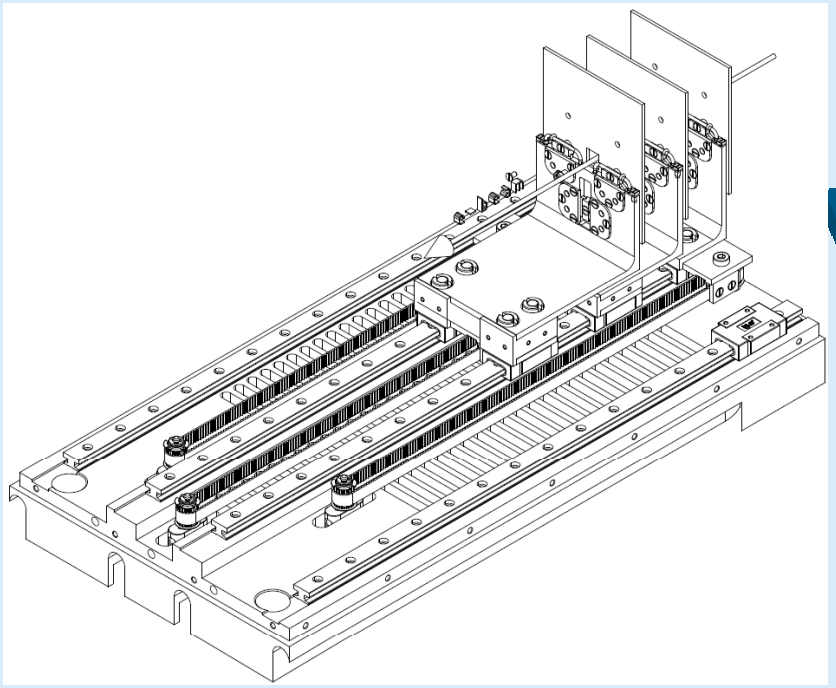


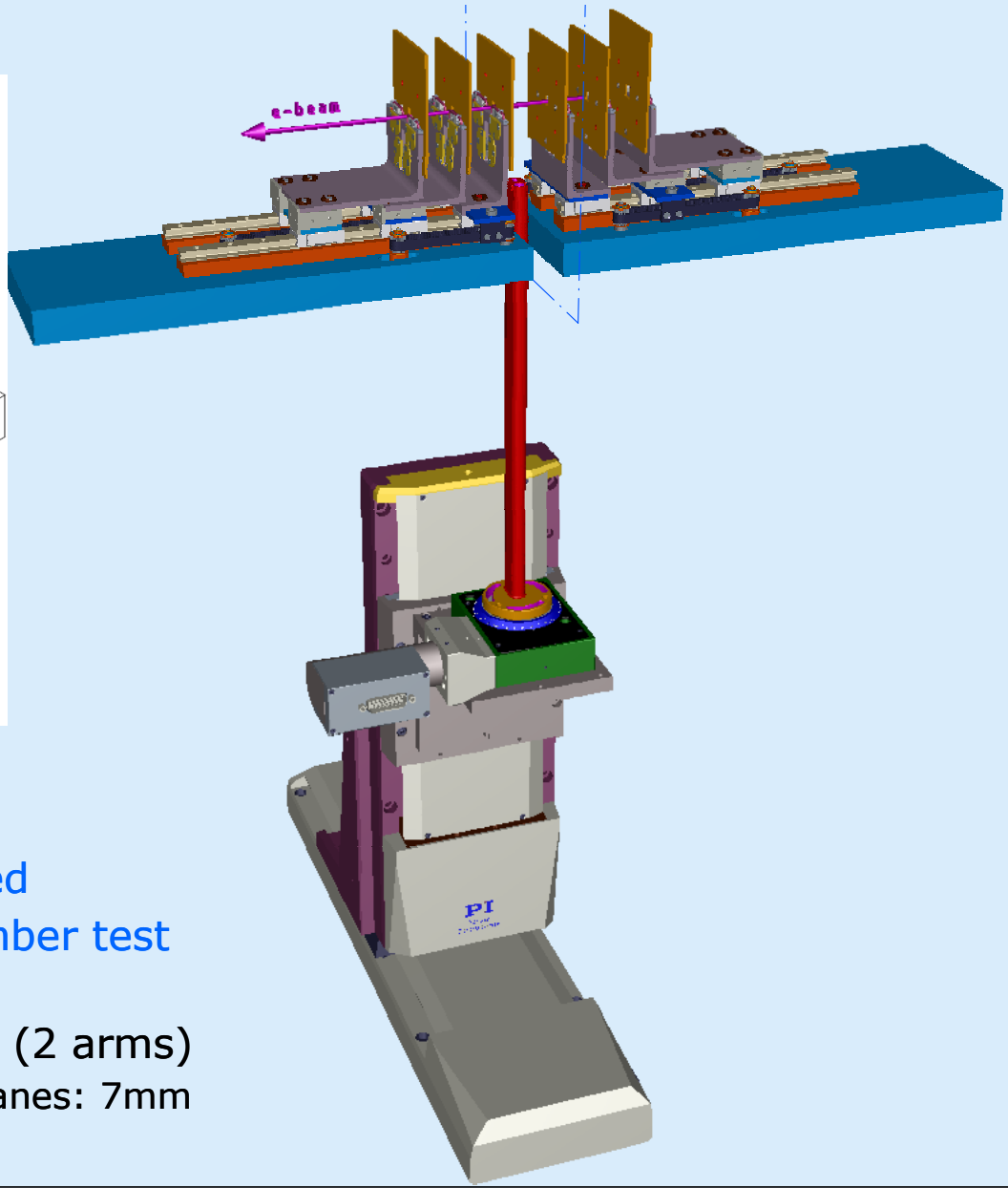
- Box 1:
  - fixed position, optical bench for three reference planes, temperature controlled
  - Wall to DUT can be removed
- Box 2:
  - movable in z-direction, optical bench for three reference planes, temperature controlled
  - Wall to DUT can be removed
- Box 3:
  - Gap between 2 and 3, closed by thermal cover
  - DUT positioned on XYϕ-table

- XYϕ-table: external with "long" mechanical structure to locate the DUT between the reference planes
  - Positioning accuracy of : 0,1mm (alignment runs foreseen)
  - accuracy: 10μm, repeatability: <0.5μm per axis

Telescope Mechanics

DESY

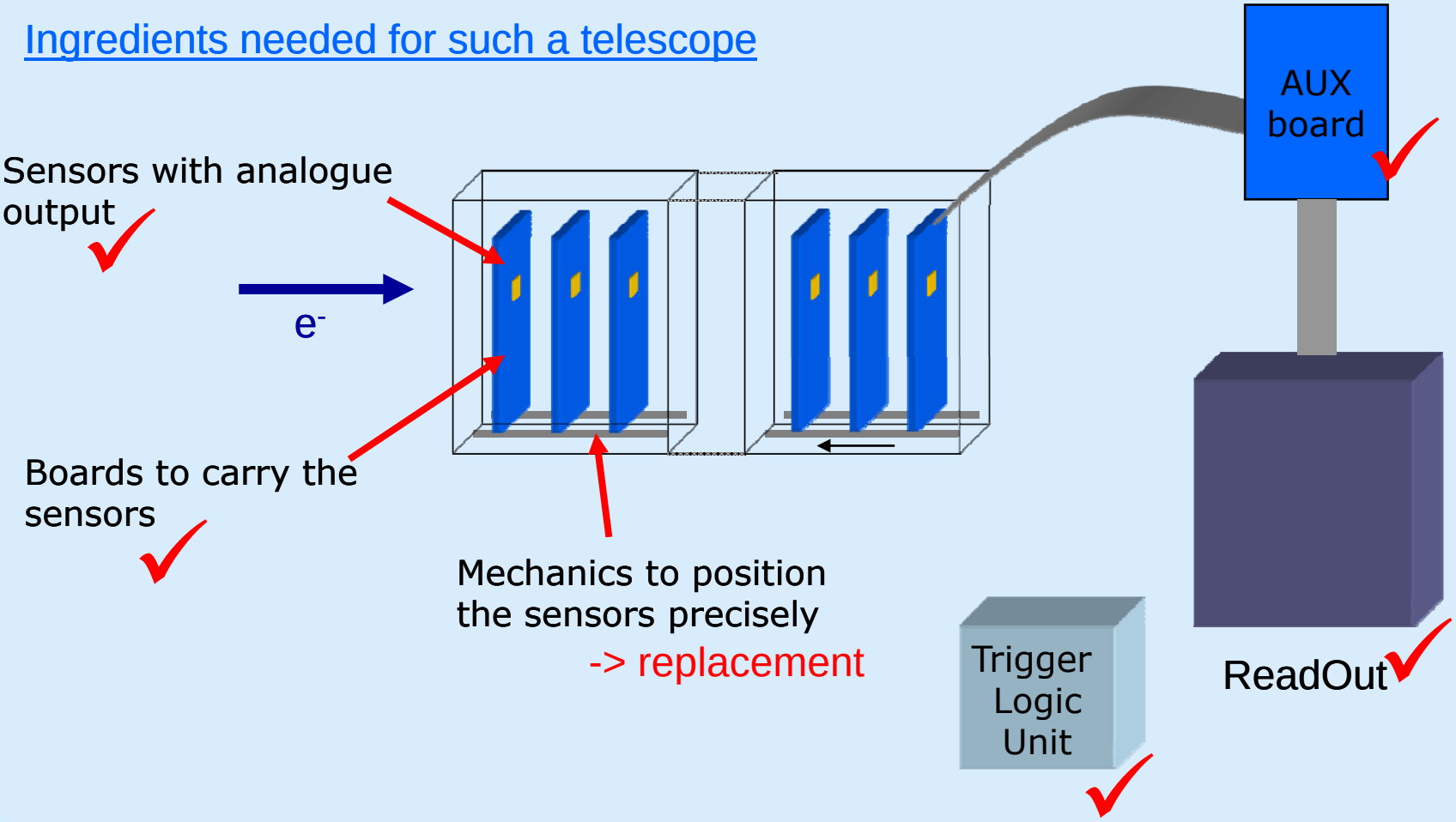




- Mechanics design completed
- Production of mechanics delayed
- Availability foreseen for September test beam
- 3 planes on one main structure (2 arms)
  - Minimal distance between planes: 7mm
  - Maximum level arm:200 mm
  - Material: aluminum

Demonstrator: Analogue Telescope

Ingredients needed for such a telescope

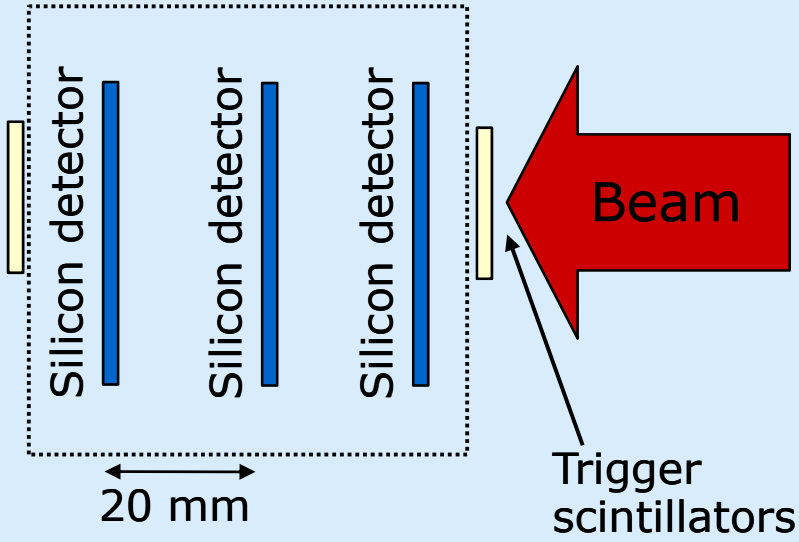


- Integration off all components and test under real conditions
- Test beam at DESY (1-6GeV electrons) and CERN (10-400GeV/c pions)

Test beam 1 – DESY June 2007

Goals of test beam 1:

- commissioning of Demonstrator
- Test of DAQ
- First time all items are running together under real conditions



- 3 sensor planes in beam
- 3 EUDRB (readout boards)
- TLU
- Original DAQ Software

Replacement Mechanics

Testbeam 1 – Statistics

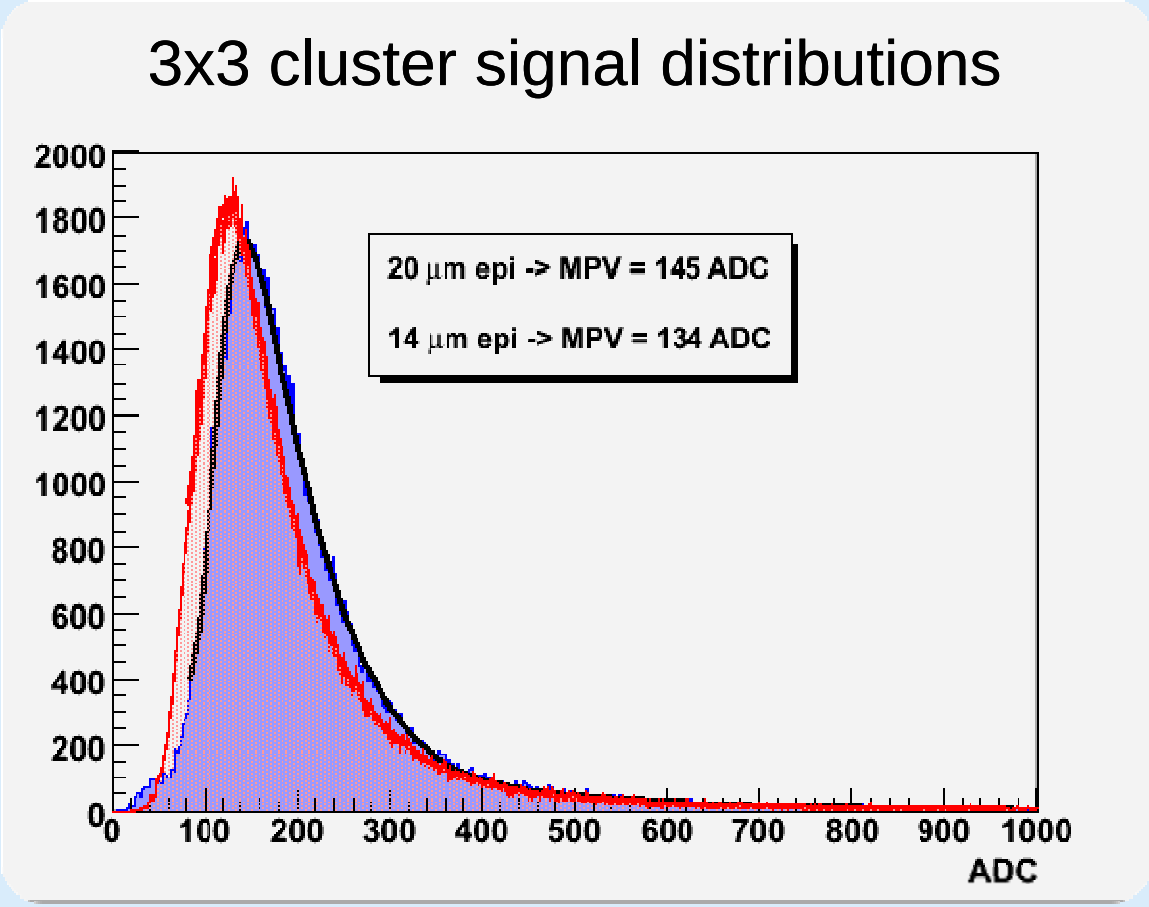
- Data was taken at ~1 Hz all the time

- ~ 200 GB of raw (full frame) 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 organisation 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

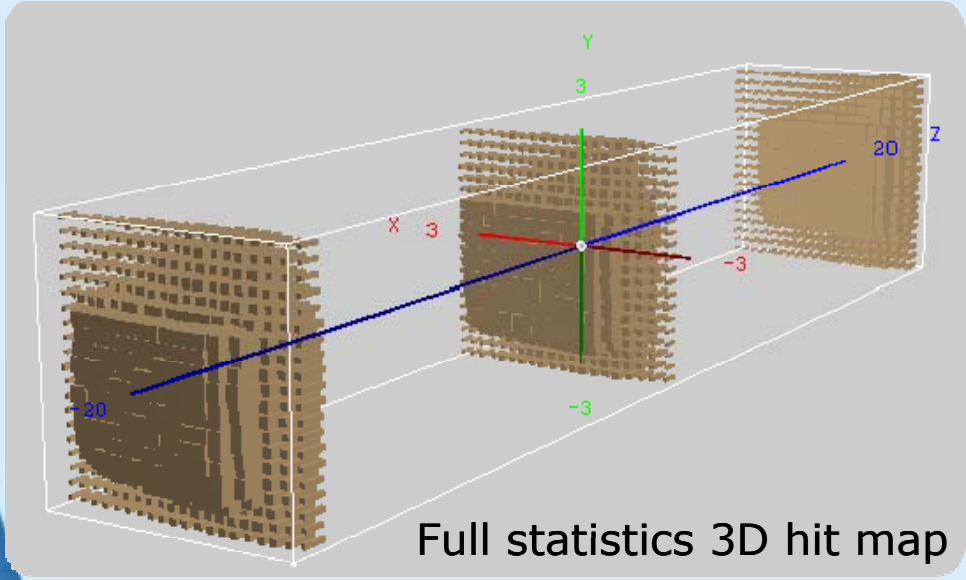
Signal distributions (3 GeV)

- Signal amplitude far enough from the noise (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



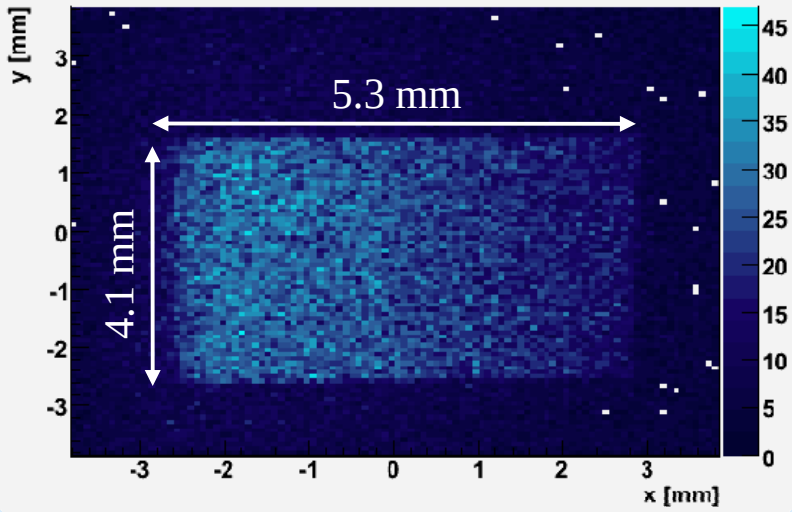
Hit map with full 3GeV statistics

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



Full statistics 3D hit map

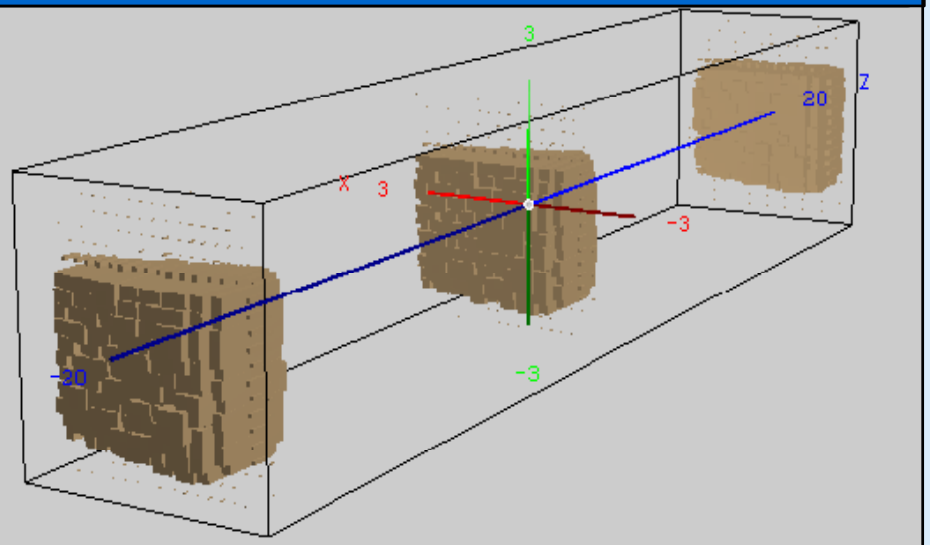
First plane hit map



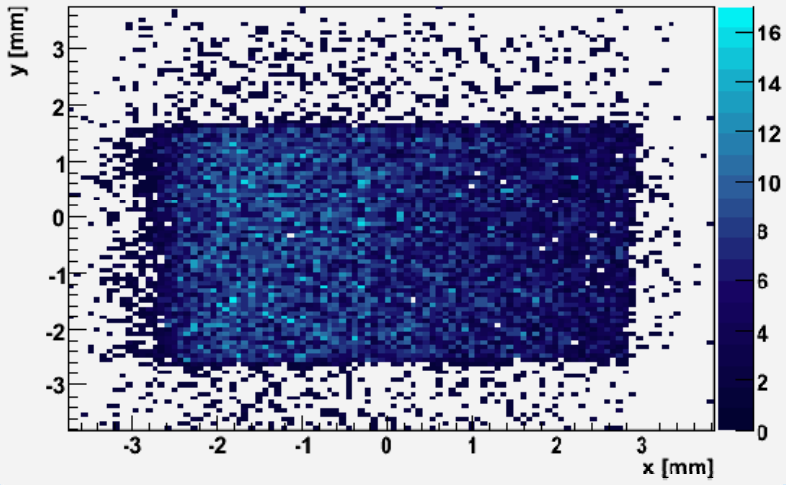
Hit map with single track

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

Single track 3D hit map



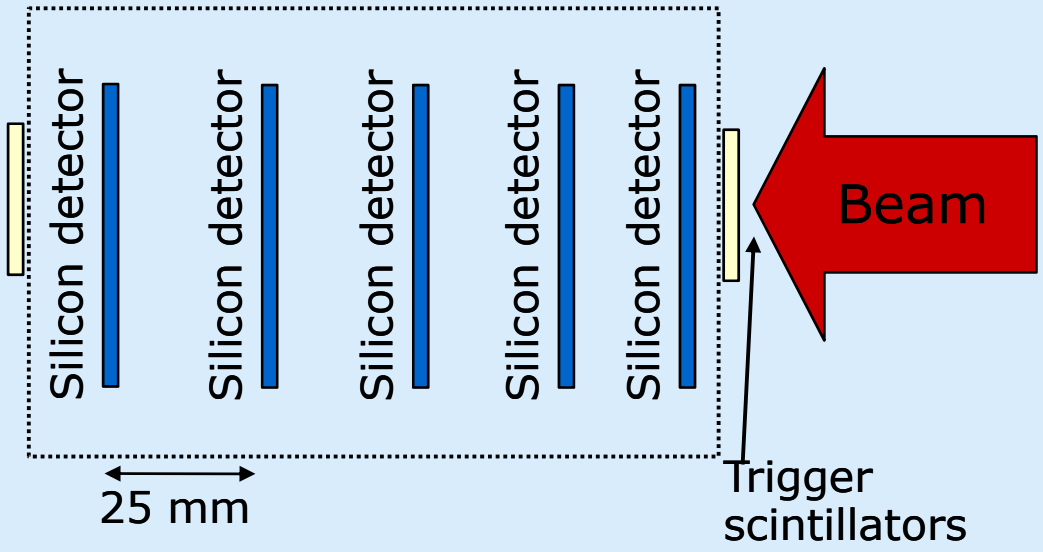
First plane hit map



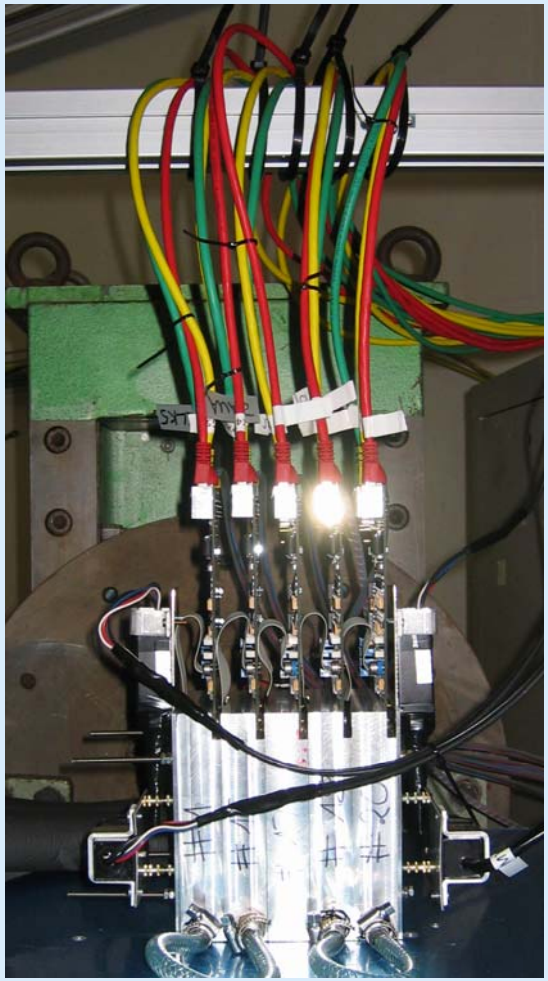
Testbeam 2 – DESY August 2007

Goals of this test beam period

- Synchronisation with first DUT (DEPFET)
- Run with more planes
- Prepare documentation



- 5 sensor planes in beam (cooled)
- 5 EUDRB (readout boards)
- TLU
- Original updated DAQ Software



Replacement Mechanics

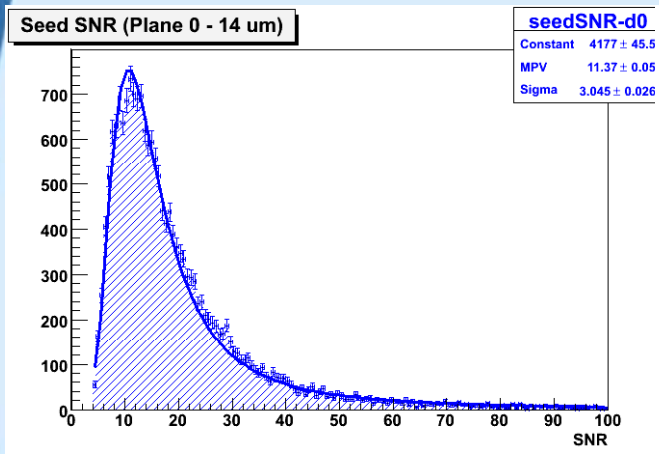
Achievements of test beam 2

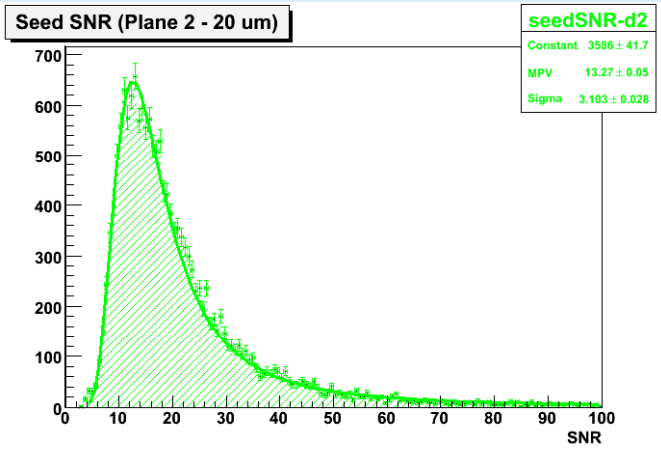
- 5 sensor planes in beam (cooled)
- run the system in synchronised mode (5 sensors)
- run with zero suppression mode on
- synchronised the readout with the DEPFET readout
- found a number of small bugs in the DAQ software

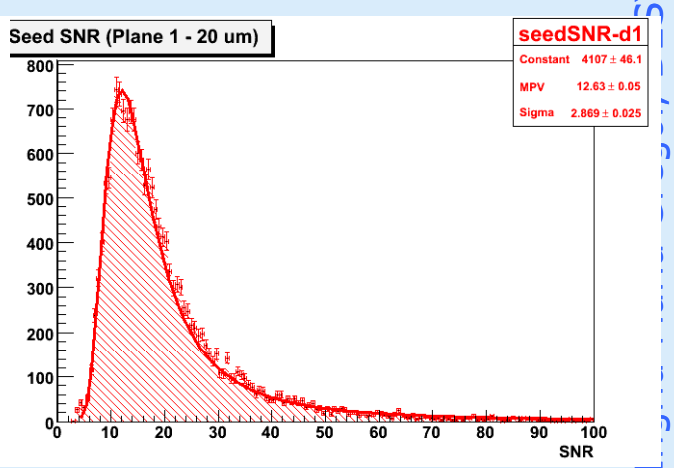
- learned to handle the system
- wrote a manual for inexperienced users
- prepared a "what to do when" for the test beam operation
- set up scripts for data handling (also for use at CERN)
- set up an online logbook visible for everybody who wants to analyse the data

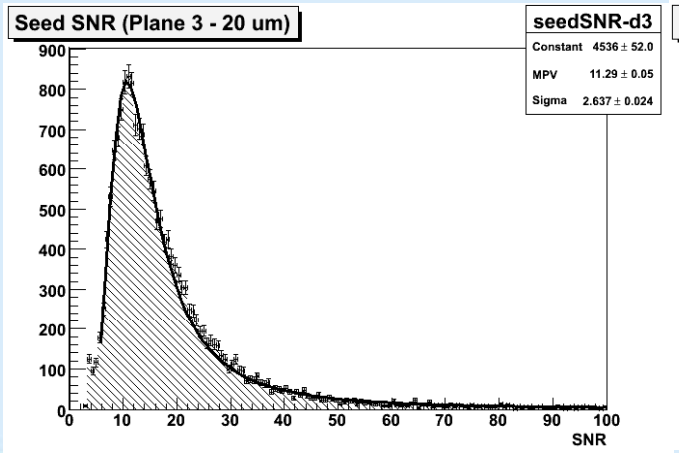
Test beam 2 – Fresh Data

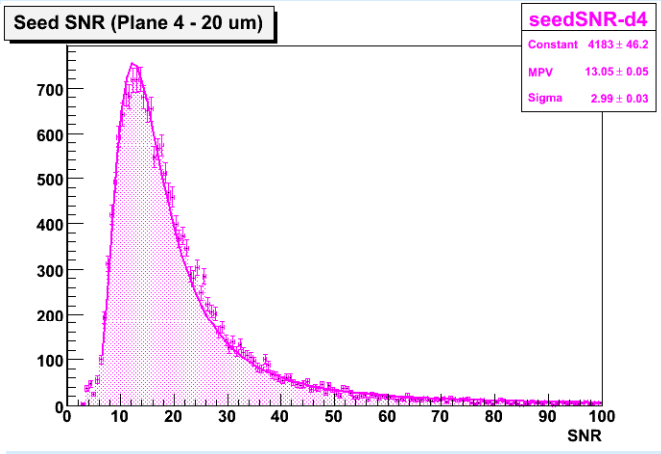
- Signal/Noise Distributions





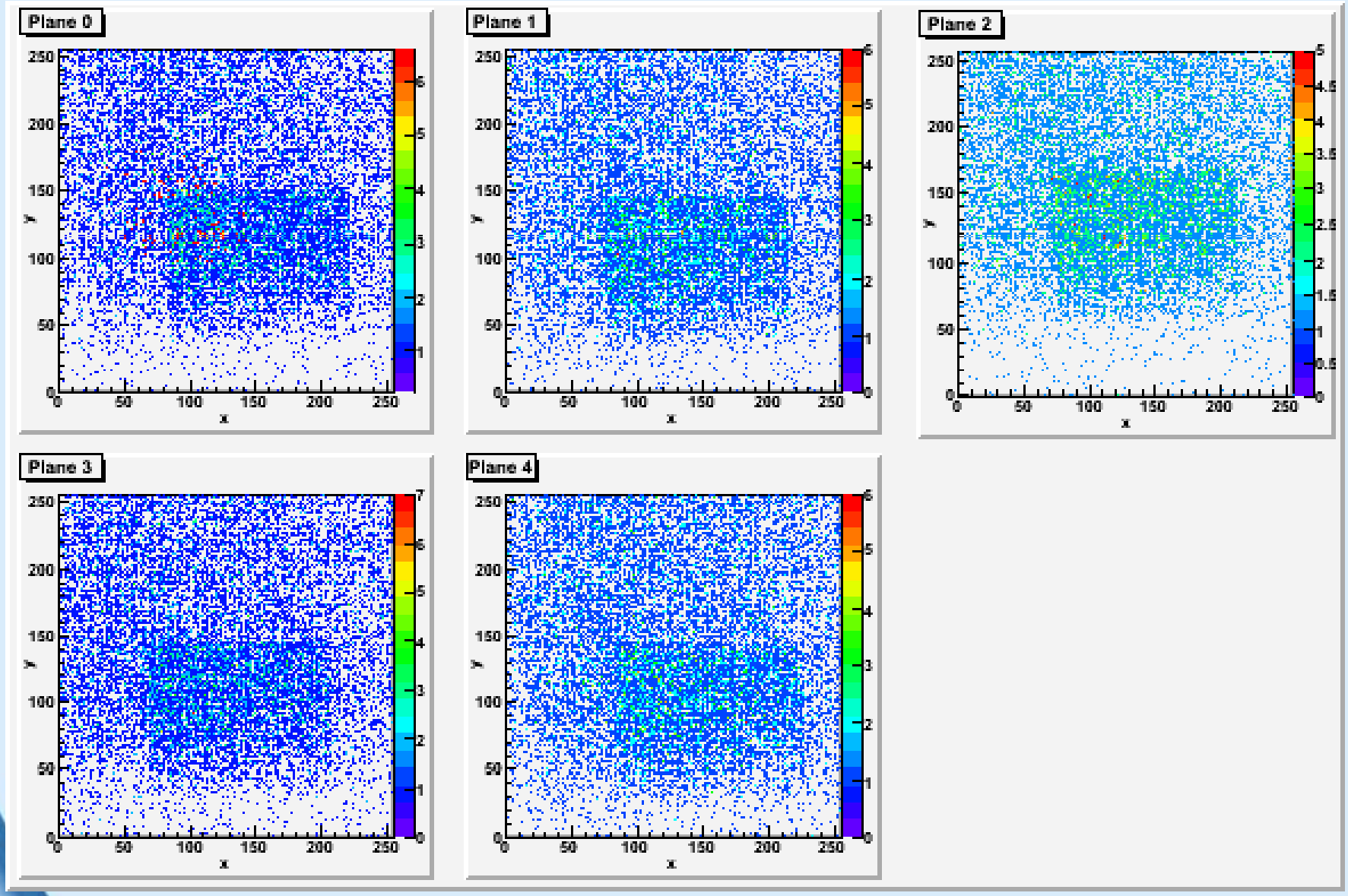






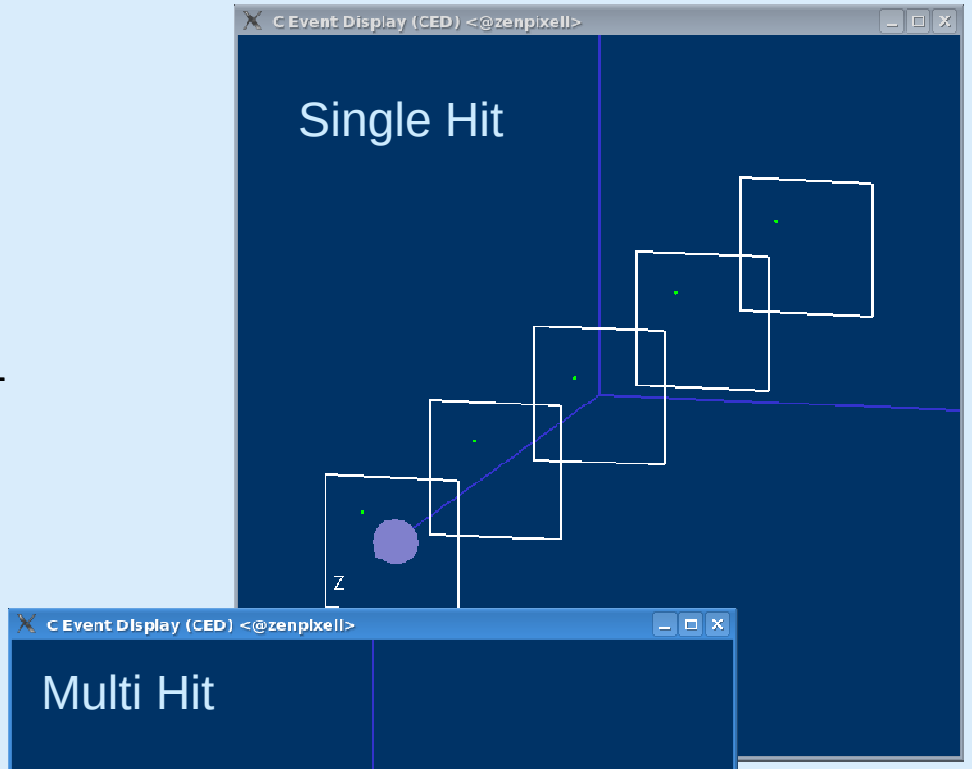
- SNR between 11 and 13

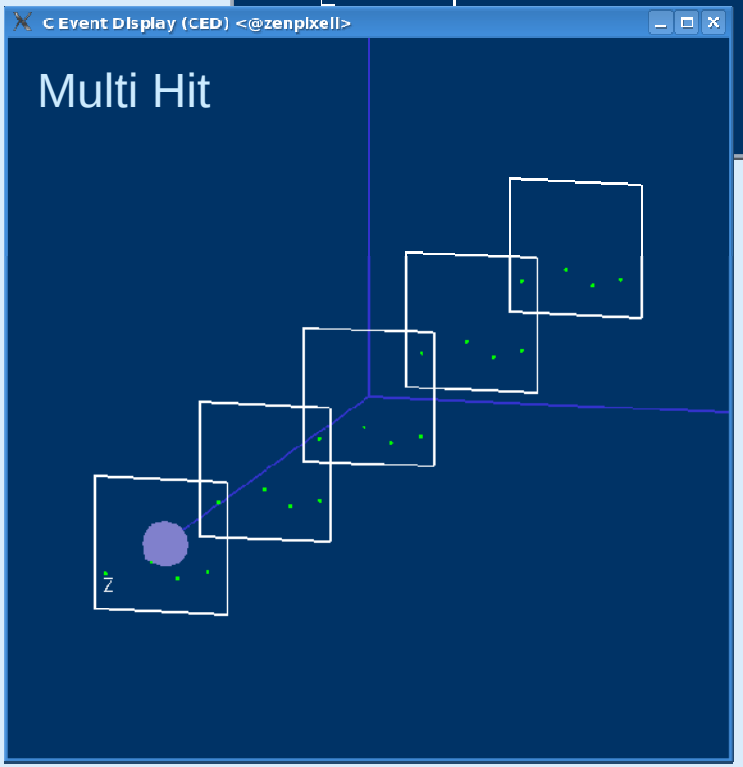
Hitmap



Test beam 2 – Fresh Data

- Statistics
  - 100.000 ev. 3GeV RAW mode (full frame)
  - 100.000 ev. 6GeV RAW mode (full frame)
  - 100.000 ev. 6GeV MIX (RAW + Zero Suppressed)
  - 450.000 ev. 6GeV Zero suppressed
- All data is transferred to the GRID
- started to analyse the new data





User Manual

EUDET-Memo-2006-xxx-1

EUDET Pixel Telescope data taking manual

Ph. Roloff*

August 20, 2007

Abstract

This manual is intended to enable an unexperienced user to take data with the EUDET pixel telescope at the DESY testbeam area 24 or elsewhere. The document is still in progress.

Online Logbook

- Google Spreadhseet to have information accessible for all possible data analysers

Google Text & Tabellen - TB-DESY-AUGUST - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

http://spreadsheets.google.com/pub?key=pDtQLOmk3OPAVDsodhPTKbA

ZEUS Homepage | ZEUS eLogBook | ZEUS CALORIMETER ... | CAL DQM section | ZEUS - DQM : DEPUT... | SPIEGEL ONLINE - Na... | LEO Deutsch-Englisch...

Google Suche Lesezeichen PageRank Rechtschreibprüfung Übersetzen Senden an Einstellungen

TB-DESY-AUGUST: Sheet1

RUN NUMBER	TYPE	DATE	START	STOP	EVT NUMBER	TOTAL	USER COMMENTS
898	Pedestal	20/08/2007	9:20:00	9:25:00	889		Maybe not cooled
899	Pedestal	20/08/2007	9:25:00	9:27:00	197		Continued from 898
900	Pedestal	20/08/2007	9:31:00	9:33:00	365		
901	Pedestal	20/08/2007	9:37:00	9:39:00	334		
902	Pedestal	20/08/2007	9:45:00	9:48:00	343		Now sensors cooled
903	6 GeV e-	20/08/2007	9:50:00	9:55:00	890		
904	6 GeV e-	20/08/2007	9:55:00	9:59:00	890		Continued from 903
905	6 GeV e-	20/08/2007	9:59:00	10:04:00	889		Continued from 904
906	6 GeV e-	20/08/2007	10:04:00	10:09:00	890		Continued from 905
907	6 GeV e-	20/08/2007	10:09:00	10:13:00	890		Continued from 906
908	6 GeV e-	20/08/2007	10:13:00	10:18:00	888		Continued from 907
909	6 GeV e-	20/08/2007	10:18:00	10:23:00	890		Continued from 908
910	6 GeV e-	20/08/2007	10:23:00	10:28:00	890		Continued from 909
911	6 GeV e-	20/08/2007	10:28:00	10:29:00	251	7368	Continued from 910
912	NOT USE	20/08/2007					
913	Pedestal	20/08/2007	10:36:00	10:38:00	351		Beam shutter closed
914	NOT USE	20/08/2007					Beam shutter opened
915	6 GeV e-	20/08/2007	10:47:00	10:52:00	889		
916	6 GeV e-	20/08/2007	10:52:00	10:57:00	890		Continued from 915
917	6 GeV e-	20/08/2007	10:57:00	11:02:00	706	2485	Continued from 916. No events were taken any more
918	NOT USE	20/08/2007					
919	Pedestal	20/08/2007	11:05:00	11:07:00	302		Beam shutter closed
920	6 GeV e-	20/08/2007	11:08:00	11:15:00	890		Beam shutter opened
921	NOT USE	20/08/2007	11:15:00	11:19:00			
922	6 GeV e-	20/08/2007	11:19:00	11:24:00	888		
923	6 GeV e-	20/08/2007	11:24:00	11:29:00	889		

Testbeam 3 – CERN September 2007

Goals of this test beam period

- Take data with JRA1 telescope at H8 test beam (10-400GeV/c pions)
  - With 6 planes in new mechanic
  - DEPFET sensor as first "user"
- Test speed and resolution (with thick sensors)
- Simplify handling of system (even more)

- Next test beam in just 3 weeks:
  - 12.9: move equipment to CERN
  - 13.9: set up and start up (as parasitic user)
  - 19.9: official testbeam period EUDET JRA1 (1week)

Next Steps until End 2007

#	Name	Date	Partner	Description/Remarks
1	TLU	18 Oct 06	Bristol	TLU working. Ship to Geneva.
2	DAQ0	18 Oct 06	Geneva	Bonn+Strasbourg DAQ + TLU work together.
3	FE0	15 Jan 07	DESY	15 Populated FE board sets with sensors (limited tests) available. Ship to Ferrara, Geneva, Strasbourg.
4	EUDRB0	15 Jan 07	Ferrara	EUDRB board partial functionality. Ship to Geneva
5	DAQ1	5 Mar 07	Geneva	DAQ partially integrated with EUDRB
6	EUDRB1	5 Mar 07	Ferrara	EUDRB board tested with FE board set and sensor (no sparsification). Ship 1 full set to Geneva.
7	FE1	5 Mar 07	Strasbourg, Geneva, Ferrara, DESY	FE board sets fully qualified
8	EUDRB2	30 Apr 07	Ferrara	2 EUDRB boards synchronized. Ship 1 set to Geneva and 1 set to DESY.
9	DAQ2	31 May 07	Geneva	DAQ fully integrated with two full FE board sets + EUDRB
10	TB0	10 June 07	DESY	Mechanics and TB infrastructure ready for integration
11	Int1	10 June	All	One Demonstrator Arm in beam
12	Int2	15 Aug	All	DESY test beam with improved DAQ and 2 arms
13	Int3	11 Sep	All	Demonstrator Ready for shipping to CERN
14	DEMO0	19 Sep	All	Demonstrator in SPS beam

NOW

Summary

- Within the EUDET JRA1 programme a pixel beam telescope is under development
  - High precision, high readout speed, easy to use
- Monolithic Active Pixels MimoTel as sensor
  - MimoTel available and tested in two JRA1 test beams
  - High precision and thinned sensors also available
- Readout completed and tested in two test beams at DESY
- DAQ software running and tested under real conditions
- Trigger Logic Unit used for trigger system

- Both test beam periods at DESY were successful AND a lot of fun!!

- Still: a lot of things to be done before next test beam (CERN)

- AND: write up details in EUDET Memos (DAQ, Analysis, EUDRB,…)

- Looking forward to test full system with DEPFET as DUT at CERN in September