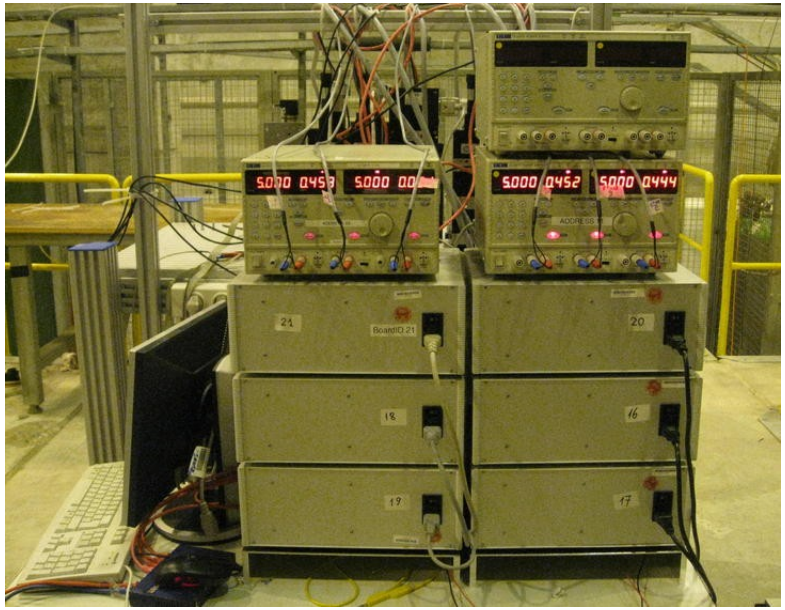
DEPFET TB summary

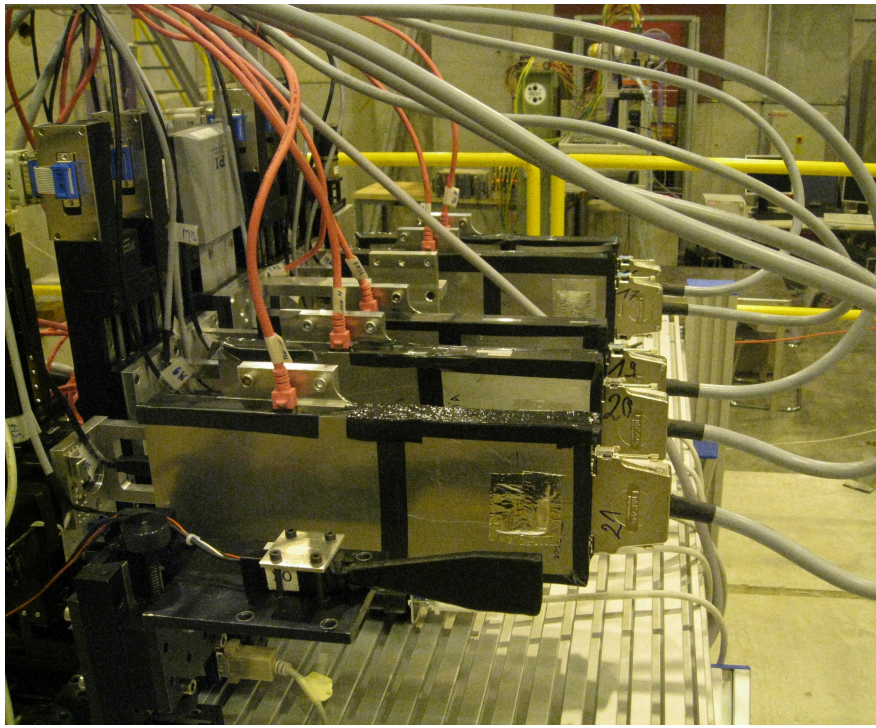
3rd DEPFET workshop – Universitat de Barcelona – October 7th 2009

Marcel Vos, IFIC Valencia

TB2009

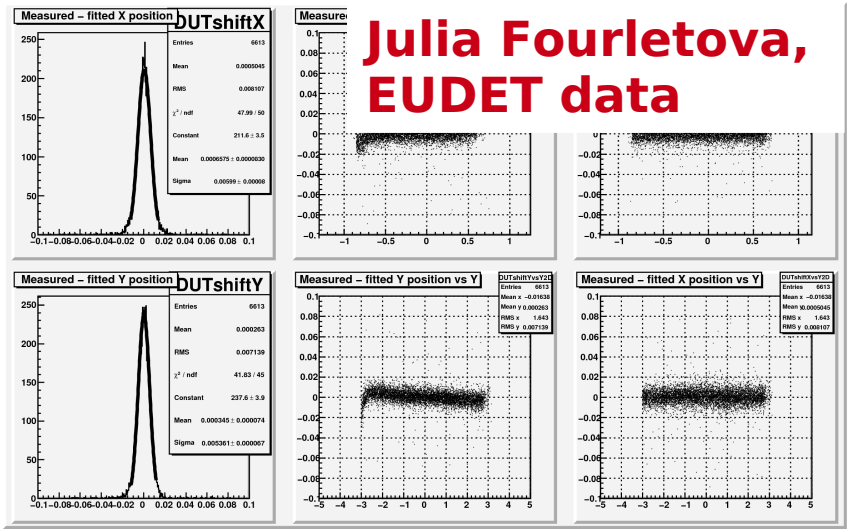
Commissioned a plug-and-play, ultra-precise telescope for TB studies of Belle-II prototypes





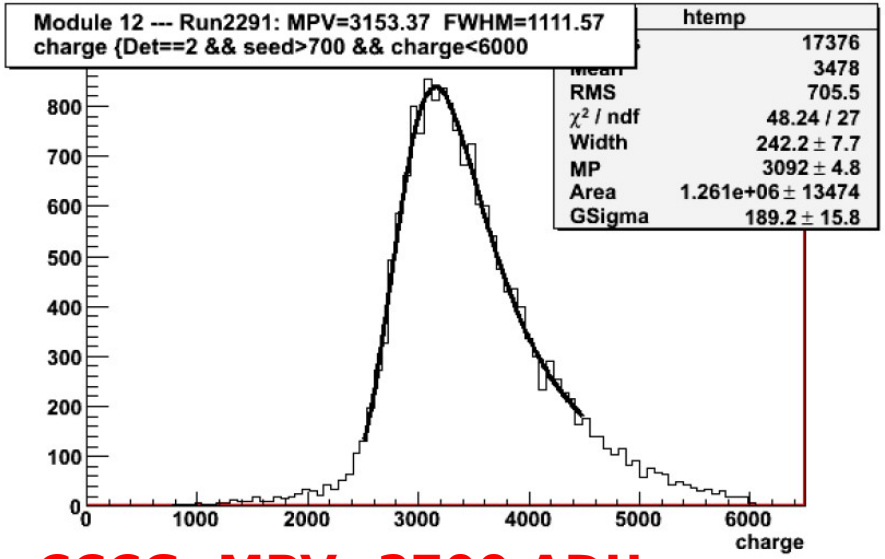
A routine job!

Some preliminary results



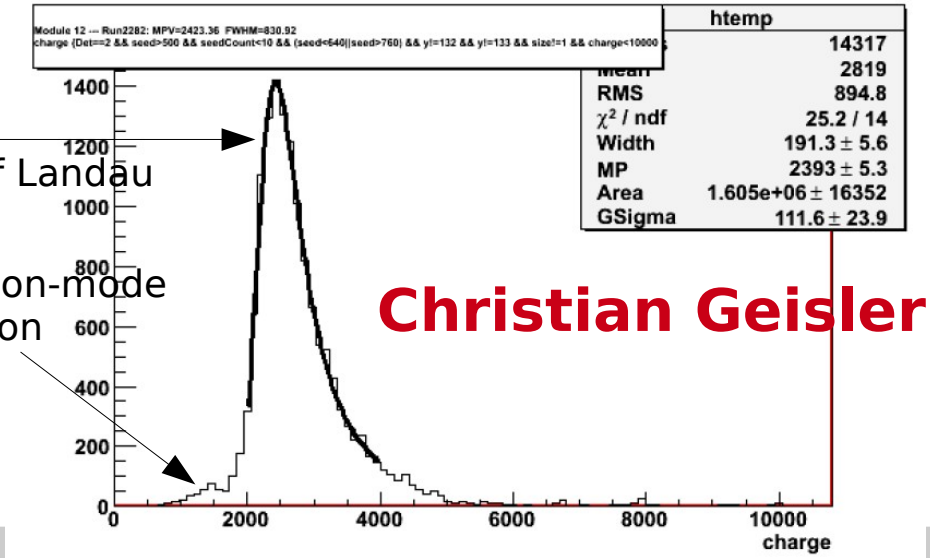
Julia Fourletova, EUDET data

20x20 mm² :MPV=3150 ADU



80 % increase in g_q with respect to 2008!

CCCG :MPV=2700 ADU

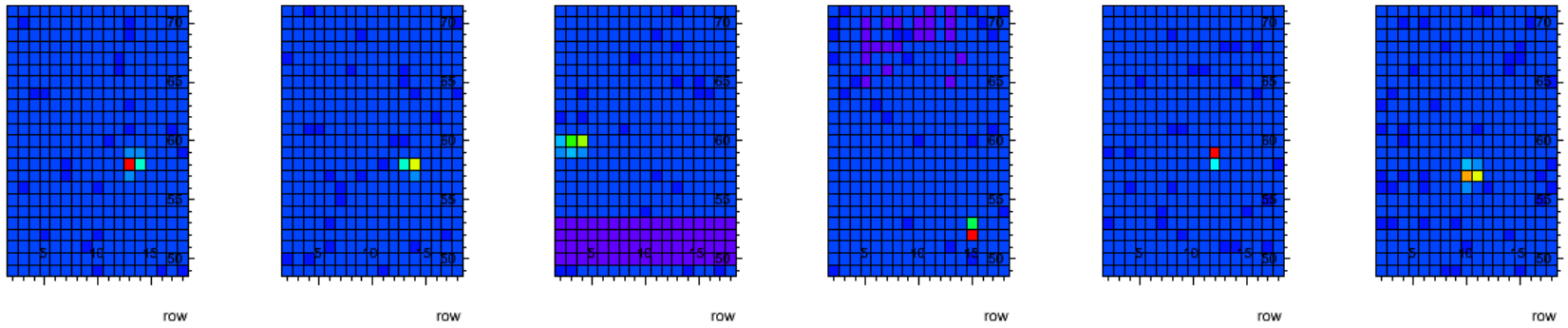


Convolution of Landau and Gaussian

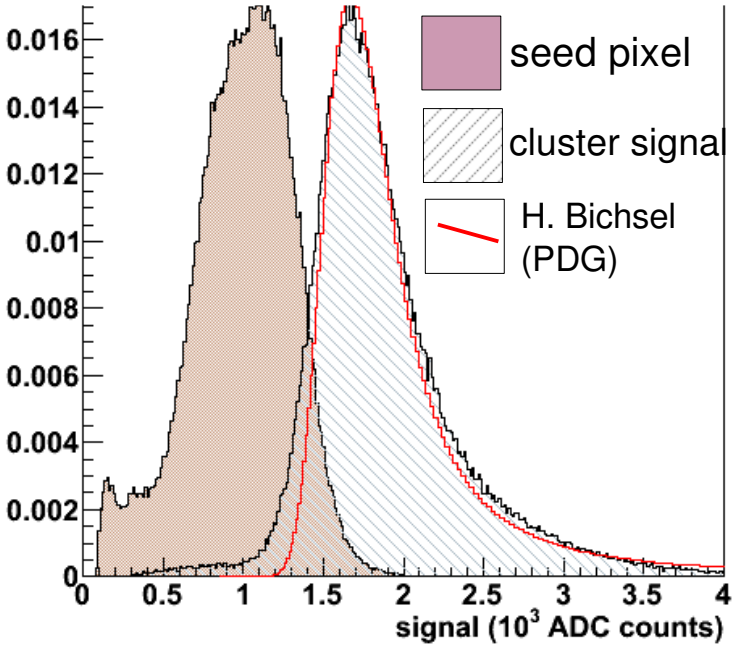
Robust common-mode noise correction

Christian Geisler

TB2008/9



A perfectly understable signal distribution
DEPFET TB2008, 120 GeV pions @ H6
Perpendicular incidence, 24 x 24 μm^2 DUT.



Nice, narrow clusters,
well aligned among the 6 modules

Finalize write-up of TB2008

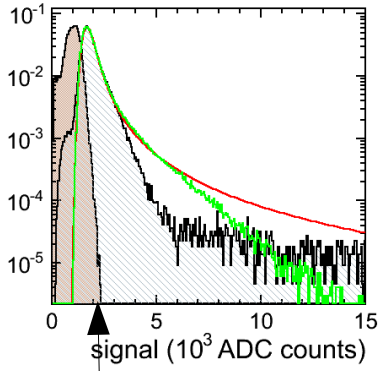
Comparison data-MC (see validation digitizer)
Energy scan

Document TB2009

Characterization (Jelena, Christian K., done!)
Online logbook

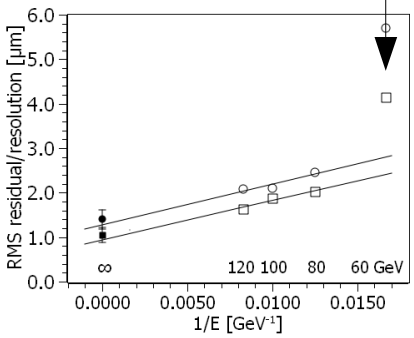
Prepare analysis

Software repository (Julia)
Data backup (IFIC, done)
Data access and shipping
(investigating GRID-CSIC in Spain)
Data pre-processing (Christian G.)



Single pixel signal saturates

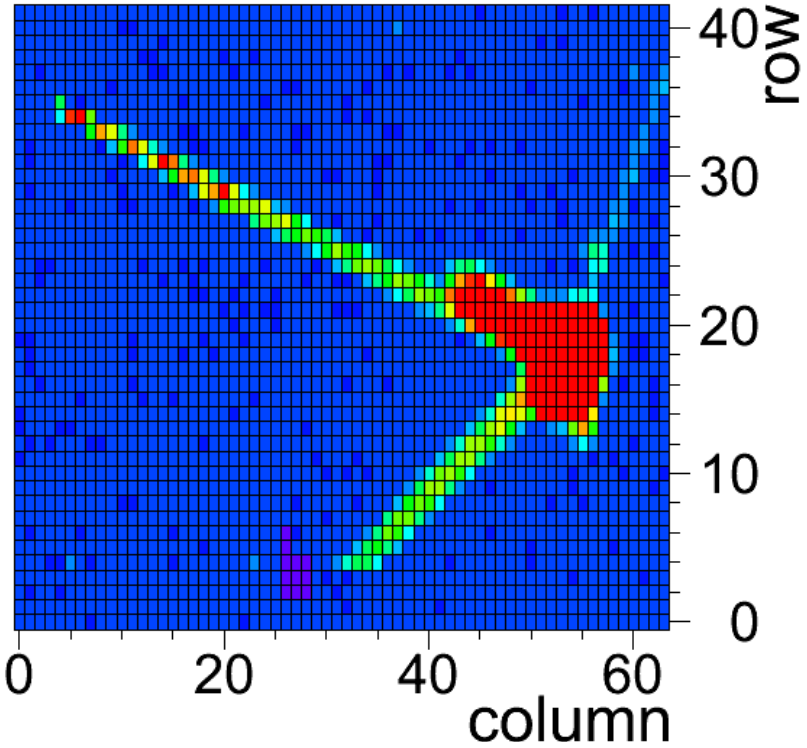
60 GeV point does not want to fit in

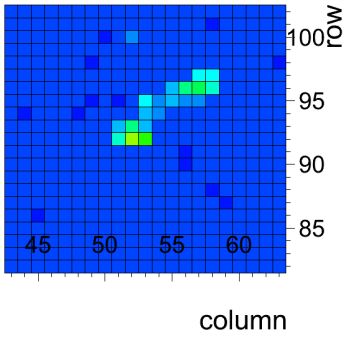


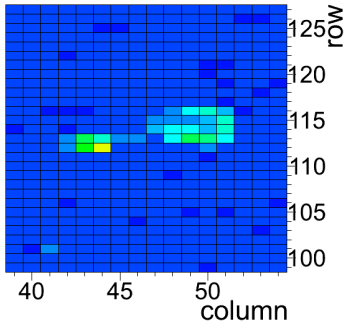
Some fun clusters

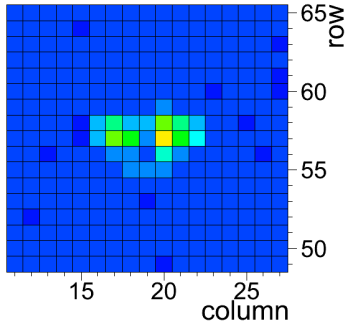
Our detectors have unprecedented performance: very fine granularity and great signal-to-noise

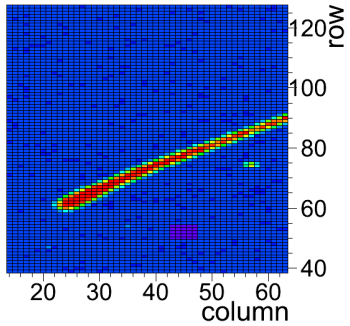
A great opportunity to understand some of the things that go on in these thin slices of silicon!











2010:

- PXD6 modules in fall?
- DCD-based read-out?

→ CERN TB (EUDET DUT)

2011:

- thinned, large area DUTs, final read-out?

→ Prove these meet Belle-II requirements

After EUDET and DEVDET, it's time for AIDA
Several DEPFET members are involved,
Belle-II detector R&D is included,
but no DEPFET involvement as such.

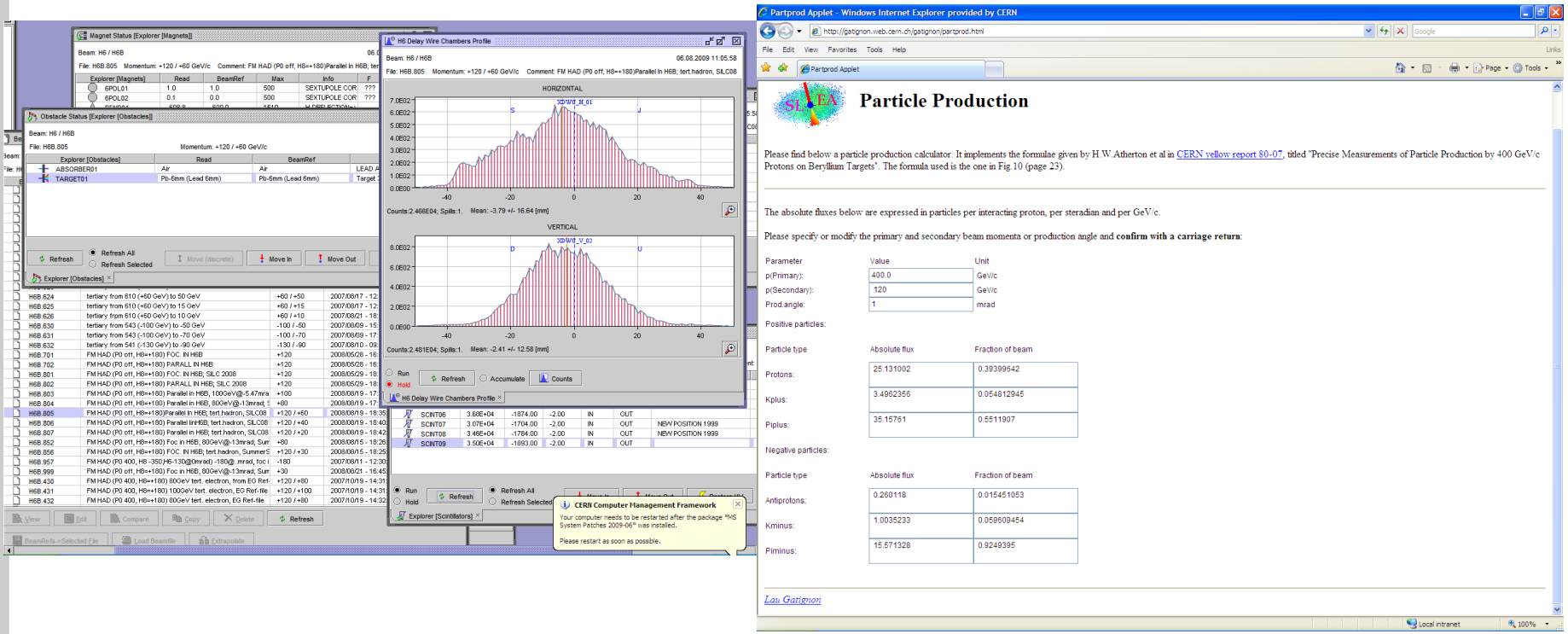
WP3: vertical interconnection (H.G.M.)

WP9: medium advanced infrastructure (M.V.)

- Precision vertex detectors
  - Telescope (à la EUDET)
  - More focus on system aspects (thermo-mechanical test bench)
- Gaseous tracking
- Highly granular calorimetry
- Materials DB

Conclusions

Thanks to the whole team (+ support from the rest of the collaboration)



Thanks to valuable help from SPS staff (in particular Hedda Gschwendtner and Horst Breuker) we were able to better control the beam energy and composition (electron beam, absorber)

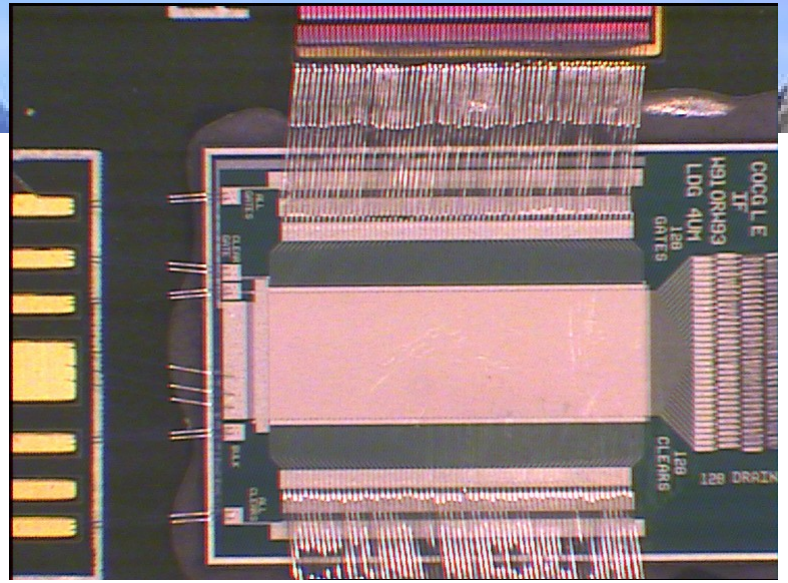
Operational experience

Two CCCG modules were assembled, but had to be discarded. A third module was built in Bonn during while the TB was being set up at CERN. Having no time and no means to test it, it was characterized at CERN by Christian and Carlos, initially with a CERN Cd source (that took 20 man hours to achieve) and finally in the beam.

First correlations in S3b multi-module system: discovered problem with “sliding” start gate. Solved by changing read-out sequence and reprogramming FPGAs (Sergey, Jochen)

Large common-mode noise, solved by reducing the frame time (9.6 ms → 1.2 ms)

TB2009



New “telescope” succesfully built

- 128x128 pixel PXD5 matrices (32x24) read using the S3b system, the new work-horse
  - ➔ Bonn, tutorial
- Standard power supplies
  - ➔ Johannes and others (Bonn)
- Centralized characterization at MPI
  - ➔ Jelena + visiting experts

DUTs:

- Irradiated module could not be tested (matrix died beforehand)
- CCCG module (SB default). First two modules are behaving badly (noisy pixels, hot spots). A third module was bonded in Bonn, shipped to CERN, characterized in the beam.
- Smaller pixel size, short gate length (20x20 μm^2)
- Even shorter gate length could not be tested due to technology problem

http://aldebaran.hll.mpg.de/twiki/bin/view/DepfetInternal/Meetings
http://aldebaran.hll.mpg.de/twiki/bin/view/DepfetInternal/ShoppingMall

A star is born

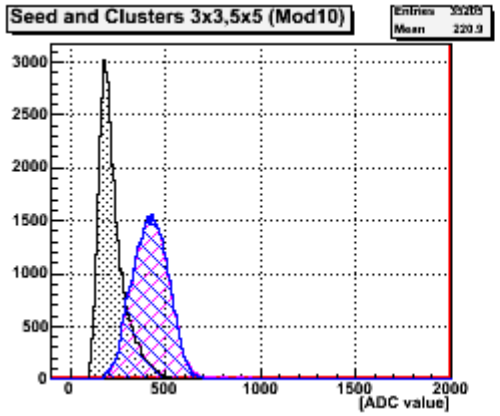
90 H09 COCG V S H 3.0.07 20x20µm², SNR 28.9 (22keV), excellent DUT module

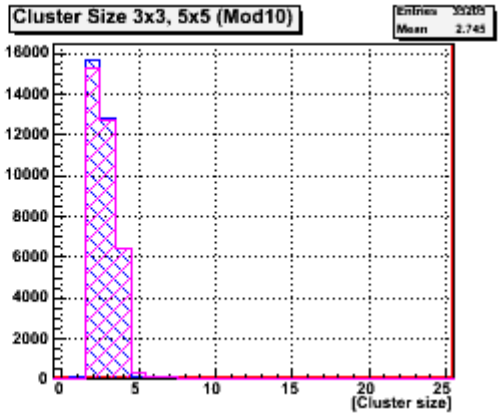
Small pixels and 5 um gate length (telescope modules = 6 um, shortest gate length = 4 um)

Over 60 % increase in signal/noise ratio with respect to telescope modules

Excellent quality (no dead/hot columns/rows/spots)

Excellent stability (no noise tails)





TB2009: programme

Voltage scans: Cross-check, we're running in optimal settings

- V_{Bias} to the wafer 110-220V

Edge scans: to study distortion of position towards the edges

- changes to position, V_{Edge}

Beam energy scan: To analyse wheter the separation "multi-scattering-intrinsic resolution" is performed correctly

80, 100, 120 GeV

electrons with 40, 60, 80 GeV

Large statistics:

- Charge collection uniformity studies
- In-pixel studies

Large intensity

Two-track resolution

TB2009 modules

92	J12	C3GL A	H 3.0.01	6 dead rows, working fine	
90	C03	COCG L E	H 3.0.02	working, but 11 mA current at Clear_Low, 3 bond wires removed from clear switcher	
S90	C02	COCG S E	H 3.0.03	working fine 29/07/09	
90	G11	COCG S E	H 3.0.04	working fine, Opt. finished, SNR 17.1 (22keV), excellent DUT module	
90	C14	COCG S E	H 3.0.05	working fine - not really 29/07/09	
91	G08	COCG L B	H 3.0.06	working fine exept one hotspot, Opt. finished, SNR 19.1 (Cd 22keV)	
90	H09	COCG V S	H 3.0.07	20x20µm², SNR 28.9 (22keV), excellent DUT module	
90	G08	COCG L B	H 3.0.08	gate on voltage not stable, dead rows and dead columns	
91	B02	COCG L B	H 3.0.09	2 Ch/Curo dead, enhanced current to sourceand Analog CURO	
91	J10	COCG L B	H 3.0.10	Good module, SNR 17.5 (22keV), one dead column	
90	M12	COCG L B	H 3.0.11	Excellent module, SNR 17.7 (22keV)	
92	B02	COCG L B	H 3.0.12	Excellent module, SNR 17.8 (22keV)	
92	D14	C3GL A	H 3.0.13	Many hot spots, Current in Gate, enhanced source current, bad mounting	
93	M08	COCG L E	H 3.0.14	München	clear-source current, enhanced source current, bad mounting
92	K11	C3GL A	H 3.0.15	München	Many noisy pixels
92	G08	COCG L B	H 3.0.16	CERN	Excellent module, SNR 18.2 (22keV)
92	H13	COCG L E	H 3.0.17	München	Technology related problems - not good matrix
92	C11	COCG L B DG 5	H 3.0.18	CERN	Dead

COCG L B -> used for telescope modules

COCG S E -> used for DUT

COCG V S -> used for DUT

CCCG L E -> used for DUT

C3GL A -> used for DUT