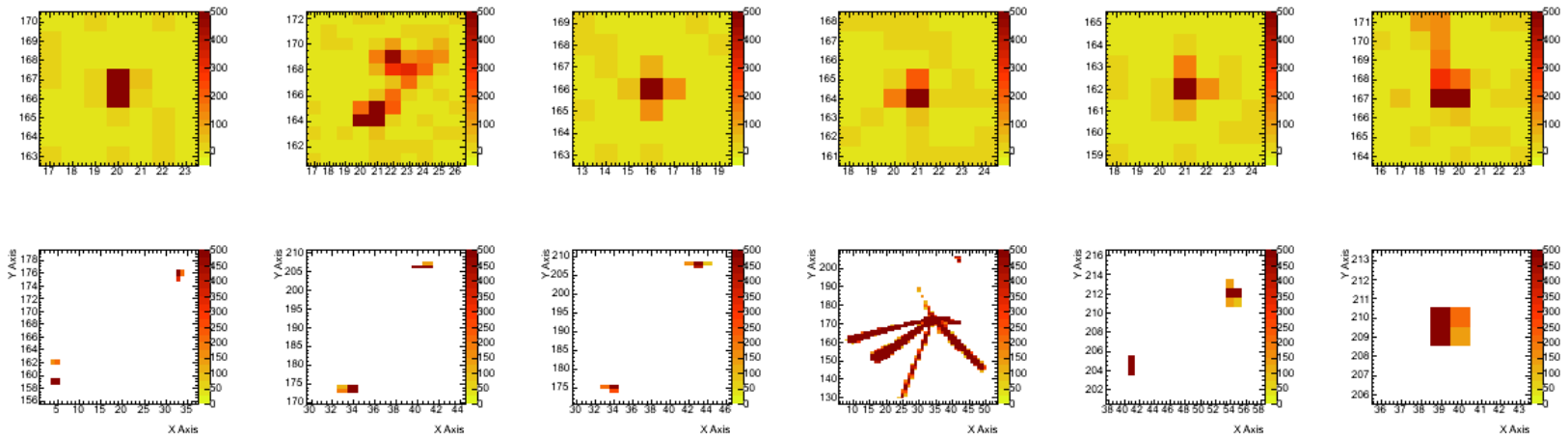


# DEPFET TB 2010



## DEPFET TB 2010

Belle-II PXD meeting  
– Nov 30<sup>th</sup> 2010 -

Marcel Vos, IFIC Valencia



# SPS Operation

## Period 6 2010 Oct 21 to Nov 22

Schedule Issue date: 15-April-2010

Version 2.0

(colour code: purple (dark) – scheduling meeting, light green (light) – weekend or holiday)

		Thu 21 Oct	Fri 22 Oct	Sat 23 Oct	Sun 24 Oct	Mon 25 Oct	Tue 26 Oct	Wed 27 Oct	Thu 28 Oct	Fri 29 Oct	Sat 30 Oct	Sun 31 Oct	Mon 1 Nov	Tue 2 Nov	Wed 3 Nov	Thu 4 Nov	Fri 5 Nov	Sat 6 Nov	Sun 7 Nov	Mon 8 Nov	Tue 9 Nov	Wed 10 Nov	Thu 11 Nov	Fri 12 Nov	Sat 13 Nov	Sun 14 Nov	Mon 15 Nov	Tue 16 Nov	Wed 17 Nov	Thu 18 Nov	Fri 19 Nov	Sat 20 Nov	Sun 21 Nov	Mon 22 Nov	
Machine		816 WED MD																																	
NORTH AREA	T2 -H2	8h NA61 Z Fodor phys		8h A Malinin		CREAM H2B		8h NA61 Z Fodor test		8h P Luukka		CMS-SiBT		8h L Tkachev																					
	T2 -H4			8h M Alfonsi		RD51		8h ALICE-VHMPID A di Mauro		8h A di Mauro		ALICE-SPD		8h A Singovski																					
	T4 -H6	8h CMOSILC APIX1		8h Wilkens				MMEGAS AIBL H6A/B		8h SavoyNavarro		SiLGRD H6B		8h M Vos		DEPFET H6B																			
	T4 -H8	8h ATLAS-3DSi		8h H Wilkens				ATLAS-STGC		8h H Wilkens				ATLAS-MDTROM H8B																					
	T4 -P0																																		
	T6 -M2	8h G Mallot																																	
	-CNGS	8h Neutrinos																																	
		CNGS																																	
		For further information contact the SPS/PS-Coordinator																																	
		<p><b>Remarks</b>                      SPS/PS-Coordinator: Horst Breuker                      E-mail: SPS.Coordinator@cern.ch                      phone: 73777 (ext. +41 22 767 3777)                      mobile: 164212 (ext. +41 76 487 4212)                      - No further remarks</p>																																	

TB2010, our beam period: 15-21 November  
 Last slot of the season, after SiLC, EUDET telescope requested

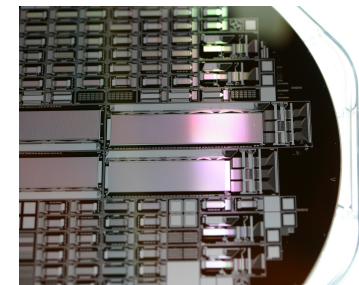
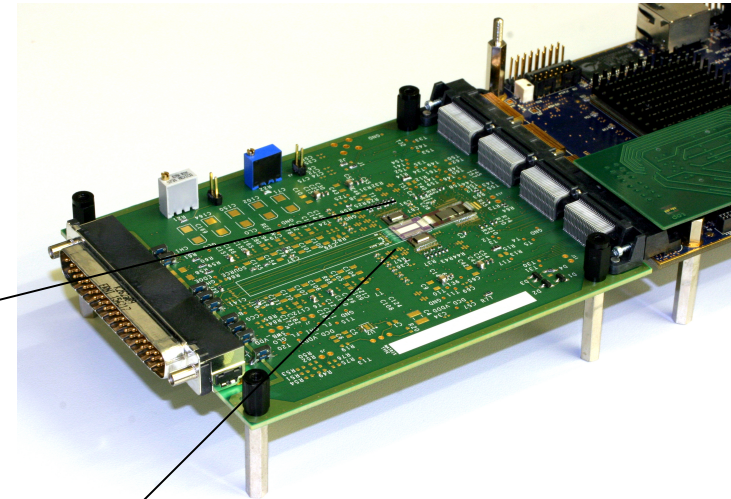
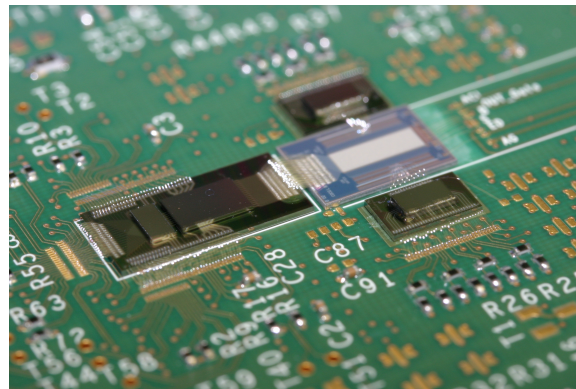


# TB2010: DUT

1) S3B module based on PXD5 with 4 um gate length (available, but not tested)

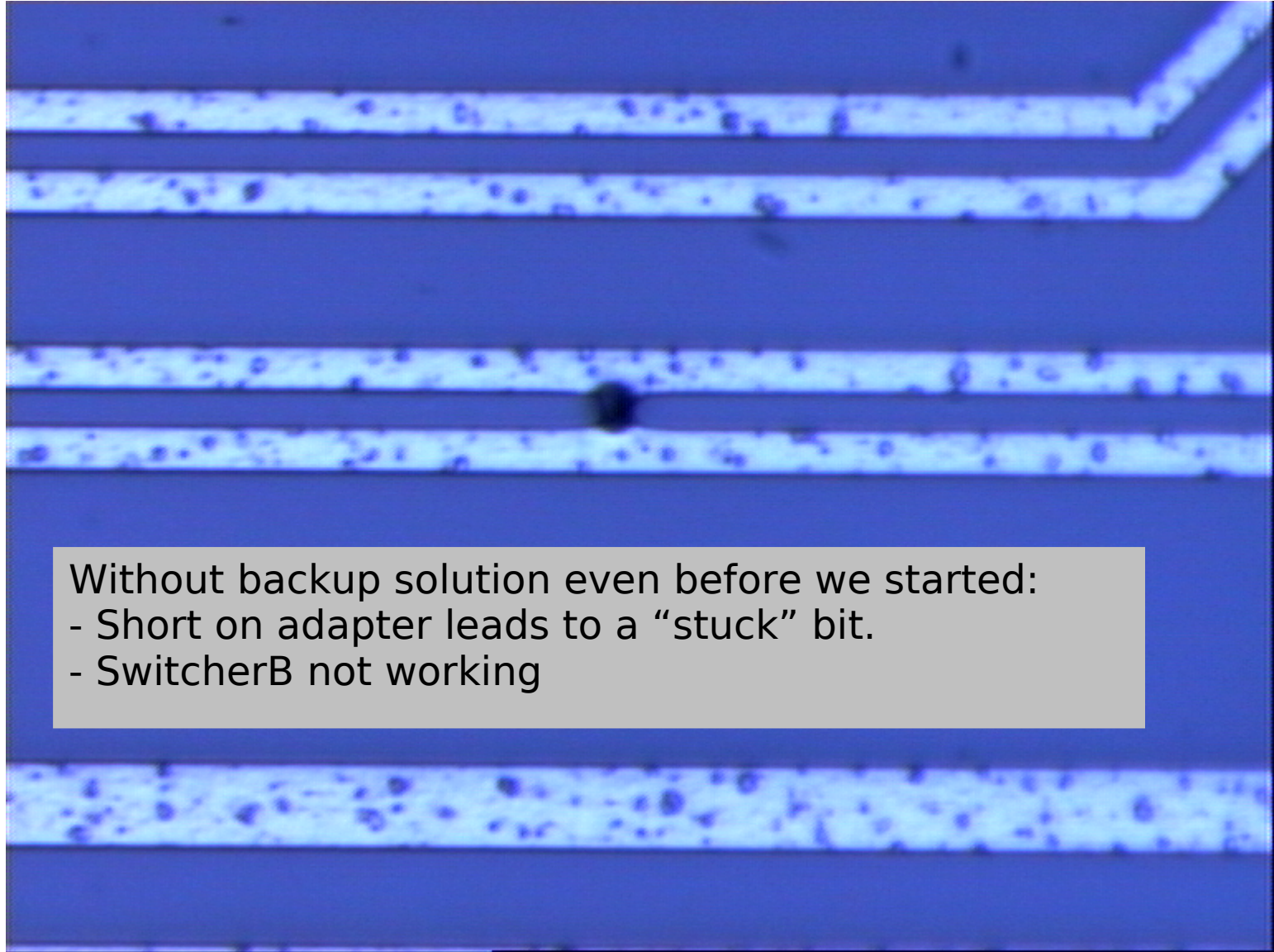
2) DCDB-based PXD5 DUT (on hybrid 4.1)

- **(Nearly) full-speed read out**  
row rate/nominal  $\sim 3$ , compared to several orders of magnitude with previous system)
- **Relevant pedestals, common mode**  
but custom power supplies, cables, etc.



No PXD6 module  
(hoped for mm<sup>2</sup> ILC design that would have  
been first thin DEPFET)

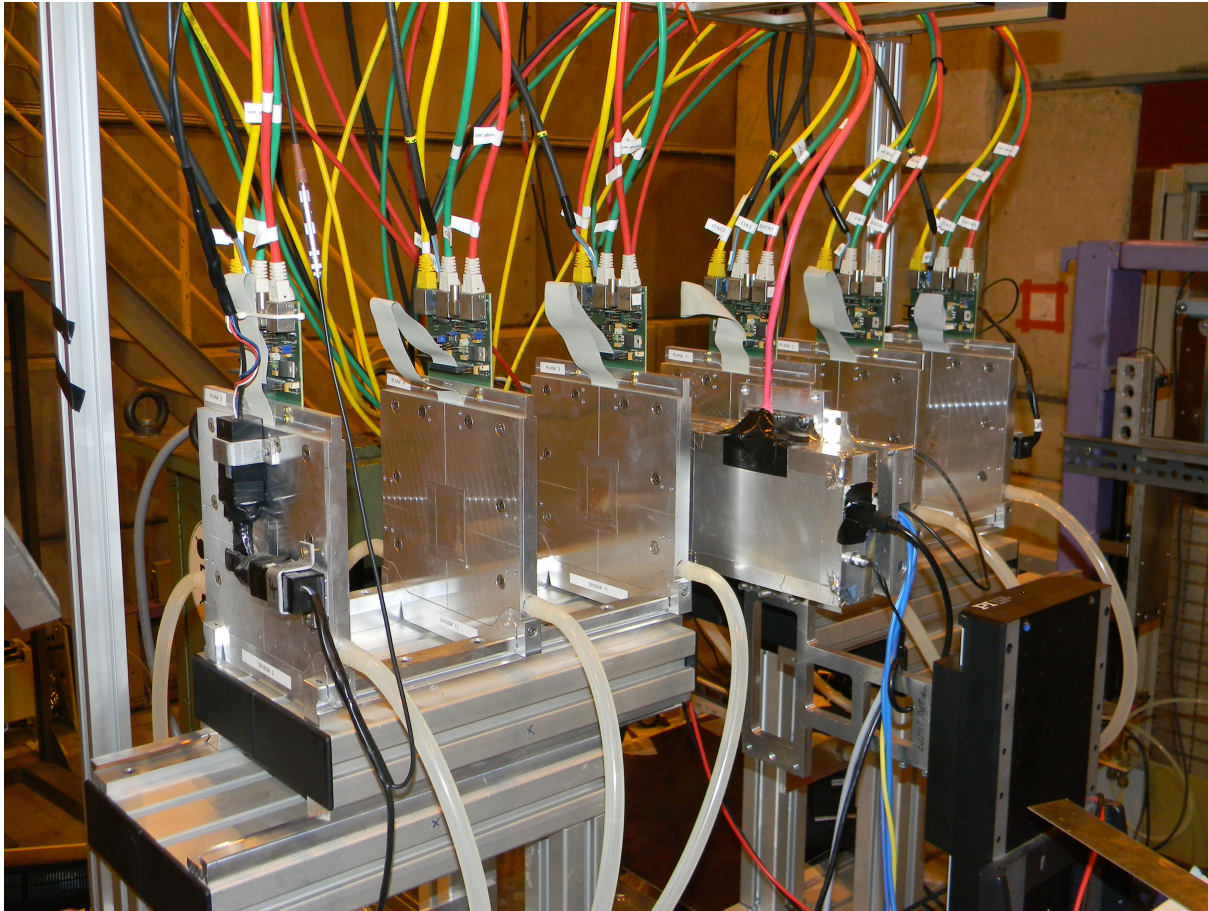
# Backup DUT



- Without backup solution even before we started:
- Short on adapter leads to a “stuck” bit.
  - SwitcherB not working

# TB2010: telescope

Telescope: use EUDET (3-5  $\mu\text{m}$  pointing precision)

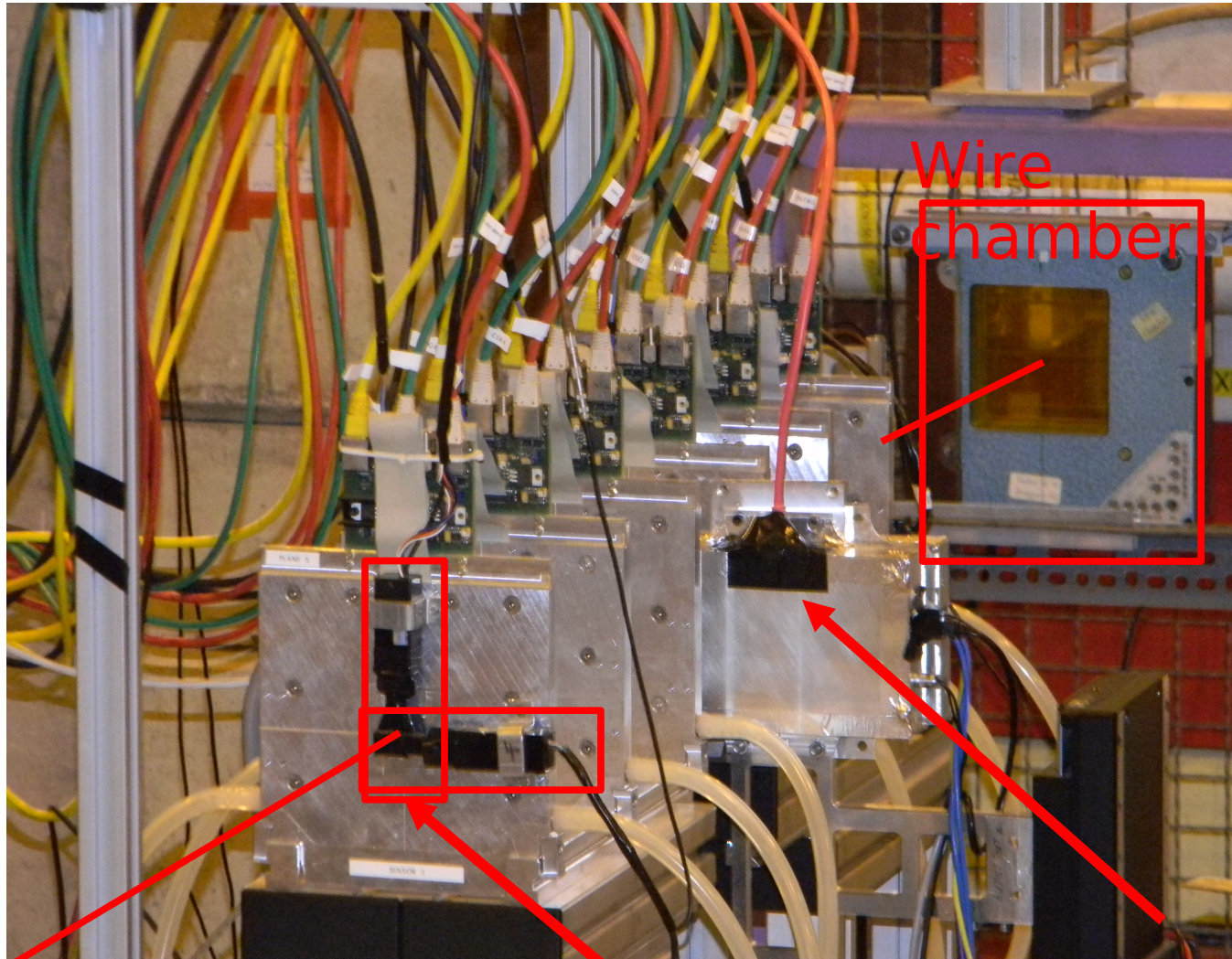


Used EUDET out of a desire to minimize our requirements on limited DEPFET resources (manpower, mostly)

Limited possibilities to characterize DUT resolution (turns out not be a big problem).

EUDET (Emlyn) has responded very well when we had problems.

# TB setup



Wire chamber

SPS H6  
beam  
line

Scintillator  
triggers

DEPFET DUT



# Power Supplies

EUDET  
telescope

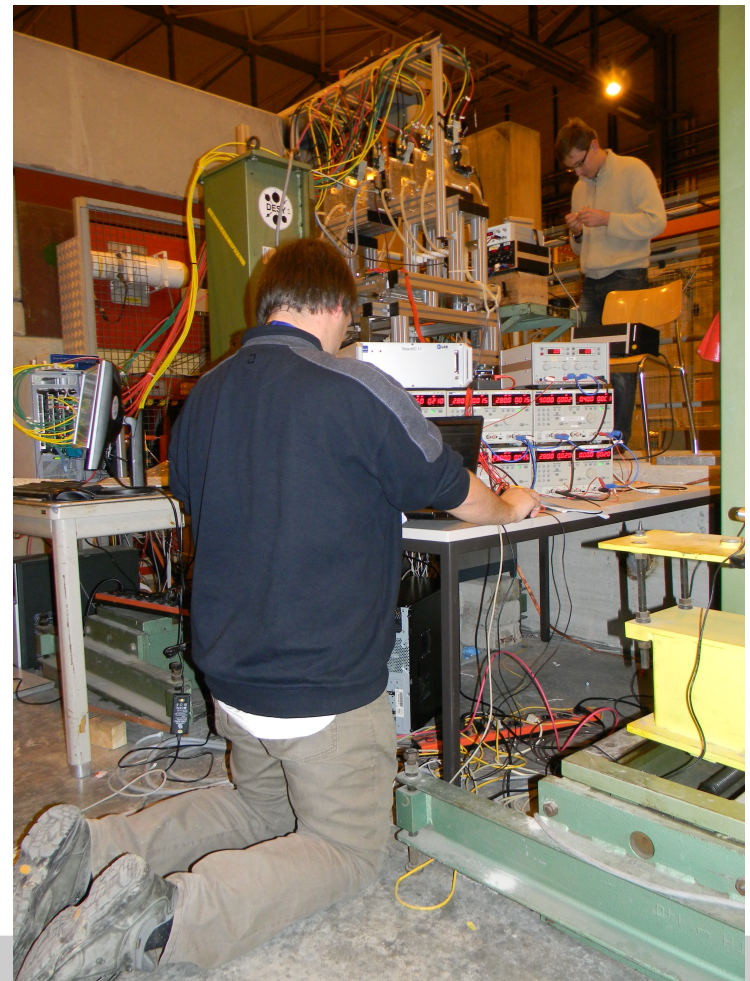
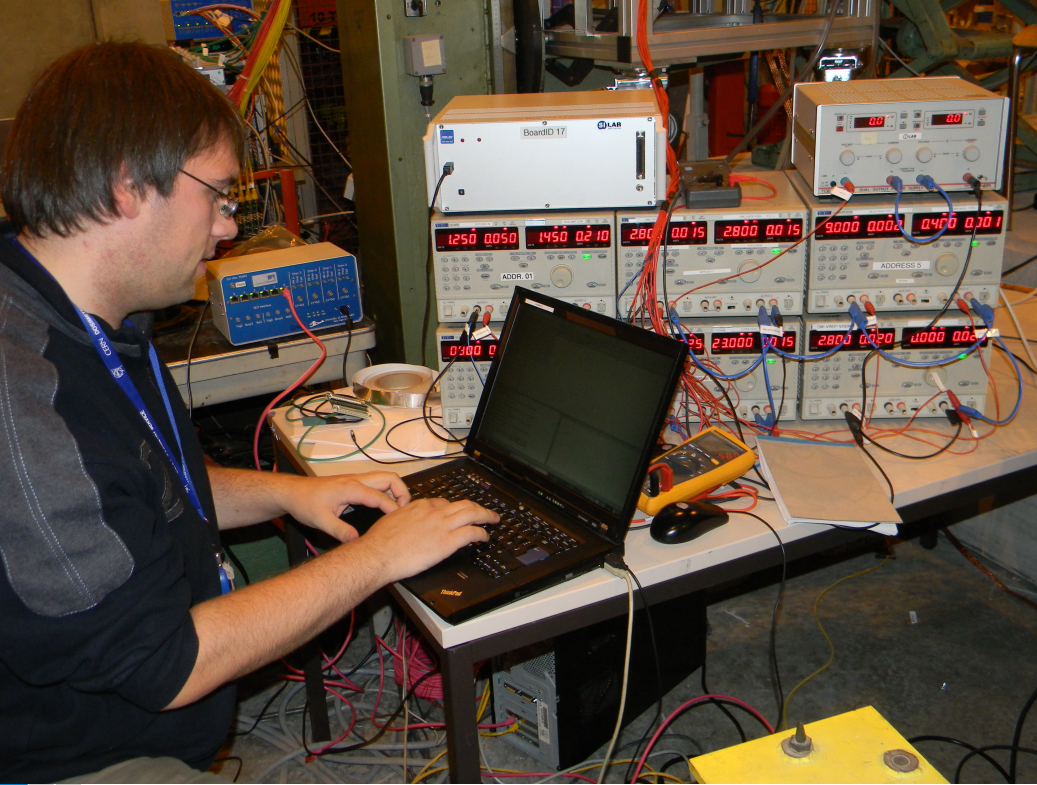


Even more  
of them!!!

Bench power  
supplies!!!!



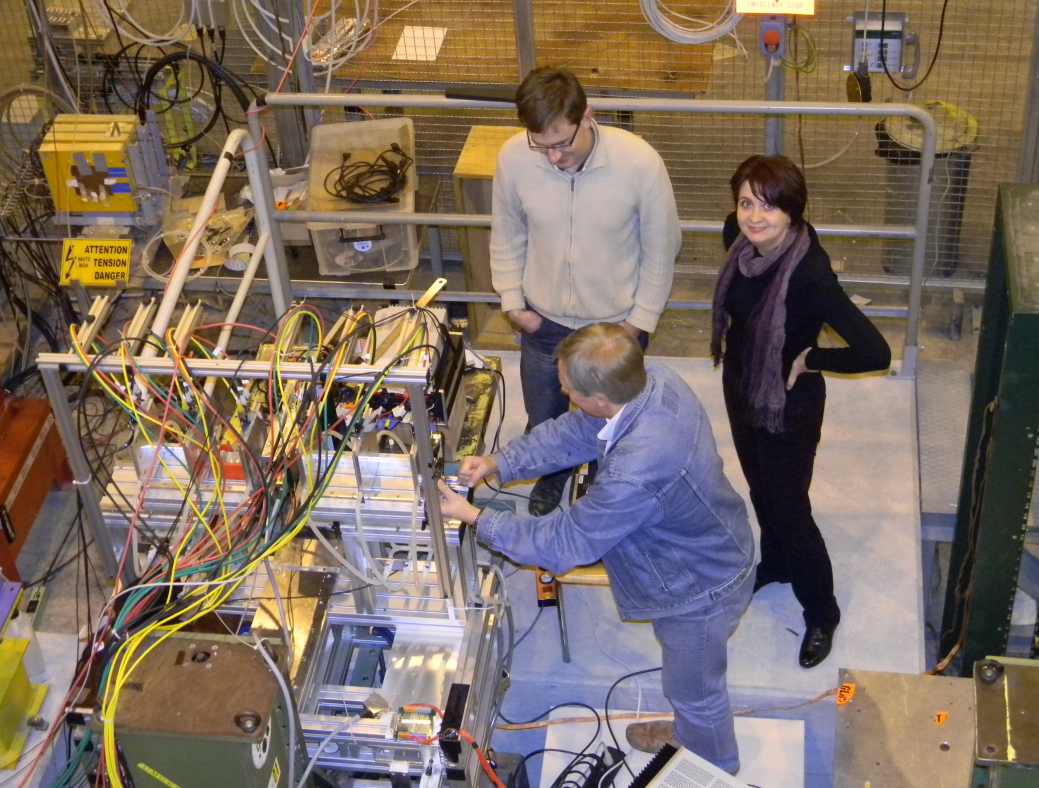
# Power supplies



- Power supplies:
- Semi-automated start-up sequence
  - Remote control
  - Monitoring







Installing extra  
trigger "finger"

Shifter looking at the online  
logbook (I think)

Offline analysis trying to keep up

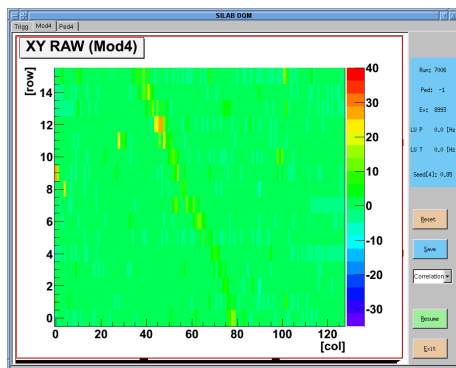


# Lessons learned during operation

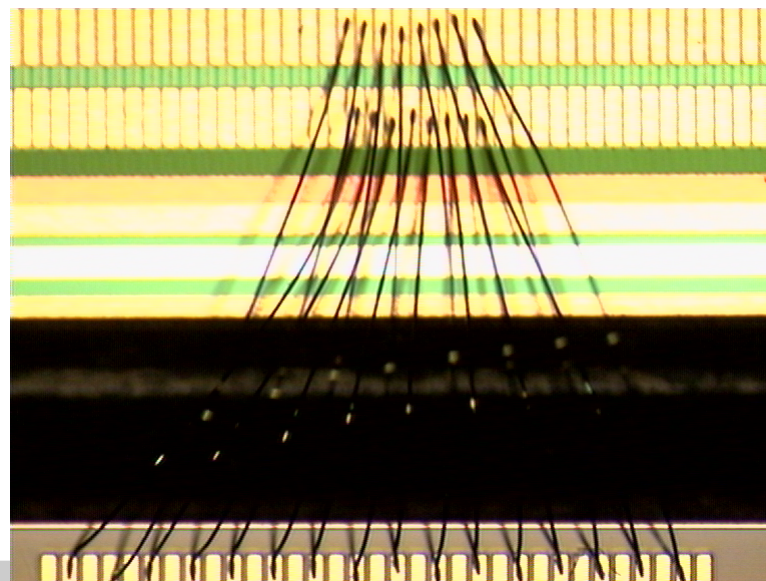
## Raw data → geographic matrix map

- DAQ stores analog information from matrix in the order that it comes out of the DCD (one lossless multiplexing step is performed on hybrid)
- Columns reshuffled according to know map
- Row reshuffled to correct switcher-sensor bonding feature

In TB x-check with laser spot, large MIP clusters, row without clear  
**Proposed measurement:** laser scan through the whole matrix, take one row out of clear sequence



Interesting cluster



Photograph by CERN bonding lab  
of sensor - switcher bonds

# Lessons learned during operation

SwitcherB operated successfully during TB2010, after two SwitcherB chips died on first hybrid 4.1 (one after brief period with life signs)

- SwitcherS has no problems (and no JTAG)
- programming wrong settings to switcher2 DAC settings can drive them to suicide...  
what about SwitcherB?
- configuration is loaded onto chips (currents change)
- JTAG blocks switcher and DCD connected

**Proposed follow-up:** Probe Switcher switch-on sequence, confirming each of the steps

DCD Pedestal spread over 2/3 of dynamic range  
(subtraction DACs not yet available... will be there for next TB???)

- offset current 11 mA/128 channels : 90 uA offset current, expected 50 uA for gate ON voltage we chose (Rainer: incomplete clear?)
- spread limits the gate ON voltage and therefore the matrix performance!!
- Source for offset current subtraction too weak?

**Proposed measurement:** Systematically map GateSource current vs. gate ON voltage (Bonn)  
Vary detector bias, temperature (whatever is needed to understand current)

# Lessons learned during operation

## DCD pedestal variations

- Variations with time of a few counts observed

**Proposed action:** careful analysis (Benjamin, Prague, Valencia)

## DCD noise:

- 0.8 LSB noise before TB and in H6 when run with same parameters in TB (no extra source)
- 1.3 LSB noise... when we changed matrix settings (ADC gain = 60 nA/ADU)

**Proposed action:** noise measurement for different gate ON voltages

## DCD ADC response:

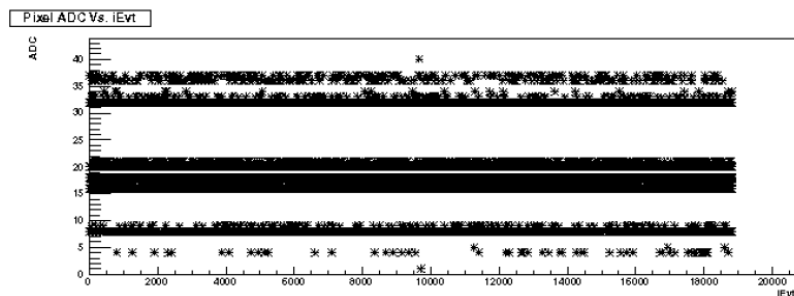
During TB Benjamin discovered “jumps” in baseline in some channels.

Slightly more careful analysis reveals instabilities in fraction of ADCs

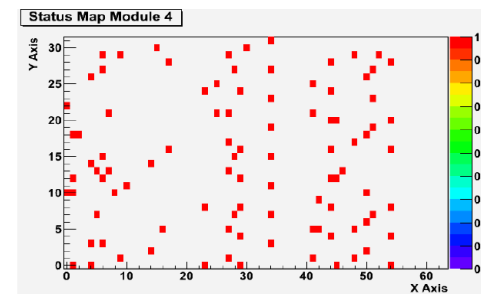
Jochen and Benjamin confirmed faulty response of a few selected ADCs in situ

**Proposed measurement:** Systematic check of all ADC responses

Repeat on several DCDs



<----- Baseline vs. event number. Discrete “jumps” are bit flips  
Bad ADC map ----->



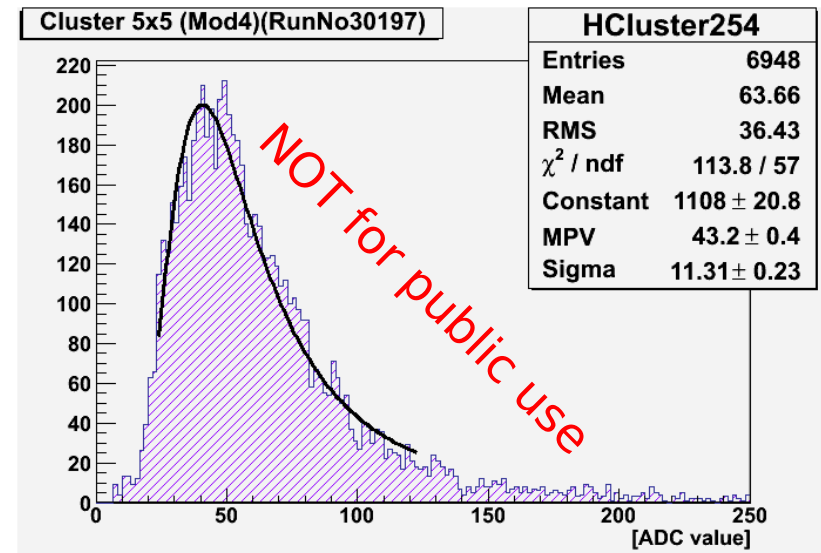
# Lessons learned during operation

## Matrix response

- Signal initially approximately 30 ADU (expect  $S/N > 130$ )
- Increased to 70-100 ADU by scanning voltages

**Proposed action:** careful analysis to clarify this number  
» (and then try to understand it)

Early 5x5 cluster  
signal distribution  
from online monitor



# Conclusions

Thanks once more to the entire team! A great collective effort.,

Too early for conclusions and interpretation. Obviously this was not a “plug-and-play” TB with “demonstrator” results, but it is an important step towards the complete system:

- Very fast development on tools (DAQ!)
- Great progress understanding DCD. Many “features” uncovered (that could have been uncovered without beam)

Not only an investment for a PXD6 TB: I do expect some “conference-quality” results. Define priority areas where deeper understanding is needed. Careful, but rapid analysis (unfortunately undermanned) to get to the bottom of urgent issues as soon as possible.

Need to submit request TB2011. June (for quick feedback on PXD6) or later (time to build a demonstrator DUT). New DCD will not be in time for 2011 SPS season.

