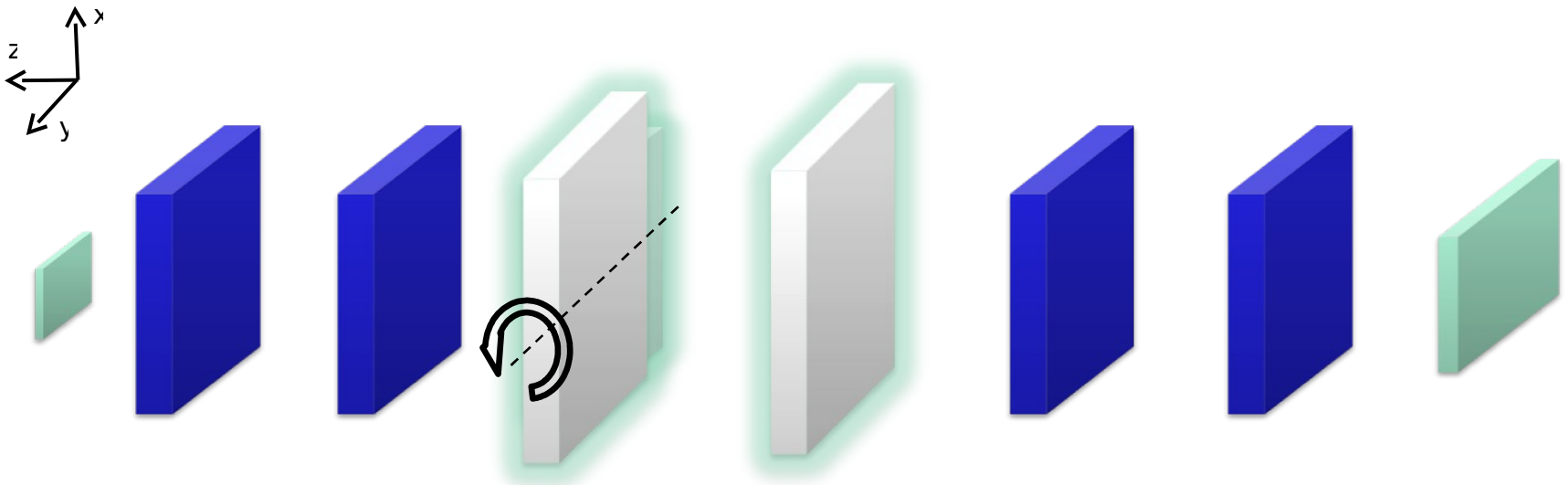
DEPFET TB summary

2nd international workshop on DEPFET detectors

Marcel Vos, IFIC Valencia

Test Beam Setup



4 Telescope planes:

- 32x24μm²
- Common Clear Gate (ordinary CLEAR structure)
- 128 x 64 pixels
- 450 μm thick

3 DUTs:

- 24X24μm²
- Capacitative coupled clear gate
- 128 x 64 pixels
- 450 μm thick

D. Cussans, EUDET-Memo-2007-02

TB2008: programme

- **Voltage scans:** Cross-check, we're running in optimal settings
  - V_{Bias} to the waffer 150-220V
  - V_{Edge}
  - $V_{ClearHigh}$
- **Angular scan:** To study resolution vs. Cluster size
  - -5, -4, -3, -2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2, 3, 4, 5, 6, 9, 12, 18, 36
- **Beam energy scan:** To analyse wheter the separation "multi-scattering-intrinsic resolution" is performed correctly
  - 20, 40, 60, 80, 120 GeV
- **Large statistics:**
  - Charge collection uniformity studies
  - In-pixel studies

3.5 TB of data

20 Million events

3 analyses of DEPFET telescope
- Bonn, Lars Reuen
- Prague, Peter & Peter
- Valencia, Carlos Mariñas

+Julia's analysis of the EUDET data

Software:
- EUDET vs private
- Data available, but in proprietary formats

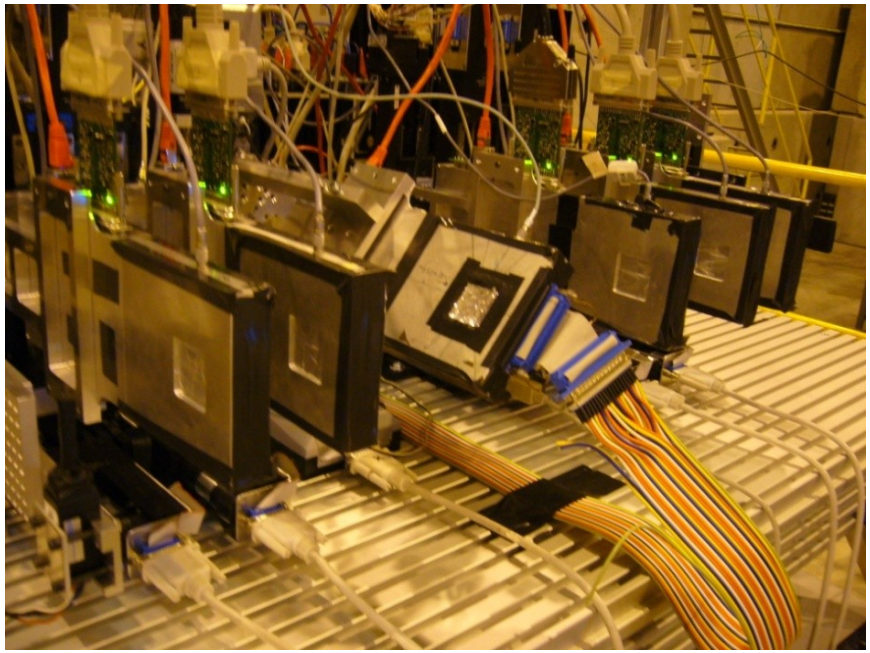
TB2008: write-up

A paper on TB2008:

Introduction: setup,

Material to be provided by Bonn (Sergey, Johannes)

- Position stages
- power supply
- DAQ

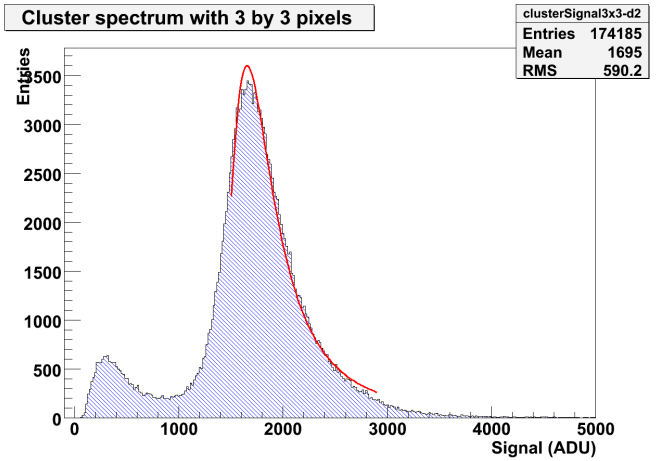


TB2008 paper:

Results I: charge collection (depend only on clustering)

Material to be provided by Valencia + others

- g_q, S/N
- gain uniformity
- cluster size (vs. angle)

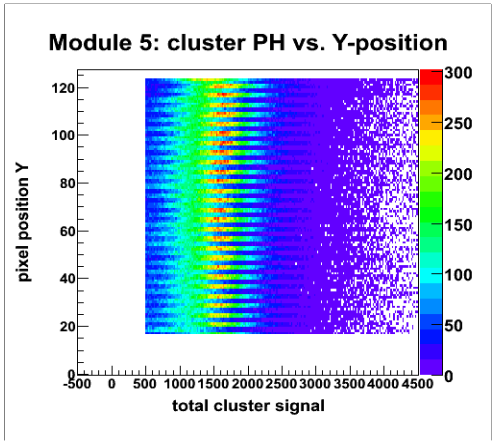


Compare to lab measurements

Translate into prediction for ILC/SuperBelle

(50 μm thickness)

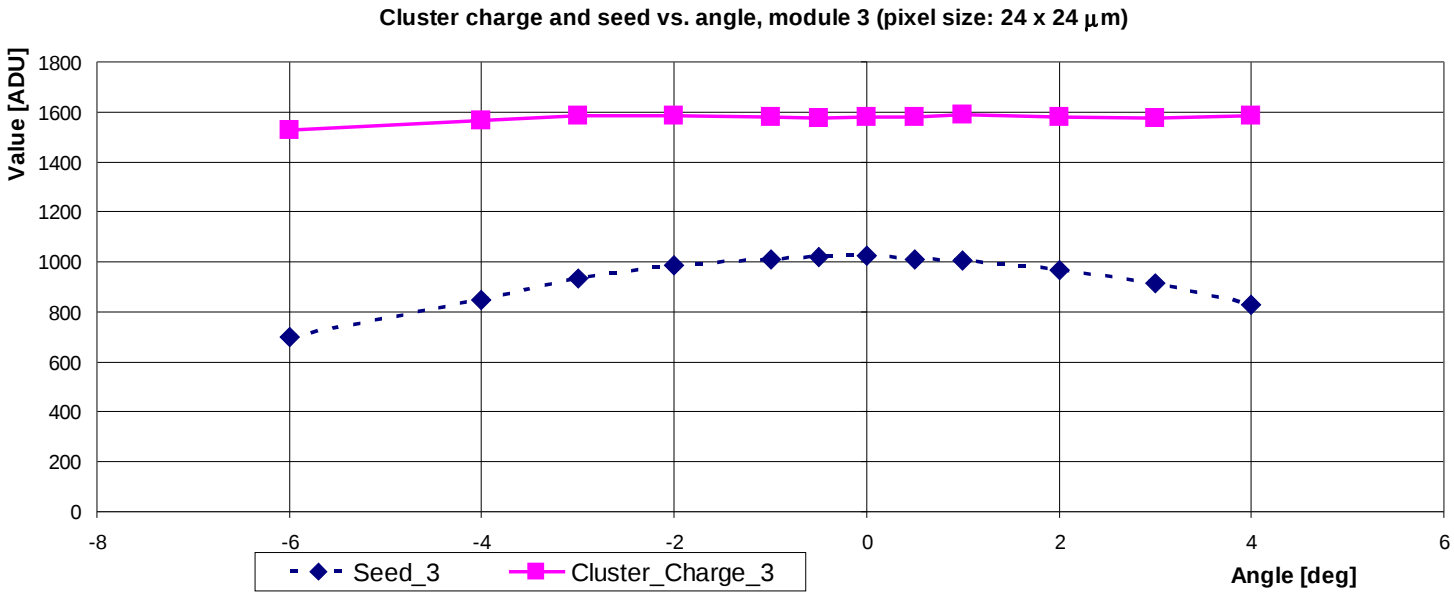
Understand this ---------->>



1757 CCCG, 1677 in the common-clear-gate half...

	d0 (32x24)	d1 (32x24)	d2 (24x24)	d3 (32x24)	d4 (32x24)	d5 (32x24)
Sig3x3(ADU)	1339	1497	1704	1715	1508	1654
Noise (ADU)	12,7	13,4	12,7	13,4	12,8	13,2
SNR	105	112	134	128	118	125
SeedSignal(ADU)	69%	56%	59%	61%	63%	64%
ENC (e^-)	345	326	286	284	309	290
g_q (pA/e^-)	283	316	360	363	319	350

TB2008: charge collection



Prague analysis

TB2008 paper:

Results II: residuals (alignment, η-correction)

Material to be provided by Prague + Bonn + others

Raw residuals from two groups agree within errors
Obtained (as much as possible) without non-standard “corrections”
Uniform response from the entire telescope, apart from the usual increase towards the edges

Module	2	14	11	6	5	7
Bonn X	3,0	2,3		2,2	3,1	3,4
Prague X	2,8	2,1	2,1	2	3	3,4
Bonn Y	2,9	2,2		2,3	3,4	3,4
Prague Y	2,4	1,7	1,7	1,8	2,4	2,8

TB2008 paper:

Results II: resolution (multiple scattering, telescope)

Material to be provided by Prague + others

We cannot ignore multiple scattering (even at 120 GeV) or telescope resolution. DUT resolution measurement obtained by plugging in a theoretical expectation for the Multiple Coulomb scattering (either by simulating the setup in GEANT4 or by a fit like P. Kvasnicka).

module	0	1	2	3	4	5
PRG residual	2.8	2.1	2.1	2.0	3.0	3.4
PRG resolution	2.0	1.5	1.7	1.4	2.5	2.5

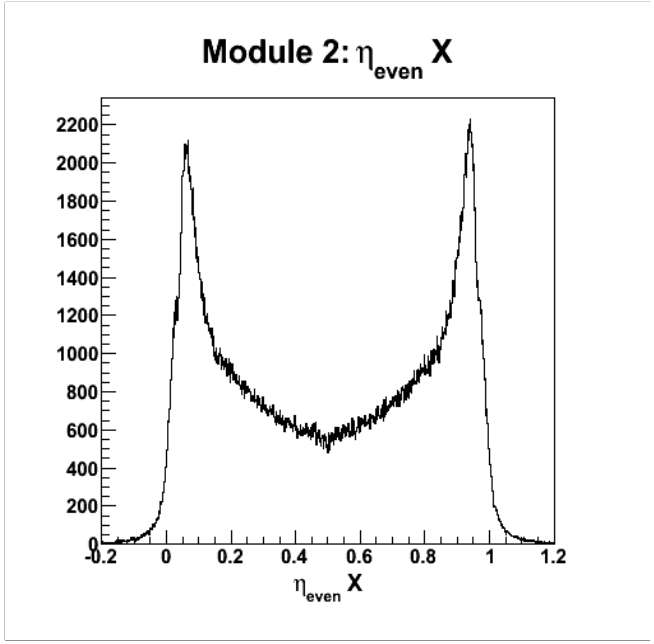
Energy scan is a useful x-check to see we disentangle intrinsic resolution correctly. To be done (Prague)

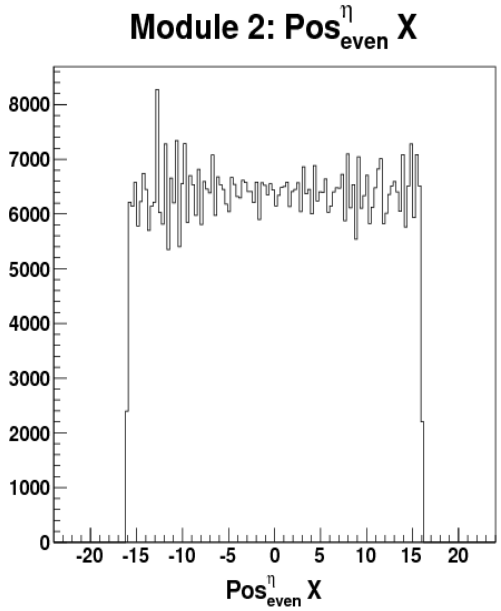
X resolution [µm]	Module 0 CCGME-S90K02 32x24 µm	Module 1 CCGME-90K02 32x24 µm	Module 2 SIMCME-S90K00 32x24 µm	Module 3 CCGME-S90I03 24x24 µm	Module 4 CCGME-S90I00 32x24 µm	Module 5 CCGME-90I00 32x24 µm
TIPP09: PRG, 1318, EdgeCut, Eta, LSR	2.0	1.5	1.7	1.4	2.5	2.5
PRG, 1318, best (Gain, EdgeCut, Eta, LSR)	2.1	1.6	1.9	1.3	2.6	2.4
PRG, 1318, Gain, Eta, LSR	2.1	1.7	2.0	1.3	2.8	2.4
PRG, 1318, Eta, LSR	2.2	1.7	2.1	1.3	2.8	2.4
PRG, 1318, Gain, Eta, LSR	2.1	1.5	1.5	1.4	2.7	2.3
PRG, 1318, Gain, EdgeCut, Eta	2.0	1.5	1.5	1.3	2.5	2.4
PRG, Cluster analysis - minimum limit	0.7	0.7	0.6	0.5	0.8	0.8
PRG, Cluster analysis - recalculate	2.1	2.2	1.9	1.5	2.4	2.4
PRG, simulation	2.3	1.4	1.8	1.5	2.5	2.7
Net Tracking Error	1.7	1.4	0.9	1.2	1.5	2.1
Multiple Scattering	1.2	0.4	0.9	0.9	0.4	1.2

TB2008 paper:

Results III: in-pixel studies

Material to be provided by Bonn (Lars) + others





TB2008: write-up

TB2008 paper or separate EUDET note:

Results IV: EUDET telescope

Material to be provided by Julia Fourletova

1) DEPFET Reader: special processor to convert raw DEPFET data to LCIO

2) additional options in PedestalAndNoise and CalibrateEvent Processors (for Common Mode correction)

3) GEAR geometry and HitMaker were adapted for the DEPFET geometry.

4) Millepede-II as alignment for DEPFET Telescope

Modification of the DEPFET Reader Processor for the new DEPFET S3B system are done.

TB2008 paper

A skeleton has been defined, the material has been identified, including responsible persons where final results are missing.

Apart from one or two remaining puzzles, the results are essentially understood and as expected.

Write-up (M.V.) over the next two months.

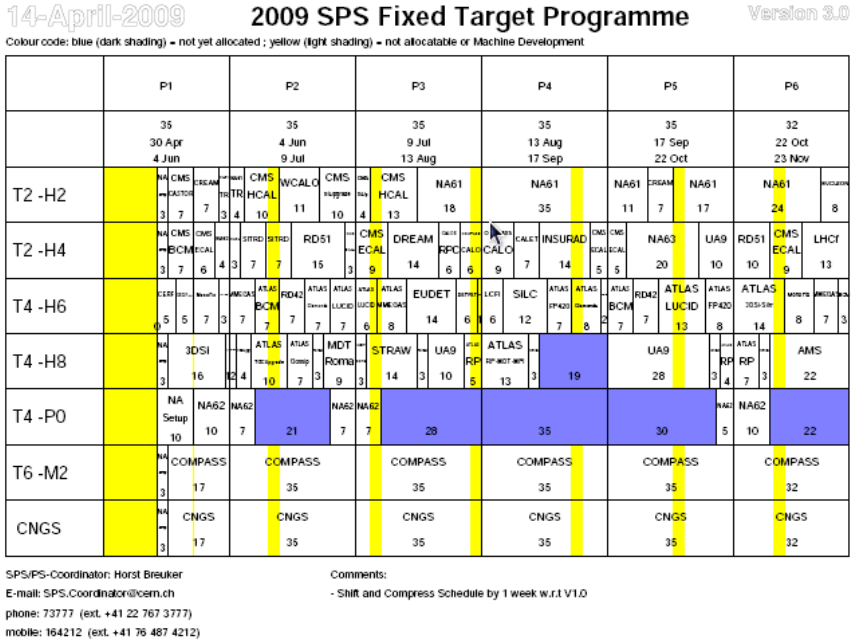
TB2009

http://spsschedule.web.cern.ch/SPSschedule/schedules/sps/2009/v300/all.pdf

This summer's TB programme:

- main user's period in second week of August
- EUDET (including DEPFET DUT) starts two weeks earlier

Setup of DEPFET telescope from approx 23rd of july, to be in the beam by end of July



14-April-2009 — 2009 SPS Fixed Target Programme — Version 3.0

Colour code: blue (dark shading) = not yet allocated ; yellow (light shading) = not allocatable or Machine Development

	P1	P2	P3	P4	P5	P6
	35 30 Apr 4 Jun	35 4 Jun 9 Jul	35 9 Jul 13 Aug	35 13 Aug 17 Sep	35 17 Sep 22 Oct	32 22 Oct 23 Nov
T2 -H2	NA 3 · CMS CASTOR 7 · CREAM 7	TR 3 · CMS HCAL 10 · WCALO 11 · CMS 10	CMS 4 · CMS HCAL 13 · NA61 18	NA61 35	NA61 11 · CREAM 7 · NA61 17	NA61 24 · 8
T2 -H4	NA 3 · CMS BCM 7 · CMS ECAL 6	4 · 3 · SITRD 7 · SITRD 7 · RD51 15 · 3	CMS ECAL 9 · DREAM 14 · RPC 6 · CALO 6	9 · CALET 7 · INSURAD 14 · CMS 5 · ECAL 5	NA63 20 · UA9 10	RD51 10 · CMS ECAL 9 · LHCf 13
T4 -H6	0 · 5 · 5 · 7 · 3 · 7 · ATLAS BCM 7 · RD42 7 · 7 · ATLAS LUCID 6	ATLAS 8 · EUDET 14 · 6 · LCFI 6 · SILC 12 · ATLAS 7 · ATLAS 8	ATLAS BCM 7 · RD42 7 · ATLAS LUCID 13 · ATLAS FP420 8	ATLAS 14 · 8 · 7 · 3
T4 -H8	NA 3 · 3DSI 16 · 12 · 4 · ATLAS 10 · ATLAS 7 · MDT 3 · 9 · 3	STRAW 14 · 3 · UA9 10 · RP 5	ATLAS 13 · 3 · 19	UA9 28 · RP 4 · ATLAS RP 7 · 3 · AMS 22
T4 -P0	NA Setup 10 · NA62 10	NA62 7 · 21 · NA62 7 · NA62 7 · 28	35	30 · 5 · NA62 10 · 22
T6 -M2	NA 3 · COMPASS 17	COMPASS 35	COMPASS 35	COMPASS 35	COMPASS 35	COMPASS 32
CNGS	NA 3 · CNGS 17	CNGS 35	CNGS 35	CNGS 35	CNGS 35	CNGS 32

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Comments:
- Shift and Compress Schedule by 1 week w.r.t V1.0

SPS H6 schedule

	==========	========	========
Date	23/7 - 6/8	6/8 - 13/8	13/8 - 19/8
Main user	EUDET	DEPFET	LCFI
Parasitic/DUT	DEPFET	?	DEPFET?

TB2009

First “telescope” modules succesfully built and tested at Bonn

- 128x128 matrices, S3b system
- the new work-horse module
- A great telescope for thinned large-pixel DUTs!

Identify matrices and auxiliary components for 5 or 6 of these systems

Interesting DUT candidates:

- Irradiated module (matrix is still in a fridge in Munich, to be evaluated this month)
- CCCG module (given Stefan's results)

Modules to be tested/characterized using standard setup

Power supplies (see Johannes Schneider's talk)

Voltages (at least scan a standard range)

DAQ/sequence

Linux DAQ ready to be used with S3b + expert available for (first part) of the beam period

Total data volume expected to be smaller than last year (compatible with storage capacity at Bonn)

Looking for someone who wants to investigate the possibility of using GRID storage (most people have access to ILC VO, what about Belle II?)

Preferably in combination with centralized preprocessing of data
RAW DATA -> zero-suppressed standard format (LCIO)

TB2010

Some possibilities, combined test beams, TB in magnetic field, etc., will be discussed in a TB workshop at LAL, 3rd - 6th of November

As silicon tracking/vertexing representative in the scientific committee I should collect ideas in this community and find candidate speakers

TB2010 will be very interesting, if there is time to convert PXD6 matrices into working modules. Beam period in fall (october/november?)

Conclusions

In summary:

Thanks to the whole team for the hard work that's the basis of the success of TB2008: to be completed by a publication of the key results

For this year:

Module preparation for TB2009 has started

fully plug-and-play system

This summer's TB period

from July 23rd to August 13th

Analysis

do not start from scratch!