

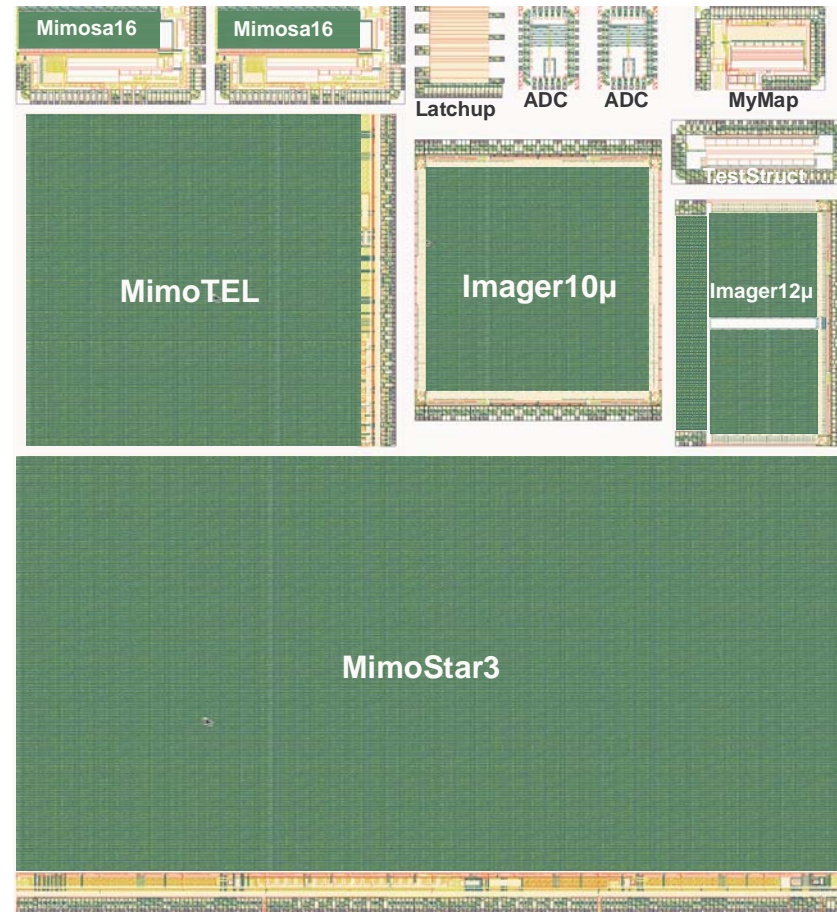
EUDET Beam Telescope: status of sensors for the demonstrator

Wojciech Dulinski on behalf of IPHC

Outline

- **Engineering run AMS-035 OPTO**
- **MimoTEL availability status**
- **Mimosa18 availability status**
- **Status of wafer thinning**
- **Beam tests of Mimosa18 (High Resolution Tracker)**
- **Conclusions**

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



Several devices of direct interest for EUDET: **MimoTEL** (256x256, 30 μm pitch), **HRTracker** (512x512, 10 μm pitch), **Mimosa16** (binary readout prototype), **MimoSTAR3L**, ADC, test structures...

“Wafer delivery story”

- End of October 2006, reception of engineering run
- Two wafers diced (one 20 and one 14 μm), beginning of tests
- Problem: missing layer (poly HighRes)
- February 2007: re-processing
- One wafer from this run submitted for thinning (down to 50 μm , on reticle basis) at the high-tech company at California (via LBL)
- Purchase of remaining (4+5) wafers and beginning of probe-testing (yield study). Currently still under way (MimoSTAR3)

EUDET Annual Meeting, Paris (EP), October 2007

MimoTELS availability status (October 2007)

Sensor #	Epi thickness	Status	Holding Inst.	Comments
1	20 μ	OK	IPHC	
2	20 μ	OK	IPHC	missing
3	20 μ	OK	IPHC	
4	20 μ	OK	Ferrara	
5	20 μ	OK	DESY	
6	20 μ	OK	DESY	
7	20 μ	OK	DESY	
8	20 μ	OK	DESY	
9	14 μ	Pixel yield?	DESY	
10	14 μ	Pixel yield?	DESY \rightarrow IPHC	to be changed
11	14 μ	OK!	DESY	
12	14 μ	OK!	DESY	
13	14 μ	OK!	DESY	
14	14 μ	OK!	DESY	
15	14 μ	OK!	IPHC	
16	20 μ	Not tested	IPHC	
17	20 μ	Not tested	IPHC	
18	20 μ	Not tested	IPHC	

EUDET Annual Meeting, Paris (EP), October 2007

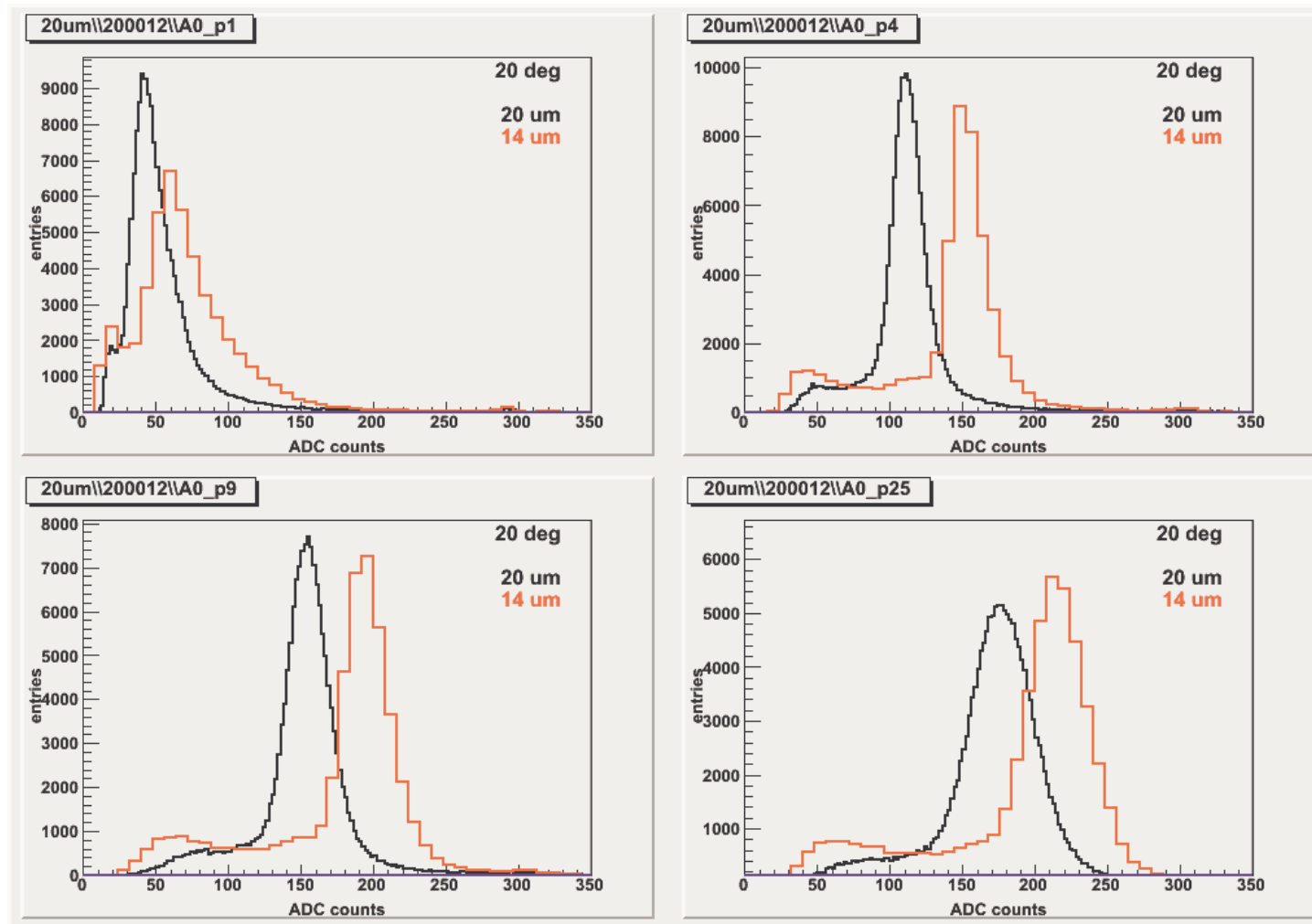
Mimosa18 availability status (October 2007)

Sensor #	Epi thickness	Status	Holding Inst.	Comments
1	20 μ	OK	IPHC	
2	20 μ	OK	IPHC	
3	20 μ	OK	IPHC	
4	20 μ	OK	IPHC	
5	20 μ	OK	DESY	
6	14 μ	OK	IPHC	
7	14 μ	OK	IPHC	
8	14 μ	OK	IPHC	
9	14 μ	OK	IPHC	
10	14 μ	OK	IPHC	
11	14 μ	OK	IPHC	
12	14 μ	OK	Frankfurt	
13	14 μ	OK	Frankfurt	6*10 ¹² n/cm ²
14	14 μ	OK	Frankfurt	10 ¹³ n/cm ²
15	14 μ	OK	Oregon	
16	20 μ	OK	Oregon	
17	20 μ	OK	IPHC	
18	20 μ ??	OK	IPHC	Run 2007
19	20 μ ??	OK	IPHC	Run 2007: thinned to 50μm!

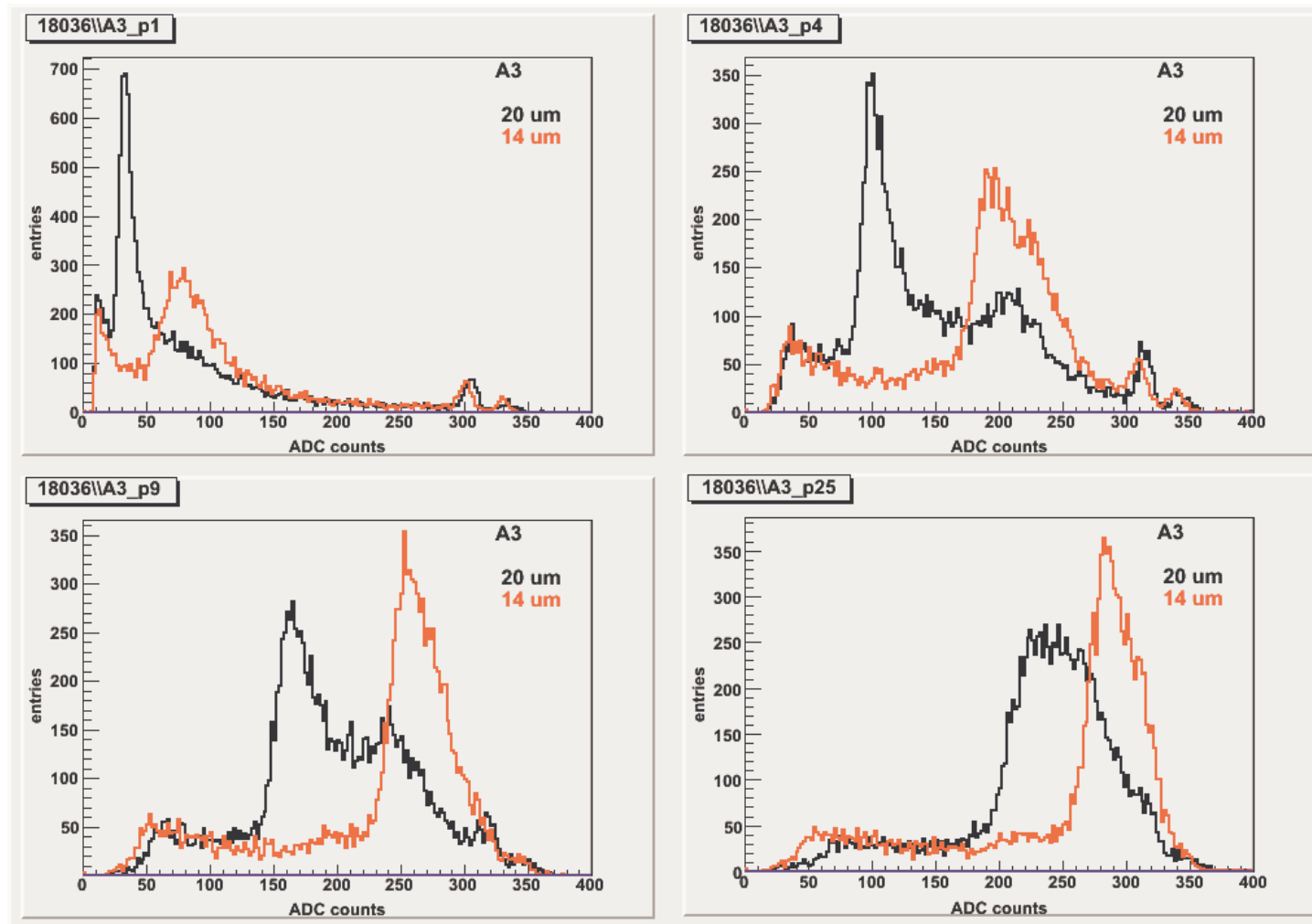
General remarks concerning tested wafers

- Dark current on rad-tol diodes (MimoSTAR, MimoTEL) is factor of 5 to 10 **higher** than expected
- Dark current on non rad-tol diodes (Mimosa18) is factor of 5 to 10 **lower** than expected...
- Excellent yield of medium-size sensors (except for two 14 μm MimoTELS), this is NOT the case of MimoSTAR3...
- Excellent noise performance of M18: ENC ~ 10 electrons at room temperature and 4 ms integration (10 MHz clock)

Calibration results with Fe⁵⁵ - MimoTEL

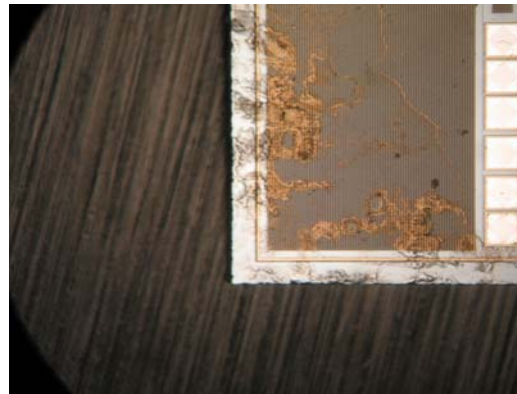
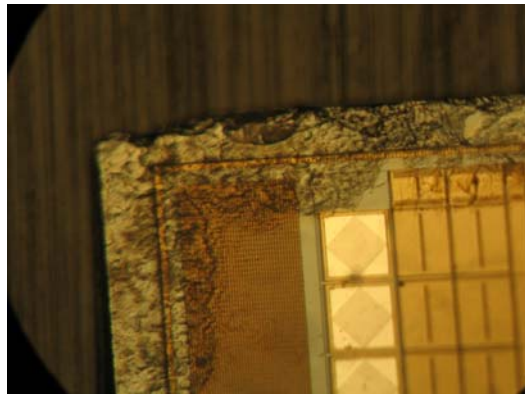


Calibration results with Fe⁵⁵ : M18 (High Resolution Tracker)



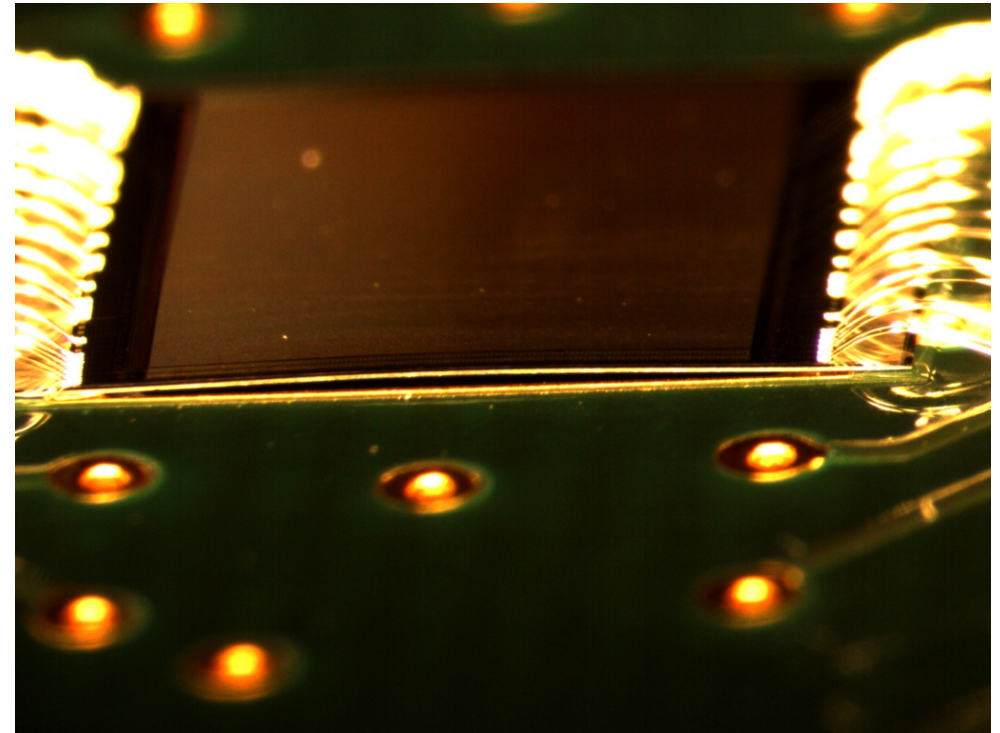
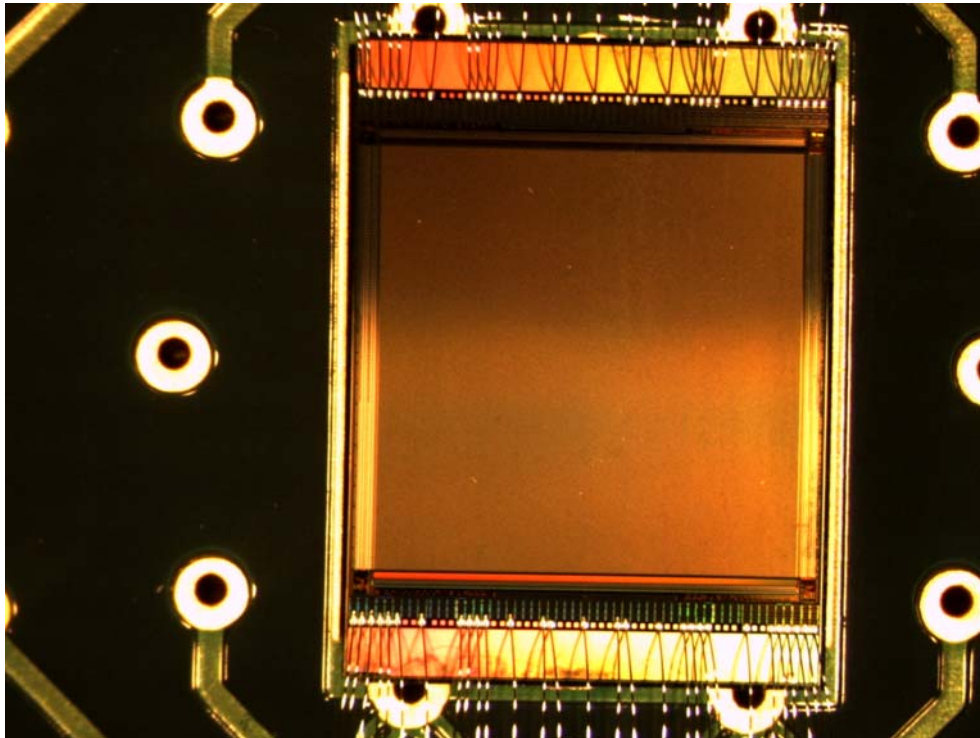
“Wafer thinning story”

First batch of three reticles from 2007 re-submission: surface pollution (over-etching?) and transport problems ...



More thinned reticles expected soon (end of October)

One Mimosa18 successfully bonded to PCB
It works, but the chip clearly bended!

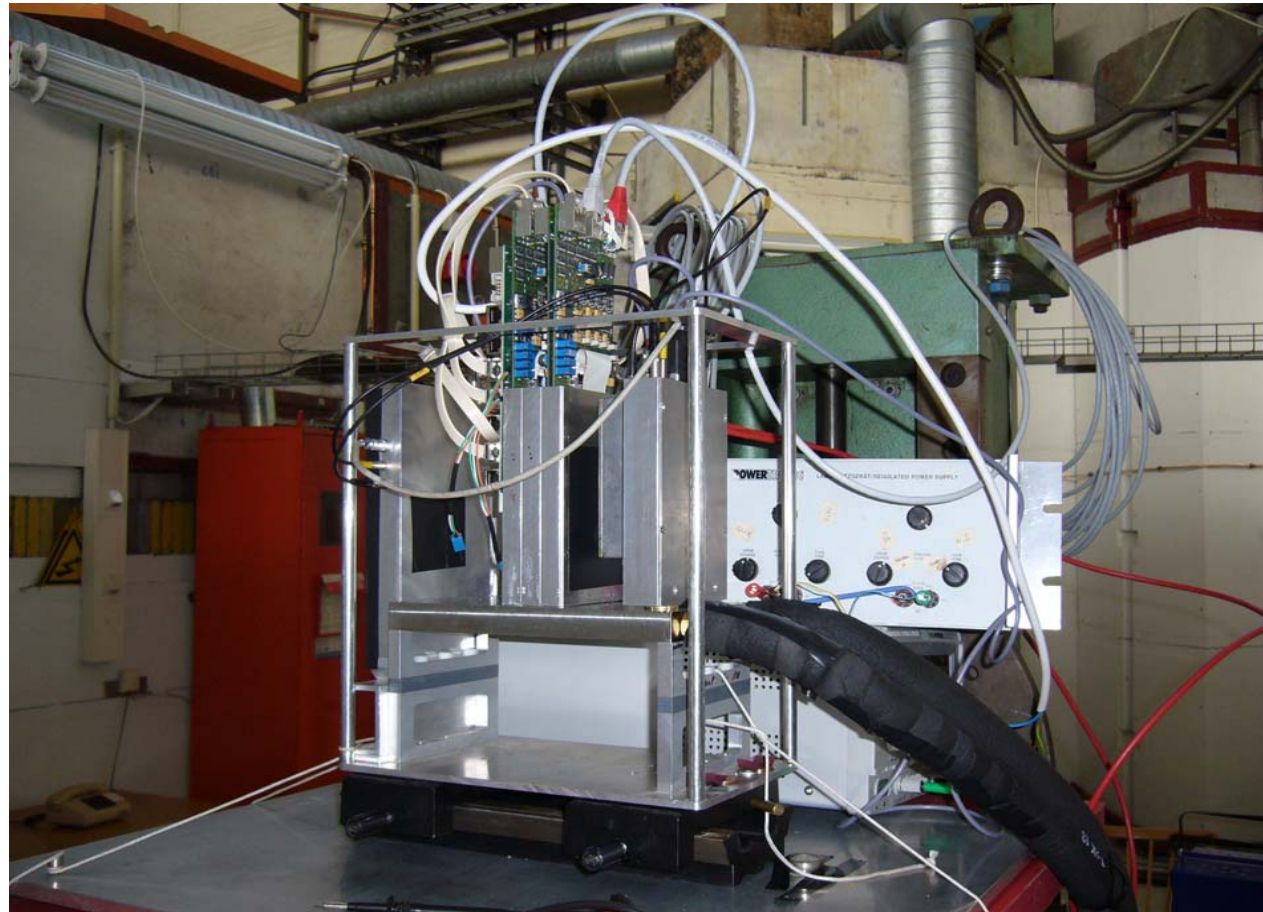


**The mounting problem still to be solved, some help expected
from CERN bonding workshop experts (Ian McGill)...**

TAPI : Telescope a Pixels

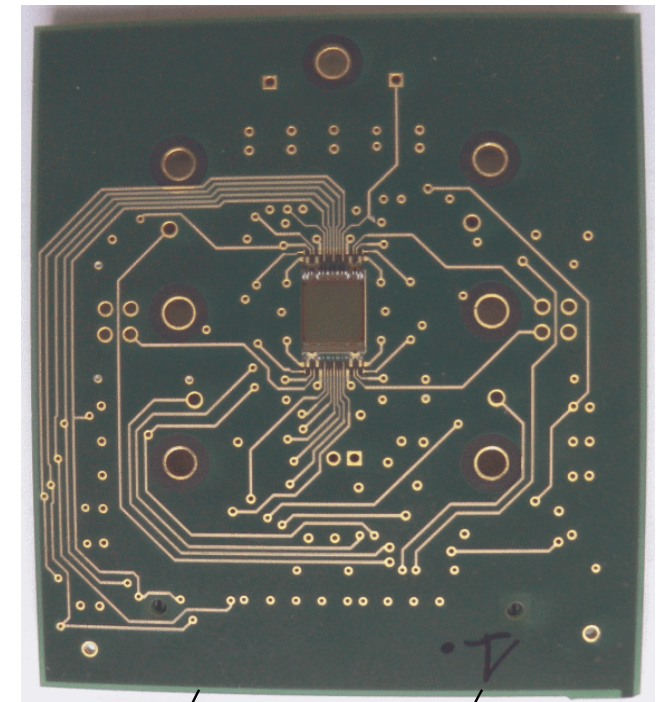
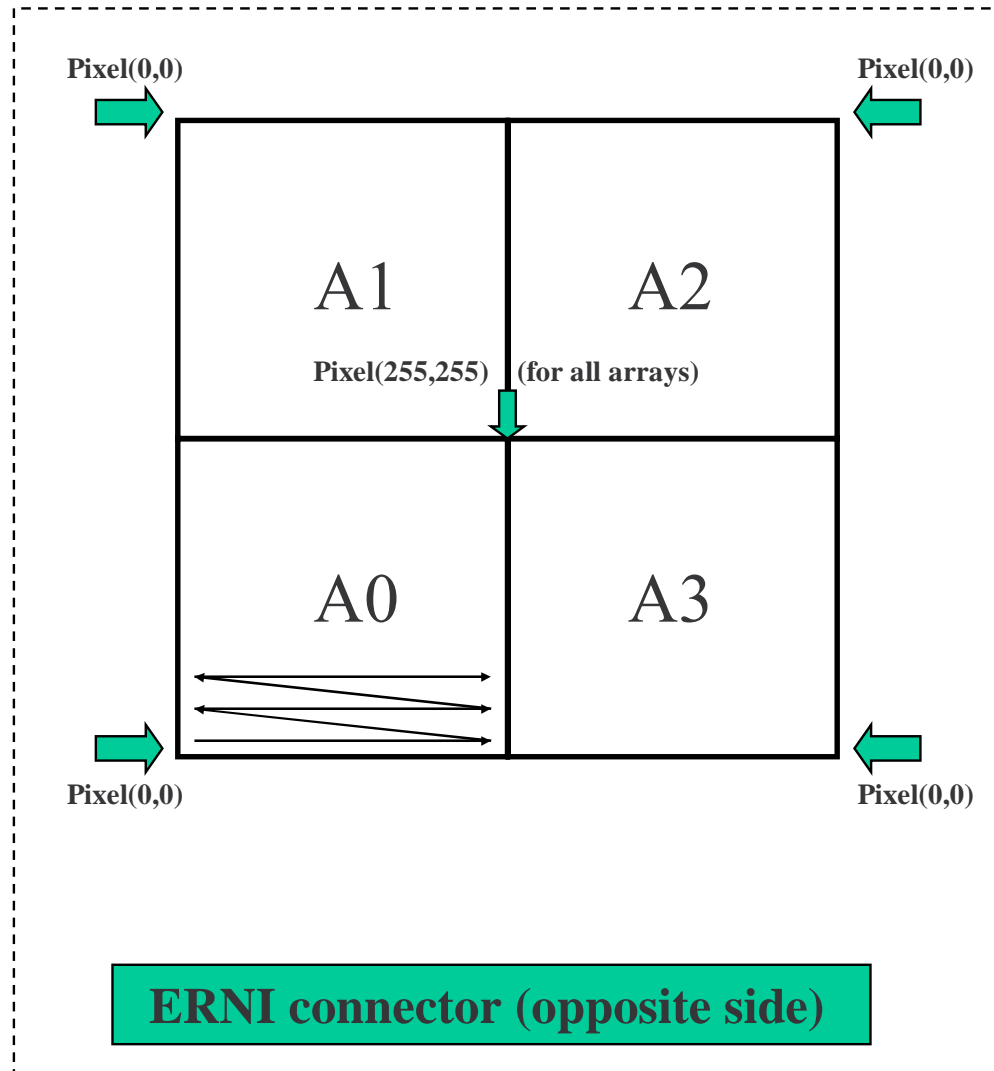
Four reference planes based on M18 plus a place for a DUT in the middle

Beam Test DESY June 2007 on beam line 24



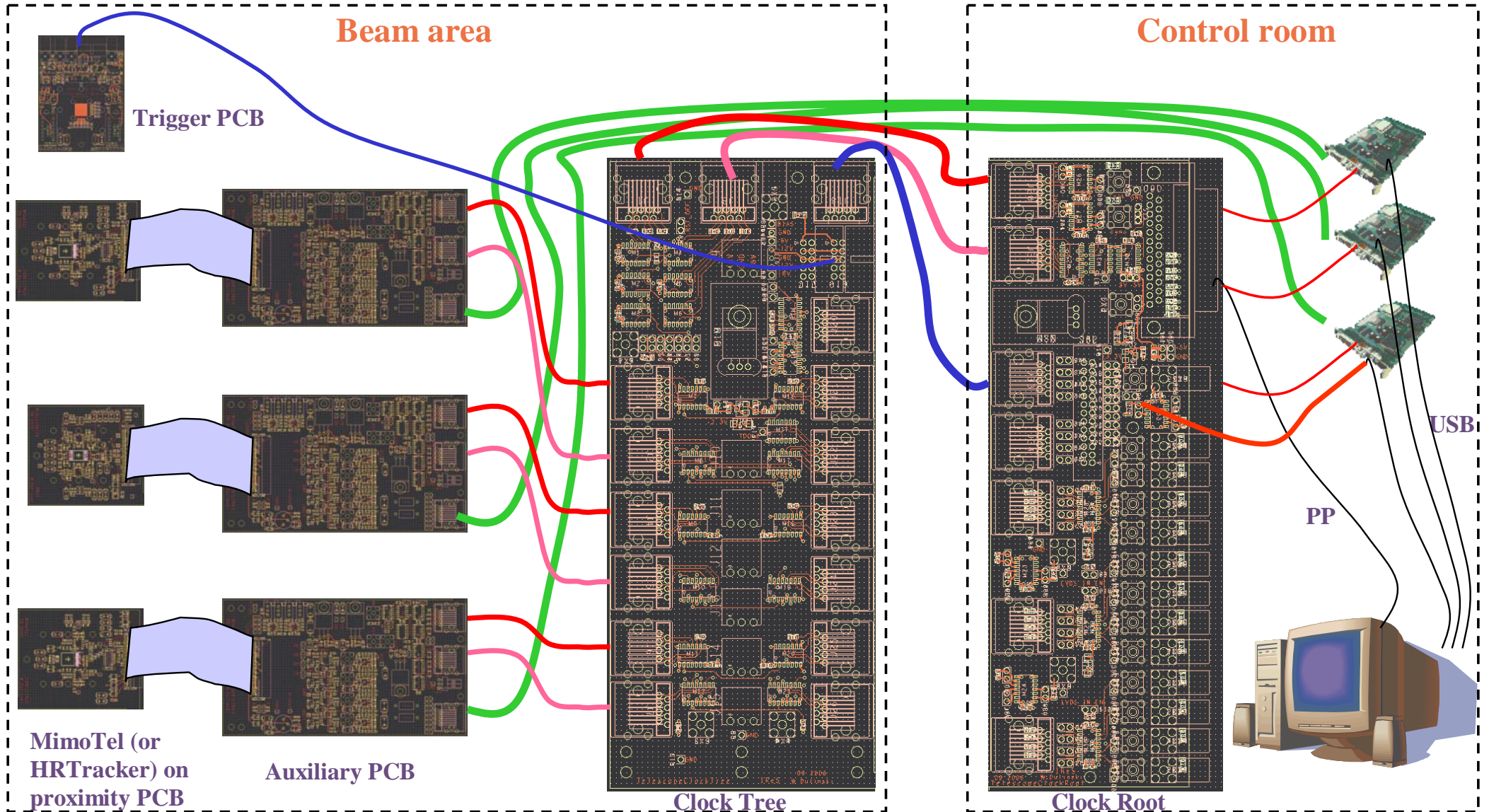
W.Dulinski, G.Claus, M.Goffe

Mimosa18 (10 μm pixel pitch) on PCB



cable

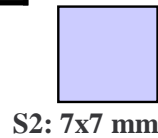
Telescope PCBs and cables



3-plane M18 μ Telescope: DESY June 07

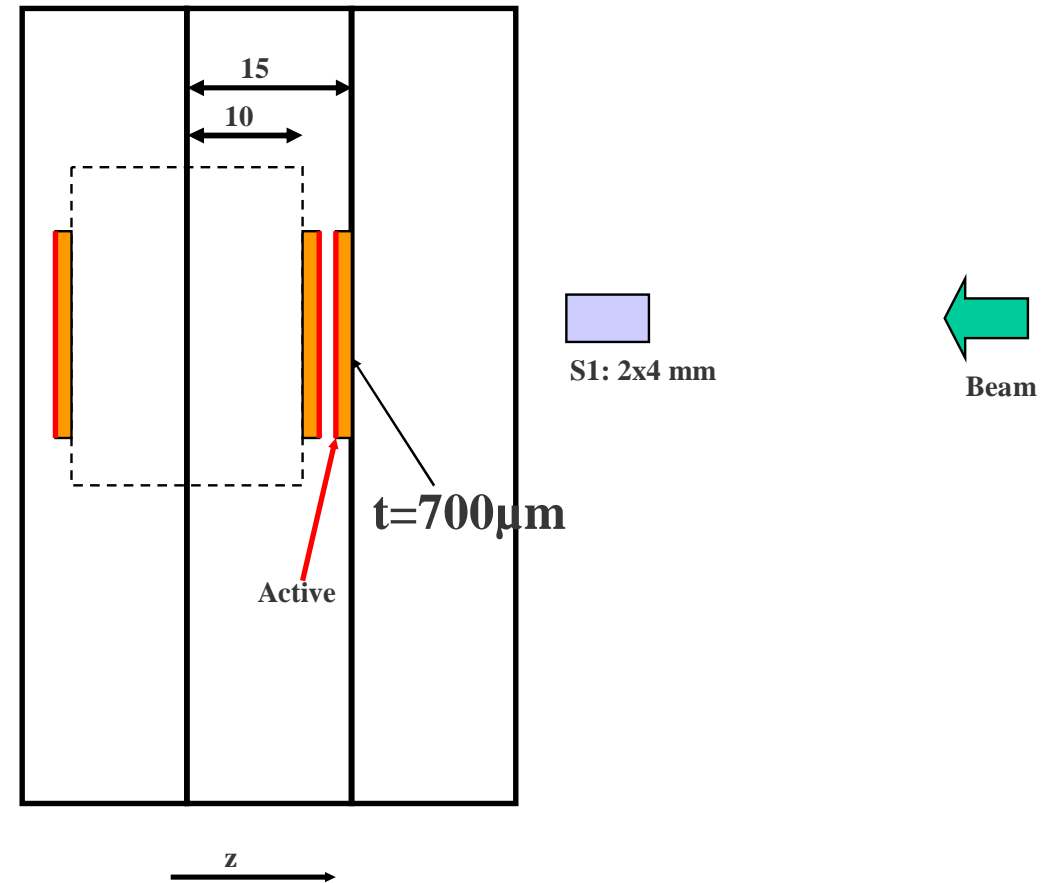
Run 18500 – 18505

z position	-t	20+t	25-t	empty
ADC #	3	2	1	0
Chip #	14 μ m-33 A3	14 μ m-32 A0	14 μ m-35 A3	Trigg_m k



Run 18506 – 18509

z position	-t	20+t	25-t	empty
ADC #	3	2	1	0
Chip #	20 μ m-4 A3	20 μ m-2 A0	20 μ m-1 A3	Trigg_m k



3-plane M18 μ Telescope: DESY June 07

μ Telescope 14 μ m

Run	Energy	#events	date
18500	5 GeV	40k	07.06.2007
18501	3 GeV	40k	07.06.2007
18502	1 GeV	40k	07.06.2007
18503	6 GeV	40k	07.06.2007
18504	2 GeV	40k	08.06.2007
18505	4 GeV	40k	08.06.2007

Run 18505: CDS!

μ Telescope 20 μ m

Run	Energy	#events	date
18506	5 GeV	40k	08.06.2007
18507	3 GeV	40k	08.06.2007
18508	1 GeV	40k	08.06.2007
18509	2 GeV	40k	08.06.2007
18510	5 GeV	120k	08.06.2007

Run 18510: with layer of tungstène in front

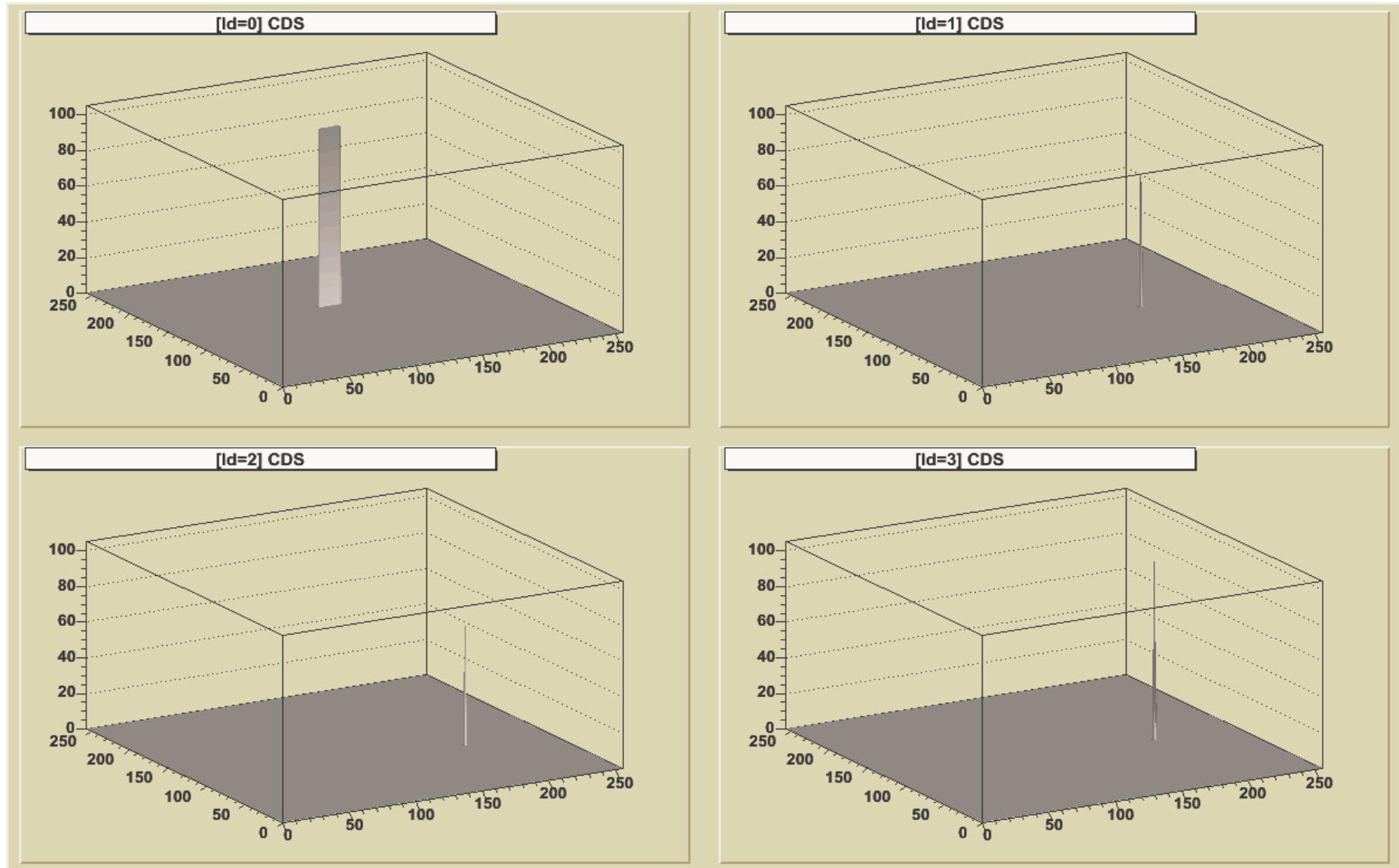
Mimosa 18 (carte USB n°26)

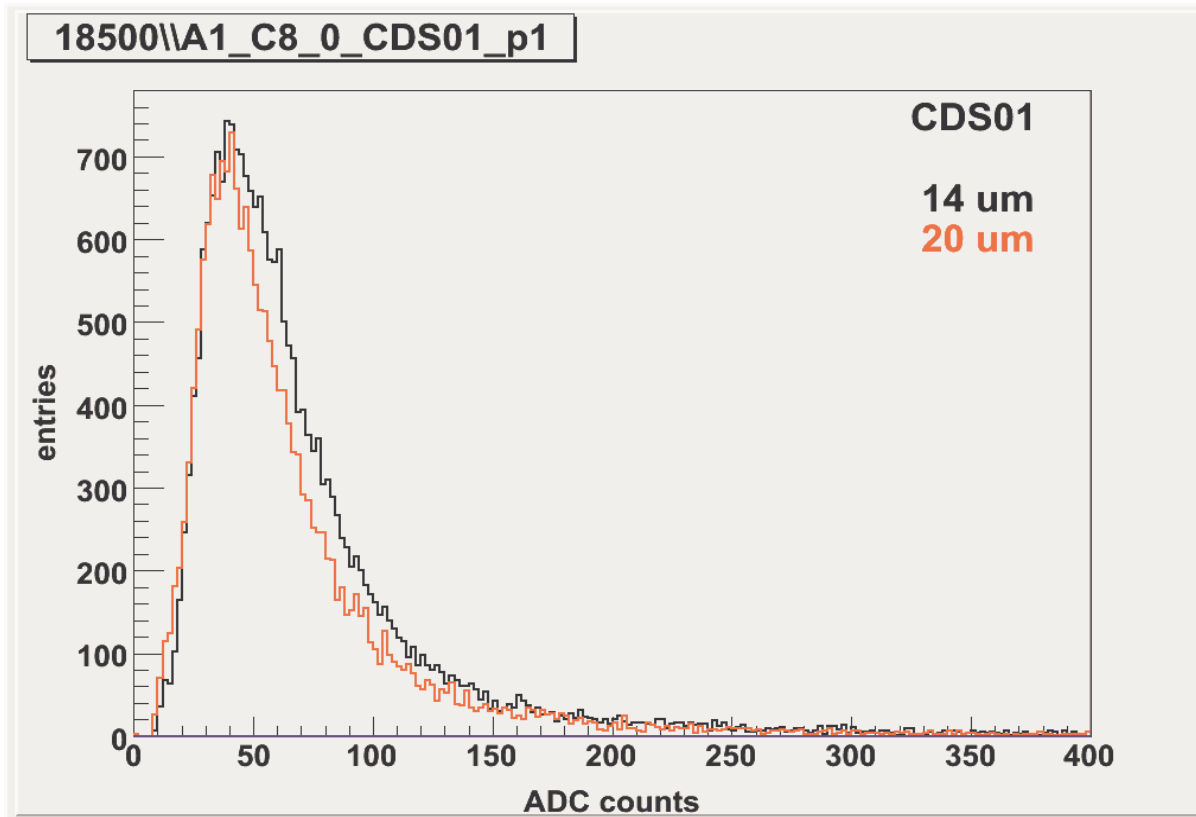
Acquisition on 3 channel (A1, A2, A3) of three submatrice (A3, A1, A3)

Run effectue a 16 MHz $\tau_i = 4$ ms

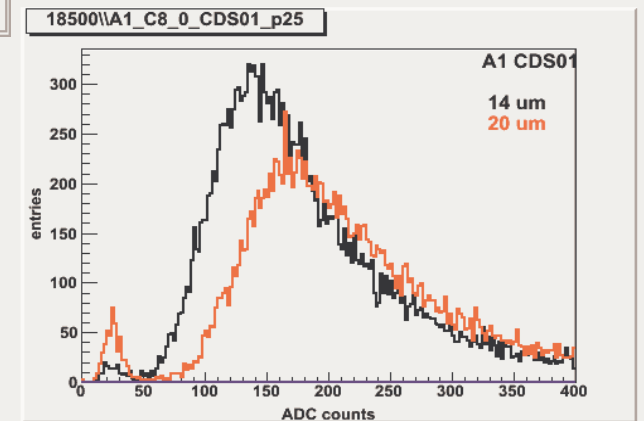
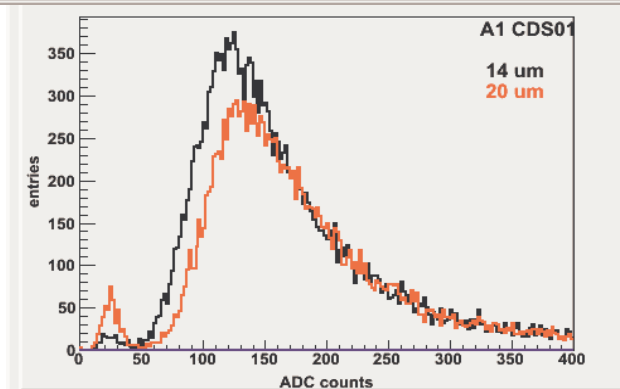
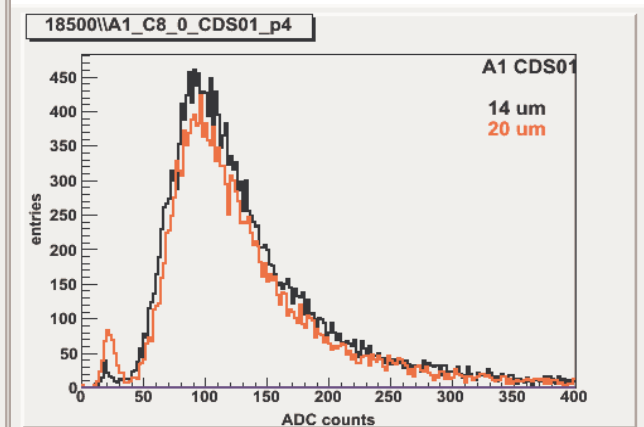
Temperature liquide 15 ° C

One event: trigger marker plus three hits





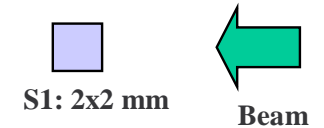
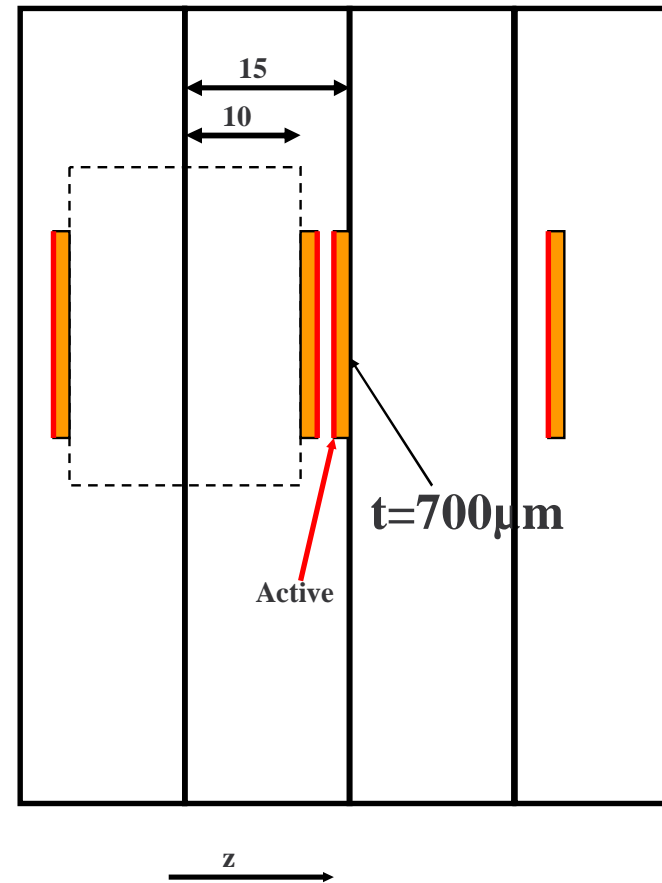
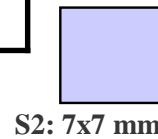
Landau distribution:
Noise ~ 1,43 ADC
S/N_{MP,seed} ~ 30



4-plane M18 μ Telescope: CERN Sept 07

Run 18520 – 18529

z position	-t	20+t	25-t	45-t
ADC #	3	2	1	0
Chip #	20 μ m-4 A3	14 μ m-33 A0	14 μ m-35 A3	20 μ m-5 A3



4-plane M18 μ Telescope: CERN Sept 07

μ Telescope 14/20 μ m

Run	Energy	#events	date
18520*	120GeV	25k	07.09.2007
18521*	120GeV	12k	08.09.2007
18522*	120GeV	20k	08.09.2007
18523*	120GeV	40k	08.09.2007
18524*	120GeV	40k	08.09.2007
18525*	120GeV	5k	10.09.2007

Run	Energy	#events	date	
18526	120GeV	10k	10.09.2007	0°, prel. adj.
18527	120GeV	10k	10.09.2007	180°, prel. adj.
18528	120GeV	50k	11.09.2007	0°, final adj.
18529	120GeV	10k	11.09.2007	180°, final adj.

COOLING at 15°C

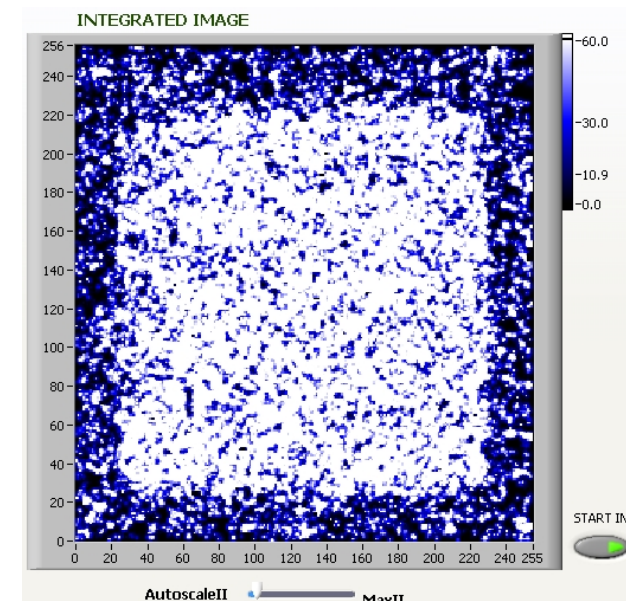
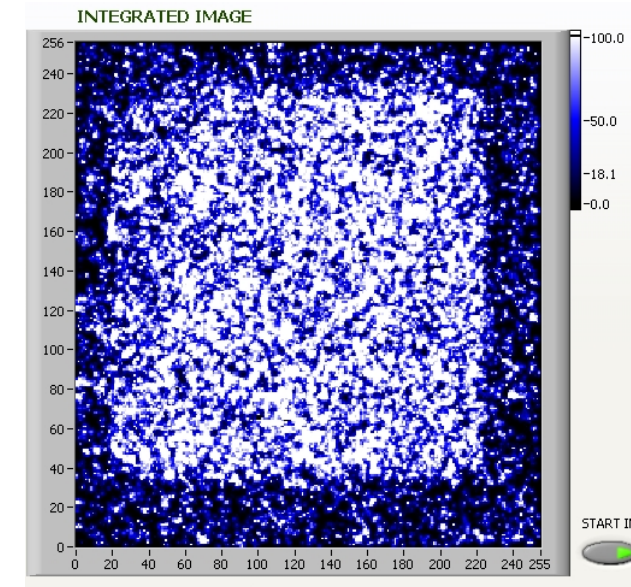
***NO COOLING, BEAM and SCINT.
POSITION ADJUSTMENT**

Mimosa 18 (carte USB n°26)

Run effectue a 16 MHz $\tau_i = 4$ ms

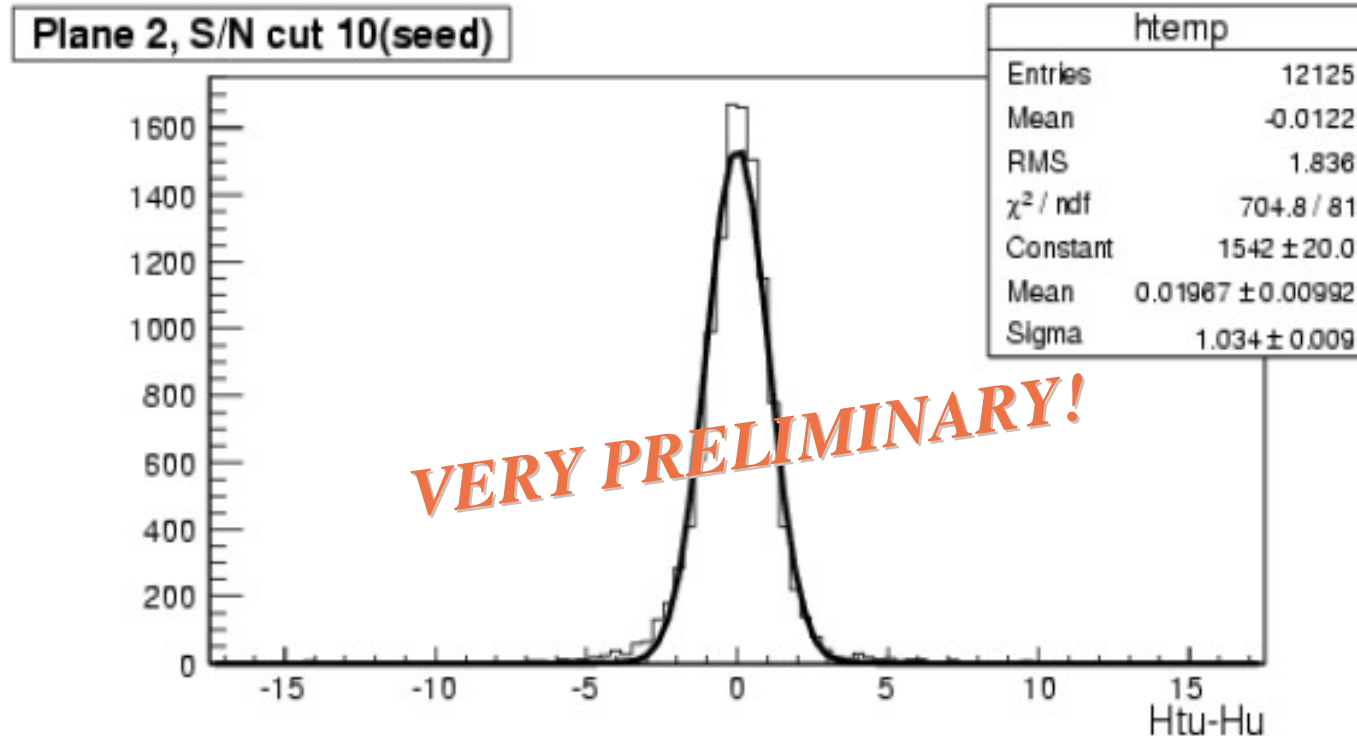
Temperature liquide 15 ° C

Beam Test CERN September 2007: TAPI on beam line H6a



**Image of 2x2 mm² trigger scintillator
on the first and the last telescope plane**

Analysis is still going on, result to be presented at NSS-2007
Volunteers are welcome to contribute!



Residual distribution for DUT

Constraints: 4 detector planes, 3 used in the track fit, one as DUT

Efficiency > 99.5%

$\sigma < 1 \mu\text{m}$ (Center-of-Gravity from 3x3 pixels)

PCB's status

- **Twenty PCB front-sets (MimoTEL + HRTracker + Auxiliary) fabricated in 2006, 5 fully assembled at IPHC, 15 fully assembled at DESY**
- **Second batch of PCBs fabricated in 2007: 10 to be assembled at DESY, 10 to be assembled at Frankfurt**
- **Production of third batch of PCBs (20 pc) is planned (October?)**

Do we need more PCBs for EUDET?

Conclusions

- **Assembling and delivery of sensors for the demonstrator went quite smoothly and is almost complete**
- **The last issue in the delivery scheme (thinned chips) is expected to happen soon**
- **Beginning of the next step: testing of Mimosa22, a binary readout sensor prototype for EUDET final telescope.
Other groups interested in this exercise?**