JRA1 Status: PCMAG, Sensors and Infrastructure

Tobias Haas
DESY/F1
11 September 2006

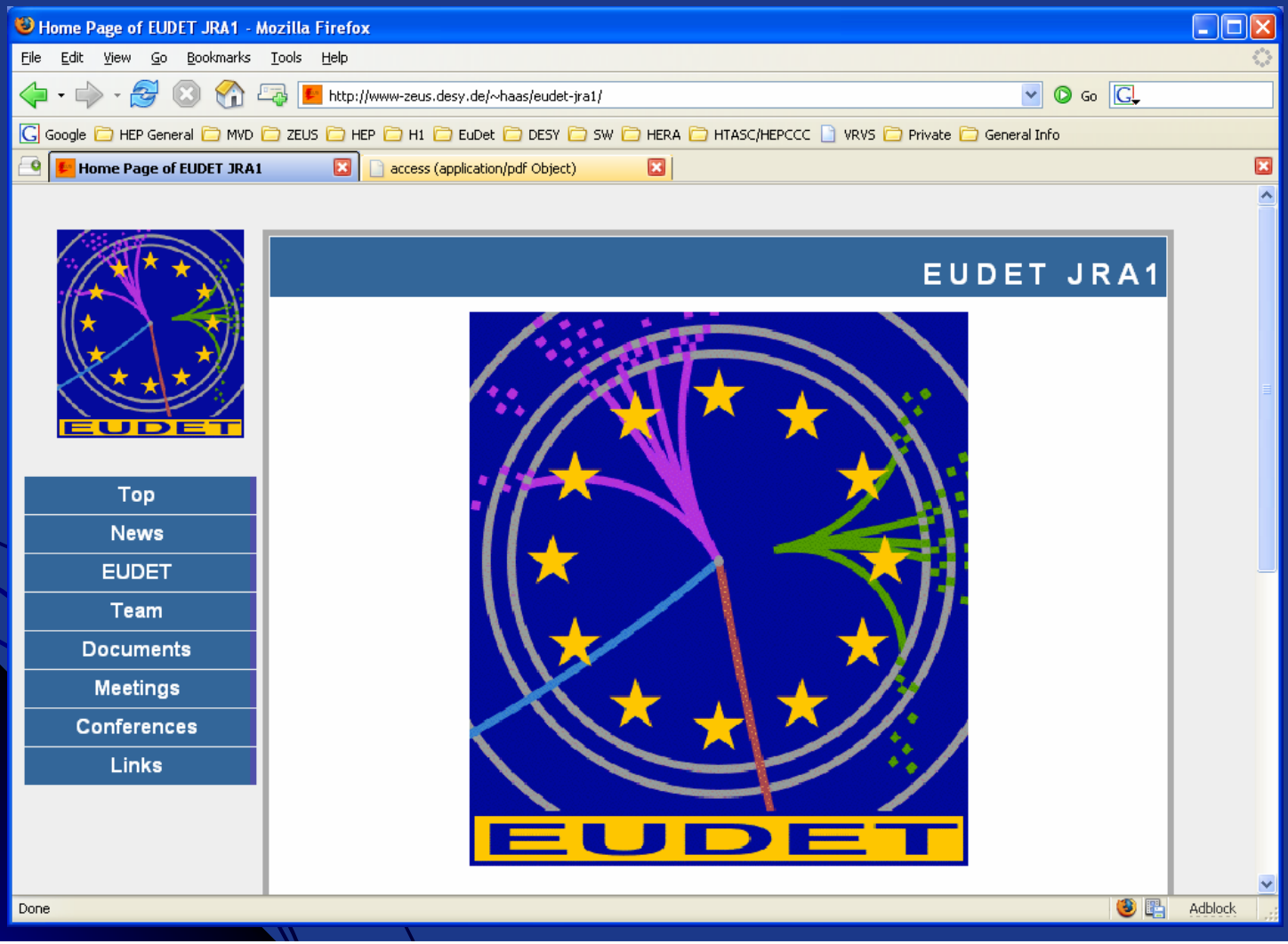
This Talk

- Reminder: JRA1
- Magnet
- Sensors
- Infrastructure
- Simulations
- Results from MIMO*2 test @ DESY
- Personnel/Finances

JRA1

- General Purpose Test beam infrastructure
  - DESY Test beam
  - PCMAG
- Pixel telescope
  - high precision (~ 1 µm even in a 6 GeV/c electron beam)
  - reasonably large area (~ 1 – 2 cm)
  - Fast readout (~1kHz frame rate) to handle higher rate environments
- ☞ *Staged Implementation*
  - Demonstrator telescope with slightly less precision and slower R/O (analog pixel sensor)
  - Final telescope with high precision and high rate (pixel sensor with ADC and data reduction on chip

WEB info


Home Page of EUDET JRA1 - Mozilla Firefox
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http://www-zeus.desy.de/~haas/eudet-jra1/
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The Team

Coordinators

Tobias Haas (JRA Coordinator)	DESY
Daniel Haas (DAQ)	Université de Genève
Wojciech Dulinski (Telescope Sensors)	IRES Strasbourg
David Cussans (Validation)	University of Bristol
Ingrid-Maria Gregor (Telescope Integration)	DESY
Katsumasa Ikematsu (PCMAG Magnet)	DESY

Collaborators

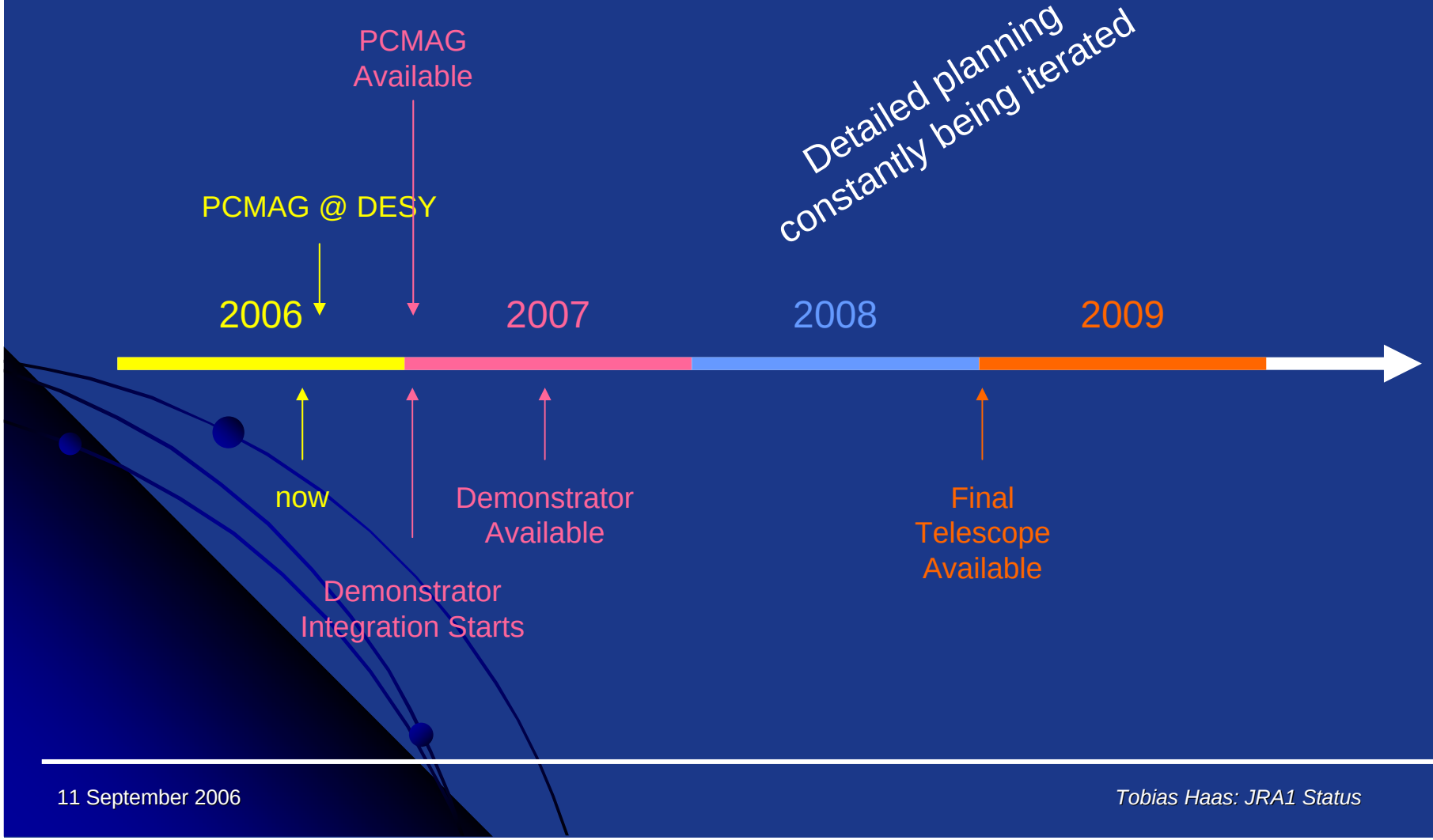
Institute	Contact
DESY (Hamburg, Germany)	Tobias Haas
CEA/DAPNIA (Saclay, France)	Pierre Lutz
CERN (Genève, Switzerland)	Lucie Linssen
CNRS/IRES (Strasbourg, France)	Marc Winter
Max-Planck-Institut für Physik (München, Germany)	Hans-Günter Moser
Universität Bonn (Bonn, Germany)	Hans Krüger
Universität Mannheim (Mannheim, Germany)	Peter Fischer
Université de Genève (Genève, Switzerland)	Martin Pohl
University of Bristol (Bristol, United Kingdom)	David Cussans
Warsaw University (Warsaw, Poland)	Aleksander Filip Zarnecki

Mailing List

Use **eudet-jra1@desy.de** to contact the members of this JRA

Last update by **Tobias Haas** on 8 Sep 2006, 17:03

Current Planning



Preparation of Test Beam Area 24/1 for PCMAG

Carsten Muhl

Entrance

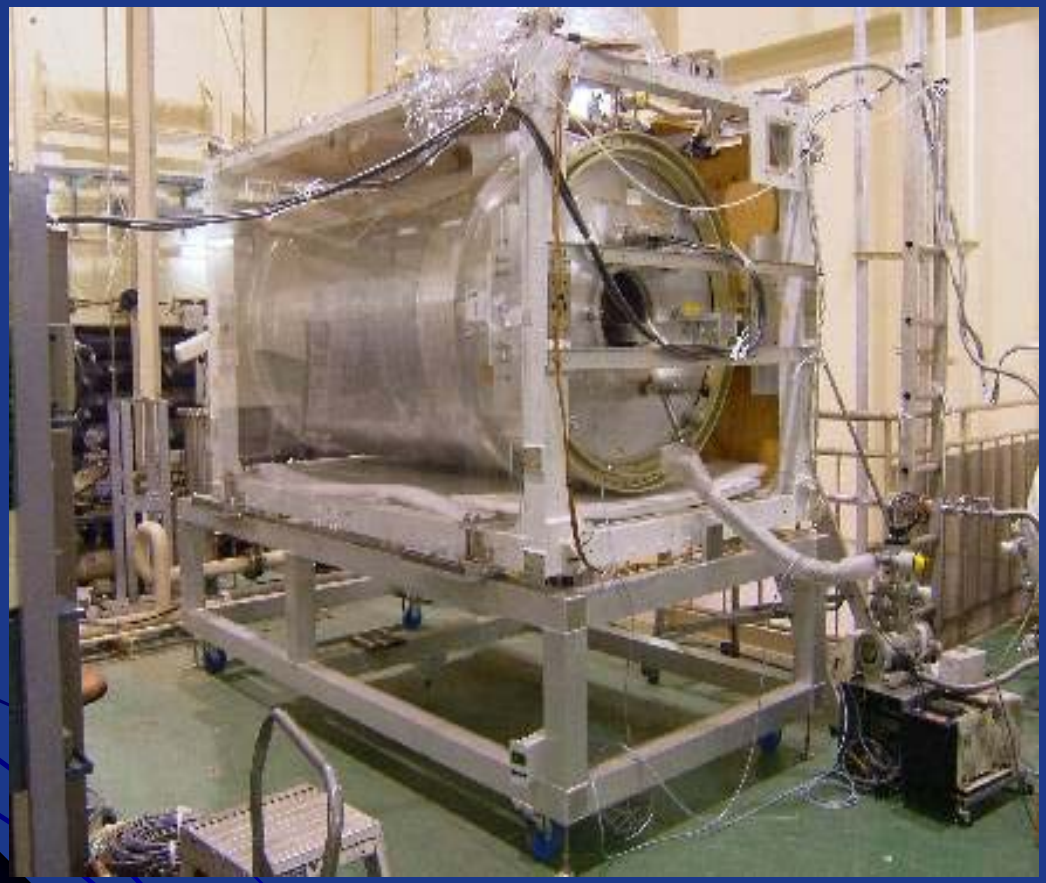
The test beam area has been renovated by MEA (Norbert Meyners).

Concrete Block as Base for PCMAG

- A concrete block is placed in the area as base for the PCMAG.
- Two holes with Ø 100mm are drilled in the floor, to access the cable trays in the cave, which connect the beam area with the control room
- A helium return line is installed.

Tobias Haas

PCMAG

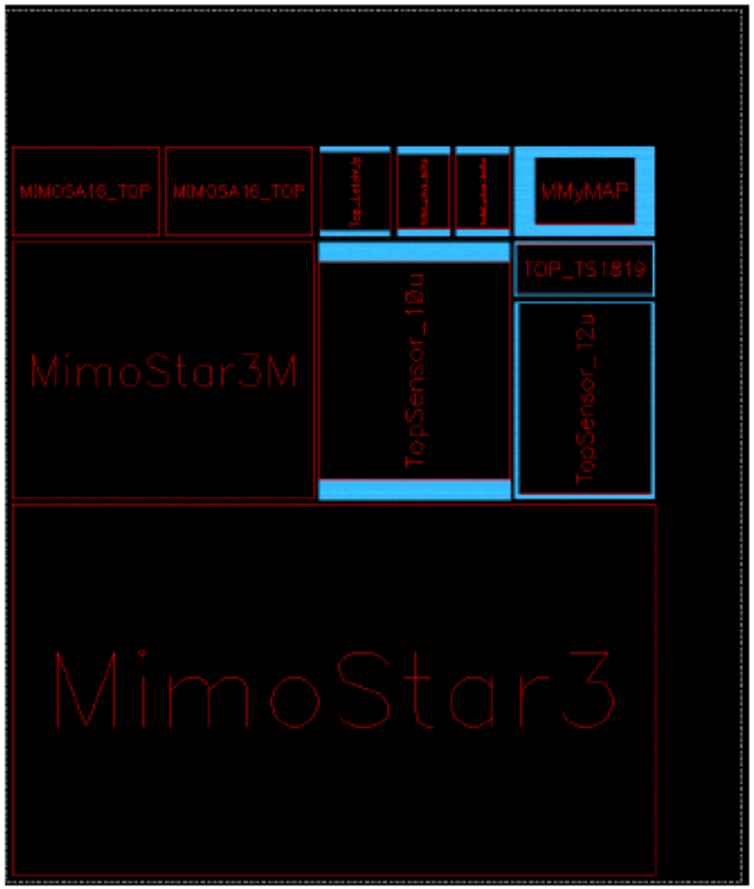


Recommissioning @ KEK

- All administrative issues about the transfer to DESY are clarified.
- Magnet arrives @ DESY at the end of September
- Commissioning to take place @ DESY in October

AMS 0.35 µm OPTO engineering run submission (June/July 2006)

Current status: production of 6 wafers at AMS



Final layout of the reticle

Structures of direct interest for EUDET

- Mimo*3M (MimoTEL): 256x256 pixels, 30µm pitch, 1KHz frame rate
- High Resolution Tracker: 512x512 pixels, 10 µm pitch, 300 Hz frame rate
- Mimosa16, the second prototype with a binary readout: 128x24 pixels, 25 µm pitch, on-chip column-level discriminator
- ADC: 5 bits
- TS1819: on-pixel amplifiers & clamping circuits

Two types of wafers with epitaxy layer thickness of 14 µm and 20 µm are used

Wafers delivery schedule

- First wafer (14 µm epi) expected before the end of September, to be used for yield study (Mimo*L) at the probe station
- Second wafer (20 µm epi) shall be immediately cut at AMS and individual chips (non-thinned) expected mid-October
- There is an open option for the purchase of four remaining wafers, if the first test results positive…

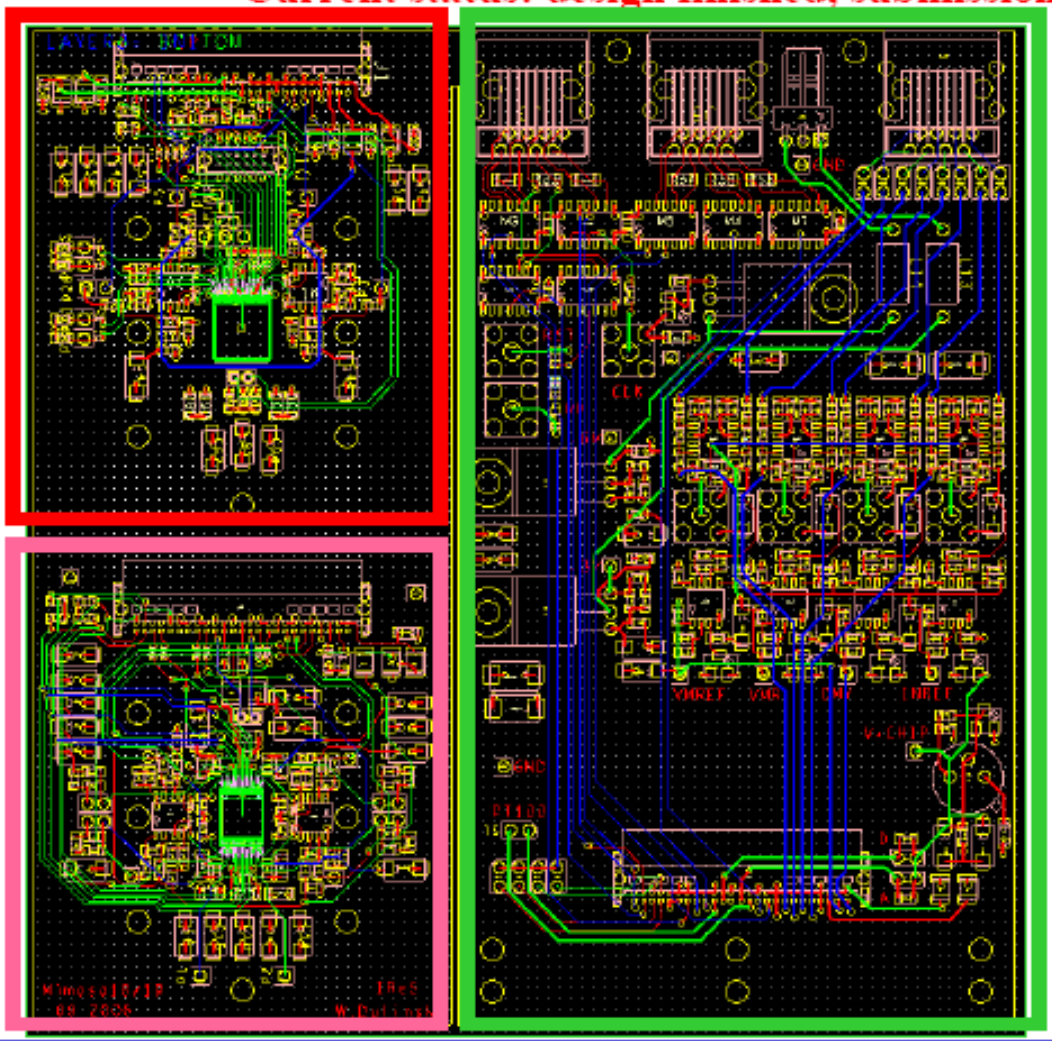
Mimo*3M (MimoTEL) tests schedule (at Strasbourg)

- Chips available from mid-October on
- Proximity boards populated and chips bonded before the end of this year
- JTAG programming model expected mid-January
- Test results expected before March 2007

Wojciech.Dulinski@ires.in2p3.fr

PCB's for tracker testing, compatible with the telescope mechanics

Current status: design finished, submission for production next week



One set of PCB's contain:

- Proximity board for Mimo*3M (MimoTEL):
- Proximity board for HiRes Tracker
- Auxiliary board for MimoTEL

PCB's delivery schedule

- Twenty PCB sets (non-populated with components) shall be available before the end of September
- Five sets will be kept at Strasbourg and populated in October, others are available for EUDET collaboration members for components mounting/debugging
- To complete the demonstrator telescope set-up, the specific clock and JTAG distribution card is still needed: work on schematics in progress at Strasbourg. Candidates to take care of that PCB production are welcome!

Progress on Binary Output Architecture and Plans

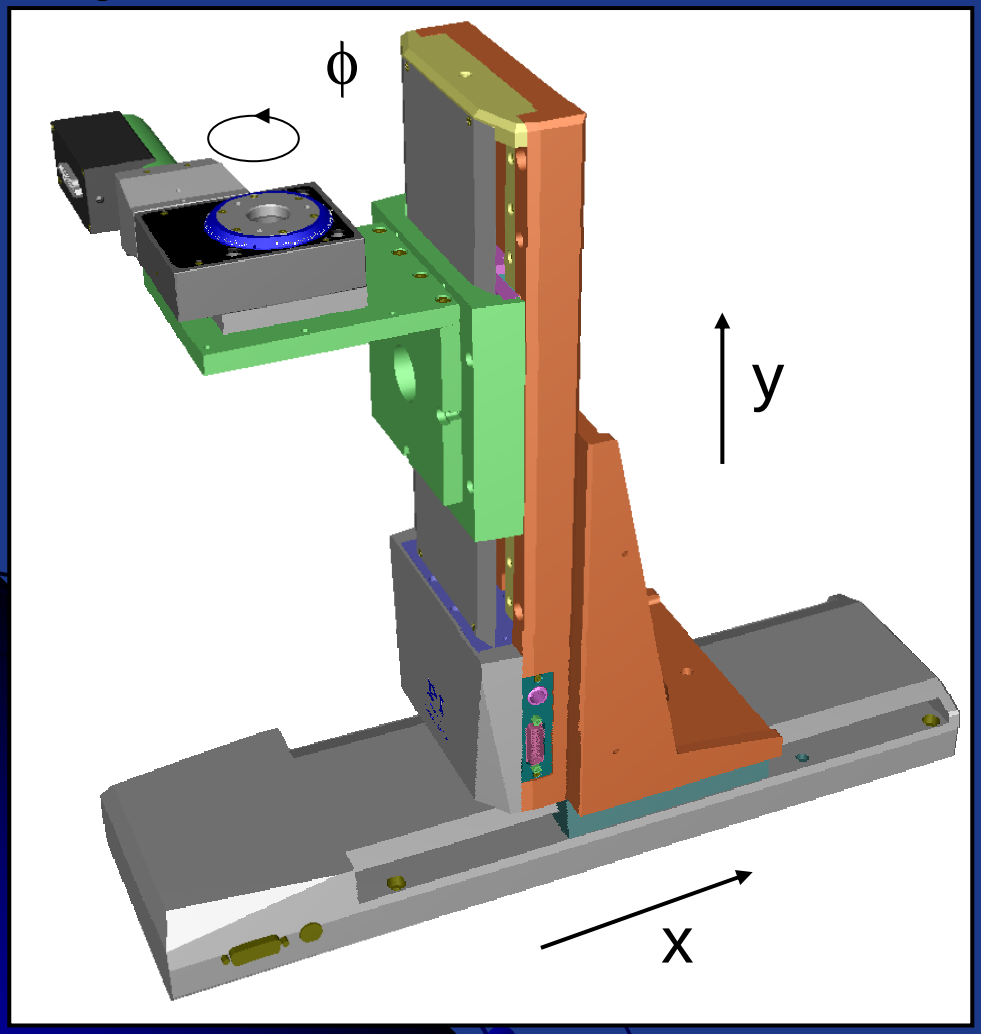
- **Achievement ▷ MIMOSA-16 = full translation of MIMOSA-8 from TSMC-0.25 to AMS-0.35 OPTO being fabricated :**
  - ✳ Prototype includes sub-array with radiation tolerant pixels at room T
  - ✳ Expected to come back from foundry end Septembre '06
  - ✳ Tests expected to start around Novembre '06 (will carry on for quite some time in '07)

- **In progress ▷ ∅ micro-circuits**
  - ✳ 1st prototype to be submitted $\lesssim$ Summer 2007
  - ✳ Developpment expected to converge $\lesssim$ end 2008

- **Next important step ▷ large scale version of MIMOSA-16**
  - ✳ Made of $\sim$ 300 columns of 256 pixels ($<$ 20 μm pitch) ???
  - ✳ Read-out time $<$ 100 μs (adjustable)
  - ✳ Design in Spring 2007 $\mapsto$ fabrication of 1st proto in Summer 2007

Carsten Muhl

DUT Positioner



- 10 offers evaluated.
- Decision for PI: offers the best price-performance ratio,
- Expected precision: few microns,
- Ordered complete stage: assembled and surveyed with steering components and software
- Expect delivery in October 2006
- Will be set up in the lab for testing in October/November 2006
- Ready for installation in test beam spring 2007

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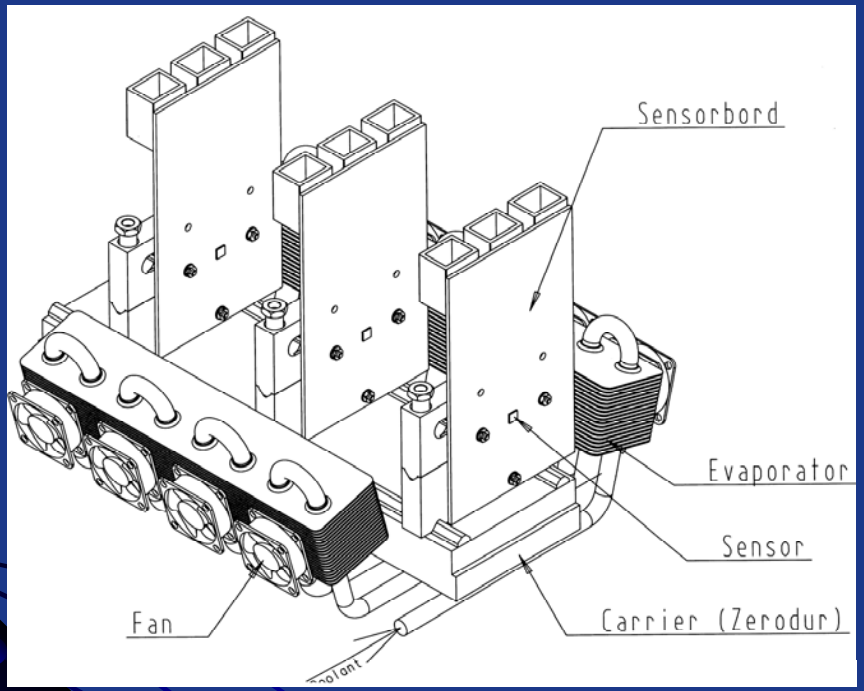
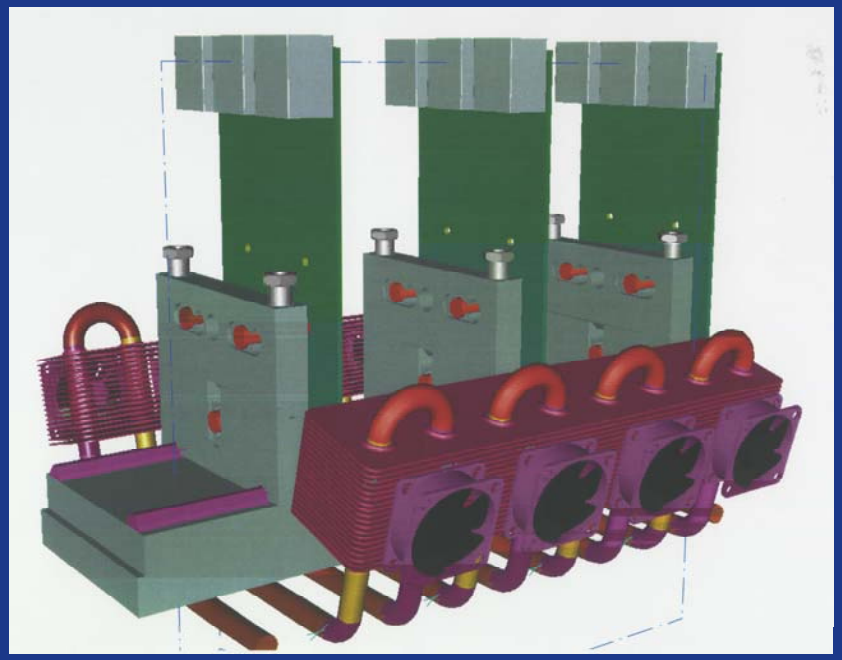
Senor Boxes



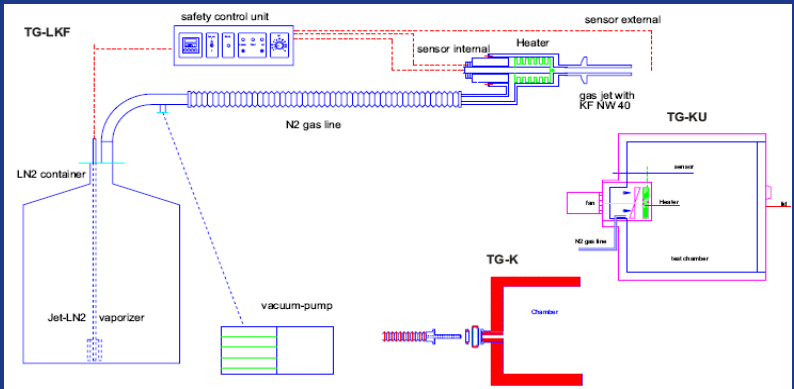


Design is still being iterated: Cooling and fixation will most likely change

Carsten Muhl

Cooling for Sensor Boxes and DUT

Regulated Cold N2 Gas System



The TG-LKF 63/50 KALTGAS system includes a standard safety control unit (a temperature controller with current value/set point display and a safety controller), a KF-NW 50 siphon with an LN2 vaporizer (Jet), a flexible, evacuable N_2 gas line with an integrated post-heating module (heater), a PT100 temperature sensor and a vacuum pump with accessories.

Cold Gas System : +170°C …-180°C

(N2-Stream Temperature Accuracy ±0,1°C)

-Expensive

-Safety regulations required

+Quick

+Precise

+Wide range of temperature

+DUT cooling possible with the same device

Evaporation Cooling Based on R404A

	R404A/R507											
	Kälteleistung in W						Verdampfungstemperatur in °C					
Liquefier 1	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10
Liquefier 2	64	85	110	141	177	218	265	318	378	–	–	–
	–	–	–	–	–	–	265	314	377	450	528	588

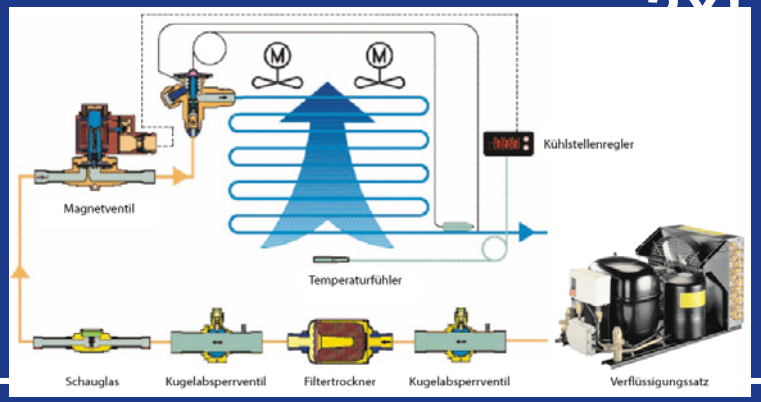
-Large area for evaporator needed → Increases Size of sensor box

-2 systems needed between -40°C and +10°C

-Slow and complex regulation

+No danger

±Standard Components except evaporator



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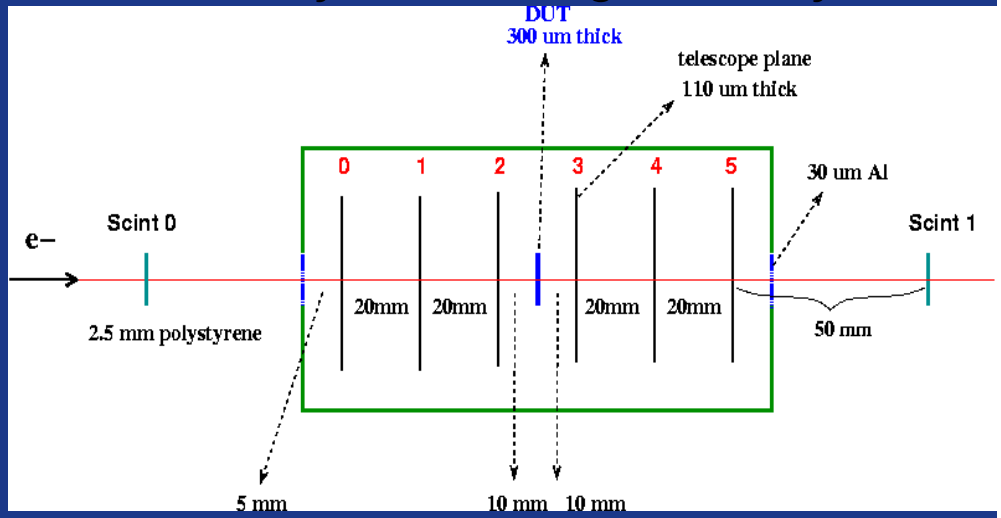
Telescope Simulations

Tatsiana Klimkovich

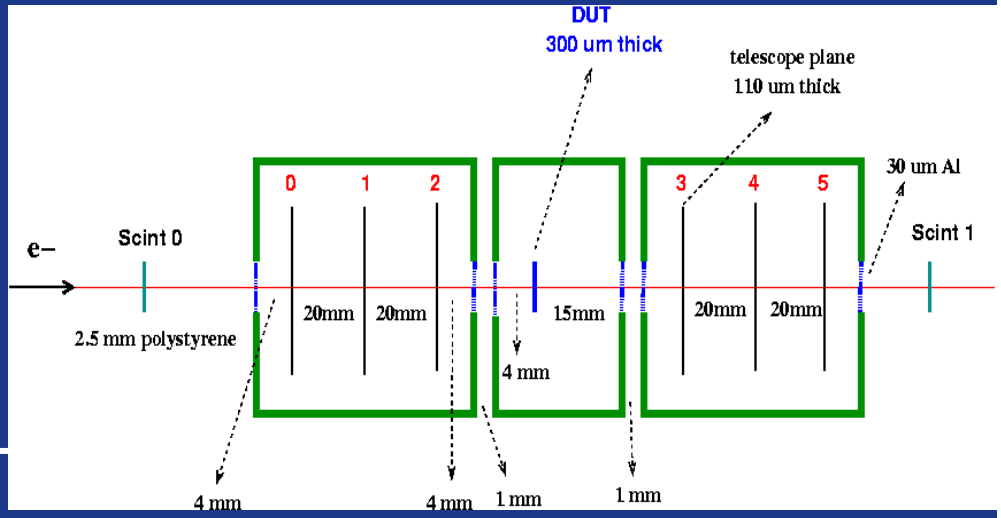
ILC Software Tools

- Full simulation: Mokka (based on Geant 4) and MySQL database
  - Output: LCIO format files
  - Stored information: hit position, deposited energy, ...
- Analysis: Marlin and Root
- Simulated 50000 events
- Assumed telescope plane intrinsic resolution – 3 um (hit positions are smeared)

Symmetric geometry



Asymmetric geometry



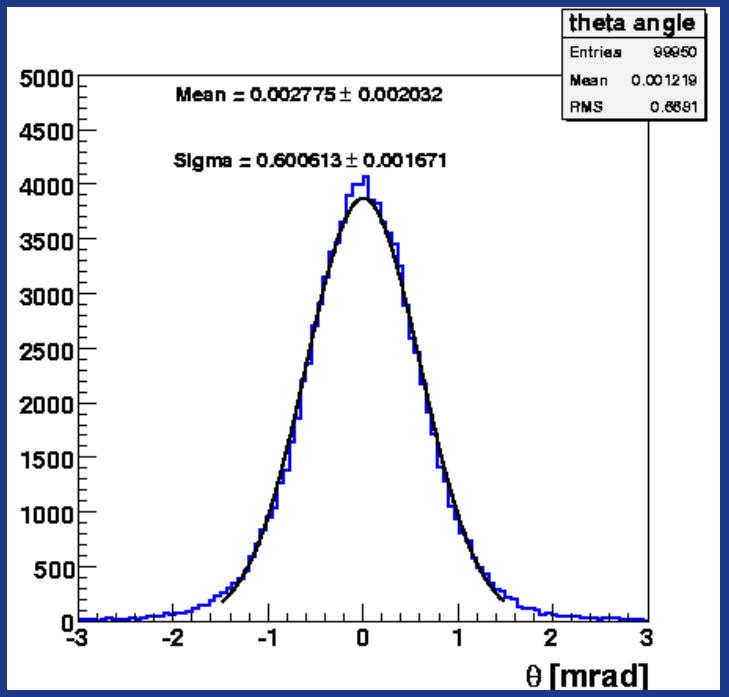
Validation

Tatsiana Klimkovich

- For small scattering angle Gaussian approximation is used for the width of the projected angular distribution:

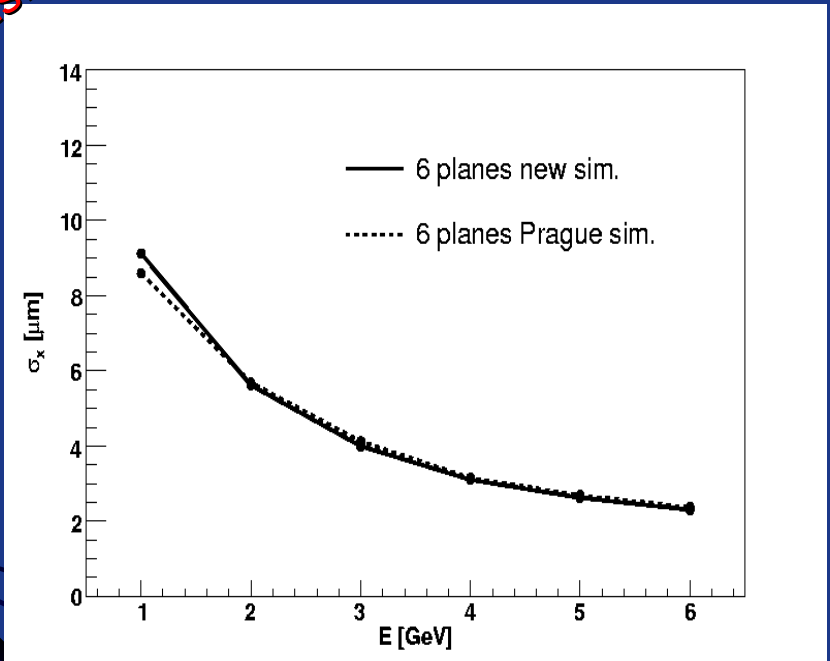
$$\theta_0 = \frac{13.6MeV}{\beta cp} z \sqrt{\frac{x}{X_0}} \left[1 + 0.038 \ln\left(\frac{x}{X_0}\right) \right]$$

- Simulate silicon wafer of 300 um thickness
- Shoot 1 GeV electrons (100000 events)
- Look at the projection of scattering angles
- Theory prediction: 0.602 mrad

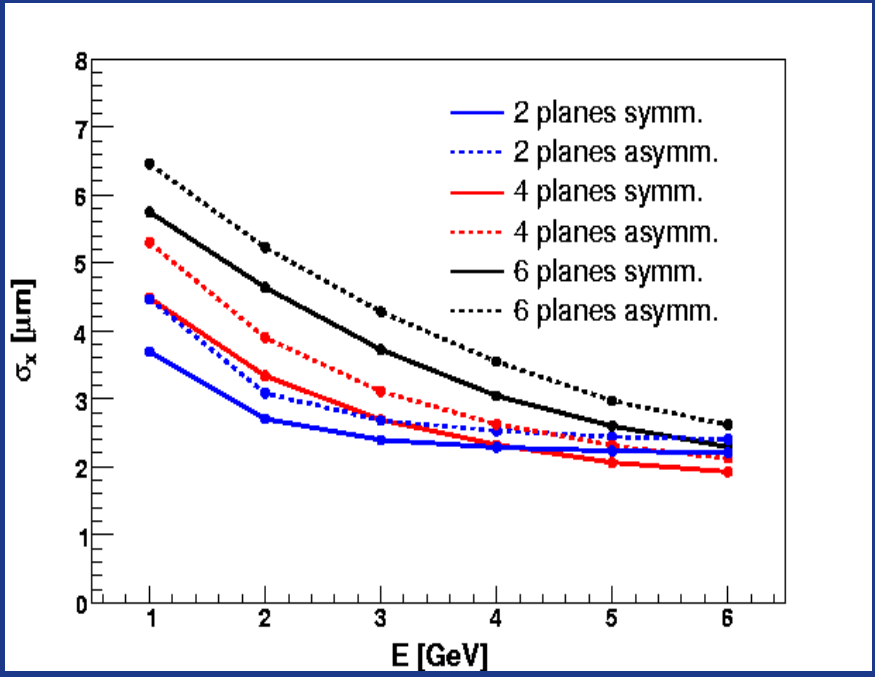


Tatsiana Klimkovich

First results



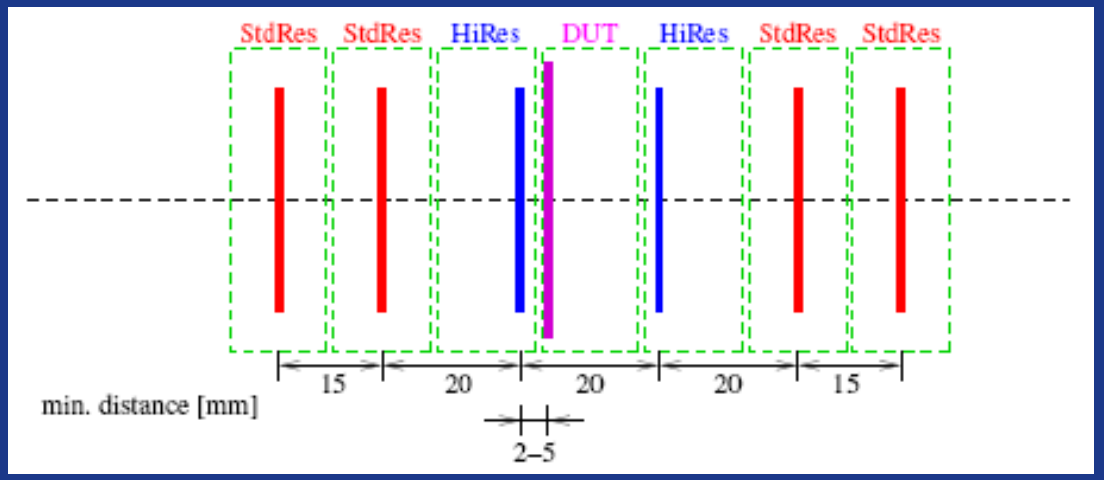
Comparison of new simulation (Mokka) with Prague simulation (Geant 4) for 6 plane symmetric geometry



Comparison of different geometries (Mokka simulation, after cuts on chi2 and track slope):

Filip Zarnecki

Precision Studies

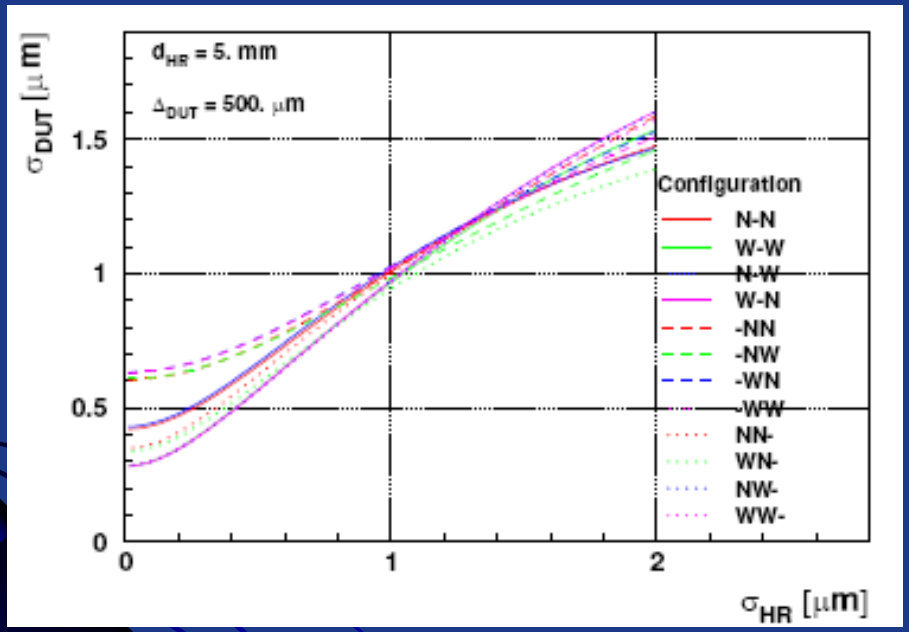


- Analytical Method
- Includes multiple scattering
- Piece-wise linear track fit

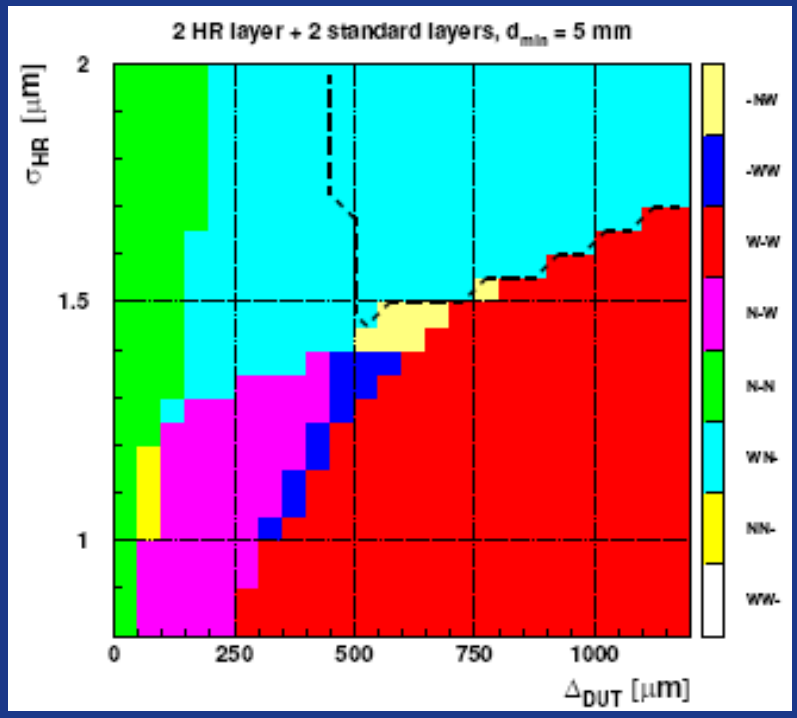
- Goals:
  - Cross check simulation
  - Optimize geometry
  - Guidance for the design
  - Understand future analysis challenges

Precision Studies: Results

Filip Zarnecki



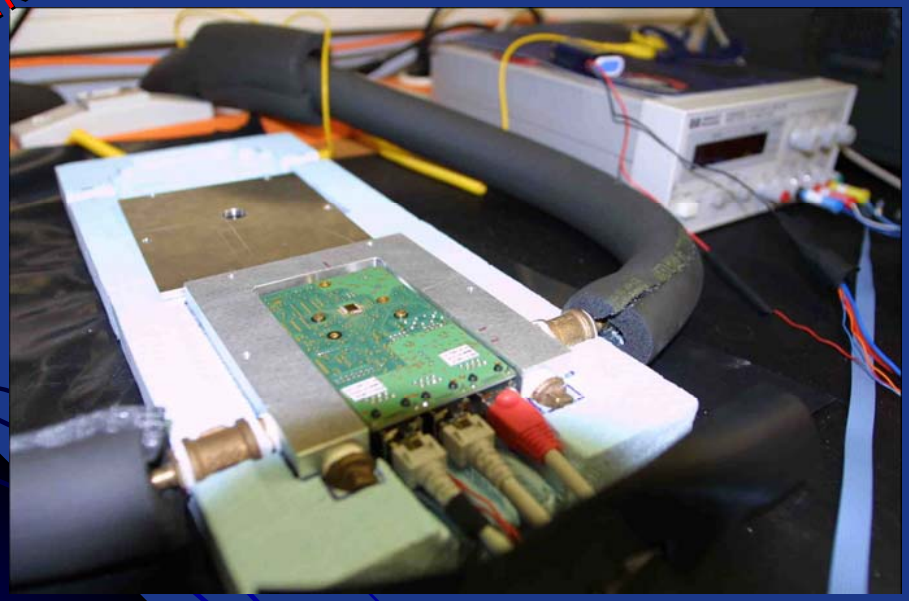
Planned Precision can be reached!



Wide choice of geometry configurations are needed depending of DUT details

Mimostar2 – Temperature Scan

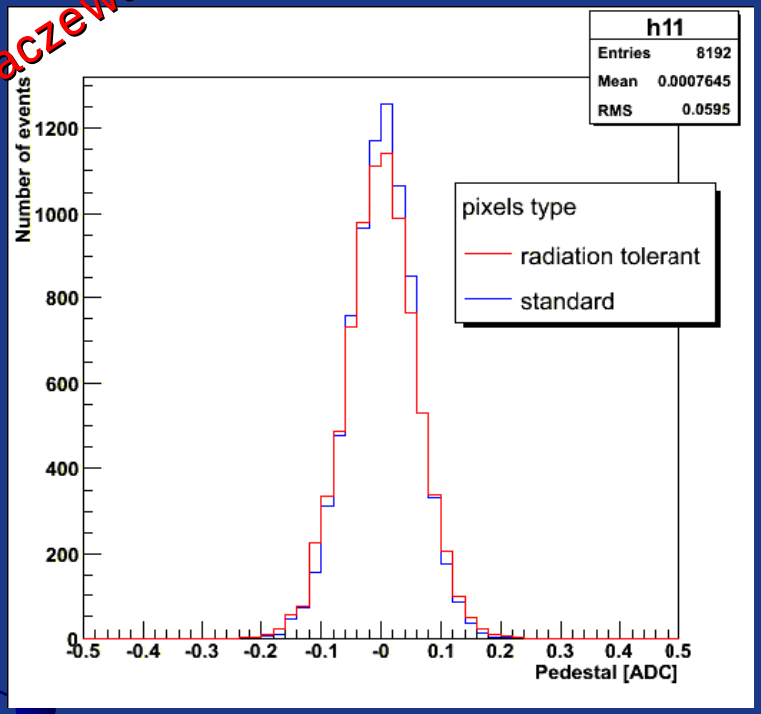
Lukasz Maczewski

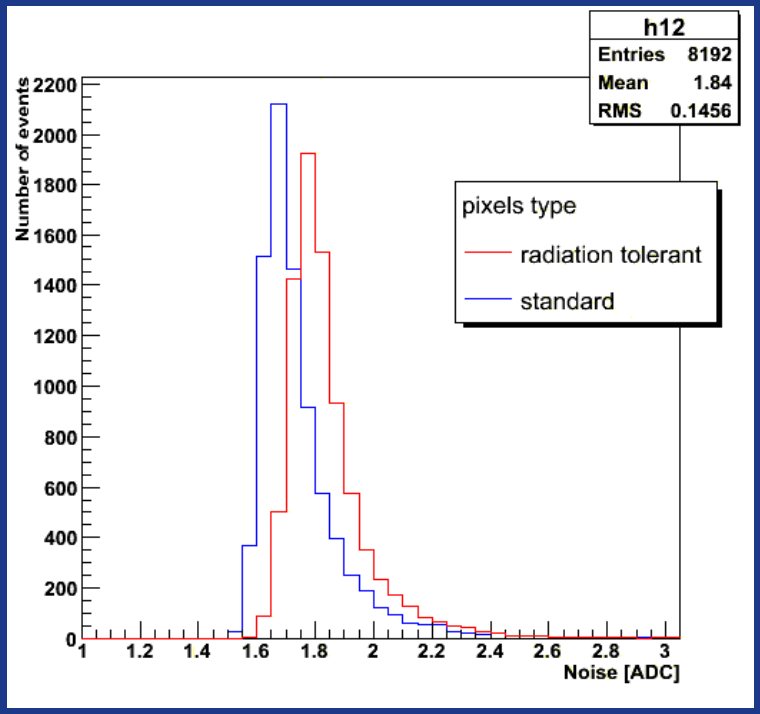


- Simple setup with Strasbourg hardware to do pedestal and source measurements
- Also source measurements were done (Fe55)
- Cooling keeps Mimostar2 at constant temperature
- Temperature Sensor inside cooling box

Pedestal and Noise Distribution

Lukasz Maczewski

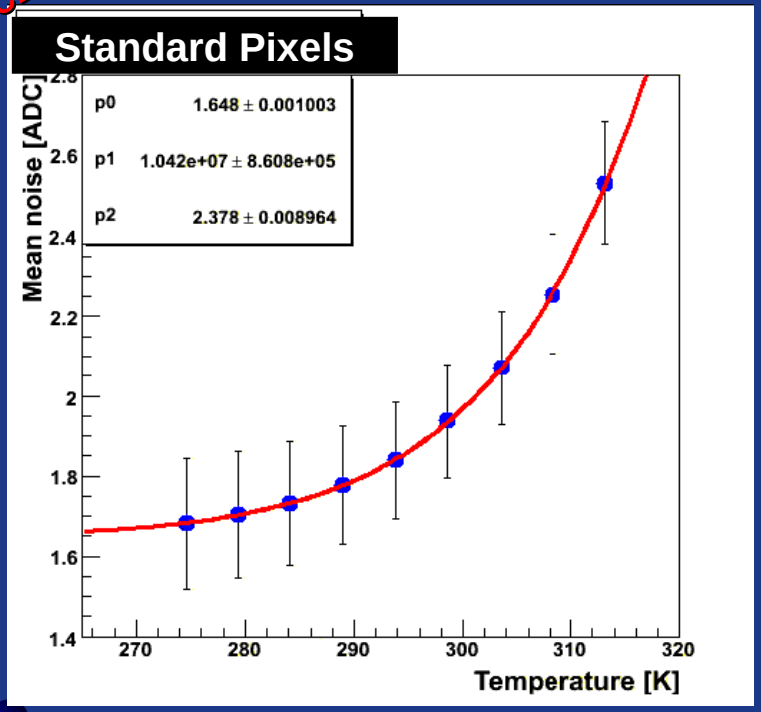


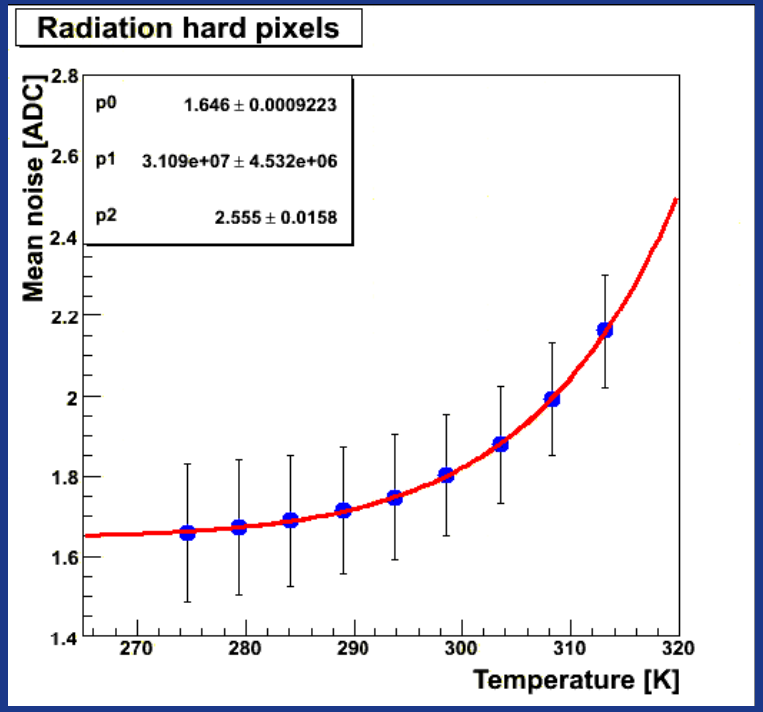


- Measurements done at 21°C
- Pedestal is distributed around 0 ADC
- Noise in the matrix with the radiation tolerant pixels is higher than in the matrix with the standard pixels

Temperature Dependence

Lukasz Maczewski





- Fit included the energy gap as a third fit parameter

$$noise = p_0 + p_1 \cdot T \cdot \sqrt{\exp(-\frac{p_2}{(2k_B T)}}$$

- Energy gaps from this fit: Eg=2.38eV Standard Pixels
  Eg=2.55eV Rad. Tol. Pixels

EU Personnel

- DESY:
  - Julia Fourletova, postdoc (7/27)
- Geneva:
  - Emlyn Corrin, postdoc (7/1)
- Bonn
  - Lars Reuen, student (1/1)
- MPI
  - Stefan Rummel, student (2/15)
- CERN
  - Jerome Alozy, student (9/1)

Finances

Info available:

- Geneva
  - Received: 119.517 CHF
  - Spent (28 Aug) 19.649 CHF
  - Extrapol. Pers. 32.500 CHF
  - Extrapol. Goods 23.288 CHF
- CNRS-IRES
  - Received: 58.935 €
  - Spent (11 Sep) 0 €
- MPI
  - Received 35.000 €
  - Spent (11 Sep) 10.294 €
  - Extrapol. Pers. 18.000 €
- DESY
  - Received: 117.072 €
  - Spent (28 Aug) 9.344 €
  - Extrapol. Pers. 20.000 €
  - Extrapol. Goods. 28.000 €
- CERN
  - Received: 18.013 CHF
  - Spent (11 Sep): 0 CHF
  - Extrapol. Pers. 14.000 CHF
  - Extrapol. Goods 0 CHF
- UBonn
  - Received: 49.944 €
  - Spent (11 Sep) 20.640 €
  - Extrapol. Pers. 28.000 €
  - Extrapol. Goods 6.000 €
- UMa
  - Received: 17.688 €
- INFN
  - Received: 10.847 €
- UBristol
  - Received: 32.424 €
- CEA
  - Received: 23.808 €