ALFA Status Report

K.Hiller , DESY Zeuthen

DESY ATLAS meeting 1/11/2007

1) Status of detector components

- CERN meeting 10/10/2007

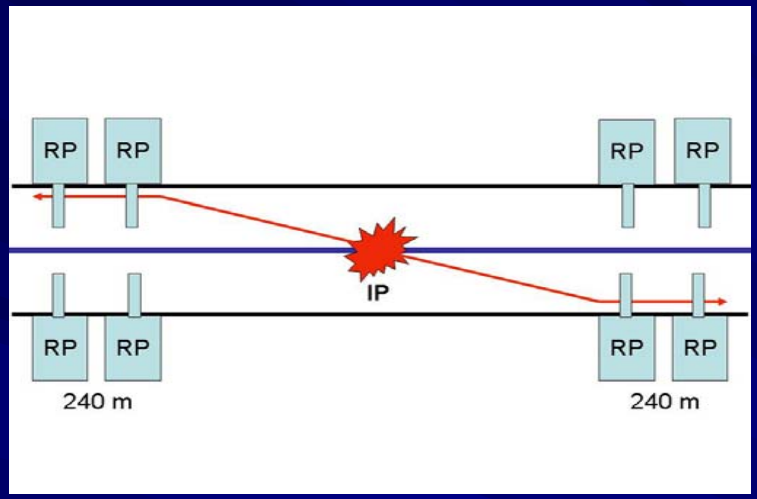
2) DESY contributions

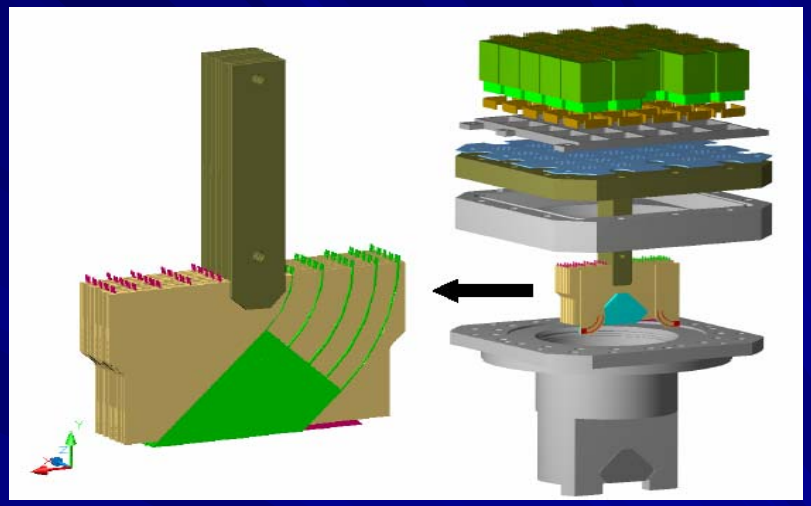
- detector metrology
- MAPMT reception tests
- trigger tile R/O

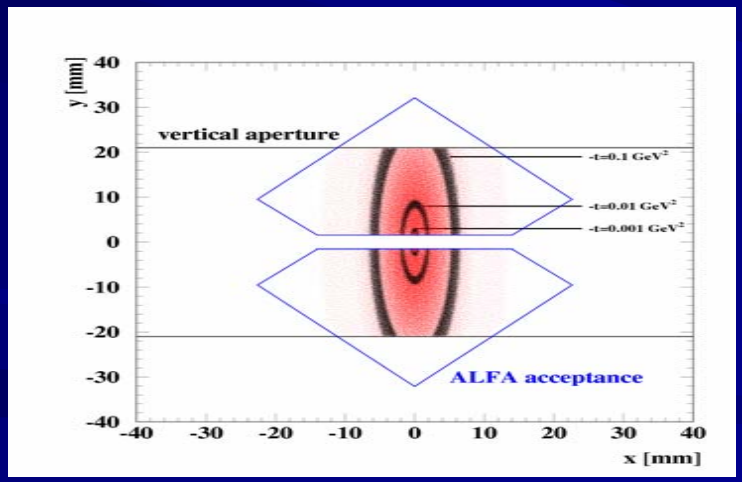
3) DESY Test Beam planning

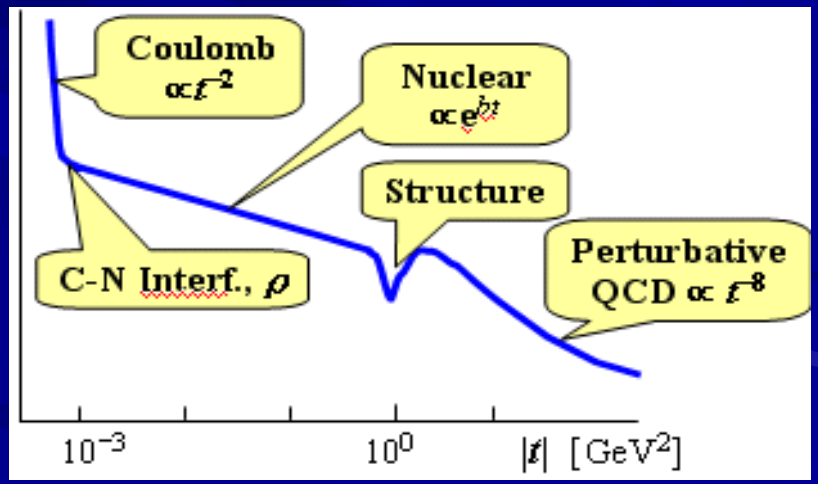
ALFA in one slide …

Absolute **L**uminosity **F**or **A**TLAS, to calibrate the LUCID detector







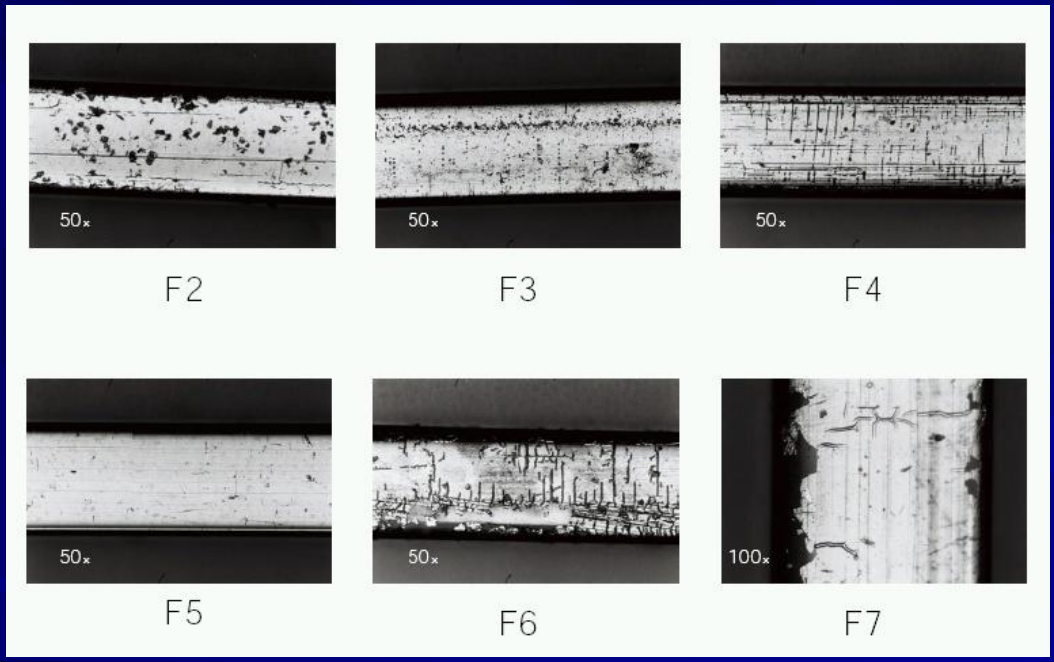


move 1.5 mm to beam → measure interference region → σ_{tot}, b, ρ, L ± 3%

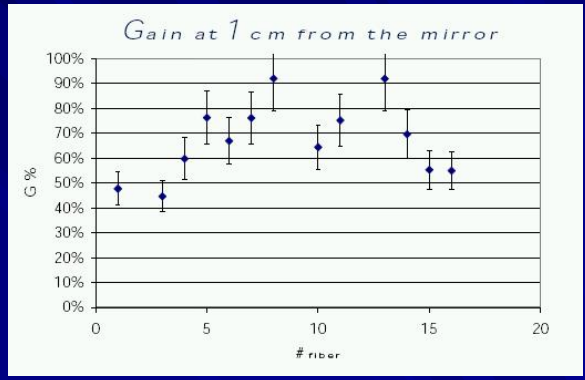
Fiber coating in Lisbon

Aim: 1) increase light yield for 45 deg.fibers
2) avoid optical cross talk

Problem : Al coating quality



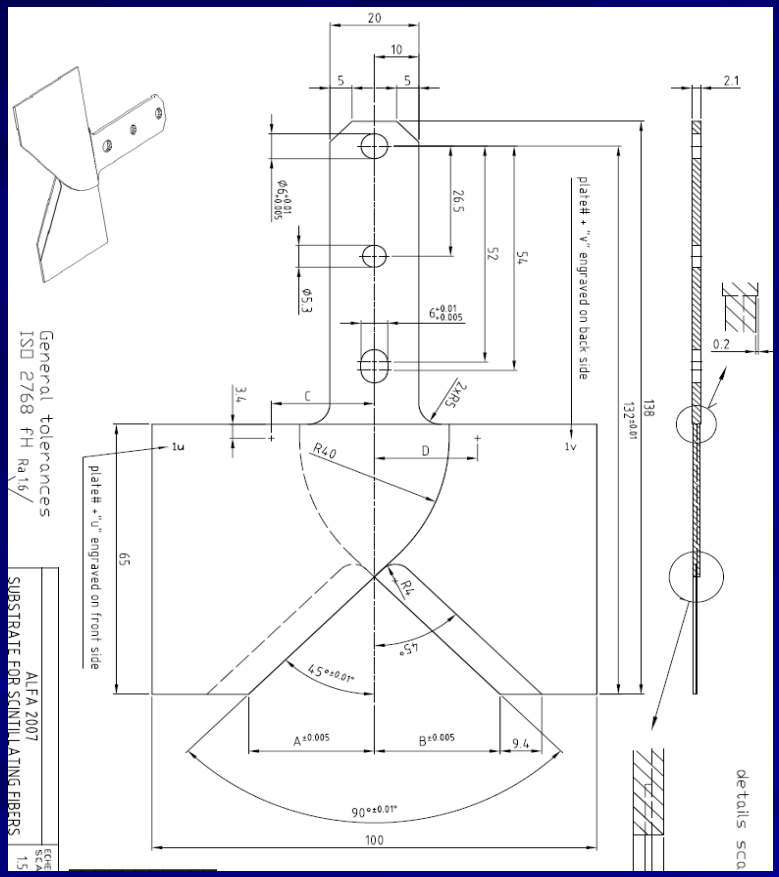
Reflectivity ~ 70 %



Upgrade of the sputtering machine
→ Hope of better results …

Ti-substrates at HU Berlin

Problem: precision < 10 micron not achieved in 1st attempt



Milling of Ti-plate on CNC machine with cold chuck

M.Jablonski

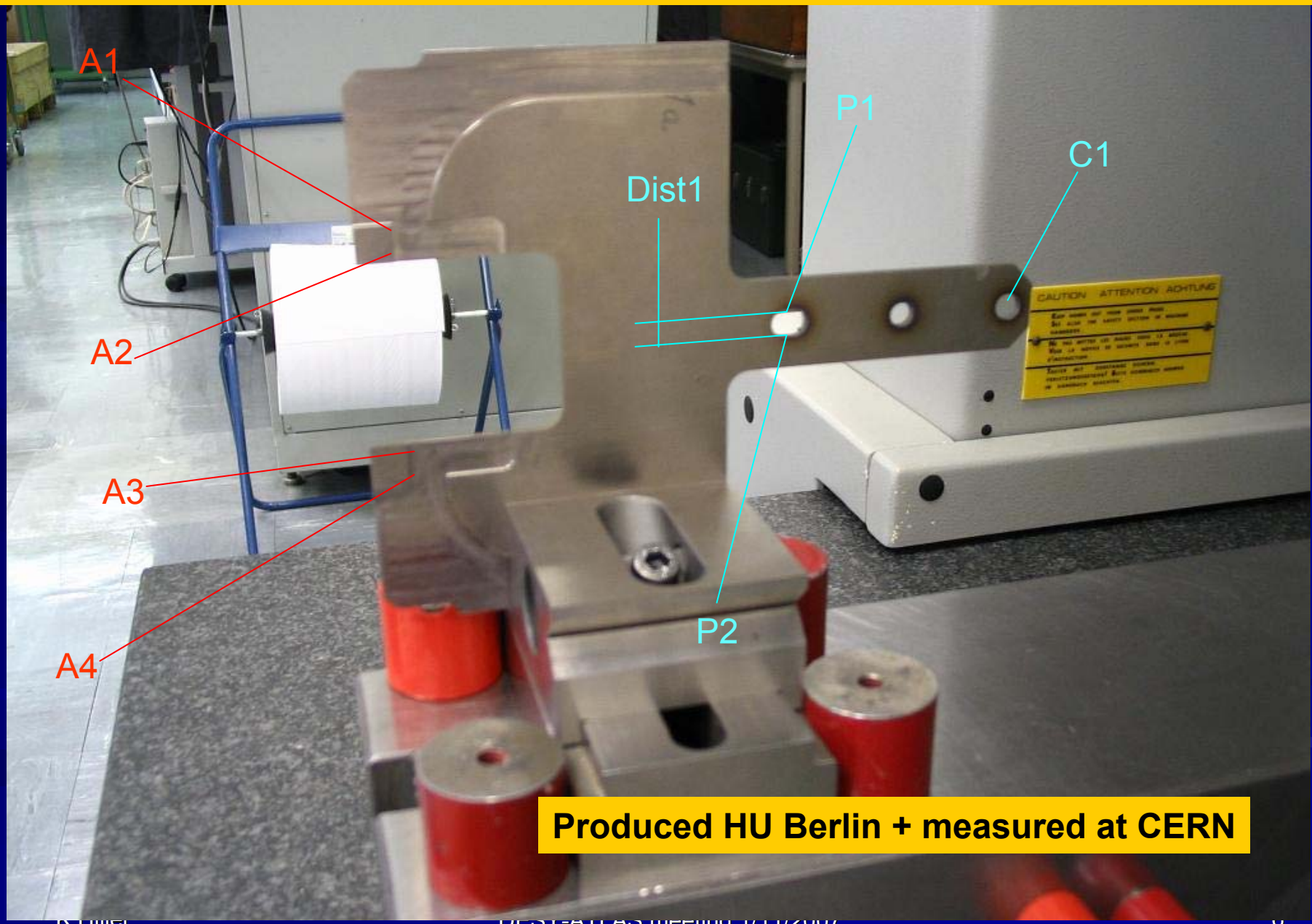
Ti-substrates at HU Berlin (2)

Next attampt: 10 + 1 substrates by electro erosion + milling

Substrate	Pres. hole (Ø6 +0.005/+0.01)	Long hole (6 +0.005/+0.01)	A (design±0.005)	A (design)	difference A	B (design±0.005)	B (design)	difference B	difference A + difference B	Angle A-side (45±0.01)	Angle B_side (45±0.01)	Angle apex
1	6.008	6.005	28.267	28.255	0.012	28.263	28.255	0.008	0.02			
2	5.97	5.951	27.931	27.972	-0.041	28.578	28.538	0.04	-0.001	44.99454	45.0084	90.00294
3	5.985	5.947	28.365	28.396	-0.031	28.144	28.114	0.03	-0.001	44.98641	45.00561	89.99202
4	6	5.983	28.102	28.114	-0.012	28.423	28.396	0.027	0.015	44.99323	45.0042	89.99743
5	6.005	6.008	28.528	28.538	-0.01	27.982	27.972	0.01	0			
6	6.008	6.002	27.895	27.901	-0.006	28.619	28.609	0.01	0.004			
7	6.006	6.005	28.316	28.326	-0.01	28.192	28.184	0.008	-0.002			
8	6.005	6.005	28.043	28.043	0	28.467	28.467	0	0			
9	6.003	6.005	28.479	28.467	0.012	28.033	28.043	-0.01	0.002			
10	6.005	6.005	28.184	28.184	0	28.336	28.326	0.01	0.01			
average	5.9995	5.9916			-0.0086			0.0133	0.0047	44.99139	45.00607	89.99746

Precision much improved

Ti-substrates for Overlap Detectors



Ti-substrates for Overlap Detectors (2)

	Référence	Théorique	Mesuré	Tol -	Tol +	Ecart	Tendance
C1	Cercle Critère : MOINDRES CARRES (en 8 pts sur NOMINAL)						
	DIAM	6.000	6.009	0.005	0.010	0.009	
	X	-1.000	-1.000			0.000	
	Y	0.000	0.000			0.000	
	Z	0.000	0.001			0.001	
	E.F.		0.004			0.004	
P1	Point sur NOMINAL						
	X	-1.000	-1.000			-0.000	
	Y	-53.000	-52.999			0.001	
	Z	3.000	3.004			0.004	
P2	Point sur NOMINAL						
	X	-1.000	-1.004			-0.004	
	Y	-53.000	-52.999			0.001	
	Z	-3.000	-3.006			-0.006	
DIST1	Distance P2 - P1 / REP2						
	D1	6.000	6.010	0.005	0.010	0.010	
A1	Point sur NOMINAL						
	X	-0.200	-0.200			-0.000	
	Y	-136.333	-136.383	-0.005	0.005	-0.050	-0.045
	Z	26.200	26.201			0.001	
A2	Point sur NOMINAL						
	X	-0.200	-0.200			-0.000	
	Y	-136.333	-136.398	-0.005	0.005	-0.065	-0.060
	Z	20.100	20.099			-0.001	
A3	Point sur NOMINAL						
	X	-0.200	-0.200			0.000	
	Y	-136.333	-136.399	-0.005	0.005	-0.066	-0.061
	Z	-20.100	-20.099			0.001	
A4	Point sur NOMINAL						
	X	-0.200	-0.200			-0.000	
	Y	-136.333	-136.393	-0.005	0.005	-0.060	-0.055
	Z	-26.100	-26.099			0.001	
A5	Point sur NOMINAL						
	X	-1.800	-1.804			-0.004	
	Y	-136.333	-136.474	-0.005	0.005	-0.141	-0.136
	Z	-25.500	-25.500			0.000	
A6	Point sur NOMINAL						
	X	-1.800	-1.802			-0.002	
	Y	-136.333	-136.471	-0.005	0.005	-0.138	-0.133
	Z	-20.000	-20.000			0.000	

	Référence	Théorique	Mesuré	Tol -	Tol +	Ecart	Tendance
A7	Point sur NOMINAL						
	X	-1.800	-1.802			-0.002	
	Y	-136.333	-136.457	-0.005	0.005	-0.124	-0.119
	Z	20.000	20.002			0.002	
A8	Point sur NOMINAL						
	X	-1.800	-1.801			-0.001	
	Y	-136.333	-136.454	-0.005	0.005	-0.121	-0.116
	Z	25.500	25.502			0.002	

A.Braem / CERN

2 overlap substrates measured

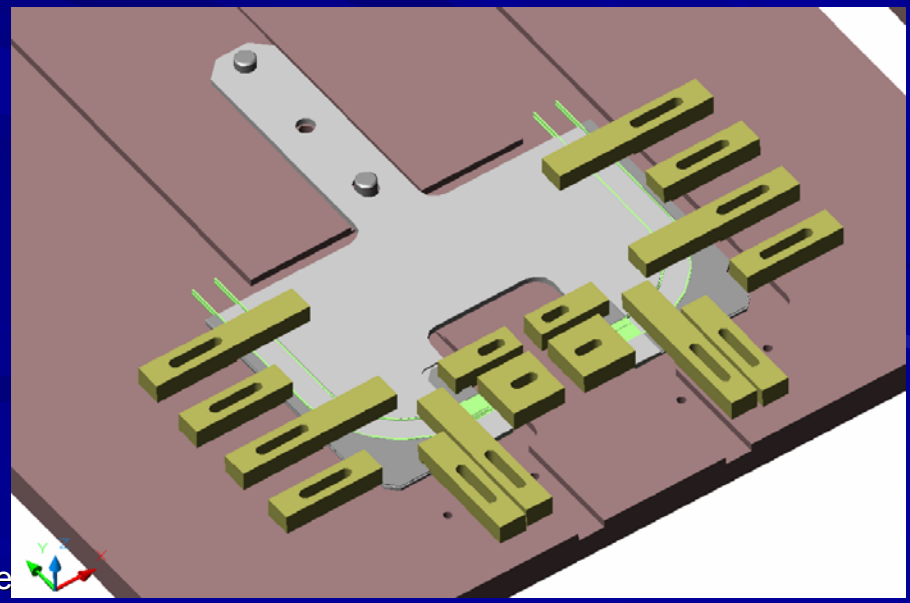
deviations up to 100 µm
reason presently unclear

resolution of OD dominated by track statistics

precision of substrates not so important as for main detectors

Detector production at Giessen

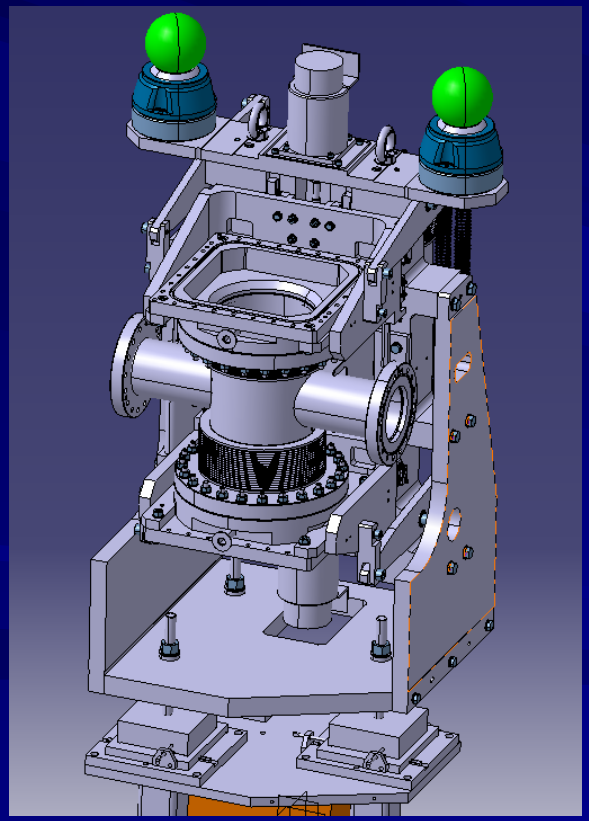
- experience from test detectors
- Training of fiber routing
- Test overlap gluing tool
- Waiting of coated fibers from Lisbon …



Roman Pot mechanics

CERN group of engineers with long experience: B.Girolamo et.al.

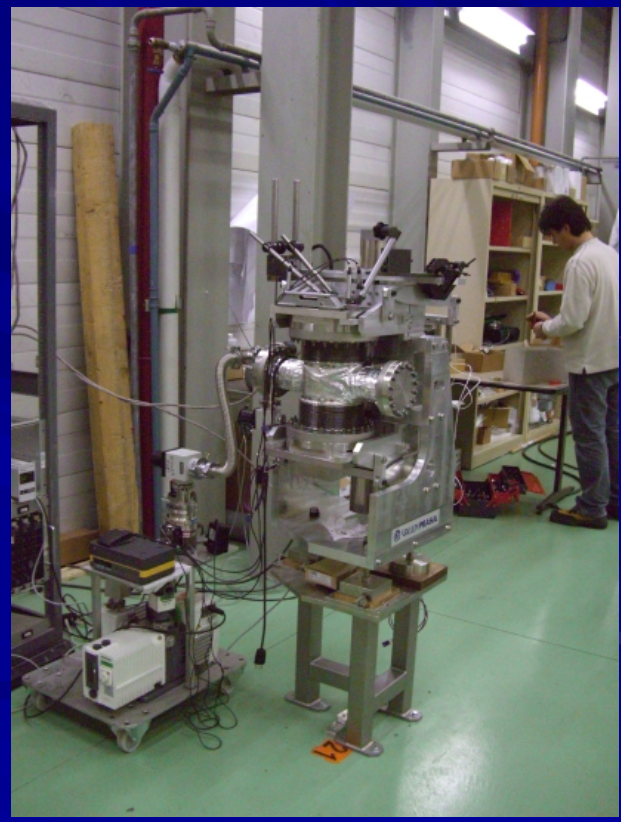
1970: first Roman Pots at CERN ISR
1987: UA4 at SPS Collider
2007: TOTEM / ALFA plus more future forward stations



Pre-production unit to study the quality of the movable system:

precision
stability
reproducibility

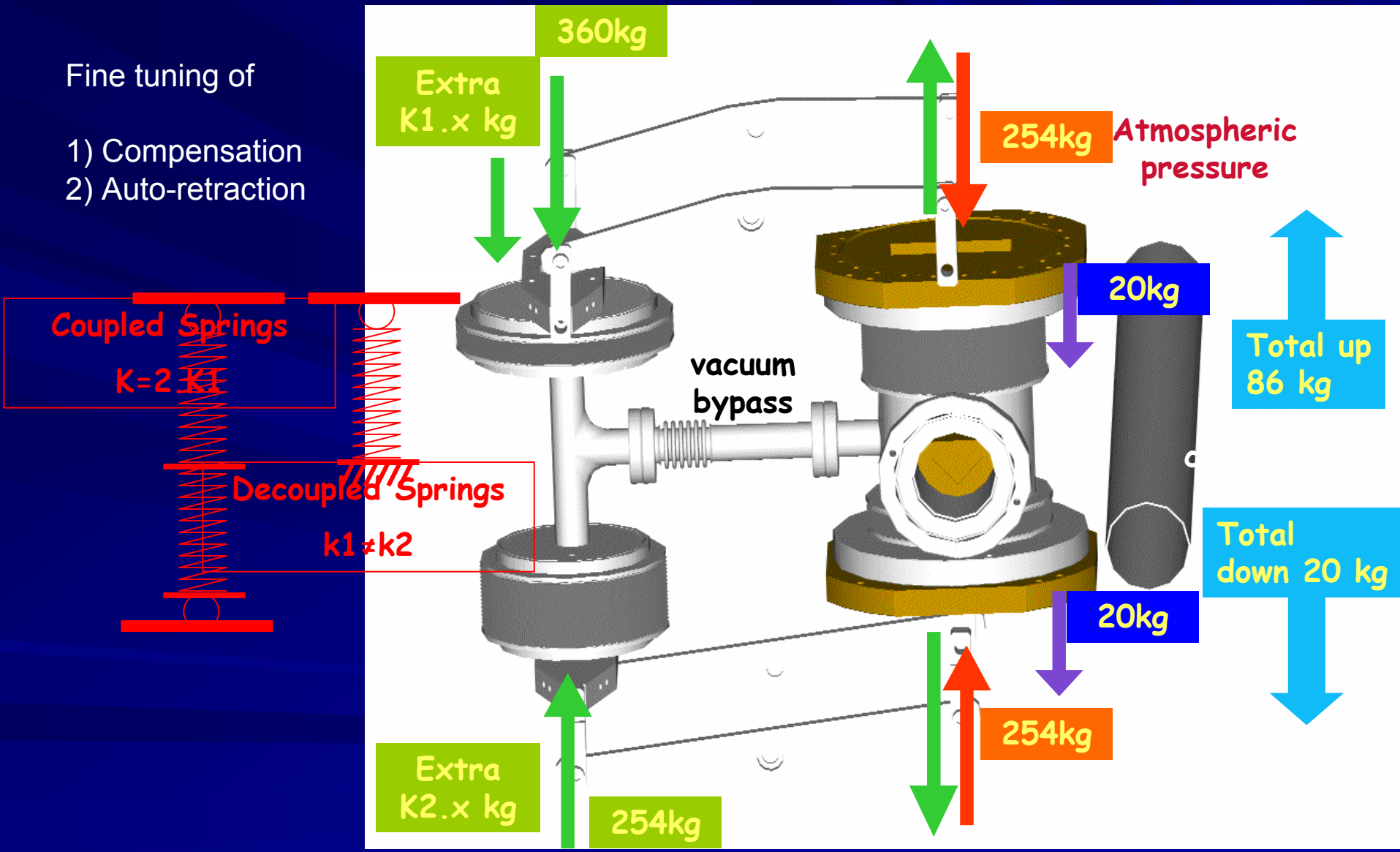
-> displacement measurements
-> influence of vacuum
-> influence of spring retraction
-> RF measurements
-> compensation system



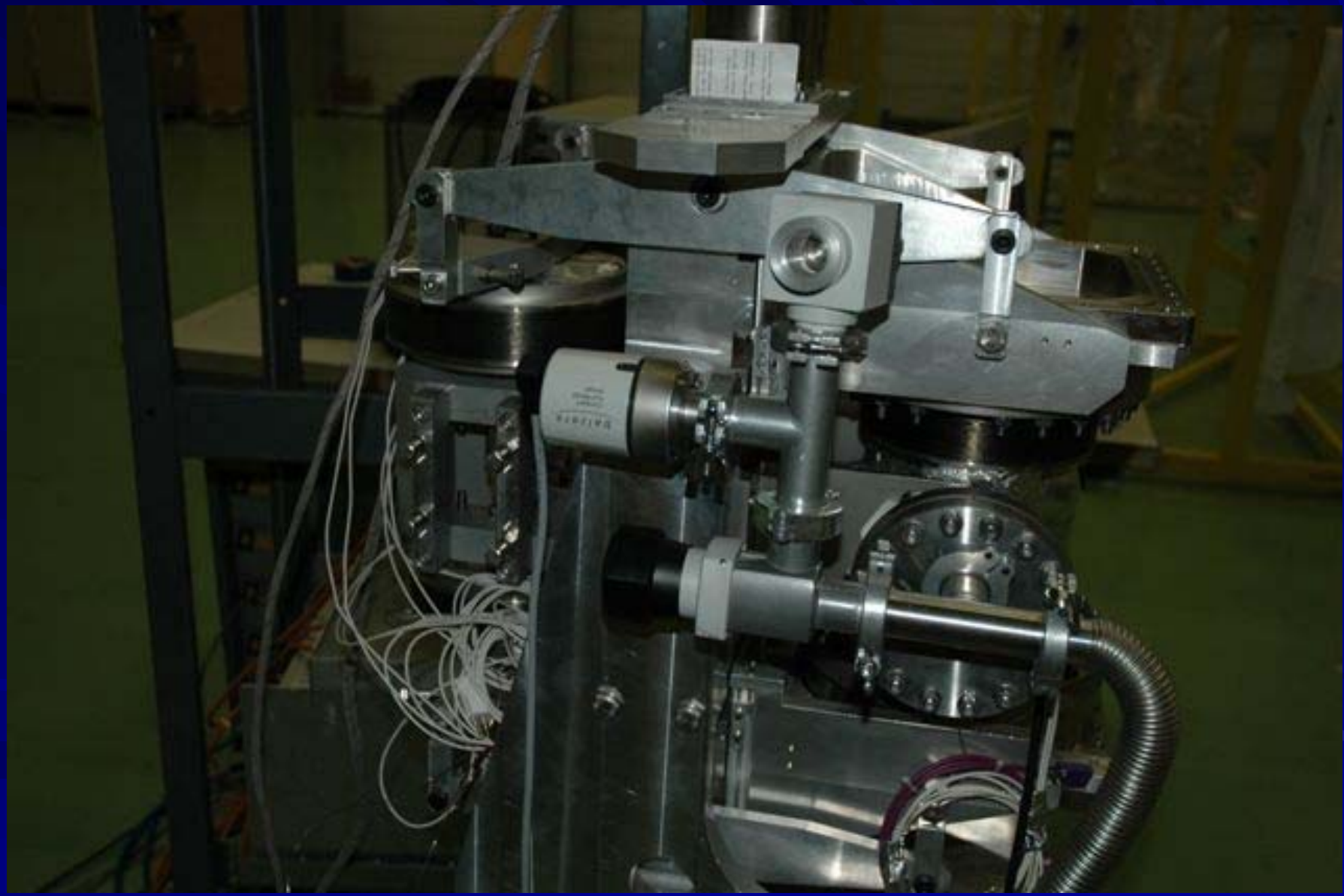
Roman Pot mechanics (2)

Fine tuning of

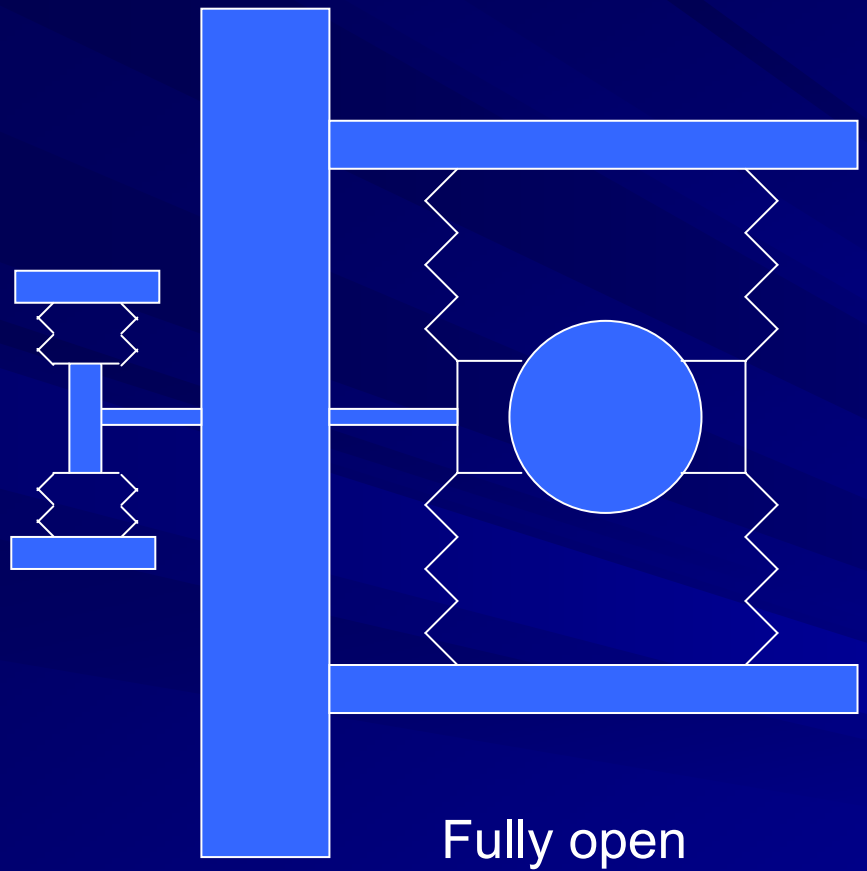
1) Compensation
2) Auto-retraction



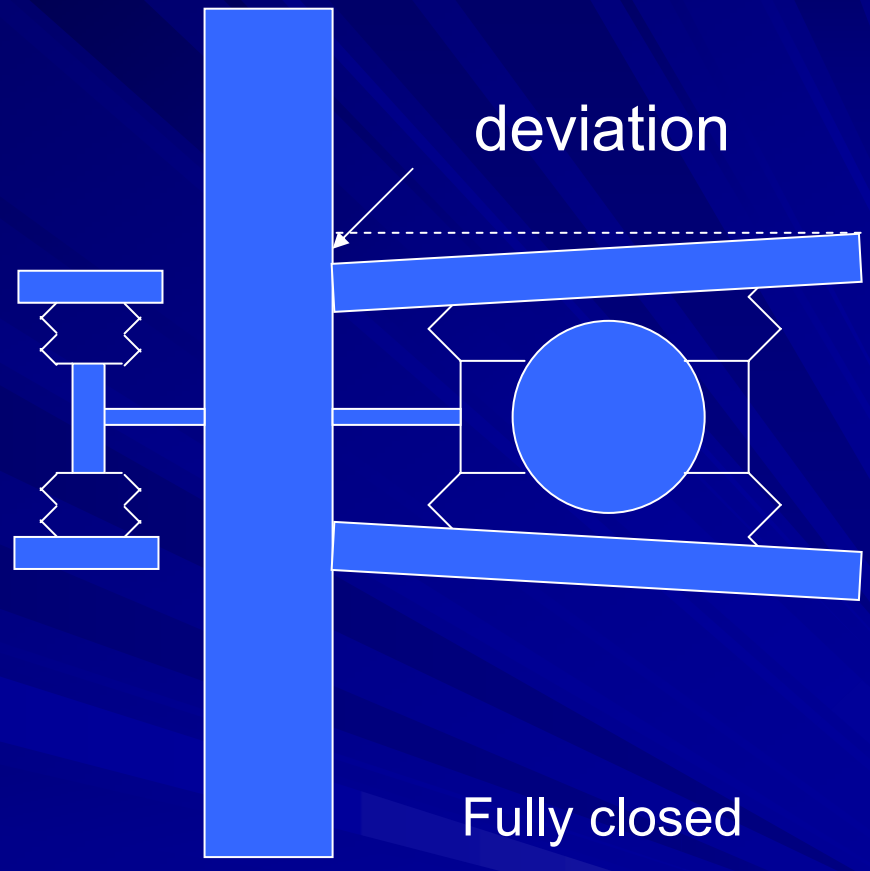
Roman Pot mechanics (3)



Roman Pot mechanics (4)



Fully open

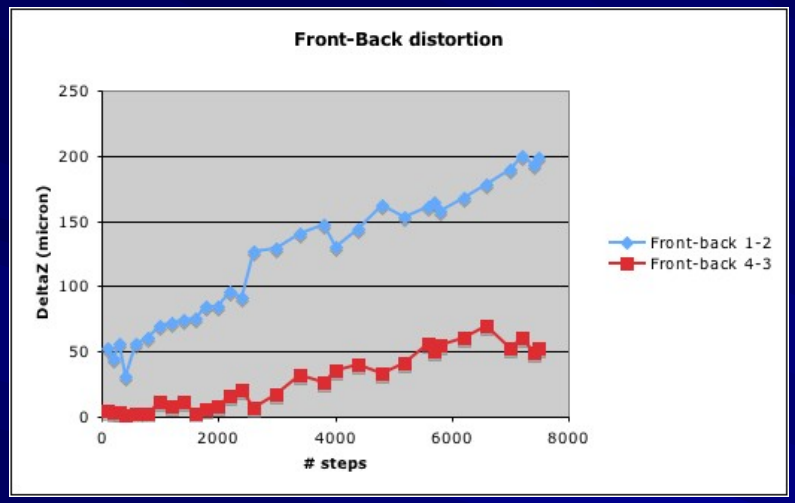


Fully closed

Observed distortions related to detector movement

Roman Pot mechanics (5)

Obtained by mechanical probes (<10mm) and laser tracker system (-> 45mm)



Some findings:

- Good reproducibility ~ 5 micron
- distortions proportional to displacement
- springs amplifies distortions

front-back distortions ~ 200 micron
→ 1 mrad in angle
→ 2 per mille in |t| or luminosity

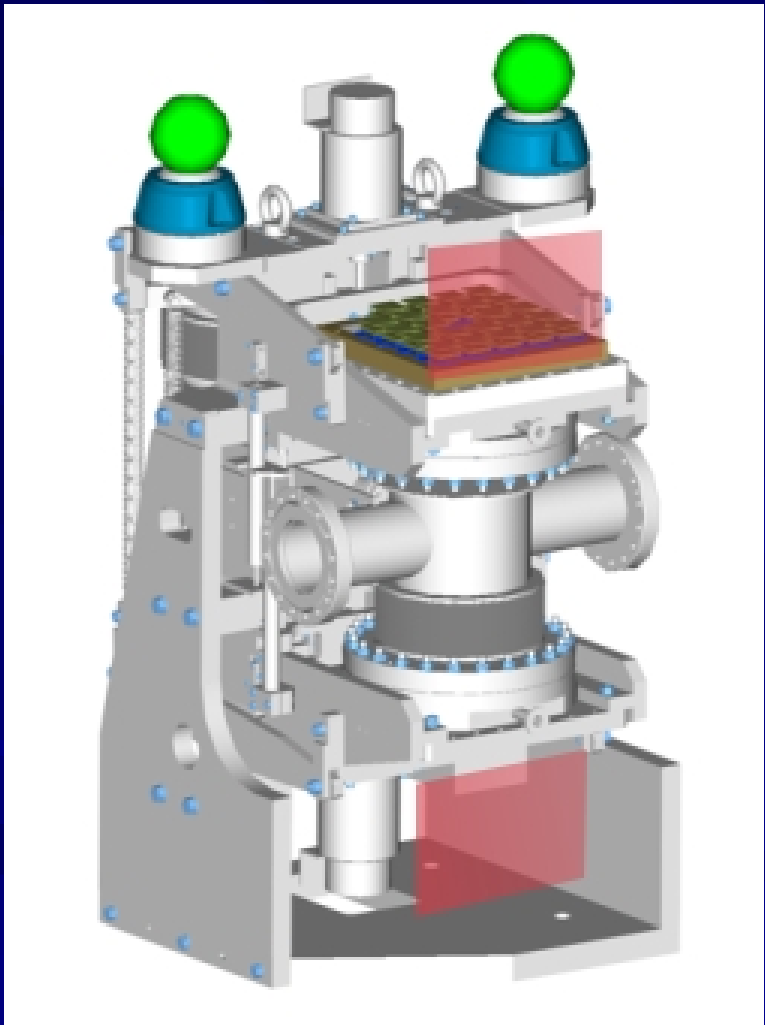
left-right distortions ~ 50 micron
→ add ~ 15 micron to detector resolution
→ minor effect for tracking

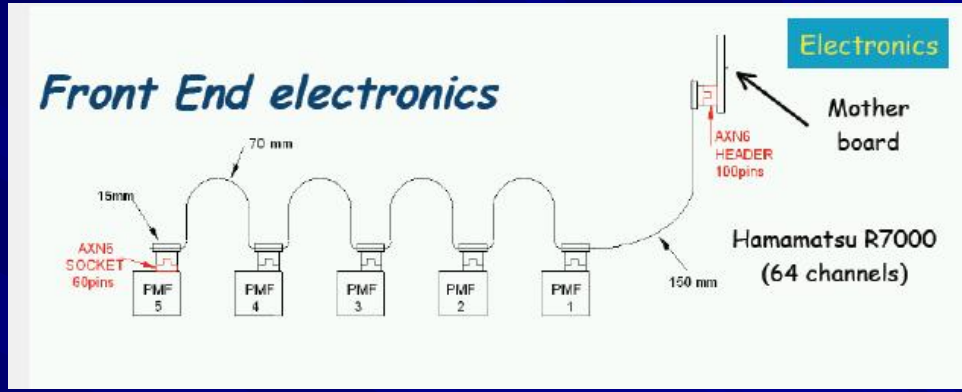
… and the measures:

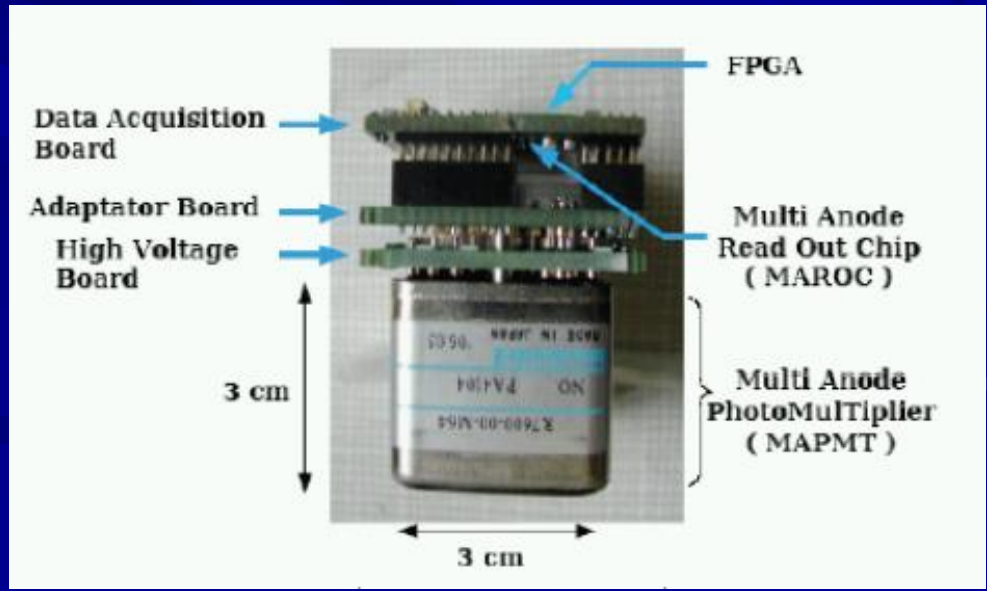
- fine tuning of spring system
- final decision of compensation system
- improve stiffness of relevant components (steel instead of aluminum)
- avoid springs by overcompensation

Fron-End Electronics

CERN with contributions Orsay and Lund, F.Anghinolfi et.al.





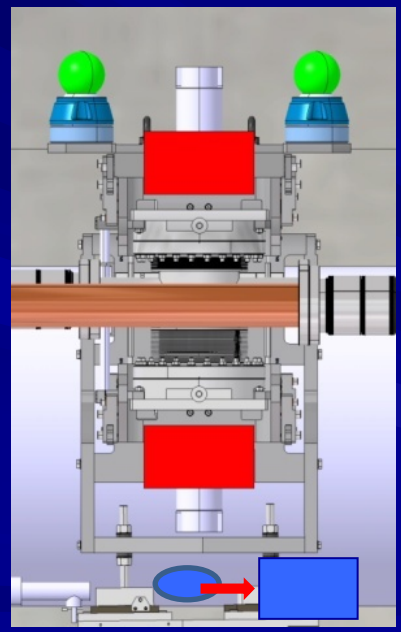


Front-End Electronics (2)

PMF-2: prototype version #2 end of October
Motherboard: production pending on PMF-2 validation
R/O software : under discussion
OD/trigger electronics: not yet started

Critical issues for next tests

Other preparations in the tunnel: ALFA patch panel



Low / HV cables
Air core cables
Optical cables
EMBL for BPMs

Cable arrivals

Software discussion

Up to stand alone software, integrate in ATLAS frame
Status → http://twiki.cern.ch/twiki/bin/view/Main/AlfaSoftware H.Stenzel

ALFA Software and Simulation

Tasks of the Software & Simulation group

- event generators for elastic scattering
- simulation of beam conditions for the high beta-star optics
- beam transport (using MADX)
- detector simulation (integartion in ATLAS)
- space point reconstruction
- t-reconstruction
- luminosity determination

➢ **elastic scattering**
➢ **MADX**
➢ **Reconstruction**
➢ **Detector simulation & Integration in ATLAS**
➢ **Test Beam Software**
➢ **Documentation**
•

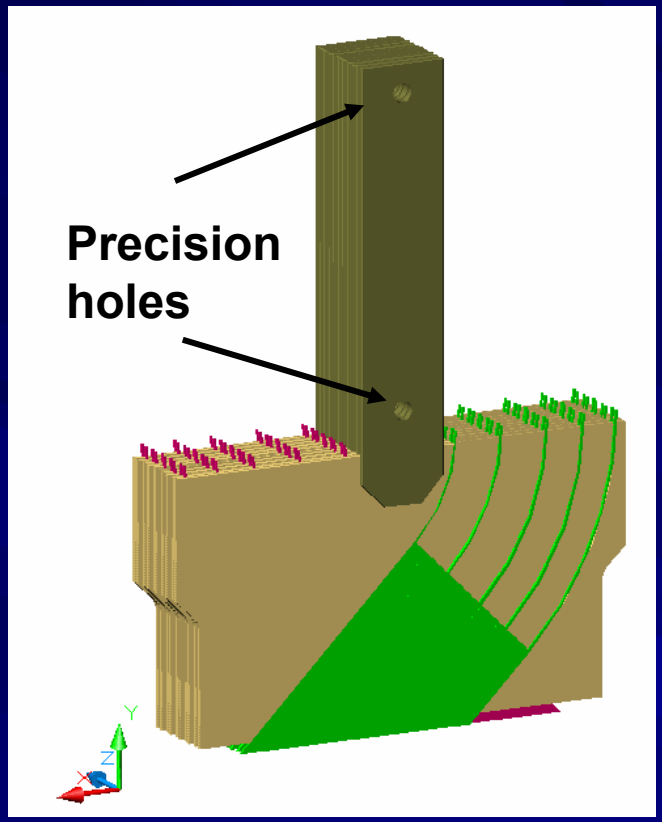
elastic scattering

To get started, use a modified version of PYTHIA to generate elastic scattering events. A fit program is also provided to do the luminosity analysis on the true t-spectrum.

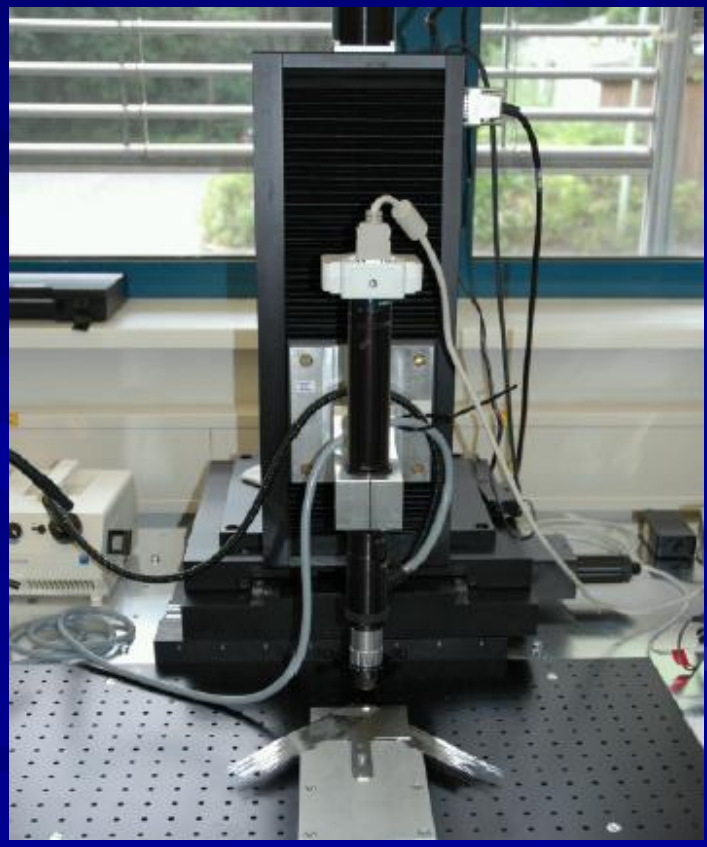
* **Getting-started software distribution**

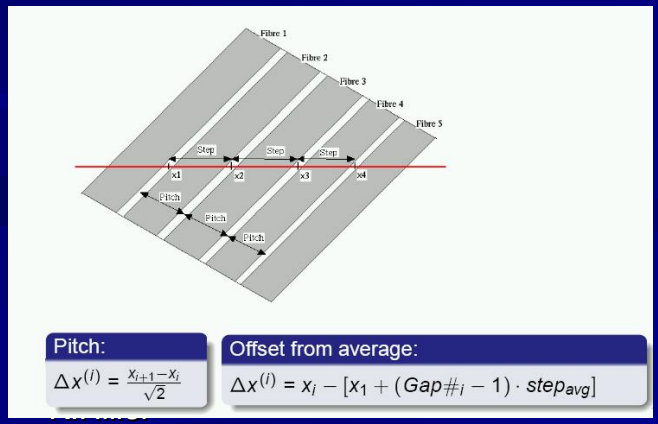
And now the DESY contributions …

Fiber Detector Metrology



1) Measure precision holes
   to fix the coordinate system
2) Measure fiber edges
   for individual fiber positioning

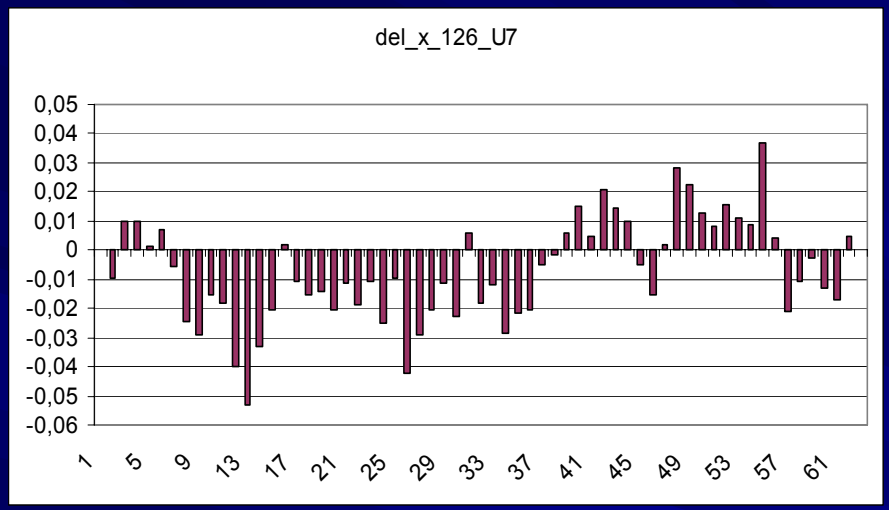




D.Petschull

Fiber Detector Metrology (2)

CERN : deviations from nominal position
~ +- 10 … 20 micron

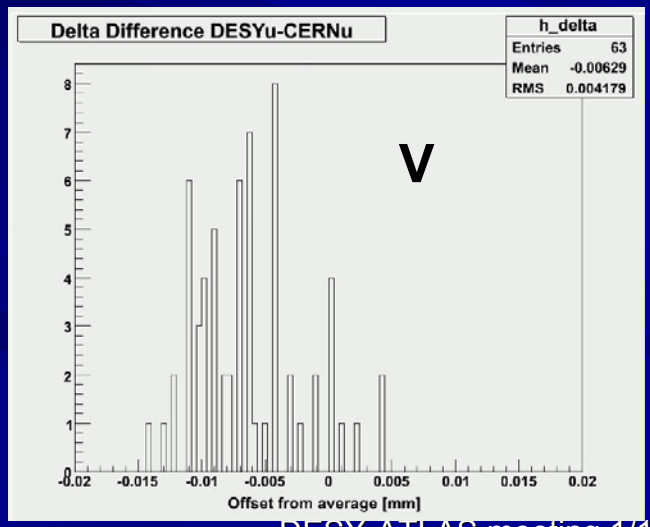


CERN – DESY comparison

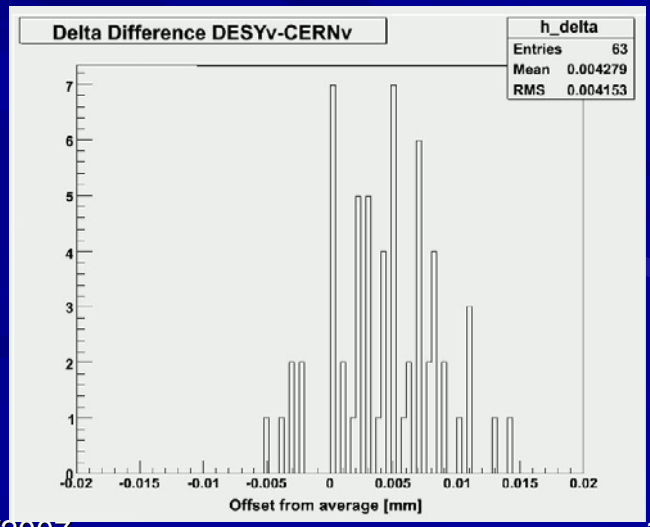
→ typical difference ± 5 µm

→ add. 5 µm syst.error
from different coordinate syst.

U



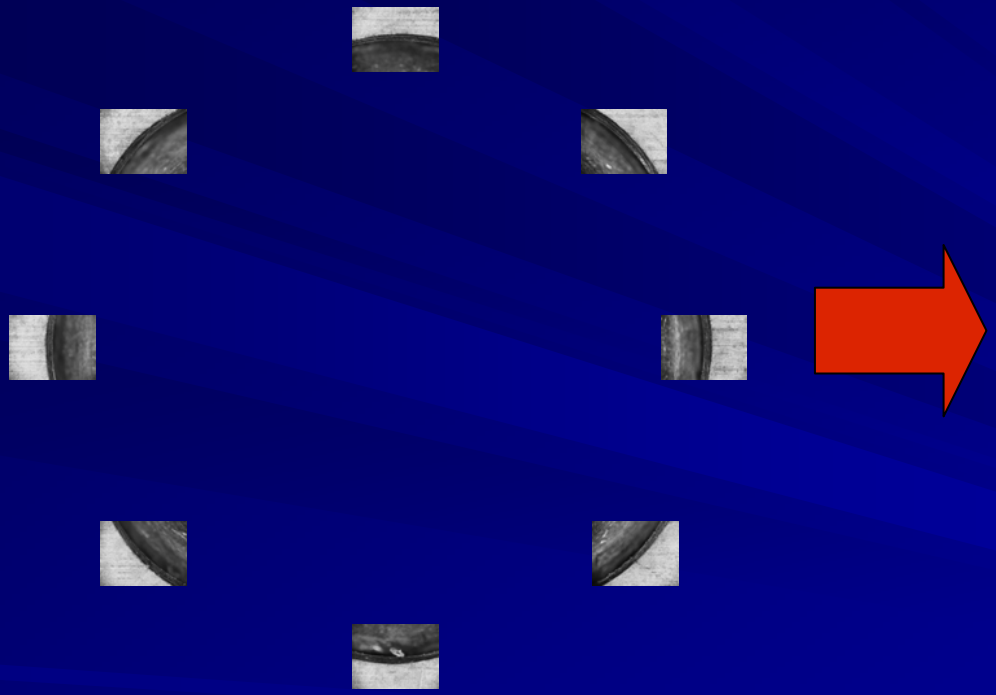
V

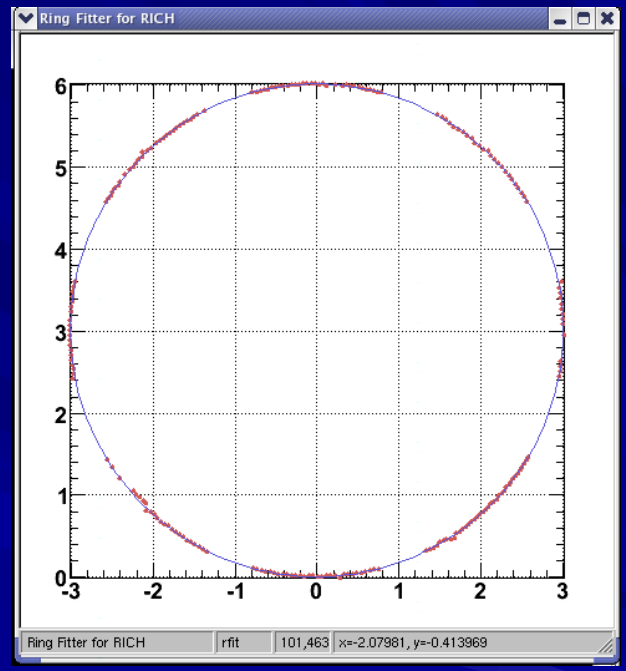


Fiber Detector Metrology (3)

- Take picture on each side of the hole
- Let LabView find the edge in the pictures

- Feed RFit with edge coordinates
- Let “Rich Fit” fit the circle

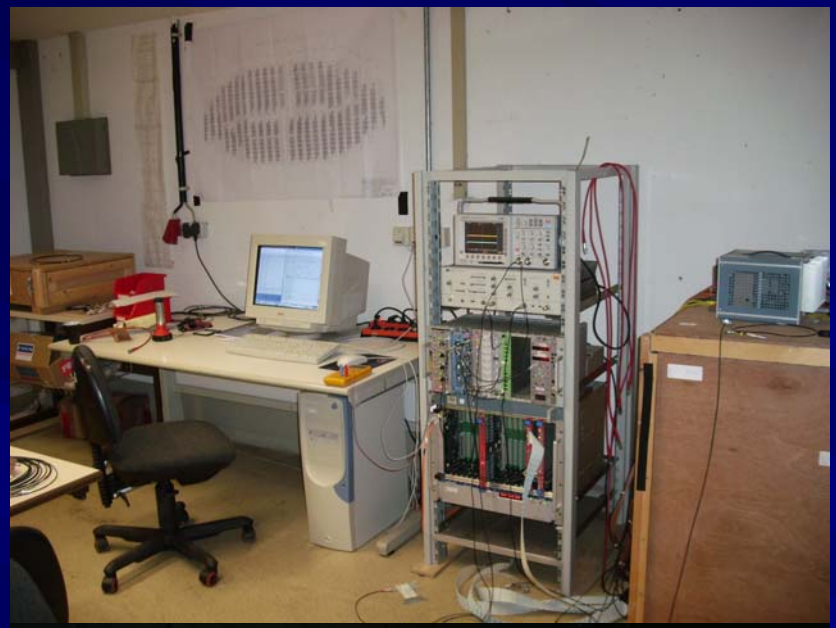


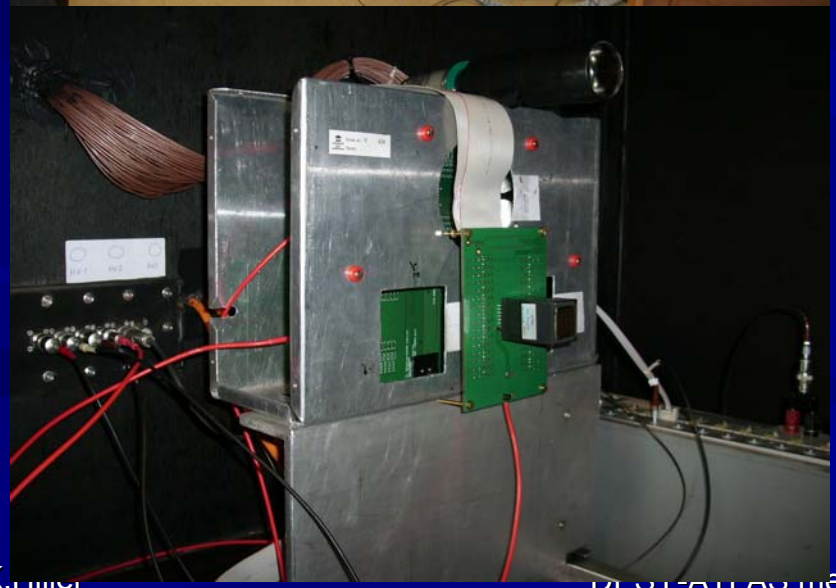


Different light sources investigated: “normal”, “through”, “gooseneck”
→ present estimate of hole center precision ~ ± 2 µm

➔ automation of fiber and hole measurements

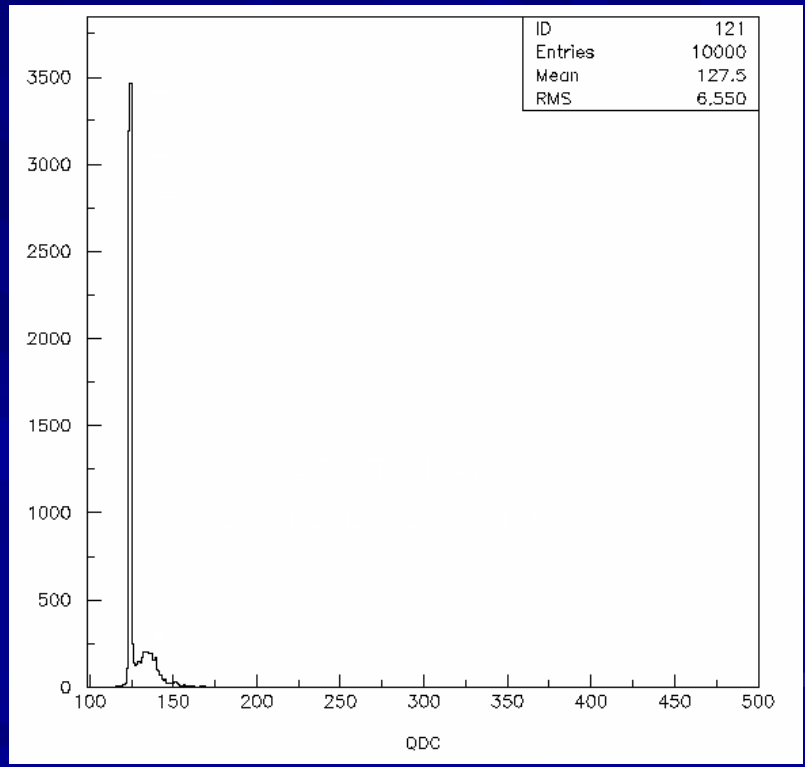
MAPMT Measurements (1)





W.Hain

Pulsed LED + filter set + analog (CAEN QDC) readout

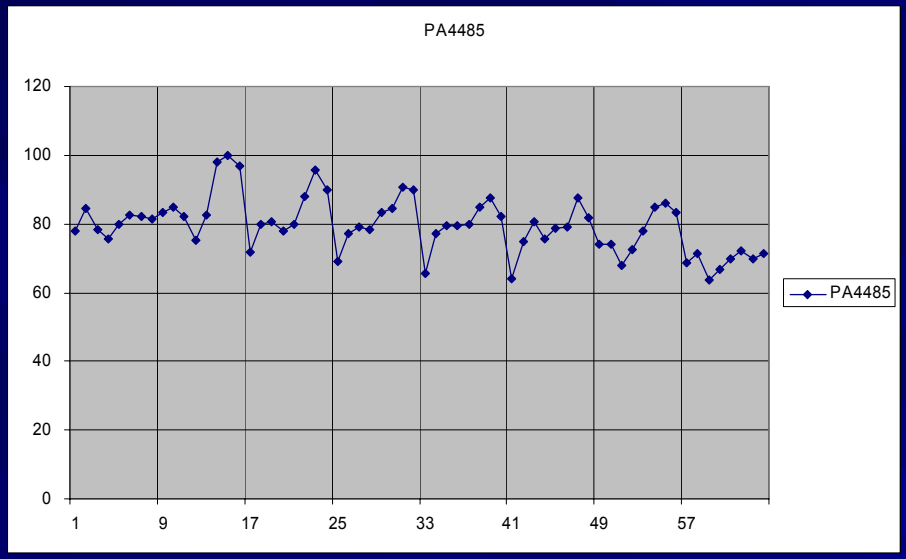


"ex-HERMES" black box

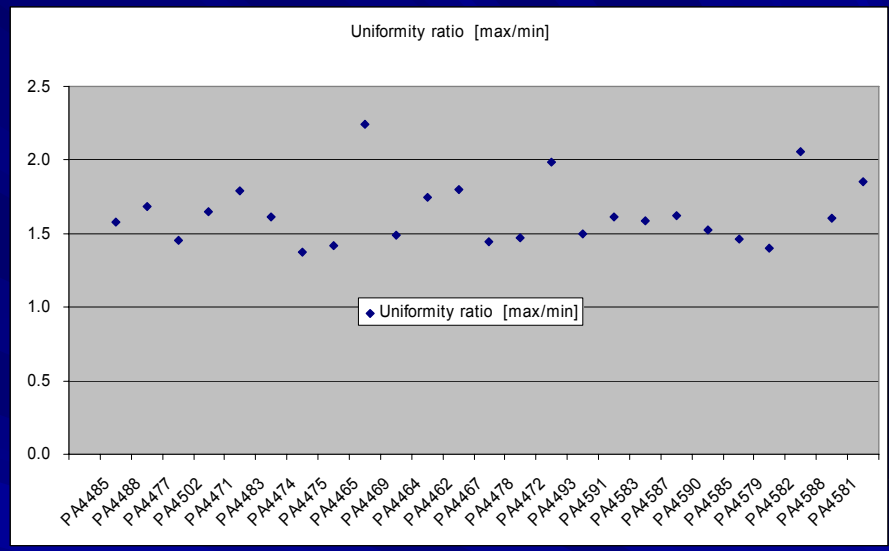
MAPMT Measurements (2)

3 out of 25 new MAPMTs H7546 measured → excellent agreement with data sheet

Typical gain variation of 64 channels



min/max ratios of all 25 MAPMTs

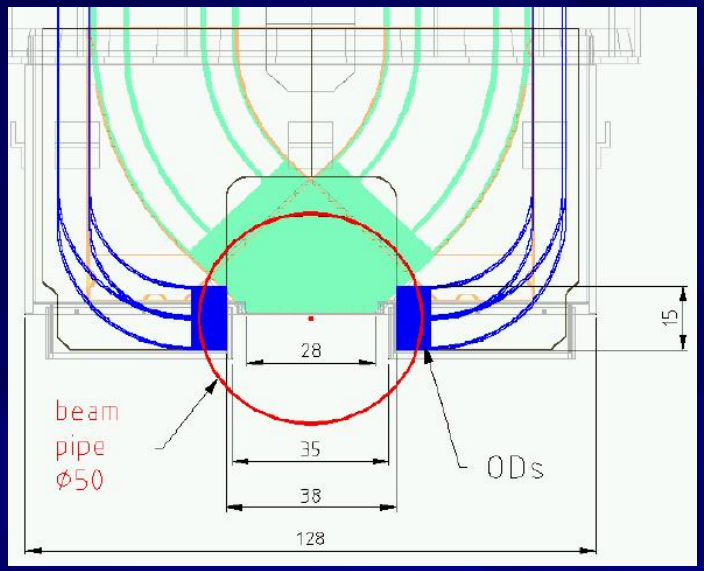


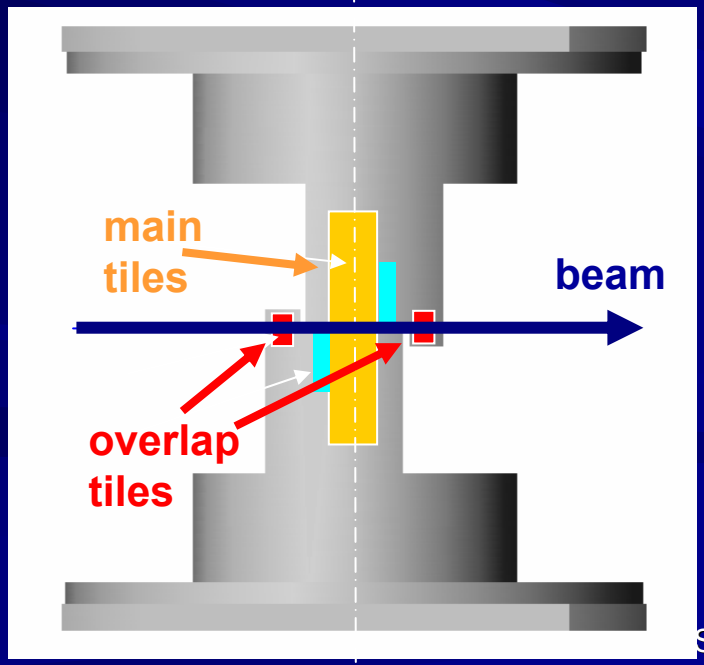
→ Develop a qualifying scheme with a data base for all MAPMTs

(→ R.Ciecielski)

→ For final digital R/O calibration with final front-end electronics at CERN

Trigger Tile R/O (1)





Main tiles:
32 x 32 mm2, 3mm thick

To allow precise tile positioning
do not fully cover the edge by fibers
→ bundle thickness ~ 2 mm

Test bundle for main tiles 32 x 2 mm2

~ 250 fibers

OD tiles:
6 x 15 mm2, 3mm thick

Bundles 30° to vertical

Made of 2 separate bundles
A: 5.2 x 2 mm2 → 38 fibers
B: 7.5 x 2 mm2 → 58 fiber

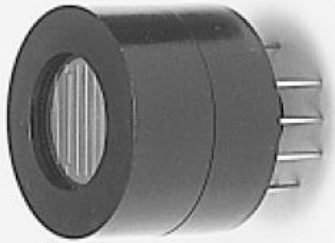
} 96 fibers (45° → 112)

Trigger Tile R/O (2)

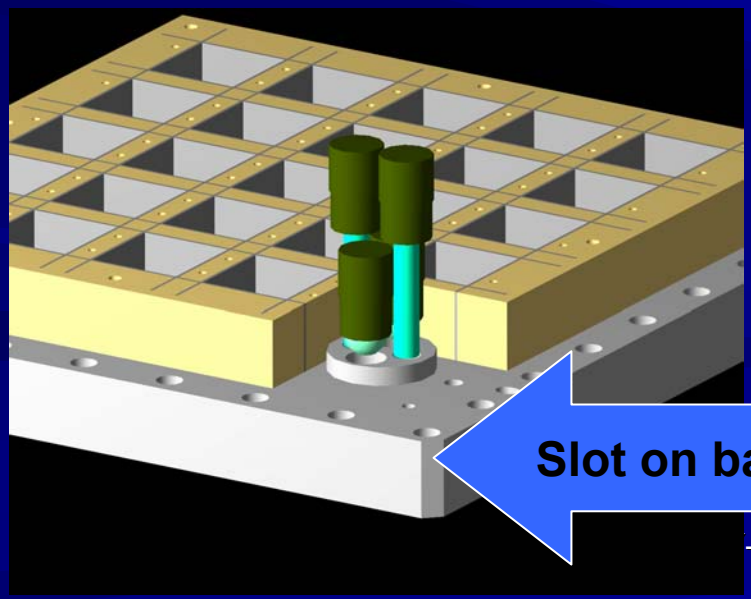
General R/O scheme from H1 FPS trigger tiles

Add 2 bundles
2 x 250 fibers

Hamamatsu



OD bundles
100 fibers

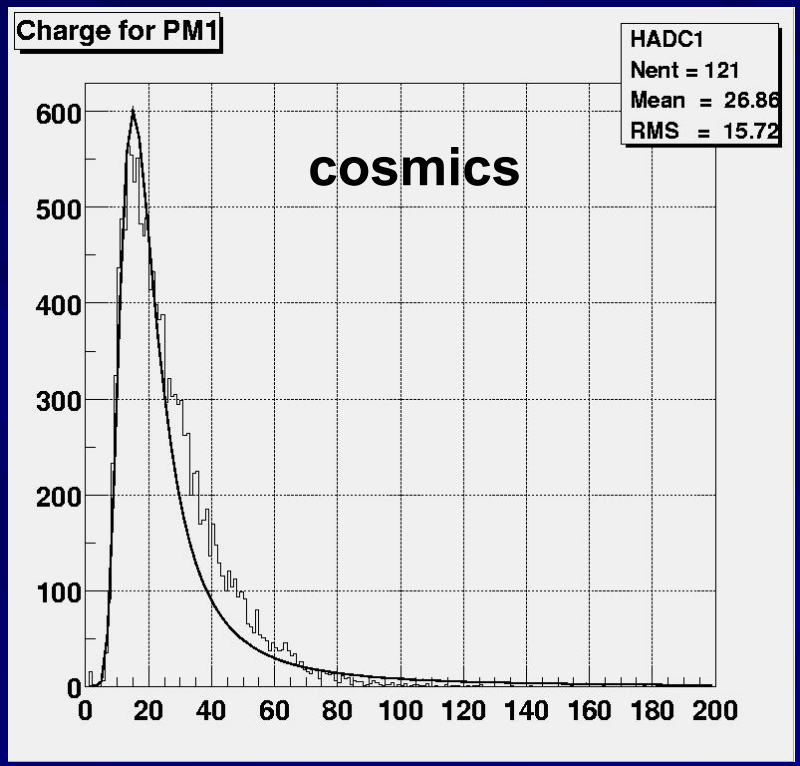


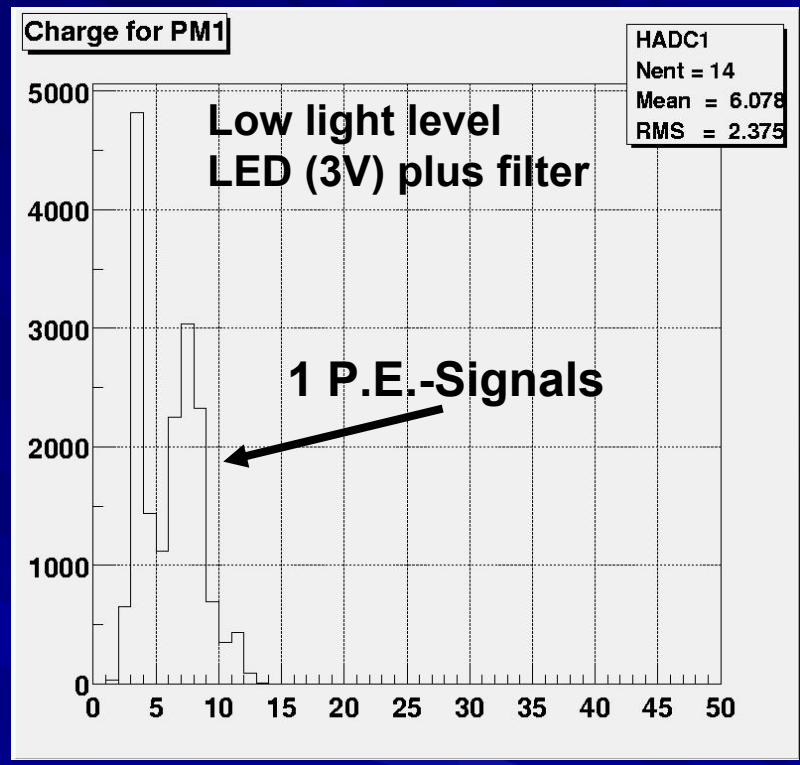
Slot on base plate

R7401 with lens D = 14mm
R7400 w/o lens D = 9mm

Trigger Tile R/O (3)

Rough estimate of light yield of H1 trigger tiles (W.Hain, K.H.)





PMT0 : 5 ± 2/1 P.E. → we can expect for ALFA tiles >~ 10 P.E.

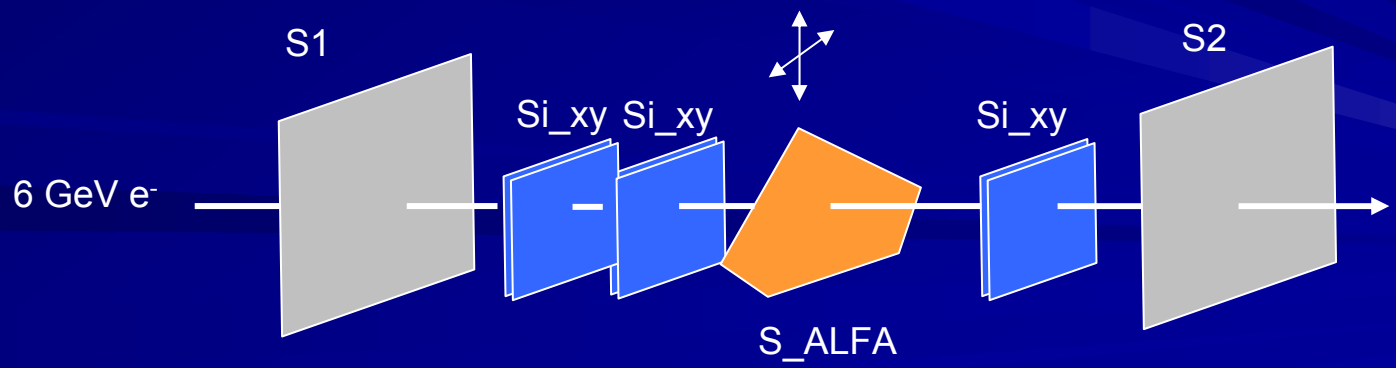
PMT1: 6 ± 2/1 P.E. → sufficient for good uniformity

Trigger Tile R/O (4)

Precise measurements using DESY test beam TB 22

1) Light yield via fiber bundles or # P.E.s
2) How efficient is the lens for light collection ? R7400 ⟷ R7401
3) Several tile coatings:
   - no coating
   - full aluminization
   - edge aluminization
   - white reflective paint
4) Several bundle options:
   - 2 single bundles r/o by 2 PMTs w/o lens
   - a twofold bundle r/o by 1 PMT with lens
   - r/o by wave length shifter fibers (2 x 1 mm2) ???
5) Uniformity across the tile area using Si-track telescope

December 10 – 21,2007
supported by EU FP7 EUDET project.
I. Gregor, U. Koetz, N.Meyners, W.Hain



Summary

- ALFA prototype takes shape
- Most critical components: 1) fiber coating
  2) front-end electronics

No back up !

- DESY contributions on schedule
- software developement for ALFA in ATLAS has started
- Schedule 2008:
  1) lab test of complete detector insert
  2) test beam of full Roman Pot
  3) installation of prototype before tunnel is closed
  4) continue construction of all ALFA stations