ALFA Project at DESY

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DESY

Hamburg, 22th of May 2007

Absolute luminosity measurements-why?

- Cross sections for "Standard " processes
  - t-tbar production
  - W/Z production
  - …….

  Theoretically known to better than 10% ……will improve in the future

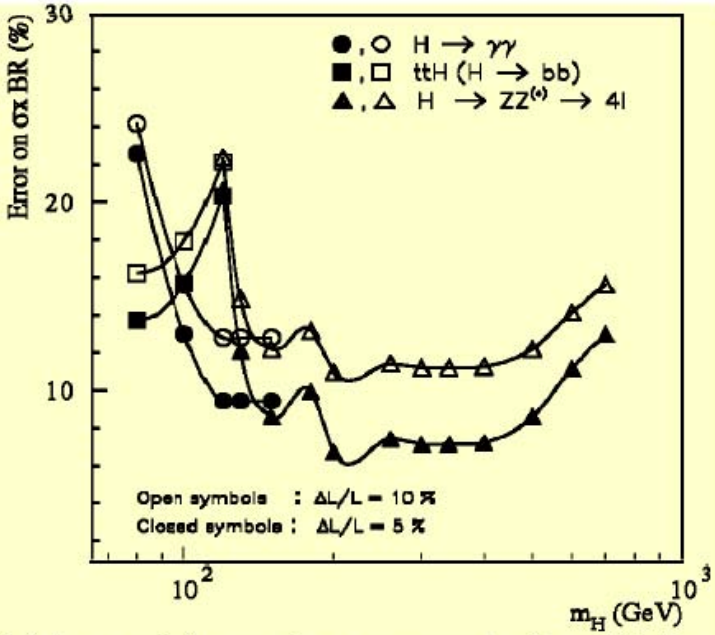
- New physics manifesting in deviation of σ x BR relative the Standard Model predictions

- Important precision measurements
  - Higgs production σ x BR
  - tanβ measurement for MSSM Higgs
  - …….

Absolute Luminosity Measurement (cont.)

Examples

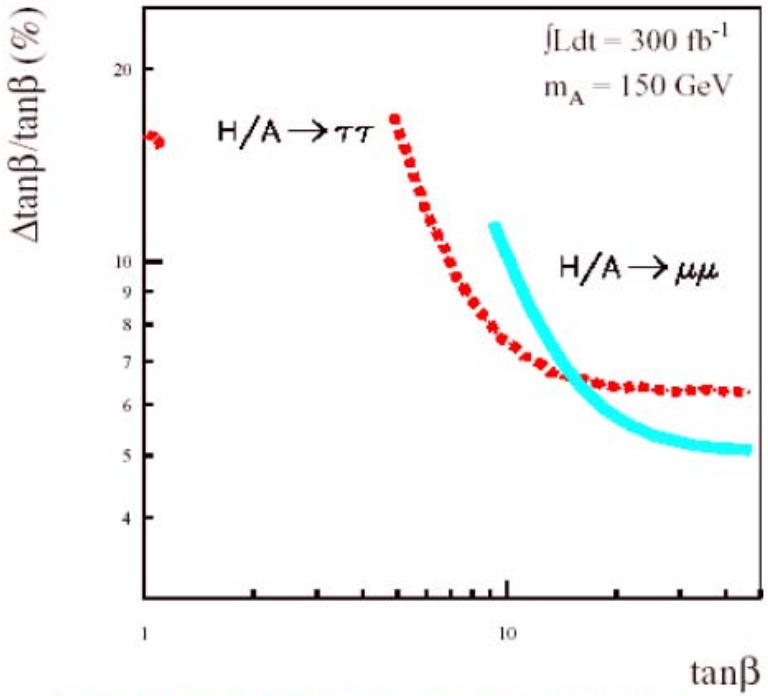
Higgs coupling



Relative precision on the measurement of $\sigma_H \times$BR for various channels, as function of m_H, at $\int L dt = 300$ fb^{-1}. The dominant uncertainty is from Luminosity: 10% (open symbols), 5% (solid symbols).

(ATLAS-TDR-15, May 1999)

tanβ measurement



Systematic error dominated by luminosity (ATLAS Physics TDR)

ALFA = Absolute Luminosity For ATLAS

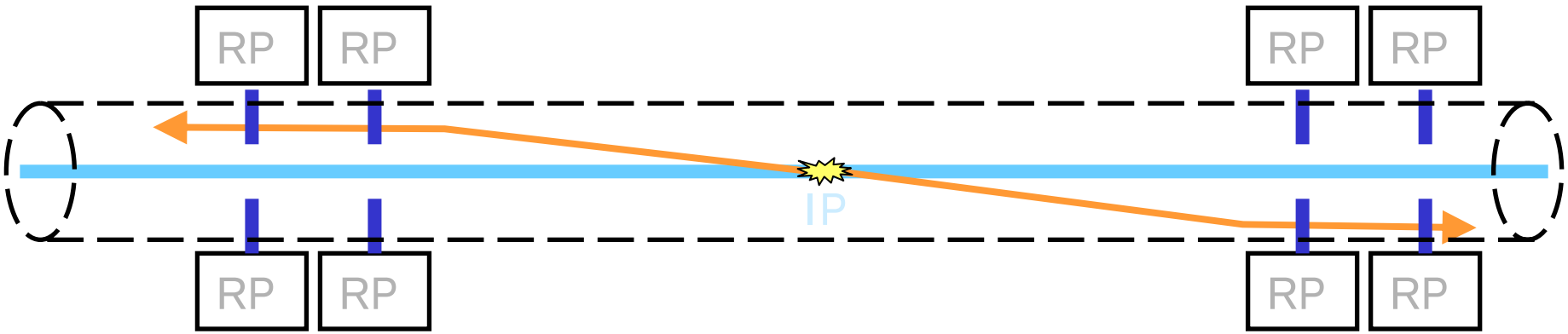
The Roman Pot mechanics.

The detectors

The electronics

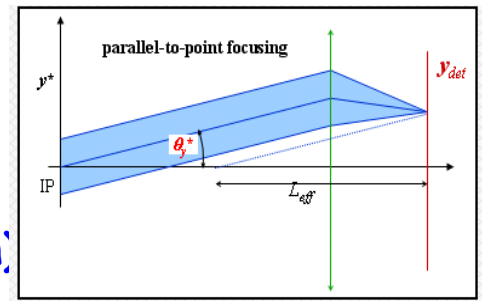
ALFA - ATLAS Roman Pots

- Goal: Determine absolute luminosity at IP1 (2-3% precision)
- Measure elastic rate dN/dt in the Coulomb interference region (à la UA4). $|t| \sim 0.00065\ GeV^2$ or $\Theta \sim 3.5$ microrad.

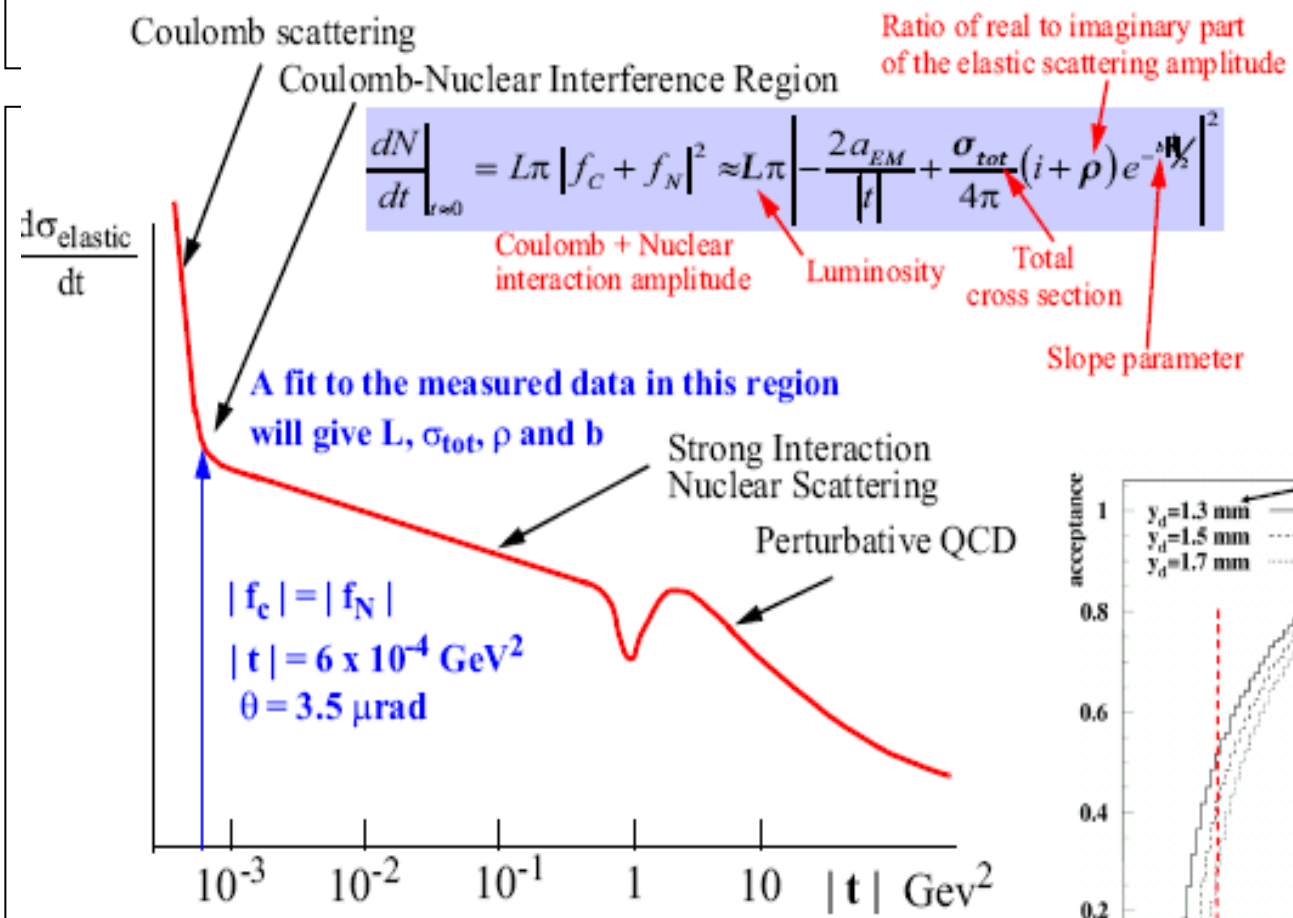


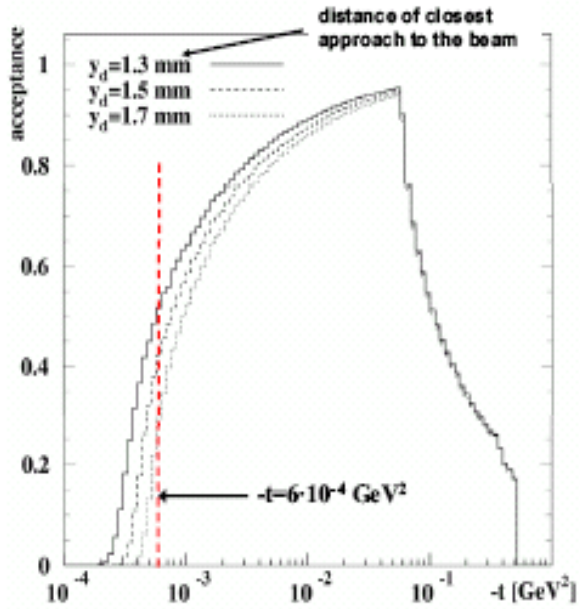
This requires (apart from special beam optics)

- **to place detectors ~1.5 mm from LHC beam axis**
- **to operate detectors in the secondary vacuum of a Roman Pot**
- **spatial resolution $s_x = s_y$ well below 100 micron (goal 30 micron)**
- **no significant inactive edge (< 100 micron)**

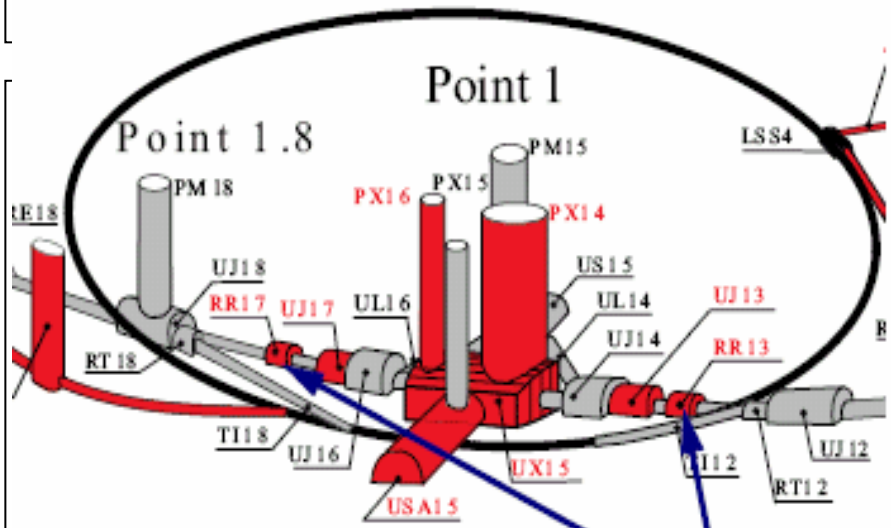


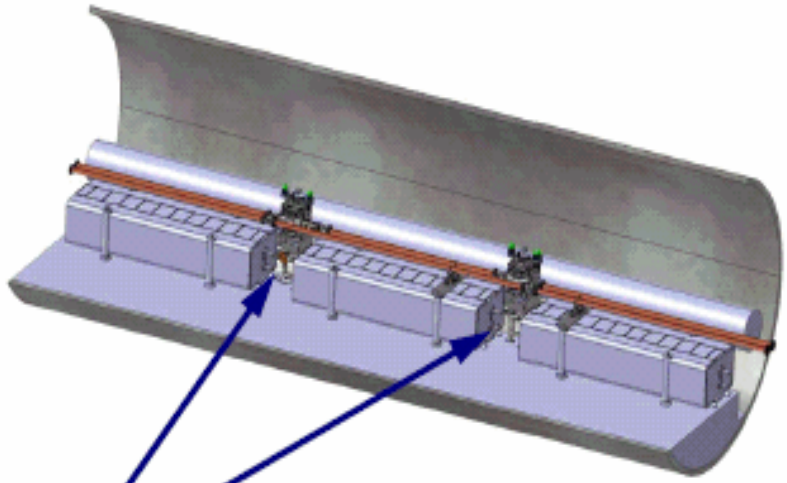
Elastic scattering





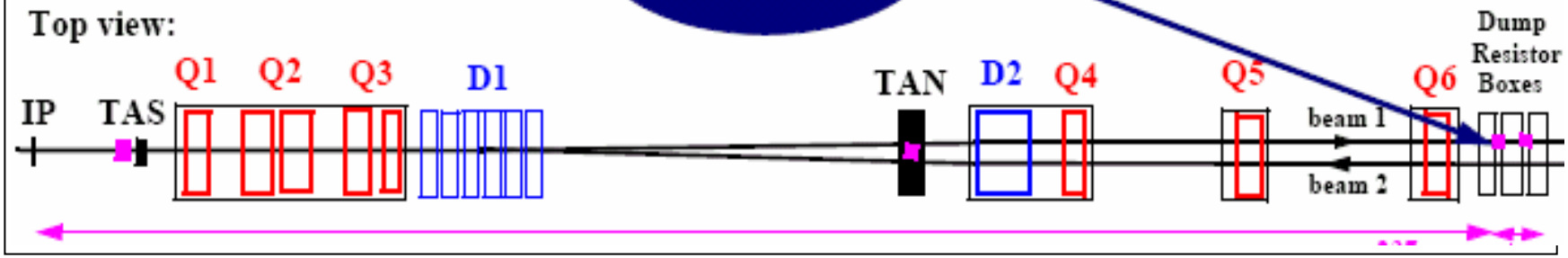
Roman Pot locations





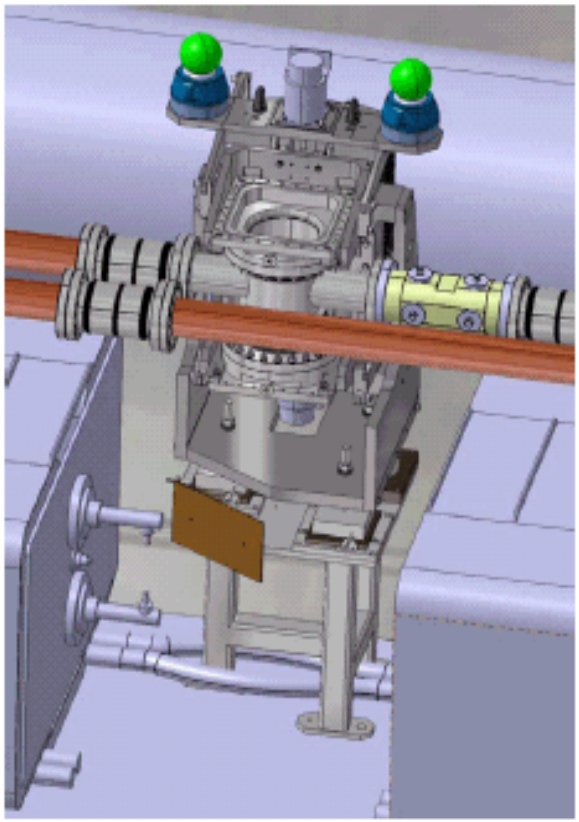
Roman Pots

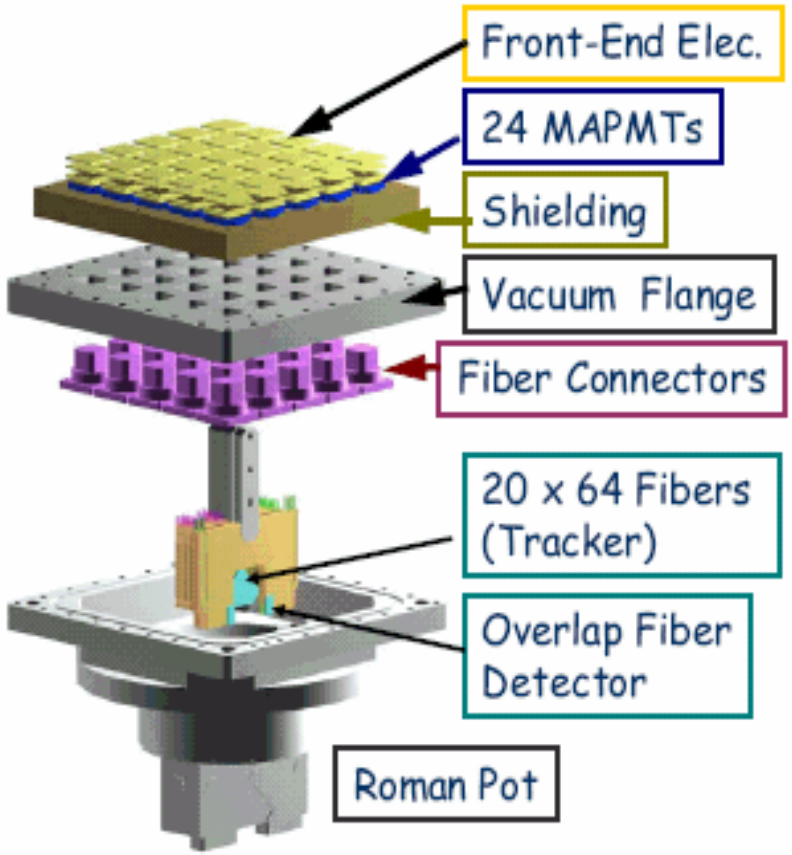
Top view:



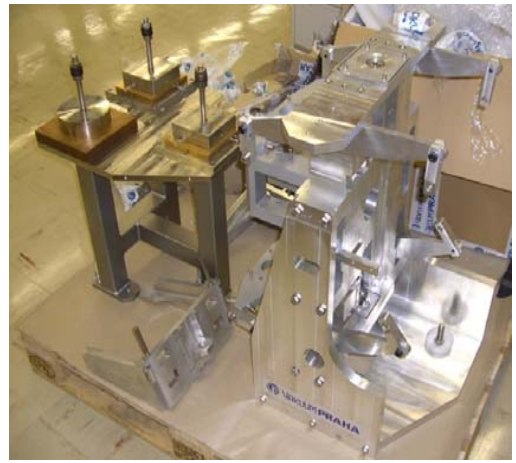
The Roman Pot mechanics

The Roman Pot Unit

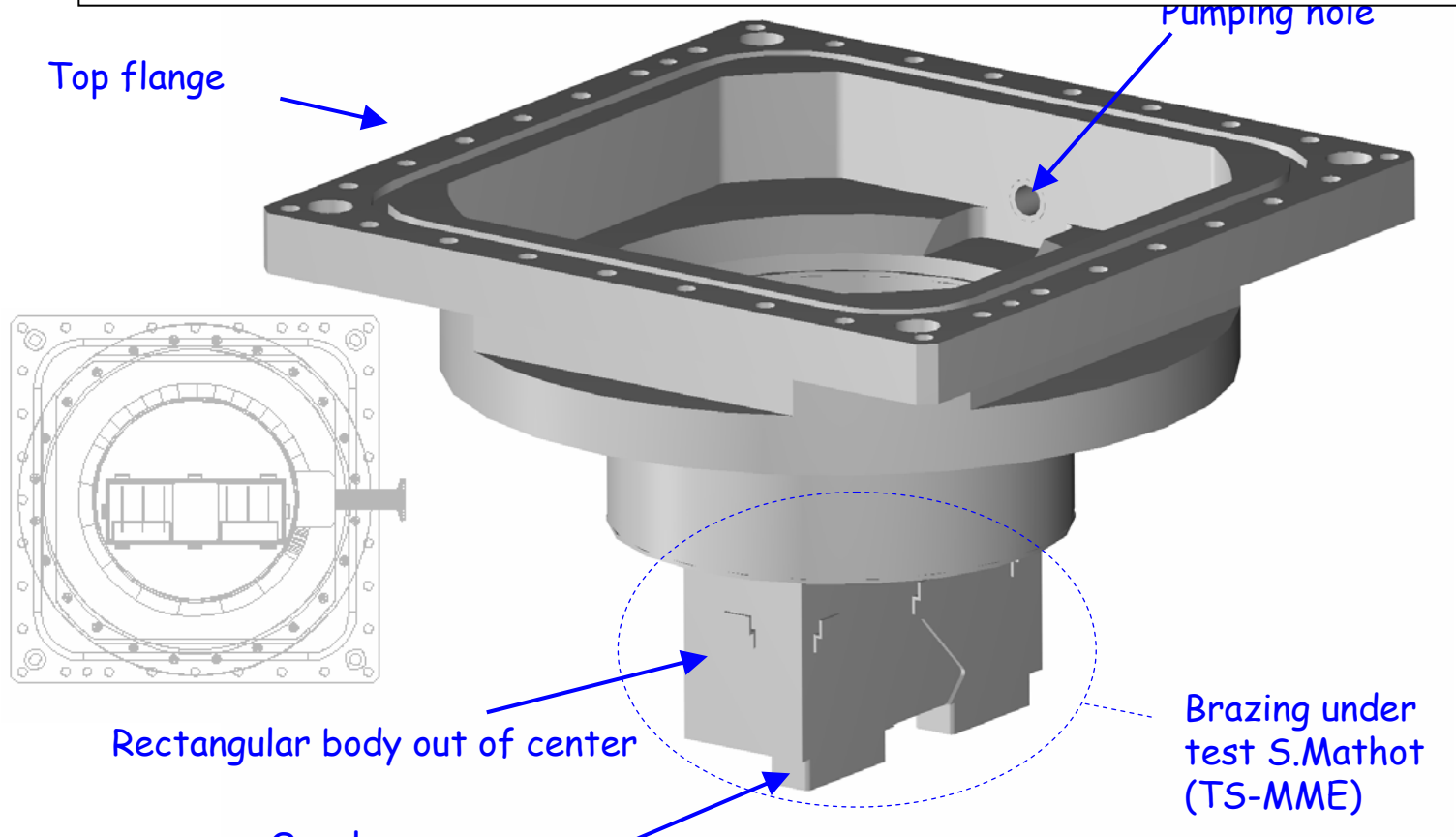




Received recenly prototype Roman Pot Unit (i.e without pot)
Now being assembled by PH/DT1 team.
Will be used to set up the control system and organize cable routing and patch panels



The Pot



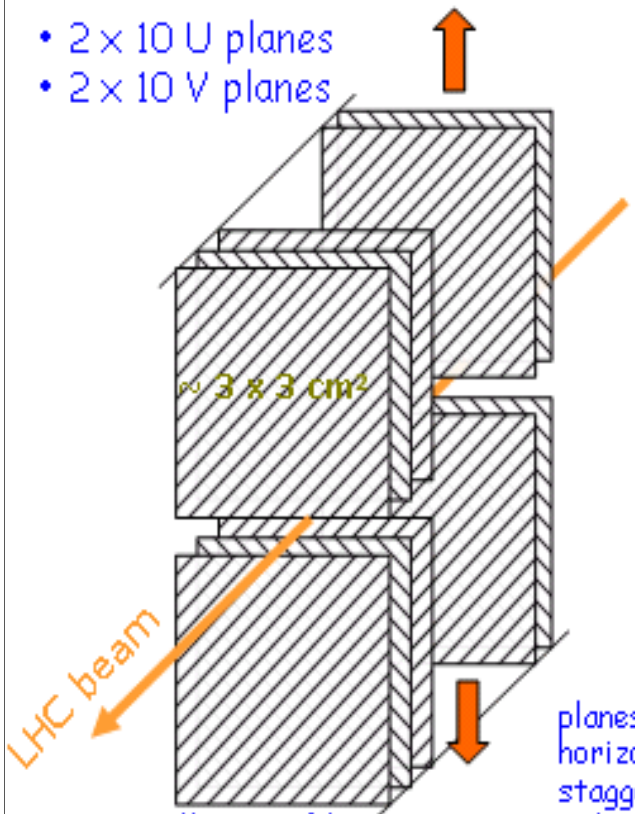
First prototype being prepared

- Will soon be vacuum tested
- Simulation of contribution to the impedanc budget ongoing

The detectors-fiber trackers

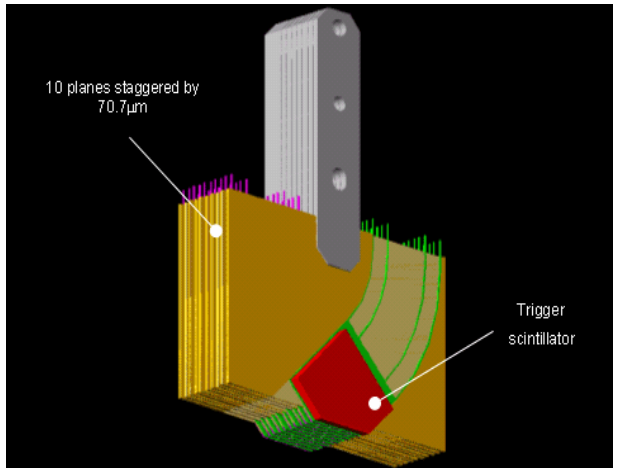
Concept

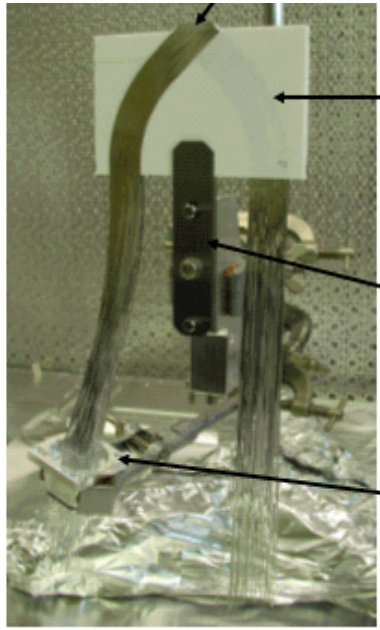
- 2 x 10 U planes
- 2 x 10 V planes



- scintillating fibres
- 0.5 mm² square

planes are horizontally staggered by multiples of 70.7 micrometer





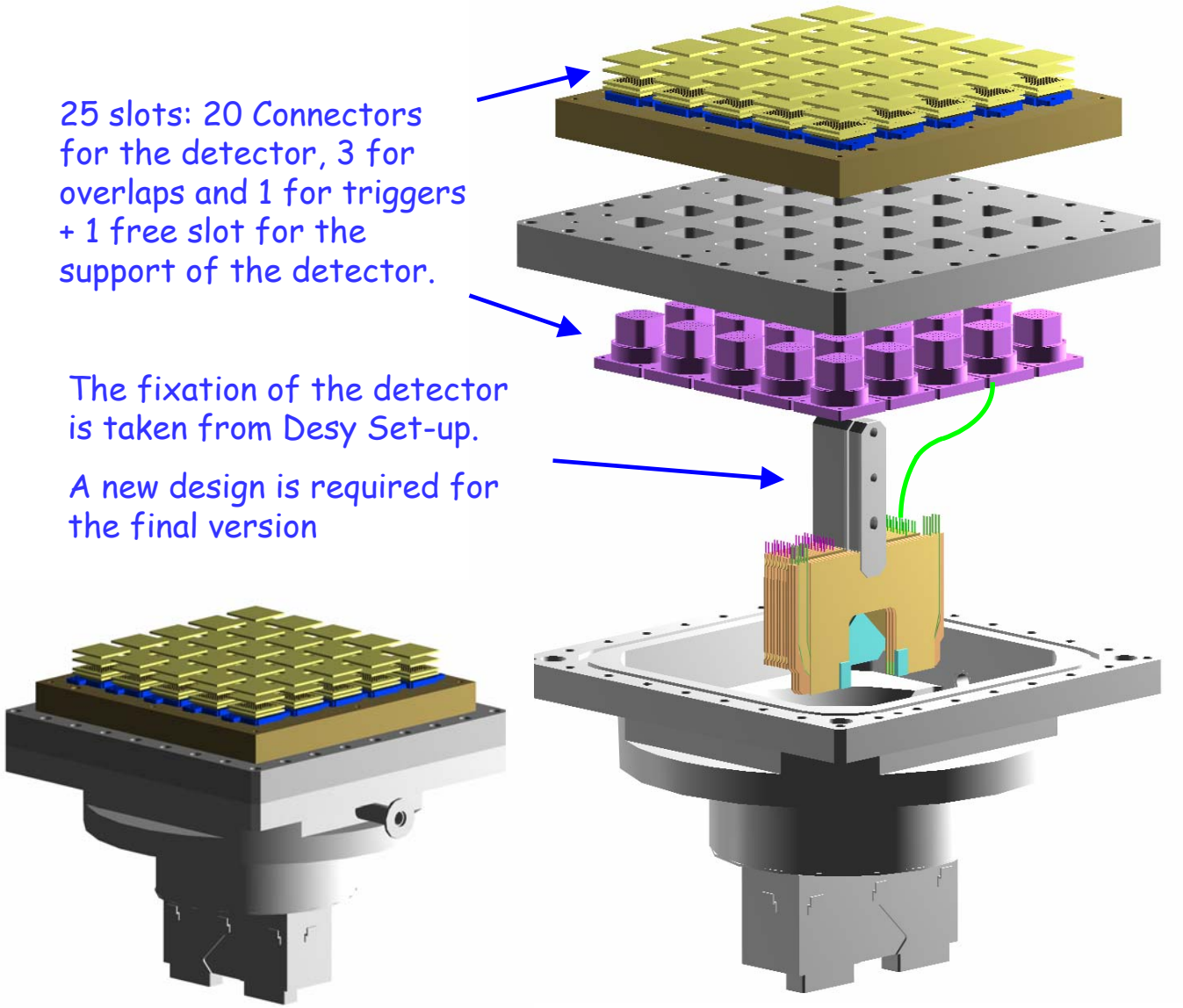
The fibres are read out by MAPMT

Design of ALFA detector

25 slots: 20 Connectors for the detector, 3 for overlaps and 1 for triggers + 1 free slot for the support of the detector.

The fixation of the detector is taken from Desy Set-up.

A new design is required for the final version



MAPMTs + PMFs + mu-metal shielding

PM baseplate

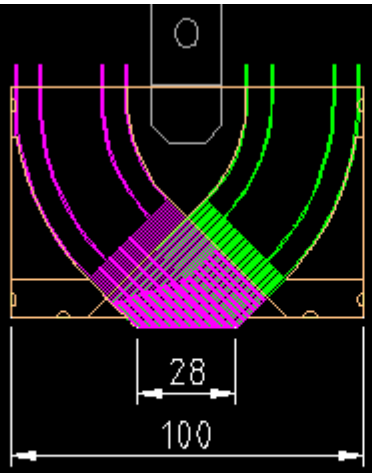
Connectors
Fiber detector
overlaps
trigger scint.

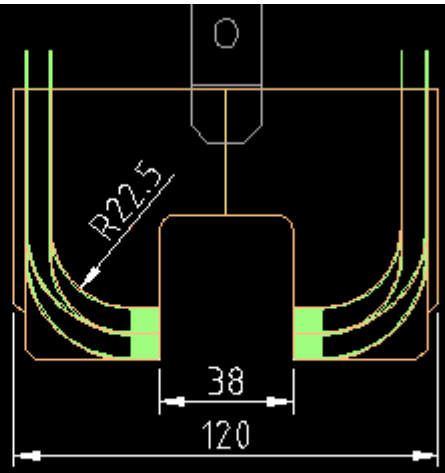
Pot

4 types of plates designed

Fiber detector:
10 plates of

2x64 fibers

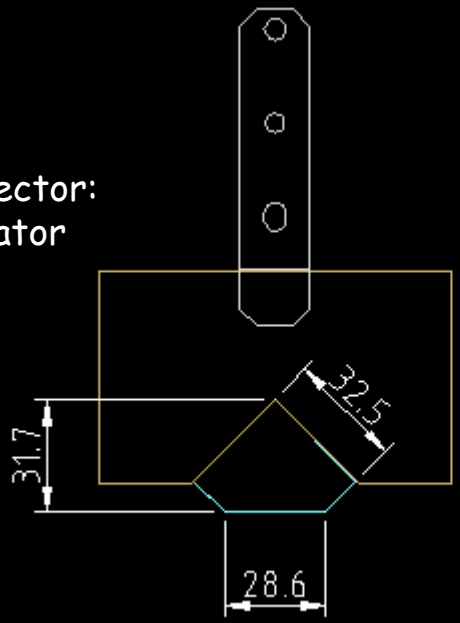


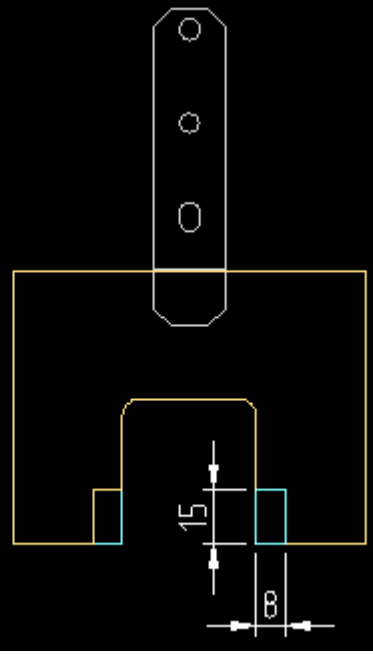


Overlap detector:
3 plates of

2x30 fibers

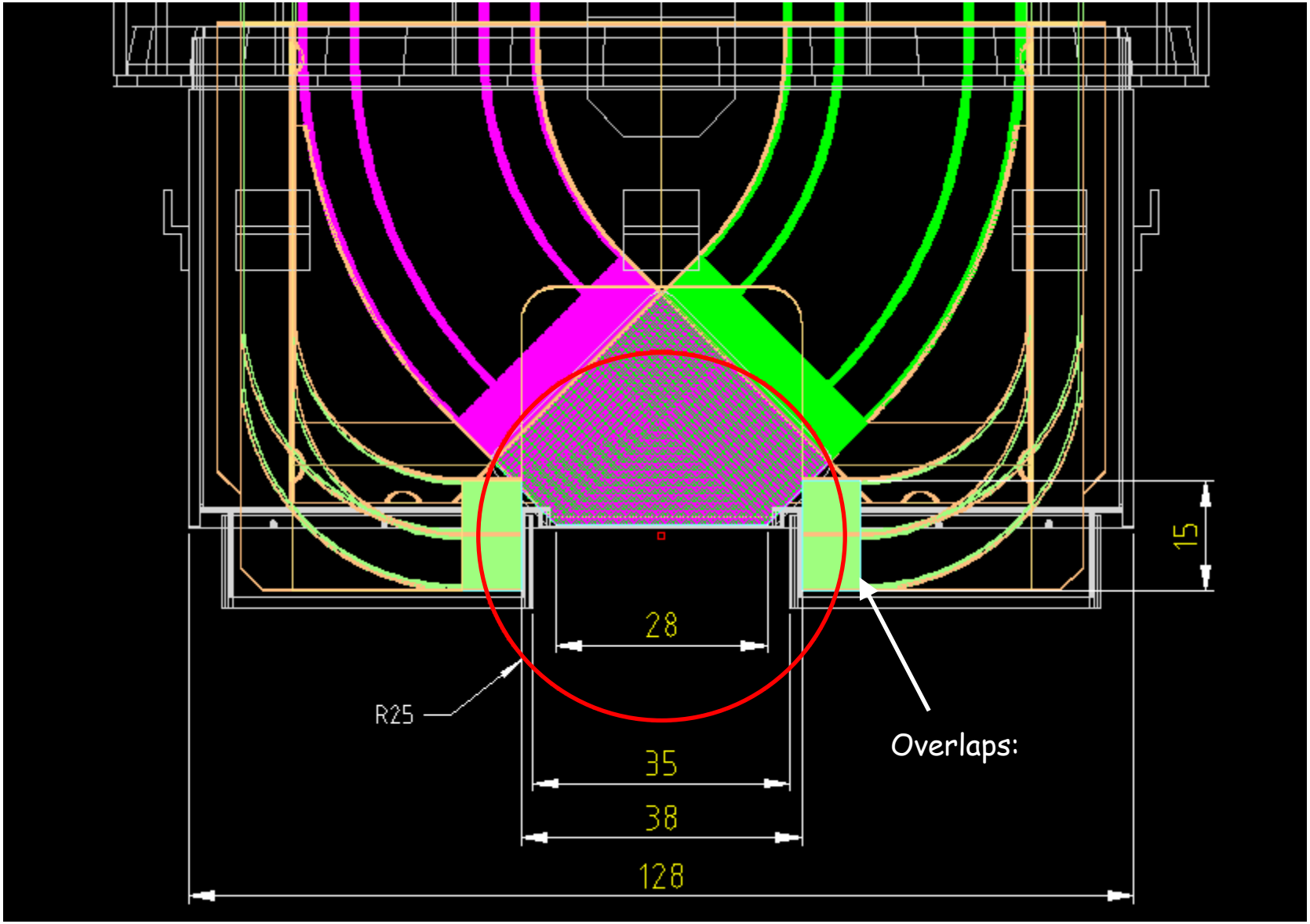
Trigger for detector:
1 plastic scintillator
3mm thick



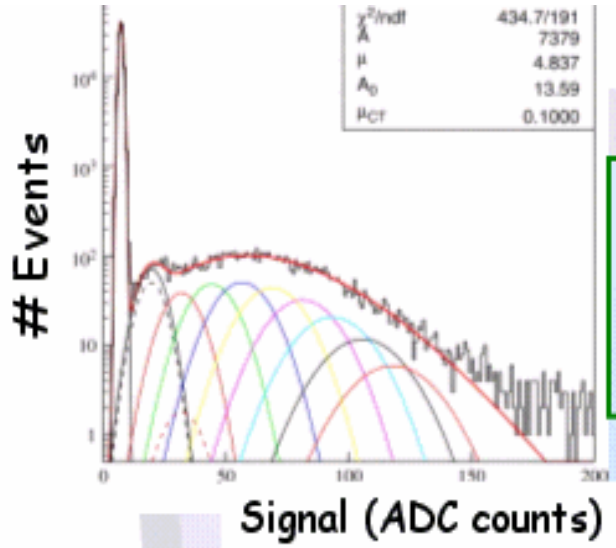


Trigger for
overlap detector:
2 plastic
scintillator 3mm
thick

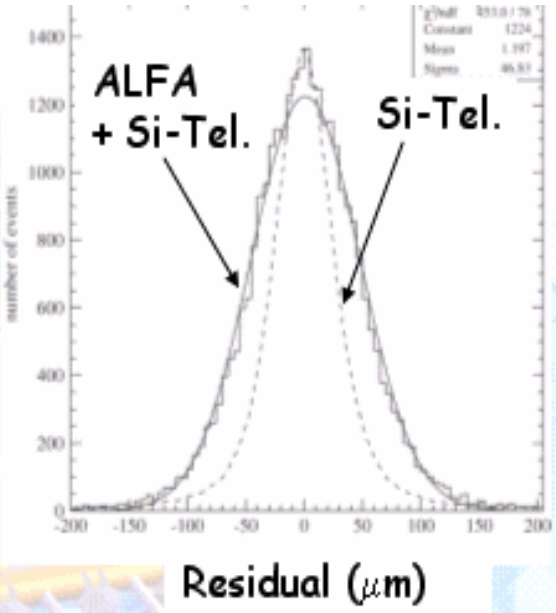
Front view of detector in pot

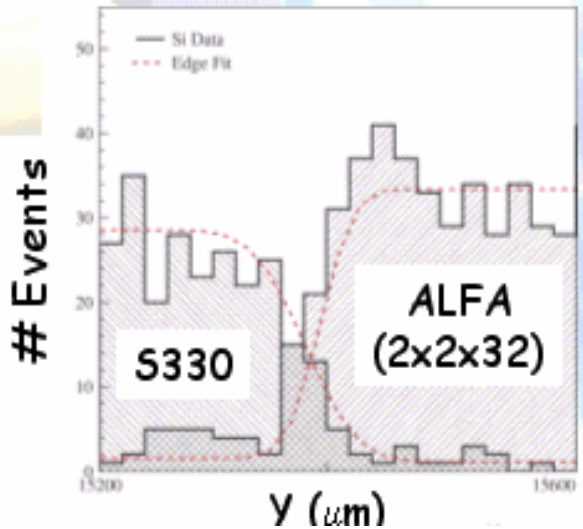


DESY test beam results



Light yield:
45° cut → 3.9 p.e.
90° cut → 4.5 p.e.
Efficiency ~ 95%

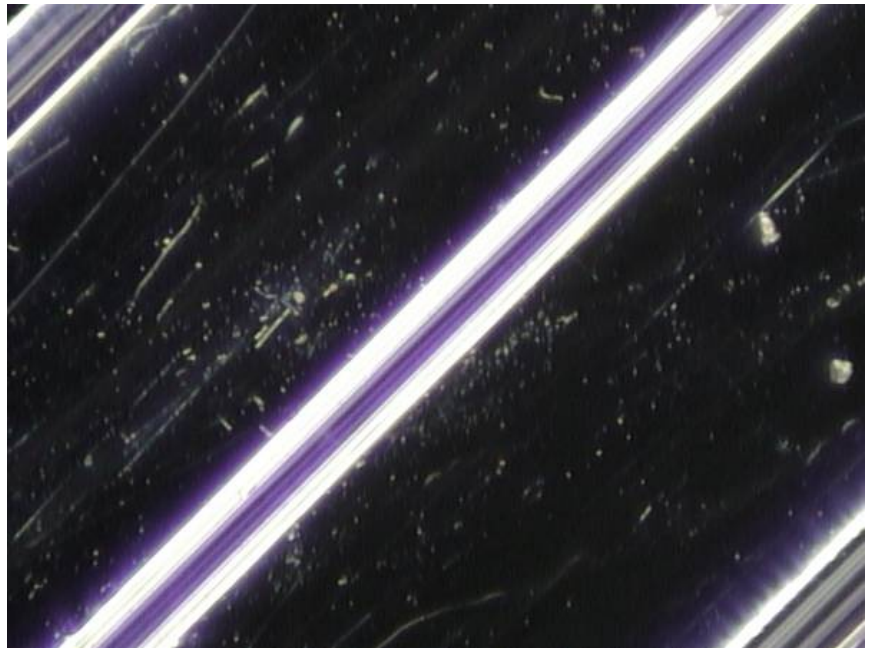


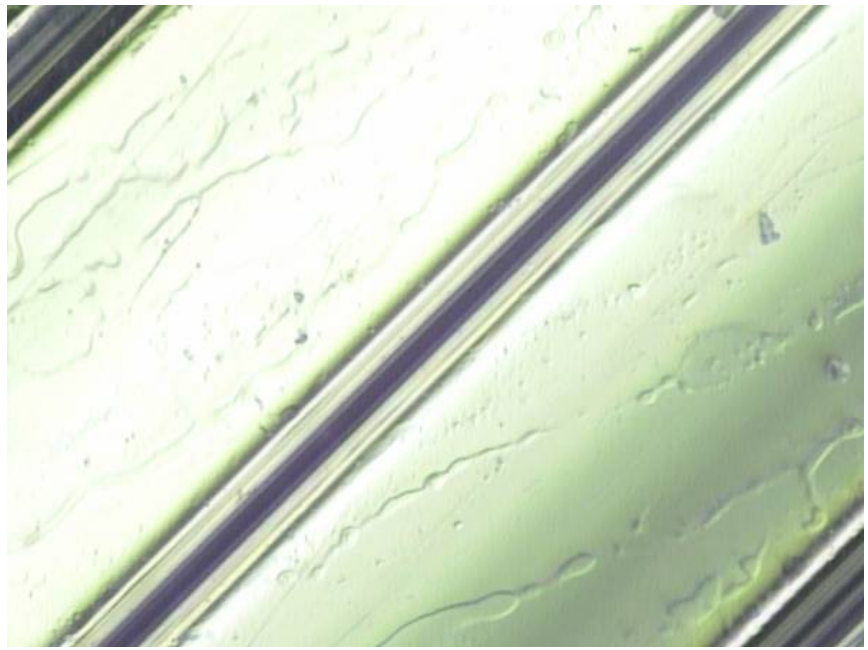


Non-Active Edge
Region << 100 μm

ALFA Resolution:
$\sigma_{x,y}$ ~ 36 μm

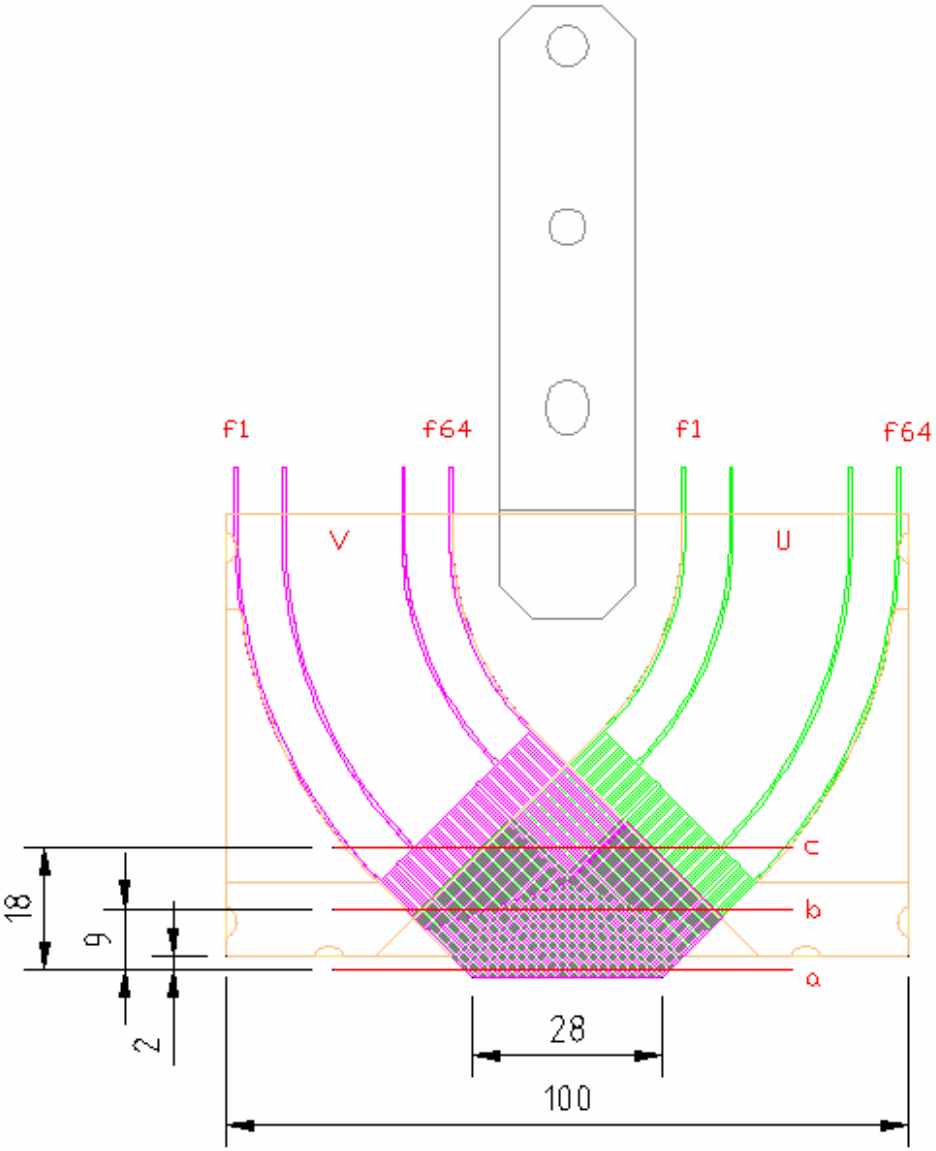
Potentially increased by multiple scattering of the relatively low energy electrons





staggering

plane	s (mm)
1	0.0000
2	0.2828
3	-0.1414
4	0.1414
5	-0.2828
6	0.3536
7	-0.0707
8	0.2121
9	-0.2121
10	0.0707



Potential Participation in Forward Physics @ ATLAS

Ingrid Gregor, Wladimir Hain, Karl-Heinz Hiller, Ulrich Kötz, Henri Kowalski, Ewelina Lobodzinska, Serguei Levonian, Uwe Schneekloth

21 March, 2007

Tobias Haas
DESY, Hamburg

Remarks

- Exciting physics perspective
  - A bit of speculative touch
  - But very solid bread and butter basis
- Interesting detector technology
  - Clear road to LHC upgrade physics
- There is know how and interest at DESY
  - 240m system
  - 420m Beam pipe
  - 420m DAQ and integration
  - Machine/Detector interface
  - Simulation and analysis

ALFA Project at DESY

14 May, 2007

Tasks for 2007:

We propose to participate in the production of one full detector station consisting of 10 detector planes, each with 64 U+V fibres and 3 Overlap detectors. The fibres are read out by MA-PMT's. The work proposed should happen in very close collaboration with Humboldt Universität (Thomas Lohse, Michael Jablonski) and Universität Giessen (Michael Düren, Hasko Stenzel).

I. Production/machining of titanium support plates (Humboldt)
II. Fabrication of fibre detectors, i. e. gluing of fibres on the titanium plates (Giessen)
III. Survey/micrometry of the glued detectors – (DESY)
IV. Acquisition and testing of part of the PMT's (DESY)
V. Assembly/Commissioning of detectors + readout: (DESY)
VI. Beam tests at DESYII (CERN, DESY, Giessen)
VII. Simulations for backgrounds and preparation of analysis software (DESY)

Cost/Efforts of DESY contribution:

Nr	Title	Material Cost (k€)	Manpower (months FTE)
III	Survey/Micrometry[1]	40	4
IV	Acquisition/Test PMTs[2]	50	6
V	Assembly/Commissioning	-	6
VI	Beamtests	-	4
VII	Simulation/Analysis	-	6

Remarks:

- It would be desirable to aim to produce a second detector already in 2007. This would allow the installation of 2 pots in 2008, a minimum setup for a real measurement. (The full detector consists of 8 pots.)
- In order to get into the project quickly, it would be desirable to send a physicist to CERN in 2007. K.-H. Hiller might be interested.
- In 2008 during installation and commissioning 2-3 people would need to spend ca. 4 months each at CERN.

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[1] The cost of 40k arises from the acquisition of a suitable survey machine. Possibly such a machine already exists at DESY.

[2] The cost quoted is for 50 MAPMTs corresponding to ¼ of the total number needed.