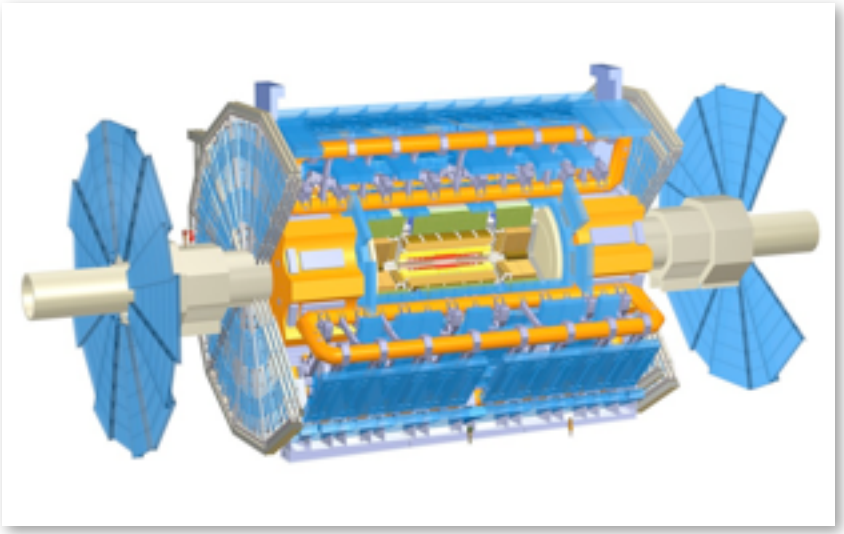
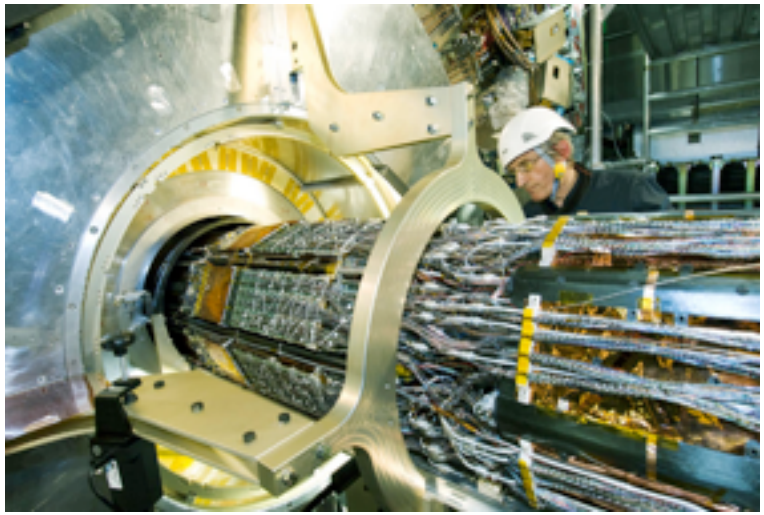
Hardware Activities of the DESY AYLAS group

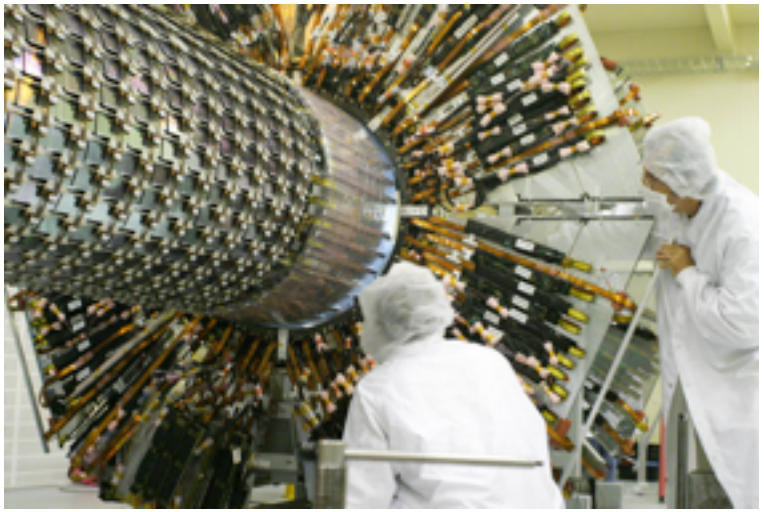
Ingrid-Maria Gregor
DESY ATLAS



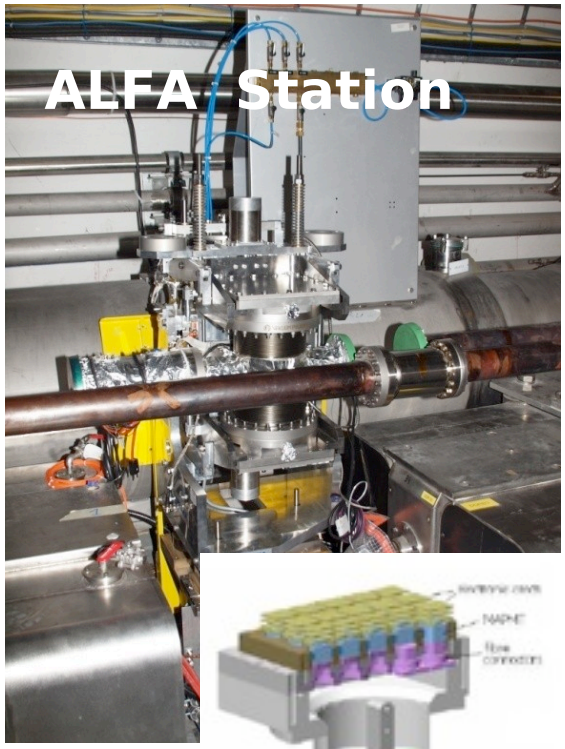
Hardware Overview

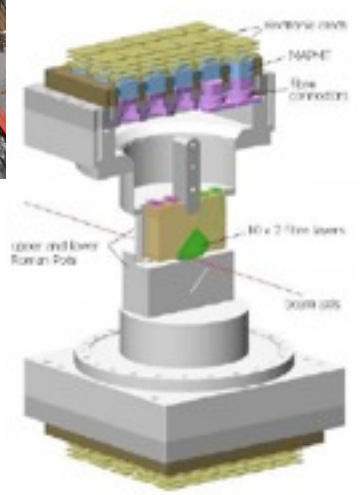
- DESY was not involved in the construction of the current ATLAS detector (HERA was still running)
- Since we joined ATLAS we took over responsibilities in different areas and are planning to build detectors for the future upgrades of ATLAS
  - ALFA production, installation and commissioning
  - Pixel and SCT operation (shifts, data quality)
  - Upgrade of Tracker





ALFA = Absolute Luminosity For ATLAS





- 8 scintillating fiber detectors located in Romans Pots.
- 0.5x0.5 mm^2 square fibers arranged in UV geometry.
- 2 Roman Pots (1 up and 1 down) form a station.
- Measurement of the angle (position) for elastic scattered protons.
- Resolution of 30-40 mu required.
- Determination of the absolute luminosity for ATLAS with an accuracy of ~ 3%.

DESY: involved in the production (mechanics, PMTs) and test beam, commission and now analysis

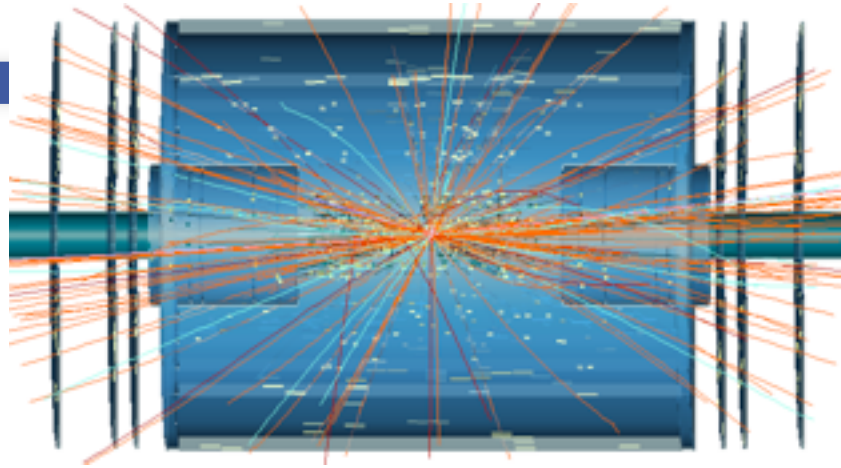
Why Upgrade?

- The new discoveries hoped for will need a lot of data to understand their nature
  - Higgs parameters
  - SUSY – spectroscopy
  - Triple gauge couplings
  - VV scattering at ~1 TeV
- In addition, the potential is significantly extended for (more difficult) physics discoveries

Challenges

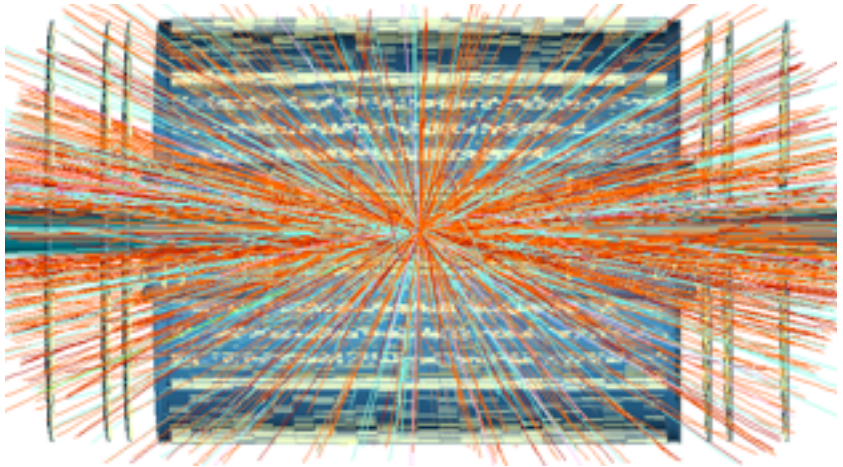
- **event pile-up, hit rates, occupancies ...**
  - improve on: material, trigger, pattern recognition, data BW, data storage
- **radiation damage**
  - improve on:materials, electronics, links, ageing, …

2.0×10^{33} cm^{-1}s^{-1} (2011)



10 pile up events

5.0×10^{34} cm^{-1}s^{-1} (2022)

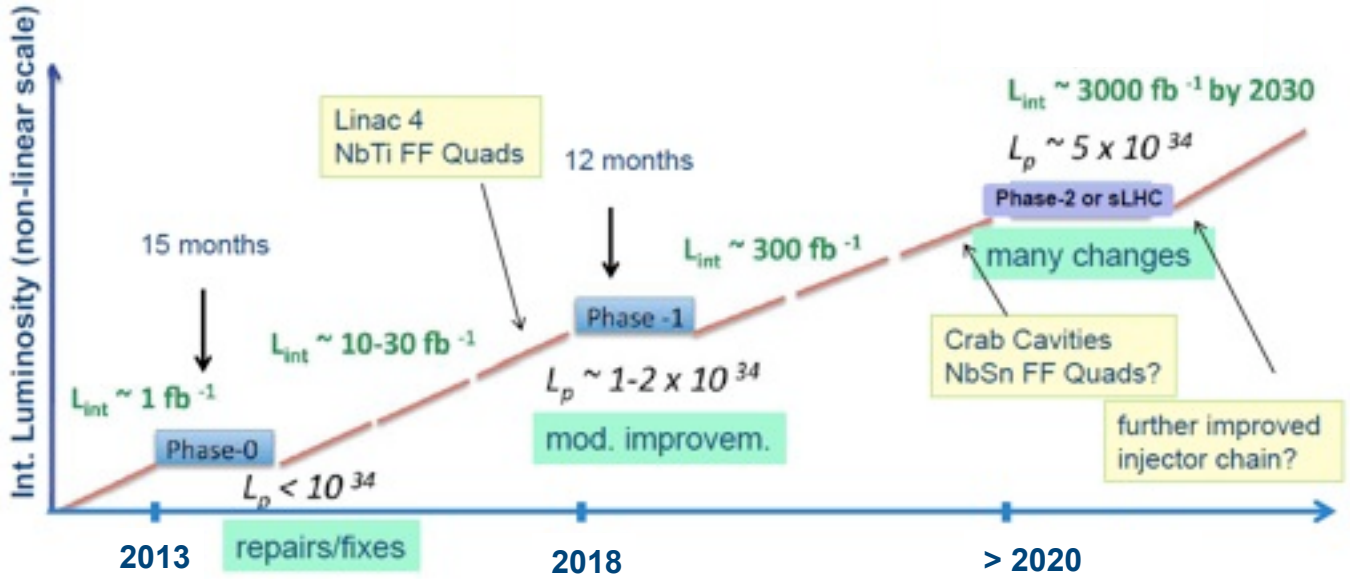


200 pile up events

Plots: Nick Styles, DESY

Tentative Schedule and ATLAS Plans

- Phase 0 (2013):
  - **Pixel: Insertable B-Layer (IBL)**
  - Pixel: opto-electronics repair
  - Muon/forward: Beam-pipe -> Beryllium
  - Infrastructure consolidation

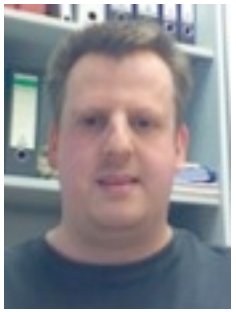


- Phase 1 (2018):
  - NewPix System (????)
  - Muon: additional SCS layers
  - TDAQ: moderate upgrades, improved level-2 triggers
  - minor consolidations: TRT HV PS, LAr LV PS, ...

- Phase 2 (>2020):
  - **ID: new tracker or only Strip ….**
  - LAr: barrel electronics and new forward elements
  - Tile Calorimeter: new electronics
  - Muons: new forward layers
  - TDAQ: major upgrades


Ingo Bloch


Conrad Friedrich


Sebastian Gerhardt


Ingrid Gregor


Franzi Hegner


Antje Huettmann


Artem Kravchenko


Tai-Hua Lin


Volker Prahl


Igor Rubinsky


Madalina Stanescu-Bellu


Marcel Stanitzki


Nick Styles


Kerstin Tackmann


Peter Vankov

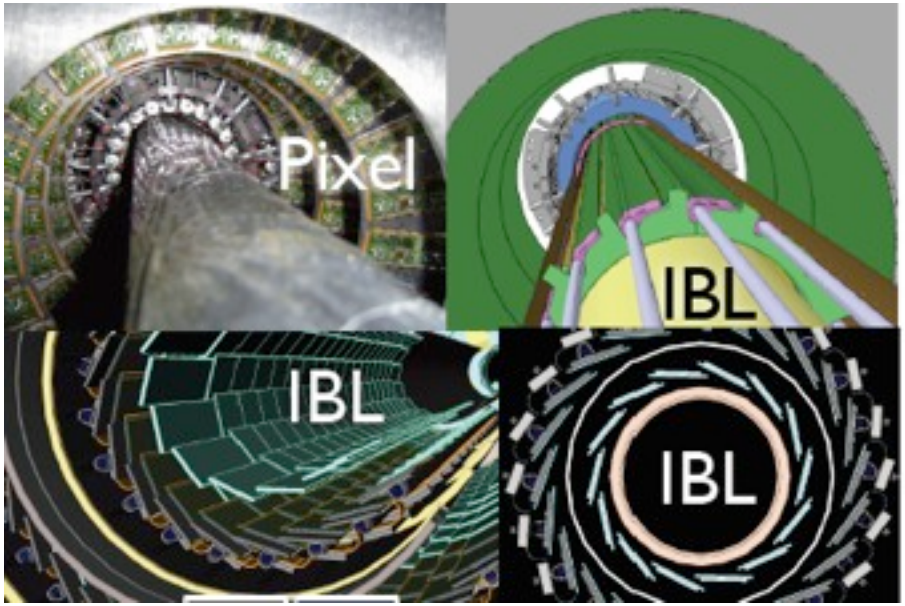

Christoph Wasicki


Hongbo Zhu

including our colleagues in Zeuthen

Phase I: Insertable B-Layer (IBL)

New innermost layer around smaller beam-pipe, 14 staves, 160 MHz readout, evaporative cooling (CO_2)

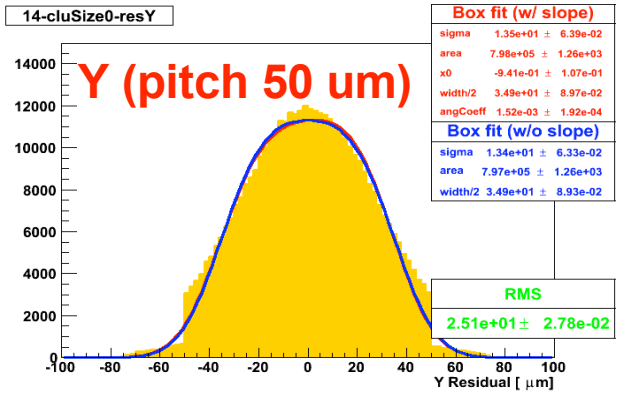


Three different sensor designs were studied:

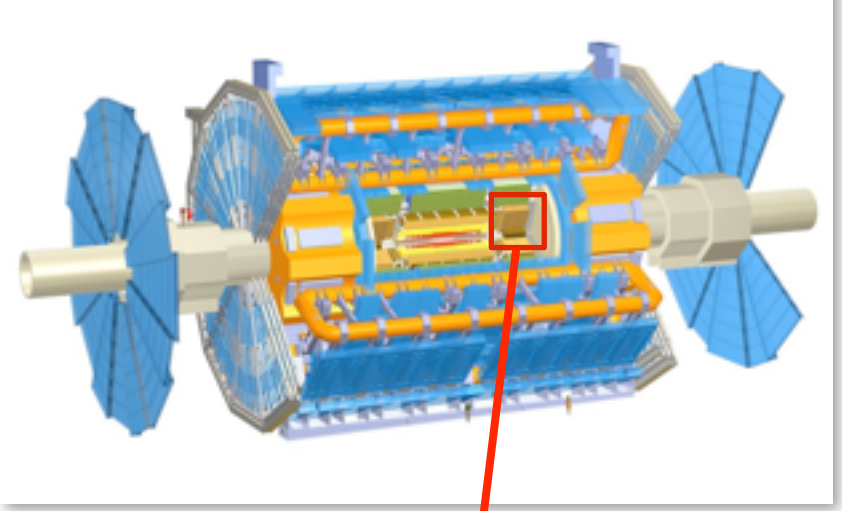
- Planar sensors
- 3D sensors
- Diamond sensors

➡ to choose the right sensor type all sensors need to be tested under the same conditions

- DESY provided the ideal test bench - a very precise pixel telescope
- DESY people are very busy with data taking, reconstruction and analyses



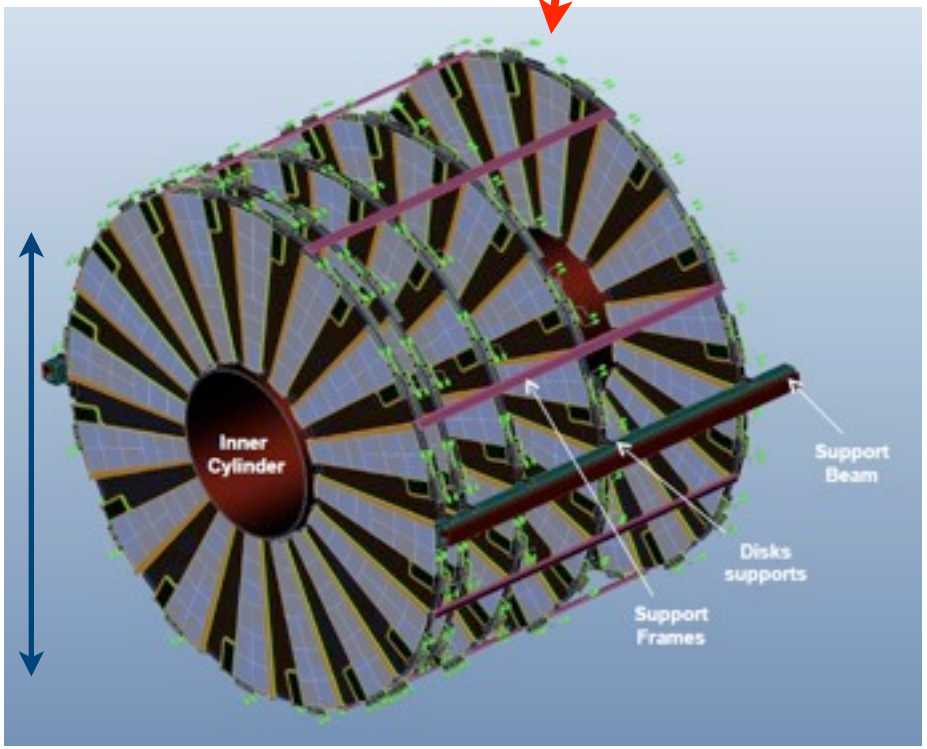
WHAT WE WANT ..



- The strip detector will consists of barrel and 2 end caps
- The diameter of the end cap discs increases to 2 m (~double)

- 5 discs on each side
  - ➔Rout= 95.0cm
  - ➔Rin = 33.7cm for all but the last disc.

  - ➔Short strip sensors up to R~60cm (2cm)
  - ➔Long strips up to Rout (6cm)



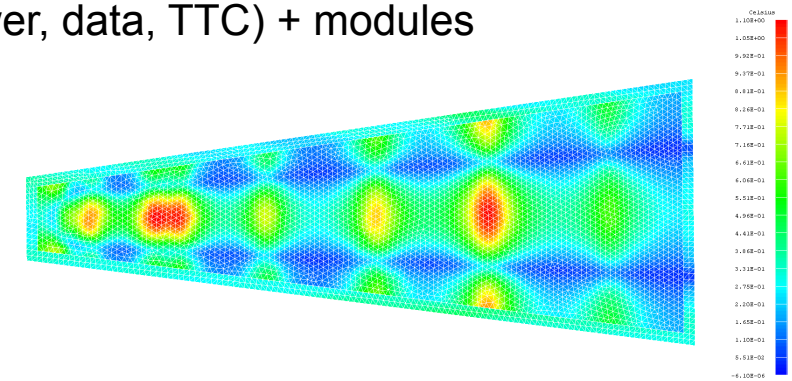
2 m

Silicon Area:

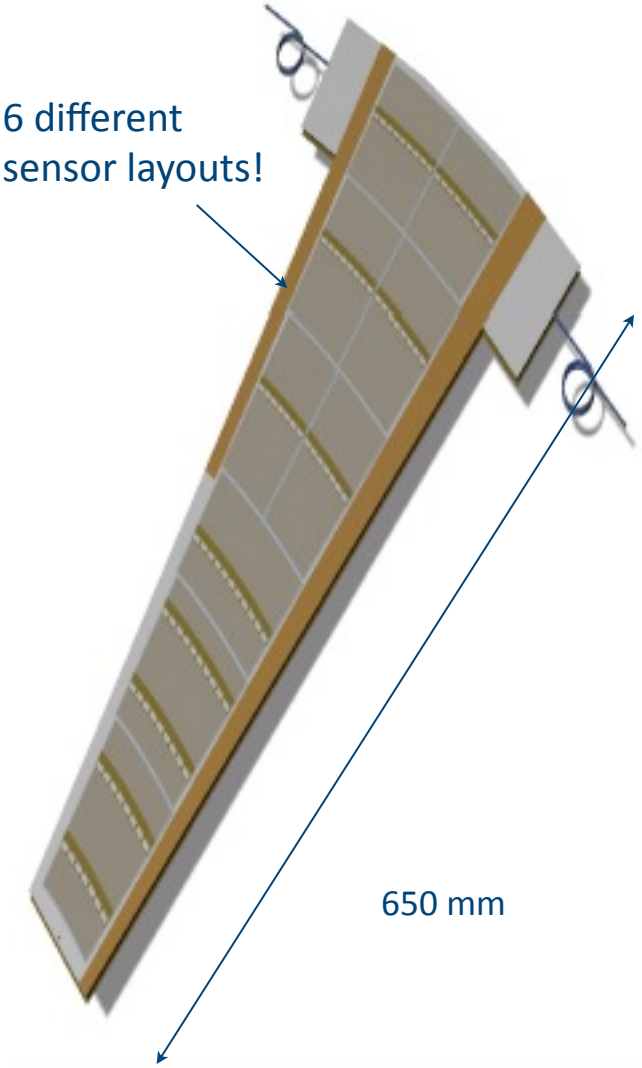
- one end cap is about 25 m^2 of Silicon ….

What is a petal ?

- **Hybrid** = kapton board with FE chips
- **Module** = silicon sensor with readout hybrid
- **Petal** = petal core structure + cooling + electrical services (power, data, TTC) + modules



- In the next 3-4 years we will conduct detailed R&D studies of many details:
  - Design of mechanical structure
  - FEM calculations
  - Electrical design from FE chip to outside world
  - Global support
  - ….
- In the end we have to build > 160 petals



Hybrid positions and dimensions

Fun: Pixel Telescope(s)

- Tool to measure the tracks of a test beam with very high precision as reference information when testing detector modules (during R&D or detector production an important test)

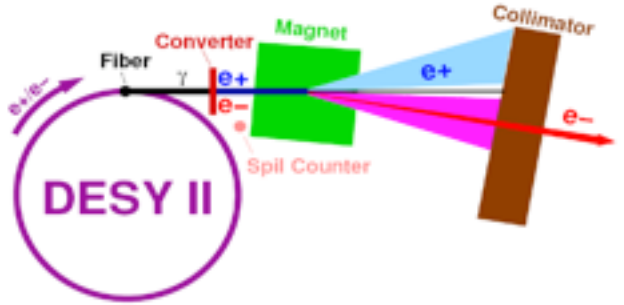
Generally applicable:

- DUTs: from small pixel sensors to larger detectors
- Very high precision: <3 µm precision even at smaller energies
- Used by many group (SPiDer, DEPFET, ATLAS ....)

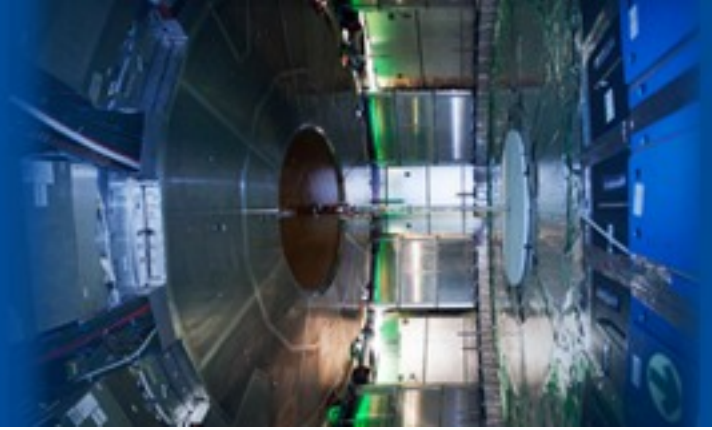
Telescope booked until fall 2011

- We built a (smart) copy of the EUDET telescope for the Bonn ELSA test beam (Helmholtz Allianz project)
- Currently being tested at DESY test beam
- **Two more telescopes in the queue !!!**

- **Goal: permanent tracking detector test bench in test beam here at DESY (to be used by FLC, CMS, ATLAS…..)**



In house electron test beam facility!!



DESY ATLAS Group

- The DESY ATLAS group is active in many different detector development projects as well as physics analyses
- Also here students play a vital role !

- Even so we are far away from CERN we can provide an ideal working environment
  - ~40 ATLAS people more or less full time at DESY
  - good connection to CERN by being represented in many working groups
  - close contact to colleagues from CMS, LC, HERA, ….
  - new large lab shared with other HEP groups
  - in house test beam

atlas.desy.de