ATLAS – High Speed Data Acquisition

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Science and Technology Facilities Council

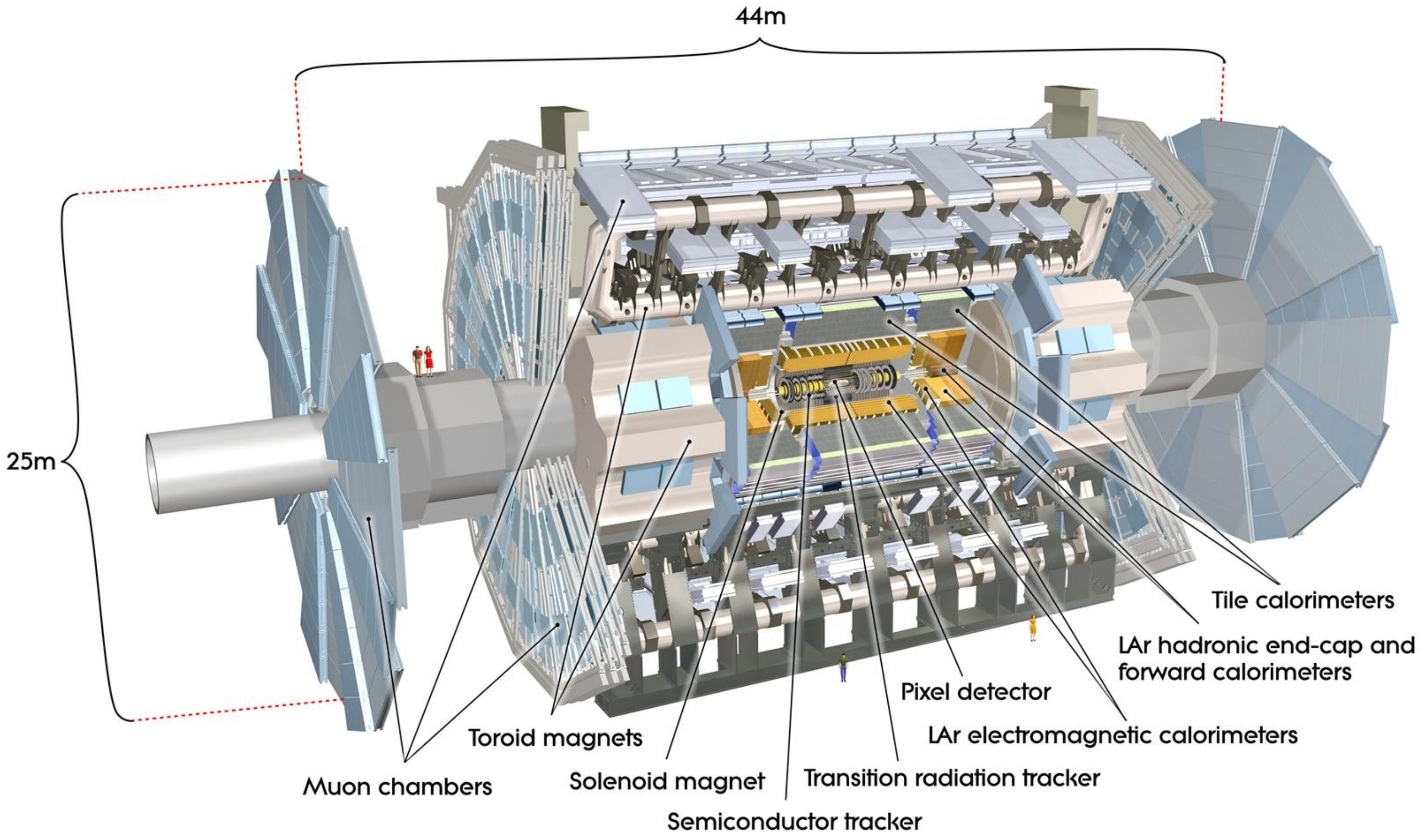
ATLAS EXPERIMENT

The Large Hadron Collider (LHC) at CERN

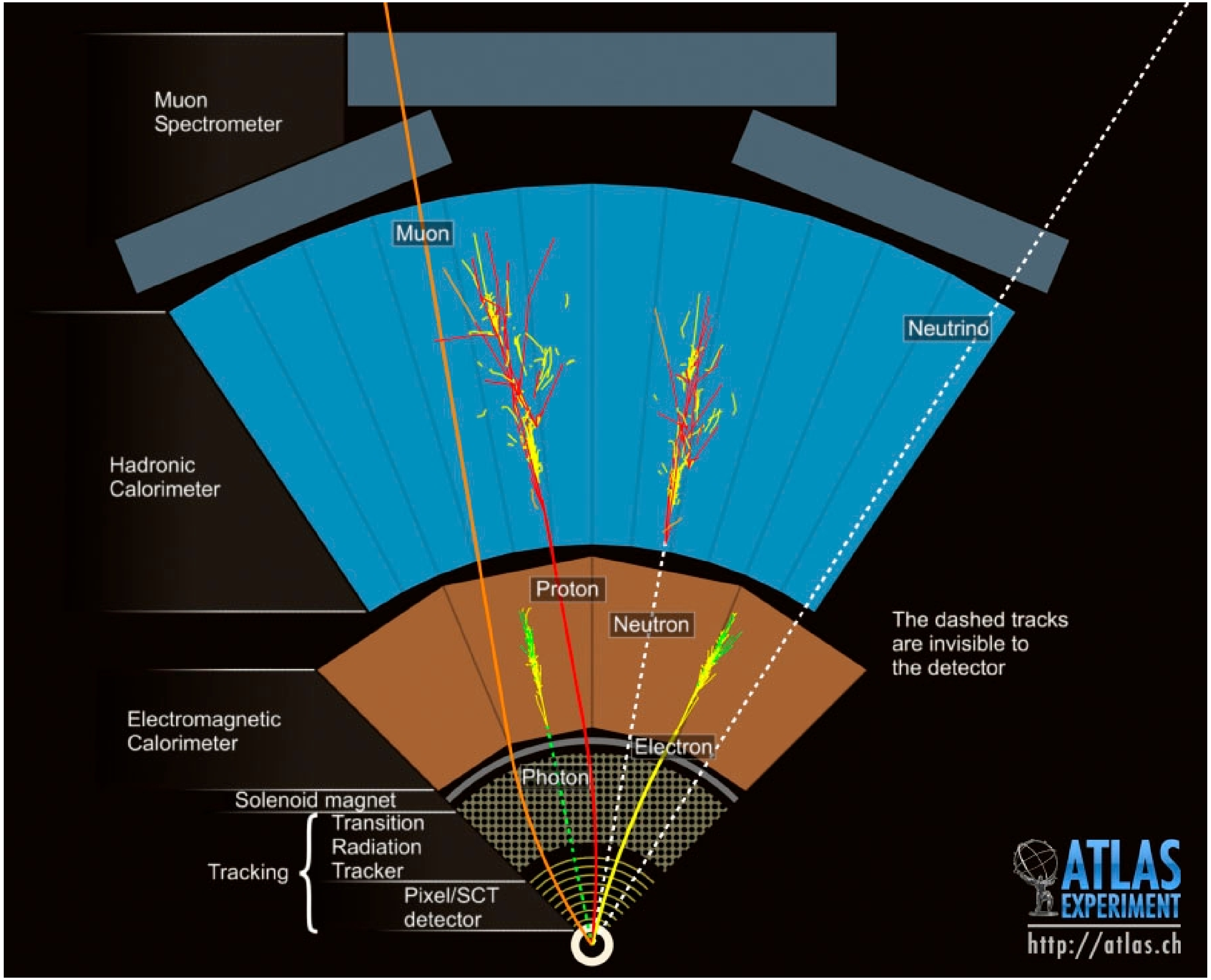
Discovery of the Higgs boson with ATLAS and CMS - 2012

The LHC will be upgraded to become the High-Luminosity LHC

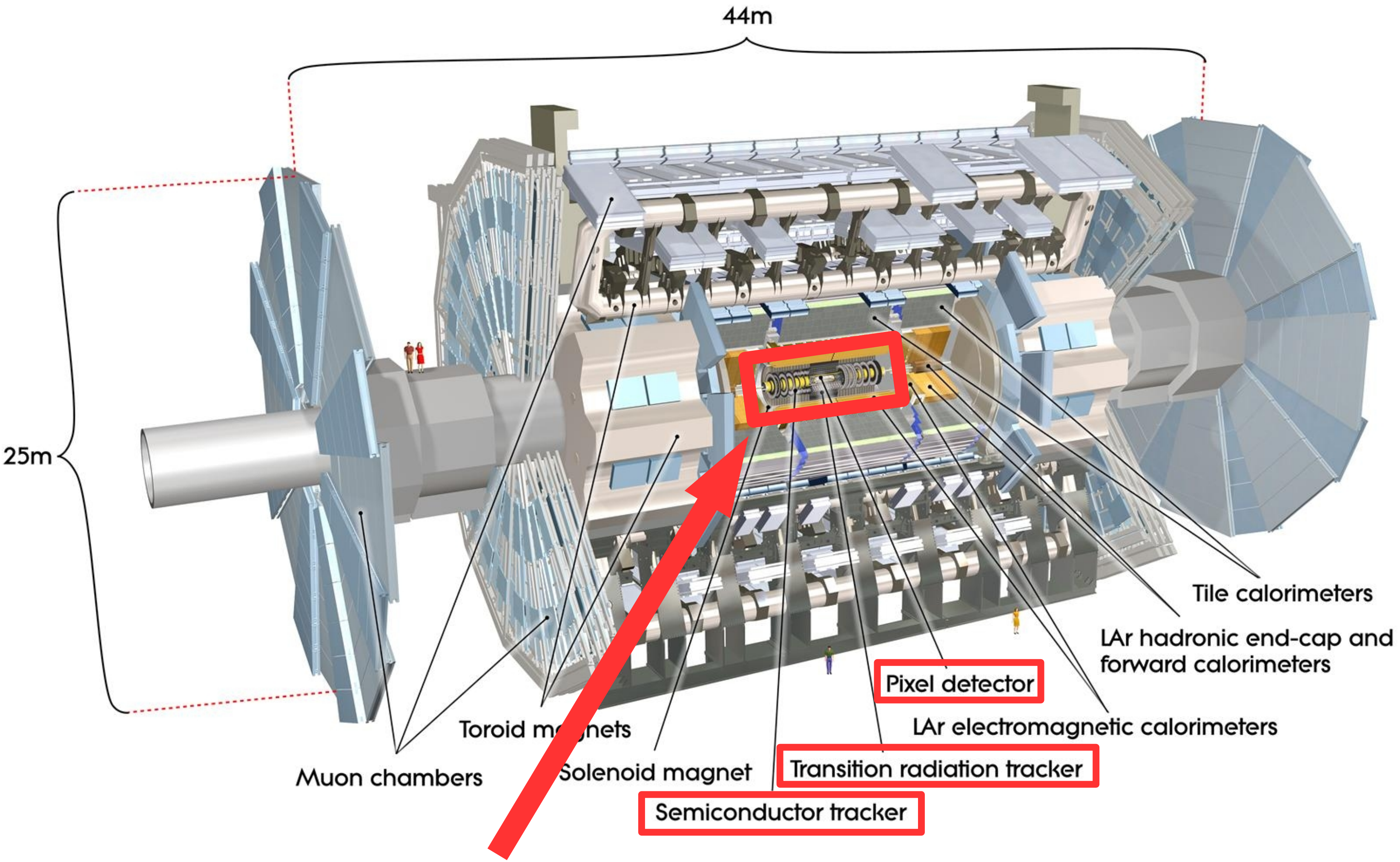
The ATLAS Detector will also be upgraded



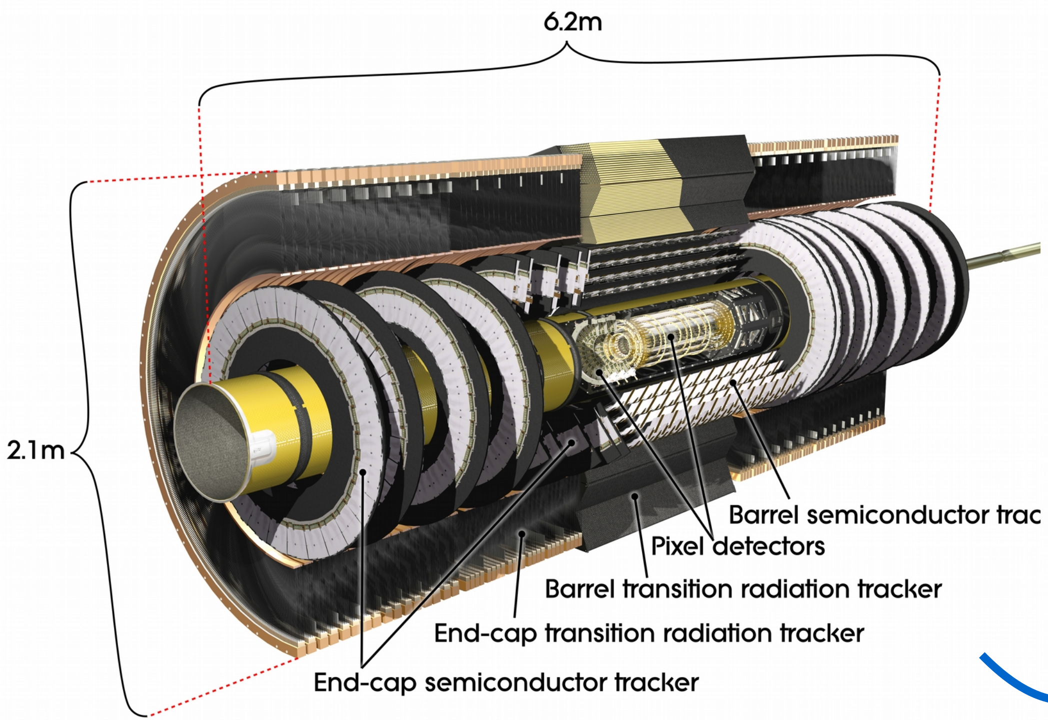
The ATLAS Detector will also be upgraded



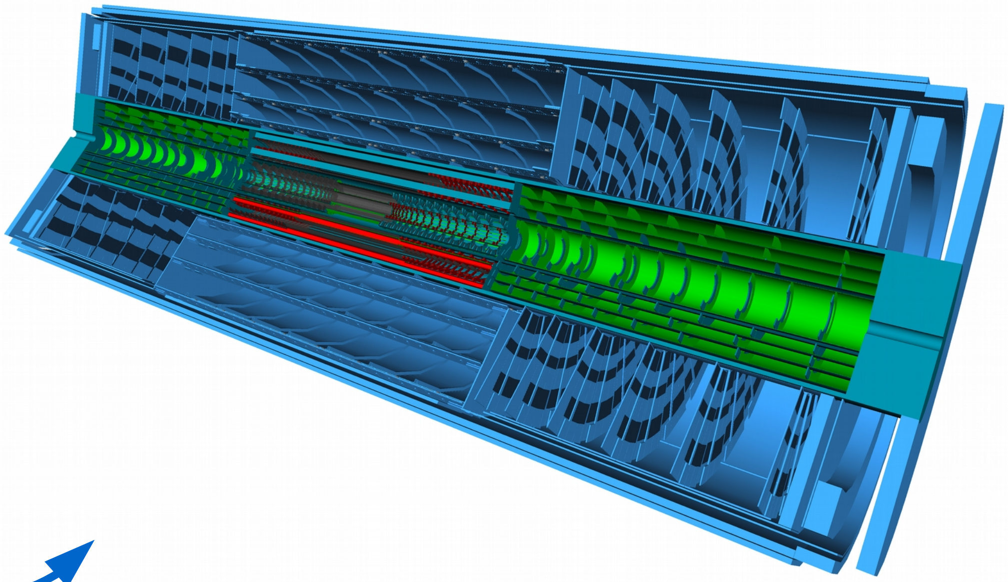
A new tracking detector will be installed



- The existing ATLAS Inner Detector (ID) will be replaced with an new Inner Tracker (ITk)

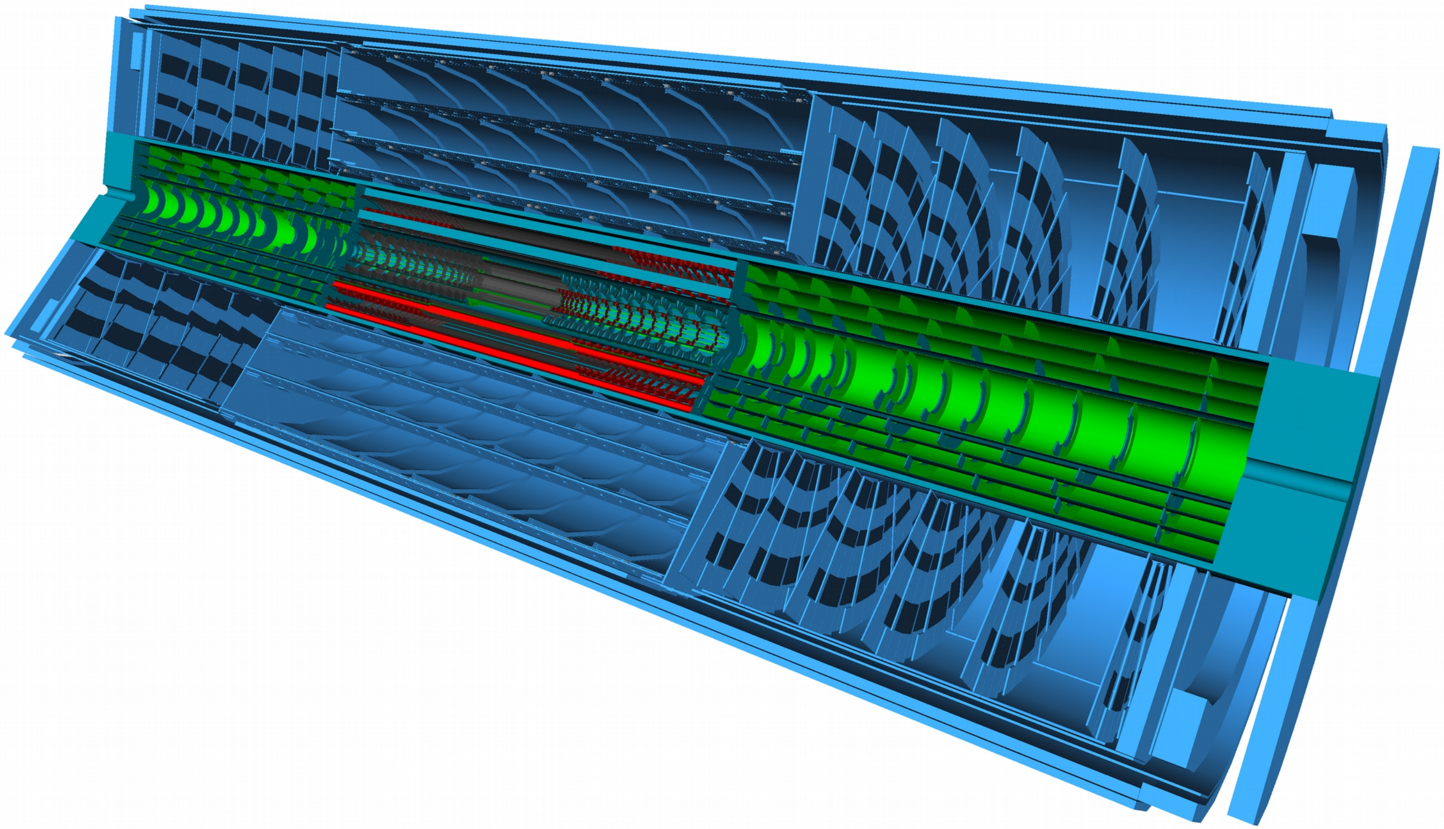


Inner Detector (ID)

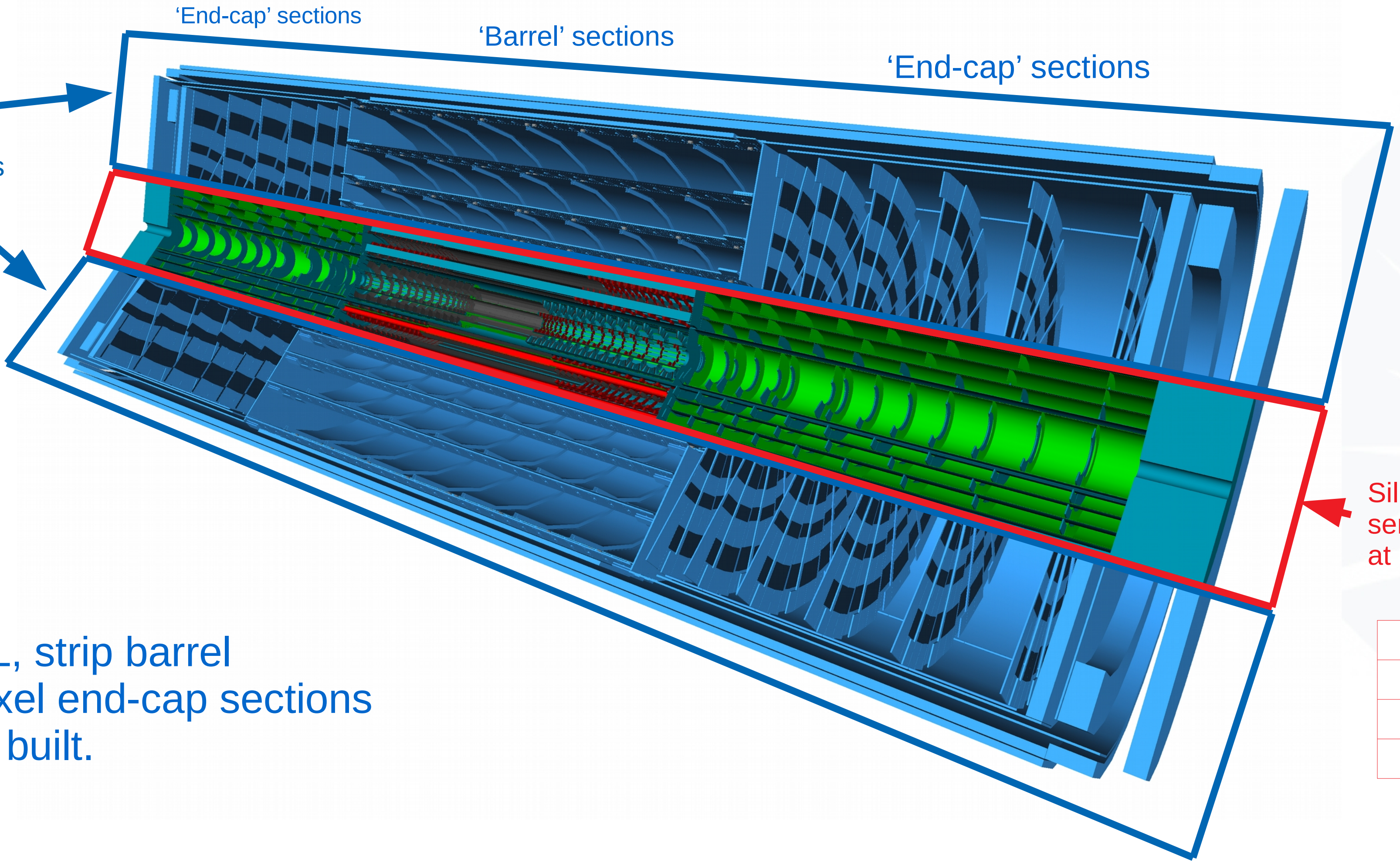


Inner Tracker (ITk)

The ITk



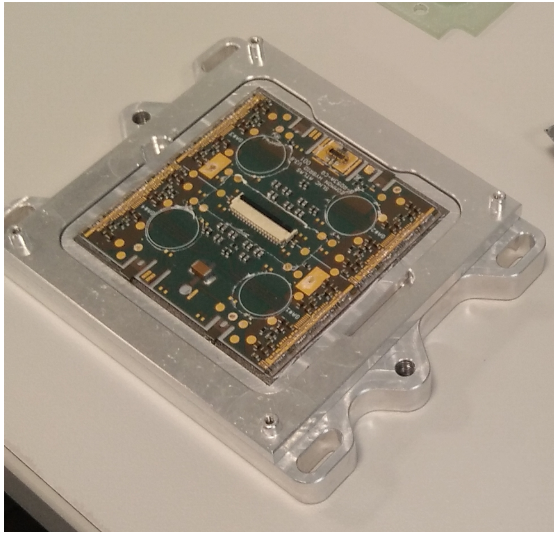
The ITk



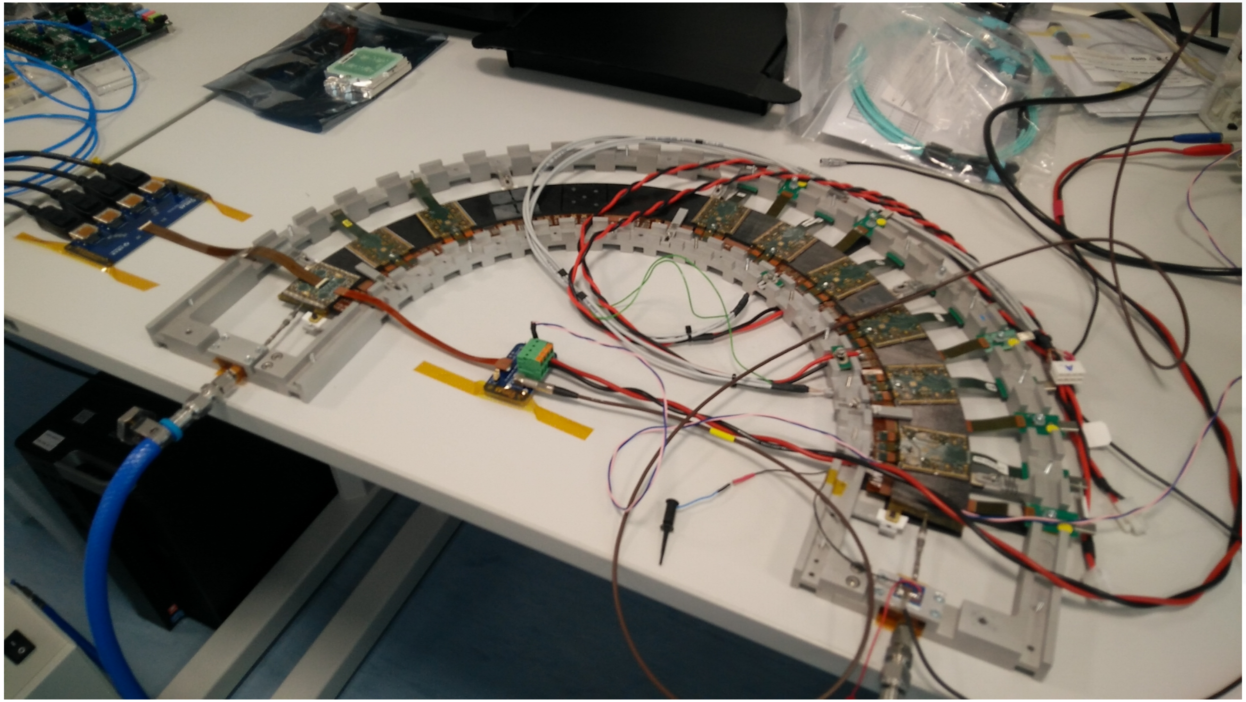
- At RAL, strip barrel and pixel end-cap sections will be built.

ITk pixel end-cap construction at RAL

- At RAL, 1500 pixel sensor modules will be mounted onto carbon fibre support structures.
- Each sensor module contains 4 readout chips (custom sensor readout electronics. 1.28 Gbps, radiation-hard).

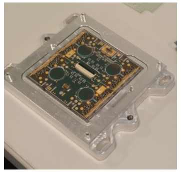


One ITk pixel module

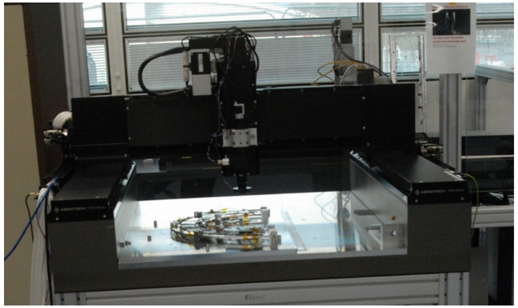


Pixel modules mounted onto a carbon fibre end-cap support structure

ITk pixel end-cap construction at RAL

1. 

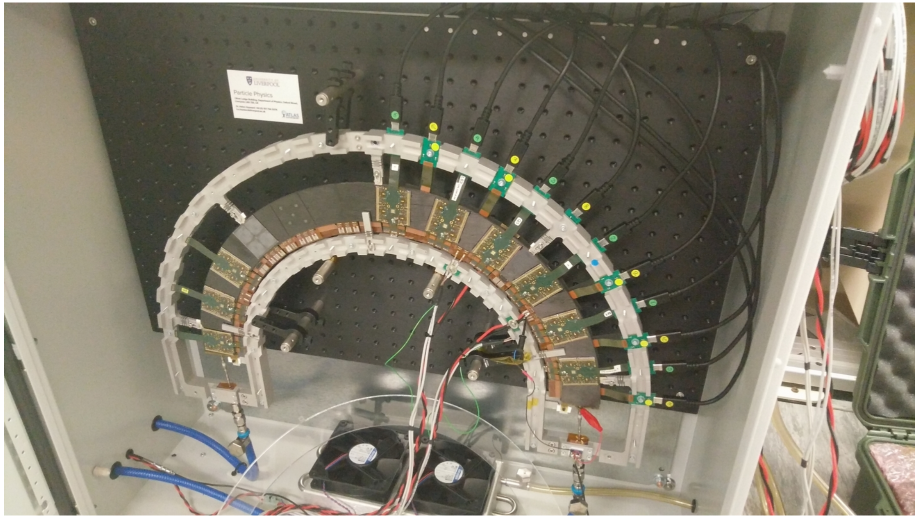
1. Every sensor, and every front-end chip, on every module, must first be powered, tested, and characterised. Given the number of devices, this must be fully automated, including analysis of test results.

2. 

2. Each module must be robotically mounted onto a carbon fibre support structure, placed to within 0.125 mm of the ideal position.

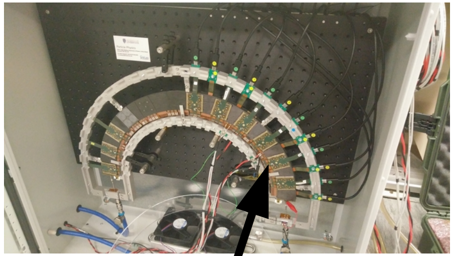
3. All modules on completed objects must be powered and automatically tested together, and results from each module compared back to its results from step 1.

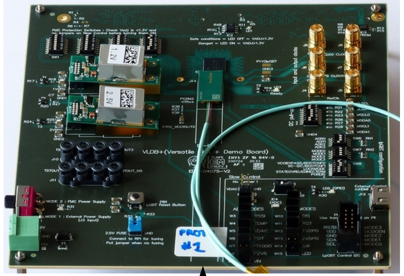
For this testing, a full ITk detector readout system ('readout chain') will be need to be built.

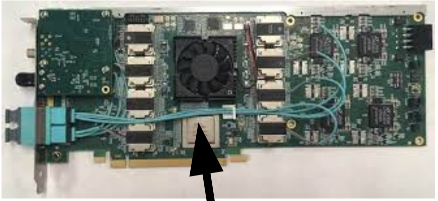
3. 

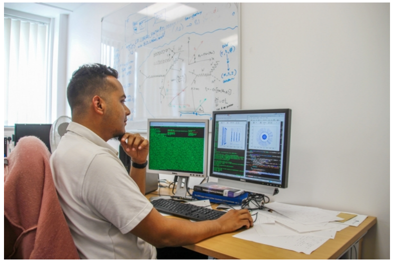
ITk pixel readout system

At RAL:









ITk pixel sensors and front-end readout chips

Copper wires

Combination of data from multiple ITk modules. Electrical to optical conversion

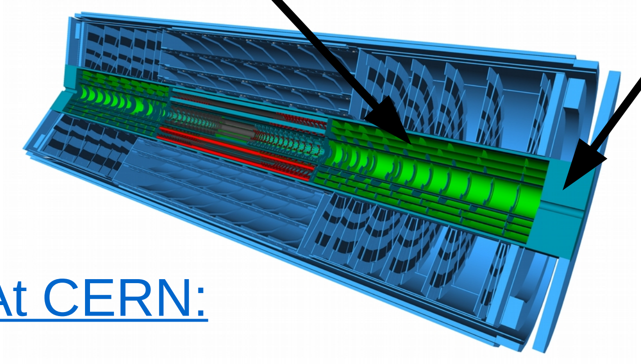
Fiber optics

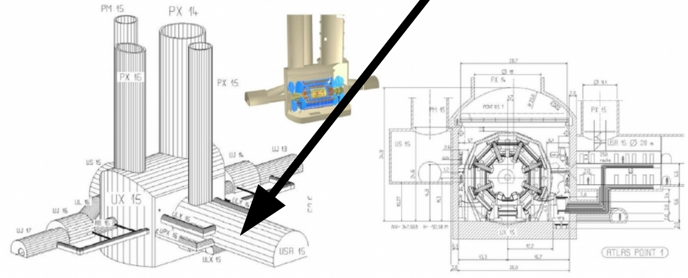
Reading optical data into PCs. Initial data analysis

Computer network

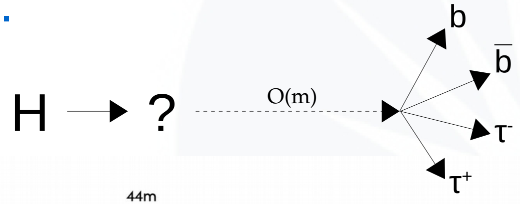
Physicists on computers, analysing the data, searching for new physics

At CERN:

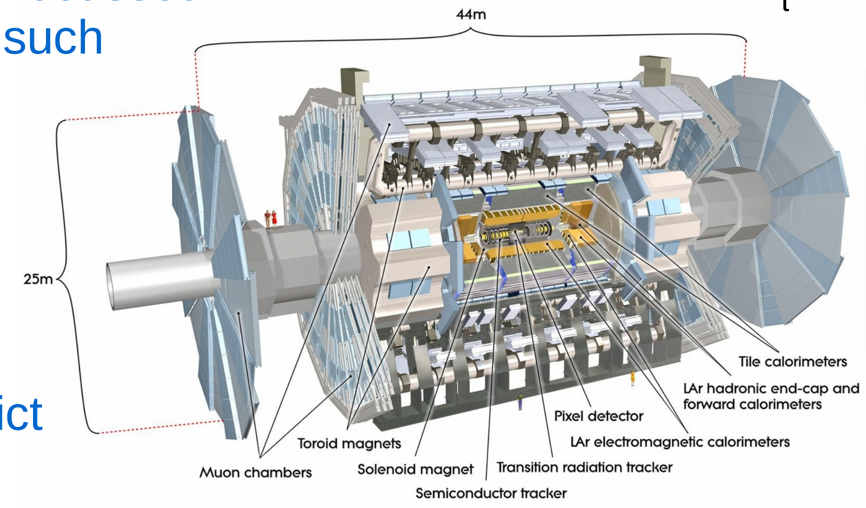




- There will also be the opportunity to take part in physics analysis.
- This will be focused on physics signatures and analysis techniques that **heavily involve the existing ATLAS tracking detector** – the Inner Detector (ID).
- In this way, we want to turn you into a well-rounded tracking expert.



- The current ATLAS detector design and software is focussed on studying particles that are either known,or have such short lifetimes that they decay in the beam pipe.
- What if a new, undiscovered, particle had a long enough lifetime that it could travel several metres through the ATLAS Detector before it decayed?
- There are theoretical models under study that predict these 'long lived particles'. Let's search for them.



What you can gain

- Not simply a PhD.

- We want to turn you into a well-rounded tracking expert, with skills in:

  - Experiment design
  - Electronics
  - Computer programming
  - High-speed digital communications
  - FPGAs
  - Detector hardware
  - Lab equipment use, programming, and automation
  - High and low voltage power
  - Thermal engineering
  - Data analysis
  - Physics analysis, and searched for new physics
  - Using a tracking detector in physics analysis
  - International collaboration in a large-scale scientific project
  - More...