QC Setup for the Characterization of ATLAS ITK OB Pixel Detector Loaded Modules at the HL-LHC

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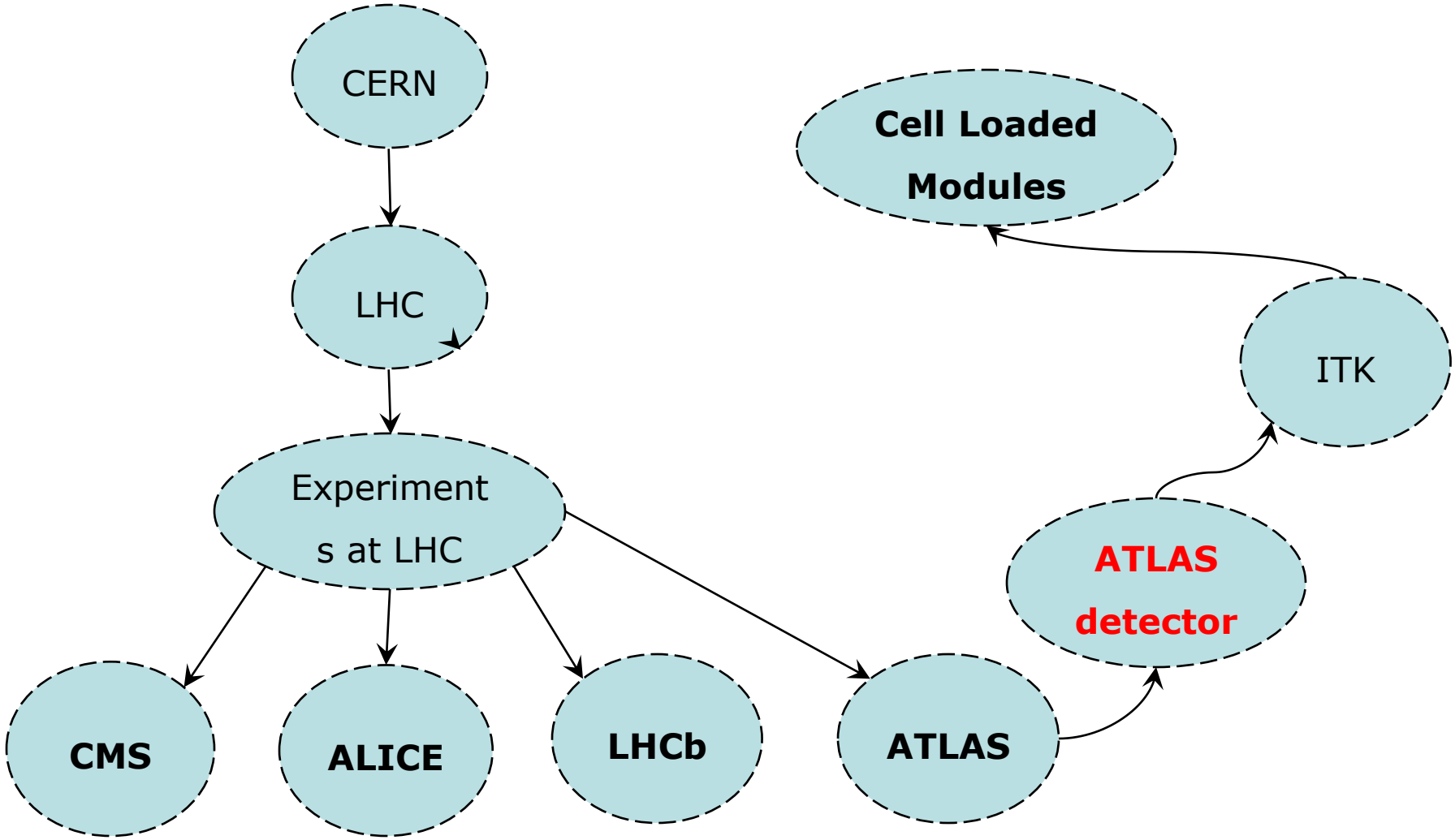
Plan

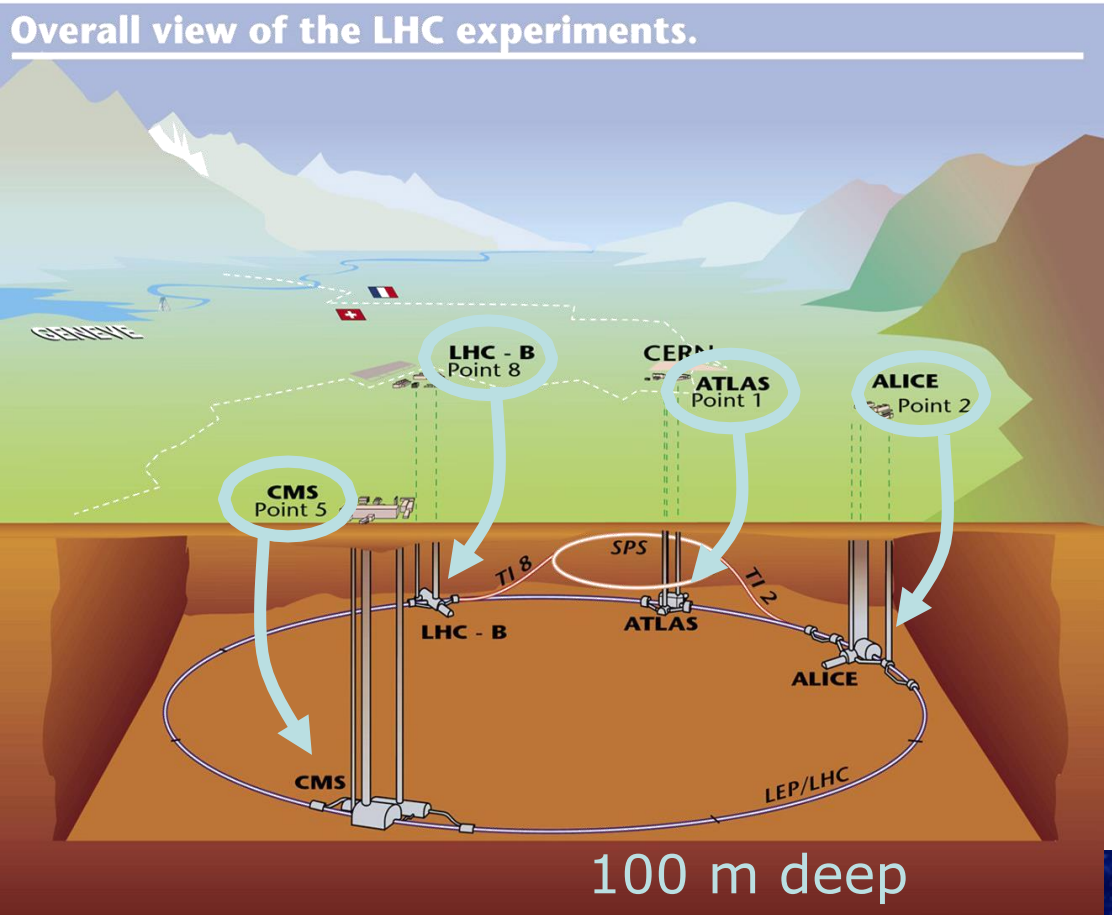

CERN
LHC
Experiments at LHC
CMS
ALICE
LHCb
ATLAS
ATLAS detector
ITK
Cell Loaded Modules

CERN is the largest laboratory for research in particle physics in the world. It provides a unique range of particle accelerator facilities.

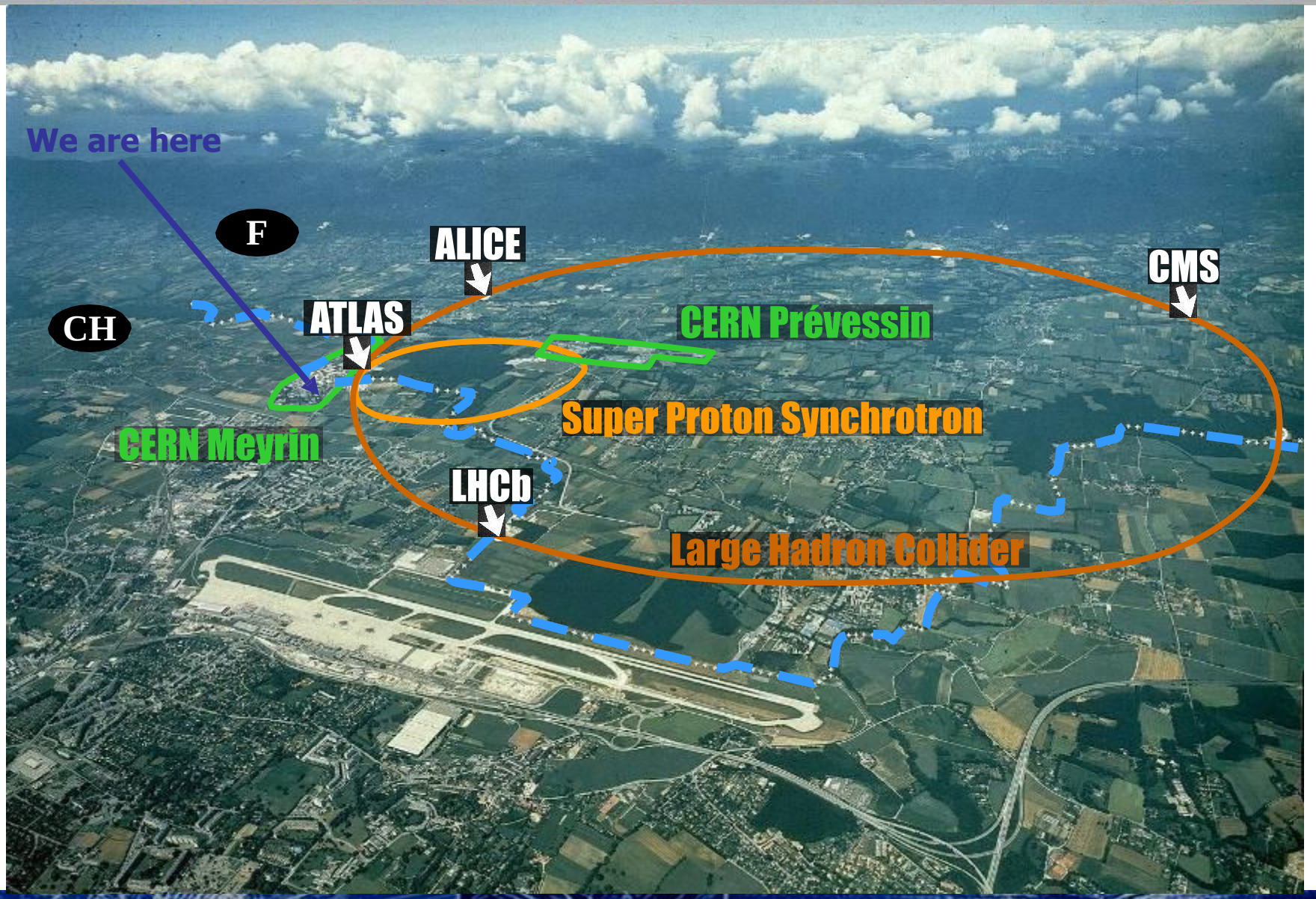
The primary mission is to explore the fundamental structure of the universe by studying the smallest known particles and the forces that govern their interactions.

At CERN, the Large Hadron collider (LHC), the Proton Synchrotron(PS), Super Proton Synchrotron (SPS), and Isotope Separator On-Line Detector (ISOLDE) are key components of the laboratory's particle accelerator complex, each playing distinct roles in various experiments and research activities.

The Large Hadron Collider (LHC) is the most powerful instrument for the investigation of particle properties ever built.



- Four large underground caverns for the detectors.
- The accelerator that produces the highest particle collision energy.
- The most intense beams for particle collisions.
- The LHC operates at a temperature below that of the outer space.


We are here
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CH
ALICE
ATLAS
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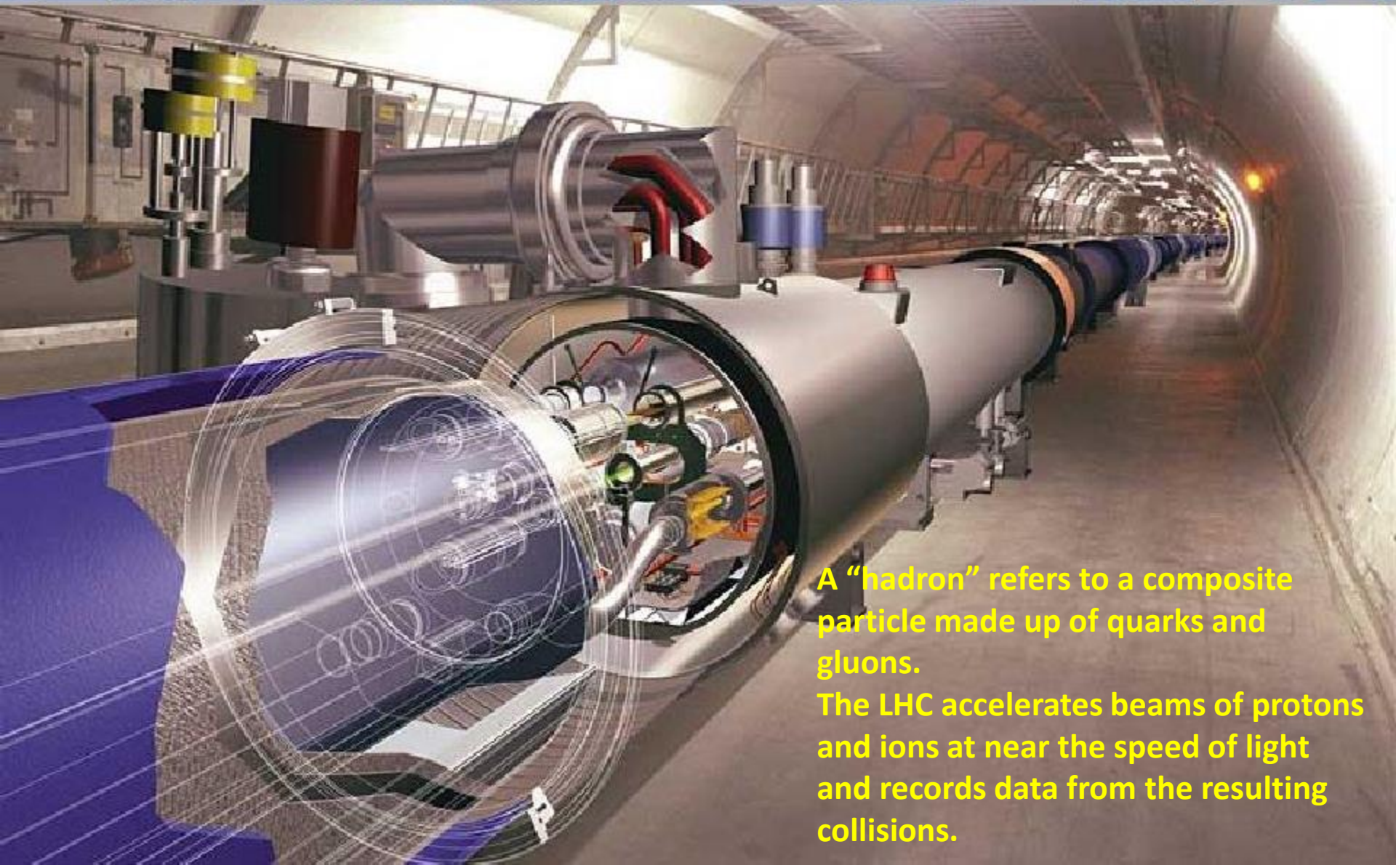
CERN Prévessin
Super Proton Synchrotron
CERN Meyrin
LHCb
Large Hadron Collider

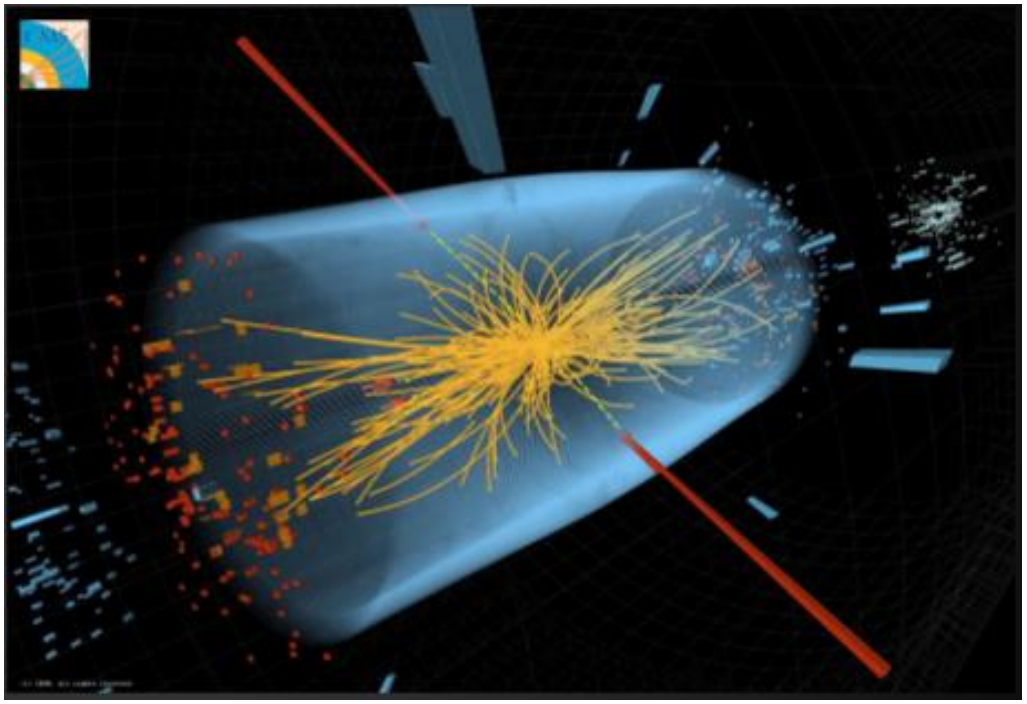
What is the LHC ?



A “hadron” refers to a composite particle made up of quarks and gluons.
The LHC accelerates beams of protons and ions at near the speed of light and records data from the resulting collisions.

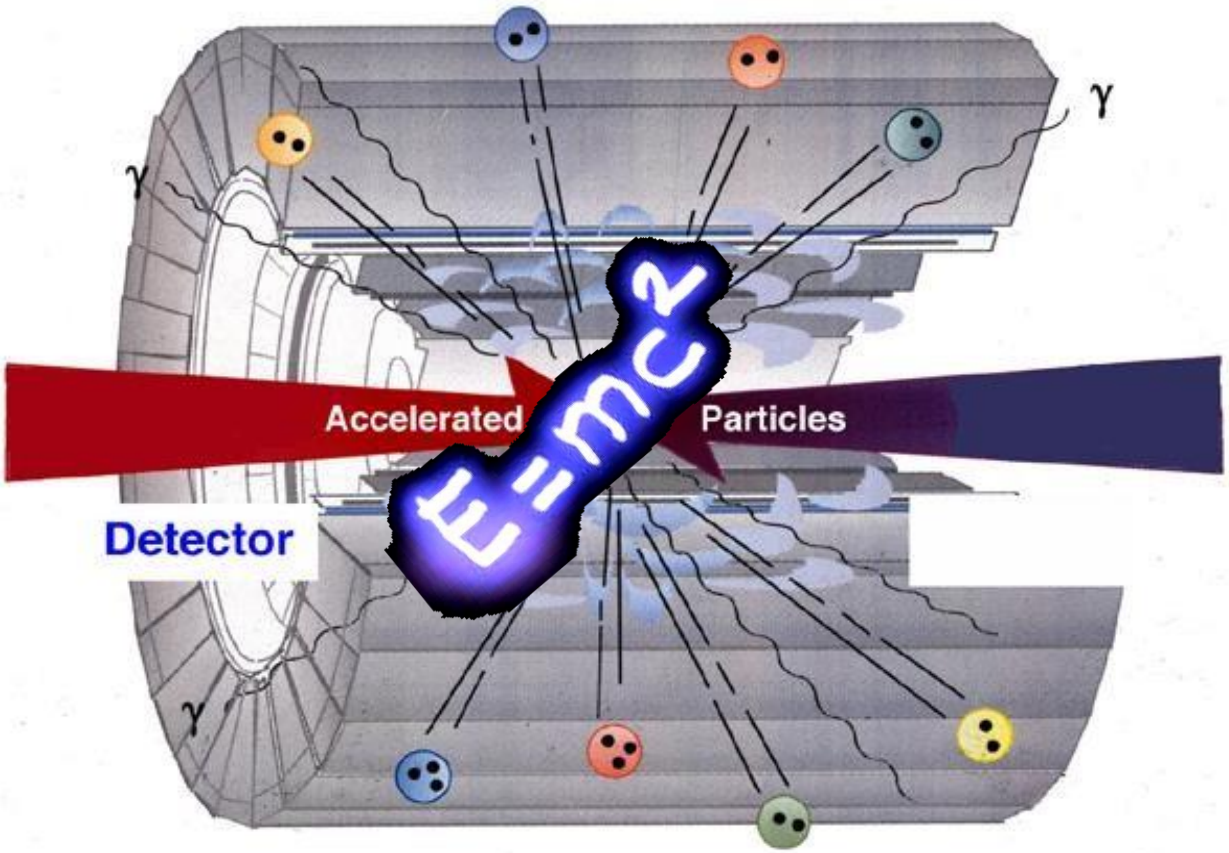
Function ?

- Protons and lead ions are accelerated to 99.99% of the speed of light.
- The particles travel through ultra-high vacuum pipes in order to minimize possible interactions with unintended particles.
- Upon interaction, the collision has the sum of the energies of the two beams.



A proton-proton interaction and its resulting photons (shown in red)

Detectors in Particle Physics



Particles with very high energy of movement are produced.

The particles are brought to collision (similar conditions as in the big bang).

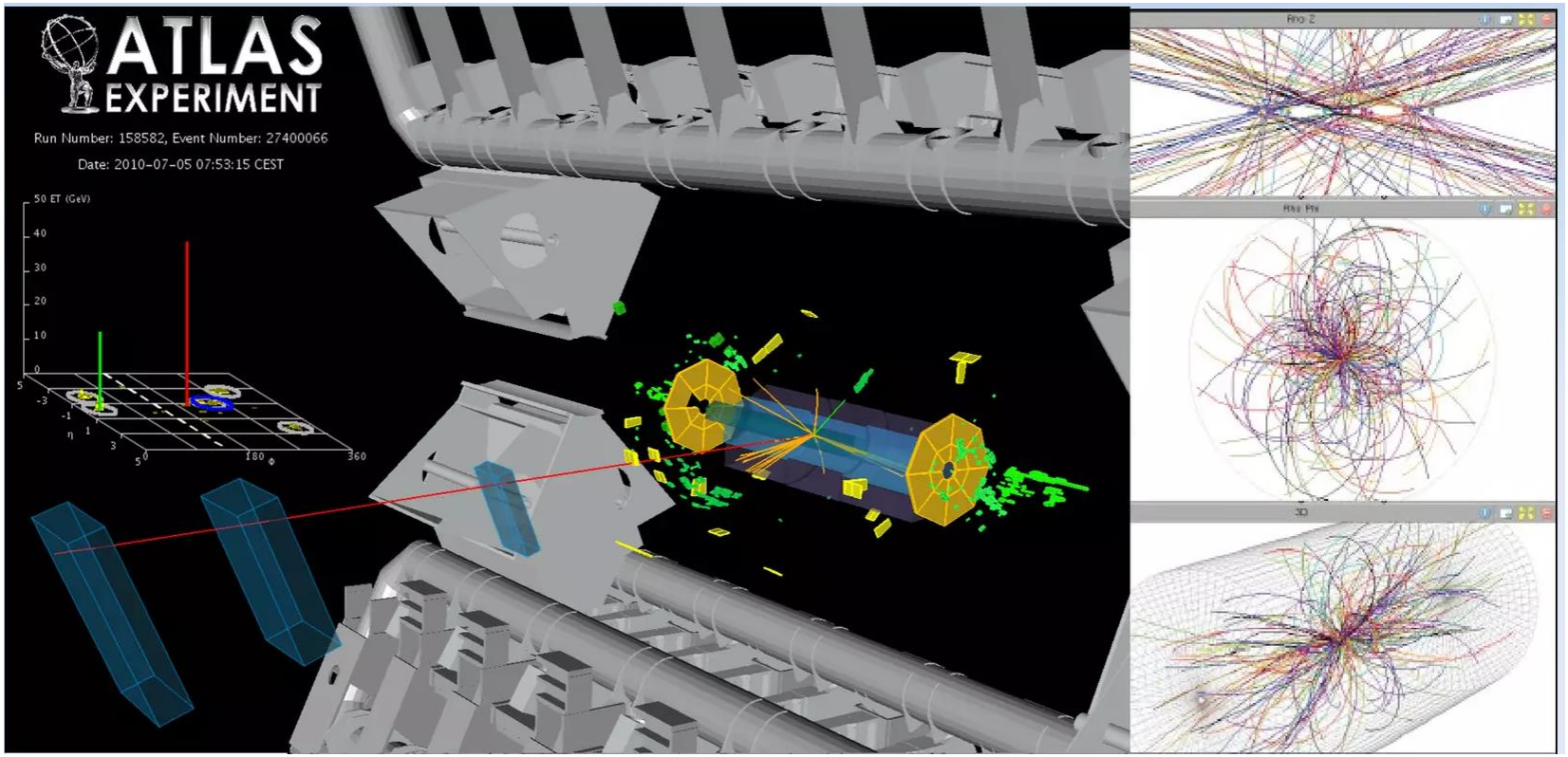
The particles that are created are recorded by detectors.

ATLAS

ATLAS (A Toroidal LHC Apparatus) is a general particle detector within the Large Hadron Collider. It is used in a wide variety of areas most notably the search for the Higgs Boson, Dark Matter, and other dimensions.

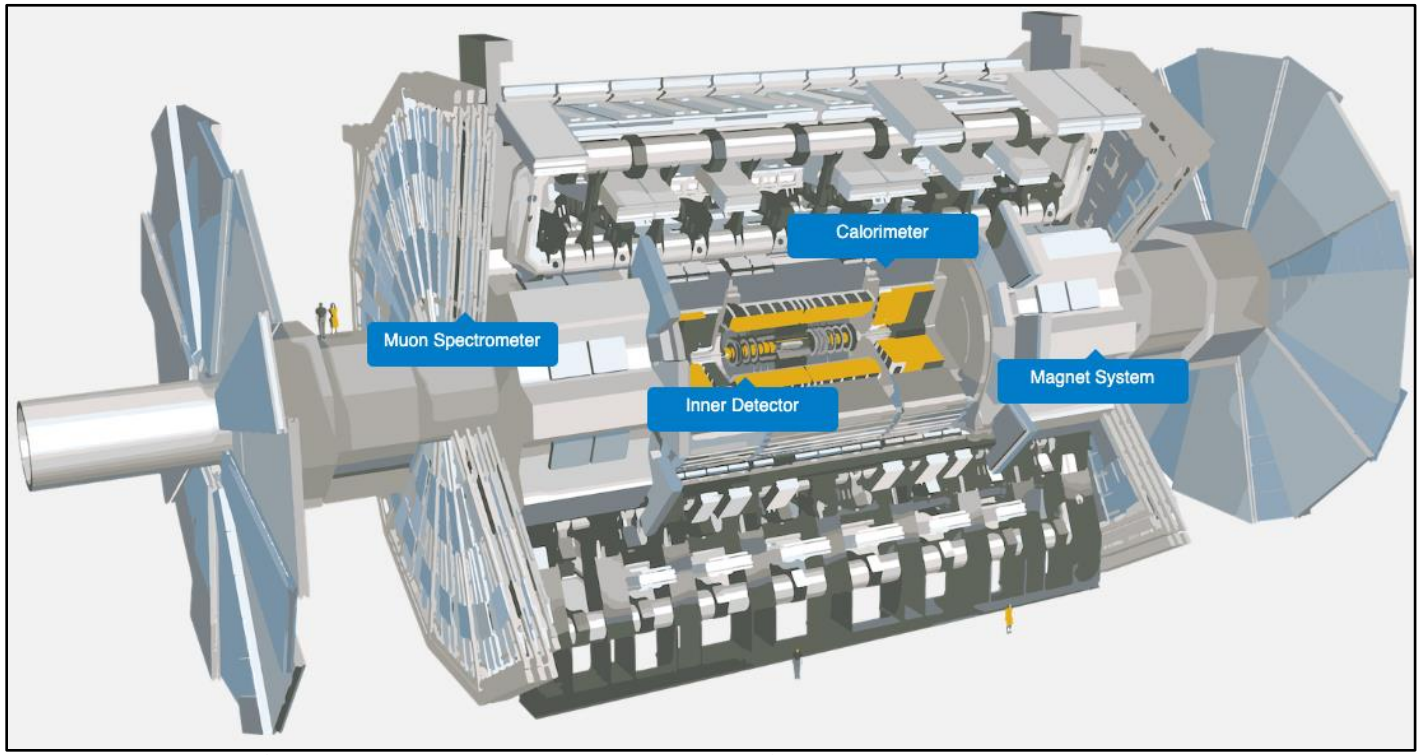
ATLAS Detector

Smashing things together
Hadron collisions being registered in 3D (full-res)



ATLAS – A Toroidal LHC ApparatuS

The **ATLAS** detector consists of a cylinder of giant superconducting magnets around the beam pipe.



The four major components of the ATLAS detector

The Trigger and Data Acquisition System selects in real time physics events with distinguishing characteristics and finally the Computing System allows to store, process and analyse vast amounts of collision data.

The Inner Detector

The first part of ATLAS to see the decay products of the collisions :

- Very compact and highly sensitive.
- Consists of three different systems of sensors all immersed in a magnetic field parallel to the beam axis.

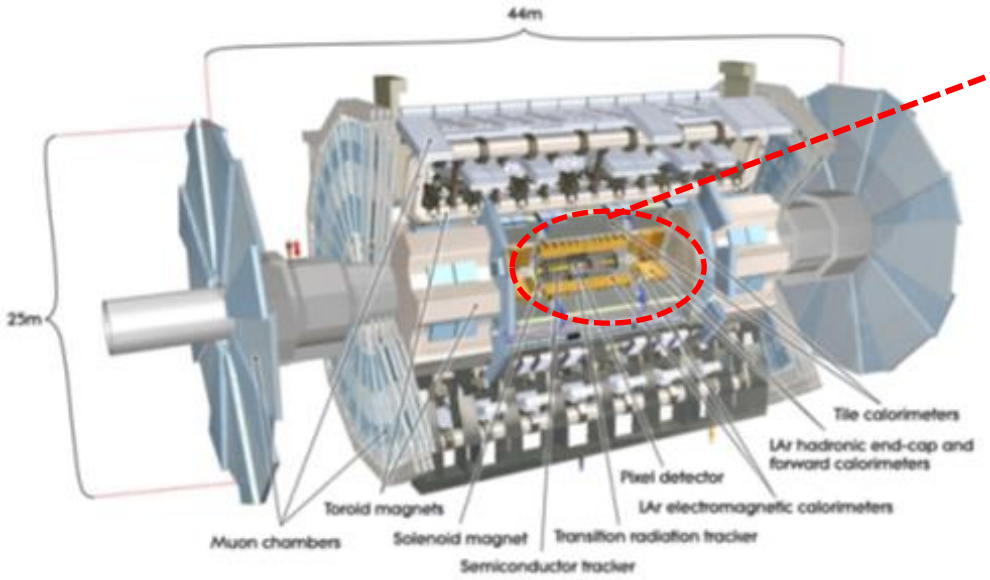
- The Inner Detector measures the **direction**, **momentum**, and **charge of electrically-charged particles** produced in each proton-proton collision.

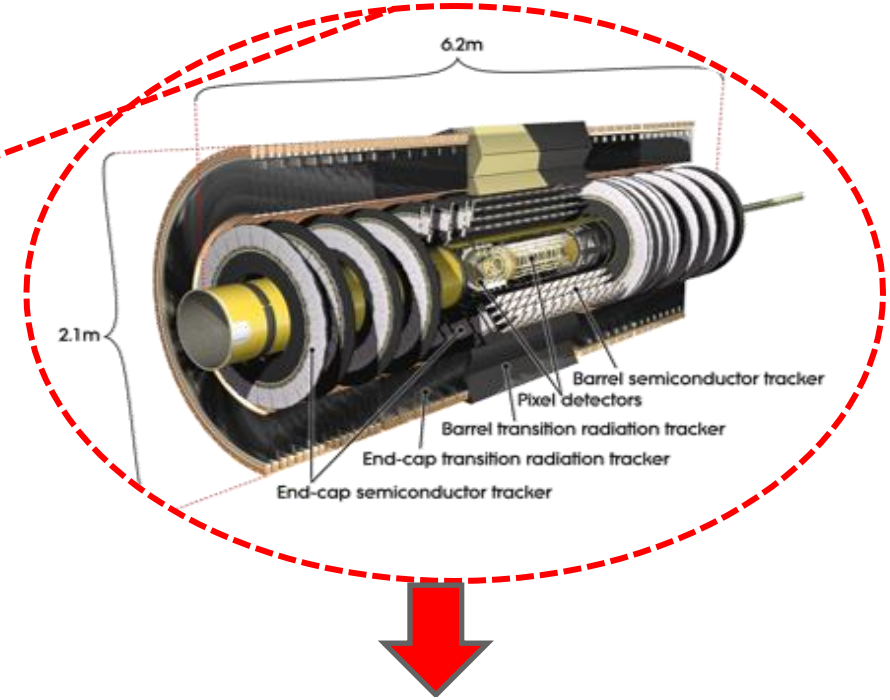
The main components of the inner detector :

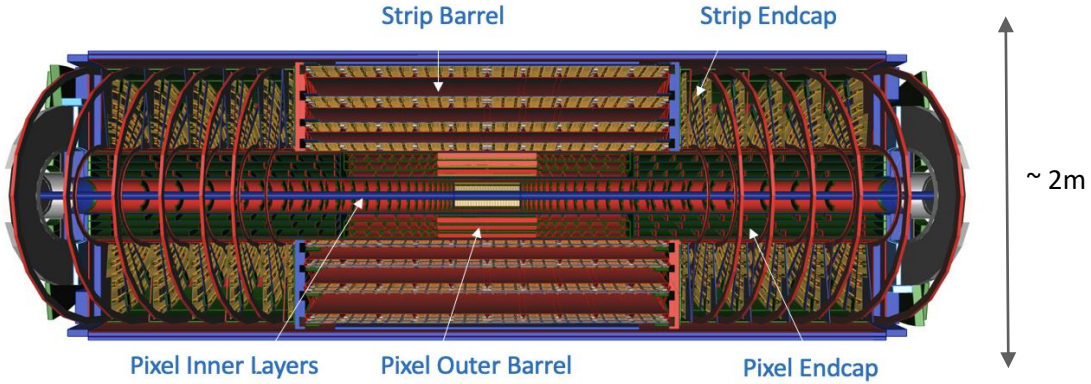
- Pixel detector
- Semiconductor Tracker
- Transition radiation tracker

The new silicon Inner Tracker (ITk)

- **At the HL-LHC, Inner Detector will be replaced with new silicon detector: Inner Tracker ITk**

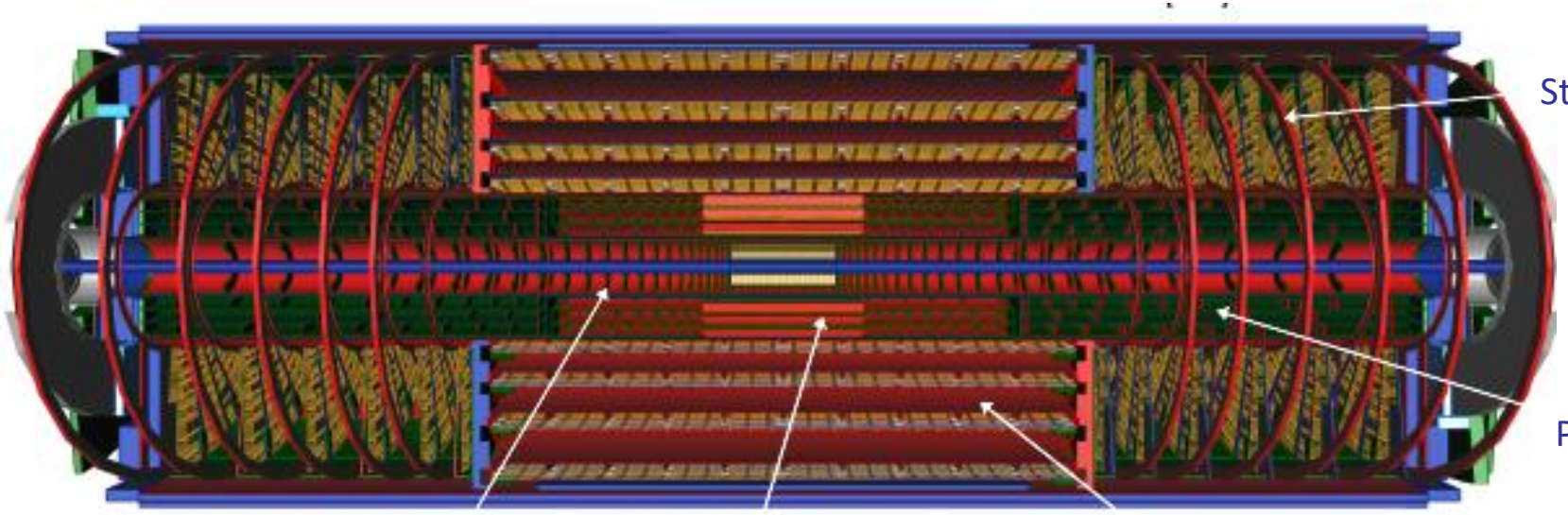






Layout of the ITk

- **Inner Tracker ITk**



ITK-2020-002

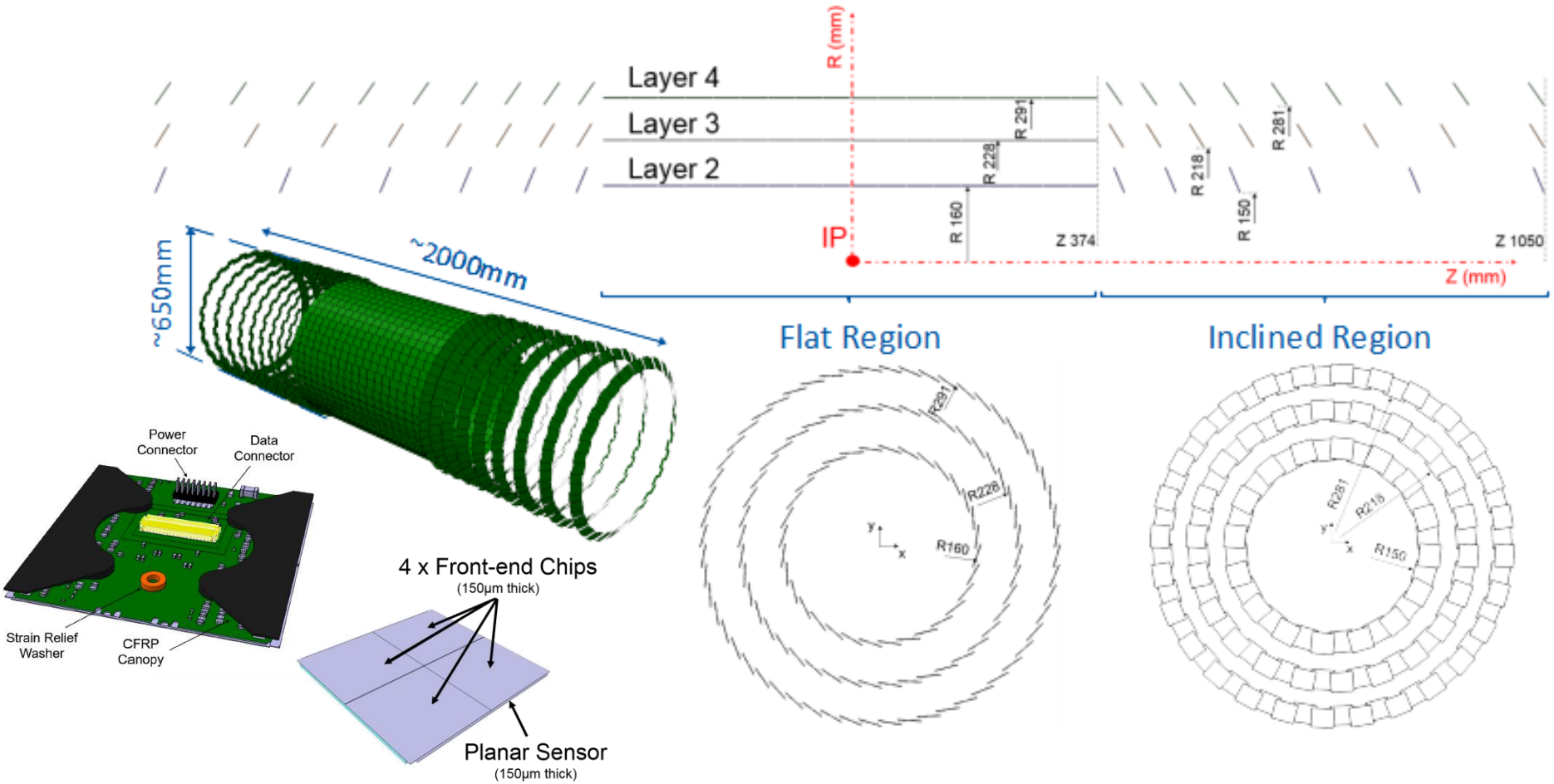
ITk Pixel Upgrade

- **ATLAS ITk Pixel Upgrade**
  - Active area ~13m^2
  - First pixel detector with inclined layout and serial powering

- **ITk Pixel Outer Barrel**
  - 4472 **Pixel modules**
  - Active area: 6.94m^2 (53.5% of Pixel Detector)
  - >14 Institutes from six different funding agencies

ITK-2020-002

Layout of Outer Barrel

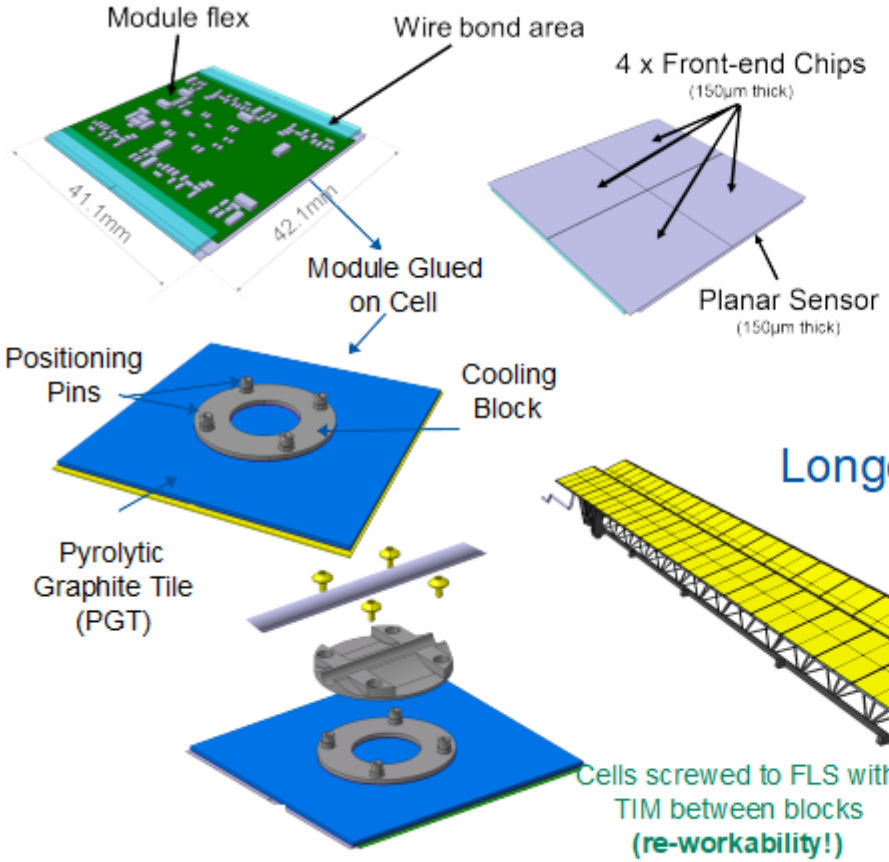


Single QUAD module type in flat & inclined regions (4472 modules)

ITK-2020-002

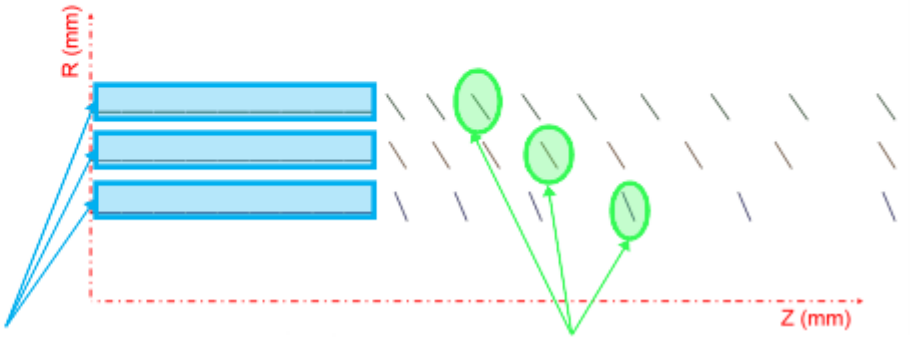
Outer Barrel : Modules and Local Supports

Module Cells (Module + PGT tile + Cooling Block)

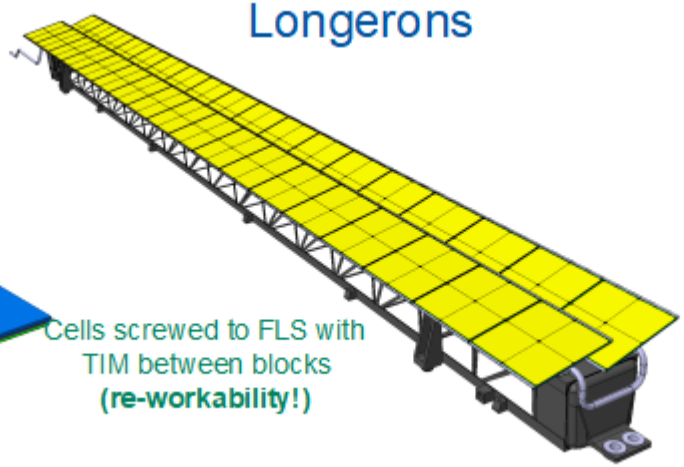


Functional Local Supports (FLS)

(Base Blocks + Cooling Pipe + CFRP Support Structure)



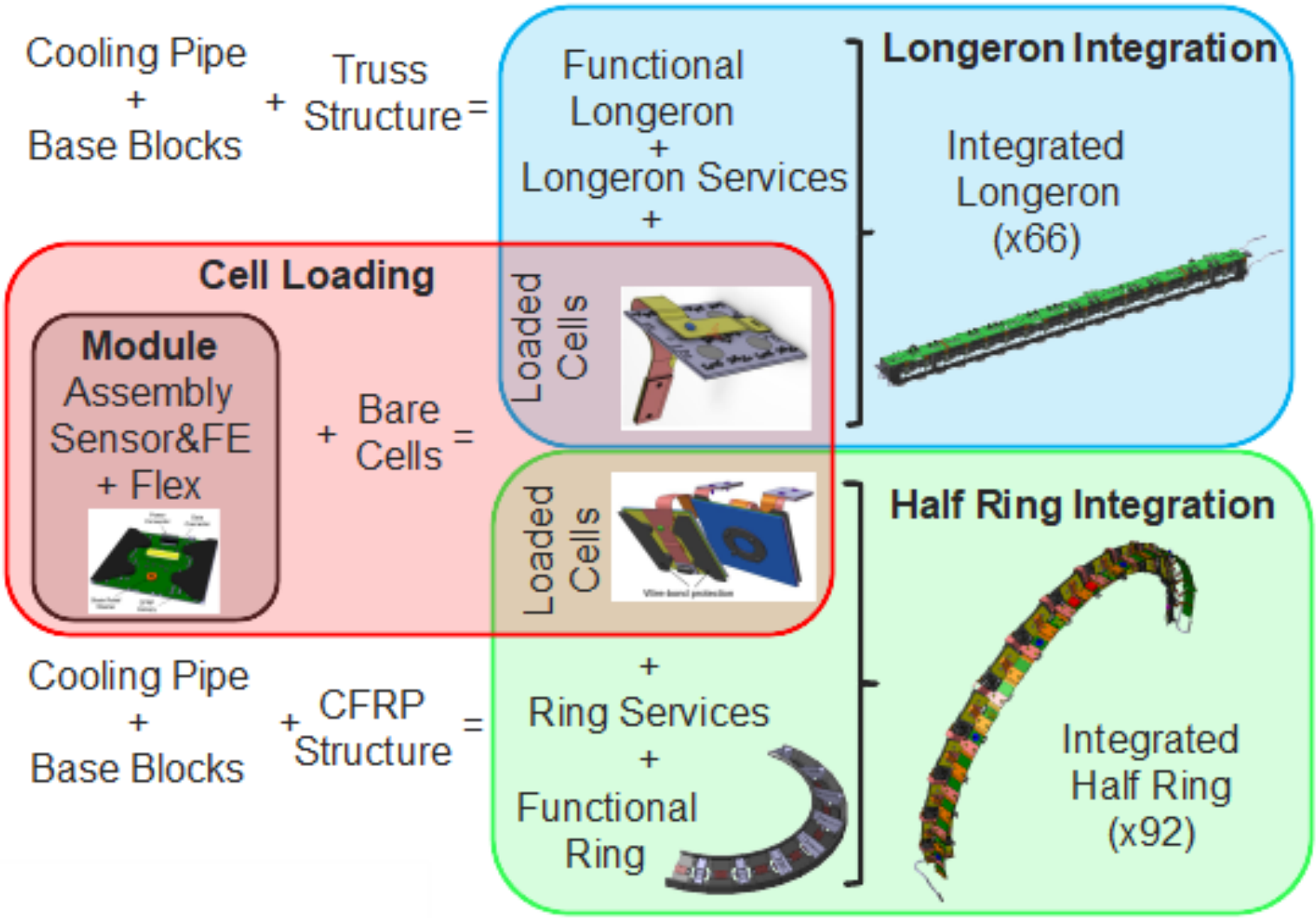
Longerons



Cells screwed to FLS with TIM between blocks **(re-workability!)**

Inclined Half-Rings

ITK Pixel Outer Barrel



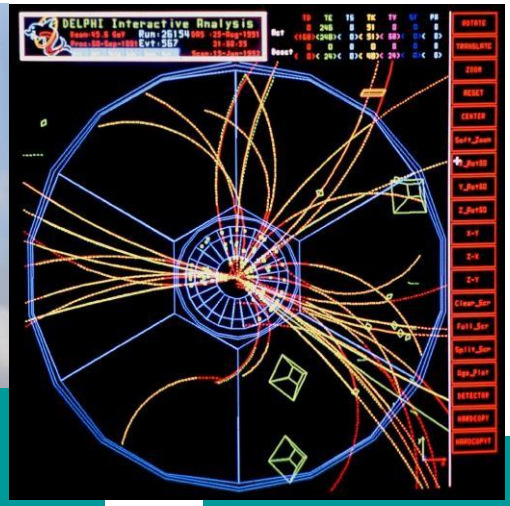
Project objectives

- **Install** a system for testing the electrical properties of loaded quad modules (**DONE**)

Project objectives

- **Commissionning** of the system. (**ONGOING**)
- **Optimize** the infrastructure with an interlock unit and cooling system. (**DONE**)
- **Evaluate the performance of the Cell Loaded Modules**
  - **Test** and **Evaluate** the performance of the loaded modules. (**ONGOING**)

CERN in a nutshell



International Collaboration

Fundamental Physics Research

Training

Technology

Thank you!