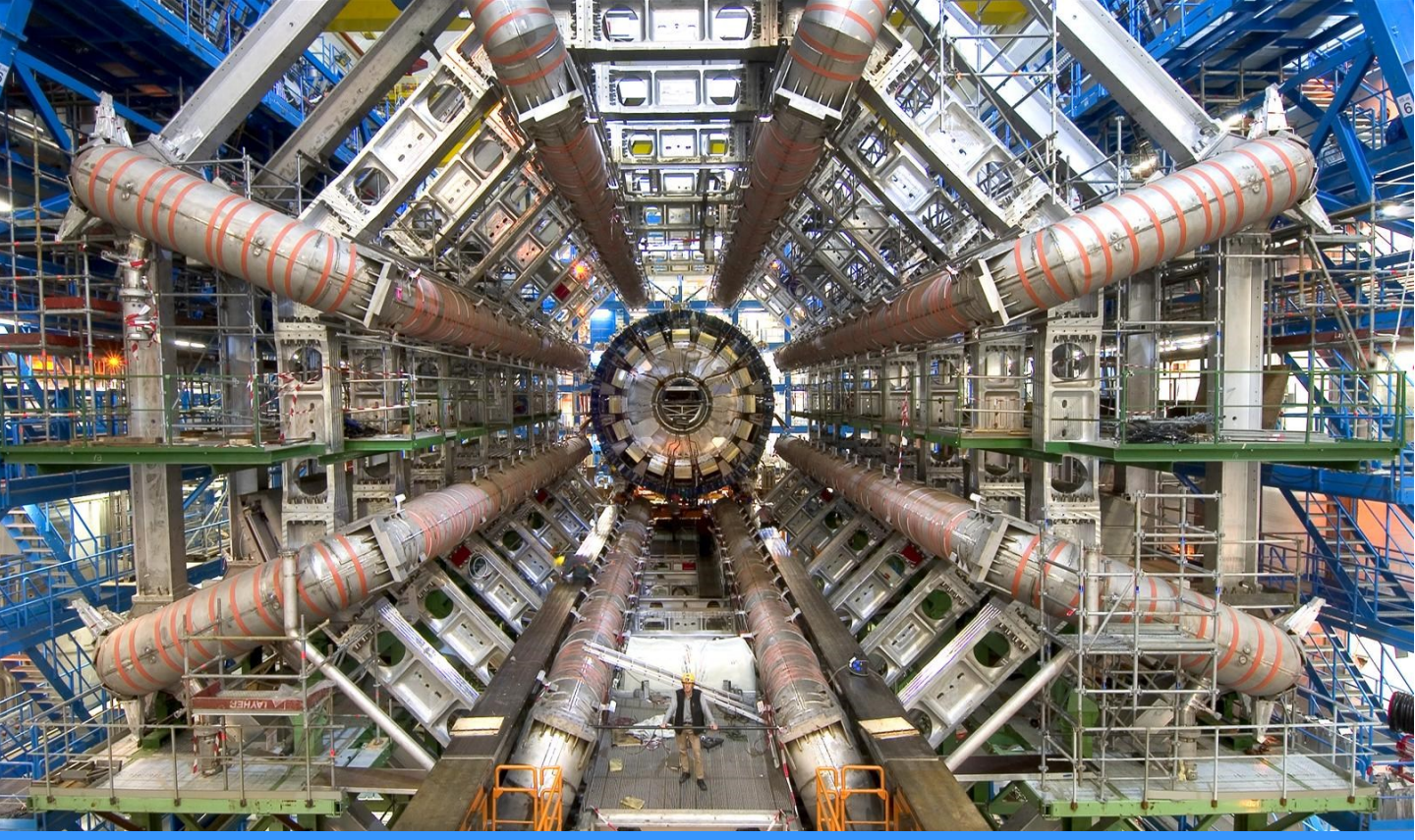
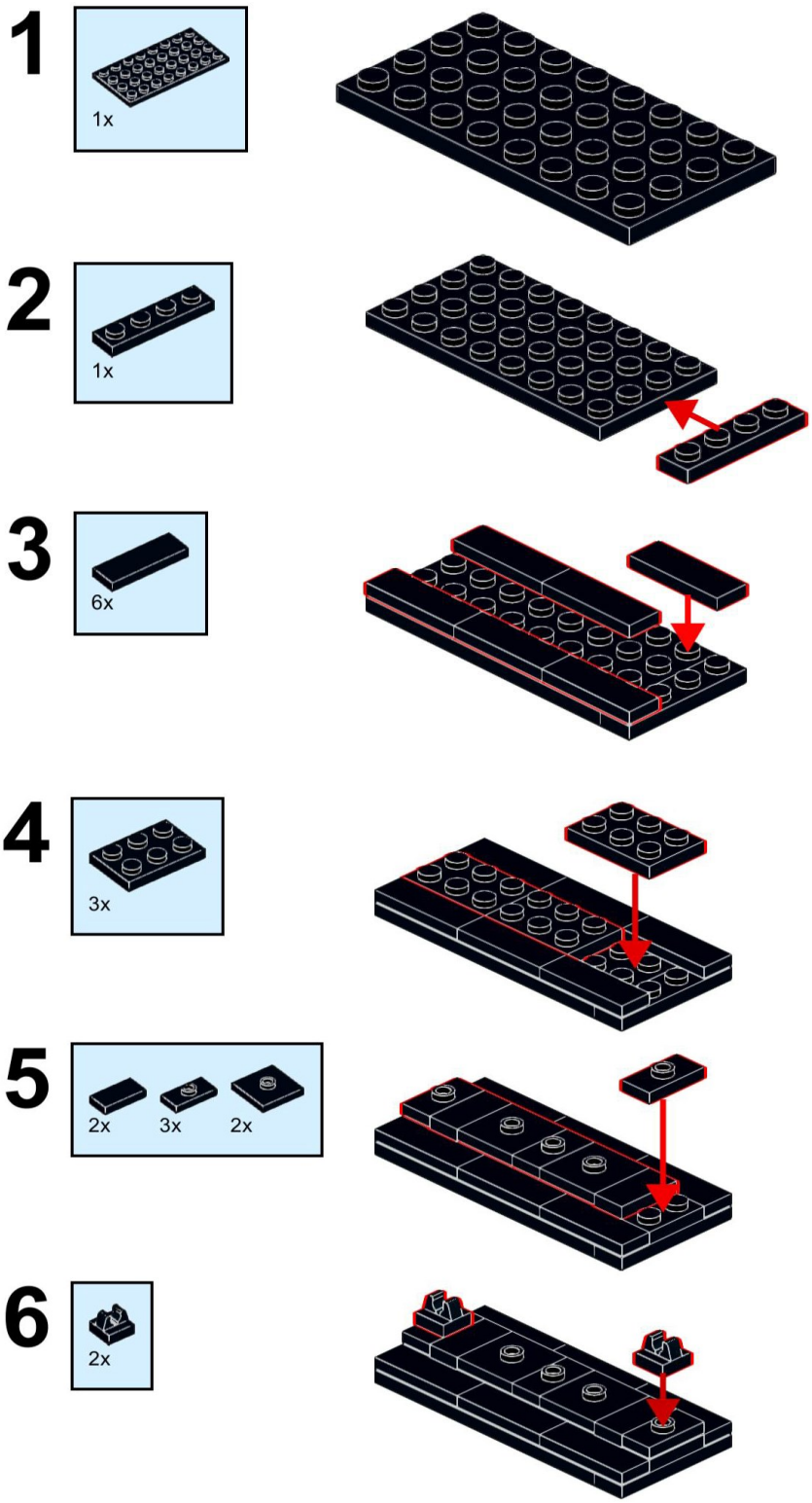


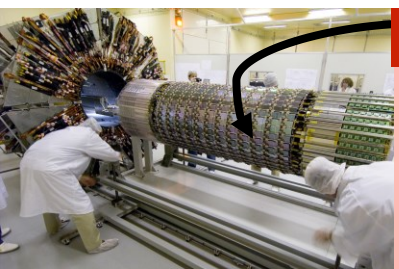
ATLAS Detector – LEGO Model

The **ATLAS detector** is a huge scientific instrument located at CERN. The ATLAS detector is designed to study the collision of high-energy particles at the world's largest particle accelerator (LHC), with the goal to find out more about the elementary particles that make up our universe and the fundamental interaction that govern their behaviour.

The ATLAS detector is shaped like a cylindrical onion, with multiple layers of highly advanced detector systems. It is about 46 meters long and 25 meters high, weighing around 7 000 tons and sits in a cavern almost 100 metres underground.

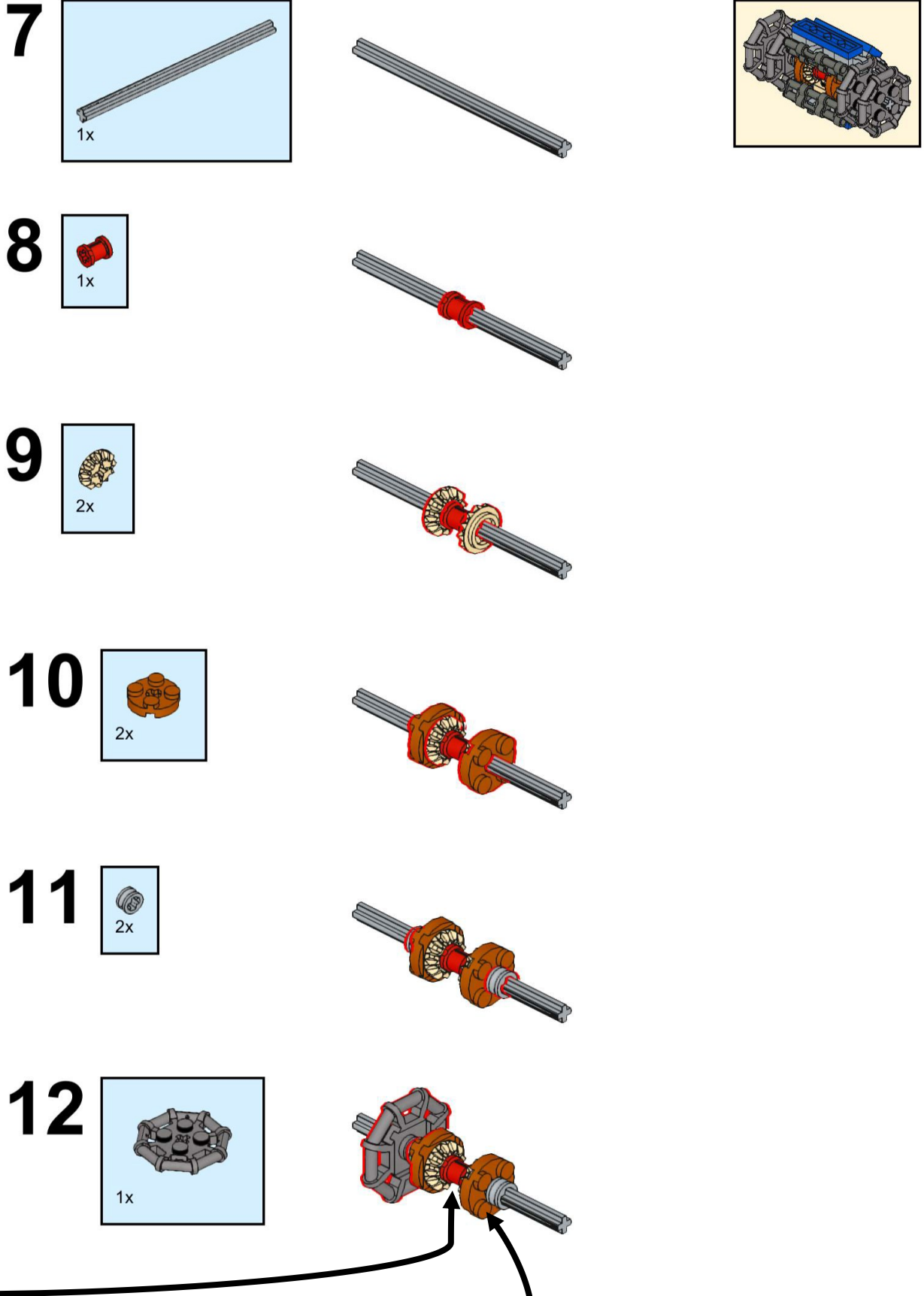
In this booklet, you will learn how to assemble a LEGO model of the ATLAS detector that is a about 600x smaller than the real detector. While assembling the different layers, you can learn more about how the ATLAS detectors works.





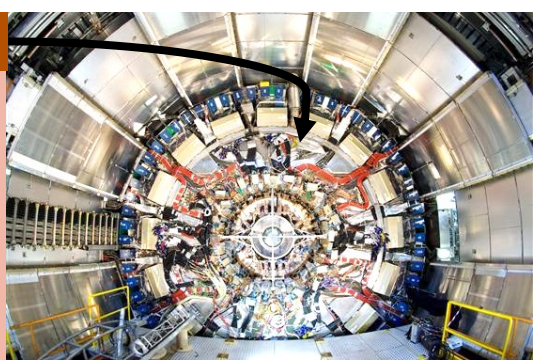
Inner Tracking System

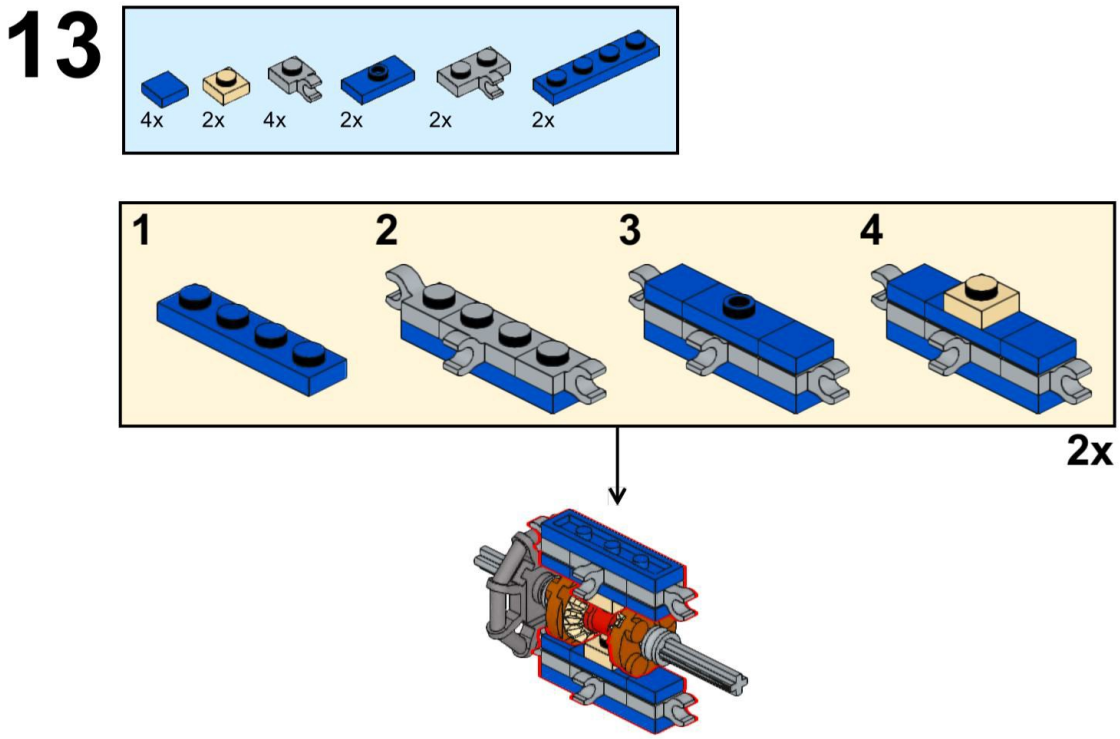
The innermost layer consists of silicon detectors that track the paths of electrically charged particles. The technology is quite similar to the one use in the camera of your smartphone. Scientists analyse how particles interact with the silicon detectors to reconstruct their trajectories accurately and find out, e.g. where exactly a particle collision took place.



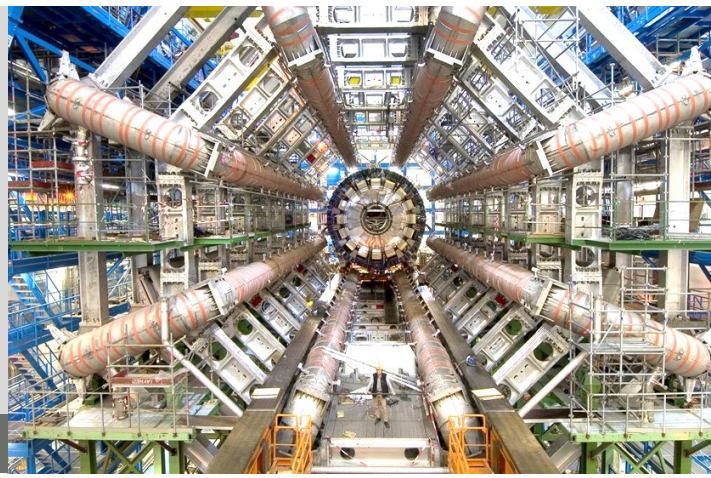
Calorimeters (Electromagnetic & Hadronic)

Calorimeters help scientists measure the energy of particles; they are basically energy meters. ATLAS uses two types of calorimeters (electromagnetic & hadronic), one focuses on particles such as electrons and photons, the other one focuses on particle systems called hadrons. By analysing the patterns particles leave inside the different layers of the calorimeters, scientists can distinguish different types of particles.

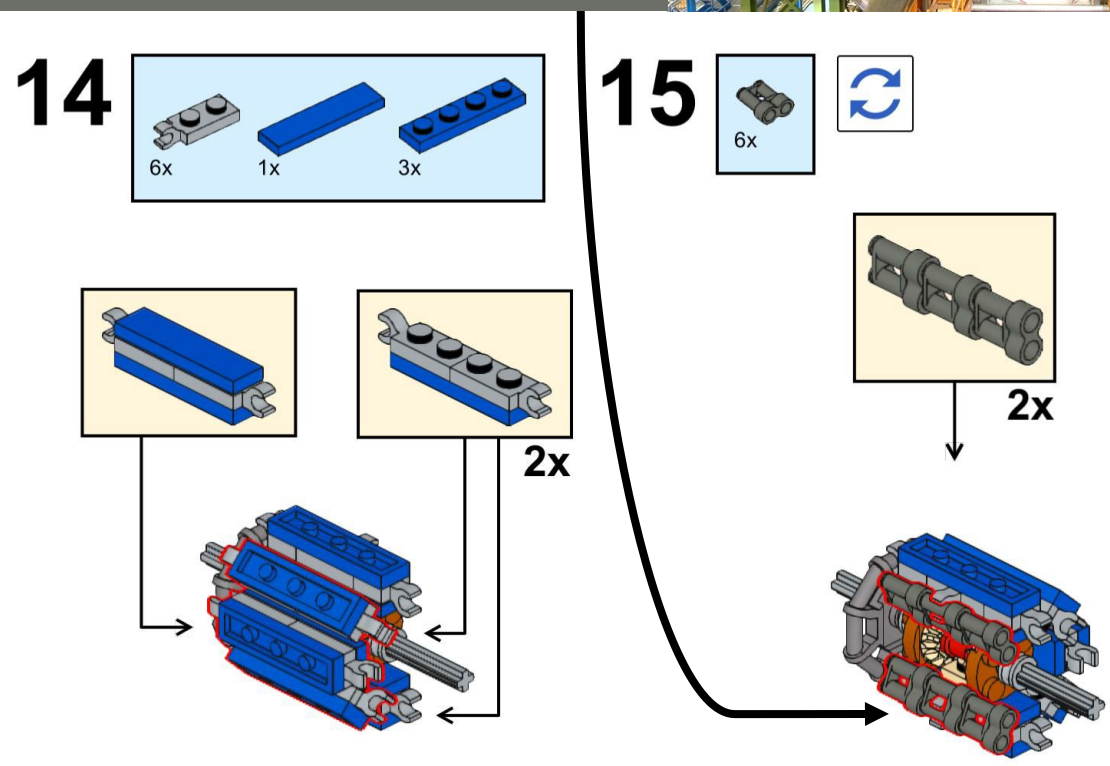




When an electrically charged particle moves through a magnetic field, it experiences a force. This force can make the particle change its path. By measuring in the direction in which a particle path bends, scientists can determine its electric charge (+ or -). The ATLAS detector uses two types of magnet systems: a cylindrical electromagnet (solenoid) and electromagnets made from a series of 8 coils (toroid). These coils use an electric current of 20 500 Ampere to create a magnetic field of up to 3.5 Tesla.



Electromagnets



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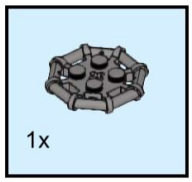

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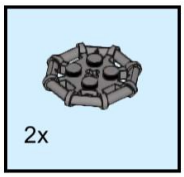
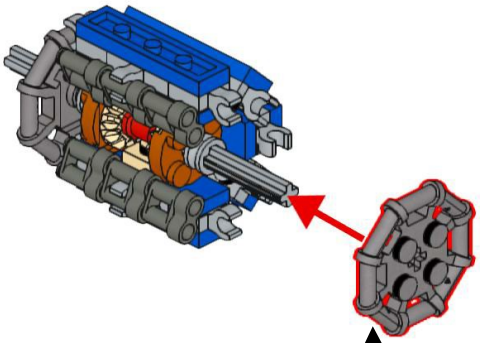
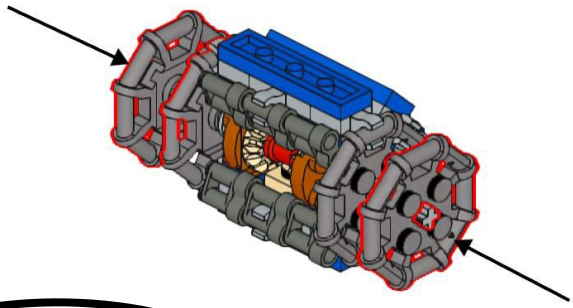


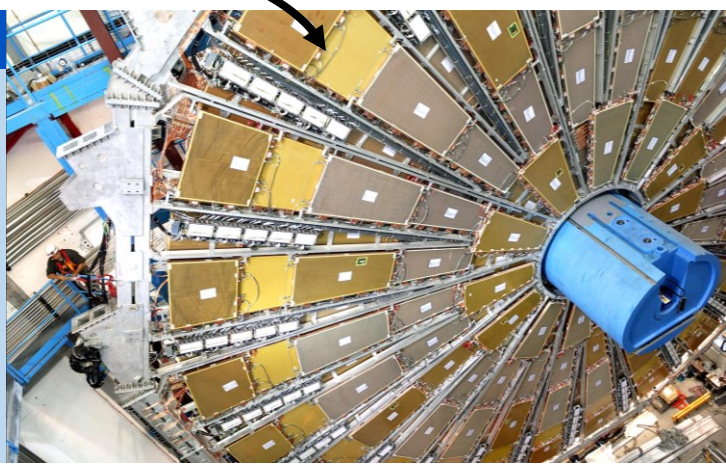




Muon System

Muons are electrically charged particles that are just like electrons and positrons, but with 200x more mass.

High energy muons are typically a sign for interesting physics. For example, the Higgs boson can transform into 4 muons. Therefore, the muon system of the ATLAS detector has been designed for the detection and measurement of muons. It consists of several layers of muon detectors that form the outermost layer of the ATLAS detector.



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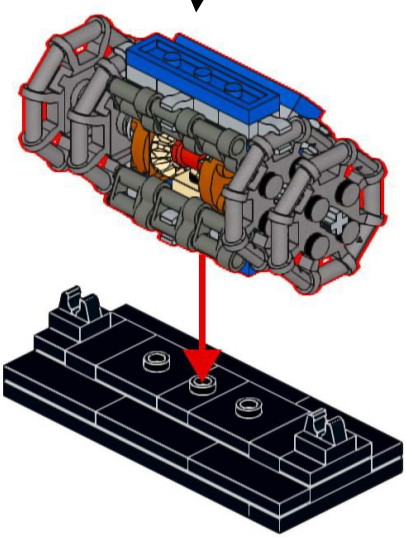

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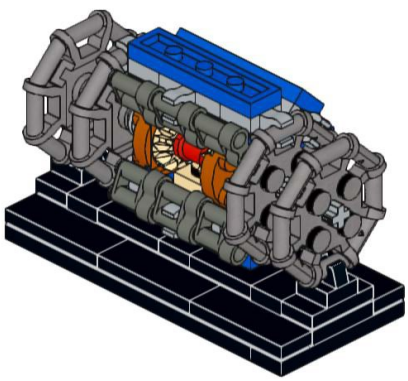
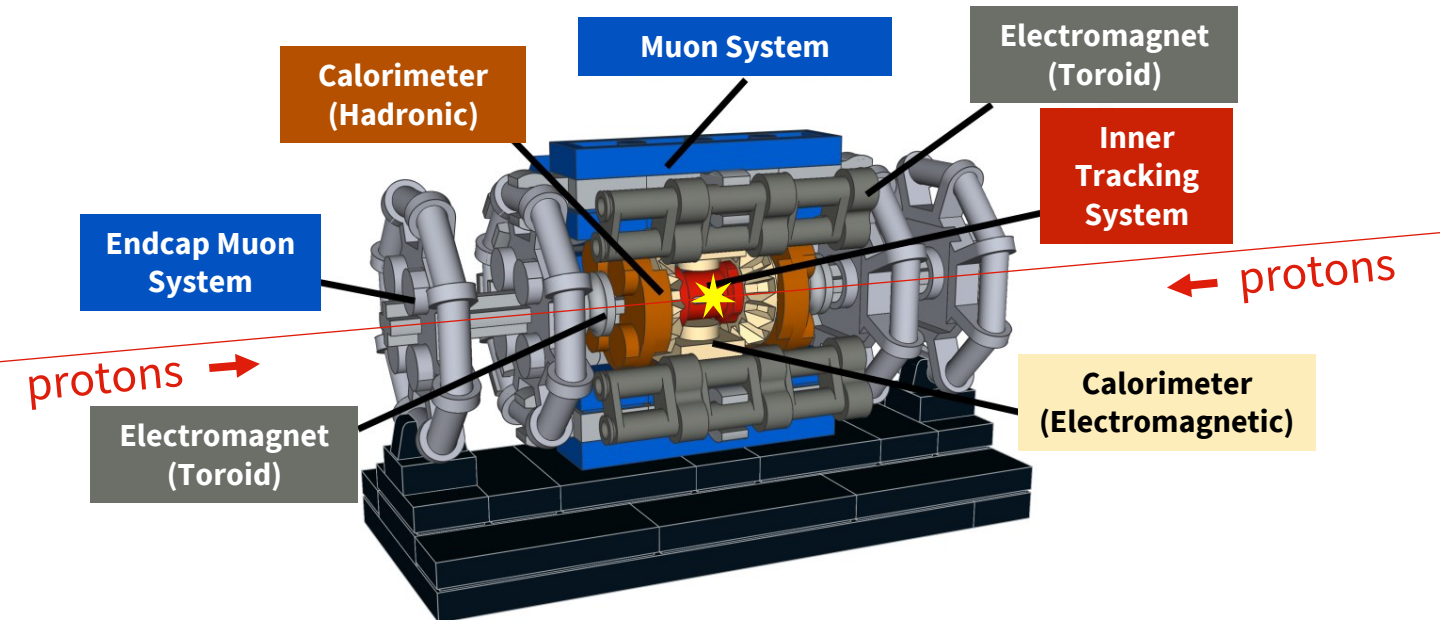


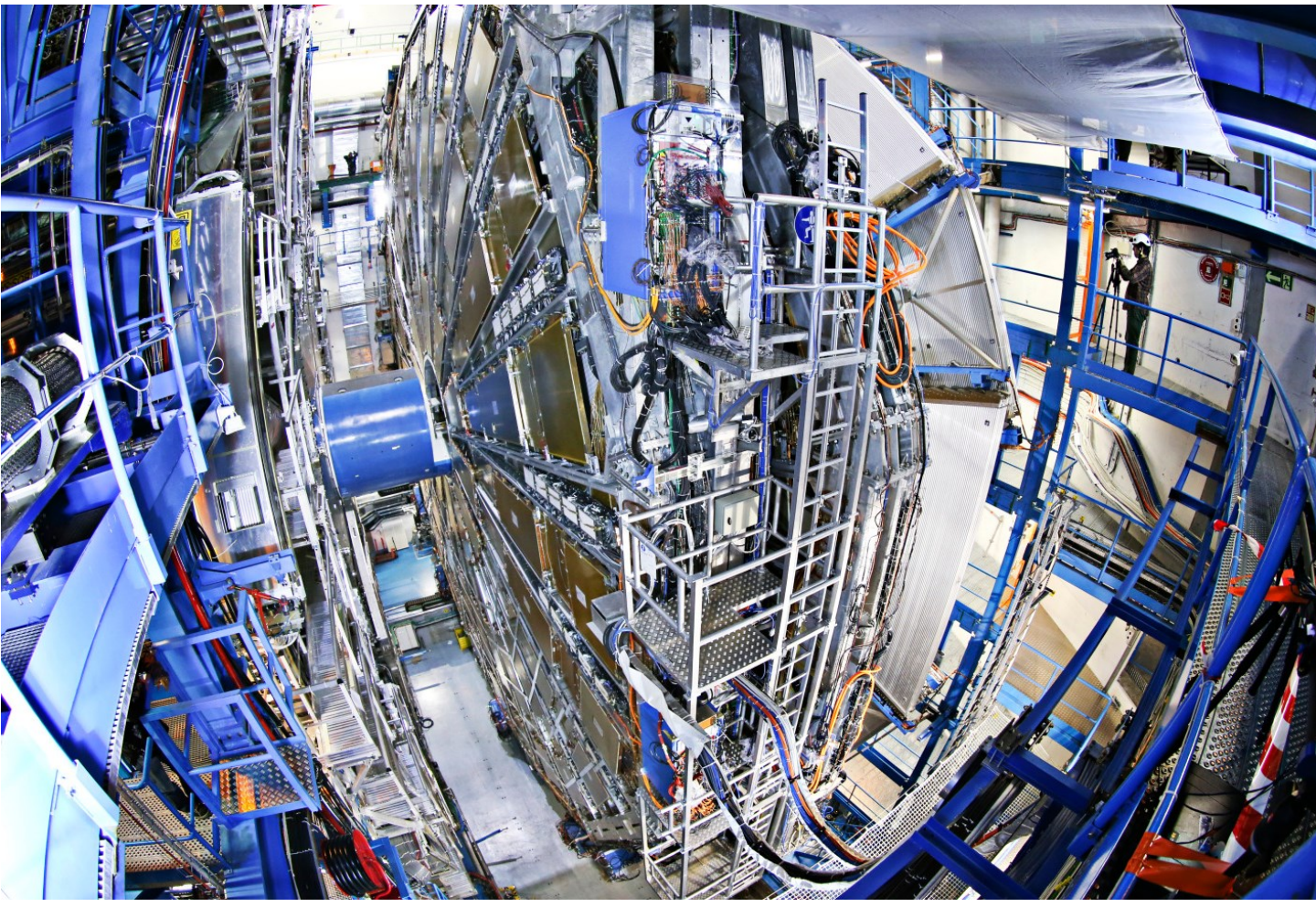
Congratulations, you have assembled a model of a particle detector at CERN!

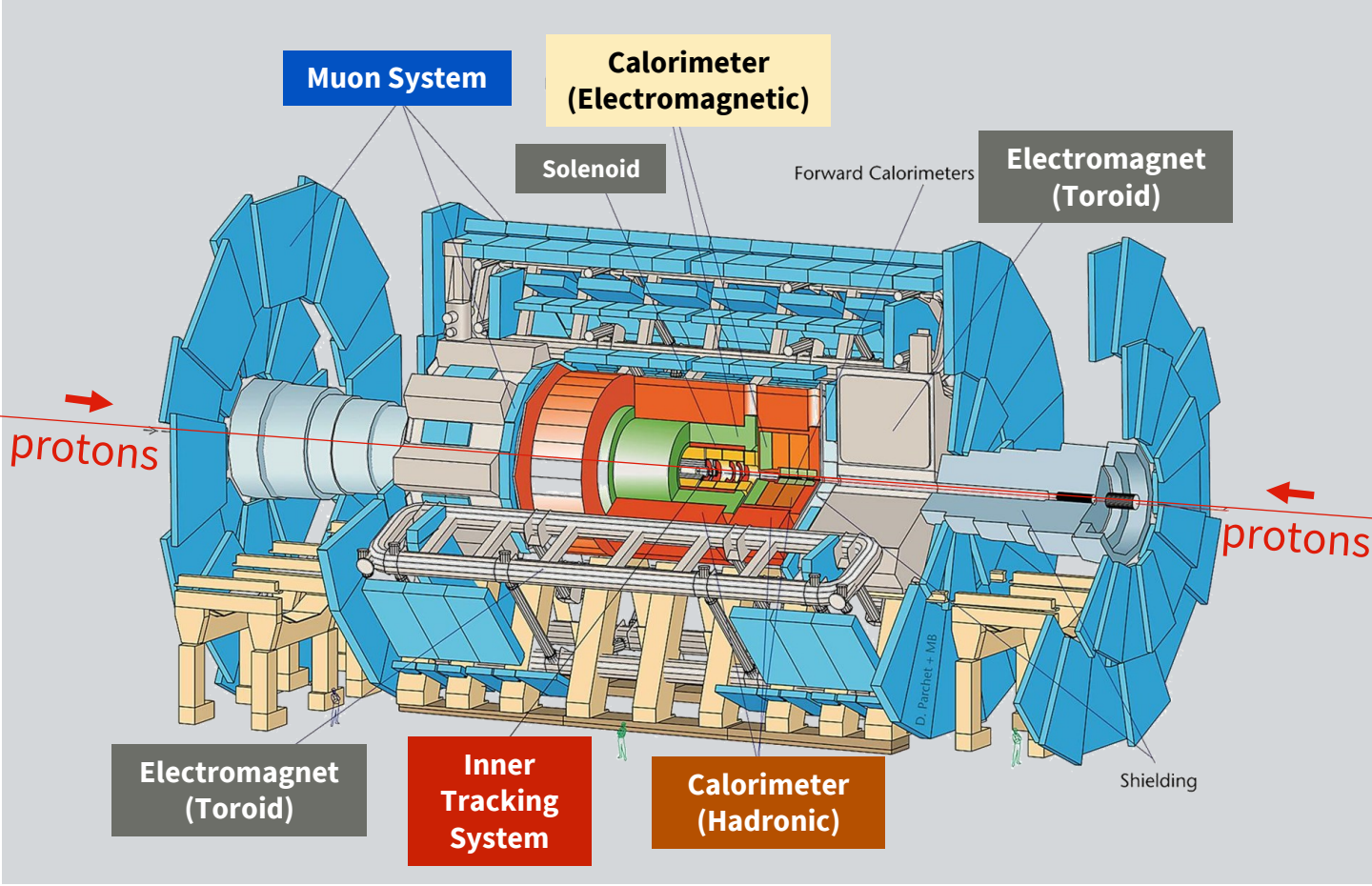


Time for a quiz! Which detector system is doing what?

Electromagnets	☐	☐ Measure the energy, e.g. of electrons
Inner Tracking System	☐	☐ Bend the path of electrically charged particles
Electromagnetic Calorimeter	☐	☐ Detect muons
Hadronic Calorimeter	☐	☐ Track the paths of electrically charged particles
Muon system	☐	☐ Measure the energy of hadrons

And that‘s how the real ATLAS detector looks like when it‘s open:





Lab workshop
LEGO detectors

Learn more about the different components of particle detectors

Idea, models and Images by Nathan Readioff & Sascha Mehlhase

https://build-your-own-particle-detector.org

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sciencegateway.education@cern