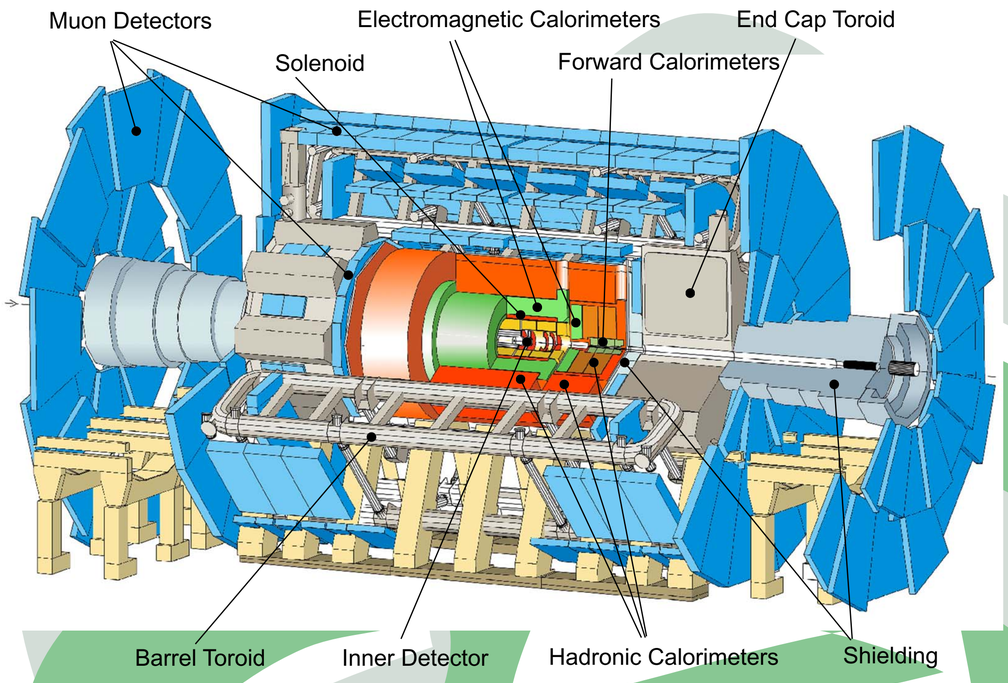
Magnet System

R.J.M.Y. Ruber, 7 March 2005
http://cern.ch/atlas-magnet



EXPLORING THE UNIVERSE

The goal of the ATLAS collaboration is to explore the fundamental nature of matter and the basic forces that shape the universe. There are 2000 physicist participating from more than 150 universities and laboratories in 34 countries.

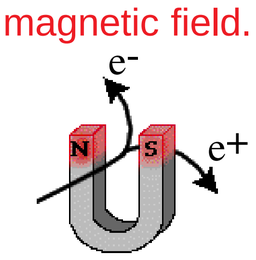
The collaboration is preparing a general purpose detector set-up for experiments with proton-proton collisions as provided by the Large Hadron Collider (LHC).

SOPHISTICATED PARTICLE MEASUREMENT

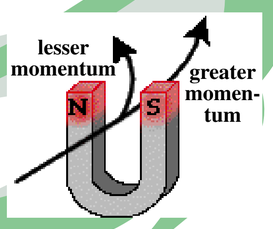
The ATLAS detector relies on a sophisticated magnet system for the momentum measurement of charged particle tracks. The magnet system consists of 25 coils grouped in four sub-systems of a Central Solenoid, a Barrel Toroid and two End-Cap Toroids. The Barrel and End-Cap Toroids are electrically and magnetically coupled.

A particular challenge of the ATLAS magnet system is its record-breaking size and the mixed configuration of solenoid and toroid magnets. It also has to accommodate the physics requirements for the ATLAS detector set-up with a light and open mechanical structure. Therefore conduction-cooled superconducting magnets are used in order to reduce material build-up and enhance particle transparency.

Particles created in a collision can be studied e.g. by using a magnetic field.
For charged particles:



Opposite charges give opposite directions.



Different momenta give different bending radii.

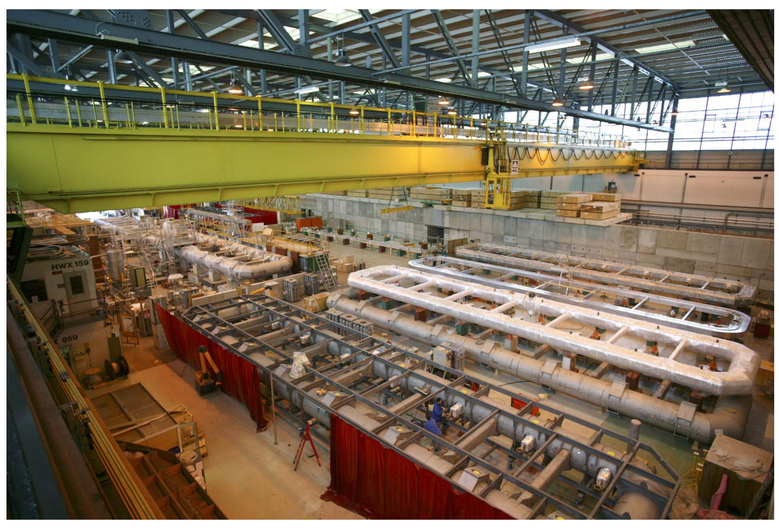
STRONG MAGNETIC FIELD THROUGH SUPERCONDUCTIVITY

The toroids are operated at a current of 20,500 amperes and generate a field integral of 2 to 8 teslametre. The solenoid is designed for a 2 tesla strong axial magnetic field at the collision point with an operating current of 7600 amperes.

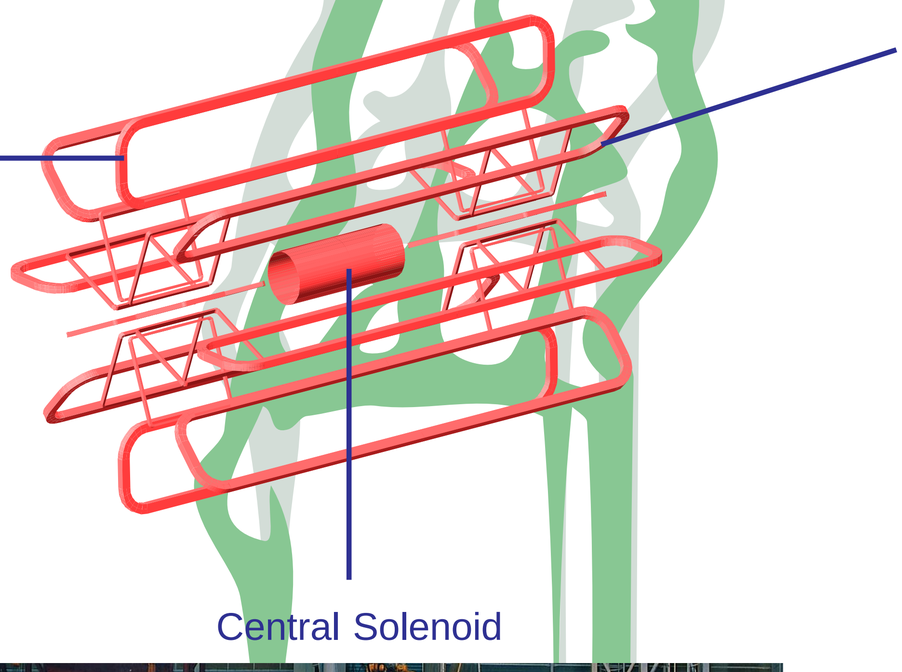
Without superconductivity it would be impossible to construct this magnet system. A one millimetre diameter superconducting wire carries 500 times more current than a one millimetre diameter copper wire.

LARGE SCALE SYSTEM

The magnet system assembly has an overall dimension of 26 meters length by 20 meters in diameter. It has a total weight of 1300 tons and stores a magnetic energy of 1600 megajoules. Each of the 25 coils is made of superconducting cables composed of niobium-titanium filaments in a copper matrix which is inserted in an aluminium bar. The coils are cooled down to 4.8 kelvin (-268 °C).

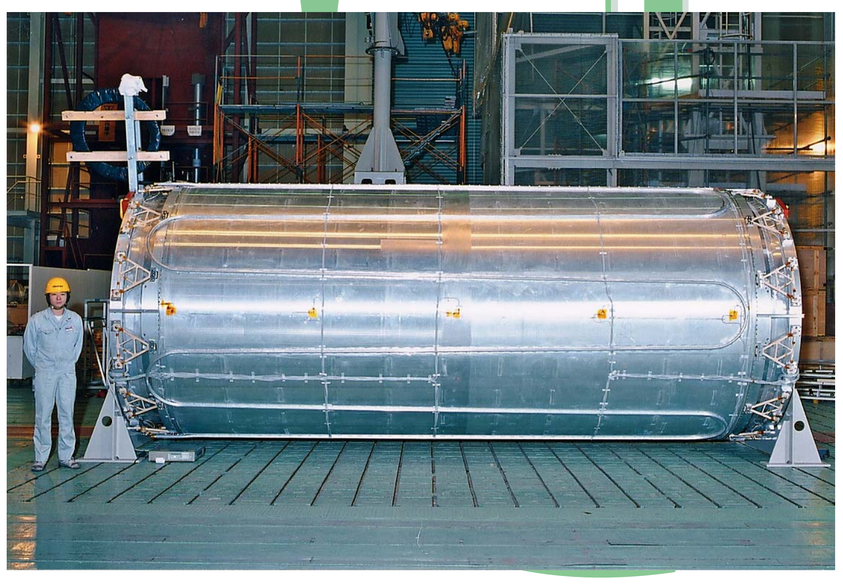


Barrel Toroid



End-Cap Toroid

Central Solenoid



INTERNATIONAL COLLABORATION

The engineering and construction is done in close co-operation between the scientific institutes CEA-DAPNIA (Fr), INFN-LASA (I), KEK (J), NIKHEF (NL), RAL (UK) and CERN and industry.

CERN
European Organization for Nuclear Research