



Higgs10 @Orsay Palaiseau Saclay

Vendredi 9 septembre 2022 14h



Auditorium Lehmann
IJCLab Bât. 200

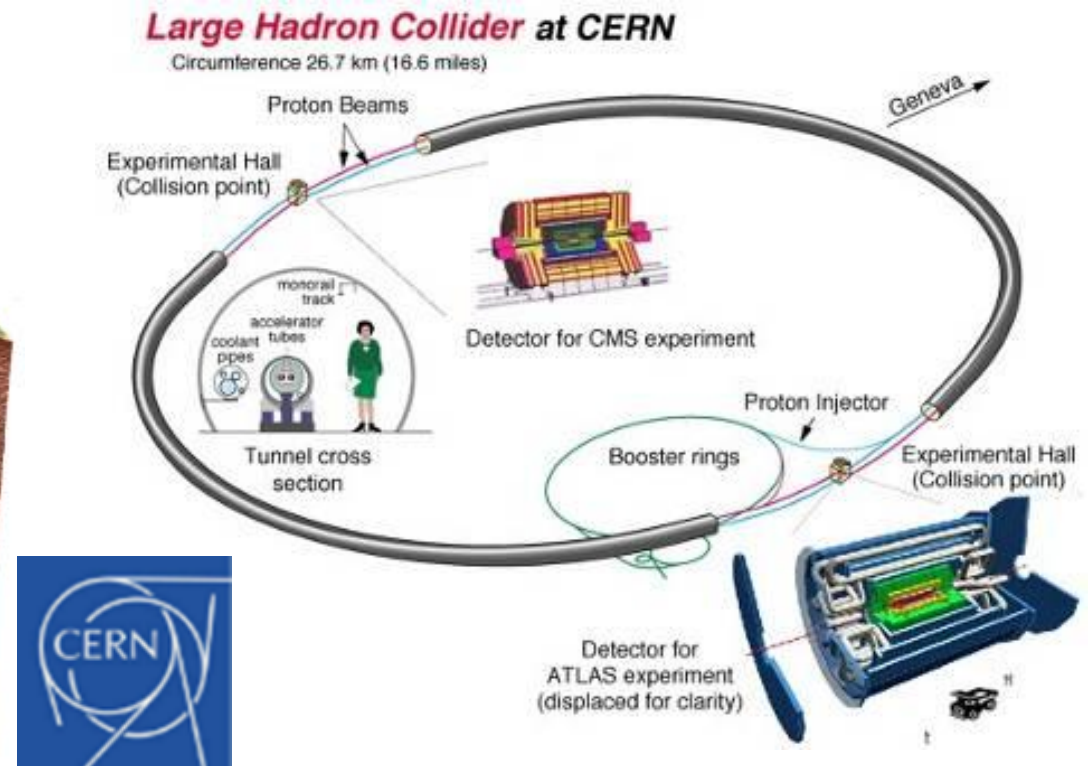
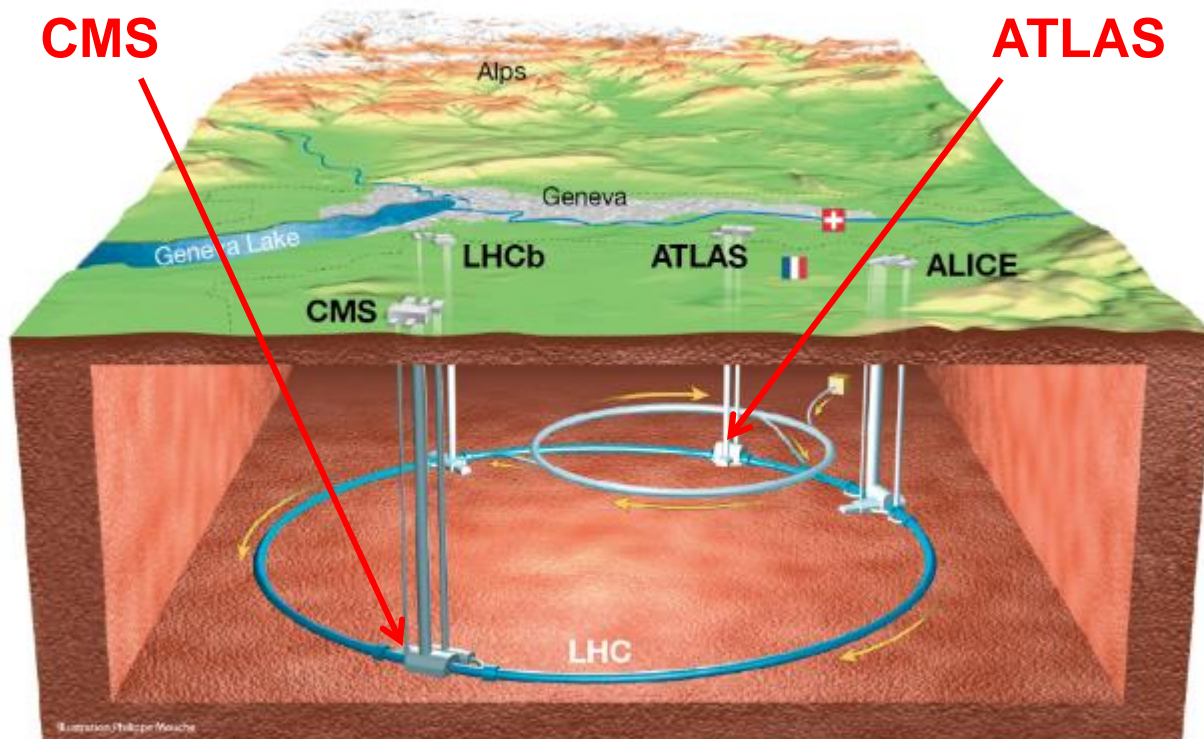


ATLAS and CMS Superconducting Magnets

Pierre Vedrine
CEA Paris Saclay

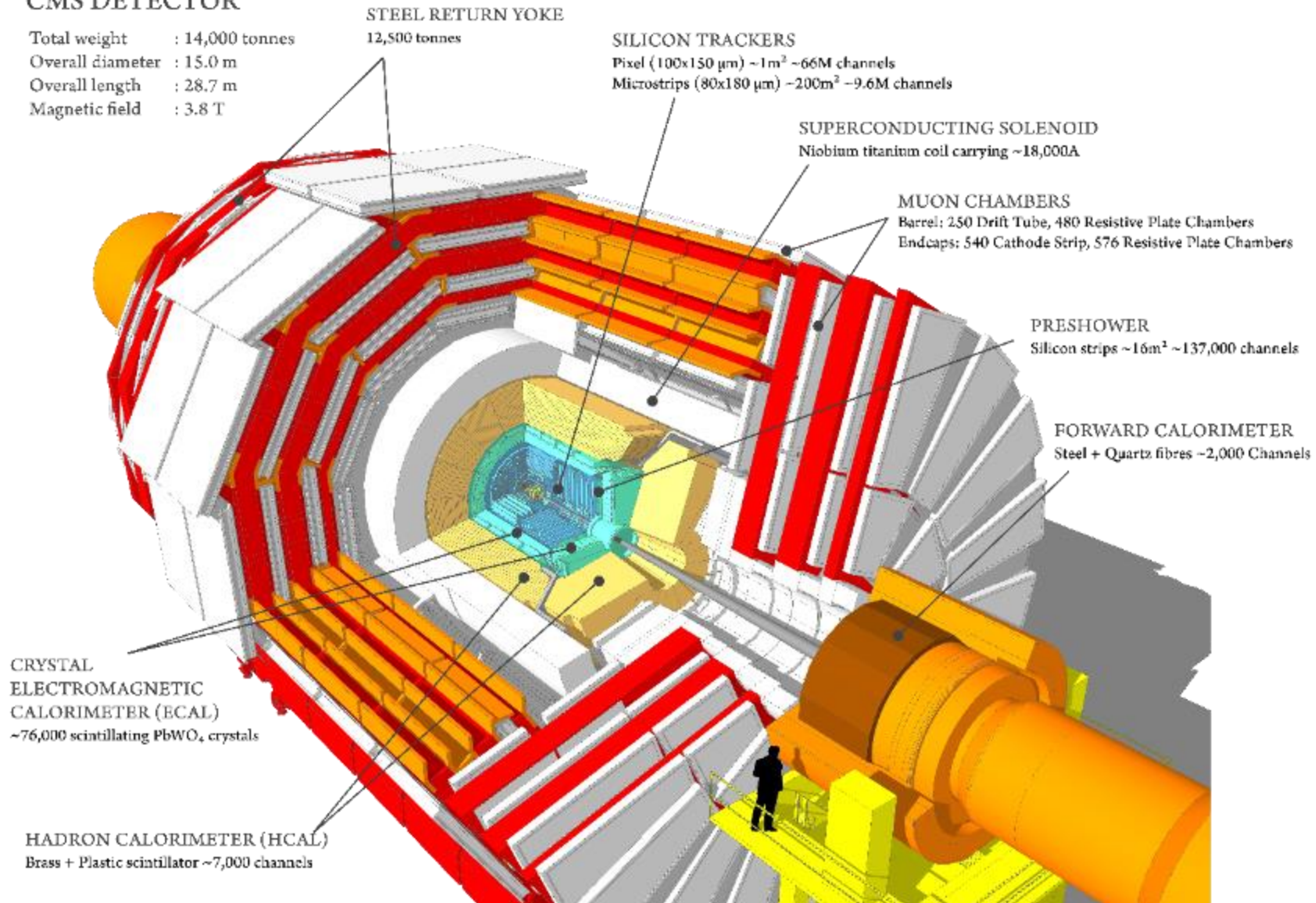


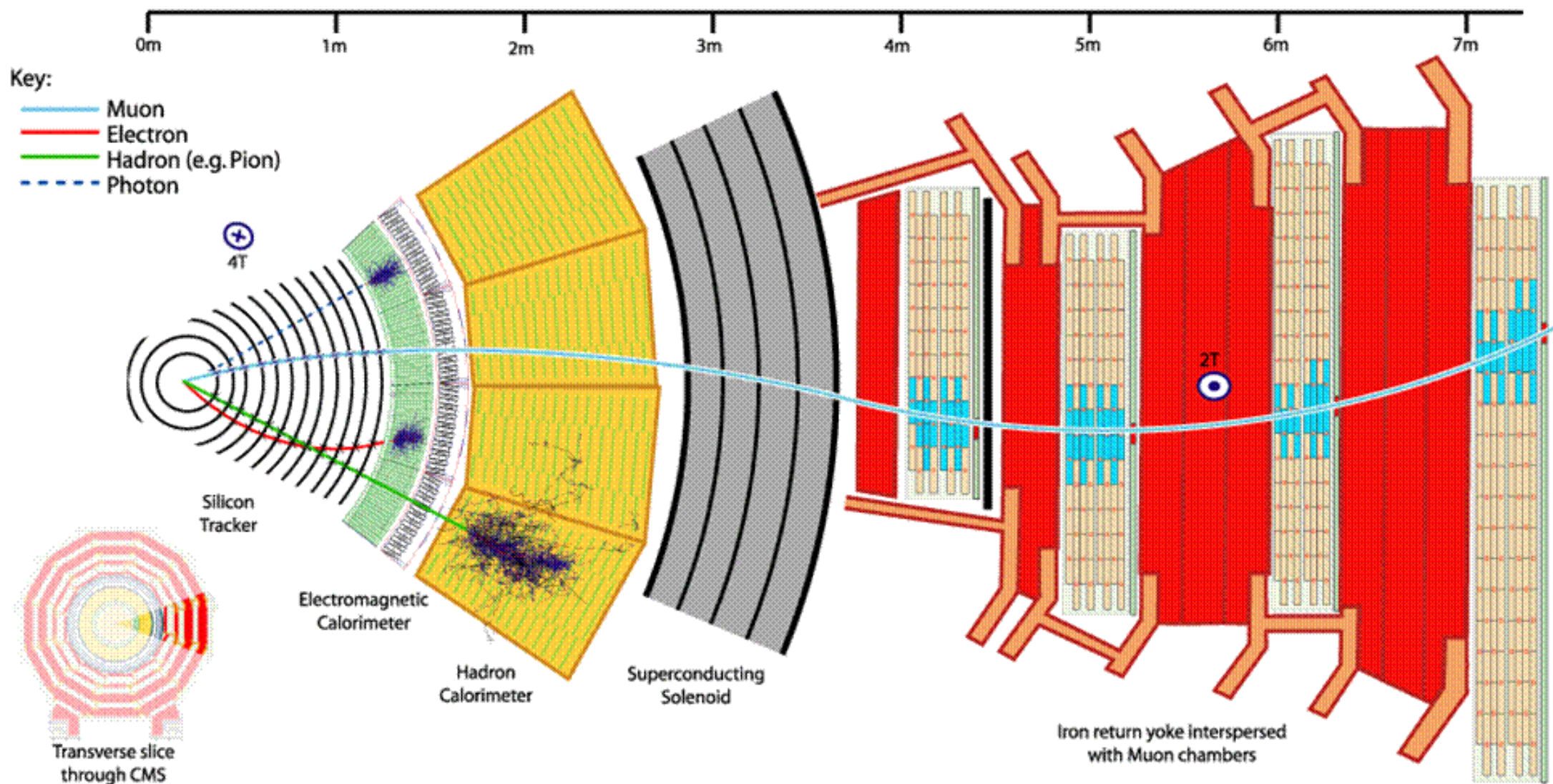
- ▶ 14 TeV proton-proton collider :
- ▶ Installed in the LEP 27 km tunnel, to produce the events needed to study the "Standard Model" of particles, to understand the "Mass", Higgs boson and more..
- ▶ Exploration and discovery machine
- ▶ 2 general ATLAS and CMS detectors, each checking the results of the other
- ▶ Can look beyond the "Standard Model" and perhaps discover a "new physics"

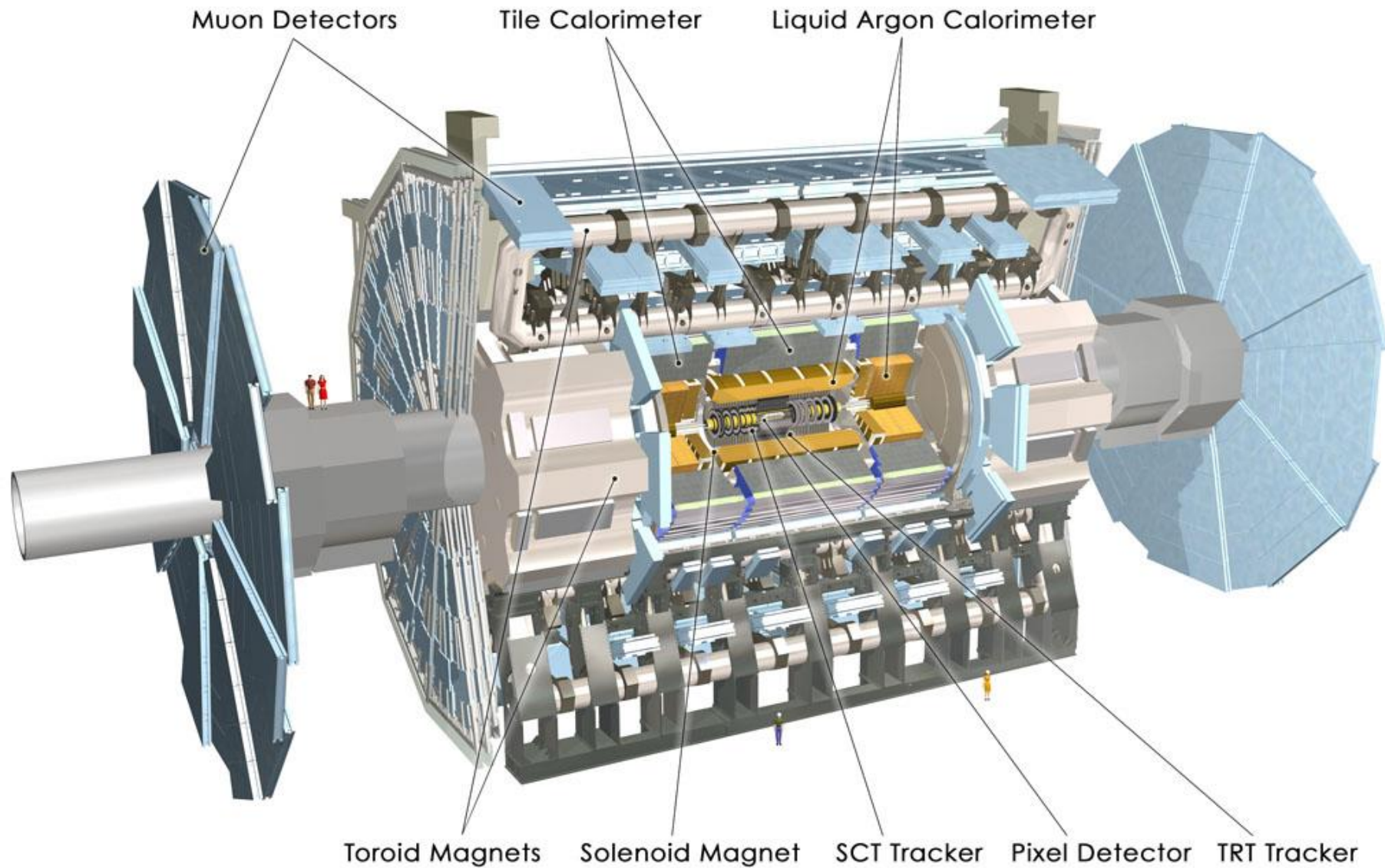


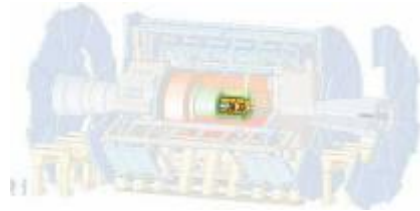
CMS DETECTOR

Total weight : 14,000 tonnes
 Overall diameter : 15.0 m
 Overall length : 28.7 m
 Magnetic field : 3.8 T









Internal trackers

determine the trajectory of electrically charged particles



Calorimeter

It consists of an electromagnetic calorimeter (green) and a hadronic (liquid argon) calorimeter (red).

It measures the energies of charged and neutral particles



Muon detector

It consists of a multitude of muon chambers.

It allows the trajectory of muons to be determined

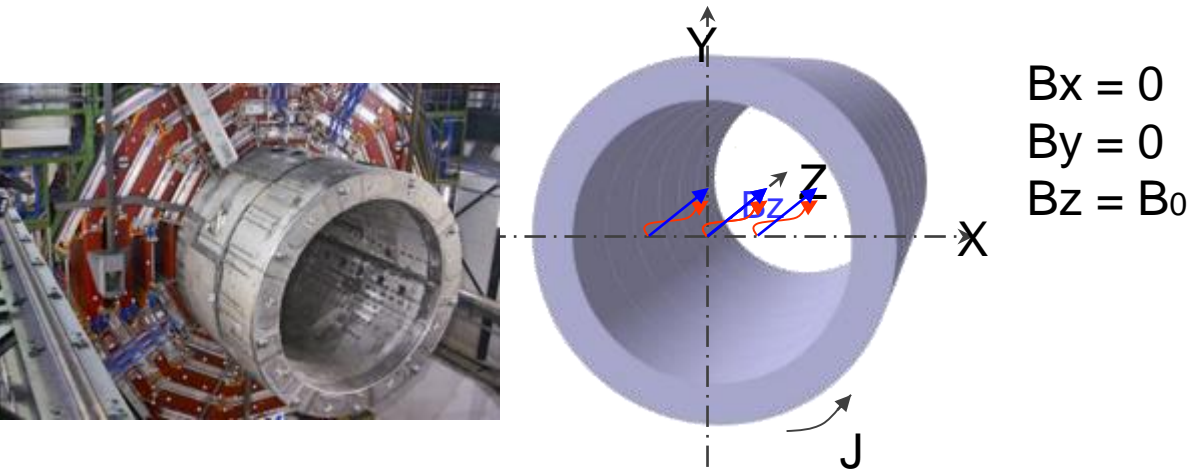


Magnets

It consists of a solenoid (which is located between the internal trackers and the calorimeter), a barrel composed of 8 toroidal coils and 2 endcap magnets

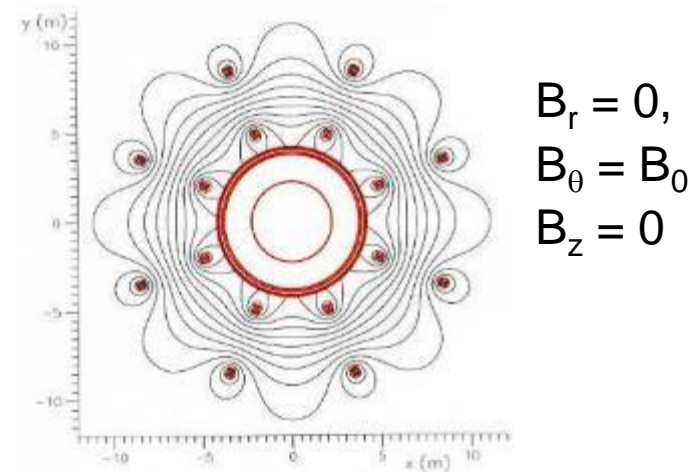
It allows the trajectory of the particles to be curved to allow their characterization

Two main types of large, superconducting detector magnets:
solenoids (e.g., ALEPH and CMS at CERN) and **toroids** (e.g., ATLAS at CERN).



+ Very good momentum resolution at large angle, compact and efficient structure.

- Requires an iron yoke, inefficient for small-angle particles.

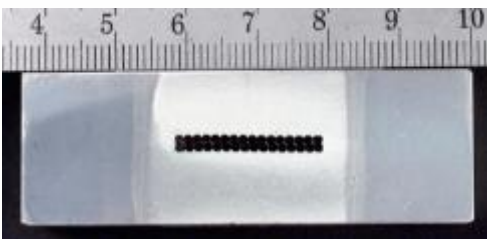
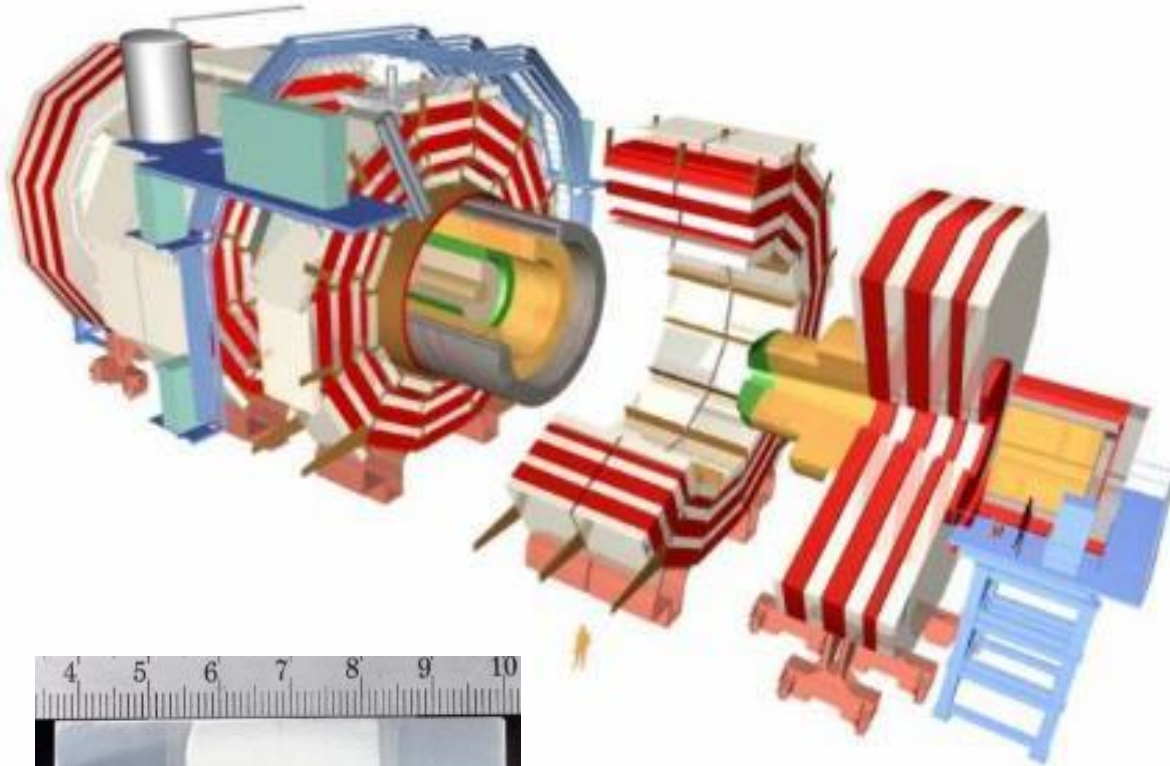


+ No field along the axis, magnetic field always transversal to the particle momentum, low fringe field, best momentum resolution at low angle.

- Very inhomogeneous magnetic field, high peak field on the conductor, complicated magnet structure.

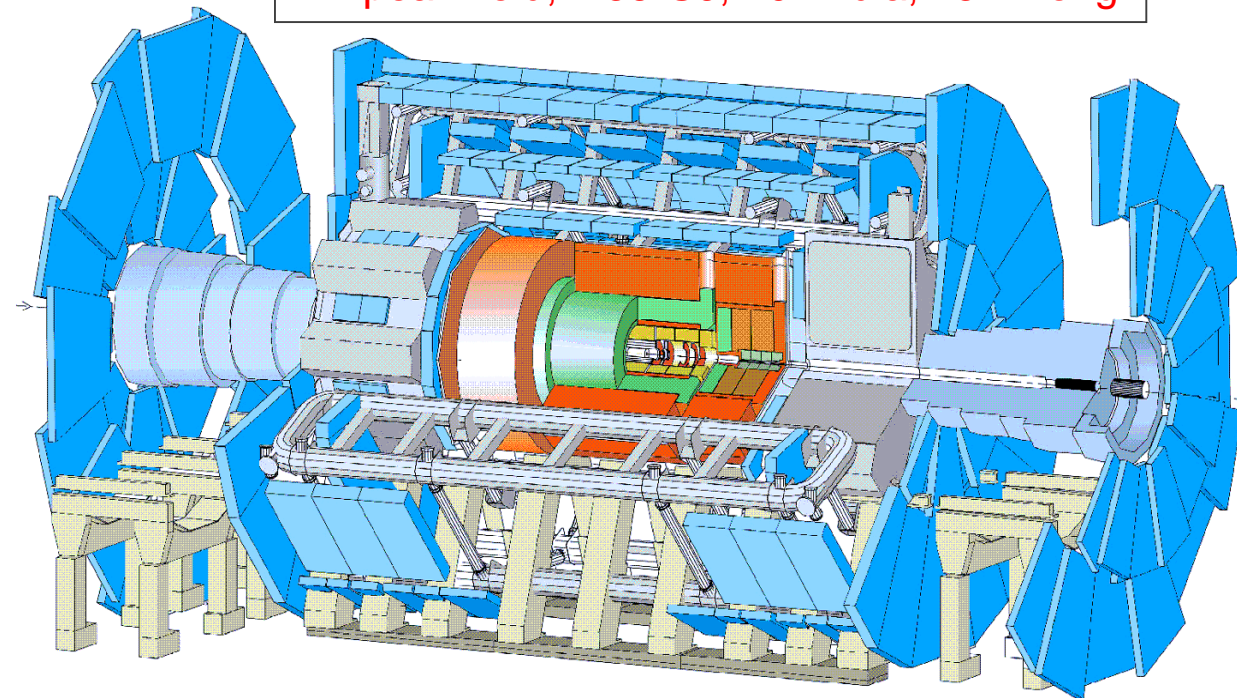
CMS

Largest Solenoid
4T, 2.7 GJ, 7m dia, 12m long



ATLAS TOROIDS

Largest field volume – 8200 m³ self
contained field (no yoke) open structure
4T peak field, 1.55 GJ, 20 m dia, 25 m long





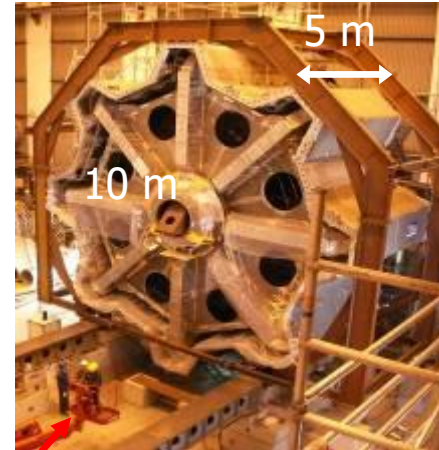
Science & Technology Facilities Council
Rutherford Appleton Laboratory



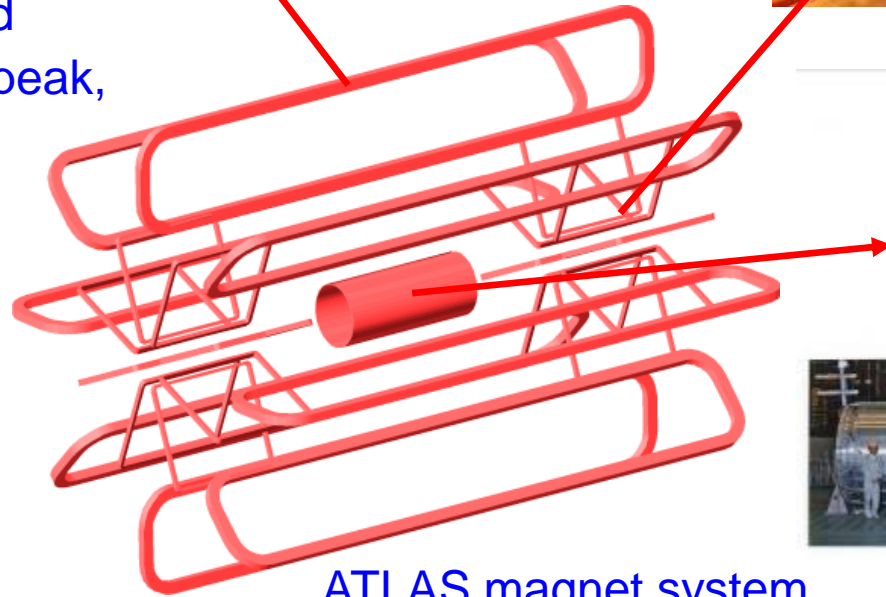
Etudes, suivi de réalisation, des tests et de l'installation



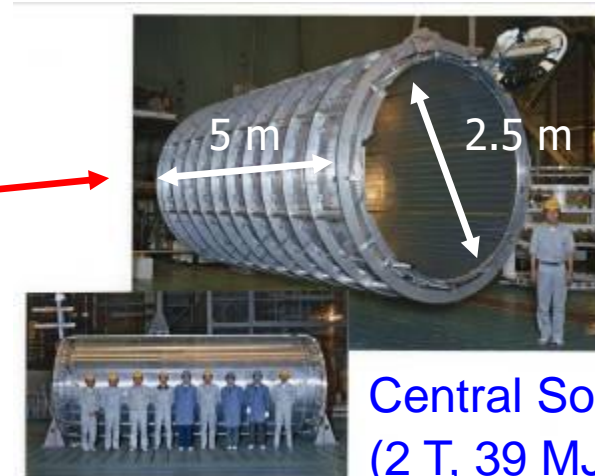
Barrel Toroid
(8 coils, 4 T peak,
1080 MJ)



End Cap
Toroid
(8 coils,
4 T peak,
250 MJ,)

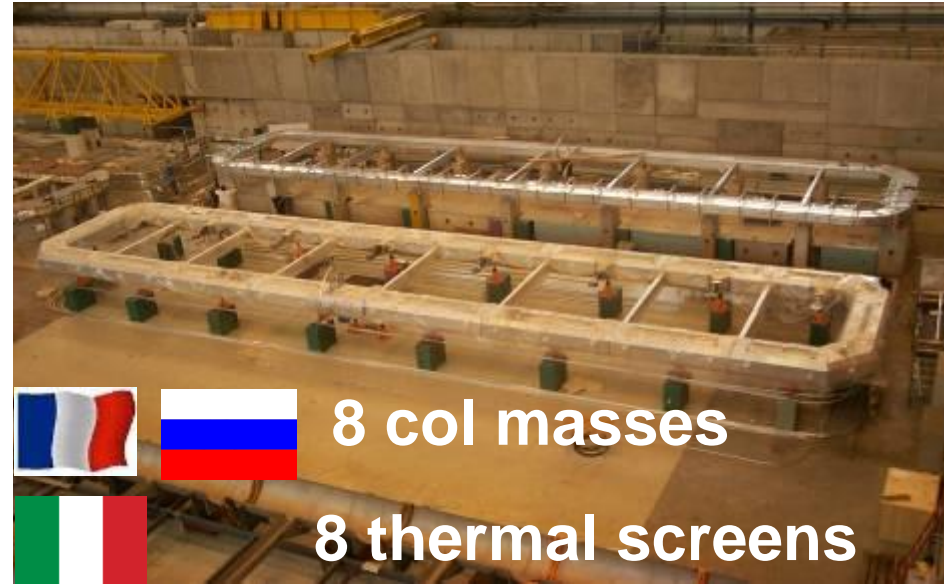


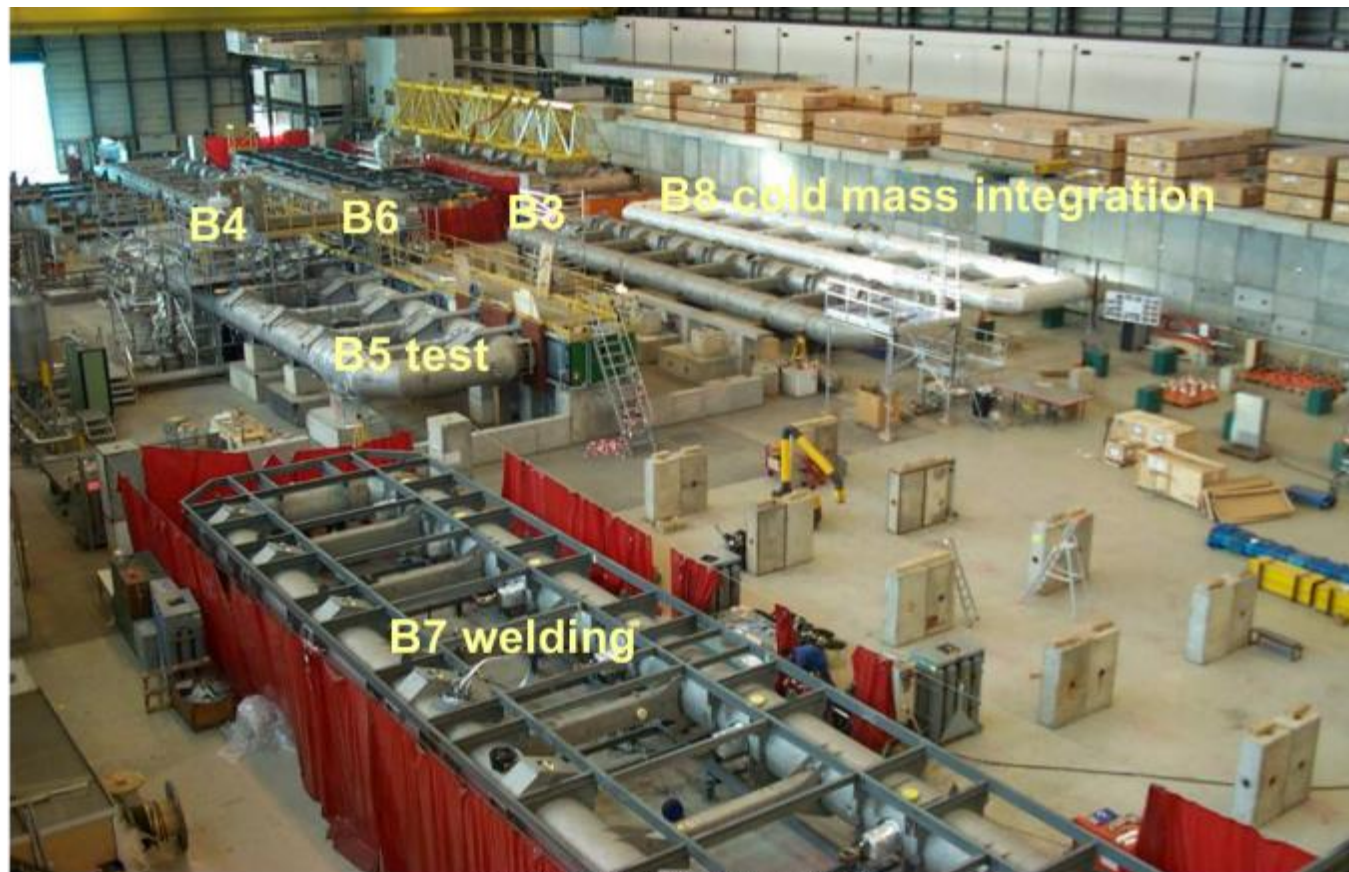
ATLAS magnet system



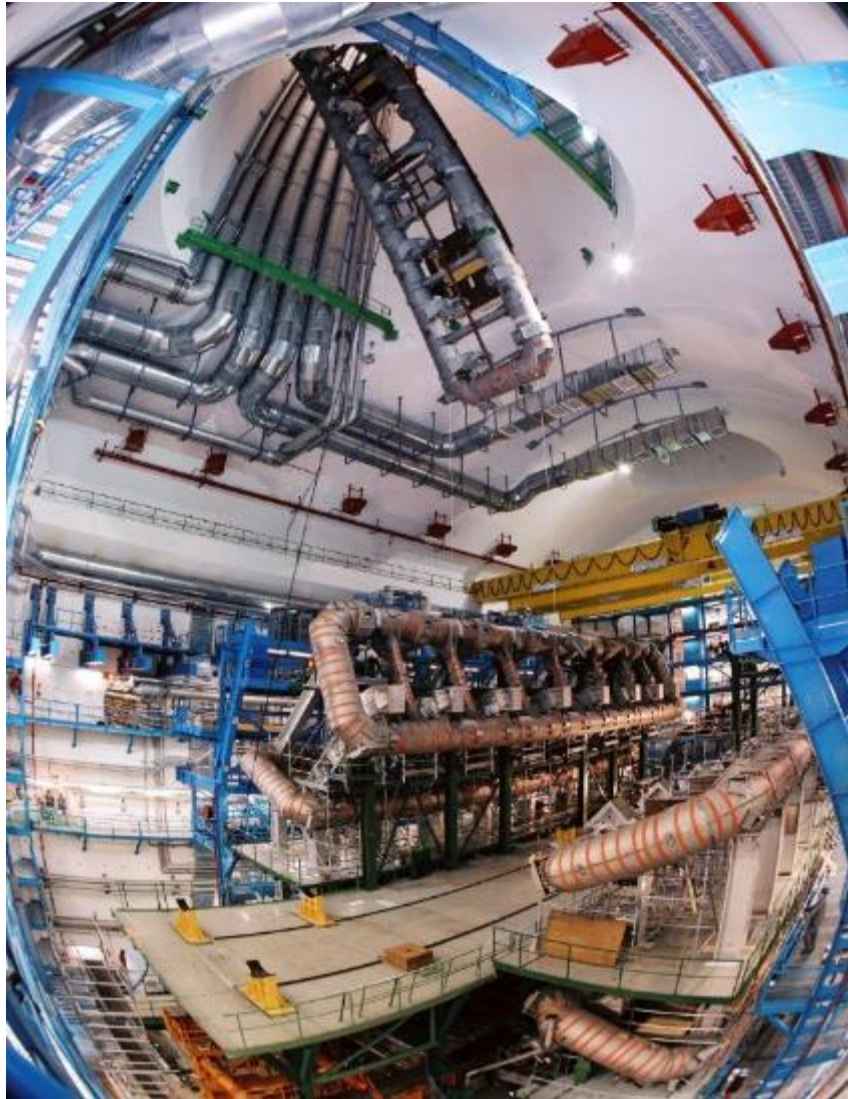
Central Solenoid
(2 T, 39 MJ)



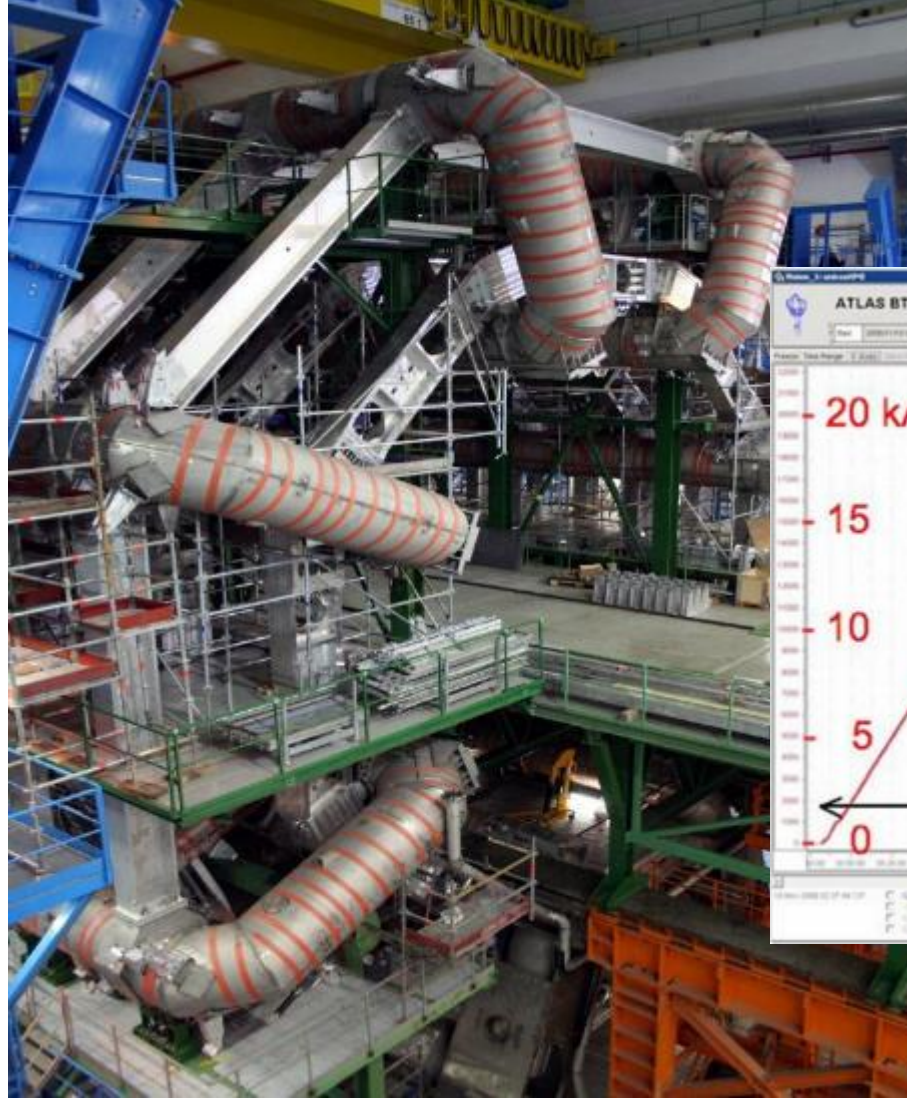




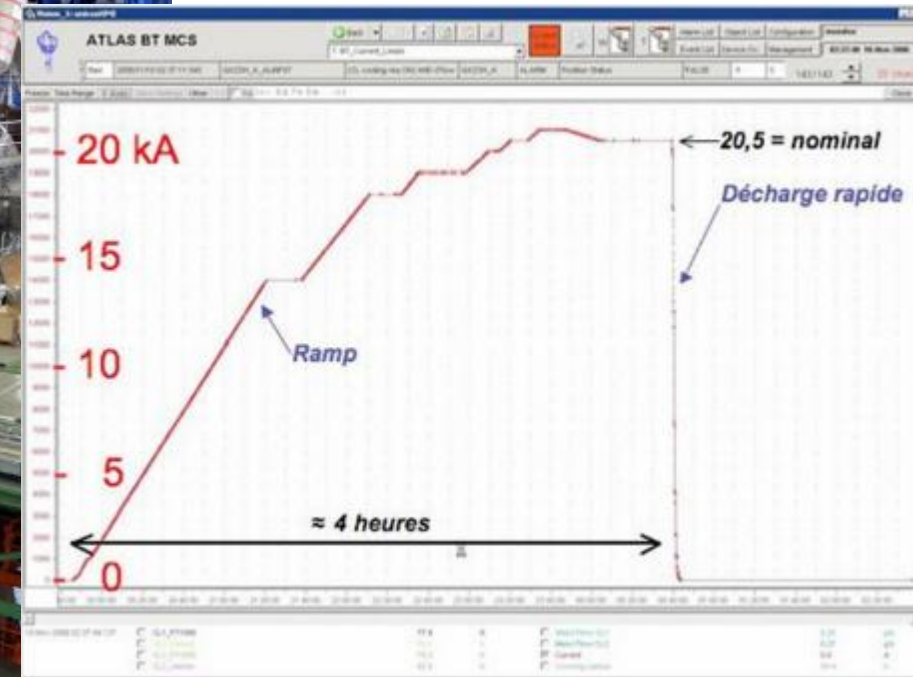
Ecole d'Été DSM - 6 juin 2007 - F. Verdine



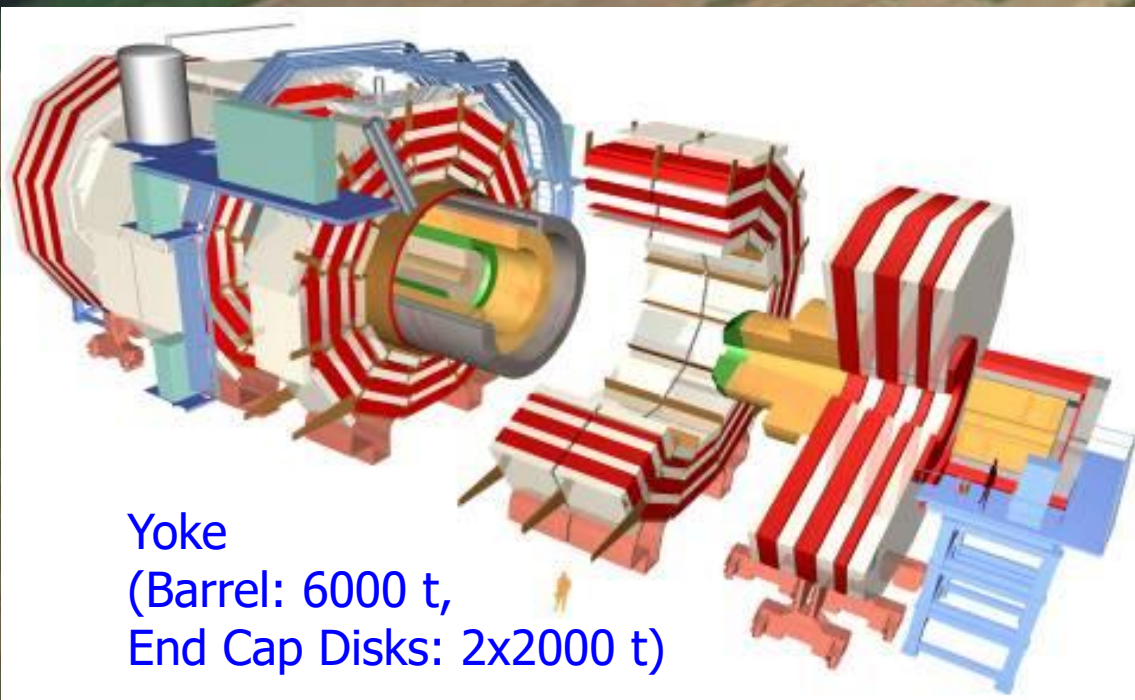
Descent of 8th Barrel Toroid coil
(4 August 2005)



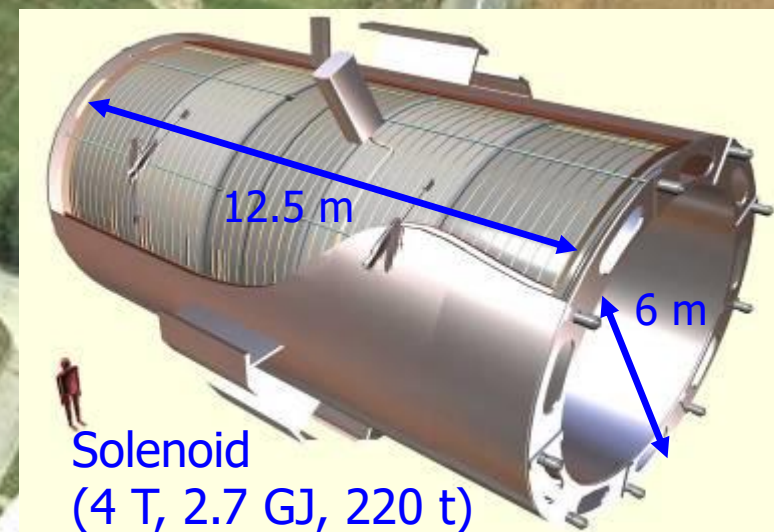
Barrel Toroid completed
(September 2005)



21 kA: 18 Oct – 10 Nov 06

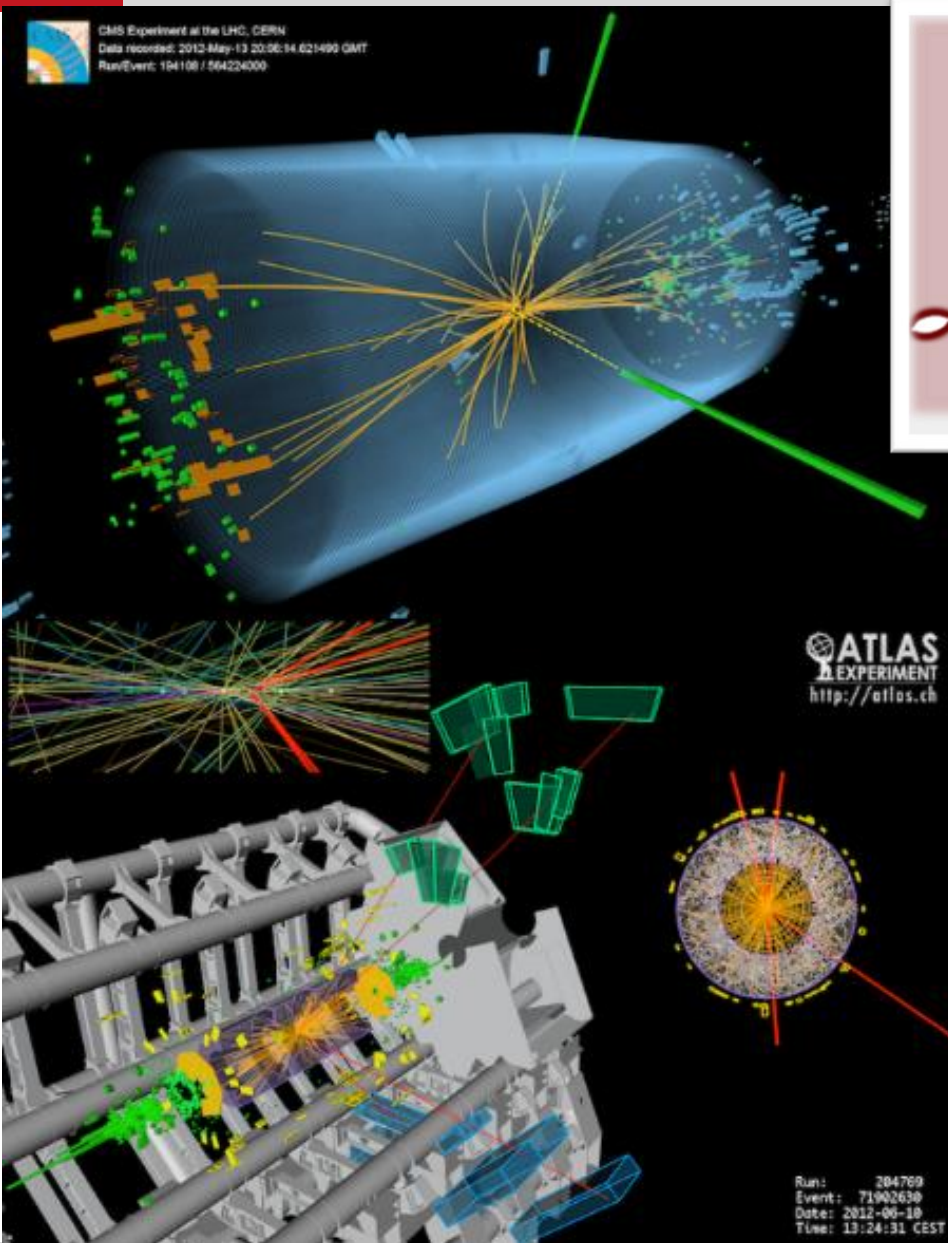


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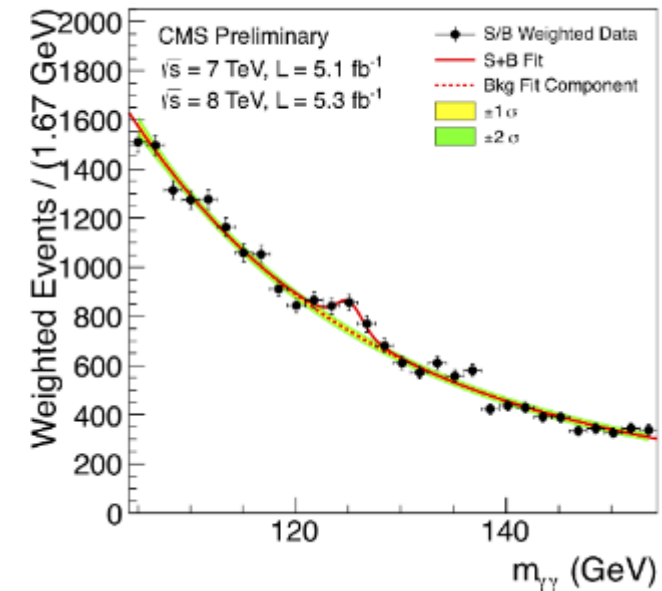








On 4 July 2012, the ATLAS and CMS experiments at CERN's Large Hadron Collider announced they had each observed a new particle in the mass region around 125 GeV.



On October 8, 2013, Peter Higgs and Francois Englert won the Nobel Prize in Physics for their work on the Higgs boson



