CERN
European laboratory for particle physics

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Source of images and text: CERN

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Angels & Demons

Organisation Européenne pour la Recherche Nucléaire

CERN

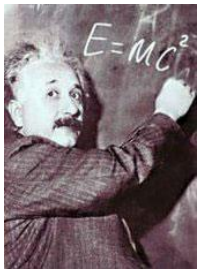
CERN openlab

60 years of science for peace

The mission of CERN

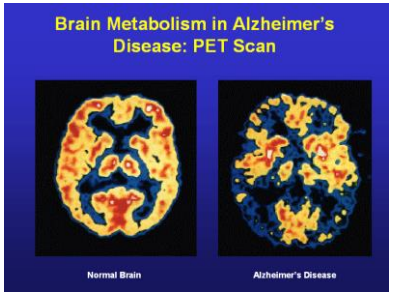
Push forward the frontiers of knowledge

The secrets of the Big Bang …what was the matter like within the first moments of the Universe's existence?

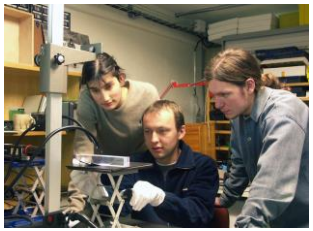


Develop new technologies for accelerators and detectors

Information technology - the Web, the GRID
Medicine - diagnosis and therapy



Train scientists and engineers of tomorrow



Unite people from different countries and cultures

Background image: Shutterstock

What is CERN?

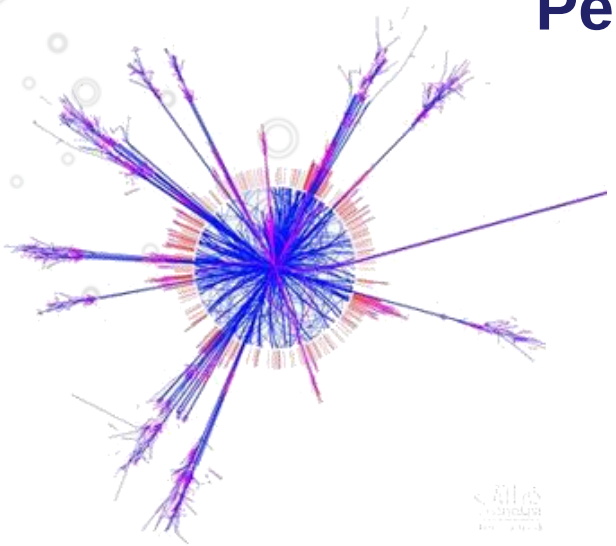
CERN in numbers

Member states

Founded by 12 European states in 1954

Today: 21 members

Poland since 1991



People involved

Staff members: 2513 (2013)

Fellows: 566

Users: 11031 (2014)

Participating institutes and universities: 645

Budget

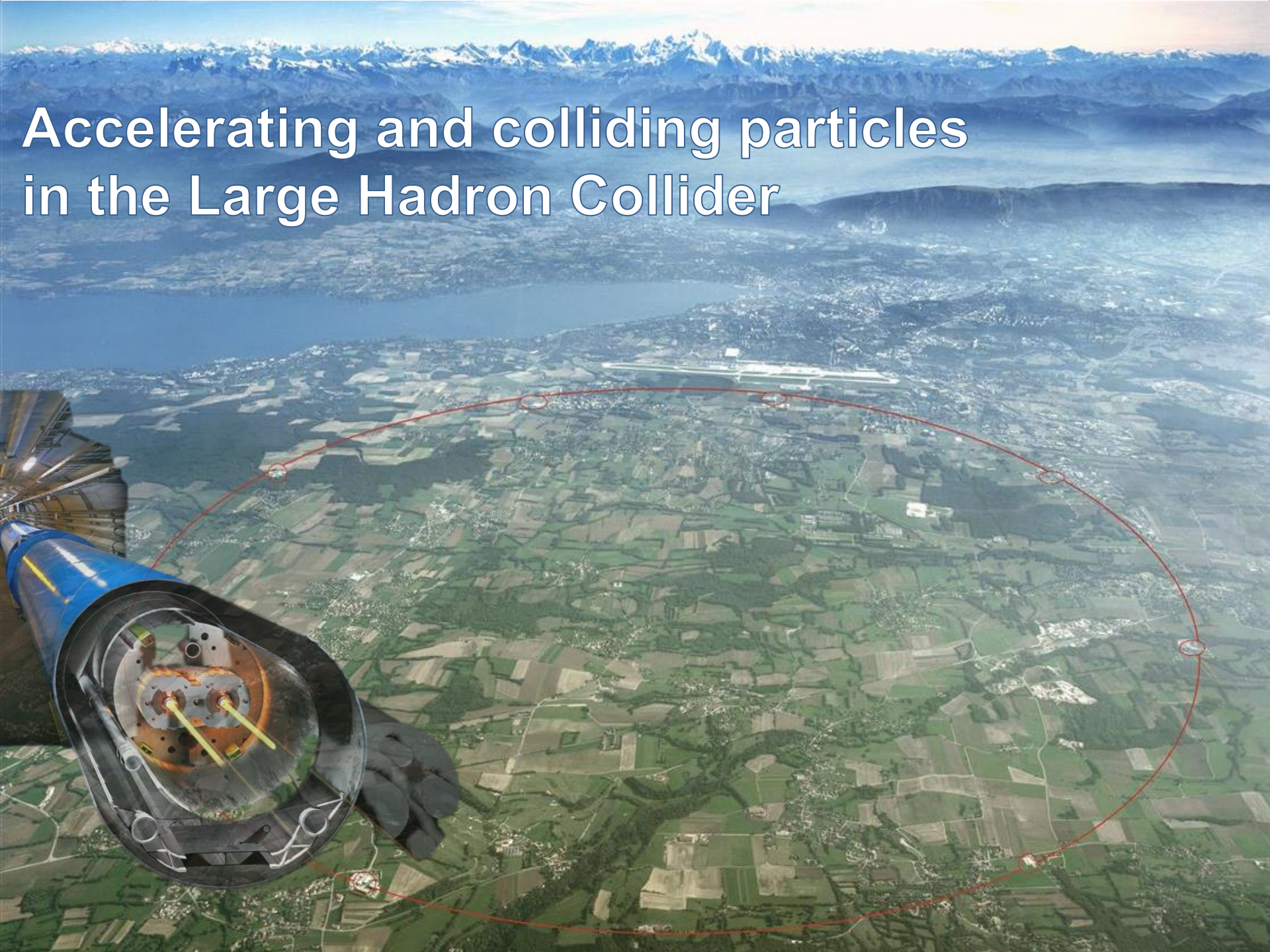
1108.5 million CHF (2014)

CERN openlab

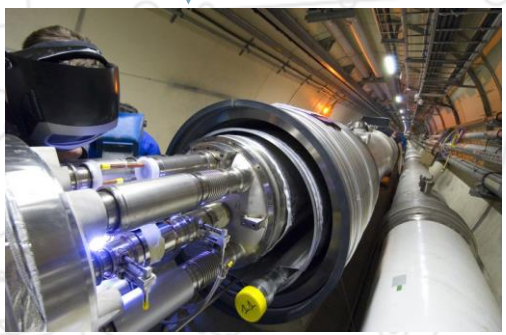
Large Hadron Collider

The LHC

Accelerating and colliding particles in the Large Hadron Collider

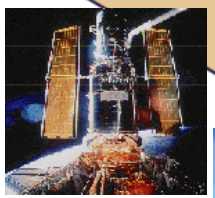


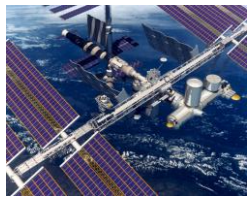
The super-microscope



LHC

Study physics laws of first moments after the big bang increasing symbiosis between particle physics, astrophysics and cosmology





Principles of operation

The LHC numbers

The tunnel's circumference is **27 km**.

Particles are accelerated to the **99.9999991%** of the speed of light.

Superconductors cooled down to **1.9 K**.

12000 A to produce magnetic field to guide the protons.

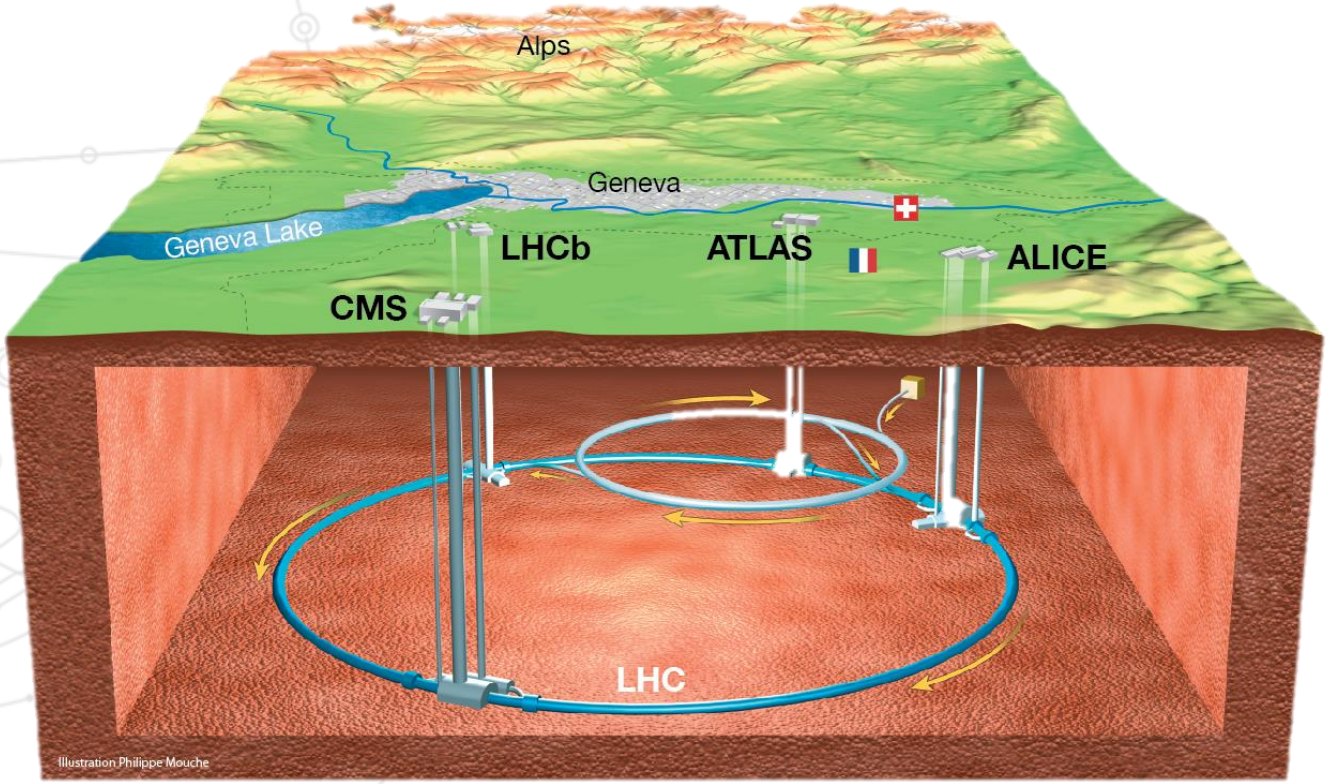
The vacuum is cleaner than the interplanetary space.

Particle bunches collide every **25 ns**.

Particle detectors

The LHC experiments

Huge “cameras” take 40 millions “pictures” of the collisions each second



The largest of the detectors

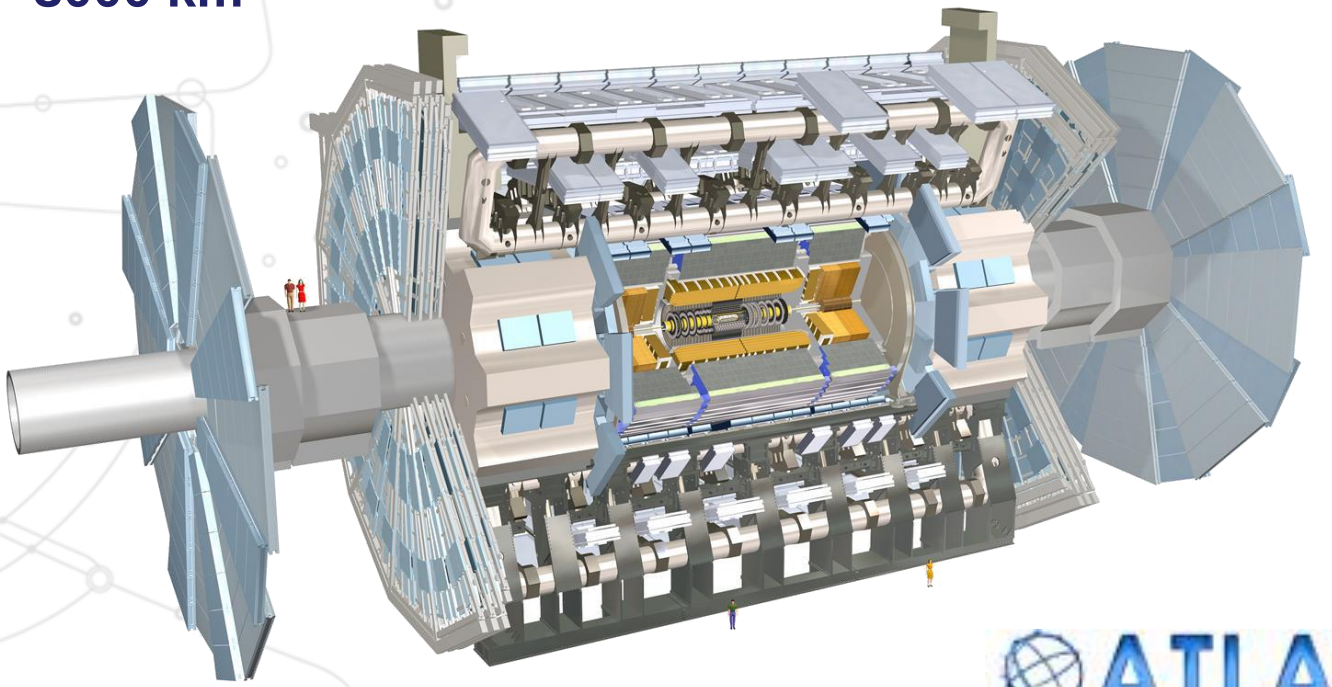
Diameter: **25 m**

Length: **46 m**

Cables: ~**3000 km**

Overall weight: **7000 tonnes**

Electronic channels: **~100 million**



ATLAS EXPERIMENT

Look for discoveries that the Standard Model cannot explain

Why the matter of the Universe is dominated by the dark matter?

Why the amounts of matter and antimatter are not equal?

New forces and unification of forces

Possible unknowns?

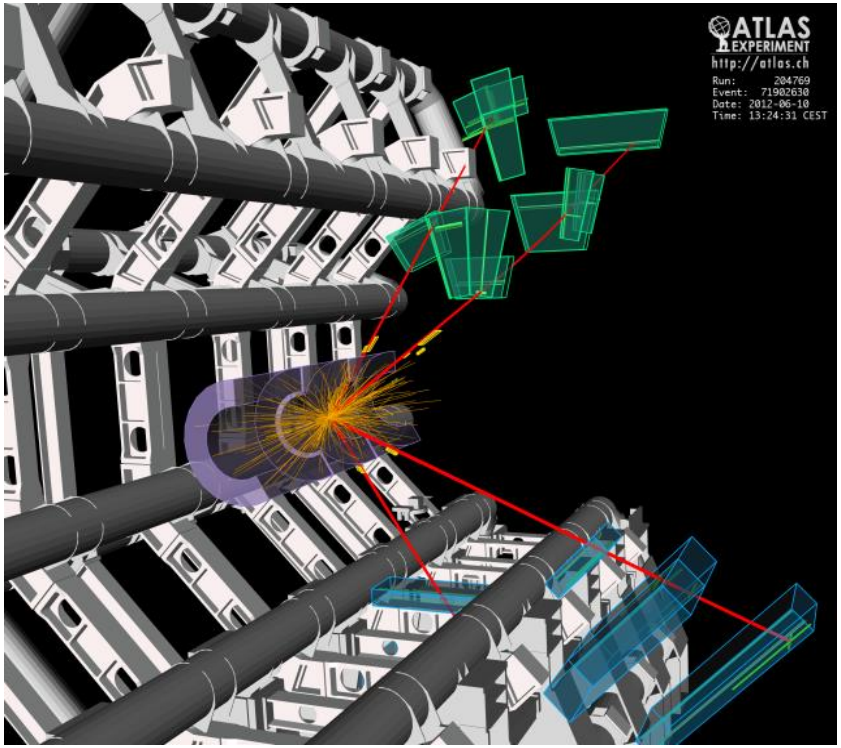
- Extra dimensions of space
- Microscopic black holes
- String theory

The Standard Model

- Discovery of the Higgs boson in 2012

Discovery of a new particle

In the Standard Model, all particles get their masses from the Higgs field.



4 July 2012

ATLAS and CMS announced they had each observed a new particle which is consistent with the Higgs boson.

8 October 2013

The Nobel prize in physics awarded jointly to F. Englert and P. Higgs for their work on the theory of the Higgs boson.

Data acquisition and processing

Big Data at CERN

Big Data at ATLAS

If all data was recorded…

100 000 CDs per second…
This stack would be 150 m high…
And would reach the moon and back twice a year

Trigger and data acquisition systems

Reduce the total amount of data

320 Mbytes per second recorded during run 1

27 CDs per minute…

Data processing

Searching for extremely rare phenomena

Online processing

Acquire the data from the detector

Select interesting events and reduce the rates

Offline processing

Event reconstruction, simulation and analysis

Worldwide LHC Computing Grid (WLCG)

Worldwide LHC Computing Grid

157 computing centers

40 countries

200 petabytes of disk storage

300 000 processing cores

25 petabytes per year

70 petabytes stored at CERN

Background image: Shutterstock

Opportunities

Education activities

Higher education

Programmes for university students and young graduates

Visits to CERN

From your classroom or by coming to CERN

Teachers

Teacher programmes and teaching resources

http://education.web.cern.ch/education/

Visit CERN

General information

Particle physics, CERN, accelerators, experiments

http://home.web.cern.ch/about

Onsite visits to CERN

Guided tours for groups

http://outreach.web.cern.ch/outreach

ATLAS Virtual Visits

Connect via video to scientists in the ATLAS control room

http://cern.ch/atlas-virtual-visit

A beamline for schools

Competition for high-school students

Winners come to CERN to run experiments

http://beamline-for-schools.web.cern.ch/

ICE-DIP 2013-2017:
The Intel-CERN European Doctorate Industrial Program

A public-private partnership to research solutions for next generation data acquisition networks, offering research training to five Early Stage Researchers in ICT

Research topics:

- Silicon photonics systems
- Next generation data acquisition networks
- High speed configurable logic
- Computing solutions for high performance data filtering

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Questions?