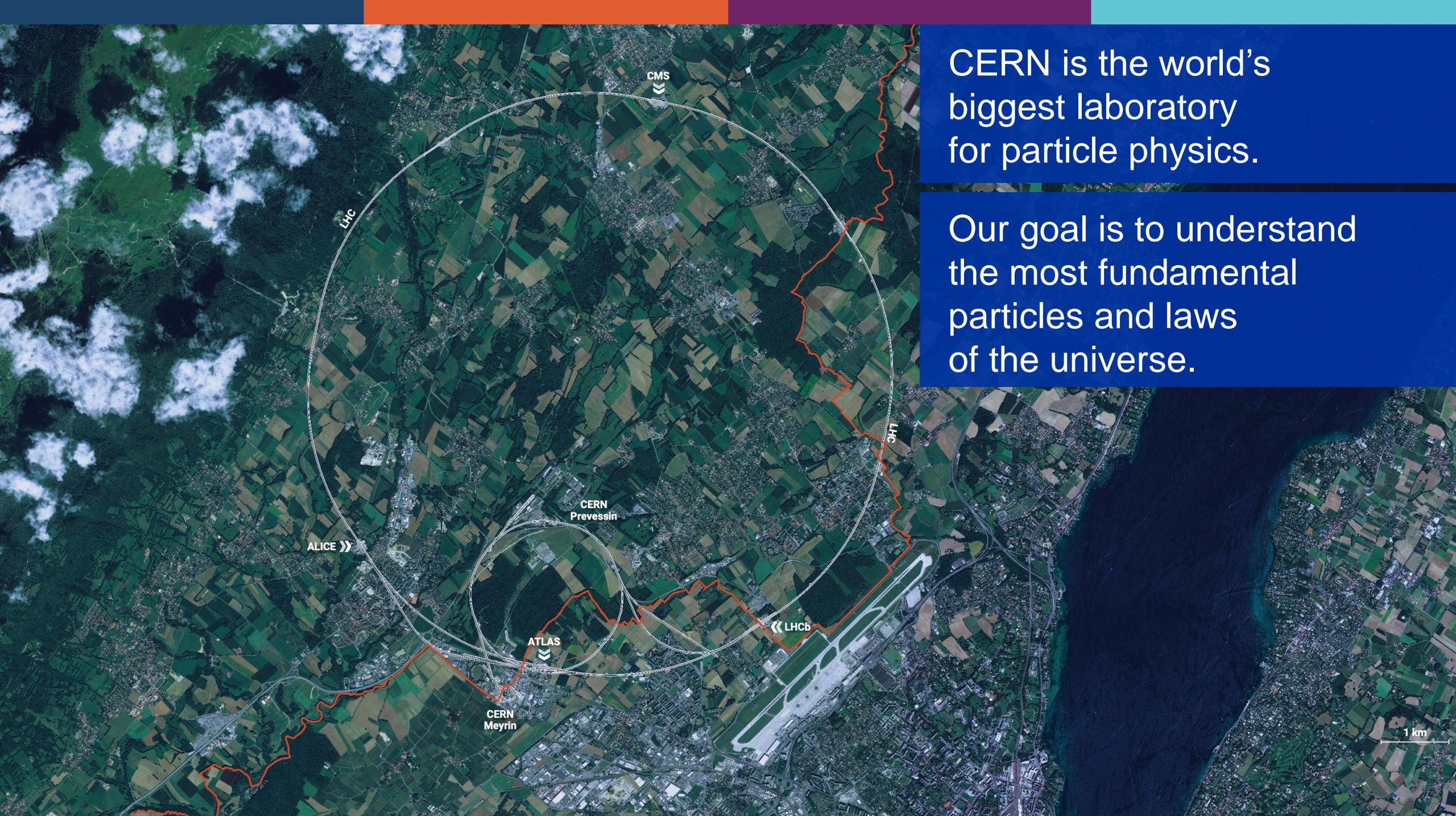




WELCOME TO CERN

Belgium @ CERN 2022

Belgian Industry days
09 & 10 May 2022



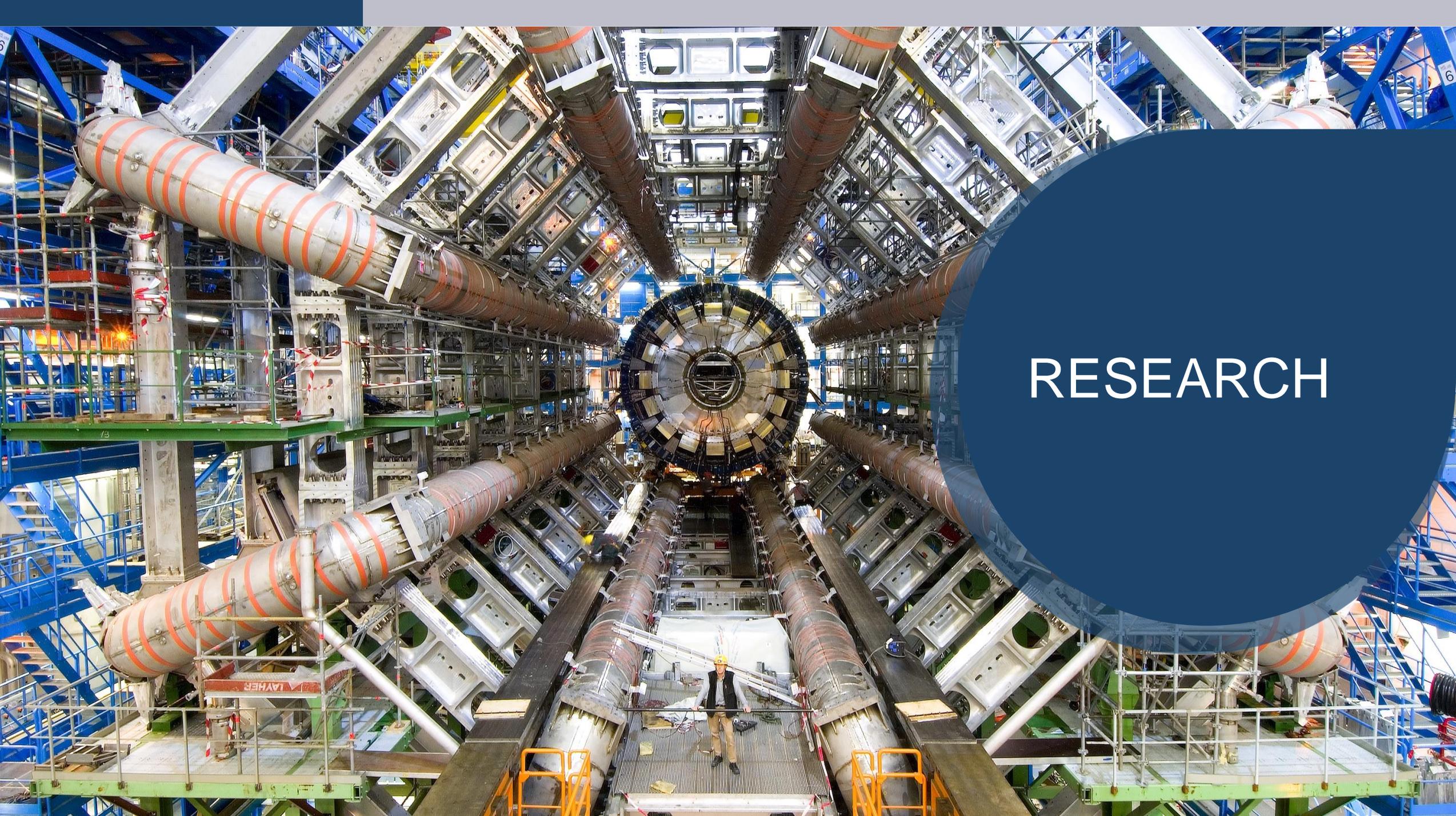
CERN is the world's biggest laboratory for particle physics.

Our goal is to understand the most fundamental particles and laws of the universe.

1 km

Four pillars underpin CERN's mission

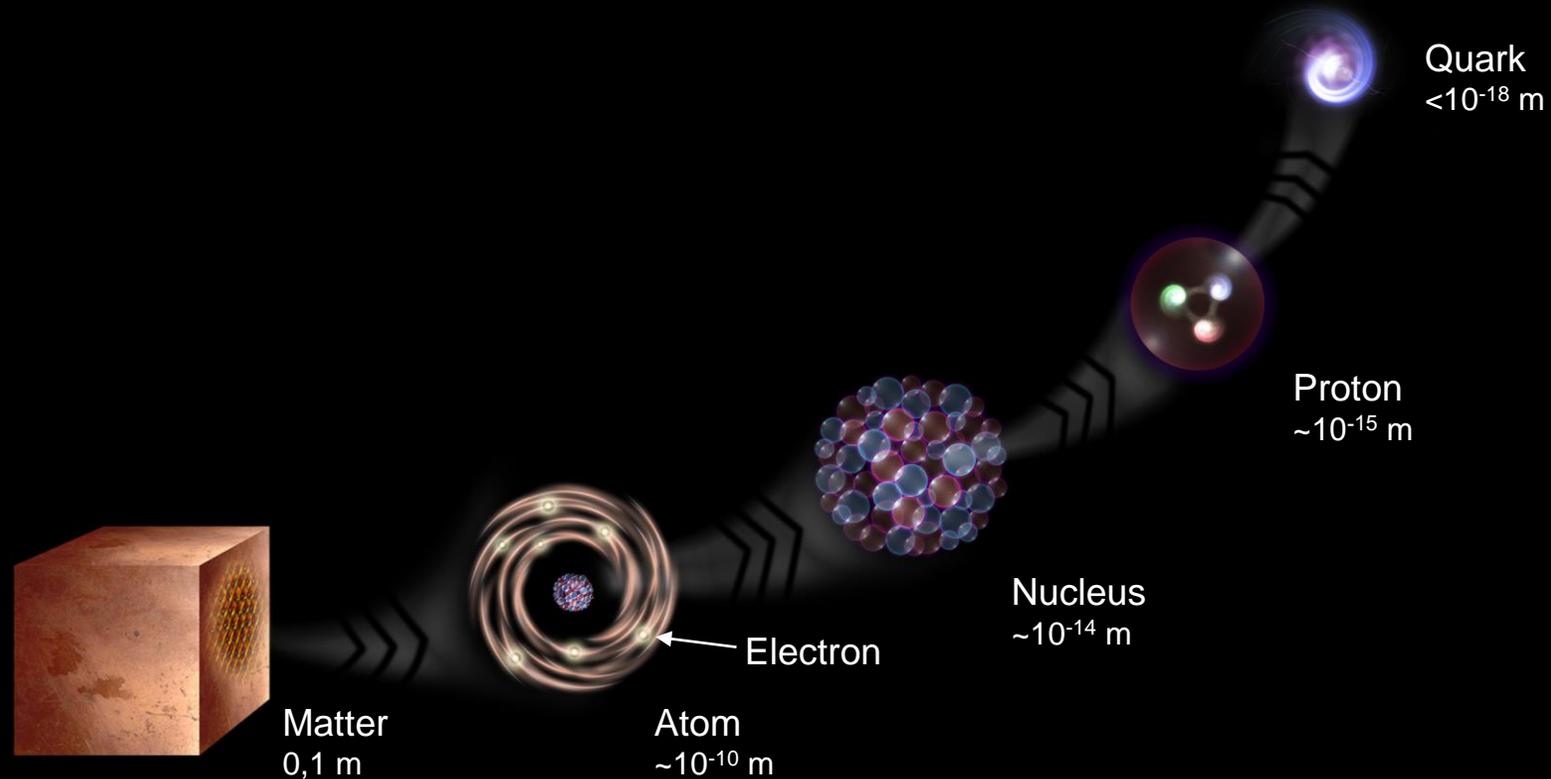


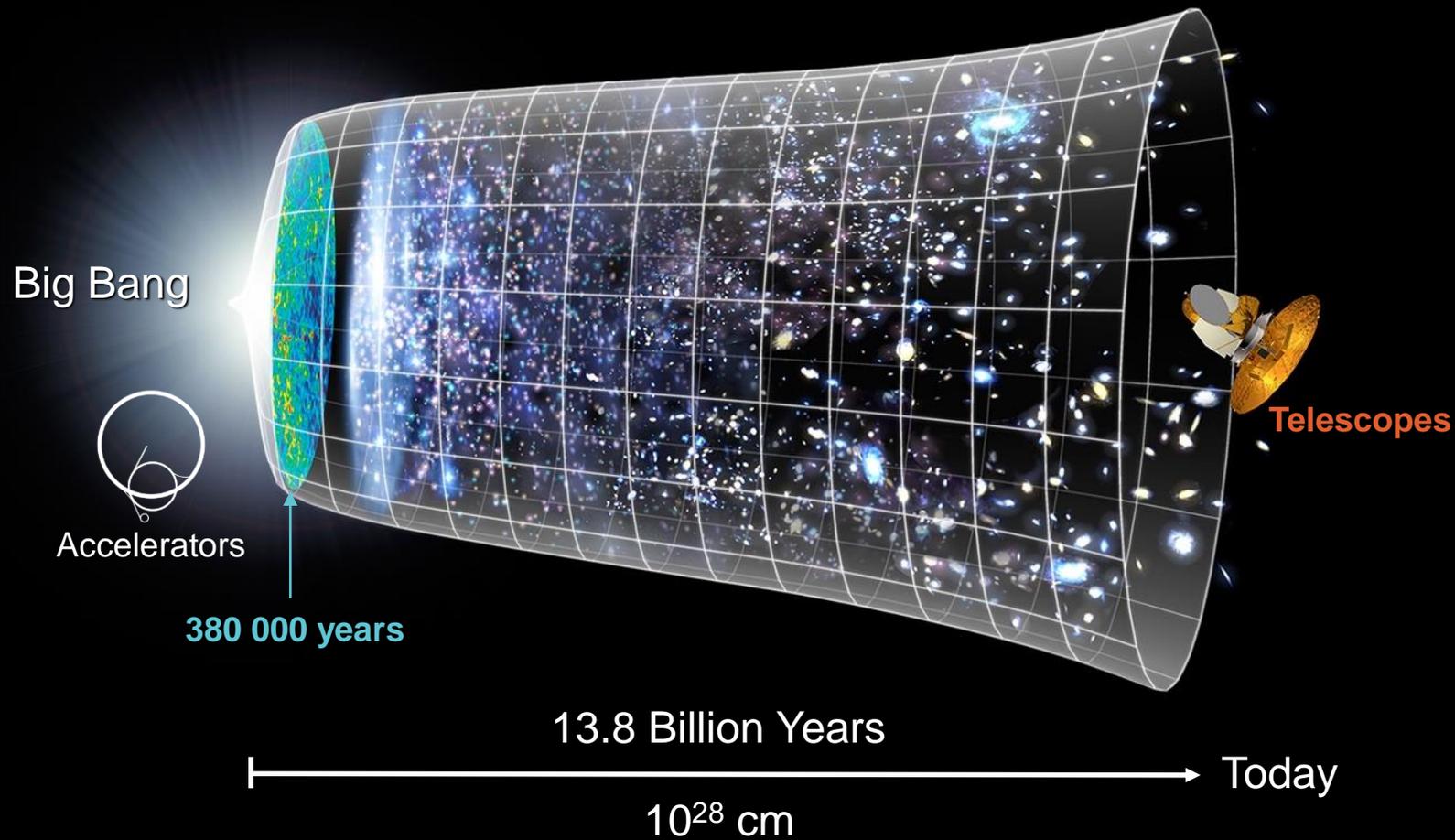


RESEARCH

What is the universe made of?

We study the elementary building blocks of matter and the forces that control their behaviour





How did the universe begin?

We reproduce the conditions a fraction of a second after the Big Bang, to gain insight into the structure and evolution of the universe.

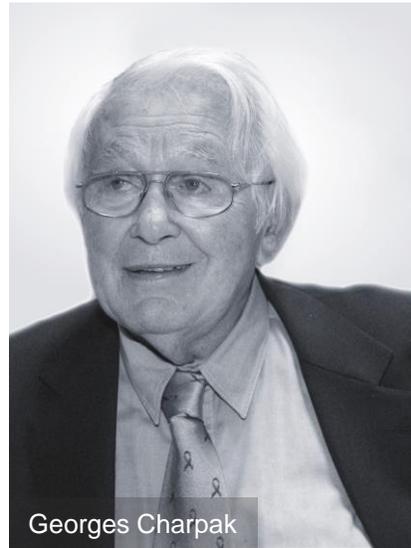
At CERN we help to answer these questions



Carlo Rubbia



Simon Van der Meer



Georges Charpak

Several CERN scientists have received Nobel Prizes for key discoveries in particle physics.

The Higgs boson was discovered in 2012; without it fundamental particles would be massless and atoms could not form.



François Englert and Peter Higgs. With Robert Brout, they proposed the mechanism in 1964.

How do we do it?

We develop technologies in three key areas

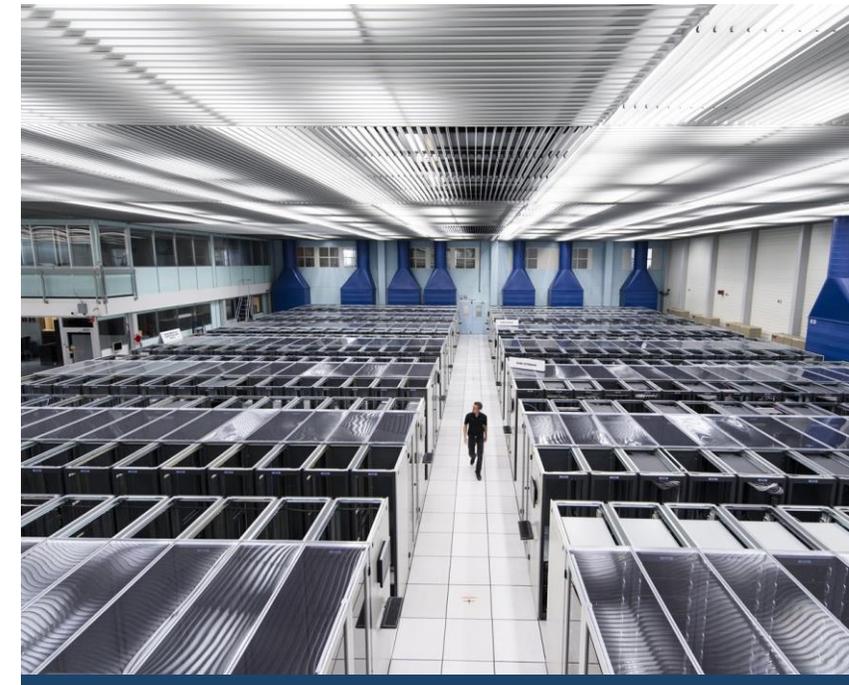
- We build the largest machines to study the smallest particles in the universe
- We develop technology to advance the limits of what is possible



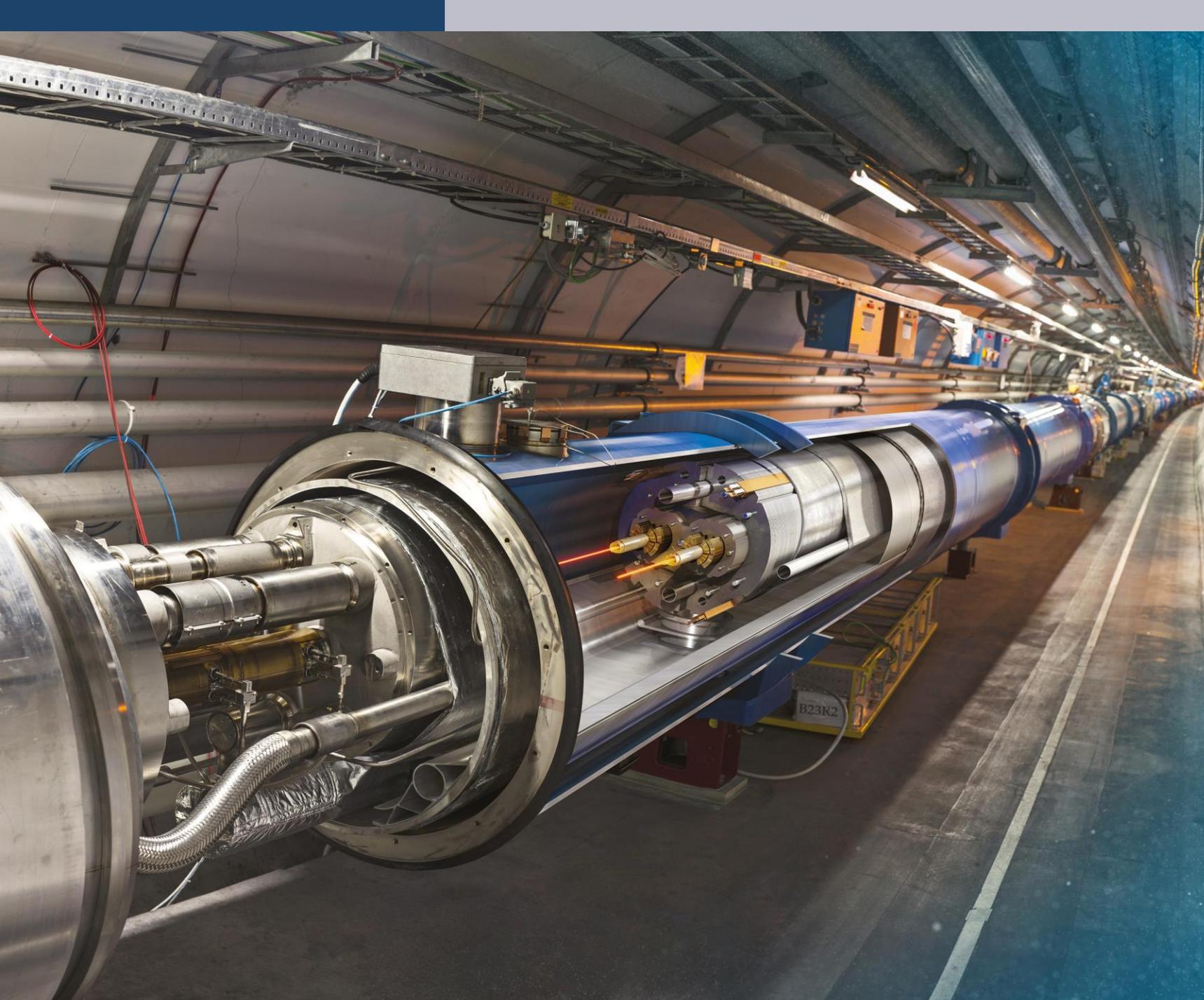
ACCELERATORS



DETECTORS



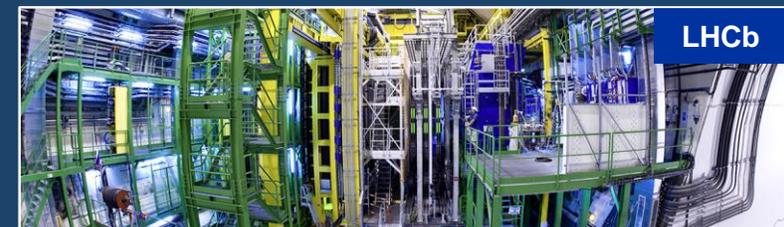
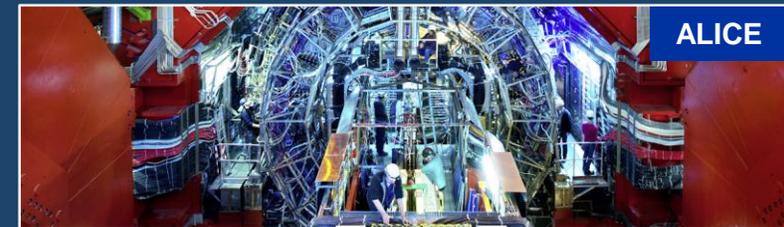
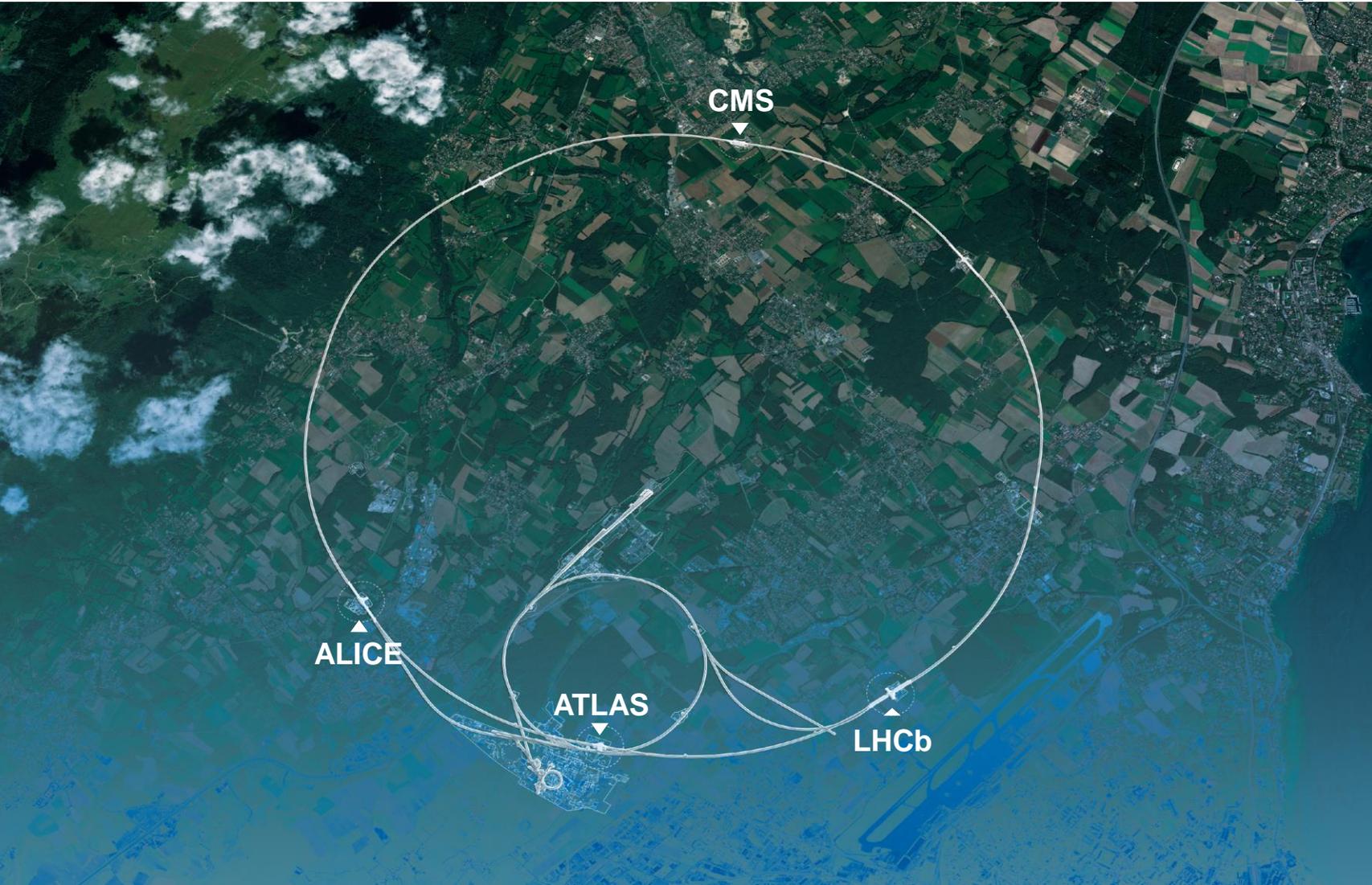
COMPUTING



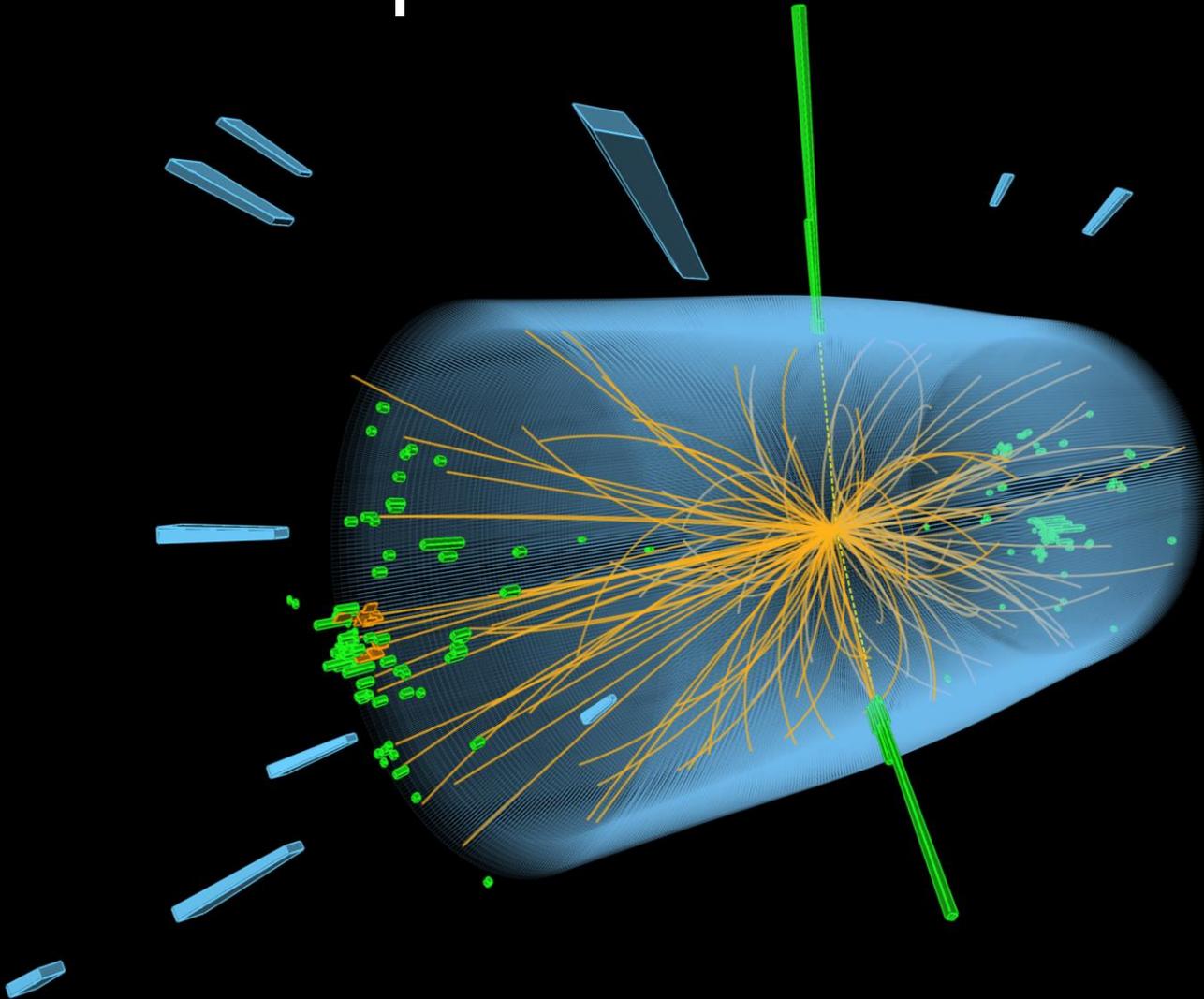
Large Hadron Collider (LHC)

- 27 km in circumference
- About 100 m underground
- Superconducting magnets steer the particles around the ring
- Particles are accelerated to close to the speed of light

Giant detectors record the particles formed at the four collision points

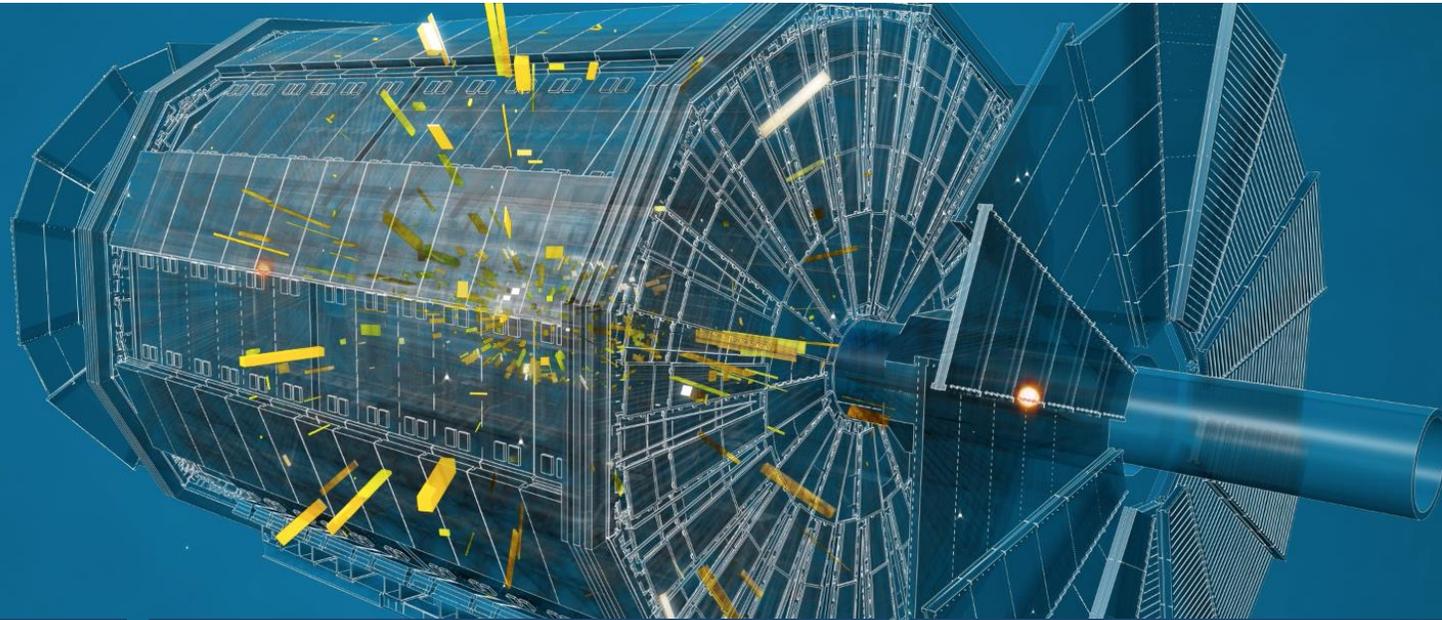


The LHC produces more than 1 billion particle collisions per second



The energy of the particles in collision is converted into new particles.

The LHC detectors are analogous to 3D cameras



The detectors measure the energy, direction and charge of new particles formed.



They take 40 million pictures a second. Only 1000 are recorded and stored.



The LHC detectors have been built by international collaborations covering all regions of the Globe.

The Worldwide LHC Computing Grid (WLCG)



Used to store, distribute, process and analyse data.

1 million processing cores in about 160 data centres and 42 countries.

More than 1000 Petabytes of CERN data stored world-wide.

CERN has a diverse scientific programme

Theoretical Particle Physics

Nuclear Physics
(ISOLDE)

Antimatter Research
(Antiproton Decelerator)



Cosmic rays and cloud formation
(CLOUD)

Fixed-target experiments, which
include searches for rare
phenomena

Contribution to the Long Baseline
Neutrino Facility in the USA
(LBNF)

There are many unanswered questions in fundamental physics

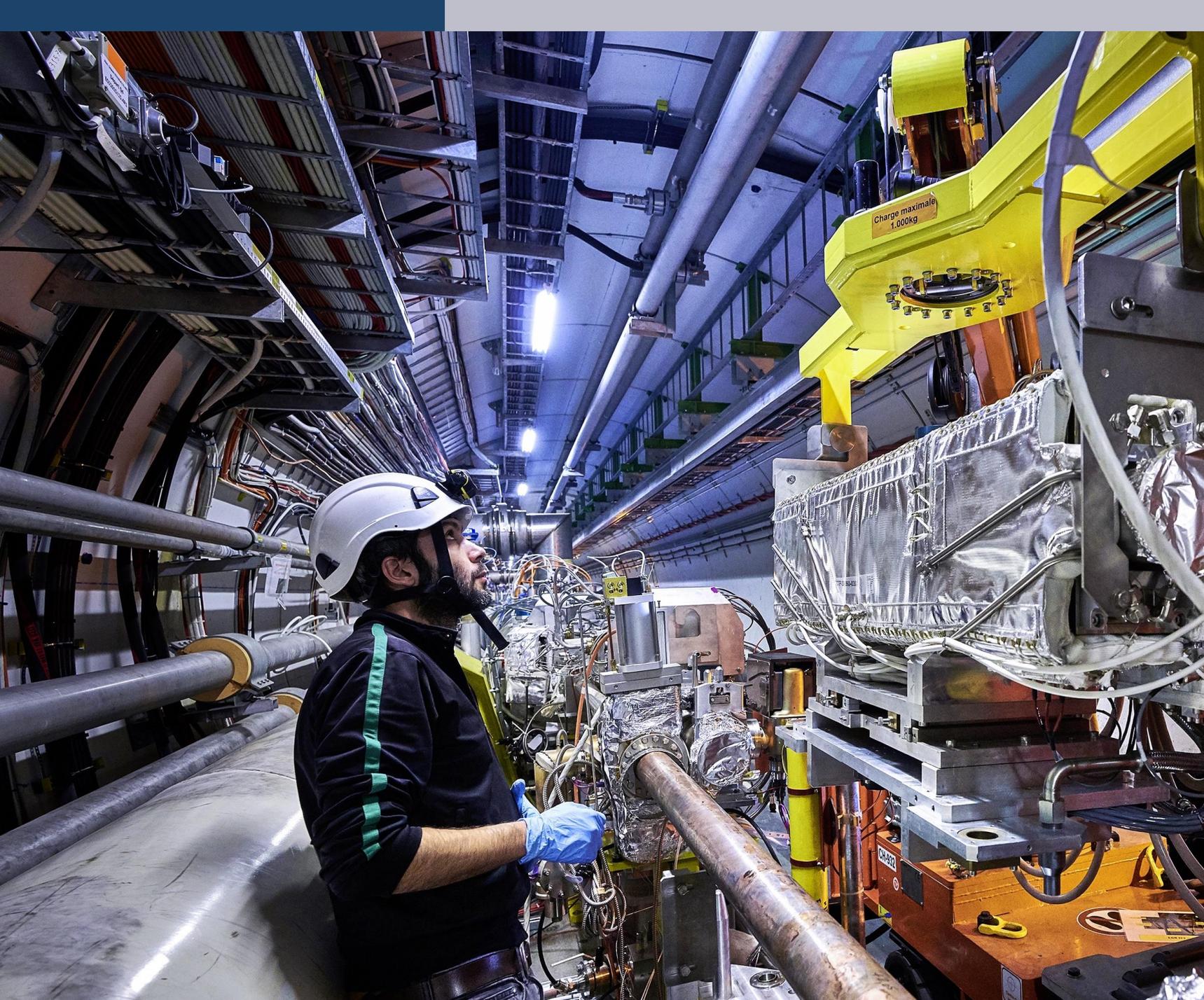
Including

95% of the mass and energy of the universe is unknown.

Is there only one Higgs boson, and does it behave exactly as expected?

Why is the universe made only of matter, with hardly any antimatter?

Why is gravity so weak compared to the other forces?



Upgrade to the High-Luminosity LHC is under way

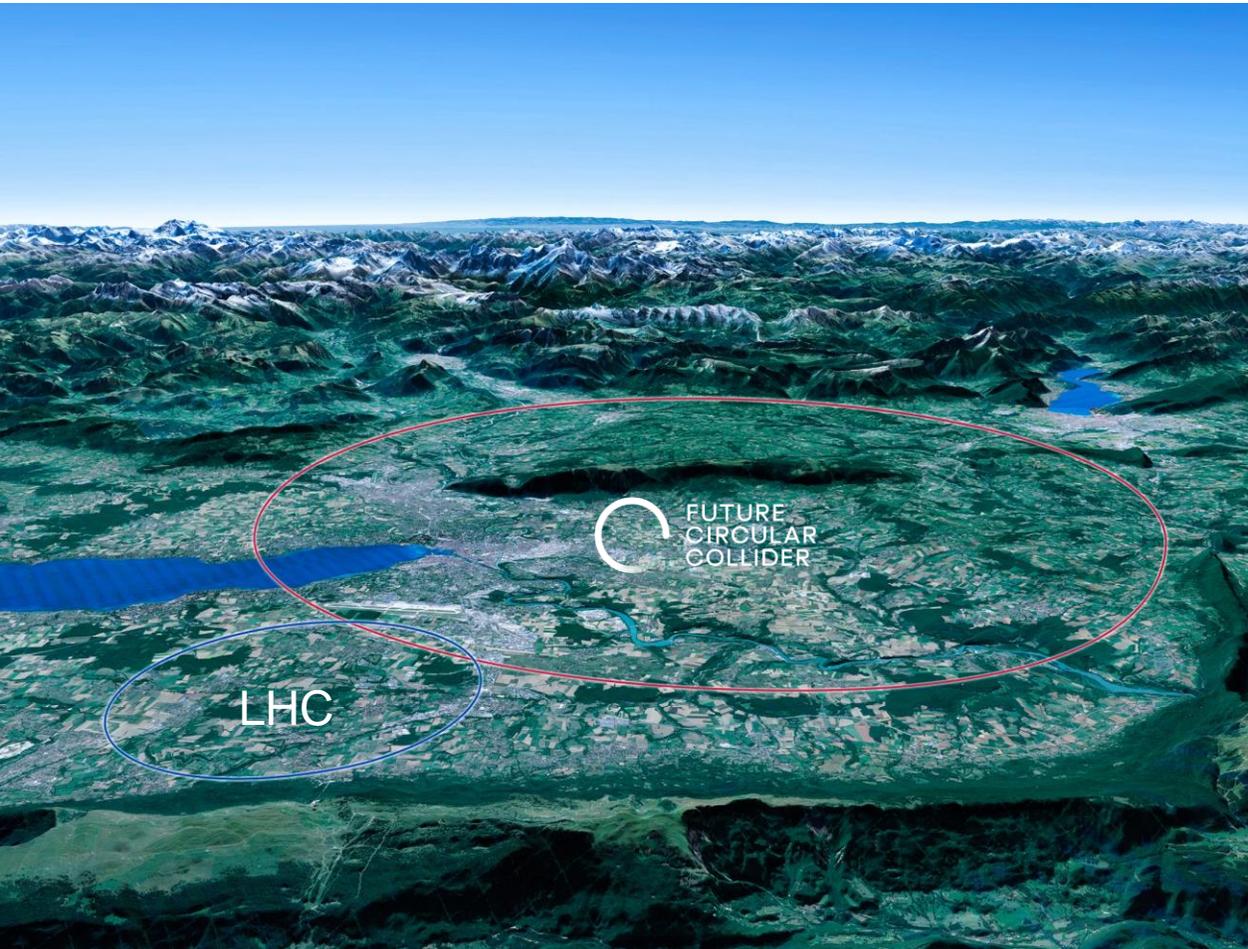
- The HL-LHC will use new technologies to provide 10 times more collisions than the LHC.
- It will give access to rare phenomena, greater precision and discovery potential.
- It will start operating in 2027, and run until 2040.



Scientific priorities for the future

Implementation of the recommendations
of the **2020 Update of the European Strategy
for Particle Physics:**

- Fully exploit the HL-LHC
- Build a Higgs factory to further understand this unique particle
- Investigate the technical and financial feasibility of a future energy-frontier 100 km collider at CERN
- Ramp up relevant R&D
- Continue supporting other projects around the world



COLLABORATION



Science for peace

CERN was founded in 1954 with 12 European Member States



23 Member States

Austria – **Belgium** – Bulgaria – Czech Republic
Denmark – Finland – France – Germany – Greece
Hungary – Israel – Italy – Netherlands – Norway
Poland – Portugal – Romania – Serbia – Slovakia
Spain – Sweden – Switzerland – United Kingdom

3 Associate Member States in the pre-stage to membership

Cyprus – Estonia – Slovenia

7 Associate Member States

Croatia – India – Latvia – Lithuania – Pakistan
Turkey – Ukraine

6 Observers

Japan – Russia (suspended) – USA
European Union – JINR – UNESCO

More than 50 Cooperation Agreements with non-Member States and Territories

Albania – Algeria – Argentina – Armenia – Australia – Azerbaijan – Bangladesh – Belarus – Bolivia
Bosnia and Herzegovina – Brazil – Canada – Chile – Colombia – Costa Rica – Ecuador – Egypt – Georgia – Honduras
Iceland – Iran – Jordan – Kazakhstan – Lebanon – Malta – Mexico – Mongolia – Montenegro – Morocco – Nepal
New Zealand – North Macedonia – Palestine – Paraguay – People's Republic of China – Peru – Philippines – Qatar
Republic of Korea – Saudi Arabia – Sri Lanka – South Africa – Thailand – Tunisia – United Arab Emirates – Vietnam

CERN's annual budget
is 1200 MCHF (equivalent
to a medium-sized European
university)

As of 31 December 2021
Employees:
2676 staff, **783** fellows

Associates:
11 175 users, **1556** others

A laboratory for people around the world

Distribution of all CERN Users by the country of their home institutes as of 31 December 2021



Geographical & cultural diversity
Users of **110 nationalities**
19.4% women

Member States **6642**

Austria 74 – Belgium 122 – Bulgaria 39 – Czech Republic 227
Denmark 42 – Finland 71 – France 811 – Germany 1129
Greece 133 – Hungary 69 – Israel 67 – Italy 1423
Netherlands 157 – Norway 69 – Poland 278 – Portugal 89
Romania 105 – Serbia 36 – Slovakia 66 – Spain 328
Sweden 88 – Switzerland 372 – United Kingdom 847

Associate Member States **55** in the pre-stage to membership

Cyprus 10 – Estonia 24 – Slovenia 21

Associate Member States **367**

Croatia 36 – India 130 – Latvia 11 – Lithuania 12 – Pakistan 30
Turkey 122 – Ukraine 26

Observers **2918**

Japan 189 – Russia (suspended) 971 – United States of America 1758



Numbers for BELGIUM



- Personnel by nationality as of 1 May 2022
 - **96 users**
 - **100 staff**
 - **10 fellows**

Non-Member States and Territories **1193**

Algeria 3 – Argentina 16 – Armenia 10 – Australia 20 – Azerbaijan 3 – Bahrain 2 – Belarus 24 – Brazil 106
Canada 189 – Chile 23 – Colombia 18 – Cuba 3 – Ecuador 6 – Egypt 16 – Georgia 36 – Hong Kong 17
Iceland 3 – Indonesia 6 – Iran 11 – Ireland 6 – Jordan 5 – Kuwait 5 – Lebanon 15 – Madagascar 1
Malaysia 4 – Malta 2 – Mexico 48 – Montenegro 5 – Morocco 18 – New Zealand 8 – Oman 1
People's Republic of China 314 – Peru 2 – Philippines 1 – Republic of Korea 113 – Singapore 3
South Africa 52 – Sri Lanka 10 – Taiwan 45 – Thailand 18 – United Arab Emirates 6

CERN is a model for open and inclusive collaboration



The LHC experiments are models of consensus building, competition and cooperation.

SESAME, a synchrotron light source in Jordan, is modelled on CERN's governance structure.



CERN provides the IT infrastructure for the satellite-analysis technology used for emergency response.



TECHNOLOGY & INNOVATION

CERN's technological innovations have applications in many fields

CERN is the birthplace of the World Wide Web

And there are many more examples

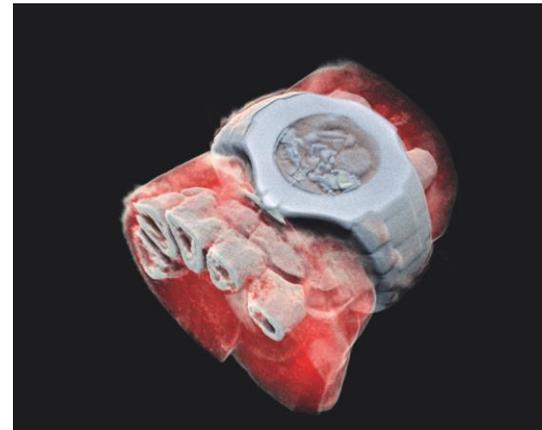
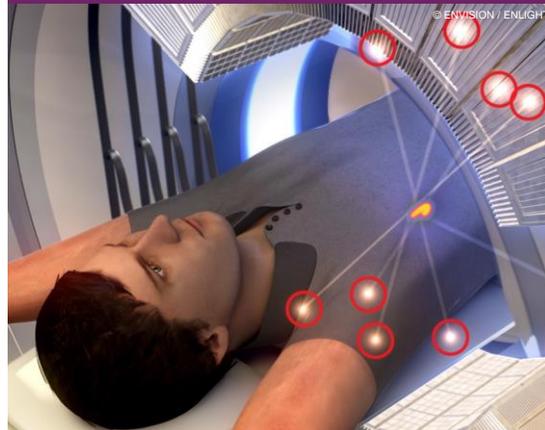
Medical imaging, cancer therapy, material science, cultural heritage, aerospace, automotive, environment, health & safety, industrial processes.

CERN's technological innovations have important applications in medicine and healthcare



Accelerator technologies are applied in cancer radiotherapy with protons, ions and electrons.

Technologies applied at CERN are also used in PET, for medical imaging and diagnostics.



Pixel detector technologies are used for high resolution 3D colour X-ray imaging.

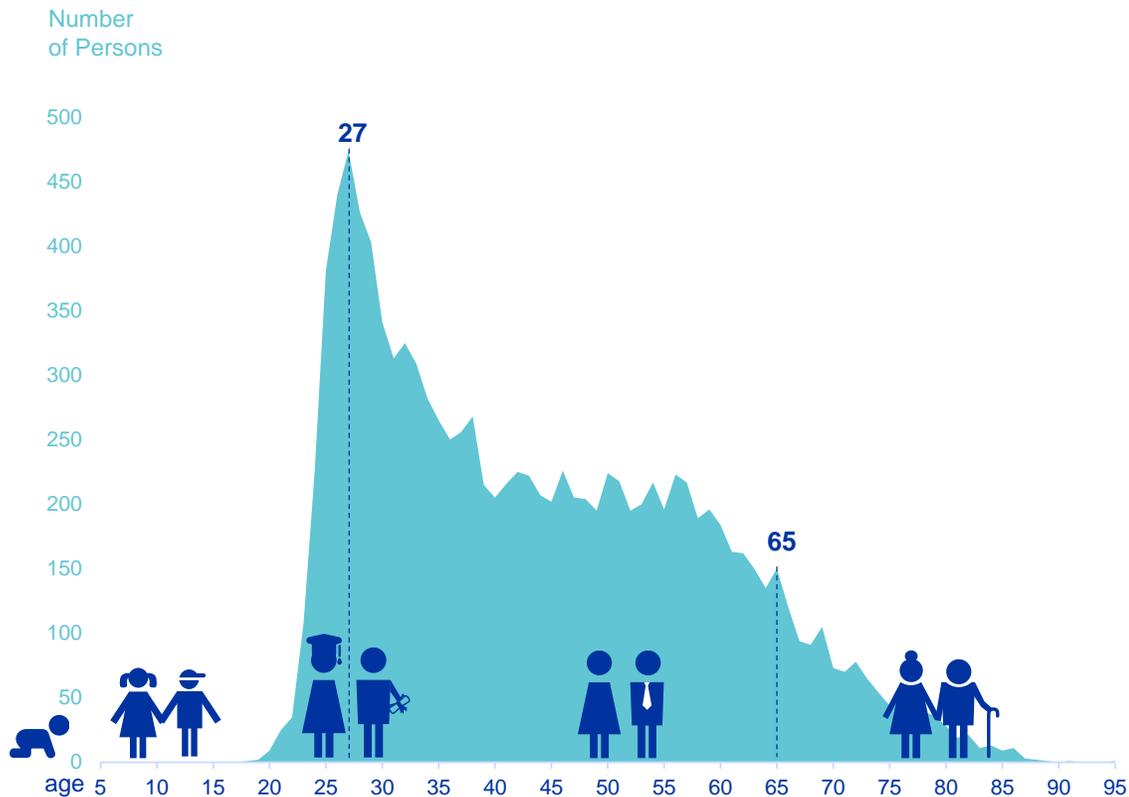
CERN produces innovative radioisotopes for nuclear medicine research.



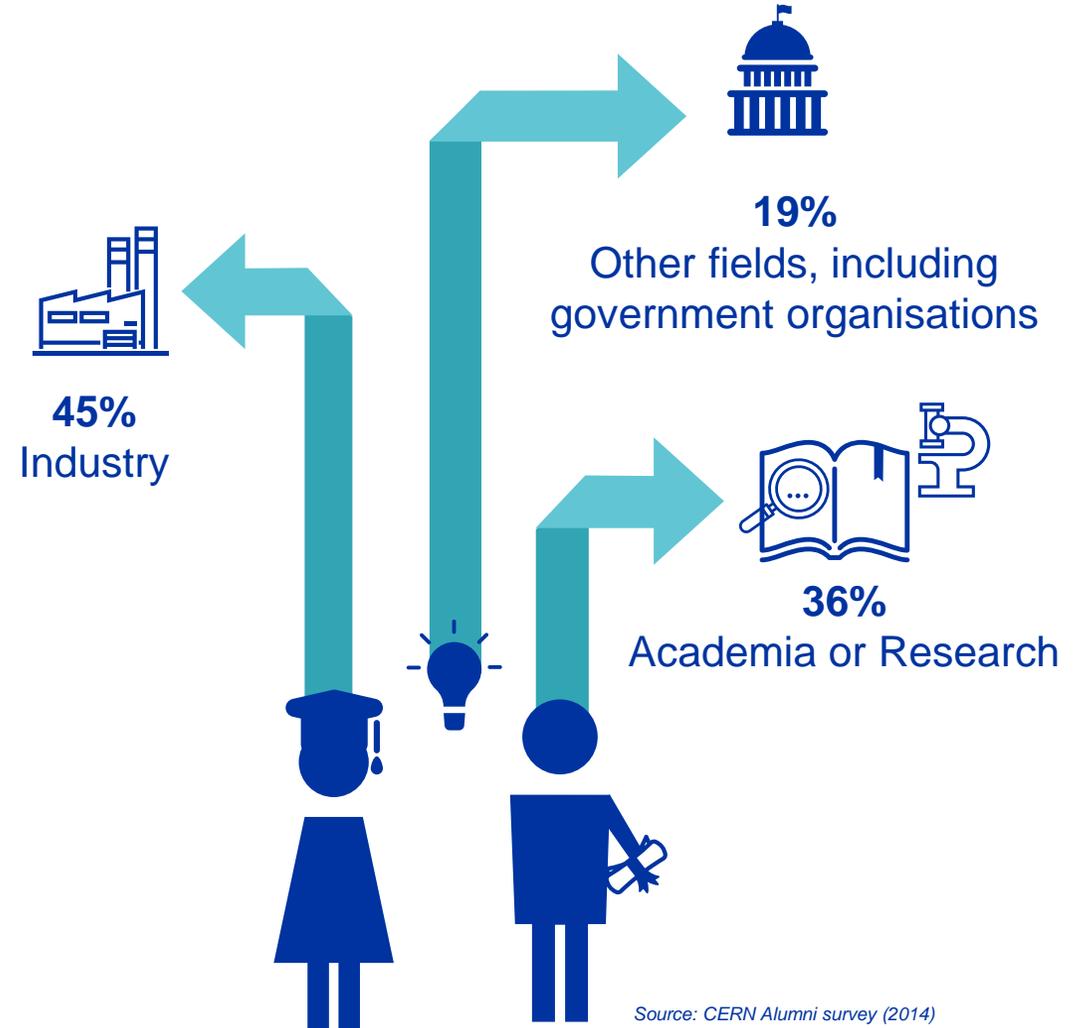
A group of students, both male and female, are wearing hard hats (yellow and blue) and are focused on a large, dark, cylindrical piece of equipment mounted on a metal frame. They appear to be in a laboratory or workshop setting. One student in the foreground is adjusting the equipment. In the background, there are other students and a green exit sign with a white arrow pointing down. A teal circular graphic is overlaid on the left side of the image, containing the text 'EDUCATION & TRAINING'.

EDUCATION & TRAINING

CERN opens a world of career opportunities



Age Distribution of Scientists working at CERN



PhD and Technical students leaving CERN

CERN's training, education and outreach programmes

300 Undergraduate students in Summer programmes
>3000 registered PhD students.

>1000 Fellows, Technical and Doctoral Students in research and applied physics, engineering and computing.

13 304 teachers since 1998 and 2000 participants in the webinar since 2020.



Numbers for BELGIUM



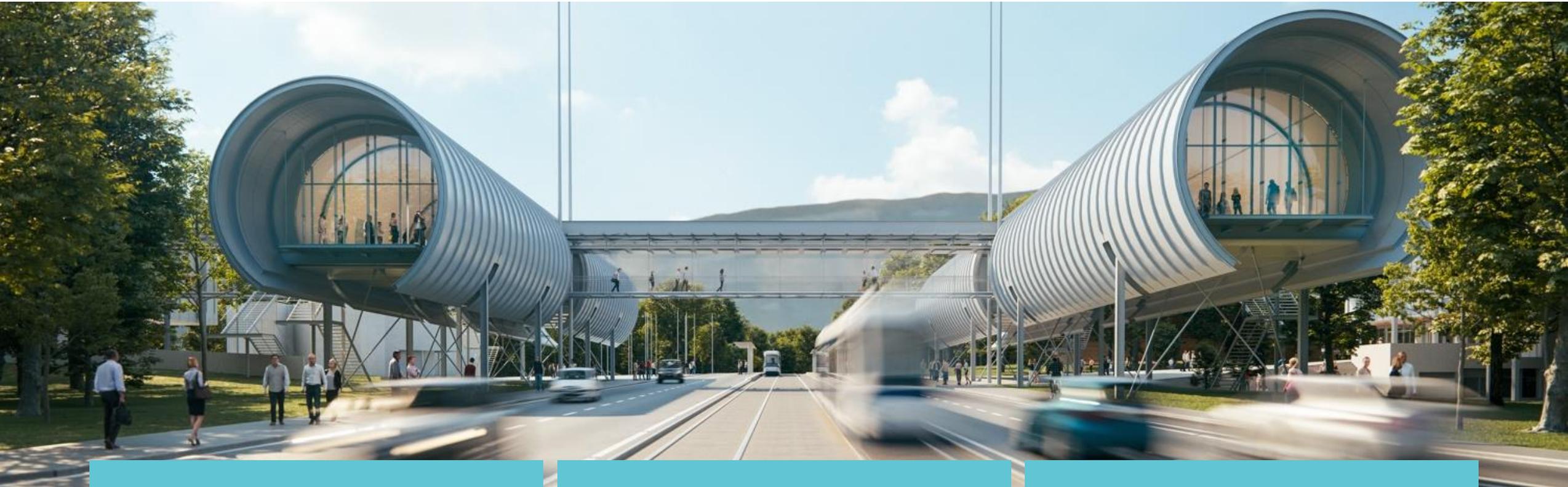
4 summer students during 2019
148 teachers in Teacher Programmes since 1998
3 teams in BL4S competition since 2014
403 students participating in S'Cool LAB
1955 visitors in 2019

151 000 visitors on guided tours of CERN in 2019, from 95 countries.

CERN engages with citizens across the globe:
on-site and travelling exhibitions in 15 countries, > 1 million visitors

Science Gateway will open in 2023, expanding CERN's outreach reach and impact, locally and globally.

CERN Science Gateway

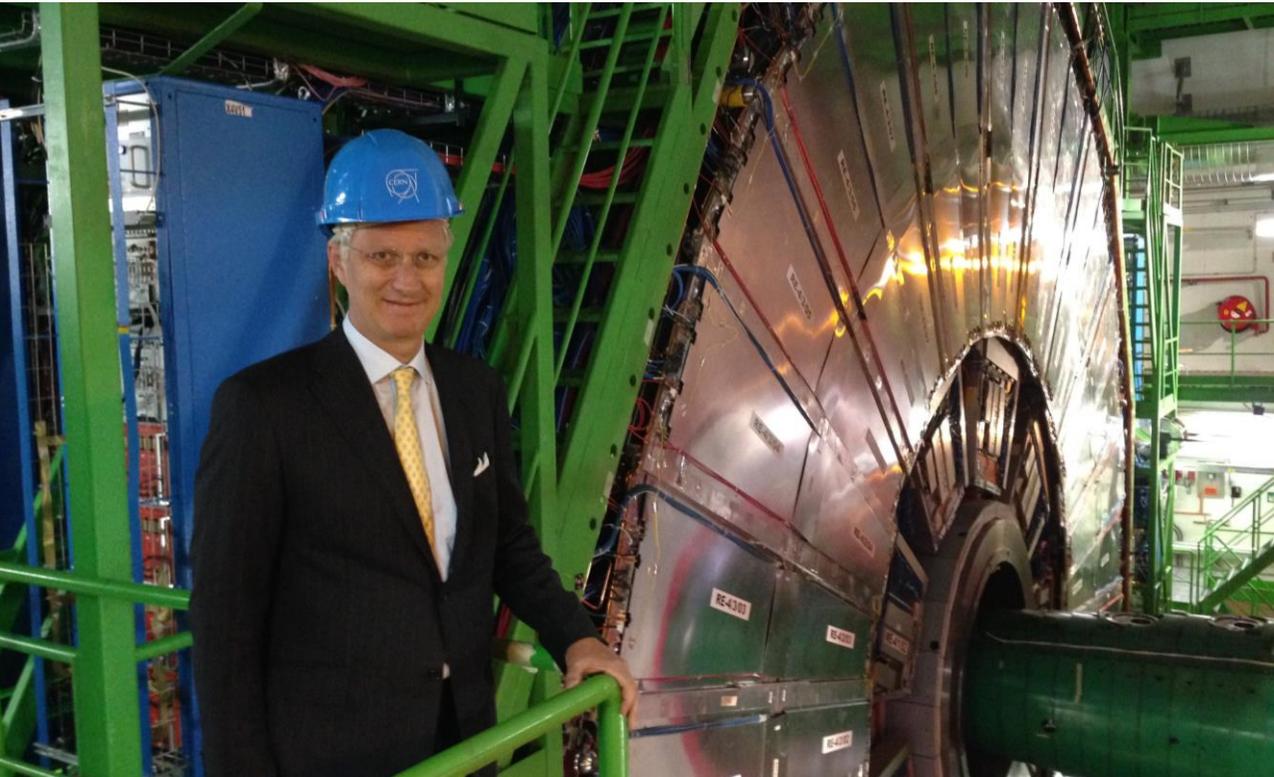


CERN's new education and outreach centre for all publics aged 5-plus.

Opening beginning of 2023.

Immersive exhibitions, education labs, events and shows.

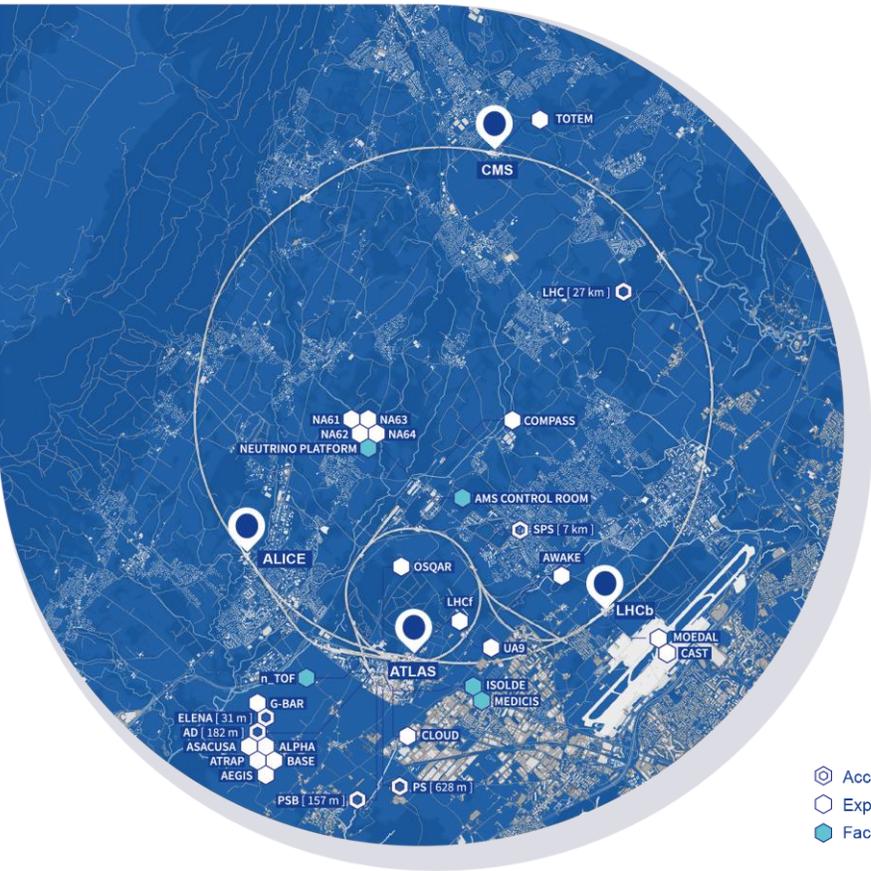
Belgium was one of CERN's founding Member States



21 May, 2014, HM Philippe, King of the Belgians, in front of the CMS detector at LHC Point 5.

- **Leon Van Hove:** CERN Director General (1976-1980)
- Belgian scientists have made significant contributions to progress in particle physics and have always been heavily involved at CERN.
- Theoretical work by Brout and Englert on the Brout-Englert-Higgs mechanism recognized by the award of the 2013 Nobel prize in Physics after the discovery of the Higgs Boson at CERN's ATLAS and CMS experiments.
- Robert Cailliau, co-inventor of the WWW.

Belgium has a strong involvement across CERN experiments



Accelerator
 Experiment
 Facility

LHC EXPERIMENTS:

CMS

6 Universities
 1 associate institute (KU Leuven)
 ~100 scientists, including >30 PhD students

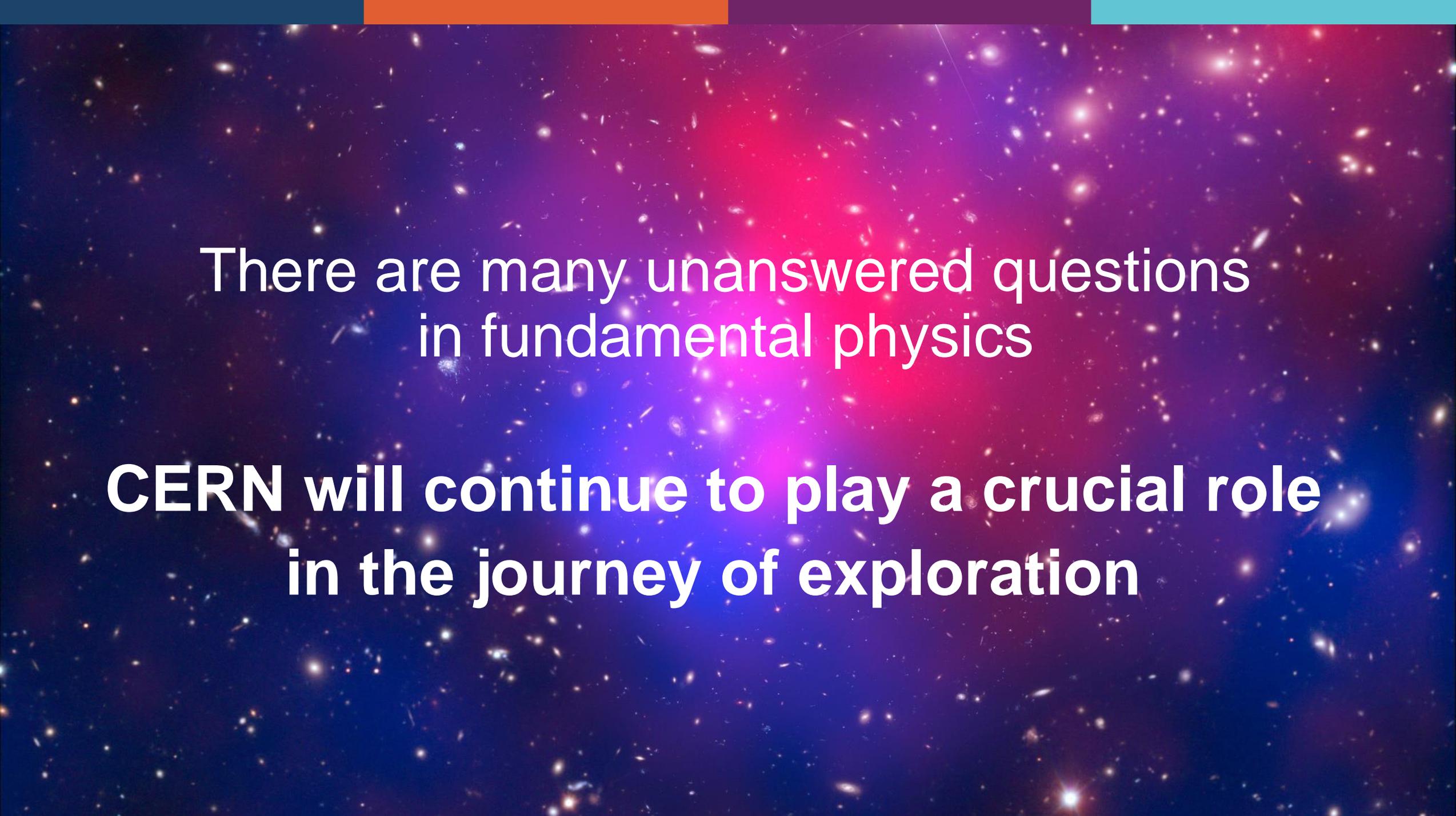
FIXED-TARGET EXPERIMENTS

- NA62
- nToF
- **Neutrino Platform**
4 institutes, 16 members

ISOLDE

5 institutes, 51 members

Belgian scientists play a significant role in the MEDICIS facility at ISOLDE to produce novel isotopes for medical research.



There are many unanswered questions
in fundamental physics

**CERN will continue to play a crucial role
in the journey of exploration**