



A journey inside CERN

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Please stand by, your journey will begin shortly...

Format of this presentation

What I will do:

- 30-45 minutes of presentation about CERN.
- Talk about CERN, experiments and a (bit) of physics.

What you can do:

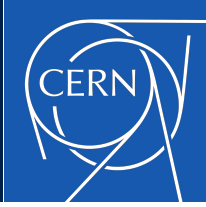
- Use the Zoom  button to ask questions during or after the presentation.
- If you feel the need to ask a question out loud during the presentation, please ask for it in the Chat first.
- Fill out the survey on the [Indico page](#).

Extra information:

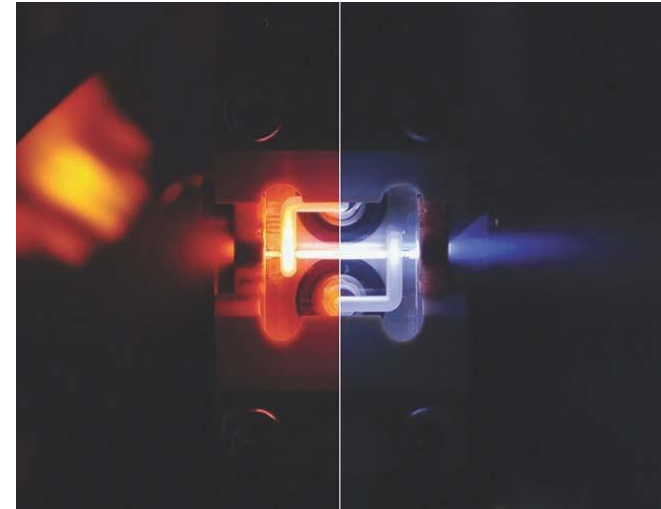
- You can find more material and links about CERN and physics on the [Indico page](#) (if you feel like a real scientist).



Who am I?



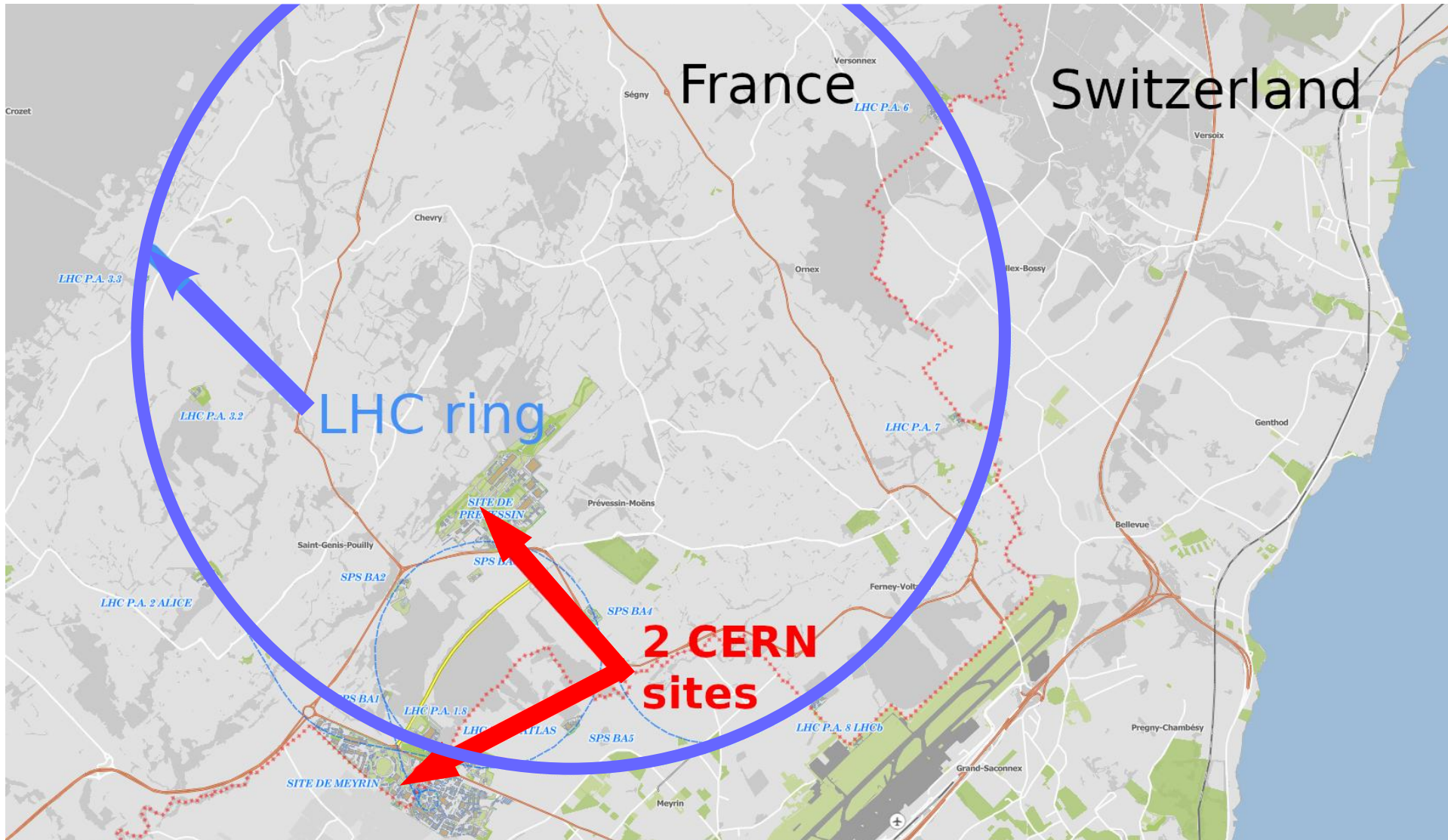
- I started working at CERN more than 4 years ago with a PhD in accelerator physics with the University of Oxford working on intensity-dependent effects in linear colliders.
- I worked on several machines, experiments and projects including:
 - The International Linear Collider in Japan
 - The Accelerator Test Facility in Japan
 - The Compact Linear Collider at CERN
- I am now working as a postdoc on the CERN Linear Electron Accelerator for Research on various types of experiments and studies.



What is and where CERN?

CERN stands for Conseil Européen pour la Recherche Nucléaire (European Council for Nuclear Research).

Established in 1954, the organization is based in a northwest suburb of Geneva on the Franco–Swiss border.



Member States of CERN

Member States (date of accession)

 Austria (1959)	 Switzerland (1953)
 Belgium (1953)	 United Kingdom (1953)
 Bulgaria (1999)	
 Czech Republic (1993)	States in accession to Membership and Associate Members
 Denmark (1953)	 Cyprus (2016)
 Finland (1991)	 India (2017)
 France (1953)	 Lithuania (2018)
 Germany (1953)	 Pakistan (2015)
 Greece (1953)	 Serbia (2012)
 Hungary (1992)	 Slovenia (2017)
 Israel (2014)	 Turkey (2015)
 Italy (1953)	 Ukraine (2016)
 Netherlands (1953)	
 Norway (1953)	
 Poland (1991)	
 Portugal (1986)	
 Romania (2016)	
 Slovakia (1993)	
 Spain (1961-1968, 1983-)	
 Sweden (1953)	



CERN, a collaboration worldwide!

- 23 members
- 8 associated members
- 3 observers
- 61 countries with agreements

CERN, a large organisation:

- 2.600 staff
- 800 fellows and apprentices
- 550 students
- 15.000 users
- 2000 from external companies

And a small town:

- A dedicated fire brigade
- A crèche
- A hostel
- 3 restaurants
- A UBS bank

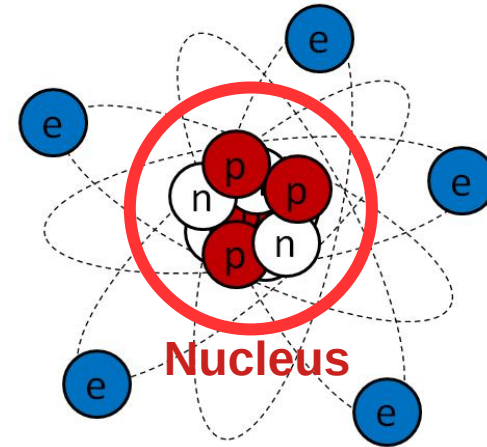


Wait, you said Nuclear?!

Don't worry!

It is written in CERN's convention that "The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available."

Nuclear for **Nucleus**, the dense region consisting of protons and neutrons at the center of an atom.



Matt Strassler 2012

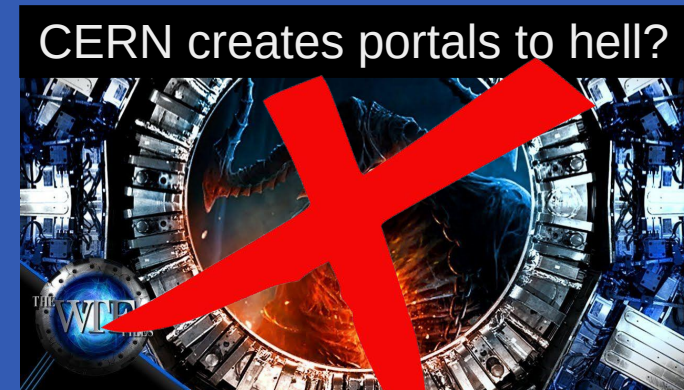
So none of the following is done at CERN:



Nope.



No way!



Are you kidding me?

What about black holes?

The LHC will not generate black holes in the cosmological sense. However, some theories suggest that the formation of tiny '**quantum**' black holes may be possible.



Not this black hole!



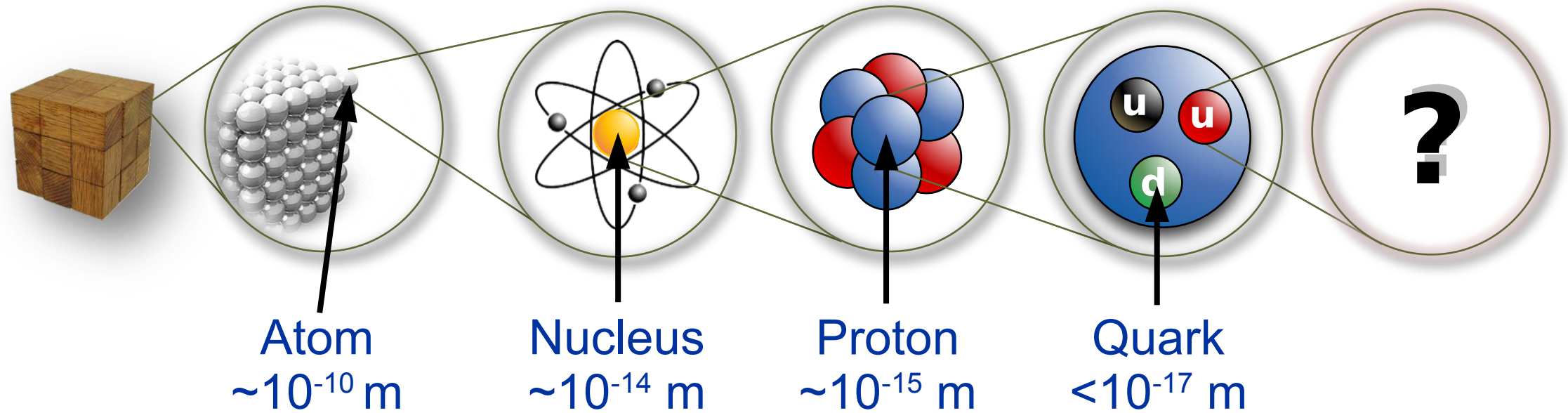
This black hole!

However, there is **no danger!**
Those black holes at CERN would be microscopic and would evaporate immediately.

To go further: <https://angelsanddemons.web.cern.ch/faq/black-hole.html>

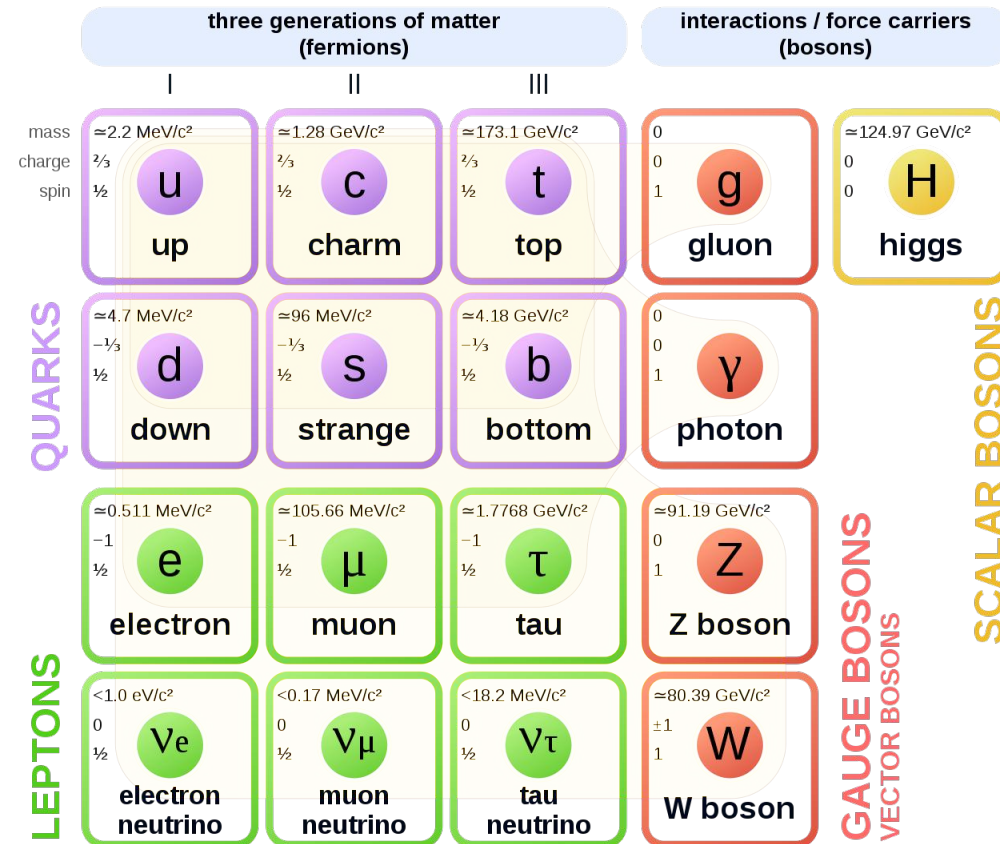
What do we do at CERN?

Study the matter and try to understand what it is made of:



What do we do at CERN?

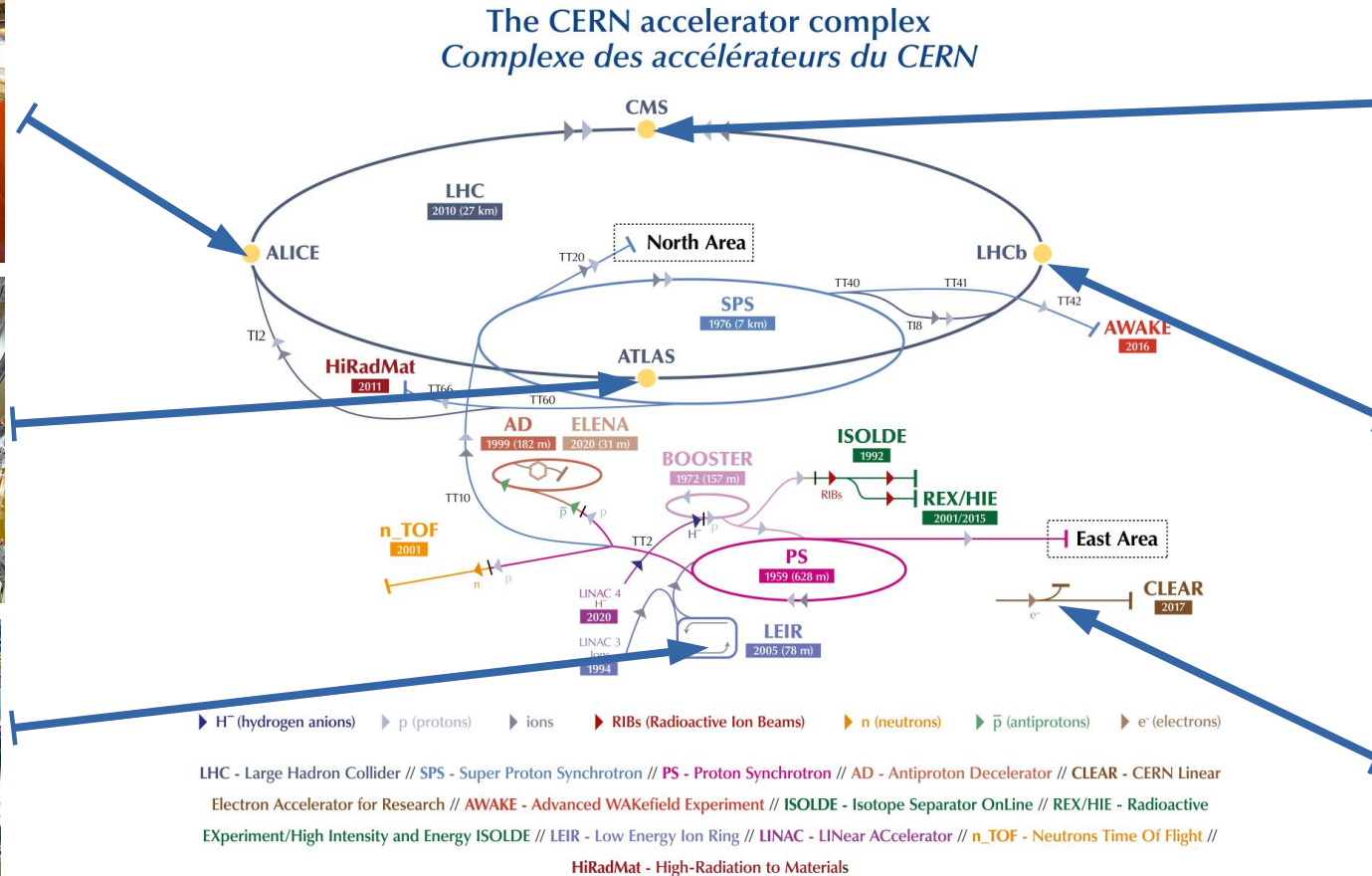
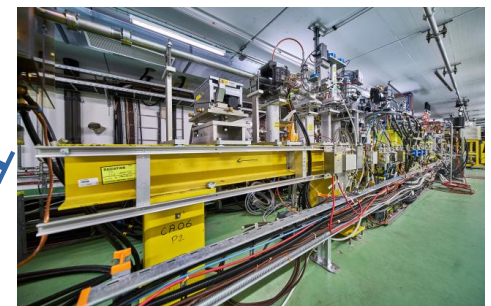
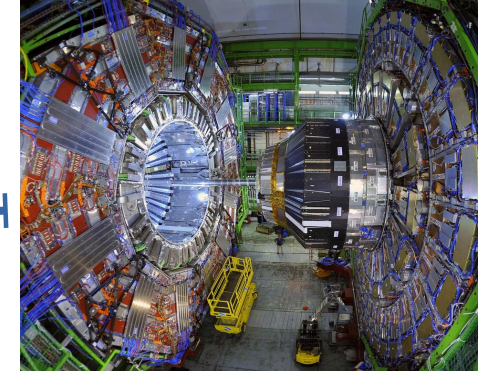
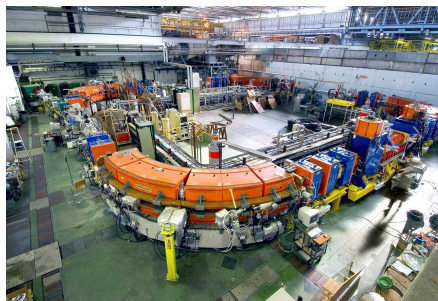
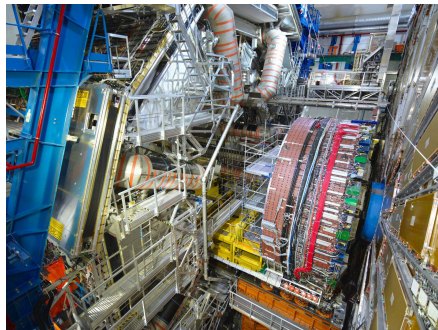
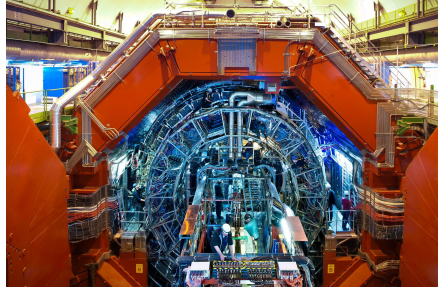
CERN helps to build the **Standard Model of Elementary Particles**, a theory describing three known **fundamental forces** of the universe as well as classifying all known **elementary particles**. It can be summarized like this:



Did you know? W and Z bosons were discovered at CERN in 1983.

How do we do it?

CERN built numerous experiments, accelerators and detectors to do so:

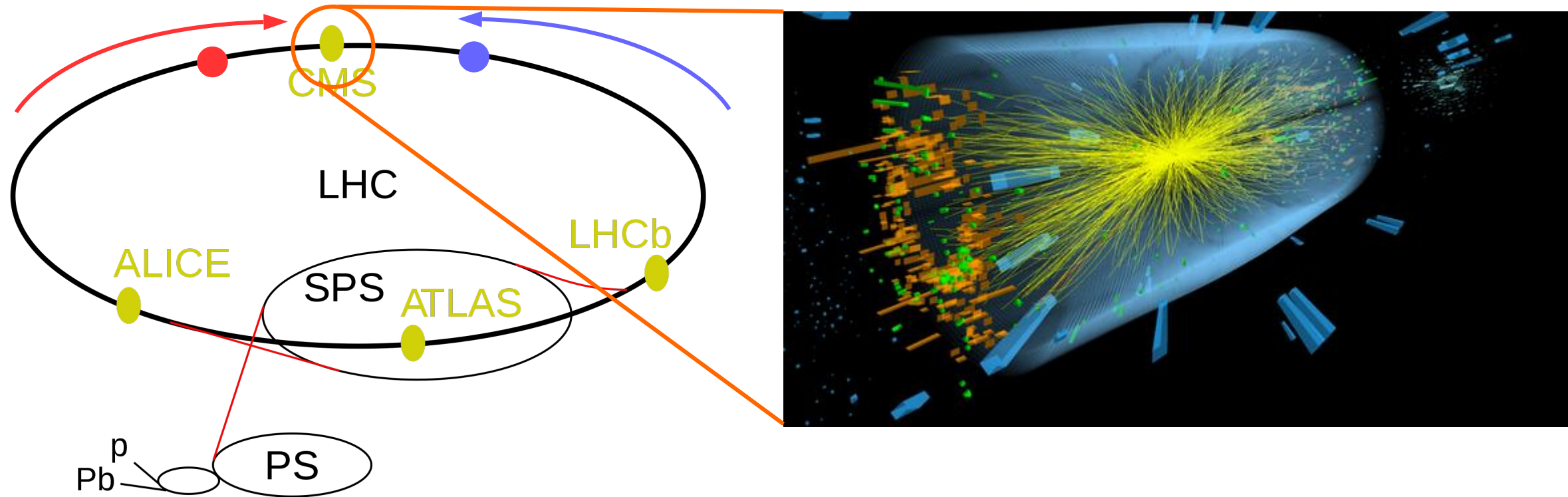


Did you know? The CMS magnet system contains about 10000 tons of iron, which is more iron than in the Eiffel Tower.

But, how does it work?

A particle collider works like a “super microscope” in order to observe the smallest particles.

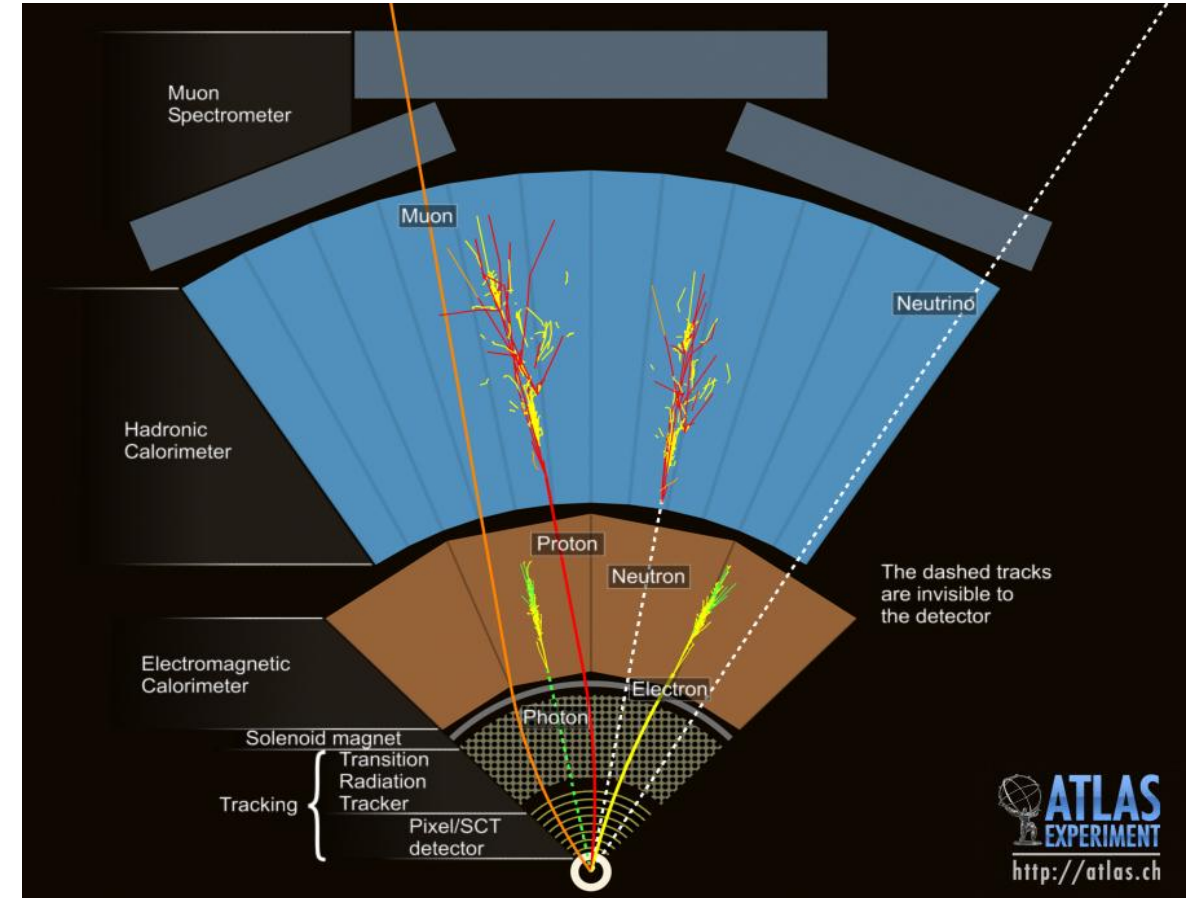
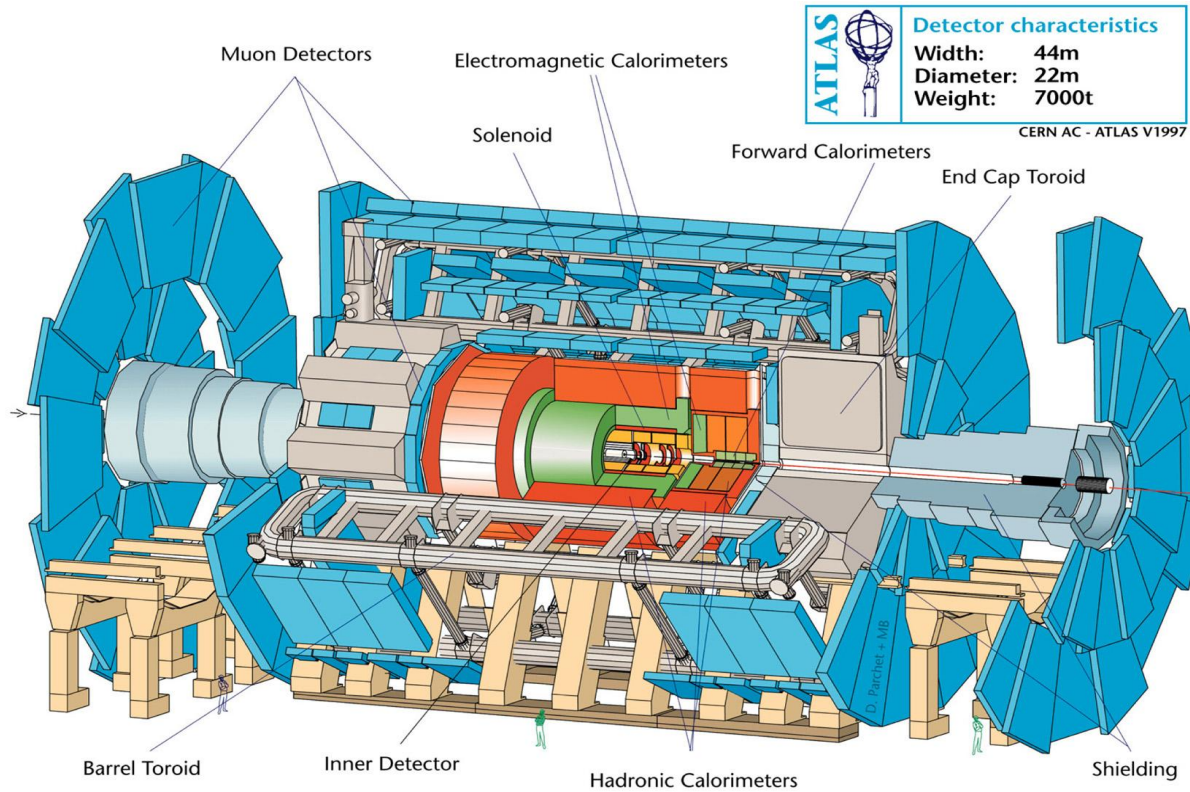
Let’s take the LHC for example where two beams are colliding at four different detectors:



Did you know? The Large Hadron Collider is colder than outer space. To be precise, it’s 1.9 K (-271.3°C), almost absolute zero. A cryogenic cooling system keeps it this cold for the sake of the superconductor electromagnets

What do we see?

Each type particle will have a different path inside the detector.



Did you know? There are around 600 million collisions per second in the LHC.

What do we do with all those data?

Those data are being analyzed thanks to the largest computing grid in the world!

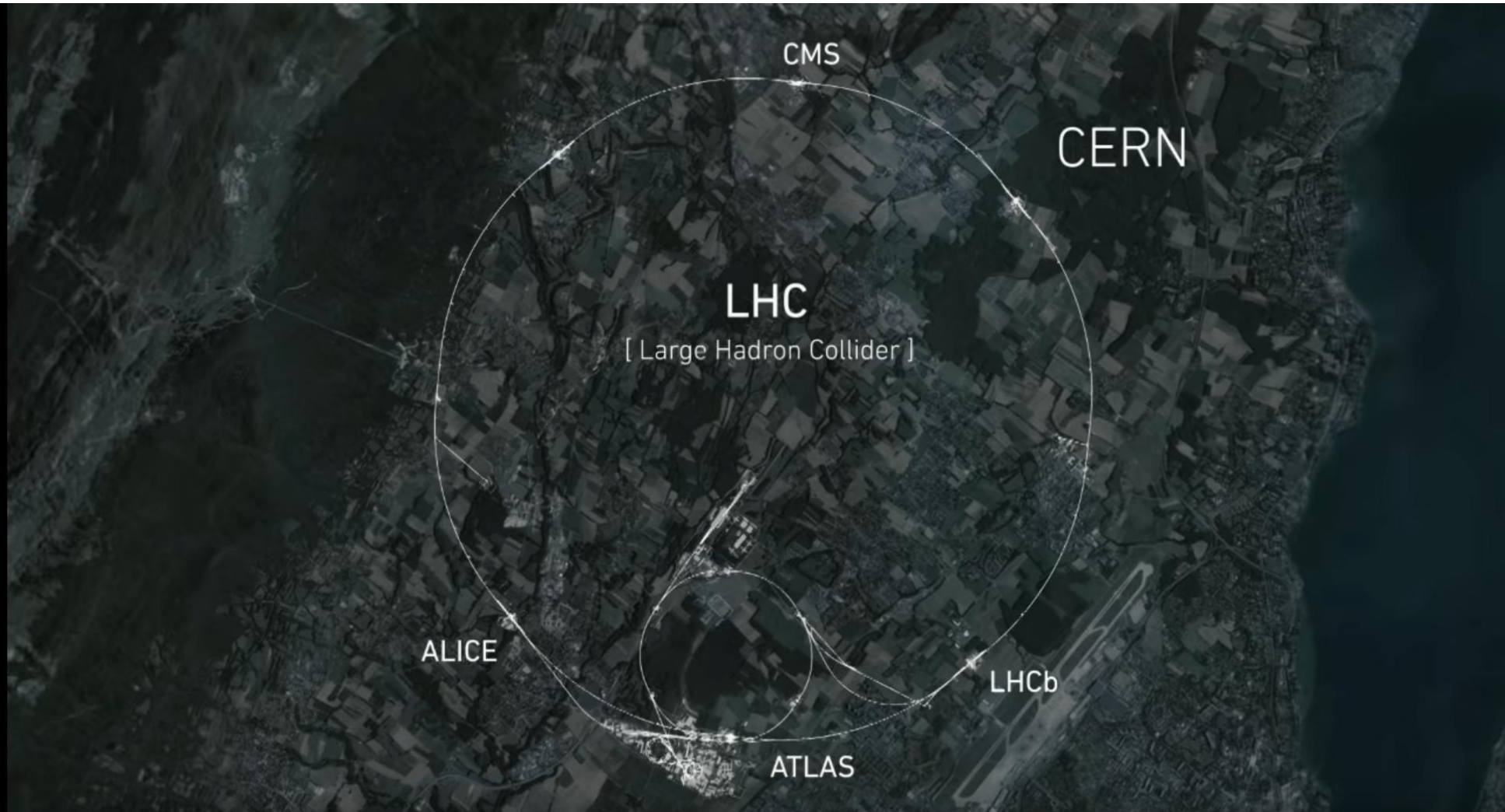


- 42 countries
- 170 data centres
- 2 millions tasks/day
- 1 million computer cores
- 1 exabyte of storage

Did you know? The data recorded by the big experiments at the LHC are enough to fill every year around 50.000 hard disks with 1 TByte memory each or corresponding to a stack of about 10 million standard DVDs.

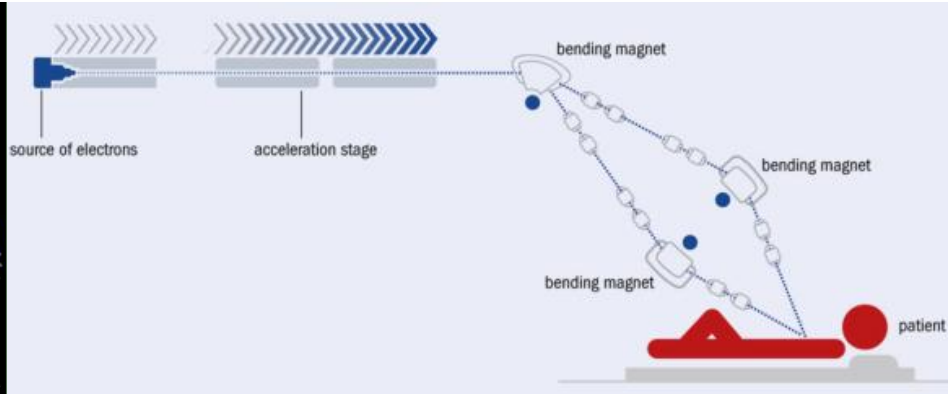
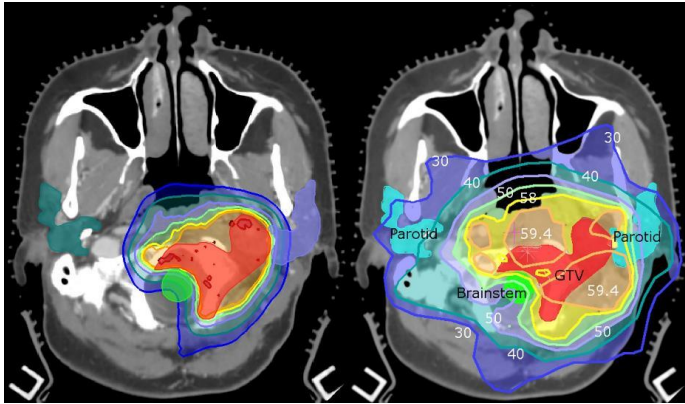
To go further: <https://wlcg-public.web.cern.ch/>
<https://home.cern/news/news/computing/>

A good summary



We don't only study particle physics!

A lot of different studies and experiments are run at CERN:



Medical applications
<https://home.cern/tags/medical-applications>



Knowledge transfer
Accelerating Innovation
<https://kt.cern/>

And many other things!

To go further: <https://kt.cern/who-are-you/general-public>

Meet TIM, the LHC tunnel's robot

The Train Inspection Monorail (TIM) is equipped with a camera and several measurement sensors to monitor the LHC tunnel in real-time .



The Web was born at CERN! (another Tim)

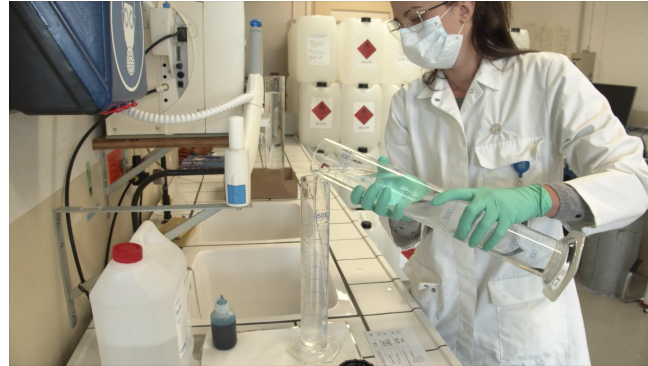
The World Wide Web was invented by a British scientist, Tim Berners-Lee, in 1989 while working at CERN



Did you know? The first website in the world was dedicated to the World Wide Web project itself and was hosted on Berners-Lee's NeXT computer. It can be found on this link: <http://info.cern.ch/hypertext/WWW/TheProject.html>

CERN against COVID-19

CERN technologies and expertise are helping in the collective global fight against COVID-19



More than 11 000 litres hydro-alcoholic liquid produced at CERN's chemistry lab



CERN's Fire and Rescue Service supports Swiss and French ambulance drivers



CERN produces and delivers protective equipment to local communities

To go further: <https://againstcovid19.cern/>

We are still at least 95% ignorant



Unlike normal matter, dark matter does not interact with the electromagnetic force. This means it does not absorb, reflect or emit light, making it extremely hard to spot. In fact, researchers have been able to infer the existence of dark matter only from the gravitational effect it seems to have on visible matter.

The matter we know and that makes up all stars and galaxies only accounts for **5% of the content of the universe!**

There is still a lot to do and discover!



To go further: <https://home.cern/science/physics/dark-matter>

You are young and you want to join CERN?

Visit now <https://careers.cern/students> to join CERN as a student!

- **Summer Student Program**
- **CERN Openlab Summer Student Program**
- **Short-term Internship Program**
- **Administrative Student Program**
- **Technical Student Program**
- **Doctoral Student Program**
- **Marie-Curies PhD positions**
- **Beamline for Schools:**
<https://beamlineforschools.cern>



Useful links

- CERN history: <https://home.cern/about/who-we-are/our-history>
- Upcoming events at CERN: <https://home.cern/events>
- CERN photo library: <https://cds.cern.ch/collection/Photos?ln=en>
- Art at CERN: <https://arts.cern/>
- For the CERN community: <https://home.cern/cern-community>
- CERN courier: <https://cerncourier.com/>



home.cern