



CERN for NTNU studenter



You can work at the coolest place in the universe!

SUISSE
FRANCE

CMS

LHCb

ATLAS

CERN Meyrin

CERN Prévessin

SPS 7 km

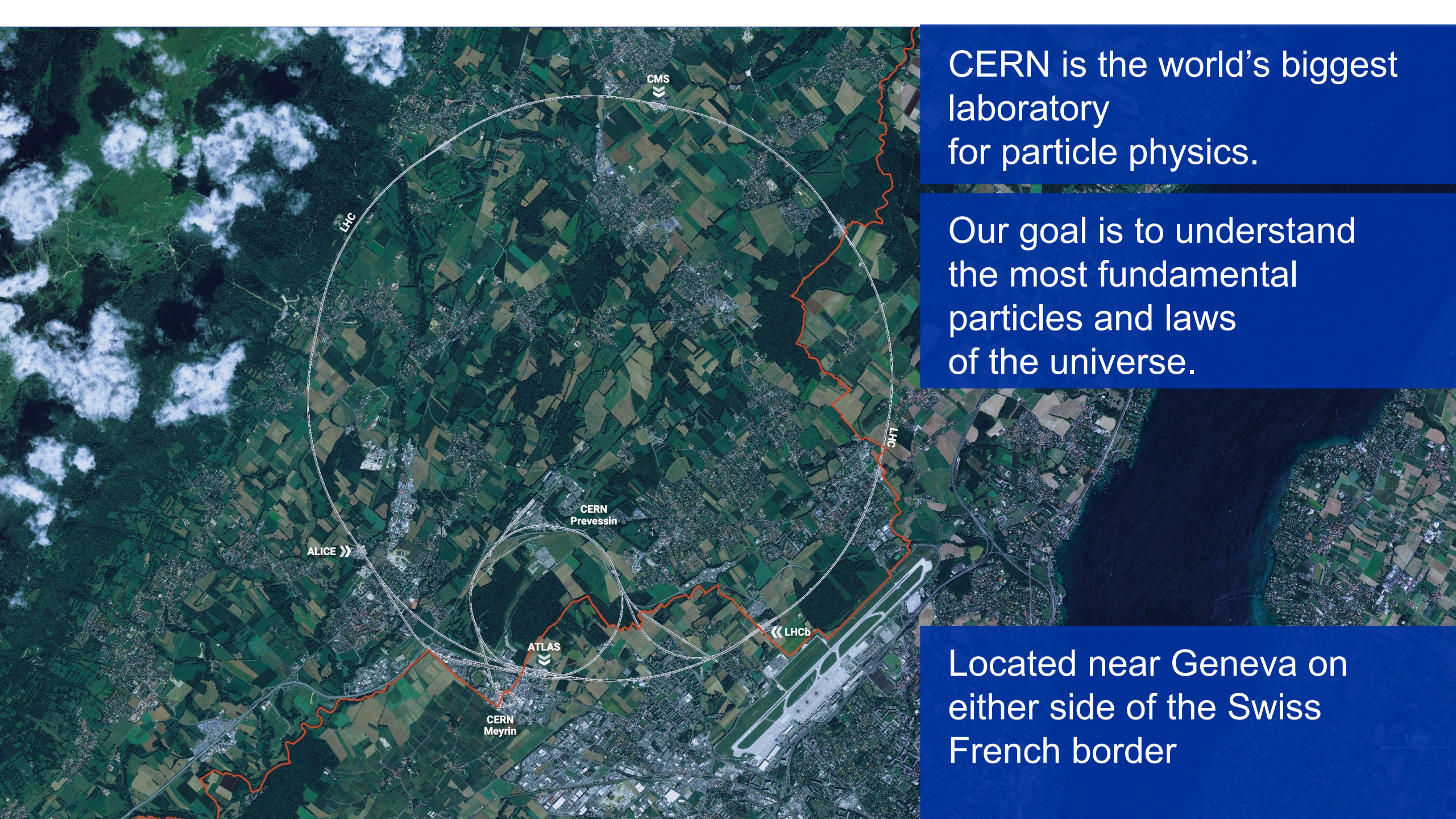
ALICE

LHC 27 km



Accelerating Science and Innovation

Nils Høimyr – CERN



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

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

Located near Geneva on either side of the Swiss French border

Science for peace

CERN was founded in 1954 with 12 European Member States



24 Member States

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

2 Associate Member States in the pre-stage to membership

Cyprus – Slovenia

8 Associate Member States

Brazil – Croatia – India – Latvia – Lithuania – Pakistan
Türkiye – Ukraine

6 Observers

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

CERN's annual budget (2024)
1224 MCHF (equivalent
to a medium-sized European
university)

As of 31 December 2023
Employees:
2666 staff, **1008** graduates & fellows
776 students
Associates:
12 370 users, **990** others

Around 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

Four pillars underpin CERN's mission



There are many unanswered questions in fundamental physics

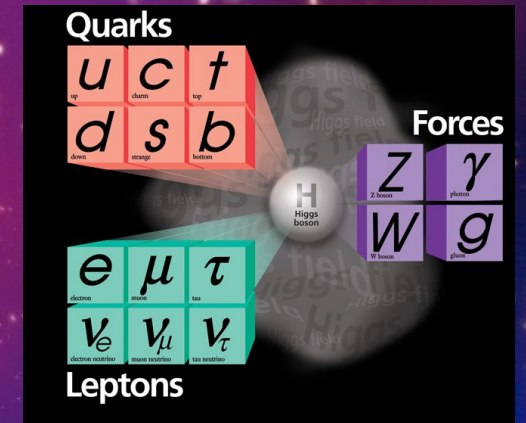
Including

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

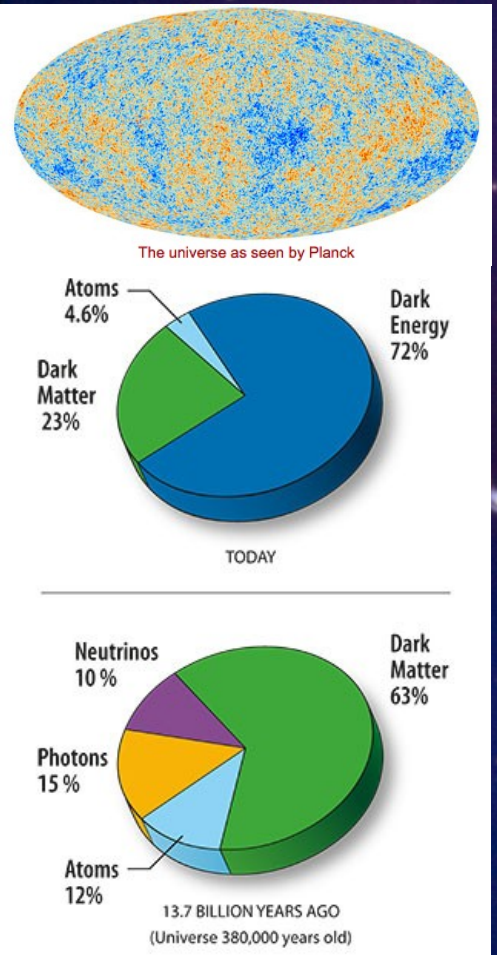
Is there only one Higgs boson, and does it behave exactly as expected?

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

Why is gravity so weak compared to the other forces?



The Higgs is new, it is special, we believe studying it in detail can be a portal to new physics

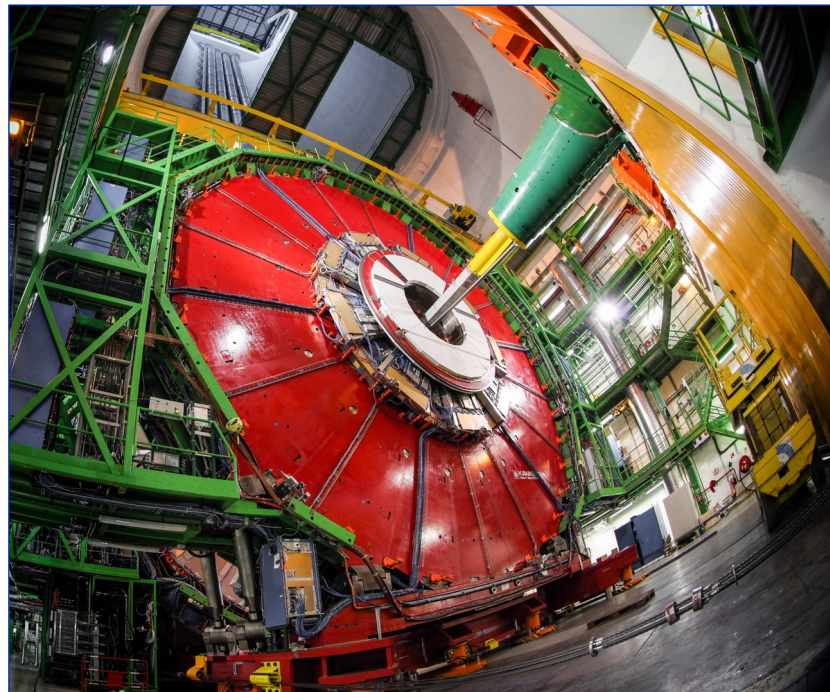


How do we do it?

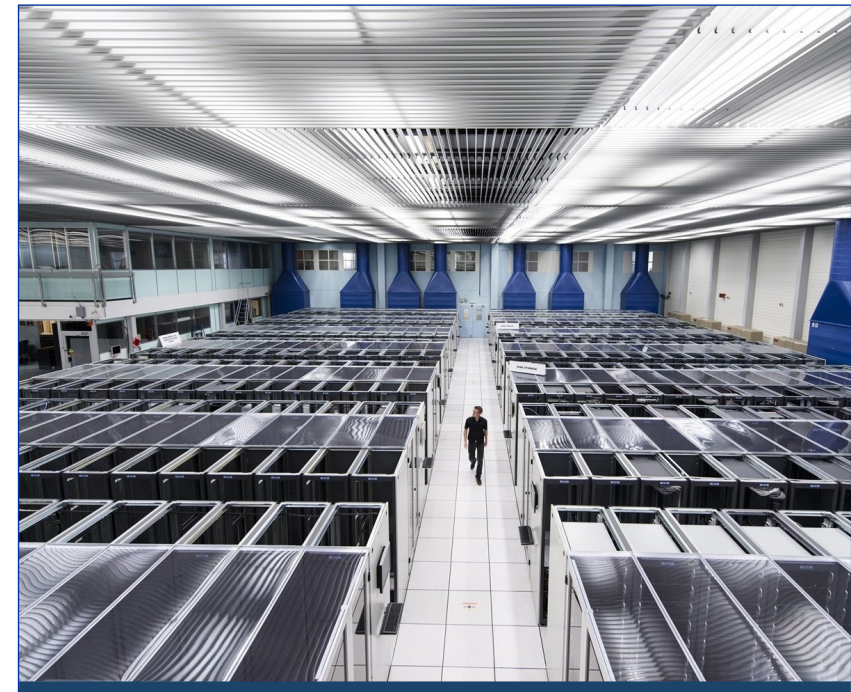
- We build the largest machines to study the smallest particles in the universe
- We develop technology to advance the limits of what is possible



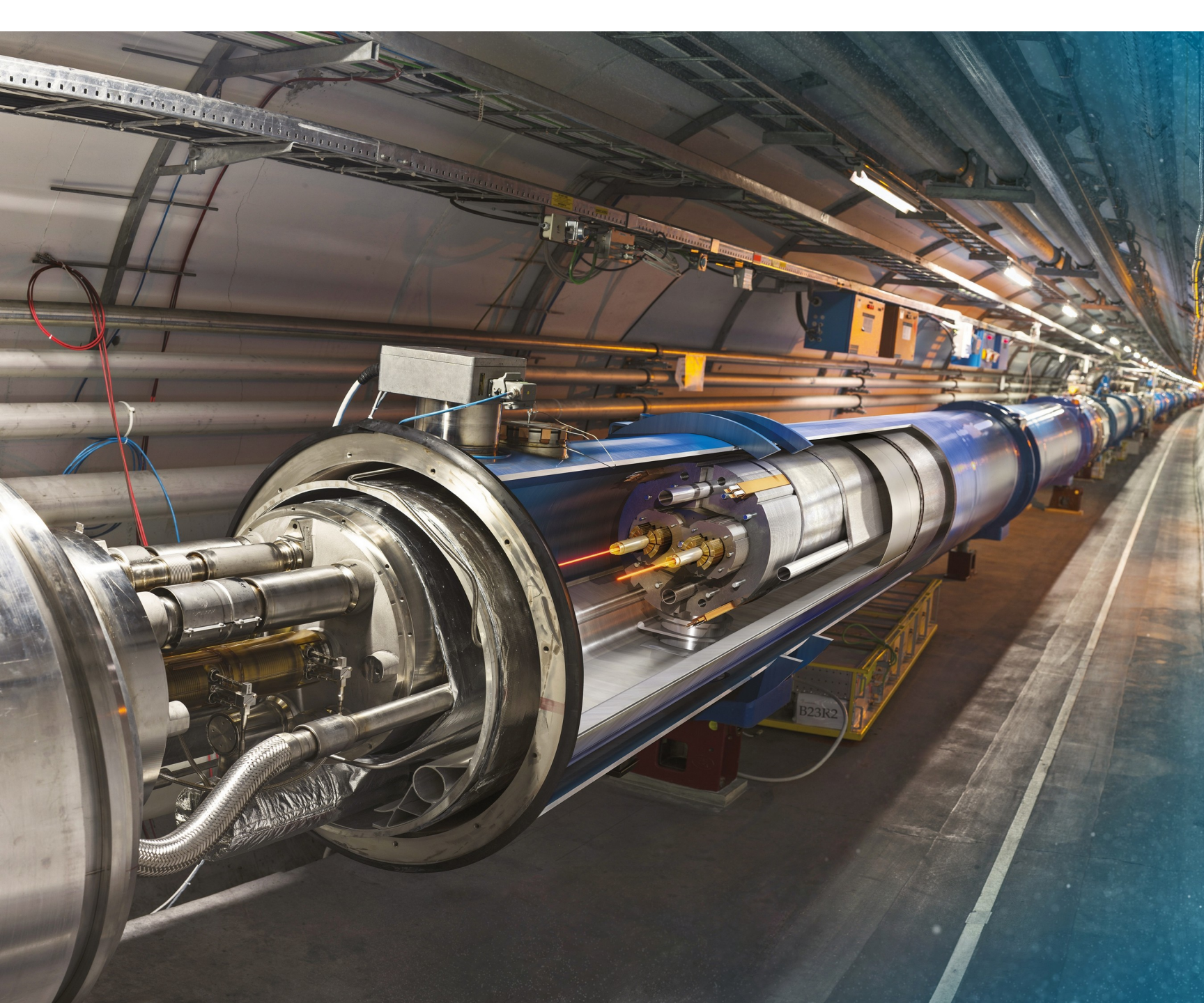
ACCELERATORS



DETECTORS



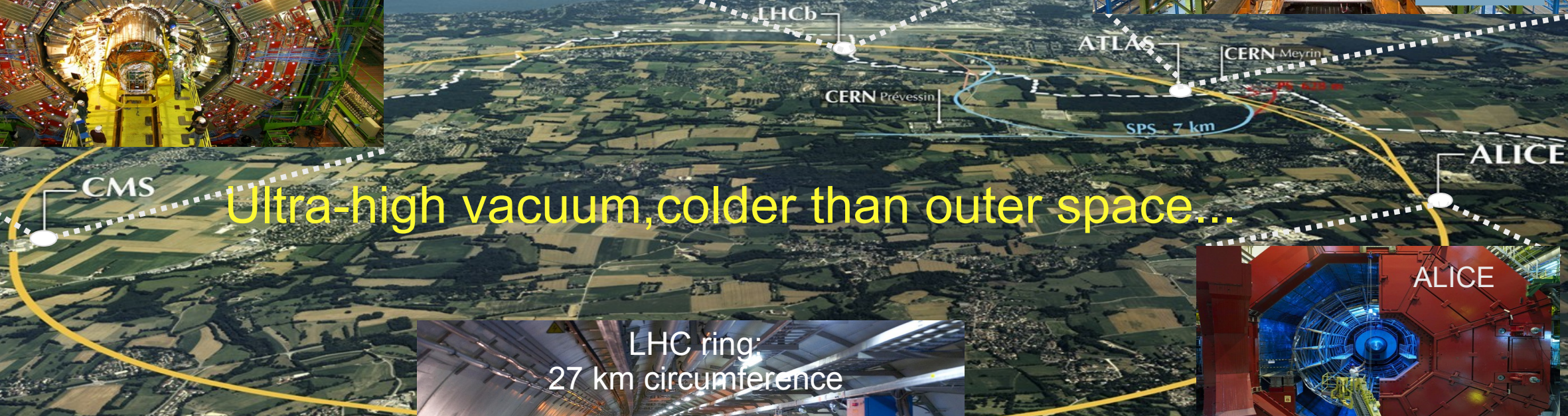
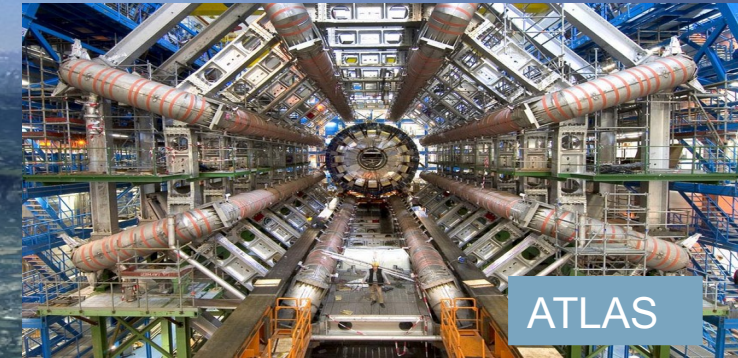
COMPUTING



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

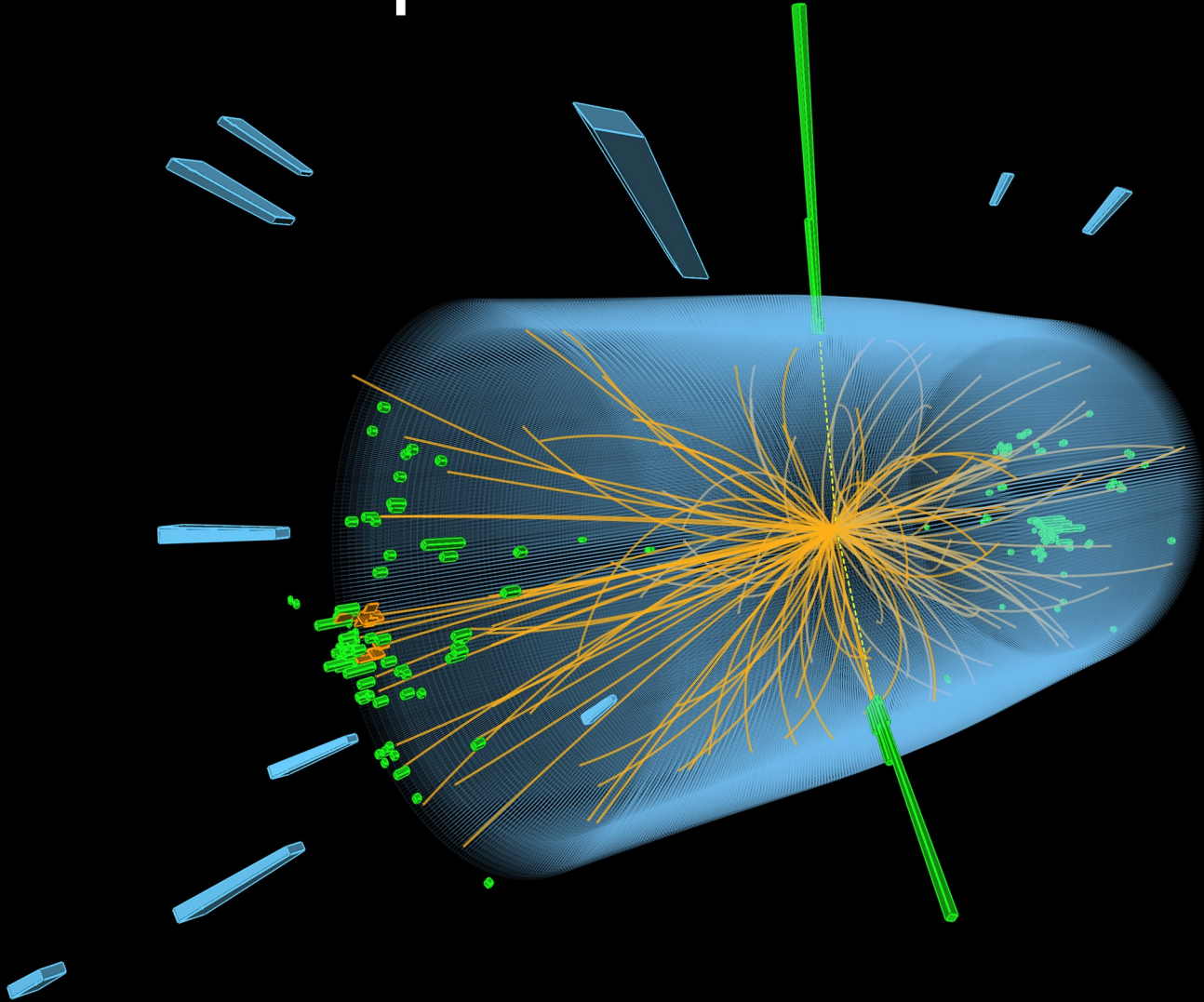
LHC accelerator and experiments



Ultra-high vacuum, colder than outer space...

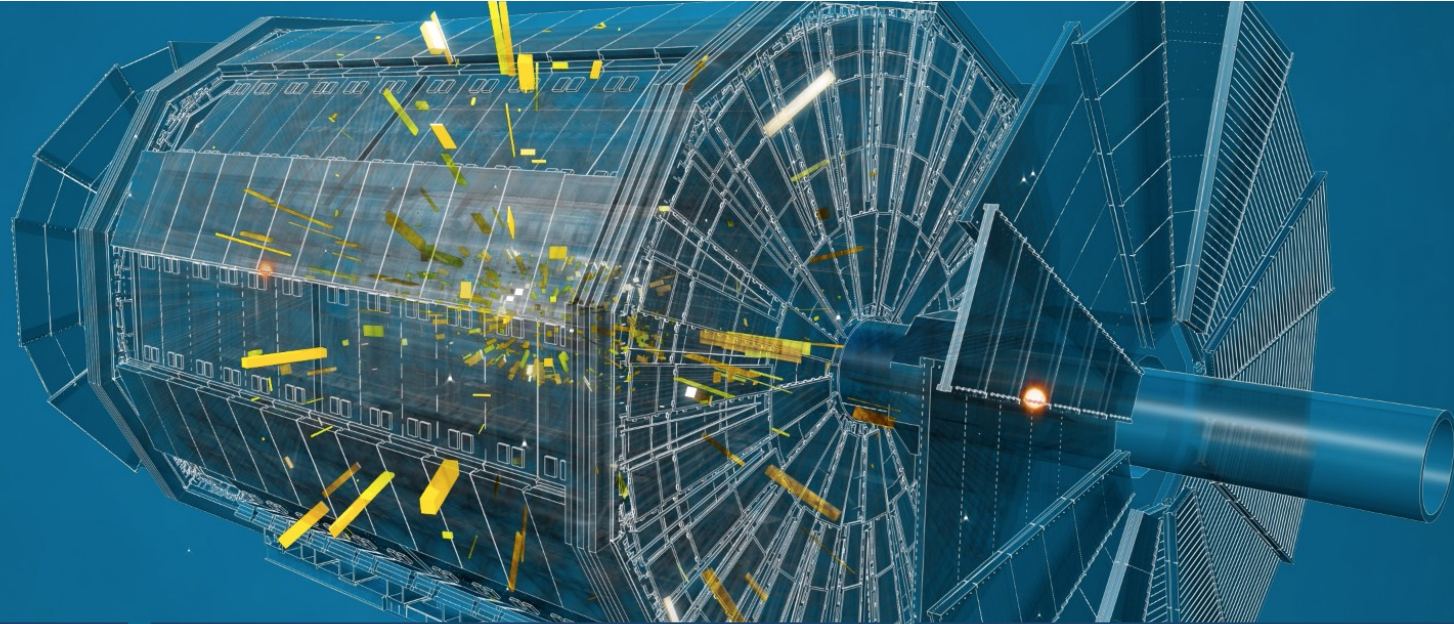


The LHC produces more than 1 billion particle collisions per second



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.

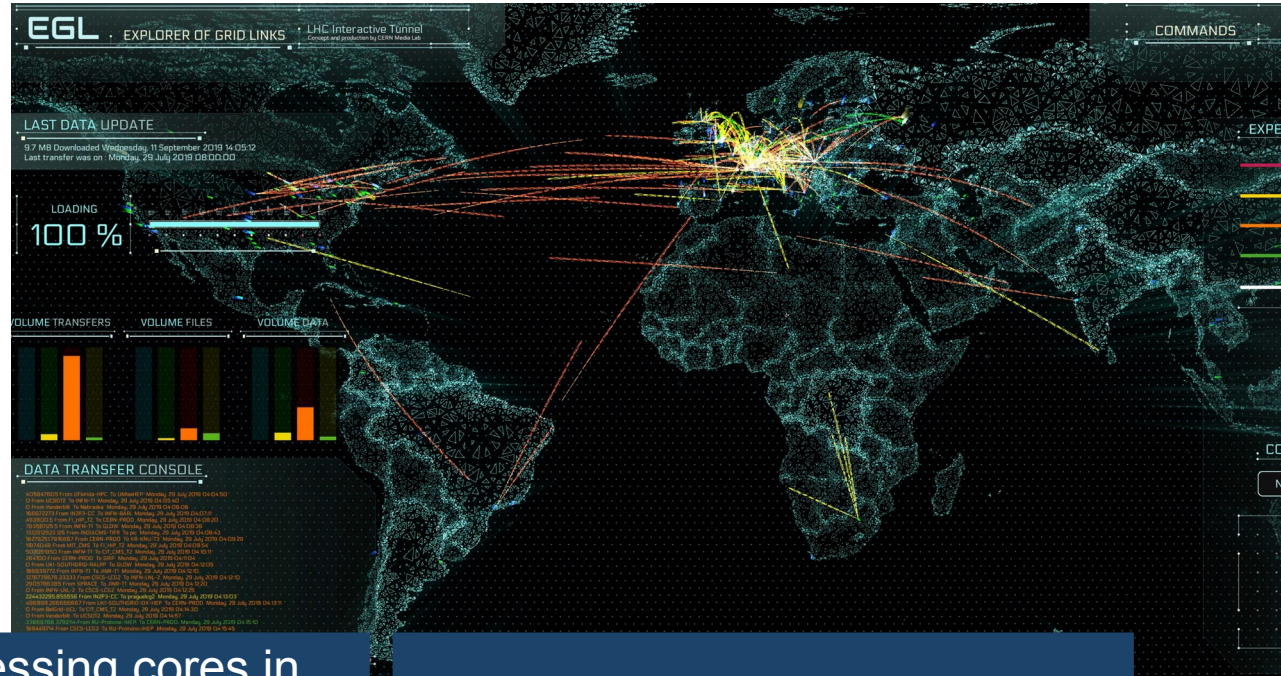


They take 40 million pictures a second. Only 1000 are recorded and stored.



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)

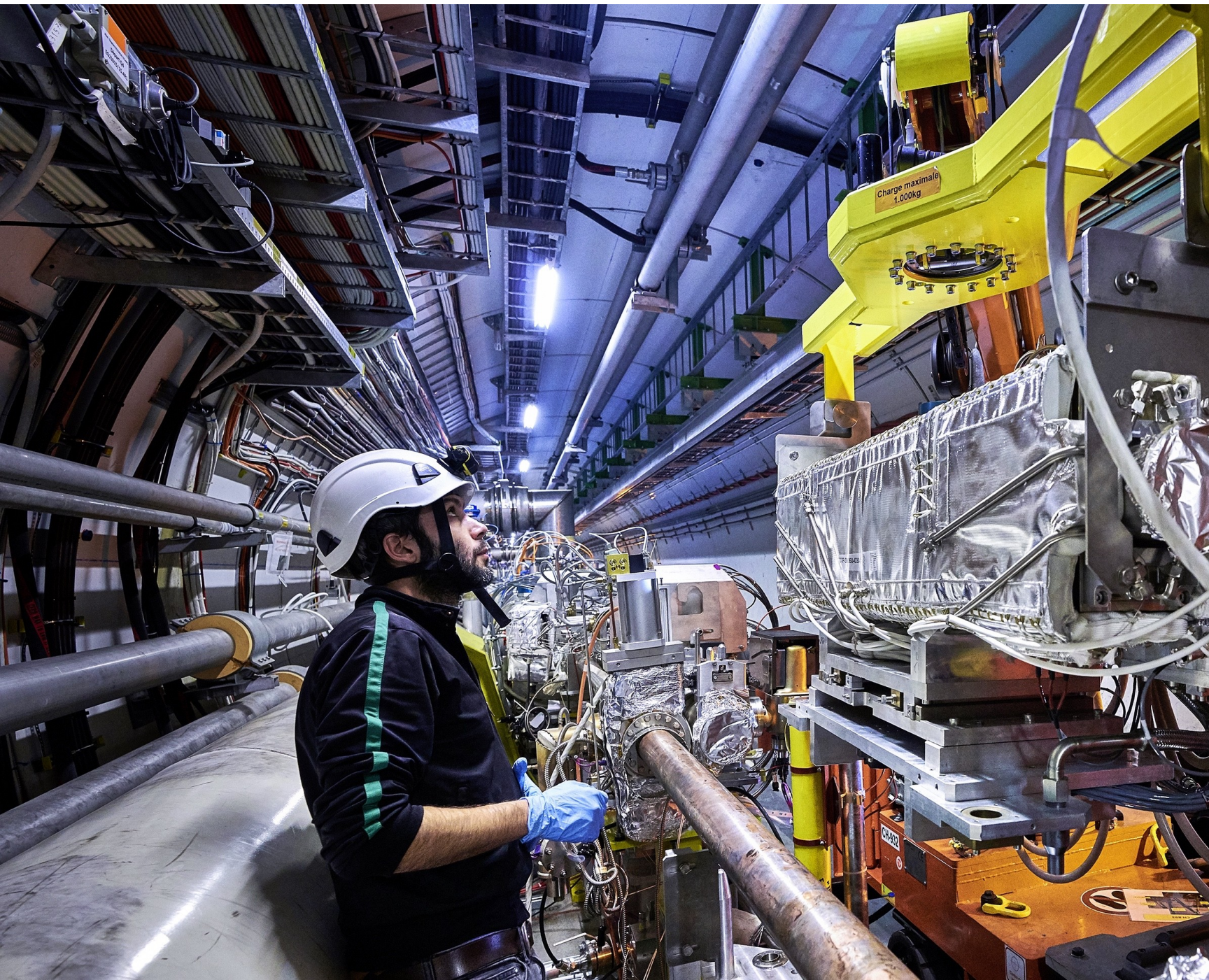
Antimatter Research
(Antiproton Decelerator)



Cosmic rays and cloud formation
(CLOUD)

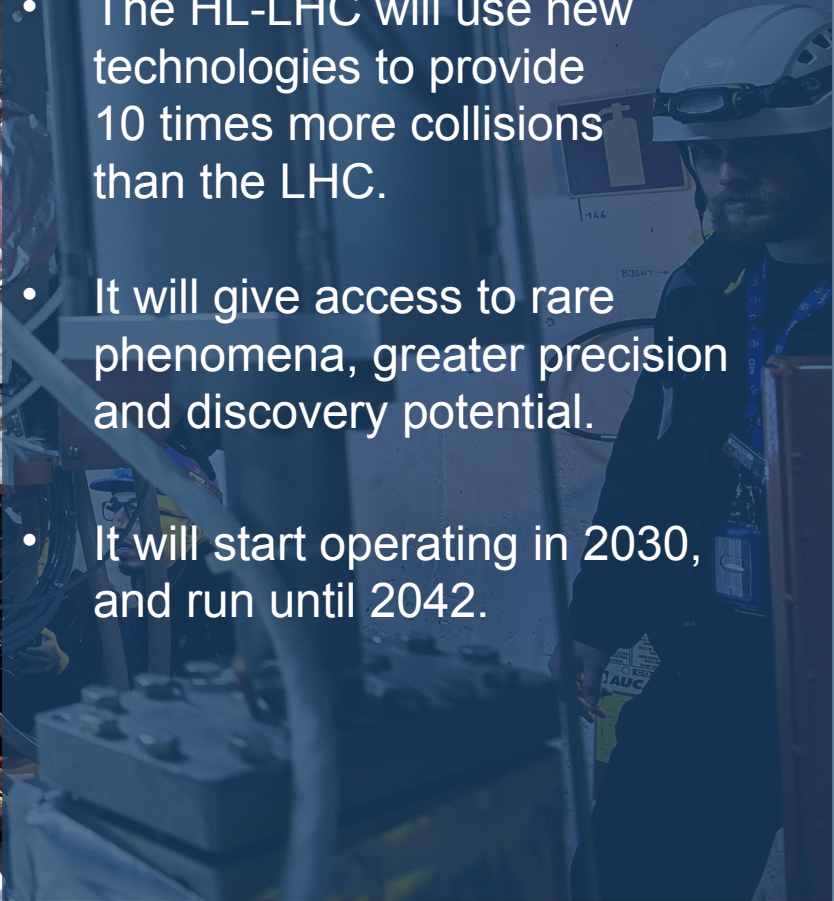
Fixed-target experiments, which
include searches for rare
phenomena

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

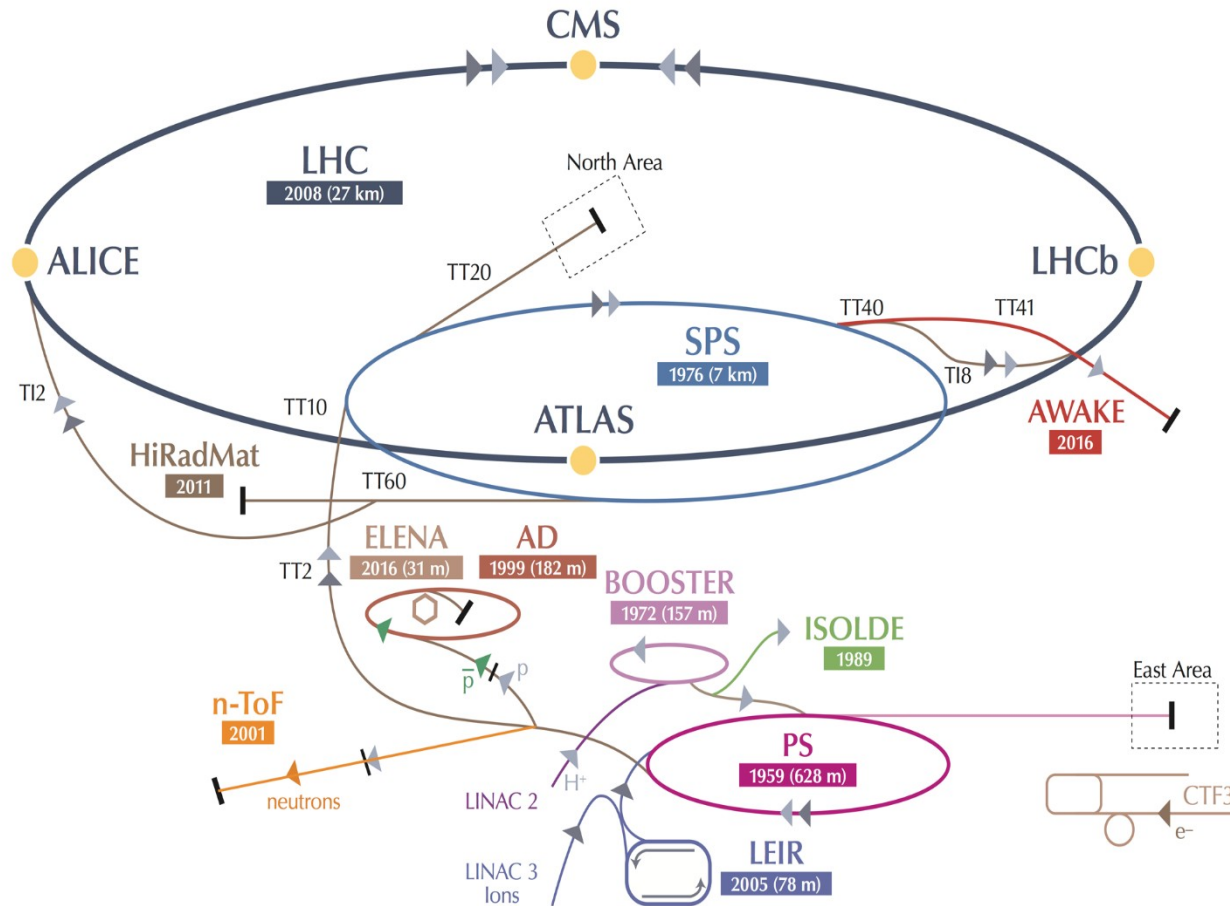


Upgrade to the High-Luminosity LHC is under way

- 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 2030, and run until 2042.



CERN's other experiments



~20 projects other than LHC with > 1200 physicists

AD: Antiproton Decelerator for antimatter studies

AWAKE: proton-induced plasma wakefield acceleration

CAST, OSQAR: axions

CLOUD: impact of cosmic rays on aerosols and clouds ☾ implications on climate

COMPASS: hadron structure and spectroscopy

ISOLDE: radioactive nuclei facility

LHC

NA61/Shine: ions and neutrino targets

NA62: rare kaon decays

NA63: radiation processes in strong EM fields

NA64: search for dark photons

Neutrino Platform: ν detector R&D for experiments in US, Japan

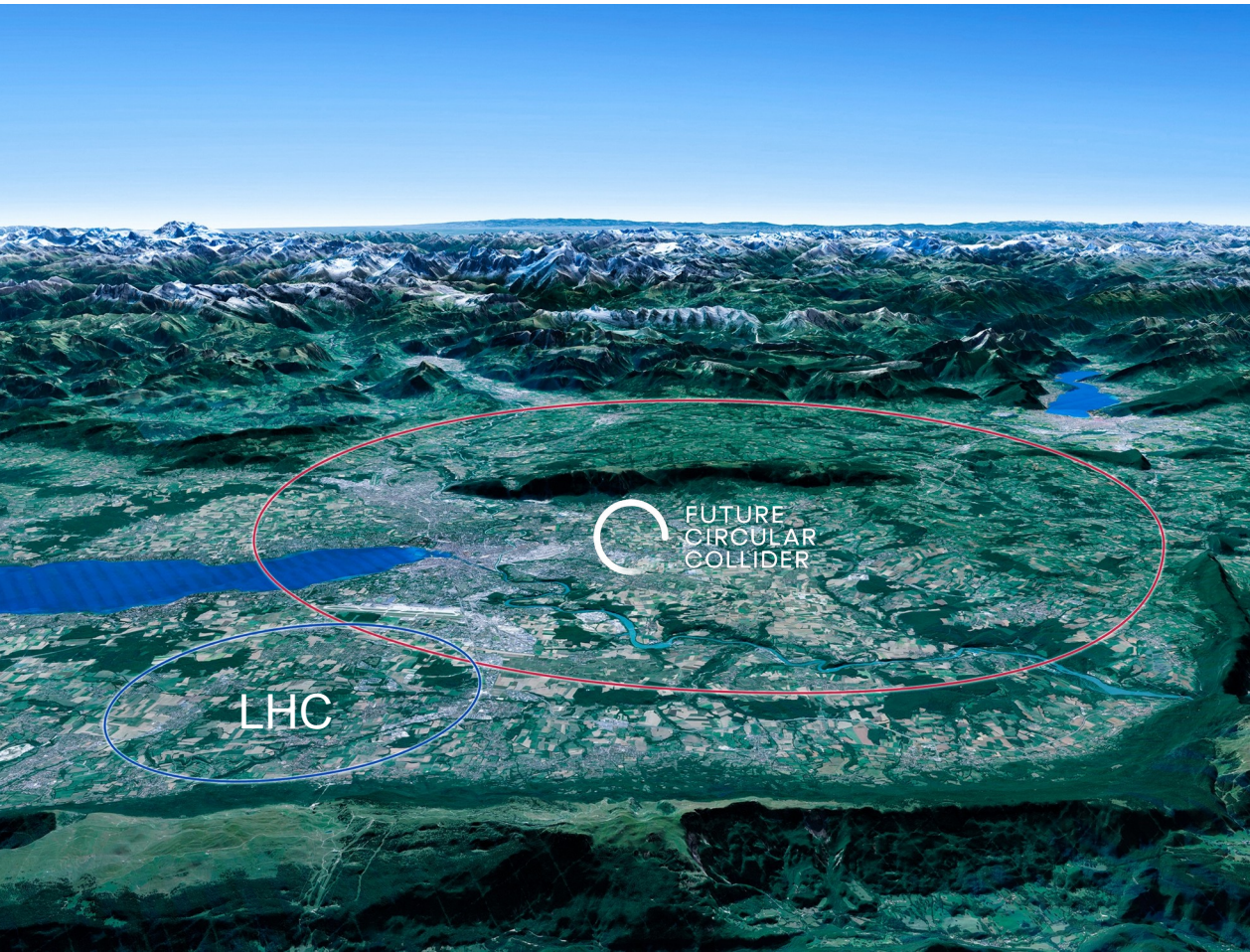
n-TOF: n-induced cross-sections

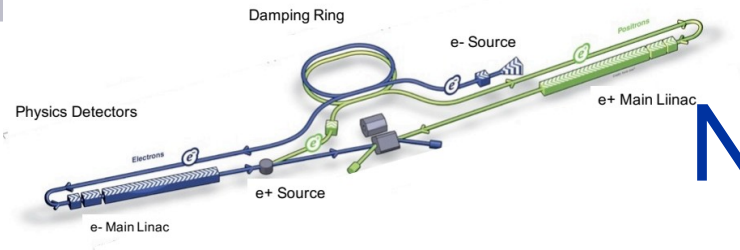
UA9: crystal collimation

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 (including muon collider and plasma acceleration)
- Continue supporting other projects around the world





Next: A Higgs factory

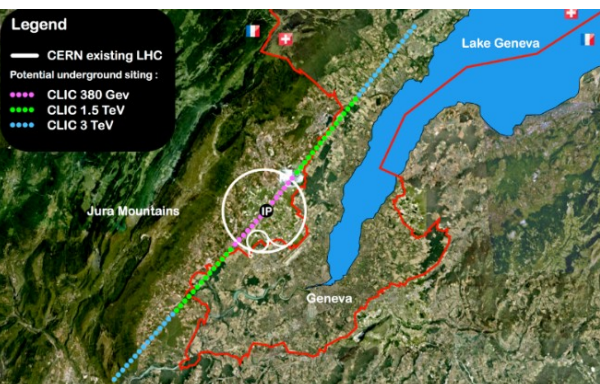
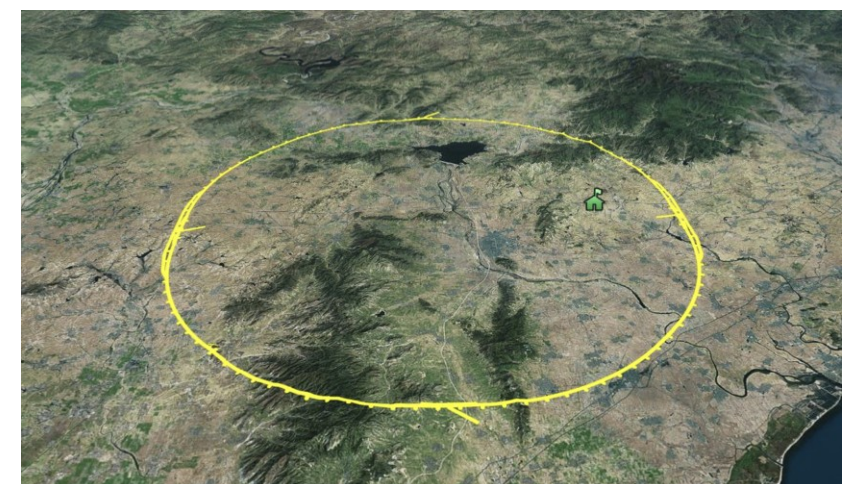


Need e+e- collisions at least at 250 GeV, four alternatives:

ILC in Japan (linear)
CLIC at CERN (linear)

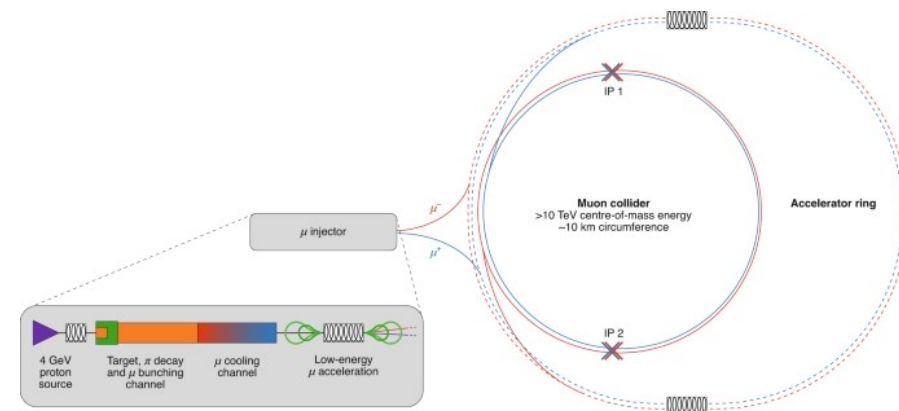
FCC at CERN (ring)
CEPC in China (ring)

Linear colliders: 13 (Higgs) -> 50 (max) km for higher energies later



Rings ~100km, can be used for protons after. This require R&D on High Field Magnets

An interesting alternative to a proton-proton collider is a muon collider, also being studied





TECHNOLOGY
& INNOVATION

The background of the slide is a network server room. On the left, there are several large, circular server racks with glowing blue lights. In the foreground, a network cable with a clear RJ45 connector is visible, extending from the right towards the center. The overall lighting is dim, with the primary light source being the blue glow of the server equipment.

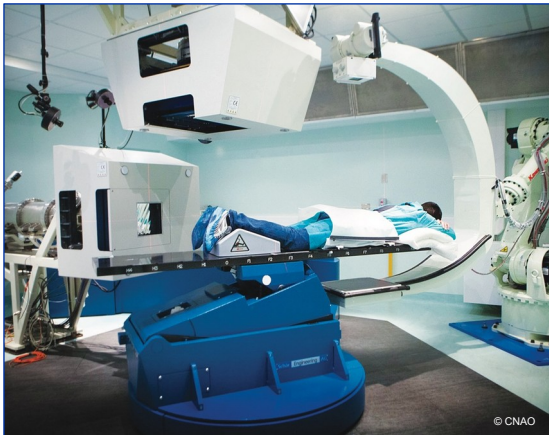
CERN's technological innovations have applications in many fields

CERN is the birthplace of the World Wide Web

And there are many more examples

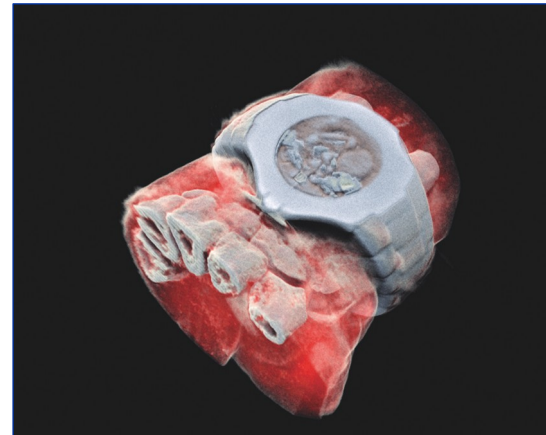
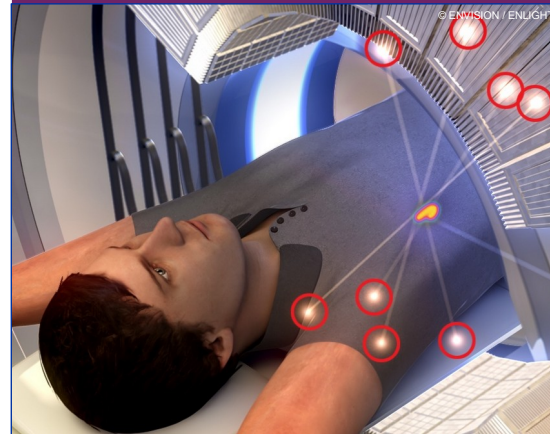
Medical imaging, cancer therapy, material science, cultural heritage, aerospace, automotive, environment, health & safety, industrial processes.

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



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

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



CERN produces innovative radioisotopes for nuclear medicine research.

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

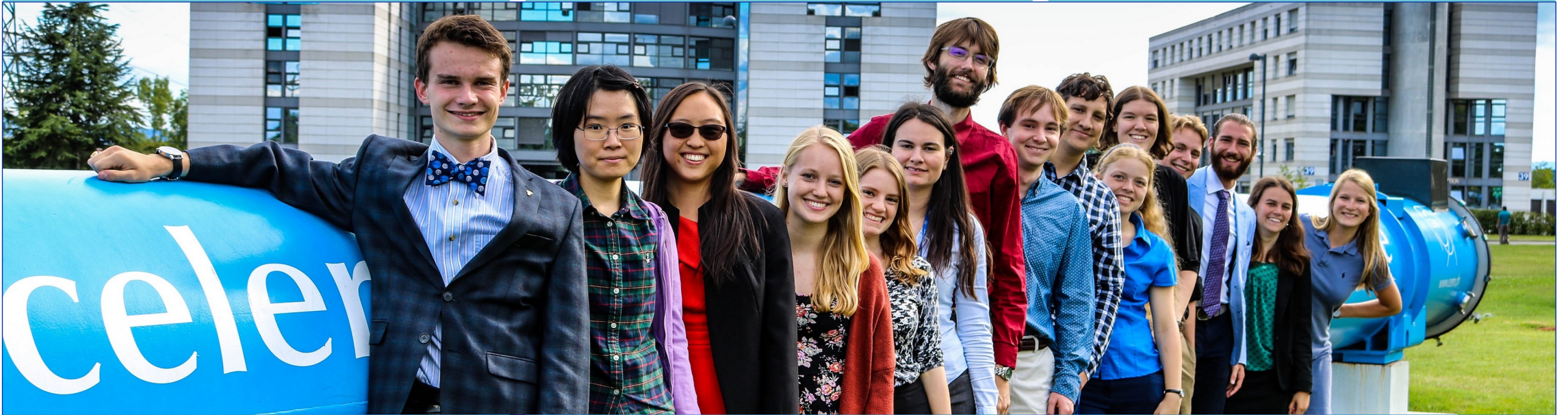


CERN trains the next generation of physicists, engineers and technicians

>3000 PhD students are registered at CERN.

600 PhD theses are completed each year.

300 undergraduate students in Summer programmes.



~800 fellows in research and applied physics, **engineering and computing**.

~200 **Technical and Doctoral Students** in applied physics, **engineering and computing**.

CERN organises schools for undergraduates and postgraduates, in all regions.

CERN science as inspiration



Science Gateway: New visitor centre at CERN inaugurated last year.



Technical Student Programme

~ 250
positions/year

”

A great place to start a career,
learn new skills, make new
friends..., *technical student in electronics*

Applied physics, electrical or electronics engineering, general or civil engineering, IT, mathematics and robotics, material and surface science, mechanical engineering...

- A project with a CERN supervisor
- An allowance of 3319 Swiss Francs per month (net of tax)
- A travel allowance
- A supplement if you have a spouse and/or have children
- Comprehensive health insurance
- 2.5 days of paid leave per month

Eligibility: minimum of 18 months of undergraduate studies

Length: 4 to 12 months

Doctoral Student Programme

~ 80 positions/year



An opportunity to meet important people, especially in the research field,
Doctoral student in Physics

Applied physics, electrical or electronics engineering, general or civil engineering, IT, mathematics and robotics, material and surface science, mechanical engineering...

- A research topic/project, leading to a PhD thesis co-supervised by the university thesis advisor and a CERN staff member
- An allowance of 3719 Swiss Francs per month (net of tax)
- A travel allowance
- A supplement if you have a spouse/partner and/or have children
- Comprehensive health insurance
- 2.5 days of paid leave per month

Eligibility: Enrolled in a doctoral programme in a university

Length: 36 months and 12 months of unpaid leave

Summer Student Programme

~ 300 positions/year



Can't imagine a better way to spend
my summer,
Summer student in computing

Applied physics, electrical or electronics engineering, general or civil engineering, IT, mathematics and robotics, material and surface science, mechanical engineering...

- Series of lectures delivered by world-wide renowned scientists, visits and workshops
- A project with a CERN supervisor
- Living allowance, incl. health insurance
- Accommodation at CERN hostel

Eligibility: 3 years of full-time studies at university level

Length: 8 to 13 weeks over summer

Early Career Professionals

~ 300
positions/year



The smartest way to kick-start your career and give it real momentum.

All disciplines in science, engineering, technical and administrative fields

- On-the-job learning by full immersion in a CERN team and their activities
- A stipend ranging from 4500 to 5500 Swiss Francs per month (net of tax)
- Comprehensive health insurance (for yourself, your spouse/partner, and children)
- Membership of the CERN Pension Fund
- Other benefits may include: installation grant, family, child and infant allowances; payment of travel expenses at the beginning and end of contract
- 2.5 days of paid leave per month.

Eligibility: From general secondary education to Master level, with max. 2 years of relevant experience after your highest degree

Length: From 6 to 36 months, in principle duration of 24 months



Experienced Project Graduates

~ 100 positions/year



Deepen your knowledge and expertise faster than anywhere else on earth.

Applied physics, electrical or electronics engineering, general or civil engineering, IT, mathematics and robotics, material and surface science, mechanical engineering...

- Work on well-defined project from A to Z with clear deliverables
- Deepen your expertise and expand your professional network by working with the best experts
- Opportunity to supervise student
- A stipend ranging from 6050 to 6650 Swiss Francs per month (net of tax)
- Comprehensive health insurance (for yourself, your spouse/partner, and children)
- Membership of the CERN Pension Fund
- Other benefits may include: installation grant, family, child and infant allowances; payment of travel expenses at the beginning and end of contract
- 2.5 days of paid leave per month

Eligibility: Master's with 2 to 6 years of relevant experience or PhD with up to 3 years of relevant experience

Length: From 6 to 36 months, in principle duration of 24 months

Research Fellows

~ 40 positions/year



Make your mark and hone your skills at a place like no other.



RESEARCH FELLOWS
TAKE PART!

Applied physics, theoretical physics, experimental physics, electrical or electronics engineering, mathematics and robotics, material and surface science, mechanical engineering...

- Define your own research project and benefit from international exposure
- A stipend ranging from 6650 to 7050 Swiss Francs per month (net of tax)
- Comprehensive health insurance (for yourself, your spouse/partner, and children)
- Membership of the CERN Pension Fund
- Other benefits may include: installation grant, family, child and infant allowances; payment of travel expenses at the beginning and end of appointment
- 2.5 days of paid leave per month

Eligibility:

- *Theoretical and Experimental Physics*: PhD with up to 6 years of relevant experience
- *Applied Sciences and Engineering*: PhD with up to 3 years of relevant experience

Length: From 6 to 36 months, in principle duration of 24 months



Staff positions

~ 150 positions/year



It's the chance to focus on being the very best at what you do.

All disciplines in science, engineering, technical and administrative fields

- Attractive compensation package
- Comprehensive health insurance (for yourself, your spouse/partner, and children)
- Membership of the CERN Pension Fund;
- Other benefits may include: (re)installation grant, family, child and infant allowances; payment of travel and removal expenses at the beginning and end of contract; unemployment coverage.
- 2.5 days of paid leave per month.

Eligibility: From general secondary education to PhD

Length: Limited duration contract (5 years). Subject to certain conditions, holders of limited-duration contracts may apply for an indefinite position



CERN - NTNU collaboration

- A long tradition of technical students from NTNU doing their Bachelor or Master thesis at CERN on projects in a number of technological domains
- CERN-NTNU Entrepreneurship week since 2008 and [NTNU-CERN-tech incubator since 2012](#)
- Formal [collaboration agreement signed in 2017](#)
- Collaboration extended in 2019 with [8 PhDs between NTNU and CERN](#)

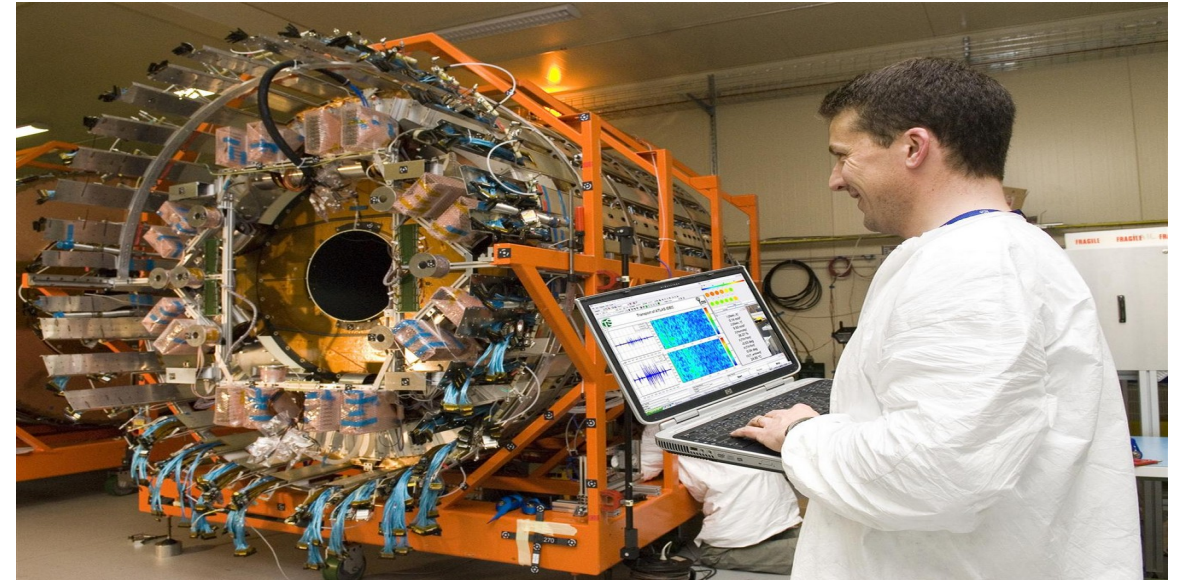
Mengder av utfordringer

- Faglig
 - På mange felt har CERN unike krav
- Mellommenneskelig
 - CERN yter tjenester til 80 forskjellige nasjonaliteter
- Sosialt
 - Utenfor CERNs gjerder snakker ikke alle engelsk ...



En typisk arbeidsdag

- Hva kan du gjøre for CERN?
 - CERN-kulturen fordrer initiativ
- Hva gjør CERN for deg?
 - Kurs: språk, ledelse, kommunikasjon, teknikk osv.
 - Tid til egenutvikling
- "Kjernetid" 8.30-17.30
 - Dog svært fleksibelt med en god lunsjpause



Et stimulerende miljø

- Banebrytende vitenskapsfolk
 - Nobelprisvinnere, primadonnaer, hippier
- Det fantes en verden uten World wide Web
 - “... where the web was born”
 - ”Vague but exciting ...”
- Akademiske foredrag
 - Forelesninger



Norsk miljø i Genève

Ansatte ved CERN

Spiser sammen, sosial omgang

Sjømannskirke med leseværelse

Ung i Sveits, taco-kveld, mor og barn treff, barnegruppe, gudstjenester osv.

Norsk kor i Genève

Med internasjonal schwung

Nordisk klubb

Tradisjonelle fester



©L. Berg llsbeth@genevalink.ch

CERN er ikke bare for nerder...

Alpene er ikke langt unna...



Internasjonalt miljø; fransk og engelsk offisielle språk

Sentral beliggenhet; tre timer med tog til Paris og Milano

Bra start på karrieren

Prosjekter utført på CERN gir konkrete resultater

- Ny teknologi for framtidige anvendelser
- Brukes ofte i produksjon for installasjoner på CERN

Opphold ved CERN gir internasjonal erfaring og nettverk som verdsettes senere

De fleste studenter og fellows/graduates fra CERN har gått videre til gode jobber, selv i dårlige tider

Fint oppslag i studentpressen



https://dusken.no/artikkel/28936/som-a-kollidere-to-naler-pa-en-kilometers-avs



Som å kollidere to nåler på ti kilometers avstand

Tekst: Mari Rødseth Foto: Jonas Halse Rygh Publisert: 14.11.2019 11:18



En journalist og en fotograf fra Under Dusken beskriver sine inntrykk av CERN.



WALT DISNEY Donald Duck

Partikkelplunder

Ole, Dole og Doffen har vunnet en fysikkonkurrans der premien er en tur til KVERN (Kjernefysikk, Vitenskapelige Eksperimenter og Råkule Naturfag), der forskere jobber med å finne ut hva alt i universet er laget av ...

Så de har en slags karusell?

Den er ikke for mennesker! Knaseren gjør at ørsmå partikler blir kastet mot hverandre i en enorm hastighet, slik at det dannes enda mindre partikler!

Og den heter faktisk K.N.A.S. - Kjernefysisk Nedbryter og Atom-Smadrer!

Der har vi Petter!

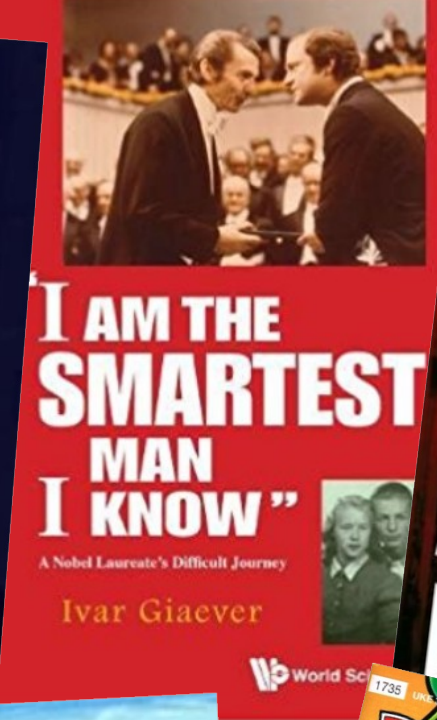
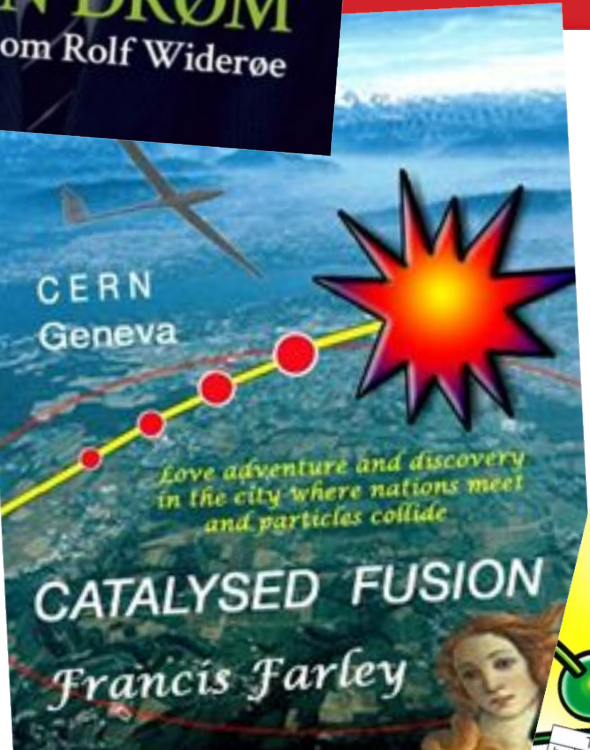
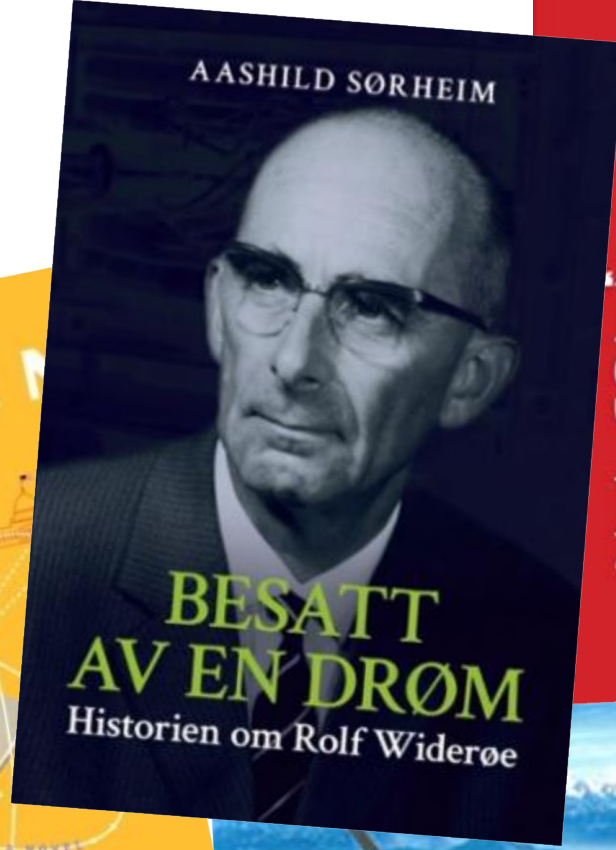
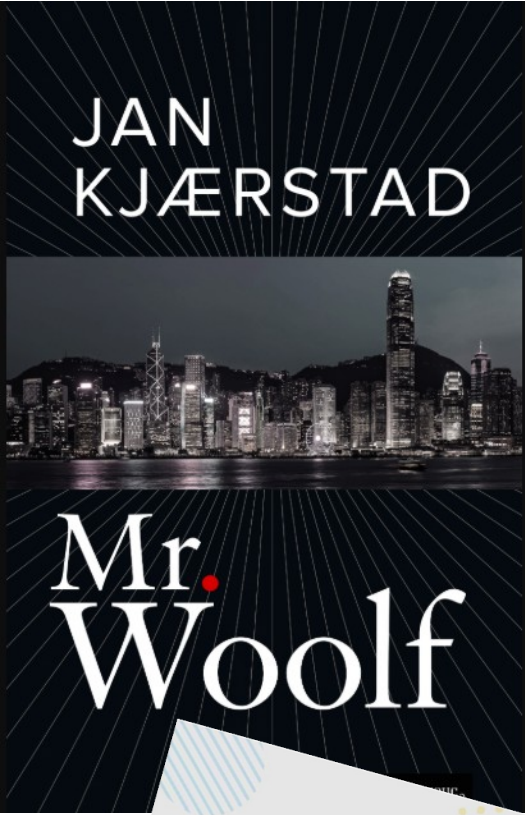
Velkommen til KVERN!



D 2016-334

Manus: Knut Nærum. Tegninger: Arlid Midthun.

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CERN for NTNU students



Come to CERN for an internship, can also be combined with a Bachelor or Master project.

- Application deadline 4 November ([Technical student programme](#)).
- Apply for 12 months if possible, better chances of getting selected.
- More [information on Innsida](#).

- Also [Doctoral student programme](#) and job opportunities for [young graduates](#) in [many disciplines](#).

Q & A

De [norske CERN sidene](#) har også endel [ofte stilte spørsmål og svar](#) om opphold ved CERN.

Noen erfaringer fra CERN; [Håvard](#), [Line](#) og [Vilde](#)

For mer inspirasjon, ta en titt her:

<https://www.youtube.com/user/CERNTV>



www.cern.ch