

The **European Organization for Nuclear Research** (French: *Organisation européenne pour la recherche nucléaire*), known as **CERN** (/sɜːrn/; French pronunciation: [sɛʁn]; derived from the name *Conseil européen pour la recherche nucléaire*), is a European research organization that operates the largest particle physics laboratory in the world. Established in 1954, the organization is based in a northwest suburb of Geneva on the Franco–Swiss border and has 22 member states.^[3] Israel is the only non-European country granted full membership.^[4] CERN is an official United Nations Observer.^[5]

The acronym CERN is also used to refer to the laboratory, which in 2016 had 2,500 scientific, technical, and administrative staff members, and hosted about 12,000 users. In the same year, CERN generated 49 petabytes of data.^[6]

CERN's main function is to provide the particle accelerators and other infrastructure needed for high-energy physics research – as a result, numerous experiments have been constructed at CERN through international collaborations. The main site at Meyrin hosts a large computing facility, which is primarily used to store and analyse data from experiments, as well as simulate events. Researchers need remote access to these facilities, so the lab has historically been a major wide area network hub. CERN is also the birthplace of the World Wide Web.^{[7][8]}

Contents

History

- Founding members
- Scientific achievements
- Computer science

Particle accelerators

- Current complex
 - Large Hadron Collider
- Decommissioned accelerators
- Possible future accelerators

Sites

Participation and funding

- Member states and budget
- Enlargement
- International relations
- Associated institutions

Open access publishing

Public exhibits

In popular culture

See also

References

External links

History

The convention establishing CERN was ratified on 29 September 1954 by 12 countries in Western Europe.^[1] The acronym CERN originally represented the French words for *Conseil Européen pour la Recherche Nucléaire* (European Council for Nuclear Research), which was a provisional council for building the laboratory, established by 12 European governments in 1952. The acronym was retained for the new laboratory after

European Organization for Nuclear Research Organisation européenne pour la recherche nucléaire



CERN's main site, from Switzerland looking towards France



Member states

Formation	September 29, 1954 ^[1]
Headquarters	Meyrin, Canton of Geneva, Switzerland
Membership	22 countries
Official languages	English and French
Council President	Ursula Bassler ^[2]



The 12 founding member states of CERN in 1954^[1]

the provisional council was dissolved, even though the name changed to the current *Organisation Européenne pour la Recherche Nucléaire* (European Organization for Nuclear Research) in 1954.^[9] According to [Lew Kowarski](#), a former director of CERN, when the name was changed, the abbreviation could have become the awkward OERN, and [Werner Heisenberg](#) said that this could "still be CERN even if the name is [not]".

CERN's first president was Sir [Benjamin Lockspeiser](#). [Edoardo Amaldi](#) was the general secretary of CERN at its early stages when operations were still provisional, while the first Director-General (1954) was [Felix Bloch](#).^[10]

The laboratory was originally devoted to the study of [atomic nuclei](#), but was soon applied to [higher-energy physics](#), concerned mainly with the study of interactions between [subatomic particles](#). Therefore, the laboratory operated by CERN is commonly referred to as the **European laboratory for particle physics** (*Laboratoire européen pour la physique des particules*), which better describes the research being performed there.

Director General	Fabiola Gianotti
Website	home.cern (https://home.cern/)

Founding members

At the sixth session of the CERN Council, which took place in Paris from 29 June - 1 July 1953, the convention establishing the organization was signed, subject to ratification, by 12 states. The convention was gradually ratified by the 12 founding Member States: [Belgium](#), [Denmark](#), [France](#), the [Federal Republic of Germany](#), [Greece](#), [Italy](#), the [Netherlands](#), [Norway](#), [Sweden](#), [Switzerland](#), the [United Kingdom](#), and [Yugoslavia](#).^[11]

Scientific achievements

Several important achievements in particle physics have been made through experiments at CERN. They include:

- 1973: The discovery of [neutral currents](#) in the [Gargamelle bubble chamber](#);^[12]
- 1983: The discovery of [W and Z bosons](#) in the [UA1](#) and [UA2](#) experiments;^[13]
- 1989: The determination of the number of light [neutrino families](#) at the [Large Electron-Positron Collider](#) (LEP) operating on the [Z boson peak](#);
- 1995: The first creation of [antihydrogen](#) atoms in the [PS210 experiment](#);^[14]
- 1999: The discovery of direct [CP violation](#) in the [NA48 experiment](#);^[15]
- 2010: The isolation of [38 atoms of antihydrogen](#);^[16]
- 2011: Maintaining [antihydrogen](#) for over 15 minutes;^[17]
- 2012: A [boson](#) with mass around 125 GeV/c² consistent with the long-sought [Higgs boson](#).^[18]

In September 2011, CERN attracted media attention when the [OPERA Collaboration](#) reported the detection of possibly [faster-than-light neutrinos](#).^[19] Further tests showed that the results were flawed due to an incorrectly connected [GPS](#) synchronization cable.^[20]

The 1984 [Nobel Prize for Physics](#) was awarded to [Carlo Rubbia](#) and [Simon van der Meer](#) for the developments that resulted in the discoveries of the [W](#) and [Z bosons](#). The 1992 [Nobel Prize for Physics](#) was awarded to CERN staff researcher [Georges Charpak](#) "for his invention and development of particle detectors, in particular the [multiwire proportional chamber](#)". The 2013 [Nobel Prize for Physics](#) was awarded to [François Englert](#) and [Peter Higgs](#) for the theoretical description of the [Higgs mechanism](#) in the year after the [Higgs boson](#) was found by CERN experiments.

Computer science

The [World Wide Web](#) began as a CERN project named [ENQUIRE](#), initiated by [Tim Berners-Lee](#) in 1989 and [Robert Cailliau](#) in 1990.^[21] Berners-Lee and Cailliau were jointly honoured by the [Association for Computing Machinery](#) in 1995 for their contributions to the development of the [World Wide Web](#).

Based on the concept of [hypertext](#), the project was intended to facilitate the sharing of information between researchers. The first website was activated in 1991. On 30 April 1993, CERN announced that the [World Wide Web](#) would be free to anyone. A copy^[22] of the original first webpage (<http://www.w3.org/History/19921103-hypertext/hypertext/WWW/TheProject.html>), created by Berners-Lee, is still published on the [World Wide Web Consortium's](#) website as a historical document.

Prior to the Web's development, CERN had pioneered the introduction of Internet technology, beginning in the early 1980s.^[23]

More recently, CERN has become a facility for the development of [grid computing](#), hosting projects including the [Enabling Grids for E-sciencE](#) (EGEE) and [LHC Computing Grid](#). It also hosts the [CERN Internet Exchange Point](#) (CIXP), one of the two main [internet exchange points](#) in Switzerland.

Particle accelerators

Current complex

CERN operates a network of six accelerators and a decelerator. Each machine in the chain increases the energy of particle beams before delivering them to experiments or to the next more powerful accelerator. Currently active machines are:

- Two linear accelerators generate low energy particles. LINAC 2 accelerates protons to 50 MeV for injection into the Proton Synchrotron Booster (PSB), and LINAC 3 provides heavy ions at 4.2 MeV/u for injection into the Low Energy Ion Ring (LEIR).^[24]
- The Proton Synchrotron Booster increases the energy of particles generated by the proton linear accelerator before they are transferred to the other accelerators.
- The Low Energy Ion Ring (LEIR) accelerates the ions from the ion linear accelerator, before transferring them to the Proton Synchrotron (PS). This accelerator was commissioned in 2005, after having been reconfigured from the previous Low Energy Antiproton Ring (LEAR).
- The 28 GeV Proton Synchrotron (PS), built during 1954—1959 and still operating as a feeder to the more powerful SPS.
- The Super Proton Synchrotron (SPS), a circular accelerator with a diameter of 2 kilometres built in a tunnel, which started operation in 1976. It was designed to deliver an energy of 300 GeV and was gradually upgraded to 450 GeV. As well as having its own beamlines for fixed-target experiments (currently COMPASS and NA62), it has been operated as a proton-antiproton collider (the SppS collider), and for accelerating high energy electrons and positrons which were injected into the Large Electron-Positron Collider (LEP). Since 2008, it has been used to inject protons and heavy ions into the Large Hadron Collider (LHC).
- The On-Line Isotope Mass Separator (ISOLDE), which is used to study unstable nuclei. The radioactive ions are produced by the impact of protons at an energy of 1.0–1.4 GeV from the Proton Synchrotron Booster. It was first commissioned in 1967 and was rebuilt with major upgrades in 1974 and 1992.
- The Antiproton Decelerator (AD), which reduces the velocity of antiprotons to about 10% of the speed of light for research of antimatter.
- The Compact Linear Collider Test Facility, which studies feasibility for the future normal conducting linear collider project.
- The AWAKE experiment, which is a proof-of-principle plasma wakefield accelerator.

Large Hadron Collider

Many activities at CERN currently involve operating the Large Hadron Collider (LHC) and the experiments for it. The LHC represents a large-scale, worldwide scientific cooperation project.

The LHC tunnel is located 100 metres underground, in the region between the Geneva International Airport and the nearby Jura mountains. The majority of its length is on the French side of the border. It uses the 27 km circumference circular tunnel previously occupied by the Large Electron–Positron Collider (LEP), which was shut down in November 2000. CERN's existing PS/SPS accelerator complexes are used to pre-accelerate protons and lead ions which are then injected into the LHC.

Seven experiments (CMS, ATLAS, LHCb, MoEDAL,^[25] TOTEM, LHC-forward and ALICE) are located along the collider; each of them studies particle collisions from a different aspect, and with different technologies. Construction for these experiments required an extraordinary engineering effort. For example, a special crane was rented from Belgium to lower pieces of the CMS detector into its underground cavern, since each piece weighed nearly 2,000 tons. The first of the approximately 5,000 magnets necessary for construction was lowered down a special shaft at 13:00 GMT on 7 March 2005.

The LHC has begun to generate vast quantities of data, which CERN streams to laboratories around the world for distributed processing (making use of a specialized grid infrastructure, the LHC Computing Grid). During April 2005, a trial successfully streamed 600 MB/s to seven different sites across the world.

The initial particle beams were injected into the LHC August 2008.^[26] The first beam was circulated through the entire LHC on 10 September 2008,^[27] but the system failed 10 days later because of a faulty magnet connection, and it was stopped for repairs on 19 September 2008.

The LHC resumed operation on 20 November 2009 by successfully circulating two beams, each with an energy of 3.5 teraelectronvolts (TeV). The challenge for the engineers was then to try to line up the two beams so that they smashed into each other. This is like "firing two needles across the Atlantic and getting them to hit each other" according to Steve Myers, director for accelerators and technology.

On 30 March 2010, the LHC successfully collided two proton beams with 3.5 TeV of energy per proton, resulting in a 7 TeV collision energy. However, this was just the start of what was needed for the expected discovery of the Higgs boson. When the 7 TeV experimental period ended, the LHC revved to 8 TeV (4 TeV per proton) starting March 2012, and soon began particle collisions at that energy. In July 2012, CERN scientists announced the discovery of a new sub-atomic particle that was later confirmed to be the Higgs boson.^[28] In March 2013, CERN announced that the measurements performed on the newly found particle allowed it to conclude that this is a Higgs boson.^[29] In early 2013, the LHC was deactivated for a two-year maintenance period, to strengthen the electrical connections between magnets inside the accelerator and for other upgrades.



This NeXT Computer used by British scientist Sir Tim Berners-Lee at CERN became the first Web server.

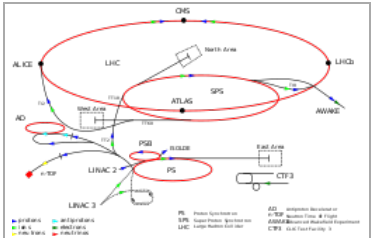


This Cisco Systems router at CERN was one of the first IP routers deployed in Europe.



A plaque at CERN commemorating the invention of the World Wide Web by Tim Berners-Lee and Robert Cailliau

CERN accelerator complex



List of current particle accelerators at CERN	
Linac 2	Accelerates protons
Linac 3	Accelerates ions
Linac 4	Accelerates negative hydrogen ions
AD	Decelerates antiprotons
LHC	Collides protons or heavy ions
LEIR	Accelerates ions
PSB	Accelerates protons or ions
PS	Accelerates protons or ions
SPS	Accelerates protons or ions



Construction of the CMS detector for LHC at CERN

On 5 April 2015, after two years of maintenance and consolidation, the LHC restarted for a second run. The first ramp to the record-breaking energy of 6.5 TeV was performed on 10 April 2015.^{[30][31]} In 2016, the design collision rate was exceeded for the first time.^[32] A second two-year period of shutdown is scheduled to begin at the end of 2018.

Decommissioned accelerators

- The original linear accelerator (LINAC 1).
- The 600 MeV Synchrocyclotron (SC) which started operation in 1957 and was shut down in 1991.
- The Intersecting Storage Rings (ISR), an early collider built from 1966 to 1971 and operated until 1984.
- The Large Electron-Positron Collider (LEP), which operated from 1989 to 2000 and was the largest machine of its kind, housed in a 27 km-long circular tunnel which now houses the Large Hadron Collider.
- The Low Energy Antiproton Ring (LEAR), commissioned in 1982, which assembled the first pieces of true antimatter, in 1995, consisting of nine atoms of antihydrogen. It was closed in 1996, and superseded by the Antiproton Decelerator.

Possible future accelerators

CERN, in collaboration with groups worldwide, is investigating two main concepts for future accelerators: A linear electron-positron collider with a new acceleration concept to increase the energy (CLIC) and a larger version of the LHC, a project currently named Future Circular Collider.^[33]

Sites

The smaller accelerators are on the main Meyrin site (also known as the West Area), which was originally built in Switzerland alongside the French border, but has been extended to span the border since 1965. The French side is under Swiss jurisdiction and there is no obvious border within the site, apart from a line of marker stones.

The SPS and LEP/LHC tunnels are almost entirely outside the main site, and are mostly buried under French farmland and invisible from the surface. However, they have surface sites at various points around them, either as the location of buildings associated with experiments or other facilities needed to operate the colliders such as cryogenic plants and access shafts. The experiments are located at the same underground level as the tunnels at these sites.

Three of these experimental sites are in France, with ATLAS in Switzerland, although some of the ancillary cryogenic and access sites are in Switzerland. The largest of the experimental sites is the Prévessin site, also known as the North Area, which is the target station for non-collider experiments on the SPS accelerator. Other sites are the ones which were used for the UA1, UA2 and the LEP experiments (the latter are used by LHC experiments).

Outside of the LEP and LHC experiments, most are officially named and numbered after the site where they were located. For example, NA32 was an experiment looking at the production of so-called "charmed" particles and located at the Prévessin (North Area) site while WA22 used the Big European Bubble Chamber (BEBC) at the Meyrin (West Area) site to examine neutrino interactions. The UA1 and UA2 experiments were considered to be in the Underground Area, i.e. situated underground at sites on the SPS accelerator.

Most of the roads on the CERN Meyrin and Prévessin sites are named after famous physicists, such as Richard Feynman, Niels Bohr, and Albert Einstein.

Participation and funding

Member states and budget

Since its foundation by 12 members in 1954, CERN regularly accepted new members. All new members have remained in the organization continuously since their accession, except Spain and Yugoslavia. Spain first joined CERN in 1961, withdrew in 1969, and rejoined in 1983. Yugoslavia was a founding member of CERN but quit in 1961. Of the 22 members, Israel joined CERN as a full member on 6 January 2014,^[34] becoming the first (and currently only) non-European full member.^[35]









The budget contributions of member states are computed based on their GDP.^[36]







Map of the Large Hadron Collider together with the Super Proton Synchrotron at CERN



Interior of office building 40 at the Meyrin site. Building 40 hosts many offices for scientists from the CMS and ATLAS collaborations.

Member state	Status since	Contribution (million CHF for 2017)	Contribution (fraction of total for 2017)	Contribution per capita ^[note 1] (CHF/person for 2017)
Founding Members ^[note 2]				
 Belgium	29 September 1954	30.9	2.76%	2.7
 Denmark	29 September 1954	19.8	1.7%	3.4
 France	29 September 1954	160.3	14.3%	2.6
 Germany	29 September 1954	228.9	20.4%	2.8
 Greece	29 September 1954	13.4	1.2%	1.6
 Italy	29 September 1954	118.9	10.6%	2.1
 Netherlands	29 September 1954	53.4	4.7%	3.0
 Norway	29 September 1954	32.4	2.8%	5.4
 Sweden	29 September 1954	30.6	2.7%	3.0
 Switzerland	29 September 1954	43.8	3.9%	4.9
 United Kingdom	29 September 1954	169.0	15.0%	2.4
 Yugoslavia ^[note 3]	29 September 1954 ^{[39][40]}	0	0%	0
Acceded Members ^[note 4]				
 Austria	1 June 1959	24.2	2.1%	2.9
 Spain ^[note 5]	1 January 1983 ^{[40][42]}	80.8	7.2%	2.0
 Portugal	1 January 1986	12.4	1.1%	1.3
 Finland	1 January 1991	15.0	1.3%	2.8
 Poland	1 July 1991	31.6	2.8%	0.8
 Hungary	1 July 1992	6.7	0.6%	0.7
 Czech Republic	1 July 1993	10.5	0.9%	1.1
 Slovakia	1 July 1993	5.4	0.5%	1.0
 Bulgaria	11 June 1999	3.3	0.3%	0.4
 Israel	6 January 2014 ^[34]	16.7	1.5%	2.7
 Romania	17 July 2016 ^[43]	11.1	1.0%	N/A
Associate Member in the pre-stage to Membership ^[note 6]				
 Serbia	15 March 2012 ^[44]	1.9	0.1%	0.1
 Cyprus	1 April 2016 ^[45]	1.0	%	
 Slovenia	4 July 2017 ^{[46][47]}	0.5	%	
Associate Members				
 Turkey	6 May 2015 ^[48]	4.7	%	

Member state	Status since	Contribution (million CHF for 2017)	Contribution (fraction of total for 2017)	Contribution per capita ^[note 1] (CHF/person for 2017)
 <u>Pakistan</u>	31 July 2015 ^[49]	1.4	%	
 <u>Ukraine</u>	5 Oct 2016 ^[50]	1.0	%	
 <u>India</u>	16 Jan 2017 ^[51]	11.6	%	
 <u>Lithuania</u>	8 Jan 2018 ^[52]		%	
Total Members, Candidates and Associates		1,142.1 ^[36]	99.4%	

1. Based on the population in 2017.

2. 12 founding members drafted the *Convention for the Establishment of a European Organization for Nuclear Research* which entered into force on 29 September 1954.^{[37][38]}

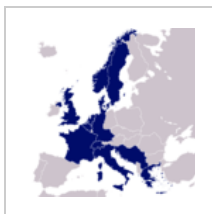
3. Yugoslavia left the organization in 1961.

4. Acceded members become CERN member states by ratifying the CERN convention.^[41]

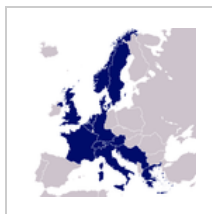
5. Spain was previously a member state from 1961 to 1969

6. Additional contribution from Candidates for Accession and Associate Member States.^[41]

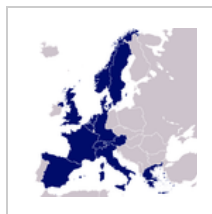
Maps of the history of CERN membership



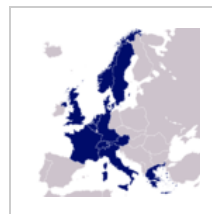
1954 (12 members):
CERN is founded ^{a[>]}
(1954-1990 borders)



1959 (13 members):
Austria joins
(1954-1990 borders)



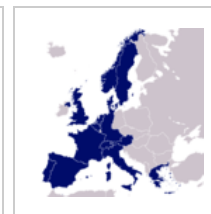
1961 (13 members):
Spain joins and
Yugoslavia leaves
(1954-1990 borders)



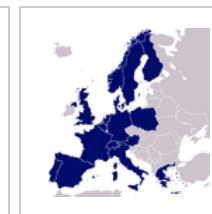
1969 (12 members):
Spain leaves
(1954-1990 borders)



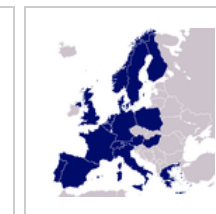
1983 (13 members):
Spain re-joins
(1954-1990 borders)



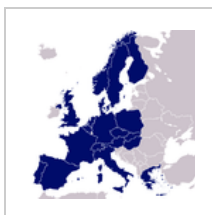
1985 (14 members):
Portugal joins
(1954-1990 borders)



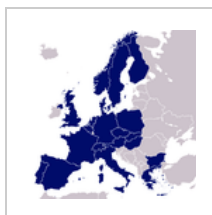
1991 (16 members):
Poland and Finland
join, and Germany
has been reunified
(post 1993 borders)



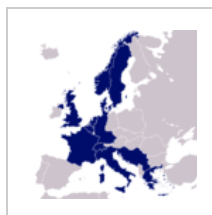
1992 (17 members):
Hungary joins (post
1993 borders)



1993 (19 members):
Czech Republic and
Slovakia join (post
1993 borders)











1999 (20 members):
Bulgaria joins (post
1993 borders)



Animated map
showing changes in
CERN membership
from 1954 until 1999
(borders are as at
dates of change)


Enlargement


Associate Members, Candidates:

-  Serbia became a candidate for accession to CERN on 19 December 2011, signed an association agreement on 10 January 2012^{[53][54]} and became an associate member in the pre-stage to membership on 15 March 2012.^[44] Full membership was approved by the CERN council on 13 December 2018 and will become effective upon the completion of certain procedures.^[55]
-  Turkey signed an association agreement on 12 May 2014^[56] and became an associate member on 6 May 2015.
-  Pakistan signed an association agreement on 19 December 2014^[57] and became an associate member on 31 July 2015.^{[58][59]}
-  Cyprus signed an association agreement on 5 October 2012 and became an associate Member in the pre-stage to membership on 1 April 2016.^[45]
-  Ukraine signed an association agreement on 3 October 2013. The agreement was ratified on 5 October 2016.^[50]
-  India signed an association agreement on 21 November 2016.^[60] The agreement was ratified on 16 January 2017.^[51]
-  Slovenia was approved for admission as an Associate Member state in the pre-stage to membership on 16 December 2016.^[46] The agreement was ratified on 4 July 2017.^[47]
-  Lithuania was approved for admission as an Associate Member state on 16 June 2017. The association agreement was signed on 27 June 2017 and ratified on 8 January 2018.^{[61][52]}

International relations

Three countries have observer status:^[62]


▪  Japan – since 1995

▪  Russia – since 1993

▪  United States – since 1997

Also observers are the following international organizations:

▪  UNESCO – since 1954


▪  European Commission – since 1985


▪ JINR – since 2014


Non-Member States (with dates of Co-operation Agreements) currently involved in CERN programmes are:^[63]


▪  Albania


▪  Algeria


▪  Argentina – 11 March 1992

▪  Armenia – 25 March 1994


▪  Australia – 1 November 1991


▪  Azerbaijan – 3 December 1997


▪  Bangladesh

▪  Belarus – 28 June 1994


▪  Bolivia


▪  Brazil – 19 February 1990 & October 2006

▪  Canada – 11 October 1996


▪  Chile – 10 October 1991


▪  China – 12 July 1991, 14 August 1997 & 17 February 2004


▪  Colombia – 15 May 1993


▪  Croatia – 18 July 1991


▪  Ecuador


▪  Egypt – 16 January 2006


▪  Estonia – 23 April 1996


▪  Georgia – 11 October 1996


▪  Iceland – 11 September 1996


▪  Iran – 5 July 2001

▪  Jordan – 12 June 2003.^[64] MoU with Jordan and SESAME, in preparation of a cooperation agreement signed in 2004.^[65]


▪  Lithuania – 9 November 2004


▪  Macedonia – 27 April 2009


▪  Malta – 10 January 2008^{[66][67]}


▪  Mexico – 20 February 1998


▪  Mongolia

▪  Montenegro – 12 October 1990


▪  Morocco – 14 April 1997

▪  New Zealand – 4 December 2003

▪  Peru – 23 February 1993

▪  Saudi Arabia – 21 January 2006

▪  South Africa – 4 July 1992

▪  South Korea – 25 October 2006

▪  United Arab Emirates – 18 January 2006

▪  Vietnam

CERN also has scientific contacts with the following countries:^[63]


▪  Cuba

▪  Ghana


▪  Ireland

▪  Latvia

▪  Lebanon

▪  Madagascar

▪  Malaysia

▪  Mozambique

▪  Palestine

▪  Philippines

▪  Qatar

▪  Rwanda

▪  Singapore

▪  Sri Lanka

▪  Taiwan

▪  Thailand

▪  Tunisia

▪  Uzbekistan

International research institutions, such as CERN, can aid in science diplomacy.^[68]

Associated institutions

▪ European Southern Observatory

▪ Swiss National Supercomputing Centre



ESO and CERN have a cooperation agreement.^[69]

Open access publishing

CERN has initiated an [open access publishing](#) project to convert scientific articles in high energy physics into [gold open access](#) by redirecting subscription fees. In the first phase from 2014-2016 3,000 libraries, consortia, research organisations, publishers and funding agencies in various countries participated.^[70] All publications by CERN authors are published with gold open access.^[71]

Public exhibits

Facilities at CERN open to the public include:

- [The Globe of Science and Innovation](#), which opened in late 2005 and is used four times a week for special exhibits.
- [The Microcosm museum on particle physics and CERN history](#).

CERN also provides daily tours to certain facilities such as the Synchro-cyclotron (CERN's first particle accelerator) and the superconducting magnet workshop.

In popular culture

- The band [Les Horribles Cernettes](#) was founded by women from CERN. The name was chosen so to have the same initials as the LHC.^{[72][73]}
- CERN's Large Hadron Collider is the subject of a (scientifically accurate) [rap](#) video starring Katherine McAlpine with some of the facility's staff.^{[74][75]}
- *[Particle Fever](#)*, a 2013 documentary, explores CERN throughout the inside and depicts the events surrounding the 2012 discovery of the [Higgs Boson](#)
- CERN is depicted in an episode of *[South Park](#)* (Season 13, Episode 6) called "Pinewood Derby". Randy Marsh, the father of one of the main characters, breaks into the "Hadron Particle Super Collider in Switzerland" and steals a "superconducting bending magnet created for use in tests with particle acceleration" to use in his son Stan's Pinewood Derby racer. Randy breaks into CERN dressed in disguise as Princess Leia from the *Star Wars* saga. The break-in is captured on surveillance tape which is then broadcast on the news.^[76]
- [John Titor](#), a self-proclaimed [time traveler](#), alleged that CERN would invent time travel in 2001.
- CERN is depicted in the [visual novel/anime series](#) *[Steins;Gate](#)* as SERN, a shadowy organization that has been researching time travel in order to restructure and control the world.
- In [Dan Brown's](#) mystery-thriller novel *[Angels & Demons](#)* and film of the same name, a canister of antimatter is stolen from CERN.^[77]
- In the popular children's series *[The 39 Clues](#)*, CERN is said to be an Ekaterina stronghold hiding the clue hydrogen.
- In Robert J. Sawyer's science fiction novel *[Flashforward](#)*, at CERN, the Large Hadron Collider accelerator is performing a run to search for the Higgs boson when the entire human race sees themselves twenty-one years and six months in the future.
- In season 3 episode 15 of the TV sitcom *[The Big Bang Theory](#)* titled "The Large Hadron Collision", [Leonard](#) and [Raj](#) travel to CERN to attend a conference and see the LHC.
- The 2012 student film *[Decay](#)*, which centers on the idea of the Large Hadron Collider transforming people into zombies, was filmed on location in CERN's maintenance tunnels.^[78]
- The Compact Muon Solenoid at CERN was used as the basis for the [Megadeth's](#) *[Super Collider](#)* album cover.
- In *[Super Lovers](#)*, Haruko (Ren's mother) worked at CERN, and Ren was taught by CERN professors
- CERN forms part of the [back story](#) of the massively multiplayer augmented reality game *[Ingress](#)*.^[79]
- In season 10 episode 6 of the BBC TV show *[Doctor Who](#)* titled "[Extremis](#)", CERN and its physicists are involved in a mysterious plot involving a book that causes everyone who reads it to kill themselves.
- In 2015, Sarah Charley, US communications manager for LHC experiments at CERN with graduate students Jesse Heilman of the University of California, Riverside, and Tom Perry and Laser Seymour Kaplan of the University of Wisconsin, Madison created a [parody video](#) (<https://www.youtube.com/watch?v=-1AF7GwAxfI>) of "Collide" a song by American artist [Howie Day](#).^[80] The lyrics were changed to be from the perspective of a proton in the Large Hadron Collider. After seeing the parody, Day re-recorded the song with the new lyrics and in February, 2017 Day released this [new version of "Collide"](#) in a video (<https://www.youtube.com/watch?v=1YB0xM9cgr8>) created during his visit to CERN.^[81]



The Globe of Science and Innovation at CERN



Line 18 goes to CERN

See also

- [CERN portal](#)
- [Joint Institute for Nuclear Research](#)
- [CERN Openlab](#)
- [Fermilab](#)
- [Large Hadron Collider](#) - Wikipedia book
- [Nederlandse Organisatie voor Wetenschappelijk Onderzoek](#)
- [Science and Technology Facilities council](#)
- [Science and technology in Switzerland](#)
- [Scientific Linux](#)
- [SLAC National Accelerator Laboratory](#)
- [World Wide Web](#)

References

1. "CERN.ch" (<http://public.web.cern.ch/public/en/About/History54-en.html>). CERN. Retrieved 20 November 2010.
2. "Ursula Bässler elected as next President of the CERN Council" (<https://home.cern/news/press-release/cern/dr-ursula-bassler-elected-next-president-cern-council>). CERN. Retrieved 15 February 2019.
3. "Member States" (<http://international-relations.web.cern.ch/International-Relations/ms/>). *International Relations*. CERN. Retrieved 25 November 2015.
4. "CERN to admit Israel as first new member state since 1999 - CERN Courier" (<http://cerncourier.com/cws/article/cern/55869>). *cerncourier.com*.
5. "Intergovernmental Organizations" (<https://www.un.org/en/sections/member-states/intergovernmental-organizations/index.html>). *www.un.org*.
6. "Annual Report 2016" (<https://cds.cern.ch/record/2270805/files/486-1611-1-SM.pdf>) (PDF). CERN. Retrieved 22 September 2017.
7. McPherson, Stephanie Sammartino (2009). *Tim Berners-Lee: Inventor of the World Wide Web* (<https://books.google.com/books?id=wK0xBWfL9GkC>). Twenty-First Century Books. ISBN 978-0-8225-7273-2. Archived (<https://web.archive.org/web/20160415133504/https://books.google.com/books?id=wK0xBWfL9GkC>) from the original on 15 April 2016.
8. Quittner, Joshua (29 March 1999). "Network Designer Tim Berners-Lee" (<http://www.time.com/time/magazine/article/0,9171,990627,00.html>). *Time Magazine*. Archived (<https://web.archive.org/web/20070815090521/http://www.time.com/time/magazine/article/0%2C9171%2C990627%2C00.html>) from the original on 15 August 2007. Retrieved 17 May 2010. (Subscription required (help)). "He wove the World Wide Web and created a mass medium for the 21st century. The World Wide Web is Berners-Lee's alone. He designed it. He loosed it on the world. And he more than anyone else has fought to keep it open, nonproprietary and free."
9. "The Name CERN" (<http://public.web.cern.ch/public/en/About/Name-en.html>). CERN. 30 September 2011. Retrieved 16 August 2012.
10. "People and things : Felix Bloch" (<https://cds.cern.ch/record/1730968>). *CERN Courier*. Retrieved 1 September 2015.
11. *The CERN convention was signed in 1953 by the 12 founding states **Belgium, Denmark, France, the Federal Republic of Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and Yugoslavia**, and entered into force on 29 September 1954.* (<https://home.cern/about/who-we-are/our-governance/member-states>). Our Member States, home.cern
12. "CERN.ch" (<http://public.web.cern.ch/public/en/About/History73-en.html>). CERN. Retrieved 20 November 2010.
13. "CERN.ch La" (<http://public.web.cern.ch/public/en/About/History83-en.html>). CERN. Retrieved 20 November 2010.
14. "CERN.ch" (<http://public.web.cern.ch/public/en/About/History95-en.html>). CERN. Retrieved 20 November 2010.
15. Fanti, V.; et al. (1999). "A new measurement of direct CP violation in two pion decays of the neutral kaon" (<http://na48.web.cern.ch/NA48/Welcome/papers/eprime97/eprime97.pdf>) (PDF). *Physics Letters B*. **465**: 335–348. arXiv:hep-ex/9909022 (<https://arxiv.org/abs/hep-ex/9909022>). Bibcode:1999PhLB..465..335F (<http://adsabs.harvard.edu/abs/1999PhLB..465..335F>). CiteSeerX 10.1.1.34.322 (<https://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.34.322>). doi:10.1016/S0370-2693(99)01030-8 (<https://doi.org/10.1016%2F0370-2693%2899%2901030-8>).
16. Thair Shaikh (18 November 2010). "Scientists capture antimatter atoms in particle breakthrough" (<http://edition.cnn.com/2010/WORLD/europe/11/18/switzerland.cern.antimatter/?hpt=Mid>). CNN.
17. Jonathan Amos (6 June 2011). "Antimatter atoms are corralled even longer" (<https://www.bbc.com/news/science-environment-13666892>). BBC.
18. CERN experiments observe particle consistent with long-sought Higgs boson | CERN press office (<http://press.cern/press-releases/2012/07/cern-experiments-observe-particle-consistent-long-sought-higgs-boson>). press.cern (2012-07-04). Retrieved on 2016-11-12.
19. Adrian Cho, *Neutrinos Travel Faster Than Light, According to One Experiment* (<http://www.sciencemag.org/news/2011/09/neutrinos-travel-faster-light-according-one-experiment>), Science NOW, 22 September 2011.
20. "OPERA experiment reports anomaly in flight time of neutrinos from CERN to Gran Sasso" (<http://press.cern/press-releases/2011/09/opera-experiment-reports-anomaly-flight-time-neutrinos-cern-gran-sasso>). CERN. Retrieved 12 November 2016.
21. "CERN.ch" (<http://public.web.cern.ch/Public/en/About/WebStory-en.html>). CERN. Retrieved 20 November 2010.
22. "The World Wide Web project" (<http://www.w3.org/History/19921103-hypertext/hypertext/WWW/TheProject.html>). W3C. Retrieved 20 November 2010.
23. "A Short History of Internet Protocols at CERN" (<http://ben.web.cern.ch/ben/TCPHIST.html>). CERN. Retrieved 20 November 2010.
24. "CERN Website – LINAC" (<http://linac2.home.cern.ch/linac2/default.htm>). CERN. Retrieved 20 November 2010.
25. CERN Courier, "MoEDAL becomes the LHC's magnificent seventh" (<http://cerncourier.com/cws/article/cern/42329>), 5 May 2010
26. Overbye, Dennis (29 July 2008). "Let the Proton Smashing Begin. (The Rap Is Already Written.)" (<https://www.nytimes.com/2008/07/29/science/29cernrap.html>). *The New York Times*.
27. "LHC First Beam" (<http://press.cern/past-events/lhc-first-beam>). CERN. Retrieved 12 November 2016.
28. Adrian Cho (13 July 2012). "Higgs Boson Makes Its Debut After Decades-Long Search". *Science*. **337** (6091): 141–143. doi:10.1126/science.337.6091.141 (<https://doi.org/10.1126%2Fscience.337.6091.141>). PMID 22798574 (<https://www.ncbi.nlm.nih.gov/pubmed/22798574>).
29. "New results indicate that particle discovered at CERN is a Higgs boson" (<http://press.cern/press-releases/2013/03/new-results-indicate-particle-discovered-cern-higgs-boson>). CERN. Retrieved 12 November 2016.



The statue of Shiva engaging in the Nataraja dance presented by the Department of Atomic Energy of India.

30. O'Lunaigh, Cian. "First successful beam at record energy of 6.5 TeV" (<https://home.cern/about/updates/2015/04/first-successful-beam-record-energy-65-tev>). *CERN: Accelerating science*. CERN. Retrieved 24 April 2015.
31. O'Lunaigh, Cian. "Proton beams are back in the LHC" (<https://home.cern/about/updates/2015/04/proton-beams-are-back-lhc>). *CERN: Accelerating science*. CERN. Retrieved 24 April 2015.
32. "LHC smashes targets for 2016 run" (<https://home.cern/about/opinion/2016/11/lhc-smashes-targets-2016-run-0>). 1 November 2016.
33. Ghosh, Pallab (2019-01-15). "Cern plans for even larger hadron collider" (<https://www.bbc.com/news/science-environment-46862486>). Retrieved 2019-01-17.
34. "Israel" (<http://international-relations.web.cern.ch/International-Relations/ms/il.html>). *International Relations*. CERN. Retrieved 5 July 2014.
35. Rahman, Fazlur. (2013-11-11) Israel may become first non-European member of nuclear research group CERN – Diplomacy and Defense Israel News (<http://www.haaretz.com/news/diplomacy-defense/1.557492>). Haaretz. Retrieved on 2014-04-28.
36. "Member States' Contributions – 2017" (<https://fap-dep.web.cern.ch/rpc/member-states-contributions>). *CERN website*. CERN. Retrieved 21 September 2017.
37. *ESA Convention* (<http://www.esa.int/esapub/sp/sp1300/sp1300EN1.pdf>) (PDF) (6th ed.). European Space Agency. September 2005. ISBN 978-92-9092-397-8.
38. "CONVENTION FOR THE ESTABLISHMENT OF A EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH" (<https://web.archive.org/web/20120701224642/https://council.web.cern.ch/council/en/Governance/Convention.html>). *CERN Council website*. CERN. Archived from the original (<http://council.web.cern.ch/council/en/governance/Convention.html>) on 1 July 2012. Retrieved 16 July 2012.
39. "Member States" (<http://international-relations.web.cern.ch/international-relations/ms/>). *International relations*. CERN. Retrieved 25 November 2015.
40. "Member States" (<http://timeline.web.cern.ch/timelines/Member-states>). *CERN timelines*. CERN. Retrieved 25 November 2015.
41. "CERN Member States" (<https://web.archive.org/web/20120701224138/https://council.web.cern.ch/council/en/MemberStates.html>). *CERN Council website*. CERN. Archived from the original (<http://council.web.cern.ch/council/en/MemberStates.html>) on 1 July 2012. Retrieved 16 July 2012.
42. "Spain" (<http://international-relations.web.cern.ch/International-Relations/ms/es.html>). *International Relations*. CERN. Retrieved 25 November 2015.
43. "CERN welcomes Romania as its twenty-second Member State | Media and Press Relations" (<http://press.cern/press-releases/2016/07/cern-welcomes-romania-its-twenty-second-member-state>). *press.cern*. Retrieved 2017-12-10.
44. "CERN Associate Members" (<http://international-relations.web.cern.ch/International-Relations/assoc/>). *International Relations*. CERN. 16 March 2012. Retrieved 5 July 2014.
45. "Cyprus" (<http://international-relations.web.cern.ch/International-Relations/assoc/cyprus.html>). *International Relations*. CERN. Retrieved 4 April 2016.
46. "Slovenia to enter the Associate Member State family of CERN" (<http://press.cern/press-releases/2016/12/slovenia-enter-associate-member-state-family-cern>). *Media and Press Relations*. CERN. 16 December 2016.
47. "Slovenia becomes an Associate Member in the pre-stage to Membership at CERN" (<http://press.cern/update/2017/07/slovenia-becomes-associate-member-pre-stage-membership-cern>). *Media and Press Relations*. CERN. 4 July 2017.
48. "Turkey" (<http://international-relations.web.cern.ch/International-Relations/assoc/turkey.html>). *International Relations*. CERN. Retrieved 28 August 2015.
49. "Pakistan" (<http://international-relations.web.cern.ch/International-Relations/assoc/pakistan.html>). *International Relations*. CERN. Retrieved 21 November 2016.
50. "Ukraine becomes an associate member of CERN" (<https://home.cern/news/news/cern/ukraine-becomes-associate-member-cern>). *Media and Press Relations*. CERN. 5 October 2016.
51. "India becomes Associate Member State of CERN" (<https://home.cern/about/updates/2017/01/india-becomes-associate-member-state-cern>). *CERN Updates*. CERN. 16 January 2017.
52. Harriet Kim Jarlett (8 January 2018). "Lithuania becomes Associate Member State of CERN" (<https://home.cern/about/updates/2018/01/lithuania-becomes-associate-member-state-cern>). *CERN*.
53. "Vesti – Srbija zvanično postala član CERN-a" (http://www.b92.net/info/vesti/index.php?yyyy=2012&mm=01&dd=10&nav_category=1331&nav_id=572568). B92. Retrieved 4 July 2012.
54. "Serbia expected to become CERN Associate Member" (<http://cms.web.cern.ch/news/serbia-expected-become-cern-associate-member>). *CMS Experiment web site*. CERN. 18 January 2012. Retrieved 5 July 2014.
55. <https://international-relations.web.cern.ch/stakeholder-relations/states/Serbia>
56. "Turkey to become Associate Member State of CERN" (<https://home.cern/about/updates/2014/05/turkey-become-associate-member-state-cern>). *CERN press release*. CERN. 12 May 2014. Retrieved 5 July 2014.
57. "Pakistan Becomes the First Associate CERN Member from Asia" (<http://www.mofa.gov.pk/pr-details.php?prID=2050>). *Government of Pakistan press releases*. Ministry of Foreign Affairs, Government of Pakistan. 20 June 2014. Retrieved 5 July 2014.
58. "Pakistan becomes Associate Member State of CERN" (<https://home.cern/about/updates/2015/07/pakistan-becomes-associate-member-state-cern>). *CERN*. Retrieved 2015-08-01.
59. "Pakistan officially becomes an associate member of CERN - The Express Tribune" (<http://tribune.com.pk/story/930265/pakistan-officially-becomes-an-associate-member-of-cern/>). Retrieved 2015-08-01.
60. "India to become Associate Member State of CERN" (<http://press.cern/press-releases/2016/11/india-become-associate-member-state-cern>). 21 November 2016.
61. "Lithuania has become associate member of CERN" (<https://www.lrp.lt/en/press-centre/press-releases/lithuania-has-become-associate-member-of-cern/27822>). *www.lrp.lt*.
62. "Observers" (<http://international-relations.web.cern.ch/International-Relations/obs/>). *International Relations*. CERN. Retrieved 15 December 2015.
63. "Member states" (<https://home.cern/about/member-states>). CERN. Retrieved 3 October 2017.
64. "Jordan" (<http://international-relations.web.cern.ch/international-relations/nms/jordan.html>). *International Relations*. CERN. Retrieved 4 July 2012.
65. "SESAME" (<https://web.archive.org/web/20120701224730/http://international-relations.web.cern.ch/International-Relations/orgints/sesame.html>). *International Relations*. CERN. 17 October 2011. Archived from the original (<http://international-relations.web.cern.ch/International-Relations/orgints/sesame.html>) on 1 July 2012. Retrieved 4 July 2012.
66. "Prime Minister of Malta visits CERN" (<http://cds.cern.ch/journal/CERNBulletin/2008/06/News%20Articles/1083445>). CERN. 10 January 2008. Retrieved 23 May 2014.
67. "Malta signs agreement with CERN" (<http://www.timesofmalta.com/articles/view/20080111/local/malta-signs-agreement-with-cern.191318>). Times of Malta. 11 January 2008. Retrieved 23 May 2014.
68. Quevedo, Fernando (July 2013). "The Importance of International Research Institutions for Science Diplomacy" (<http://www.sciencediplomacy.org/perspective/2013/importance-international-research-institutions-for-science-diplomacy>). *Science & Diplomacy*. **2** (3).
69. "ESO and CERN Sign Cooperation Agreement" (<http://www.eso.org/public/announcements/ann15098/>). Retrieved 21 December 2015.

70. Loizides, F.; Smidt, B. (2016). *Positioning and Power in Academic Publishing: Players, Agents and Agendas: Proceedings of the 20th International Conference on Electronic Publishing* (<http://ebooks.iospress.nl/book/positioning-and-power-in-academic-publishing-players-agents-and-agendas-proceedings-of-the-20th-international-conference-on-electronic-publishing>). IOS Press. p. 9. ISBN 978-1-61499-649-1.
71. Open Access Policy for CERN Physics Publications (<https://cds.cern.ch/record/1955574>), CERN-OPEN-2014-049, 27. April 2017
72. Malcolm W Brown (29 December 1998). "Physicists Discover Another Unifying Force: Doo-Wop" (<http://musicclub.web.cern.ch/MusiClub/bands/cernettes/Press/NYT.pdf>) (PDF). *The New York Times*. Retrieved 2010-09-21.
73. Heather McCabe (10 February 1999). "Grrl Geeks Rock Out" (<http://musicclub.web.cern.ch/MusiClub/bands/cernettes/Press/Wired.pdf>) (PDF). *Wired News*. Retrieved 2010-09-21.
74. "Large Hadron Rap" (<https://www.youtube.com/watch?v=j50ZssEojtM>). *YouTube*. Retrieved 20 November 2010.
75. "Large Hadron Collider Rap Video Is a Hit" (<http://news.nationalgeographic.com/news/2008/09/080910-odd-particl-AP.html>), National Geographic News. 10 September 2008. Retrieved 13 August 2010.
76. "Southparkstudios.com" (<http://www.southparkstudios.com/full-episodes/s13e06-pinewood-derby>). South Park Studios. Retrieved 25 May 2011.
77. "Angels and Demons - the science behind the story" (<http://angelsanddemons.web.cern.ch/>). CERN. Retrieved 29 July 2017.
78. Boyle, Rebecca (31 October 2012). "Large Hadron Collider Unleashes Rampaging Zombies" (<http://www.popsci.com/science/article/2012-10/physics-students-film-zombie-movie-large-hadron-collider>). Retrieved 22 November 2012.
79. A year of Google Ingress (<https://www.wired.com/2014/01/a-year-of-google-ingress/>) January 2014
80. "Musician Howie Day records love song to physics | CERN" (<https://home.cern/news/news/cern/musician-howie-day-records-love-song-physics>). *home.cern*. Retrieved 2018-11-26.
81. "Howie Day records love song to physics" (<https://www.symmetrismagazine.org/article/howie-day-records-love-song-to-physics>). *symmetry magazine*. Retrieved 2018-11-26.

External links

- Official website (<https://home.cern/>)
- *The emerald city - CERN at 50* (<https://www.economist.com/science-and-technology/2004/03/25/the-emerald-city>) by The Economist
- *CERN Courier* - International journal of high-energy physics (<http://cerncourier.com/>)
- *Big Bang Day: The Making of CERN* (<https://www.bbc.co.uk/programmes/b00d9b4b>), September 2008, A BBC Radio program

Retrieved from "<https://en.wikipedia.org/w/index.php?title=CERN&oldid=883528994>"

This page was last edited on 15 February 2019, at 23:02 (UTC).

Text is available under the Creative Commons Attribution-ShareAlike License; additional terms may apply. By using this site, you agree to the [Terms of Use](#) and [Privacy Policy](#). Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.