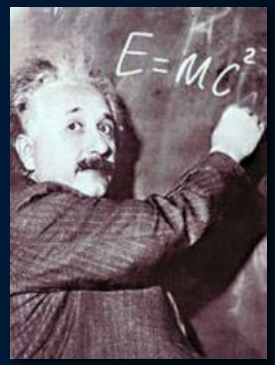
Past – Present - Future

Christoph Schäfer 18.7.2018 Poltava

The Mission of CERN

- **Push back** the frontiers of knowledge

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

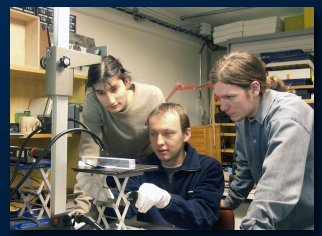


- **Develop** new technologies for accelerators and detectors

  Information technology - the Web and the GRID

  Medicine - diagnosis and therapy

- **Train** scientists and engineers of tomorrow



- **Unite** people from different countries and cultures

Today:
22 Member States and 8 associate member states

~ 2500 staff
~ 1800 other paid personnel
~ 13000 scientific users

Budget (2018) ~ 1100 MCHF

Member States: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland and United Kingdom

Associate Members in the Pre-Stage to Membership: Cyprus, Serbia, Slovenia

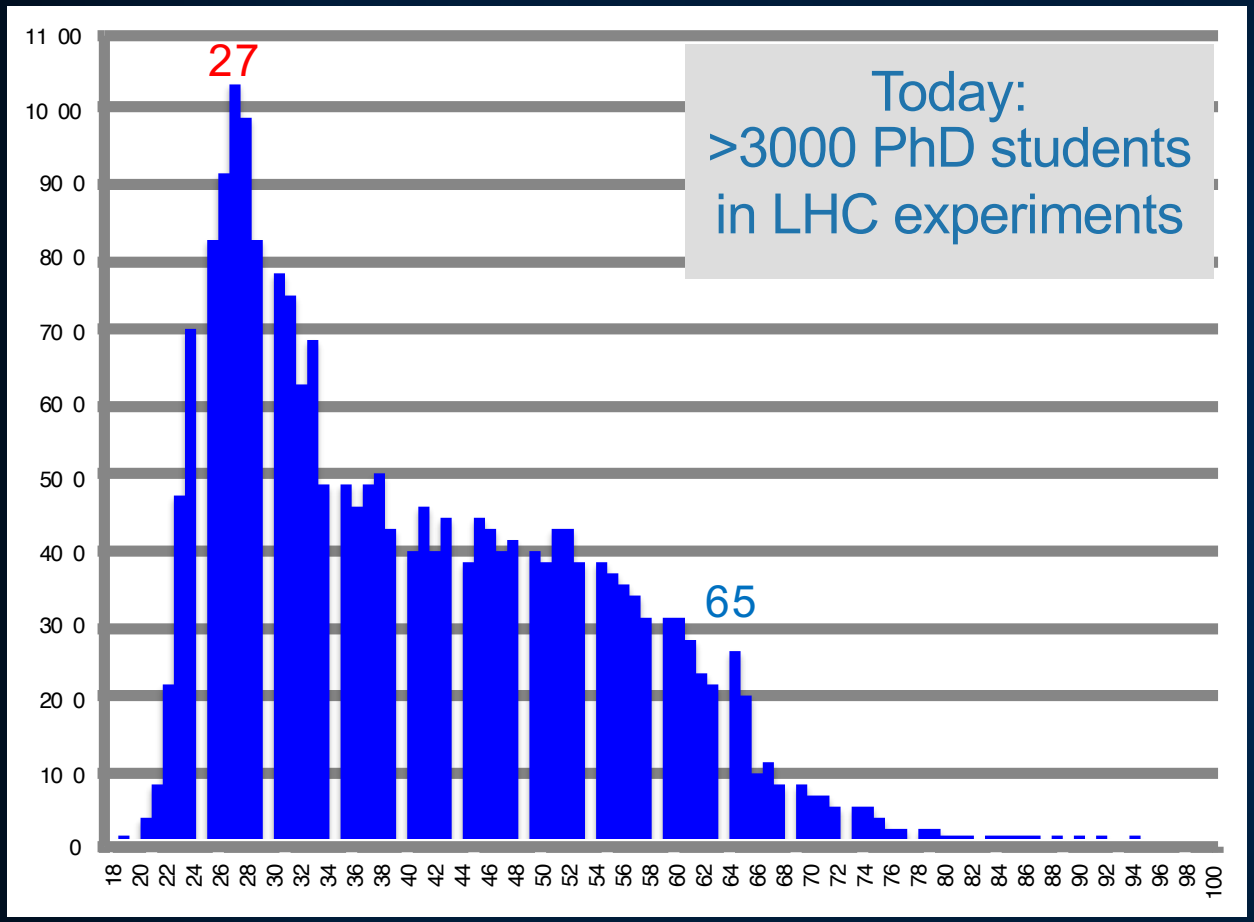
Associate Member States: India, Lithuania, Pakistan, Turkey, Ukraine

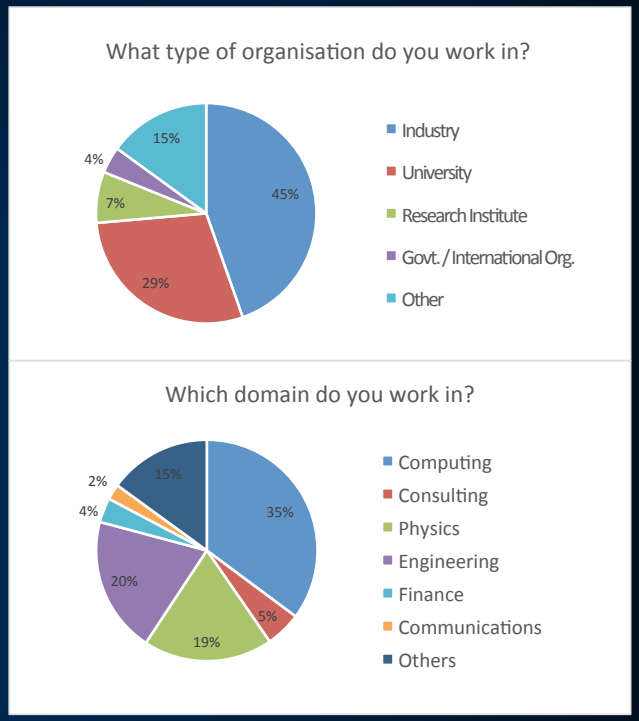
Applications for Membership or Associate Membership: Brazil, Croatia

Observers to Council: Japan, Russia, United States of America; European Union, JINR and UNESCO

Age Distribution of Scientists

- and where they go afterwards

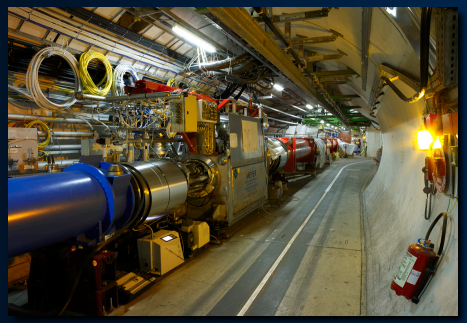




They do not all stay: where do they go?

Innovation
Education
CERN
uniting people
Research

CERN: Our Core Competences



Accelerating particle beams

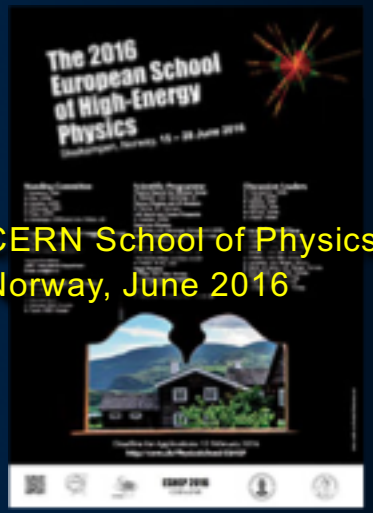
Detecting particles

Large-scale computing (Grid)

CERN Education Activities

Scientists at CERN
Academic Training Programme

Young Researchers
CERN School of High Energy Physics
CERN School of Computing
CERN Accelerator School



CERN School of Physics
Norway, June 2016

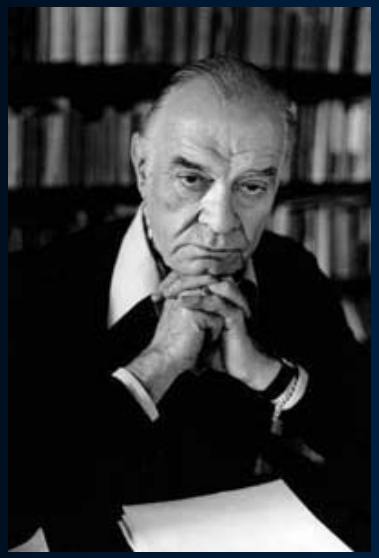
Physics Students
Summer Students Programme

CERN Teacher Schools
International and National Programmes

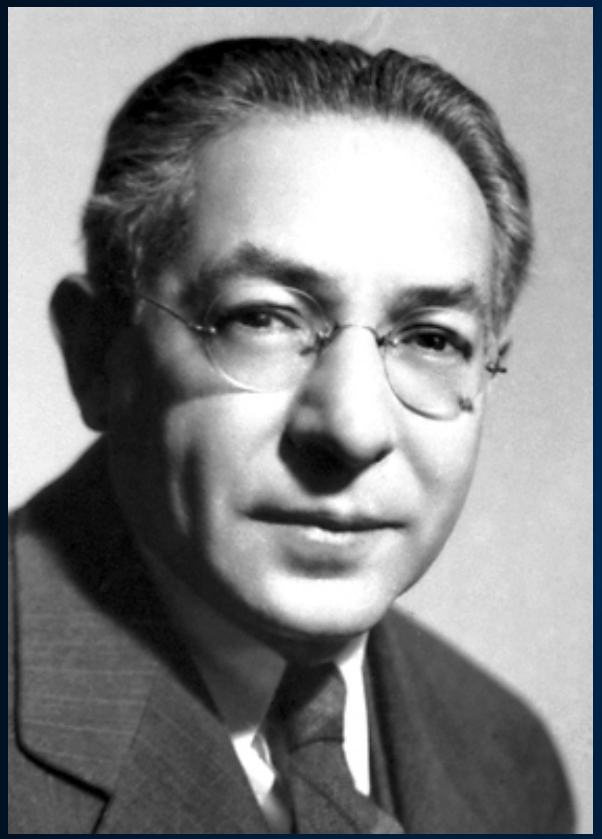
History and Highlights

1949: The origins of CERN in Lausanne

- European science was depleted after the war
- Nuclear scientists wanted to do something for peace
- Political and scientific consensus
- Denis de Rougemont and Louis de Broglie put forward a proposal at the European Cultural Conference in Lausanne in 1949

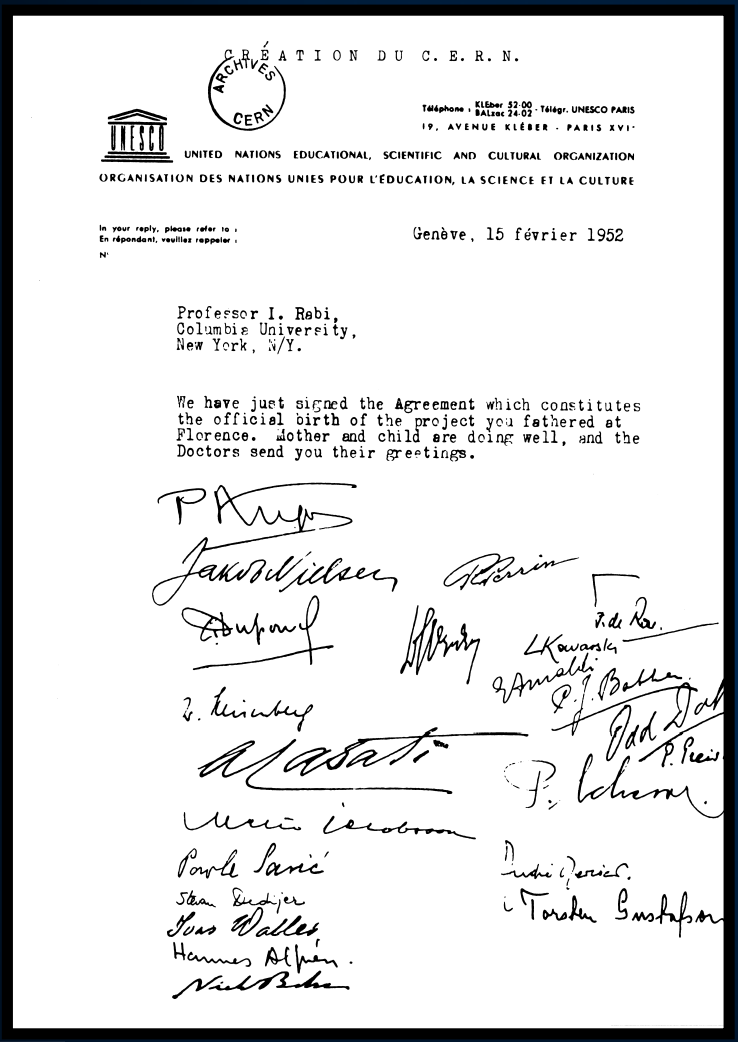


1950: UNESCO General Conference, Florence



American Nobel laureate, Isidor Rabi tables a resolution authorizing UNESCO to: *"assist and encourage the formation of regional research laboratories in order to increase international scientific collaboration…"*

1951: UNESCO intergovernmental meeting, Paris



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ARCHIVES CERN

UNESCO

Téléphone : KLÉber 52-00 - Télégr. UNESCO PARIS
19, AVENUE KLÉBER - PARIS XVI[e]

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
ORGANISATION DES NATIONS UNIES POUR L'ÉDUCATION, LA SCIENCE ET LA CULTURE

In your reply, please refer to :
En répondant, veuillez rappeler :
N°

Genève, 15 février 1952

Professor I. Rabi,
Columbia University,
New York, N/Y.

We have just signed the Agreement which constitutes the official birth of the project you fathered at Florence. Mother and child are doing well, and the Doctors send you their greetings.

At a meeting of UNESCO in Paris in December 1951, the first resolution concerning the establishment of a European Council for Nuclear Research was adopted. Two months later, 11 countries signed an agreement establishing the provisional Council – the acronym CERN was born.

1952: The choice of Geneva

Sur le terrain du futur institut nucléaire

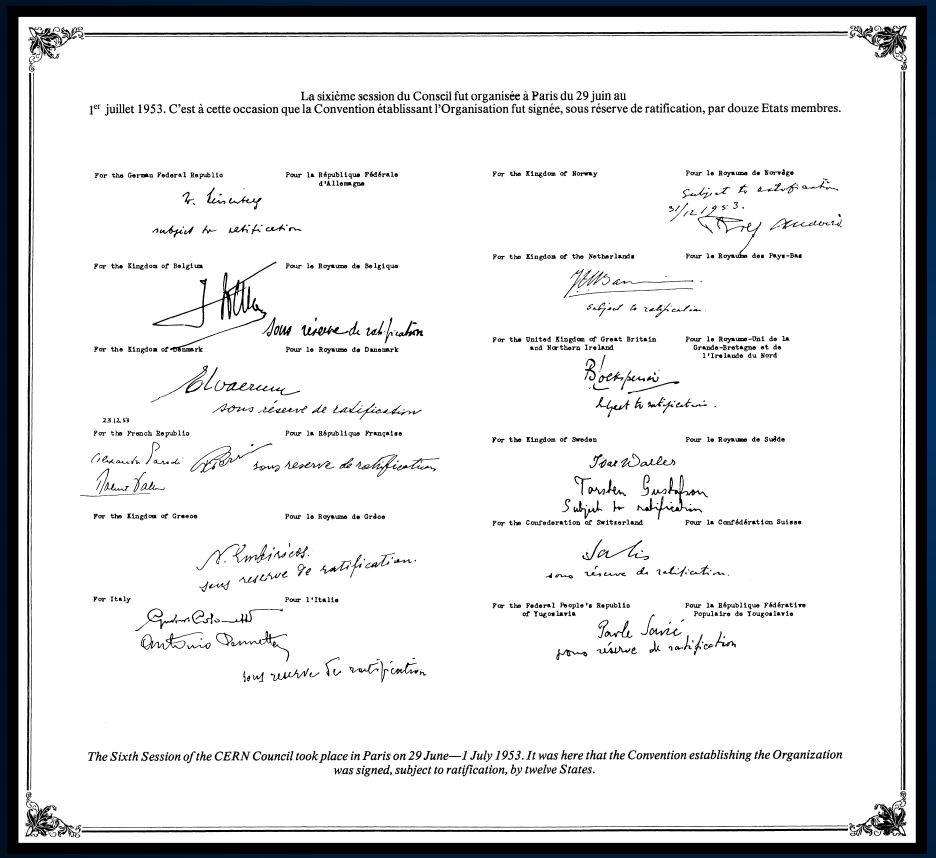
Sous la conduite de M. A. Picot, les membres du Conseil européen pour la recherche nucléaire se sont rendus hier à Meyrin pour reconnaître le terrain où s'élèvera le Centre nucléaire (voir en Dernière heure)

(Photo Freddy Bertrand, Genève)

La Suisse du 30 octobre 1953

At the provisional Council's third session in October 1952, Geneva was chosen as the site of the future Laboratory. This choice was finally ratified in a referendum organized by the Canton of Geneva in June 1953.

1954: The organization is born



La sixième session du Conseil fut organisée à Paris du 29 juin au 1er juillet 1953. C'est à cette occasion que la Convention établissant l'Organisation fut signée, sous réserve de ratification, par douze Etats membres.

For the German Federal Republic — Pour la République Fédérale d'Allemagne
subject to ratification

For the Kingdom of Belgium — Pour le Royaume de Belgique
sous réserve de ratification

For the Kingdom of Denmark — Pour le Royaume de Danemark
sous réserve de ratification
28.12.53

For the French Republic — Pour la République Française
sous réserve de ratification

For the Kingdom of Greece — Pour le Royaume de Grèce
sous réserve de ratification.

For Italy — Pour l'Italie
sous réserve de ratification

For the Kingdom of Norway — Pour le Royaume de Norvège
Subject to ratification
31/12/53

For the Kingdom of the Netherlands — Pour le Royaume des Pays-Bas
subject to ratification

For the United Kingdom of Great Britain and Northern Ireland — Pour le Royaume-Uni de la Grande-Bretagne et de l'Irlande du Nord
Subject to ratification

For the Kingdom of Sweden — Pour le Royaume de Suède
Subject to ratification

For the Confederation of Switzerland — Pour la Confédération Suisse
sous réserve de ratification.

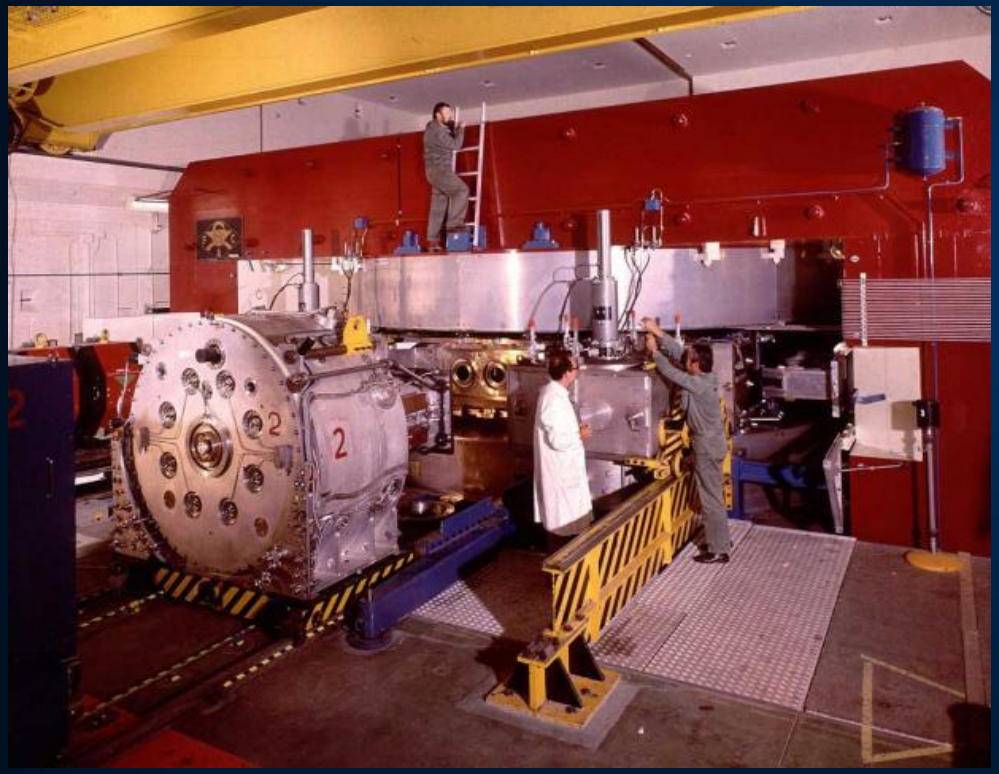
For the Federal People's Republic of Yugoslavia — Pour la République Fédérative Populaire de Yougoslavie
sous réserve de ratification

The Sixth Session of the CERN Council took place in Paris on 29 June—1 July 1953. It was here that the Convention establishing the Organization was signed, subject to ratification, by twelve States.

The CERN Convention, established in July 1953, was ratified by the 12 founding Member States: Belgium, Denmark, France, the Federal Republic of Germany, Greece, Italy, the Netherlands, Norway, Sweden, Switzerland, the UK, and Yugoslavia. On 29 September 1954, the European Organization for Nuclear Research officially came into being. CERN was dissolved but the acronym remains.

1957: CERN's first accelerator: the Synchrocyclotron

1957: CERN's first accelerator: the Synchrocyclotron



The SC provided a beam of 600 MeV for particle physics (until 1964) and nuclear physics (until 1990 for ISOLDE)

33 years of successful operation!

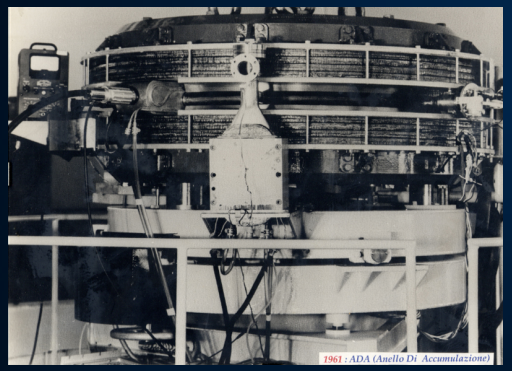
1958: CERN’s first experiment

In July 1958, Tito Fazzini, Giuseppe Fidecaro, Alec Merrison, Helmut Paul and Alvin Tollestrup produced conclusive evidence that approximately one pion in ten thousand decayed into an electron and a neutrino, as predicted by the weak interaction theory: the first of CERN's great discoveries.

1959: The Proton Synchrotron - CERN's first big machine

Start up of the CERN Proton Synchrotron, assisted by

Hildred Blewett from Brookhaven….

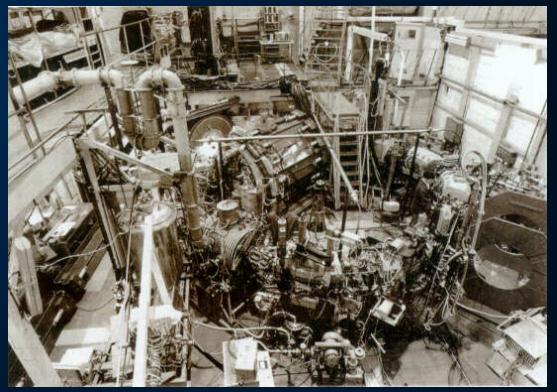


1961: ADA at Frascati…

The late 1950s saw the healthy competitive collaboration between the US, Soviet Union and the rest of Europe that continues to this day…

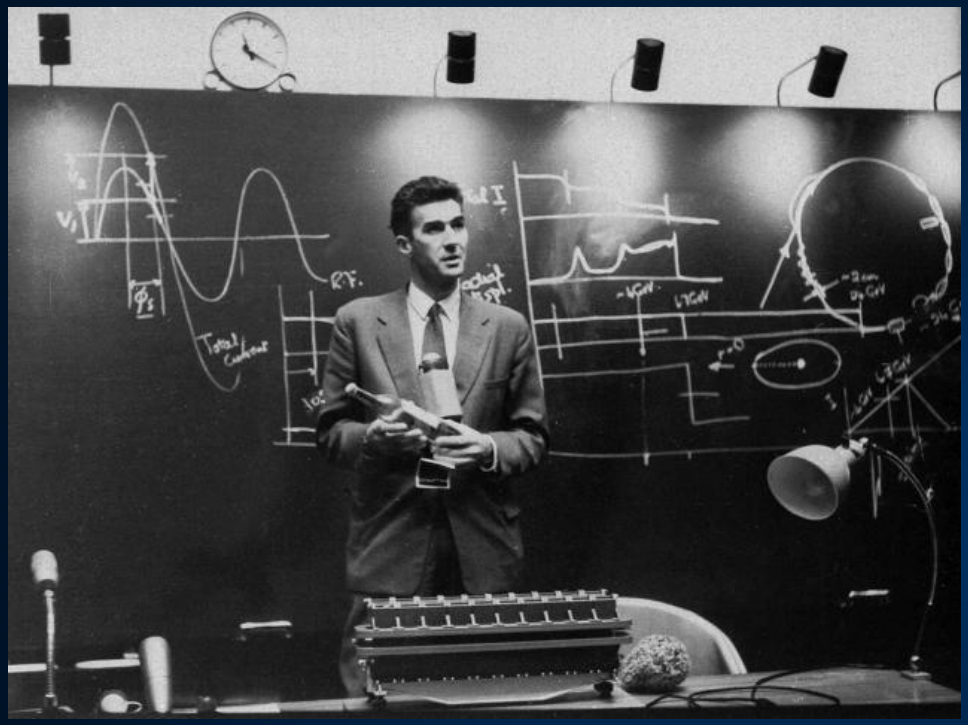
… who shared the technique of strong focusing, invented at

Brookhaven, with her European colleagues.



… and VEPP-1 at Novosibirsk

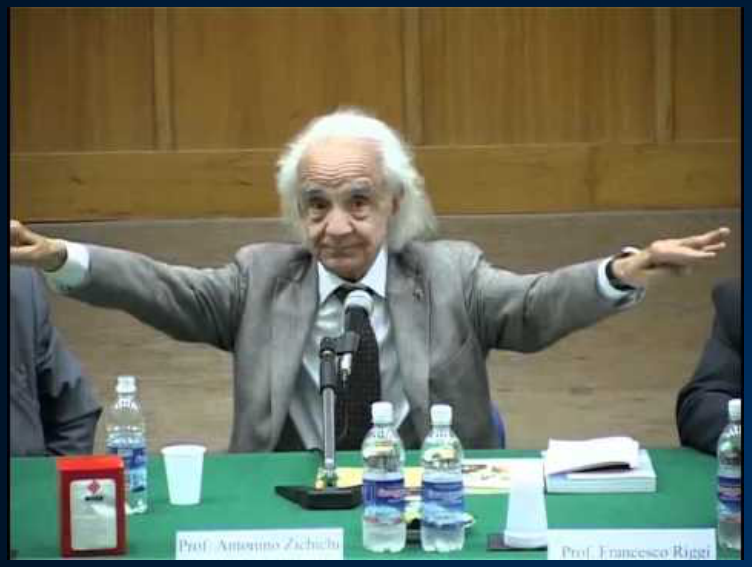
1959: The Proton Synchrotron - CERN's first big machine



John Adams – CERN DG – with a Vodka bottle from Dubna: to be emptied when the PS passed the Synchrophasotron's energy record of 10 GeV.

The PS accelerated protons up to 28 GeV – for a brief period the PS was the word's highest energy accelerator

1965: Experiments at the PS

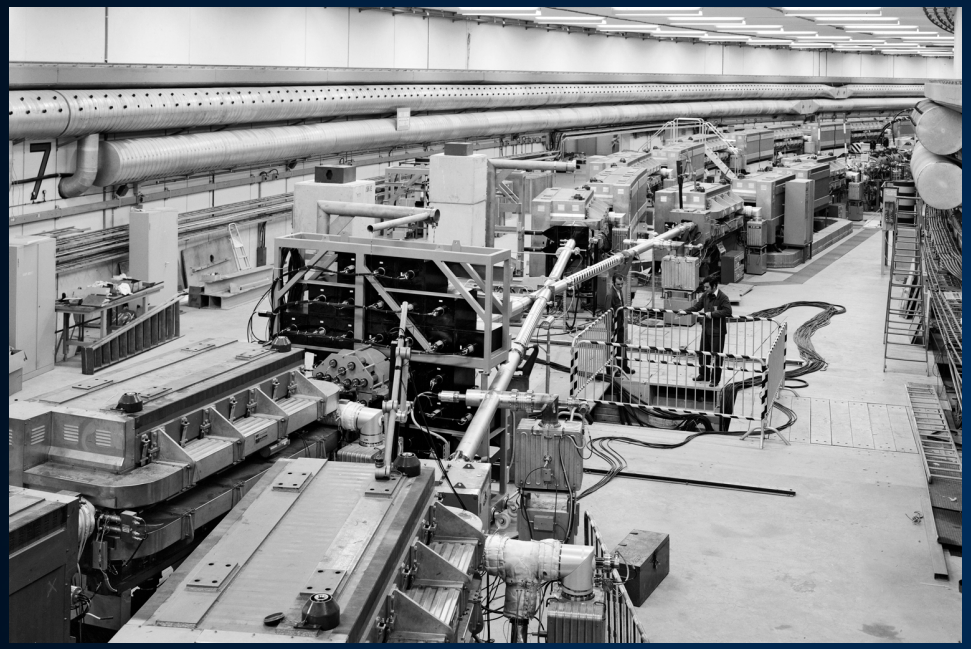


By 1965 all three particles that make the atom were known including their antiparticles.

Question was: do antiparticles stick together as particles do?

Antonino Zichichi at the PS and Leon Lederman at Brookhaven observed simultaneously an antinucleus – antideuterium.

1965: Approval of the Intersecting Storage Rings: The world's first hadron collider



Huge gain of collision energy is gained by shooting protons head on instead of a fixed target

Two interconnected rings are used to pile up protons coming from the PS

1971: First collisions at the ISR: The world's first hadron collider

New accelerator concepts were demonstrated at the ISR – Stochastic Cooling by Simon van der Meer

The ISR was in operation for 13 years, paving the way to the SPS.

Kjell Johnsen announcing the first interactions from colliding proton beams

1967: Looking to the East…

In 1967, CERN signed an agreement with the USSR that led to exchanges of personnel and equipment between CERN and Serpukhov.

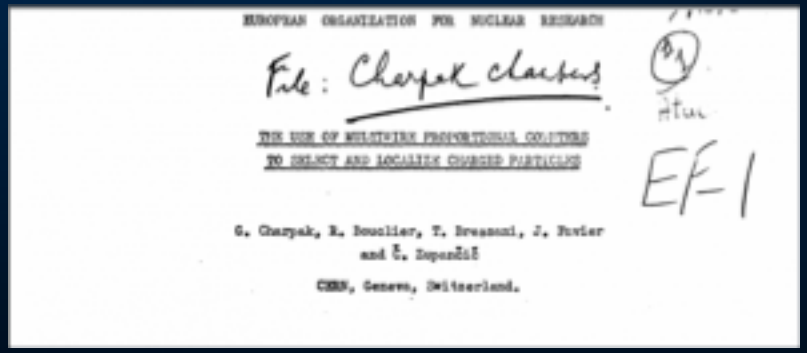
Earlier in the decade, CERN had been the scene of the first scientific contacts between East and West Germany following the erection of the Berlin wall..

1967: The arrival of a new friendly rival: Fermilab

1968: MWPC – revolutionising the way particle physics is done

Detecting particles was a mainly a manual, tedious and labour intensive job – unsuited for rare particle decays

George Charpak developed the MultiWire Proportional Chamber – detection is now electronically done and 1000 times higher counting rate!



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

File: Charpak classics

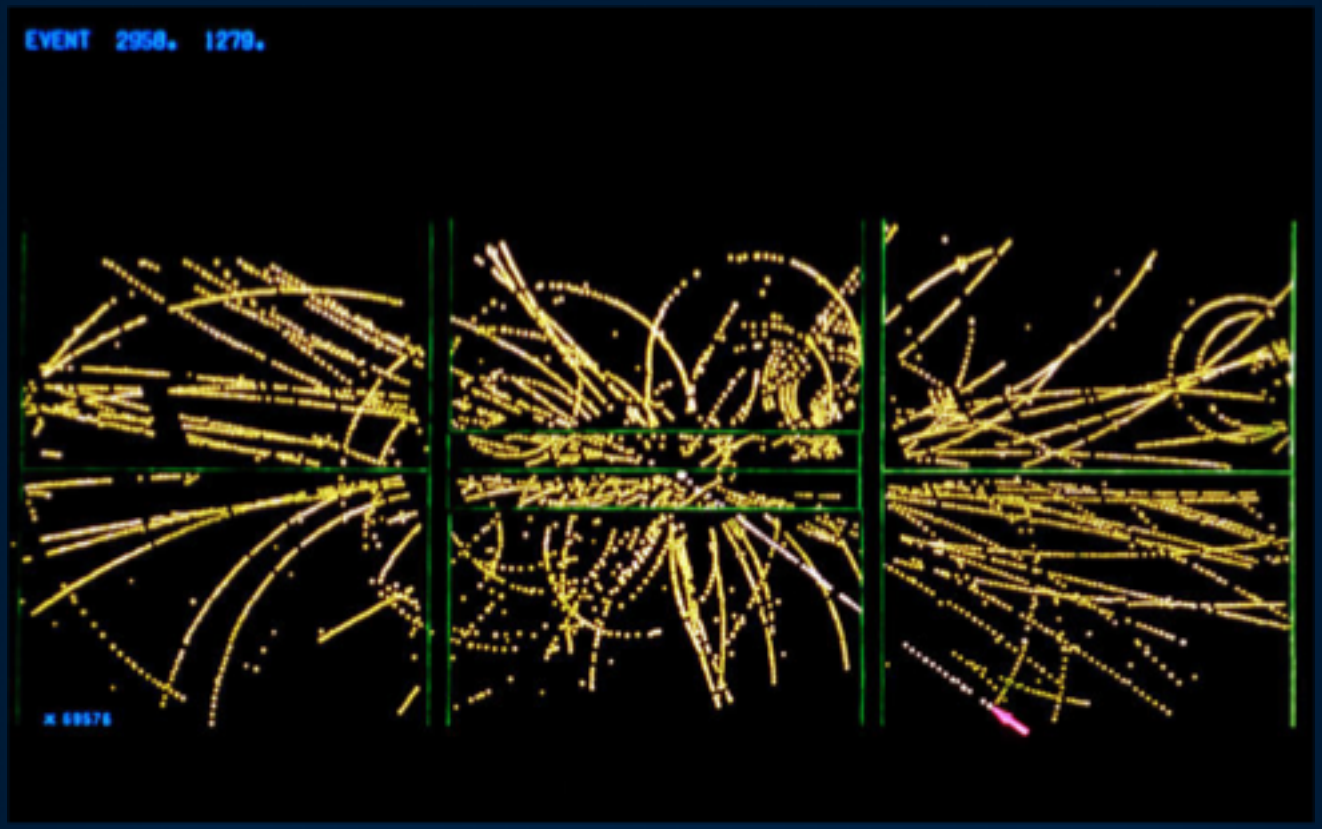
EF-1

THE USE OF MULTIWIRE PROPORTIONAL COUNTERS
TO SELECT AND LOCALIZE CHARGED PARTICLES

G. Charpak, R. Bouclier, T. Bressani, J. Favier and C. Zupančič

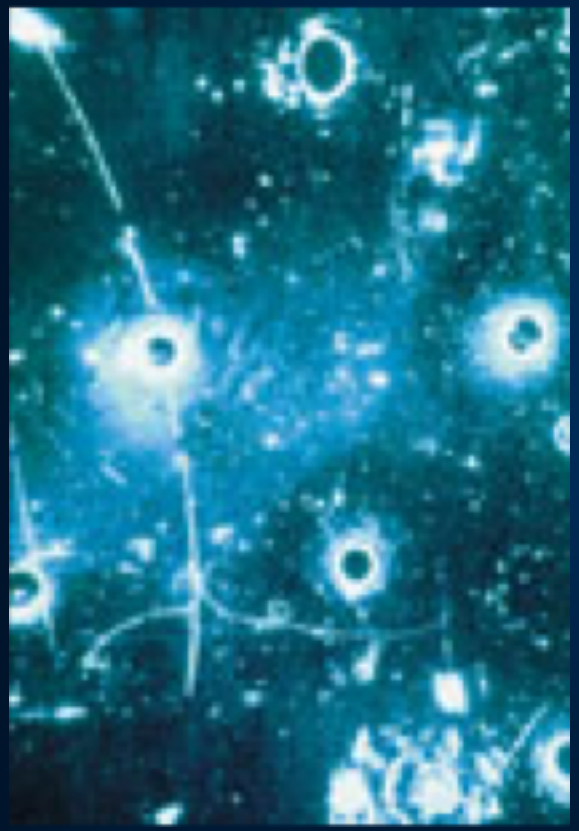
CERN, Geneva, Switzerland.

1968: MWPC – revolutionising the way particle physics is done



Electronic particle track detection is now standard in all particle detectors

1973: Weak Neutral Currents at the Gargamelle Bubble Chamber



A huge bubble chamber with 18T of fluorocarbons

Observation of weak neutral currents predicted by theory

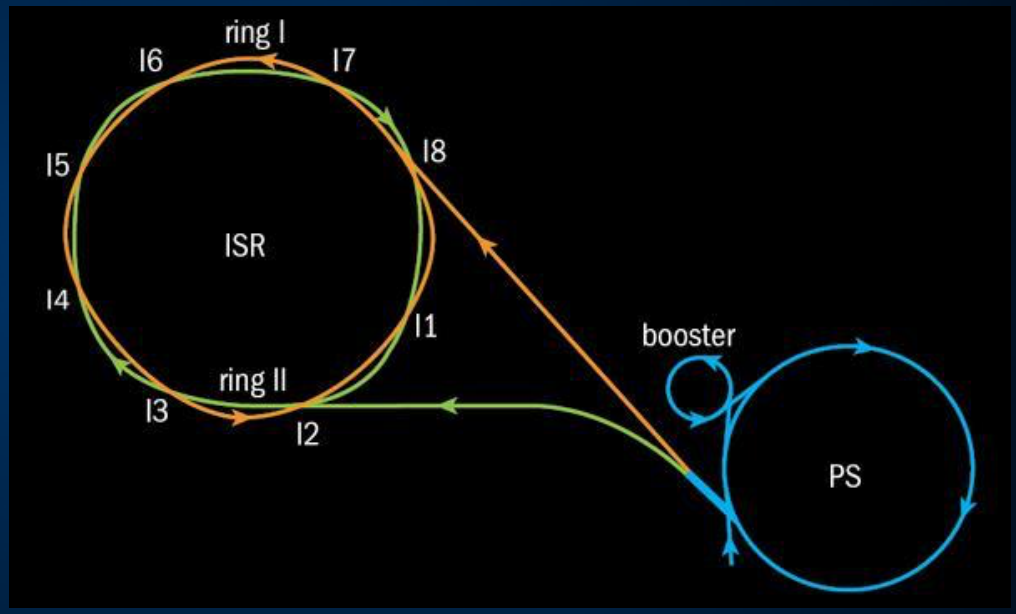
1976: The Super Proton Synchrotron - CERN goes underground

CERN expanding to France

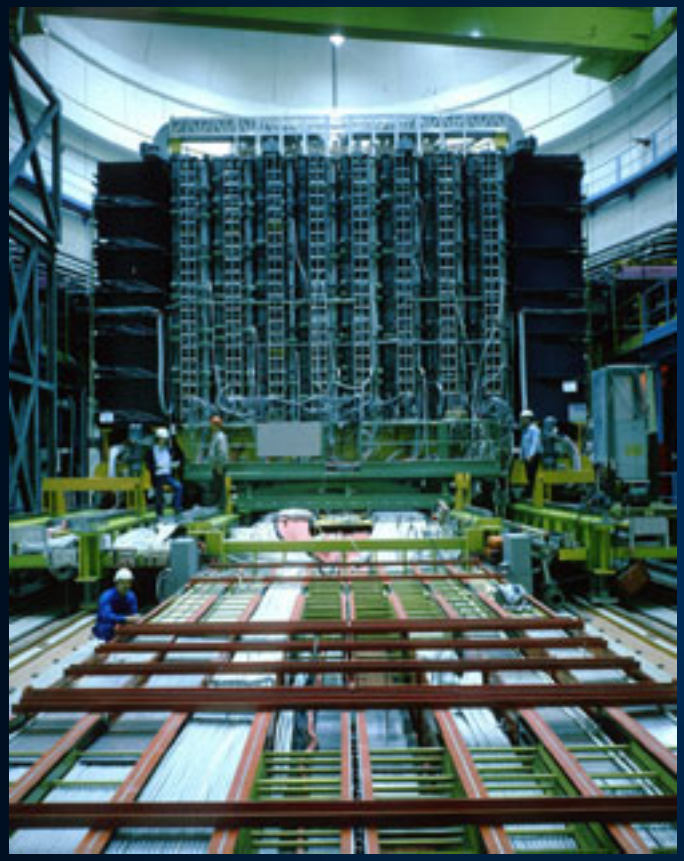
The SPS was built ahead of schedule and operated above design energy: 400 GeV

1981:First Proton-Antiproton Collisions at the ISR

The ISR was an excellent device for particle physics. When decommissioned in 1984 it had delivered many excellent results, one being the indication that protons have a sub structure, eventually recognized as quarks and gluons.
The experience of proton-antiproton collisions was later applied to the SPS



1983: CERN's first golden age



UA1 Experiment at the SPS

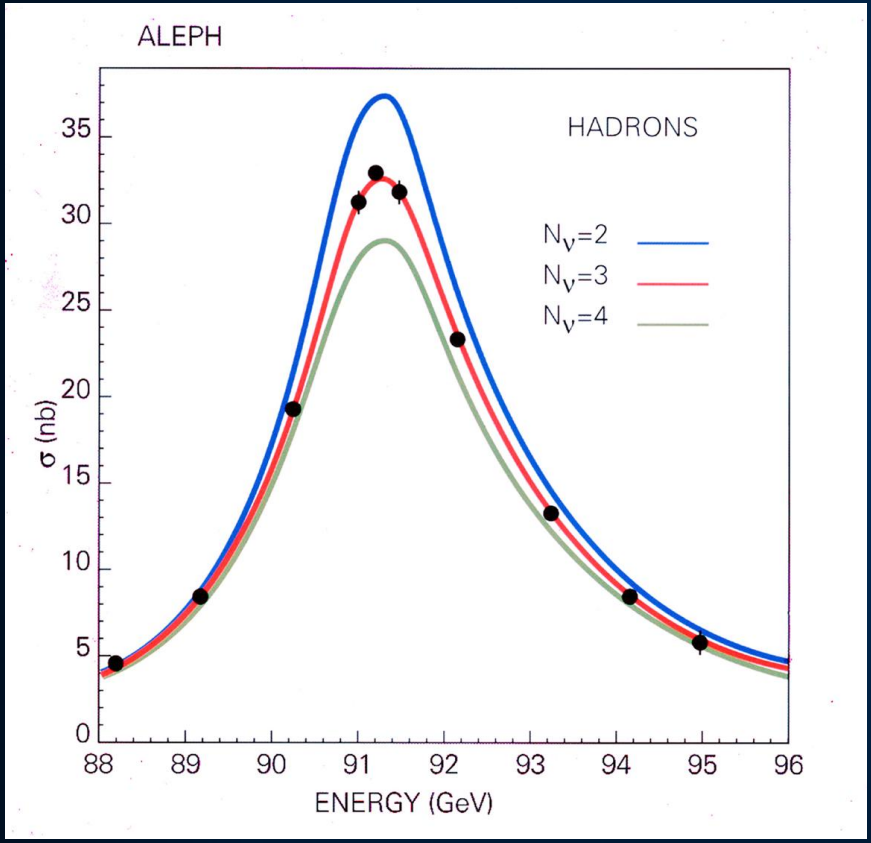
- The SPS working as a collider discovers the W and Z particles, mediators of the weak interaction.
- This experimental confirmation of the electroweak theory leads to the award of the Nobel prize the following year…
- … and continues CERN's tradition of electroweak science.

1989: LEP – Large Electron Positron Collider

The largest accelerator ever built – 27 km circumference.

Operated at 100 GeV to produce 17 million Z Bosons

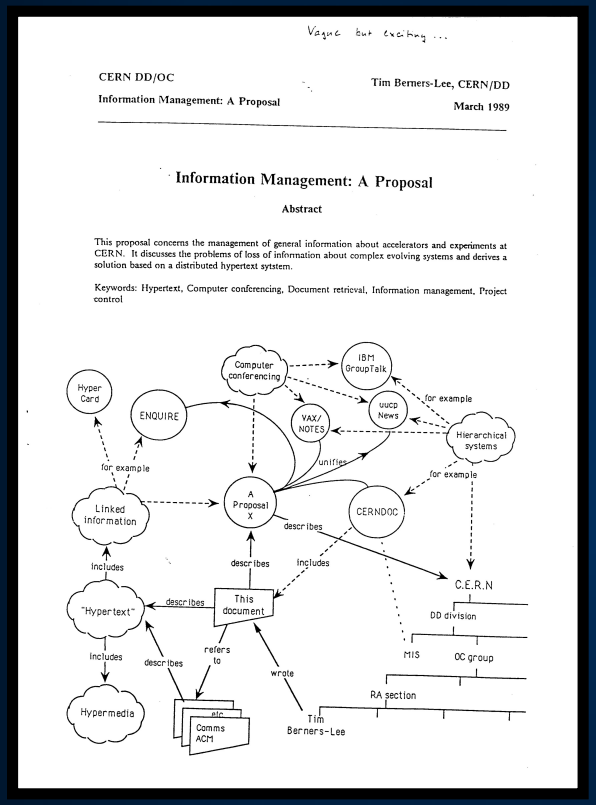
1989: LEP – The Z factory



High precision measurement of electroweak physics

There are only three generations of neutrinos

1989: The birth of the World Wide Web



Vague but exciting ...

CERN DD/OC

Tim Berners-Lee, CERN/DD

Information Management: A Proposal

March 1989

Information Management: A Proposal

Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext sytstem.

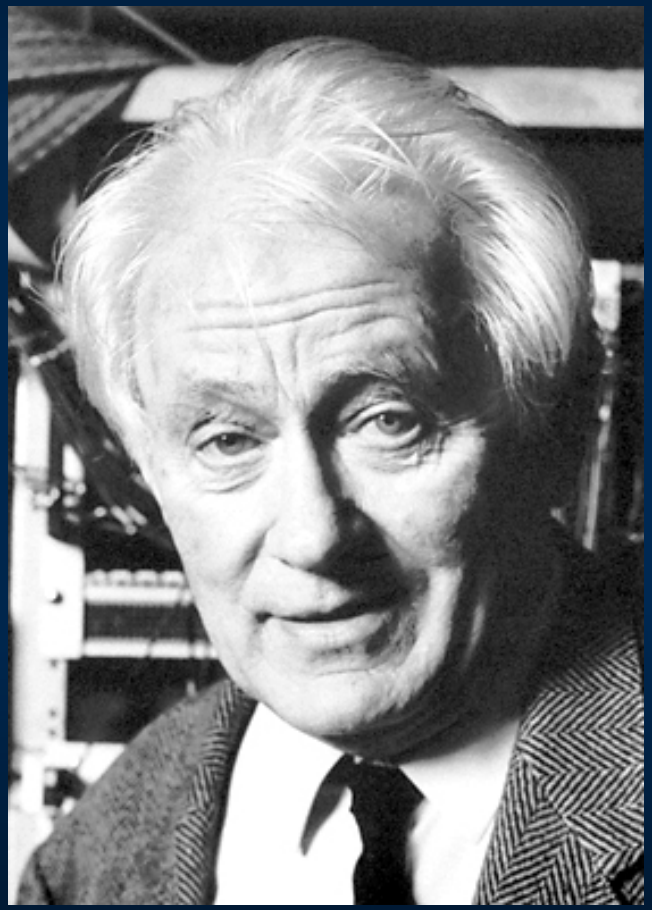
Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control

Tim Berners Lee proposed the web concept

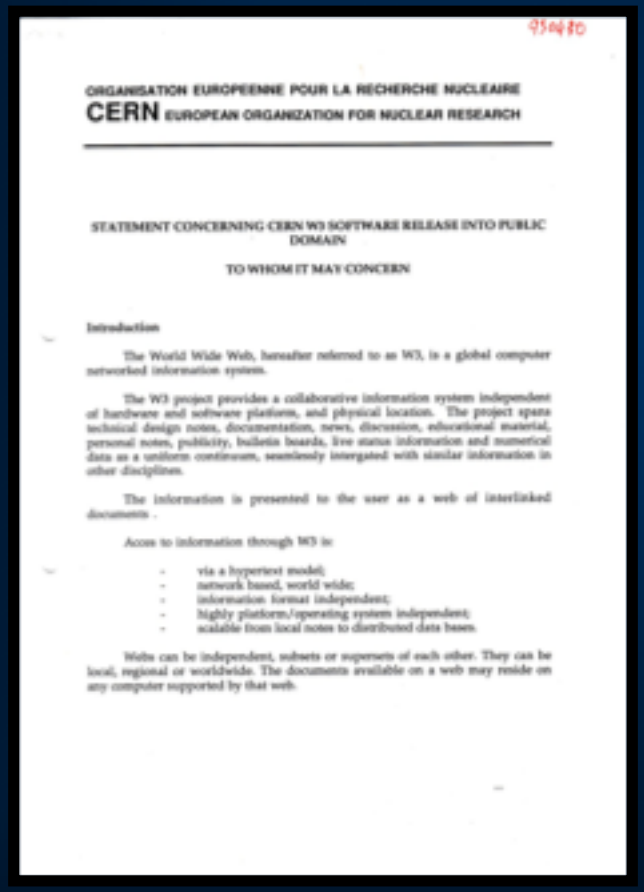
The first web address:

http://info.cern.ch/hypertext/WWW/TheProject.html

1992: George Charpak wins the Nobel Prize



1993: Release of the Web to Public Domaine
The most valuable document ever?



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ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

STATEMENT CONCERNING CERN W3 SOFTWARE RELEASE INTO PUBLIC DOMAIN

TO WHOM IT MAY CONCERN

Introduction

The World Wide Web, hereafter referred to as W3, is a global computer networked information system.

The W3 project provides a collaborative information system independent of hardware and software platform, and physical location. The project spans technical design notes, documentation, news, discussion, educational material, personal notes, publicity, bulletin boards, live status information and numerical data as a uniform continuum, seamlessly intergated with similar information in other disciplines.

The information is presented to the user as a web of interlinked documents .

Acces to information through W3 is:

- via a hypertext model;
- network based, world wide;
- information format independent;
- highly platform/operating system independent;
- scalable from local notes to distributed data bases.

Webs can be independent, subsets or supersets of each other. They can be local, regional or worldwide. The documents available on a web may reside on any computer supported by that web.

2.

Declaration

The following CERN software is hereby put into the public domain:

- W 3 basic ("line-mode") client
- W 3 basic server
- W 3 library of common code.

CERN's intention in this is to further compatibility, common practices, and standards in networking and computer supported collaboration. This does not constitute a precedent to be applied to any other CERN copyright software.

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Geneva, 30 April 1993

W. Hoogland
Director of Research

H. Weber
Director of Administration

opie certifiée conforme

sit à Genève le 03-05-93

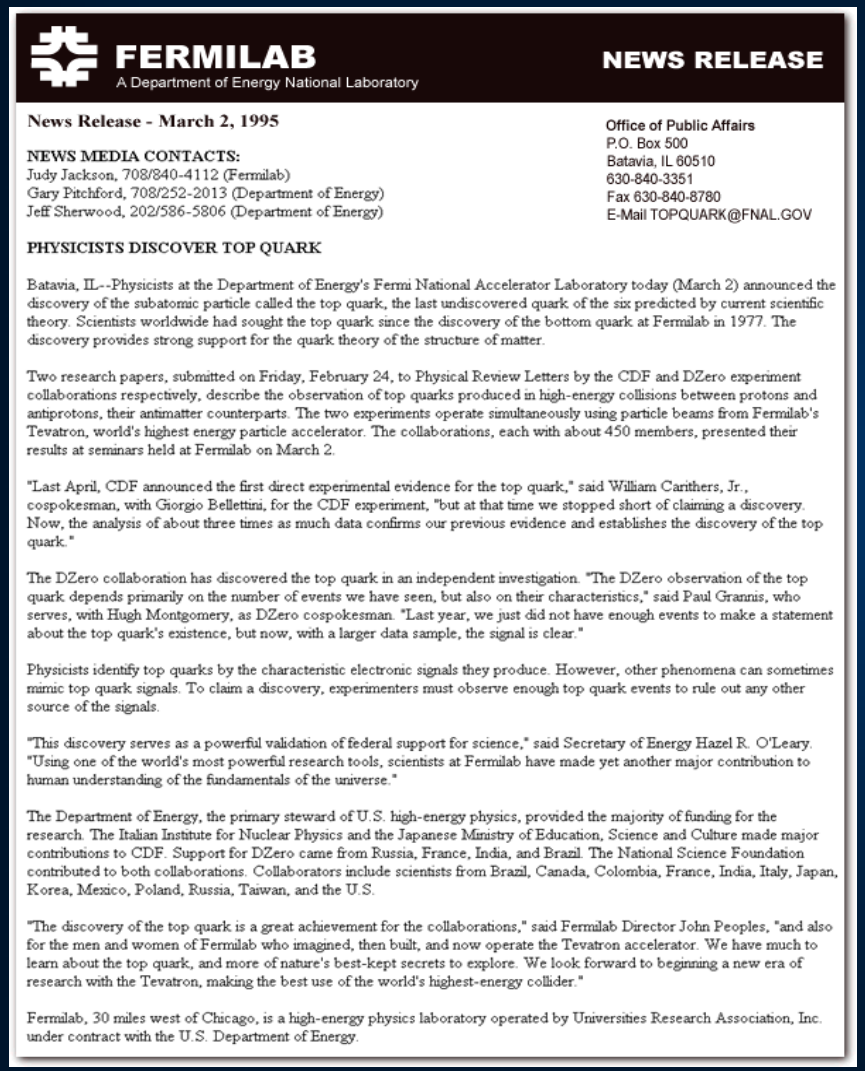
1993: A tiny preference for matter

- CERN experiment NA31 publishes the first indication at the particle level that nature has a preference for matter over antimatter… accompanied by Fermilab experiment E731.
- This result was refined in 2001 by NA48 at CERN and KTeV at Fermilab.

1993: US cancels the SSC project

1994: CERN Council approves LHC...
SSC was gone, but it shaped the LHC.
CERN embraces US, Japan, others… CERN becomes a global laboratory

1995: A discovery at Fermilab – the Top Quark



FERMILAB
A Department of Energy National Laboratory

NEWS RELEASE

News Release - March 2, 1995

NEWS MEDIA CONTACTS:
Judy Jackson, 708/840-4112 (Fermilab)
Gary Pitchford, 708/252-2013 (Department of Energy)
Jeff Sherwood, 202/586-5806 (Department of Energy)

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PHYSICISTS DISCOVER TOP QUARK

Batavia, IL--Physicists at the Department of Energy's Fermi National Accelerator Laboratory today (March 2) announced the discovery of the subatomic particle called the top quark, the last undiscovered quark of the six predicted by current scientific theory. Scientists worldwide had sought the top quark since the discovery of the bottom quark at Fermilab in 1977. The discovery provides strong support for the quark theory of the structure of matter.

Two research papers, submitted on Friday, February 24, to Physical Review Letters by the CDF and DZero experiment collaborations respectively, describe the observation of top quarks produced in high-energy collisions between protons and antiprotons, their antimatter counterparts. The two experiments operate simultaneously using particle beams from Fermilab's Tevatron, world's highest energy particle accelerator. The collaborations, each with about 450 members, presented their results at seminars held at Fermilab on March 2.

"Last April, CDF announced the first direct experimental evidence for the top quark," said William Carithers, Jr., cospokesman, with Giorgio Bellettini, for the CDF experiment, "but at that time we stopped short of claiming a discovery. Now, the analysis of about three times as much data confirms our previous evidence and establishes the discovery of the top quark."

The DZero collaboration has discovered the top quark in an independent investigation. "The DZero observation of the top quark depends primarily on the number of events we have seen, but also on their characteristics," said Paul Grannis, who serves, with Hugh Montgomery, as DZero cospokesman. "Last year, we just did not have enough events to make a statement about the top quark's existence, but now, with a larger data sample, the signal is clear."

Physicists identify top quarks by the characteristic electronic signals they produce. However, other phenomena can sometimes mimic top quark signals. To claim a discovery, experimenters must observe enough top quark events to rule out any other source of the signals.

"This discovery serves as a powerful validation of federal support for science," said Secretary of Energy Hazel R. O'Leary. "Using one of the world's most powerful research tools, scientists at Fermilab have made yet another major contribution to human understanding of the fundamentals of the universe."

The Department of Energy, the primary steward of U.S. high-energy physics, provided the majority of funding for the research. The Italian Institute for Nuclear Physics and the Japanese Ministry of Education, Science and Culture made major contributions to CDF. Support for DZero came from Russia, France, India, and Brazil. The National Science Foundation contributed to both collaborations. Collaborators include scientists from Brazil, Canada, Colombia, France, India, Italy, Japan, Korea, Mexico, Poland, Russia, Taiwan, and the U.S.

"The discovery of the top quark is a great achievement for the collaborations," said Fermilab Director John Peoples, "and also for the men and women of Fermilab who imagined, then built, and now operate the Tevatron accelerator. We have much to learn about the top quark, and more of nature's best-kept secrets to explore. We look forward to beginning a new era of research with the Tevatron, making the best use of the world's highest-energy collider."

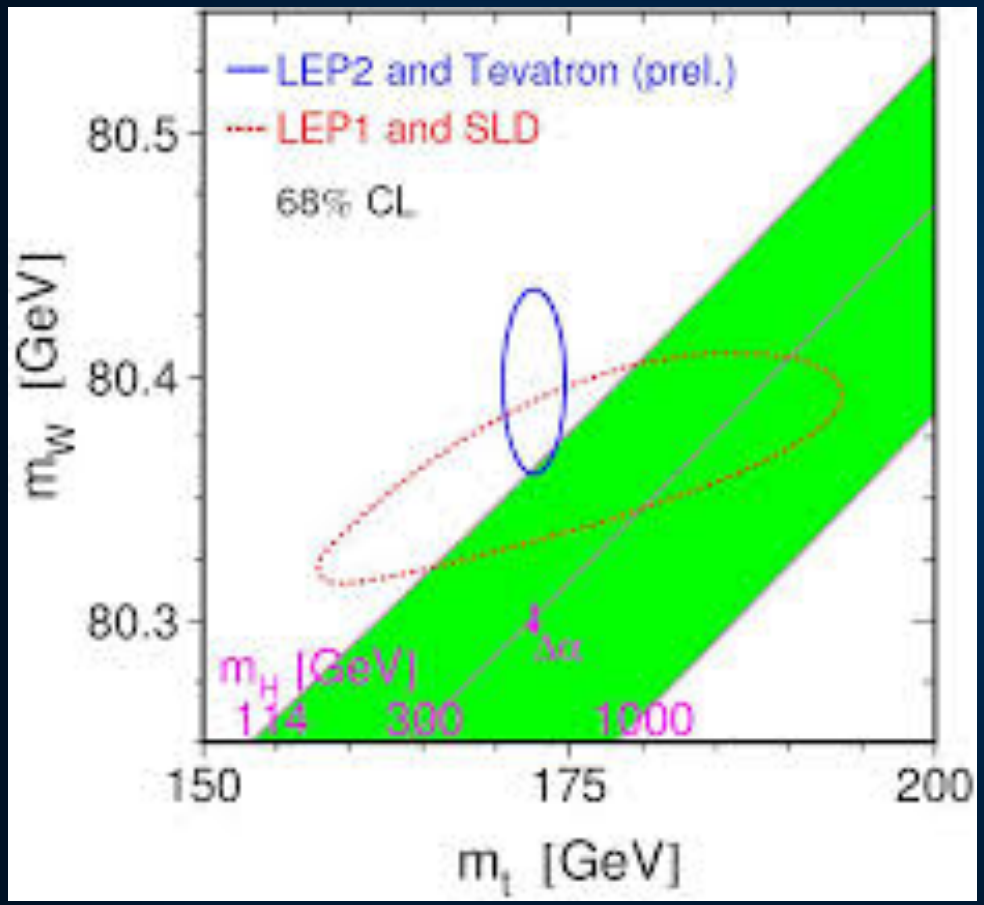
Fermilab, 30 miles west of Chicago, is a high-energy physics laboratory operated by Universities Research Association, Inc. under contract with the U.S. Department of Energy.

D0 and CDF discovered the top quark

Mass of the top quark was to high to be produced at LEP directly, but LEPs high precision electroweak measurements were already hinting on the top mass range

CERN

1996: LEP II – The W factory



LEP was upgraded to study also the W Boson. In 2000, the last year of operation, LEP II reached an center of mass energy of 209 GeV

2000: The end of LEP

2 November 2000: Steve Myers pulls the plug

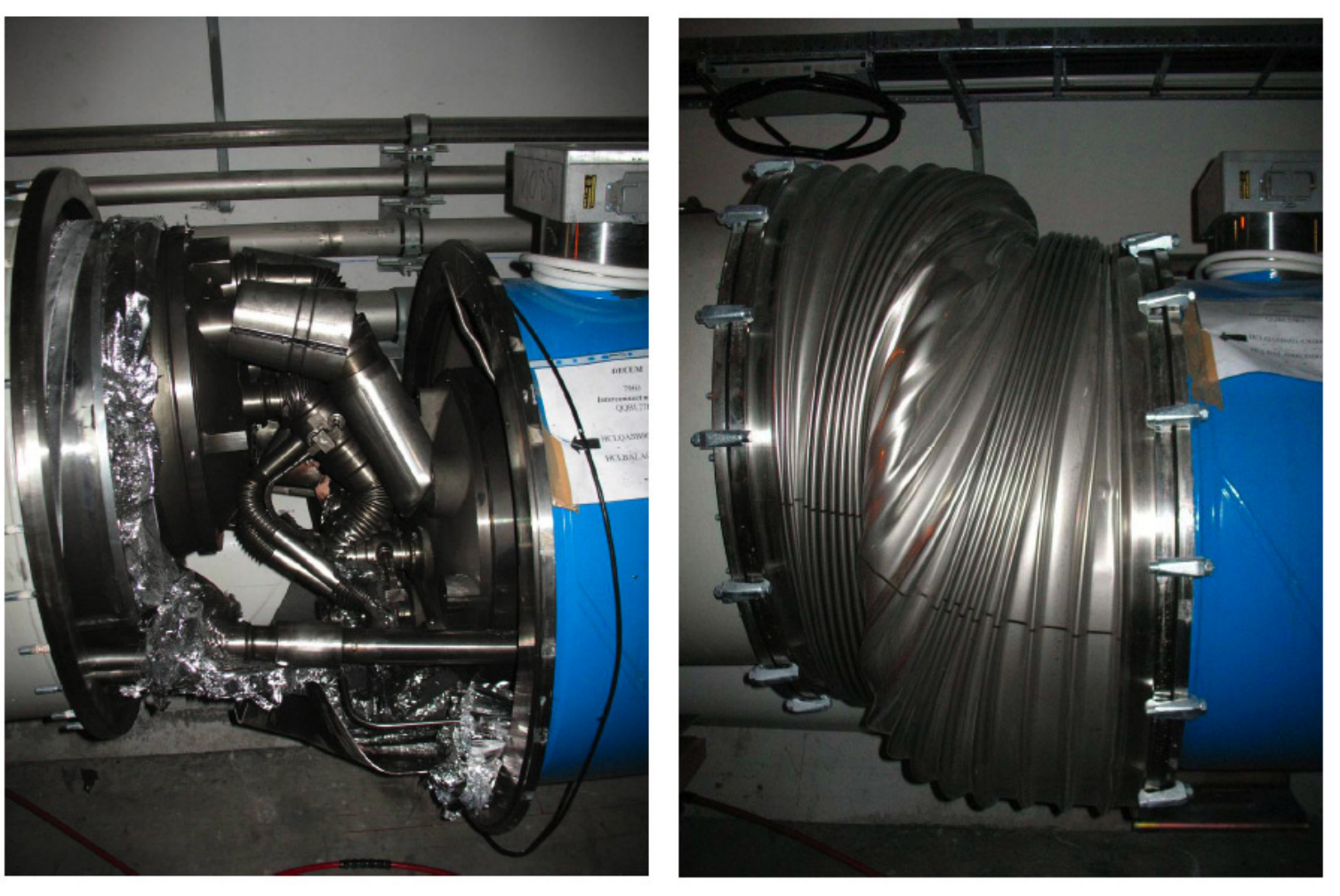
2003: Fear and loathing… are they going to end the world?

Has the new CERN project – the LHC - the potential to create a black hole that swallows our planet earth?

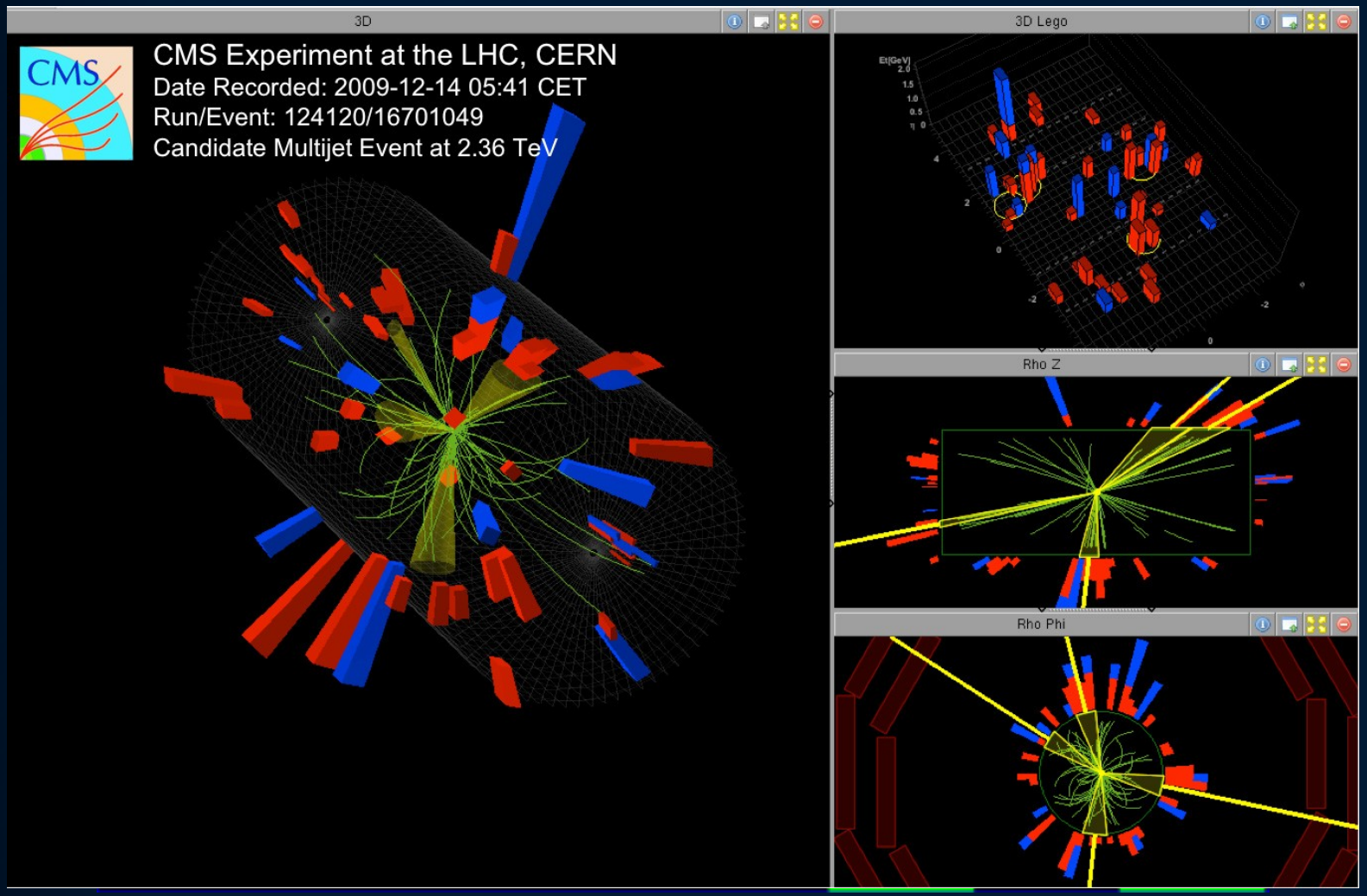
2008: LHC - First beam

LHC is now the most powerful particle accelerator ever built

2008: A few days later: LHC- Breakdown



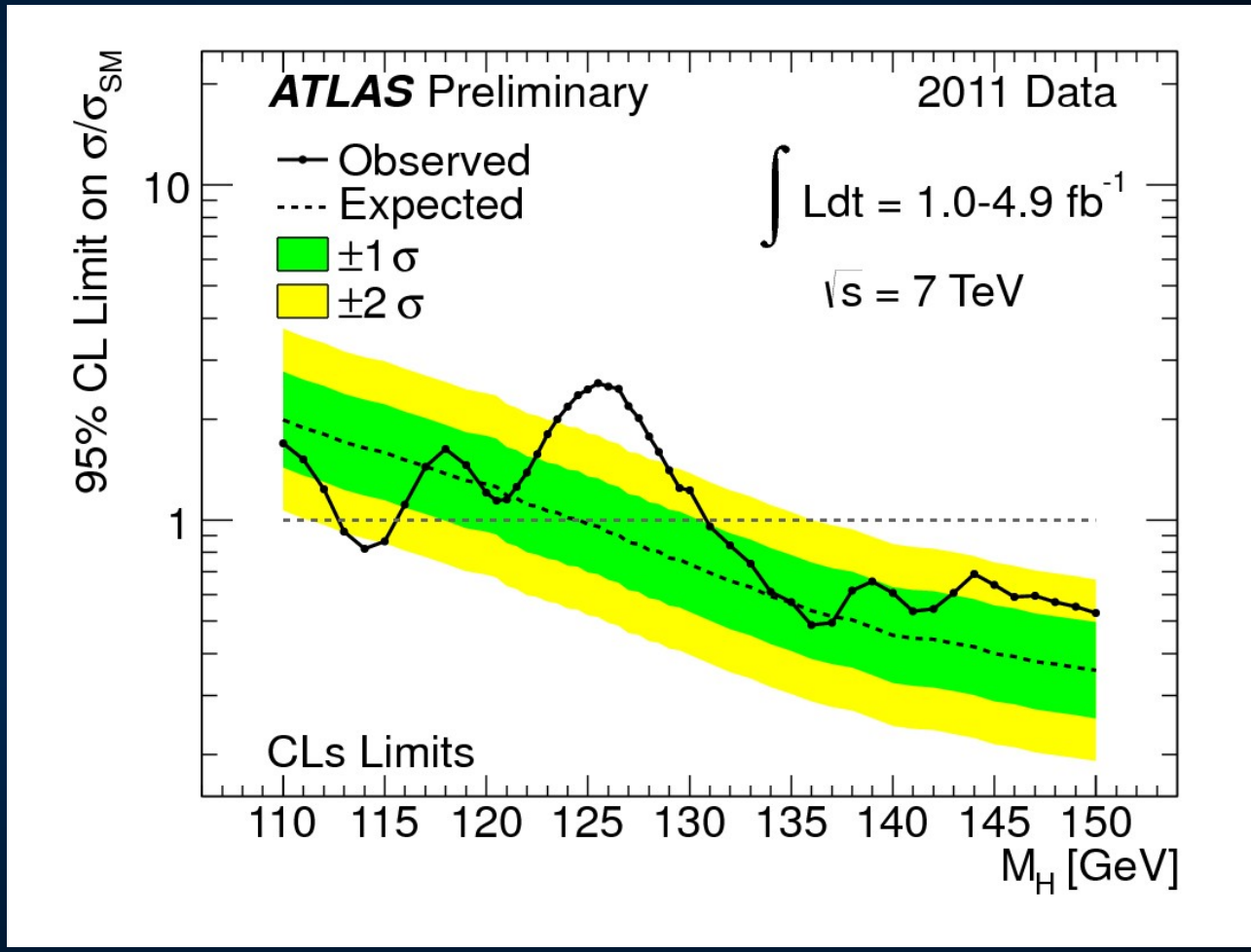
2009: LHC - First collisions



2010: The LHC overtakes the Tevatron
High energy running begins

- LHC starts running at 3.5 TeV per beam
- Soon recording data far faster than the Tevatron

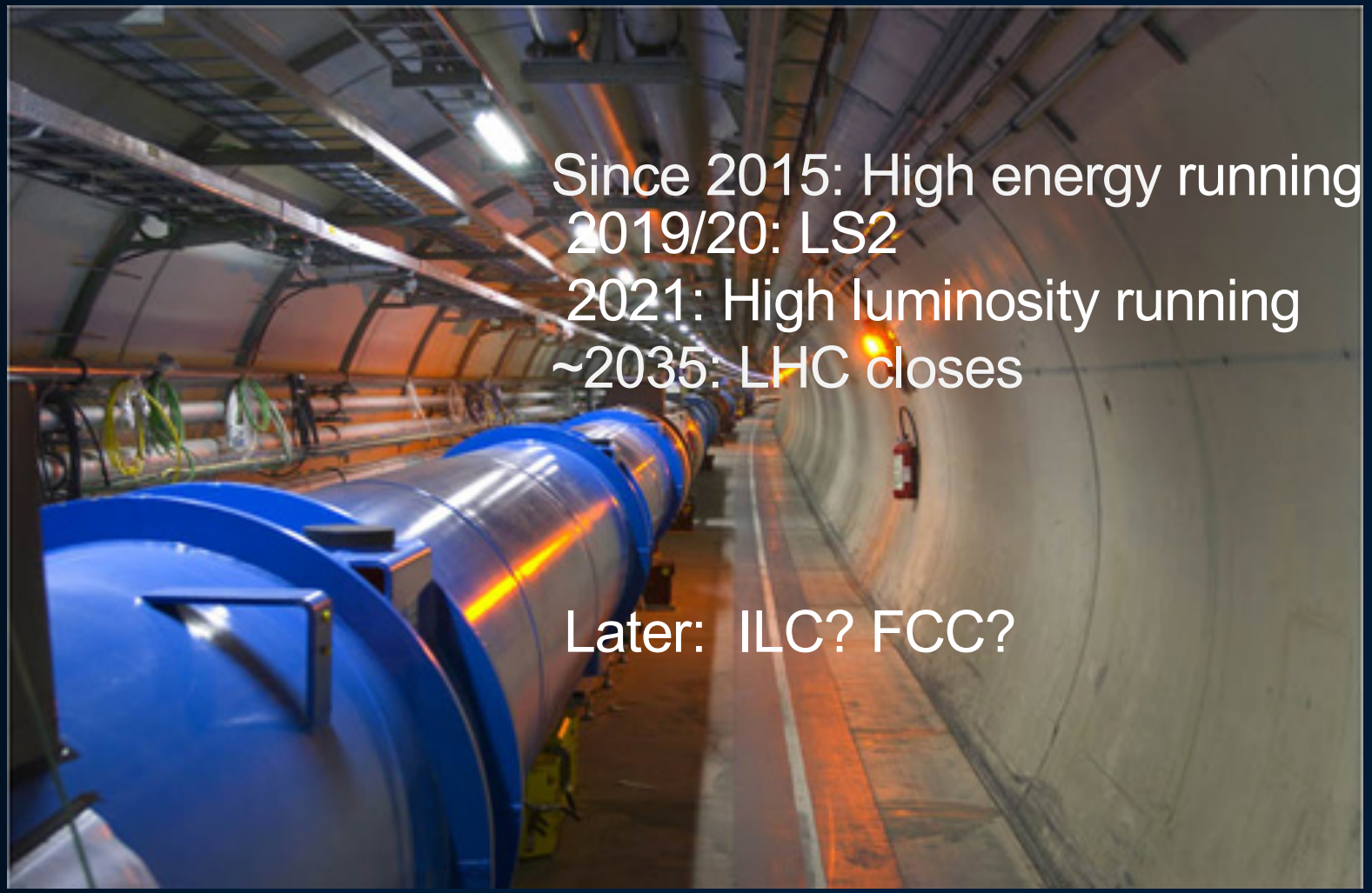
2011: Hints of Higgs



2012: A discovery!

'The Large Hadron Collider at CERN is the largest most complex machine in the world, possibly the universe. By smashing particles together at enormous energies, it recreates the conditions of the Big Bang. The recent discovery of what looks like the "Higgs particle" is a triumph of human endeavour and international collaboration. It will change our perception of the world and has the potential to offer insights into a complete theory of everything.'
Stephen Hawking

What next?



The physics will tell us where to go…
and YOU will participate!


LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km
Thank You!
Дякую!
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