Fundamental Research in an International Perspective

CERN – European Organization for Nuclear Research

The Organization, current research, and education.

Dr. Sascha Marc Schmeling

Science for peace

CERN was founded in 1954 with 12 European Member States

23 Member States

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

3 Associate Member States in the pre-stage to membership

Cyprus – Estonia – Slovenia

7 Associate Member States

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

6 Observers

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

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

As of 31 December 2022
Employees:
2658 staff, **900** fellows
Associates:
11 860 users, **1516** 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

A laboratory for people around the world

Distribution of all CERN Users by the country of their home institutes as of 31 December 2022

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

Member States 7147

Austria 85 – **Belgium** 129 – **Bulgaria** 43 – **Czech Republic** 244
Denmark 49 – **Finland** 90 – **France** 844 – **Germany** 1225
Greece 119 – **Hungary** 73 – **Israel** 64 – **Italy** 1527
Netherlands 169 – **Norway** 79 – **Poland** 305 – **Portugal** 100
Romania 109 – **Serbia** 33 – **Slovakia** 70 – **Spain** 383
Sweden 103 – **Switzerland** 406 – **United Kingdom** 898

Associate Member States in the pre-stage to membership **69**

Cyprus 15 – **Estonia** 30 – **Slovenia** 24

Associate Member States **382**

Croatia 38 – **India** 132 – **Latvia** 16 – **Lithuania** 14 – **Pakistan** 35
Türkiye 122 – **Ukraine** 25

Observers **2991**

Japan 216 – **Russia** (suspended) 873 – **United States of America** 1902

Non-Member States and Territories **1271**

Algeria 2 – **Argentina** 13 – **Armenia** 8 – **Australia** 21 – **Azerbaijan** 2 – **Bahrain** 4 – **Belarus** 18 – **Brazil** 122
Canada 199 – **Chile** 34 – **Colombia** 21 – **Costa Rica** 2 – **Cuba** 3 – **Ecuador** 4 – **Egypt** 20 – **Georgia** 32
Hong Kong 15 – **Iceland** 3 – **Indonesia** 5 – **Iran** 11 – **Ireland** 5 – **Jordan** 5 – **Kuwait** 4 – **Lebanon** 13 – **Madagascar** 1
Malaysia 4 – **Malta** 1 – **Mexico** 49 – **Montenegro** 4 – **Morocco** 19 – **New Zealand** 5 – **Nigeria** 1 – **Oman** 1
Palestine 1 – **People's Republic of China** 333 – **Peru** 2 – **Philippines** 1 – **Republic of Korea** 147 – **Singapore** 2
South Africa 52 – **Sri Lanka** 10 – **Taiwan** 45 – **Thailand** 17 – **Tunisia** 2 – **United Arab Emirates** 7 – **Viet Nam** 1

CERN Council

President: E. Rabinovici

Secretary: CERN DG

- (Associate) Member States: 2 delegates each
- ex-officio
  - FC Chair
  - SPC Chair
- various observers by invitation, incl. ECFA Chair

Finance Committee

Chairperson: L. Salzarulo

- (Associate) Member States: 1-3 delegates each
- ex-officio
  - Council President
  - SPC Chair

Scientific Policy Committee

Chairperson: H. Montgomery

- 14 individual members
- ex-officio
  - ECFA Chair
  - Chair of CERN Committees (LHCC, MAC,SPSC, INTC)
- permanent invitations
  - CERN DG, Council President, FC Chair

Audit Committee

Chairperson: J. Schieck

Tripartite Employment Forum

Chairperson: B. Åsman

Pension Fund Governing Board

Chairperson: O. Malmberg

CERN – The Organization

Council Secretariat
Legal Service

Director General
Fabiola Gianotti

Internal Audit
Health, Safety, and Environment Unit

Finance and Human Resources
Rafael Bello

Research and Computing
Joachim Mnich

Accelerators and Technologoy
Mike Lamont

International Relations
Charlotte Warakaulle

Finance and Administrative Procedures
Florian Sonnemann

Human Resources
James Purvis

Industry, Procurement, and Technology Transfer
Christopher Hartley

Site and Civil Engineering
Mar Capeans

Experimental Physics
Manfred Krammer

Theoretical Physics
Gian Giudice

Information Technologies
Enrica Porcari

Beams
Rhodri Jones

Engineering
Katy Foraz

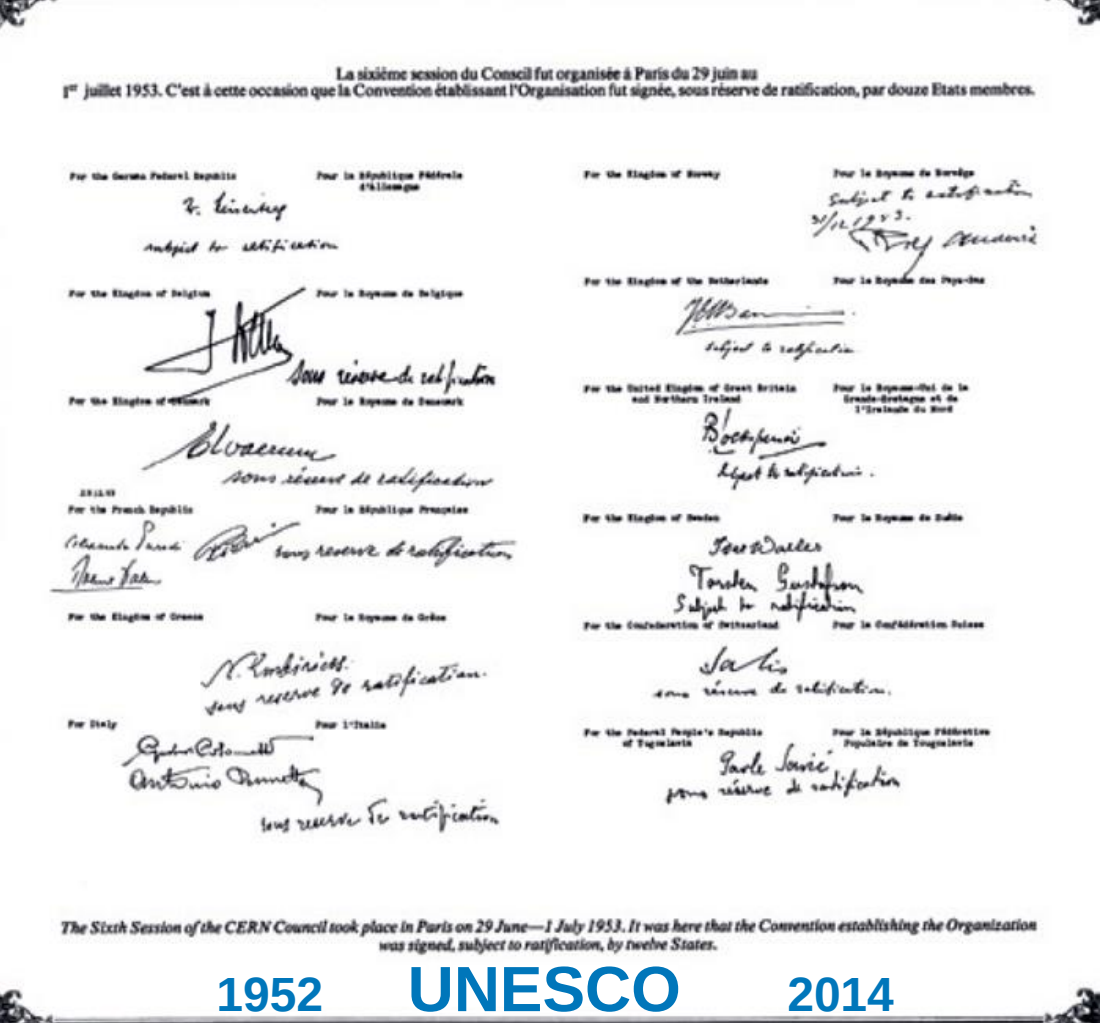
Systems
Brennan Goddard

Technology
Jose Miguel Jimenez

Education, Communication, and Outreach

Diplomatic and Stakeholder Relations

CERN Lab Organisation 2021-2025 (from 30.06.2021)



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.

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.

1952 **UNESCO** 2014

The Mission

Fundamental Research
at the frontier of human knowledge

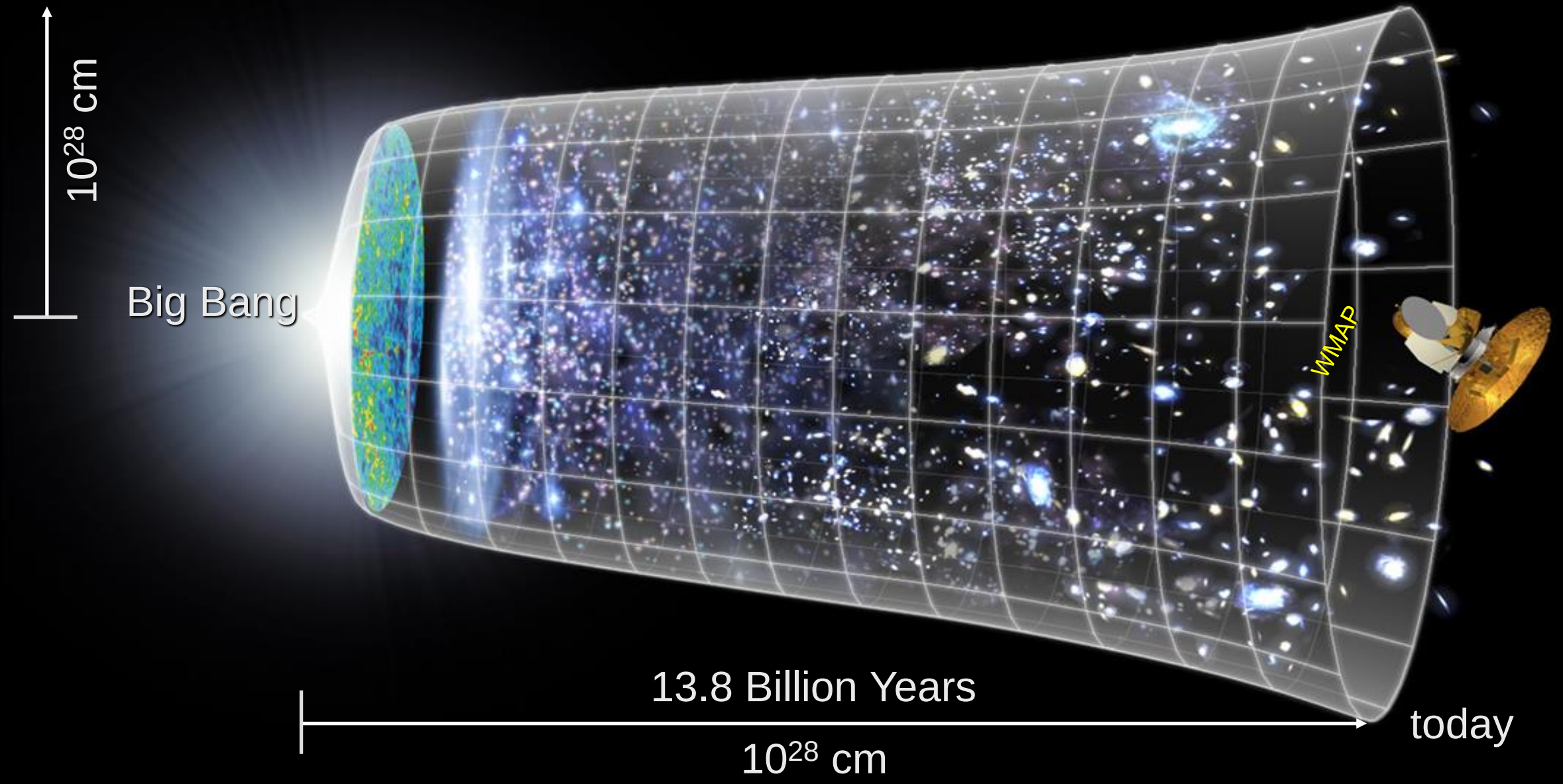
Innovative Technologies
for fundamental research

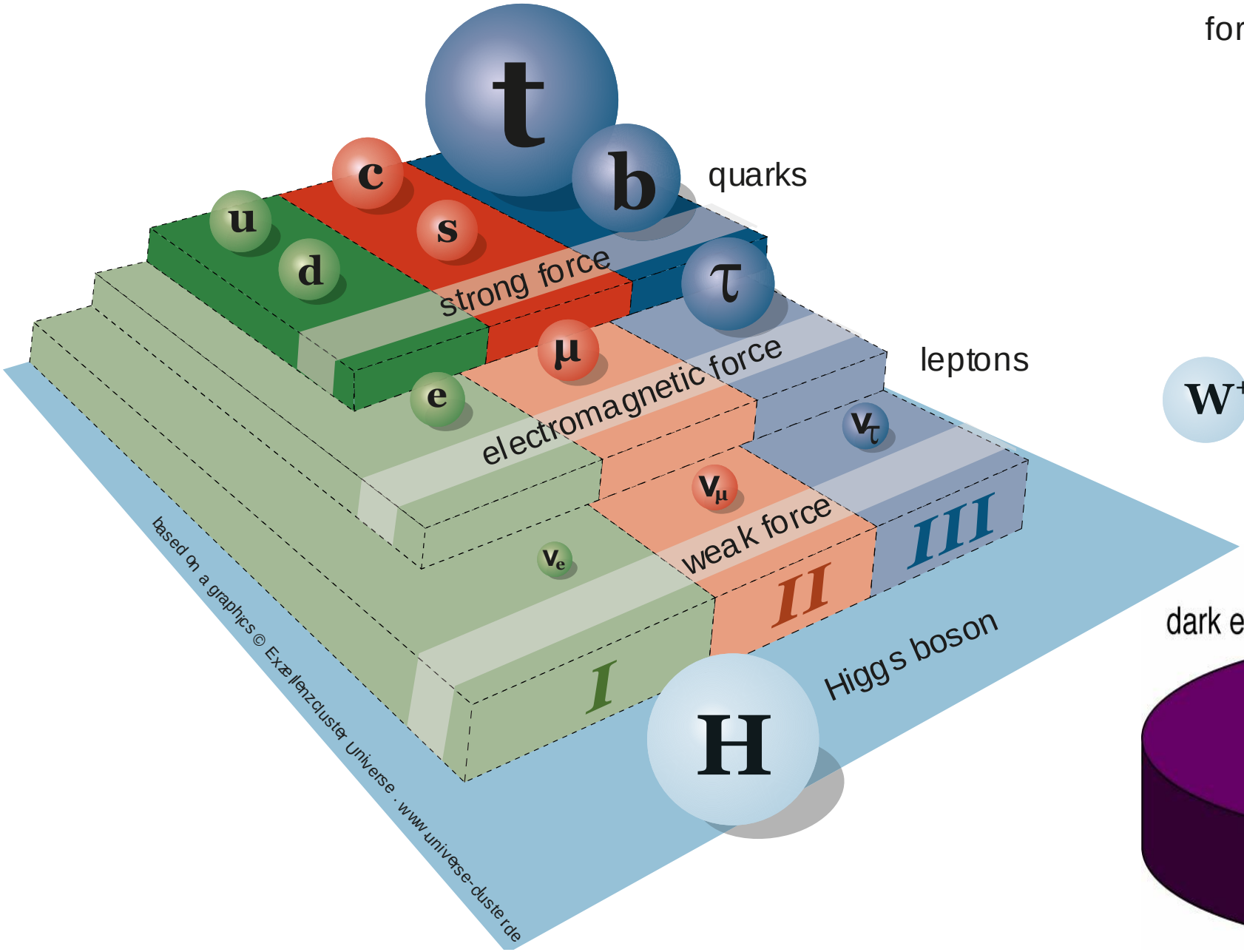
Collaboration
for the good of humanity

Education & Inspiration
training of future generations

The Scientific Challenge

Research on the Development of the Universe



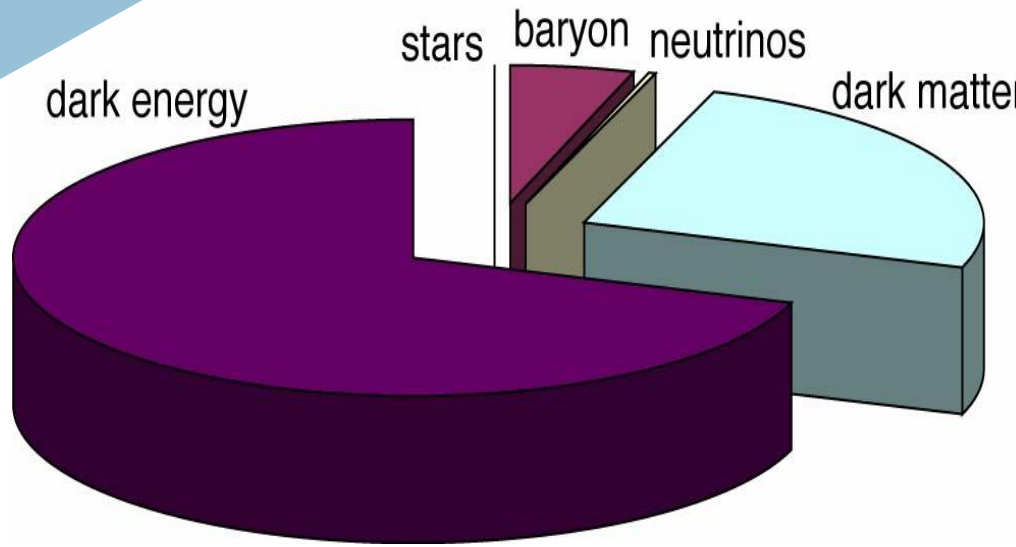


force carriers

g

γ

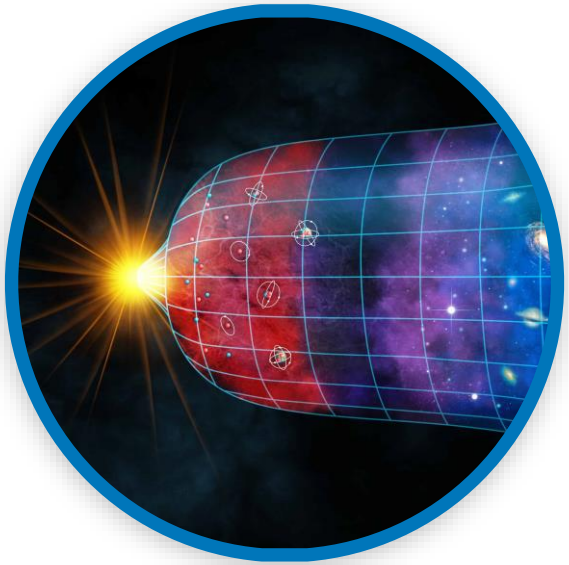
W^+ Z^o W^-



Standard Model

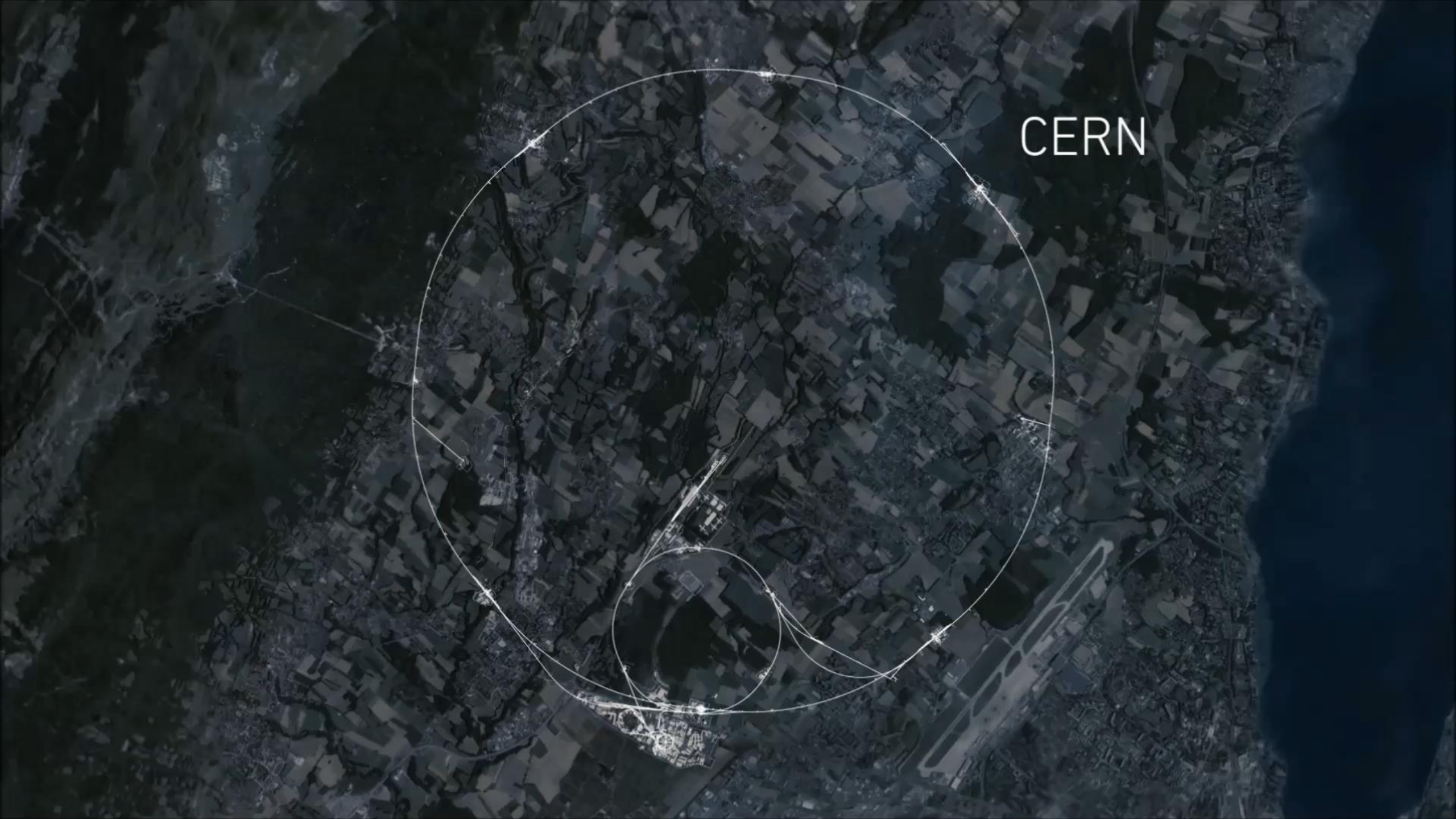
Research Questions

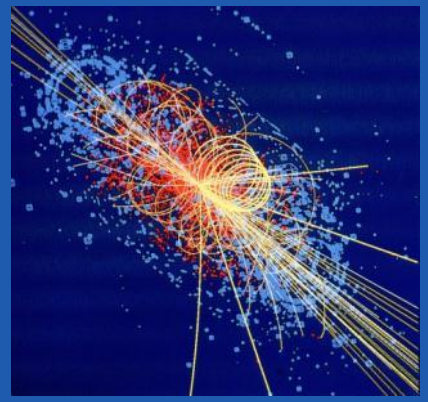
Early Universe



Anti-Matter

Dark Matter


CERN

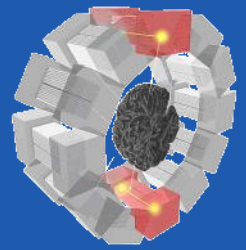


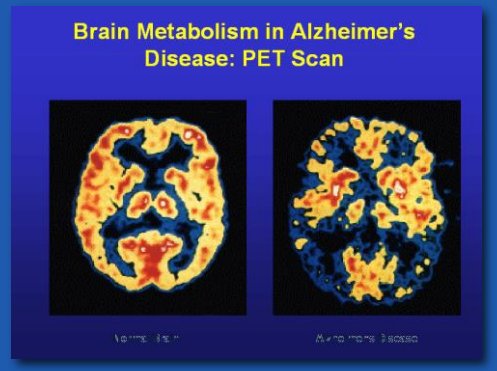
Particle Detection

Imaging

ClearPEM

PET Scanner

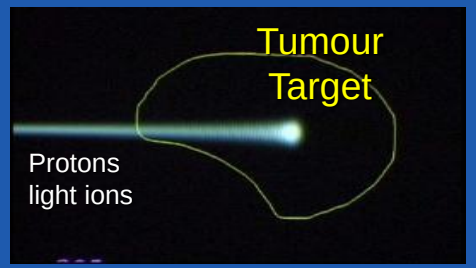


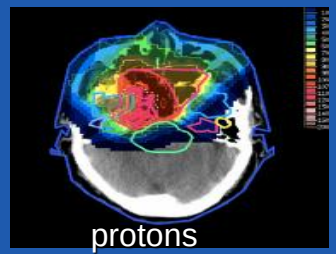


Accelerated Particle Beams

~30’000 accelerators world-wide
~17’000 for medical applications

Hadron Therapy

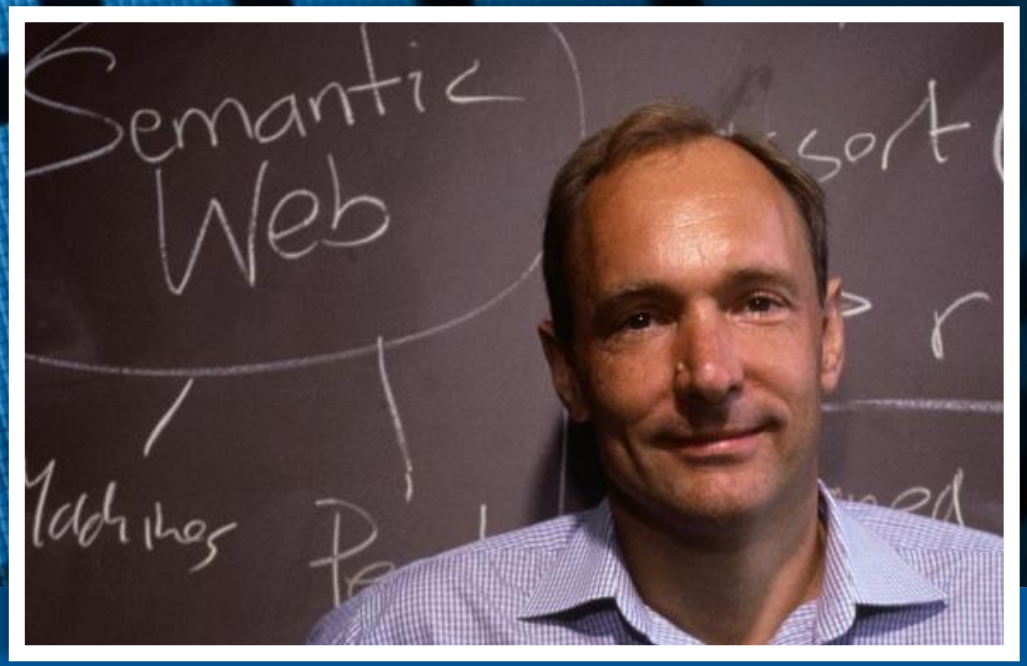




>70’000 patients/a world-wide (30 institutes)
>21’000 patients/a in Europe (9 institutes)

Medical Applications

World Wide Web



Sustainable Development Goals
Transforming our world

IYBSSD2022
International Year
of Basic Sciences
for Sustainable Development

CERN | THE GLOBAL GOALS For Sustainable Development

CERN Director-General Rolf Heuer addressing the Open Working Group on Sustainable Development Goals in December 2013.

The CERN input may be found at https://sustainabledevelopment.un.org/content/documents/4628cern.pdf

Mapping
CERN Contributions to the SDGs

SDG 3 - HEALTH
CERN helps to develop technologies that contribute to better healthcare for all, such as medical imaging and hadron therapy.

THERAPY
Accelerators provide particle beams for more targeted cancer treatment.

SDG 4 - EDUCATION
Education is one of CERN's core missions. We offer high quality programmes that inspire thousands of students, teachers and young researchers each year.

BEAMLINE FOR SCHOOLS COMPETITION
Students from the two winning teams spend a week at CERN to carry out their experiment using a CERN accelerator.

SDG 5 - GENDER
Diversity is a core value for CERN. Our diversity policy aims at leveraging the added value that comes from bringing together people of different nationalities, genders, professions and ages.

25 BY 25 DIVERSITY & INCLUSION INITIATIVE
First ever targets-based strategy to boost the nationality and gender diversity within the Staff and Fellows population.
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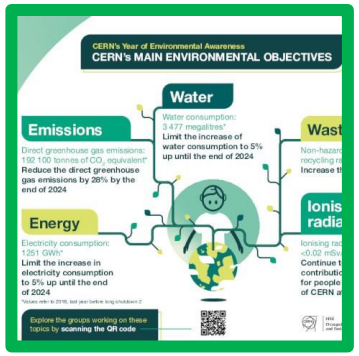
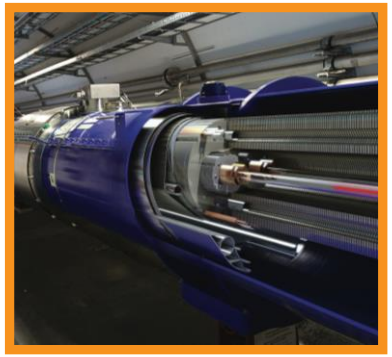
SDG 7 - ENERGY
CERN develops strategies for minimise the increase of energy consumed by the installations, increase energy efficiency and implement energy recovery.



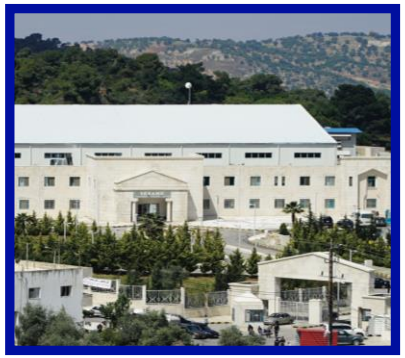
HEATING LOCAL HOUSING
Heat recovered from CERN's accelerator cooling systems to heat a new residential area in the town of Ferney-Voltaire, benefiting up to 8000 people.

SDG 9 - INNOVATION
CERN inventions are brought to industry through knowledge transfer, to have a positive impact on society and innovation.



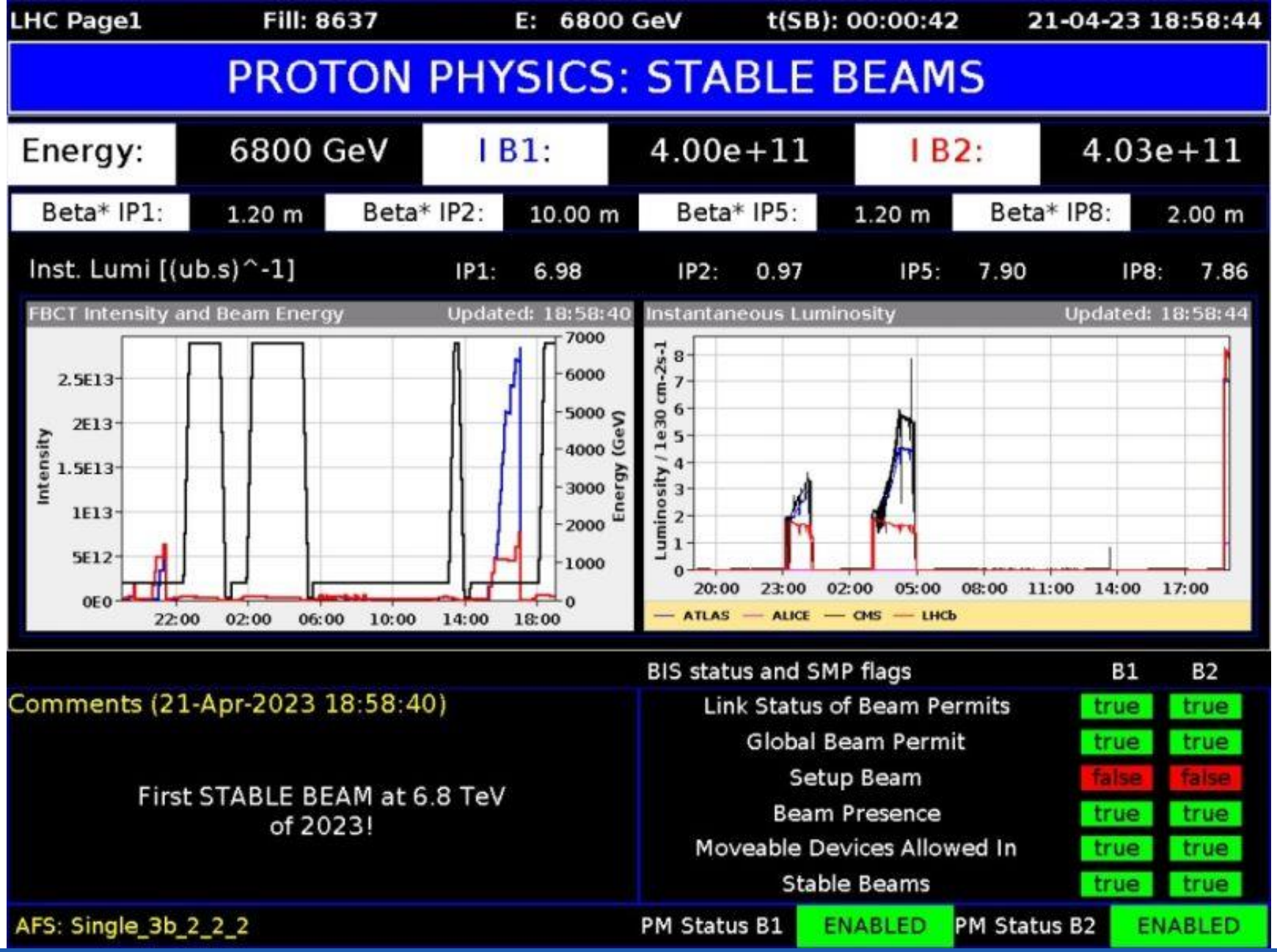
A MAGNET IN THE LHC TUNNEL
Exploring the universe requires new technologies and ingenious engineering to build the machines that explore physics at a new frontier.

SDG 16 & 17 - INTERNATIONAL COOPERATION
CERN is a successful model for international collaboration. CERN gathers researchers from all over the world, contributing to human knowledge and peace, for the benefit of all.



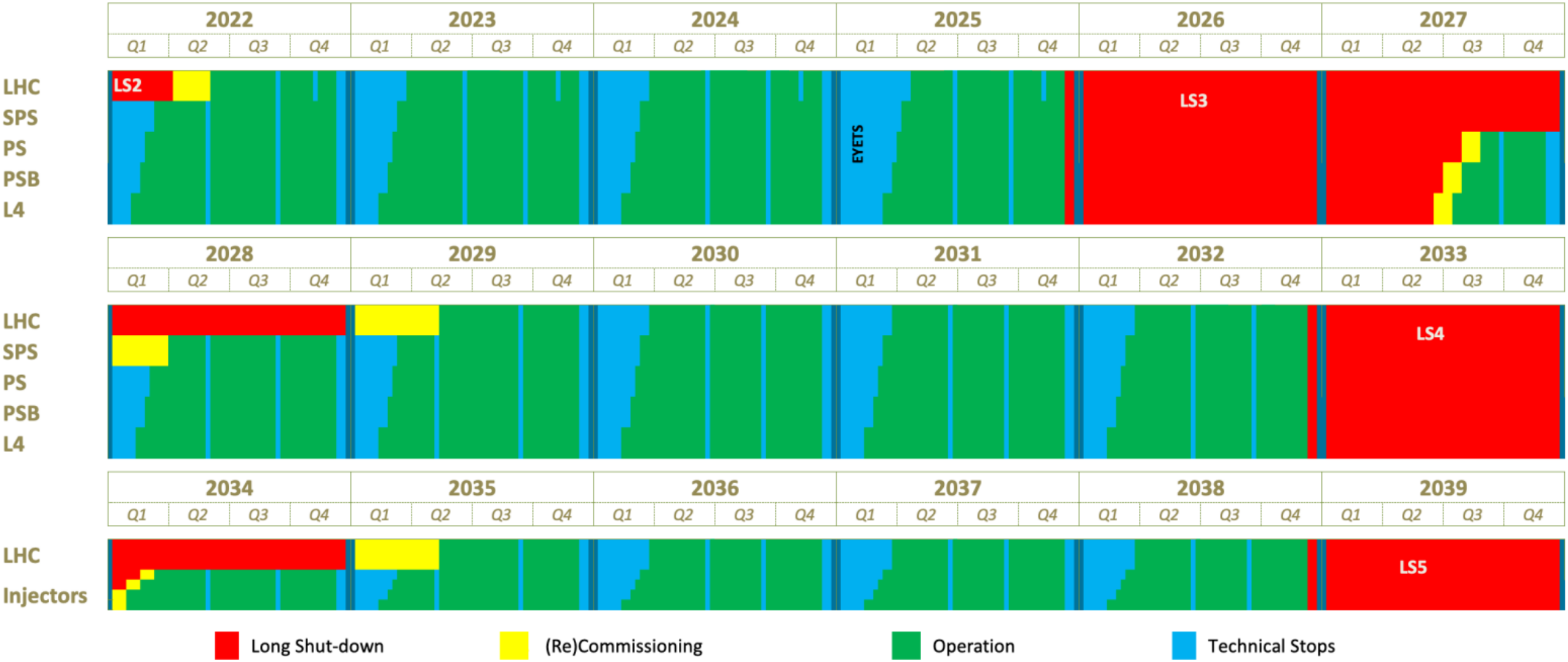
SESAME
This new synchrotron light source in Jordan started operation in 2017. It is a unique collaboration between eight Middle East members, modelled on CERN's governance structure.

What happens now?



Recently at CERN

Long Term Schedule for CERN Accelerator complex



EDMS No.	REV.	VALIDITY
2311633	2.0	RELEASED

REFERENCE
ACC-PM-MS-004

And then?


2020 UPDATE OF THE EUROPEAN STRATEGY
FOR PARTICLE PHYSICS
by the European Strategy Group

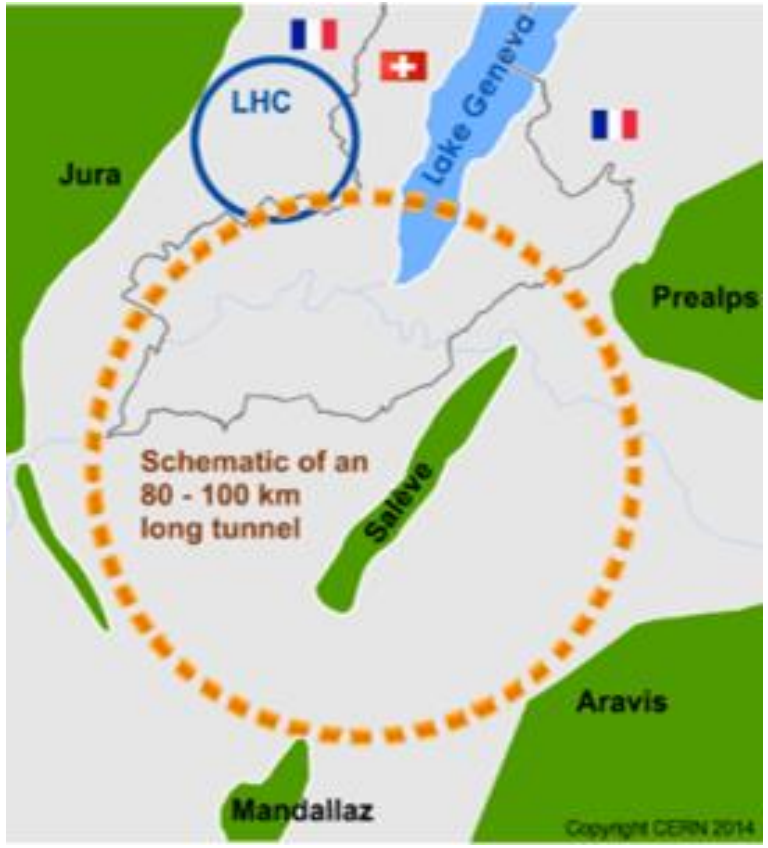
CERN Scientific Priorities for the Future

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

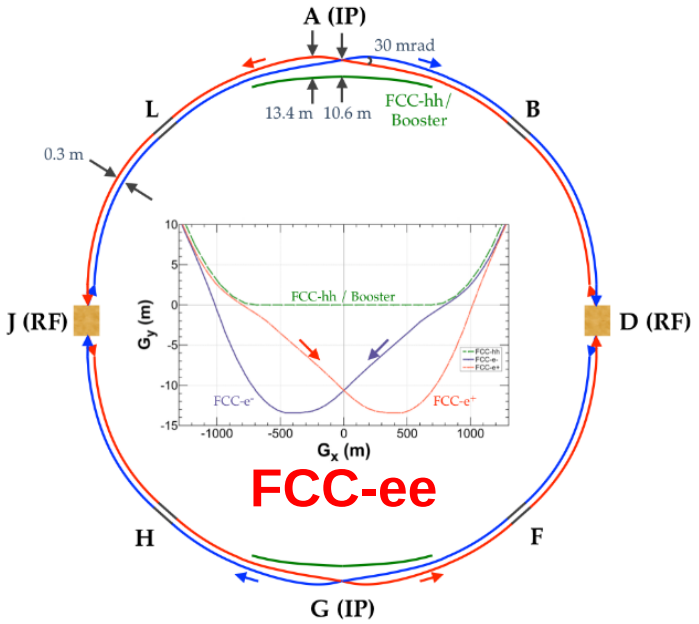
- Fully exploit the LHC & HL-LHC.
- Build a Higgs factory to further understand this unique particle.
- Investigate the technical and financial feasibility of a future energy-frontier 100 km collider at CERN.
- Ramp up relevant R&D.
- Continue supporting other projects around the world.

The FCC Integrated Programme
Inspired by successful LEP – LHC Programmes at CERN

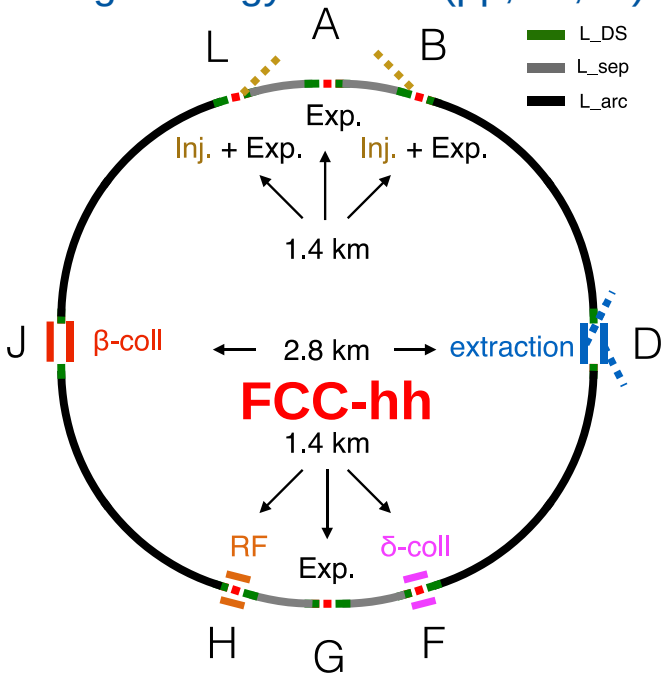
Complementary physics, common civil engineering and technical infrastructures, building on and reusing CERN's existing infrastructure, FCC integrated project allows seamless continuation of HEP after HL-LHC



Phase 1 : FCC-ee
electron – positron Collider
Higgs, Z, W, ttbar Factory at highest lumi

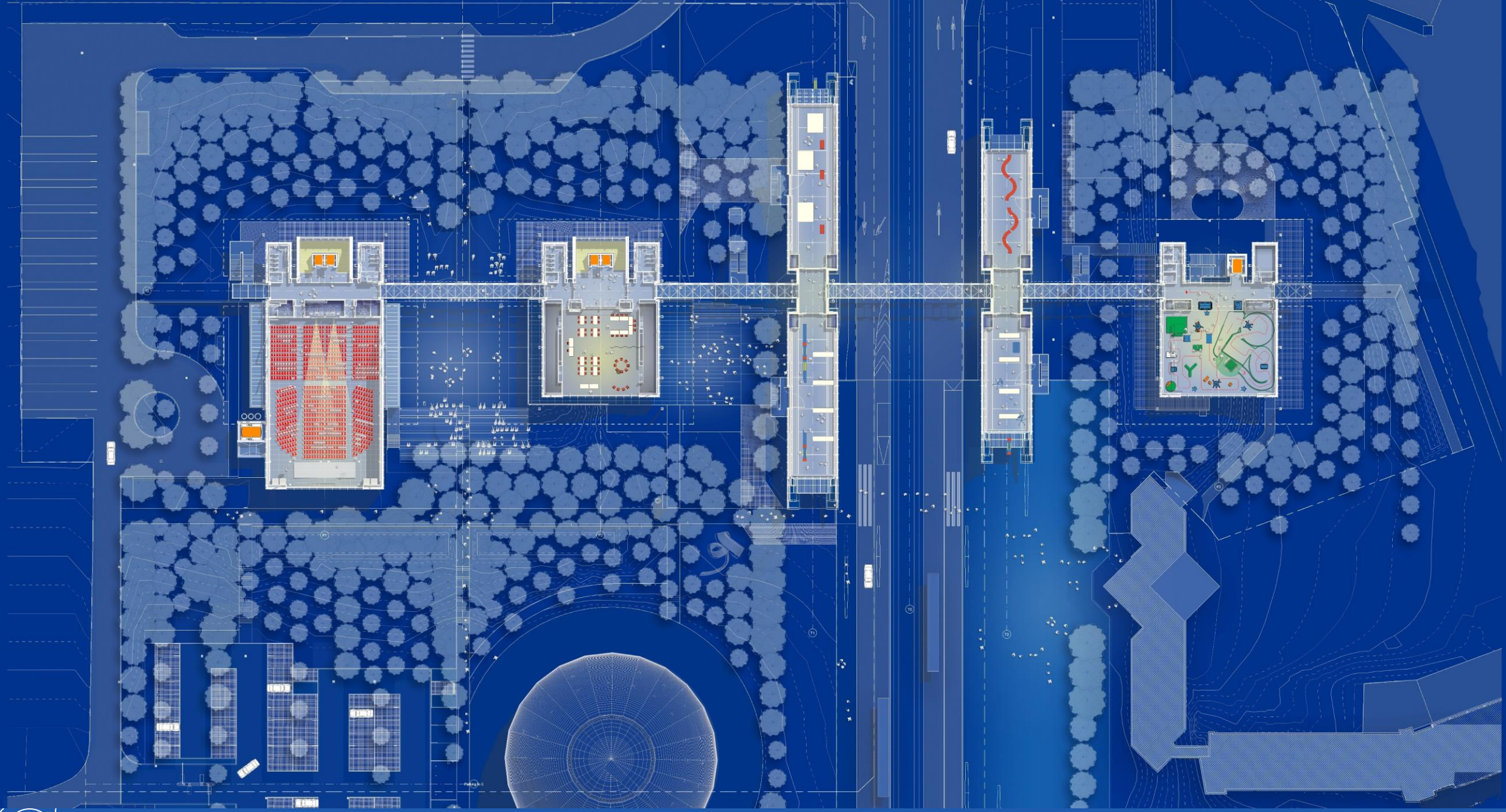


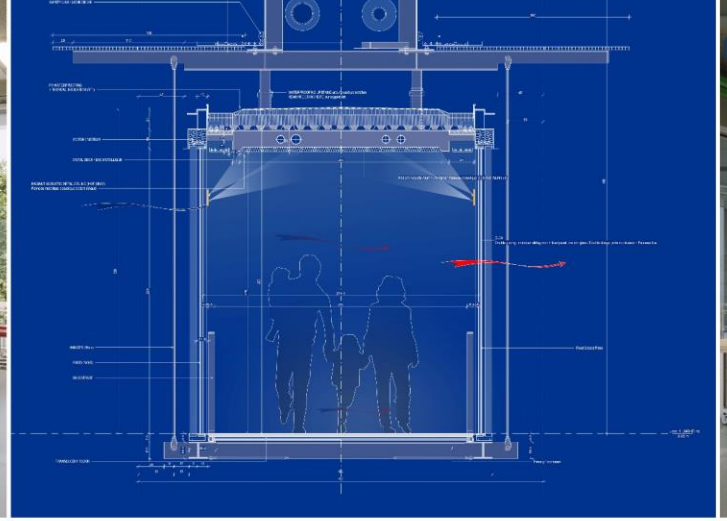
Phase 2 : FCC-hh
proton – proton Collider
High-energy frontier (pp,ion,eh)



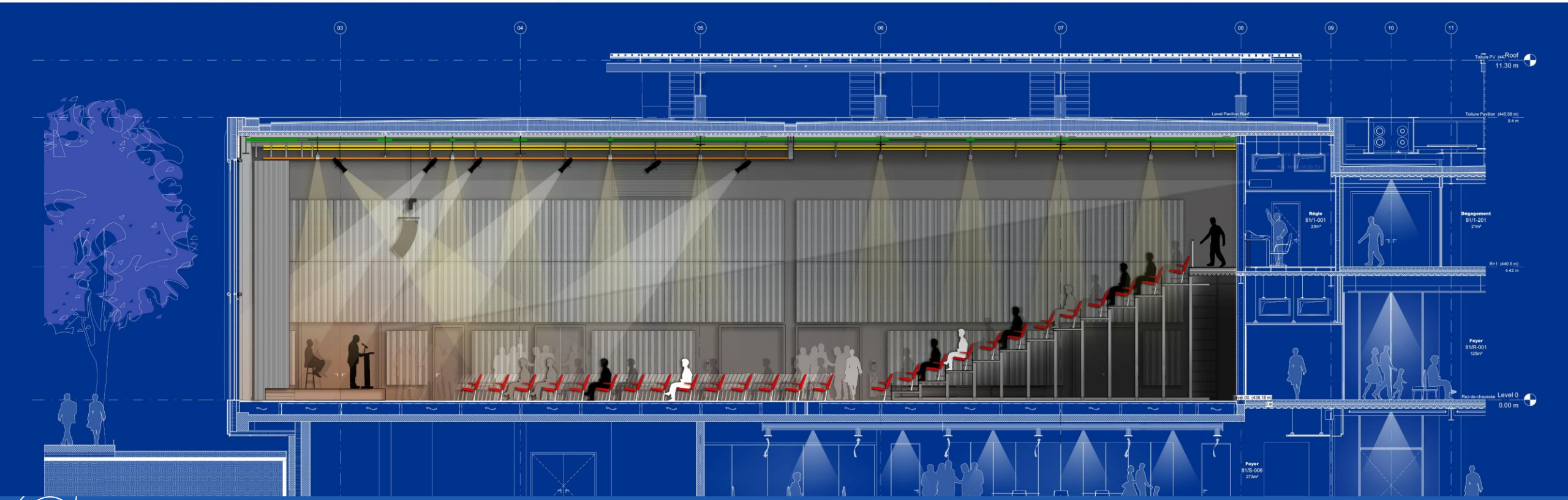
2020 - 2040 | 2040 - 2055 | 2060 - 2090


CERN Science Gateway






Labs


03
04
05
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07
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11
Toiture PV (447 m²)
Roof
11.30 m
Level Pavilion Roof
Toiture Pavillon (445.58 m)
9.4 m
Régie
81/1-001
23m²
Dégagement
81/1-201
21m²
R+1 (440.6 m)
4.42 m
Foyer
81/R-001
125m²
Rez-de-chaussée
Level 0
0.00 m
Foyer
81/S-006
273m²

Opportunities

QUEST

ORIGIN

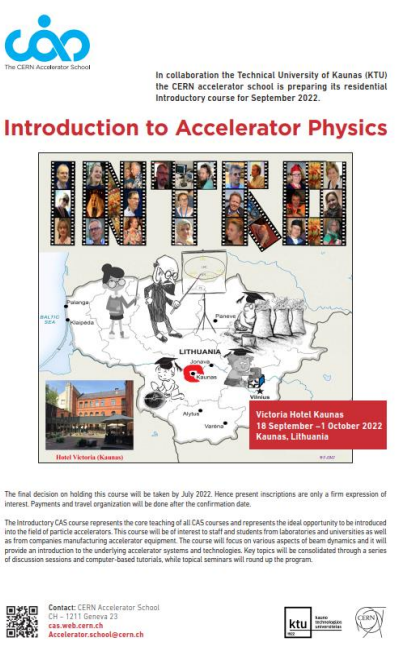
Research Fellowships

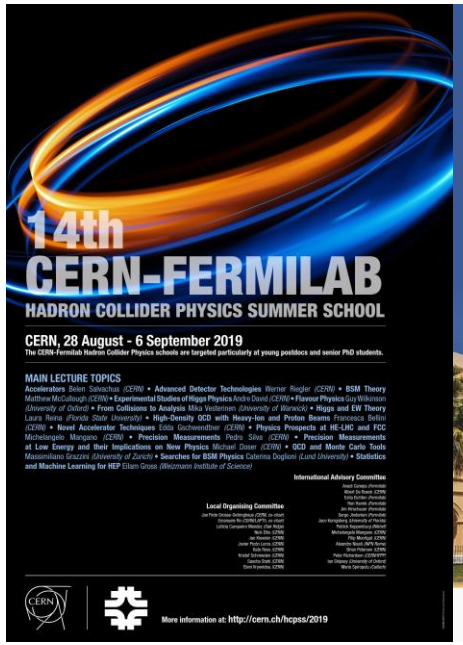
25 by '25

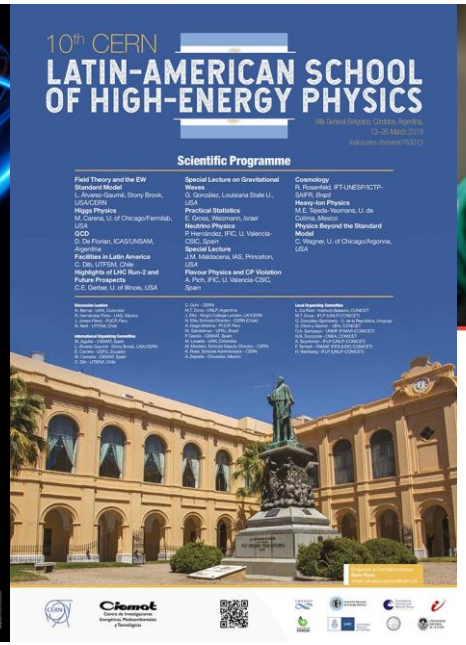
4 QUALITY EDUCATION

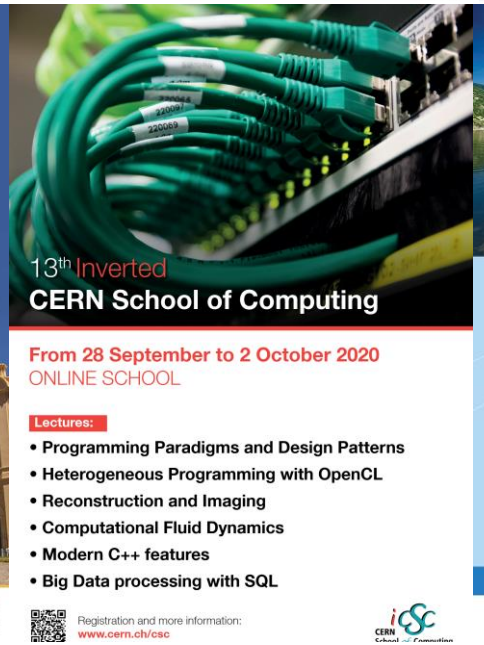
5 GENDER EQUALITY

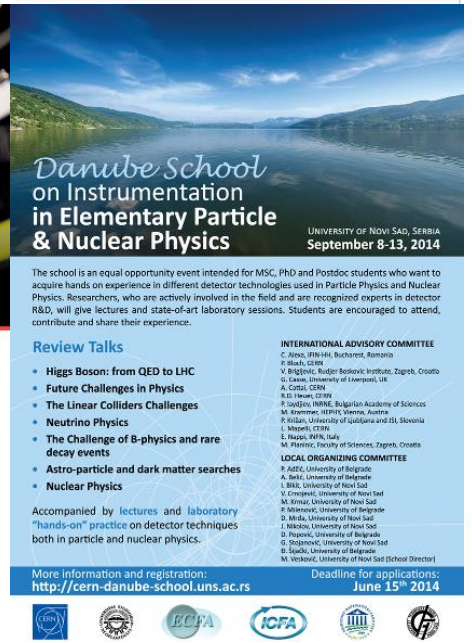
Educational Opportunities – Tertiary and Beyond







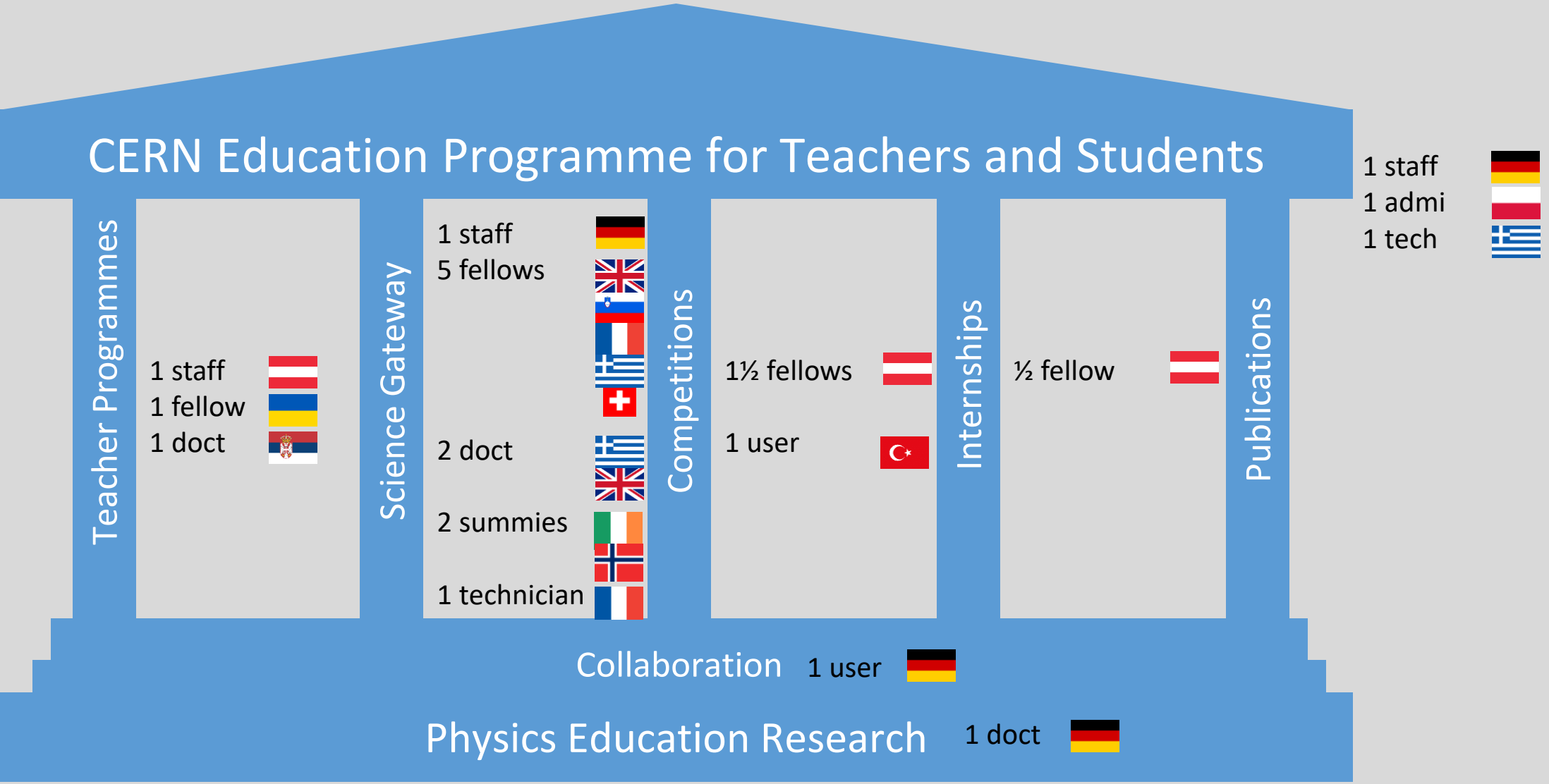




CERN Schools

17 PARTNERSHIPS FOR THE GOALS

4 QUALITY EDUCATION



Education Team Summer 2023

Teacher Progamme Participants 1998-2022 (Total: 13 871)

Member States 11 056
Austria 300 – Belgium 149 – Bulgaria 821
Czech Republic 171 – Denmark 348 – Finland 550
France 465 - Germany 1142 – Greece 952
Hungary 561 – Israel 56 – Italy 1139
Netherlands 227 – Norway 158 – Poland 588
Portugal 495 – Romania 20 – Serbia 84
Slovakia 307 – Spain 705 – Sweden 311
Switzerland 135 – United Kingdom 1372

Associate Member States in the pre-stage to Membership 165
Cyprus 16 – Estonia 105 – Slovenia 44

Associate Member States 889
Croatia 114 – India 15 – Latvia 76 – Lithuania 64
Pakistan 9 – Türkiye 403 – Ukraine 208

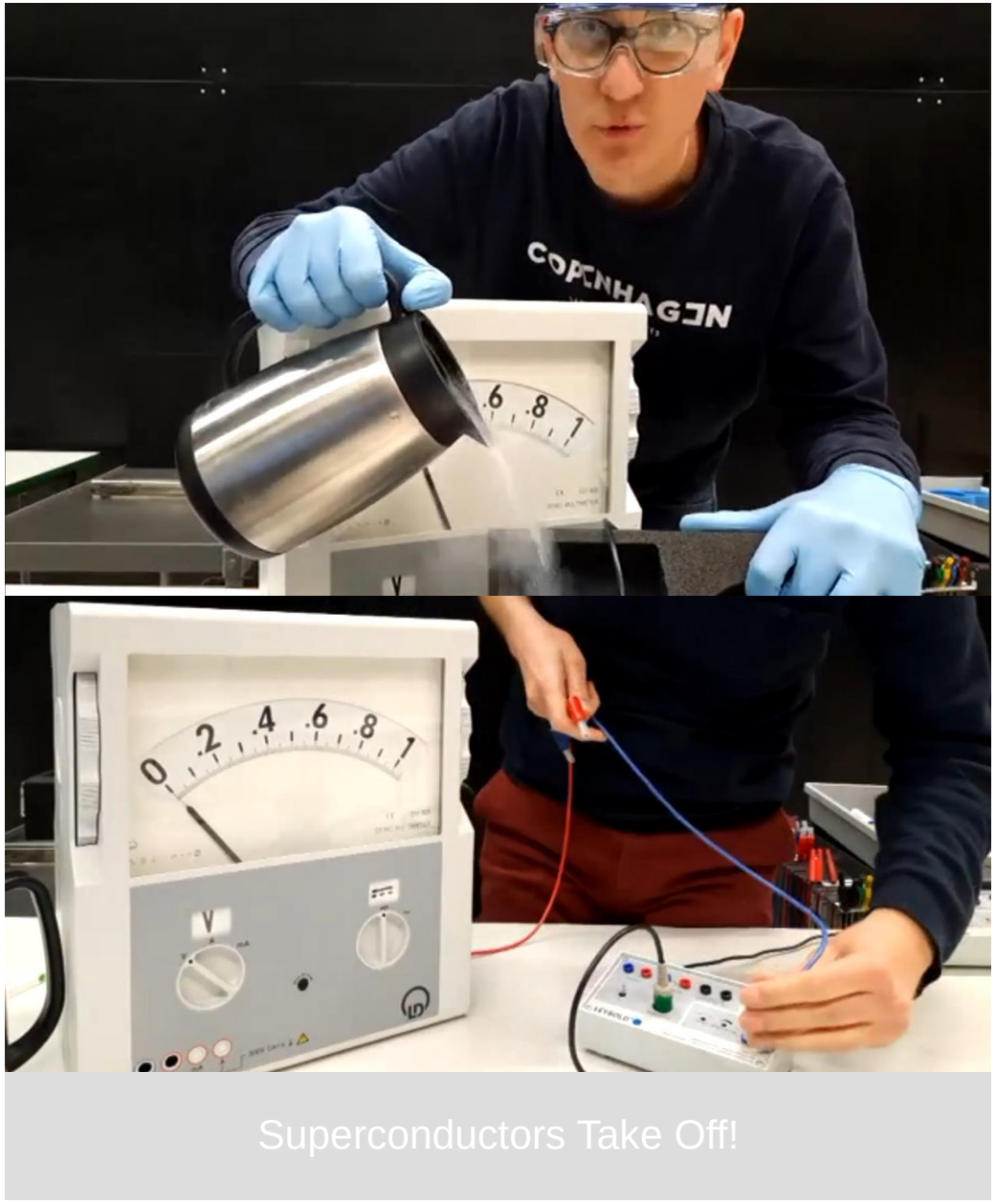
Observers 579
Japan 12 – Russia (suspended) 431
United States of America 136

Non-Member States and Territories 1182
Algeria 11 – Angola 11 – Argentina 3 – Armenia 3 – Australia 14 – Azerbaijan 2 – Bahrain 3 – Bangladesh 1 – Belarus 11
Bosnia & Herzegovina 36 – Brazil 273 – Burundi 2 – Cameroon 11 – Canada 20 – Cape Verde 5 – Chile 4 – Colombia 8
Costa Rica 4 – Dominican Republic 73 – Ecuador 2 – Egypt 3 – Eswatini 1 – Georgia 194 – Ghana 7 – Guinea Bissau 2
Indonesia 3 – Iran 15 – Ireland 10 – Jordan 13 – Kazakhstan 14 – Kenya 4 – Kuwait 1 – Kyrgyzstan 1 – Lebanon 21
Madagascar 2 – Malaysia 3 – Malta 51 – Mexico 113 – Moldova 4 – Mongolia 1 – Montenegro 17 – Morocco 2
Mozambique 24 – Nepal 6 – New Zealand 5 – Nigeria 2 – North Macedonia 13 – Palestinian Territories 5
People's Republic of China 3 – Philippines 2 – Qatar 1 – Republic of Korea 49 – Rwanda 20 – Sao Tome 8
Saudi Arabia 1 – Singapore 2 – South Africa 9 – Sri Lanka 3 – Taiwan 1 – Tajikistan 1 – Tanzania 1 – Thailand 23
Timor-Leste 10 – Uganda 3 – United Arab Emirates 1 – Uruguay 3 – Venezuela 1 – Vietnam 2 – Zimbabwe 1

Teacher Programmes

Virtual Science Shows – the pandemic as great opportunity

- Live interactive demonstrations of scientific phenomena
- Links to CERN research
- Questions and answers
- Various languages

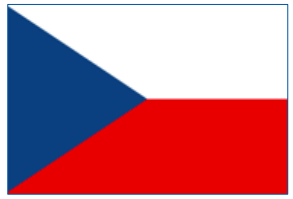


2017





2018



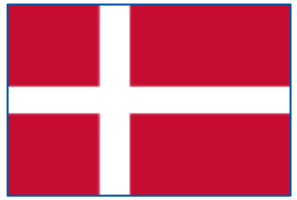


2019





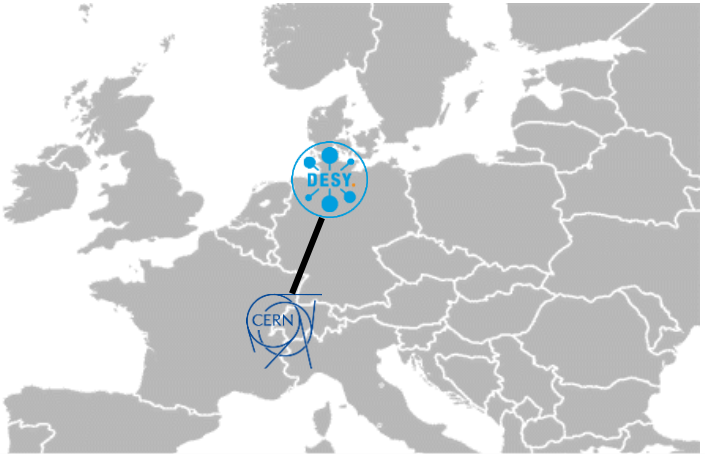

2021

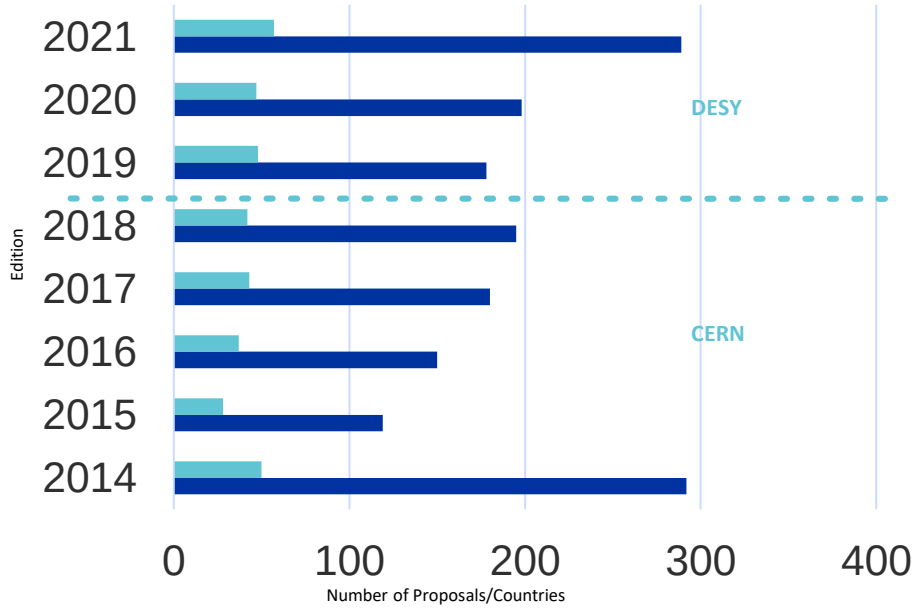




2022


High-School Students Internship Programme

- Competition for High-School Student Teams
- Normally at CERN's PS, 2019-21 at DESY
- Participation 2021
  - 298 proposals
- 2022
  - back at CERN for the finals of the competition
  - with 1 additional winning team at DESY





beamline for schools
cern.ch/bl4s
powered by CERN & DESY

Beamline for Schools Competition

Evaluation of CER

Anja Kranjc Horvat

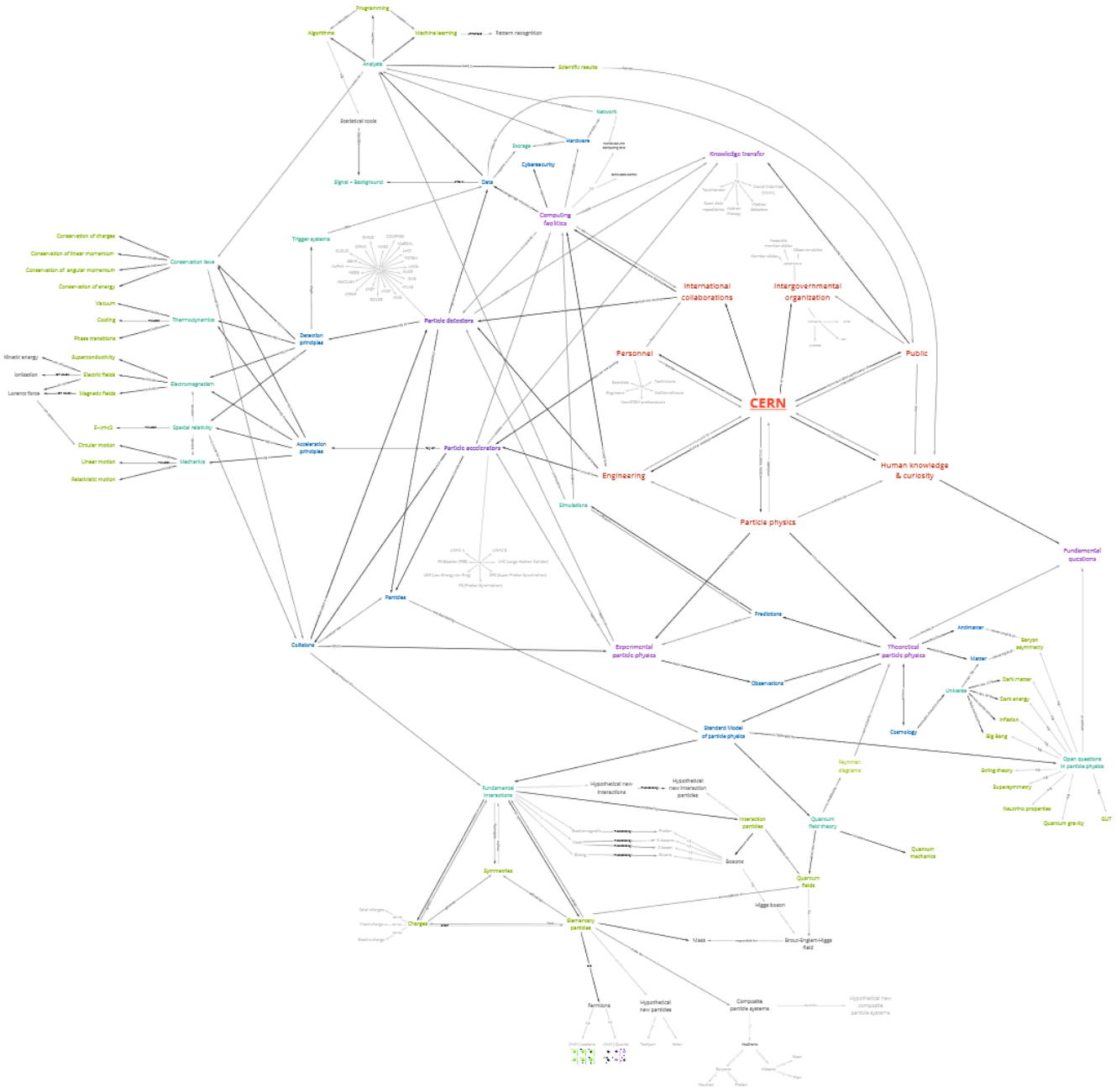
Link to CERN

Evaluation of CERN's Tea
overview of concepts in tl
***physics"* to ...**

- inform and improve C
- create a valuable teac

Paper: Kranjc Horvat, A., Wiener, J., S
Learning goals of professional devel
institutions: A Delphi study with differe
Teacher Education.

What would you like high-school students to know about CERN and particle physics?



Fostering i

Sarah Zöchling

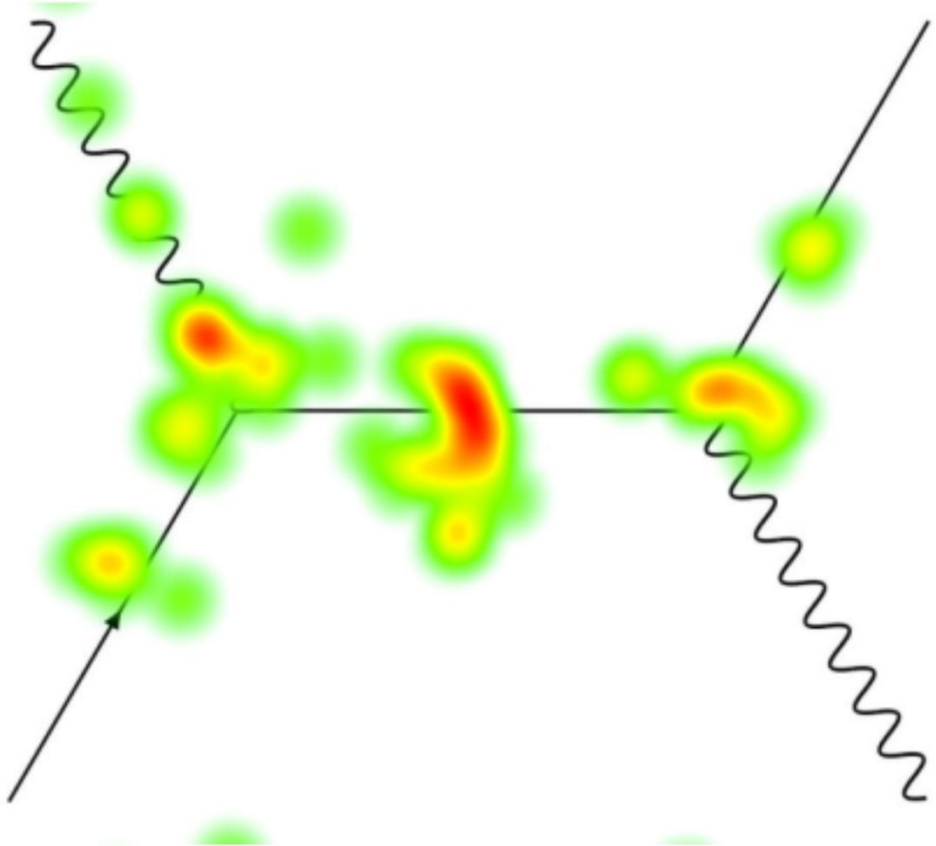
Link to CERN

Development of interest in partic students' interes contexts to …

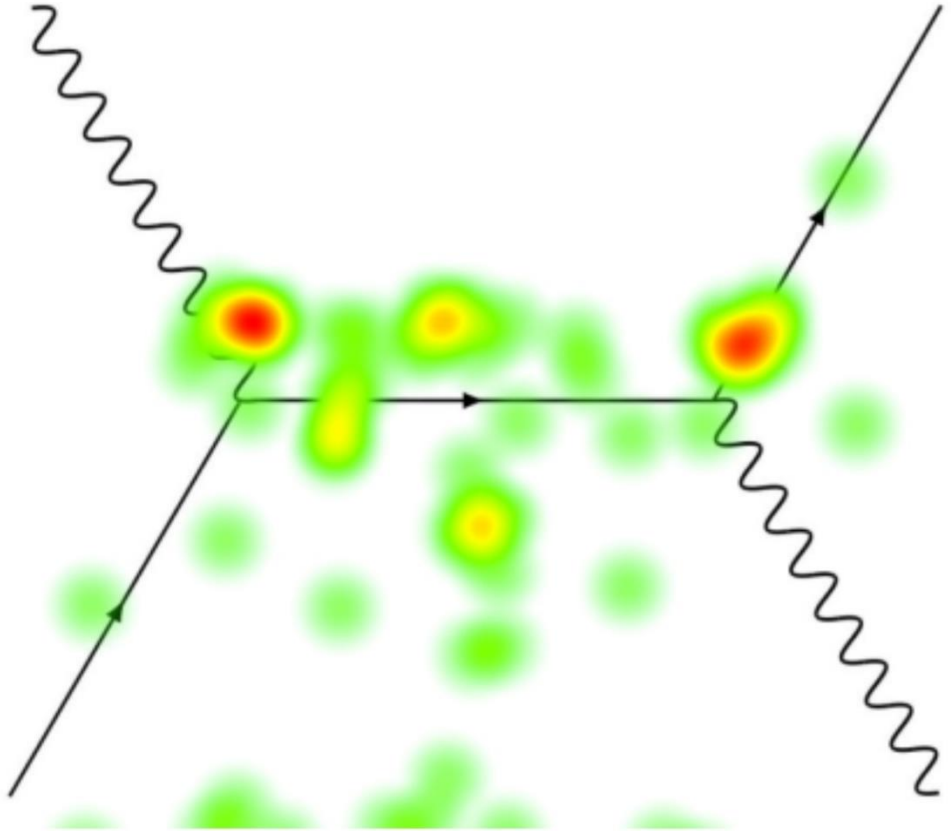
- define interest
- give recommer material

Eye Tracking in PER

Novices



Experts



How many Vertices is the diagram composed of?

Your Questions