Grundlagenforschung in einer internationalen Perspektive

CERN – European Organization for Nuclear Research

The Organization, current research, and education.

Dr. Sascha Marc Schmeling

Science for peace

CERN was founded in 1954 by 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 Associates Member States in the pre-stage to membership

Cyprus – Estonia – Slovenia

7 Associate Member States

Croatia – India – Latvia – Lithuania – Pakistan – Turkey – Ukraine

6 Observers

Japan – Russia – USA
European Union – JINR – UNESCO

CERN's annual budget is 1228 MCHF (equivalent to a medium-sized European university)

As of 31 December 2021
Employees:
2676 staff, **783** fellows

Associates:
11 175 users, **1699** others

More than 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 – Iceland
Iran – Jordan – Kazakhstan – Latvia – 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 2021

Geographical & cultural diversity
Users of **115 nationalities**
and **from 77 countries**
~ 23% women

Member States 6642

Austria 74 – **Belgium** 122 – **Bulgaria** 39 – **Czech Republic** 227
Denmark 42 – **Finland** 71 – **France** 811 – **Germany** 1129
Greece 133 – **Hungary** 69 – **Israel** 67 – **Italy** 1423
Netherlands 157 – **Norway** 69 – **Poland** 278 – **Portugal** 89
Romania 105 – **Serbia** 36 – **Slovakia** 66 – **Spain** 328
Sweden 88 – **Switzerland** 372 – **United Kingdom** 847

Associate Member States **55**
in the pre-stage to membership

Cyprus 10 – **Estonia** 24 – **Slovenia** 21

Associate Member States **367**

Croatia 36 – **India** 130 – **Latvia** 11 – **Lithuania** 11 – **Pakistan** 30
Turkey 122 – **Ukraine** 26

Observer States **2917**

Japan 189 – **Russia** 971 – **United States of America** 1757

Other countries **1194**

Algeria 3 – **Argentina** 16 – **Armenia** 10 – **Australia** 20 – **Azerbaijan** 3 – **Bahrain** 2 – **Belarus** 24 – **Brazil** 106
Canada 189 – **Chile** 23 – **Colombia** 18 – **Cuba** 3 – **Ecuador** 6 – **Egypt** 16 – **Georgia** 36
Hong Kong 17 – **Iceland** 3 – **Indonesia** 6 – **Iran** 11 – **Ireland** 6 – **Jordan** 5 – **Kuwait** 5 – **Lebanon** 15
Madagascar 1 – **Malaysia** 4 – **Malta** 2 – **Mexico** 48 – **Montenegro** 5 – **Morocco** 18 – **New Zealand** 8 – **Oman** 1
People's Republic of China 314 – **Peru** 2 – **Philippines** 1 – **Republic of Korea** 113 – **Singapore** 3
South Africa 52 – **Sri Lanka** 10 – **Taiwan** 45 – **Thailand** 18 – **United Arab Emirates** 6

CERN Council

President: E. Rabinovici

Secretary: CERN DG

- (Associate) Member States: jeweils 2 Delegierte
- ex-officio
  - FC Vorsitz
  - SPC Vorsitz
- Verschiedene Beobachter auf Einladung, incl. ECFA Vorsitz

Finance Committee

Chairperson: U. Doselli

- (Associate) Member States: jeweils 1-3 Delegierte
- ex-officio
  - Council Präsident(in)
  - SPC Vorsitz

Scientific Policy Committee

Chairperson: L. Rivkin

- 14 individuelle Mitglieder
- ex-officio
  - ECFA Vorsitz
  - Vorsitzende von CERN Komitees (LHCC, MAC,SPSC, INTC)
- ständig Eingeladene
  - CERN DG, Council Präsident(in), FC Vorsitz

Audit Committee

Chairperson: FC Chair

Tripartite Employment Forum

Chairperson: B. Åsman

Pension Fund Governing Board

Chairperson: O. Malmberg

CERN – Die Organisation

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 Labor-Organisation 2021-2025 (ab 30.06.2021)

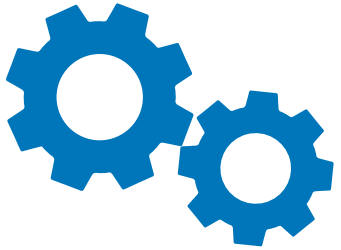
„Die Misson“

Grundlagenforschung

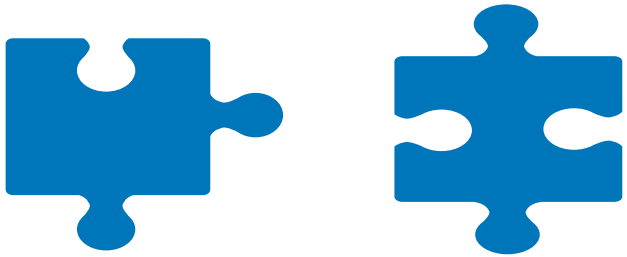
an der Grenze des menschlichen Wissens

Innovative Technologien

für die Forschung

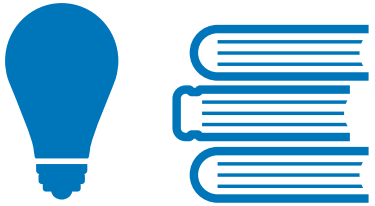


Zusammenarbeit



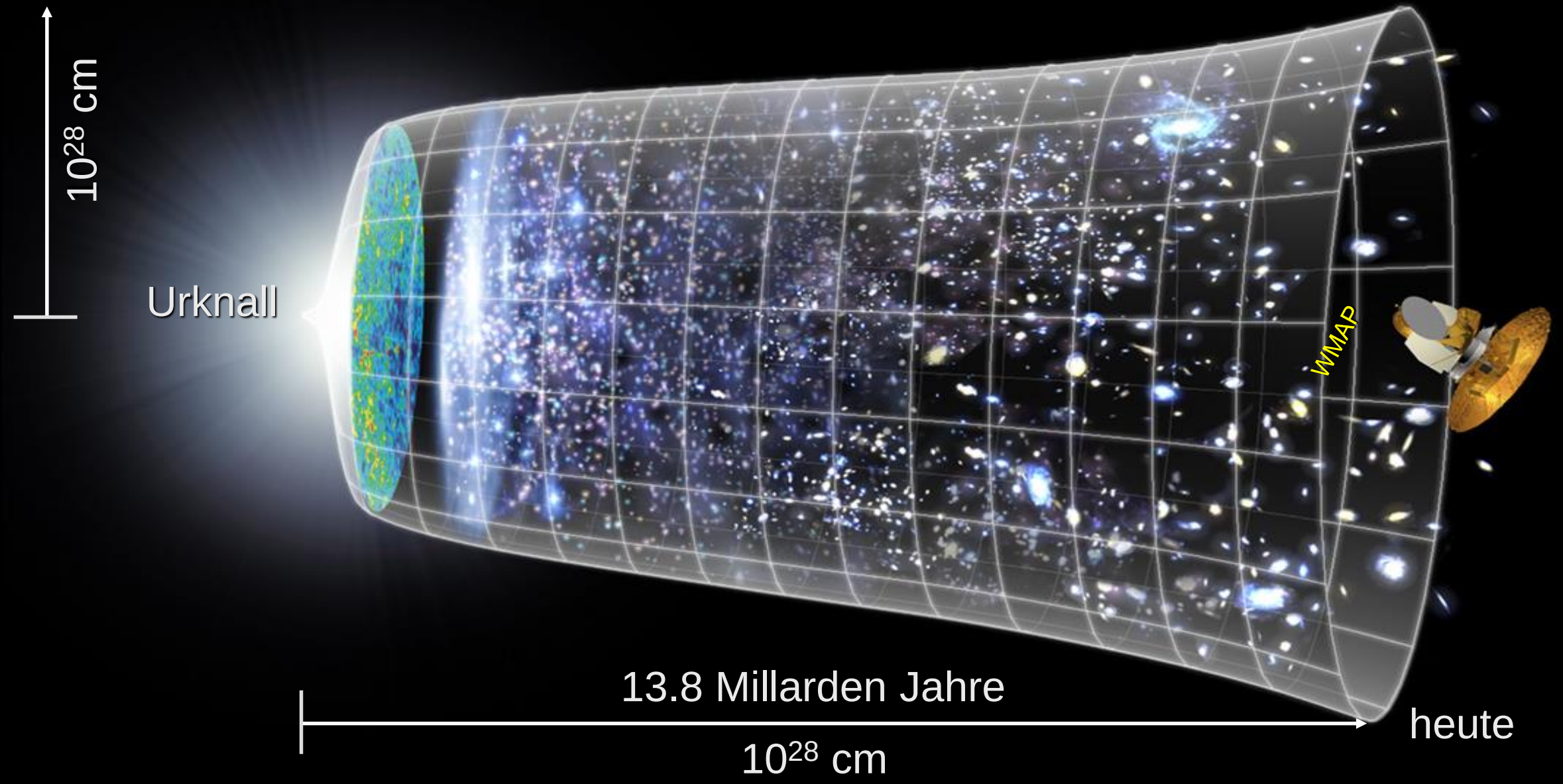
Bildung und Wissensvermittlung

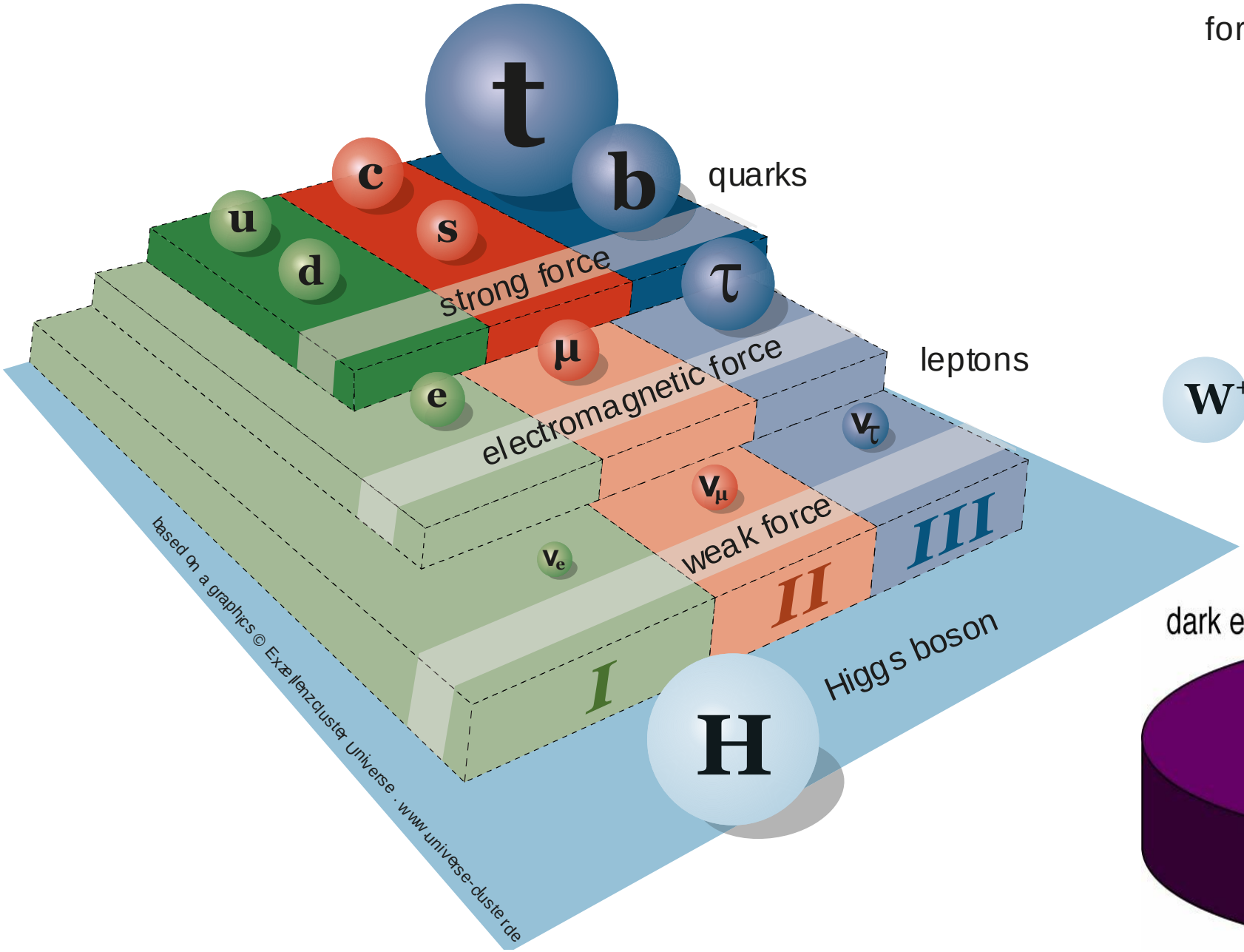
u.a. die Aus- und Weiterbildung von Wissenschaftler(inne)n und Ingenieur(inne)n.
aber eben auch Bildungsprogramme für Alle



Die Wissenschaftliche Herausforderung

Forschung über die Geschichte des Universums



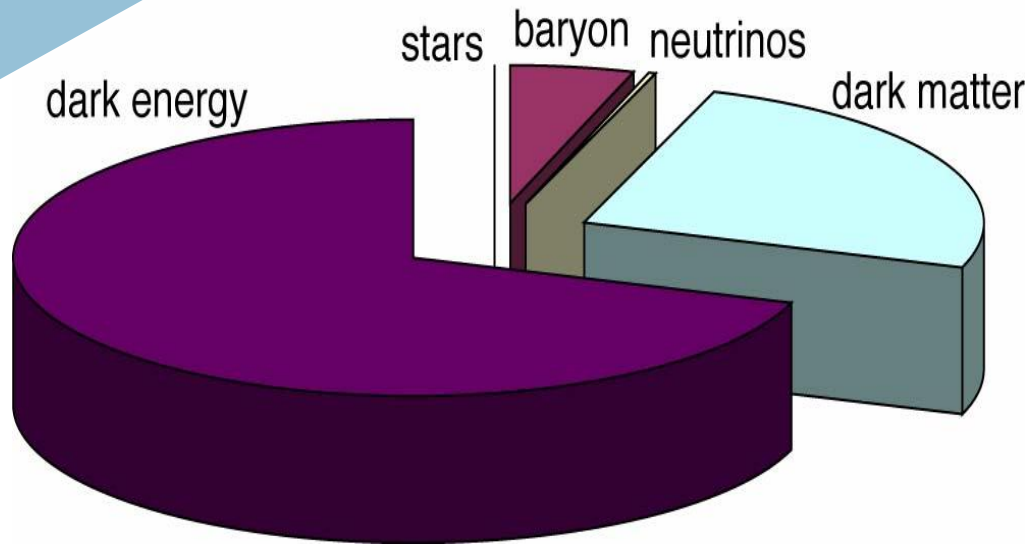


force carriers

g

γ

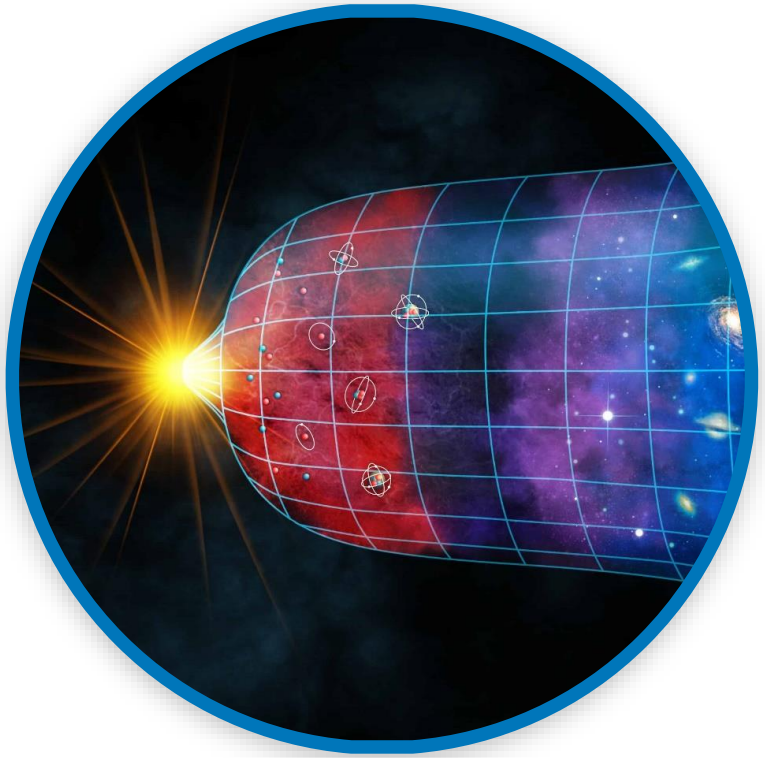
W^+ Z^o W^-



Standard Model

weitere Forschungsfragen

das frühe Universum



Antimaterie

Dunkle Materie

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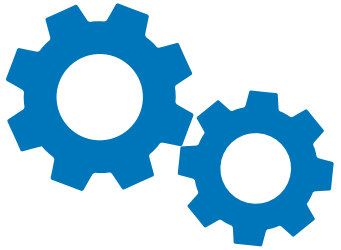

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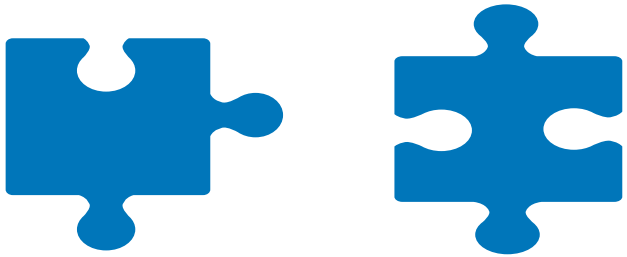

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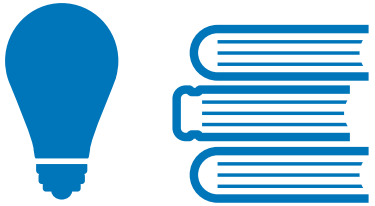
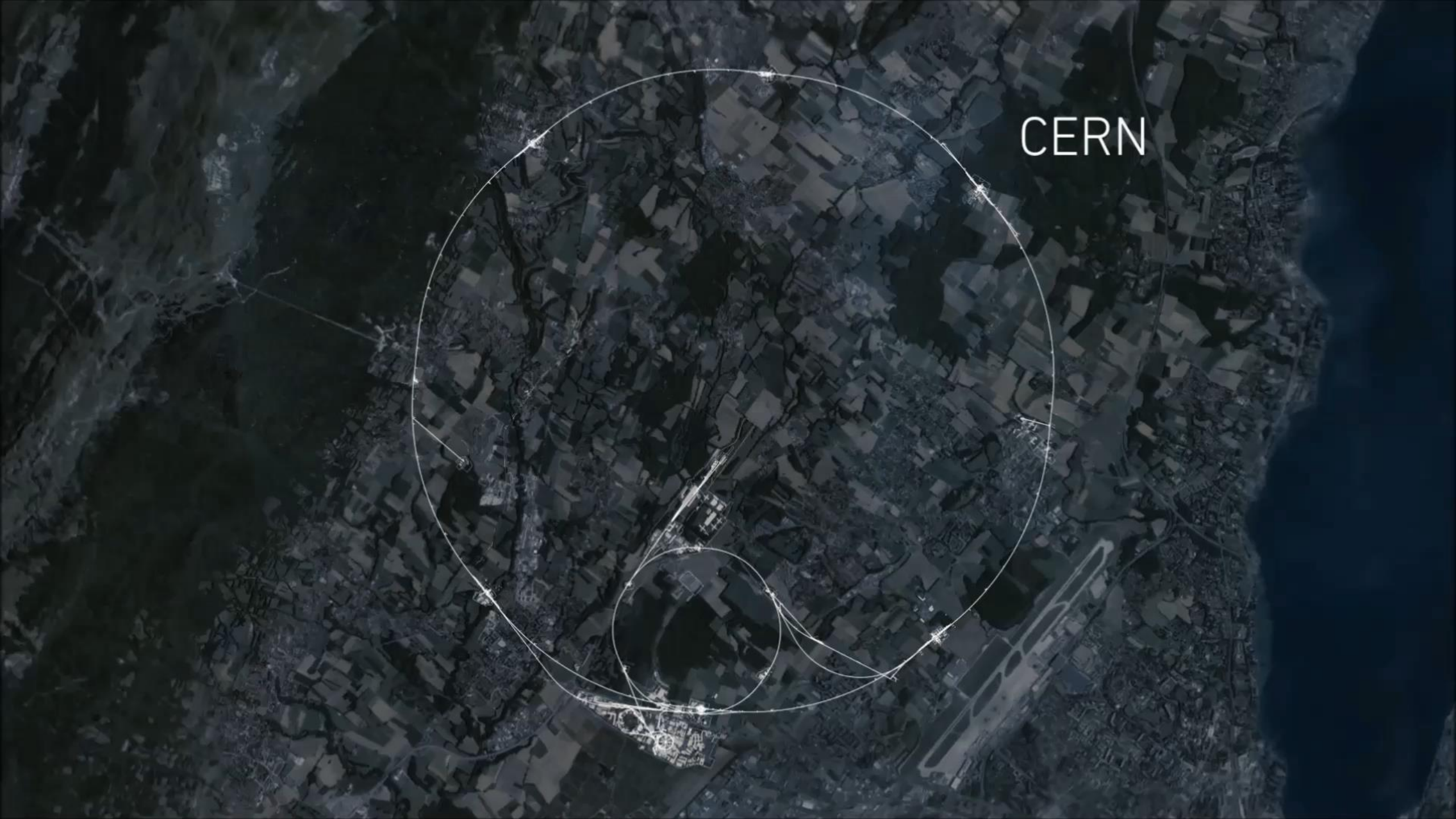
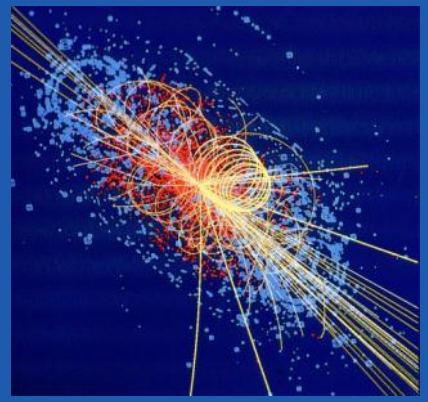



CERN

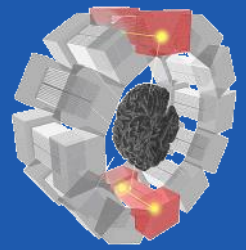


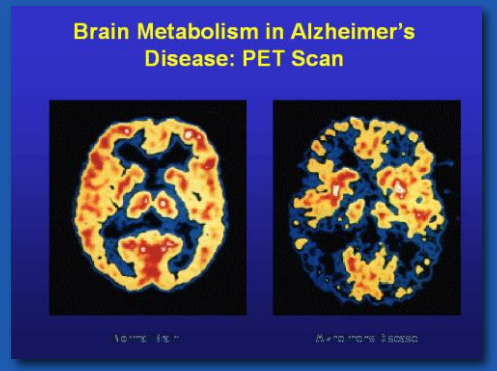
Particle Detection

Imaging

ClearPEM

PET Scanner

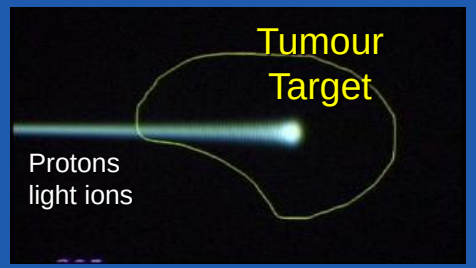


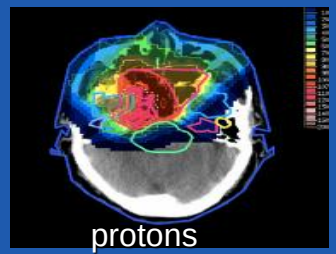


Accelerated Particle Beams

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

Hadron Therapy

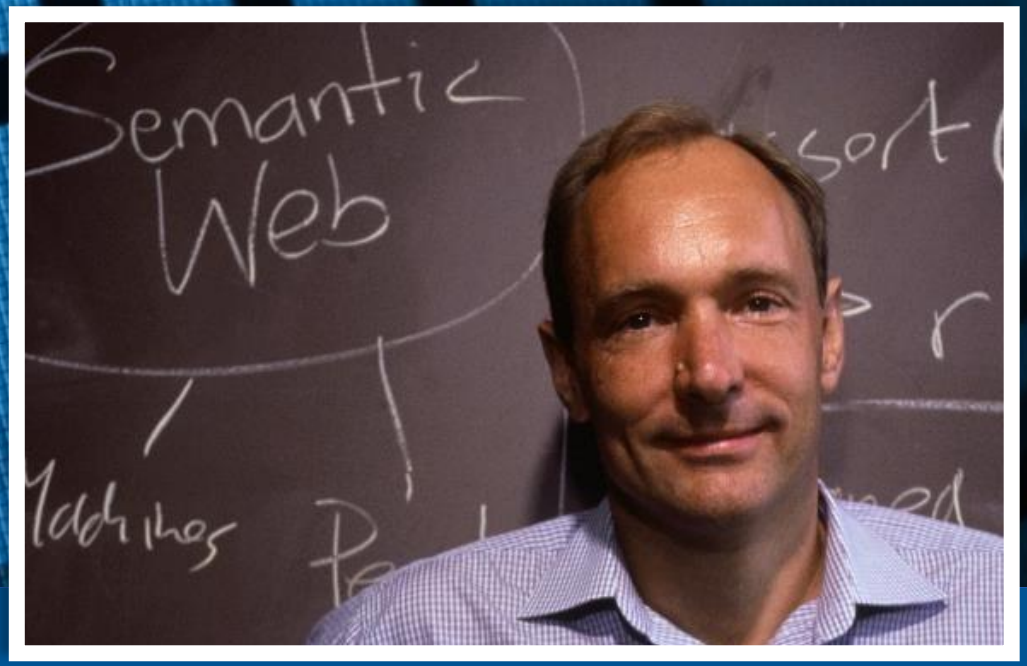




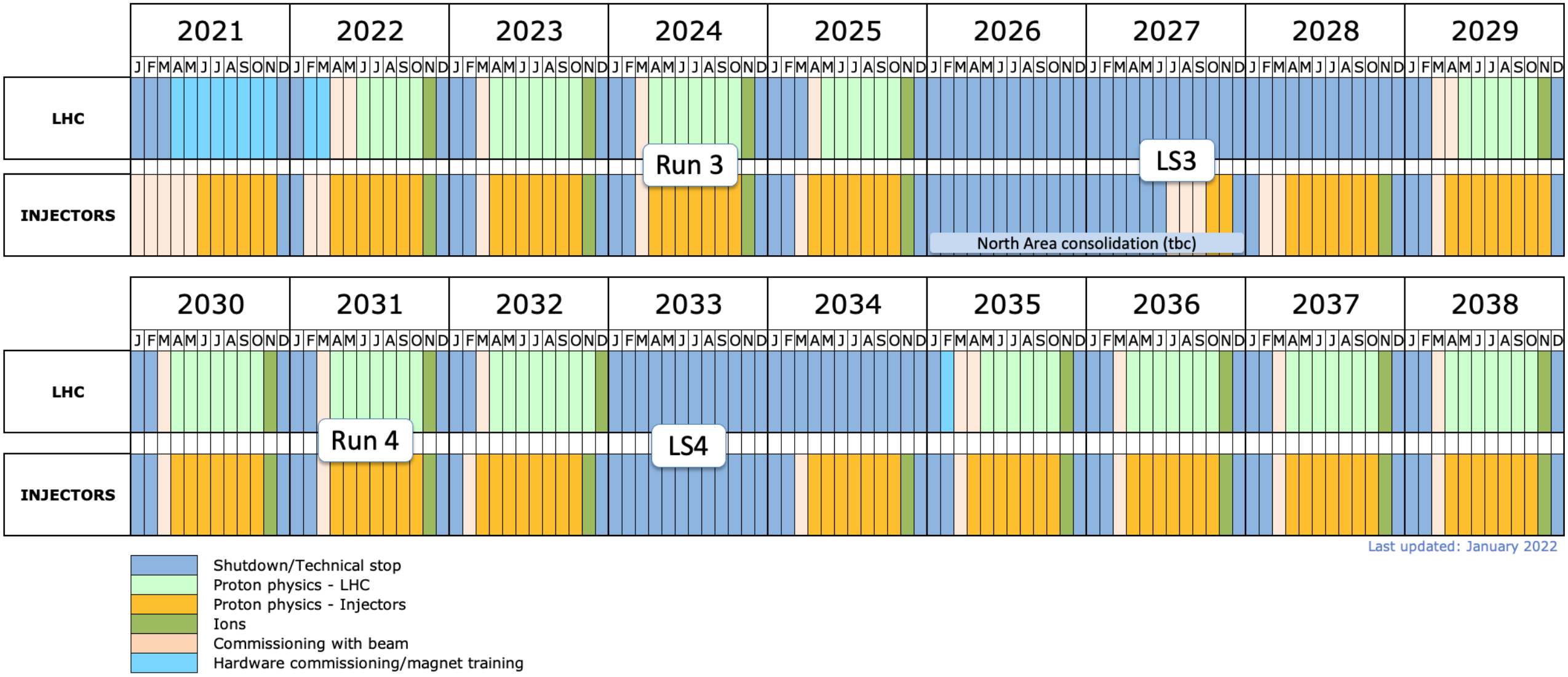
>70’000 patients/a world-wide (30 institutes)
>21’000 patients/a in Europe (9 institutes)

Medical Applications

World Wide Web



Was passiert gerade?

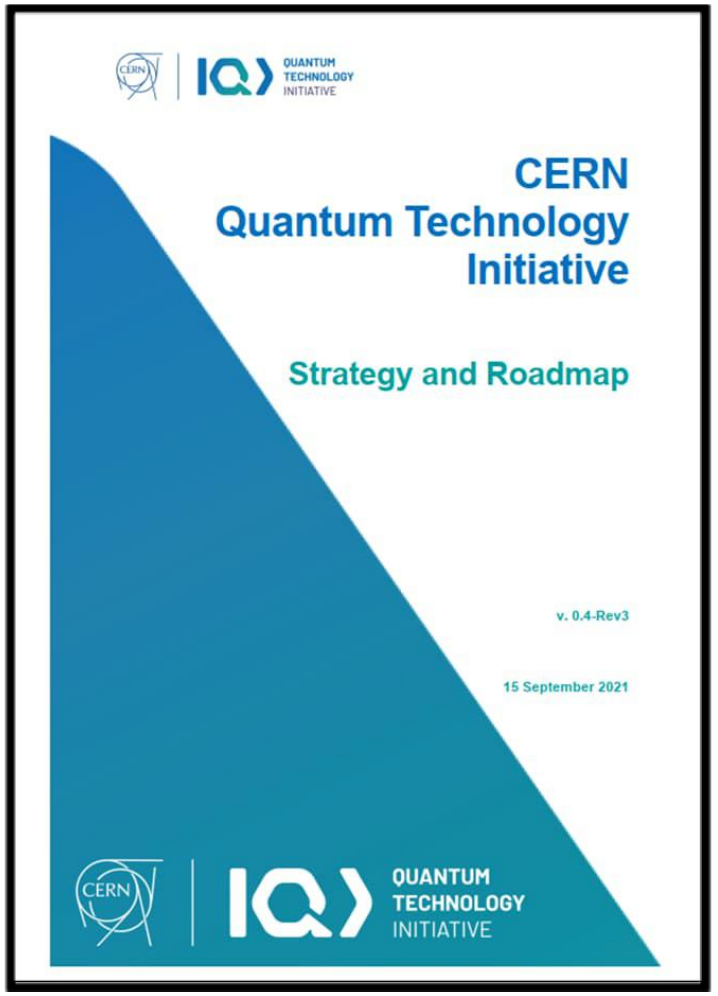


Last updated: January 2022

CERN Quantum Technology Initiative

Established in September 2020
Achievements in 2021:

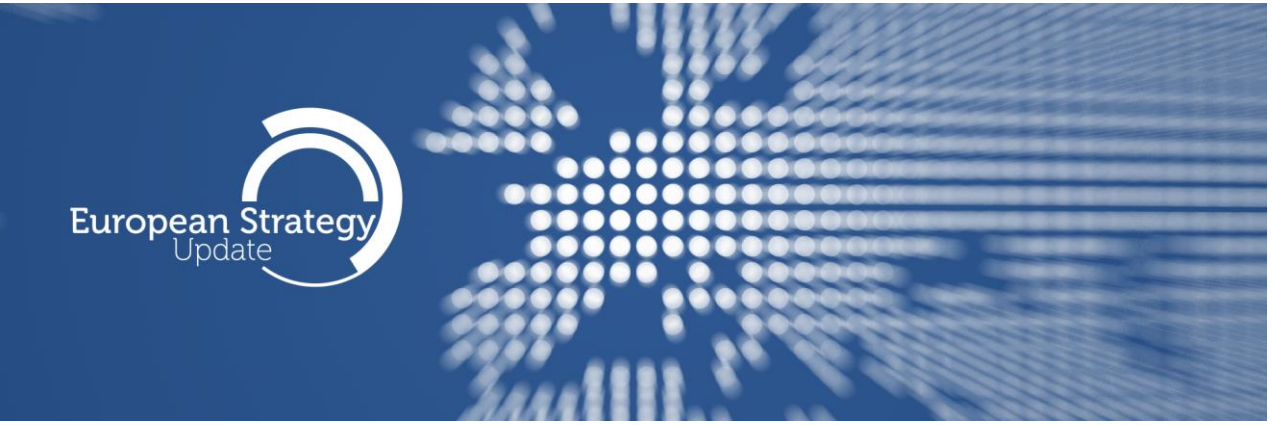
- Setting up the initiative and its governance
  - Coordination Task Force, Advisory Board, Web site, comms channels, branding, awareness
- Projects and PhD programme
  - Research programme as part of CERN DOCT programme
  - Research collaborations with institutes in the Member States and beyond (17 ongoing projects)
- Infrastructure
  - Local classic cluster for quantum computing simulations, a dedicated simulator, and access to quantum hardware from different providers
- Strategy and Roadmap
  - Developed in discussions with the CERN community, the Advisory Board and experts from the HEP/quantum communities, published in September 2021

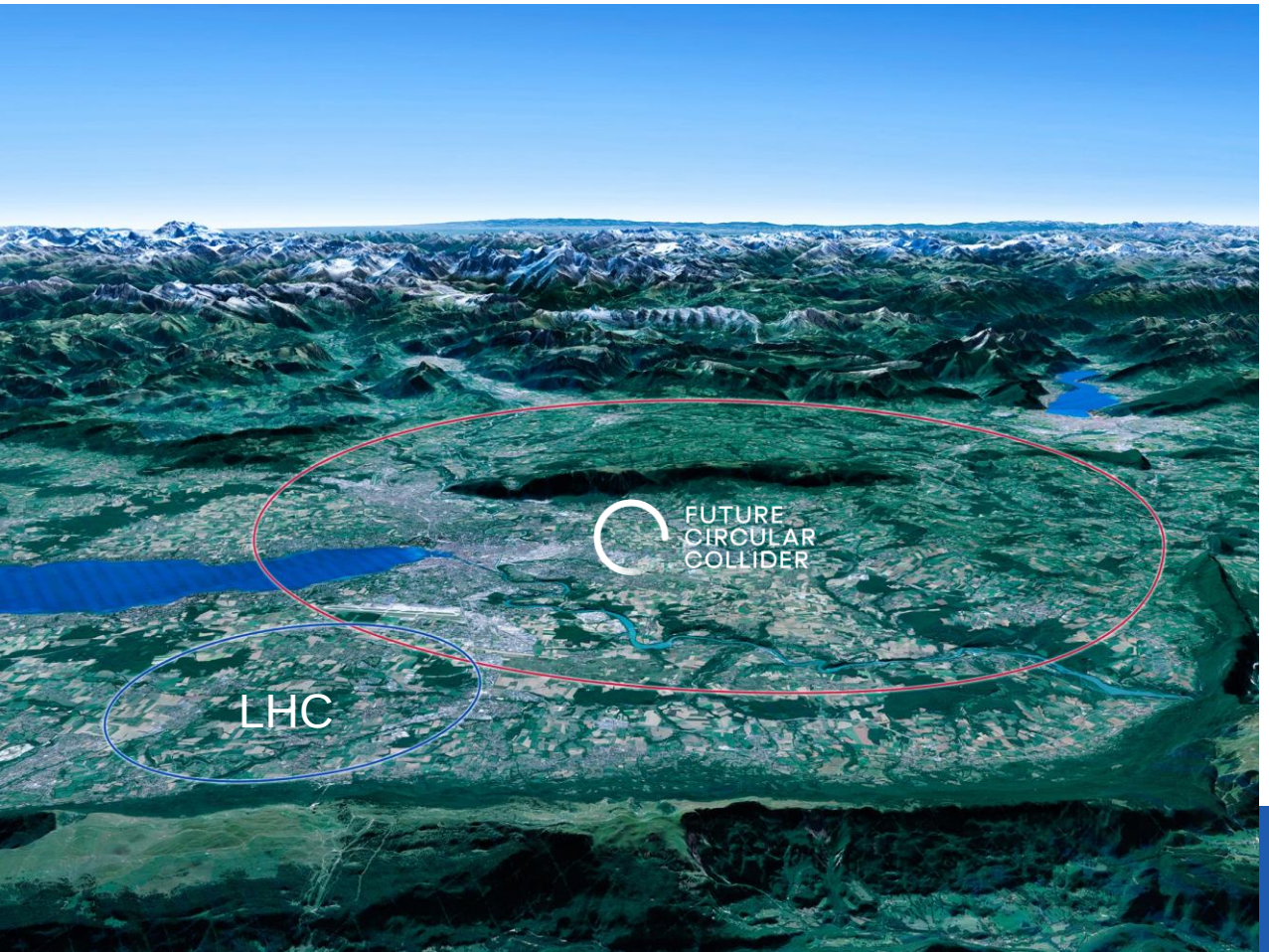


https://doi.org/10.5281/zenodo.5553774

Und dann?


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





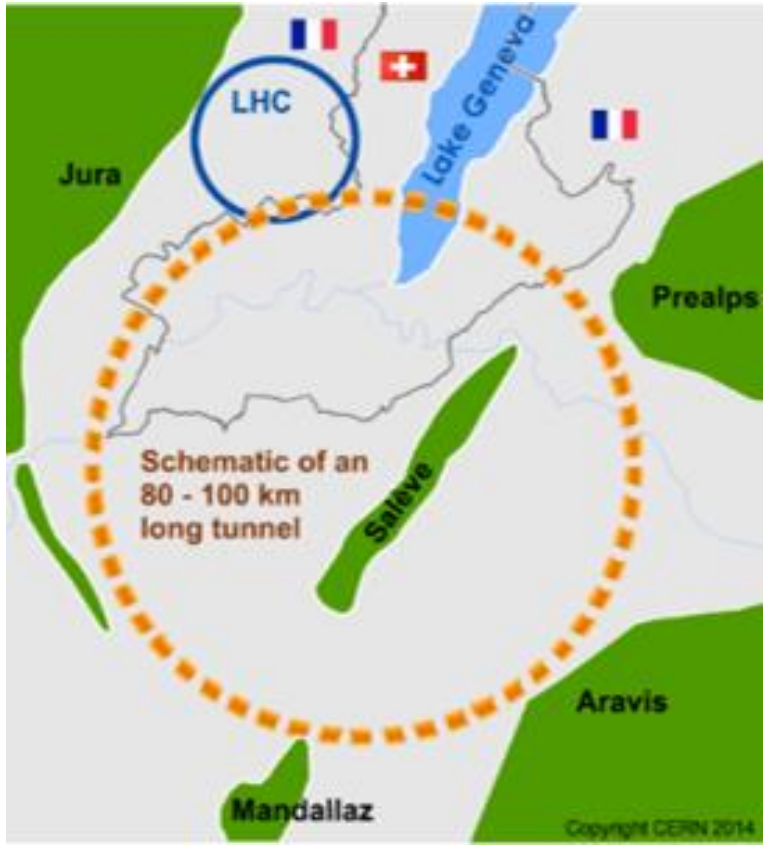
CERN Scientific Priorities for the Future

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

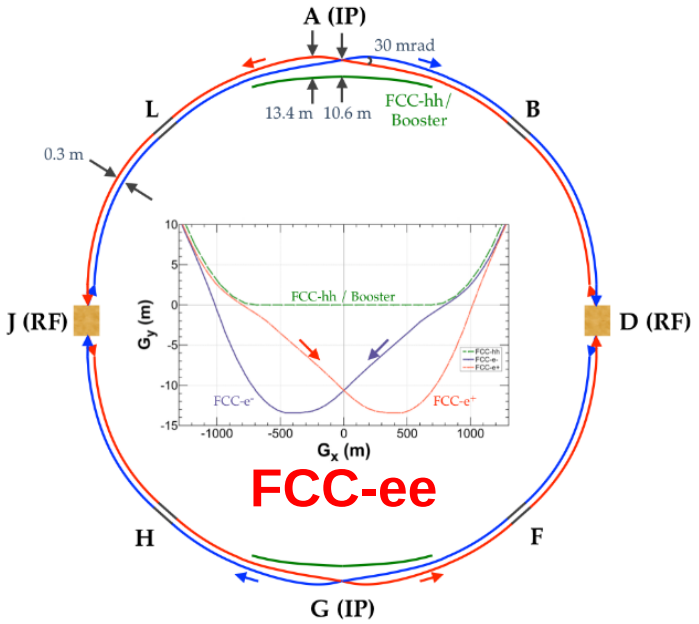
- Fully exploit the LHC & HL-LHC.
- Build a Higgs factory to further understand this unique particle.
- Investigate the technical and financial feasibility of a future energy-frontier 100 km collider at CERN.
- Ramp up relevant R&D.
- Continue supporting other projects around the world.

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

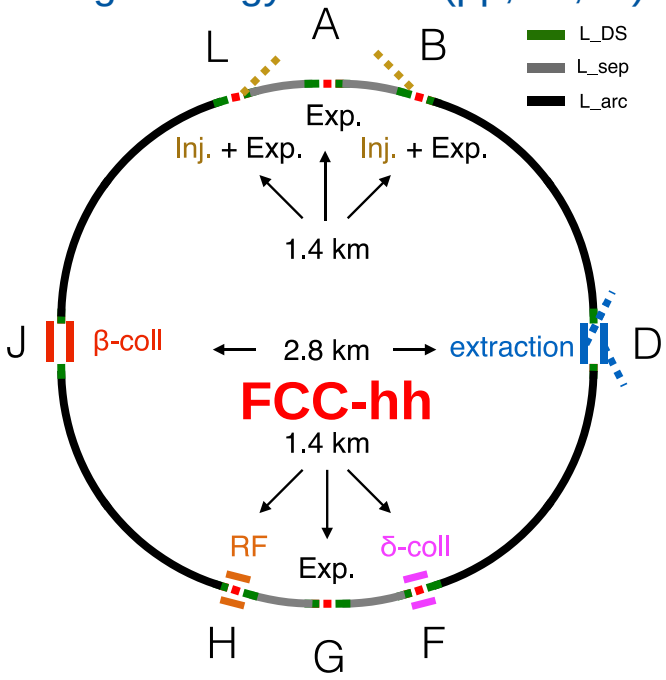
Complementary physics, common civil engineering and technical infrastructures, building on and reusing CERN's existing infrastructure, FCC integrated project allows seamless continuation of HEP after HL-LHC



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



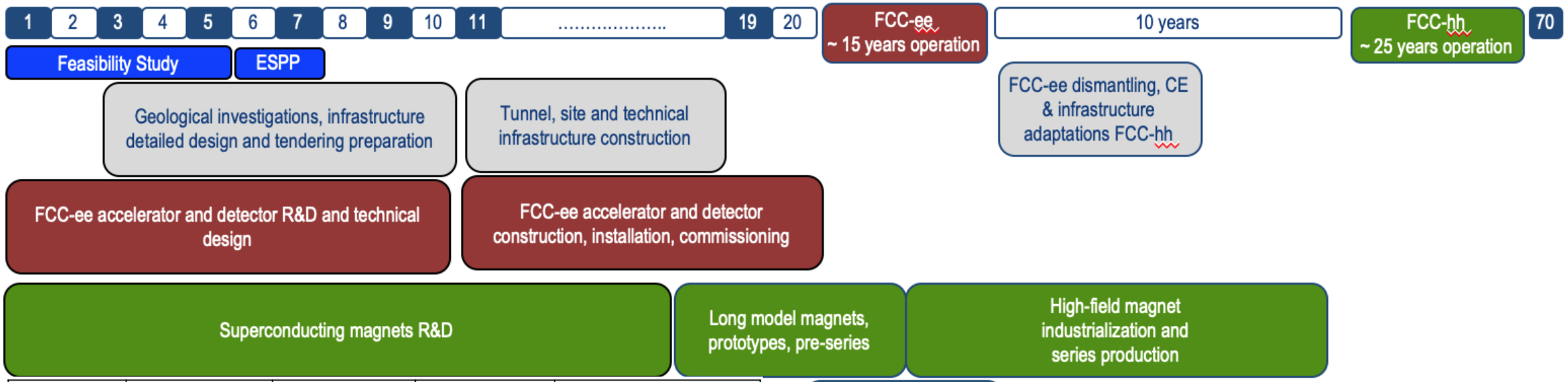
Phase 2 : FCC-hh
proton – proton Collider
High-energy frontier (pp,ion,eh)



2020 - 2040 | 2040 - 2055 | 2060 - 2090

Timeline of the FCC Integrated Programme

Technical schedule



	√s		L /IP ($cm^{-2}\,s^{-1}$)	Int. L /IP(ab^{-1})	Comments
e^+e^- **FCC-ee**	~90 GeV 160 240 ~365	Z WW H top	230 x10^{34} 28 8.5 1.5	75 5 2.5 0.8	2-4 experiments Total ~ 15 years of operation
pp **FCC-hh**	100 TeV		5 x 10^{34} 30	20-30	2+2 experiments Total ~ 25 years of operation
PbPb **FCC-hh**	$\sqrt{s_{NN}}$ = 39TeV		3 x 10^{29}	100 nb^{-1}/run	1 run = 1 month operation
ep **Fcc-eh**	3.5 TeV		1.5 10^{34}	2 ab^{-1}	60 GeV e- from ERL Concurrent operation with pp for ~ 20 years
e-Pb **Fcc-eh**	$\sqrt{s_{eN}}$ = 2.2 TeV		0.5 10^{34}	1 fb^{-1}	60 GeV e- from ERL Concurrent operation with PbPb

- Feasibility Study: 2021-2025
- If project approved before end of decade → construction can start beginning 2030s
- FCC-ee operation ~2045-2060
- FCC-hh operation 2070-2090++

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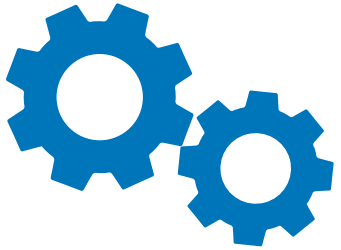
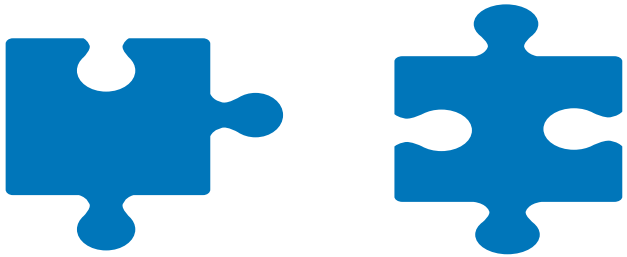


Zusammenarbeit



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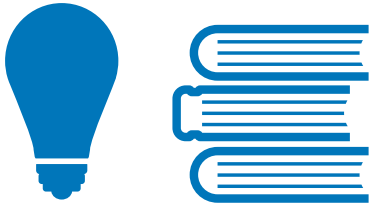


Education Team 2022

CERN Education Programme for Teachers and Students

1 staff
1 admin
1 tech

Teacher Programmes

1 staff
1 fellow

S'Cool LAB

1 fellow
2 doct

1 technician

Competitions

2 fellow

1 user

Internships

1 fellow

Publications

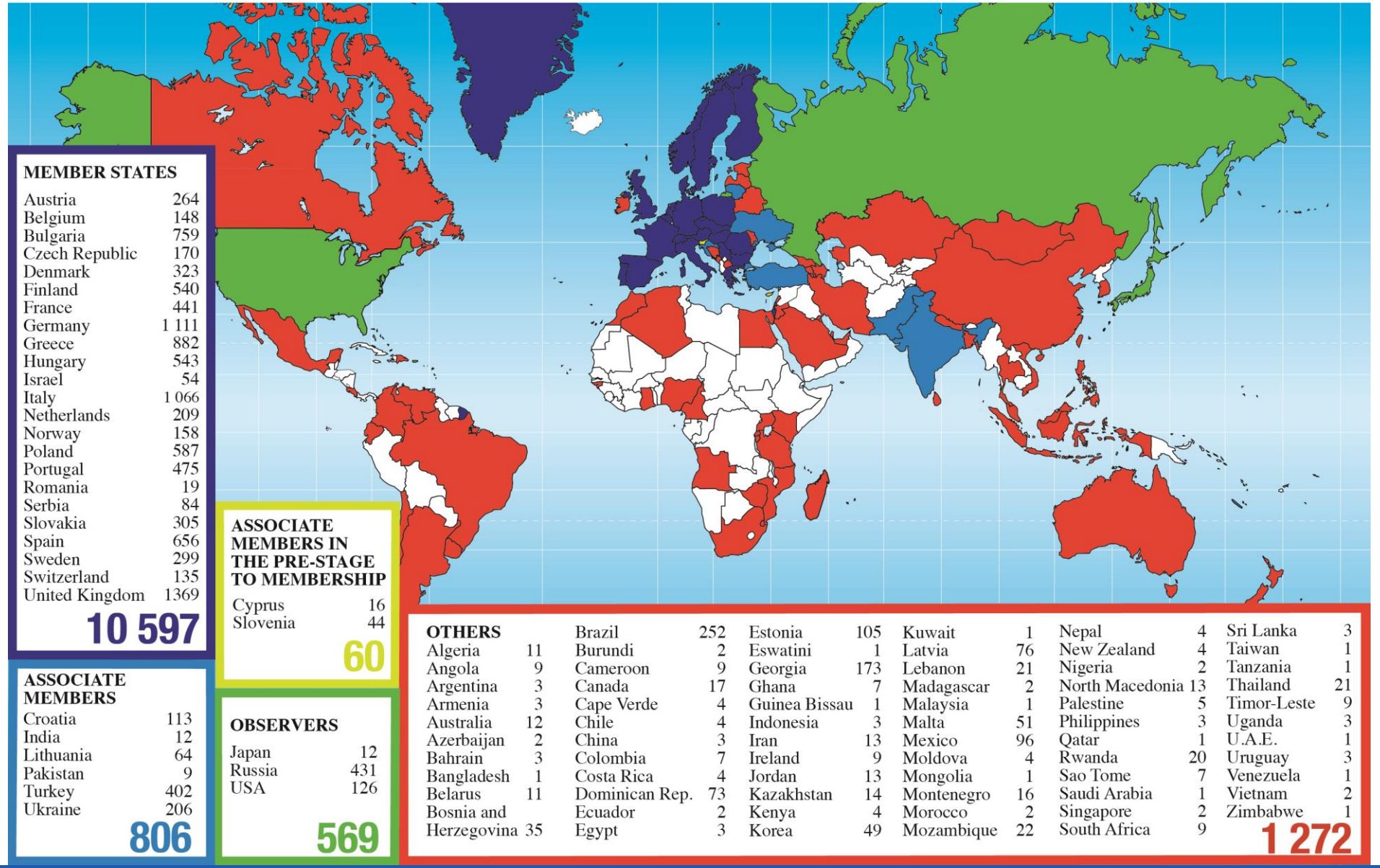
Collaboration 1 user

Physics Education Research 3 doct

1 staff
3 fellows

1 doct

Teacher Programme Participants 1998 - 2020 (Total: 13 304)



MEMBER STATES

Austria	264
Belgium	148
Bulgaria	759
Czech Republic	170
Denmark	323
Finland	540
France	441
Germany	1 111
Greece	882
Hungary	543
Israel	54
Italy	1 066
Netherlands	209
Norway	158
Poland	587
Portugal	475
Romania	19
Serbia	84
Slovakia	305
Spain	656
Sweden	299
Switzerland	135
United Kingdom	1369

10 597

ASSOCIATE MEMBERS

Croatia	113
India	12
Lithuania	64
Pakistan	9
Turkey	402
Ukraine	206

806

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP

Cyprus	16
Slovenia	44

60

OBSERVERS

Japan	12
Russia	431
USA	126

569

OTHERS

Algeria	11	Brazil	252	Estonia	105	Kuwait	1	Nepal	4	Sri Lanka	3
Angola	9	Burundi	2	Eswatini	1	Latvia	76	New Zealand	4	Taiwan	1
Argentina	3	Cameroon	9	Georgia	173	Lebanon	21	Nigeria	2	Tanzania	1
Armenia	3	Canada	17	Ghana	7	Madagascar	2	North Macedonia	13	Thailand	21
Australia	12	Cape Verde	4	Guinea Bissau	1	Malaysia	1	Palestine	5	Timor-Leste	9
Azerbaijan	2	Chile	4	Indonesia	3	Malta	51	Philippines	3	Uganda	3
Bahrain	3	China	3	Iran	13	Mexico	96	Qatar	1	U.A.E.	1
Bangladesh	1	Colombia	7	Ireland	9	Moldova	4	Rwanda	20	Uruguay	3
Belarus	11	Costa Rica	4	Jordan	13	Mongolia	1	Sao Tome	7	Venezuela	1
Bosnia and Herzegovina	35	Dominican Rep.	73	Kazakhstan	14	Montenegro	16	Saudi Arabia	1	Vietnam	2
		Ecuador	2	Kenya	4	Morocco	2	Singapore	2	Zimbabwe	1
		Egypt	3	Korea	49	Mozambique	22	South Africa	9		

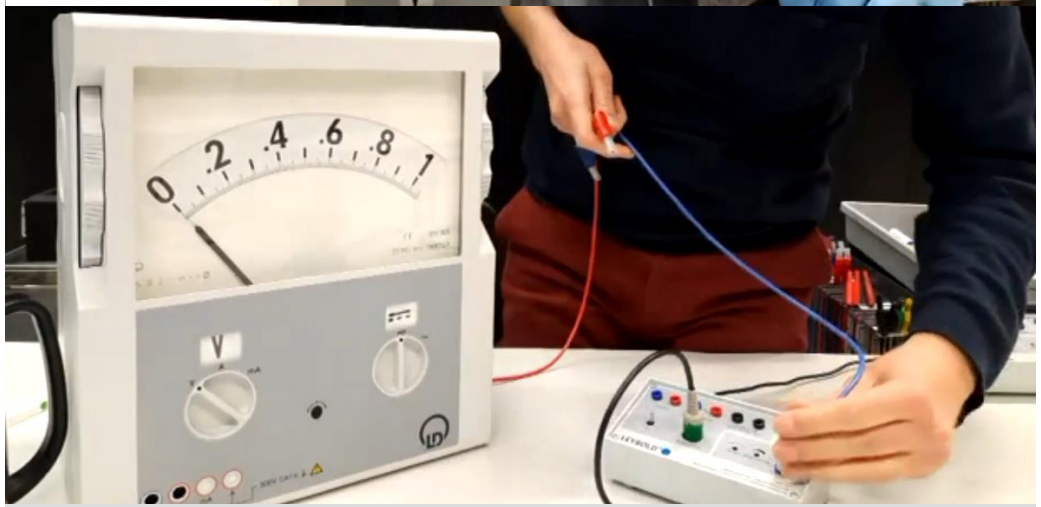
1 272

Teacher Programmes


S'Cool LAB
Welcome
There is always a way to do it better... find it!
If you can't explain it simply, you don't understand it well enc

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

It's Just a Phase!

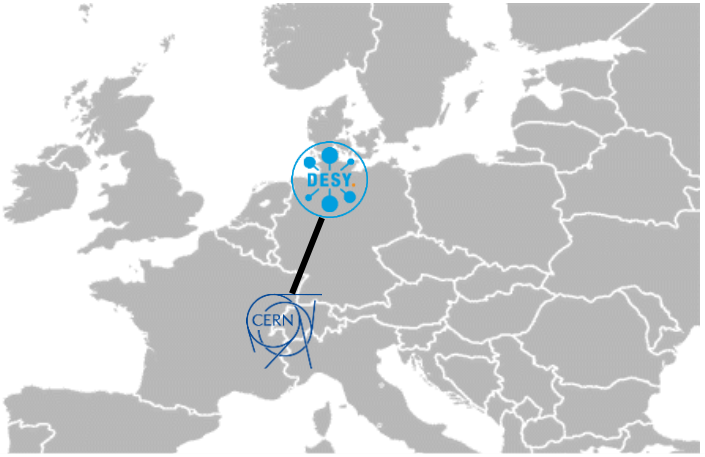


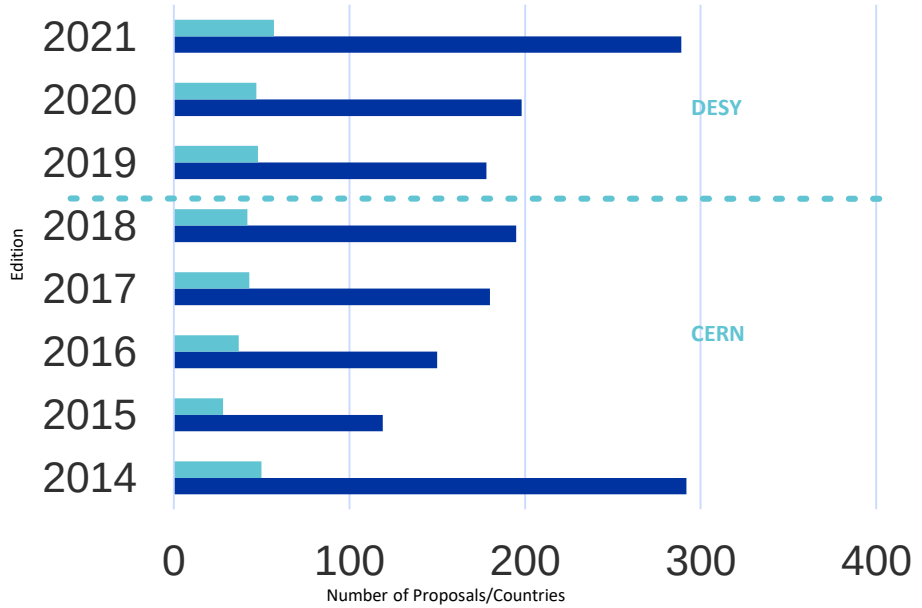
Superconductors Take Off!

Virtual Science Shows – the pandemic as great opportunity

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

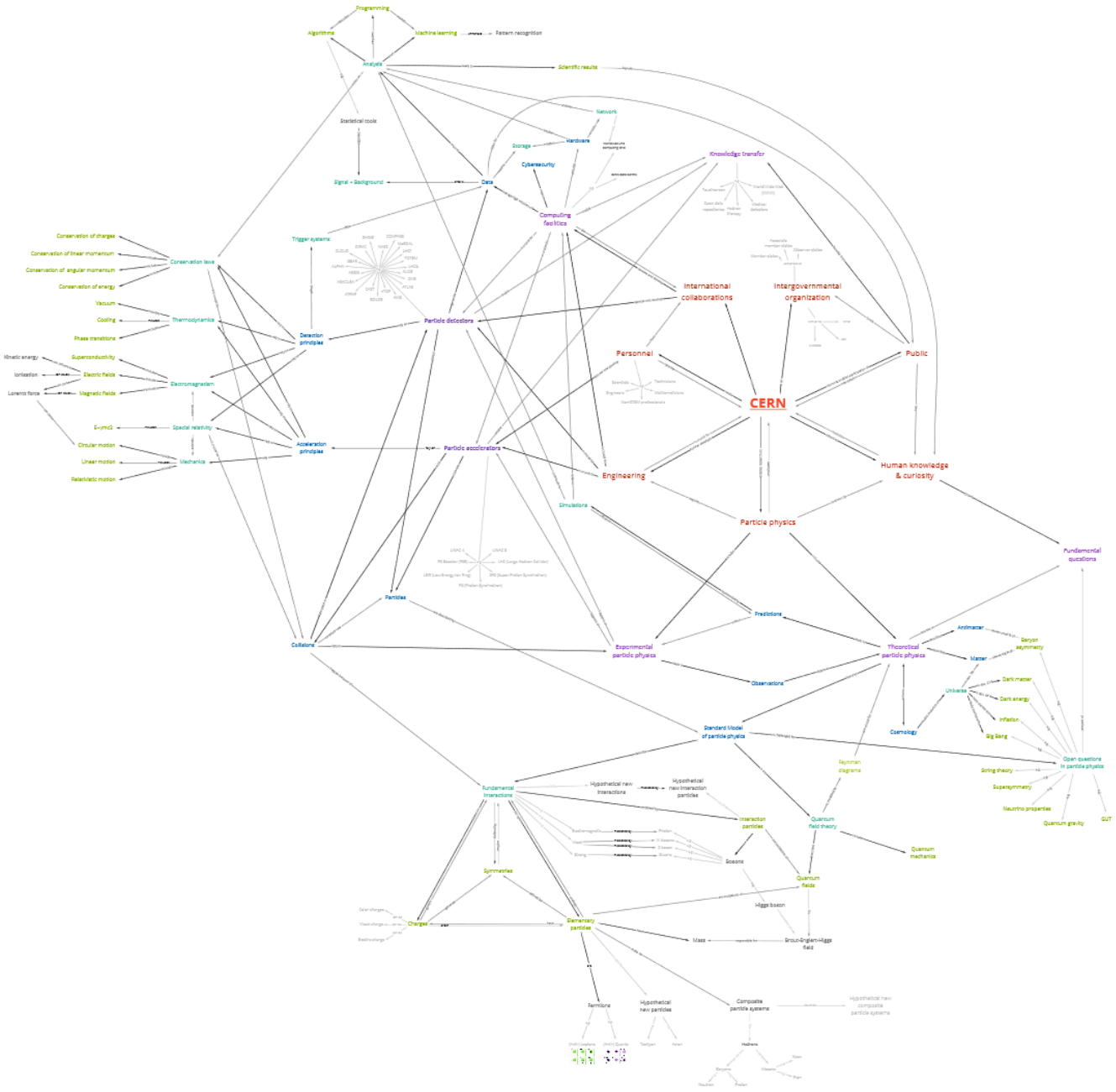
Link to CERN

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

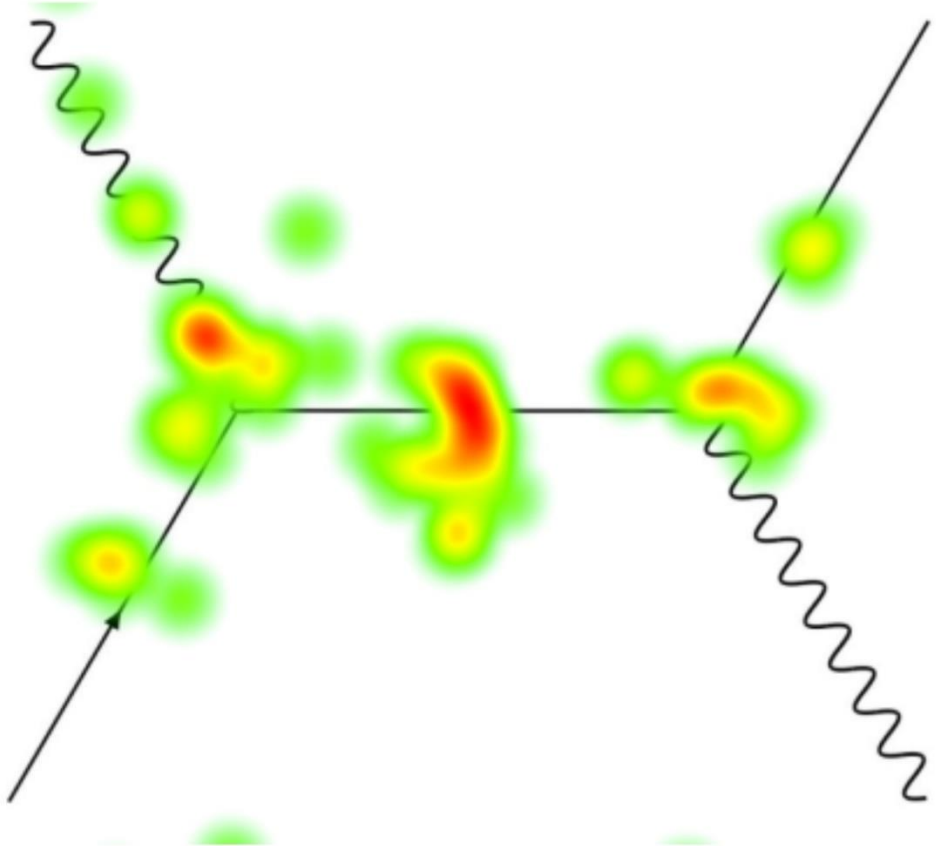
Link to CERN

Development of interest in partic students' interes contexts to …

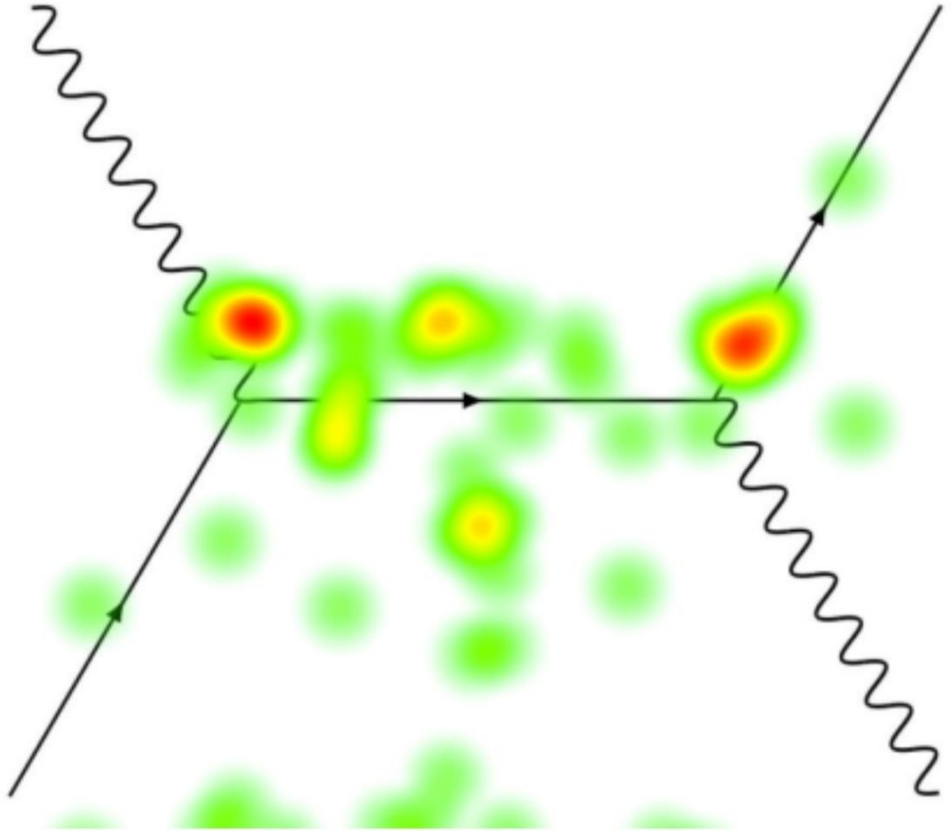
- define interest
- give recommer material

Eye Tracking in PER

Novices

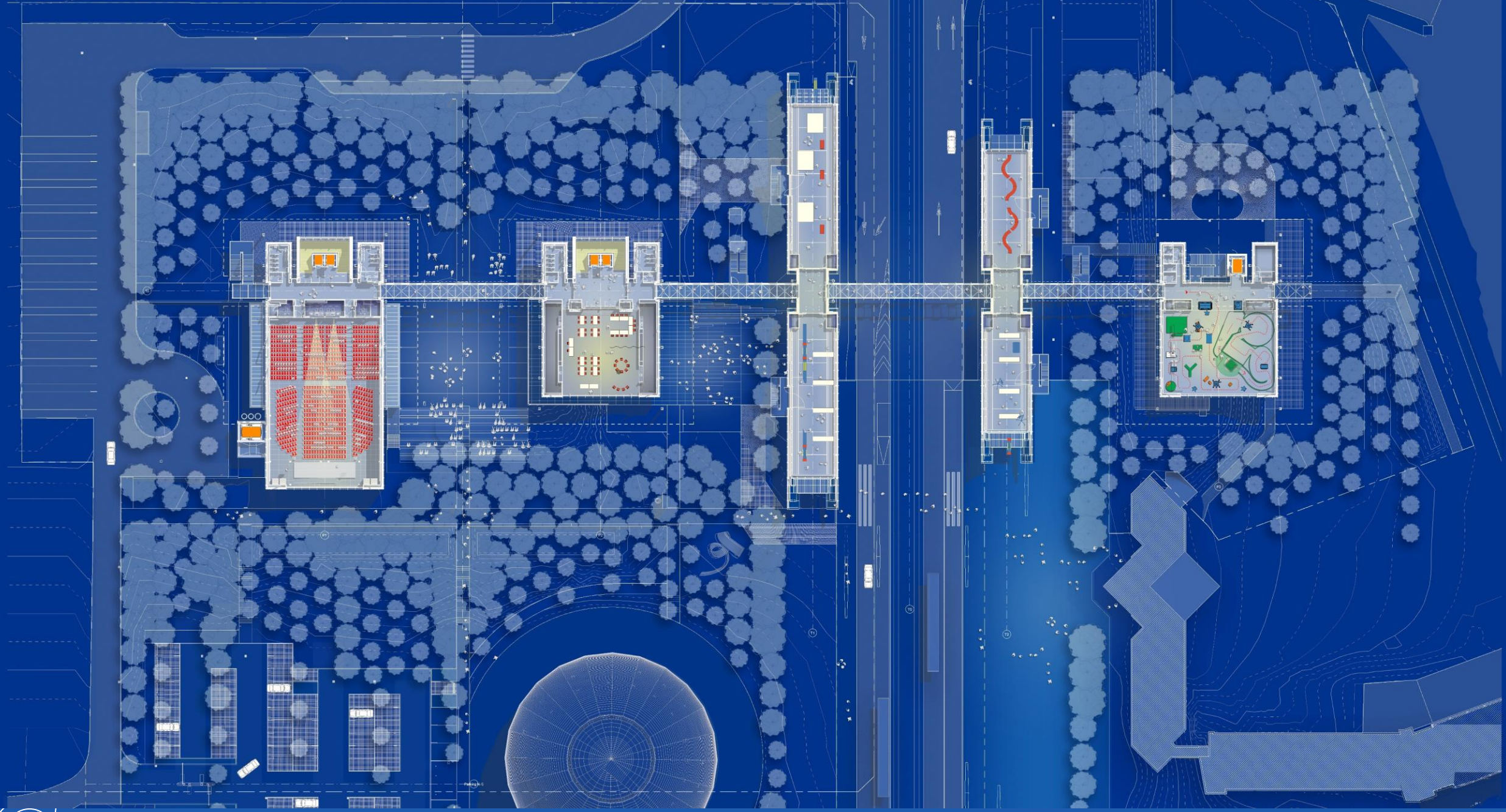


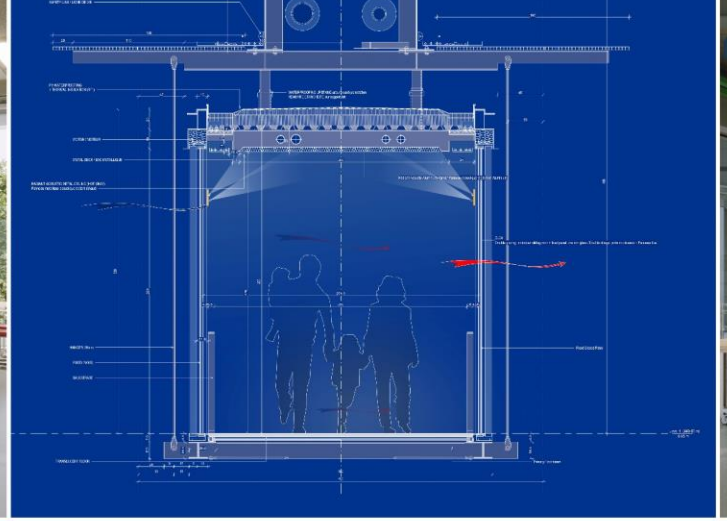
Experts

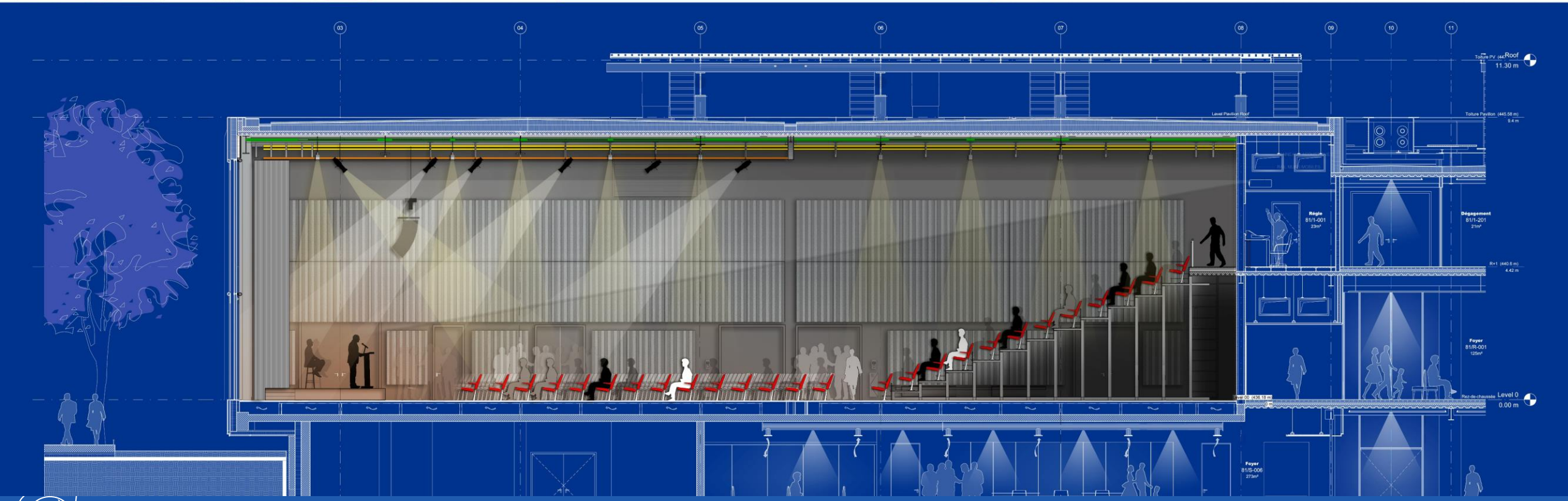


How many Vertices is the diagram composed of?


CERN Science Gateway






03
04
05
06
07
08
09
10
11
Toiture PV (447.00 m)
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

Ihre Fragen