

Welcome



Visit of Team Finland
Lead by Ambassador, Mr. Timo Rajakangas

November 1st, 2019



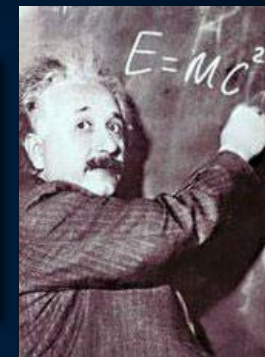
to **Accelerating Science and Innovation**



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?

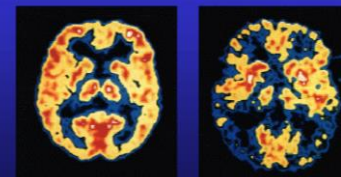


❑ **Develop** new technologies for accelerators and detectors

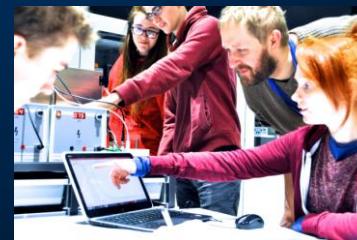
Information technology - the Web and the GRID
Medicine - diagnosis and therapy



Brain Metabolism in Alzheimer's Disease: PET Scan



❑ **Train** scientists and engineers of tomorrow



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



CERN: founded in 1954: 12 European States

“Science for Peace”

Today: 22 Member States

~ 2600 staff

~ 1800 other paid personnel

~ 14000 scientific users

Budget (2019) ~ 1200 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, Estonia

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



Science is getting more and more global

Distribution of All CERN Users by Location of Institute on 28 January 2019



MEMBER STATES

Austria	102
Belgium	159
Bulgaria	49
Czech Republic	253
Danmark	63
Finland	110
France	919
Germany	1383
Greece	157
Hungary	68
Israel	79
Italy	1627
Netherlands	192
Norway	94
Poland	322
Portugal	104
Romania	106
Slovakia	88
Spain	403
Sweden	124
Switzerland	482
United Kingdom	1042

7926

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP

Cyprus	15
Serbia	36
Slovenia	24

75

ASSOCIATE MEMBERS 444

India	218
Lithuania	24
Pakistan	48
Turkey	120
Ukraine	34

OBSERVERS

Japan	270
Russia	1110
USA	2053

3433

OTHERS

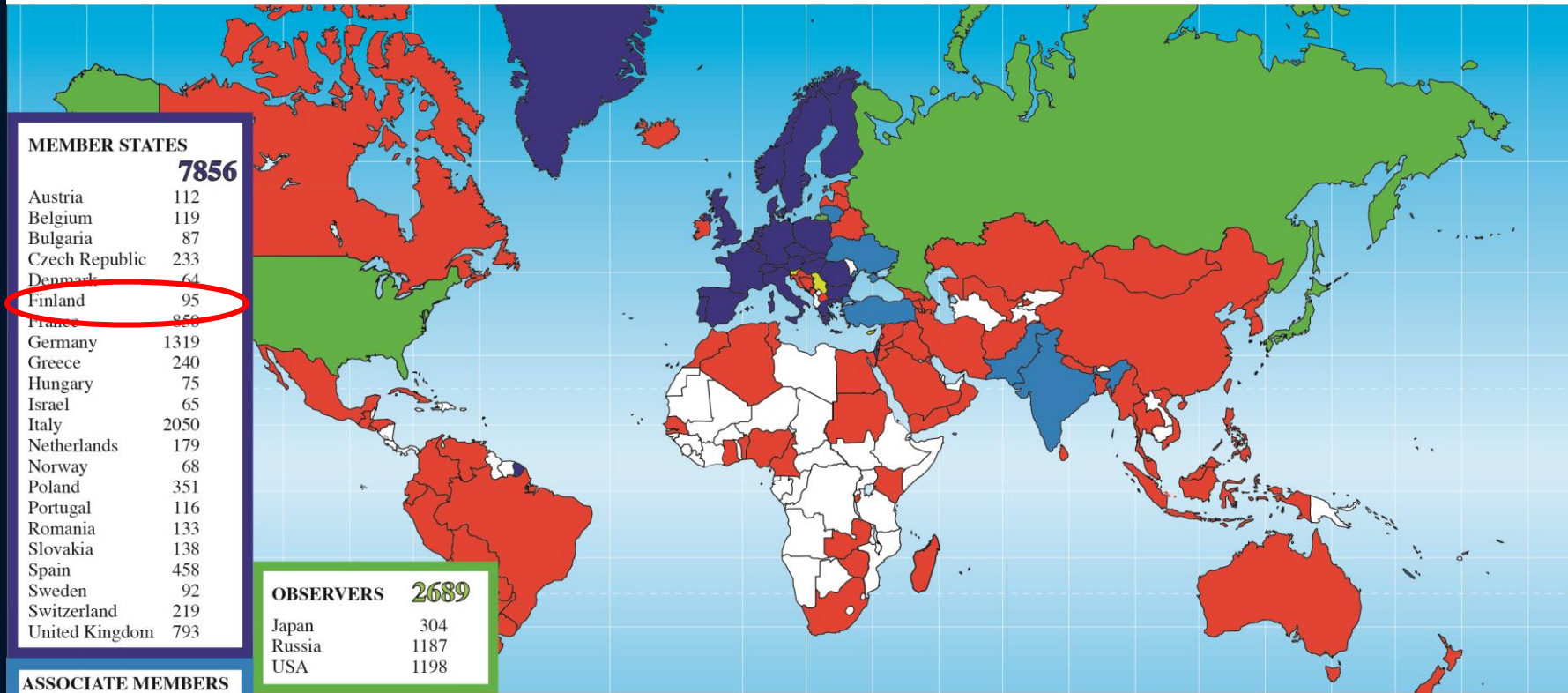
Algeria	3	Chile	19	Iceland	3	Mongolia	2	Sri Lanka	8
Argentina	18	China	331	Indonesia	6	Montenegro	7	T.F.Y.R.O.M.	1
Armenia	16	Colombia	26	Iran	23	Morocco	14	Taiwan	59
Australia	32	Croatia	39	Ireland	11	New Zealand	8	Thailand	18
Azerbaijan	5	Cuba	4	Korea	161	Oman	4	U.A.E.	1
Bangladesh	2	Ecuador	4	Latvia	2	Peru	3	Venezuela	1
Belarus	21	Egypt	17	Lebanon	16	Puerto Rico	1		
Brazil	121	Estonia	18	Malaysia	12	Saudi Arabia	1		
Canada	207	Georgia	32	Malta	7	Singapore	5		
		Hong Kong	20	Mexico	58	South Africa	75		

1442



Science is getting more and more global

Distribution of All CERN Users by Nationality on 28 January 2019



ASSOCIATE MEMBERS		757
India	376	
Lithuania	37	
Pakistan	77	
Turkey	154	
Ukraine	113	

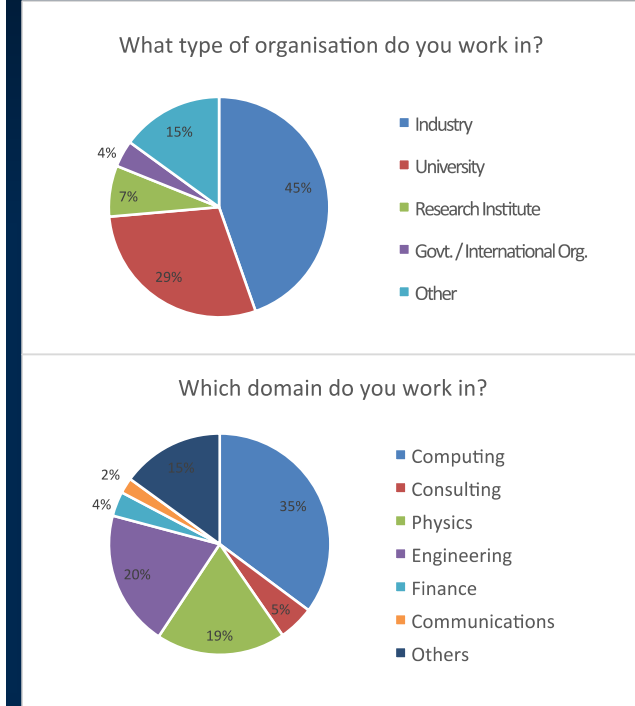
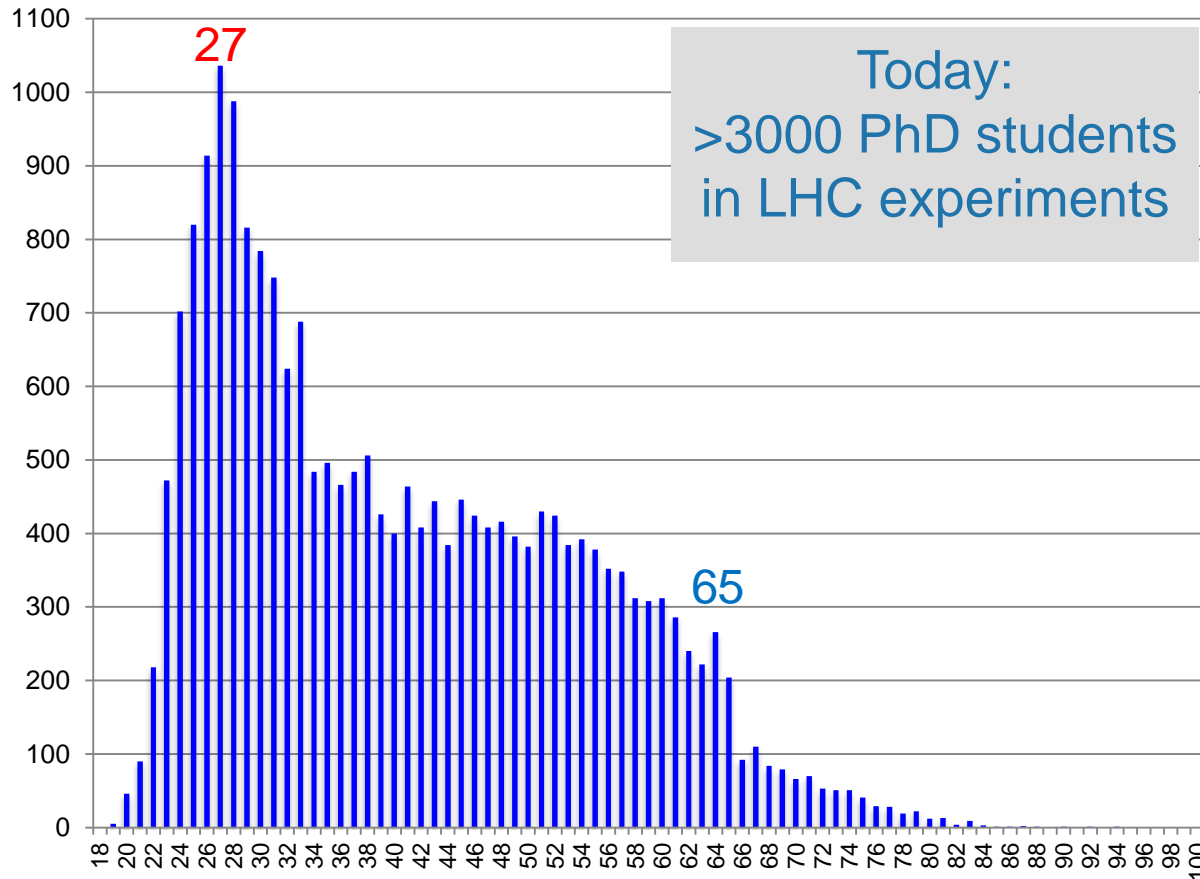
ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP		108
Cyprus	23	
Serbia	52	
Slovenia	33	

OTHERS		1930
Afghanistan	3	
Algeria	14	
Argentina	26	
Armenia	22	
Australia	34	
Azerbaijan	10	
Bangladesh	8	
Belarus	46	
Benin	1	
Bolivia	3	
Bosnia & Herzegovina	3	
Brazil	126	
Burundi	1	
Cameroon	1	
Canada	168	
Chile	21	
China	557	
Colombia	42	
Croatia	49	
Cuba	16	
Ecuador	8	
Egypt	24	
El Salvador	1	
Estonia	15	
Georgia	49	
Ghana	1	
Guatemala	1	
Hong Kong	1	
Honduras	1	
Iceland	4	
Ireland	14	
Iran	51	
Iraq	1	
Ireland	14	
Jordan	2	
Kazakhstan	10	
Kenya	1	
Korea	174	
Latvia	3	
Lebanon	24	
Luxembourg	4	
Madagascar	1	
Malaysia	20	
Malta	8	
Mexico	86	
Mongolia	2	
Montenegro	11	
Morocco	22	
Myanmar	2	
Nepal	7	
New Zealand	5	
Nigeria	3	
North Korea	3	
Oman	3	
Palestine	7	
Paraguay	1	
Peru	6	
Philippines	3	
Saint Kitts and Nevis	1	
San Marino	1	
Saudi Arabia	4	
Senegal	1	
Singapore	5	
South Africa	48	
Sri Lanka	10	
Sudan	1	
Syria	1	
Taiwan	56	
Thailand	26	
T.F.Y.R.O.M.	3	
Tunisia	3	
Uruguay	1	
Uzbekistan	3	
Venezuela	10	
Viet Nam	12	
Zambia	1	
Zimbabwe	2	



Age Distribution of Scientists

- and where they go afterwards

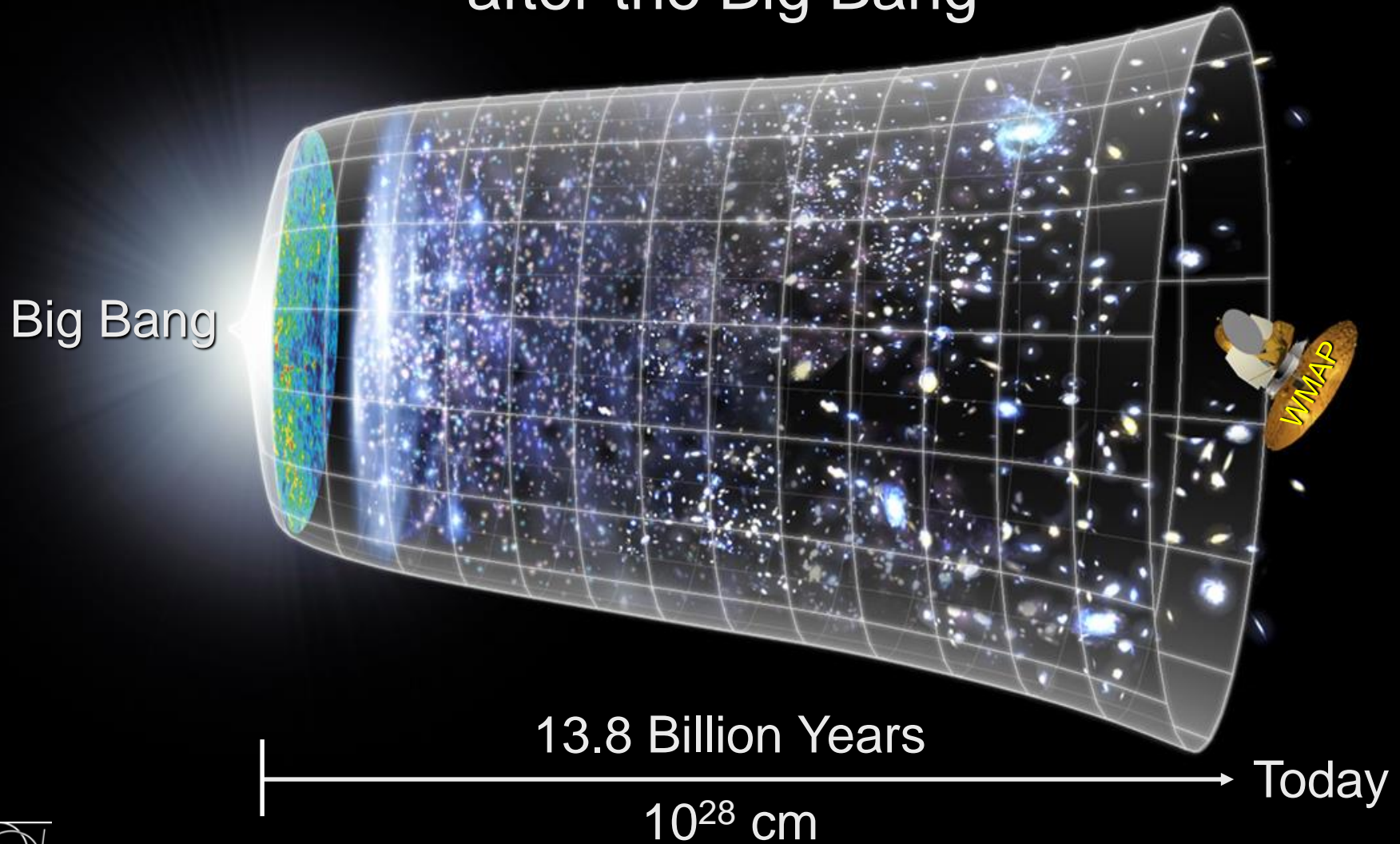


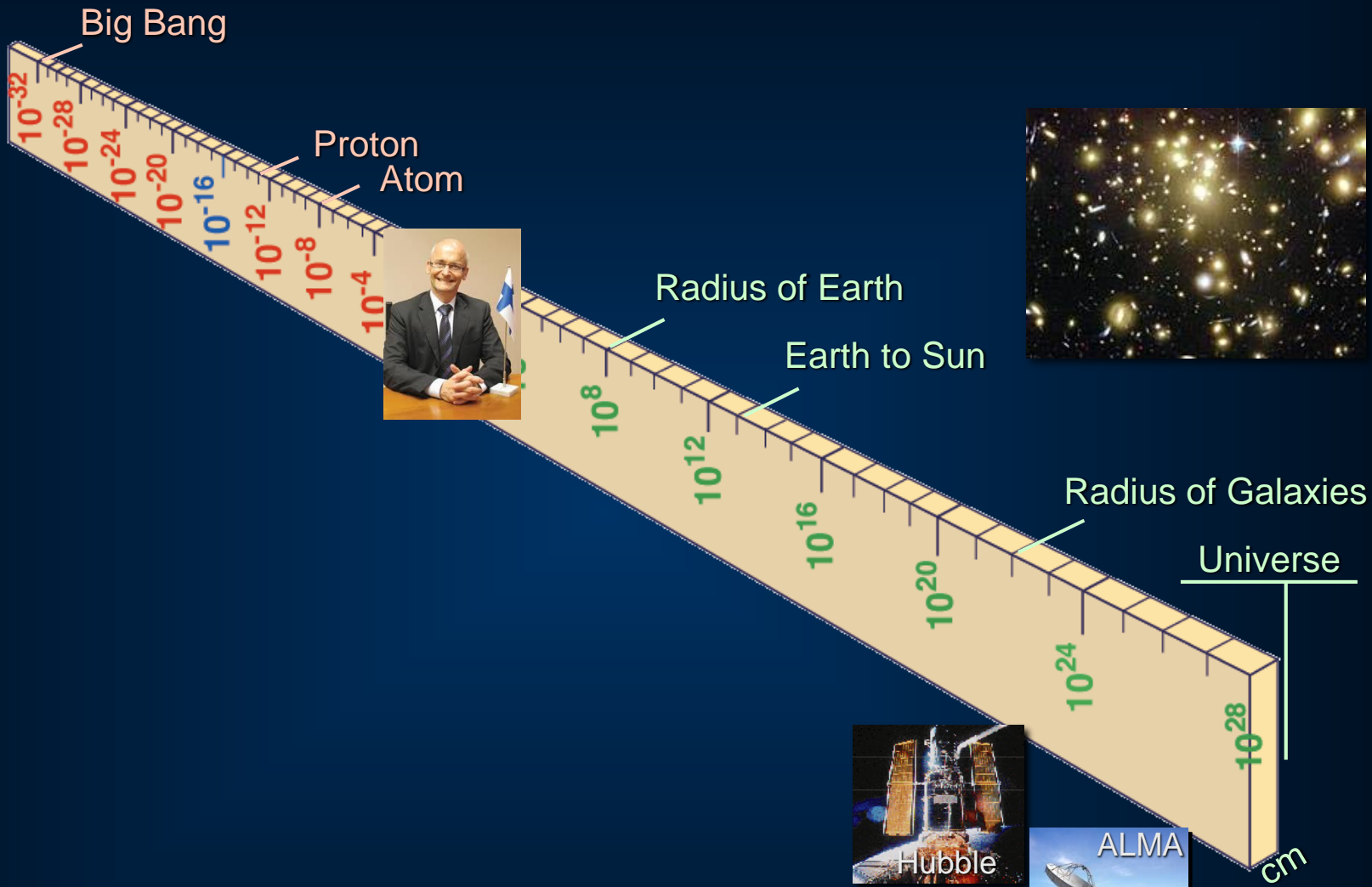
They do not all stay: where do they go?



Next Scientific Challenge:

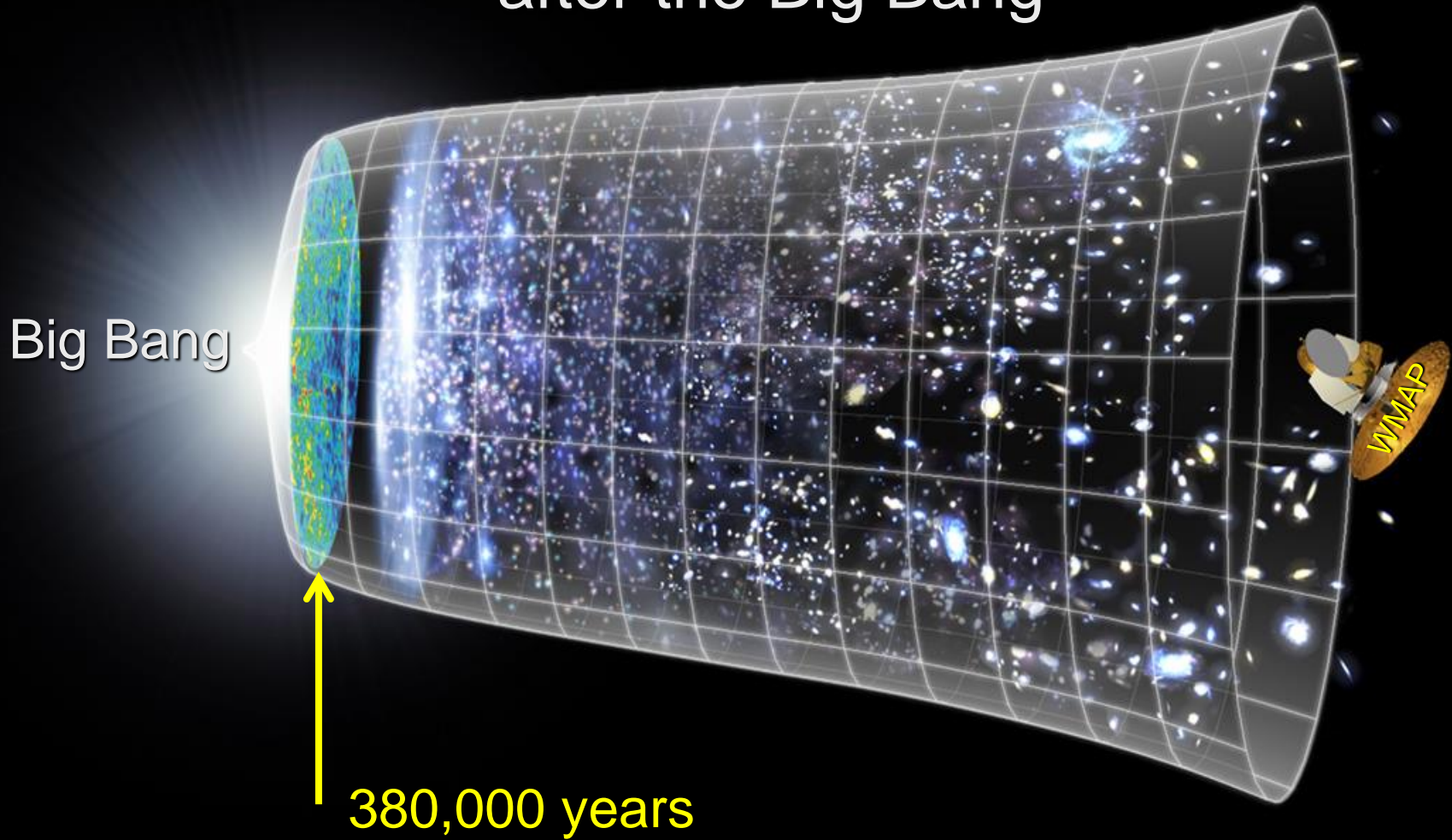
to understand the very first moments of our Universe
after the Big Bang

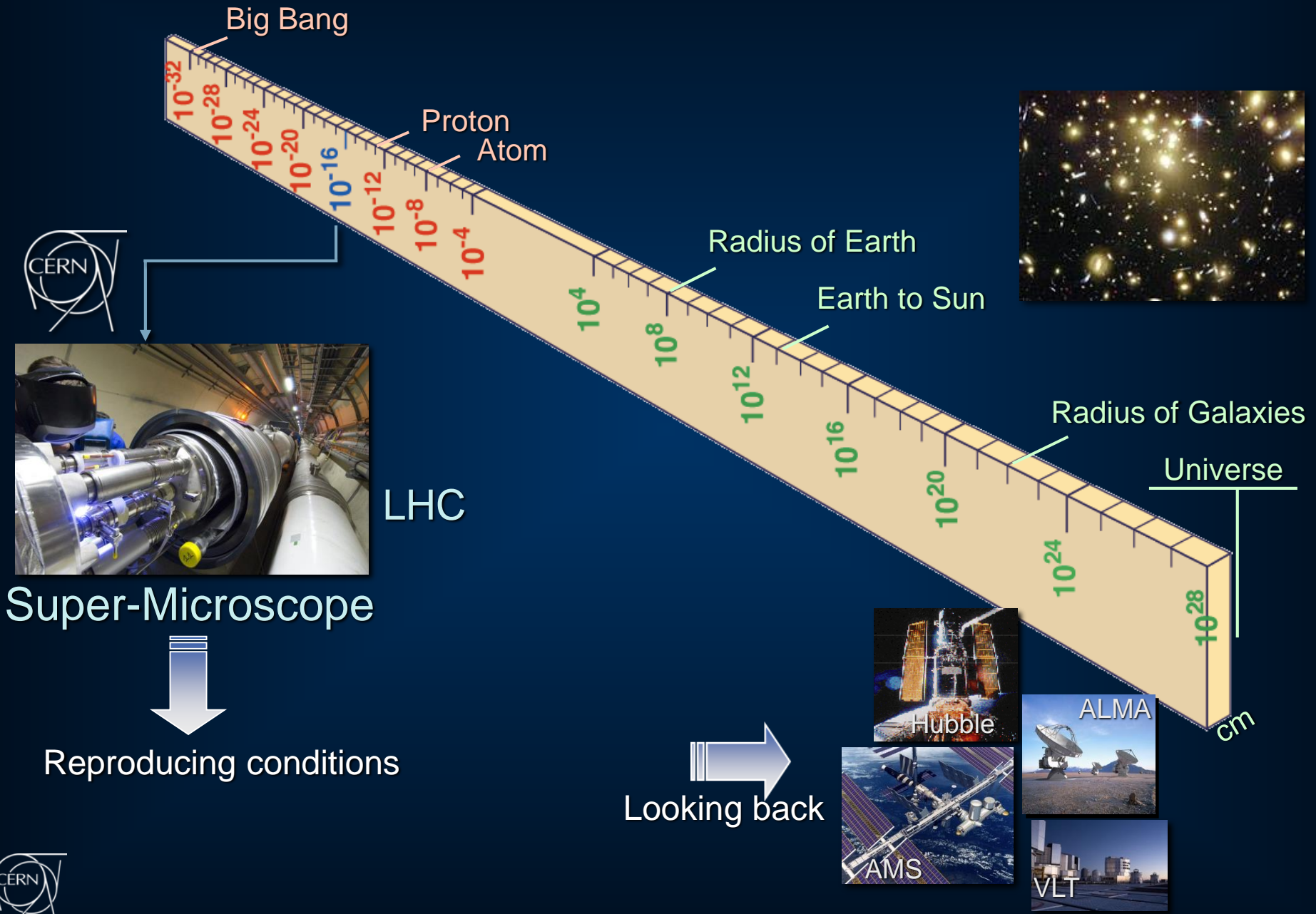




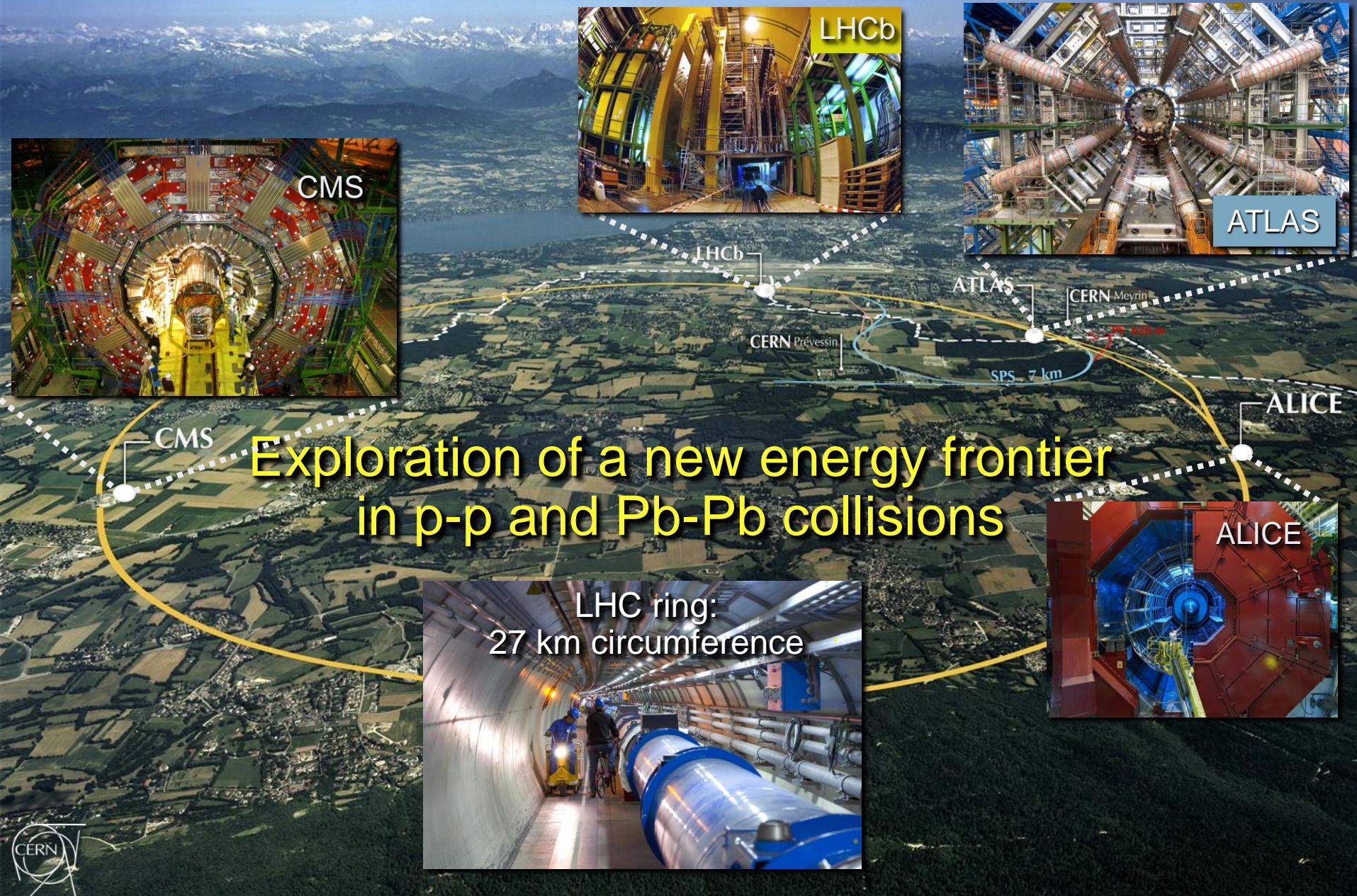
Next Scientific Challenge:

to understand the very first moments of our Universe
after the Big Bang





2010: a New Era in Fundamental Science



Exploration of a new energy frontier
in p-p and Pb-Pb collisions

LHC ring:
27 km circumference

Discovery 2012, Nobel Prize in Physics 2013



The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs *"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider"*.

Future of particle physics

High Luminosity LHC until 2035

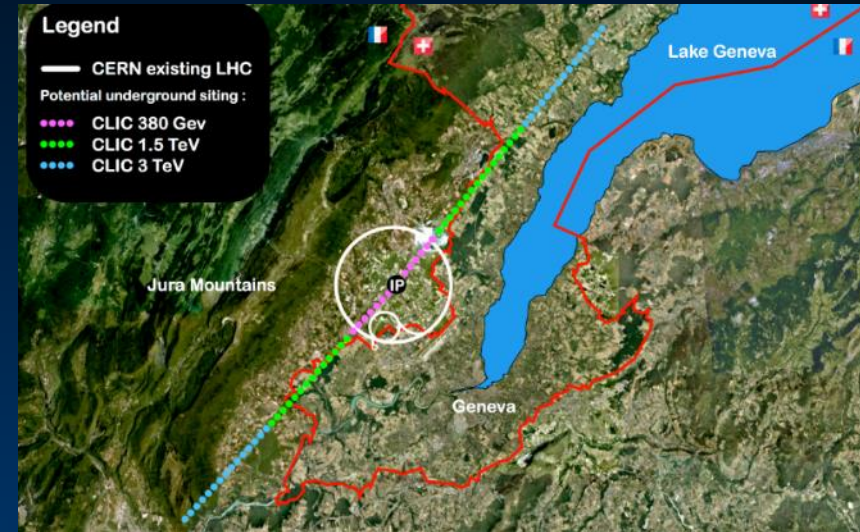
- Ten times more collisions than the original design

Studies in progress:

Compact Linear Collider (CLIC)

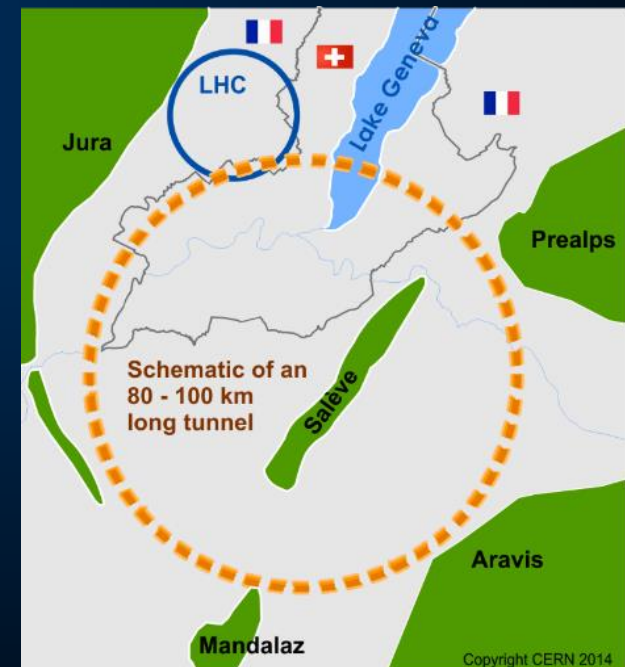


- Linear e^+e^- collider \sqrt{s} up to 3 TeV



Future Circular Collider (FCC)

- New technology magnets \rightarrow 100 TeV pp collisions in 100km ring
- e^+e^- collider (FCC-ee) as 1st step?
- HE-LHC in the present LHC tunnel with FCC-hh technology?



European Strategy for Particle Physics

- Preparing next update in 2020





CERN: Particle Physics and Innovation

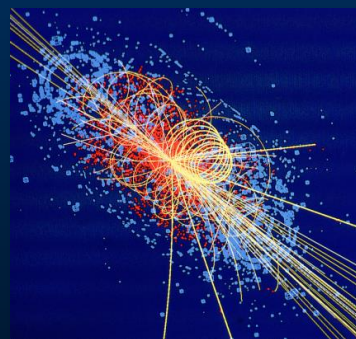
- **Interfacing** between fundamental science and key technological developments



- **CERN Technologies and Innovation**



Accelerating particle beams



Detecting particles



Large-scale computing (Grid)

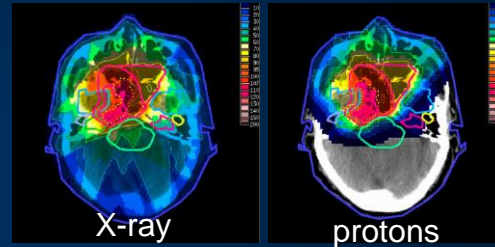
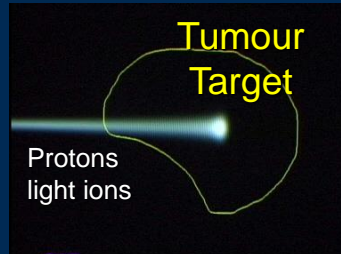
Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer



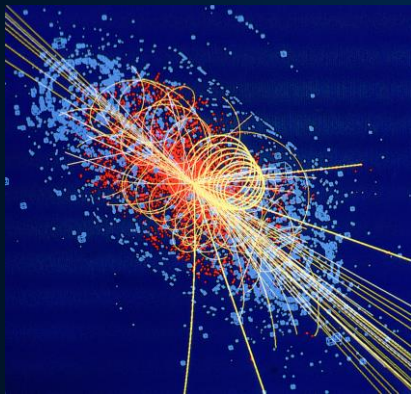
Hadron Therapy

Accelerating particle beams
~30'000 accelerators worldwide
~17'000 used for medicine



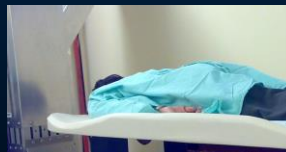
Leadership in Ion Beam Therapy now in Europe and Japan

>100'000 patients treated worldwide (45 facilities)
>50'000 patients treated in Europe (14 facilities)

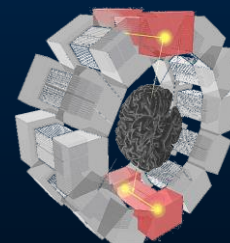


Imaging

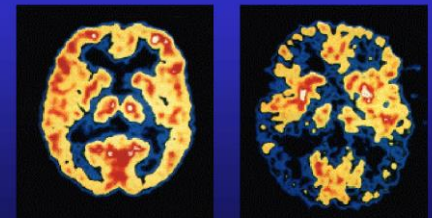
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)



PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



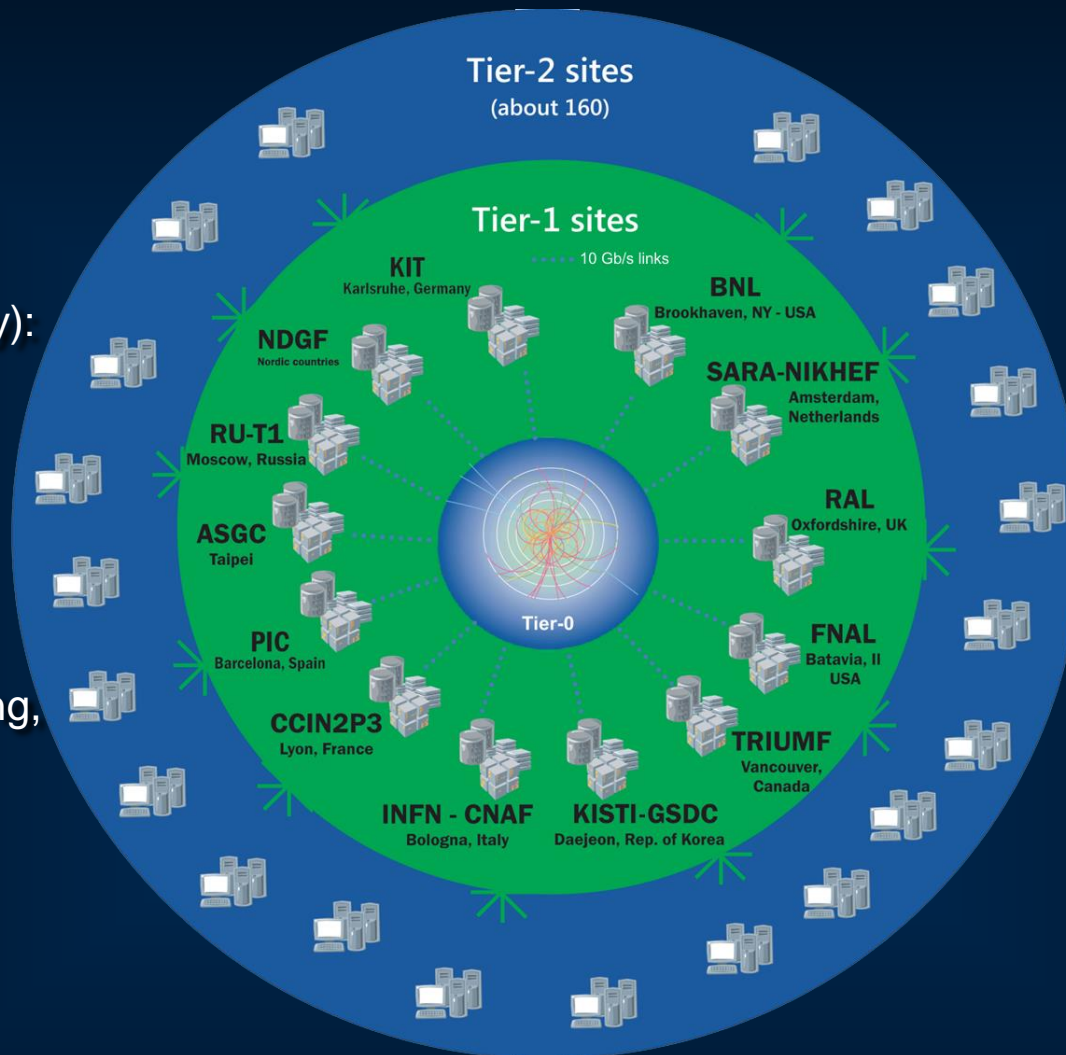
Detecting particles

The Worldwide LHC Computing Grid

Tier-0
(CERN and Hungary):
data recording,
reconstruction and
distribution

Tier-1: permanent
storage, reprocessing,
analysis

Tier-2: simulation,
end-user analysis



>170 sites in,
42 countries

750k CPU cores

800 PB of storage

> 2 million jobs/day

35 GB/s global
transfers

WLCG:

An International collaboration to distribute and analyse LHC data

Integrates computer centres worldwide that provide computing and storage resource into a single infrastructure accessible by all LHC physicists



CERN Education Activities

Scientists at CERN Academic Training Programme



Young Researchers

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



Undergraduates Summer Students Programme



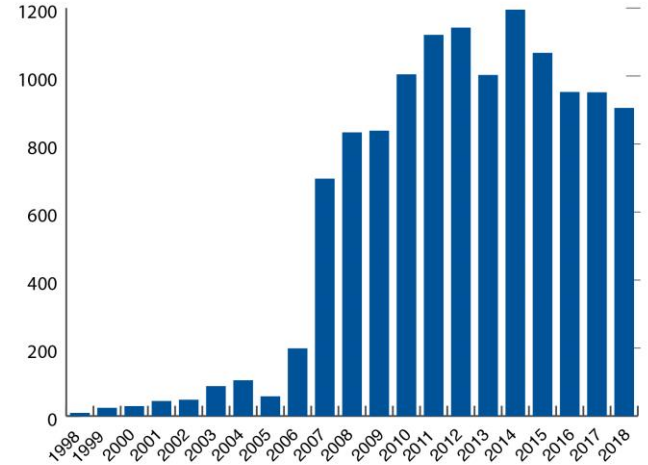
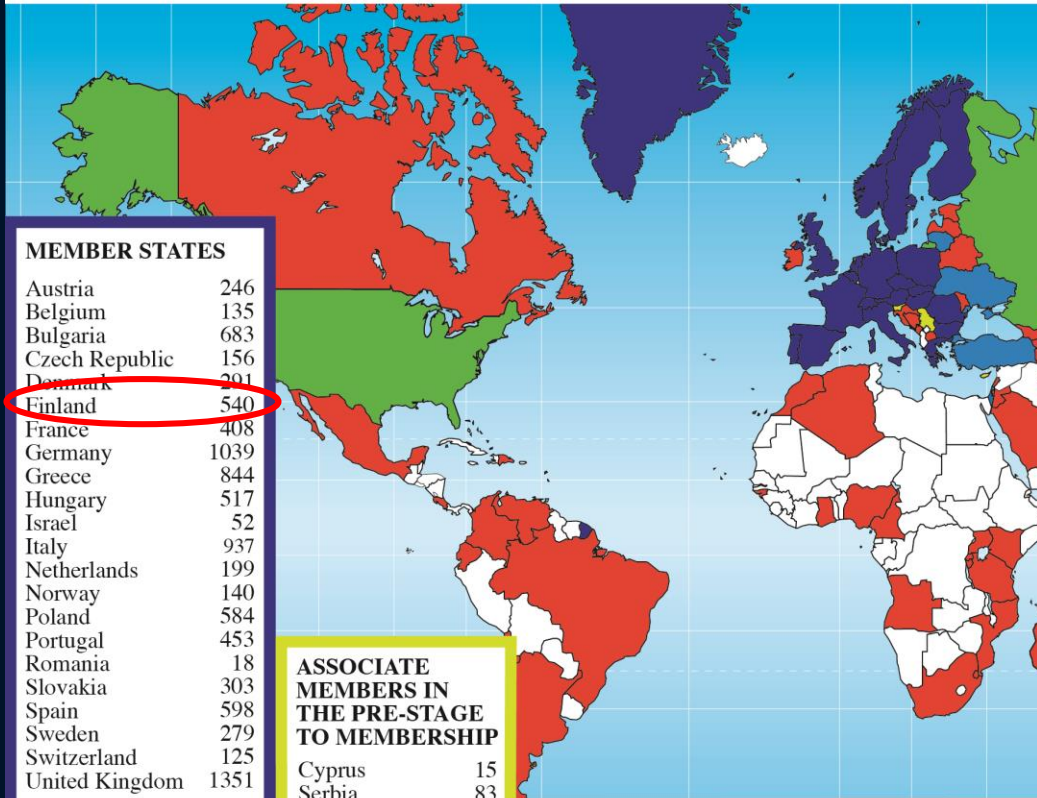
CERN Teacher Schools International and National Programmes

Public visitors
135 thousand per year



CERN Teacher

Teacher Programme Participants 1998 - 2018 (Total: 12320)



MEMBER STATES	
Austria	246
Belgium	135
Bulgaria	683
Czech Republic	156
Denmark	201
Finland	540
France	408
Germany	1039
Greece	844
Hungary	517
Israel	52
Italy	937
Netherlands	199
Norway	140
Poland	584
Portugal	453
Romania	18
Slovakia	303
Spain	598
Sweden	279
Switzerland	125
United Kingdom	1351

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP	
Cyprus	15
Serbia	83
Slovenia	21

119

ASSOCIATE MEMBERS	
India	10
Lithuania	54
Pakistan	7
Turkey	327
Ukraine	179

577

OBSERVERS	
Japan	12
Russia	408
USA	116

536

OTHERS											
Algeria	10	Burundi	2	Estonia	92	Lebanon	21	Palestine	5	T.F.Y.R.O.M.	13
Angola	7	Cameroon	9	Georgia	154	Madagascar	2	Philippines	2	Thailand	19
Argentina	2	Canada	14	Ghana	7	Malta	37	Qatar	1	Timor-Leste	9
Armenia	3	Cape Verde	4	Guinea Bissau	1	Mexico	83	Rwanda	20	Uganda	3
Australia	9	Chile	3	Indonesia	3	Moldova	4	Sao Tome	7	U.A.E.	1
Azerbaijan	2	China	2	Iran	12	Mongolia	1	Saudi Arabia	1	Venezuela	1
Bahrain	2	Colombia	2	Ireland	9	Montenegro	16	Singapore	2		
Belarus	8	Costa Rica	4	Jordan	13	Morocco	2	South Africa	8		
Bosnia and Herzegovina	6	Dominican Rep.	72	Kazakhstan	14	Mozambique	22	Sri Lanka	2		
Brazil	231	Ecuador	2	Kenya	4	Nepal	3	Swaziland	1		
		Egypt	2	Korea	49	New Zealand	4	Taiwan	1		
				Latvia	62	Nigeria	1	Tanzania	1		

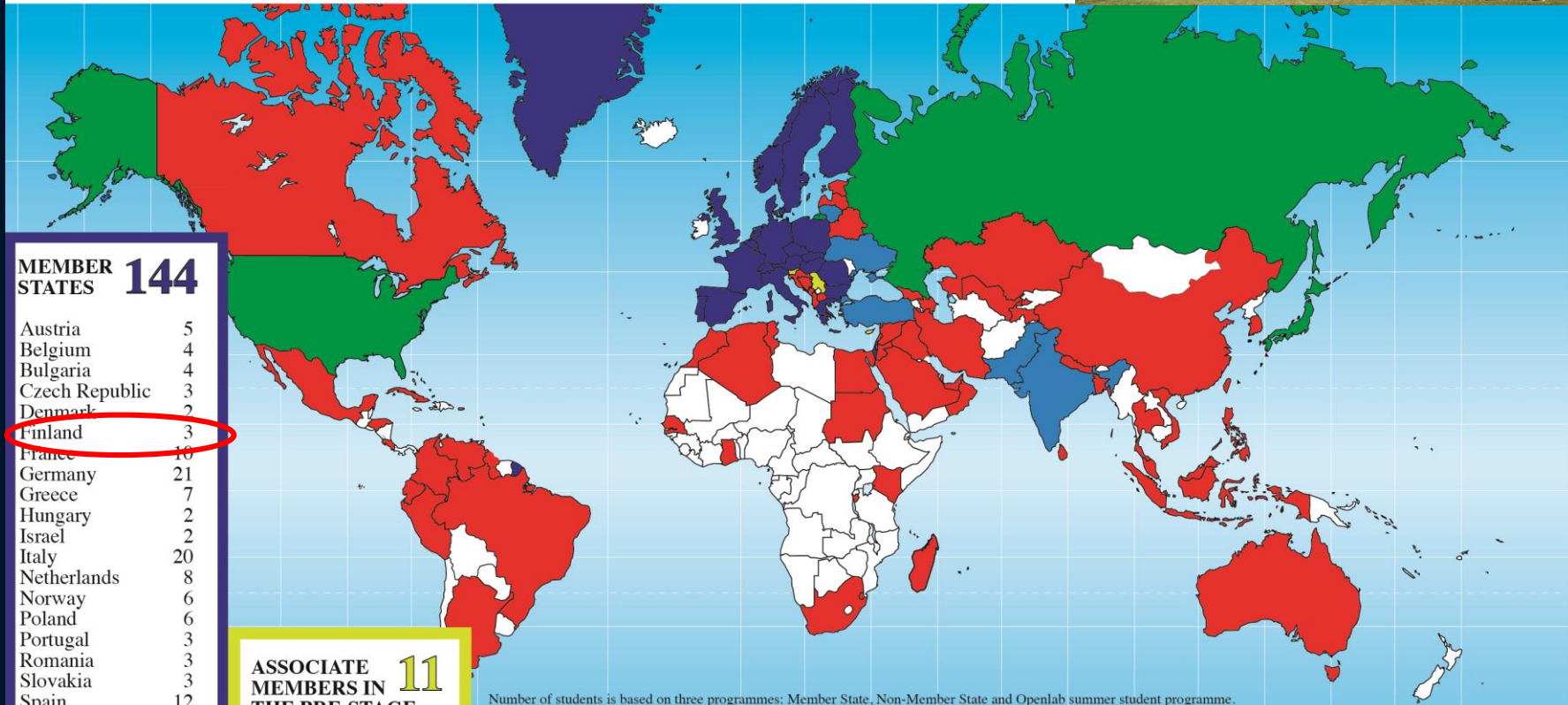
1190



Summer Students 2018



Summer Students 2018



MEMBER STATES 144

Austria	5
Belgium	4
Bulgaria	4
Czech Republic	3
Denmark	2
Finland	3
France	10
Germany	21
Greece	7
Hungary	2
Israel	2
Italy	20
Netherlands	8
Norway	6
Poland	6
Portugal	3
Romania	3
Slovakia	3
Spain	12
Sweden	5
Switzerland	1
United Kingdom	14

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP 11

Cyprus	5
Serbia	2
Slovenia	4

OBSERVERS 35

Japan	4
Russia	8
USA	23

Number of students is based on three programmes: Member State, Non-Member State and Openlab summer student programme.

OTHERS

Albania	2	Brazil	3	Georgia	2	Kosovo	1	Palestine	2	Taiwan	1
Algeria	4	Burundi	1	Ghana	1	Latvia	2	Peru	1	Thailand	4
Argentina	1	Canada	5	Guyana	1	Lebanon	2	Philippines	2	T.F.Y.R.O.M.	1
Australia	1	Chile	1	Honduras	1	Luxembourg	1	Puerto Rico	1	Tunisia	1
Azerbaijan	3	China	10	Indonesia	3	Malaysia	3	Qatar	1	U.A.E.	1
Bahrain	1	Colombia	1	Iran	2	Malta	3	Saudi Arabia	1	Uzbekistan	1
Bangladesh	1	Costa Rica	4	Iraq	1	Mexico	2	Singapore	2	Venezuela	1
Belarus	2	Croatia	1	Ireland	1	Moldova	1	Soudan	1	Viet Nam	3
Bosnia & Herzegovina	2	Cuba	1	Jordan	1	Montenegro	3	South Africa	2		
		Ecuador	2	Kazakhstan	2	Morocco	1	Sri Lanka	4		
		Egypt	3	Kenya	1	Nepal	1	Syria	1		
		Estonia	2	Korea	2	Oman	1	Tajikistan	1		

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Finland and CERN



Finland joined CERN as a Member State in 1991, but Finnish groups have participated in CERN experiments almost since its foundation.

Scientists from Finland participate in the

- ❑ LHC experiments: ALICE, CMS, MOEDAL, TOTEM
- ❑ non-LHC experiments: ISOLDE, CLIC/CTF3 & CLOUD (Cosmic rays and cloud formation)

Finnish Institutes involved:

- ❑ Helsinki Institute of Physics (HIP), coordinating participation of
 - ❑ University of Helsinki
 - ❑ Aalto University
 - ❑ Tampere University
 - ❑ Finnish Meteorological Institute, Helsinki
 - ❑ University of Jyväskylä
 - ❑ University of Kuopio
 - ❑ Lappeenranta University of Technology





Finland and CERN



Strong involvements in the LHC experiments



ALICE

ALICE:

University of Jyväskylä
Helsinki Institute of
Physics (HIP)



CMS:

University of Helsinki
Helsinki Institute of
Physics (HIP)
Lappeenranta University
of Technology

TOTEM (next to CMS):

University of Helsinki
Helsinki Institute of
Physics (HIP)



Strong contribution also to the LHC Computing Grid (WLCG)





Finland and CERN

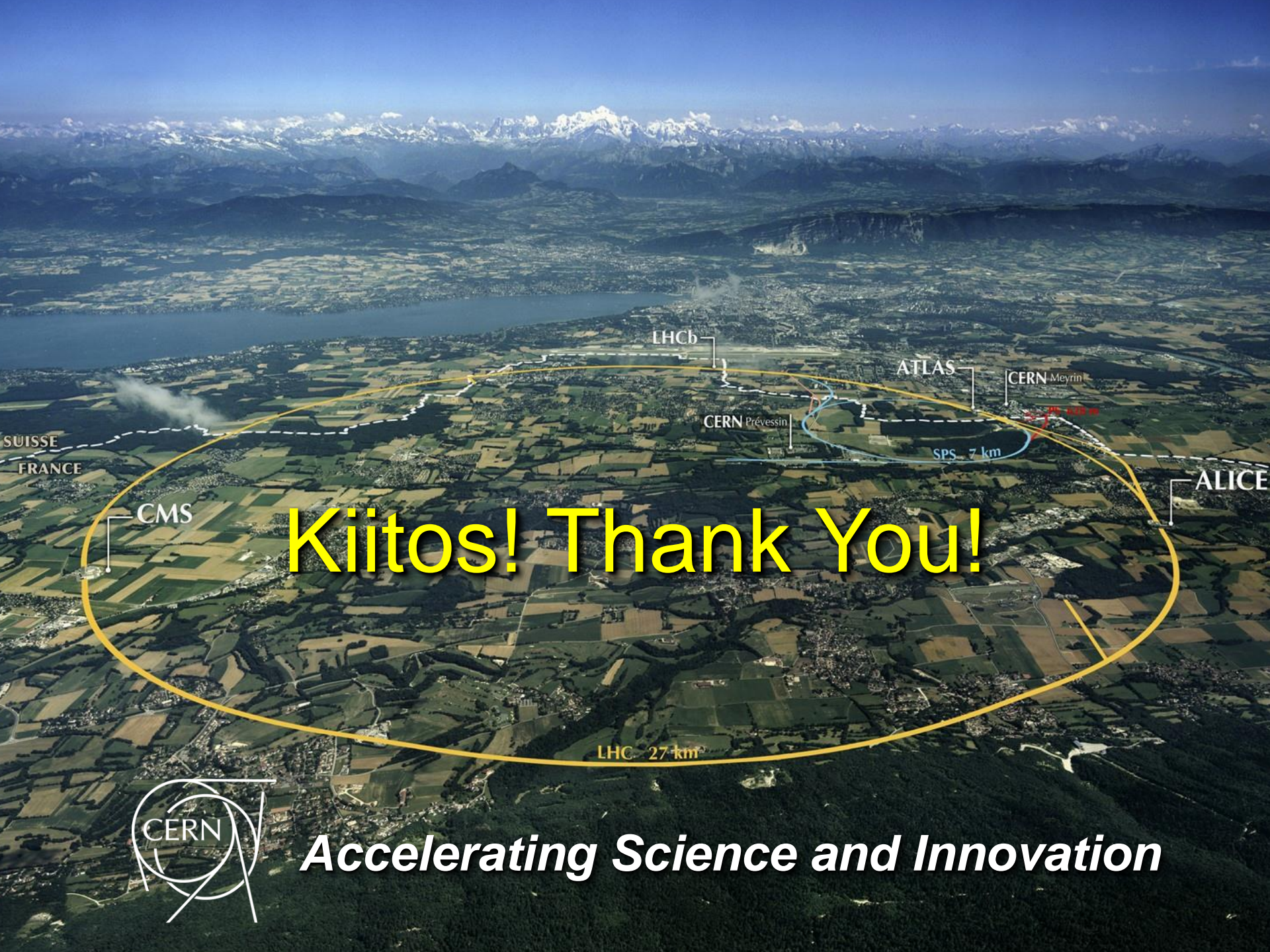


High-current
and
high-precision
LHC power converters



[2kA, 8V]





Kiitos! Thank You!



Accelerating Science and Innovation

Safety Information for Visitors

Safety is our highest priority

We are confident that you have read the Safety Information provided prior to the visit and ask that you take the time to read the document placed in front of you once more before embarking on the site visit.

By taking part in the site visit you are deemed to have understood and accepted the Safety Information provided to you.

Please always follow the instructions given by your guide and do not hesitate to ask if you have any questions.

