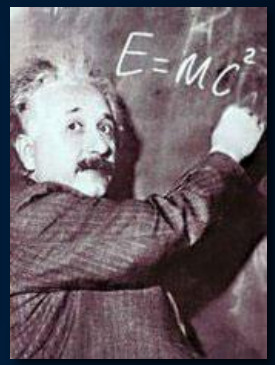

Welcome
LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
Visit of John Wood & Group
LHC 27 km
CERN
to
Accelerating Science and Innovation

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

- **Train** scientists and engineers of tomorrow

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

CERN: founded in 1954: 12 European States
"Science for Peace"
Today: 23 Member States

~ 2600 staff
~ 1800 other paid personnel
~ 13600 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, Serbia, Slovak Republic, Spain, Sweden, Switzerland and United Kingdom

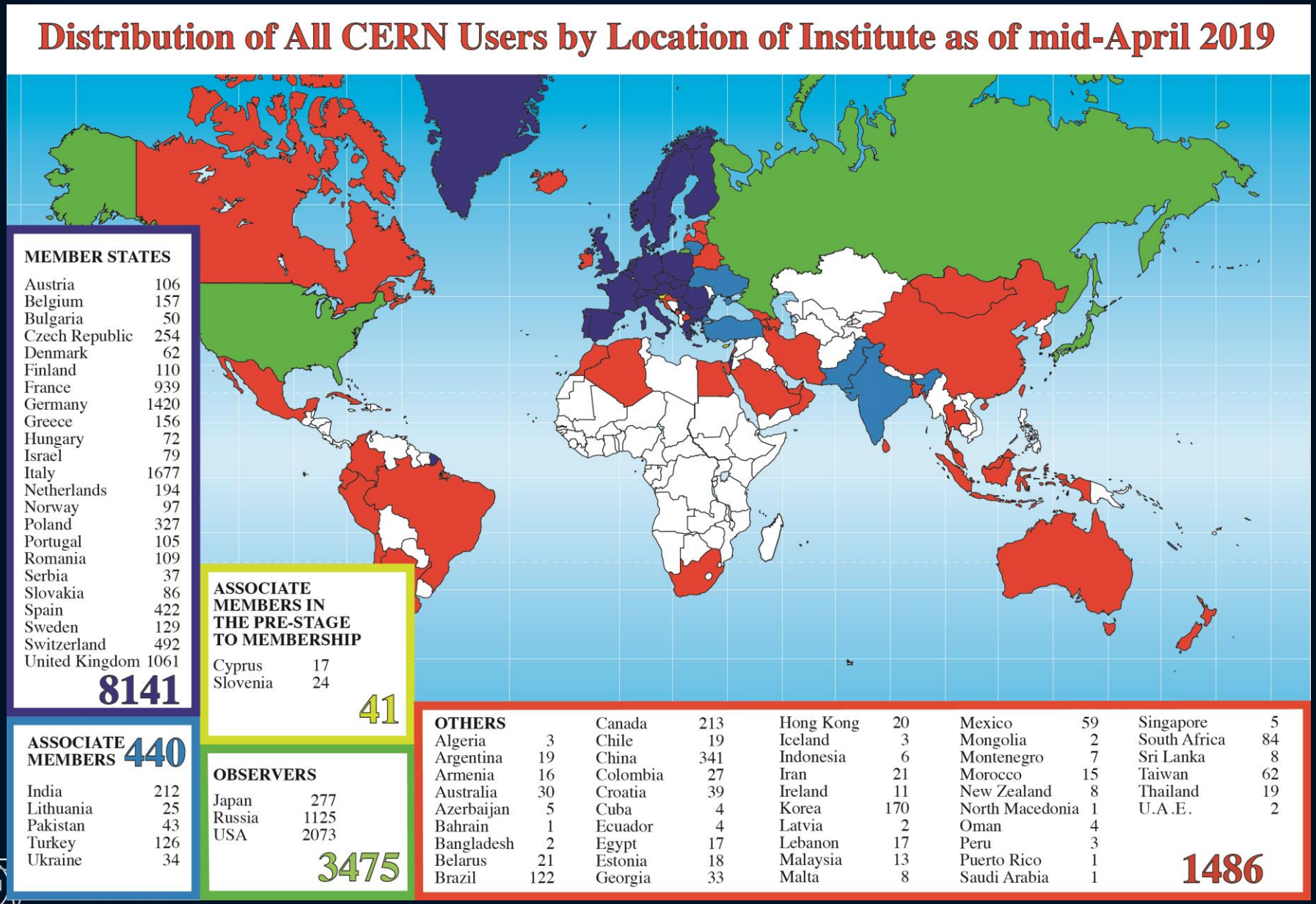
Associate Members in the Pre-Stage to Membership: Cyprus, Slovenia

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

Applications for Membership or Associate Membership:
Brazil, Croatia, Estonia

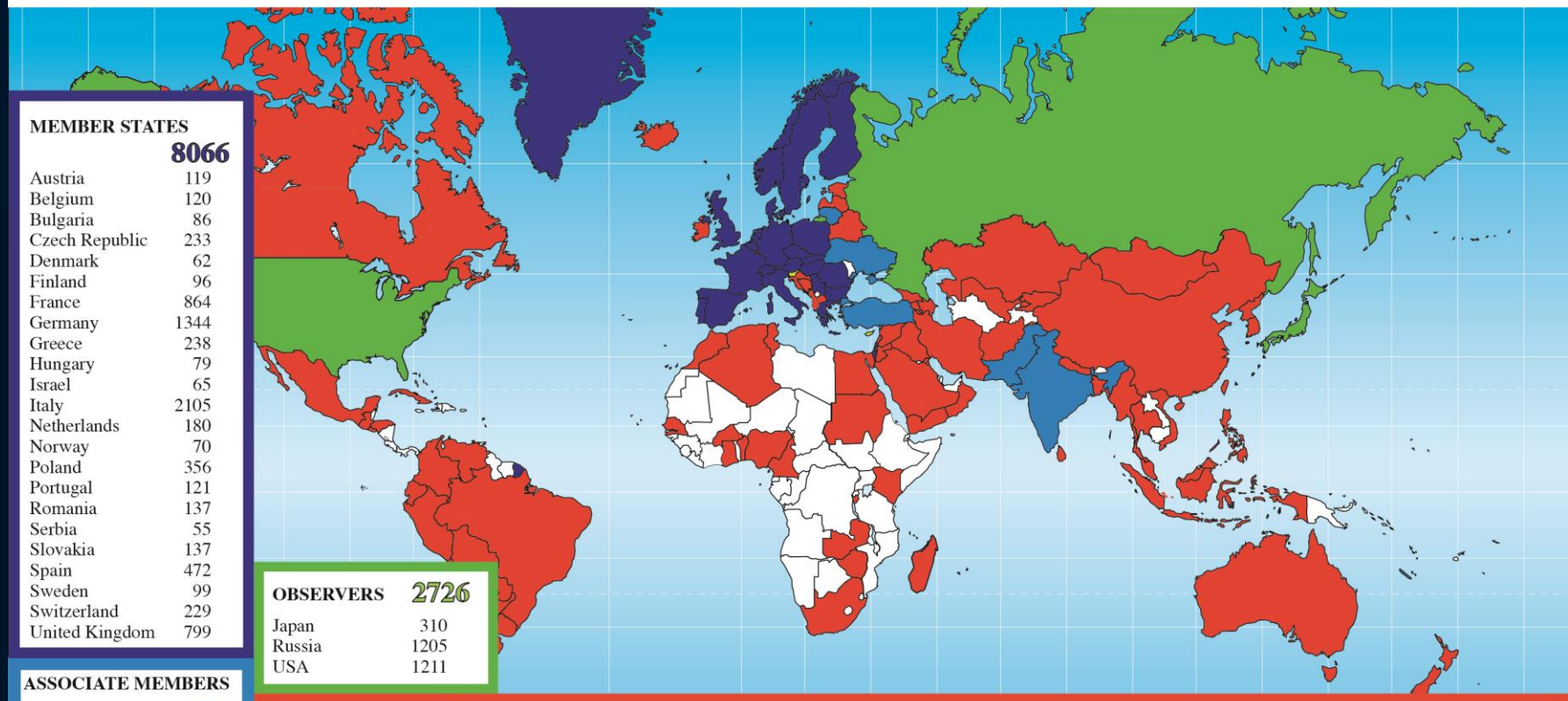
Observers to Council: Japan, Russia, United States of America;
European Union, JINR and UNESCO

Science is getting more and more global



Science is getting more and more global

Distribution of All CERN Users by Nationality as of mid-April 2019



MEMBER STATES 8066

Austria	119
Belgium	120
Bulgaria	86
Czech Republic	233
Denmark	62
Finland	96
France	864
Germany	1344
Greece	238
Hungary	79
Israel	65
Italy	2105
Netherlands	180
Norway	70
Poland	356
Portugal	121
Romania	137
Serbia	55
Slovakia	137
Spain	472
Sweden	99
Switzerland	229
United Kingdom	799

OBSERVERS 2726

Japan	310
Russia	1205
USA	1211

ASSOCIATE MEMBERS 778

India	387
Lithuania	39
Pakistan	71
Turkey	165
Ukraine	116

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP 59

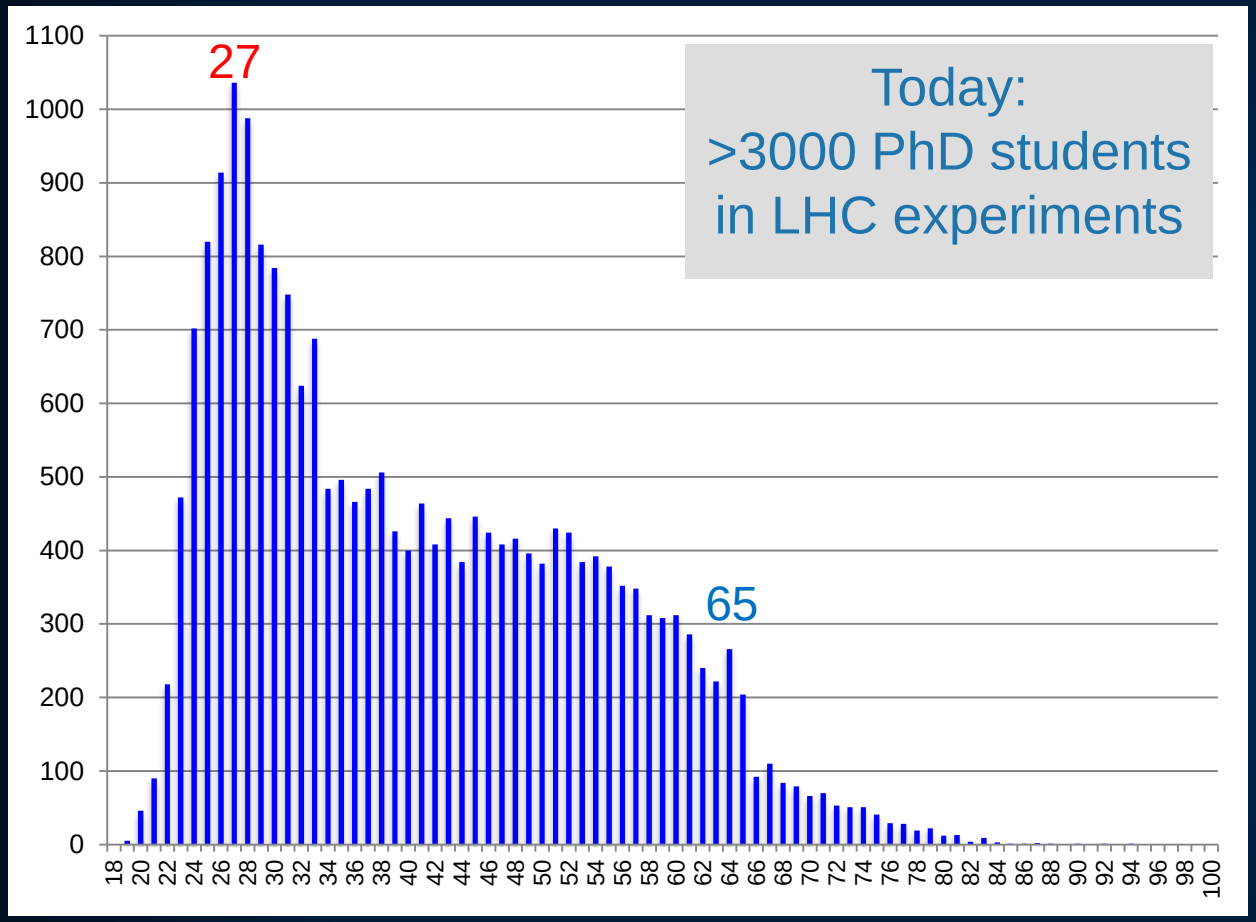
Cyprus	26
Slovenia	33

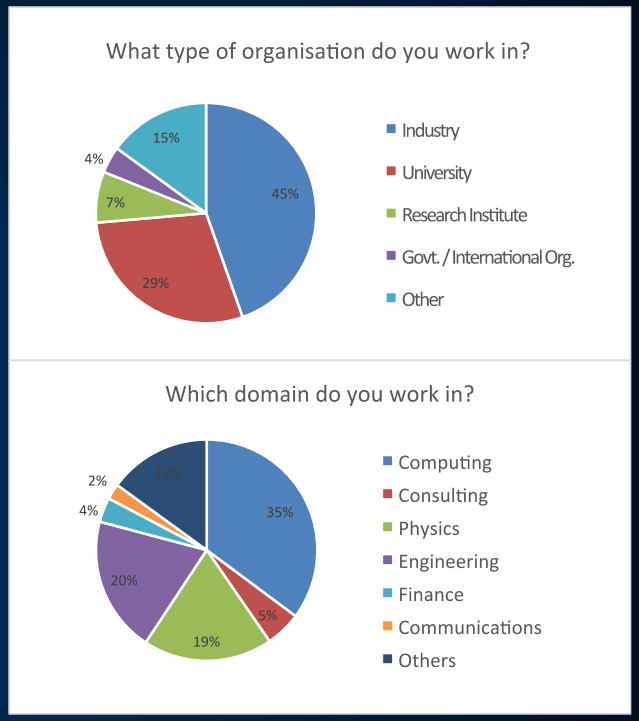
OTHERS 1999

Albania	4	Bolivia	3	Ecuador	10	Iraq	1	Malta	9	Palestine	7	Sudan	1
Algeria	14	Bosnia & Herzegovina	3	Egypt	27	Ireland	13	Mexico	85	Paraguay	1	Syria	1
Argentina	26	Brazil	127	El Salvador	1	Jordan	2	Mongolia	2	Peru	6	Taiwan	56
Armenia	22	Burkina Faso	1	Estonia	15	Kazakhstan	10	Montenegro	11	Philippines	3	Thailand	26
Australia	36	Burundi	1	Georgia	51	Kenya	1	Morocco	24	Saint Kitts and Nevis	1	Tunisia	4
Azerbaijan	10	Cameroon	1	Ghana	1	Korea	183	Myanmar	2	San Marino	1	Uruguay	1
Bahrain	1	Canada	170	Guatemala	1	Kyrgyzstan	1	Nepal	7	Saudi Arabia	4	Uzbekistan	3
Bangladesh	8	Chile	21	Hong Kong	1	Latvia	4	New Zealand	5	Senegal	1	Venezuela	9
Belarus	45	China	576	Honduras	1	Lebanon	27	Nigeria	4	Singapore	5	Viet Nam	11
Benin	1	Colombia	44	Iceland	4	Luxembourg	4	North Korea	4	South Africa	56	Zambia	1
		Croatia	50	Indonesia	11	Madagascar	1	North Macedonia	3	Sri Lanka	10	Zimbabwe	2
		Cuba	16	Iran	58	Malaysia	22	Oman	3				

Age Distribution of Scientists

- and where they go afterwards

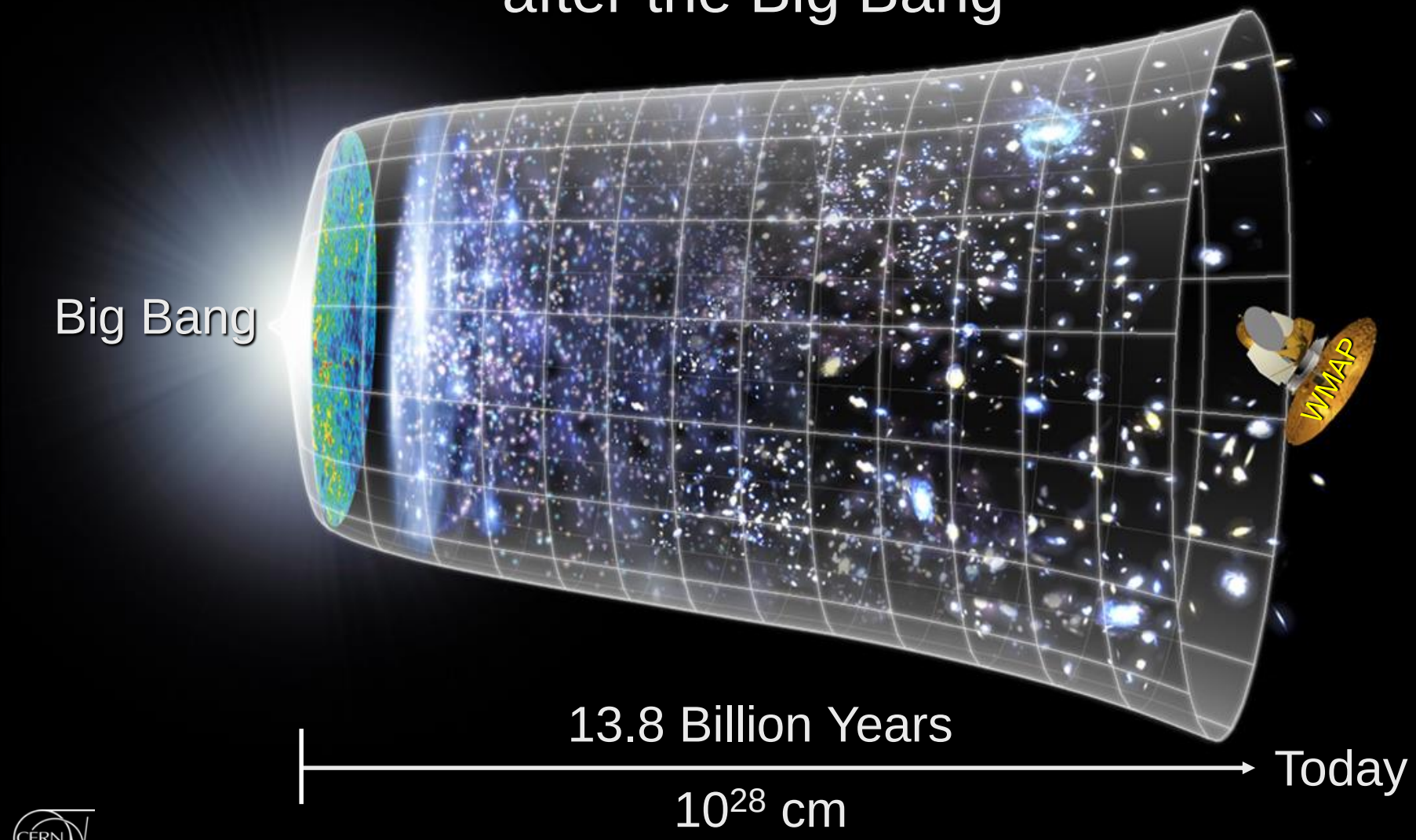


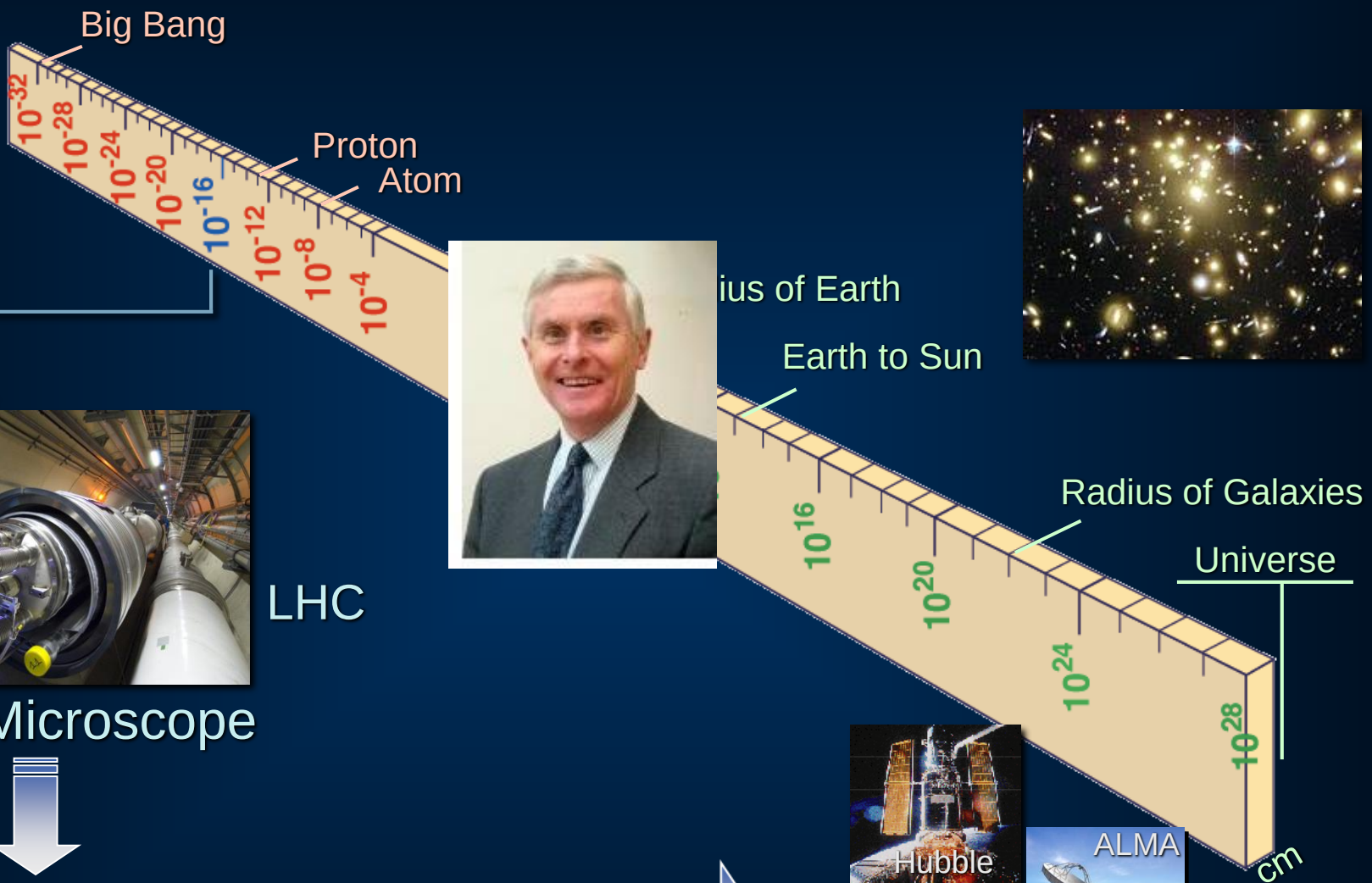


They do not all stay: where do they go?

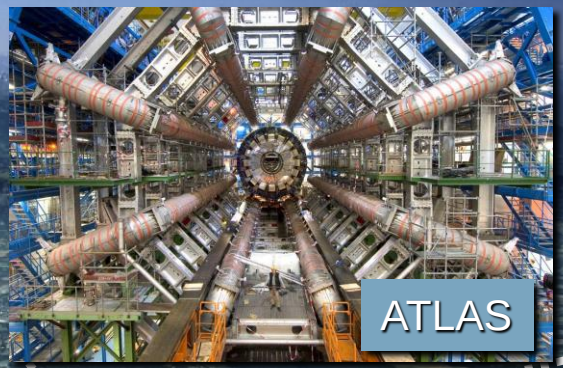
Our Scientific Challenge:

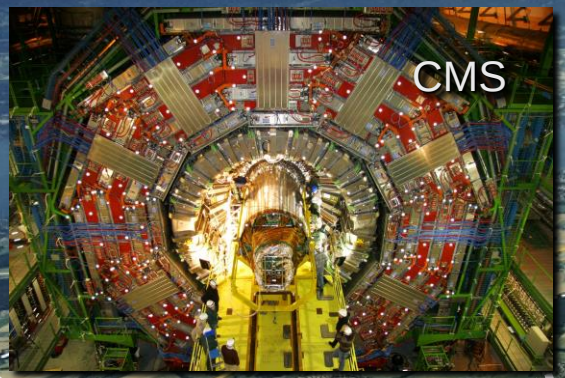
to understand the very first moments of our Universe after the Big Bang




Big Bang
Proton
Atom
ius of Earth
Earth to Sun
Radius of Galaxies
Universe
cm
LHC
Super-Microscope
Reproducing conditions
Looking back
Hubble
ALMA
AMS
VLT

2010: a New Era in Fundamental Science





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

CERN

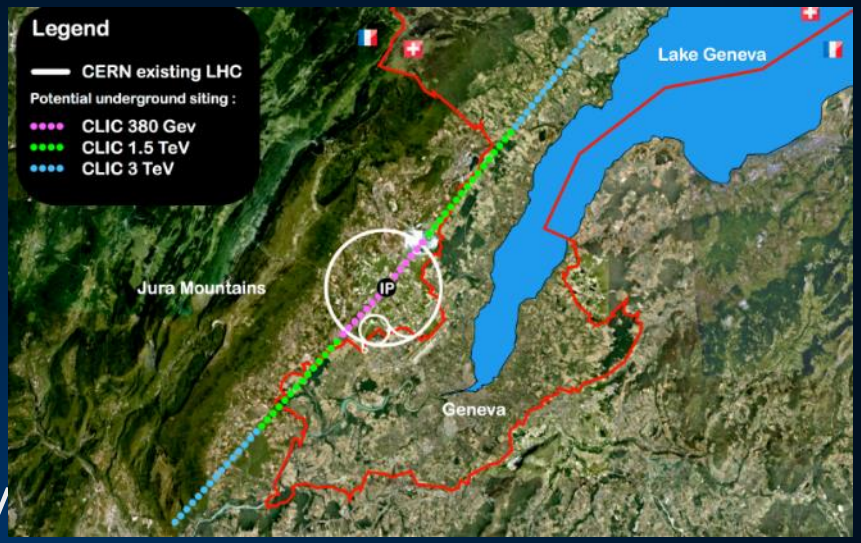
Discovery 2012, Nobel Prize in Physics 2013

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

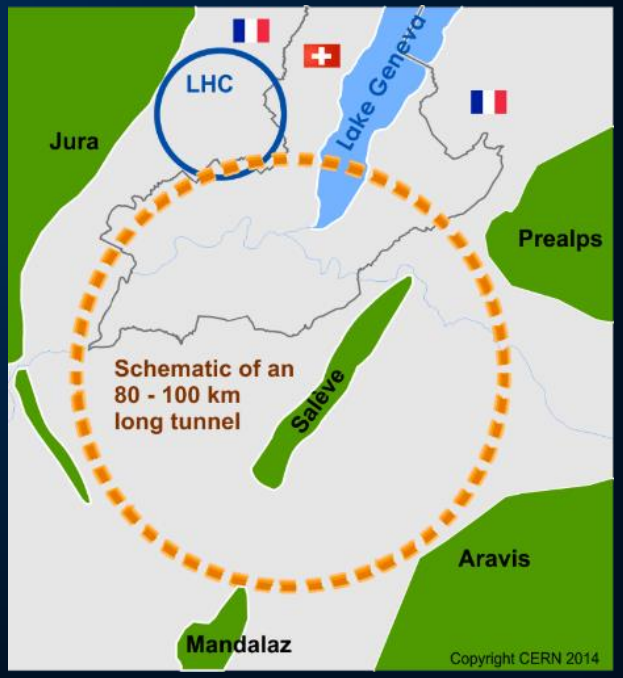


Studies in progress:
Compact Linear Collider (CLIC)

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

Future Circular Collider (FCC)

- New technology magnets → 100 TeV pp collisions in 100km ring
- e^+e^- collider (FCC-ee) as 1st step?



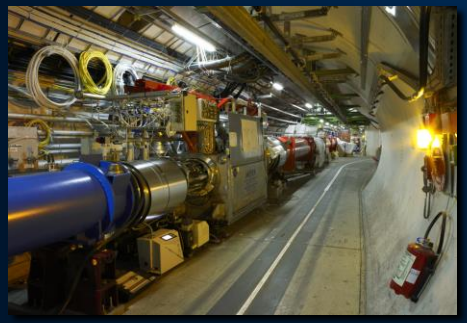
European Strategy for Particle Physics

- Preparing next update in 2020

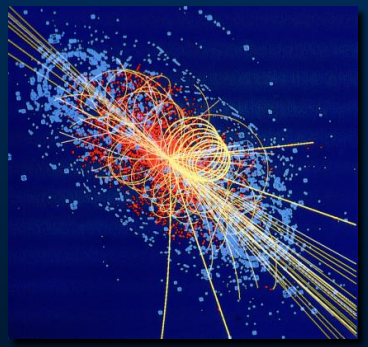
CERN: Particle Physics and Innovation

- Interfacing between fundamental science and key technological developments

- CERN Technologies and Innovation



Accelerating particle beams

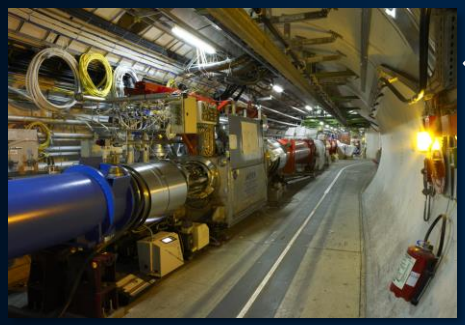


Detecting particles

Large-scale computing (Grid)

Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer

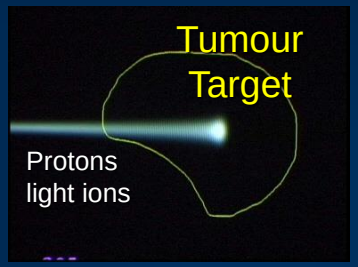


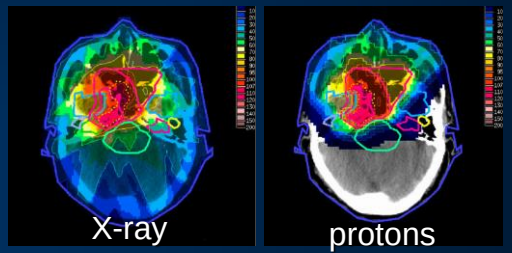
Accelerating particle beams

~30’000 accelerators worldwide

~17’000 used for medicine

Hadron Therapy

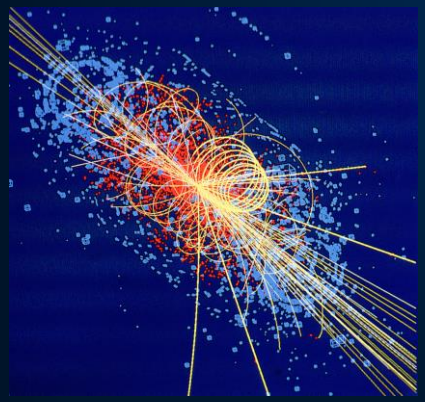




Leadership in Ion Beam Therapy now in Europe and Japan

>100’000 patients treated worldwide (45 facilities)

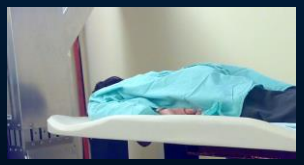
>50’000 patients treated in Europe (14 facilities)



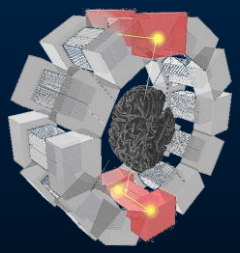
Detecting particles

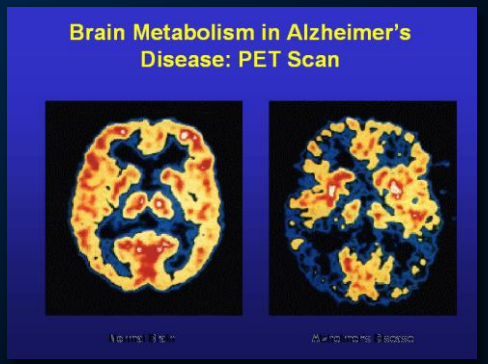
Imaging

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



PET Scanner



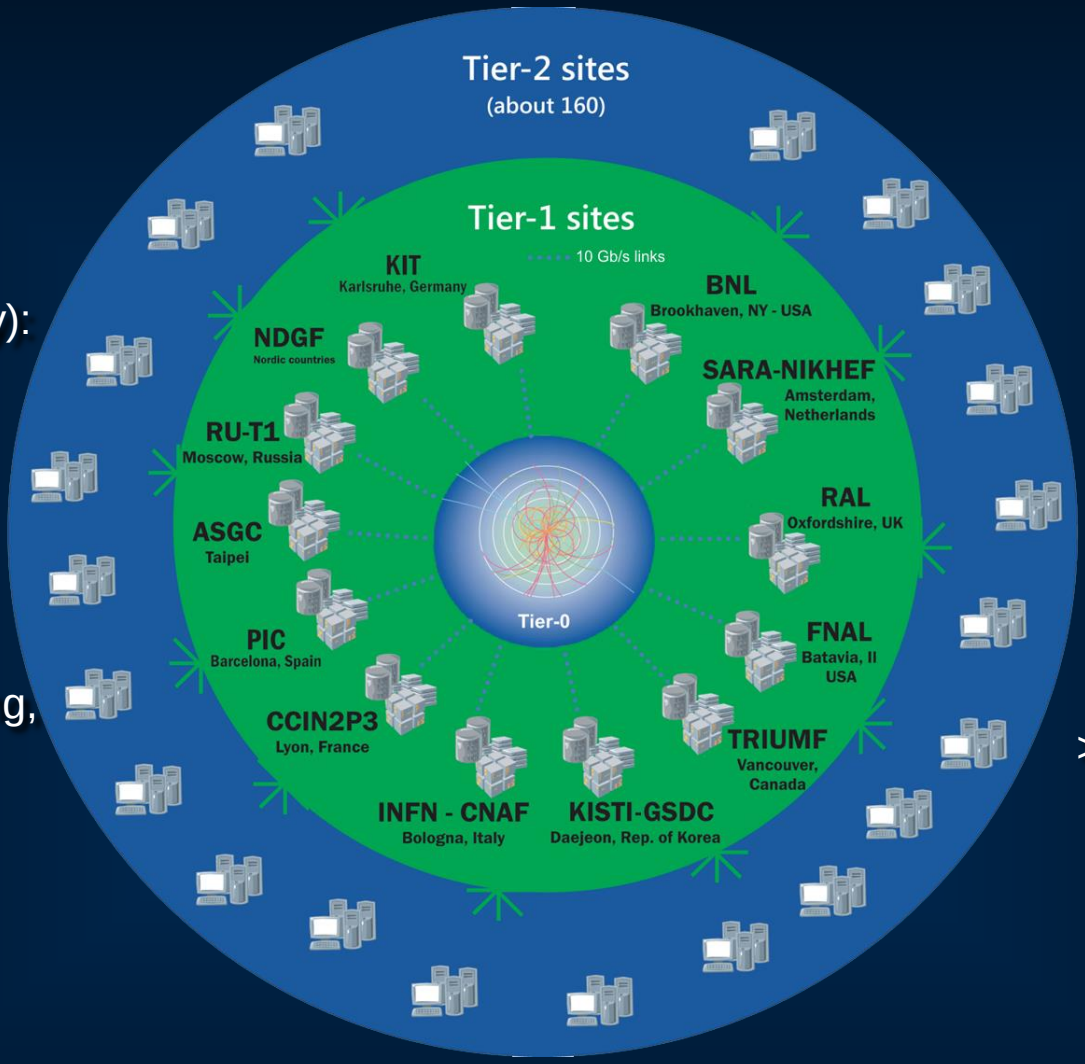


The Worldwide LHC Computing Grid

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

CERN Education Activities

Scientists at CERN
Academic Training Programme

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

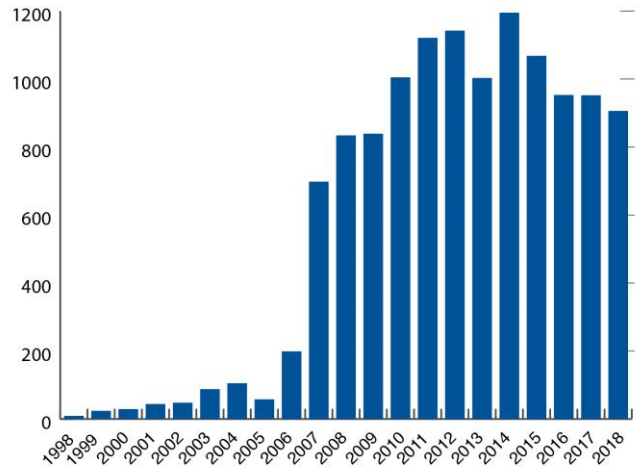
Undergraduates
Summer Students Programme

CERN Teacher Schools
International and National Programmes

Public visitors
135 thousand per year

CERN Teacher Programme

Teacher Programme Participants 1998 - 2018 (Total: 12320)



MEMBER STATES

Austria	246
Belgium	135
Bulgaria	683
Czech Republic	156
Denmark	291
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

9898

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

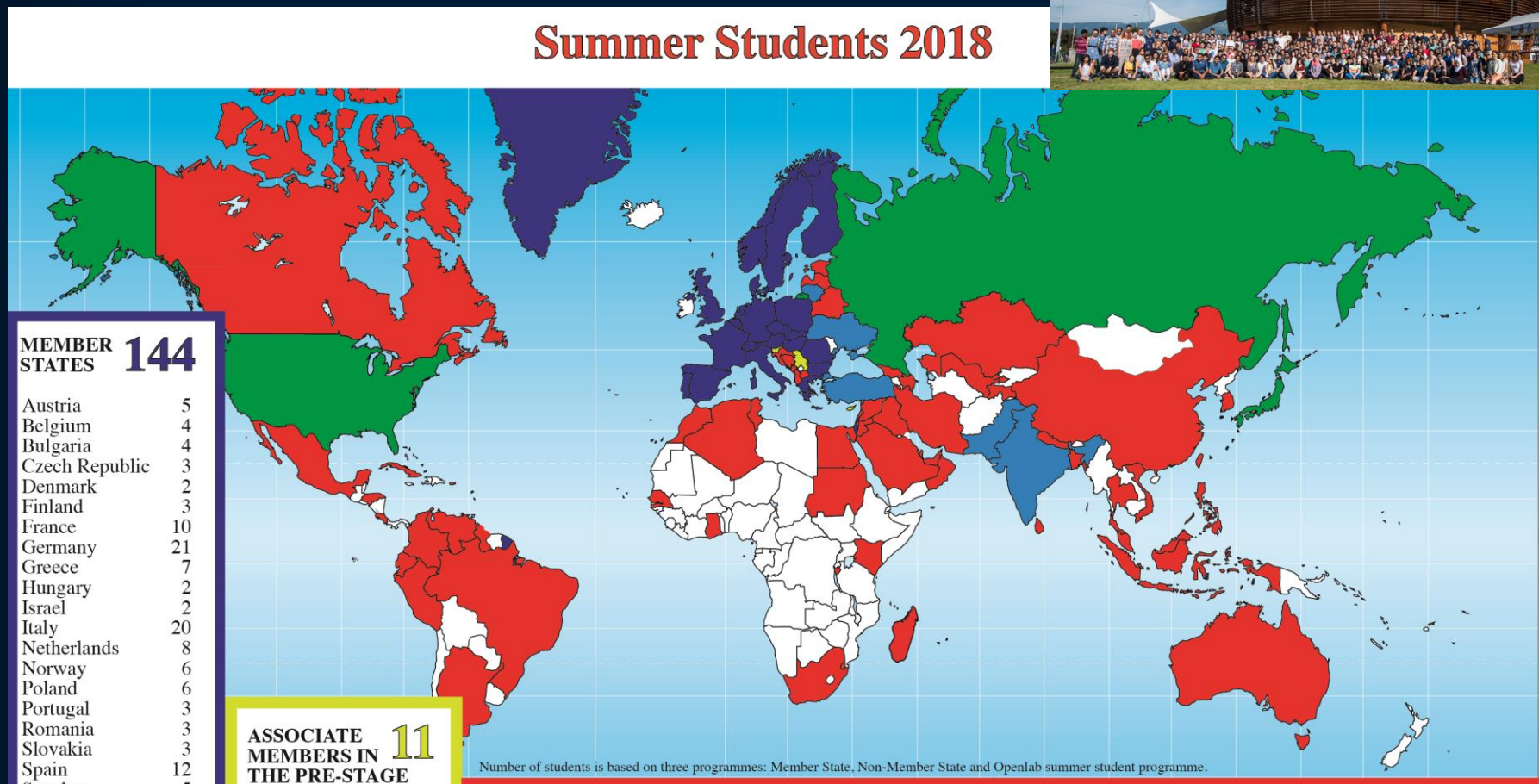
536

OTHERS

Algeria	10	Burundi	2	Estonia	92	Lebanon	21	North Macedonia	13	Tanzania	1
Angola	7	Cameroon	9	Georgia	154	Madagascar	2	Palestine	5	Thailand	19
Argentina	2	Canada	14	Ghana	7	Malta	37	Philippines	2	Timor-Leste	9
Armenia	3	Cape Verde	4	Guinea Bissau	1	Mexico	83	Qatar	1	Uganda	3
Australia	9	Chile	3	Indonesia	3	Moldova	4	Rwanda	20	U.A.E.	1
Azerbaijan	2	China	2	Iran	12	Mongolia	1	Sao Tome	7	Venezuela	1
Bahrain	2	Colombia	2	Ireland	9	Montenegro	16	Saudi Arabia	1		
Belarus	8	Costa Rica	4	Jordan	13	Morocco	2	Singapore	2		
Bosnia and Herzegovina	6	Croatia	81	Kazakhstan	14	Mozambique	22	South Africa	8		
Brazil	231	Dominican Rep.	72	Kenya	4	Nepal	3	Sri Lanka	2		
		Ecuador	2	Korea	49	New Zealand	4	Swaziland	1		
		Egypt	2	Latvia	62	Nigeria	1	Taiwan	1		

1190

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 25

India	12
Lithuania	3
Pakistan	5
Turkey	1
Ukraine	4

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP 11

Cyprus	5
Serbia	2
Slovenia	4

OBSERVERS 35

Japan	4
Russia	8
USA	23

OTHERS

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

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LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km
Thank You!
CERN
Accelerating Science and Innovation