Welcome

IPU Committee on Middle East Questions

Roundtable on Water

The role of science and technology in projects of peace

Geneva, 1 June 2016

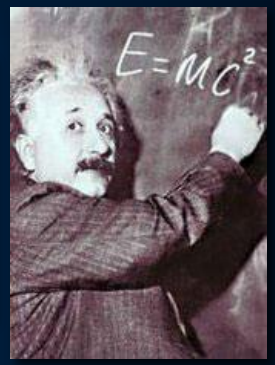
Maurizio Bona, CERN

to Accelerating Science and Innovation

The Mission of CERN

- **Push back** the frontiers of knowledge

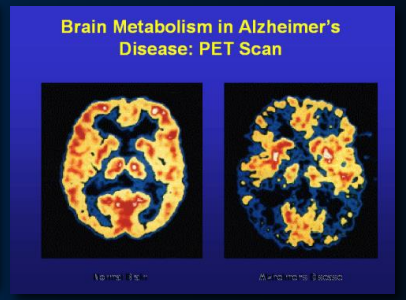
  E.g. the secrets of the Big Bang …what was the matter like within the first moments of the Universe's existence?



- **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: 21 Member States

~ 2300 staff
~ 1400 other paid personnel
~ 12500 scientific users

Budget (2016) ~1000 MCHF

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

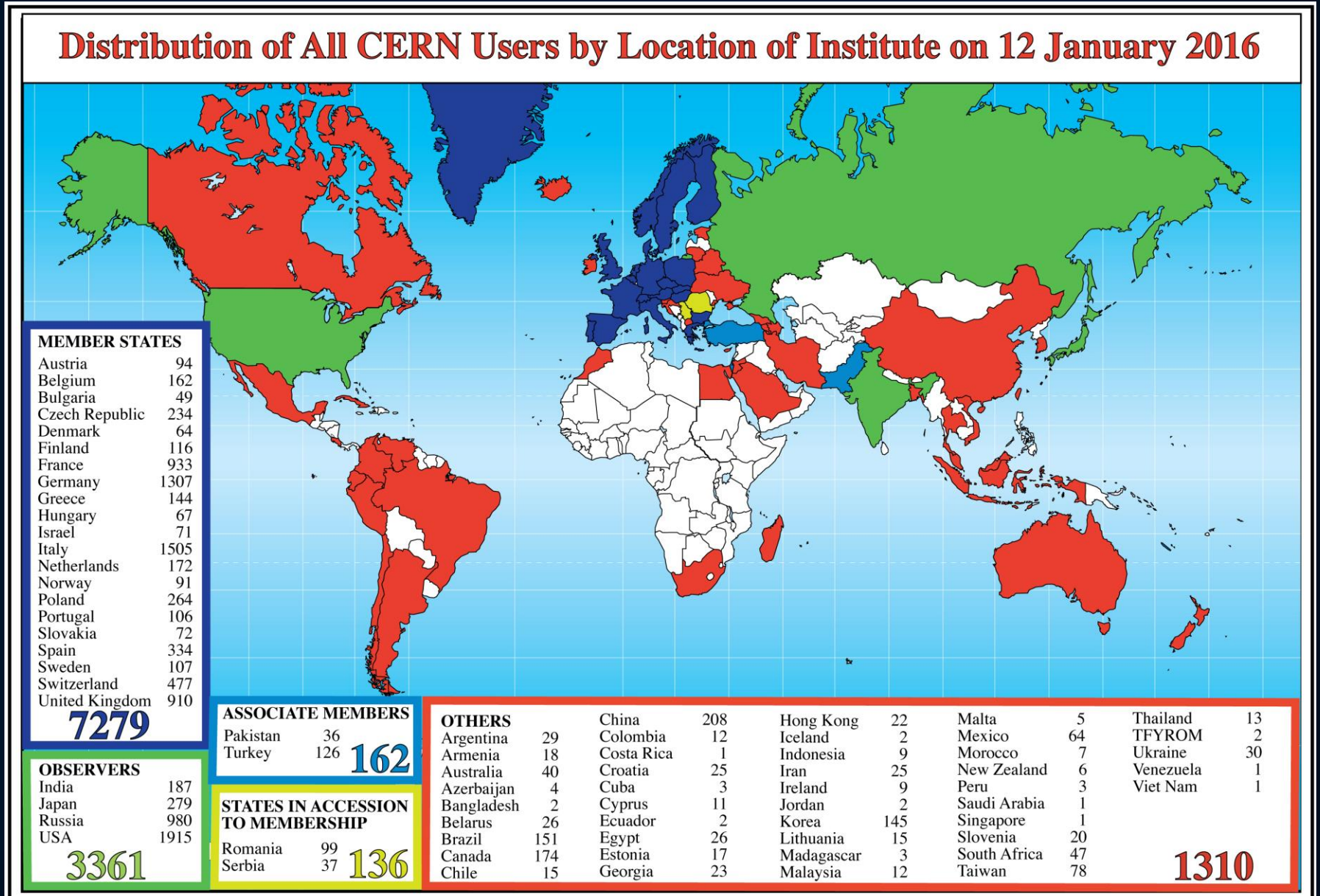
Associate Member States: Cyprus, Pakistan, Turkey

States in accession to Membership: Romania, Serbia

Applications for Membership or Associate Membership: Brazil, Croatia, India, Lithuania, Russia, Slovenia, Ukraine

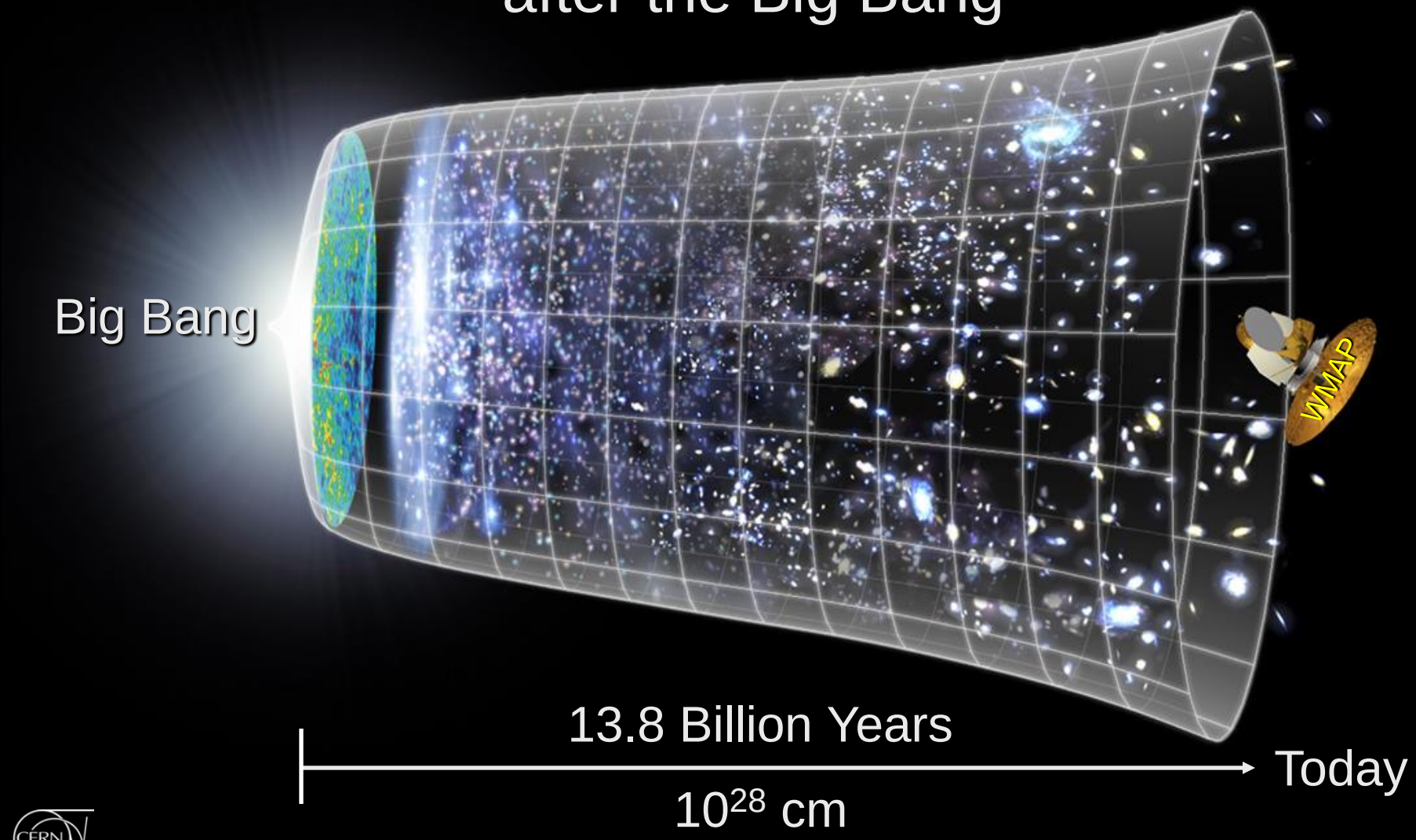
Observers to Council: India, Japan, Russia, United States of America; European Union, JINR and UNESCO

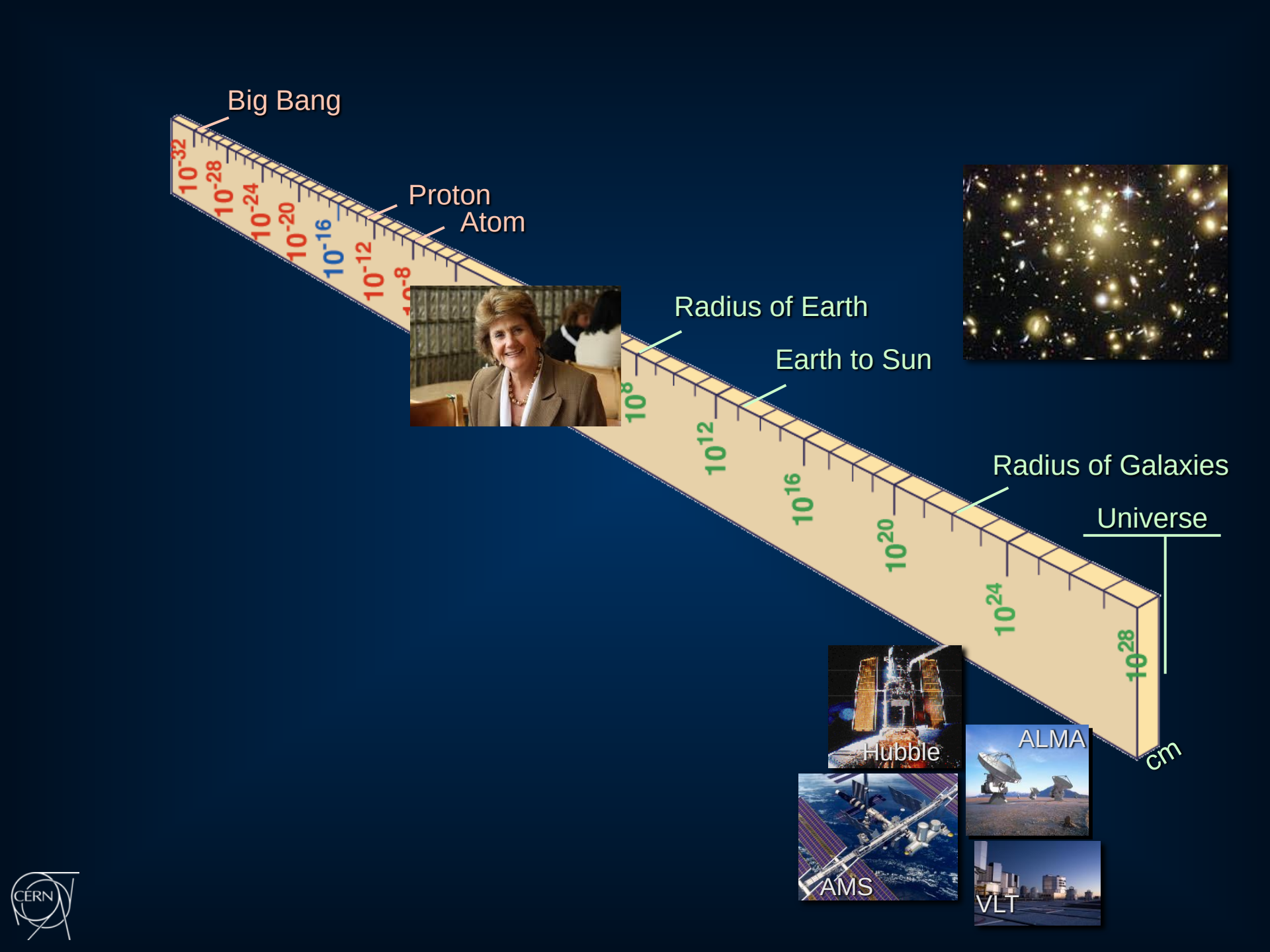
Science is getting more and more global



Our Scientific Challenge:

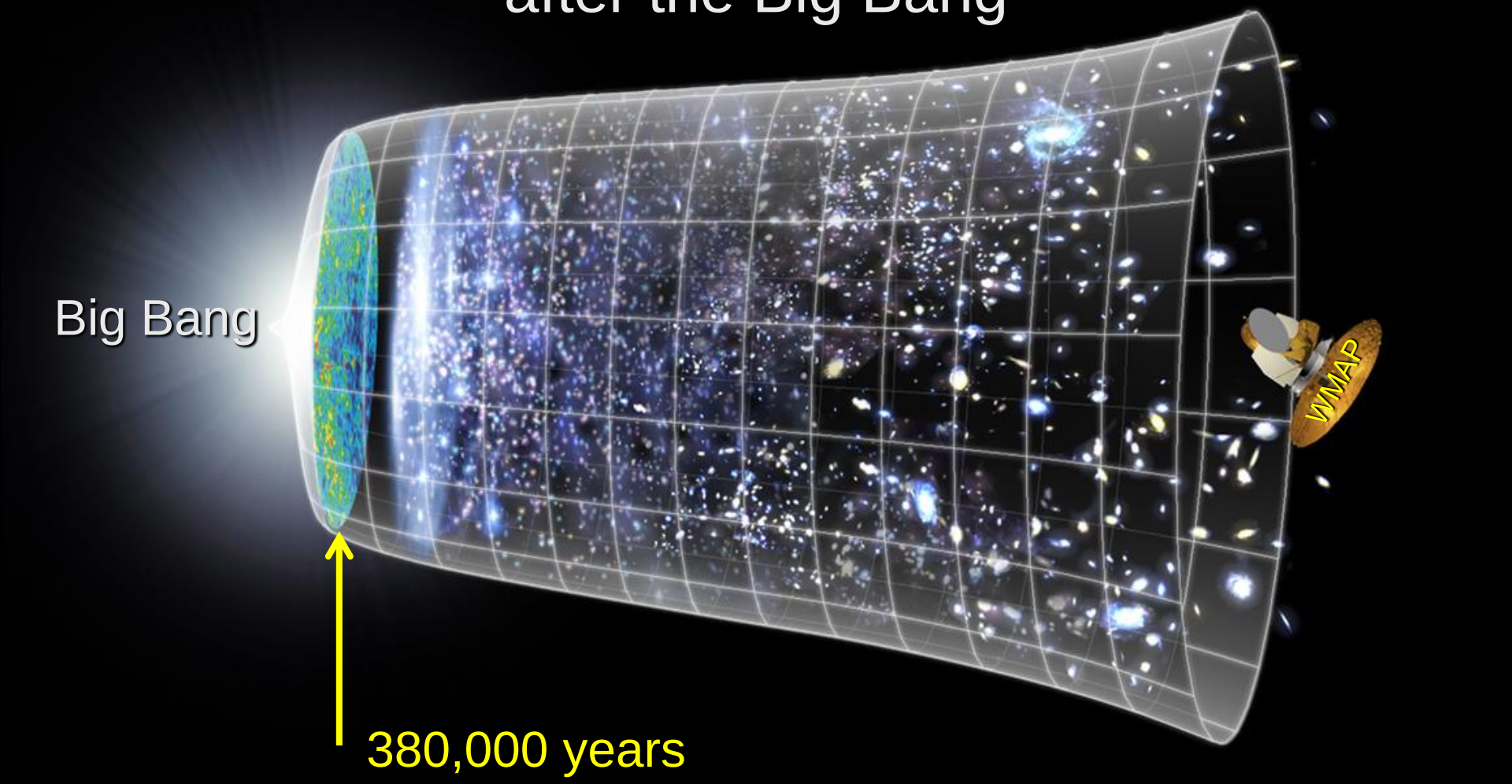
to understand the very first moments of our Universe after the Big Bang

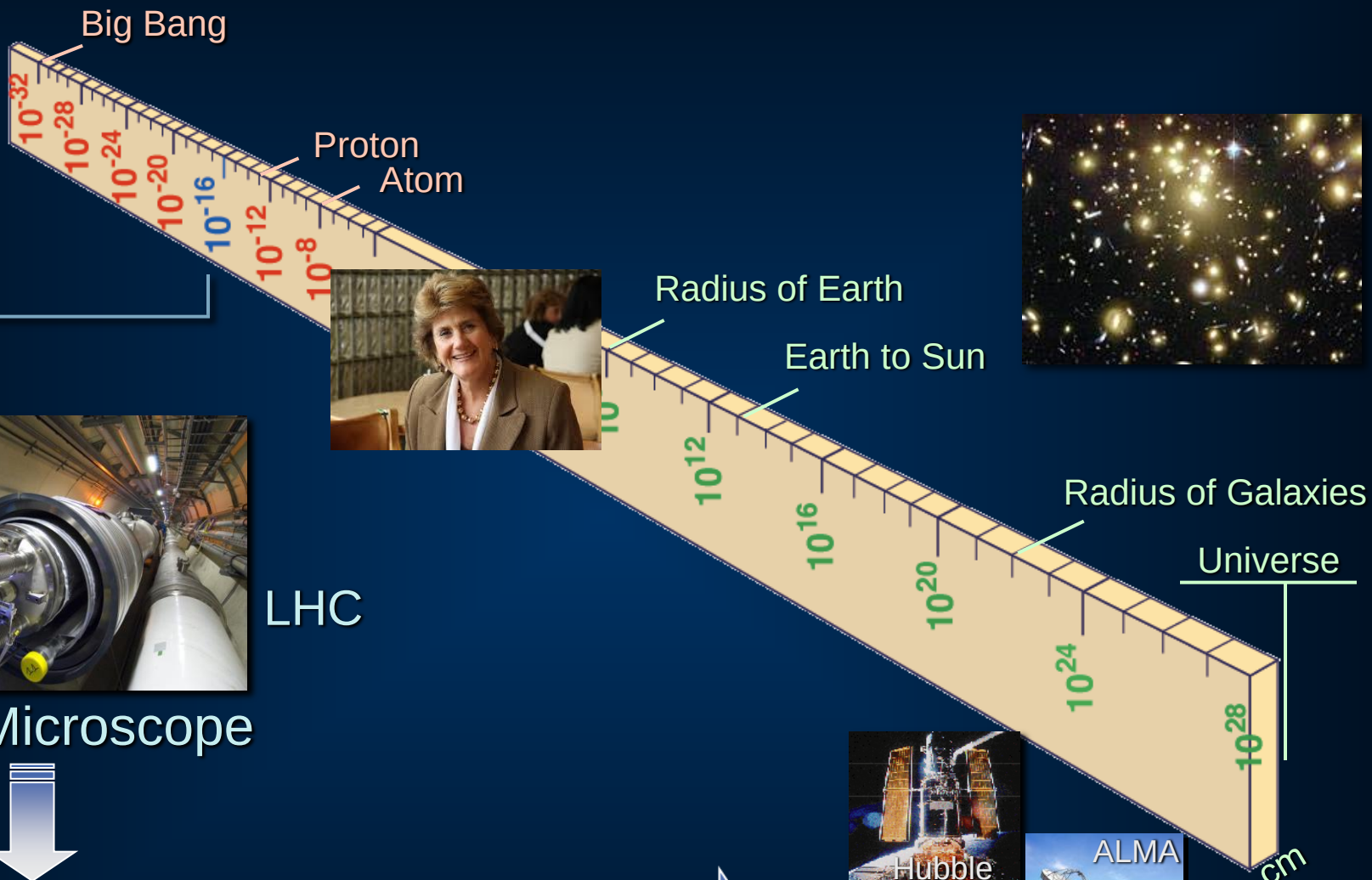



Big Bang
Proton
Atom
Radius of Earth
Earth to Sun
Radius of Galaxies
Universe
10^{-32}
10^{-28}
10^{-24}
10^{-20}
10^{-16}
10^{-12}
10^{-8}
10^{8}
10^{12}
10^{16}
10^{20}
10^{24}
10^{28}
cm
Hubble
ALMA
AMS
VLT
CERN

Our Scientific Challenge:

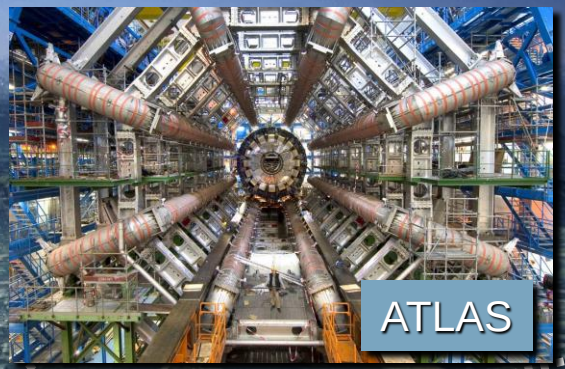
to understand the very first moments of our Universe after the Big Bang

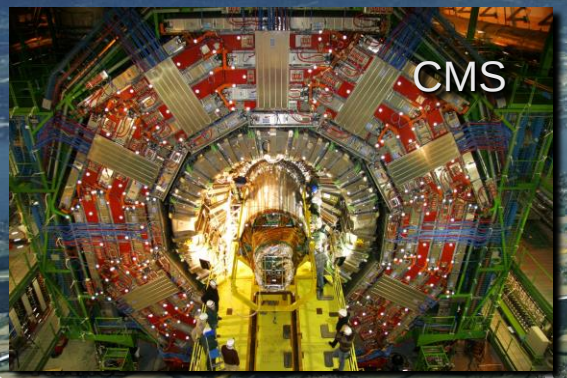



Big Bang
Proton
Atom
Radius of Earth
Earth to Sun
Radius of Galaxies
Universe
cm
LHC
Super-Microscope
Reproducing conditions
Looking back
Hubble
ALMA
AMS
VLT

2010: a New Era in Fundamental Science

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





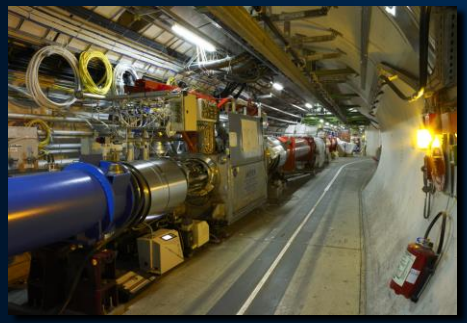
$$E = m c^2$$

Innovation
Education
CERN
uniting people
Research

CERN: Particle Physics and Innovation

- Interfacing between fundamental science and key technological developments

- CERN Technologies and Innovation



Accelerating particle beams

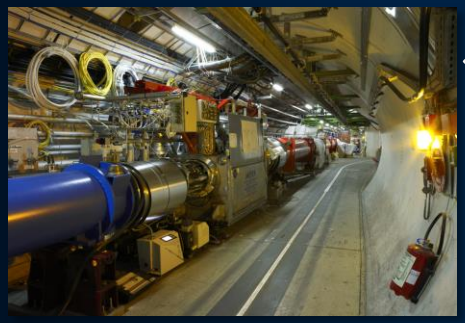
Detecting particles

Large-scale computing (Grid)

CERN

Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer

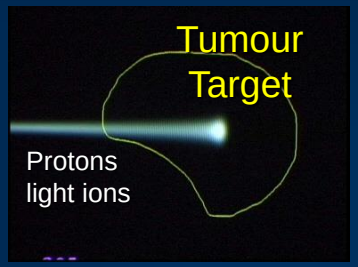


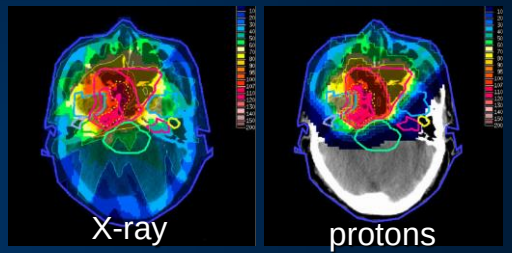
Accelerating particle beams

~30’000 accelerators worldwide

~17’000 used for medicine

Hadron Therapy

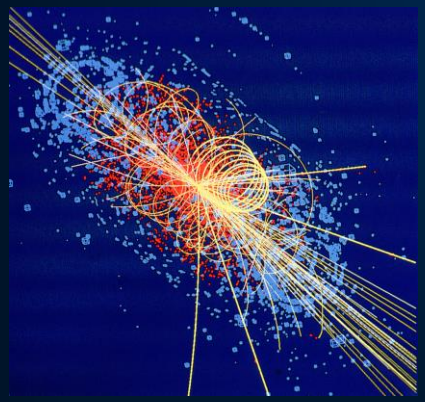




Leadership in Ion Beam Therapy now in Europe and Japan

>100’000 patients treated worldwide (45 facilities)

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

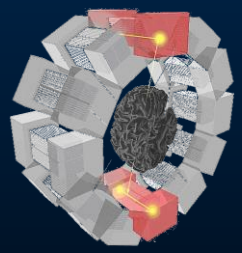


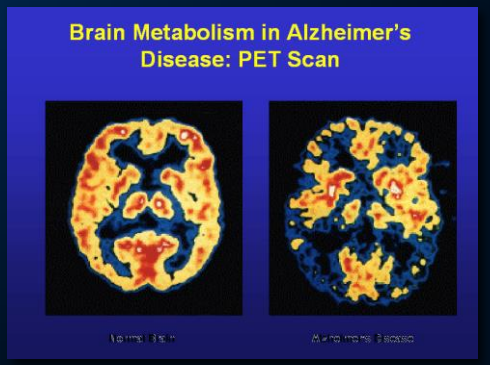
Detecting particles

Imaging

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

PET Scanner



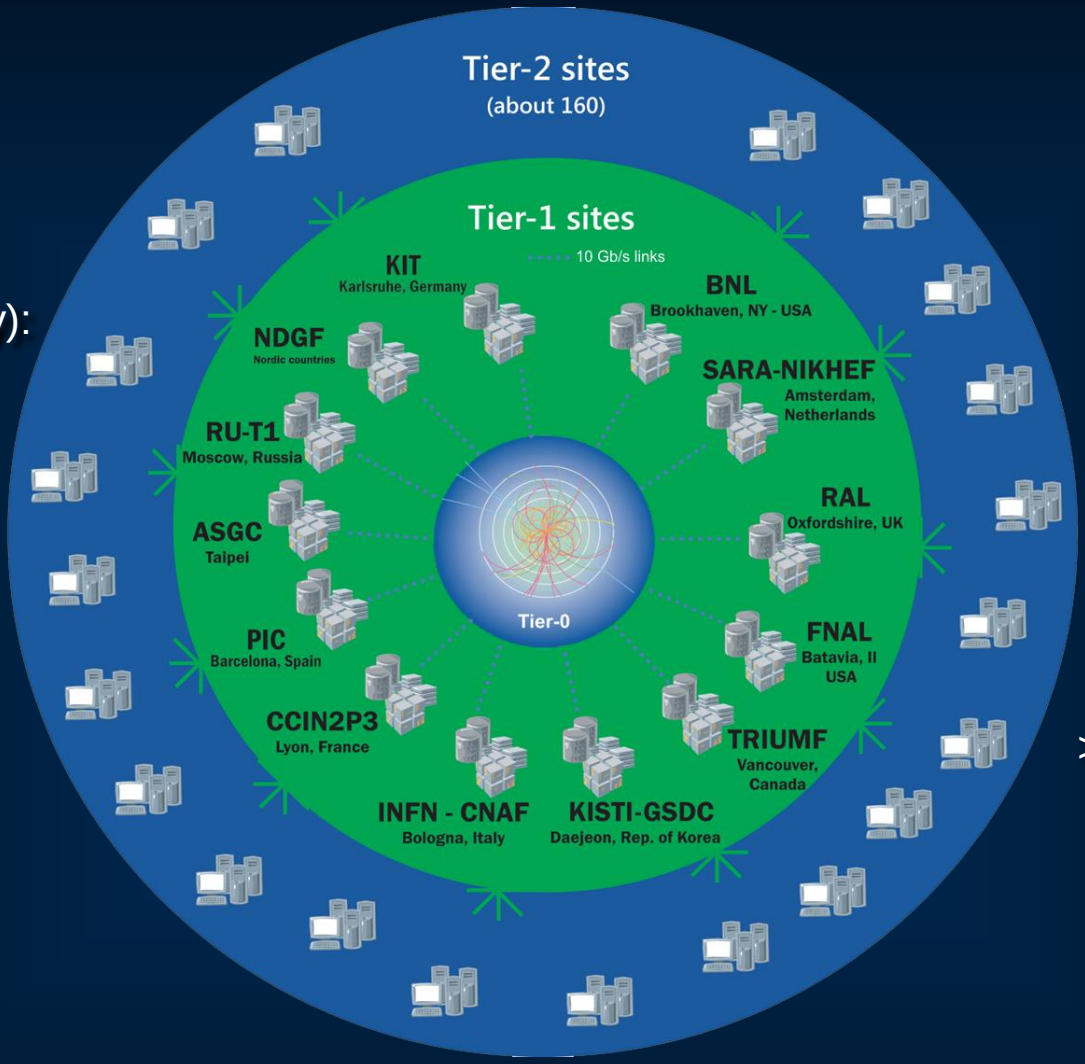


The Worldwide LHC Computing Grid

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

Tier-1: permanent
storage, re-
processing,
analysis

Tier-2: Simulation,
end-user analysis



~170 sites,
40 countries

~500k CPU cores

500 PB of storage

> 2 million jobs/day

10-100 Gb links

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

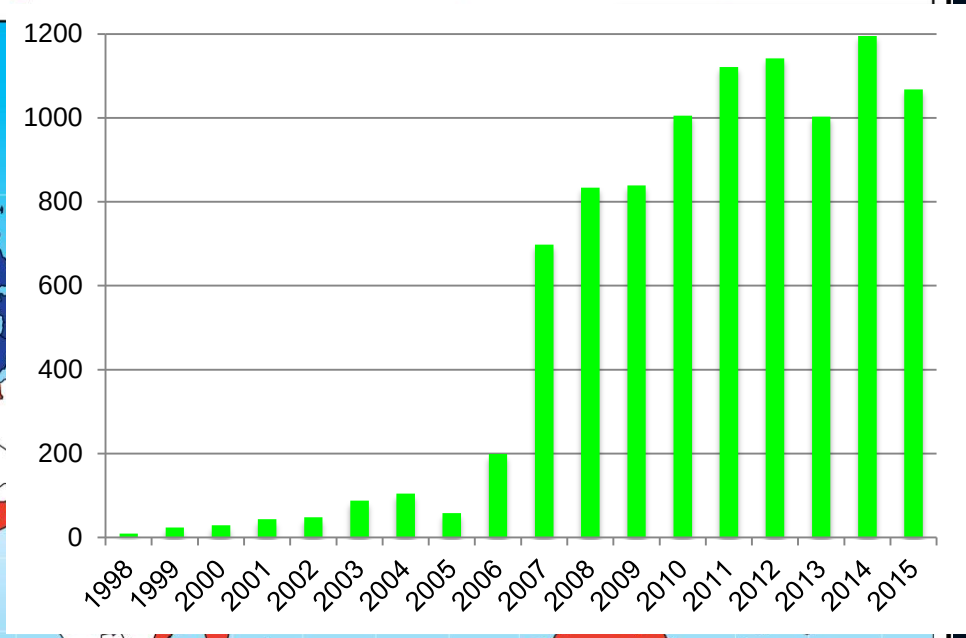
Young Researchers
CERN School of High Energy Physics
CERN School of Computing
CERN Accelerator School

Physics Students
Summer Students
Programme

CERN Teacher Schools
International and National
Programmes

CERN Teacher Programme

Teacher Programme Participants 1998 - 2015 (Total: 9509)



MEMBER STATES

Austria	177
Belgium	123
Bulgaria	455
Czech Republic	154
Denmark	199
Finland	498
France	314
Germany	902
Greece	671
Hungary	446
Israel	47
Italy	551
Netherlands	143
Norway	106
Poland	580
Portugal	386
Slovakia	222
Spain	441
Sweden	216
Switzerland	124
United Kingdom	1161

7916

ASSOCIATE MEMBERS 163

Pakistan	2
Turkey	161

CANDIDATES FOR ACCESSION

Romania	14
Serbia	68

82

OBSERVERS

India	4
Japan	7
Russia	336
USA	97

444

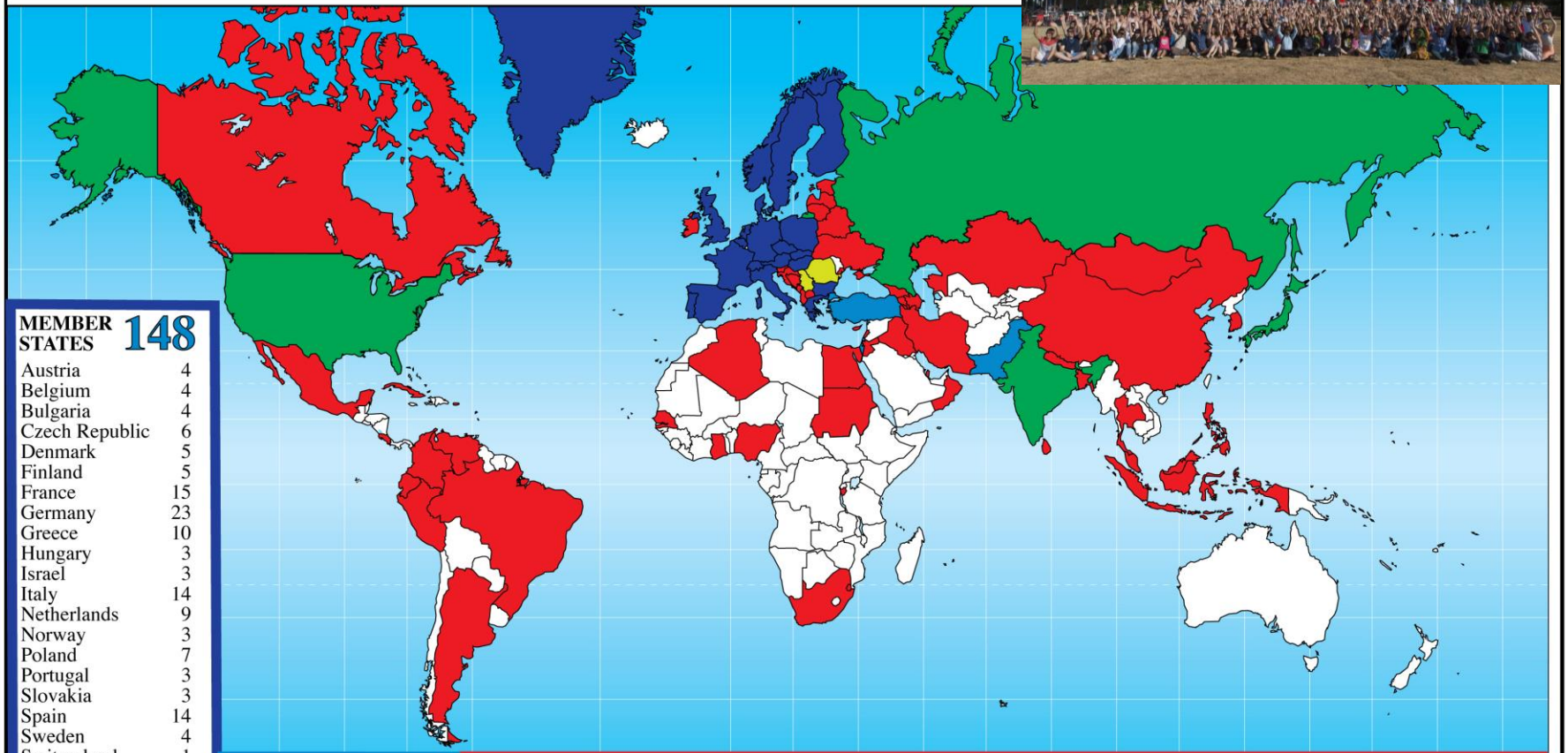
OTHERS

Angola	7	Cape Verde	4	Ghana	6	Malta	36	Sao Tome	6	Uganda	3
Armenia	1	Chile	3	Guinea Bissau	1	Mexico	14	Saudi Arabia	1	Ukraine	117
Australia	6	China	2	Iran	6	Mongolia	1	Singapore	2	U.A.E.	1
Azerbaijan	1	Costa Rica	4	Ireland	8	Montenegro	14	Slovenia	21		
Bahrain	2	Croatia	23	Jordan	11	Morocco	2	South Africa	7		
Belarus	3	Cyprus	10	Kazakhstan	8	Mozambique	21	South Korea	48		
Brazil	167	Dominican Rep.	45	Kenya	4	Nepal	2	Swaziland	1		
Burundi	2	Ecuador	2	Latvia	1	New Zealand	2	Taiwan	1		
Cameroon	4	Egypt	2	Lebanon	1	Palestine (O.T.)	4	Thailand	12		
Canada	8	Estonia	66	Lithuania	32	Qatar	1	T.F.Y.R.O.M.	12		
		Georgia	104	Madagascar	2	Rwanda	20	Timor-Leste	9		

904

Summer Students 2015

Summer Students 2015



MEMBER STATES	148
Austria	4
Belgium	4
Bulgaria	4
Czech Republic	6
Denmark	5
Finland	5
France	15
Germany	23
Greece	10
Hungary	3
Israel	3
Italy	14
Netherlands	9
Norway	3
Poland	7
Portugal	3
Slovakia	3
Spain	14
Sweden	4
Switzerland	1
United Kingdom	8

OBSERVERS	44
India	13
Japan	4
Russia	9
USA	18

ASSOCIATE MEMBERS	15
Pakistan	8
Turkey	7

CANDIDATES FOR ACCESSION	9
Romania	6
Serbia	3

OTHERS		Brunei	2	Egypt	2	Kazakhstan	1	Nepal	1	South Africa	2
Albania	2	Burundi	1	Estonia	2	Korea	1	Nigeria	1	Sri Lanka	1
Algeria	4	Canada	3	Georgia	1	Latvia	1	Oman	1	Sudan	1
Argentina	3	China	12	Ghana	1	Lebanon	3	Palestine	1	Thailand	3
Armenia	1	Colombia	1	Gibraltar	1	Lithuania	2	Peru	1	T.F.Y.R.O.M.	3
Azerbaijan	1	Costa Rica	2	Indonesia	1	Malaysia	3	Philippines	1	Ukraine	1
Bangladesh	1	Croatia	2	Iran	2	Malta	4	Puerto Rico	1	Venezuela	1
Belarus	1	Cuba	1	Iraq	1	Mexico	1	Qatar	1		
Bosnia	1	Cyprus	1	Ireland	1	Mongolia	2	Singapore	2		
Brazil	2	Ecuador	1	Jordan	1	Montenegro	1	Slovenia	1		105


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