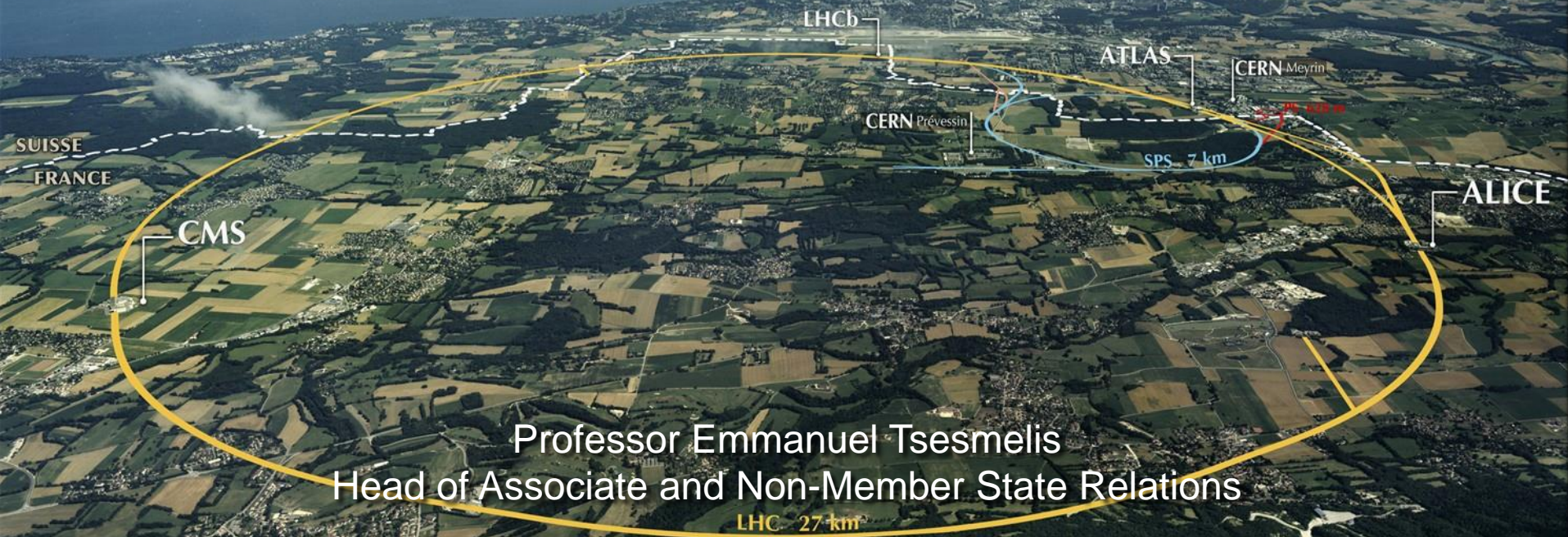


# Introduction to CERN



Professor Emmanuel Tsesmelis  
Head of Associate and Non-Member State Relations

South Asian High Energy Physics Instrumentation Workshop  
Kathmandu University  
Nepal  
20-21 June 2017

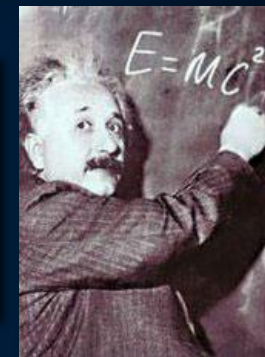




# The Mission of CERN

## ❑ 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?

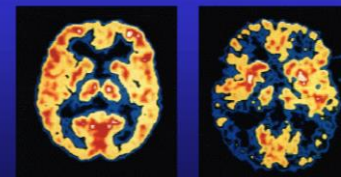


## ❑ Develop new technologies for accelerators and detectors

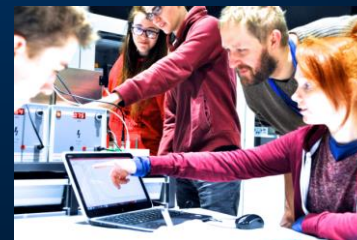
Information technology - the Web and the GRID  
Medicine - diagnosis and therapy



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

~ 2'500 staff

~ 1'800 other paid personnel

~ 13'000 scientific users

Budget (2017) ~ 1'100 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 Member States:** India, Pakistan, Turkey, Ukraine

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

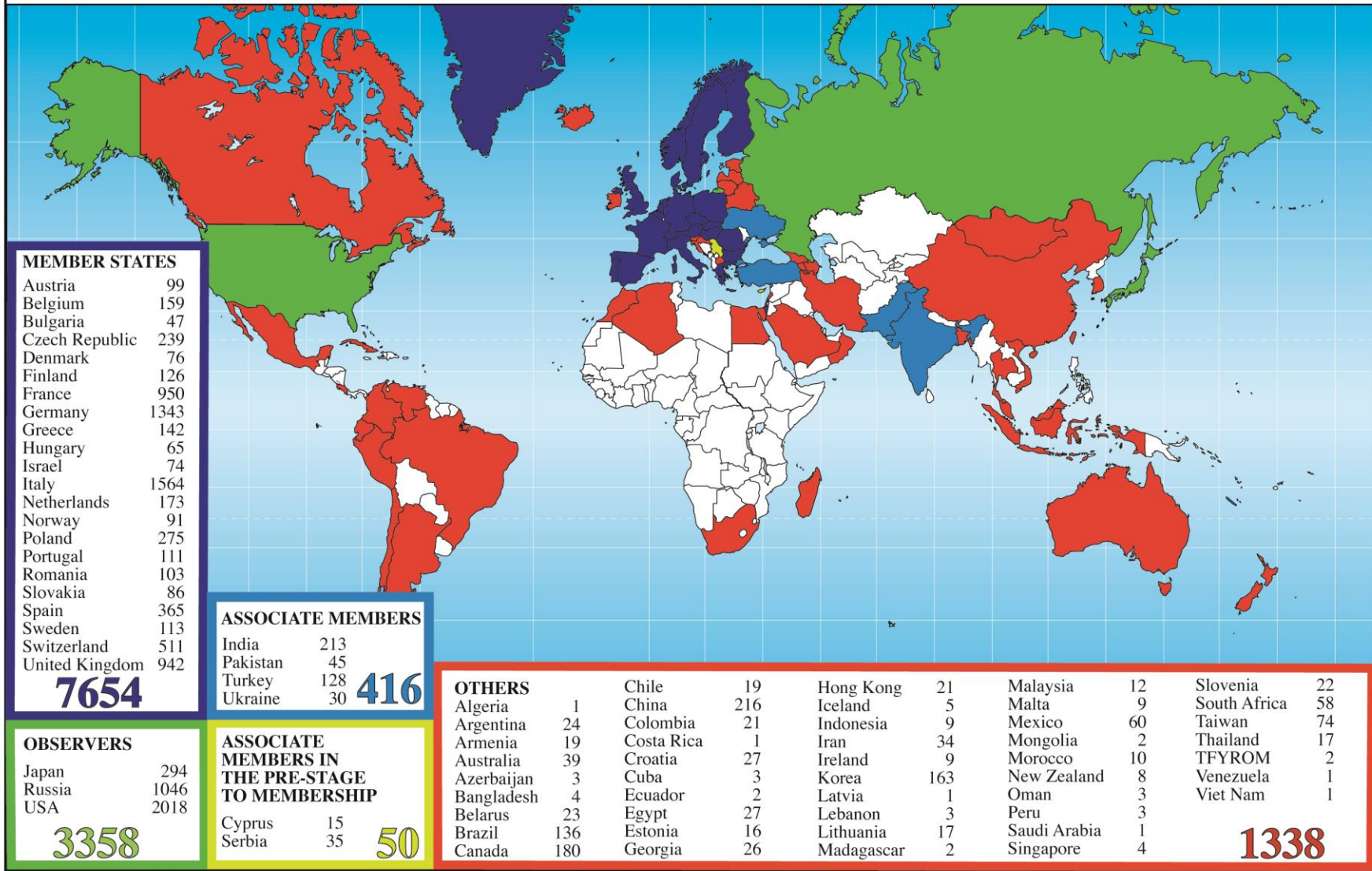
**Applications for Membership or Associate Membership:**

Brazil, Croatia, Lithuania, Russia, Slovenia

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

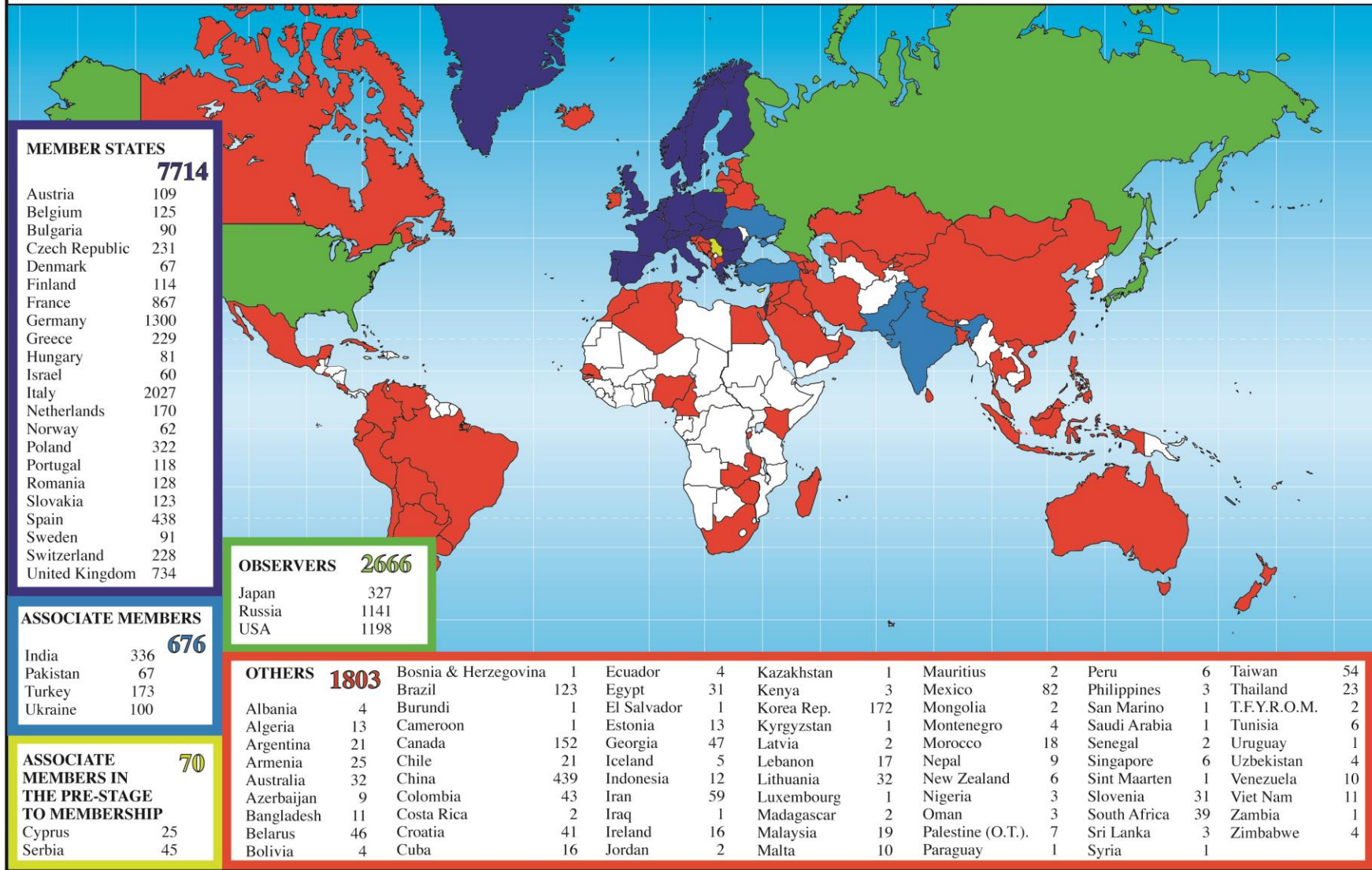
# Science is getting more and more global

## Distribution of All CERN Users by Location of Institute on 12 January 2017



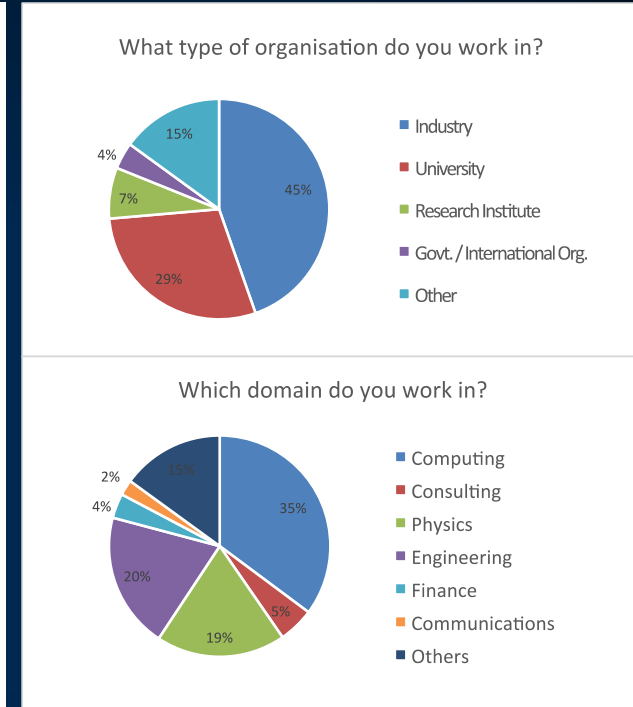
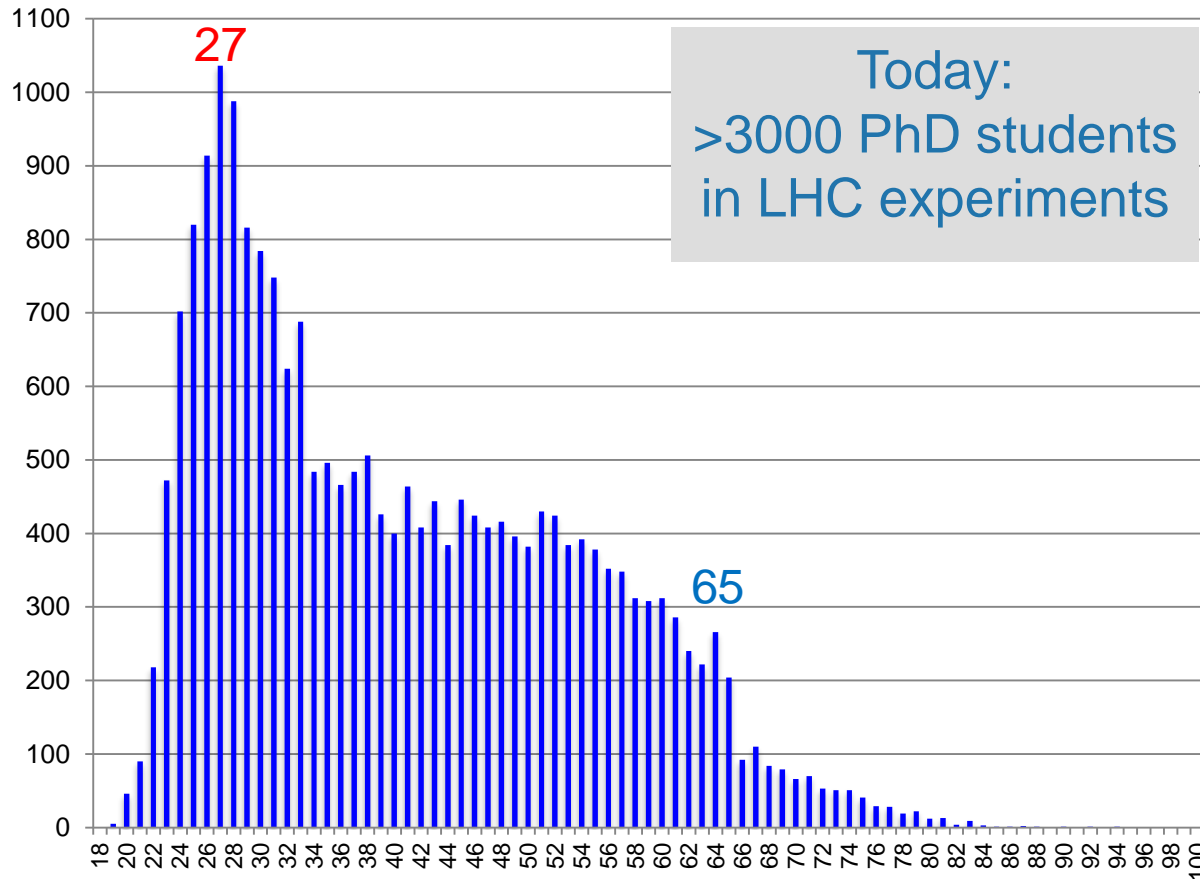
# Science is getting more and more global

## Distribution of All CERN Users by Nationality on 20 January 2017



# Age Distribution of Scientists

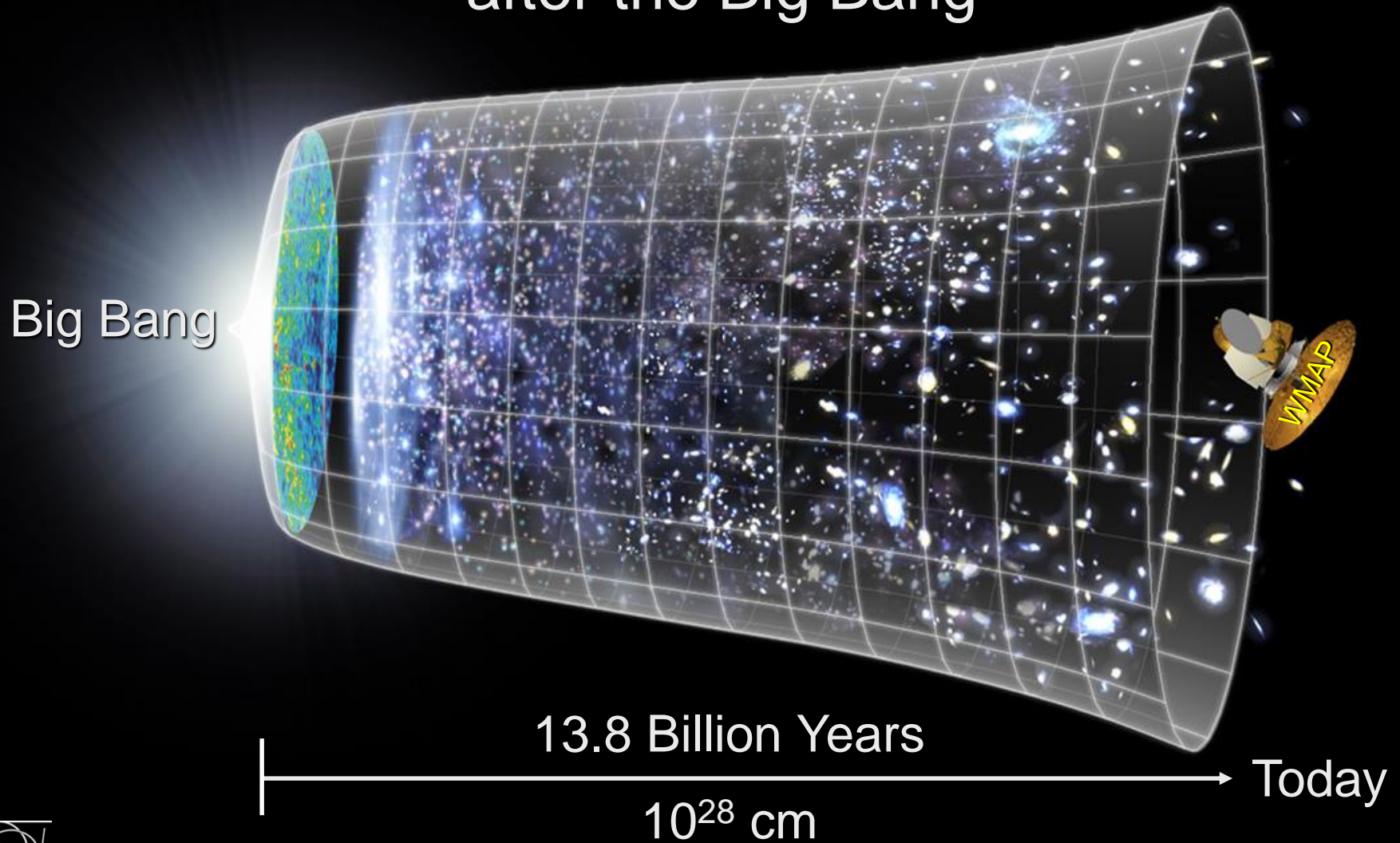
- and where they go afterwards

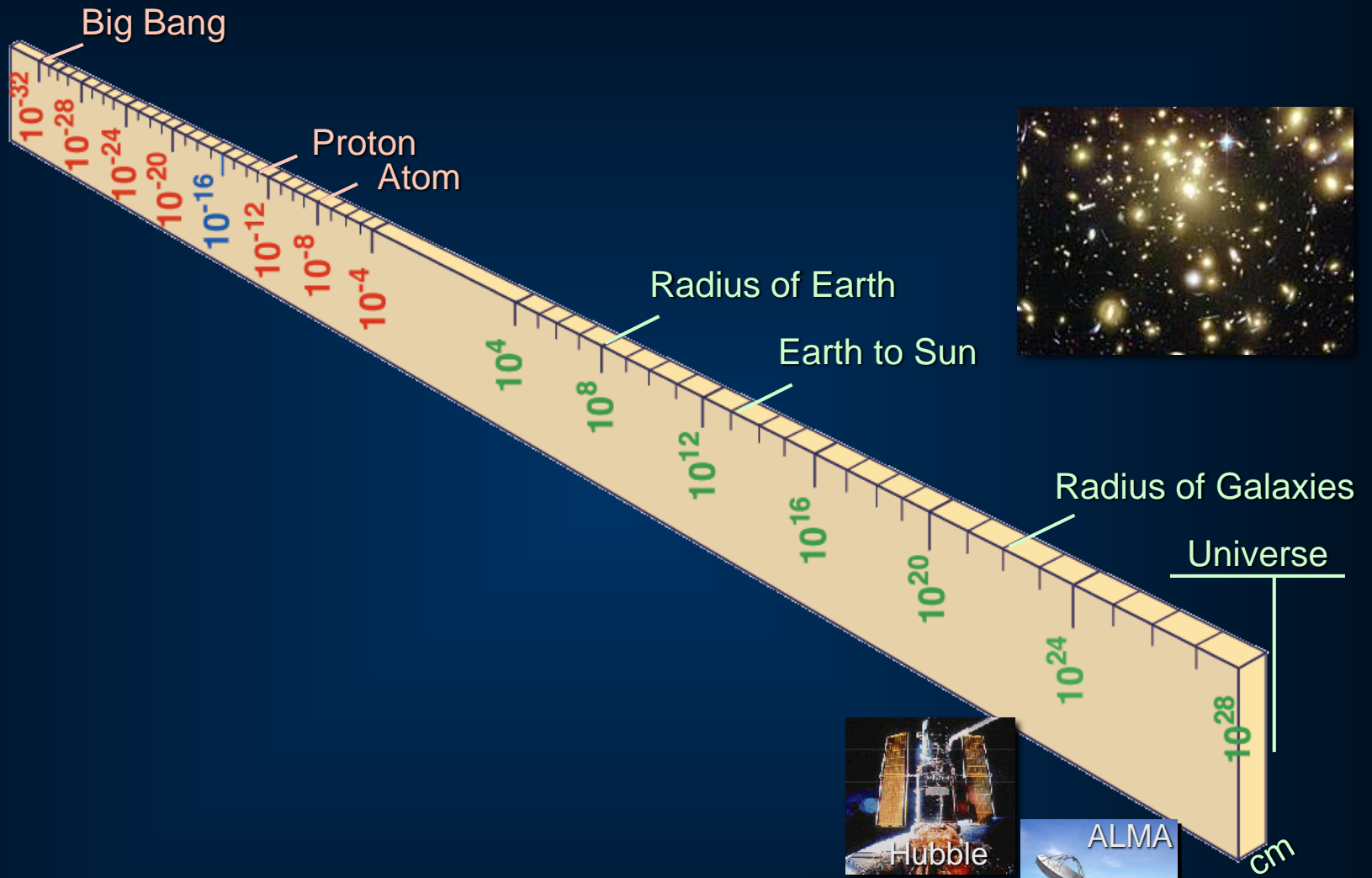


They do not all stay: where do they go?

# Next Scientific Challenge:

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

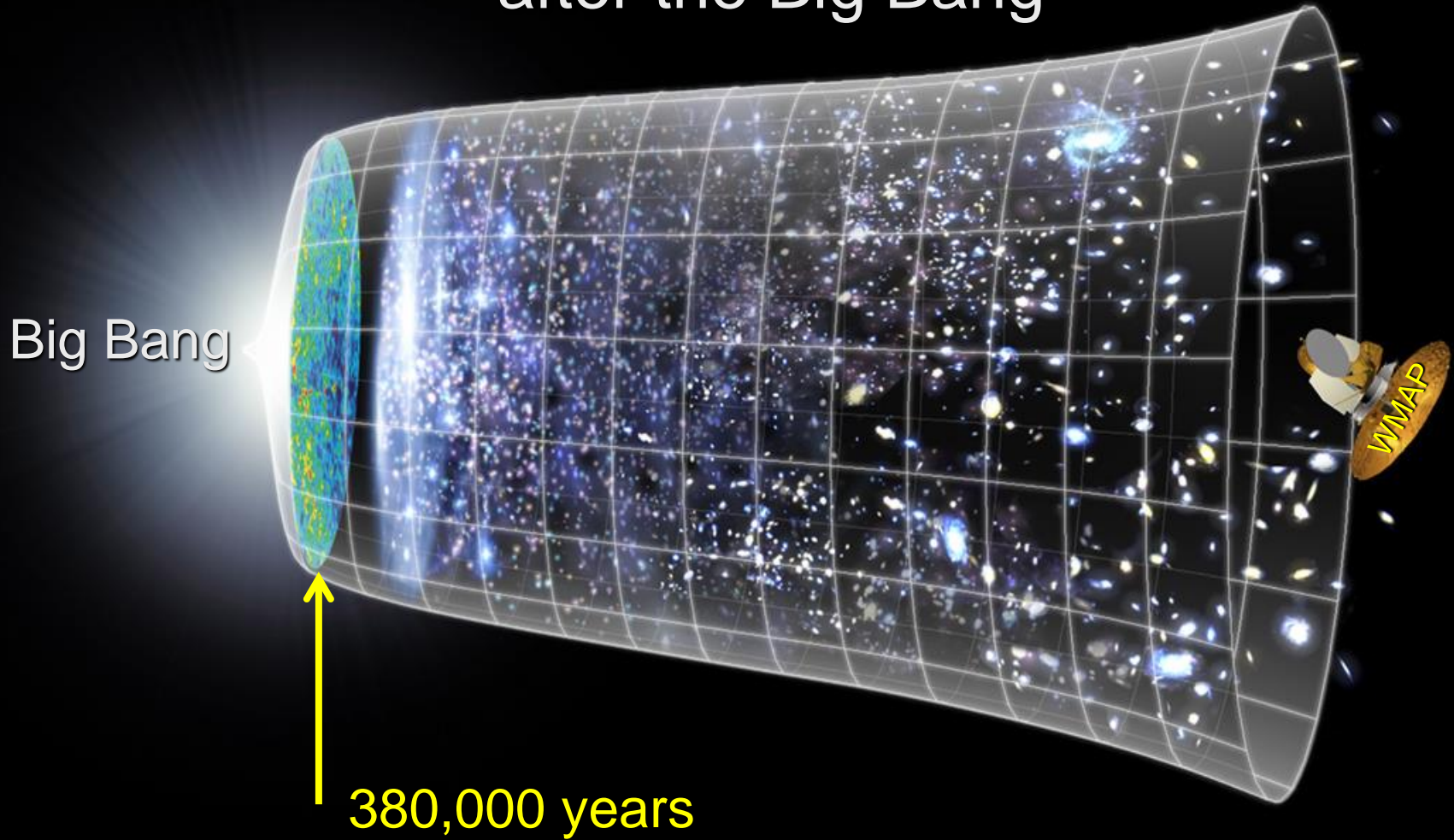


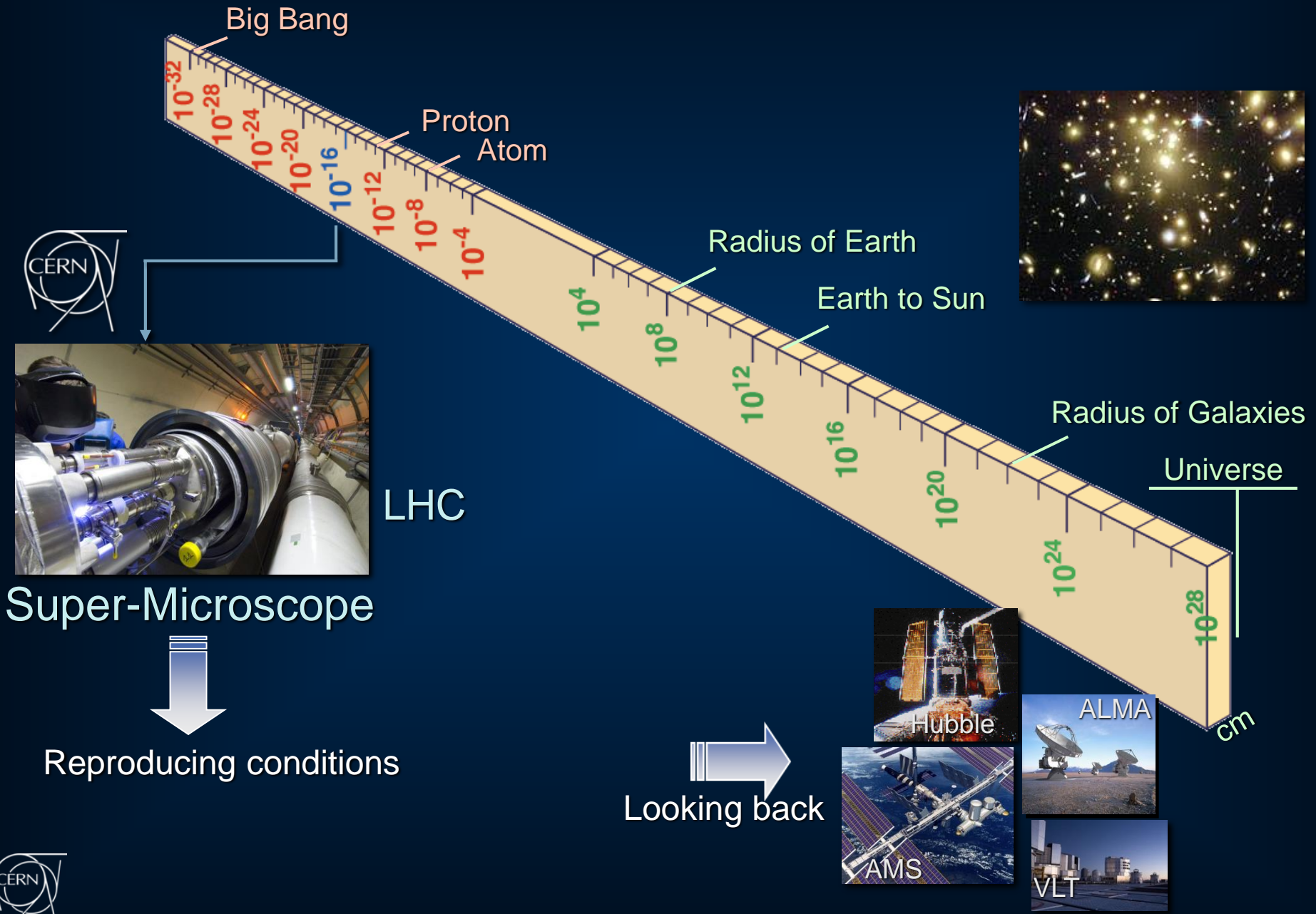




# Next Scientific Challenge:

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



# 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"*.



# CERN: Particle Physics and Innovation

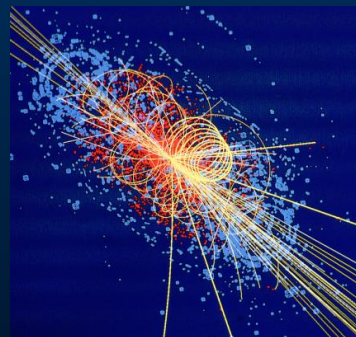
- **Interfacing** between fundamental science and key technological developments



- **CERN Technologies and Innovation**



Accelerating particle beams



Detecting particles



Large-scale computing (Grid)

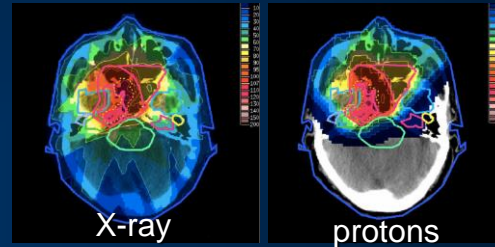
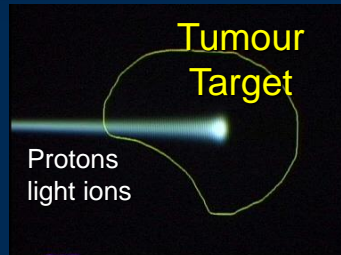
# Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer



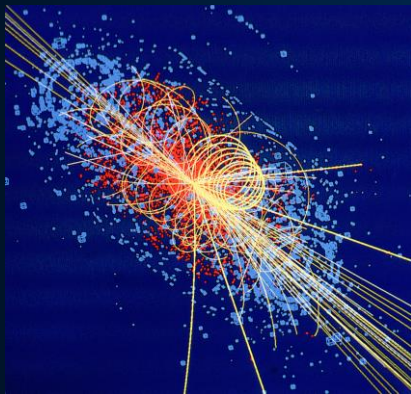
## Hadron Therapy

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)

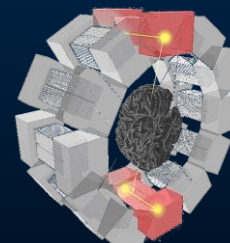


## Imaging

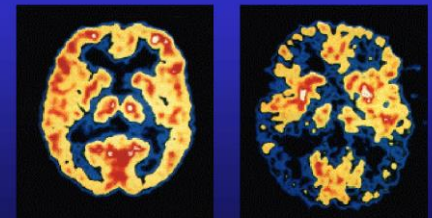
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)



## PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



Normal Brain

Alzheimer's Disease

Detecting particles

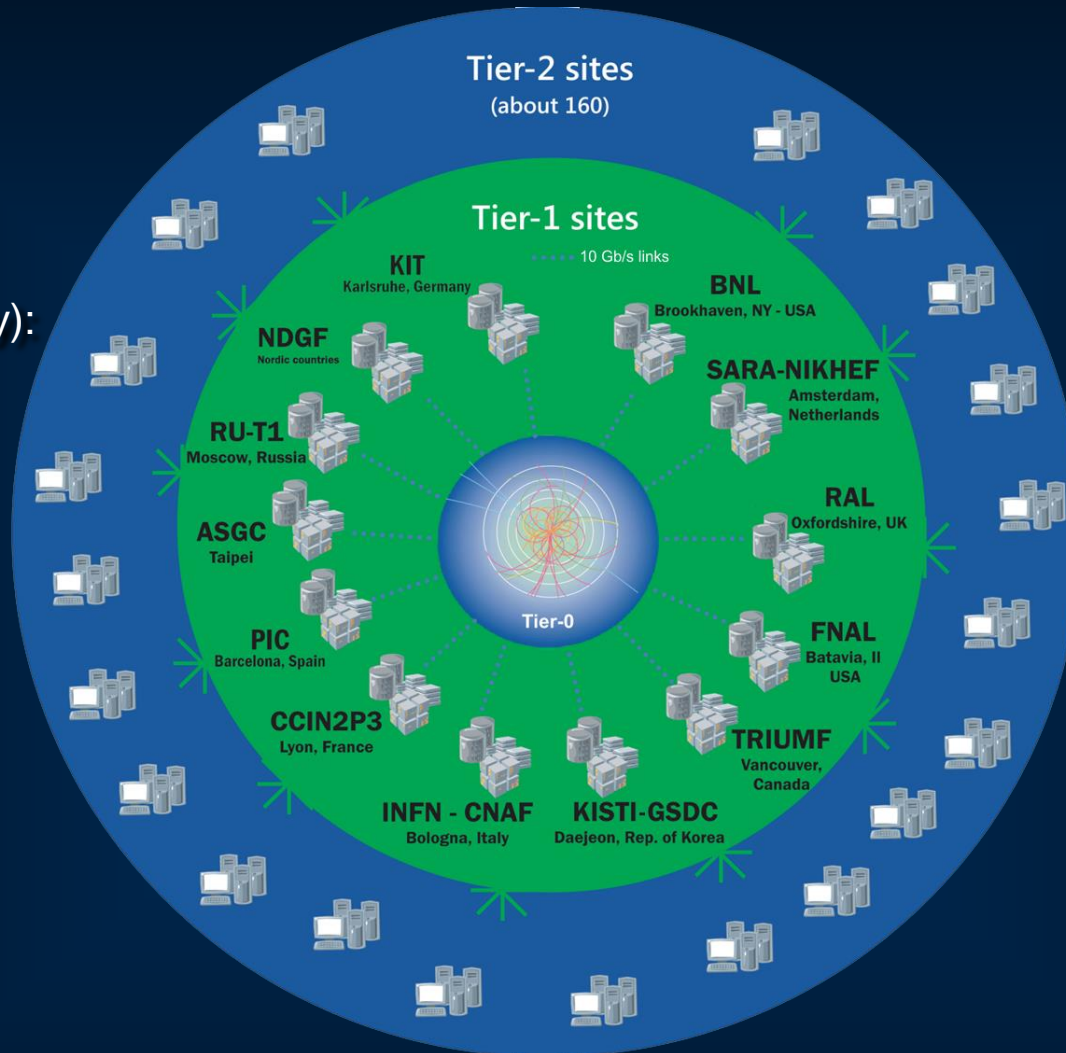


# The Worldwide LHC Computing Grid

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

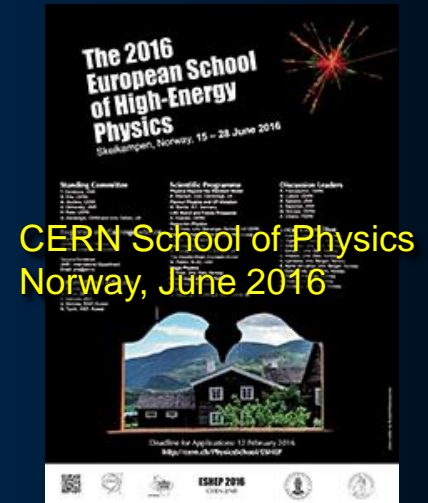
## Scientists at CERN

Academic Training Programme



## Young Researchers

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



CERN School of Physics  
Norway, June 2016

## Physics Students

Summer Students  
Programme



## CERN Teacher Schools

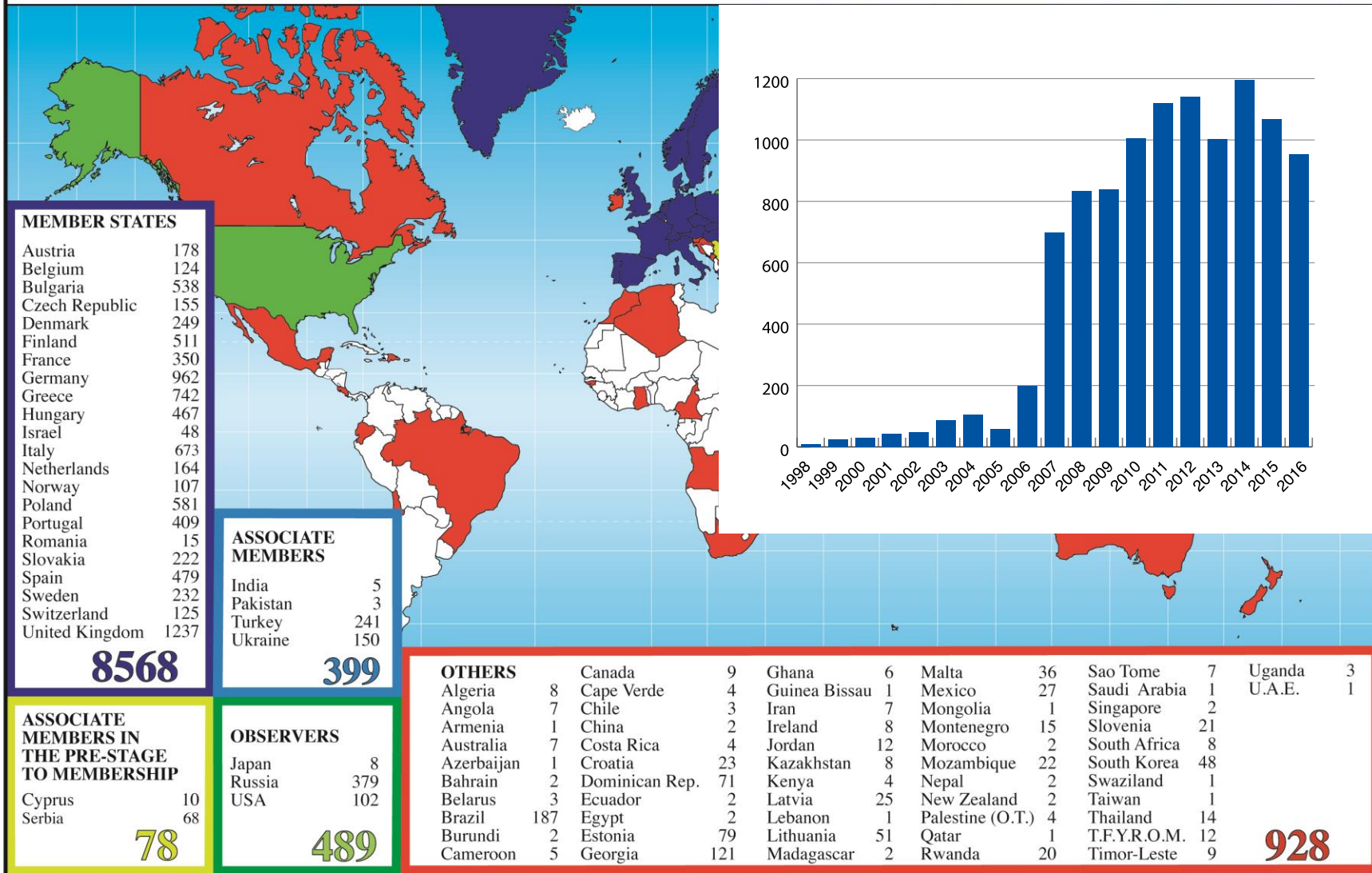
International and National  
Programmes





# CERN Teacher Programme

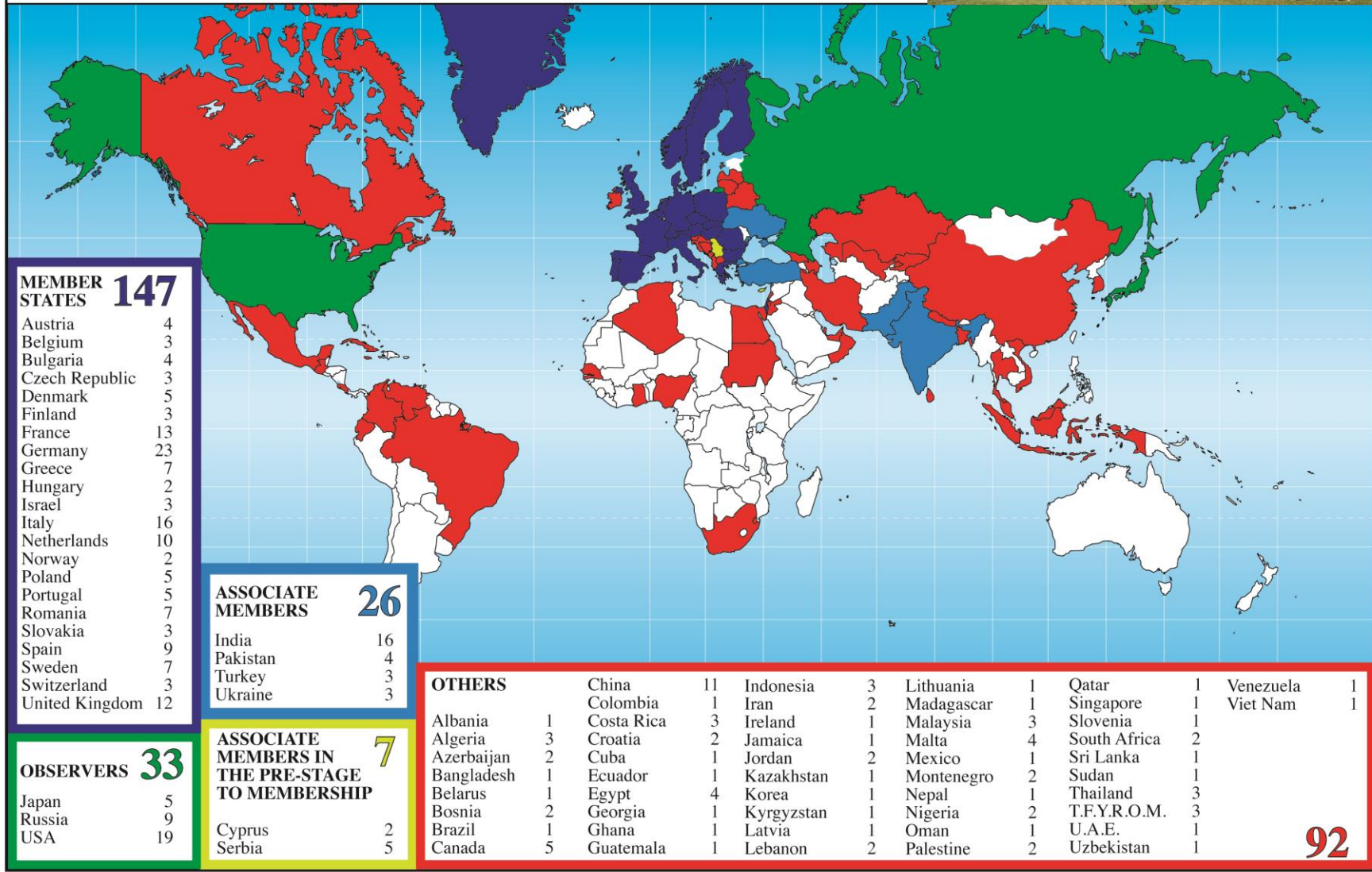
## Teacher Programme Participants 1998 - 2016 (Total: 10462)



# Summer Students 2016



## Summer Students 2016



# South Asia and CERN



- ❑ Bangladesh
  - ❑ International Co-operation Agreement
  - ❑ Participation in LHC Programme (ALICE) and ISOLDE
- ❑ India
  - ❑ Associate Member
  - ❑ Participation in LHC Programme (ALICE, CMS), Fixed-target Programme (COMPASS, ISOLDE, nTOF), Accelerator Projects (CLIC, FCC, LHC, LINAC4), WLCG
- ❑ Nepal
  - ❑ International Co-operation Agreement
- ❑ Pakistan
  - ❑ Associate Member
  - ❑ Participation in LHC Programme (ALICE, CMS), Accelerator Projects (CLIC, LINAC4), WLCG
- ❑ Sri Lanka
  - ❑ International Co-operation Agreement
  - ❑ Participation in LHC Programme (CMS)

*Launching discussions for collaboration with Afghanistan, Bhutan, Maldives, Mauritius*





Thank You!



*Accelerating Science and Innovation*