Welcome – Hoşgeldiniz

Prof. Emmanuel Tsesmelis
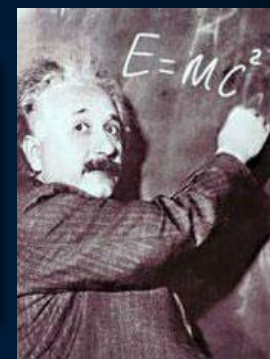Deputy Head of International Relations
CERN

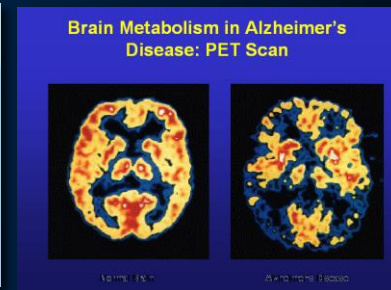*Accelerating Science and Innovation*

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?
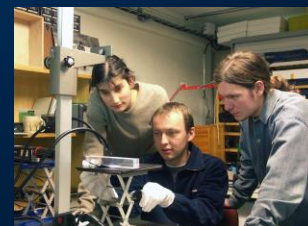
- **Develop** new technologies for accelerators and detectors

  Information technology - the Web and the GRID

  Medicine - diagnosis and therapy

- **Train** scientists and engineers of tomorrow

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

Brain Metabolism in Alzheimer's Disease: PET Scan

CERN: founded in 1954: 12 European States
"Science for Peace"
Today: 21 Member States

~ 2500 staff
~ 1300 other paid personnel
~ 12100 scientific users
Budget (2015) ~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: Pakistan, Turkey

States in accession to Membership: Romania, Serbia

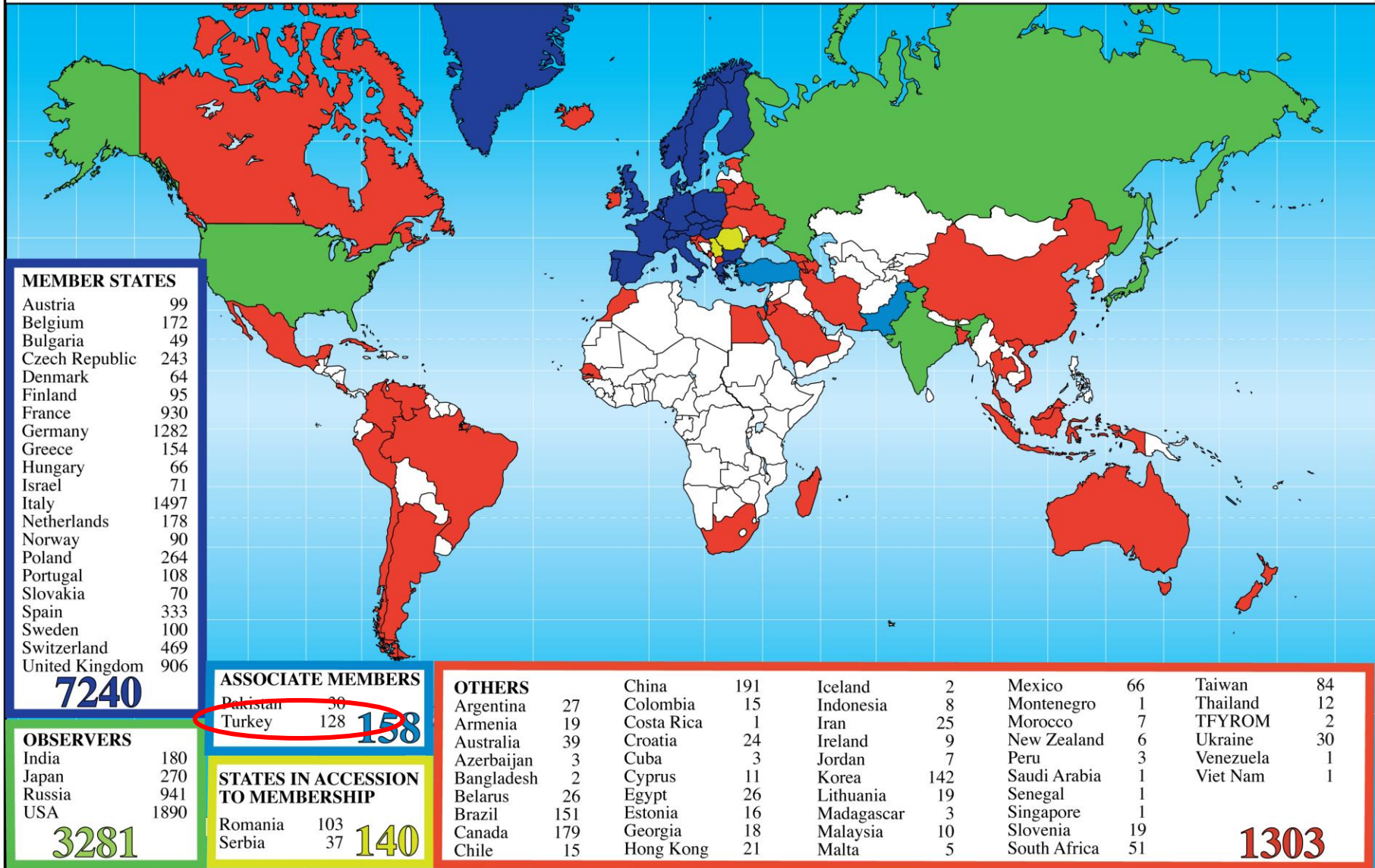**Applications for Membership or Associate Membership:**
Azerbaijan, Brazil, Croatia, Cyprus, India Russia, Slovenia, Ukraine

Observers to Council: India, Japan, Russia, United States of America; European Union, JINR and UNESCO
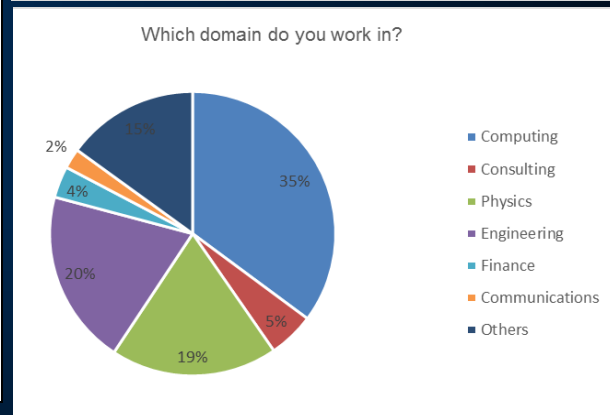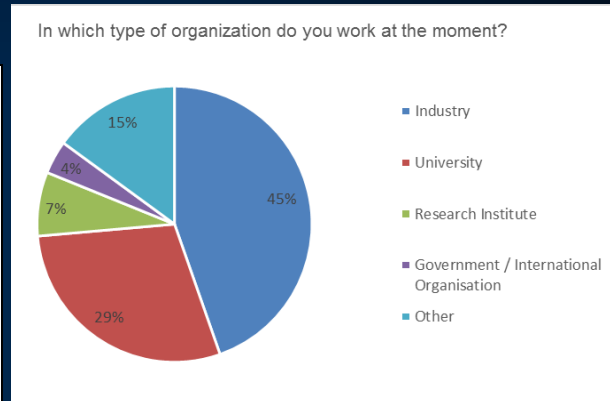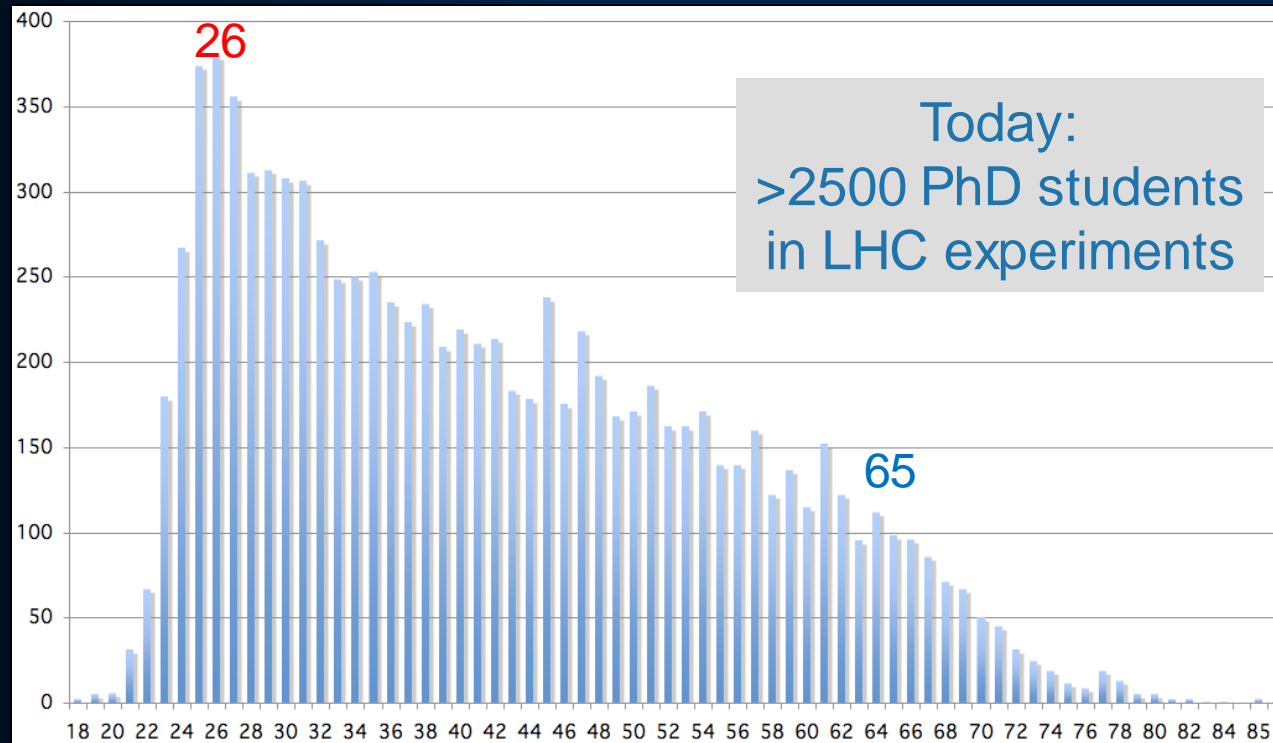
Science is getting more and more global

Distribution of All CERN Users by Location of Institute on 21 September 2015

MEMBER STATES

Austria	99
Belgium	172
Bulgaria	49
Czech Republic	243
Denmark	64
Finland	95
France	930
Germany	1282
Greece	154
Hungary	66
Israel	71
Italy	1497
Netherlands	178
Norway	90
Poland	264
Portugal	108
Slovakia	70
Spain	333
Sweden	100
Switzerland	469
United Kingdom	906

7240

OBSERVERS

India	180
Japan	270
Russia	941
USA	1890

3281

ASSOCIATE MEMBERS

Pakistan	30
Turkey	128

158

STATES IN ACCESSION TO MEMBERSHIP

Romania	103
Serbia	37

140

OTHERS

Argentina	27	China	191	Iceland	2	Mexico	66
Armenia	19	Colombia	15	Indonesia	8	Montenegro	1
Australia	39	Costa Rica	1	Iran	25	Morocco	7
Azerbaijan	3	Croatia	24	Ireland	9	New Zealand	6
Bangladesh	2	Cuba	3	Jordan	7	Peru	3
Belarus	26	Cyprus	11	Korea	142	Saudi Arabia	1
Brazil	151	Egypt	26	Lithuania	19	Senegal	1
Canada	179	Estonia	16	Madagascar	3	Singapore	1
Chile	15	Georgia	18	Malaysia	10	Slovenia	19
		Hong Kong	21	Malta	5	South Africa	51

Taiwan	84
Thailand	12
TFYROM	2
Ukraine	30
Venezuela	1
Viet Nam	1

1303

Age Distribution of Scientists
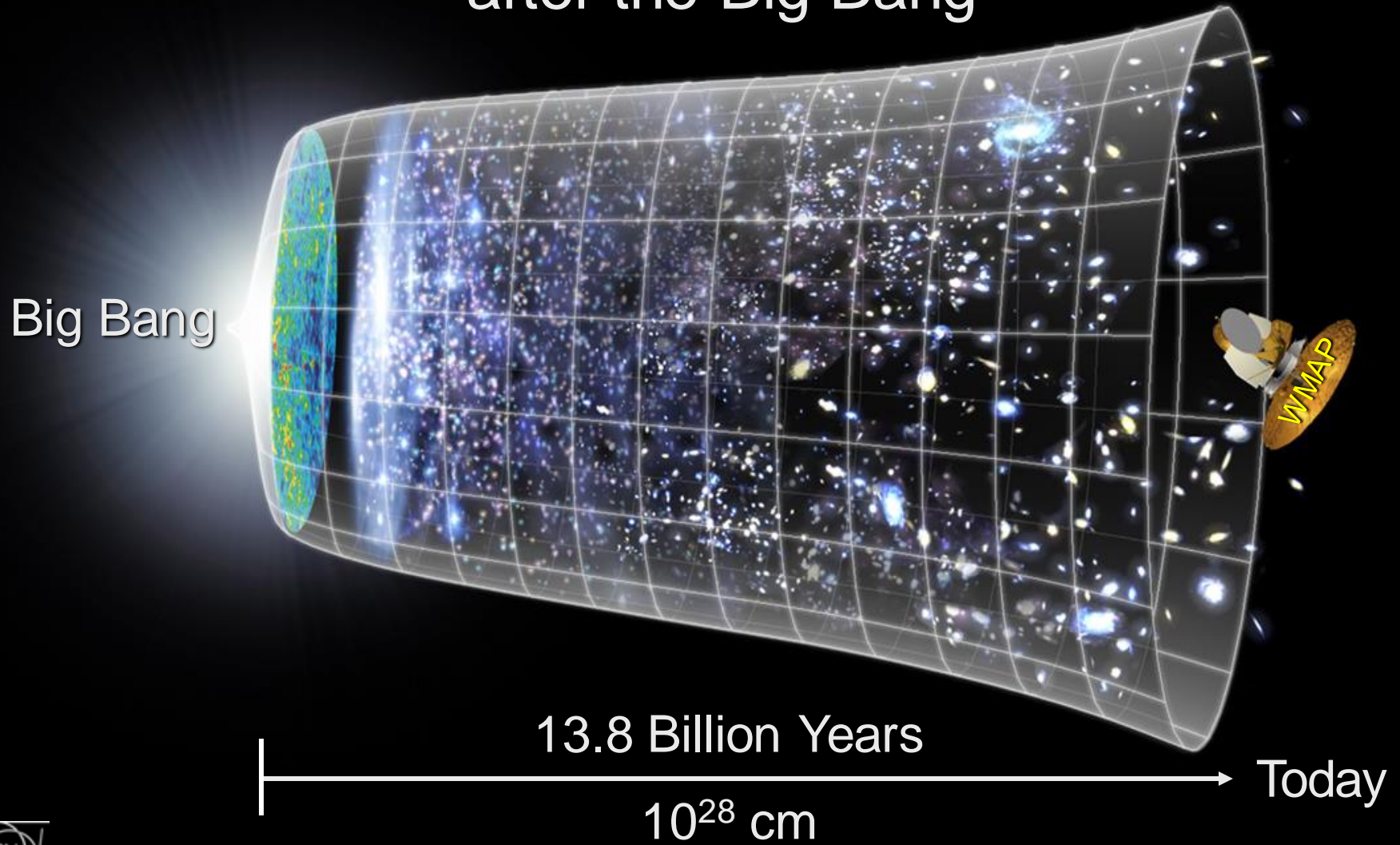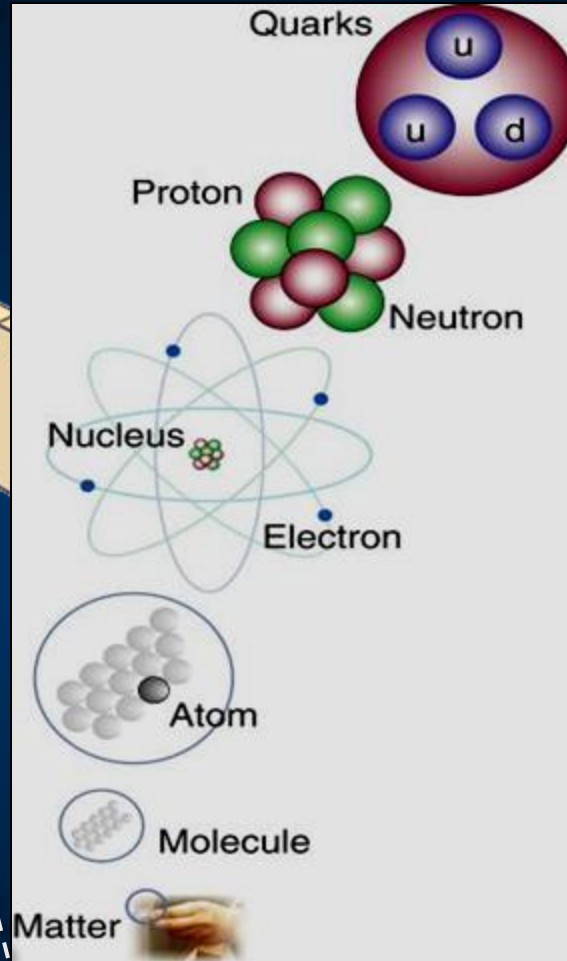## - and where they go afterwards
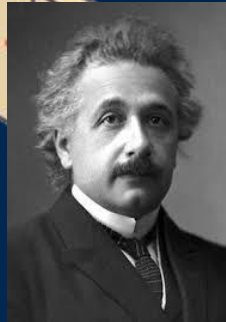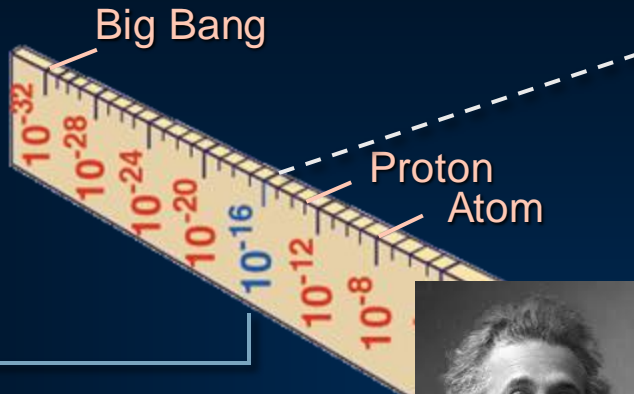

Today:
>2500 PhD students
in LHC experiments

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

Big Bang

WMAP

13.8 Billion Years

10^{28} cm

Today

Big Bang

Proton
Atom

Quarks

Proton

Neutron

Nucleus

Electron

Atom

Molecule

Matter

Radius of Galaxies

Universe
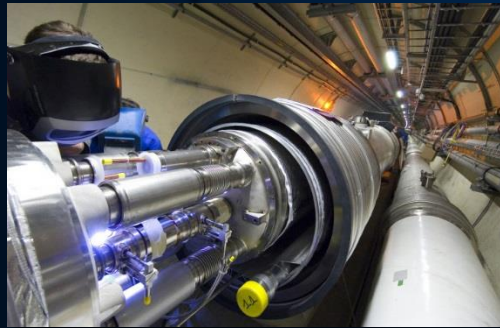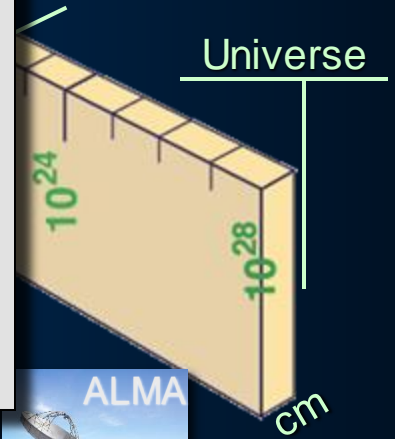
LHC

Super-Microscope

Study physics laws of first moments after Big Bang increasing Symbiosis between Particle Physics, Astrophysics and Cosmology

ALMA

AMS

VLT

2010: a New Era in Fundamental Science

LHCb

ATLAS

CMS

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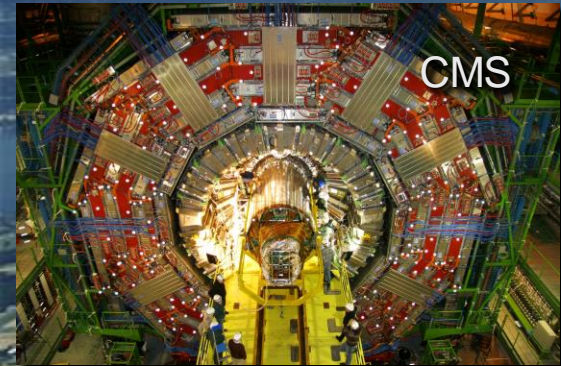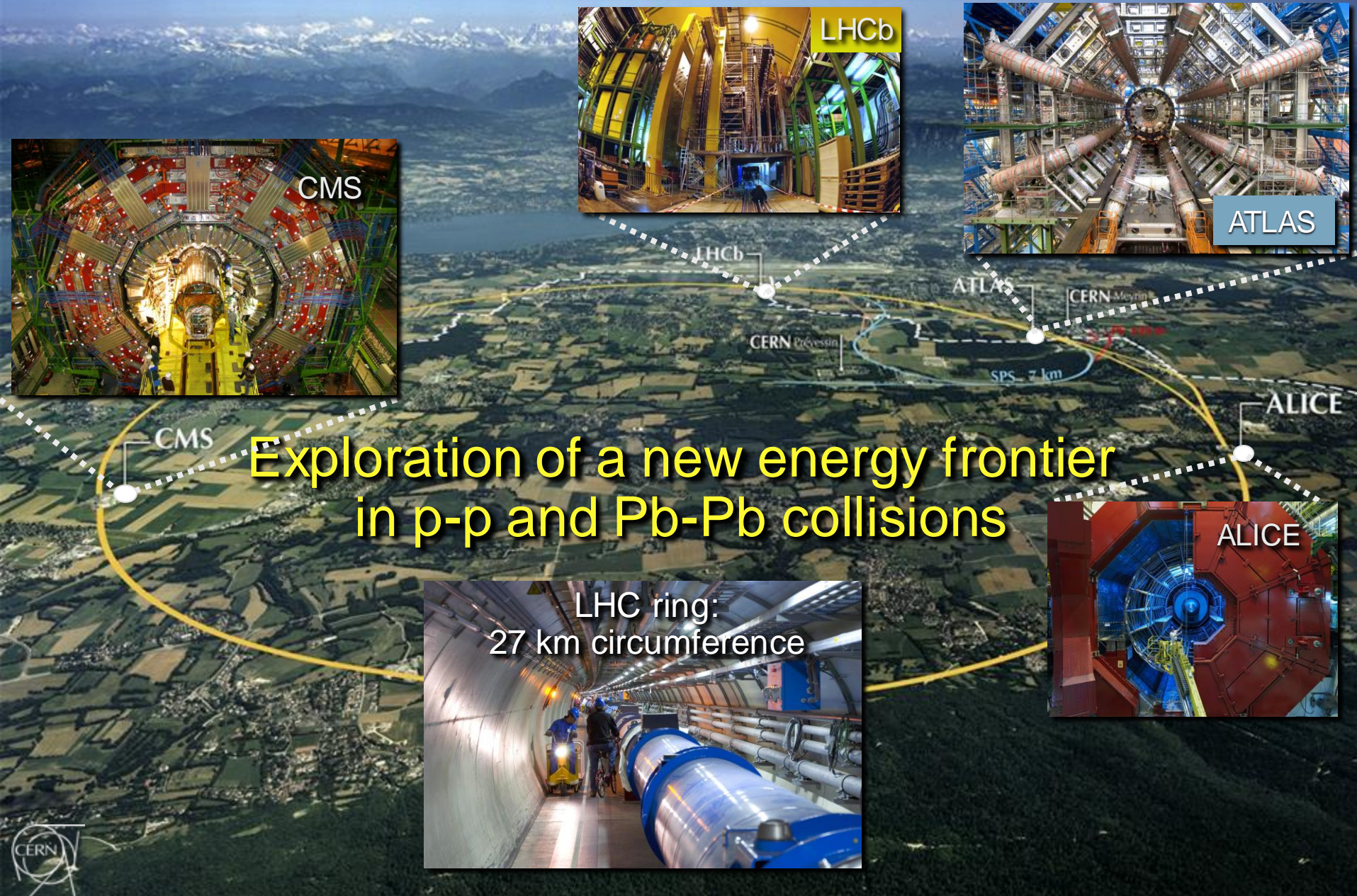
Exploration of a new energy frontier
in p-p and Pb-Pb collisions

LHC ring:
27 km circumference

Nobel Prize in Physics 2013

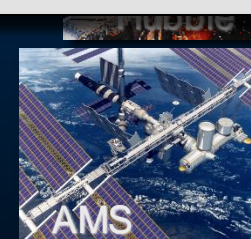The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs *"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental 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

Tumour Target

Protons light ions

X-ray

protons

Leadership in Ion Beam Therapy now in Europe and Japan

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

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

Imaging

PET Scanner

Brain Metabolism in Alzheimer's Disease: PET Scan
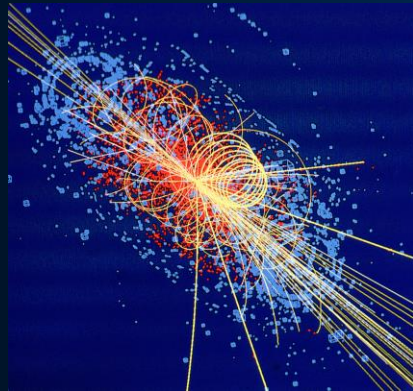
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)
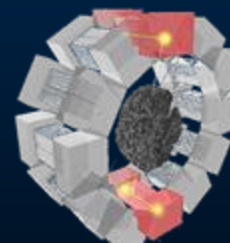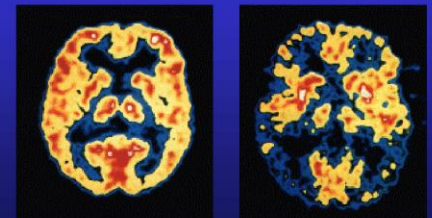
Detecting particles

The Worldwide LHC Computing Grid

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

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

Tier-2: Simulation, end-user analysis

Tier-2 sites (about 160)

Tier-1 sites

10 Gb/s links

KIT Karlsruhe, Germany

BNL Brookhaven, NY - USA

NDGF Nordic countries

SARA-NIKHEF Amsterdam, Netherlands

RU-T1 Moscow, Russia

RAL Oxfordshire, UK

ASGC Taipei

Tier-0

FNAL Batavia, Il USA

PIC Barcelona, Spain

CCIN2P3 Lyon, France

TRIUMF Vancouver, Canada

INFN - CNAF Bologna, Italy

KISTI-GSDC Daejeon, Rep. of Korea
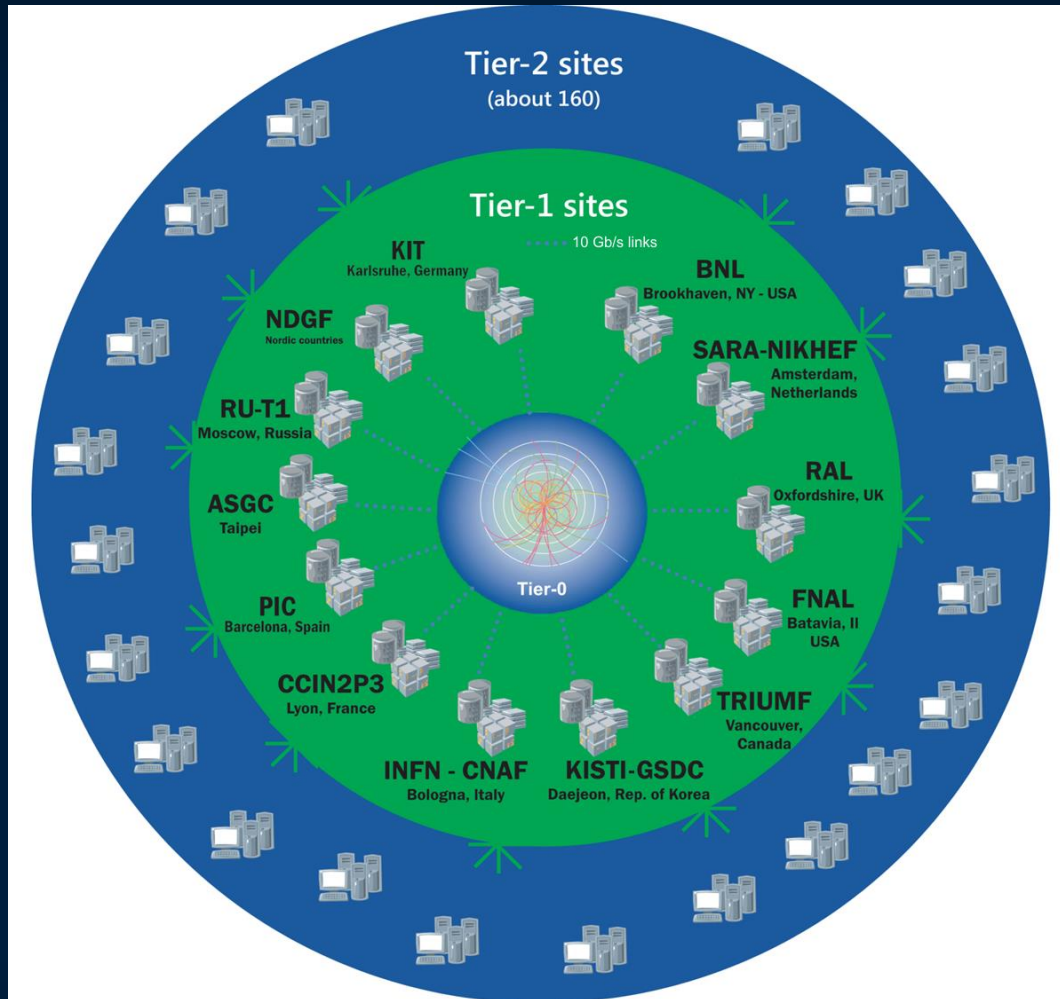
Nearly 170 sites, 40 countries

~350'000 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

Asia-Europe-Pacific School of High-Energy Physics

Fukuoka, Japan, 2012
Puri, India, 2014
China, 2016

Latin American School of High-Energy Physics

Natal, Brazil, 2011
Arequipa, Peru, 2013
Ibarra, Ecuador, 2015

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

The 2014 European School of High-Energy Physics
CERN School of Physics
Bulgaria, June 2015

Physics Students
Summer Students Programme

CERN Teacher Schools
International and National Programmes

CERN

CERN Teacher Programme

Teacher Programme Participants 1998 - 2014   (Total: 8430)

Bar chart: Teacher Programme Participants by year (1998–2014), values rising from near 0 in 1998 to approximately 200 in 2006, ~700 in 2007, ~830 in 2008, ~840 in 2009, ~1000 in 2010, ~1120 in 2011, ~1140 in 2012, ~970 in 2013, ~1200 in 2014.

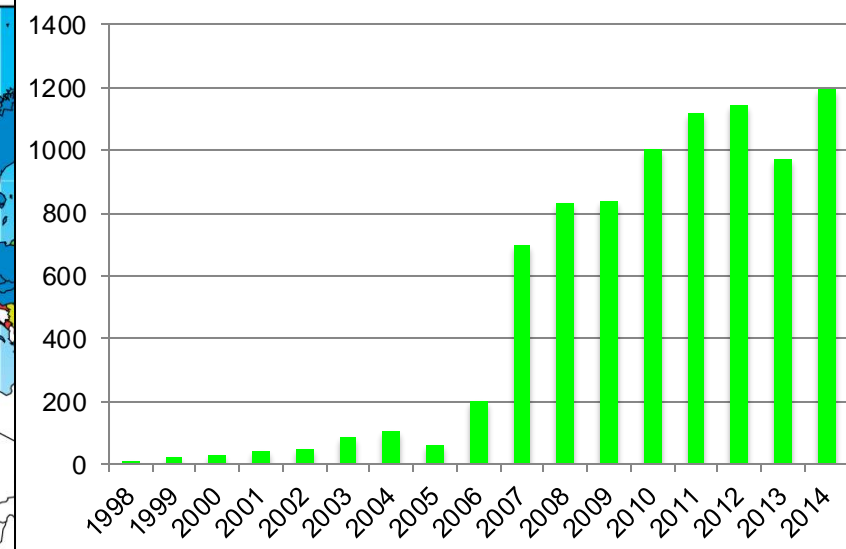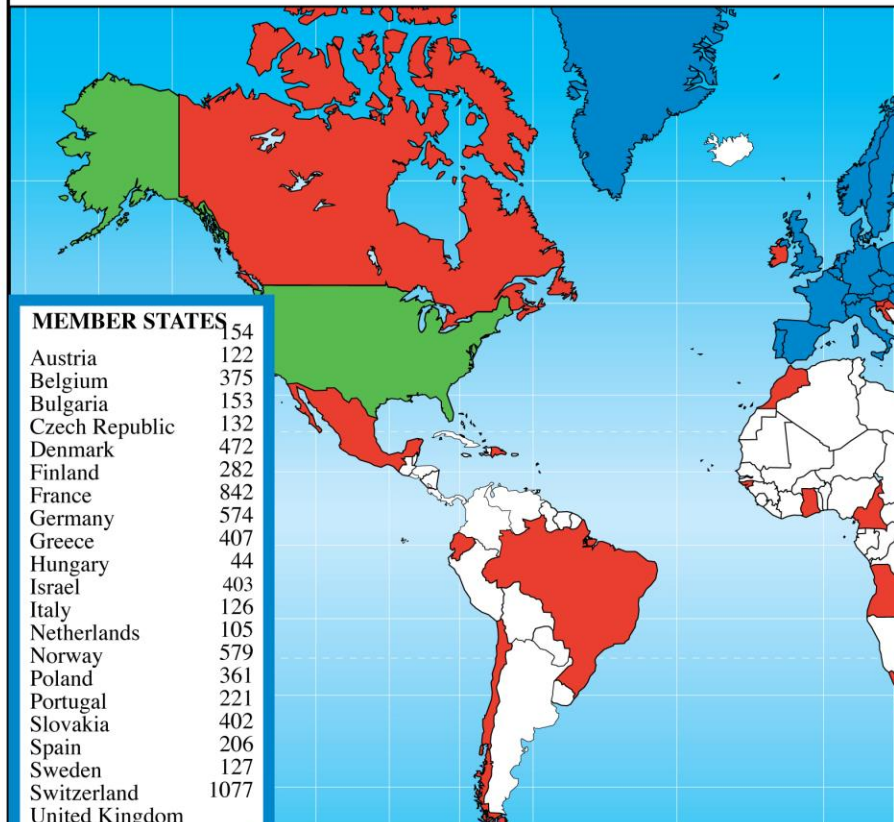| MEMBER STATES	
	54
Austria	122
Belgium	375
Bulgaria	153
Czech Republic	132
Denmark	472
Finland	282
France	842
Germany	574
Greece	407
Hungary	44
Israel	403
Italy	126
Netherlands	105
Norway	579
Poland	361
Portugal	221
Slovakia	402
Spain	206
Sweden	127
Switzerland	1077
United Kingdom	

7164

OBSERVER STATES	
India	3
Japan	6
Russia	279
Turkey	74
U.S.A.	92

454

CANDIDATE FOR ACCESSION	
Romania	13
Serbia	47

60

OTHERS								
Angola	7	Chile	3	Ireland	7	Montenegro	13	Slovenia	21
Armenia	1	China	2	Jordan	11	Morocco	2	South Africa	6
Australia	6	Croatia	2	Kazakhstan	5	Mozambique	19	South Korea	48
Azerbaijan	1	Cyprus	8	Kenya	4	Nepal	1	Swaziland	1
Belarus	2	Dominican Rep.	24	Latvia	1	New Zealand	1	Thailand	10
Brazil	144	Ecuador	2	Lebanon	1	Palestine (O.T.)	1	T.F.Y.R.O.M.	11
Burundi	2	Estonia	54	Lithuania	16	Qatar	1	Timor-Leste	7
Cameroon	4	Georgia	88	Madagascar	2	Rwanda	20	Uganda	3
Canada	7	Ghana	6	Malta	36	Sao Tome	5	Ukraine	113
Cape Verde	4	Guinea Bissau	1	Mexico	10	Saudi Arabia	1	U.A.E.	1
		Iran	3	Mongolia	1	Singapore	2		

752

CERN

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 MEMBER

Turkey	7

CANDIDATES FOR ACCESSION 9

Romania	6
Serbia	3

OTHERS 105

Albania	2	Brunei	2	Egypt	2	Kazakhstan	1
Algeria	4	Burundi	1	Estonia	2	Korea, South	1
Argentina	3	Canada	3	Georgia	1	Latvia	1
Armenia	1	China	12	Ghana	1	Lebanon	3
Azerbaijan	1	Colombia	1	Gibraltar	1	Lithuania	2
Bangladesh	1	Costa Rica	2	Indonesia	1	Malaysia	3
Belarus	1	Croatia	2	Iran	2	Malta	4
Bosnia	1	Cuba	1	Iraq	1	Mexico	1
Brazil	2	Cyprus	1	Ireland	1	Mongolia	2
		Ecuador	1	Jordan	1	Montenegro	1

|			
Nepal	1	Slovenia	1
Nigeria	1	South Africa	2
Oman	1	Sri Lanka	1
Pakistan	8	Sudan	1
Palestine	1	Thailand	3
Peru	1	T.F.Y.R.O.M.	3
Philippines	1	Ukraine	1
Puerto Rico	1	Venezuela	1
Qatar	1		
Singapore	2		

CERN

Turkey and CERN

- ❑ Turkey had Observer Status at CERN since 1961
- ❑ International Cooperation Agreement signed in 2008
- ❑ Application to join CERN made in 2009
- ❑ Turkey became an Associate Member State on 6 May 2015

Involvements of Turkish Physicists in CERN Programme

- ❑ Participation in experiments at CERN:
  - ✧ LHC: ATLAS and CMS
  - ✧ non-LHC: involvements in OPERA, ISOLDE, CAST
- ❑ Collaboration in advanced accelerator R&D for CLIC

CMS
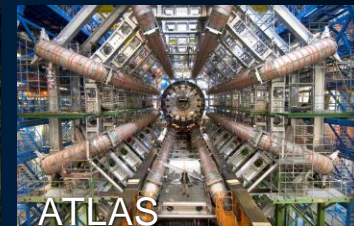
ATLAS

Turkey and CERN

Strong involvement in the LHC experiments ATLAS and CMS

ATLAS
2 Institutions
Ankara University[1]
Bogazici University[2]

Contribution to the Inner Detector
(TRT)

Innovative technologies
developed

CMS
3 Institutes
Cukurova University, Adana
Middle-East Technical
                University, Ankara
Bogazici Univerity, Istanbul

Mechanics for forward hadron
calorimeter

[1] includes also physicists from Dumlupinar University, Gazi University, TOBB University of Economy
   and Technology, TAEA Ankara
[2] includes also physicists from Dogus University Istanbul, Gaziantep University, Istanbul Technical Univ.

Thank You!
Teşekkürler !

Accelerating Science and Innovation