## Welcome - Bem-vindo

His Excellency Professor Manuel Heitor

Minister of Science, Technology and Higher, Education

And

Professor Eurico Brilliante sps. z km

CMS Secretary of State of Internationalization (SE-Int, MNE)

And

Professor Helena Pereira

President of Foundation for Science and Technology (MCTES-FCT)

Portuguese Republic

LHC 27 km



Accelerating Science and Innovation



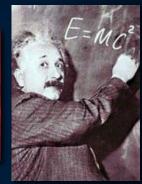
## The Mission of CERN

Research

Push back the frontiers of knowledge

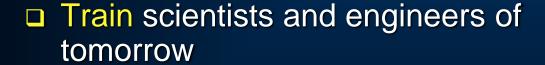
E.g. the secrets of the Big Bang ...what was the matter like within the first moments of the Universe's existence?

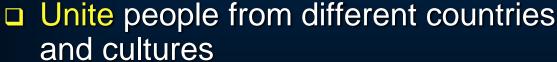




 Develop new technologies for accelerators and detectors

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

















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



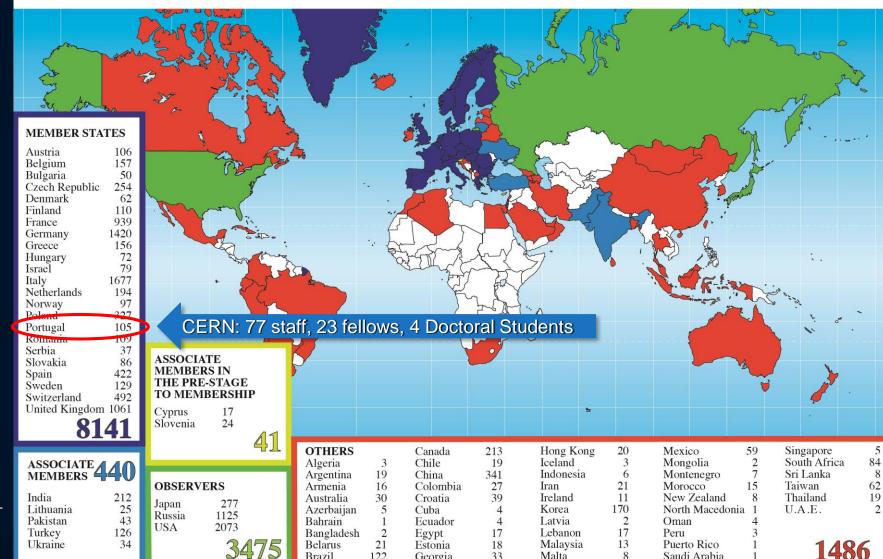
Associate Members in the Pre-Stage to Membership: Cyprus, Slovenia Associate Member States: India, Lithuania, Pakistan, Turkey, Ukraine Applications for Membership or Associate Membership: Brazil, Croatia, Estonia

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



### Science is getting more and more global

#### Distribution of All CERN Users by Location of Institute as of mid-April 2019



Brazil

122

Georgia

33

Malta

Saudi Arabia



### Science is getting more and more global

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

A som	- Alex	_
	TO C	
MEMBER STAT		ľ
	8066	
Austria	119	Ì
Belgium	120	
Bulgaria	86	
Czech Republic	233	
Denmark	62	ı
Finland	96	
France	864	
Germany	1344	
Greece	238	ı
Hungary	79	
Israel	65	
Italy	2105	
Netherlands	180	
Norway	70	
Doland	356	
Portugal	121	1
Romania	137	
Serbia	55	
Slovakia	137	
Spain	472	
Sweden	99	
Switzerland	229	
United Kingdom	799	

ASSOCIATE MEMBERS							
India	387	778					
Lithuania	39						
Pakistan	71						
Turkey	165						
Ukraine	116						

ASSOCIATE	59
MEMBERS:	
THE PRE-ST	<b>FAGE</b>
ТО МЕМВЕ	RSHIP
Cyprus	26
Cypius	20

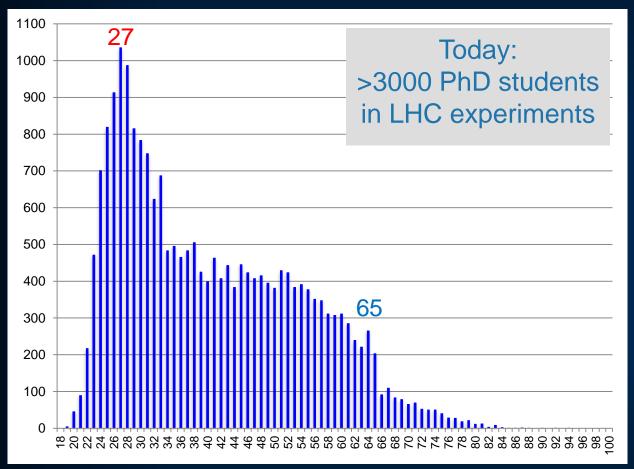
6	
7	
as l	OBSERVERS 2726  Japan 310 Russia 1205 USA 1211
78	

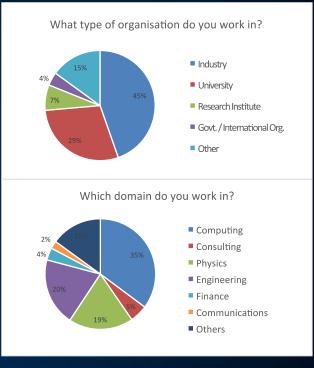
OTHERS	1999	Bolivia	3	Ecuador	10	Iraq	1	Malta	9	Palestine	7	Sudan	1
		Bosnia & Herzeg	govina 3	Egypt	27	Ireland	13	Mexico	85	Paraguay	1	Syria	1
Albania	4	Brazil	127	El Salvador	1	Jordan	2	Mongolia	2	Peru	6	Taiwan	56
Algeria	14	Burkina Faso	1	Estonia	15	Kazakhstan	10	Montenegro	11	Philippines	3	Thailand	26
Argentina	26	Burundi	1	Georgia	51	Kenya	1	Morocco	24	Saint Kitts		Tunisia	4
Armenia	22	Cameroon	1	Ghana	1	Korea	183	Myanmar	2	and Nevis	1	Uruguay	1
Australia	36	Canada	170	Guatemala	1	Kyrgyzstan	1	Nepal	7	San Marino	1	Uzbekistan	3
Azerbaijan	10	Chile	21	Hong Kong	1	Latvia	4	New Zealand	5	Saudi Arabia	4	Venezuela	9
Bahrain	1	China	576	Honduras	1	Lebanon	27	Nigeria	4	Senegal	1	Viet Nam	11
Bangladesh	8	Colombia	44	Iceland	4	Luxembourg	4	North Korea	4	Singapore	5	Zambia	1
Belarus	45	Croatia	50	Indonesia	11	Madagascar	1	North Macedonia	3	South Africa	56	Zimbabwe	2
Benin	1	Cuba	16	Iran	58	Malaysia	22	Oman	3	Sri Lanka	10		



### Age Distribution of Scientists

- and where they go afterwards



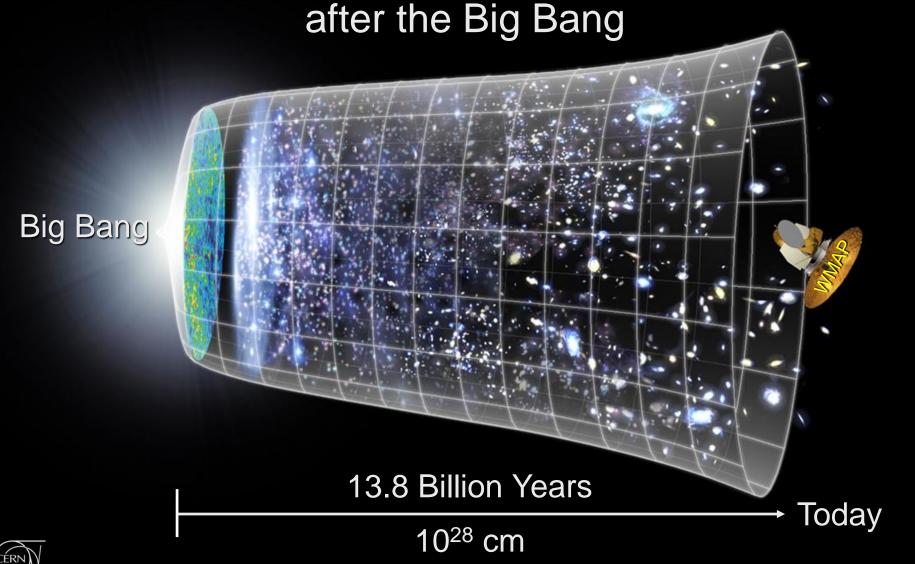


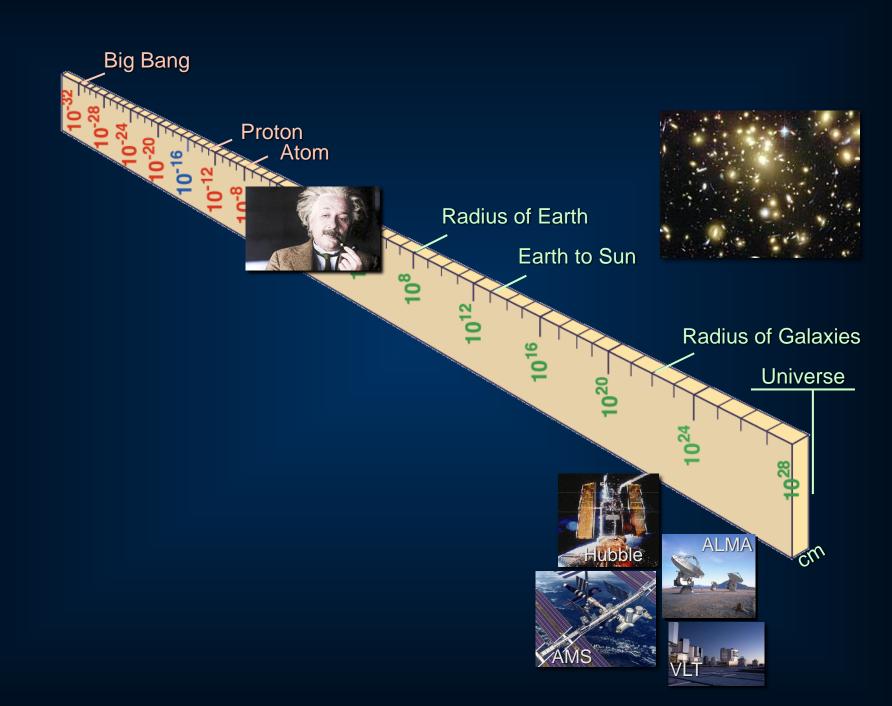
They do not all stay: where do they go?



## Our Scientific Challenge:

to understand the very first moments of our Universe

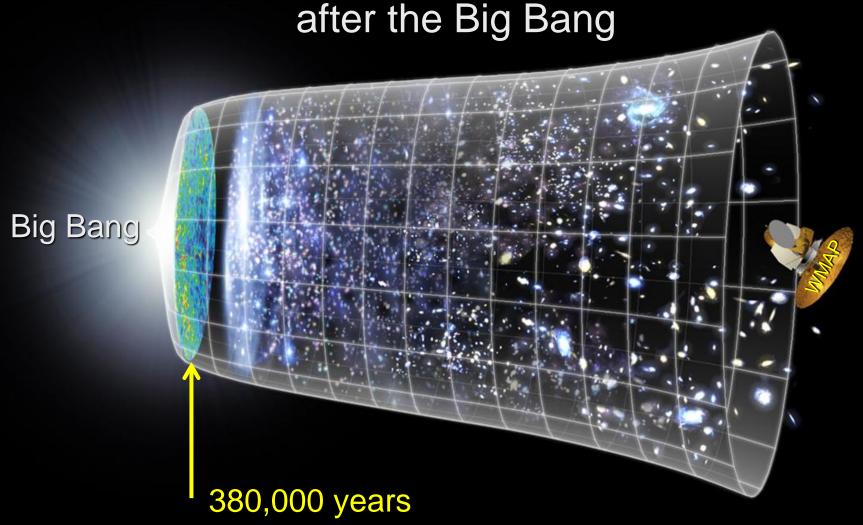




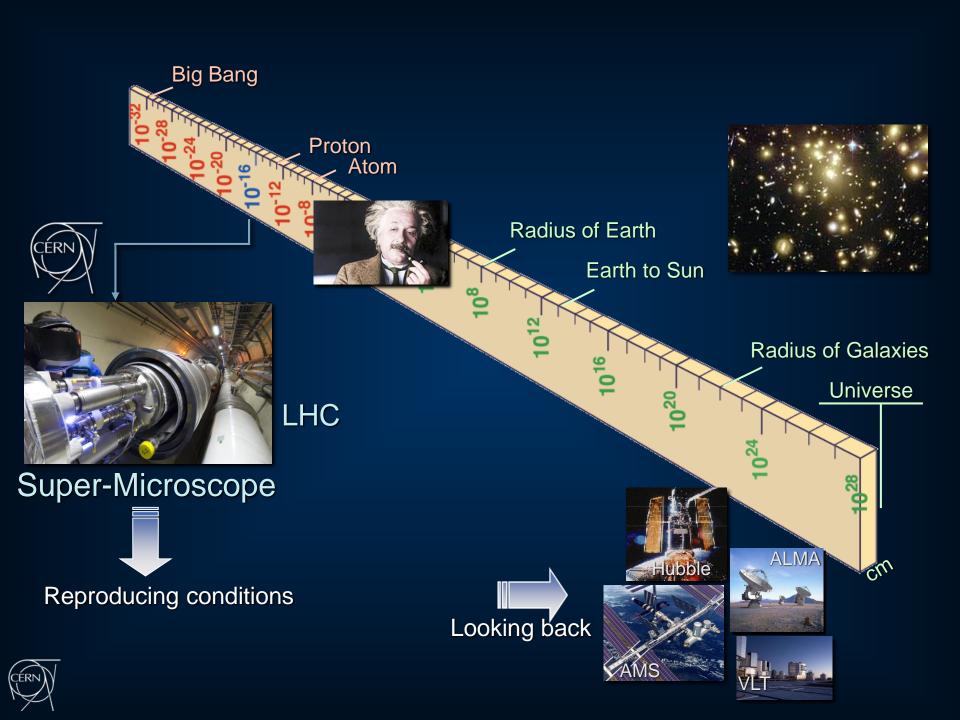


## Our Scientific Challenge:

to understand the very first moments of our Universe







## 2010: a New Era in Fundamental Science



### 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 √s up to 3 TeV

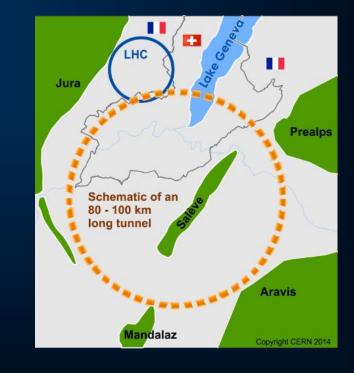


#### Future Circular Collider (FCC)

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

#### **European Strategy for Particle Physics**

Preparing next update in 2020







## **CERN: Particle Physics and Innovation**

Research

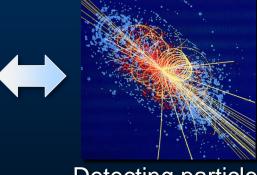
 Interfacing between fundamental science and key technological developments



CERN Technologies and Innovation



Accelerating particle beams



Detecting particles



Large-scale computing (Grid)



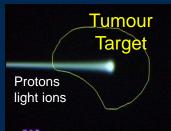
#### Medical Application as an Example of Particle Physics Spin-off

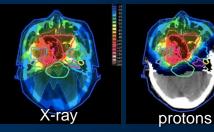
Combining Physics, ICT, Biology and Medicine to fight cancer



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)



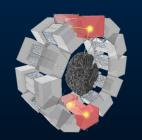
Detecting particles



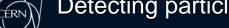
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)



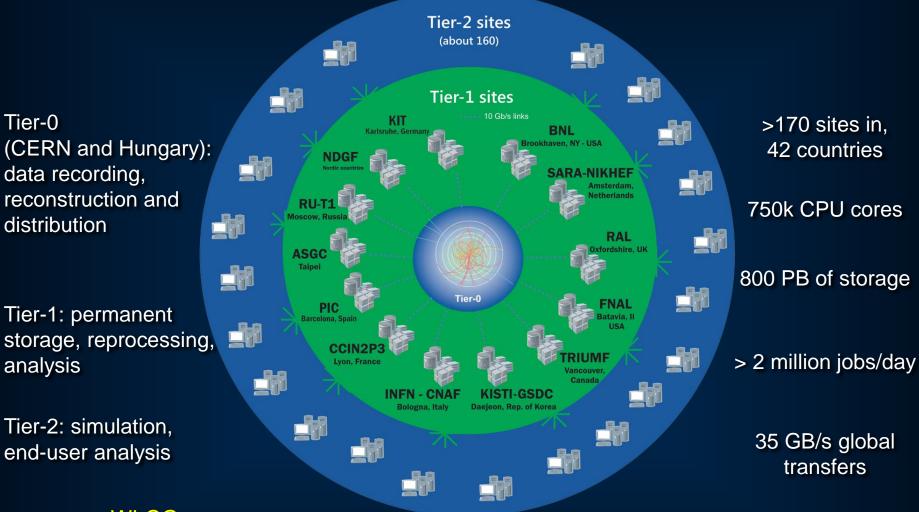
#### PET Scanner







### The Worldwide LHC Computing Grid



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

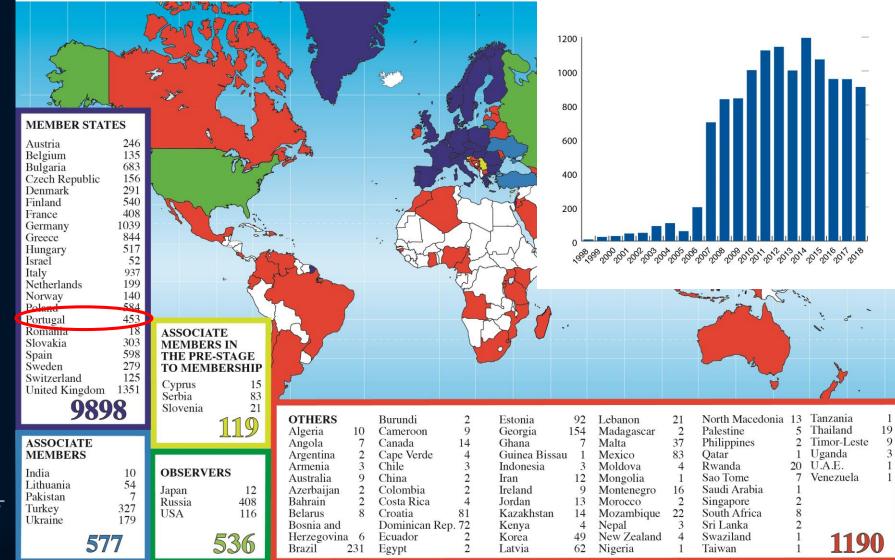
#### Public visitors

135 thousand per year



## CERN Teacher Programme

#### **Teacher Programme Participants 1998 - 2018 (Total: 12320)**





## Summer Students 2018

**Summer Students 2018** 





United Kingdom 14

India	12	OBSERVERS	3
Lithuania	3		
Pakistan	5	Japan	- 3
Turkey	1	Russia	9
Ukraine	4	USA	2

Cyprus Serbia Slovenia

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



## Portugal and CERN



- □ Portugal joined CERN as a Member State in 1986
- The Laboratório de Instrumentação e Física Experimental de Partículas (LIP) was created at the same time to carry out all activities related to experimental particle physics, involving researchers coming from universities as well as LIP's own scientific staff
- Strong participation in LHC (ATLAS, CMS) and non-LHC (CLOUD, COMPASS, ISOLDE, nTOF) programme and strong partner in the GRID
- Strong participation in R&D programmes for medical application (Clear PEM, PET consortium)
- □ Training/Education:
  - Excellent example of engineer training programme
  - Very successful teacher training and outreach programmes
- Very balanced approach between contributions at CERN and investments at home and very good industrial relations





# Contributions to the ATLAS and CMS experiments at LHC



## LIP is a member of ATLAS since 1992



Major role in the construction of the TileCal Hadron Calorimeter and Trigger/Data Acquisition system, in collaboration with industry and technology institutes



Robot for fiber insertion. 600 000 fibers inserted in Lisbon and later in Coimbra



WLS optical fibers routing. Fiber aluminization done in Lisbon

Detector Commissioning and Operation Data analysis



## LIP is a member of CMS since 1992



Major role in the construction of the Trigger and Data Acquisition of the Electromagnetic Calorimeter, in collaboration with industry and technology institutes



Detector Commissioning and Operation Data analysis



### **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.