

Welcome



Introduction to CERN

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CERN International Relations
3 December 2020



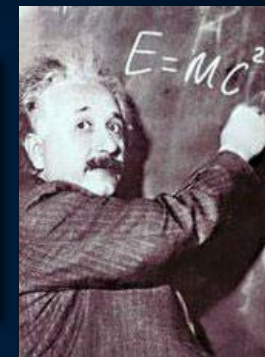
to **Accelerating Science and Innovation**



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?

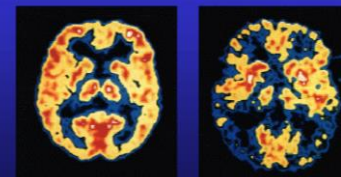


❑ Develop new technologies for accelerators and detectors

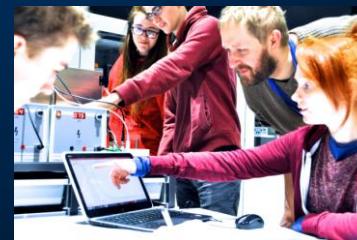
Information technology - the Web and the GRID
Medicine - diagnosis and therapy



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: 23 Member States

Employees: ~2 700 staff, 800 fellows
Associates: ~11 800 users, 1 300 others
Budget (2019) ~ 1 200 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: Croatia, India, Lithuania, Pakistan, Turkey, Ukraine

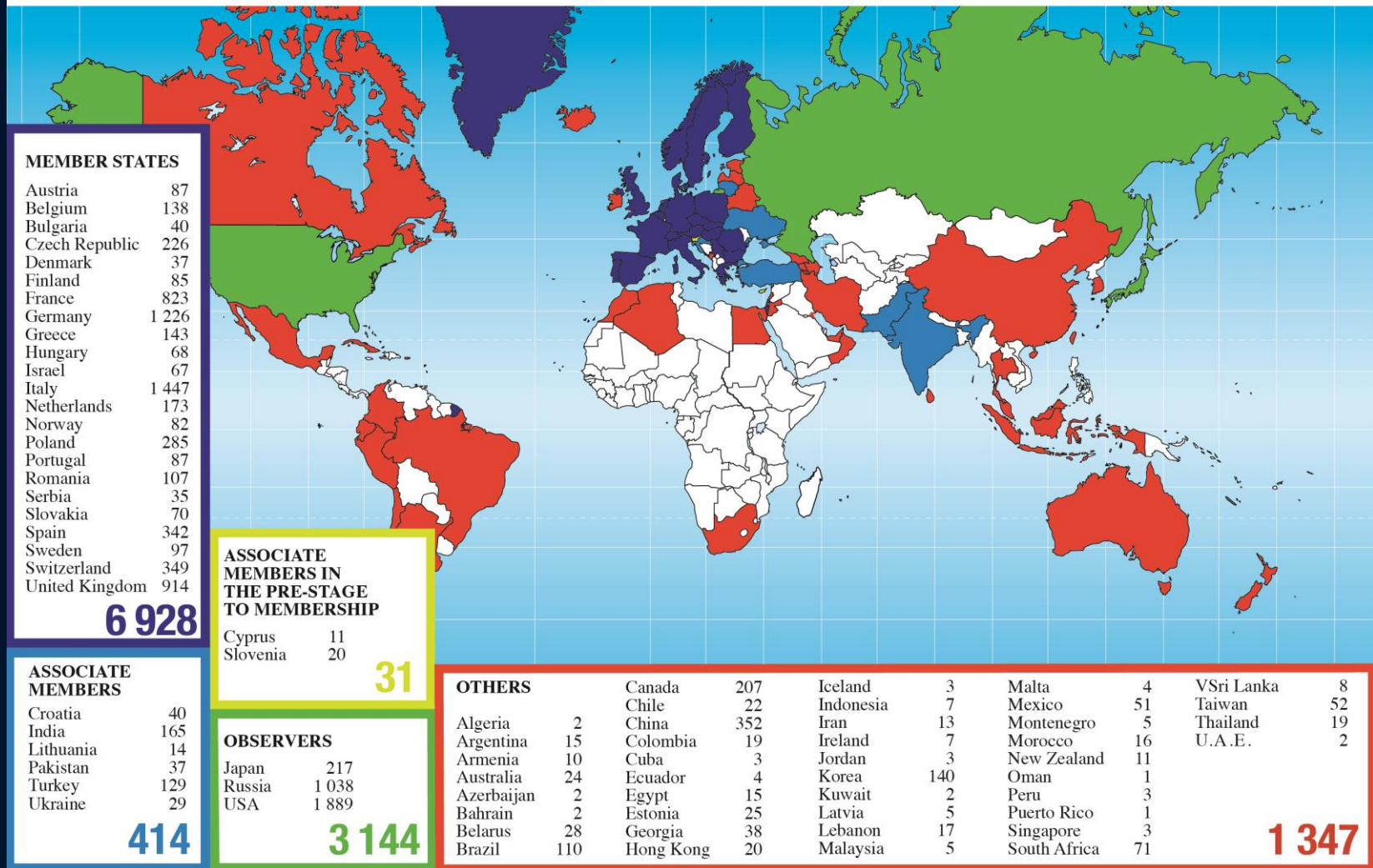
Applications for Membership or Associate Membership: Brazil, Estonia, Latvia

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



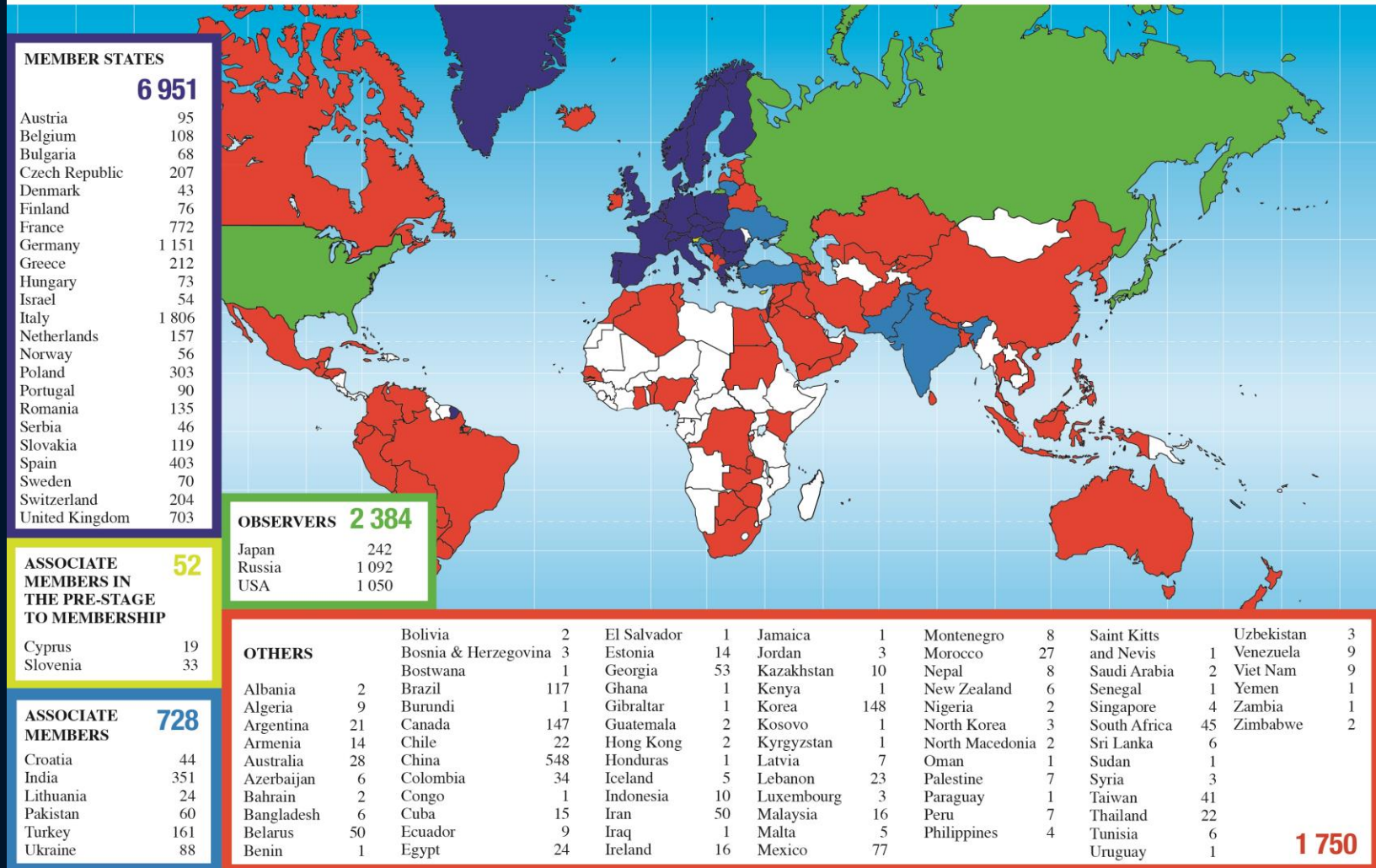
Science is getting more and more global

Distribution of All CERN Users by Location of Institute on 29 September 2020



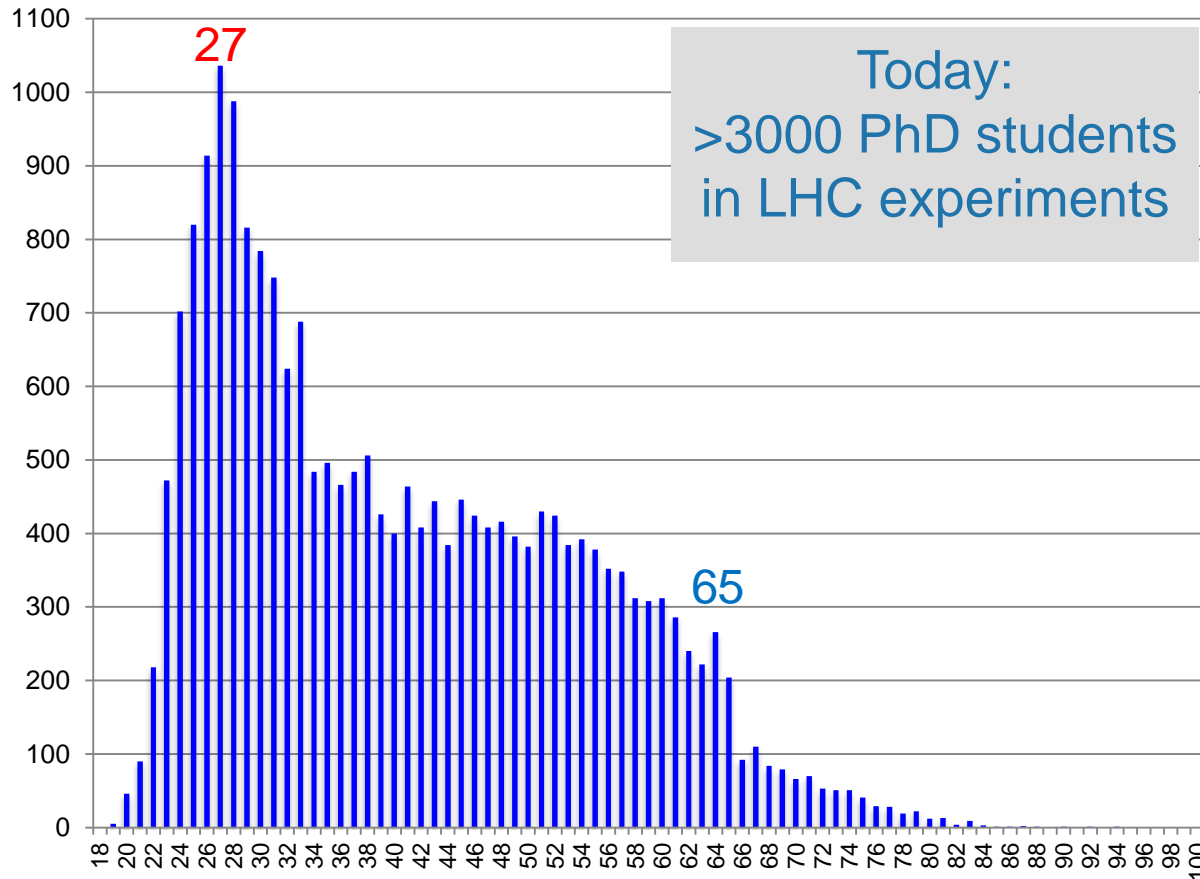
Science is getting more and more global

Distribution of All CERN Users by Nationality on 29 September 2020

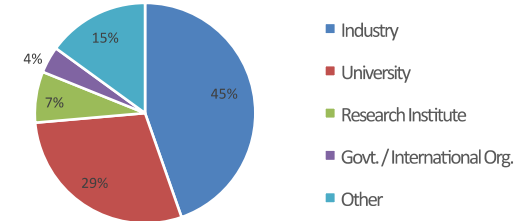


Age Distribution of Scientists

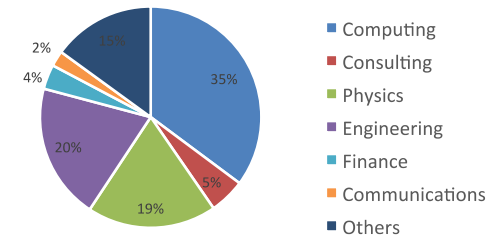
- and where they go afterwards



What type of organisation do you work in?



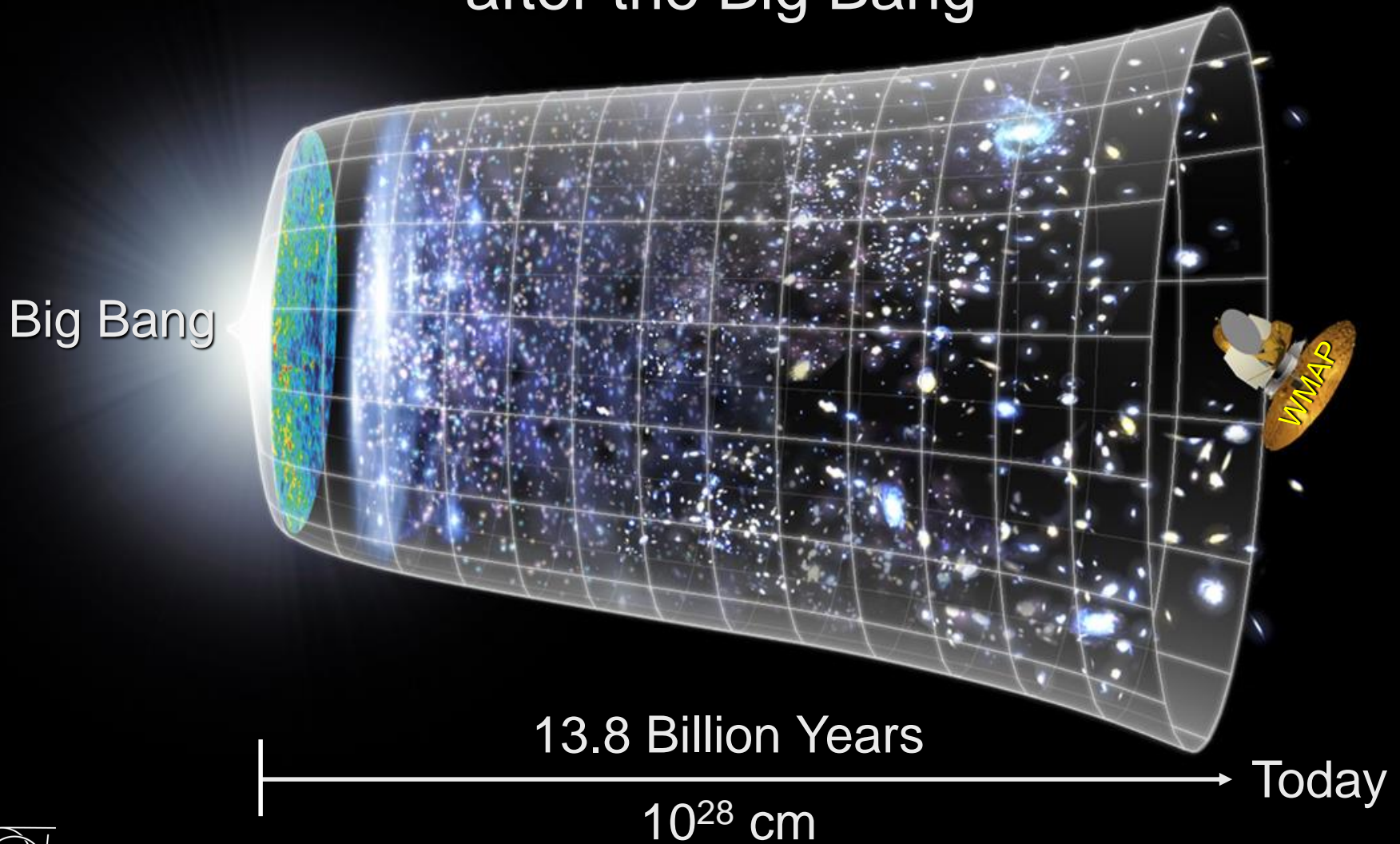
Which domain do you work in?

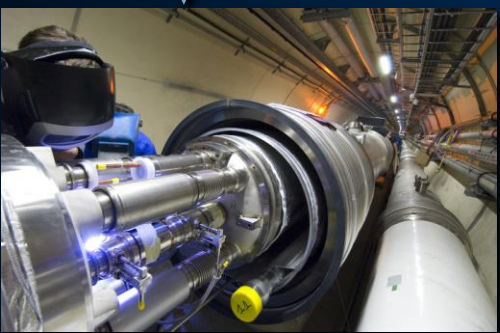
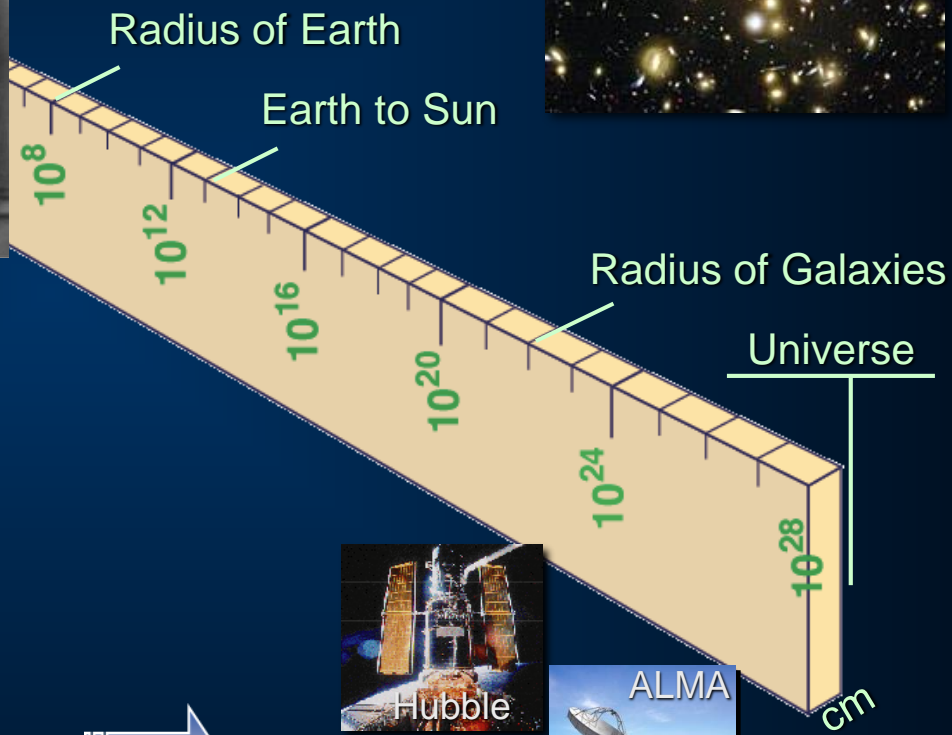
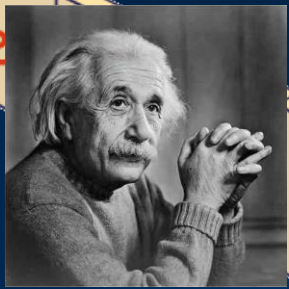
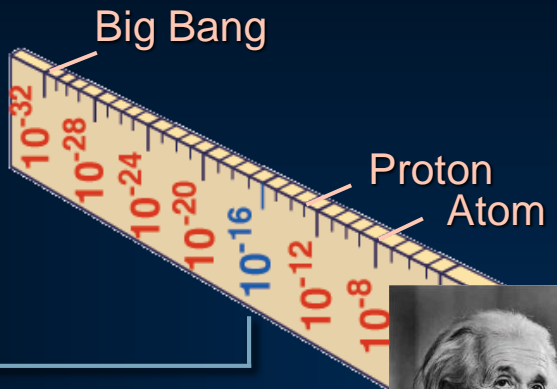


They do not all stay: where do they go?

Our Scientific Challenge:

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





LHC

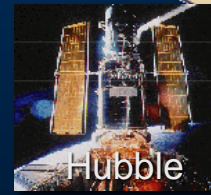
Super-Microscope



Reproducing conditions



Looking back



2010: a New Era in Fundamental Science



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

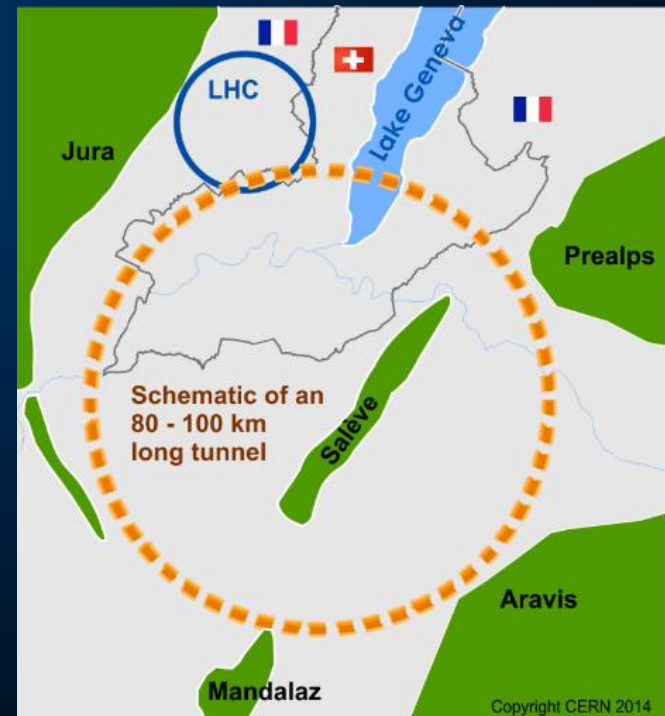
Discovery 2012, Nobel Prize in Physics 2013



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"*.

Future of Particle Physics

- **European Strategy for Particle Physics.** Road map for particle physics, updated by CERN Council in June 2020. Priorities include:
 - **Full exploitation of LHC physics potential.** Successful completion of high-luminosity upgrade of accelerators and experiments.
 - **Electron-positron Higgs factory as highest priority next collider.**
 - **Ramping up R&D on advanced accelerator technologies.**
- Investigation of feasibility of a **future 100 TeV hadron collider at CERN with electron-positron Higgs factory as possible first stage.** Prepare plan for the next strategy update (~2026).
- **Support long-baseline neutrino projects in Japan and US, and high-impact Scientific Diversity Programme,** complementary to high-energy colliders.





CERN: Particle Physics and Innovation

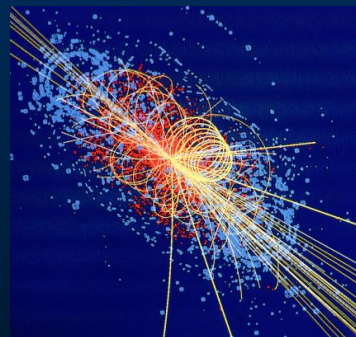
- **Interfacing** between fundamental science and key technological developments



- **CERN Technologies and Innovation**



Accelerating particle beams



Detecting particles



Large-scale computing (Grid)

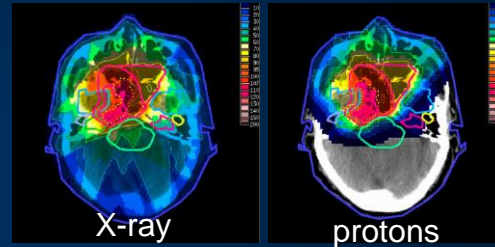
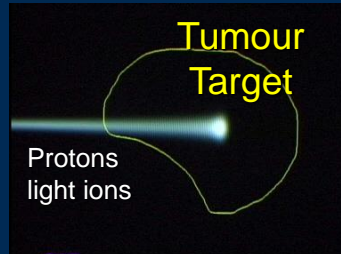
Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer



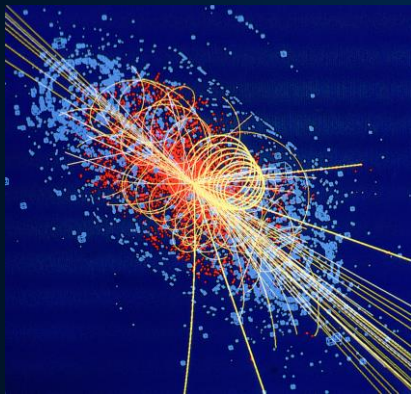
Hadron Therapy

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



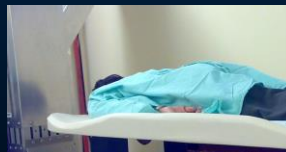
Leadership in Ion Beam Therapy now in Europe and Japan

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

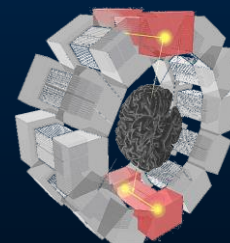


Imaging

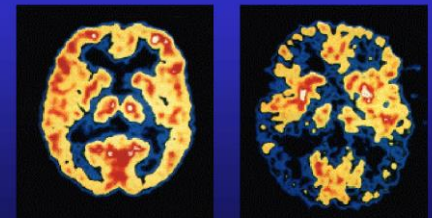
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)



PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



Normal Brain Alzheimer's Disease



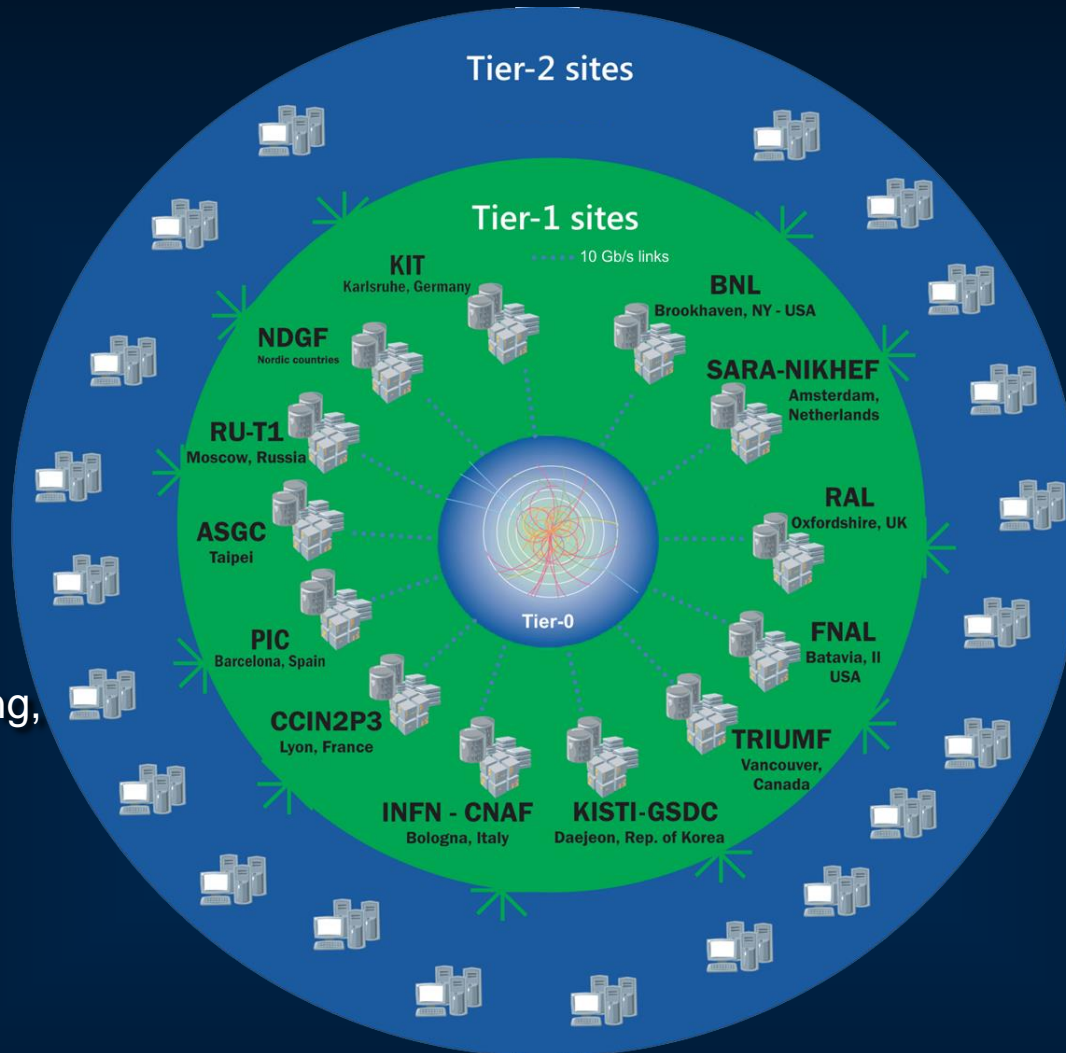
Detecting particles

The Worldwide LHC Computing Grid

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

Tier-1: permanent
storage, reprocessing,
analysis

Tier-2: simulation,
end-user analysis



~ 170 sites in
> 40 countries

1 million CPU cores

1000 PB of storage

> 2 million jobs/day

50 GB/s global
transfers

WLCG:

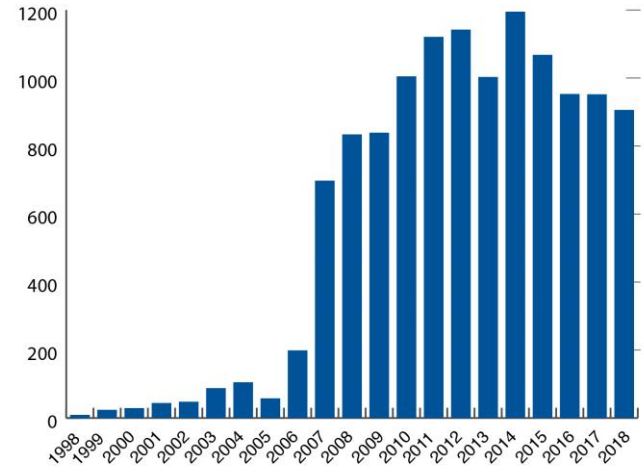
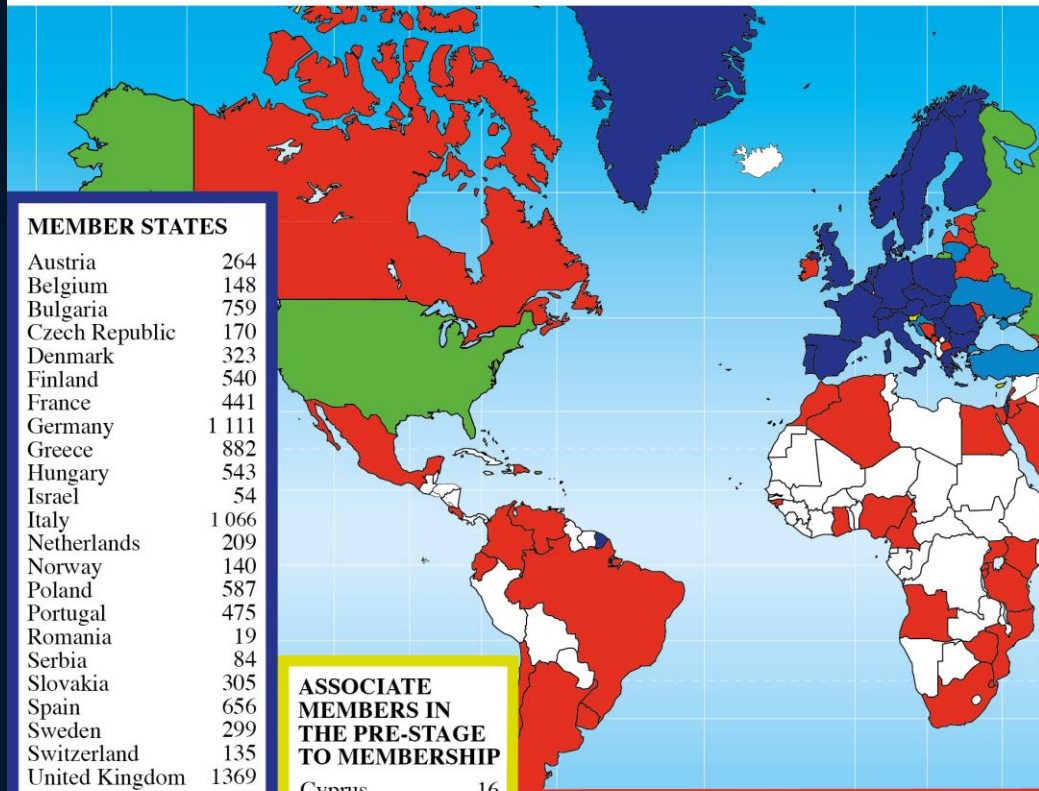
An International collaboration to distribute and analyse LHC data

Integrates computer centres worldwide that provide computing and storage resource into a single infrastructure accessible by all LHC physicists



CERN Teacher Programme

Teacher Programme Participants 1998 - 2019 (Total: 13 224)



MEMBER STATES	
Austria	264
Belgium	148
Bulgaria	759
Czech Republic	170
Denmark	323
Finland	540
France	441
Germany	1 111
Greece	882
Hungary	543
Israel	54
Italy	1 066
Netherlands	209
Norway	140
Poland	587
Portugal	475
Romania	19
Serbia	84
Slovakia	305
Spain	656
Sweden	299
Switzerland	135
United Kingdom	1369

10 579

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP	
Cyprus	16
Slovenia	44

60

ASSOCIATE MEMBERS	
Croatia	113
India	12
Lithuania	64
Pakistan	9
Turkey	364
Ukraine	206

768

OBSERVERS	
Japan	12
Russia	431
USA	126

569

OTHERS	
Algeria	11
Angola	9
Argentina	3
Armenia	3
Australia	12
Azerbaijan	2
Bahrain	3
Bangladesh	1
Belarus	11
Bosnia and Herzegovina	11
Brazil	252
Burundi	2
Cameroon	9
Canada	17
Cape Verde	4
Chile	4
China	3
Colombia	7
Costa Rica	4
Dominican Rep.	73
Ecuador	2
Egypt	3
Estonia	105
Eswatini	1
Georgia	173
Ghana	7
Guinea Bissau	1
Indonesia	3
Iran	13
Ireland	9
Jordan	13
Kazakhstan	14
Kenya	4
Korea	49
Kuwait	1
Latvia	76
Lebanon	21
Madagascar	2
Malaysia	1
Malta	51
Mexico	96
Moldova	4
Mongolia	1
Montenegro	16
Morocco	2
Mozambique	22
Nepal	4
New Zealand	4
Nigeria	2
North Macedonia	13
Palestine	5
Philippines	3
Qatar	1
Rwanda	20
Sao Tome	7
Saudi Arabia	1
Singapore	2
South Africa	9
Sri Lanka	3
Taiwan	1
Tanzania	1
Thailand	21
Timor-Leste	9
Uganda	3
U.A.E.	1
Uruguay	3
Venezuela	1
Vietnam	2
Zimbabwe	1

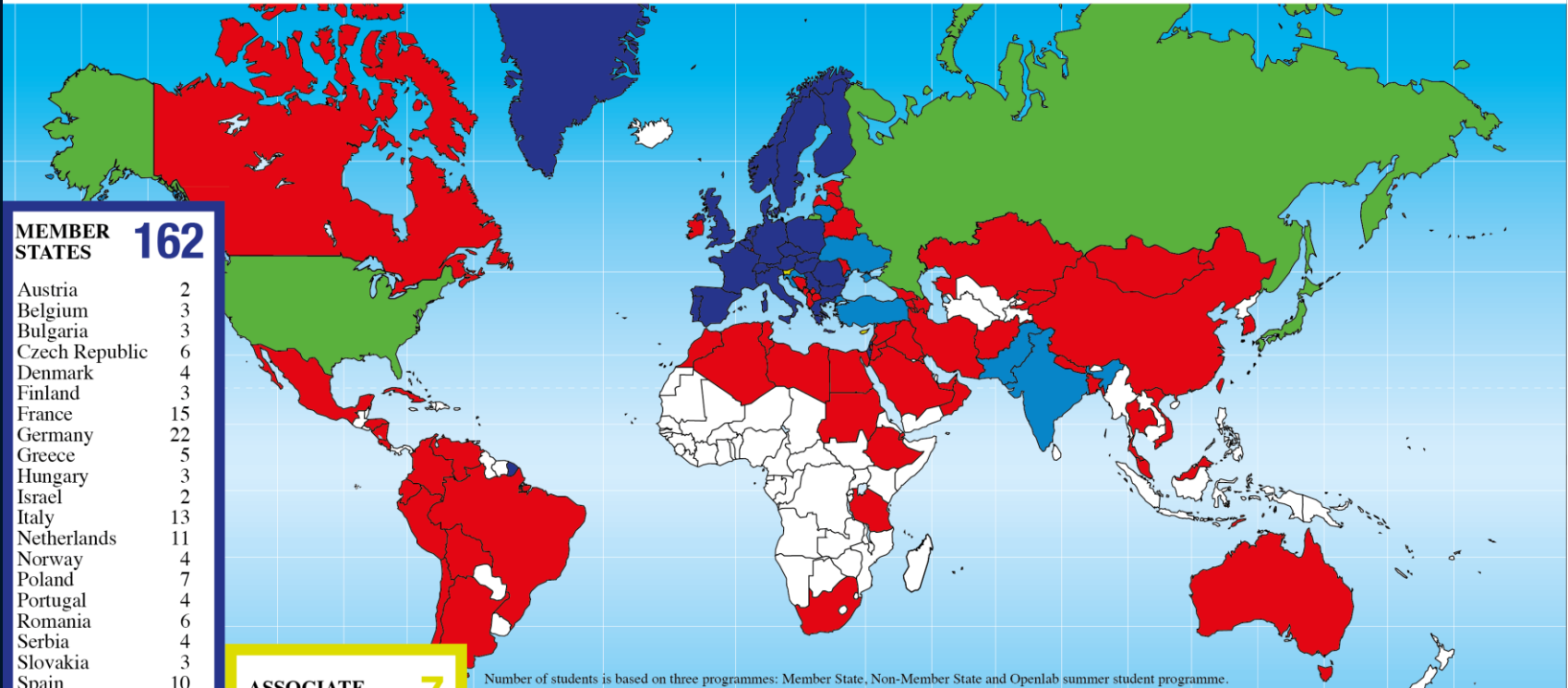
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Summer Students 2020



Summer Students 2020



MEMBER STATES 162

Austria	2
Belgium	3
Bulgaria	3
Czech Republic	6
Denmark	4
Finland	3
France	15
Germany	22
Greece	5
Hungary	3
Israel	2
Italy	13
Netherlands	11
Norway	4
Poland	7
Portugal	4
Romania	6
Serbia	4
Slovakia	3
Spain	10
Sweden	4
Switzerland	6
United Kingdom	22

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP 7

Cyprus	4
Slovenia	3

ASSOCIATE MEMBERS 23

Croatia	2
India	9
Lithuania	2
Pakistan	4
Turkey	4
Ukraine	2

OBSERVERS 37

Japan	4
Russia	9
USA	24

Number of students is based on three programmes: Member State, Non-Member State and Openlab summer student programme.

OTHERS		OTHERS		OTHERS		OTHERS	
Afghanistan	1	Bosnia & Herzegovina	4	Ethiopia	1	Kyrgyzstan	1
Albania	1	Brazil	3	Georgia	1	Latvia	2
Algeria	1	Cambodia	1	Guatemala	1	Lebanon	6
Andorra	1	Canada	7	Honduras	2	Libya	1
Argentina	1	Chile	2	Hong Kong	3	Madagascar	1
Armenia	1	China	8	Iran	2	Malaysia	2
Australia	5	Colombia	3	Iraq	1	Malta	3
Azerbaijan	1	Costa Rica	3	Ireland	1	Mexico	2
Bahrain	2	Cuba	1	Jordan	2	Moldova	1
Bangladesh	1	Ecuador	2	Kazakhstan	1	Mongolia	1
Belarus	1	Egypt	3	Korea	2	Montenegro	4
Bolivia	1	Estonia	2	Kosovo	1	Morocco	1
				Kuwait	4	Nepal	2
						Nicaragua	1
						North Macedonia	1
						Oman	1
						Palestine	1
						Peru	1
						Saudi Arabia	3
						South Africa	2
						Sudan	1
						Syrian Arab Rep.	2
						Taiwan	1
						Tanzania	1
						Thailand	4
						Tunisia	1
						U.A.E	1
						Venezuela	2
						Viet Nam	1
						Yemen	1

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Thank You!



Accelerating Science and Innovation