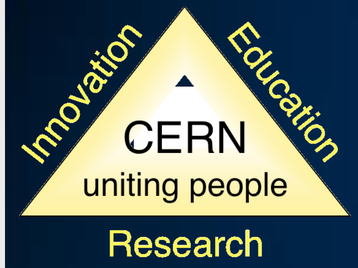
CERN

A glimpse of the very early universe

Rolf Landua

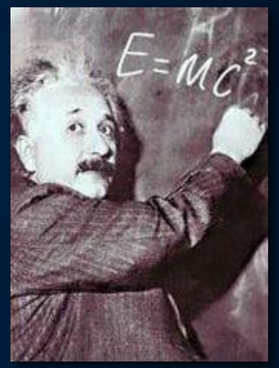
Old questions by philosophers - new answers by scientists



The Mission of CERN

- **Push forward** the frontiers of knowledge

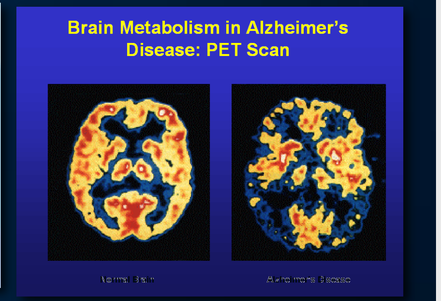
  E.g. the secrets of the Big Bang …what the matter like within the first moments of the Universe's exi

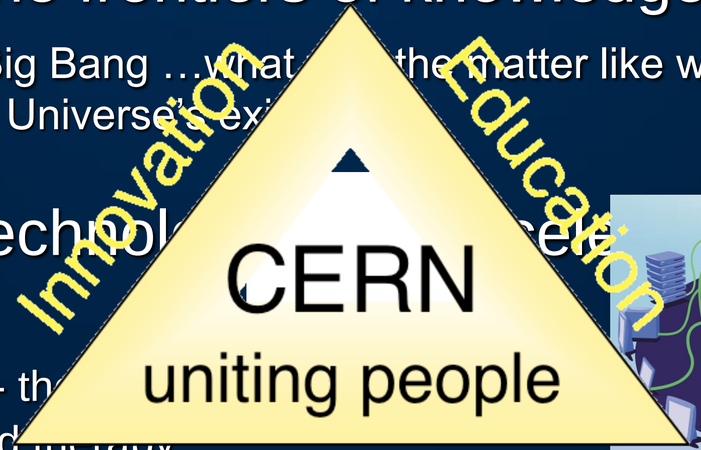


- **Develop** new technol… …eele… and detectors

  Information technology - th…

  Medicine - diagnosis and therapy





- **Train** scientists and engineers of tomor…

- **Unite** people from different countries ar… cultures

CERN was founded 1954: 12 European States

"Science for Peace"

Today: 21 Member States

~ 2300 staff
~ 1620 other paid personnel
~ 10500 users

Budget (2014) ~1000 MCHF

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

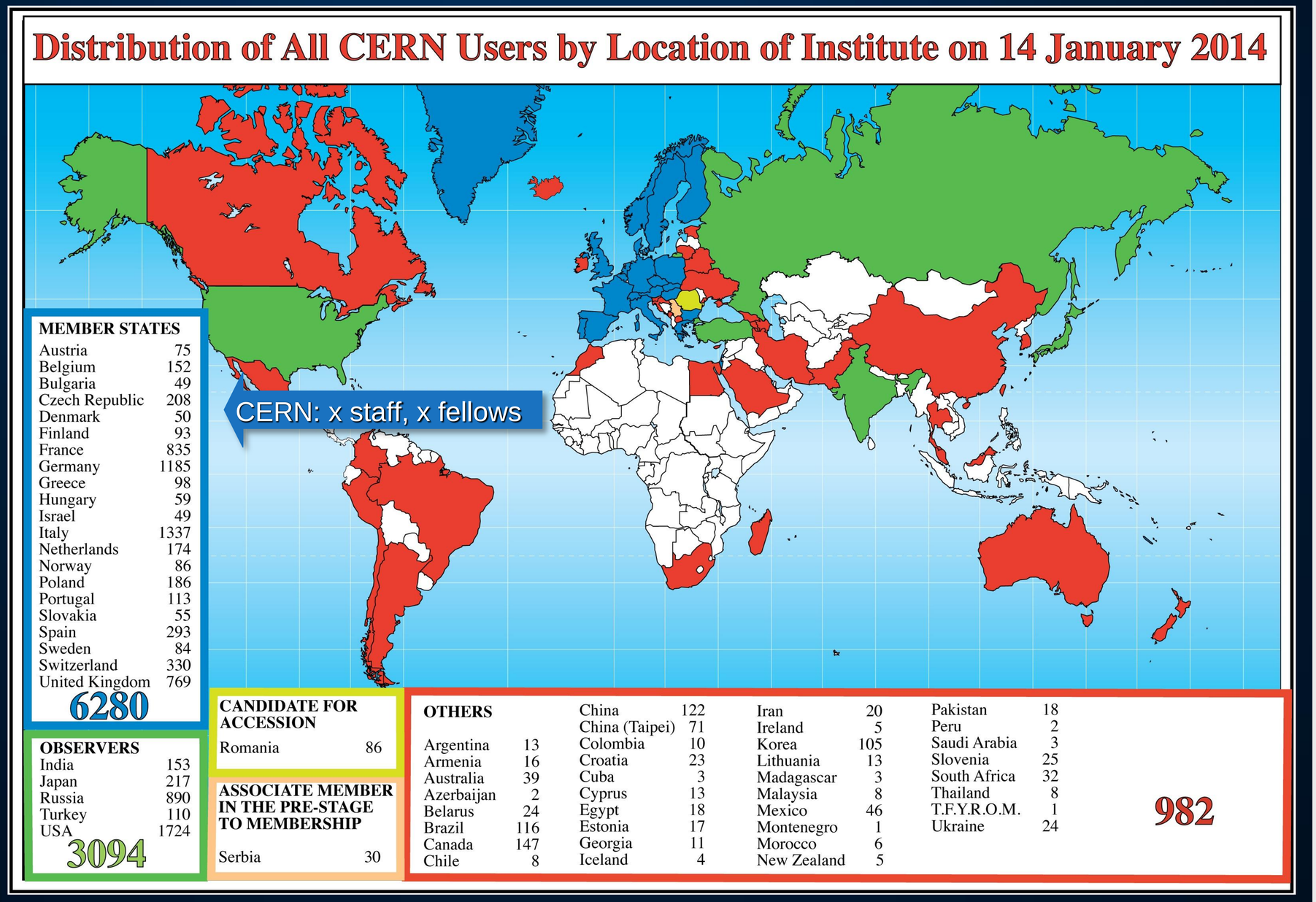
Candidate for Accession: Romania

Associate Member in Pre-Stage to Membership: Serbia

Applicant States for Membership or Associate Membership: Brazil, Cyprus, Pakistan, Russia, Slovenia, Turkey, Ukraine

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

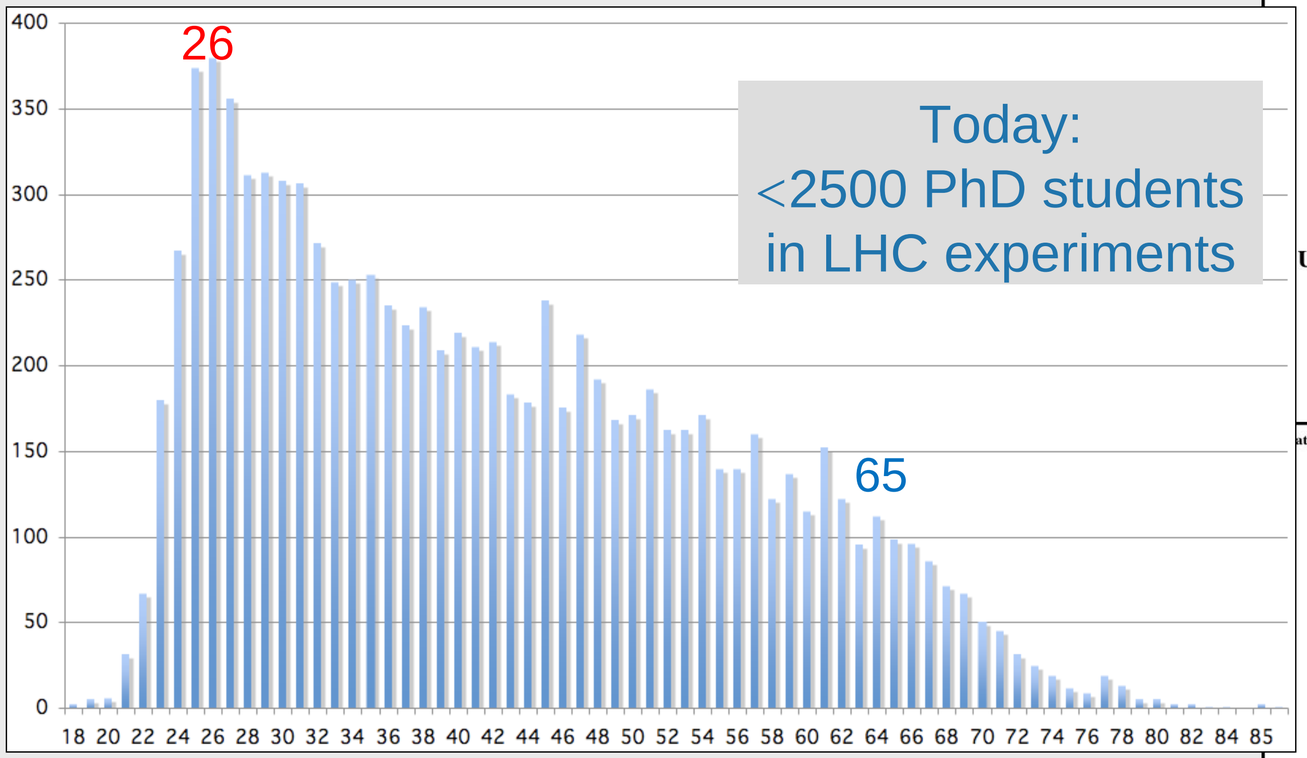
Science is getting more and more global



Age Distribution of Scientists

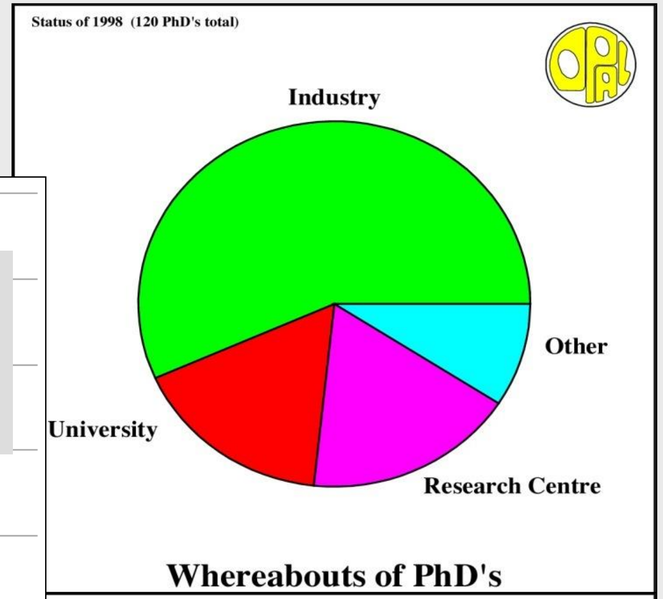
- and where they go afterwards

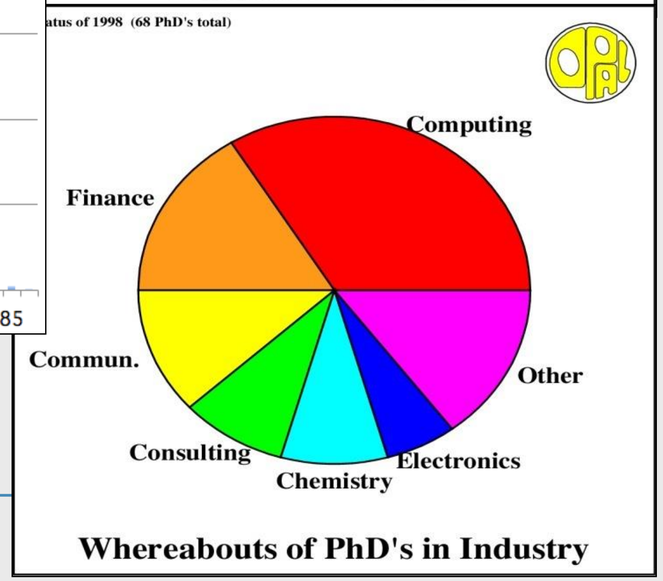
Survey in March 2009



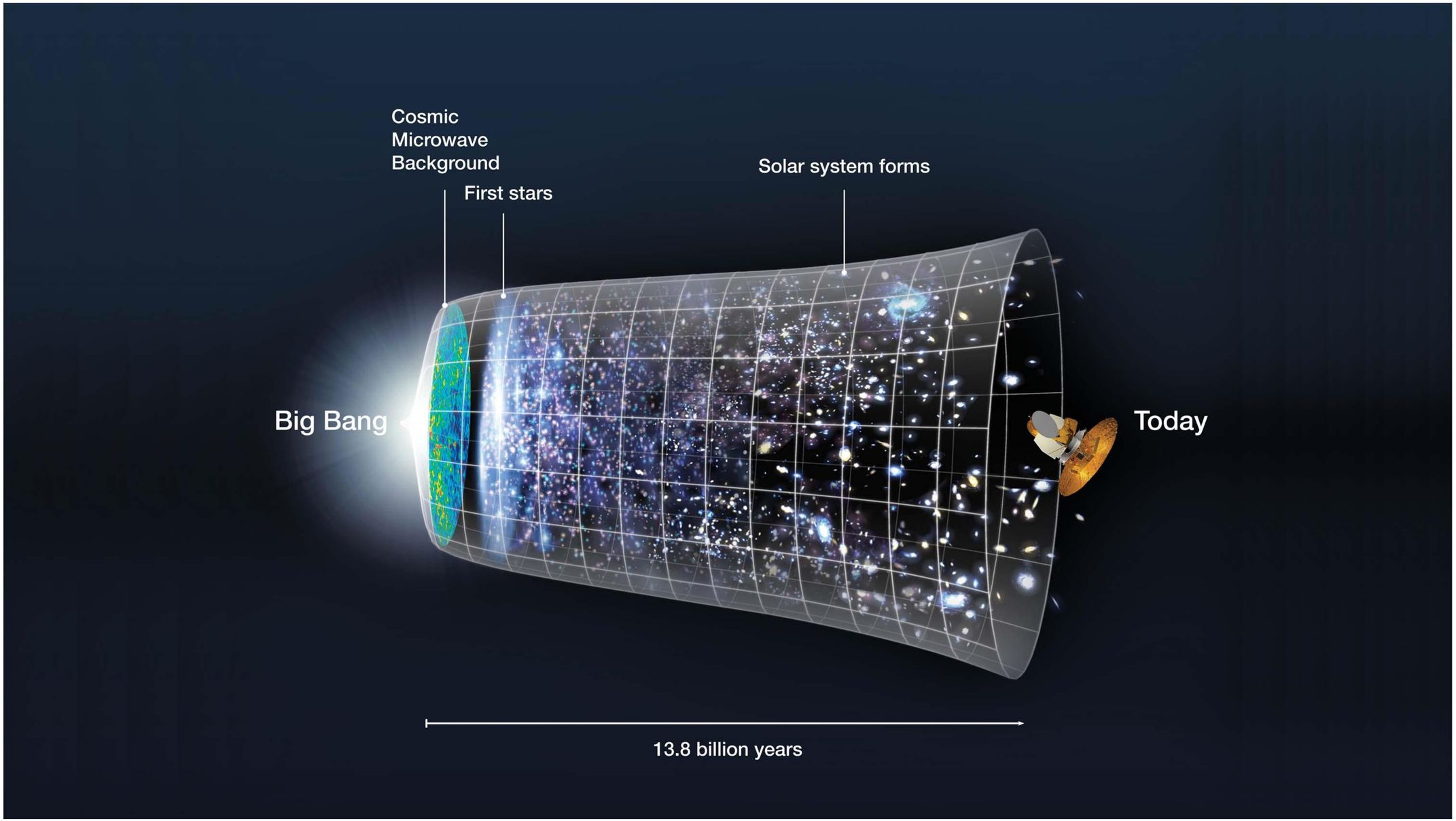
Today:
<2500 PhD students
in LHC experiments

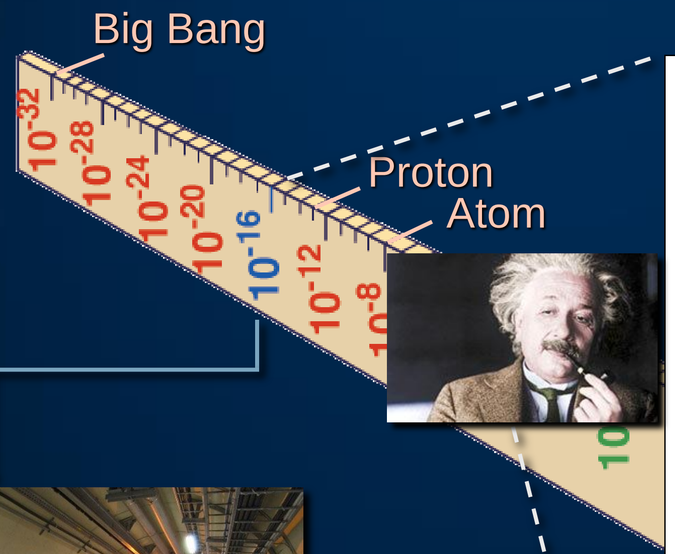
They do not all stay: where do they go?

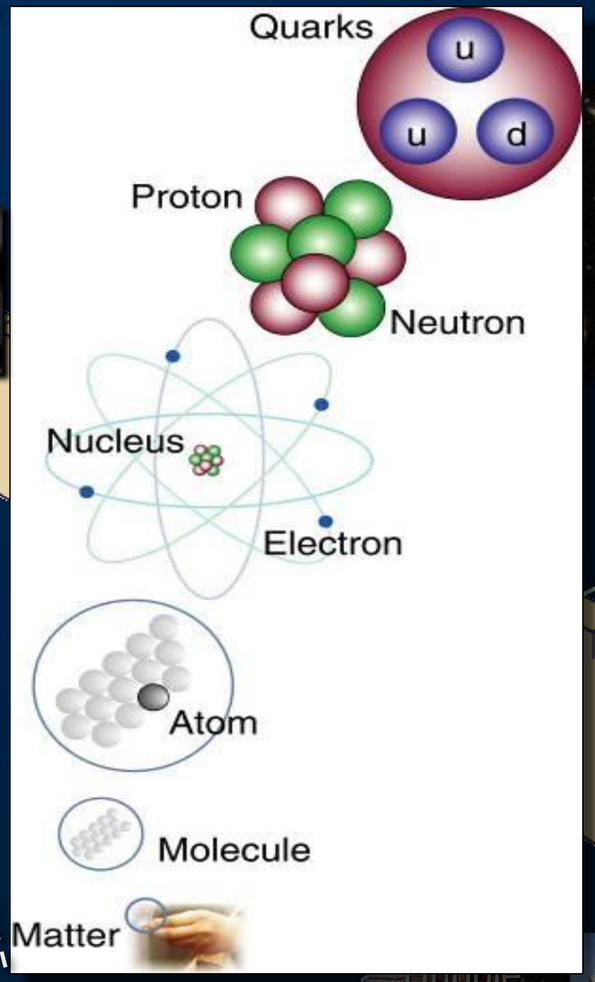


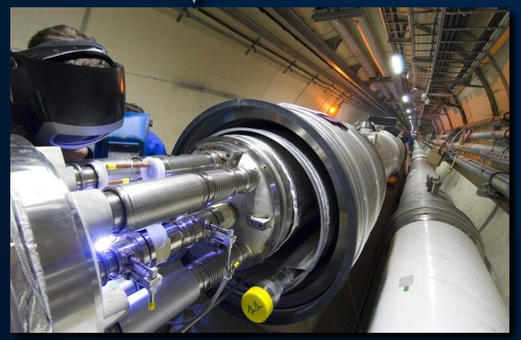


Cosmic evolution: 13.8 billion years









LHC

Super-Microscope

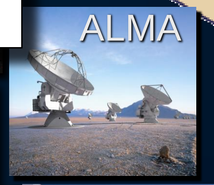
Radius of Galaxies

Universe

10^{24}

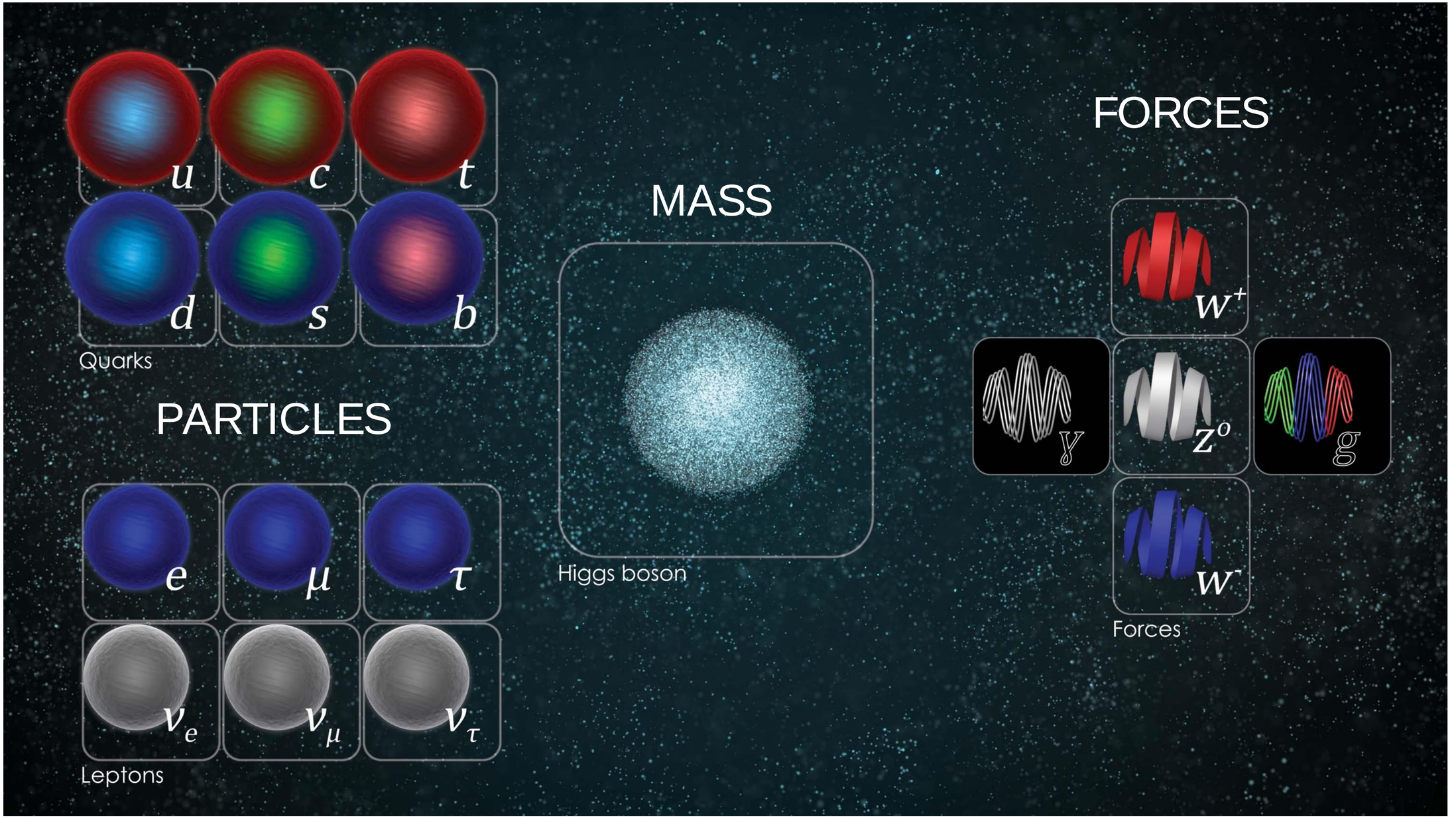
10^{28}

cm

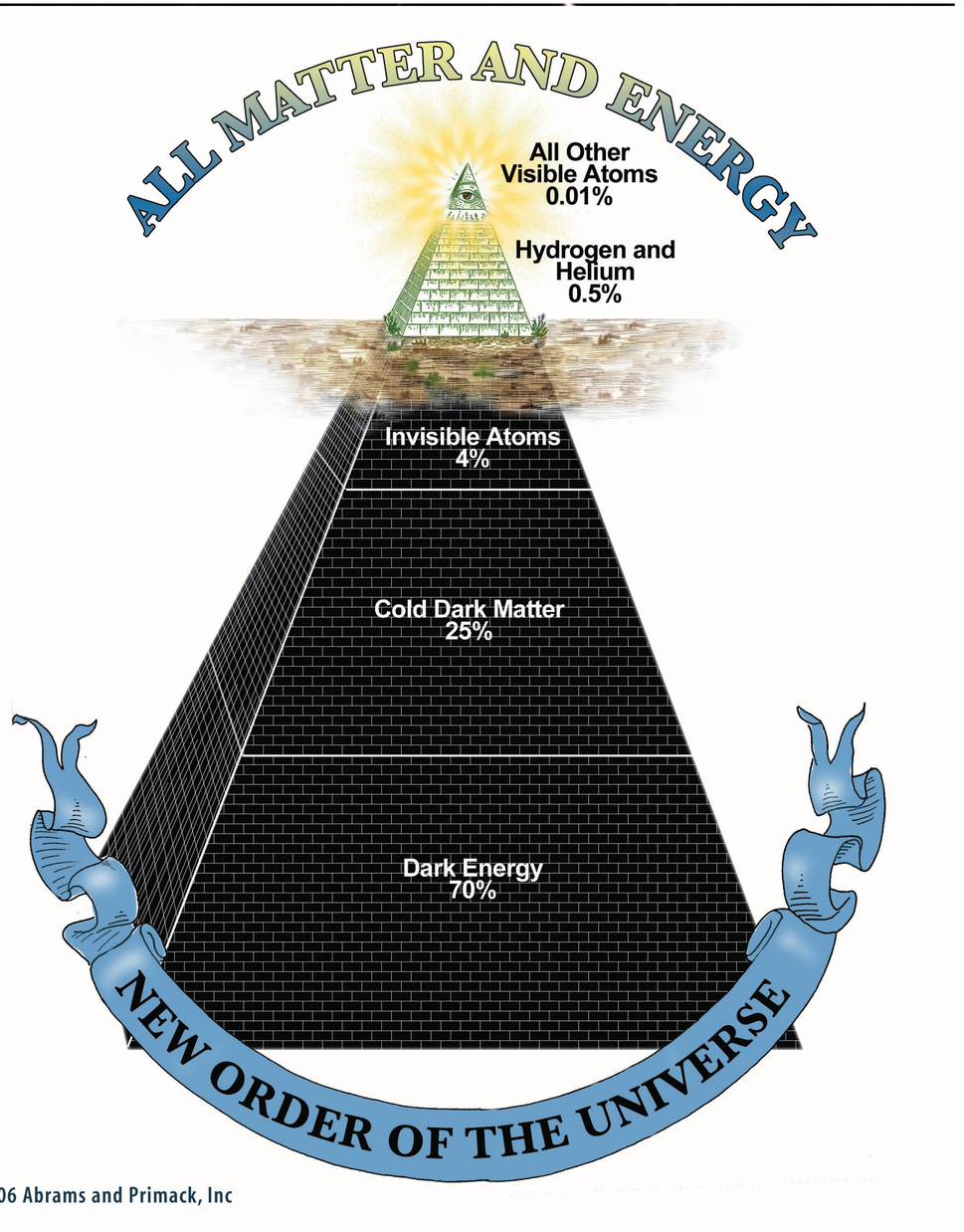


Study physics laws of first moments after Big Bang
increasing Symbiosis between Particle Physics,
Astrophysics and Cosmology

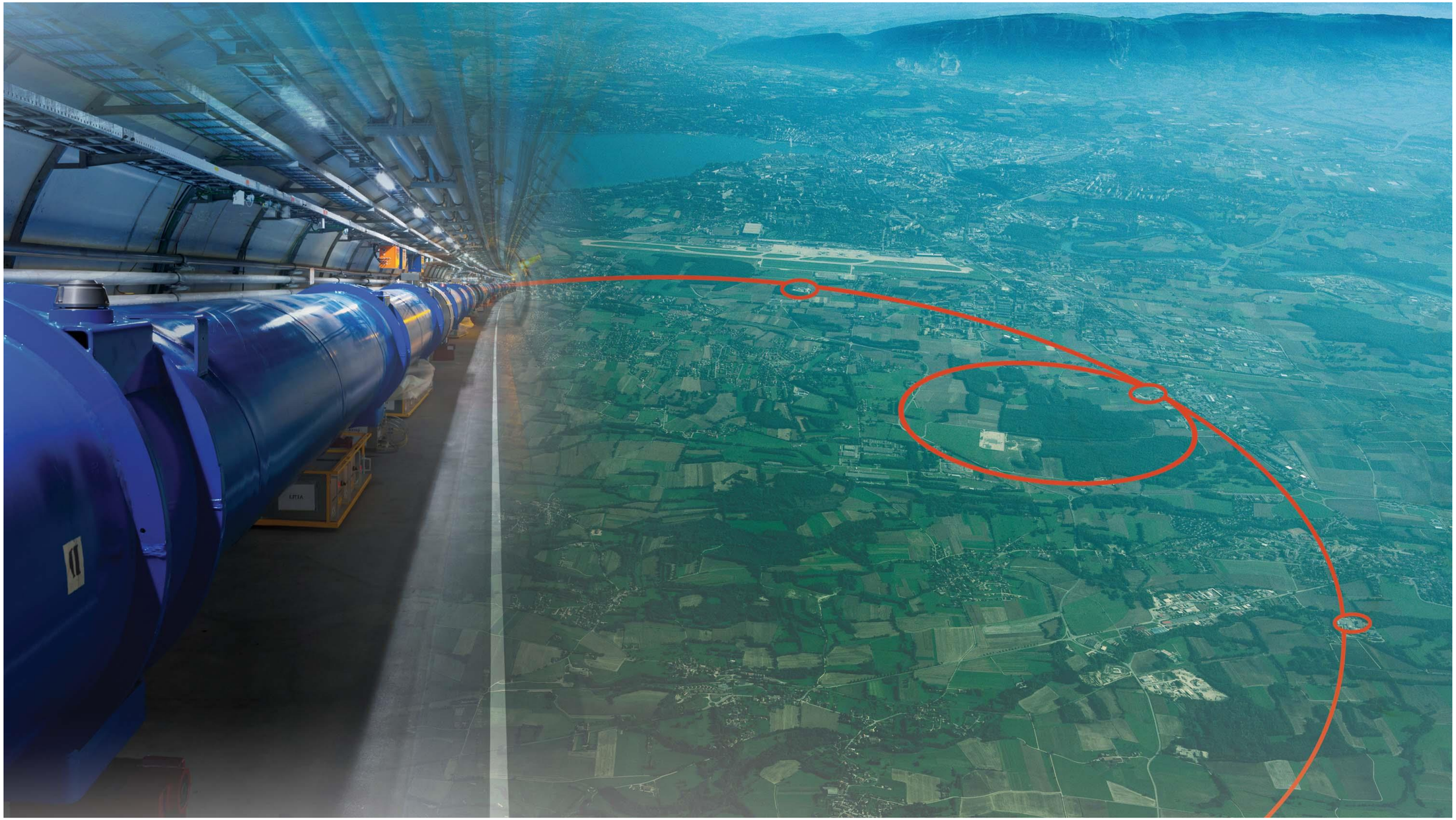
Origin of particles and forces



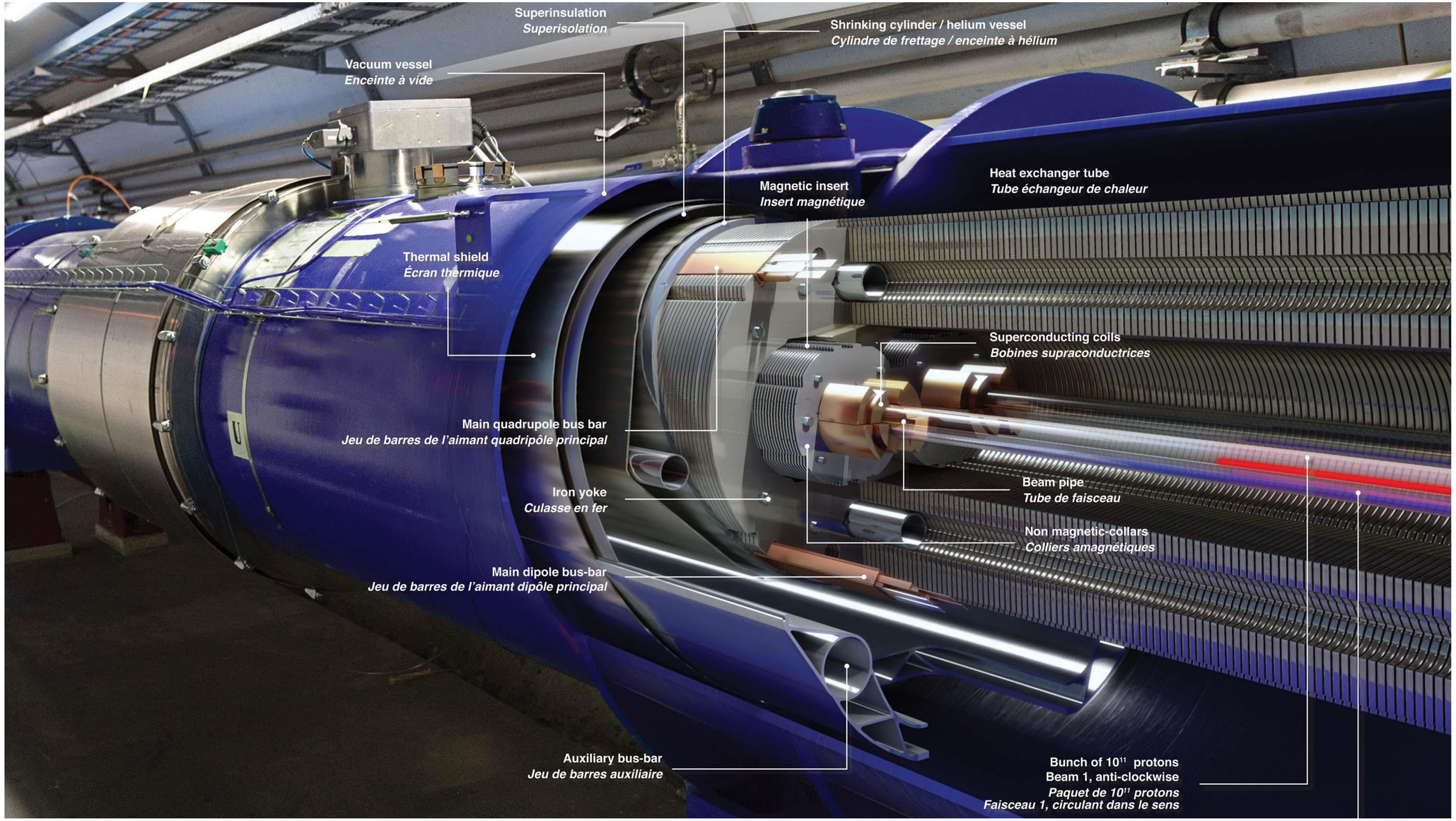
The mysteries of the universe - today



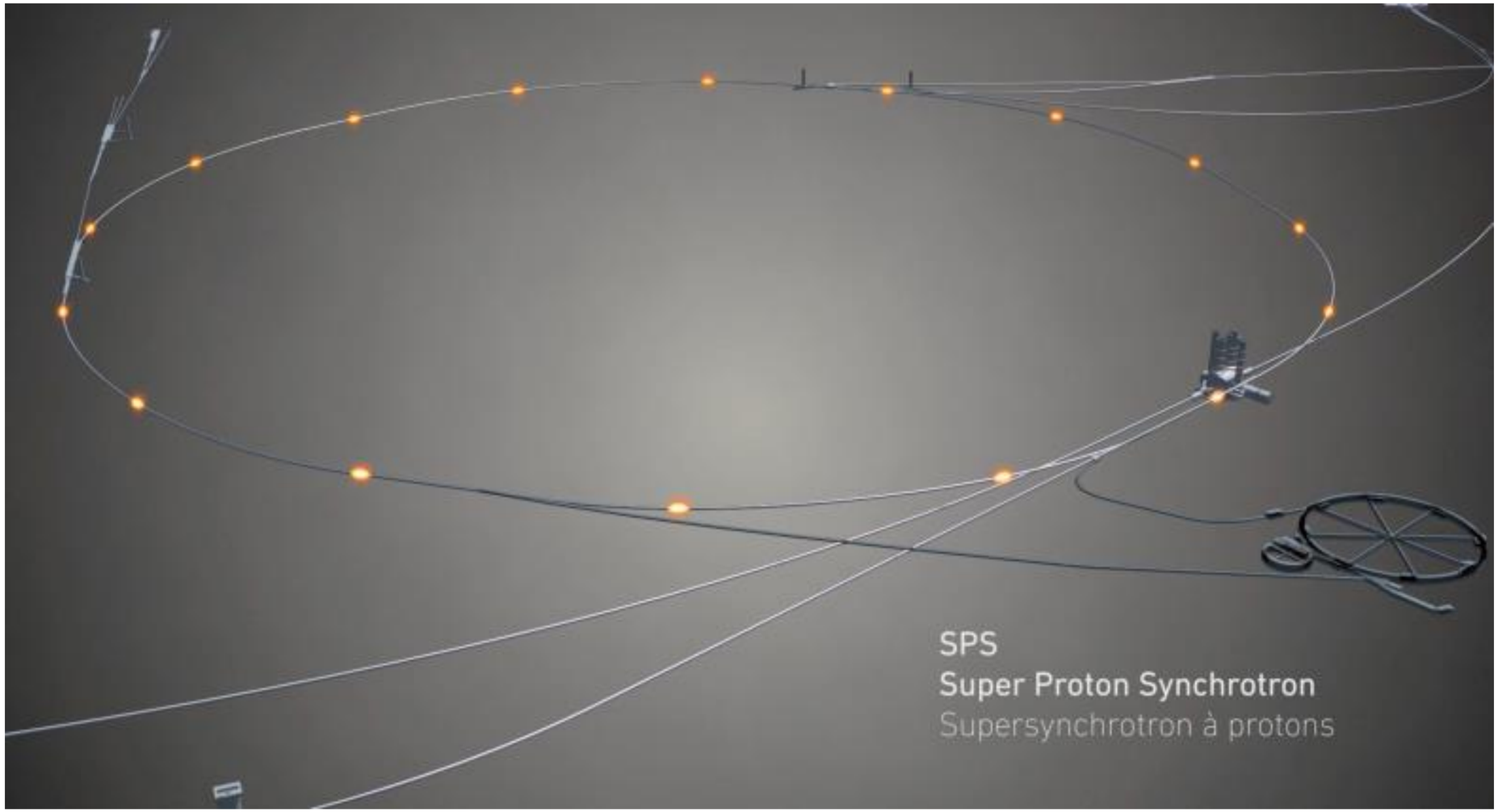
CERN



Large Hadron Collider - LHC

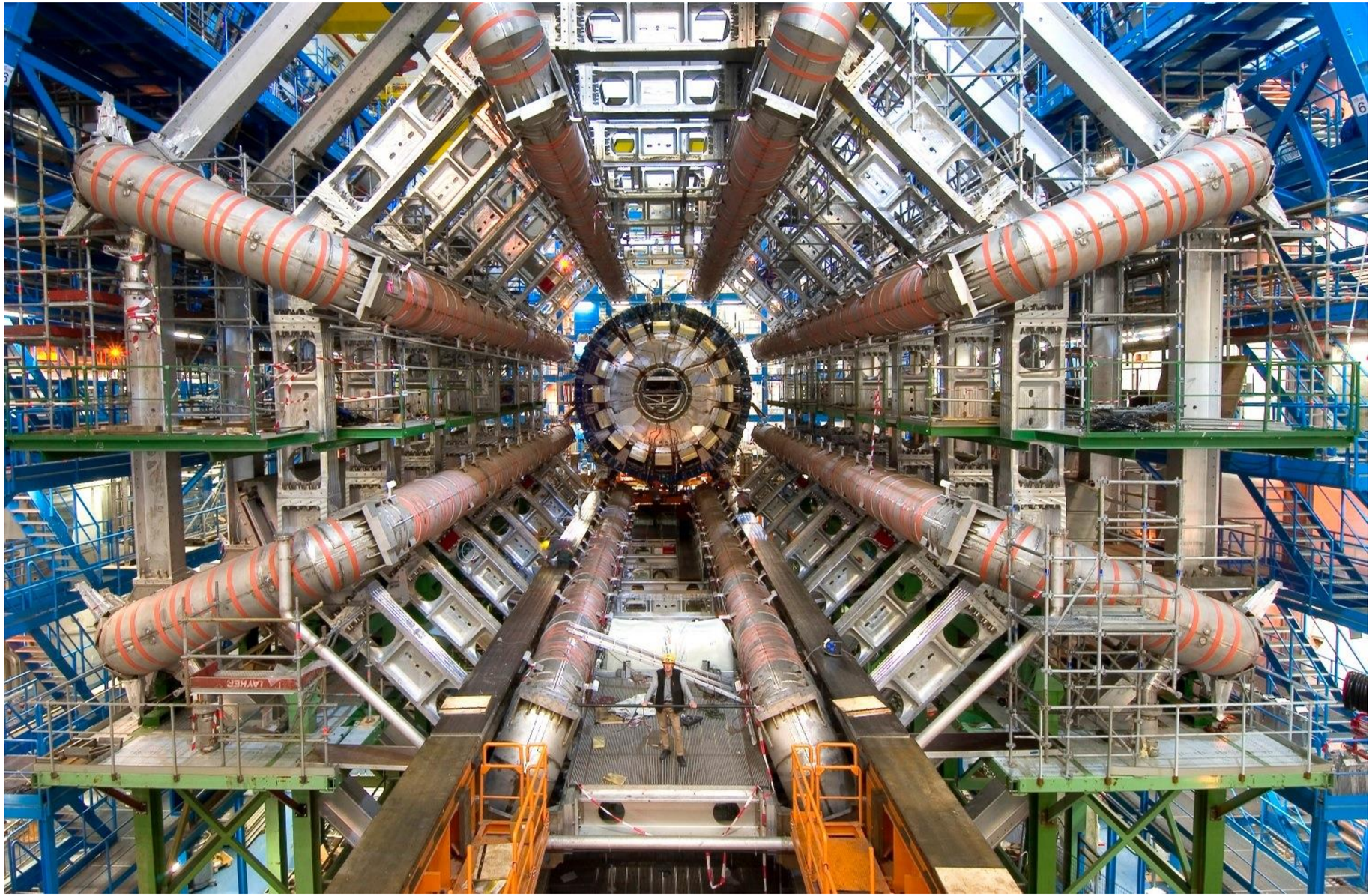


CERN Accelerators

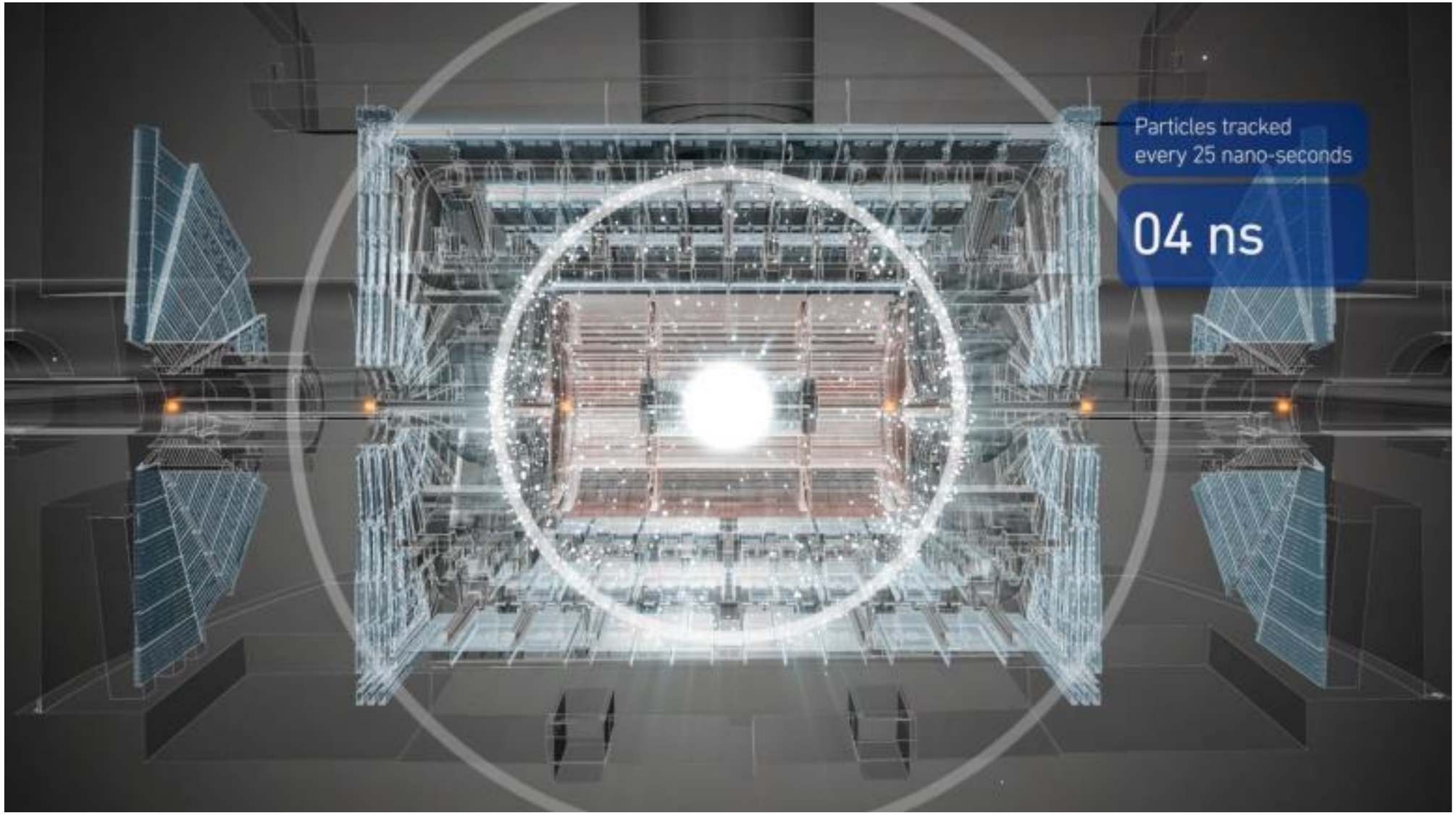


CERN Accelerator - Animation

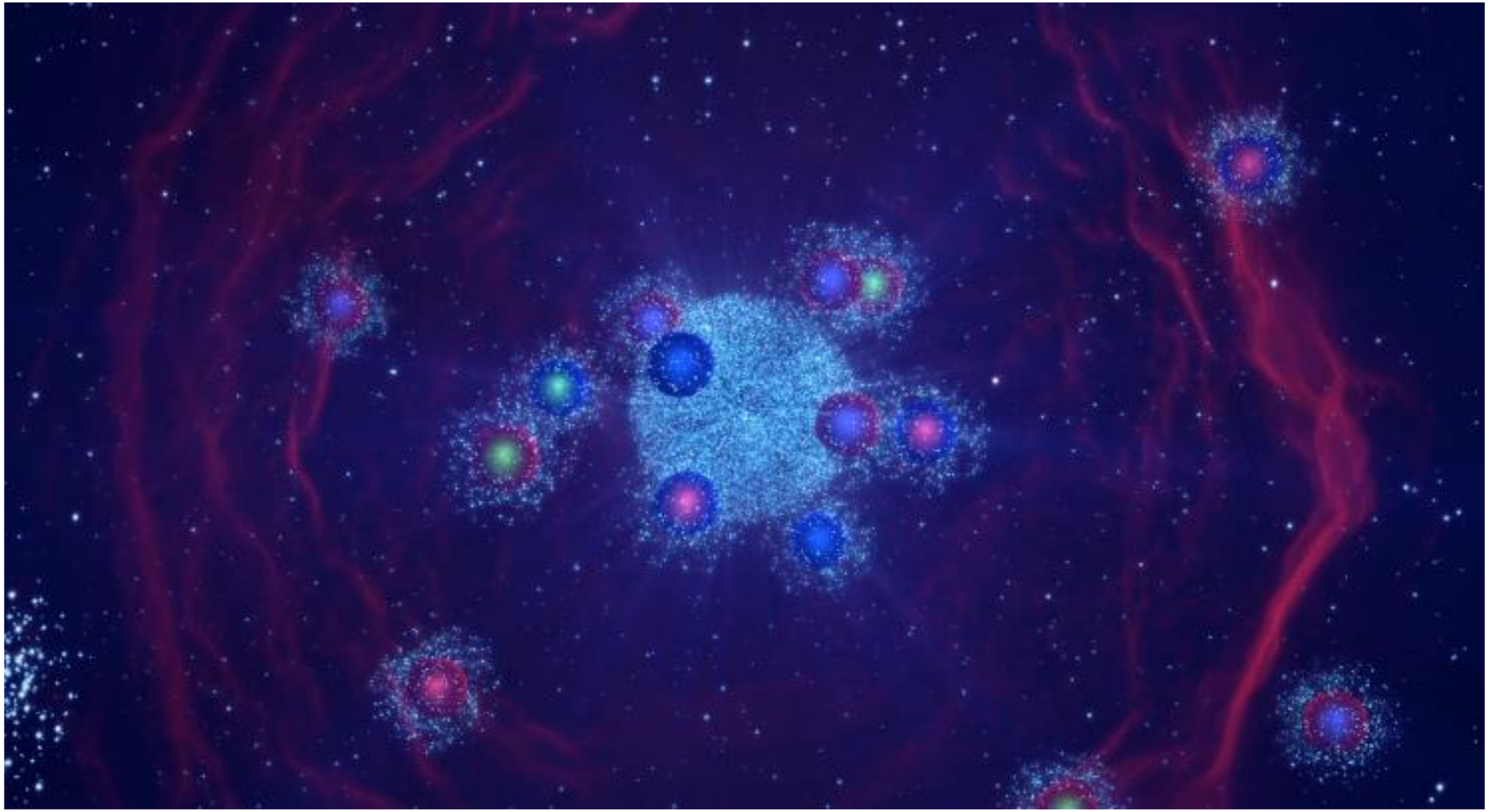
LHC experiments - huge detectors



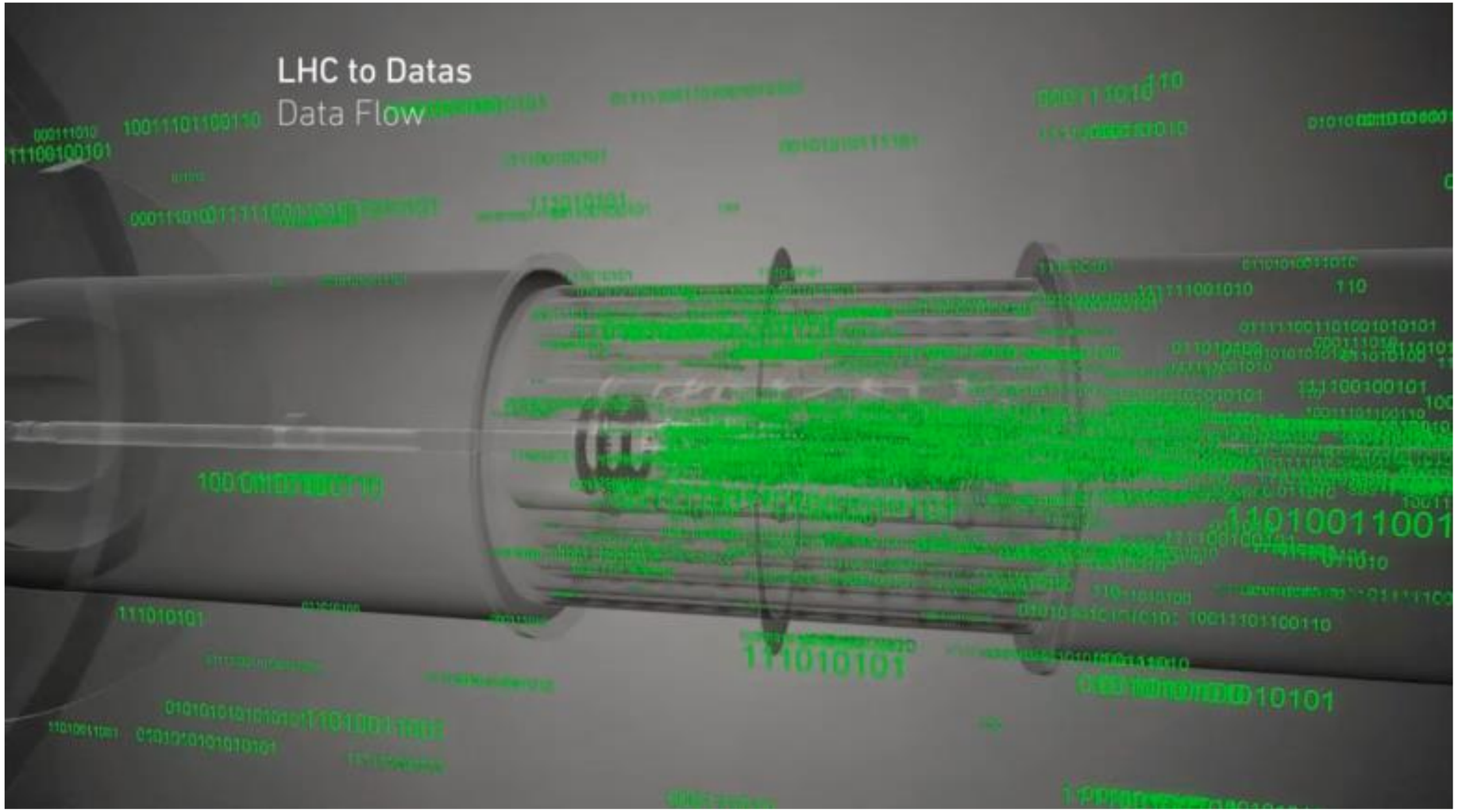
Collisions in ATLAS detector: 600 million per second



Higgs boson production: 1 in 10,000,000,000 events



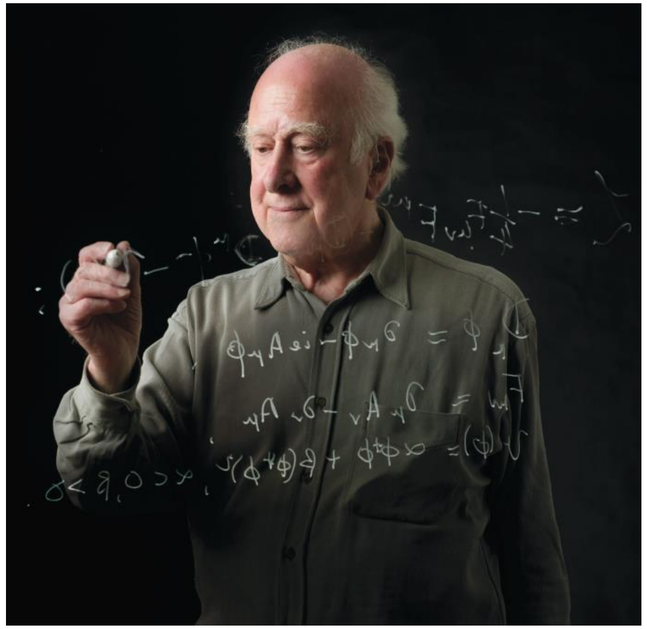
LHC data flood: primary rate ~ 1000 TB/sec



Nobel Prize in Physics 2013

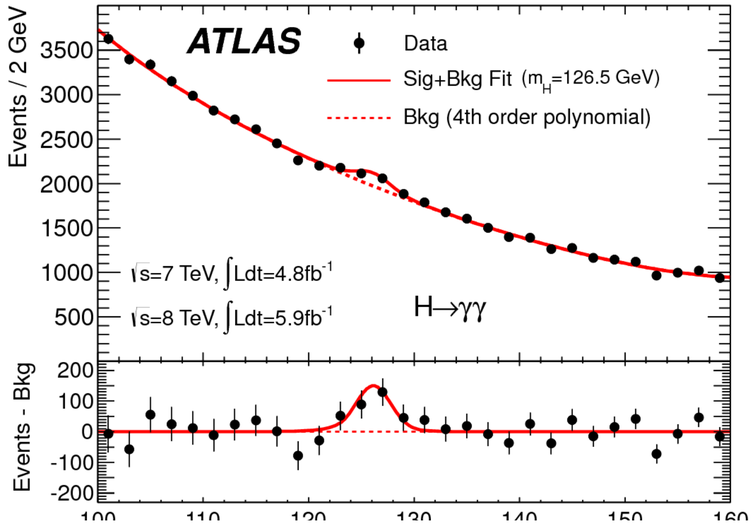
The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs *"for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider".*

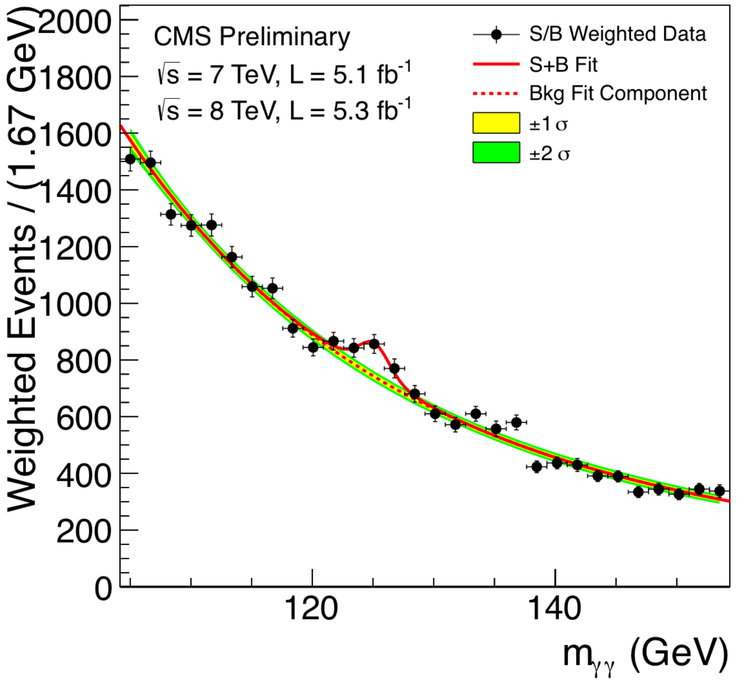
The discovery of a Higgs boson



1964

2012





CERN Education Activities

Scientists at CERN
Academic Training Programme

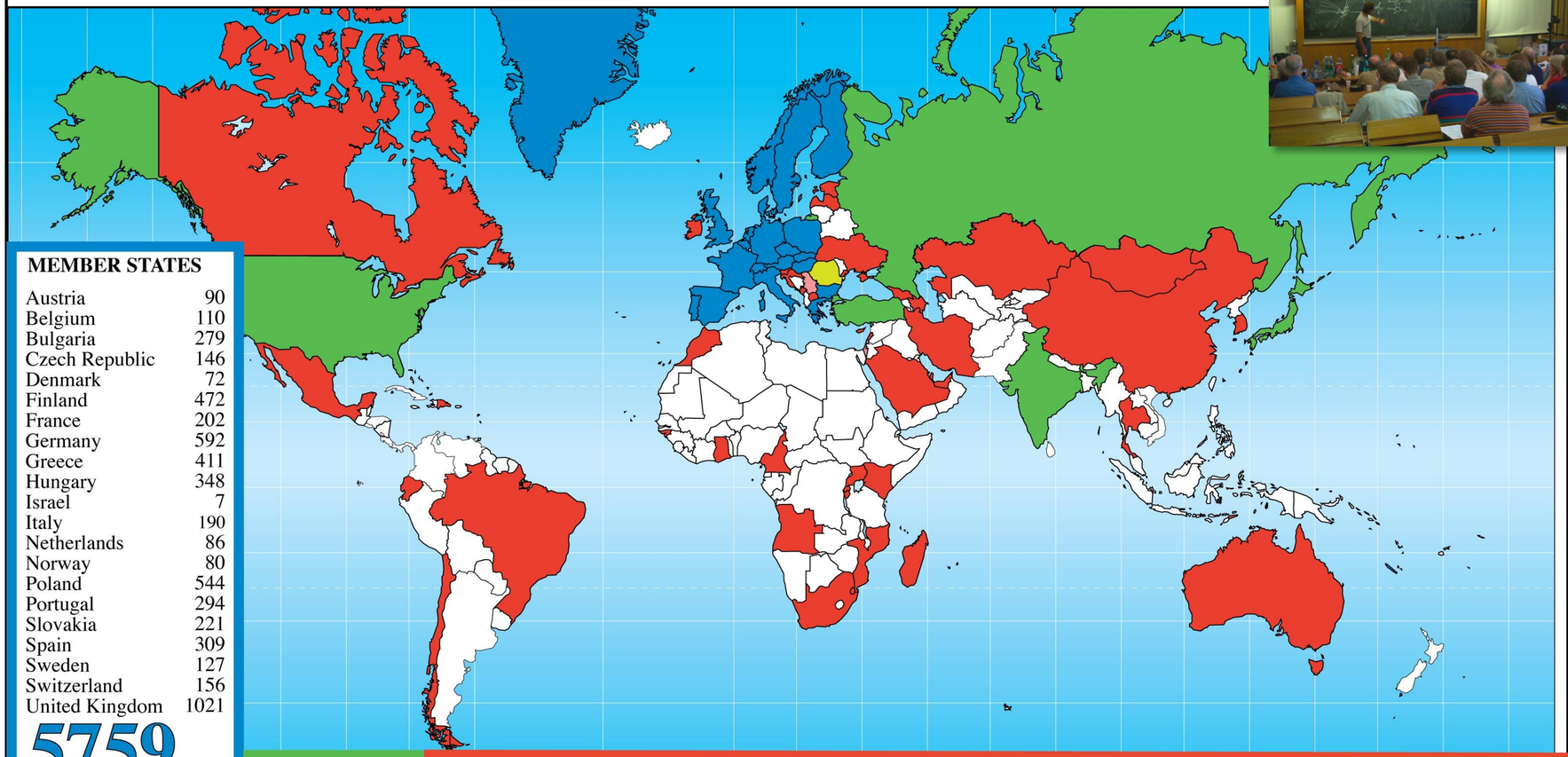
Young Researchers
CERN School of High Energy Physics
CERN School of Computing
CERN Accelerator School

Physics Students
Summer Students Programme

CERN Teacher Schools
International and National Programmes

CERN Teacher Programme

Teacher Programme Participants 1998 - 2013



MEMBER STATES

Austria	90
Belgium	110
Bulgaria	279
Czech Republic	146
Denmark	72
Finland	472
France	202
Germany	592
Greece	411
Hungary	348
Israel	7
Italy	190
Netherlands	86
Norway	80
Poland	544
Portugal	294
Slovakia	221
Spain	309
Sweden	127
Switzerland	156
United Kingdom	1021

5759

CANDIDATE FOR ACCESSION

Romania	12

ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP

Serbia	14

OBSERVER STATES

India	2
Japan	5
Russia	163
Turkey	3
USA	65

238

OTHERS

Angola	4	China	1	Ireland	5	Morocco	2	Swaziland	1
Australia	5	Croatia	1	Kazakhstan	3	Mozambique	17	Thailand	7
Azerbaijan	1	Cyprus	8	Kenya	4	Qatar	1	T.F.Y.R.O.M.	11
Brazil	83	Dominican Rep.	2	Latvia	1	Rwanda	17	Timor-Leste	4
Burundi	1	Ecuador	2	Lebanon	1	Sao Tome	3	Uganda	3
Cameroon	3	Estonia	37	Madagascar	2	Saudi Arabia	1	Ukraine	57
Canada	3	Georgia	55	Malta	36	Singapore	2	U.A.E.	1
Cape Verde	3	Ghana	6	Mexico	6	Slovenia	21		
Chile	3	Guinea Bissau	1	Mongolia	1	South Africa	6		
		Iran	1	Montenegro	13	South Korea	44		

490

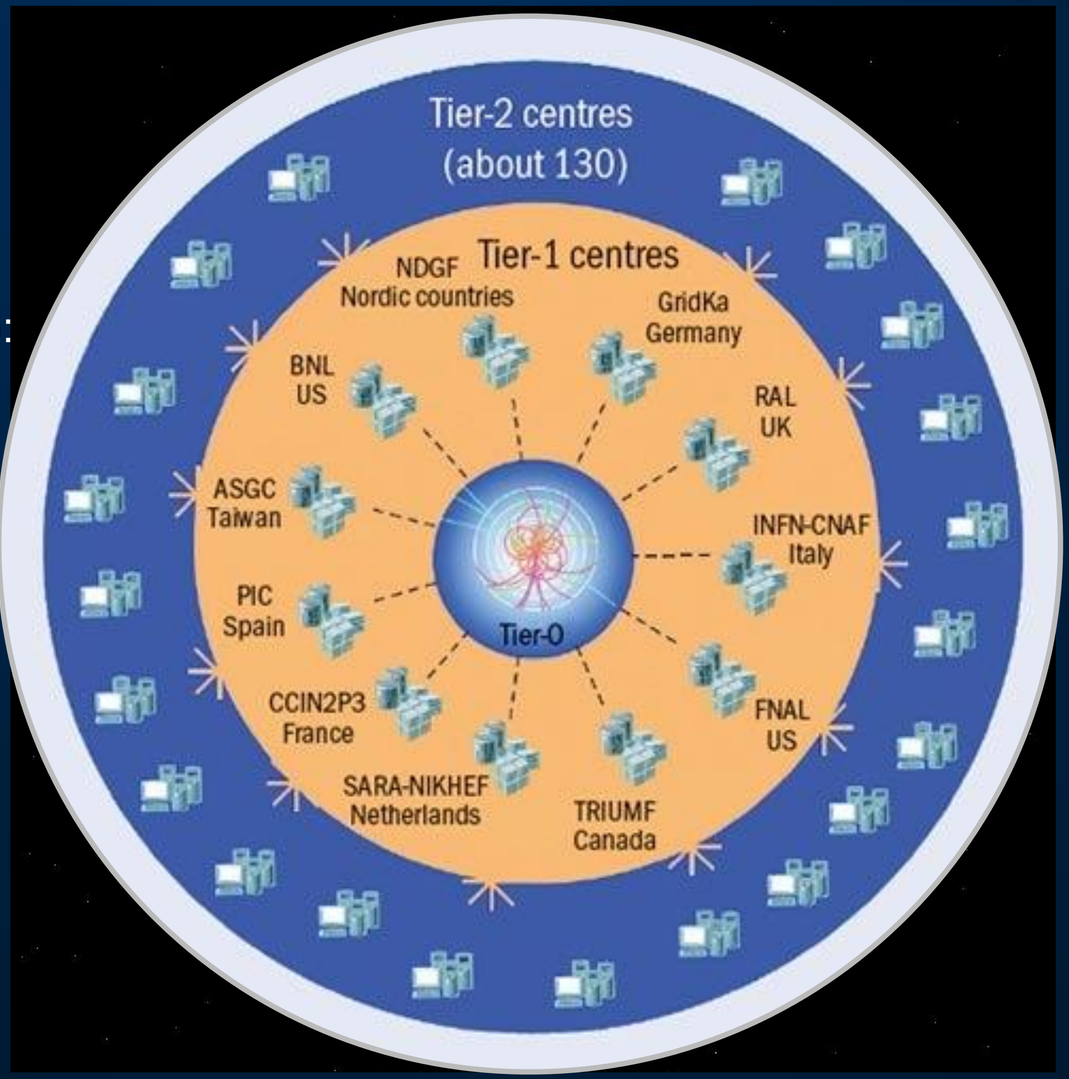
Pushing the frontiers - the World-Wide Web is 25 years old

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



nearly 160 sites,
35 countries

~250’000 cores

173 PB of storage

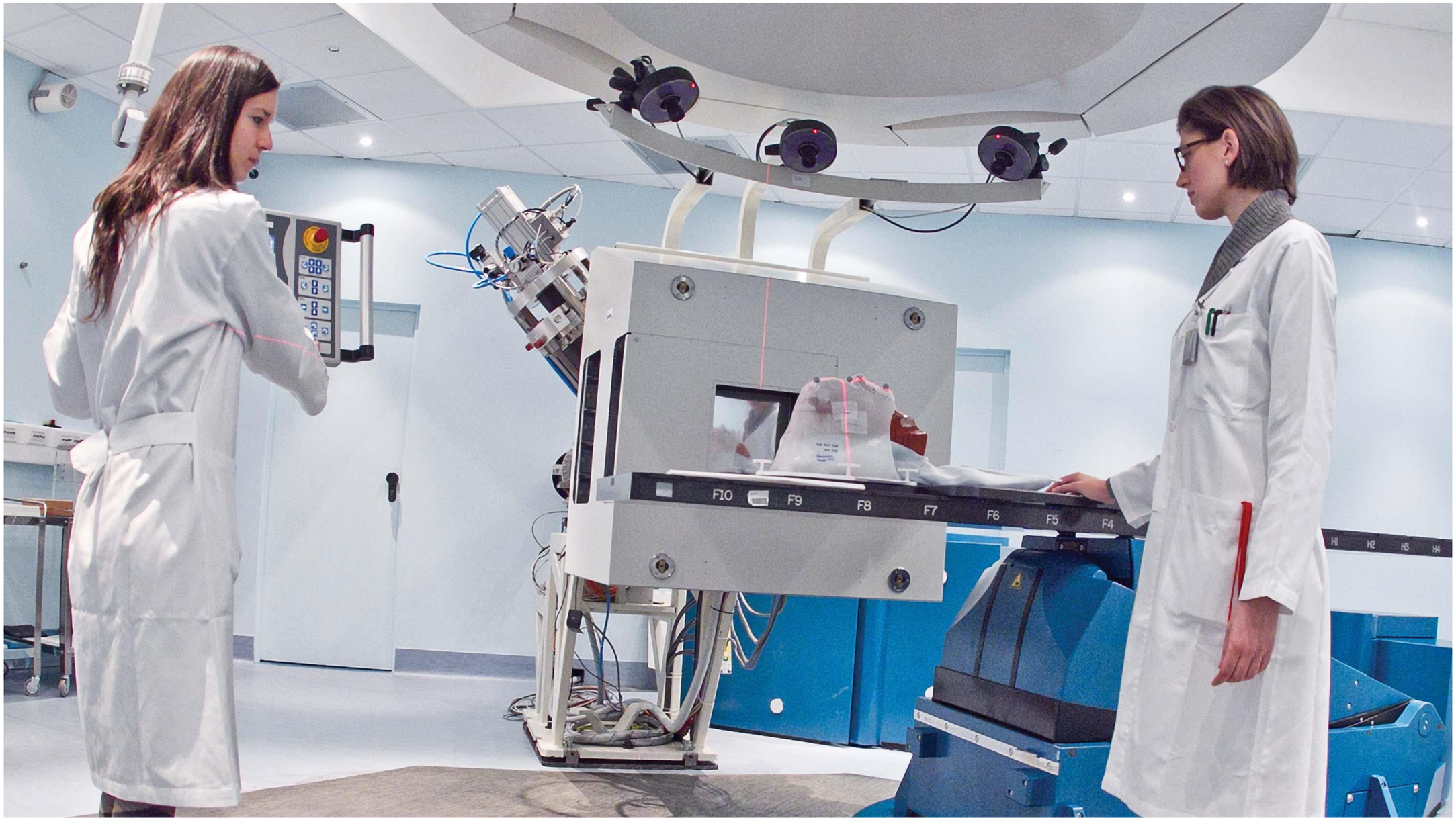
> 2 million jobs/day

10 Gb links

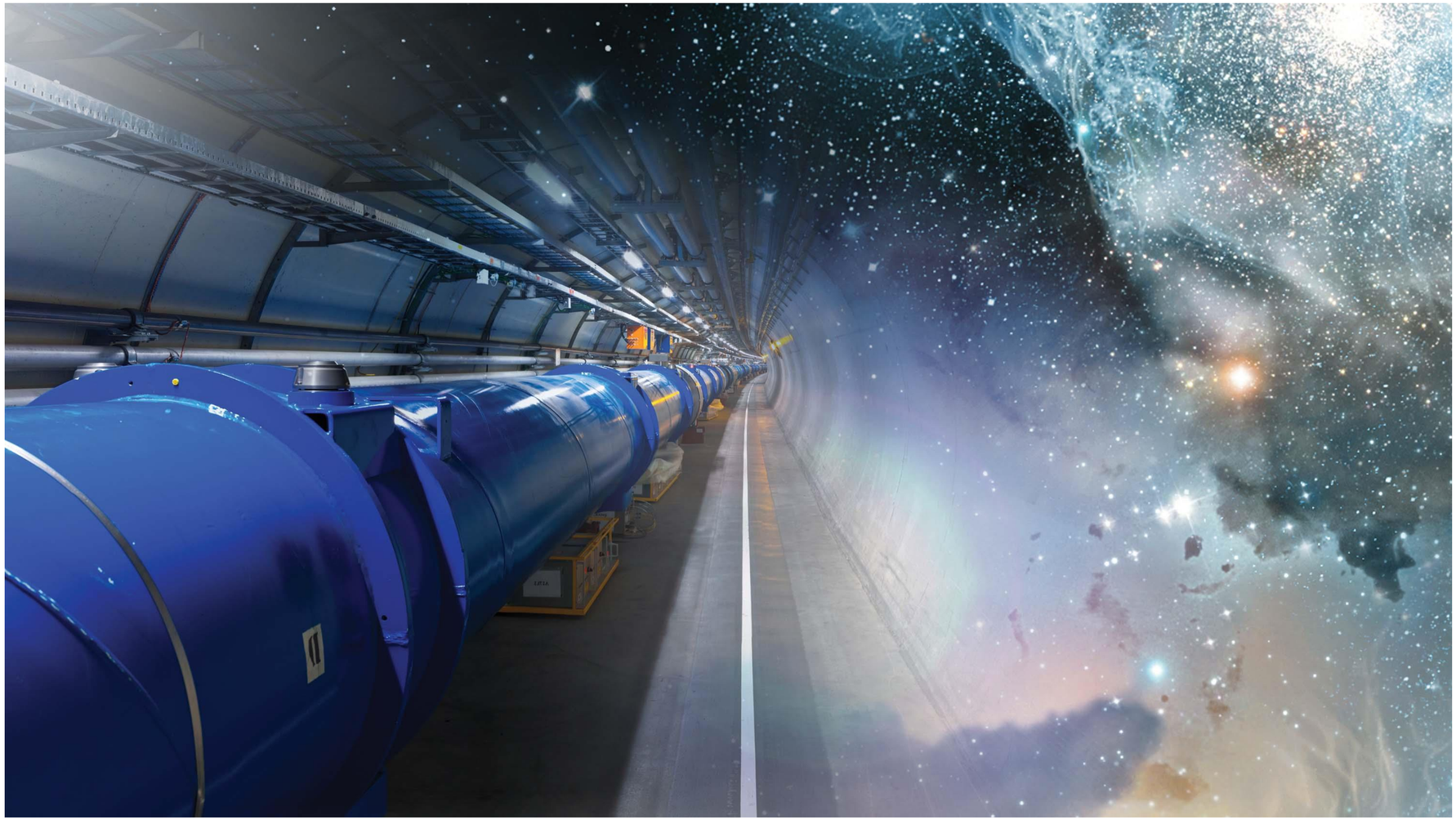
WLCG:
An International collaboration to distribute and analyse LHC data

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

Pushing the frontiers - medical diagnostics and therapy



Pushing the frontiers: new discoveries are waiting



2015: Energy increase from 8 to 13 TeV + higher intensity