



CERN

A glimpse of the very early universe

Dr. Rolf Landua

Old questions by philosophers - new answers by scientists

DA DOVE VENIAMO ?
QUE SOMMES NOUS ?

WAS SIND WIR ?

CHE COSA SIAMO ?

WHERE DO WE COME FROM ?

DOVE ANDIAMO ?

WHERE ARE WE GOING ?
WOHIN GEHEN WIR ?

D'OU VENONS NOUS ?

WOHER KOMMEN WIR ?

¿ DE DÓNDE VENIMOS ?

¿ QUÉ SOMOS ?

WHAT ARE WE ?

OÙ ALLONS NOUS ?

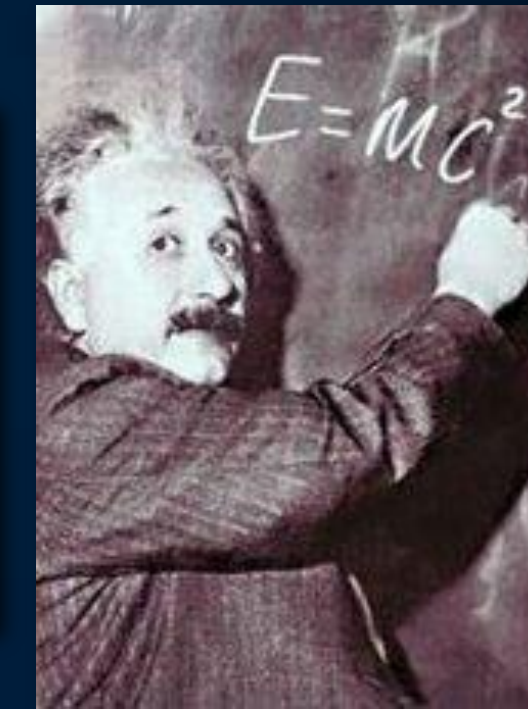
¿ A DÓNDE VAMOS ?



The Mission of CERN

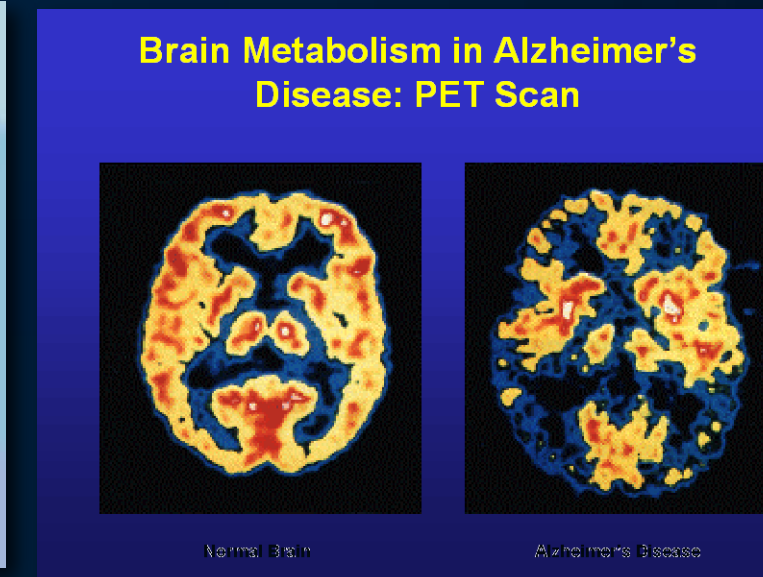
→ **Push forward** the frontiers of knowledge

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

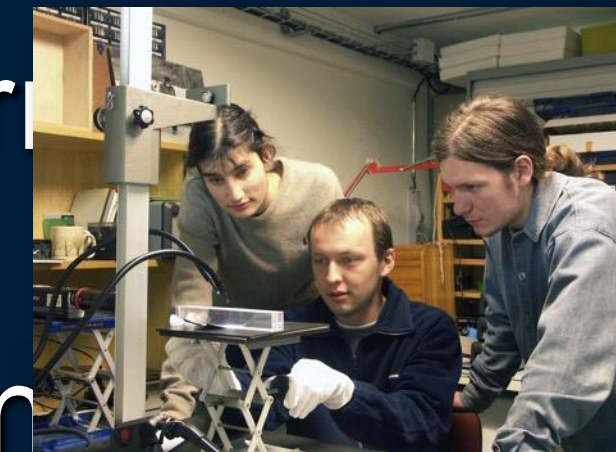


→ **Develop** new technologies and detectors

Information technology - the Internet
Medicine - diagnosis and therapy



→ **Train** scientists and engineers of tomorrow



→ **Unite** people from different countries and 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

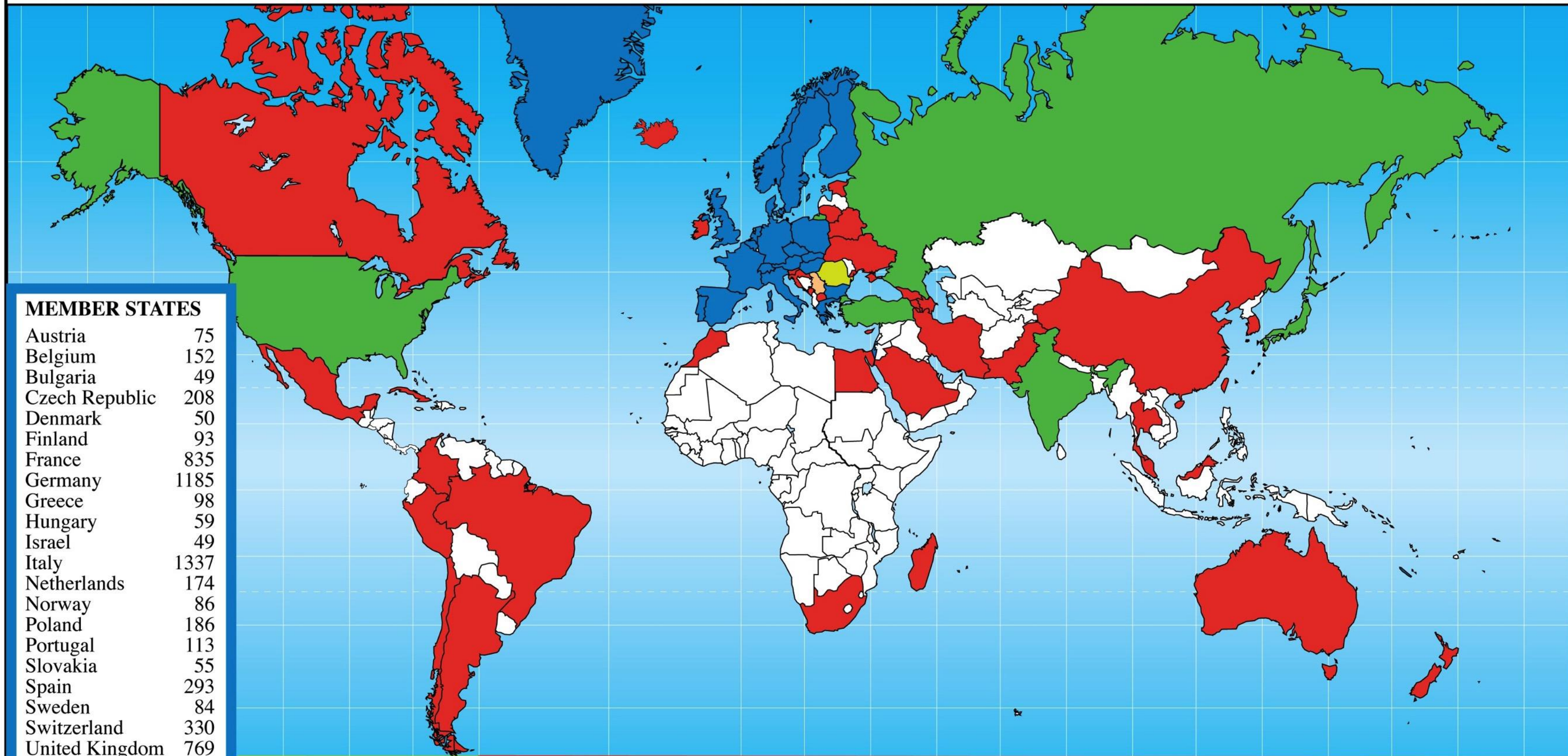
Applicant States for Membership or Associate Membership:
Brazil, Cyprus, Pakistan, Russia, Slovenia, Turkey, Ukraine

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



Science is getting more and more global

Distribution of All CERN Users by Location of Institute on 14 January 2014



MEMBER STATES

Austria	75
Belgium	152
Bulgaria	49
Czech Republic	208
Denmark	50
Finland	93
France	835
Germany	1185
Greece	98
Hungary	59
Israel	49
Italy	1337
Netherlands	174
Norway	86
Poland	186
Portugal	113
Slovakia	55
Spain	293
Sweden	84
Switzerland	330
United Kingdom	769

6280

OBSERVERS

India	153
Japan	217
Russia	890
Turkey	110
USA	1724

3094

CANDIDATE FOR ACCESSION

Romania	86
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ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP

Serbia	30
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OTHERS

Argentina	13
Armenia	16
Australia	39
Azerbaijan	2
Belarus	24
Brazil	116
Canada	147
Chile	8

China	122
China (Taipei)	71
Colombia	10
Croatia	23
Cuba	3
Cyprus	13
Egypt	18
Estonia	17
Georgia	11
Iceland	4

Iran	20
Ireland	5
Korea	105
Lithuania	13
Madagascar	3
Malaysia	8
Mexico	46
Montenegro	1
Morocco	6
New Zealand	5

Pakistan	18
Peru	2
Saudi Arabia	3
Slovenia	25
South Africa	32
Thailand	8
T.F.Y.R.O.M.	1
Ukraine	24

982

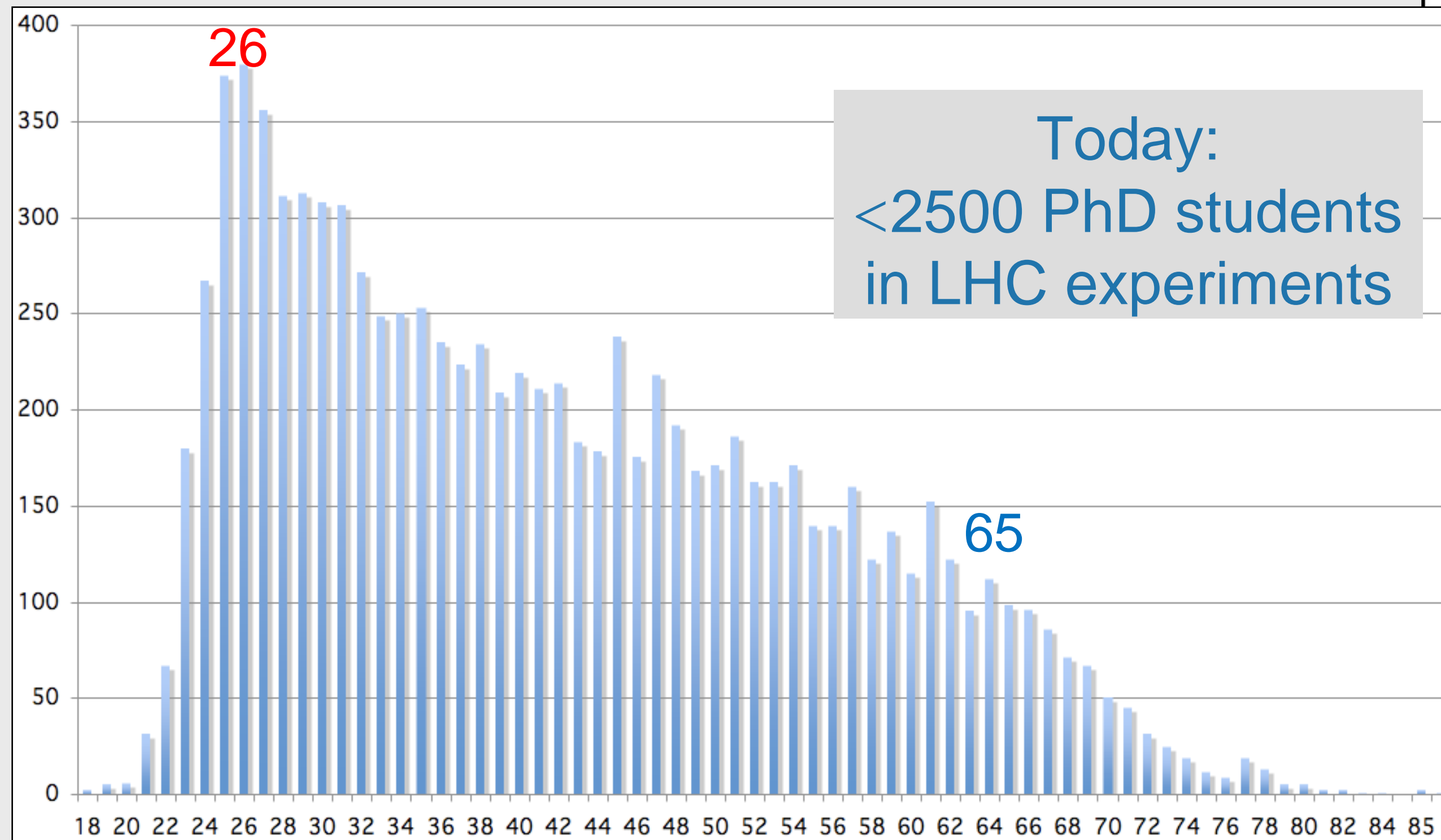




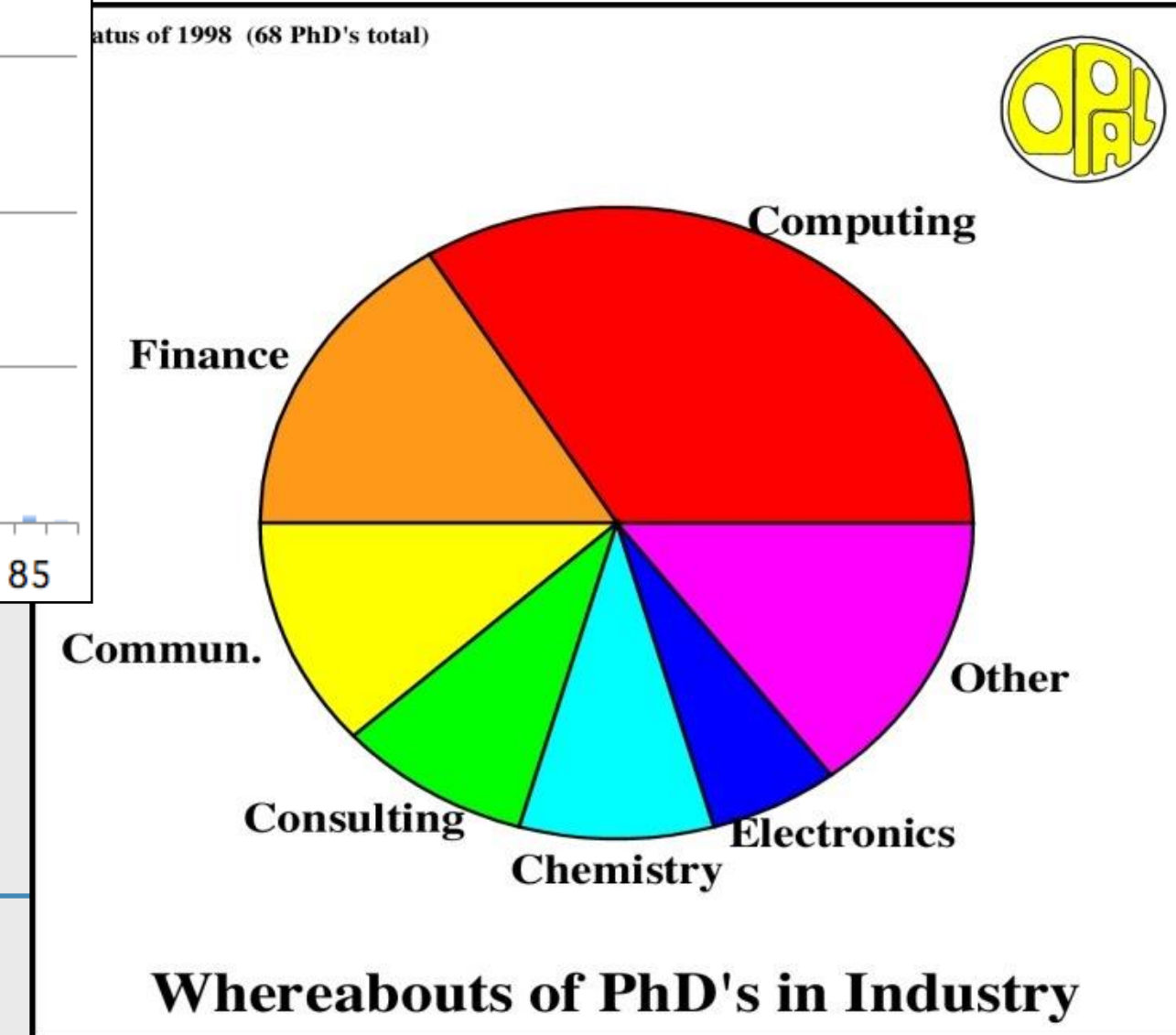
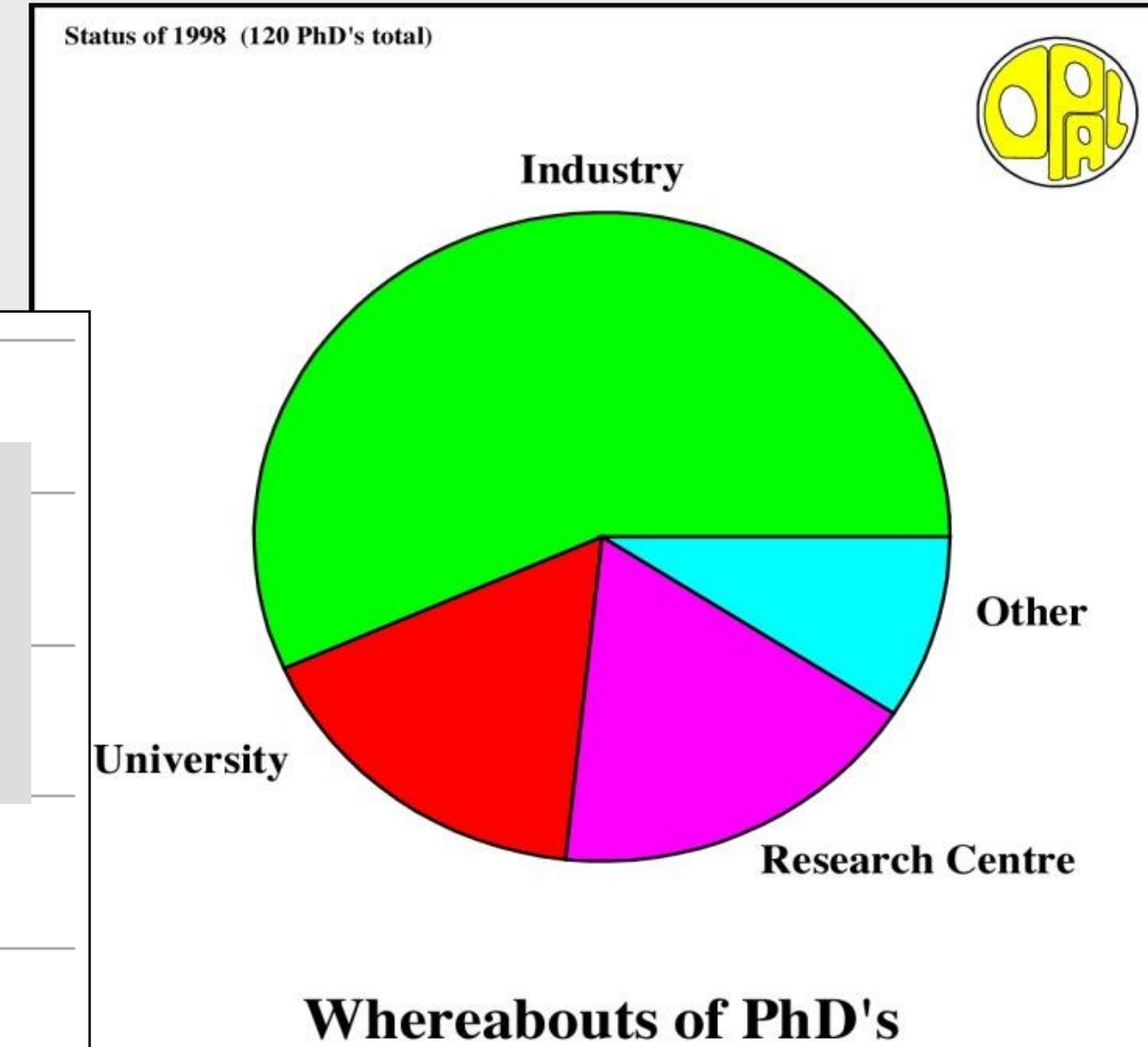
Age Distribution of Scientists

- and where they go afterwards

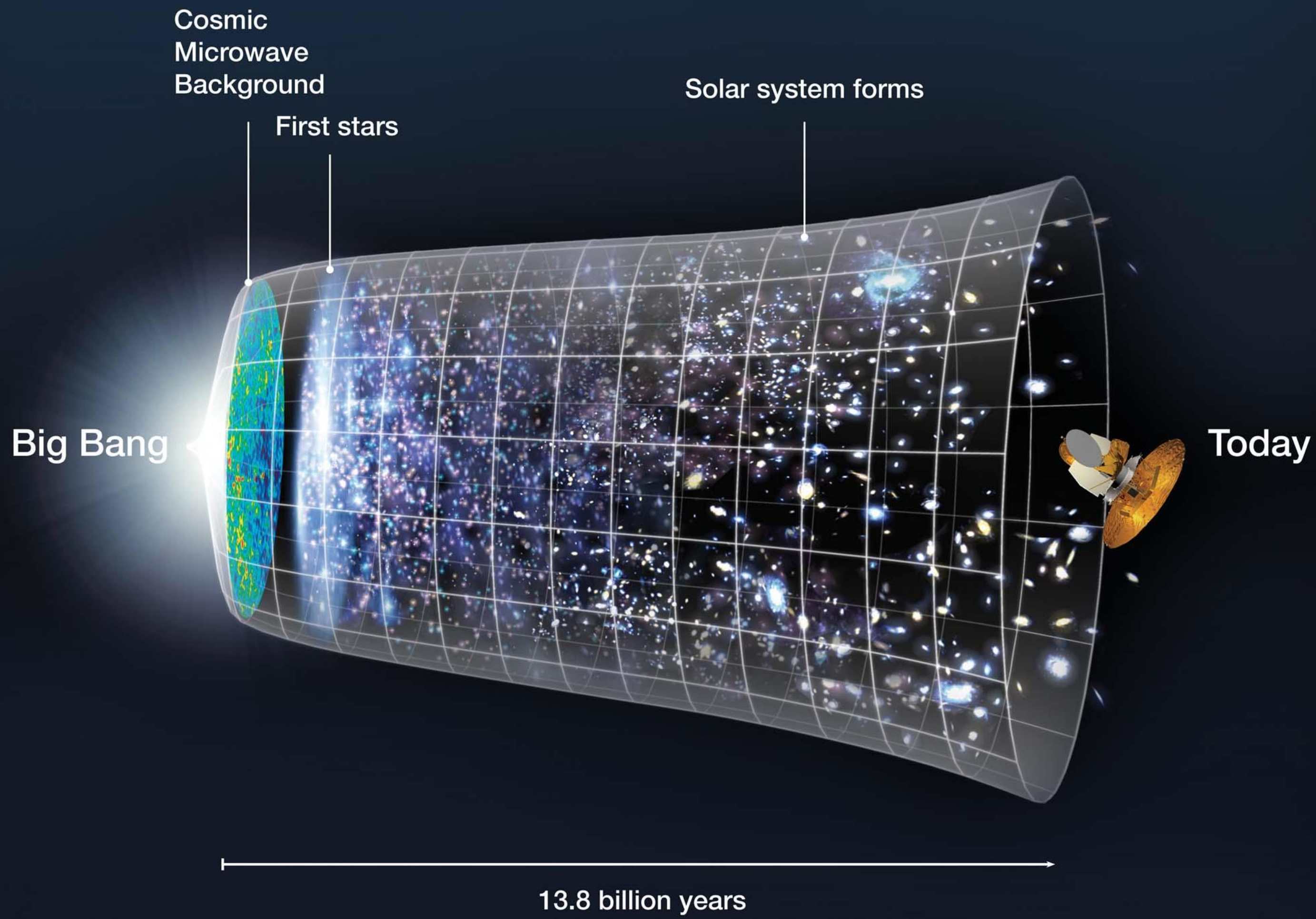
Survey in March 2009

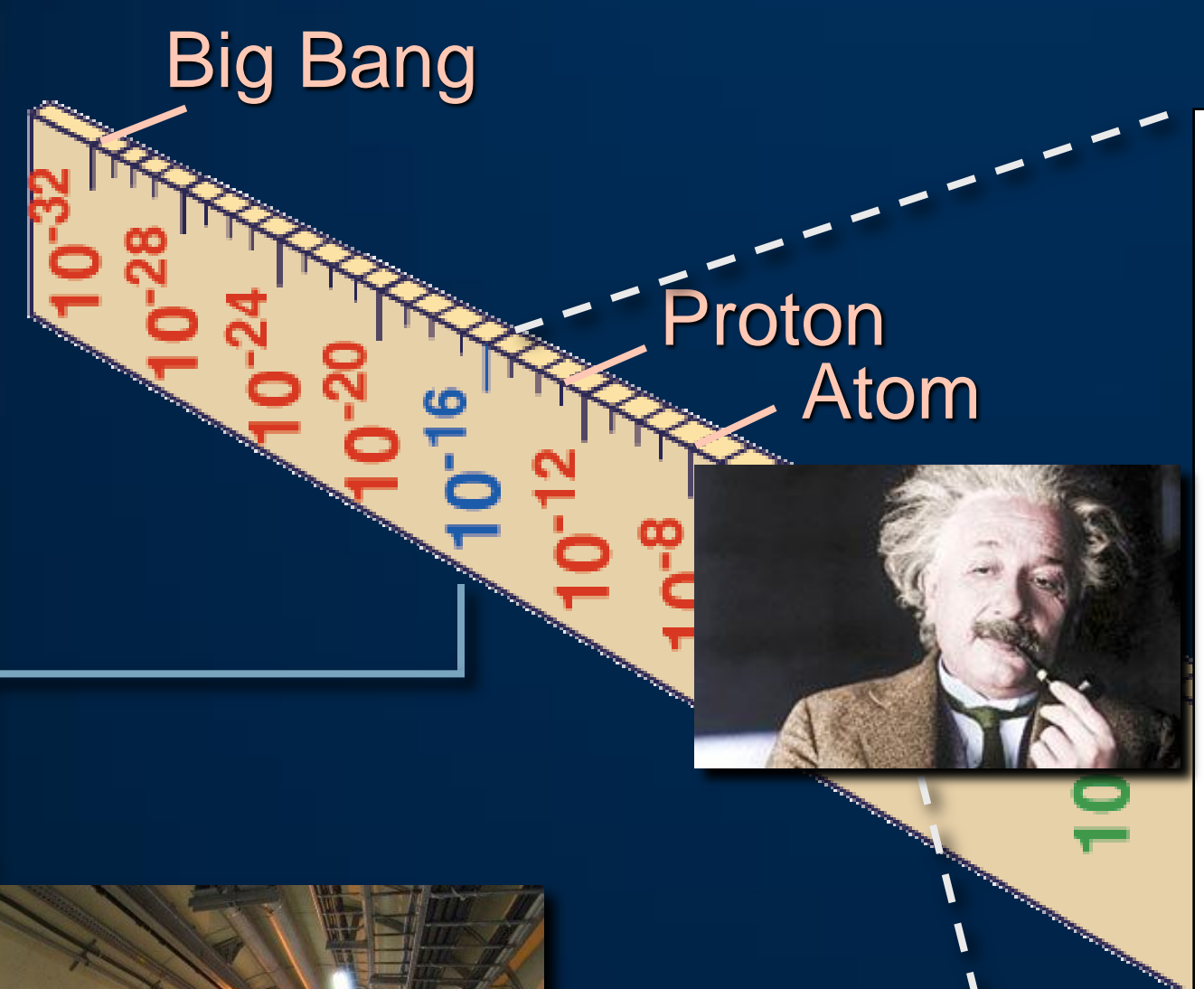


They do not all stay: where do they go?



Cosmic evolution: 13.8 billion years



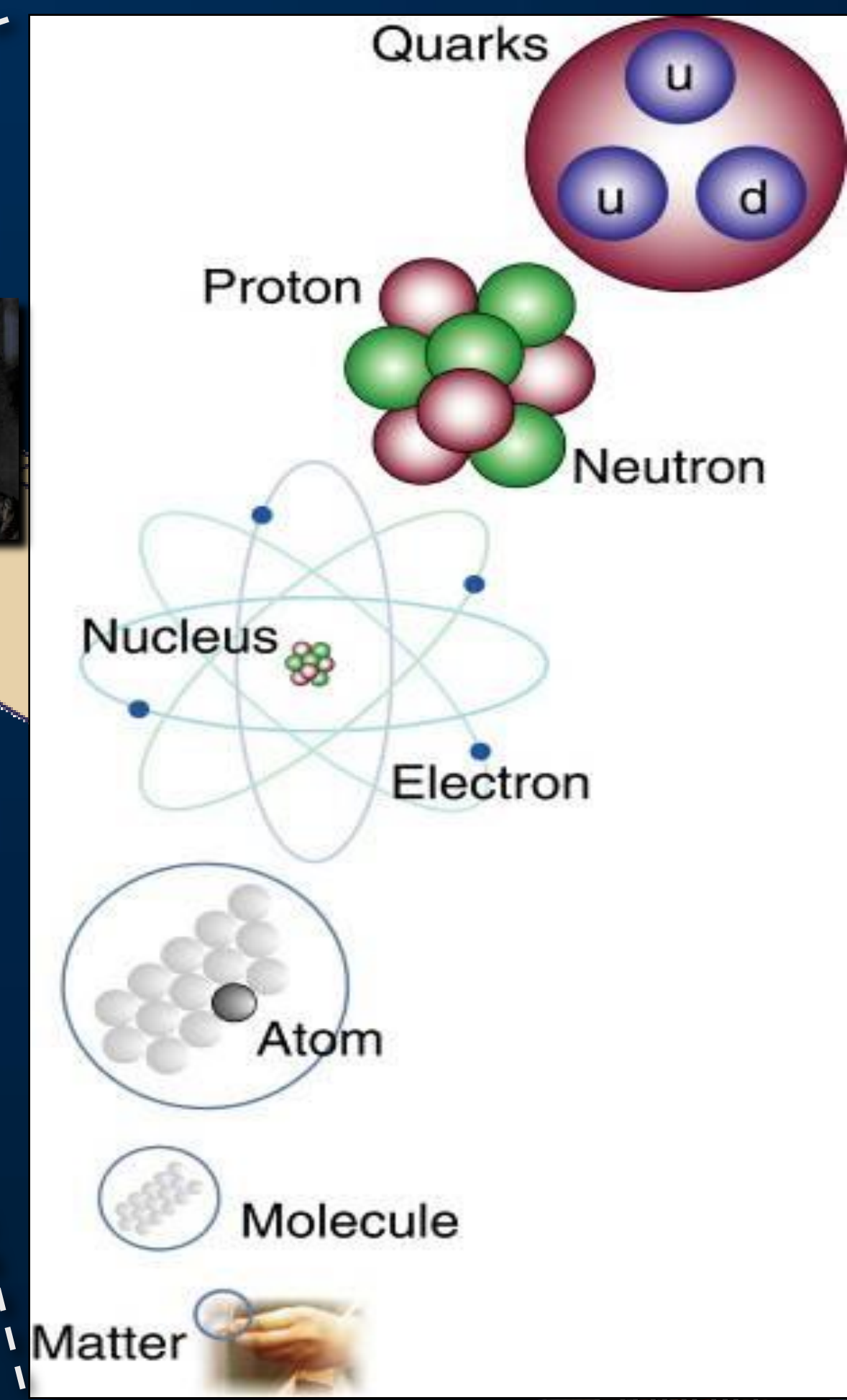


LHC

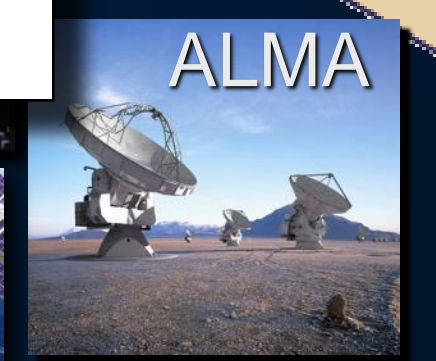
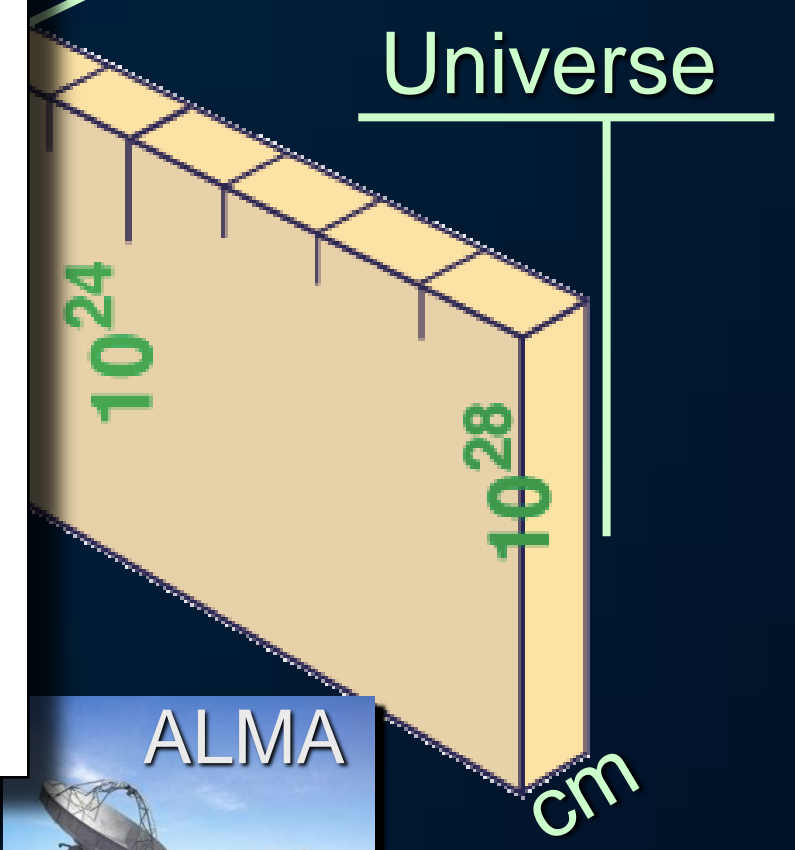
Super-Microscope



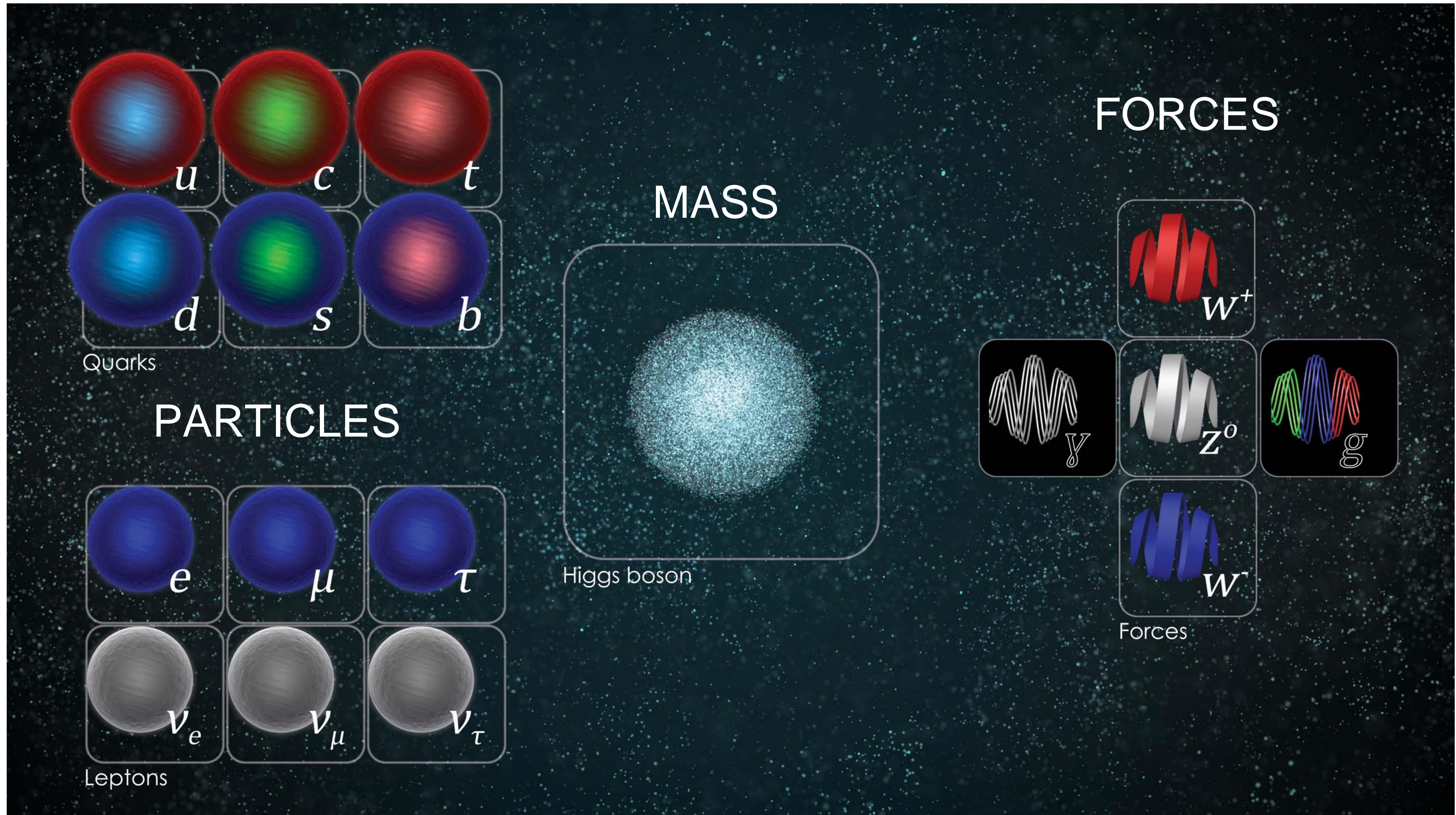
Study physics laws of first moments after Big Bang
 increasing Symbiosis between Particle Physics,
 Astrophysics and Cosmology



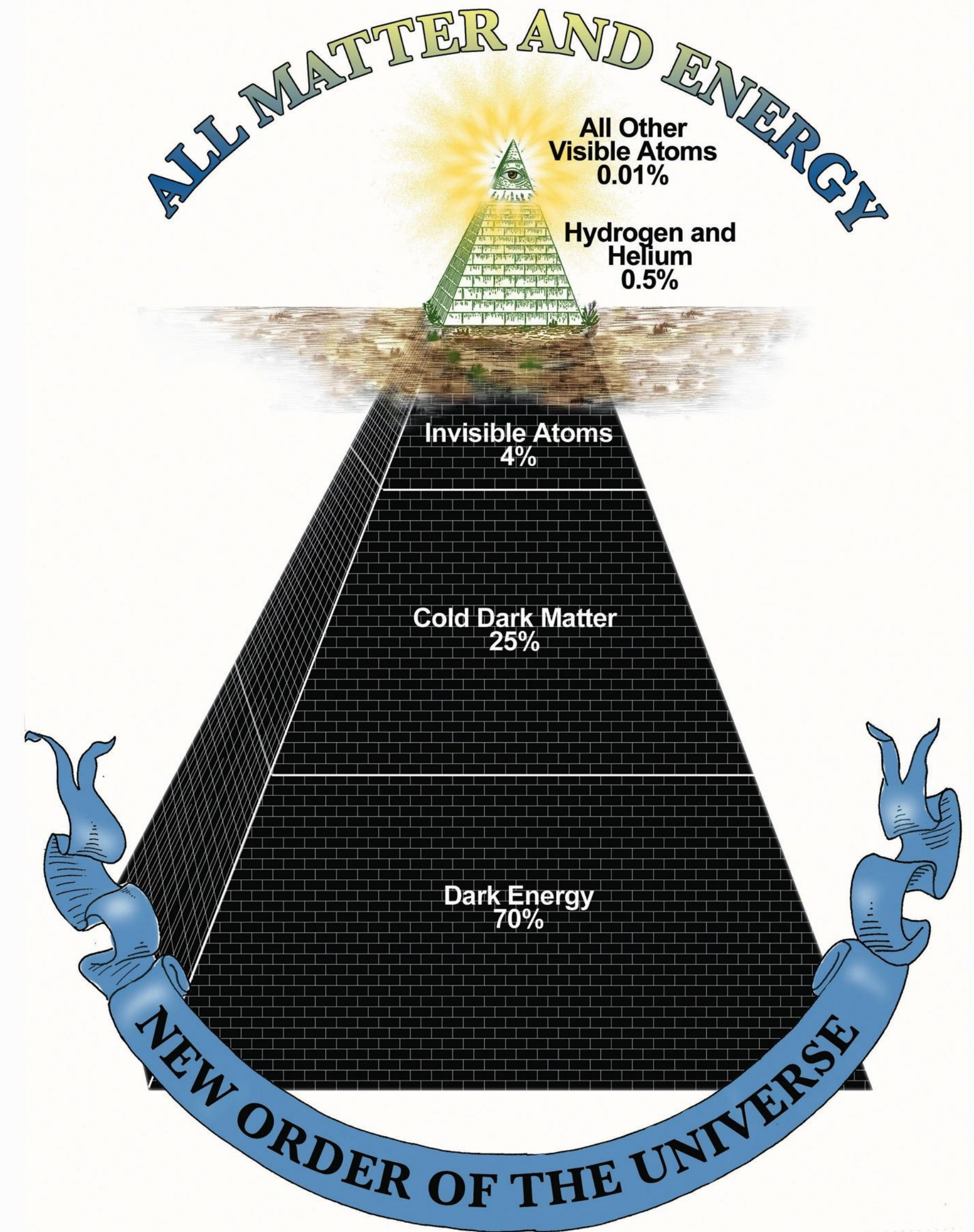
Radius of Galaxies



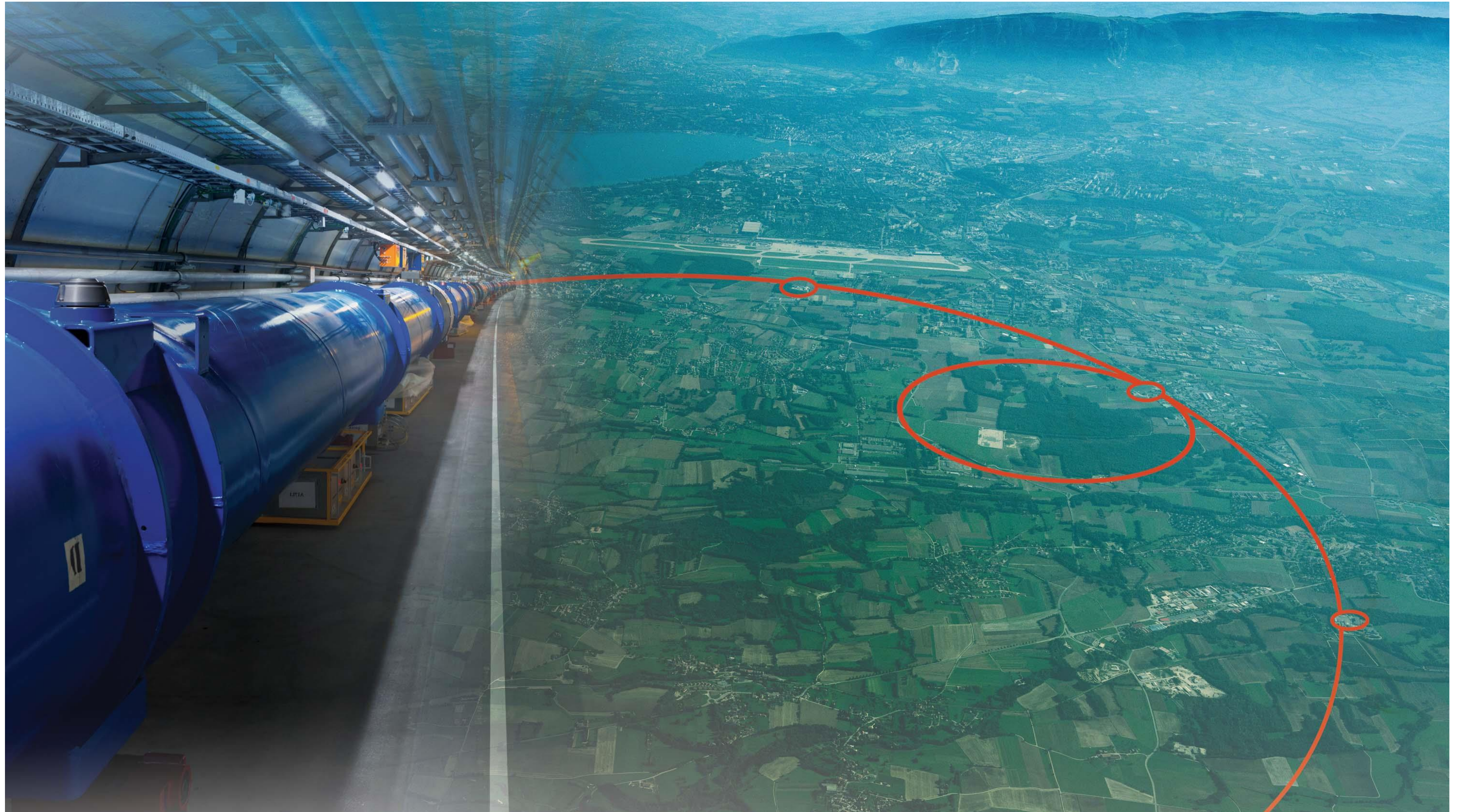
Origin of particles and forces



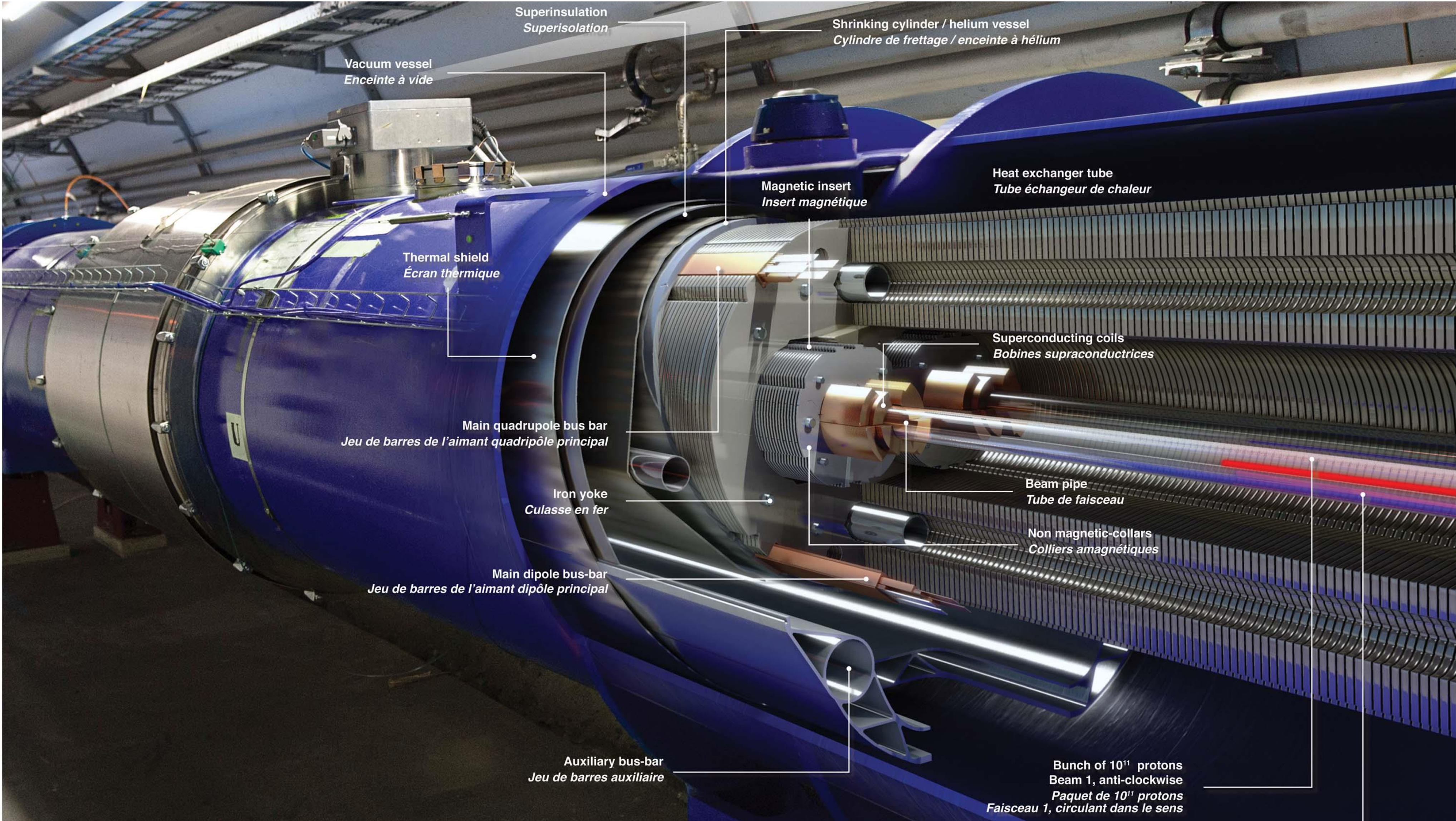
The mysteries of the universe - today



CERN



Large Hadron Collider - LHC



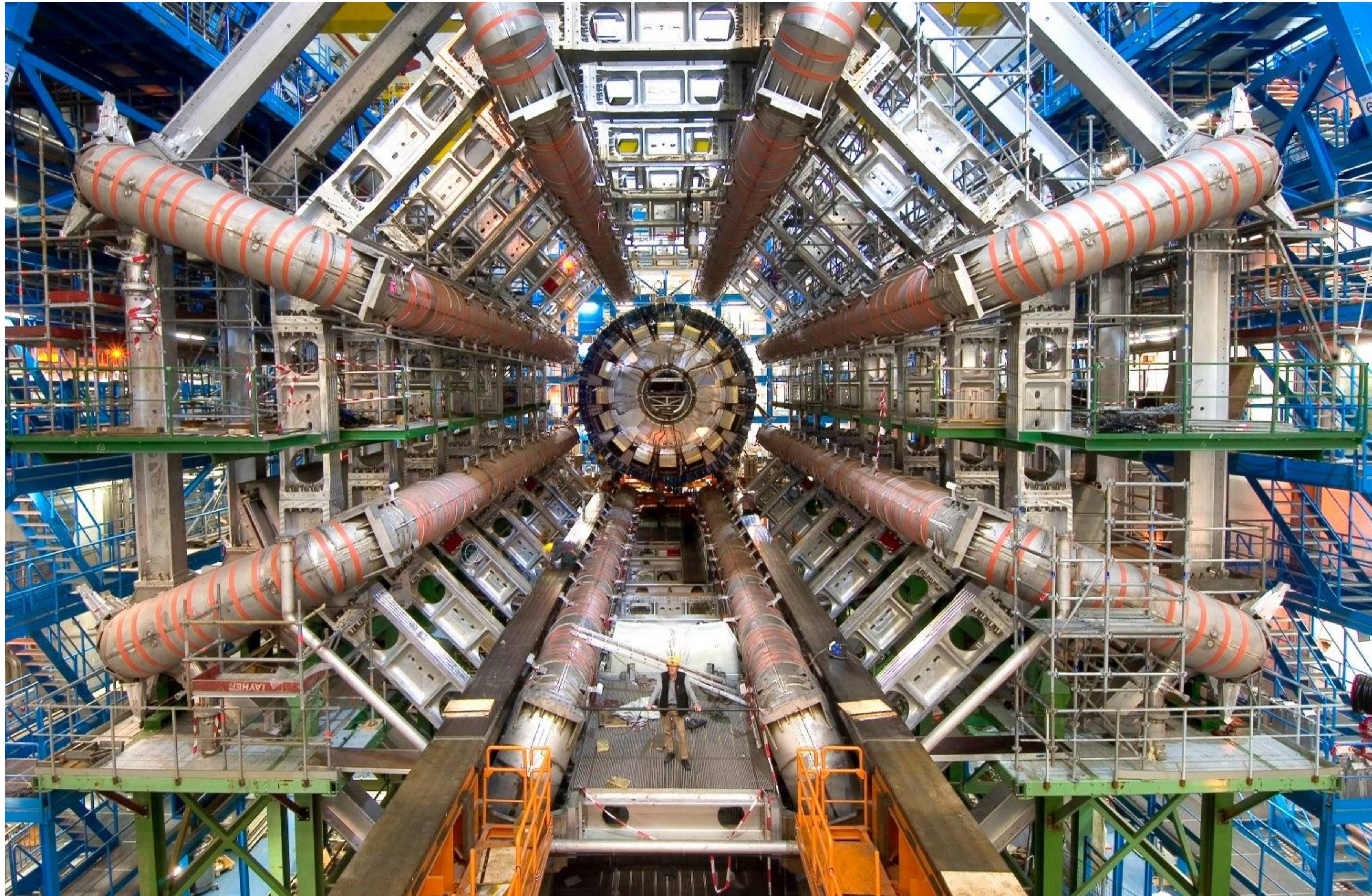
CERN Accelerators



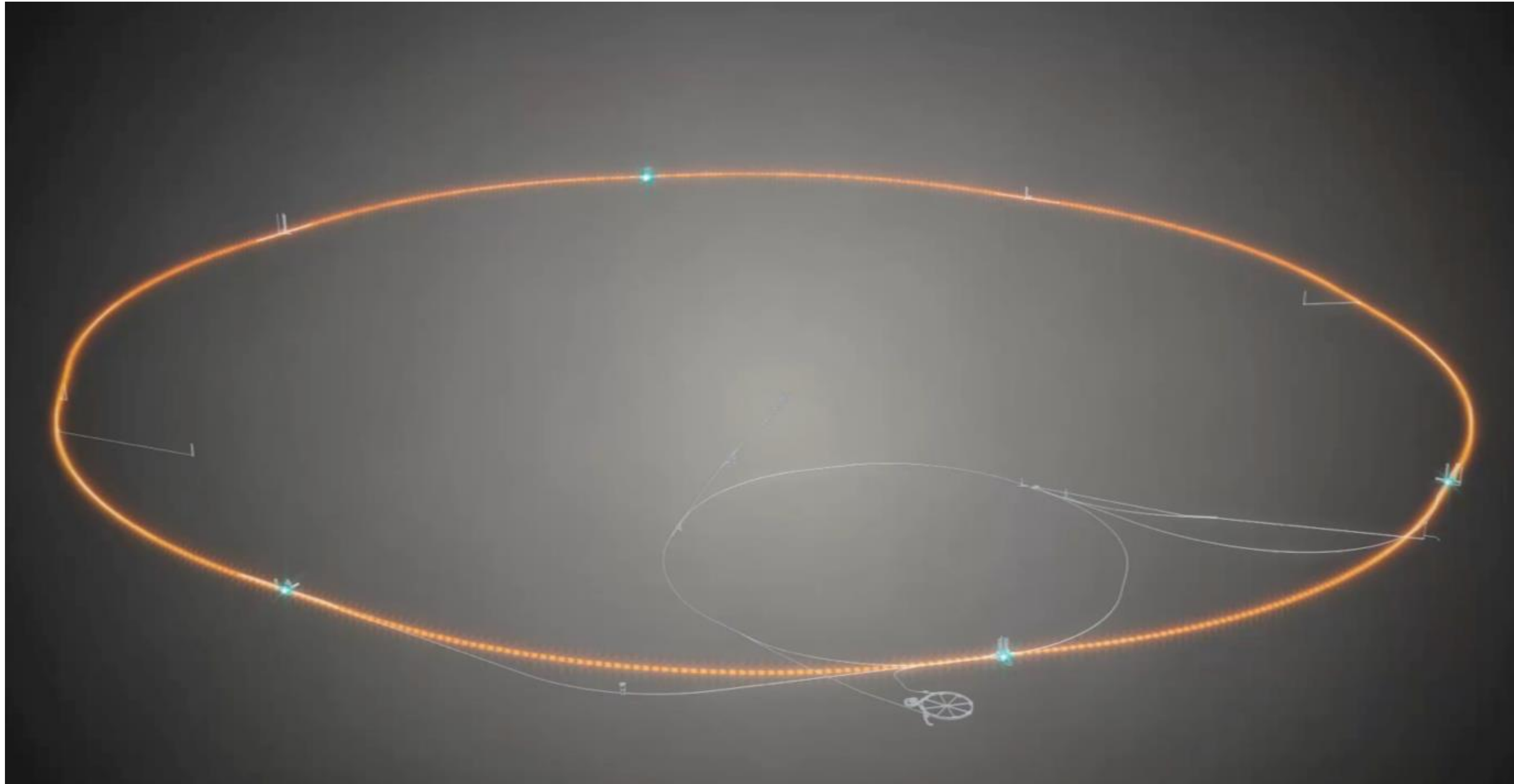
All animations can be downloaded from:

<http://cern60.web.cern.ch/en/cern-exhibitions-content>

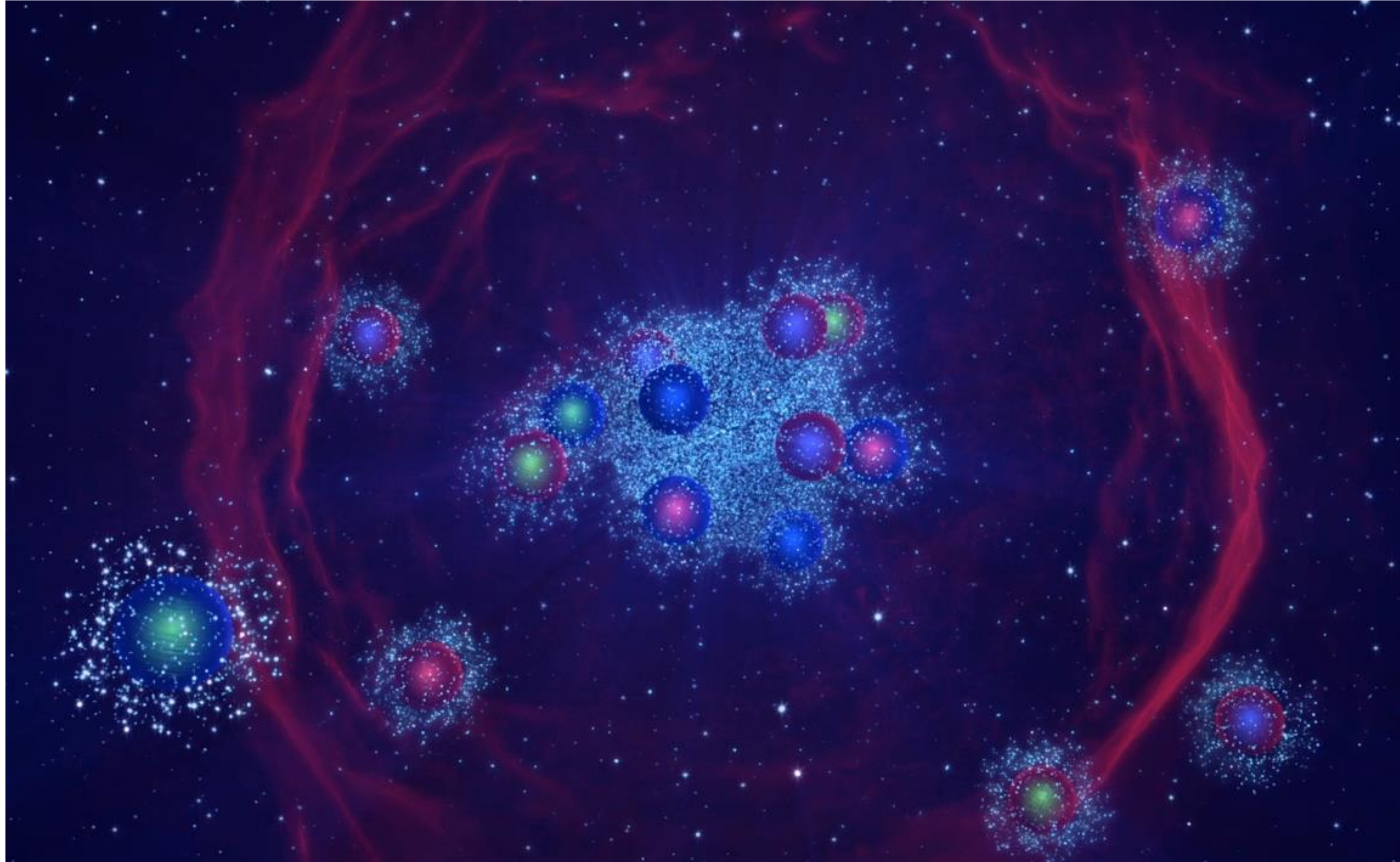
LHC experiments - huge detectors



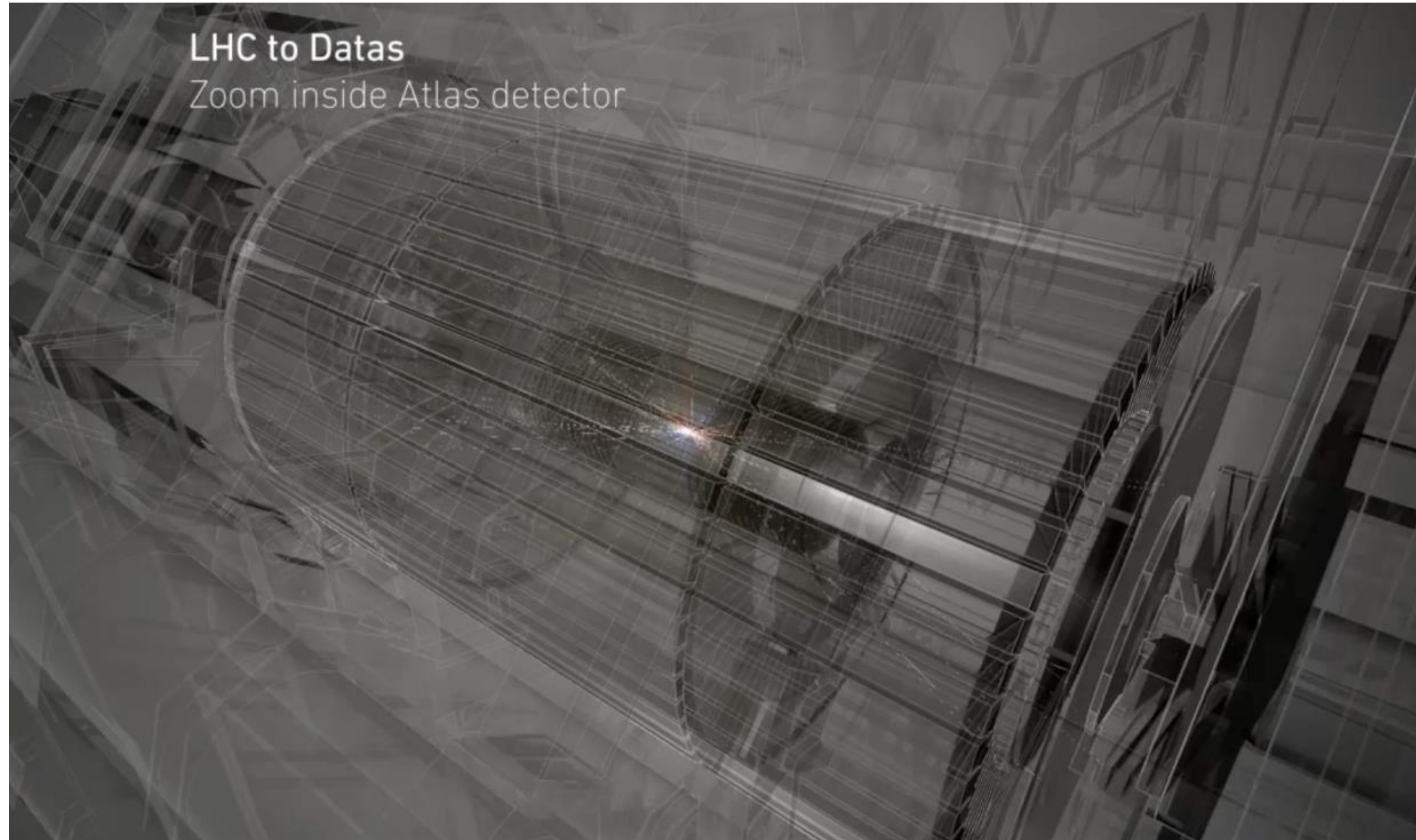
Collisions in ATLAS detector: 600 million per second



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



LHC data flood: primary rate ~ 1000 TB/sec



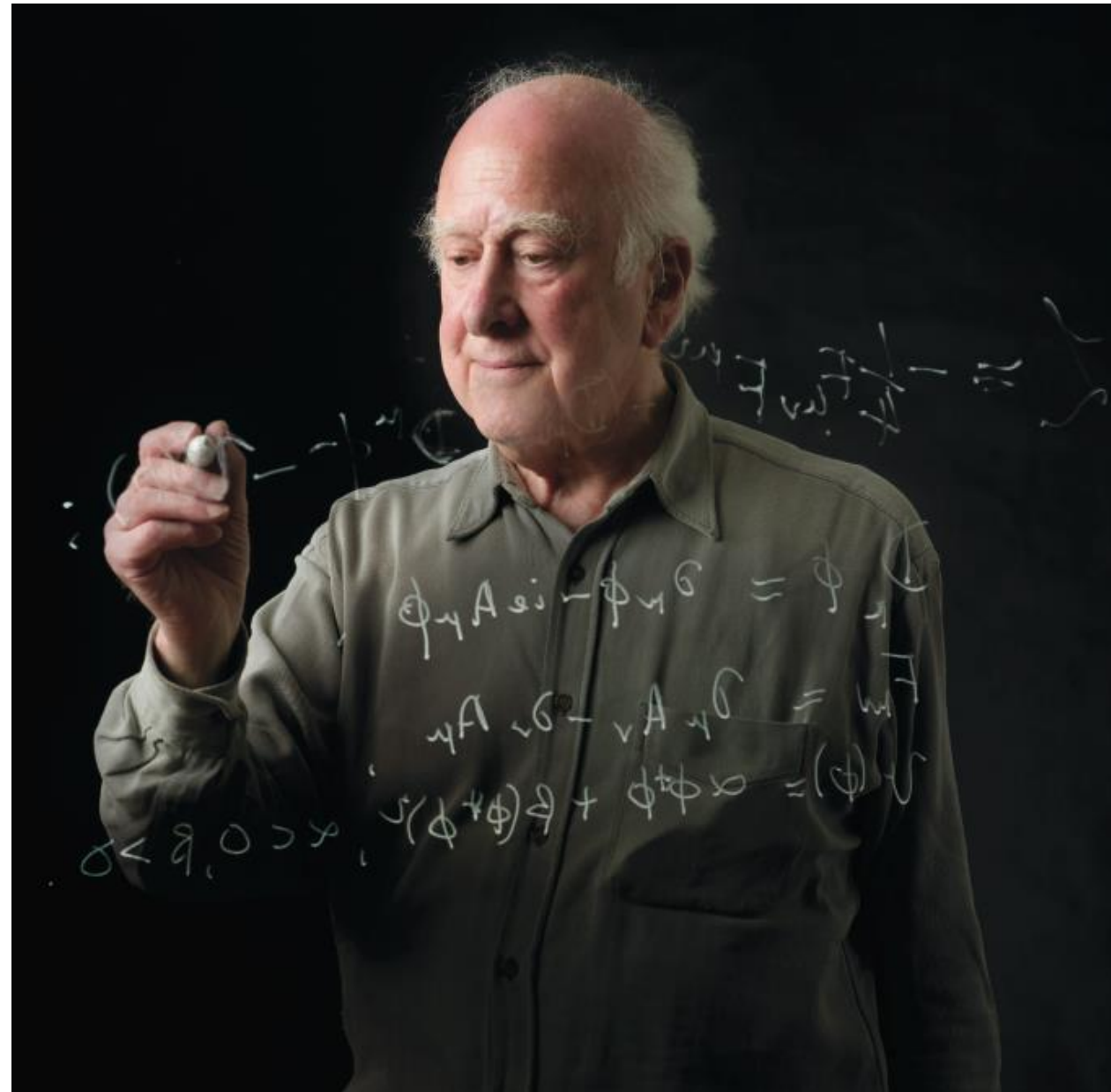
Nobel Prize in Physics 2013



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"*.



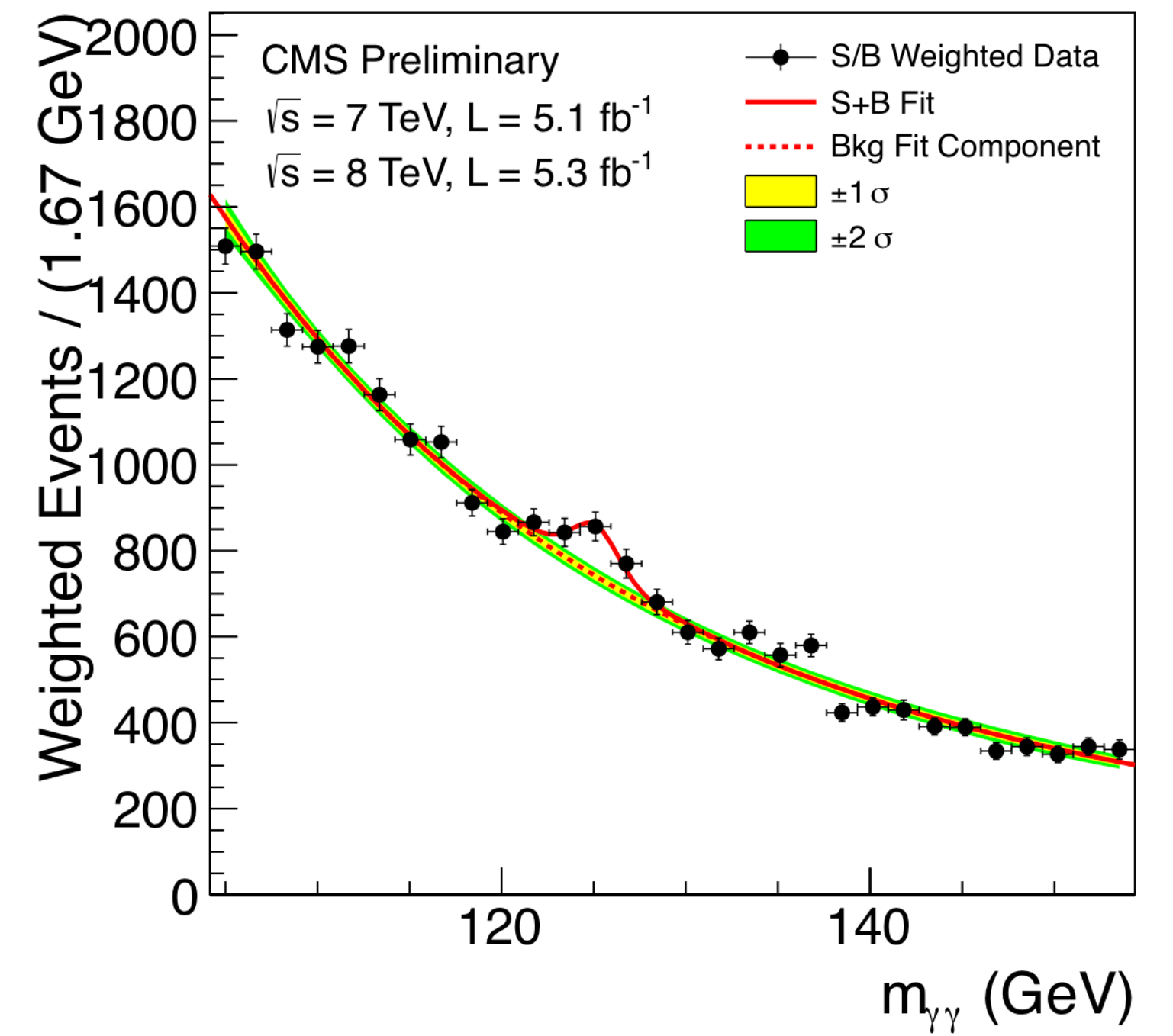
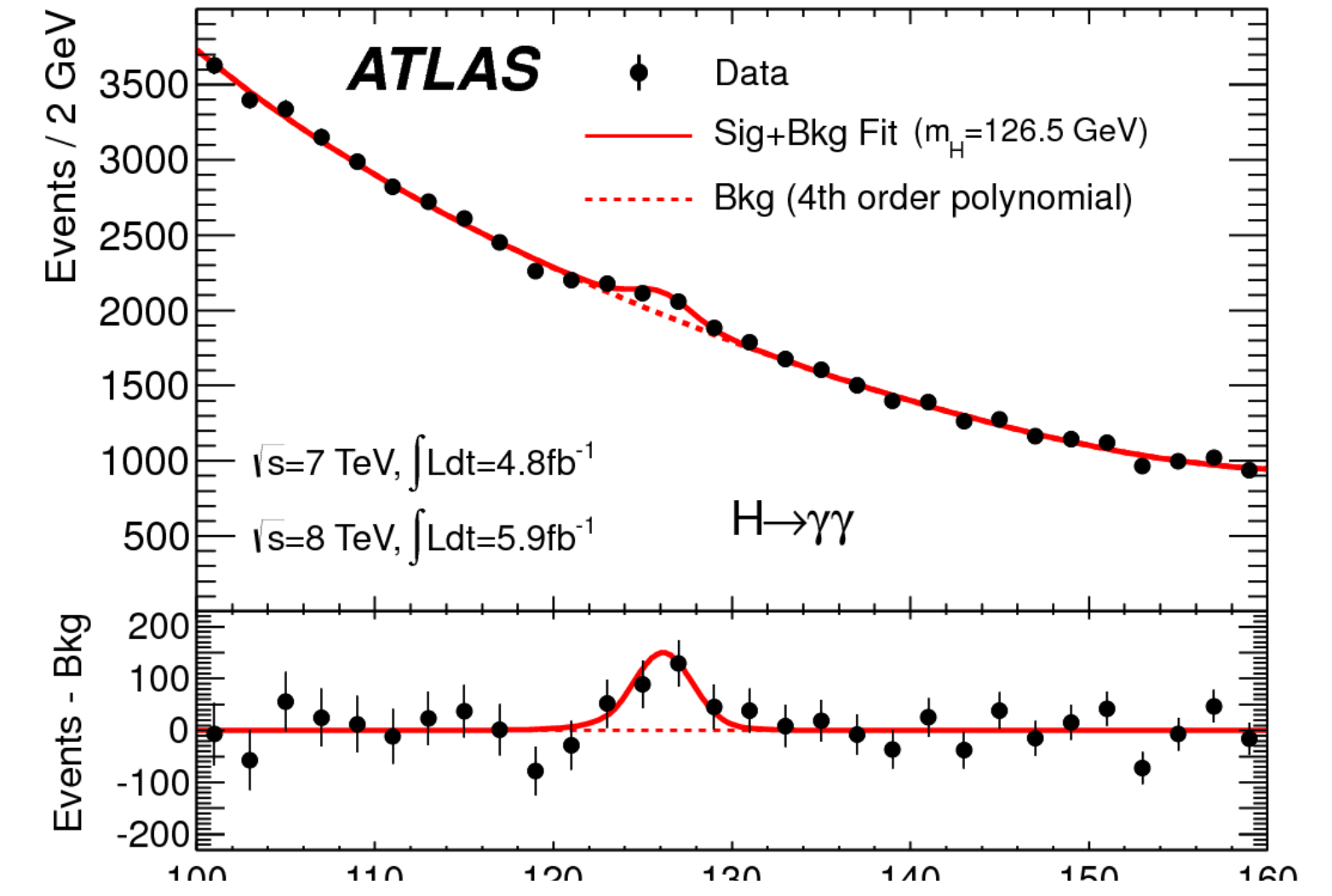
The discovery of a Higgs boson



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



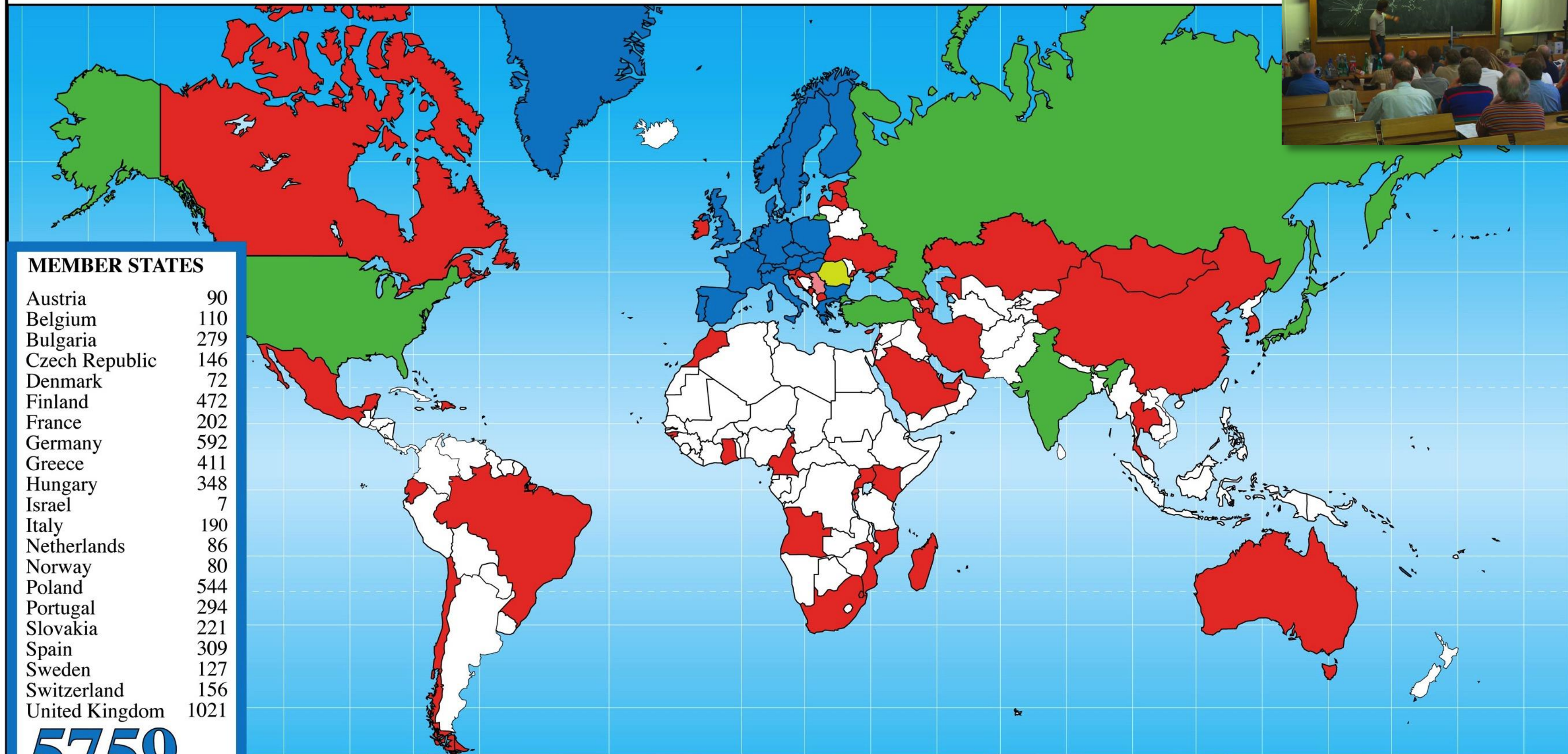
Physics Students
Summer Students Programme



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
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ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP

Serbia	14
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OBSERVER STATES

India	2
Japan	5
Russia	163
Turkey	3
USA	65

238

OTHERS

Angola	4
Australia	5
Azerbaijan	1
Brazil	83
Burundi	1
Cameroon	3
Canada	3
Cape Verde	3
Chile	3

China	1
Croatia	1
Cyprus	8
Dominican Rep.	2
Ecuador	2
Estonia	37
Georgia	55
Ghana	6
Guinea Bissau	1
Iran	1

Ireland	5
Kazakhstan	3
Kenya	4
Latvia	1
Lebanon	1
Madagascar	2
Malta	36
Mexico	6
Mongolia	1
Montenegro	13

Morocco	2
Mozambique	17
Qatar	1
Rwanda	17
Sao Tome	3
Saudi Arabia	1
Singapore	2
Slovenia	21
South Africa	6
South Korea	44

Swaziland	1
Thailand	7
T.F.Y.R.O.M.	11
Timor-Leste	4
Uganda	3
Ukraine	57
U.A.E.	1

490



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

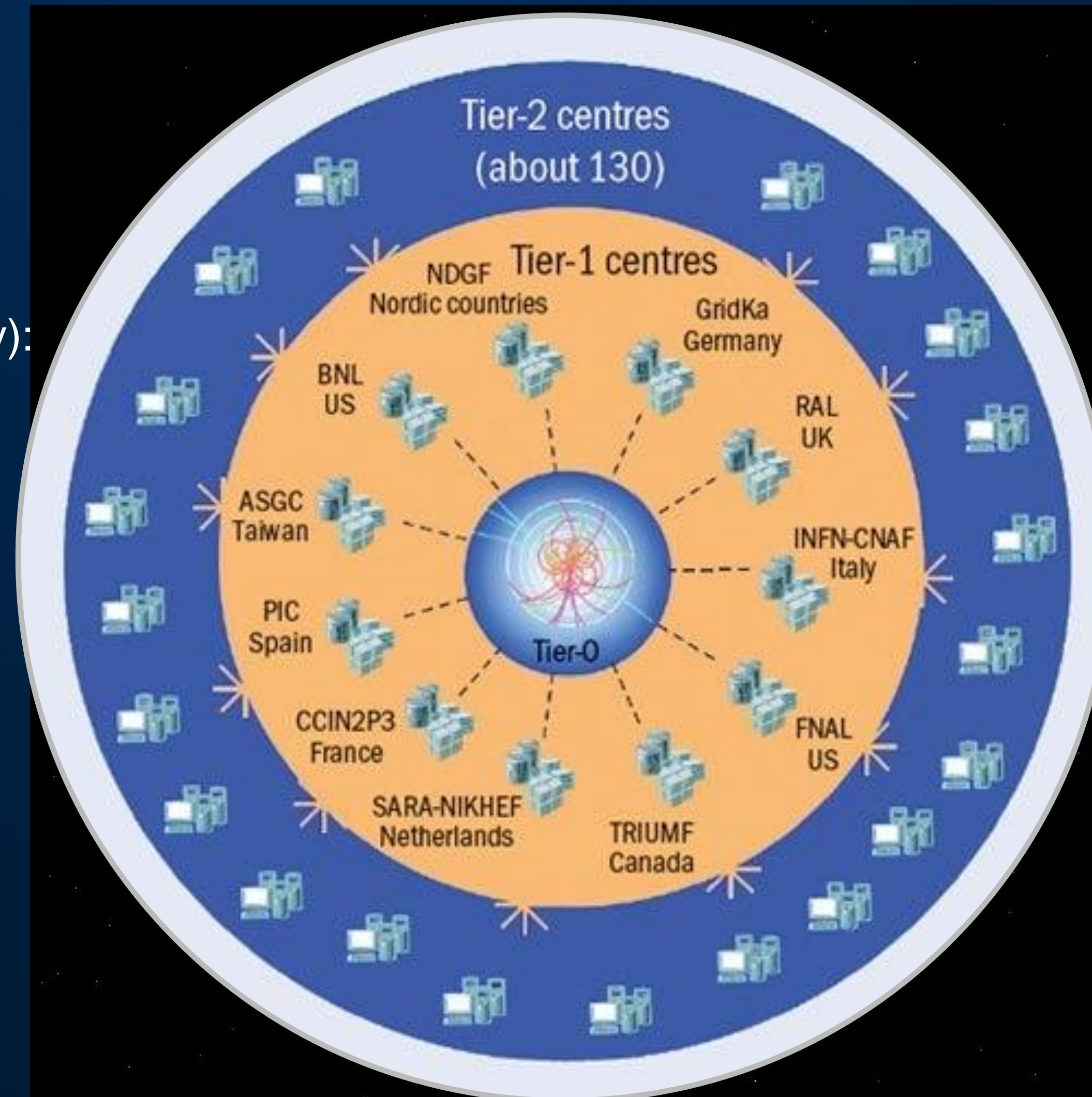


The Worldwide LHC Computing Grid

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

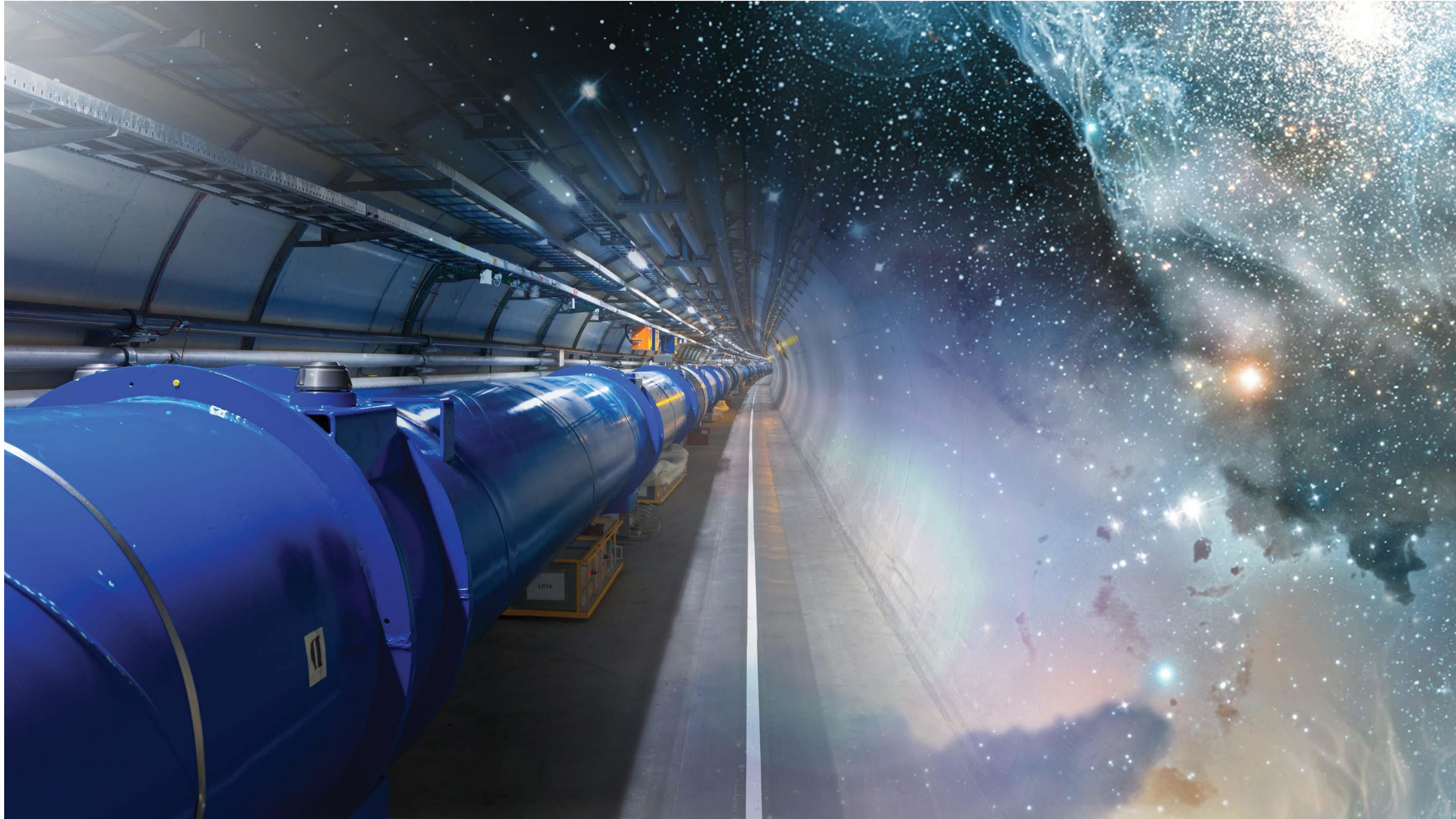
Integrates computer centres worldwide that provide computing and storage resource into a single infrastructure accessible by all LHC physicists



Pushing the frontiers - medical diagnostics and therapy



Pushing the frontiers: **new discoveries are waiting**



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