Stories about CERN

Mick Storr
CERN and University of Birmingham

Accelerating Science and Innovation

1945 l'Europe après deux guerres dévastatrices en moins de 30 ans

Les chercheurs quittent l'Europe pour USA

CERN: founded in 1954: 12 European States
"Science for Peace"
Today: 23 Member States

~ 2'500 staff
~ 1'800 other paid personnel
~ 13'000 scientific users

Budget (2019) ~ 1'300 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 Member States: Croatia, India, Lithuania, Pakistan, Turkey, Ukraine

Associate Members in the Pre-Stage to Membership: Cyprus, Slovenia

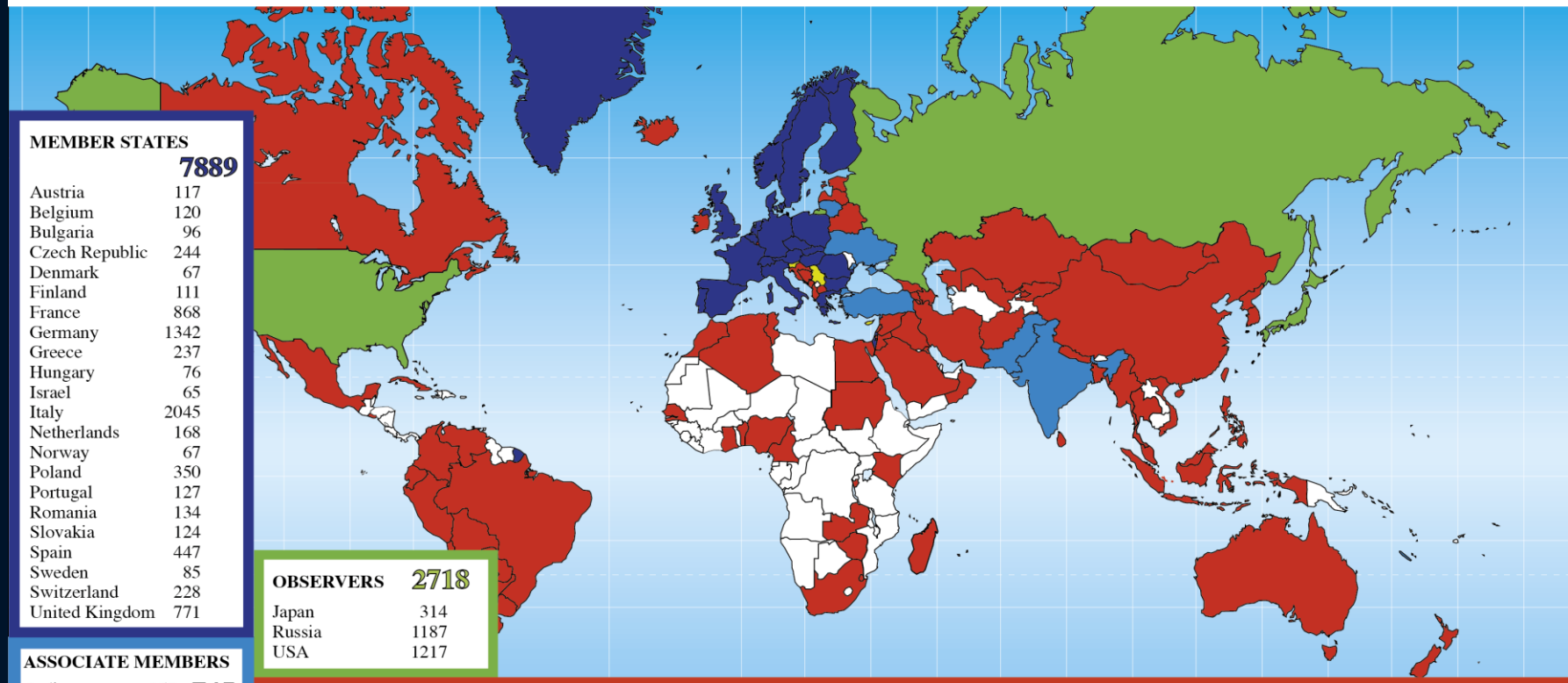
Non-Member States with co-operation agreements: 35

Scientific contacts: 24

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

Science is getting more and more global

Distribution of All CERN Users by Nationality on 24 January 2018



MEMBER STATES	7889
Austria	117
Belgium	120
Bulgaria	96
Czech Republic	244
Denmark	67
Finland	111
France	868
Germany	1342
Greece	237
Hungary	76
Israel	65
Italy	2045
Netherlands	168
Norway	67
Poland	350
Portugal	127
Romania	134
Slovakia	124
Spain	447
Sweden	85
Switzerland	228
United Kingdom	771

ASSOCIATE MEMBERS		745
India	357	
Lithuania	35	
Pakistan	65	
Turkey	173	
Ukraine	115	

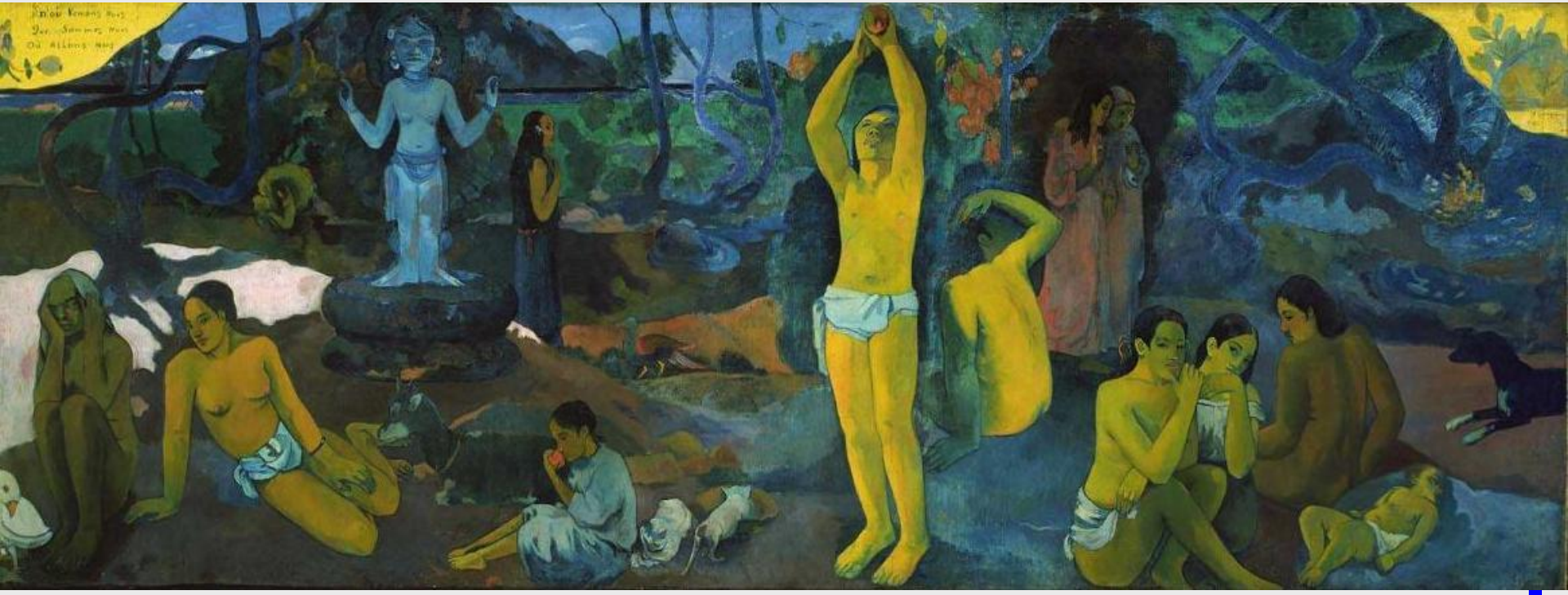
ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP	118
Cyprus	26
Serbia	57
Slovenia	35

OBSERVERS	2718
Japan	314
Russia	1187
USA	1217

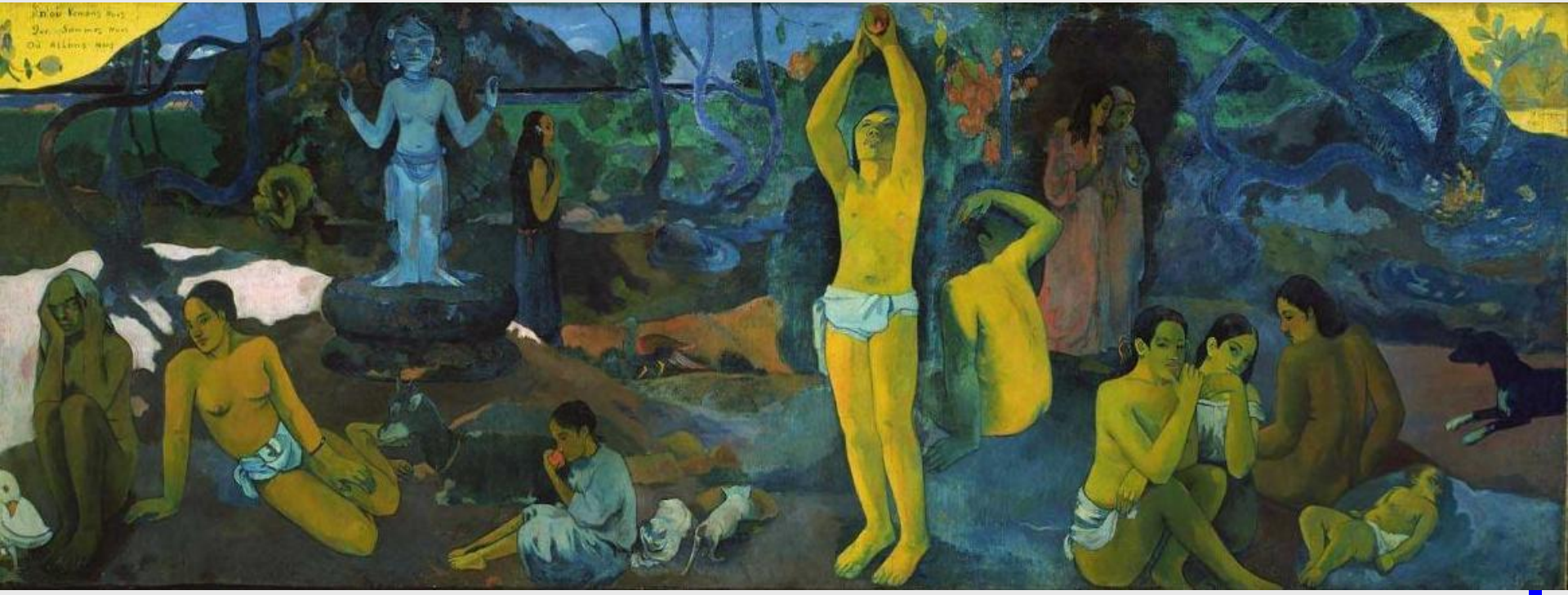
OTHERS	1872
Afghanistan	1
Albania	3
Algeria	14
Argentina	27
Armenia	19
Australia	31
Azerbaijan	10
Bangladesh	11
Belarus	48
Benin	1
Bolivia	4
Bosnia & Herzegovina	2
Brazil	135
Burundi	1
Cameroon	1
Canada	161
Chile	20
China	510
Colombia	45
Croatia	41
Cuba	12
Ecuador	6
Egypt	31
El Salvador	1
Estonia	15
Georgia	46
Ghana	1
Hong Kong	1
Iceland	3
Indonesia	11
Iran	51
Iraq	1
Ireland	16
Jordan	1
Kazakhstan	5
Kenya	3
Korea Rep.	185
Kyrgyzstan	1
Latvia	2
Lebanon	23
Luxembourg	2
Madagascar	4
Malaysia	15
Malta	9
Mauritius	1
Mexico	82
Mongolia	2
Montenegro	11
Morocco	20
Myanmar	1
Nepal	10
New Zealand	5
Nigeria	3
North Korea	1
Oman	3
Palestine (O.T.).	7
Paraguay	2
Peru	7
Philippines	3
Saint Kitts and Nevis	1
Saudi Arabia	2
Senegal	1
Singapore	4
South Africa	56
Sri Lanka	6
Sudan	1
Swaziland	1
Syria	1
Taiwan	51
Thailand	22
T.F.Y.R.O.M.	2
Tunisia	5
Uruguay	1
Uzbekistan	4
Venezuela	10
Viet Nam	13
Zambia	1
Zimbabwe	2

CERN

European Organization for Nuclear Research
Organisation Européenne pour la Recherche Nucléaire



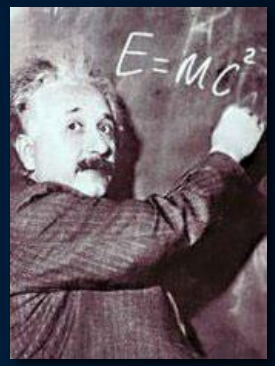
“Where do we come from?
What are we?
Where are we going?”



The aim of particle physics, CERN & the LHC:
What is the Universe made of?

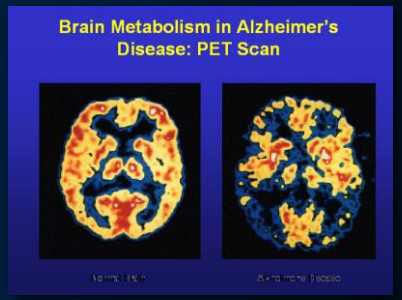
Innovation
Education
CERN
uniting people
Research

The Mission of CERN



- **Push forward** 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

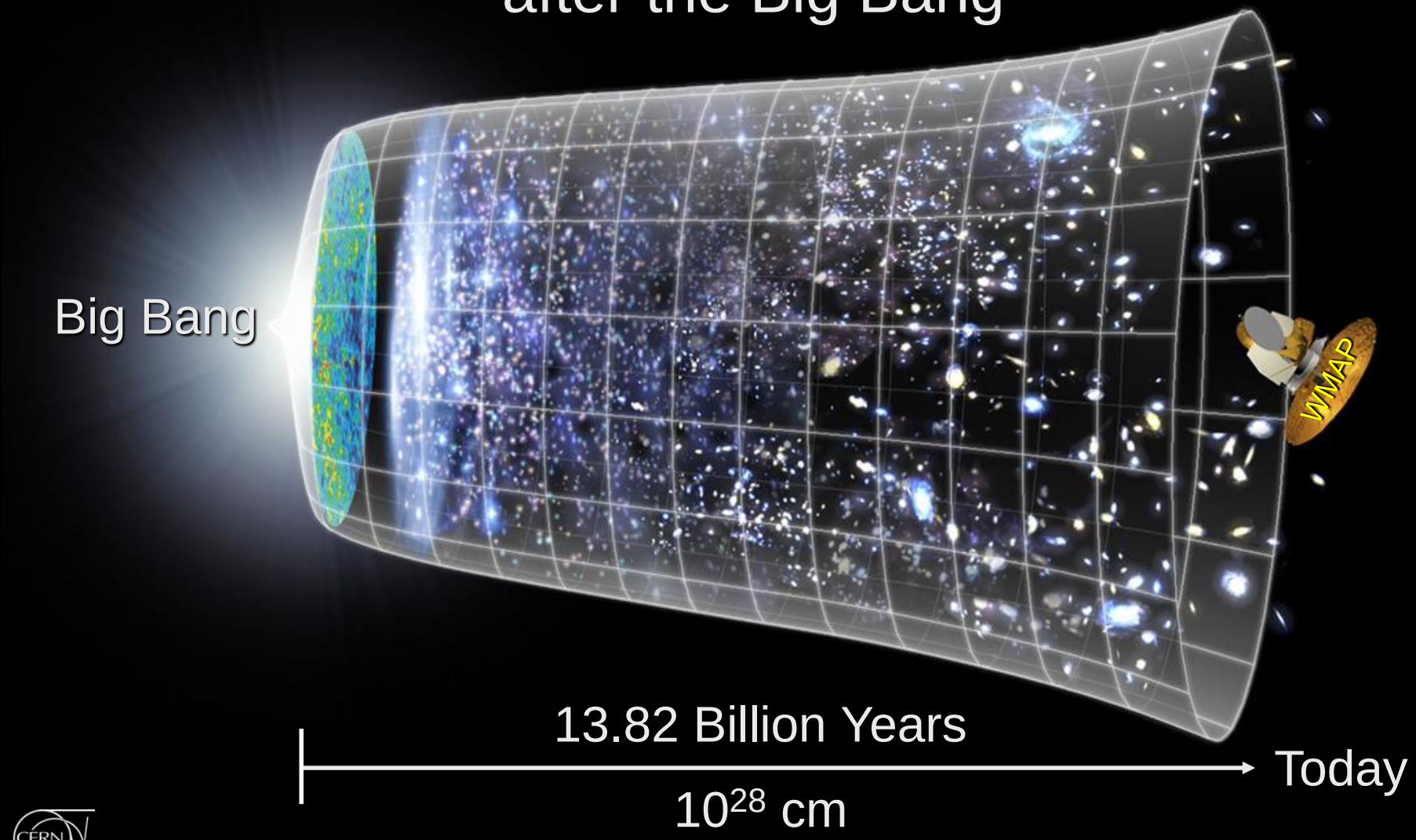
- **Train** scientists and engineers of tomorrow

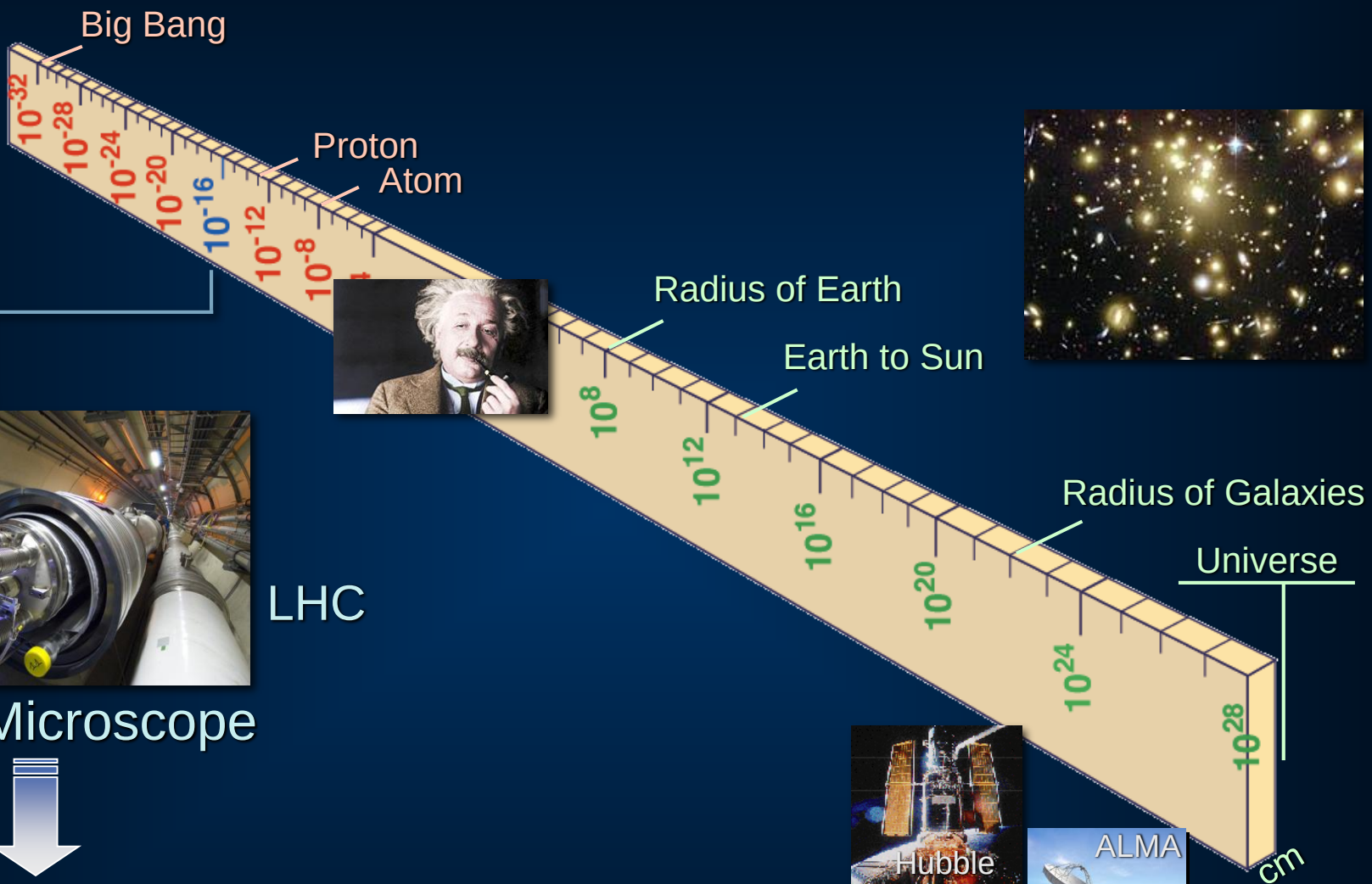
- **Unite** people from different countries and cultures

CERN

Scientific Challenge:

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





CERN

LHC

Super-Microscope

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

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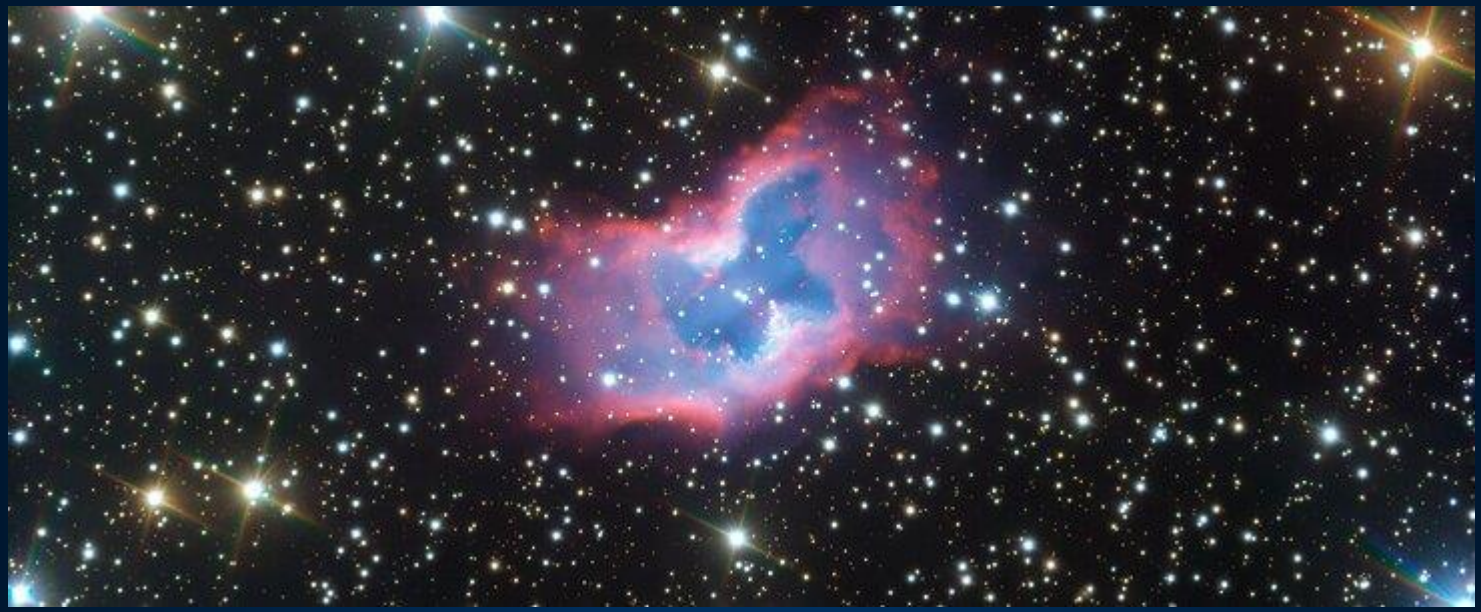
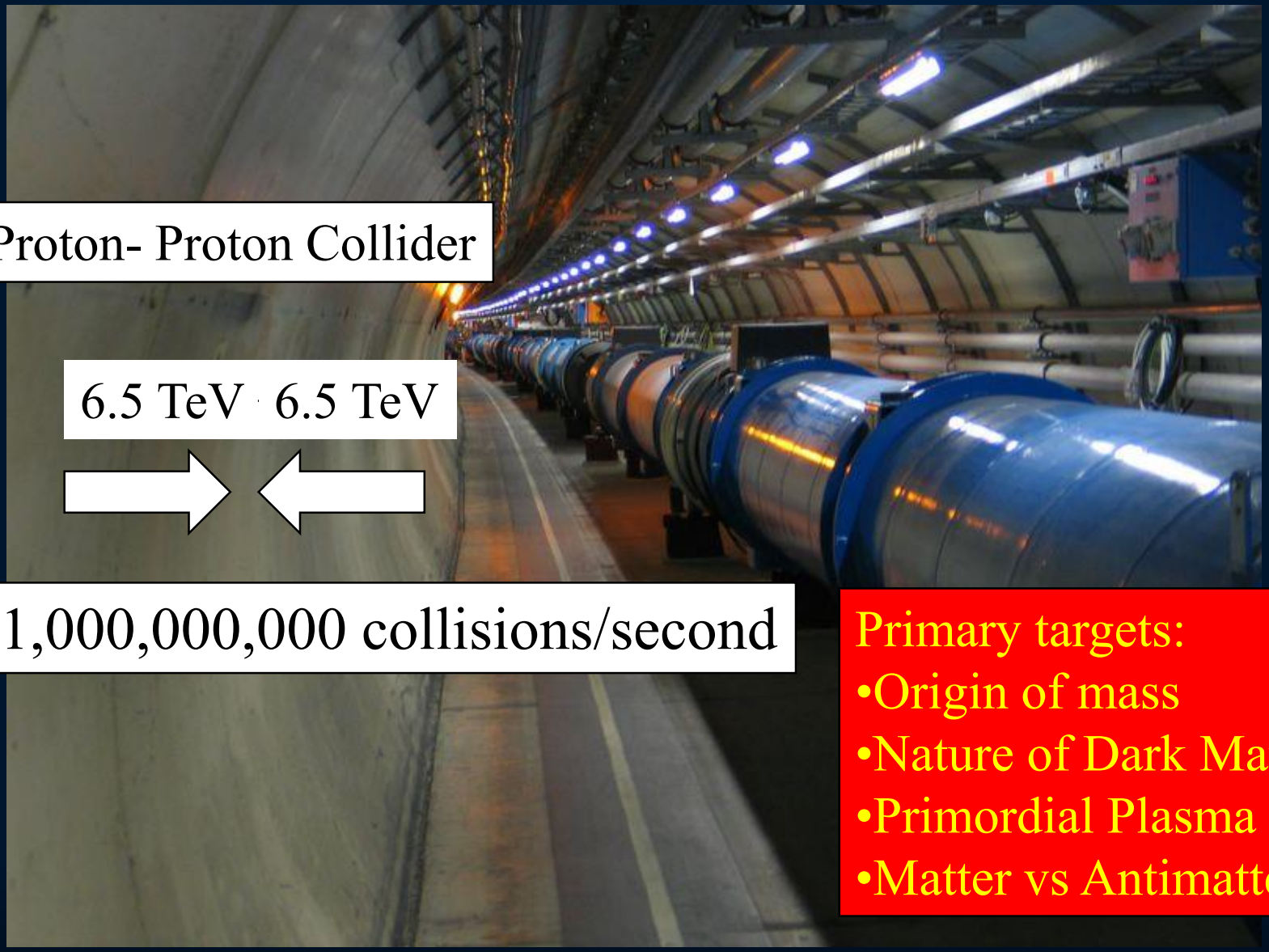


Resembling a butterfly with its symmetrical structure, beautiful colours, and intricate patterns, this striking bubble of gas — known as NGC 2899 — appears to float and flutter across the sky in this new picture from ESO's Very Large Telescope (VLT).

This object is located between 3000 and 6500 light-years away in the Southern constellation of Vela (The Sails).

https://www.eso.org/public/news/eso2012/?lang

The Large Hadron Collider (LHC)



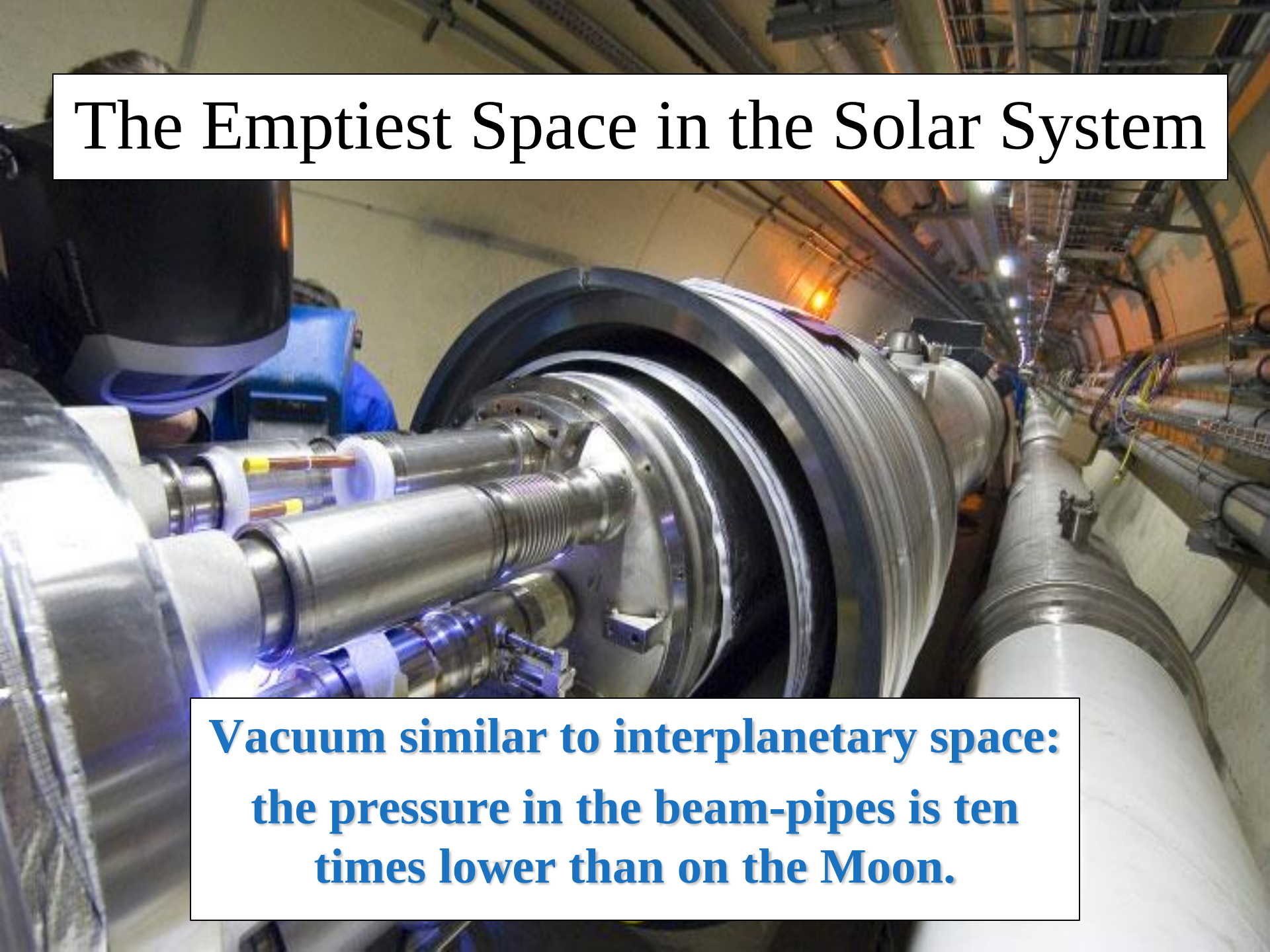
Proton- Proton Collider

6.5 TeV · 6.5 TeV

1,000,000,000 collisions/second

Primary targets:
- Origin of mass
- Nature of Dark Matter
- Primordial Plasma
- Matter vs Antimatter

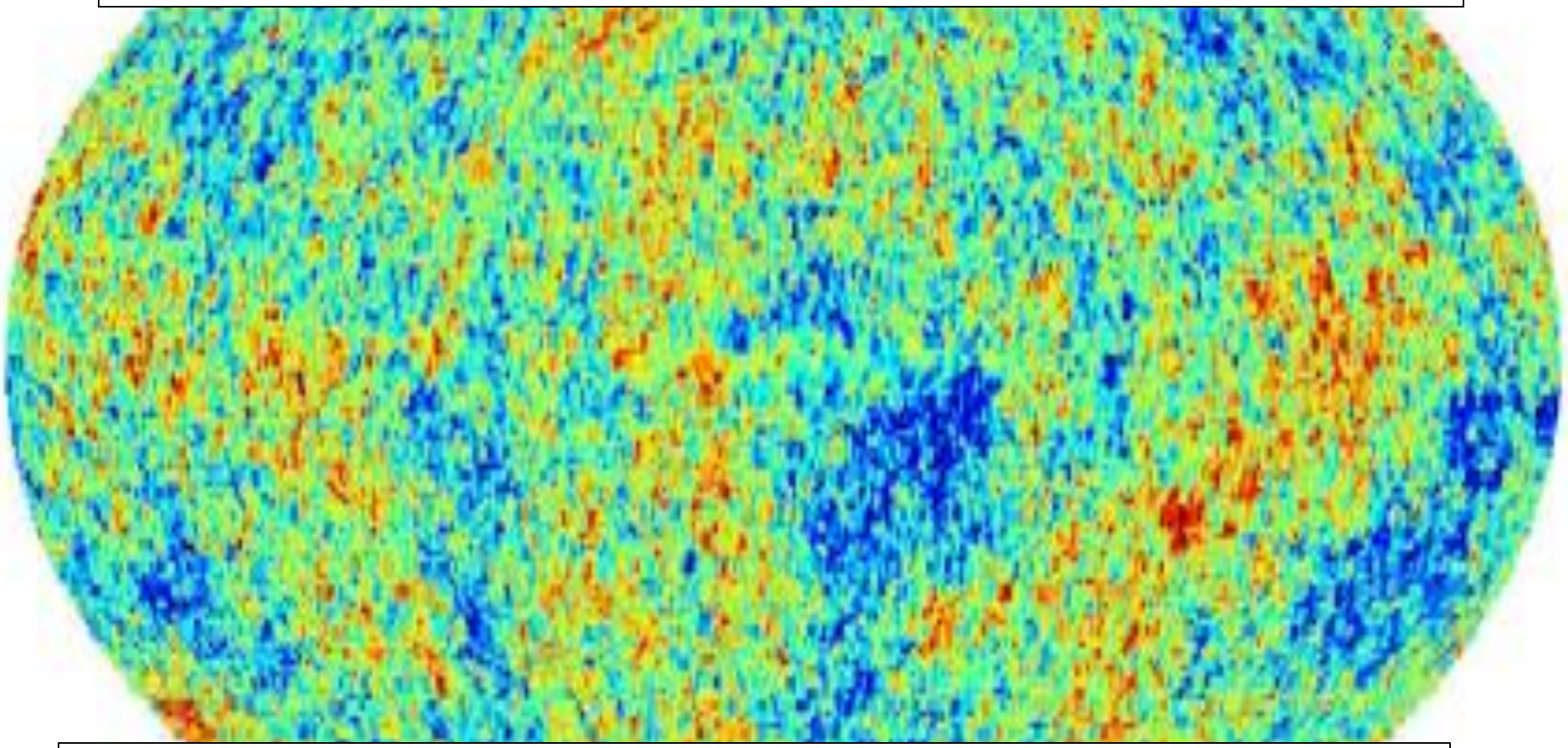
The Emptiest Space in the Solar System



Vacuum similar to interplanetary space:

the pressure in the beam-pipes is ten times lower than on the Moon.

Colder than Outer Space

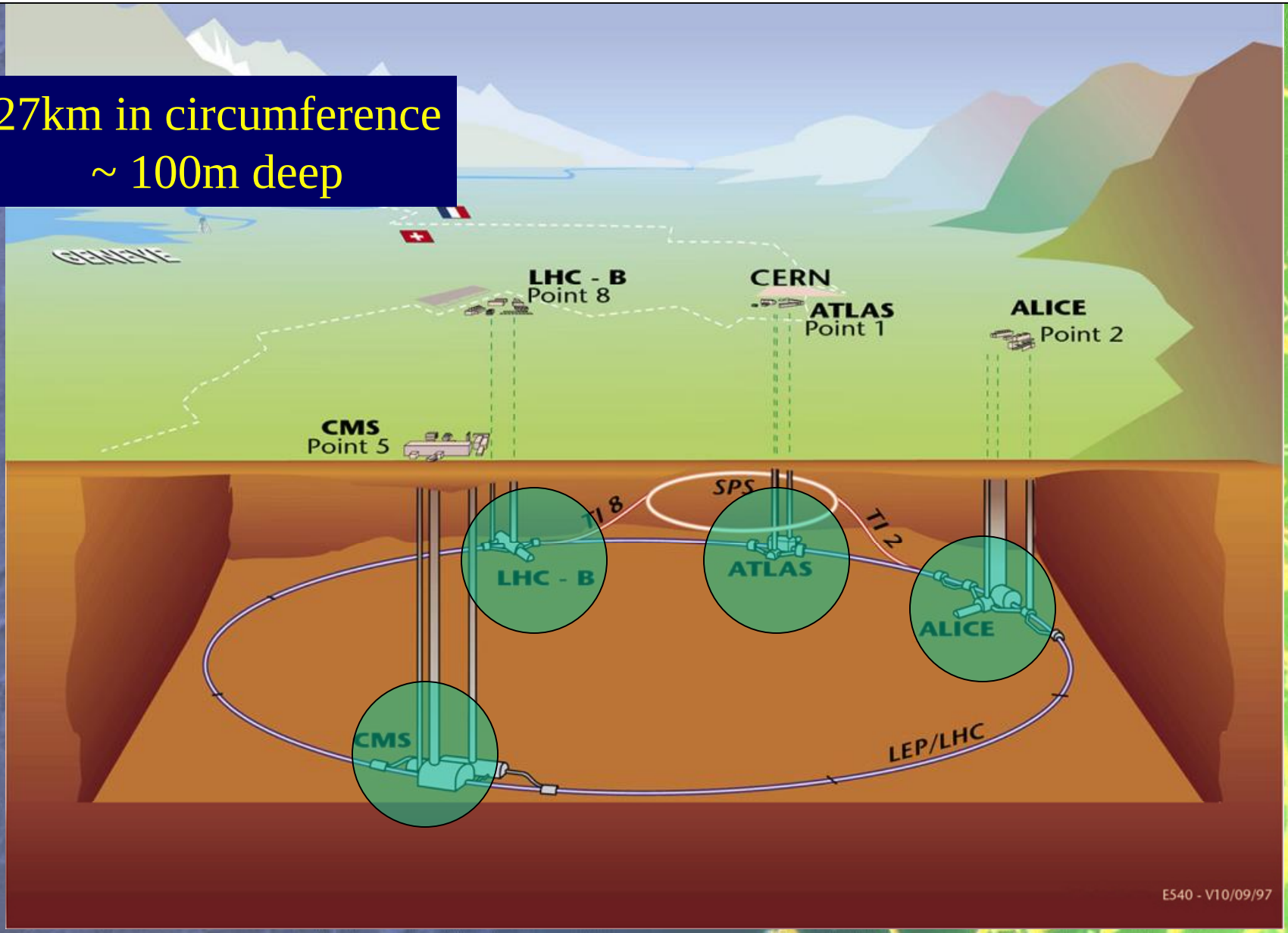


LHC 1.9 degrees above absolute zero = - 271 C

Outer space 2.7 degrees above zero = - 270 C

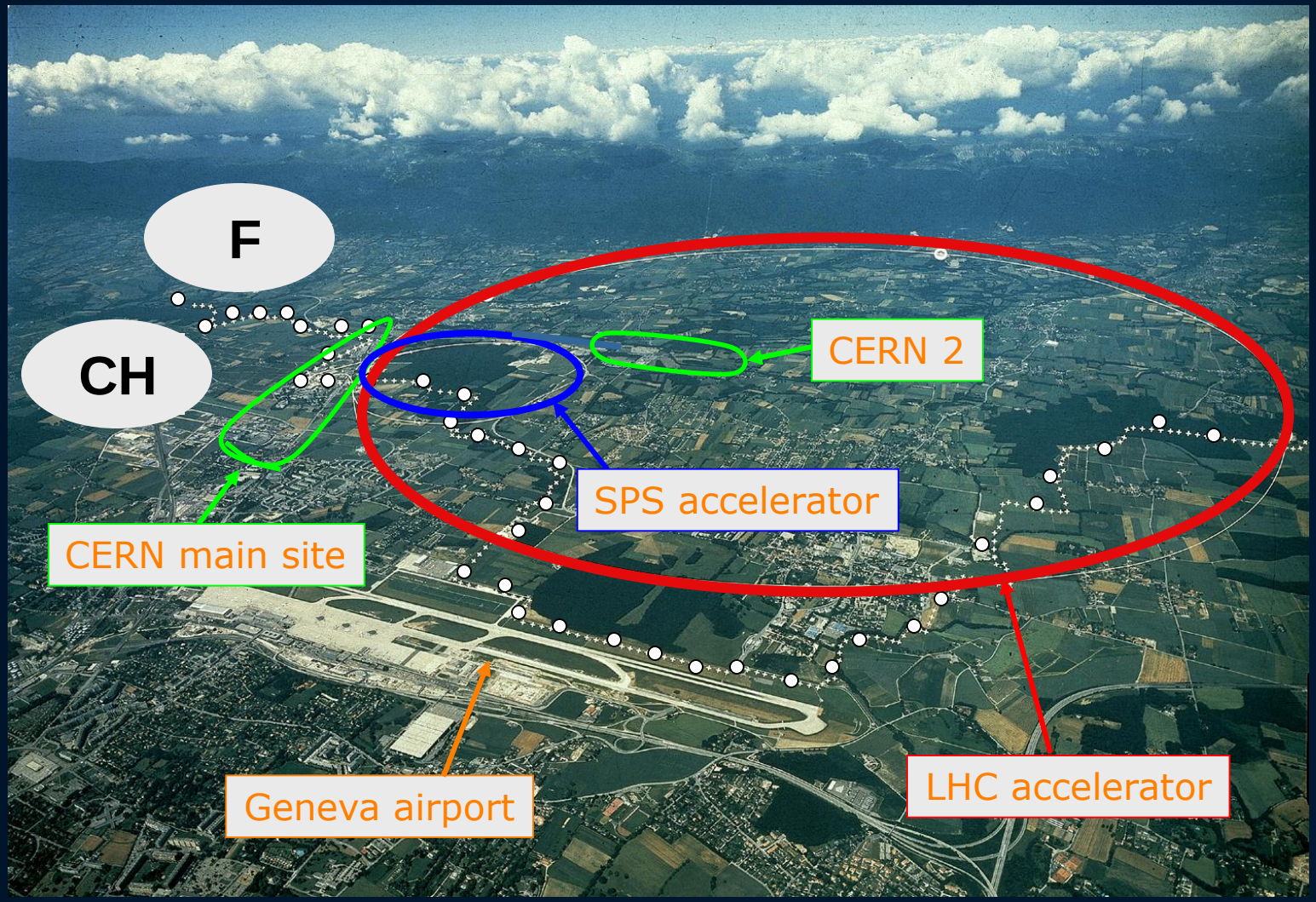
General View of LHC & its Experiments

27km in circumference
~ 100m deep



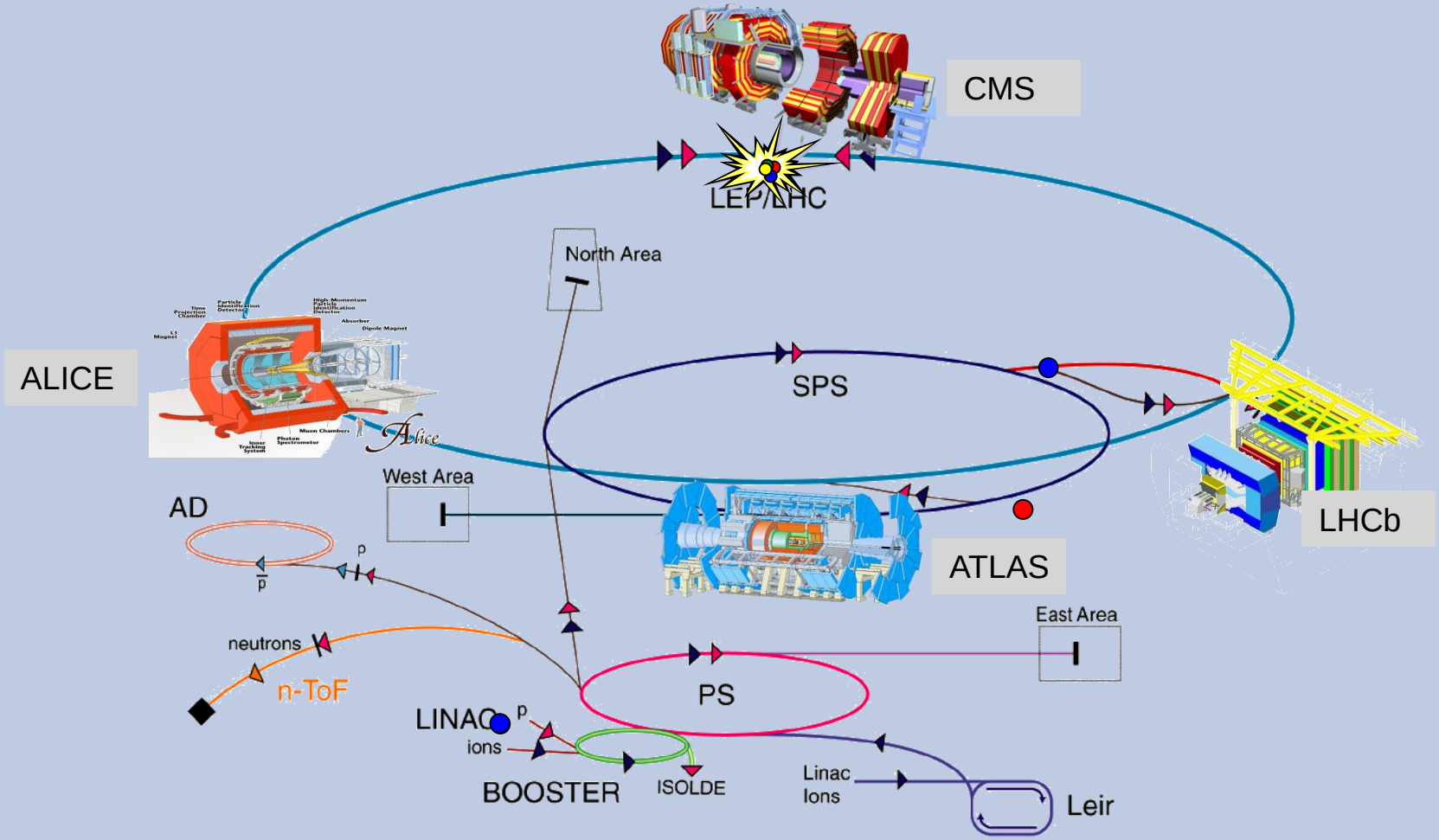
The size of ATLAS

Compared to the Brandenberg Gate - Berlin

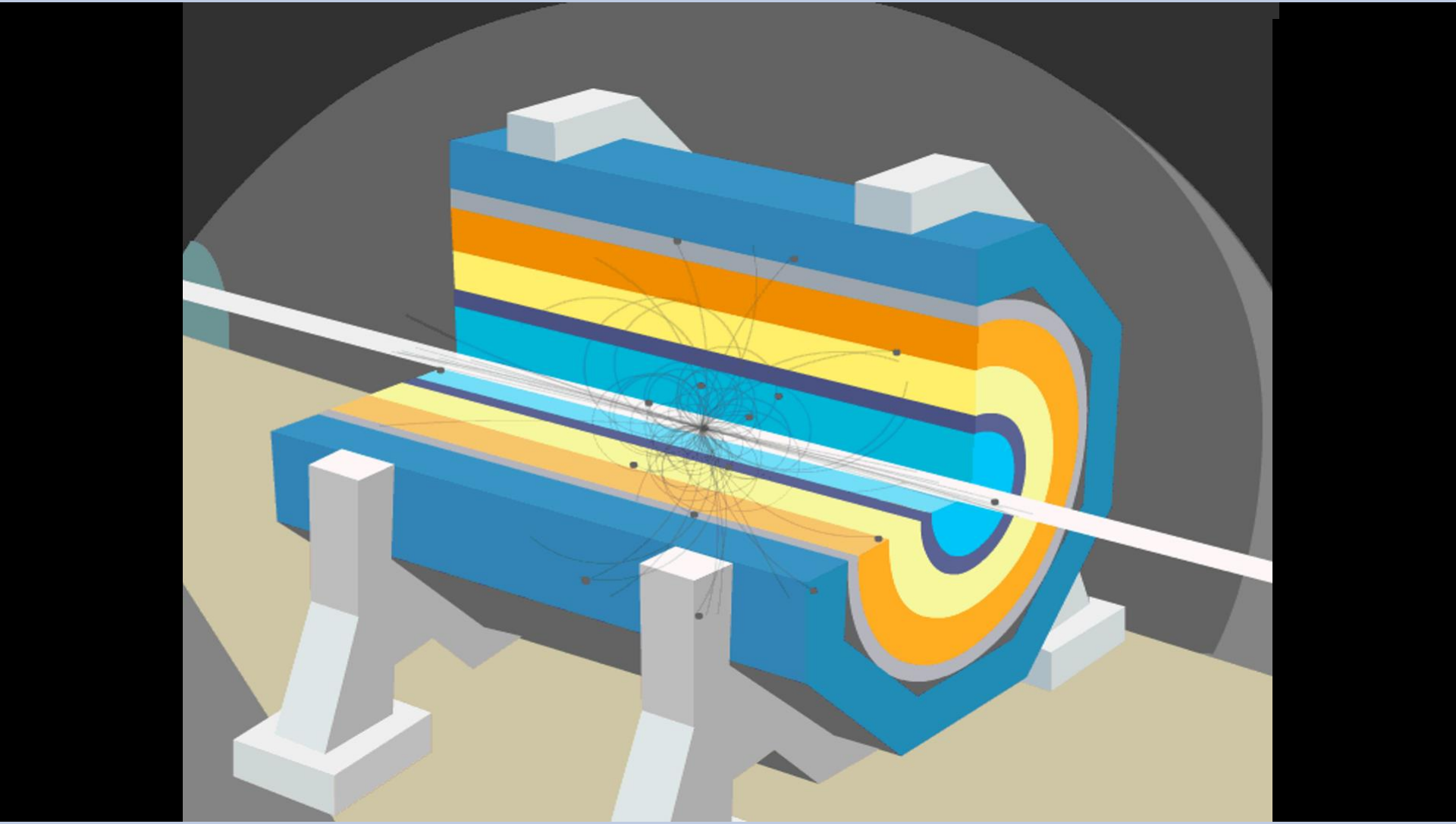

F
CH
CERN 2
SPS accelerator
CERN main site
Geneva airport
LHC accelerator

Large Hadron Collider

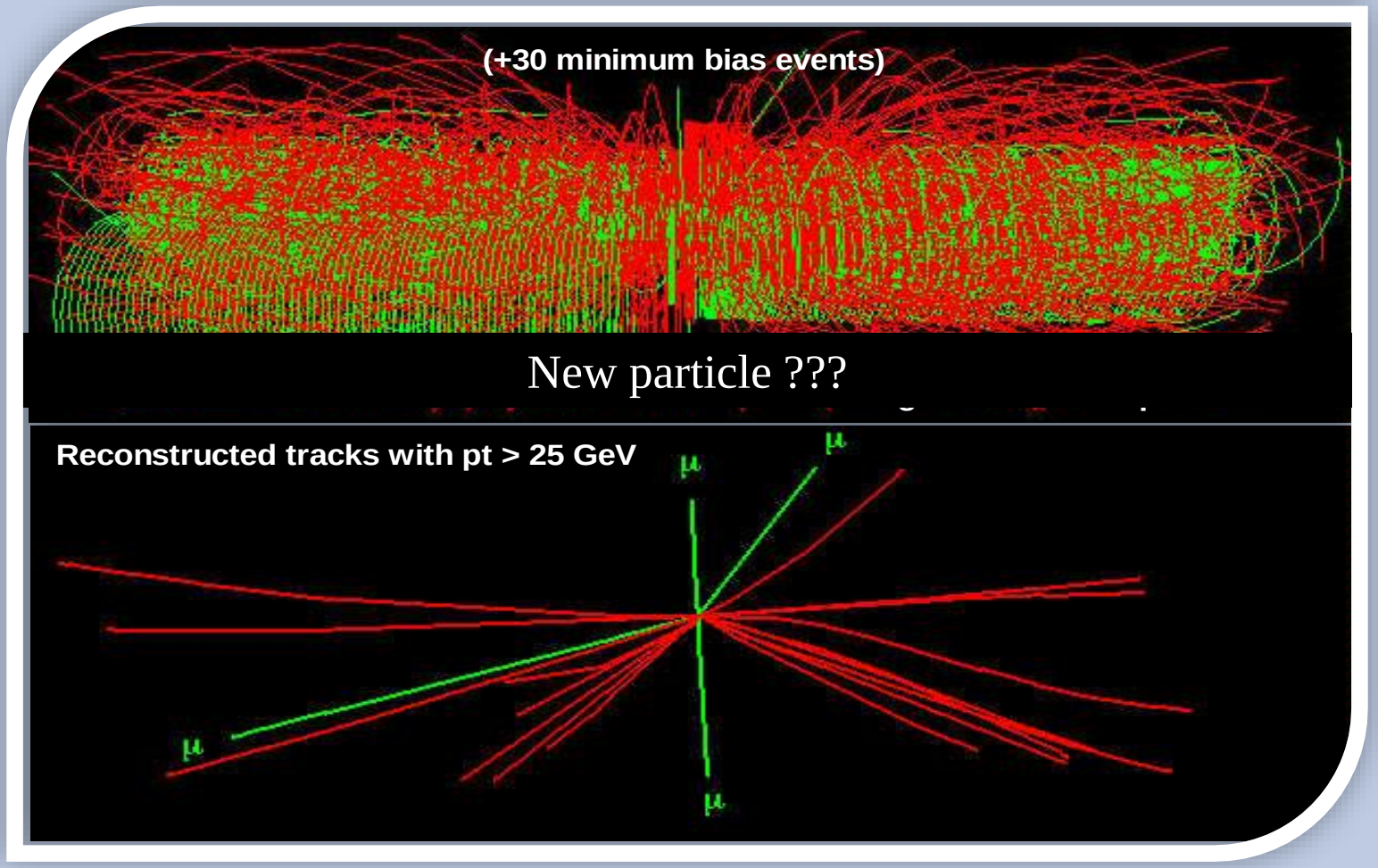
Collision of proton beams… …observed in giant detectors



Generic Cylindrical Particle Detector



- Searching for new particles requires selection and analysis of enormous quantity of data from LHC detectors



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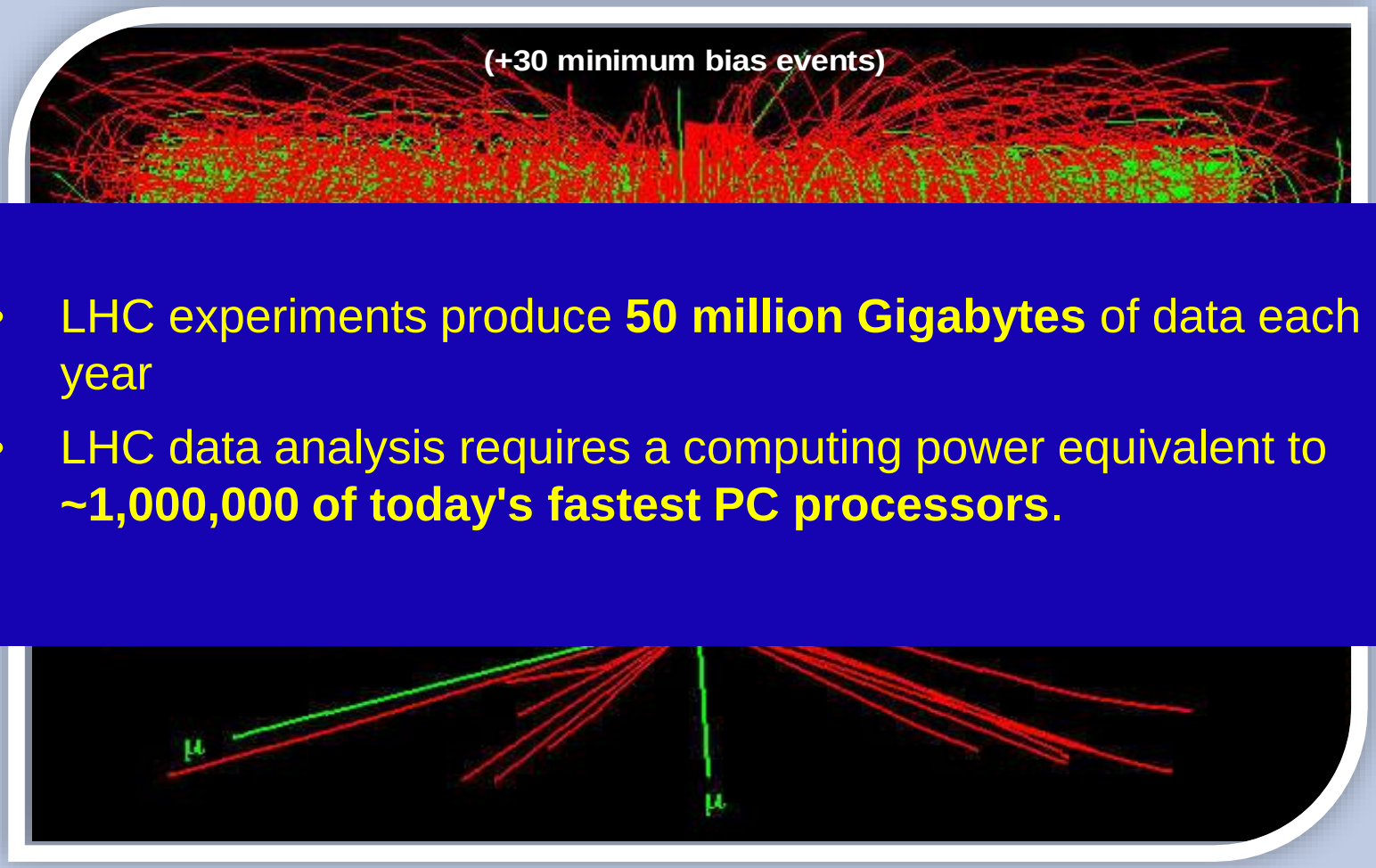
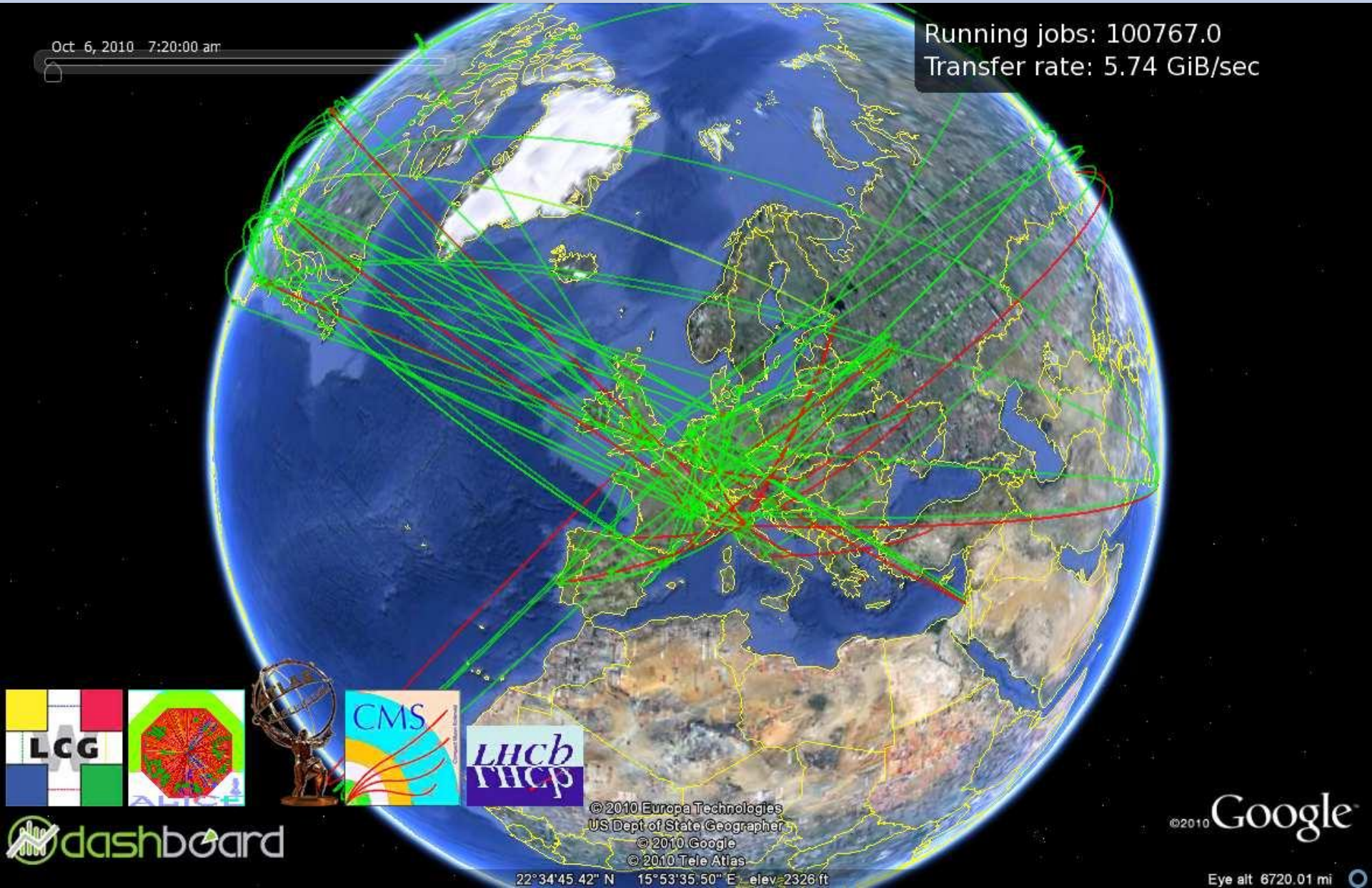
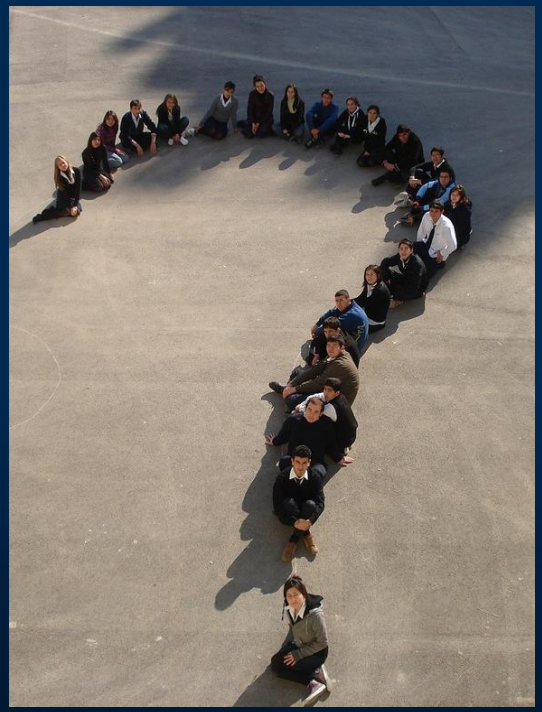


- LHC experiments produce **50 million Gigabytes** of data each year
- LHC data analysis requires a computing power equivalent to **~1,000,000 of today's fastest PC processors**.

LCG-LHC Computing GRID



Personnel



Workforce

- **Physicists**
  - **Experimental**
  - **Theoretical**
- **Applied Physicists and Engineers**
- **Technicians**
- **Craftsmen**
- **Administrative personnel**
- **Fellows**
- **Doctoral Students**
- **Technical Students**
- **Associates**
- **Summer Students**
- **Employees of CERN**
- **Users**

ATLAS and CMS experiments present Higgs search status
13 December 2011. In a seminar held at CERN[1] today, the ATLAS[2] and CMS[3] experiments presented the status of their searches for the Standard Model Higgs boson.

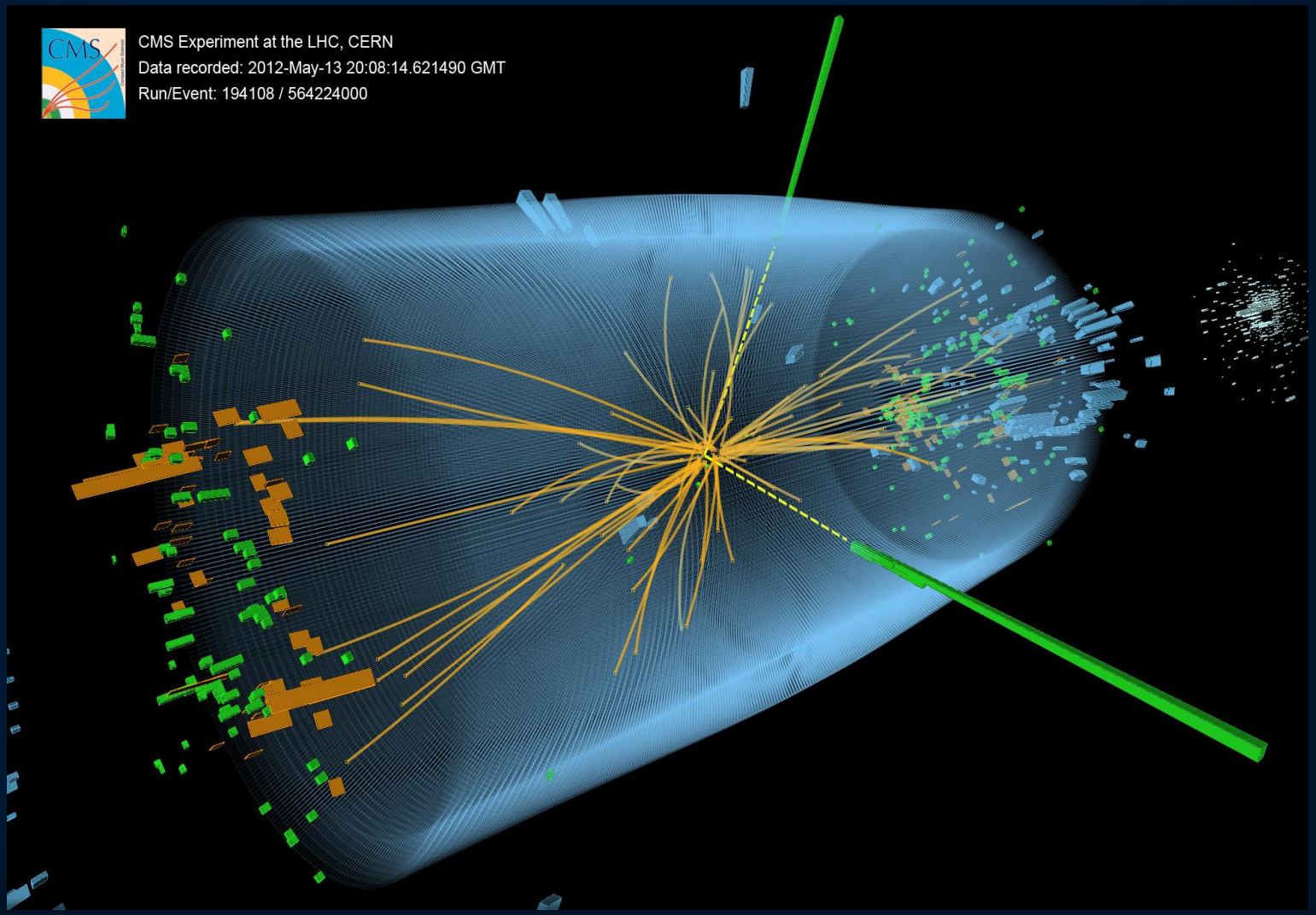
Their results are based on the analysis of considerably more data than those presented at the summer conferences, sufficient to make significant progress in the search for the Higgs boson, but not enough to make any conclusive statement on the existence or non-existence of the elusive Higgs.

The main conclusion is that the Standard Model Higgs boson, if it exists, is most likely to have a mass constrained to the range 116-130 GeV by the ATLAS experiment, and 115-127 GeV by CMS.

Tantalising hints have been seen by both experiments in this mass region, but these are not yet strong enough to claim a discovery.

4 July 2012: CERN press conference

“CERN experiments observe particle consistent with long-sought Higgs boson”



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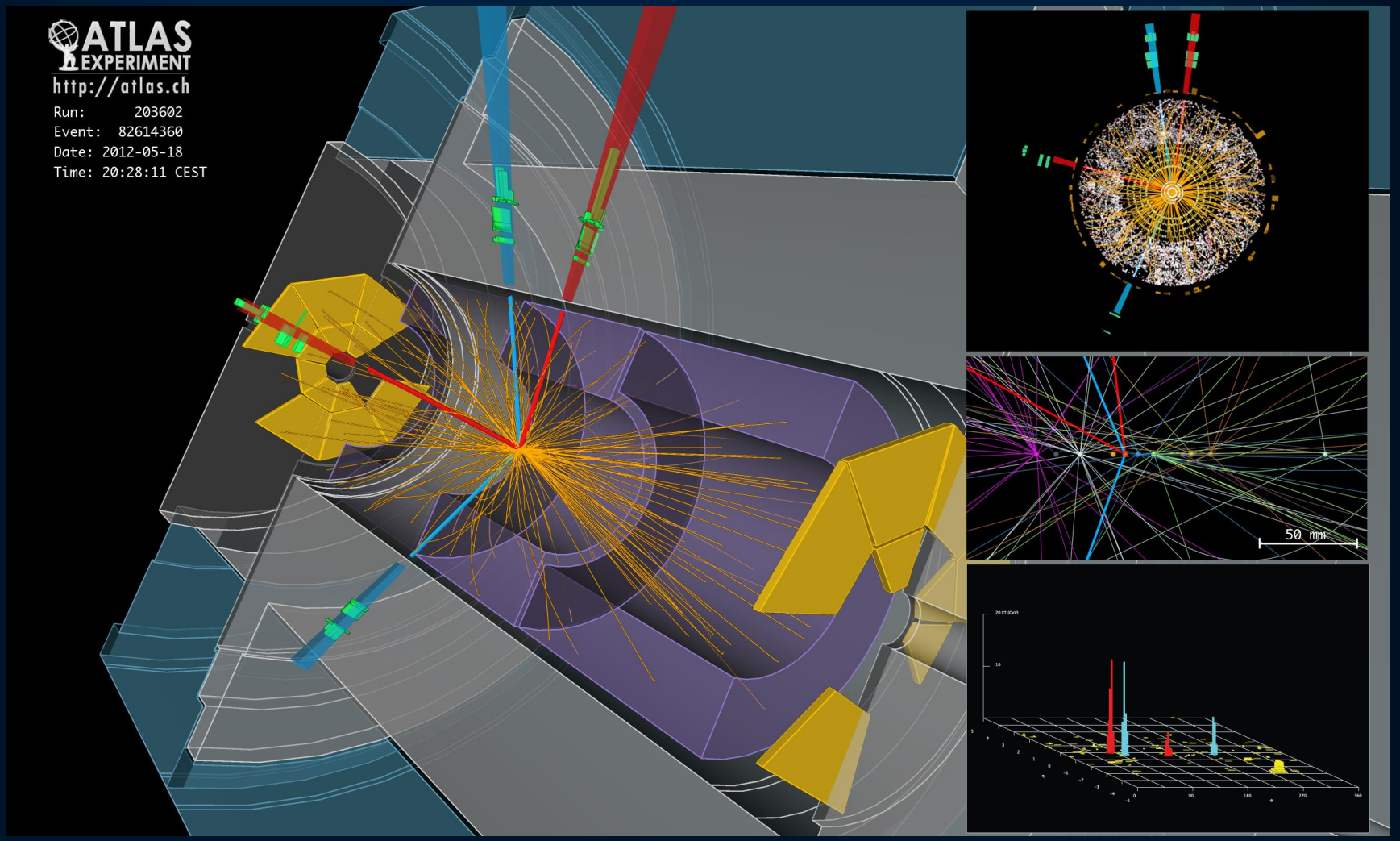


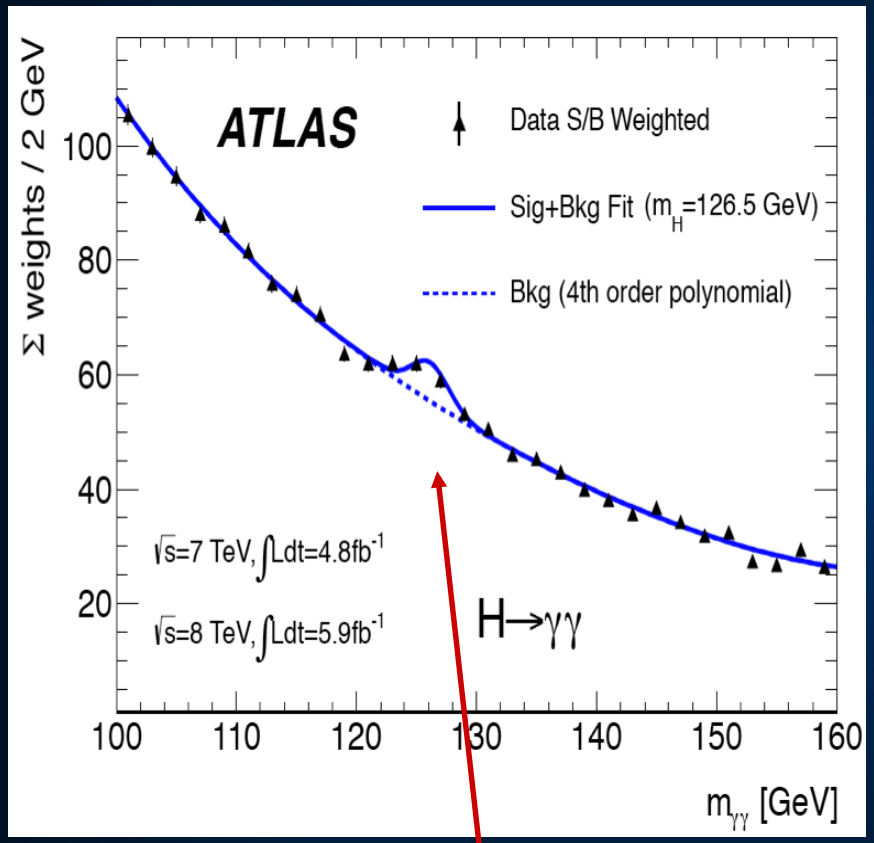
CERN experiments observe particle consistent with long-sought Higgs boson
Geneva, 4 July 2012.

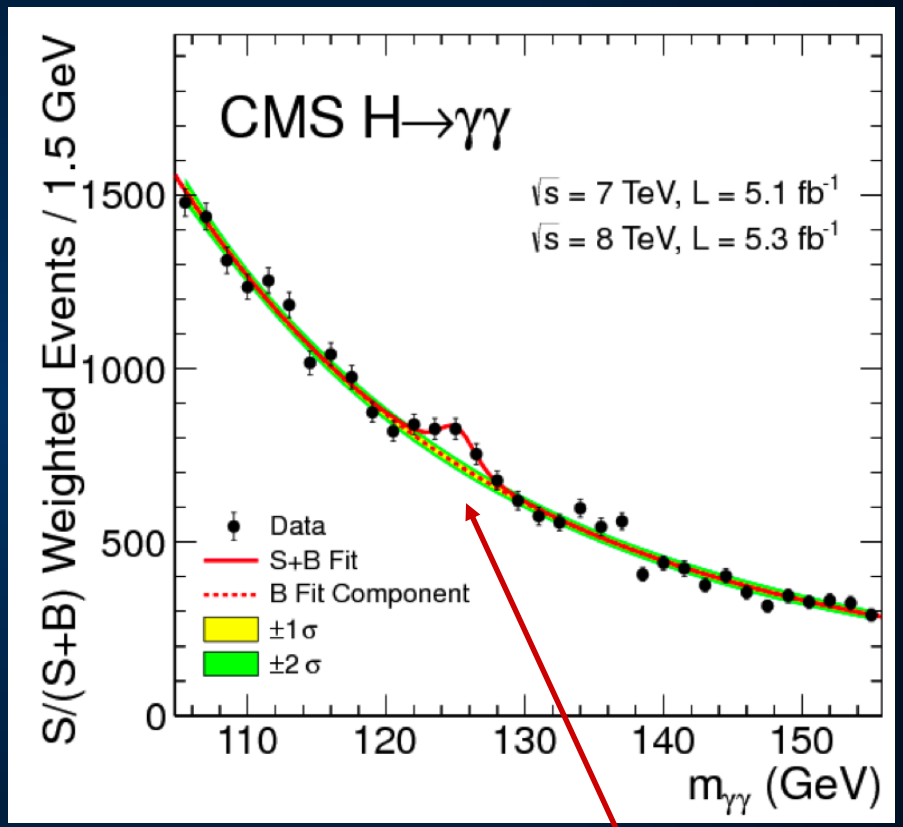
At a seminar held at CERN[1] today as a curtain raiser to the year's major particle physics conference, ICHEP2012 in Melbourne, the ATLAS and CMS experiments presented their latest preliminary results in the search for the long sought Higgs particle. **Both experiments observe a new particle in the mass region around 125-126 GeV**.

*"**We observe in our data clear signs of a new particle, at the level of 5 sigma, in the mass region around 126 GeV**. The outstanding performance of the LHC and ATLAS and the huge efforts of many people have brought us to this exciting stage,"* said ATLAS experiment spokesperson Fabiola Gianotti, *"but a little more time is needed to prepare these results for publication."*

*"**The results are preliminary but the 5 sigma signal at around 125 GeV we're seeing is dramatic**. This is indeed a new particle. We know it must be a boson and it's the heaviest boson ever found,"* said CMS experiment spokesperson Joe Incandela. *"**The implications are very significant and it is precisely for this reason that we must be extremely diligent in all of our studies and cross-checks**."*

Higgs decay to $\gamma\gamma$, ATLAS and CMS, summer 2012 data





July 4th at CERN, after the Higgs seminar

Peter Higgs and Francois Englert