



Stories about CERN

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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

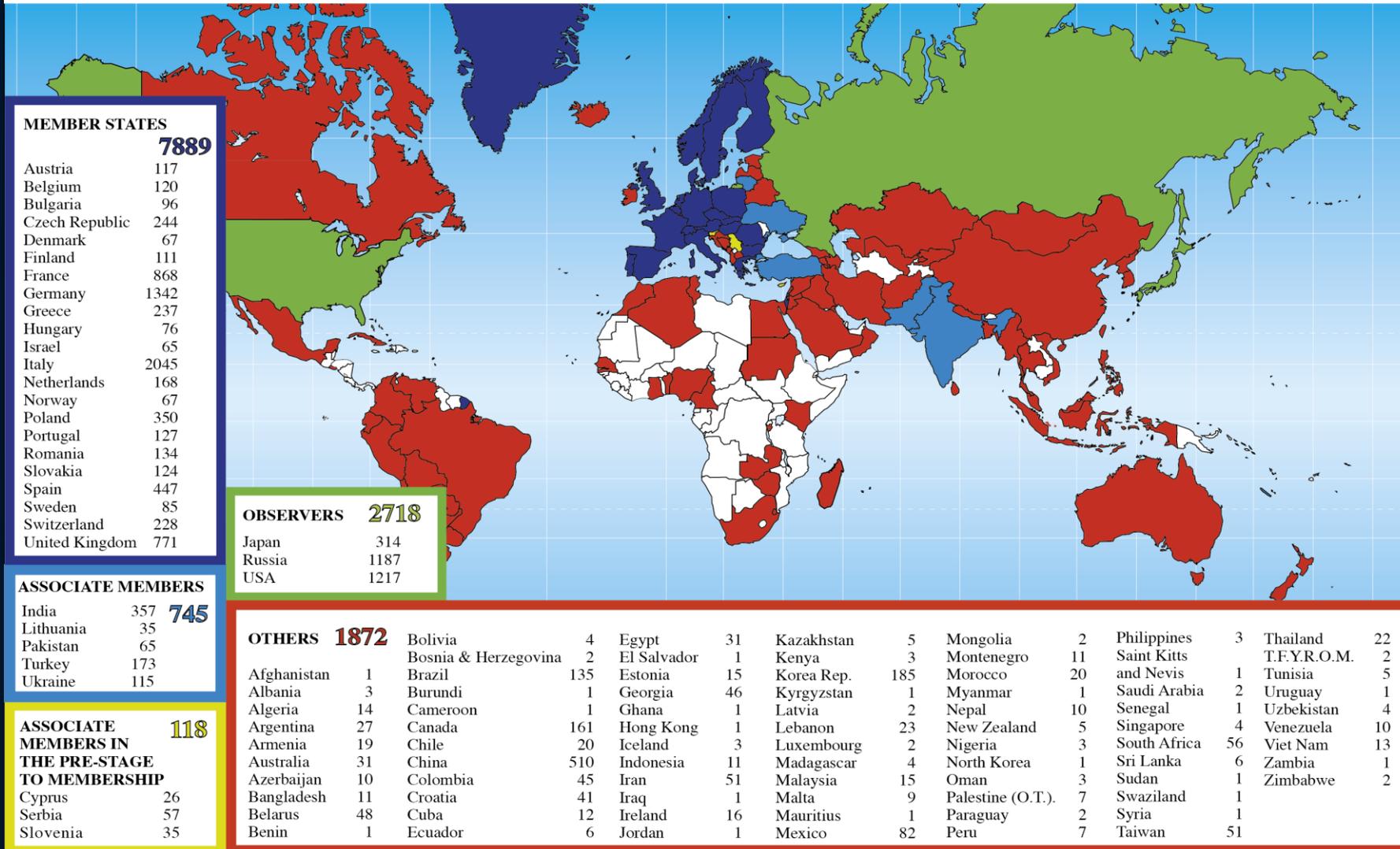
Scientific contacts: 24

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





CERN

European Organization for Nuclear Research
Organisation Européenne pour la Recherche Nucléaire



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



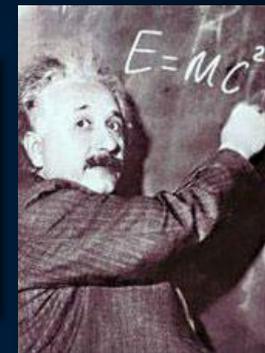
**The aim of particle physics, CERN & the LHC:
What is the Universe made of?**



The Mission of CERN

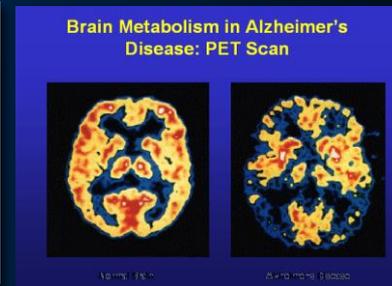
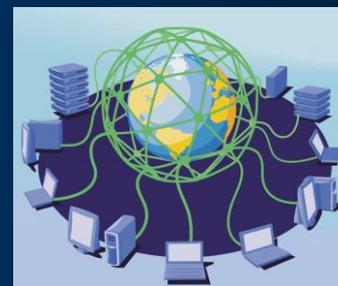
- ❑ **Push forward** the frontiers of knowledge

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

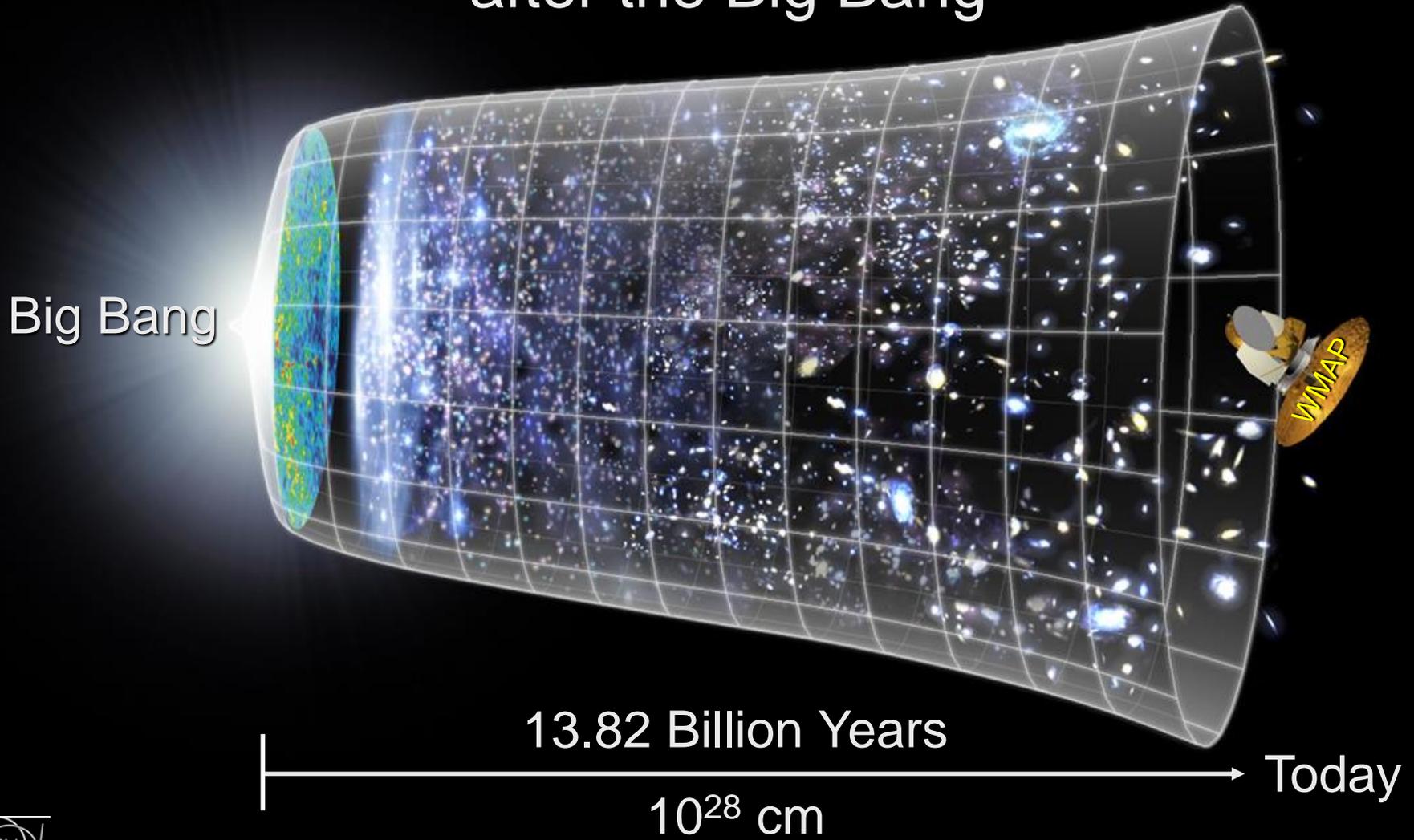


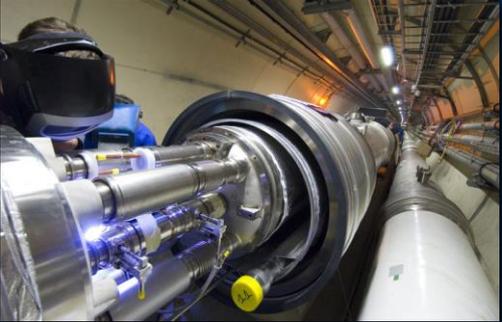
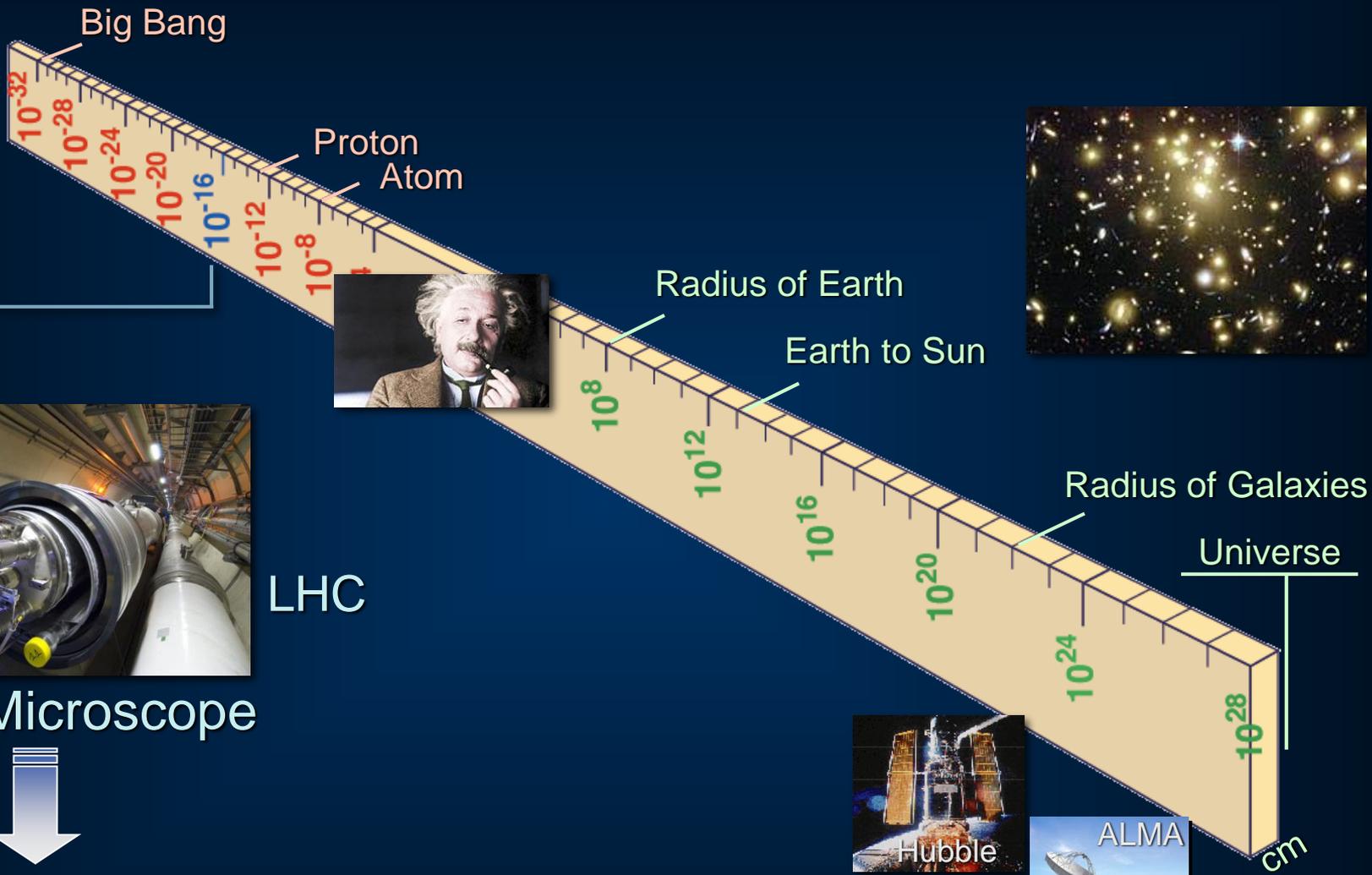
- ❑ **Unite** people from different countries and cultures



Scientific Challenge:

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





LHC

Super-Microscope



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





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).

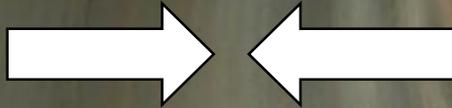
This object is located between 3000 and 6500 light-years away in the Southern constellation of Vela (The Sails).

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

The Large Hadron Collider (LHC)

Proton- Proton Collider

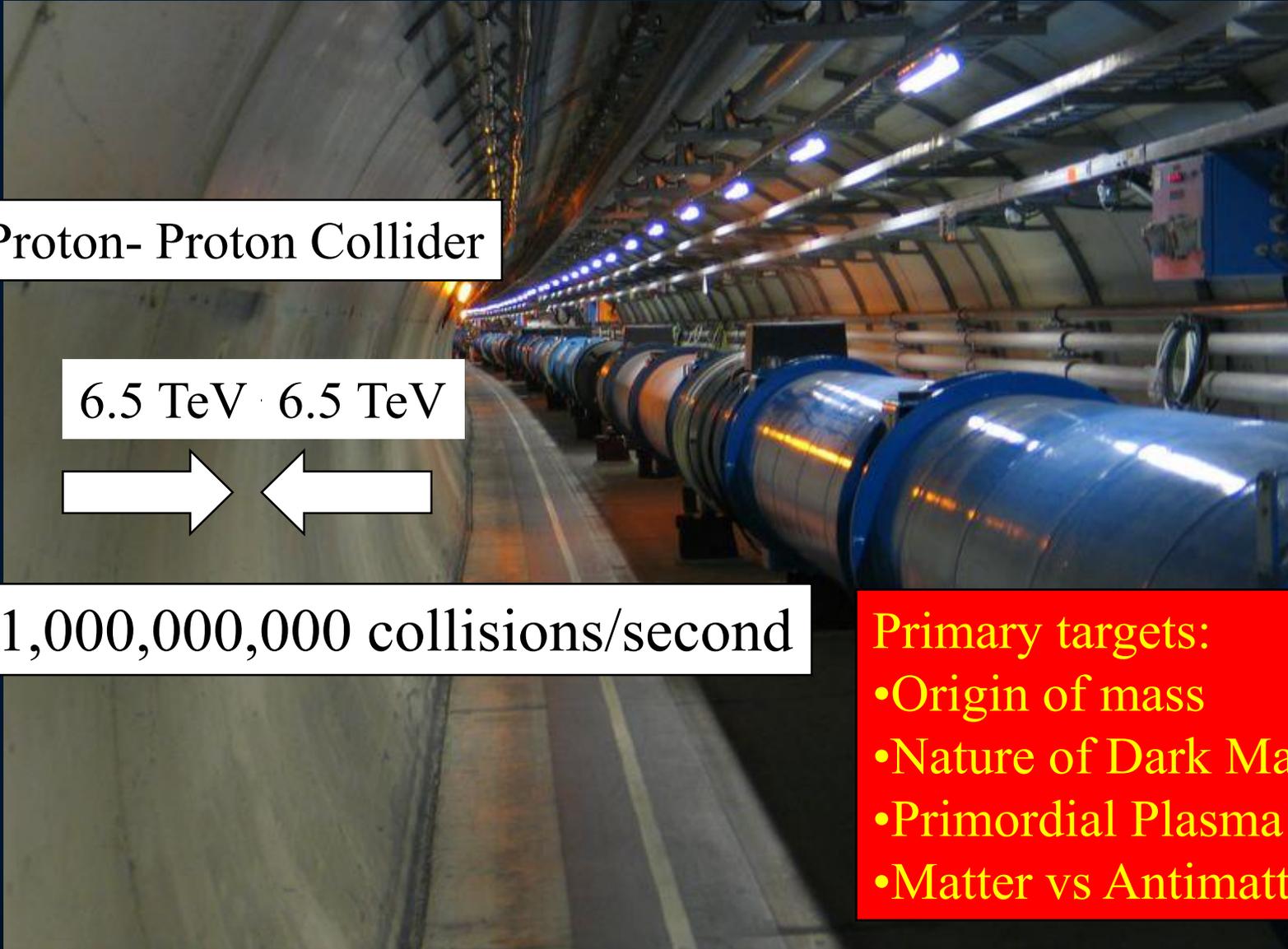
6.5 TeV · 6.5 TeV



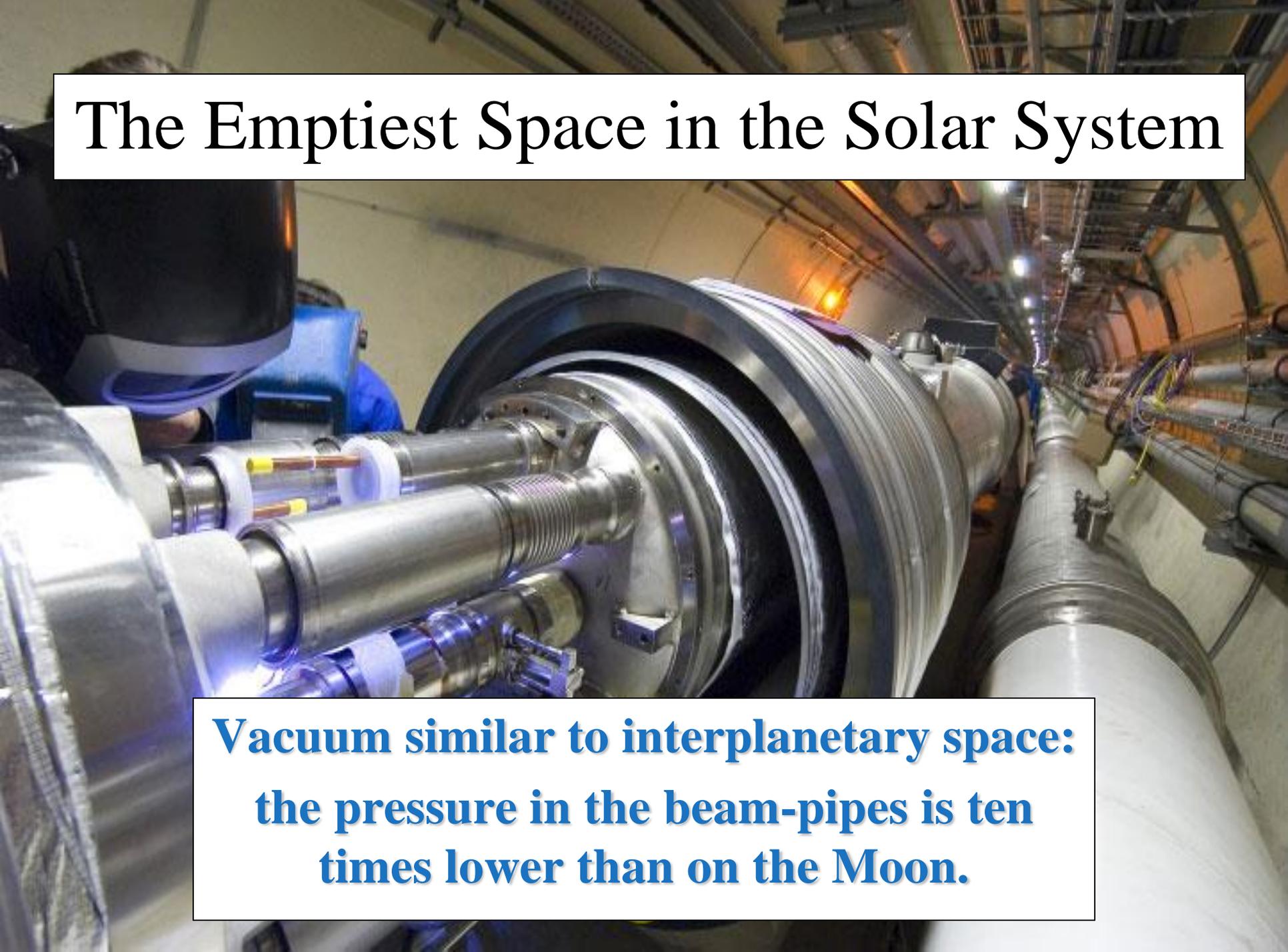
1,000,000,000 collisions/second

Primary targets:

- Origin of mass
- Nature of Dark Matter
- Primordial Plasma
- Matter vs Antimatter

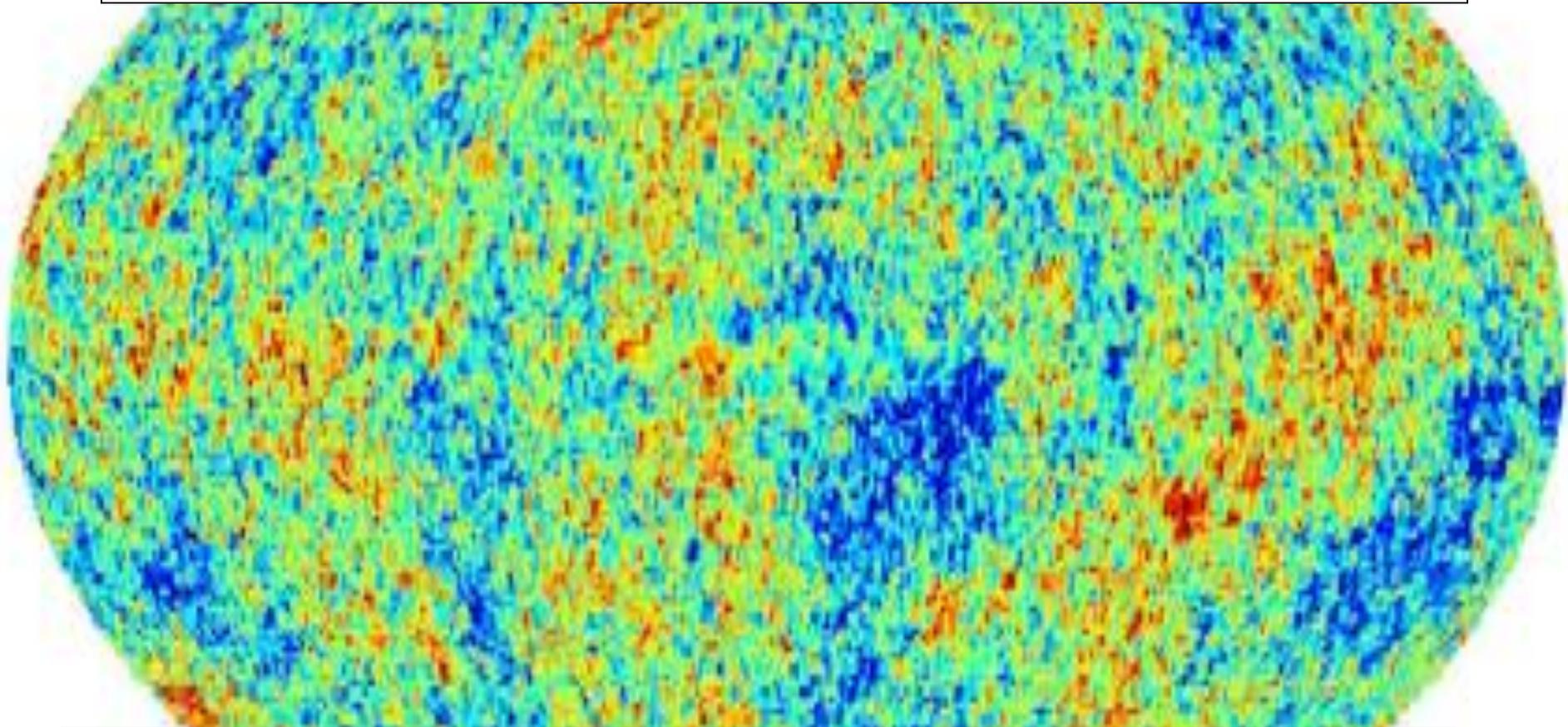


The Emptiest Space in the Solar System



**Vacuum similar to interplanetary space:
the pressure in the beam-pipes is ten
times lower than on the Moon.**

Colder than Outer Space

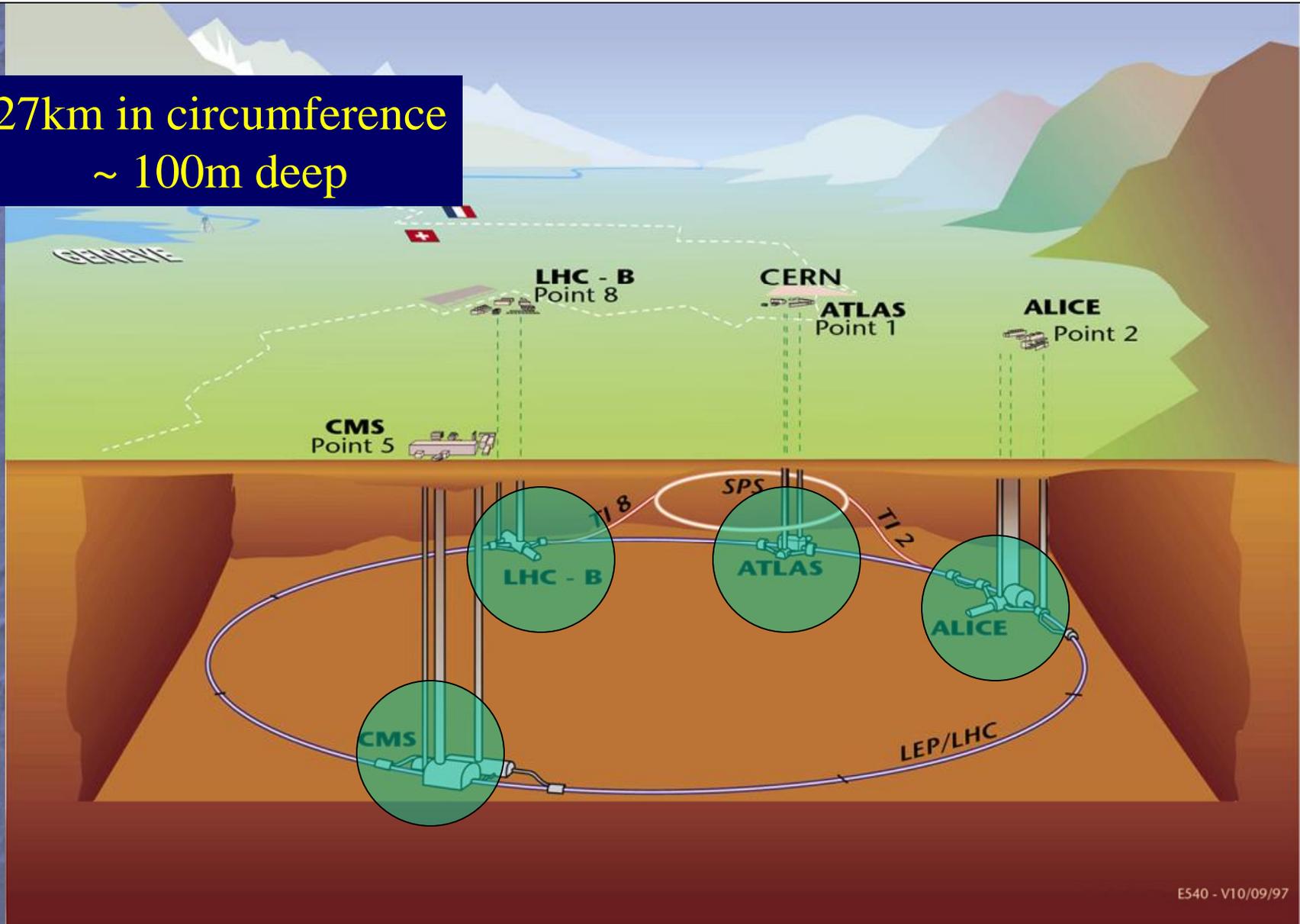


LHC 1.9 degrees above absolute zero = - 271 C

Outer space 2.7 degrees above zero = - 270 C

General View of LHC & its Experiments

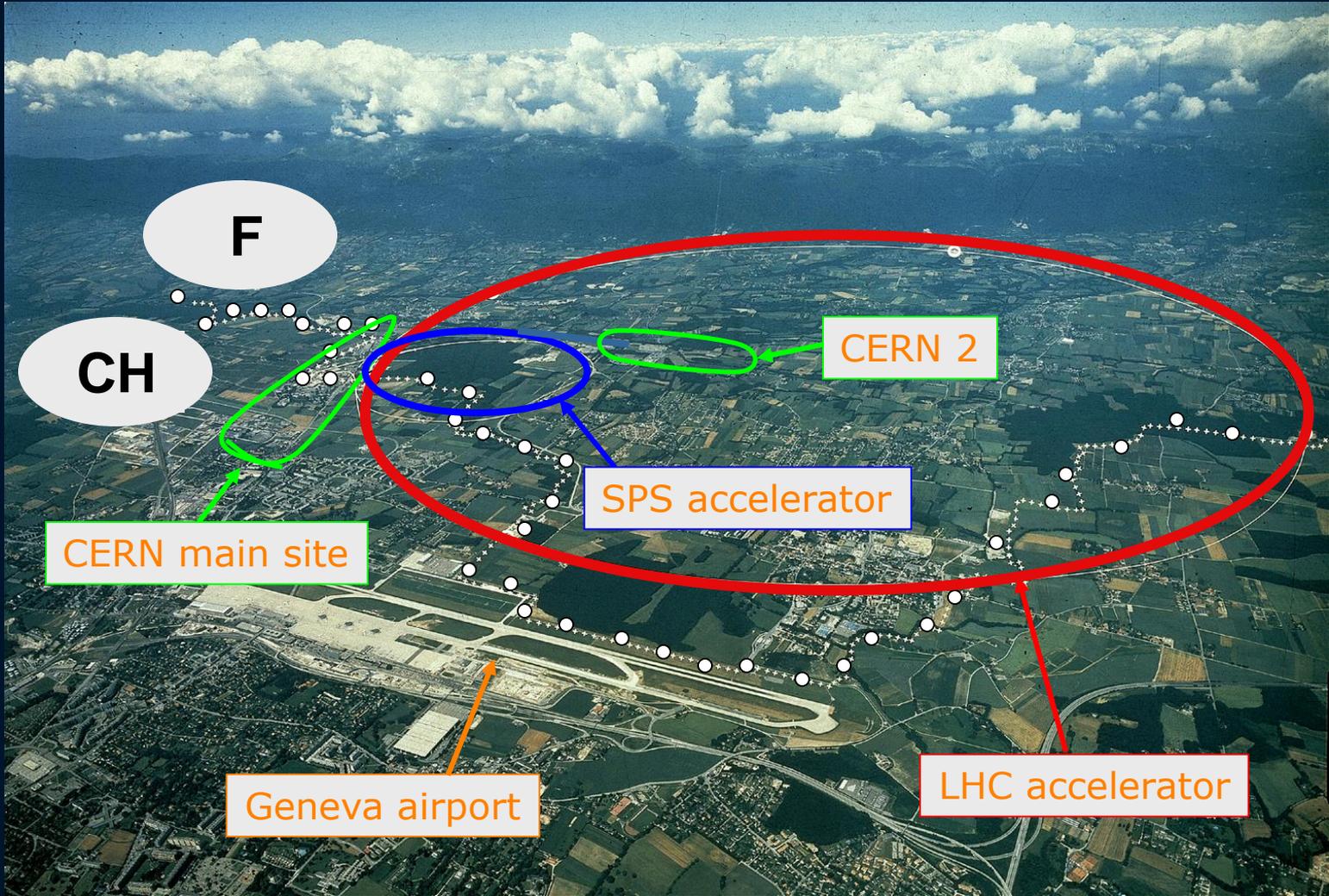
27km in circumference
~ 100m deep



The size of ATLAS



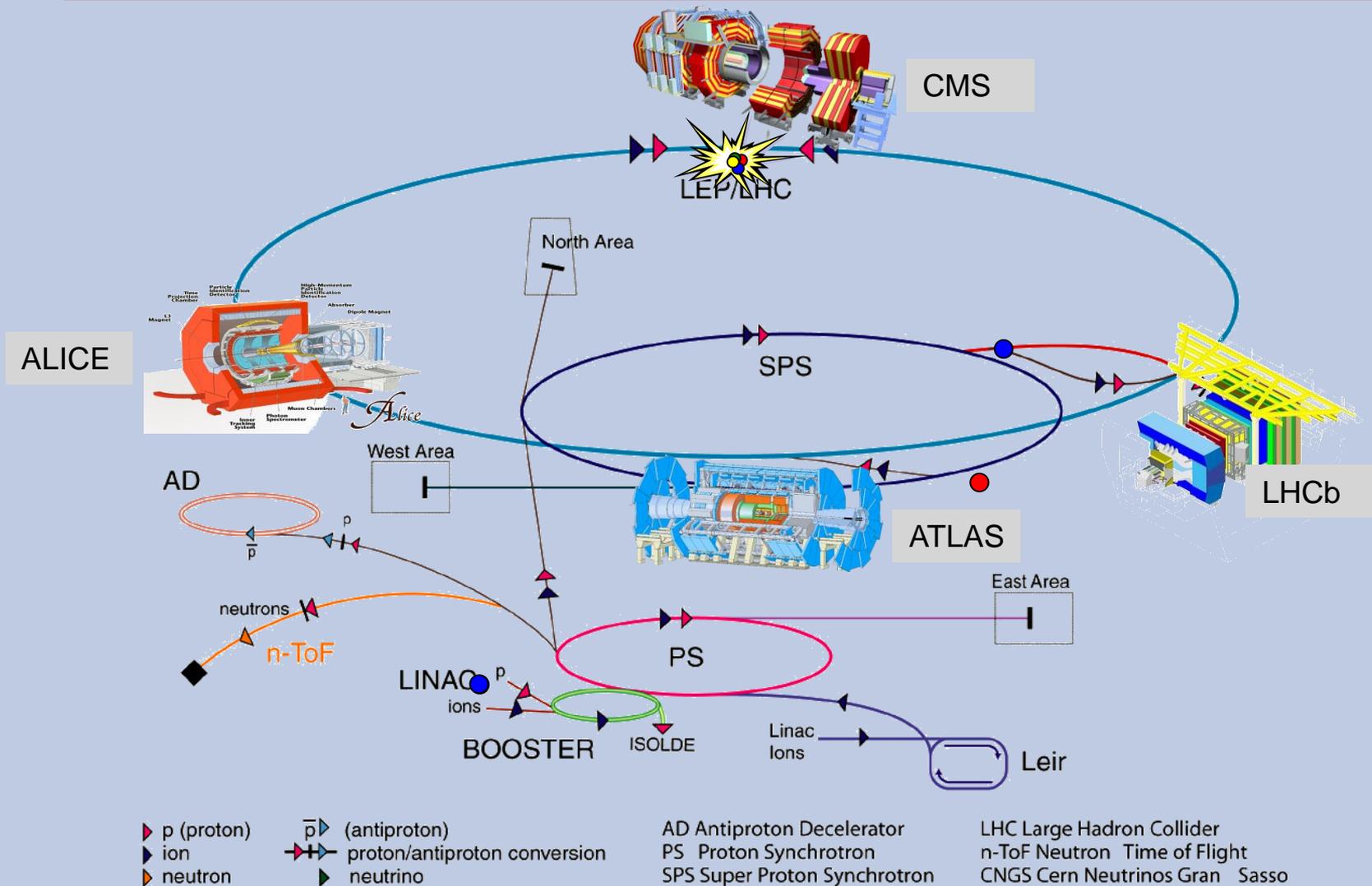
Compared to the Brandenburg Gate - Berlin



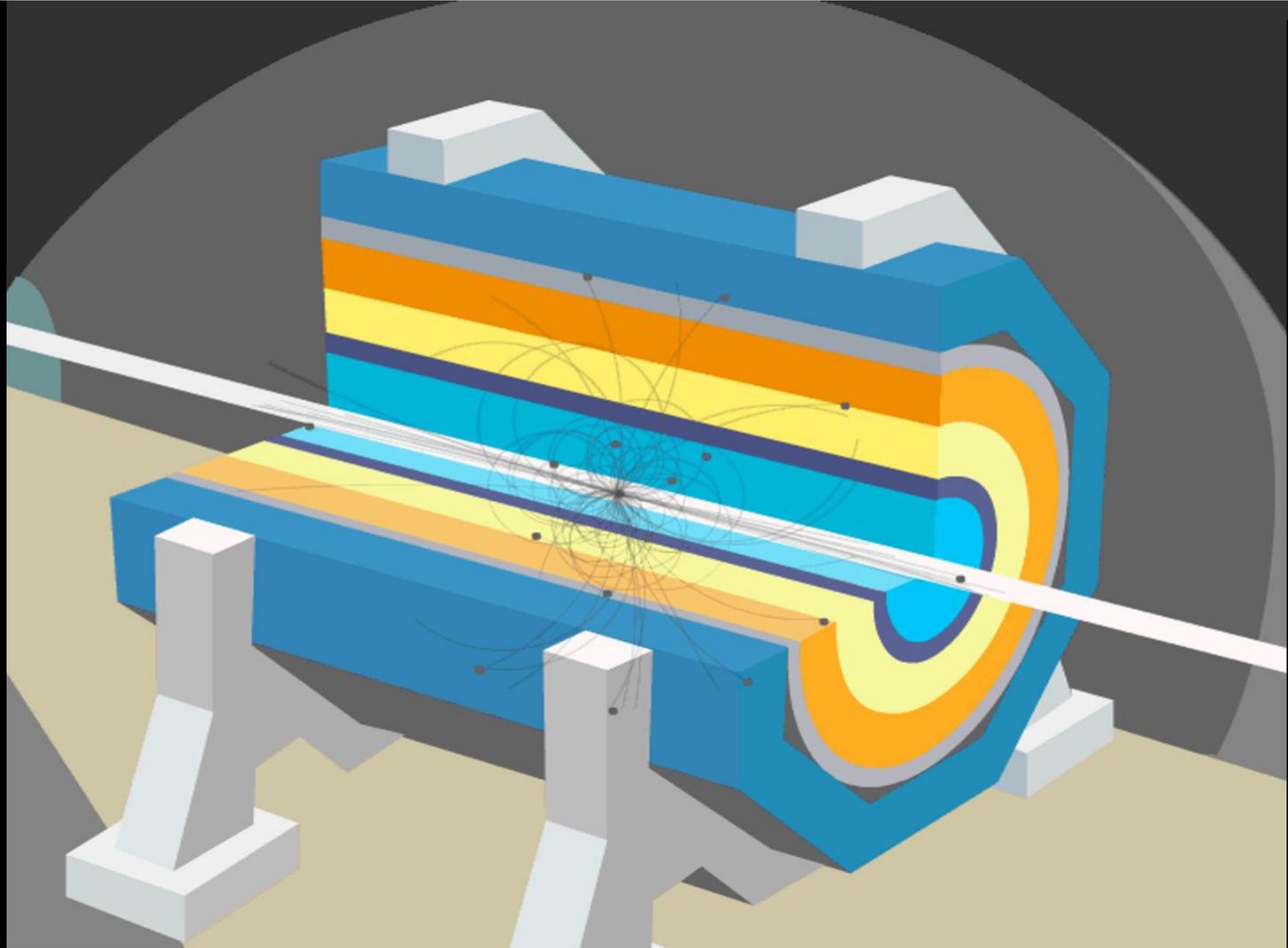
Large Hadron Collider

Collision of proton beams...

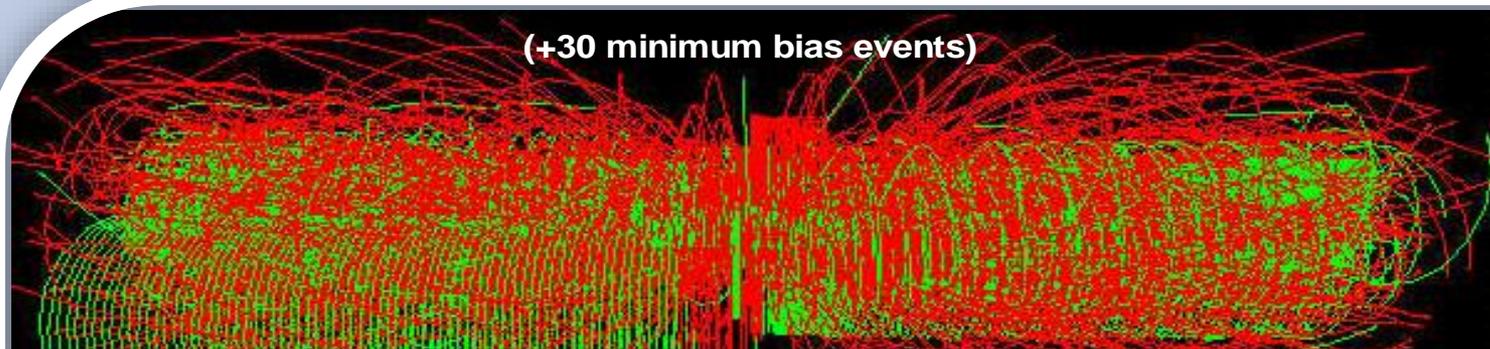
...observed in giant detectors



Generic Cylindrical Particle Detector

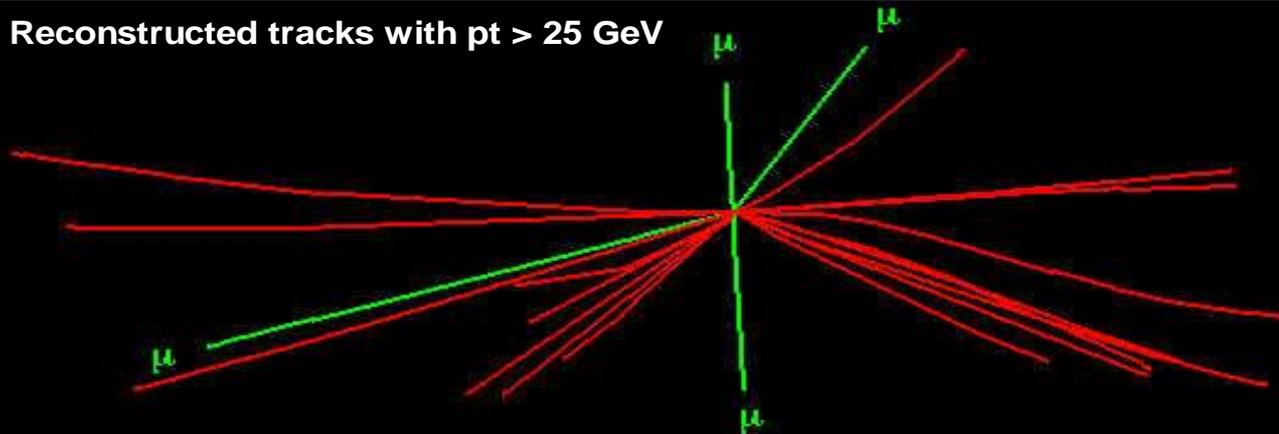


- ❑ Searching for new particles requires selection and analysis of enormous quantity of data from LHC detectors

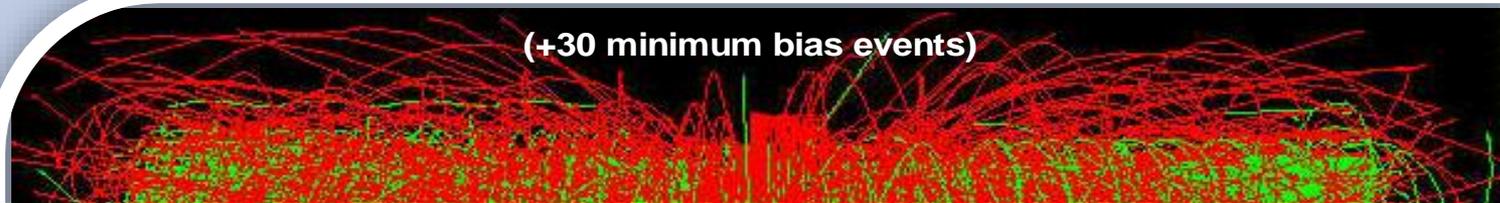


New particle ???

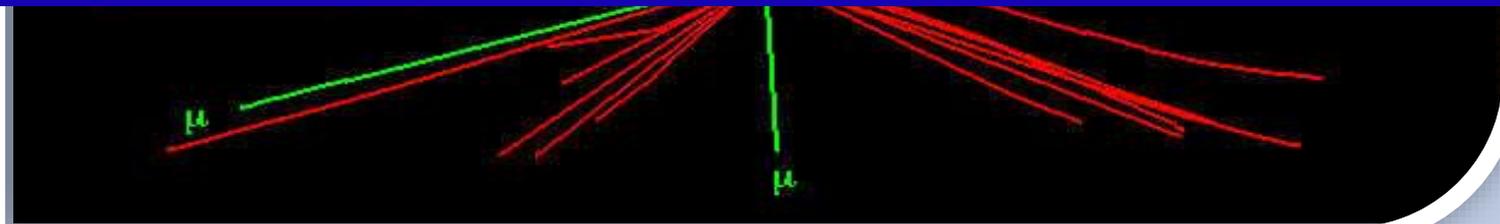
Reconstructed tracks with $pt > 25$ GeV



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



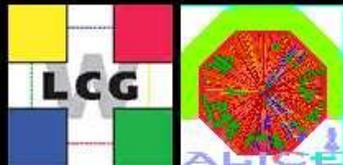
- LHC experiments produce **50 million Gigabytes** of data each year
- LHC data analysis requires a computing power equivalent to **~1,000,000 of today's fastest PC processors.**



LCG-LHC Computing GRID

Oct 6, 2010 7:20:00 am

Running jobs: 100767.0
Transfer rate: 5.74 GiB/sec



© 2010 Europa Technologies
US Dept of State Geographer

© 2010 Google
© 2010 Tele Atlas

22°34'45.42" N 15°53'35.50" E elev=2326 ft

©2010 Google

Eye alt 6720.01 mi

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 CERN¹ today, the ATLAS² and CMS³ 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.

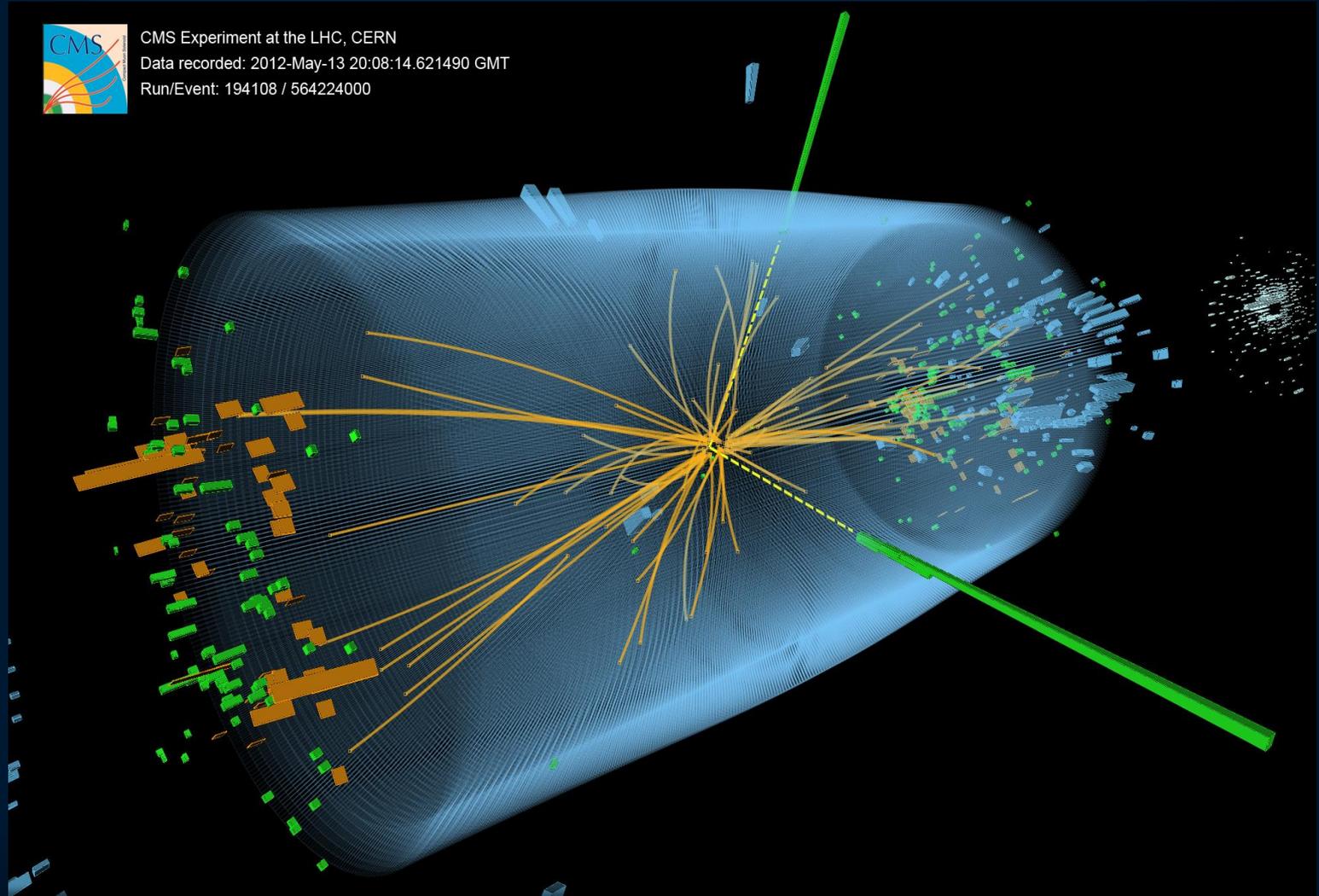




4 July 2012: CERN press conference



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





4 July 2012: CERN press conference

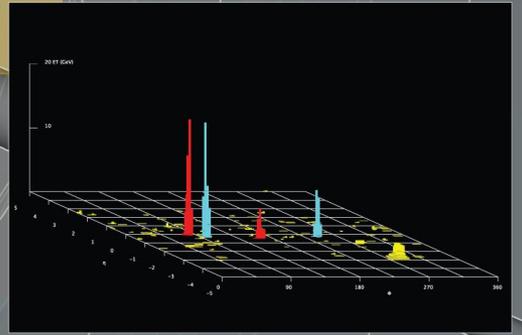
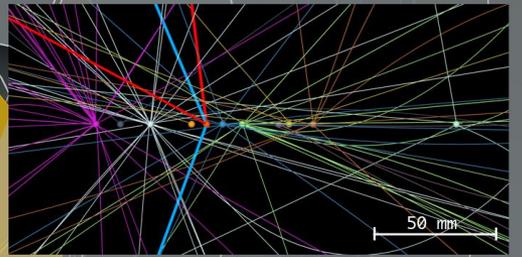
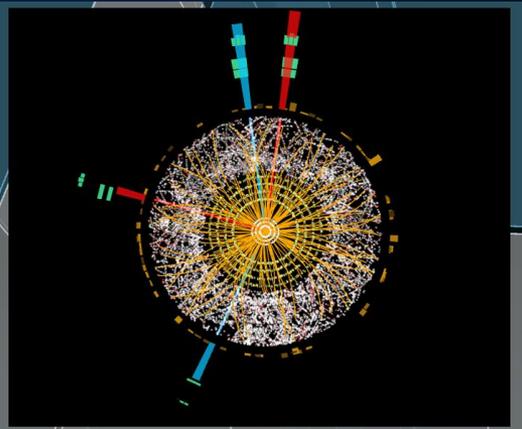
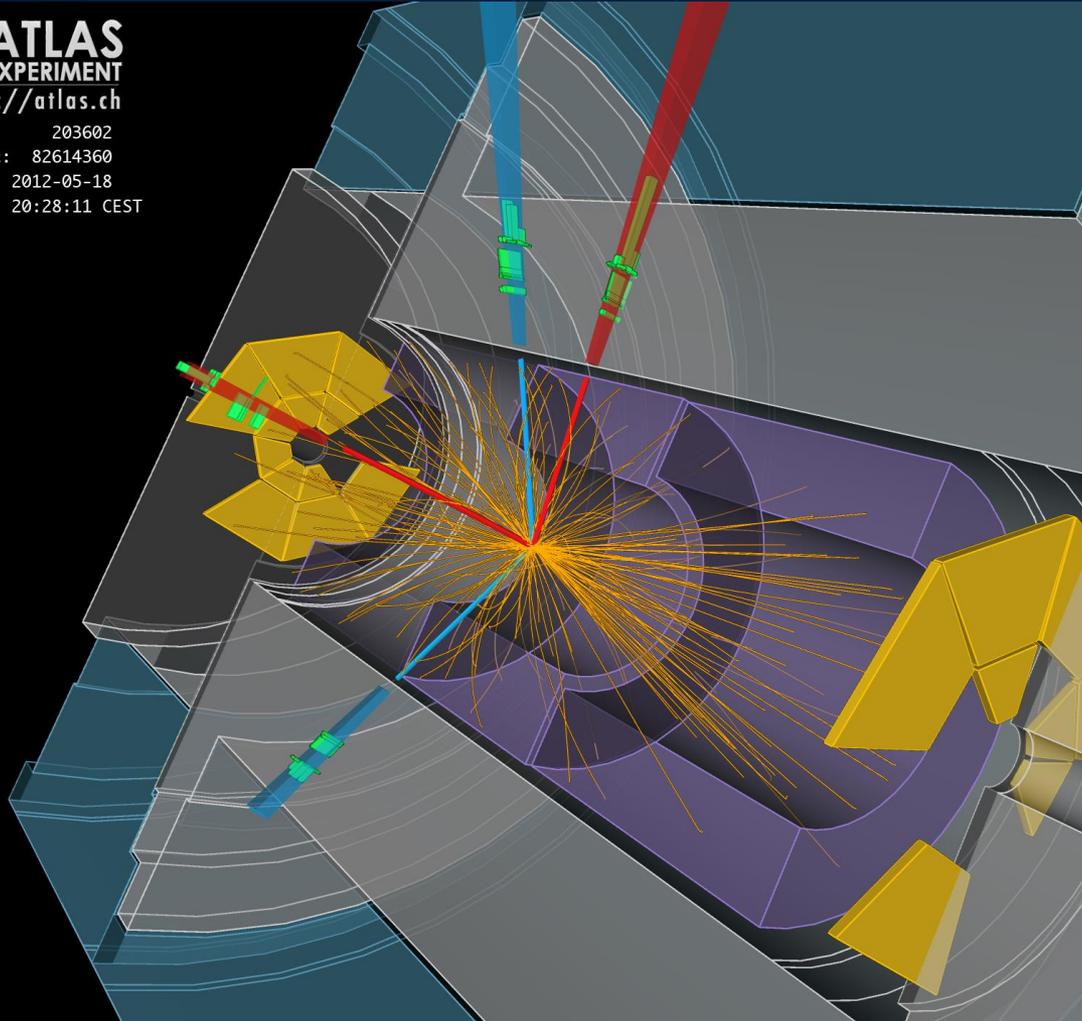


“CERN experiments observe particle consistent with long-sought Higgs boson”

ATLAS
EXPERIMENT

<http://atlas.ch>

Run: 203602
Event: 82614360
Date: 2012-05-18
Time: 20:28:11 CEST



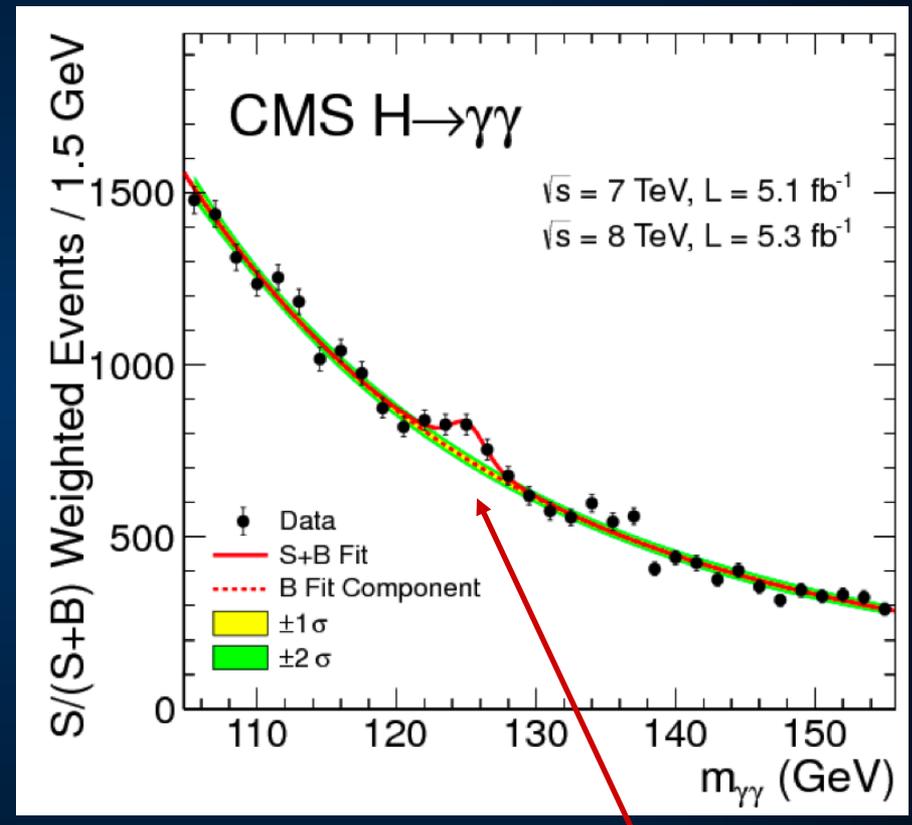
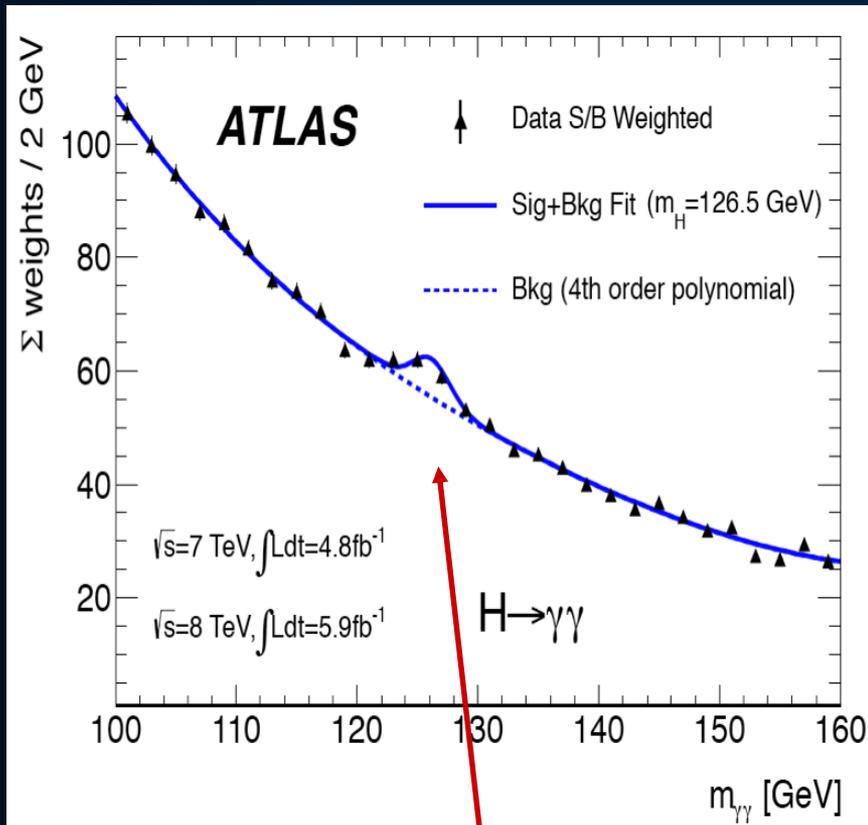
CERN experiments observe particle consistent with long-sought Higgs boson Geneva, 4 July 2012.

At a seminar held at CERN¹ 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

