

CERN

European Organization for Nuclear Research

Organisation Européenne pour la Recherche Nucléaire

CERN – Research, Innovation and Education

Mick Storr

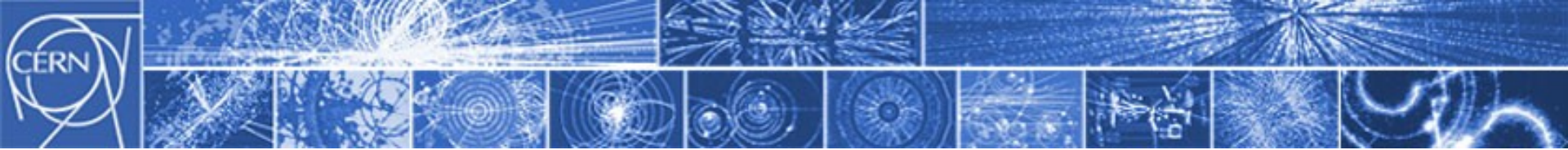
CERN

Geneva, Switzerland

Kosice

14/4/2011





30th November 2009 LHC sets new world record

Early this morning CERN's Large Hadron Collider become the world's highest energy particle accelerator, having accelerated its twin beams of protons to an energy of **1.18 TeV**. This exceeds the previous world record of 0.98 TeV, which had been held by the US Fermi National Accelerator



CERN was founded 1954: 12 European States Today: 20 Member States



~ 2300 staff

~ 790 other paid personnel

> 10000 users

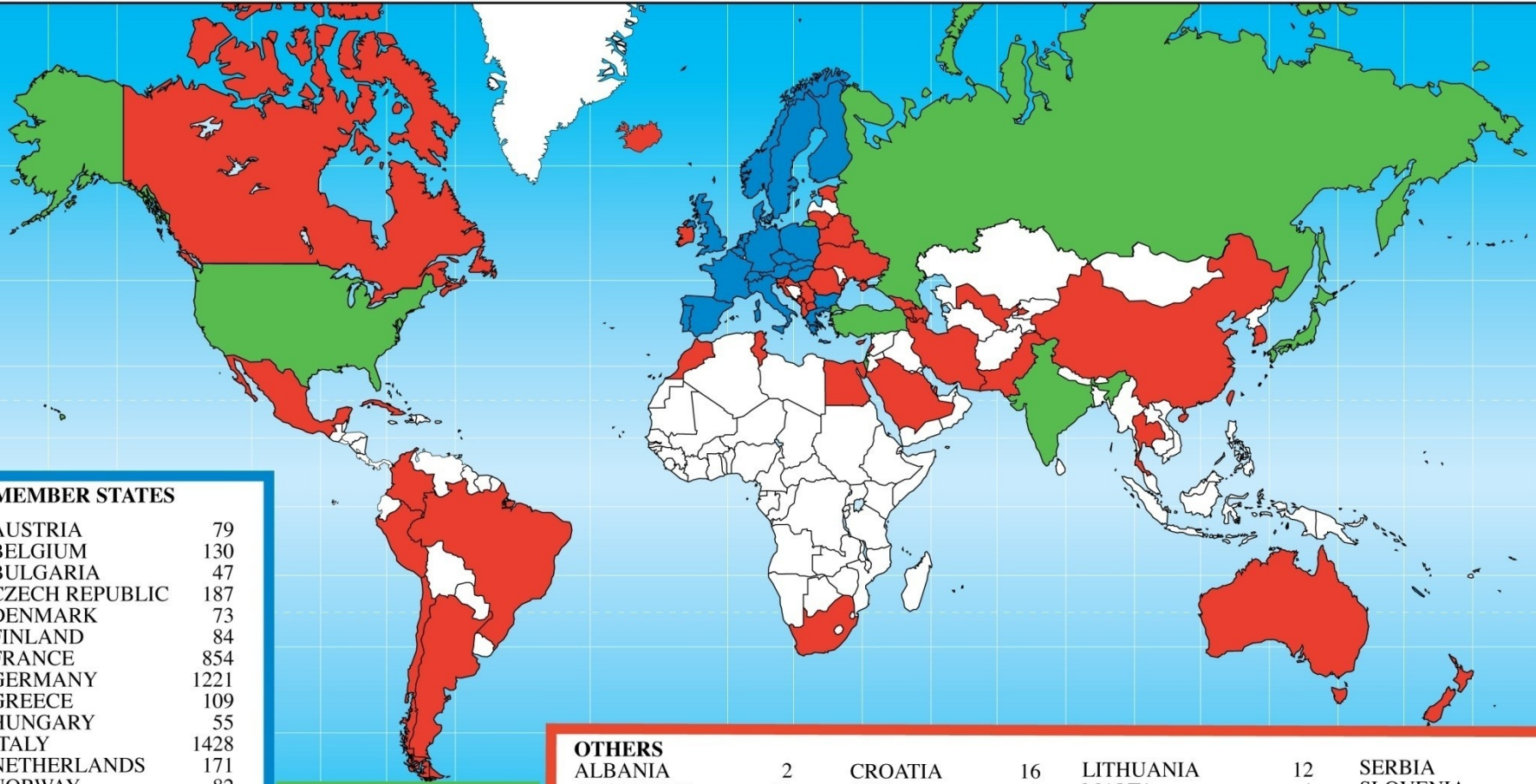
Budget (2011) ~1000 MCHF

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

1 Candidate for Accession: Romania

8 Observers to Council: India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and UNESCO

Distribution of All CERN Users by Nation of Institute on 6 January 2011



MEMBER STATES

AUSTRIA	79
BELGIUM	130
BULGARIA	47
CZECH REPUBLIC	187
DENMARK	73
FINLAND	84
FRANCE	854
GERMANY	1221
GREECE	109
HUNGARY	55
ITALY	1428
NETHERLANDS	171
NORWAY	82
POLAND	193
PORTUGAL	134
SLOVAKIA	61
SPAIN	329
SWEDEN	72
SWITZERLAND	351
UNITED KINGDOM	701

OBSERVER STATES

INDIA	91
ISRAEL	60
JAPAN	204
RUSSIA	829
TURKEY	67
USA	1684

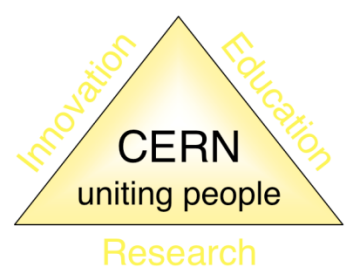
OTHERS

ALBANIA	2	CROATIA	16	LITHUANIA	12	SERBIA	22
ARGENTINA	11	CUBA	4	MALTA	1	SLOVENIA	29
ARMENIA	12	CYPRUS	8	MEXICO	32	SOUTH AFRICA	11
AUSTRALIA	19	EGYPT	5	MONTENEGRO	1	THAILAND	1
AZERBAIJAN	1	ESTONIA	11	MOROCCO	5	F.Y.R.O.M.	2
BELARUS	20	GEORGIA	8	NEW ZEALAND	8	TUNISIA	1
BRAZIL	79	ICELAND	3	PAKISTAN	16	UKRAINE	18
CANADA	150	IRAN	17	PERU	2	UZBEKISTAN	1
CHILE	3	IRELAND	14	QATAR	1		
CHINA	84	KOREA	74	ROMANIA	62		
CHINA (TAIPEI)	50	LEBANON	1	SAUDI ARABIA	2		
COLOMBIA	9						

6361

2935

828



The Mission of CERN

- **Push**

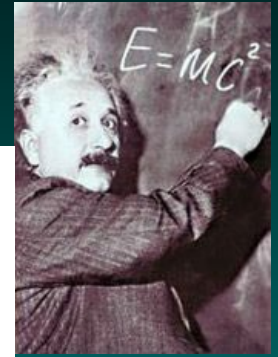
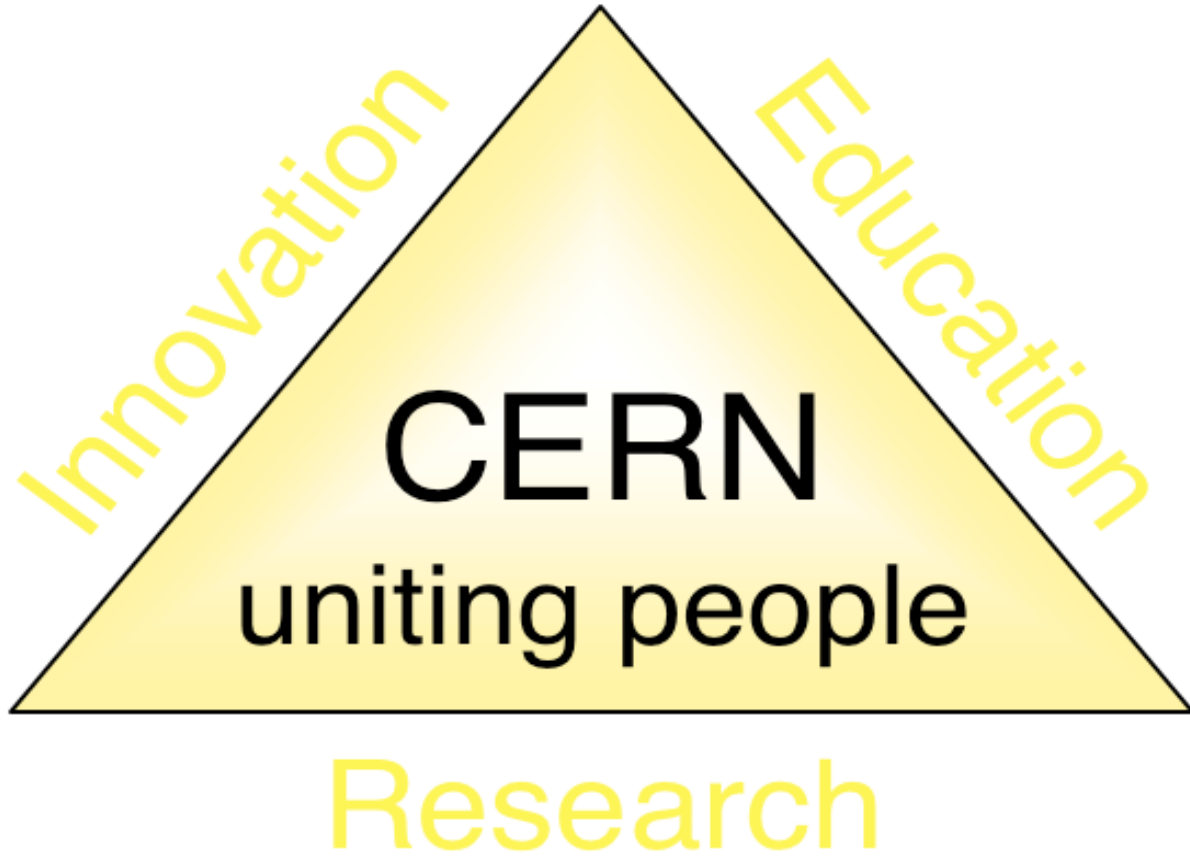
E.g. the s
the first r

- **Devel**
acceler

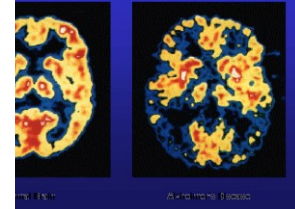
Informati
Medicine

- **Train**
tomor

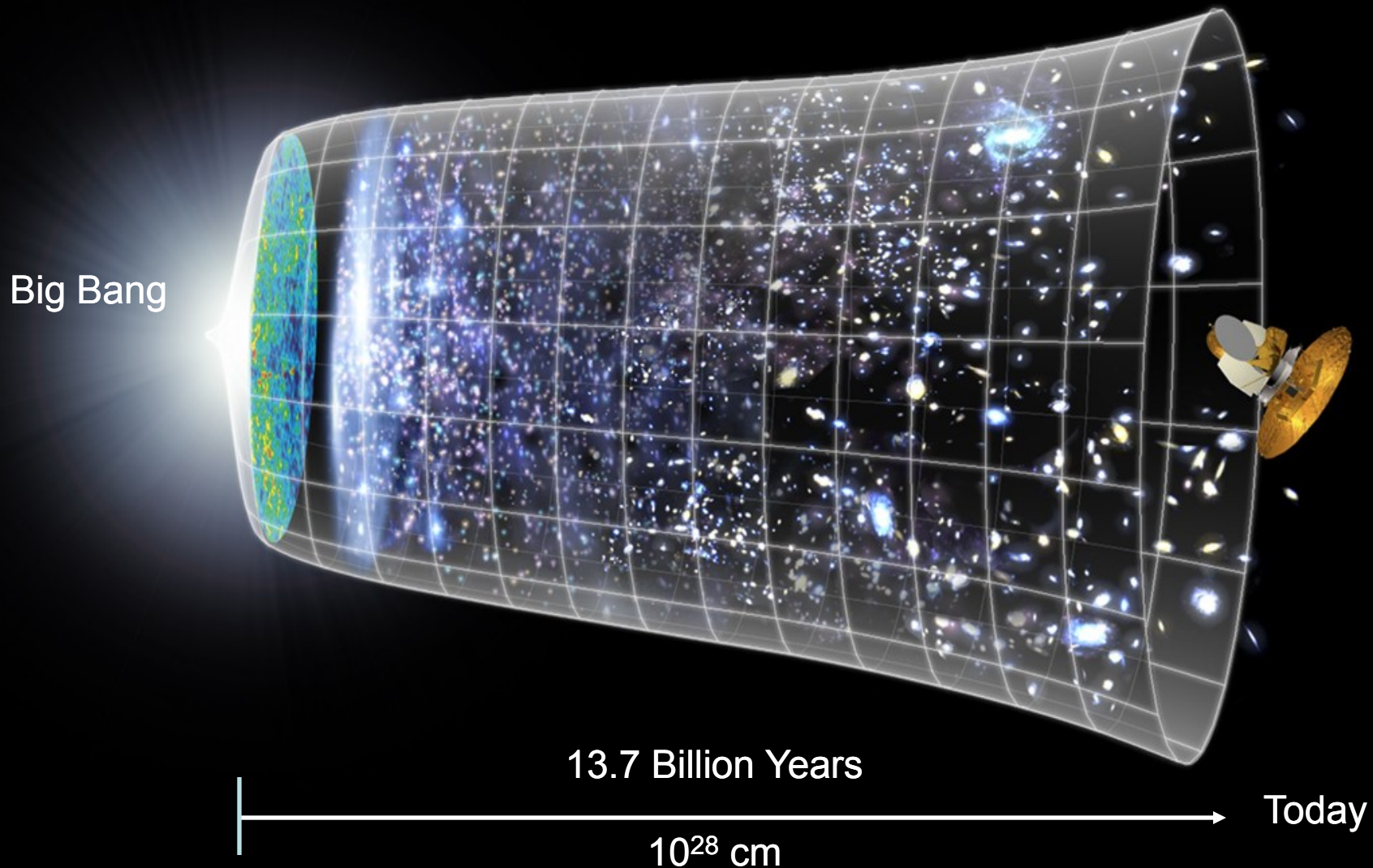
- **Unite** people from different countries and cultures

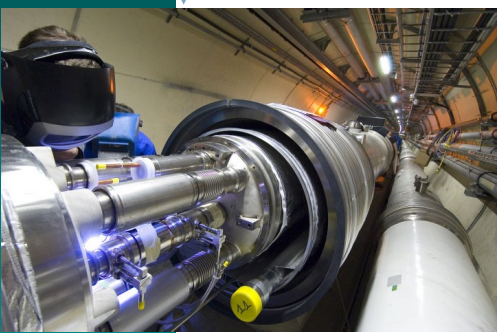
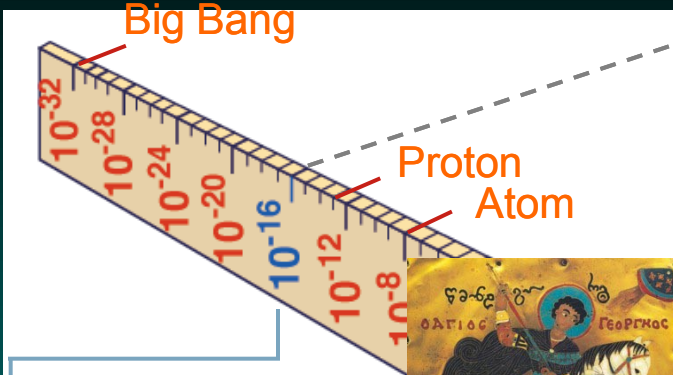


Metabolism in Alzheimer's Disease: PET Scan



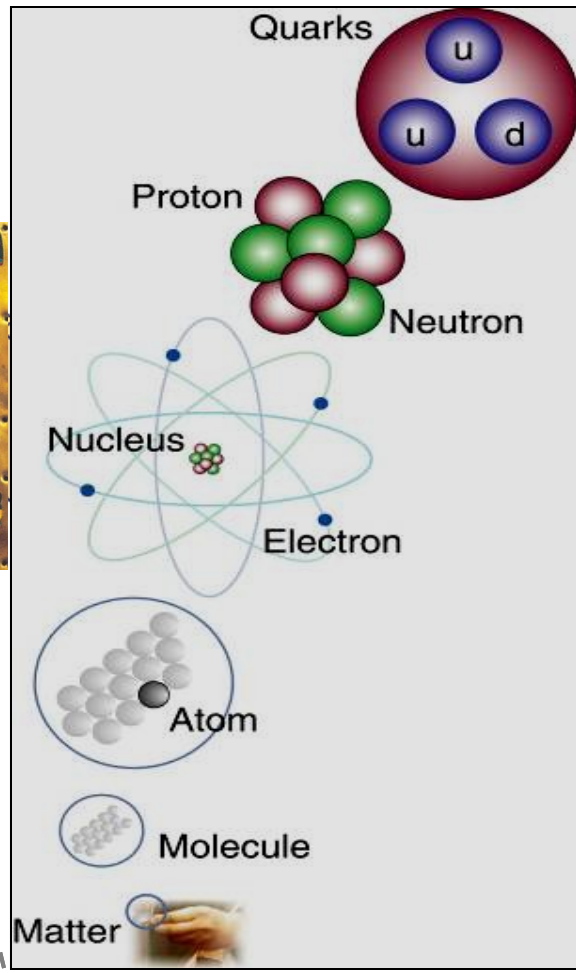
Evolution of the Universe



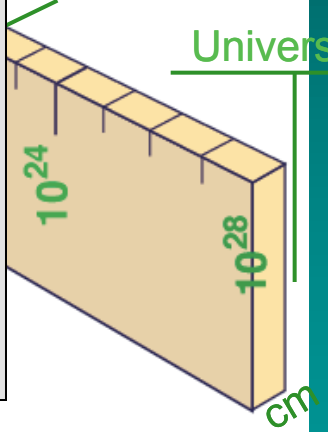


LHC

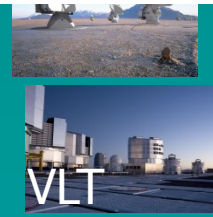
Super-Microscope



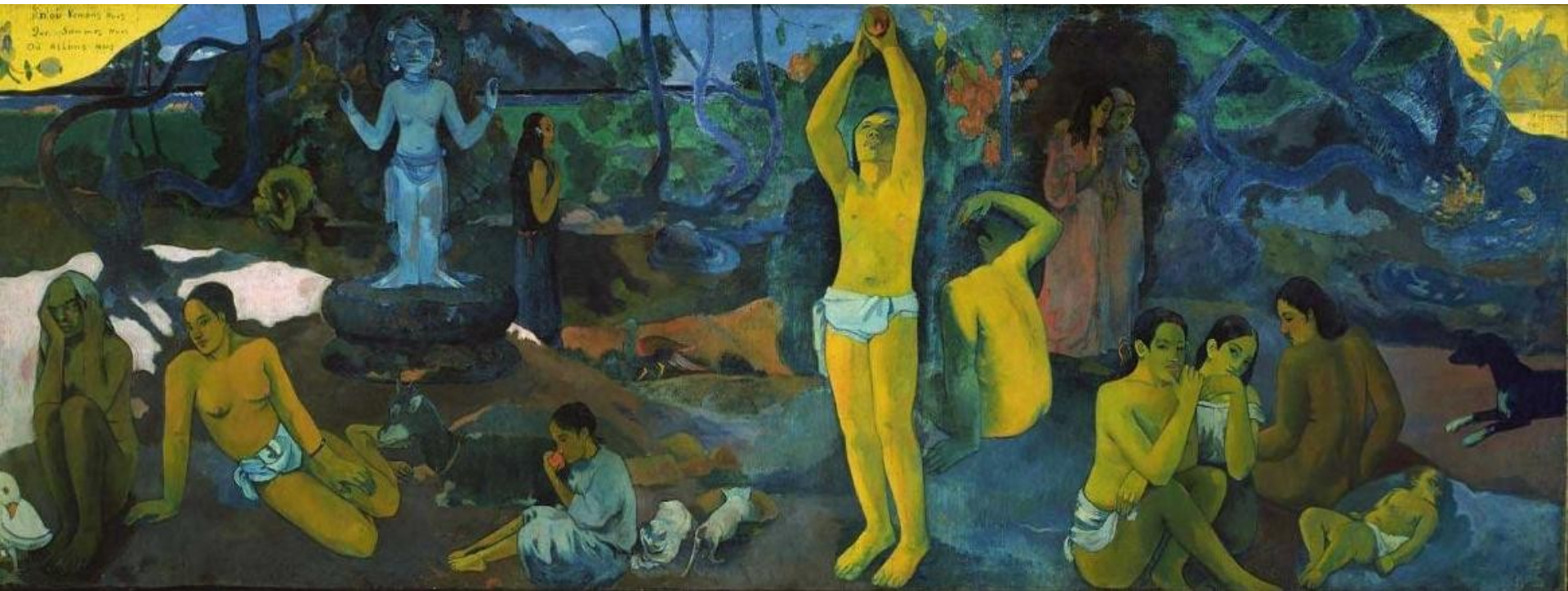
Radius of Galaxies
Universe



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



**“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 Large Hadron Collider (LHC)

Proton- Proton Collider

7 TeV + 7 TeV



1,000,000,000 collisions/second

Total energy over 14,000 proton masses

Primary targets:

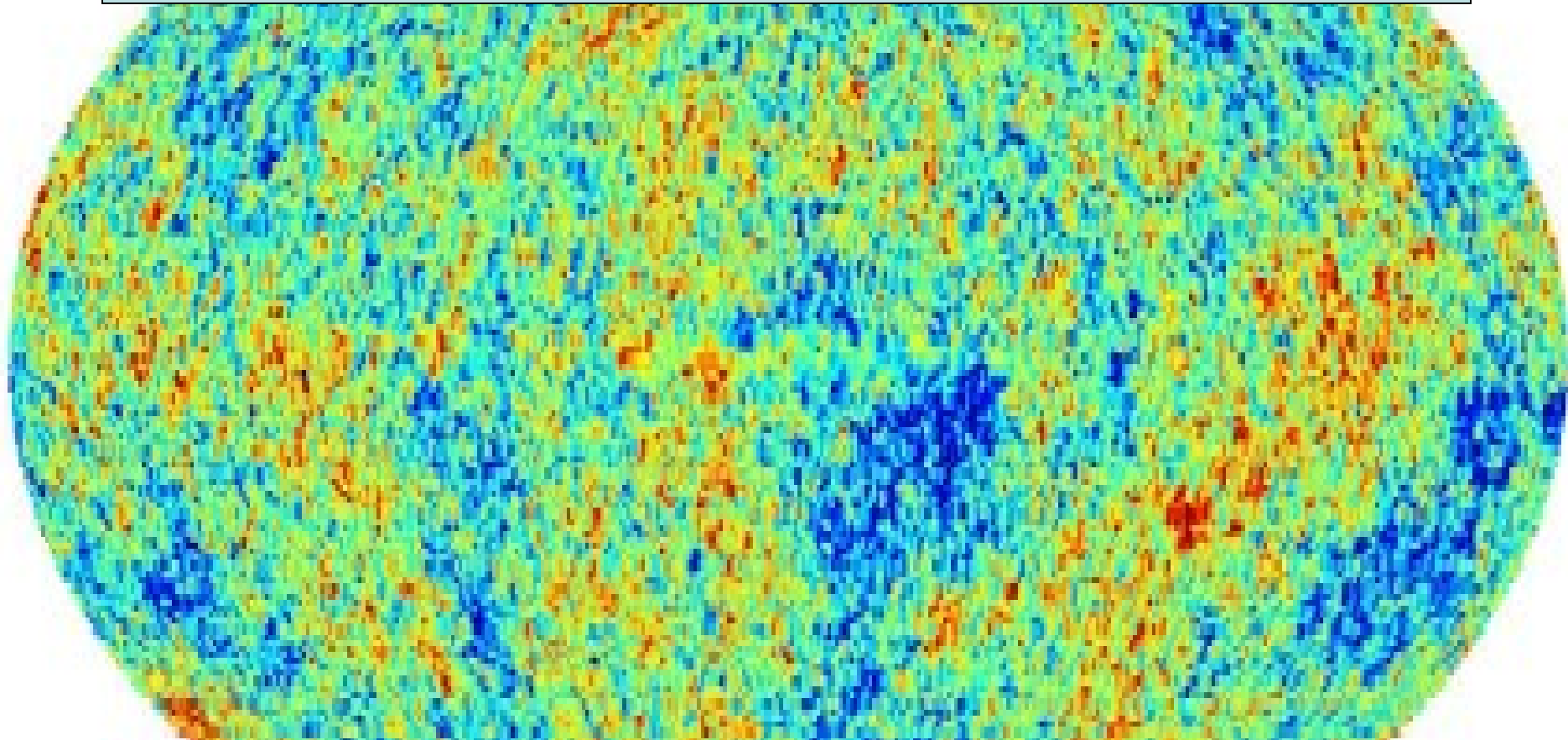
- Origin of mass
- Nature of Dark Matter
- Primordial Plasma
- Matter vs Antimatter

The Emptiest Space in the Solar System

A photograph of a long, brightly lit tunnel, likely a particle accelerator or synchrotron facility. The tunnel is filled with complex machinery, including large cylindrical components and pipes. The lighting is warm and focused on the equipment, creating a sense of depth and scale. The perspective is from the end of the tunnel, looking down its length.

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

Colder than Outer Space

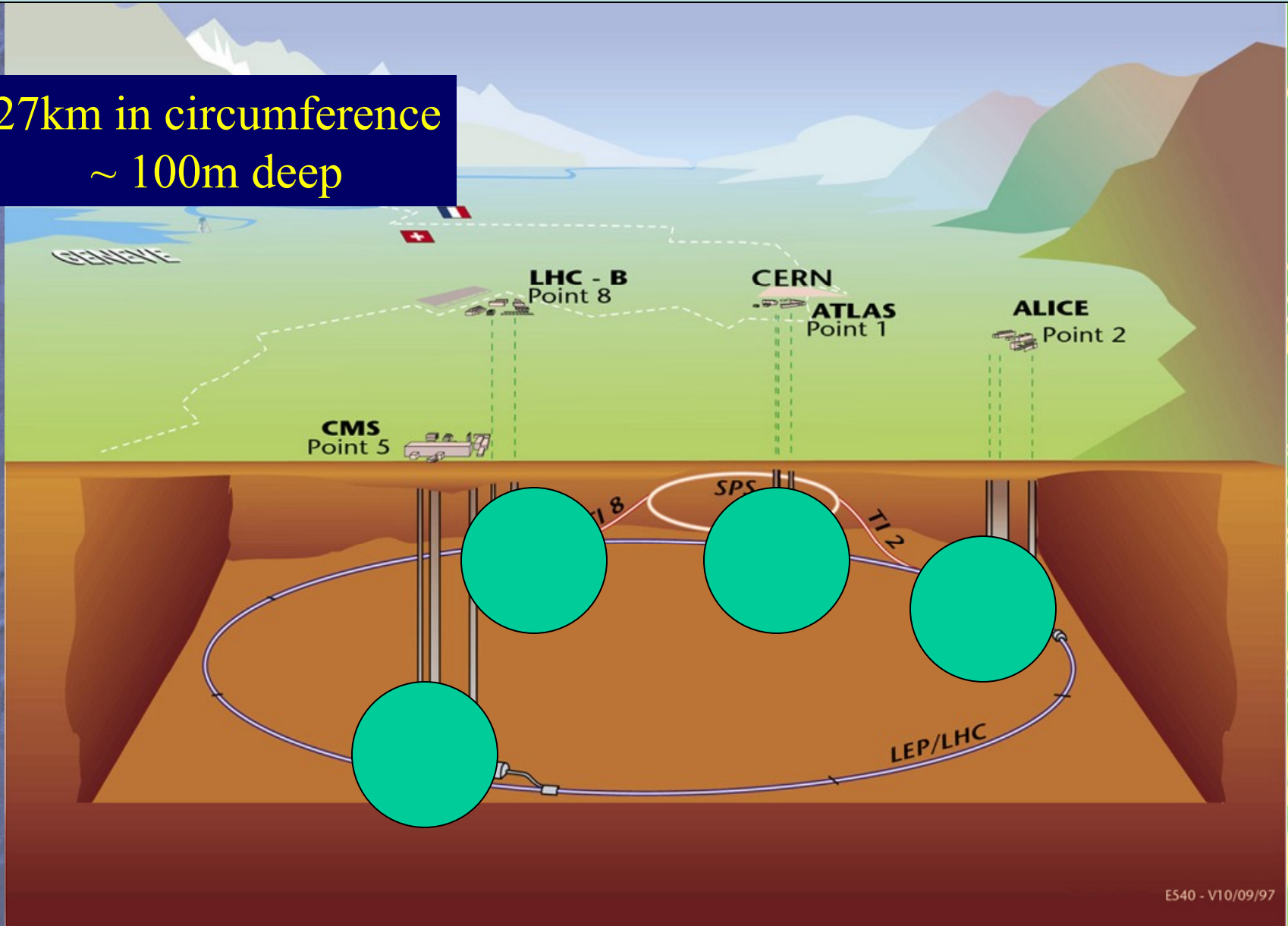


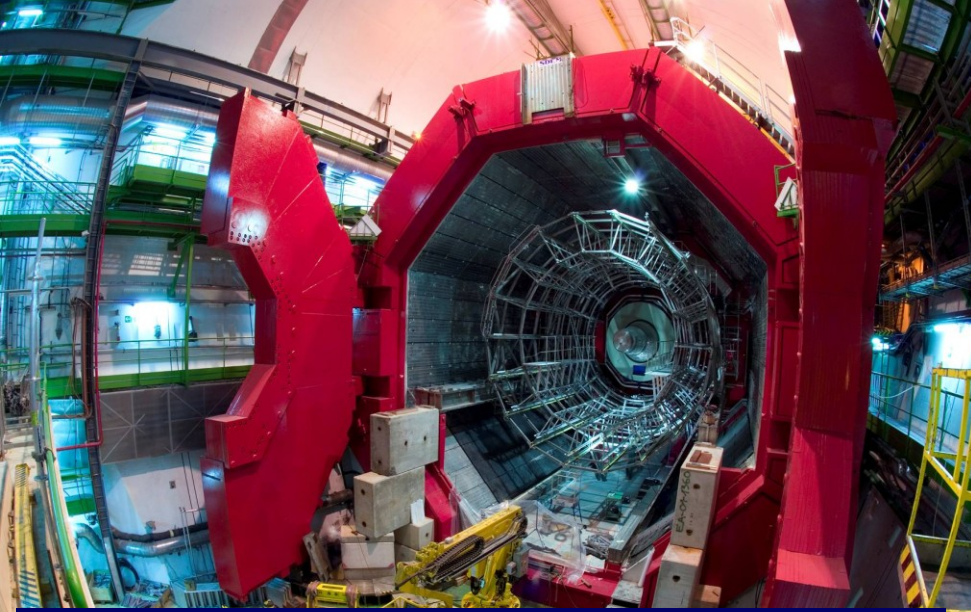
LHC 1.9 degrees above absolute zero = - 271 C

Outer space 2.7 degrees above zero = - 270 C

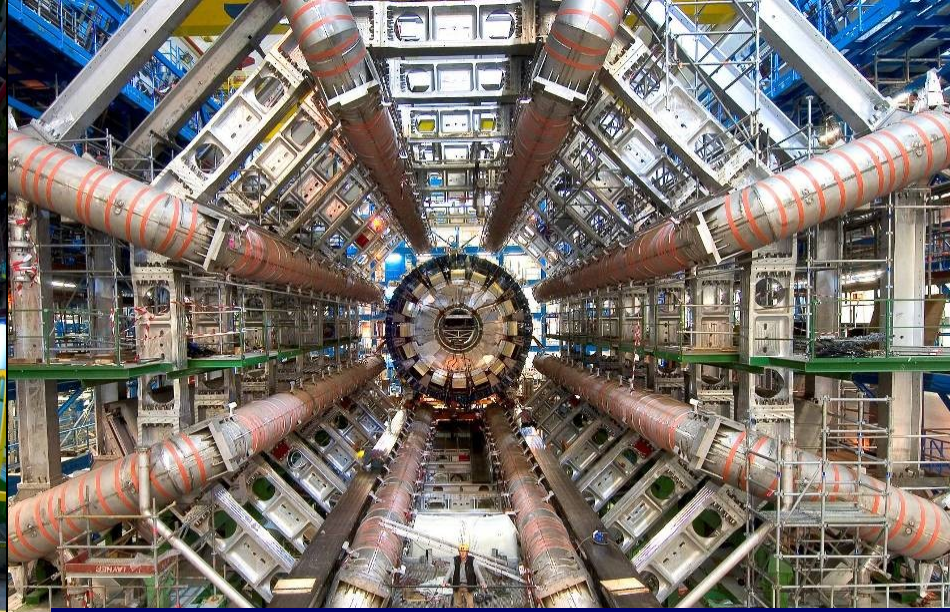
General View of LHC & its Experiments

27km in circumference
~ 100m deep

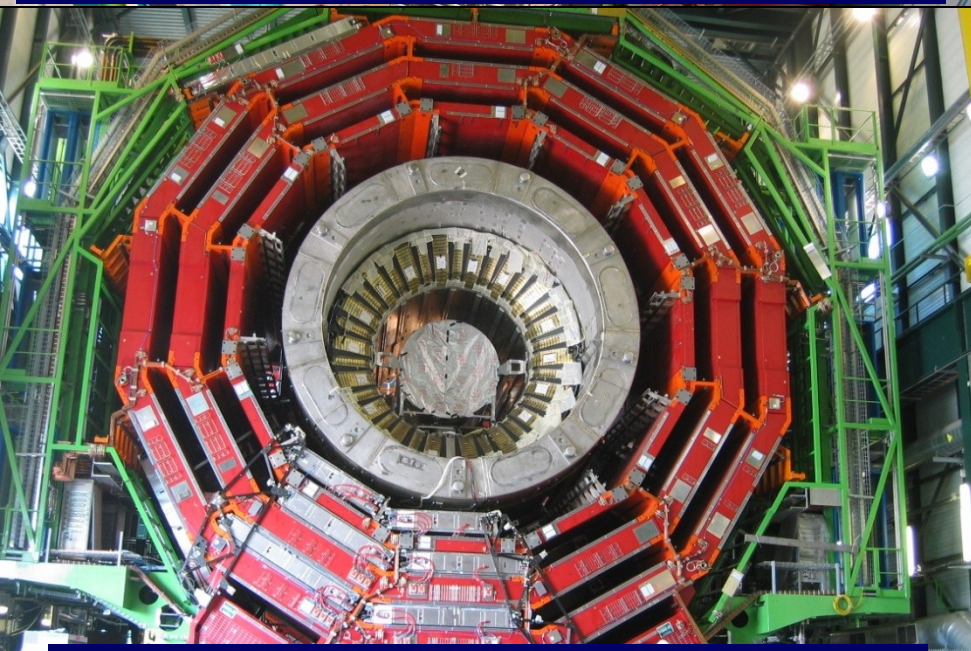




ALICE: Primordial cosmic plasma



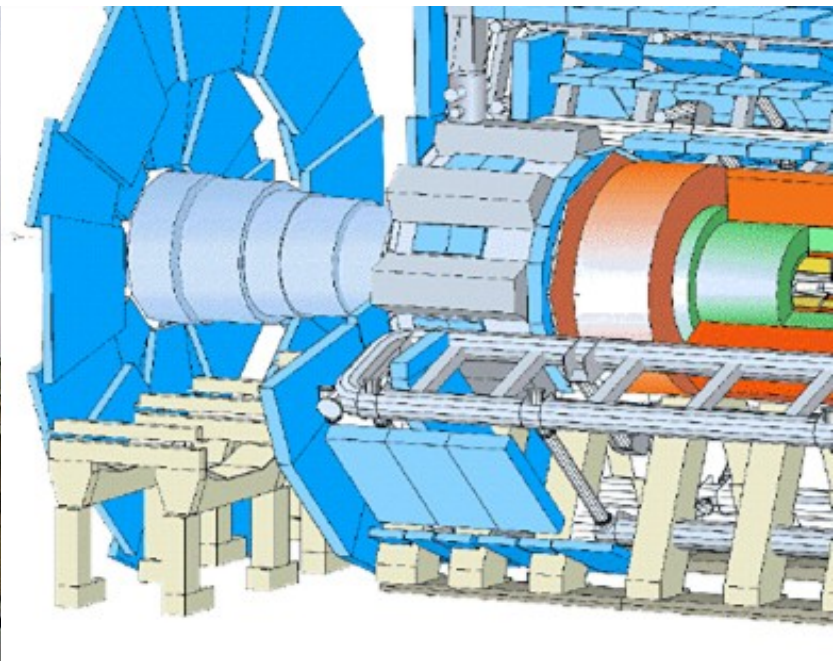
ATLAS: Higgs and supersymmetry



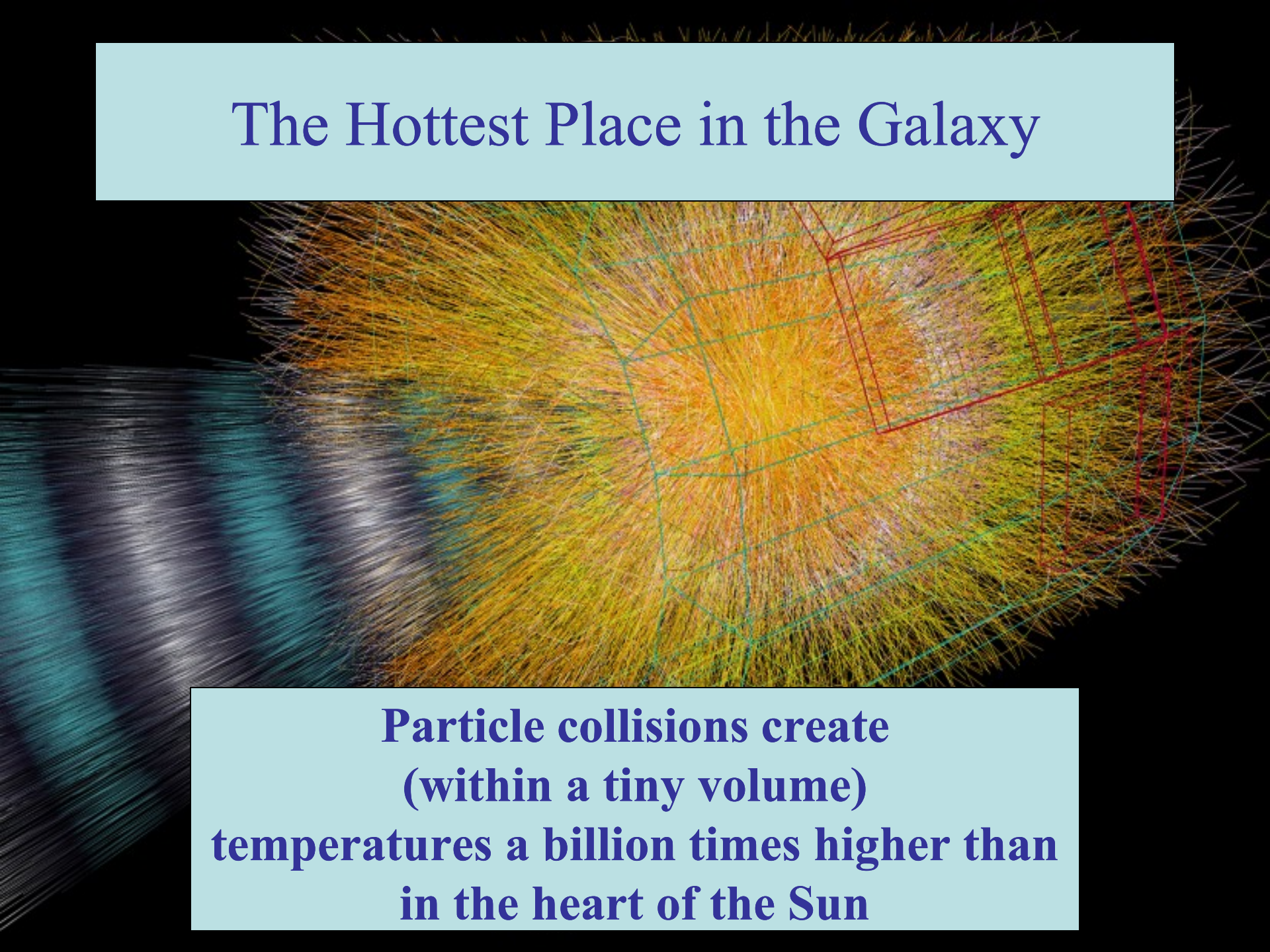
CMS: Higgs and supersymmetry



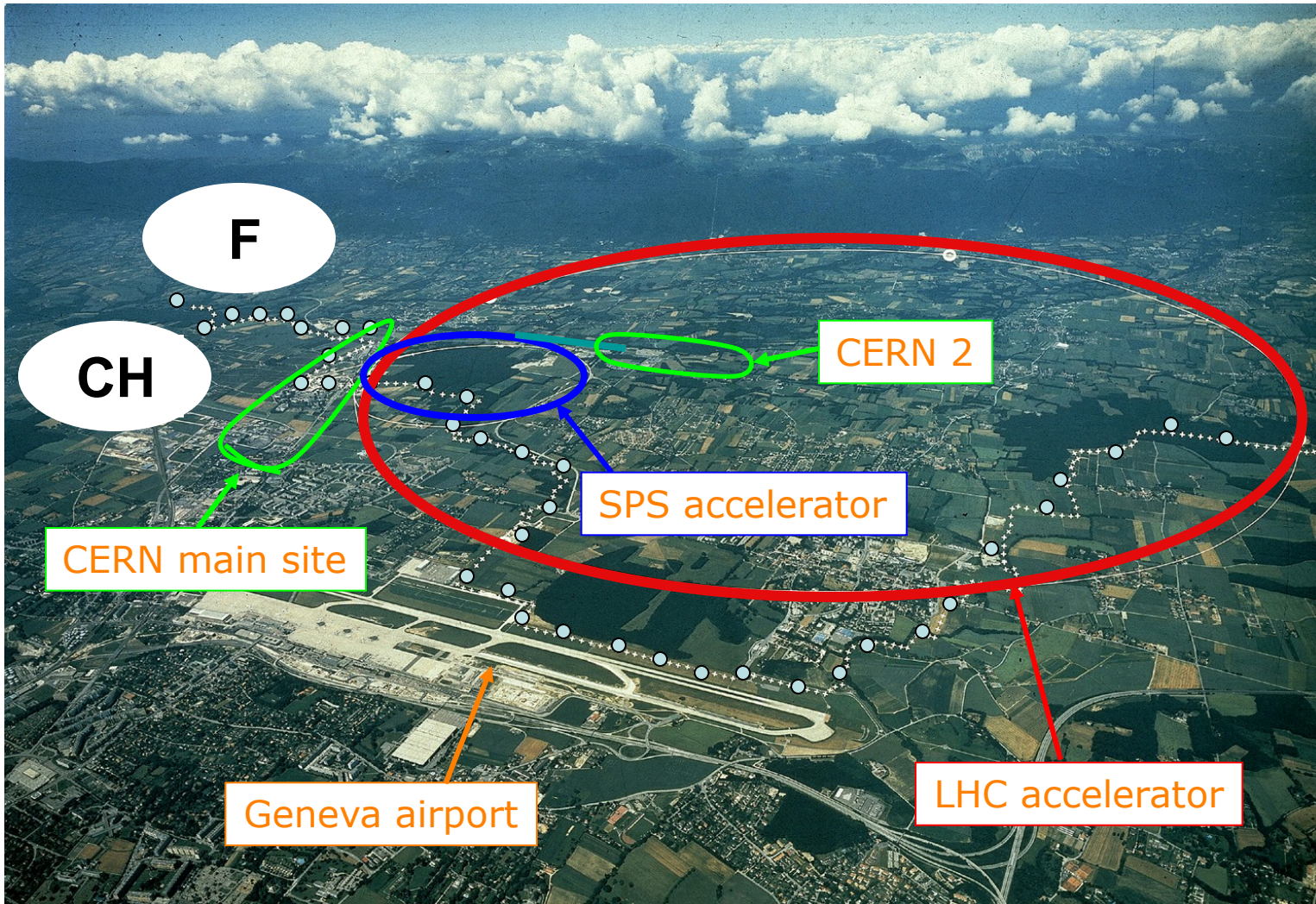
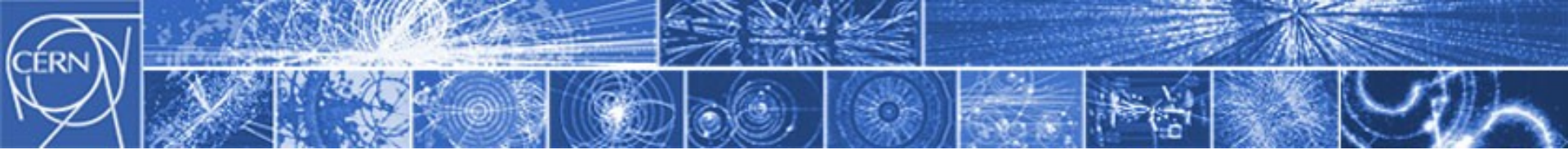
LHCb: Matter-antimatter difference

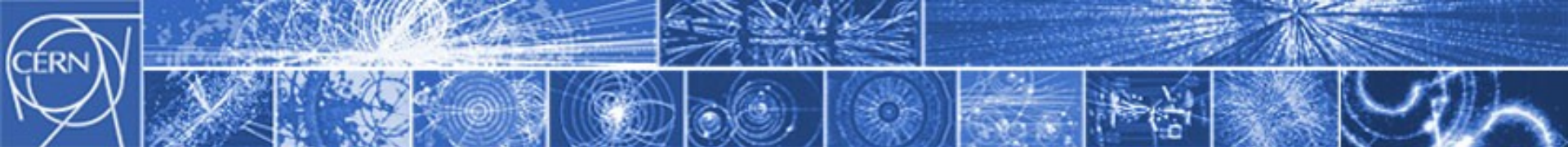


The Hottest Place in the Galaxy

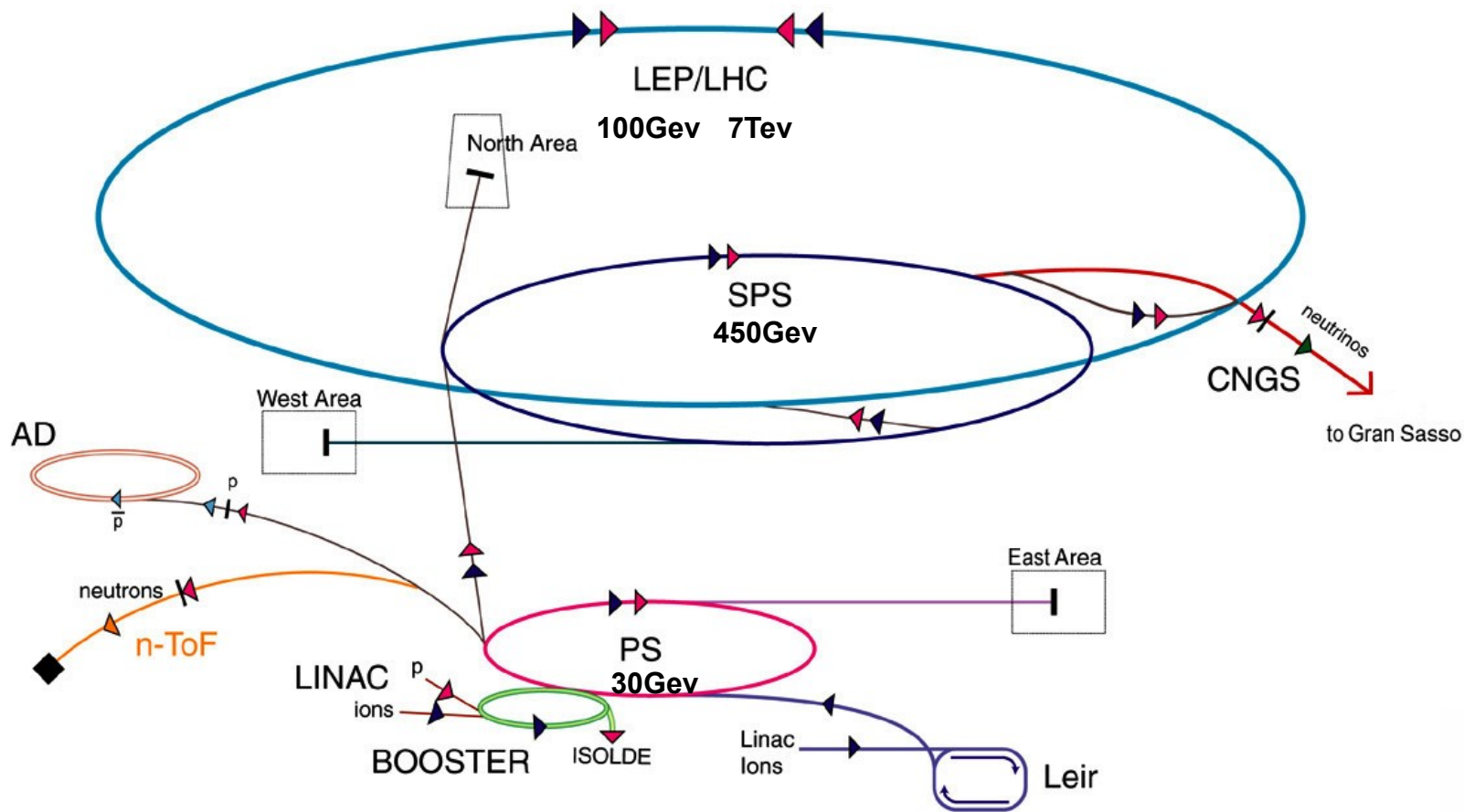


**Particle collisions create
(within a tiny volume)
temperatures a billion times higher than
in the heart of the Sun**





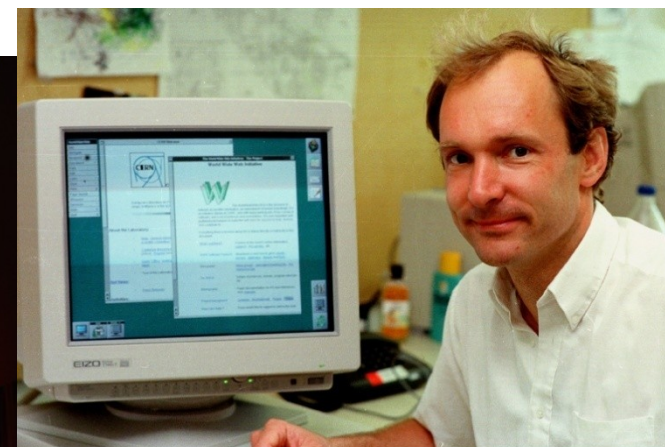
Accelerator chain at CERN, a complex business



- ▶ p (proton)
- ▶ ion
- ▶ neutron
- ▶ \bar{p} (antiproton)
- ▶ \leftrightarrow proton/antiproton conversion
- ▶ neutrino

- AD Antiproton Decelerator
- PS Proton Synchrotron
- SPS Super Proton Synchrotron

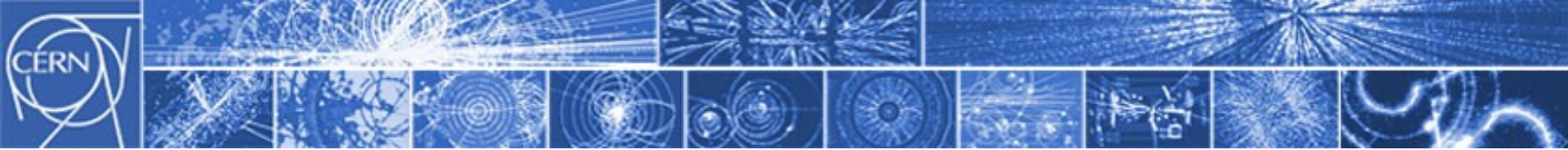
- LHC Large Hadron Collider
- n-ToF Neutron Time of Flight
- CNGS Cern Neutrinos Gran Sasso



Tim Berners-Lee
World Wide Web
1989

www.cern.ch

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**





CERN Education Activities

Scientists at CERN

Academic Training Programme

Young Researchers

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

CERN Personnel

Training Programmes

Language, Management, Technical



CERN School of Computing
Uxbridge, UK, 2010

Physics Students

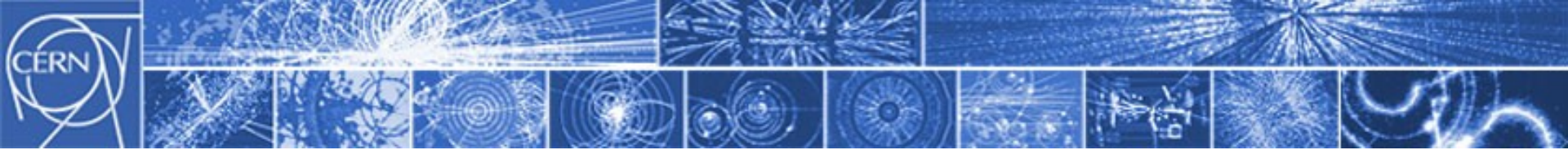
Summer Students Programme



CERN Teacher Schools

International and National Programmes





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What next ?