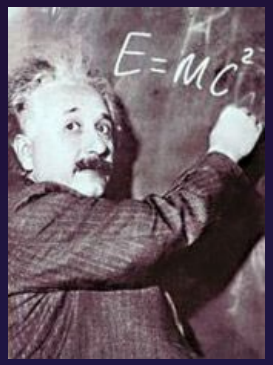

Welcome - Добро пожаловать
Second CERN-JINR Dubna School Teachers Programme – November 2009
to
CERN
Accelerating Science and Innovation

Introduction to

CERN-European Organization for Nuclear Research

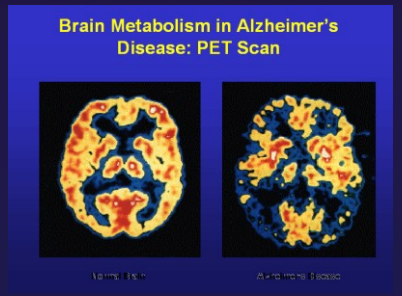
Tadeusz KURTYKA – CERN - Projects Office of Accelerator Sector / International Relations Office

The Mission of CERN



- Push back the frontiers of knowledge

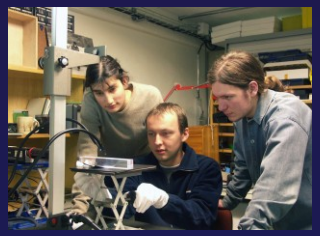
  E.g. the secrets of the Big Bang …what was the matter like within the first seconds of the Universe's life?



- Develop new technologies

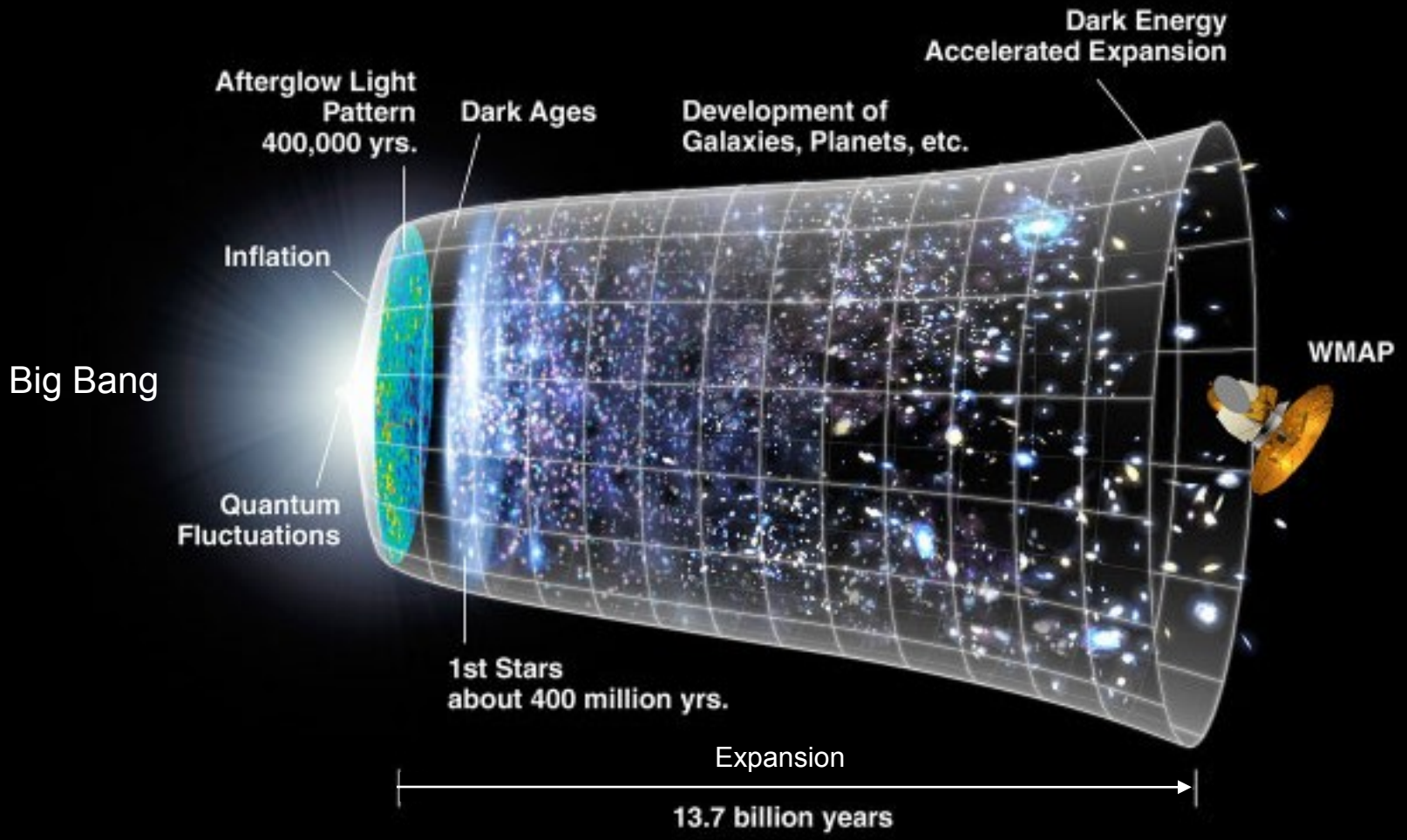
  Information technology - the Web and the GRID

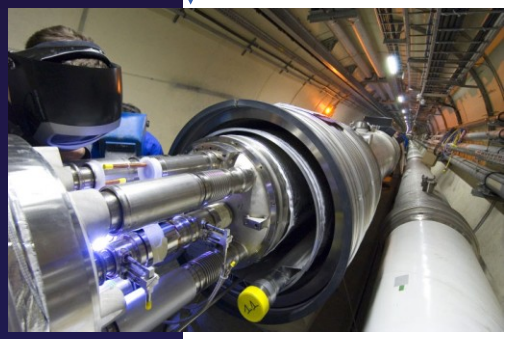
  Medicine - diagnosis and therapy



- Train scientists and engineers of tomorrow

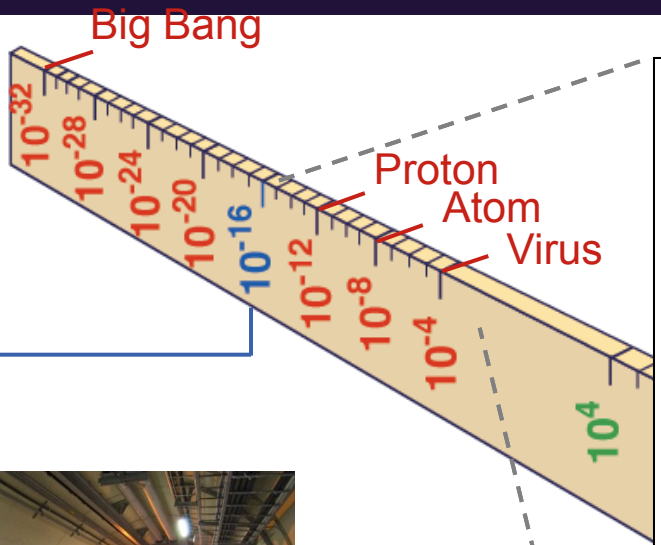
- Unite people from different countries and cultures

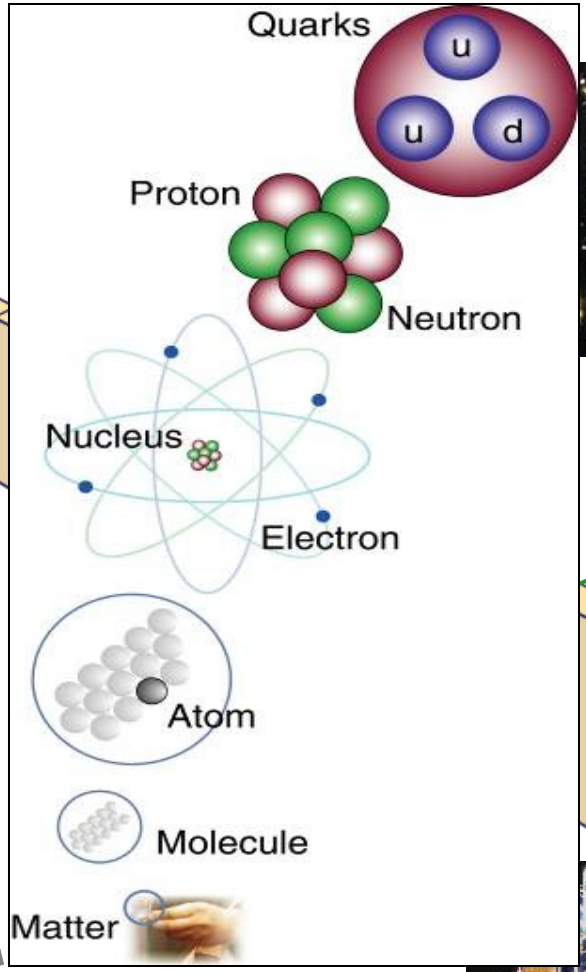

Dark Energy
Accelerated Expansion
Afterglow Light
Pattern
400,000 yrs.
Dark Ages
Development of
Galaxies, Planets, etc.
Inflation
Big Bang
WMAP
Quantum
Fluctuations
1st Stars
about 400 million yrs.
Expansion
13.7 billion years

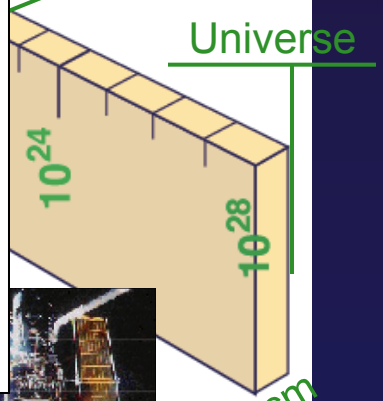


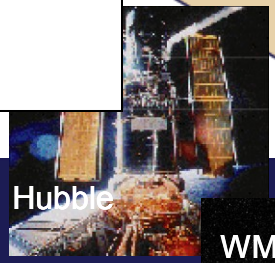
Super-Microscope

LHC







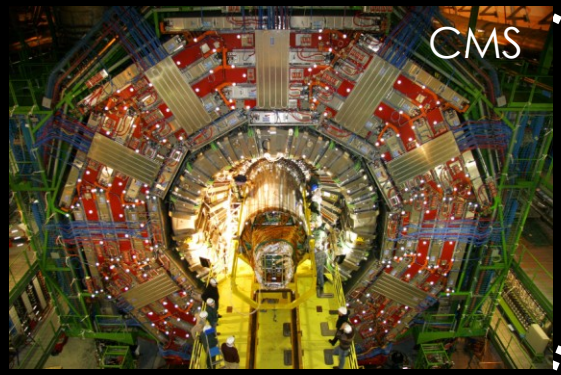


Study physics laws of first moments after Big Bang

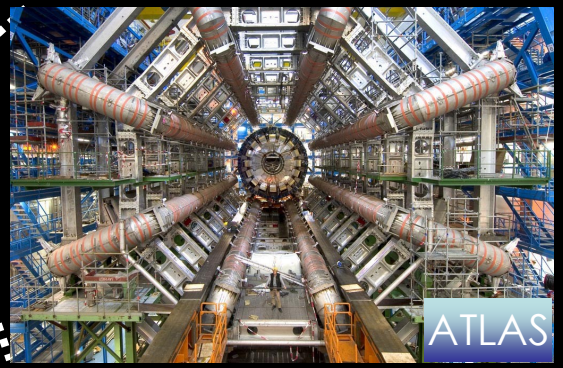
↙ increasing Symbiosis between Particle Physics, Astrophysics and Cosmology

Enter a New Era in Fundamental Science

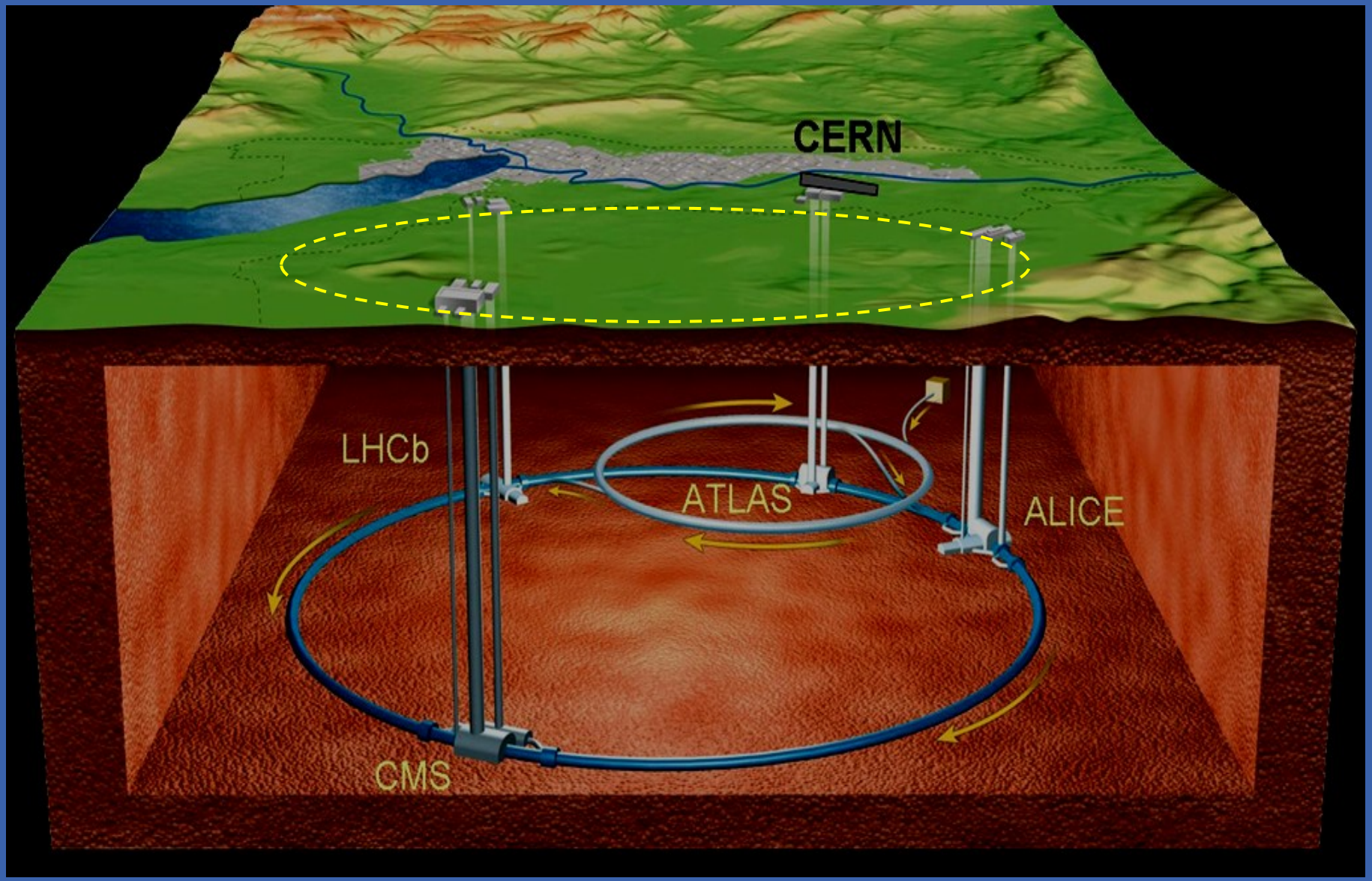
Start-up of the Large Hadron Collider (LHC), one of the largest and truly global scientific projects ever, is the most exciting turning point in particle physics.



Exploration of a new energy frontier
Proton-proton collisions at E_{CM} = 14 TeV

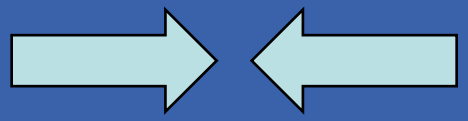


LHC – Large Hadron Collider



LHC - Large Hadron Collider

7 TeV + 7 TeV



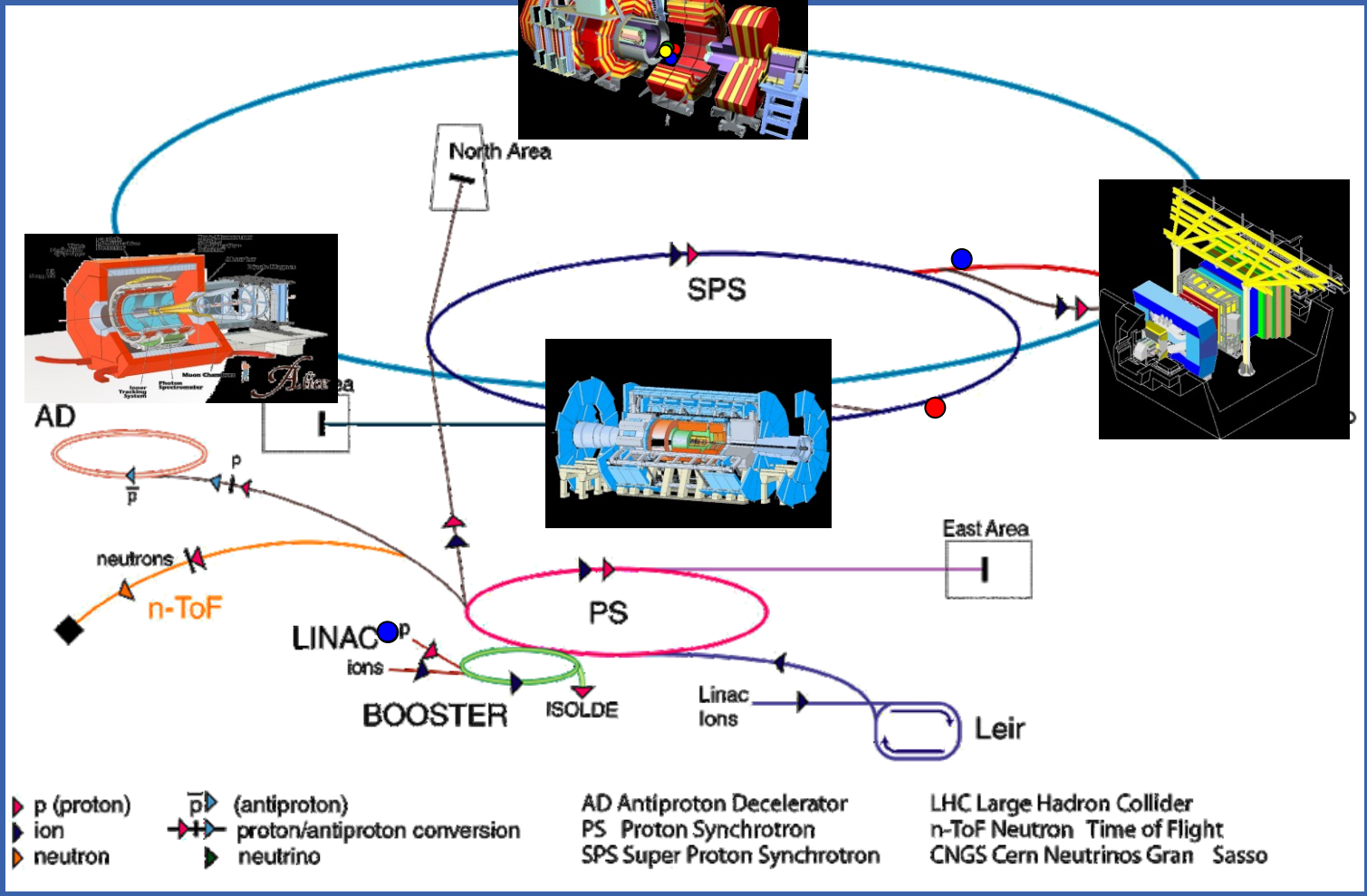
Luminosity = $10^{34}cm^{-2}sec^{-1}$

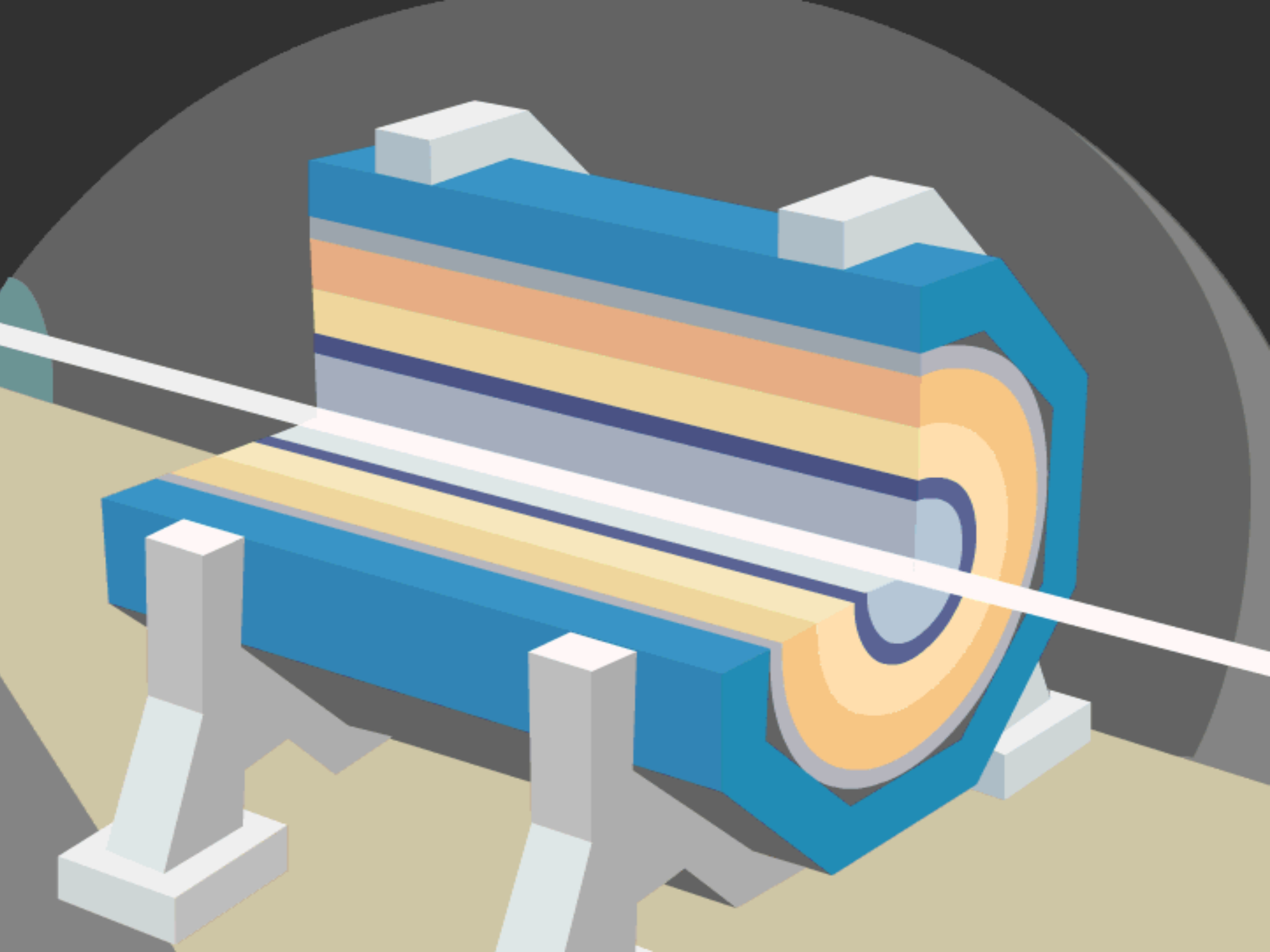
Primary targets:
- Origin of mass
- Nature of Dark Matter
- Primordial Plasma
- Matter vs Antimatter

The LHC results will determine the future course of High Energy Physics

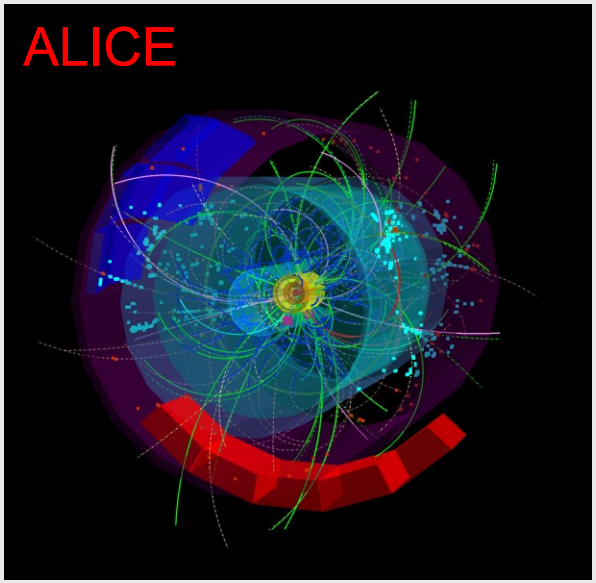
The large Hadron Collider

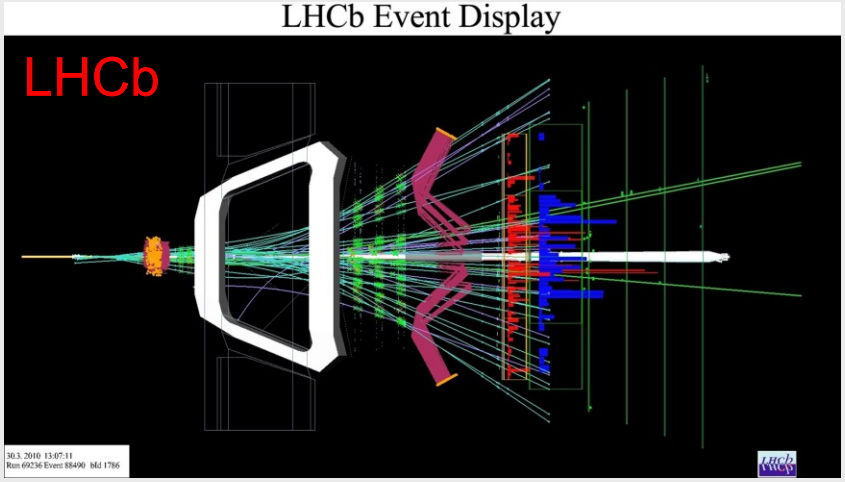
Collision of proton beams… …observed in giant detectors

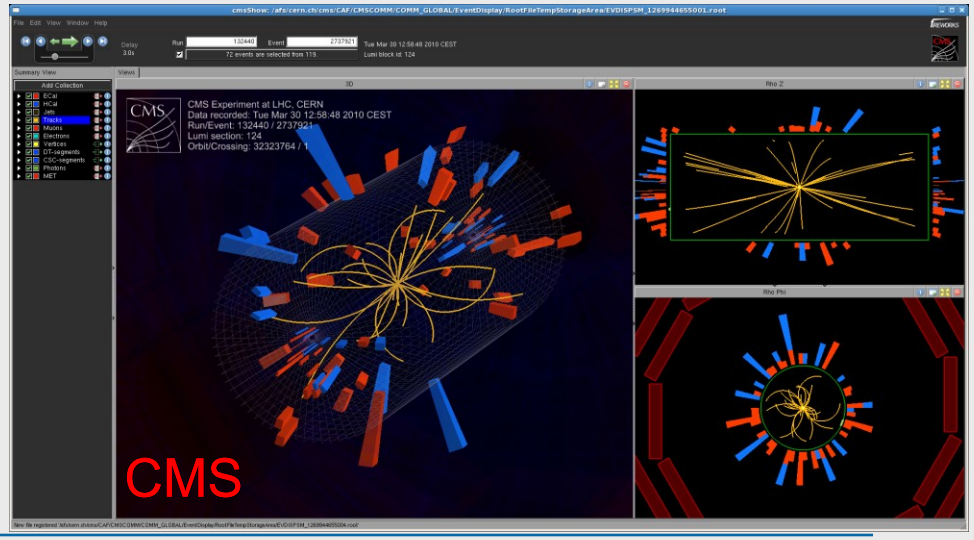




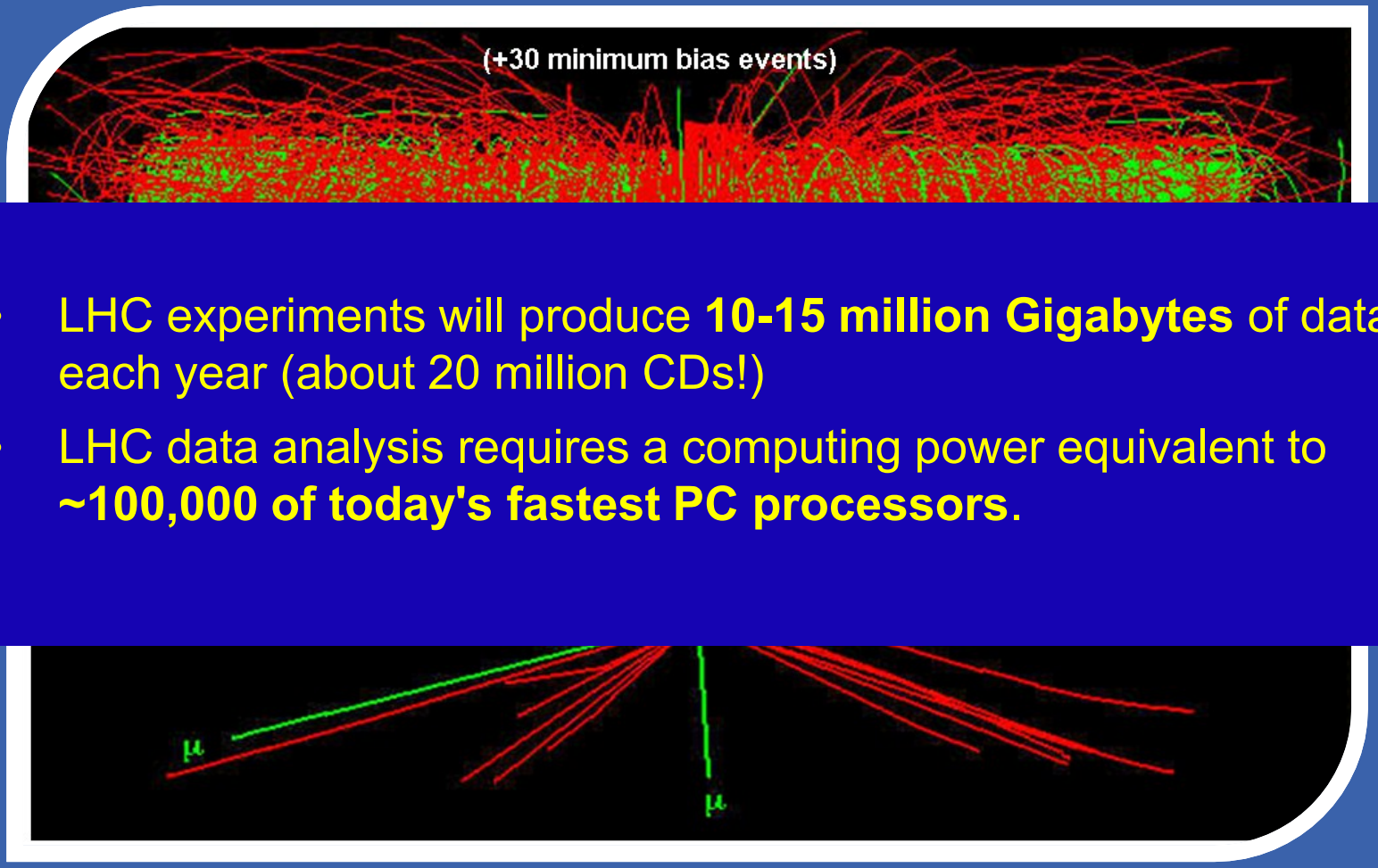
LHC: First collisions at 2x3.5 TeV: 30 March 2010



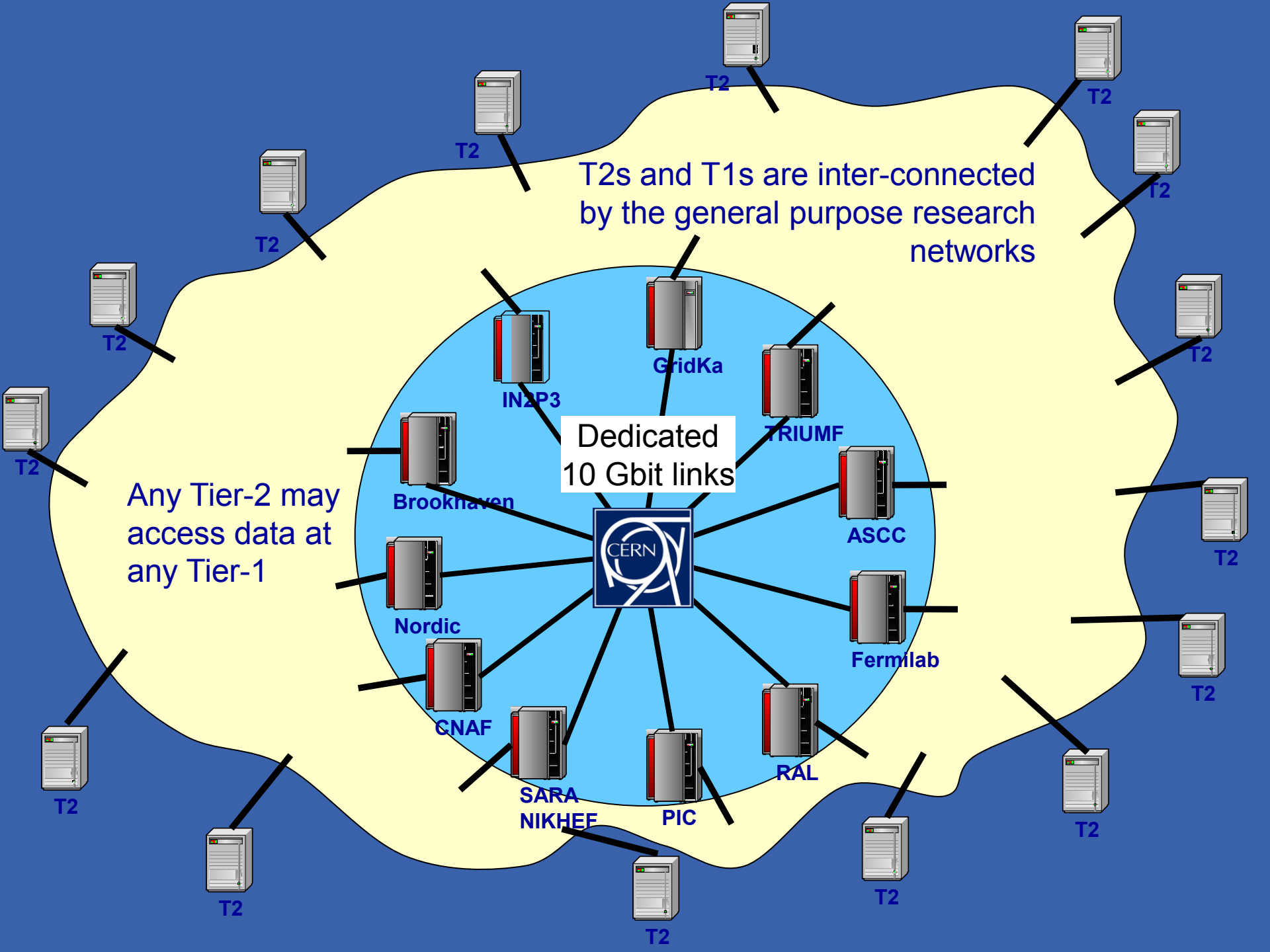




- Searching for new particles requires selection and analysis of enormous quantity of data from LHC detectors



- LHC experiments will produce **10-15 million Gigabytes** of data each year (about 20 million CDs!)
- LHC data analysis requires a computing power equivalent to **~100,000 of today's fastest PC processors**.

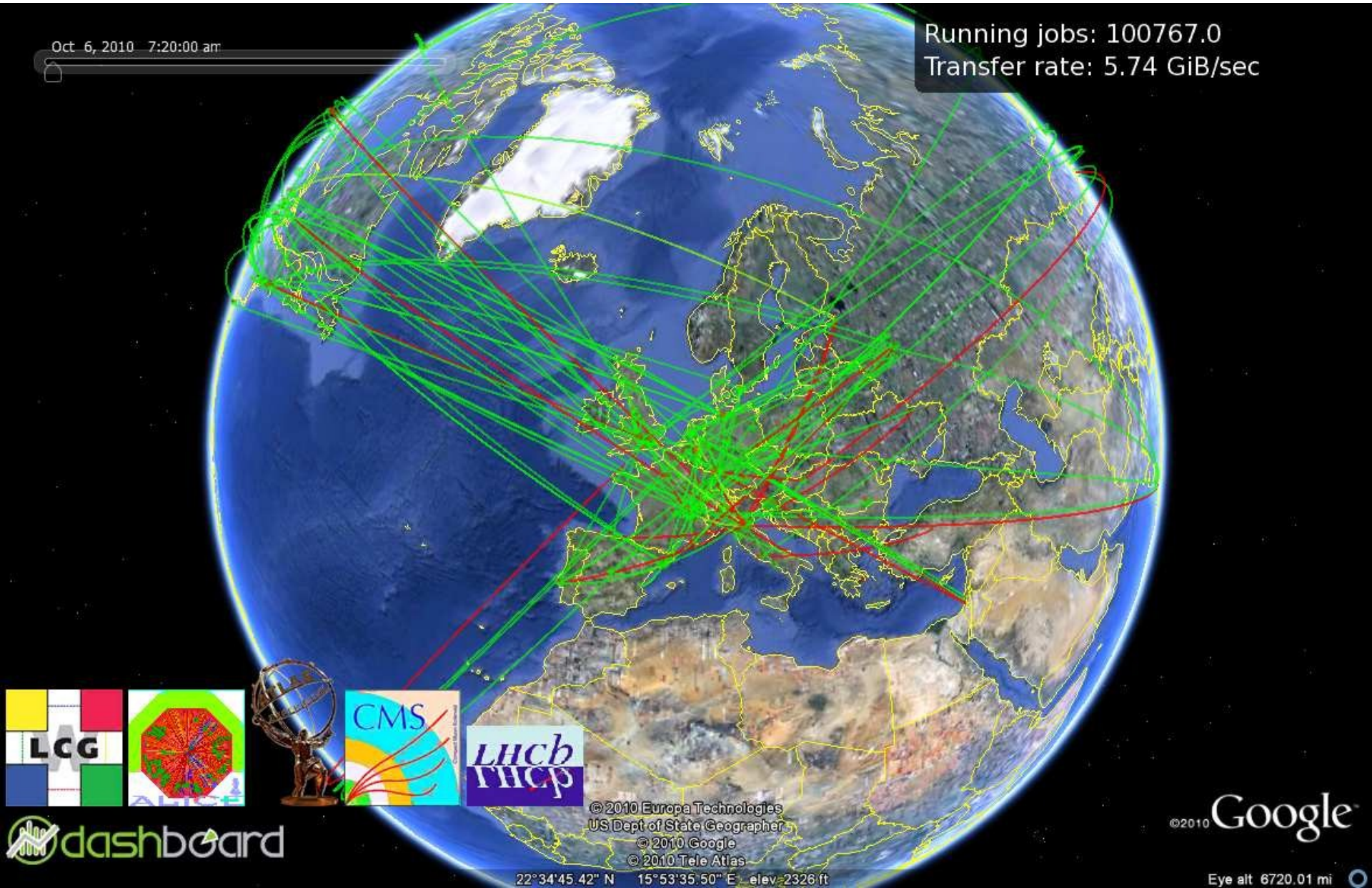

T2s and T1s are inter-connected by the general purpose research networks
Any Tier-2 may access data at any Tier-1
Dedicated 10 Gbit links
CERN
GridKa
IN2P3
TRIUMF
Brookhaven
ASCC
Nordic
Fermilab
CNAF
RAL
SARA
NIKHEF
PIC
T2

The Worldwide LHC Computing Grid

The LHC physics data analysis service distributed across the world

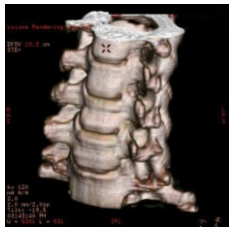
- CERN, 11 large *Tier-1* centres, over 200 *Tier-2* centres

LCG-LHC Computing GRID



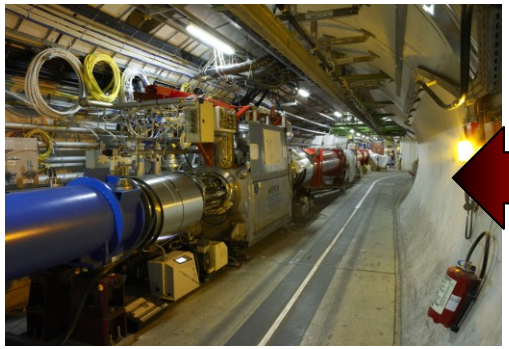
CERN Technologies - Innovation

Medical imaging



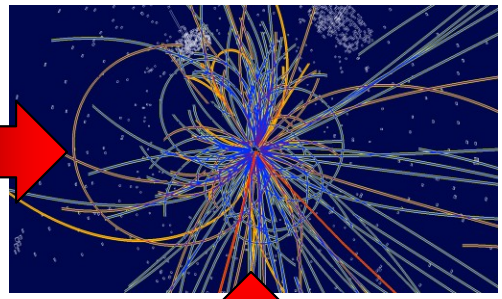
Example: medical application

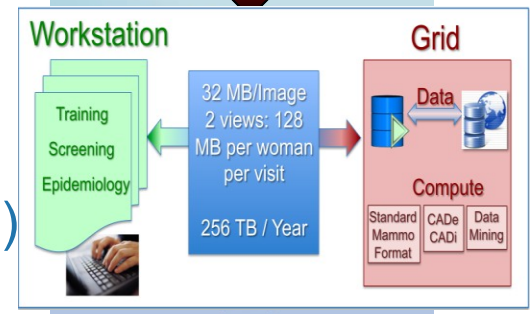
Accelerating particle beams



Charged hadron beam that loses energy in matter

Detecting particles

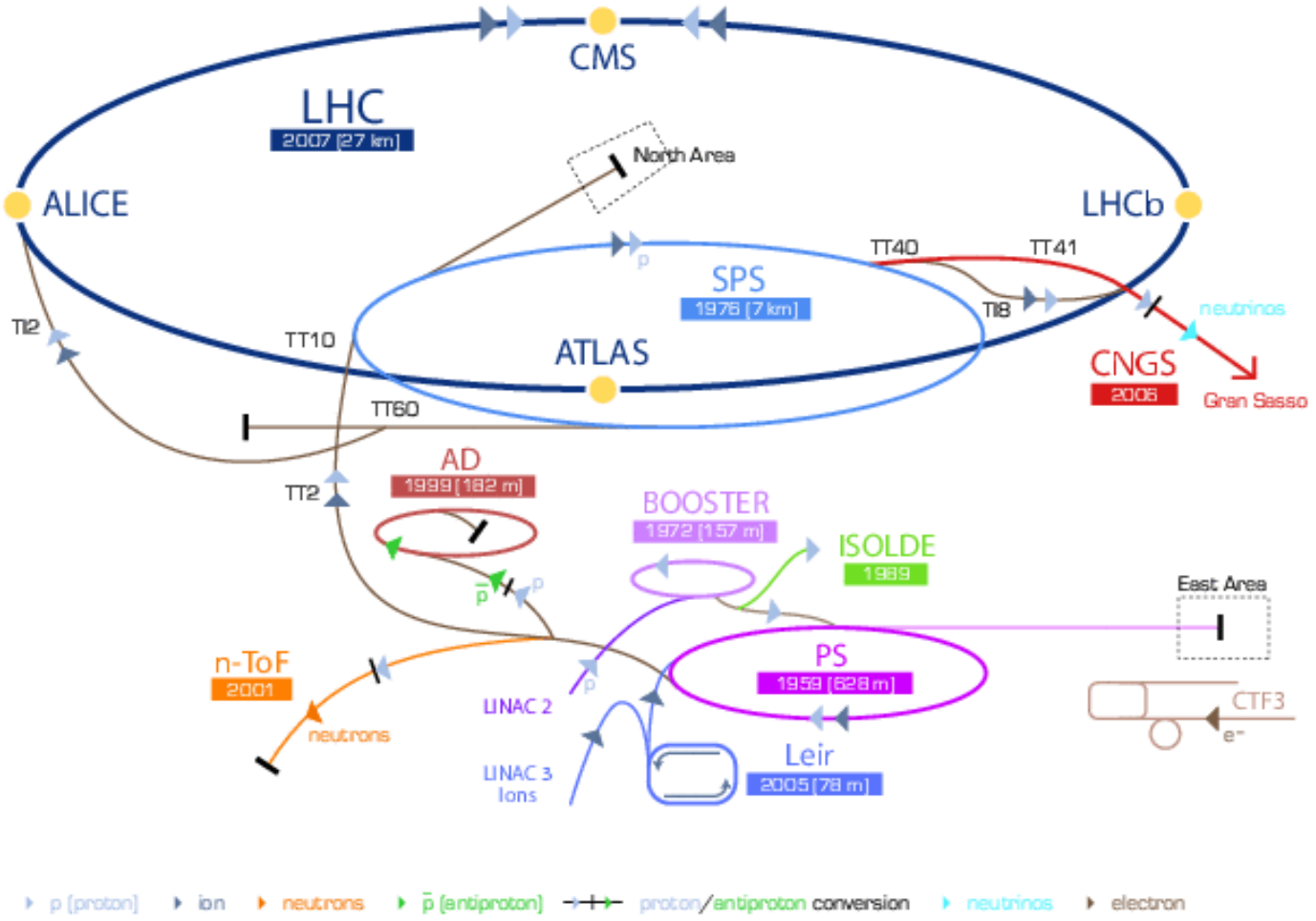




Large-scale **computing** (Grid)

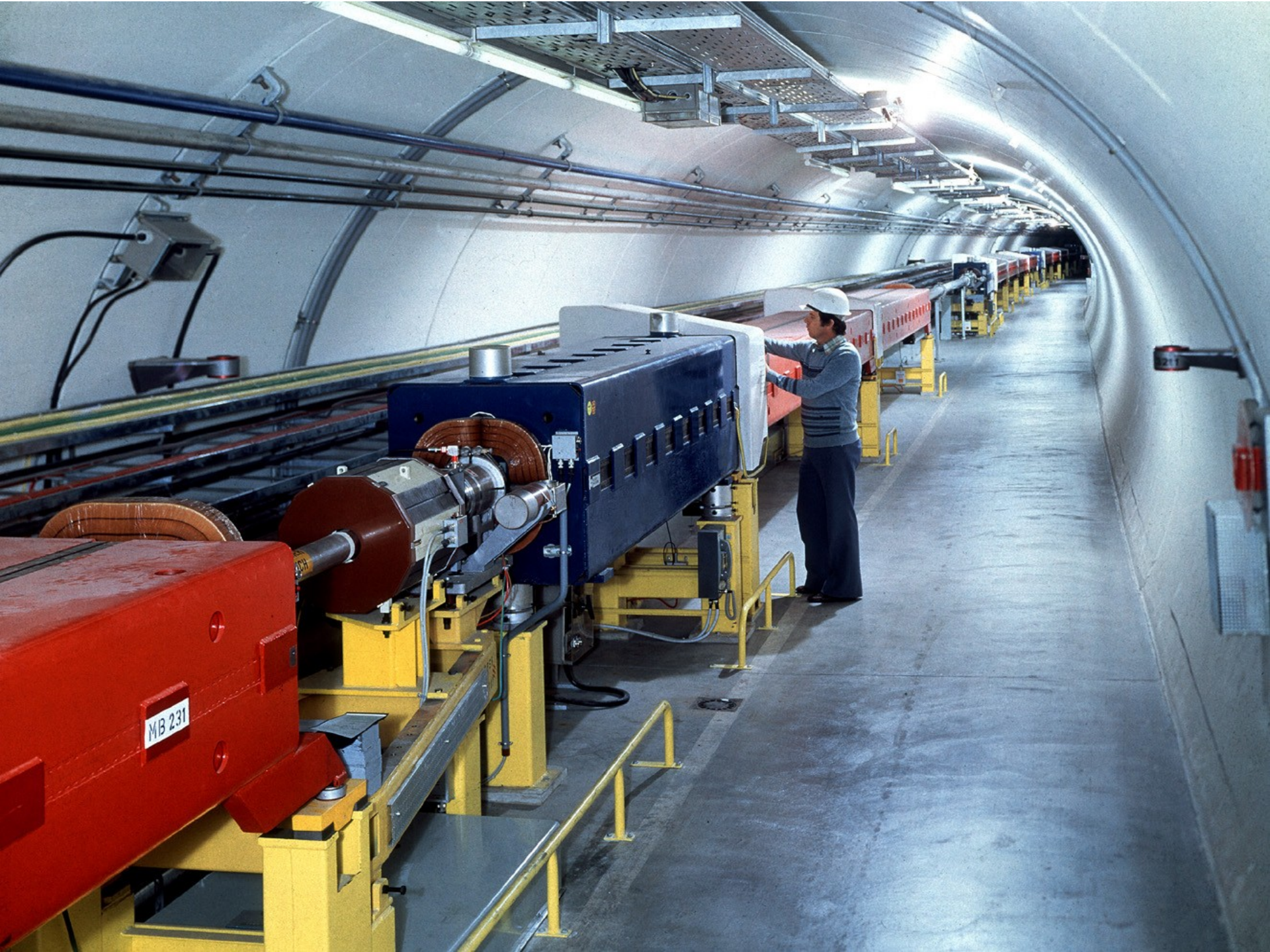
Grid computing for medical data management and analysis

CERN – world biggest accelerator complex




PA 312 3T


PS - 50
years
of service!!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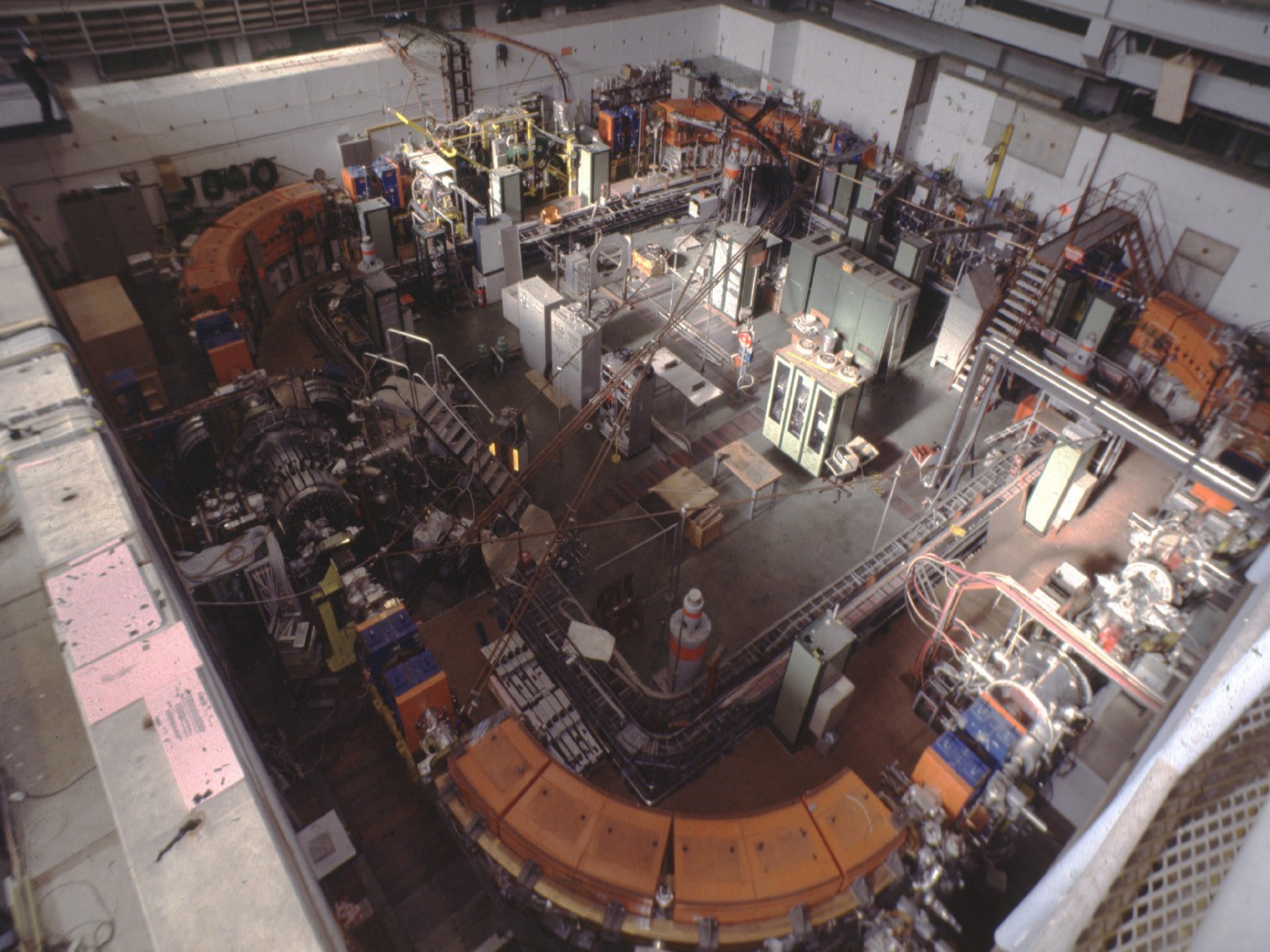
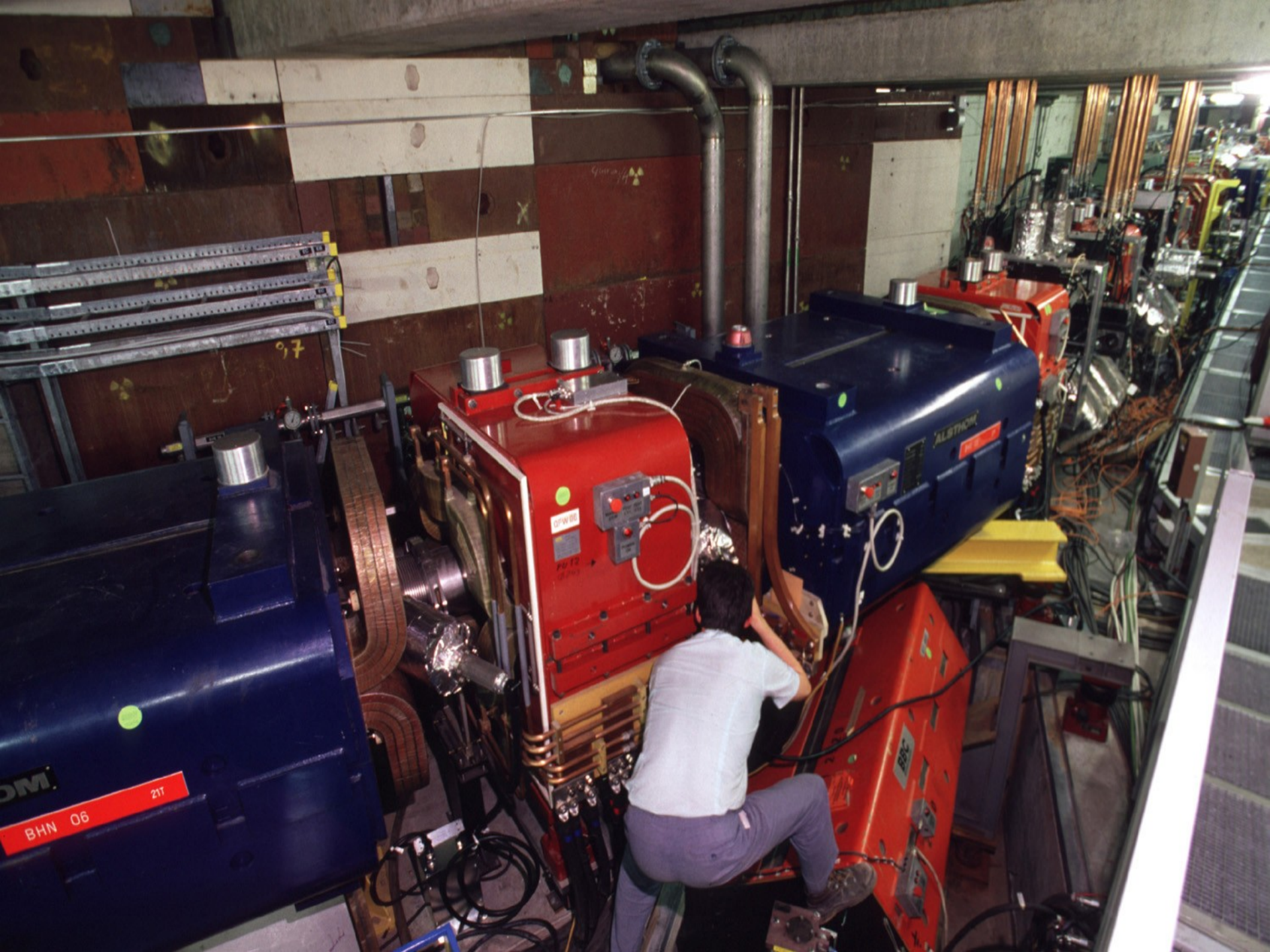
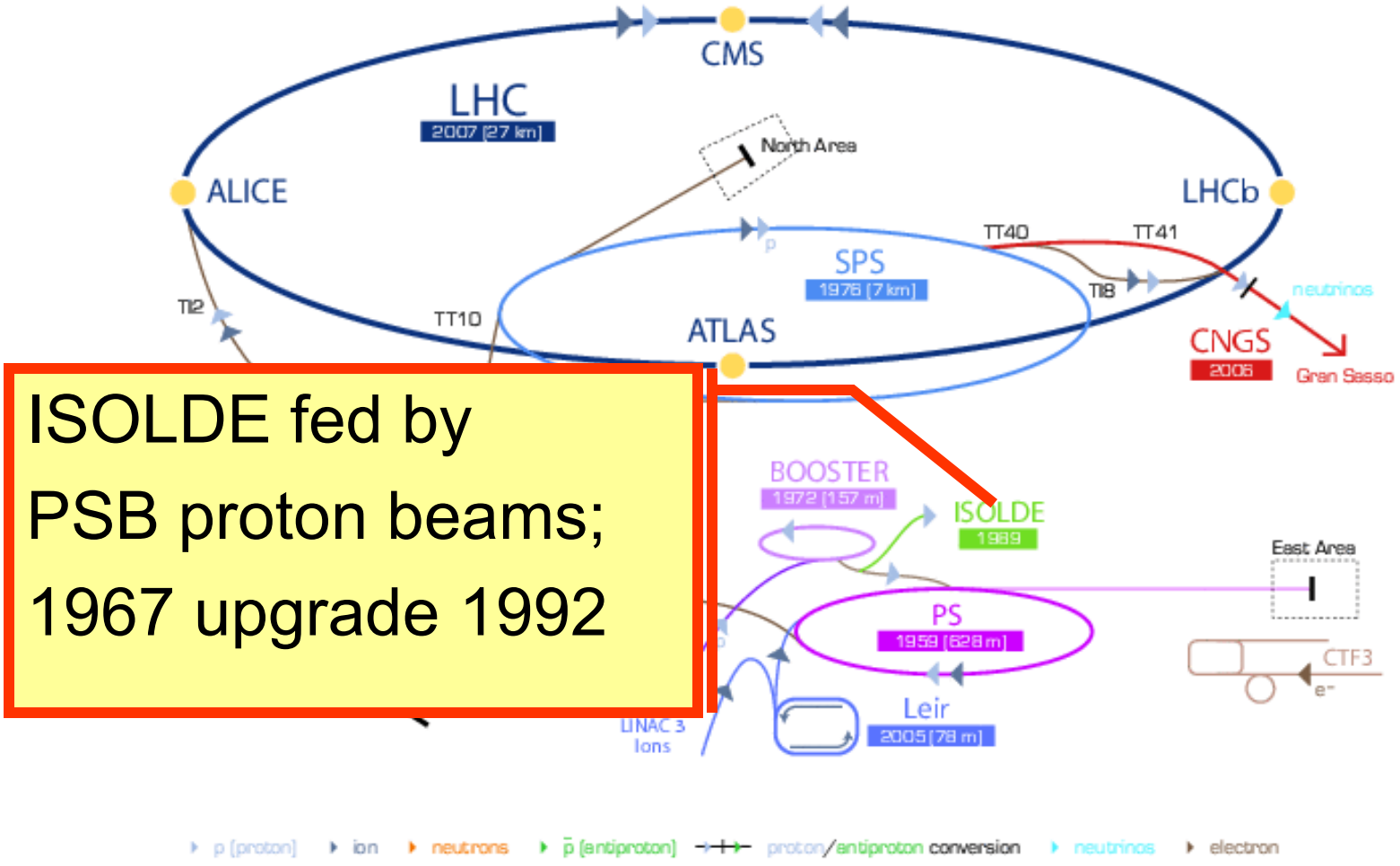



BHN 06
21T
ALSTHOM

CERN accelerator complex,
working not only for LHC

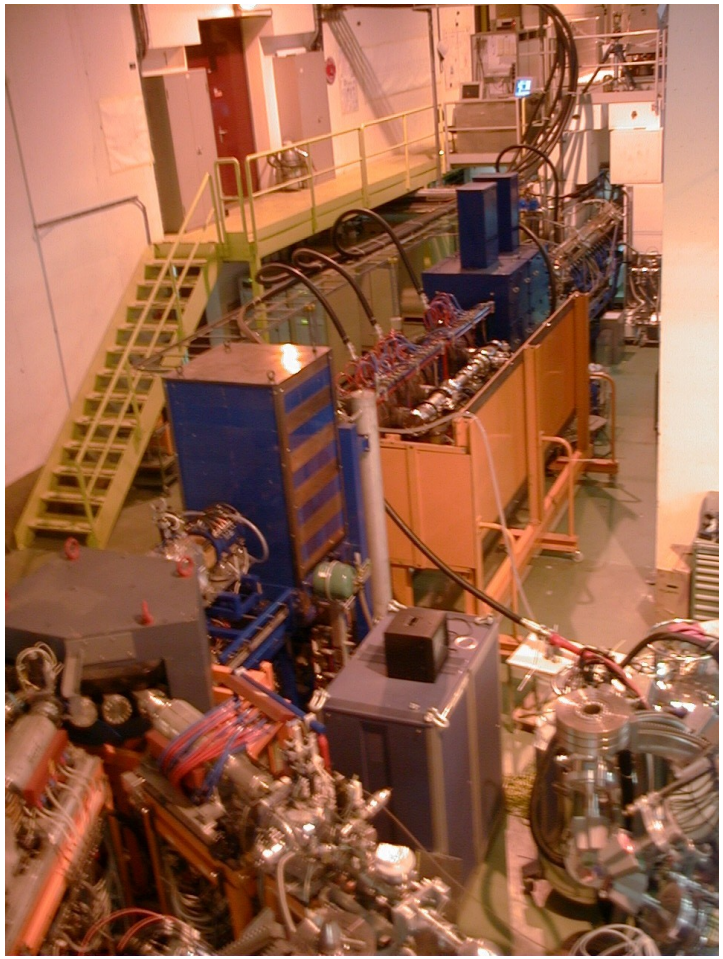


ISOLDE fed by
PSB proton beams;
1967 upgrade 1992

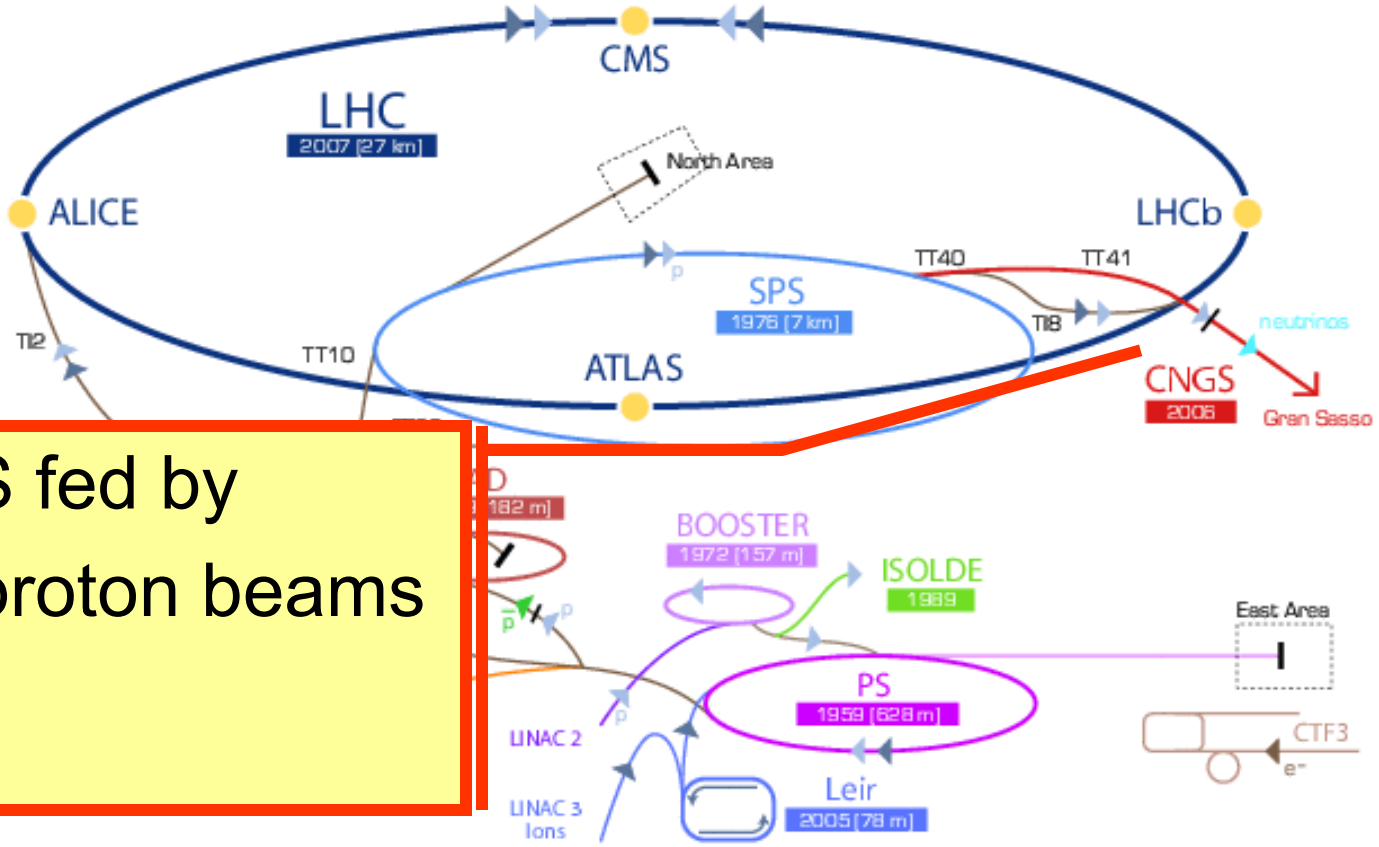
ISOLDE - Isotope Separator On Line, and Radioactive beam EXperiment (REX)

An alchemical factory for nuclear physics

Low-energy beams of radioactive isotopes - atomic nuclei. The facility, located at the Proton-Synchrotron Booster (PSB), is like a small alchemical factory, changing one element to another. It produces a total of more than 1000 different isotopes for a wide range of research.



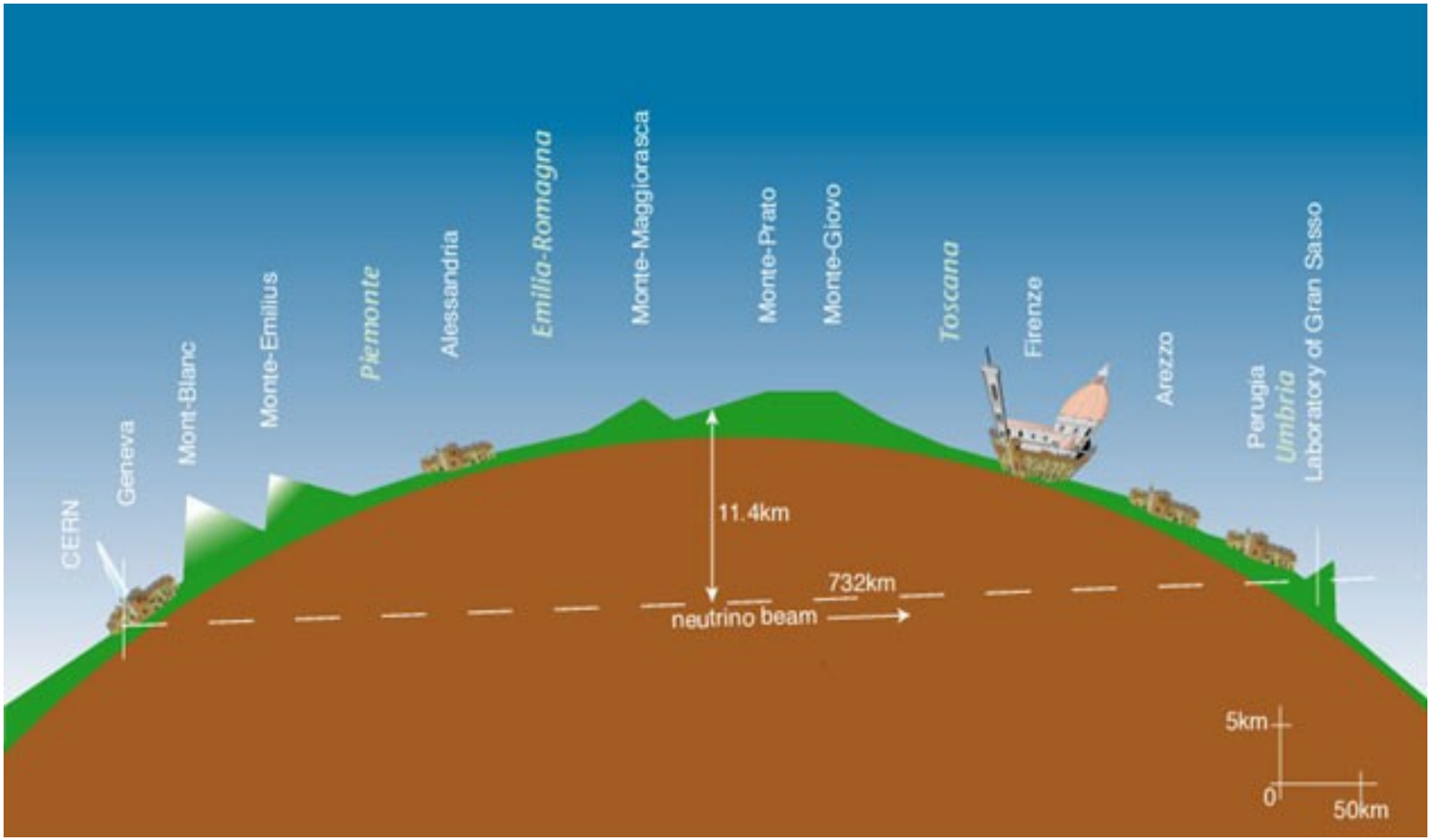
CERN accelerator complex,
working not only for LHC !



CNGS fed by
SPS proton beams

CNGS – CERN Neutrino to Gran Sasso experiment - investigation of the nature of neutrinos

CERN sends muon neutrinos to the Gran Sasso National Laboratory (LNGS), 732 km away in Italy. There, two experiments, OPERA and ICARUS, wait to find out if any of the muon neutrinos have transformed into tau neutrinos. To create the neutrino beam, a proton beam from the Super Proton Synchrotron (SPS) is used.

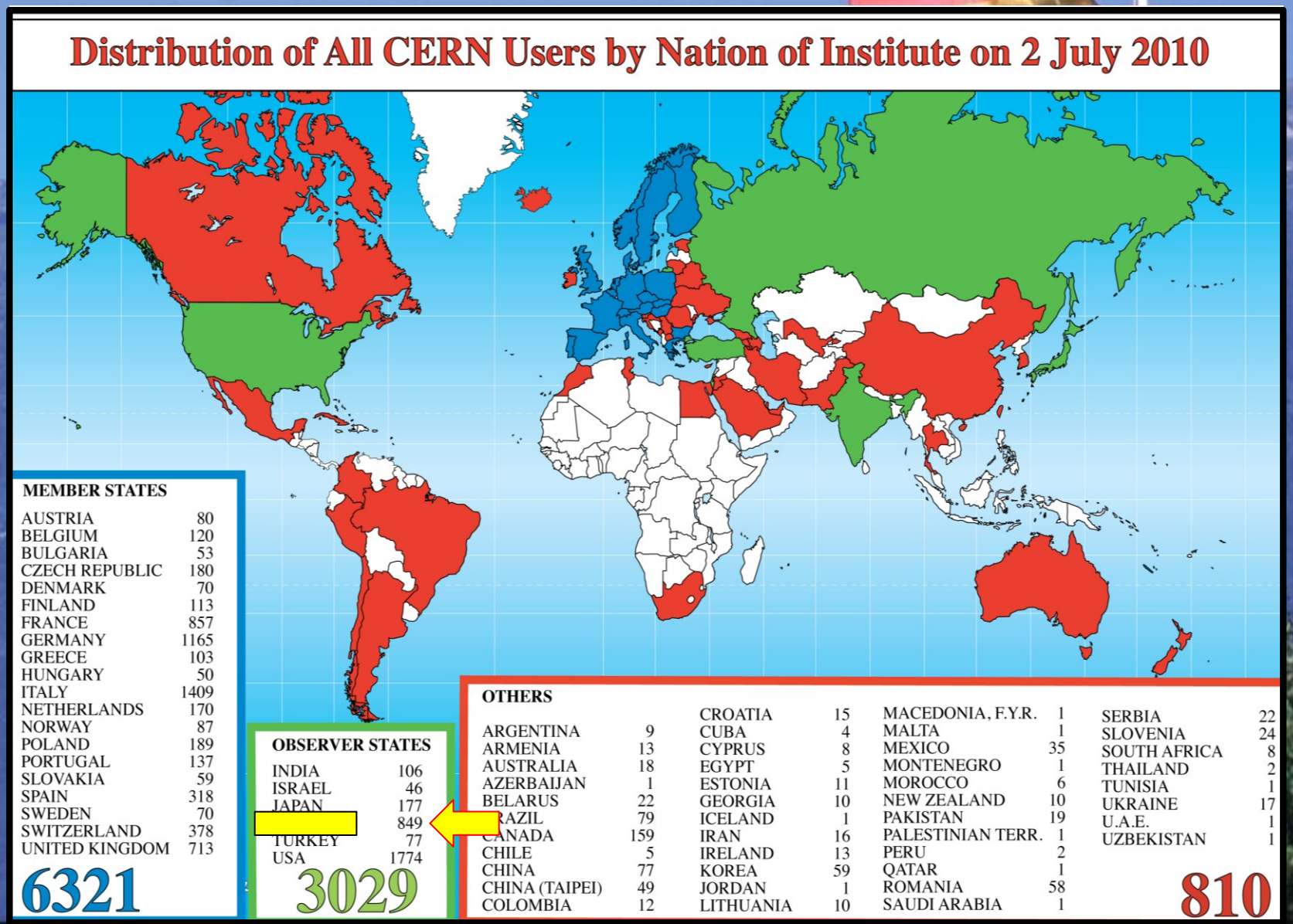


CERN was founded in 1954 by 12 European States
Today: 20 Member States

- ~ 2300 staff
- ~ 790 other paid personnel
- > 10000 users
- Budget (2010) ~1100 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 Membership: Romania.
- 8 Observers to Council: India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and UNESCO

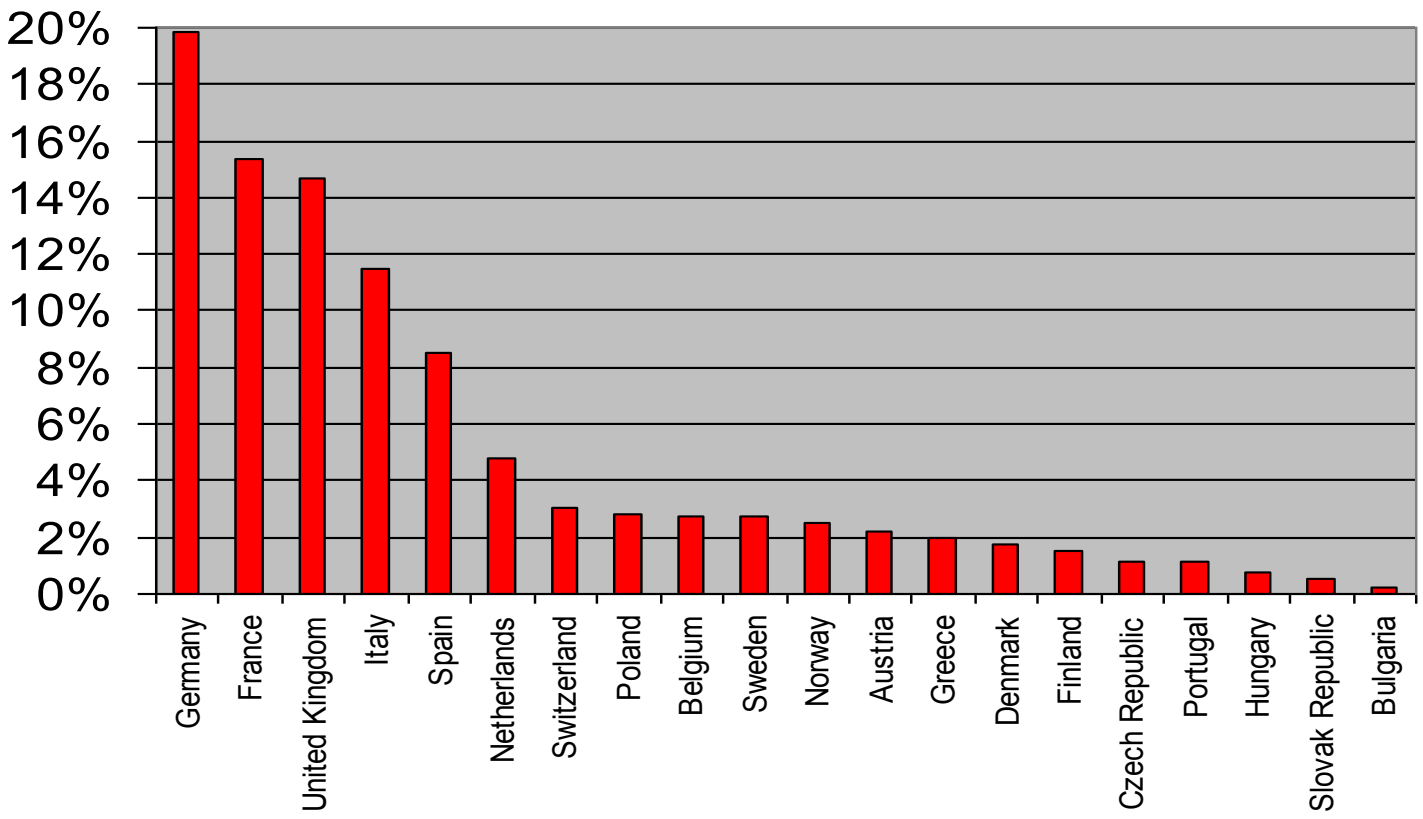
CERN in Numbers



Participation of Non-Member States in CERN scientific programmes

- **CERN is financed by 20 Member States, with annual contributions proportional to the Net National Income (or GDP), but has scientific and educational links with more than 100 countries!**
- **Non-Member States participate in financing selected Projects**
- **Over 40 Non-Member States participated in the LHC construction, providing around 1/6 th of its cost and over 3000 of physicists and engineers (over 1/3 of the total);**

CERN budget 2009 *



* 1098.49 MCHF

Contribution of CIS countries to LHC
(CIS - Содружество Независимых Государств, СНГ)

Important contribution of the Russian Federation

Estimated value for CERN: LHC Experiments & Accelerator – 160 MCHF

Highly appreciated contribution of other CIS countries.

Important role of JINR - Dubna in creating LHC collaborations with CIS countries →

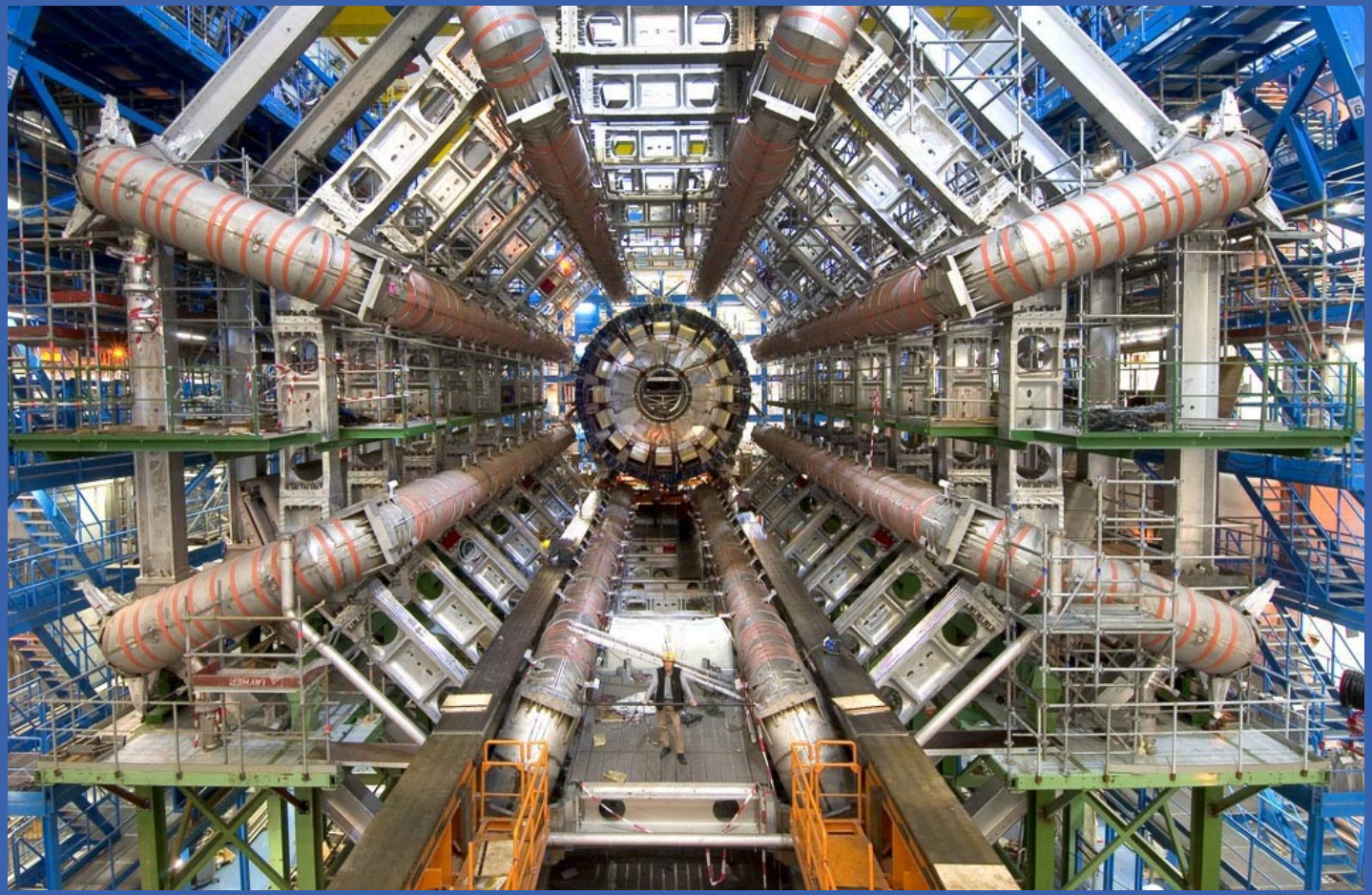
Armenia, Azerbaijan, Belarus,
Georgia, Ukraine (and also other JINR Members!)

Example: Russia-Dubna Member States (RDMS) collaboration within CMS

Contribution of CIS countries to LHC

(CIS = Содружество Независимых Государств, СНГ)

Physicists and engineers from CIS countries have notably contributed to the construction of all LHC experiments (ATLAS, ALICE ,CMS, LHCb) and to the LHC accelerator



Unique Technologies developed for LHC

Example: SCINTILLATING CRYSTALS - monocrystals of $PbWO_4$ developed and produced in Russia - the main elements (70'000 pieces!) in the Compact Muon Solenoid (CMS) detector at the CERN Large Hadron Collider (LHC)

CERN - Education

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

First course for Russian Teachers

CERN, November 2009
Family photo with
CERN,s Director
Prof. Heuer

TV ¨VESTI¨ reporting on
November 03, 2009

Science Bringing Nations Together

"…the promotion of contacts between scientists, students…."

….and Physics Teachers !


Thank you!
Спасибо !