

# Welcome



Shanghai Institute of Applied Physics  
Dalian Institute of Chemical Physics  
Shanghai Foundation Engineering Group  
Chinese Academy of Sciences, Shanghai Branch

to



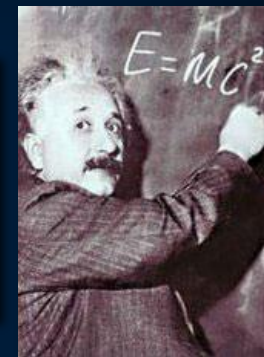
***Accelerating Science and Innovation***



# The Mission of CERN

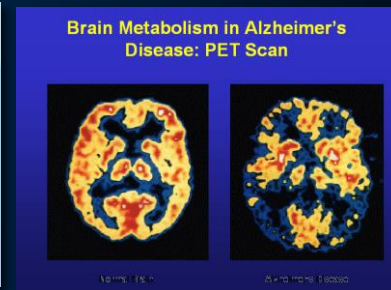
## ❑ Push back the frontiers of knowledge

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

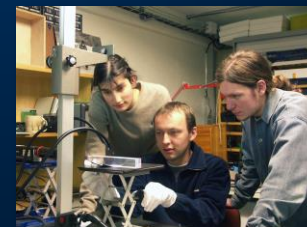


## ❑ Develop new technologies for accelerators and detectors

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: founded in 1954: 12 European States

“Science for Peace”

## Today: 21 Member States

~ 2300 staff

~ 1400 other paid personnel

~ 12500 scientific users

Budget (2015) ~1000 MCHF

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

**Associate Member States:** Pakistan, Turkey

**States in accession to Membership:** Romania, Serbia

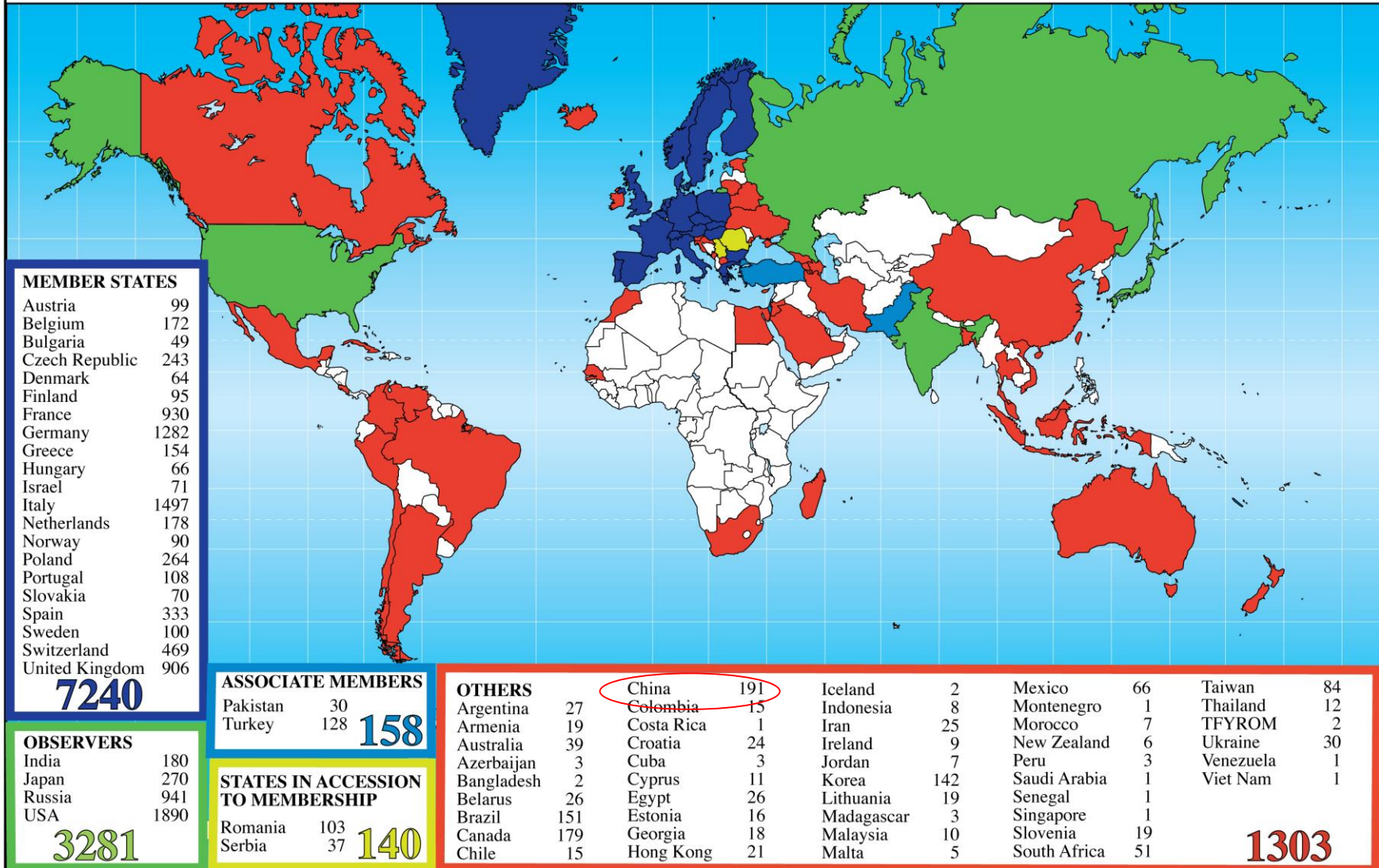
**Applications for Membership or Associate Membership:**

Azerbaijan, Brazil, Croatia, Cyprus, India, Russia, Slovenia, Ukraine

**Observers to Council:** India, Japan, Russia, United States of America; European Union, JINR and UNESCO

# Science is getting more and more global

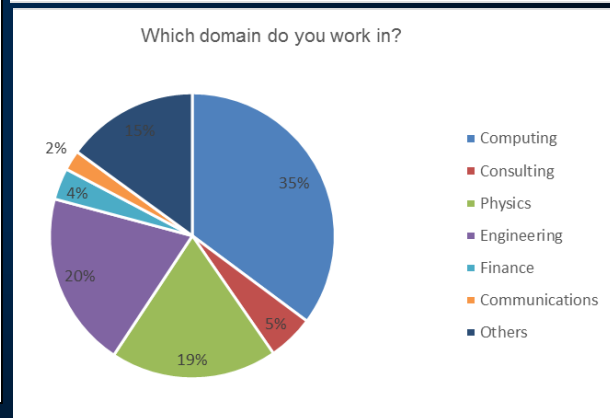
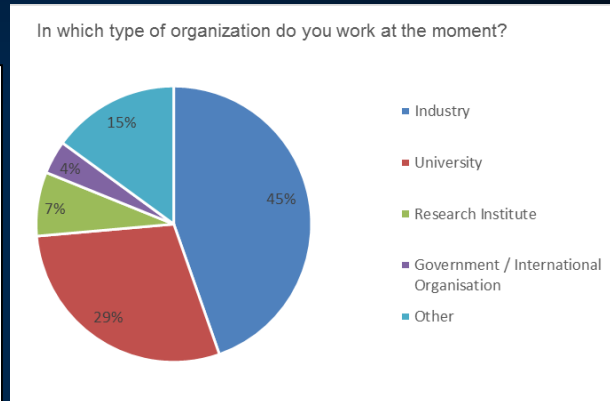
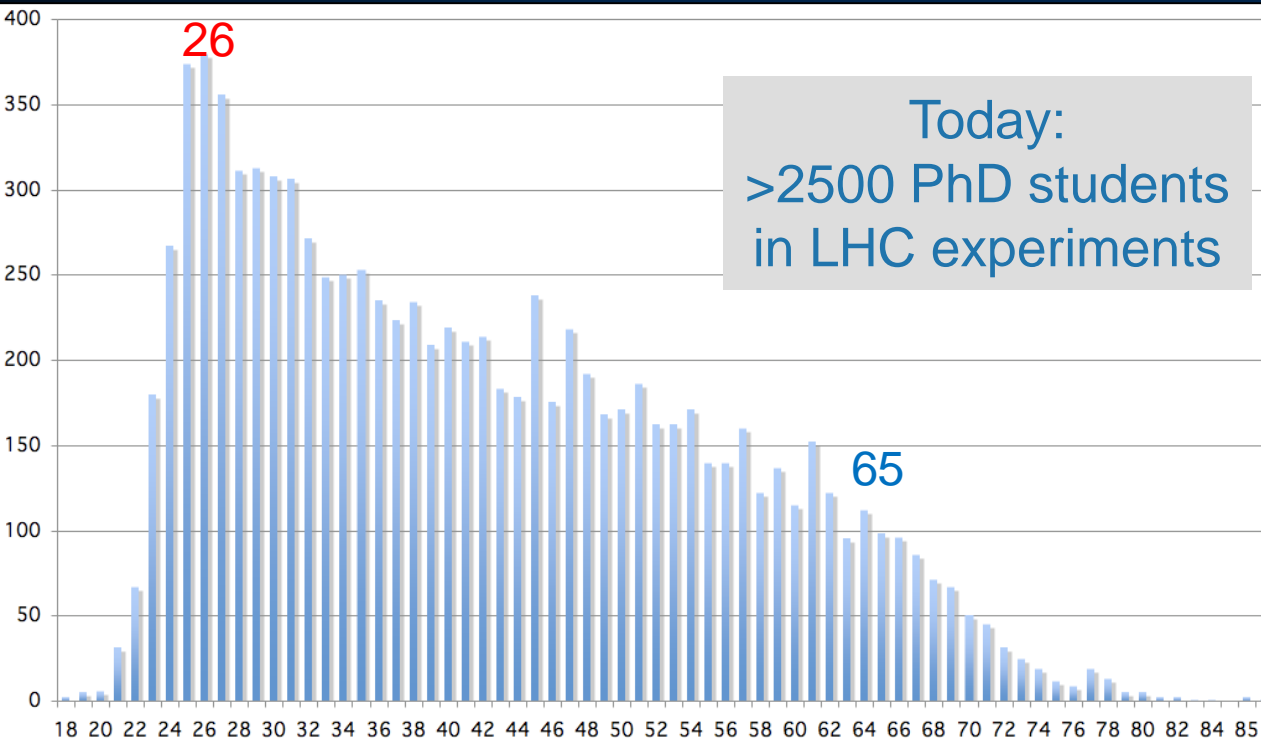
## Distribution of All CERN Users by Location of Institute on 21 September 2015





# Age Distribution of Scientists

- and where they go afterwards

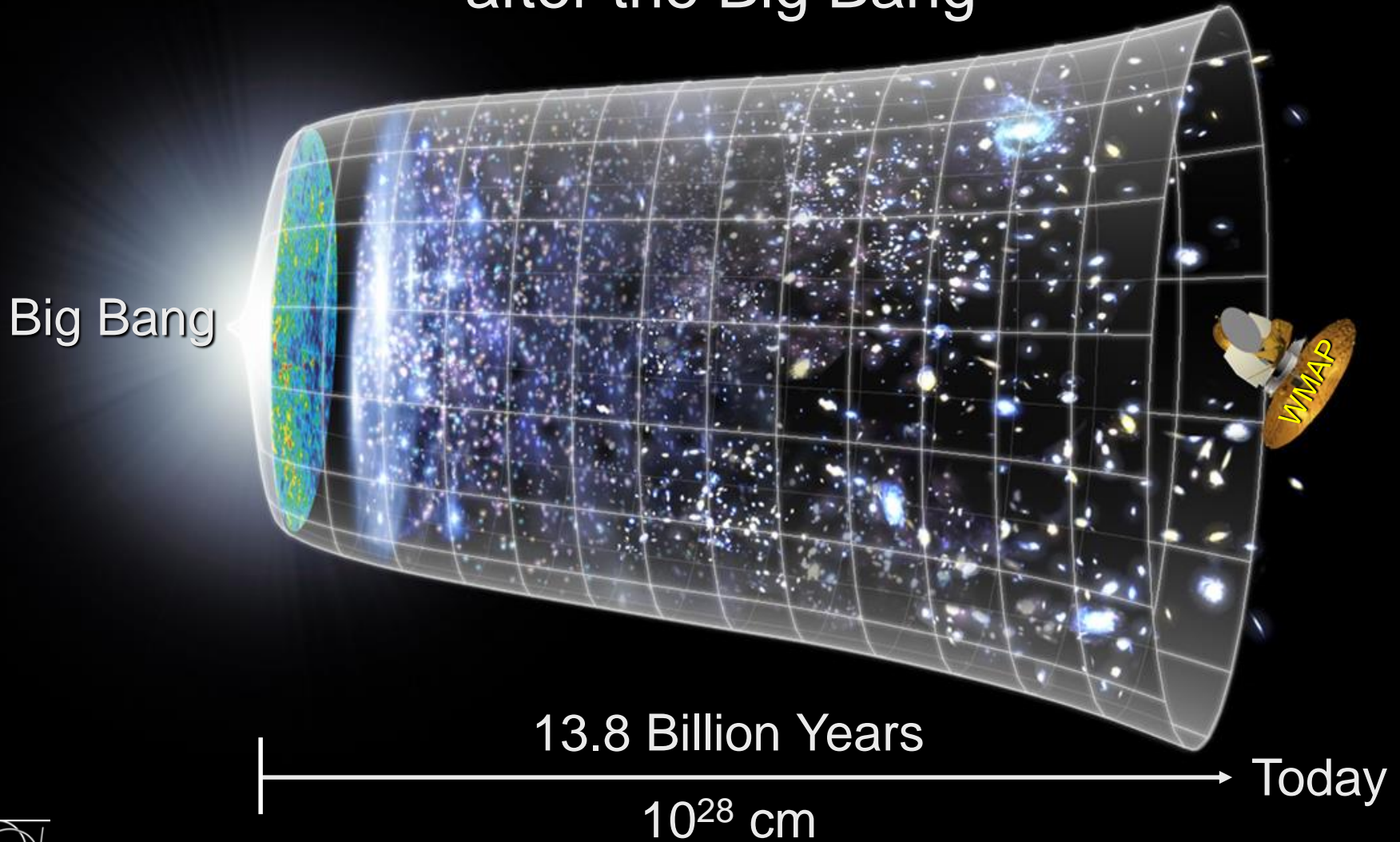


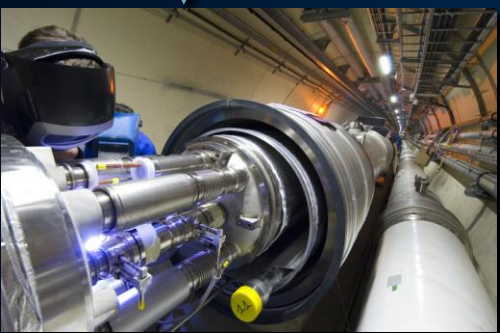
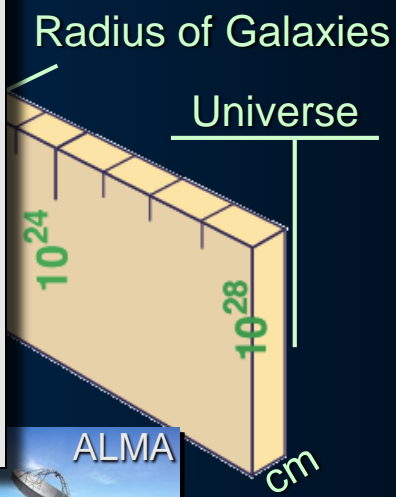
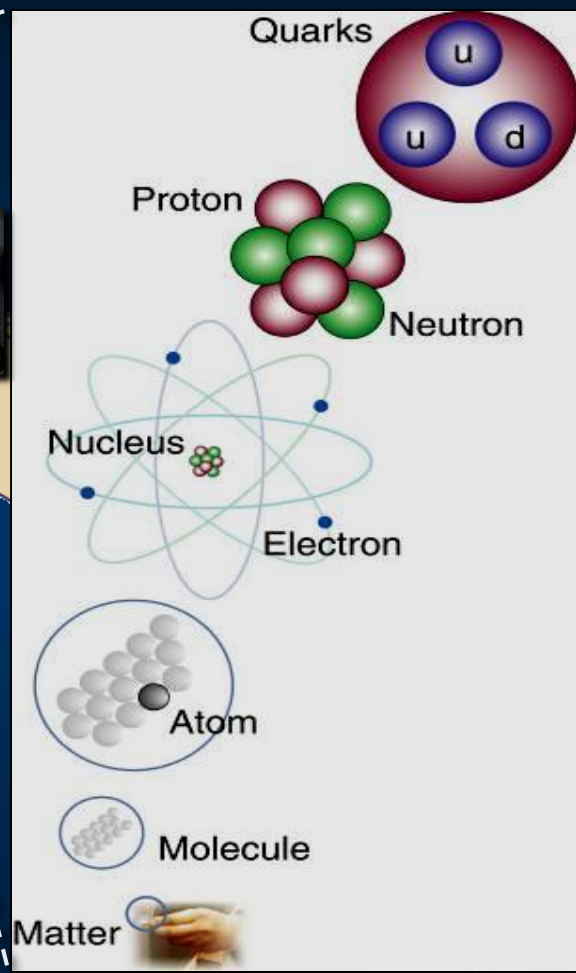
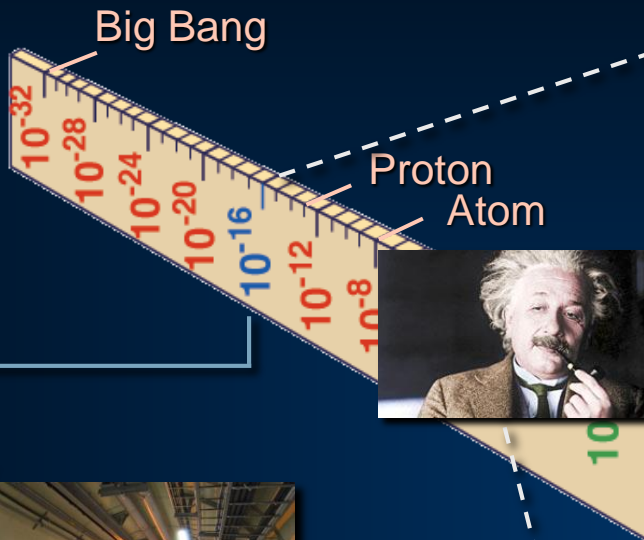
They do not all stay: where do they go?



# Next Scientific Challenge:

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



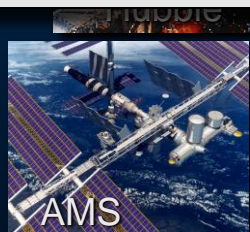


LHC

Super-Microscope



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

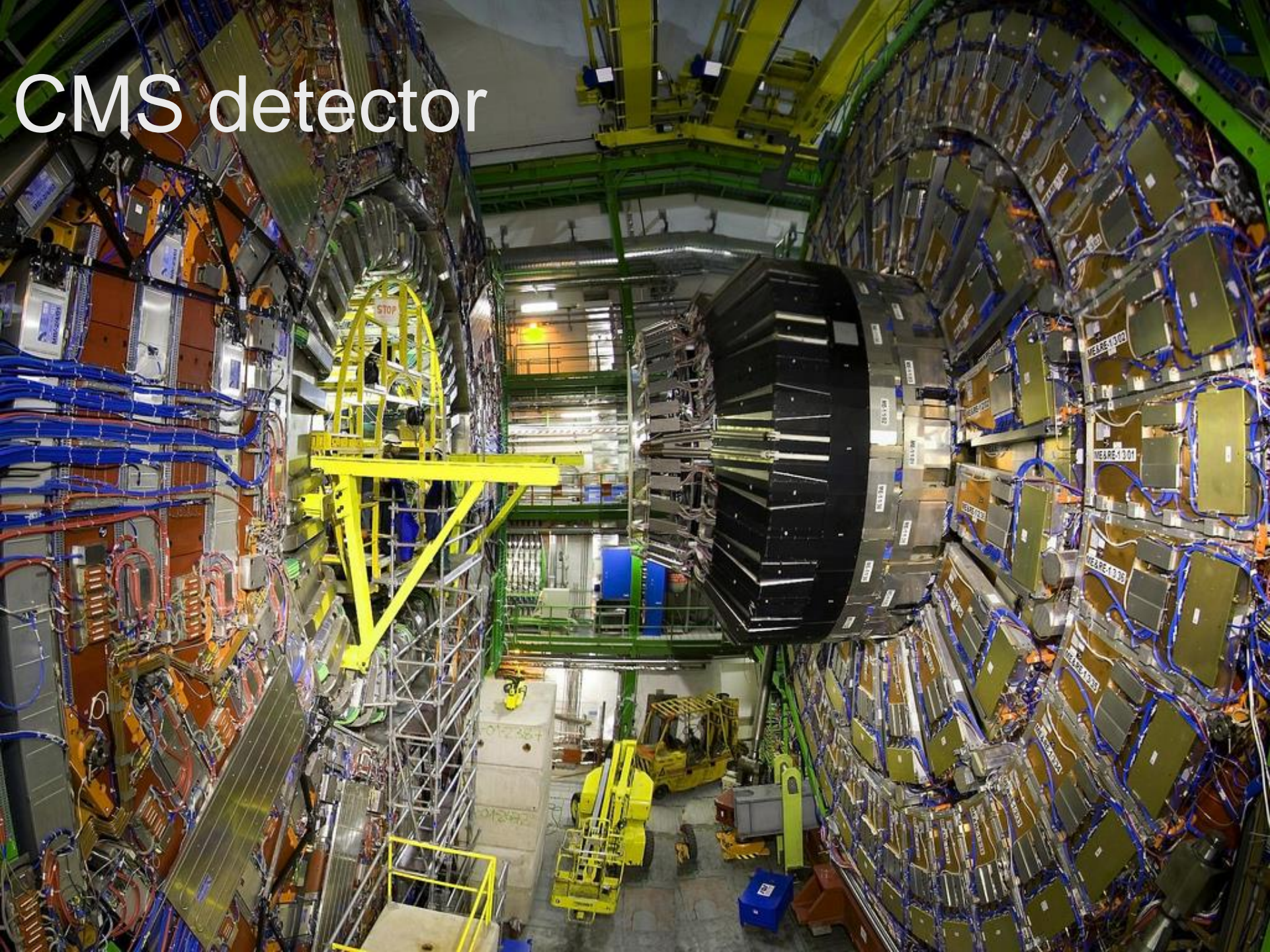


# 2010: a New Era in Fundamental Science

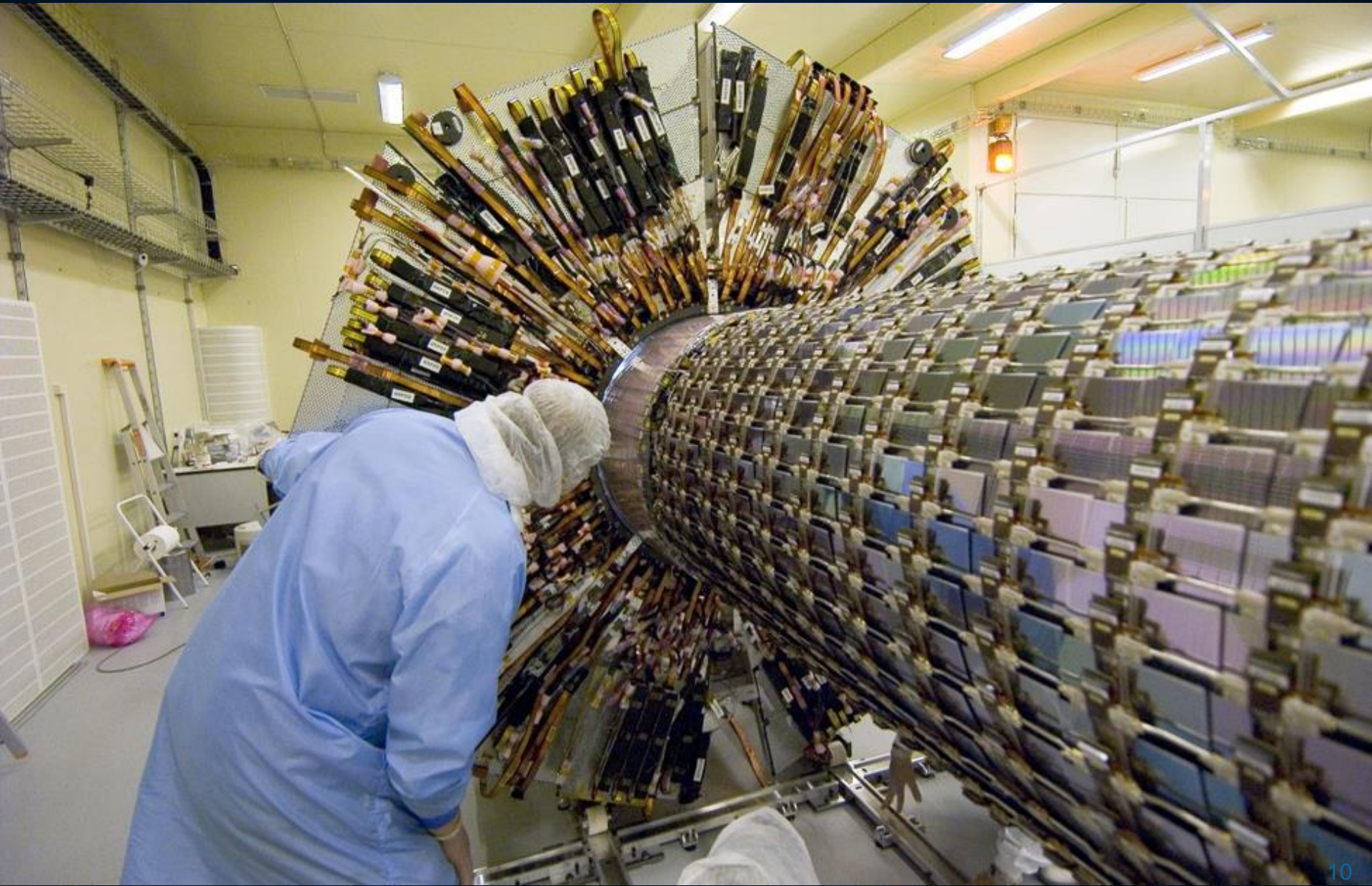




# CMS detector



# ATLAS silicon tracker



# ATLAS calorimeter



# Discovery 2012, 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"*.



# CERN: Particle Physics and Innovation

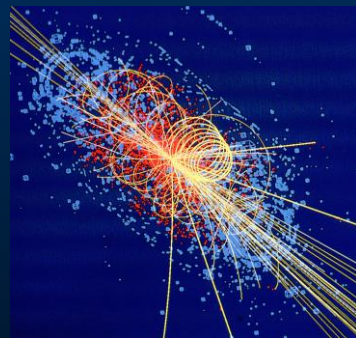
- ❑ **Interfacing** between fundamental science and key technological developments



- ❑ **CERN Technologies and Innovation**



Accelerating particle beams



Detecting particles



Large-scale computing (Grid)

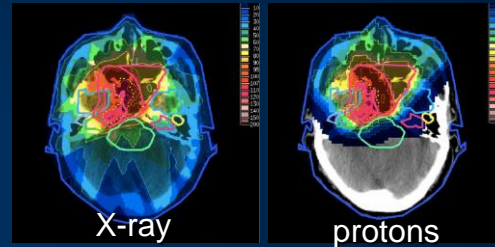
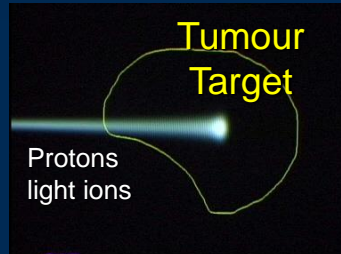
# Medical Application as an Example of Particle Physics Spin-off

Combining Physics, ICT, Biology and Medicine to fight cancer



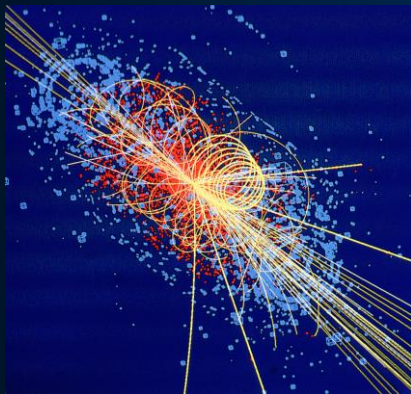
## Hadron Therapy

Accelerating particle beams  
~30'000 accelerators worldwide  
~17'000 used for medicine



Leadership in Ion Beam Therapy now in Europe and Japan

>100'000 patients treated worldwide (45 facilities)  
>50'000 patients treated in Europe (14 facilities)

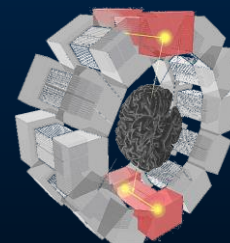


## Imaging

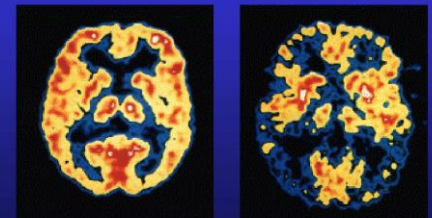
Clinical trial in Portugal, France and Italy for new breast imaging system (ClearPEM)



## PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



Normal Brain

Alzheimer's Disease

Detecting particles

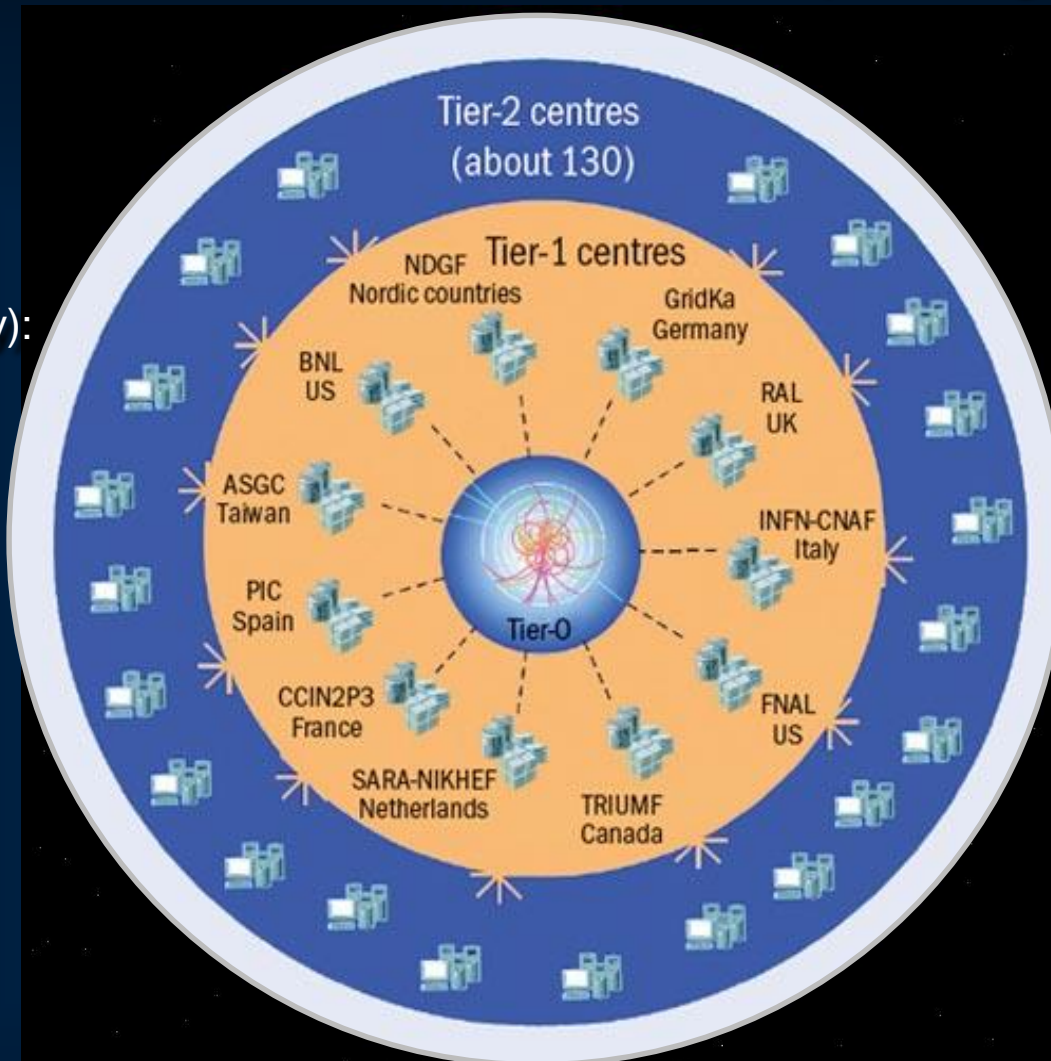


# The Worldwide LHC Computing Grid

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





SUISSE  
FRANCE

LHCb

ATLAS

CERN Meyrin

CERN Prévessin

SPS 7 km

CMS

ALICE

# Thank You!

LHC 27 km



***Accelerating Science and Innovation***



# Safety Information for Visitors

*Safety is our highest priority*

We are confident that you have read the Safety Information provided prior to the visit and ask that you take the time to read the document placed in front of you once more before embarking on the site visit.

By taking part in the site visit you are deemed to have understood and accepted the Safety Information provided to you.

Please always follow the instructions given by your guide and do not hesitate to ask if you have any questions.





# Possible additional transparencies



SUISSE  
FRANCE

CMS

LHCb

CERN  
Prévessin

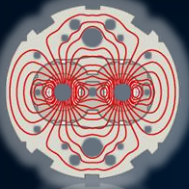
ATLAS

CERN  
Meyrin

SPS 7 km

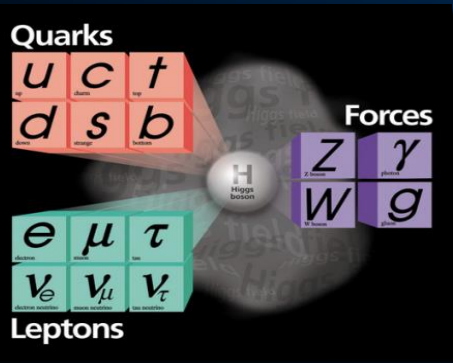
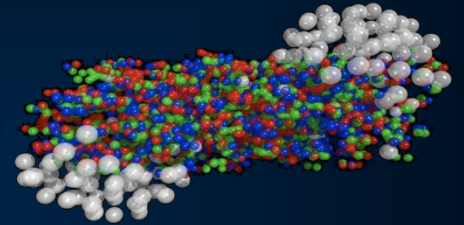
ALICE

LHC 27 km



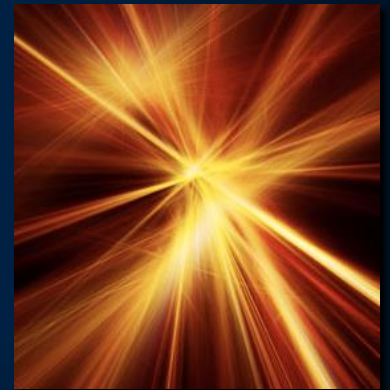
# The study of LHC data will allow us to answer some of the big questions ...

Will we understand the **primordial state of matter** after the Big Bang before protons and neutrons formed?



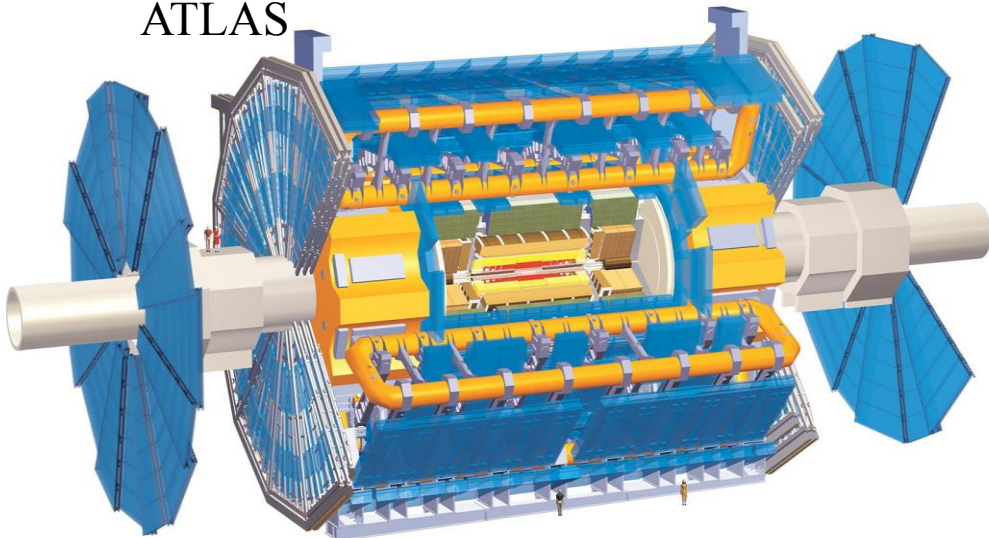
Have we found “THE” **Higgs particle** that is responsible for **giving mass** to all elementary particles?

Will we find the reason why **antimatter and matter did not completely destroy each other**?

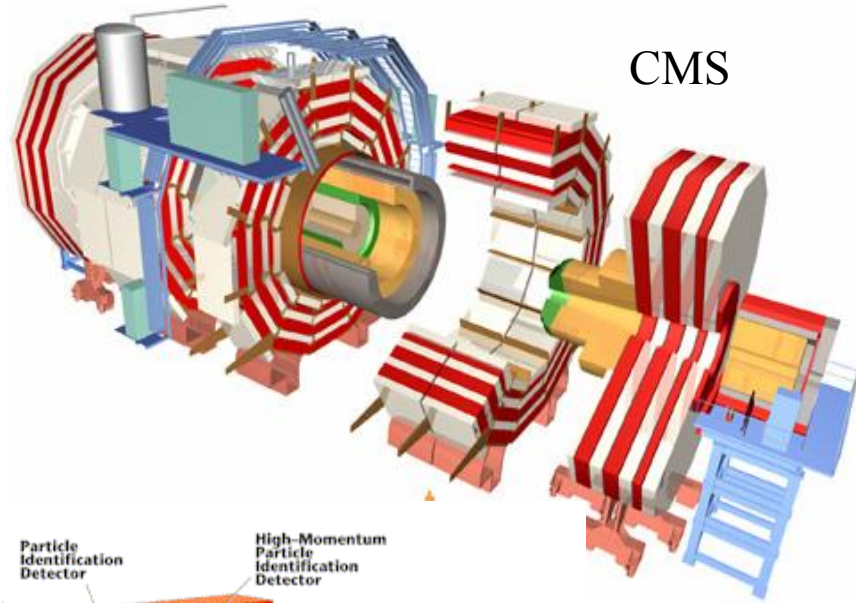


Will we find the **particle(s)** that make up the **mysterious 'dark matter'** in our Universe?

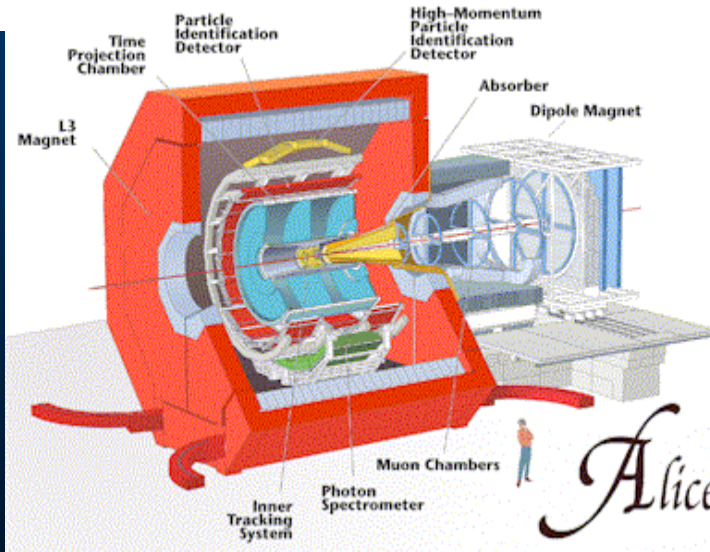
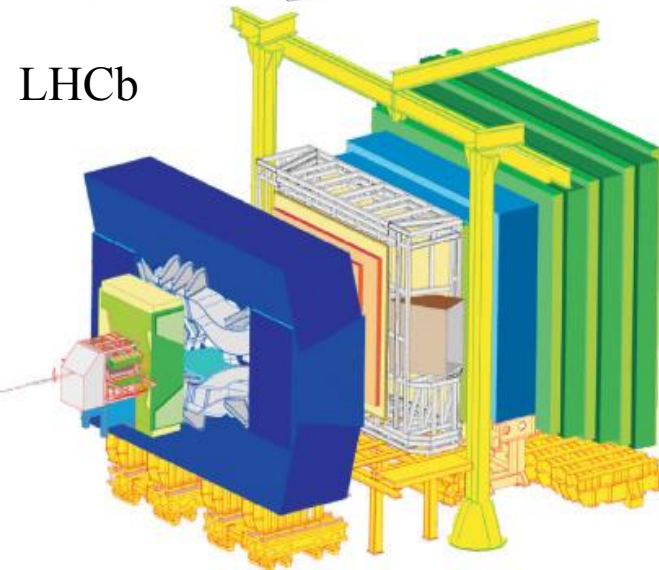
ATLAS



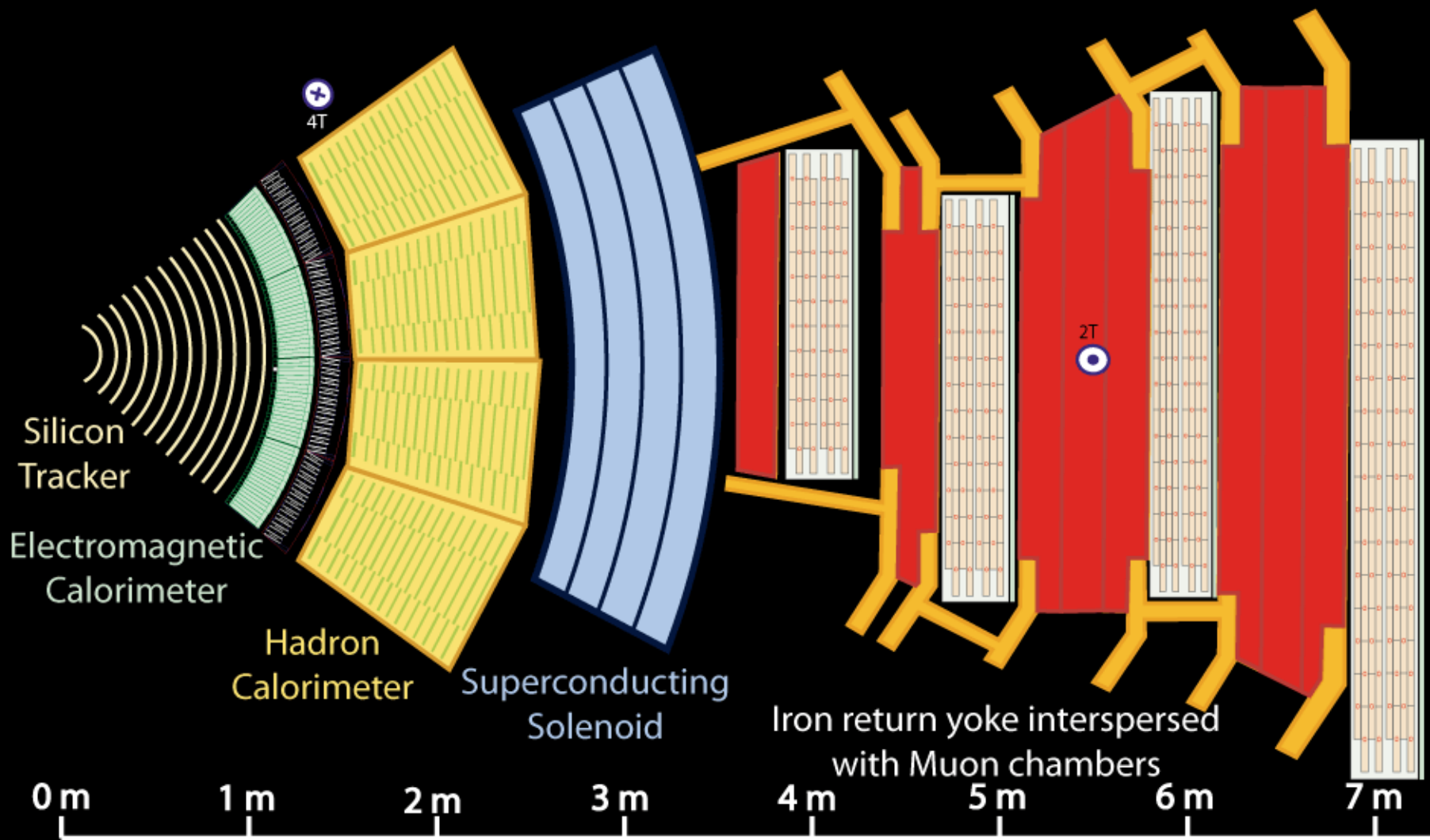
CMS



LHCb



*Alice*



Key:

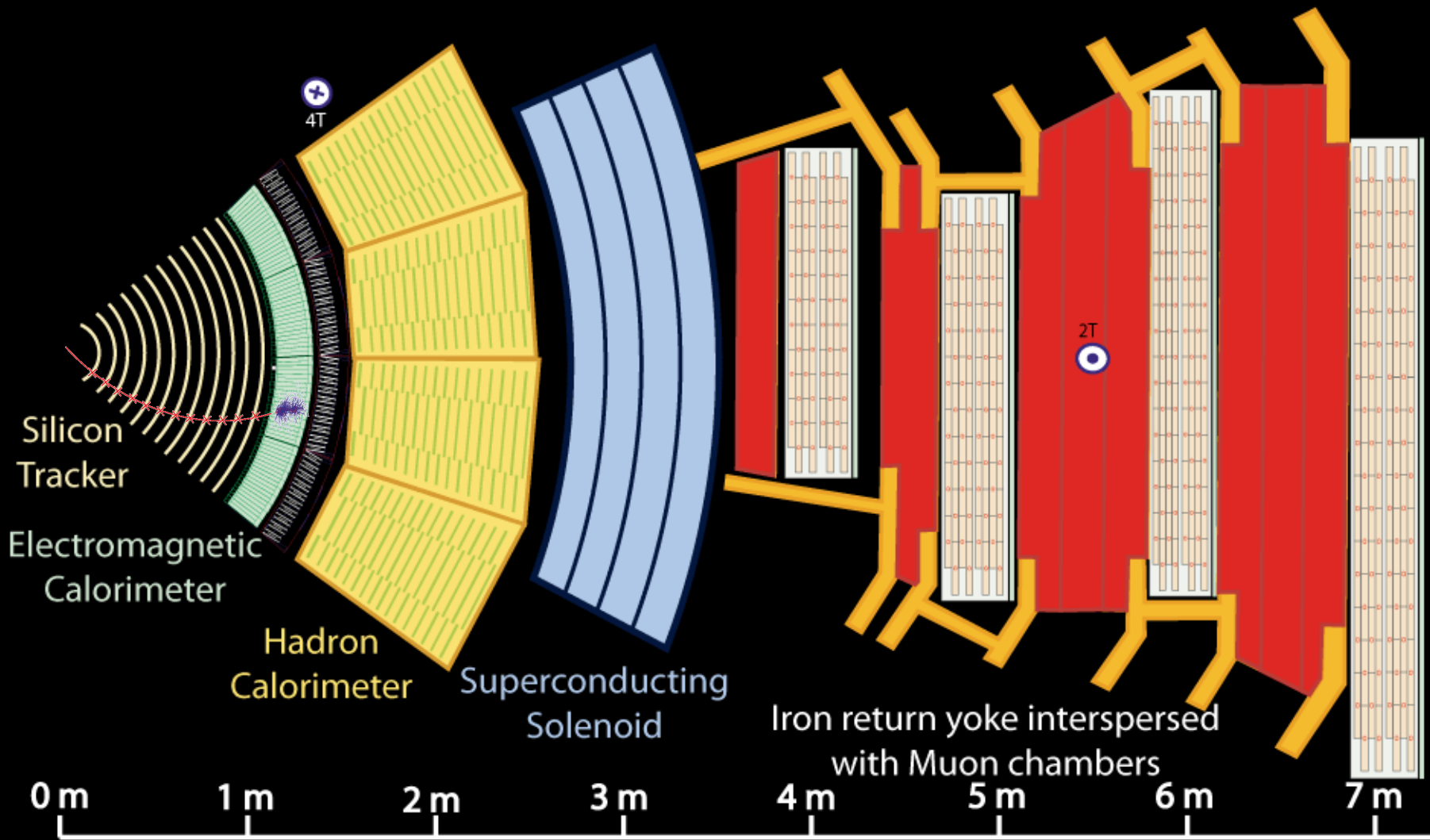
— Muon

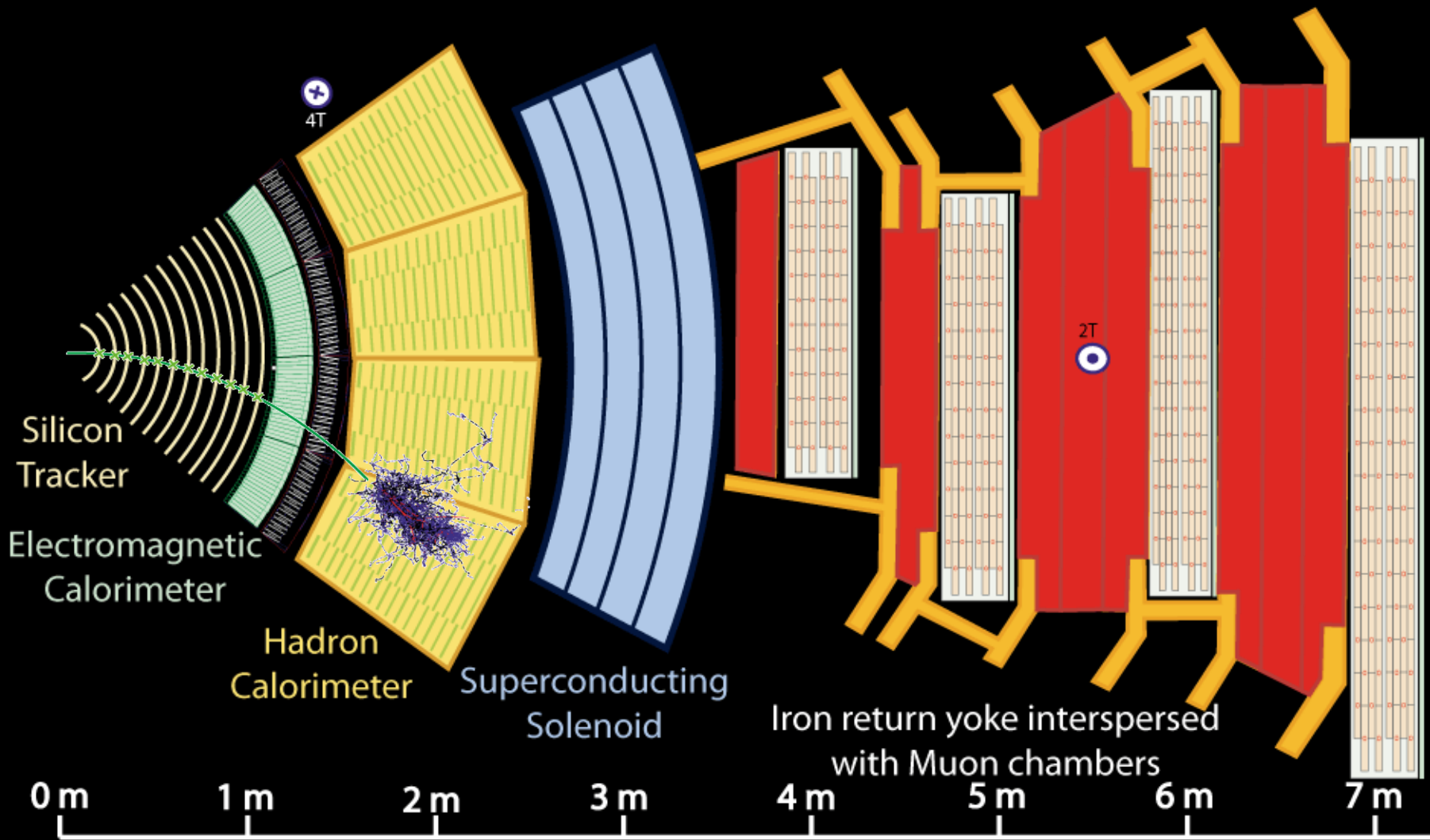
— Electron

— Charged Hadron (e.g. Pion)

- - - Neutral Hadron (e.g. Neutron)

- - - Photon





Key:

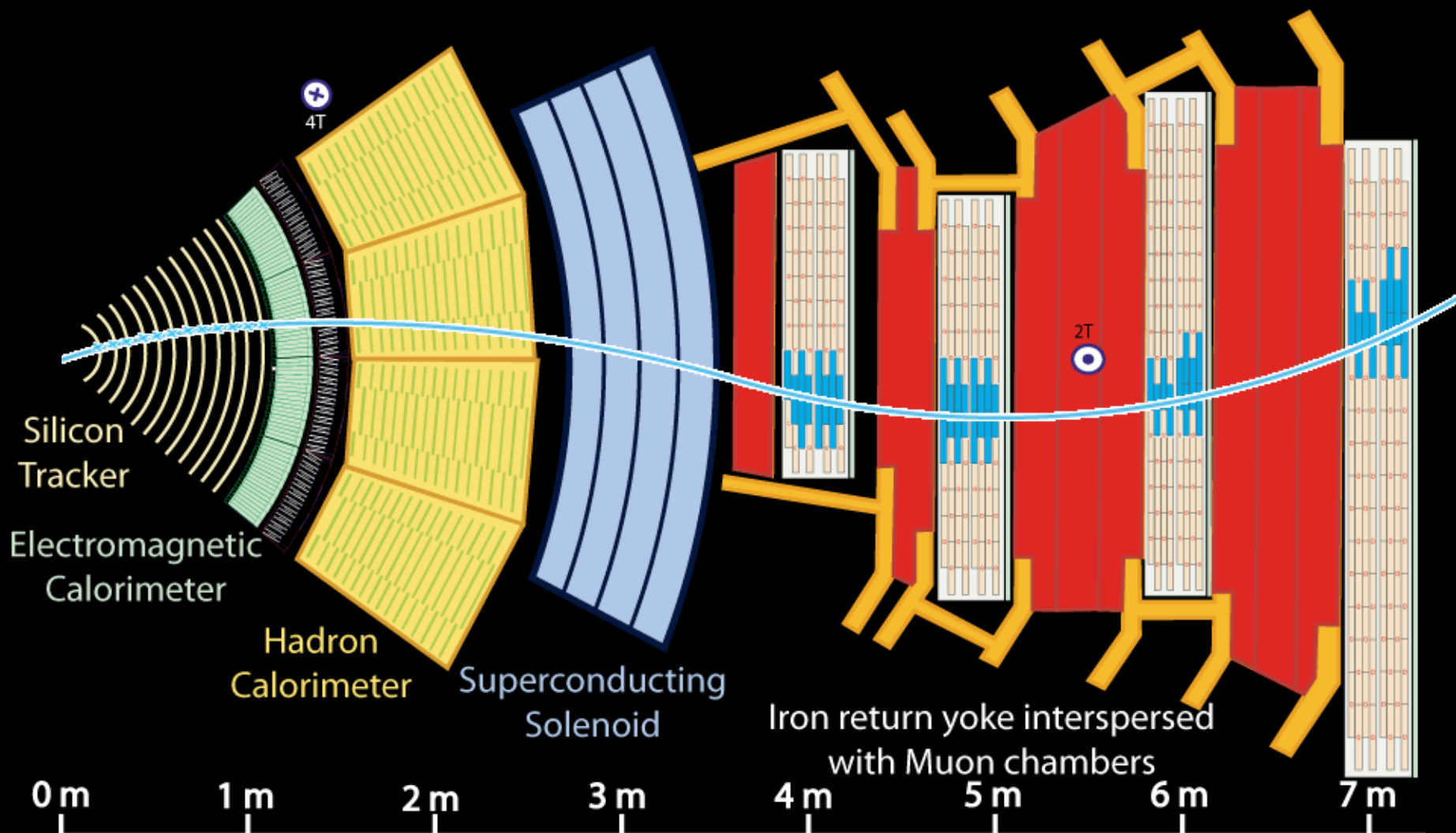
— Muon

— Electron

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- - - Photon

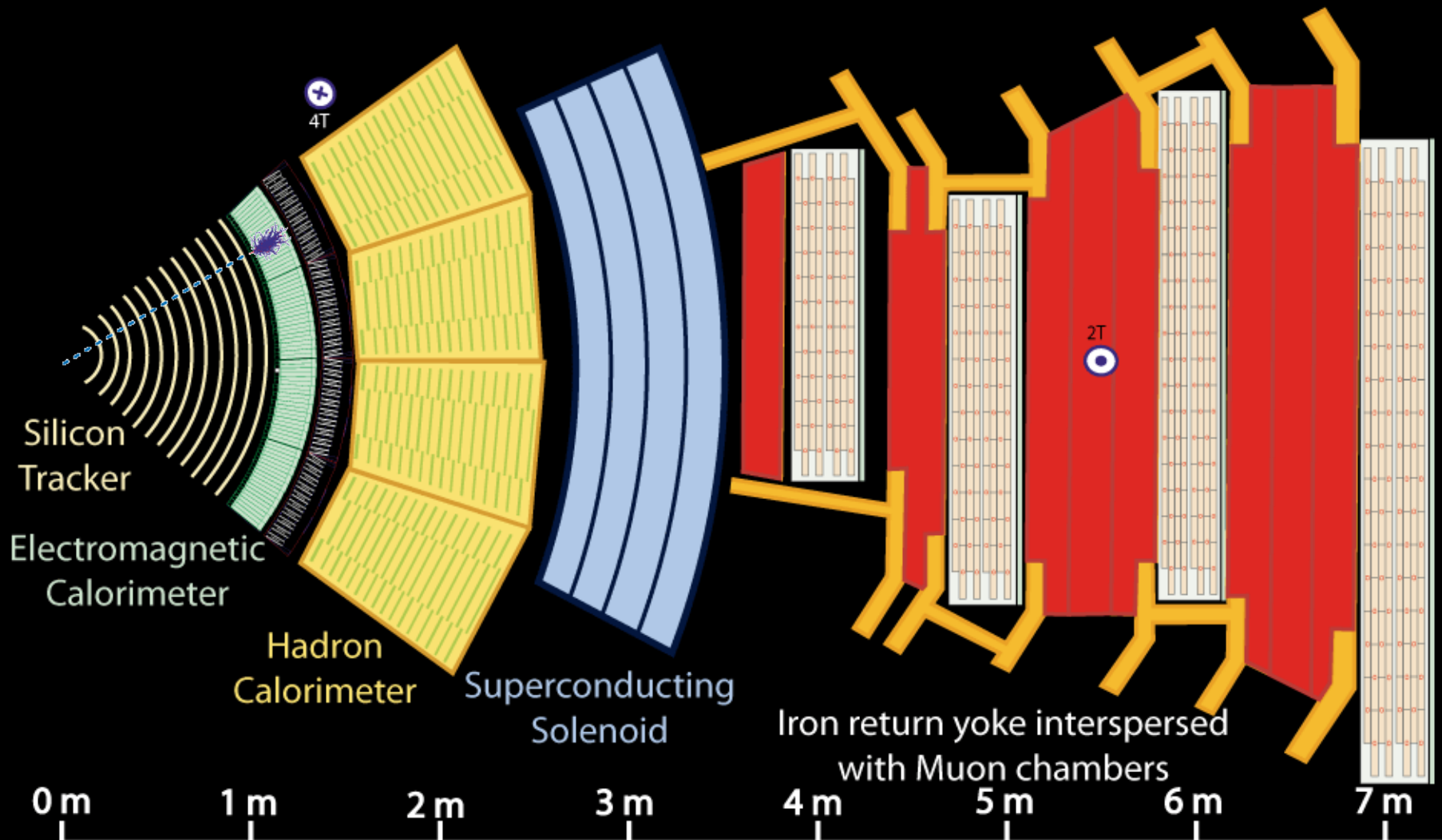


0 m      1 m      2 m      3 m      4 m      5 m      6 m      7 m

Key:

- Muon
- Electron
- Charged Hadron (e.g. Pion)
- - - Neutral Hadron (e.g. Neutron)
- - - Photon





Key:

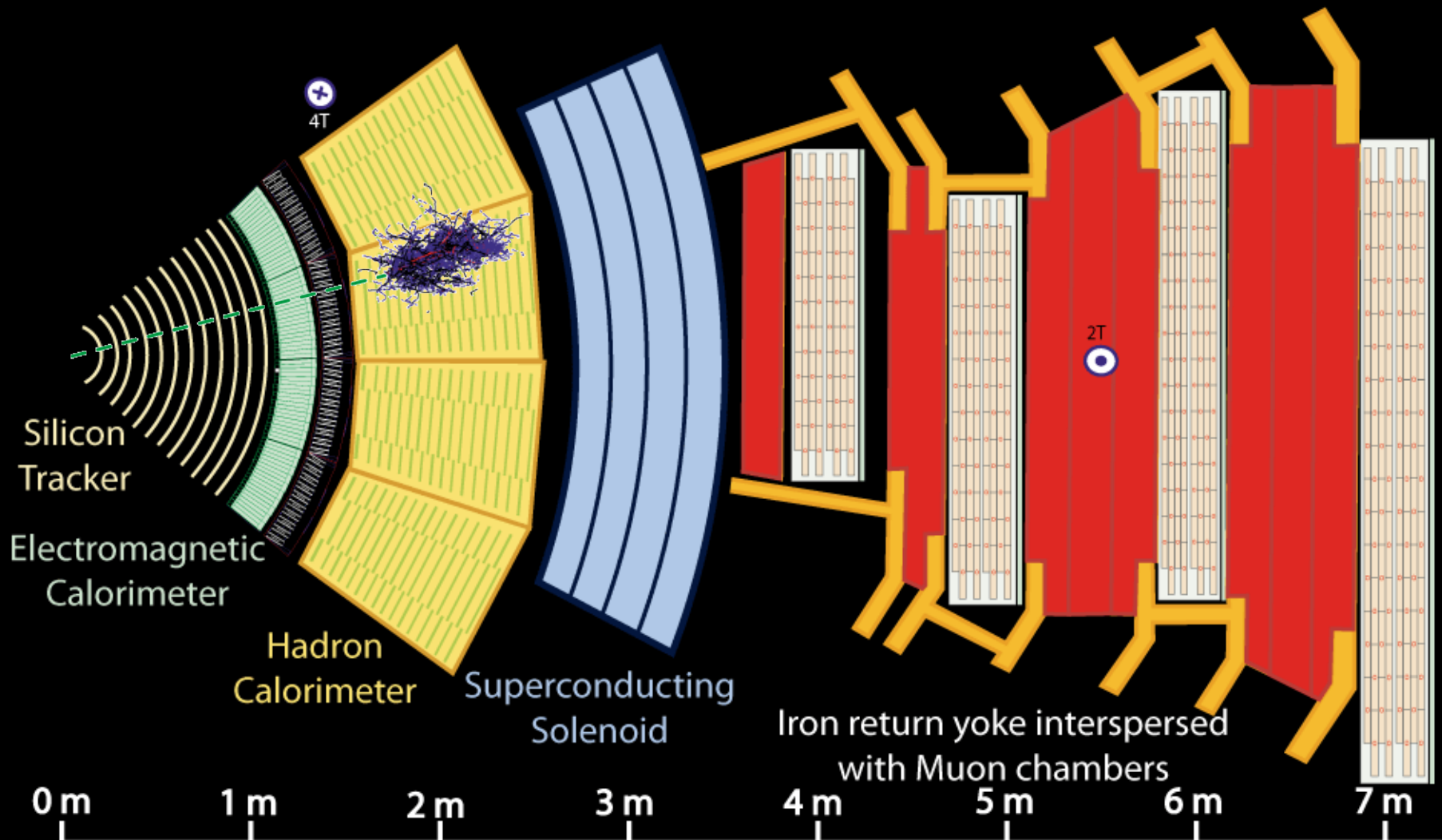
— Muon

— Electron

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Key:

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