



# *Welcome to CERN*

Dr. Sascha Schmeling



European Organization for Particle Physics  
*Organisation européenne pour la physique des particules*

# CERN was founded in 1954 by 12 European States

## “Science for Peace”

Today there are 22 Member States

~ 2,560 staff  
~ 2,490 other paid personnel  
~12,000 users  
Budget (2018) ~1,240 MCHF

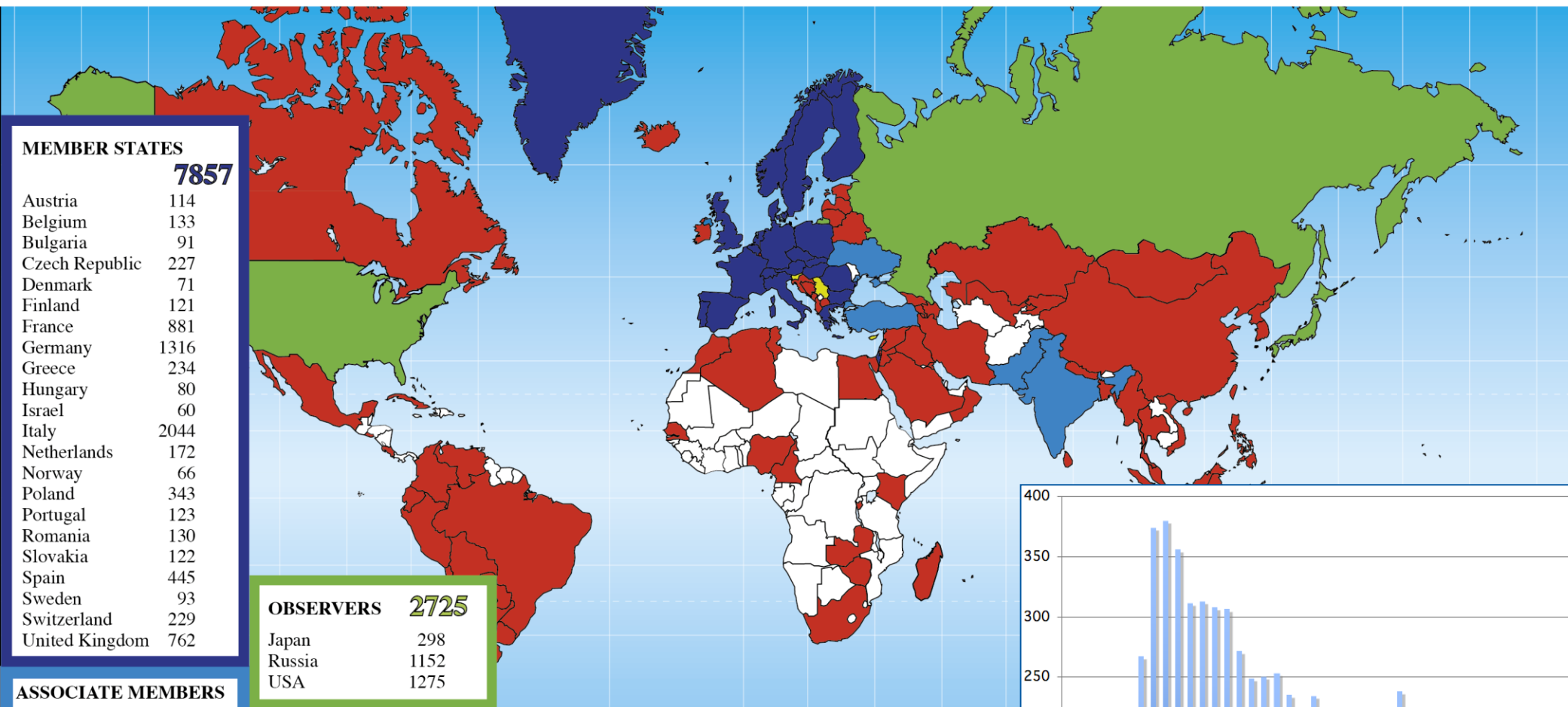
**Member States:** Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom

**Associate Member States:** India, Lithuania, Pakistan, Turkey, Ukraine; **States in Accession to Membership:** Cyprus, Serbia, Slovenia

**Interested States (not exhaustive):** Australia, Brazil, Canada, Croatia, Estonia, Ireland, Latvia, South Korea

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

# Distribution of All CERN Users by Nationality on 5 July 2017



## MEMBER STATES

**7857**

Austria	114
Belgium	133
Bulgaria	91
Czech Republic	227
Denmark	71
Finland	121
France	881
Germany	1316
Greece	234
Hungary	80
Israel	60
Italy	2044
Netherlands	172
Norway	66
Poland	343
Portugal	123
Romania	130
Slovakia	122
Spain	445
Sweden	93
Switzerland	229
United Kingdom	762

## OBSERVERS

**2725**

Japan	298
Russia	1152
USA	1275

## ASSOCIATE MEMBERS

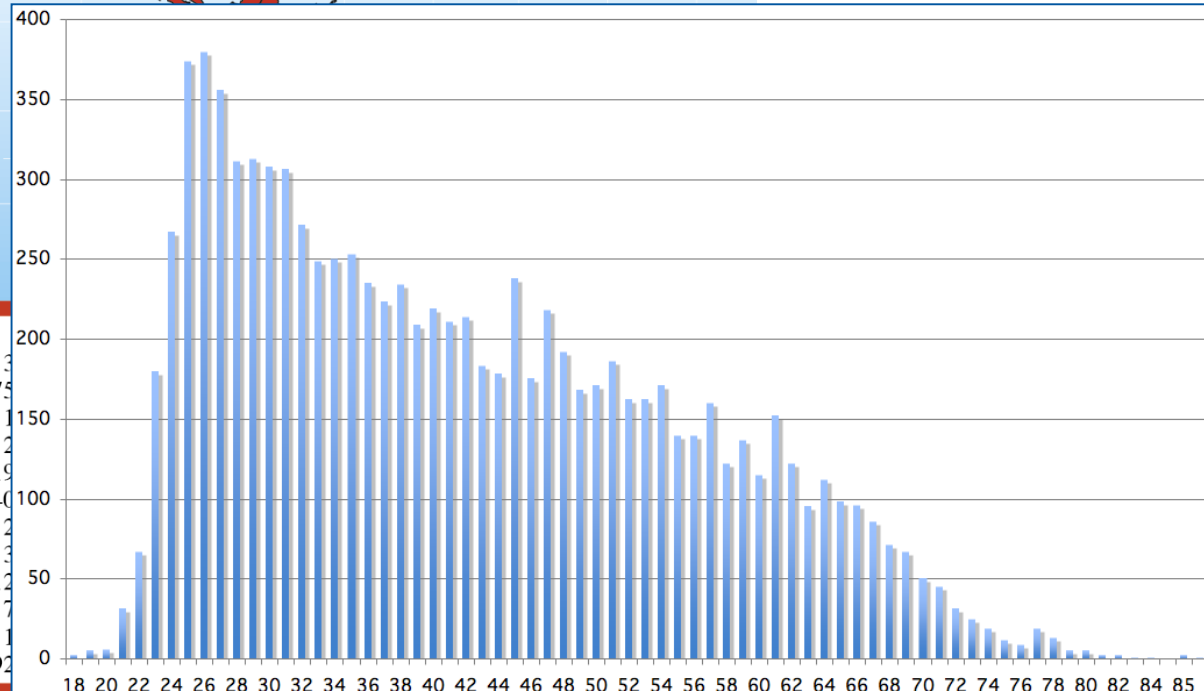
**710**

India	360
Pakistan	61
Turkey	179
Ukraine	110

## OTHERS

**1865**

Albania	3	Bosnia & Herzegovina	1	Egypt	33	Kenya	3
Algeria	14	Brazil	131	El Salvador	1	Korea Rep.	175
Argentina	24	Burundi	1	Estonia	17	Kyrgyzstan	1
Armenia	25	Cameroon	1	Georgia	45	Latvia	1
Australia	30	Canada	161	Hong Kong	1	Lebanon	19
Azerbaijan	9	Chile	22	Iceland	5	Lithuania	40
Bangladesh	12	China	482	Indonesia	11	Luxembourg	2
Belarus	47	Colombia	45	Iran	52	Madagascar	3
Bolivia	3	Costa Rica	1	Iraq	1	Malaysia	12
		Croatia	41	Ireland	17	Malta	7
		Cuba	15	Jordan	2	Mauritius	1
		Ecuador	4	Kazakhstan	4	Mexico	92



## ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP

**104**

Cyprus	26
Serbia	47
Slovenia	31



**CERN Council**  
President: S. de Jong

member states  
    2 delegates  
candidates for accession  
    2 delegates  
associate member states  
    2 delegates  
ex officio members  
different observers on invitation

**Finance Committee**  
President: O. Malmberg

member states  
    2 delegates  
candidates for accession  
    2 delegates  
associate member states  
    2 delegates  
ex officio members  
different observers on invitation

**Scientific Policy Committee**  
President: K. Ellis

16 individual members  
ex officio members

**Tripartite Employment Forum**  
Chairperson: B. Dormy

**Pension Fund Governing Board**  
Chairperson: T. Roth



Council Secretariat  
Legal Service

Director General  
**Fabiola Gianotti**

Internal Audit  
Health, Safety, and Environment Unit

Finance and Human  
Resources  
**Martin Steinacher**

Research and Computing  
**Eckhard Elsen**

Accelerators and  
Technology  
**Frédéric Bordry**

International Relations  
**Charlotte Warakaulle**

**Finance and  
Administrative Procedures**  
Florian Sonnemann

**Experimental Physics**  
Manfred Krammer

**Beams**  
Paul Collier

**Education, Communication,  
and Outreach**

**Human Resources**  
James Purvis

**Theoretical Physics**  
Gian Giudice

**Technology**  
Jose Miguel Jimenez

**Protocol**

**Industry, Procurement, and  
Technology Transfer**  
Thierry Lagrange

**Information Technologies**  
Frédéric Hemmer

**Engineering**  
Roberto Losito

**Stakeholder Relations**

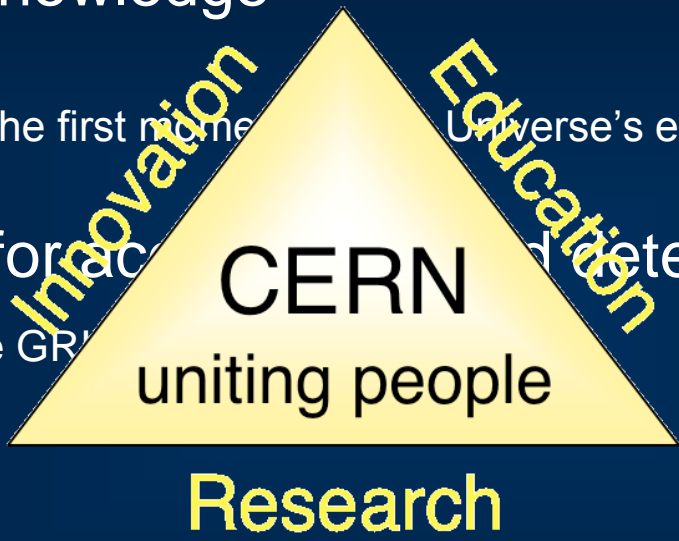
**Space Management  
and Buildings**  
Lluís Miralles Verge



# Current Organisation

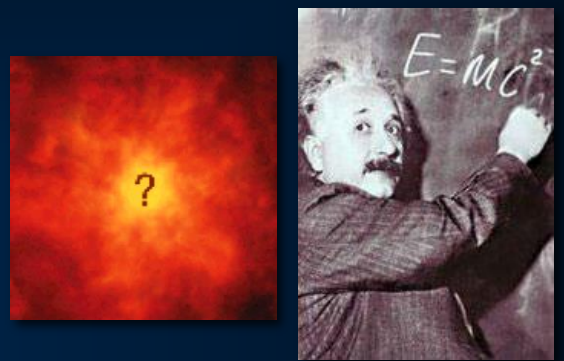


# The Mission of CERN



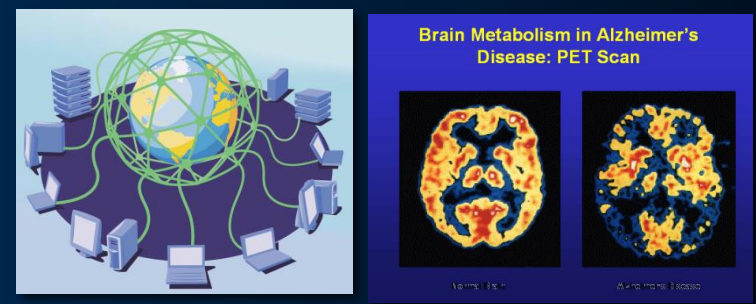
□ **Push back** the frontiers of knowledge

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

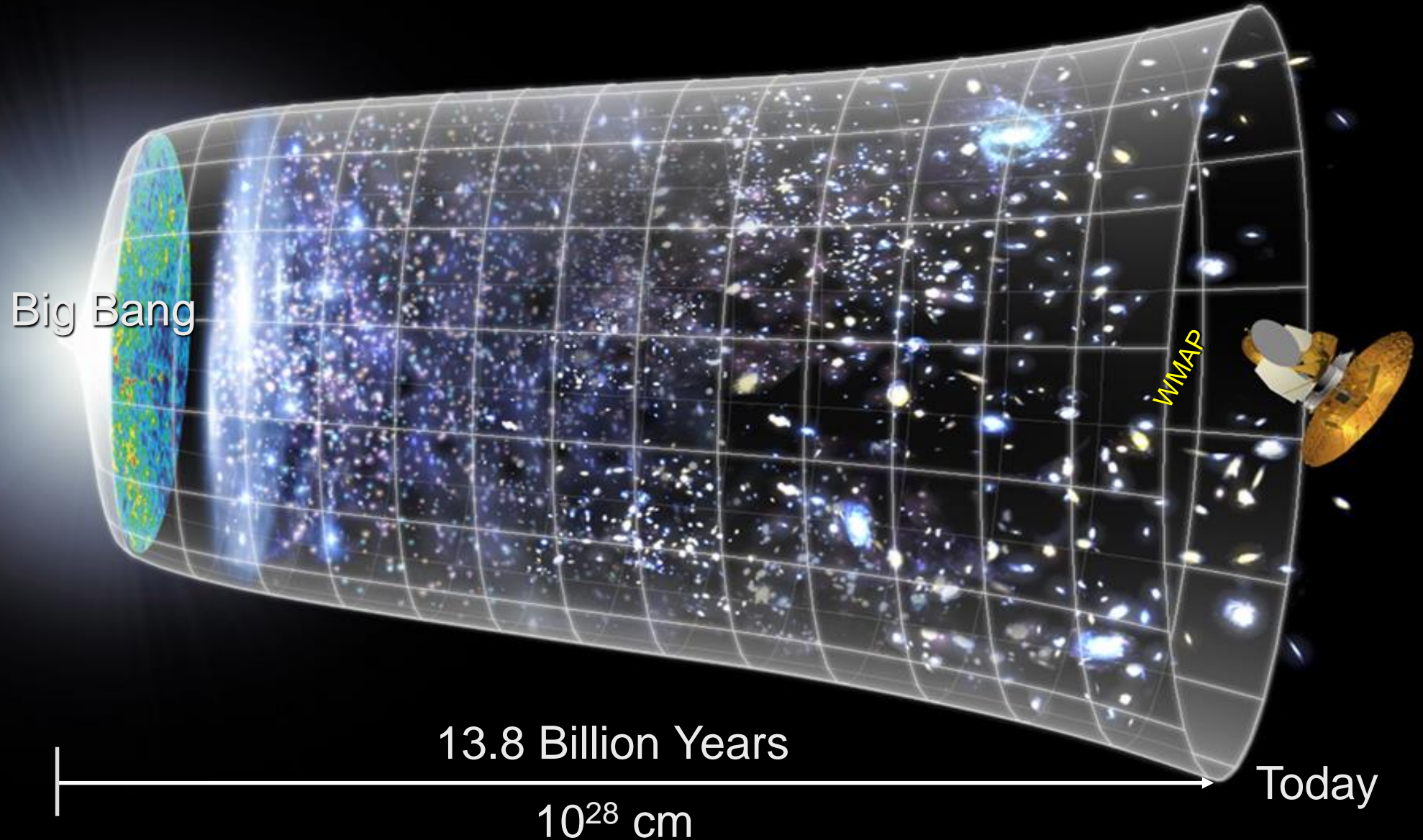


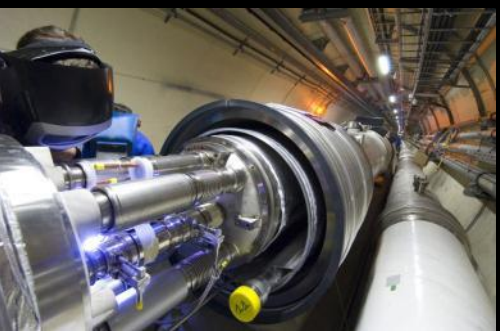
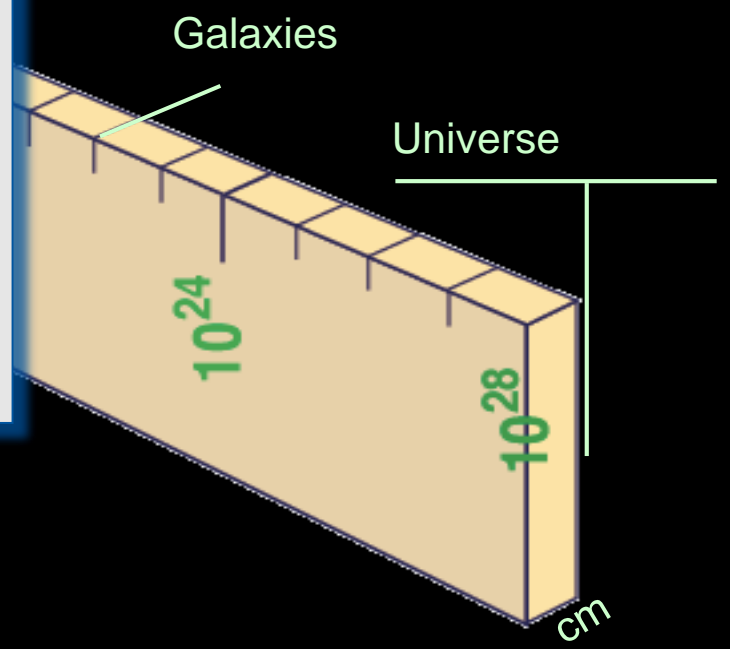
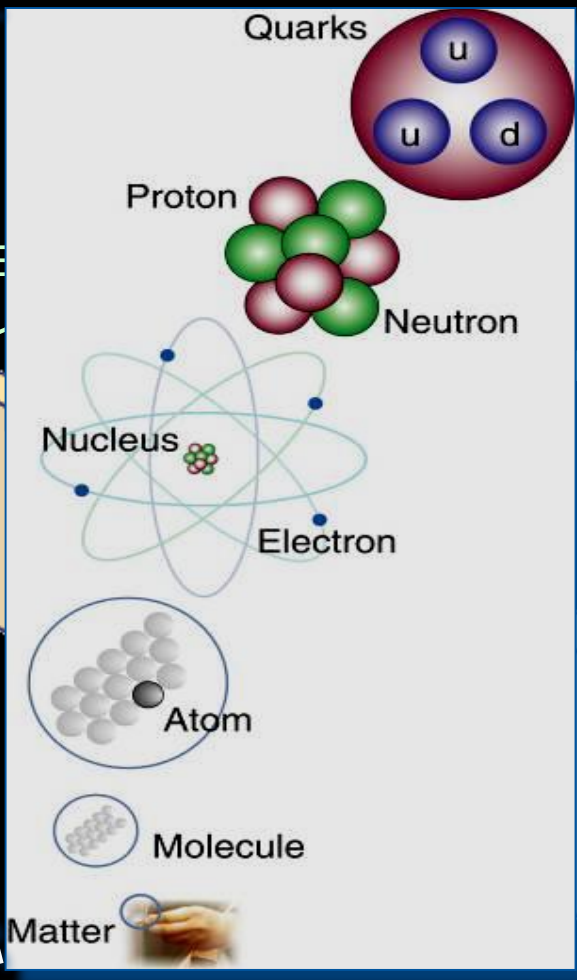
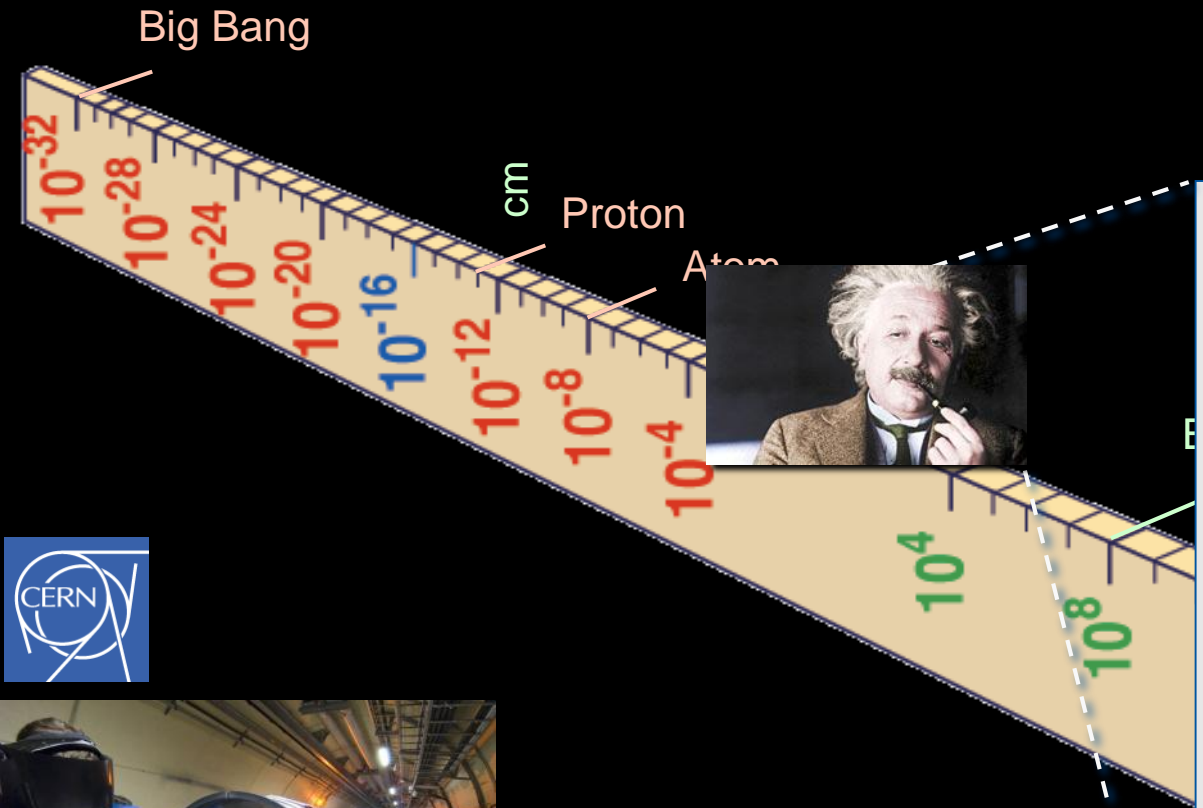
□ **Unite** people from different countries and cultures





# Scientific Challenge: Explore the Evolution of the Early Universe





LHC

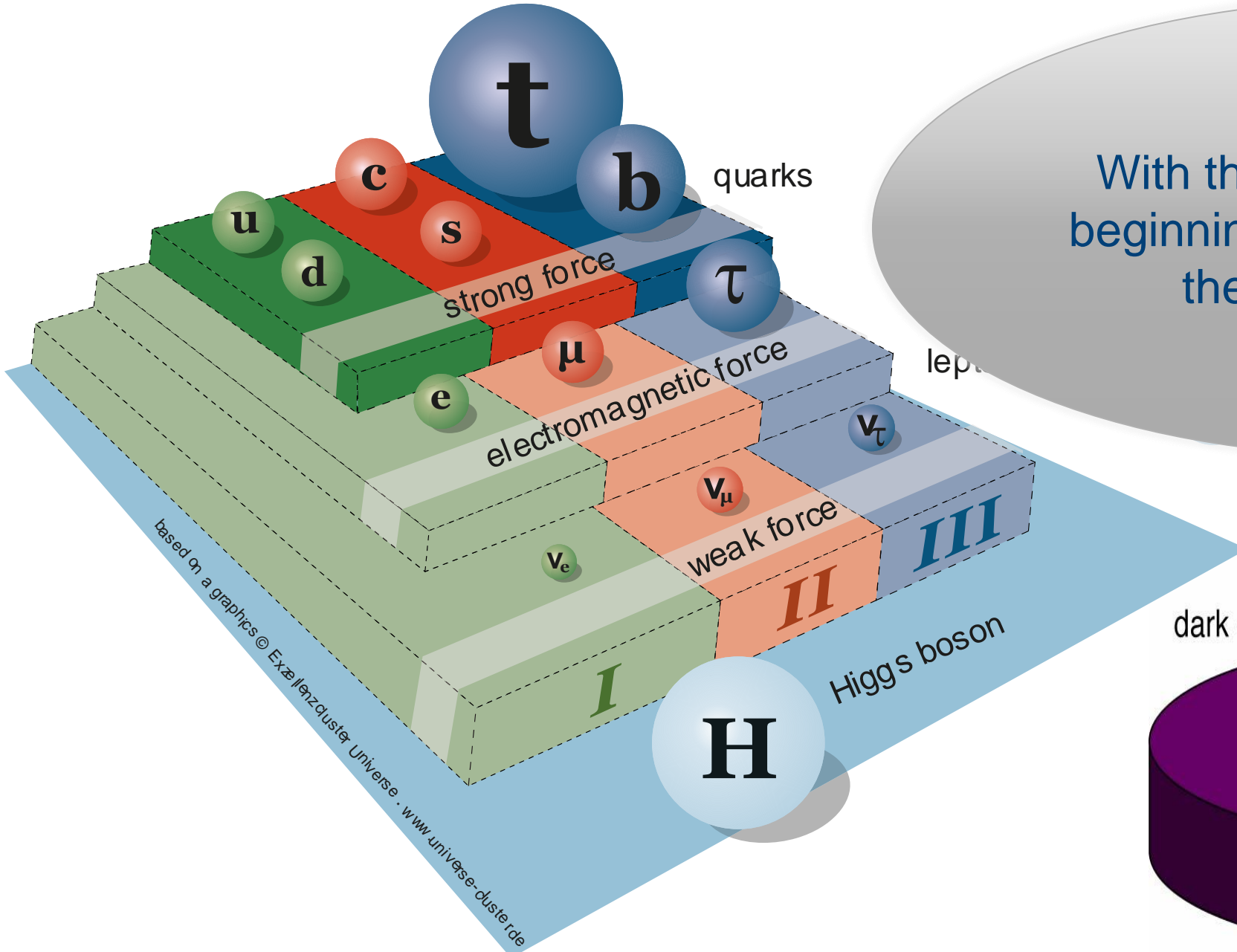
Supermicroscope



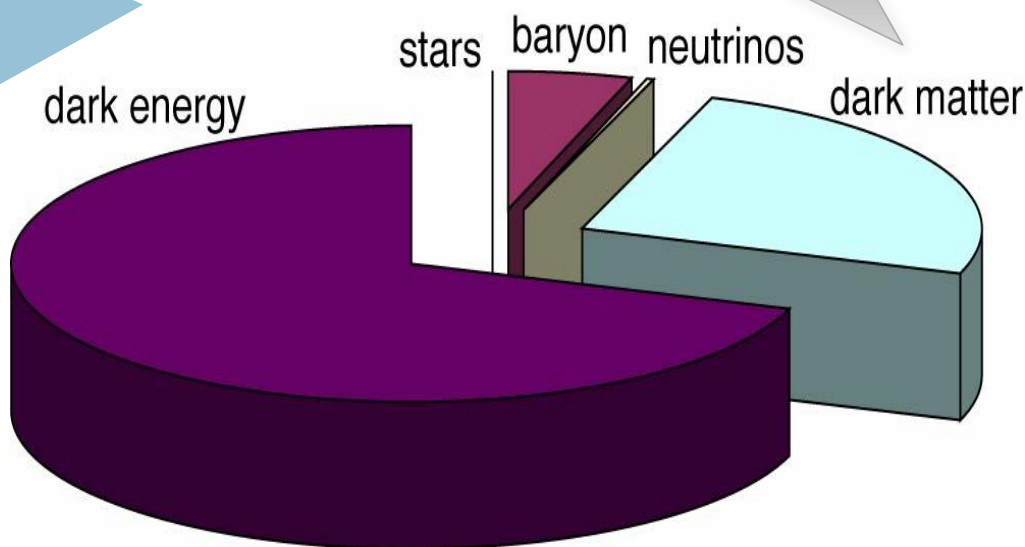
The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider".



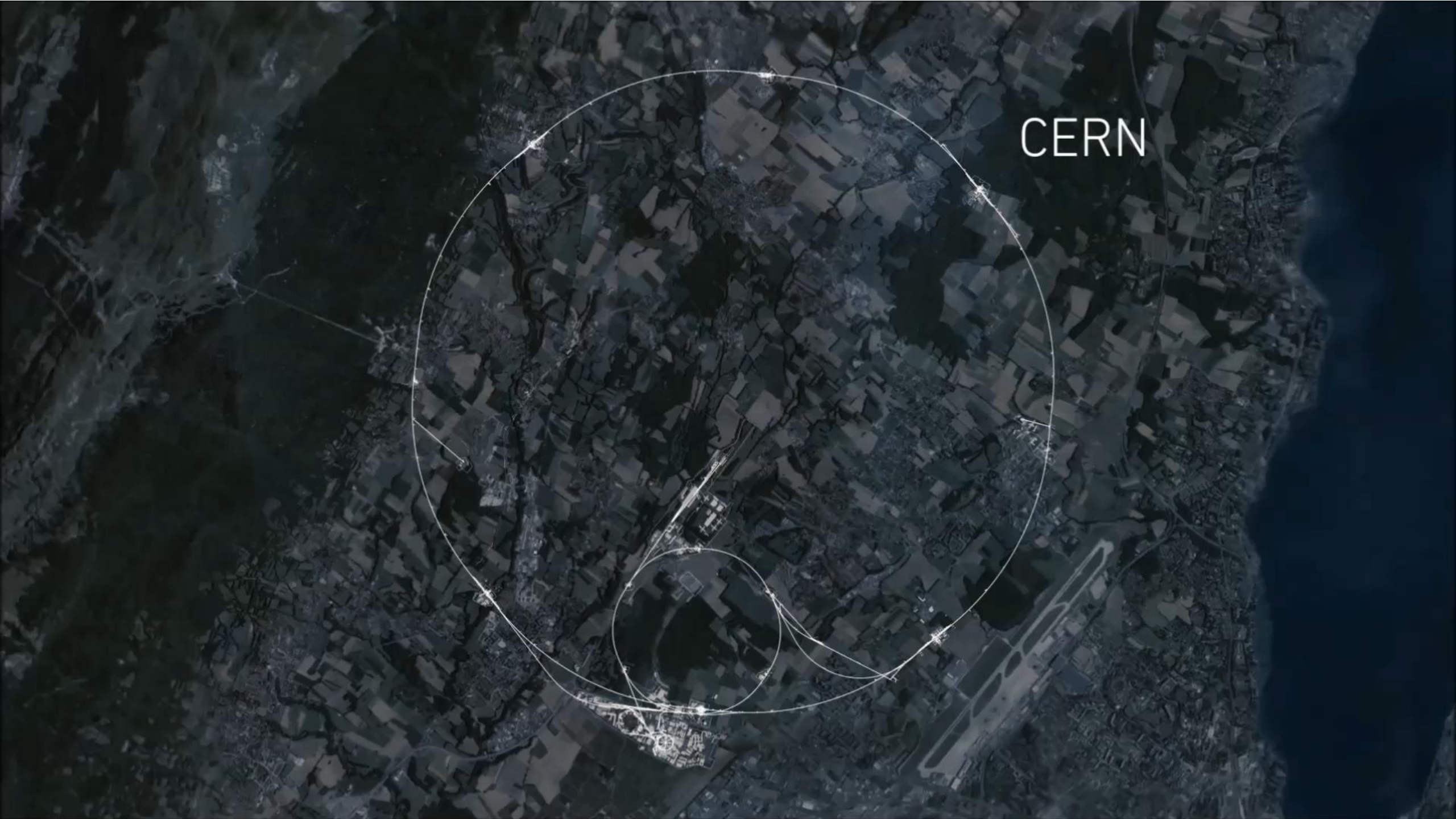
Physics Nobel Prize 2013

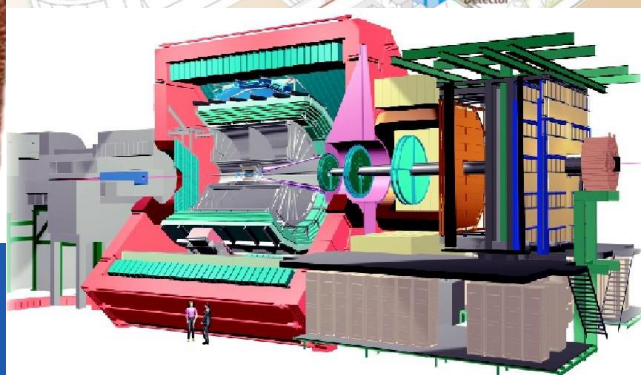
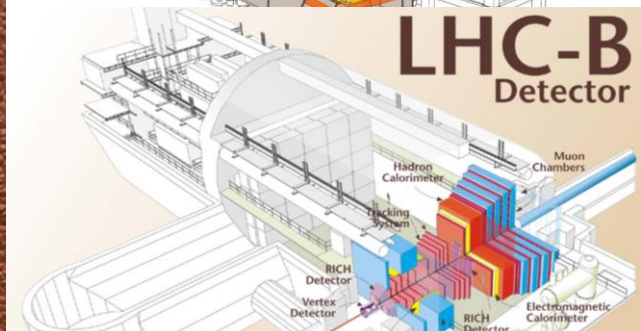
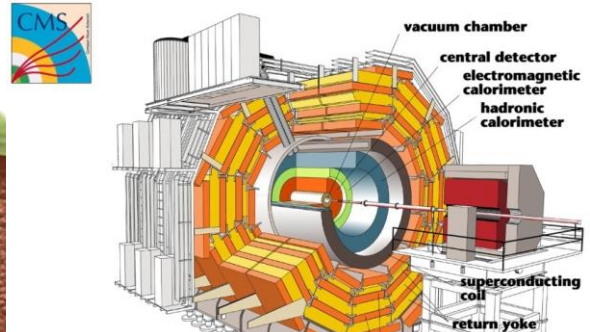
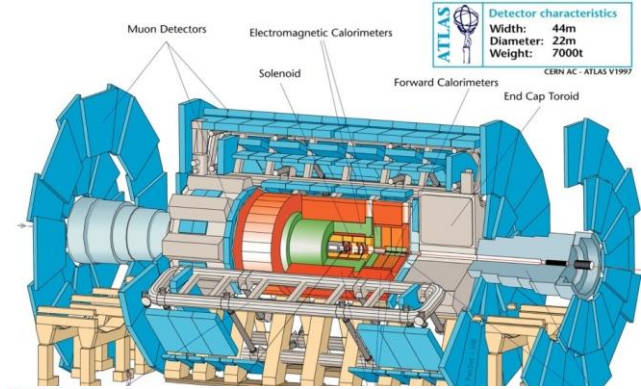
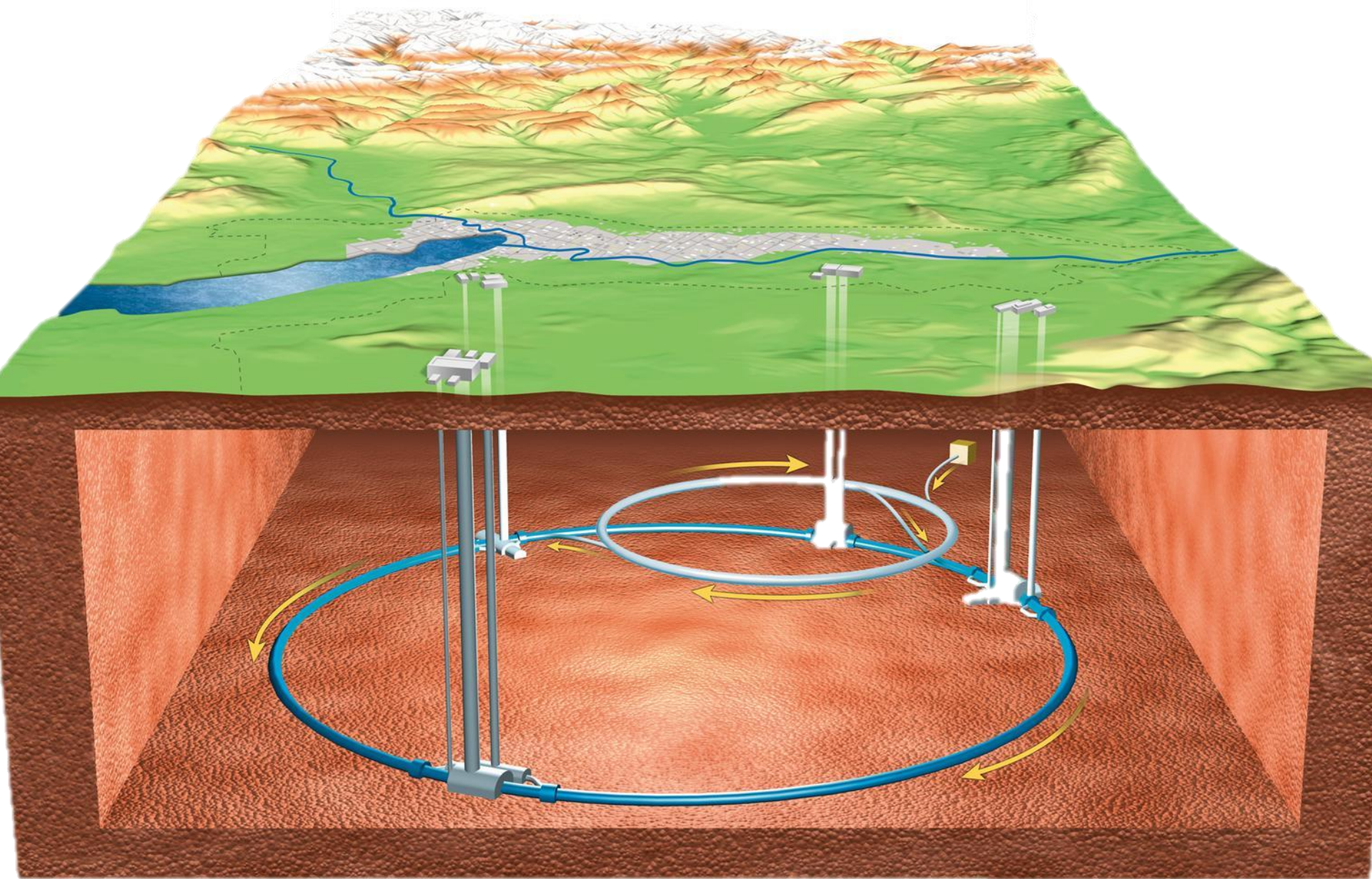


With the LHC, we are at the beginning of the exploration of the „Dark Universe“



CERN





# Miscellaneous Activities



**Apprentices**

**Doctoral Students**

**Accelerator School**

**Academic Training**

**Exhibitions**

**Fellows**

**Physics School**

**Computing School**

**Visits**

**CERN-Latin America School**

**Technical Students**

**Outreach**

**Summer Students**

**Microcosm**

**Language Training**

**Technical Training**

**Science on Stage**

**Communications Training**

**Conferences**

**Teachers programmes**

**Management Training**



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

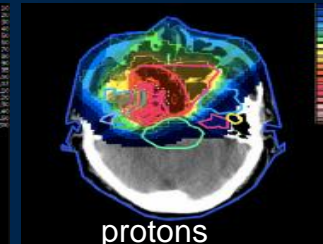
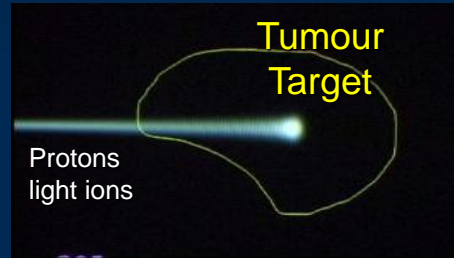
Combining Physics, ICT, Biology, and Medicine to Fight Cancer



## Hadron Therapy

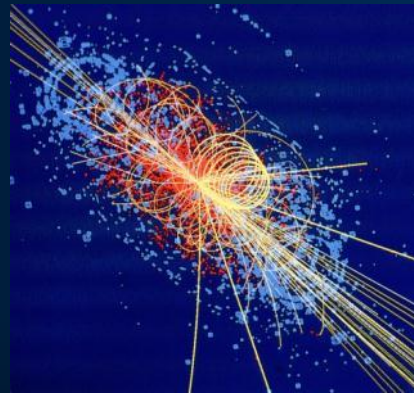
### Accelerating particle beams

~30'000 accelerators worldwide  
~17'000 used for medicine



Leadership in Ion Beam Therapy now in Europe and Japan

>70'000 patients treated worldwide (30 facilities)  
>21'000 patients treated in Europe (9 facilities)



### Detecting particles

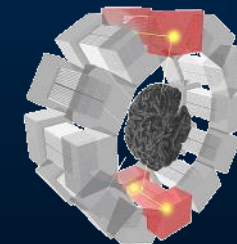


## Imaging

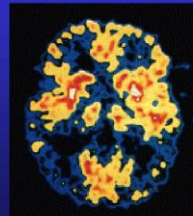
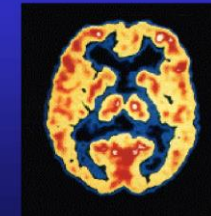
Clinical trial in Portugal for new breast imaging system (ClearPEM)



## PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



Normal brain

Alzheimer's disease

# World Wide Web

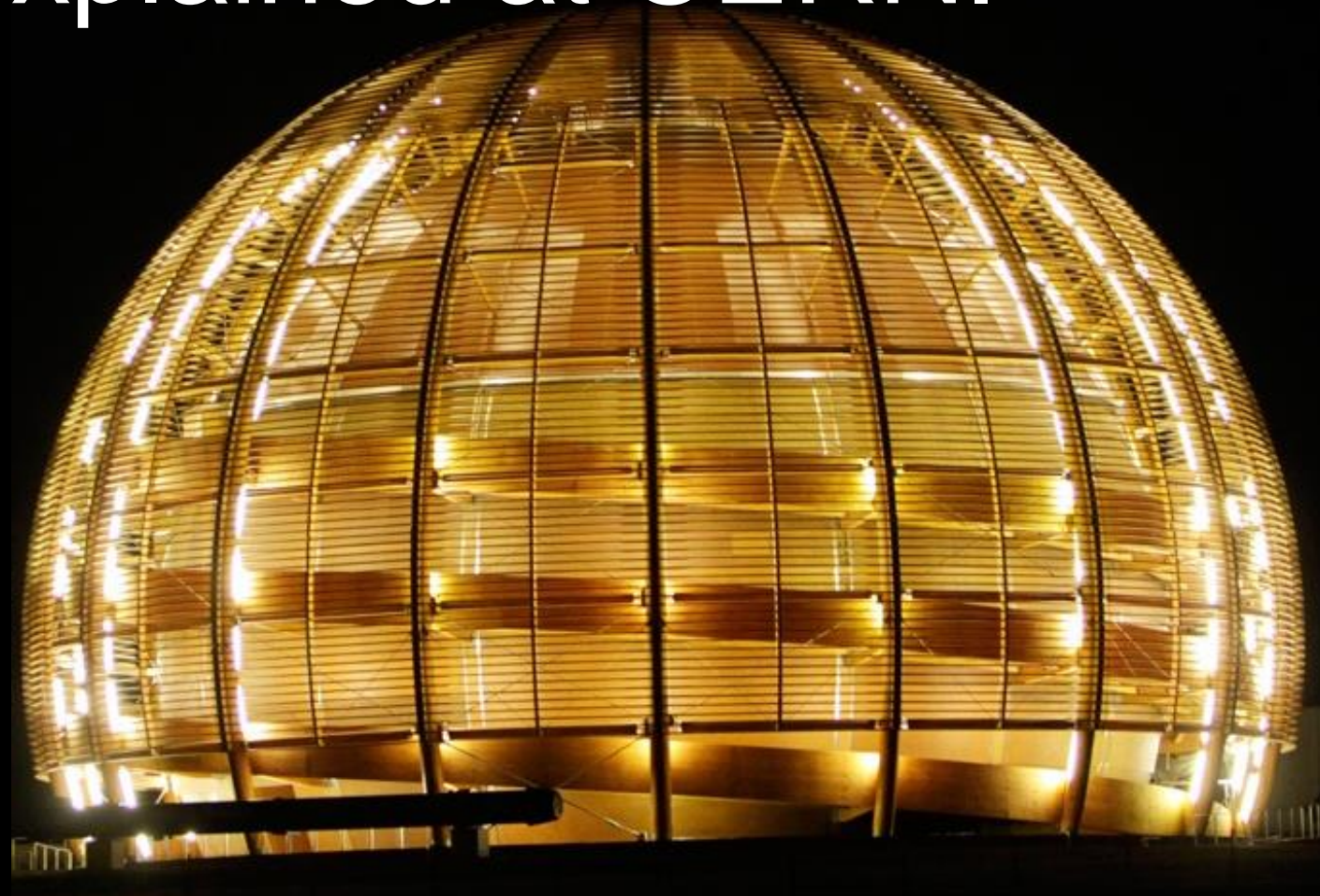
# WWW



European Organization for Particle Physics  
*Organisation européenne pour la physique des particules*

“Magic is not happening at CERN,  
magic is being explained at CERN.”

*Tom Hanks*



European Organization for Particle Physics  
*Organisation européenne pour la physique des particules*

# What happens nowadays?

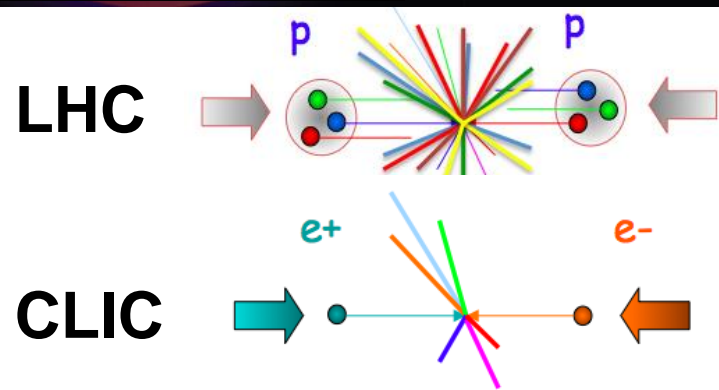


**And then?**



proton

electron  
positron



p-p collisions	e <sup>+</sup> e <sup>-</sup> collisions
<p><b>Proton is compound object</b></p> <ul style="list-style-type: none"> <li>→ Initial state not known event-by-event</li> <li>→ Limits achievable precision</li> </ul>	<p><b>e<sup>+</sup>/e<sup>-</sup> are point-like</b></p> <ul style="list-style-type: none"> <li>→ Initial state well defined (<math>\sqrt{s}</math> / polarisation)</li> <li>→ High-precision measurements</li> </ul>
<p><b>High rates of QCD backgrounds</b></p> <ul style="list-style-type: none"> <li>→ Complex triggering schemes</li> <li>→ High levels of radiation</li> </ul>	<p><b>Cleaner experimental environment</b></p> <ul style="list-style-type: none"> <li>→ trigger-less readout</li> <li>→ Low radiation levels</li> </ul>
<p>High cross-sections for <b>colored-states</b></p>	<p>Superior sensitivity for <b>electro-weak states</b></p>



# From Discovery to Precision

slide content: Lucie Linssen, 2014



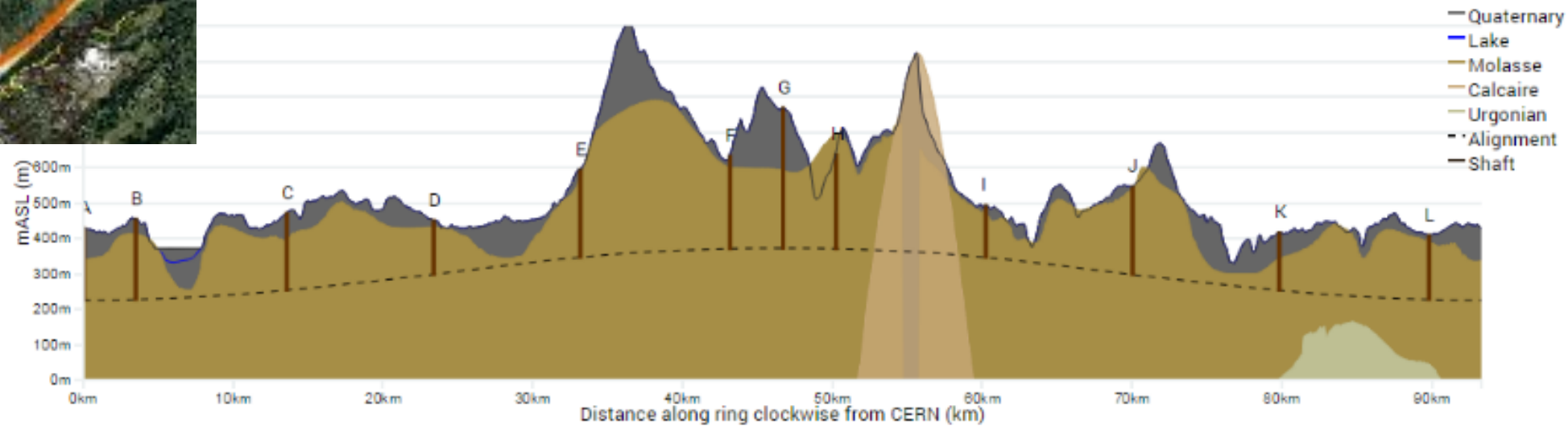
# An international Study for a Future Circular Collider



- $pp$ -collider (*FCC-hh*)
- $e^+e^-$ -collider (*FCC-ee*)
- $p-e$  (*FCC-he*) Option
- 80-100 km tunnels

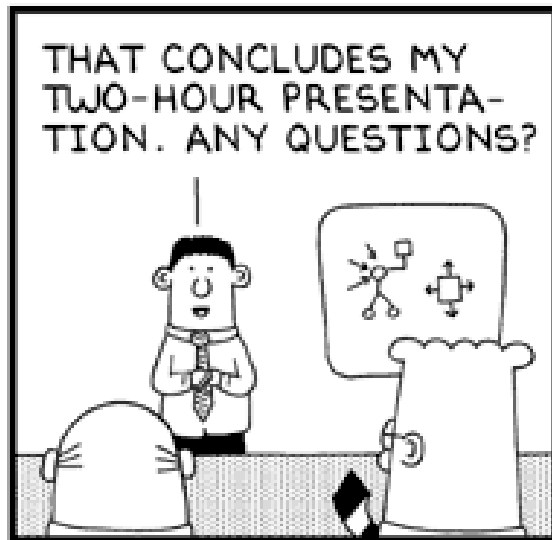
**~16 T  $\Rightarrow$  100 TeV  $pp$  in 100 km**  
**~20 T  $\Rightarrow$  100 TeV  $pp$  in 80 km**

a simulation of a possible layout





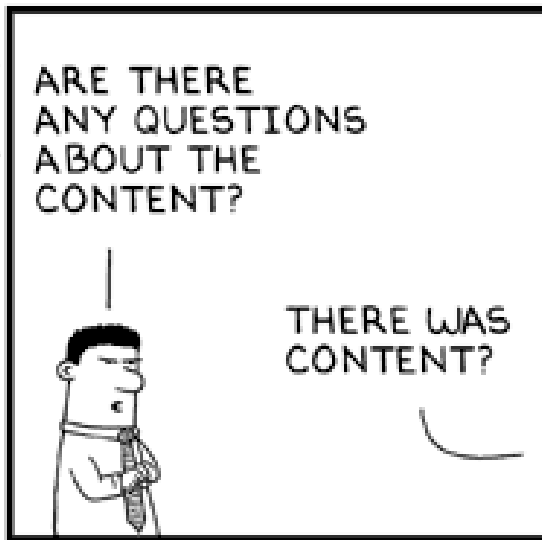
# Your Questions!



www.dilbert.com scottadams@aol.com



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[www.cern.ch](http://www.cern.ch)