

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

~ 2.400 staff
~ 1.600 other paid personnel
~11.000 users
Budget (2016) ~1.000 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

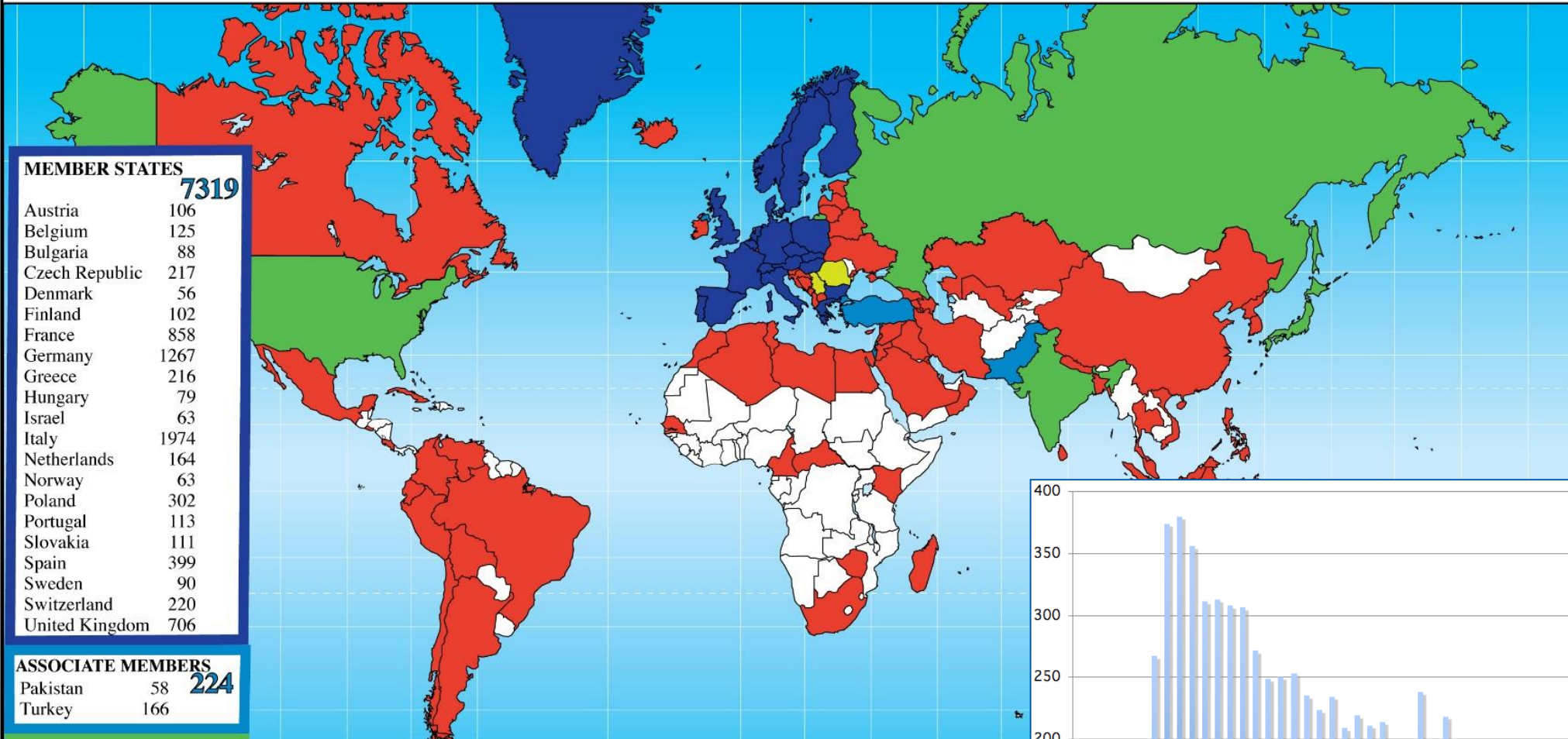
Associate Member States: Pakistan, Turkey, Ukraine

States in Accession to Membership: Cyprus, Serbia

Applicant States: Brazil, Croatia, India, Lithuania, Russian Federation, Slovenia

Observers to Council: India, Japan, Russian Federation, Turkey, United States of America; EUComm, JINR, and UNESCO

Distribution of All CERN Users by Nationality on 12 January 2016



MEMBER STATES **7319**

Austria	106
Belgium	125
Bulgaria	88
Czech Republic	217
Denmark	56
Finland	102
France	858
Germany	1267
Greece	216
Hungary	79
Israel	63
Italy	1974
Netherlands	164
Norway	63
Poland	302
Portugal	113
Slovakia	111
Spain	399
Sweden	90
Switzerland	220
United Kingdom	706

ASSOCIATE MEMBERS **224**

Pakistan	58
Turkey	166

OBSERVERS **2775**

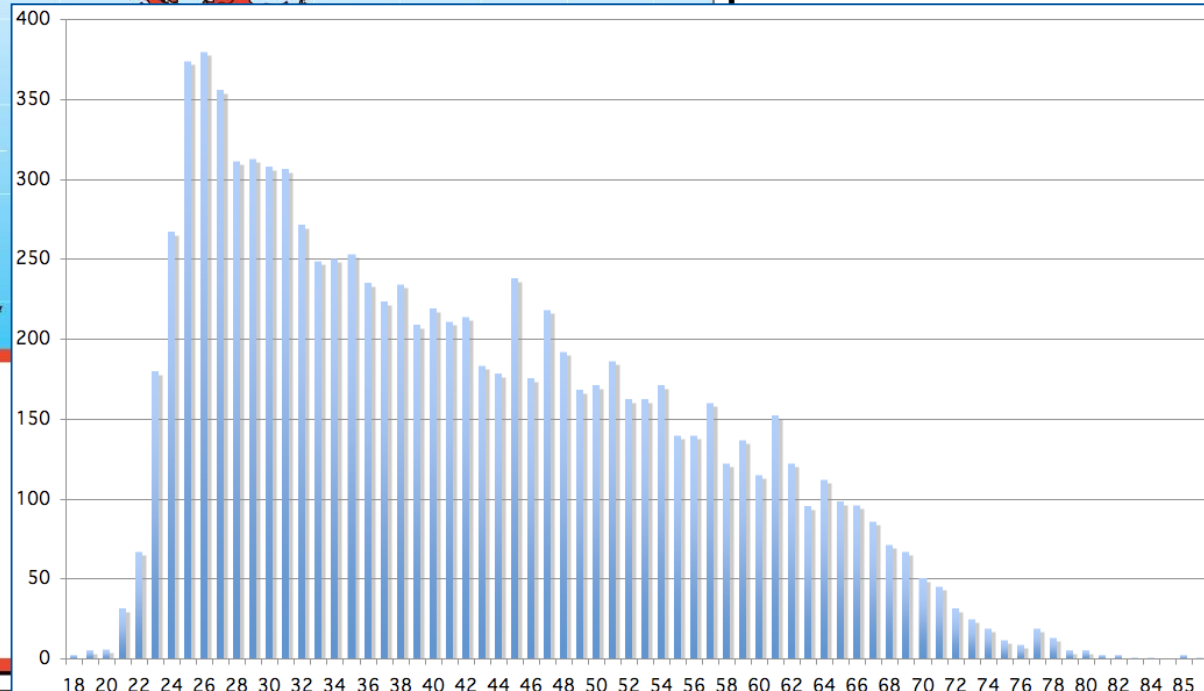
India	284
Japan	316
Russia	1071
USA	1104

STATES IN ACCESSION TO MEMBERSHIP **176**

Romania	131
Serbia	45

OTHERS

Bosnia & Herzegovina	1	Cyprus	19	Jordan	8
Brazil	135	Ecuador	4	Kazakhstan	1
Albania	4	Cameroon	2	Kenya	2
Algeria	8	Canada	154	Egypt	24
Argentina	24	Central African Rep.	1	El Salvador	1
Armenia	27	Chile	20	Estonia	15
Australia	31	China	421	Georgia	44
Azerbaijan	11	Colombia	38	Iceland	4
Bangladesh	7	Costa Rica	1	Indonesia	10
Belarus	50	Croatia	38	Iran	54
Bolivia	2	Cuba	13	Iraq	1
				Latvia	1
				Lebanon	12
				Libya	1
				Lithuania	30
				Luxembourg	2
				Madagascar	4
				Korea, D.P.R.	4
				Korea Rep.	151





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: C. Jamieson

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: T. Nakada

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

Relations
Charlotte Warakaulle

Human Resources
James Purvis

Theoretical Physics
Gian Giudice

Technology
Jose Miguel Jimenez

**Education, Communication,
and Outreach**
N.N.

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

Information Technologies
Frédéric Hemmer

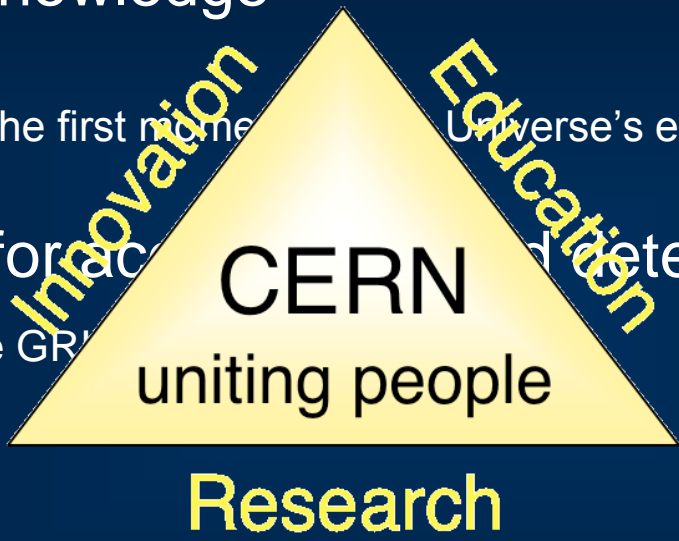
Engineering
Roberto Losito

**Space Management
and Buildings**
Lluís Miralles Verge





The Mission of CERN



❑ **Push back** the frontiers of knowledge

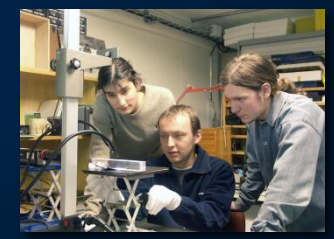
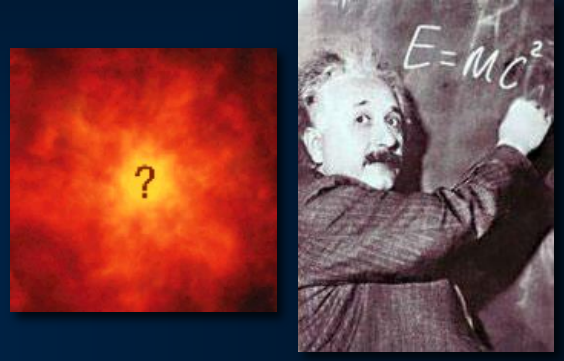
E.g. the secrets of the Big Bang ...
 ... what was the matter like within the first moments of the Universe's existence?

❑ **Develop** new technologies for accelerators and detectors

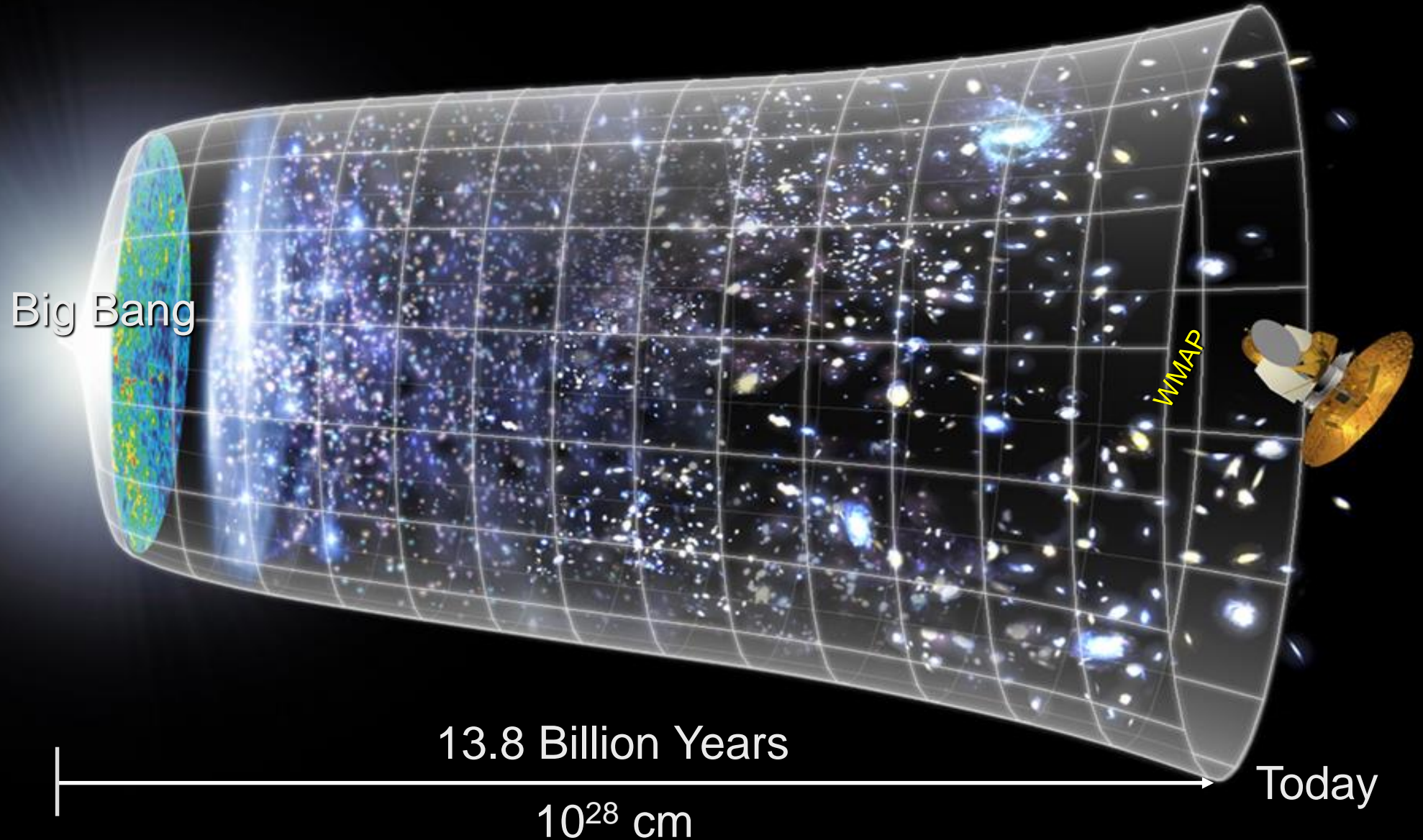
Information technology - the Web and the GRID
 Medicine - diagnosis and therapy

❑ **Train** scientists and engineers of tomorrow

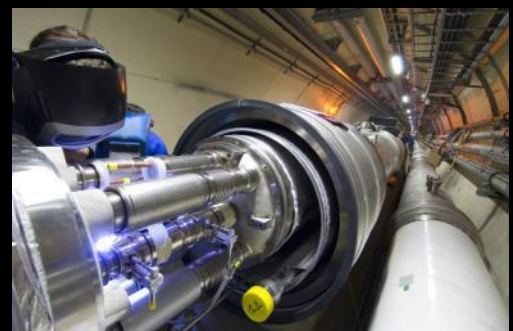
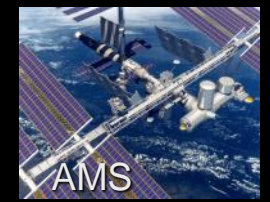
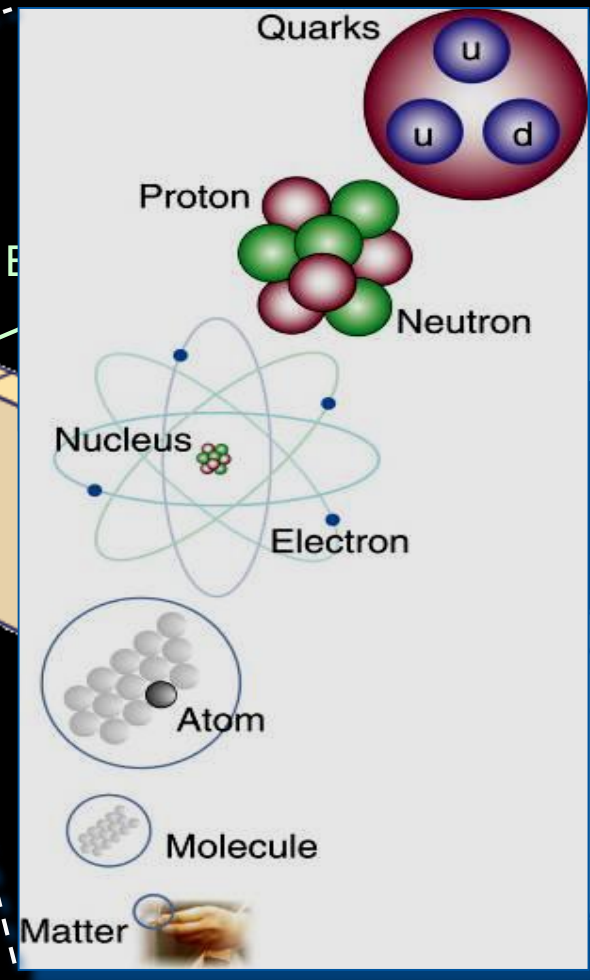
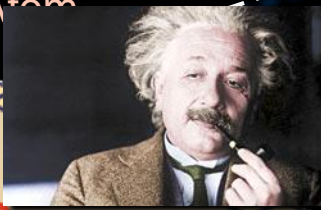
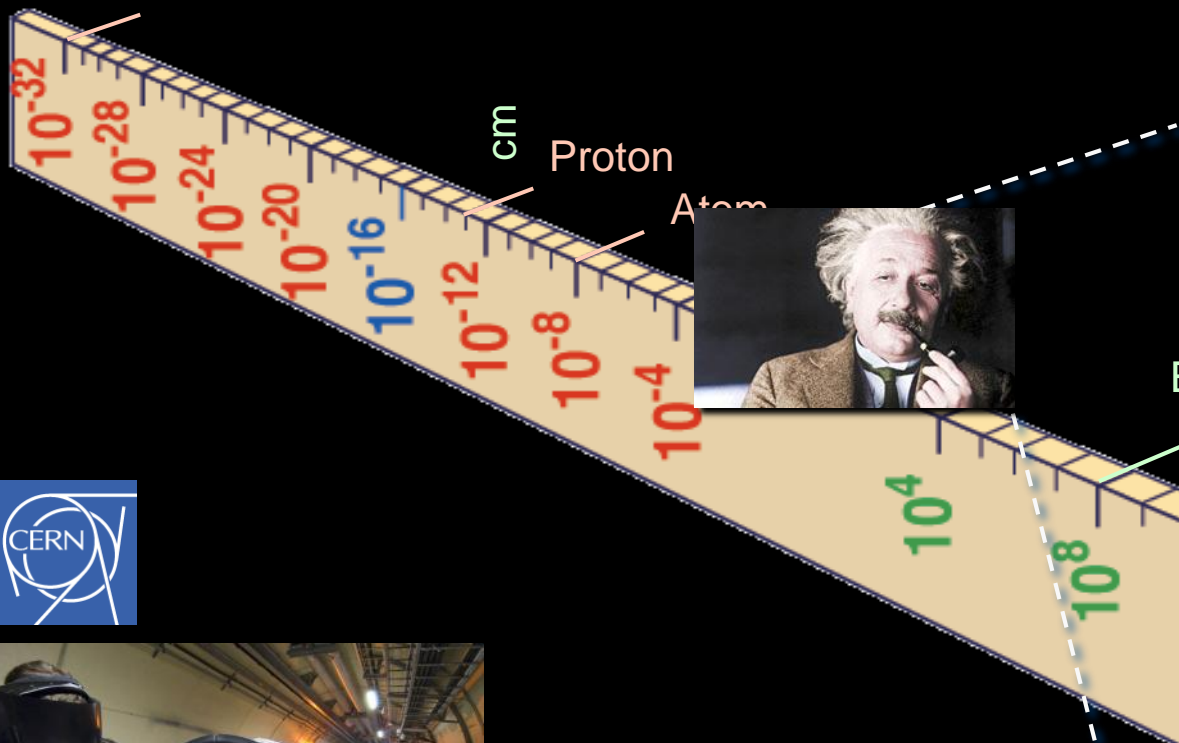
❑ **Unite** people from different countries and cultures



Scientific Challenge: Explore the Evolution of the Early Universe

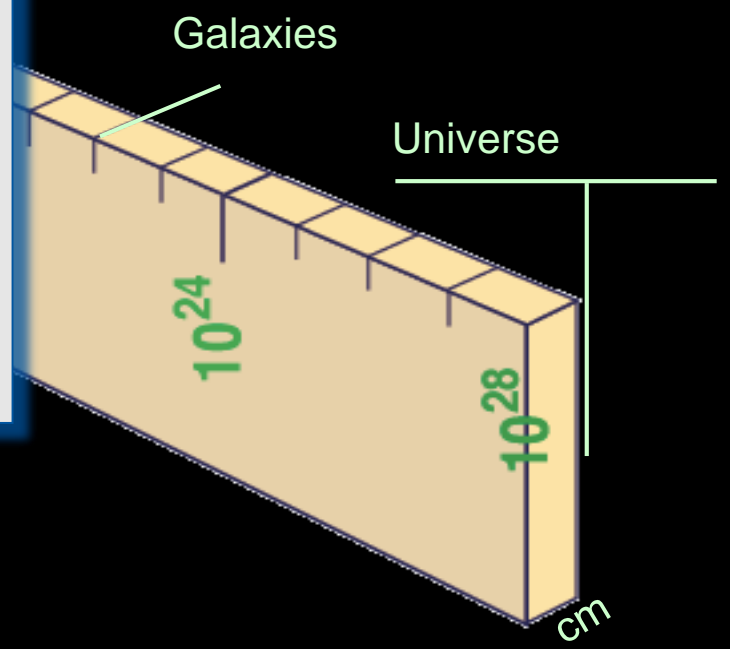


Big Bang



LHC

Supermicroscope

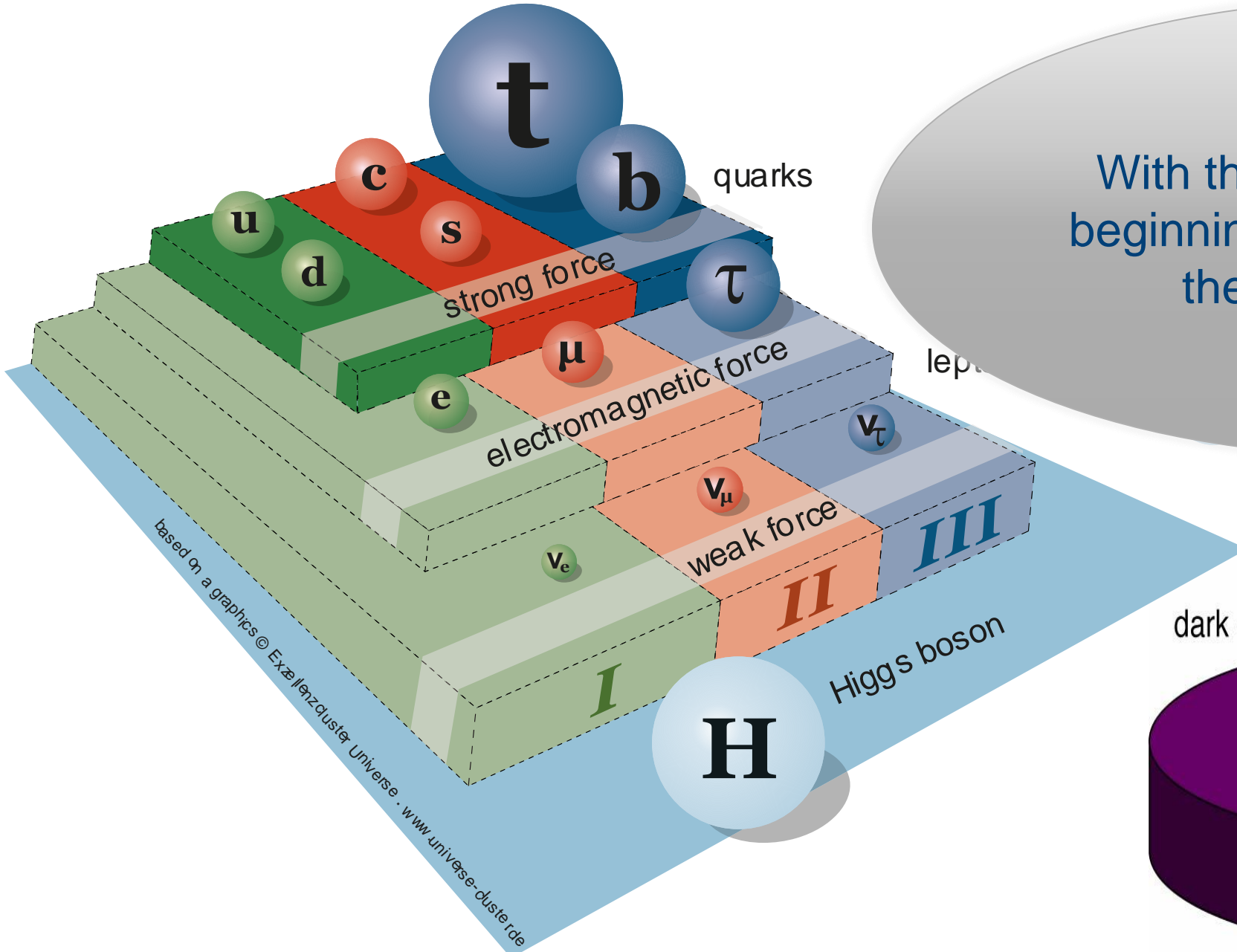




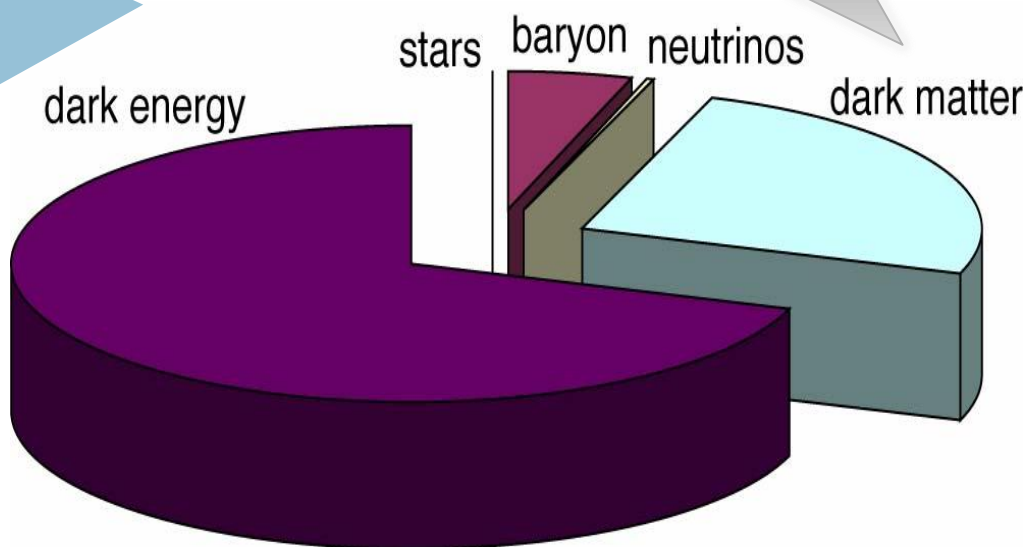
The Nobel Prize in Physics 2013 was awarded jointly to François Englert and Peter W. Higgs "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental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



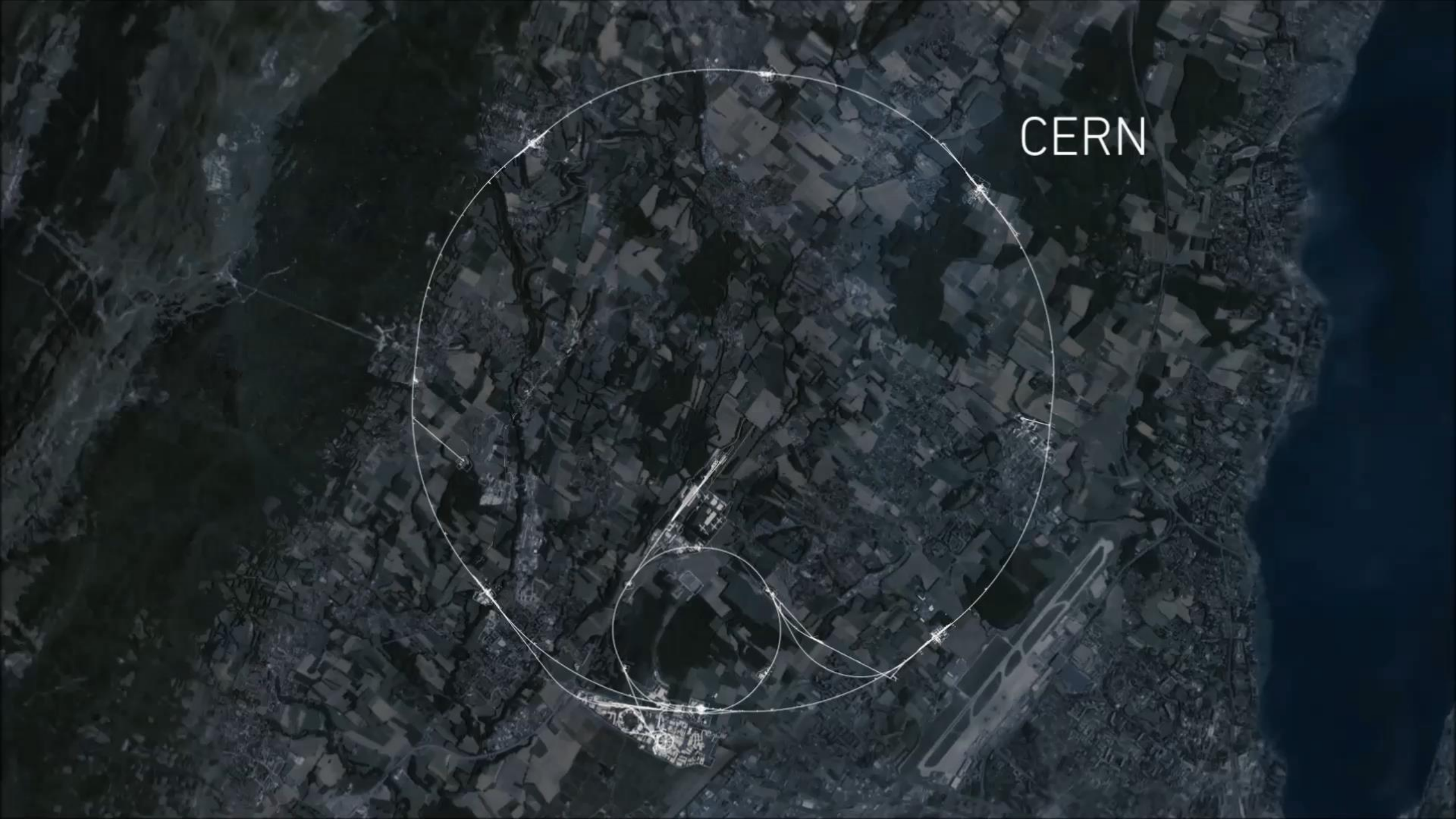
Physics Nobel Prize 2013

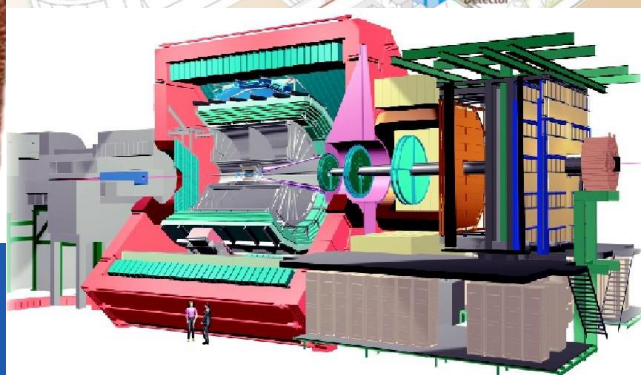
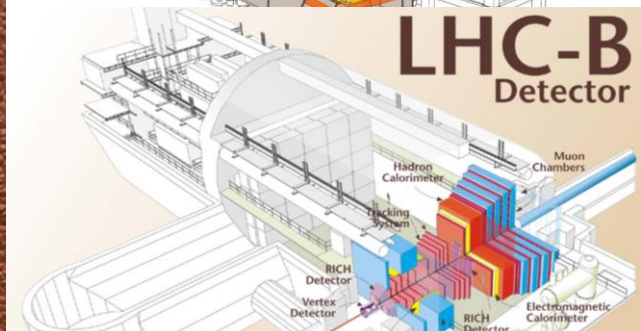
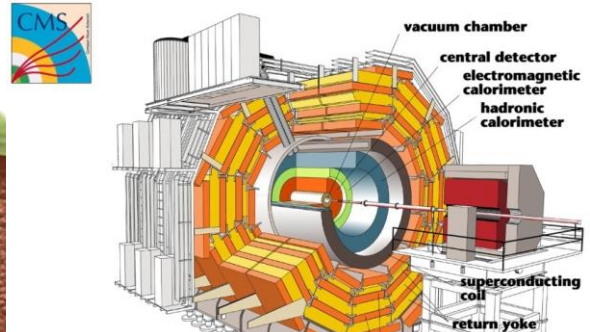
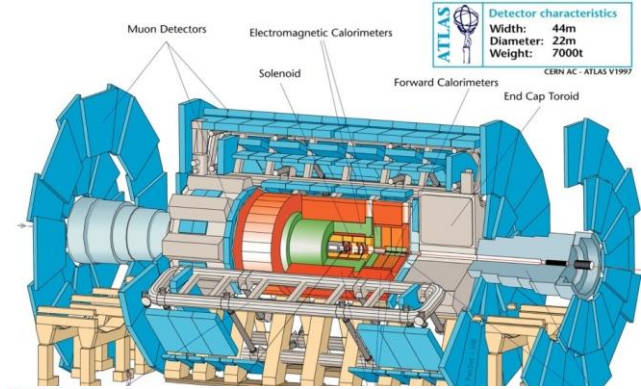
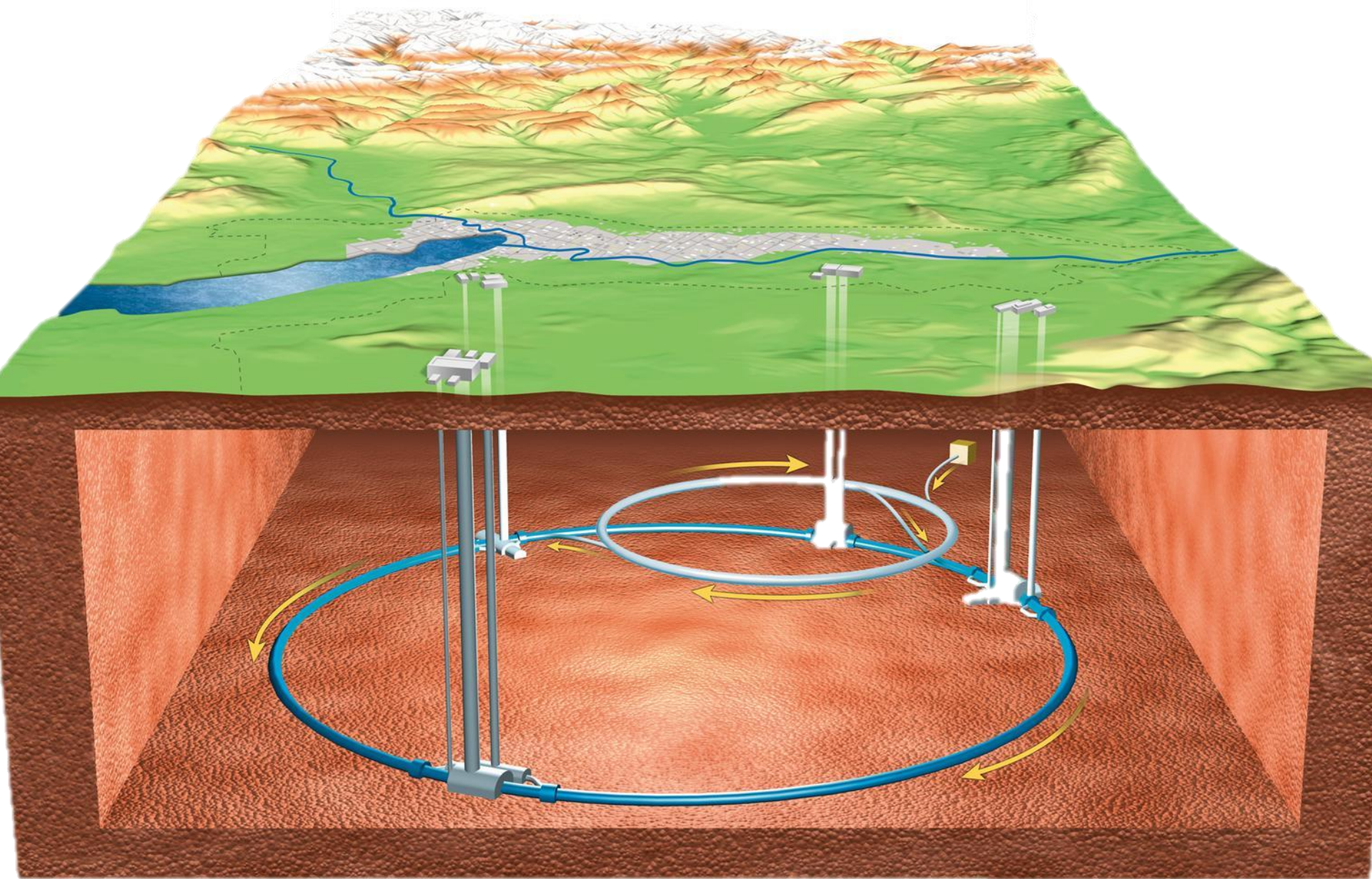


With the LHC, we are at the beginning of the exploration of the „Dark Universe“



CERN





Detector characteristics
 Width: 44m
 Diameter: 22m
 Weight: 7000t
 CERN AC - ATLAS V1997



Big LHC Experiments

Miscellaneous Activities



Apprentices

Doctoral Students

Accelerator School

Academic Training

Exhibitions

Fellows

Physics School

Computing School

Visits

CERN-Latin America School

Technical Students

Summer Students

Microcosm

Outreach

Language Training

Technical Training

Science on Stage

Communications Training

Conferences

Teachers programmes

Management Training

Medical Application as an Example of Particle Physics Spin-off

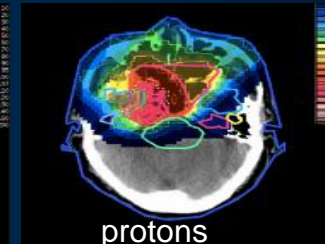
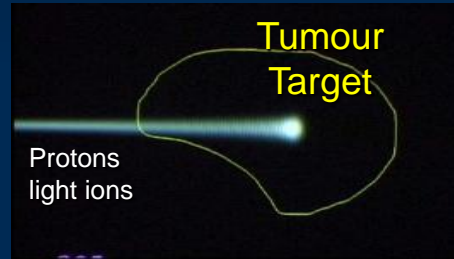
Combining Physics, ICT, Biology, and Medicine to Fight Cancer



Hadron Therapy

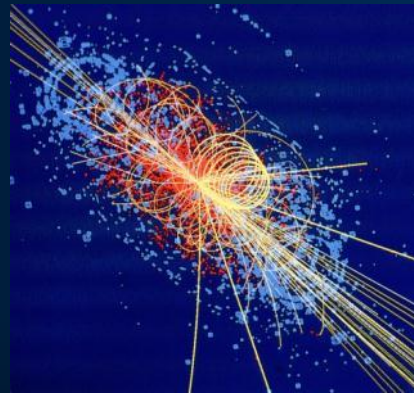
Accelerating particle beams

~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

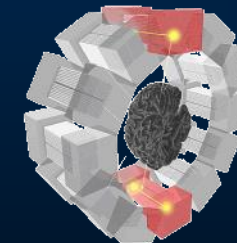


Imaging

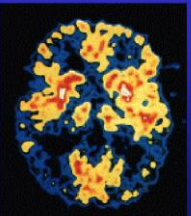
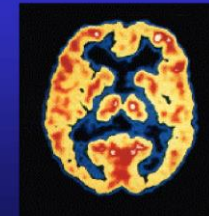
Clinical trial in Portugal for new breast imaging system (ClearPEM)



PET Scanner



Brain Metabolism in Alzheimer's Disease: PET Scan



Normal brain

Alzheimer's disease

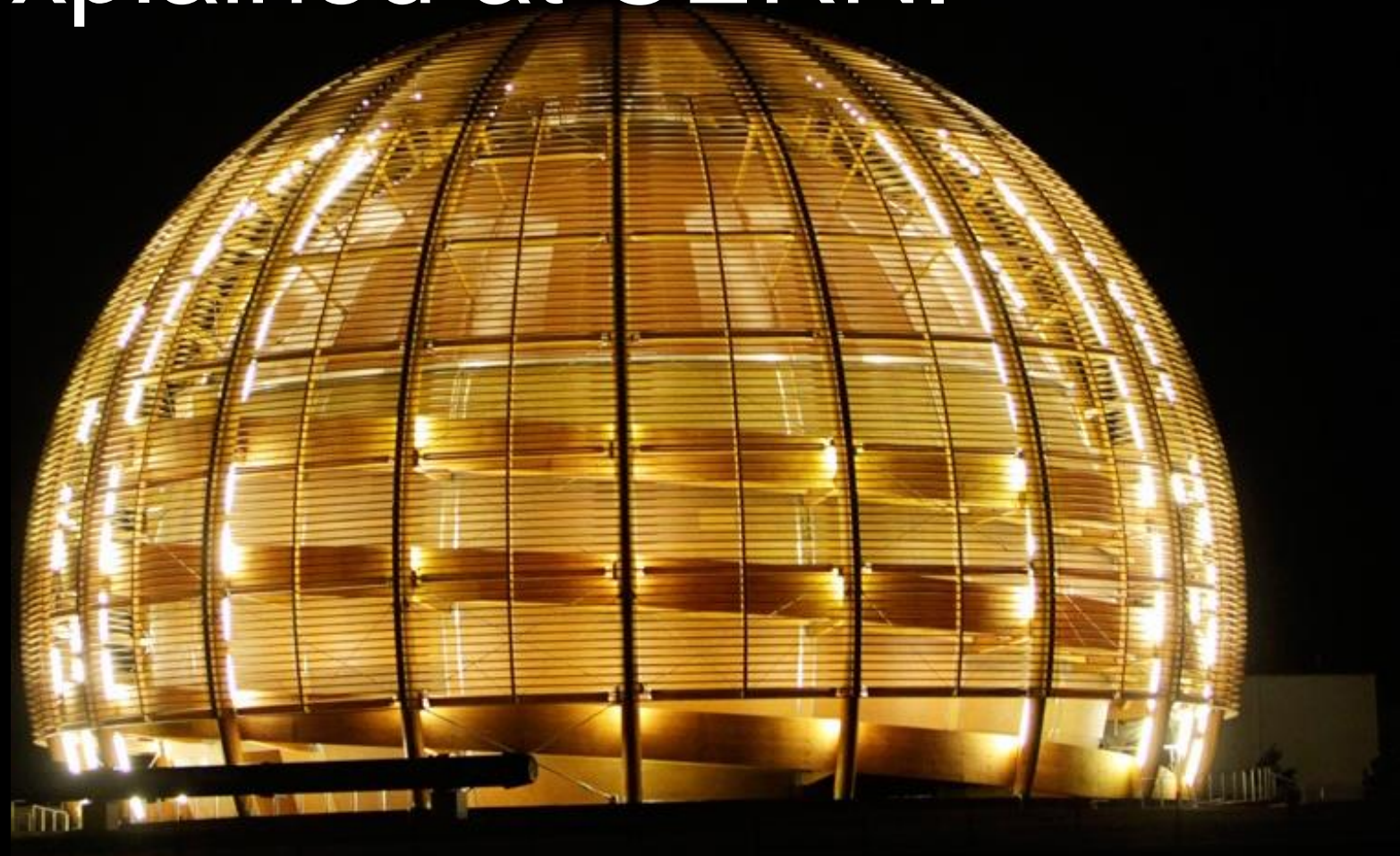
World Wide Web

WWW



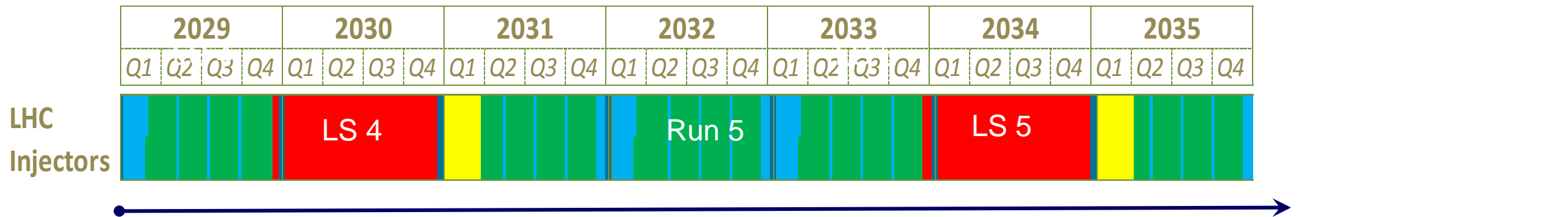
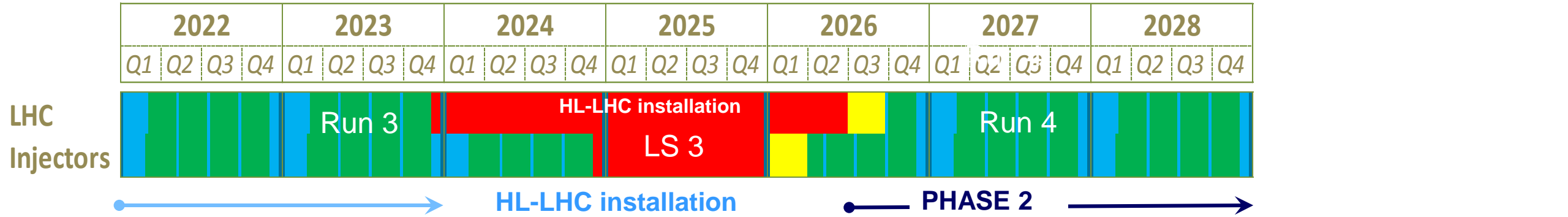
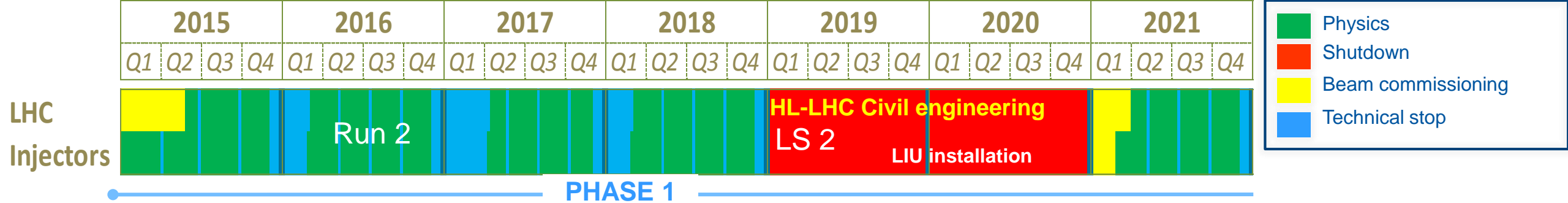
“Magic is not happening at CERN,
magic is being explained at CERN.”

Tom Hanks



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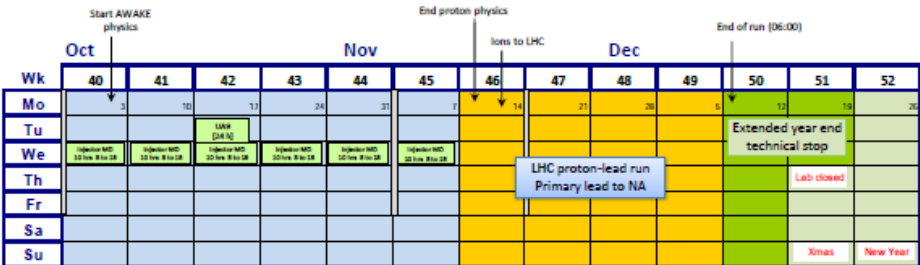
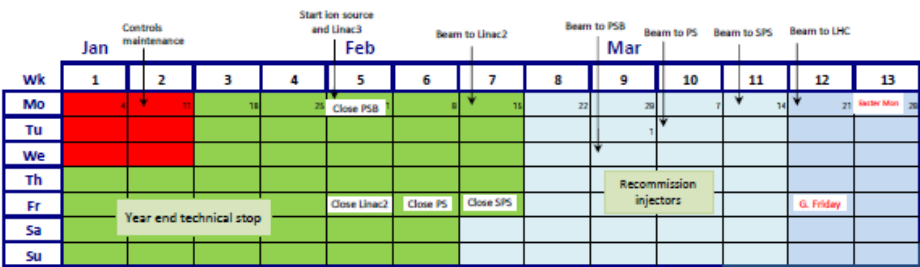
What happens nowadays?



LS2 starting in 2019 => 24 months + 3 months BC
 LS3 LHC: starting in 2024 => 30 months + 3 months BC
 Injectors: in 2025 => 13 months + 3 months BC

2016 Injector Accelerator Schedule

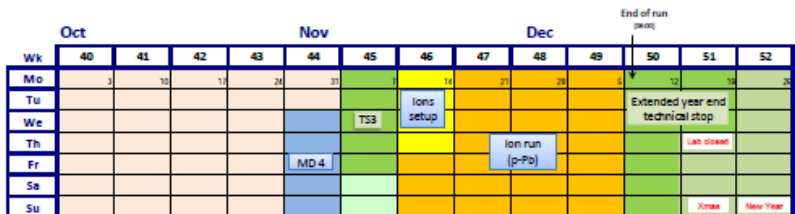
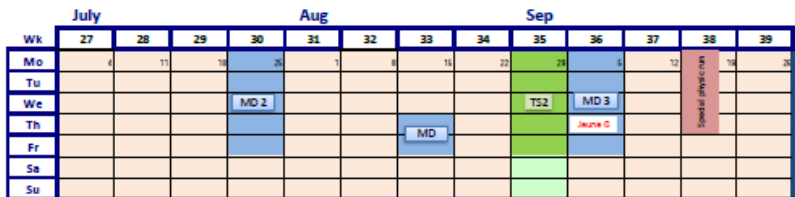
Approved by the Research Board - September 2015



Injector Complex MD Block
 Technical stop for the Injector Chain
 Ions to LHC/NA
 AD Setting-up & Studies
 HiRadMat: possible beam request

LHC Schedule 2016

Approved by the Research Board, December 2015



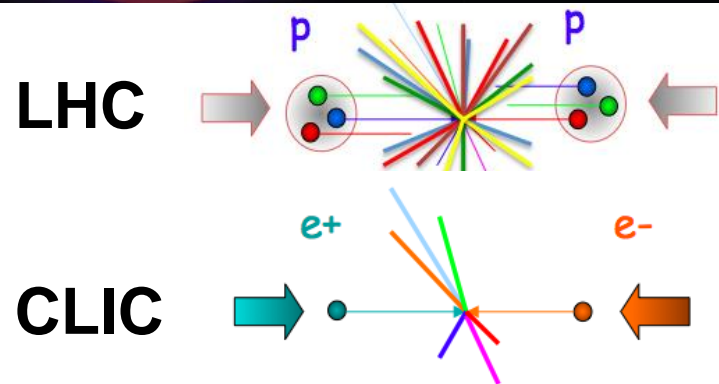
Technical Stop
 Recommisioning with beam
 Scrubbing (indicative - dates to be established)
 Machine development
 Special physics runs - schedule to be established

And then?



proton

electron
positron



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



From Discovery to Precision

slide content: Lucie Linssen, 2014



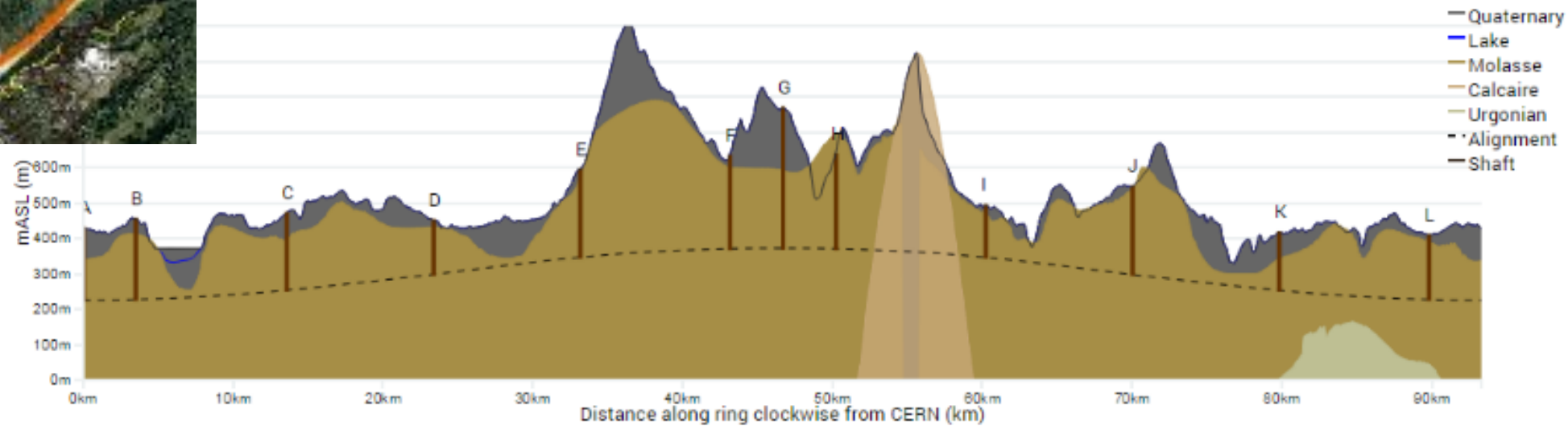
An international Study for a Future Circular Collider



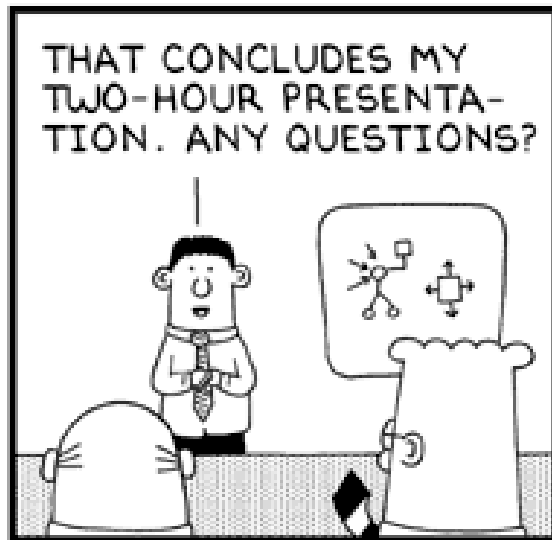
- pp -collider (*FCC-hh*)
- e^+e^- -collider (*FCC-ee*)
- $p-e$ (*FCC-he*) Option
- 80-100 km tunnels

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

a simulation of a possible layout



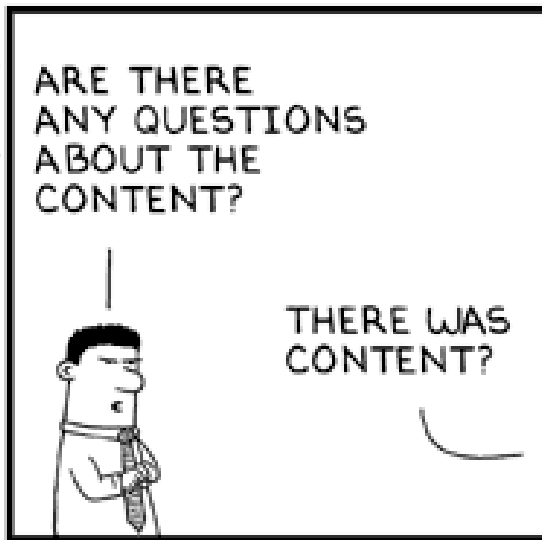
Your Questions!



www.dilbert.com scottadams@aol.com



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