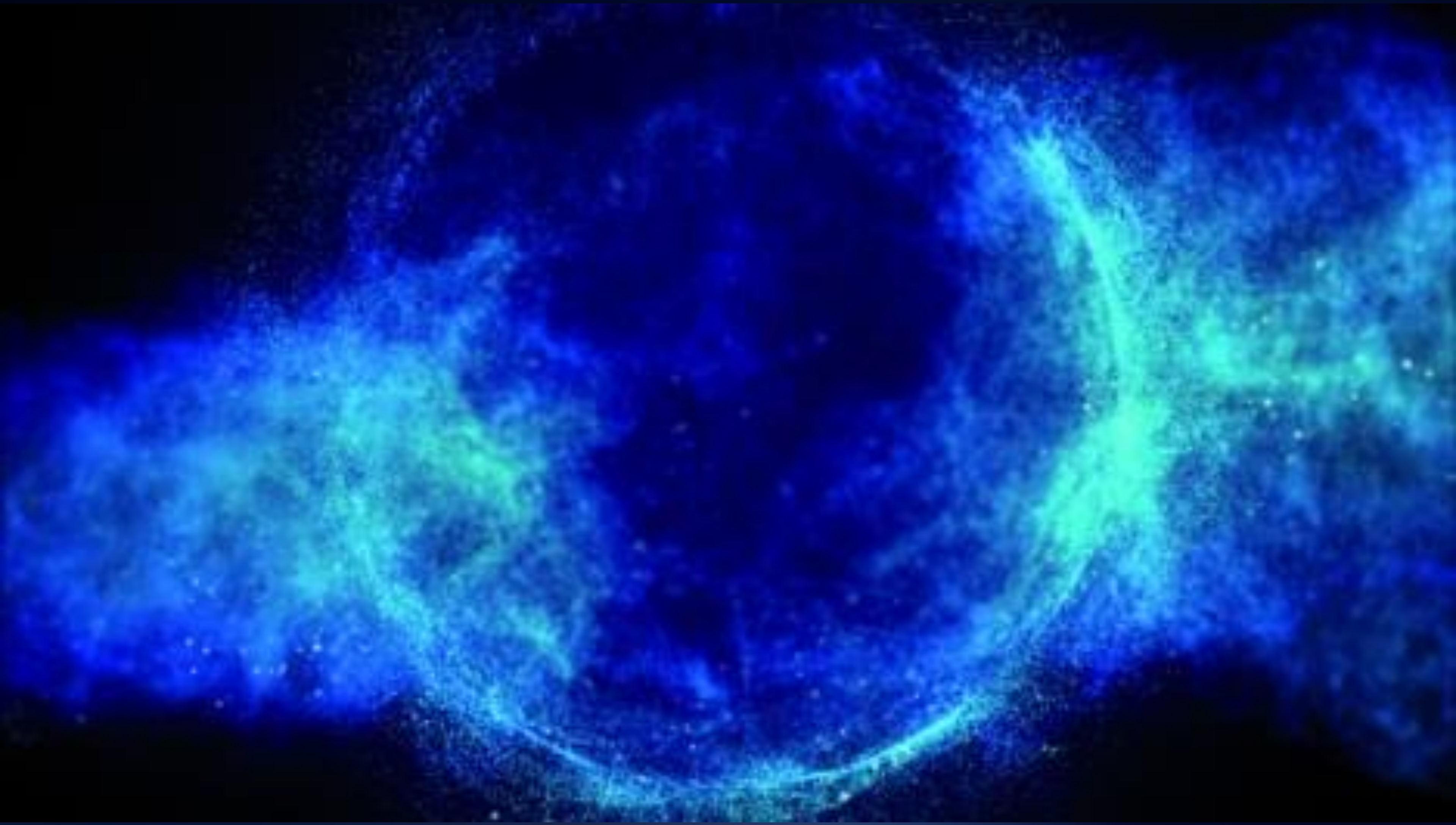
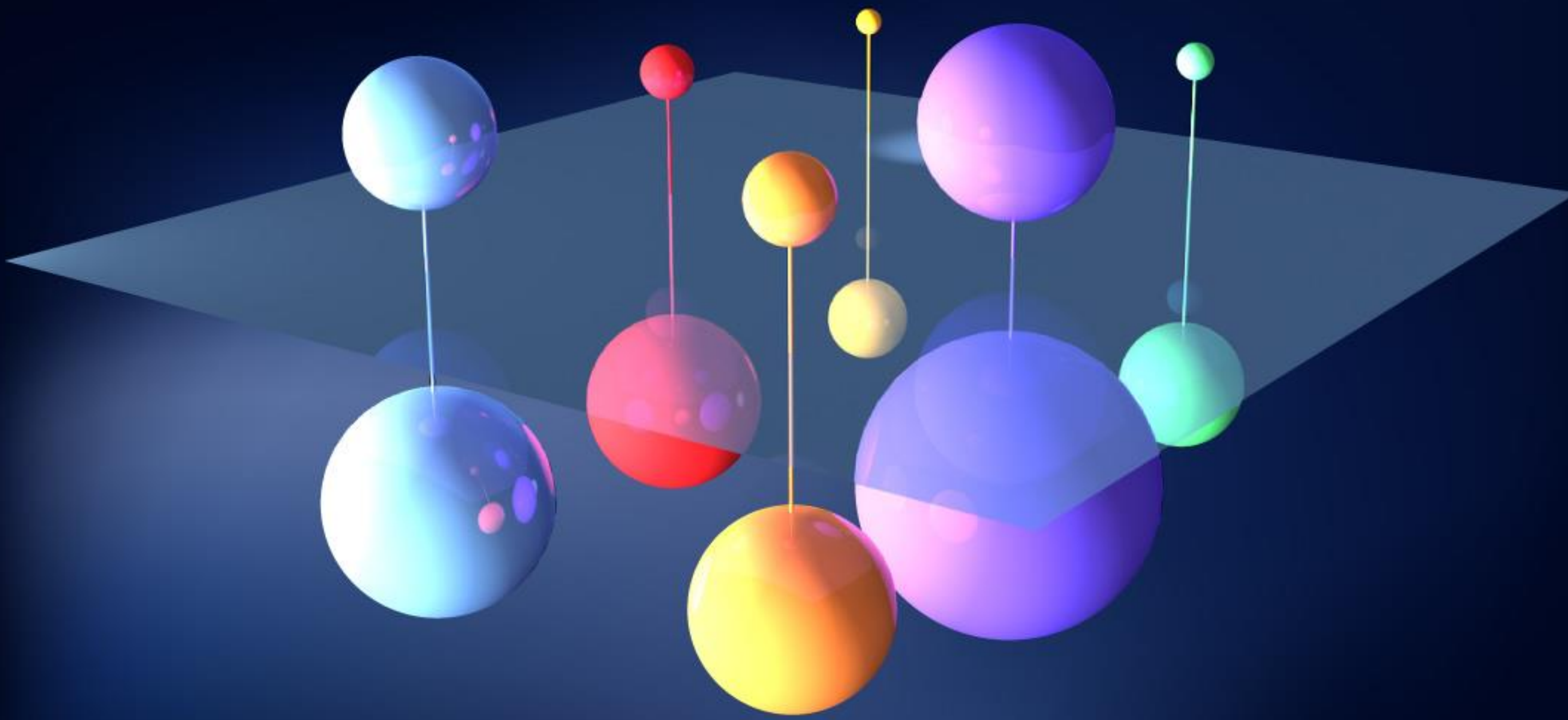
Why Are We Here?: Connecting the Micro and Macro

About CERN, Physics, and Innovation

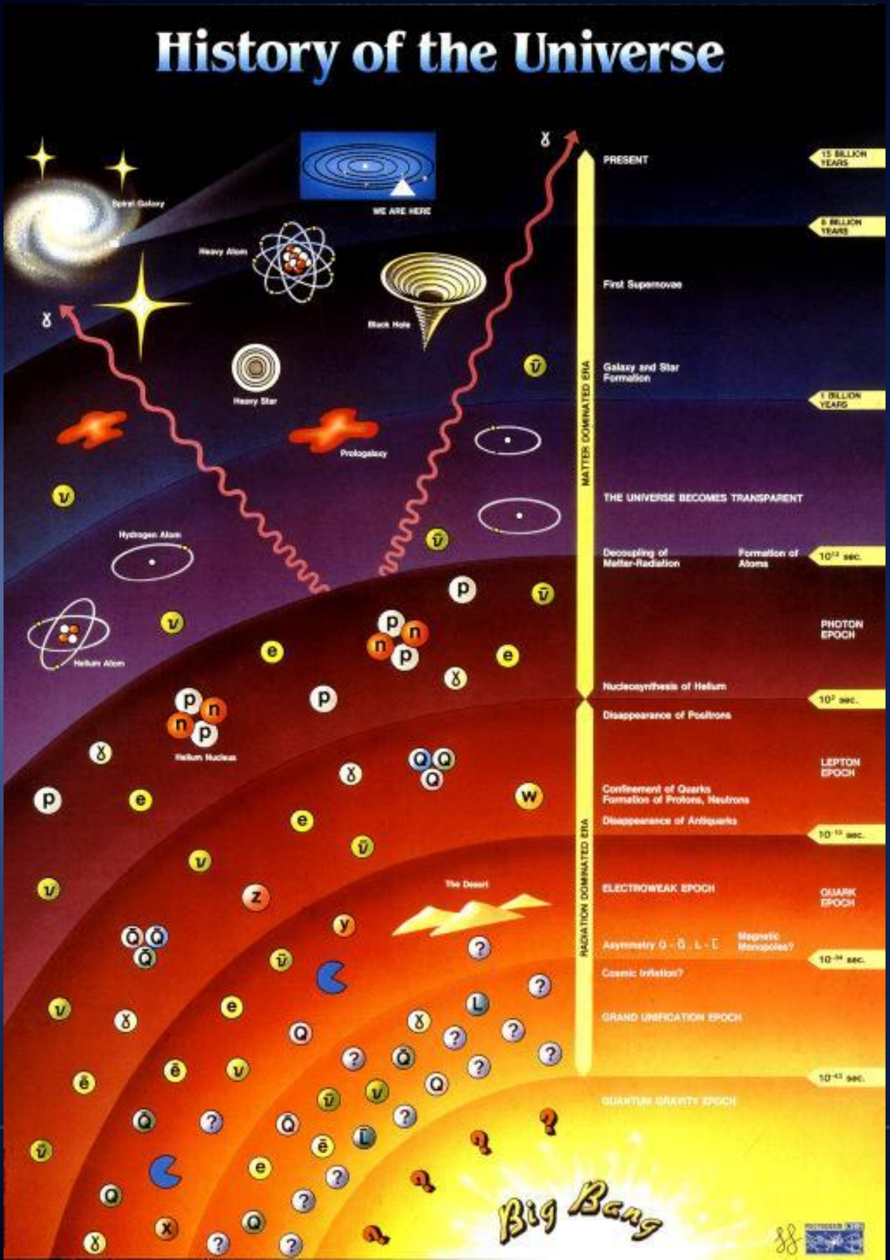
OPER-CBI March 27, 2023
Markus Nordberg (CERN)

What is Wrong with this Picture?



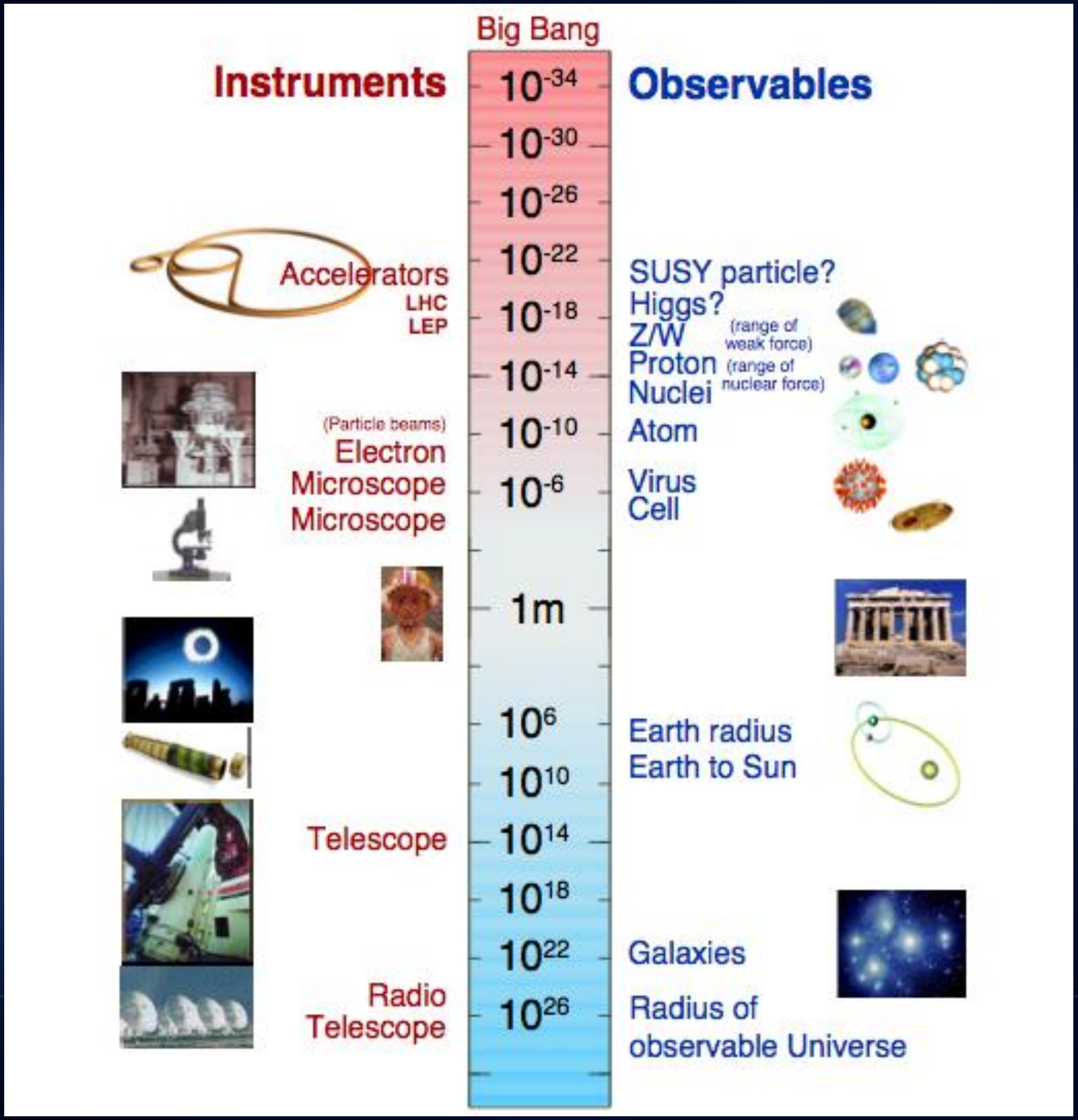



How does CERN Connect?

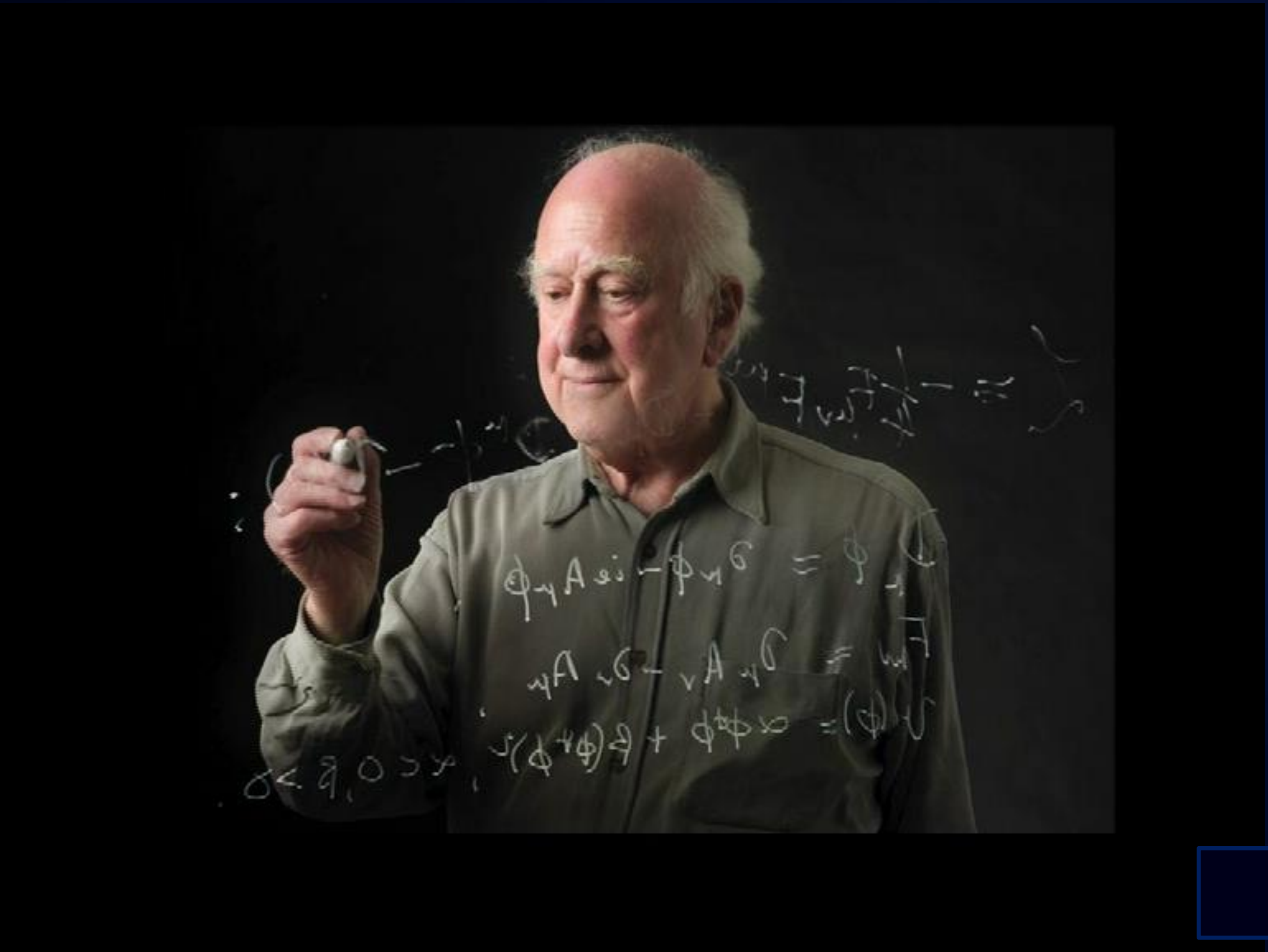


Size of things

How does CERN Measure?



Where do we start?




StorageTek
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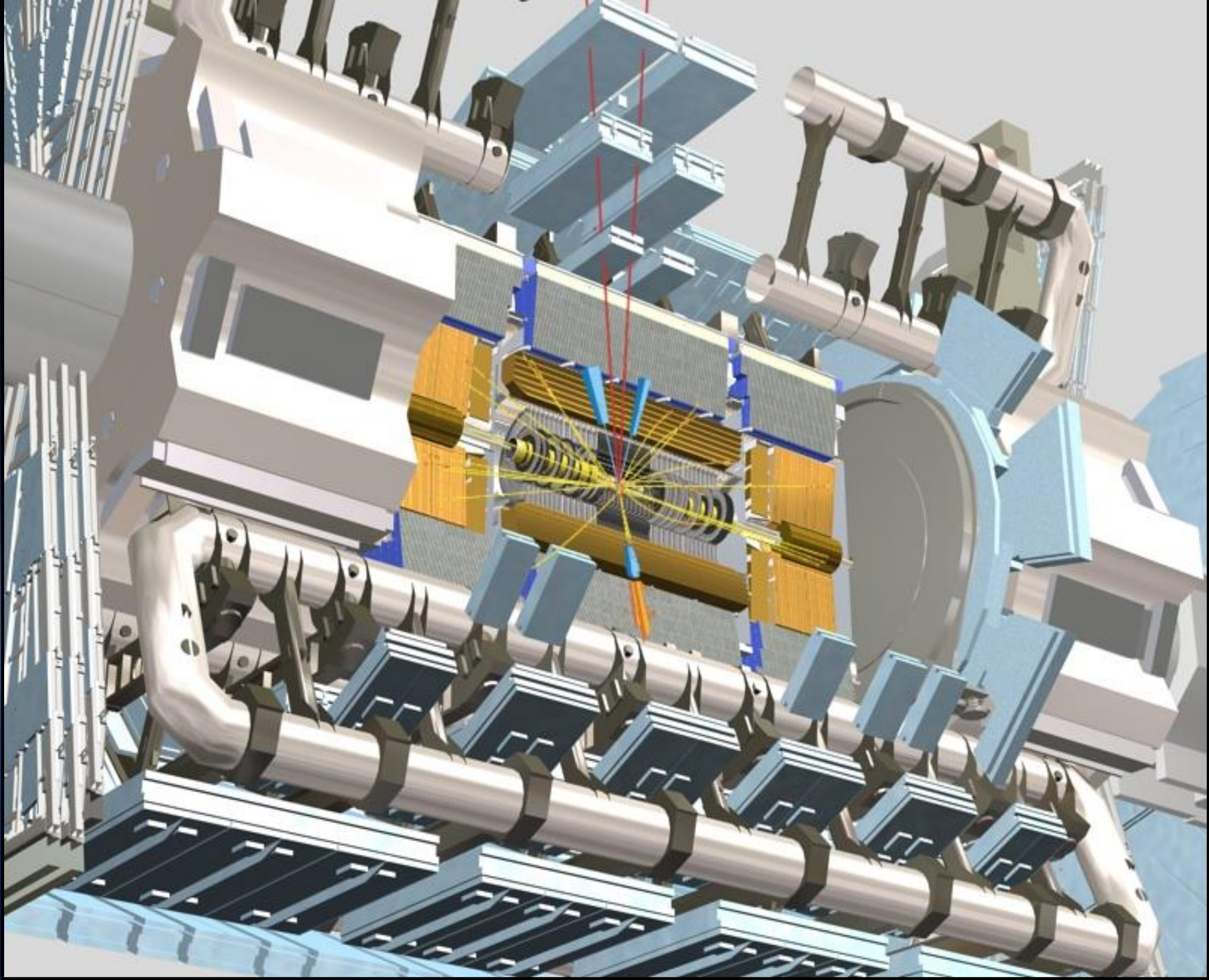
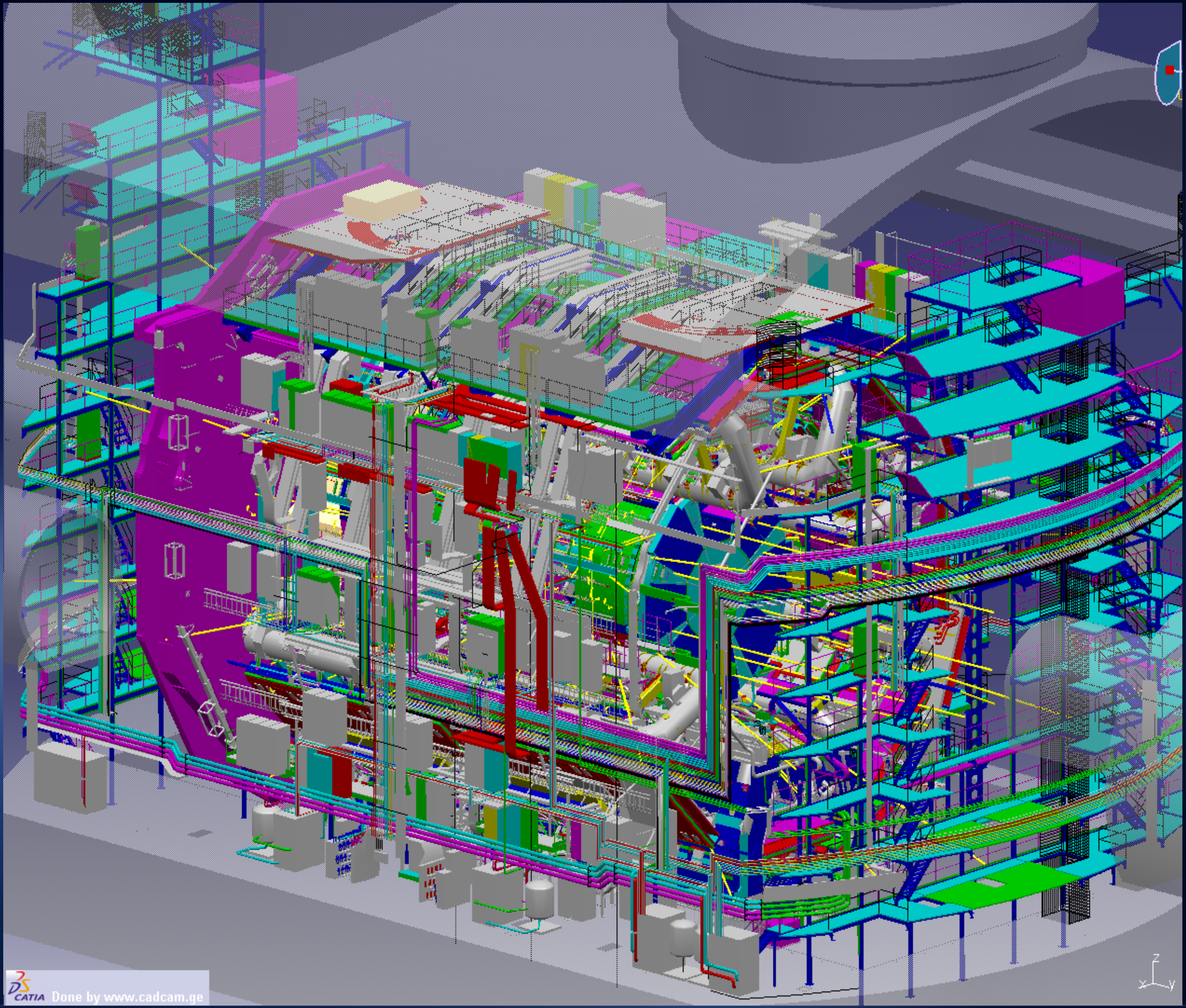
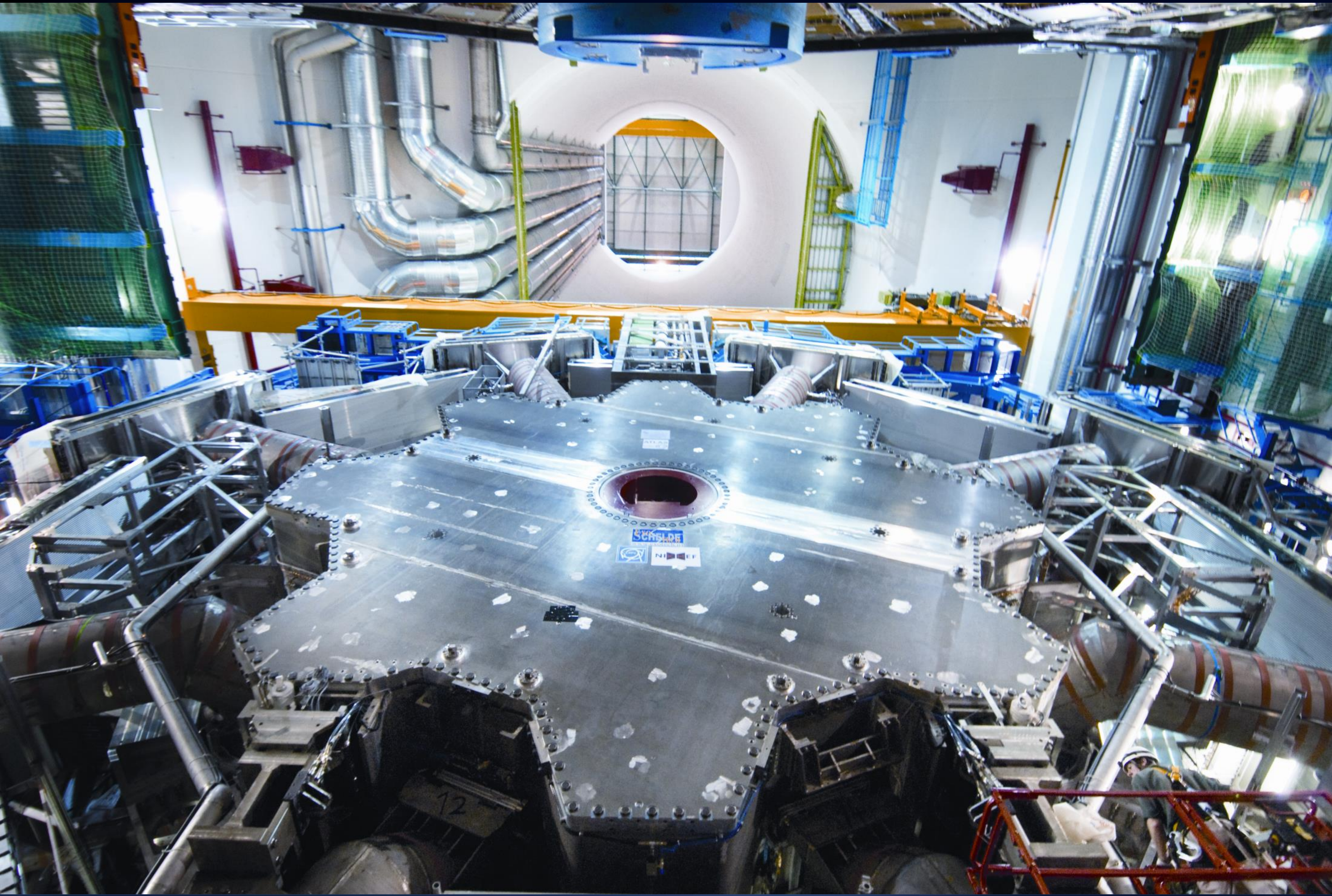


ATLAS EXPERIMENT

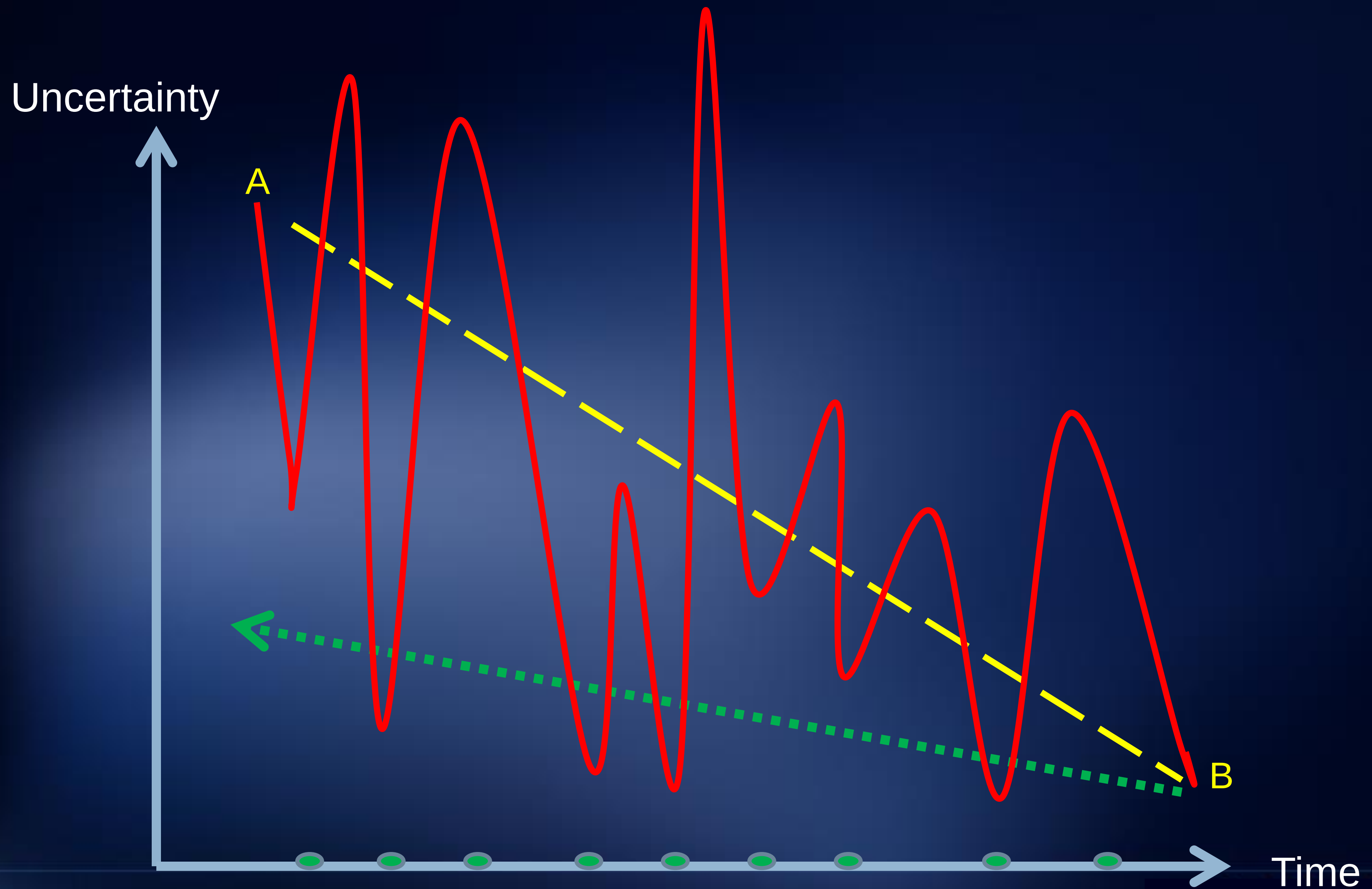


ATLAS EXPERIMENT

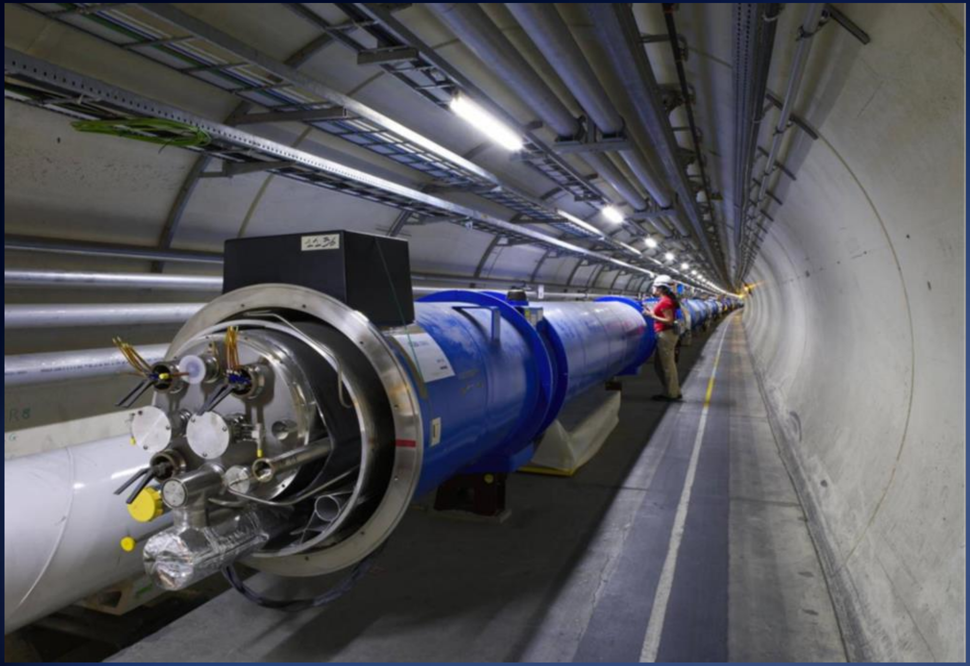


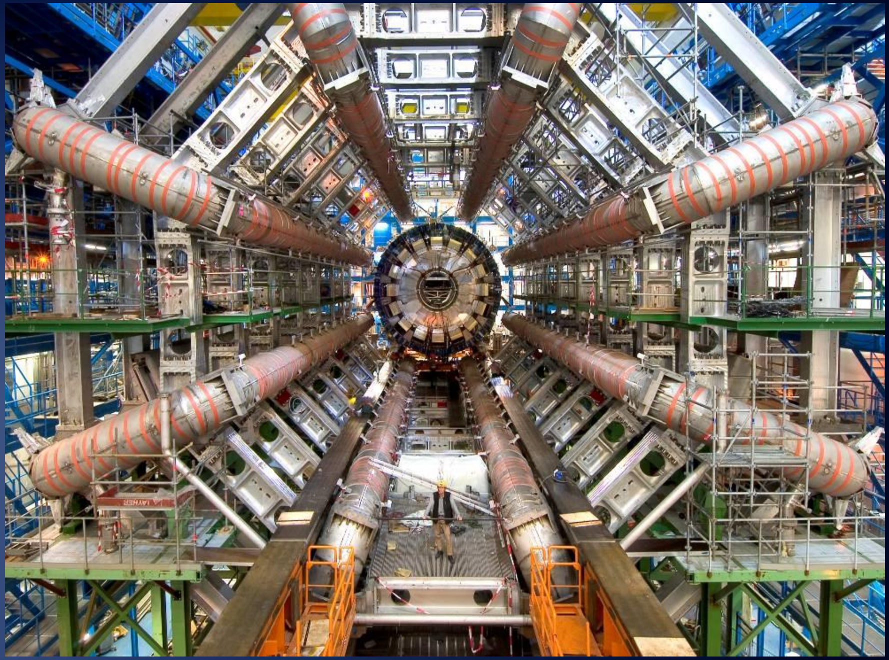
Implementing Strategy is Not Linear

Absorbing vs. Reducing Uncertainty



Seeing the Micro needs the Macro (scopes)





CERN was founded 1954: 12 European States
Today: 23 Member States

- ~ 2676 staff, 783 Fellows
- ~ 1700 other paid personnel
- ~ 11 200 users
- Budget (2022) ~1200 MCHF

- 23 Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.
- 9 Associate Members: Croatia, Cyprus, Estonia, India, Lithuania, Pakistan, Slovenia, Turkiye, Ukraine.
- 6 Observers to Council: Japan, the Russian Federation, the United States of America, Turkey, the European Commission and Unesco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Charged-particle multiplicities in pp interactions at $\sqrt{s} = 900$ GeV measured with the ATLAS detector at the LHC [☆,☆☆]

ATLAS Collaboration

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ABSTRACT

The first measurements from proton–proton collisions recorded with the ATLAS detector at th are presented. Data were collected in December 2009 using a minimum-bias trigger during col at a centre-of-mass energy of 900 GeV. The charged-particle multiplicity, its dependence on tran momentum and pseudorapidity, and the relationship between mean transverse momentum and ch particle multiplicity are measured for events with at least one charged particle in the kinematic $|\eta| < 2.5$ and $p_T > 500$ MeV. The measurements are compared to Monte Carlo models of proton- collisions and to results from other experiments at the same centre-of-mass energy. The charged-p multiplicity per event and unit of pseudorapidity at $\eta = 0$ is measured to be 1.333 ± 0.003(s 0.040(syst.), which is 5–15% higher than the Monte Carlo models predict.

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1. Introduction

Inclusive charged-particle distributions have been measured in pp and $p\bar{p}$ collisions at a range of different centre-of-mass energi 13]. Many of these measurements have been used to constrain phenomenological models of soft-hadronic interactions and to p properties at higher centre-of-mass energies. Most of the previous charged-particle multiplicity measurements were obtained by sel data with a double-arm coincidence trigger, thus removing large fractions of diffractive events. The data were then further correct remove the remaining single-diffractive component. This selection is referred to as non-single-diffractive (NSD). In some cases, desig as inelastic non-diffractive, the residual double-diffractive component was also subtracted. The selection of NSD or inelastic non-diffr charged-particle spectra involves model-dependent corrections for the diffractive components and for effects of the trigger selecti events with no charged particles within the acceptance of the detector. The measurement presented in this Letter implements a dif strategy, which uses a single-arm trigger overlapping with the acceptance of the tracking volume. Results are presented as incl inelastic distributions, with minimal model-dependence, by requiring one charged particle within the acceptance of the measureme

This Letter reports on a measurement of primary charged particles with a momentum component transverse to the beam dire

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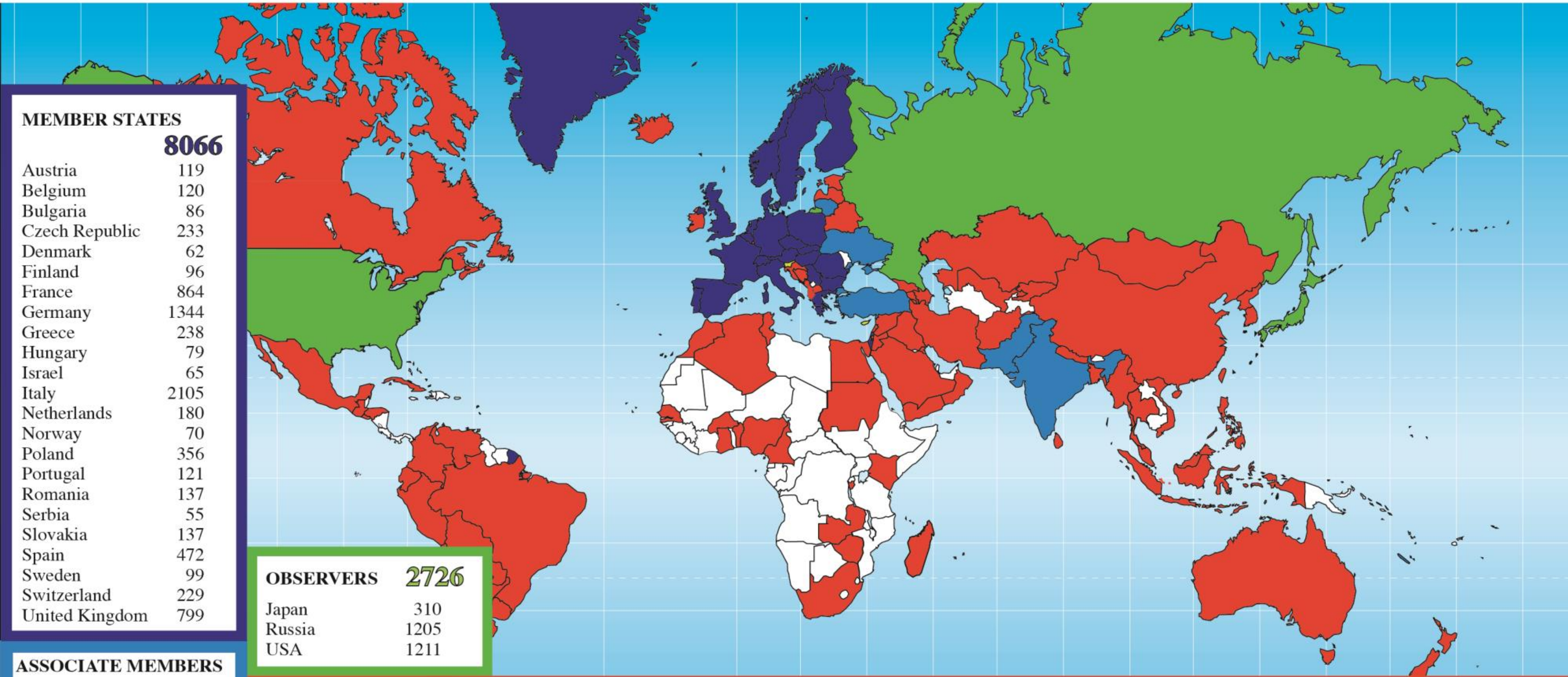
A Global Reach

Distribution of All CERN Users by Nationality as of mid-April 2019



MEMBER STATES	8066
Austria	119
Belgium	120
Bulgaria	86
Czech Republic	233
Denmark	62
Finland	96
France	864
Germany	1344
Greece	238
Hungary	79
Israel	65
Italy	2105
Netherlands	180
Norway	70
Poland	356
Portugal	121
Romania	137
Serbia	55
Slovakia	137
Spain	472
Sweden	99
Switzerland	229
United Kingdom	799

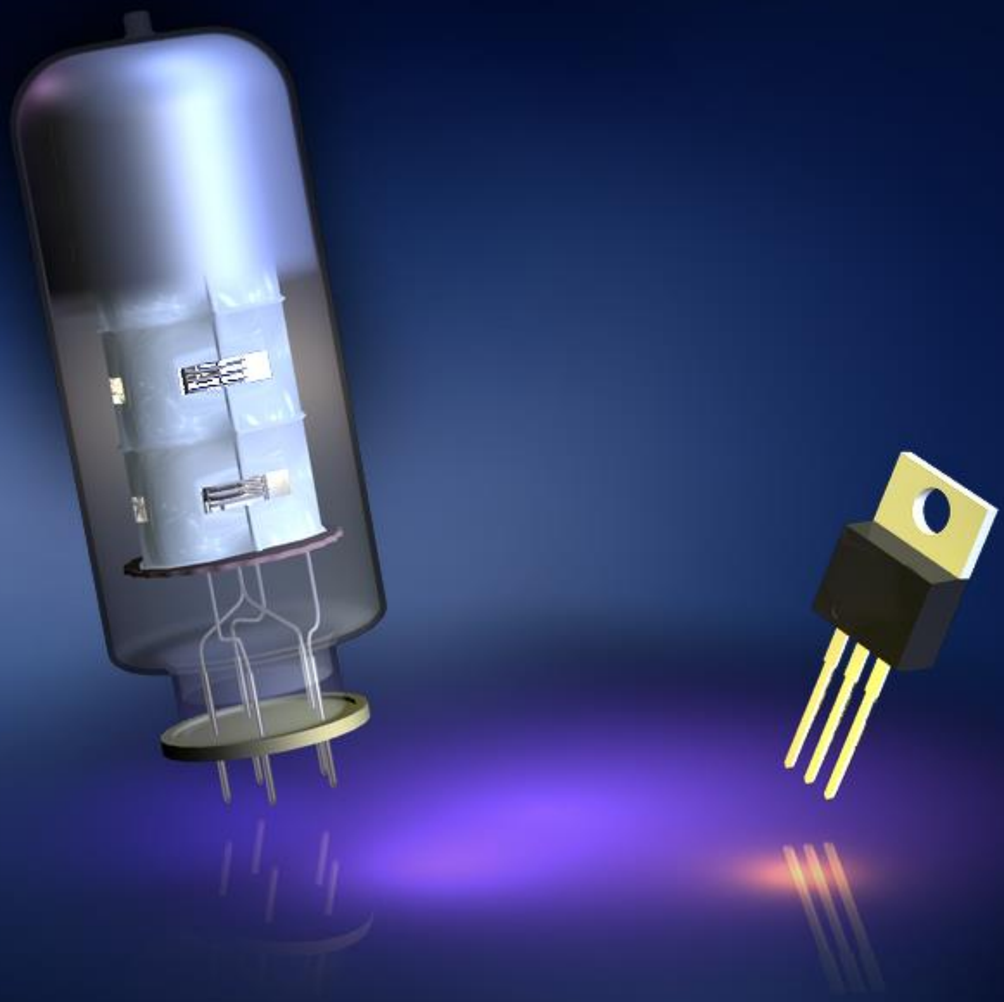
OBSERVERS	2726
Japan	310
Russia	1205
USA	1211

ASSOCIATE MEMBERS	778
India	387
Lithuania	39
Pakistan	71
Turkey	165
Ukraine	116

ASSOCIATE MEMBERS IN THE PRE-STAGE TO MEMBERSHIP	59
Cyprus	26
Slovenia	33

OTHERS	1999
Albania	4
Algeria	14
Argentina	26
Armenia	22
Australia	36
Azerbaijan	10
Bahrain	1
Bangladesh	8
Belarus	45
Benin	1
Bolivia	3
Bosnia & Herzegovina	3
Brazil	127
Burkina Faso	1
Burundi	1
Cameroon	1
Canada	170
Chile	21
China	576
Colombia	44
Croatia	50
Cuba	16
Ecuador	10
Egypt	27
El Salvador	1
Estonia	15
Georgia	51
Ghana	1
Guatemala	1
Hong Kong	1
Honduras	1
Iceland	4
Indonesia	11
Iran	58
Iraq	1
Ireland	13
Jordan	2
Kazakhstan	10
Kenya	1
Korea	183
Kyrgyzstan	1
Latvia	4
Lebanon	27
Luxembourg	4
Madagascar	1
Malaysia	22
Malta	9
Mexico	85
Mongolia	2
Montenegro	11
Morocco	24
Myanmar	2
Nepal	7
New Zealand	5
Nigeria	4
North Korea	4
North Macedonia	3
Oman	3
Palestine	7
Paraguay	1
Peru	6
Philippines	3
Saint Kitts and Nevis	1
San Marino	1
Saudi Arabia	4
Senegal	1
Singapore	5
South Africa	56
Sri Lanka	10
Sudan	1
Syria	1
Taiwan	56
Thailand	26
Tunisia	4
Uruguay	1
Uzbekistan	3
Venezuela	9
Viet Nam	11
Zambia	1
Zimbabwe	2

(How) Do We Manage This?



What do you see differently?