When infinitely large meets infinitely small

François Briard
Visitors and Local Engagement
Computer Engineer

What does a computer engineer *(allergic to physics)* do at CERN ?

CERN
What is it?

What does *CERN* stand for ?

Conseil
Européen pour la
Recherche
Nucléaire

European
Council for
Nuclear
Research

1953

What does *CERN* stand for ?

Organisation
Européenne pour la
Recherche
Nucléaire

European
Organization for
Nuclear
Research

1954

Nuclear?

European laboratory for particle physics

CERN
Who is it?

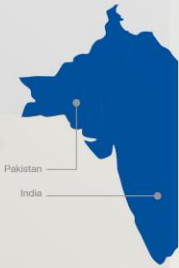
Member States

Budget (2020)
1,168 billion CHF
0,970 billion GBP
1,210 billion USD

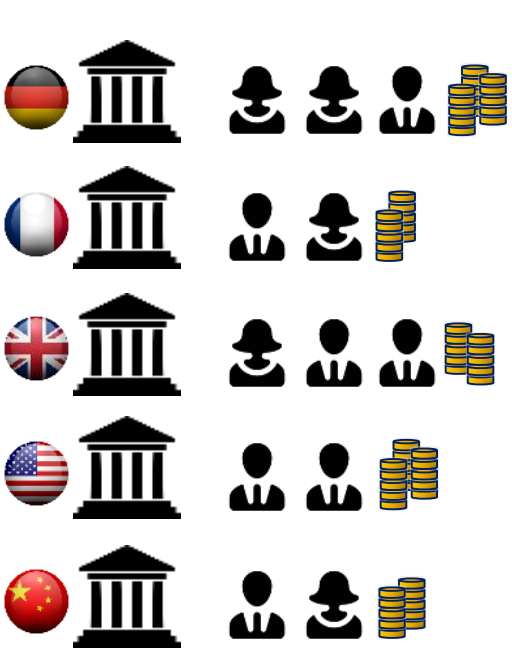
- Austria (1959)
- Belgium (1953)
- Bulgaria (1999)
- Czech Republic (1993)
- Denmark (1953)
- Finland (1991)
- France (1953)
- Germany (1953)
- Greece (1953)
- Hungary (1992)
- Israel (2014)
- Italy (1953)
- Netherlands (1953)
- Norway (1953)
- Poland (1991)
- Portugal (1986)
- Romania (2016)
- Serbia (2019)
- Slovakia (1993)
- Spain (1961-1968, 1983-)
- Sweden (1953)
- Switzerland (1953)
- United Kingdom (1953)

Associated

- Croatia (2019)
- Cyprus (2016)
- India (2017)
- Lithuania (2018)
- Pakistan (2015)
- Slovenia (2017)
- Turkey (2015)
- Ukraine (2016)



Collaborations



ATLAS

In reality, ATLAS gathers

- 44 countries
- 261 institutes
- 8442 participants

and there are 261 active collaborations in 2020

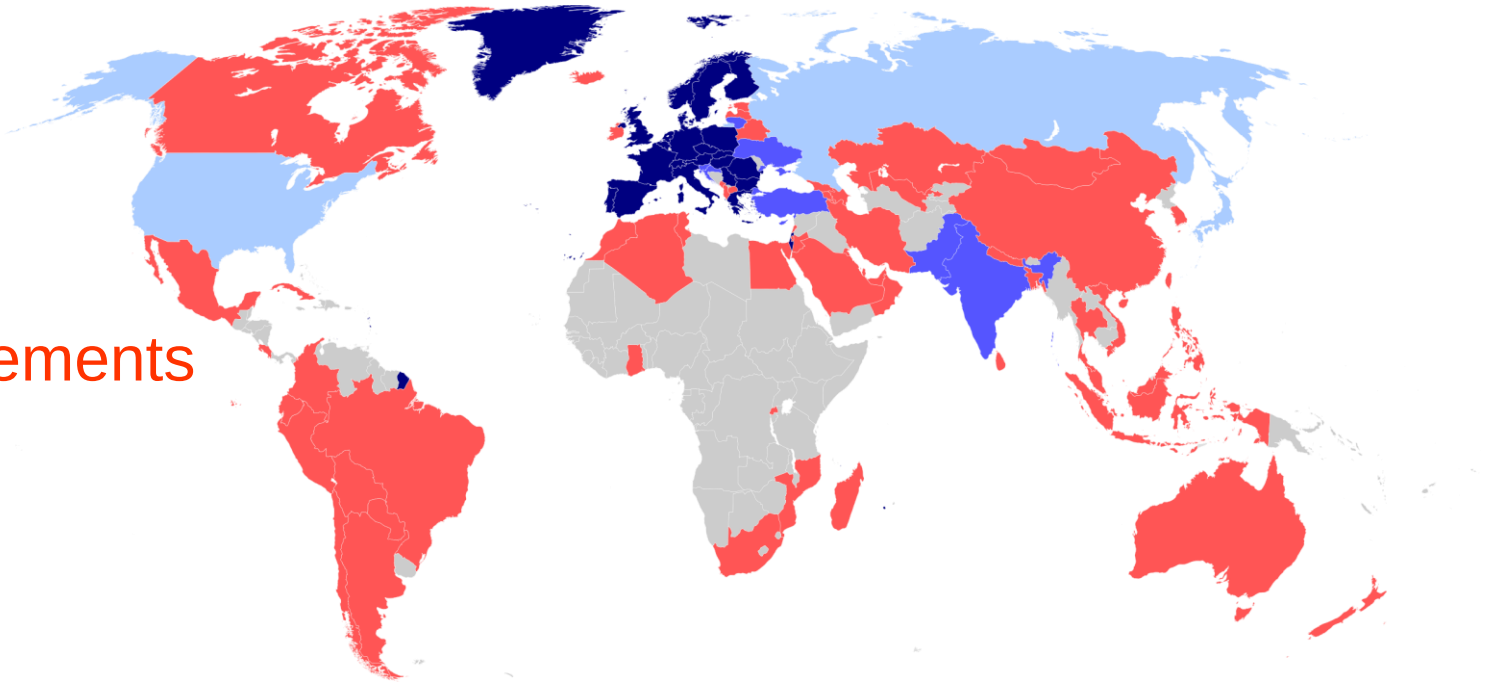
A world collaboration

23 members

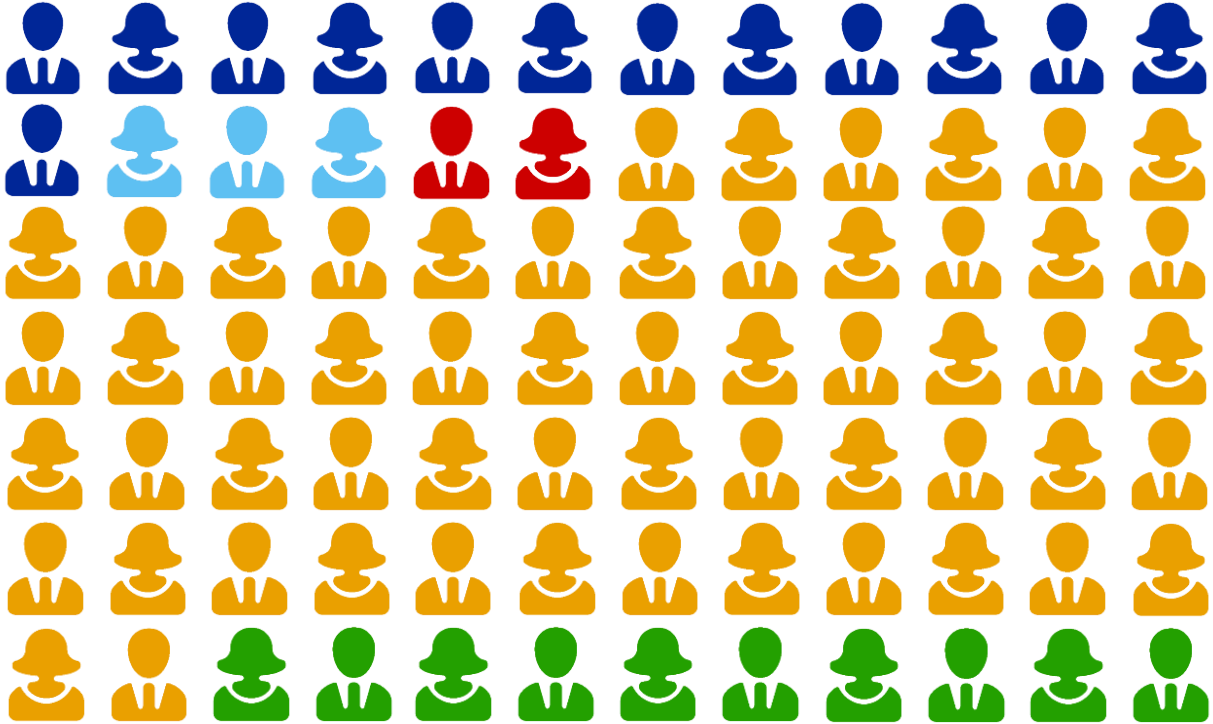
8 associated

3 observers

61 with agreements



How many persons?



20 000!

2 600 staff

800 fellows
apprentices

550 students

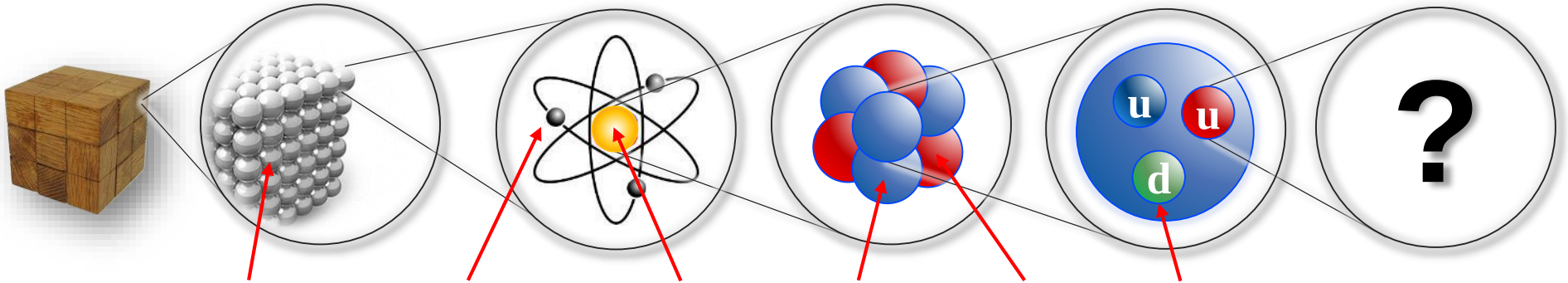
15 000 users

2 000 external
companies

CERN
What for?

Fundamental research

What is the matter made of



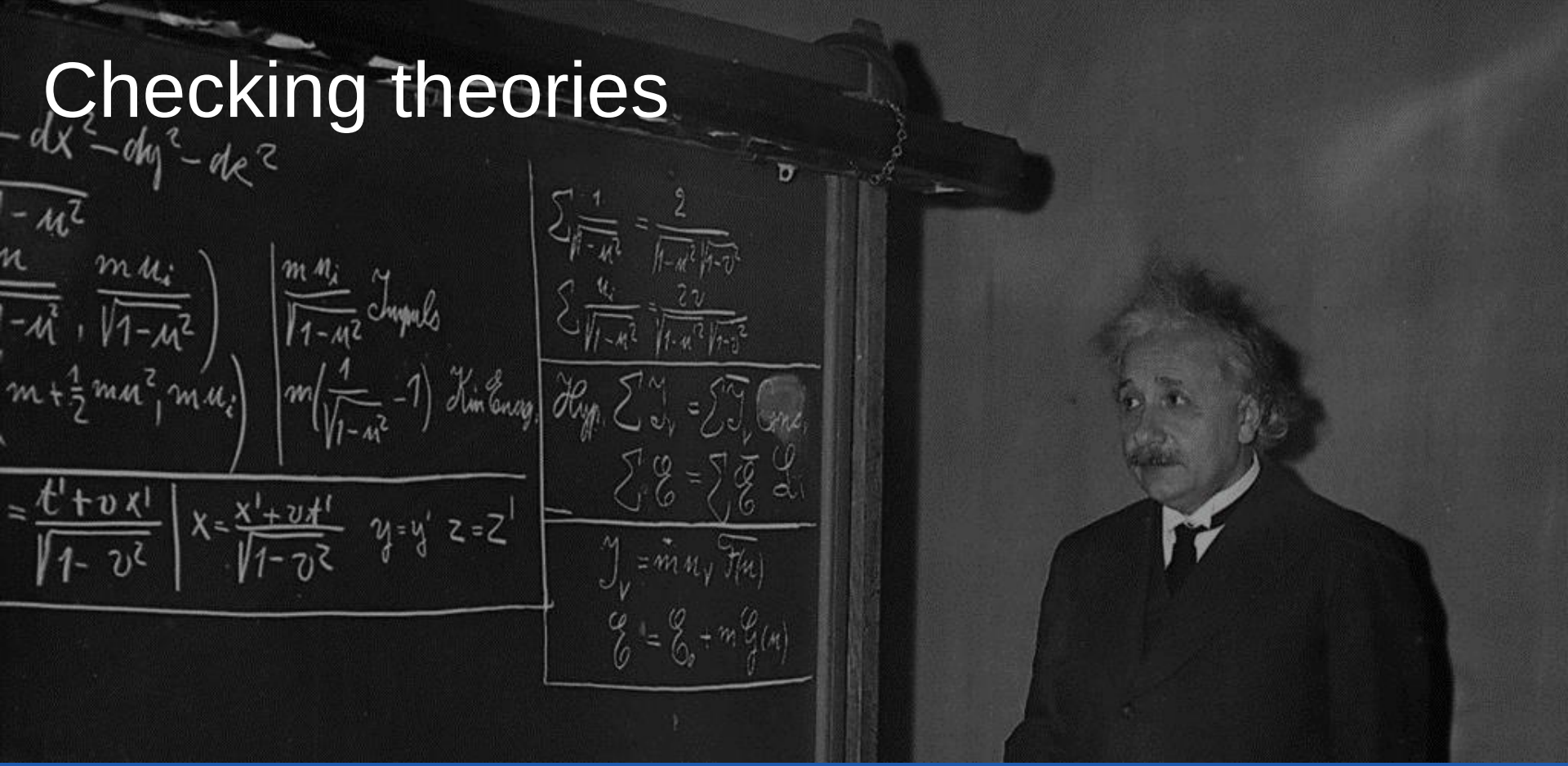
atom — 4th - 5th BCE

electron — nucleus — End of 19th century

proton — neutron — Begining of 20th century

quark — 1960s

Checking theories



Standard model

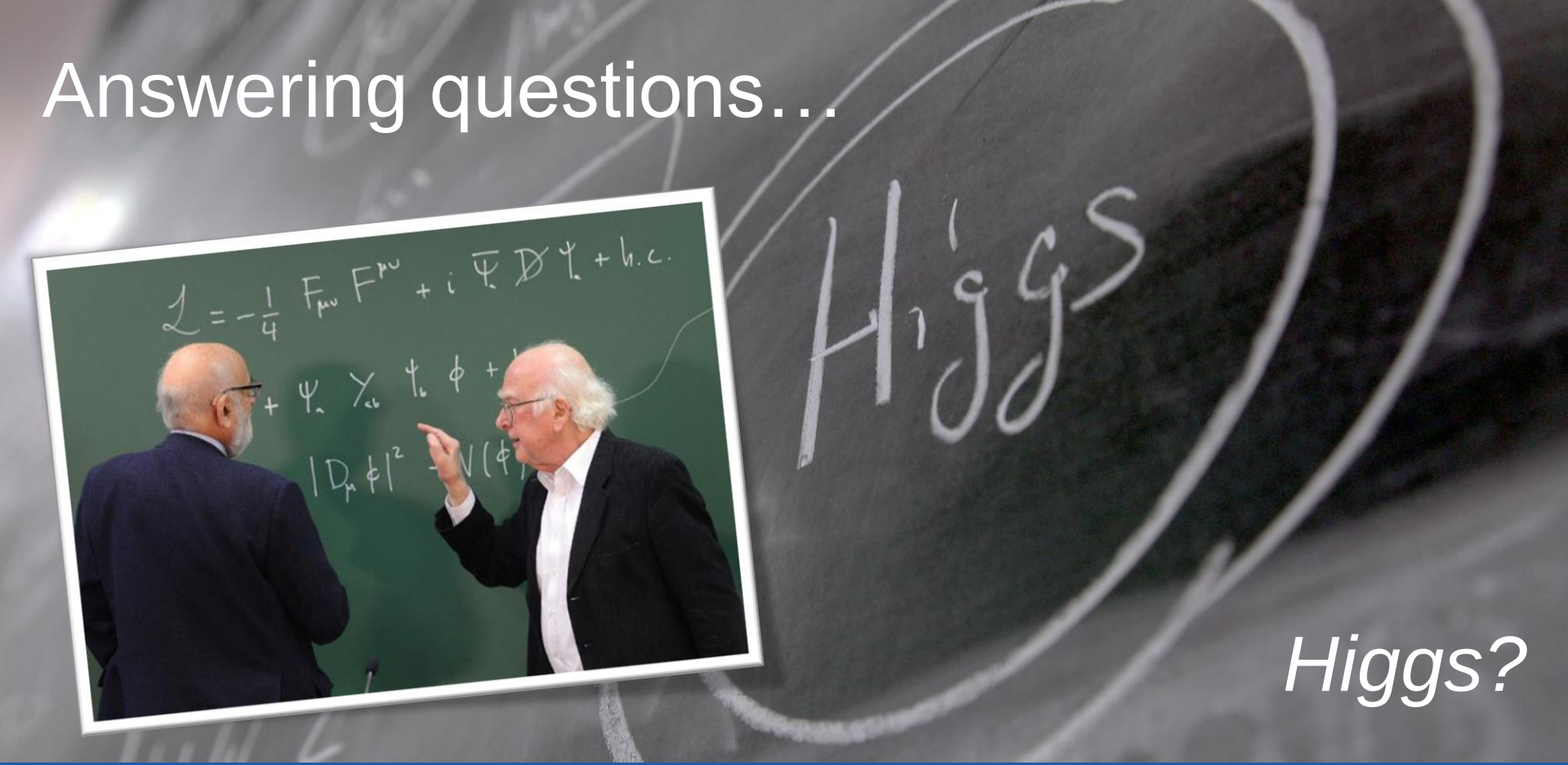
Images:
www.particlezoo.net

	LEPTONS				QUARKS			
ORDINARY MATTER	ELECTRON		ELECTRON NEUTRINO		UP		DOWN	
	MUON		MUON NEUTRINO		CHARM		STRANGE	
	TAU		TAU NEUTRINO		TOP		BOTTOM	

GLUONS	PHOTONS	BOSONS	GRAVITONS
Strong force	*Electromagnetic force*	*Weak force*	*Gravity*

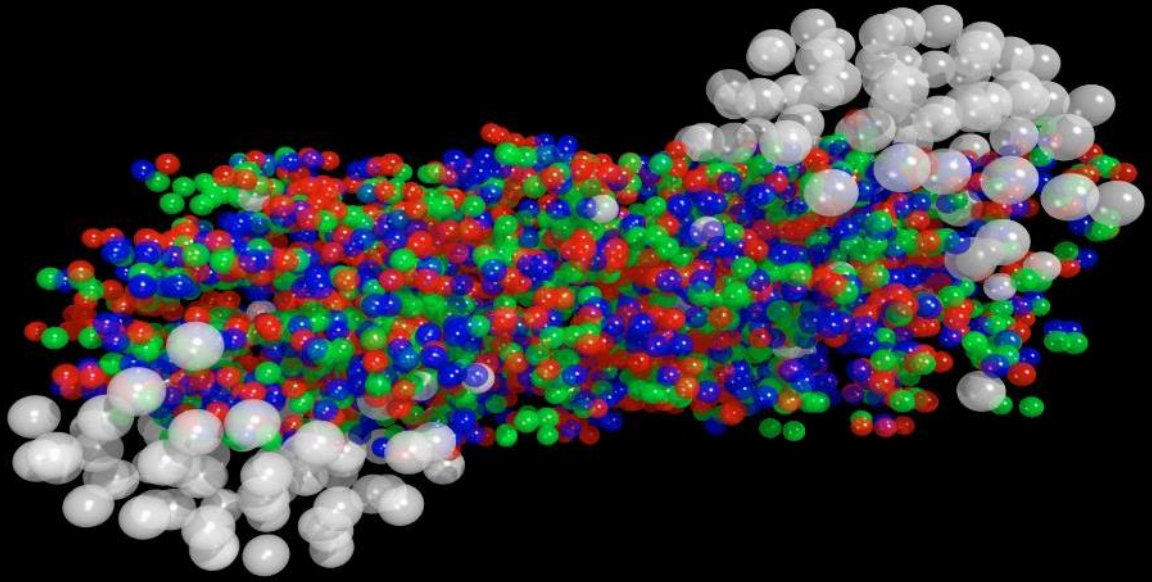
CERN

Answering questions…



Higgs?

Answering questions …



Quark gluon plasma?

Answering questions…

Antimatter ?

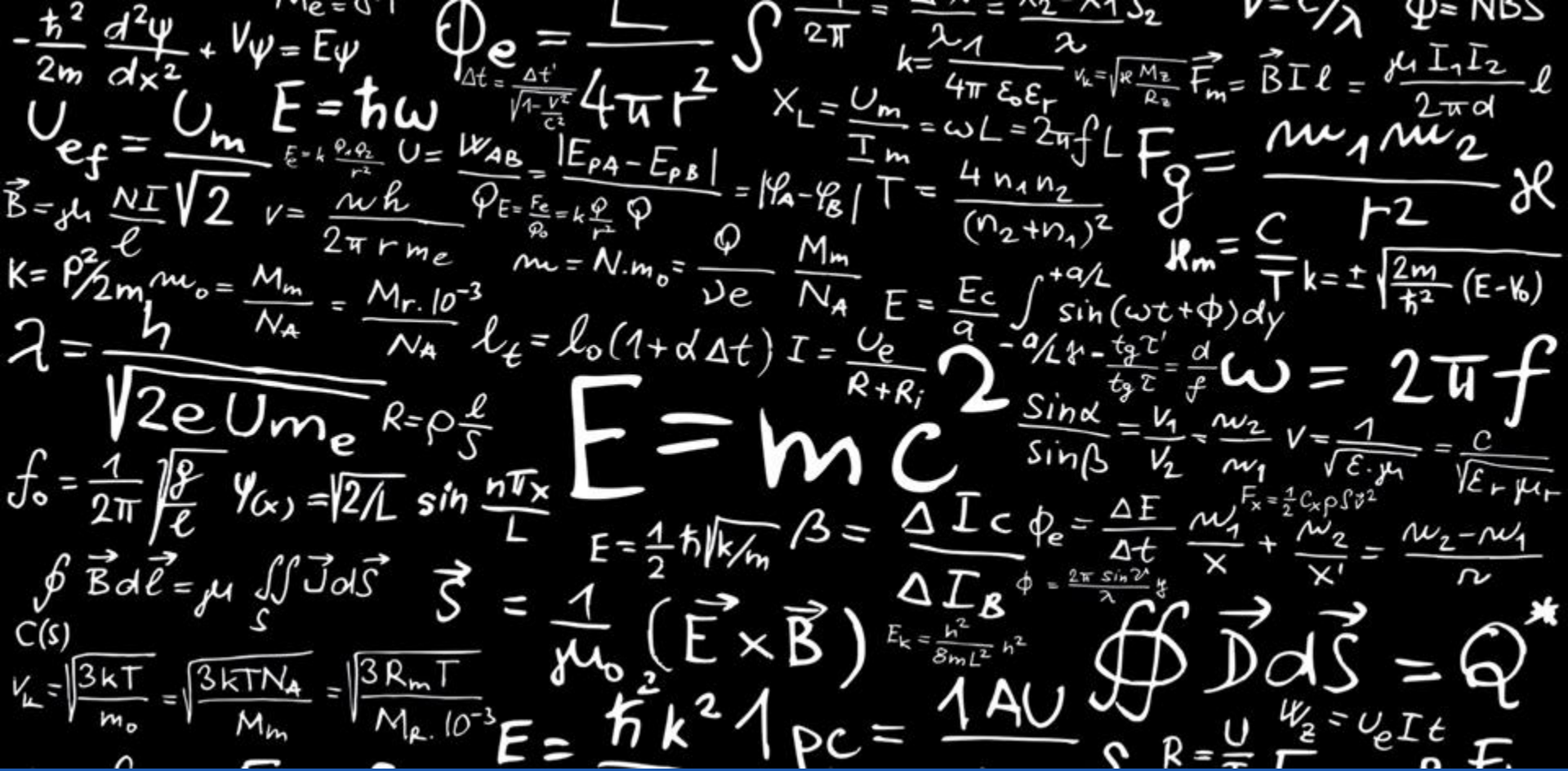
Answering questions…

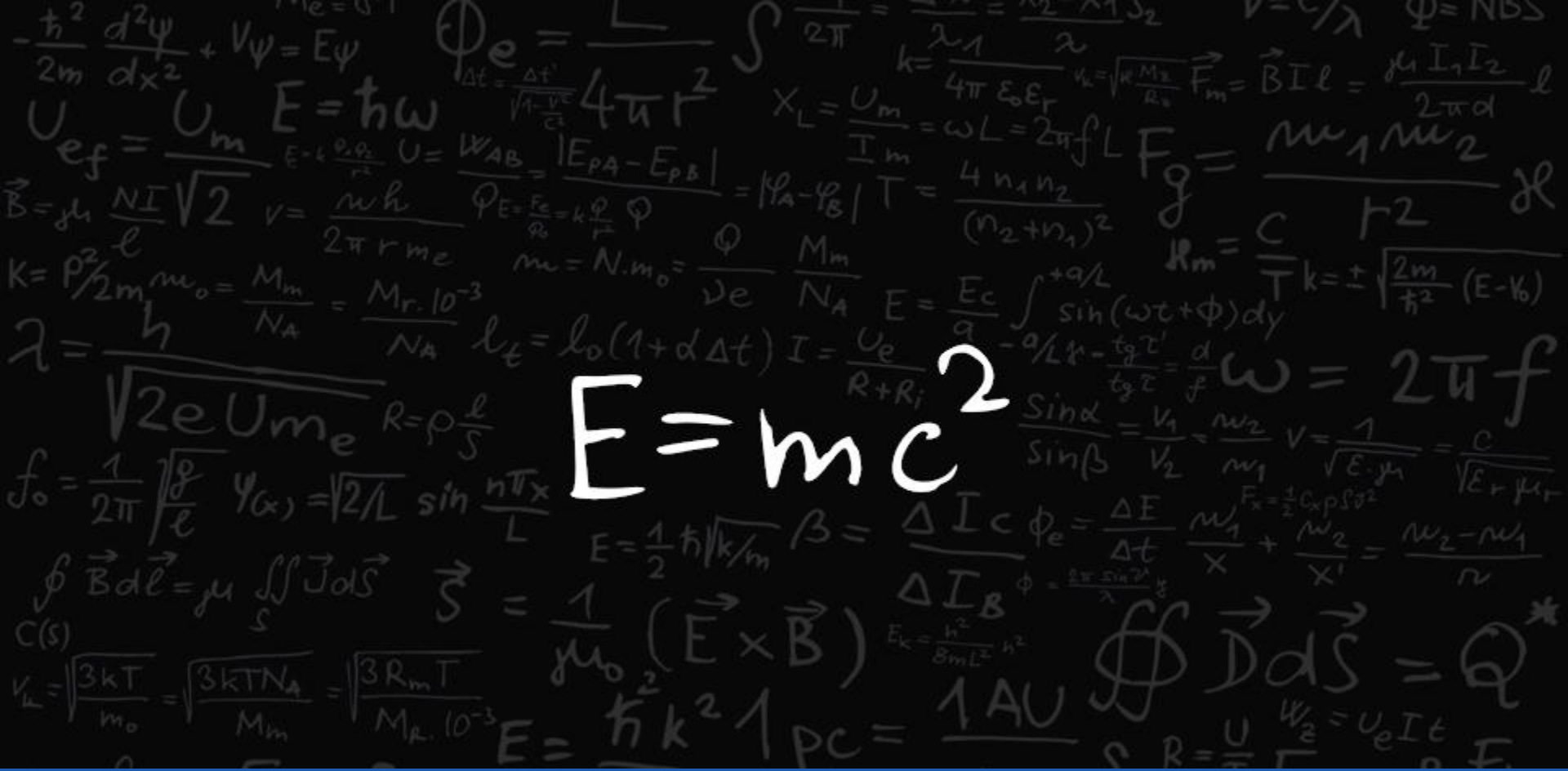
Dark matter?

CERN

How does it work?

Accelerating and colliding


E = mc²
E = ħω
ω = 2πf
Φ = NBS
F_g = m₁m₂/r² ϰ
ϕ_e = ΔE/Δt
ϕ = 2π sin ϑ/λ y
E_k = h²/8mL² n²
1 pc = 1 AU
W_z = U_e I t

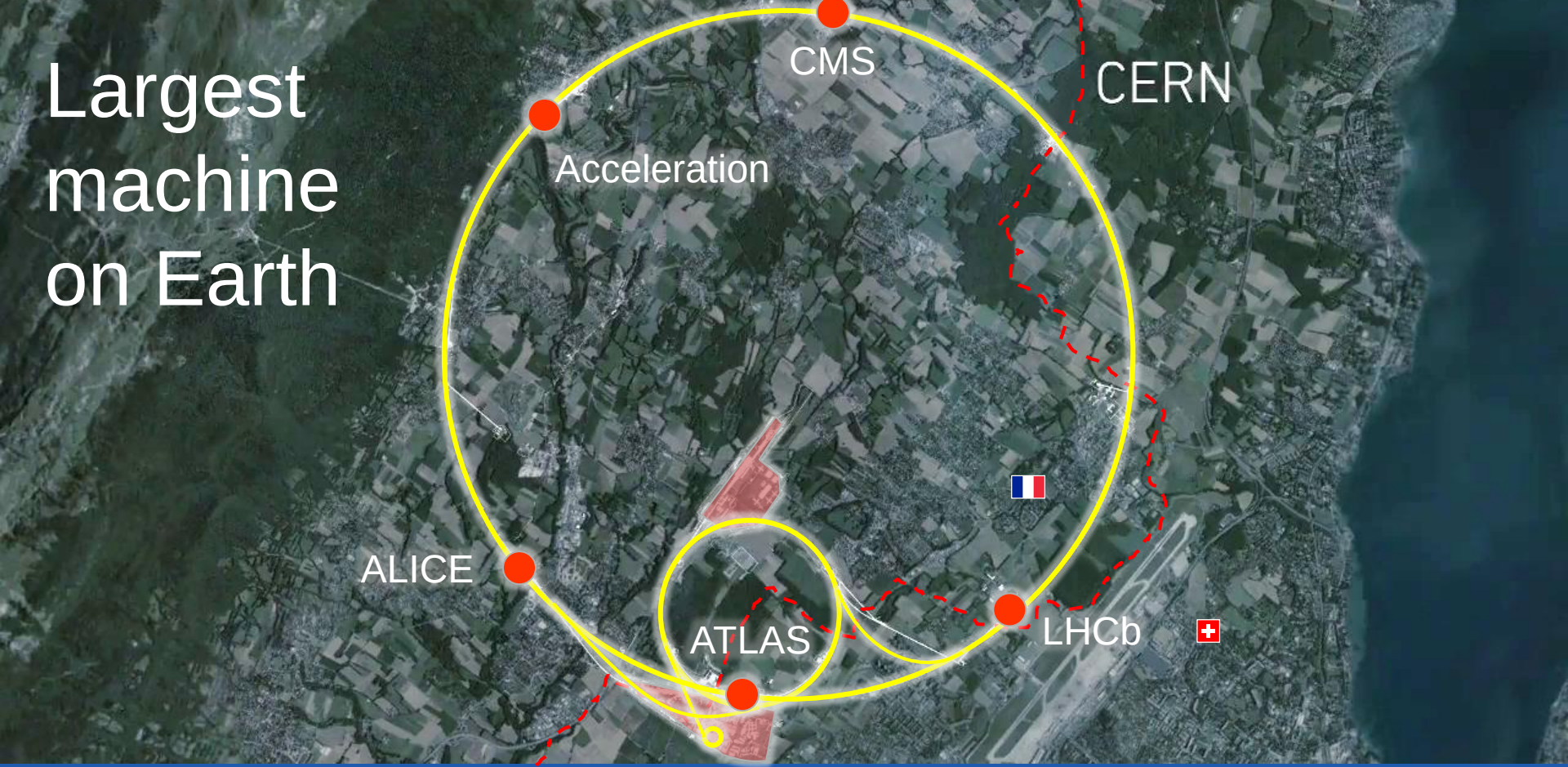

$E = mc^2$

Incredible levels of energy

7 TeV

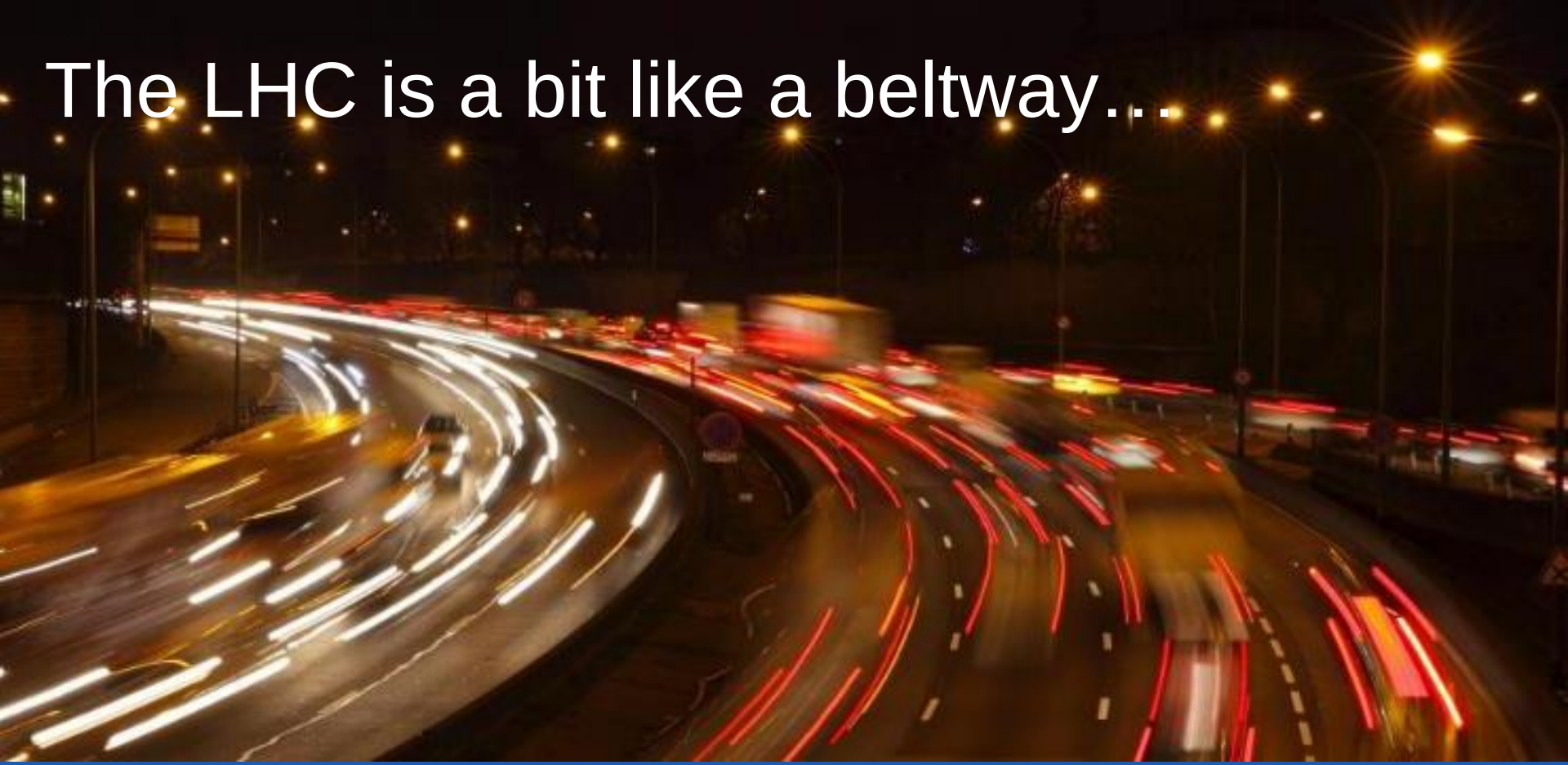
The equivalent energy of
100’000’000’000’000’000’000’000 protons
into one of them

Largest machine on Earth



Doment
Bollebeek
Hamme
Wambeek
Machelen
Aéroport de Bruxelles
Humelgem
Affligem
Asse
Kobbeghem
Wemmel
Asbeek
Walfergem
Releghem
Atomium
Parc de Laeken
Schoonaarde
Kortenberg
Zaventem
Bekkerzeel
Steenvoort
Jette
LAEKEN
Evere
Ganshoren
Ternat
Berchem-Sainte-Agathe
Schaerbeek
Koekelberg
Kraainem
Vrebos
Moorsel
Kooige
Leefdaal
Terlindenbeek
Klapscheutbeek
Zierbeek
Kattem
Bruxelles
Wezembeek-Oppem
Woluwe-Saint-Lambert
Dilbeek
Porte de Hal
Muséum des sciences naturelles
Hunselbeek
Anderlecht
Eizeringen
Sint-Anna-Pede
Ixelles
Etterbeek
Rodebeek
Vossem
Saint-Gilles
Woluwe-Saint-Pierre
Pede-Sainte-Gertrude
Tervuren
NEERPEDE
LA ROUE
VOGELENZANG
Auderghem
Voer
Duisburg
Forest
Lennik
Vlezenbeek
WATERMAEL
Uccle
Bois de la Cambre
Slagvijverbeek
Zandbeek
STALLE
Eizer
Gooik
BOITSFORT
RUISBROEK
Drogenbos
Watermael-Boitsfort
Halve Steen
Huldenberg
Sint-Laureins-Berchem
Elingen
Oudenaken
Leeuw-Saint-Pierre
LEERBEEK
Putbeek
BRUXELLES
RÉGION FLAMANDE
Overijse

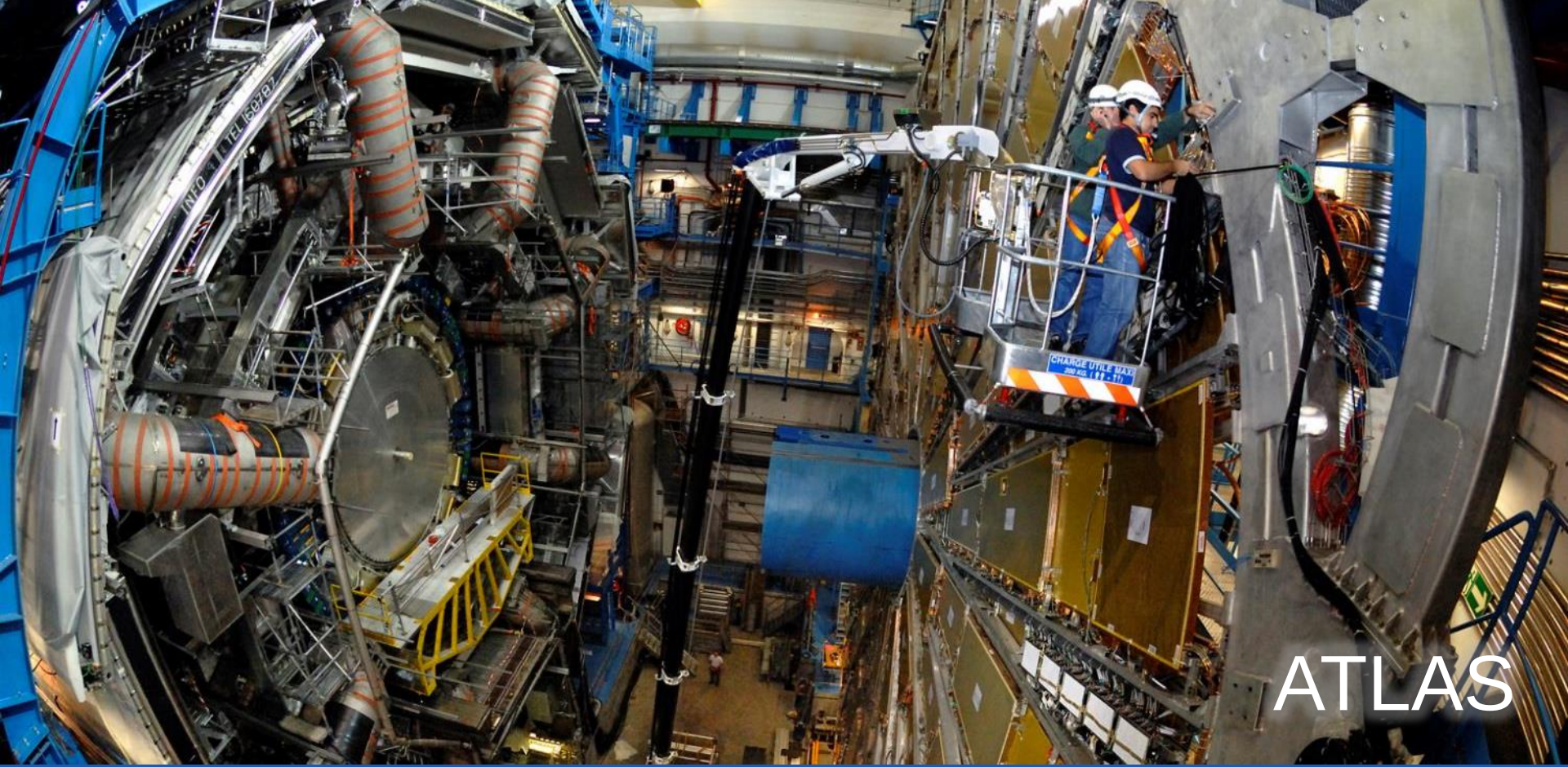
The LHC is a bit like a beltway…



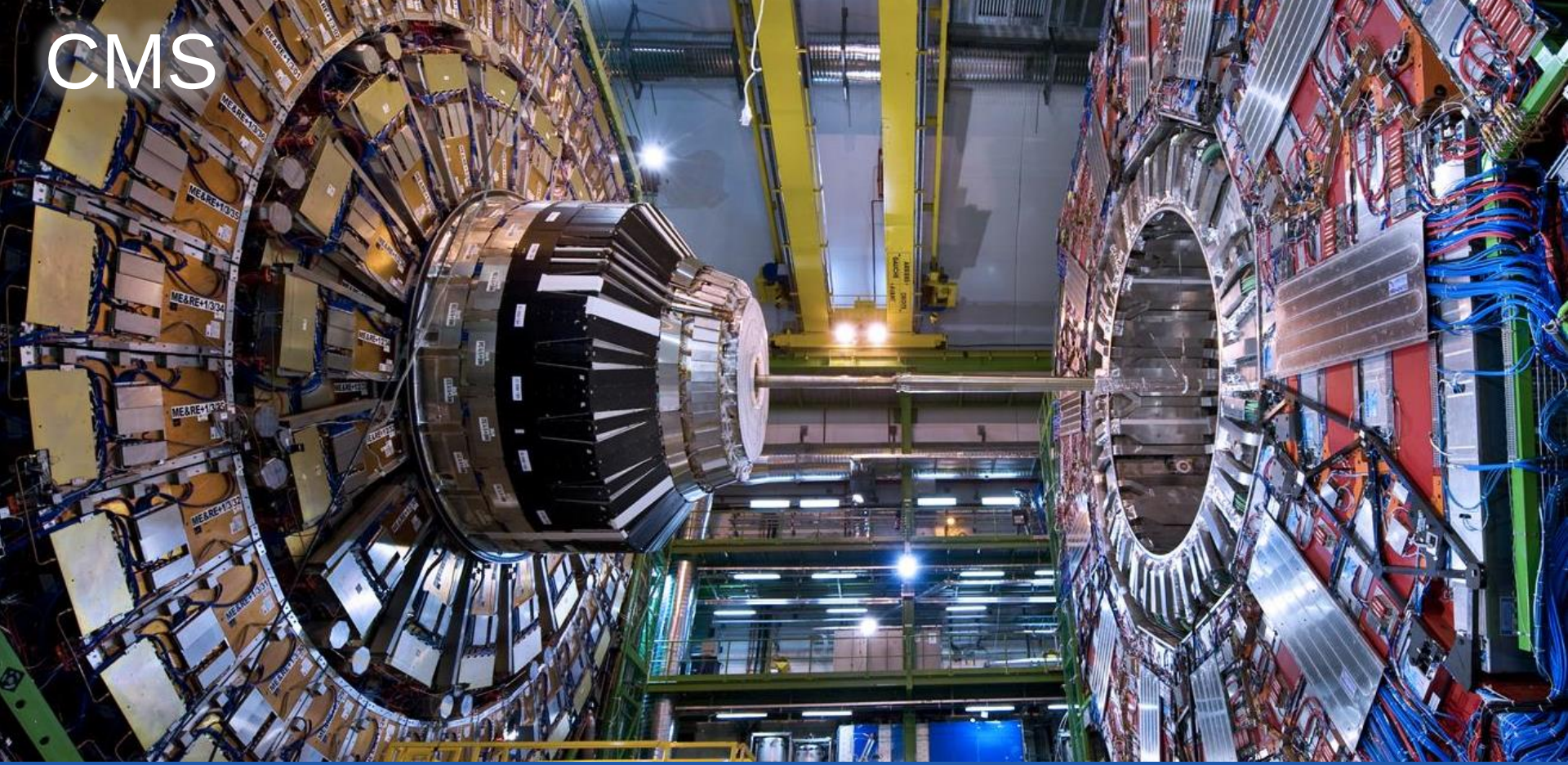
The most powerful magnets

The highest vacuum

The coldest temperatures

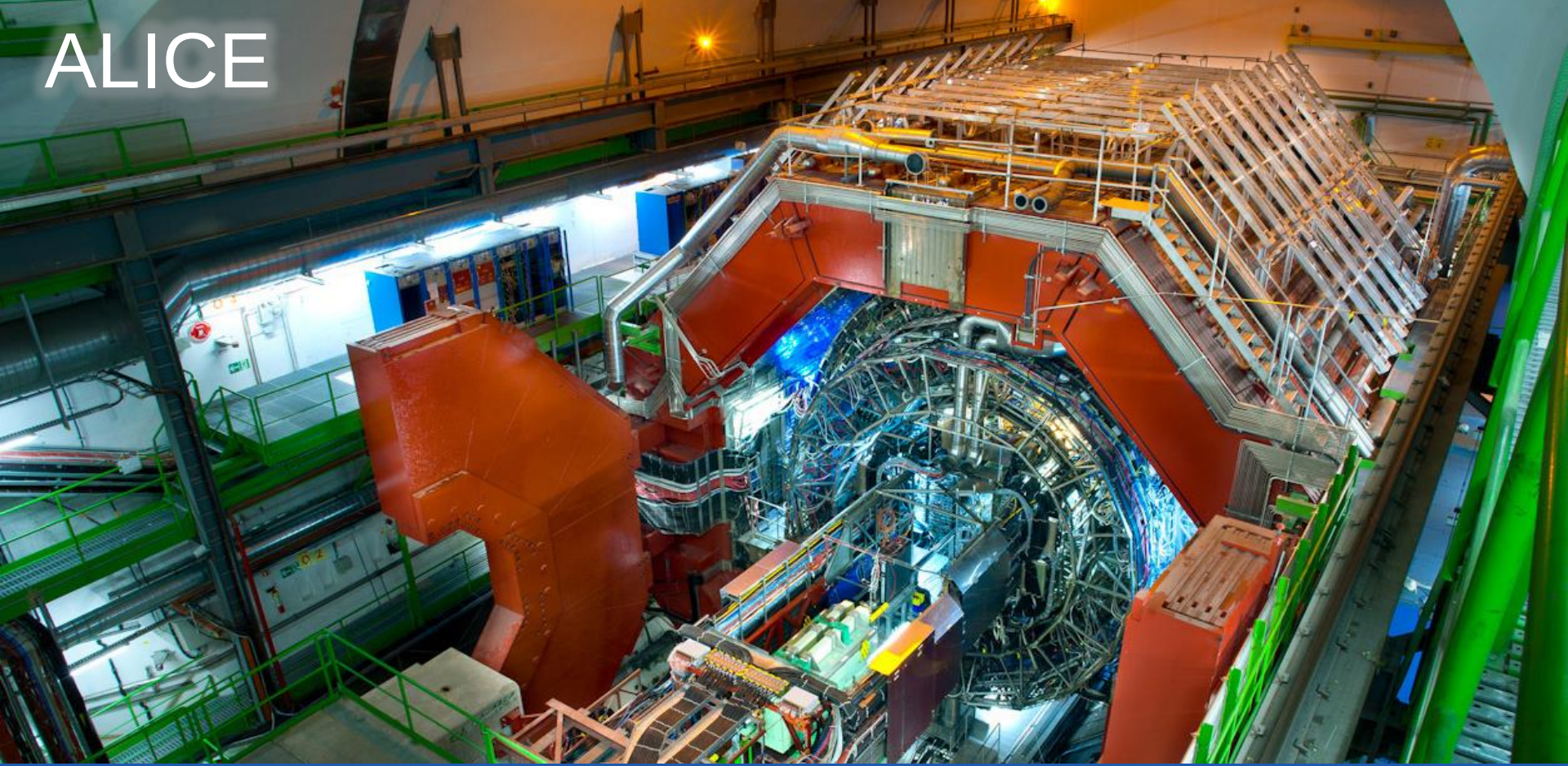

ATLAS

CMS



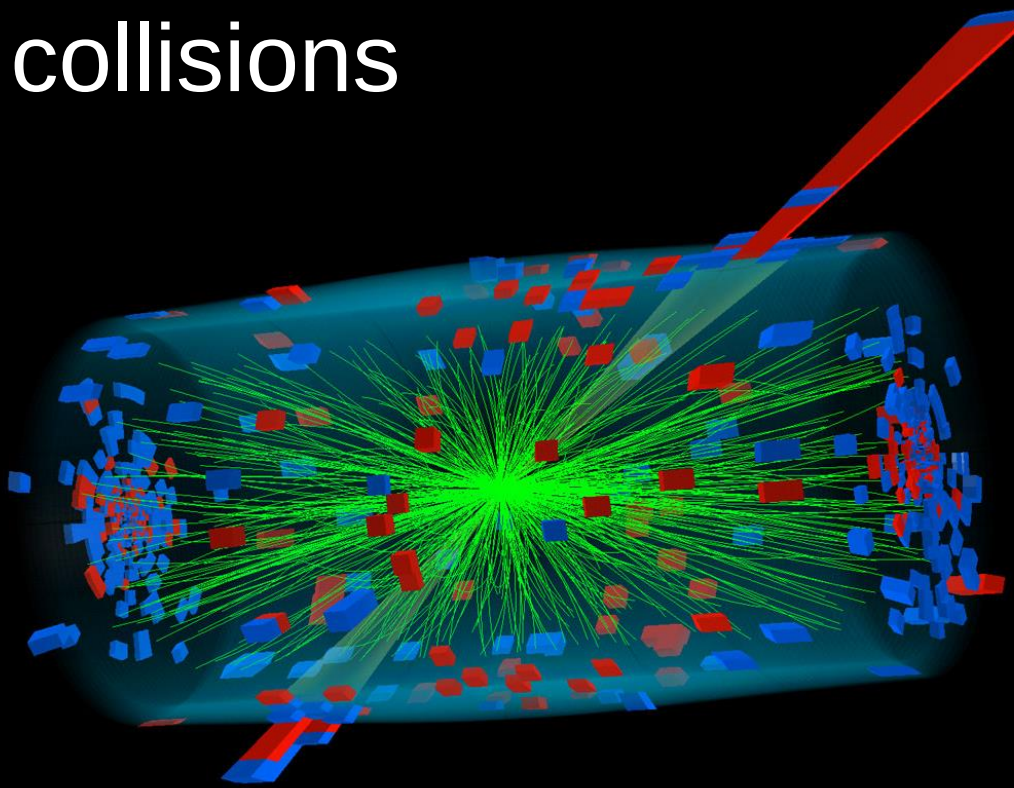
CERN

ALICE

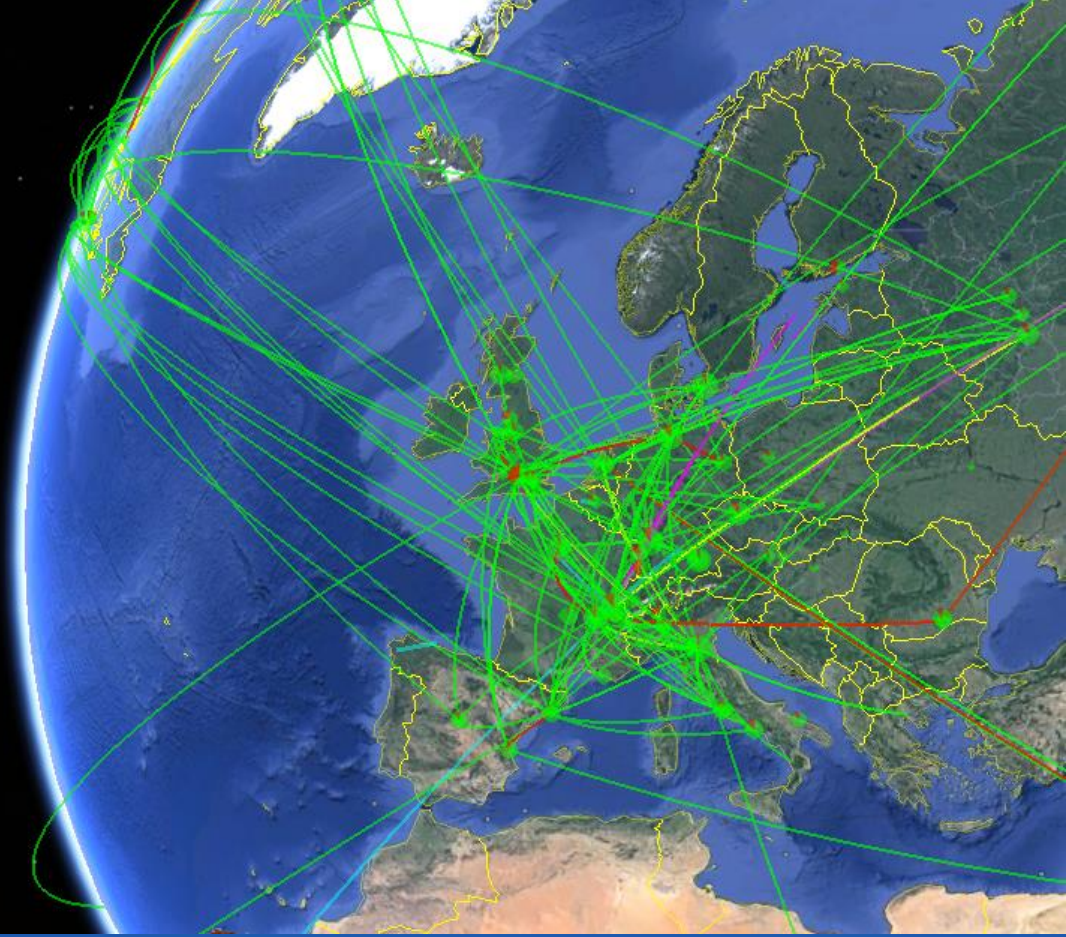


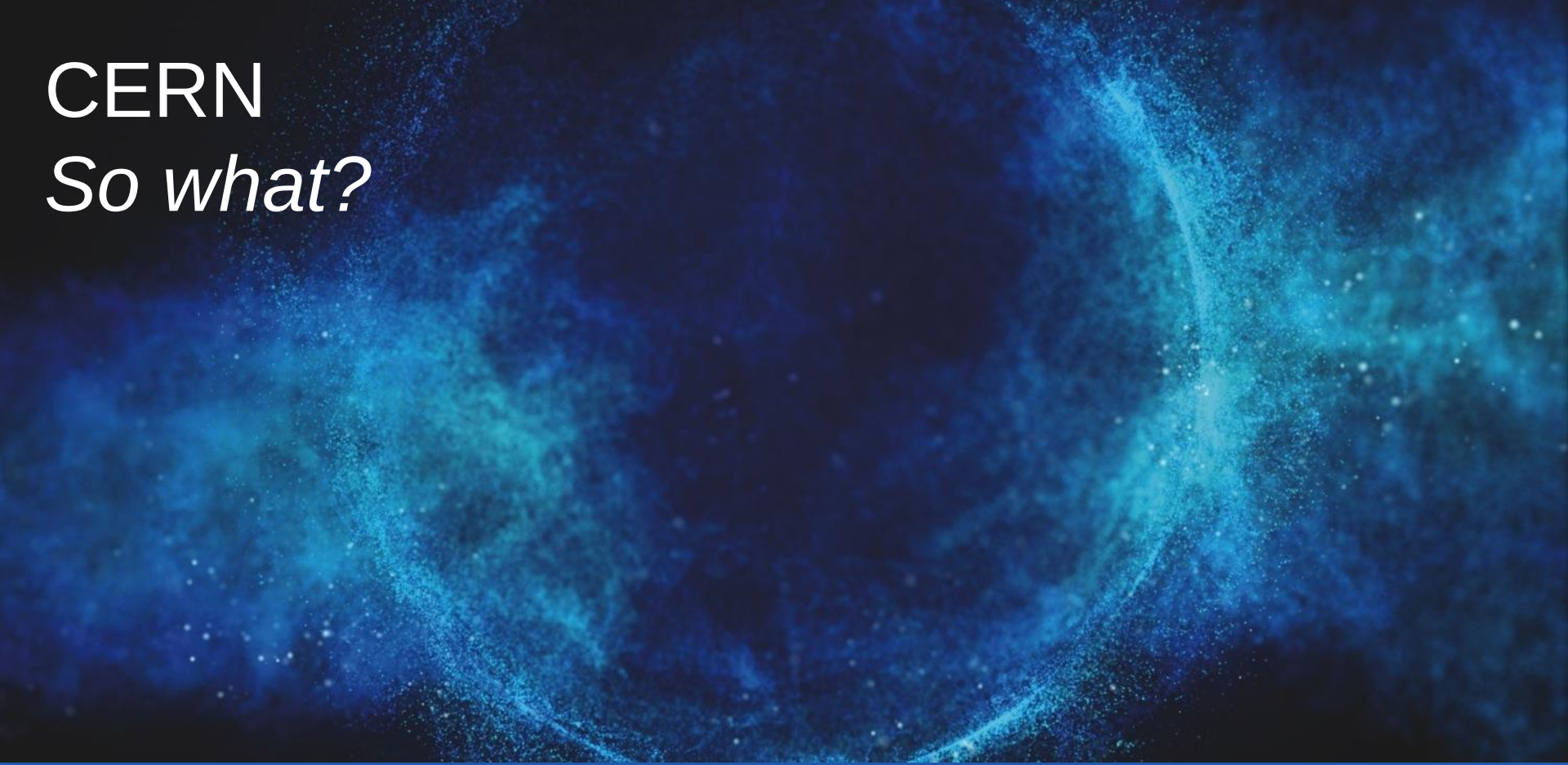
LHCb

Million of collisions

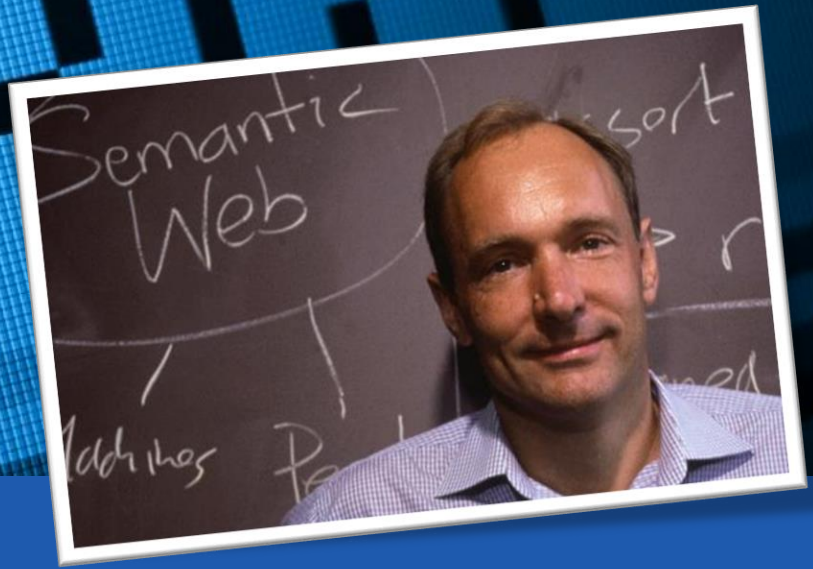


The largest computing grid

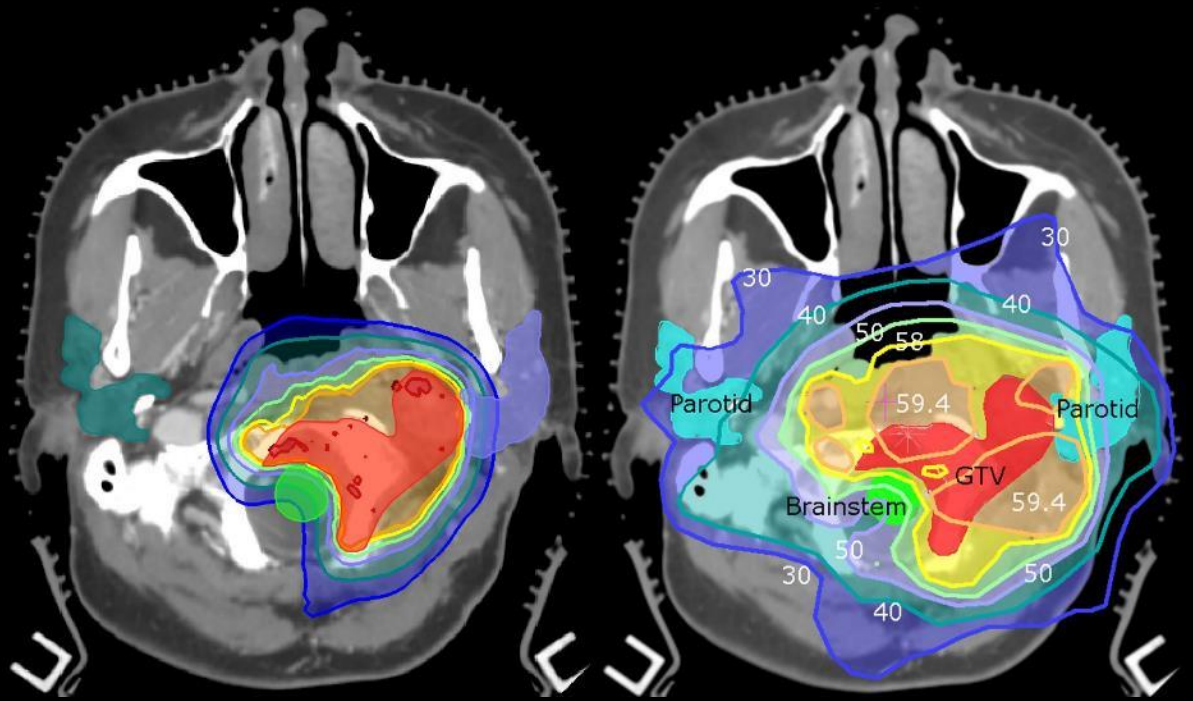


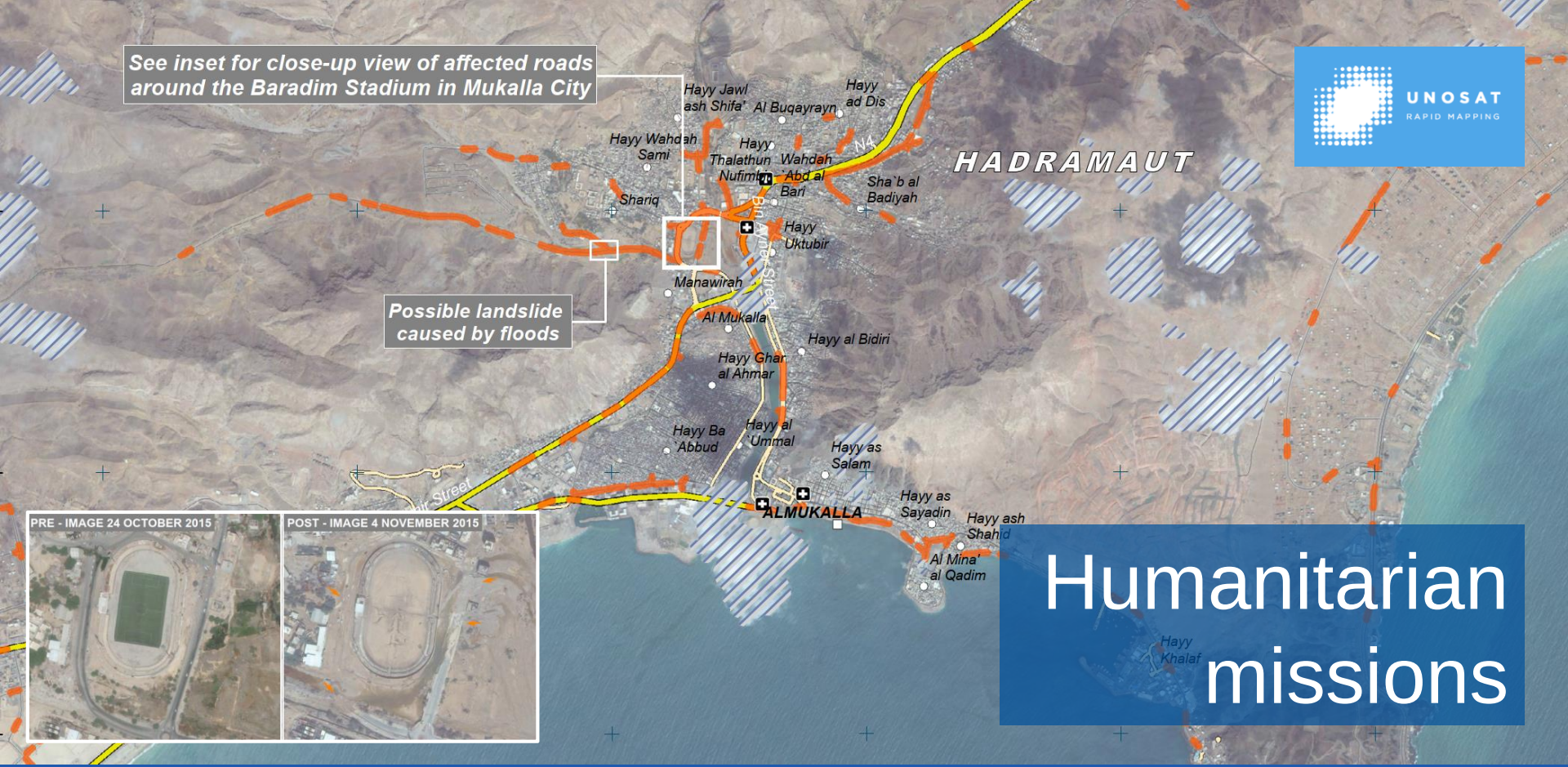

CERN
So what?

World Wide Web



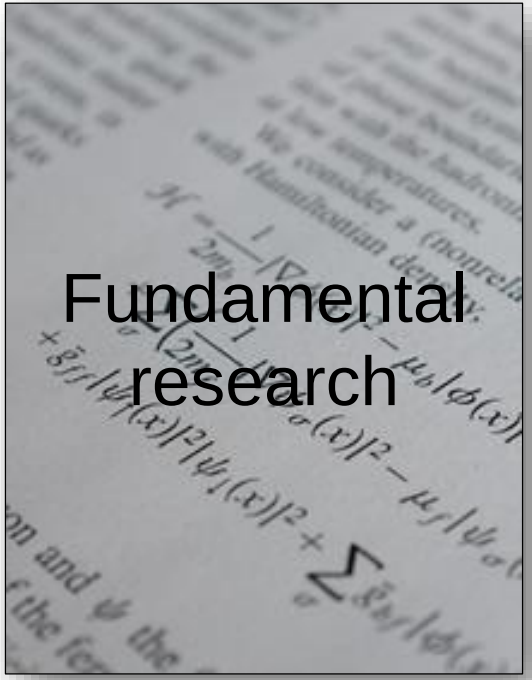
Medical applications

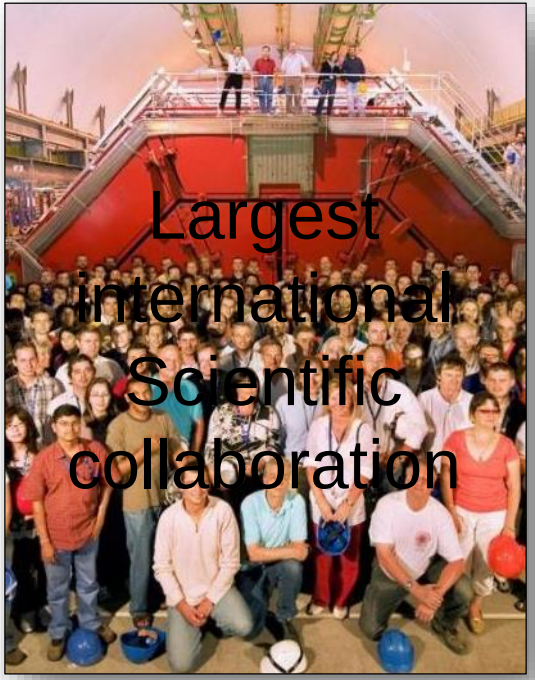




Humanitarian missions

In a nutshell…





Thanks for your attention!

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