Incontri di Fisica Moderna

Dip. di Fisica Pavia

21 Marzo 2023

UNIVERSITÀ DI PAVIA

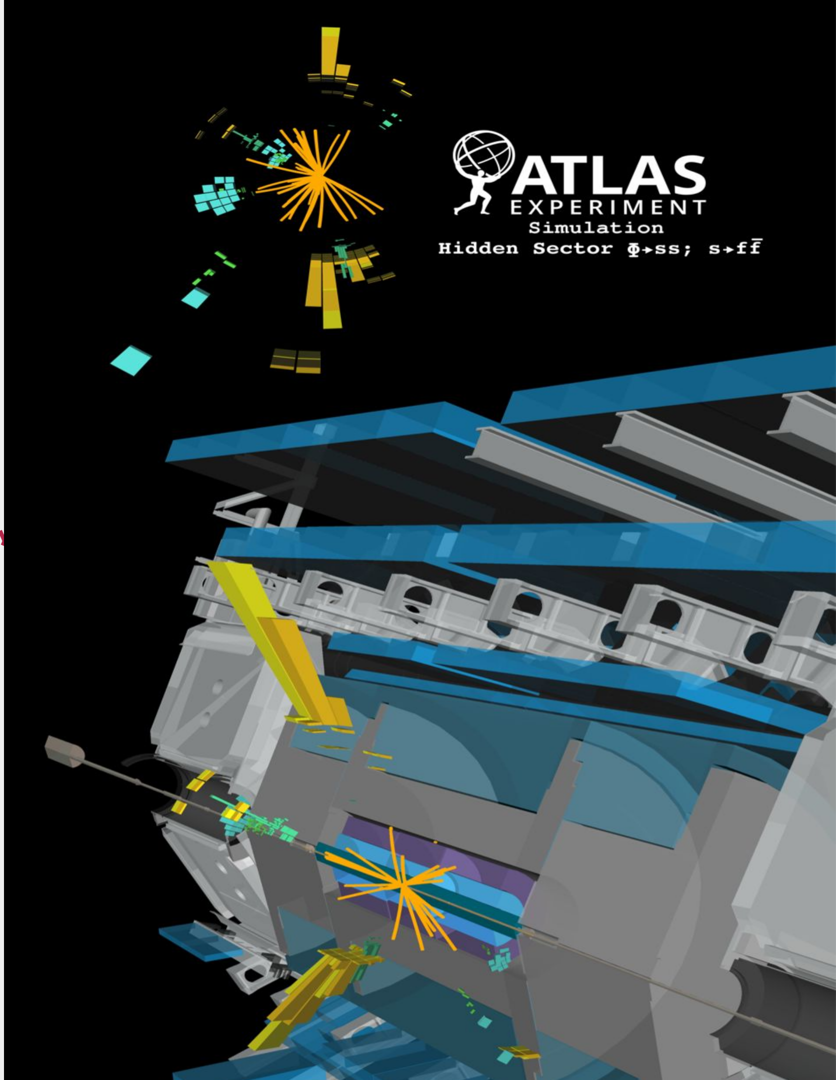
Istituto Nazionale di Fisica Nucleare

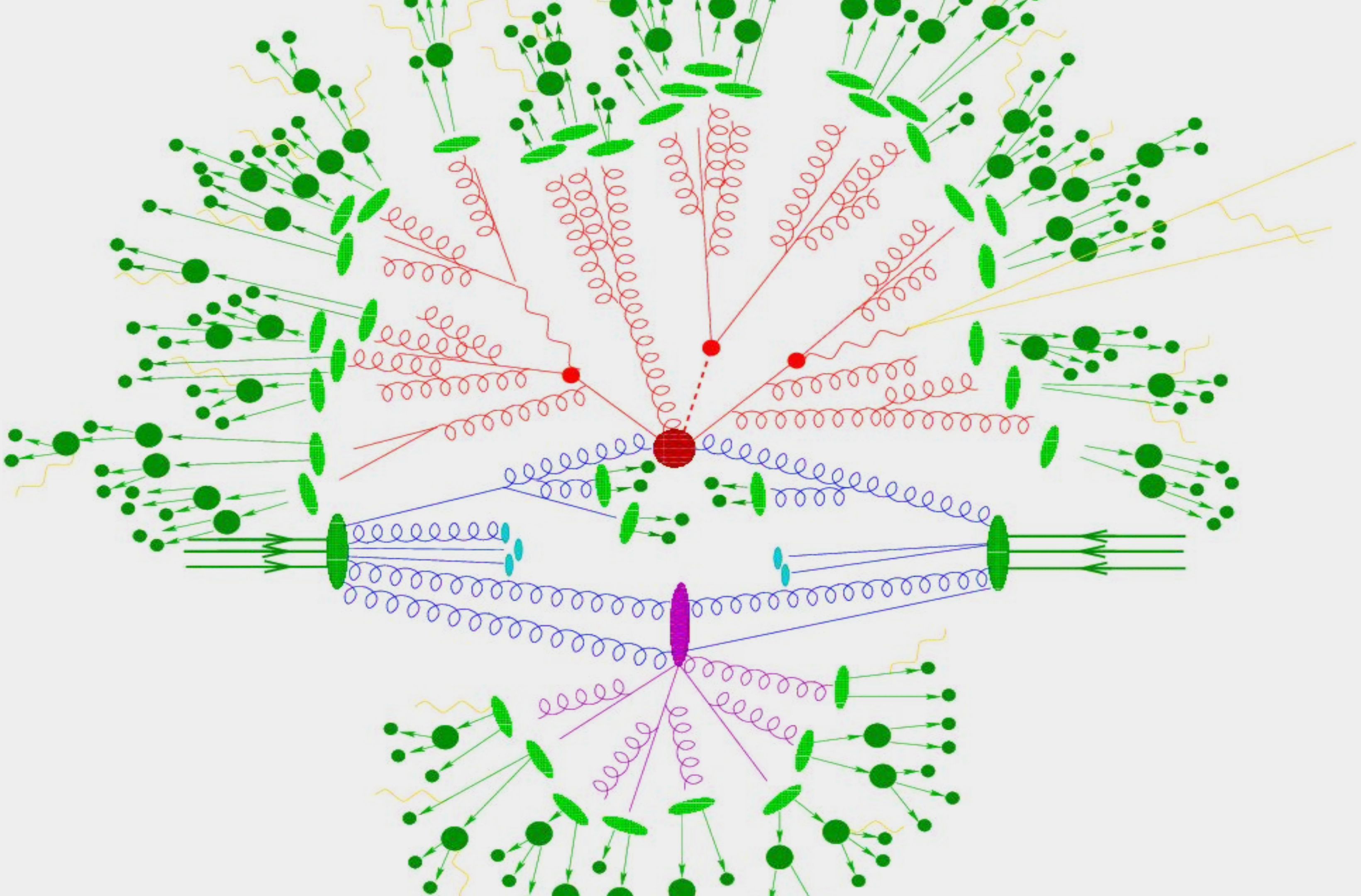
Ai confini dell’indivisibile

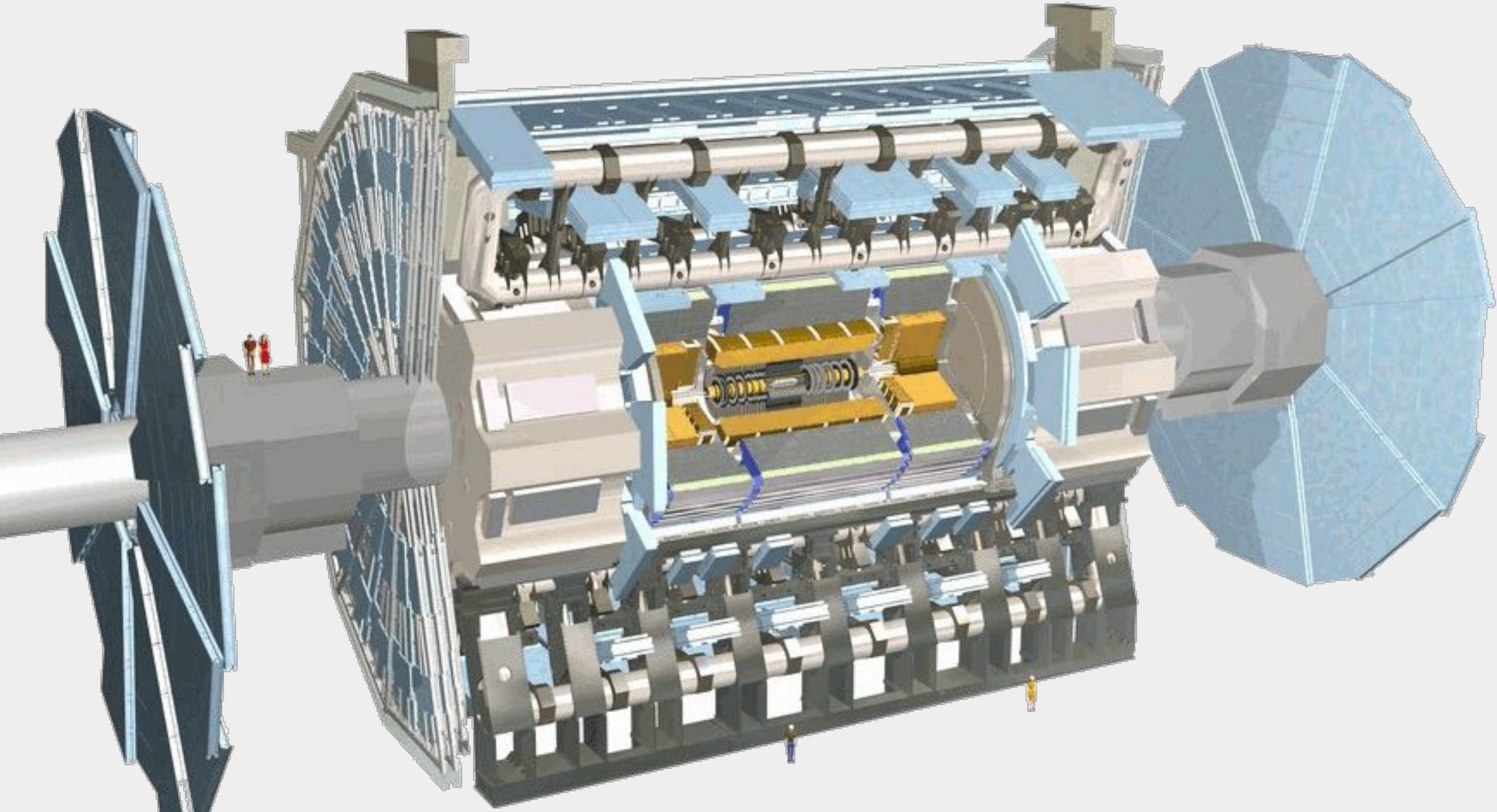
C. Aimè, D. Rebuzzi, A. Negri

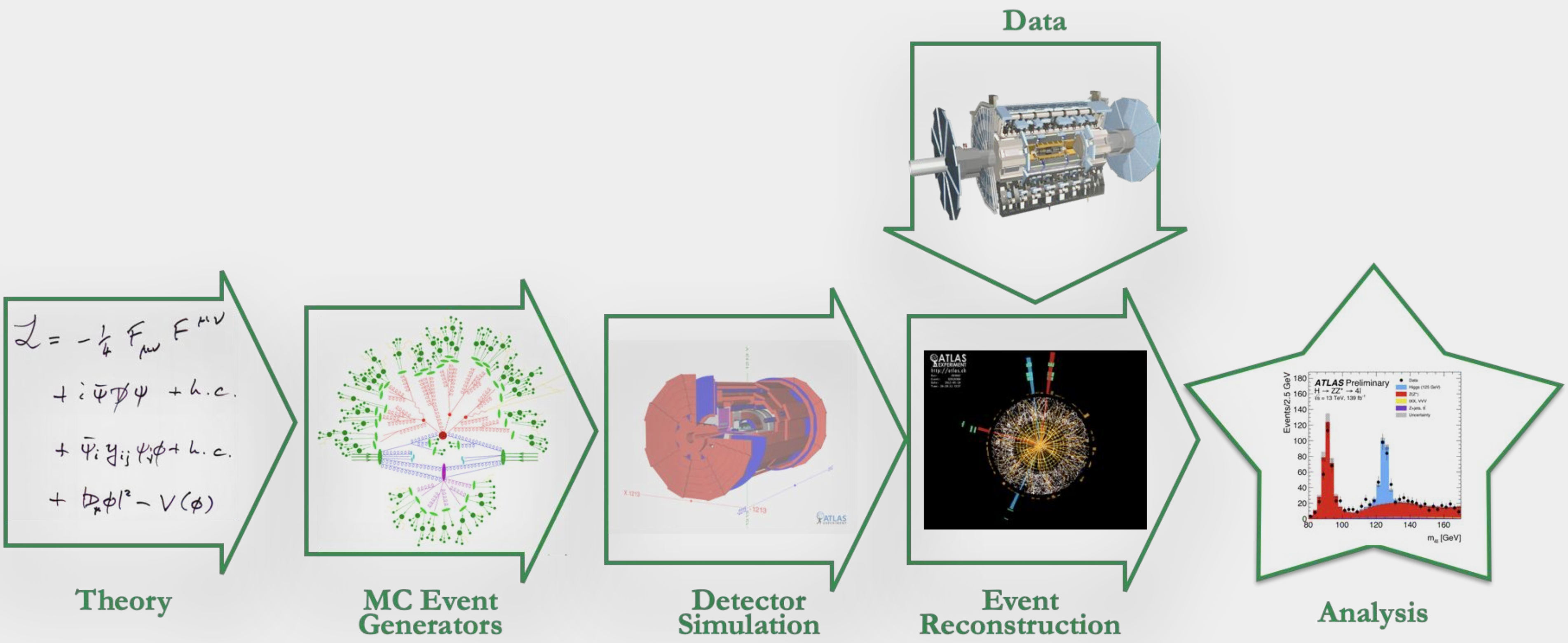
Come si fa a confrontare le predizioni della teoria con i risultati di un esperimento?

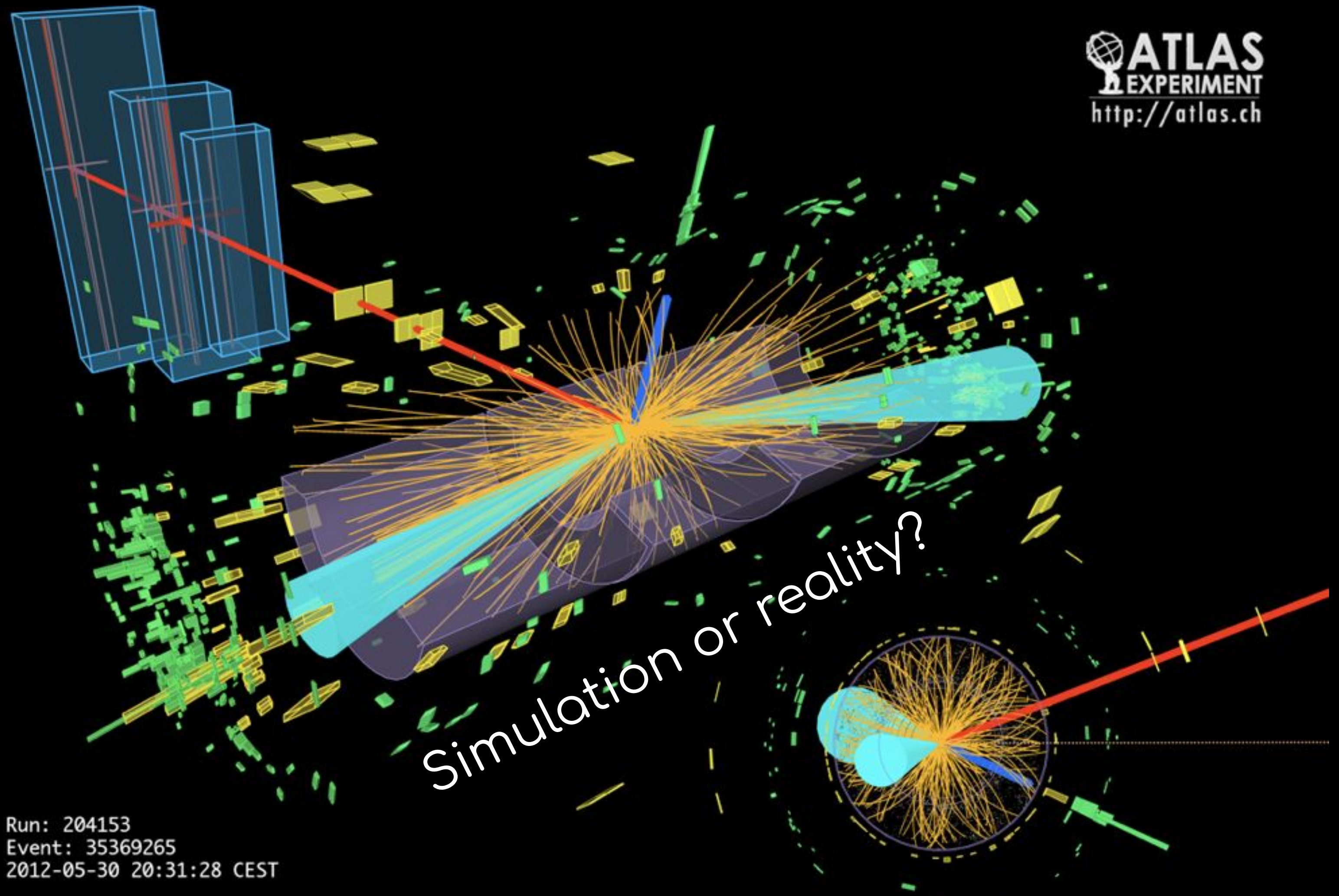
$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu}$$
$$+ i \bar{\Psi} \not{D} \Psi + h.c.$$
$$+ \bar{\Psi}_i y_{ij} \Psi_j \phi + h.c.$$
$$+ |D_\mu \phi|^2 - V(\phi)$$

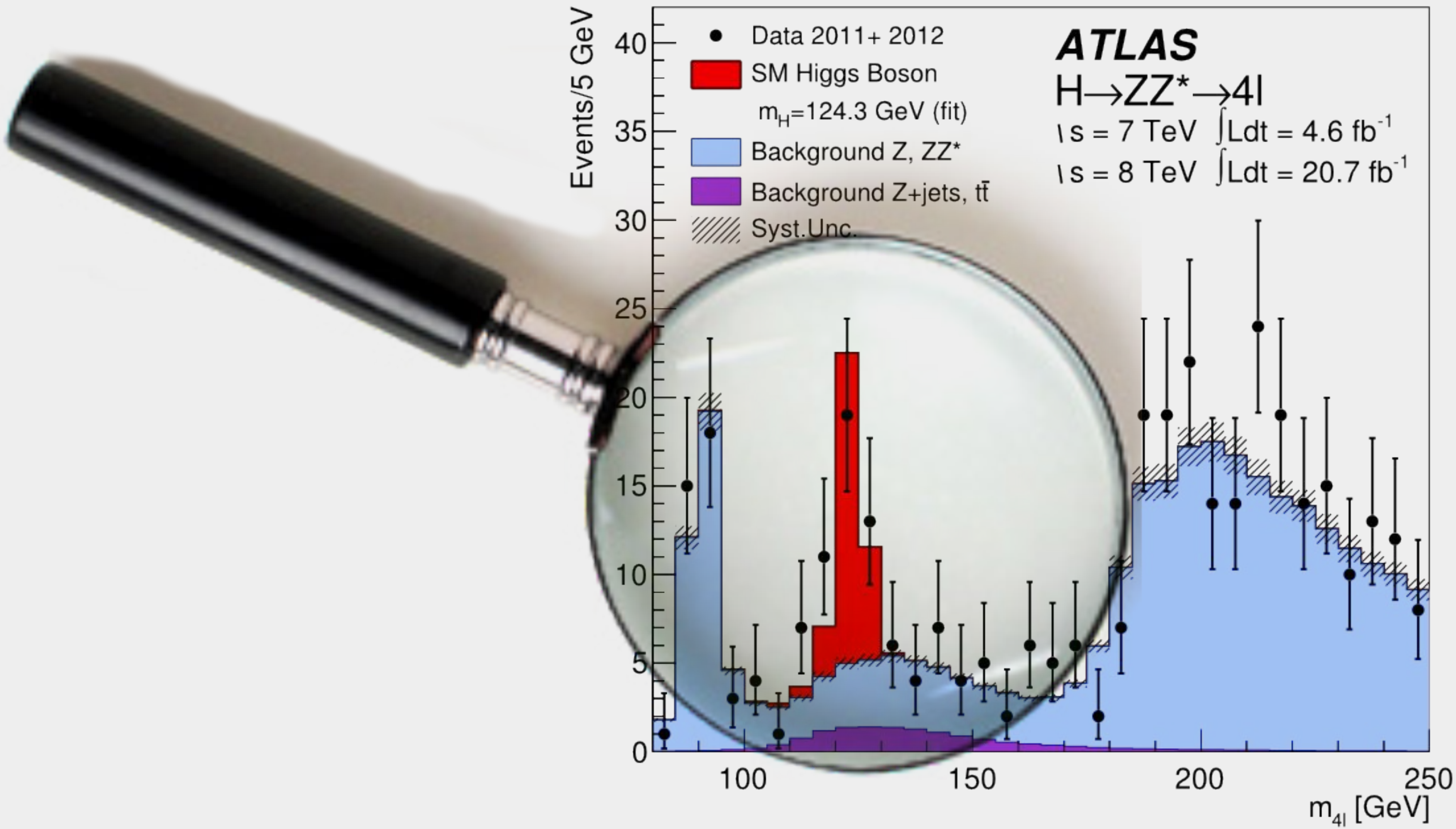







Data
Theory
MC Event Generators
Detector Simulation
Event Reconstruction
Analysis
ATLAS Preliminary
H → ZZ* → 4l
√s = 13 TeV, 139 fb⁻¹
Events/2.5 GeV
m4l [GeV]


ATLAS
EXPERIMENT
http://atlas.ch
Simulation or reality?
Run: 204153
Event: 35369265
2012-05-30 20:31:28 CEST



Data 2011+ 2012
SM Higgs Boson
m_H=124.3 GeV (fit)
Background Z, ZZ*
Background Z+jets, $t\bar{t}$
Syst.Unc.
ATLAS
$H \rightarrow ZZ^* \rightarrow 4l$
$\sqrt{s}$ = 7 TeV $\int Ldt$ = 4.6 fb^{-1}
$\sqrt{s}$ = 8 TeV $\int Ldt$ = 20.7 fb^{-1}
Events/5 GeV
0
5
10
15
20
25
30
35
40
100
150
200
250
m_{4l} [GeV]

Oltre alla ricerca, che **lavori** può svolgere un fisico sperimentale delle particelle?

Utilizzo particelle

Informatica

Elettronica

Telecomunicazioni

Finanza

Industria.*

Agricoltura

Analisi dati

Gestione dati

R&D Rivelatori

Gestione e coordinamento

Problem Solving


Ambiente: giovane, internazionale, challenging

R&D

Big Data

Infografica 2008

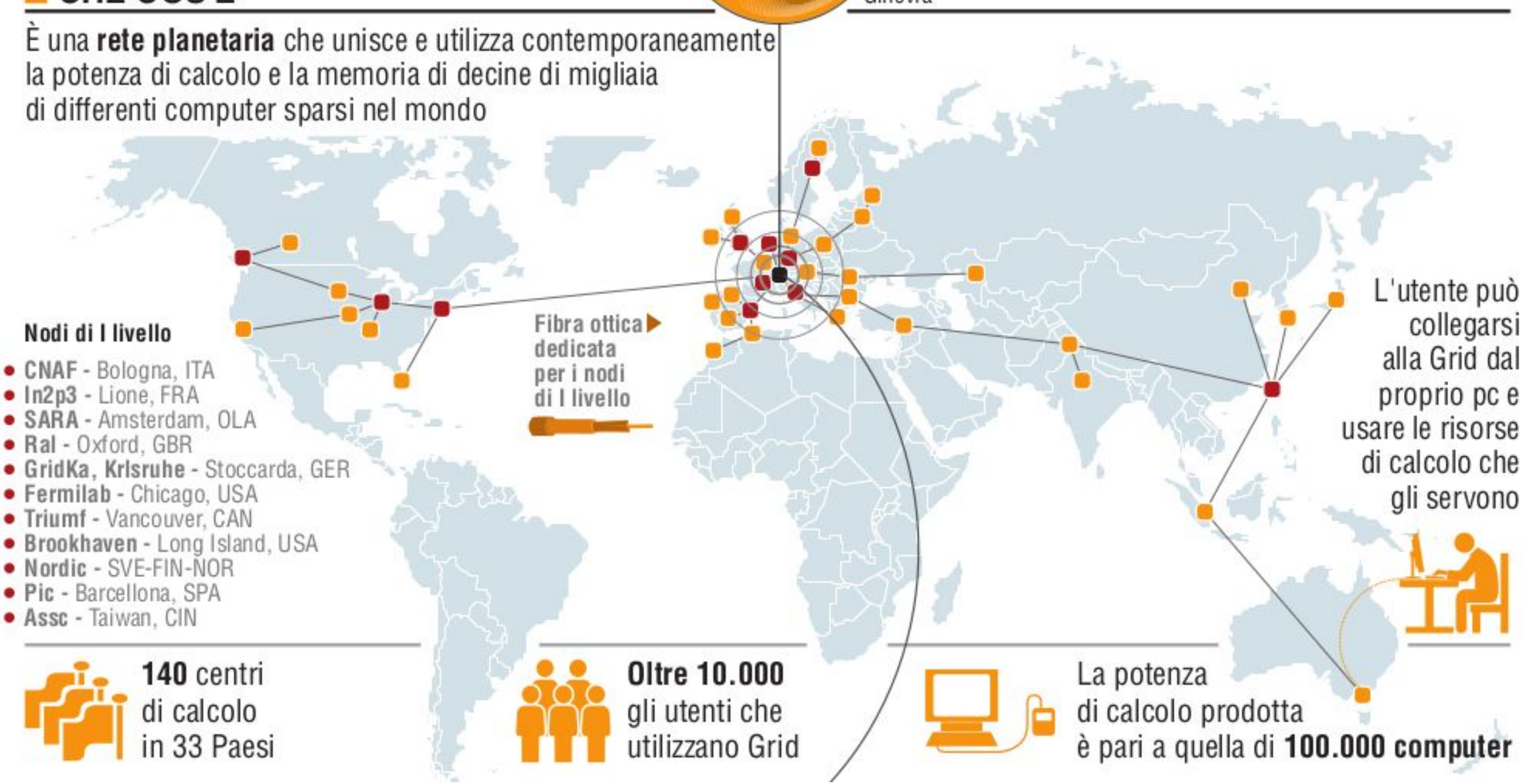
Accelerator LHC

Grid

INFN Istituto Nazionale di Fisica Nucleare

CHE COS'È

È una **rete planetaria** che unisce e utilizza contemporaneamente la potenza di calcolo e la memoria di decine di migliaia di differenti computer sparsi nel mondo



Nodi di I livello

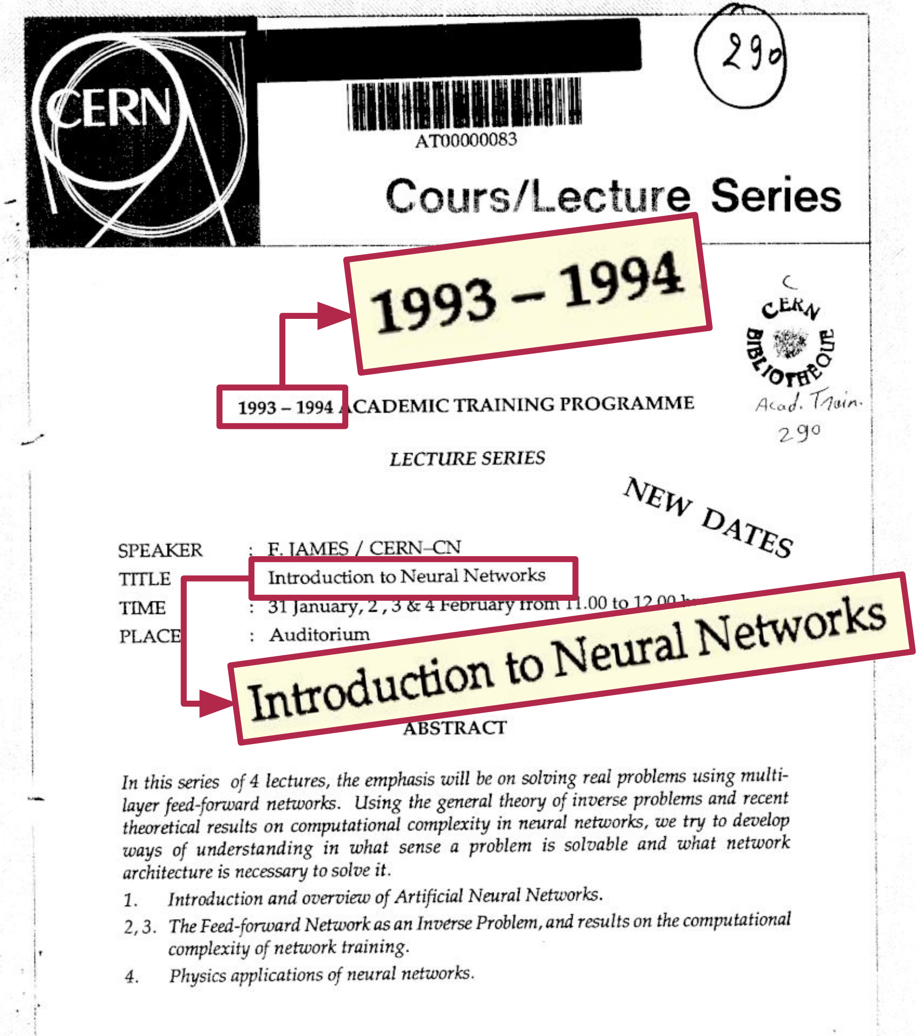
- **CNAF** - Bologna, ITA
- **In2p3** - Lione, FRA
- **SARA** - Amsterdam, OLA
- **Ral** - Oxford, GBR
- **GridKa, Krlsruhe** - Stoccarda, GER
- **Fermilab** - Chicago, USA
- **Triumf** - Vancouver, CAN
- **Brookhaven** - Long Island, USA
- **Nordic** - SVE-FIN-NOR
- **Pic** - Barcellona, SPA
- **Assc** - Taiwan, CIN

L'utente può collegarsi alla Grid dal proprio pc e usare le risorse di calcolo che gli servono

140 centri di calcolo in 33 Paesi

Oltre 10.000 gli utenti che utilizzano Grid

La potenza di calcolo prodotta è pari a quella di **100.000 computer**



CERN

AT00000083

290

Cours/Lecture Series

1993 – 1994

1993 – 1994 ACADEMIC TRAINING PROGRAMME

LECTURE SERIES

NEW DATES

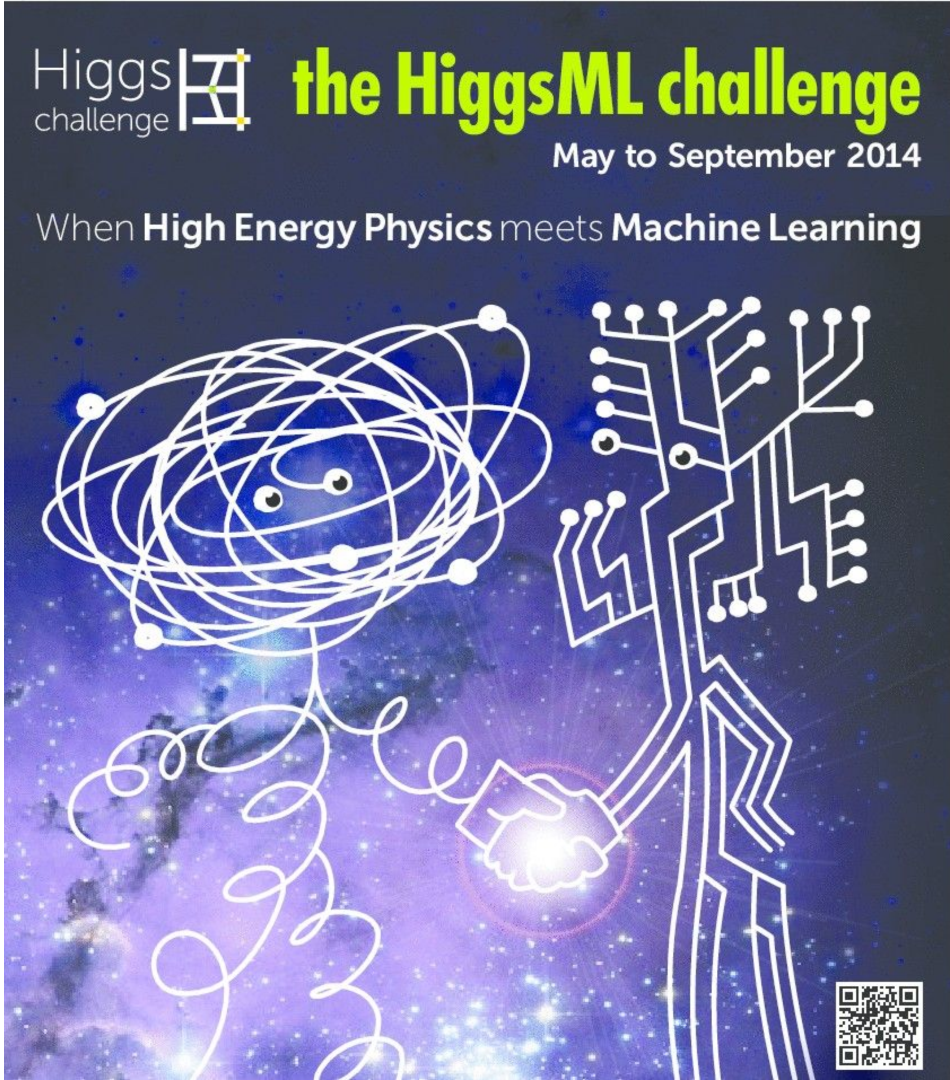
SPEAKER : F. JAMES / CERN–CN
TITLE : Introduction to Neural Networks
TIME : 31 January, 2, 3 & 4 February from 11.00 to 12.00 h
PLACE : Auditorium

Introduction to Neural Networks

ABSTRACT

In this series of 4 lectures, the emphasis will be on solving real problems using multi-layer feed-forward networks. Using the general theory of inverse problems and recent theoretical results on computational complexity in neural networks, we try to develop ways of understanding in what sense a problem is solvable and what network architecture is necessary to solve it.

1. *Introduction and overview of Artificial Neural Networks.*
2, 3. *The Feed-forward Network as an Inverse Problem, and results on the computational complexity of network training.*
4. *Physics applications of neural networks.*

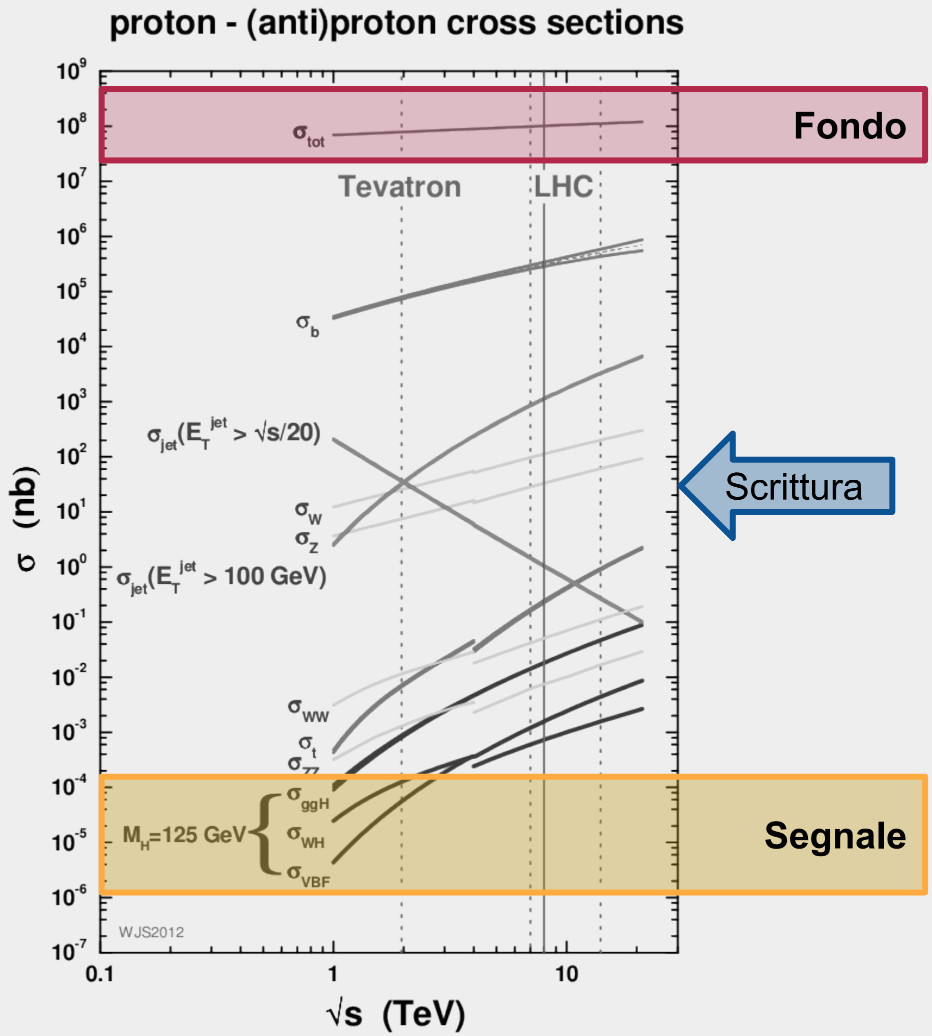


SandboxAQ: Solving challenging problems with AI + Quantum for positive impact

Get AQ

Find out more

SandboxAQ is an enterprise SaaS company combining AI + Quantum tech to solve hard problems impacting society. Our solutions include post-RSA cybersecurity modules that migrate enterprises to higher levels of security. These SandboxAQ modules enable post-quantum cryptography (PQC) in line with the new standards that are now emerging in this field.



proton - (anti)proton cross sections
Fondo
Scrittura
Segnale
σ_tot
Tevatron
LHC
σ_b
σ_jet(E_T^jet > √s/20)
σ_W
σ_Z
σ_jet(E_T^jet > 100 GeV)
σ_WW
σ_t
σ_ZZ
σ_ggH
σ_WH
σ_VBF
M_H=125 GeV
WJS2012
σ (nb)
√s (TeV)

x 400

Qual è la **giornata** tipo di un fisico sperimentale delle particelle?

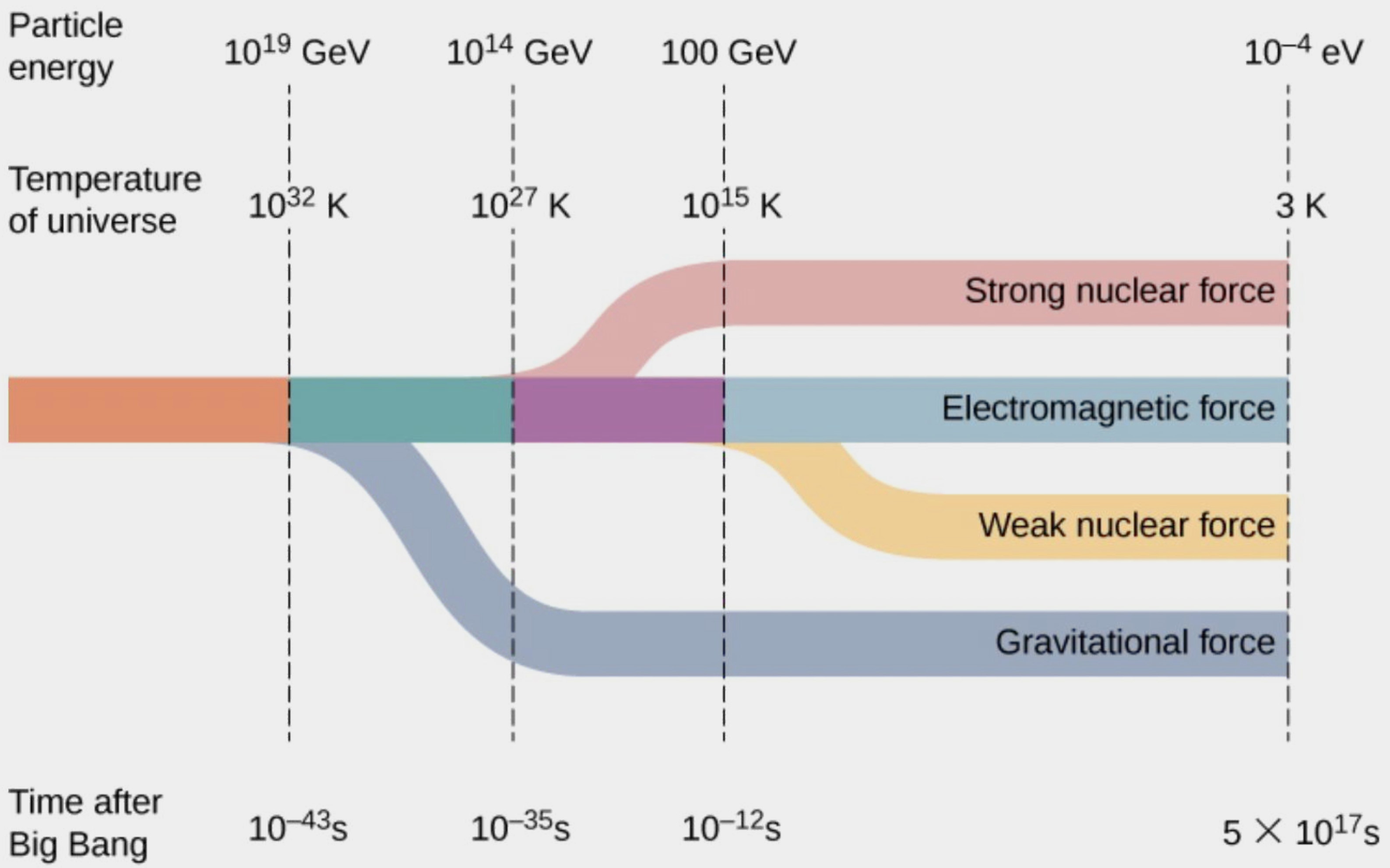
21 Martedì
Marzo 2023

06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00

Fare

Appunti

Come funziona il campo di **Higgs**?

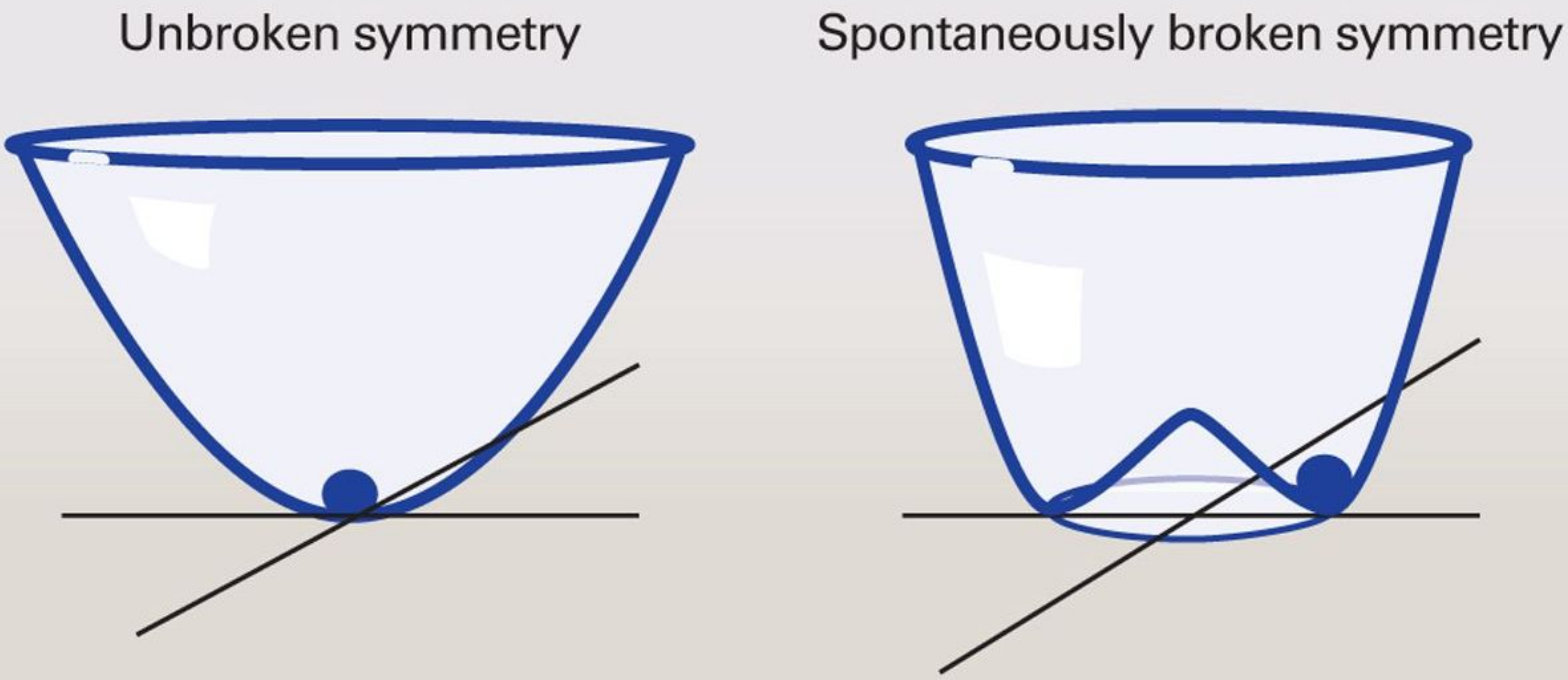

Particle energy
10^{19} GeV
10^{14} GeV
100 GeV
10^{-4} eV
Temperature of universe
10^{32} K
10^{27} K
10^{15} K
3 K
Strong nuclear force
Electromagnetic force
Weak nuclear force
Gravitational force
Time after Big Bang
10^{-43}s
10^{-35}s
10^{-12}s
5×10^{17}s

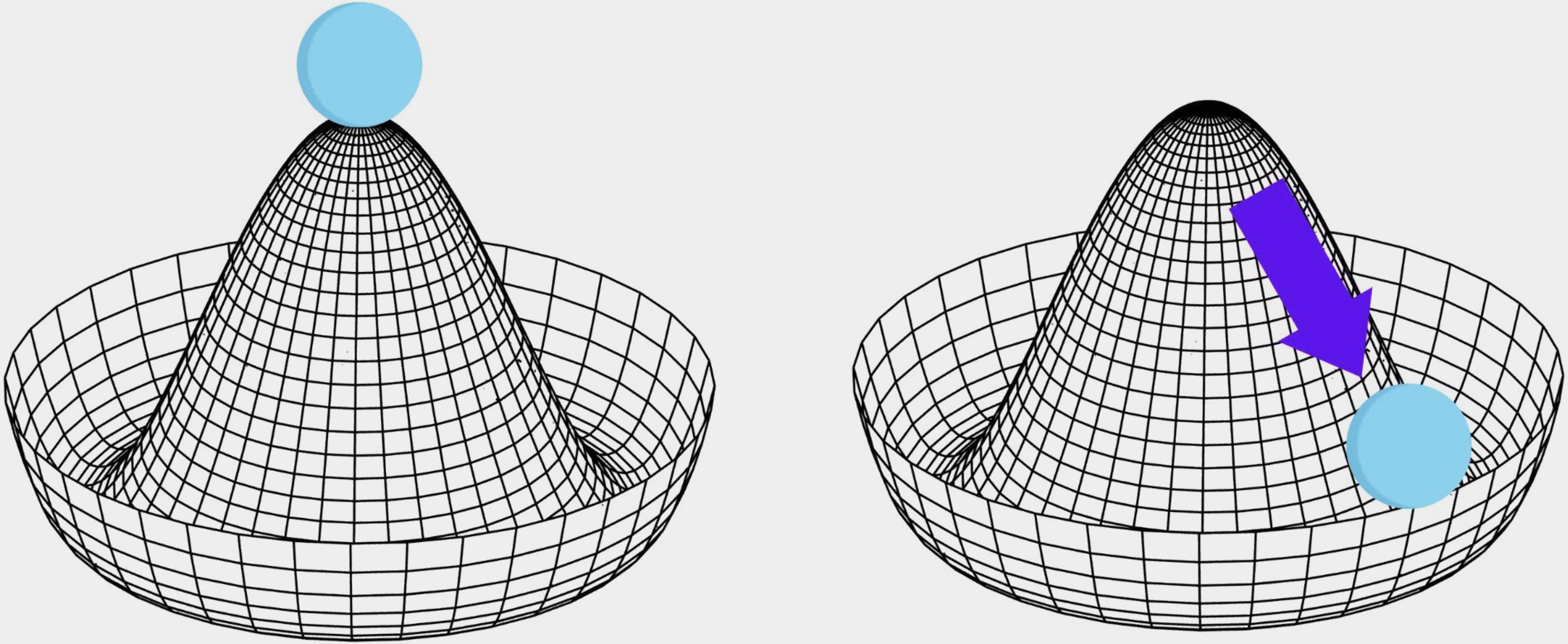
$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu}$$

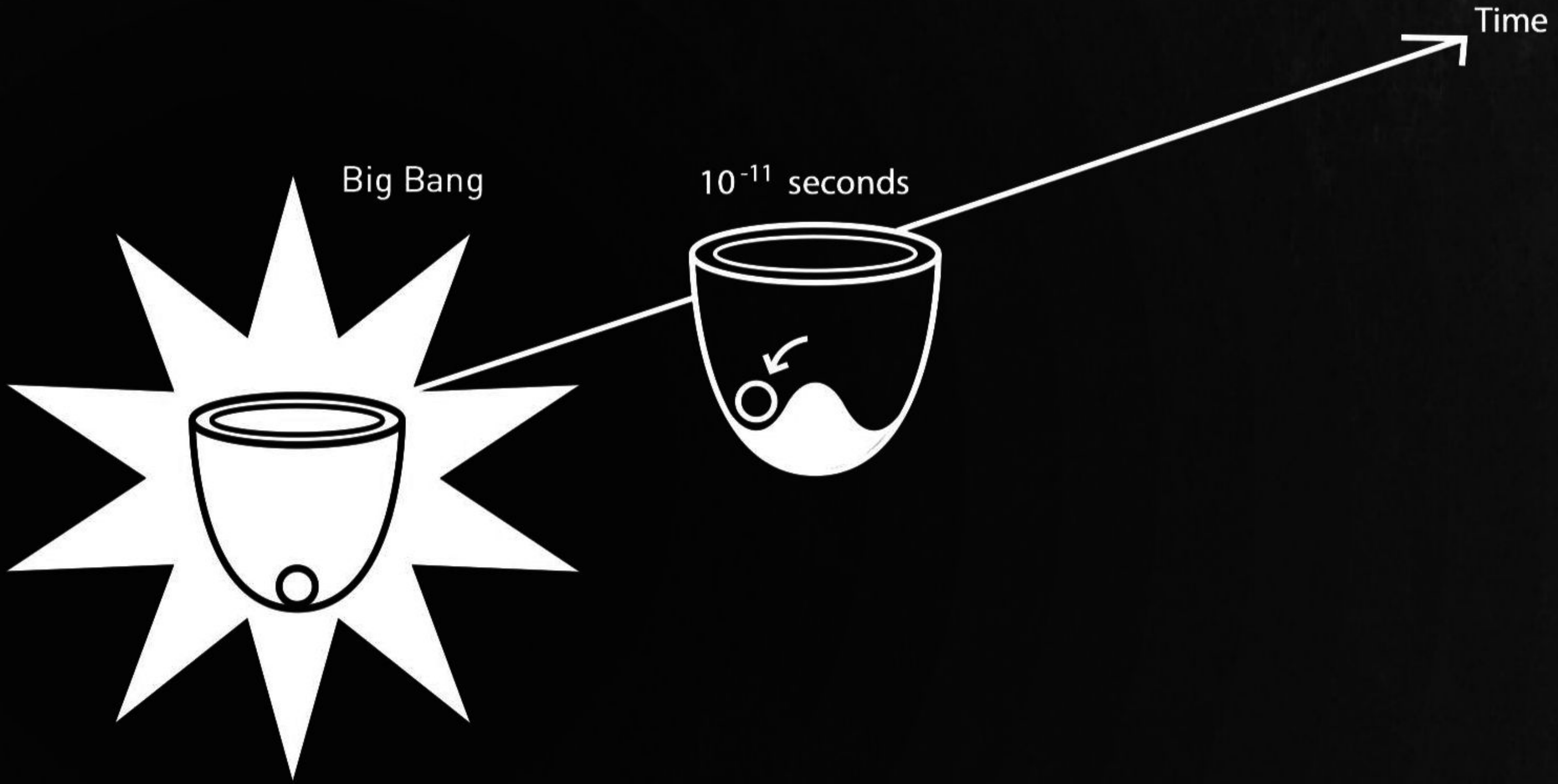
$$+ i \bar{\Psi} \not{D} \psi + h.c.$$

$$+ \bar{\Psi}_i y_{ij} \psi_j \phi + h.c.$$

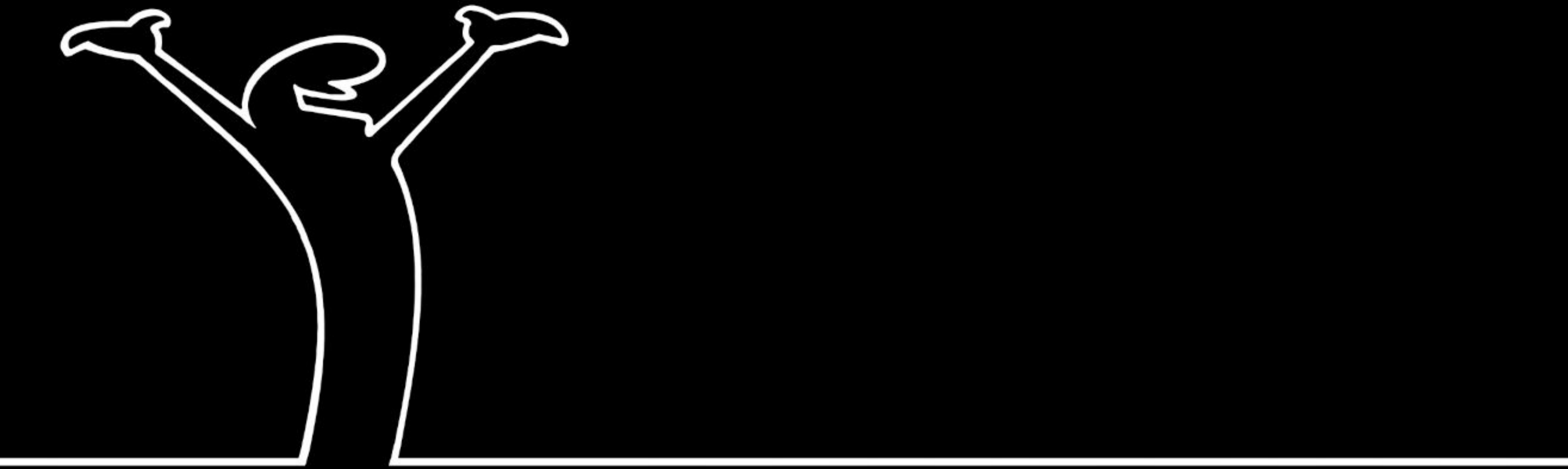
$$+ |D_\mu \phi|^2 - \boxed{V(\phi)}$$


Unbroken symmetry
Spontaneously broken symmetry




Time
Big Bang
10^{-11} seconds

Voi che c’eravate come l’avete vissuta?




1996


1996


2009
ATLAS

2009

2010

ATLAS Control Room
30-3-10 6:01
Physics
trol room
ATLAS EXPERIMENT
CERN


4/7/2012@Cern


4/7/2012@Cern
Prof. Peter Higgs

4/7/2012@PV

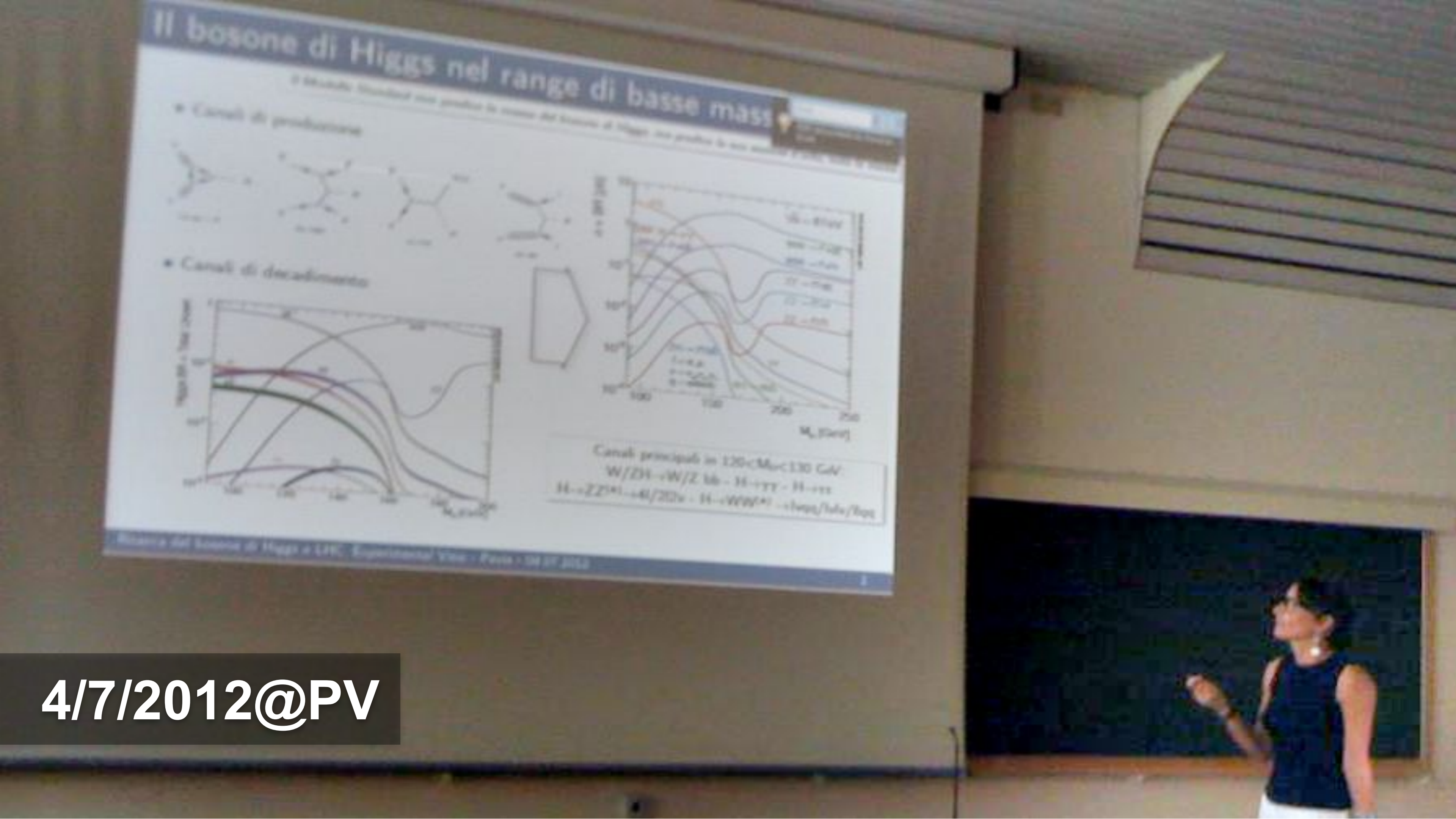
Mercoledì 4 luglio 2012, ore 9:00

DIPARTIMENTO DI FISICA

Aula A102

Presentazione dei recenti risultati sulla ricerca del Bosone di Higgs a LHC

Collegamento con il CERN


Il bosone di Higgs nel range di basse mass
Canali di produzione
Canali di decadimento
Canali principali in 120<M_H<130 GeV:
4/7/2012@PV

Quali sono i principali **esperimenti** di fisica delle particelle che si stanno svolgendo in Italia e nel mondo?

INFN

Istituto Nazionale di Fisica Nucleare

CSN1
Fisica delle
Particelle

CSN2
Fisica delle
Astroparticelle

CSN3
Fisica
Nucleare

CSN4
Fisica
Teorica

CSN5
Ricerca
Tecnologica

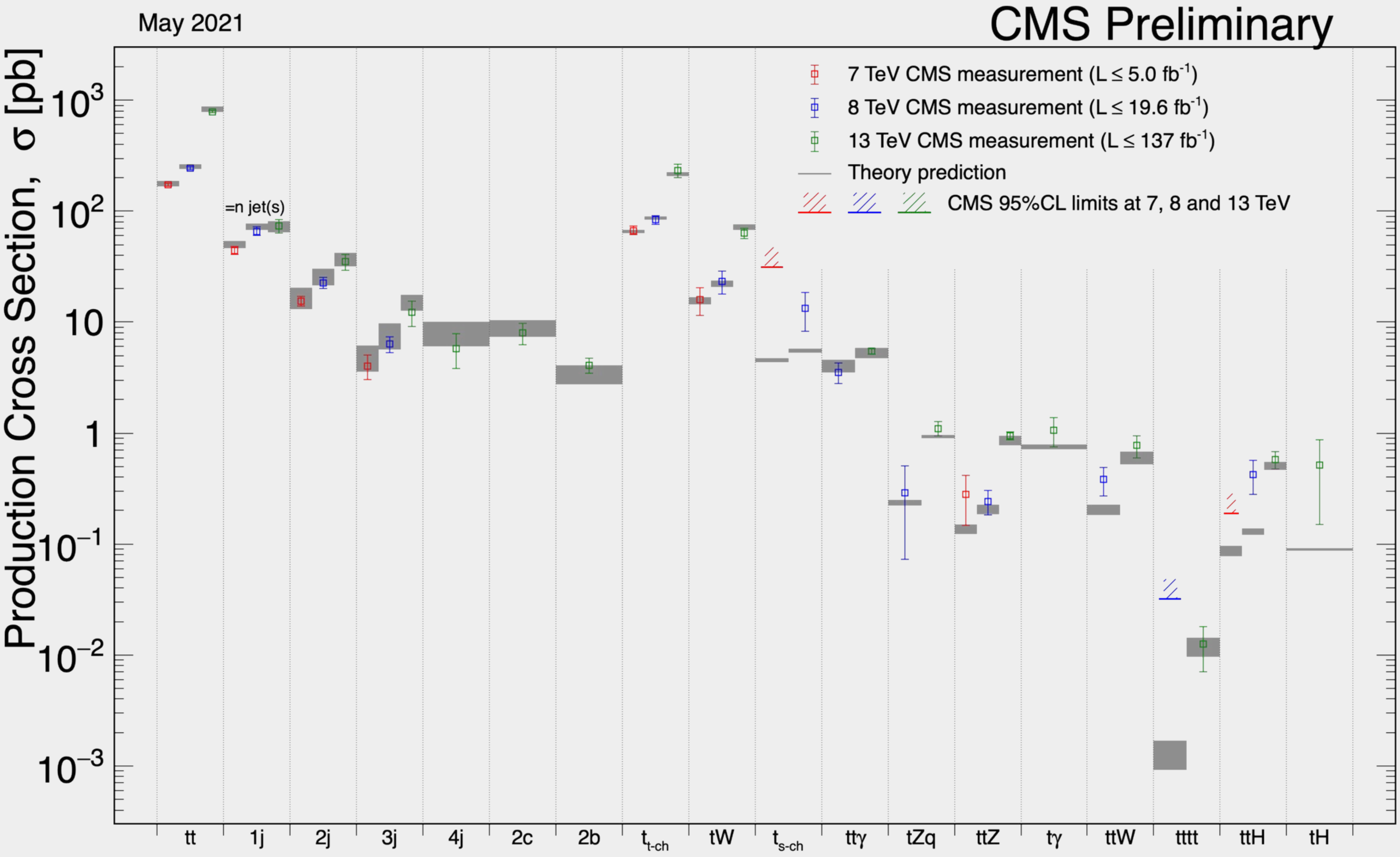
CSN1
Fisica delle
Particelle

Frontiera dell’energia

ALICE[gr3], ATLAS, CMS, LHC-b
LHC-f , SNDLHC

Frontiera dell’intensità

BELLE2, BESIII, KLOE, NA62
GMINUS2, MUONE
MEG, Mu2e
AMBER, PADME



All results at: http://cern.ch/go/pNj7

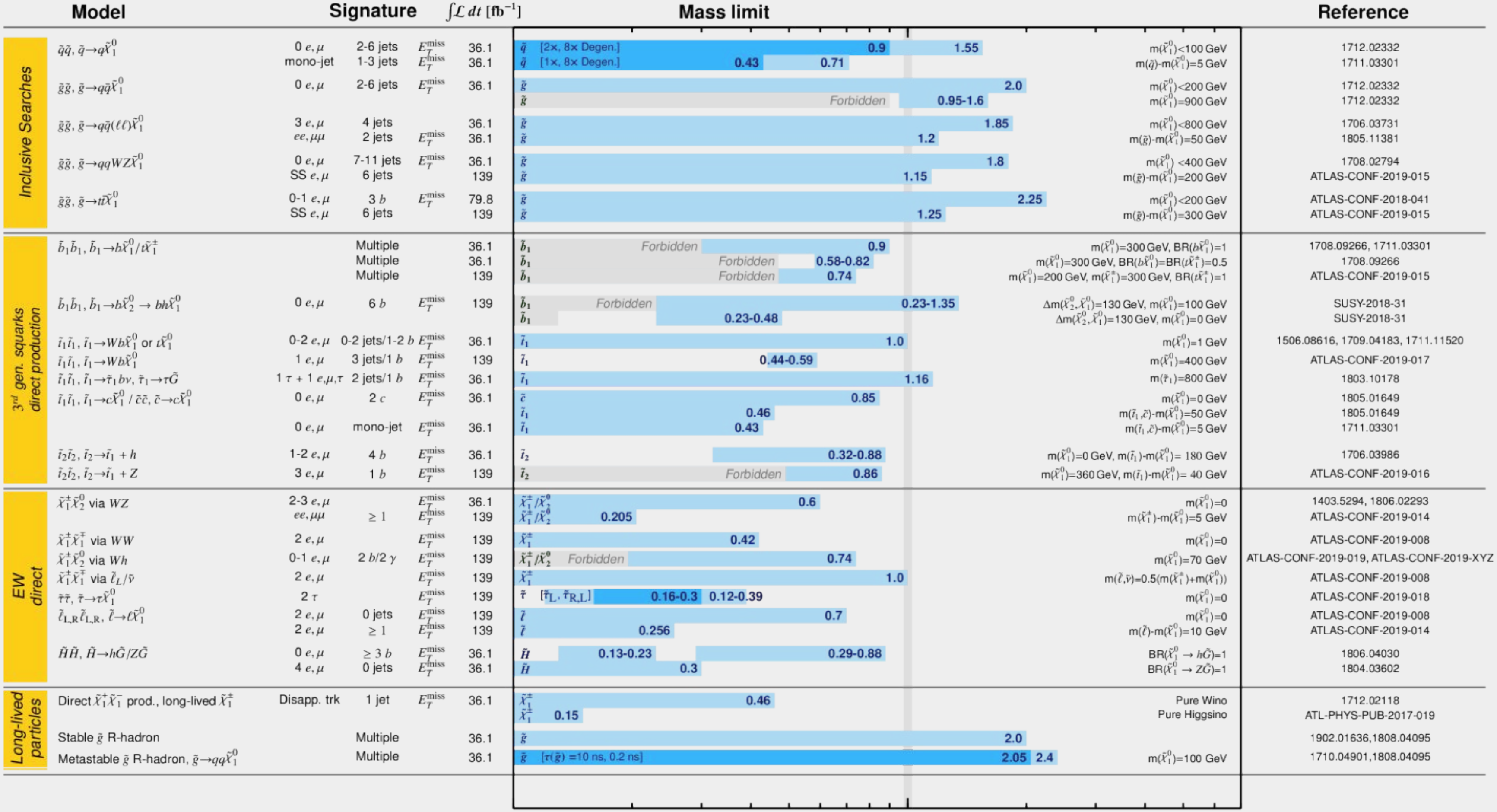
“Qualcosa” non torna

- Materia e energia oscura
- Antimateria
- Neutrini
- Momento magnetico anomalo del muone
- Unificazione forze
- Quark indivisibili
- Altre dimensioni

ATLAS SUSY Searches* - 95% CL Lower Limits

July 2019

ATLAS Preliminary
$\sqrt{s}$ = 13 TeV



*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

CSN1

Fisica delle

Particelle

Pavia: **60** persone

Frontiera dell'energia

ALICE(gr3), ATLAS, CMS, LHC-b
LHC-f , SNDLHC

Frontiera dell'intensità

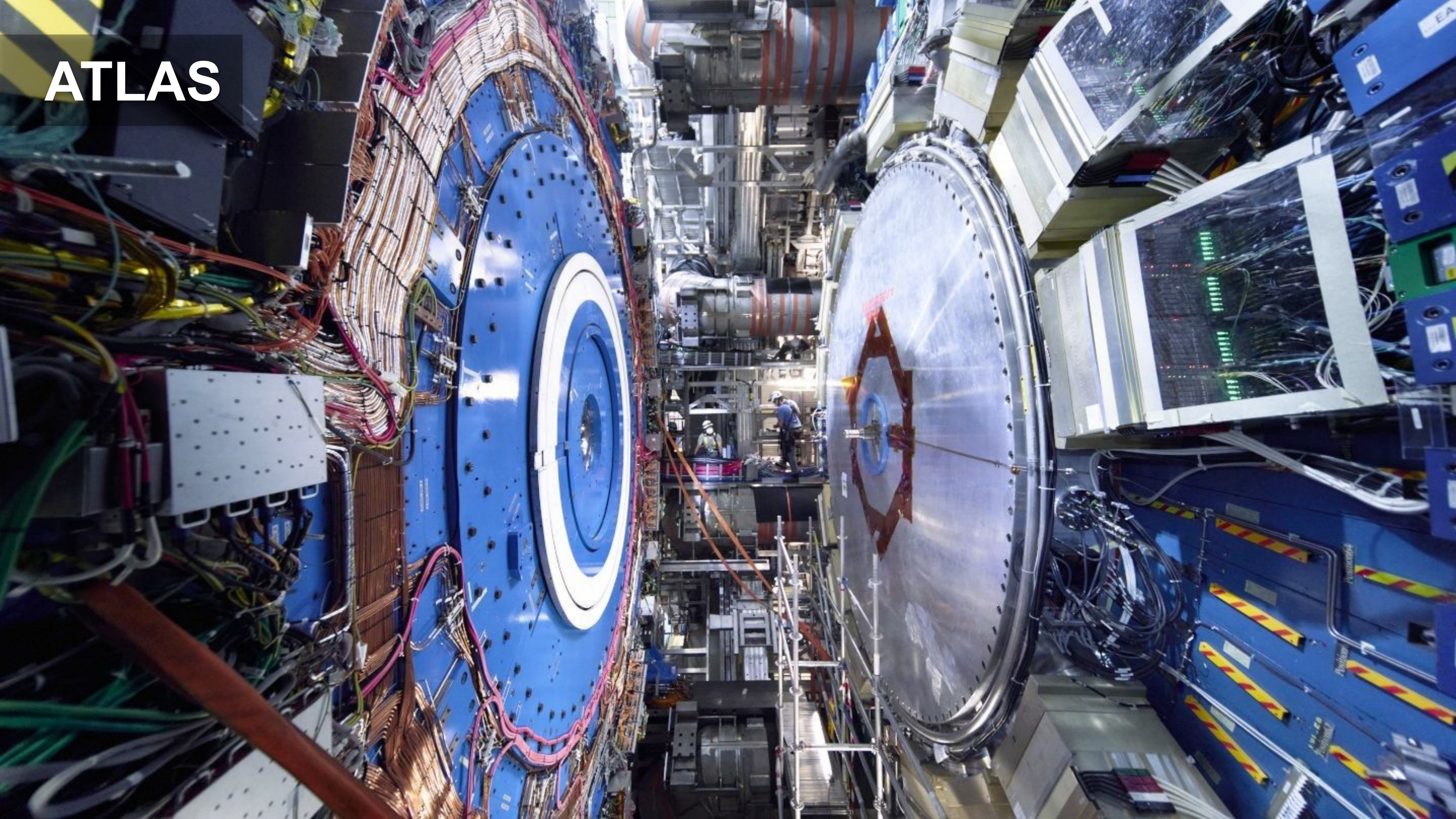
BELLE2, BESIII, KLOE, NA62
GMINUS2, MUONE
MEG, Mu2e
AMBER, PADME

LHC

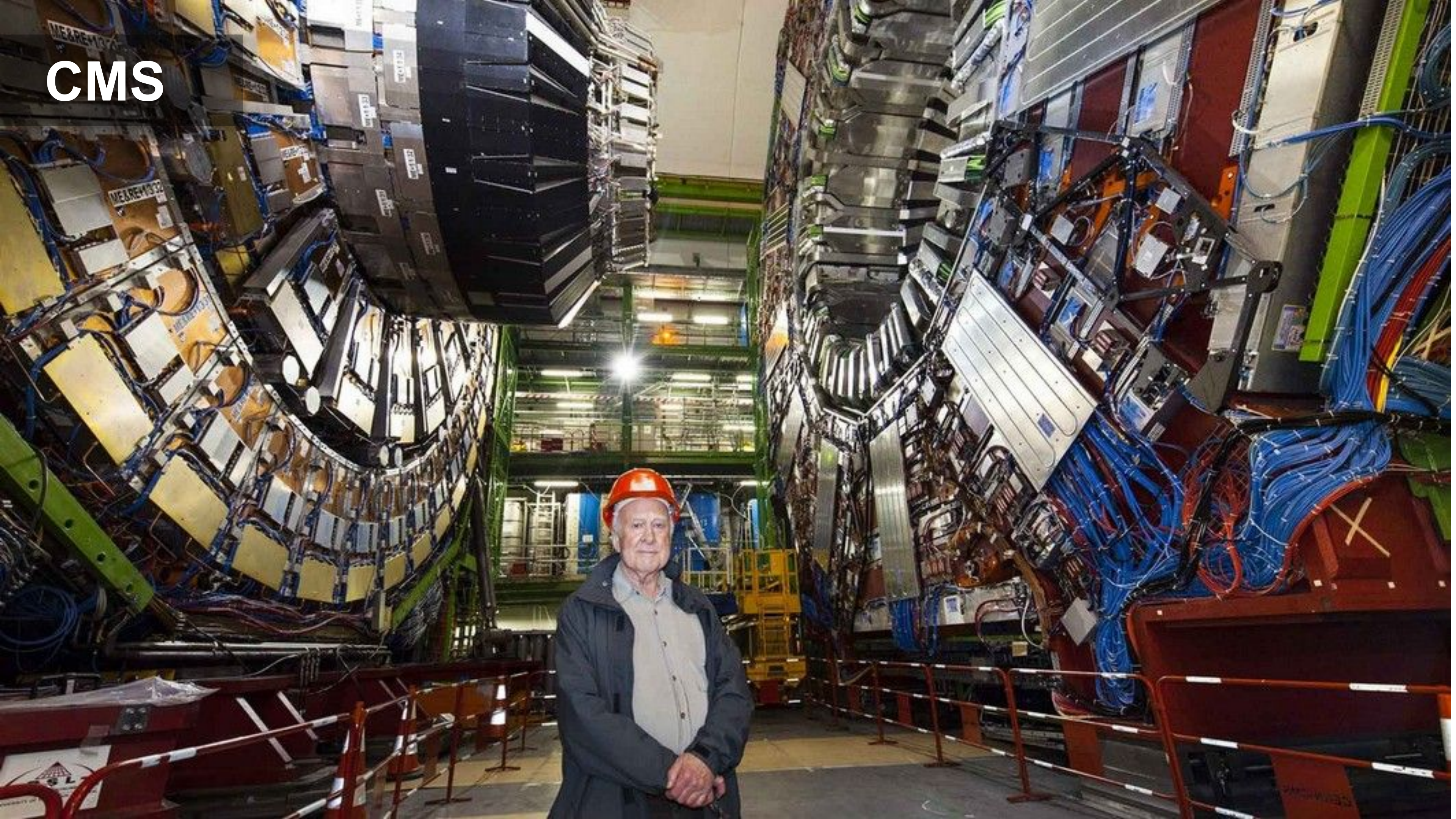

LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km

ALICE

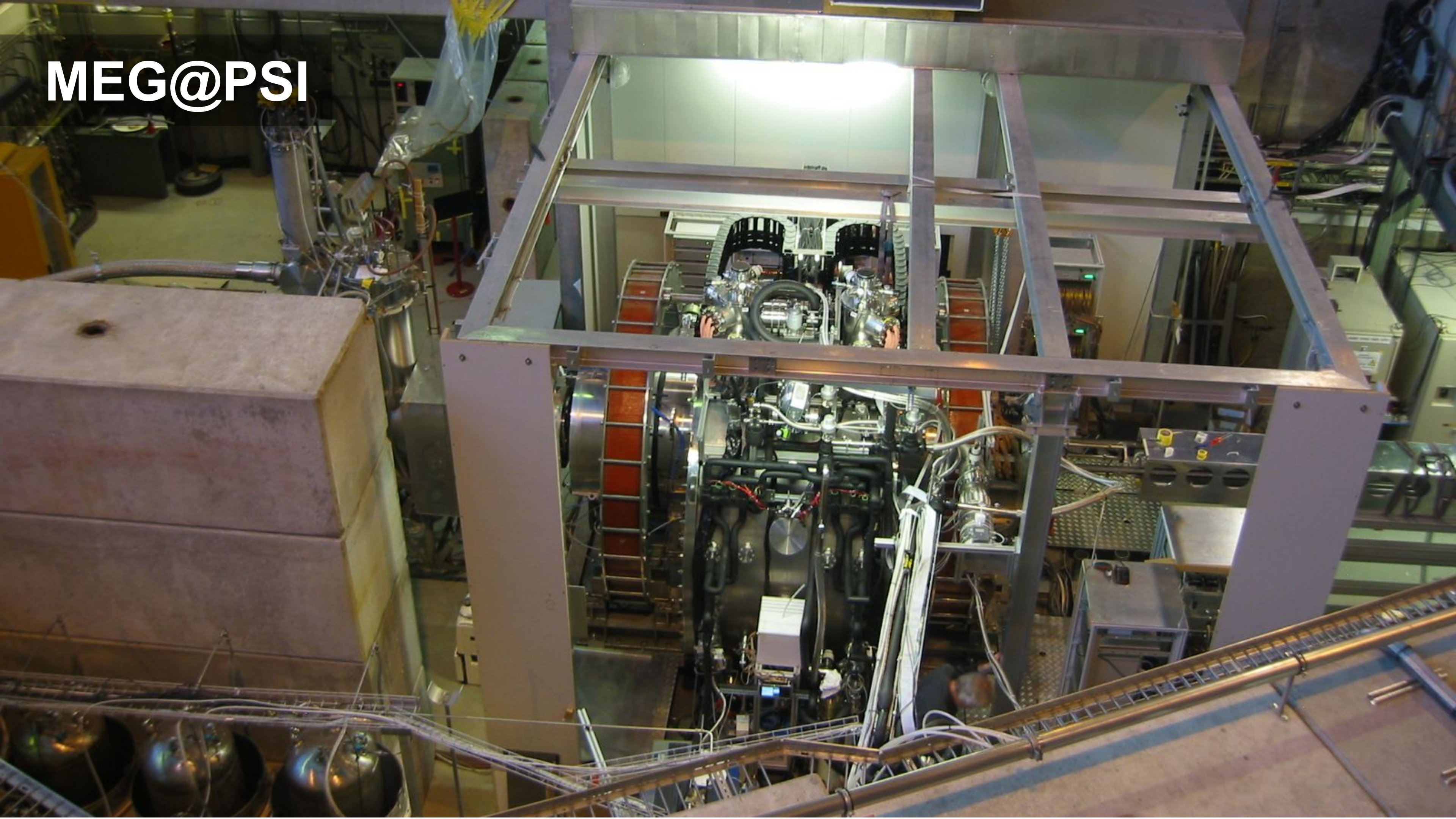
ATLAS



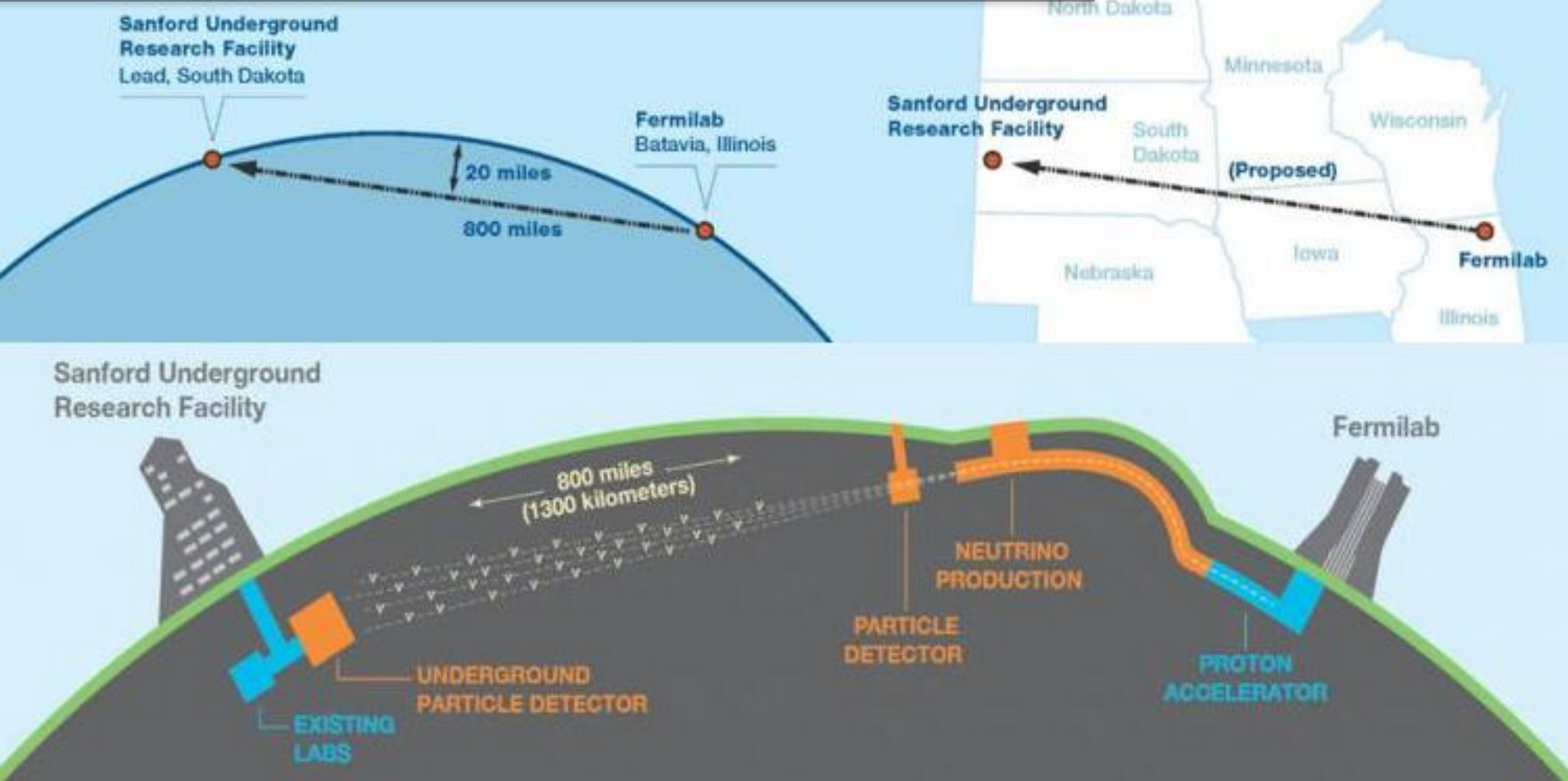
CMS



MEG@PSI

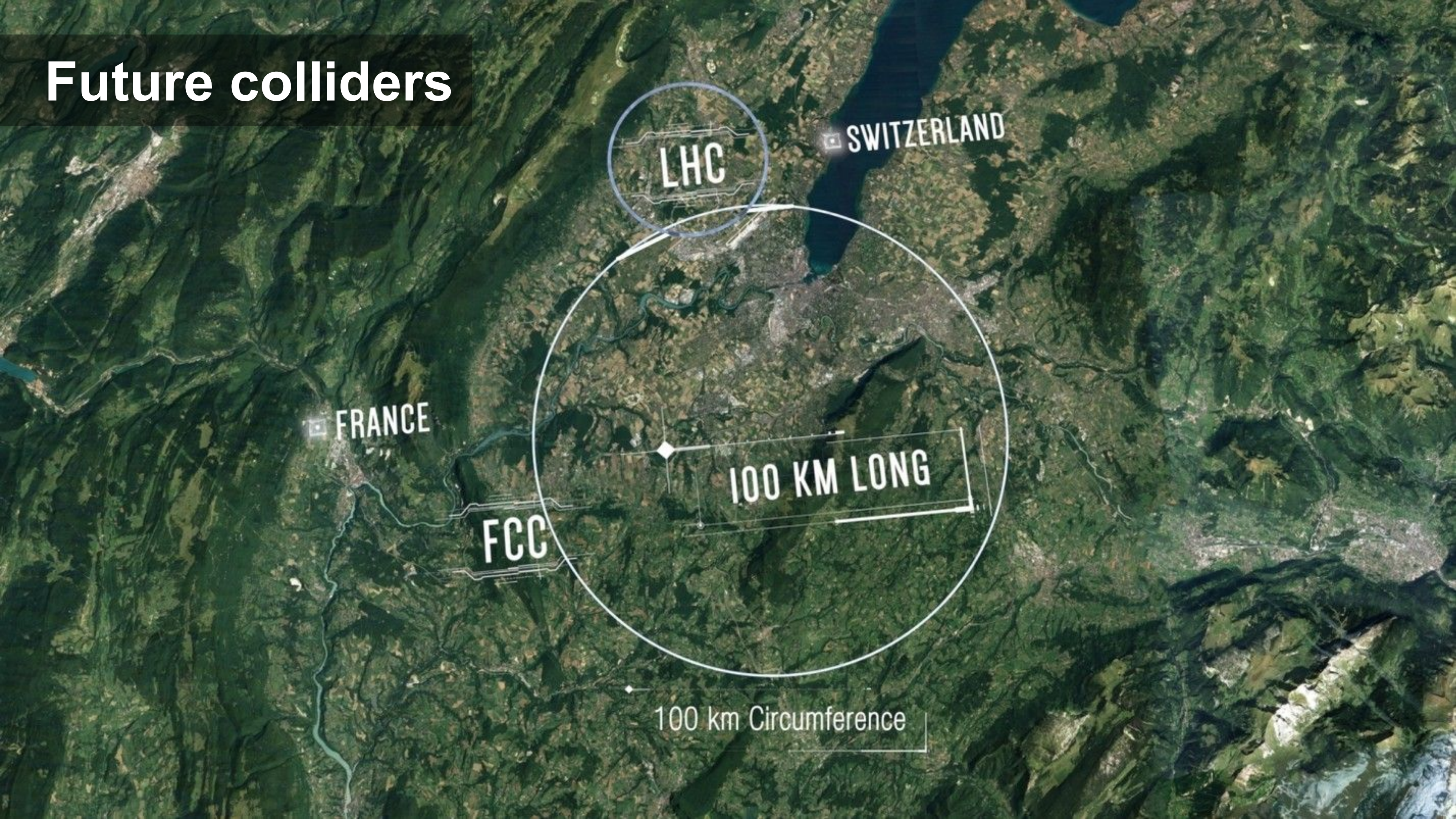


Deep Undergroud Neutrino Experiment



Quali sono i programmi **futuri**?

Future colliders



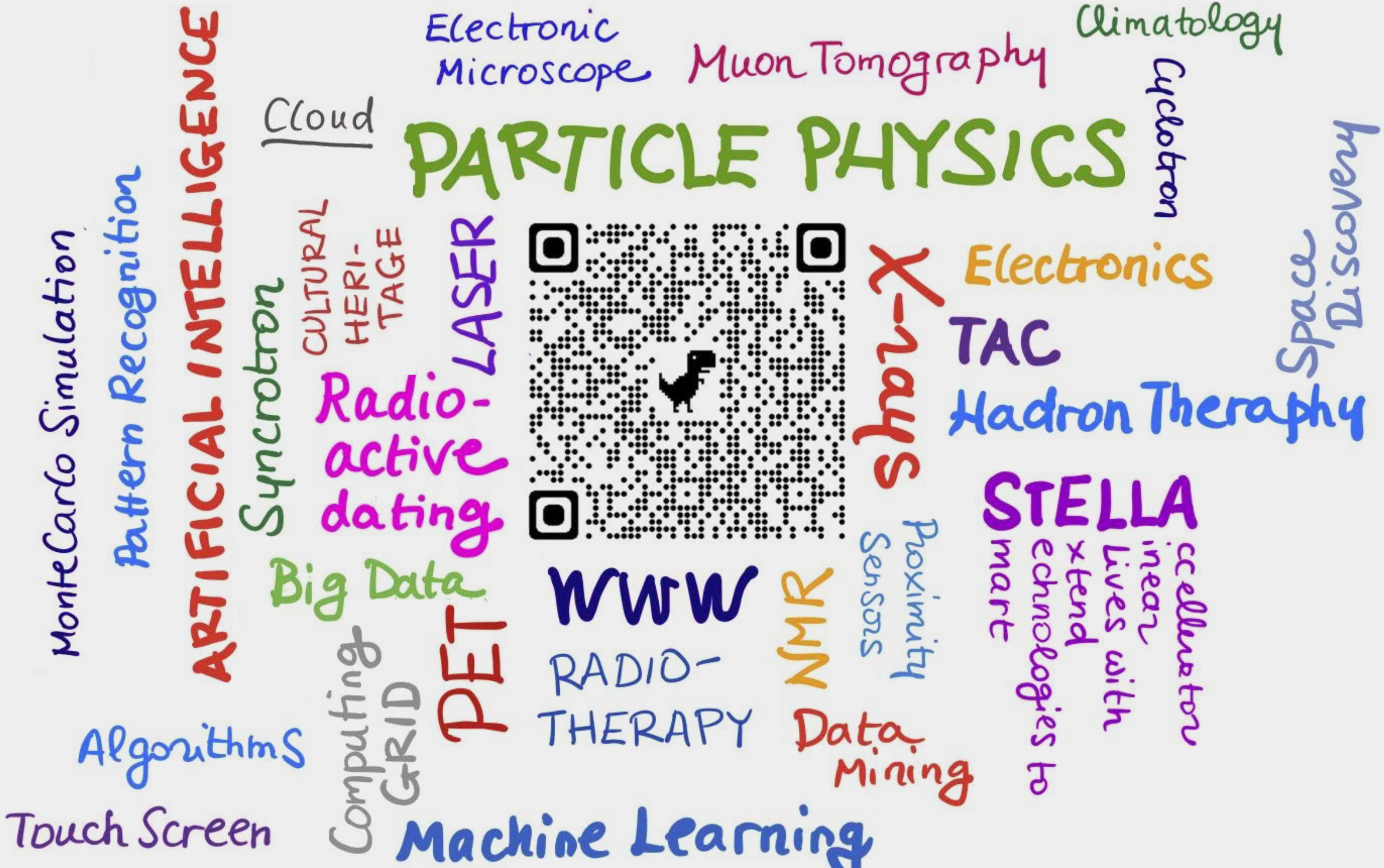
Physics Opportunities

International
MUON Collider
Collaboration

May 30, 2022
https://muoncollider.web.cern.ch

Muon Collider Physics Summary

Submitted to the Proceedings of the US Community Study
on the Future of Particle Physics (Snowmass 2021)



Electronic Microscope
Muon Tomography
Climatology
Cloud
PARTICLE PHYSICS
Cyclotron
ARTIFICIAL INTELLIGENCE
MonteCarlo Simulation
Pattern Recognition
Syncrotron
CULTURAL HERI-TAGE
LASER
Radio-active dating
X-rays
Electronics
TAC
Space Discovery
Hadron Theraphy
STELLA
mart
echnologies to
xtend
Lives with
inear
ccelerator
Proximity Sensors
Big Data
WWW
NMR
PET
RADIO-THERAPY
Data Mining
Computing GRID
Algorithms
Touch Screen
Machine Learning