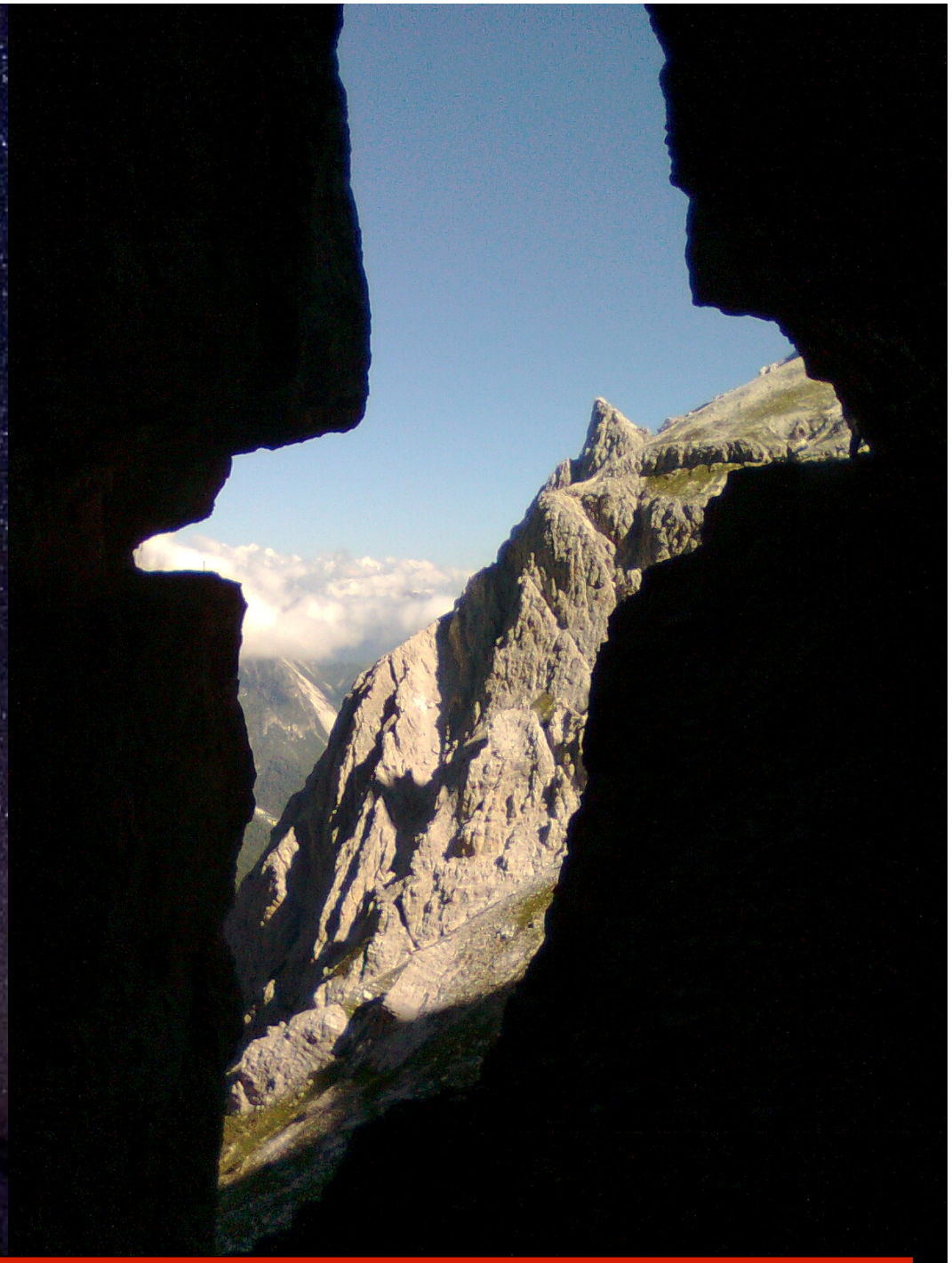
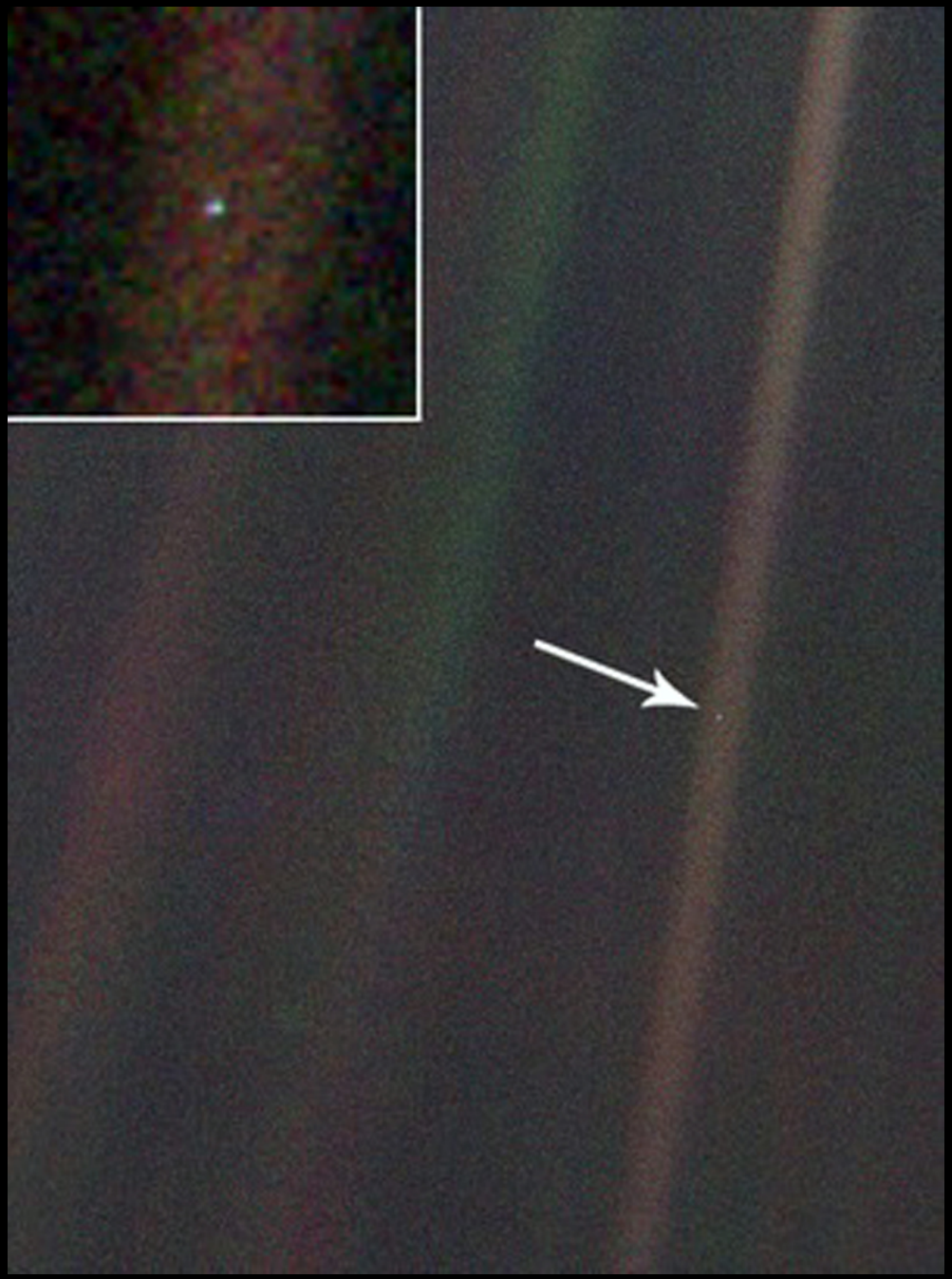
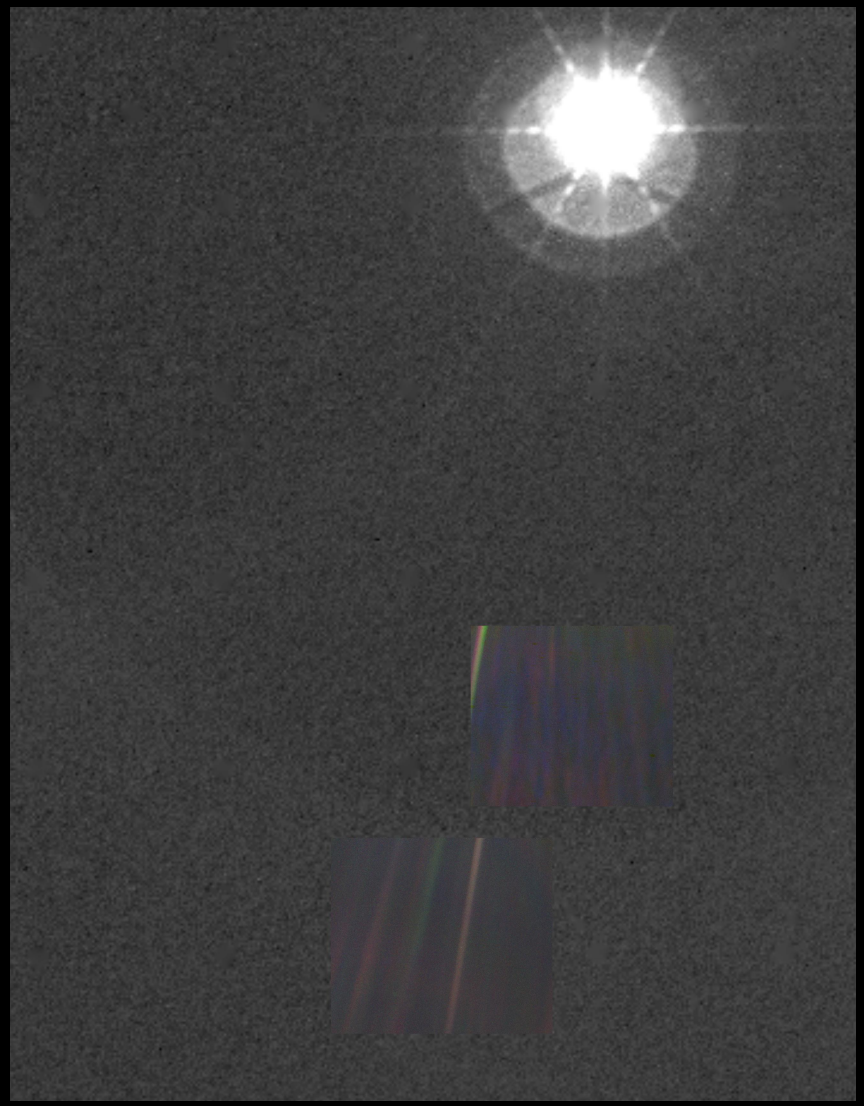
Barbara Sciascia (INFN)

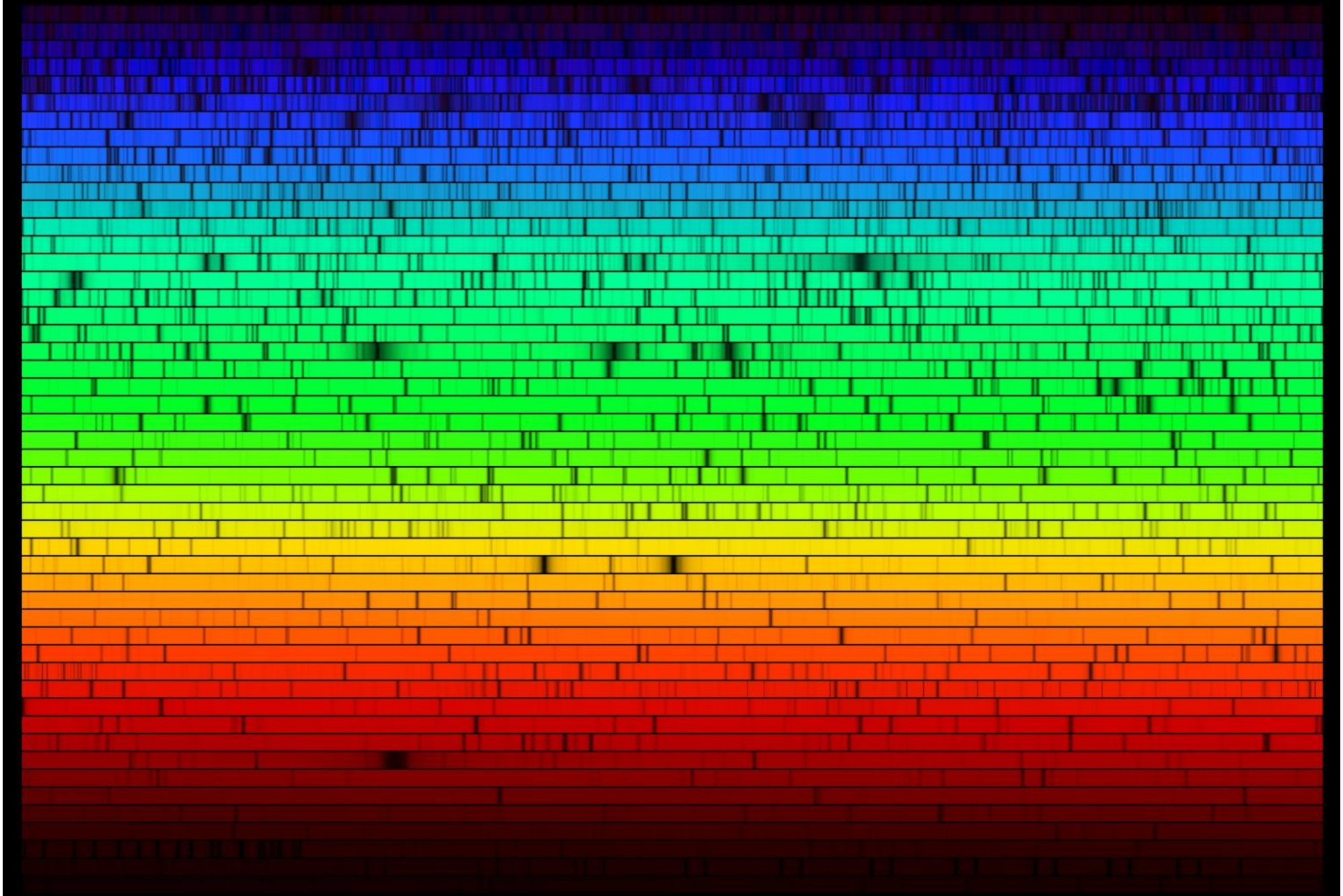
23 maggio 2015
LNF Open Day

Io dico l'Universo

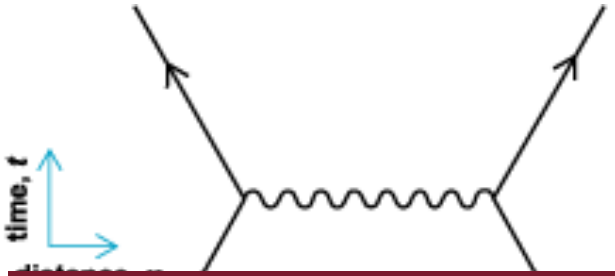


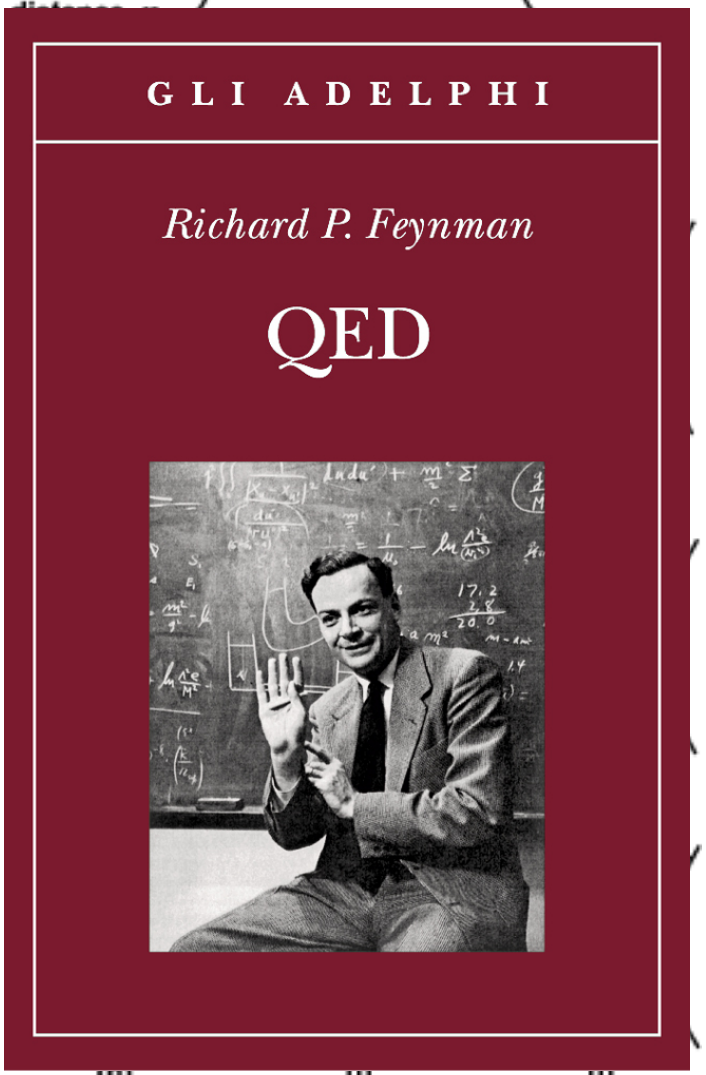






Tra teoria ed esperimento





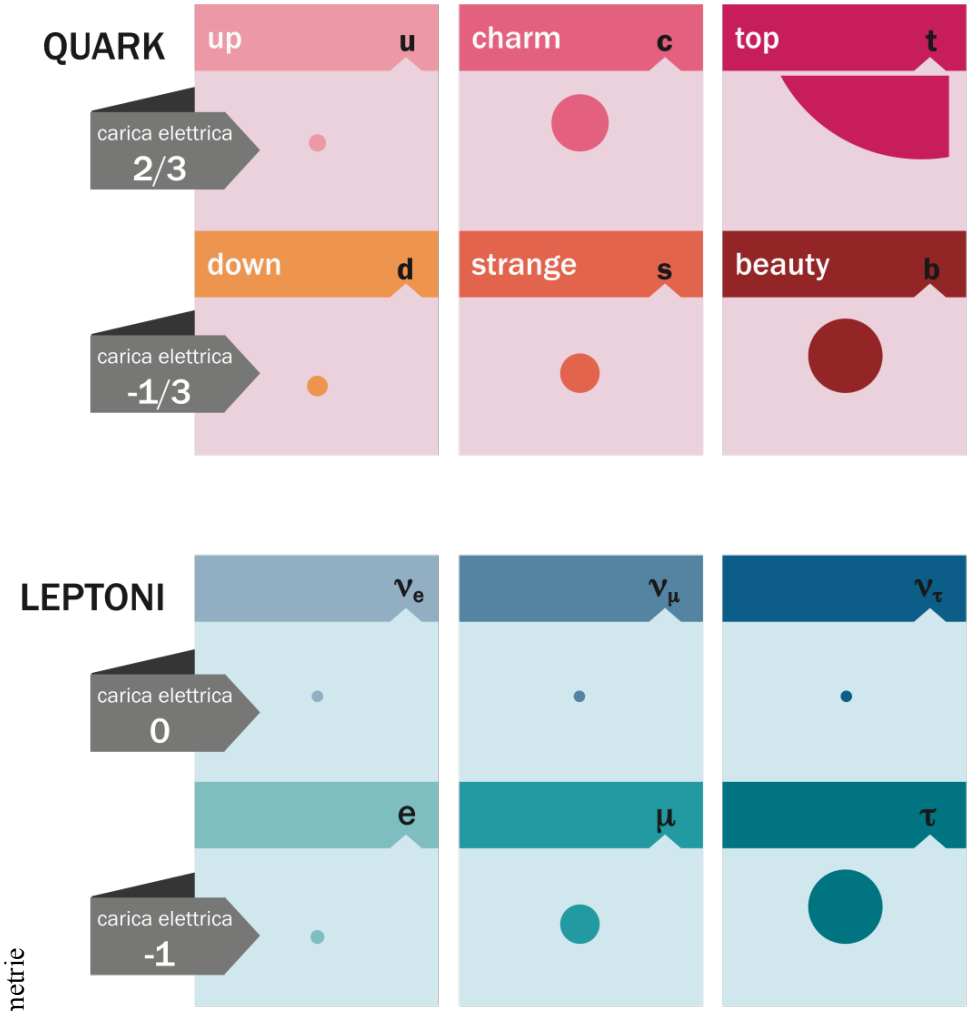
United Nations
Educational, Scientific and
Cultural Organization

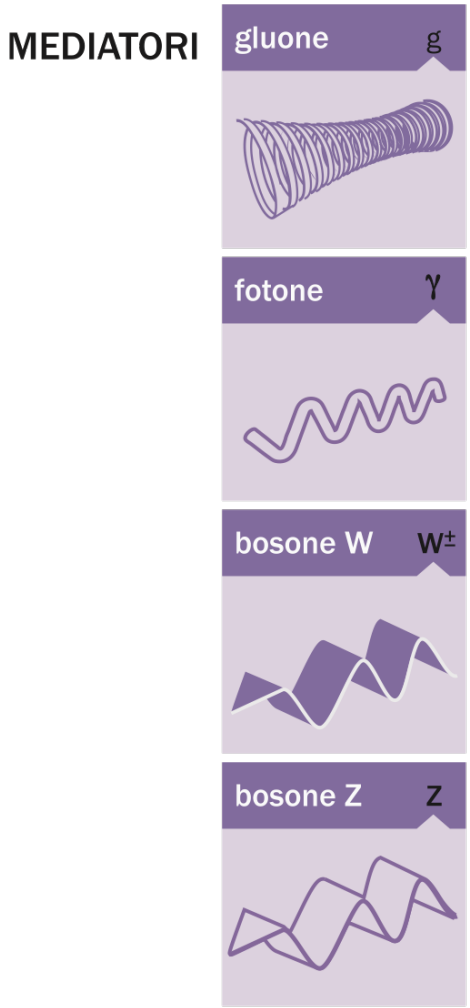
International
Year of Light
2015

Di che cosa è fatto l'universo

“Modello chimico”: tavola periodica

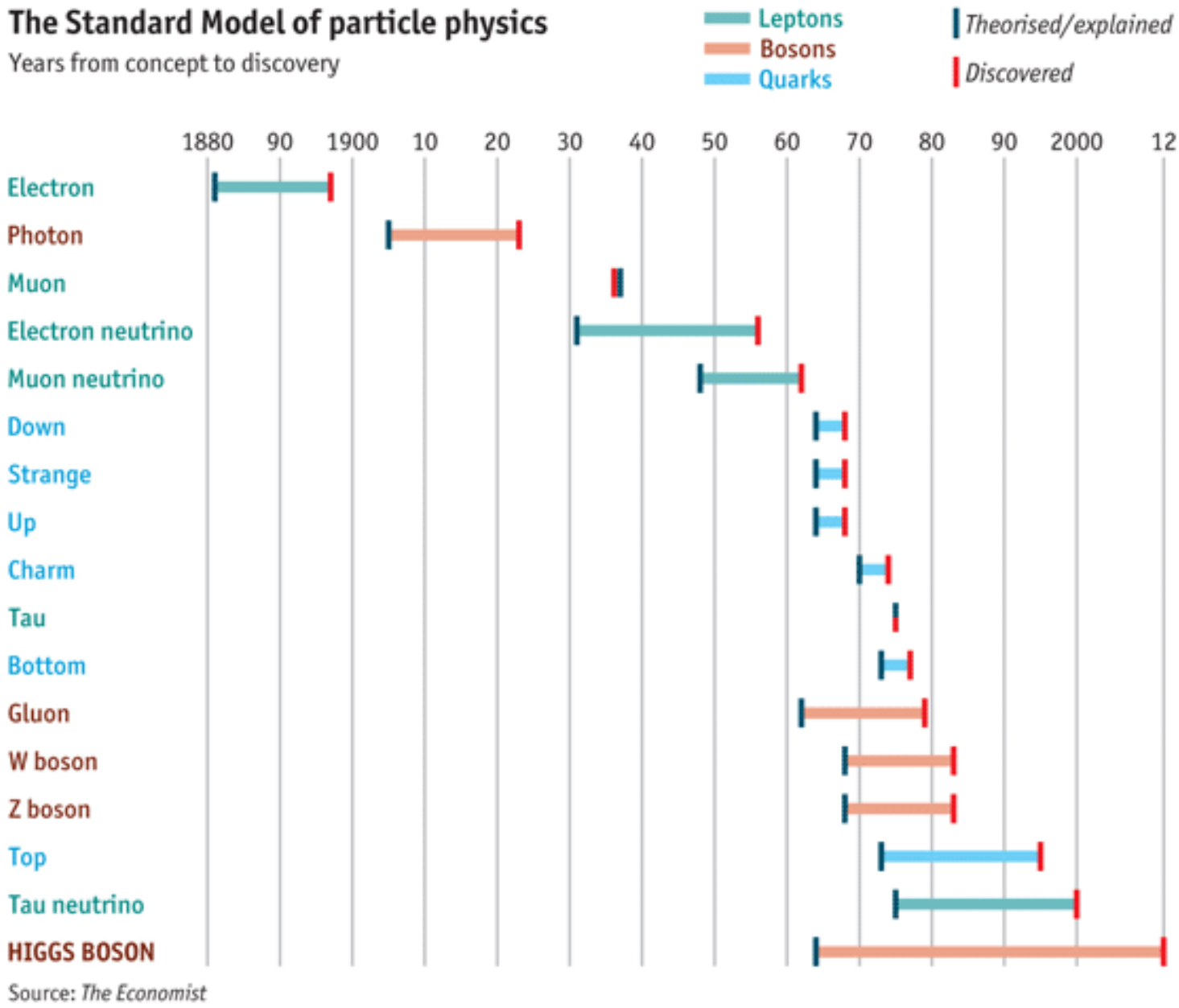
Modello Standard: una nuova tavola



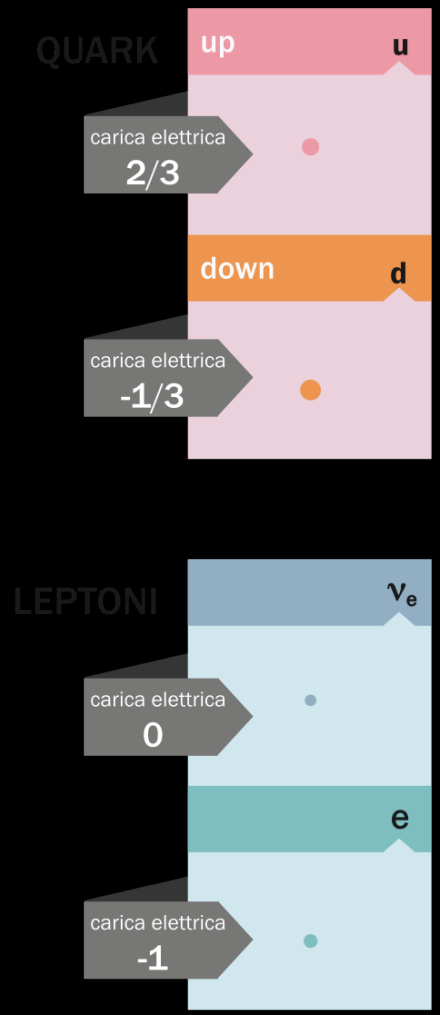


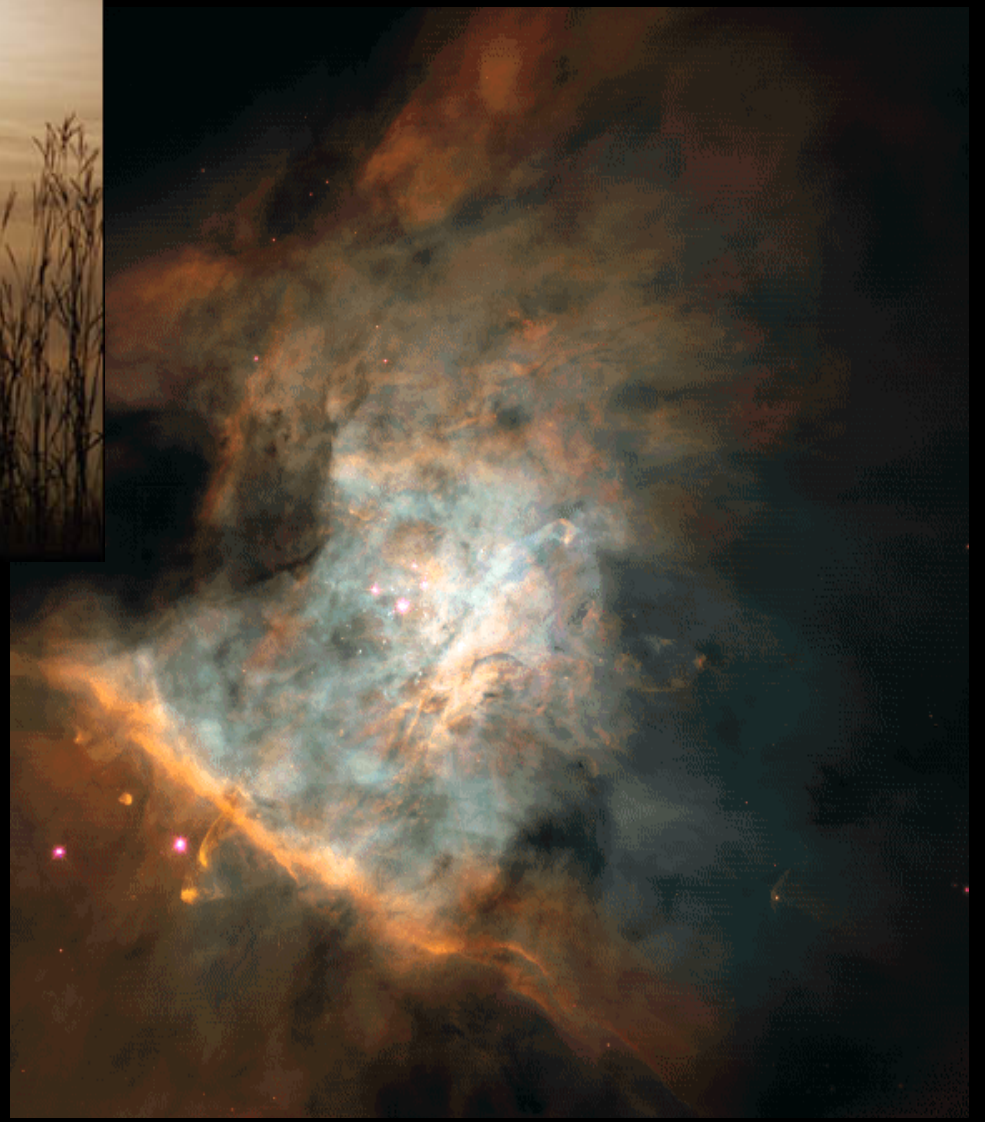
Credits: Asimmetrie

Modello Standard: 130 anni di scoperte

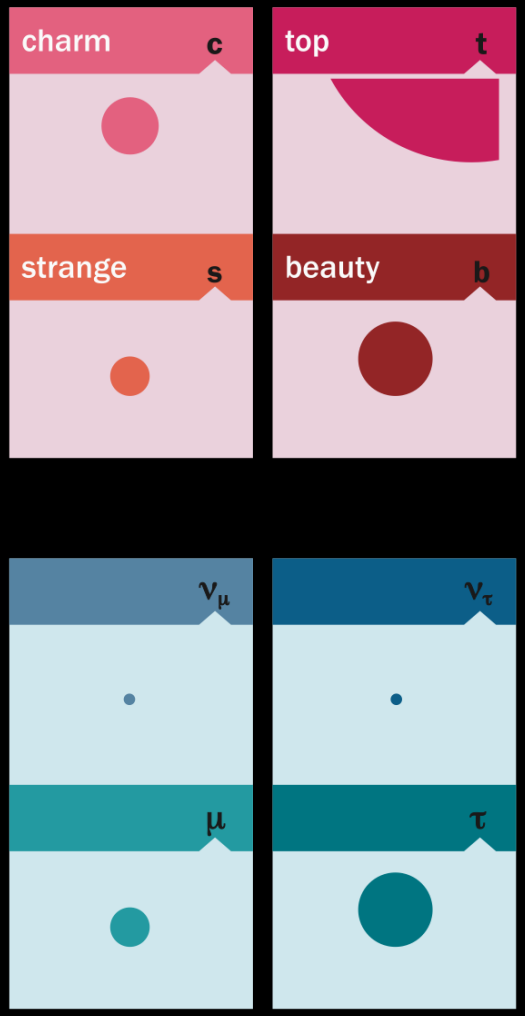


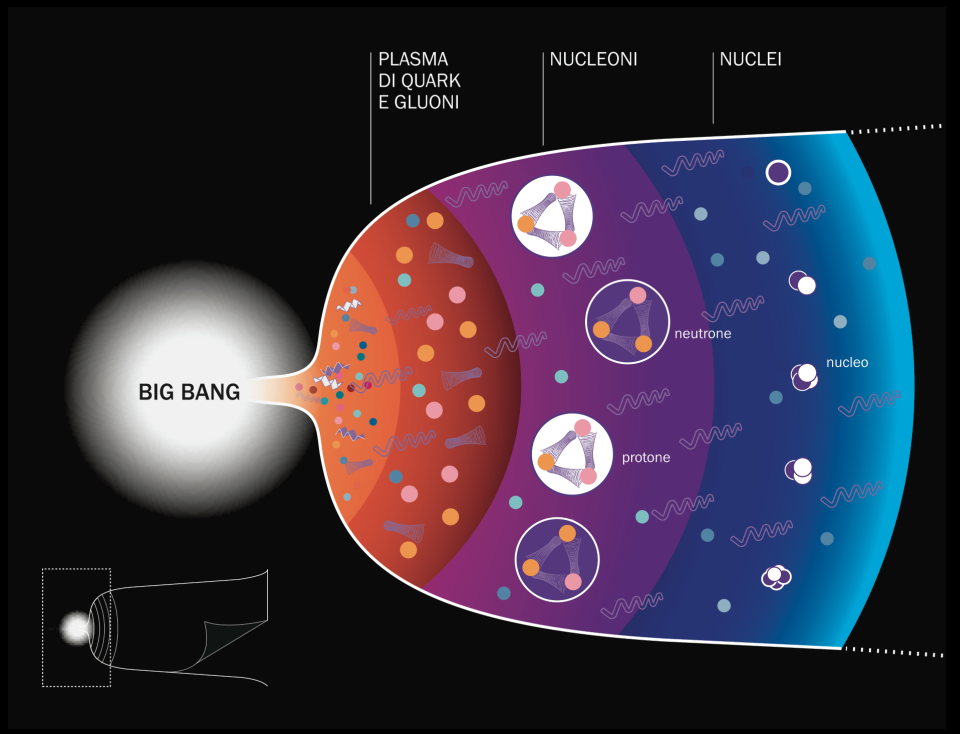
Materia "ordinaria"



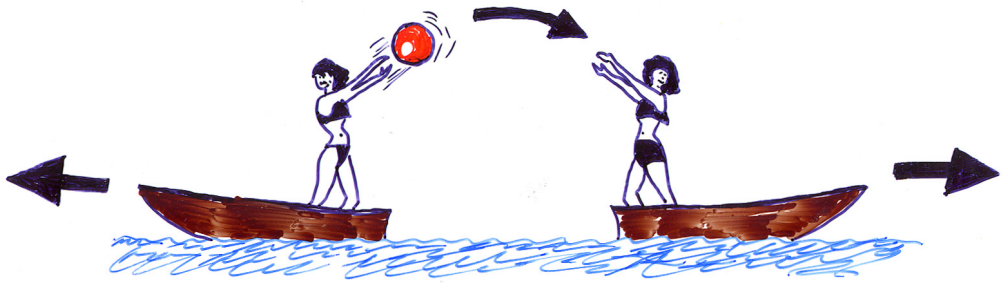


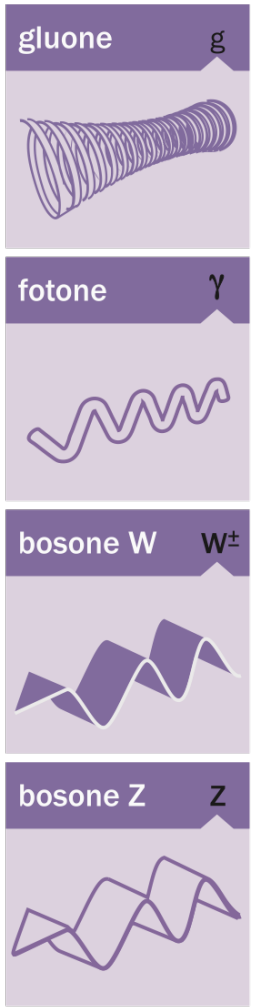
“solo” più pesante (?)





Mediatori delle forze

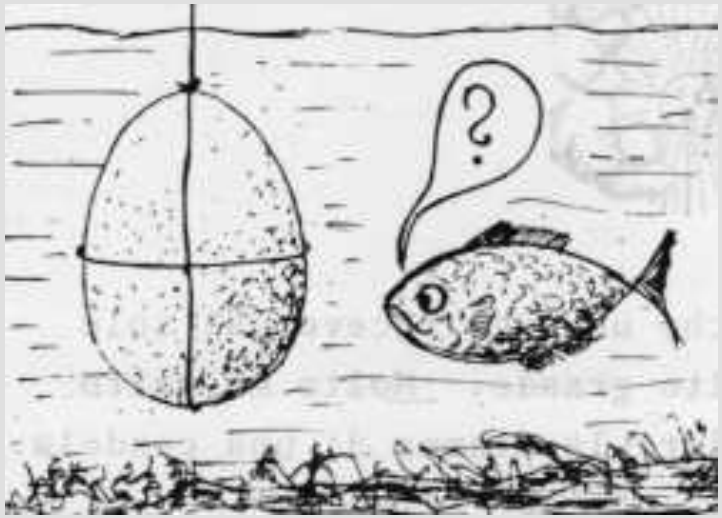


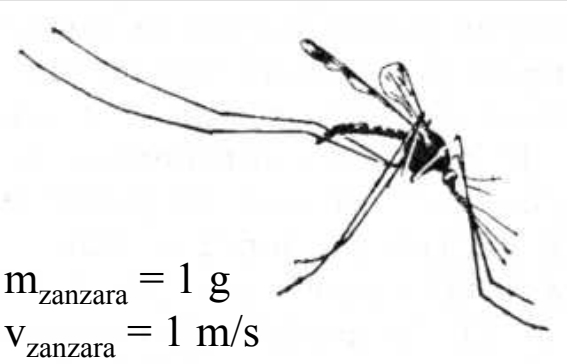


Il bosone di Higgs

Large Hadron Collider (LHC)

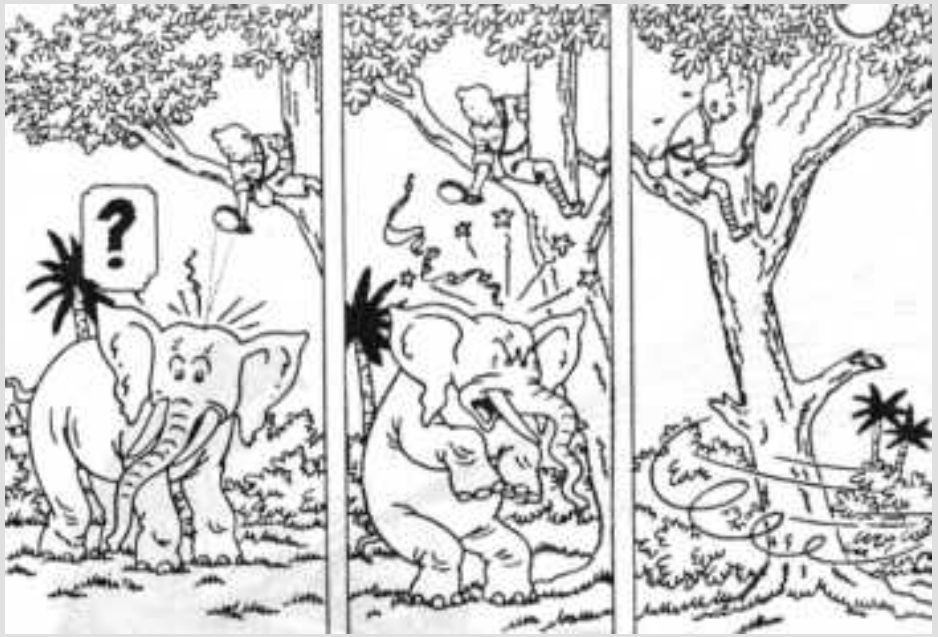
Fisica delle "alte" energie





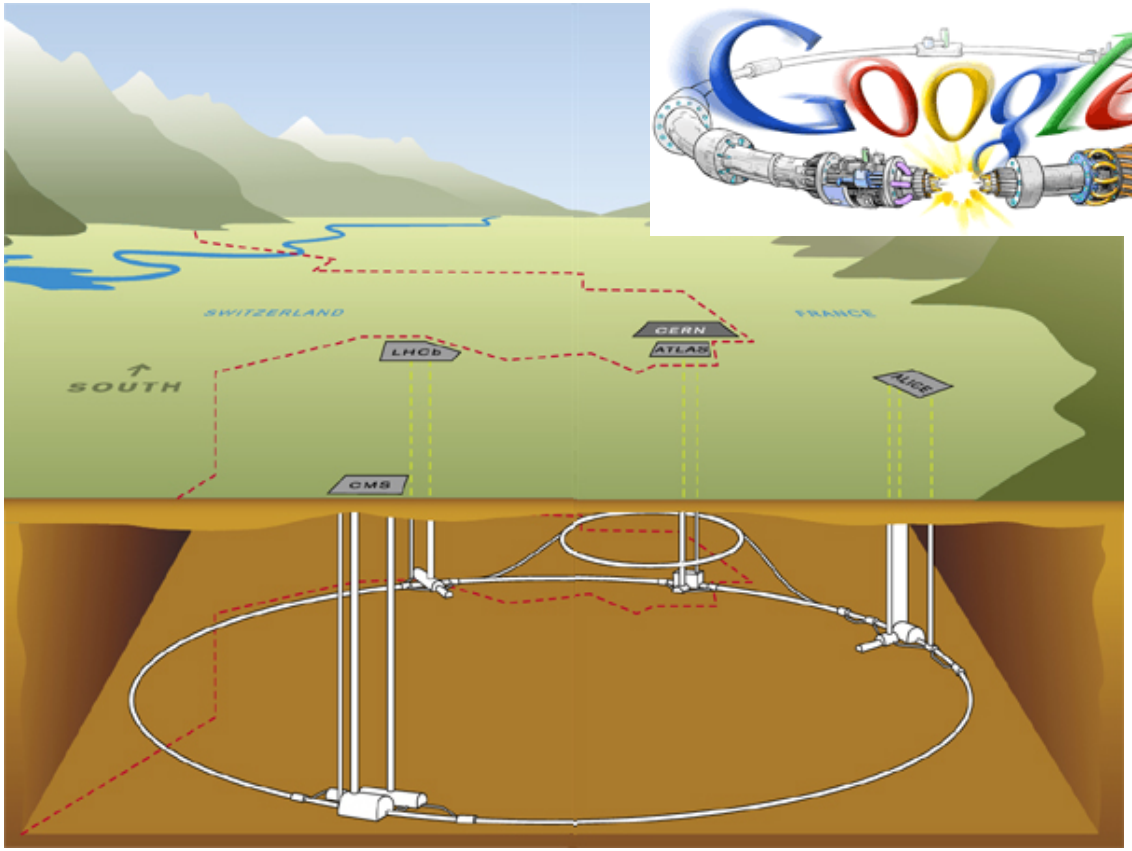
$m_{zanzara} = 1$ g
$v_{zanzara} = 1$ m/s

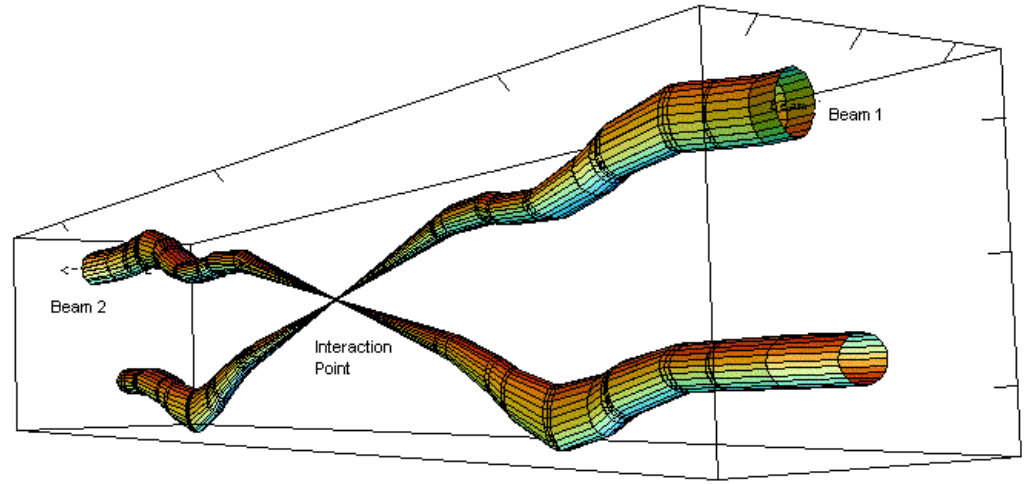
LHC(2015):
13 TeV



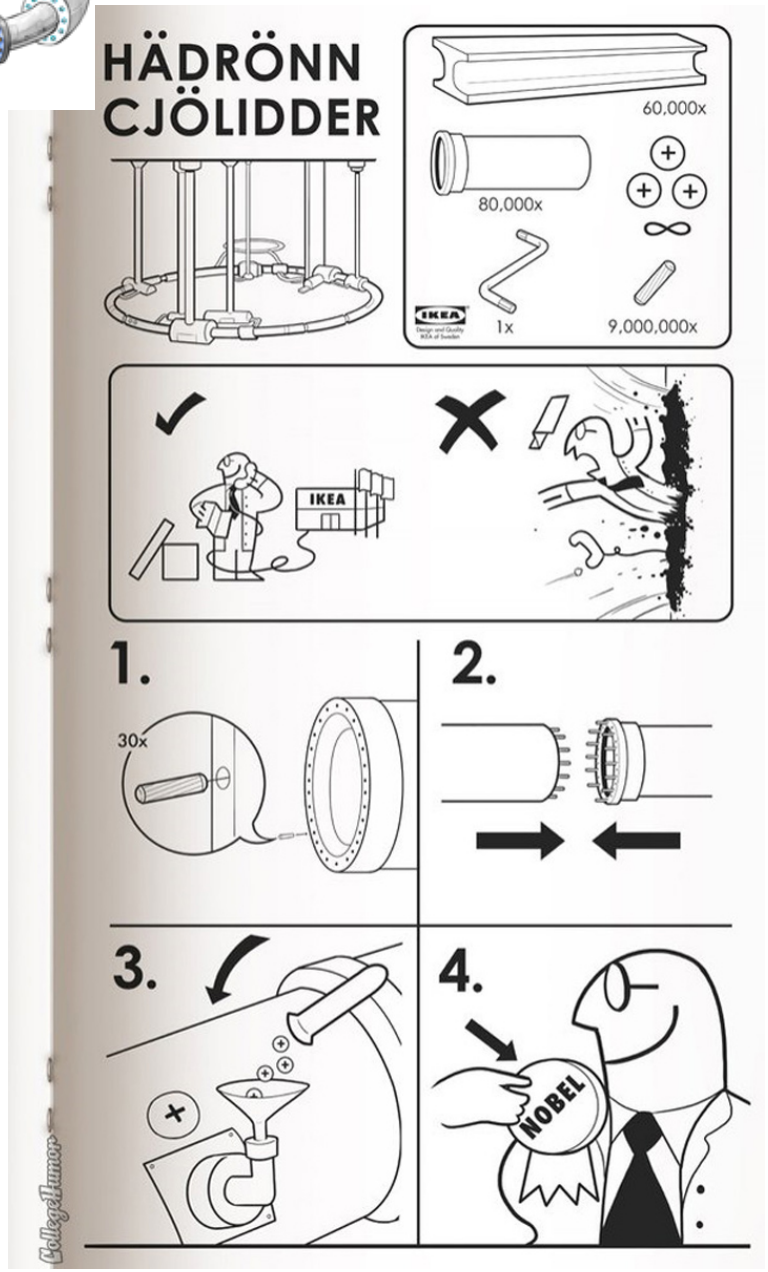
$E_{zanzara} = 10^{-3}$ J $= 6.25 \times 10^{15}$ eV $=$ **6.25 × 10³ TeV**

LHC

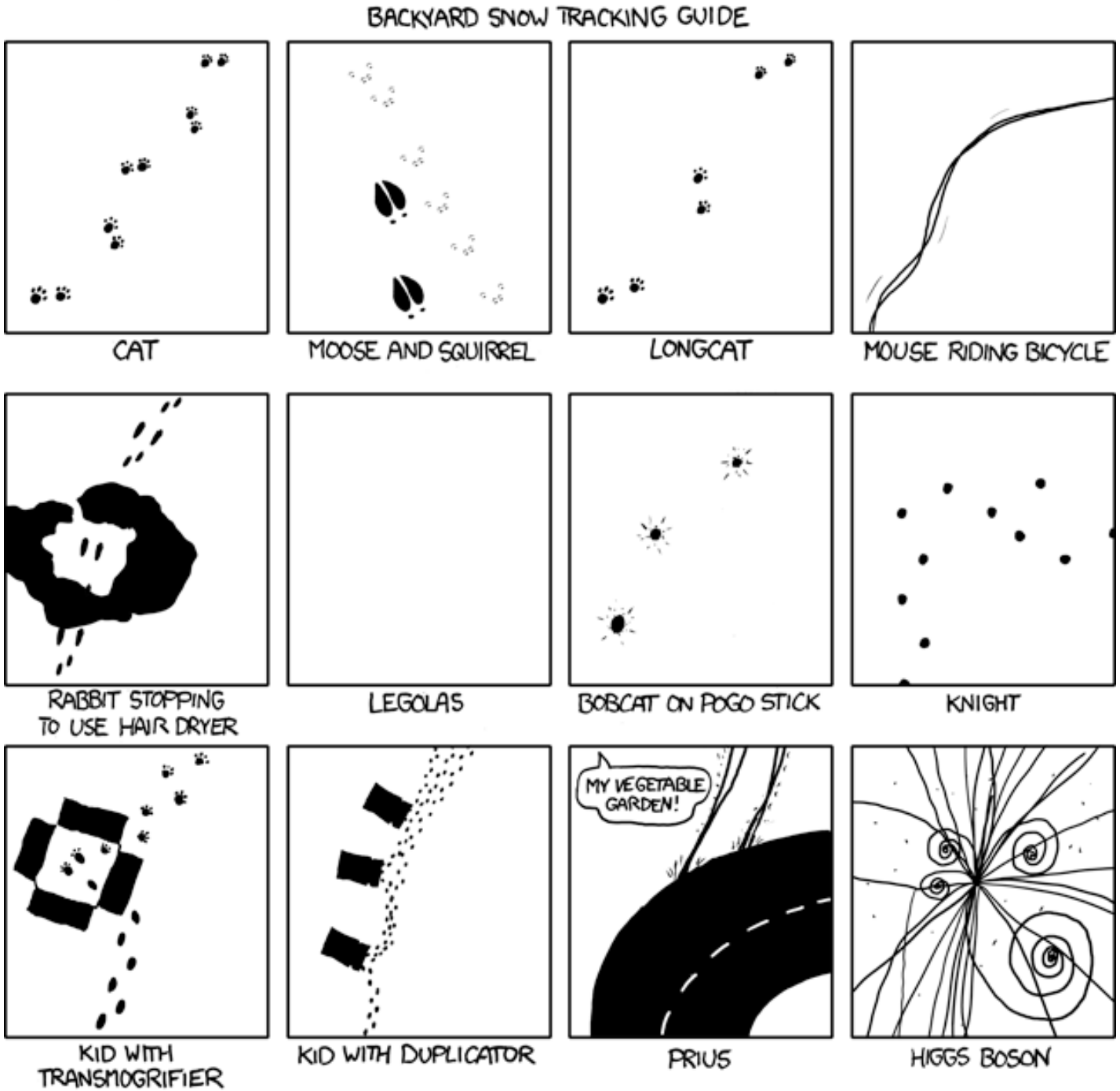




Relative beam sizes around IP1 (Atlas) in collision

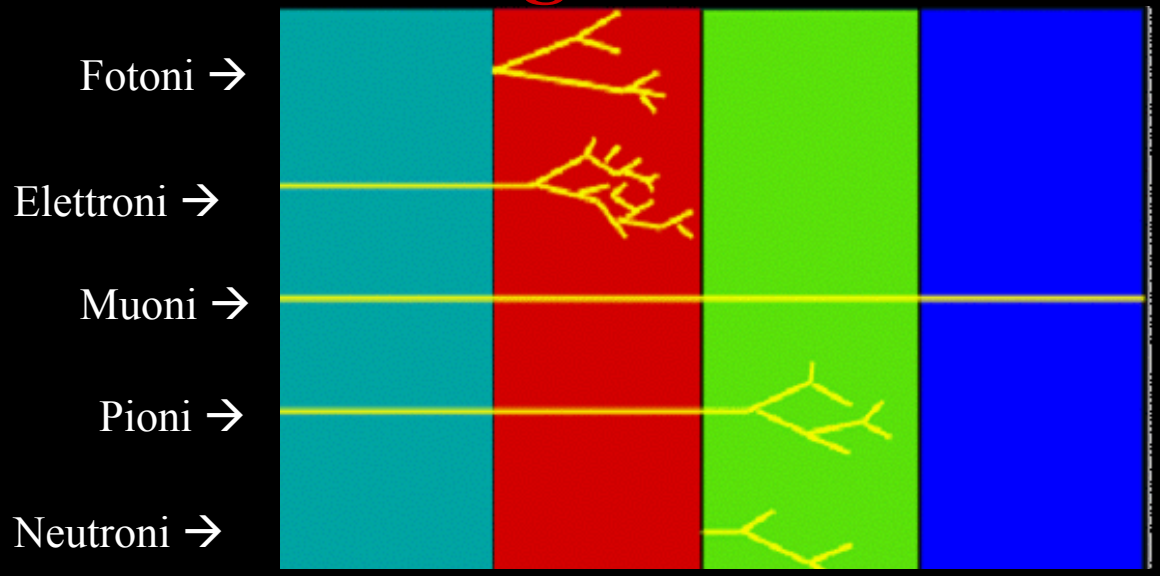


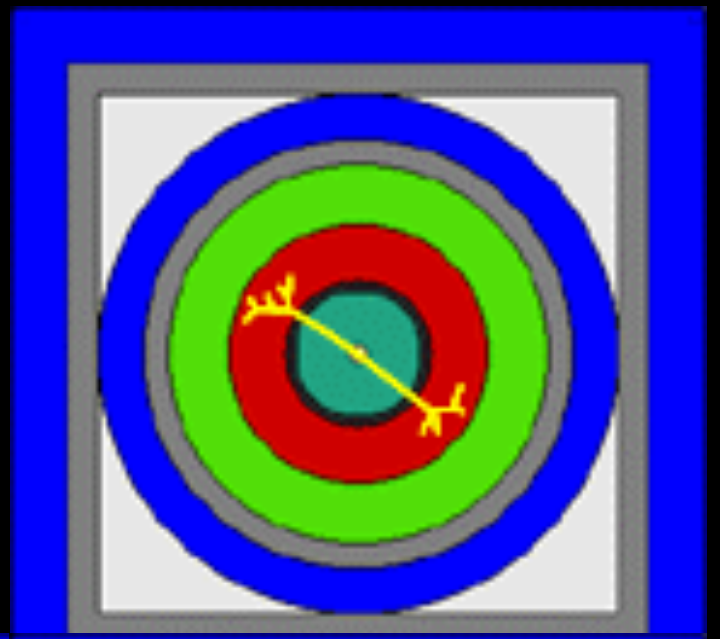
Vedere le particelle?

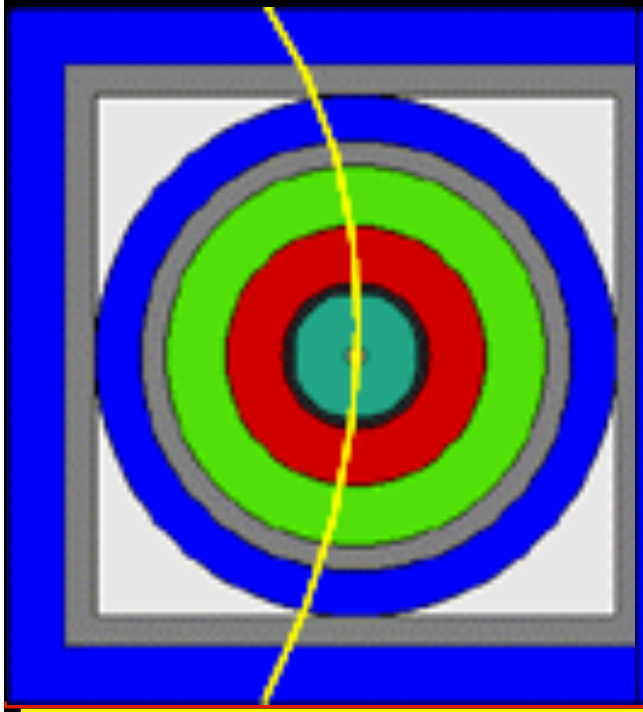


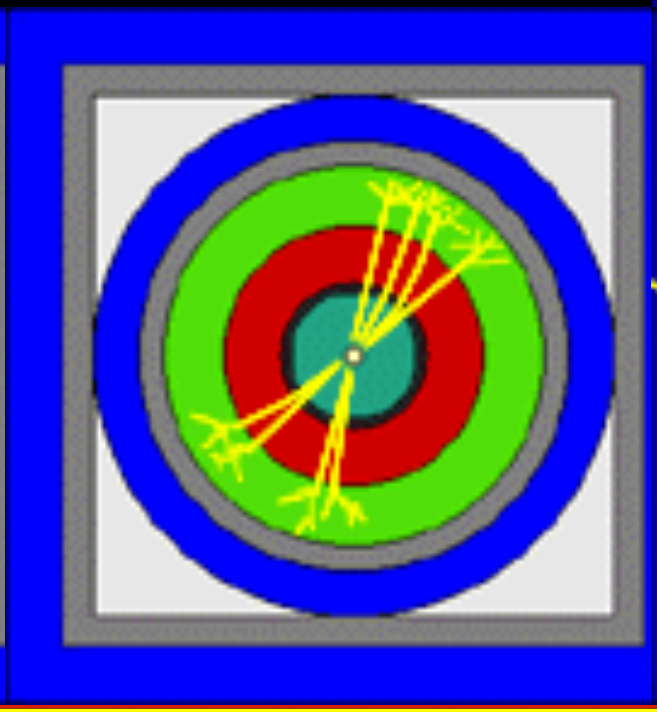
[https://xkcd.com/702/]

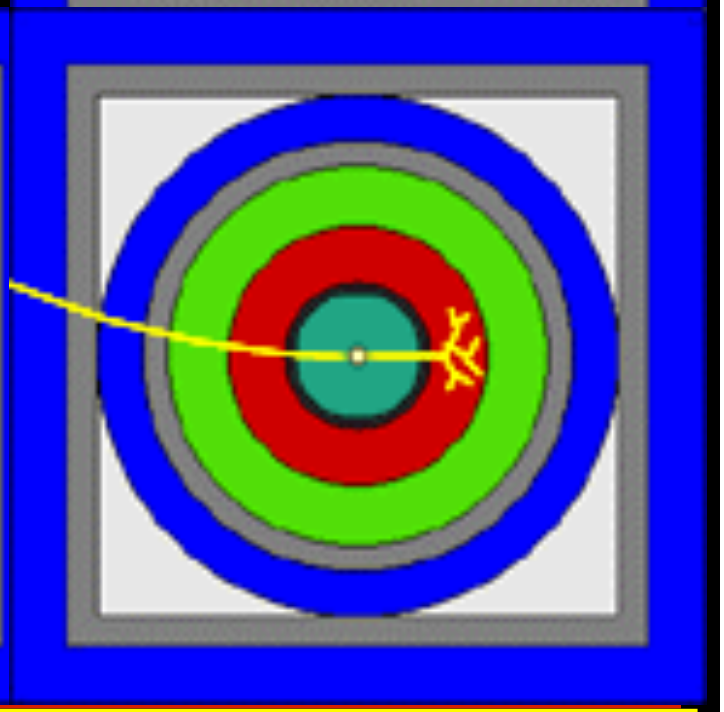
Riconoscere gli eventi

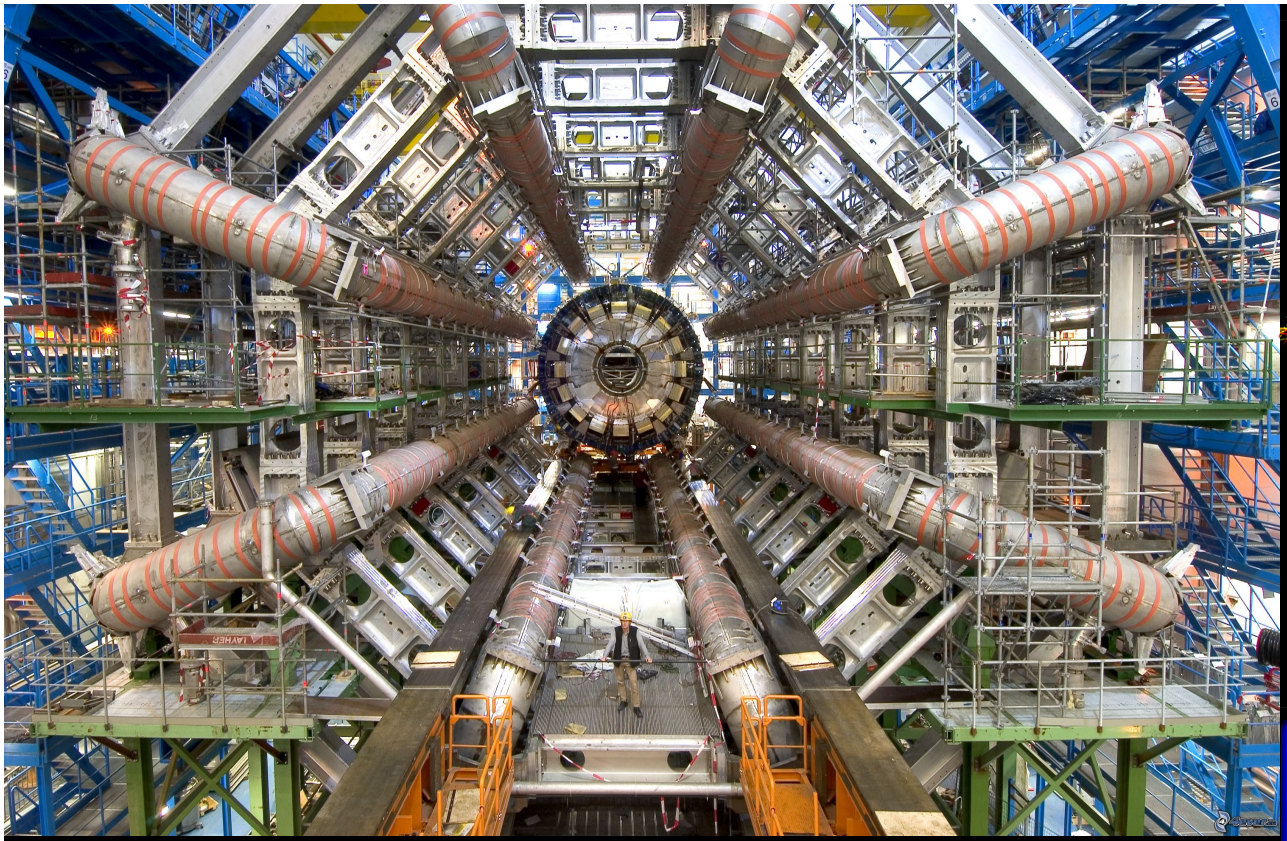


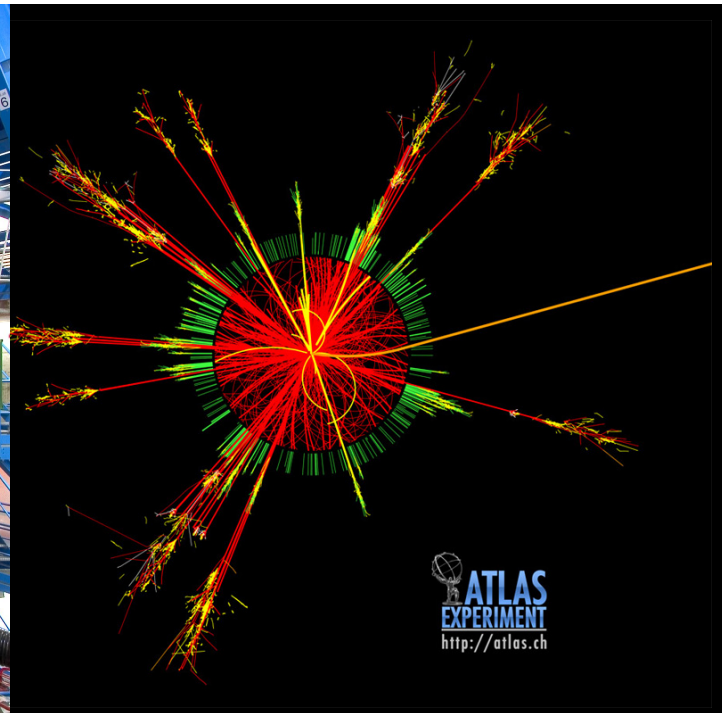


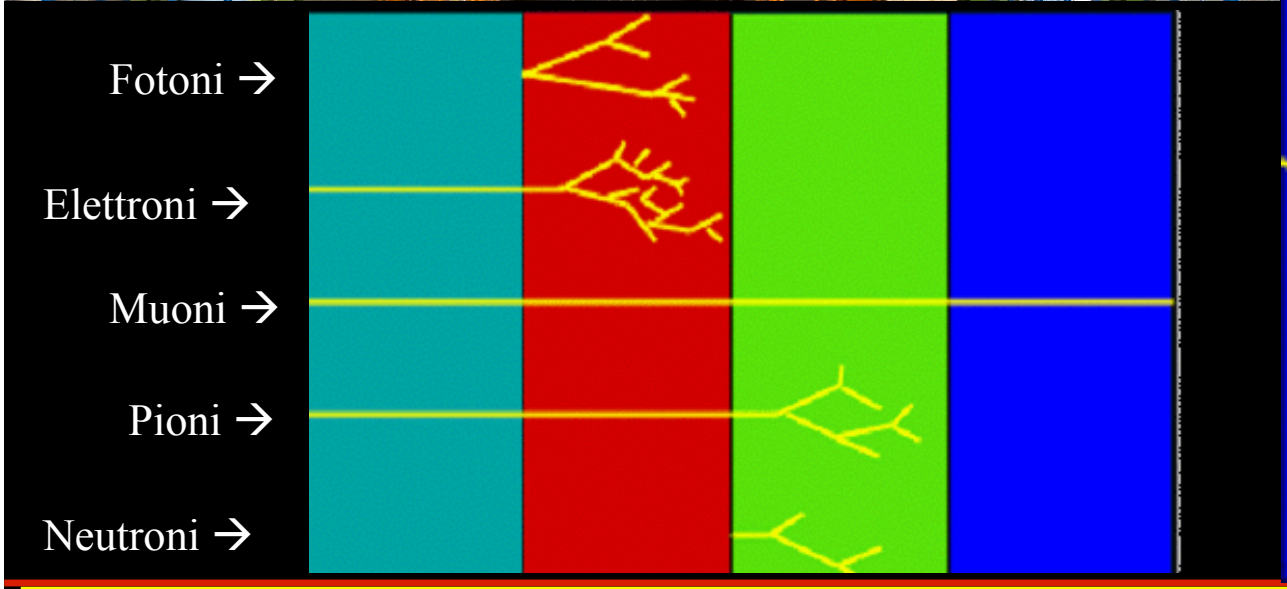


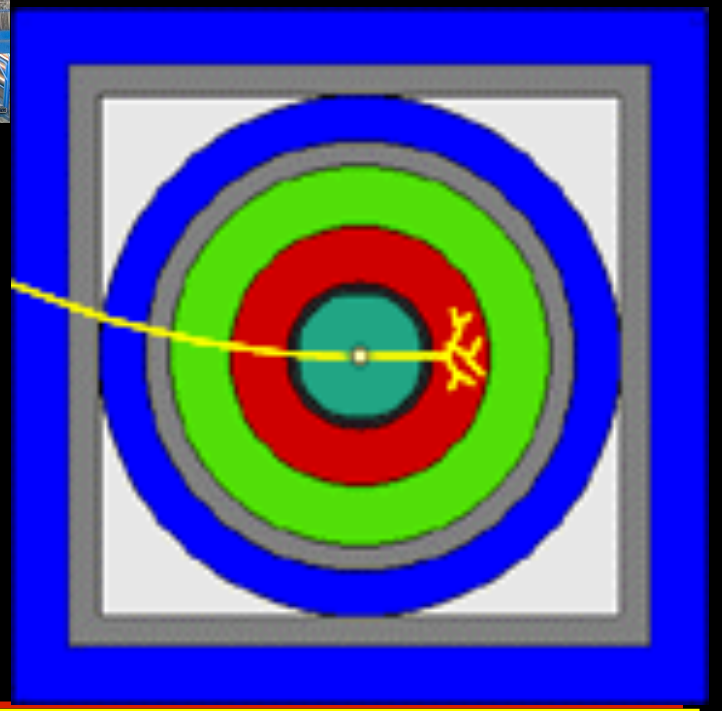




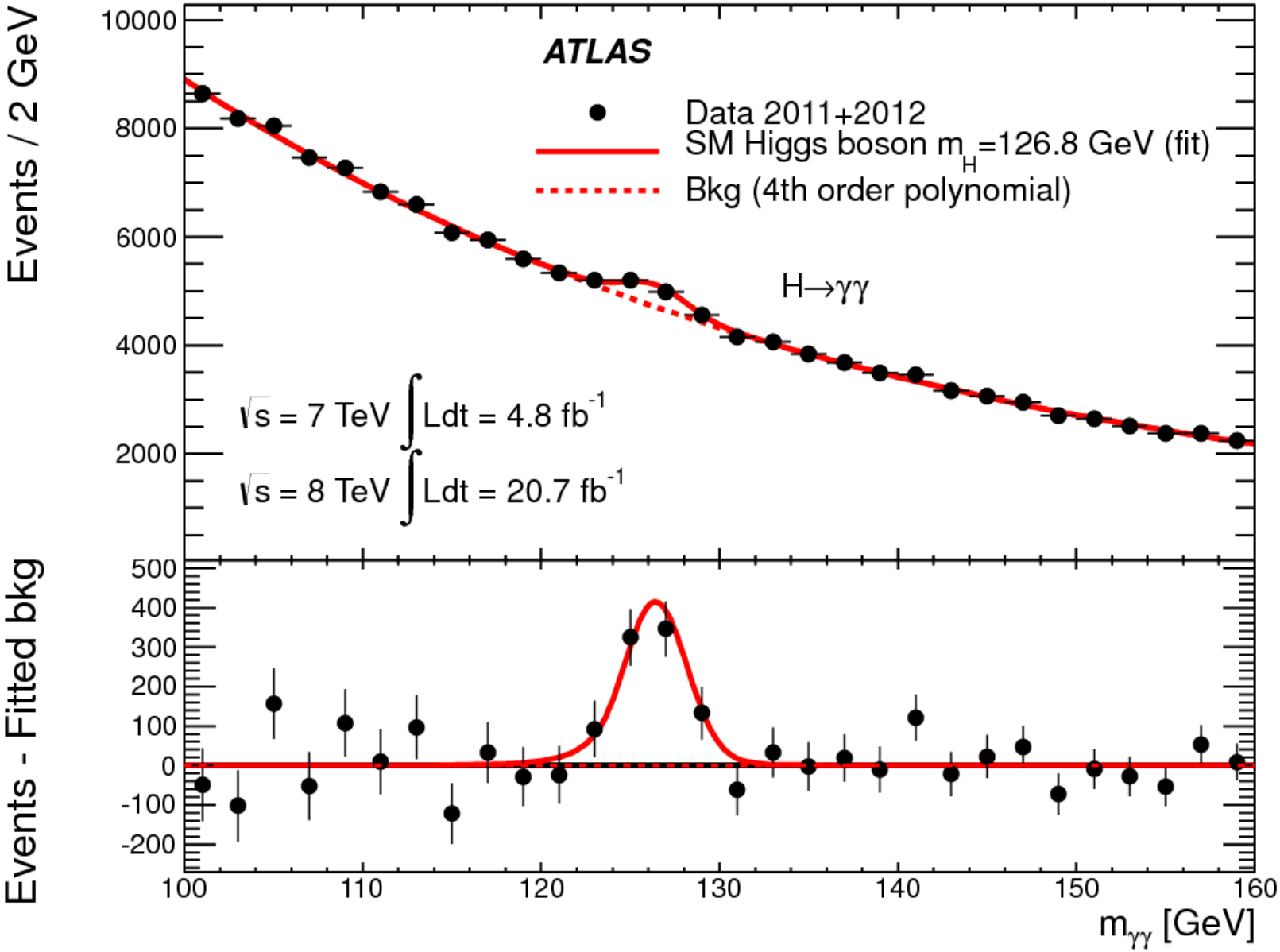


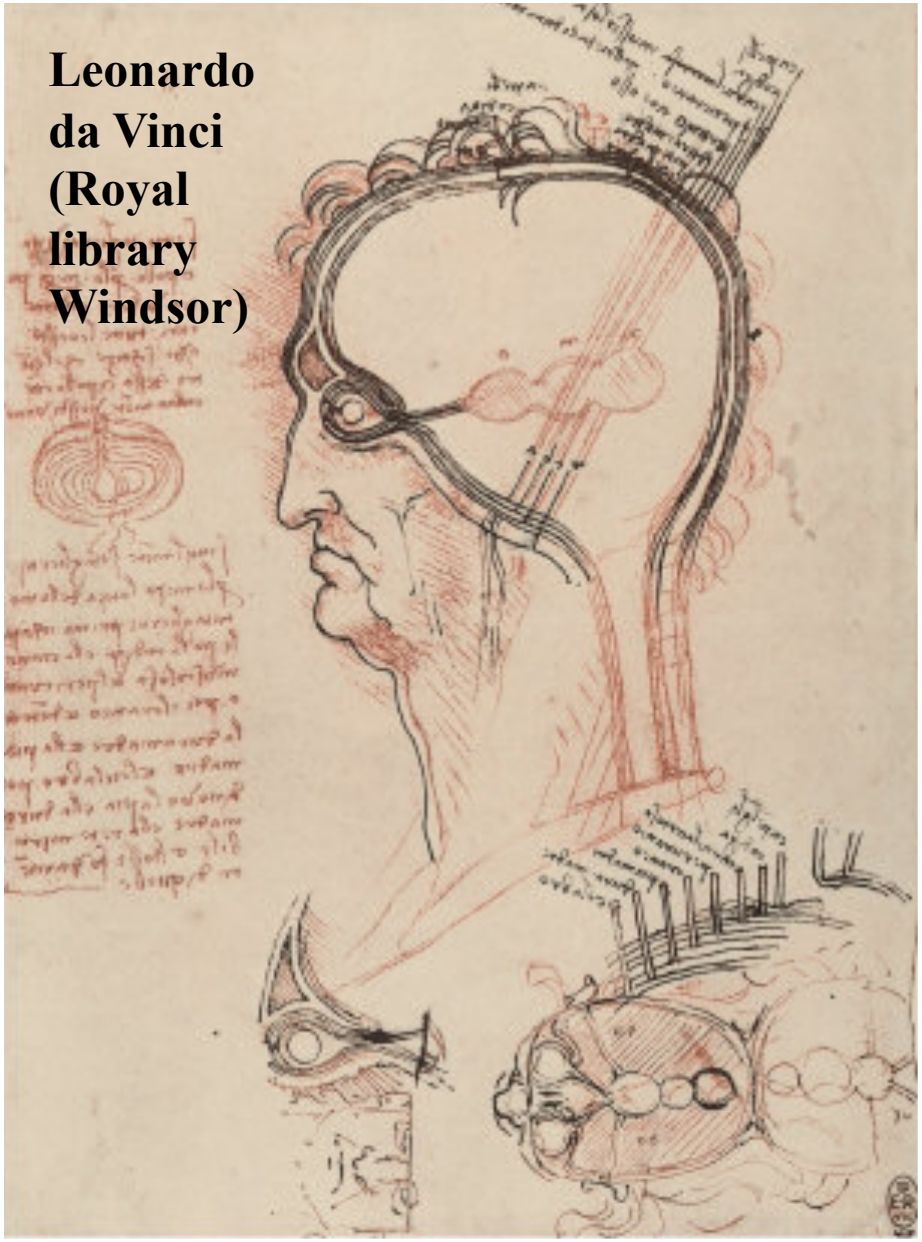

ATLAS
EXPERIMENT
http://atlas.ch


Fotoni →
Elettroni →
Muoni →
Pioni →
Neutroni →

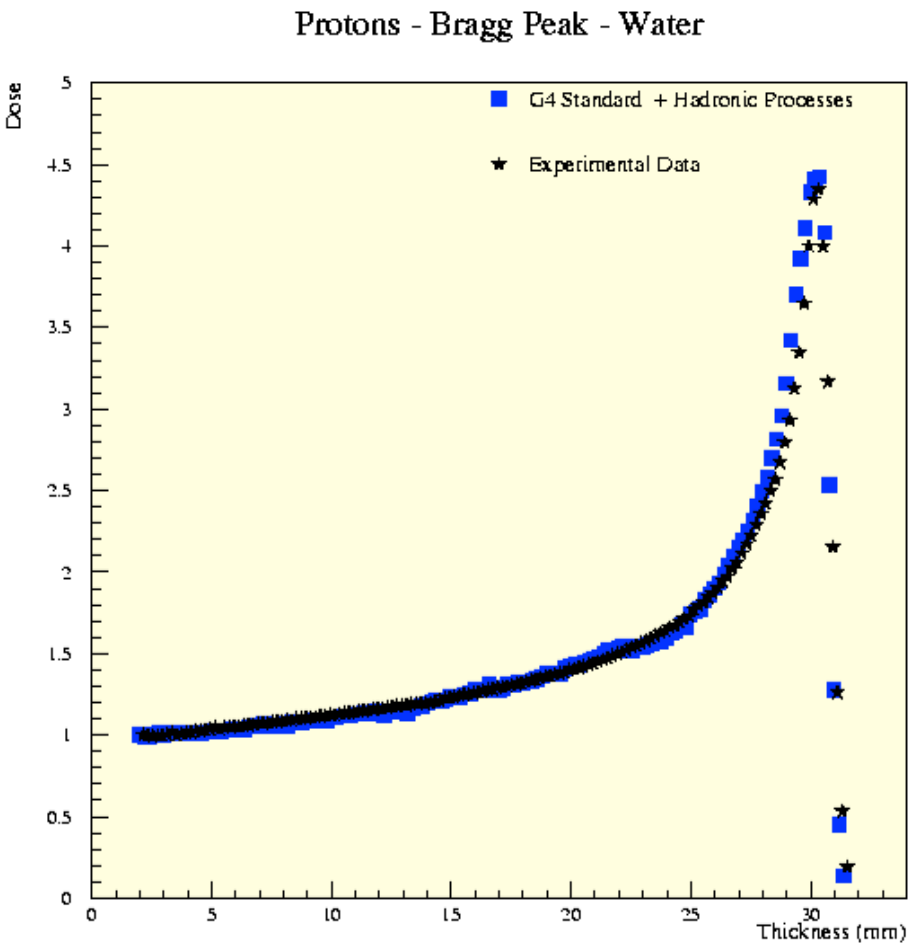


Il bosone di Higgs

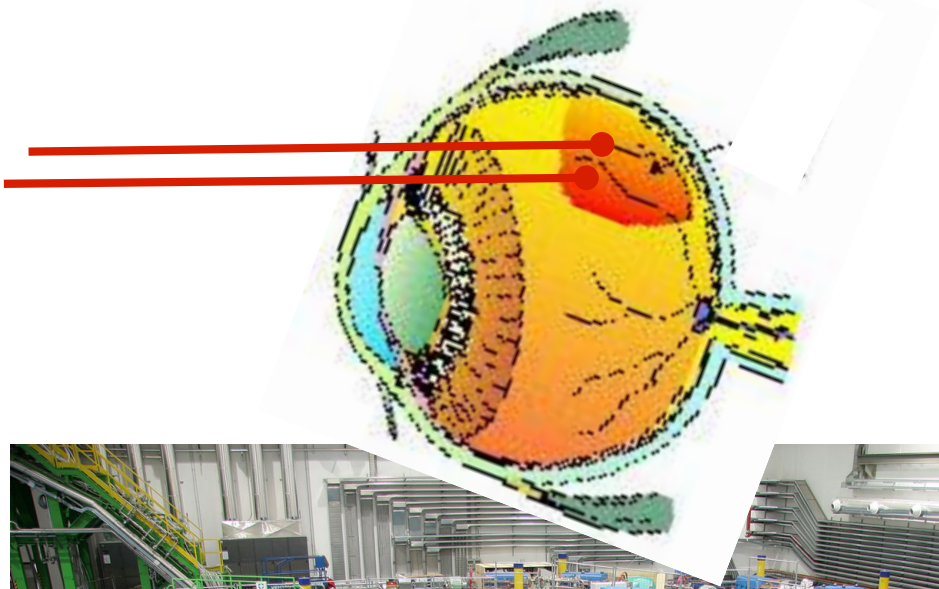


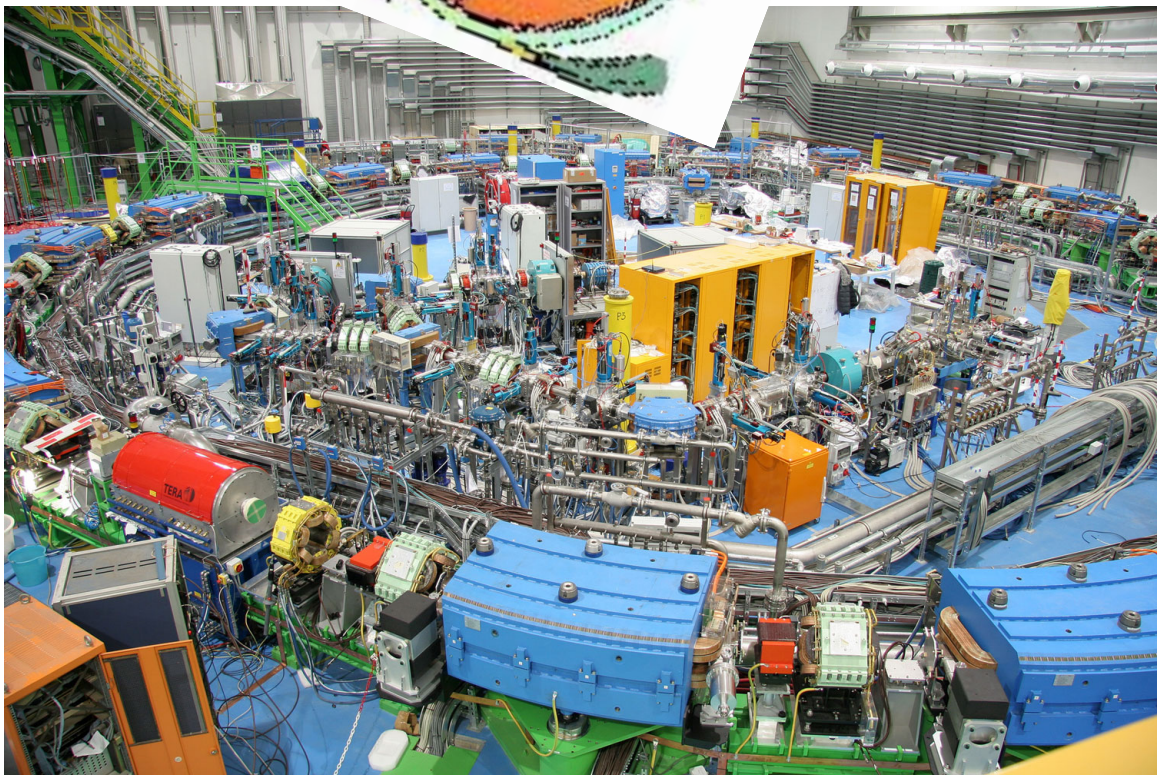


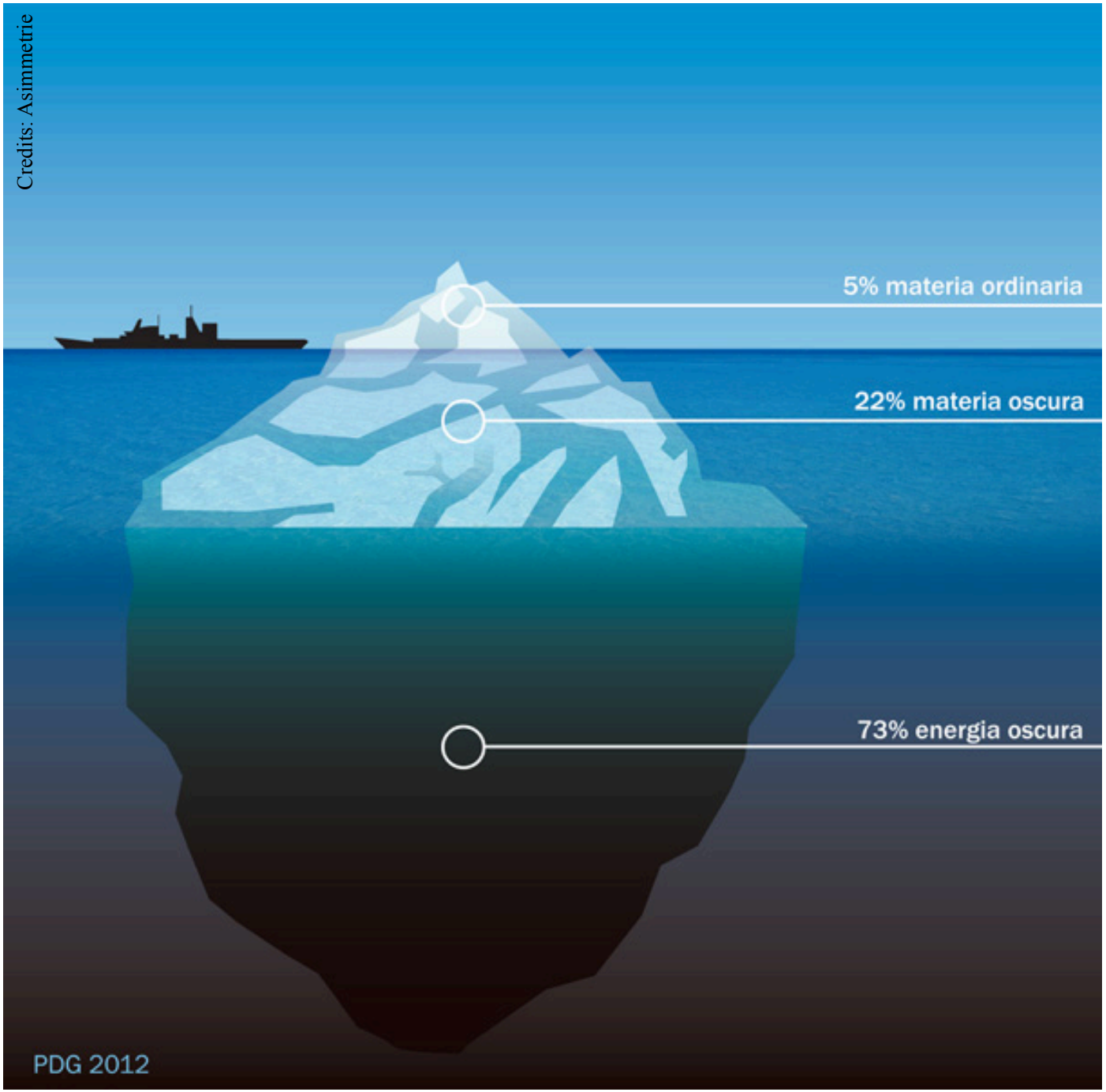
Ostinatamente curiosi…



CNAO www.cnao.it



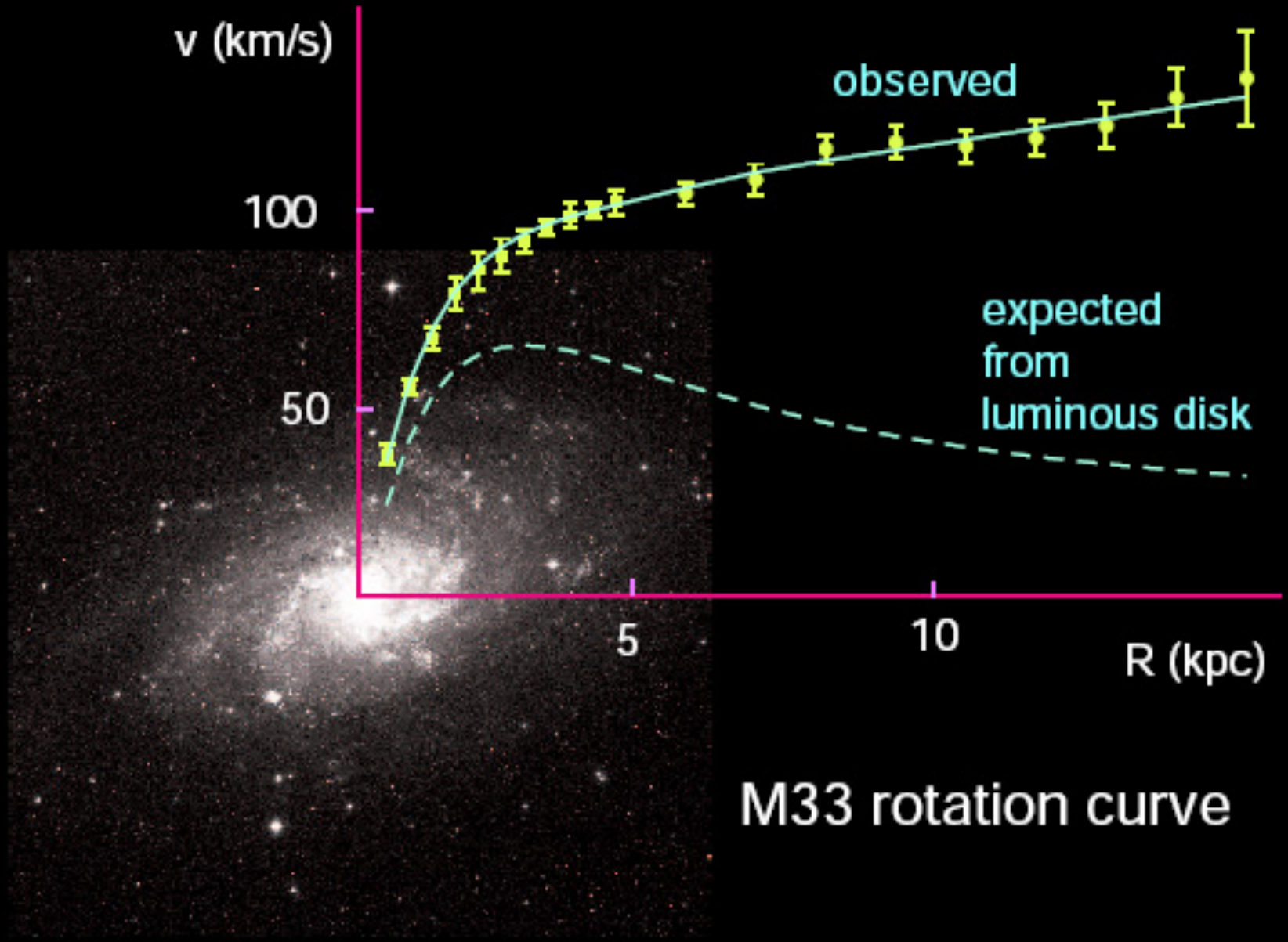




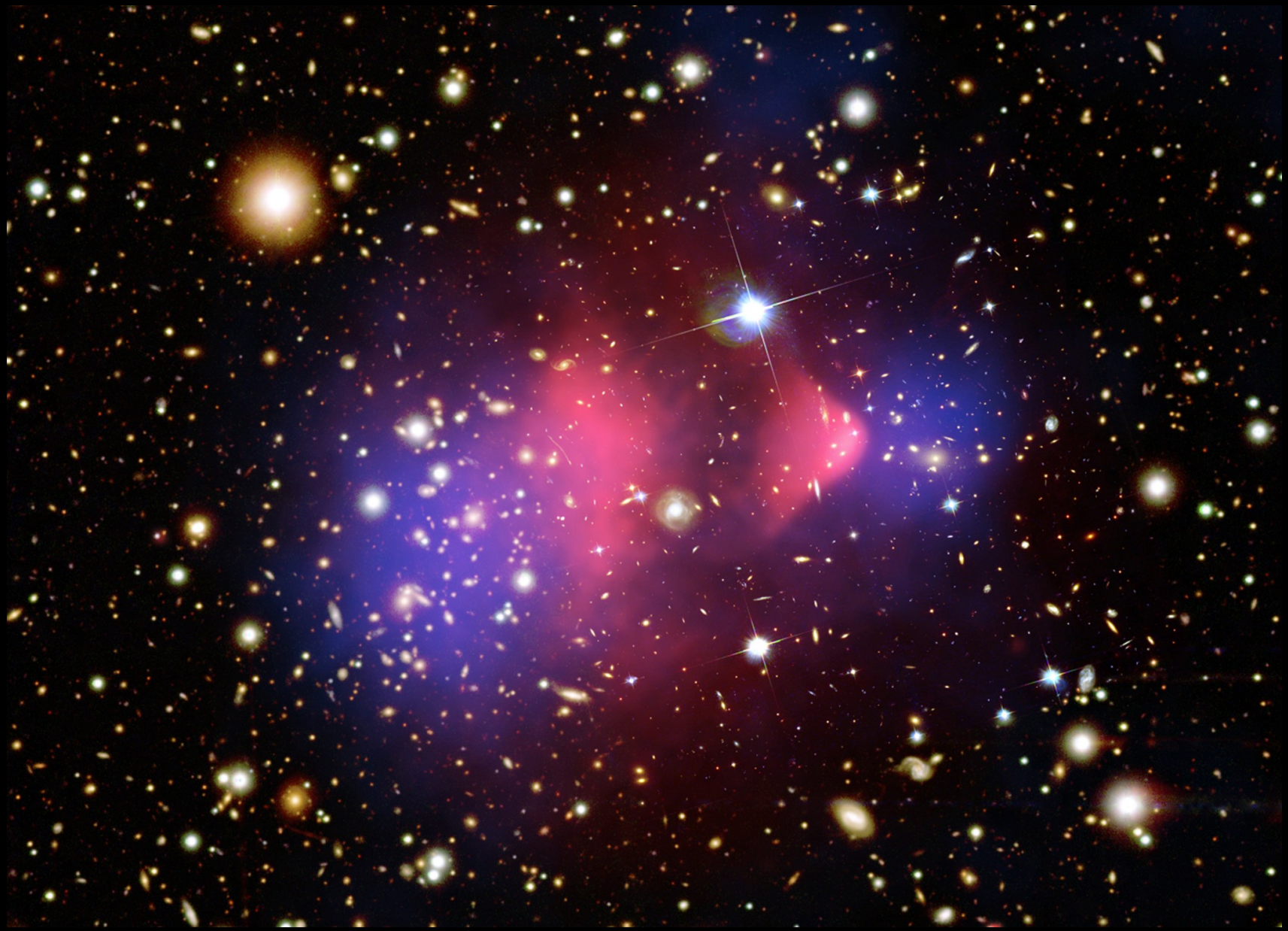
Solo la punta dell'iceberg

[PDG 2014:
Materia ordinaria 5%
Materia oscura 27%
Energia oscura 68%]

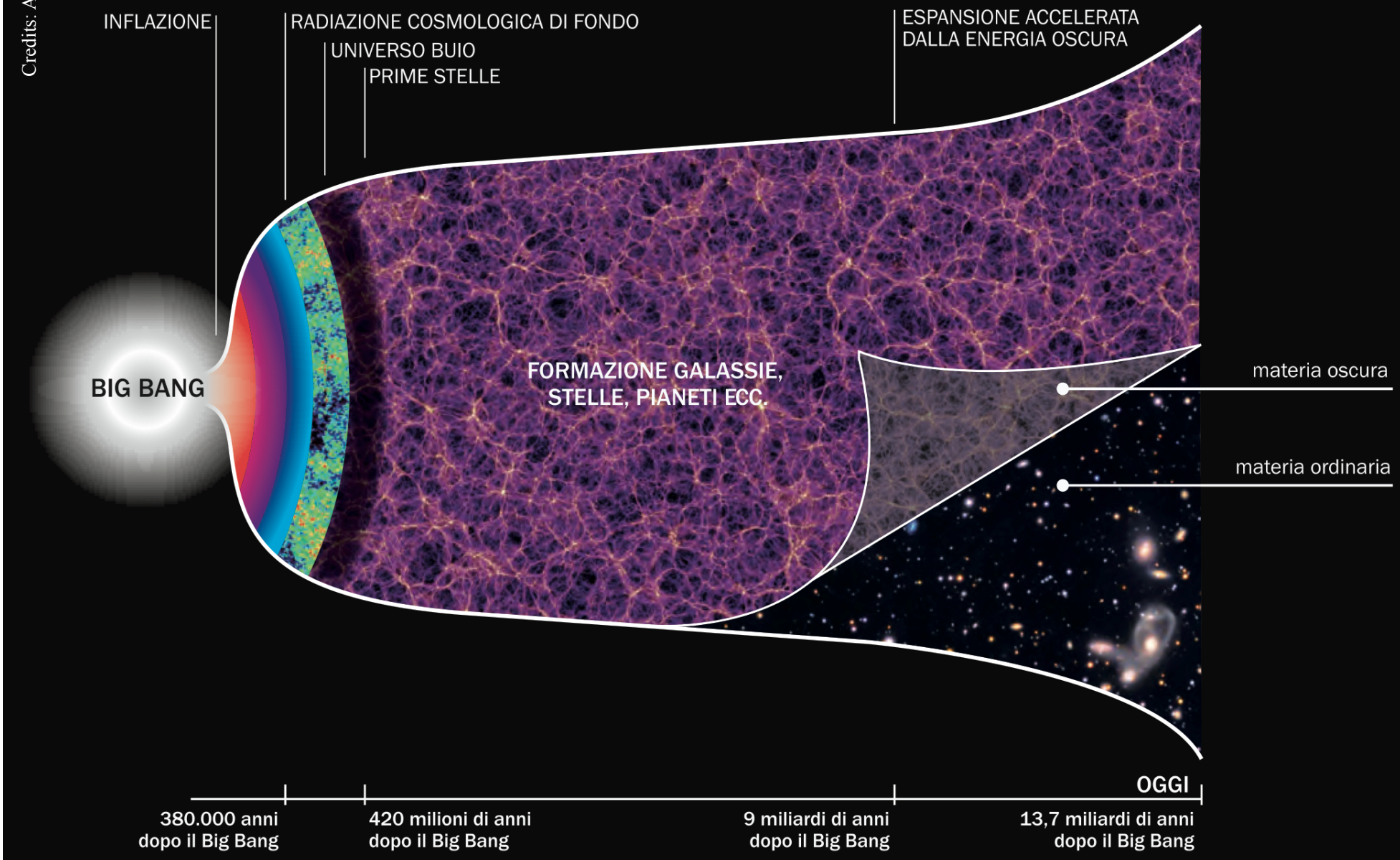
Materia e Materia Oscura



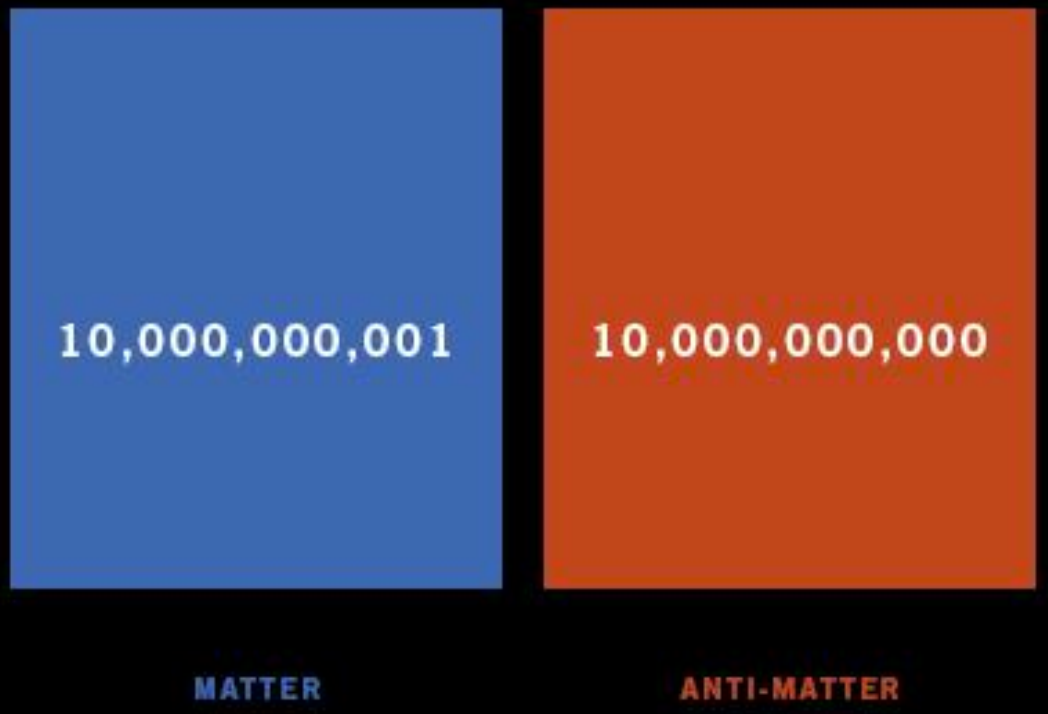
Materia e Materia Oscura



Modello Standard Cosmologico



Materia e Antimateria

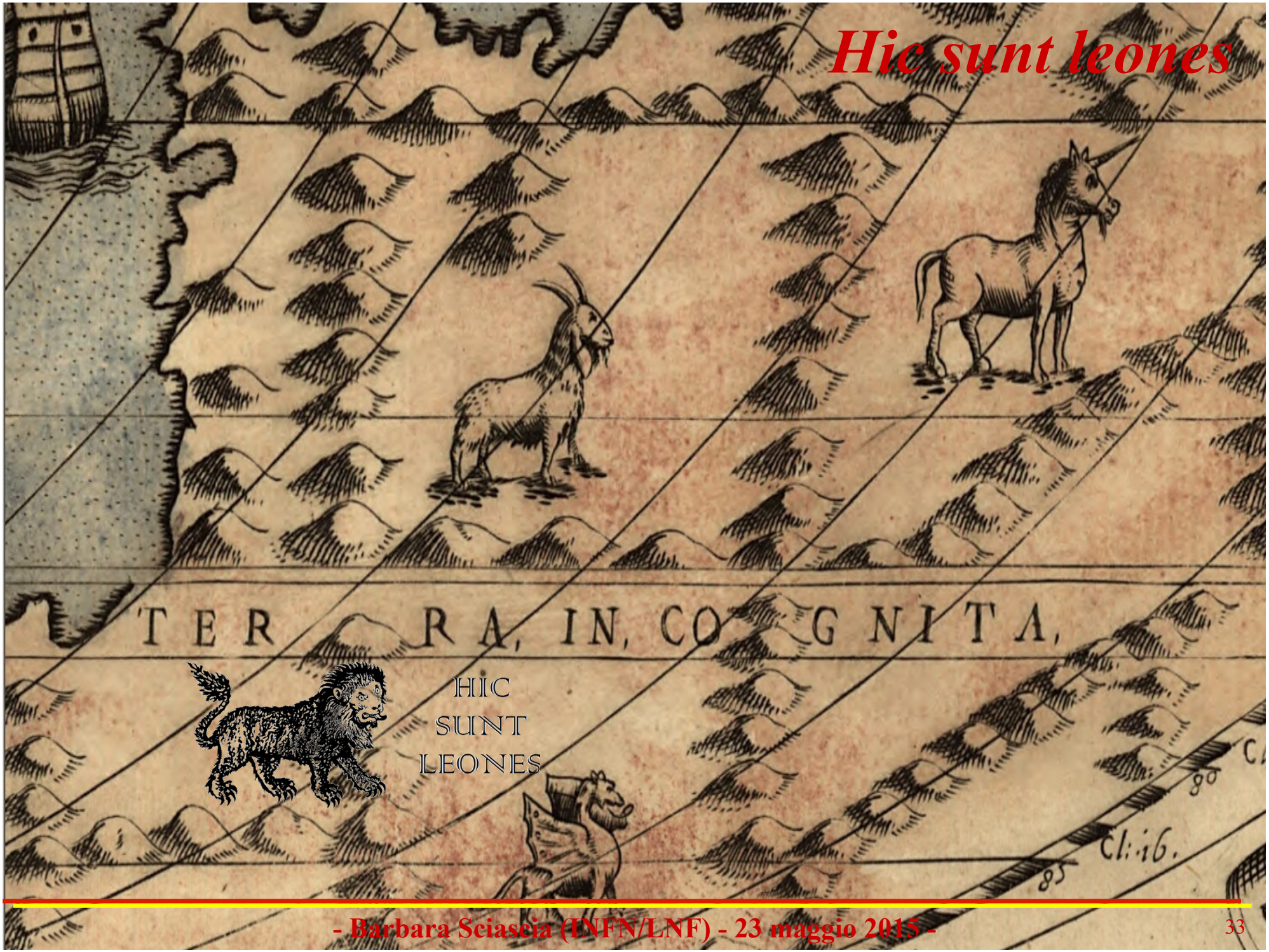


Credits: Hitoshi Murayama

Materia e Antimateria

Credits: Hitoshi Murayama

Hic sunt leones



Il fascino dell'impossibile

nature International weekly journal of science

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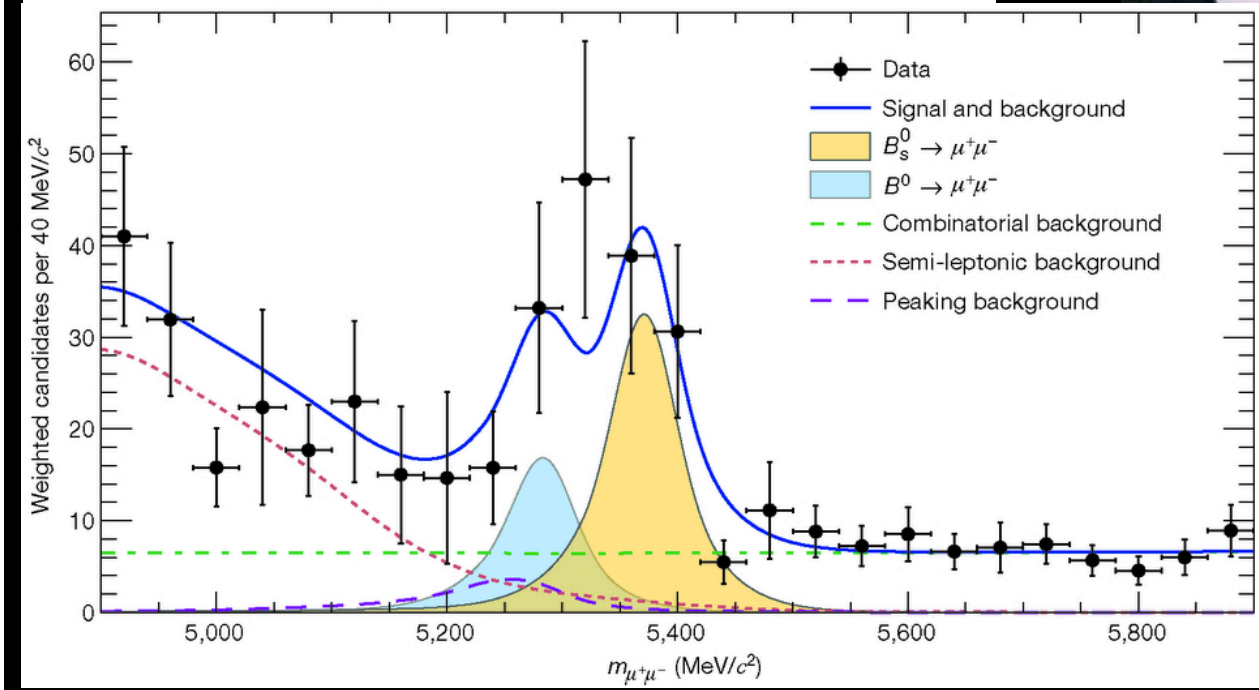
NATURE | LETTER OPEN

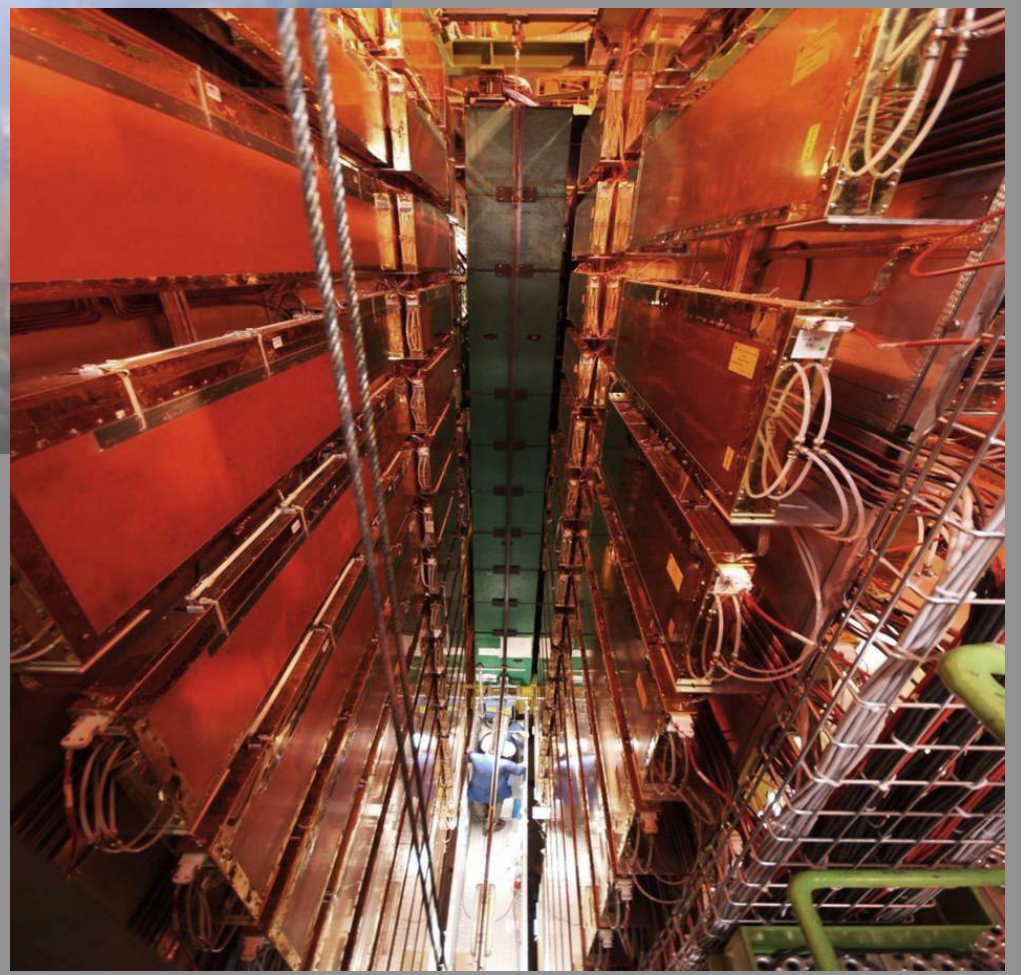
Observation of the rare $B_s^0 \to \mu^+\mu^-$ decay from the combined analysis of CMS and LHCb data

CMS Collaboration & LHCb Collaboration

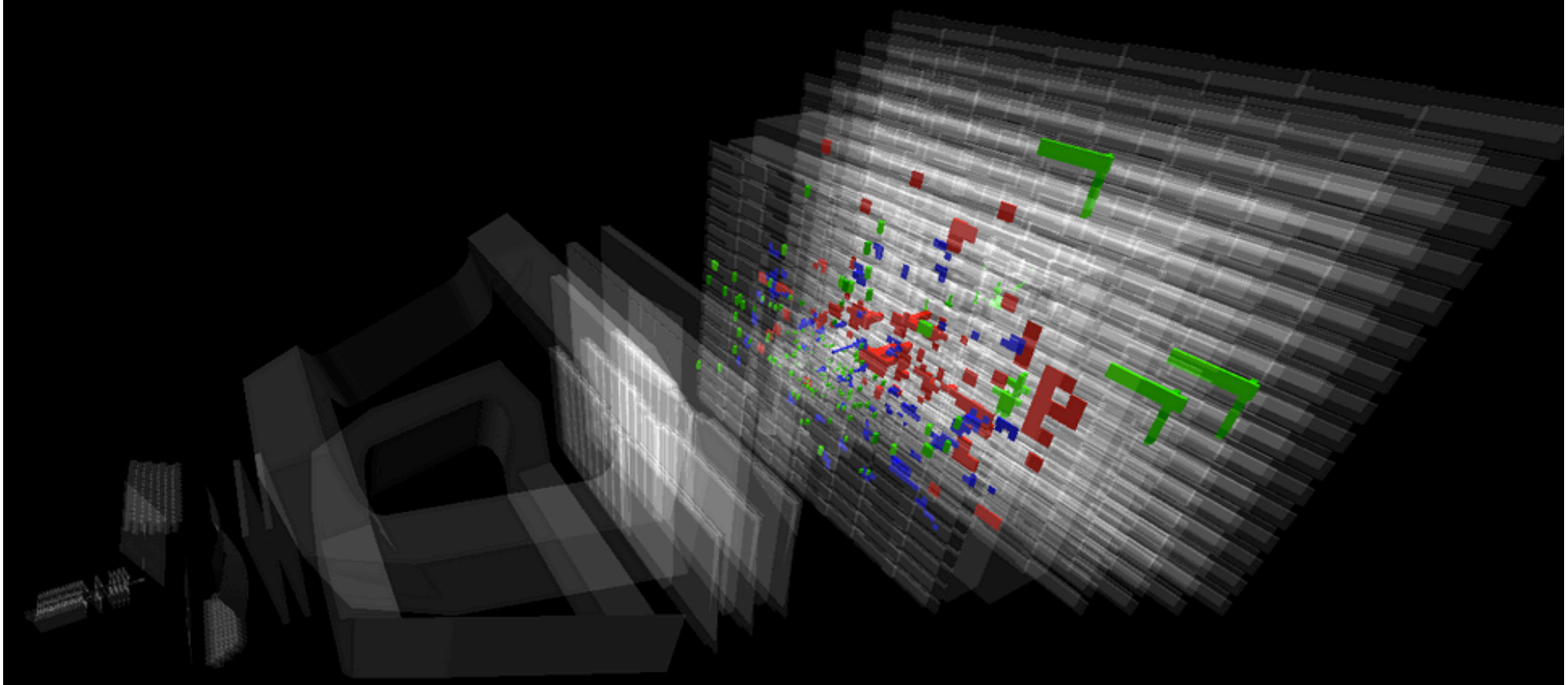


L'inizio [LHCb]

Foto: Andrea Littera

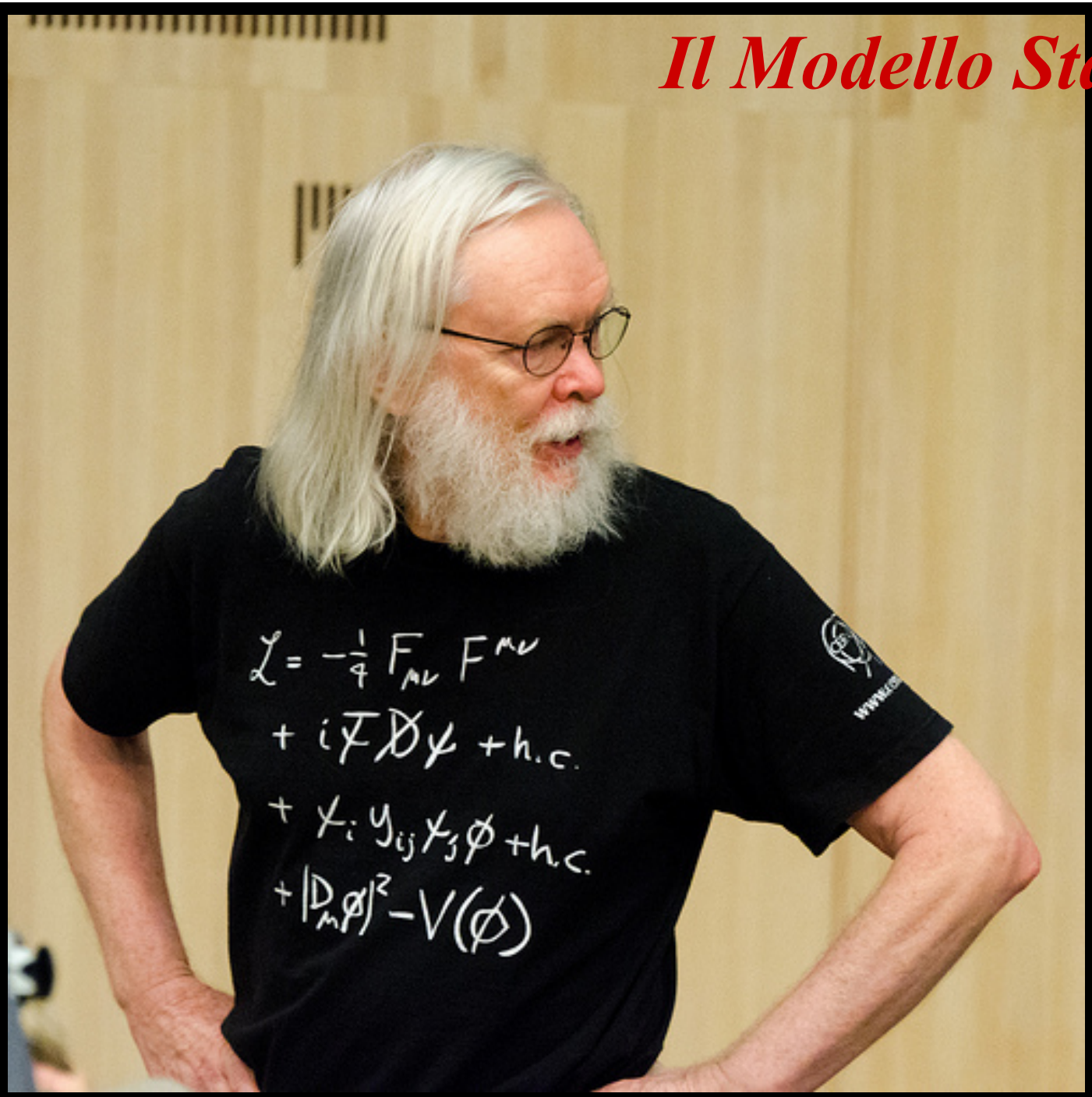


Il futuro: LHC per la prima volta a 13 TeV



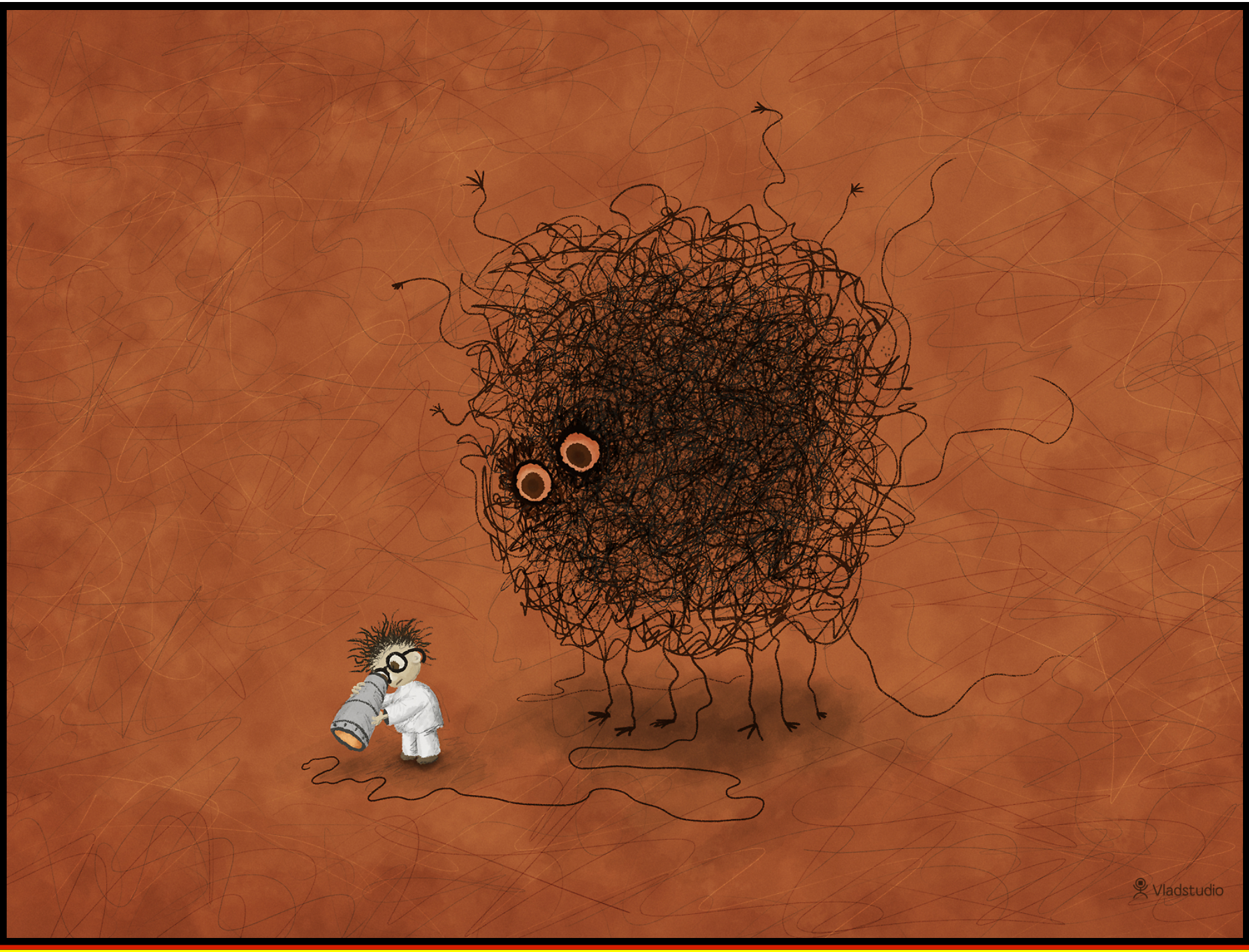
[LHCb]

Il Modello Standard



Un'equazione

Relativita` speciale e generale


Vladstudio

Grazie e

buona visita!

Approfondimenti

Lezioni:
D.Domenici (rivelatori) e G. Isidori (Modello Standard)
(http://www.lnf.infn.it/edu/stagelnf/2014/masterclass/)

Libri:
"**L'universo elegante**" di B. Greene, Einaudi
"**La legge fisica**" di R.P.Feynman, Adelphi
"**I primi tre minuti**" di S. Weinberg, Mondadori.
"**La particella di Dio**" di L.Lederman, Mondadori
"**Particelle familiari**" di M. Delmastro, Laterza

Asimmetrie, rivista semestrale dell'INFN (www.asimmetrie.it) in particolare AS6 [acceleratori], AS7 [antimateria], AS8 [bosone di Higgs], AS11 [simmetrie], AS14 [massa], AS16 [1964], AS18 [#NuovaFisica]

TED talks (https://www.ted.com) cercate B. Cox, B. Greene

Supersymmetry:
http://www.quantumdiaries.org/2014/03/14/the-standard-model-a-beautiful-but-flawed-theory/
http://www.quantumdiaries.org/2014/03/19/supersymmetry-a-tantalising-theory/

INFN

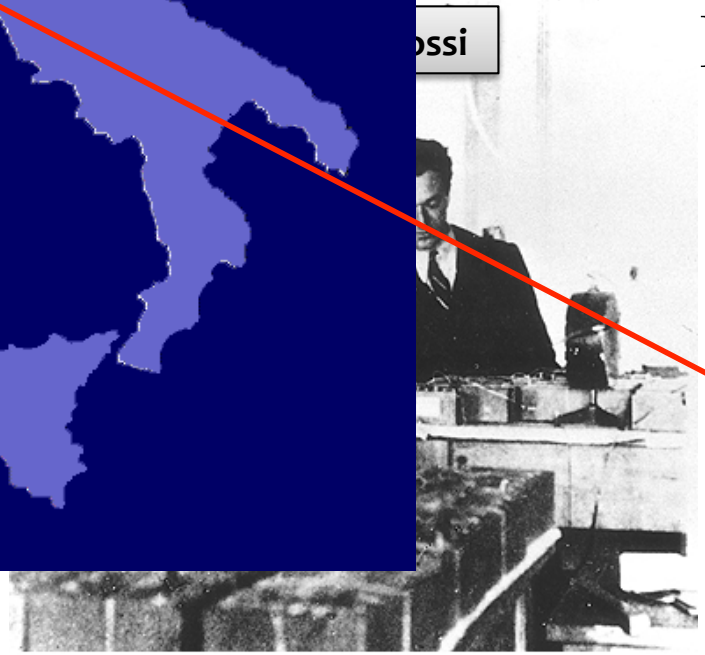
1951

4 Sezioni universitarie

Milano, Torino, Padova, e Roma

1957

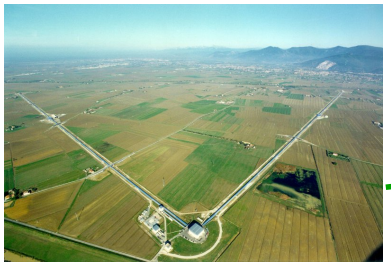
Laboratori Nazionali di Frascati



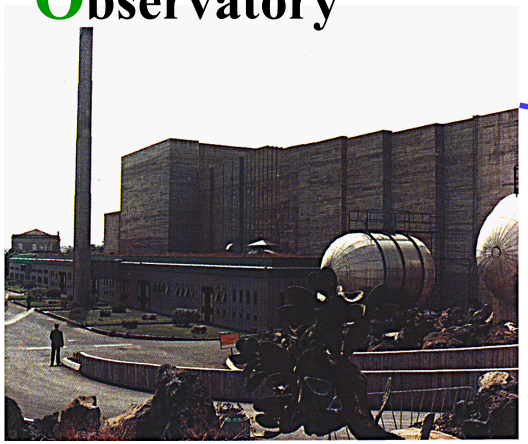
Frascati

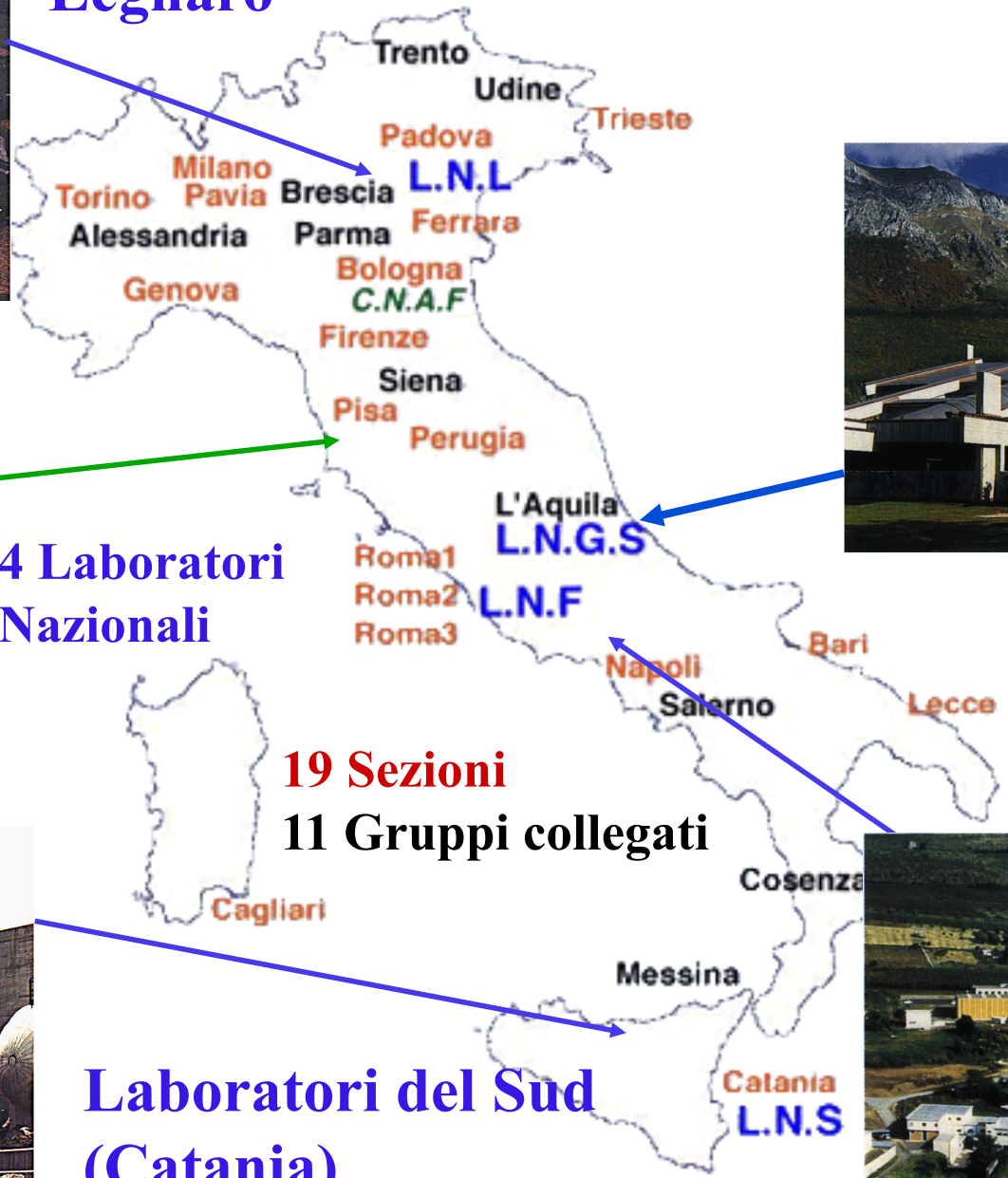
INFN

Legnaro



VIRGO-EGO
European
Gravitational
Observatory





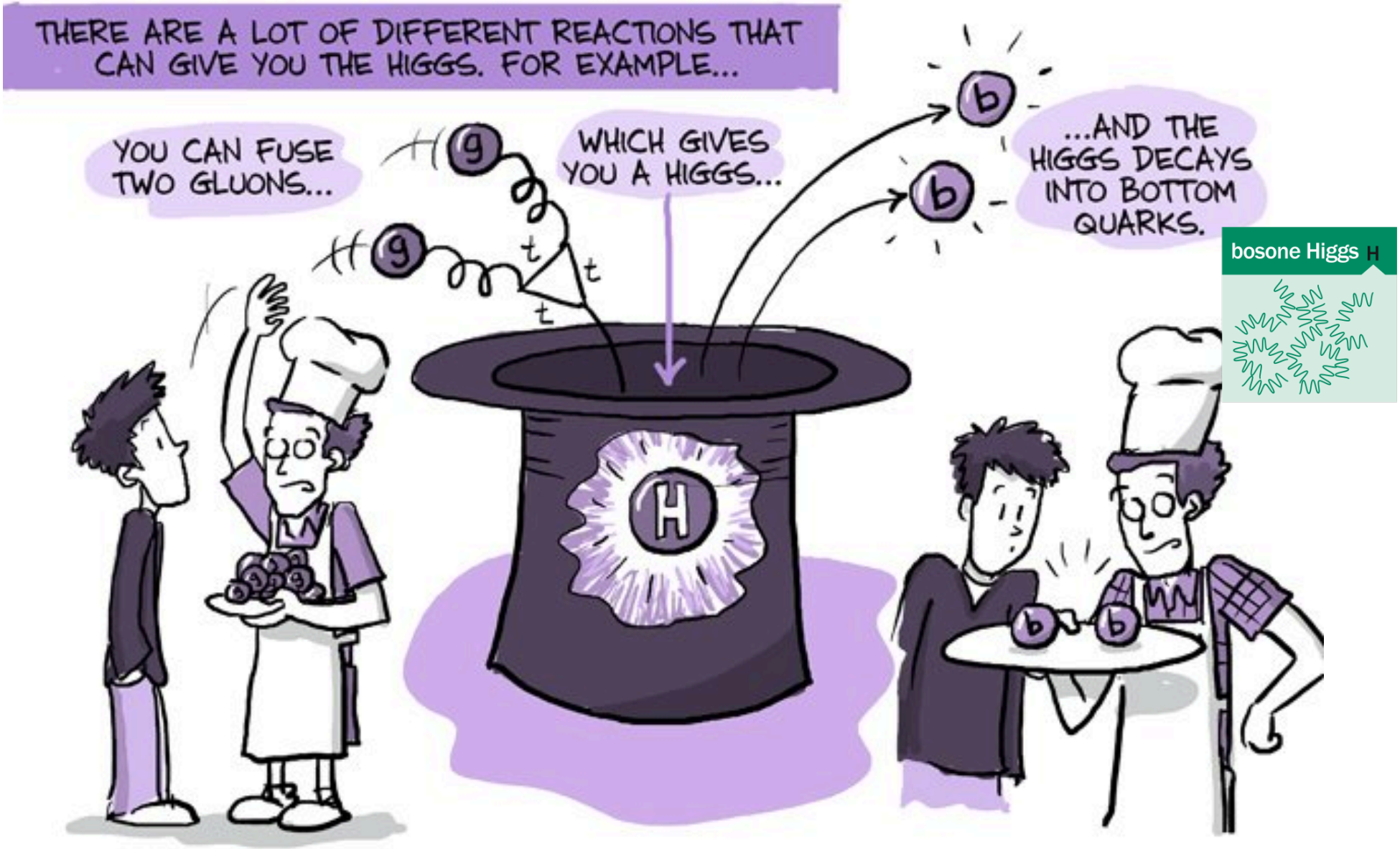
4 Laboratori
Nazionali

19 Sezioni
11 Gruppi collegati

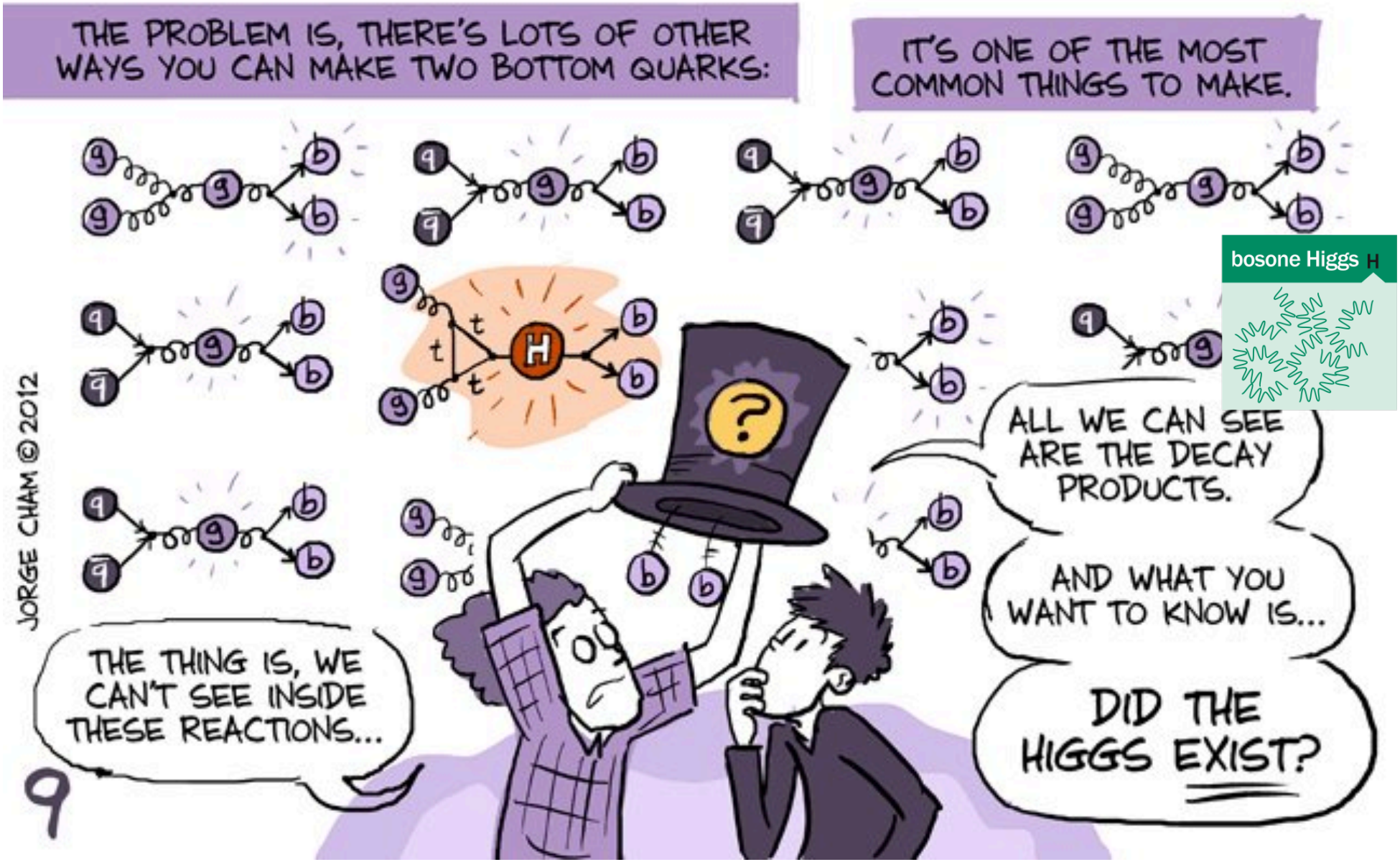
Gran Sasso

Laboratori del Sud
(Catania)

Il bosone di Higgs

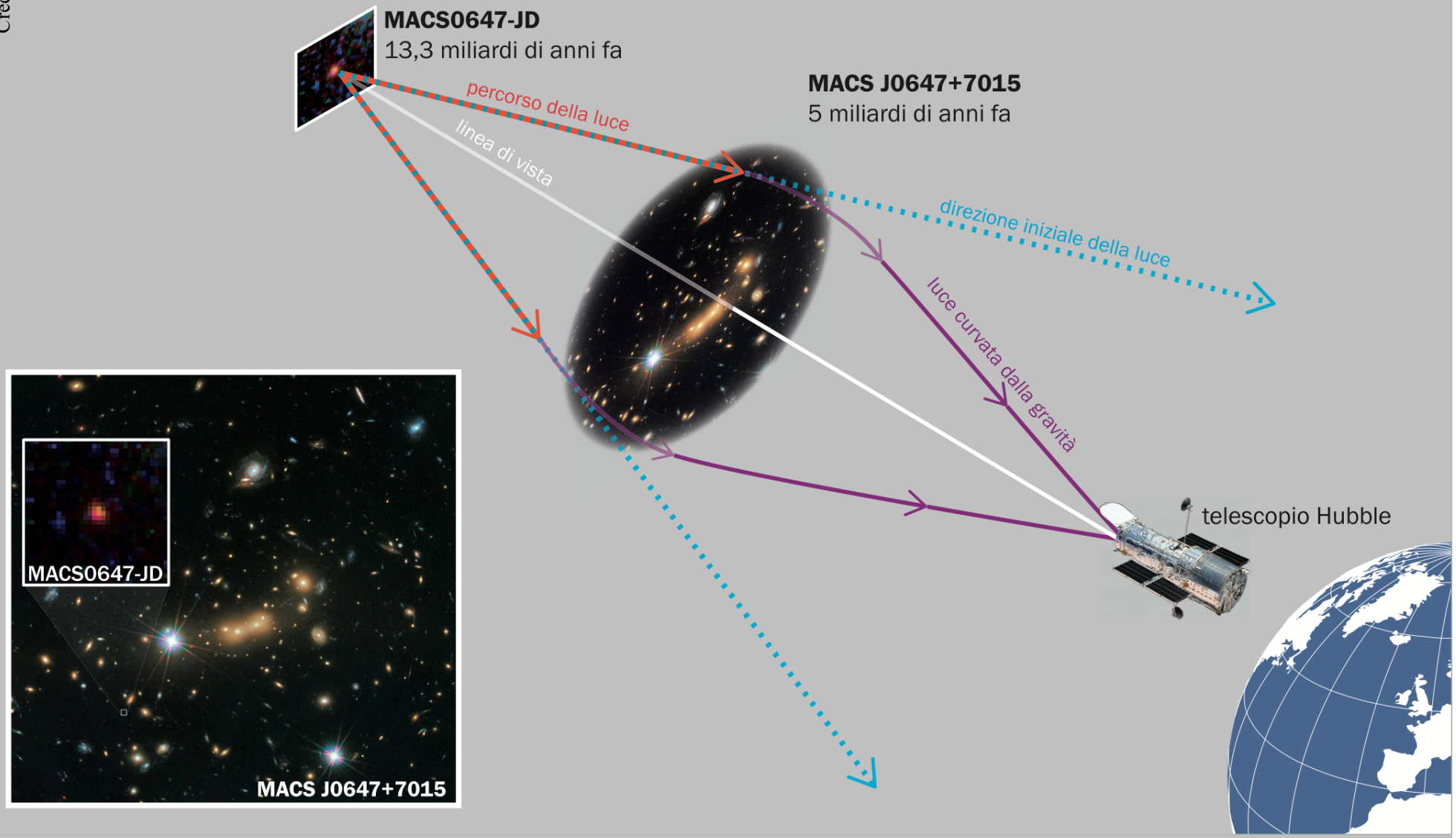


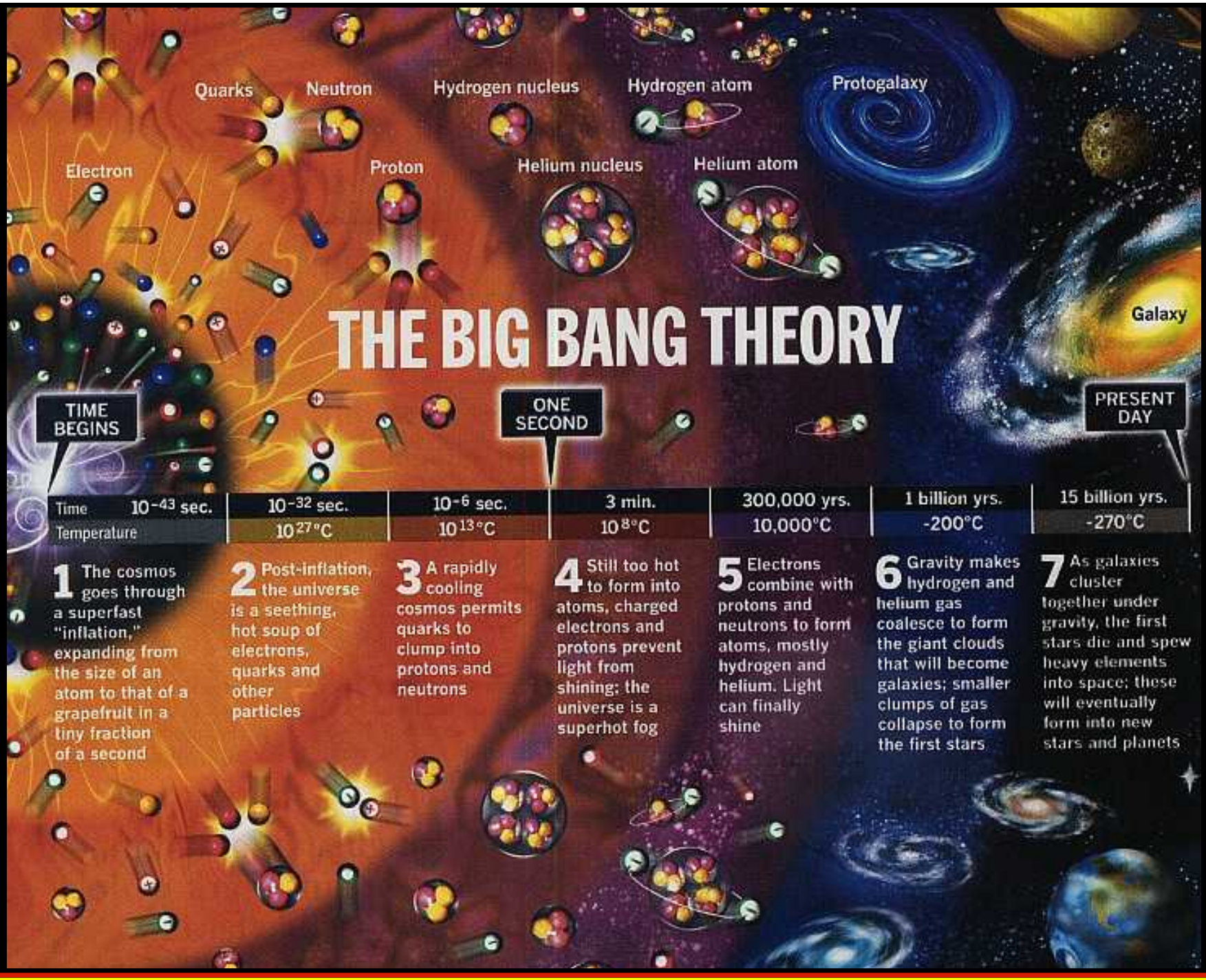
Il bosone di Higgs



Gravitational lensing

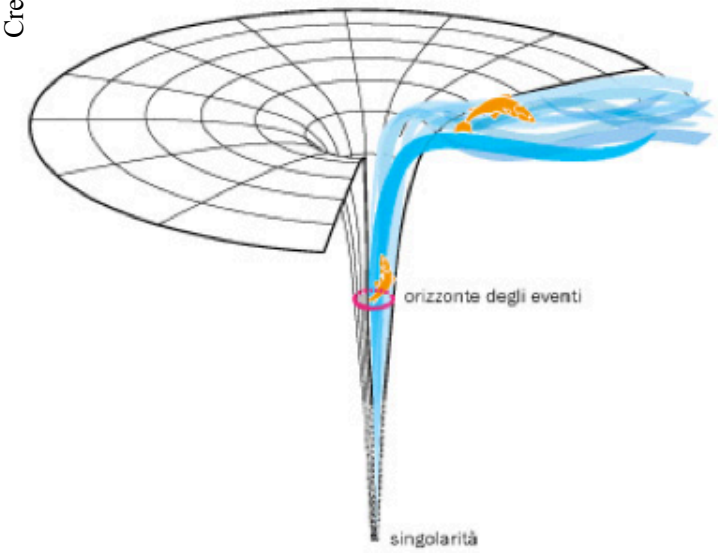
Credits: Asimmetrie

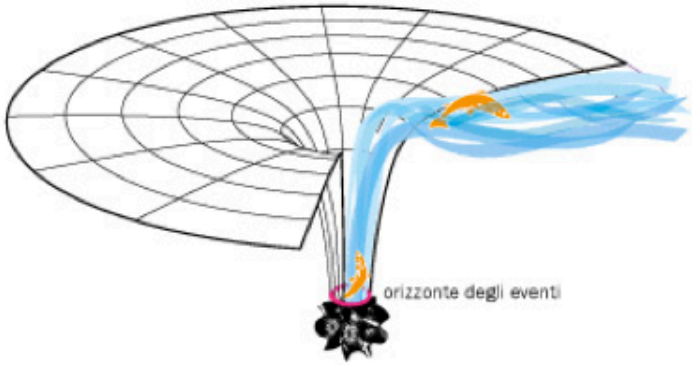


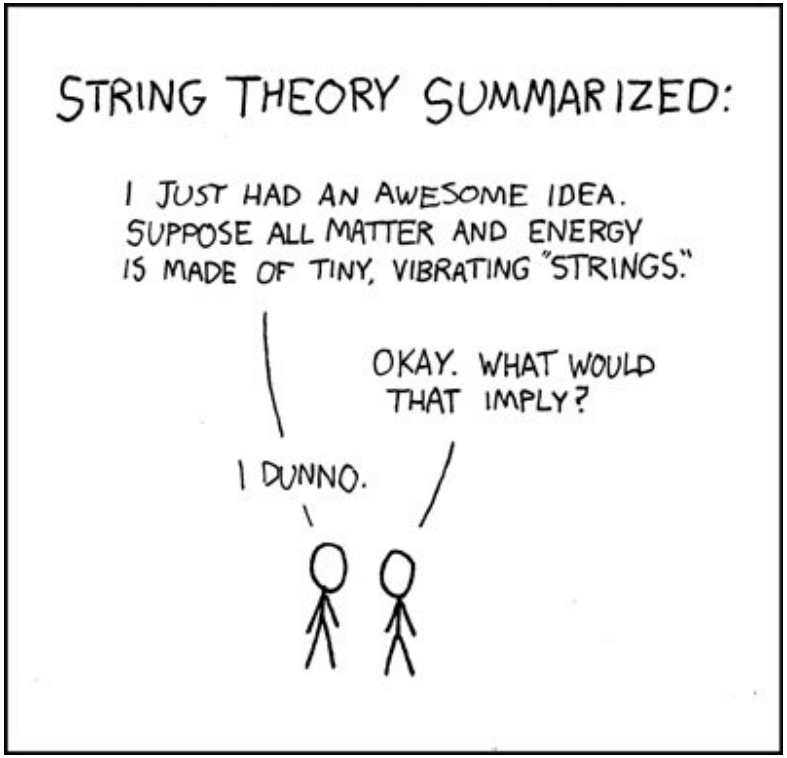

THE BIG BANG THEORY
Quarks
Neutron
Hydrogen nucleus
Hydrogen atom
Protogalaxy
Electron
Proton
Helium nucleus
Helium atom
Galaxy
TIME BEGINS
ONE SECOND
PRESENT DAY
Time
Temperature
10^{-43} sec.
10^{-32} sec.
10^{27}°C
10^{-6} sec.
10^{13}°C
3 min.
10^{8}°C
300,000 yrs.
10,000°C
1 billion yrs.
-200°C
15 billion yrs.
-270°C
1 The cosmos goes through a superfast "inflation," expanding from the size of an atom to that of a grapefruit in a tiny fraction of a second
2 Post-inflation, the universe is a seething, hot soup of electrons, quarks and other particles
3 A rapidly cooling cosmos permits quarks to clump into protons and neutrons
4 Still too hot to form into atoms, charged electrons and protons prevent light from shining; the universe is a superhot fog
5 Electrons combine with protons and neutrons to form atoms, mostly hydrogen and helium. Light can finally shine
6 Gravity makes hydrogen and helium gas coalesce to form the giant clouds that will become galaxies; smaller clumps of gas collapse to form the first stars
7 As galaxies cluster together under gravity, the first stars die and spew heavy elements into space; these will eventually form into new stars and planets

Credits: Asimmetrie

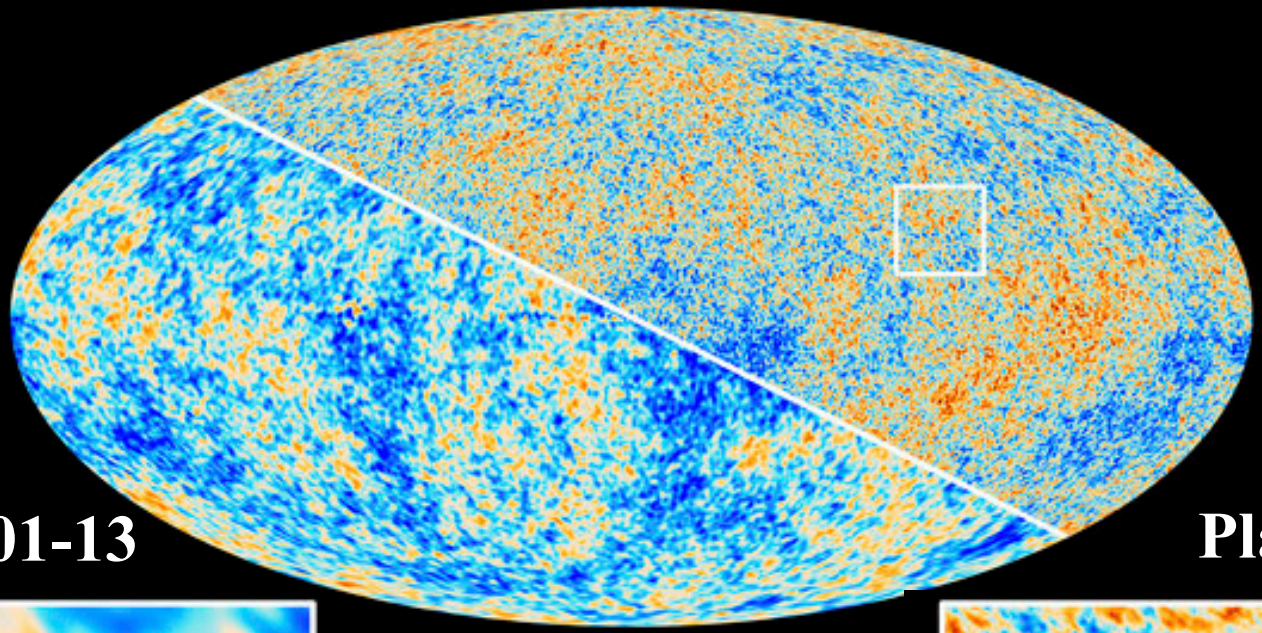
Teoria delle stringhe



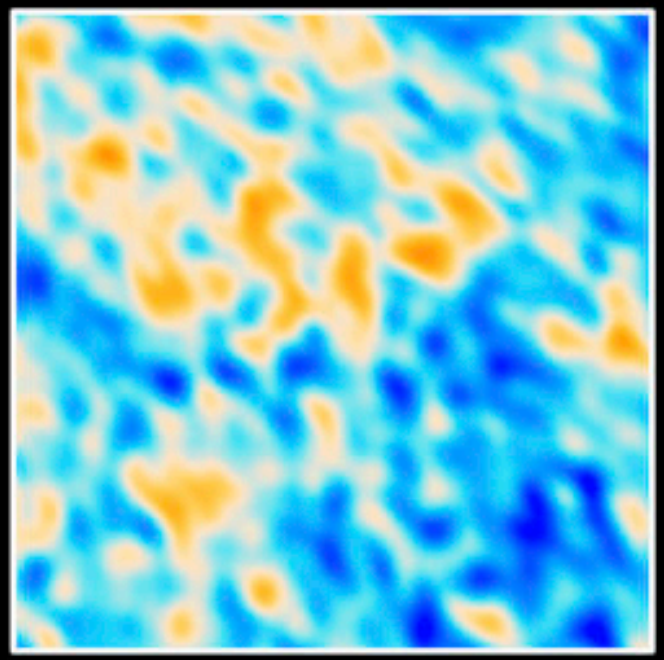




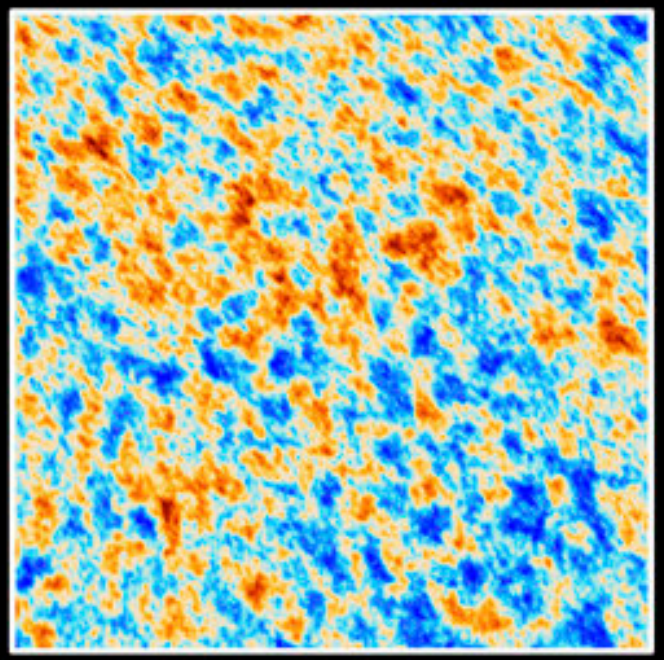
Radiazione cosmica di fondo



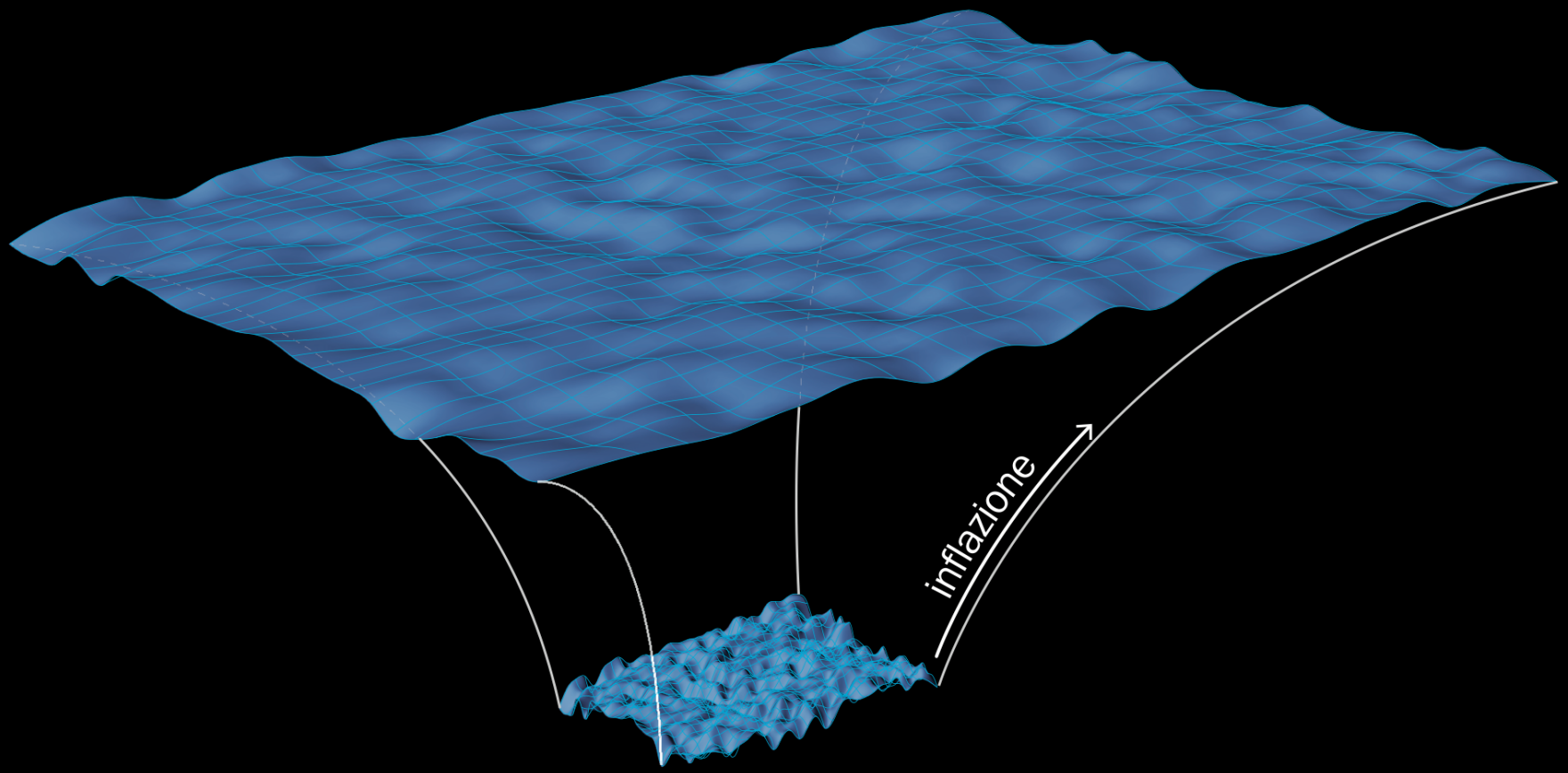
WMAP, 2001-13



Planck, 2013

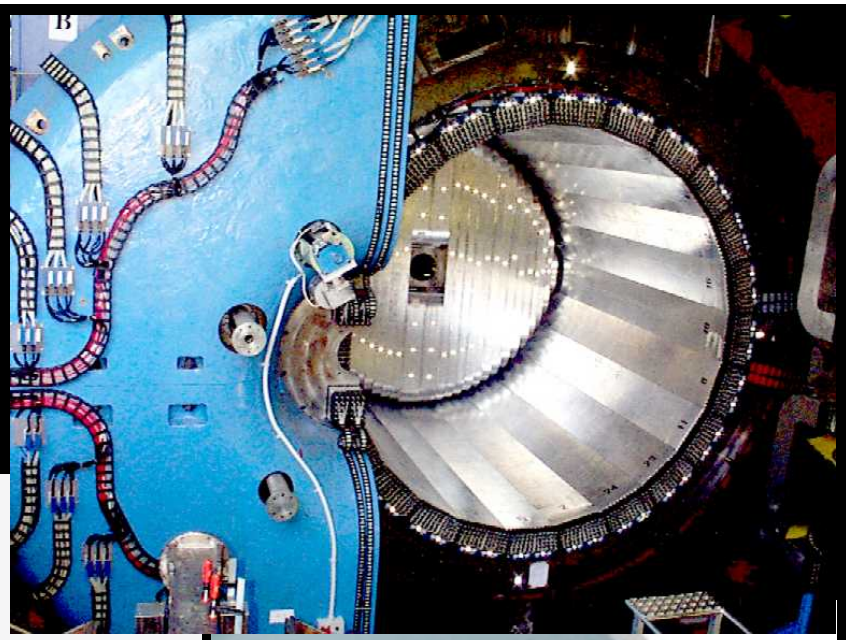


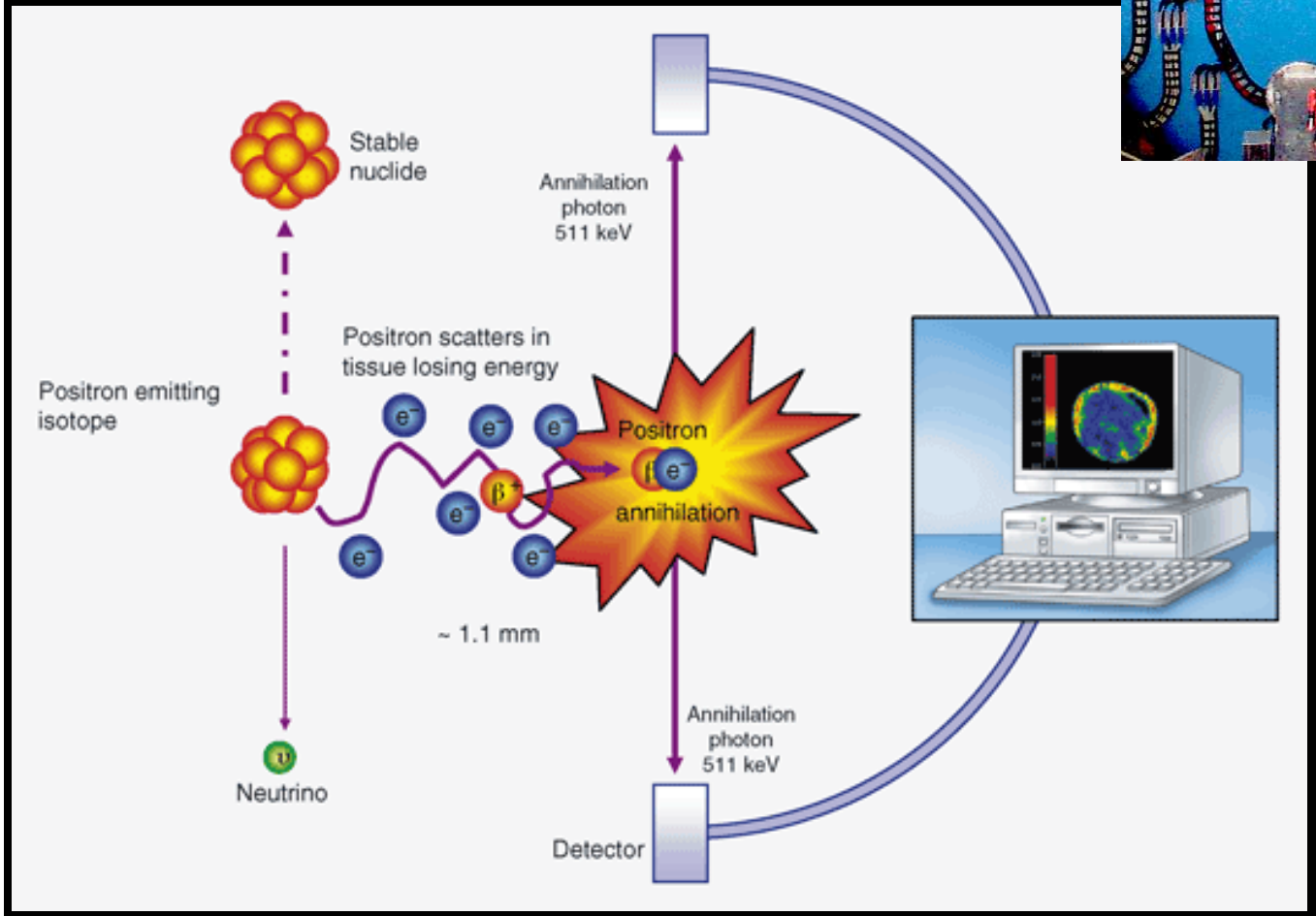
Inflazione

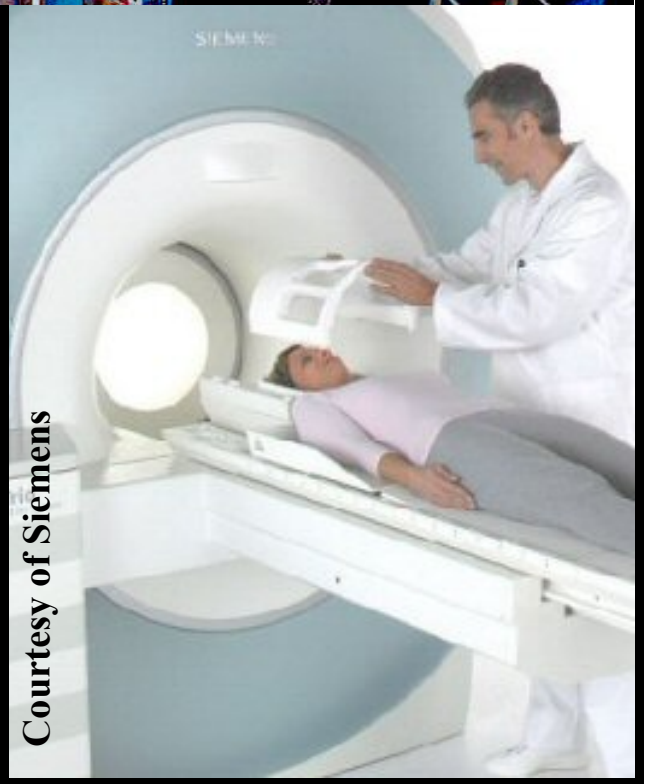


Credits: Asimmetrie

Positron Emission Tomography (PET)

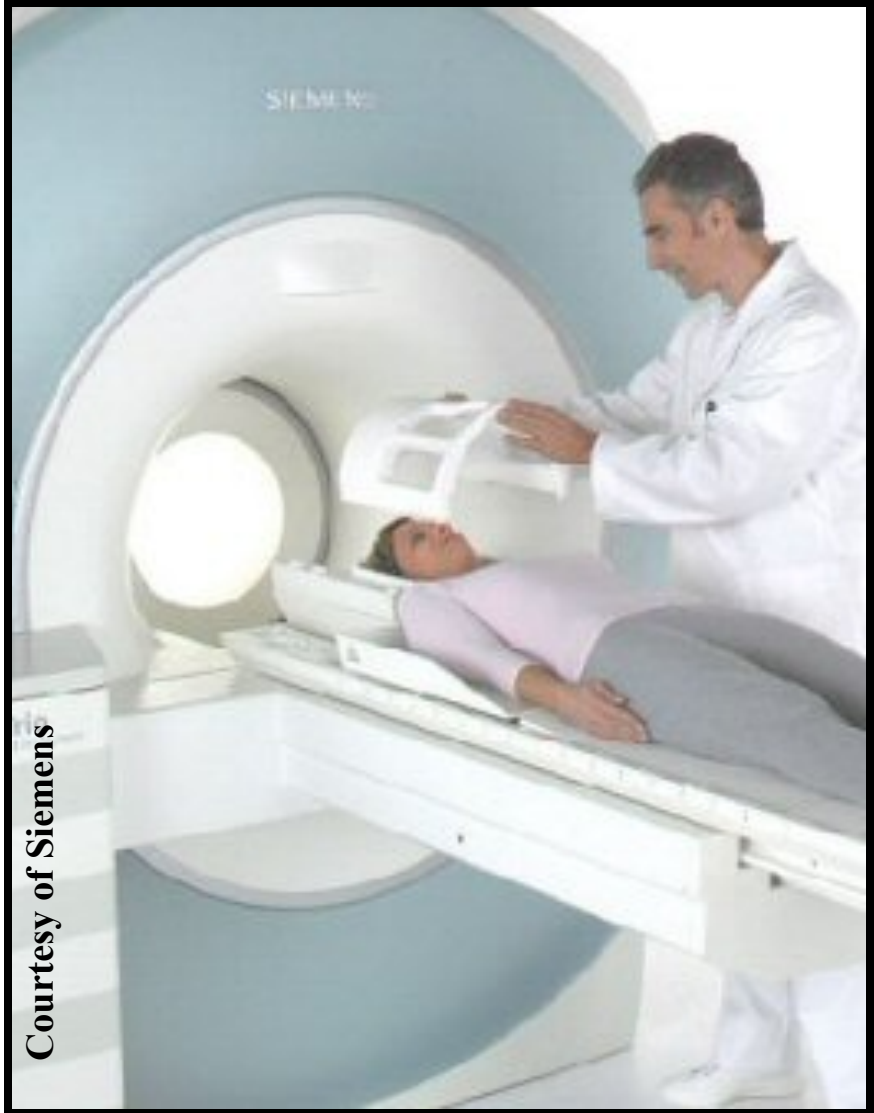




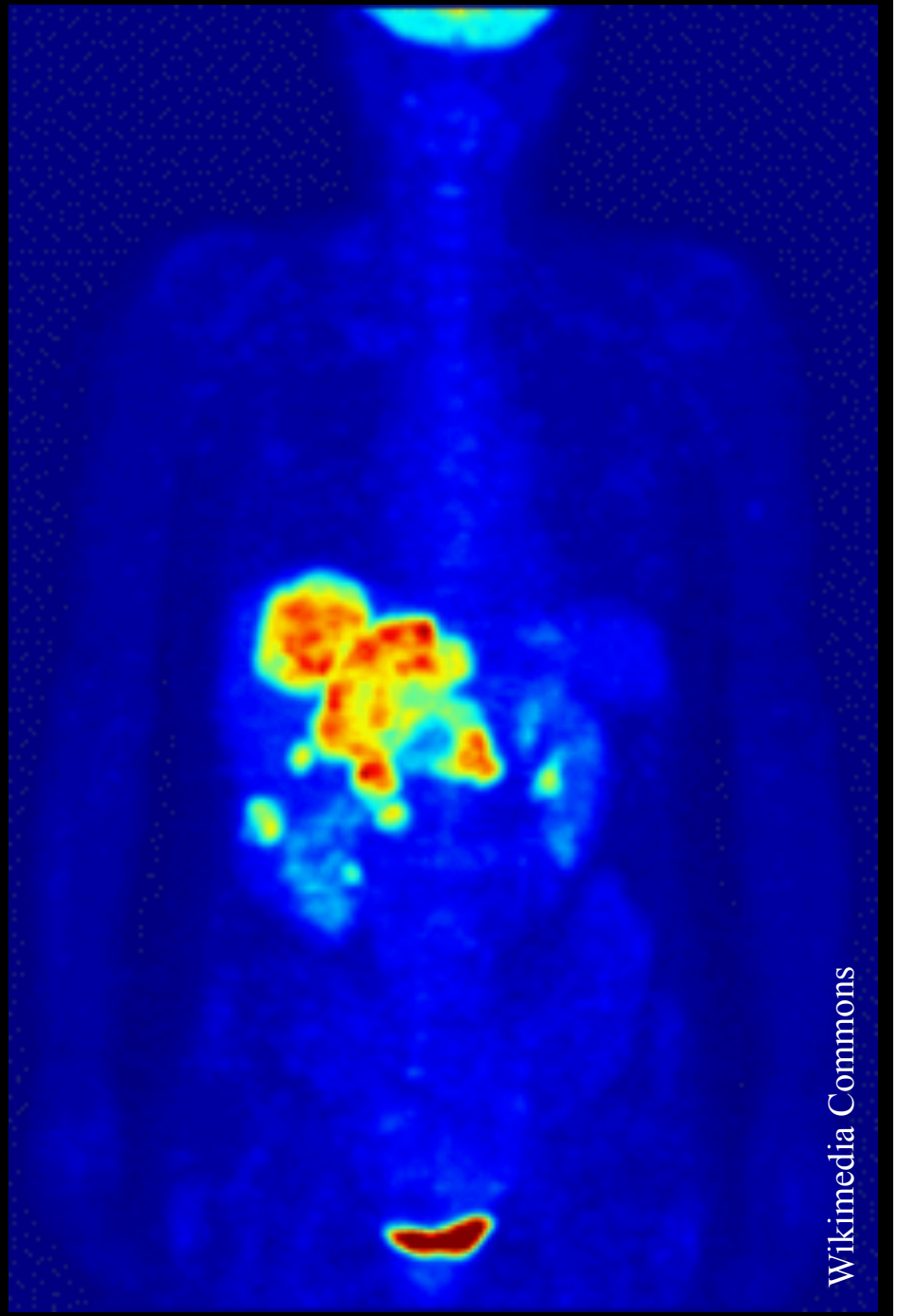


Courtesy of Siemens

Positron Emission Tomography (PET)

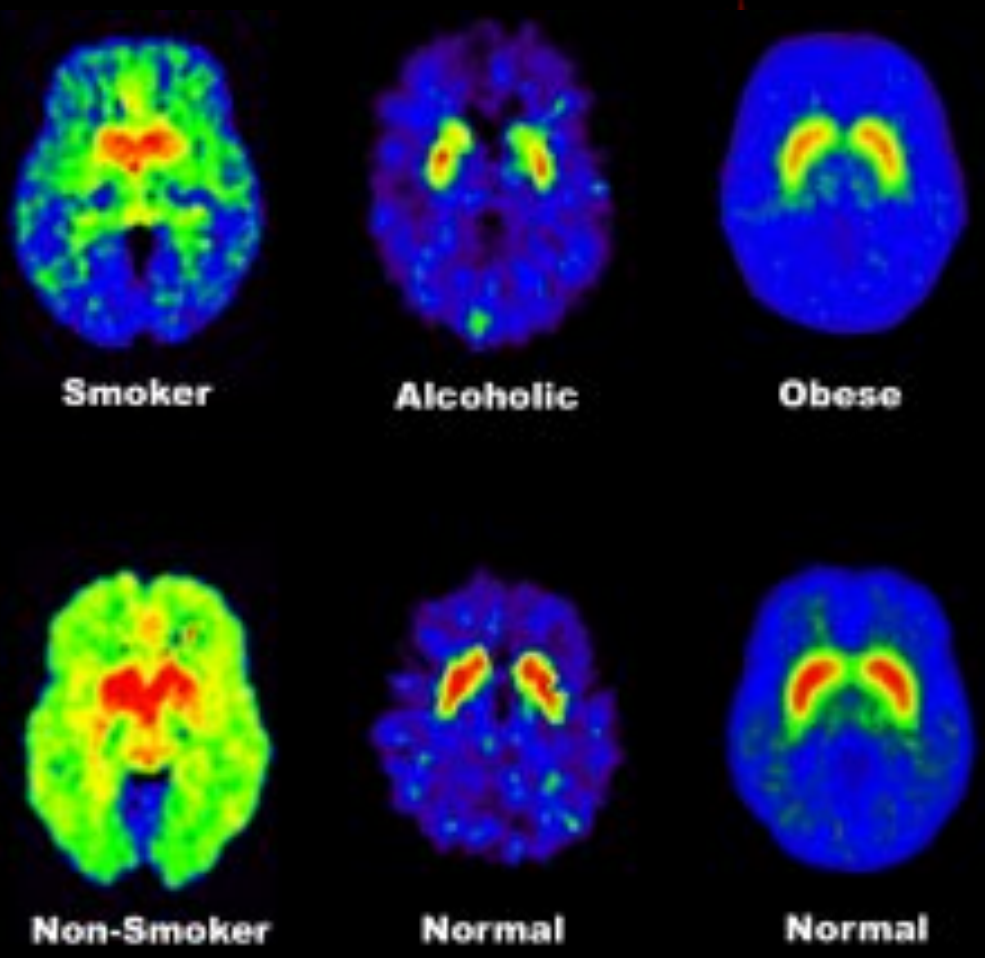


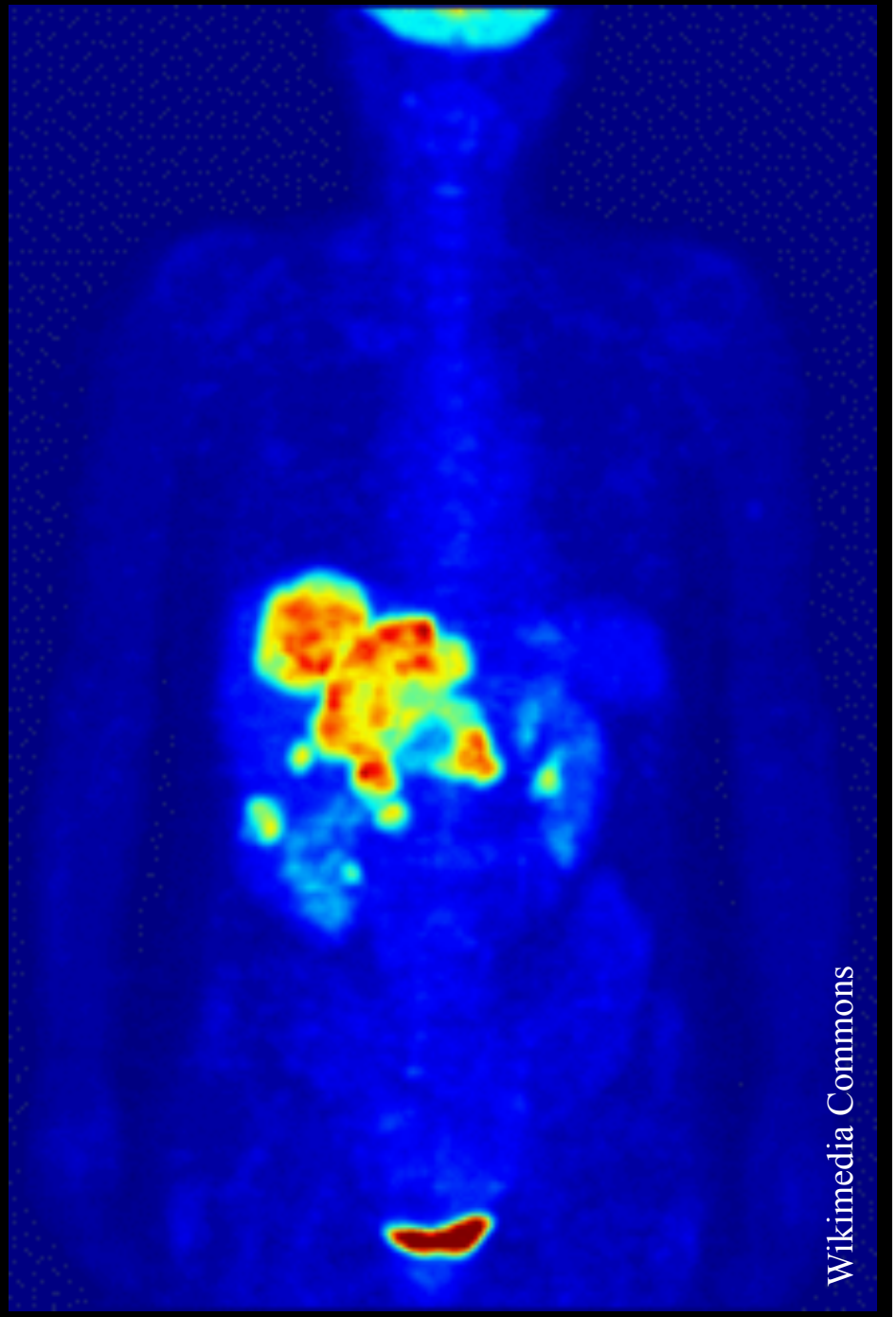
Courtesy of Siemens



Wikimedia Commons

PET





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SETI INSTITUTE

(Search for Extra-Terrestrial Intelligence)

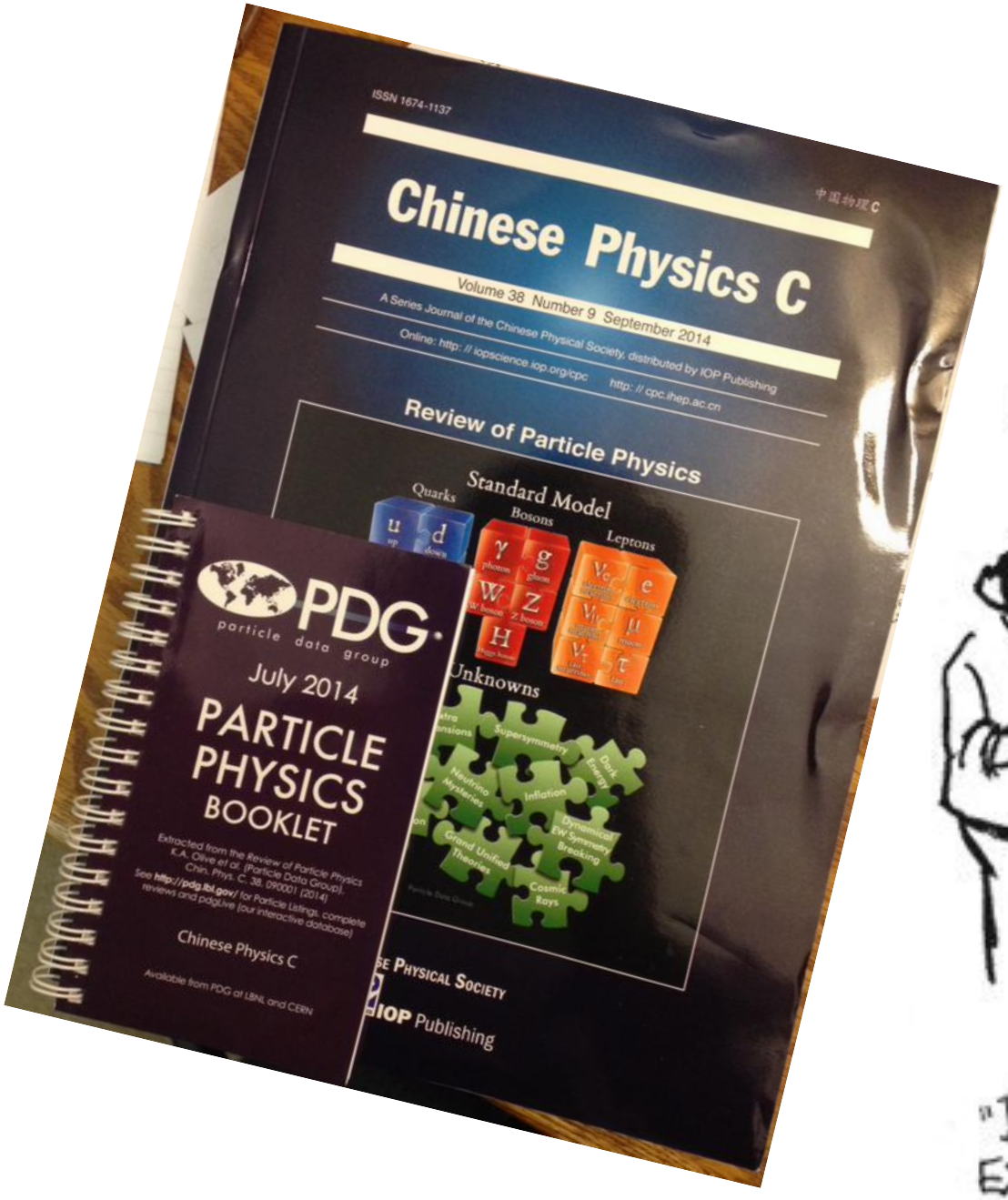
“Angeli e Demoni”

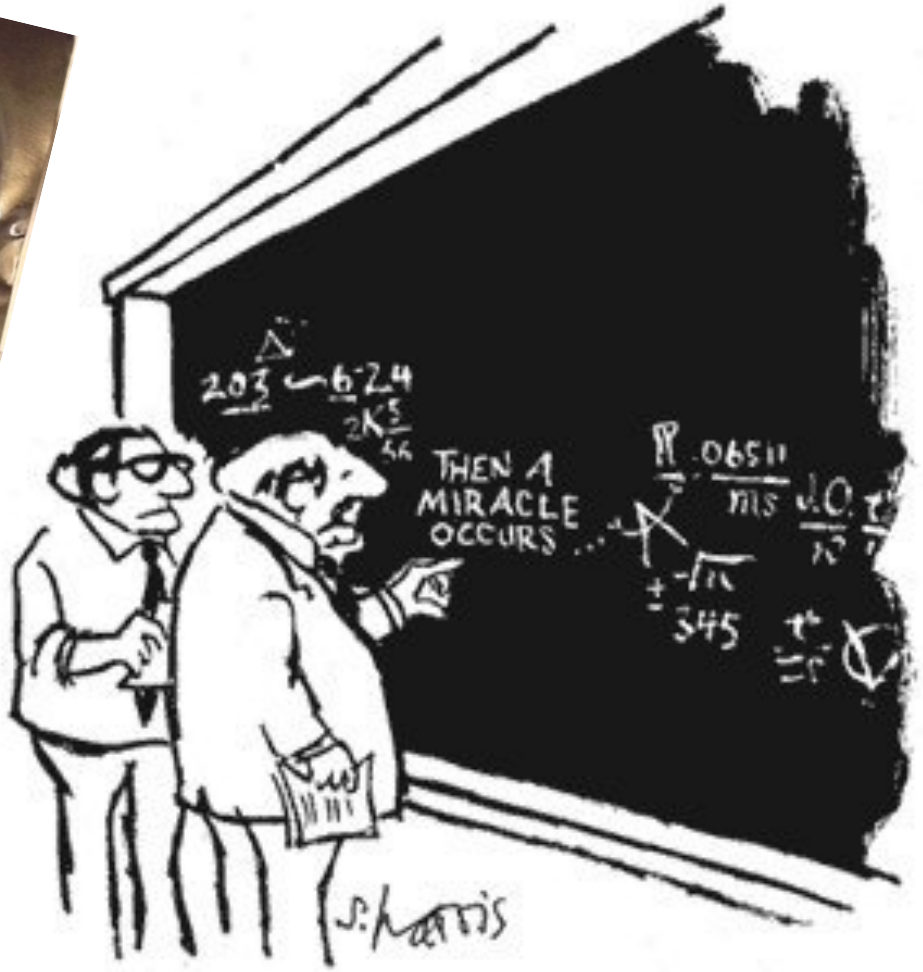
• **Creazione di atomi di anti-materia**: la prima volta 9 atomi in 3 settimane, oggi decine di migliaia al giorno. 10 milioni di miliardi di volte per riempire un palloncino (cioe` molti miliardi di anni)

• **Potere distruttivo**: con 0.5 g di anti-materia stesso effetto di una bomba nucleare da 20 kton, ma ci metteremmo miliardi di anni per produrla… e` poco probabile che chiunque voglia aspettare cosi` a lungo.

• **Costi**: l’anti-materia ha solo 1 decimiliardesimo dell’energia usata per produrla. Tutta l’anti-materia finora prodotta al CERN potrebbe fornire energia per una lampadina per pochi minuti.

Un'equazione





"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."