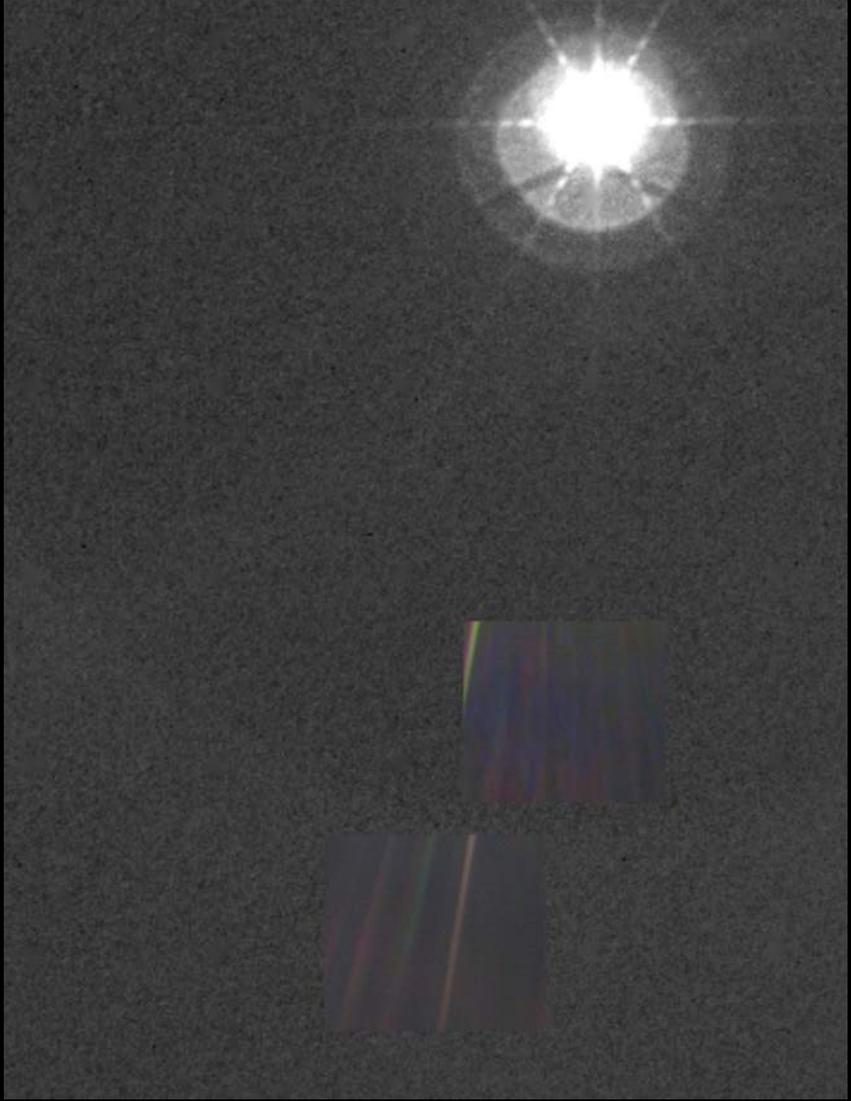
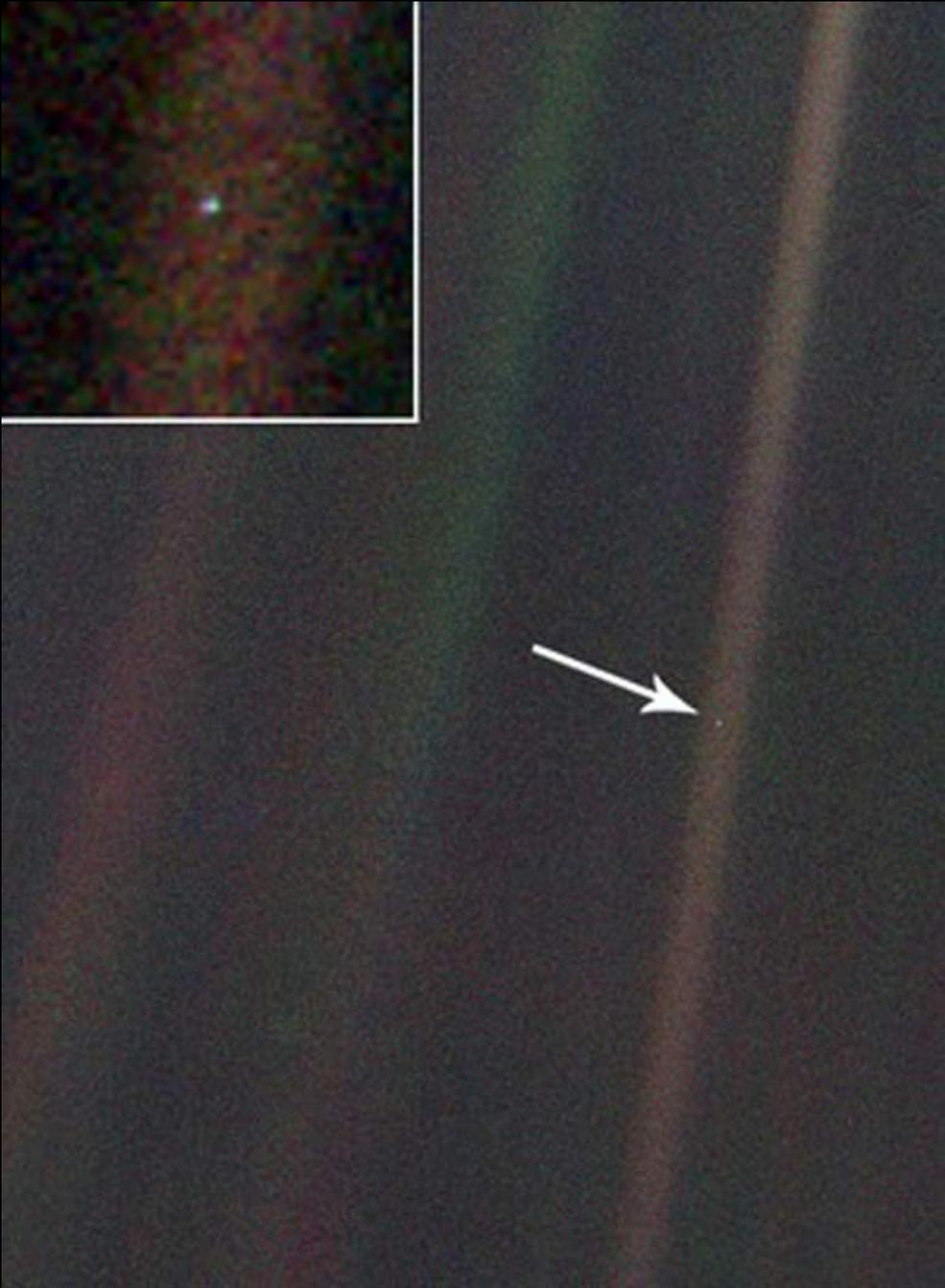


Barbara Sciascia (INFN)

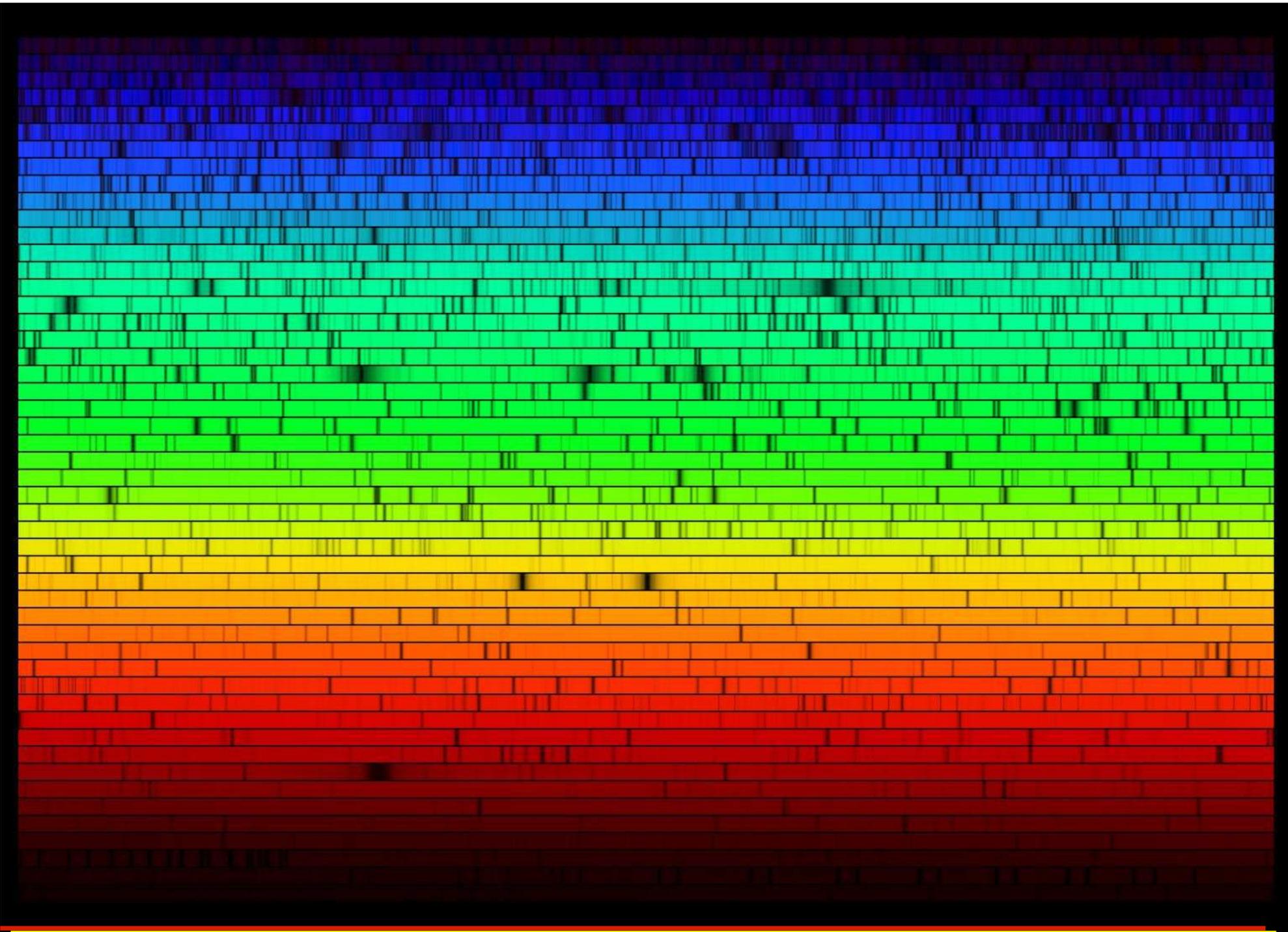
*25 settembre 2015
Notte Europea dei Ricercatori*

Io dico l'Universo











Tra teoria ed esperimento





Di che cosa è fatto l'universo



“Modello chimico”: tavola periodica



Modello Standard: una nuova tavola

| QUARK | up u | charm c | top t |
|-------------------------|--------|-----------|---------|
| carica elettrica $2/3$ | | | |
| carica elettrica $-1/3$ | | | |

| MEDIATORI | gluone g |
|------------------|------------|
| | |
| fotone γ | |
| | |
| bosone W W^\pm | |
| | |
| bosone Z Z | |
| | |



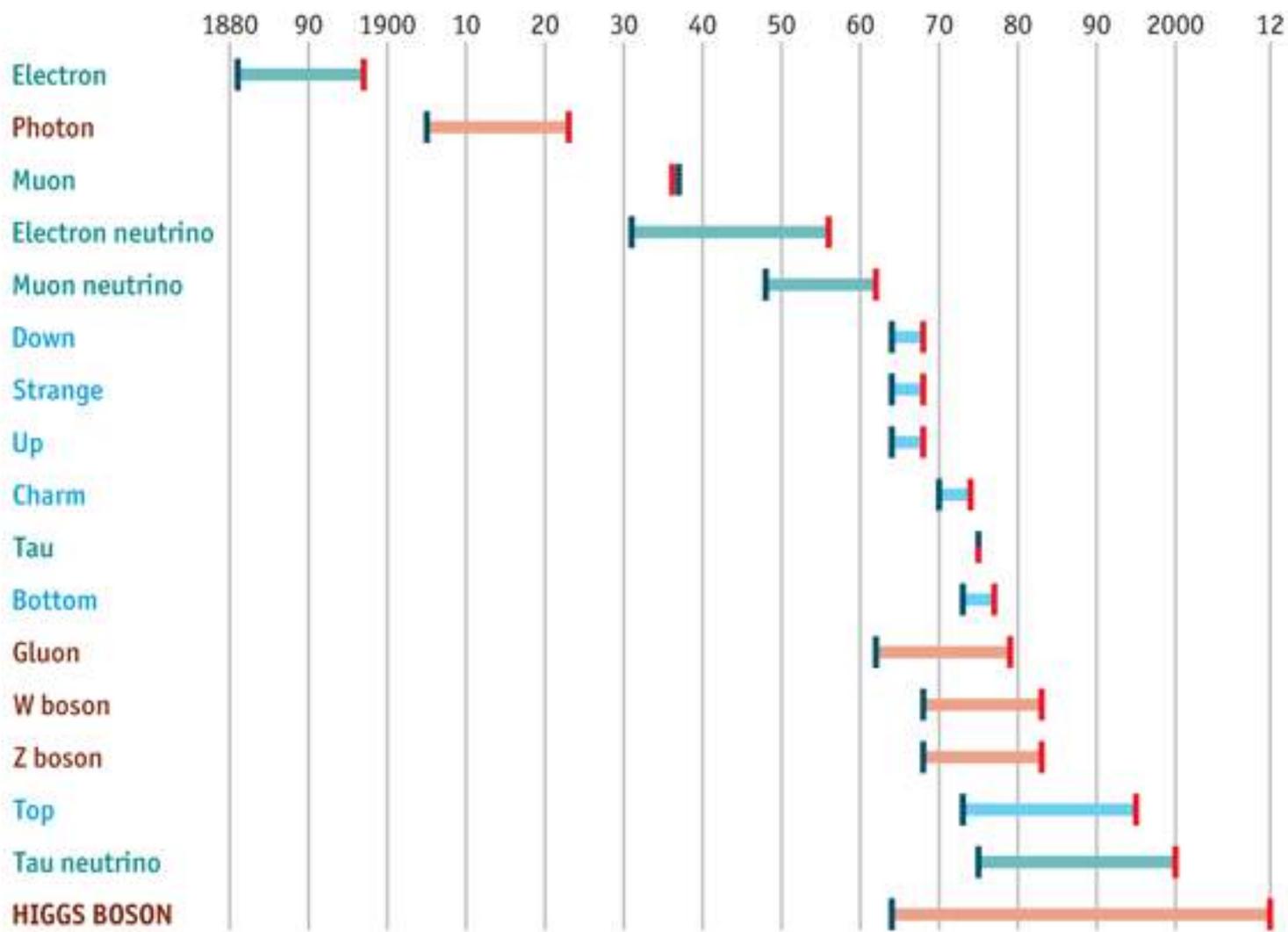
| LEPTONI | ν_e | ν_μ | ν_τ |
|-----------------------|---------|-----------|------------|
| carica elettrica 0 | | | |
| carica elettrica -1 | | | |

Credits: Asimmetrie

Modello Standard: 130 anni di scoperte

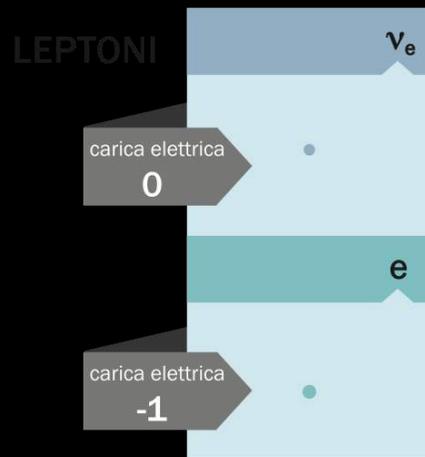
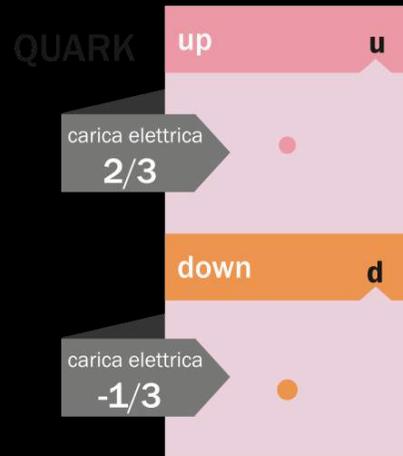
The Standard Model of particle physics

Years from concept to discovery

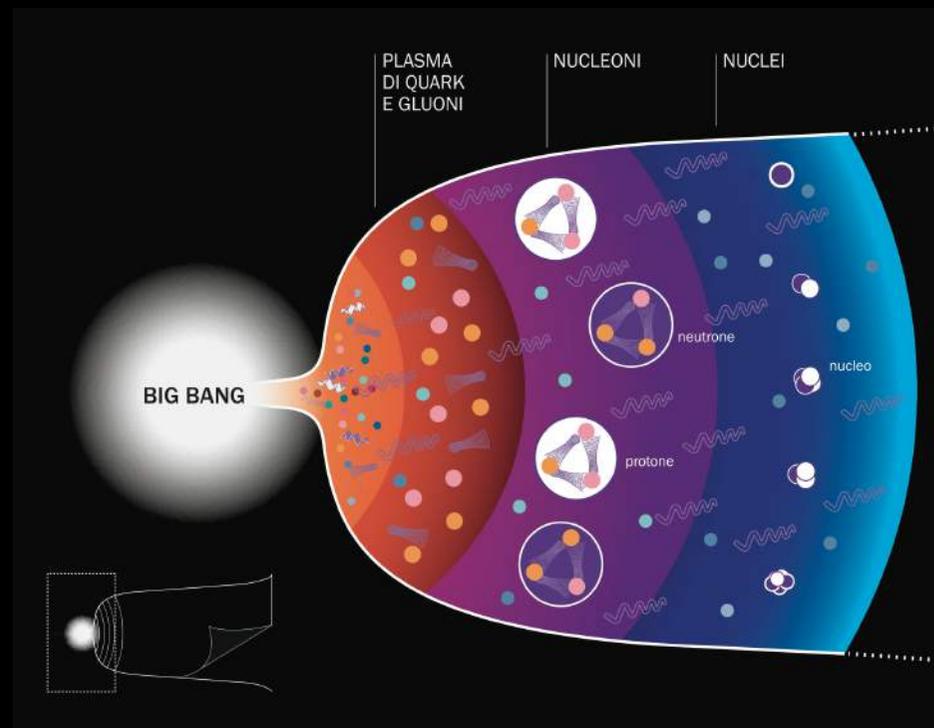
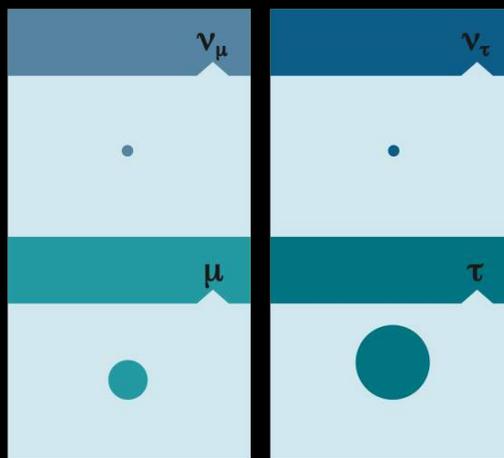
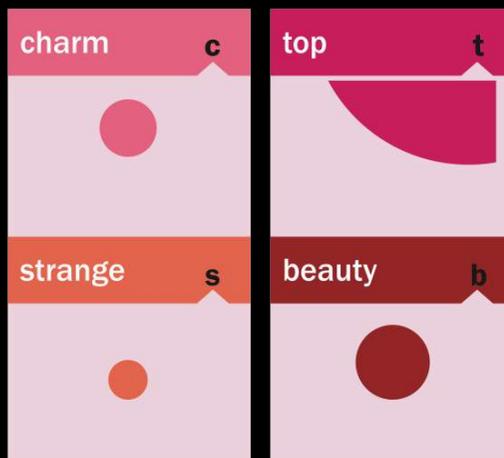


Source: *The Economist*

Materia "ordinaria"

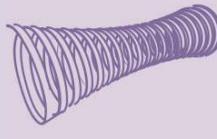


“solo” più pesante (?)



Mediatori delle forze



| | |
|---|-----------|
| gluone | g |
|  | |
| fotone | γ |
|  | |
| bosone W | W^{\pm} |
|  | |
| bosone Z | Z |
|  | |

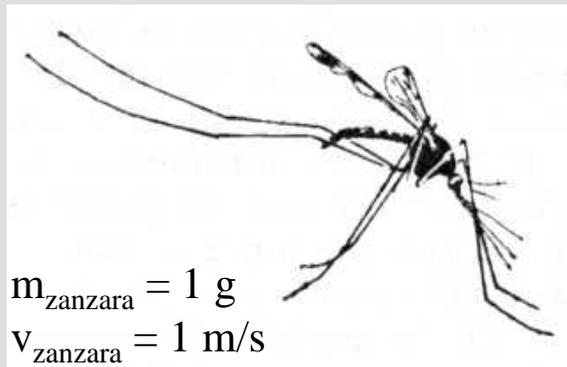
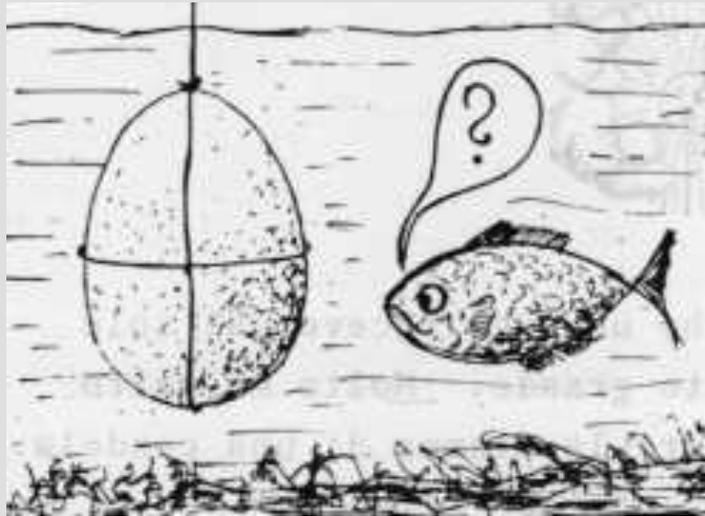
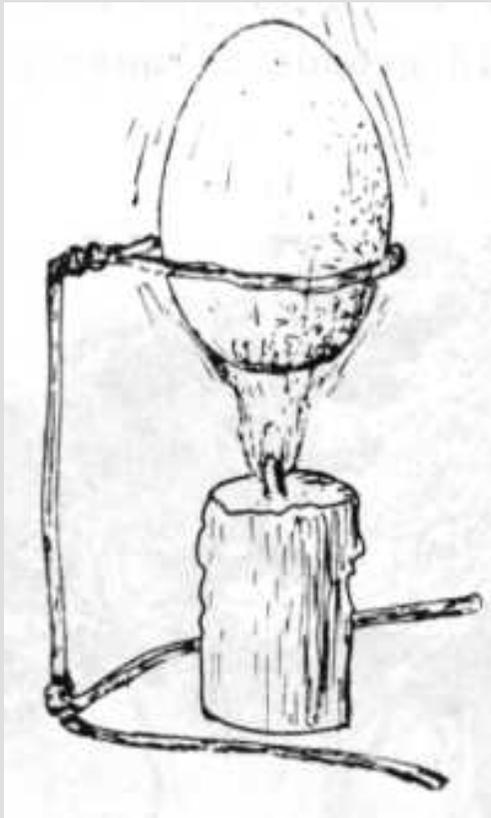
Il bosone di Higgs



Large Hadron Collider (LHC)



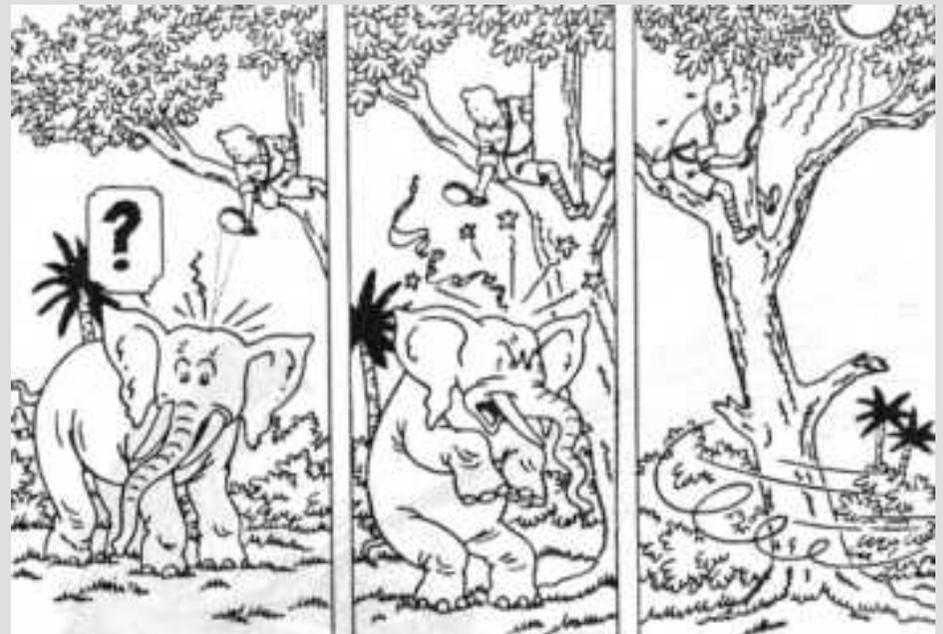
Fisica delle “alte” energie

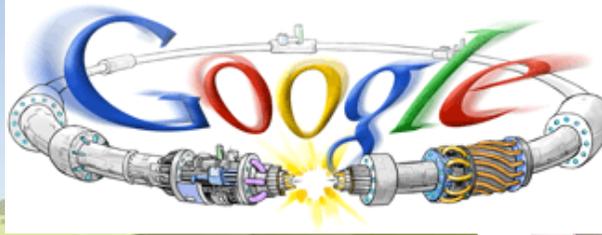
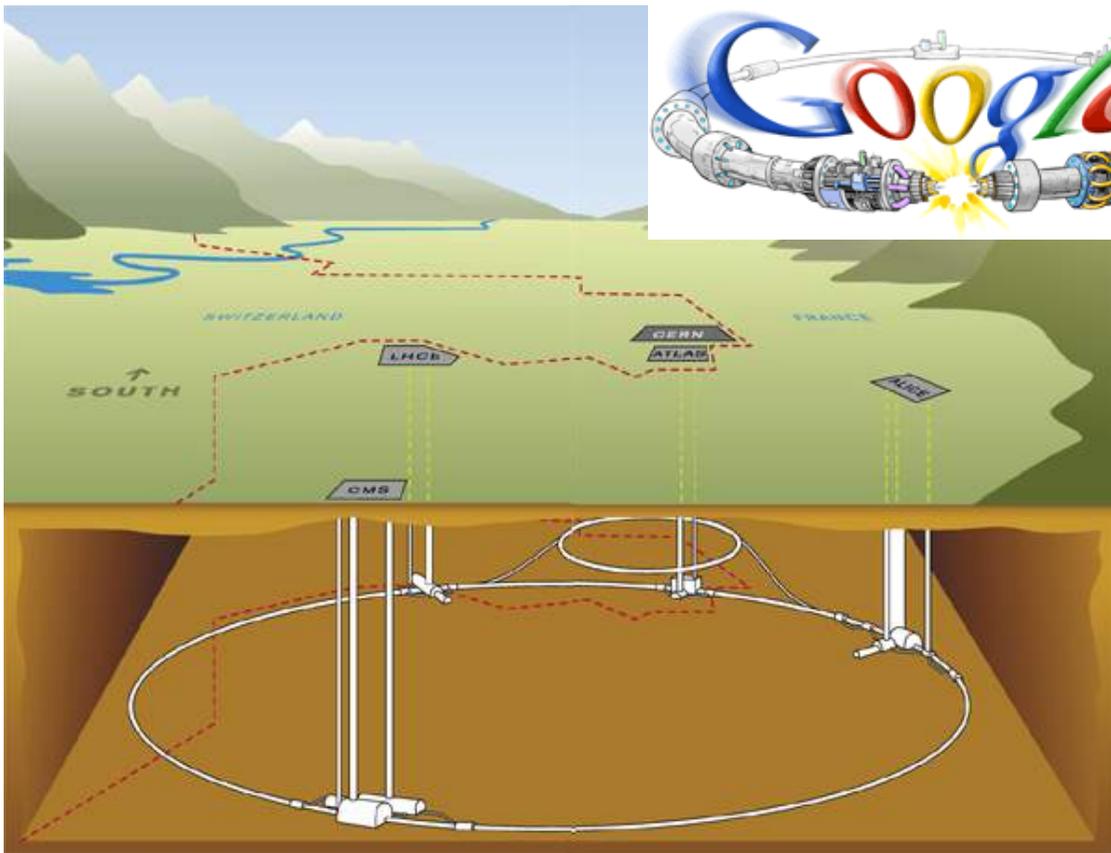


$$m_{\text{zanzara}} = 1 \text{ g}$$
$$v_{\text{zanzara}} = 1 \text{ m/s}$$

**LHC(2015):
13 TeV**

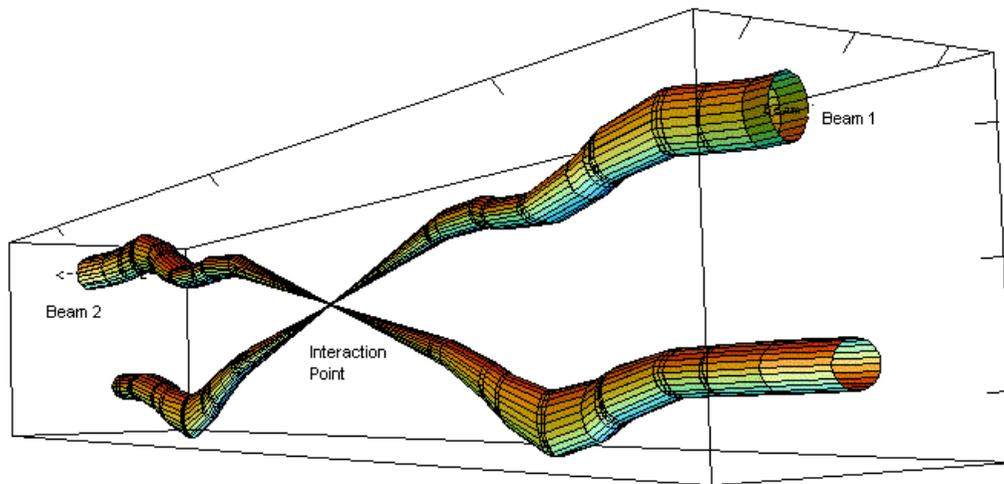
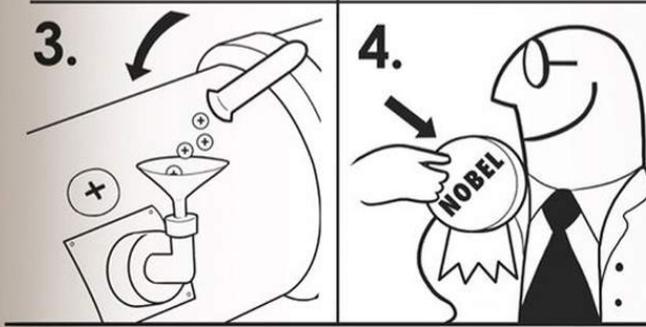
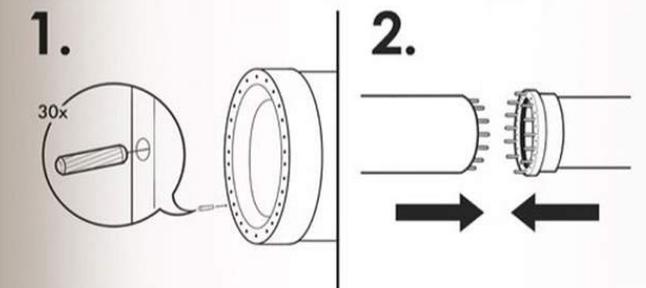
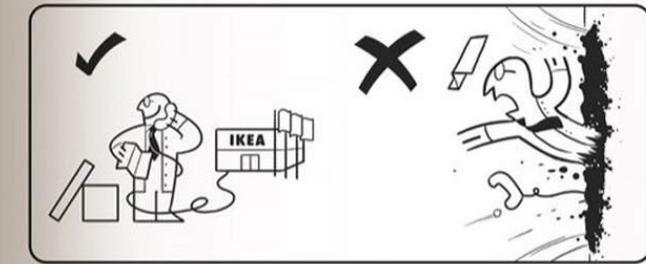
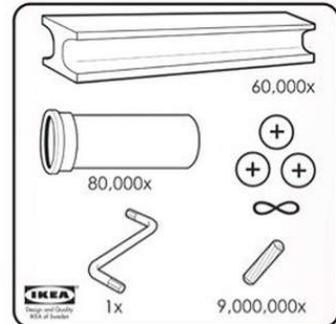
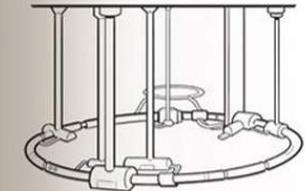
$$E_{\text{zanzara}} = 10^{-3} \text{ J} = 6.25 \times 10^{15} \text{ eV} = \mathbf{6.25 \times 10^3 \text{ TeV}}$$





LHC

**HÄDRÖNN
CJÖLIDDER**

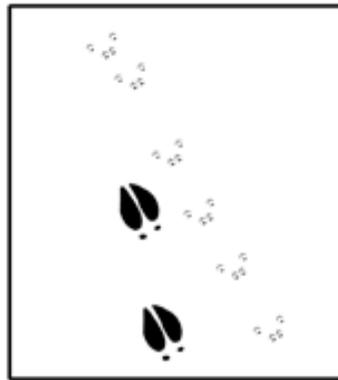


Relative beam sizes around IP1 (Atlas) in collision

BACKYARD SNOW TRACKING GUIDE



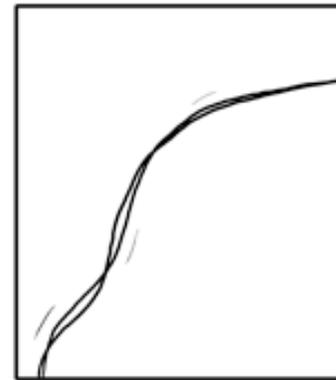
CAT



MOOSE AND SQUIRREL



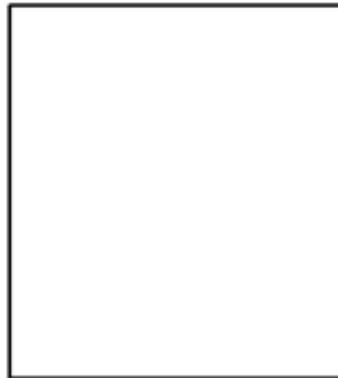
LONGCAT



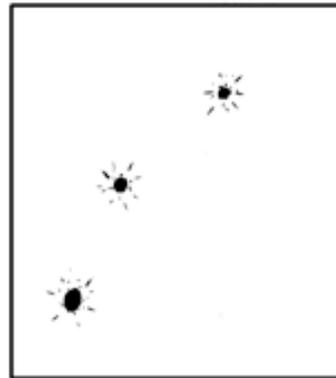
MOUSE RIDING BICYCLE



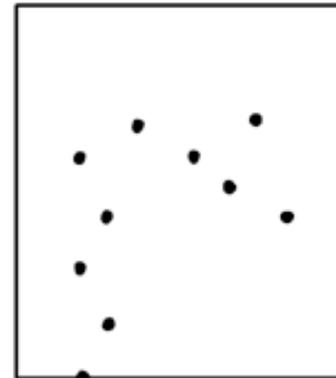
RABBIT STOPPING
TO USE HAIR DRYER



LEGOLAS



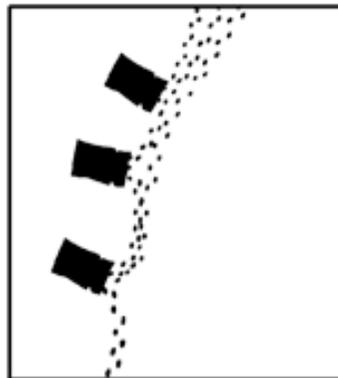
BOBCAT ON POGO STICK



KNIGHT



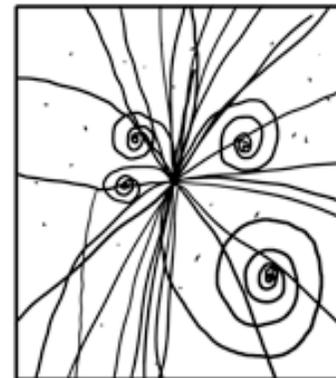
KID WITH
TRANSMOGRIFIER



KID WITH DUPLICATOR



PRIUS

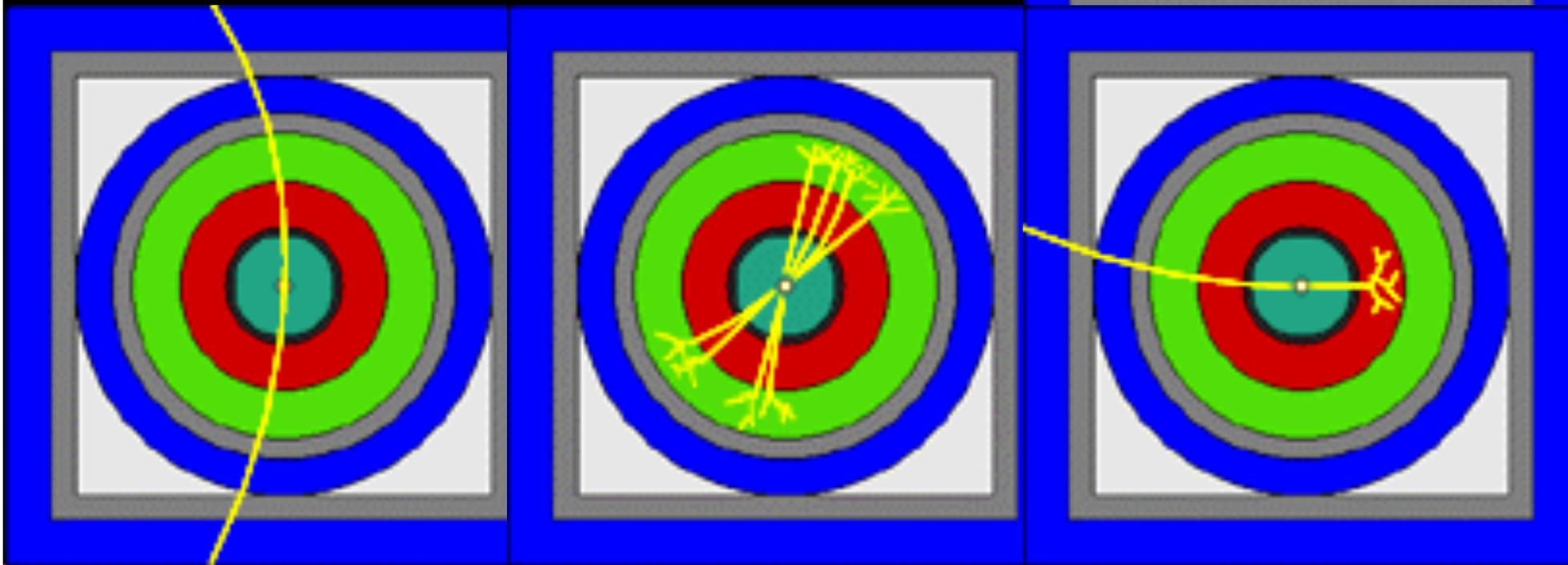
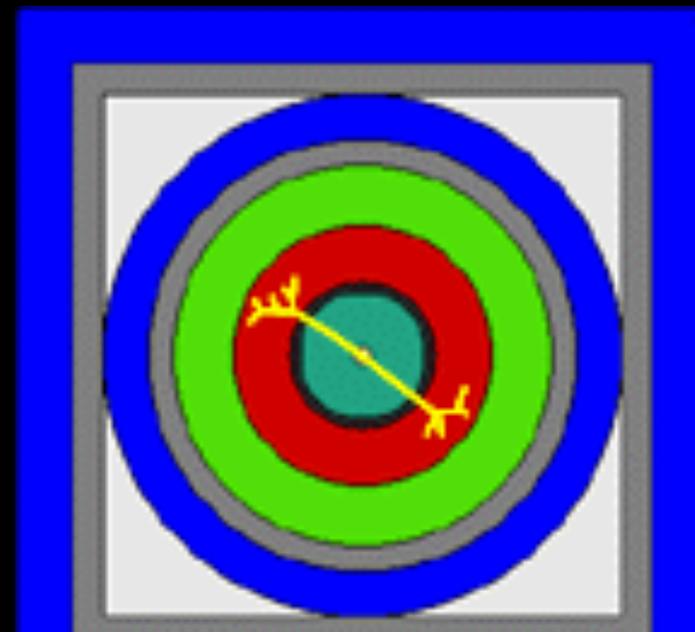
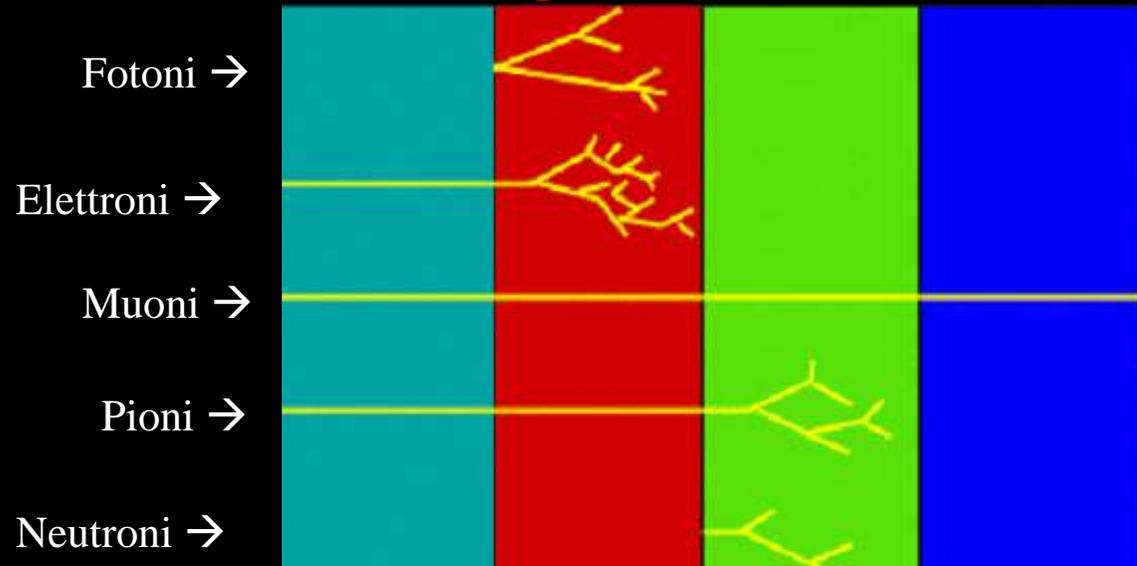


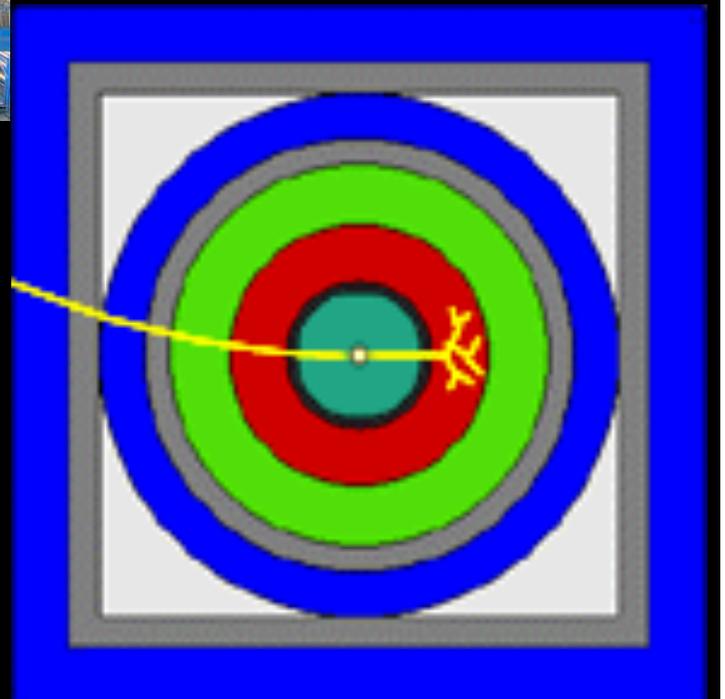
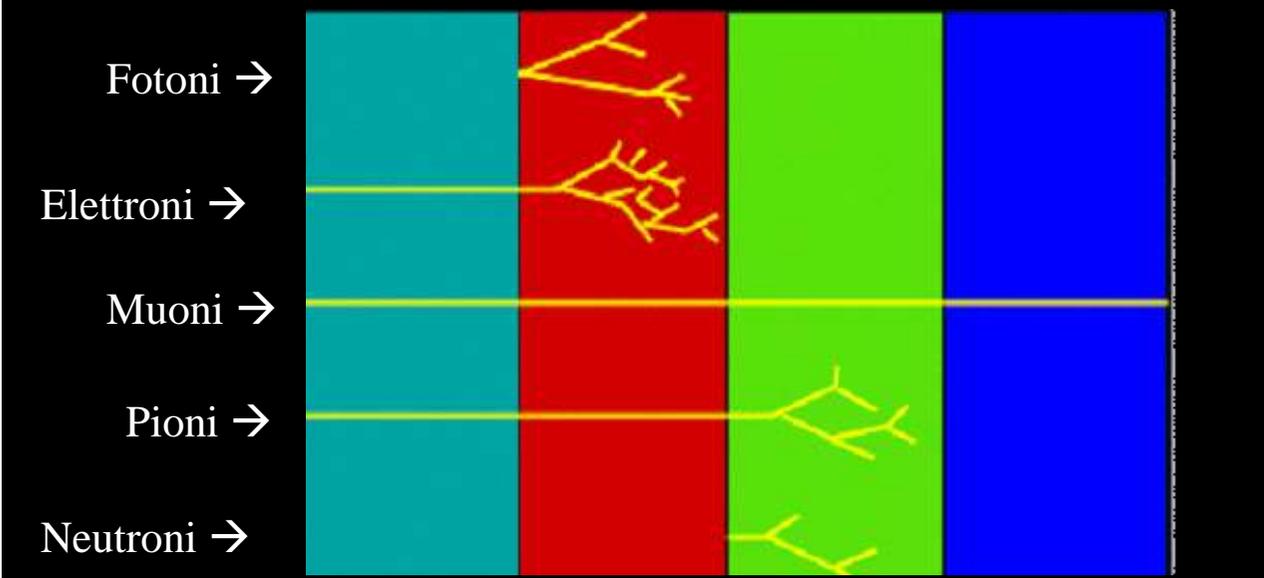
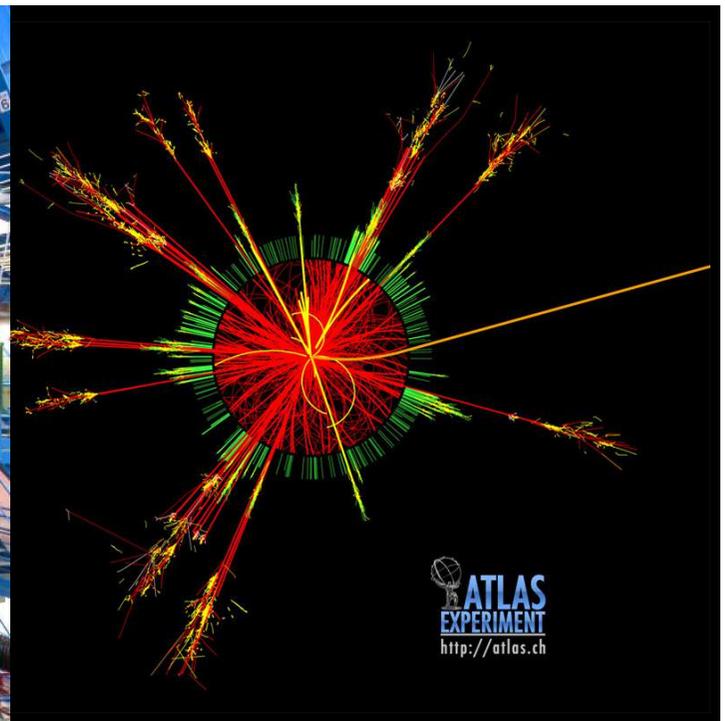
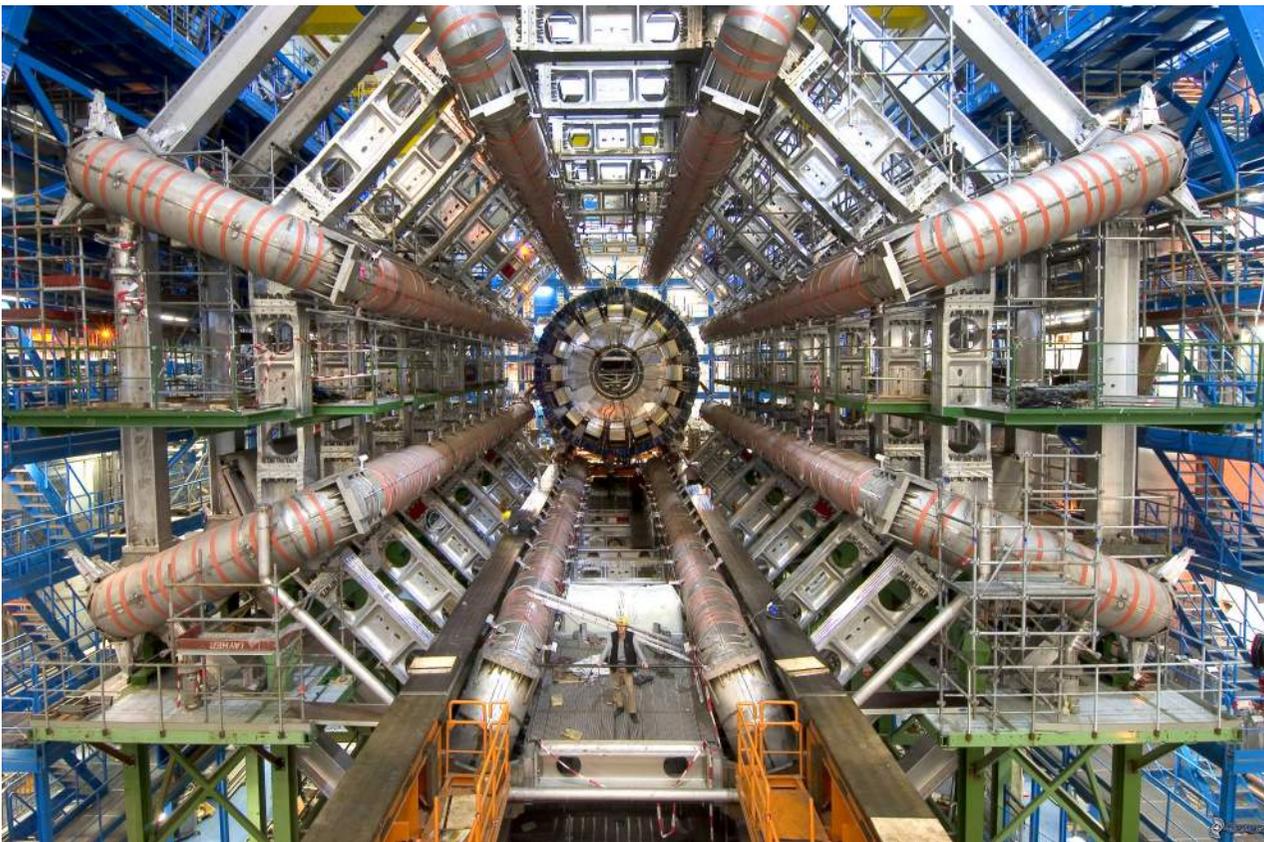
HIGGS BOSON

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

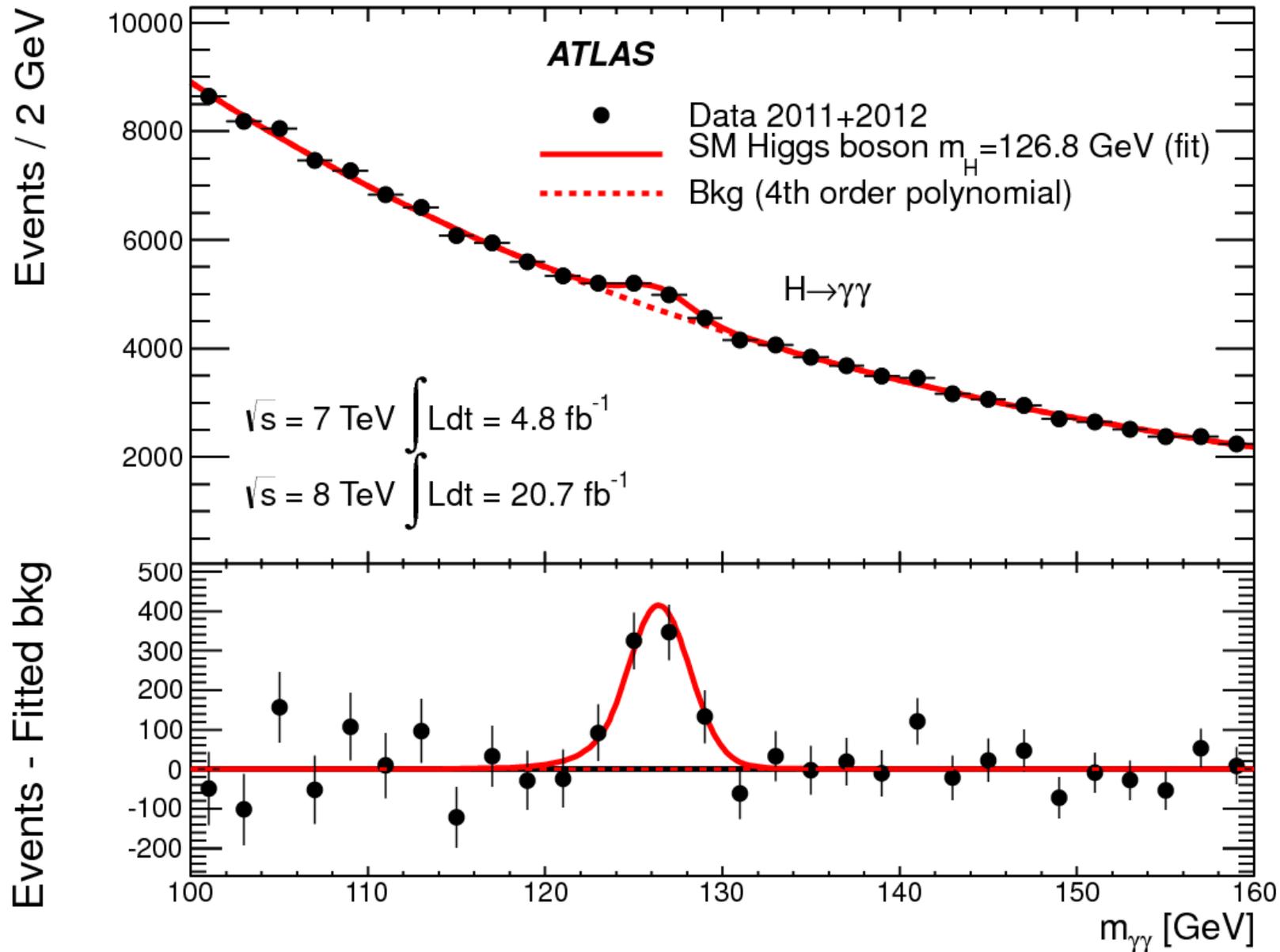
*Vedere le
particelle?*

Riconoscere gli eventi

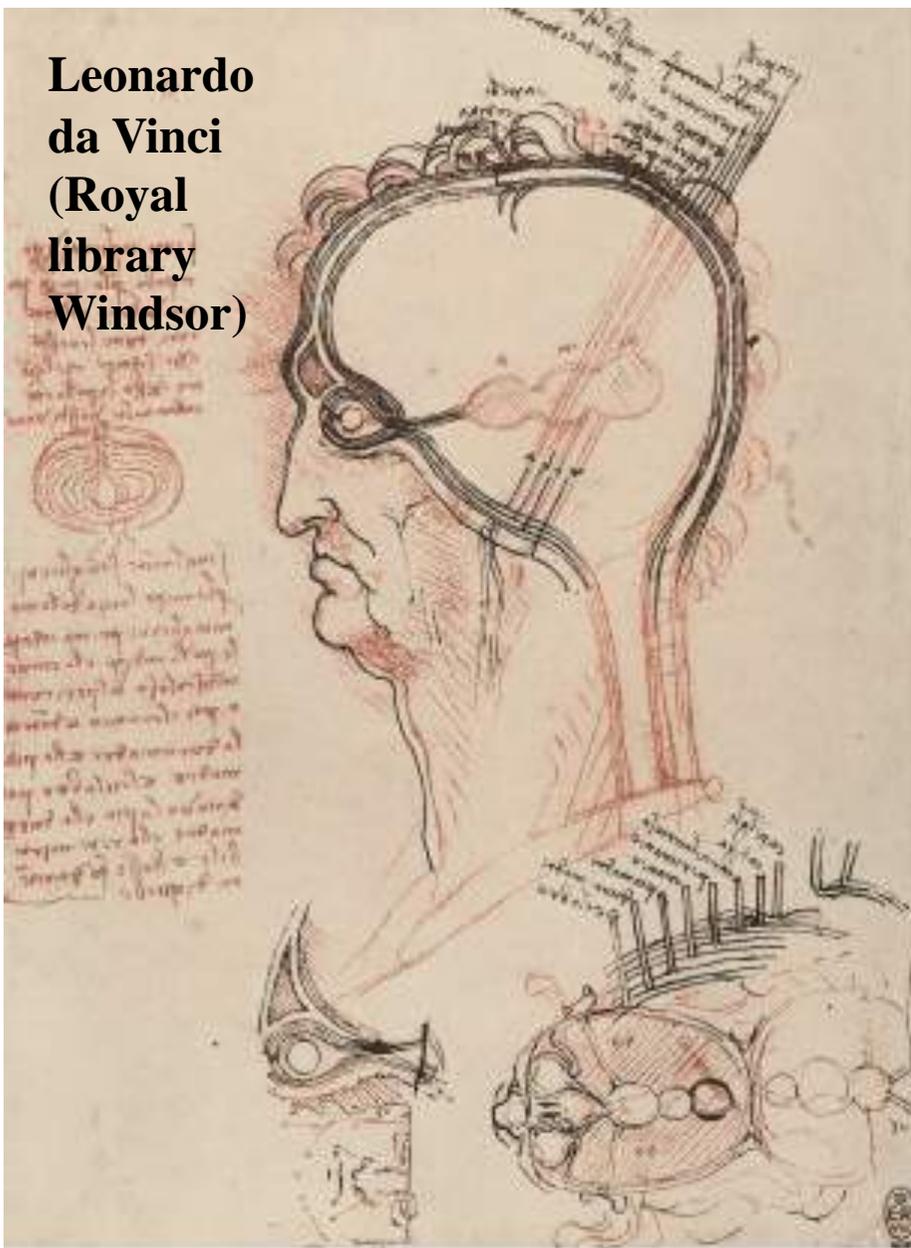




Il bosone di Higgs

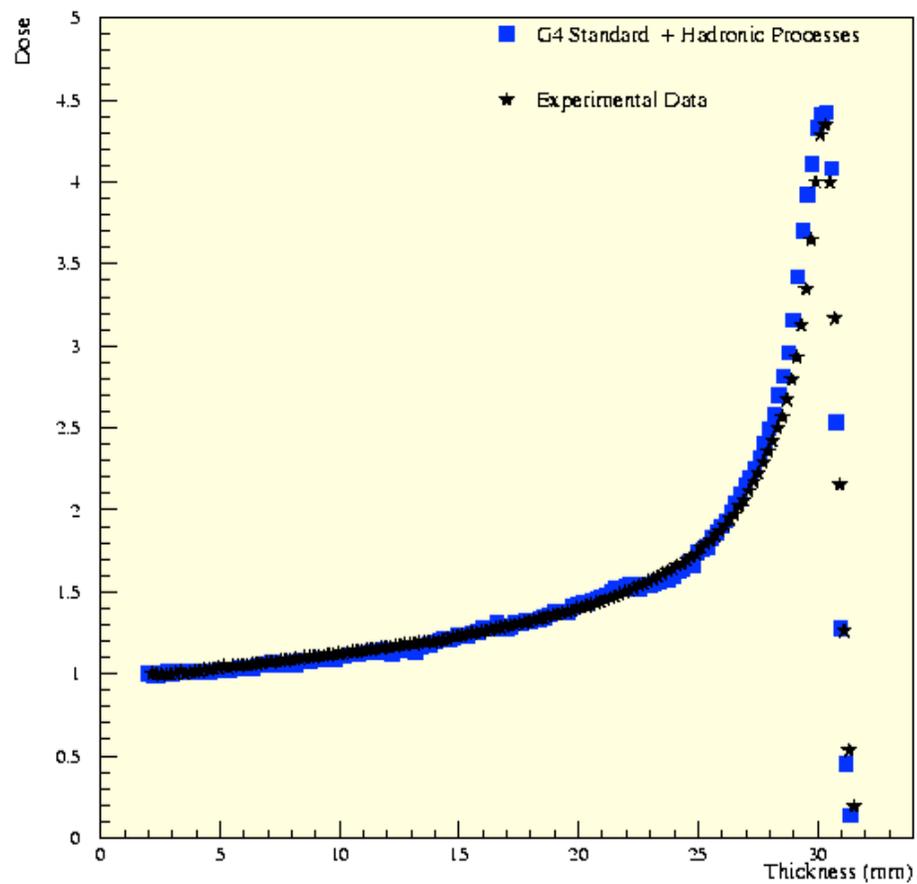


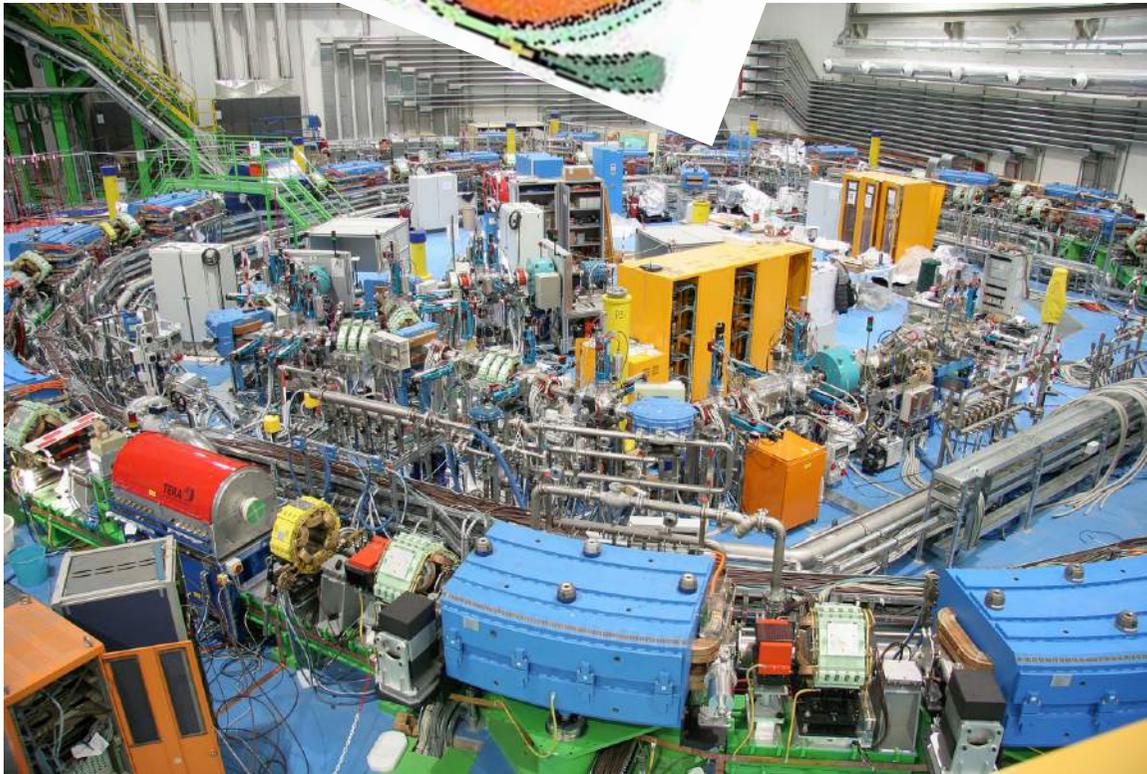
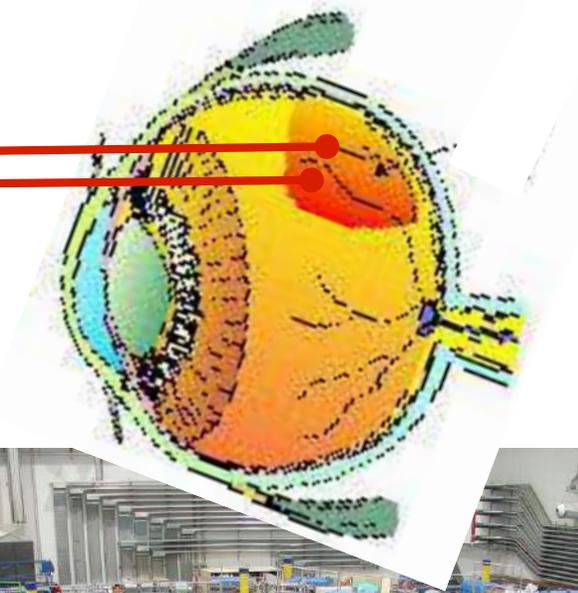
Leonardo
da Vinci
(Royal
library
Windsor)

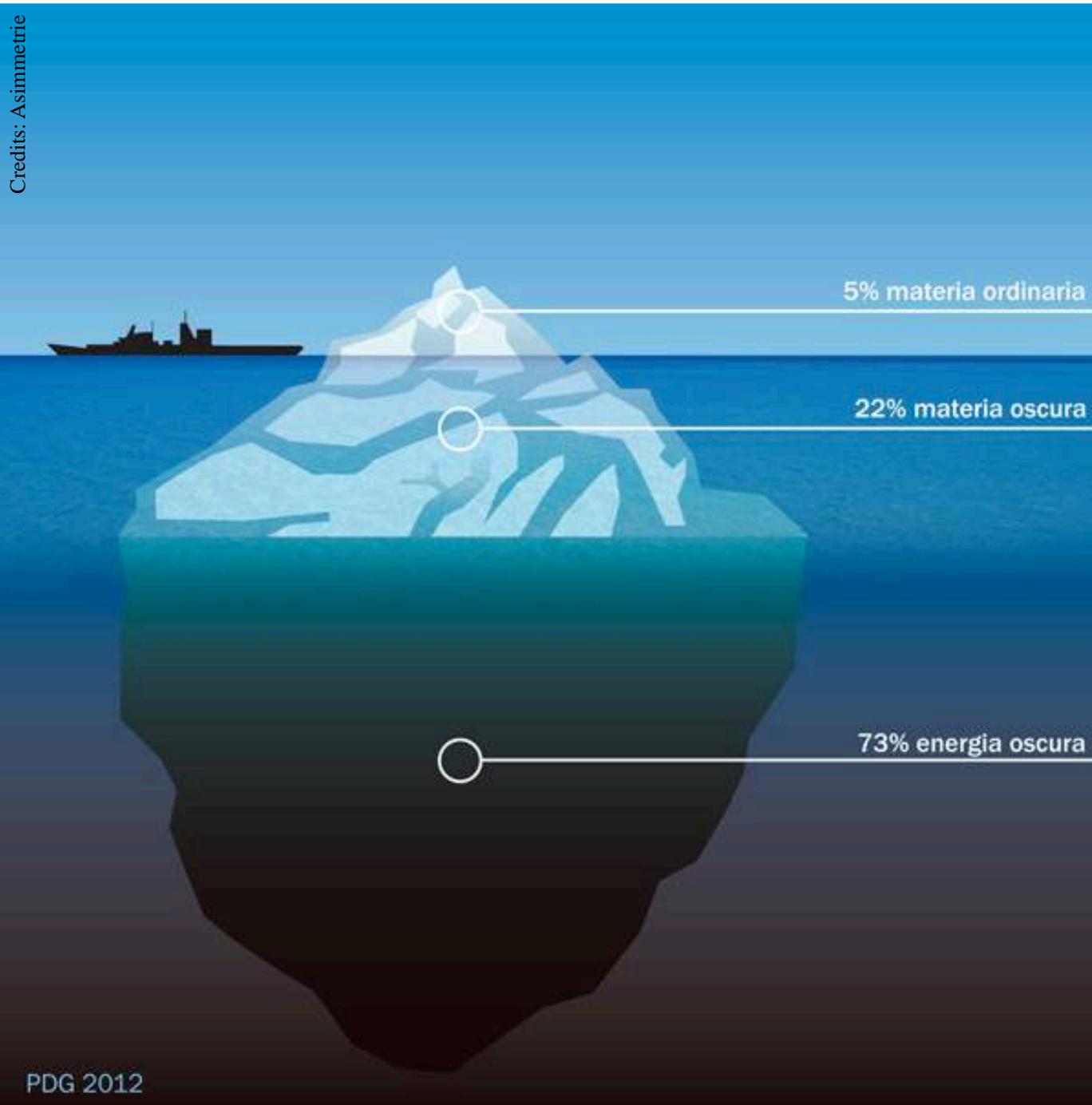


Ostinatamente curiosi...

Protons - Bragg Peak - Water





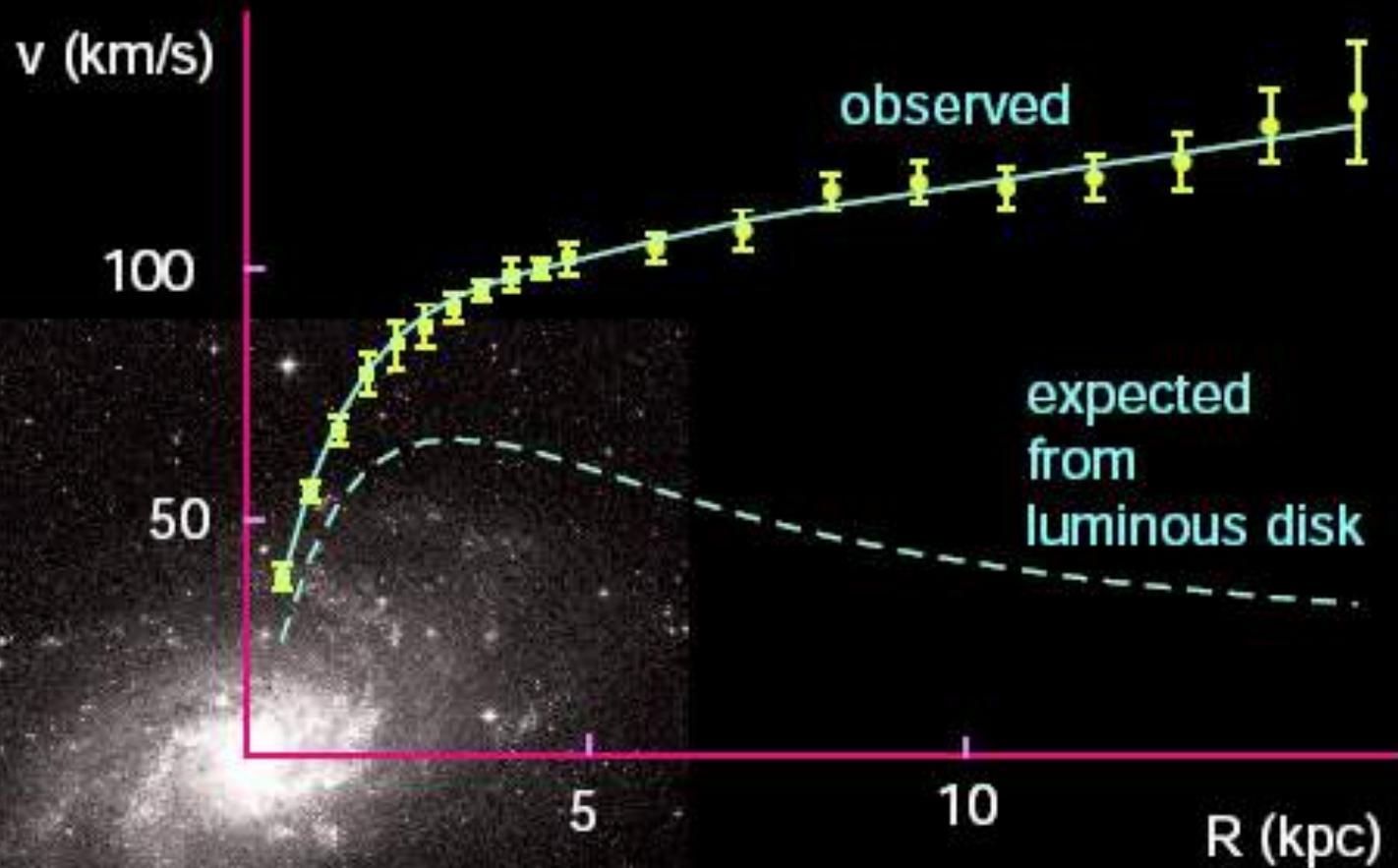


PDG 2012

Solo la punta dell'iceberg

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

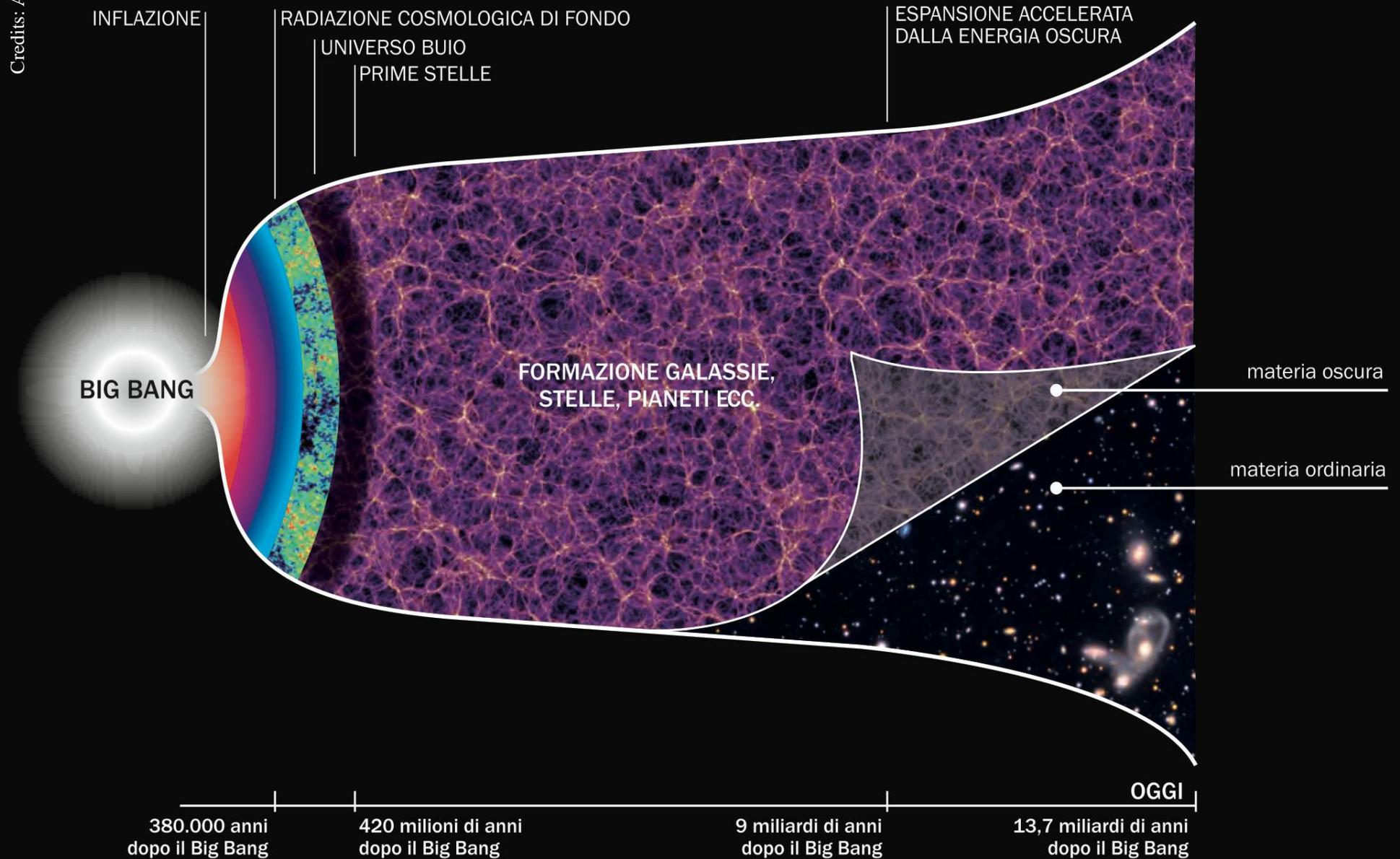
Materia e Materia Oscura



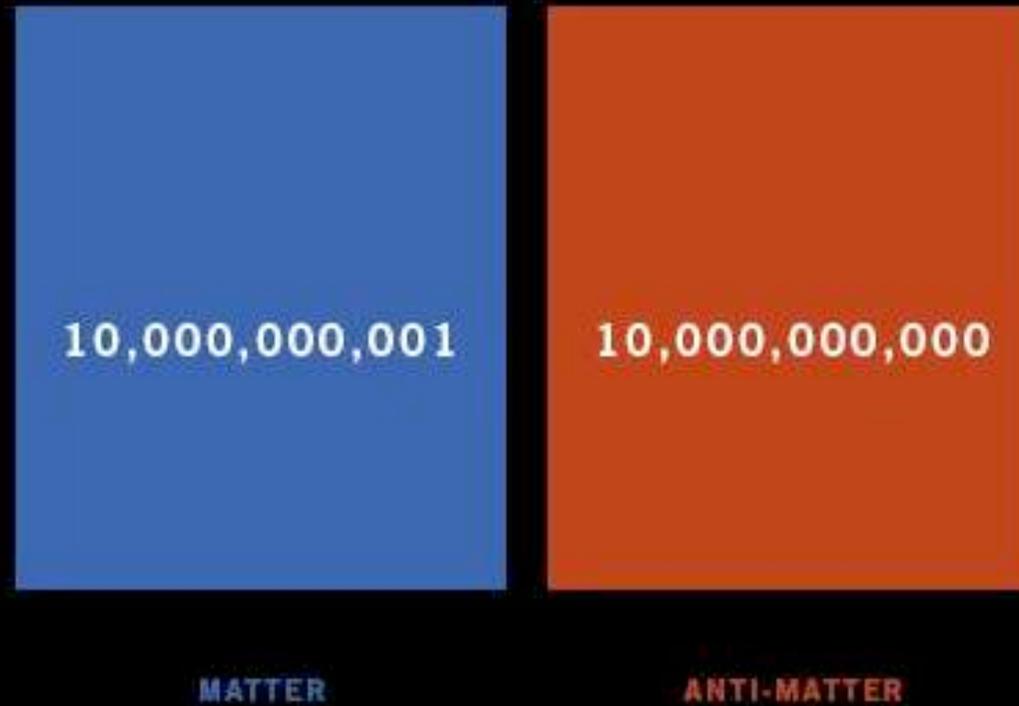
M33 rotation curve

Modello Standard Cosmologico

Credits: Asimmetrie



Materia e Antimateria



Credits: Hitoshi Murayama

Materia e Antimateria

•
US

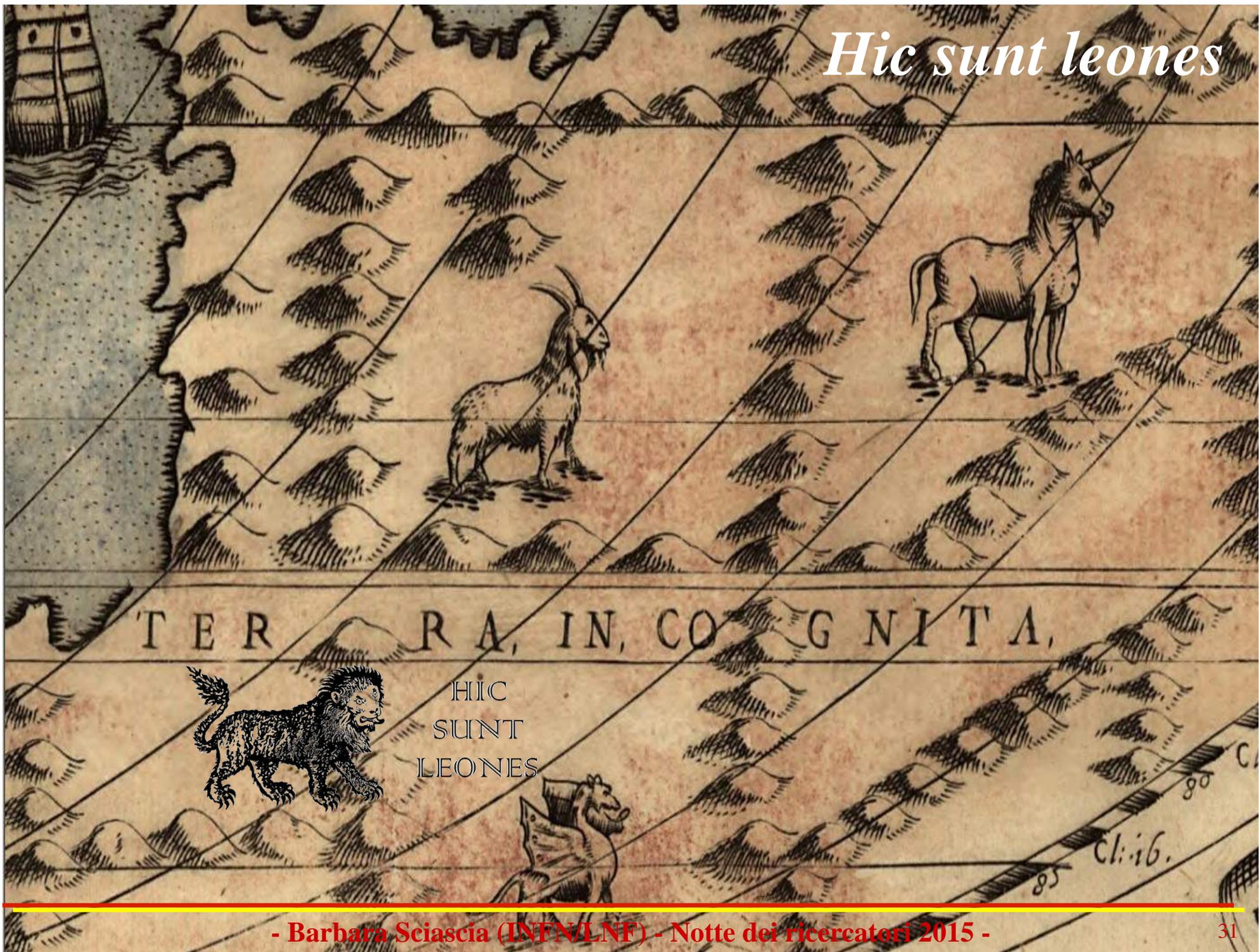
1

MATTER

ANTI-MATTER

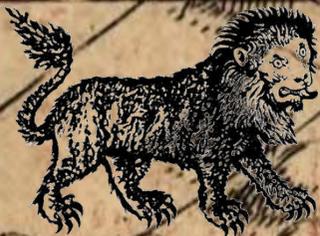
Credits: Hitoshi Murayama

Hic sunt leones



TERRA INCOGNITA

HIC
SUNT
LEONES



Pentaquark

Pentaquark publicity

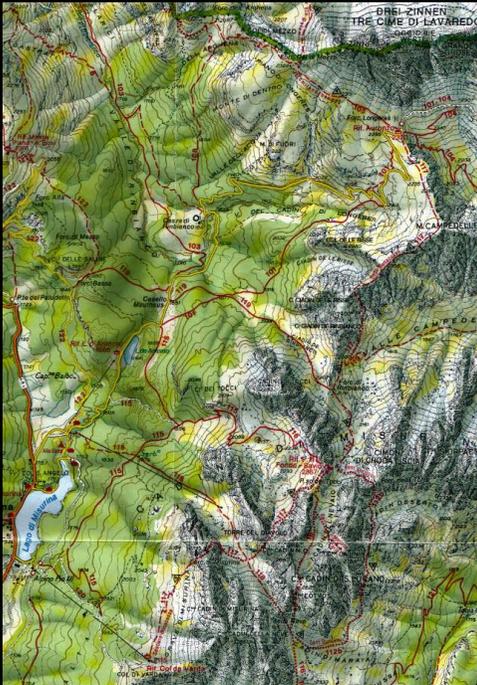
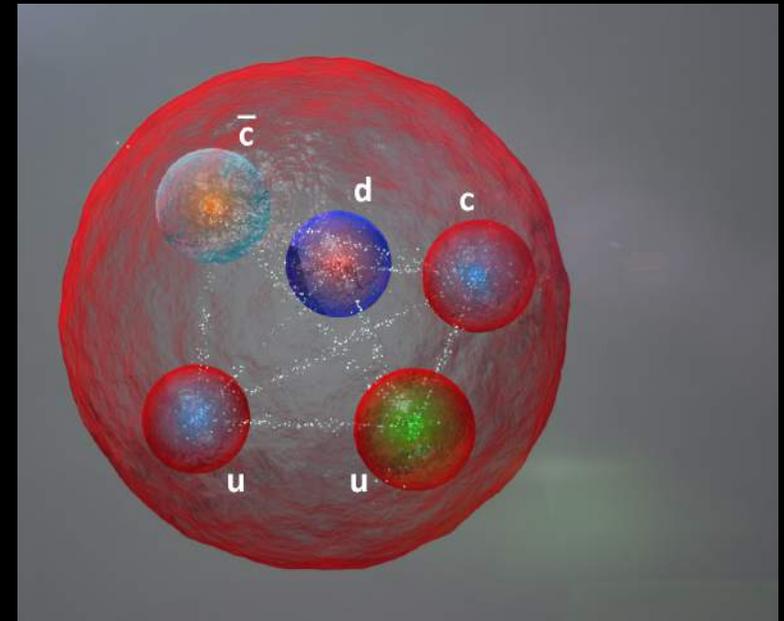
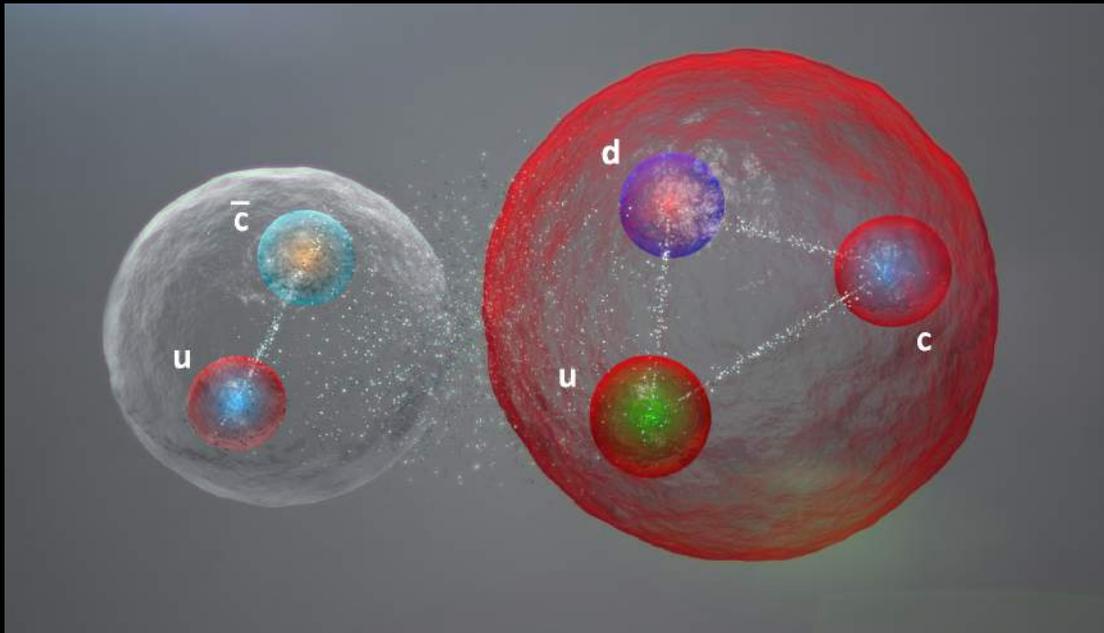
~2000 news clips on one day, the biggest CERN story of the last year concerning a physics result



+ great interest in the community



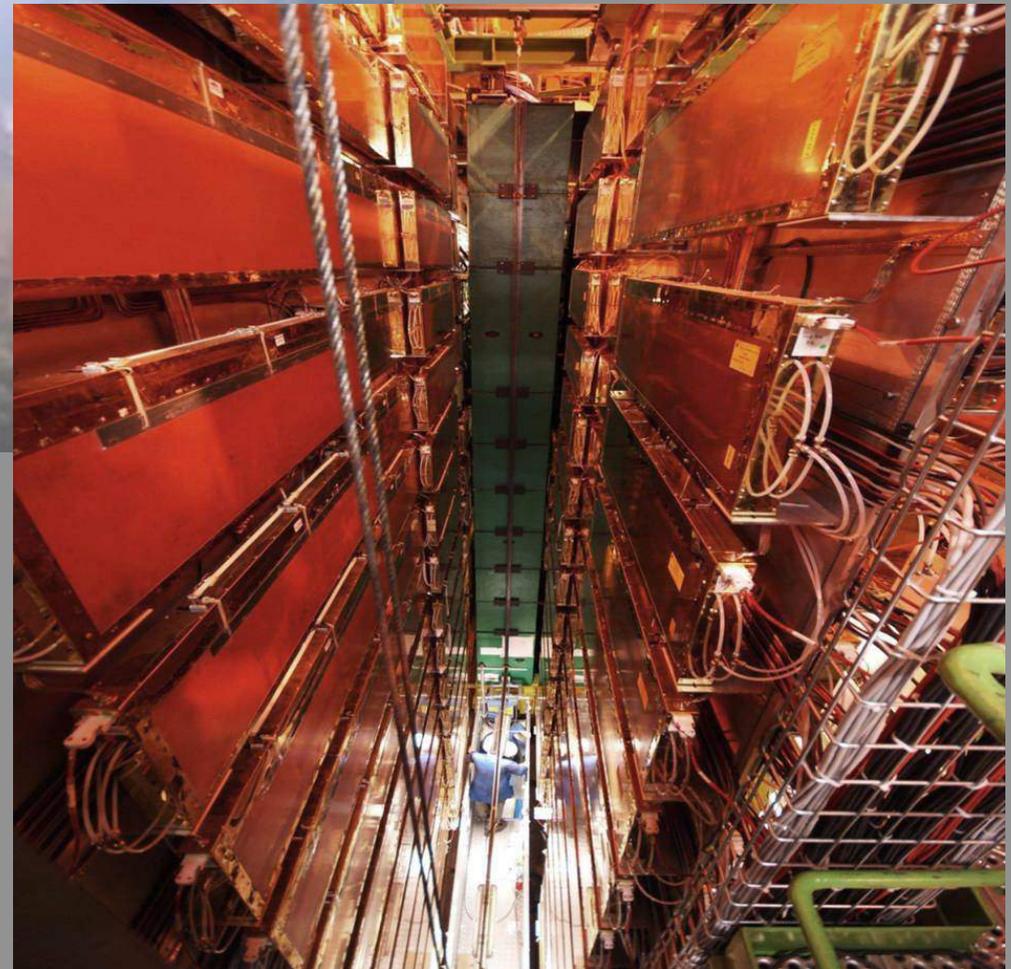
Pentaquark



L'inizio [LHCb]



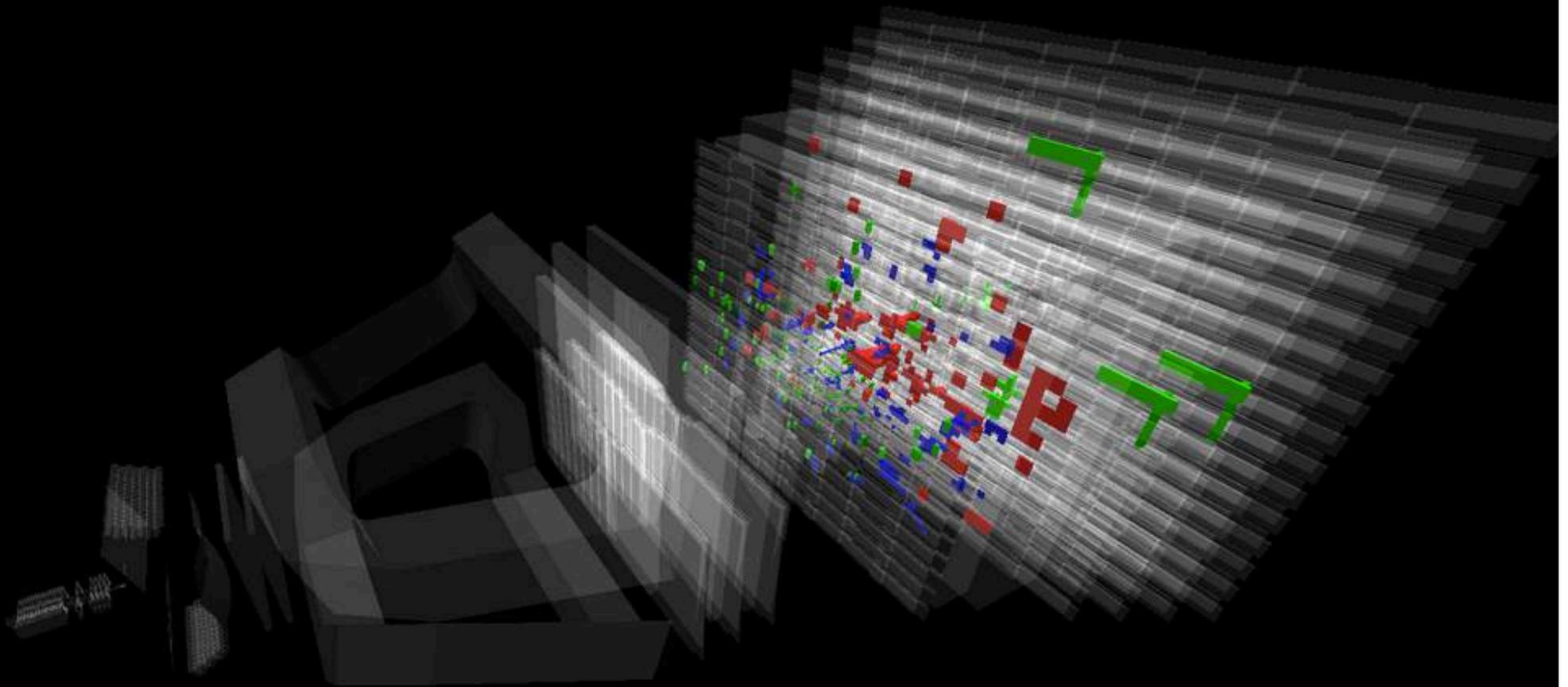
Foto: Andrea Littera



Il futuro: LHC per la prima volta a 13 TeV

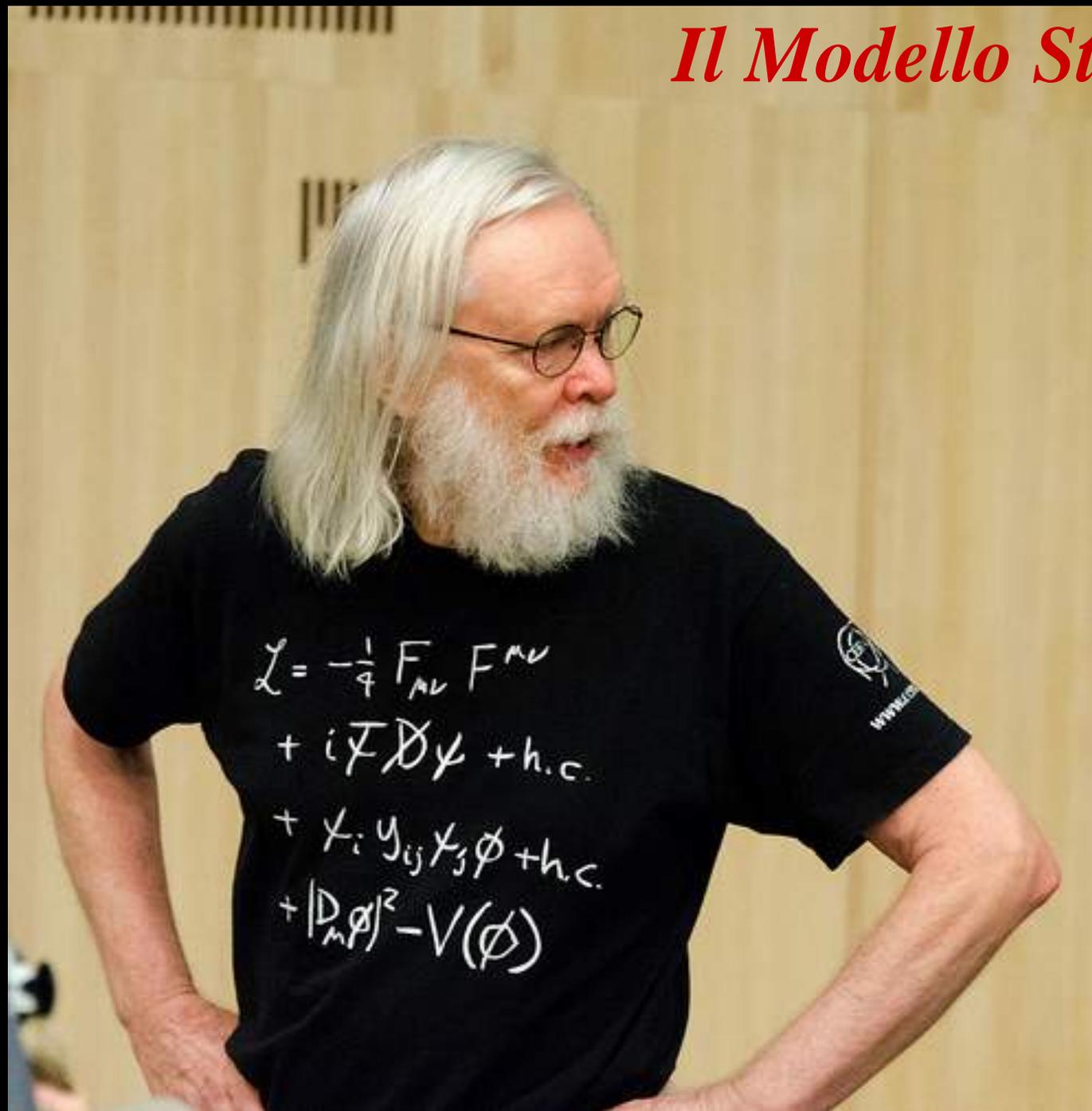


Il futuro: LHC per la prima volta a 13 TeV



[LHCb]

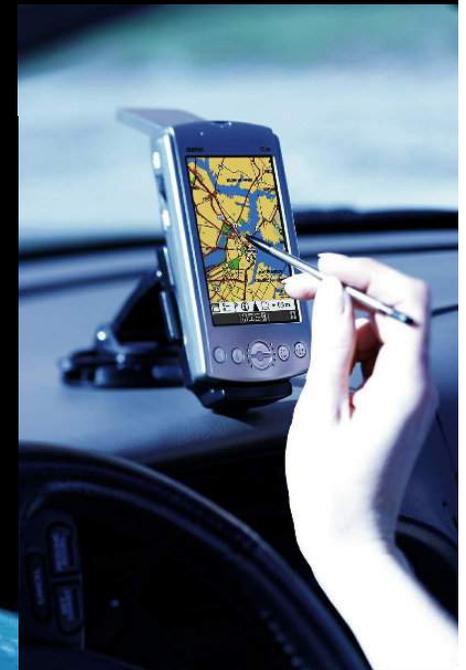
Il Modello Standard

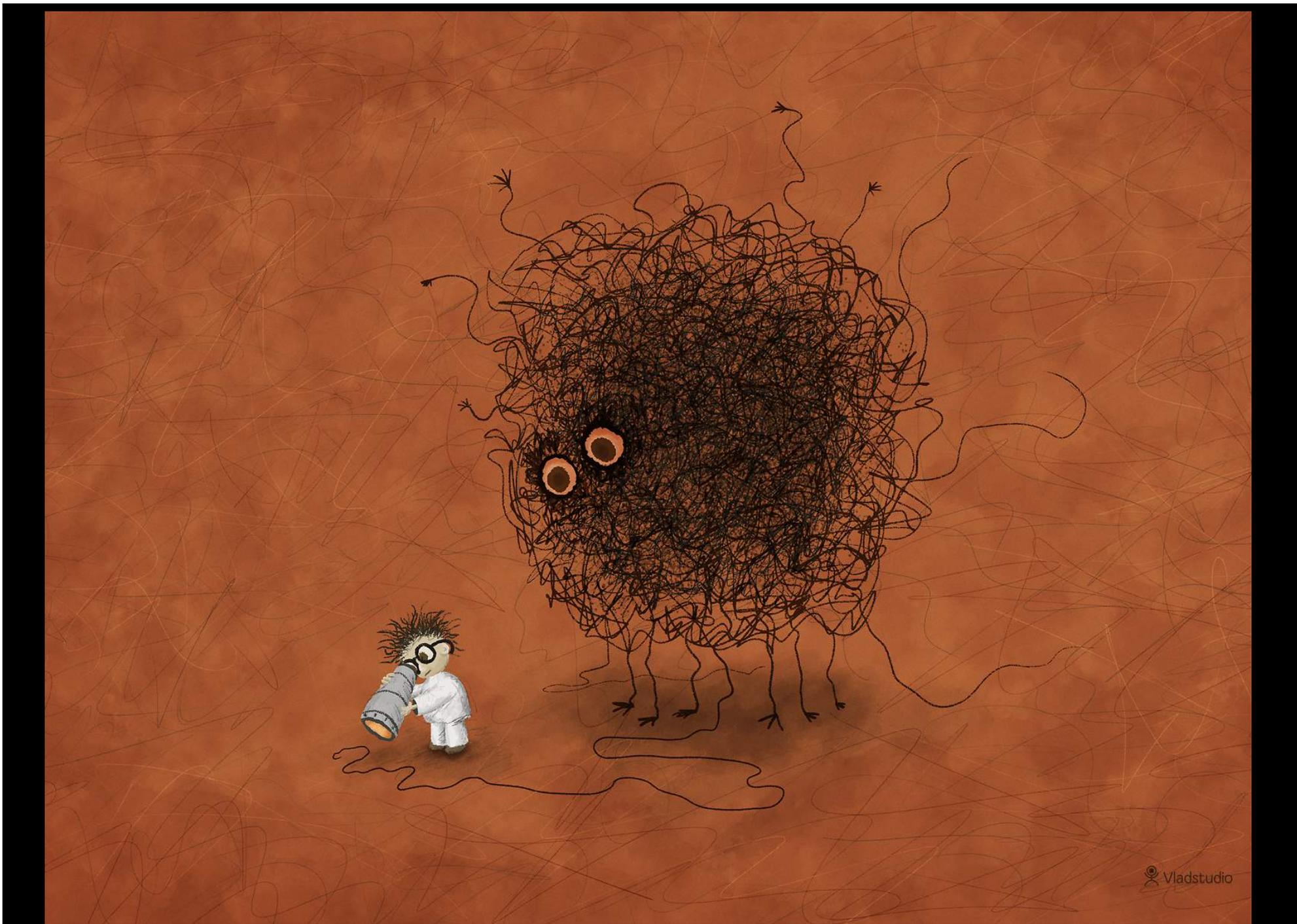


Un'equazione



Relatività speciale e generale





*Grazie e
buona visita!*

Approfondimenti

Lezioni:

D.Domenici (rivelatori) e G. Isidori (Modello Standard)

(<http://www.lnf.infn.it/edu/stageInf/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/>



1951

4 Sezioni universitarie
Milano, Torino, Padova, e Roma

1957

**Laboratori Nazionali di
Frascati**



Frascati



D'Agost

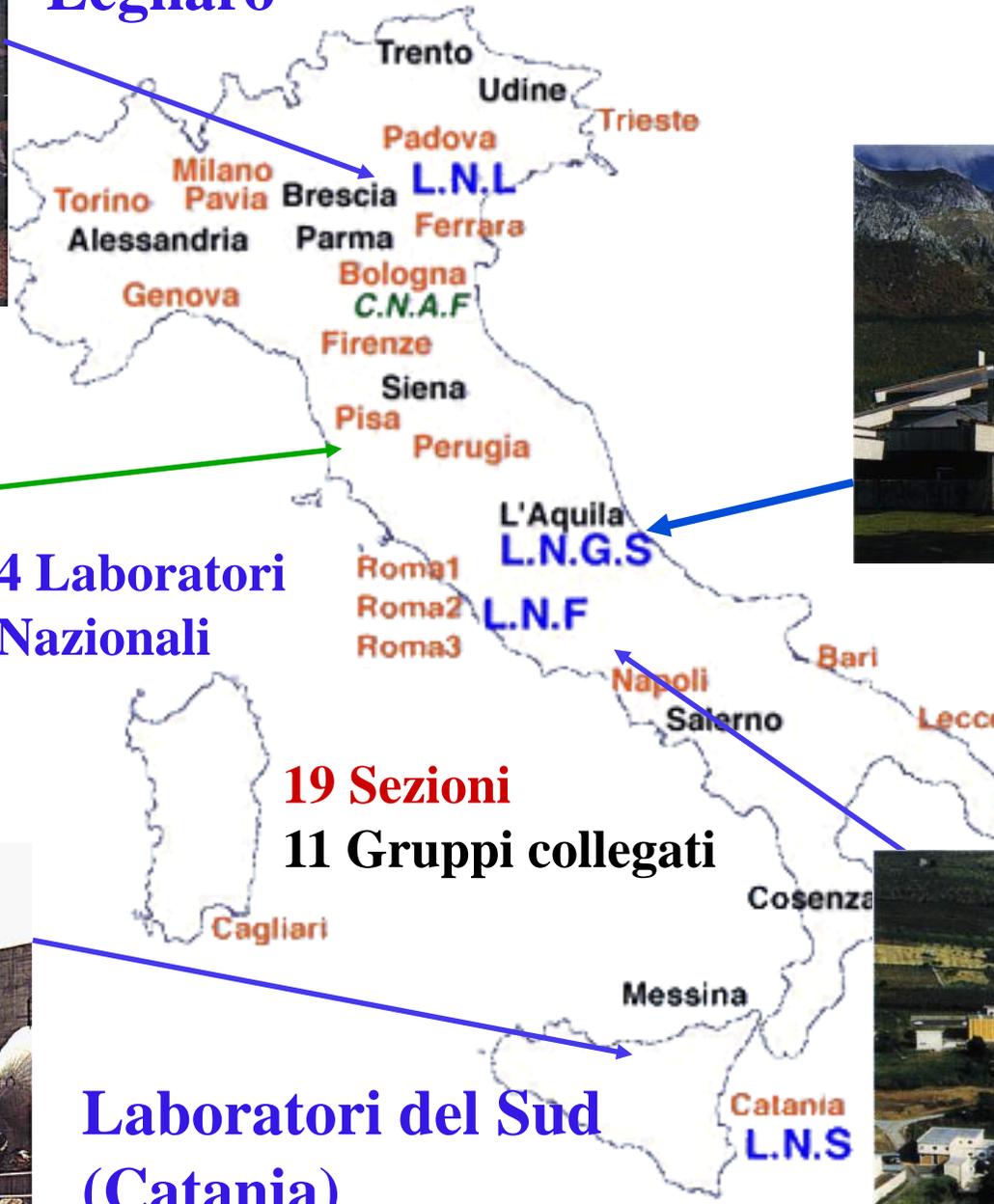
ossi

INFN

Gran Sasso

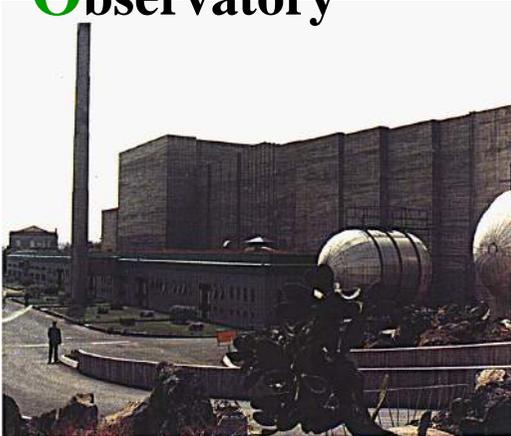


Legnaro



VIRGO-EGO
European
Gravitational
Observatory

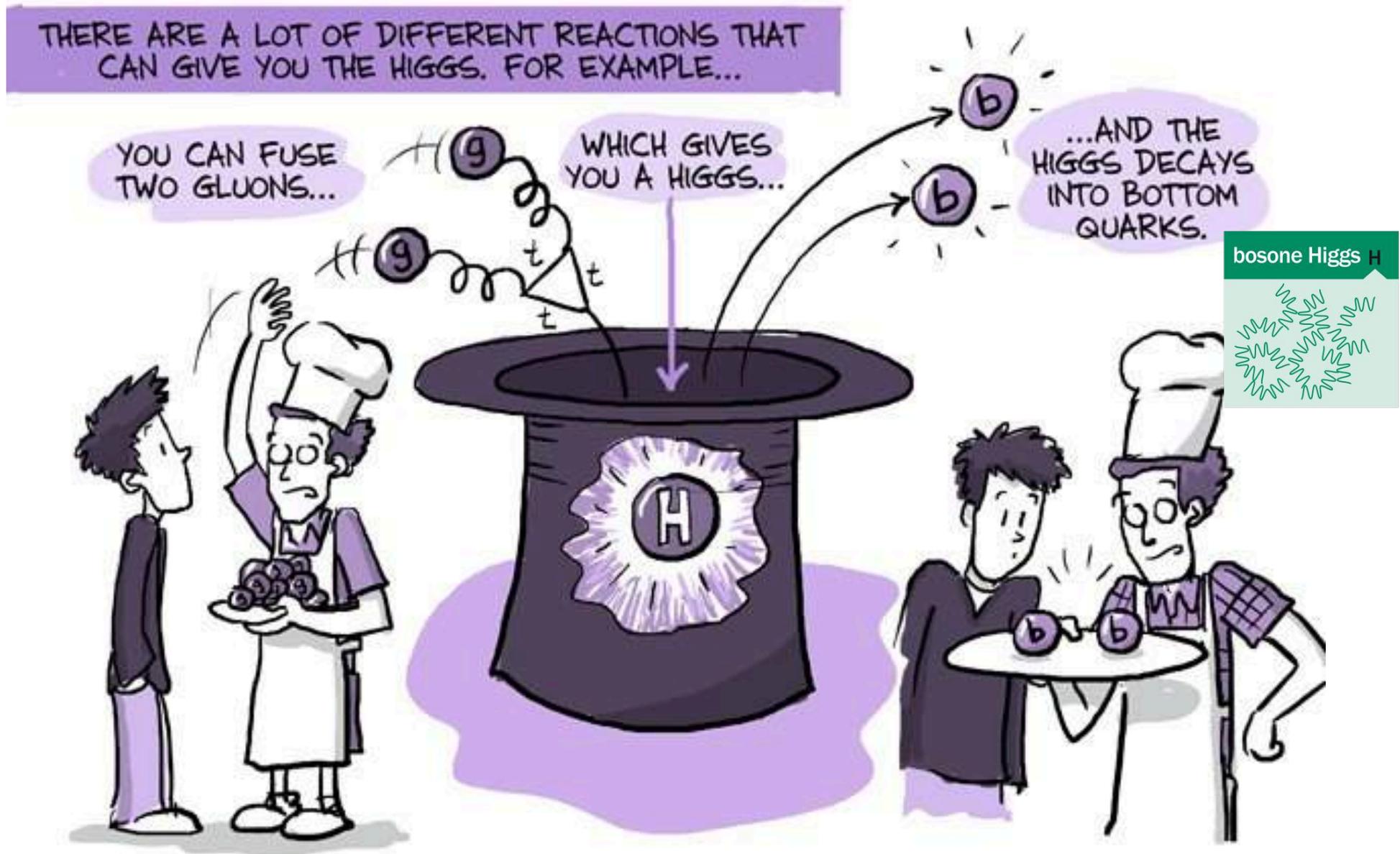
4 Laboratori
Nazionali



Laboratori del Sud
(Catania)



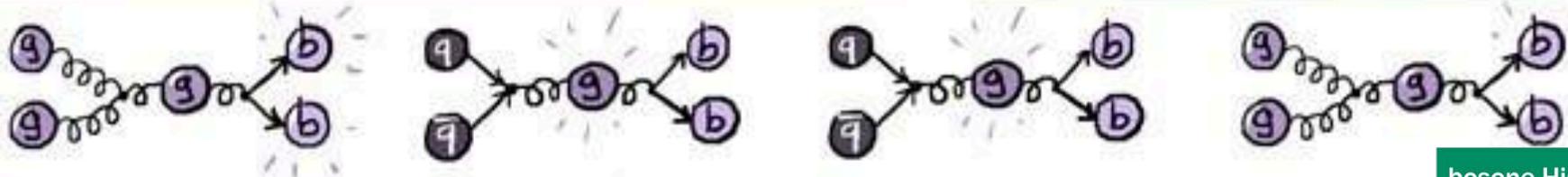
Il bosone di Higgs



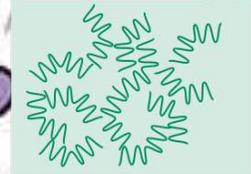
Il bosone di Higgs

THE PROBLEM IS, THERE'S LOTS OF OTHER WAYS YOU CAN MAKE TWO BOTTOM QUARKS:

IT'S ONE OF THE MOST COMMON THINGS TO MAKE.



bosone Higgs H



JORGE CHAM © 2012

THE THING IS, WE CAN'T SEE INSIDE THESE REACTIONS...

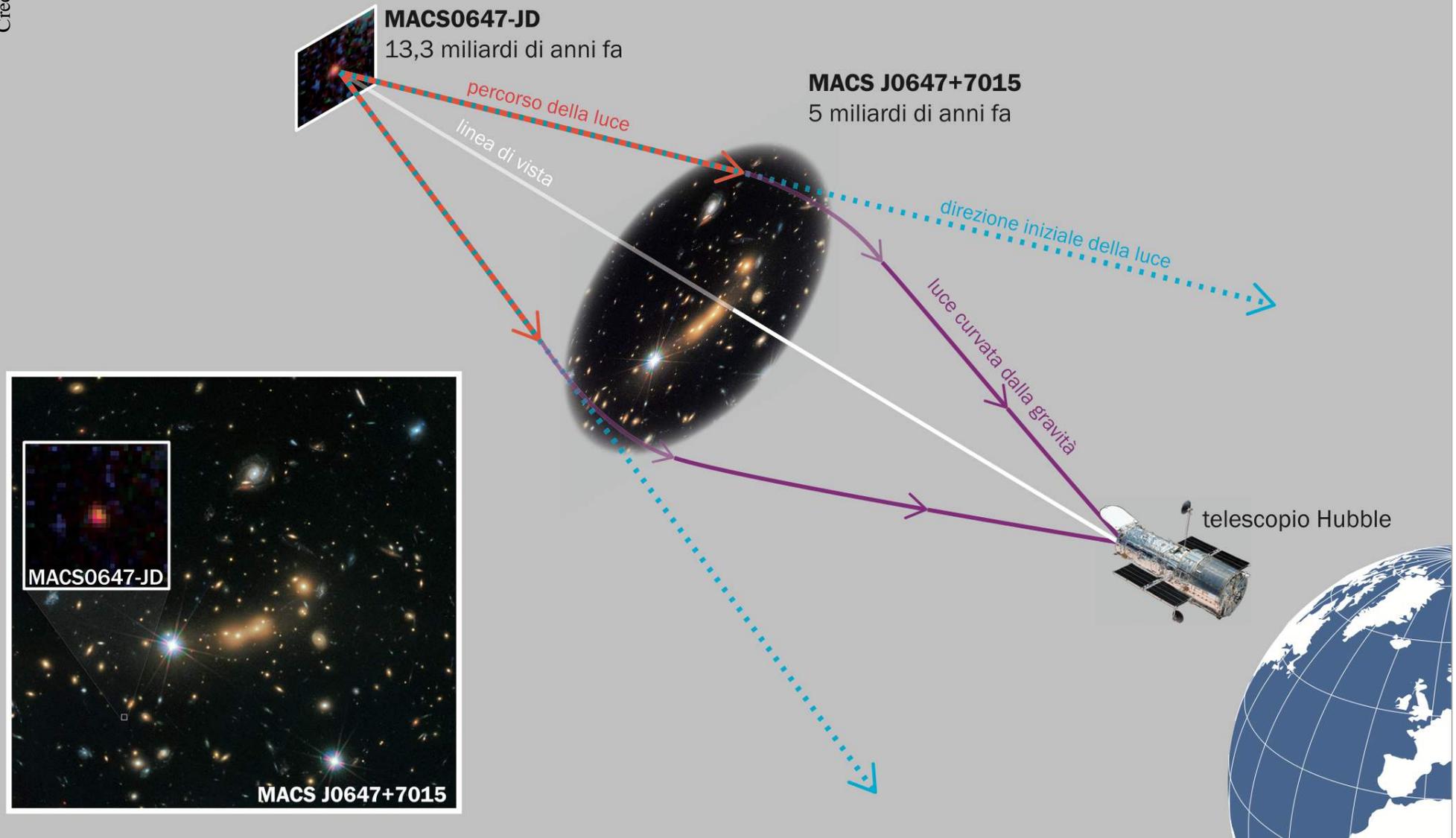


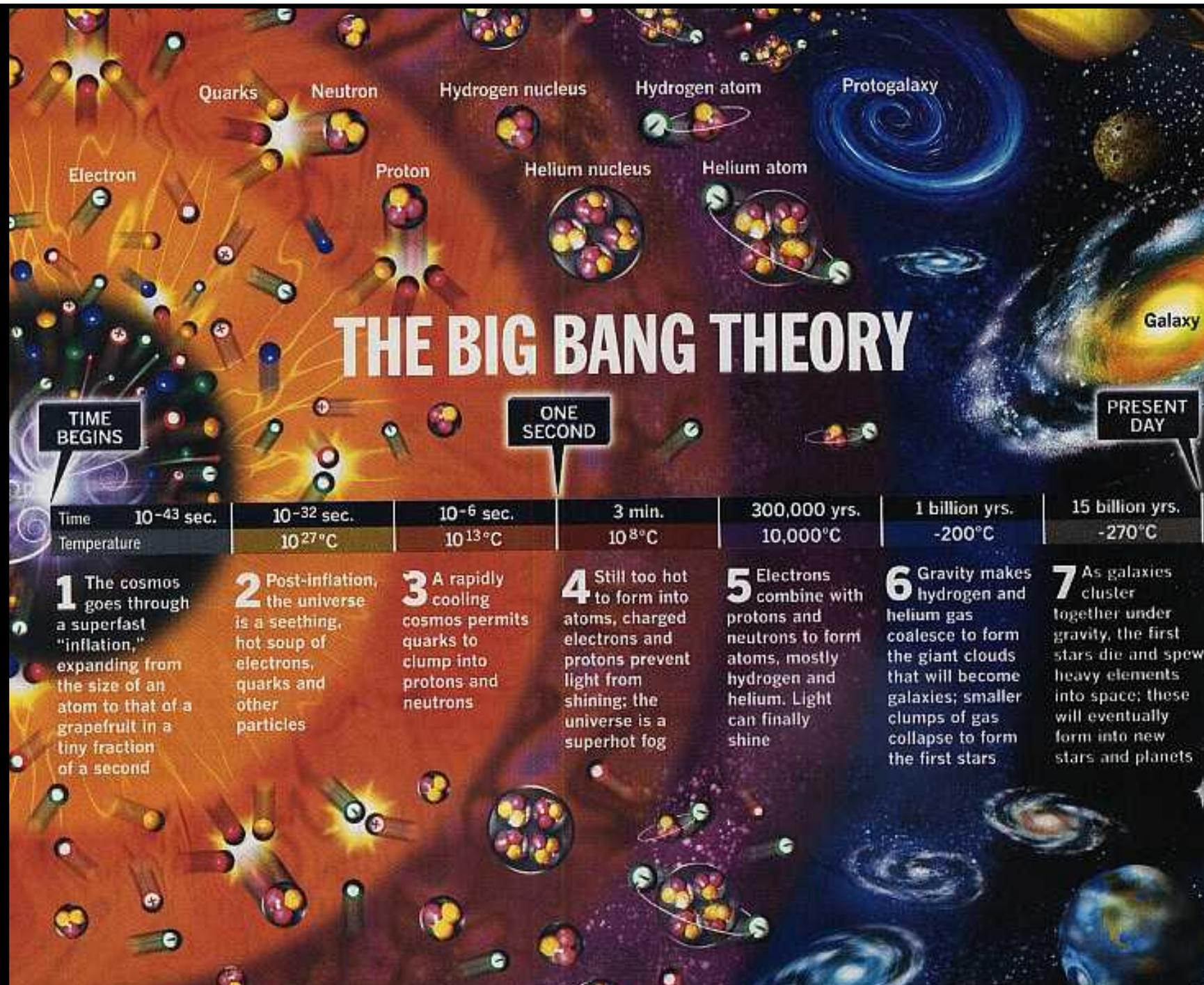
ALL WE CAN SEE ARE THE DECAY PRODUCTS.

AND WHAT YOU WANT TO KNOW IS...

DID THE HIGGS EXIST?

Gravitational lensing





Il fascino dell'impossibile

nature International weekly journal of science

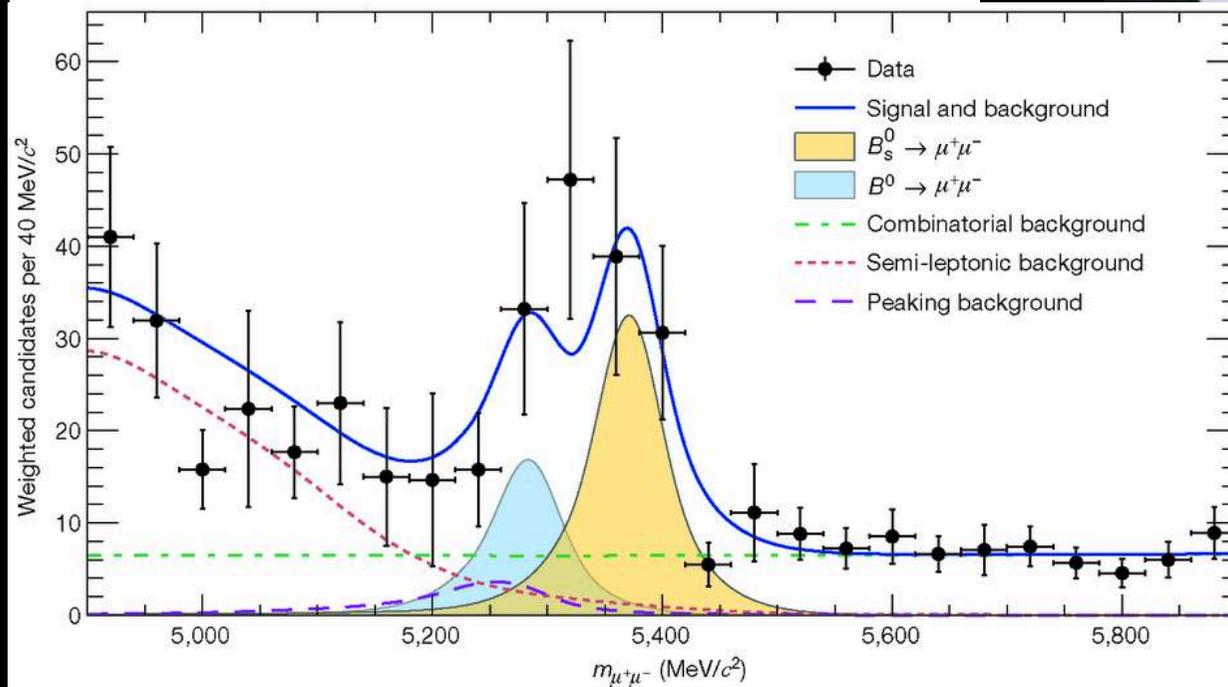
Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video | For Authors

Research > Letters > Article

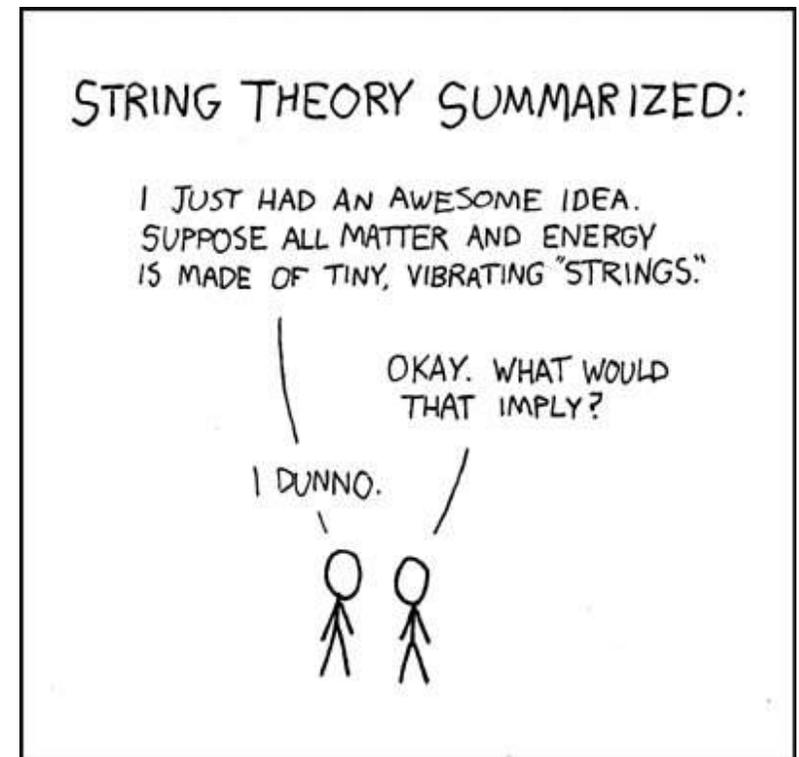
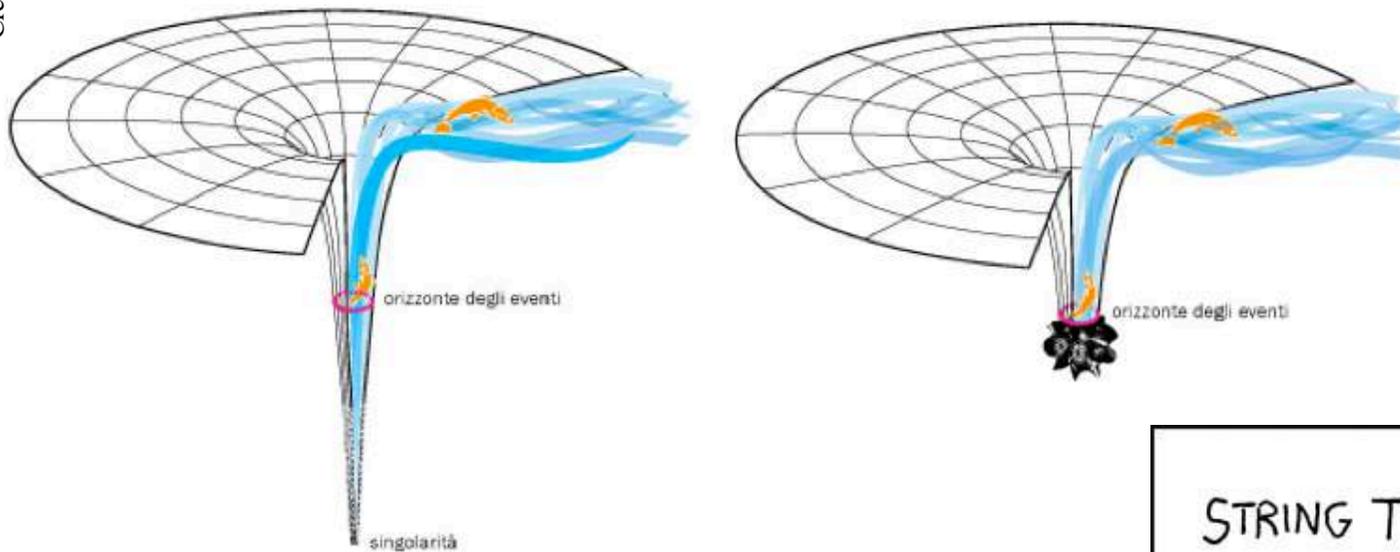
NATURE | LETTER OPEN

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

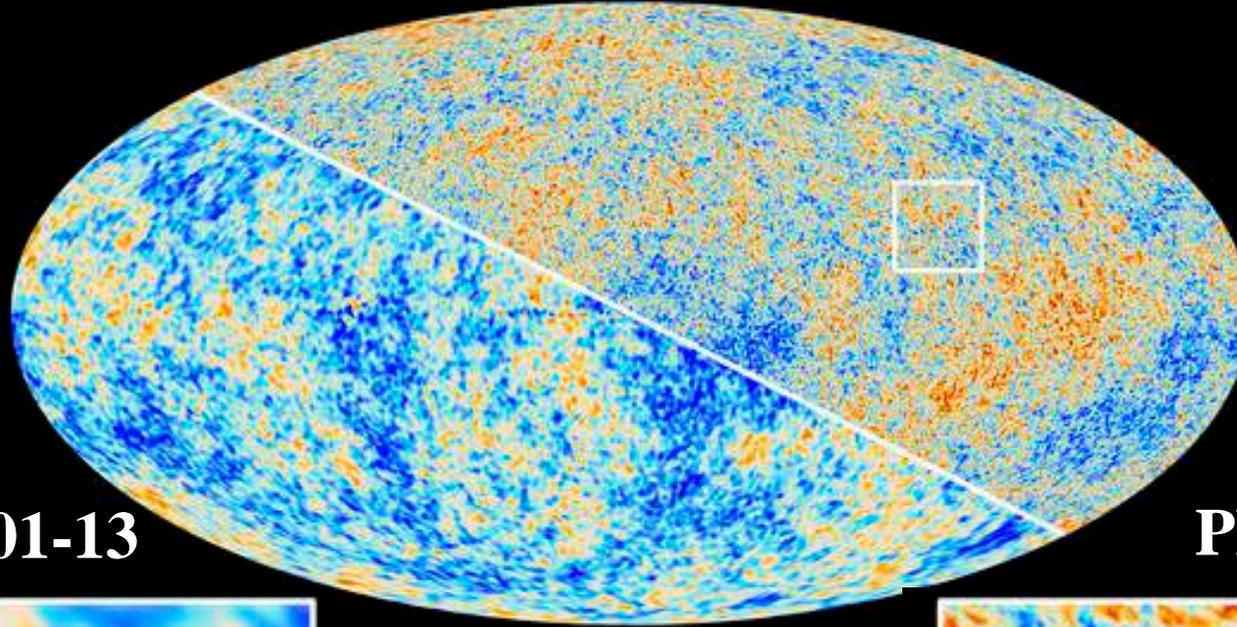
CMS Collaboration & LHCb Collaboration



Teoria delle stringhe

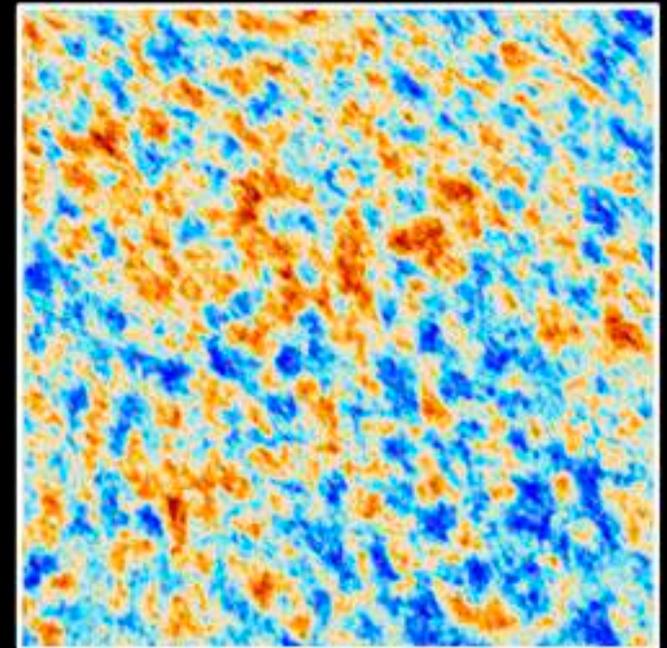
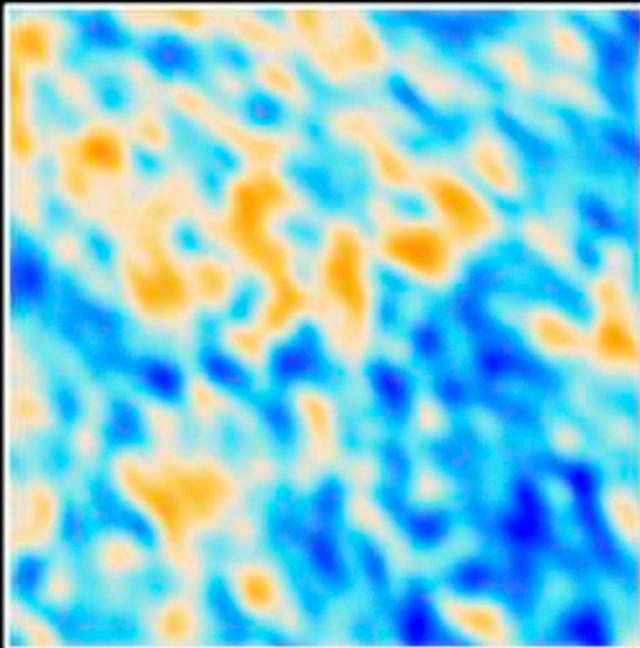


Radiazione cosmica di fondo

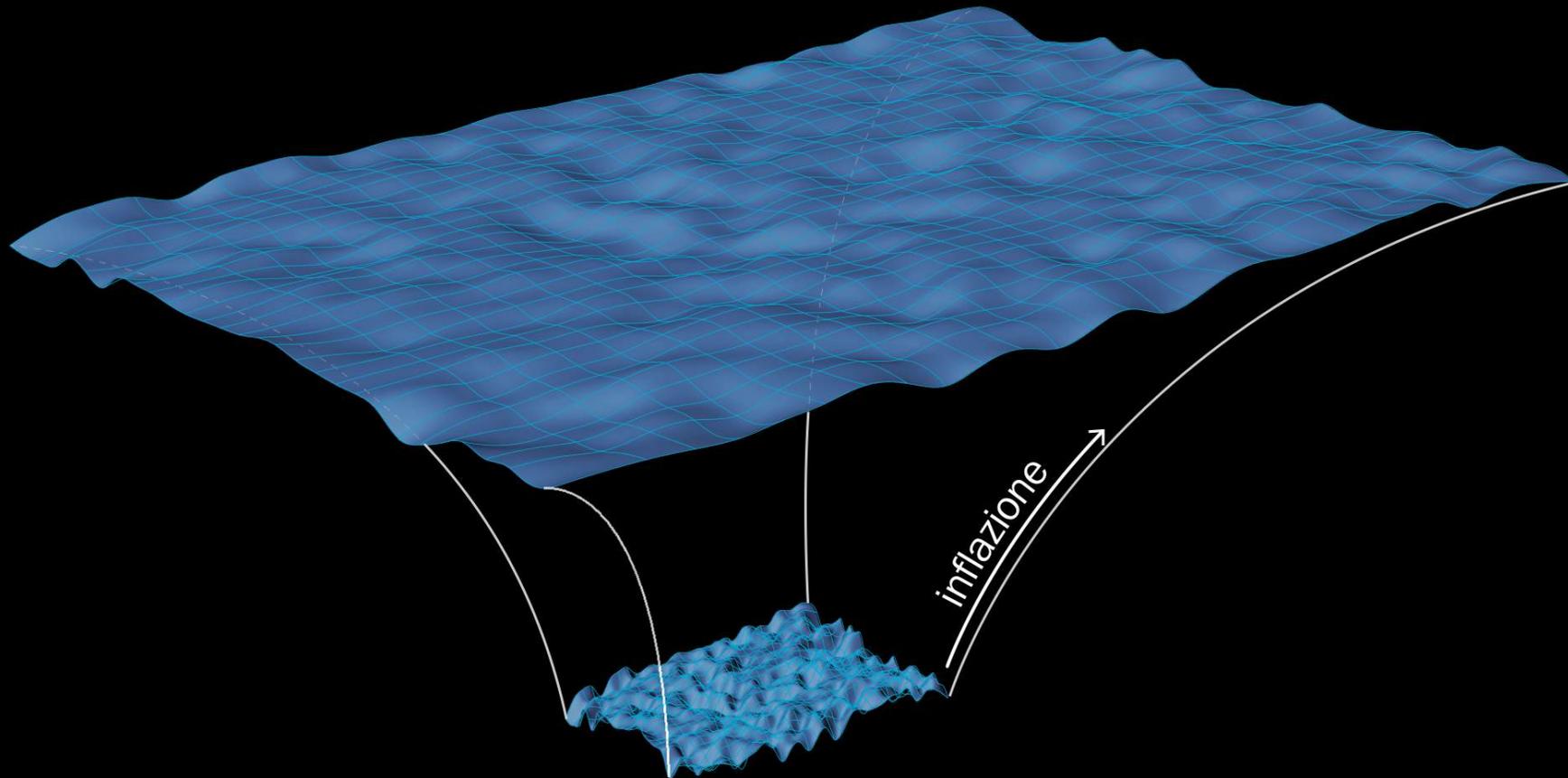


WMAP, 2001-13

Planck, 2013

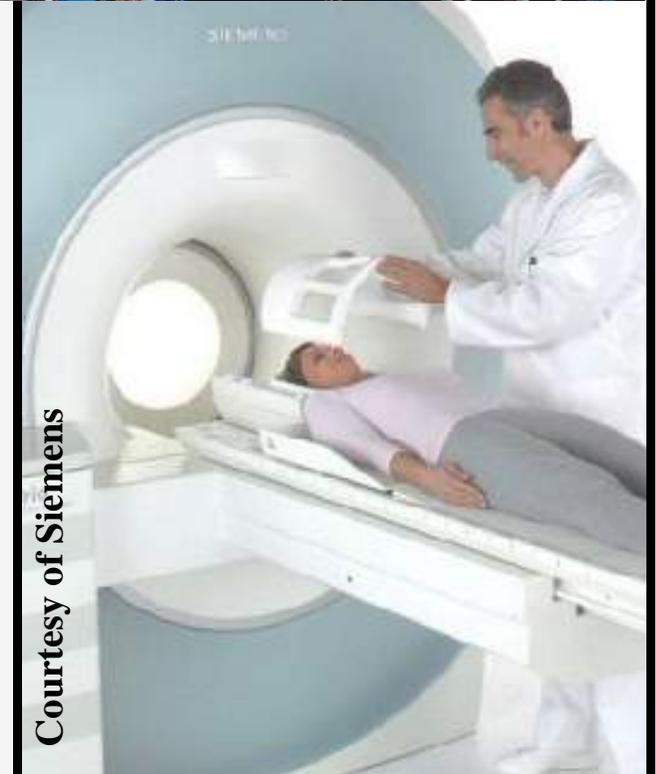
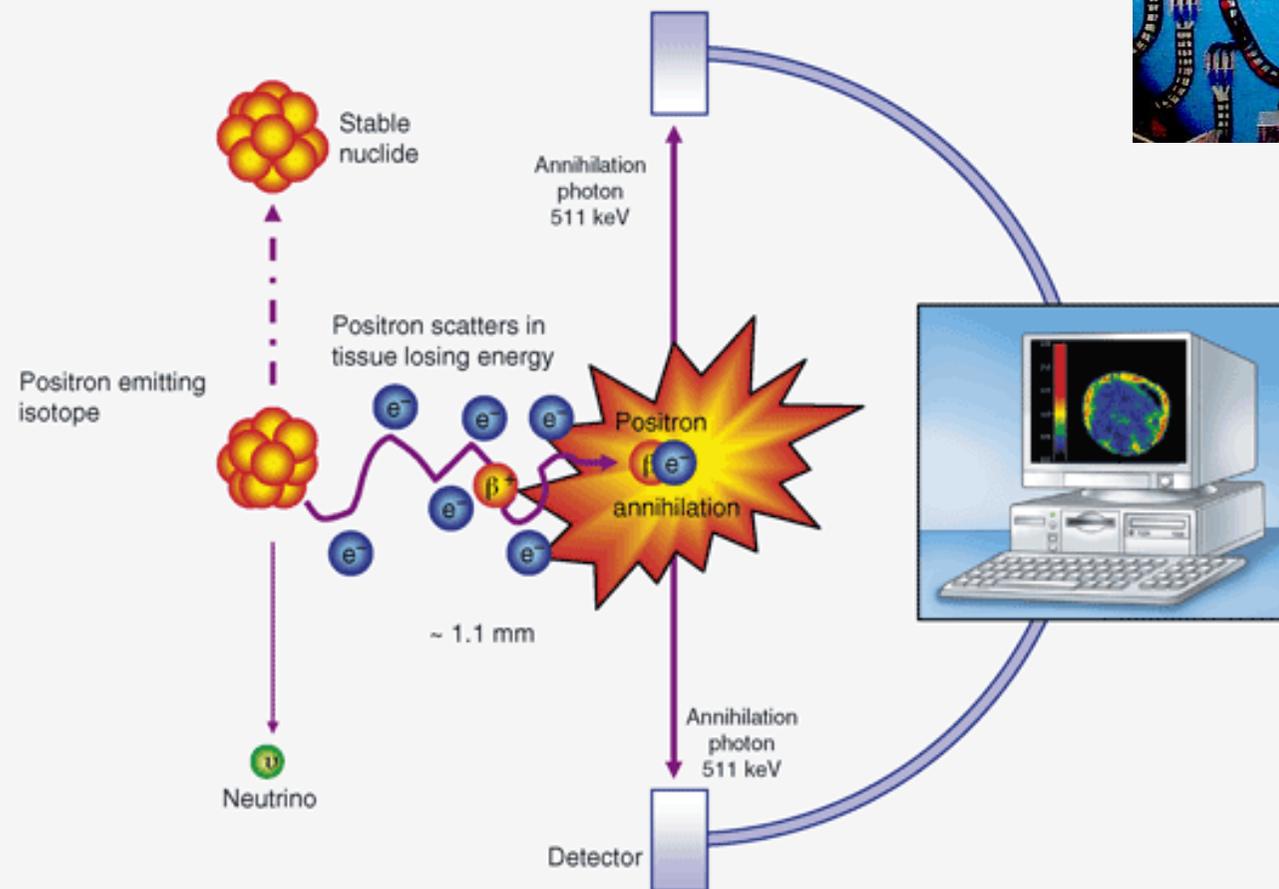
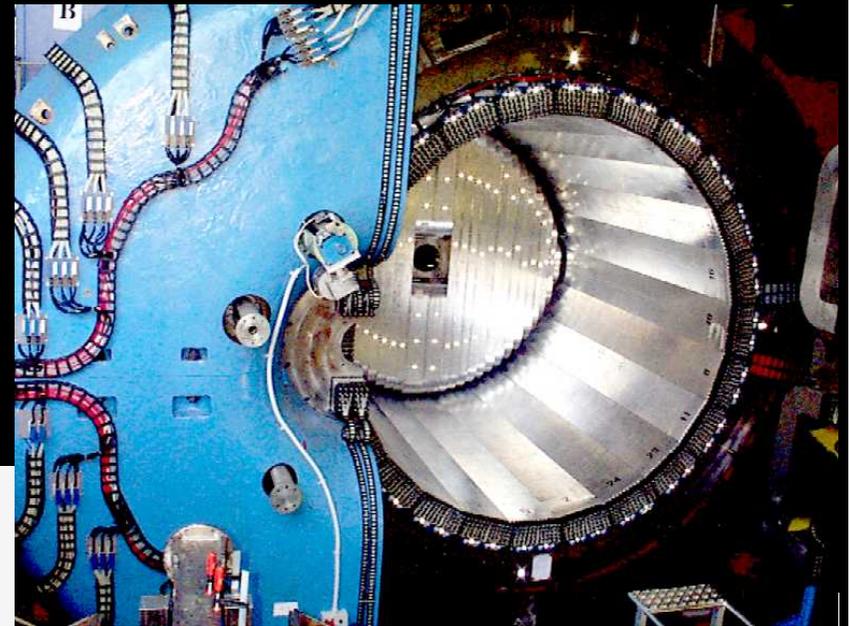


Inflazione



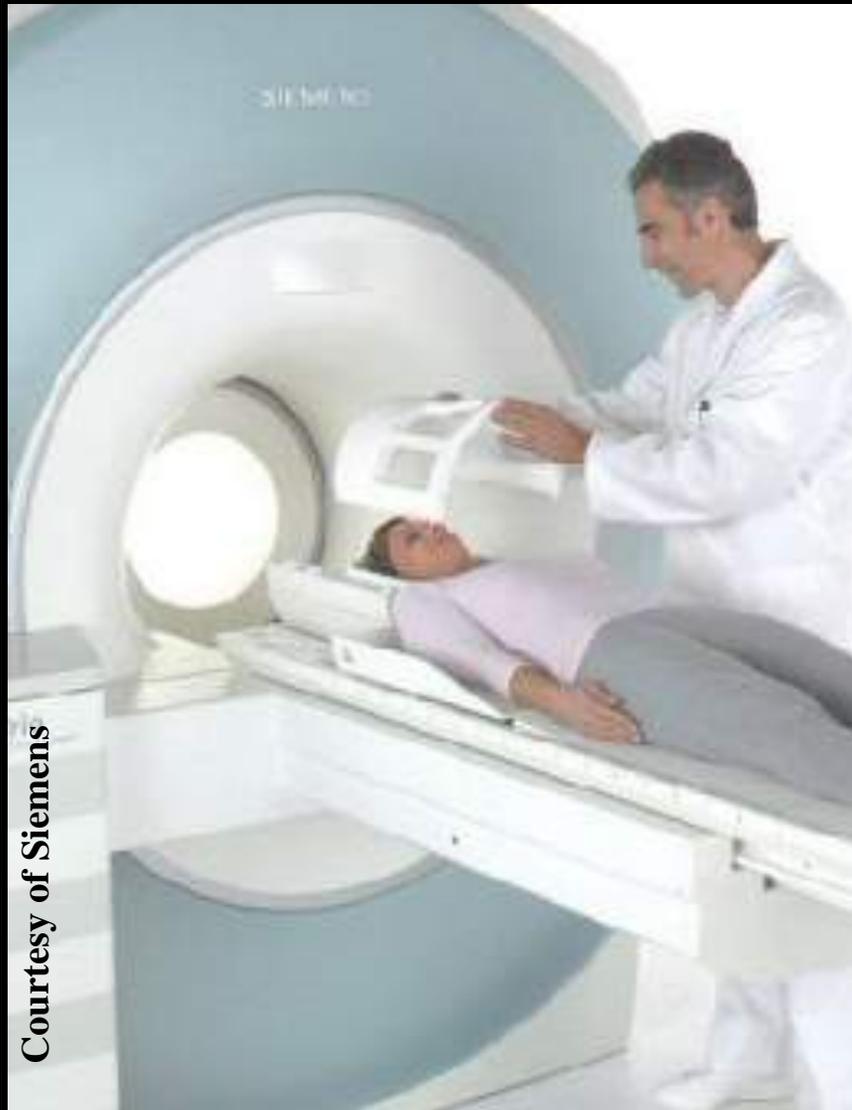
Credits: Asimmetrie

Positron Emission Tomography (PET)

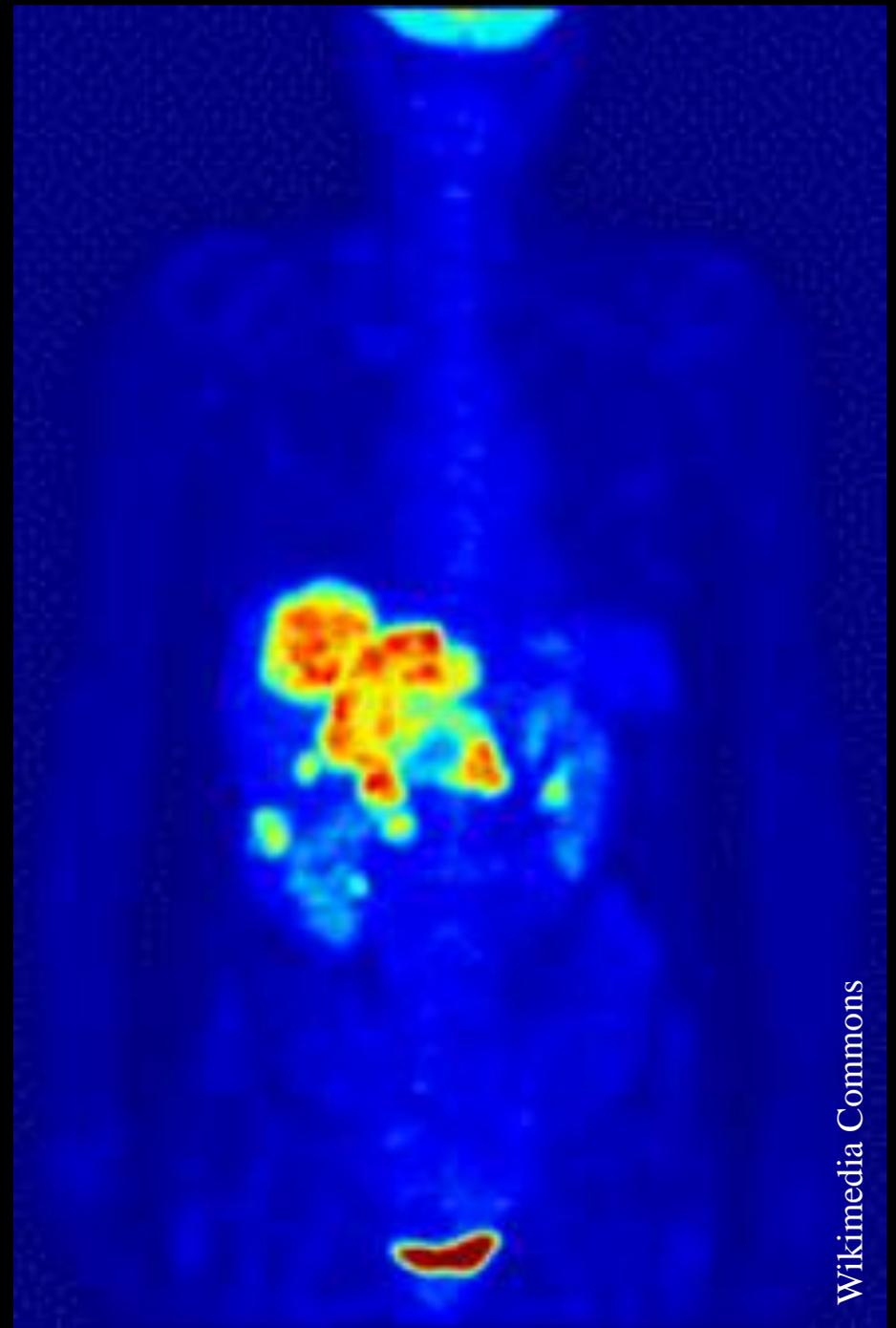


Courtesy of Siemens

Positron Emission Tomography (PET)

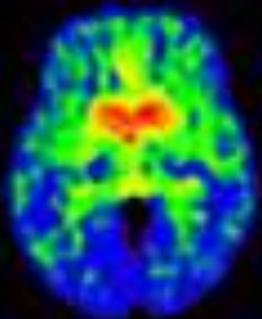


Courtesy of Siemens

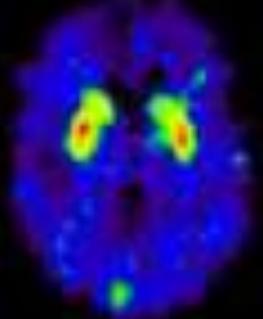


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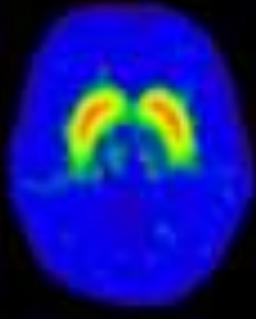
PET



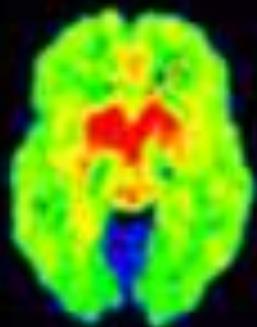
Smoker



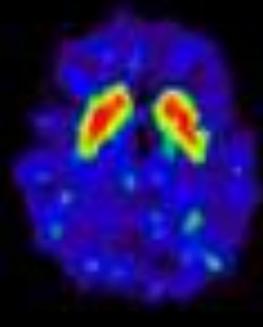
Alcoholic



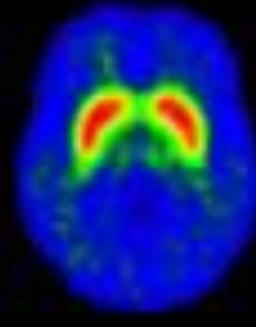
Obese



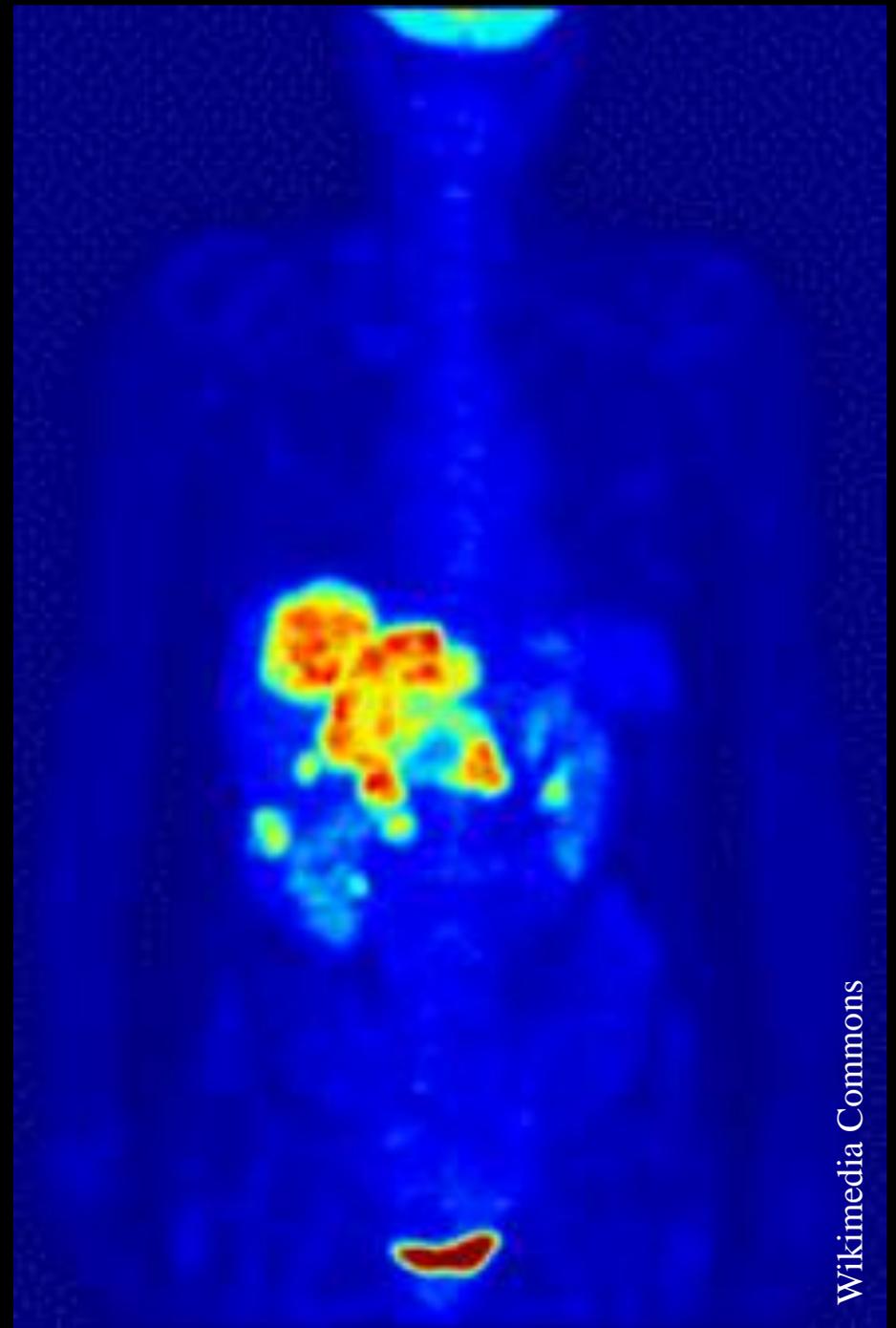
Non-Smoker



Normal



Normal



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Materia e Materia Oscura





*(Search for
Extra-Terrestrial
Intelligence)*



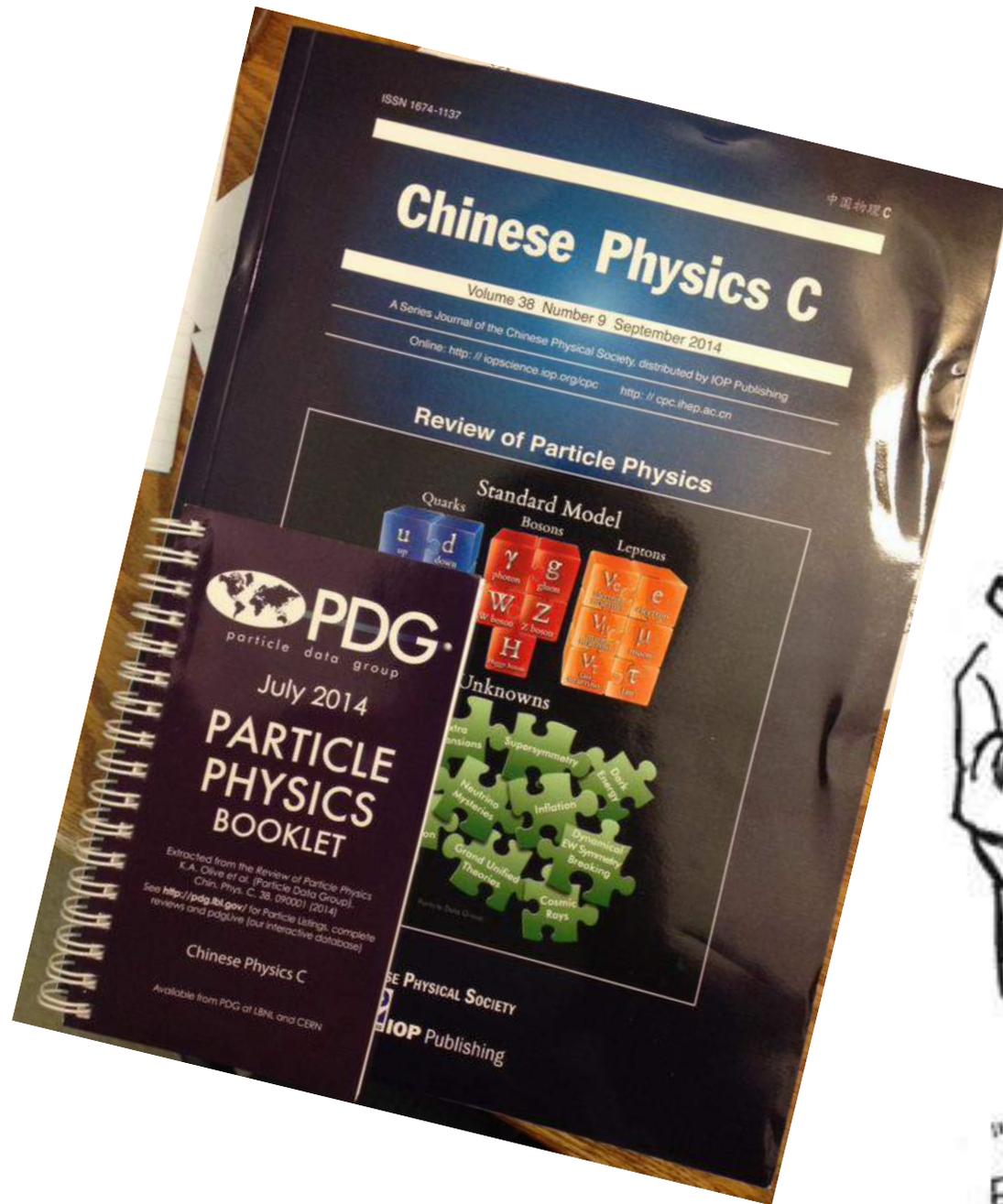
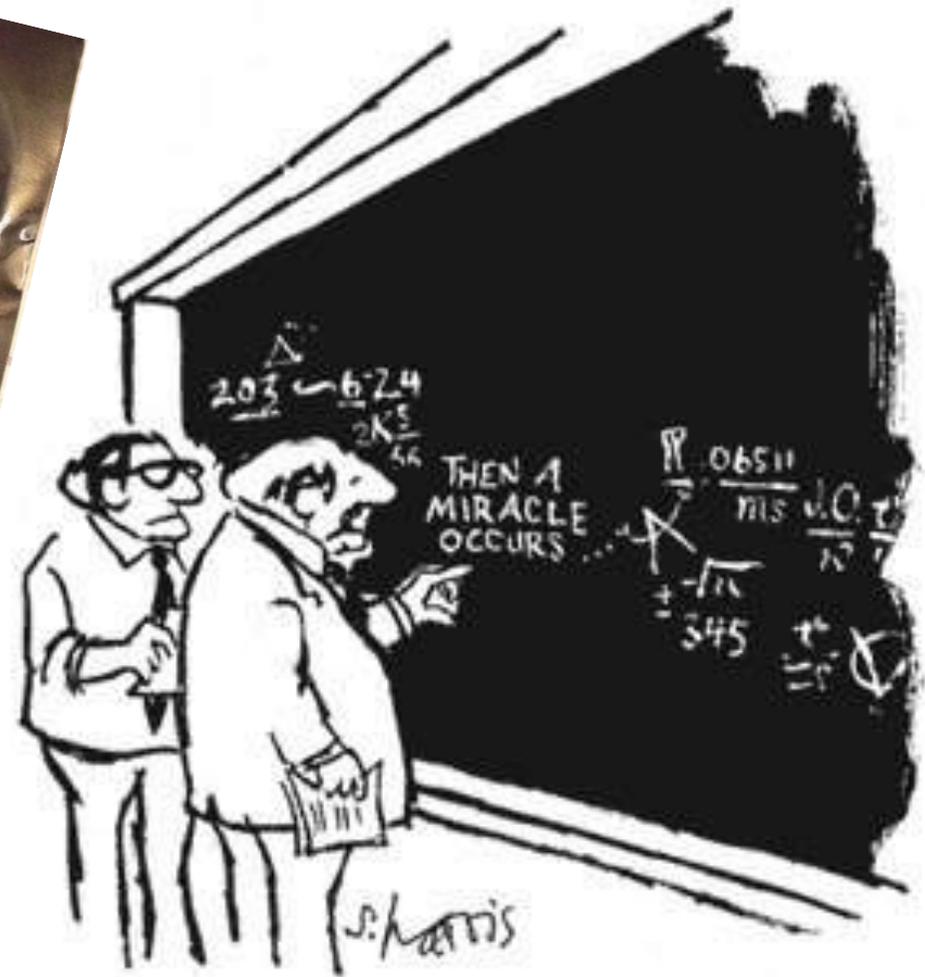
“Angeli e Demoni”

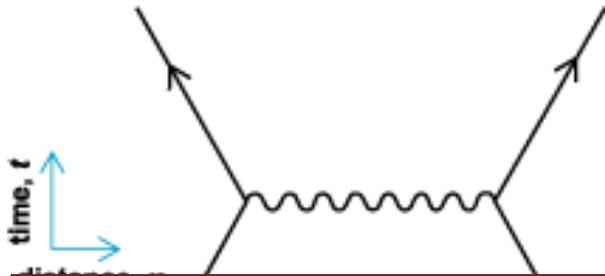
- Creazione di atomi di anti-materia: la prima volta 9 atomi in 3 settimane, oggi decine di migliaia al giorno. **10 milioni di miliardi di volte** per riempire un palloncino (cioè molti miliardi di anni)



- 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 così 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

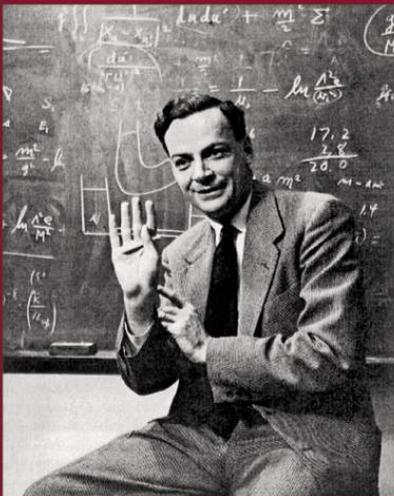




GLI ADELPHI

Richard P. Feynman

QED



United Nations
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