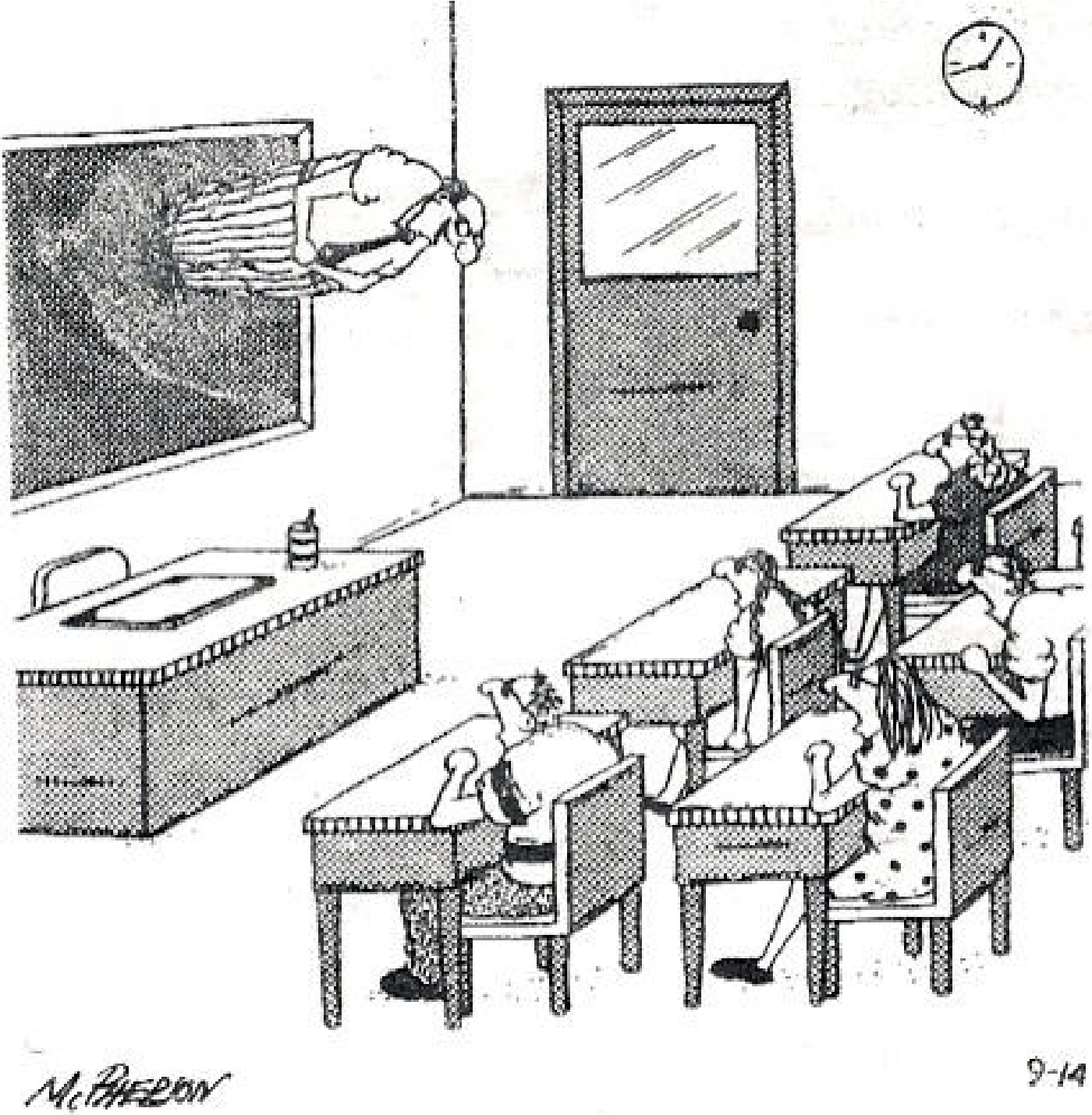


"Good morning, and welcome to
The Wonders of Physics."

Corso di Fisica per Medicina

Prof. Francesco Marzari (MED 3)
francesco.marzari@pd.infn.it
http://www.pd.infn.it/~marzari/

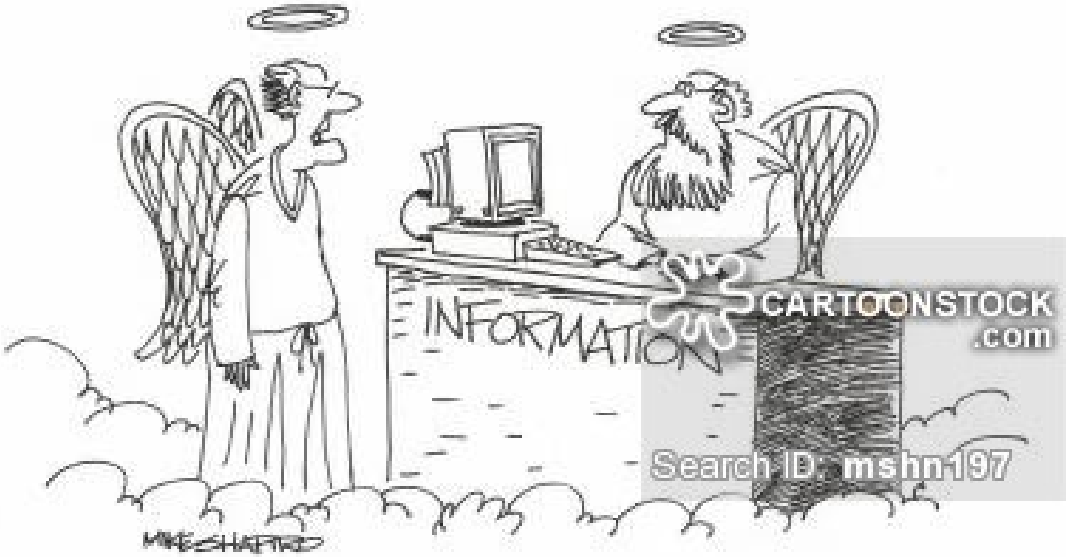
Libri:
Fisica per le scienze dalle Vita, Bellini et al., Piccin
Fisica Biomedica, Scannicchio, Edises

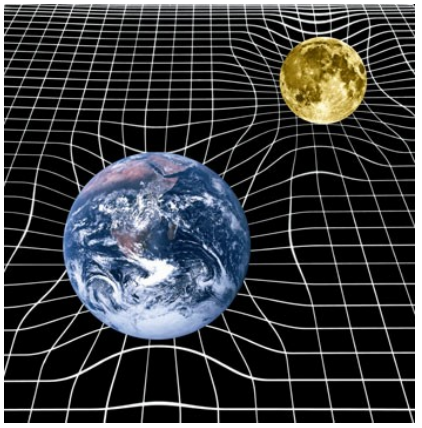
Esame:
scritto, 12 domande a risposta multipla che possono implicare calcoli anche teorici, 4 problemi.

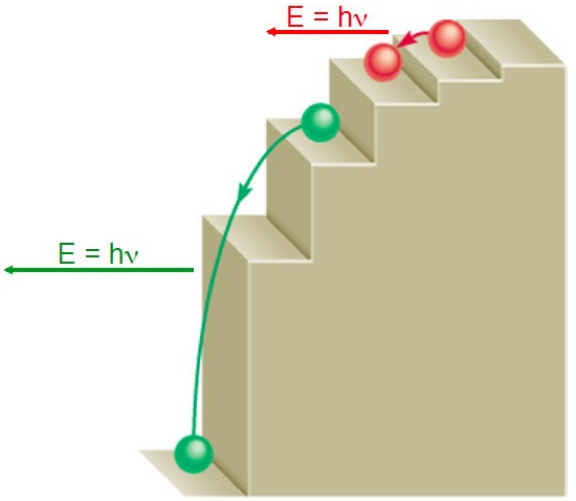
Programma del corso

- Dinamica, equazioni del moto in forma vettoriale, forze
- Energia e sua conservazione, lavoro.
- Conservazione della quantità di moto e del momento angolare, momenti delle forze
- Statica dei fluidi (ad es. Archimede), dinamica dei fluidi (Bernoulli, Poiseuille...)
- Termodinamica, legge dei gas perfetti, trasformazioni termodinamiche.
- Elettricità e correnti
- Campo magnetico e sue proprietà
- Onde di vario tipo
- Ottica e lenti
- Emissione di onde elettromagnetiche, vari tipi di radiazione
- Decadimenti radioattivi

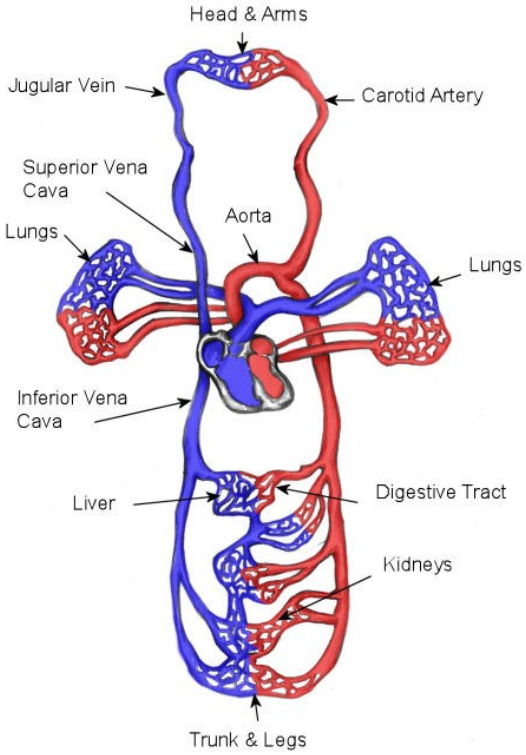
Fisica Moderna: Relatività Generale e Quantistica

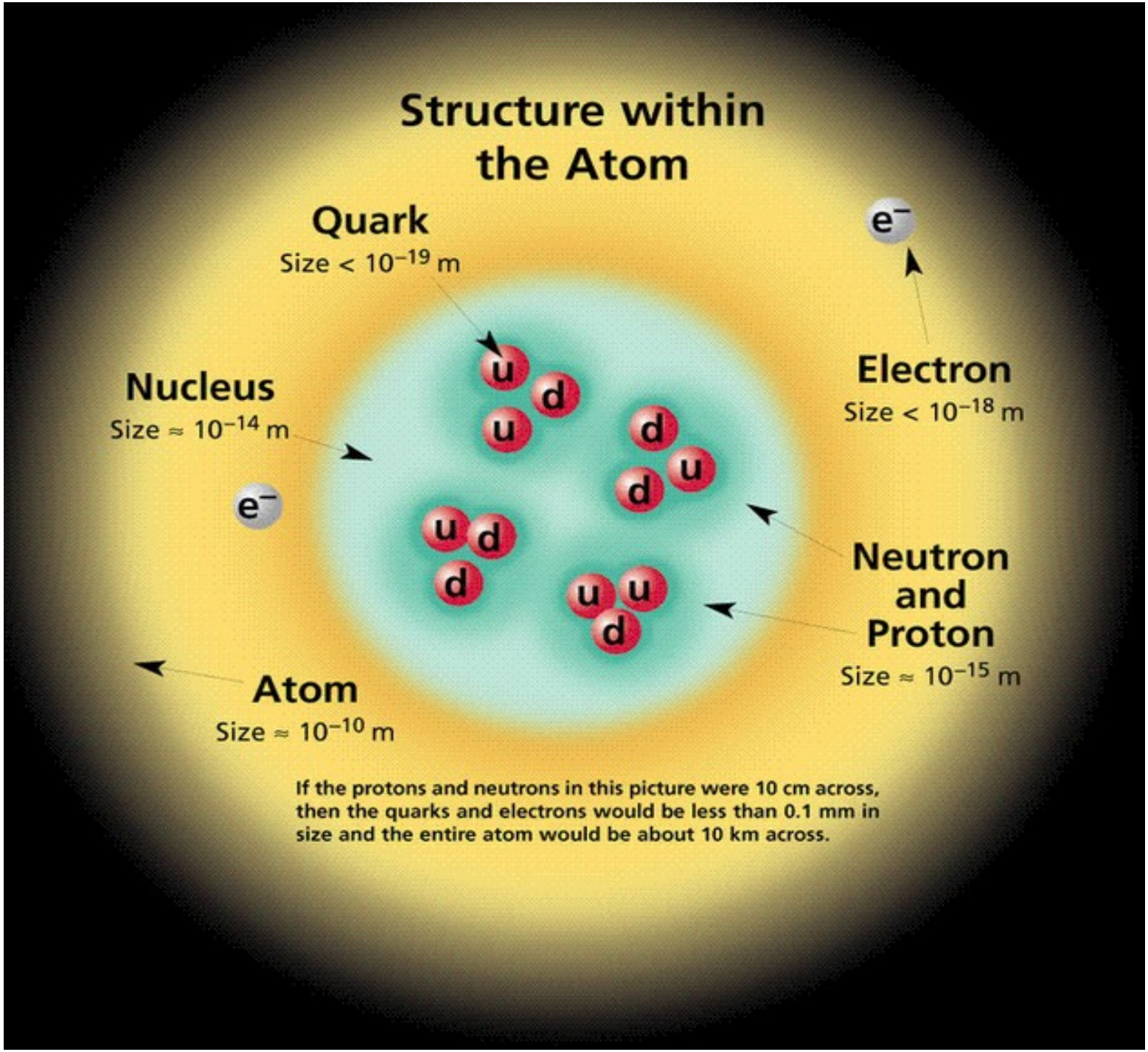




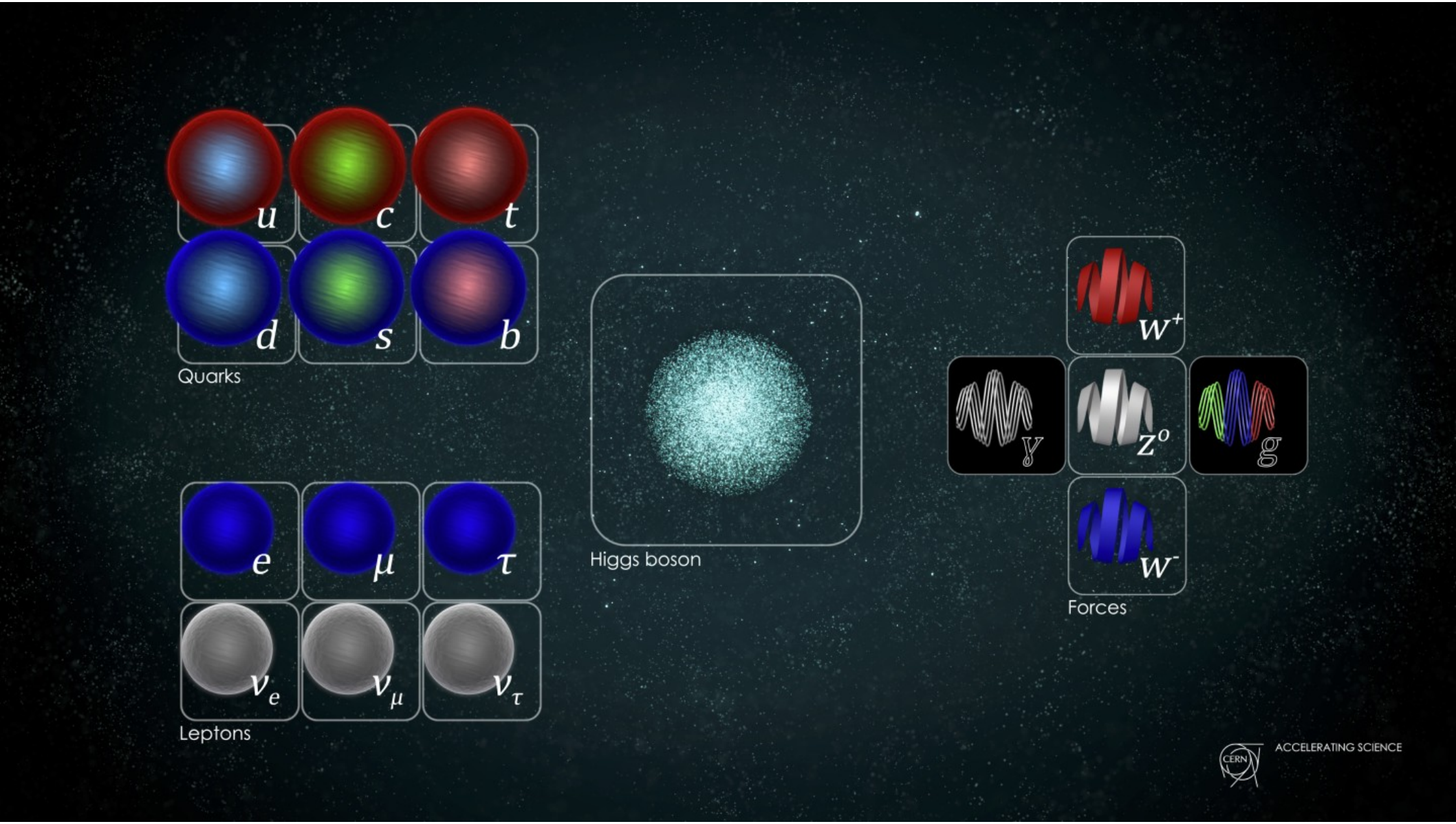


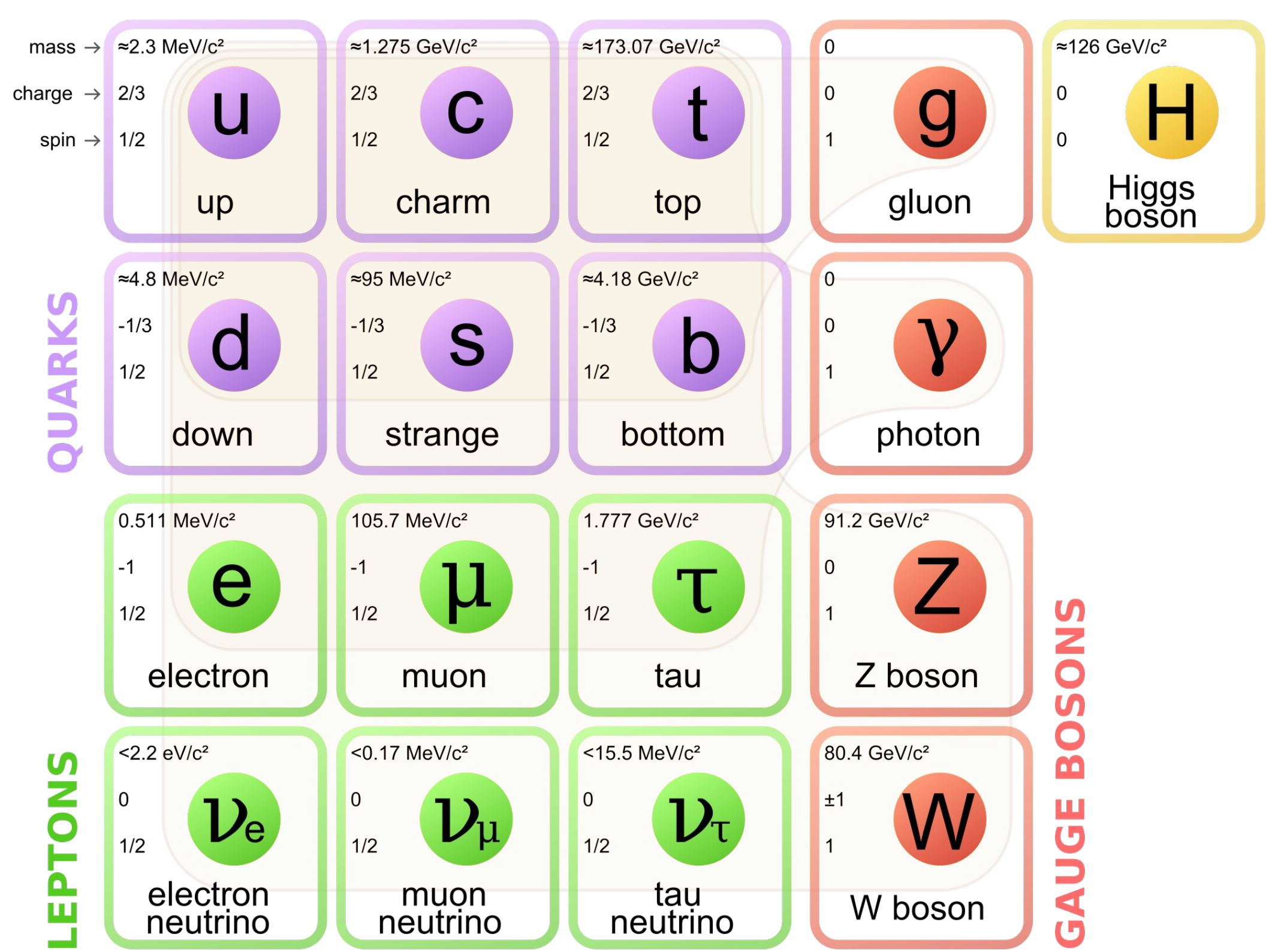
- **Fisiologia e funzionamento del corpo umano**
- **Strumenti diagnostici**
- **Terapie**




Structure within the Atom
Quark
Size < 10^{-19} m
e^-
Electron
Size < 10^{-18} m
Nucleus
Size ≈ 10^{-14} m
u
d
u
d
d
u
e^-
u
d
d
Neutron and Proton
Size ≈ 10^{-15} m
u
u
d
Atom
Size ≈ 10^{-10} m
If the protons and neutrons in this picture were 10 cm across, then the quarks and electrons would be less than 0.1 mm in size and the entire atom would be about 10 km across.

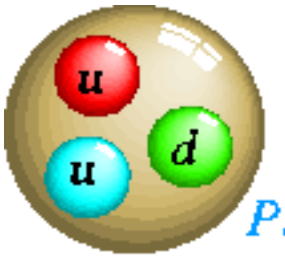
Costituenti fondamentali della materia.



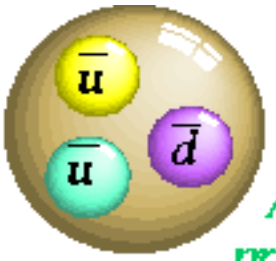

mass →
charge →
spin →
≈2.3 MeV/c²
2/3
1/2
u
up
≈1.275 GeV/c²
2/3
1/2
c
charm
≈173.07 GeV/c²
2/3
1/2
t
top
0
0
1
g
gluon
≈126 GeV/c²
0
0
H
Higgs boson
QUARKS
≈4.8 MeV/c²
-1/3
1/2
d
down
≈95 MeV/c²
-1/3
1/2
s
strange
≈4.18 GeV/c²
-1/3
1/2
b
bottom
0
0
1
γ
photon
0.511 MeV/c²
-1
1/2
e
electron
105.7 MeV/c²
-1
1/2
μ
muon
1.777 GeV/c²
-1
1/2
τ
tau
91.2 GeV/c²
0
1
Z
Z boson
LEPTONS
<2.2 eV/c²
0
1/2
νe
electron neutrino
<0.17 MeV/c²
0
1/2
νμ
muon neutrino
<15.5 MeV/c²
0
1/2
ντ
tau neutrino
80.4 GeV/c²
±1
1
W
W boson
GAUGE BOSONS

ADRONI

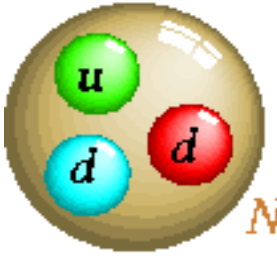
BARIONI



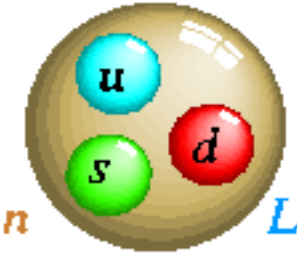
Proton



Anti-proton

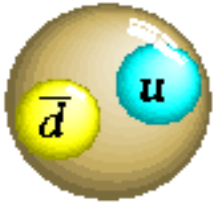


Neutron

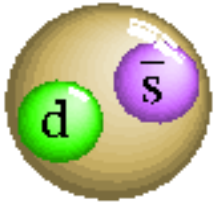


Lambda

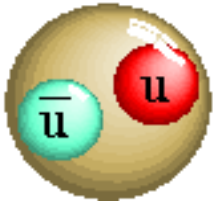
MESONI



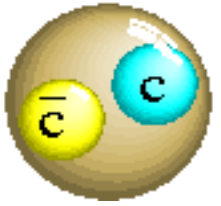
π^+



K^o

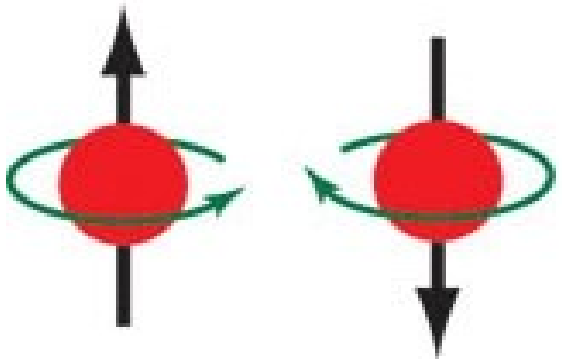


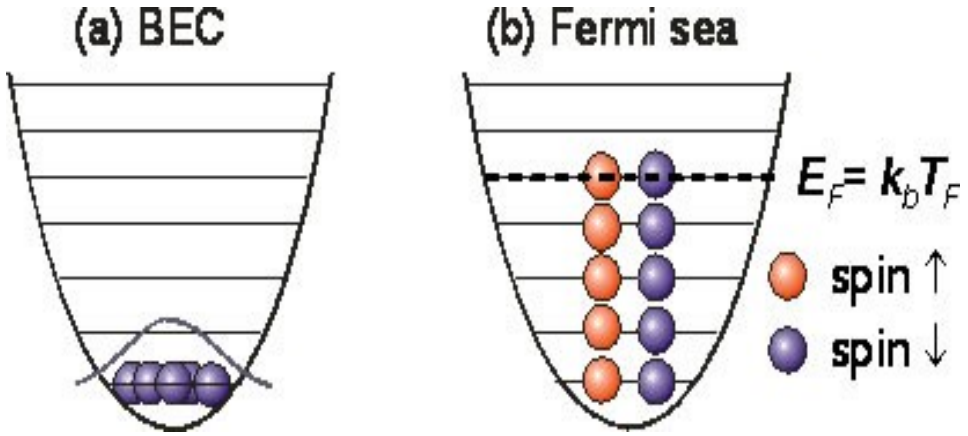
π^o



J/ψ

SPIN: proprietà intrinseca della particelle legata al momento angolare.



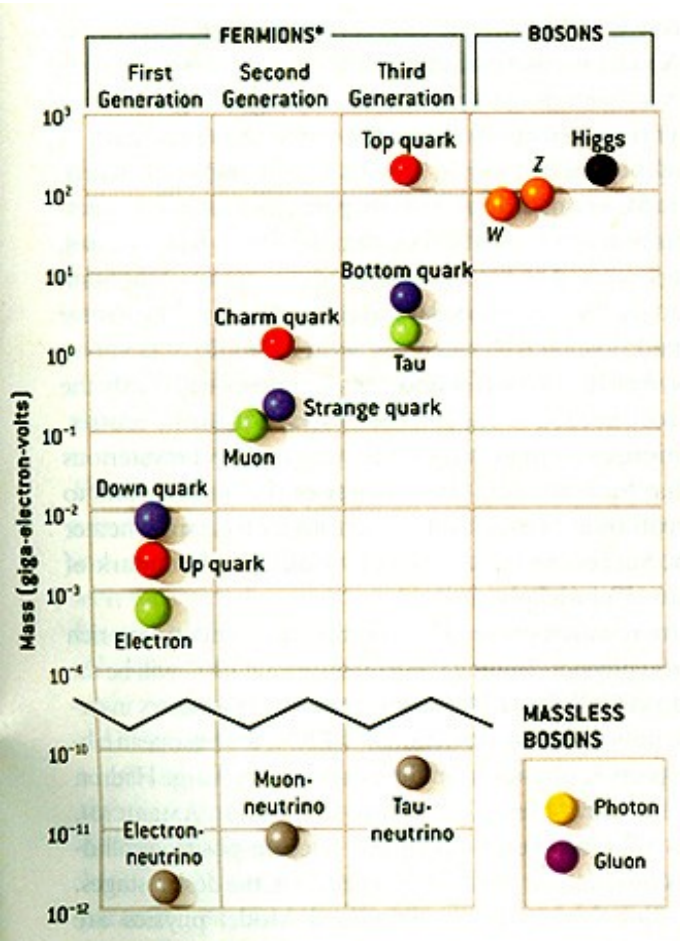


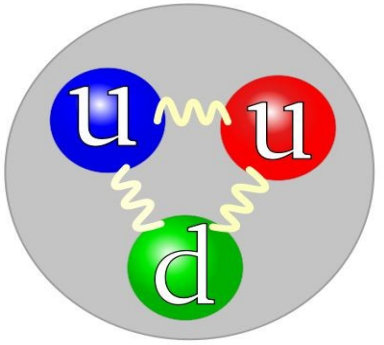
Fermions		Bosons
Leptons Quarks	Spin $\frac{1}{2}$	1
		Carrier Bosons $\gamma W^+ W^- Z^0 g$
Baryons (qqq)	$\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots$	0, 1, 2, …
		Mesons $(q\bar{q})$

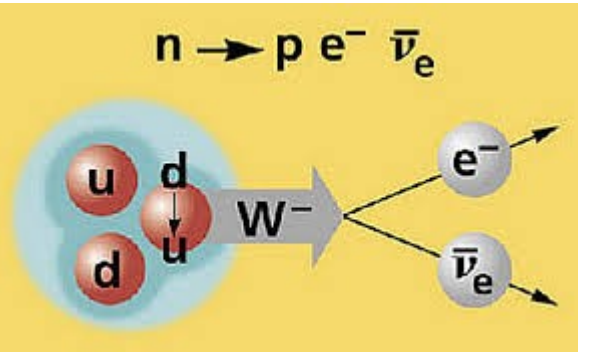
Principio di esclusione di Pauli: due fermioni non possono occupare simultaneamente lo stesso stato quantico. Importante per la struttura elettronica degli atomi. I bosoni invece si.

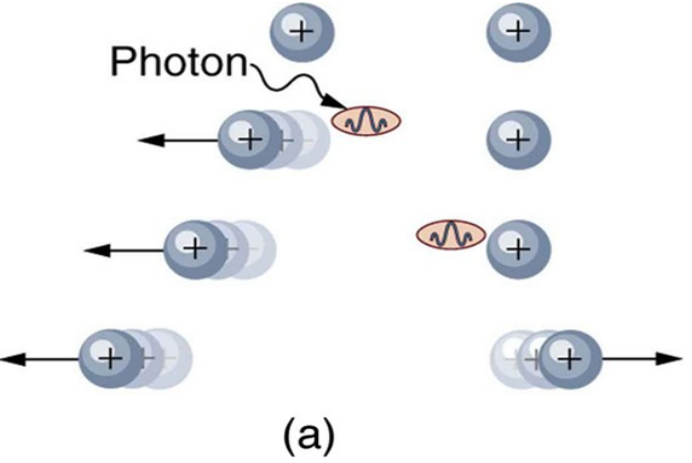
BEC: Bose Einsten condensation, a bassa temperatura i bosoni si concentrano in un singolo stato.

Decadimento beta, interazione debole.





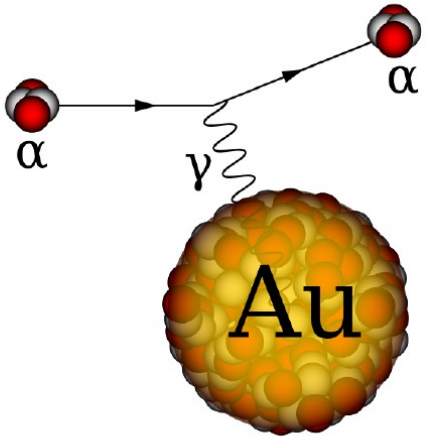




		Strength	Range (m)	Particle
Strong	Force which holds nucleus togeher	1	10^{-15} (diameter of a medium sized nucleus)	gluons, π(nucleons)
Electro-magnetic		$\frac{1}{137}$	Infinite	photon mass = 0 spin = 1
Weak	neutrino interaction induces beta decay	10^{-6}	10^{-18} (0.1% of the diameter of a proton)	Intermediate vector bosons W^+, W^-, Z_0, mass > 80 GeV spin =1
Gravity		6×10^{-39}	Infinite	graviton ? mass = 0 spin = 2

standard model particle interactions

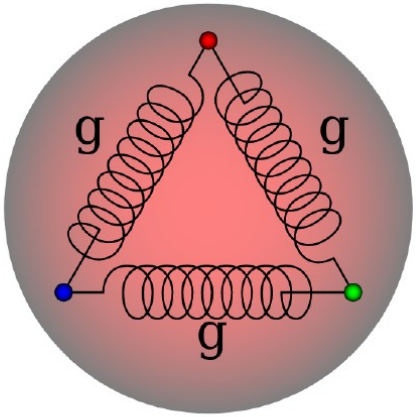
electromagnetic (charge)



alpha particle scattering in the gold foil experiment

interaction mediated by photons

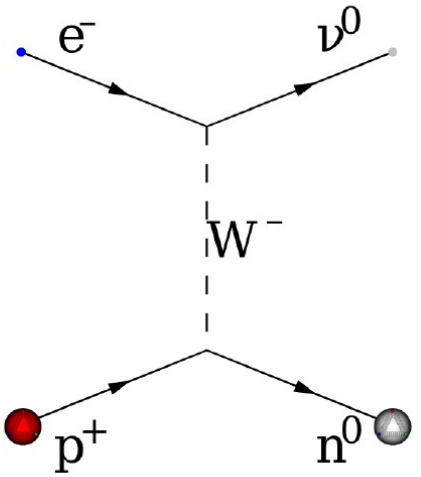
strong (color)



quarks bound together within a proton

interaction mediated by gluons

weak (flavor)



reverse beta decay

interaction mediated by W and Z particles

physics.info

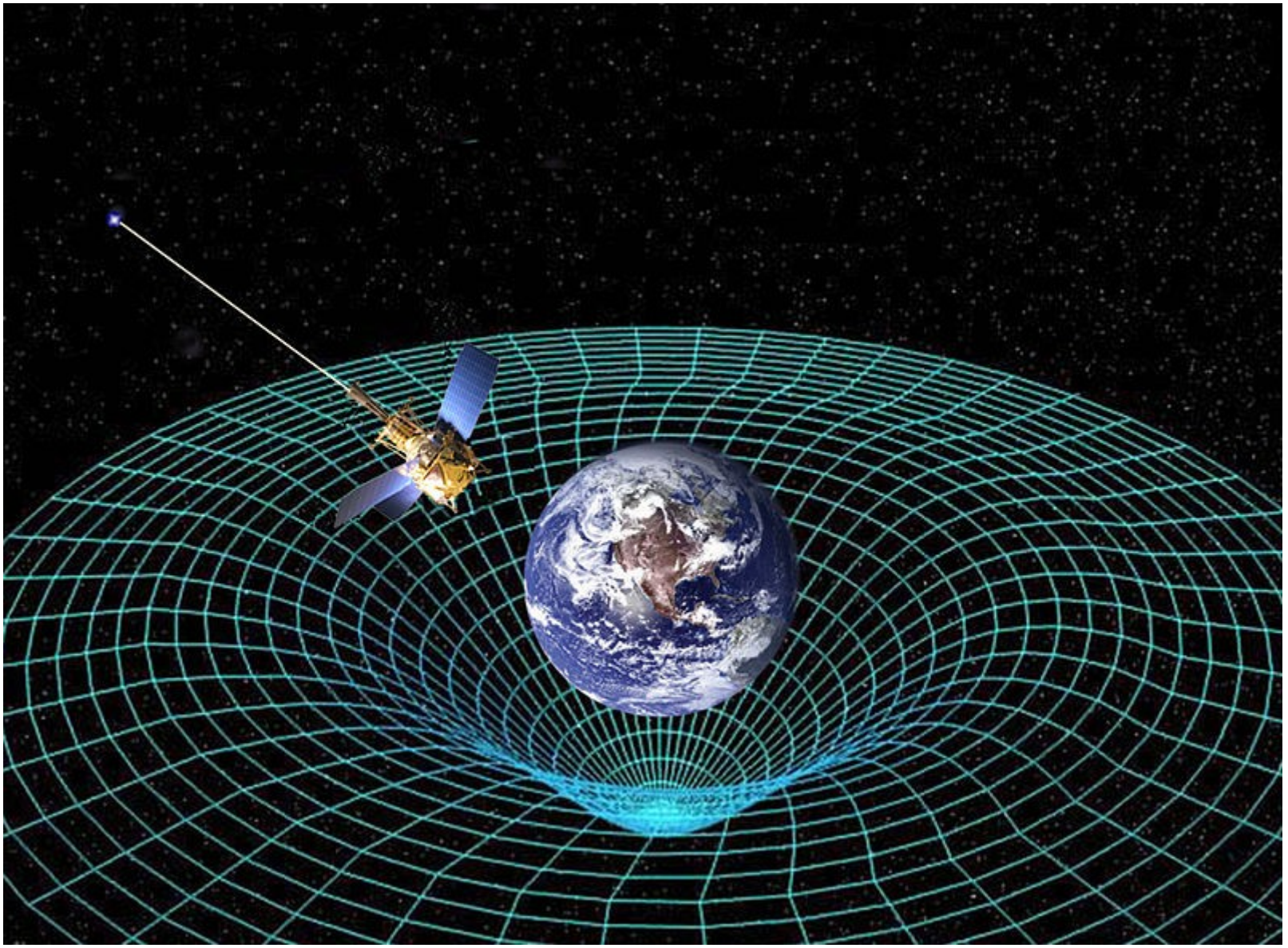
Modello standard NON include la gravità quindi non è una teoria unificata completa.

GRAVITY

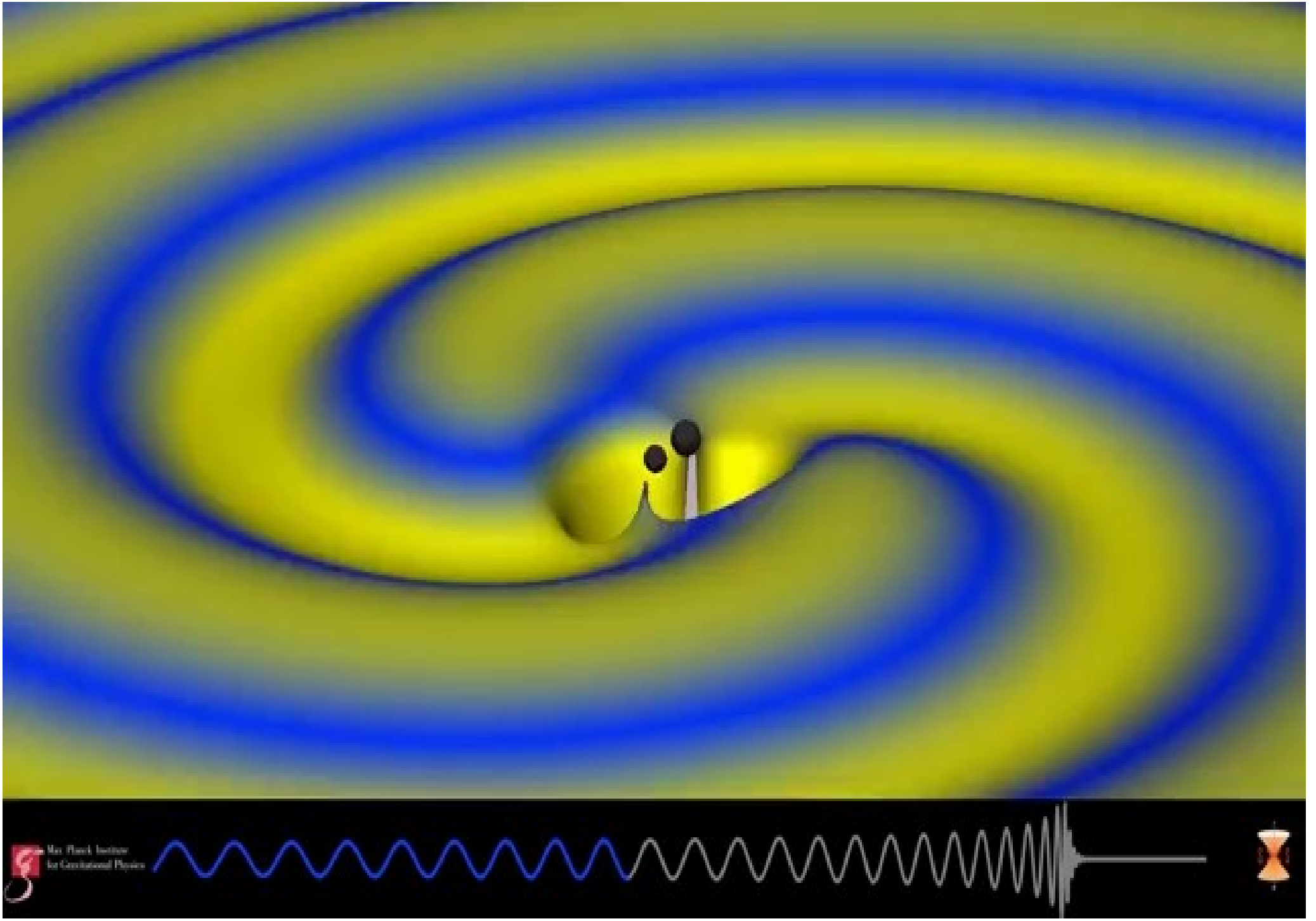
UNIVERSO:

- **$7x10^{22}$ Stelle**
- **$100/200x10^{9}$ galassie**
- **Via Lattea $\sim 100/200x10^{9}$ stelle**

Spazio-tempo curvo



$$G^{\mu\nu} = 8\pi T^{\mu\nu}$$


Max Planck Institute
for Gravitational Physics

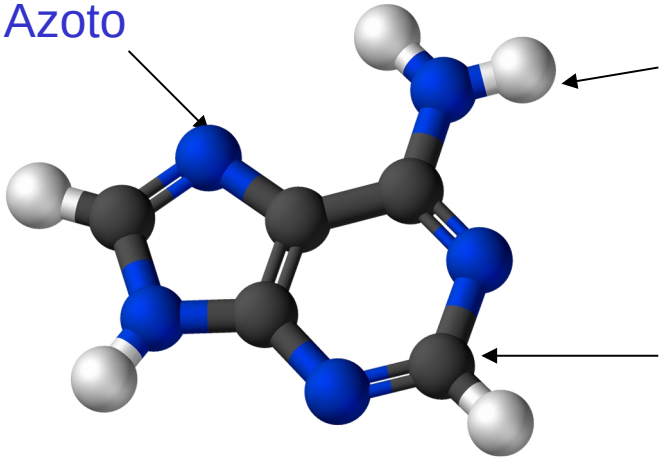
FORZE ELETTROMAGNETICHE

Azoto

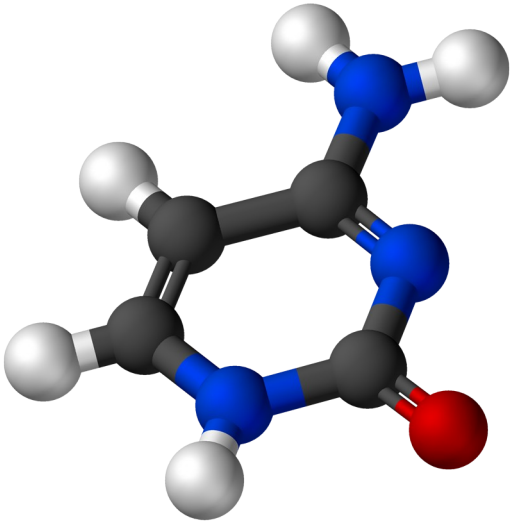
Idrogeno

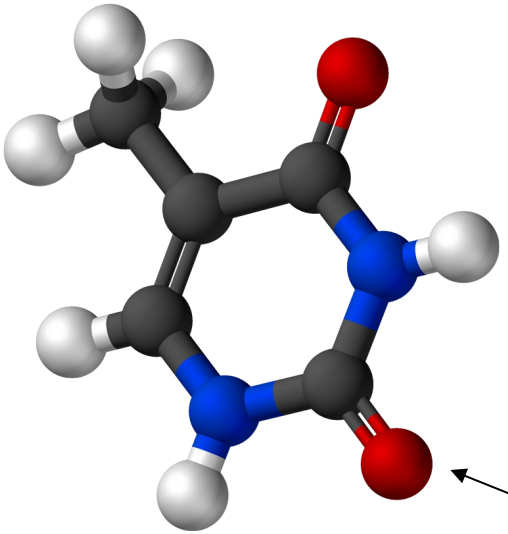
Il nucleotide Adenina

Carbonio



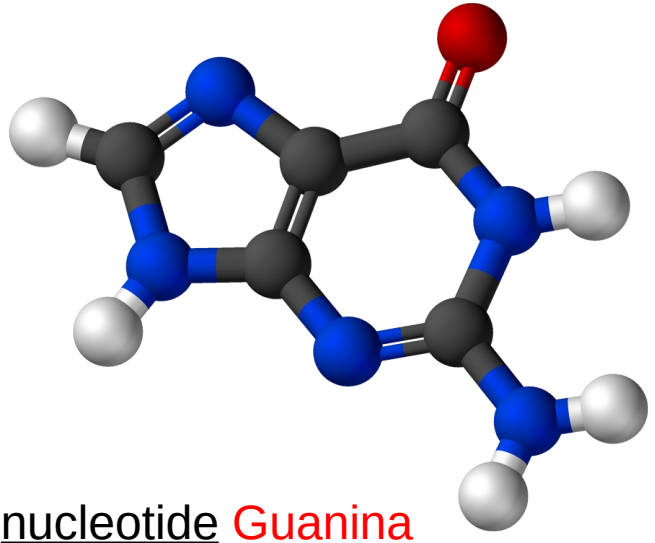
Il nucleotide Citosina





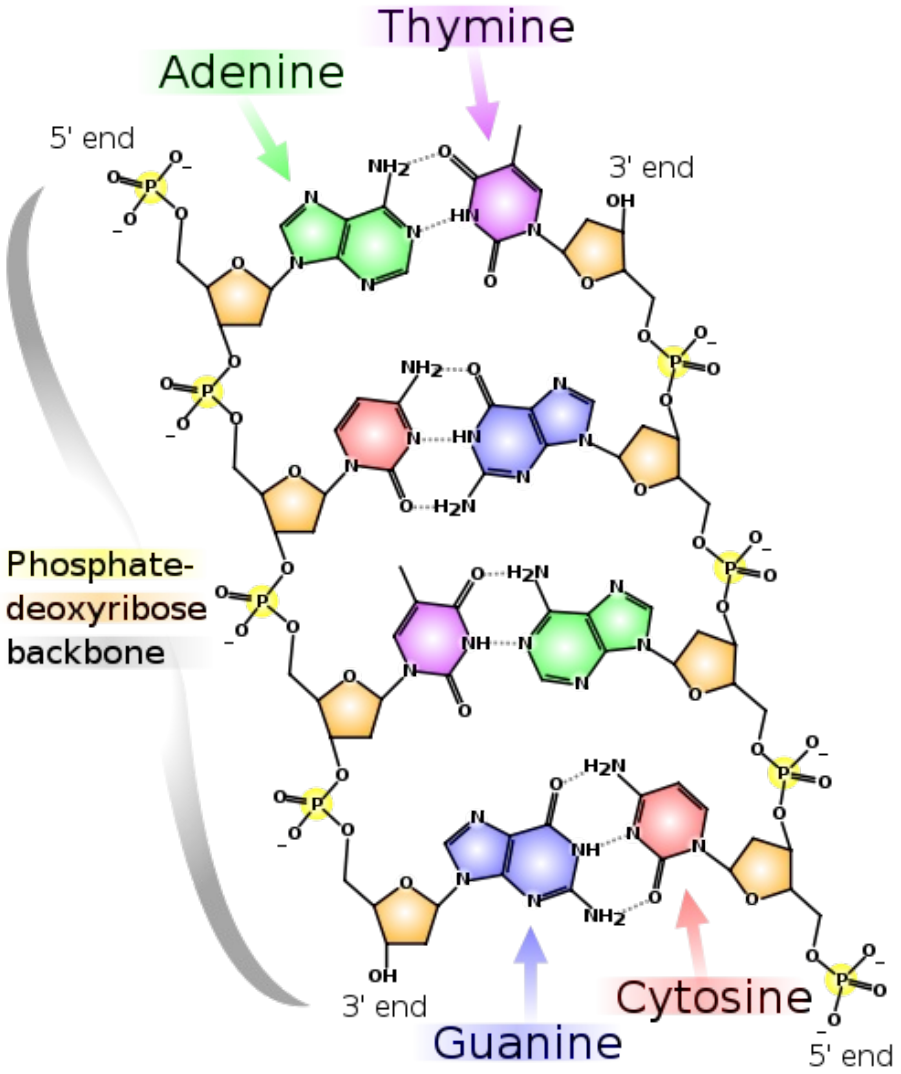
Ossigeno

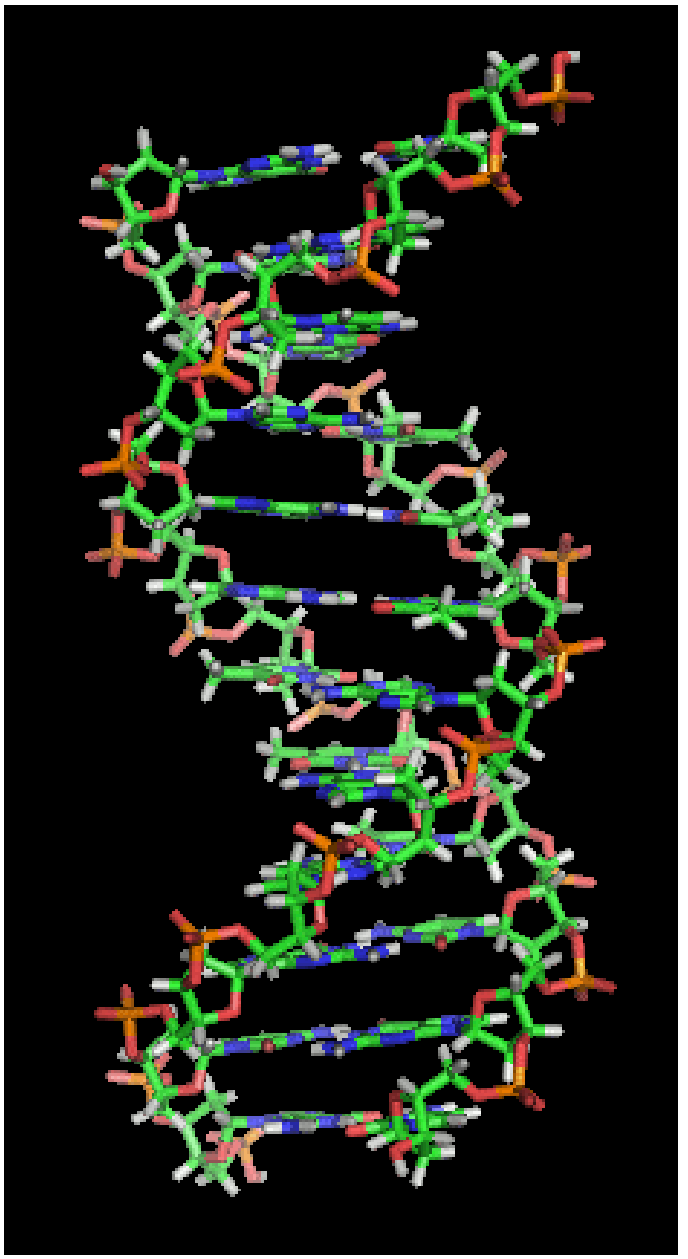
Il nucleotide Timina

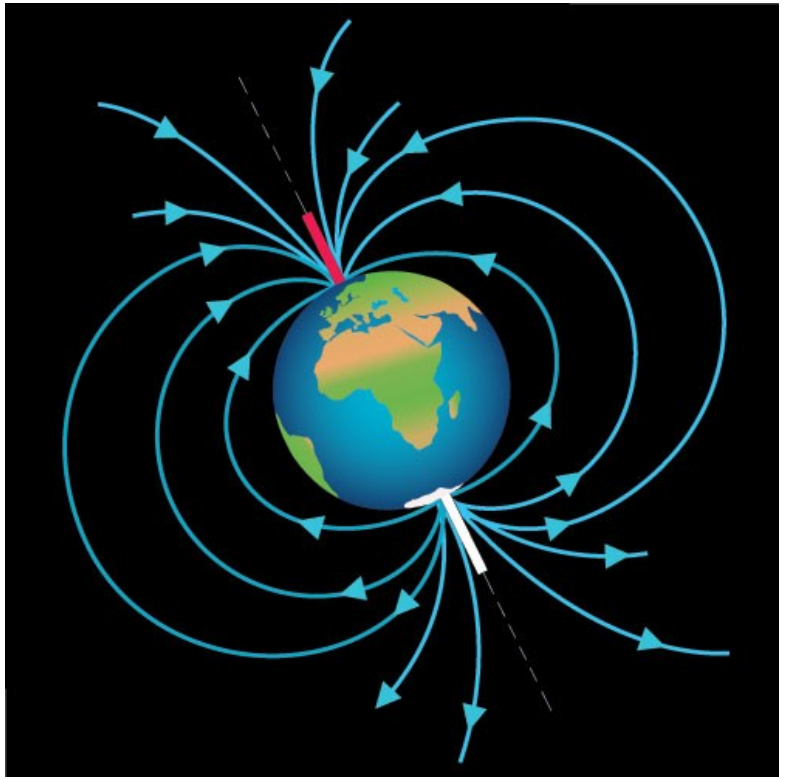


Il nucleotide Guanina

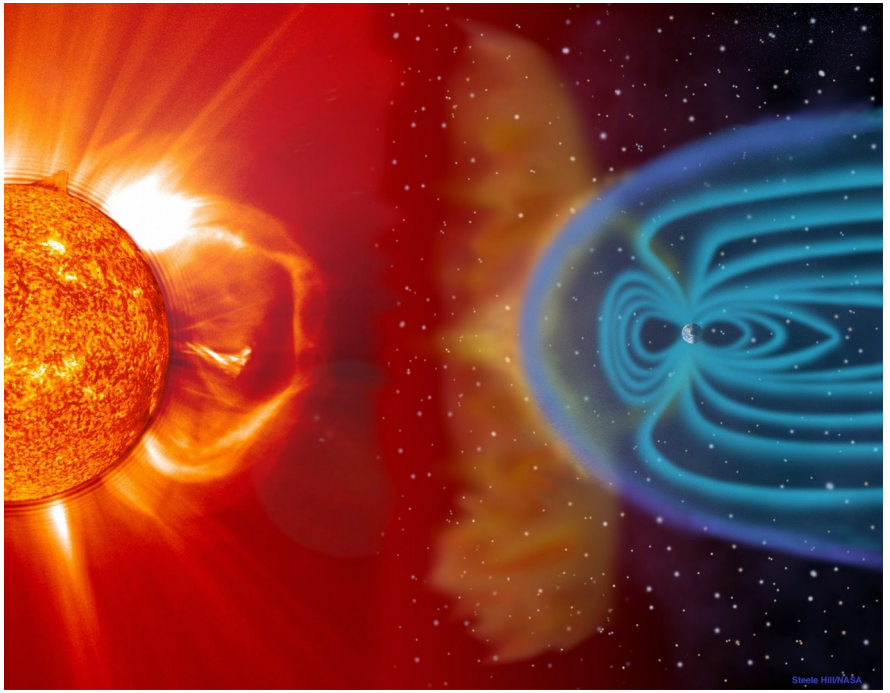
DNA

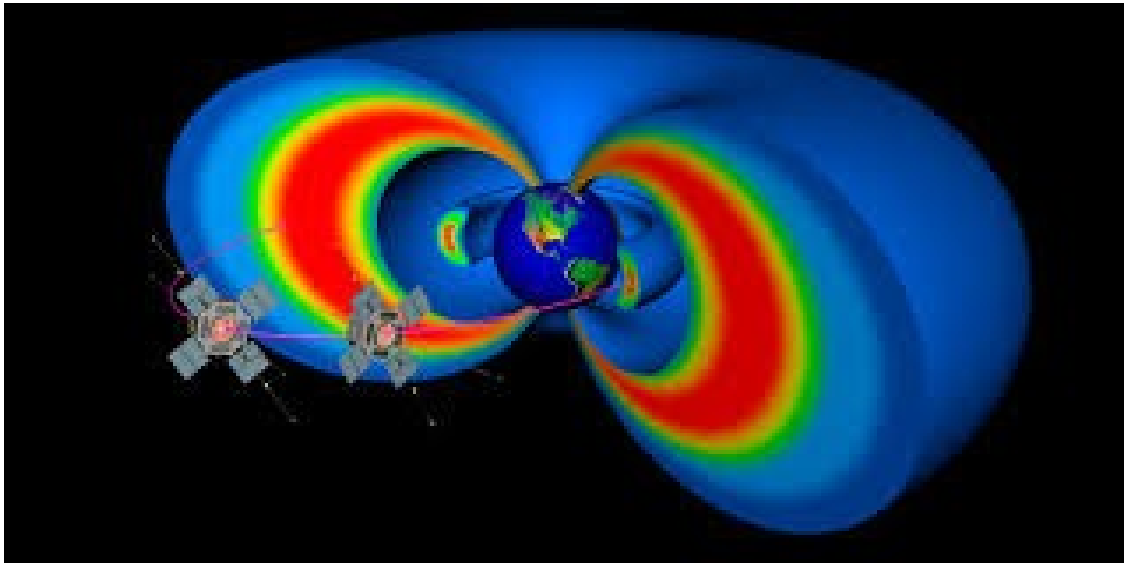

Thymine
Adenine
5' end
3' end
Phosphate-
deoxyribose
backbone
3' end
Guanine
Cytosine
5' end



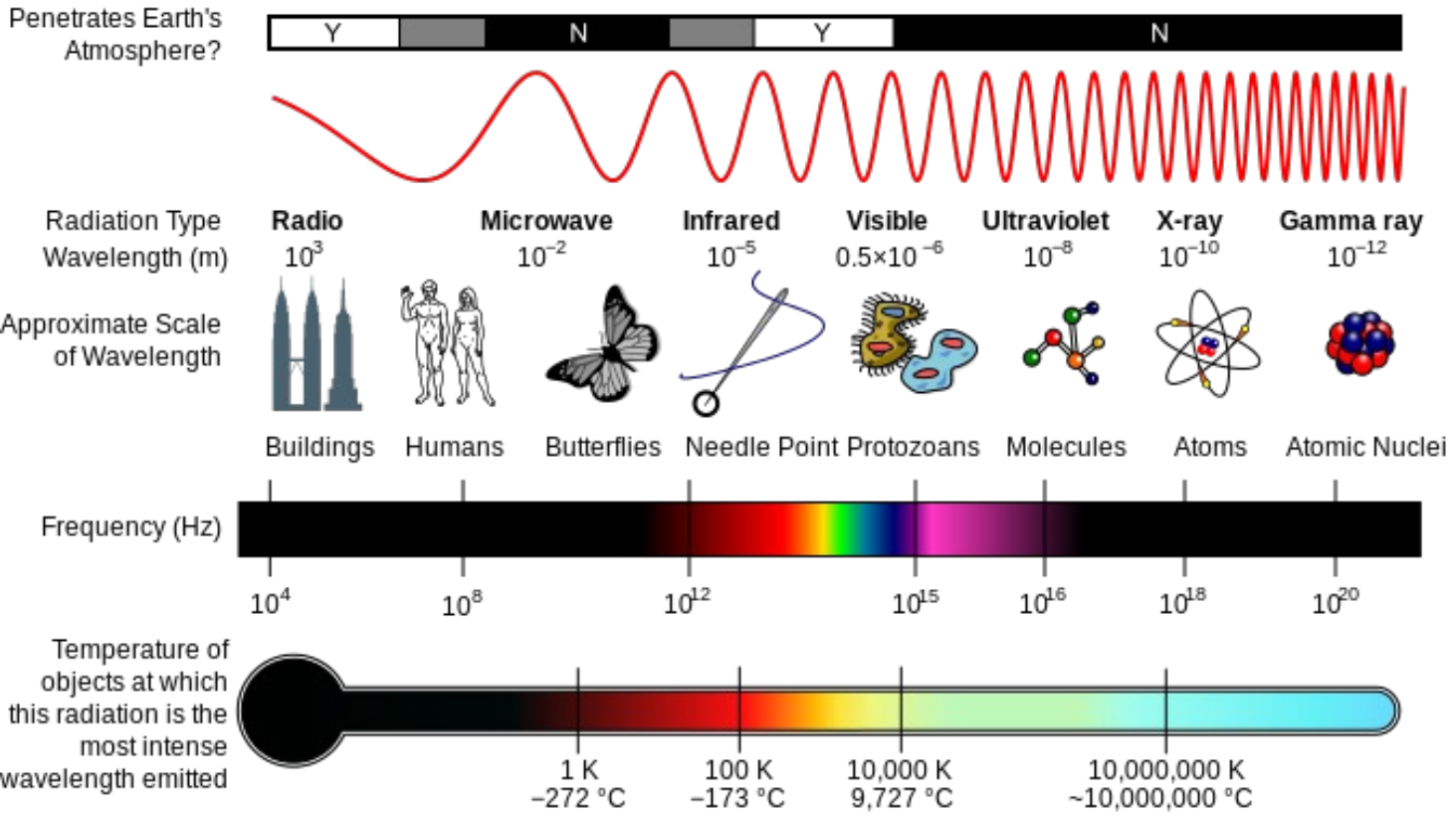


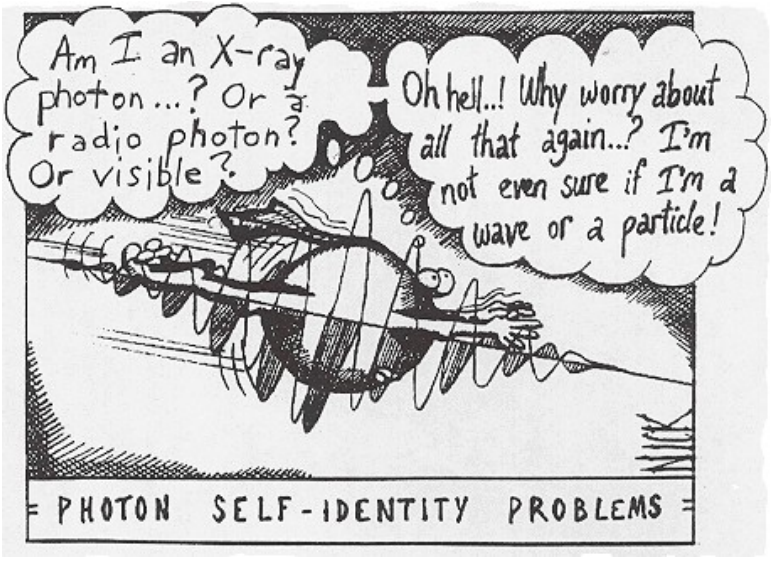
Campo magnetico terrestre: protegge la vita tramite la magnetosfera, mette a rischio quella degli astronauti nelle fasce di Van Allen.





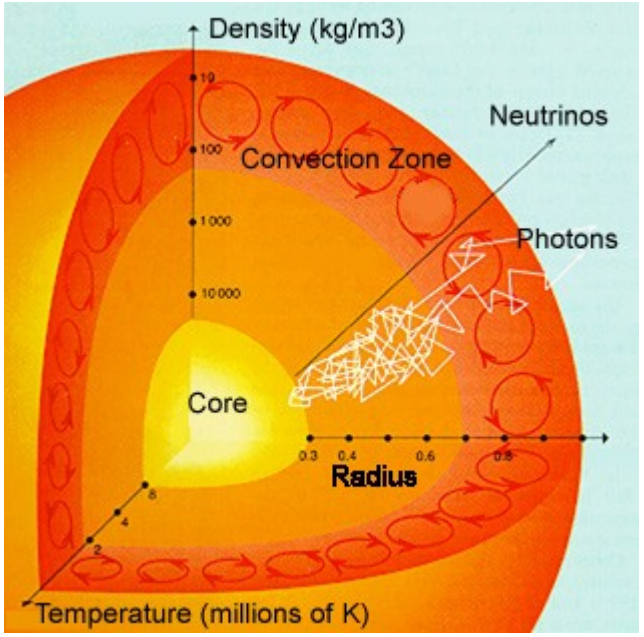
Onde elettromagnetiche

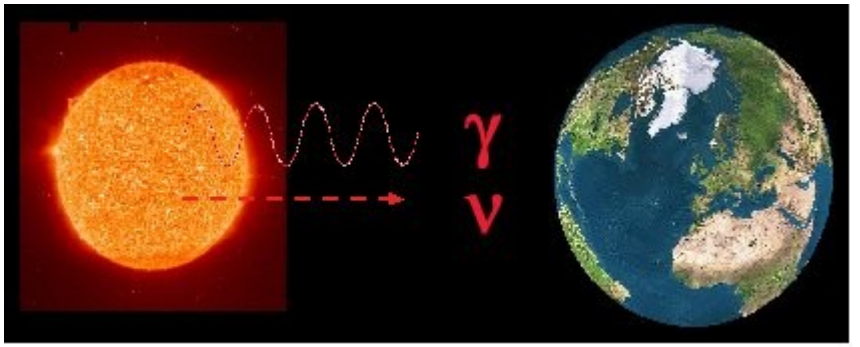


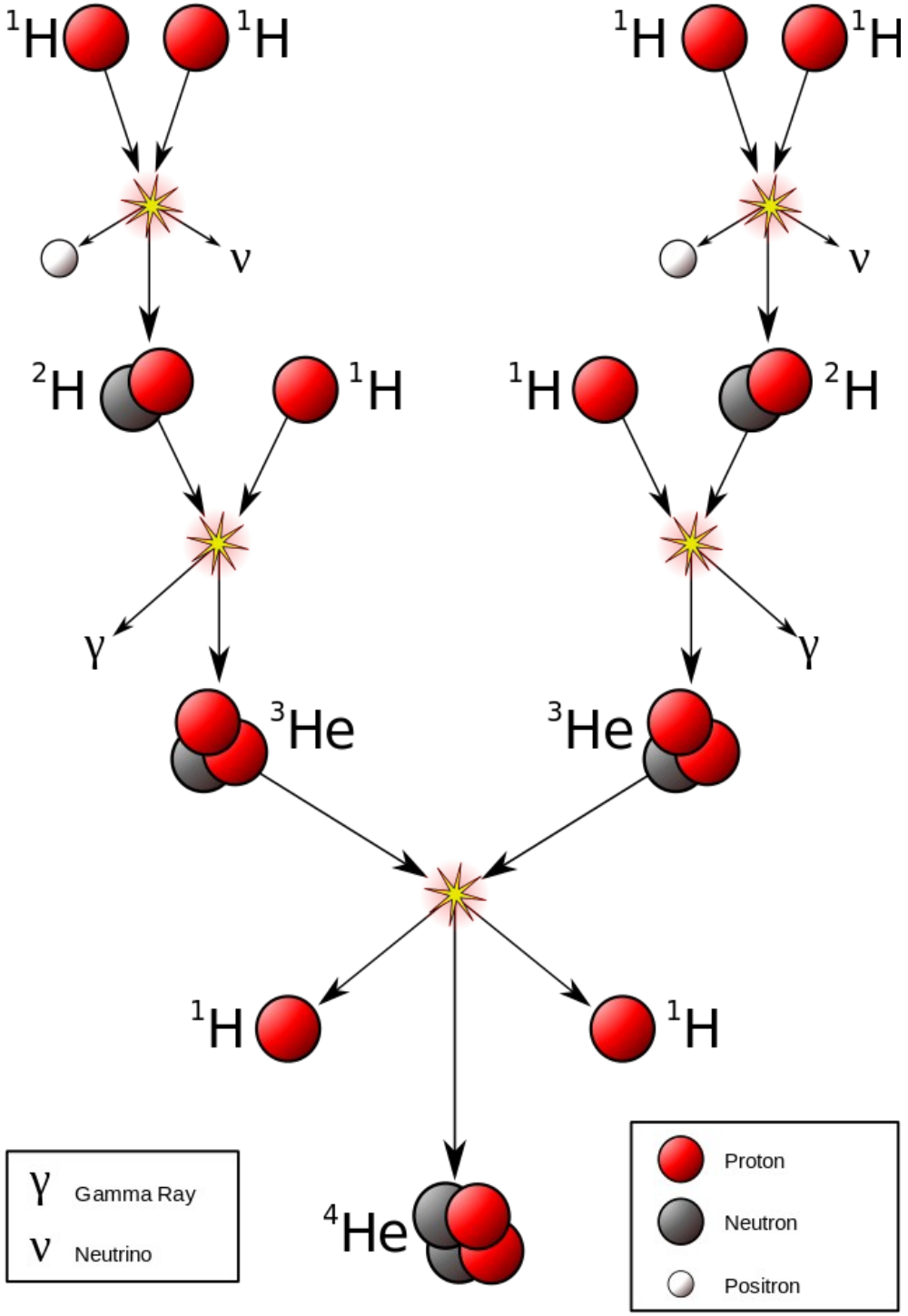


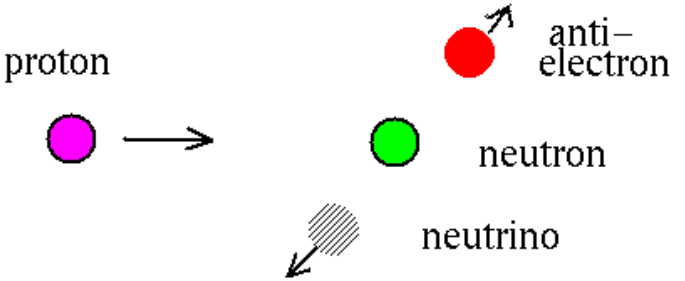
INTERAZIONE FORTE E DEBOLE:

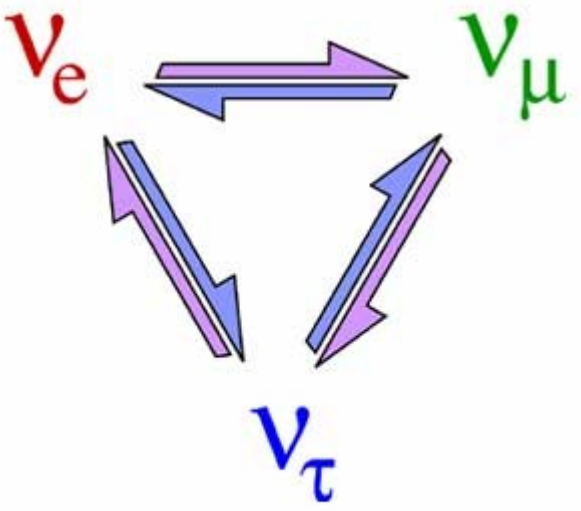
Interazione debole: i neutrini solari











The periodic change of neutrino flavor from one type into another is referred to as neutrino oscillations.

Questioni non risolte dal modello standard:

1) Che cos'è la 'dark matter'?

2) Che cosa è successo all'antimateria dopo il big bang (l'attuale universo è fatto di materia ma le equazioni sono simmetriche)

3) Come includere la gravità?