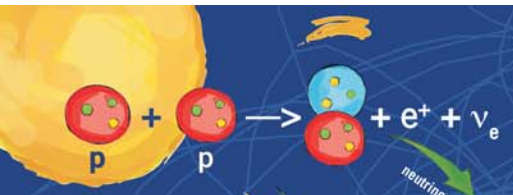
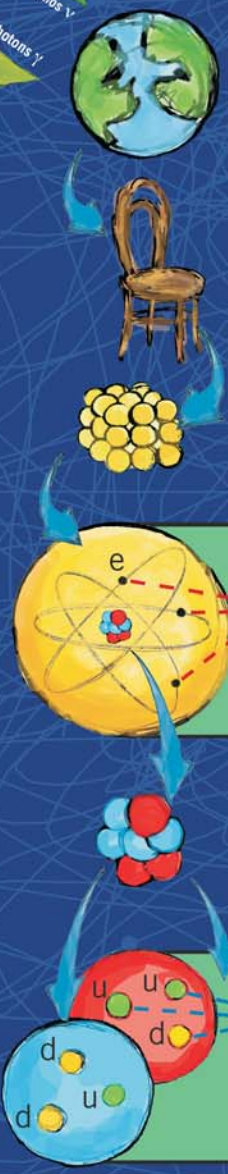
Elementary components of matter



10^{6} m	EARTH
1 m	OBJECT
10^{-6} m	CRYSTAL
10^{-10} m	ATOM
10^{-14} m	ATOM NUCLEUS
10^{-15} m	PROTON
	NEUTRON
	ANTIMATTER



	1st family	2nd family	3rd family
	Particles of the first family make up all ordinary matter (protons, neutrons, atoms...)	More massive & unstable replica of the first family. The muon is 200 times heavier than the electron.	Even more massive replica of the first family. The tau lepton is 3600 times heavier than the electron.
LEPTONS These particles are insensitive to strong interaction.	e electron $m_e = 9.109\ 10^{-31}$ kg ; $Q = -Q_e = -1.602\ 10^{-19}$ c	μ muon $Q = -Q_e$	τ tau $Q = -Q_e$
	ν_e electron neutrino $Q = 0$	ν_μ muon neutrino $Q = 0$	ν_τ tau neutrino $Q = 0$
QUARKS The numerous subatomic particles are all made of quark triplets or of quark-antiquark pairs.	u up $Q = 2/3\ Q_e$	c charm $Q = 2/3\ Q_e$	t top $Q = 2/3\ Q_e$
	d down $Q = -1/3\ Q_e$	s strange $Q = -1/3\ Q_e$	b bottom $Q = -1/3\ Q_e$

To each particle, corresponds an antiparticle with quasi identical properties. The electric charge of an antiparticle is opposite to the one of the corresponding particle.

http://www.ipp.ca/poster
http://sfp.in2p3.fr/affiche

Fundamental interactions

There are PARTICLES ASSOCIATED to each fundamental interaction, allowing its propagation.

Gravity
Universal attraction, planets, galaxies.
GRAVITON ?

Weak interaction
Radioactive decays.
Z^0, W^+, W^-

Electromagnetism
Electricity, magnetism, atom and crystal cohesion, chemistry.
PHOTON

Strong interaction
Proton and neutron cohesion.
GLUON

The 4 fundamental interactions are all needed for the Sun (and all the stars) to shine:

- Star formation caused by gravity;
- Nuclear fusion reactions caused by weak and strong interactions;
- Light production : electromagnetic interaction.

The 4 particles of the first family are all present in the Sun which sends an intense flux of photons and neutrinos to Earth.

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