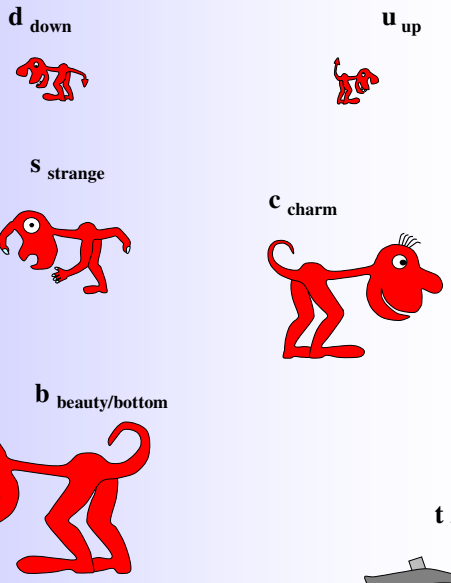
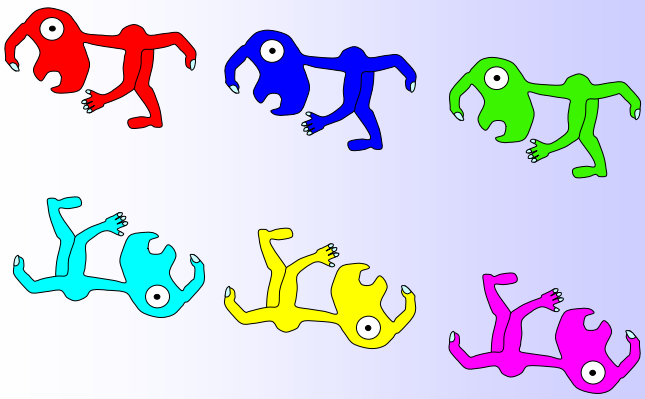
Enigmatic quarks

Quarks seem to be the same, but they smell different (*)

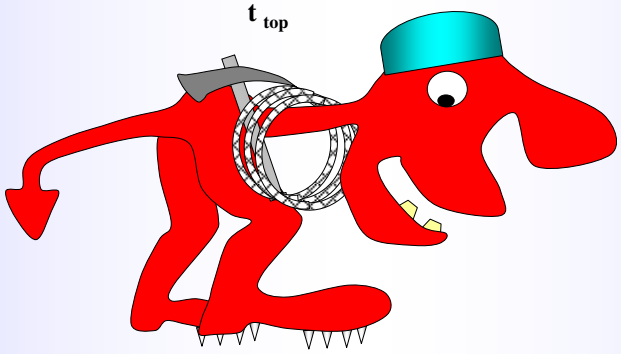


Quarks and colors

Quarks are in three-intermixing colors. Anti-quarks, are in anti-colors.
Here below, two parts of one quark family are walking for a meeting.



If a quark joins his anti-quark – a meson is born (don't mix with misalliance)



So many people worked to discover one (top) quark …

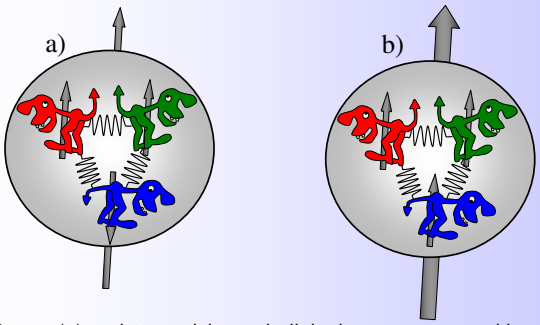
Proton & Co.

Proton (uud)

Isospin=1/2
Mass m=938.27231 ±0.00028 MeV (=1836 electron masses)
Electric momentum D= (-3,7±6,3)x10^{-23} e cm
Magnetic momentum m= 2,792847386 ± 0,000000066 μ_B
Lifetime t=1,6x10^{25} yr (>>age of the Universe =14,5x10^{9} yr)

Neutron** (udd)

Isospin=1/2
Mass m=939.56563 ±0.00028 MeV (a bit more than proton)
Electric momentum D< 12x10^{-26} $e$cm
Magnetic momentum m= -1,91304275±0,000000456 μ_B
Electric charge q=(-0,4±1,1)x10^{-21} e (read: zero!)
Lifetime t=888,65 ± 3,5 s (= academic quarter!)



Proton (a) and Δ^+ particle are built in the same way - with two "up" quarks and one "down" quark. The only difference is in spin, what causes that the Δ^+ particle is 30% heavier than proton.

Standard Model of fundamental interactions and particles

INTERACTION	SOURCE	PARTICLES MEDIATING	MASS	POWER
Gravitational	mass	graviton G	0	10^{-39}
Electromagnetic	charge	foton γ	0	10^{-2}
Strong	colour	gluon g	0	1
Weak	weak charge	bosons $W^{\pm}$ Z^0	80 GeV 91 GeV	10^{-7}

LEPTONS SPIN = 1/2			QUARKS SPIN = 1/2		
FLAVOR	MASS GeV/c^2	ELECTRIC CHARGE	FLAVOR	MASS GeV/c^2	ELECTRIC CHARGE
ν_e	< 7x10^{-8}	0	u	≈0.003	2/3
e$^-$	0.000511	-1	d	≈0.006	-1/3
ν_μ	< 0.0003	0	c	1.5	2/3
μ^-	0.106	-1	s	≈0.1	-1/3
ν_τ	< 0.03	0	t	170	2/3
τ^-	1.7771	-1	b	4.7	-1/3

(*)The size of the quark corresponds here to its mass. The only necessary trick here was to use four dimensions – the masses scale as the fourth power of the size.
Note that the tail indicates the charge – positive or negative.

(**) If lepton is a Greek *lepton* (1 cent) coin, 2.3 g, than neutron is 8 cm-side steel cube.

Masses of light quarks are known with almost 50% error bar.
These best data are following : 1/2(m_u+m_d)=4.2 MeV/c^2; 1.5<m_u<5 MeV; 5<m_d<9 MeV/c^2
and for *strange* quark m_s=0.105±0.033 GeV/c^2 [Manohor 2002]
Quarks are, after all, quite light particles: the *u* quark is only six times heavier than electron.