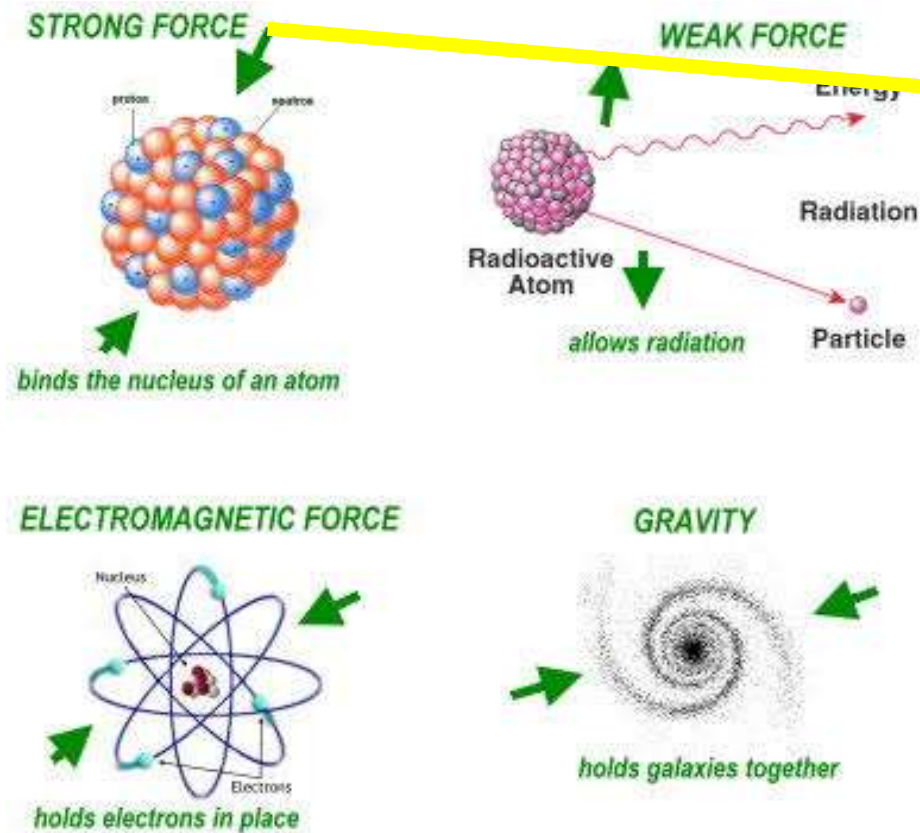


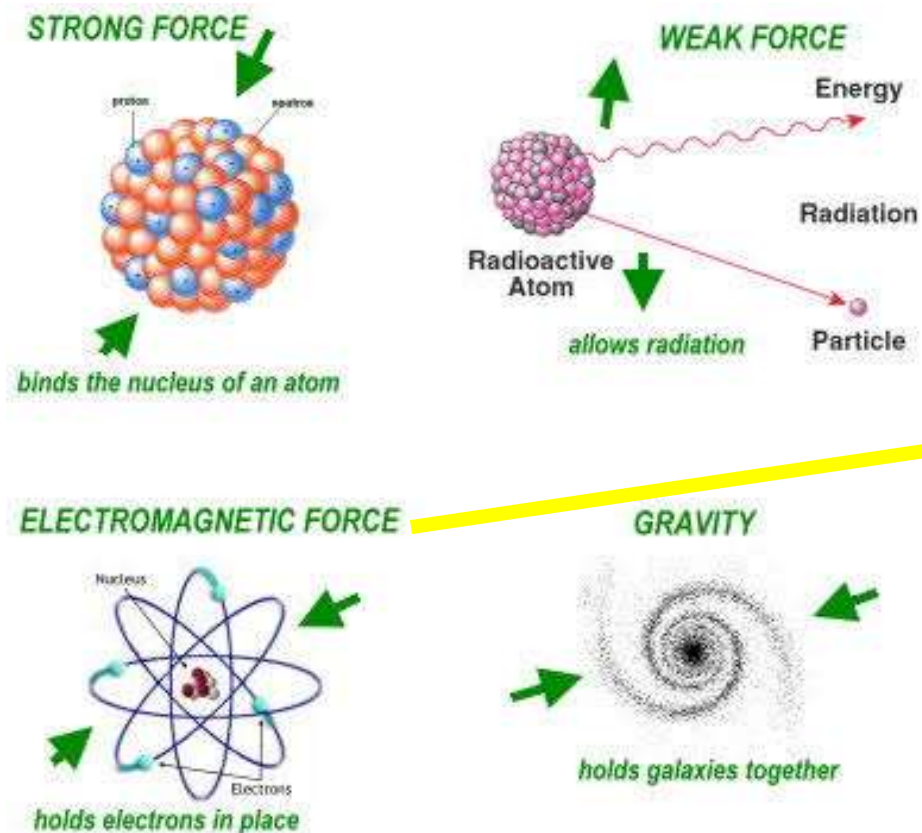
The big picture



Standard Model of Elementary Particles

three generations of matter (fermions)			interactions / force carriers (bosons)	
I	II	III		
mass $\approx 2.16 \text{ MeV}/c^2$ charge $\frac{2}{3}$ spin $\frac{1}{2}$ u up	mass $\approx 1.273 \text{ GeV}/c^2$ charge $\frac{2}{3}$ spin $\frac{1}{2}$ c charm	mass $\approx 172.57 \text{ GeV}/c^2$ charge $\frac{2}{3}$ spin $\frac{1}{2}$ t top	mass $\approx 125.2 \text{ GeV}/c^2$ charge 0 spin 0 H higgs	SCALAR BOSONS
QUARKS mass $\approx 4.7 \text{ MeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ d down	mass $\approx 93.5 \text{ MeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ s strange	mass $\approx 4.183 \text{ GeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ b bottom	mass 0 charge 0 spin 1 γ photon	
mass $\approx 0.511 \text{ MeV}/c^2$ charge -1 spin $\frac{1}{2}$ e electron	mass $\approx 105.66 \text{ MeV}/c^2$ charge -1 spin $\frac{1}{2}$ μ muon	mass $\approx 1.77693 \text{ GeV}/c^2$ charge -1 spin $\frac{1}{2}$ τ tau	mass $\approx 91.188 \text{ GeV}/c^2$ charge 0 spin 1 Z Z boson	
LEPTONS mass $< 0.8 \text{ eV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_e electron neutrino	mass $< 0.17 \text{ MeV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_μ muon neutrino	mass $< 18.2 \text{ MeV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_τ tau neutrino	mass $\approx 80.3692 \text{ GeV}/c^2$ charge ± 1 spin 1 W W boson	GAUGE BOSONS VECTOR BOSONS

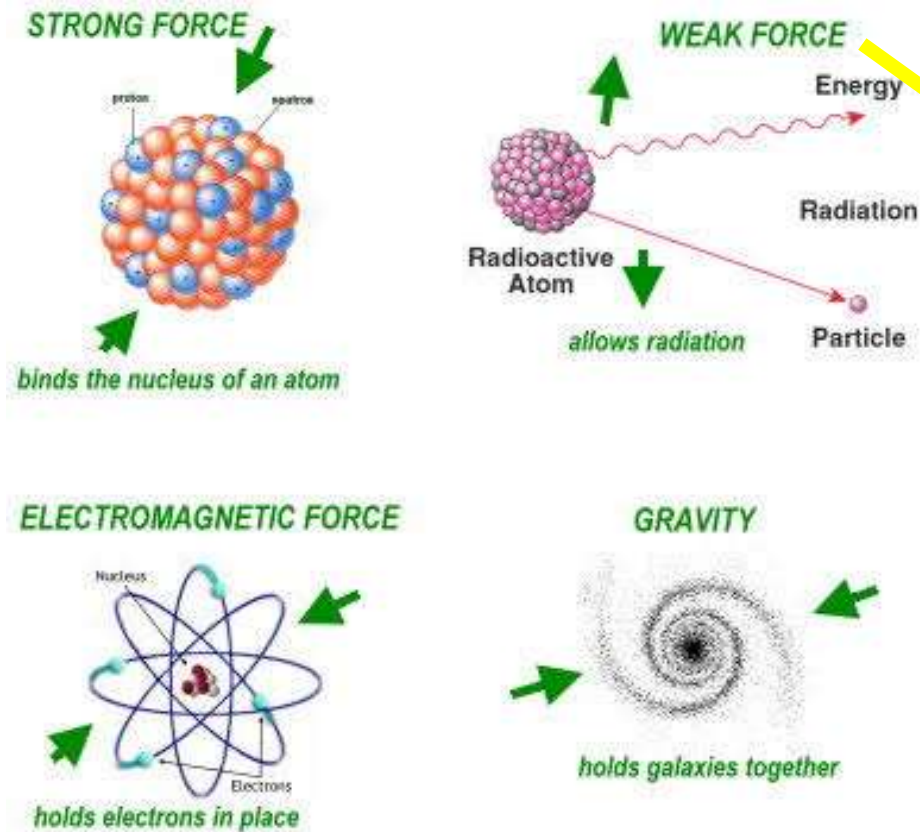
The big picture



Standard Model of Elementary Particles

three generations of matter (fermions)						interactions / force carriers (bosons)	
	I	II	III				
QUARKS	mass $\approx 2.16 \text{ MeV}/c^2$ charge $\frac{2}{3}$ spin $\frac{1}{2}$ u up	mass $\approx 1.273 \text{ GeV}/c^2$ charge $\frac{2}{3}$ spin $\frac{1}{2}$ c charm	mass $\approx 172.57 \text{ GeV}/c^2$ charge $\frac{2}{3}$ spin $\frac{1}{2}$ t top			mass $\approx 125.2 \text{ GeV}/c^2$ charge 0 spin 0 H higgs	SCALAR BOSONS
	mass $\approx 4.7 \text{ MeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ d down	mass $\approx 93.5 \text{ MeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ s strange	mass $\approx 4.183 \text{ GeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ b bottom			mass 0 charge 0 spin 1 γ photon	
LEPTONS	mass $\approx 0.511 \text{ MeV}/c^2$ charge -1 spin $\frac{1}{2}$ e electron	mass $\approx 105.66 \text{ MeV}/c^2$ charge -1 spin $\frac{1}{2}$ μ muon	mass $\approx 1.77693 \text{ GeV}/c^2$ charge -1 spin $\frac{1}{2}$ τ tau			mass $\approx 91.188 \text{ GeV}/c^2$ charge 0 spin 1 Z Z boson	GAUGE BOSONS VECTOR BOSONS
	mass $< 0.8 \text{ eV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_e electron neutrino	mass $< 0.17 \text{ MeV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_μ muon neutrino	mass $< 18.2 \text{ MeV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_τ tau neutrino			mass $\approx 80.3692 \text{ GeV}/c^2$ charge ± 1 spin 1 W W boson	

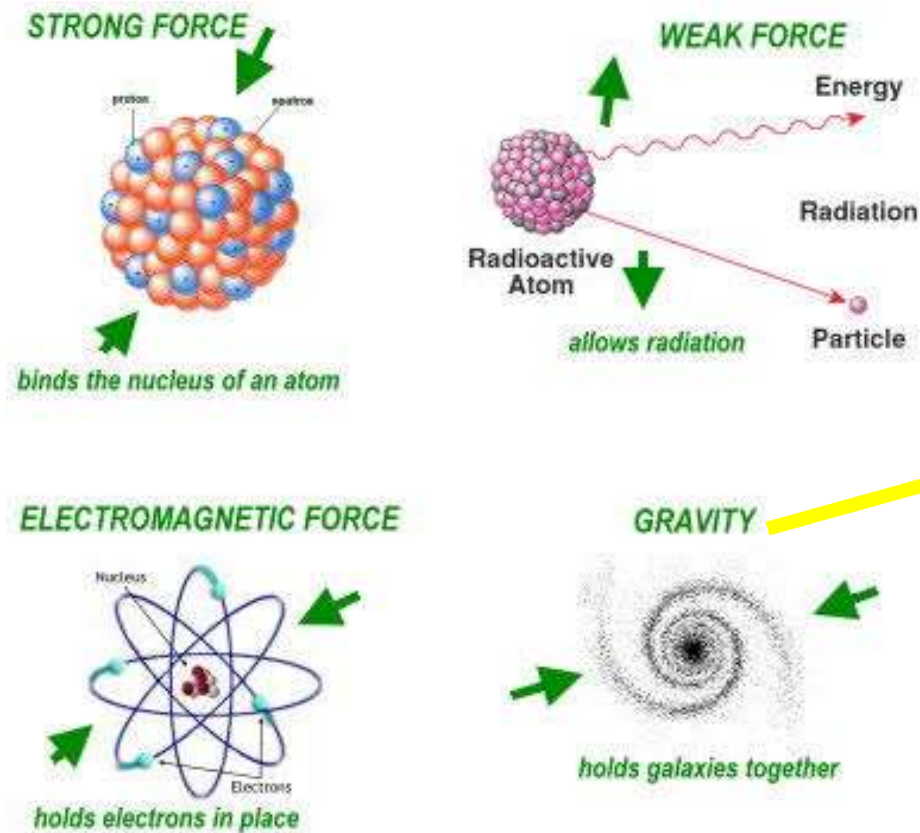
The big picture



Standard Model of Elementary Particles

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	mass $\approx 4.18 \text{ MeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ d down	mass $\approx 93.5 \text{ MeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ s strange	mass $\approx 4.183 \text{ GeV}/c^2$ charge $-\frac{1}{3}$ spin $\frac{1}{2}$ b bottom	mass 0 charge 0 spin 1 γ photon
	mass $\approx 0.511 \text{ MeV}/c^2$ charge -1 spin $\frac{1}{2}$ e electron	mass $\approx 105.66 \text{ MeV}/c^2$ charge -1 spin $\frac{1}{2}$ μ muon	mass $\approx 1.77693 \text{ GeV}/c^2$ charge -1 spin $\frac{1}{2}$ τ tau	mass $\approx 91.188 \text{ GeV}/c^2$ charge 0 spin 1 Z Z boson
LEPTONS	mass $< 0.8 \text{ eV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_e electron neutrino	mass $< 0.17 \text{ MeV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_μ muon neutrino	mass $< 18.2 \text{ MeV}/c^2$ charge 0 spin $\frac{1}{2}$ ν_τ tau neutrino	mass $\approx 80.3692 \text{ GeV}/c^2$ charge ± 1 spin 1 W W boson
				GAUGE BOSONS VECTOR BOSONS
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				GAUGE BOSONS VECTOR BOSONS
				SCALAR BOSONS

Particle classification

"Classification is the first stage in the development of any science" (D. Griffiths)
It provides conceptual schemes which allow the basic ideas to emerge.

Markus and Rosenfeld UCRL-8030 Table I

Masses and mean lives of elementary particles; November, 1957
(The antiparticles are assumed to have the same spins, masses, and mean lives as the particles listed)

Particle	Spin	Mass (Errors represent standard deviation) (MeV)	Mass difference (MeV)	Mean life (sec)	Decay rate (number per second)
Photon γ	1	0		stable	0
Leptons	ν	0		stable	0
	e^-	0.510976 (a)		stable	0
	μ^-	105.70 $\pm$ 0.06 (a)		(2.22 $\pm$ 0.02) $\times 10^{-6}$	0.45 $\times 10^6$
Mesons	π^+	139.53 $\pm$ 0.06 (a)	4.6 (a)	2.56 $\pm$ 0.05 $\times 10^{-8}$ (a)	0.39 $\times 10^8$
	π^0	135.04 $\pm$ 0.16 (a)		$< 4 \times 10^{-16}$ (d)	$> 2.5 \times 10^{15}$
	K^+	494.0 $\pm$ 0.2 (g)	0.4 $\pm$ 1.8	(1.224 $\pm$ 0.013) $\times 10^{-8}$ (h)	0.815 $\times 10^8$
	K^0	494.4 $\pm$ 1.8 (i)		K_1 : (0.95 $\pm$ 0.08) $\times 10^{-10}$ (e)	1.05 $\times 10^{10}$
				K_2 : (4 $< \tau < 13$) $\times 10^{-8}$ (c)	(0.07 $< \tau < 0.25$) $\times 10^8$
Baryons	p	938.213 $\pm$ 0.01 (a)	7.1 $\pm$ 0.4	stable	0.0
	n	939.506 $\pm$ 0.01 (a)		(1.04 $\pm$ 0.13) $\times 10^{+3}$ (a)	0.96 $\times 10^{-3}$
	Λ	1115.2 $\pm$ 0.14 (j)		(2.77 $\pm$ 0.15) $\times 10^{-10}$ (k)	0.36 $\times 10^{10}$
	Σ^+	1189.4 $\pm$ 0.25 (l)		(0.83 $\pm$ 0.05) $\times 10^{-10}$ (m)	1.21 $\times 10^{10}$
	Σ^-	1196.5 $\pm$ 0.5 (n)		(1.67 $\pm$ 0.17) $\times 10^{-10}$ (o)	0.60 $\times 10^{10}$
	Ξ^0	1190.5 $\pm$ 0.9 (p)	6.0 $\pm$ 1.4	(< 0.1) $\times 10^{-10}$ (b)	$> 10 \times 10^{10}$
				theoretically $\sim 10^{-19}$	theoretically $\sim 10^{19}$
	Ξ^-	1320.4 $\pm$ 2.2 (q)		(4.6 $< \tau < 200$) $\times 10^{-10}$ (f)	($> 0.005, < 0.2$) $\times 10^{10}$
	Ξ^0	?		?	?

The first Rosenfeld
"wallet card" (1958)

Later on:

"If I could remember the names of all these
particles, I would have been a botanist"
(E. Fermi)

Still, you must know and memorize the values of masses and lifetimes
of the main particles, as these contain relevant conceptual information