

bosons → integer spin → can overlap

Forces	strength	range	particle	couples to
Strong	1	short ~ nucleon	Gluon	"color"
Electromagnetism	10^{-2}	long ~ $1/r^2$	Photon	charge
Weak	10^{-6}	short	W^{\pm}, Z	$e^{-},$ up f , down ν
Gravity	10^{-38}	long	Graviton (?)	all energy

fermions → half-integer spin → cannot overlap

Fundamental Forces and Particles

Stuff	notes	$=m c \text{Energy}^2$	charge	color
family 1 (ALL NORMAL MATTER)	electron (e) neutrino (ν_e) up quark down quark	0.0005 GeV 0 (?) 1/3 GeV 1/3 GeV	-1 0 +2/3	no no r, g, b
family 2	muon (μ) ν_{μ} charm strange	0.1 GeV 0 (?) 1.5 GeV 0.5 GeV	Same as above.	
family 3	tau (τ) ν_{τ} top bottom	1.8 GeV 0 (?) ~ 150 GeV ? 5 GeV	Same as above.	