

# Standard Model of Elementary Particles

three generations of matter  
(fermions)

interactions / force carriers  
(bosons)

I

II

III

mass  
charge  
spin

QUARKS

LEPTONS

$\approx 2.2 \text{ MeV}/c^2$

$\frac{2}{3}$

$\frac{1}{2}$

u

up

$\approx 1.28 \text{ GeV}/c^2$

$\frac{2}{3}$

$\frac{1}{2}$

c

charm

$\approx 173.1 \text{ GeV}/c^2$

$\frac{2}{3}$

$\frac{1}{2}$

t

top

$\approx 4.7 \text{ MeV}/c^2$

$-\frac{1}{3}$

$\frac{1}{2}$

d

down

$\approx 96 \text{ MeV}/c^2$

$-\frac{1}{3}$

$\frac{1}{2}$

s

strange

$\approx 4.18 \text{ GeV}/c^2$

$-\frac{1}{3}$

$\frac{1}{2}$

b

bottom

$\approx 0.511 \text{ MeV}/c^2$

-1

$\frac{1}{2}$

e

electron

$\approx 105.66 \text{ MeV}/c^2$

-1

$\frac{1}{2}$

$\mu$

muon

$\approx 1.7768 \text{ GeV}/c^2$

-1

$\frac{1}{2}$

$\tau$

tau

$< 1.0 \text{ eV}/c^2$

0

$\frac{1}{2}$

$\nu_e$

electron  
neutrino

$< 0.17 \text{ MeV}/c^2$

0

$\frac{1}{2}$

$\nu_\mu$

muon  
neutrino

$< 18.2 \text{ MeV}/c^2$

0

$\frac{1}{2}$

$\nu_\tau$

tau  
neutrino

0

0

1

g

gluon

$\approx 124.97 \text{ GeV}/c^2$

0

0

H

higgs

0

0

1

$\gamma$

photon

$\approx 91.19 \text{ GeV}/c^2$

0

1

Z

Z boson

$\approx 80.39 \text{ GeV}/c^2$

$\pm 1$

1

W

W boson

GAUGE BOSONS  
VECTOR BOSONS

SCALAR BOSONS