

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

0
0
1
g
gluon

$\approx 125.11 \text{ GeV}/c^2$
0
0
H
higgs

$\approx 4.7 \text{ MeV}/c^2$
 $-\frac{1}{3}$
 $\frac{1}{2}$
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

0
0
1
 γ
photon

$\approx 0.511 \text{ MeV}/c^2$
-1
 $\frac{1}{2}$
e
electron

$\approx 105.66 \text{ MeV}/c^2$
-1
 $\frac{1}{2}$
 μ
muon

$\approx 1.7768 \text{ GeV}/c^2$
-1
 $\frac{1}{2}$
 τ
tau

$\approx 91.19 \text{ GeV}/c^2$
0
1
Z
Z boson

$< 1.0 \text{ eV}/c^2$
0
 $\frac{1}{2}$
 ν_e
electron
neutrino

$< 0.17 \text{ MeV}/c^2$
0
 $\frac{1}{2}$
 ν_μ
muon
neutrino

$< 18.2 \text{ MeV}/c^2$
0
 $\frac{1}{2}$
 ν_τ
tau
neutrino

$\approx 80.360 \text{ GeV}/c^2$
 ± 1
1
W
W boson

GAUGE BOSONS
VECTOR BOSONS

SCALAR BOSONS