

Three Generations
of Matter (Fermions)

I

II

III

mass→
charge→
spin→
name→

2.4 MeV
 $\frac{2}{3}$
 $\frac{1}{2}$
u
up

1.27 GeV
 $\frac{2}{3}$
 $\frac{1}{2}$
c
charm

171.2 GeV
 $\frac{2}{3}$
 $\frac{1}{2}$
t
top

0
0
1
γ
photon

Quarks

4.8 MeV
 $-\frac{1}{3}$
 $\frac{1}{2}$
d
down

104 MeV
 $-\frac{1}{3}$
 $\frac{1}{2}$
s
strange

4.2 GeV
 $-\frac{1}{3}$
 $\frac{1}{2}$
b
bottom

0
0
1
g
gluon

<2.2 eV
0
 $\frac{1}{2}$
ν_e
electron
neutrino

<0.17 MeV
0
 $\frac{1}{2}$
ν_μ
muon
neutrino

<15.5 MeV
0
 $\frac{1}{2}$
ν_τ
tau
neutrino

91.2 GeV
0
1
Z⁰
weak
force

Leptons

0.511 MeV
-1
 $\frac{1}{2}$
e
electron

105.7 MeV
-1
 $\frac{1}{2}$
μ
muon

1.777 GeV
-1
 $\frac{1}{2}$
τ
tau

80.4 GeV
±1
1
W[±]
weak
force

Bosons (Forces)