

# Particle Chart

## Quarks

<p><b>UP QUARK</b> DISCOVERED: 1969</p> <p>MATTER PARTICLE</p> <p>Mass: <math>2 \text{ MeV}/c^2</math> Electric Charge: <math>+\frac{2}{3}</math> Strong Charges: blue, red, green Weak Charge: <math>+\frac{1}{2}</math> Lifetime: unlimited</p>	<p><b>CHARM QUARK</b> DISCOVERED: 1974</p> <p>MATTER PARTICLE</p> <p>Mass: <math>1300 \text{ MeV}/c^2</math> Electric Charge: <math>+\frac{2}{3}</math> Strong Charges: blue, red, green Weak Charge: <math>+\frac{1}{2}</math> Lifetime: <math>10^{-13} \text{ s}</math></p>	<p><b>TOP QUARK</b> DISCOVERED: 1995</p> <p>MATTER PARTICLE</p> <p>Mass: <math>173 \cdot 10^3 \text{ MeV}/c^2</math> Electric Charge: <math>+\frac{2}{3}</math> Strong Charges: blue, red, green Weak Charge: <math>+\frac{1}{2}</math> Lifetime: <math>6 \cdot 10^{-25} \text{ s}</math></p>
<p><b>DOWN QUARK</b> DISCOVERED: 1969</p> <p>MATTER PARTICLE</p> <p>Mass: <math>5 \text{ MeV}/c^2</math> Electric Charge: <math>-\frac{1}{3}</math> Strong Charges: blue, red, green Weak Charge: <math>-\frac{1}{2}</math> Lifetime: 900s</p>	<p><b>STRANGE QUARK</b> DISCOVERED: 1969</p> <p>MATTER PARTICLE</p> <p>Mass: <math>100 \text{ MeV}/c^2</math> Electric Charge: <math>-\frac{1}{3}</math> Strong Charges: blue, red, green Weak Charge: <math>-\frac{1}{2}</math> Lifetime: <math>5 \cdot 10^{-8} \text{ s}</math></p>	<p><b>BOTTOM QUARK</b> DISCOVERED: 1977</p> <p>MATTER PARTICLE</p> <p>Mass: <math>4200 \text{ MeV}/c^2</math> Electric Charge: <math>-\frac{1}{3}</math> Strong Charges: blue, red, green Weak Charge: <math>-\frac{1}{2}</math> Lifetime: <math>2 \cdot 10^{-12} \text{ s}</math></p>

## Leptons

<p><b>ELECTRON</b> DISCOVERED: 1897</p> <p>MATTER PARTICLE</p> <p>Mass: <math>0.511 \text{ MeV}/c^2</math> Electric Charge: -1 Strong Charges: - Weak Charge: <math>-\frac{1}{2}</math> Lifetime: unlimited</p>	<p><b>MUON</b> DISCOVERED: 1937</p> <p>MATTER PARTICLE</p> <p>Mass: <math>106 \text{ MeV}/c^2</math> Electric Charge: -1 Strong Charges: - Weak Charge: <math>-\frac{1}{2}</math> Lifetime: <math>2.2 \cdot 10^{-6} \text{ s}</math></p>	<p><b>TAU</b> DISCOVERED: 1975</p> <p>MATTER PARTICLE</p> <p>Mass: <math>1777 \text{ MeV}/c^2</math> Electric Charge: -1 Strong Charges: - Weak Charge: <math>-\frac{1}{2}</math> Lifetime: <math>2.9 \cdot 10^{-13} \text{ s}</math></p>
<p><b>ELECTRON NEUTRINO</b> DISCOVERED: 1956</p> <p>MATTER PARTICLE</p> <p>Mass: <math>&lt; 2 \cdot 10^{-6} \text{ MeV}/c^2</math> Electric Charge: 0 Strong Charges: - Weak Charge: <math>+\frac{1}{2}</math> Lifetime: undefined</p>	<p><b>MUON NEUTRINO</b> DISCOVERED: 1962</p> <p>MATTER PARTICLE</p> <p>Mass: <math>&lt; 2 \cdot 10^{-6} \text{ MeV}/c^2</math> Electric Charge: 0 Strong Charges: - Weak Charge: <math>+\frac{1}{2}</math> Lifetime: undefined</p>	<p><b>TAU NEUTRINO</b> DISCOVERED: 2000</p> <p>MATTER PARTICLE</p> <p>Mass: <math>&lt; 2 \cdot 10^{-6} \text{ MeV}/c^2</math> Electric Charge: 0 Strong Charges: - Weak Charge: <math>+\frac{1}{2}</math> Lifetime: undefined</p>

## Force Carriers

**GLUON**  
DISCOVERED: 1979

EXCHANGE PARTICLE

Mass: 0  
Electric Charge: 0  
Strong Charges: red, blue, green  
Weak Charge: + antired, antiblue, antigreen  
Lifetime: unlimited  
Range:  $10^{-16} \text{ m}$

**HIGGS BOSON**  
DISCOVERED: 2012

EXCHANGE PARTICLE

Mass:  $125 \cdot 10^3 \text{ MeV}/c^2$   
Electric Charge: 0  
Strong Charges: -  
Weak Charge:  $-\frac{1}{2}$   
Lifetime:  $2 \cdot 10^{-22} \text{ s}$

**PHOTON**  
DISCOVERED: 1905

EXCHANGE PARTICLE

Mass: 0  
Electric Charge: 0  
Strong Charges: -  
Weak Charge: 0  
Lifetime: unlimited  
Range: unlimited

**Z BOSON**  
DISCOVERED: 1983

EXCHANGE PARTICLE

Mass:  $912 \cdot 10^3 \text{ MeV}/c^2$   
Electric Charge: 0  
Strong Charges: -  
Weak Charge: 0  
Lifetime:  $3 \cdot 10^{-25} \text{ s}$   
Range:  $10^{-18} \text{ m}$

**W<sup>-</sup> BOSON**  
DISCOVERED: 1983

EXCHANGE PARTICLE

Mass:  $80.4 \cdot 10^3 \text{ MeV}/c^2$   
Electric Charge: -1  
Strong Charges: -  
Weak Charge: -1  
Lifetime:  $3 \cdot 10^{-25} \text{ s}$   
Range:  $10^{-18} \text{ m}$

**W<sup>+</sup> BOSON**  
DISCOVERED: 1983

EXCHANGE PARTICLE

Mass:  $80.4 \cdot 10^3 \text{ MeV}/c^2$   
Electric Charge: +1  
Strong Charges: -  
Weak Charge: +1  
Lifetime:  $3 \cdot 10^{-25} \text{ s}$   
Range:  $10^{-18} \text{ m}$