

# FUNDAMENTAL PARTICLES

Fundamental Particles are the smallest things scientists have discovered. So far, no one has been able to split them into smaller pieces. Everything is made of combinations of these particles

## FERMIONS

Fermions are particles that cannot exist together if they have identical properties.

### PARTICLES

#### Quarks there are 6 Flavors of Quarks:

Positive Electric Charge  
LESS MASS



Up (u)



Charm (c)

MORE MASS



Top (t)

Negative Electric Charge  
LESS MASS



Down (d)



Strange (s)

MORE MASS



Bottom (b)

#### Leptons there are 6 types of Leptons:

No Electric Charge



Electron-Neutrino (ν<sub>e</sub>)



Muon-Neutrino (ν<sub>μ</sub>)



Tau-Neutrino (ν<sub>τ</sub>)

Negative Electric Charge  
LESS MASS



Electron (e)



Muon (μ)



Tau (τ)

### ANTI-PARTICLES

#### Anti-quarks

Negative Electric Charge  
LESS MASS



Anti-up (ū)



Anti-charm (c̄)

MORE MASS



Anti-top (t̄)

Positive Electric Charge  
LESS MASS



Anti-down (d̄)



Anti-strange (s̄)

MORE MASS



Anti-bottom (b̄)

#### Anti-leptons

No Electric Charge



Anti-electron-Neutrino (ν̄<sub>e</sub>)



Anti-muon-Neutrino (ν̄<sub>μ</sub>)



Anti-tau-Neutrino (ν̄<sub>τ</sub>)

Positive Electric Charge  
LESS MASS



Positron (ē)



Anti-muon (μ̄)

MORE MASS



Anti-tau (τ̄)

## BOSONS

Bosons are particles that can group together even if they have exactly identical properties.

### Force Carrier Particles

Electromagnetic Force:



Photons

Weak Force:



W's



Z's

Strong Force:



Gluons



Higgs