

Topic 6A: Standard Model of Particle Physics

Skill 47:

The Universe Functions due to Four Fundamental Forces

- Strong Force: responsible for keeping the nucleus together. Causes attraction between nucleons (protons & neutrons) due to presence of quarks. Force carrier is known as the GLUON
- Electromagnetic Force: responsible for interactions between charged particles and magnetic materials. Causes like charges to repel & opposite charges to attract. Force carrier is known as the PHOTON
- Weak Force: responsible for radioactive decay (alpha, beta, gamma). Force carriers are W & Z
- Gravitational Force: Causes all masses to attract. unverified force carrier known as a graviton

Particles of the 4 forces are categorized as:

Quarks - particles that interact through strong force. They have fractional charge $\pm \frac{2}{3}$ or $\pm \frac{1}{3}$ so they must combine to form stable particles with a whole # or zero charge.

Examples

up top charm
down bottom strange

Leptons - Particles that do not experience the strong force

electron
muon
tau
neutrino

Bosons - Force carriers, transmit forces in space

Gluon, Photon, W, Z
Graviton

Hadrons - Particles made up of quarks

Baryon, Meson

Baryon - Particles made up of 3 quarks

Proton u u d, Neutron u d d

Meson - Particles made up of 1 quark & 1 antiquark

Anti-particles are identical to corresponding particles but have opposite charge. represented by line over top up = u anti up = $\bar{u}$

Under the appropriate circumstances particles & matching antiparticle annihilate each other $\rightarrow$ which means they convert to energy in the form of photons.

The most common particles in matter are the components of atoms

up quarks, down quarks & electrons

Proton u u d
Neutron u d d

electron e^-

The other particles are results of high energy events and typically short lived