

Astronomy 25: The Standard Model

*Quark matter fermions*¹

- 6 quarks: up, down, charm, strange, top, bottom
- 3-quark hadrons: baryons (p, n, etc.)

*Quark matter bosons*¹

- 2-quark hadrons: mesons

*Elementary leptons*¹

- Leptons: electrons, muons, tau, and three neutrinos

*Elementary bosons*²

- Photons (conveys the electromagnetic force)
- W^+ , W^- , Z boson (convey the weak interaction)
- Gluons (convey color/strong force)
- Gravitons (conveys gravity, not yet actually part of the Standard Model)
- Higgs bosons (a mechanism for generating mass)

*Three families (or generations) of particles*³

- Family 1 contains all the particles encountered in everyday matter: up and down quarks (so protons, neutrons), electron, electron neutrino
- Families 2, 3 include bizarre, unstable particles

Forces

- Electroweak (electromagnetic and weak)
- Strong force (a side-effect of the color force)
- Gravity (from gravitons, not yet incorporated into the theory)

¹Antimatter twins exist for all particles in this group.

²I think that all these particles constitute their own antiparticles.

³Additional particles, etc., such as axions, have been added to expand upon the Standard Model, and are not so well supported.