

The ultimate force in the universe: **Some thoughts about gravity.**

Four known forces:

Electromagnetism: James Clerk Maxwell (1831-1879) realized that electricity and magnetism were related and could be described by one set of equations. (light, chemical action also explained here)

Weak force: Involved in radioactive decay (nucleus of atoms). 1960's theory combined the weak and electromagnetism into the electroweak theory.

Strong force: Holds the nucleus of atoms together.

Gravity: Operates at great distances.

Gravity through the ages

Aristotle: Earth, water, fire, air. Earth and water fall 'down' to the center of the cosmos (geocentric or earth centered universe). The more earth or water in the object, the faster it is attracted to the center.

Galileo: Did experiments that showed the mass of an object doesn't affect how fast it falls.

Newton: Developed the 3 basic laws of motion, and equation for gravity:

$$\mathbf{F} = \frac{-\mathbf{G} \times \mathbf{M} \times \mathbf{m}}{\mathbf{r} \times \mathbf{r}}$$

Force is equal to a constant (G) times the masses of the two objects (M and m) divided by the distance squared (r x r).

Why do astronomers care about gravity?

Determines the fate of the universe (expand forever, or contract back in a "big crunch").
Responsible for formation of stars and solar systems (including our own about 5 billion years ago).

Determines the fate of stars when they die (white dwarfs, neutron star, or black hole).

Holds galaxies together.

Determines orbits of objects around each other.