Physics 1304

Physics

study of matter + energy and their behavior at fundamental level

- mechanics
- gravity
- electricity
- optics
- magnetism
- thermodynamics
- relativity, quantum mechanics
- *particle physics (our specialty)
- cosmology

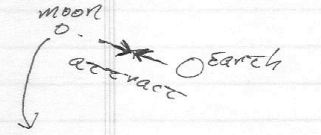
A very interesting field (+ broad!)

- at the foundation of modern technology

In "mechanics" you've studied motion of massive bodies. In the context of forces, the gravitational attraction between 2 masses is

$$F = -G \frac{m_1 m_2}{r^2}$$

Newton's Law of Gravitation



- a force between masses, - a property of matter

Classically, we think of action-at-a-distance. (nothing touching)

There are other phenomena that are not described by gravity.

Electric Force $F = k \frac{q_1 q_2}{r^2}$ (charges)

Overview

Electrical phenom. → electronics (R, I, C, L)

→ fundamental parameter in matter: CHARGE

Charged matter exerts a force on other charged matter

Magnetic phenom.

→ another aspect of physics of matter

→ inherently related to electric charge

Electromagnetism → light

Optical phenom.

→ study of light, a manifestation of EM

Relativity ← MODERN CLASSICAL → physics

Quantum Mechanics

E+M

→ foundation for most of modern science + technology

- → electronics
- → optics
- → semiconductors
- → ~~nuclear~~

*Chemistry

→ complex systems of atoms interacting via E+M

*Biology

- → DNA, genetic material
- → ions thru cell membranes
- → neural signals ~~heartbeat~~

*Engineering

→ friction → electron interactions for nearby materials

- → tensile strength
- → computer storage
- → ~~motor~~ generators

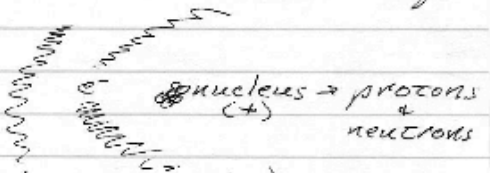
Charge Quantization

Originally, "electricity" thought of as a fluid. Two kinds observed, given names 'positive' & 'negative' by B. Franklin.

@ fundamental level, matter consists of atoms.

	Q	m
p	+e	1.7×10^{-27} kg
n	0	"
e	-e	9.1×10^{-31} kg

(much lighter)



- composed of electrons (e^-)
  - in "clouds" or "shells" of probability around nucleus
- also protons (p) & neutrons (n) in nucleus

→ electrons easiest to move since light ∴ electricity made up of electrons

→ so electricity is discrete property

$$Q = Ne$$

Q: total charge; e: electron charge