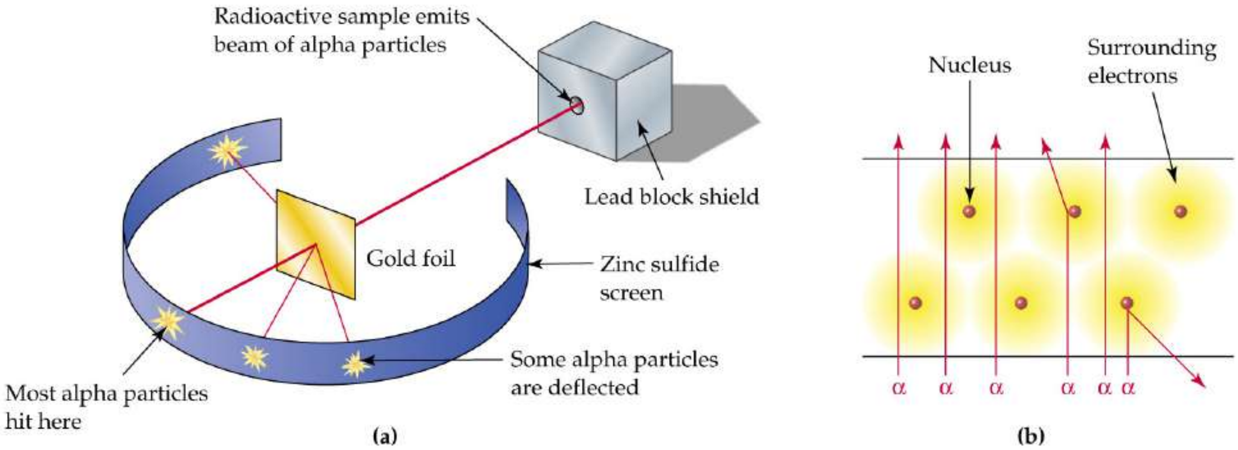
1909 Ernst Rutherford
Gold Foil Experiment:

http://www.mhhe.com/physsci/chemistry/essentialchemistry/flash/ruther14.swf



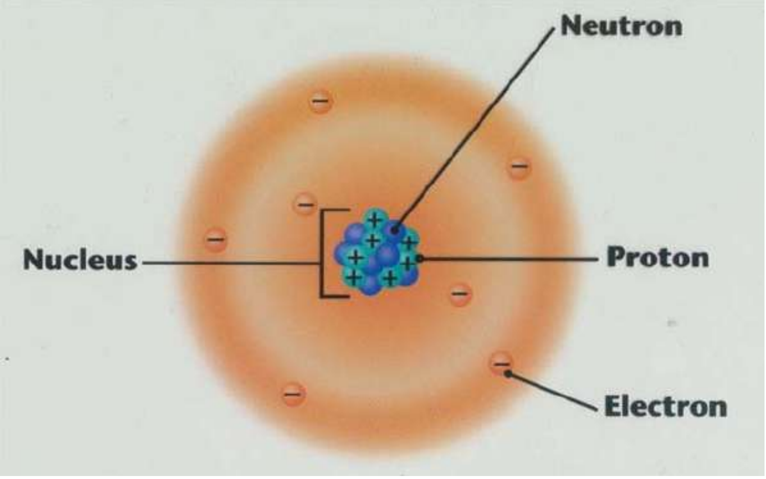
Conclusions:

- atom is mostly empty space
- a few (very few) "+" α particles were deflected ∴ atom must have a solid "+" center, the nucleus
- electrons on the outside account for the atoms' neutrality

1911-Millikan oil drop experiment:

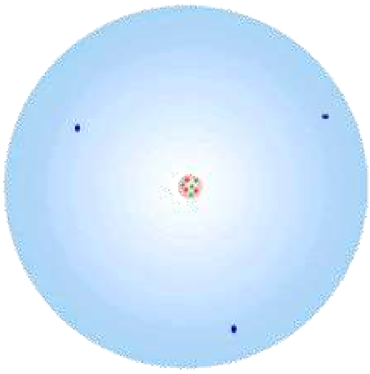
- measured charge and mass of an e^-
- charge = 1.6×10^{-19} c (coulomb)
- m = 9.1×10^{-28} g

1932 -James Chadwick-discovered neutrons (n^o)



Particle	Relative Mass	Charge
Proton	1	+1
Neutron	1	0
Electron	1/1840	-1

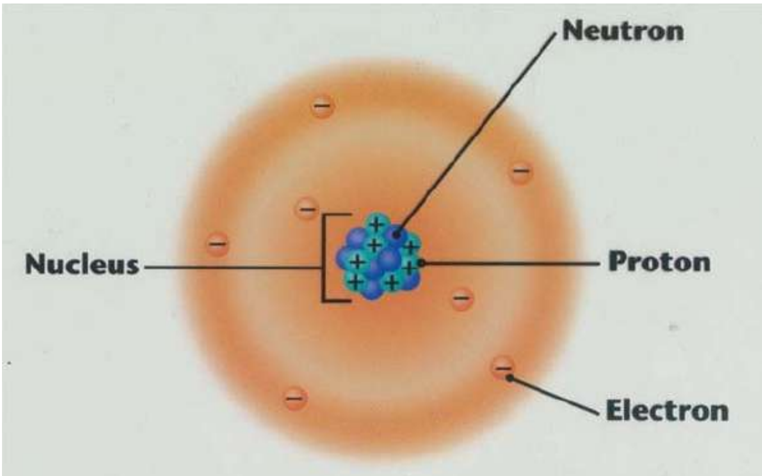
Dual Nature of Light and Electrons



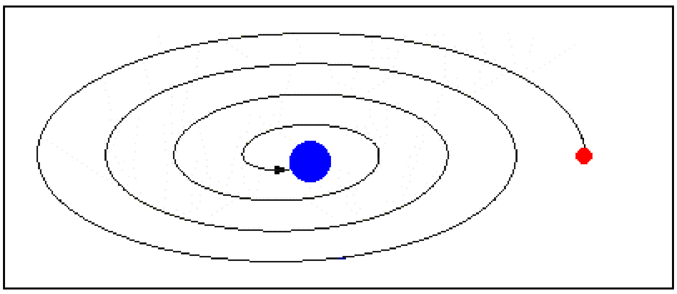
Rutherford Model of the atom

The problem with Rutherford's model:
Why don't e^- fall towards the p^+ nucleus?

Rutherford's explanation- the motion of e^- keep them circling just like the planets

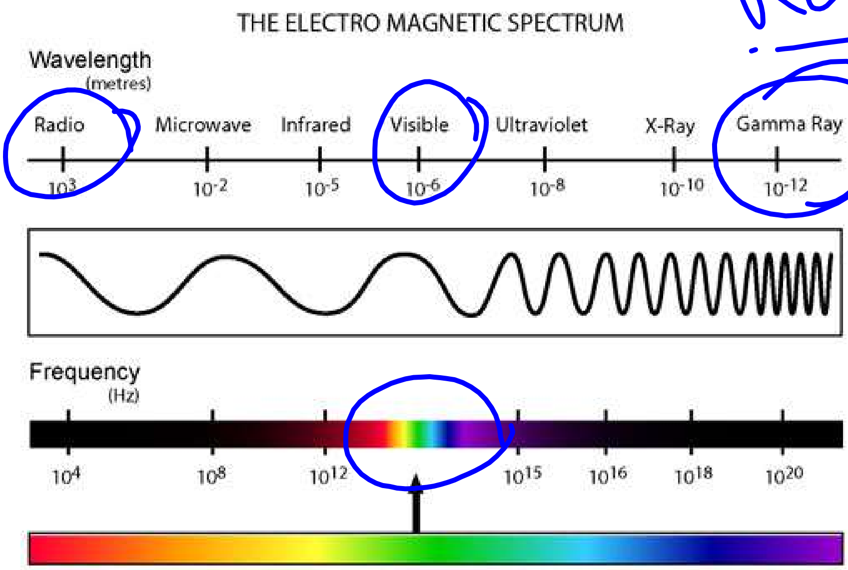


BUT-Moving charges release energy in the form of electromagnetic radiation; therefore eventually atoms should collapse


The electron should fall on the nucleus.

Electromagnetic Radiation

ROYGBIV



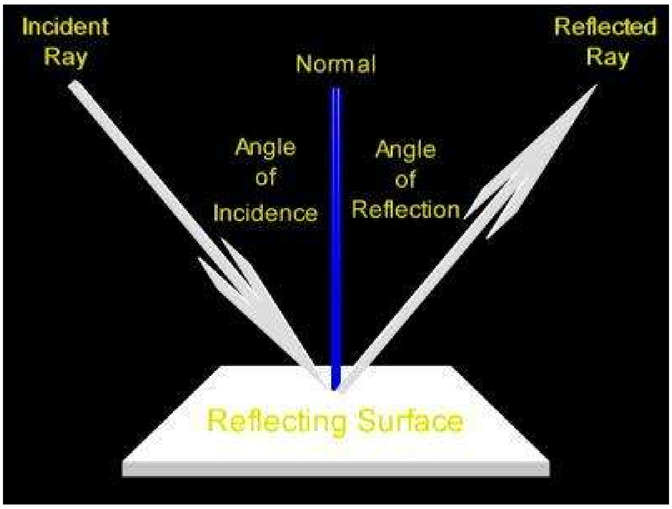
Energy is transmitted, but how?

a) waves

b) particles

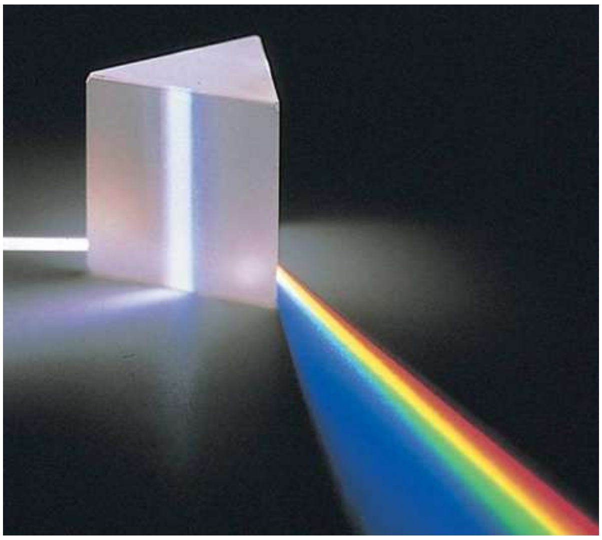
photons

Light as waves:
Reflection:

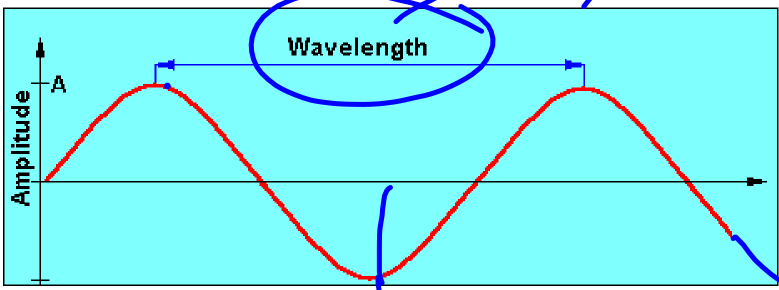


http://id.mind.net/~zona/mstm/physics/light/rayOptics/reflection/reflection1.html

Refraction:



Light waves:



- Wavelength or λ: distance between 2 neighboring peaks or troughs

  (meters/wave)

- Frequency or f: number of peaks that pass through a point each second

  f = cycles (or waves)/sec (cps) or Hertz (Hz)

  http://id.mind.net/~zona/mstm/physics/waves/partsOfAWave/waveParts.htm

- v(wave velocity) is the distance a peak moves through a unit of time and = f x λ

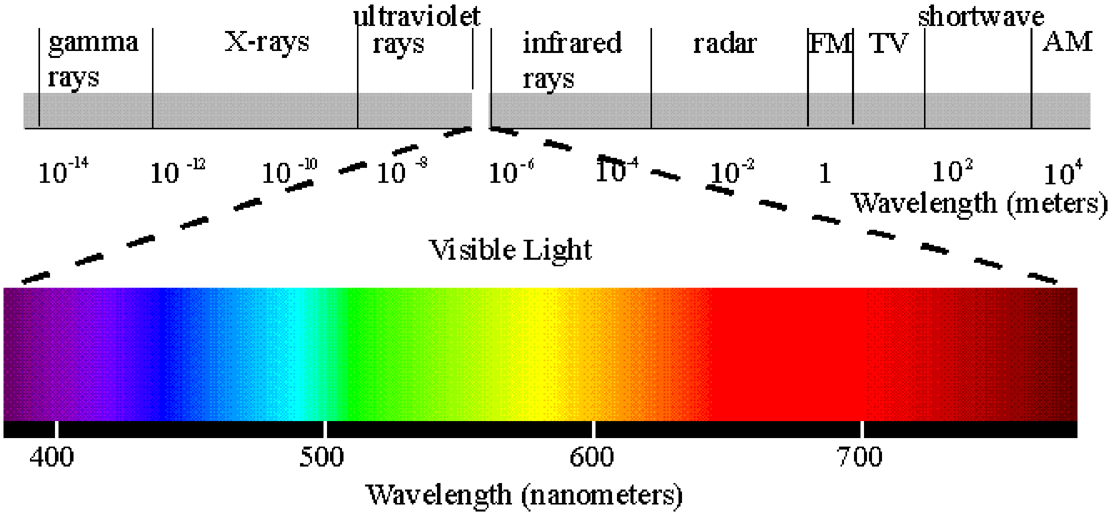
  v = (meters/wave)x (waves/sec) = m/s

- for all light v = 3 x 10^8 m/s = c (speed of light)

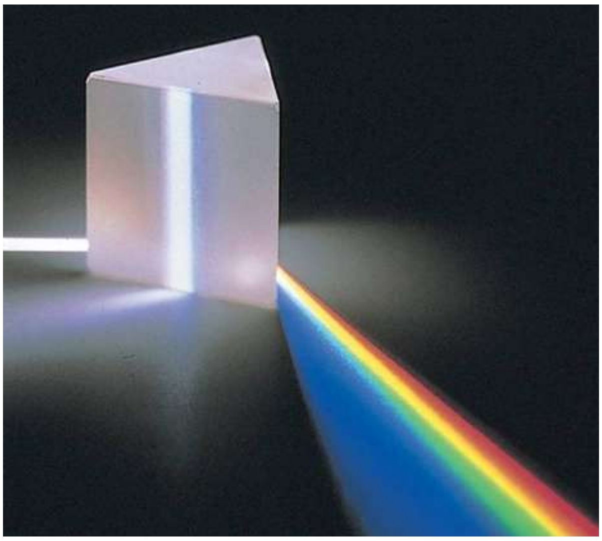
- So if green light: λ = 5 x 10^{-7}m

  f = ? cps or Hz 6 x 10^{14}

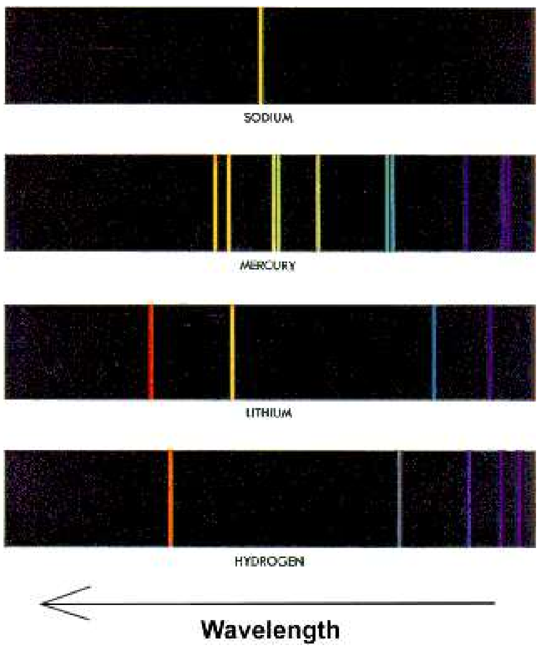
Each color has is own f and λ,



Rainbow spectrum can be obtained from white light



But each individual element, when heated, will only give off light of certain λ and f called a bright line spectrum:



But light was also shown to behave like particles:

Photons:

- packets of energy (quanta)
- each packet contains different amounts of energy
- Max Planck developed a way to measure the energy of a photon:

$E(\text{energy}) = f \times h$

$h = \text{Planck's constant} = 6.6 \times 10^{-34}$ J/Hz

So how much energy is there is a photon of green light?

$E = h \times f$; $f = 6 \times 10^{14}$ Hz

$E = 6.6 \times 10^{-34}$ J/Hz $\times 6 \times 10^{14}$ Hz $=$
3.96×10^{-19} J

Practice Problems:

1. Calculate the wavelength (in meters) of radiation with a frequency of 8.0×10^{14} hertz (Hz).

2. Calculate the energy of a photon of radiation with a frequency of 8.5×10^{14} hertz (Hz).

Homework:

1.Finish Practice Problems

2. Read textbook problems 323-327

3. Do Homework sheet