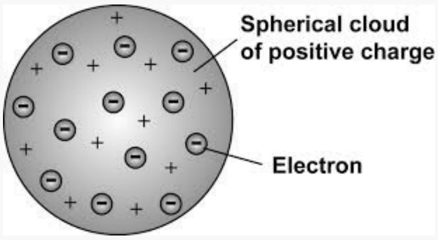
Nuclear Physics Cheat Sheet

by Bendash13 (Bendash13) via cheatography.com/24992/cs/7489/

J.J Thompson's Model



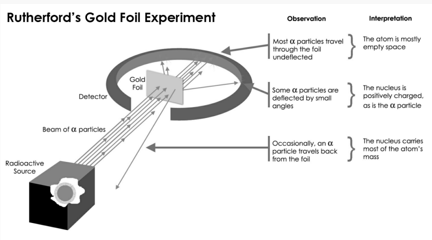
Rutherford's Gold Foil Experiment Explained

In Rutherford's gold foil experiment an Alpha particle emitter is placed inside a vacuum chamber pointing at a leaf of gold foil. Around the gold foil is a circular sheet of Zinc Sulfide (ZnS). The Zinc Sulfide emits Photons (light) when it absorbs Alpha particles.

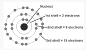
If Thompson's model of the atom was correct then the Alpha particles would have passed through largely unaffected with possibly some slight deflection

But when Rutherford ran his experiment 98% passed straight through, just under 2% deflected at a large angle and less than 1% were reflected straight back at the emitter.

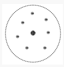
Rutherford's Gold Foil Experiment



Neils Bohr's model



Rutherford's model



Atomic Models

Aristotle	Matter infinitely divisible
Democratis	Matter is made up of smaller parts, new matter is made up of small Lego like blocks of indivisable elements
Dalton	Matter is divisible to the extreme but not infinitely divisible.
J.J. Thompson	Uniformly spaced electrons in positively charged cloud of matter
Ernest Rutherford	Most of the atom is empty space with a dense nucleus.
Neils Bohr	Electrons exist in discrete and fixed energy shells surrounding the nucleus

Types of Radiation

Alpha particles	Helium nuclei, highly charged (+2), heavy, slow, travels few cm in air, stopped by a sheet of paper
Beta particles	Electron, -1 charge, light (1/1836 atomic mass), fast (90% light speed), stopped by 5mm of metal, travels 30cm in air
Gamma Rays	Electromagnetic radiation, shortwave length, high frequency, travels at lightspeed, can penetrate several cm of lead

Isotopes

Isotopes are atoms with varying numbers of neutrons in the nucleus. The number of protons and electrons remain the same.

Half-Life

The Half-Life of a radioactive isotope is the length of time it takes for the number of atoms of that isotope to have decreased by half, **this does not mean half the mass or volume**

Half-Life Equations

$$\text{elapsed time} = \text{half-life} \times \frac{\log\left(\frac{\text{beginning amount}}{\text{ending amount}}\right)}{\log 2}$$

$$\text{half-life} = \frac{\text{elapsed time} \times \log 2}{\log\left[\frac{\text{Beginning Amount}}{\text{Ending Amount}}\right]}$$

$$\text{Beginning Amount} = \text{Ending Amount} \times 2^{n}$$

where 'n' $= \frac{\text{elapsed time}}{\text{half-life}}$ OR 'n' = number of half-lives

$$\text{Ending Amount} = \frac{\text{Beginning Amount}}{2^{n}}$$

Nuclear Equation Rules

Mass number must be equal on both sides of the equation

Charge must be equal on both sides of the equation

Nuclear Fission

Fission is what happens when a large unstable nucleus absorbs a neutron, then splits in half

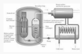
Uranium 235 fission equation

$${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{90}_{36}Kr + {}^{143}_{56}Ba + {}^{1}_{0}n + {}^{1}_{0}n + {}^{1}_{0}n$$

Nuclear Fission Reactor

Fuel Rods	Fuel rods are usually Uranium 238 enriched with 3% Uranium 235
Control Rods	Control rods are used to control the fission rate (usually made of Silver, Iridium, Cobalt, Cadmium or Boron)
Coolant	The Coolant carries energy to the steam generator. (Can be any liquid but usually Water or molten metal

Nuclear Reactor Diagram (Fission)



Nuclear Fusion

Nuclear Fusion is when two small nuclei fuse to form a larger nucleus.

Nuclear Fusion Equation

$${}^{1}_{1}H + {}^{1}_{1}H \rightarrow {}^{2}_{1}H + {}^{0}_{1}\beta^{+} + \nu$$ (nutrino)

$${}^{2}_{1}H + {}^{1}_{1}H \rightarrow {}^{3}_{2}He + \gamma$$

$${}^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + 2\,{}^{1}_{1}H$$

$$4\,{}^{1}_{1}H \rightarrow {}^{4}_{2}He + 2\,{}^{0}_{1}\beta^{+} + 2\gamma + 2\nu$$ Overall reaction

Theory of Special Relativity

Einsteins theory of special relativity (E=MC^2) allows us to calculate the energy released in a nuclear reactor

Radiation Badges