PHYSICS
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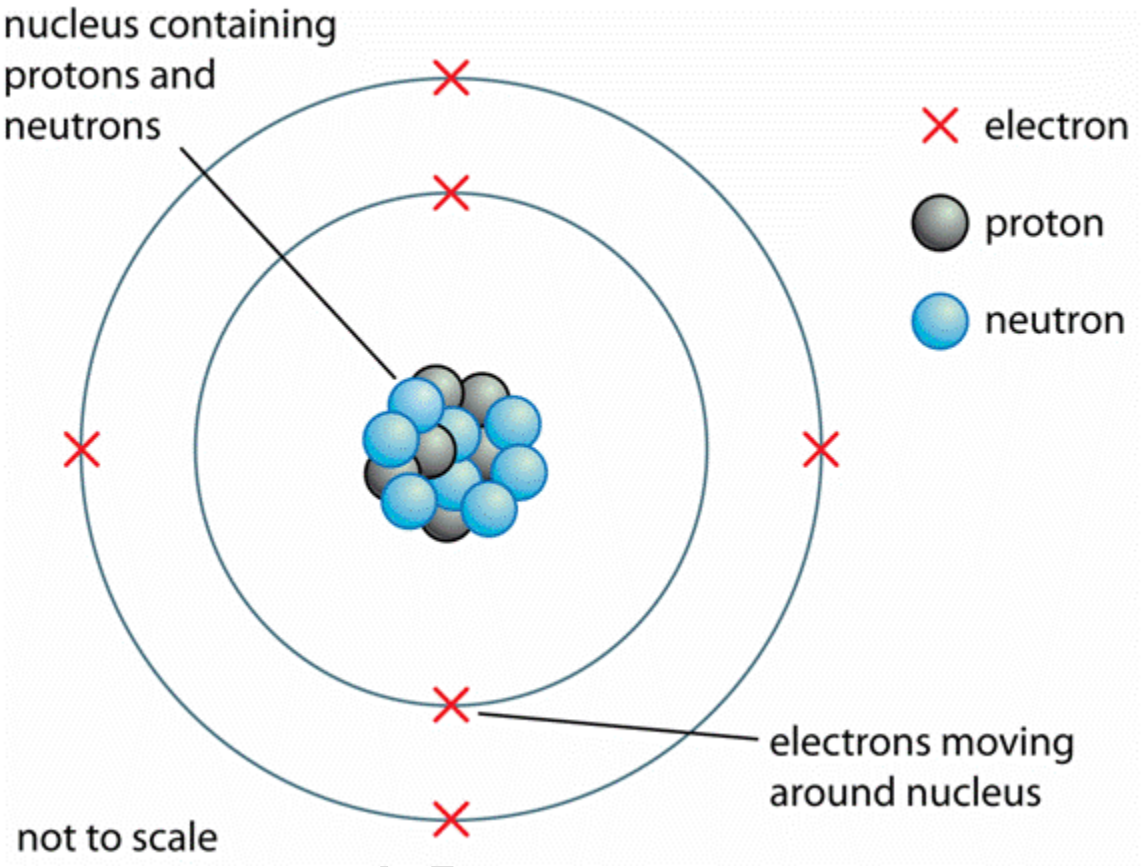
PHYSICS OF THE ATOM

The atom is the smallest basic unit of an element which possesses the properties of the element.

Structure of the Atom



The term valent means outermost, therefore only the electrons on the outermost shell are called valent.

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Notation

$${}^{b}_{a}X^{c}_{d}$$

X – element symbol

a – atomic number (number of protons

b – mass number (sum of protons and neutrons)

c – oxidation number (charge)

d – number of atoms in a molecule

The Subatomic Particles

These are the particles that make up the atom:

1. Proton
2. Neutron
3. Electron

Subatomic Particle	Relative Mass	Relative Charge	Location
Proton	1	+1	Intra nuclear
Neutron	1	0	Intra nuclear
Electron	$1/1840$	-1	Extra nuclear

Intra Nuclear – Inside the nucleus

Extra Nuclear – Outside the nucleus

The term relative mass means compared to.

Relative mass for subatomic particles means compared to $1/12$ the mass of a 12_C nucleus.

Relative charge means compared to the charge of a hydrogen nucleus (a proton).

Atoms are naturally neutral since the number of protons is equal to the number of electrons and hence the charges balance of.

When atoms lose or gain electrons, they become charged. Loss of electrons result in a positive charge and gain of electrons results in a negative charge.

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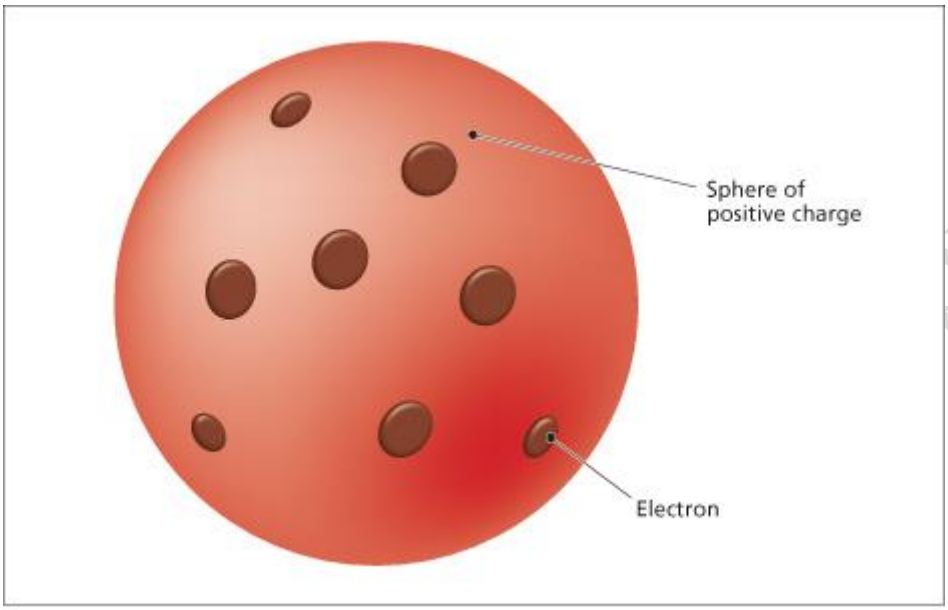
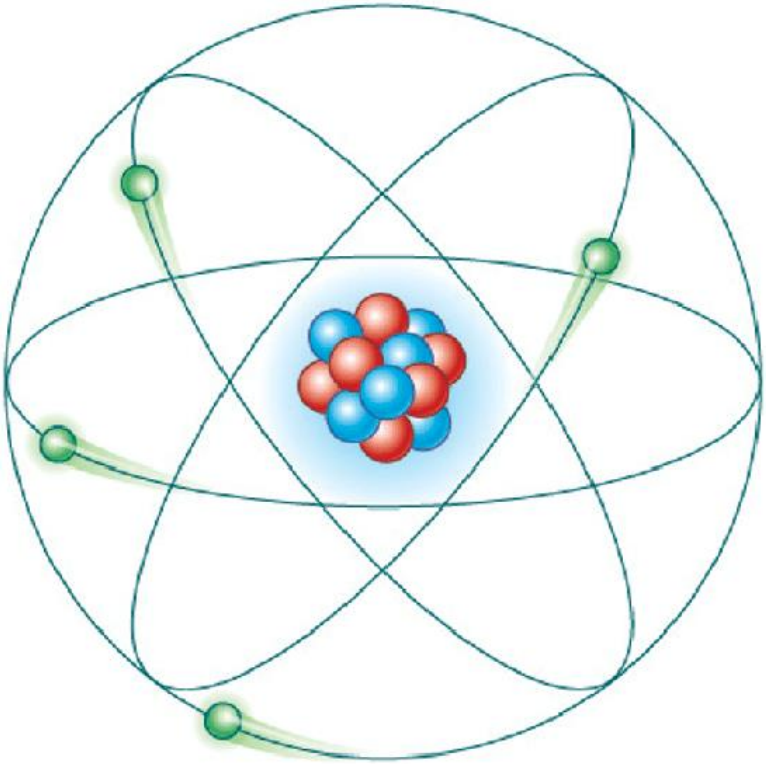
1. 1902 – Thompson's 'Plum Pudding' Atom



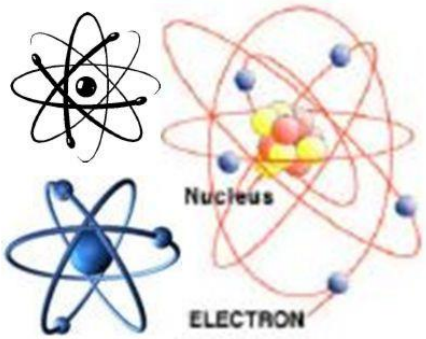
2. 1913 – Rutherford-Bohr Model: Electrons orbit a nucleus like planets orbiting the sun.

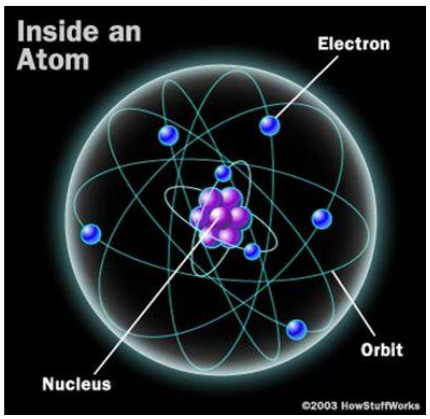


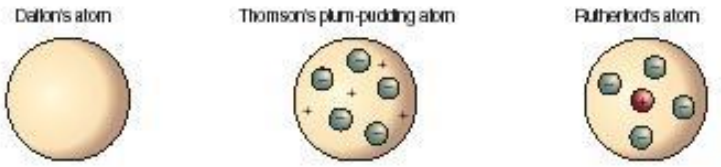
3. Today

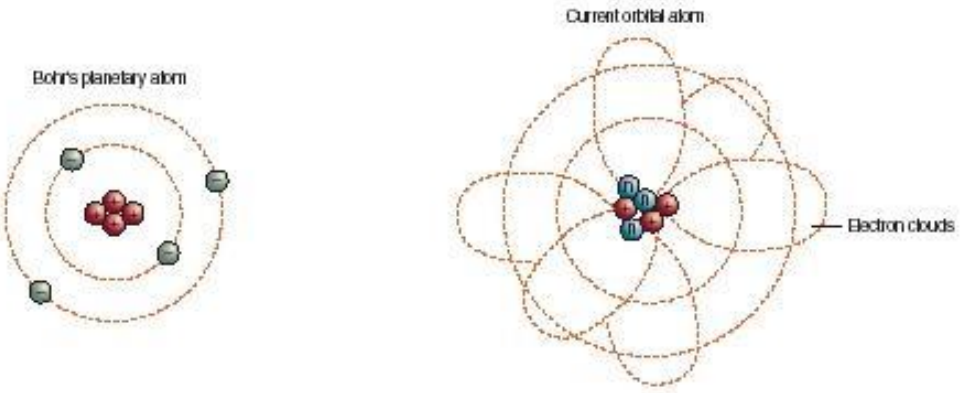
Modern Model

- Electron Cloud Model ~ 1920's to present
  - Electrons form a negatively charged cloud around the nucleus.
  - It is impossible to determine exactly where an electron is at any given time. (probability instead)
  - Higher probability of electrons near nucleus.









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Year	**Event**
Before 1897	*Atoms were thought to be small visible particles*
1897	*Joseph John Thompson provided evidence that the cathode rays may come from all elements and that being particles much smaller than atoms are common constituency of all atoms*
1902 – 1907	*Lord Kelvin and J. J. Thompson independently suggested a plum pudding atom model. In 1906 Earnest Rutherford observed alpha particles passing through a thin sheet of mica without making holes in it. Alpha particles could pass through the atoms themselves*
1911	*Geiger-Marsden fired alpha particles through gold foil and found evidence for the nuclear model of the atom as proposed by Rutherford*
1913	*Niels Bohr found the link between atomic spectra quantum theory and Rutherford's nuclear model of the atom. Bohr's new model had electrons in stable orbits around the nucleus, like planets around the sun*
1932	*J. Chadwick identified the neutron as a neutral particle found in the nucleus of atoms along with the protons*
Today	*There are now many complicated models involving new theories and particles but we try to picture the atom with a very small, dense nucleus surrounded by a cloud of negative electrons. The position of an electron cannot be precisely pinpointed and it is thought to behave as a wave as will a particle.*

"The analogy to an atom is a size of a pea at the centre of a football field, where the pea represents the nucleus of the atom and the dust or the stands represents the electrons."

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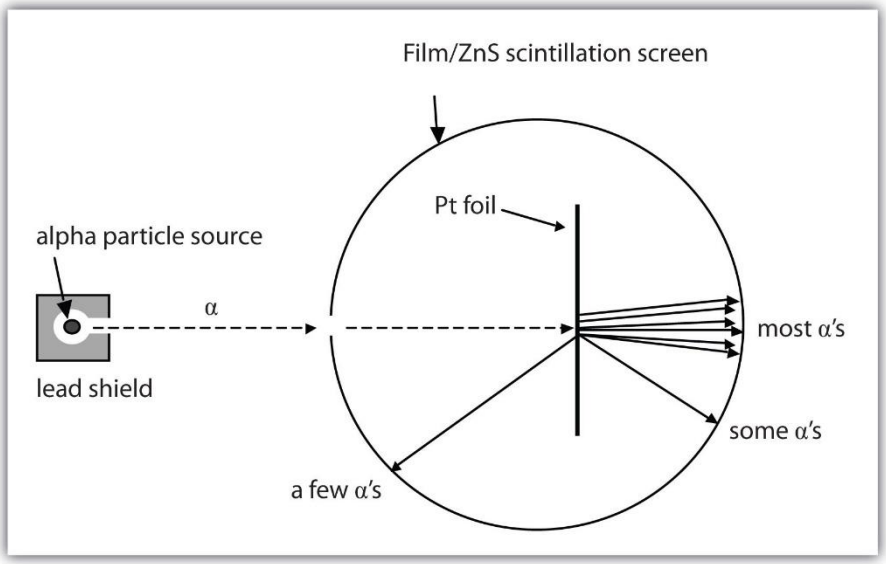
THE GEIGER-MARSDEN EXPERIMENT



Geiger and Marsden were two assistants of Rutherford. Rutherford had demonstrated that alpha particles were able to pass through solid substances without creating holes. In the Geiger-Marsden experiment, tin metal foils were bombarded with alpha particles. The number and the pathway were observed.

Findings:

1. Most of the alpha particles passed straight through.
2. Some of the alpha particles were deflected to varied degrees.
3. A few alpha particles bounced right back to its source even without touching the nucleus of the atom.

Conclusions Drawn:

1. Since most of the alpha particles pass straight through the foil, it indicates that most of the atom is nothing but free or empty space.
2. Since alpha particles bounce back to its source even without striking the nucleus, this indicates that alpha particles were repelled, ie, the nucleus was positively charged.
3. Since the atom is neutral then there exists separate negative charges.
4. The deflected alpha particles had greater degrees of deflection, the closer they were to the nucleus.

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Isotopes

An isotope are atoms with the same proton number but different number of neutrons (same atomic number but different mass number).

Ex.	$^{35}_{17}X$	$^{34}_{17}X$
	P = 17	P = 17
	N = 18	N = 17

It can be seen for the atom X, the atomic number is the same however the mass number is different and therefore are isotopes of the element X.

Examples of Isotopes:

1. Radioactive carbon
2. Chlorine