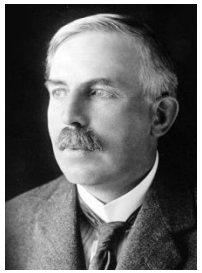
Atoms

Rutherford's α particle – gold foil experiment

J J Thomson

discovered e/m of electron

Nobel Prize in Physics in 1906 for his work on the discovery of the electron and investigations into the electrical conductivity of gases.



Ernst Rutherford

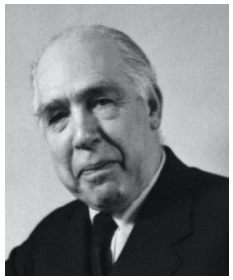
A student of J J Thomson

He proposed model of atom and an experiment to verify it

Nobel Prize in Chemistry in 1908 for his investigations into the disintegration of the elements and the chemistry of radioactive substances

Geiger & Marsden

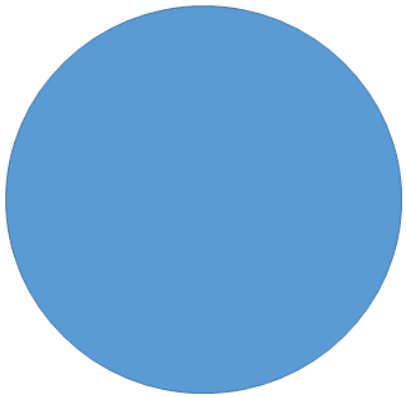
Carried out the α particle gold foil experiment



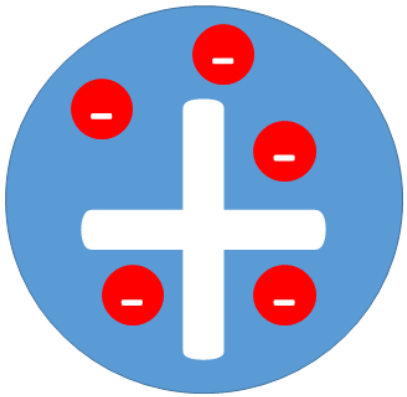
Neils Bohr

obtained structure of atom and energy levels based on some postulates

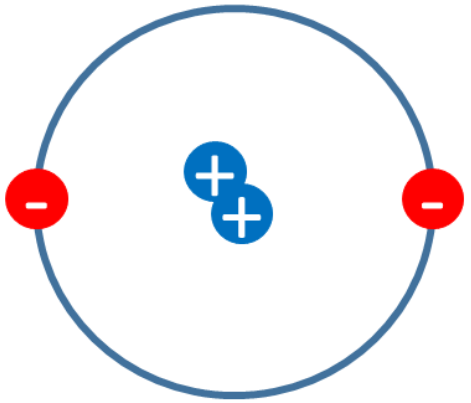
Competing (and conflicting) models of atom



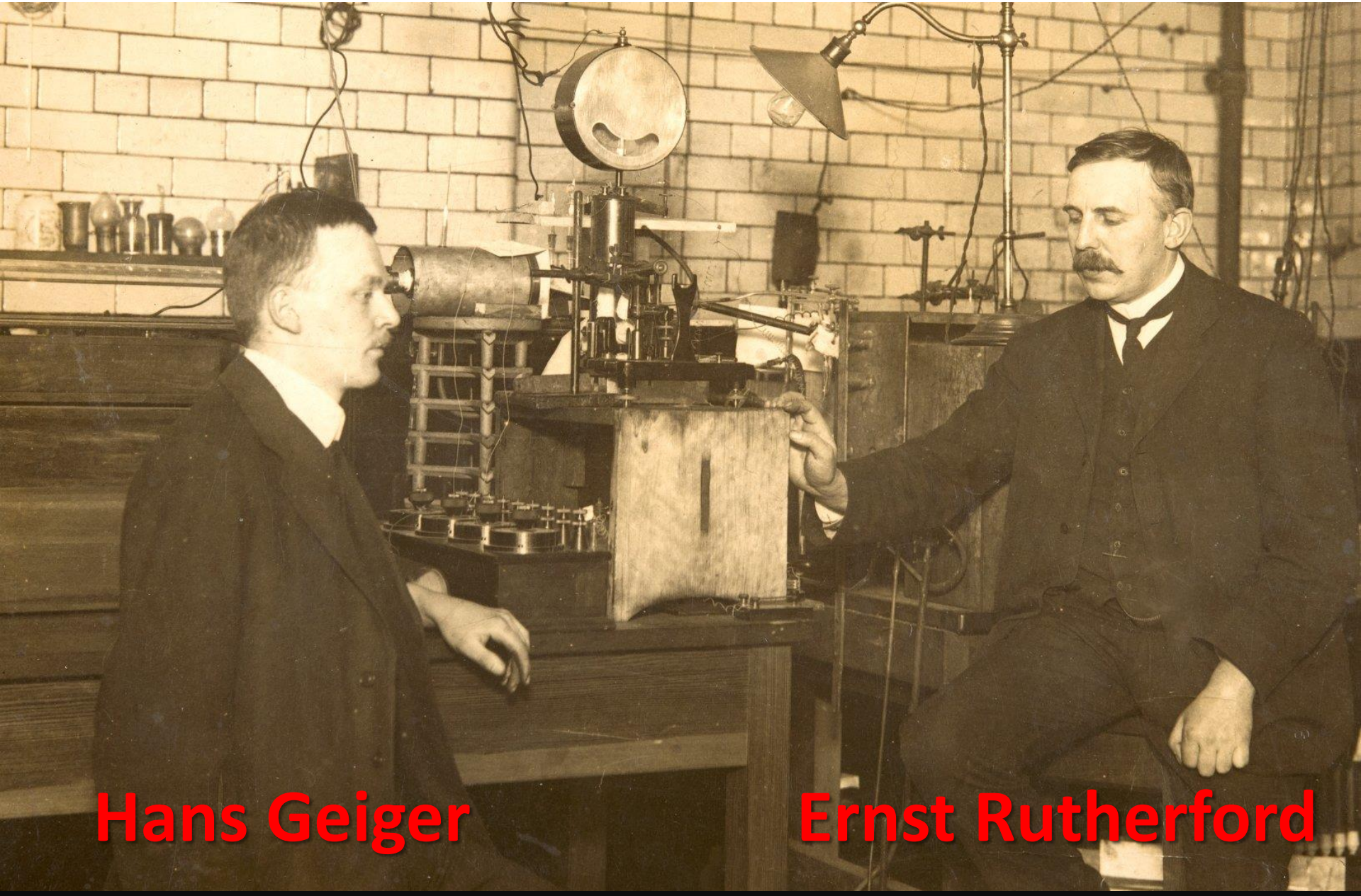
John Dalton (1803):
Atoms are tiny, hard spheres that cannot be split up.



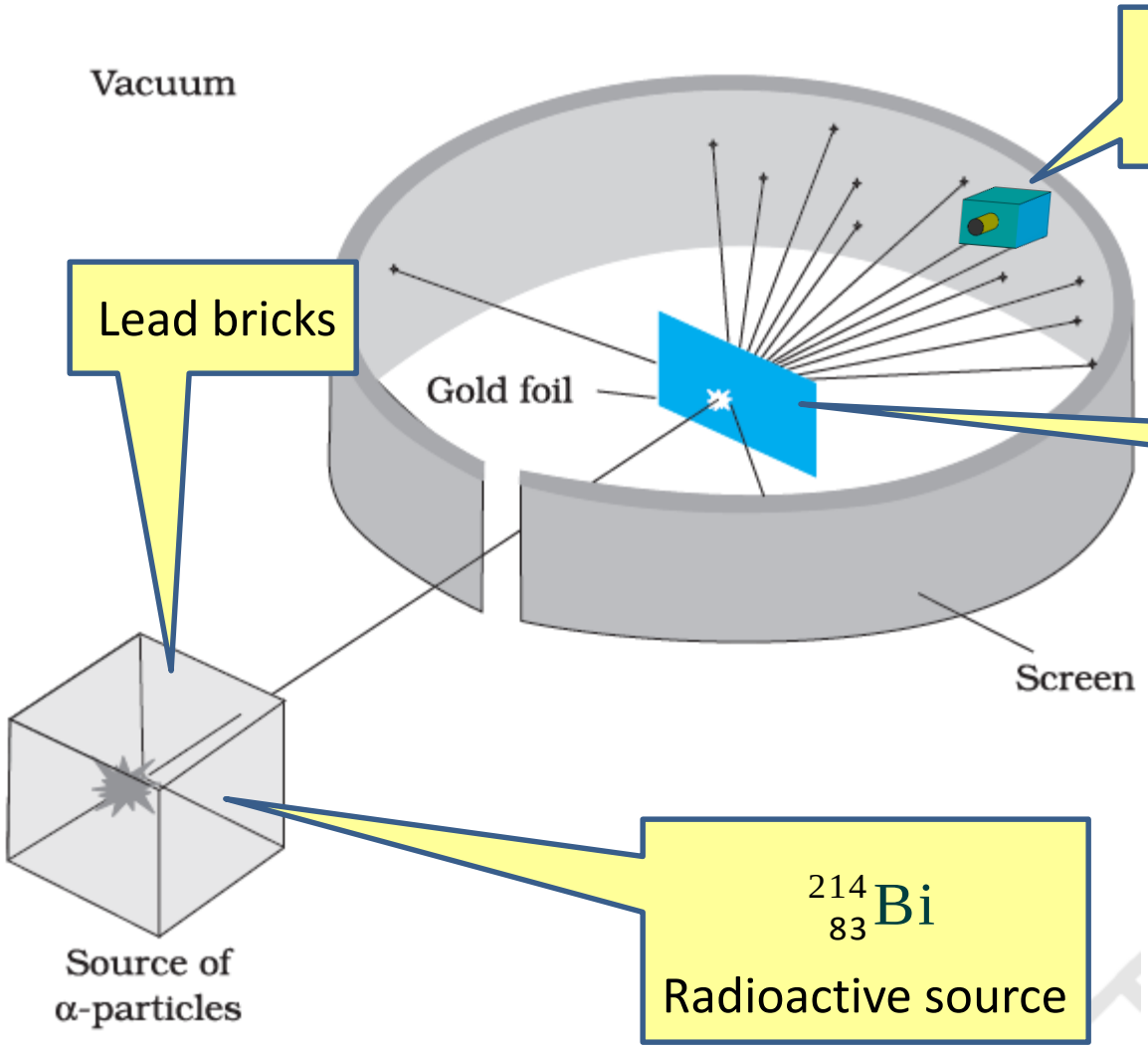
J.J. Thomson (1897):
Electrons are distributed inside a positive mass like raising in a plum pudding.

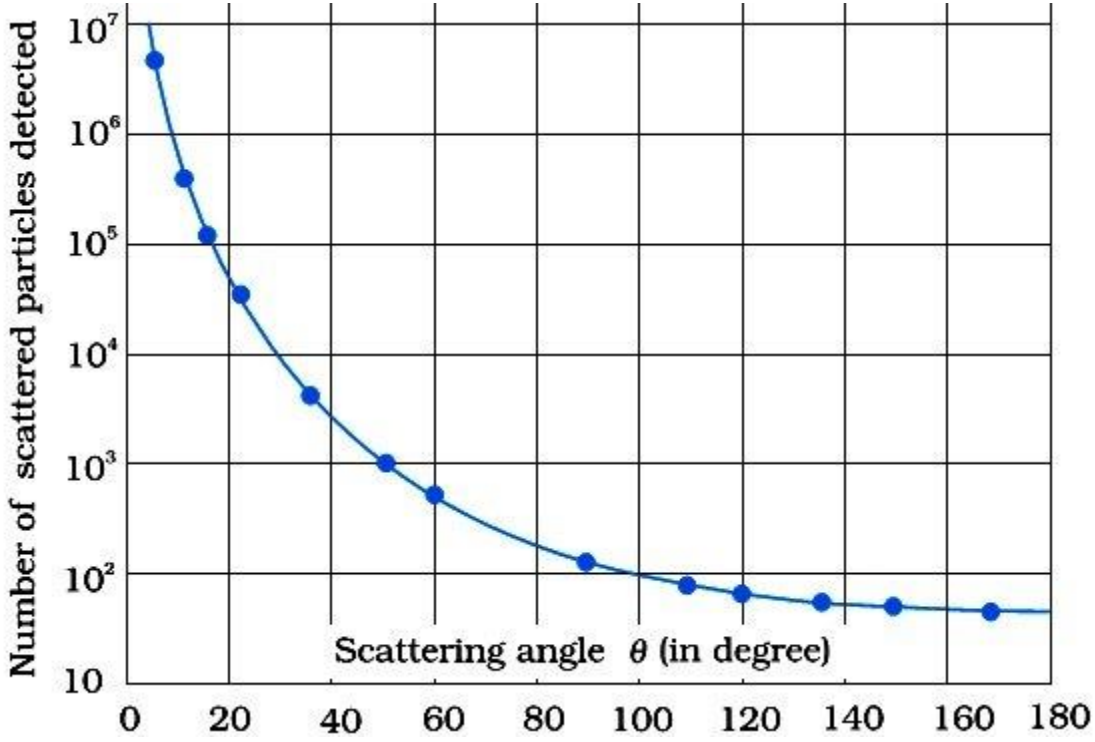


Ernest Rutherford (1909):
Most of the atom's mass is inside the nucleus. Electrons circle the nucleus. Most of the atom is empty space.


Hans Geiger
Ernst Rutherford

α particle - gold foil experiment





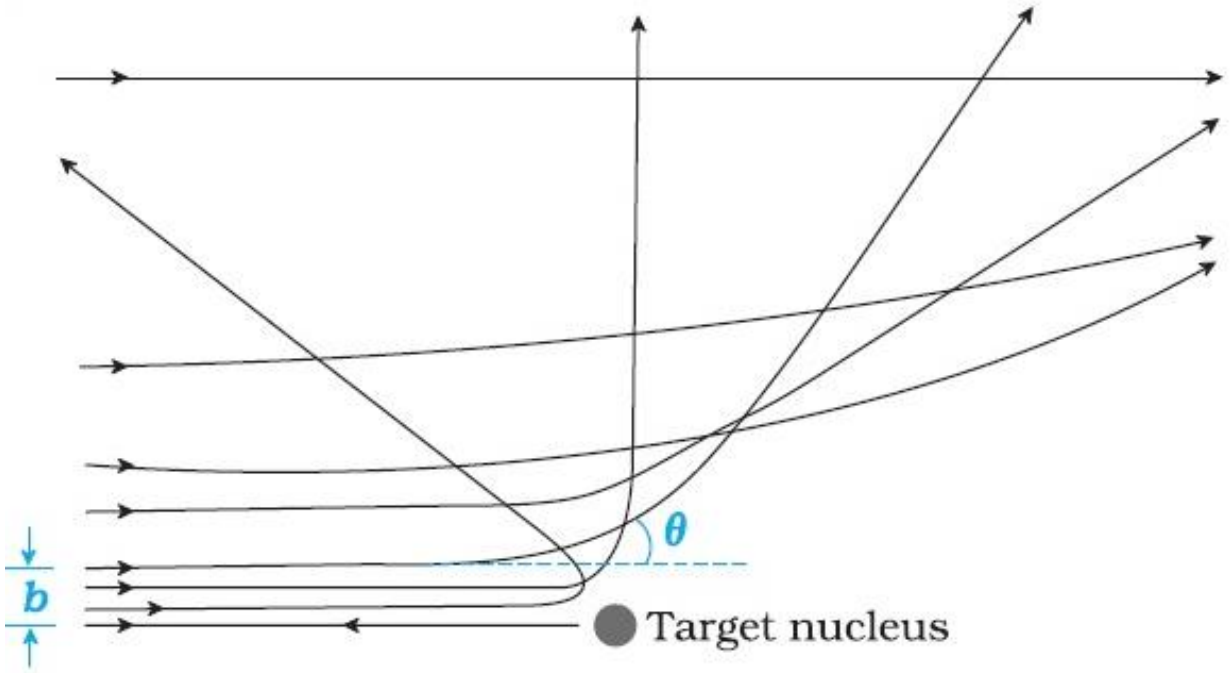
Observations

- Most of the α particles pass through the foil
- A small fraction of α particles undergo complete reversal of path
- There is no "loss" of alpha particles

Inferences

- Most of the space is empty
- All positive charge and almost all of the mass is concentrated in a very small space (called nucleus)
- Negative charge should be distributed in a very large space when compared to the nucleus.

Impact parameter (b) is the perpendicular distance of closest approach of alpha particle if it was not deflected by the nucleus i.e. the perpendicular distance of the initial velocity vector of α-particle from the centre of the nucleus.



Scattering angle (θ) : is the angle between the initial path of the alpha particle approaching the nucleus and the final path as it moves away after colliding with the nucleus.

As the impact parameter increases the scattering angle decreases. This is because the alpha particle passes from a larger distance from the nucleus and is therefore less deflected by the nucleus.

Click here for simulation

Thomson's atomic model

An atom is spherical in shape. Negatively charged electrons are "embedded" in a positively charged "jelly". An atom is electrically neutral as the total positive charge is equal to the total negative charge.

Thomson's atomic model failed to explain

(a) Stability of atom
(b) Observations from scattering experiment of Rutherford
(c) Spectrum of light emitted by the atom

Rutherford's atomic model

An atom has a tiny, dense, positively charged core called a nucleus. Almost all the mass is concentrated at the core (also called the nucleus). Negative particles (called electrons) revolve around the nucleus.

Drawbacks of Rutherford's atomic model

(a) Stability of atom as a revolving (accelerated) electron should continuously radiate energy and hence collapse into the nucleus
(b) Spectrum of atom was found to be discrete