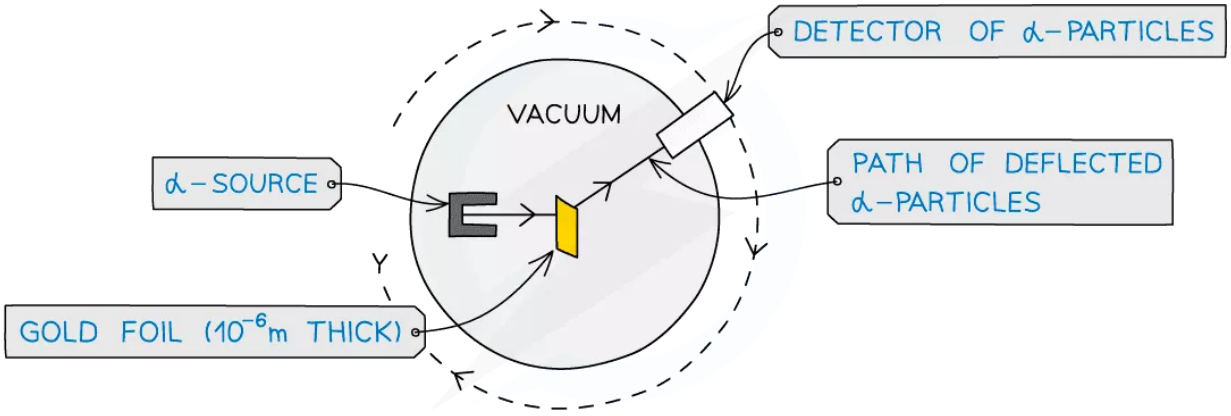
α-Scattering

Evidence for the structure of the atom was discovered by Ernest Rutherford in the beginning of the 20th century from the study of **α-particle scattering.**

The experimental setup consists of alpha particles fired at thin gold foil and a detector on the other side to detect how many particles deflected at different angles



- **Results of the experiment:**
  - Most particles pass straight through
  - Some are scattered appreciably
  - Very few – 1 in 8,000 – suffered deflections > 90
- **Conclusion:**
  - All mass and charge concentrated in the center of atom ∴ nucleus is small and very dense
  - Nucleus is positively charged as α-particles are repelled/deflected

The Atom

Nucleon number: Total number of protons and neutrons present in an atom.

Proton/atomic number: Total number of protons (+ve charge particles).

Isotope: Atoms of the same element with a different number of neutrons but the same number of protons.

Radiations

	α- particle	β-particle		γ-ray
		β^-	β^+	
Identity	Helium nucleus	Fast-moving electron/positron		Electro-magnetic
Symbol	${}^{4}_{2}He$	${}^{0}_{-1}e$	${}^{0}_{+1}e$	γ
Charge	2	-1	1	0
Relative Mass	4	$\frac{1}{1840}$		0
Speed	Slow (5% of c)	Fast (90% of c)		v of Light (c) ($3 \times 10^8\ ms^{-1}$)
Energy	Discrete	Varying		
Stopped by	Paper	Few mm of aluminum		Few cm of lead
Ionizing power	High	Low		Very Low
Effect of Magnetic field	Deflected slightly	Deflected greater		Undeflected
Effect of Electric field	Attracted to -ve	Attracted to		
		+ve	-ve	

Types of Decay

α-decay: loses a helium proton

β^--decay: neutron turns into a proton and an electron & electron antineutrino are emitted

β^+-decay: Proton turns into a neutron and a positron & electron neutrino are emitted.

γ-decay: A nucleus changes from a higher energy state to a lower energy state through the emission of electromagnetic radiation (photons).

Fundamental Particles

Fundamental Particle: A particle that cannot be split up into anything smaller.

- Electron is a fundamental particle but protons and neutrons are not .
- Protons and neutrons are made up of different combinations of smaller particles called quarks.

Table of Quarks:

Quark	Symbol	Charge
Up	u	$+2/3$
Down	d	$-1/3$
Strange	s	$-1/3$

- All particles have their corresponding **antiparticle**

Antiquark	Symbol	Charge
Anti-Up	$\bar{u}$	$-2/3$
Anti-Down	$\bar{d}$	$+1/3$
Anti-Strange	$\bar{s}$	$+1/3$

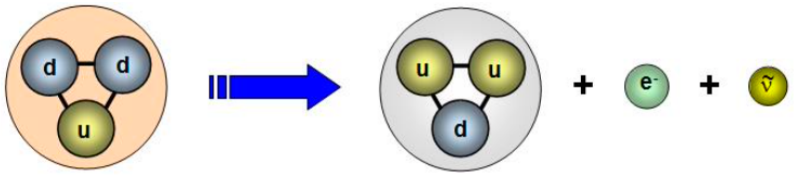
Quark Models of Proton and Neutron:

Proton	Neutron
2 Up quark & 1 Down quark $+\frac{2}{3}+\frac{2}{3}-\frac{1}{3}=+1$	**1 Up quark & 2 Down quark** $+\frac{2}{3}-\frac{1}{3}-\frac{1}{3}=0$

Quark Nature of β-decay

- **Conventional model of β-decay:**
  - **β^--decay:** $n \rightarrow p + \beta^- + \bar{\upsilon}$
  - **β^+-decay:** $p \rightarrow n + \beta^+ + \upsilon$

- **Quark model of β-decay:**
  - **β^--decay:**



  - **β^+-decay:**