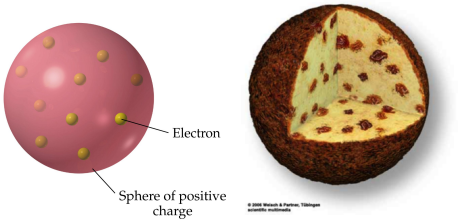
Radioactivity

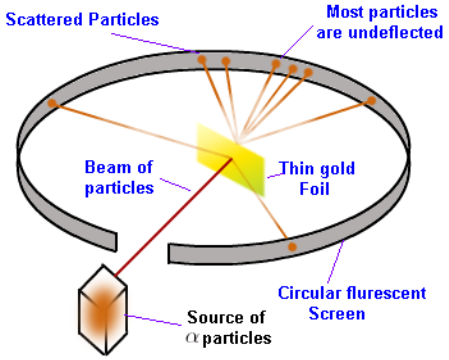
1 Rutherford Scattering

1.1 The plum pudding model



The plum pudding model was the initial model of the atom, stating a sphere of positive charge with electrons embedded into it.

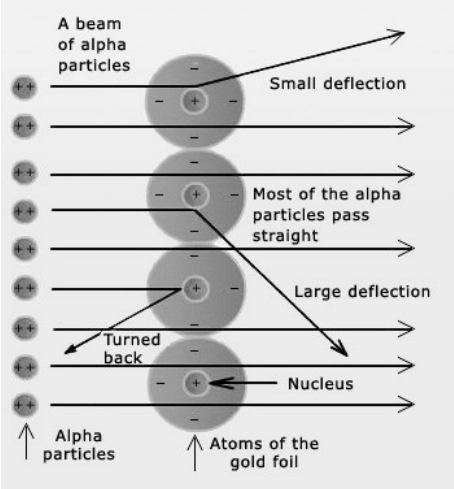
1.2 Rutherford's experiment



Rutherford's experiment involved firing a beam of alpha particles at gold foil and measuring the paths of particles from the foil.

- Gold was used as it was expected to have a large nucleus
- The screen fluoresces when collided with
- This showed the atom was mostly empty space with a positive nucleus

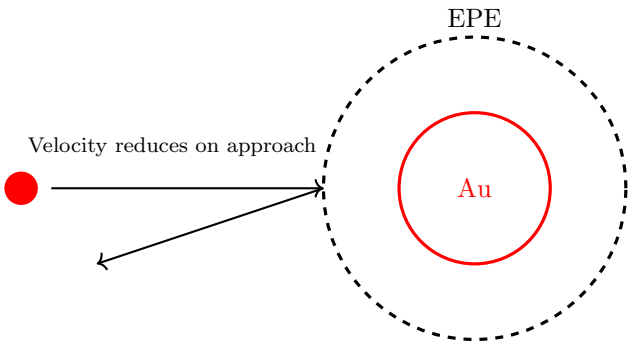
1.2.1 Results



Observation	Explanation
Most electrons pass all the way through	Atoms are mostly empty space
Some are deflected	The atom has a positive centre
Some are deflected by significant angles	The positive charge is condensed in a small area

1.3 Estimating the size of the nucleus

1.3.1 Closest approach method



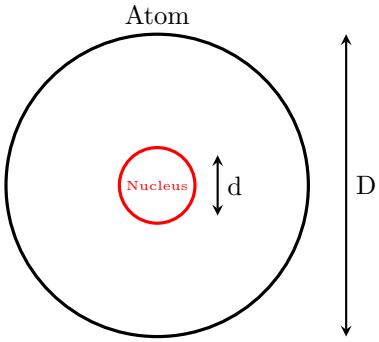
KE=EPE

$$8.0 \times 10^{-13} = \frac{1}{4\pi\epsilon_0} \times \frac{Q_{Au}}{r} \times Q_\alpha$$

$$r = 4.55 \times 10^{-14}$$

1.3.2 Estimate from scattering data

- About $\frac{1}{10{,}000}$ deflected through more than 90°
- Foil had n layers of atoms



$$\frac{\frac{1}{4}\pi d^2}{\frac{1}{4}\pi D^2} = \frac{d^2}{D^2} = \frac{1}{10,000n}$$

$n = 10^4$ layers

$$\frac{d^2}{D^2} = \frac{1}{10,000 \times 1 \times 10^4}$$

$$d = \frac{D}{10,000}$$