GEIGER MARSDEN α PARTICLE SCATTERING EXPERIMENT

- This experiment was conducted by Geiger and Marsden to obtain information regarding the structure of an atom

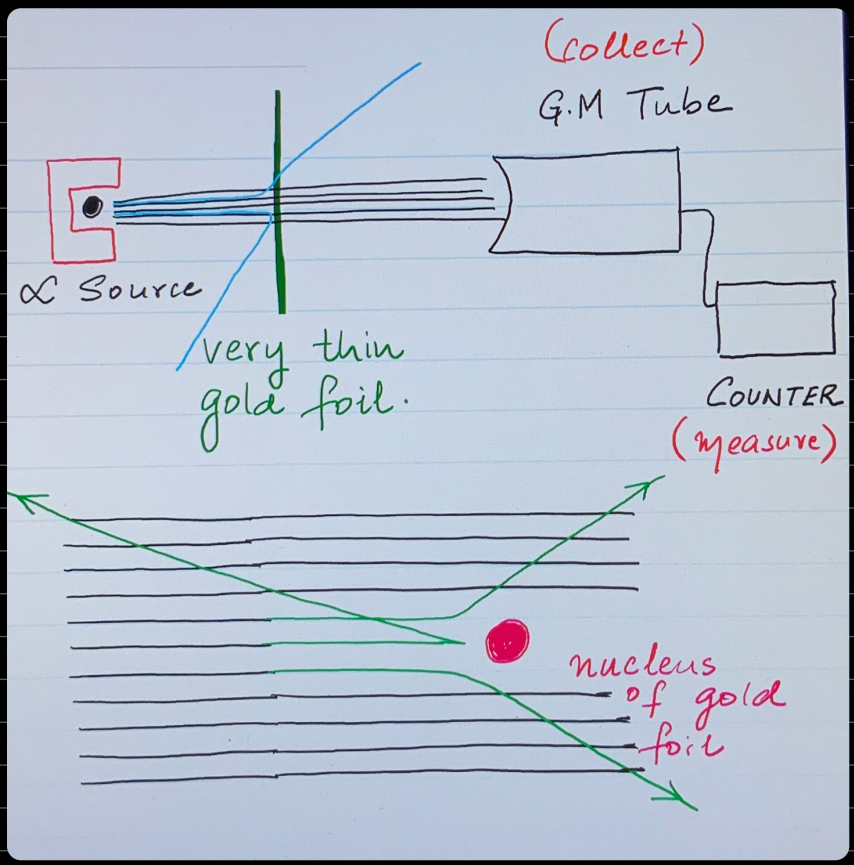
- The following observations and conclusions were made :

Observation : Most of the α particles passed right through the gold foil (i.e. deviated by less than 10°)

Conclusion : Size of nucleus is very small as compared to the size of an atom

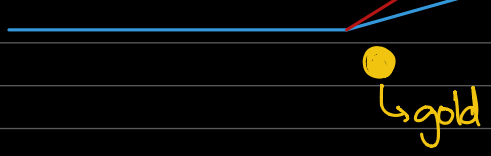
Observation : Very few particles were deflected through large angles

Conclusion : Nucleus is heavy, dense, and positively charged



Q. Why was gold foil used ?
A. Gold is unreactive / inert, and it has a heavy nucleus so it can apply an appreciable force of repulsion on an α particle

Q. What if an α particle with a greater KE travels towards the gold nucleus?
A. In that case, the angle of deflection of the particle will decrease



This is because an α particle with greater KE travels faster and gives less time to the gold nucleus to apply a force, hence undergoes a smaller deflection

Q. What if the gold nucleus is replaced with another gold nucleus which is an isotope of the original one. Will there be a difference in the outcome?

A. No difference
This is because neutrons are neutral particles, hence they do not affect the outcome

Q. Why were β particles not used in the experiment?

A. i) β particles are negatively charged so it can easily get influenced by the orbital electrons

ii) β have a range of KE / speed & this might influence / effect the force they experience, leading to inconclusive results

iii) They will get attracted / absorbed by the nucleus instead of undergoing repulsion

Q. Using the above experiment, how can we explain the fact that the gold nucleus has a very high density whereas gold atom has a relatively low density

A. In the case of the gold nucleus, there is a large mass occupied in a very small volume, hence high density whereas in the case of a gold atom, there is almost the same mass occupying a much larger volume, hence lower density

Q. Given that ...

Diameter of gold nucleus = 10^{-14} m
Diameter of gold atom = 10^{-10} m
} → Learn

Gold : $^{197}_{79}Au$

Calculate ...

i) the total mass of protons in a gold nucleus

$79u = 79(1.67 \times 10^{-27})$ kg

ii) the total mass of the nucleons

$179u = 179(1.67 \times 10^{-27})$ kg

iii) Ratio of $\frac{\text{density of gold nucleus}}{\text{density of gold atom}}$

$$\frac{\rho_N}{\rho_A} = \frac{\frac{M_N}{V_N}}{\frac{M_N}{V_A}}$$

$M_N \approx M_A$ because e^- have negligible mass

$$= \frac{V_A}{V_N}$$

$$= \frac{\frac{4}{3}\pi (10^{-10}/2)^3}{\frac{4}{3}\pi (10^{-14}/2)^3}$$

$$\frac{\rho_N}{\rho_A} = \frac{10^{12}}{1} \rightarrow \underline{\text{Ans}}$$