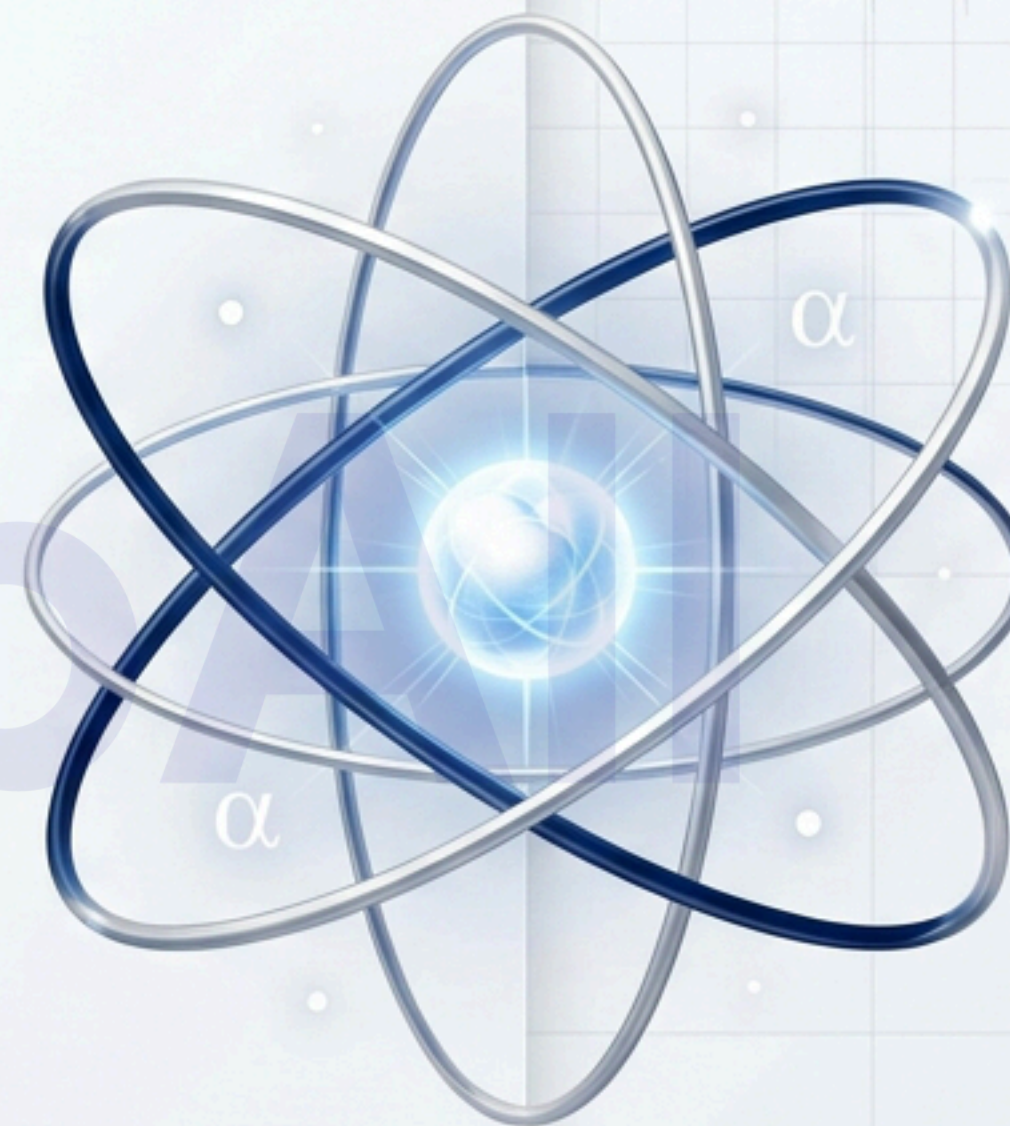


CHEMISTRY UNIT 2 • STRUCTURE OF ATOM (2.2.2)

Rutherford's Nuclear Model of Atom

The α -particle scattering experiment that rewrote our understanding of matter.



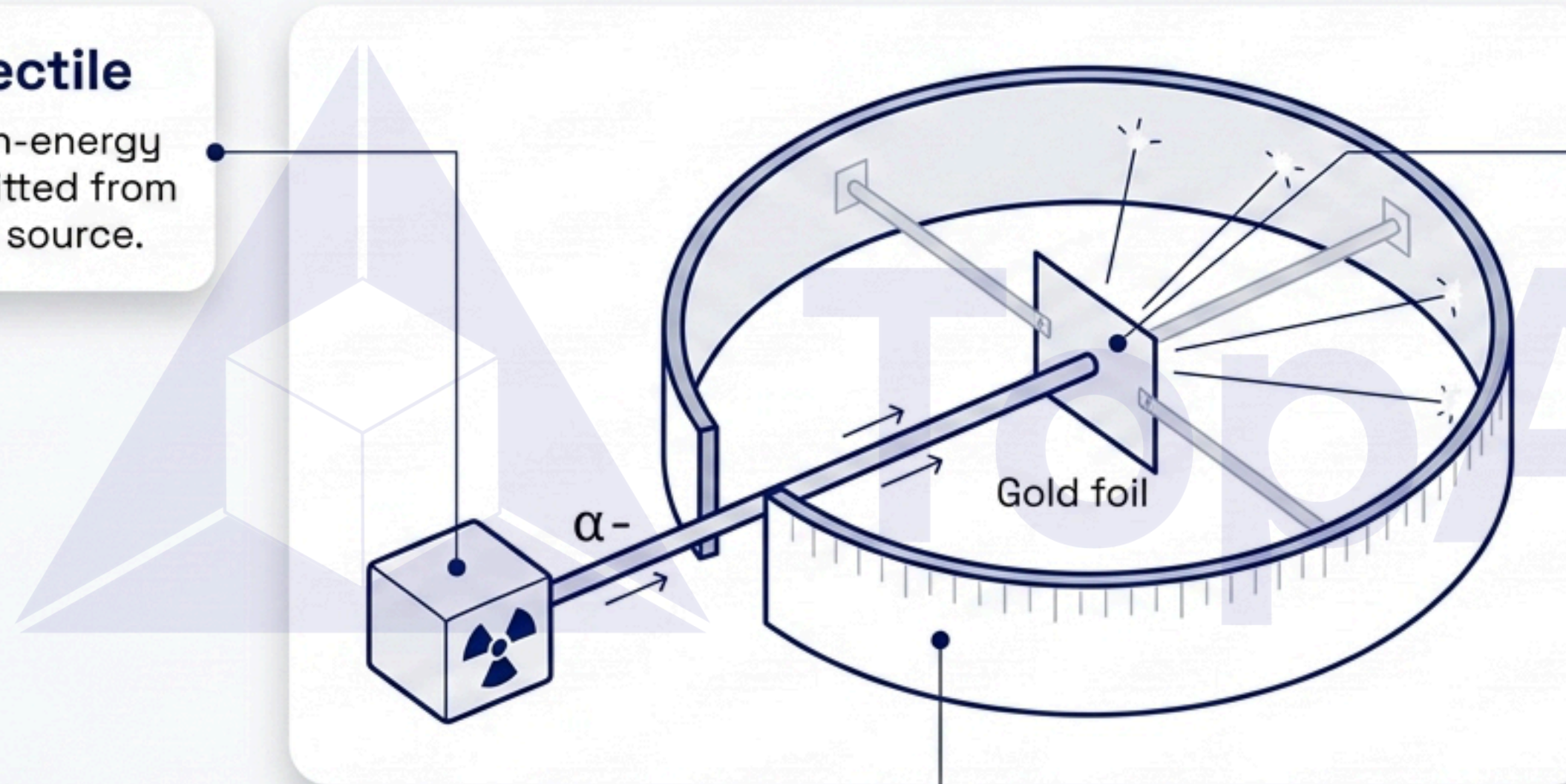
The α -Scattering Setup

The Projectile

Stream of high-energy α -particles emitted from a radioactive source.

The Target

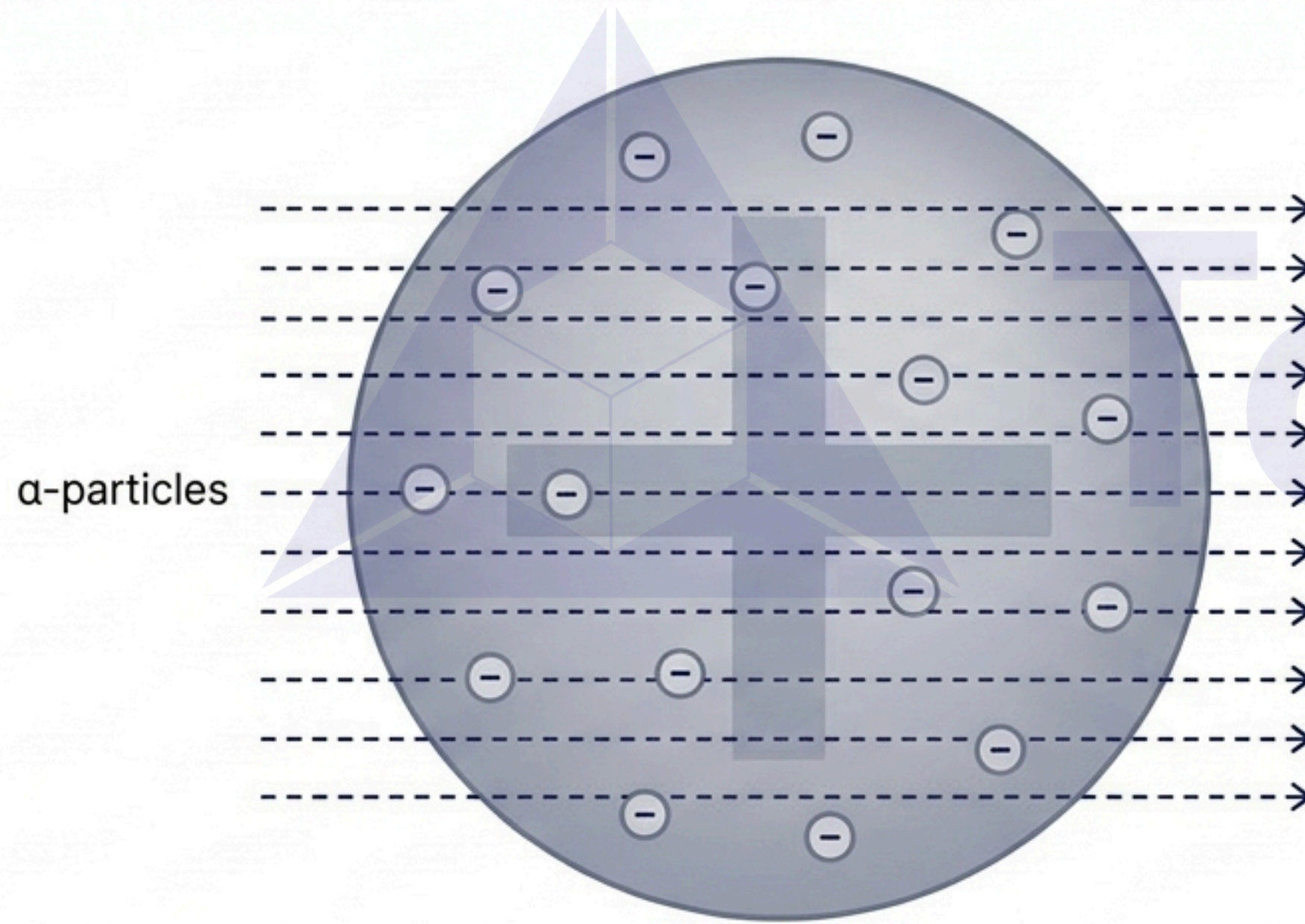
Extremely thin gold metal foil (thickness ~ 100 nm).



The Detector

Circular fluorescent zinc sulphide screen.
Strikes produce a tiny flash of light.

What Science Expected to See



The Prevailing Theory

Thomson's model assumed mass and positive charge were spread evenly over the entire atom.

The Prediction

High-energy α -particles should possess enough momentum to pass directly through this uniform distribution.

Expected Trajectory

Particles would slow down slightly and change direction only by very small angles.



**You've Learned the Theory.
Let's Test Them Now.**

$$E=mc^2$$



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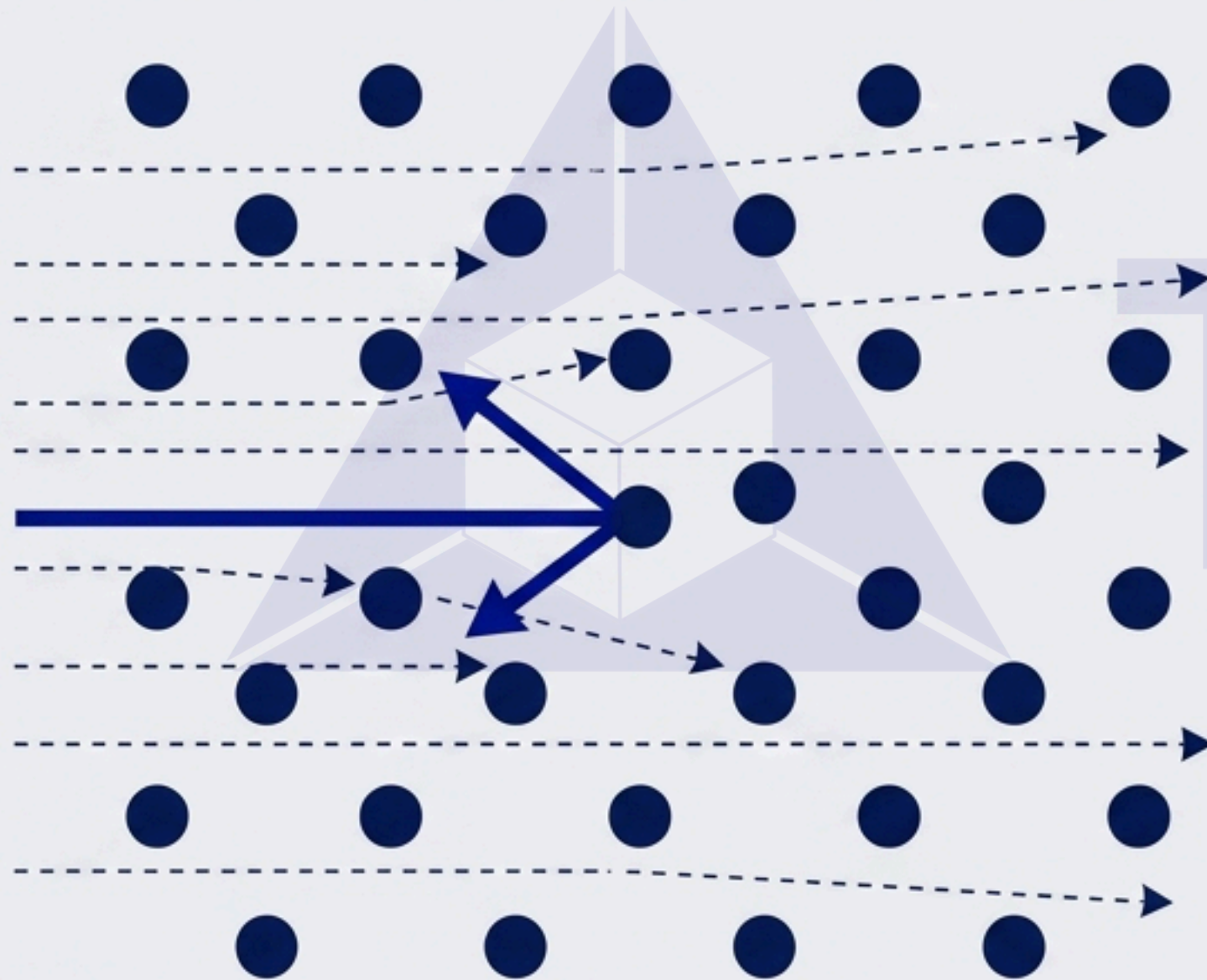
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The Unexpected Reality



Observation 01 | The Majority

Most of the α -particles passed through the gold foil completely undeflected.

Observation 02 | The Minority

A small fraction of the α -particles were deflected by small angles.

Observation 03 | The Anomaly

A very few α -particles (~ 1 in 20,000) bounced back, deflected by nearly 180° .

Decoding the Observations

Observation: Most passed through undeflected.



Conclusion: **Vast Empty Space.**
Most of the volume inside an atom is entirely empty.

Observation: A few positively charged α -particles were deflected.



Conclusion: **Concentrated Positive Charge.**
The deflection requires enormous repulsive force; positive charge is not spread out.

Observation: 1 in 20,000 bounced back entirely.

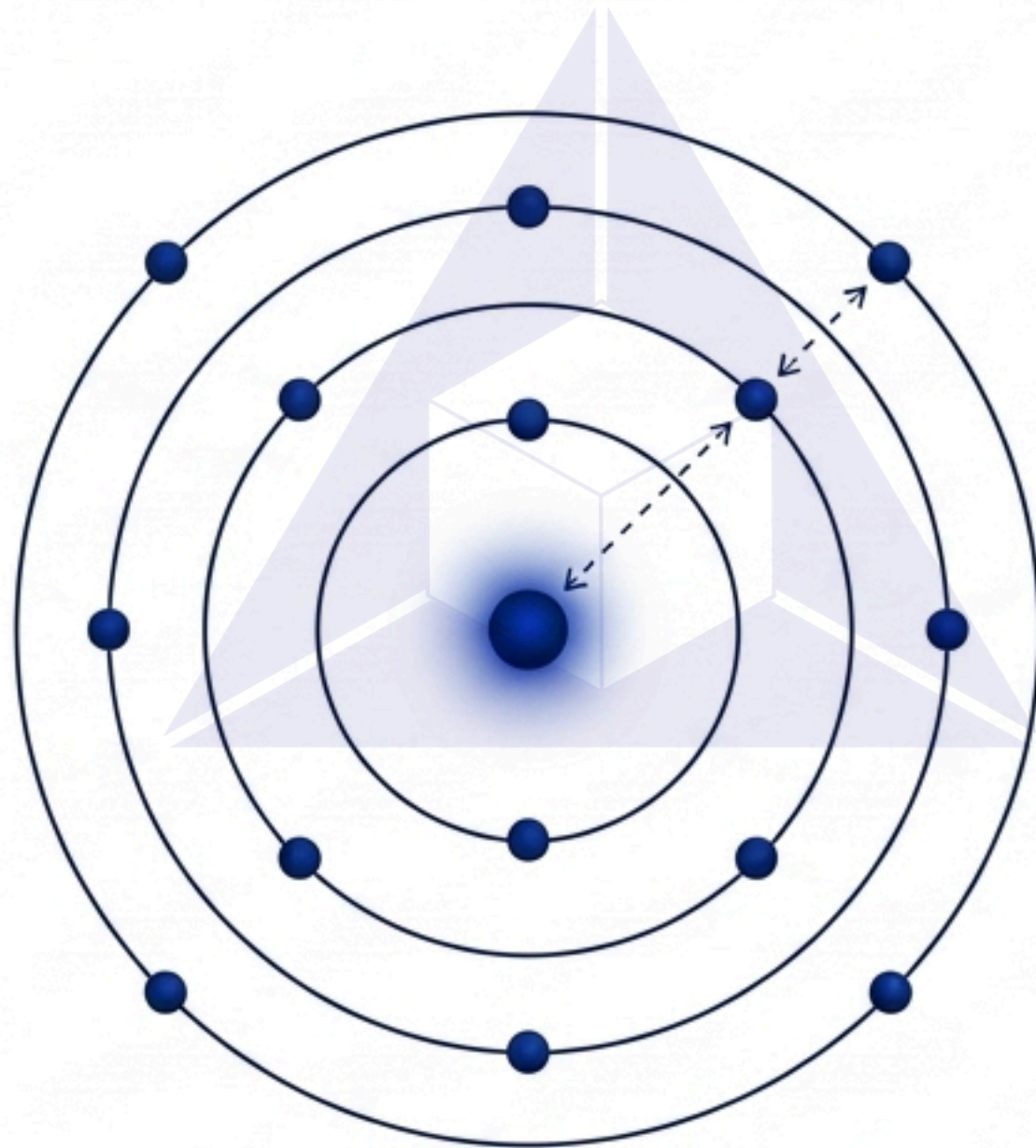


Conclusion: **Incredibly Dense Core.** The positive charge and most of the mass are concentrated in an extremely small volume (the nucleus).

The Scale

If the nucleus was a cricket ball, the radius of the atom would be about 5 km.

Rutherford's Nuclear Model



The Nucleus

Positive charge and almost all mass are densely concentrated in an extremely small central region.

The Orbits

Electrons revolve around the nucleus at very high speeds in circular paths, akin to planets around the sun.

The Bind

Electrons and the nucleus are held together by strong electrostatic forces of attraction.

The Atom, Redefined

The Macro (Vast Empty Space)

Concept

The atom is overwhelmingly empty space.

Scale

Atomic radius is $\sim 10^{-10}$ m.

Evidence

Most α -particles passed through the gold foil without any interaction.

The Micro (Tiny Dense Nucleus)

Concept

All positive charge and mass sit at the center.

Scale

Nuclear radius is $\sim 10^{-15}$ m.

Evidence

1 in 20,000 α -particles were repelled back by 180° .

Formula Highlight Card

Size Disparity: The atom is 10^5 (100,000) times larger than its nucleus.



You've Learned the Theory.

Now Let's Test It.

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