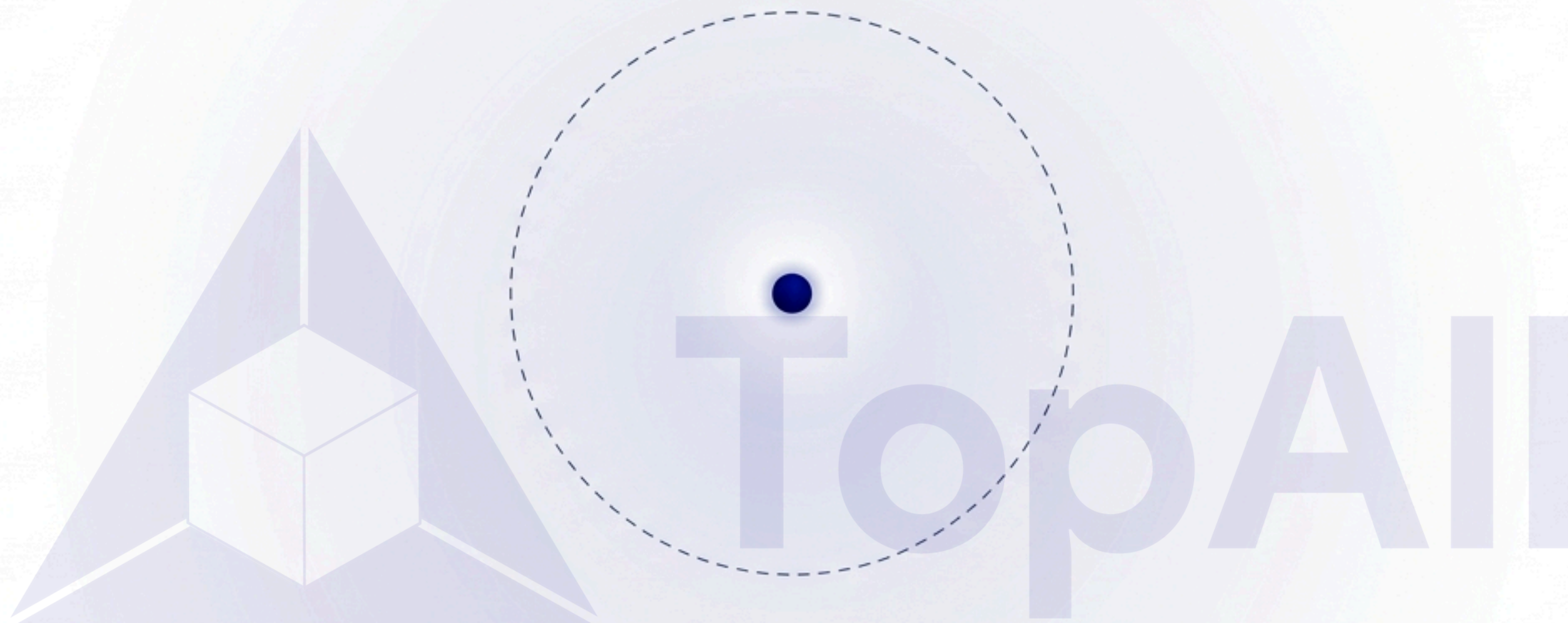


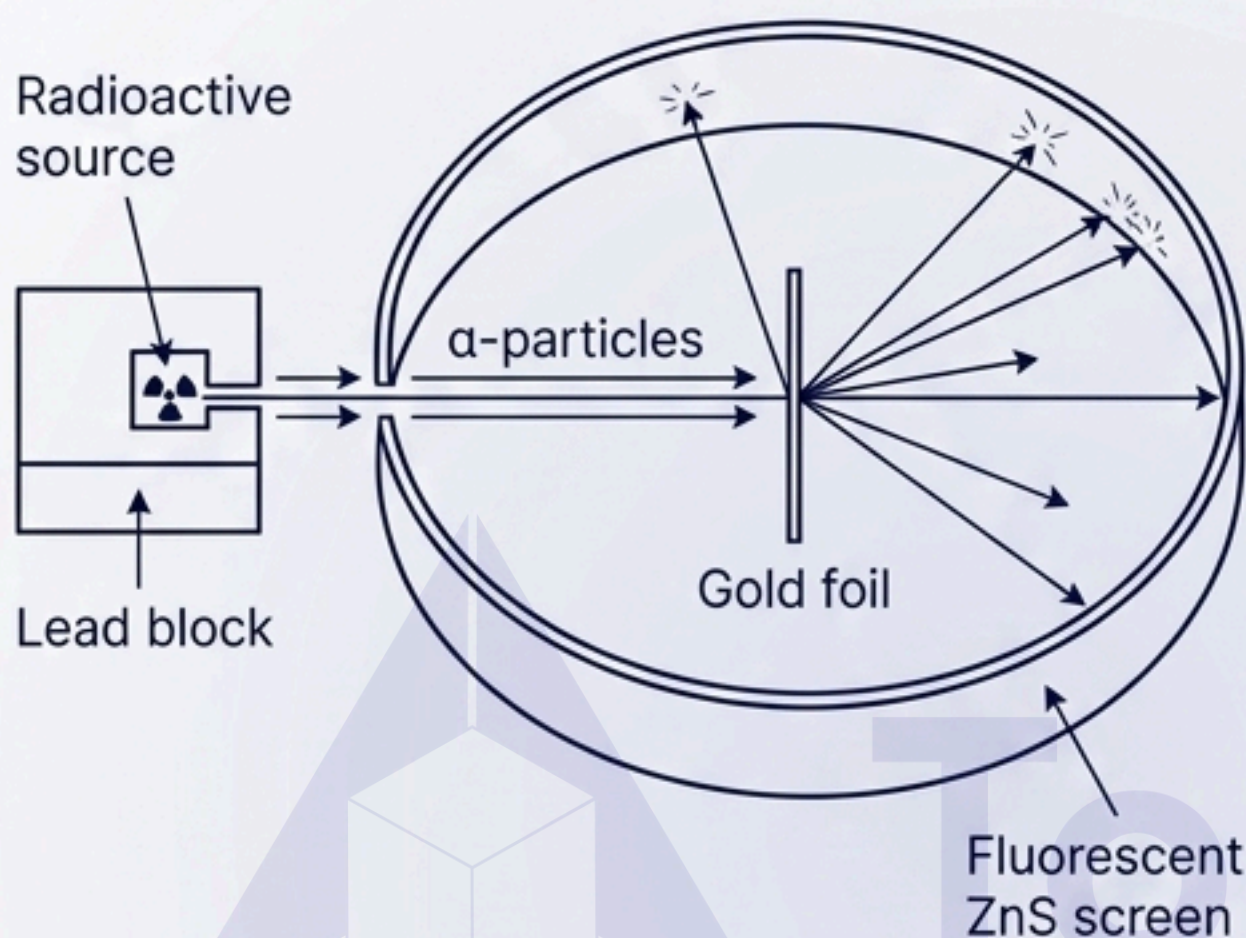


Rutherford Gold Foil Experiment

The Discovery of the Atomic Nucleus

2.2.2 Rutherford's Nuclear Model

The Apparatus & The Expectation

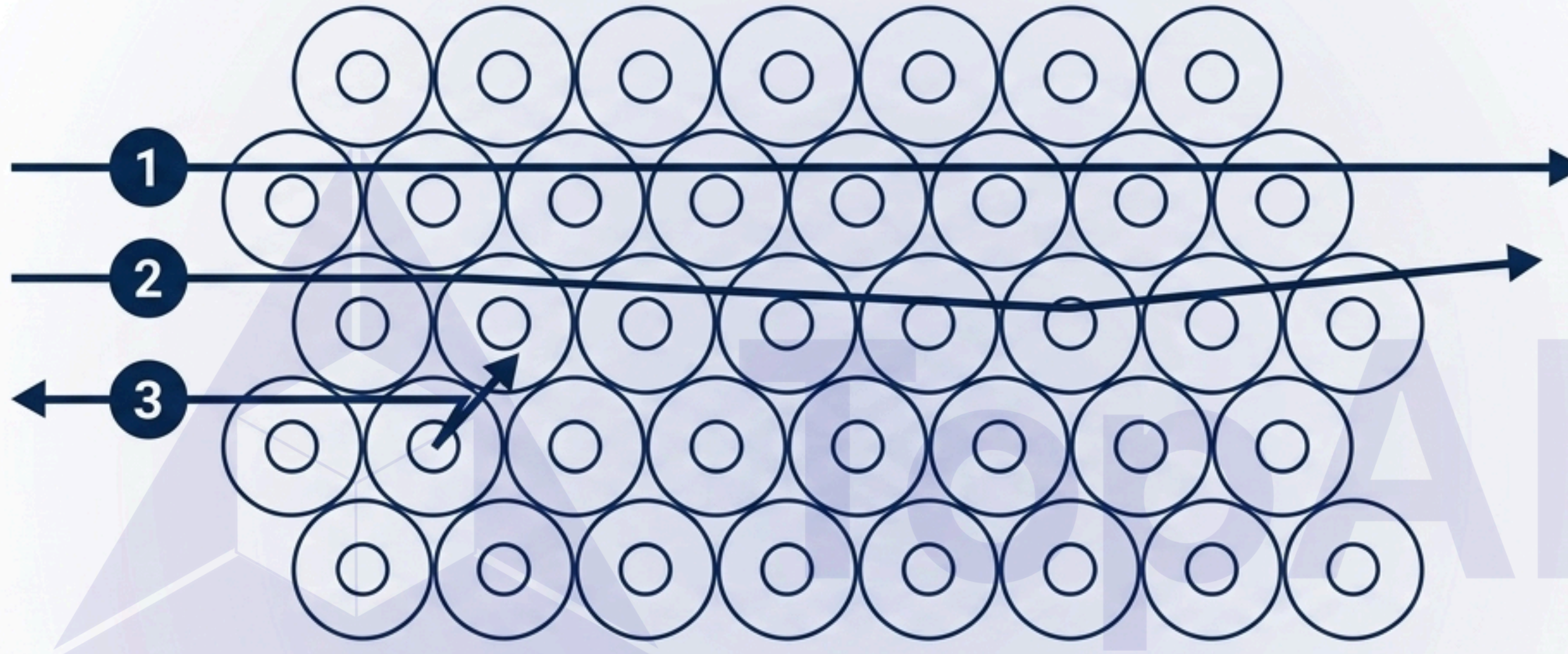


- **Source:**
High-energy α -particles
- **Target:**
Extremely thin gold metal foil (~ 100 nm)
- **Detector:**
Circular fluorescent Zinc Sulphide (ZnS) screen

THE EXPECTATION

Based on Thomson's Plum Pudding model, mass was assumed to be evenly spread. Therefore, high-energy α -particles should pass directly through with only minor deflections.

The Unexpected Results



1

Most α -particles passed directly through the gold foil undeflected.

2

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

3

A very few (~1 in 20,000) bounced back, deflecting by nearly 180° .

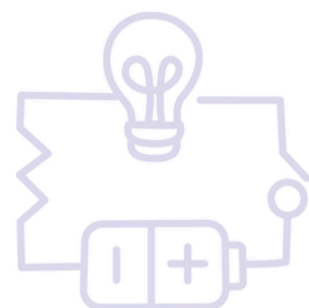
Decoding the Data: Observation → Inference

Most passed directly through.	>	Most of the space in the atom is empty .
A few deflected by small angles.	>	Positive charge is densely concentrated in a tiny volume.
Very few (1 in 20,000) bounced back 180°.	>	The central volume (nucleus) is negligibly small compared to the total volume.



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

$$E=mc^2$$



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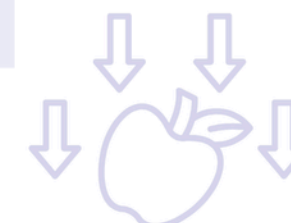
Practice Now



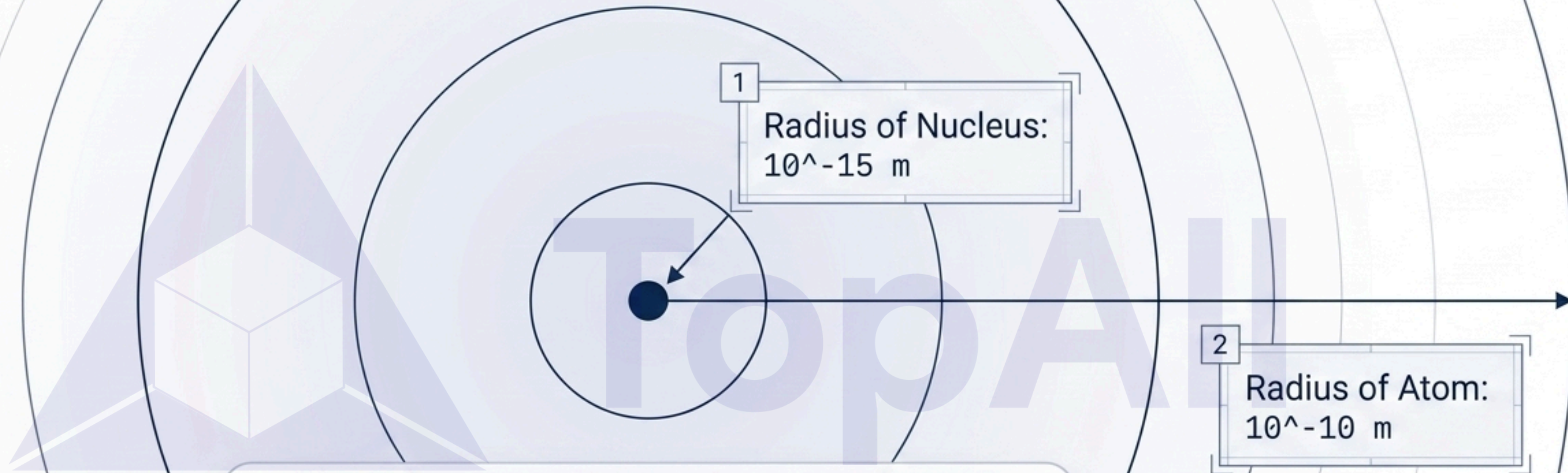
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Mind-Boggling Proportions

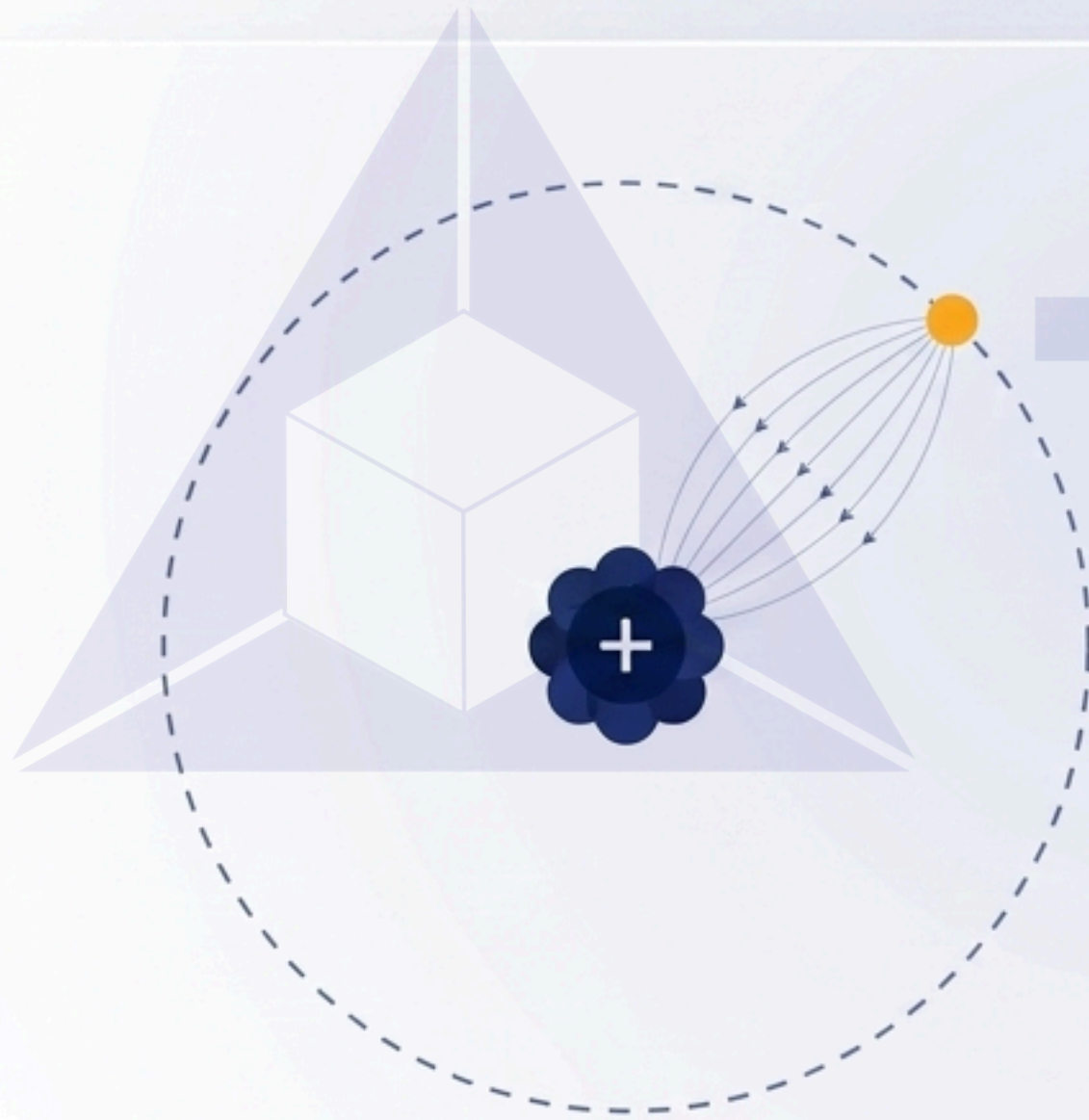


If the nucleus were the size of a **cricket ball**, the radius of the atom would be about **5 kilometers**.

The atom is functionally a vast vacuum surrounding a microscopic, highly dense core.

Rutherford's Nuclear Model

Overturning the Plum Pudding paradigm (1911).



1

The Nucleus

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

2

The Orbits

Electrons revolve around the nucleus at very high speeds in circular paths (resembling a miniature solar system).

3

The Glue

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

The Fatal Flaw (Drawbacks)

Why couldn't this model explain atomic stability?

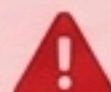
1. Circular motion implies continuous acceleration.

2. Maxwell's Theory: Accelerated charged particles emit electromagnetic radiation.

3. Orbiting electrons must continuously lose energy.

4. The orbit shrinks; the electron spirals into the nucleus in just 10^{-8} s.



 **JEE Trap:** Rutherford's model says absolutely nothing about the distribution of electrons or their discrete energies.

Key Takeaways

High-yield points for JEE revision.

- ✓ **Nucleus Discovered:** Proved the existence of a dense, positively charged center through α -particle scattering.
- ✓ **Vast Emptiness:** Established that the overwhelming majority of atomic volume is completely empty space.
- ✓ **Scale Ratio:** The nucleus (10^{-15} m) is 100,000 times smaller than the atom (10^{-10} m).
- ✓ **The Limitation:** Completely fails to explain atomic stability against Maxwell's electromagnetic theory (the spiraling electron problem).



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