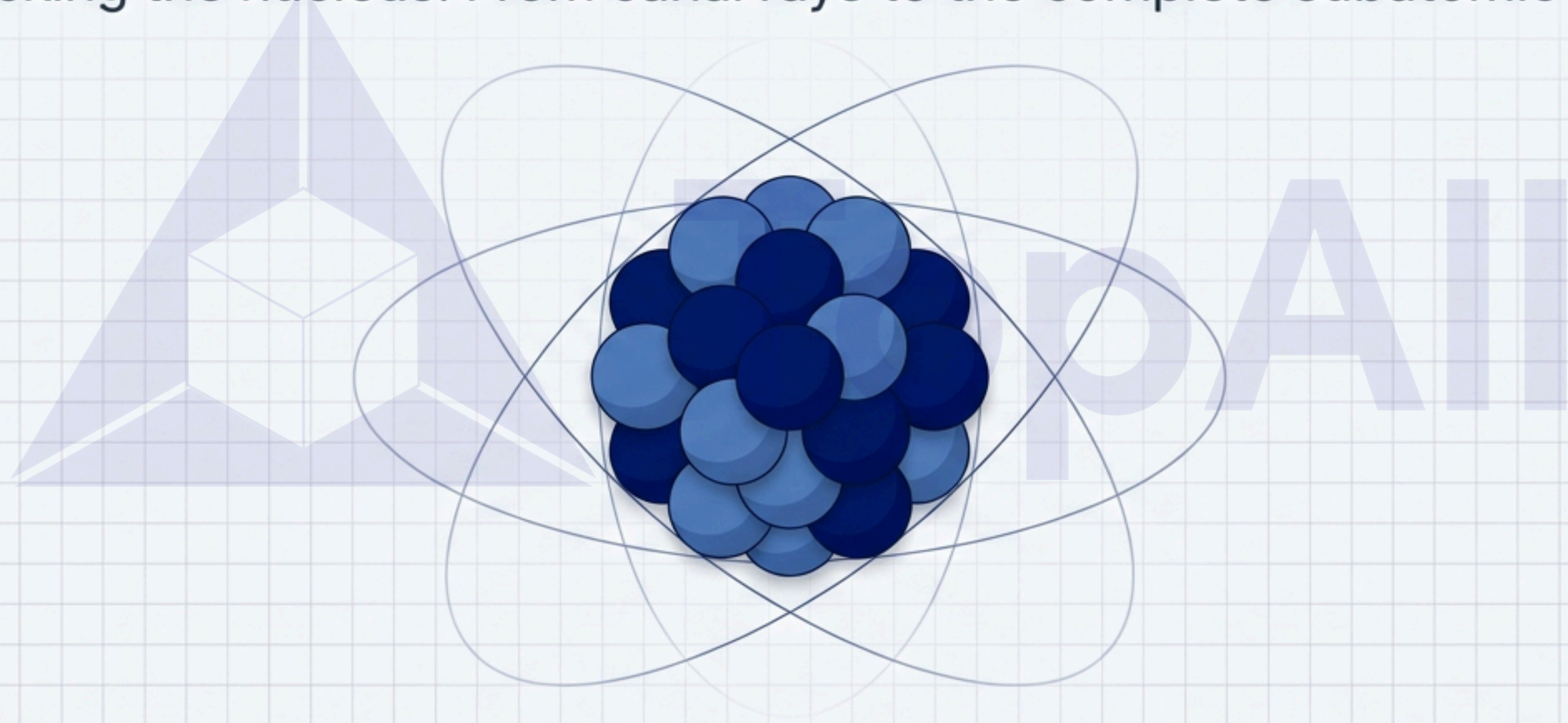


2.1.4 Discovery of Protons and Neutrons

Unlocking the nucleus: From canal rays to the complete subatomic triad.

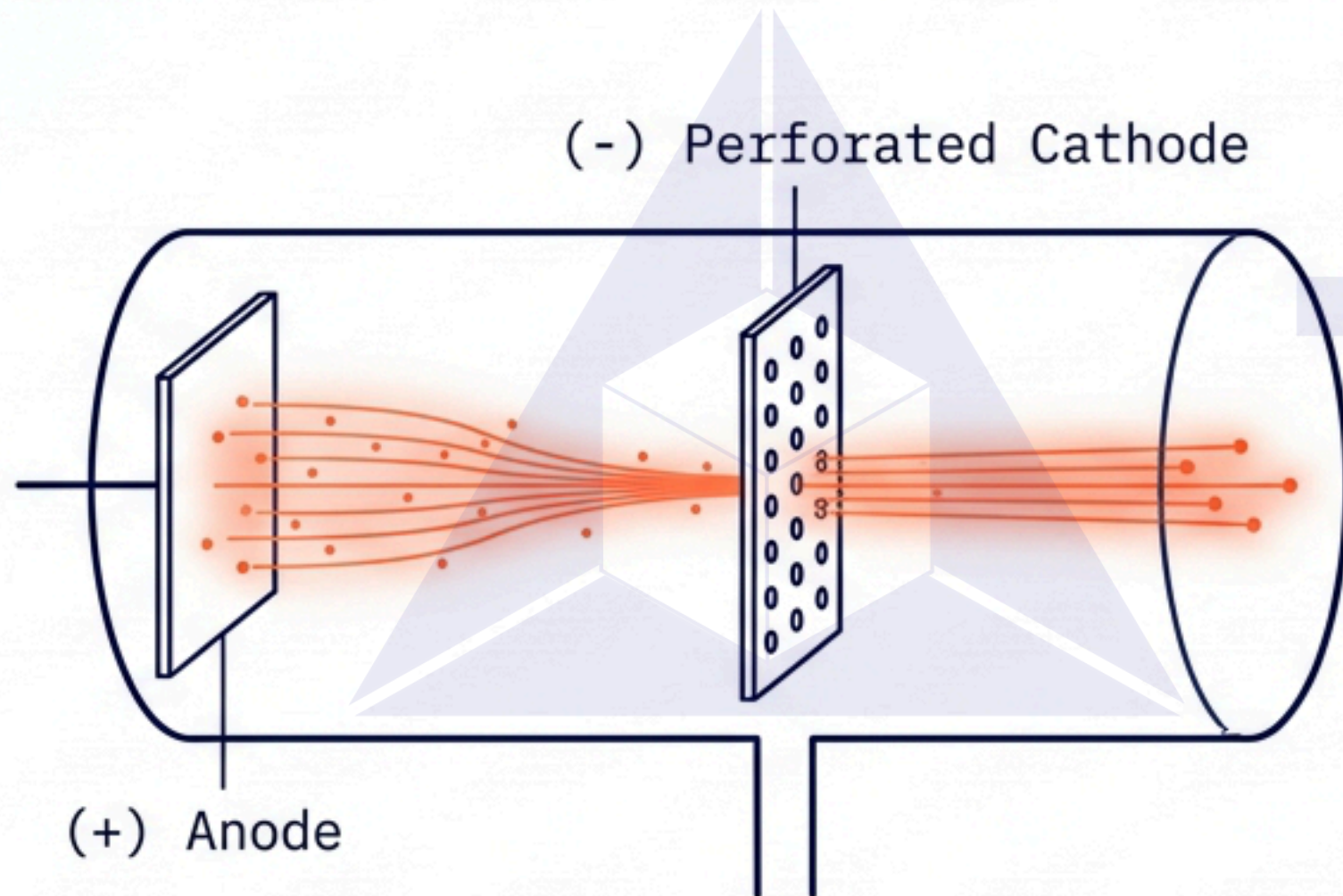


Exam-Smart Summary

Based on Section 2.1.4

Reading Time: ~3 mins

Canal Rays: The First Clue



Nature:

Positively charged gaseous ions.

Mass:

Depends heavily on the nature of the gas present in the tube.

Charge-to-Mass Ratio:

Varies depending on the gas from which they originate.

Behavior:

Deflects in magnetic or electrical fields in the exact opposite direction to that observed for electrons/cathode rays.

Unlike universal electrons, the mass and charge of canal ray particles change based on the specific gas used.

THE SIMPLEST POSITIVE ION



Isolating the Proton (1919)

Hydrogen Gas (H₂) - Electrons (e⁻) =

**Lightest
Positive
Ion (H⁺)**

The Discovery

The smallest and lightest positive ion was obtained by using Hydrogen gas in the discharge tube.

The Characterization

Formally characterized as a fundamental particle in 1919 and officially named the proton.

Charge: $+1.602176 \times 10^{-19} \text{ C}$ | Relative Charge: +1



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

$$E=mc^2$$



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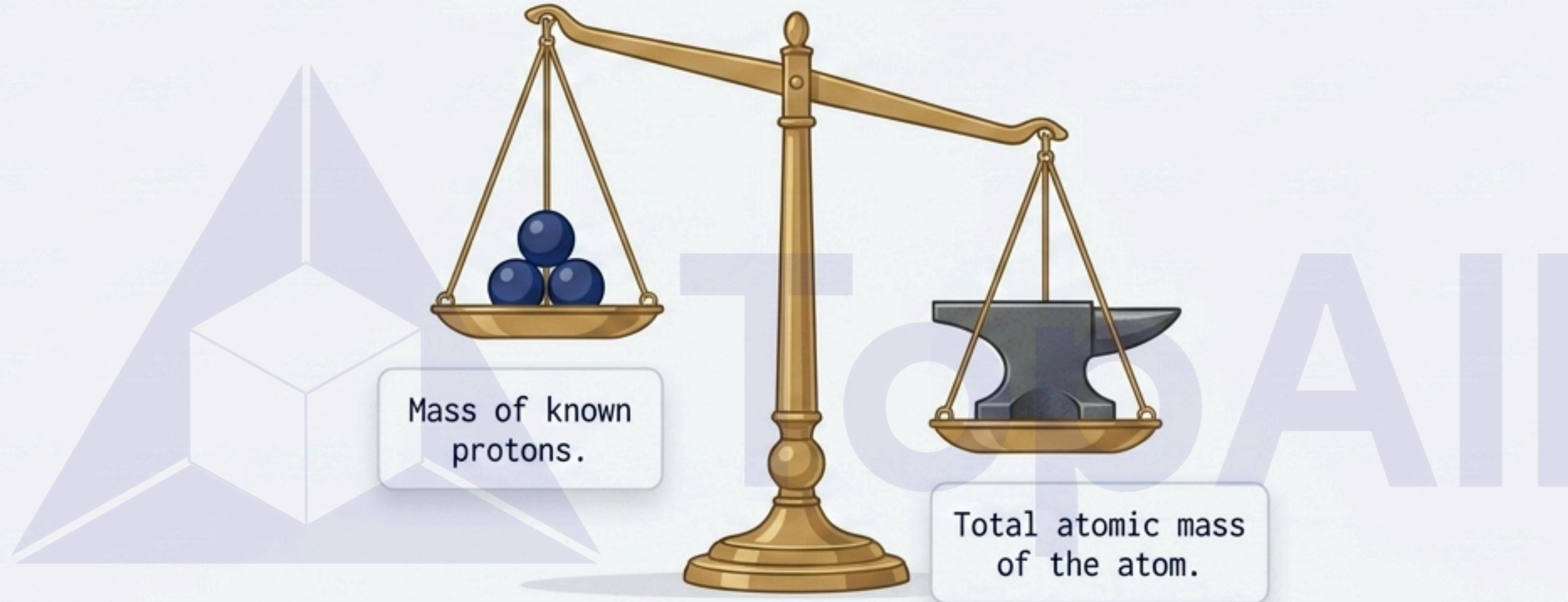
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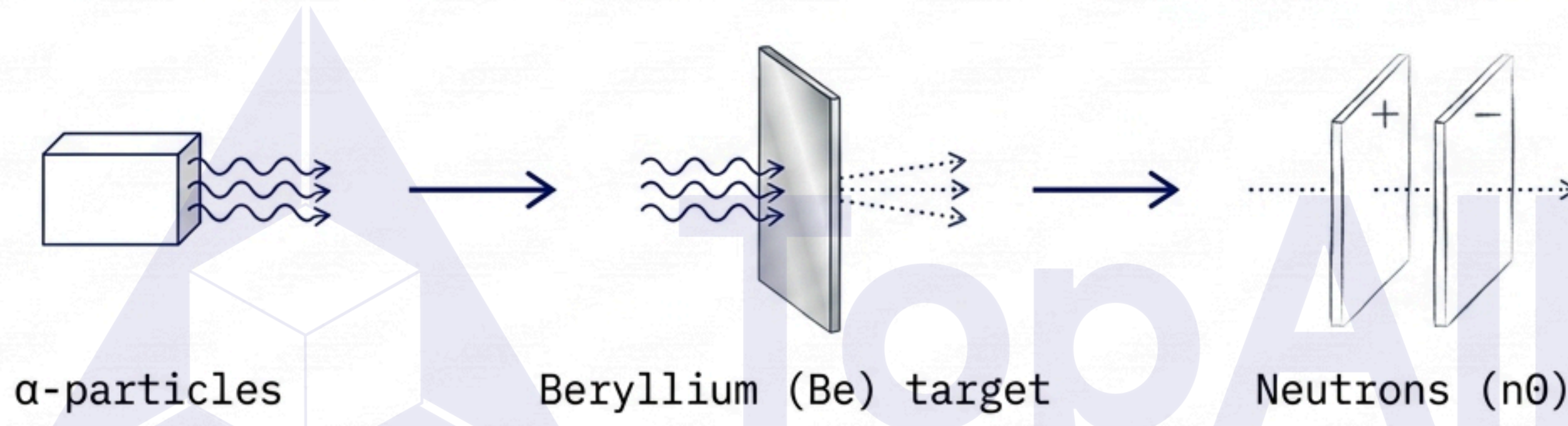
The "Mass Gap" in the Nucleus



A crucial need emerged: Electrically neutral particles must exist within the atom to account for the missing mass without altering the electrical balance established by protons and electrons.

→ This mathematical gap paved the way for the final piece of the subatomic puzzle.

Chadwick Discovers the Neutron



Identity

Electrically neutral (0 charge).

Mass

Possesses a mass slightly greater than that of a proton.

Naming

Discovered and coined "neutrons" by James Chadwick.

Properties of Fundamental Particles

Particle	Symbol	Absolute Charge (C)	Relative Charge	Mass (kg)	Mass (u)	Approx Mass (u)
Electron	e	$-1.602176 \times 10^{-19}$	-1	9.109382×10^{-31}	0.00054	0
Proton	p	$+1.602176 \times 10^{-19}$	+1	$1.6726216 \times 10^{-27}$	1.00727	1
Neutron	n	0	0	1.674927×10^{-27}	1.00867	1

Atoms are built from these three fundamental particles. Chemical behavior is dictated by electrons, while mass is dictated by the nucleus (protons + neutrons).



You've Learned the Theory.

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