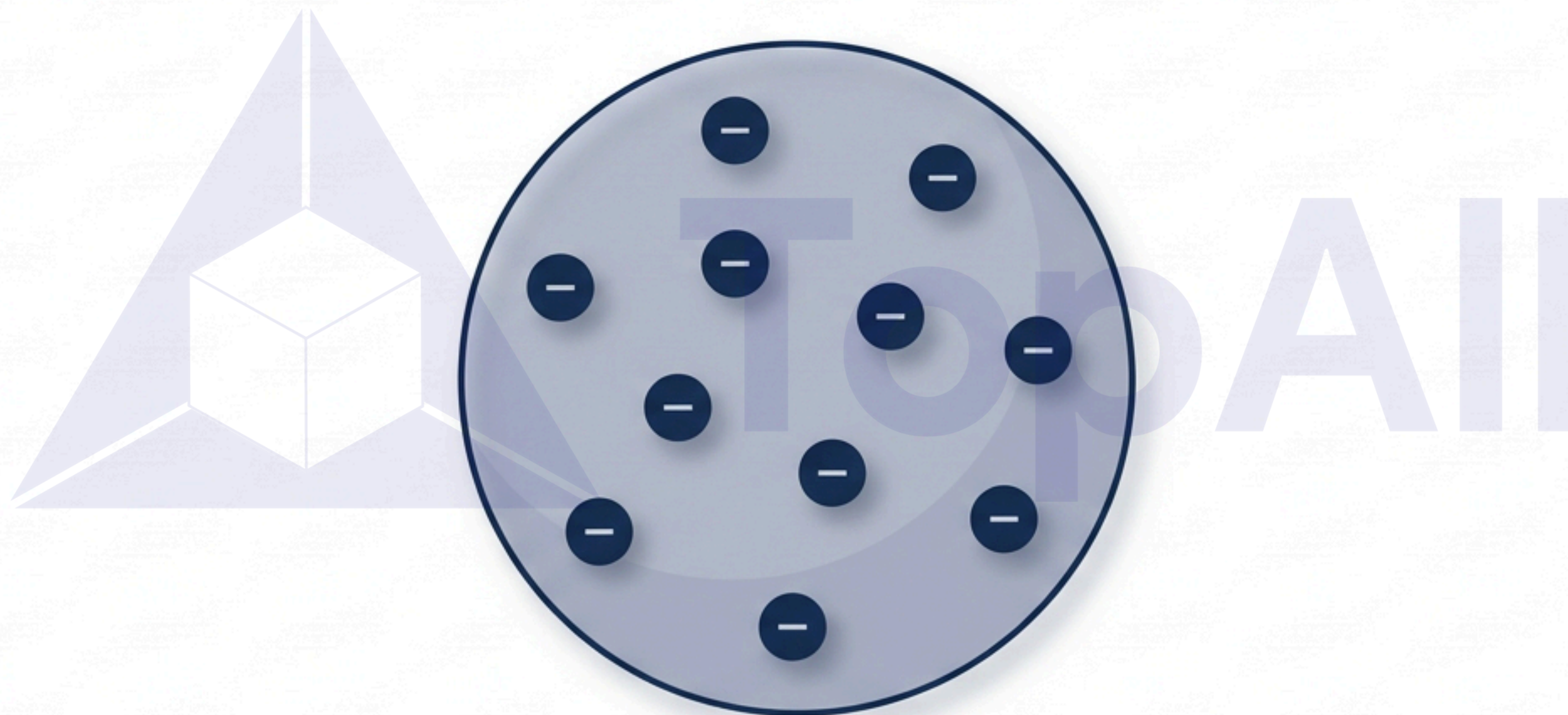


2.2.1 Thomson Model of Atom

The first structural model of the atom to incorporate sub-atomic particles.



Proposed by J.J. Thomson

Year: 1898

CORE POSTULATES

Positive Sphere with Embedded Electrons

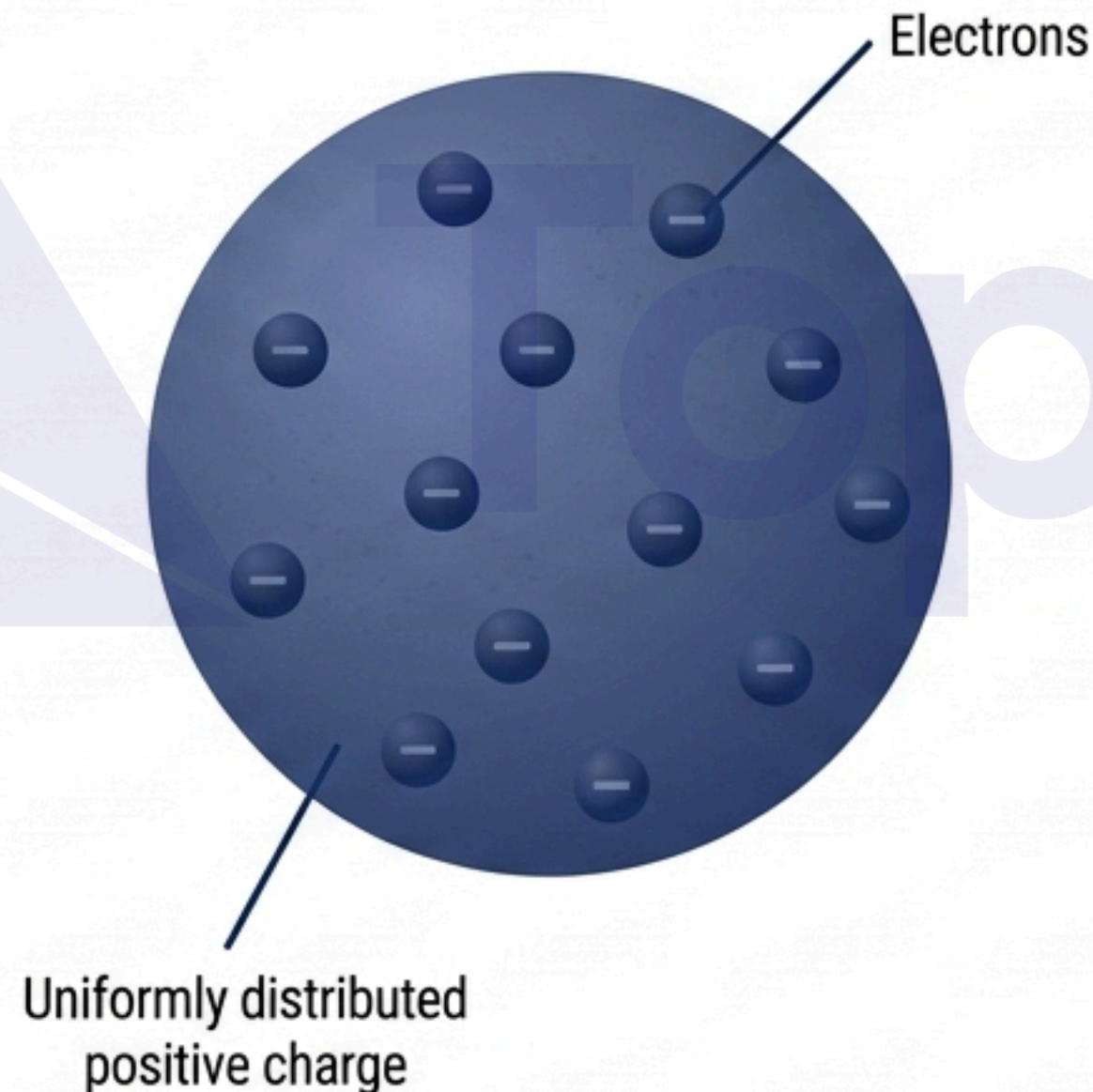
Spherical Geometry

The atom possesses a spherical shape.

$$\text{Radius} \approx 10^{-10} \text{ m}$$

Embedded Electrons

Negatively charged electrons are embedded within the positive sphere in a manner that achieves the most stable electrostatic arrangement.



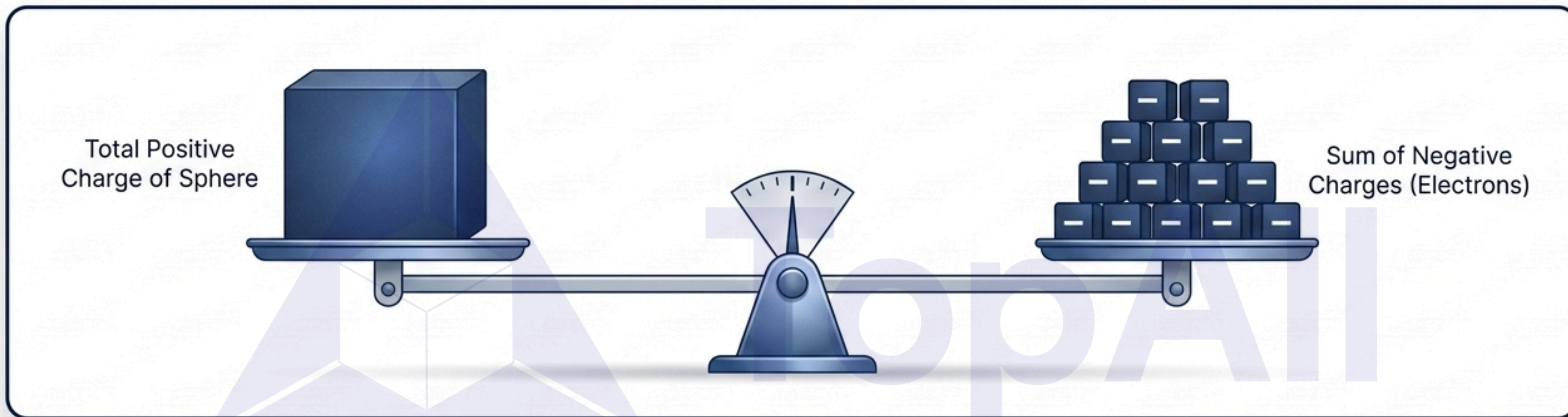
Charge Distribution

Positive charge is not localized in a nucleus; it is uniformly distributed throughout the entire volume of the atomic sphere.

Uniform Mass

A critical (and ultimately incorrect) assumption of this model is that the mass of the atom is uniformly distributed over the entire atom.

Why It Explained Electrical Neutrality



The Electrostatic Balance

Prior to this model, it was an established fact that atoms were electrically neutral. Thomson's model successfully accounted for this phenomenon by proposing that the magnitude of the continuous positive charge exactly cancels out the total negative charge of all embedded electrons.

$$\sum (+ \text{ charge}) + \sum (- \text{ charge}) = 0$$

Result: The atom behaves as an electrically neutral entity overall.



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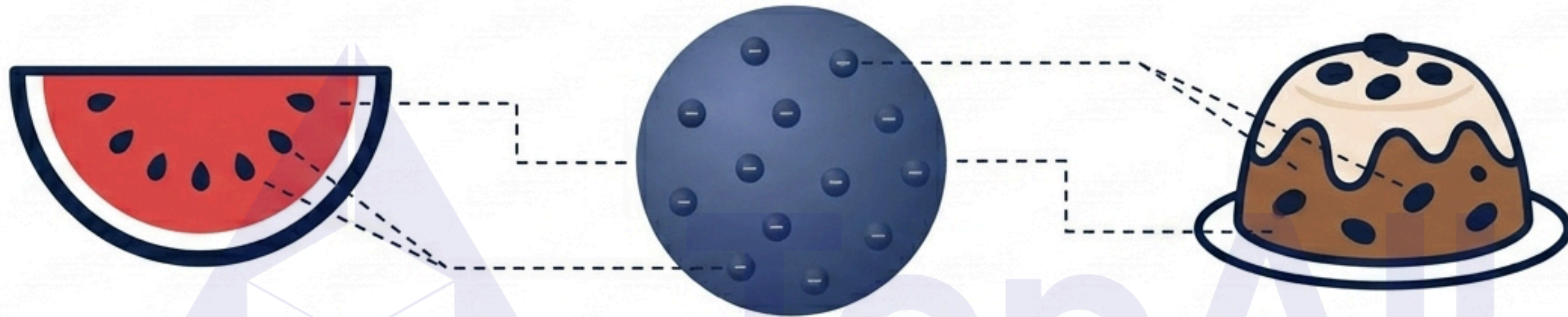
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Plum Pudding & Watermelon Visualizations



Panel 1: The Watermelon Model

- **Red Edible Part:** Represents the continuous sphere of uniformly distributed positive charge.
- **Black Seeds:** Represent the discrete, negatively charged electrons embedded within the positive sphere.

Panel 2: The Plum / Raisin Pudding Model

- **The Pudding Base:** Represents the continuous, uniform positive charge cloud.
- **The Plums / Raisins:** Represent the discrete, negatively charged electrons scattered throughout.

Core Concept: Regardless of the analogy used, the structural visualization remains identical: discrete negative particles suspended within a continuous positive medium.

Strengths and Limits of the Thomson Model

Historical Milestone

- **Sub-atomic Integration:** The first model to successfully incorporate the newly discovered sub-atomic particles (electrons) into a cohesive atomic structure.
- **Electrical Neutrality:** Successfully explained the overall electrical neutrality of the atom, solving a major physics requirement of the time.
- *Historical Note: Thomson was awarded the Nobel Prize in Physics in 1906.*

Fatal Flaws

- **Inaccurate Mass Distribution:** The core assumption that atomic mass is uniformly distributed was proven entirely incorrect.
- **Failed Experimental Testing:** The model was completely inconsistent with the results of later physical tests—specifically, it could not explain the large deflections and bouncing back of particles observed in **Rutherford's α -particle scattering experiment**.

Conclusion: While foundational for integrating the electron, Thomson's model was ultimately discarded because it failed to account for a dense, centralized atomic nucleus.



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