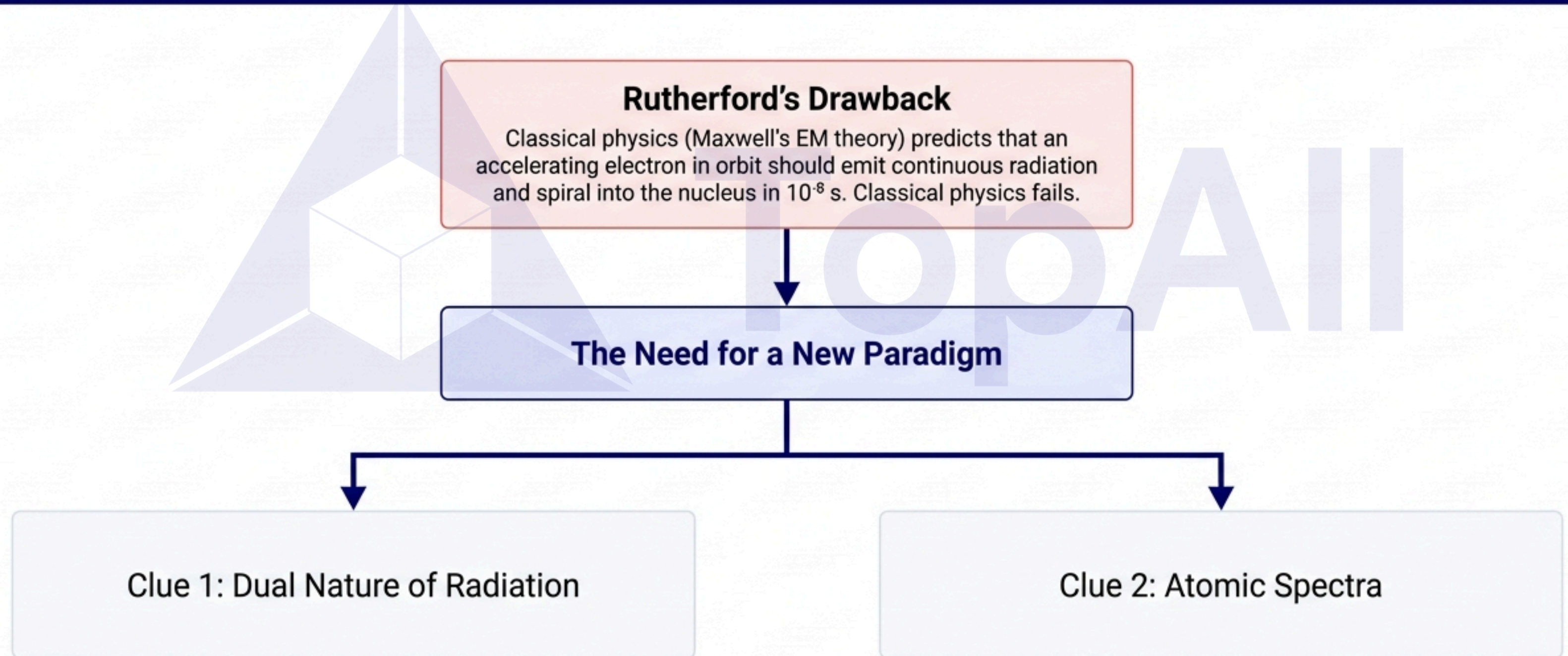


Before Bohr's Model

The two scientific breakthroughs that rescued atomic theory from classical physics.

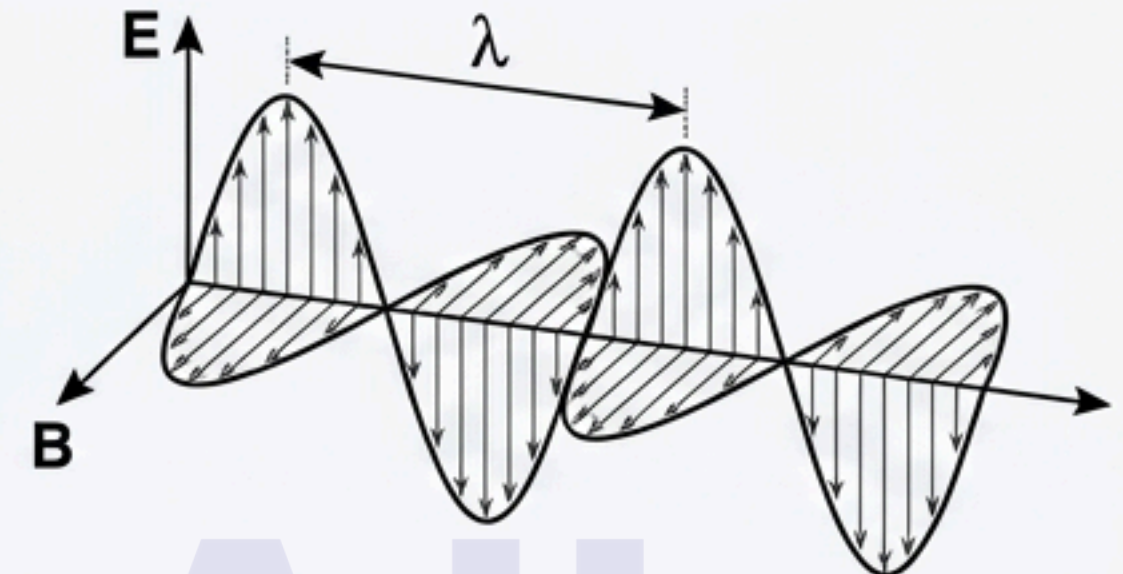


Clue 1: Dual character of electromagnetic radiation.

1. Wave Nature (Maxwell)

EM radiation travels as oscillating fields. Successfully explains macroscopic phenomena like diffraction and interference.

$$c = v\lambda$$

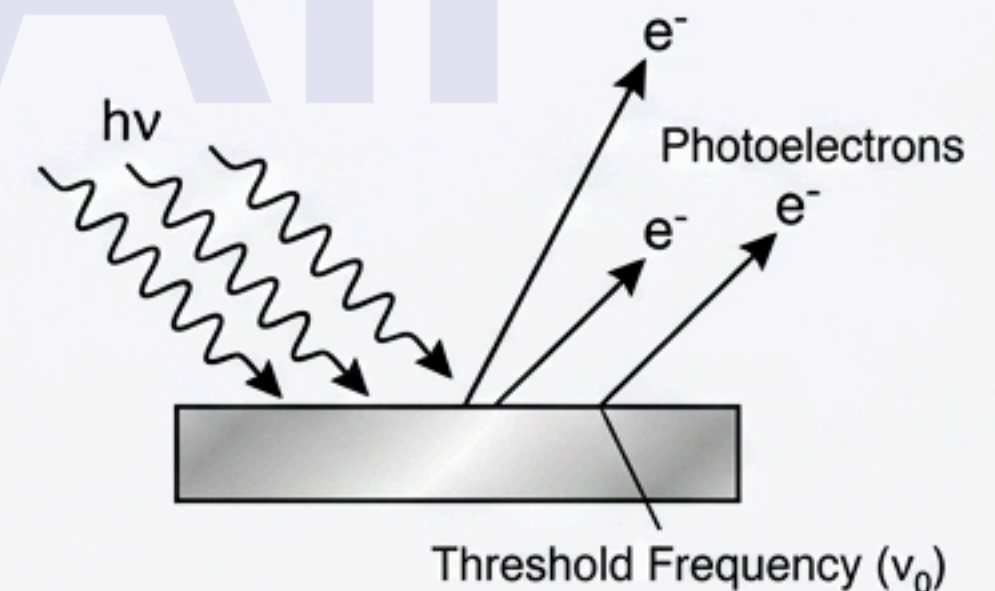


DUALITY

2. Particle Nature (Planck & Einstein)

Energy is emitted or absorbed only in discrete chunks (quanta/photons). Successfully explains black body radiation & the photoelectric effect.

$$E = h\nu$$



JEE TRAP: Don't use wave theory to explain the photoelectric effect! Classical physics cannot explain the existence of a threshold frequency (ν_0).



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$$E=mc^2$$



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Clue 2: Atomic Spectra



Continuous Spectrum: All wavelengths present (e.g., white light through a prism).



Line Emission Spectrum: Only specific wavelengths present. The gas emits discrete, isolated chunks of energy—like an atomic fingerprint.

The Mathematical Proof: Rydberg Formula

Johannes Rydberg noted that all series of lines in the hydrogen spectrum could be described by a **single expression dependent on integers (n)**. This proved that **allowed energy levels within the atom are rigidly fixed**.

$$\bar{\nu} = 109,677 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \text{ cm}^{-1}$$

The Synthesis: Bridging to Bohr

How the two clues perfectly locked together to form a new atomic model.

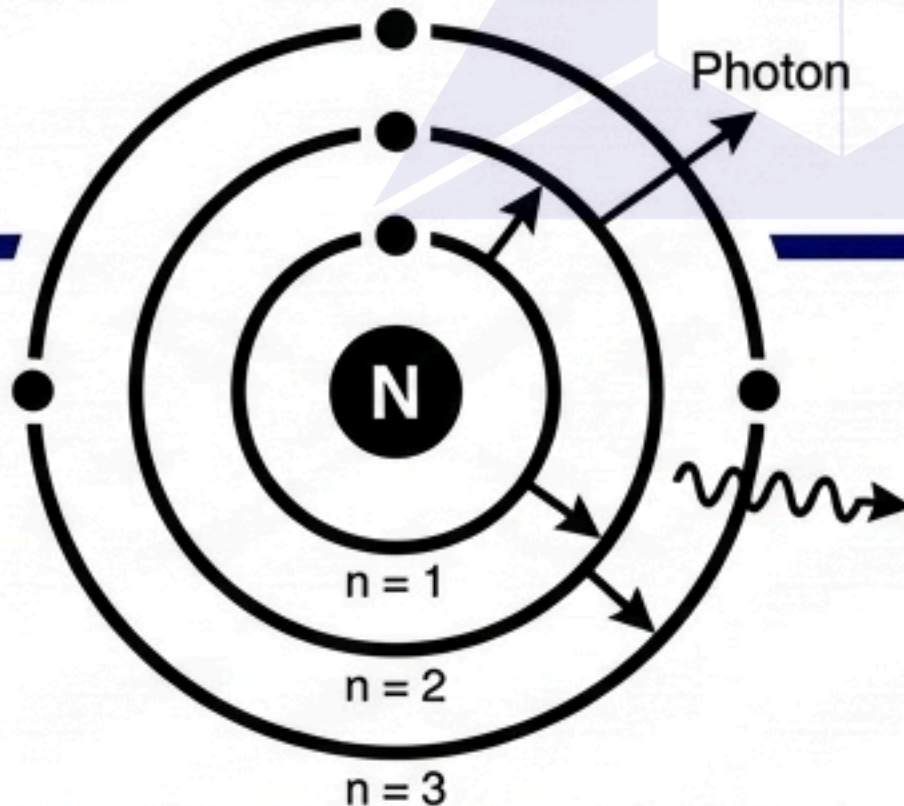


Clue 1: Energy travels in discrete packets (Photons).
 $E = h\nu$

Clue 2: Atoms only emit or absorb specific, discrete frequencies of light.



Therefore, the electrons inside the atom **MUST** exist in fixed, discrete energy states.



The Bohr Model (1913): Electrons revolve in fixed, stationary circular orbits. Energy is only absorbed or emitted when an electron jumps directly between these allowed orbits, bypassing the space in between.

Key Takeaways

Summarizing the paradigm shift in atomic structure.



Rooted in Experiment

The Bohr model was a direct, necessary solution to explain experimental observations of Black Body radiation, the Photoelectric effect, and Line Spectra.



Caution: Dual Nature Limits

At this stage in history, 'Dual Nature' strictly applied to electromagnetic radiation (light), NOT to matter (electrons). Matter waves are introduced later by de Broglie.



The End of Classical Limits

Classical mechanics completely failed at the microscopic level. The introduction of Planck's constant (h) marked the birth of quantum atomic theory.



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