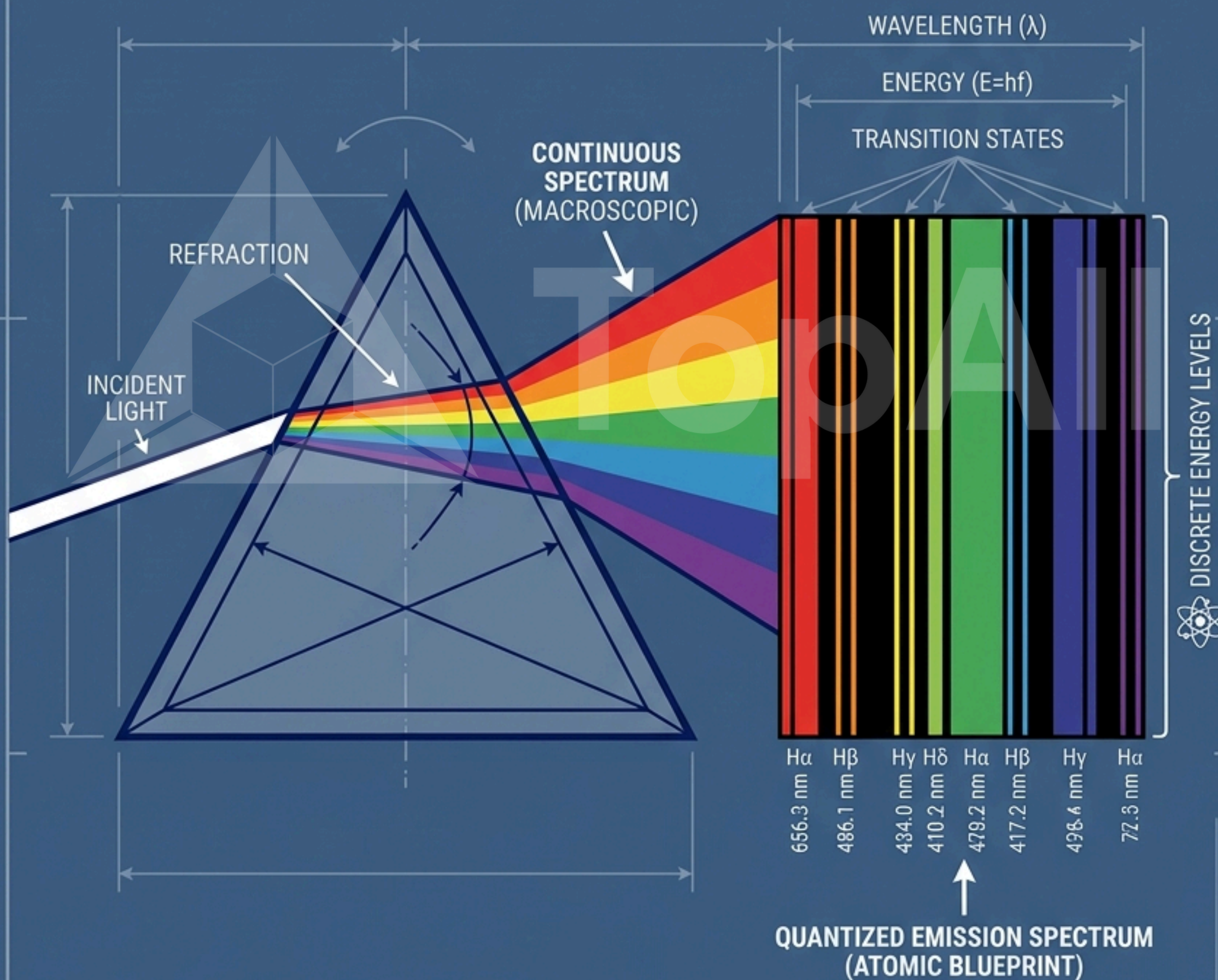
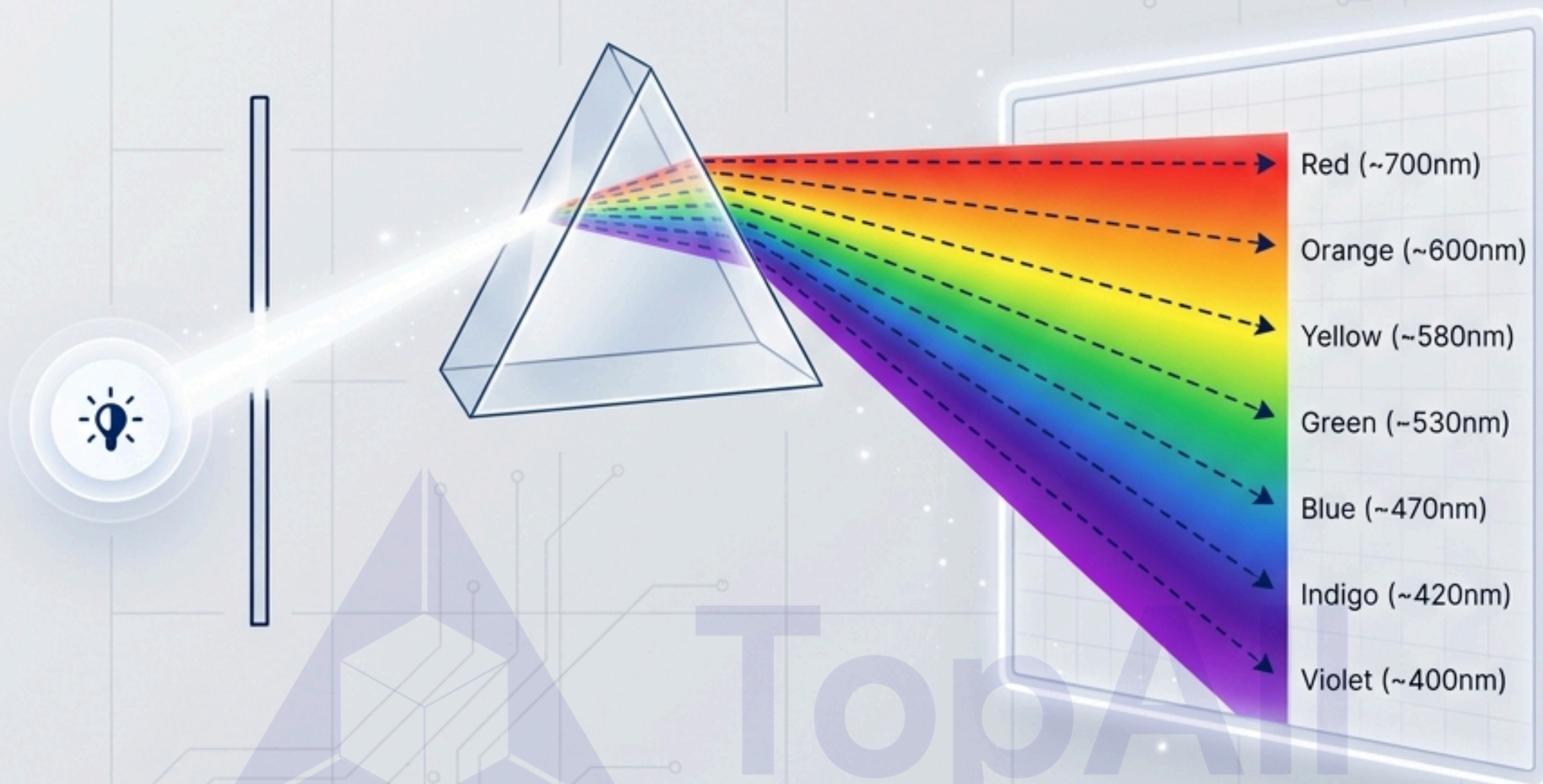


ATOMIC SPECTRA

From macroscopic light to the quantized blueprint of the atom.



The Baseline: The Continuous Spectrum



Source



Ordinary white light (contains all wavelengths in the visible range).

Mechanism



Shorter wavelengths (violet) bend more than longer wavelengths (red) when passing through the prism.

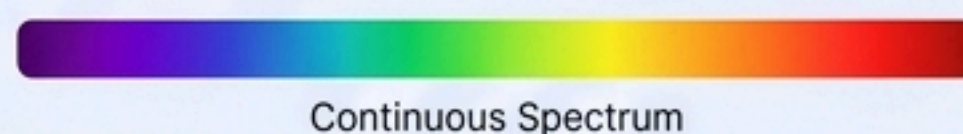
Visible Range

Violet (7.50×10^{14} Hz) to Red (4×10^{14} Hz).

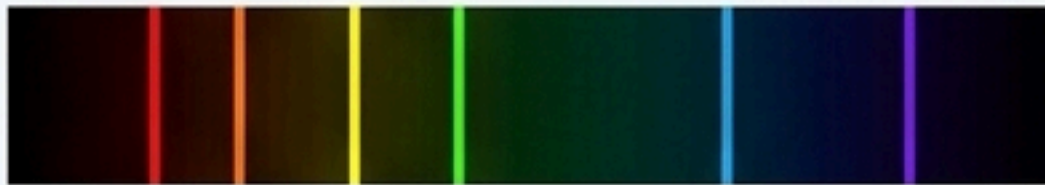


The Result

A continuous spectrum—colors merge seamlessly with zero gaps or missing wavelengths.



The Anomaly: Emission vs. Absorption



Emission Spectrum	Absorption Spectrum
 Source Excited gas/atoms (energy supplied by heat or irradiation).	White light passed through a cool, unexcited gas.
 Process Atoms release absorbed energy as radiation.	Atoms absorb specific wavelengths from the continuum.
 Visual Appearance Photographic Positive (Bright lines).	Photographic Negative (Dark missing lines).
 Outcome Specific bright colored lines on a dark background.	Dark spaces/gaps in an otherwise continuous bright spectrum.



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

$$E=mc^2$$



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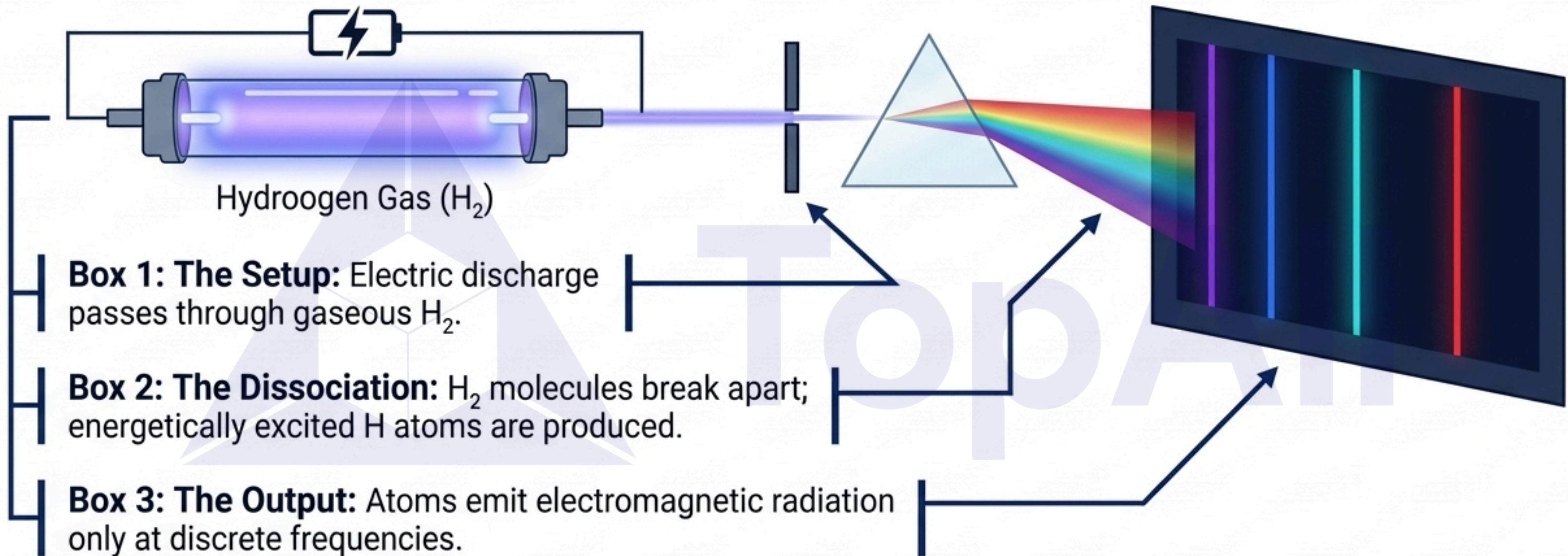
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- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



The Prototype: Hydrogen's Fingerprint



Line spectra are the fingerprints of the universe. Just as fingerprints identify humans, exact line line matching identifies unknown elements (e.g., the discovery of Helium in the sun).

The Mathematical Code

$\bar{\nu}$: Wavenumber
(Number of wavelengths
per unit length).

n_1 : Destination orbit
(Lower energy state).

$$\bar{\nu} = 109677 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

109677 : The Rydberg
Constant (R_H) for Hydrogen.

n_2 : Origin orbit
(Higher energy state,
where $n_2 = n_1 + 1, n_1 + 2, \dots$).



JEE Trap! The standard Rydberg constant 109,677 is in units of cm^{-1} .
Do not confuse this with meters or Hertz during calculations!

Mapping the Spectral Series

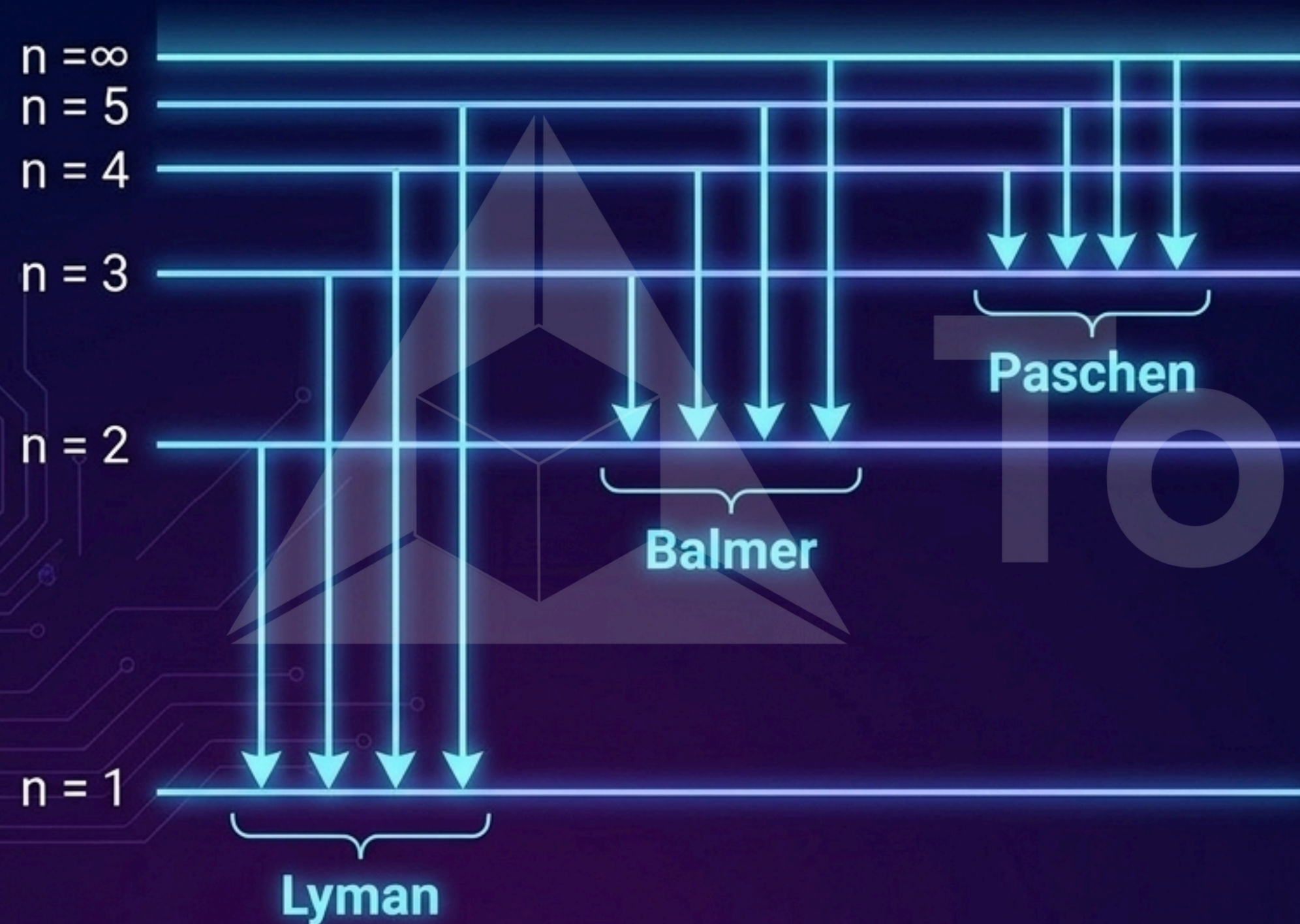
Electromagnetic Region

Destination Orbit (n_1)

	$n_1 = 1$	$n_1 = 2$	$n_1 = 3$	$n_1 = 4$	$n_1 = 5$
Ultraviolet	Lyman Series $n_1 = 1 \leftarrow n_2 = 2, 3 \dots$				
Visible		Balmer Series $n_1 = 2 \leftarrow n_2 = 3, 4 \dots$			
Infrared			Paschen Series $n_1 = 3 \leftarrow n_2 = 4, 5 \dots$	Brackett Series $n_1 = 4 \leftarrow n_2 = 5, 6 \dots$	Pfund Series $n_1 = 5 \leftarrow n_2 = 6, 7 \dots$

The Balmer series contains the **ONLY** lines in the hydrogen spectrum that appear in the visible region.

The Energy Cascade



$$\Delta E = E_f - E_i = h\nu$$

The exact energy gap dictates the exact color/frequency of the photon emitted.

The Ultimate Proof

Concept: Line spectra are the ultimate experimental proof of quantized energy levels.

Meaning: Electrons cannot exist in the space between orbits. They can only absorb or emit energy in discrete, exact amounts (quanta) to jump between locked states.



JEE Exam Traps

- **Sign Convention Error:** Remember that for an emission spectrum ($n_i > n_f$), ΔE is **NEGATIVE** because energy is released.
- **Absorption vs. Emission:** If a problem states 'absorption,' the electron is moving to a higher principal quantum number ($n_f > n_i$). The Rydberg equation parenthesis term will be **positive**.



You've Learned the Theory.

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