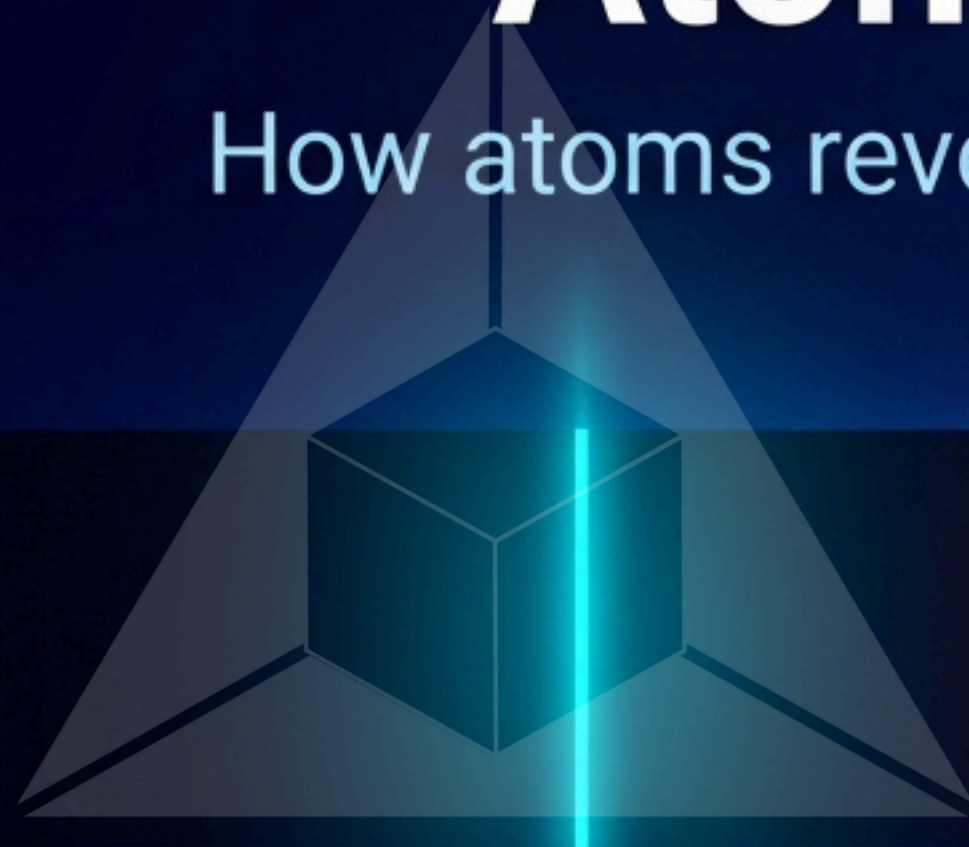


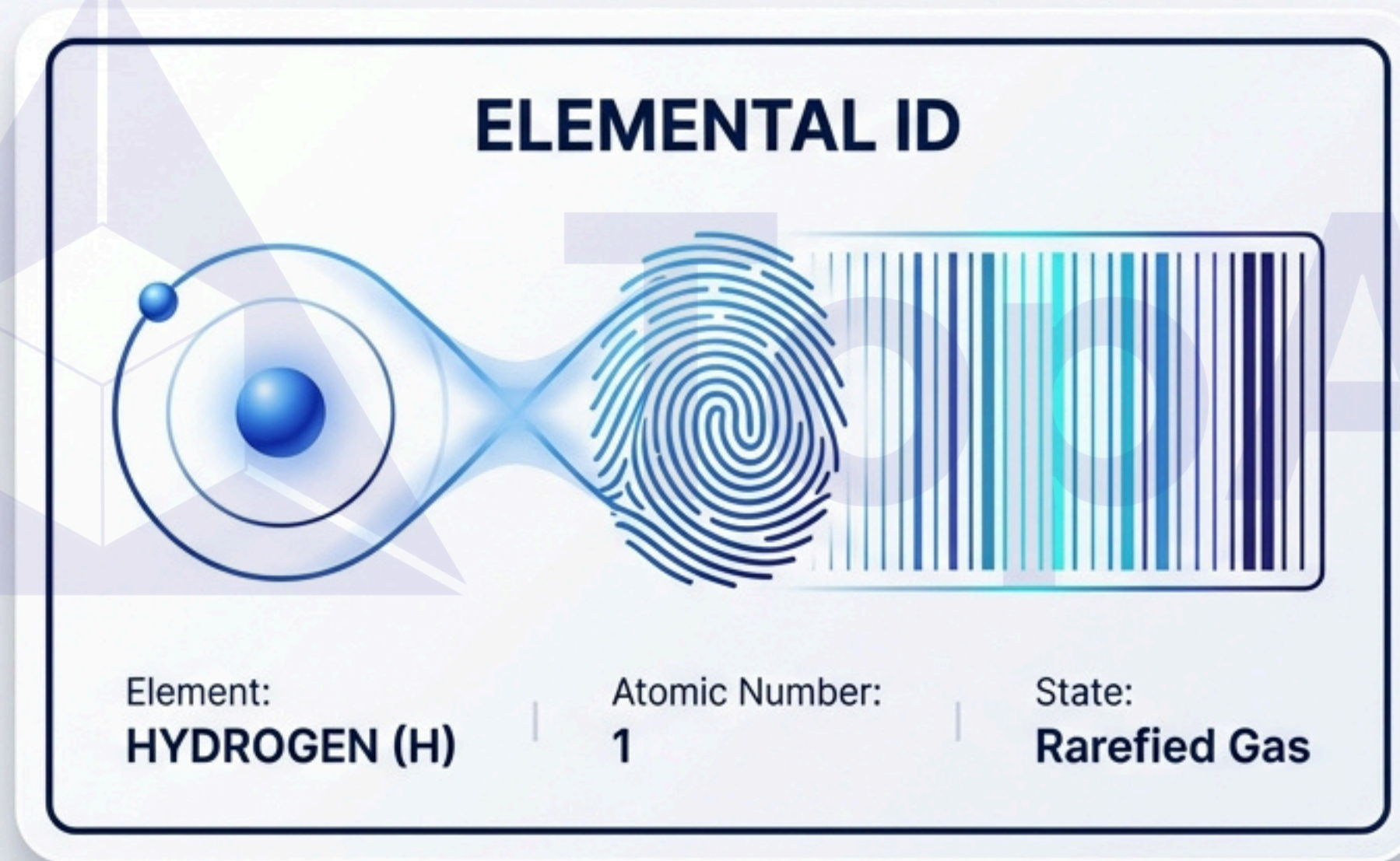
Atomic Spectra

How atoms reveal themselves through light



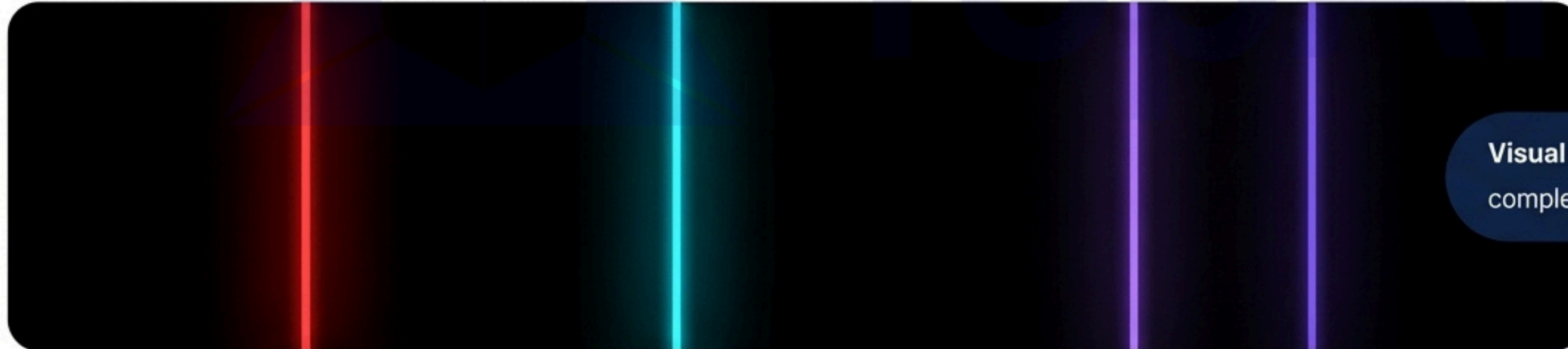
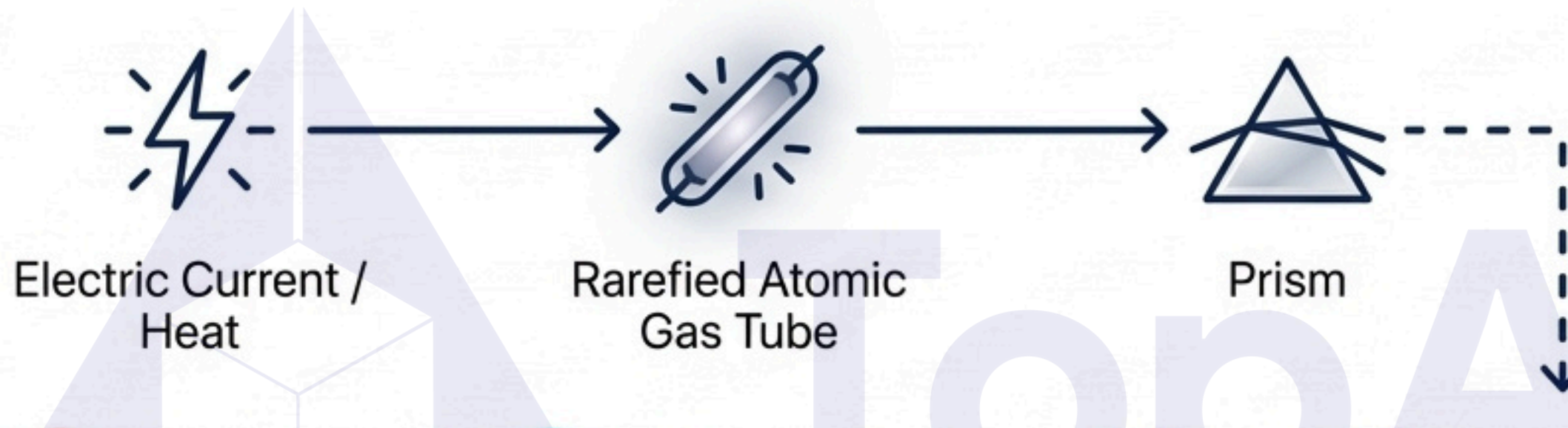
The Elemental Fingerprint

In the early 19th century, physicists discovered that every element has a unique, characteristic spectrum. By observing the light emitted from rarefied gases, we can identify elements anywhere in the universe.



H2: Emission Line Spectrum

When an atomic gas or vapour is excited at low pressure, it emits radiation containing only specific, discrete wavelengths.



Visual Signature: Bright lines on completely dark background.

The emission line spectrum of Hydrogen features a fixed set of specific visible lines.



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$$E=mc^2$$



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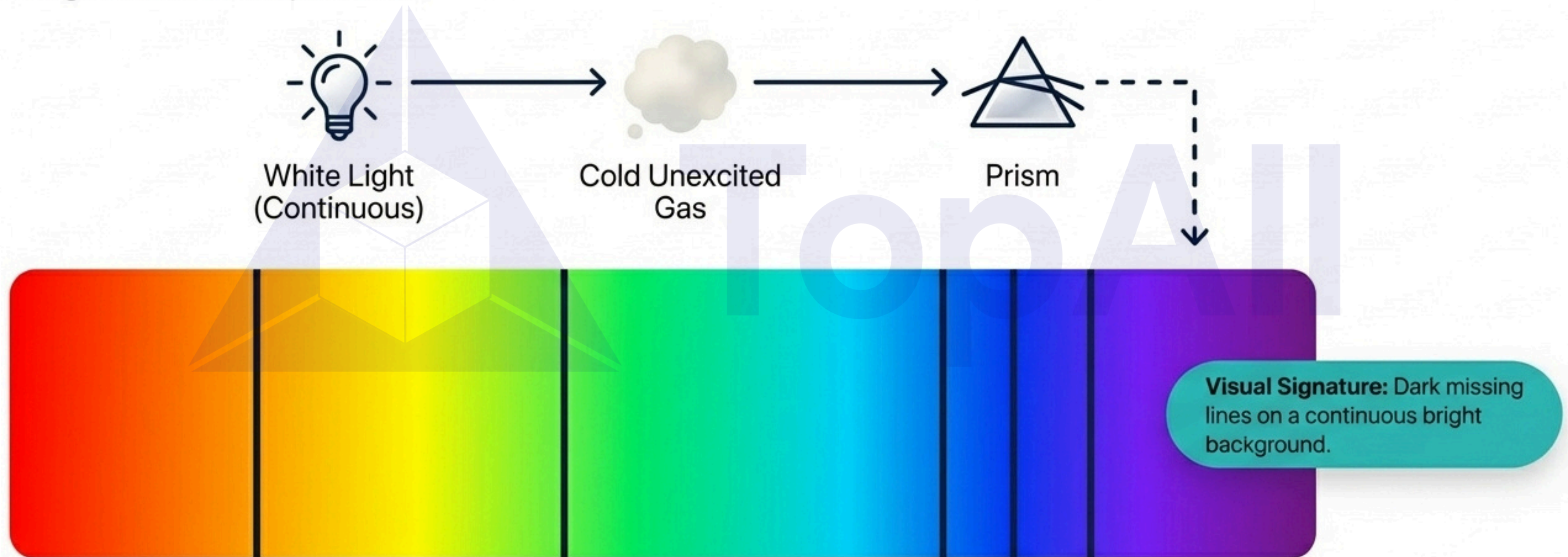
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H2: Absorption Spectrum

When continuous white light passes through a gas, specific wavelengths are absorbed. These dark lines correspond precisely to the wavelengths found in the gas's emission spectrum.



H2: Diagnostic Matrix: Emission vs Absorption



Emission Spectrum

- **Source:** Hot, electrically excited rarefied gas.
- **Appearance:** Bright glowing lines on a dark background.
- **Mechanism:** Energy is released as photons.



Absorption Spectrum

- **Source:** White light passing through cold gas.
- **Appearance:** Dark missing lines on a continuous rainbow.
- **Mechanism:** Energy is consumed from incoming photons.

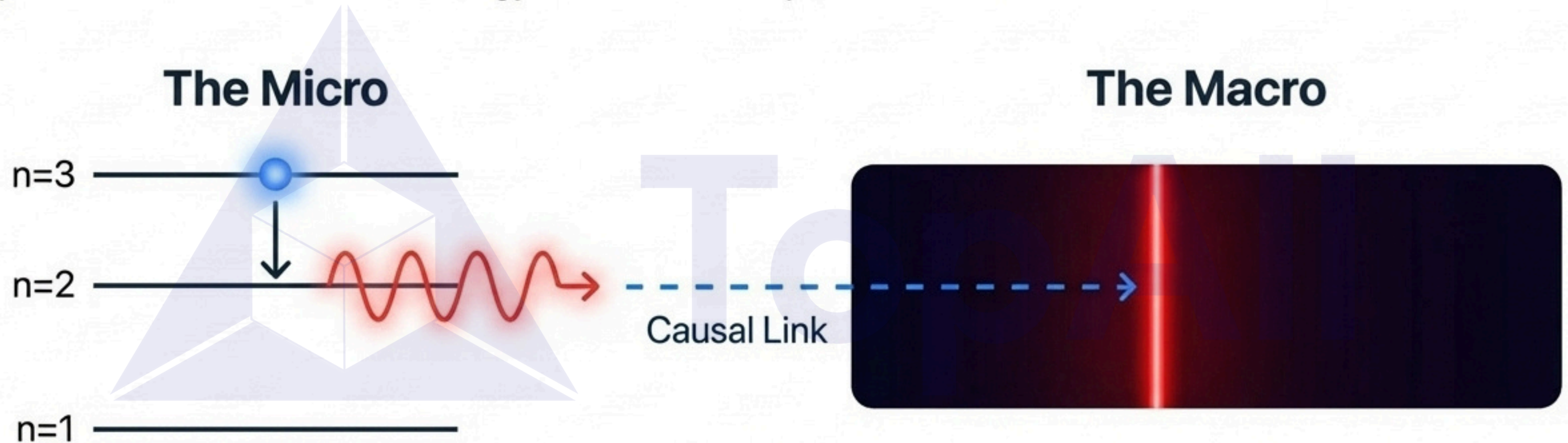
EXAM TRAP

Trap: Thinking the dark and bright lines for the same element appear at different wavelengths.

Fact: Absorption dark lines occur at the EXACT same wavelengths as emission bright lines. They are two sides of the same atomic coin.

H2: Why Spectra Matter

Rutherford's classical atom predicted continuous energy emission, which would create a smooth rainbow. The existence of sharp, discrete spectral lines proved that internal atomic energy is restricted to specific levels.



KEY TAKEAWAY: Discrete macroscopic spectral lines are the ultimate proof of discrete microscopic energy states (quantization).

H2: Recap + Practice

Recap

- ✓ **Spectra** act as universal, unique fingerprints for identifying elements.
- ✓ **Emission** = bright lines on dark (energy released by excited gas).
- ✓ **Absorption** = dark lines on bright (energy absorbed by cold gas).

Check Your Understanding

Q1: If continuous white light is transmitted through an unexcited hydrogen cloud, which type of spectrum is observed?

Q2: True or False: A gas will absorb different wavelengths than it emits.



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