

Limitations of Bohr's Atomic Model

Where the planetary model breaks down.



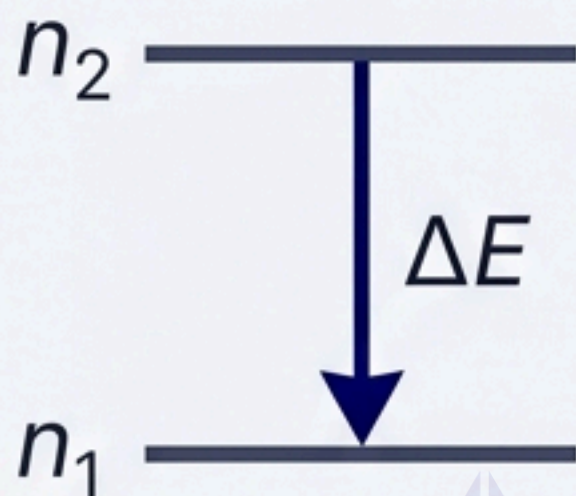
Bohr's model successfully explained hydrogen's stability and primary spectrum, but testing the model against complex physical realities revealed fundamental boundaries to its predictive power.



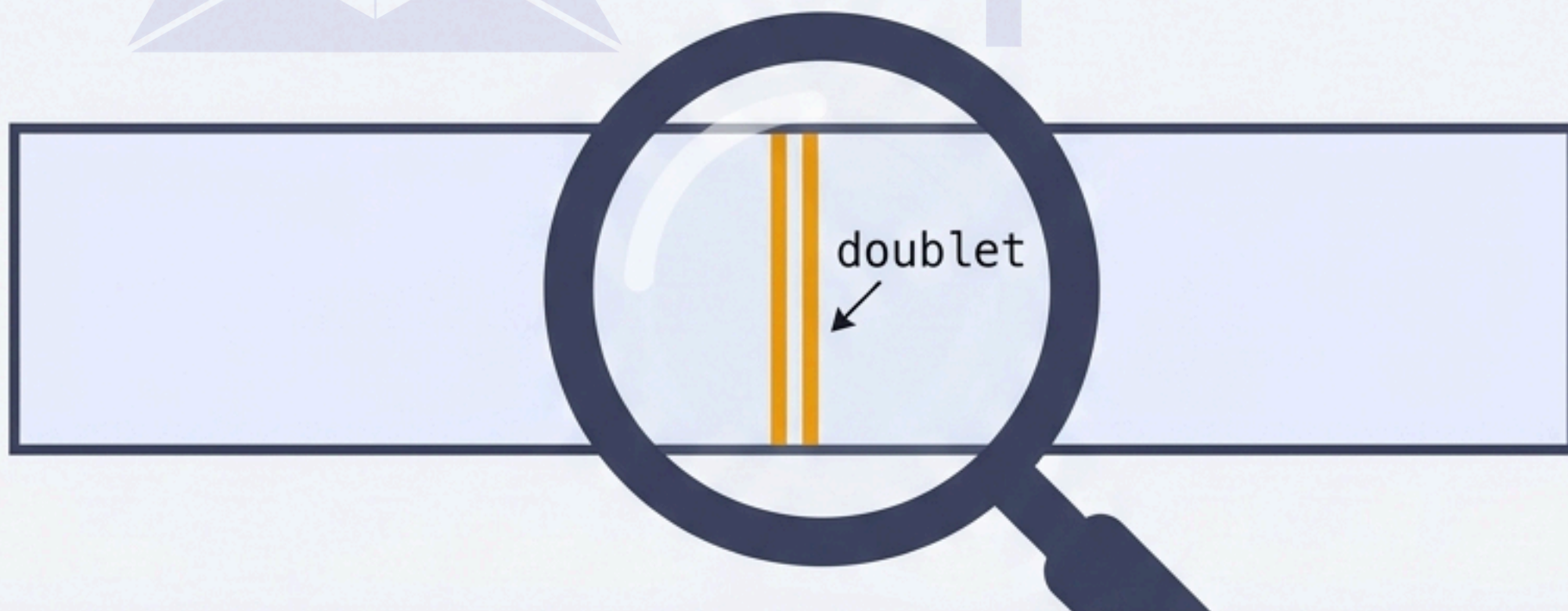
Limitation 1: The Fine Spectrum Anomaly



Low-Resolution View (Bohr's Prediction)



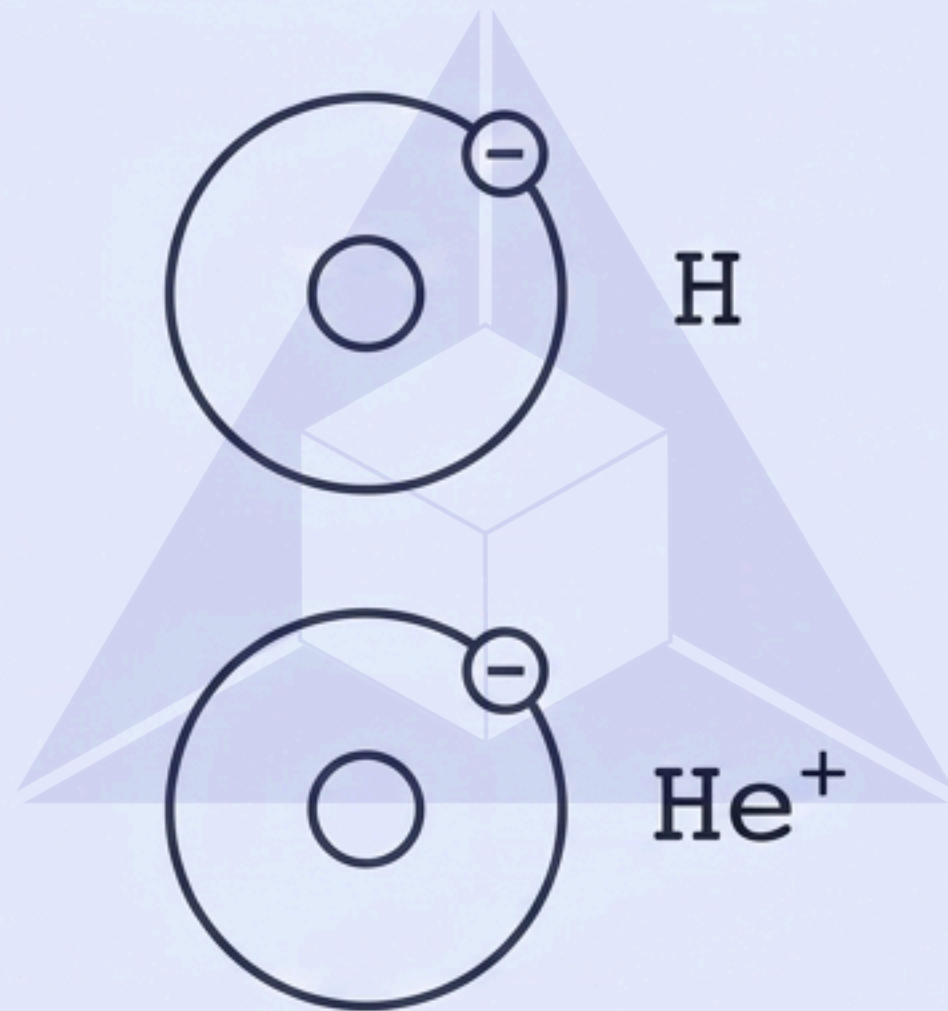
High-Resolution View (Actual Reality)



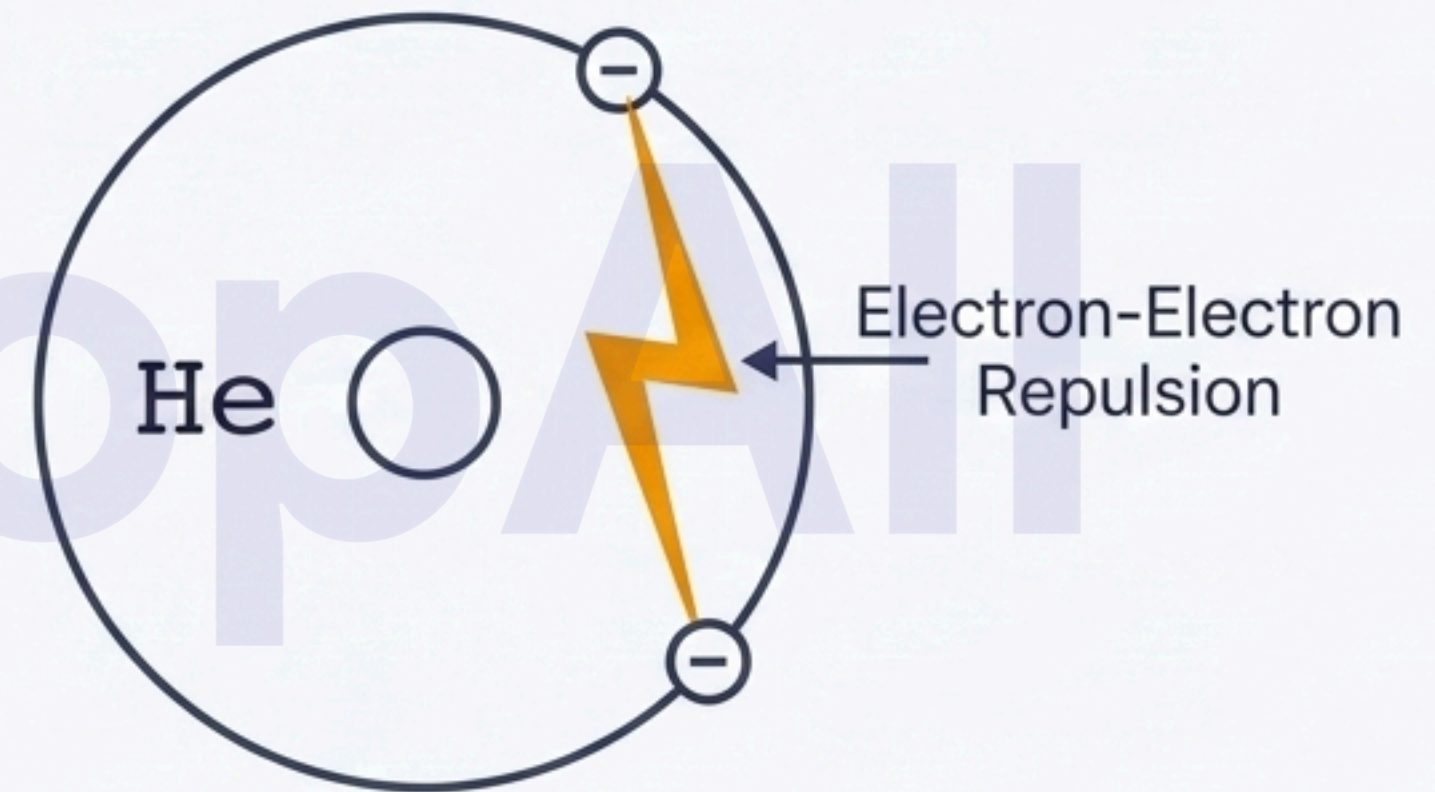
Bohr's model fails to account for the finer details of the hydrogen spectrum. When observed with sophisticated spectroscopic techniques, supposedly single spectral lines are actually doublets (closely spaced pairs).

Limitation 2: The Multi-Electron Failure

Valid: Single-Electron Systems



Invalid: Multi-Electron Systems



Bohr's math only works for a single electron interacting with a nucleus. It completely fails for atoms with two or more electrons (like neutral Helium) because it cannot account for the repulsive forces between multiple electrons.



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$$E=mc^2$$



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Key Highlights

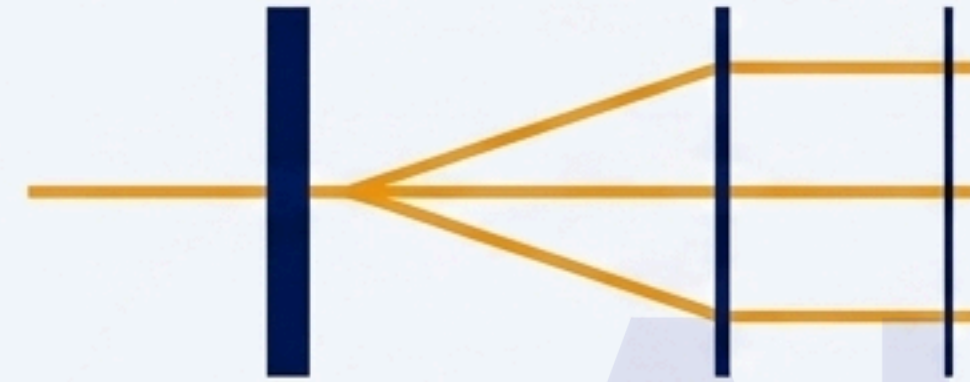
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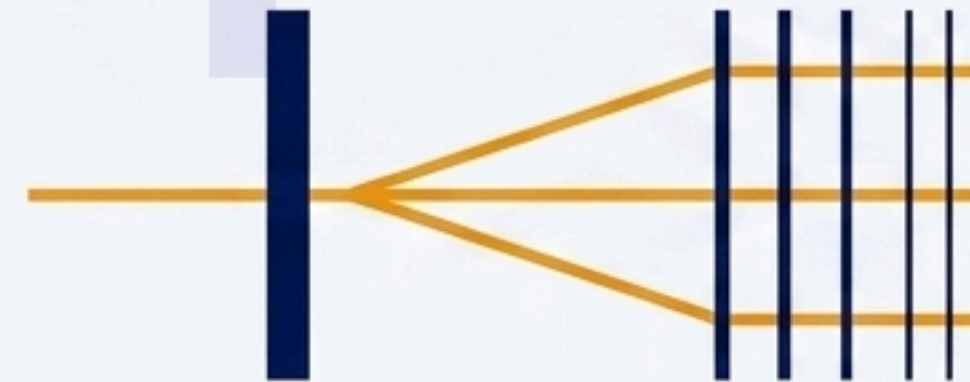
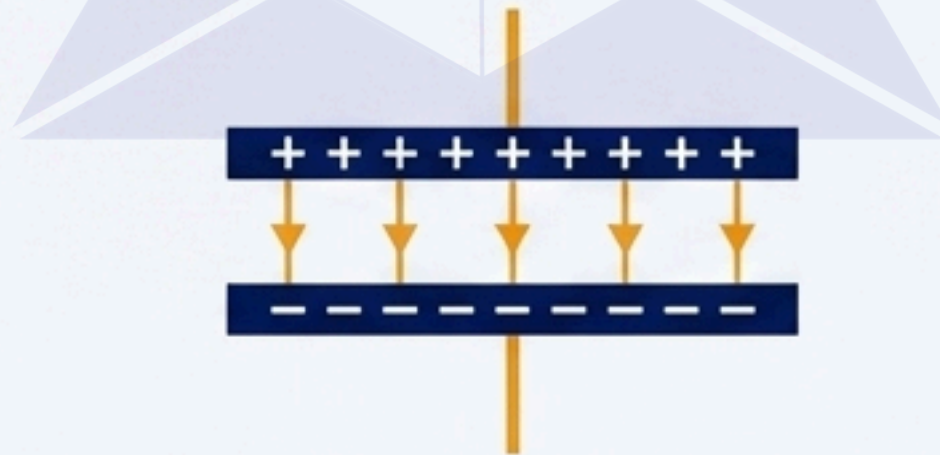
Limitation 3: Vulnerability to External Fields



Zeeman Effect (Magnetic Field)

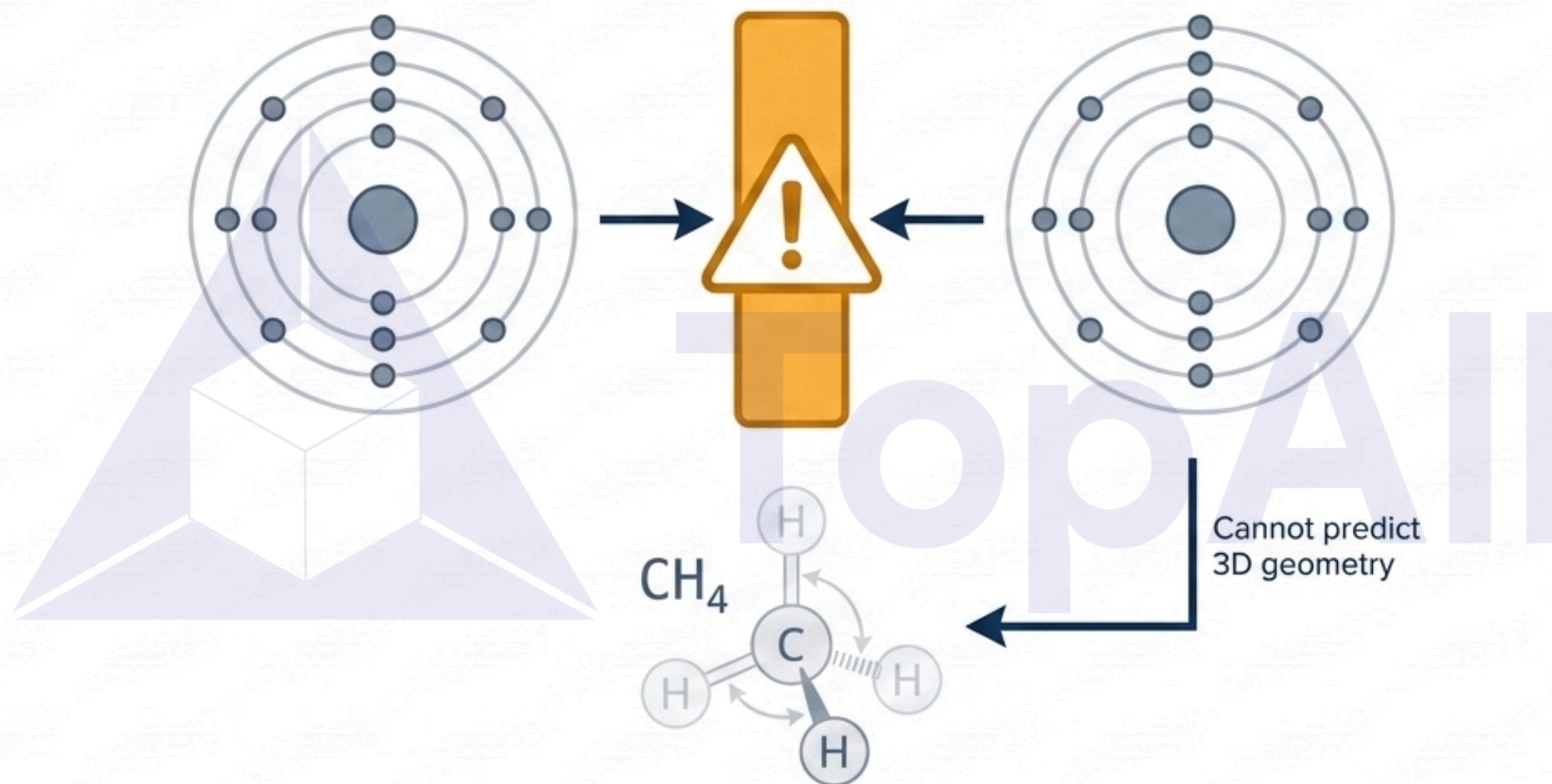


Stark Effect (Electric Field)



Bohr's theory is unable to explain why atomic spectral lines undergo further splitting when the atom is subjected to external magnetic or electric fields.

Limitation 4: The Chemical Bonding Paradox



The model could not explain the ability of atoms to form molecules via chemical bonds. Flat, two-dimensional circular orbits offer no physical mechanism for creating directional covalent bonds or complex 3D molecular shapes.

The Bohr Boundary: Diagnostic Checklist



Strictly for Hydrogen-Like Species

Valid Species	Invalid Species
✓ H ✓ He⁺ ✓ Li²⁺ ✓ Be³⁺	✗ Neutral He ✗ Li ✗ Be ✗ H⁺ (no electron)

Mathematical constraint: Z (Atomic Number) = Any integer, but e^- (Electrons) **MUST** = 1.

JEE TRAP: Before calculating radius (r_n) or energy (E_n) using Bohr equations, always **verify the species has exactly one electron**. Applying Bohr math to neutral multi-electron atoms is a guaranteed error.



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