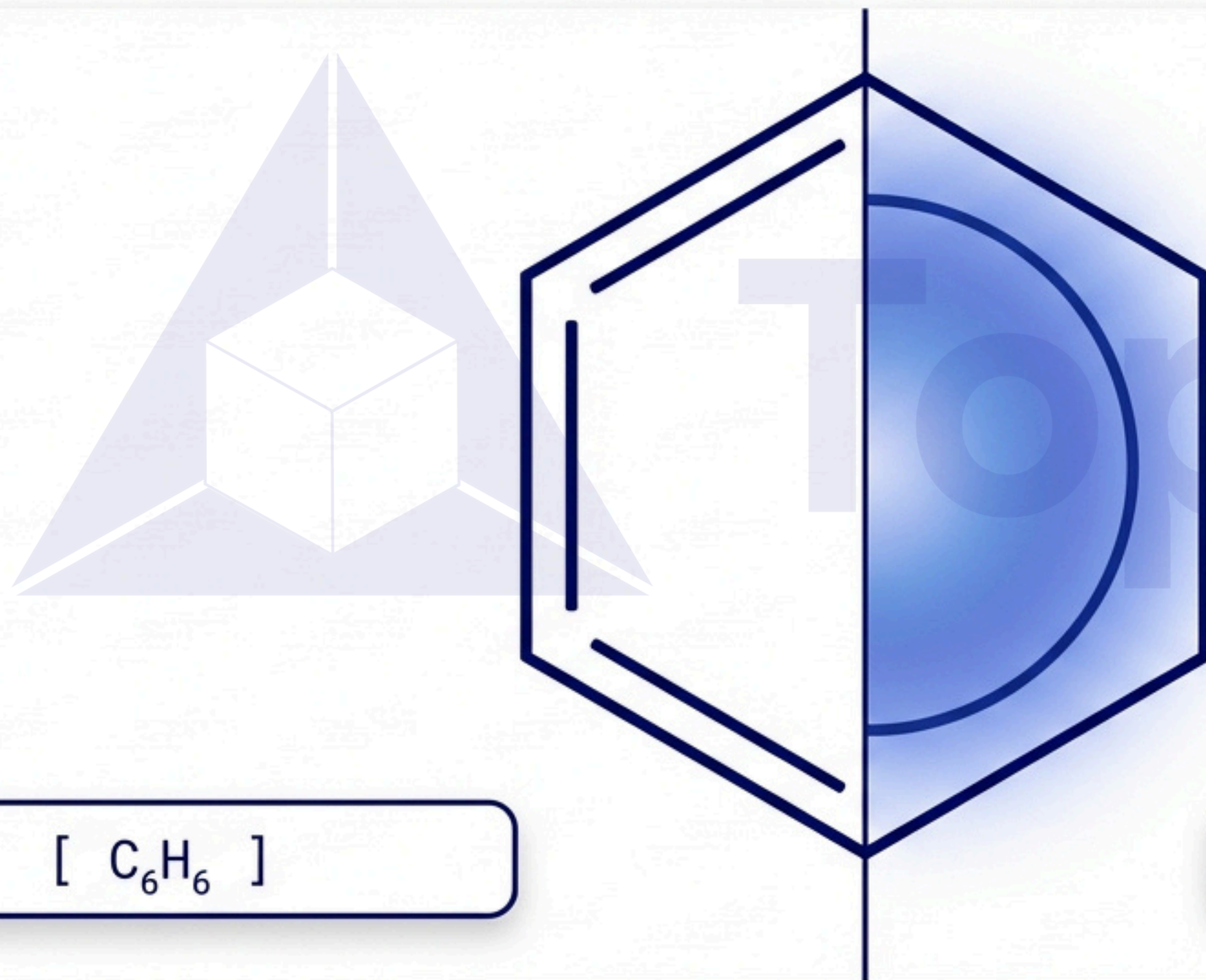


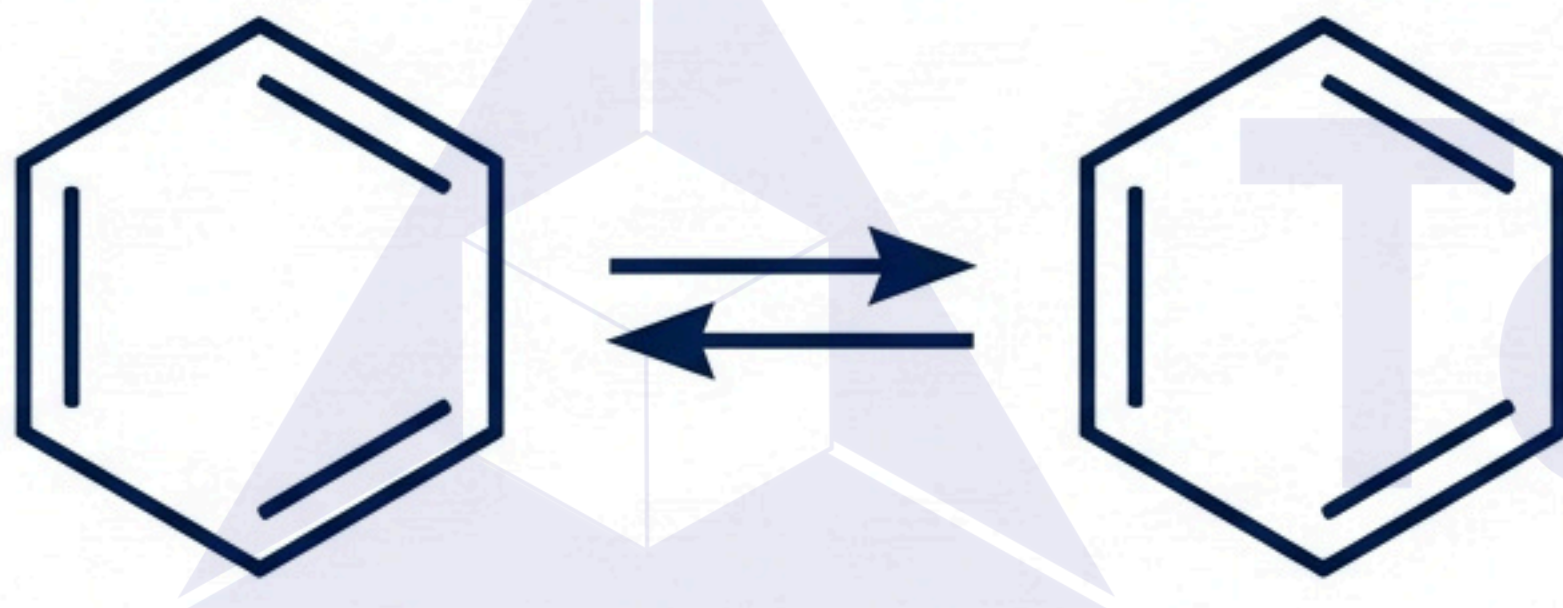
STRUCTURE OF BENZENE



Degree of Unsaturation: 4

The Kekulé-Style View

Card A (The Model)



Proposed cyclic arrangement of six carbon atoms with alternate single and double bonds.

Card B (The Timeline)

- 1825
Michael Faraday isolates Benzene.
- 1865
August Kekulé proposes the dynamic structural formula.

Crucial Insight: All six carbon and six hydrogen atoms are identical.

The Structural Anomaly

Why the Alternating Model Fails

Anomaly Detected: Benzene is not just cyclohexatriene.

Expectation (Hypothetical Cyclohexatriene)



- Should have two distinct bond lengths.
- Should be highly reactive and undergo typical alkene addition reactions.

Reality (Actual Benzene)



- Unusually stable molecule.
- Strongly prefers substitution reactions (retaining the ring) over addition reactions.



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

$$E=mc^2$$



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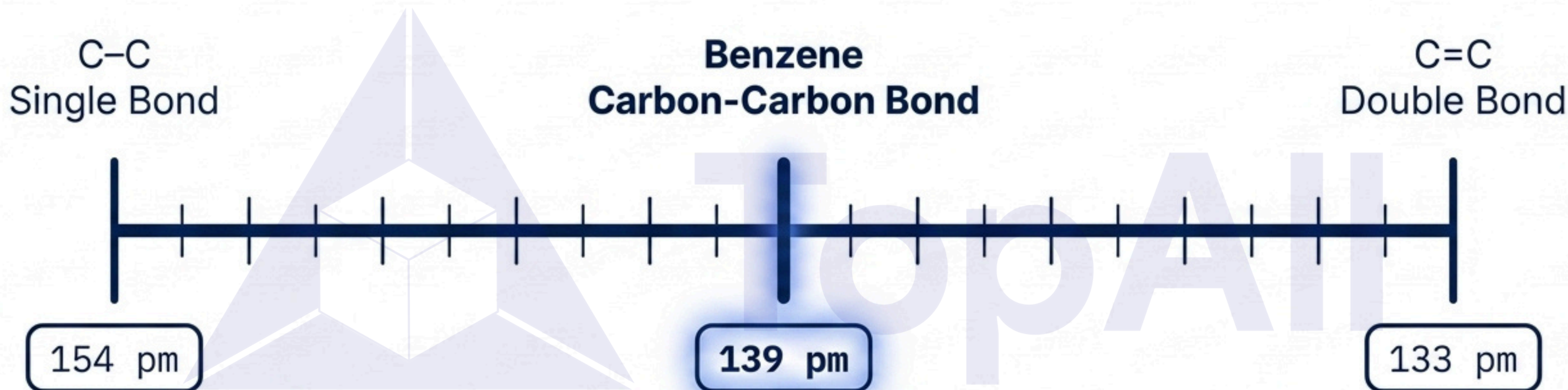
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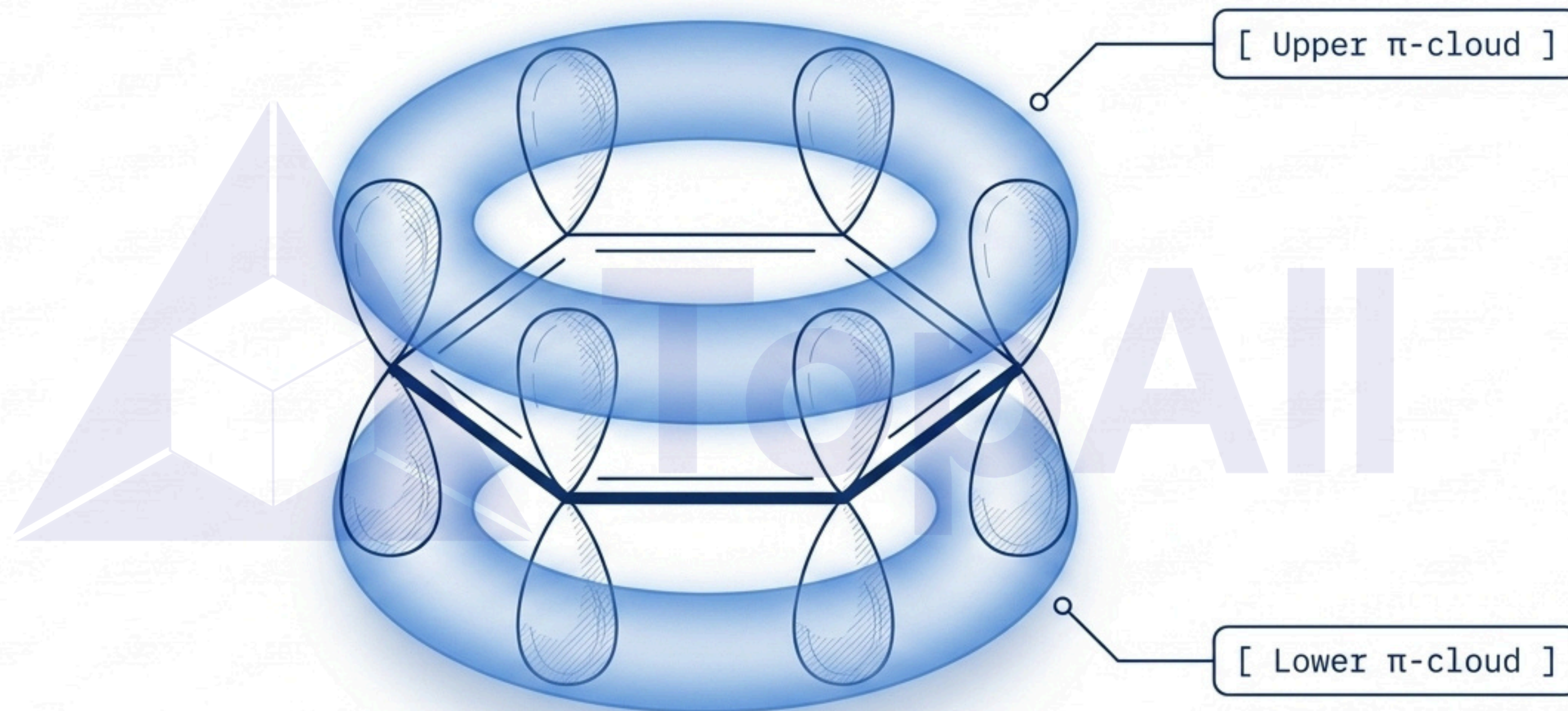


The Proof: Equal 139 pm Bond Lengths



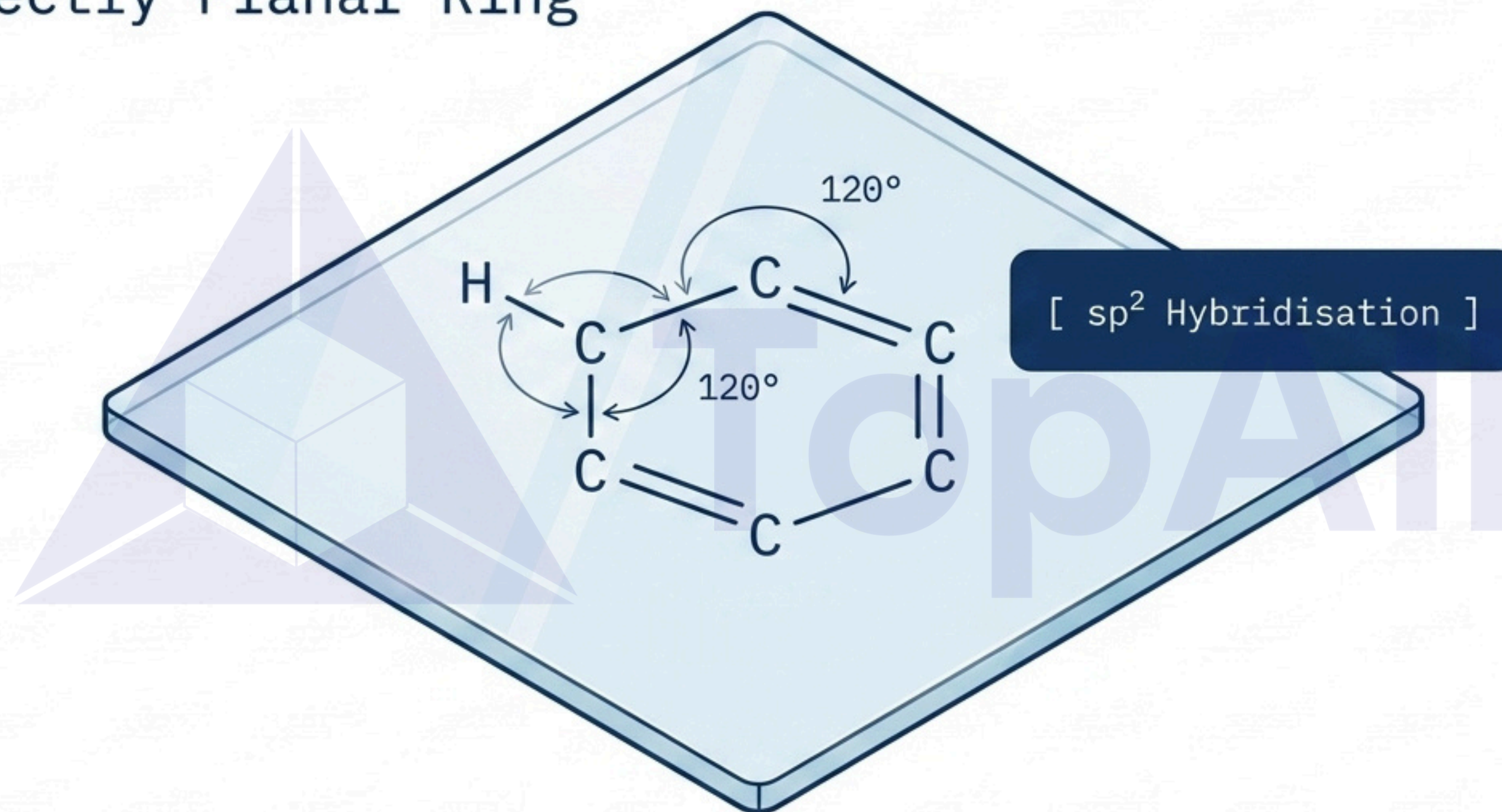
X-ray diffraction data reveals all six C–C bonds are identical. The intermediate length proves the absence of pure single or double bonds, indicating partial double bond character across the entire ring.

The Delocalised Pi Electron Cloud



Six π electrons move freely about the six carbon nuclei, attracted more strongly than localized electrons.

A Perfectly Planar Ring



Coplanarity is a mandatory condition. If the ring wasn't flat, lateral p-orbital overlap would be impossible.

Delocalisation Equals Extra Stability

1.

p-orbitals
overlap laterally.

2.

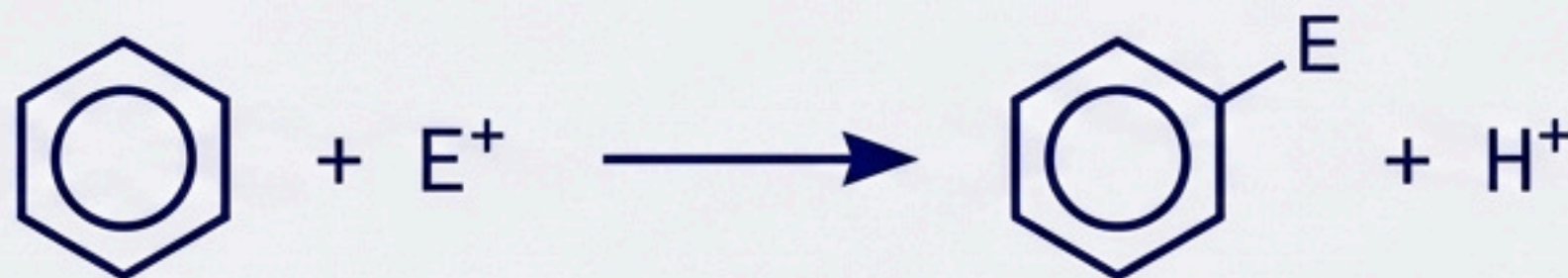
6 π electrons
delocalize over all
6 nuclei.

3.

Electron cloud is
held more tightly
by the nuclei.

4.

Molecule achieves
unusually high
thermodynamic
stability.



Consequence: Prefers Electrophilic Substitution to protect the stable π system.

Benzene is Not Cyclohexatriene

	Hypothetical Cyclohexatriene (Kekulé)	Actual Benzene (Modern)
Bond Lengths	Alternating 154pm & 133pm	Uniform 139pm
Reactivity	Addition (Ring breaks)	Substitution (Ring stays)
Electron State	Localized π bonds	Delocalized π cloud

Key Takeaways Panel

- Benzene represents a unique class of aromatic stability.
- Follows the $(4n + 2)$ π electron rule (where $n=1$, yielding 6 delocalized π electrons).



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