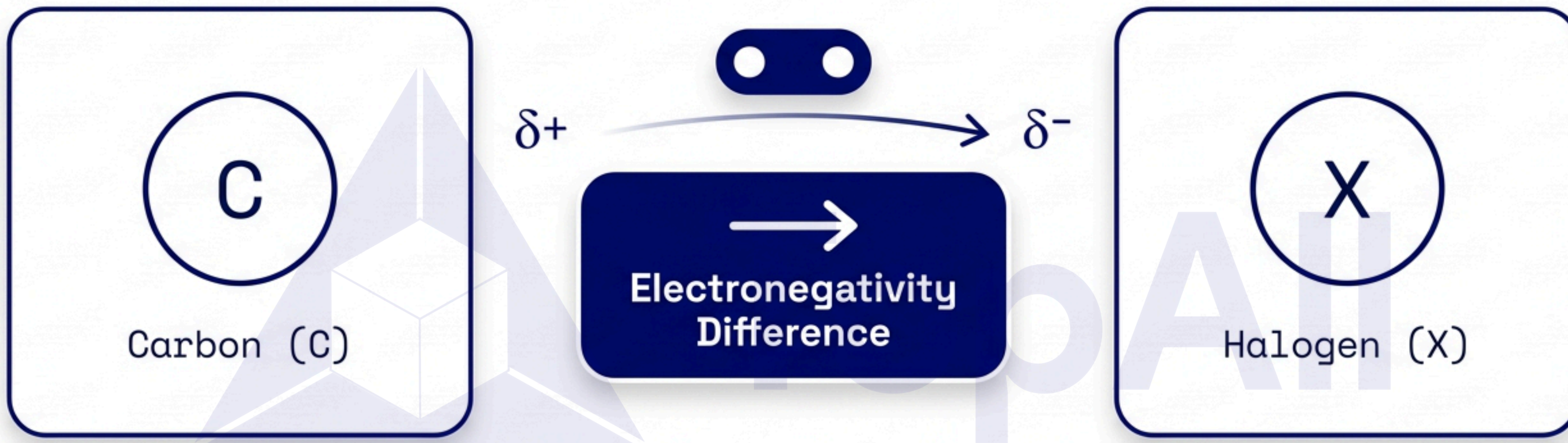


Why the C-X Bond Is Reactive

Deconstructing the nature, polarity, and physical properties of haloalkanes.



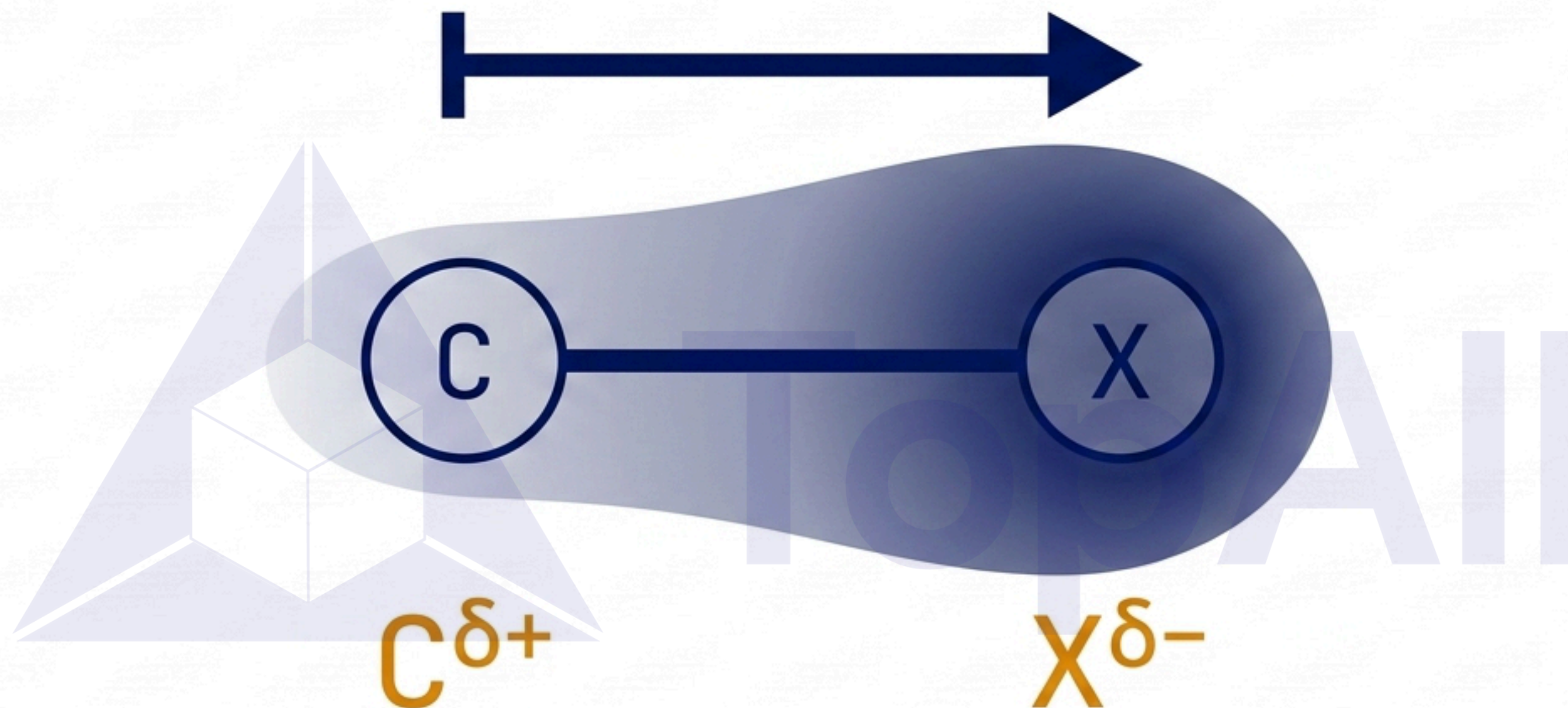
The Core Principle: Electronegativity



Halogen atoms are fundamentally more electronegative than carbon atoms.

This disparity means the shared pair of electrons in the covalent bond is not shared equally. The halogen exerts a stronger pull on the electron cloud.

Anatomy of the Polar Bond



The partial positive charge ($C^{\delta+}$) makes the carbon atom electron-deficient. This makes it a prime target for nucleophiles—the key to nucleophilic substitution reactions.



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

$$E=mc^2$$



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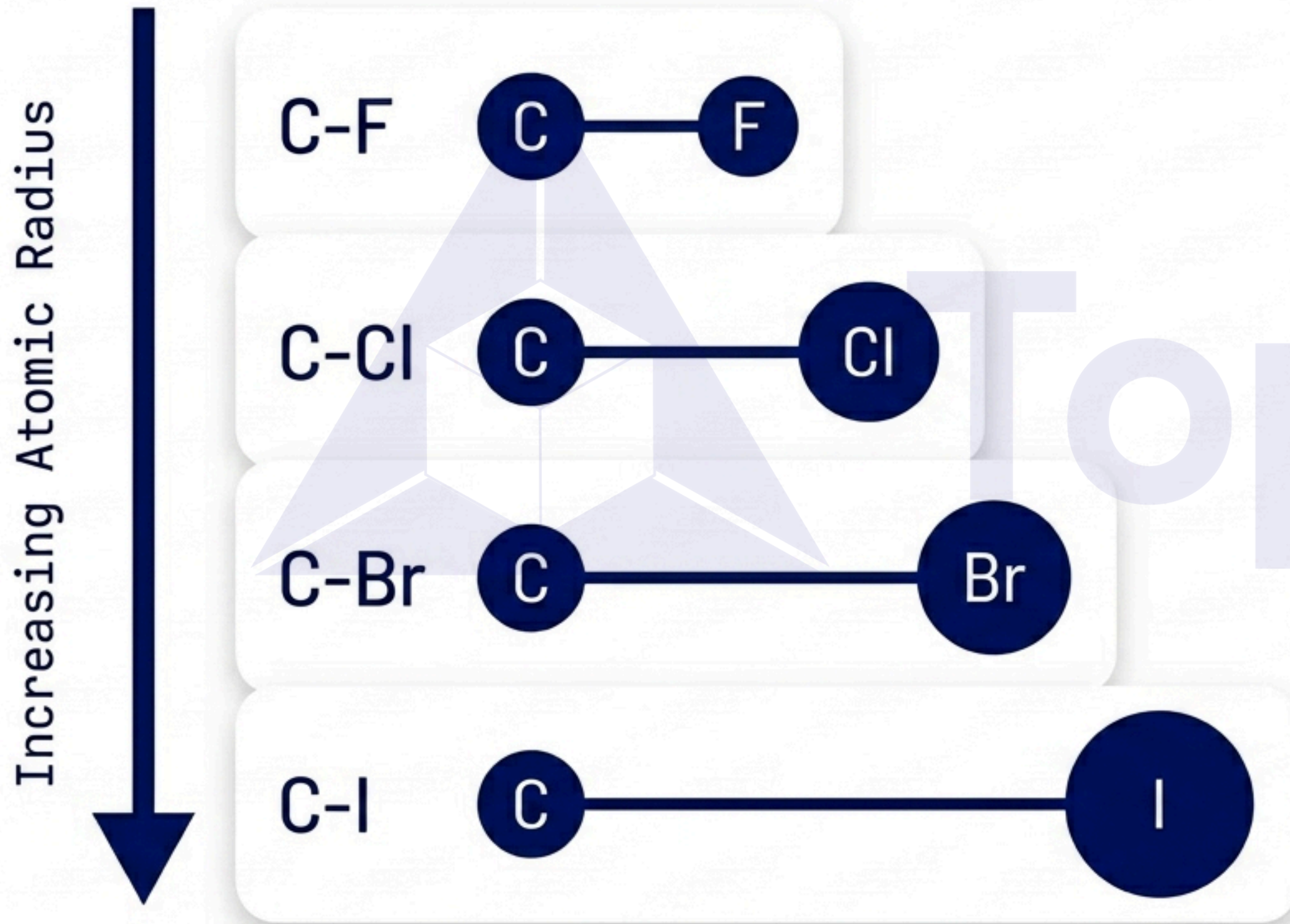
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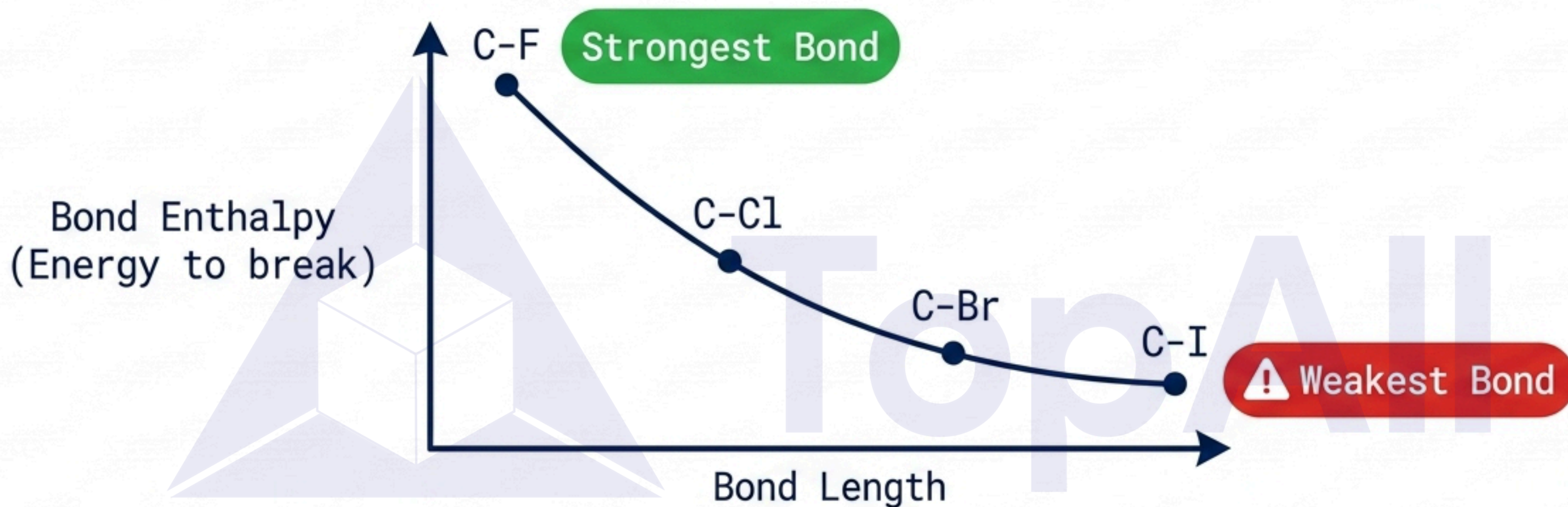
The Dimension Variable: Moving Down Group 17



As we go down the group in the periodic table, the physical size of the halogen atom increases.

Consequently, the carbon-halogen bond length stretches, changing the fundamental stability of the molecule.

The Strength Variable: Bond Enthalpy



Bond enthalpy represents the energy required to break the C-X bond.

Inverse Relationship: As the halogen atom gets larger and the bond lengthens, the bond becomes exponentially easier to break.

Empirical Evidence: Methyl Halides

$\text{CH}_3\text{-F}$

Length: 139 pm

Enthalpy: 452 kJ/mol

Dipole: 1.847 D

$\text{CH}_3\text{-Cl}$

Length: 178 pm

Enthalpy: 351 kJ/mol

Dipole: 1.860 D

$\text{CH}_3\text{-Br}$

Length: 193 pm

Enthalpy: 293 kJ/mol

Dipole: 1.830 D

$\text{CH}_3\text{-I}$

Length: 214 pm

Enthalpy: 234 kJ/mol

Dipole: 1.636 D

Key Takeaways: The Equation of Reactivity



The Size Factor: Iodine's massive size creates a long, weak bond, making iodoalkanes the fastest to react.

The Polarity Factor: Despite varying dipole moments, the permanent $\text{C}^{\delta+} - \text{X}^{\delta-}$ polarization is the universal trigger for nucleophilic attack across all haloalkanes.



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