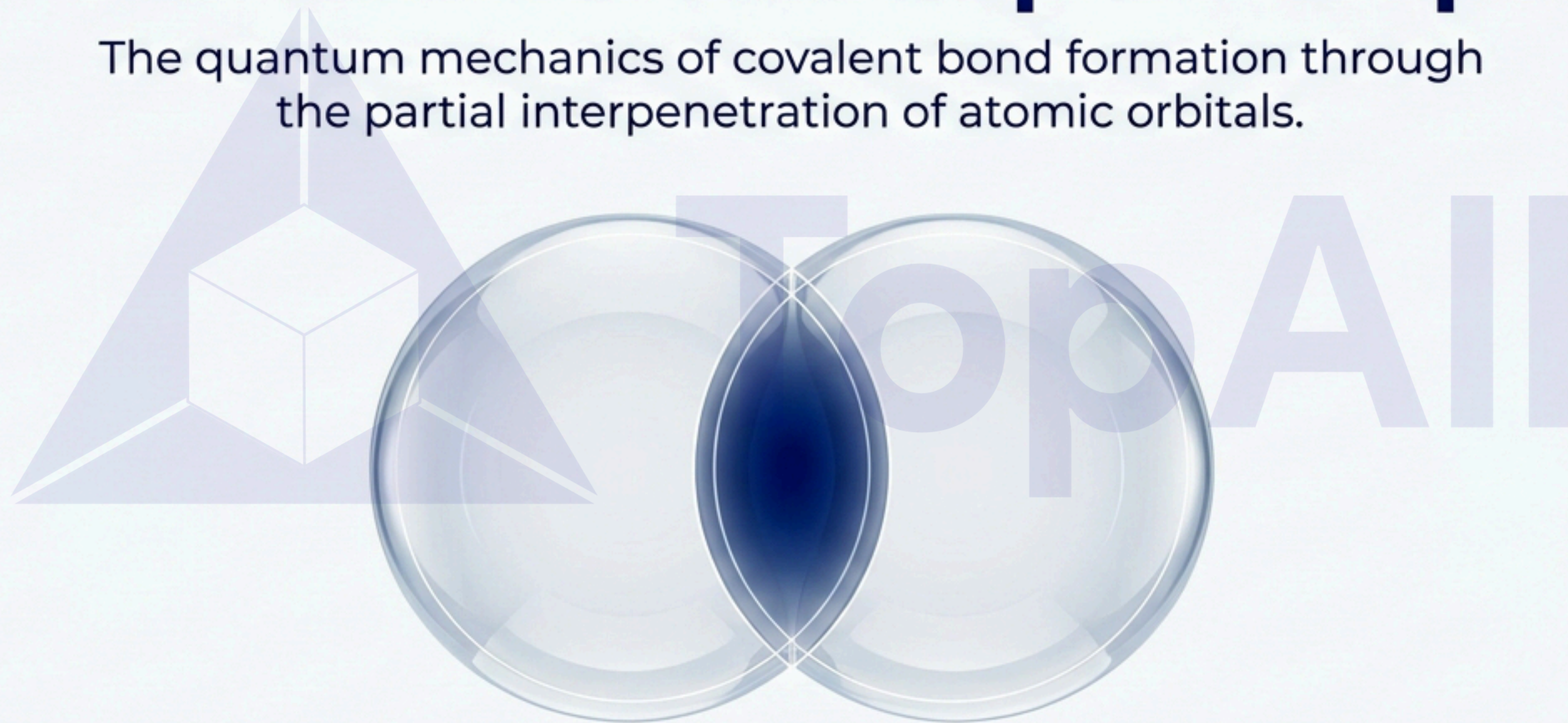


VALENCE BOND THEORY (VB)

4.5.1 Orbital Overlap Concept

The quantum mechanics of covalent bond formation through the partial interpenetration of atomic orbitals.



DEFINING THE CONCEPT

What Is Orbital Overlap?

According to Valence Bond Theory, a covalent bond forms when atoms approach each other and their atomic orbitals undergo **partial interpenetration**.



Isolated State

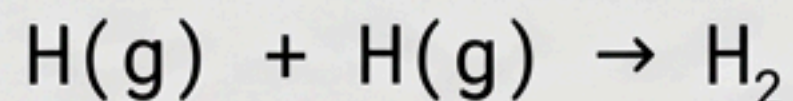
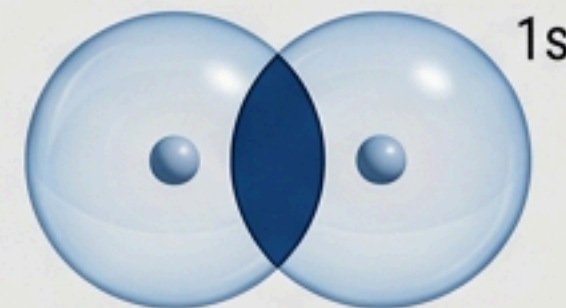
No interaction. High potential energy.



Exam Key: Partial Interpenetration

The Overlap (Minimum Energy State)

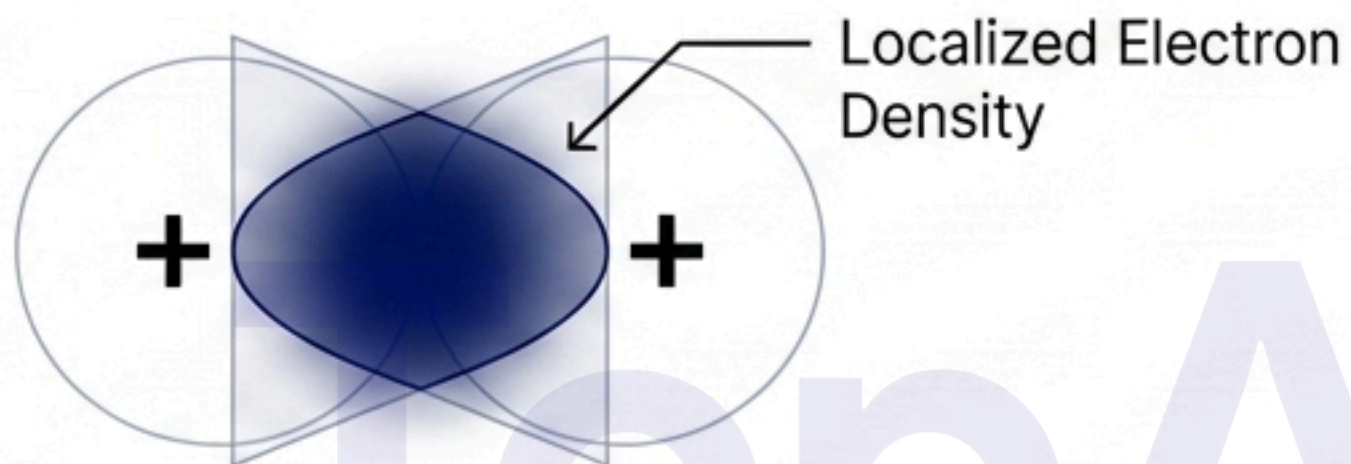
Orbitals merge. System acquires minimum energy.



Orbitals merge to achieve stability

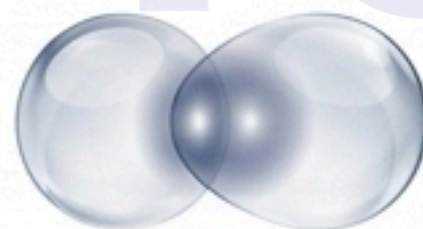
How Electron Density Builds Between Nuclei

The overlap of atomic orbitals results in a localized build-up of negative charge between the two positive nuclei.



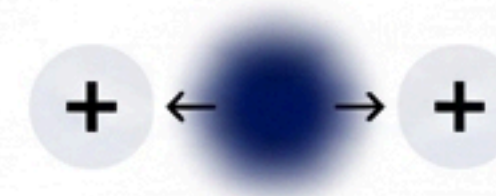
Opposite Spins

Electrons in the overlapping orbitals must have opposite spins.



Electron Pairing

The merging of orbitals allows these valence electrons to pair up.



Nuclei Shielding

The concentrated electron density acts as a glue, balancing the repulsive forces between the two positive nuclei.



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$$E=mc^2$$



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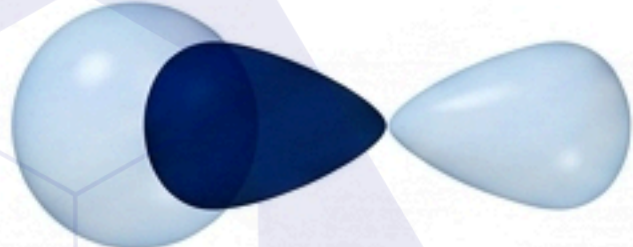
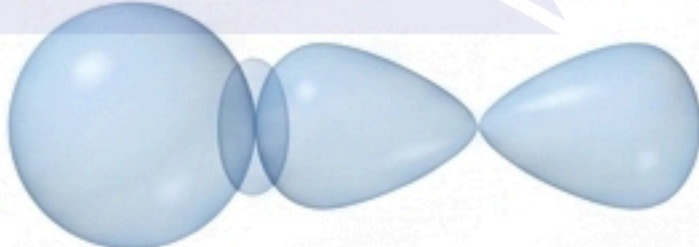
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Stronger Overlap vs Weaker Overlap

The extent of overlap fundamentally dictates the strength of the covalent bond.

	Extent of Overlap	Energy & Stability
A	 Greater Overlap	Maximum release of energy. Highly stable, strong bond.
B	 Smaller Overlap	Minimal release of energy. Weaker, less stable bond.

The Golden Rule: Greater overlap = Stronger Covalent Bond.

Final Recap: Effective Overlap Drives Stability

Nature always favors the lowest energy state. Orbital overlap is the physical mechanism that allows atoms to achieve this stability through **covalent bonding**.

1. Requirement

Partial interpenetration of atomic orbitals.

2. Condition

Valence electrons must have opposite spins.

3. Result

Electron density builds between nuclei.

4. Rule

More effective overlap = More stable bonding.

Bond Enthalpy



The massive energy required to break the H_2 bond proves the extreme stability generated by the 1s-1s orbital overlap.



You've Learned the Theory.

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