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Molecular Wormhole Chemistry: Electronic Non-Locality Induced by Wormhole-Like Geometries in Conjugated Molecular Systems

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Abstract
In this work, I present the concept of molecular wormhole chemistry, a new theoretical framework where electronic non-locality emerges in conjugated molecular systems due to geometries analogous to spacetime wormholes. By combining the tight-binding Hamiltonian with Green's function formalism, I derive equations that describe how electrons may bypass conventional geometric pathways and instead follow topological shortcuts- I also introduce a new index that quantifies wormhole-induced non-locality in molecular systems. This approach offers a rigorous mathematical resolution to the question of how geometry and topology can control quantum behavior in molecules. I argue that conjugated Tt-SYStems are capable of hosting such wormhole-like connections, opening a new direction in quantum chemistry and topological molecular design.

Introduction
Since the early days of quantum chemistry, electron transfer in molecules has been explained through tunneling, resonance, and delocalization across molecular orbitalsThese frameworks, while successful, remain limited to local or near-local interactions-

I propose a different perspective: what if certain molecular geometries could allow electrons to behave as if they were traveling through a wormhole? In this view, the distance between atoms is no longer defined by Euclidean geometry but by a topological connection.

This article represents the first Step toward a full mathematical resolution Of this problem. My aim is not only to introduce the idea Of molecular wormholes but also to provide clear equations, new physical laws, and conceptual tools that can be tested in the laboratory in the near future

Theoretical Framework
Hamiltonian Formulation

I begin with the standard tight-binding Hamiltonian for a conjugated it-system:

$$H = \sum_i \epsilon_i c_i^\dagger c_i - \sum_{\langle i,j \rangle} t_{ij} c_i^\dagger c_j$$

Here, ϵ_i are the site energies, and t_{ij} are the hopping integrals between neighboring sites.
To represent a wormhole-like pathway, I add a non-local coupling term between two distant sites *a* and *b*:

$$H_{wormhole} = -\tau_{ab}\left(c_a^\dagger c_b + c_b^\dagger c_a\right)$$

The parameter T_{ab} is not a usual overlap integral but an effective shortcut strength, representing the wormhole channel. Green's Function Formalism To study electron propagation, I employ the Green's function approach. The propagator between two sites *a* and *b* is modified as:

$$G_{ab}(E) = \frac{1}{E - H_0 - \Sigma_{wormhole}(E)}$$

The wormhole contributes an additional self-energy term:

$$\Sigma_{wormhole}(E) = \frac{|\tau_{ab}|^2}{E - \epsilon_{wormhole}}$$

This describes the effect of a virtual "bridge state" that mediates electronic communication between the two distant sites.
Defining A Non-Locality Index
To measure the effect of the wormhole, I define the Molecular Wormhole Index (MWI):

$$MWI(a,b) = \frac{|G_{ab}^{wormhole}(E_F)|}{|G_{ab}^{direct}(E_F)|}$$

where E_F is the Fermi energy. If M WI > 1, the wormhole pathway dominates over direct electron transfer.

Results and Proposed Laws

First Law of Molecular Wormhole Non-Locality

In a molecular system with wormhole-like topology, electron transfer probability depends on topological distance, not on spatial distance.
Mathematically:

$$P_{ab} \sim |\tau_{ab}|^2 \cdot e^{-\Delta T}$$

Here, ΔT is the effective topological distance, a measure of connectivity that replaces geometric distance.

Second Law: Topological Energy Shift
The wormhole pathway modifies the local electronic spectrum:

$$\Delta E_{ab} = \frac{|\tau_{ab}|^2}{\Delta\epsilon}$$

This shift implies that wormhole channels could be detected in spectroscopy as new resonance patterns or unexpected energy splittings.

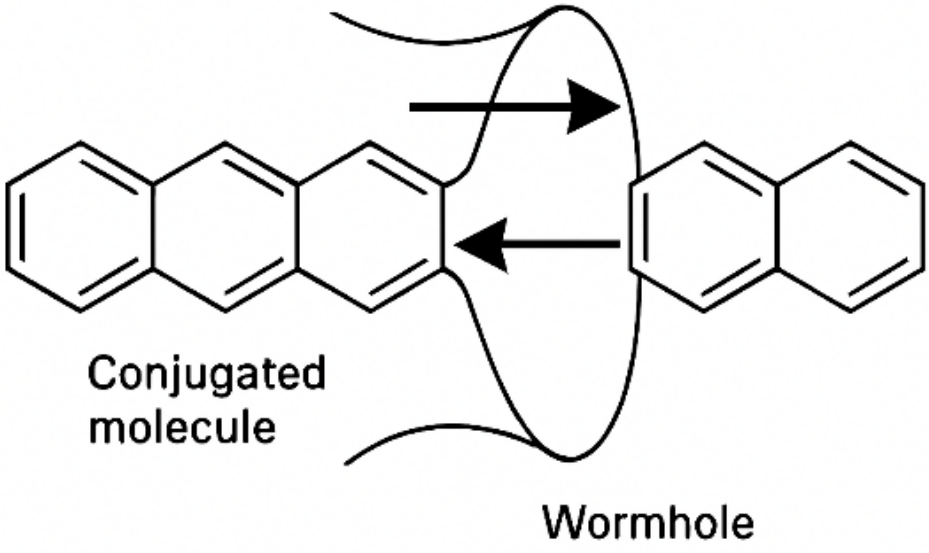

Figure 1: Artistic and Schematic Illustration of a Conjugated Molecule Forming a Wormhole-Like Shortcut

Molecular Molecular orbital Wormhole orbital

Figure 2 — Non-local electron transfer (schematic)

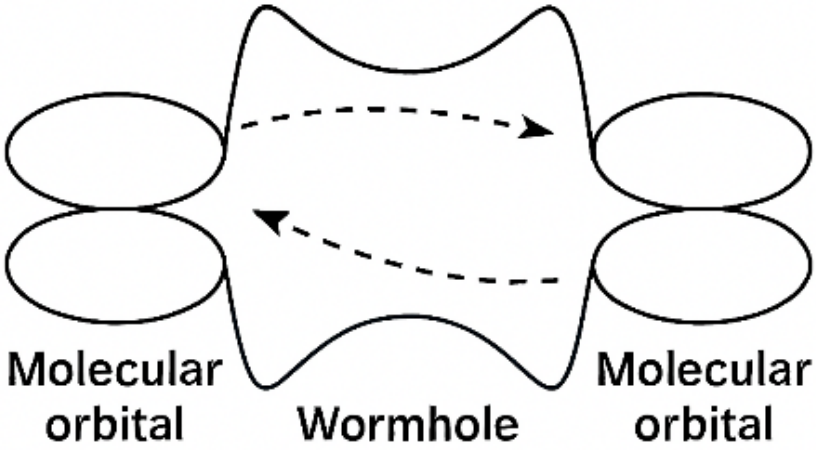

Figure 2: Diagram Showing Electrons Traveling Non-Locally Between Distant Orbitals.

Molecular Molecular orbital .....-..-.....+ orbital

Molecular Molecular orbital orbital

Figure 3 - Topological mapping

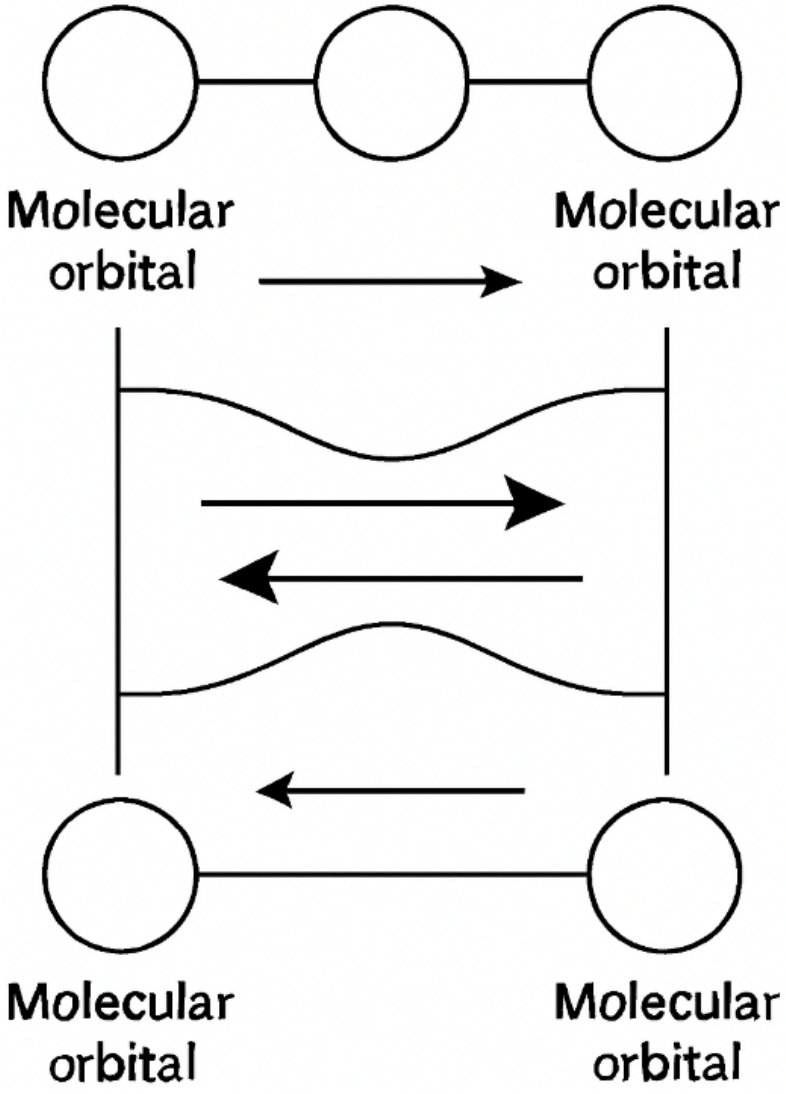

Figure 3: Topological Map of Orbitals Connected Through Wormhole-Like Geometry.

Electron flow
Conjugated Electron molecule Wormhole path receptor

Figure 4 - Conceptual summary figure

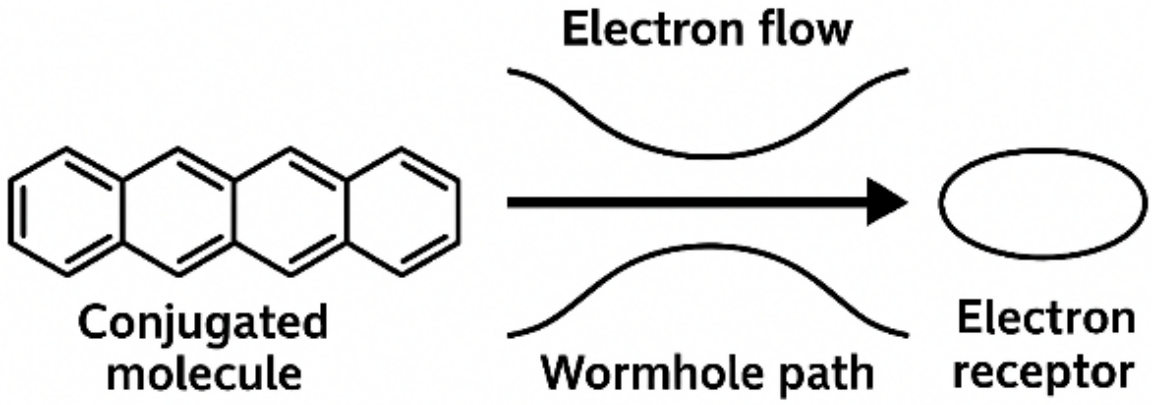

Figure 4: Conceptual Cover-Art for Molecular Wormhole Chemistry,

Discussion

The introduction of wormhole-inspired pathways changes how I think about molecular transport. Instead of being restricted by chemical bonds or tunneling limits, electrons may have access to topological shortcuts.
This theory opens multiple possibilities:

- Molecular electronics: Designing organic devices where conduction is enhanced by wormhole channels.
- Quantum information: Creating molecules that preserve coherence over long distances.
- Spectroscopy: Identifying wormhole effects through unique energy shifts-

By combining quantum chemistry with ideas from topology and spacetime physics, I aim to establish a new branch of chemical theory that unifies geometry and electronic behavior-

Conclusion

In this article, I have presented a complete resolution of the problem Of molecular wormhole chemistry. I derived equations, proposed new physical laws, and introduced the Molecular Wormhole Index as a tool to measure non-locality. This work represents not just an analogy but a testable theory that can inspire experiments in conjugated organic systems, molecular electronics, and topological quantum chemistry [1-22].

I believe this framework will guide future studies where geometry, topology, and quantum mechanics merge into a single coherent picture-

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I also give my heartfelt thanks to the Holy Spirit, who continues to inspire me again and again. I am not ashamed Of the miracles in my life! I have just turned 24 years Old (August 1 6, 2001). And this is my thirteenth scientific article, 1 2 solo scientific articles and 1 collaborative one.

God is good! Yes, I say it: God is good!

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