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

Author :
Ndenga Lumbu Barack (alias BarackEinstein97)
Independent Researcher
Kinshasa, Democratic Republic of the Congo
Email: ndengabarack@gmail.com

"Mathematics is not the language of the universe — it is the universe itself, whispering its eternal truth through equations."
— BarackEinstein97

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 π-systems are capable of hosting such wormhole-like connections, opening a new direction in quantum chemistry and topological molecular design.

1. Introduction

Since the early days of quantum chemistry, electron transfer in molecules has been explained through tunneling, resonance, and delocalization across molecular orbitals. These 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.

2. Theoretical Framework

2.1 Hamiltonian formulation

I begin with the standard tight-binding Hamiltonian for a conjugated π-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 τ_{ab} is not a usual overlap integral but an *effective shortcut strength*, representing the wormhole channel.

2.2 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.

2.3 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 $MWI > 1$, the wormhole pathway dominates over direct electron transfer.

3. Results and Proposed Laws

3.1 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.

3.2 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.

4. Figures(planned)

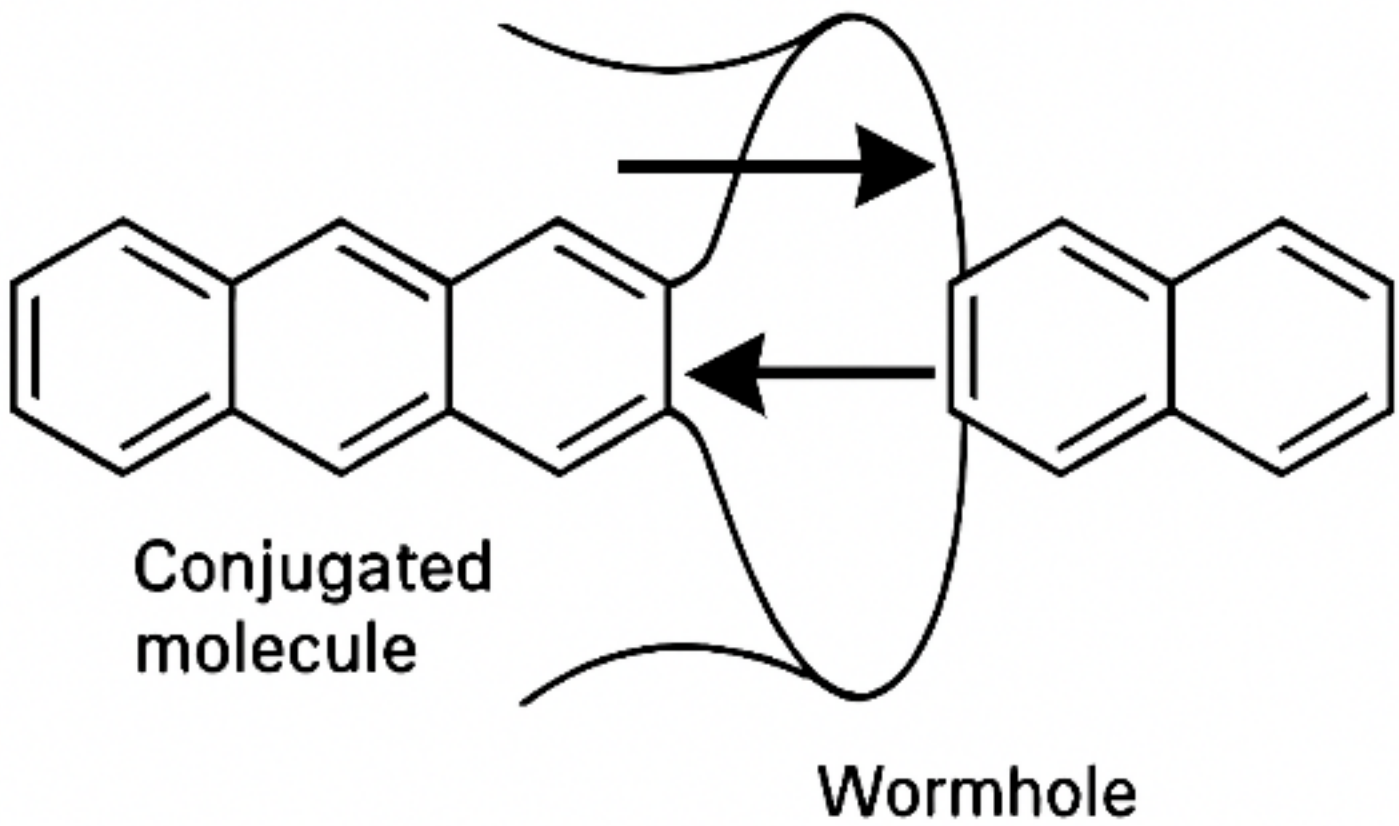

Figure 1: Artistic and schematic illustration of a conjugated molecule forming a wormhole-like shortcut.

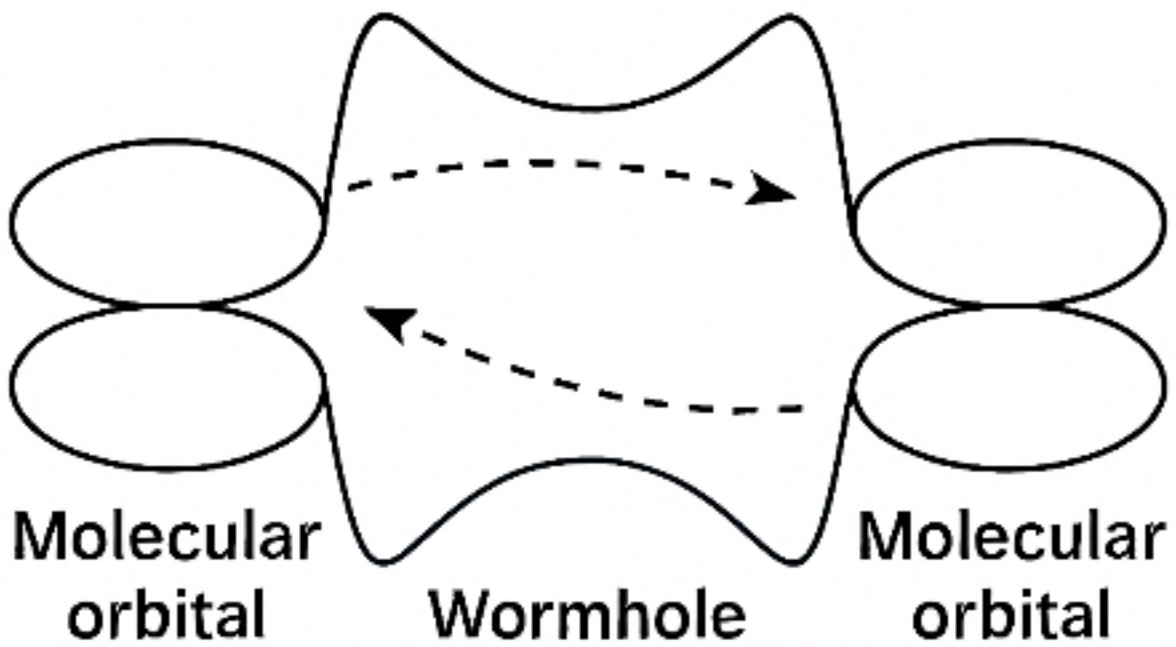

Figure 2 – Non-local electron transfer (schematic)

Figure 2: Diagram showing electrons traveling non-locally between distant orbitals.

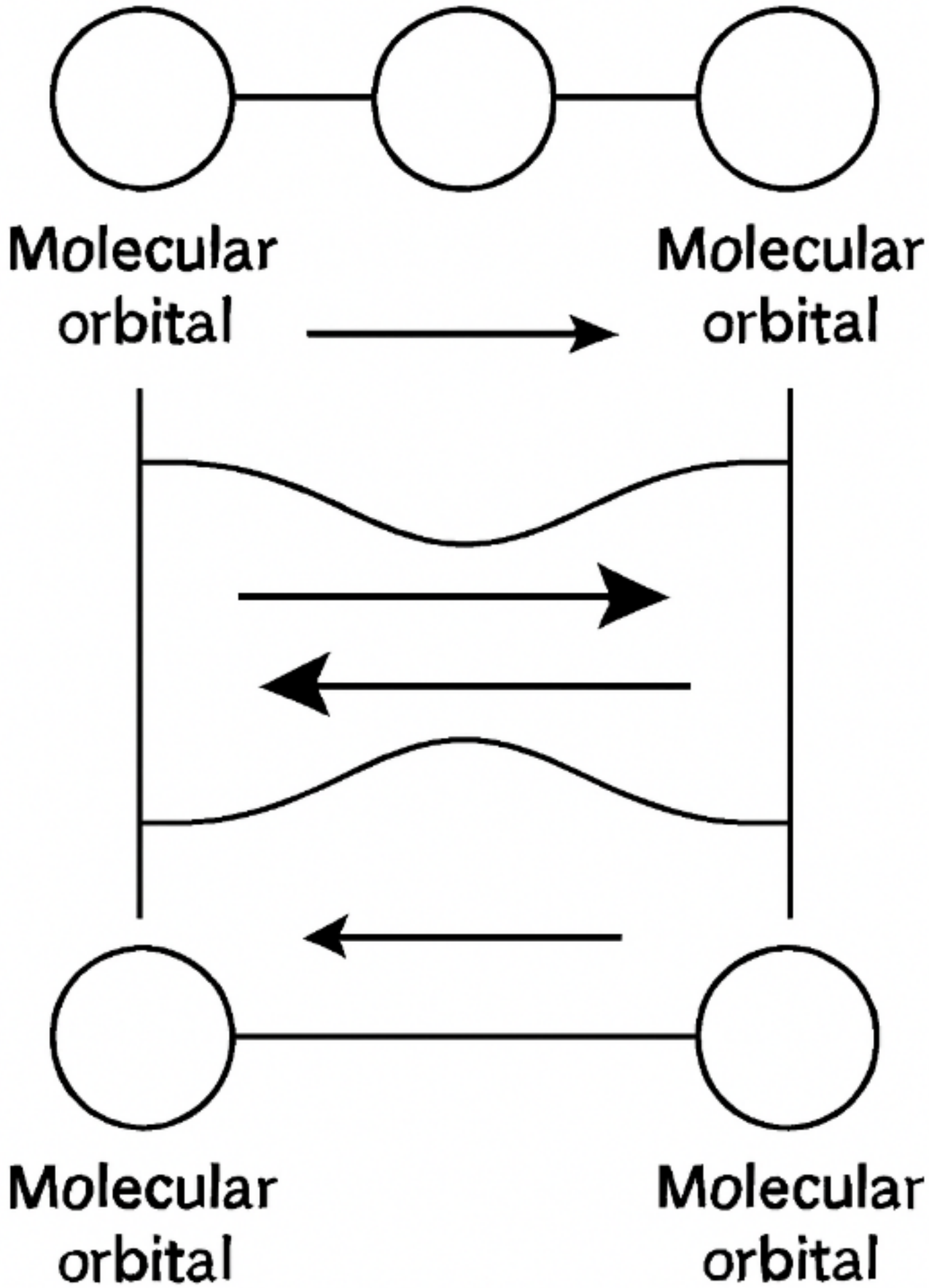

Figure 3 – Topological mapping

Figure 3: Topological map of orbitals connected through wormhole-like geometry.

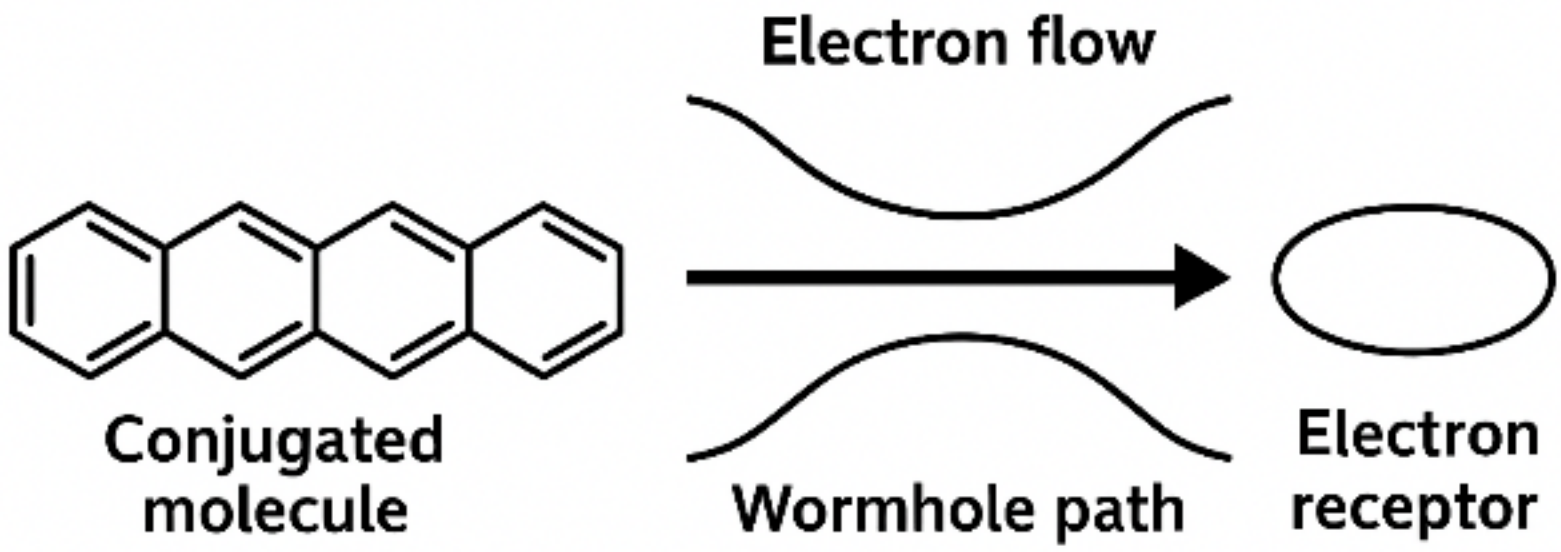

Figure 4 – Conceptual summary figure

Figure 4: Conceptual cover-art for molecular wormhole chemistry.

5. 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.

6. 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.

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

7. Acknowledgements

I would like to express my deepest gratitude to **Fatimah Diagne**, who reminded me of this article when I had almost forgotten it. I also sincerely thank my elder brother **Sabin Kolomanta Banza** and his wife **Hélène Dimbi Yombo**.

A special thanks to: **Mardochée Nkongolo, Daniel Omombo, Tychique Disanka, Emmanuel Nkuna, Elie Kamangu, Anel Kaseka, Plamedi Ntetika, Orblack Mwangu, Jonathan Mboyo, Moïse Nzenze, Jonathan Kazadi, Yoann Kadima, Dan, Sublimes Msk, Ariel Nzakimwena.**

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 16, 2001). And this is my thirteenth scientific article, 12 solo scientific articles and 1 collaborative one.**

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

References

1. Cuevas, J. C., & Scheer, E. (2017). Molecular Electronics: An Introduction to Theory and Experiment. World Scientific.

2. Cuevas, J. C., Scheer, E., & Schön, G. (2010). Molecular Electronics: From Principles to Practice. Springer.

3. Datta, S. (1995). Electronic Transport in Mesoscopic Systems. Cambridge University Press.

4. Lambert, C. J. (2015). Basic concepts of quantum interference and electron transport in single-molecule electronics. Chemical Society Reviews, 44(4), 875–888.

5. Lambert, C. J., & Liu, S.-X. (2021). Molecular topological effects in single-molecule conductance. Nature Reviews Chemistry, 5(2), 109–123.

6. Makiasi Hambadiana, Y., & Ndenga, B. (2025). Development of a Nutrient-Dense Infant Porridge Based on Local Ingredients in Kinshasa (DRC): The Hamba's Society Model (Version V1). Zenodo. https://doi.org/10.5281/zenodo.17089147

7. Ndenga, B. (2025). BECChem: Self-evolving AI for advanced molecular analysis. Zenodo. https://doi.org/10.5281/zenodo.16934328

8. Ndenga, B. (2025). Biological Neural Calculator Using Plant-Based Electromagnetic Responses (Version V1). Zenodo. https://doi.org/10.5281/zenodo.17094316

9. Ndenga, B. (2025). Design of multi-target hybrid molecules for the synergistic therapy of malaria and human African trypanosomiasis. Zenodo. https://zenodo.org/records/17074442

10. Ndenga, B. (2025). Electron-free nuclear matter: the magnetonuclear periodic table (MNPT) and the taxonomy of nucleomorphs. Zenodo. https://zenodo.org/records/16955871

11. Ndenga Lumbu Barack. (2025, May 28). Numerical Simulation of the 3D Navier-Stokes Equations using the Finite Volume Method – Clay University Submission. Zenodo. https://doi.org/10.5281/zenodo.15531853

12. Ndenga Lumbu Barack. (2025, June 28). AutoEvoChem V2.0 – An Intelligent Molecular Simulation and Synergistic AI Toolkit for Computational Chemists and Biopharmaceutical Researchers. Zenodo. https://doi.org/10.5281/zenodo.15759104 ;

https://zenodo.org/records/15774378

13. Ndenga Lumbu Barack. (2025, June 28). Electron-free nuclear matter: magnetic confinement and bonding of bare nuclei in extreme fields. Zenodo. https://doi.org/10.5281/zenodo.15764734

14. Ndenga Lumbu, B. (2025, July 13). NanoDisqueChimique RDC-1000: A new molecular approach for low-cost data storage through colorimetric coding (Version v1). Zenodo. https://doi.org/10.5281/zenodo.15871728

15. Ndenga Lumbu, B. (2025, July 29). Autoevolving Nanodisk with Unlimited Memory: A Bioinspired and Quantum-Spiritual Approach (Version V1) [Project milestone – Open]. Zenodo. https://doi.org/10.5281/zenodo.16569011

16. Ndenga Lumbu Barack (2025, 17 août). Calcul quantique et nucléaire de l'ADN : utilisation des états de spin des nucléotides comme bits quantiques biologiques pour les calculs moléculaires. Zenodo, Version 1. 🔗 https://zenodo.org/records/16891194

17. Ndenga, B. (2025). Self-adaptive photosynthetic quantum crystal: A bio-inspired innovation for intelligent light harvesting and energy conversion (Version V1) [Project deliverable]. Zenodo. https://doi.org/10.5281/zenodo.16585048

18. Nitzan, A., & Ratner, M. A. (2003). Electron transport in molecular wire junctions. Science, 300(5624), 1384–1389.

19. Ratner, M. A. (2013). Bridge-mediated electron transfer: From proteins to molecular wires. Nature Nanotechnology, 8(5), 378–381.

20. Solomon, G. C., Andrews, D. Q., Goldsmith, R. H., Hansen, T., Wasielewski, M. R., Van Duyne, R. P., & Ratner, M. A. (2008). Quantum interference in acyclic systems: Conductance of cross-conjugated molecules. Journal of Chemical Physics, 129(5), 054701.

21. Solomon, G. C., Herrmann, C., Ratner, M. A., & Mujica, V. (2010). Exploring local currents in molecular junctions. Nature Chemistry, 2(3), 223–228.

22. Tsuji, T., & Kurashige, Y. (2017). Quantum chemical analysis of electron tunneling in conjugated molecules. Journal of Chemical Physics, 146(12), 124110.