

Unifying Trends in Physics, Chemistry and Biology and the Emergence of Life

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Abstract

We present a unified theoretical framework (“UPCB”) that integrates trends in Physics, Chemistry, and Biology into a single *Quantum Network Model*. Departing from the point-particle paradigm of the Standard Model, we propose that fundamental entities are nodes in a quantum information processing network, emerging from a “Quantum Computing” substrate ($2+2 \rightarrow 3+1$ Hopf fibration).

Key unifications include: (1) The *Wilsonization* of the Gauge Theory, identifying the Electron as a time-like “T-quark” and unifying the lepton and quark sectors; (2) The topological unification of bonds, where chemical (covalent/ionic) and nuclear (Masonic) bonds are shown to be isomorphic graph connections distinguished only by the genus of the interaction (Grothendieck’s *Dessins d’Enfant*); and (3) The identification of Chirality Induced Spin Selectivity (CISS) as the macroscopic manifestation of the fundamental gauge chirality.

We argue that the emergence of Life is not accidental but mandated by the “diode-like” rectification of quantum information flow through chiral centers, challenging the traditional thermodynamic view of entropy in self-organizing systems.

1 Introduction

Recent progress in quantum physics, leads to an conceptual advancements upgrading the regarding the Standard Model, including unification of fundamental interactions, fermion-boson unification via a Network Model approach to interactions, and to clarification regarding the emergence of Space-Time-Mater from Gauge Theory integrating Quantum Computing viewpoint.

Extending the scope of modeling interactions from Elementary Particle Physics to Chemistry, provides a unified language and framework for quantum systems and their interactions, with feedback allowing to further develop the Standard Model in Elementary Particle Physics.

The article is a continuation of the unifying approach started in [55], with electrons (or rather orbitals and chemical bonds) and mesons treated on an equal footing, separate from baryons which are the only “matter particles” (various geometries and excitations of nucleon).

Prospects of a Universal Paradigm emerges, and to begin understanding that, contrary to the ingrained mentality resulting from the 2nd Law of Thermodynamics, life is mandatory to emerge and complexity of the universe increases acquiring more levels to its hierarchy of structures, to be reported elsewhere.

2 The Quantum Network Model

The unification of Physics, Chemistry, and Biology proposed here rests on a fundamental shift in perspective: replacing the point-particle paradigm of Quantum Field Theory (QFT) with a **Quantum Network Model**. In this framework, the fundamental degrees of freedom are not isolated particles, but nodes and links in a quantum information processing network, governed by the flow of quantum information (qubits).

This section details the mathematical emergence of this structure from the Gauge Theory of the Standard Model, specifically via the formalism of *Wilsonization* derived from the author’s previous work on the emergence of space-time [59].

2.1 From Point-Particles to Gauge Networks

The Standard Model (SM) successfully classifies elementary particles but treats them as point-like excitations of abstract fields. However, the experimental reality—specifically in scattering experiments—is described by Quark Line Diagrams (QLDs). These diagrams hint at a deeper topological reality where “particles” are graph-theoretical objects.

We propose that the fundamental “Quantum System” (QS) is not a point on a manifold, but a network node with internal topology, isomorphic to the Riemann sphere $\mathbb{C}P^1 \cong S^2$. The interactions between these nodes are mediated by gauge connections, which we now formalize.

2.2 The Quark-Qubit Correspondence and Wilsonization

The central mechanism of our unification is the correspondence between the qubit space (spinors) used in Quantum Computing and the emergent space-time geometry of the Standard Model. We refer to this process as *Wilsonization*, extending K. Wilson’s lattice gauge theory concept where continuous fields are replaced by transport operators (Wilson Lines) along links.

2.2.1 The $2 + 2 \rightarrow 3 + 1$ Hopf Fibration

The geometric origin of the “3+1” space-time signature lies in the properties of the fundamental representation of the spin group. The qubit is the fundamental unit, described by a spinor in \mathbb{C}^2 . The geometry of the qubit state space is the Bloch Sphere (S^2), which arises from the Hopf fibration of the 3-sphere ($S^3 \cong SU(2)$):

$$S^1 \hookrightarrow S^3 \xrightarrow{\pi} S^2 \quad (1)$$

This fibration encodes the relationship between the quantum phase (S^1) and the observable direction in 3D space (S^2).

At the algebraic level, the unification of the spinor degrees of freedom corresponds to the decomposition of the complexified Lie algebra. The “equation of dimensions” governing this emergence is:

$$2 \otimes 2^* \cong 3 \oplus 1 \quad (2)$$

Here, the tensor product of a spinor (2) and its conjugate (2^*) yields the adjoint representation of $SU(2)$, which consists of:

- **The Triplet (3):** Three generators corresponding to the Pauli matrices $\sigma_x, \sigma_y, \sigma_z$. In our model, these space-like generators are identified with the three color quarks (R, G, B) defining the local spatial frame.
- **The Singlet (1):** The identity matrix, or the generator of the $U(1)$ phase. In our model, this time-like generator is identified with the Electron (or T-quark).

2.3 The Electron-Quark Unification

A major consequence of the Wilsonization formalism is the unification of the electron with the quark sector. In the standard view, leptons and quarks are disjoint. In the Quantum Network Model, they are components of the same gauge connection bundle.

2.3.1 The Electron as a Time-like Quark (T-Quark)

We identify the electron not merely as a lepton, but as the *time-like* quark (T). This identification is consistent with the $3 + 1$ splitting of the gauge generators discussed above.

- **Quarks (R, G, B):** Correspond to the spatial degrees of freedom (Space-like). They are confined because spatial directions cannot be separated from the manifold they define.
- **Electron (T):** Corresponds to the time-like degree of freedom (the “Quantum Clock”). It is not confined in the same sense because time flows (monodromy) orthogonally to space in the observer’s frame.

Thus, the "atom" is not a nucleus orbited by electrons, but a coherent gauge bundle where the nuclear quarks (R, G, B) establish the spatial frame, and the electron (T) generates the temporal evolution (phase rotation).

2.4 Network Topology: Dessins d'Enfants

To rigorously describe the "Network" connecting these quantum systems, we employ Grothendieck's theory of *Dessins d'Enfants* ("Children's Drawings").

A Dessin is a bipartite graph embedded on a Riemann surface, uniquely defined by a Belyi map $f : X \rightarrow \mathbb{CP}^1$. This provides a bridge between:

1. **Combinatorics:** The discrete structure of the network (nodes and bonds).
2. **Topology:** The genus of the surface (related to the number of loops/handles in the quantum system).
3. **Number Theory:** The field of definition of the algebraic curve.

In this context, chemical bonds and nuclear interactions are treated on equal footing as edges in a Dessin.

- A **Covalent Bond** corresponds to a specific topological gluing of the Riemann spheres associated with two atoms.
- The **Masonic Bond** (nuclear interaction) is a higher-genus connection involving the color-quark lines (R, G, B).

This topological universality explains why patterns in Chemistry (valency, bond geometry) mirror patterns in Particle Physics (baryon vertex structure): they are both manifestations of the underlying modular group symmetry of the network.

3 The Hierarchy of Bonds: From Nuclear to Chemical

The standard reductionist approach treats Nuclear Physics and Chemistry as distinct disciplines governed by forces differing by orders of magnitude in strength. However, in the *Quantum Network Model*, forces are manifestations of network topology. Consequently, the mechanisms binding quarks into nucleons (Nuclear Physics) and atoms into molecules (Chemistry) share a fundamental topological isomorphism.

We propose that leptonic bonds (ionic and covalent) are topologically equivalent to nuclear bonds. They are distinguished only by the specific gauge fibers involved—space-like quarks (R, G, B) for nuclear matter and time-like quarks (T , i.e., electrons) for chemical matter.

3.1 Topological Universality of Interaction

In the language of Quark Line Diagrams (QLD), a bond is formed when the gauge lines of two distinct quantum systems undergo a recoupling or sharing process. This topological event is independent of the energy scale.

3.1.1 The Masonic Bond (Nuclear)

At the hadronic level, baryons are formed by triplets of color quarks. The interaction between nucleons (e.g., in a Deuteron nucleus) is traditionally modeled by meson exchange. In our topological framework, we identify this as the **Masonic Bond**.

A Masonic bond represents the interlocking of the quark lines between two baryons. It acts as a "strong" graph connection where the internal color lines (R, G, B) participate in the networking. The stability of the nucleus arises from the high connectivity (genus) of this sub-network.

3.1.2 The Leptonic Bond (Chemical)

Chemistry arises at the next level of the hierarchy. If we view the nucleon as a closed “color” node, the remaining degree of freedom is the time-like gauge generator—the electron (T -quark), as derived in Section 2.3.

A **Chemical Bond** is, therefore, a “Masonic bond of the T-sector.”

- **Covalent Bonding:** Corresponds to the topological sharing of the T -quark lines between two atomic nodes. Just as quarks are confined in hadrons, electrons in a covalent bond are delocalized (confined) within the molecular orbital, forming a closed loop in the network.
- **Ionic Bonding:** Corresponds to the transfer of a T -line from one node to another, altering the local charge (homology) of the nodes but maintaining the overall network conservation laws.

3.2 The Deuteron-Hydrogen Correspondence

To illustrate this unification, we compare the simplest nuclear system with the simplest molecular system.

1. **The Deuteron (pn):** A bound state of a proton and a neutron. It is held together by the residual strong force (exchange of color-neutral information).
2. **The Hydrogen Molecule (H_2):** A bound state of two protons. It is held together by the exchange/sharing of electrons (T -quarks).

From the perspective of *Dessins d'Enfants* (Section 2.4), these two systems represent the same graph topology. The Hydrogen molecule is simply a “scaled-up” Deuteron where the binding agents are T -quarks rather than gluons/pions.

3.3 Implications for Material Science

This topological perspective implies that the principles governing nuclear stability (Magic Numbers, Shell Model) have direct analogues in Chemistry (Valence Shells, Octet Rule). Both are consequences of filling the available slots in the representations of the underlying symmetry groups of the network.

By treating the electron as a quark-like entity (the T -quark), we unify the description of matter: **Matter is a fractal network of Gauge Bonds**, iterating the same topological patterns from the femtometer scale (Nuclei) to the nanometer scale (Molecules).

4 Chirality and the Emergence of Life

The unification of Physics and Chemistry leads naturally to the third pillar of this work: Biology. The distinguishing feature of biological matter is its ability to self-organize and process information. We propose that the physical mechanism underlying this capability is **Chirality Induced Spin Selectivity (CISS)**, which acts as the bridge between the fundamental chirality of the Standard Model and the macroscopic homochirality of Life.

4.1 The Primordial Chirality of the Gauge Field

In the Standard Model, chirality is intrinsic, not accidental. The Weak Interaction acting on fermions maximally violates Parity, distinguishing between left-handed and right-handed states. In the standard “Pointwise QFT” framework, this is often treated as an algebraic feature of the Lagrangian.

However, in the *Quantum Network Model*, this chirality is geometric. It stems from the Hopf fibration structure ($2 + 2 \rightarrow 3 + 1$) discussed in Section 2.2. The fiber (qubit space) possesses a natural twist. Life does not merely “choose” a handedness; it emerges from a universe that is fundamentally chiral at the gauge level.

4.2 CISS: The Macroscopic Manifestation

The mechanism that propagates this fundamental quantum asymmetry to the biological scale is the CISS effect. Experimental evidence confirms that electron transport through chiral molecules (like DNA and α -helices in proteins) is spin-selective.

In our unified framework, we interpret CISS as follows:

- Biological polymers act as **helical waveguides** for the "T-quark" (electron).
- Due to the geometric coupling between the electron's linear momentum and its intrinsic spin (spin-orbit coupling), the chiral geometry of the molecule acts as a spin filter.
- This spin polarization reduces backscattering, allowing for highly efficient, coherence-preserving electron transport over long distances—a requirement for the complex redox reactions sustaining life.

4.3 Beyond Pointwise QFT: Why Geometry Matters

Why has this fundamental connection been overlooked in standard biophysics? We argue that the standard CPT-invariant QFT is insufficient for modeling life because it relies on a "Pointwise" approximation.

1. **The Limitation of Points:** Standard QFT treats the electron as a dimensionless point mass. While effective for calculating scattering cross-sections, this model discards the internal topological information of the gauge fiber.
2. **The Network Advantage:** In our model, the electron is a node with internal spinor structure ($SU(2)$ geometry). When this structured "T-quark" traverses a chiral molecular network, its internal phase geometry interacts non-trivially with the network topology.

Therefore, Life is not a random accident that broke symmetry. It is a system that self-organized to be compatible with the intrinsic chirality of the T-quark gauge connection. The homochirality of amino acids and sugars is the structural impedance matching required to couple efficiently to the quantum vacuum's chiral geometry.

5 Conclusion and Future Directions

This work serves as the "Main Program" integrating the "subroutines" of the author's research journey into a coherent whole. By upgrading the Standard Model from a Pointwise QFT to a *Quantum Network Model*, we reveal that Physics, Chemistry, and Biology are not separate domains, but hierarchical expressions of the same topological rules governing quantum information flow.

5.1 Summary of Unification

The transition from the "heraclitean" flow of Quantum Computing to the fixed manifold of Space-Time is mediated by the *Wilsonization* process. The identification of the electron as the time-like T-quark ($U(1)$ generator) provides the missing link that unifies the atomic and nuclear descriptions of matter. Consequently, the "Network" becomes the primary ontology, where chemical bonds and nuclear forces are simply different topological realizations of gauge connectivity.

5.2 Perspectives: Time, Mirror Life, and Entropy

This framework opens several radical avenues for future research, which we briefly sketch here:

1. **The Nature of Time and Antimatter:** The emergence equation $2 \otimes 2^* \cong 3 \oplus 1$ inherently admits a conjugate solution. This duality suggests that "Antimatter" is not a distinct substance, but ordinary matter interacting with a reversed quantum phase orientation relative to the observer. In this view, "Time" is not a fundamental linear dimension, but an emergent order parameter—a "recording label" for an observer with memory tracking quantum state evolution. This aligns with the "Quantum Echo" protocols in modern Quantum Computing.

2. **The "Diode" of Life:** The CISS effect acts as a topological diode for quantum information. By filtering spin, chiral biological molecules "rectify" the flow of energy and momentum (the T -quark current). This suggests that the emergence of Life is a mandatory consequence of gauge geometry: the system prefers to "team up" and self-assemble to optimize this flow.
3. **Beyond Thermodynamics:** This accumulation of order challenges the traditional interpretation of the Second Law of Thermodynamics. While valid for steam engines (dissipative systems), the Second Law does not account for the "syntropic" capacity of chiral quantum networks to accumulate information and potentials. Life is the mechanism by which the Universe locally reverses entropy via the geometry of the connection.

In conclusion, the Universe is a Quantum Network. Physics describes its nodes, Chemistry its links, and Biology its self-optimizing flow.

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References

- [1] C. W. Johnson, O. C. Gordon, Proton-neutron entanglement in the nuclear shell model, 2210.14338
- [2] C. Wood, Physicists Observe 'Unobservable' Quantum Phase Transition, Quanta Magazine, Sept. 11, 2023, <https://www.quantamagazine.org/physicists-observe-unobservable-quantum-phase-transition-20230911/>; see also <https://arxiv.org/abs/1903.05124> for a QC perspective.
- [3] L. M. Ionescu, On Emergence of Relativistic Time from Quantum Phase, <https://vixra.org/abs/2303.0149>
- [4] L. M. Ionescu, A Quark Fields Emergent Space-Time and Gravity, <https://vixra.org/abs/2303.0030>
- [5] L. M. Ionescu, Some Unifications Needed in Particle Physics, <https://vixra.org/abs/2301.0142>
- [6] L. M. Ionescu, Planck's constant and EM transmission channels, TBA.
- [7] M. O'Dowl, What happens in a transition?, <https://www.youtube.com/watch?v=j5HyMNNSGqQ>; or <https://www.quantamagazine.org/physicists-who-explored-tiny-glimpses-of-time-win-nobel-prize-20231003/>
- [8] H. Jehle, The relationship of flux quantization to charge quantization and the fine structure constant, <https://onlinelibrary.wiley.com/doi/10.1002/qua.560030303>; as well as his follow-up articles from 1971-1982 (see also <https://vixra.org/abs/2308.0180>)
- [9] S. A. Shelkunoff, The impedance concept and applications to problems of reflection, refraction, shielding and power absorption, BSTJ 17: 1. January 1938, <https://archive.org/details/bstj17-1-17>
- [10] M. O'Dowl, What happens during a quantum jump, YT: PBS Space-Time, <https://www.youtube.com/watch?v=j5HyMNNSGqQ>
- [11] Yasemin saplakoglu, Magnetism May Have Given Life Its Molecular Asymmetry, Quanta Magazine, Sept. 23, 2023, <https://www.quantamagazine.org/magnetism-may-have-given-life-its-molecular-asymmetry-20230906>
- [12] Wikipedia, Universal Harmonic Oscillator - Nondimensionalization, <https://en.wikipedia.org/wiki/Nondimensionalization>
- [13] Audrey Terras, Fourier Analysis on Finite Groups and Applications, LMSST 83, 1999.
- [14] L. M. Ionescu, Recent R&D contributions: https://vixra.org/author/lucian_m_ionescu

- [15] Ricardo Aguilar, Studying interactions in String Theory, <https://www.ictp-saifr.org/studying-interactions-in-string-theory/>
- [16] Wladimir Guglinsky, Proton magnetic moment calculated through a model where quarks have angular momentum, <https://www.researchgate.net/publication/357930446>
- [17] Ady Stern and Netanel H. Lindner, Topological Quantum Computation—From Basic Concepts to First Experiments, *SCIENCE* 8 Mar 2013, Vol 339, Issue 6124, pp. 1179-1184, <https://www.science.org/doi/10.1126/science.1231473>
- [18] L. M. Ionescu, On Hodge structures and Periods: algebraic aspects, <https://arxiv.org/abs/2105.13115>
- [19] L. M. Ionescu, Beauty and the Beast, <https://vixra.org/abs/2304.0051>
- [20] L. M. Ionescu, AG-Tools for EPP, <https://vixra.org/abs/2305.0001>
- [21] L. M. Ionescu, Real Numbers: a new (quantum) look, with a hierarchical structure, <https://vixra.org/abs/2311.0005>
- [22] Josh Nosta, Contradicting the Law of Entropy, Information Seeks Order”, <https://www.psychologytoday.com/us/blog/the-digital-self/202310/contradicting-the-law-of-entropy-information-seeks-order>
- [23] Melvin M. Vopson, The mass-energy-information principle.
- [24] M. M. Vopson, S. Lepadatu, Second law of information dynamics, *AIP Advances* 12, 2022.
- [25] Yasemin Saplakoglu, Magnetism May Have Given Life Its Molecular Asymmetry, *Quanta Magazine*, Sept. 6 2023, <https://www.quantamagazine.org/magnetism-may-have-given-life-its-molecular-asymmetry-20230906/>
- [26] Google: “Ciss effect”; see also Origins of Life Initiative <https://origins.harvard.edu/> etc.
- [27] L. M. Ionescu, “What is a muon anyways: meson or lepton?”, <https://www.scirp.org/journal/paperinformation?paperid=99319>
- [28] L. M. Ionescu, Recent work towards a new Scientific paradigm, https://vixra.org/author/lucian_m_ionescu
- [29] Robert Hazen, “Is there a second arrow of time? New research says yes”, <https://bigthink.com/the-well/the-second-arrow-of-time/>, https://www.realclearscience.com/video/2024/07/10/is_there_a_second_arrow_of_time_1043400.html
- [30] S. Weinberg, *The Quantum Theory of Fields*, Cambridge University Press, 2005.
- [31] T. Weigend, QFT I + II, https://www.ippp.dur.ac.uk/mspannow/files/SkriptQFT_Weigand.pdf
- [32] Wikipedia: Higgs mechanism, https://en.wikipedia.org/wiki/Higgs_mechanism
- [33] L. M. Ionescu, On The Current Physics Crises and The Hierarchy Problem, <https://vixra.org/abs/2301.0041>
- [34] L. M. Ionescu, Some Unifications Needed in Particle Physics, <https://vixra.org/abs/2301.0142>
- [35] L. M. Ionescu, On Emergence of Relativistic Time from Quantum Phase,
- [36] <https://vixra.org/abs/2303.0149>
- [37] L. M. Ionescu, To Understand The Universe: “Follow the Qi!”, <https://vixra.org/abs/2307.0084>
- [38] L. M. Ionescu, A Note on Manifolds VS Networks as Mathematics Models in Modern Physics, <https://vixra.org/abs/1912.0095>

- [39] L. M. Ionescu, A holistic approach to Quantum Physics, <http://www.aascit.org/journal/archive2?journalId=940&paperId=5323>
- [40] L. M. Ionescu, Natural Units, Pi-Groups and Period Laws, <https://vixra.org/abs/2309.0086>
- [41] L. M. Ionescu, What is entanglement?, <https://vixra.org/abs/2310.0011>
- [42] L. M. Ionescu, Illinois State University articles and presentations, <https://about.illinoisstate.edu/lmiones/research/>
- [43] L. M. Ionescu, On Quark Field and Nuclear Physics, <https://vixra.org/abs/2212.0217>
- [44] Wikipedia, QCD, https://en.wikipedia.org/wiki/Quantum_chromodynamics
- [45] L. M. Ionescu, “From Beeing to becoming”, TBA / work in progress, 2024.
- [46] L. M. Ionescu, Generalized Cobordism Categories, NSF GP.
- [47] L. M. Ionescu, “The Beauty and The Beast”, <https://vixra.org/abs/2304.0051>
- [48] Wikipedia: orbital hybridization, https://en.wikipedia.org/wiki/Orbital_hybridisation
- [49] L. M. Ionescu, The Qubit Model: A Platonic and Exceptional Quantum Theory, <https://vixra.org/abs/1912.0547>
- [50] R. J. Moon, The Geometric basis for the Periodic table of elements, <https://21sci-tech.com/Articles%202004/Spring2004/Periodicity.pdf>; See also “Sacred Solids in the Atomic Nucleus” and refs within;
- [51] F. Potter, “CKM and PMNS mixing matrices from discrete subgroups of $SU(2)$ ”, <https://iopscience.iop.org/article/10.1088/1742-6596/631/1/012024/meta>; see also [52]
- [52] F. Potter, works: <http://www.sciencegems.com/Icosahedron.html>
- [53] G. pripoae, C. Pripoae and L. M. Ionescu, On Mobius transformations as Polya vector fields from Lie Theory viewpoint, work in progress, 2024.
- [54] Walsh, Nuclear structure from average quark positions, ChemRxiv, 2023, <https://chemrxiv.org/engage/chemrxiv/article-details/6408e493cc600523a3dfef8b>
- [55] L. M. Ionescu, A String Theory Flavor Model of Baryon Nodes and Lepto-Mesonic Links, <https://vixra.org/abs/2405.0082>
- [56] Wikipedia: Carbon, <https://en.wikipedia.org/wiki/Carbon>
- [57] Ilya I. Prigojine, “From Being to Becoming: Time and complexity in the physical sciences”, <https://archive.org/details/frombeingtobecom00ipri>
- [58] See Google AI search: “Carlo Rovelli and the String Theory landscape problem”.
- [59] L. M. Ionescu, “Emergence of Space-Time Physics from Quantum Computing Formalism”, Proceedings of the XVI International Workshop on Lie Theory and Its Applications in Physics, Varna, Bulgaria, June 16-22, 2025 (To appear).
- [60] L. M. Ionescu, “Unifying Trends in Physics, Chemistry and Biology”, <https://vixra.org/abs/2408.0093>