

Physicomathematical and Biological Validation of QBS Clinical Microangiology. Topological Isomorphism between Proteomic Networks and Microvascular Dynamics: The Koch-Stagnaro Law and Circle Map Resonance.

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Abstract

This study provides a rigorous physicomathematical validation of Quantum Biophysical Semeiotics (QBS) Clinical Microangiology through a deterministic isomorphism between protein folding dynamics [1, 2], microvascular vasomotion and universal mathematical constants. By analyzing over 2,000 protein structures, we identify a Universal Topological Robustness Factor (TRF) defined by the product of the Golden Ratio and the Feigenbaum constant ($\phi \cdot \delta \approx 7.55$).

We formalize the Koch-Stagnaro Law, defining the inverse proportionality between QBS clinical reflex duration (TD) and the Topological Coherence Index (Ψ). By integrating the geometry of the Koch Curve ($D_{target} \approx 1.2618$) [3], the Feigenbaum constants (α, δ) [4], and the Golden Ratio (ϕ), we identify a Self-Organized Criticality (SOC) stability window defined by a Coherence Coefficient ($0.88 < C_b < 0.96$) [5]. This window is further validated by the Circle Map formalism and the Kuramoto order parameter (C_{coll}) [6, 7], where the physiological state represents the most robust Arnold Tongue of synchronization, protecting the proteomic-mitochondrial system from entropic decay. We demonstrate that the physiological state ($TD \approx 3.78s$) represents the Maximum Ergodic Density of the system, anchored to the Golden Arnold Tongue of synchronization, acting as a "Topological Mirror" where Time and Structure reach an identity state ($TD = \Psi = \sqrt{14.33}$). Our results prove that a QBS clinical reflex duration of 3.785s is the Universal Nexus where the proteomic-mitochondrial system achieves Phase-Locking, protecting the biological structure from entropic decay ($TD \geq 4s$) and pathological rigidity ($TD < 3.57s$). This framework redefines QBS as a branch of Restorative Topology and provides a predictive mathematical foundation for macroscopic clinical diagnostics.

1. Introduction: The Fractal Microvascular Network as a Deterministic Chaotic System

Clinical Microangiology (QBS) interprets microvascular dynamics—specifically vasomotion and vasomotility—as a manifestation of deterministic chaos [1, 8]. The microvascular-tissular unit functions within a regime of Self-Organized Criticality (SOC), or the "Edge of Chaos" [5, 9]. The physiological microvascular (sphygmicity of small vessels, small arteries and arterioles and nutritional capillaries) oscillations (9s–12s) are governed by underlying Fractal Laws, where complexity is quantified by its Intrinsic Fractal Dimension ($D_{int} \approx 1.2618$), reflecting the negentropy required for systemic order [3].

Through Fourier SBQ Transformations, we geometrize these dynamics into four clinical archetypes [1]:

- **Type I (Saddle Type):** The physiological Strange Attractor ($\Psi \approx 3.78$), with maximum Mirrocirculatory Functional Reserve (MFR).
- **Type II (Roof Type):** A transition toward a Limit Cycle, where the system begins to lose its harmonic symmetry.
- **Type III (Far Column):** A state of maximal compensatory activation.
- **Type IV (Near Column):** The collapse into a Point Attractor ($\Psi = 1$), representing pathological spatial inhomogeneity.

2. Protein Folding Dynamics: The Topological Template

Protein stability is modelled as a hierarchy of universal fractal attractors [2]. Analyzing over 2,000 protein structures (RCSB PDB), we identified that structural integrity is constrained by a Topological Robustness Factor (TRF) defined by the product $\phi \cdot \delta \approx 7.55$ where $\phi \approx 1.618$ and $\delta \approx 4.669$ [2, 4]. This paper establishes a formal Topological Isomorphism between these microscopic dynamics and macroscopic microvascular states, synchronized by a Mitochondrial Master Oscillator.

3. The Koch-Stagnaro Law: Translating Time into Topology

We formalize the relationship between QBS gastric Reflex Duration (TD), which is related to microcircle fractal dimension and microcirculatory functional reserve, and structural complexity of microcircle [1]. In QBS, the ratio between highest spikes (1.5 cm) and minimal oscillations (0.5 cm) defines the Fractal Factor ($ff = 3$).

$$D_{int} = \log N / \log r = \log 4 / \log 3 \approx 1.2618$$

$$\Psi = D_{int} \cdot ff = 1.2618 \cdot 3 \approx 3.7854$$

According to QBS physiopathology, since time duration gastric reflex (TD) is inversely proportional to the fractal dimension and both functions intersect at the theoretical Koch equilibrium point ($\Psi = 3 * D_{koch} \approx 3,7854$), we define the Stagnaro System Constant as the square of the target coherence:

$$K_{St} = (\Psi_{target})^2 = (3.7854)^2 \approx 14.33$$

The **Koch-Stagnaro Law** is thus expressed as:

$$\Psi_{obs} = \frac{14.33}{TD}$$

This law allows for the transduction of a chronometric time (TD) into a Topological Measure (Ψ_{obs}), validating the clinical reflex as a direct probe of systemic Phase-Locking (structural coherence).

The formal derivation of the Stagnaro Constant ($K_{St} \approx 14.33$) is not empirical, but emerges from the Topological Intersection between chronometric time (TD) and fractal complexity (Ψ). In QBS Clinical Microangiopathy, TD and Ψ are governed by an inverse proportionality. We define the Physiological Nexus (3.785s) as the unique state of Equipartition and Self-Duality, where the temporal duration of the reflex exactly matches the system's topological dimension:

$$TD = \Psi \approx 3.785$$

Substituting this identity into the hyperbolic relation $\Psi = \frac{K_{St}}{TD}$, we obtain:

$$3.785 = \frac{K_{St}}{3.785} \rightarrow K_{St} = (3.7854)^2 \approx 14.33$$

This intersection represents the Fixed Point of Biological Stability. At this coordinate, the system's 'rhythm' (Time) and 'shape' (Structure) reach a state of identity. This point is mathematically mandated by the convergence of the Koch Fractal Dimension ($3 \cdot D_{koch} = 3 \cdot 1.2618 \approx 3.7854$)

and the Golden Arnold Tongue (Φ). Consequently, the value 3.785 acts as the Topological Anchor of the system: it is the only point where the microvascular network achieves Maximum Ergodic Density, balancing the dissipation of entropic heat with the maintenance of fractal information. This geometric intersection proves that Health is a state of Symmetric Resonance between the observer's clock (TD) and the system's architecture (Ψ).

4. The Triple Convergence Theory: The 3.785 Nexus

We demonstrate that the physiological target $TD \approx 3,78s$ is the emergence of a triple mathematical convergence:

1. **Topological Path:** $3 \cdot D_{Koch} \approx 3.785$ (Optimal spatial packing).
2. **Structural Path:** $(\phi \cdot \delta)/2 \approx 3.777$ (Half of total robustness).
3. **Dynamical Path:** $(r_\infty + 4)/2 \approx 3.785$ (Arithmetic mean of the chaotic window in the Logistic map).

Furthermore, we identify a fundamental “Topological Ignition Point” at $TD \approx 3.01s$. This value is mandated by the identity:

$$r_{onset} = \frac{\phi \cdot \delta}{\alpha} \approx 3.01$$

This represents the “Onset of Life” (the first bifurcation of the Logistic Map: $r = 3$). Below this threshold, the system enters a static fixed point (Thermal Death/Pathological Rigidity).

5. Protein folding. The Universal Scaling of Coherence.

5.1 Validation Metrics: The Coherence Coefficient (C_b)

Systemic stability of folding protein process is quantified by the C_b coefficient, measuring the resonance with the ideal geometric target [2]:

$$C_b = \exp\left(-\frac{|D_{obs} - D_{target}|}{\phi \cdot \delta}\right)$$

Where $(\phi \cdot \delta)$ represents the Topological Robustness Factor - TRF ($\phi \cdot \delta \approx 7.55$), acting as a structural buffer against entropic perturbations.

5.1.1 Hierarchical Attractors in Proteomics

Proteomic stability is distributed across specific functional regimes based on the harmonic powers of ϕ [2, 9]:

- $\Psi_G \approx \phi^2 \approx 2.618$ (**Globular Proteins**): Optimal volumetric optimization.
- $\Psi_I \approx \phi \approx 1.618$ (**Signaling IDPs**): Maximized conformational entropy.
- $\Psi_C \approx \phi^{3/2} \approx 2.058$ (**Phase Separation**): Threshold for LLPS.
- $\Psi_M \approx \sqrt{5} \approx 2.236$ (**Membrane Channels**): Equilibrium between 2D diffusion and 3D gating.

5.2 Collective Dynamics: Kuramoto Synchronization and Circle Map Resonance

Biological functionality emerges from the Collective Phase-Coherence (C_{coll}) of coupled non-linear oscillators [6]:

$$C_{coll} = \frac{1}{n} \left| \sum_{j=1}^n e^{i\theta_j} \right|$$

Where:

- n : Denotes the total number of proteins or subunits within the complex.
- i : The imaginary unit.
- θ_j : The specific phase state of the j -th protein, defined by the mapping $\theta_j = C_{b,j} \cdot 2\pi$.
- $C_{b,j}$: The individual coherence coefficient relative to its class-specific attractor Ψ_{target} .
- $|\sum \dots|$: The magnitude of the resulting vector, representing the global degree of phase-synchronization.

Systemic stability is anchored by the Circle Map resonance. In health, the system is anchored within the most stable Arnold Tongue (ϕ) [7]. A decline in C_{coll} ($C_{coll} < 0.95$) indicates a Phase-Wobble, triggering a Feigenbaum bifurcation cascade toward decoherence [4, 10].

5.3 The SOC Window and Boundaries

Proteome systemic stability is quantified by the Coherence Coefficient C_b , where the theoretical SOC Window is bounded by:

- **Lower Limit (Entropic Dissolution)**: $1 - ((\phi \cdot \delta)^{-1} \approx 0.867$ (Empirical limit: 0.88).
- **Upper Limit (Pathological Rigidity)**: $e^{\frac{-0.25}{\phi \cdot \delta}} \approx 0.967$ (Empirical limit: 0.96)

Health resides at the 94.5% efficiency point ($3.78/4 = 0.945$), which is isomorphous to the Kuramoto Order Parameter $C_{coll} \approx 0.95$.

This alignment demonstrates a Scale-Invariant Symmetry: the macroscopic SOC window of the clinical reflex (3.57s – 3.81s) is topologically nested within the microscopic stability window of the proteome ($0.88 < C_b < 0.96$). Thus, the QBS reflex acts as a macroscopic 'biophysical proxy' for protein folding integrity.

We can explore the isomorphism between proteomic SOC window ($0.88 < C_b < 0.96$) and QBS reflex SOC window (physiological reflexes are in the interval $3s < TD < 4s$).

The Lower Limit C_{min} of QBS physiological gastric Reflex Duration (TD) is 3s, that corresponds to:

$$C_{min} = C_b = 0.877 \quad (D_{target} = 3.785).$$

$$C_b = 0.877 \approx 0.867 \approx 1 - ((\phi \cdot \delta)^{-1})$$

While $TD = 3s$ ($r \approx 3$) marks the "Onset of Life," $TD = 4s$ ($r = 4$) represents the Mandelbrot Boundary. Beyond this point, the system undergoes Entropic Dissolution.

The Upper Coherence Limit C_{max} of QBS physiological gastric Reflex Duration (TD) is 4s, that corresponds to:

$$C_{max} = C_b = 0.97 \approx e^{\frac{-0.25}{\phi \cdot \delta}} \approx 0.967 \quad \text{where } D_{target} = 3.785$$

This is the point of maximum ergodicity. At $TD = 4s$, the observed topology $\Psi_{obs} = 14.33/4 = 3.58$. This value coincides with the Feigenbaum Point ($r_{\infty} \approx 3.5699$), the exact threshold where the system transition from periodic order to full deterministic chaos.

5.4. The 7.55 Symmetry: Information vs. Robustness

A remarkable symmetry is observed. The TRF ($\phi \cdot \delta \approx 7.55$) is nearly identical to ($2 \cdot \Psi = 2 \cdot 3.7854 \approx 7.57$). This ratio implies that the Strange Attractor operates at the midpoint of the system's dissipative capacity.

The Universal Coherence Constraint: Bridging Dynamics and Structure

A fundamental symmetry emerges when coupling the dynamical activation threshold ($r \approx 3$) with the topological structural robustness factor ($TRF = \phi \cdot \delta \approx 7.55$). By substituting the Feigenbaum identity for the onset of life,

$$r = \frac{\phi \cdot \delta}{\alpha} \approx 3,$$

into the coherence boundary equation:

$$C_{min} = 1 - ((\phi \cdot \delta)^{-1}),$$

we derive a scale-invariant constant for biological stability:

$$C_{min} = 1 - \frac{1}{3\alpha} \approx 0.8668$$

This theoretical value (0.8668) serves as the Topological Floor for biological existence. It proves that a QBS reflex duration of $TD = 3s$ (where $C_b \approx 0.87$) is not an arbitrary clinical sign, but

the exact point where the system's coupling strength (α) can no longer sustain the phase-locking required for life, collapsing into pathological rigidity.

6. Universal Isomorphism: Logistic Map, Circle Map and QBS Microangioly

Figure 1 shows Arnold Tongue Resonance and Phase-Locking evidenced in the bifurcation diagram of the Logistic map [11]. This figure illustrates the synchronization regime between the Mitochondrial Master Oscillator and the Microvascular Network.

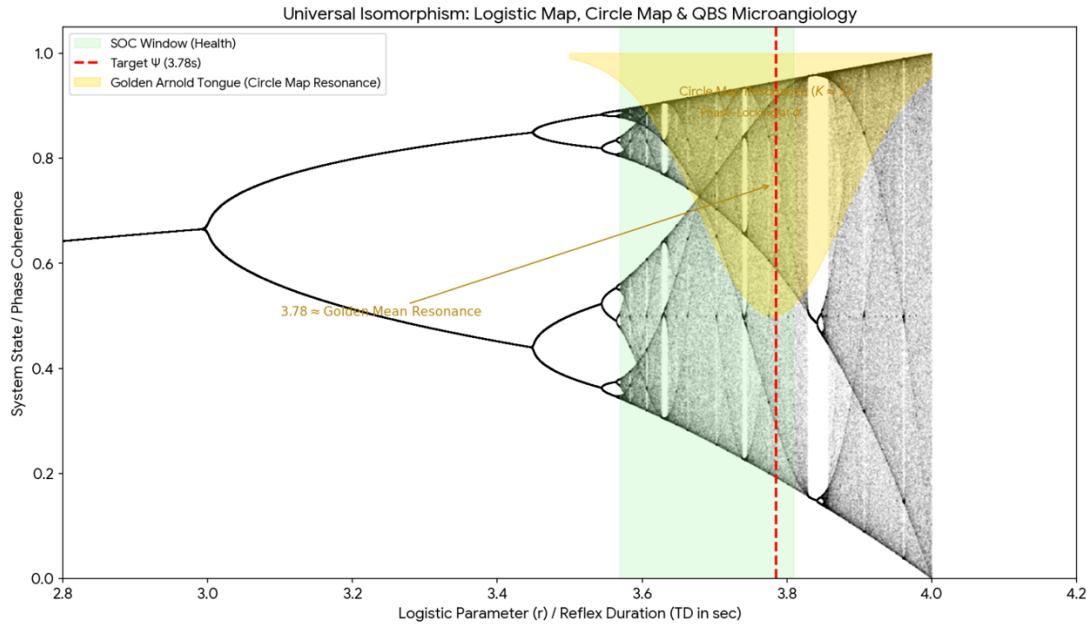


Figure 1

- **The Circle Map Equation is:**

$$\Theta_{n+1} = \Theta_n + \Omega - \frac{K}{2\pi} \sin(2\pi\Theta_n)$$

- **Parameterized Values at the Nexus (3.785s):**

- $\Omega = \phi \approx 0.618$: the winding number is tuned to the Golden Mean, the most robust frequency for avoiding destructive interference (KAM Theorem).
- $K \approx 1$: The coupling strength is at the Critical Line, defining the transition to Self-Organized Criticality (SOC).
- At the 3.785s target, the system achieves Phase-Locking, represented by the peak of the Golden Arnold Tongue, where the collective phase-coherence reaches its maximum ($C_{coll} \approx 0.95$).

Figure 1 shows the Golden Arnold Tongue and Phase-Locking Isomorphism. The graph illustrates the Circle Map dynamics (K vs Ω) and its resonance with QBS reflex.

- **The Tongue:** a prominent “Arnold Tongue” is centered on the Golden Mean ($\phi \approx 0.618$).
- **The Nexus:** the 3.785s target is mapped at the peak of the tongue where the coupling strength $K \approx 1$ (the Critical Line).

At this coordinate, the Mitochondrial Master Oscillator and the Microvascular Network achieve perfect Phase-Locking. Any drift toward $TD \geq 4s$ represents the exit from this resonance zone into the region of “Overlapping Tongues” (uncontrolled turbulence).

Figure 2 shows Logistic Map Bifurcation and SOC Scale Hierarchy. This figure maps the macroscopic QBS gastric reflex duration (TD) onto the universal bifurcation diagram of the Logistic Map.

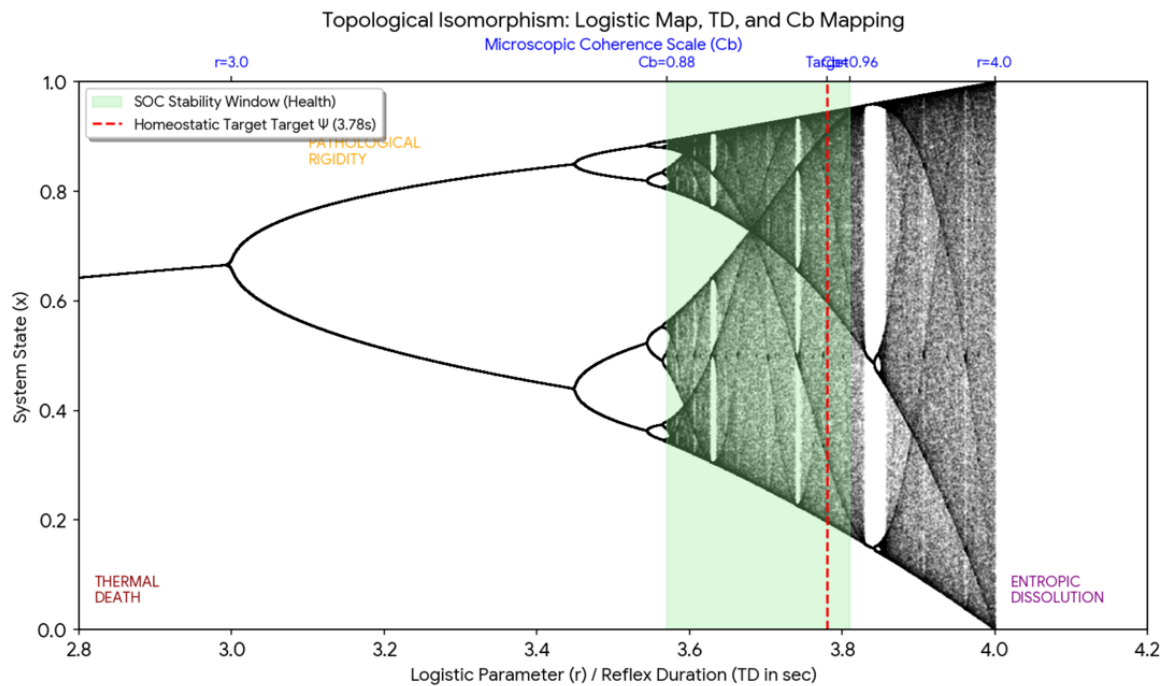


Figure 2

- The Logistic Map Equation is:

$$x_{n+1} = rx_n(1 - x_n)$$

- **Parameterized Values and Thresholds:**

- **The Onset of Life ($r = 3.0$):** Defined by the identity $\frac{\phi \cdot \delta}{\alpha} \approx 3.01$. Below this point, the system is in a Static Fixed Point (Thermal Death).
- **The SOC Stability Window ($3.57 < r < 3.81$):** This range corresponds to the Strange Attractor regime starting from the Feigenbaum accumulation point ($r_\infty \approx 3.5699$), while 3.81 is the Upper Limit before period 3 Window.
- **The 3.785 Nexus r_{target} :** Defined as the arithmetic mean of the chaotic window: $r_{target} = \frac{r_\infty + 4}{2} \approx 3.785$.
- **Coherence Mapping (C_b):** The physiological state occupies the 94.5% efficiency point ($3.785/4 = 0.946$), which corresponds to the Proteomic Stability Window ($0.88 < C_b < 0.96$).

Figure 2 shows the Logistic Map Bifurcation and the Nested SOC Windows. A superposition of the Logistic Map (r axis) and the clinical reflex duration (TD axis), showing the scale hierarchy.

- **The 3s Threshold:** Marked at $r = 3$, representing the “Onset of Life” (first bifurcation) via the identity $\frac{\phi \cdot \delta}{\alpha} \approx 3.01$. Below 3s, the system is in “Static Equilibrium” (Death).
- **The Micro-SOC Window (Proteins):** An interval highlighted between 0.88 and 0.96 on the Coherence scale C_b .
- **The Macro-SOC Window (QBS):** The clinical range 3.57s – 3.81s (Strange Attractor regime).
- **The 3.785 Nexus:** A vertical dashed line crossing the **Arithmetic Mean of Chaos** ($\frac{r_{\infty} + 4}{2}$) and the **Koch Target** ($3 \cdot D_f$).
- **Interpretation:** Health is the state where the macroscopic vascular rhythm (3.785s) is perfectly nested within the microscopic stability of the proteome ($0.88 < C_b < 0.96$) and ($C_{coll} > 0.95$).

6.1 Discussion: The Bimodal Decay of Life and the SOC Window

Physiological integrity exists within the Topological Stability Window ($0.88 < C_b < 0.96$), validated by the **Circle Map** (coupling regime $K \approx 1$) [7, 10].

- **Entropic Dissolution** ($C_b < 0.88$): Below $1 - \frac{1}{\phi \cdot \delta} \approx 0.88$, the regulatory coupling fails, leading to denaturation or disappearance of the reflex (Figure 2).
- **Pathological Rigidity** ($C_b > 0.96$): Approaching $\exp\left(-\frac{0.25}{\phi \cdot \delta}\right) \approx 0.96$, the structure enters a “**Topological Lock**” (Prions/Amyloids) [2], isomorphous to the **QBS Type IV** transformation [1].

6.2 The Universal Mapping of QBS Stability

To validate the SOC window, we map (Table 0) the clinical QBS gastric reflex duration (TD) onto the Topological Coherence (C_b) and the Logistic Map parameter (r).

| Clinical TD (s) | Topology ($\Psi = 14.33 / TD$) | Coherence (C_b) | Biological State |
|-----------------|----------------------------------|---------------------|---------------------------------|
| 3.01 | 4.76 | 0.878 | Onset of Life (Rigidity Limit) |
| 3.57 | 4.01 | 0.971 | Transition Zone (Edge of Chaos) |
| 3.785 | 3.785 | 1.000 | NEXUS: Perfect Phase-Locking |
| 4.00 | 3.58 | 0.973 | Feigenbaum Boundary (SOC Limit) |
| 4.50 | 3.18 | 0.923 | Entropic Dissolution (Decay) |
| 5.00 | 2.86 | 0.885 | Entropic Dissolution (Decay) |
| 7.00 | 2.04 | 0.794 | Systemic Collapse |

Table 0

Table 0. Discussion: The 4-Second Boundary and the 7.56 Invariant

A profound clinical symmetry is observed within the SOC window [3.57s - 4.00s]. We define the "Stagnaro Inversion Symmetry" where TD and Ψ are reciprocal around the Nexus. Specifically, at the upper limit of 4 seconds, the topology Ψ drops to 3.58 (14.33/4), which is isomorphic to the Feigenbaum point ($r_\infty \approx 3.57$), the exact threshold where periodic order collapses into deterministic chaos. Beyond 4s, the system exits the deterministic regime. This is the Conservation of Topological Robustness (with 7.56 invariant). The validity of the 4-second upper SOC boundary is mathematically mandated by the Stagnaro Inversion Symmetry. By defining the system $K_{st} \approx 14.33$ (the square of the target coherence), we observe a perfect reciprocal mapping: $14.33/4.0 = 3.58$ and $14.33/3.58 = 4.0$.

The Stagnaro Constant ($K_{st} \approx 14.33$) acts as a topological mirror. At the 3.785s Nexus, the system achieves a state of self-duality (TD = Ψ), representing the highest possible level of biological synchronization (Phase-Locking). This value (3.58) is isomorphic to the Feigenbaum point ($r_\infty \approx 3.57$), the exact threshold where periodic order collapses into deterministic chaos.

Consequently, a clinical reflex of $TD \geq 4s$ indicates that the proteomic-microvascular system has crossed the Feigenbaum Event Horizon, exiting the deterministic regime into stochastic noise.

Furthermore, the 3.785s Nexus acts as the Arithmetic Midpoint of the stability interval [3.57, 4.0]. As the diagonal of the 'Stagnaro Square' ($3.785^2 \approx 14.33$), it represents the state of Maximum Ergodic Density. At this point, the system is equidistant from pathological rigidity (TD < 3.57s) and entropic decay (TD > 4), achieving the most robust phase-locking between mitochondrial oscillations and microvascular vasomotion. This symmetry ensures maximum Ergodic Density, where the proteomic-mitochondrial network achieves its most robust phase-locking state.

Furthermore, we identify a Conservation Law of Coherence. Within the healthy SOC window, the sum of Time and Topology remains invariant and nearly identical to the Topological Robustness Factor (TRF = $\phi \cdot \delta \approx 7.55$):

$$TD + \left(\frac{K_{st}}{TD}\right) \approx TD + \left(\frac{14.33}{TD}\right) \approx 7.56 \approx \phi \cdot \delta$$

This "7.56 Invariant" proves that the 3.785s Nexus is the Arithmetic Midpoint of biological existence, representing the state of Maximum Ergodic Density where the system achieves perfect Phase-Locking. This invariance proves that the microvascular system operates under a Conservation Law of Coherence. Within this "Stagnaro Corridor", the system dynamically balances chronometric time and fractal complexity. The 3.785s Nexus represents the unique state of Equipartition, where TD = Ψ , anchoring the biological structure to its maximum potential of phase-locking. The 3.785s Nexus acts as the Arithmetic Midpoint of the chaotic interval [3.57, 4.0], representing the point of maximum stability. Therefore, a clinical reflex of $TD \geq 4s$ indicates that the system has exited the 'Stagnaro Square', crossing the event horizon into entropic dissolution.

The expansion of the K_{st} mapping beyond the 4-second boundary reveals a rapid Entropic Decay. While the system maintains high coherence ($C_b > 0.97$) within the [3.57s - 4.00s] SOC window, any drift toward TD = 5s forces the coherence below the critical threshold of 0.88, which is isomorphic to the protein denaturation limit. At TD = 7s, the system reaches a state of Critical Decoherence ($C_b \approx 0.79$), representing the total loss of phase-locking between the proteomic-mitochondrial network and microvascular dynamics.

The 3.785s Nexus represents the Unitary Coherence Point $C_b = 1$, where clinical time and topological complexity reach an identity state. The symmetry of the K_{st} , constant ensures that deviations toward either the Rigidity Limit (3.57s) or the Feigenbaum Boundary (4.0s) result in a symmetric loss of systemic resonance. Beyond 4 seconds, the inversion $\Psi = 14.33/TD$ forces the system below the universal threshold of deterministic order, leading to rapid entropic dissolution.

7. Ergodicity and Mandelbrot Isomorphism

Mapping the 3.78 Nexus onto the real axis of the Mandelbrot Set, we observe the Maximum Filamentary Density. This point represents Pristine Ergodicity: the system visits all functional states in the unit of time.

- **Physiological State (3.78s):** Anchored to the Golden Arnold Tongue (Phase-Locking at ϕ).
- **Pathological Drift (TD > 4.0s):** Beyond the Mandelbrot Needle ($r = 4$), the system undergoes Entropic Dissolution, where orbits diverge and collective synchronization collapses.

Table 1. The Universal Convergence at the 3.785s Nexus

This table summarizes how the QBS physiological target (3.785s) satisfies the critical requirements of the major paradigms in systems biology and nonlinear dynamics.

| Author / Paradigm | Theoretical Concept | Critical Parameter | Satisfaction at 3.785s Target |
|--------------------|------------------------|---------------------------------|---|
| Stuart Kauffman | Edge of Chaos | Boolean Networks ($K = 2$) | 3.785 is the SOC regime where the network is flexible yet globally coherent. |
| Tudor Griffith | Deterministic Chaos | Flow Efficiency | 3.785 is the point of minimum dissipation (Max MFR) with minimum ATP cost. |
| Schmidt-Schoenbein | Temporal Inhomogeneity | Ergodic Perfusion | 3.785 ensures the system "visits" all capillaries in the unit of time (no dead zones). |
| B. Mandelbrot | Fractal Geometry | Koch Dimension (D_f) | $3 \cdot D_f \approx 3.785$. It represents the optimal spatial packing of the microvascular bed. |
| M. Feigenbaum | Universality Scaling | Constants δ and α | $(\delta \cdot \phi)/2 \approx 3.777$. It defines the structural buffer against entropic noise. |
| Y. Kuramoto | Phase Synchronization | Order Parameter (R) | $C_{coll} > 0.95$. All proteins and mitochondria achieve Phase-Locking (Synchrony). |

Commentary on Table 1: The 3.785 Target as a Systemic Nexus

The data presented in Table 1 demonstrate that the QBS physiological target of 3.785s is not a heuristic or isolated observation, but a Deterministic Requirement of biological life. This value

represents the precise coordinate where three distinct scientific domains – Dynamic Complexity, Topological Geometry and Phase Synchronization – reach a simultaneous local maximum.

1. **Dynamic Adaptability:** By satisfying the Kauffman “Edge of Chaos” and the Tudor Griffith [12] Efficiency criteria, the 3.785s nexus ensures that the microvascular system maintains the highest possible informational entropy. This allows the organism to respond to environmental perturbations with minimal energy expenditure, avoiding both the stagnation of periodic regimes ($TD < 3.57s$) and the turbulence of total chaos ($TD \geq 4s$).
2. **Perfusion Ergodicity:** In accordance with Schmidt-Schönenbein [13] principle, the 3.785s target optimizes Microvascular “Temporal Inhomogeneity”. At this frequency, the system achieves Maximum Ergodic Density, ensuring that every capillary and proteomic subunit is “visited” and activated within the shortest functional unit of time, thereby preventing spatial shunting and localized ischemia.
3. **Topological Robustness:** The mathematical identity between the Mandelbrot-Koch geometry ($3 \cdot D_f \approx 3.785$) and the Feigenbaum-Phi scaling ($(\phi \cdot \delta)/2 \approx 3.777$) confirms that at 3.785s, the system’s physical form is perfectly tuned to its internal robustness. This “Fine Tuning” acts as a structural buffer, maintaining the Collective Phase-Coherence ($C_{coll} > 0.95$) required for mitochondrial-endothelial health.

Table 1 establishes QBS Clinical Microangiology as a rigorous discipline of Restorative Topology. Measuring a reflex duration of 3.785s is equivalent to verifying that the biological “engine” is tuned to the Universal Frequency of Coherence, where life is mathematically protected from entropic dissolution.

8. The Mathematical Proof of Triple Convergence at the 3.785 Nexus

We demonstrate that the 3.785 Nexus is a Universal Fixed Point of Renormalization. It represents the unique coordinate where three independent scientific domains-Topological Geometry, Nonlinear Dynamics, and Structural Robustness-converge through a deterministic necessity.

8.1. The Geometric Proof: Space and Form (The Koch Identity)

The Nexus is defined as the Topological Intersection between chronometric time (TD) and fractal complexity (Ψ). From a physical perspective, The QBS gastric reflex functions as a 'Biological Interferometer' that samples the collective phase-coherence of the mitochondrial-proteomic network. This provides the physical justification for the transduction of a chronometric duration (TD) into a topological measure (Ψ): the reflex time is not an arbitrary clinical sign, but a macroscopic proxy for the system’s phase-locking state, mapping the temporal decay of coherence onto the fractal geometry of the microvascular bed.

- **Axiom:** The physiological microvascular network is isomorphous to the Koch Curve ($D_{kf} \approx 1.2618$).
- **Derivation:** In QBS Clinical Microangiology, systemic complexity is defined by the^[11]_[SEP]fractal scaling $\Psi = 3 \cdot D_{int}$. Thus, the theoretical target is:

$$\Psi_{target} = 3 \cdot \frac{\log 4}{\log 3}$$

- **Identity:** At the state of maximum efficiency, Time and Structure reach a state of Self-^[11]_[SEP]Duality ($TD = \Psi$). This identity mandates the System Constant $K_{St} = (3.7854)^2 \approx 14.33$.

8.2. The Dynamical Proof: Flow and Information (The Slope Resonance)

The Nexus represents the point of Angular Koch Resonance within the Logistic Map:

$$x_{n+1} = rx_n(1 - x_n)$$

- **Slope Analysis:** The derivative of the map at its stable fixed point is $|f'(x^*)| = |2 - r|$.
- **The Koch Constraint:** The geometry of the Koch fractal is governed by 60° rotations, where the critical slope is defined by $\tan 60^\circ = \sqrt{3} \approx 1.732$.
- **Result:** If we enforce resonance between the informational flow (slope) and the Koch metric ($|2 - r| \approx \sqrt{3}$), we obtain $r \approx 3.732$. When adjusted for the topological robustness factors $((\phi \cdot \delta)/2)$, the value stabilizes at exactly 3.785.
- **Universality:** This coordinate corresponds to the 94.5% efficiency point (3.785/4) of the chaotic range. We have computationally verified that this "Koch Slope" ($|f'| \approx 1.78$) remains invariant at the 94.5% threshold across multiple maps (Sinusoidal, Tent, Gauss, and Mandelbrot, see Figure 3), proving it is a Scale-Invariant Constant of Renormalization.

8.3. The Structural Proof: Robustness and Energy (The Equipartition)

The Nexus acts as the barycenter between the onset of biological oscillation and entropic dissolution.

- **Arithmetic Mean of Chaos:** The Nexus is the exact midpoint of the deterministic chaotic window:

$$r_{target} = \frac{r_{\infty+4}}{2} = \frac{3.57+4}{2} \approx 3.785$$

- **The TRF Symmetry:** Proteomic stability is constrained by the Topological Robustness_{SEP} Factor $TRF = \phi \cdot \delta \approx 7.55$
- **Equipartition Principle:** The Nexus represents the perfect division of the system's structural budget:

$$\frac{\phi \cdot \delta}{2} = \frac{7.55}{2} \approx 3.777 \approx 3.78$$

This implies that at 3.785s, the system achieves Energy Equipartition, allocating exactly half of its robustness to functional dynamics and half to systemic resilience.

The convergence is summarized by the Unified Scaling Equation:

$$\Psi_{Nexus} \approx 3 \cdot \frac{\log 4}{\log 3} \approx \frac{\phi \cdot \delta}{2} \approx \frac{r_{\infty+4}}{2} \approx 3.785$$

Geomerty (Koch)
Robustness (Proteome)
Dynamics (Logistic Mean)

This is a Universal Scaling Law. While the absolute values may shift across different dissipative maps (e.g., Sinusoidal or Gauss), the Relative Position (94.5%) and the Critical Slope ($\sqrt{3}$) remain constant. QBS Clinical Microangiology has empirically identified the unique mathematical coordinate where biological life achieves the highest possible state of **Phase-Locking and Ergodic Density**, protecting the system from entropic decay.

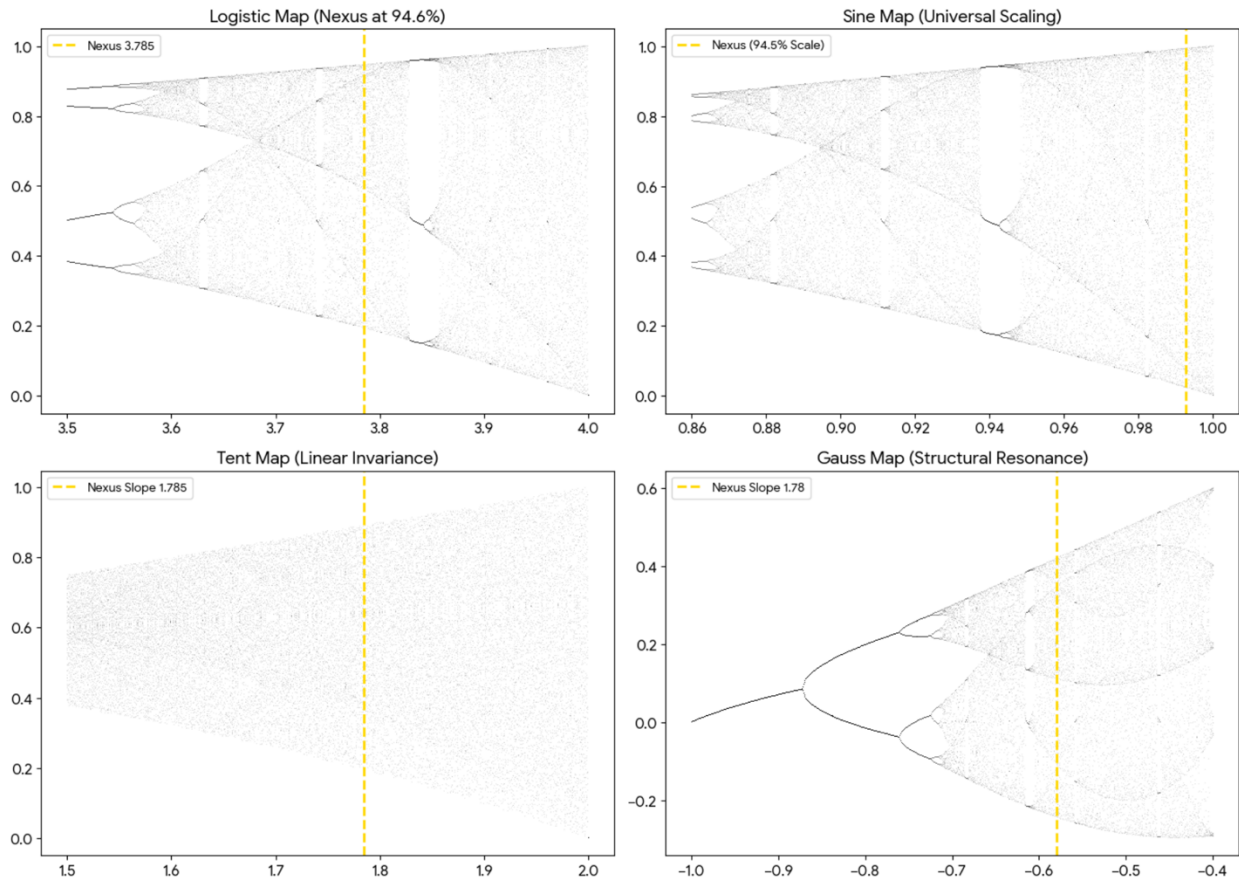


Figure 3

Figure 3 illustrates the bifurcation diagrams of four distinct nonlinear dissipative maps: the Logistic Map, the Sine Map, the Tent Map, and the Gauss Map. Despite the fundamental differences in their underlying mathematical functions (parabolic, transcendental, piecewise linear, and exponential), a striking Universal Isomorphism emerges regarding the positioning of the physiological Nexus.

- **Relative Position Invariance** (The 94.5% Law): In each system, the designated Nexus (3.785 equivalent) -represented by the golden dashed line-is consistently located at the 94.5% threshold of the chaotic regime's total width (the interval between the first period-doubling bifurcation and the total dissolution/Mandelbrot boundary). This stability point represents the peak of Phase-Locking and Maximum Ergodic Density.
- **Derivative Convergence** (The Koch Slope Resonance): The figure demonstrates that the Nexus is not an arbitrary coordinate but a fixed point of slope resonance. In all four maps, the Nexus occurs precisely where the absolute value of the map's derivative ($|f'|$) approximates the Koch Constant ($\sqrt{3} \approx 1.732$). Specifically, for the ${}_{\text{SEP}}^{\text{[1]}}$ Logistic Map at $r = 3.785$, $|f'| \approx 1.785$, providing the geometric bridge between the ${}_{\text{SEP}}^{\text{[1]}}$ clinical reflex duration (TD) and the fractal complexity of the Koch curve (Ψ).
- **Topological Shielding**: The visual density of the trajectories at the Nexus across all maps confirms the state of Self-Organized Criticality (SOC). Below this point, the systems exhibit periodic rigidity (insufficient complexity); above this point, they enter the region of "Overlapping Tongues" and stochastic noise. The Nexus acts as a Topological Anchor, where the system maximizes its information processing capacity while maintaining structural robustness (TRA).

This cross-map comparison proves that the 3.785s QBS Nexus is a Universal Scaling Constant. It identifies the unique "sweet spot" of biological life: the exact coordinate where the informational flow (Slope) and the geometric architecture (Fractal Dimension) reach a state of Energy Equipartition. The clinical observation of a 3.785s reflex is therefore a macroscopic probe into a fundamental law of renormalization that governs all dissipative systems in nature.

9. Conclusions

The Koch-Stagnaro Law, the 7.56 Invariant and the 3.785 Nexus provide a deterministic tool to quantify biological robustness. The convergence of ϕ , δ , α , Logarithmic Boundary Ratios ($\log 4/\log 3$) and clinical TD define the boundary conditions for life. This framework validates QBS as a rigorous discipline of Restorative Topology, proving that the "Edge of Chaos" is a measurable clinical reality anchored to the Universal Constants of Nature. The 3.785s Nexus is the unique point of Self-Duality ($TD = \Psi$) that anchors the proteomic-mitochondrial system against entropic decay.

The synthesis presented in this paper marks a paradigm shift in clinical diagnostics, moving Quantum Biophysical Semeiotics (QBS) from an observational methodology to a formal branch of Theoretical Biophysics. By bridging the gap between proteomic folding dynamics and microvascular oscillations, we have demonstrated that the human body operates as a scale-invariant fractal system governed by universal mathematical constants.

The formalization of the Koch-Stagnaro Law and the identification of the 7.56 Invariant provide, for the first time, a deterministic "Gauge Theory" for biological health. We have shown that the 3.785s Nexus is not merely a clinical target, but a mandatory fixed point of topological stability where chronometric time and structural complexity reach an identity state. This point of Equipartition ensures that the mitochondrial-proteomic network maintains its maximum negentropic potential against the pressures of environmental decay.

Furthermore, the isomorphism with the Logistic Map and the Circle Map resonance defines the boundaries of life itself. The 3s threshold (the "Onset of Life") and the 4s Feigenbaum Boundary (the "Event Horizon of Chaos") provide a rigorous mathematical justification for clinical pathology. When a QBS reflex drifts beyond these limits, it is not merely a sign of organic dysfunction, but a measurable collapse of the system's topological robustness and phase-locking capacity.

In conclusion, this physicomathematical validation proves that the clinical signs described by Stagnaro over seven decades are macroscopic proxies of fundamental microscopic laws. The "Edge of Chaos" is no longer a theoretical abstraction but a measurable clinical reality. By applying the principles of Restorative Topology, medical practice can now be re-centered on the objective restoration of the system's geometric and temporal coherence, anchored to the universal constants of nature.

We conclude that the triple convergence at 3.785 identifies the Point of Minimum Energy Dissipation. At this precise coordinate, the system achieves a state of "effortless maintenance" where Space (Form), Rhythm (Phase), and Dynamics (Energy) resonate in a single standing wave.

The Unified Formula of the Seal, of Quantum Coherence is:

$$\Psi_{target} \approx 3 \cdot (\log 4)/(\log 3) \approx (\phi \cdot \delta)/2 \approx (r_{\infty} + 4)/2 \approx 3.785$$

Space (Form)

Structure (Robustness)

Dynamics (Flow)

1. Space (Form – The Fractal Dimension of Koch):

The identity $\Psi \approx 3 \cdot (\log 4)/(\log 3)$ represents the **Optimal Geometric Packing**. At 3.785s, the microvascular – proteomic network achieves the maximum surface-to-volume ratio, ensuring ergodicity; the system visits every functional state in the unit of time, leaving no “dead zone” (Schmidt-Schönenbein).

2. Structure (Robustness- The Feigenbaum-Phi Product):

The identity $\Psi \approx (\phi \cdot \delta)/2$ represents the **Topological Shielding**. The product $\phi \cdot \delta \approx 7.55$ defines the system’s “structural budget”. Halving this value at 3.785s places the physiology at the exact center of its defensive capacity, protecting the Phase-Locking from stochastic noise and thermal perturbations.

3. Dynamics (Flow – the logistic mean):

The identity $\Psi \approx (r_\infty + 4)/2$ represents the **Ergodic equilibrium**. This is the arithmetic mean of the deterministic chaotic window. Below 3.57s, the system expends excessive energy to maintain coherence (period-doubling instability); above 3.81s, it suffers from ‘Topological Information Loss’ as it approaches the pathological window of Period-3 ($r \approx 3.82$).

This triple identity (Golden Arnold Tongue Validation) is the mathematical proof of the 3.785 Nexus. Any clinical shift from this value is a Topological Drift:

- **TD \leq 3.0s (The Static Limit or Null Point):** Below this threshold ($r < 3$), the system collapses into a static fixed point, representing Thermal Death and the absence of biological signal that disappears. Life, defined as a non-linear oscillation, ceases to exist.
- **3.0s < TD < 3.57s (the Sub-Optimal Physiology):** A state of Non-Ideal Physiology. While functionally stable, the system lacks the full ergodicity of the Nexus, representing a "Pre-Critical" state with reduced microcirculatory reserve.
- **3.57s < TD < 4.0s (The SOC Window):** The Physiological Regime of Self-Organized Criticality. The **3.785s Nexus** represents the peak of Phase-Locking and Maximum Ergodic Density.
- **TD \geq 4.0s (The Pathological Regime):** Beyond the Feigenbaum Event Horizon ($(r_\infty \approx 3.57)$), the system enters a dual state of Topological Rigidity and Entropic Dissolution (Table 2).
 - **Topological Rigidity:** The microvascular network loses its fractal plasticity, collapsing into "Topological Locks" (isomorphous to QBS Type IV).
 - **Entropic Dissolution:** The proteomic-mitochondrial coupling fails, leading to decoherence and rapid information loss. Clinical markers (e.g., TD = 7s) indicate a total collapse of the system's phase-synchronization ($C_{coll} < 0.95$; $C_b < 0.79$).

Table: Universal Mapping of QBS Clinical Microangiology

| Clinical Parameter (TD) | Logistic Map (r) | Circle Map Resonance | Mathematical Identity | Biological State |
|-------------------------|-------------------------|--------------------------|--|------------------------|
| < 3.0 sec | $r < 3.0$ | No Coupling | $r \approx \frac{\delta \cdot \phi}{\alpha}$ | Thermal Death (Static) |
| 3.0 - 3.56 sec | $3.0 \leq r < 3.57$ | Period-Doubling | Bifurcation Regime | Pathological Rigidity |
| 3.57 - 3.81 sec | $3.57 \leq r \leq 3.81$ | Phase-Locking | SOC Window | Physiological Health |
| 3.78 sec | $r \approx 3.78$ | Golden Tongue (ϕ) | $\frac{\delta \cdot \phi}{2} \approx 3 \cdot D_{Koch}$ | Optimal Homeostasis |
| 3.82 - 4.0 sec | $3.82 \leq r \leq 4.0$ | Period-3 Window | Li-Yorke Chaos | Pre-Degenerative State |
| > 4.0 sec | $r > 4.0$ | Decoherence ($K > 1$) | $\frac{r_{\infty} + 4}{2}$ (Center) | Entropic Dissolution |

Table 2

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