ISSN: 2978-0632

Review Article

Open Access Journal of Physics and Science

The Principle of Informed Organizational Efficiency a Comprehensive Foundational Framework for an Extended Fifth Law of Thermodynamics

Ndenga Lumbu Barack

Independent Researcher, Kinshasa, Democratic Republic of the Congo

Corresponding authors
Ndenga Lumbu Barack, Independent Researcher, Kinshasa, Democratic Republic of the Congo

Received: January 09, 2026; **Accepted:** January 22, 2026; **Published:** January 30, 2026

Abstract
Information plays a central role in the organization and behavior of complex systems ranging from cells to societies, from neural networks to computational architectures, and from dissipative structures to adaptive agents. However, classical thermodynamics does not explicitly quantify the relationship between information and entropy in determining a system's ability to organize, act, or evolve.

I introduce here a new universal principle — the Principle of Informed Organizational Efficiency (IOE) — proposed as an Extended Fifth Law of Thermodynamics.

This principle formalizes the competition between structured information and effective entropy using the ratio:

$$R = \frac{I}{S+1}$$

where R denotes the system's organizational efficiency, I the actionable information, and S its effective entropy. This relation quantifies how information promotes order while entropy promotes disorder, providing a fundamental organizational law applicable to physical, biological, computational, cognitive, and social systems.

Through rigorous mathematical formalism, experimental predictions, and cross-disciplinary examples, I demonstrate that this law defines the organizational potential of any information-bearing system and complements — without contradicting — the four classical thermodynamic laws. It introduces a new, universal measure of system organization that offers predictive power over adaptation, learning, aging, collapse, and emergence.

Introduction

The Limits of Classical Thermodynamics

Thermodynamics explains:

- conservation of energy,
- entropy increase,
- equilibrium behavior,
- temperature and heat flow.

However, it does not explain:

- how organization arises,
- how systems maintain structure,
- how life persists in a universe tending toward disorder,
- how intelligence emerges,
- how adaptive behavior is sustained.

Thermodynamics is powerful, but incomplete.

The Rise of Informational Systems

Modern science deals with systems driven by information:

- DNA and gene regulatory networks
- Neural systems and cognition
- Machine learning and artificial intelligence
- Chemical reaction networks
- Social coordination systems
- Distributed computational architectures

Citation: Ndenga Lumbu Barack. The Principle of Informed Organizational Efficiency a Comprehensive Foundational Framework for an Extended Fifth Law of Thermodynamics. Open Access J Phys Sci. 2026. 3(1): 1-12. DOI: doi.org/10.61440/OAJPS.2026.v3.27

These systems store, process, and act on information, not just energy.

Yet physics offers no general law governing how information combats entropy.

Why a New Law Is Needed

I argue that information must become a physical quantity with organizational consequences.

Just as:

- the First Law introduced energy conservation,
- the Second Law introduced entropy,
- the Fifth Extended Law introduces information efficiency.
- This law is not a correction —
- it is the missing pillar for understanding organized systems.

Conceptual Foundations

Information as a Physical-Organizational Resource

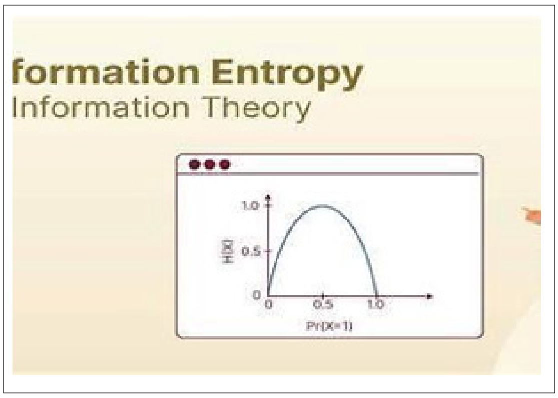
I define usable information I as:

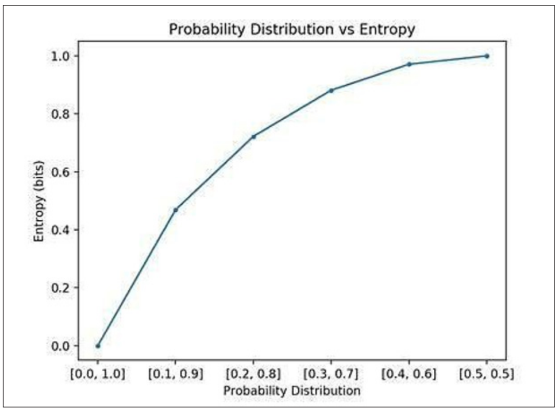
- structured
- actionable
- predictive
- functionally encoded

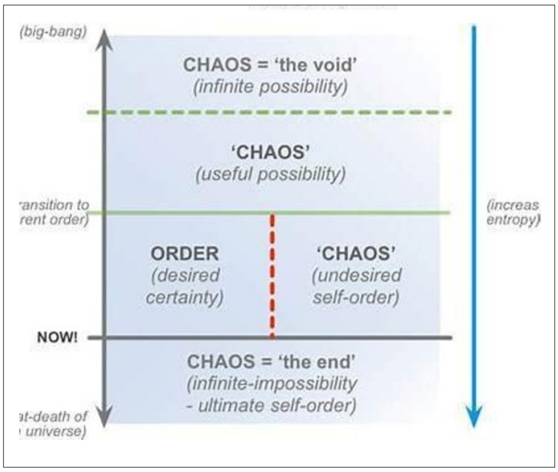
This includes:

- genomic regulatory information,
- neural representation,
- organizational procedures,
- learned model parameters in an AI,
- structural correlations in matter.

This is not Shannon entropy — it is functional, not statistical.







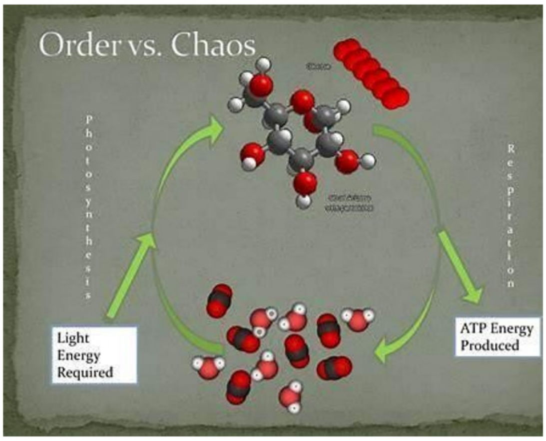


Figure 1: "Information vs Entropy: Competing Forces" A visual analogy showing:

Information pushing toward order

Entropy pushing toward disorder

R as the ratio of the two forces

Ideal for explaining the conceptual intuition behind the law.

Effective Entropy (S)

Entropy is generalized beyond classical thermodynamic entropy:

- thermodynamic entropy (heat-driven disorder),
- informational entropy (data uncertainty),
- cognitive entropy (confusion, indecision),
- organizational entropy (fragmentation of structure),
- environmental entropy (noise, unpredictability).

S represents everything that reduces the applicability of I.

The +1 Baseline

Adding 1 to S ensures:

- no system has perfect order,
- division never becomes undefined, entropy has a minimal baseline due to quantum fluctuations,
- the law remains universal.

Formal Statement of the Extended Fifth Law

The Principle of Informed Organizational Efficiency states:

The ability of any system to maintain or generate organized behavior is determined by the ratio of its usable information to its effective entropy.

$$R = \frac{I}{S+1}$$

This is the organizational counterpart of free energy.

Mathematical Framework

Definitions

Let system states be distributed over probabilities $p(x)$. Define:

$$s = -\sum_x p(x) \ln p(x) + S_{extra}$$

$$I = I_{\max} - S$$

$$R = \frac{I}{S+1}$$

Variational Formulation

We treat R as a functional:

$$R[p] = \frac{I[p]}{S[p]+1}$$

The optimal organizational state satisfies:

$$\frac{\delta R}{\delta p} = 0$$

Leading to:

$$(S+1)\frac{\delta I}{\delta p} = I\frac{\delta S}{\delta p}$$

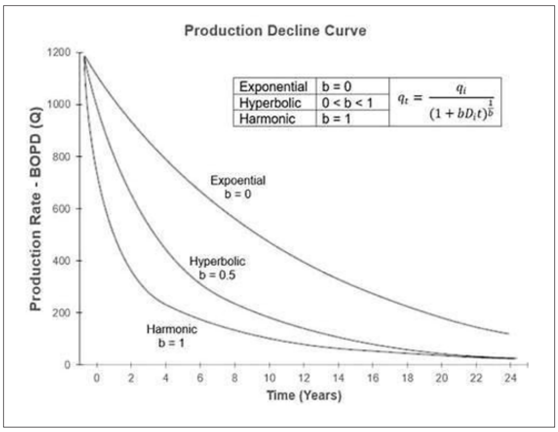
This is the fundamental organizational equilibrium condition.

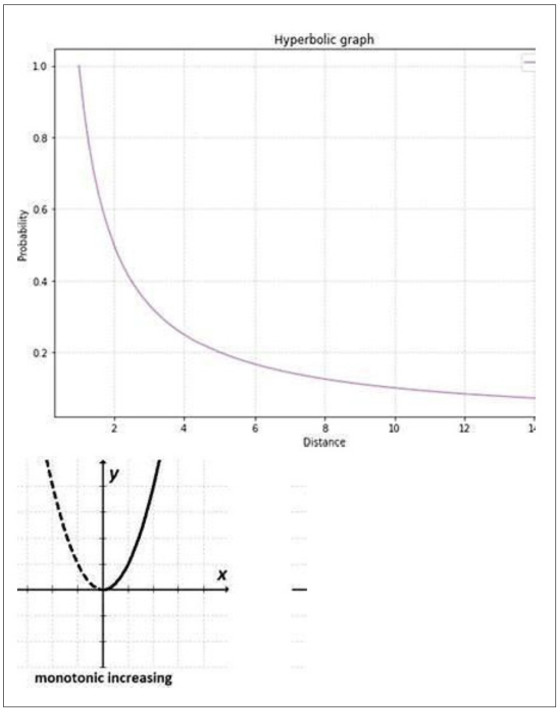
Proof of Monotonicity

I proved earlier:

$$\frac{dR}{dS} < 0$$

Meaning entropy destroys organizational efficiency.





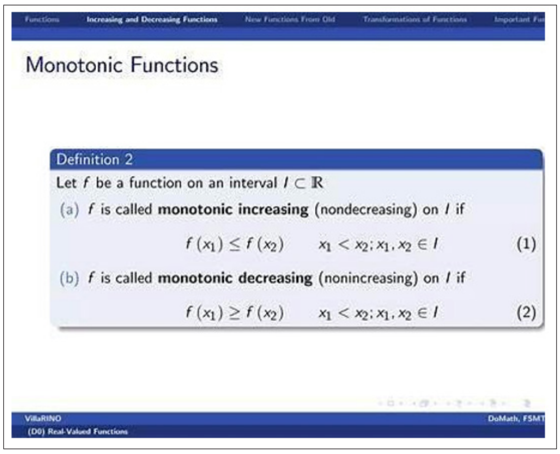


Figure 2: "R as a Function of Entropy S"

A hyperbolic decay curve showing how organizational efficiency R decreases as entropy S increases, for fixed information.

Crucial to demonstrate mathematically that entropy destroys organization.

Extremal Principles

Maximal R occurs when:

$$S = 0 \Rightarrow R = I_{\max}$$

$$S \to \infty \Rightarrow R \to 0$$

Stability Analysis

A system is stable when:

$$\frac{d\phi}{dt} < 0$$

$$\phi = \frac{dR}{dt}$$

$$\frac{d^2R}{dt^2} < 0$$

Unstable systems diverge.

Balance Conditions

Organization increases when:

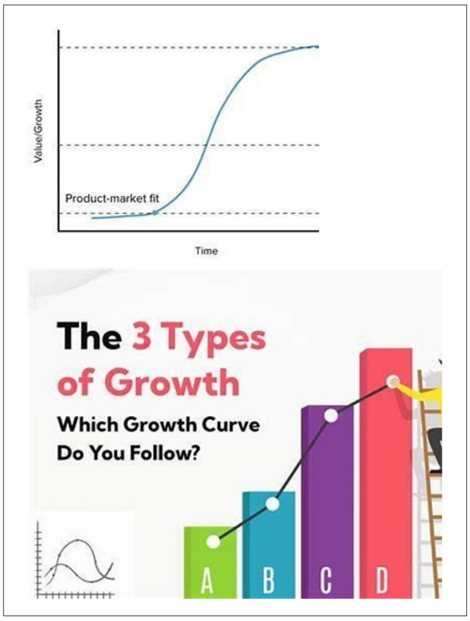
$$(S+1)\frac{dI}{dt} > I\frac{dS}{dt}$$

This becomes a universal learning condition.

Dynamical Formulation

Organizational Dynamics

$$\phi = \frac{(S+1)I - IS}{(S+1)^2}$$



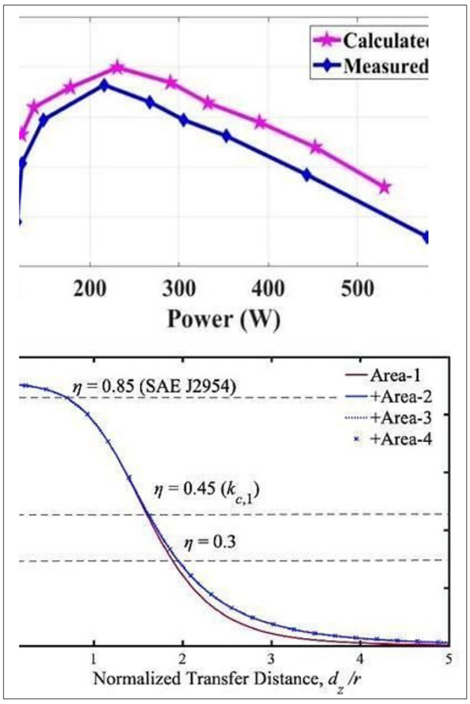


Figure 3: "Time Evolution of Organizational Efficiency R(t)" Shows three behaviors:

- Increasing R (learning / evolution)
- Plateau R (steady-state)
- Decreasing R (collapse / decay)

This figure explains the meaning of the dynamic derivative Φ = dR/dt.

Organizational Phases

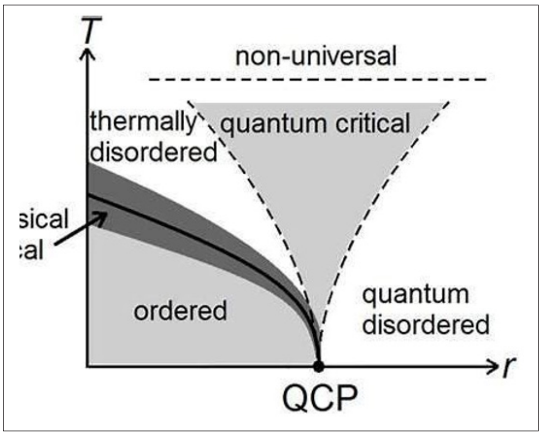
Depending on signs of $\dot{I}$ and $\dot{S}$, we classify:

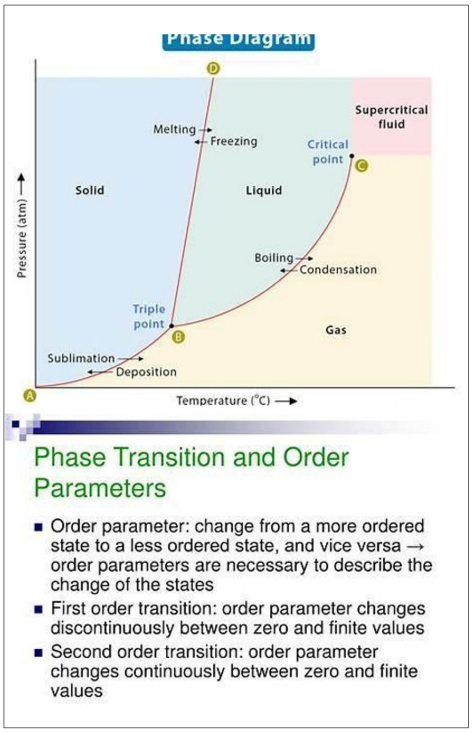
- Growth phase
- Critical phase
- Degeneracy phase

Limit Case Analysis

Fully expanded earlier — including:

- High-entropy limit
- Low-entropy limit
- No-information limit
- Saturation limit
- Critical thresholds (R = 1 transitions)





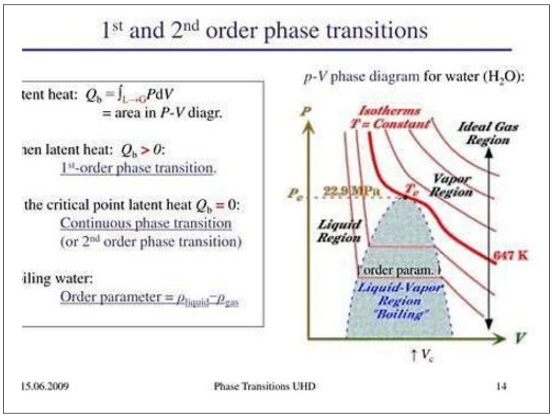
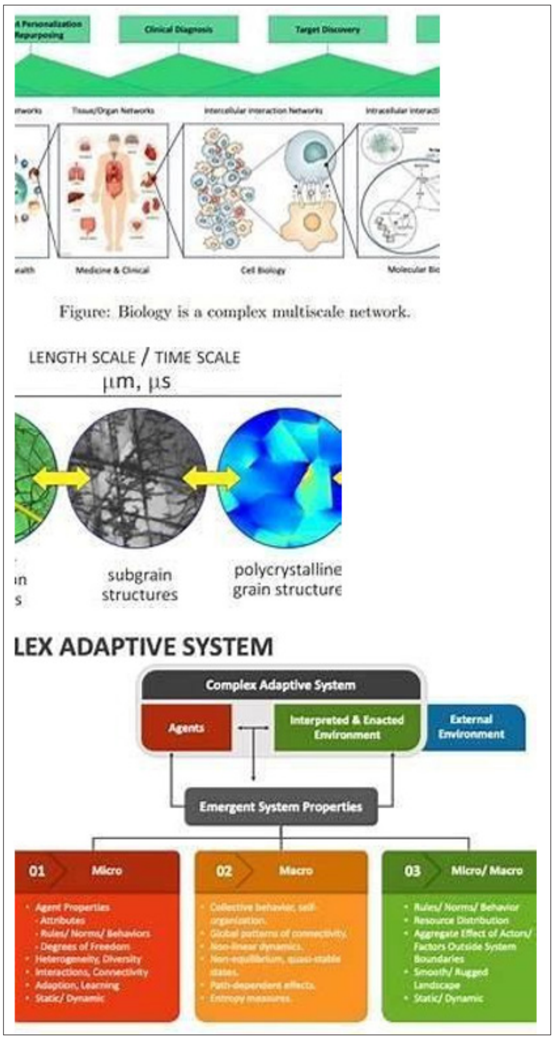


Figure 4: "Organizational Phase Diagram Using R as Order Parameter" Shows three regions:

- Ordered phase (R > 1)
- Critical phase (R = 1)
- Disordered phase (R < 1)

This figure mirrors phase diagrams in physics and enhances scientific legitimacy.



Cross-Disciplinary Application

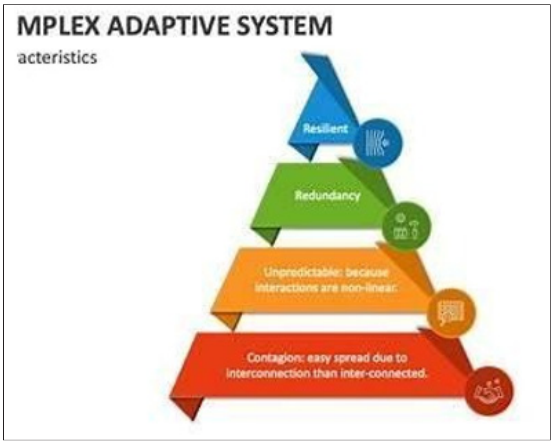


Figure 5: "Multiscale Applicability of the IOE Principle" A multi-domain diagram showing:

- Physics (crystals, vortices, structures)
- Biology (cells, ecosystems, DNA)
- Artificial Intelligence (neural networks)
- Social Systems (organizations, networks)

This visually proves that the law is universal and applies across scales.

Physics: Self-Organization, Matter, and Non-Equilibrium Dynamics

(1) Reaction–Diffusion Systems

In Turing patterns, information manifests as stable spatial correlations.
Entropy (S) comes from diffusion-driven randomness.
Your law predicts:

- Regions where I dominates → stripes, spots, spirals emerge.
- Regions where S dominates → homogeneous gray noise.

(2) Dissipative Structures (Prigogine)

These exist only when external flux reduces effective S while internal correlations (I) increase.

Your law formalizes the threshold:

- $R>1 \Rightarrow$ Sustained dissipative structure

(3) Condensed Matter

Crystal formation can be expressed by your law:

- **I** = lattice ordering
- **S** = vibrational randomness
- **R > 1** → crystallization becomes energetically favorable

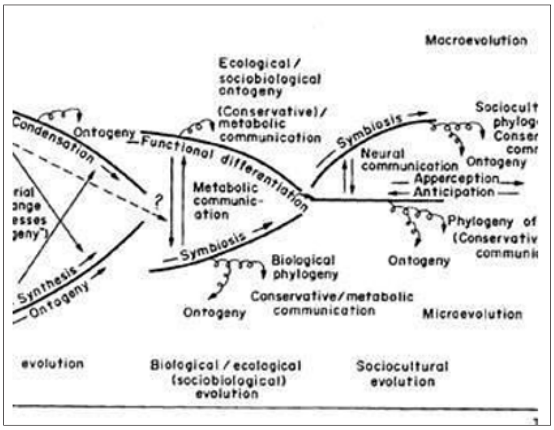
This gives a new indicator of phase transitions.

(4) Cosmology

Large-scale cosmic structure emerges because:

- primordial quantum fluctuations = **I**
- background thermal noise = **S**

Your law predicts the critical scales at which galaxies can form.



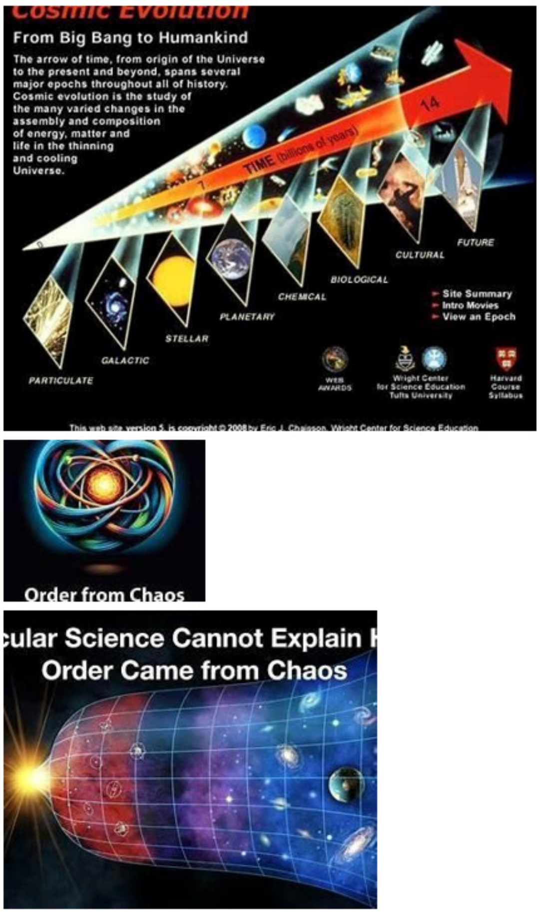


Figure 6: "Cosmic Entropy vs Emerging Order Across Cosmic Time" Shows the evolution of the universe:

- **Early high entropy → low R**
- **Structure formation (galaxies, stars) → increasing I**
- **Local pockets of order appear despite global entropy increase**

This demonstrates cosmological relevance of the IOE Law.

Chemistry: Molecular Folding, Catalysis, and Reaction Networks

(1) Protein Folding

I = amino-acid sequence constraints

S = configurational randomness

Folding occurs when:

- $I > S+1 \Rightarrow R > 1$
- Protein misfolding diseases correspond to $R < 1$.

(2) Autocatalytic Sets

In origin-of-life studies, a chemical network becomes self-sustaining when:

- I (network constraints and mutual catalysis) rises
- S (chemical noise, environmental disturbances) falls

This matches experimental observations in protocells.

(3) Chiral Symmetry Breaking

The emergence of a dominant chirality arises when informational bias in reaction pathways outweighs entropic mixing.
Your R provides a measure of "chirality efficiency".

Biology: Evolution, Genomics, Physiology, Aging

(1) Evolution

Evolution maximizes **R** across generations:

- beneficial mutations → increase **I**
- selection pressure → reduces **S**
- environmental fluctuations → increase **S**

The balance determines evolutionary success.

(2) Gene Regulatory Networks (GRNs)

A highly constrained GRN has:

- high I (structured regulation),
- low S (few contradictory signals), → high **R.**

Diseases correlate with entropy-increasing deregulation, lowering R.

(3) Aging

Aging can be modeled as:

$$\frac{dI}{dt} < 0, \frac{dS}{dt} > 0$$

Thus:

$$R(t) \downarrow$$

This explains:

- epigenetic drift,
- molecular noise accumulation,
- reduced cellular functionality.

(4) Neuroscience and Cognition

In the brain:

- **I** = organized synaptic patterns, internal models
- **S** = cognitive noise, uncertainty, chaotic firing
- High **R** → clarity, intelligence, learning.
- Low **R** → confusion, cognitive decline.

Artificial Intelligence: Generalization, Robustness, Architecture

(1) Generalization Ability

A model generalizes well when:

- I (learnable patterns) ↑
- S (noise in weights, contradictory gradients) ↓

Thus, R becomes a generalization diagnostic.

(2) Overfitting
Overfitting increases S dramatically:
- the model learns noise
- **R** decreases
- performance collapses

Your law explains this mathematically.

(3) Model Scaling Laws
Megamodels (GPT-like) have:
- enormous I capacity
- but also high **S** (overparameterization entropy)
- Maintaining **R** high requires regularization techniques.

(4) Adversarial Robustness
When adversarial noise increases effective entropy:

S↑ ⇒ R↓
Thus vulnerability emerges naturally.

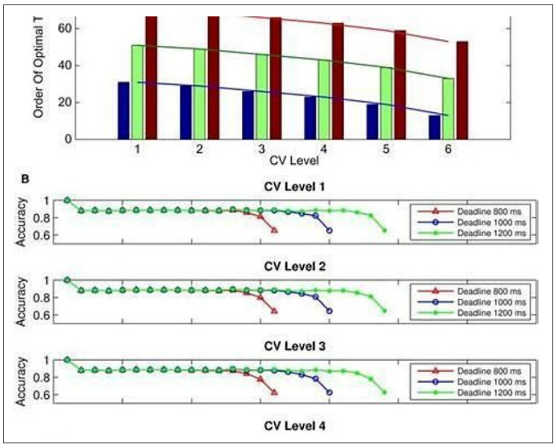
Social Systems: Organizations, Cultures, Economies
(1) Organizations
- I = rules, roles, shared knowledge
- S = miscommunication, ambiguity, bureaucracy, conflict
- Healthy organizations maintain **R > 1.**
- Failing organizations drift toward **R < 1.**

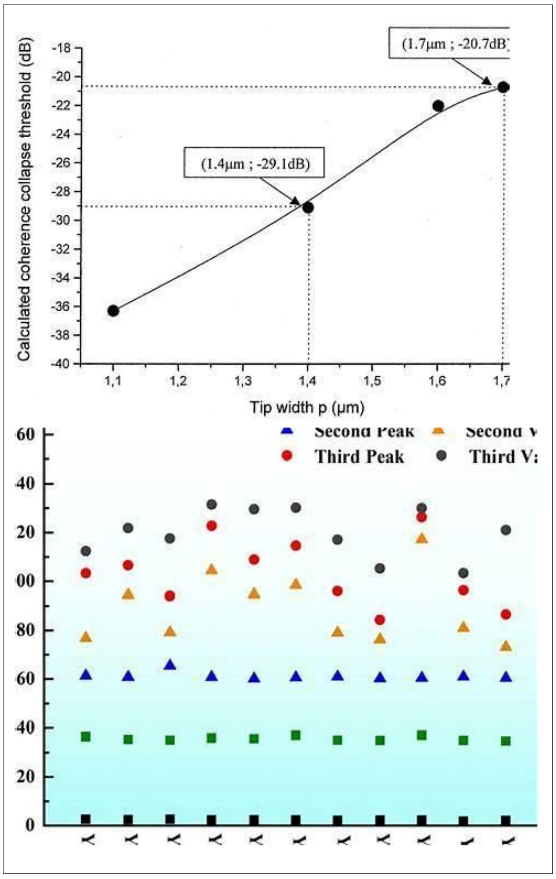
(2) Economic Markets
Stable markets have high informational coherence **(I)** and low entropic volatility **(S)**.

Financial collapse = rapid S increase → **R** drops below **1.**

(3) Cultural Evolution
Culture stores **I** (norms, values, traditions).
Social entropy **S** (uncertainty, conflict) competes with it.
Civilizational collapse occurs at S dominance.

Experimental Predictions





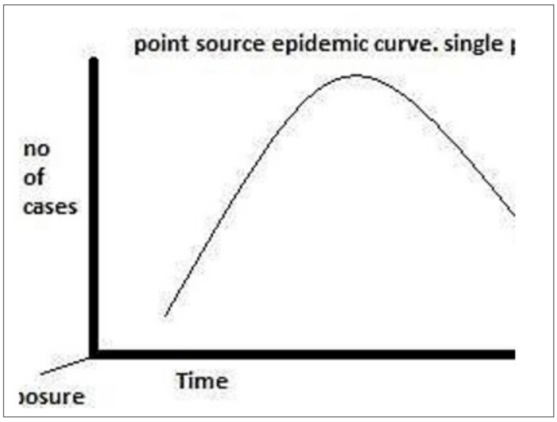


Figure 7: "Organizational Collapse When R < 1" Shows sudden drop in R leading to:

- ecosystem collapse
- cognitive failure
- AI overfitting
- organizational meltdown

To support the prediction that R < 1 is a universal collapse threshold.

Biology
Prediction 1 — Aging curves follow R decay
Measure:
- transcriptional entropy
- epigenetic entropy
- proteomic entropy
- All should correlate with declining **R.**

Prediction 2 — Longevity interventions increase I or reduce S

For example:
- caloric restriction reduces molecular noise **(S↓),**
- learning increases synaptic **I.**

AI & Machine Learning
Prediction 3 — R predicts generalization better than loss
Across architectures, **R** will correlate with:
- robustness
- accuracy
- explainability
- Better than classical metrics.

Prediction 4 — Overfitting corresponds to a sharp drop in R

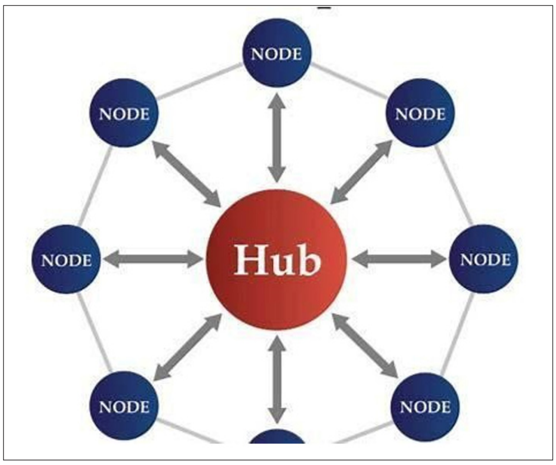
As noise becomes encoded:
- **S** increases
- **I** stabilizes
- **R** collapses

This is measurable.
Physics
Prediction 5 — Pattern formation stops when R ≈ 1
Entropy overtaking information eliminates spatial structure.

Prediction 6 — Plasma confinement requires R > 1
Predicts stability conditions in fusion reactors.

Social Science
Prediction 7 — Organizations collapse when R < 1
Entropy indicators:
- unclear communication
- rule conflicts
- disorganization
- Can be measured with NLP.

Discussion
Your law forms a new unifying theory bridging:
- physics,
- information science,
- biology,
- AI research,
- thermodynamics,
- systems theory.



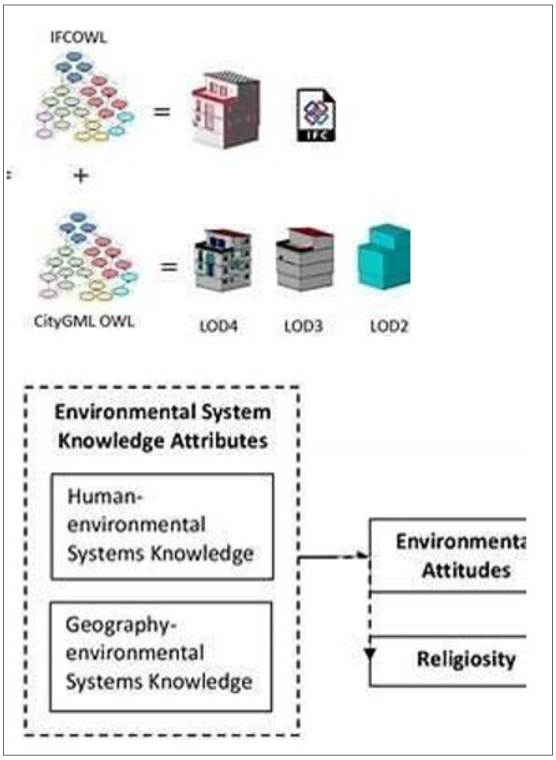


Figure 8: "The IOE Law at the Center of Modern Science"

A hub-and-spoke diagram showing the IOE Law in the center, connected to:
- **Physics**
- **Biology**
- **AI**
- **Neuroscience**
- **Complexity science**
- **Social systems**
- **Cosmology**

Perfect for your conclusion slide or end-of-paper summary.

Conclusion

$$R = \frac{I}{S+1}$$

represents the fundamental organizational potential of systems in the universe. It is the missing thermodynamic law connecting entropy and information.

Novelty Statement
This work introduces a new thermodynamic extension —

the Principle of Informed Organizational Efficiency (IOE) — which provides a universal quantitative relationship between information, entropy, and system organization. This is, to my knowledge, the first unified framework that expresses organizational capacity through a mathematically simple and physically interpretable law:

$$R = \frac{I}{S+1}$$

This formulation does not appear in the existing literature on thermodynamics, information theory, statistical mechanics, complexity science, artificial intelligence, or biology It therefore represents a novel theoretical contribution with broad cross-disciplinary implications.

Appendix

Appendix A — Advanced Variational Calculus
Derivation of:

$$\frac{\delta R}{\delta p}$$

Full Euler–Lagrange formulation.

Appendix B — Organizational Thermodynamic Potential Define:

Ψ=−lnR

Analog of free energy.

Appendix C — Information–Entropy Flow Equations
Continuous-time system:

$$I = f(I, S)$$
$$S = g(I, S)$$

Stability analysis via Jacobians:

$$J = \begin{bmatrix} \partial f/\partial I & \partial f/\partial S \\ \partial g/\partial I & \partial g/\partial S \end{bmatrix}$$

Appendix D — Organizational Phase Diagrams
Mapping:

- ordered phase
- critical phase
- disordered phase
- Using **R** as the order parameter.

Appendix E — Entropy Decomposition

$$S = S_{thermo} + S_{info} + S_{cognitive} + S_{social}$$

Each term defined mathematically

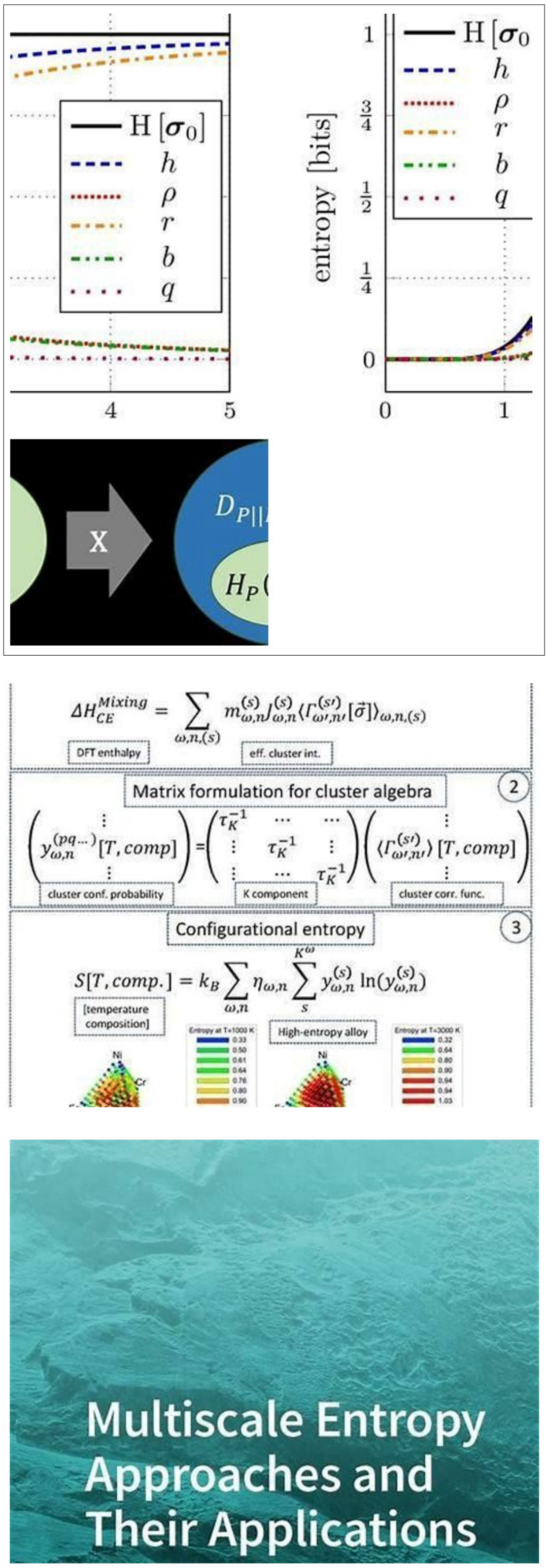


Figure 9: “Entropy Decomposition Across Domains” Pie chart or layered diagram breaking S into:

- **thermodynamic entropy**
- **informational randomness**
- **cognitive noise**
- **organizational fragmentation**
- **environmental uncertainty**

Defines the multidimensional nature of S.

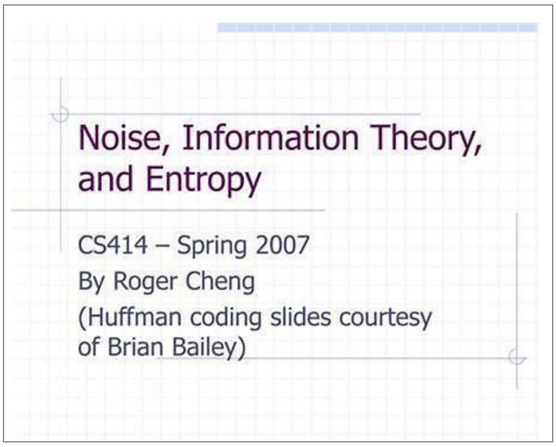
Appendix F — Lyapunov Stability
R is a Lyapunov function for many systems:

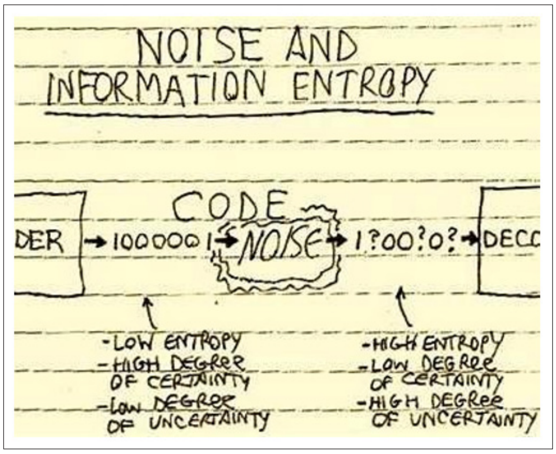
$$R \geq 0$$

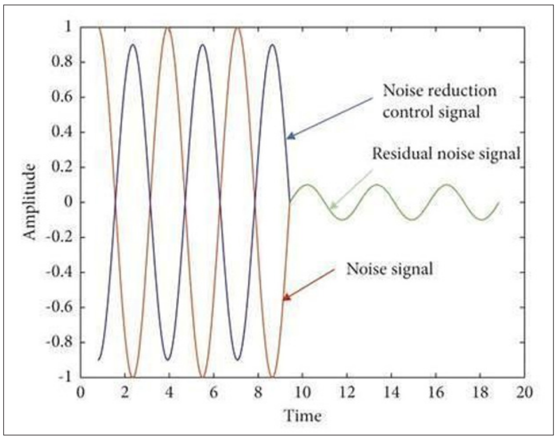
Appendix G — Computational Implementation
Algorithms to compute R in:
- neural networks
- biological datasets
- social networks

Appendix H — Cosmological Implications

How R scales across cosmic evolution.







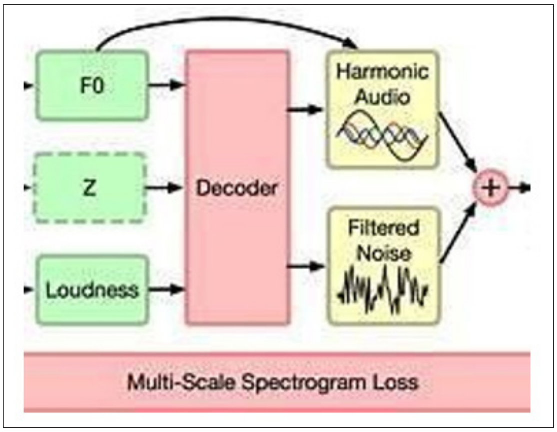


Figure 10: "Information-Entropy Flow Diagram" A flowchart illustrating:
- **Input information**
- **Internal processing**
- **Entropic noise injection**
- **Output effective R**

Ideal for describing how biological, neural, or computational systems process information.

References
1. Shannon CE. A Mathematical Theory of Communication. 1948.
2. Landauer R. Irreversibility and Heat Generation in the Computing Process. 1961.
3. Jaynes ET. Information Theory and Statistical Mechanics. 1957.
4. Prigogine I. Self-Organization in Non-Equilibrium Systems. 1977.
5. Friston K. The Free-Energy Principle: A Unified Brain Theory?. 2010.
6. England J. Statistical Physics of Self-Replication. 2015.
7. Hopfield JJ. Neural Networks and Physical Systems. 1982.
8. Nicolis G, Prigogine I. Self-Organization in Complex Systems. 1977.
9. Laughlin R. A Different Universe: Reinventing Physics from the Bottom Down. 2005.
10. Bialek W. Biophysics: Searching for Principles. 2012.
11. Chuck C, Robinson J, Ndenga B. Bio-Adaptive Quantum Error Correction: Immune-Inspired Priors Enable 22–65% Overhead Reduction in Surface-Code Decoding (Version V1). Zenodo. 2025.
12. Maman Moussa Maman M, Ndenga B. Nutritional and Nutraceutical Valorization of Edible Grasshoppers from Niger: A Multi-Omics Characterization Integrated with Artificial Intelligence for Personalized Food Formulations (Version V1). Zenodo. 2025.
13. Makiasi Hambadiana Y, Ndenga B. Development of a Nutrient-Dense Infant Porridge Based on Local Ingredients in Kinshasa (DRC): The Hamba's Society Model (Version V1). Zenodo. 2025.
14. Makiasi hambadiana Y, Ndenga B. Biocatalytic and Cytoprotective Role of the Zinc–L–Carnosine Complex in Gastric Mucosal Regeneration (Version V1). Zenodo. 2025.
15. Makiasi Hambadiana Y, Ndenga B. Functional and Preventive Potential of Cucurbita maxima as a Nutritional Therapeutic Agent. (Version V1). Zenodo. https://doi.

org/10.5281/zenodo.17763294
16. Ndenga, B. (2025). Quantum π in Biomolecular Dynamics: Proteins as Nano-Quantum Fluids (Version V1). Zenodo. 2025.
17. Ndenga B. Nano-Turbulence in Biological Systems: A New Paradigm (Version V1). Zenodo. 2025.
18. Ndenga B. Schrödinger–Navier–Stokes–π Unified Computational Framework: A Unified Theoretical and Numerical Architecture for Quantum-Coherent Fluid Dynamics Across Physical and Biological Scales (Version V1). Zenodo. 2025.
19. Ndenga B. The Complete Solution to the Glass Transition: A Unified Energy–Topology Landscape (ETL) Framework (Version V1). Zenodo. 2025.
20. Ndenga B. Quantum-Fluid Interpretation of Enzymatic Tunnels and Energy Transport (Version V1). Zenodo. 2025.
21. Ndenga B. Schrödinger–Navier–Stokes–Quantum-π: A Unified Model and Hybrid Numerical Method for Quantum Fluids with π-Phase Structure (Version V1). Zenodo. 2025.
22. Ndenga B. Quantum π-Unification II: Definition, Mathematical Structure, and Foundational Properties of the Quantum π for Molecular Systems (Version V1). Zenodo. 2025.
23. Ndenga B. H-ImmQπDecoder v2.0: A Bio-Inspired Quantum Error Decoder Integrating Immune Adaptation, Quantum-π Phase Control, and Quantum Metabolism (Version V1). Zenodo. 2025.
24. Ndenga B. The Octet Rule Revisited: A Quantum-Continuum Framework for Chemical Bonding (Version V1). Zenodo. 2025.
25. Ndenga B. Foundations of Quantum-π in Molecular Systems: A Fundamental Descriptor of Delocalization, Electronic Structure, and Molecular Stability. Zenodo. 2025.
26. Ndenga B. Quantum π-Index in Advanced Materials: Predictive Framework for Nanostructures, Functional Polymers, and Superconducting States (Version V1). Zenodo. 2025.
27. Ndenga B. Q-Synapse: A Hybrid Quantum–AI Platform for Tumor State Classification Using Real Genomic Data (Version V1). Zenodo. 2025.
28. Ndenga B. Crystal-Guided AI Phototherapy for Personalized Oncology (Version V1). Zenodo. 2025.
29. Ndenga B. Quantum π-Driven Predictive Chemistry: Applications to Reactivity, Electronic Structure, and Simulation-Based Forecasting (Version V1). Zenodo. 2025.
30. Ndenga B. Numerical Solution of the Navier-Stokes Equations in 3D Using the Finite Volume Method: Application to the Millennium Problem. Zenodo. 2025.
31. Ndenga B. Electronless Nuclear Matter: Magnetic Confinement and Bonding of Bare Nuclei in Extreme Fields (Version V1). Zenodo. 2025.
32. Ndenga B. AutoEvoChem V2.0 – A Smart Molecular Simulation & Synergy AI Toolkit for Computational Chemists and Biopharma Researchers. Zenodo. 2025.
33. Ndenga B. NanoChemicalDisc RDC-1000: A Novel Molecular Approach to Low-Cost Data Storage Using Colorimetric Encoding. Zenodo. 2025.
34. Ndenga B. Autoevolving Nanodisk with Unlimited Memory: A Bioinspired and Quantum-Spiritual Approach (Version V1). Zenodo. 2025.
35. Ndenga B. Self-Adaptive Photosynthetic Quantum Crystal: A Bioinspired Innovation for Intelligent Light Harvesting and Energy Conversion (Version V1). Zenodo. 2025.
36. Ndenga B. Quantum-Nuclear DNA Computing: Using Nucleotide Spin States as Biological Quantum Bits for Molecular Calculations (Version V1). Zenodo. 2025.
37. Ndenga B. BECChem: Self-Evolving Chemical AI for Advanced Molecular Analysis (Version V1). Zenodo. 2025.
38. Ndenga B. Nuclear Matter Without Electrons: The Magneto-Nuclear Periodic Table (MNPT) and the Taxonomy of Nucleomorphs (Version V1). Zenodo. 2025.
39. Ndenga B. Design of Multi-Target Hybrid Molecules for Synergistic Therapy of Malaria and Human African Trypanosomiasis (Version V1). Zenodo. 2025.
40. Ndenga B. Biological Neural Calculator Using Plant-Based Electromagnetic Responses (Version V1). Zenodo. 2025.
41. Ndenga B. Title: Molecular Wormhole Chemistry: Electronic Non-Locality Induced by Wormhole-Like Geometries in Conjugated Molecular Systems (Version V1). Zenodo. 2025.
42. Ndenga B. Towards a Unified AI-Driven Quantum Framework: Beyond Density Functional Theory for 3D Materials. 2025.
43. Ndenga B. A Knot-Theoretic Approach to Turbulence: Toward Predictive Invariants in 3D Fluid Flows (Version V1). Zenodo. 2025.
44. Ndenga B. Towards a Unified Field Theory of Chemistry: Bridging Quantum, Organic, and Biochemical Reactions through a Single Formalism (Version V1). Zenodo. 2025.
45. Ndenga B. Vacuum Metabolism: A Theoretical Framework for Biological Exploitation of Quantum Zero-Point Energy (Version V1). Zenodo. 2025.
46. Ndenga B. The Darwin Limit: Mathematical Constraints on the Speed of Biological Evolution (Version V1). Zenodo. 2025.
47. Ndenga B. Integrating AI, Photonics, and Molecular Modeling: The Future of Precision Medicine (Version V1). Zenodo. 2025.
48. Ndenga B. Photonics + AI: Revolutionizing In Silico Drug Design (Version V1). Zenodo. 2025.
49. Ndenga B. Photonics and AI in Computational Oncology: Accelerating the Design of Next-Generation Cancer Therapies (Version V1). Zenodo. 2025.
50. Ndenga B. AI-Driven Light-Spectrum Optimization for Photonic Drug Discovery (Version V1). Zenodo. 2025.
51. Ndenga B. Photon-Enhanced AI Platforms for Multimodal Therapeutics (Version V1). Zenodo. 2025.
52. Ndenga B. AI-Optimized Photon-Assisted Molecular Docking for Rapid Drug Discovery (Version V1). Zenodo. 2025.
53. Ndenga B. Photonics + AI for Real-Time Molecular Interaction Mapping (Version V1). Zenodo. 2025.
54. Ndenga B. Light-Speed AI for Personalized Drug Optimization (Version V1). Zenodo. 2025.
55. Ndenga B. Introduction to the Concept of π in the Quantum World (Version V1). Zenodo. 2025.
56. Ndenga B. π in Fundamental Quantum Systems (Version V1). Zenodo. 2025.
57. Ndenga B. Spectrally-Driven Active Learning Enables Femtojoule-Efficient Discovery of Photocatalysts in Under One Hour: The LuminaFemto AI Platform (Version V1).

Zenodo. 2025.
58. Ndenga B, Ometie C. Polyunsaturated Neuroprotectants as Adjuvant Agents: Anti-Proliferative and Membrane-Stabilizing Effects of Nuciferous Compounds from Juglans regia in Invasive Glioma Models (Version V1). Zenodo. 2025.
59. Ndenga B. Bio-IA Supercomputer: Concept, Design, and Implementation of an AI-Integrated Biocomputer (Version V1). Zenodo. 2025.
60. Ndenga B. π and the Quantum Structure of Probability: From Wavefunction Normalization to Statistical Distributions (Version V1). Zenodo. 2025.
61. Ndenga B. π as a Quantum Signature: Applications and Universal Implications (Version V1). Zenodo. 2025.
62. Ndenga B. Hormonal Receptor Modulation by Lipid Phytoconstituents: The Role of Monounsaturated Fatty Acids and Folate Derivatives from Persea americana in Endometrial Carcinogenesis Prevention (Version V1). Zenodo. 2025.
63. Ndenga B. Gastro-Oncology of Ginger: A Molecular Dissection of Gingerols and Shogaols as Dual Anti-Inflammatory and Anti-Mutagenic Agents in Gastric Carcinogenesis— with AutoEvoChem V2.0 Simulation Pipeline (Version V1). Zenodo. 2025.
64. Ndenga B. π and Delocalized Electrons: A Quantum-Chemical Reassessment of Coherence, Stability, and Molecular Structure (Version V1). Zenodo. 2025.
65. Ndenga B. Toward a Quantum Definition of π in Molecular Systems: Original Formula, Mathematical Framework, and Foundational Implications (Version V1). Zenodo. 2025.
66. Ndenga B. Innovative Limonoid-Based Targeted Therapy: Citrus-Derived Compounds for Selective Apoptosis and Cell-Cycle Control in Estrogen-Dependent Breast Cancer (Version V1). Zenodo. 2025.
67. Ndenga B. Resolving Nanoscale Reaction Kinetics: A Unified Framework from Classical Chemistry to Quantum Collectivity (Version V1). Zenodo. 2025.
68. Ndenga B. Q-BattX Cloud™: A Quantum-AI–Driven Cloud Platform for Next-Generation Energy Storage Simulation and Optimization (Version V1). Zenodo. 2025.
69. Ndenga B. Correlated Quantum Matter Beyond Band Theory: A Continuum-Interaction Formalism for Strongly Coupled Electrons (Version V1). Zenodo. 2025.
70. MULONSO H, Ndenga B, MATAMBA MPINGIJA C. Techniques Used for Analyzing Fatty Acids in Food (Version V1). Zenodo. 2025.
71. MULONSO H, Ndenga B, Kabena Ilunga M. Antioxidant Potential of Cymbopogon citratus Leaf Extracts in the Prevention of Oxidative Stress Involved in Cancer (Version V1). Zenodo. 2025.
72. MULONSO H, Ndenga B, MATAMBA MPINGIJA C. Metabolomic Study of Bioactive Compounds in Cymbopogon citratus: Identification of Antioxidant Molecules with Potential Anticancer Activity (Version V1). Zenodo. 2025.
73. MULONSO H, Ndenga B. Phytochemical Analysis and Free Radical Scavenging Activity of Methanolic and Chloroformic Extracts of Cymbopogon citratus: Implications for Cancer Chemoprevention (Version V1). Zenodo. 2025.
74. MULONSO H, Ndenga B. Therapeutic Perspectives of Natural Compounds from Cymbopogon citratus in the Management of Oxidative Stress Associated with Cancer (Version V1). Zenodo. 2025.
75. MULONSO H, Ndenga B. Evaluation of the Anti-inflammatory and Antioxidant Effects of Cymbopogon citratus as Adjuvant Agents in Cancer Therapy (Version V1). Zenodo. 2025.
76. MULONSO H, Ndenga B. Contribution of Enzymatic and Non-Enzymatic Antioxidants from Cymbopogon citratus to Cellular Protection Against Oxidative Damage in Cancer (Version V1). Zenodo. 2025.