Informational Curvature Theory (ICT)

A Constraint-Based Framework for Physical and Informational Structure

Author: Richard Rodier – Independent Researcher

ORCID: https://orcid.org/0009-0009-9292-8052

Abstract

Informational Curvature Theory (ICT) proposes that information, rather than matter or energy alone, constitutes a fundamental organising substrate of physical systems. ICT introduces *informational curvature* as a measurable geometric property describing how information is structured, bounded, and coherently related across scales and domains. Unlike force-based or dynamical theories, ICT is formulated as a constraint framework that specifies the conditions under which physical behaviours emerge. Preliminary empirical applications across diverse domains suggest that established physical theories may arise as limiting cases of informational organisation. This work presents the conceptual foundations, operational mapping, and theoretical implications of ICT.

---

1. Motivation and Context

Modern physics is divided between theories optimised for different regimes: General Relativity (GR) for smooth, large-scale structure and Quantum Field Theory (QFT) for localised, probabilistic behaviour. Despite their success, these frameworks lack a shared foundational quantity capable of describing organisation across domains.

Information theory has long been recognised as relevant to physics, yet information is typically treated as derivative rather than fundamental. ICT reverses this relationship: **physical behaviour is treated as a consequence of informational organisation**, not its cause.

---

2. Core Premise

ICT asserts that the organisation of information imposes geometric constraints on observable behaviour.

These constraints do not replace physical laws but determine the regimes in which particular laws are valid.

ICT is:

- not a force theory
- not a field theory
- not a dynamical replacement for existing physics

It is a **law-like constraint framework** governing informational structure.

---

3. Informational Curvature

3.1 Definition

Informational curvature describes how information is structured within a system with respect to:

- disorder
- coherence
- boundedness
- relational coupling

Curvature is not spatial curvature in the relativistic sense, nor is it statistical entropy alone. It is a **geometric property of informational organisation**.

---

4. Operational Dimensions

Informational curvature is operationalised through four measurable dimensions:

Symbol	Dimension	Description
α	Entropy Gradient	Directional change in informational disorder
β	Modal Coherence	Stability of structure across representations
γ	Boundedness	Degree of informational confinement
δ	Relational Resonance	Coupled coherence across α–γ

A derived scalar, **λ**, summarises the system's informational state but is not itself fundamental.

These quantities are empirically measurable and domain-agnostic.

---

5. Informational Regimes and Behaviour

Observed analyses reveal consistent mappings between informational regimes and observed behaviour:

Informational Regime	Rubric Signature	Emergent Behaviour
Smooth, bounded	Low α, high β, high γ, high δ	Classical / GR-like
Fragmented, local	High α, variable β, low γ, low δ	Quantum / QFT-like
Unstructured	High α, low β, low γ, low δ	Noise / thermal
Persistent attractors	Low α, high β, mid–high γ, high δ	Stable informational geometry

These mappings are not imposed but emerge across multiple domains.

---

6. Relation to Existing Physical Theories

ICT does not seek to supersede established theories. Instead, it **constrains the informational conditions under which those theories apply**.

6.1 General Relativity Limit

In regimes of:

- high boundedness (γ),
- high modal coherence (β),
- low entropy gradient (α),

informational curvature becomes smooth and stable. In this limit, system behaviour is indistinguishable from GR-like geometric dynamics.

6.2 Quantum Field Theory Limit

In regimes of:

- low boundedness,
- high entropy gradients,
- fragmented relational coupling,

informational curvature becomes localised and discontinuous. In this limit, system behaviour aligns with QFT-like probabilistic descriptions.

ICT reduces to GR and QFT **as limiting informational behaviours**, not as formal derivations.

---

7. Saturation vs Convergence

A key empirical signature of ICT is **saturation**, not convergence.

- Increasing data volume does not indefinitely refine results.
- Informational metrics stabilise beyond a threshold.
- Variance collapses toward numerical precision.

This behaviour indicates that ICT measures **structural constraints**, not trends or correlations. Saturation is characteristic of law-like behaviour rather than statistical models.

---

8. Universality and Domain Independence

ICT has been examined in contexts including:

- physical sciences,
- biological systems,
- cosmological datasets,
- observational astronomy.

The recurrence of consistent informational regimes across unrelated domains suggests that informational curvature is **not domain-specific**, reinforcing its candidacy as a foundational principle.

---

9. Implications

If informational organisation constrains physical behaviour, then:

- physical laws describe permissible informational geometries,
- apparent theoretical incompatibilities arise from regime mismatches,
- unification emerges through constraint, not equation synthesis.

ICT reframes foundational physics as a problem of **informational geometry**.

---

10. Scope and Future Work

This work establishes ICT as a conceptual and empirical framework. Formal extensions, computational implementations, and domain-specific analyses are ongoing and will be presented separately.

Conclusion

Informational Curvature Theory introduces a constraint-based perspective in which physical behaviour emerges from the geometry of information itself. By identifying informational curvature as a unifying quantity, ICT provides a coherent framework capable of accommodating both classical and quantum regimes without modifying existing laws. The theory does not predict forces; it constrains how information may organise — and physics follows.