

The Fractal Metascience Paradigm: Foundations of a Universal Scientific Framework

Abstract

The Fractal Metascience Paradigm (FMP) represents a transdisciplinary scientific theory that integrates systemic, fractal, and cognitive dimensions into a unified epistemological framework. This article introduces FMP as a novel metaparadigm grounded in the principles of complexity science, systems theory, fractal mathematics, and epistemological pluralism. It aims to establish the scientific legitimacy of FMP by analyzing its foundational structure, conceptual logic, and implications across physics, biology, philosophy, and social sciences. Particular emphasis is placed on the paradigm's potential to unify traditionally disjointed domains of knowledge and generate a new ontology of scientific reasoning. Sources are cited using the APA 7 format.

1. Introduction

In modern science, increasing specialization has led to fragmented understandings of reality. In response, researchers across disciplines have called for unifying paradigms that transcend domain-specific boundaries (Nicolescu, 2002; Laszlo, 2004). The Fractal Metascience Paradigm (FMP) addresses this need by proposing a holistic, fractal-structured approach to scientific inquiry that integrates systemic, recursive, and cognitive perspectives into a singular meta-framework.

2. Theoretical Background

2.1 General Systems Theory and Fractal Mathematics

General Systems Theory (von Bertalanffy, 1968) provides a foundational model of open, hierarchical systems that self-regulate through feedback. This is extended in the Fractal Metascience Paradigm by incorporating fractal geometry, which describes recursive, scale-invariant structures in nature (Mandelbrot, 1983). Laszlo (2004) further highlights that such fractal dynamics suggest a deeper systemic coherence across domains.

2.2 Epistemology and the Logic of Scientific Paradigms

Kuhn (1970) and Morin (2008) emphasize that paradigms determine not only what is known but how knowledge is constructed. FMP reframes scientific reasoning using fractal recursion as a core cognitive operation, where knowledge is iteratively structured across micro- and macro-levels. This aligns with constructivist epistemologies that see knowledge as emergent from dynamic processes (Piaget, 1972).

3. Conceptual Structure of FMP

FMP is built on five key principles:

1. **Fractal Recursion** – Knowledge structures repeat at multiple levels of scale.
2. **Synchronicity and Diachronicity** – All knowledge has both structural (synchronic) and processual (diachronic) dimensions.

3. **Holographic Cognition** – Each part of a system encodes information about the whole (Bohm, 1980).
4. **Cognitive-Semantic Coevolution** – Thought and meaning evolve fractally through recursive feedback.
5. **Metasystemic Integration** – All subsystems of knowledge are embedded in higher-order epistemic frames.

4. Interdisciplinary Applications

4.1 Physics

FMP resonates with recent efforts in quantum gravity and field theory that seek scale-invariant formulations (Smolin, 2013). Its fractal ontology supports interpretations of quantum entanglement as holographic information encoding (Susskind & Maldacena, 2013).

4.2 Biology

Fractal structures abound in morphogenesis, neural networks, and ecological systems (Goldberger et al., 2002). FMP offers a unifying framework for understanding how biological complexity arises from recursive self-organization.

4.3 Philosophy and Cognitive Science

FMP aligns with integral epistemologies that bridge mind and matter (Wilber, 2000). Its recursive logic underlies human cognition, reflecting the brain's fractal-like neural architecture (Sporns, 2011).

4.4 Social Systems

Sociology and economics increasingly adopt complexity-based models (Miller & Page, 2007). FMP frames institutions, ideologies, and cultural memes as fractally evolving systems.

5. Implications for Scientific Methodology

FMP challenges linear-logical models of research by emphasizing circular causality, feedback, and trans-level reasoning. It calls for new methods that can model dynamic, non-linear, and self-similar phenomena across domains (Capra & Luisi, 2014).

6. Conclusion

The Fractal Metascience Paradigm presents a coherent, scientifically grounded meta-framework capable of integrating diverse disciplines into a dynamic, recursive whole. It lays the groundwork for a unified theory of knowledge and existence, built on the principles of fractality, recursion, and systemic coherence.

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