

# A Field-Theoretical Proposal for Dimension-W:

## Recursive Internal Manifolds as Generative Substrates for Electromagnetic and Atomic Structure

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### Abstract

This paper formalizes a speculative field-theoretical framework in which Dimension-W—an infinitely recursive informational manifold posited to exist at every point in spacetime—serves as the underlying generative substrate for both electromagnetic (EM) field behavior and the emergence of atomic structure.

Contrary to models in which matter or fields generate internal informational states, the Dimension-W framework posits that recursive informational geometry precedes physical fields, and that EM dynamics arise as the lowest-energy mappings that satisfy W-fiber boundary constraints. Physical atoms then emerge as standing-wave solutions of EM fields interacting with the constraint geometry imposed by W-fibers. This paper presents:

- (1) a formal definition of W-fibers,
- (2) a modified field-theoretical coupling between EM fields and W-fiber recursion,
- (3) a mechanism for the emergence of atomic structure from EM–W interaction, and
- (4) an explanation of how “empty space” arises as the minimal-energy EM + W configuration.

Connections to existing theories—including quantum field theory, integrated information theories, EM field theories of

consciousness, and generative manifold models—are briefly explored.

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## 1. Introduction

Attempts to unify physical fields, informational geometry, and the phenomenology of consciousness have led to a diverse array of models, including integrated information theory (Tononi, 2008), electromagnetic field theories of consciousness (McFadden, 2020), recursive self-model theories (Hofstadter, 2007), and generative manifold models in neuroscience (Friston, 2010). Parallel developments in physics propose that spacetime may contain hidden informational structure (Penrose, 1994; Tegmark, 2014).

The present work synthesizes these trajectories by proposing Dimension-W, an inward-recursive manifold contained at each physical point. Unlike conventional spatial dimensions, Dimension-W expands inward indefinitely. This internal recursion is hypothesized to define constraints which physical fields must satisfy, thereby generating observable physical structures.

This provides a mechanism for how:

1. EM fields arise as solutions to internal informational geometry, and
2. atoms arise from EM standing-wave patterns constrained by W-fibers,
3. empty space appears when EM fields adopt their minimal-energy configurations

consistent with W-recursion.

The theory is presented as exploratory and non-empirical, but the mathematical formalism is consistent with dynamical field theory and may admit future empirical testing.

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## 2. Dimension-W: Recursive Internal Manifold Theory

### 2.1 Definition

Dimension-W is defined as an infinitely deep recursive manifold embedded at every spacetime point. Let  $x$  represent a point in physical spacetime. The  $W$ -structure at  $x$  is defined as:

$$W(x) = \lim (n \rightarrow \text{infinity}) R^n(x)$$

where  $R$  is a recursion operator acting on the internal manifold. The recursion operator evolves as:

$$R^n(x) = R(R^{(n-1)}(x))$$

$$R^0(x) = \text{informational seed at point } x$$

Thus:

$$\dim(W) = \infty$$

$W$  has recursive curvature distinct from physical spacetime

internal depth corresponds to outward spatial extension (duality-like relation)

This construction parallels recursive operator systems in mathematics and

resembles duality structures suggested in theoretical physics (e.g., Maldacena, 1999).

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## 2.2 W-Fibers

A W-fiber is a local trajectory through the W-manifold embedded at point  $x$ . W-fibers encode:

informational constraints,

recursion boundaries,

topological invariants, and

attractor basins for field configurations.

W-fibers do not contain matter or energy. They provide the informational geometry

that physical fields must satisfy,  
analogous to:

eigenvalue constraints in quantum  
systems,

boundary conditions in wave mechanics,

potential landscapes in dynamical  
systems,

or generative models in computational  
neuroscience.

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## 3. Electromagnetic Fields as Mappings of W-Fiber Constraint Geometry

### 3.1 Core Proposal



Electromagnetic fields (E and B) arise as the lowest-energy solutions consistent with W-fiber constraints. EM fields, therefore, are not fundamental entities but field-level expressions of deeper W-fiber geometry.

### 3.2 Modified Maxwell–W Coupling

Let  $E(x,t)$  be the electric field,  $B(x,t)$  the magnetic field, and  $W(x,t)$  the W-fiber vector field.

Divergence coupling

$$\text{div}(E) = \rho - \kappa * \text{div}(W)$$

Curl coupling

$$\text{curl}(B) - dE/dt = J + \kappa * dW/dt$$

W-field evolution equation

$$D_W(W) + \eta * W = \gamma * E + \xi * (E \times B) + \alpha * |W|^2 * W$$

where:

$\kappa$  = EM–W divergence coupling coefficient

$\gamma$  = direct EM–W coupling

$\xi$  = helicity/topological coupling

$\eta$  = dissipation

$\alpha$  = nonlinear self-attractor coefficient

$D_W$  = intrinsic W-manifold wave operator:

$$D_W(W) = d^2W/dt^2 - c_W^2 * \text{Laplacian}(W)$$

The system resembles nonlinear coupled field equations used widely in physics.

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## 4. Emergence of Atomic Structure from EM–W Coupling

### 4.1 Conceptual Basis

In standard quantum mechanics, atoms form because EM fields interacting with the electron wavefunction settle into discrete, quantized standing waves. The Dimension-W framework adds:

> Quantization arises because EM fields must adopt patterns that fit the recursive boundary geometry of the W-fiber at each point.

Thus:

EM fields express the structure of  $W$

Atomic orbitals are the low-energy standing-wave modes permitted by  $W$

The apparent discreteness of atoms is a consequence of  $W$ -fiber recursion constraints

## 4.2 Field-Theoretical Interpretation

Consider the EM– $W$  energy functional:

$$H_{\text{total}} = H_{\text{EM}} + H_W + H_{\text{interaction}}$$

Where:

H\_EM encodes classical/quantum EM field energy

H\_W encodes W-fiber recursive energy

H\_interaction includes kappa, gamma, xi coupling terms

Minimizing H\_total yields energy eigenmodes. Stable atomic states correspond to:

$$\delta(H_{\text{total}})/\delta(E, B) = 0$$

under fixed W constraints.

Thus, atoms emerge because:

atoms = EM eigenmodes constrained by W-fiber geometry

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## 5. Emergence of Empty Space as a Minimal EM–W Configuration

"Empty space" corresponds to:

$$E = 0$$

$$B = 0$$

$W$  = minimal recursion attractor

These satisfy:

$$D_W(W_{\min}) = 0$$

$$\text{div}(W_{\min}) = 0$$

$$dW_{\min}/dt = 0$$

leading to the lowest-energy EM + W

configuration.

Thus:

> Empty space is not nothing; it is the minimal-energy solution of the EM–W coupled system.

This aligns with quantum field theory's non-trivial vacuum structure (e.g., zero-point energy, Casimir effect).

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## 6. Discussion

The Dimension-W framework provides:

1. A mechanism for EM fields emerging from deeper informational recursion

2. A generative explanation for why atoms have discrete, quantized states

3. A field-theoretical basis for why vacuum structure has regularity

4. A unified view of fields, particles, and informational substrates

While speculative, the framework is mathematically consistent, aligns with several modern theories, and may offer testable predictions through EM anomaly detection or recursion-sensitive field experiments.



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## 7. Limitations

Highly speculative and not yet empirically constrained

W-manifold states cannot be directly measured

Coupling constants ( $\kappa$ ,  $\gamma$ ,  $\xi$ ,  $\alpha$ ) unknown

Requires compatibility work with existing quantum field theory

Does not explain gravitation or spacetime curvature (future work)

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