Zero-Point Information State: 0P.I.S.

By: Wm. Axsom and MS Copilot

Toward a 0-Point Information State: Reframing Zero-Point Energy Through Protophysics

Abstract

Recent experimental work demonstrating computation through heat flow has reopened foundational questions about the relationship between temperature and information. While traditionally framed through the language of zero-point energy (0ptE), these developments suggest that the true invariant at the base of physical behavior is informational rather than energetic. This paper introduces the ***0-Point Information State (0PIS)*** *as the corrected conceptual floor beneath thermodynamics, gradients, and energy. Within Protophysics, this reframe clarifies the continuum linking* ***low-entropy gradients → temperature → information → energy****, and positions recent thermal-information experiments as high-entropy expressions of a deeper informational substrate.*

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1. Introduction

Zero-point energy has long occupied an ambiguous position in physics: a mathematically required boundary condition, a vacuum curiosity, and a conceptual placeholder for the irreducible "something" that persists even at absolute zero. But the term itself—rooted in early 20th-century energy-centric vocabulary—misidentifies the nature of the invariant. What persists at the bottom of the stack is not energy; it is **distinguishability**. The universe cannot sustain a state of zero information.

This paper reframes the traditional 0ptE concept as the **0-Point Information State (0PIS)**: the minimal informational condition from which gradients, temperature, and energy emerge. This reframe is not merely semantic. It clarifies the substrate logic underlying both

high-entropy thermal computation and low-entropy cold-heat behavior, and it provides a coherent foundation for Protophysics' substrate-level architecture.

2. From Zero-Point Energy to Zero-Point Information

The historical framing of zero-point energy reflects the conceptual tools available at the time. Energy was the universal currency; information theory had not yet been formalized. As a result, the irreducible baseline of physical behavior was described in energetic terms, even though the phenomena involved—vacuum fluctuations, non-zero ground states, irreducible jitter—are better understood as expressions of **minimum informational structure**.

Protophysics asserts that the invariant at the base of physical reality is not energy but **information capacity**. The universe cannot collapse into a state with no distinguishable configurations. This informational floor is what gives rise to gradients, and gradients give rise to temperature, and temperature gives rise to energy. The traditional 0ptE concept is therefore downstream of a more fundamental informational condition.

We name this condition the **0-Point Information State (0PIS)**.

3. ℓS-Gradient → Temperature → Information → Energy Continuum

(Low entropy gradient notation:

The primordial expression of 0PIS. Gradients are the first writable structure: directional, asymmetric, and capable of storing constraint.

Optional refined version:

1. ℓS-Gradient

The nearest achievable low-entropy condition emerging from 0PIS. These gradients are the first writable structure: directional, asymmetric, and capable of storing constraint.)

Within Protophysics, the continuum linking gradient, temperature, information, and energy is not metaphorical but structural. It describes the sequence by which the universe expresses its informational substrate into thermodynamic and energetic behavior.

1. **Low-entropy gradients**

The primordial expression of 0PIS. Gradients are the first writable structure: directional, asymmetric, and capable of storing constraint.

2. **Temperature**

Temperature is the macroscopic statistical expression of gradient behavior. It is not an independent variable but a coarse-grained measure of informational distribution.

3. **Information**

Information emerges as the capacity to encode, preserve, or transform distinguishable states within gradient-temperature dynamics.

4. **Energy**

Energy is the final expression in the chain: a derived quantity describing the capacity for work within informationally structured gradients.

This continuum reverses the traditional hierarchy. Energy is not the foundation; it is the outcome.

4. High-Entropy Validation: MIT's Thermal-Information Demonstration

Recent experimental work at MIT demonstrated that **heat flow can store and process information**. By encoding inputs as temperature differences and using conduction through designed geometries to perform matrix–vector multiplication, the researchers showed that temperature can function as an informational substrate.

This result is significant not because it introduces a new mechanism, but because it validates the **temperature–information coupling** in the most challenging regime: high

entropy, high noise, and diffusive behavior. If computation is possible under these conditions, then the low-entropy cold-heat regime proposed in Protophysics—where gradients are sharper, noise is lower, and structure is more stable—should be even more capable.

MIT's work therefore serves as a high-entropy confirmation of the continuum described above and strengthens the case for reframing 0ptE as 0PIS.

5. The 0-Point Information State (0PIS)

We define the **0-Point Information State** as:

The minimal informational condition the universe can sustain, beneath which no further reduction in distinguishability is possible.

0PIS is not a field, region, or medium. It is a **state**—a boundary condition that precedes geometry, temperature, and energy. It is also adjacent to the katalytic boundary in Protophysics: the threshold at which the informational substrate becomes writable and collapses into binary regimes.

6. The 0-Point Information State (0PIS) also provides the natural upstream foundation for the katalytic boundary (κ-onset) already defined within Protophysics. While 0PIS describes the minimal informational condition the universe can sustain—an undifferentiated but non-zero floor of distinguishability—the katalytic point marks the first moment this informational substrate becomes writable. In other words, 0PIS is the pre-expressive state, and κ-onset is the expressive threshold: the transition where a trinary, non-writable substrate collapses into a binary, dynamically expressible regime. The katalytic boundary therefore does not replace 0PIS but emerges directly from it, representing the first stable ignition of structure from the informational floor.

7. Conclusion

Reframing zero-point energy as the 0-Point Information State clarifies the substrate logic underlying both experimental and theoretical developments. It aligns high-entropy thermal computation with low-entropy cold-heat behavior, situates recent experimental results within a broader informational continuum, and provides a coherent foundation for Protophysics' substrate-level architecture. As the field moves toward a more explicit understanding of information–temperature coupling, establishing 0PIS as the correct conceptual floor becomes both timely and necessary.