

# **ToE Living Review Letters Series, Letter IV—Monograph Edition. An Introduction to the Mathematical Theory and Core Concepts of the Theory of Entropicity (ToE): A Rigorous Path Toward a Complete Derivation of the Einstein Field Equations of General Relativity as a Limiting Case from an Entropic Field Theory**

**A Five-Part Definitive Reference Work on the Theory of Entropicity (ToE)**

## **Keywords:**

Obidi Convention, Obidi Calculus, Einstein-Obidi Convention, Einstein-Obidi Calculus, Obidi Fraktur Index, Operator Product Compactification, Obidi's Hierarchical Indices, Obidi's Primary Index Notations (OPIN), Obidi's Secondary Index Notations (OSIN)

## **PART I**

The Revolutionary Inversion and Mathematical Prerequisites

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Canonical Archive: <https://entropicity.github.io/Theory-of-Entropicity-ToE/>

First Edition—June 2026 Written: Wednesday, 03 June 2026

## Some Historical Footnote for Posterity— Ahead of a Preface:

The reader already well familiar with the Theory of Entropicity (ToE) knows by now that my main aim in my endeavors has been to discover general and fundamental principles of nature, and that I am less concerned for the most part about the details of how nature works—I must leave that labor of love to others who have greater inclinations toward such matters. This serves as a crucial frontispiece for the reader, which is to enable him or her to know ahead of time about my inherent motivations; and for me, to keep me steady in my purpose.

This, then, relative to my purpose, is the first time, after over a year of my labors in the formulation of the Theory of Entropicity (ToE), that I can say I have actually made some progress; and that what I have done so far in the past one year of my turmoil and toil in the development of the Theory of Entropicity (ToE) is actually child's play compared to the present work on the subject....

...When **Albert Einstein** was invited to the University of Göttingen by the illustrious **David Hilbert** in June of 1915 to deliver six consequential lectures within an intense week on his emerging Theory of General Relativity, Einstein had occasion to discuss with some of the greatest mathematical minds of the 20th Century; and it was after that period of another intense effort, and with the disturbing communication that Hilbert had already discovered the mathematical action principle of General Relativity [later to be called the Einstein-Hilbert Action, in honor of Hilbert and Einstein, in recognition of their enduring and undeniable accomplishments], Einstein, one more time, in a last desperate effort, tackled with immortal brutal force the problem he had been encountering in his **General Relativity (GR)** prior to his momentous Göttingen visit, which namely was to arrive at the final correct form of the consistent **generally covariant field equations**, and which he eventually found [discovered] with great exhilaration and heavenly joy...

**So, I feel that same indescribable exhilaration and heavenly joy at this very moment over my discovery in this work you now hold in your hands.**

With that said, I here commit you to your own arduous task of reading through this monograph [ToE LRLS Letter IV], which you must now begin; and **may you find in it equivalent and comparable joy.**

## Dedication

To the unnamed student who once asked, “Why does entropy always increase?” and was told “Because that is the second law.” and asked again, “But why?” and was told to stop asking.

This monograph is the beginning of an answer.

To every physicist who has stared at the Einstein field equations and felt, beneath their mathematical beauty, the quiet insistence that something deeper must be there.

To **Dr. Olalekan T. Owolawi**—in whose correspondence the first light of this Theory of Entropicity (ToE) was struck. [Reference the **Owolawi-Obidi Correspondence (OOC)** on the Foundation of the Theory of Entropicity (ToE)]

And to all who understand that the universe does not merely *have* entropy. The universe *is* entropy, organized.

## Epigraphs

“It is wrong to think that the task of physics is to find out how Nature is. Physics concerns what we can say about Nature.”

— Niels Bohr

“The most incomprehensible thing about the universe is that it is comprehensible.”

— Albert Einstein, *Physics and Reality*, 1936

“It from Bit. Otherwise put, every it—every particle, every field of force, even the spacetime continuum itself—derives its existence, its meaning, its very being from answers to yes-or-no questions.”

— John Archibald Wheeler, *It from Bit*, 1990

“The entropy of the universe tends to a maximum.”

— Rudolf Clausius, *The Mechanical Theory of Heat*, 1865

“The fundamental object of study in physics is not the particle, nor the field, nor the wave—it is the distinction. The capacity of a physical system to be in one state rather than another is the root of all measurable reality.”

— John Onimisi Obidi, *ToE Living Review Letter I (The Ontological Primacy of Entropy)*, 2026

“It is a beautiful and profound fact that the equations of motion for a gravitational system can be derived from the purely thermodynamic concept of entropy on a holographic screen.”

— Erik Verlinde, *On the Origin of Gravity and the Laws of Newton*, 2011

“The Einstein equation of state: the proportionality of entropy to horizon area in all local Rindler causal horizons, together with the fundamental relation  $\delta Q = T\delta S$ , implies the Einstein field equation.”

— Ted Jacobson, *Thermodynamics of Spacetime*, *Physical Review Letters*, 1995

“The information-geometric structure of a statistical manifold is not merely an analogy for physics. It is the arena in which physics, properly understood, takes place. To derive gravity from entropy is not to demote gravity—it is to elevate entropy to its rightful station as the most fundamental field in nature.”

— John Onimisi Obidi, *ToE Living Review Letter III (From Information Geometry to Information Gravity)*, 2026

## Abstract

The Theory of Entropicity (ToE) is a programmatic, mathematically rigorous framework in theoretical and mathematical physics whose central claim is that entropy—understood not merely as a thermodynamic bookkeeping variable but as a primary, dynamical, real-valued scalar field defined over a differentiable manifold—is the most primitive physical quantity from which all other physical structure, including spacetime geometry and the matter content that curves it, can be systematically derived. This monograph constitutes the first in a five-part series intended as a definitive reference work for the ToE program. Part I lays the full mathematical and conceptual foundation. Its purpose is twofold: first, to make the central philosophical and scientific argument for the ontological inversion that places entropy at the root of the physical hierarchy, and second, to develop with complete pedagogical rigour every mathematical prerequisite—differential geometry, tensor

calculus, fiber bundle theory, and the statistical foundations of kinetic theory—that the remaining four parts will require and build upon.

The standard hierarchy of contemporary theoretical physics flows from a reductionist program: matter is composed of particles, particles obey quantum field theories, thermodynamics and statistical mechanics emerge as coarse-grained approximations to the underlying quantum dynamics, and entropy is a derived, emergent concept applicable only to sufficiently complex systems. ToE inverts this hierarchy by a deliberate and carefully argued ontological declaration: the entropy field  $S(x)$ , defined as a smooth function on the entropic manifold  $\Lambda$ , is not emergent from particle physics but is instead the ground-level physical datum from which metric geometry, particle physics, and gravitational field equations all emerge as limiting cases. This inversion is not metaphysical speculation; it is supported by a convergent body of modern physics results, including Bekenstein's identification of black hole entropy with horizon area (Bekenstein 1973), Hawking's derivation of thermal radiation from quantum fields in curved spacetime (Hawking 1975), Jacobson's celebrated thermodynamic derivation of the Einstein field equations from the entropy-area law (Jacobson 1995), Verlinde's entropic force program (Verlinde 2011), Padmanabhan's thermodynamic structure of spacetime, and Bianconi's recent Gravity from Entropy program (Bianconi 2023). The ToE program, developed by Obidi in the ToE Living Review Letters Series (Letters I through IV, 2025–2026), makes a stronger and more systematic claim than any of these: it provides an explicit and complete chain of mathematical maps from information-geometric structure to Lorentzian spacetime and from entropy distributions to the stress-energy tensor.

The chain of maps central to ToE may be summarized as follows. One begins with a parametric family of probability distributions  $\{p(x|\theta)\}$  on the entropic manifold  $\Lambda$ , parametrized by coordinates  $\theta_\mu$ . The Fisher–Rao metric on the corresponding statistical manifold provides a natural Riemannian metric on parameter space. The Obidi Transformation, defined in Part III, deforms this metric by incorporating an entropic anisotropy tensor  $\Sigma_{\mu\nu}$  derived from the Kullback–Leibler divergence structure, breaking the invariance established by Čencov's theorem and selecting a unique physical metric. This deformed metric, the Obidi Metric, is shown to be a Lorentzian metric of signature  $(-, +, +, +)$ , whose curvature—expressed through the Obidi Curvature Invariant—encodes the entropic geometry of the manifold. The left-hand side of the Einstein field equations, namely the Einstein tensor  $G_{\mu\nu}$ , is shown to emerge from the curvature of the Obidi metric in the infrared (IR) limit of the theory, where all information-geometric microstructure has been coarse-grained away. The right-hand side, namely the stress-energy tensor  $T_{\mu\nu}$ , emerges from the second moment of the entropic probability distribution over momentum fiber spaces, as the fiber integral of  $p_\mu p_\nu$  weighted by the entropic distribution function

$f(\text{ent})(x, \Omega)$ . The Einstein field equations therefore appear not as fundamental postulates but as the IR limit of the Master Entropic Equation (MEE), the fundamental field equation of ToE.

Part I of this monograph is organized as follows. Chapter 1 orients the reader with respect to the scope, purpose, and prerequisites of the full monograph. Chapter 2 presents the revolutionary inversion argument in full, including its scientific evidence base and its formal statement as the Obidi Conjecture. Chapter 3 develops the theory of smooth manifolds in full pedagogical detail, covering charts, atlases, tangent and cotangent bundles, pushforwards, and pullbacks. Chapter 4 develops tensor algebra, the metric tensor, affine connections, the Levi-Civita connection, the Riemann curvature tensor, the Ricci tensor, the Ricci scalar, the Einstein tensor, and the Bianchi identity. Chapter 5 introduces fiber bundle theory and the mathematics of coarse-graining via fiber integrals, establishing the precise mathematical model by which microscopic entropic structure gives rise to macroscopic physical fields. Chapter 6 develops the statistical and probabilistic foundations of the theory, establishing that physical tensors are moment objects of distribution functions, and connecting the maximum entropy principle to the selection of physical states. The monograph closes Part I with a summary, a notation guide, and an interim bibliography for Parts I through II.

**Keywords:** Theory of Entropicity, entropic gravity, information geometry, Fisher–Rao metric, Einstein field equations, statistical manifold, fiber bundle, coarse-graining, maximum entropy, Obidi Metric, Obidi Transformation, Obidi Stress-Energy Tensor (OSET), Lorentzian geometry.

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## **Preface**

*John Onimisi Obidi—Research Lab, The Aether—June 4, 2026*

This monograph was not written because the author believed he had all the answers. It was written because he believed he had found the right question. The question—stated with the full weight it deserves—is this: is entropy a property that physical systems *have*, or is it a field from which physical systems *emerge*? The standard answer, embedded in every graduate curriculum in theoretical physics, is the former. Particles exist, fields exist. **But the Theory of Entropicity (ToE) inverts that hierarchy and declares that Entropy is a universal, fundamental Field of Nature from which all reality emerges.**

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