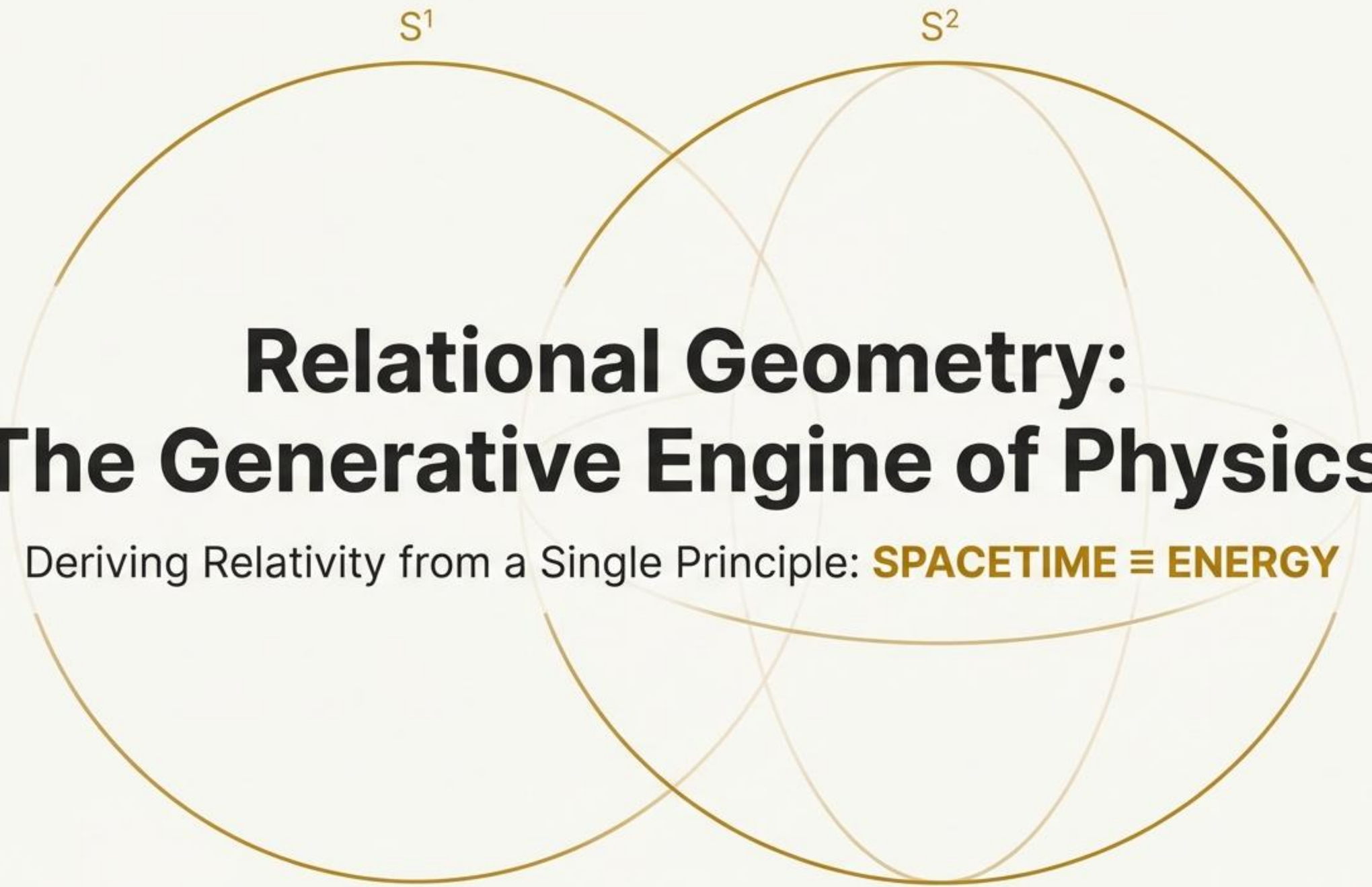


Relational Geometry: The Generative Engine of Physics

Deriving Relativity from a Single Principle: **SPACETIME ≡ ENERGY**

The Ontological Blind Spot in Modern Physics

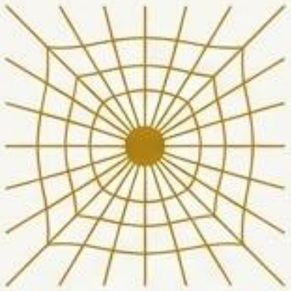
“An Unpaid Ontological Bill.”

All present-day theories (SR, GR, QFT) are built with a bi-variable syntax. This split is not an empirical discovery but an inherited assumption.

Historical Pattern: Major breakthroughs delete assumptions, not add them. Copernicus deleted the Earth/cosmos split; Einstein deleted the space/time split. The spacetime/energy split is the last survivor.

Until an experiment varies the amount of space while holding everything else fixed, the spacetime–energy separation remains an un-evidenced metaphysical postulate.

The Consequences of the Split



Singularities

The formalism predicts infinite density and curvature in black holes and the Big Bang.

The "Dark" Universe

Requires the postulation of Dark Matter and Dark Energy to fit observations, which remain undetected.

Local Energy Ambiguity

In GR, gravitational energy “cannot be localized,” leading to foundational paradoxes.

Postulated, Not Derived

Key principles, like the Equivalence Principle, are assumed rather than derived from a deeper structure.

These are not isolated problems; they are symptoms of a single, foundational error.
Bad philosophy creates complexity.

The Unifying Principle: An Act of Subtraction

This equivalence is not algebraic but ontological. It is not introduced as a new postulate but as the result of removing the hidden assumption separating structure from dynamics.

If no empirical or logical ground justifies the distinction, the distinction must be dissolved.

This single act of epistemic hygiene is sufficient to generate the entire structure of physics.

Deriving the Relational Carriers

SPACETIME ≡ ENERGY

↓

[Closure, Conservation, Isotropy]

↓

Minimal Permitted Topologies

- **Closure:** The system is self-contained. There is no external reservoir for energy.
- **Conservation:** The total relational 'transformation resource' is conserved.
- **Isotropy:** No direction is a priori privileged in a background-free system.

The Carriers

These constraints uniquely select the minimal, maximally symmetric carriers for energy relations:

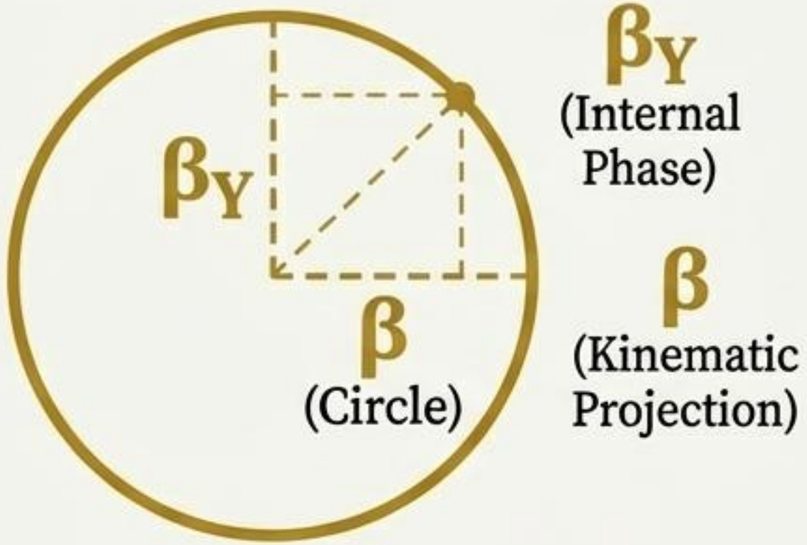
S^1 (The Circle):
For 1-DOF directional (Kinematic) relations.

S^2 (The Sphere):
For 2-DOF omnidirectional (Potential/Gravitational) relations.

Key Insight: These are not spatial entities. They are the non-spatial architectures that encode the rules of energy transformation.

The Emergence of Physics as Geometric Projection

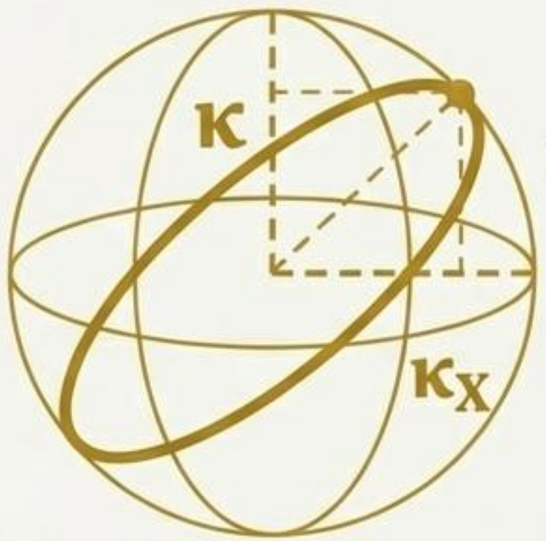
Kinematic Relations (S^1)



$$\beta^2 + \beta_Y^2 = 1$$

Physical Consequence: An increase in relational motion (β) forces a decrease in internal phase (β_Y). This is the geometric origin of time dilation and length contraction.

Potential Relations (S^2)



$$\kappa^2 + \kappa_X^2 = 1$$

Physical Consequence: An increase in gravitational potential (κ) forces a decrease in internal phase (κ_X). This is the geometric origin of gravitational redshift.

The geometry of spacetime is the shadow cast by the geometry of relations.

The Geometric Exchange Rate: Unifying the Carriers

How does a closed system partition its energy budget between its kinematic (S^1) and potential (S^2) modes?

The only distinguishable property between the carriers is their dimensionality, or degrees of freedom (d.o.f.).

The only logical, non-arbitrary exchange rate (R) must be the ratio of their d.o.f.:

$$R = \frac{\text{d.o.f.}(S^2)}{\text{d.o.f.}(S^1)} = \frac{2}{1} = 2$$

Energy budgets are conserved in their quadratic form (β^2, κ^2). Equating them via the exchange rate yields the Energetic Closure Condition:

$$\kappa^2 = 2\beta^2$$

This is the relational analogue of the Virial Theorem. It is the geometric law of energetic balance for any stable, closed system.

The Unified Field: From Abstract Geometry to Physical Density

The geometric projection κ is operationally measurable via redshift and is directly equivalent to the normalized energy density of a system.

Geometric Definition **Equivalence to Density**

$$\kappa^2 = \frac{R_s}{r} \quad = \quad \kappa^2 = \frac{\rho}{\rho_{max}}$$

Where $\rho_{max} = \frac{c^2}{8\pi G r^2}$ is the geometrically-defined saturation density, preventing singularities.

$$\kappa^2 = R_s/r = \rho/\rho_{max}$$

The state of the field geometry (κ^2) ***is*** the state of the energy distribution (ρ/ρ_{max}). They are not cause and effect; they are the same thing viewed through different lenses.

Explaining General Relativity, Not Just Matching It

All known GR critical surfaces emerge as simple, elegant symmetries between the κ and β projections, derived from the single closure law $\kappa^2 = 2\beta^2$.

Phenomenon	Radius	β^2	κ^2	Relational Geometry Condition
ISCO	$3\,R_s$	1/6	1/3	Marginal Stability ($Q = Q_t$)
Photon Sphere	$1.5\,R_s$	1/3	2/3	Null Circular Orbits ($\theta_1 = \theta_2$)
Static Horizon	R_s	1/2	1	Gravitational Closure ($\kappa^2=1$)
Extremal Kerr	$0.5\,R_s$	1	2	Kinematic Closure ($\beta^2=1$)

GR finds these solutions by solving complex differential equations. RG derives them from simple algebraic symmetries. The physics is not in the calculus, but in the geometry.

Orbital Mechanics without Mass or G

All observable orbital structure follows from two directly measurable frequency projections: κ (from redshift) and β (from Doppler). Everything else is algebra.

Case Study: Mercury's Precession

Step 1: The Inputs (Purely Optical)

Kinematic Projection β_p: From radar telemetry of perihelion velocity ($v_p \approx 58.98$ km/s).
$\beta_p \approx 1.967 \times 10^{-4}$.

Potential Projection κ_p: From the Sun's measured gravitational redshift ($z \approx 2.12 \times 10^{-6}$), scaled to Mercury's perihelion.
$\kappa_p \approx 2.533 \times 10^{-4}$.

Step 2: The Universal Precession Law (Pure Algebra)

$$\Delta\varphi = \frac{3\pi}{2} \frac{\kappa_p^4}{\beta_p^2}$$

Step 3: The Result

Plugging in the values yields $\Delta\varphi \approx 5.00 \times 10^{-7}$ rad/orbit.

This corresponds **exactly to the observed 43 arcseconds per century.**

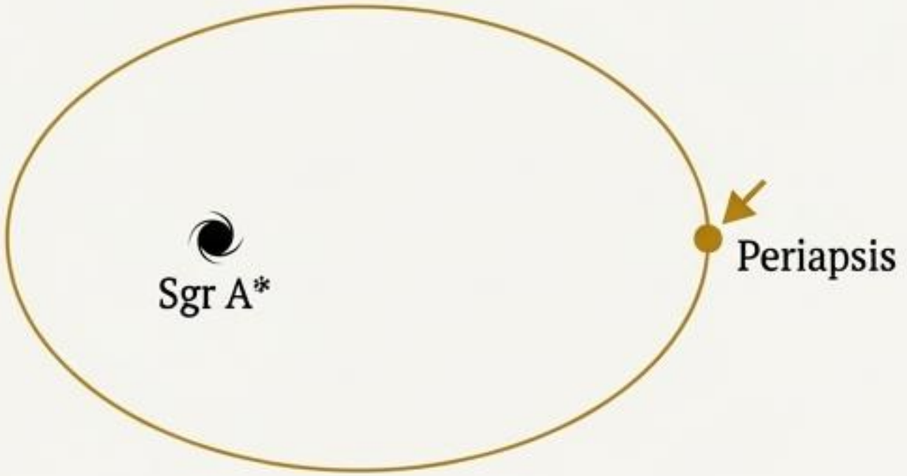
Mass (M) and the gravitational constant (G) are not fundamental inputs. They are 'legacy converters' used to map our geometry back to historical units.

The Ultimate Test: A Blind Prediction for S4716

Unlike GR, which requires mass (M) from long-term monitoring, RG can make a "Snapshot Prediction" from instantaneous orbital data.

The Target

Star S4716, orbiting the Sgr A* black hole. Precession unmeasured as of Nov 2025.
Next periapsis passage: mid-2026.



The Inputs (from PeiЯker et al., 2022):

- Observed Velocity at Periapsis: $v_p \approx 8000$ km/s $\rightarrow \beta_p \approx 0.026685$
- Observed Eccentricity: $e \approx 0.756$

The Geometric Reconstruction:

1. Use e and β_p to reconstruct the hidden potential depth:

$$\kappa_p = \beta_p \sqrt{\frac{2}{1+e}} \rightarrow \kappa_p \approx 0.02848$$

2. Apply the Universal Precession Law: $\Delta\varphi = \frac{3\pi}{2} \frac{\kappa_p^4}{\beta_p^2}$

The Falsifiable Prediction:

$\Delta\varphi \approx 15$ arcminutes per orbit

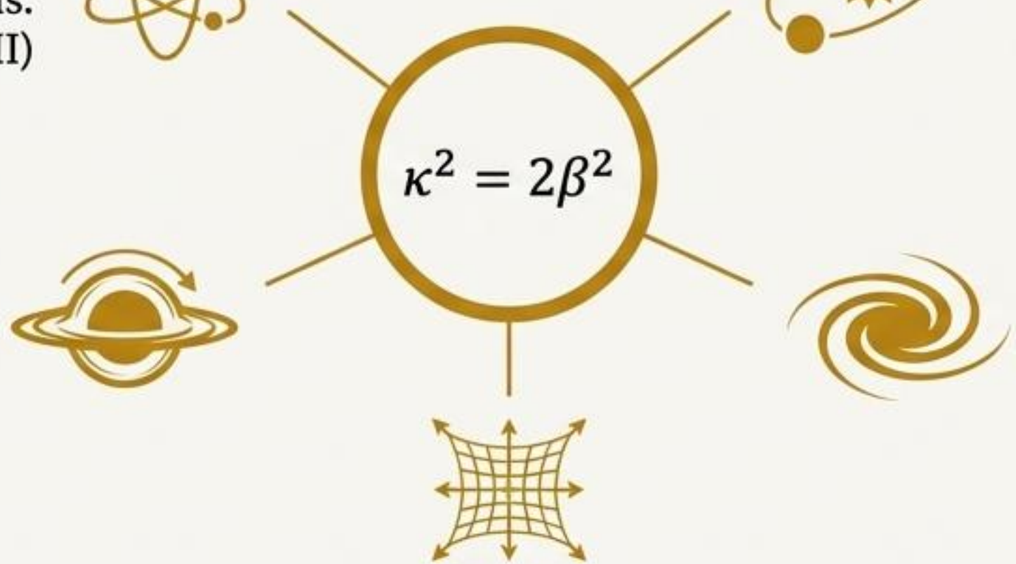
Confirmation will validate that a single, mass-free geometric principle unifies physics from the quantum to the cosmic scale. This is a critical test.

The Scope of a Single Geometric Principle

The same geometric closure condition ($\kappa^2 = 2\beta^2$) successfully describes phenomena across all physical scales, without free parameters or 'dark' entities.

Quantum Systems: Describes the Hydrogen atom ground state and energy levels. (Ref: WILL Part III)

Solar System: Predicts Mercury's precession and Earth's GPS calibration. (Ref: WILL Part I)



Strong Gravity: Defines Black Hole horizons and S-star orbits like S2 and S4716. (Ref: WILL Part I)

Galactic Dynamics: Fits rotation curves for 175 galaxies without Dark Matter. (Ref: WILL Part II)

Cosmology: Derives the global energy density of the Universe without Dark Energy, yielding $\Lambda = 2/(3r^2)$. (Ref: WILL Part II)

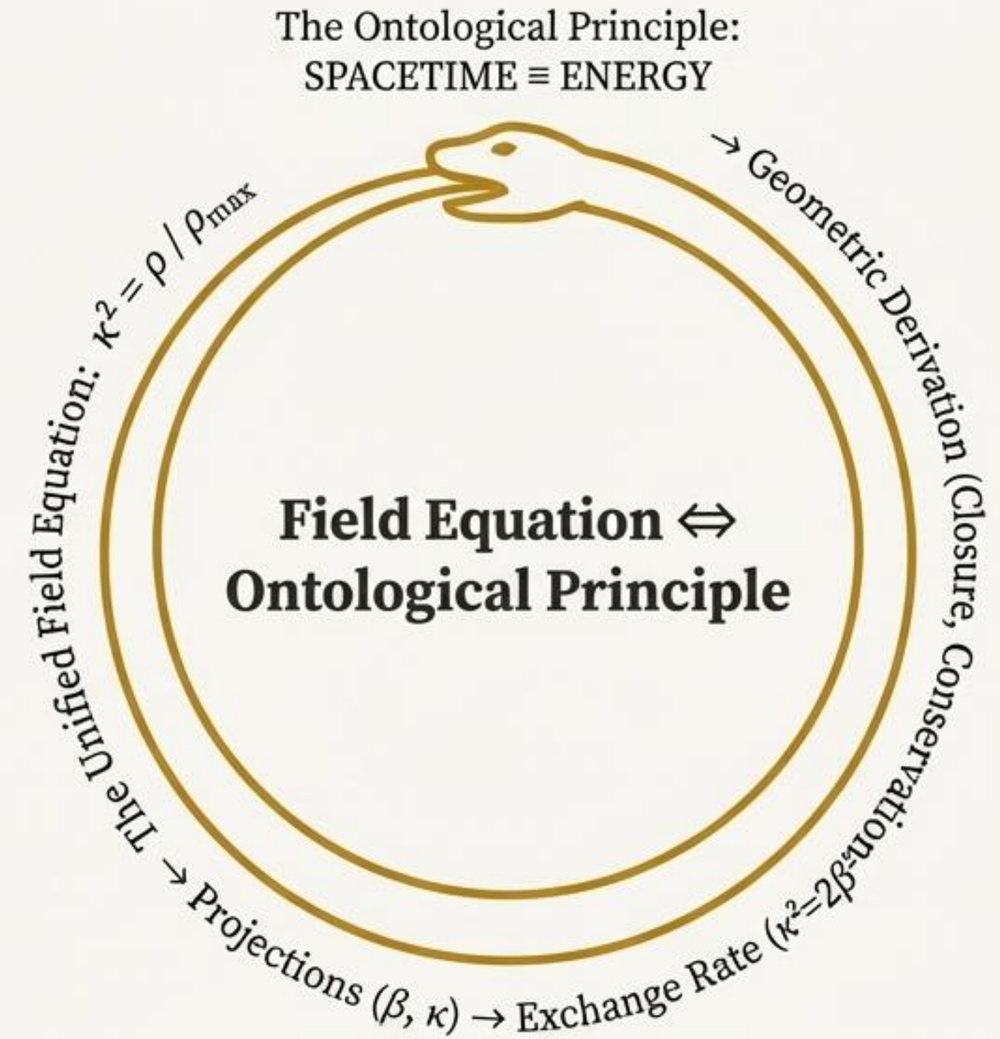
Unity is not the goal of physics; it is the origin.

A Paradigm Shift: From Descriptive to Generative Physics

Descriptive Physics (Standard Paradigm)	Generative Physics (Relational Geometry)
Phenomena are observed, then summarized into empirical laws.	Laws emerge as inevitable consequences of relational geometry.
Physical laws are **assumptions** introduced to model reality.	Physical laws are **identities** enforced by geometric self-consistency.
Time and space are treated as external backgrounds.	Time and space are projections of energy relations.
Dynamics is the evolution of states **in** time.	Dynamics is the ordered succession of balanced states; time is **emergent**.
Goal: Describe what is observed.	**Goal:** Show why nothing else is possible.

The historical escalation of mathematical complexity in physics did not reveal deeper reality—it compensated for a philosophical mistake.

The Theoretical Ouroboros: Logical Closure



The principle generates its own mathematical expression, and the expression validates the principle. This is the mark of a complete and self-consistent theory.

WILL ≡ ET / ML = 1

The universe is not a stage where energy acts through time upon space.
It is a single, self-balancing structure whose internal distinctions generate all phenomena.
It is a single, self-balancing structure whose internal distinctions generate all phenomena.

Geometry ≡ Energy ≡ Causality ≡ WILL

WILL is not the unit of something—but the Unity of Everything.

The full paper is archived on Zenodo: [Link to be inserted]