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December 22, 2025

Editors
Foundations of Physics

Dear Editor,

I am pleased to submit the manuscript *Emergent Equivalence Principle from Relational Time and Connection Dynamics* for consideration as a Research Article in *Foundations of Physics*.

Summary. The manuscript gives a conservative, structural account in which the Equivalence Principle (EP) is not taken as a primitive axiom but emerges as a *low-energy organizing symmetry*. The synthesis rests on three mature strands: (i) Lorentzian inertial structure fixed operationally from causality; (ii) relational-time dynamics in which mild deformations of a global constraint yield an effective Hamiltonian $\hat{H}_{\text{eff}} = \hat{H}(I + \hat{H}/\Lambda)^{-1}$ with a universal energy–energy cross-term at low energies; and (iii) the geometric trinity (curvature/torsion/non-metricity) as conceptually inequivalent but dynamically equivalent codings of the same empirical content. In this framework, weak-field redshift and Newtonian-like behavior follow without postulating the EP, while the affine connection’s role in mediating inertial vs. gravitational effects is made explicit. The domain of validity is stated in operational terms amenable to quantum-clock tests.

What is new (concise).

- *Operational scaffold:* Causal automorphism results are used to motivate Lorentz kinematics from clocks, signaling, and causal order—no privileged field needed.
- *Relational mechanism:* A simple constraint deformation produces \hat{H}_{eff} and, in a controlled low-energy expansion, a *universal* cross-term $-2\Lambda\hat{H}_A \otimes \hat{H}_B$. This seeds both gravitational redshift and a Newtonian-like interaction structure without adding forces.
- *Emergent EP:* Within the regime $\|\hat{H}\|/\Lambda \ll 1$, universality of free fall and equality of inertial/gravitational mass are *derived features* of the relational structure. The EP is recast as a low-energy symmetry compatible with multiple geometric codings (GR/TEGR/STEGR).
- *Transparent limits:* Leading weak-field redshift is recovered by identifying Λ^{-1} with a potential scale; the analysis cleanly states what is *not* yet derived (distance dependence $1/r$) and how to get it (spatial reference frames/quantum reference frames).
- *Affine-connection clarity:* The account makes explicit how the connection partitions inertial vs. gravitational contributions across curvature-, torsion-, and non-metricity-based descriptions.

Distinctive predictions / testable consequences.

- *Coherence-dependent redshift corrections:* Small, state-dependent deviations scale with clock resolution/energy variance; they are *not* fifth-force-like and targetable via quantum-clock interferometry.
- *Regime of deviations:* Departures are expected when relational deformations cease to be perturbative (large $\|\hat{H}\|/\Lambda$), or when sources are in energy superpositions—offering clear experimental knobs.
- *Geometry-agnostic phenomenology:* Low-energy predictions are invariant under GR/TEGR/STEGR “geometric trinity,” reinforcing that any observed deviation would diagnose the relational sector rather than a specific geometric encoding.

Why *Foundations of Physics*. The paper reorganizes well-tested phenomenology without altering it, clarifies the logical dependence among causality, dynamics, and geometry, and isolates concrete, falsifiable signatures. This speaks directly to the journal’s focus on conceptual structure, cross-theory coherence, and experimentally anchored foundational claims.

Availability and transparency. A timestamped preprint is available at Zenodo (DOI: 10.5281/zen-

odo.18018114). The submission is original, not under consideration elsewhere, and the authorship/affiliation information is accurate. There is no external funding and no conflicts of interest. Data and code are not applicable; the work consists of analytical derivations with figures included.

Thank you for considering this manuscript. I would be grateful if you would consider it for publication as a Research Article in *Foundations of Physics*.

Sincerely,

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