

Phenomenal Time as a Thermal Projection: A Metric Deformation of General Relativity from IVI Noumenal Structure

Abstract

We propose a deformation of the general relativistic lapse function in which the observed flow of time arises as a projection from a higher-dimensional, reversible, space-like parameter. This framework originates in the IVI (Intangibly Verified Information) structure, where spacetime \mathcal{M} is embedded in a total space $\mathcal{E} = \mathcal{M} \times \mathbb{I}$ with an additional coordinate $i \in \mathbb{I}$ representing noumenal evolution. A projection map $K : \mathcal{E} \rightarrow \mathcal{M}$, dependent on local thermal and structural fields, induces a deformation of $g_{00}(x)$ of the form

$$g_{00}(x) \approx - \left[1 + \frac{2\Phi(x)}{c^2} - \varepsilon_{\text{grain}} F(\kappa(x)) + \varepsilon_{\text{flat}} G(T(x)) \right].$$

The functions $\kappa(x)$ and $T(x)$ represent, respectively, local fractal-grain structure and local radiation/temperature fields, with F and G smooth dimensionless shape functions; $\varepsilon_{\text{grain}}$ and $\varepsilon_{\text{flat}}$ are small couplings. In the limit $(\varepsilon_{\text{grain}}, \varepsilon_{\text{flat}}) \rightarrow (0, 0)$, general relativity is fully recovered.

We show that under a saturation condition $j\ell^2 = 1$, where $j = m\ell^2/t^2$, the manifold undergoes a curvature flattening in the time direction: time becomes geometrically flat and reduces to a spatial invariant $m\ell^2$. Inverse projection restores exponential structure, producing a logarithmic unfolding

$$i(t) = \frac{2}{3}m^{3/2} \ln |t| + C.$$

The resulting deformation yields two concrete and falsifiable predictions: (i) a radiation-induced flattening observable in optical clock residuals, and (ii) a structure-induced thickening detectable through strong-lensing time-delay residuals.

1 Introduction

General relativity (GR) successfully describes gravitation via the geometry of a four-dimensional Lorentzian manifold (\mathcal{M}, g) . However, GR does not explain the microscopic origin of the lapse function or the arrow of time. In standard relativity, time is assumed to be fundamentally distinct from space through metric signature, rather than emergent from deeper structure.

We investigate a deformation of the lapse motivated by the IVI framework, in which observed time is a projection from a higher-dimensional, reversible, space-like parameter. We show that GR is recovered as a limiting case and that the corrections lead to clear, falsifiable experimental signatures.

2 Geometric Setting

Let the total space be

$$\mathcal{E} = \mathcal{M} \times \mathbb{I},$$

with \mathcal{M} the spacetime manifold and \mathbb{I} a one-dimensional fiber coordinatized by i . There is a canonical projection $\pi : \mathcal{E} \rightarrow \mathcal{M}$ and a second map $K : \mathcal{E} \rightarrow \mathcal{M}$ determining the phenomenal embedding. We introduce three operators:

$$Q : \mathbb{I} \rightarrow \mathbb{I}, \quad F : \mathcal{M} \rightarrow \mathcal{M}, \quad K : \mathcal{E} \rightarrow \mathcal{M},$$

corresponding respectively to reversible i -flow, fractal structural modification, and projection to observed spacetime.

Let $\kappa(x) \geq 0$ denote a local grain-structure density induced by F , and let $T(x) \geq 0$ denote a local temperature/radiation field.

3 Metric Deformation

In the weak-field limit, with Newtonian potential $\Phi(x)$, the metric component g_{00} takes the form

$$g_{00}(x) \approx - \left[1 + \frac{2\Phi(x)}{c^2} - \varepsilon_{\text{grain}} F(\kappa(x)) + \varepsilon_{\text{flat}} G(T(x)) \right]. \quad (1)$$

The sign structure implies:

$$\text{grain (matter)} \Rightarrow \text{thickening of time}, \quad \text{radiation (heat)} \Rightarrow \text{flattening of time}.$$

4 Dual Projections and the Derivation of the Sheet, the Log, and the Lapse

We now explain the geometric mechanism behind the deformation. The starting point is the Kakeya-inspired scalar

$$j = \frac{m\ell^2}{t^2},$$

where ℓ is a coarse spatial scale and t the observed time. The IVI saturation condition

$$j \frac{\ell^3}{\ell} = 1 \quad \implies \quad j\ell^2 = 1$$

eliminates one dynamical degree of freedom and forces

$$t = \sqrt{m} \ell^2.$$

Under this constraint, the combination $jt^2 = m\ell^2$ becomes a spatial invariant. Geometrically, this enforces *curvature flattening along the time direction*: the sectional curvature associated with

time-like planes goes to zero. In this regime, time becomes geometrically flat.

To reconstruct observed time from the i -fiber, we note that $t \sim \ell^2$ implies $d\ell/\ell = \frac{1}{2} dt/t$. Because i measures multiplicative scale depth, the only invariant measure is

$$di = C(m) \frac{dt}{t},$$

whose integral uniquely yields

$$i(t) = \frac{2}{3} m^{3/2} \ln |t| + C.$$

Thus the inverse projection must be logarithmic: projection collapses curvature, and unprojection unwinds it logarithmically.

Next, define a deviation from the sheet,

$$\delta(x) = 1 - j(x)\ell(x)^2.$$

To first order in the weak field, the only admissible scalars are Φ/c^2 , $F(\kappa)$, and $G(T)$, so

$$\delta(x) = -\frac{2\Phi(x)}{c^2} + \varepsilon_{\text{grain}} F(\kappa(x)) - \varepsilon_{\text{flat}} G(T(x)).$$

Identifying the relativistic lapse via $W := -g_{00}$ yields exactly Eq. (1).

5 Recovery of General Relativity

Setting $\varepsilon_{\text{grain}} \rightarrow 0$ and $\varepsilon_{\text{flat}} \rightarrow 0$ reduces Eq. (1) to the standard GR expression

$$g_{00}(x) \approx - \left[1 + \frac{2\Phi(x)}{c^2} \right].$$

6 Experimental Signatures

6.1 Optical Clocks (Local Flattening)

Residual fractional frequency shifts after standard BBR corrections obey

$$\frac{\Delta\nu}{\nu} \approx \frac{1}{2} \varepsilon_{\text{flat}} (G(T_1) - G(T_2)).$$

6.2 Strong Lensing (Cosmic Thickening)

Time-delay residuals obey

$$\frac{\Delta t_{\text{obs}} - \Delta t_{\text{GR}}}{\Delta t_{\text{GR}}} \approx \frac{1}{2} \varepsilon_{\text{grain}} F(\kappa_{\text{LOS}}).$$

7 Conclusion

We have shown that GR can be viewed as the projection limit of a higher-dimensional structure and that its lapse function admits a physically motivated thermal-structural deformation. The model recovers GR when deformation terms vanish and yields clear, sign-definite experimental predictions.