A Phenomenological TEU Model for Time-Dependent Gravitational Coupling from Ancient-Photon Deflection Residuals

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Abstract

The Theory of the Empty Universe (TEU) proposes that gravity emerges from a differential deformation of space-time. In this framework, particles preserve an internal deformation state associated with their formation epoch, while the external vacuum continues to deform as the universe expands. This article develops a preliminary phenomenological model connecting ancient-photon solar-deflection residuals with an effective photon gravitational susceptibility and a time-dependent gravitational coupling. Motivated by the high-redshift quasar 0229+131 and the comparison source 0235+164, the observed residual is represented by a dimensionless parameter $\mu_\gamma = (\alpha_{\text{obs}} - \alpha_{\text{GR}})/\alpha_{\text{GR}}$. The cosmological part of the model is formulated as a smooth TEU gravitational law,

$$G_{\text{TEU}}(t) = G_0 \left(\frac{t_0}{t}\right)^{1/3}, \tag{1}$$

where G_0 is the present measured gravitational constant, t_0 is the present age of the universe in the TEU framework, and t is the cosmic age. For $t_0 = 3.4 \times 10^{15}$ yr, this gives

$$G_{\text{TEU}}(t) = \frac{1.0036 \times 10^{-5}}{\sqrt[3]{t}}, \tag{2}$$

with t in years and G in $\text{m}^3\,\text{kg}^{-1}\,\text{s}^{-2}$. The model is not presented as a confirmed variation of Newton's local constant, but as an effective deformation-coupling law within TEU. Its testable implication is that sufficiently old photons may show a positive residual in solar gravitational deflection after standard relativistic, plasma, and instrumental corrections.

1 Introduction

The Theory of the Empty Universe (TEU) interprets gravity as a consequence of the differential deformation of space-time. In the TEU picture, a particle is not merely an object placed inside space-time; it is a localized energy-field structure that contains an internal deformation state. Since the external universe continues to expand and deform, while the internal deformation stored in a particle remains approximately fixed, a differential deformation appears. This differential is identified with the physical origin of gravitational interaction.

A particularly interesting consequence arises for photons. In the TEU framework, a newly emitted photon initially contains no significant deformation differential relative to the surrounding vacuum. However, as the photon propagates over cosmological time, the external vacuum continues evolving while the photon's internal space-time state remains associated with its emission epoch. Therefore, ancient photons may acquire an effective gravitational susceptibility. This does not necessarily imply a conventional photon rest mass. Rather, it can be modeled as an effective TEU gravitational-mass contribution.

This article develops a compact phenomenological formulation connecting three ideas:

1. ancient-photon gravitational-deflection residuals,
2. an effective photon mass/susceptibility parameter μ_γ,
3. and a time-dependent TEU gravitational coupling $G_{\mathrm{TEU}}(t)$.

The model remains speculative and requires statistical validation using VLBI or astrometric observations of high-redshift sources near the Sun.

2 TEU Background: External Temporal Deformation of Space

TEU proposes that the universe began as an infinitesimal spatial state of zero volume. The convergence of the spatial dimensions with a vectorial dimension called time generated a continuous deformation of space, producing a dynamic space-time sphere. Under the simplest TEU geometry, the radial deformation of the universe propagates at the speed of light,

$$R(t) = ct, \tag{3}$$

where $R(t)$ is the radius of the deforming universe, c is the speed of light, and t is the age of the universe.

The corresponding geometric volume is

$$V(t) = \frac{4}{3}\pi R(t)^3, \tag{4}$$

therefore

$$V(t) = \frac{4}{3}\pi (ct)^3. \tag{5}$$

Thus,

$$V(t) \propto t^3. \tag{6}$$

The conceptual postulate can be stated as follows:

> **Postulate of External Temporal Deformation.** In TEU, the time dimension acts as an external convergent deformation field on the space dimension. This convergence deforms space radially and generates the expanding universe. Gravity is the internal manifestation of the resistance of space-time to this external temporal deformation.

Under this interpretation, the gravitational coupling is not fundamentally a fixed number independent of cosmic epoch. Rather, the measured value of G today is the present value of a deformation-coupling function.

3 Solar Deflection Residuals and the Effective Photon Parameter

For a source observed near the Sun, general relativity predicts a solar gravitational deflection $\alpha_{\rm GR}$. If the observed value is $\alpha_{\rm obs}$, we define the dimensionless TEU photon residual parameter

$$\mu_\gamma = \frac{\alpha_{\rm obs} - \alpha_{\rm GR}}{\alpha_{\rm GR}}. \tag{7}$$

Equivalently,

$$\alpha_{\rm obs} = \alpha_{\rm GR}(1 + \mu_\gamma). \tag{8}$$

In this model, μ_γ is not interpreted as a direct variation of Newton's local gravitational constant. Instead, it is treated as an effective gravitational susceptibility of an ancient photon:

$$\mu_\gamma \longleftrightarrow \text{effective TEU photon gravitational-mass contribution.} \tag{9}$$

3.1 Case 1: 0229+131

For the high-redshift quasar 0229+131, the relevant values used in the present phenomenological estimate are

$$z_{0229} = 2.059, \tag{10}$$

$$\alpha_{\rm obs} \approx 0.3100'', \tag{11}$$

$$\alpha_{\rm GR} \approx 0.3010''. \tag{12}$$

Therefore,

$$\Delta\alpha = 0.3100'' - 0.3010'' = 0.0090'', \tag{13}$$

which is

$$\Delta\alpha = 9\,\text{mas}. \tag{14}$$

The relative residual is

$$\mu_{0229} = \frac{0.0090}{0.3010} \approx 0.03. \tag{15}$$

Thus,

$$\boxed{\mu_{0229} \approx 3.0\%.} \tag{16}$$

3.2 Case 2: 0235+164

For 0235+164, a lower-redshift comparison source observed near the Sun in the AUA020 VLBI session, the redshift is approximately

$$z_{0235} \approx 0.94. \tag{17}$$

Using the published post-fit γ deviation for this source as a deflection-residual proxy, the effective residual used here is

$$\mu_{0235} \approx 0.000082. \tag{18}$$

Therefore,

$$\boxed{\mu_{0235} \approx 0.0082\%.} \tag{19}$$

Table 1: Phenomenological photon residuals used in the TEU model.

Source	Redshift	Approx. residual μ_γ	Interpretation
0235+164	0.94	8.2×10^{-5}	nearly GR-like
0229+131	2.059	3.0×10^{-2}	possible ancient-photon excess

This comparison motivated the interpretation that the observed excess should not be treated directly as $G/G_0 - 1$. Instead, it should be represented as an effective photon term that multiplies the cosmological deformation-coupling law.

4 Time-Dependent TEU Gravitational Coupling

A first aggressive model was

$$G(t) = G_0 \left(\frac{t_0}{t}\right), \tag{20}$$

which is equivalent to $G \propto 1/t$. However, this produces extremely large early-universe values. A smoother model is obtained by taking a cubic-root dependence:

$$\boxed{G_{\mathrm{TEU}}(t) = G_0 \left(\frac{t_0}{t}\right)^{1/3}.} \tag{21}$$

This preserves the qualitative TEU requirement that the effective gravitational coupling was larger in the early universe,

$$t < t_0 \quad \Rightarrow \quad G_{\mathrm{TEU}}(t) > G_0, \tag{22}$$

while avoiding the excessive growth of the $1/t$ model.

Using

$$G_0 = 6.6743 \times 10^{-11}\,\mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}, \tag{23}$$

and the TEU age scale

$$t_0 = 3.4 \times 10^{15}\,\mathrm{yr}, \tag{24}$$

we define

$$C = G_0 \sqrt[3]{t_0}. \tag{25}$$

Numerically,

$$C \approx 1.0036 \times 10^{-5}\,\mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}\,\mathrm{yr}^{1/3}. \tag{26}$$

Therefore,

$$\boxed{G_{\mathrm{TEU}}(t) = \frac{1.0036 \times 10^{-5}}{\sqrt[3]{t}},} \tag{27}$$

where t is measured in years and G_{TEU} is obtained in $\mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}$.

5 Including the Ancient-Photon Effective Term

The effective coupling experienced by an ancient photon can then be written as

$$\boxed{G_{\gamma,\text{eff}}(t,z) = G_{\text{TEU}}(t)(1+\mu_\gamma).} \tag{28}$$

Substituting the explicit time law,

$$\boxed{G_{\gamma,\text{eff}}(t,z) = G_0\left(\frac{t_0}{t}\right)^{1/3}(1+\mu_\gamma).} \tag{29}$$

Or numerically,

$$\boxed{G_{\gamma,\text{eff}}(t,z) = \frac{1.0036\times 10^{-5}}{\sqrt[3]{t}}(1+\mu_\gamma),} \tag{30}$$

with t in years.

For the two motivating sources,

$$G_{\gamma,\text{eff},0235}(t) = G_{\text{TEU}}(t)(1.000082), \tag{31}$$

$$G_{\gamma,\text{eff},0229}(t) = G_{\text{TEU}}(t)(1.03). \tag{32}$$

6 Value at the First Second

One second corresponds to

$$t = \frac{1}{31,557,600}\,\text{yr} \approx 3.1688\times 10^{-8}\,\text{yr}. \tag{33}$$

Therefore,

$$G_{\text{TEU}}(1\,\text{s}) = \frac{1.0036\times 10^{-5}}{\sqrt[3]{3.1688\times 10^{-8}}}. \tag{34}$$

This gives

$$\boxed{G_{\text{TEU}}(1\,\text{s}) \approx 3.17\times 10^{-3}\,\text{m}^3\,\text{kg}^{-1}\,\text{s}^{-2}.} \tag{35}$$

Relative to the current value,

$$\frac{G_{\text{TEU}}(1\,\text{s})}{G_0} \approx 4.75\times 10^{7}. \tag{36}$$

Thus, in this model,

$$\boxed{G_{\text{TEU}}(1\,\text{s}) \approx 47.5 \text{ million times } G_0.} \tag{37}$$

7 Deformation Density and Deformation Resistance

The TEU volume at time t is

$$V(t) = \frac{4}{3}\pi(ct)^3. \tag{38}$$

At $t = 1$ s,

$$R(1\,\mathrm{s}) = c(1\,\mathrm{s}) = 2.99792458 \times 10^8\,\mathrm{m}, \tag{39}$$

so

$$\boxed{V(1\,\mathrm{s}) \approx 1.13 \times 10^{26}\,\mathrm{m}^3.} \tag{40}$$

A deformation-density-like parameter can be defined as

$$\boxed{\rho_G(t) = \frac{G_{\mathrm{TEU}}(t)}{V(t)}.} \tag{41}$$

At the first second,

$$\rho_G(1\,\mathrm{s}) = \frac{3.17 \times 10^{-3}}{1.13 \times 10^{26}}, \tag{42}$$

therefore

$$\boxed{\rho_G(1\,\mathrm{s}) \approx 2.8 \times 10^{-29}\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}.} \tag{43}$$

This is not a mass density in $\mathrm{kg\,m^{-3}}$. It is an effective gravitational coupling per unit volume.

The inverse quantity is

$$\boxed{\mathcal{I}_G(t) = \rho_G(t)^{-1} = \frac{V(t)}{G_{\mathrm{TEU}}(t)},} \tag{44}$$

with units

$$[\mathcal{I}_G] = \mathrm{kg\,s}^2. \tag{45}$$

At the first second,

$$\boxed{\mathcal{I}_G(1\,\mathrm{s}) \approx 3.56 \times 10^{28}\,\mathrm{kg\,s}^2.} \tag{46}$$

This may be interpreted within TEU as an effective deformation resistance of the universe.

Because

$$G_{\mathrm{TEU}}(t) \propto t^{-1/3} \tag{47}$$

and

$$V(t) \propto t^3, \tag{48}$$

then

$$\rho_G(t) = \frac{G(t)}{V(t)} \propto t^{-10/3}, \tag{49}$$

and

$$\mathcal{I}_G(t) \propto t^{10/3}. \tag{50}$$

Thus, in this model, the gravitational coupling decreases smoothly, but the volumetric deformation density decreases much more rapidly.

8 Discussion

The key conceptual step is separating two different effects:

1. the cosmological deformation-coupling law $G_{\mathrm{TEU}}(t)$,
2. the ancient-photon effective susceptibility μ_γ.

The quasar residual is therefore not interpreted as a direct measurement of $G(t)$ at the source epoch. Instead, it is interpreted as an additional effective photon term caused by the photon's internal deformation state becoming increasingly different from the external vacuum over cosmological propagation time.

This avoids the main difficulty of identifying a few-percent deflection residual with a direct few-percent change in the universal gravitational constant. Under the present TEU model, the observed residual is represented by

$$\mu_\gamma = \frac{\alpha_{\mathrm{obs}} - \alpha_{\mathrm{GR}}}{\alpha_{\mathrm{GR}}}, \tag{51}$$

while the background coupling evolves as

$$G_{\mathrm{TEU}}(t) = G_0 \left(\frac{t_0}{t}\right)^{1/3}. \tag{52}$$

A future statistical test would require a sample of high-redshift radio sources observed at low solar elongation, with careful control of plasma delay, source structure, instrumental systematics, and standard post-Newtonian modeling. The testable TEU expectation is not merely an isolated anomaly, but a positive correlation between residual deflection and photon cosmological age.

9 Conclusion

Starting from the TEU interpretation of gravity as differential space-time deformation, this article proposed a compact phenomenological law for the effective gravitational coupling:

$$\boxed{G_{\mathrm{TEU}}(t) = G_0 \left(\frac{t_0}{t}\right)^{1/3}.} \tag{53}$$

Using $G_0 = 6.6743 \times 10^{-11}\,\mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}$ and $t_0 = 3.4 \times 10^{15}$ yr, the reduced numerical expression is

$$\boxed{G_{\mathrm{TEU}}(t) = \frac{1.0036 \times 10^{-5}}{\sqrt[3]{t}},} \tag{54}$$

where t is measured in years.

The quasar deflection residuals are incorporated through an effective photon term,

$$\boxed{G_{\gamma,\mathrm{eff}}(t,z) = G_{\mathrm{TEU}}(t)(1+\mu_\gamma),} \tag{55}$$

with

$$\boxed{\mu_\gamma = \frac{\alpha_{\mathrm{obs}} - \alpha_{\mathrm{GR}}}{\alpha_{\mathrm{GR}}}.} \tag{56}$$

The resulting postulate is that the convergence of the time dimension externally deforms the space dimension, generating radial expansion and producing gravity as the internal resistance of space-time to this deformation. The model is preliminary, but it provides a clear mathematical structure for future observational tests.

References

References

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