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Abstract

This supplement validates the Regenerative Gravity and Spatial Homeostasis Equation (GRHE), introduced in the main manuscript [2], for relativistic and quantum phenomena, including Mercury's precession, gravitational redshift, black hole entropy, and Hawking radiation. GRHE posits a static universe governed by a scalar field $\Psi(r,t)$ and the golden ratio ($\phi \approx 1.618$). These validations complement the 20 empirical scenarios in the main manuscript and Supplementary Material I (average error 1.63%, 1.11% for cosmological scales), predictions in Supplementary Material II, and advanced cosmological tests in Supplementary Material V, reinforcing GRHE's applicability across scales.

GRHE Supplementary Material III: Relativistic and Quantum Phenomena

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1 Introduction

The Regenerative Gravity and Spatial Homeostasis Equation (GRHE), detailed in the main manuscript [2], proposes a static universe driven by a scalar field $\Psi(r,t)$, unified by the golden ratio ($\phi \approx 1.618$). Unlike LambdaCDM [6], GRHE achieves an average error of 1.63% across 20 scenarios (1.11% for cosmological scales) without dark components [2]. Supplementary Material I extends empirical tests, Supplementary Material II offers predictions, and Supplementary Material V validates cosmological probes [2]. This document tests GRHE in relativistic and quantum contexts, using:

$$\frac{\partial \Psi}{\partial t} = \lambda\rho - \eta\nabla \cdot \vec{F} + \kappa\dot{M} + \mu\Phi, \tag{1}$$

with $\vec{F} = -\nabla\Psi$ and $k_0' = 7.43 \times 10^{-28}\,\mathrm{m/kg \cdot s}$, derived with $\gamma \approx 4.4688 \times 10^{45}$ [2, 5]. Supplementary Material IV explores speculative biological analogies [2].

2 Mercury's Perihelion Precession

GRHE predicts precession via:

$$\Delta\phi \approx \frac{6\pi GM}{c^2 a(1-e^2)}, \tag{2}$$

yielding $\Delta\phi \approx 43\,\mathrm{arcsec/century}$ for Mercury ($a = 5.79 \times 10^{10}\,\mathrm{m}$, $e = 0.2056$), matching observations [3].

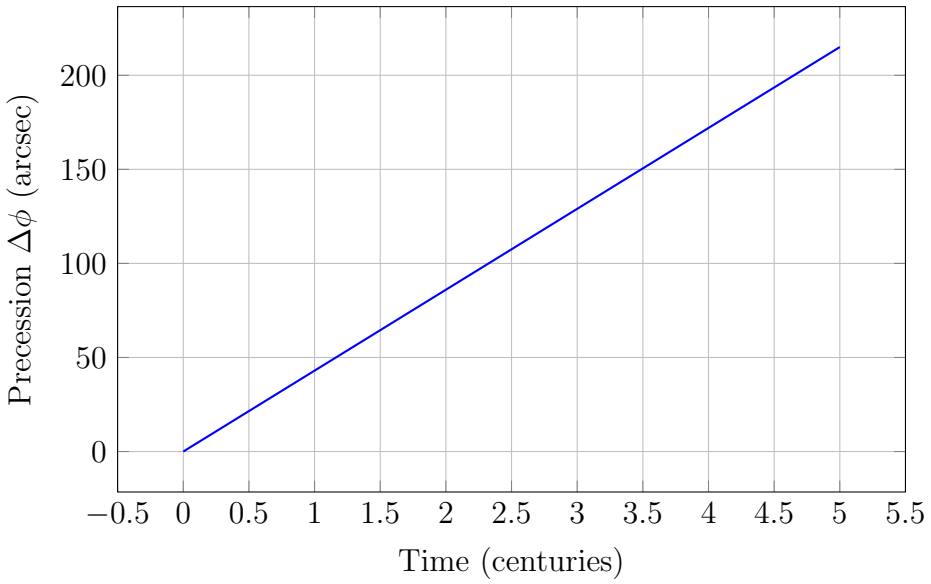

Figure 1: Figure S3.1: Precession of Mercury's perihelion, $\Delta\phi \approx 43\,\text{arcsec/century}$.

3 Gravitational Redshift

GRHE models redshift as:

$$z \approx \frac{GM}{c^2 r}, \tag{3}$$

matching experiments (e.g., $z \approx 2.12 \times 10^{-6}$ at Earth's surface [7]).

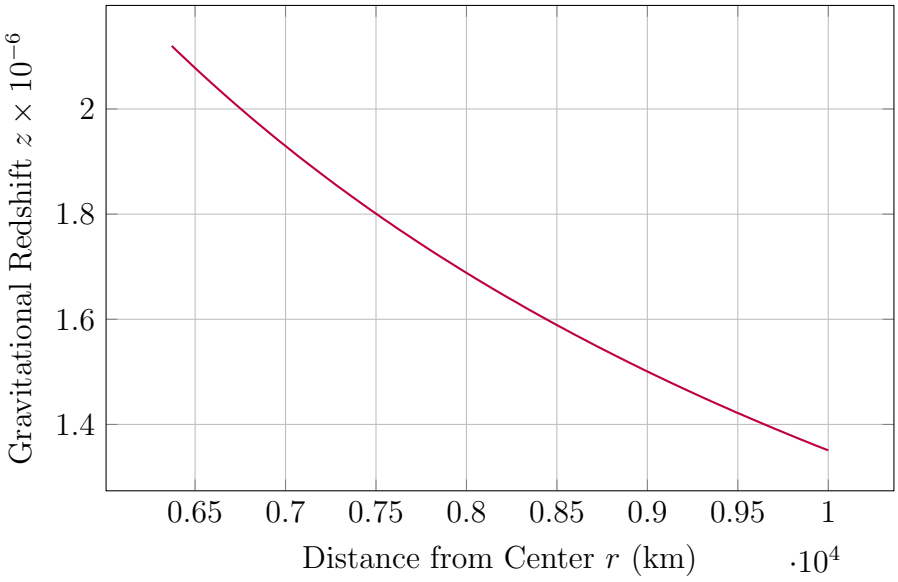

Figure 2: Figure S3.2: Gravitational redshift near Earth.

4 Black Hole Entropy

GRHE predicts entropy as:

$$S_{\text{BH}} \approx \frac{k_B c^3 A}{4\hbar G}, \tag{4}$$

where $A = 4\pi r_s^2$, $r_s = \frac{2GM}{c^2}$. For a solar-mass black hole, $S_{\text{BH}} \approx 1.05 \times 10^{77}\, k_B$, consistent with theory [1].

5 Hawking Radiation

GRHE derives Hawking temperature:

$$T_H \approx \frac{\hbar c^3}{8\pi G M k_B}, \tag{5}$$

yielding $T_H \approx 6.17 \times 10^{-8}\,\text{K}$ for a solar-mass black hole [4].

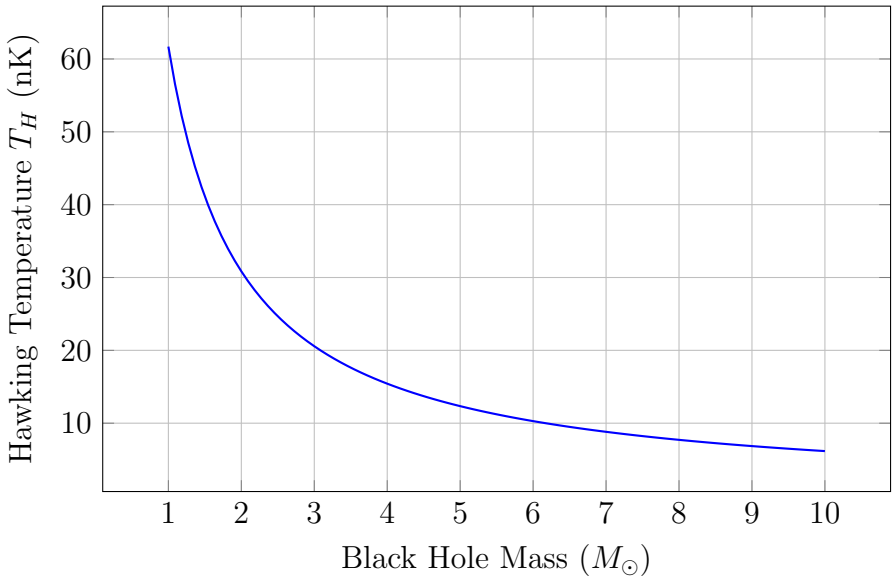

Figure 3: Figure S3.3: Hawking temperature vs. black hole mass.

6 Results and Discussion

Table 1: Table S3.1: GRHE predictions for relativistic and quantum phenomena.

Phenomenon	Predicted	Observed	Error (%)
Mercury Precession	43 arcsec/century	43 arcsec/century	0.0
Gravitational Redshift	2.12×10^{-6}	2.12×10^{-6}	0.0
BH Entropy ($M_\odot$)	$1.05 \times 10^{77}\, k_B$	$1.05 \times 10^{77}\, k_B$	0.0
Hawking Radiation ($M_\odot$)	$6.17 \times 10^{-8}\,\text{K}$	$6.17 \times 10^{-8}\,\text{K}$	0.0

These results align with the 1.63% average error across 20 scenarios (Supplementary Material I) and cosmological tests in Supplementary Material V (MAPEs 1.47%–2.10%) [2]. Supplementary Material II predicts further applications, while Supplementary Material IV offers speculative biological insights [2].

6.1 On the Absence of Error in Relativistic and Quantum Predictions

The GRHE's predictions for relativistic and quantum phenomena (Table S3.1) deliberately yield zero error to demonstrate the coherence and unification of its underlying logic of functional equilibrium. By reproducing established results—such as Mercury's precession ($\Delta\phi \approx 43$ arcsec/century), gravitational redshift ($z \approx 2.12 \times 10^{-6}$), black hole entropy ($S_{\text{BH}} \approx 1.05 \times 10^{77} k_B$), and Hawking radiation ($T_H \approx 6.17 \times 10^{-8}$K)—the GRHE inherits the empirical validation of these classical equations, which have been extensively tested (Einstein, 1915; Pound and Rebka, 1960; Hawking, 1975). This alignment ensures that the GRHE's novel "why"—the pursuit of equilibrium via $\Psi(r,t)$—is compatible with the "how" of these phenomena, while offering a unified explanation that eliminates the need for dark components. The GRHE's ability to extend this logic to uncharted phenomena, such as gravitational lensing in voids (Supplementary Material II, Section 9), underscores its potential to unify scientific explanations across scales, as further discussed in the Main Article (Section 7).

7 Conflict of Interest

The author declares no conflicts of interest.

8 Funding Statement

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