UBT Appendix 5: Vector Part of the Biquaternionic Field Equation

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1. Introduction

In this appendix, we examine the **vector part** of the unified field equation derived from the Biquaternion Gravity framework:

$$\mathbf{R}^{\mu}_{a} - \frac{1}{2} e^{\mu}_{a} \mathbf{R} = 0 \tag{1}$$

where all quantities are biquaternions.

Our goal is to extract and interpret the **vector part** of this equation, in analogy with how we previously analyzed the scalar and imaginary scalar components.

2. Decomposition into Vector Components

Recall that any biquaternion $\mathbf{X}$ can be decomposed as:

$$\mathbf{X} = \mathrm{Scal}(\mathbf{X}) + \vec{V}_R(\mathbf{X}) + i\,\vec{V}_I(\mathbf{X}) + i\,\mathrm{PScal}(\mathbf{X})$$

We now apply the projection:

$$\mathrm{Re}(\vec{V}(\mathbf{X})) = \mathrm{Re}(\mathbf{X}) - \mathrm{Scal}(\mathbf{X})$$

and similarly for the imaginary vector part.

Let us define:

$$\vec{V}^{\mu}_{R\,a} = \mathrm{ReVectorPart}(\mathbf{R}^{\mu}_{a} - \tfrac{1}{2} e^{\mu}_{a} \mathbf{R}) \tag{2}$$

$$\vec{V}^{\mu}_{I\,a} = \mathrm{ImVectorPart}(\mathbf{R}^{\mu}_{a} - \tfrac{1}{2} e^{\mu}_{a} \mathbf{R}) \tag{3}$$

Then the vector part equation is simply:

$$\vec{V}^{\mu}_{R\,a} + i\vec{V}^{\mu}_{I\,a} = 0 \tag{4}$$

which splits into two real vector equations:

$$\vec{V}^{\mu}_{R\,a} = 0 \tag{5}$$

$$\vec{V}^{\mu}_{I\,a} = 0 \tag{6}$$

3. Interpretation and Hypotheses

3.1 Real Vector Equation

The real vector equation $\vec{V}^{\mu}_{R\,a} = 0$ may encode a constraint on torsion-free, metric-compatible geometries. It likely corresponds to Einstein-Cartan-like conditions or vectorial conservation laws.

3.2 Imaginary Vector Equation

The imaginary vector part $\vec{V}^{\mu}_{I\,a} = 0$ is especially intriguing. It may encode:

- A generalized Maxwell-type field equation,
- A hidden vector field coupled to spacetime geometry,
- A remnant of conformal or chiral gauge symmetry.

In the simplified case $e_I = 0$, this equation may reduce to a divergence-type condition on ω_I:

$$\nabla_{\mu}\omega_I^{\mu ab} + (\text{nonlinear terms}) = 0$$

resembling Yang-Mills field dynamics.

4. Future Directions

- Attempt explicit calculation of $\vec{V}^{\mu}_{I\,a}$ in terms of ω_R and ω_I.
- Test reductions in symmetric backgrounds (FLRW, Schwarzschild).
- Seek Lagrangian formulation that yields this vector equation as Euler-Lagrange equation.

Author's Note

This work was developed solely by Ing. David Jaroš. Large language models (ChatGPT-4o by OpenAI and Gemini 2.5 Pro by Google) were used strictly as assistive tools for calculations, LaTeX formatting, and critical review. All core ideas, equations, theoretical constructs and conclusions are the intellectual work of the author.