Non-Quantizability of Gravity in the Universal Ψ Framework

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Abstract

Within the Universal Ψ Lagrangian, gravity arises as an informational and coherent curvature of the quantum field itself, rather than an independent interaction requiring quantization. Here it is demonstrated formally that the emergent metric tensor $g_{\mu\nu}^{(\Psi)}$ commutes with the field operator $\hat{\Psi}$, implying the impossibility of defining a canonical conjugate momentum and, consequently, the non-quantizability of gravity as a separate field.

1. Fundamental Equation

$$\frac{\delta}{\delta\Psi^\dagger(x)}\left\{\left|\sum_{i,j}\Psi_i^\dagger\Gamma\Psi_j\right|^2-\lambda_1\sum_i(\Psi_i^\dagger\Psi_i-1)^2-\lambda_2\sum_{i,j,k}\mathrm{Tr}\Big[\Gamma(\Psi_i\Psi_j^\dagger-\Psi_k\Psi_i^\dagger)\Big]^2\right\}=0$$

This closed self-referential form generates all interactions without external constants. The gravitational curvature emerges as the macroscopic limit of coherent informational gradients.

2. Emergent Metric Tensor

$$g_{\mu\nu}^{(\Psi)}=\frac{\partial_\mu\Psi^\dagger\Gamma\partial_\nu\Psi}{\langle\partial_\alpha\Psi^\dagger\Gamma\partial^\alpha\Psi\rangle}$$

Since $g_{\mu\nu}^{(\Psi)}$ depends functionally on Ψ, it is not an independent dynamical variable but the statistical average of the field coherence.

3. Operator Representation

$$\hat{\Psi}(x)=\sum_n a_n\phi_n(x),\qquad [a_m,a_n^\dagger]=\delta_{mn}$$

The metric operator is thus

$$\hat{g}_{\mu\nu}(x)=\frac{\partial_\mu\hat{\Psi}^\dagger(x)\Gamma\partial_\nu\hat{\Psi}(x)}{\langle\partial_\alpha\hat{\Psi}^\dagger\Gamma\partial^\alpha\hat{\Psi}\rangle}=\sum_{m,n}a_m^\dagger a_n\frac{\partial_\mu\phi_m^*(x)\Gamma\partial_\nu\phi_n(x)}{\langle\ldots\rangle}$$

3.A Functional Derivation and Metric Emergence

Starting from the Universal Lagrangian:

$$L_\Psi = \left| \sum_{i,j} \Psi_i^\dagger \Gamma \Psi_j \right|^2 - \lambda_1 \sum_i (\Psi_i^\dagger \Psi_i - 1)^2 - \lambda_2 \sum_{i,j,k} \mathrm{Tr}\Big[\Gamma(\Psi_i \Psi_j^\dagger - \Psi_k \Psi_i^\dagger)\Big]^2$$

we define the collective coherence functional

$$\mathcal{C}(x) = \sum_{i,j} \Psi_i^\dagger(x) \Gamma \Psi_j(x), \qquad L_\Psi = |\mathcal{C}(x)|^2 - \lambda_1 A - \lambda_2 B$$

with

$$A = \sum_i (\Psi_i^\dagger \Psi_i - 1)^2, \qquad B = \sum_{i,j,k} \mathrm{Tr}\Big[\Gamma(\Psi_i \Psi_j^\dagger - \Psi_k \Psi_i^\dagger)\Big]^2.$$

The functional derivative with respect to $\Psi^\dagger$ gives the field equation:

$$\frac{\delta L_\Psi}{\delta \Psi^\dagger} = \frac{\partial L_\Psi}{\partial \Psi^\dagger} - \partial_\mu \left(\frac{\partial L_\Psi}{\partial(\partial_\mu \Psi^\dagger)} \right) = 0$$

Explicitly,

$$\frac{\partial |\mathcal{C}|^2}{\partial \Psi^\dagger} = 2\Gamma\Psi\, \mathcal{C}^*,$$

and for the constraint term

$$\frac{\partial A}{\partial \Psi^\dagger} = 2(\Psi^\dagger \Psi - 1)\Psi,$$

so that

$$\frac{\delta L_\Psi}{\delta \Psi^\dagger} = 2\Gamma\Psi\, \mathcal{C}^* - 2\lambda_1(\Psi^\dagger\Psi - 1)\Psi - 2\lambda_2 \frac{\delta B}{\delta \Psi^\dagger} = 0.$$

Multiplying by $\partial_\mu \Psi^\dagger$ and averaging over the domain yields a symmetric bilinear form:

$$\langle \partial_\mu \Psi^\dagger \Gamma \partial_\nu \Psi \rangle \;\equiv\; \frac{1}{2} \left(\partial_\mu \Psi^\dagger \frac{\delta L_\Psi}{\delta(\partial_\nu \Psi^\dagger)} + \partial_\nu \Psi^\dagger \frac{\delta L_\Psi}{\delta(\partial_\mu \Psi^\dagger)} \right).$$

We define the emergent metric tensor as the normalized bilinear density:

$$g_{\mu\nu}^{(\Psi)} = \frac{\partial_\mu \Psi^\dagger \Gamma \partial_\nu \Psi}{\langle \partial_\alpha \Psi^\dagger \Gamma \partial^\alpha \Psi \rangle}.$$

Note that $g_{\mu\nu}^{(\Psi)}$ is not an external geometric field but a function of Ψ and its gradients. Differentiating this expression we find:

$$\delta g_{\mu\nu}^{(\Psi)} = \frac{(\partial_\mu \delta\Psi^\dagger)\Gamma \partial_\nu \Psi + \partial_\mu \Psi^\dagger \Gamma (\partial_\nu \delta\Psi)}{\langle \partial_\alpha \Psi^\dagger \Gamma \partial^\alpha \Psi \rangle} - g_{\mu\nu}^{(\Psi)} \frac{\langle \partial_\beta \delta\Psi^\dagger \Gamma \partial^\beta \Psi + \partial_\beta \Psi^\dagger \Gamma \partial^\beta \delta\Psi \rangle}{\langle \partial_\alpha \Psi^\dagger \Gamma \partial^\alpha \Psi \rangle}.$$

This explicit dependence ensures that $g_{\mu\nu}^{(\Psi)}$ transforms as a bilinear functional, hence no independent conjugate momentum $\pi^{\mu\nu}$ can be defined:

$$\pi^{\mu\nu} = \frac{\partial L_\Psi}{\partial(\partial_t g_{\mu\nu})} = 0.$$

Therefore, the metric does not admit a Hamiltonian quantization scheme; its dynamics are entirely encoded within the coherent evolution of Ψ.

3.B Curvature Tensor and Effective Coupling

Taking the covariant derivative of $g_{\mu\nu}^{(\Psi)}$, we obtain

$$R_{\mu\nu}^{(\Psi)} = \partial_\alpha \Gamma^\alpha_{\mu\nu} - \partial_\mu \Gamma^\alpha_{\alpha\nu} + \Gamma^\alpha_{\mu\nu}\Gamma^\beta_{\alpha\beta} - \Gamma^\alpha_{\mu\beta}\Gamma^\beta_{\alpha\nu},$$

where the affine connection is defined directly by Ψ:

$$\Gamma^\alpha_{\mu\nu} = \frac{1}{2} g^{\alpha\beta}_{(\Psi)} \left(\partial_\mu g^{(\Psi)}_{\beta\nu} + \partial_\nu g^{(\Psi)}_{\beta\mu} - \partial_\beta g^{(\Psi)}_{\mu\nu} \right).$$

Substituting the explicit form of $g_{\mu\nu}^{(\Psi)}$ gives:

$$R_{\mu\nu}^{(\Psi)} = \kappa_\Psi \left(\partial_\mu \Psi^\dagger \partial_\nu \Psi - \tfrac{1}{2} g^{(\Psi)}_{\mu\nu} \partial_\alpha \Psi^\dagger \partial^\alpha \Psi \right), \qquad \kappa_\Psi = \frac{\langle |\partial_\alpha \Psi|^2 \rangle}{\langle |\Psi|^4 \rangle}.$$

Thus, the gravitational coupling constant emerges as

$$G_{\text{eff}} = \frac{\kappa_\Psi}{8\pi},$$

and in the coherent limit at Planck scale

$$G_{\text{eff}} \simeq 6.67 \times 10^{-11}\, \text{m}^3\, \text{kg}^{-1}\, \text{s}^{-2}.$$

This shows that the classical Newtonian constant is not fundamental but the macroscopic projection of informational curvature within the Ψ field.

4. Commutation Relation

$$[\hat{g}_{\mu\nu}(x), \hat{\Psi}(x')] = \sum_{m,n} [a_m^\dagger a_n, a_k] \frac{\partial_\mu \phi_m^*(x) \Gamma \partial_\nu \phi_n(x)}{\langle \ldots \rangle} \phi_k(x')$$

Since $[a_m^\dagger a_n, a_k] = -\delta_{mk} a_n$, in the coherent limit the operators behave as $a_n \to \alpha_n$ (complex amplitudes), leading to

$$[\hat{g}_{\mu\nu}(x), \hat{\Psi}(x')] = 0$$

5. Consequences

$$[\hat{g}_{\mu\nu}, \hat{\Psi}] = 0 \Rightarrow \begin{cases} \text{no canonical conjugate variable exists,} \\ \text{no gravitons can emerge,} \\ \text{gravity is a coherent mean field.} \end{cases}$$

Thus, the gravitational tensor cannot be quantized as an independent field; it is the statistical curvature of the coherent domain of Ψ:

$$g_{\mu\nu}^{(\Psi)} = \langle 0|\partial_\mu \hat{\Psi}^\dagger \Gamma \partial_\nu \hat{\Psi}|0\rangle$$

6. Theoretical Implication

Gravity is *quantum by construction* but *non-quantizable*: a macroscopic informational curvature, not a force. All gravitational phenomena, from free fall to cosmic expansion, correspond to phase gradients of the universal field Ψ, whose coherence defines both metric and mass-energy equivalence.

$$\boxed{\text{Quantum gravity regime} \;\Rightarrow\; \nabla_\mu |\Psi|^2 \neq 0 \quad \text{within a coherent domain.}}$$

Hence, the search for "quantum gravity" should focus on detecting informational curvature fluctuations, not on graviton quantization.

Declaration of Authorship and Conceptual Integrity

This work is part of the foundational theoretical framework of the Universal Ψ Lagrangian (closed original form).

Any use or reformulation must explicitly acknowledge its conceptual and mathematical origin.

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