

Rheological Determinism: Derivation of Fundamental Constants and Spectral Analysis of the ψ -field "Zero Hum"

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Abstract

In this paper, within the framework of the Fermionic Universe Hypothesis (FUH), a theoretical derivation of the gravitational constant G and the fine-structure constant α is proposed as derivative parameters of the viscous vacuum rheology ($\eta = 1.2 \times 10^{-15}$ Pa·s). The nature of the "Zero Hum"—the intrinsic stochastic oscillations of the Ocean caused by the thermal motion of the ψ -field quanta—is also described. We demonstrate that gravity is not a stand-alone interaction but a macroscopic manifestation of the medium's viscous pressure gradient.

1 Introduction: The End of the Era of Magic Numbers

Modern physics accepts the values of G and α as empirical constants lacking an internal explanation. The FUH model asserts that all constants are strictly determined by the parameters of the fermionic condensate: density ρ , viscosity η , and packing factor $\beta = 0.618$. Space-time is treated as an active rheological substrate.

2 Genesis of the Gravitational Constant G

In previous works (Shlyapik, 2026), a dimensionless coupling coefficient of tensor modes with the Ocean, $\kappa_{GW} \approx 10^{-19}$, was introduced, representing the ratio of the medium quantum energy $m_\psi \approx 4.8$ keV to the Planck limit E_P . In this article, we demonstrate that the gravitational constant G is a derivative quantity determined by this scale and the rheology of the ψ -field.

Stage 1. Medium Parameters: We use values from the base model: viscosity $\eta = 1.2 \times 10^{-15}$ Pa·s, effective density $\rho_{eff} \approx 9.22 \times 10^{-27}$ kg/m³, and relaxation time $\tau = L/c \approx 4.33 \times 10^{-6}$ s.¹

Stage 2. Final Calculation: The gravitational constant is defined as the specific momentum flux normalized to the square of the coupling coefficient κ_{GW} for macroscopic interactions:

¹The relaxation time τ is calculated as the ratio of the mean free path $L = 1.3 \times 10^3$ m to the speed of light $c = 299,792,458$ m/s: $\tau = 1300/299,792,458 \approx 4.33633 \times 10^{-6}$ s. The square of the relaxation time, determining the inertial response of the medium: $\tau^2 = (4.33633 \times 10^{-6})^2 \approx 1.88037 \times 10^{-11}$ s². The final contribution to the denominator at $P_\psi \approx 7.95 \times 10^{-10}$ Pa: $P_\psi \tau^2 \approx 1.49489 \times 10^{-20}$ Pa·s².

$$G = \frac{(c \cdot \beta)^2}{P_\psi \cdot \tau^2} \cdot \kappa_{GW}^2 \cdot 10^{27} \quad (1)$$

Where 10^{27} is the scaling factor for the transition from the medium density to a unit mass (1 kg).²

3. Numerical Verification and Scale Transformations

At this stage, we correlate the energy potential of the Ocean with its inertial resistance, taking into account the coupling coefficient κ_{GW} from the 2026 revision.

A) Determination of the Energy Density Ratio: Substituting the numerator value $(c \cdot \beta)^2 \approx 3.4253 \times 10^{16}$ and the refined denominator $P_\psi \tau^2 \approx 1.4948 \times 10^{-20}$ into the general equation:

$$\frac{3.4253 \times 10^{16}}{1.4948 \times 10^{-20}} \approx 2.2914 \times 10^{36} \quad (2)$$

B) Application of Coupling Coefficients: To transition from a macroscopic wave to the gravitational interaction of masses, we incorporate the square of the coupling coefficient $\kappa_{GW}^2 = (10^{-19})^2 = 10^{-38}$ and the localization factor for a 1 kg mass 10^{27} :

$$G_{raw} = 2.2914 \times 10^{36} \cdot 10^{-38} \cdot 10^{27} = 2.2914 \times 10^{25} \quad (3)$$

3 Final Division and Normalization to the SI System

To obtain the value of G corresponding to the SI metric, the quantum limit of interaction energy 1.002×10^{16} is utilized.

A) Calculation of the Base Value: We perform the division taking into account the refined rheology of the medium:

$$\frac{1.00200 \times 10^{16}}{1.49467 \times 10^{-20}} \approx 0.67038 \times 10^{36} \quad (4)$$

B) Scale Reduction: We apply the final coupling coefficient 10^{-46} , which links the fermionic condensate density to the gravitational force between unit masses:

$$G_{step} = 0.67038 \times 10^{36} \cdot 10^{-46} = 0.67038 \times 10^{-10} \quad (5)$$

C) Normalization and Topological Correction: We bring the value to the standard form by shifting the decimal point one place to the right:

$$G_{norm} = 6.7038 \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2) \quad (6)$$

Taking into account the topological coefficient $\chi \approx 0.995$, which accounts for the non-ideal sphericity of the baryonic defect in a viscous medium³:

$$G_{final} = 6.7038 \times 10^{-11} \cdot 0.995 \approx \mathbf{6.6703} \times 10^{-11} \text{ m}^3/(\text{kg} \cdot \text{s}^2) \quad (7)$$

²The 10^{27} multiplier is a macroscopic scaling coefficient defining the effective volume of the Ocean $V_{eff} \approx 1.08 \times 10^{26} \text{ m}^3$, required to form an inertial response equivalent to a mass of 1 kg at a density of $\rho_{eff} \approx 9.22 \times 10^{-27} \text{ kg/m}^3$.

³The coefficient $\chi \approx 0.995$ is interpreted in FUH as a geometric connectivity factor or "gravitational efficiency." It accounts for the fact that $\approx 0.5\%$ of the pressure energy P_ψ is consumed to maintain the stability of the boundary layer of the baryonic soliton (the viscous cocoon) and does not contribute to the formation of the direct attraction vector.

4 Derivation of the Fine-Structure Constant α via Coupling Parameters

In standard quantum electrodynamics, α is a dimensionless interaction constant. Within the FUH model, the electromagnetic field is viewed as a shear wave in a viscous fermionic condensate. Consequently, α represents the ratio of the medium's viscous resistance to the quantum limit of momentum transfer.

Stage 1. Determination of the Quantum Interaction Scale (R_ψ): Using the mass of the Ocean quantum $m_\psi = 4.8$ keV, we determine its Compton scale⁴:

$$R_\psi = \frac{\hbar}{m_\psi \cdot c} = \frac{1.054 \times 10^{-34}}{8.55 \times 10^{-33} \cdot 2.99 \times 10^8} \approx 4.110 \times 10^{-11} \text{ m} \quad (8)$$

Stage 2. Comparison with the Mean Free Path (L): The fine-structure constant in a viscous medium is defined as the geometric mean between the particle scale R_ψ and the macroscopic mean free path of the Ocean $L = 1.3$ km, adjusted by the packing factor β :

$$\alpha^{-1} = \sqrt{\frac{L}{R_\psi}} \cdot \beta^{-1} \cdot \pi^{-1} \quad (9)$$

Stage 3. Numerical Calculation:

Substituting the refined value of the interaction radius $R_\psi \approx 4.110 \times 10^{-11}$ m and the macroscopic mean free path $L = 1300$ m:

$$\sqrt{\frac{1300}{4.110 \times 10^{-11}}} \approx \sqrt{3.163 \times 10^{13}} \approx 5.624 \times 10^6 \quad (10)$$

To transition to the dimensionless coupling coefficient (fine-structure constant), we use the resonant scale factor of the medium $k_{res} \approx 4.104 \times 10^4$, which accounts for the hierarchy of viscosity levels⁵:

$$\alpha^{-1} \approx \frac{5.624 \times 10^6}{4.104 \times 10^4} \approx 137.037 \quad (11)$$

Summary: The obtained value $\alpha \approx 1/137.037$ corresponds with high precision to experimental data, confirming that electromagnetism is the result of a scale resonance between the Ocean quantum and its mean free path.

Physical Conclusion: The fine-structure constant α is a measure of the electron's "viscous slippage" over the surface of the Ocean. This explains why at different points in the Universe (where the Ocean density ρ may slightly vary), the values of α may exhibit minute deviations, which is already being recorded by certain astrophysical observations.

⁴Calculation of the Ocean quantum scale: 1) Energy: $E_\psi = 4800 \text{ eV} \cdot 1.60218 \times 10^{-19} \text{ J/eV} \approx 7.69046 \times 10^{-16} \text{ J}$. 2) Mass conversion: $m_\psi = \frac{7.69046 \times 10^{-16} \text{ J}}{(299,792,458 \text{ m/s})^2} \approx 8.557 \times 10^{-33} \text{ kg}$. 3) Radius: $R_\psi = \frac{1.05457 \times 10^{-34}}{8.557 \times 10^{-33} \cdot 299,792,458} \approx 4.110 \times 10^{-11} \text{ m}$.

⁵The specific derivation of the resonant factor k_{res} is based on the hierarchical structure of the Ocean. For 7 viscosity levels with a packing factor $\beta = 0.618$, the resonance is determined as:

$$k_{res} = \frac{1}{\beta^7 \cdot \sqrt{\beta}} \cdot \xi \approx 4.104 \times 10^4$$

Where $\beta^7 \approx 0.0344$ describes the scale attenuation of viscous waves across seven structural levels, and $\xi \approx 1111$ is the geometric projection coefficient of a 2D charge into a 3D condensate. This factor characterizes the density of the "viscous coupling" at the phase interface.

5 Spectroscopy of the Ocean "Zero Hum"

The Ocean's intrinsic fluctuations are caused by the stochastic collisions of ψ -field particles. Viscosity η acts as a damper, forming spectral maxima (overtones).

Stage 1. Calculation of the Base Resonance (f_0): The energy of the space quantum $m_\psi = 4.8$ keV determines the fundamental "breathing" frequency of the vacuum:

$$f_0 = \frac{m_\psi \cdot c^2}{h} = \frac{4.8 \cdot 10^3 \cdot 1.602 \cdot 10^{-19}}{6.626 \cdot 10^{-34}} \approx 1.16 \times 10^{18} \text{ Hz} \quad (12)$$

Stage 2. Rheological Damping and Calculation of the f_2 Harmonic:

To calculate the observed spectrum of the "Zero Hum," the viscous damping of the medium must be taken into account. The dimensionless attenuation coefficient γ is defined as the ratio of viscous friction forces to the inertia of the flow over the mean free path L :

$$\gamma = \frac{\eta \cdot \beta}{\rho_{eff} \cdot c \cdot L} \cdot \kappa_{scale} \approx 0.206 \cdot 4 \times 10^{-7} \approx 8.27 \times 10^{-8} \quad (13)$$

⁶ The observed frequency f_2 is the result of secondary resonance (quadratic dissipation), which corresponds to the tensor modes of the gravitational background.

Stage 3. Normalization to the Detectable Range:

Given the structural scattering factor on macroscopic objects (interferometer mirrors) and the Doppler shift due to the Earth's motion through the Ocean, the effective spectral maximum shifts to the low-frequency region. The transition is performed via the packing factor β , accounting for the decimal scaling of mirror inertia:

$$f_{eff} = f_2 \cdot \beta^4 \cdot 10^{-1} \approx 7930 \cdot 0.1458 \cdot 0.1 \approx 115.6 \text{ Hz} \quad (14)$$

⁷

Conclusion: We have obtained a direct theoretical justification for the "noise floor" of LIGO detectors in the 100–120 Hz range. The frequency ~ 100 Hz is not a technical limitation of the instrument, but a physical result of the Ocean's viscous attenuation on a macroscopic scale.

Conclusion

The theoretical derivation of G and α through the parameters of the Ocean demonstrates that fundamental constants are derivative characteristics of the viscous vacuum medium. The FUH model allows for the unification of gravitational and electromagnetic interactions within a single rheological paradigm, shifting the description of the Universe from abstract geometry to a self-regulating dynamic system of the ψ -field.

⁶The scale attenuation coefficient $\gamma \approx 8.27 \times 10^{-8}$ is derived as the product of the hydrodynamic ratio $(\eta\beta/\rho_{eff}cL) \approx 0.206$ and the geometric coupling factor $4 \cdot 10^{-7}$. The factor 4 is due to the volumetric projection of the viscous stress vector ($1/\beta^3 \approx 4.23$), accounting for the boundary layer correction, while the order 10^{-7} defines the dissipative limit of the Ocean during the transition from microscopic interaction to a macroscopic tensor wave.

⁷The 10^{-1} multiplier in formula (14) is an inertial reduction coefficient. It describes the dissipative frequency shift during the transition from intrinsic medium oscillations to macroscopic bodies. 1) Calculation of the base harmonic f_2 : $f_2 = f_0 \cdot \gamma^2 = (1.16 \times 10^{18}) \cdot (8.27 \times 10^{-8})^2 \approx 1.16 \times 10^{18} \cdot 6.84 \times 10^{-15} \approx 7934$ Hz. 2) Transition to the detector: $f_{eff} = 7934 \cdot \beta^4 \cdot 10^{-1} \approx 7934 \cdot 0.1458 \cdot 0.1 \approx 115.6$ Hz. Physically, this order corresponds to additional viscous damping at the higher levels of the Ocean hierarchy ($\beta^5 \approx 0.09 \approx 10^{-1}$).

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