On the Derivation and Role of the Gravitational Wave Coupling g_{wave} in Unified Wave Theory

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October 30, 2025

1 Introduction

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Abstract

A refined derivation of the gravitational–wave coupling constant $g_{wave} \approx 0.085$ is presented within the framework of Unified Wave Theory (UWT). The approach resolves the apparent infinite–radius paradox by introducing the *flat–fabric limit*, establishing g_{wave} as a finite, local scalar–wave coupling in the post–inflationary, nearly flat spacetime. Numerical simulations and analytical arguments suggest that this coupling governs scalar–field coherence, with potential implications for plasma stability, condensed systems, and biological electromagnetics.

2 Introduction

Unified Wave Theory (UWT) proposes a dual–scalar field framework (Φ_1, Φ_2) unifying gravitational and electromagnetic phenomena [1]. A key parameter, g_{wave}, couples these fields yet differs by roughly nine orders of magnitude from Newton's gravitational constant $G = 6.674 \times 10^{-11}\,\mathrm{m}^3\,\mathrm{kg}^{-1}\,\mathrm{s}^{-2}$. This paper derives g_{wave} from the field–split potential, interprets its role via the flat–fabric limit, and outlines supporting simulations.

3 Theoretical Framework

3.1 Field Split and Potential

Unit convention. All quantities are expressed in natural units ($\hbar = c = 1$) unless stated otherwise.

The pre–split Higgs–like potential is

$$V_{pre}(\phi) = \lambda_{pre}(\phi^2 - v_{pre}^2)^2, \tag{1}$$

with $\lambda_{pre} \approx 2.51 \times 10^{-6}\,\mathrm{GeV}^{-2}$ and $v_{pre} \approx 0.246\,\mathrm{GeV}$. Post–split, incorporating CP violation ($\delta_{CP} \approx -75°$),

$$V_{trans}(\phi) = \lambda_{pre}\big(|\phi_1|^2 - 12v_{pre}^2 + |\phi_2|^2 \cos(\epsilon_{CP} + \delta_{CP})\big)\,, \tag{2}$$

where $\epsilon_{CP} \approx 2.58 \times 10^{-41}$. The resulting energy shift is $\Delta E_{split} \approx 4.3 \times 10^{-2}\,\mathrm{GeV}$.

3.2 Derivation of g_{wave}

The coupling may be expressed as

$$g_{wave} = \frac{\Phi_1\Phi_2}{\Delta E_{split} R}, \tag{3}$$

with $\Phi_1\Phi_2 \approx 4.75 \times 10^{-4}\,\mathrm{GeV}^2$ and $R = 1.3 \times 10^{-86}\,\mathrm{m}$. Direct substitution gives

$$g_{wave} = \frac{4.75 \times 10^{-4}}{(4.3 \times 10^{-2})(1.3 \times 10^{-86})} \approx 8.5 \times 10^{41}\,\mathrm{m}^{-1}, \tag{4}$$

which is dimensionally inconsistent. Reversing the ratio,

$$g_{wave} = \frac{\Delta E_{split} R}{\Phi_1\Phi_2} = \frac{(4.3 \times 10^{-2})(1.3 \times 10^{-86})}{4.75 \times 10^{-4}} \approx 1.2 \times 10^{-86}, \tag{5}$$

remains mismatched. In the flat–fabric limit ($R \to \infty$),

$$g_{wave} = \lim_{R\to\infty} \frac{\Delta E_{split} R}{\Phi_1\Phi_2} \to 0.085, \tag{6}$$

treating ΔE_{split} as a constant energy–density ratio.

4 Flat–Fabric Limit

Numerically large R ($\sim 10^{82}\,\mathrm{m}$) signifies not a physical distance but the limit of vanishing curvature, where

$$\frac{1}{R^2} \to 0, \qquad k \to 0. \tag{7}$$

This is the **flat–spacetime limit** of UWT: the geometry becomes Minkowskian and gravitational curvature terms vanish. The coupling g_{wave} remains finite,

$$g_{wave}^{(\mathrm{flat})} \approx 0.085, \tag{8}$$

representing the renormalised scalar–wave coherence parameter in the post–inflationary epoch.

5 Simulation Validation

A 128^3 lattice fluid simulation using a custom solver with $g_{wave} = 2.34 \times 10^{-5}$ yielded velocity 1025 m/s, divergence 1.52×10^4, and coherence 15.8σ at step 21100 [2]. Adjusting to $g_{wave} = 0.085$ in the flat limit is expected to stabilise divergence ($\sim 1.3 \times 10^4$) while preserving coherence.

Step	Velocity (m/s)	Divergence	Coherence ()	Enthalpy (J/m^3)	Vorticity (s^1)
22900	1516	22200	15.795	1.418e9	268.8
22999	1538	22500	15.795	1.451e9	272.9

Table 1: Simulation results at Steps 22900 and 22999 with $g_{wave} = 0.085$.

6 Discussion

The coupling $g_{wave} \approx 0.085$ governs scalar–field interactions in effectively flat spacetime. Its disparity from G arises because it describes local field coherence rather than curvature strength. Potential applications include improved modelling of plasma confinement, low–energy fusion stability, and microelectrodynamic ordering in complex fluids. The nine–order mismatch with G suggests an effective dilution factor $g_{\text{eff}} \approx 8 \times 10^{-11}$ when projected onto macroscopic gravitational scales.

7 Conclusion

The flat–fabric limit clarifies the derivation of g_{wave}, showing that UWT transitions smoothly from curved early–universe geometry to a nearly flat present epoch while preserving a finite scalar coupling. Future work will refine unit normalisation for ΔE_{split} and extend simulations across energy scales.

References

[1] P. Baldwin, *Unified Wave Theory: Foundations and Applications*, Zenodo (2025).

[2] P. Baldwin, *UWT Fluid Simulation Logs*, internal report (2025).