# Gravitational Waves Are All You Need: A Conceptual Framework for the Emergence of Matter from Self-Interacting Spacetime Waves

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#### Abstract

In this paper, I propose a minimal framework for describing all physical phenomena — matter, energy, and spacetime itself — as emergent properties of self-interacting gravitational waves. Drawing inspiration from computational models such as Conway's Game of Life, I argue that a sufficiently complex wave system, governed by local interaction rules, can give rise to Turing-complete dynamics capable of simulating any physical process. This approach removes the need for additional constructs such as particles, fields, or extra dimensions. Instead, matter is understood as stable patterns of wave interference within spacetime itself. I outline the conceptual basis of this framework, address potential objections, and suggest pathways for future mathematical modeling and experimental exploration.

#### 1 Introduction

Physics has historically progressed by reducing complex phenomena to simpler underlying principles. In this spirit, I propose a radical simplification: that gravitational waves, interacting within spacetime, are sufficient to describe all known physical phenomena.

This approach draws parallels with computational universes, where simple local rules can produce complex and emergent behavior. Conway's Game of Life demonstrates that universal computation can arise from minimal conditions.

# 2 Computational Universes and Self-Interacting Waves

A computational system requires:

• Self-interaction or local state dependence

• Rules governing the evolution of states

Gravitational waves, as distortions of spacetime, naturally possess these properties. If these waves interact non-linearly and can store information in stable interference patterns, then matter and energy could emerge as a consequence of wave dynamics alone.

#### 3 Matter as Stable Wave Structures

I propose that particles are stable wave configurations, analogous to resonance in confined systems. Just as a box of photons can exhibit mass due to internal energy, matter may be a self-sustaining interference pattern of spacetime waves.

This model explains:

- Why mass distorts spacetime (it is spacetime structure itself)
- Why energy is equivalent to mass (waves storing movement)
- Why matter appears stable (robust wave configurations)

## 4 Addressing Objections

### 4.1 Michelson-Morley Experiment

This experiment disproved the classical ether but does not contradict a dynamic spacetime interpretation consistent with general relativity. In my framework, waves propagate within spacetime without requiring a fixed medium.

#### 4.2 Origin of Waves

I acknowledge that the origin of these waves remains unknown. However, this is consistent with other models that also leave the question of initial conditions open (e.g., Big Bang cosmology).

# 5 Predictions and Applications

- Dark matter as alternative stable wave ecosystems
- Radioactivity as frequency instability within confined wave structures
- Energy release as wave deconfinement

Future work could involve simulations demonstrating how simple interacting waves can form stable, particle-like structures.

# 6 Conclusion

I have outlined a conceptual framework in which gravitational waves alone can account for the emergence of matter, energy, and physical laws. This bottom-up approach minimizes assumptions and aligns with known physical phenomena. Future research should focus on developing mathematical models and simulations to test the feasibility of this hypothesis.

#### 7 References

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