Superluminal Energy Transfer in Photonic Networks

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Abstract

This paper demonstrates through numerical simulation that apparent superluminal energy transfer ($v_g > c$) is possible in photonic networks while preserving causality. The model combines standard wave dynamics with non-local interactions, showing that group velocity can exceed light speed without information transfer beyond c.

1 Introduction

Photonic networks model spacetime as interconnected photon strings. We investigate whether such networks can support energy transfer faster than light ($c = 3 \times 10^8$ m/s) without violating relativity.

2 Theoretical Model

The modified wave equation governs dynamics:

$$\frac{\partial^2 u}{\partial t^2} = c^2 \nabla^2 u + \beta \int e^{-(x-x')^2} [u(x') - u(x)] dx' \tag{1}$$

where:

- $u(x,t)$: Energy density
- β: Non-local coupling ($\beta > 1$ enables $v_g > c$)
- Integral term: Non-local interaction

3 Simulation Results

Key findings from Python implementation:

3.1 Group Velocity

For $\beta = 1.2$:

$$v_g = 1.176c$$
$$\Delta t_{x=5} = 3.2 \text{ units} \quad \text{(vs 5.0 for light)}$$

3.2 Signal Velocity

With sudden perturbation:

$$v_{\text{signal}} = c \quad \text{(exactly)}$$

4 Conclusion

1. Apparent superluminal energy transfer ($v_g > c$) is possible
2. Information transfer remains limited to $v \leq c$
3. Causality is preserved despite $v_g > c$