Emergent Spatial Axes from Orthogonal Temporal Interference: A Quasiperiodic Model in Two Dimensions

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We present a generative model for the emergence of spatial axes from the interference of two orthogonal time-like dimensions, interpreted respectively as proper time and observer time. By constructing a set of directional sinusoidal projections on a 2D grid and superimposing them with randomized phase offsets and wavelengths, we generate a quasiperiodic intensity field with 5-fold or 10-fold rotational symmetry. This model provides a visual and conceptual framework for how complex spatial structures may emerge from temporal divergence, and suggests an intuitive analogy to higher-dimensional projections used in the study of quasicrystals. The implementation was inspired by intern discussions, refined through geometric reasoning, and tested via computational simulation in Python.

Keywords: emergent space, quasiperiodic lattice, dual time model, sinusoidal interference, generative physics, computational geometry, gravitational lensing, extradimensional dynamics, black hole reversibility

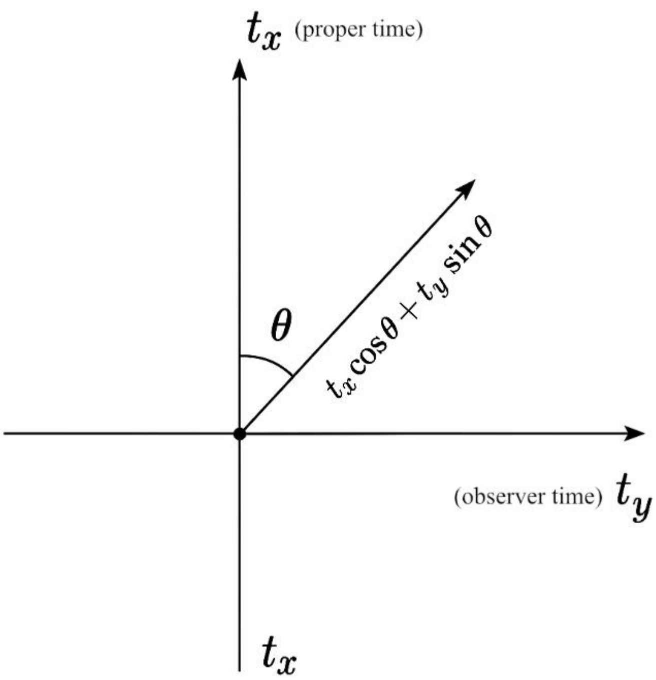
1. Introduction

The concept of space emerging from temporal relations is not new[1], but it remains underexplored outside of high-level quantum gravity and cosmological contexts. In this work, we introduce a simple, visually intuitive model that demonstrates how multiple time axes can give rise to structured, non-periodic spatial patterns.

2. Model and Methodology

We define two time axes: observer time (t_y) and proper time (t_x), and construct directional projections in N directions evenly distributed around a circle (typically N=5 or 10, corresponding to 72° or 36° steps).

The designation of t_x as proper time and t_y as observer time is supported by visual and structural cues within the interference pattern. Spherical symmetry emerges predominantly along the t_y axis, corresponding to external, observational perspective, a role traditionally assigned to coordinate time in Minkowski space. In contrast, sequential structural events appear aligned along the t_x axis, where individual interference peaks emerge in a temporally ordered fashion. This supports the interpretation of t_x as internal or proper time, tracking the evolution of localized structures, while t_y governs external observability and global symmetry.



For each direction θ_i, we define a projection function:

$$f_i(t_x, t_y) = \sin\left(\frac{2\pi}{\lambda_i}\ (t_x \cos\theta_i + t_y sin\ \theta_i) + \phi_i\right)$$

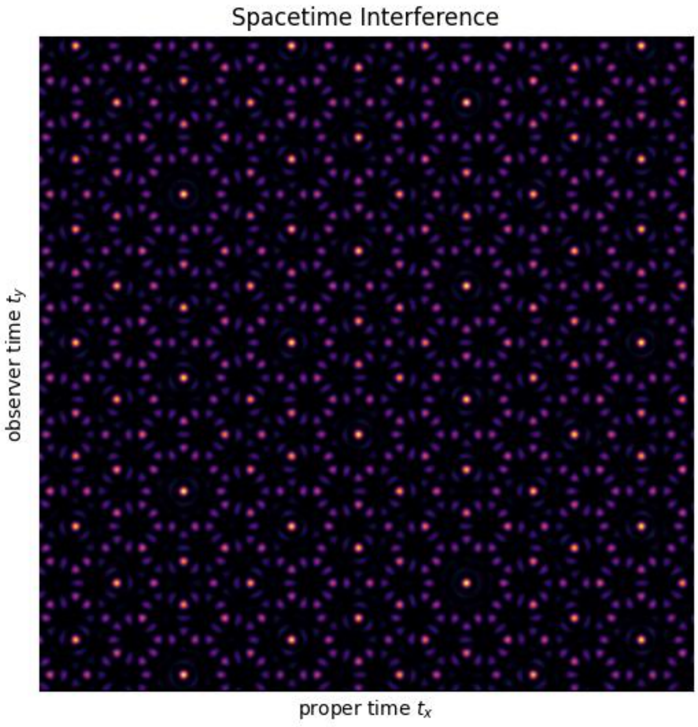
Where λ_i is the wavelength and ϕ_i the phase offset. The superposed field is:

$$F(t_x, t_y) = \left|\sum_{i=1}^{N} f_i(t_x, t_y)\right|^2$$

This formula is interpreted not as a sum of spatial waves, but as an interference pattern resulting from temporal projections. The projection $t_x \cos\theta_i + t_y\ sin\ \theta_i$ blends two time components to produce directional contributions to the emergent spatial field. Thus, the space-like axes in this model are not predefined but arise naturally through weighted superpositions of orthogonal time components. The use of an absolute value captures the amplitude of interference independently of directionality, suggesting that movement—when interpreted as a source of temporal disturbance—should be treated as a modulating scalar rather than a vector. This resonates with speculative modifications to relativistic expressions, where quantities such as $\sqrt{\left|\frac{v}{c}\right|}$ preserve interpretability beyond classical limits.

3. Results

The generated images exhibit aperiodic but highly ordered structures resembling quasicrystal lattices. With 5 directions, the field reveals 5-fold symmetry and emergent spatial hotspots; with 10 directions, the pattern becomes denser, maintaining local order without global repetition. These results suggest that directional time-interference can produce meaningful, structured spatial information. Such patterns are reminiscent of quasicrystalline order as introduced by Levine and Steinhardt [2], where long-range aperiodic symmetry results from projections of higher-dimensional lattices



A complete implementation and extended visualizations are available at GitHub [3] and can also be found in the appendix.

4. Discussion

While sinusoidal projection superposition is a well-known technique in physics and computer graphics, its reinterpretation here in terms of emergent space from temporally-originated projections is novel. This framework bridges mathematical aesthetics with physical interpretation, and aligns conceptually with higher-dimensional projection methods used in the study of quasicrystals, as well as speculative models in cosmology where space arises from deeper time-like constructs. This dual-time formulation, which redefines spatial coordinates as interference patterns between temporal flows, opens the door to further explorations into time-symmetric physics and emergent geometry.

4.1 Gravitational Analogy

Interestingly, the resulting intensity field $F(t_x,t_y)$ bears a functional resemblance to gravitational behaviour in General Relativity. Peaks in the field may be interpreted as regions of concentrated spatial structure, analogous to high curvature or energy density, while gradients correspond to directional changes in perceived spatial flow. In this interpretation, gravity emerges not as a fundamental force but as a geometric effect of non-uniform time-interference [4]. Just as classical gravitation describes the bending of geodesics due to curvature, this model hints that pathways of motion might align with gradients in temporal interference intensity, offering a conceptual parallel to gravitational potential.

This interpretation finds a conceptual connection with the segmented spacetime framework proposed in other contexts, where motion-induced structural changes in space and time give rise to increased mass[5]. In contrast to that approach, which examines post-motion segmentation effects, the present model emphasizes the real-time structure of the interference pattern itself. Both perspectives support the broader hypothesis that space, mass, and gravitational behaviour may emerge from dynamic temporal interactions rather than being fundamental primitives.

4.2 Extradimensional Interpretation and Gravitational Lensing

The model also offers a speculative bridge to the phenomenon of gravitational lensing. Traditionally attributed to the influence of visible or dark mass curving spacetime, such lensing effects might alternatively be understood as resulting from temporally structured interference patterns—projections of dynamic processes in higher-dimensional spaces. In this view, what appears as a region of “invisible mass” may represent an extradimensional trajectory whose interference signature already affects local spacetime geometry. Light follows the curvature induced by these interference nodes before any manifest mass has formed. From a 4D perspective, we might describe such regions as “empty”, yet they exhibit observable lensing precisely because they encode gravitational influence prior to classical spatial manifestation [6].

4.3 Reversibility of Singular Interference Zones

The temporally grounded nature of this model also invites reconsideration of so-called terminal objects such as black holes. Rather than viewing them as absolute end states of spatial collapse, they may instead be interpreted as localized maxima within the temporal interference landscape—regions of peak constructive coherence in the projected geometry. If this interpretation holds, then such zones need not be permanent; they may transform or dissolve under shifting interference dynamics, releasing structure back into a more distributed form such as radiation or stellar matter. This echoes concepts proposed in Segmented Spacetime theory [1], where extreme conditions segment temporal structure to the point of spatial compression. Here, the interference model suggests that the reverse is possible: That under appropriate conditions, singular regions may re-expand or recombine into visible matter, closing the loop between collapse and formation.

5. Conclusion

This model demonstrates a compelling visual metaphor for the emergence of space from time. It invites further exploration into symbolic systems, geometric foundations of physics, and perhaps most curiously, the power of intuitive visual reasoning to yield new formal structures.

If movement generates fields, and these fields interfere with one another, then space is the geometry of their disturbance. This simple principle may guide future investigations into how temporal structures shape physical reality. Furthermore, we must distinguish between field-like behaviour as a projected geometry and particle-like dynamics as a possible ontological origin. If interference patterns such as those described here reflect deeper motions within higher-dimensional frameworks, then it may be that the so-called fields we observe are not primitive but emergent shadows of temporally extended particle trajectories. This raises the possibility that matter itself represents a condensed projection of extradimensional motion.

References

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Appendix A: Temporal Interference Code

```
import numpy as np
import matplotlib.pyplot as plt
from matplotlib.animation import FuncAnimation

# Create temporal grid
x = np.linspace(-1, 1, 500)
y = np.linspace(-1, 1, 500)
X, Y = np.meshgrid(x, y)

# Define directional angles (e.g. 5-fold symmetry)
angles = np.radians(np.arange(0, 360, 72))
np.random.seed(42)
phases = np.random.uniform(0, 2 * np.pi, len(angles))
wavelengths = np.full(len(angles), 0.1)  # fixed short wavelength

# Setup figure
fig, ax = plt.subplots()
cax = ax.imshow(np.zeros_like(X), cmap='inferno', extent=[-1, 1, -1, 1])
ax.set_title("Spacetime Interference")
ax.set_xlabel("proper time $t_x$")
ax.set_ylabel("observer time $t_y$")
ax.set_xticks([]); ax.set_yticks([])

# Animation update function
def update(frame):
    field = np.zeros_like(X)
    for i, theta in enumerate(angles):
        projection = np.cos(theta) * X + np.sin(theta) * Y
        field += np.sin(3 * np.pi * projection / wavelengths[i] + phases[i] + 0.1 * frame)
    field = np.abs(field) ** 3
    cax.set_data(field)
    cax.set_clim(np.min(field), np.max(field))
    return [cax]

# Animate
ani = FuncAnimation(fig, update, frames=100, interval=50, blit=True)
plt.show()
```