Title : High-Frame-Rate Imaging of Light Propagation over Macroscopic Distances
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Abstract

This thought experiment explores the hypothetical observation of light propagation along a 300,000 km planar surface. A futuristic camera with 300,000 fps and 100,000-pixel resolution records the event. Each frame captures the light pulse advancing approximately 1 km, allowing visualization of light in motion over macroscopic distances. This conceptual experiment demonstrates the finite propagation of light in a slow-motion frame-by-frame manner.

1. Introduction & Motivation

Light is traditionally considered instantaneous at human scales, but high-speed imaging can reveal its finite propagation. MIT femtophotography has shown light-in-motion over millimeter scales. This experiment extends that idea to macroscopic distances using a hypothetical camera.

2. Assumptions

Plane length: 300,000 km

Light speed: 3 × 10^5 km/s

Camera: 3 × 10^5 fps, 100,000 pixels resolution

Observation: light emitted at one end at t = 0

3. Framewise Calculation

$$\text{Distance per frame} = \frac{300,000\ \text{km}}{300,000\ \text{frames}} = 1\ \text{km/frame}$$

Each frame shows light moving 1 km forward.

4. Expected Observation

Light appears advancing 1 km per frame in the recorded video.

Human eyes cannot perceive this without ultra-high-speed recording.

Conceptually, this shows frame-by-frame visualization of light's finite propagation.

5. Limitations

1. Practical cameras with these specifications do not exist.

2. Pixel resolution limits detail (~3 km/pixel).

3. Relativity and causality constraints are idealized.

4. Atmospheric or medium effects ignored.

6. Relation to Prior Work

MIT femtophotography (2009–2010) captured light in motion using streak cameras at millimeter distances.

This is a macroscopic thought experiment extension.

7. Conclusion & Priority Claim

Light can be visualized moving 1 km per frame over a macroscopic plane.

Conceptual idea formulated and recorded by Sunil Singh Rawat, 24 October 2025.

Figure : Schematic Diagram