Abstract

This note develops a structural account of light as a maximal admissible mode of propagation, derived from minimal assumptions of locality, global coherence, and admissible continuation. The treatment is ontology-agnostic and does not presuppose spacetime, fields, or particle dynamics. It is intended as a focused extension of the broader framework developed in the main paper by Elad Genish, where admissibility-based persistence and non-closure are introduced as primitive organizing principles. The ideas presented here are consistent with, and supported by, realizability results obtained in the RNSE system, which serves as an existence proof that the underlying structural constraints can be instantiated computationally. No specific implementation details are assumed.

Admissible Propagation and the Nature of Light

Primitive Assumptions

We assume the following minimal structural principles:

1. **Locality.** State updates occur through local interactions; no instantaneous global updates are permitted.
2. **Global Coherence.** Not all local transitions are admissible; global consistency constraints restrict allowable evolutions.
3. **Continuity of Admissible Evolution.** From any admissible state, at least one admissible continuation exists.

These assumptions impose no specific physical ontology and make no reference to spacetime, fields, or particles.

Admissible Propagation

Let $\mathcal{S}$ denote the space of system states. For each $s \in \mathcal{S}$, let $\mathcal{A}(s) \subset \mathcal{S}$ denote the set of admissible continuations of s.

A *disturbance* is defined as a localized deviation δs from a reference state s.

A *propagation mode* is a mapping

$$\Phi : (s, \delta s) \mapsto (s', \delta s')$$

such that $s' \in \mathcal{A}(s)$ and global coherence is preserved.

Existence of a Maximal Propagation Speed

Proposition 1. *If locality and global coherence both hold, then there exists a finite maximal admissible propagation speed* $v_{\max}$.

Sketch. Instantaneous propagation would violate locality. Unbounded but finite propagation would prevent consistent enforcement of global coherence, leading to incompatible dependency orderings among coupled local updates. Therefore, admissibility requires a finite upper bound on propagation speed. □

Thus, admissible propagation satisfies

$$0 < v \leq v_{\max}.$$

Definition of Light

Definition 1. ***(Light)*** *Light is the class of admissible disturbances that propagate at the maximal allowed speed* $v_{\max}$ *while preserving global coherence.*

This definition does not presuppose wave or particle ontology.

Invariance of the Maximal Speed

Proposition 2. *The maximal propagation speed* $v_{\max}$ *is invariant across all admissible frames of description internal to the system.*

Sketch. Any frame admitting propagation faster than $v_{\max}$ violates admissibility. Any frame that enforces a lower universal bound while claiming completeness of admissible evolution is incomplete. Thus, $v_{\max}$ is invariant across all admissible internal descriptions. □

Relation to Physical Theories

In relativistic physics, the constant c realizes $v_{\max}$. Maxwellian dynamics provide one realization whose characteristic propagation speed saturates this bound. Massless fields correspond precisely to disturbances whose evolution lies on the admissible frontier.

This formulation does not derive specific field equations but explains the structural necessity of a universal propagation limit.

Curvature and Gravitational Effects

If admissibility depends on global structure, then admissible propagation paths vary with that structure. Disturbances propagating at $v_{\max}$ necessarily follow these admissible paths, yielding curvature effects without invoking force-based dynamics.

Summary

Light is not a primitive substance but a universal propagation mode: the maximal-rate admissible traversal of localized disturbance consistent with global coherence.