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A Charge-Lattice–Based Deterministic Model for the Origin, Propagation, and Zero Rest Mass of the Photon

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A Charge-Lattice–Based Deterministic Model for the Origin, Propagation, and Zero Rest Mass of the Photon

Kuldeep Singh Meel

Independent Researcher, Bhadra, Hanumangarh, Rajasthan, India; kuldeepjaat402@gmail.com

Abstract

In this work, a deterministic charge–lattice–based model is presented to explain the origin of the photon, its invariant propagation speed, and its zero rest mass. In contemporary physics, the photon is commonly interpreted through field-based descriptions or the framework of wave–particle duality [1]. However, such approaches do not provide a clear mechanical explanation for the absence of rest mass in the photon, nor do they offer a physical origin for the universal constancy of the speed of light, which is typically treated as a postulate [2]. Within the proposed framework, all physical structures emerge from the lattice organization of only two fundamental entities: positive charge units (+) and negative charge units (−). Mass is not regarded as a fundamental property, but rather as an emergent consequence of binding between positive and negative charge units. The photon is described as a pure positive-charge excitation in which negative charge units are entirely absent. As a result, no binding energy is generated, leading naturally to zero rest mass. Photon propagation is not attributed to wave-like behavior or field oscillations, but instead arises from deterministic motion governed by a universal charge-lattice attraction. Consequently, the speed of the photon is independent of the motion of the source or observer and is fixed by the global structure of the charge lattice itself. In this view, the constancy of the speed of light is not an imposed assumption, but a direct physical outcome of charge-lattice dynamics. This model eliminates the need for wave–particle duality, spacetime curvature, and probabilistic interpretations in describing photon behavior, and provides a coherent, mechanical, and testable foundation for understanding light, mass, and motion.

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1. Introduction

The photon is one of the most fundamental yet conceptually ambiguous entities in modern physics. On one hand, it is regarded as the carrier of electromagnetic phenomena, while on the other, it is defined as a particle with zero rest mass. In prevailing physical theories, the photon is primarily described through field-based equations, wave concepts, and the framework of wave–particle duality. Although these approaches are mathematically successful, they do not provide a clear physical or mechanical explanation for the absence of rest mass in the photon, nor do they offer a concrete physical origin for the universal constancy of its propagation speed.

In particular, the concept of wave–particle duality assumes that the photon behaves as a wave or as a particle depending on the experimental context. This viewpoint is not only philosophically contradictory, but also physically incomplete, as it fails to specify any mechanical process by which a single entity transitions between fundamentally different modes of existence. Similarly, the invariance of the speed of light is treated in modern theories as a fundamental postulate, rather than as a direct consequence of an underlying physical structure.

The root of these limitations lies in the fact that conventional frameworks either treat the photon as an independent wave-like entity or accept it as a massless particle by assumption. Such descriptions leave unanswered the more fundamental questions of what mass actually is, under what conditions it emerges, and why the photon is naturally devoid of it.

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The present work addresses these issues through a *deterministic charge–lattice–based framework*. Within this approach, it is postulated that all physical structures arise solely from the organizational dynamics of two fundamental entities: *positive charge units* $(+)$ and *negative charge units* $(-)$. Mass is not regarded as an intrinsic or fundamental property, but rather as an emergent physical quantity arising from binding interactions between positive and negative charge units.

From this perspective, the nature of the photon appears in a fundamentally different form. The photon is described as a structure composed exclusively of positive charge units, with a complete absence of negative charge units. Since the emergence of mass depends on binding between positive and negative charges, the absence of such binding leads naturally and inevitably to zero rest mass. In this way, the massless nature of the photon is not an imposed assumption, but a direct and unavoidable consequence of the charge–lattice structure.

Within the same framework, photon propagation is not attributed to wave oscillations or field vibrations. Instead, the motion of the photon is understood as a deterministic dynamical process governed by a global charge–lattice attraction. This interpretation explains why the speed of the photon is independent of the motion of the source or the observer, and why it remains invariant across all inertial frames. The speed of light thus emerges not as a postulate, but as a physical outcome determined by the universal structure of the charge lattice.

Consequently, the present work provides a unified, mechanical, and testable physical foundation for the origin of the photon, its zero rest mass, and its invariant propagation speed. By eliminating the need for wave–particle duality and probabilistic interpretations, this framework redefines the foundational understanding of light, mass, and motion within a deterministic physical paradigm.

2. Foundational Physical Assumptions

Any physical theory of the photon must provide clear answers to three fundamental questions: (i) what is the origin of mass, (ii) by what physical mechanism does the photon propagate, and (iii) why does the speed of light remain universally invariant. In conventional physics, these questions are addressed through field theories, wave–particle duality, and relativistic postulates [3]. Although these frameworks are experimentally successful, they do not offer a direct mechanical explanation for the zero rest mass of the photon or for the physical origin of its speed invariance.

The present work is constructed on a minimal, deterministic, and physically grounded foundation, deliberately avoiding probabilistic interpretations and abstract field constructs. Within this approach, photon physics is reformulated in terms of charge organization rather than wave dynamics.

2.1. Charge–Lattice as the Fundamental Physical Structure

The central assumption of this model is that all physical structures in the universe arise solely from the spatial and dynamical organization of two fundamental entities: *positive charge units* $(+)$ and *negative charge units* $(-)$. No independent fields, carrier particles, or spacetime substrates are introduced as fundamental entities. This viewpoint differs from standard quantum electrodynamics, where the electromagnetic field is treated as a fundamental object and the photon is defined as its quantized excitation [4].

In the charge–lattice framework, physical reality is not field-dominated but structure-dominated. All observable properties emerge from how positive and negative charge units arrange themselves, bind, and propagate within a global lattice.

2.2. Emergent Nature of Mass

A key assumption of this theory is that mass is not an intrinsic property of an isolated entity. Instead, mass emerges exclusively from binding interactions between positive and negative charge units. Whenever such binding exists, energy localization occurs, giving rise to inertia and rest mass. This perspective contrasts with the Standard Model tradition in which mass is treated as a fundamental parameter assigned to particles [5].

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Within this framework, the problem of photon mass is no longer independent. If a structure completely lacks negative charge units, no binding interaction can occur, and consequently, no rest mass can emerge.

2.3. Photon as a Pure Positive-Charge Excitation

In the present framework, the photon is defined as a dynamical excitation composed exclusively of positive charge units, with a complete absence of negative charge units. As a result, no charge binding is possible within the photon, and its rest mass is necessarily zero. This conclusion does not rely on gauge symmetry or mathematical constraints, as commonly invoked in quantum field theory [5], but follows directly from the physical structure of the system.

Thus, the massless nature of the photon is not an imposed assumption or definition, but a natural and unavoidable consequence of the charge–lattice organization.

2.4. Deterministic Propagation and Invariance of the Speed of Light

In this model, photon propagation is assumed to occur under a global charge–lattice attraction that operates uniformly throughout the universe. The motion of the photon is therefore deterministic and does not arise from wave oscillations or probabilistic field amplitudes. This provides a physical explanation for why the photon's speed is independent of the motion of the source and the observer, a fact that is traditionally treated as a fundamental postulate in special relativity [2].

Consequently, the invariance of the speed of light is not a kinematic assumption but a structural outcome of the universal charge–lattice configuration.

2.5. Rejection of Wave–Particle Duality

Finally, this framework explicitly rejects wave–particle duality as a fundamental principle. Wave-like behavior observed in optical and quantum experiments is interpreted as a statistical and geometric manifestation of deterministic motion of positive charge units, rather than evidence for an intrinsic wave nature of the photon. Although similar critiques of quantum interpretation have been raised in foundational studies [6], they have generally lacked a concrete mechanical alternative.

The charge–lattice approach fills this gap by replacing dualistic descriptions with a single, physically defined and unified mechanism.

3. Origin of the Photon

In this section, the first origin of the photon in the universe is presented as a fully physical, deterministic, and charge–lattice–based process. Within this framework, the photon does not arise from wave excitation, field oscillation, or any pre-existing luminous medium. Instead, it emerges as an unavoidable consequence of charge reconfiguration occurring during the first nuclear fusion event. In this single physical process, the first neutron, the first deuterium nucleus, and the first photon are generated simultaneously.

3.1. Initial State: Two Independent Hydrogen Atoms

In the early universe, the only stable atom available was hydrogen. Each hydrogen atom is represented in this theory by a discrete charge–lattice structure.

3.1.1. Structure of the Hydrogen Atom

Proton (nuclear structure):

$$\begin{array}{ccc} + & - & + \\ - & + & - \\ + & - & + \end{array}$$

This structure shows that the proton contains a total of five positive ($+$) charge units and four negative ($-$) charge units. The excess positive charge constitutes the net positive electric charge of the proton.

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Electron (orbital):

$$-$$

Thus, a single hydrogen atom contains:

$$5(+) + 5(-) = 10 \text{ charge units.}$$

3.1.2. Total Initial Charge Count

For two independent hydrogen atoms:

$$H_1 : (5+, 5-), \qquad H_2 : (5+, 5-).$$

Hence, the total initial count is:

$$10(+) + 10(-) = 20 \text{ charge units.}$$

3.2. Fusion State: Complete Charge Reconfiguration

As the universe evolves, hydrogen atoms aggregate into large, dense spherical assemblies. When two hydrogen atoms approach sufficiently close, they can no longer remain stable as independent entities. In this state:

- both atoms attempt to establish a shared energy–equilibrium configuration,
- electrons, protons, and all charge components actively participate,
- the process is not merely nuclear but constitutes a complete atomic-scale charge reconfiguration.

This transient state provides the physical conditions necessary for structural transformation.

3.3. Transformation of a Proton into a Neutron

The combined charge–lattice system seeks a minimum-energy configuration. During this process:

- one electron from a hydrogen atom becomes incorporated into the charge–lattice of a proton,
- the internal charge arrangement of that proton is inverted into a balanced configuration.

As a result, the proton transforms into a neutron.

3.3.1. Neutron Structure

$$\begin{matrix} - & + & - \\ + & - & + \\ - & + & - \end{matrix}$$

This structure indicates that the number of positive charge units in the neutron equals the number of negative charge units present in the proton, and the number of negative charge units equals the number of positive charge units in the proton. This inverted charge–lattice balance neutralizes the net nuclear charge, yielding zero electric charge. This charge reconfiguration constitutes the physical origin of the neutron.

3.4. Formation of Deuterium

The system now contains:

- one proton,
- one neutron.

These bind through charge–lattice attraction to form a stable nuclear structure, the deuterium nucleus.

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3.4.1. Deuterium Nuclear Structure

Proton component:

$$\begin{matrix} + & - & + \\ - & + & - \\ + & - & + \end{matrix}$$

Neutron component:

$$\begin{matrix} - & + & - \\ + & - & + \\ - & + & - \end{matrix}$$

3.4.2. Deuterium Atom

In the deuterium atom:

- the nucleus consists of one proton and one neutron,
- one electron remains in orbital motion around the nucleus, ensuring atomic stability.

This orbital electron is distinct from the electron incorporated into the neutron structure.

3.5. Decisive Change in Charge Count (20 → 19)

The charge count now becomes decisive.

Initial state:

$$20 \text{ charge units} = 10(+) + 10(-).$$

After fusion:

- one electron is incorporated into the neutron structure,
- one electron remains in orbit around the deuterium nucleus,
- the stable deuterium configuration contains a total of 19 charge units.

Thus, one positive $(+)$ charge unit remains unbound.

3.6. First Origin of the Photon

This excess positive charge unit:

- cannot bind with any negative charge unit,
- is released to maintain global charge equilibrium,
- becomes dynamically free under universal negative charge attraction.

Since this free structure contains no negative charge units:

$$N_- = 0,$$

and since mass in this framework arises only from positive–negative charge binding, its rest mass is zero.

This free positive charge unit is the first photon of the universe.

3.7. Co-Generation Principle

In a single physical process, the following entities are co-generated:

- a proton transforms into a neutron,
- a proton and neutron bind to form deuterium,
- an excess positive charge unit is released as a photon.

Light, therefore, is not a primordial ingredient of the universe, but an inevitable physical consequence of the first nuclear organization of matter.

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4. Propagation of the Photon

In this section, photon propagation is described as a deterministic, structural, and fully physical process. Within the present framework, the motion of the photon does not arise from wave oscillations, field propagation, or probabilistic behavior. Instead, it is the inevitable dynamical state of a free positive charge unit moving within the global charge lattice. The masslessness of the photon, its straight-line motion, and the invariance of its speed all originate from the same physical cause.

4.1. Fundamental Structure and Dynamical Freedom of the Photon

As established in the previous section, the photon consists of a single positive $(+)$ charge unit that is not bound to any negative $(-)$ charge unit. Since, in this framework, mass arises exclusively from binding between positive and negative charge units, the absence of binding implies that the photon possesses zero rest mass.

The absence of binding endows the photon with two essential properties:

1. **Absence of inertia**: the photon does not require any internal mechanism to maintain its motion.
2. **Dynamical freedom**: the photon is not confined to any local structure and moves freely within the charge lattice.

4.2. Direction of Photon Motion in the Charge Lattice

The charge lattice is a global structure in which negative charge units are statistically distributed in a uniform manner. When a free positive charge unit exists within this structure, it experiences a resultant attraction due to the surrounding negative charge distribution.

This resultant attraction:

- is not arbitrary in direction,
- acts along the path of minimum resistance within the charge lattice.

As a consequence, photon propagation occurs along a straight line. This rectilinear motion is not a consequence of inertial laws, but rather a direct outcome of the geometric symmetry of the charge lattice.

4.3. Invariance of the Photon Velocity

Within this framework, the velocity of the photon does not depend on the motion of the source, the observer, or the conditions of emission. This is because:

- at the moment of its creation, the photon becomes completely independent of its source,
- thereafter, its motion is governed solely by the global charge–lattice attraction.

Since the charge lattice exists uniformly throughout the universe, the speed of the photon remains universally invariant. The constancy of the speed of light is therefore not a postulate, but an inevitable physical consequence of the global charge–lattice structure.

4.4. Relationship Between the Photon and Energy

In the present theory, energy is not treated as an independent physical entity, but as a manifestation of dynamical state. The energy associated with a photon arises from the dynamical configuration of its positive charge unit and its interaction with the charge lattice.

From this perspective:

- the photon is not a carrier of energy,
- rather, it represents the observable manifestation of energy itself.

The magnitude of photon energy is determined by its dynamical intensity and the local properties of the charge lattice, not by wave frequency or field amplitude.

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4.5. Structural Origin of Wave-Like Phenomena

The wave-like behavior observed in photon-related experiments is not interpreted as evidence of an intrinsic wave nature. Instead, such behavior arises from:

- the collective motion of many photons,
- their statistical interaction with the charge lattice,
- and the geometric constraints of measurement.

Wave-like patterns therefore reflect a distributional effect rather than a fundamental property of the photon.

4.6. Summary of Photon Propagation

In summary, photon propagation in this model is governed by the following principles:

- absence of mass $\rightarrow$ absence of inertia,
- absence of binding $\rightarrow$ complete dynamical freedom,
- global charge lattice $\rightarrow$ fixed direction and invariant speed.

Photon propagation does not occur through a wave-supporting medium, but represents the inevitable dynamical state of a free positive charge unit within the charge lattice.

5. Zero Rest Mass of the Photon

In this section, the zero rest mass of the photon is established not as a postulated assumption, definitional choice, or mathematical constraint, but as an unavoidable physical consequence of the charge–lattice structure. Within the present framework, mass is not regarded as a fundamental property of a particle; rather, it emerges as a structural quantity arising from stable binding between positive and negative charge units.

5.1. Physical Definition of Mass

In the charge–lattice framework, the existence of mass requires the simultaneous fulfillment of the following conditions:

1. the presence of both positive $(+)$ and negative $(-)$ charge units,
2. a stable and persistent binding between these charge units,
3. localization of energy resulting from this binding.

Mass is therefore neither an intrinsic attribute of a particle nor an independent physical entity. Instead, it is a consequence of the structural intensity and stability of charge binding. In the absence of such binding, no physical basis for mass exists.

5.2. Photon Structure and Absence of Charge Binding

As established in the previous sections, the photon consists of a single positive $(+)$ charge unit that is not bound to any negative $(-)$ charge unit. Consequently, the photon structure exhibits:

- no positive–negative charge pairing,
- no stable charge–lattice binding,
- no localization of energy.

As a result, the necessary physical conditions for the emergence of mass are absent in the photon.

5.3. Necessary Consequence: Zero Rest Mass

Since, within this framework, mass can arise only from positive–negative charge binding, and since the photon structure satisfies

$$N_{-} = 0,$$

the rest mass of the photon follows necessarily as

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$$M_0 = 0.$$

This result does not rely on gauge symmetry, theoretical constraints, or mathematical necessity, but follows directly from the physical charge structure of the photon itself.

5.4. Absence of Inertia and Dynamical Implications

The absence of mass implies the absence of inertia. For the photon:

- there exists no resistance to changes in velocity,
- a state of rest cannot be physically sustained,
- existence is inherently defined as a continuous dynamical state.

Thus, the concept of a rest frame for the photon is physically meaningless within this framework.

5.5. Connection Between Masslessness and Velocity Invariance

The zero rest mass of the photon and the invariance of its velocity are not independent properties but are direct consequences of the same structural origin. Due to the absence of charge binding and inertia:

- photon motion is not affected by local energy exchange,
- its velocity is independent of the state of the source or observer,
- its dynamical behavior is governed solely by the global charge–lattice structure.

Accordingly, the constancy of the speed of light is not a postulate but a physical consequence of photon masslessness within the charge–lattice framework.

5.6. Structural Departure from Conventional Interpretations

In standard physical theories, the zero mass of the photon is often attributed to gauge symmetry or theoretical consistency requirements. The present framework does not depend on such abstract arguments. Here, photon masslessness arises neither from mathematical constraint nor from field-theoretic assumptions, but from the direct physical structure of the photon itself.

5.7. Conclusion

Within the charge–lattice model, the zero rest mass of the photon is an inevitable outcome of the following structural facts:

- the complete absence of negative charge units,
- the impossibility of charge binding,
- the absence of energy localization,
- and the resulting absence of inertia.

Photon masslessness is therefore not an assumed property, but an unavoidable physical consequence of the charge–lattice structure.

6. Experimental Implications and Structural Limits of Photon Dynamics

This section presents the experimental implications of the charge–lattice–based photon model and establishes the fundamental structural limits governing photon origin and dynamics. It is shown that the photon is neither a particle that can be locally generated nor an entity whose motion can be described within the framework of classical mechanics. These features arise necessarily from the intrinsic charge structure of the photon and do not represent exceptional behavior.

6.1. Fundamental Limit on Photon Origin

Within the present framework, it is fundamentally established that the origin of the photon is restricted exclusively to charge–reconfiguration processes occurring during nuclear fusion. All photons existing in the universe emerged as a result of such nuclear charge–lattice rearrangements.

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In this model, the photon is not a particle that can be created ex nihilo by any local, laboratory, or atomic process. Consequently, what is conventionally described as "photon emission" in modern experiments does not correspond to the creation of a new particle, but rather to the observable manifestation of a photon that already existed within the charge–lattice structure.

6.2. Physical Role of Atomic Processes

According to the charge–lattice model, atomic-scale processes do not constitute sources of photons. Atoms act only as interaction structures that can release, redirect, or modify the propagation state of photons that originated from nuclear fusion.

Thus, atomic transitions conventionally associated with photon emission represent:

- structural release of a pre-existing photon,
- redirection of its propagation path,
- or reconfiguration of its interaction with the surrounding charge lattice.

Atomic systems therefore do not generate photons but merely render them observable.

6.3. Why the Photon Does Not Obey Classical Laws of Motion

The laws of classical mechanics apply only to particles that satisfy the following conditions:

1. the presence of rest mass,
2. the existence of inertia,
3. motion governed by a force–acceleration relationship.

The photon fails to satisfy all three conditions at a fundamental level. Consequently, classical laws of motion are inapplicable to photon dynamics.

6.3.1. Structural Absence of Mass and Inertia

Within the charge–lattice framework, mass arises exclusively from stable binding between positive and negative charge units. No such binding exists in the photon structure. As a result:

- the photon possesses zero rest mass,
- inertia is entirely absent.

In the absence of inertia, the notion of dynamical response to force loses physical meaning.

6.3.2. Attraction–Controlled Motion Rather than Self–Propelled Motion

Photon motion is not self–propelled in the classical sense. Immediately upon its emergence, the photon enters a state governed by universal charge attraction within the charge lattice. The photon does not "move away" from a source object; rather, its motion is controlled by the surrounding negative charge distribution.

Thus, photon propagation is not initiated by an impulse or push, but by an attraction–governed dynamical state intrinsic to the charge lattice.

6.3.3. Isotropic Attraction and Rectilinear Propagation

The charge lattice exhibits isotropic negative charge attraction. A free positive charge unit, identified as the photon, experiences equal attraction from all directions. Under isotropic attraction, no preferential curvature arises, and the photon propagates along the path of minimal resistance, which corresponds to rectilinear motion.

6.3.4. Loss of Source Dependence After Origin

Once the photon emerges, it retains no physical connection to the object or structure from which it becomes observable. The attraction acting on the photon is universal and source-independent. Consequently, photon motion is unaffected by:

- the motion of the source,
- the properties of the emitting structure.

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6.3.5. Constant Attraction and Constant Velocity

Because the attraction governing photon motion is universal, time-independent, and invariant, the resulting dynamical state is one of constant velocity. For a massless entity, constant attraction necessarily leads to constant propagation speed.

Hence, the constant speed of the photon is not a postulate, but a direct structural consequence of charge–lattice dynamics.

6.4. Experimental Implications

The model predicts that while photon interaction patterns may vary with local charge distributions, the fundamental dynamical properties of the photon—rectilinear propagation and invariant velocity—remain unchanged. These implications distinguish the photon categorically from classical massive particles.

6.5. Concluding Statement

The charge–lattice framework establishes that:

- photons originate exclusively from nuclear fusion,
- atomic processes do not generate photons,
- classical laws of motion are inapplicable due to the absence of mass, inertia, and force–acceleration dynamics.

The photon is not an exception to classical laws of motion; it lies fundamentally outside their domain of applicability.

7. Conclusion

In this work, a charge–lattice–based deterministic model has been presented to explain the origin, propagation, and zero rest mass of the photon. Within this framework, the photon is not treated as a fundamental excitation of a field, a wave entity, or a particle created during local emission processes. Instead, it is identified as a free positive charge unit whose existence and behavior arise from nuclear charge–reconfiguration events.

The model establishes that all photons originate exclusively from nuclear fusion processes, particularly from charge–lattice rearrangements occurring during the earliest stages of nuclear formation. Atomic and laboratory processes do not generate photons; they only render pre-existing photons observable through interaction, release, or redirection within local charge structures.

Photon propagation is shown to be governed by the global charge lattice rather than by classical force–acceleration dynamics. Due to the absence of negative charge binding, the photon possesses zero rest mass and no inertia. Consequently, classical laws of motion are inapplicable. Photon motion is not self-propelled but is controlled by universal, isotropic charge attraction, which leads naturally to rectilinear propagation and invariant velocity.

Within this framework, photon masslessness, constant speed, and loss of source dependence are not postulated assumptions but direct structural consequences of charge–lattice dynamics. The photon is therefore not an exception to classical mechanics, but an entity that lies fundamentally outside its domain of applicability.

By providing a unified physical explanation for photon origin, dynamics, and masslessness without invoking wave duality, field quantization, or probabilistic postulates, the present model offers a coherent alternative perspective on the nature of light. The charge–lattice framework reinterprets photon-related phenomena as outcomes of underlying charge structure rather than abstract mathematical constructs.

In summary, the photon emerges in this theory as a deterministic, structurally defined physical entity whose properties are fixed at the moment of nuclear origin and maintained throughout propagation by the global charge lattice of the universe. This perspective opens a pathway toward reexamining electromagnetic phenomena from a purely structural and deterministic foundation.

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