The NUVO Charge

Part 17 of the NUVO Theory Series

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Abstract

This paper reformulates the nature of electric charge within the scalar-topological framework of NUVO theory. Rather than treating charge as a fundamental property or a source of vector fields, we define it as an open-loop discontinuity in a globally conserved scalar flux—sinertia. Positive and negative charges are interpreted as scalar flux sinks and sources, respectively, forming topological endpoints that induce directional momentum gradients without altering the conformal scalar field $\lambda(x)$.

We show that scalar flux imbalances between charges generate effective forces through coherent sinertia transport, reproducing the behavior of classical electrostatics and electrodynamics without invoking electric or magnetic fields. All charge-based interactions, including attraction, repulsion, and photon emission, arise from geometric reconnection conditions between open-loop structures. Quantization of charge emerges naturally from scalar coherence constraints, and conservation of charge follows from topological pairing rules.

The theory recovers Coulomb's law, Lorentz-like motion effects, and field equation analogues through scalar flux geometry and divergence conditions. Motion-dependent phenomena, including magnetism and radiation, are shown to result from coherent flux compression and directional memory in moving sinertia streams.

This work eliminates the need for dual field constructs by embedding charge within the same scalar coherence architecture that governs mass, curvature, and light. Charge becomes a geometric role—an interface condition within the scalar network of space-providing a unified and physically grounded account of all electric phenomena. This paper constitutes Part 17 of the NUVO Theory Series.

1 Introduction

In the NUVO framework, all physical phenomena arise from scalar-coherent geometry governed by the flow of a conserved quantity known as *sinertia*. This scalar flux shapes the conformal structure of space through closed-loop configurations and enables interaction between matter systems through open-loop structures. Mass, curvature, acceleration, and radiation are no longer treated as separate effects, but as distinct manifestations of the underlying sinertia topology.

This paper presents a scalar-topological formulation of electric charge in NUVO theory, rooted in the geometry of sinertia. Unlike traditional models that introduce electric charge as a fundamental property or as a coupling constant in field theory, NUVO defines charge as a broken sinertia loop—a topological discontinuity in the otherwise closed scalar flux structure. This broken connection forms an open endpoint in scalar space, resulting in directional scalar imbalance that drives acceleration and charge-based interaction.

In this view, a positive charge corresponds to a scalar flux sink: an open-loop endpoint that continuously draws in scalar flux from the surrounding space. A negative charge is a scalar flux source: an endpoint that expels sinertia outward. The surrounding space responds to this open-loop configuration by generating an induced scalar gradient, which causes charged particles to accelerate—mimicking the behavior of the electric field without invoking vector fields or potentials.

Charge in NUVO theory is not an object but a geometric role: a localized topological state in the scalar flow network. This provides a natural explanation for both charge quantization and conservation. Since all sinertia operates through closed-loop conservation, any disruption to this structure—such as a broken loop—must occur in matched pairs. Hence, every appearance of positive charge is accompanied by an equal and opposite negative charge, ensuring global conservation of scalar topology.

Furthermore, because charge corresponds to a persistent scalar flux imbalance, it acts as a conduit for energy transfer through scalar space. When two opposite charges interact, their open-loop structures attempt to rejoin, forming scalar-coherent configurations. When scalar closure is achieved through acceleration or radiation, a photon is emitted as a dynamically closed sinertia loop—a topic developed fully in Part 18 of the NUVO Theory Series.

This paper is Part 17 of the NUVO Theory Series and lays the foundation for understanding charge purely in terms of scalar geometry and sinertia flow. The goal is to replace the field-theoretic abstraction of charge with a physically grounded, topologically constrained picture in which charge arises from loop topology and scalar conservation. Throughout, we emphasize geometric clarity, coherence conditions, and the interaction rules that emerge from scalar flux continuity.

2 Geometric Placement of Charge in NUVO Space

In NUVO theory, the geometry of space is shaped by the flow and conservation of sinertia—a scalar quantity that propagates through and structures the conformal fabric of spacetime. The scalar field $\lambda(x)$ arises from closed-loop sinertia configurations that induce curvature, while open-loop sinertia defines the directional dynamics responsible for interaction and acceleration.

Electric charge emerges within this structure not as a particle property, but as a topological anomaly: a disruption in the otherwise loop-closed sinertia network. It is represented geometrically by an *open endpoint* in scalar flux—an interface through which sinertia either enters or exits the local topology.

2.1 Open-Loop Structures and Charge Polarity

A positive charge corresponds to a persistent scalar flux *sink*. It manifests as an open sinertia connector that continuously draws scalar flow inward. This generates an effective scalar gradient in the surrounding region, attracting other scalar-connected structures (such as negative charges) and accelerating neutral masses via sinertia coupling if the charge is in motion.

Conversely, a negative charge behaves as a scalar flux *source*, emitting scalar flux outward through an open-loop boundary. The scalar field itself remains unmodified by this emission, but the surrounding region becomes permeated by directed sinertia flow. Other nearby charges experience acceleration according to their scalar compatibility and orientation with respect to this open-loop flux. The interaction is topological, not field-based: charge responds to flux direction and scalar loop alignment, not to a deformation of the scalar modulation field $\lambda(x)$.

Unlike closed sinertia loops (which source curvature and modify $\lambda(x)$), these open-loop charge structures do not alter the scalar field itself. Instead, they reside within the scalar geometry and interact by introducing a net scalar flux imbalance—either as a source or a sink. This imbalance does not deform space, but it reorients the directional flow of sinertia through the surrounding region.

When another open-loop configuration is present nearby, the overlapping flux introduces a relative scalar phase and direction mismatch. This creates what NUVO interprets as a *directional scalar gradient pressure*—a non-curvature effect that induces motion in charged structures. This pressure arises not from a potential field but from scalar loop alignment constraints: charges move to restore topological continuity or minimize flux interference. The effect is geometric, but not gravitational, and uniquely governs charge-based acceleration in flat scalar space.

2.2 Topological Localization

Charge is inherently localized because scalar flux divergence cannot be sustained across open space. Instead, all open-loop endpoints must be embedded within a larger coherent scalar framework. This means:

- Every open-loop charge must either terminate at another charge (e.g., opposite sign) or radiate scalar flux into a dynamically closed structure (e.g., a photon).
- Charge distributions must be topologically consistent with global sinertia conservation.
- Local scalar flux gradients fall off with distance, consistent with inverse-square interaction profiles.

This geometric interpretation naturally explains why isolated charges do not exist in physical reality. Every charge must arise as part of a pair or system, ensuring conservation of scalar connectivity. This principle underlies conservation of electric charge as a topological rule, not a fundamental symmetry.

2.3 Charge as an Interface Condition

Within NUVO space, the scalar frame is smooth and continuous except at charge points, where the topology of sinertia is explicitly broken. These locations act as interface boundaries—analogous to electrical terminals or scalar "ports." They define preferred directions for scalar flux and establish the conditions for interaction between otherwise disjoint regions of space.

Charge does not distort space like mass, nor does it close upon itself like a photon. It anchors open-loop structures that define energy flow pathways and enable dynamic connection with other topological systems. In this sense, charges serve as functional endpoints for scalar transport, making them the necessary agents of interaction and acceleration.

2.4 Summary

Charge in NUVO theory is the geometric expression of an open sinertia loop—an interface through which scalar flux enters or exits space. Positive charge is a sink, negative charge a source. These structures are topologically constrained, geometrically embedded, and always paired or balanced to conserve scalar continuity. They do not curve space but modulate its dynamics by controlling scalar flow across topological discontinuities. This scalar-geometric foundation replaces abstract field-theoretic charge with a physically grounded, interaction-driven framework rooted in sinertia conservation.

3 Scalar Flow and Charge-Based Acceleration

Charged particles in NUVO theory are defined by their open-loop sinertia structure: a persistent scalar flux imbalance that exists as a directional source or sink. These open endpoints do not modify the scalar field $\lambda(x)$ directly but induce interaction through the differential motion of sinertia in their surrounding region. This directional flow results in a measurable acceleration of nearby charges and scalar-coupled systems.

3.1 Scalar Imbalance and Gradient Formation

In the absence of mass, the scalar field $\lambda(x)$ remains conformally flat, governed by distant closed sinertia loops. However, when an open-loop charge is present, it introduces a continuous scalar flux imbalance—either inward (sink) or outward (source). Though this does not deform the scalar metric directly, it does establish a *gradient of sinertia motion*, as the surrounding scalar network attempts to balance the imposed flow.

This gradient has the physical effect of inducing momentum change in nearby sinertia-coupled structures. In effect, the open-loop charge locally "tilts" the scalar frame, not geometrically, but dynamically—by altering the flow lines of scalar propagation. The result is a directional acceleration aligned with the scalar flux vector:

$$\vec{a} \propto \nabla \Phi_q,$$

where Φ_q represents the scalar potential induced by the open-loop configuration.

3.2 Attraction and Repulsion Without Field Lines

This scalar topology reproduces the traditional behavior of electric attraction and repulsion, but without field lines or virtual interactions:

- Two charges of opposite sign act as scalar source and sink. The scalar flux flows directly between them, forming a coherent scalar channel. The system experiences a mutual acceleration as sinertia flows from source to sink.
- Two charges of the same sign both emit or absorb scalar flux in the same direction, creating interference in the scalar transport pattern. The resulting imbalance deflects each charge away from the other, as the scalar flux cannot easily reconcile two identical endpoints.

Thus, the apparent repulsion or attraction is the result of scalar flux compatibility and phase-directed imbalance—not the result of abstract vector fields or force carriers.

3.3 Charge-Mediated Environments and Apparent Neutral Response

In NUVO theory, scalar charge [3] structures do not modify the scalar modulation field $\lambda(x)$, and thus do not directly influence neutral closed-loop sinertia systems. However, in environments with extreme charge density or rapid emission events, the geometry of local scalar flow may become perturbed due to boundary interference, photon emission, or sinertia congestion.

While these effects do not couple directly to a neutral system, they may momentarily distort the surrounding scalar frame in which motion occurs—leading to apparent anomalies in geodesic [5] propagation, scalar delay, or coherence mismatches. Such effects are not true accelerations, but frame-relative deviations arising from scalar flow environment dynamics.

These phenomena are rare and subdominant, but may be detectable in highly active systems such as pulsars, ion jets, or photon-saturated cavities.

3.4 No Reaction Force from the Scalar Field

Because open-loop charges do not directly alter the scalar field $\lambda(x)$, there is no reactive back-curvature or long-range geometrization of charge. Instead, all observable effects arise from scalar flux imbalance and local momentum exchange. This distinguishes charge-based acceleration from gravitational acceleration: the former is directional and driven by open-loop sinertia, the latter is symmetric and driven by closed-loop curvature.

Nevertheless, both effects arise from sinertia motion, unified by a common scalar-conformal geometry.

3.5 Summary

Acceleration due to electric charge in NUVO theory arises from scalar flux imbalance introduced by open-loop sinertia endpoints. The induced gradient does not deform space but redirects scalar propagation, resulting in momentum exchange with other charges or sinertia-bound systems. Attraction, repulsion, and charge-induced motion follow naturally from the scalar network's attempt to restore flux continuity. This scalar flow replaces field-based forces with physically grounded dynamics derived from the geometry of sinertia.

4 Charge Conservation and Topological Pairing

In NUVO theory, charge arises not from intrinsic particle properties but from the presence of open-loop sinertia configurations—scalar flux endpoints embedded in the geometric structure of space. This reinterpretation transforms charge conservation from an imposed symmetry into a topological necessity: the scalar flux network must remain globally closed, even if locally broken. As a result, all instances of charge must occur in balanced, oppositely signed pairs.

4.1 Topological Necessity of Pair Formation

Since sinertia propagates through loops, any disruption in loop continuity must introduce two complementary endpoints:

- One endpoint acts as a scalar flux *source*—a negative charge.
- The other acts as a scalar flux *sink*—a positive charge.

These two endpoints represent the beginning and end of a scalar flux channel. They are spatially separated but topologically linked. The creation of a single charge is therefore impossible; charge must always be produced in a paired topology to preserve the global integrity of scalar continuity.

4.2 Stability of Charge and Non-Reclosure

The persistence of charge arises from the inability of these endpoints to spontaneously reconnect. In stable charged particles such as electrons and protons, the scalar flux structure becomes embedded in a more complex internal configuration, preventing spontaneous loop re-closure.

This topological barrier stabilizes charge over long timescales. Only through interaction with an oppositely charged partner—or through scalar-mediated transitions such as photon emission—can the system reconfigure to eliminate the open-loop structure.

4.3 Annihilation as Loop Restoration

When a positive and negative charge encounter one another under appropriate conditions, their scalar endpoints can reconnect. This process does not annihilate the particles in a traditional sense, but rather re-forms a closed sinertia loop—typically emitted as a photon or reabsorbed into a neutral scalar structure.

This loop closure process:

- Restores scalar continuity.
- Eliminates the local open-loop gradient.
- Preserves total scalar flux.

In this way, annihilation is reinterpreted as a reconnection event in the scalar topology.

NUVO theory further hypothesizes that this reconnection is not equivalent to the fully closed gravitational sinertia loop, but retains a fractional openness due to the intervening scalar permeability of space. The resulting structure remains dynamically closed but not topologically complete, allowing interaction with surrounding charge and field configurations. This partial coupling is modulated by the permittivity of space, and NUVO proposes that the fine-structure constant α represents the maximal scalar reconnection ratio achievable through vacuum. As such, α emerges not as a coupling constant in the conventional sense, but as a geometric limit on loop coherence across spatial separation, explaining its pervasive appearance in charge-related phenomena, including photon emission and absorption.

4.4 Quantization from Loop Coherence

Because scalar flux can only be sustained in stable loops or endpoints under strict coherence constraints, the total flux entering or exiting a point must match a quantized unit. This explains the observed discrete nature of electric charge: a fundamental open-loop configuration corresponds to a minimal flux quanta, which cannot be further divided without violating scalar coherence.

This provides a geometric and topological foundation for the quantization of electric charge, without the need for field quantization or symmetry group imposition.

4.5 Summary

Charge conservation in NUVO theory arises from the requirement that scalar flux remain globally continuous, even when locally disrupted. All charges appear in topological pairs, linked by their origin in broken sinertia loops. Annihilation corresponds to loop restoration, and quantization emerges from the coherence conditions of scalar flux transport. This framework provides a geometric and topological explanation for the conservation and discreteness of electric charge.

5 Interaction with Photons

Photons in NUVO theory are dynamically closed sinertia loops—finite, coherent scalar structures that carry quantized energy without coupling to the scalar field $\lambda(x)$. They emerge naturally from the dynamics of open-loop sinertia configurations, particularly through interactions between oppositely charged endpoints. In this context, the photon plays a fundamental role in resolving scalar flux imbalance and facilitating loop reconnection between charge pairs.

5.1 Photon Emission as Loop Closure

When a positive and negative charge interact—either during acceleration, orbital transition, or annihilation—their scalar flux structures may partially or fully reconnect. In cases where a direct reconnection is topologically obstructed, a closed-loop sinertia structure may detach, forming a photon. This process restores scalar continuity by removing the net imbalance in local sinertia flow.

The photon thus acts as a dynamically sealed fragment of scalar flux that:

- Carries away the excess energy associated with charge reconfiguration,
- Preserves scalar phase coherence from the point of emission,
- Propagates independently along null geodesics in scalar-conformal space.

This replaces the classical notion of electromagnetic [4] radiation with a topological sinertia process: photon emission is not the result of field oscillation, but of loop reconnection dynamics in the scalar flux network.

5.2 Photon Absorption as Reconnection

Conversely, when a photon encounters a compatible charge structure—typically an open-loop sinertia endpoint with matching scalar phase—it may be absorbed. In this process, the photon's scalar loop reconnects with the open structure, reintegrating its scalar flux into the charged system.

This reconnection:

- Alters the local scalar topology or configuration of the system (e.g., orbital resonance or directional sinertia alignment),
- May induce transitions between bound charge states, such as atomic [1] energy levels,
- Eliminates the photon's independent loop identity as it becomes part of the open-loop sinertia flow.

Photon absorption is thus not an energetic transfer in a field sense, but a topological realignment of scalar continuity.

5.3 Selection Rules from Scalar Compatibility

Not all photon-loop and charge-endpoint pairs are compatible. The photon's internal scalar phase structure must align with the charge system's boundary condition for reconnection to occur. This constraint leads naturally to discrete selection rules:

- Only photons with specific loop frequencies (energies) can connect with particular charge states.
- Only phase-matched loops will reconnect; others will continue to propagate or scatter.

- **Scalar flux conservation forbids unbalanced absorption.** While scalar reconnection may occur partially across multiple open-loop structures, the total scalar flux must be coherently conserved across the network. In this way, partial absorption by one charge is always balanced by complementary absorption elsewhere—ensuring that the full scalar loop is topologically preserved, even when distributed among multiple participants.

These conditions account for the observed discrete nature of emission and absorption spectra without invoking quantized field operators.

5.4 Charge Stability and Radiative Balance

In stable systems such as atoms, charge configurations maintain scalar coherence by cycling sinertia through periodic reconnections. Transitions between states—especially under perturbation—may result in photon emission as scalar flux redistributes to restore equilibrium.

In this way, photons function as scalar discharge events that maintain the dynamic integrity of charge-bound systems. They are not particles emitted at random, but necessary closures of scalar loop structure driven by topology and coherence.

5.5 Summary

Photons in NUVO theory arise from and interact with charge as scalar loop reconnection events. Emission corresponds to the detachment of a dynamically closed sinertia loop during charge realignment. Absorption corresponds to the reintegration of scalar flux from a compatible photon into an open-loop system. These processes are governed by scalar phase matching and loop topology, replacing field-based electromagnetic interaction with a coherent geometric mechanism rooted in sinertia continuity.

6 Scalar Force Laws

In classical electrodynamics, the force between electric charges is described by Coulomb's law and generalized through the Lorentz force. These laws are rooted in vector field theory, where forces are mediated by continuous electric and magnetic fields. In NUVO theory, no such fields exist. Instead, all interaction arises from the motion of scalar sinertia through space and its coupling to open-loop structures.

Force, in this context, is not a primitive concept—it is the result of a momentum gradient induced by scalar flux imbalance. When two charges interact, scalar flux moves from one open endpoint to the other. This flux transport creates a unidirectional momentum exchange, which appears as an effective force.

6.1 Force Between Two Static Charges

Consider two point charges q_1 and q_2, modeled as scalar flux sink and source, separated by distance r. Scalar flux travels coherently from source to sink, creating a net directional flow of sinertia. This unidirectional flux imparts a momentum differential between the charges:

$$\frac{d\vec{p}}{dt} \propto \frac{q_1 q_2}{4\pi r^2}\hat{r},$$

where the scalar proportionality constant (including geometric and coherence scaling) replaces the classical ε_0^{-1}. This expression mirrors Coulomb's law, but it is derived not from fields, but from flux conservation and scalar path compression.

Importantly, the force is not a field quantity acting at a distance—it is a continuous momentum transfer via scalar flux guided by the coherent scalar network.

6.2 Scalar Interaction as Local Momentum Flow

In NUVO theory, each charge maintains a persistent scalar imbalance. When placed near another charge, the scalar frame between them becomes modulated by directional flux. This creates a gradient in the local scalar momentum:

$$\vec{a} = \frac{1}{m}\nabla \Pi_q,$$

where Π_q represents the scalar momentum density due to coherent flux from the charge interaction, and m is the inertial mass of the test particle.

Unlike traditional forces, this scalar acceleration:

- Acts directly along the scalar flux path.
- Is mediated through coherent scalar flow, not a field.
- Is symmetric in isolated systems (action-reaction arises from scalar conservation).

6.3 Directionality and Phase Dependence

In NUVO theory, scalar flux is quantized and phase-coherent, meaning that the conditions for momentum transfer are more restrictive than in traditional force models. An interaction between charged structures does not automatically result in acceleration. Instead, the transfer of scalar momentum depends critically on:

- The relative orientation of scalar flux endpoints (source and sink alignment),
- The scalar phase alignment between the interacting structures,
- The continuity and coherence of scalar transport across the intervening region.

When scalar flux reaches a charged structure in a phase-compatible orientation—but without altering the net sinertia flow into the system—the result is no change in motion, and thus no acceleration. This explains how interactions can occur (e.g., exchange of scalar coherence or photon emission thresholds) without producing force effects.

Such coherence-sensitive behavior implies that scalar force laws are not isotropic or instantaneous. They depend on local scalar propagation limits and on topological filtering, where only compatible phase and orientation permit momentum exchange. In saturated or balanced configurations, scalar flow may continue without effect until a depletion, mismatch, or reconfiguration occurs.

6.4 Reduction to Coulomb Law in Symmetric Limit

In the weak-field, low-velocity, static limit, the NUVO scalar interaction reduces to the standard form:

$$F = \frac{1}{4\pi\varepsilon_{\text{eff}}} \frac{q_1 q_2}{r^2},$$

where ε_{eff} is the emergent scalar impedance of space, defined by the geometry of sinertia transport between charges. This formal correspondence preserves empirical success while grounding the origin of interaction in scalar coherence, not postulated fields.

6.5 Summary

The effective "force" between charges in NUVO theory is a manifestation of scalar flux imbalance and coherent sinertia transport. It arises from unidirectional momentum exchange along open-loop pathways and is governed by phase alignment and topology. In the symmetric limit, it reduces to Coulomb's law but is fundamentally geometric and flux-driven rather than field-based.

7 Coupling with Geodesics

In NUVO theory, massive particles follow geodesics defined by the scalar field $\lambda(x)$, which encodes curvature generated by closed-loop sinertia (i.e., mass). These geodesics reflect the natural, unaccelerated paths of scalar-coherent transport under the influence of gravitational curvature [2] alone. However, the presence of electric charge introduces open-loop scalar flux that overlays directional momentum transfer onto geodesic motion.

This section explores how the sinertia structure of a charged particle deviates from geodesic motion, and how scalar charge interacts with curved geometry.

7.1 Geodesics and Neutral Particles

For a neutral particle, the path of motion is purely dictated by the conformal scalar field $\lambda(x)$, with trajectory governed by the scalar-modulated metric:

$$ds^2 = \lambda^2(x)\, \eta_{\mu\nu} dx^\mu dx^\nu.$$

These paths conserve sinertia via closed-loop curvature and require no external force. Acceleration arises only from the scalar gradient encoded in $\lambda(x)$, which defines the background geometry of NUVO space.

7.2 Deviation from Geodesics via Scalar Flux Coupling

A charged particle introduces an open-loop sinertia endpoint. This configuration interacts not only with $\lambda(x)$, but also with the scalar flux structure from surrounding charges. The result is a deviation from the geodesic path, caused by:

- An external scalar momentum gradient $\nabla\Pi_q$,

- A directional overlay of unbalanced sinertia transport,
- A dynamic re-alignment of local scalar motion due to open-loop coupling.

Thus, the worldline of a charged particle is not a pure geodesic, but a modified trajectory:

$$\frac{d^2x^\mu}{d\tau^2} + \Gamma^\mu_{\alpha\beta}\frac{dx^\alpha}{d\tau}\frac{dx^\beta}{d\tau} = a^\mu_{\text{scalar}},$$

where the right-hand term encodes scalar flux-induced acceleration due to charge interaction.

7.3 Scalar Compatibility with Geometry

Importantly, scalar flux from charge does not distort the scalar field $\lambda(x)$, as it does not create curvature. Instead, it overlays a directional sinertia stream upon the existing geometry. The charged particle remains in scalar space, but travels through it with momentum supplied by open-loop coupling.

The scalar field $\lambda(x)$ governs the geometry, while the scalar flux $\Phi_q(x)$ governs the deviation from passive motion. These two influences coexist but originate from distinct topological regimes:

- Closed-loop sinertia: curvature, mass, gravitational motion.
- Open-loop sinertia: directional flux, charge, electromagnetic interaction.

7.4 Photon Geodesics and Charge Influence

Photons—dynamically closed sinertia loops—follow null geodesics of the scalar geometry and do not deviate due to charge. However, they can be absorbed or emitted by charges if scalar phase matching conditions are met. During this process, the photon ceases to propagate and transfers its scalar momentum to the open-loop structure.

Hence, while photons are unaffected by charge in transit, their generation and absorption are governed by the interaction of scalar coherence with geodesic structure.

7.5 Summary

In NUVO theory, charge introduces open-loop scalar flux that modifies geodesic motion via momentum exchange. Charged particles follow curved paths defined not only by $\lambda(x)$, but also by scalar flux gradients induced by nearby charges. This coupling explains how electromagnetic interactions alter motion within curved geometry, without violating scalar conservation or introducing extraneous forces.

8 Scalar Field Equation Analogues

While classical electrodynamics is governed by Maxwell's equations—four coupled vector field relations describing $\vec{E}$, $\vec{B}$, and their sources—NUVO theory replaces these constructs with scalar flux transport governed by topological continuity. The goal of this section is to recover analogous relationships in NUVO, using scalar quantities and coherence conditions rather than fields.

8.1 Scalar Flux Divergence and Charge Density

In classical theory, Gauss's law relates electric flux to charge density:

$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}.$$

In NUVO theory, the divergence of scalar sinertia flux replaces the electric field:

$$\nabla \cdot \Phi_q(x) = \rho_q(x),$$

where $\Phi_q(x)$ is the scalar flux vector field representing the net directional flow of sinertia due to charge, and $\rho_q(x)$ is the scalar charge density—effectively the spatial distribution of open-loop endpoints.

Unlike the classical field, $\Phi_q(x)$ is not fundamental; it is derived from the geometry of sinertia propagation between charges.

8.2 Flux Curl and Absence of Scalar Vorticity

Faraday's and Ampère's laws involve the curl of electric and magnetic fields. In NUVO theory, scalar flux is irrotational unless modulated by coherent closed-loop motion (e.g., photons or moving charges). In the static case:

$$\nabla \times \Phi_q(x) = 0,$$

reflecting that scalar sinertia flows in direct paths unless redirected by coherent dynamic processes. There is no native magnetic field; circulation emerges only from loop closure, as addressed in Section 11.

8.3 Charge Conservation from Scalar Continuity

The scalar continuity equation replaces the displacement current term:

$$\frac{\partial \rho_q}{\partial t} + \nabla \cdot \Phi_q = 0.$$

This expresses local conservation of scalar flux: the rate of change of open-loop charge density must equal the net outflow of scalar flux. It arises directly from topological conservation and is not postulated.

8.4 Scalar Wave Equation for Radiative Modes

Photon propagation corresponds to oscillating sinertia loops traveling through space. The scalar coherence field $\lambda_q(x,t)$ representing the envelope of this sinertia satisfies a wave-like equation in the absence of charges:

$$\Box\lambda_q = 0.$$

In the presence of dynamic open-loop transitions (i.e., accelerating charges), the scalar wave equation becomes sourced:

$$\Box\lambda_q(x,t) = S_q(x,t),$$

where S_q encodes the topological reconnection events that create or absorb scalar loops. This replaces the classical idea of an accelerating charge "emitting" radiation with a precise topological criterion for sinertia detachment.

8.5 Comparison Summary

Classical Field Relation	**NUVO Scalar Analogue**
$\nabla \cdot \vec{E} = \rho/\varepsilon_0$	$\nabla \cdot \Phi_q = \rho_q$
$\nabla \times \vec{E} = -\partial\vec{B}/\partial t$	$\nabla \times \Phi_q = 0$ (static)
$\nabla \cdot \vec{B} = 0$	No independent $\vec{B}$; see Section 11
$\nabla \times \vec{B} = \mu_0\vec{J} + \mu_0\varepsilon_0\partial\vec{E}/\partial t$	$\nabla \cdot \Phi_q + \partial\rho_q/\partial t = 0$

These scalar analogues preserve the structure of electromagnetic laws but reinterpret them through sinertia topology and continuity.

8.6 Summary

NUVO theory replaces vector field equations with scalar flux relationships rooted in topological conservation. Charge density arises from divergence of sinertia, continuity from flux conservation, and radiation from loop dynamics. The resulting equations resemble Maxwell's laws in form but reflect a deeper geometric origin grounded in scalar coherence.

9 Applications and Examples

To demonstrate the predictive and interpretive power of the NUVO scalar-charge model, this section presents several physically relevant examples. Each illustrates how scalar loop topology, flux conservation, and phase coherence yield classical behavior while retaining geometric consistency with NUVO space.

9.1 Orbital Motion in the Hydrogen Atom

In the hydrogen atom, the electron is a negative scalar flux source and the proton is a positive scalar sink. Scalar sinertia flows continuously from the electron to the proton, forming a coherent channel. The stability of this system arises from the dynamic balance of:

- The scalar flux gradient from the open-loop topology,
- The scalar-coherent orbital geometry (e.g., resonance at $r = \lambda^2 r_e$),
- Quantization conditions from internal phase closure (as developed in Part 18).

The scalar interaction generates centripetal acceleration, balancing inertial propagation within a curved scalar frame. Discrete energy levels emerge from quantized scalar phase wrapping—there is no need to invoke a Coulomb field or potential.

9.2 Dipole Structures

A classical electric dipole consists of a positive and negative charge separated by distance d. In NUVO theory, this configuration forms a localized open-loop pair connected by a coherent scalar flux channel. The resulting sinertia structure:

- Produces a directional scalar gradient in space,
- Aligns with the dipole axis,
- Induces net acceleration on nearby charges based on their phase compatibility.

When oscillating, such a dipole modulates its surrounding scalar flux, altering the coherence geometry of the sinertia environment. If the modulation reaches a phase configuration that permits dynamic loop closure across the scalar topology, a photon may form as a self-contained sinertia loop—detaching from the dipole system as a quantized coherence structure. This process depends not only on motion, but on scalar phase alignment, local depletion conditions, and topological closure thresholds.

9.3 Electron-Positron Annihilation

When an electron and positron meet, their open-loop scalar flux endpoints reconnect, forming a dynamically closed sinertia loop—a photon. This process:

- Eliminates both open-loop structures,
- Emits energy proportional to their scalar phase difference,
- Satisfies momentum and sinertia conservation globally.

Annihilation is reinterpreted as a topological closure of scalar flux, not a destruction of particles.

This raises an important distinction: why does a proton not annihilate with an electron, despite having opposite charges? In NUVO theory, this is explained by asymmetric sinertia flow. The proton, having much greater mass, accelerates far more slowly than the electron in response to the same scalar gradient. This mismatch prevents mutual coherence during approach, allowing scalar repulsion to emerge and stabilize a bound state rather than trigger annihilation.

In contrast, the electron and positron have identical scalar mass profiles. Their mutual acceleration is symmetric, preventing repulsive buildup and permitting scalar loop closure with high probability.

This further suggests a deeper question—whether the electron may represent a pure open-loop scalar structure, with no internal closed sinertia loop. In such a model, mutual annihilation would fully close the sinertia system, leaving no internal scalar residue. While this remains speculative, it aligns with the complete disappearance of rest mass and charge during annihilation.

An important open question in NUVO theory is whether the electron possesses an internal closed-loop sinertia structure. If so, it would couple to gravitational curvature via scalar modulation. Empirical evidence for gravitational acceleration of free electrons remains inconclusive, and a definitive measurement would constrain whether electrons contain internal scalar closure or exist as pure open-loop charge structures. In NUVO, this distinction is critical to understanding both annihilation and gravitational interaction at the quantum scale.

9.4 Field-Line Deflection and Shielding

Consider a charged particle approaching a conductive plate. In classical theory, field lines terminate on induced surface charges. In NUVO theory, the scalar flux from the open-loop endpoint of the charge redirects coherently through the conductive material, which acts as a sink for scalar flux via induced loop configurations.

This model explains:

- Electrostatic shielding,
- Image-charge effects (as topological mirror endpoints),
- Force deflection and null zones without invoking invisible fields.

9.5 Dynamic Scalar Flux Under Motion

A moving charge introduces directional flux compression and phase shift. Scalar sinertia trails behind the charge with a coherence delay governed by propagation speed and surrounding scalar geometry. This leads to:

- Effective directionality and beam-like interaction,
- Radiative emission under acceleration (loop detachment),
- Induced momentum transfer to neutral particles (scalar drag).

These dynamic effects become the basis for scalar interpretations of magnetism (covered in Section 11).

9.6 Summary

The scalar-coherent model of charge reproduces key physical behaviors across atomic, molecular, and macroscopic systems. From orbital resonance to radiative transitions and shielding effects, scalar flux dynamics offer a topological foundation that unifies classical results with geometric coherence. This removes the need for external field constructs while preserving all empirically observed interactions.

10 Dynamic and Magnetic Effects

In classical electrodynamics, moving charges give rise to magnetic fields and velocity-dependent forces. These effects are encapsulated in the Lorentz force and described via the $\vec{B}$ field. NUVO theory, which uses no vector fields, accounts for these effects through coherent sinertia dynamics: moving open-loop flux structures generate transverse scalar distortions that give rise to magnetic-like behavior and motion-dependent interactions.

10.1 Scalar Flux Compression and Directional Memory

A moving charge drags scalar flux behind it, creating an asymmetric distribution in its surrounding sinertia network. This "compression" and coherence lag yields a directional memory in the scalar flux:

- Scalar flux emitted by the charge becomes elongated or compressed depending on motion.
- This creates a transverse modulation in the scalar flux paths around the trajectory.
- Interacting particles experience phase delay and directional preference.

This distortion reproduces the key effect of magnetic vector fields: the rotation or deflection of charges in the presence of current-like flux patterns.

10.2 Velocity-Dependent Force (Lorentz Analogue)

When a test charge moves through a region influenced by scalar flux from another moving charge, its trajectory deviates due to scalar coherence realignment. The effective force experienced is:

$$\vec{F}_{\text{eff}} \propto q(\vec{v} \times \nabla \Phi_q),$$

where $\vec{v}$ is the velocity of the test charge and $\nabla \Phi_q$ represents the gradient of coherent scalar flux due to the source motion. This cross-product structure emerges from the geometric deflection required to maintain scalar continuity in the moving frame.

This reproduces the form of the classical Lorentz force without invoking a magnetic field:

$$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B}).$$

In NUVO, both $\vec{E}$ and $\vec{B}$ are replaced by directional scalar flux dynamics and topological reconnection constraints.

10.3 Induced Scalar Circulation and Loop Formation

A steady current—many charges moving coherently—produces a persistent scalar distortion in space. This circulating scalar flux wraps around the current axis, forming a loop of induced phase gradient. This effect:

- Mirrors the magnetic field generated by a wire,
- Produces forces on nearby moving charges,
- Explains inductive coupling and loop-induced photon emission.

Importantly, the effect is not due to a new field—it is the result of coherent scalar redistribution under collective charge motion.

10.4 Mutual Motion and Topological Drag

When two charges move in parallel, their scalar flux patterns co-evolve. If the flux is compatible, they experience an attractive transverse realignment (akin to magnetic attraction). If incompatible, they experience flux deflection. This explains:

- Current-current attraction or repulsion,
- Scalar coherence drag between conductors,
- Stabilization of coherent current loops in confined systems.

These effects form the scalar-geometric basis of classical electromagnetism's dynamic sector.

10.5 Summary

Magnetic and motion-dependent effects in NUVO theory arise from distortion and compression of scalar flux due to moving charges. There are no $\vec{B}$ fields—only coherent realignment of scalar momentum under motion. This framework recovers all known magnetic phenomena through phase-coherent geometry and scalar topology, providing a unified explanation for both static and dynamic electromagnetic behavior.

11 Summary and Principles

This paper reformulates electric charge within the NUVO scalar-conformal framework as a topological phenomenon: the presence of open-loop sinertia. Rather than treating charge as a static property or field source, NUVO defines charge as a scalar flux discontinuity—an endpoint in the globally conserved sinertia network. Through this interpretation, electric phenomena arise naturally from scalar coherence, topology, and flux conservation.

We summarize the key insights and principles developed in this scalar-based charge model:

1. **Charge is a dynamic topological discontinuity in sinertia.** Positive and negative charges act as open-loop endpoints in the scalar network—sinks and sources of scalar flux, respectively. These endpoints generate scalar flux gradients, but they are not fixed anchors. Rather, they are dynamically responsive to the surrounding scalar environment. Their motion arises from the net sinertia imbalance imposed by nearby charges or coherent flux structures. Charge interaction is thus mutual, directional, and governed by the geometry of loop phase alignment.

2. **All charge arises in paired configurations.** Because scalar sinertia is conserved and closed-loop by default, any break in the loop topology must create two complementary endpoints: a source and a sink. This explains the conservation and symmetry of electric charge.

3. **Open-loop sinertia induces acceleration through scalar momentum flow.** The directional scalar flux from charge creates momentum gradients that manifest as effective forces. These effects mimic Coulomb and Lorentz forces but are derived from scalar geometry, not from external fields.

4. **Charge does not modify scalar curvature $\lambda(x)$.** Unlike mass, which generates closed-loop sinertia and curvature, charge interacts with space through directional sinertia without altering the conformal structure. This separation explains why charge does not gravitate.

5. **Quantization of charge arises from scalar coherence.** Open-loop endpoints must match discrete phase and flux conditions to maintain coherence. This yields stable, indivisible units of charge and explains why all observed fundamental particles carry identical charge magnitudes.

6. **Photons arise from loop reconnection between charge endpoints.** When scalar flux between charges becomes dynamically closed, a photon is emitted—forming a closed-loop sinertia structure. Conversely, photons are absorbed when scalar phase permits reconnection to an open endpoint.

7. **Magnetic and dynamic effects emerge from moving scalar flux.** Motion compresses scalar flux lines, producing transverse distortions that induce velocity-dependent momentum exchange. This replaces magnetic fields with geometric sinertia dynamics.

8. **Electromagnetic laws emerge as scalar transport relations.** Classical field equations (e.g., Maxwell's laws) are recovered as scalar flux conservation identities and wave equations for loop detachment. These emerge in the appropriate limits without invoking field constructs.

9. **Charge interaction is fully geometric and deterministic.** There is no probabilistic collapse or force mediation by virtual particles. All interactions arise from scalar compatibility, coherence, and global conservation of sinertia.

Conclusion

This sinertia-based formulation of charge completes the unification of electric interaction with gravitational curvature [2] and quantum coherence within the NUVO framework. Mass, charge, and light all arise as structured configurations of a single scalar flux—defined by whether sinertia loops are closed, open, or dynamically reconfiguring. This geometric foundation eliminates field dualism, restores physical continuity, and offers a unified structure for understanding interaction at all scales.

This work is Part 17 of the NUVO Theory Series. Part 18 develops the structure of the photon as a dynamically closed sinertia loop, and Part 19 will continue this trajectory toward a unified scalar interpretation of quantum measurement and matter-field coupling.

A Mathematical Structures and Conventions

This appendix defines the scalar-topological quantities, symbols, and mathematical conventions used throughout the paper, reflecting the sinertia-only formulation of NUVO theory.

A.1 Scalar Frame and Field

- $\lambda(x)$: The scalar conformal field, which determines the local modulation of space in the NUVO framework. It reflects the presence of closed-loop sinertia (mass) and defines the local scaling of distance and time.
- $\lambda_q(x)$: A scalar phase or flux field representing coherent sinertia transport associated with charge (open-loop structures). Used in wave propagation and charge-based interaction contexts.
- $\Box$: The scalar d'Alembertian operator on conformally flat spacetime, defined with respect to the scalar frame. In flat coordinates, $\Box = \frac{1}{\lambda^2}(\partial_t^2 - \nabla^2)$.

A.2 Sinertia Structures

- **Closed-loop sinertia**: Curved scalar flow associated with mass and curvature. These structures shape the scalar field $\lambda(x)$ and define geodesics.
- **Open-loop sinertia**: Scalar flux endpoints associated with electric charge. These induce momentum gradients but do not modify $\lambda(x)$ directly.
- $\Phi_q(x)$: The scalar flux vector representing the local direction and magnitude of sinertia flow from or to a charge. This replaces classical field lines.
- $\rho_q(x)$: Scalar charge density; the density of open sinertia endpoints in space.

A.3 Loop Conditions and Phase Coherence

- $\phi(s)$: Scalar phase along a loop coordinate s. For coherence, loops must satisfy:

$$\phi(s + L) = \phi(s) + 2\pi n, \quad n \in \mathbb{Z}^+.$$

- L: Scalar loop length (local arc length under conformal frame).
- $\lambda_\nu = c/\nu$: Scalar coherence wavelength of a photon-like loop, associated with frequency ν.

A.4 Units and Constants

- c: Scalar transport velocity—speed of sinertia propagation in vacuum, determined by scalar coherence conditions.

- h: Scalar action constant. Defined as the minimal scalar flux (action) associated with a fully phase-closed sinertia loop.
- ε_0, μ_0: Interpreted not as fundamental properties of vacuum, but as emergent coherence parameters in scalar topology. They govern the density and impedance of sinertia flux in charge interaction regions (discussed in Appendix C).

A.5 Notation

- Scalars and scalar fields are written in upright Roman (λ, Φ, ϕ).
- Vector-like scalar flux (e.g., Φ_q) denotes directional transport of sinertia, not a true vector field.
- All quantities are defined in conformally flat coordinates unless otherwise specified.
- The notation avoids vector field constructs unless reinterpreted in scalar-coherent terms.

A.6 Terminology Note

Throughout this paper, the term “sinertia” refers to all scalar flux, whether closed (mass, curvature) or open (charge, interaction). We no longer use separate terms for different states of scalar energy flow. Photons, masses, and charges are treated as structured configurations of sinertia under different topological constraints.

B Falsifiability and Monopoles

A key strength of NUVO theory is its geometric foundation in scalar sinertia topology, which offers both explanatory power and falsifiability. This appendix identifies a concrete, testable prediction of the theory: the non-existence of isolated magnetic or electric monopoles.

B.1 Scalar Charge as a Topological Endpoint

In NUVO theory, charge is not a point source of a field but a topological feature of sinertia: an open-loop endpoint in an otherwise globally conserved scalar flux network. Scalar flux must always originate and terminate in balanced pairs (source and sink), preserving total coherence.

As a result:

- No isolated source or sink of scalar sinertia can exist without a corresponding opposite endpoint.
- Any observation of a single, unpaired scalar flux origin (i.e., a true monopole) would violate the scalar loop conservation principle.
- All known electric charges—electrons, protons, etc.—exist in topologically paired systems, consistent with this requirement.

B.2 Magnetic Monopoles and Loop Structure

In classical electrodynamics, magnetic fields arise from circulating electric currents, and no magnetic monopoles have ever been observed. NUVO theory explains this as a natural consequence of scalar loop dynamics:

- Magnetic-like behavior arises from distortions in scalar flux due to moving charges (see Section 11).
- There is no independent magnetic flux or field—only coherent scalar circulation in motion.
- A magnetic monopole would imply a source or sink of pure circulation, which is not permitted in NUVO's scalar framework.

Thus, NUVO not only predicts the absence of magnetic monopoles—it explains why such objects cannot form within the scalar topology of space.

B.3 Experimental Implications

The following observations would falsify NUVO theory as currently formulated:

1. Detection of an isolated electric or magnetic monopole, without a topologically coupled counterpart.

2. Observation of asymmetric scalar flux (e.g., persistent net divergence of scalar momentum) not accounted for by known open-loop pairs.
3. Confirmation of particle-like entities that carry curvature-inducing mass but no associated closed sinertia loop.

No such observations have been confirmed to date. However, NUVO remains falsifiable in principle, which distinguishes it from many reformulations that preserve quantum or field structures but lack testable constraints.

B.4 Summary

NUVO theory predicts the impossibility of isolated monopoles, based on the conservation of scalar sinertia in all configurations. This prediction is geometric, not model-dependent, and offers a clear empirical test. Any confirmed detection of a monopole—electric or magnetic—would constitute a direct refutation of the scalar-topological model of charge.

C Classical Constants in Scalar Topology

In traditional physics, constants such as ε_0, μ_0, c, and h are treated as fundamental quantities that define the behavior of electric and magnetic fields and their propagation. In NUVO theory, these constants acquire new meaning: they emerge from the coherent geometry and transport characteristics of scalar sinertia in space.

C.1 The Speed of Light as Scalar Transport Velocity

In classical theory, the vacuum speed of light is defined as:

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}.$$

In NUVO theory, c is the limiting velocity for scalar flux propagation through vacuum—specifically, for the propagation of dynamically closed sinertia loops (i.e., photons). This velocity reflects the scalar-coherent structure of space itself, not a property of electromagnetic fields.

Here, c is understood as:

$$c = \text{maximum group velocity of scalar coherence transport.}$$

C.2 ε_0 and μ_0 as Emergent Scalar Impedance Parameters

In NUVO theory, ε_0 and μ_0 are not intrinsic properties of vacuum as a medium. Instead, they emerge from the scalar-coherent impedance of space to directional sinertia flux between open-loop endpoints (charges).

Specifically:

- ε_0 represents the scalar resistance of space to the divergence of scalar momentum—i.e., the "compliance" of the sinertia network to flux spread.
- μ_0 characterizes the scalar inertial delay in propagating phase-wrapped loop structures (e.g., in dynamic or closed-loop motion).

These quantities relate to the geometry of scalar flux pathways between charges and affect how scalar momentum accumulates and propagates during open-loop interaction.

C.3 The Planck Constant h as Loop Quantization Rule

In NUVO theory, h is not a quantum of energy in abstract Hilbert space—it is the scalar action associated with the minimal phase-wrapped closure of a sinertia loop. That is:

$$E = h\nu \quad \Rightarrow \quad h = \text{scalar action required for one full coherence wrap.}$$

Thus, h reflects the topological quantization of scalar flux in loop structures and underpins both photon energy and charge quantization.

C.4 Rewriting Classical Relations

Under NUVO scalar interpretation:

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2} \quad \longrightarrow \quad F = \text{scalar momentum gradient from coherent sinertia flow.}$$

Here, ε_0 is understood as the geometric density scaling factor for scalar flux coupling between open-loop endpoints—no electric field exists, only a regulated scalar transport pathway.

C.5 Summary

In NUVO theory, classical constants take on physically grounded roles within scalar geometry:

- c: Transport velocity of scalar coherence.
- ε_0: Scalar flux compliance of vacuum space.
- μ_0: Phase propagation inertia of sinertia loops.
- h: Action unit for scalar loop quantization.

These constants are not fundamental properties of fields or empty space, but expressions of scalar transport behavior governed by geometry, topology, and coherence.

D Historical Interpretation of Constants and Resolution in NUVO

The classical constants ε_0, μ_0, and c emerged historically in the context of electromagnetic theory. They were initially interpreted as describing a physical medium (the ”ether”) through which electric and magnetic fields propagated. The Michelson–Morley experiment famously nullified this view, leading to the rise of relativistic field theory where these constants became abstract parameters with no physical medium.

NUVO theory offers a reconciliation. It restores a physical interpretation of these constants—not as properties of a material ether, but as emergent parameters of scalar flux geometry. This reinterpretation resolves tensions in historical models and clarifies why the field-based formalism persisted despite conceptual gaps.

D.1 The Ether Debate Revisited

Before relativity, ε_0 and μ_0 were regarded as vacuum permittivity and permeability—properties of a supposed ether that supported wave propagation. The null result of the Michelson–Morley experiment undermined the ether hypothesis, prompting a shift to spacetime invariance and relativistic fields.

However, the conceptual dilemma remained: How can space have impedance-like properties (ε_0, μ_0) if it is not a medium?

NUVO resolves this by showing that:

- Space is not filled with a material substrate, but is structured by the scalar coherence of sinertia.
- Constants like ε_0 and μ_0 describe how scalar flux interacts with that coherent topology—not with “stuff” in space.
- Wave propagation is a result of topological motion of scalar coherence loops—not oscillations of a medium.

D.2 Reinterpreting the Speed of Light

The classical relationship:

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

was seen as a coincidence until it was folded into relativistic electrodynamics. In NUVO theory, this relation emerges naturally:

- c reflects the maximal scalar propagation speed between coherent sinertia configurations.
- ε_0 and μ_0 encode the spatial topology that governs how sinertia flux moves between open-loop structures.

- Their product defines the impedance of coherent scalar transport—not the speed of a field in a vacuum.

This restores physical meaning to the constants without invoking an ether.

D.3 Field-Free Conservation Laws

Historically, Maxwell's equations unified electric and magnetic fields under a set of differential equations—but they still required interpretation through invisible vector fields and potentials. NUVO replaces these with:

- Scalar flux divergence and continuity,
- Topological loop conservation,
- Quantized action from scalar phase closure.

This field-free formulation preserves empirical results while resolving foundational ambiguities about what fields are and how they interact.

D.4 Conclusion

NUVO theory offers a historically coherent reinterpretation of the classical constants:

- They describe scalar coherence geometry—not ether,
- They arise from topological structure—not imposed postulates,
- They are preserved in form but explained in function.

This perspective bridges the conceptual gap between pre-relativistic physics and modern scalar coherence theory, completing a century-long search for physical meaning behind constants that once anchored a rejected medium.

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