The Next Electromagnetic Revolution: Maxwell's Equations in the Framework of Quarkbase Cosmology

Carlos Omeñaca Prado

September 2025

Contents

Abstract

The Quarkbase theory reformulates the foundations of electromagnetic interaction by interpreting classical fields not as abstract entities in empty space, but as pressure distributions within a continuous, frictionless plasma that permeates the universe. In this framework, Maxwell's equations acquire a physical substrate: they describe the reorganization of pressure lines in this hidden medium rather than mere mathematical relations among charges and currents. This reinterpretation preserves the predictive power of classical electromagnetism while providing a consistent field-based foundation for potential extensions and experimental tests.

1 Communications and Field Propagation

Conventional radio and optical communications rely on electromagnetic waves that attenuate through scattering and absorption. Within the Quarkbase framework, these fields correspond to pressure modes of the etheric plasma. In ideal conditions, such pressure configurations could propagate with minimal dissipation, implying the theoretical possibility of near-lossless transmission across long distances.

- **Plasma-based antennas**: devices that encode information directly in longitudinal pressure modes.
- **Low-loss transmission**: propagation of stable field patterns with reduced energy dissipation.
- **Correlated channels**: long-range coherence emerging from the collective reorganization of the pressure field.

2 Energy Exchange and Dynamic Pressure Systems

In this view, energy is stored not in discrete charge carriers but in the pressure states of the etheric medium. Engineered cavities may, in principle, couple resonantly to these states, allowing reversible energy exchange analogous to Casimir-type effects.

- **Resonant vacuum cavities**: systems tuned to excite and recover pressure-field modes.
- **Anisotropic pressure drives**: devices that generate directed forces by controlled redistribution of pressure in the medium.

3 Material and Information Applications

If permittivity (ε_0) and permeability (μ_0) are local emergent properties of the plasma, modifying them becomes a problem of field engineering.

- **Vacuum metamaterials**: media that locally tailor ε_0 and μ_0 to control light propagation.

- **Pressure-field logic**: computation based on solitonic or resonant pressure modes instead of electron flow.
- **Stable plasma patterns**: information storage in long-lived field configurations of the medium.

4 Biophysical Interaction Frontier

As organized matter, biological structures interact with the etheric plasma through local modulations of pressure and vorticity. This interaction could, in principle, enable non-ionizing diagnostic and control methods.

- **Pressure-field imaging**: detection of subtle plasma reorganizations near biological tissues.
- **Molecular alignment control**: fine manipulation of molecular bonds via coherent pressure coupling.

5 Conceptual Horizons

Beyond its theoretical reconstruction of electromagnetism, the Quarkbase framework outlines several speculative frontiers that follow logically from its equations:

- **Gravitational lensing by pressure gradients**: engineering local curvature of the plasma to modify effective weight or inertia.
- **Protective plasma interfaces**: controlled redistribution of pressure fields to deflect high-energy particles.
- **Temporal synchronization**: investigation of global oscillations of the plasma as potential reference for high-precision timekeeping.

6 Formal Reinterpretation of Maxwell's Equations within the Etheric-Plasma Framework

In the Quarkbase formulation, the electromagnetic vacuum is replaced by a continuous, frictionless medium described by pressure and vorticity fields. Maxwell's equations retain their mathematical form but acquire a physical substrate.

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}, \quad (1) \tag{1}$$

$$\nabla \cdot \mathbf{B} = 0, \quad (2) \tag{2}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}, \quad (3) \tag{3}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}. \quad (4) \tag{4}$$

6.1 Interpretation in the Quarkbase Theory

- The **etheric plasma** constitutes the true physical vacuum.
- The electric field $\mathbf{E}$ represents **pressure gradients** in the medium generated by localized quarkbase configurations.
- The magnetic field $\mathbf{B}$ corresponds to the **vorticity** of the same medium.
- The charge density ρ measures the **local excess or deficit of pressure** around a quarkbase.
- The current density $\mathbf{J}$ denotes a **steady flow of plasma reorganization**.

6.2 Gauss's Law (1)

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}.$$

In this framework, the divergence of $\mathbf{E}$ quantifies the intensity of local pressure displacement in the plasma. A charge is thus identified with a stationary node of excess pressure, and the electric field with its spatial gradient.

6.3 Gauss's Law for Magnetism (2)

$$\nabla \cdot \mathbf{B} = 0.$$

Magnetic monopoles cannot exist because the vorticity of the plasma must form closed loops; circular pressure flows have no endpoints.

6.4 Faraday's Law (3)

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}.$$

A temporal variation in vorticity forces the medium to redistribute pressure. An electromagnetic wave thus represents a coupled oscillation of longitudinal pressure ($\mathbf{E}$) and transverse vorticity ($\mathbf{B}$) in the etheric plasma.

6.5 Ampère–Maxwell Law (4)

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}.$$

Here, $\mathbf{J}$ expresses sustained plasma motion, while the displacement term $\partial \mathbf{E}/\partial t$ indicates that even a time-varying pressure field in the absence of matter induces vorticity.

6.6 General Interpretation

Maxwell's equations remain valid but are reinterpreted: the electromagnetic vacuum is not empty, but an elastic and conservative medium.

- A **charge** corresponds to a stable pressure node.
- $\mathbf{E}$ is the pressure gradient around that node.
- $\mathbf{B}$ is the rotational motion (vorticity) of the plasma.
- An electromagnetic wave is a self-sustained oscillation of pressure and vorticity in this medium.

Thus, Maxwell's formalism is preserved but endowed with a physical substrate: the etheric plasma that carries and sustains electromagnetic phenomena.

7 Derivation of Electromagnetic Wave Equations in the Etheric-Plasma Framework

We now derive the standard electromagnetic wave equations starting from the plasma-based reinterpretation of the vacuum. The potentials are: a scalar pressure potential $\Psi(\mathbf{x}, t)$ describing longitudinal modes, and a vector potential $\mathbf{A}(\mathbf{x}, t)$ describing vorticity.

Procedure:

1. Define $\mathbf{E}$ and $\mathbf{B}$ in terms of Ψ and $\mathbf{A}$.
2. Choose a natural gauge (Lorenz type).
3. Derive the wave equations for $\mathbf{E}$, $\mathbf{B}$, and the potentials.
4. Provide the physical interpretation.

Notation is consistent with the Quarkbase framework: Ψ denotes the classical pressure potential, and Φ the quantum field when relevant.

8 Field Identification: Emergence of E and B

Physical model:

- $\Psi(\mathbf{x}, t)$ — scalar pressure potential; its gradients produce longitudinal forces.
- $\mathbf{A}(\mathbf{x}, t)$ — vector potential associated with plasma vorticity.

The electromagnetic fields are defined as:

$$\boxed{\mathbf{E} = -\nabla\Psi - \frac{\partial \mathbf{A}}{\partial t}, \qquad \mathbf{B} = \nabla \times \mathbf{A}.} \tag{D1}$$

9 Field Equations and Charge Conservation

9.1 Gauss's Law

$$\nabla\cdot\mathbf{E} = \frac{\rho_{\text{eff}}}{\varepsilon_0}, \tag{5}$$

where ρ_{eff} denotes the effective density of plasma displacement induced by the local field. Using (D1):

$$-\nabla^2\Psi - \frac{\partial}{\partial t}(\nabla\cdot\mathbf{A}) = \frac{\rho_{\text{eff}}}{\varepsilon_0}. \tag{G}$$

9.2 Ampère–Maxwell Law

$$\nabla\times\mathbf{B} = \mu_0\mathbf{J}_{\text{eff}} + \mu_0\varepsilon_0\frac{\partial \mathbf{E}}{\partial t}, \tag{6}$$

and substituting (D1):

$$-\nabla^2\mathbf{A} + \nabla(\nabla\cdot\mathbf{A}) + \mu_0\varepsilon_0\frac{\partial^2\mathbf{A}}{\partial t^2} = \mu_0\mathbf{J}_{\text{eff}} - \mu_0\varepsilon_0\nabla\frac{\partial\Psi}{\partial t}. \tag{A}$$

9.3 Charge Conservation

$$\nabla\cdot\mathbf{J}_{\text{eff}} + \frac{\partial\rho_{\text{eff}}}{\partial t} = 0. \tag{C}$$

10 Natural Gauge Choice: Lorenz-Type Condition

$$\boxed{\nabla\cdot\mathbf{A} + \frac{1}{c^2}\frac{\partial\Psi}{\partial t} = 0.} \tag{Gau}$$

10.1 Wave Equations

$$\frac{1}{c^2}\frac{\partial^2\Psi}{\partial t^2} - \nabla^2\Psi = \frac{\rho_{\text{eff}}}{\varepsilon_0}, \tag{W_scalar}$$

$$\frac{1}{c^2}\frac{\partial^2\mathbf{A}}{\partial t^2} - \nabla^2\mathbf{A} = \mu_0\mathbf{J}_{\text{eff}}. \tag{W_vector}$$

11 Wave Equations for the Fields E and B

11.1 Magnetic Field

$$\frac{1}{c^2}\frac{\partial^2 \mathbf{B}}{\partial t^2} - \nabla^2 \mathbf{B} = \mu_0 \, \nabla \times \mathbf{J}_{\text{eff}}. \tag{W-B}$$

In vacuum: $\Box \mathbf{B} = 0$.

11.2 Electric Field

$$\frac{1}{c^2}\frac{\partial^2 \mathbf{E}}{\partial t^2} - \nabla^2 \mathbf{E} = -\frac{1}{\varepsilon_0}\nabla \rho_{\text{eff}} - \mu_0 \frac{\partial \mathbf{J}_{\text{eff}}}{\partial t}. \tag{W-E}$$

In vacuum: $\Box \mathbf{E} = 0$.

12 Longitudinal and Transverse Coupling

- **Transverse modes**: dominated by $\mathbf{A}$, corresponding to perturbations that propagate at the velocity c and describe photons.
- **Longitudinal modes**: associated with Ψ, representing compressional oscillations of the plasma. With screening, they satisfy a Klein–Gordon–type equation:

$$\frac{1}{c^2}\frac{\partial^2 \Psi}{\partial t^2} - \nabla^2 \Psi + \lambda^{-2}\Psi = \frac{\rho_{\text{eff}}}{\varepsilon_0}.$$

13 Physical Interpretation

- The vacuum behaves as an elastic medium in which transverse perturbations correspond to photons.
- Longitudinal perturbations are associated with static fields or with distributions of effective charge.
- If λ is finite, the photon acquires an effective mass; experimental limits impose λ to be extremely large.
- Possible implications include slight wave dispersion, propagation anisotropies, and controlled simulations in analogous plasmas.

14 Technological and Conceptual Perspectives

14.1 Communications and Vacuum Control

In principle, antennas or resonant cavities could be developed to directly excite pressure modes of the plasma, which would imply transmission with reduced losses and new forms of field coherence.

14.2 Energy Conversion and Storage

Resonant coupling with the modes of the medium could allow reversible energy exchange analogous to the Casimir effect. Anisotropic pressure configurations could generate directed forces without expelling mass.

14.3 Materials and Computation

If ε_0 and μ_0 are emergent properties of the plasma, materials with local control of these quantities could modify the speed of light or its direction of propagation, opening the possibility of optical circuits with negligible dissipation.

14.4 Biomedicine

Pressure interactions at the molecular scale could be investigated as a basis for non-invasive diagnostic or manipulation techniques.

14.5 Conclusion

The reinterpretation of Maxwell's framework within the **Quarkbase** theory preserves all of classical electrodynamics while assigning it a definite physical substrate: a continuous, frictionless plasma that supports both transverse (photon) and longitudinal (pressure) modes. This approach unifies the description of charges, fields, and waves under a single pressure dynamics, offering new avenues for experimental verification and for engineering of the vacuum.

14.6 Energy Conversion and Propulsion Concepts

Within the Quarkbase interpretation, magnetic phenomena correspond to rotational pressure flows of the etheric plasma. This suggests that dynamic asymmetries in those flows could, in principle, produce measurable forces without expelling reaction mass. Although speculative, the mechanism remains consistent with the conservation laws if the plasma itself provides the reaction counterpart through internal momentum exchange.

- **Resonant vacuum generators:** cavities designed to sustain standing pressure waves might enable reversible energy exchange with the etheric medium, analogous to a macroscopic Casimir effect.
- **Anisotropic pressure drives:** configurations that produce directional redistribution of pressure could generate thrust while preserving total momentum in the field–medium system.
- **Structured-field batteries:** energy stored as stable, localized pressure patterns (plasma solitons) could in principle allow lossless energy retention without thermal degradation.

These ideas should be regarded as theoretical possibilities subject to strict experimental validation. They follow naturally from the physical reinterpretation of electromagnetic stresses as manifestations of pressure and vorticity in a continuous medium.

14.7 Biomedical and Nanoscale Interactions

Matter at molecular and cellular scales is immersed in, and interacts with, the same plasma background that carries electromagnetic phenomena. The presence of this medium allows, at least conceptually, the development of diagnostic and control techniques based on its local reorganization.

- **Pressure-field imaging:** measurement of subtle reorganizations of the plasma surrounding biological structures could provide non-ionizing, high-resolution imaging modalities.
- **Molecular alignment control:** coherent modulation of pressure gradients may allow targeted reconfiguration of molecular bonds, suggesting pathways for precision protein or DNA manipulation without direct chemical intervention.

These interactions are expected to be extremely weak under ordinary conditions, but could become measurable in resonant environments or under coherent excitation of the plasma field.

14.8 Conceptual Horizons and Gravitational Coupling

Beyond electrodynamics, the same field formalism extends naturally to gravity if pressure curvature in the plasma medium replaces spacetime curvature as the effective source of gravitation. Although purely theoretical at this stage, the framework points toward several long-term research directions:

- **Gravitational–pressure lenses:** engineered regions of pressure curvature could locally modify the apparent weight of test masses or the trajectory of light.
- **Protective plasma interfaces:** controlled rearrangements of the pressure field might act as shielding structures against energetic particles or radiation.
- **Temporal synchronization phenomena:** if the plasma possesses global oscillatory modes, they might serve as natural frequency standards for precision metrology or time synchronization experiments.

14.9 Extended Conclusion

The reinterpretation of Maxwell's equations within the Quarkbase framework preserves classical electrodynamics while endowing it with a definite physical substrate: a continuous, frictionless plasma that supports both transverse (electromagnetic) and longitudinal (pressure) excitations. This unified description of charges, fields, and waves invites a broader experimental program aimed at detecting deviations from perfect vacuum behavior, exploring coupling between electromagnetic and pressure modes, and testing the possible mechanical properties of the etheric medium. Whether or not these effects prove observable, the theory provides a coherent mathematical structure that integrates classical and quantum aspects of field dynamics under a single pressure-based ontology.

References

[1] C. Omeñaca Prado, *Genesis Quarkbase: A New Genesis for Physics*, Figshare Preprint (2025).

[2] C. Omeñaca Prado, *Optical Absorption, Quantum Hall Effect, and Superconductivity in Graphene: An Interpretation from Quarkbase Cosmology*, Figshare Preprint (2025).

[3] J. C. Maxwell, *A Dynamical Theory of the Electromagnetic Field*, Philosophical Transactions of the Royal Society of London **155**, 459–512 (1865).

[4] J. D. Jackson, *Classical Electrodynamics*, 3rd ed. (Wiley, New York, 1999).

[5] H. B. G. Casimir, *On the Attraction Between Two Perfectly Conducting Plates*, Proc. K. Ned. Akad. Wet. **51**, 793–795 (1948).

[6] L. D. Landau and E. M. Lifshitz, *Electrodynamics of Continuous Media*, 2nd ed. (Pergamon Press, Oxford, 1984).