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# Principle of Scalar Electrodynamics Phenomena Proof and Theoretical Research

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**Abstract:** There exist a lot of controversial issues around the subject of SW (Scalar Waves) and the purpose of this white paper is to take an innovative theoretical approach to prove and backup up existence of such phenomena. We basically define this wave as a SLW (Scalar Longitudinal Wave), whose existence derives from the MCE (More Complete Electrodynamic) theory aspect of Maxwell's classical electrodynamic equations. MCE falls into the QED (Quantum Electrodynamic) aspect of the Maxwell's equations, in particular out of his four famous classical equations, our interest focuses on the one that is known to us as Faraday's Law of the Maxwell's Equation set.

**Key words:** Scalar wave, more complete Maxwell's equation, longitudinal wave, quantum electrodynamic, lagrangian and hamiltonian relationship.

## 1. Introduction

From a classical physics point of view, typically there are three kinds of waves:

(1) Mechanical waves (i.e. wave on string);

(2) EM (Electromagnetic) waves (i.e. $\vec{E}$ and $\vec{B}$ fields from Maxwell's Equations to deduce the Wave Equations, where these waves carry energy from one place to another);

(3) Quantum mechanical waves (i.e. using Schrödinger's Equation to study particle movement).

Note that a Soliton Wave is an exceptional case and should be addressed separately, since this wave falls into a different category than the three types defined above.

The second type wave in the above list (i.e. EM Waves) is the subject of our interest, which is consistent with the electric field $\vec{E}$ and the magnetic field $\vec{B}$. The EM Wave itself divides into two sub-categories as:

(A) Transverse waves;

(B) Longitudinal Pressure Waves, also known as SLW (Scalar Longitudinal Waves).

Of the above two waves, the SLW wave is the matter of interest and it is the subject of this white paper.

## 2. Description of Transverse and Longitudinal Waves

A wave is defined as a disturbance which travels through a particular medium. The medium is a material through which a wave travels from one location to another location. We can take as an example a slinky wave which can be stretched from one end to the other and comes to a static condition. This static condition is called its neutral condition or equilibrium state.

In the slinky coil, the particles move up and down and then come into their equilibrium state. This generates a disturbance in the coil which moves from one end to the other. This is the movement of a slinky pulse. This is a single disturbance in a medium from one location to another. If it is done continuously and in a periodical manner, then it is called a wave. These disturbances are also called energy transport waves. They are found in different shapes, showing different behaviors, and characteristic properties. They are classified mainly into two types that are longitudinal and transverse. Here we are discussing the longitudinal waves, their properties and examples. The movement

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of wave is parallel to direction of travel of the particles in these waves.

*2.1 Transverse Waves*

For transverse waves the displacement of the medium is perpendicular to the direction of propagation of the wave. A ripple on a pond and a wave on a string are easily visualized transverse waves (see Fig. 1).

Transverse waves cannot propagate in a gas or a liquid because there is no mechanism for driving motion perpendicular to the direction of propagation of the wave. In summary, a transverse wave is a wave in which the oscillation is perpendicular to the direction of wave propagation. EM waves (and Secondary-Waves (or S-Waves or Shear waves sometimes called an Elastic S-Waves) in general are transverse waves.

*2.2 Longitudinal Waves*

In longitudinal waves the displacement of the medium is parallel to the propagation of the wave. A wave in a "slinky" is a good visualization. Sound waves in air are longitudinal waves (see Fig. 2).

Therefore, a longitudinal wave is one in which the oscillation is in the direction of, or opposite to the direction of wave propagation. Sound waves [and Primary-Waves or (P-Waves) in general] are longitudinal waves. A wave motion in which the particles of the medium oscillate about their mean positions in the direction of propagation of the wave, is called a longitudinal wave.

## 3. What Are SLWs?

SLWs are conceived as longitudinal waves, similar to sound waves. Unlike the transversal waves of electromagnetism, which move up and down perpendicular to the direction of propagation, longitudinal waves vibrate in line with the direction of propagation. Transversal waves can be, observed in water ripples: the ripples move up and down as the overall waves move outward, such that there are two actions: one moving up and down, and the other propagating in a specific direction outward.

Technically speaking, scalar waves have magnitude but no direction, since they are, imagined to be the result of two EM waves that are 180 degrees out of phase with one another, which leads to both signals being canceled out. This results in a kind of "pressure wave".

Mathematical physicist James Clerk Maxwell, in his original mathematical equations concerning

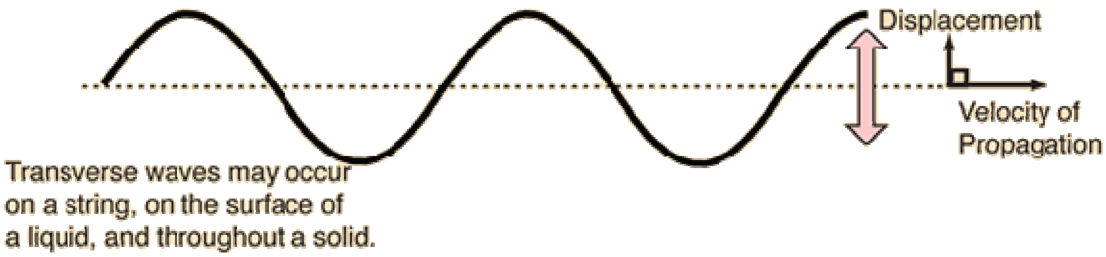


**Fig. 1 Depiction of a transverse wave.**

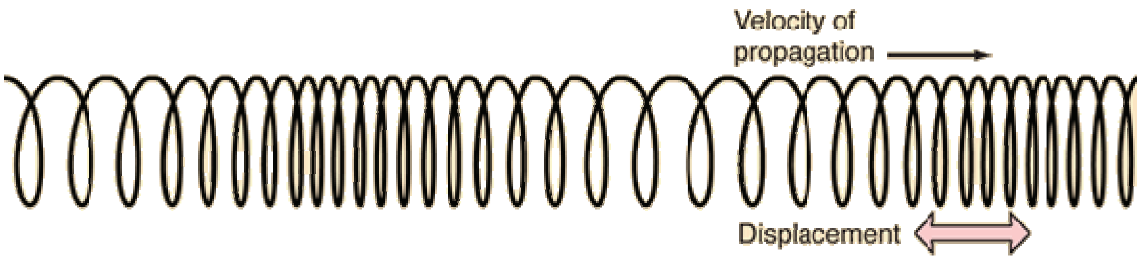


**Fig. 2 Depiction of a longitudinal wave.**

electromagnetism, established the theoretical existence of scalar waves. After his death, however, later physicists assumed these equations were meaningless, since scalar waves had not been observed, and they were not repeatedly verified by the scientific community at large.

Vibrational, or subtle energetic research, however, has helped advance our understanding of scalar waves. One important discovery states that there are many different types of scalar waves, not just those of the EM variety. For example, there are vital scalar waves (corresponding with the vital or "Qi" body), emotional scalar waves, mental scalar waves, causal scalar waves, and so forth. In essence, as far as we are aware, all "subtle" energies are, made up of various types of scalar waves.

Some general properties of scalar waves (of the beneficial kind) include:

- Seem to travel faster than the speed of light;
- Seem to transcend space and time;
- Cause the molecular structure of water to become coherently reordered;
- Positively increase immune function in mammals;
- Are involved in the formation process in nature.

It has been suggested that the scalar wave, as it was understood by some physicists and engineers in the field, is not an EM (electromagnetic) wave. An EM wave has both Electric ( $\vec{E}$ ) fields and Magnetic ( $\vec{B}$ ) fields and power flow in EM waves is by means of the Poynting vector, as Eq. (1) written below:

$$\vec{S} = \vec{E} \times \vec{B} \quad \text{Watts/m}^2 \tag{1}$$

The energy per second crossing a unit area whose normal is pointed in the direction of $\vec{S}$ is the energy in the EM wave.

A scalar wave has no time varying $\vec{B}$ field (In some cases, it also has no $\vec{E}$ field). Thus, it has no energy propagated in the EM wave form. It must be realized, however that any vector could be added that may be integrated to zero over a closed surface and Poynting theorem still applies. Thus, there is some ambiguity in even stating the relationship that is given by Eq. (1) for the total EM energy flow.

Therefore, based on above suggestion, the scalar wave could be accompanied by a vector potential $\vec{A}$. $\vec{E}$, and yet $\vec{B}$ remain zero in the far field.

From EM theory, one can write the following relationship:

$$\begin{cases} \vec{E} = -\vec{\nabla}\phi - \dfrac{1}{c}\dfrac{\partial \vec{A}}{\partial t} \\ \vec{B} = \vec{\nabla} \times \vec{A} \end{cases} \tag{2}$$

In this case $\phi$ in Eq. (2) is the scalar (electric) potential and $\vec{A}$ is the magnetic vector potential. The Maxwell's equations, then predict the following mathematical relations [1]:

$$\nabla^2 \phi - \frac{1}{c^2}\frac{\partial^2 \phi}{\partial t^2} = 0 \quad \text{(Scalar Potential Waves)} \tag{3}$$

$$\nabla^2 \vec{A} - \frac{1}{c^2}\frac{\partial^2 \vec{A}}{\partial t^2} = 0 \quad \text{(Vector Potential Waves)} \tag{4}$$

A solution appears to exist for the special case of $\vec{E} = 0$, $\vec{B} = 0$, and $\nabla \times \vec{A} = 0$, for a new wave satisfying the following relations.

$$\begin{cases} \vec{A} = \vec{\nabla} S \\ \phi = -\dfrac{1}{c}\dfrac{\partial S}{\partial t} \end{cases} \tag{5}$$

In Eq. (5), $S$ then satisfies the following relationship:

$$\nabla^2 S - \frac{1}{c^2}\frac{\partial^2 S}{\partial t^2} \tag{6}$$

Note that in Eq. (6) the quantity $c$ represents the speed of light.

Mathematically $S$ is a "Potential" with a wave equation, one that suggests propagation of this wave even through $\vec{E} = \vec{B} = 0$ and the Poynting theorem indicates no EM power flow.

From the above analyses, the suggestion is that there exists a solution to Maxwell's Equations involving a scalar wave with potential $S$ that can propagate without Poynting vector EM power flow. However, the question arises as to where the energy is drawn from to sustain such a flow of energy. Some suggesting a vector that integrates to zero over a closed surface might be added in the theory, as suggested above. Another is the possibility of drawing energy from the vacuum, assuming net energy could be drawn from "free space". Quantum electrodynamics allows random energy in free space but conventional EM theory has not allowed this to date. Random energy in free space that is built of force fields that sum to zero is a possible approach. If so, these might be a source of energy to drive the $S$ waves drawn from "free space". A number of engineers/scientists in the community have suggested that, if realizable, the scalar wave could represent a new form of wave propagation that could penetrate sea water or be used as a new approach for DEWs (directed energy weapons).

However, this author suggests considering a different innovative theoretical approach to prove mathematically, the existence of SLW, where we can take a look at the MCE (more complete electrodynamic) theory of Maxwell's Equations, especially Faraday's equation. In this schema, we generate an SLW, by deriving the Lagrangian Density Equation for the MCE. It can be written as [2]:

$$\pounds = -\frac{\varepsilon c^2}{4} F_{\mu\nu} F^{\mu\nu} + J_{\mu} A^{\mu} - \frac{\gamma \varepsilon c^2}{2}\left(\partial_{\mu} A^{\mu}\right)^2 - \frac{\varepsilon c^2 k^2}{2}\left(A_{\mu} A^{\mu}\right) \quad (7)$$

The Lagrangian Density Equation written in terms of the Potential $\vec{A}$ and $\phi$ then follows:

$$?_{EM} = \frac{\varepsilon c^2}{2}\left[\frac{1}{c^2}\left(\nabla\vec{\phi} + \frac{\partial \vec{A}}{\partial t}\right)^2 - \nabla \times \vec{A})^2\right] - \rho\vec{\phi} + \vec{J} \cdot \vec{A} - \frac{\varepsilon c^2}{2}\left(\underbrace{\frac{1}{c^2}\frac{\partial \vec{\phi}}{\partial t} + \nabla \cdot \vec{A}}_{C}\right)^2 \quad (8)$$

## 4. Proof of Principle of Scalar Electrodynamics and Theoretical Research

I am sure most of us have heard of scalar electrodynamics. However, we probably have many questions about this electrodynamic phenomenon. Since it has been up to now mostly shrouded in mystery, we may even wonder whether it exists at all; and if it exists, do we need exotic conditions to produce and use it, or will it require a drastic transformation in our current understanding of classical electrodynamics, or how much of an impact will it have on future modes of power generation and conversion, with applications in weaponry, medicine or a low energy fusion driven energy source (D + D reaction)?

There is also a possibility of applying such a SEW (scalar electrodynamics wave) to develop and demonstrate an AE (all-electronic) engine that would replace EM (electro-mechanical) engines for vehicle propulsion.

Second, a newly proposed application of this source of energy, might be of interest to the Special Warfare Group folks in the Navy, utilizing the SLW for underwater communications.

To clarify these issues, hopefully, we provide the answers to these and some other questions below. First is some helpful background material on where we are currently.

Our knowledge of the properties and dynamics of EM systems is believed to be the most solid and firmly established in all classical physics. By its extension to quantum electrodynamics, describing accurately the interaction of light and matter at the sub-atomic realm, has resulted in the most successful theoretical scientific theory to date, agreeing with corresponding experimental findings to astounding levels of precision. Accordingly, these developments have led to the belief among physicists that theory of classical electrodynamics is complete and that it is essentially a closed subject.

However, at least as far back to the era of Nikola Tesla, there have been continual rumblings of discontent stemming from occasional physical evidence from both laboratory experiments and observation of natural phenomena such as the dynamics of atmospheric electricity, etc., to suggest that in extreme situations involving the production of high energies at specific frequencies, there might be some cracks exposed in the supposed impenetrable monolithic fortress of classical/quantum electrodynamics, implying possible key missing theoretical and physical elements. Unfortunately, some of these observed phenomena have been difficult to replicate and produce on-demand. Moreover, some have been shown to apparently violate some of the established principles underlying classical thermodynamics. On top of that, many of those courageous individuals promoting study of these effects have couched their understanding of the limited reliable experimental evidence available from these sources, in language unfamiliar to the legion of mainstream technical specialists in electrodynamics, preventing clear communication of these ideas. Also, the various sources that have sought to convey this information have at times delivered contradictory statements.

It is therefore no wonder that for many decades, such exotic claims have been disregarded, ignored and summarily discounted by mainstream physics. However, due to important developments over the past two years, there has been a welcome resurgence of research in this area, bringing back renewed interest towards the certification of the existence these formerly rejected anomalous energy phenomena. Consequently, this renaissance of a serious enterprise in searching for specific weaknesses that currently plague a fuller understanding of electrodynamics, has propelled the proponents of this research to more systematically outline in a clearer fashion: (1) the possible properties of these dynamics, (2) how inclusion could change our current understanding of electricity and magnetism, as well as (3) suggesting implications for potential, vast, practical ramifications to the disciplines of physics, engineering and energy generation.

On this point, the incompleteness in our received understanding of the properties of electro-dynamical systems can be attributed to the failure to properly incorporate what can be termed—the electro-scalar force—in the structural edifice of electrodynamics. Unbeknownst to most specialists in the disciplines mentioned, over the last decade there has quietly but inexorably emerged bona fide physical evidence for the existence of scalar-longitudinal wave dynamics in recent inventions and discoveries. As technology leads to new understanding, at this point we are certainly rapidly approaching a time in which these findings can no longer be pushed aside or ignored by orthodox physics, and physics must come to terms with their potential physical and philosophical impacts on our world society. We could be on the brink of a new era in science and technology the likes of which this generation has never seen before. Despite what mainstream physics may claim, the study of electrodynamics is by no means a closed book.

It is the purpose of this effort paper to report on these unique, various recent inventions and their possible modes of operation, and to convince those listening of their value for hopefully directing a future program geared towards the rigorous clarification and certification, of the specific role the electroscalar domain might play in shaping a future, consistent, classical, electrodynamics. Also, by extension, to perhaps shed light on the current thorny conceptual and mathematical inconsistencies that do exist, in the present interpretation of relativistic quantum mechanics. In this regard, it is anticipated that by incorporating this more expansive electrodynamic model, that the source of the extant problems with gauge invariance in quantum electrodynamics and the subsequent unavoidable divergences in energy/charge, might be identified and ameliorated.

Not only does the electroscalar domain have the potential to address such lofty theoretical questions surrounding fundamental physics, but another aim of this effort is to show that the protocol necessary for generating these field effects may be present not only in exotic conditions involving large field strengths and specific frequencies involving expensive infrastructure such as the LHC (Large Hadron Collider), but as recent discoveries suggest, may be present in the physical manipulation of ordinary everyday objects. We will also see that nature has been and may be engaged in the process of using SLWs (scalar-longitudinal waves) in many ways as yet unsuspected and undetected by humanity. Some of these modalities of scalar wave generation to be investigated include the following: chemical bond-breaking, particularly as a precursor to seismic events (illuminating the study and development of earthquake early warning system), solar events (related to eclipses), and sunspot activity and how it impacts the Earth's magnetosphere. Moreover, this overview of the unique aspects of the electroscalar domain will suggest that many of the currently unexplained anomalies such as over-unity power observed in various energy devices, and exotic energy effects associated with LENRs (Low Energy Nuclear Reactions), may find some basis in fact. In regard to the latter "cold fusion" type scenarios, the electroscalar wave might be the actual agent needed to reduce the nuclear Coulomb barrier, thus providing the long sought for viable theoretical explanation of this phenomenon. Longitudinal electrodynamic forces in exploding wires, etc., may actually be due to the operation of electroscalar waves at the sub-atomic levels of nature. For instance, the extraordinary energies produced by Ken Shoulder's charge clusters (Footnote needed), may also be due to electroscalar mechanisms. Moreover, these observations, spanning as they do across many cross-disciplines of science, beg the question as to the possible universality of the SLW. The longitudinal electroscalar wave, not present in current electrodynamics, may represent a general, key, over-arching principle, leading to new paradigms in other sciences besides physics. This idea will also be explored, showing the possible connection of scalar-longitudinal (aka, electroscalar) wave dynamics to biophysical systems. Admittedly, we are proposing quite an ambitious agenda in reaching for these goals, but I think you will see that recent innovations will have proven equal to the task of supporting this quest.

Insight into the incompleteness of classical electrodynamics can begin with the Helmholtz theorem, which states that any sufficiently smooth three-dimensional vector field can be uniquely decomposed into two parts. By extension, a generalized theorem exists, certified through the recent scholarly work of physicist-mathematician Dale Woodside (2009) [3] (see Eq. (7) as well) for unique decomposition of a sufficiently smooth, Minkowski four-vector field (three spatial dimensions, plus time) into four-irrotational and four-solenoidal parts, together with the tangential and normal components on the bounding surface. With this background, the theoretical existence of the electroscalar wave can be attributed to failure to include certain terms in the standard, general, four-dimensional, electromagnetic, Lagrangian density that are related to the four-irrotational parts of the vector field. Here, $\varepsilon$ is electrical permittivity—not necessarily of the vacuum. Specifically, the electroscalar field becomes incorporated in the structure of electrodynamics, when we let in Eq. (7) for $\gamma$ = 1 and $k$ = $2\pi mc/\text{h}$ = 0. As we can see in this representation as Eq. (7), it is the presence of the third term that describes these new features.

We can see more clearly how this term arises by writing the Lagrangian density in terms of the standard EM scalar ($\phi$) (see Eq. (8)) and magnetic vector potentials (A), without the electroscalar representation included. This equation has zero divergence of the potentials (formally called solenoidal), consistent with classical electromagnetics, as we see here. The second class of four-vector fields has zero curl of the potentials (irrotational vector field), which will emerge once we add this scalar factor. Here we see it is represented by the last term, which is usually zero in standard classical electromagnetics. The expression in the parentheses, when set equal to zero, describes what is known as the Lorenz condition, which makes the scalar potential and the vector potential in their usual form, mathematically dependent on each other. Accordingly, the usual EM theory then specifies that the potentials may be chosen arbitrarily, based on the specific, so-called, gauge that is chosen for this purpose. However, the MCE theory allows for a non-zero value for this scalar-valued expression, essentially making the potentials independent of each other, where this new scalar-valued component (C in Eq. (8) that we may call it Lagrangian Density) is a dynamic function of space and time. It is this new idea of independence of the potentials, out of which the scalar value (C) derives, and from which the unique properties and dynamics of the SLW (scalar longitudinal electrodynamic) wave arise.

To put all this in perspective, a MCE model may be derived from this last equation of the Lagrangian density. The Lagrangian expression is important in physics, since invariance of the Lagrangian under any transformation gives rise to a conserved quantity. Now, as is well known, conservation of charge-current is a fundamental principle of physics and nature. Conventionally, in classical electrodynamics charged matter creates an $\vec{E}$ field. Motion of charged matter creates a magnetic $\vec{B}$ field from an electrical current which in turn influences the $\vec{B}$ and $\vec{E}$ fields.

Before continuing further then, consider:

| | | |
|---|---|---|
| $\vec{E} = -\nabla\phi - \frac{\partial \vec{A}}{\partial t}$ | Relativistic Covariance | (9) |
| $\vec{B} = \nabla \times \vec{A}$ | Classical Fields ($\vec{B}$ and $\vec{E}$) in terms of usual classical potentials ($\vec{A}$ and $\vec{\phi}$) | (10) |
| $C = \frac{1}{c^2}\frac{\partial \vec{\phi}}{\partial t} + \nabla \cdot \vec{A}$ | Classical wave equations for $\vec{A}$, $\vec{B}$ | (11) |
| $\nabla \times \vec{B} - \frac{1}{c^2}\frac{\partial \vec{E}}{\partial t} - \nabla C = \mu \vec{J}$ | $\vec{E}$ and $\vec{\phi}$ without the use of a gauge | (12) |
| $\nabla \cdot \vec{E} + \frac{\partial C}{\partial t} = \frac{\rho}{\varepsilon}$ | Condition (the MCE theory produces cancellation of $\partial C/\partial t$ and $-\nabla C$ in the classical wave equation for $\vec{\phi}$ and $\vec{A}$, thus eliminating the need for a gauge condition) | (13) |

These effects can be modeled by Maxwell's equations. Now, exactly how and to what degree do these equations change when the new scalar-valued $C$ field is incorporated. Those of you who are knowledgeable of Maxwellian theory will notice the two homogeneous Maxwell's equations—representing Faraday's law and $\nabla \cdot \vec{B}$ (standard Gauss law equation for divergence less magnetic field) are both unchanged from the classical model. Notice the last three equations incorporate this new scalar component which is labeled $C$. This formulation as defined by Eq. (11) creates a somewhat revised version of Maxwell's equations, with one new term $-\nabla C$ in Gauss' Law (Eq. (13)), where $\rho$ is the charge density, and one new term ($\partial C/\partial t$) in Ampere's Law (Eq. (12)), where J is the current density. We see these new equations lead to some important conditions. First, relativistic covariance is preserved. Second, the classical fields $\vec{E}$ and $\vec{B}$ are unchanged in terms of the usual classical potentials ($\vec{A}$ and $\vec{\phi}$). We have the same classical wave equations for $\vec{A}$, $\vec{\phi}$, $\vec{E}$ and $\vec{B}$ without the use of a gauge condition (and its attendant incompleteness). The MCE theory shows cancellation of $\partial C / \partial t$ and $-\nabla C$ in the classical wave equations for $\vec{\phi}$ and $\vec{A}$. And an SLW (scalar-longitudinal wave) is revealed, composed of the scalar and longitudinal-electric fields.

A wave equation for C is revealed by use of the time derivative of Eq. (13), added to divergence of Eq. (12). Now, as is known, matching conditions at the interface between two different media are required to solve Maxwell's equations. The divergence theorem by Eq. (14) will yield interface matching in the normal component ("n") of $\nabla C / \mu$ as shown in Eq. (15).

$$\frac{\partial^2 C}{\partial c^2 t^2} - \nabla^2 C \equiv \Box^2 C = \mu \left( \frac{\partial \rho}{\partial t} + \nabla \cdot \vec{J} \right) \quad (14)$$

$$\left( \frac{\nabla C}{\mu} \right)_{1n} = \left( \frac{\nabla C}{\mu} \right)_{1n} \quad (15)$$

$$C = C_0 \exp[j(kr - \omega t)] / r \quad (16)$$

Note: The above set of Eqs. (14) and (15) are presenting a Wave Equation for Scalar Factor $C$ matching condition in Normal Component of $\nabla C / \mu$, a Spherically Symmetric Wave Solution for $C$.

The subscripts in Eq. (15) denote $\nabla C / \mu$ in medium 1 or medium 2, respectively ($\mu$) is magnetic permeability—again not necessarily that of the vacuum). In this regard, with the vector potential ($\vec{A}$) and scalar potential ($\vec{\phi}$) now stipulated as independent of each other, it is the surface charge density at the interface which produces a discontinuity in the gradient of the scalar potential, rather than the standard discontinuity in the normal component of $\vec{E}$ (see Hively's paper, for further details (reference)). Notice also from Eq. (14), the source for the scalar factor C implies a violation of charge conservation (RHS (Right Hand Side) non-zero), a situation which we noted cannot exist in macroscopic nature. Nevertheless, this will be compatible with standard Maxwellian theory if this violation occurs at very short time scales, such as occurs in sub-atomic interactions. Now, interestingly, with the stipulation of charge conservation on large time scales, giving zero on RHS of Eq. (8), longitudinal wave-like solutions are produced with the lowest order form in a spherically symmetric geometry at a distance (r), $C = C_0 \exp[j(kr - \omega t)] / r$. Applying the boundary condition, $C \to 0$ as $r \to \infty$ is thus trivially satisfied. The $C$ wave therefore, is a pressure wave, similar to that in acoustics and hydrodynamics. This is unique under the new MCE model since, although classical electrodynamics forbids a spherically symmetric transverse wave to exist, this constraint will be absent under MCE theory. Also, an unprecedented result is that these longitudinal $C$ waves will have energy but no momentum. But, this is not unlike charged particle-antiparticle fluctuations which also have energy but no net momentum.

Now the question is why this constraint prohibiting a spherically symmetric wave is lifted in MCE. The answer can be seen in the following sets of Eq. (17) below for the wave equation for the vertical magnetic field.

$$\begin{cases} \dfrac{1}{c^2}\dfrac{\partial^2 \vec{B}}{\partial t^2} - \nabla^2 \vec{B} = \mu_0 \left( \nabla \times \vec{J} \right) \\ \nabla \times \vec{J} = 0 \quad \to \quad J = \nabla \kappa \\ \text{Gradient - Driven Current} \to \text{SLW} \end{cases} \quad (17)$$

The set of Eq. (17) is established for the Wave Equation for $\vec{B}$ Resulting Gradient-Driven Current in MCE for generating the SLW.

Notice again, the source of the magnetic field (Right Hand Side (RHS)) is a non-zero value of $\nabla \times \vec{J}$, which signifies solenoidal current density, as is the case in standard Maxwellian theory. When $\vec{B}$ is zero, so is $\nabla \times \vec{J}$. This is an important result. Then the current density is irrotational, which implies that $J = \nabla \kappa$. Here $\kappa$ is a scalar function of space and time. Thus, in contrast to the closed current paths generated in ordinary Maxwell theory which result in classical waves that arise from a solenoidal current density ($\nabla \times \vec{J} \neq 0$), $J$ for the SLW is gradient-driven and may be uniquely detectable. We also see from this result that a zero value of the magnetic field is a necessary and sufficient condition for this gradient-driven current. Now, since in linearly conductive media, the current density ($\vec{J}$) is directly proportional to the electric field intensity ($\vec{E}$) that produced it (where $\sigma$ is the conductivity, this does not appear to be relevant) this gradient driven current will then produce a longitudinal $\vec{E}$-field.

Based on the calculations so far, we can establish, the Wave Equation for the $\vec{E}$ solution is a Longitudinal $\vec{E}$ in MCE and gives Spherically Symmetric wave solutions for $\vec{E}$ and $\vec{J}$ in linearly conductive media.

$$\frac{\partial^2 \vec{E}}{\partial c^2 t^2} - \nabla^2 \vec{E} = \left( \frac{\partial^2}{\partial c^2 t^2} - \nabla^2 \right) \vec{E} \equiv \Box^2 \vec{E} = -\mu \frac{\partial \vec{J}}{\partial t} - \frac{\nabla \rho}{\varepsilon} \tag{18}$$

$$E = E_r \hat{r} \exp[j(kr - \omega t)] / r \tag{19}$$

$$\vec{J} = \sigma \vec{E} \quad \rightarrow \quad \Box^2 \vec{J} = 0 \tag{20}$$

We can also see this from examining the standard vector wave equation for the electric field. The wave equation for $\vec{E}$ (Eq. (18)) arises from the curl of Faraday's law, use of $\nabla \times \vec{B}$ from Ampere's law Eq. (6) and substitution of $\nabla \cdot \vec{E}$ from Eq. (18) with cancellation of the terms $\nabla(\partial C / \partial t) = (\partial / \partial t)\nabla C$. When the RHS of Eq. (13) is zero, the lowest order, outgoing spherical wave is $E = E_r \hat{r} \exp[j(kr - \omega t)] / r$, where $\hat{r}$ represents the unit vector in the radial direction and r represents the radial distance. The electrical field is also longitudinal. Substitution of $\vec{J} = \sigma \vec{E}$ into $\Box^2 \vec{E} = 0$ (Laplacian?) results in $\Box^2 \vec{J} = 0$, meaning that current density is also radial. The SLW equations for $E$ and $J$ are remarkable for several reasons. First, the vector SLW equations for $\vec{E}$ and $\vec{J}$ are fully captured in one wave equation for the scalar function $(\kappa)$, $\Box^2 \kappa = 0$. Second, these forms are like $\Box^2 C = 0$. Third, these equations have zero on the RHS for propagation in conductive media. This arises since $\vec{B} = 0$ for the SLW, implying no back EM field from $\partial \vec{B} / \partial t$ in Faraday's law which in turn gives no circulating eddy currents. Experimentation has shown that the SLW is not subject to the skin effect in media with linear electric conductivity, and travels with minimum resistance in any conductive media.

This last fact affords some insight into another related on-going conundrum in condensed matter physics—the mystery surrounding high temperature superconductivity (HTS). As we know, the physical problem of HTS is one of the major unsolved problems in theoretical condensed matter physics, in part, because the materials are somewhat complex, multi-layered crystals.

Here the MCE theory may provide an explanation on the basis of gradient-driven currents between (or among) the crystal layers. The new MCE Hamiltonian (Eq. (16)) includes the SLW due to gradient-driven currents among the crystalline layers as an explanation for HTS.

The Electrodynamic Hamiltonian for MCE is written as:

$$\mathcal{H}_{EM} = \left( \frac{\varepsilon E^2}{2} + \frac{B^2}{2\mu} \right) + \left( \rho - \varepsilon \nabla \cdot \vec{E} \right) \vec{\phi} - \vec{J} \cdot \vec{A} + \frac{C^2}{2\mu} + \frac{C \nabla \cdot \vec{A}}{\mu} \tag{21}$$

In conclusion we can build an antenna based on the above concept within the laboratory environment and use simulation software such as Multi-Physics COMSOL or the ANSYS computer code to model such an antenna.

Therefore, we have provided adequate analysis in this effort to show the field of electrodynamics (classical and quantum), although considered to be totally understood, with any criticisms of incompleteness on the part of dissenters essentially taken as veritable heresy, nevertheless needs re-evaluation in terms of apparent unfortunate sins of omission in the failure to include an electroscalar component. Anomalies previously not completely understood may get a boost of new understanding from the operation of electroscalar energy. We have seen this in the three instances examined—the mechanism of generation of seismic precursor electrical signals due to the movement of the Earth's crust, the ordinary peeling of adhesive tape, as well as irradiation by the special TESLAR chip, the common feature of the breaking of chemical bonds (needs a reference or references). In fact, we may ultimately find that any phenomena requiring the breaking of chemical bonds, in either inanimate or biological systems, may actually be scalar-wave mediated.

Thus, we may discover that the scientific disciplines of chemistry or biochemistry may be more closely related to physics than is currently thought. Accordingly, the experimental and theoretical re-evaluation of even the simplest phenomena in this regard, such as tribo-electrification processes described above, is of the absolute essence for those researchers knowledgeable of the necessity for this re-assessment of electromagnetics. As stated in the introduction, it may even turn out that the gradient-driven current and associated scalar-longitudinal wave could be the umbrella concept under which many of the currently unexplained electrodynamic phenomena that are frequently under discussion in our conferences might find a satisfying explanation. The new SLW patent itself—which is the centerpiece of this talk—is a primary example of the type of invention that probably would not have seen the light of day even ten years ago. As previously mentioned, we are seeing more of this inspired breakthrough technology based on operating principles formerly viewed with rank skepticism bordering on haughty derision by mainstream science, now surfacing to provide an able challenge to the prevailing worldview by reproducible corroborating tests by independent sources. This revolution in the technological witness to the overhaul of current orthodoxy is definitely a harbinger of the rapidly approaching time where many of the encrusted and equally ill-conceived still accepted paradigms of science, thought to underpin our sentient reality—will fall by the wayside. On a grander panoramic scale, our expanding knowledge gleaned from further examining the electroscalar wave concept, as applied to areas of investigation such as cold fusion research, over-unity power sources, etc., will explicitly shape the future of society as well as science, especially concerning our openness to phenomena that challenge our current belief systems.

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