Generalised Classical Electrodynamics for the prediction of scalar field effects

'the theoretical background of Tesla's longitudinal electric waves, electrostatic energy, the Hutchison effect, and more'

Koen van Vlaenderen
Electrical engineer, ME
Alkmaar, The Netherlands
kovavla@zonnet.nl

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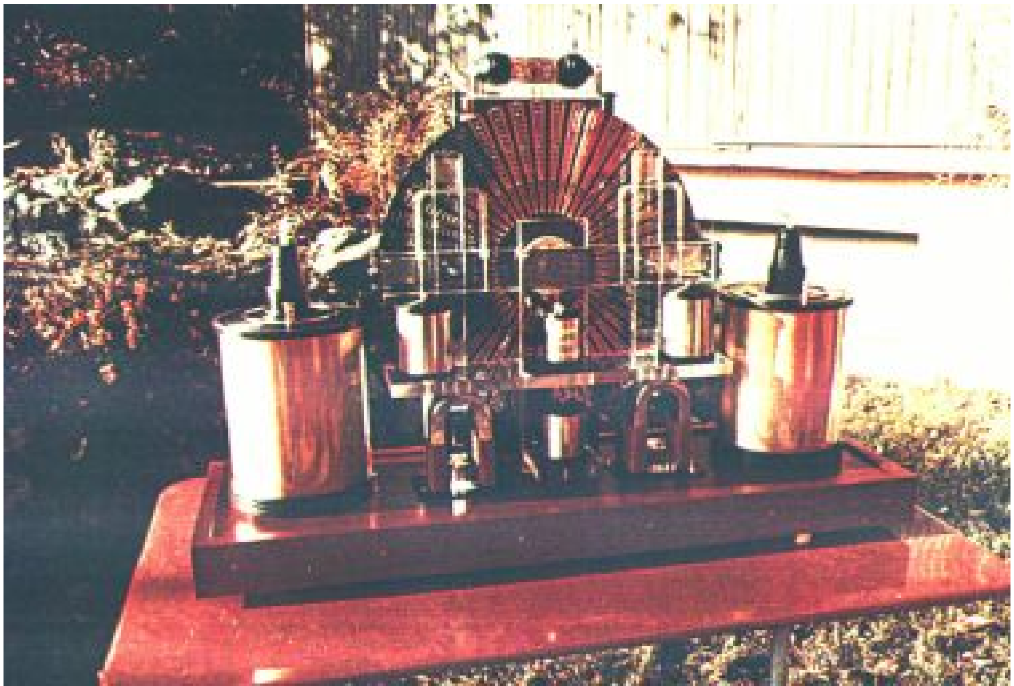
Introduction



The internet provides information about Tesla's energy technology and free energy devices in general, for instance the

Swiss Testatika machine, see picture. This information has been kept secret for civilians for almost a century. Officially, the longitudinal electric Tesla waves, electrostatic energy flow and electrodynamical overunity devices, are nonexistent. Yet more and more people are convinced these phenomena exist. What seems missing is a consistent mathematical theory that offers a rational explanation for this very important technology. There are many ideas and most of them are not expressed in exact mathematical form or do not have a clear relation with mainstream science. On the other hand, the official scientific theories do not offer much explanation either, with the exception of Stochastic ElectroDynamics (SED) that defines the Zero Point Field (ZPF) as a natural energy resource. The popular ideas of Tom Bearden about free energy devices are not expressed in the form of a single consistent and exact theory; his ideas are often inconsistent and raise many questions. Another Tesla researcher, prof. Constantin Meyl, has described an altered electrodynamics theory that is mathematically inconsistent, as outlined and proven by dr. Bruhn.

The Swiss electrical engineer Andre Waser and I published a paper in Hadronic press about an generalisation of classical electrodynamics theory that includes a scalar field. This enabled us to define a new class of longitudinal vacuum waves, the energy flow vector of these waves, electrostatic energy conversion, and a longitudinal force that acts on current elements. My second paper on this subject is presented here, and it has been published also in the following book: 'Has the last word said about Electrodynamics'? This book presents a collection of scientific papers edited by A. Chubykalo and V. Onoochin. This theory offers consistent answers to the question: what are the basic principles of static charge based free energy devices?

The scalar field: a 7th field component

Oliver Heaviside reduced Maxwell's equations to a few vector/scalar equations of 6 field components. Heaviside did not like the concept of electromagnetic potentials, because these potentials are unphysical and abstract in comparison with the “measurable” fields. Yet the potentials are very useful in order to simplify many calculations and useful for the prediction of new physical effects, such as the Aharonov-Bohm effect. Here it is shown that extra scalar field terms, that are defined in terms of the electromagnetic potentials, can be added to the Maxwell/Heaviside field equations of Classical Electrodynamics (CED). The scalar field is introduced in the spirit of Oliver Heaviside, who stressed the importance of fields, and of James Clerc Maxwell, who predicted vacuum waves by adding a new displacement current term to the Ampère law.

First we define the fields in terms of the electromagnetic potentials Φ and $\mathbf{A}$.

$$-\nabla\Phi - \frac{\partial \mathbf{A}}{\partial t} = \mathbf{E} \quad \text{the electric field} \qquad (1)$$

$$\nabla \times \mathbf{A} = \mathbf{B} \quad \text{the magnetic field} \qquad (2)$$

$$-\lambda_0 \varepsilon_0 \mu_0 \frac{\partial \Phi}{\partial t} - \nabla \cdot \mathbf{A} = S \quad \text{the scalar field, a seventh field component} \quad (3)$$

The official theory of electrodynamics presumes that always S=0, and this is called "*gauge condition*". When λ_0= 0 and S=0 this is known as the Coulomb gauge, and when λ_0= 1 and S=0 this is known as the Lorentz gauge condition. Gauge conditions, however, are based on *circular* arguments that seem to prove the arbitrariness of the electromagnetic potentials. The hidden question, does scalar field S have physical meaning (or can S be useful in order to describe observable phenomena), cannot be answered without relevant experimentation. Therefore the usual circular arguments that seem to validate these gauge conditions should be rejected as an unscientific theoretical development that is not based on empirical evidence. In order to predict possible electroscalar field effects, I evaluated a generalisation of CED that includes scalar field S in all the equations. Amazingly, the predicted electroscalar effects are in qualitative agreement with Nikola Tesla's ideas observations of longitudinal electric waves and electrostatic power phenomena.

The following decoupled inhomogeneous potential wave equations (ρ is charge density, **J** is current density).

$$\lambda_0 \varepsilon_0 \mu_0 \frac{\partial^2 \Phi}{\partial t^2} - \nabla^2 \Phi = \frac{\rho}{\varepsilon_0} \quad (4)$$

$$\varepsilon_0 \mu_0 \frac{\partial^2 \mathbf{A}}{\partial t^2} + \nabla \times \nabla \times \mathbf{A} - \frac{1}{\lambda_0} \nabla \nabla \cdot \mathbf{A} = \mu_0 \mathbf{J} \quad (5)$$

together with two extra vector identities ($\nabla \cdot \nabla \times \mathbf{A} = 0$ and $\nabla \times \nabla \Phi = \mathbf{0}$) , can be rewritten into the Maxwell/Heaviside field equations with extra scalar field terms:

$$\nabla \cdot \mathbf{E} - \frac{\partial S}{\partial t} = \frac{\rho}{\varepsilon_0} \quad \text{generalised Gauss law} \quad (6)$$

$$\nabla \cdot \mathbf{B} = 0 \quad (7)$$

$$\frac{\partial \mathbf{B}}{\partial t} + \nabla \times \mathbf{E} = \mathbf{0} \quad \text{Faraday's law} \quad (8)$$

$$\nabla \times \mathbf{B} + \frac{1}{\lambda_0} \nabla S - \varepsilon_0 \mu_0 \frac{\partial \mathbf{E}}{\partial t} = \mu_0 \mathbf{J} \quad \text{generalised Ampère law} \quad (9)$$

The standard textbook procedure is vice verse: first one descibes a gauge condition (S=0), then these S terms can be added to the field equations (because these terms are zero) in order to decouple the electromagnetic potentials. The generalised field equations are gauge variant, since it is assumed that field S is not zero in general and related to physical effects. Standard CED is considered a special case: S=0. Note that the longitudinal wave solutions of the decoupled potential wave equations also depend on λ_0. The speed of the phase velocity of the electric potential waves and longitudinal magnetic potential waves is $v = 1/\sqrt{(\lambda_0\varepsilon_0\mu_0)}$. For lim $\lambda_0\downarrow 0$ these waves have infinite speed (immediate action at a distance), and for $\lambda_0 = 1$ these waves have speed c, also known as the retarded potentials. In reality, λ_0 can have a value between 0 and 1 for vacuum, which means that these waves have superluminal finite speed, as claimed by several scientists.

The addition of the factors $\partial_t\mathsf{S}$ and $(1/\lambda_0)\nabla\mathsf{S}$ to the field equations is not unlike the addition of the displacement current term $\varepsilon_0\mu_0\, \partial_t\mathbf{E}$ by Maxwell, which lead to the prediction of the transversal electromagnetic wave. In Maxwell's days there was discussion about the necessity of the electromagnetic fields: Weber's force law explained all known electrodynamical effects without the need of electromagnetic fields. However, the prediction and discovery of the TEM wave showed the physical relevance of the field concept and Maxwell's theory. The same discussion can be raised about the physical meaning of the electromagnetic potentials, with special consideration for the longitudinal wave solutions. It is very strange that this discussion is avoided by assuming arbitrary gauge conditions. One speaks of the 'unphysical' longitudinal and 'unphysical' time-like wave solutions, while Maxwell's prediction of the transversal electromagnetic wave is considered to be one of the most important developments in modern science. Apparently, Galilei's natural philosophy of *empirical* science was neglected by mainstream physicists, especially when Tesla's observations of longitudinal electric waves were considered to be “impossible”.

In the following paragraphs I show that the addition of the factors $\partial_t\mathsf{S}$ and $(1/\lambda_0)\nabla\mathsf{S}$ leads to the prediction of longitudinal electroscalar waves and other scalar field effects.

The induction of scalar fields

The following inhomogeneous field wave equations can be derived from the generalised field equations:

$$\varepsilon_0\mu_0 \frac{\partial^2\mathbf{E}}{\partial t^2} + \nabla\times\nabla\times\mathbf{E} - \frac{1}{\lambda_0}\nabla\nabla\cdot\mathbf{E} = -\mu_0\frac{\partial\mathbf{J}}{\partial t} - \frac{\nabla\rho}{\lambda_0\,\varepsilon_0} \qquad (10)$$

$$\varepsilon_0\mu_0 \frac{\partial^2\mathbf{B}}{\partial t^2} + \nabla\times\nabla\times\mathbf{B} = \mu_0\nabla\times\mathbf{J} \qquad (11)$$

$$\varepsilon_0\mu_0 \frac{\partial^2 S}{\partial t^2} - \frac{1}{\lambda_0}\nabla\cdot\nabla S = -\mu_0\left(\nabla\cdot\mathbf{J} + \frac{\partial\rho}{\partial t}\right) \qquad (12)$$

First note that the electric field now has a longitudinal waves solution for vacuum, with speed $v = 1/\sqrt{(\lambda_0\varepsilon_0\mu_0)}$, as described by Nikola Tesla, also see the next paragraph. In case $\lambda_0\downarrow 0$, then equation (10) becomes the well known equation $\nabla\nabla\cdot\mathbf{E} = (1/\varepsilon_0)\nabla\rho$. Therefore we can interprete Gauss' law as an inhomogeneous wave equation with wave solutions that have infinitely high speed, or in other words: immediate action at a distance. In order to arrive at this conclusion the Coulomb gauge condition is not required! Physical reality, however, can differ from this picture, such that a static potential only appears to be static, while in reality the “static” potential is based on waves with very high finite speed.

Classically, the law of charge continuity is assumed to be valid, then the scalar field is always a solution of the homogeneous wave equation, see equation (12). However, the conservation of charge is locally violated in the situation of *tunneling* charges, therefore the non-classical electron tunneling can be a source for inhomogeneous scalar field S solutions. Also, the electron (or some other elementary particle) charge might tunnel internally, which means that the electron charge density is not constant in time, and also produces a scalar field, see also the next paragraph. Another possibility for inducing scalar fields waves is by means of a *charge density wave* (CDW) or a *longitudinal current density wave* (LCDW). To illustrate this, set fields **E=0** and **B=0** in the Maxwell equations, then the following equation can be deduced, by eliminating the S terms:

$$\nabla\rho + \lambda_0\varepsilon_0\mu_0 \frac{\partial \mathbf{J}}{\partial t} = \mathbf{0}$$

By combining this equation with the charge continuity equation:

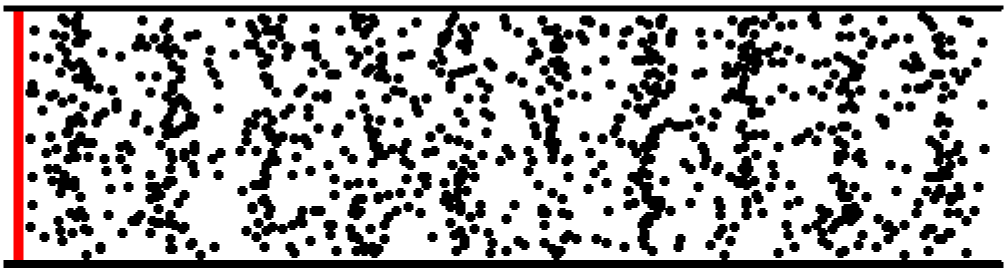
$$\nabla\cdot\mathbf{J} + \frac{\partial\rho}{\partial t} = 0$$

the following charge density and current density wave equations are derived:

$$\lambda_0\varepsilon_0\mu_0 \frac{\partial^2\rho}{\partial t^2} - \nabla\cdot\nabla\rho = 0$$

$$\lambda_0\varepsilon_0\mu_0 \frac{\partial^2\mathbf{J}}{\partial t^2} - \nabla\nabla\cdot\mathbf{J} = 0$$

The solutions of these equations are CDW and LCDW. Such waves can induce a homogeneous scalar field wave, and vice verse, the internal forces in a CDW and LCDW can solely be a scalar field interaction. In ordinary room-temperature copper wires, the electron transport has a thermic nature; there is a net movement of electrons, and the charge/current density in each wire cross section is constant. Gustaf Kirchhoff already described a century ago in his paper " On the motion of electricity in conductors" the two possibilities for electron transport in conductors: LCDWs or a thermic net movement of electrons. This theory of electrodynamics with extra scalar field actually *predicts* a LCDW scalar wave, and it would be interesting to look for LCDWs in conductors at room temperature. For instance, Avramenko's single wire transmission line might carry a LCDW, see animated gif.



Consider the definition of scalar field S, see equation (3). In most situations the scalar field component $\lambda_0\varepsilon_0\mu_0\, \partial_t\Phi$ is not strong enough to overcome the small factor $\varepsilon_0\mu_0 = 1.11\cdot10^{-17}$ s^2/m^2. Only a rapidly fluctuating source of high voltage, such as a pulsed power system, can induce scalar field effects that are *noticeable*. Also the other scalar field component, $\nabla\cdot\mathbf{A}$ is not very common, since this scalar field component is induced by *diverging* or *converging* currents. Usually one expects induced magnetic fields, for example by rotating currents. Since wires are thought of as one dimensional objects, one does not look for effects caused by diverging current (except for the "undesirable" skin effect). One can use capacitors of large metal surfaces, flat or spherical, in order to create a divergent current. In most modern capacitors currents cannot diverge and therefore cannot induce noticeable scalar fields effects. A fine example of diverging current are discharge tubes. In such tubes diverging discharges occur from a central electrode to a surrounding cylindrical metal hull. Another example: in Tesla's pancake coil currents diverge from a central point, or converge to a central point, and therefore the pancake coil might also be a source of scalar fields. The divergence factor of currents in a charge/current density wave is non-zero, therefore a CDW might be quite stable via some sort of scalar field self-induction. If one can measure scalar field effects that are no longer predicted by standard CED (such as a longitudinal electrodynamical force), then we have to accept that S is as real as the electric or magnetic field.

The Coulomb near field, the deBrogly wave, and charge stability

A new type of longitudinal wave solution can be found by setting $\mathbf{B} = \mathbf{0}$ and $\mathbf{J} = \mathbf{0}$.

$$\nabla\cdot\mathbf{E} - \frac{\partial S}{\partial t} = \frac{\rho}{\varepsilon_0} \qquad (13)$$

$$\nabla\times\mathbf{E} = \mathbf{0} \qquad (14)$$

$$\nabla S - \lambda_0\varepsilon_0\mu_0\frac{\partial\mathbf{E}}{\partial t} = \mathbf{0} \qquad (15)$$

From these equations two wave equations for the electric field and scalar field can be derived:

$$\lambda_0 \varepsilon_0 \mu_0 \frac{\partial^2 \mathbf{E}}{\partial t^2} - \nabla \nabla \cdot \mathbf{E} = -\frac{1}{\varepsilon_0} \nabla \rho \qquad (16)$$

$$\lambda_0 \varepsilon_0 \mu_0 \frac{\partial^2 S}{\partial t^2} - \nabla \cdot \nabla S = -\lambda_0 \mu_0 \frac{\partial \rho}{\partial t} \qquad (17)$$

The Coulomb field

For vacuum ($\rho = 0$) the solution of these wave equations can be described as a longitudinal electro-scalar wave (LES wave), or Tesla wave. The energy flow of this wave is likely to be proportional to $\mathbf{E}S$, similar to the Poynting vector $\mathbf{E} \times \mathbf{B}$ that represents the energy flow of TEM waves. This will be proven in the next section. Usually one sees the Coulomb field as a non-radiative near field. E.T. Whittaker showed that any 1/r scalar potential can be decomposed into a set of potential waves, in "On the partial differential equations of mathematical physics"page 355. The modified Gauss' law (with its extra scalar field term) contributes to Whittaker's point of view: it can be used to define the energy flow associated with these Whittaker waves. The *gradient* of the Whittaker electric potential waves are longitudinal electric waves, and the *time derivative* of the Whittaker electric potential waves are scalar field waves. Tom Bearden's reference to "Whittaker's infolded hidden EM structure in the scalar potential" is mathematically wrong, because there is no magnetic field component. Therefore, the Whittaker wave decomposition of a Coulomb potential, into a set of potential waves, gives rise to a hidden $\mathbf{E}S$ energy flow of Tesla LES waves. These LES waves are *radiative far field waves* that *cancel* each other at the long range, which results into the Coulomb near field.

The wave nature of particles

There are several formalisms that describe the wave nature of elementary particles (the deBrogly wave): quantum theory, Bohm's deterministic theory, stochastic electrodynamics. I would like to add another option: the dynamical interaction with a background of LES waves with a particle. This can explain the particle's wave nature, and it also gives rise to its Coulomb field. The charge density within the particle volume is not static, otherwise $\partial_t \rho$ would be zero, and then the charge could not be a source of scalar field S. Consequently, I assume the internal charge/currents of a charged particle are *discontinuous*, such that it is also a source of scalar fields, see equation (12). The ordering of the random phases in the LES wave spectrum results into a phase-ordered Whittaker wave spectrum that form the Coulomb potential and the Coulomb field. Particles that do not order the phases of the externally interacting background LES radiation, simply appear to be electrically neutral. While SED assumes a fibrating point particle of constant charge density that interacts with a background of random TEM waves, I assume that the particle has internal charge density fluctuations such that it can order the random phase of the interacting LES wave spectrum, which causes an observable Coulomb field.

The stability of charged particles

According to classical electrodynamics, any charged particle (positive or negative) should be unstable, because of the repelling internal electric field Coulomb forces. For instance, the EV cluster discovered by Ken Shoulders which is a stable electron cluster where the number of electrons in the order of Avogadro's number, cannot be stable in standard theory. The question of the charged particle stability can only be solved classically by considering other non-electric forces, such as the magnetic field and scalar field forces. Harold Aspden assumed that the EV cluster forms a current ring with a self-induced magnetic field that further confines the EV cluster in space. This model has been criticized by Constantin Meyl: “a magnetic field cannot confine the EV cluster, because an extra a longitudinal force is required for the spacial confinement of the EV cluster”. I think C. Meyl is right here. Suppose the charge explodes and starts to *diverge* very rapidly, then this might induce a scalar field. For an electron cluster explosion the induced S field is positive ($S = -\nabla\cdot\mathbf{A} > 0$) and this induces a longitudinal scalar field force $\mathbf{F} = q\mathbf{v}S$ (see next paragraph for the derivation of the scalar field force). The direction of this force points into the opposite direction of the electron velocity vector, since q is negative. This means that the electron is decellerated, stopped, and then accelerated towards the EV cluster center point. This means that the scalar field force converges the electrons until the Coulomb force becomes dominant. Then the electrons start to diverge again, then converge, etc.... which is a dynamical stable EV cluster. According to this model, the charge density of the EV cluster is wave-like, swinging between a minimum and maximum charge density.

Extended power/force theorems

The addition of the S field terms in the Maxwell equations makes it possible to generalise the electrodynamical power- and force theorems. First it is necessary to introduce a charge/current density gauge transformation:

$$\rho \quad \rightarrow \quad \rho' = \rho + \varepsilon_0 \frac{\partial S}{\partial t} \qquad (18)$$

$$\mathbf{J} \quad \rightarrow \quad \mathbf{J}' = \mathbf{J} - \frac{1}{\lambda_0 \mu_0} \nabla S \qquad (19)$$

This transformation transforms the Maxwell/Heaviside equations into the more general field equations (6-9), and it is very similar qua mathematical form to the potential gauge transformation. The time derivative and the gradient of the scalar field can be understood as an additional massless charge/current density in space, which restores the gauge symmetry. The charge/current density transformation can also be applied to generalize the power and force theorems of classical dynamics. These theorems are:

Power theorem, in differential form	$-\mathbf{J}\cdot\mathbf{E} = \frac{\varepsilon_0}{2}\frac{\partial(E^2)}{\partial t} + \frac{1}{2\mu_0}\frac{\partial(B^2)}{\partial t} + \frac{1}{\mu_0}\nabla\cdot(\mathbf{E}\times\mathbf{B})$	(20)
Force theorem, in differential form	$\rho\mathbf{E} + \mathbf{J}\times\mathbf{B} = \varepsilon_0\left((\nabla\cdot\mathbf{E})\mathbf{E} + (\nabla\times\mathbf{E})\times\mathbf{E}\right) + \frac{1}{\mu_0}(\nabla\times\mathbf{B})\times\mathbf{B} - \varepsilon_0\frac{\partial(\mathbf{E}\times\mathbf{B})}{\partial t}$	(21)

Equation (20) is a power flow balance between the power provided by an external source, the change in time of the total field energy, and the energy flow in the form of electro-magnetic radiation. Equation (21) is a force balance between the force applied by an external source, the field stress and the change in time of the momentum of the electro-magnetic radiation. Just like the Maxwell/Heaviside equations can be generalized by the transformations (18) and (19), we can transform the left hand side of equations (20) and (21):

$$
\begin{aligned}
\mathbf{J}\cdot\mathbf{E} \quad \rightarrow \quad & \left(\mathbf{J} - \frac{1}{\lambda_0\mu_0}\nabla S\right)\cdot\mathbf{E} = \\
& \mathbf{J}\cdot\mathbf{E} - \frac{1}{\lambda_0\mu_0}\nabla S\cdot\mathbf{E} = \\
& \mathbf{J}\cdot\mathbf{E} - \frac{1}{\lambda_0\mu_0}\nabla(S\cdot\mathbf{E}) + \frac{1}{\lambda_0\mu_0}S\nabla\cdot\mathbf{E} = \\
& \mathbf{J}\cdot\mathbf{E} - \frac{1}{\lambda_0\mu_0}\nabla(S\cdot\mathbf{E}) + \frac{1}{\lambda_0\mu_0}S\left(\frac{\rho}{\varepsilon_0} + \frac{\partial S}{\partial t}\right) = \\
& \mathbf{J}\cdot\mathbf{E} + \frac{1}{\lambda_0\mu_0\varepsilon_0}S\rho - \frac{1}{\lambda_0\mu_0}\nabla(S\cdot\mathbf{E}) + \frac{1}{2\lambda_0\mu_0}\frac{\partial(S^2)}{\partial t}
\end{aligned}
\qquad (22
$$

$$\rho\mathbf{E} + \mathbf{J}\times\mathbf{B} \quad -\left(\rho + \varepsilon_0\frac{\partial S}{\partial t}\right)\mathbf{E} + \left(\mathbf{J} - \frac{1}{\lambda_0\mu_0}\nabla S\right)\times\mathbf{B} =$$

$$(\rho\mathbf{E} + \mathbf{J}\times\mathbf{B}) + \varepsilon_0\frac{\partial S}{\partial t}\mathbf{E} - \frac{1}{\lambda_0\mu_0}\nabla S\times\mathbf{B} =$$

$$(\rho\mathbf{E} + \mathbf{J}\times\mathbf{B}) + \varepsilon_0\frac{\partial(S\mathbf{E})}{\partial t} - \varepsilon_0 S\frac{\partial\mathbf{E}}{\partial t} - \frac{1}{\lambda_0\mu_0}\nabla S\times\mathbf{B} =$$

$$(\rho\mathbf{E} + \mathbf{J}\times\mathbf{B}) + \varepsilon_0\frac{\partial(S\mathbf{E})}{\partial t} + S\left(\mathbf{J} - \frac{1}{\lambda_0\mu_0}\nabla S - \frac{1}{\mu_0}\nabla\times\mathbf{B}\right) - \frac{1}{\lambda_0\mu_0}\nabla$$

$$(\rho\mathbf{E} + \mathbf{J}\times\mathbf{B} + \mathbf{J}S) + \varepsilon_0\frac{\partial(S\mathbf{E})}{\partial t} - S\left(\frac{1}{\lambda_0\mu_0}\nabla S + \frac{1}{\mu_0}\nabla\times\mathbf{B}\right) - \frac{1}{\lambda_0\mu_0} \qquad (23)$$

Hence, the generalized power and force theorems become:

$$-\mathbf{J}\cdot\mathbf{E} - \frac{1}{\lambda_0\varepsilon_0\mu_0}\rho S = \frac{\varepsilon_0}{2}\frac{\partial(E^2)}{\partial t} + \frac{1}{2\mu_0}\frac{\partial(B^2)}{\partial t} + \frac{1}{2\lambda_0\mu_0}\frac{\partial(S^2)}{\partial t} + \frac{1}{\mu_0}\nabla\cdot\left(\mathbf{E}\times\mathbf{B} - \frac{1}{\lambda_0}\right) \qquad (24)$$

$$\rho\mathbf{E} + \mathbf{J}\times\mathbf{B} + \mathbf{J}S = \varepsilon_0\left((\nabla\cdot\mathbf{E})\mathbf{E} + (\nabla\times\mathbf{E})\times\mathbf{E}\right) + \frac{1}{\mu_0}\left(\frac{1}{\lambda_0}\nabla S + \nabla\times\mathbf{B}\right)\times\mathbf{B} + \left(\frac{1}{\lambda_0}\nabla S\right) \qquad (25)$$

These extended energy/momentum theorems contain many new and interesting terms.

- *Applied static charge energy*, $-\frac{1}{\lambda_0\varepsilon_0\mu_0}\rho S = \rho\frac{\partial\Phi}{\partial t} + \frac{\rho}{\lambda_0\varepsilon_0\mu_0}\nabla\cdot\mathbf{A}$

This describes the unusual applied power by static charge already mentioned by Tesla, and this term is in agreement with the interpretation of a Coulomb field as a radiative LES wave near field. The well known power law $P = IV = d_t(Q)V$ expresses energy conversion by means of dynamical charge Q and static voltage V. For a particular volume v, the static charge power term $P = \iiint_v(\rho\, d_t(\Phi))dv = Q\, d_tV$ (assumed that $d_t\Phi = d_tV$ is constant within the volume) and this expresses energy conversion by means of static charge Q and dynamical voltage V.

- *Energy flow* in the form of *longitudinal electro-scalar radiation*, $-\frac{1}{\lambda_0\mu_0}\mathbf{E}S$

This is likely the non-Hertzian radiation discovered by Tesla.
Evaluating this term:

$$-\frac{1}{\lambda_0\mu_0}\mathbf{E}S = -\frac{1}{\lambda_0\mu_0}\left(-\nabla\Phi-\frac{\partial\mathbf{A}}{\partial t}\right)\left(-\lambda_0\mu_0\varepsilon_0\frac{\partial\Phi}{\partial t}-\nabla\cdot\mathbf{A}\right) = -\varepsilon_0\nabla\Phi\frac{\partial\Phi}{\partial t} - \frac{1}{\lambda_0\mu_0}\frac{\partial\mathbf{A}}{\partial t}\nabla\cdot\mathbf{A} - \text{mixed term}$$

The term $-\varepsilon_0\nabla\Phi\partial_t\Phi$, also used by Wesley and Monstein in '*Observation of scalar longitudinal electrodynamic waves*' , expresses the energy flow associated with the Whittaker wave decomposition of an electrostatic potential Φ. This term does not depend on the value of λ_0, therefore LES wave with near infinite speed ($\lambda_0=0$) can represent a finite energy flow. The energy flow vector of the LES wave is called the Tesla vector from now on. The scalar field can be thought of as a scalar magnetic field: it acts on currents rather than on static charge, electro-scalar interaction is radiation (just like electromagnetic interaction), and there are mixed magnetoscalar field stress terms. A fine example of a wired transport of LES wave energy flow could very well be the Avramenko *single wire* power transmission system. The energy flow in the single wire wave guide cannot take the form of a transversal electromagnetic (TEM) wave, since the electric field in a single wire can only be longitudinal with respect to the direction wave propagation. Nevertheless, Avramenko has reported an efficient powerflow by means of high voltage pulses through single wires, probably by means of LES waves.

- *Scalar field energy density*, $\frac{1}{\lambda_0\mu_0}S^2$

Like the electric field and the magnetic field, the scalar field also has energy density.

- *Longitudinal Ampère force*, $\mathbf{J}S$.

Longitudinal forces that act on current elements have been researched by Jan Nasilowski and Peter Graneau and Neil Graneau, see '*Ampère-Neumann Electrodynamics of Metals*'. The longitudinal *Ampère* force is such that in case S>0 positively charged particles are accelerated and negatively charged particles are decelerated. When S<0 then the positively charged particles are decelerated while the negatively charged particles are accelerated. For instance, in a metal conductor a negative S field can accelerated the free (and bound) electrons while the positively charged metal nuclei are decelerated, which gives rise to drop in temperature of the metal conductor. The strange Hutchison effect, about distorted metals or other distorted materials, could be related to a positive S field that cools free electrons and heats the ion lattice, such that the solid metal bends, melts and ruptures. Also the cooled electron flow diminshes the metal lattice bond forces.

- *Magneto-scalar field stress*, $\frac{1}{\lambda_0\mu_0}(\nabla S\times\mathbf{B}+S\nabla S) + \frac{1}{\mu_0}S\nabla\times\mathbf{B}$

Energy flow of Tesla waves

A Tesla wave is a longitudinal electro-scalar wave. Other theorists claim that Tesla's longitudinal wave is a longitudinal *magnetic* wave, but this is not how Nikola Tesla described the longitudinal wave phenomenon. Also the Russian scientists Ignatiev back engineered Tesla's energy transmitter as a transmitter of longitudinal electric waves *without* magnetic field component. Let us evaluate this wave and its power flow. The longitudinal electric wave can be described as:

$$\mathbf{E} = (A \cos(\omega t - kx), 0, 0)$$

which is a longitudinal electric wave in the x-direction, and with phase velocity $v = \omega/k = 1/\sqrt{(\lambda_0 \varepsilon_0 \mu_0)}$

Then the scalar field S is described by

$$S = -A/v \cos(\omega t - kx) = -A \sqrt{(\lambda_0 \varepsilon_0 \mu_0)} \cos(\omega t - kx)$$

The energy flow of longitudinal electro-scalar wave is described by the Tesla vector

$$\mathbf{P} = -1/(\mu_0 \lambda_0)\mathbf{E}S = 1/(\mu_0 \lambda_0) (A \cos(\omega t - kx), 0, 0) A \sqrt{(\lambda_0 \varepsilon_0 \mu_0)} \cos(\omega t - kx) = (\sqrt{(\varepsilon_0/(\lambda_0 \mu_0))} A^2 \cos^2(\omega t - kx) , 0, 0)$$

which is a positive energy flow in the x-direction, as it should be. Just like TEM waves, a LES wave can be wireless or guided by a wave medium, such as the single wire in Avramenko's single wire energy transportation system. A single wire cannot function as a TEM wave guide, since the electric field of the TEM wave should be perpendicular to the wave propagation direction. The only type of field wave guided by a single wire is the longitudinal electroscalar wave alias the Tesla wave. The single wire energy transmission line was demonstrated by Nikola Tesla just after the year 1900.

The theory of electrodynamics with scalar field, expressed in biquaternion equations

(Bi)quaternion numbers and quaternion calculus were discovered by Rowan Hamilton and is very suitable for expressing 4-vectors or 8-vectors. Typical examples of 4 dimensional physical qualities are time-space, electro-magnetic potential, power-force, energy-momentum. Cornelius Lanczos and Andre Gsponer wrote several papers about applying biquaternion in physics, see for instance the paper of Andre Gsponer: THE PHYSICAL HERITAGE OF SIR W.R. HAMILTON, for further references. There are several options for the syntax of biquaternions, and a very elegant one has been developed by André Waser and me, and it is as follows:

Let a_0 be a scalar, let $\mathbf{A} = (a_1, a_2, a_3)$ be a vector and let $\boldsymbol{i} = (i, j, k)$ be the Hamiltonean vector, where i, j, k are the Hamiltonean numbers. Then the 4-vector (a_0, a_1, a_2, a_3) can be expressed by the quaternion $A = a_0 + \boldsymbol{i}\cdot\mathbf{A} = a_0 + ia_1 + ja_2 + ka_3$. The notation $A = a_0 + \boldsymbol{i}\cdot\mathbf{A}$ has the advantage that we can separate easily the scalar part (a_0) and the vector part (a_1, a_2, a_3) of the quaternion. If a_0, a_1, a_2, a_3 are complex numbers then we speak of a bi-quaternion which consists of 8 real numbers. The following equations define the calculus of quaternions:

$$A+B = a_0+b_0 \quad + \quad \boldsymbol{i}\cdot[\mathbf{A} + \mathbf{B}] \qquad (26)$$
$$AB = a_0b_0 - \mathbf{A}\cdot\mathbf{B} \quad + \quad \boldsymbol{i}\cdot[b_0\mathbf{A} + a_0\mathbf{B} + \mathbf{A}\times\mathbf{B}] \qquad (27)$$
$$A^* = -a_0 \quad + \quad \boldsymbol{i}\cdot\mathbf{A} \qquad (28)$$

For the special case λ_0=1, the presented theory can be cast in biquaternion form. The biquaternion gradient, biquaternion potential and biquaternion current are defined by equations 29, 30, 31 (i is the imaginary number, the constant c is the speed of light):

4 gradient	$\nabla = i/c\, \partial_t \; + \boldsymbol{i}\cdot\nabla$		(29)
4 potential	$A = i/c\, \Phi \; + \boldsymbol{i}\cdot\mathbf{A}$		(30)
4 current	$J = ic\, \rho \; + \boldsymbol{i}\cdot\mathbf{J}$		(31)
4 field	$F = \nabla A = S + \boldsymbol{i}\cdot[\mathbf{E}/(ic) + \mathbf{B}]$		(32)
Maxwell/Heaviside equation	$\mu_0 J = \nabla^* F = \nabla^*\nabla A$		(33)
field wave equation	$\mu_0 \nabla J = \nabla\nabla^* F$		(34)
power/force theorem	$\mu_0 f = \mu_0 JF = (\nabla^* F)F = \nabla^*\nabla A(\nabla A)$		(35)

It is amazingly simple to define the fields (equation 32), the Maxwell/Heaviside equations (equation 33) and the power/force theorems (equation 35). The interested reader can evaluate equations 32, 33, 34 and 35 by applying the product rule 26, and derive the field equations 6, 7, 8, 9, 10, 11, 12 and the power/force theorems 24, 25, in case λ_0=1. Keep in mind that one biquaternion equations is in fact a compact notation of two scalar equations (real scalar equals real scalar and imaginary scalar equals imaginary scalar) and two vector equations (real vector equals real vector and imaginary vector equals imaginary vector). For example, we can express the 4 Maxwell/Heaviside equations in a single biquaternion equation $\mu_0\nabla J = \nabla^* F$.
Hint: the scalar $\nabla\nabla^* = (\varepsilon_0\mu_0\, \partial_t^2 - \nabla^2)$ is an operator that automatically defines (in)homogeneous wave equations. The most important implication of the biquaternion form is the natural appearance of the scalar field in the equations. The usual electrodynamics equations without scalar field, cast in biquaternion notation, are more complicated than the above equations that *include* the scalar field.

Maxwell's original theory was formulated in quaternion form as well, however, his theory did not include the scalar field S as defined in equation (3). Maxwell adopted the Lorentz gauge condition, so the original Maxwell theory did not describe longitudinal electrical wave modes. The statement that Maxwell's original CED theory in quaternion form is a more general theory than the CED theory in the Heaviside vector form, is not true, and this is also the conclusion of Gerhard Bruhn.

Another theorist who describes a quaternion electrodynamics theory is Doug Sweetser.
Sweetser's scalar g-field is similar to my S-field, and gives rise to longitudinal **E**-g waves with

speed c, etc... Sweetser associates field g with gravity. A disadvantage of the quaternion theory is the fact that constant λ_0 has to be 1, and this is also true for Sweetser's theory. Sweetser uses quaternions, because bi-quaternions do not constitute a division algebra. This means that only two field equations remain: the $\nabla\cdot\mathbf{B} = 0$ law is added to the Gauss law, and the Faraday law is added to the Ampère law. The equations (7) and (8) can be proven anyway, by means of the definitions (1) and (2) and two vector identities ($\nabla\cdot\nabla\times\mathbf{A} = 0$ and $\nabla\times\nabla\Phi = \mathbf{0}$), so this addition is not a problem.

A classical Aharonov Bohm (AB) effect?

The AB effect is a quantum mechanical effect that is about inducing a phase shift in the phase of an electron wave (described by wave function ψ) by an external non-rotational magnetic potential $\mathbf{A} = \nabla\chi$, where χ is a scalar function. The phase shifted wave function ψ' is expressed as: $\psi' = \psi \exp(i\chi)$. This phase shift is visible when observing electron interference patterns. DeBrogly pointed out that electron interferences are not gauge invariant. The AB effect does not involve electric or magnetic fields, and the effect cannot be shielded by a Faraday cage. Some authors assume that the AB effect can be described as a classical electrodynamical effect, but in general this effect cannot be explained without considering the “non-classical” wave nature of particles. However, a special case of AB effect might also be a classical effect. If χ is a *periodic* function (for instance, a wave solution), then the phase shift in the particle wave is also periodic, and this means that the *frequency* of the particle wave has been modulated by the non-rotational magnetic potential. An altered frequency is equivalent to an altered kinetic energy, because of the Planck relation. In other words: a periodic scalar function χ induces a periodic longitudinal force that alters the kinetic energy of a moving electron. Suppose that χ is the solution of a wave equation, then $\nabla\cdot\nabla\chi$ cannot be zero, and therefore the divergence of the magnetic potential $\nabla\cdot\mathbf{A}$ cannot be zero. Let also be $\Phi = -\partial_t\chi$ then $S = -\lambda_0\varepsilon_0\mu_0\,\partial_t\Phi - \nabla\cdot\mathbf{A} = \lambda_0\varepsilon_0\mu_0\,\partial_t^2\chi - \nabla^2\chi$ which is an inhomogeneous wave equation that depends on scalar field S. The historical Aharonov-Bohm experiment is such that the divergence of the magnetic potential is zero, therefore function χ cannot be a wave solution, and only a phase shift has been observed. If the phase shift of the quantum wave function can also be a a frequency shift, then this shows that the Maxwell/Heaviside theory is *classically* incomplete. Then a classical theory is needed that predicts a new longitudinal electrodynamical force which can change the kinetic energy of charges. This is one of the effects of the scalar field.

Symmetry breaking

Between the Super Symmetry of a “pre-BigBang” cosmos, and the broken symmetry cosmos we live in, lies the process of symmetry breaking. The physicists believe that gravity became the first separate force, then the nuclear forces became distinct forces, and at last the electro-magnetic force emerged. This happened during the cool down of an evolving cosmos. The Maxwell theory was the first known gauge symmetrical theory, and the symmetry implies that the electric field and the magnetic field are actually electromagnetic fields that can be quantized into photons. I wonder if this 'photon field' picture is correct. Who says that the vacuum cannot show lower energetic states such that also the electromagnetic field symmetry becomes 'spontaneously' broken? I call this the “Super Asymmetry” (SuAs) principle. The presented generalisation of classical electrodynamics is not gauge invariant, therefore it is not gauge symmetrical. The electric field and the magnetic field can exist independently. Each symmetry breaking introduces a scalar field, such as the Higgs field and the Nambu-Goldstone fields. These scalar fields are defined within the context of quantum mechanics. The presented scalar field S is defined in the context of a classical theory, which is appropriate since the Maxwell/Lorentz theory is classical. According to this theory the Coulomb field is a pure electric field and it does not involve symmetrical electromagnetic waves, only pure longitudinal electroscalar waves, which means a lowering of the vacuum energy with respect to the gauge symmetrical EM vacuum. Each symmetry breaking means an extra form of order or coherence, on various scales. The Coulomb charge “orders” the random phases of vacuum waves into a coherent spectrum of LES wave radiation, which is observable as the Coulomb field (as described by Whittaker).

This reminds me of the famous Wright brothers, who discovered by wind-tunnel tests on wings that the airodynamics theory of their days was *wrong*. The curved wings made by the Wright brothers used under pressure in stead of over pressure. I suppose that the current scientific view about vacuum states is also wrong. Only when we make use of the vacuum “underpressure” (a lowered vacuum energy state with broken EM symmetry) can we make Star Trek real, and can we make use of cheap free energy devices.

Electrogravity and mass

There might be a link between Harold Puthoff's Polarized Vacuum (PV) theory, which models gravitic effects, and the presented scalar field: a bidirectional longitudinal electroscalar wave. Two superimposed LES waves that travel in opposite direction can result in a *standing* scalar field wave. The components of the two opposite LES waves cancel each other, as pointed out by Tom Bearden. The time derivative of this standing scalar wave is equivalent to a *space charge* (see equation (6)), or in other words, *a vacuum polarization*. This pattern of bidirectional LES waves (space charge) alters the diëlectric 'constant' of space slightly, which explains the bending of light (TEM) waves by gravity. Without the *exact* definition of the LES wave, Tom Bearden's notion of a 'standing bidirectional scalar wave' cannot be understood at all, and also the theoretical link with Puthoff's PV theory would not exist. The bidirectional LES wave requires a 'phase lock' of two LES waves in opposite direction. This tuned phase between the bidirectional LES waves, transmitted by two massive bodies, could be gravity.

The Hutchison effect includes levitation of heavy objects. Hutchison's equipment consists of two or more tuned Tesla transformers, such that a bidirectional standing scalar S wave might be induced between the Tesla transformers. The longitudinal electric field might be cancelled by means of proper tuning of the transformers. The paragraph “Electrodynamical free energy devices” described that indeed a Tesla transformer can induce observable longitudinal electroscalar field waves, because of the high voltage high frequency characteristics.

The Podkletnov effect could be based entirely on the collective tunnelling of electrons which is clearly a feature of the superconductive device made by E. Podkletnov. A collective tunnelling of electrons is equivalent to discontinuous charge/currents such that $\nabla\cdot\mathbf{J} + \partial_t\rho \neq 0$, and a discontinuous charge/current distribution is a source for pure scalar field S (without electric field component), see equation (12). This does not mean that the conservation of charge is violated. Podkletnov also used an external magnetic field in order to enhance the effects, however, the gravitic effect occurred also without this magnetic field. Hutchison and Podkletnov applied two different methods for inducing a classical macroscopic scalar field, and both researchers observed gravitic effects.

In order to understand gravity we have to understand mass. Some researchers, such as Jerry E. Bayles, conjecture that the essence of mass is a standing scalar field wave, in itself. This could mean that a massive particle consists of standing scalar S waves, which further means that LES waves are reflected *internally*, forming a 3-D standing scalar wave pattern. Then a gravity field is like an external form of mass. Standing scalar waves (gravity) on external cosmic scale forms the macro-cosmos, while the particle's internal standing scalar wave is a micro-cosmos. The interaction between external standing scalar wave and internal standing scalar wave is equivalent to Newton's action and reaction force. In principle, there is no known LES wave speed limit, so gravity wave interaction might be virtually instantaneous.
The recent research of Bose-Einstein Condensates reveals internal superfluidity and superconductivity inside a BEC. If any elementary particle is a stable BEC in essence, including the electron, then 'elementary' means 'stable'. In that case an electron or other particle consists of many refined charged elements that form discontinuous charge/currents (like a structured 3-D array of Josephson junctions) that are tunnelling through its internal potentials. Again, such discontinuous charge/currents are sources of scalar S field. Particle stability also means that the internal Coulomb forces should be compensated by internal magnetic field and longitudinal scalar field forces.

The wave nature of elementary particles.

W.A. Hofer explained brightly by means of his microdynamics that the QM non-deterministic interpretation of the particle wave function is the consequence of not considering a particle's intrinsic potential energy, but only intrinsic kinetic energy, which is an arbitrary choice unbased on experimental evidence. If both intrinsic kinetic and potential energy are attributes of a particle, then its wave nature is simpy the transformation of kinetic energy into potential energy, and vice verse. Thus, an elementary particle/wave cannot be a 1 particle system, since its wave nature reveals the interaction (and its intrinsic potential) of more refined sub-quantum particles. However, Werner Hofer only considers intrinsic electromagnetic fields, while it is the intuition of J.E. Bayles that actually a scalar field is the internal field.

Thermoscalar effects

Solids, fluids or gasses can be heated or cooled by direct thermic conduction or by means of electromagnetic fields. By definition, a scalar field S can also induce thermic effects in metals or plasmas, since the longitudinal S force $\mathbf{F} = q\mathbf{v}S$ accelerates or decelerates charged particles. Several thermoscalar effects can be described:

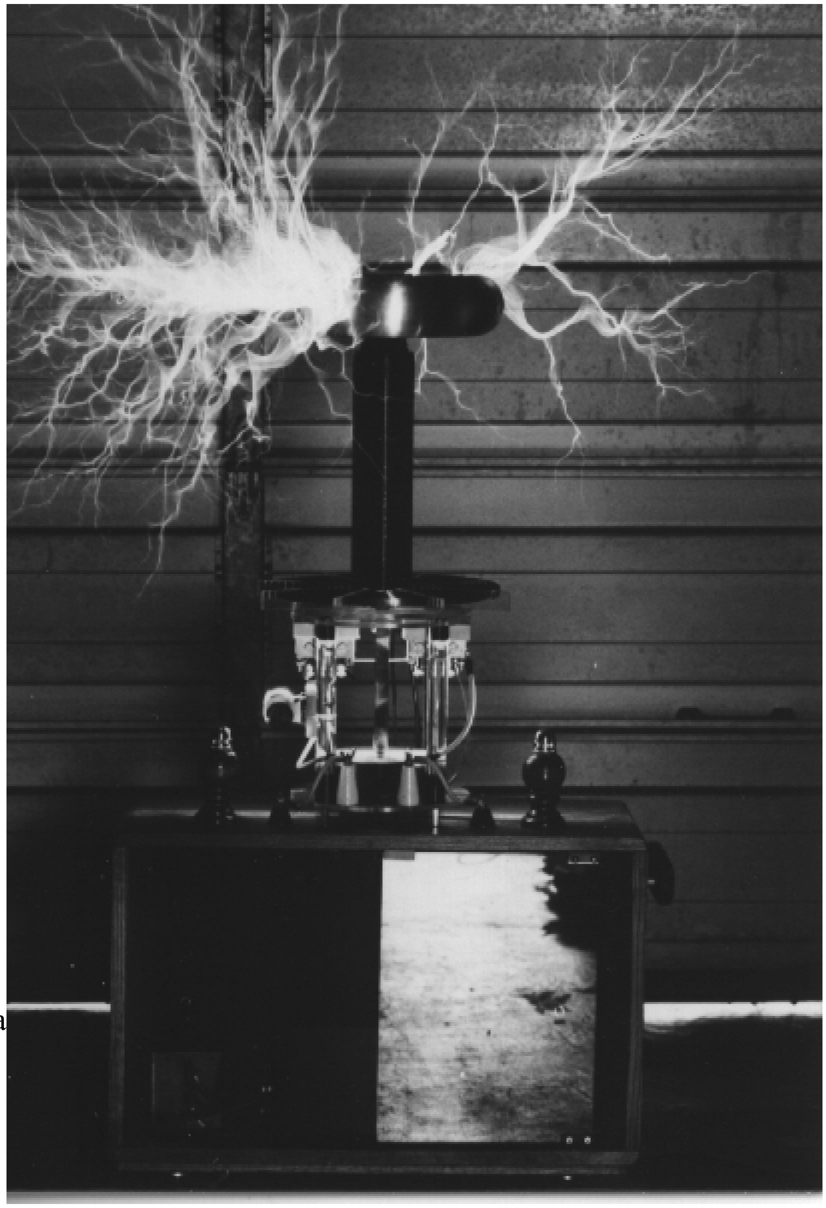
The Hutchison effect
Suppose $S>0$, then positive ions or nuclei are accelerated while negative ions or electrons are decelerated. For instance, the speed of conduction electrons in metals can be greatly reduced while the vibration speed of the metal nuclei is slightly increased, since the mass of the nuclei is much greater than the electron mass. Because of the decelerated conduction electrons (that form the glue between the metal nuclei) the atomic bonds break, and so the metal melts, distorts, ruptures, without noticeable rise in temperature. This has been observed by John Hutchison: the jellification and distortion of metals by an external field, without apparent rise in temperature of the metal object.

Cold current effect
When $S<0$, then the positively charged metal lattice atoms are decelerated (cooled down) while the conduction electrons are accelerated by the longitudinal scalar field force. This could very well explain the cold current phenomenon where the temperature of conductive medium drops and at the same time an extra current is observed, since the accelerated electrons diffuse away from the cold spot into a warmer area with less energetic electrons. Several researchers have observed this cold current phenomenon, such as Nikola Tesla, Thomas Moray, Edwin Gray and Floyd Sweet.

Efficient lighting
A gas could also be ionised, or its orbital electrons excited into higher energy states, by means of a negative S field, since such a field accelerates electrons while the positively charged nuclei are decellerated. This means that ordinary lamps can emit light without a temperature rise of the light bulb, so the lamp shines and it does not get hot. Such an effect has been reported by Floyd Sweet. The energy efficiency of the light bulb is enhanced greatly by means of scalar field excitation.

Electrodynamical free energy devices

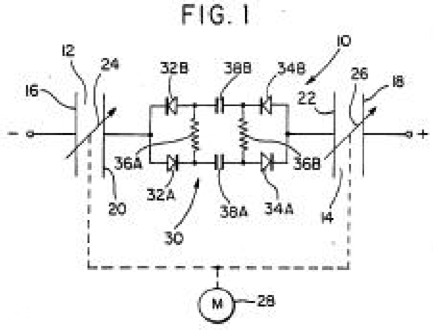
A device operates in overunity mode if the output power of the device exceeds the input power. This means that the device is an open system that can assimilate extra energy from the environment that has no price tag. The device can convert this energy into electricity. For example, a solar cell is an free energy device according to this definition. A solar cell absorbs sun light (TEM waves) and converts this energy into electricity. Now that longitudinal electroscalar (LES) wave radiation has been defined, it is necessary to research the literature for possible devices that can input extra energy in the form of LES radiation.



Firstly, a class of electrical devices that show very abrupt voltage changes in time (scalar factor $-\lambda_0\varepsilon_0\mu_0\,\partial_t\Phi$), for instance Tesla's resonant transformer (see picture), can be re-evaluated for a free energy effect. Suppose a voltage V is harmonic: $V = A \sin(\omega t)$, then $-\lambda_0\varepsilon_0\mu_0 dV/dt = -\lambda_0\varepsilon_0\mu_0 A\omega \cos(\omega t)$. By optimising factor $A\omega$ it can compensate for the small factor $\lambda_0\varepsilon_0\mu_0$, then measurable scalar field effect can be expected. Tesla's patents show a gradual development with respect to this optimisation, which resulted into high voltage high frequency resonant transformers. For a free energy effect, the Tesla transformer should be combined with a lot of static charge, since scalar power is defined as $P = Q\, dV/dt$. Tesla coil builders usually think in terms of high voltage, but the high frequency is just as important for optimising the term $A\omega$. Non-harmonic sources of abruptly changing voltages are known as pulsed-power devices, for instance the back EMF spike of an electromagnet with high inductance that is switched off. Again, this should be combined with a large charge reservoire, such as a battery.

William W. Hyde's patent (US patent 4897592) can also be classified as a static charge power device: *Electrostatic Energy Field Power Generating System.* Hyde's device is

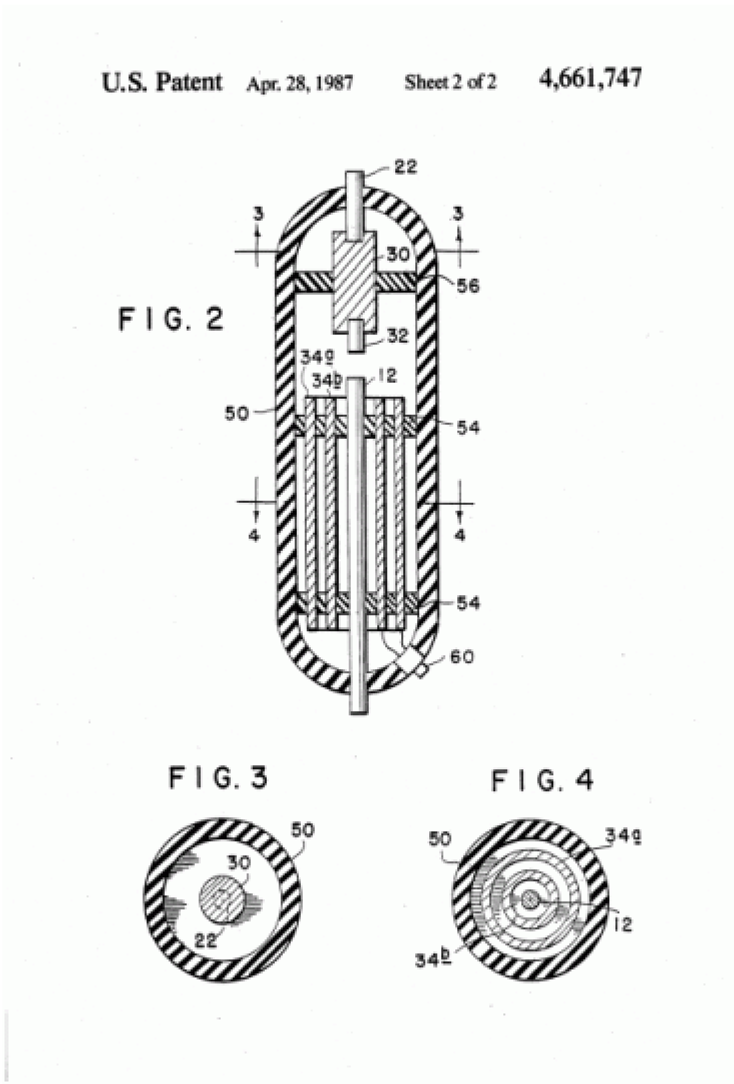
FIG. 1



based on a capacitor with constant charge Q and variable capacity C, such that a variable voltage can be induced. This system makes use of a variable diëlectric medium in the form of a rotor between two highly charged electrodes, see figure. The electrostatic energy conversion is as follows:

$P = Q\,\partial_t V = Q\,\partial_t(Q/C) = -Q^2/C^2\,\partial_t C = -V^2\,\partial_t C.$ The overunity operation can be explained in terms of electro-scalar field effects. W. Hyde claims his device shows C.O.P. > 10.

The radiant energy receiver by Thomas Moray is also a high voltage high frequency device based on discharges. The received radiant energy by Moray's device could very well have the form of longitudinal electroscalar waves. Moray's device produced a high frequency “current” that could power several light bulbs without heating the lead wires nor the light bulbs.



There are electrical devices that show very abrupt voltage changes and divergent or convergent currents, such as Edwin Gray's conversion element (see picture of US Patent 4,661,747), the Swiss Testatika machine and Chernetski's discharge tube. In these cases also the other scalar field factor $\nabla\cdot\mathbf{A}$ (the divergence of the magnetic potential) might be important, since these devices show divergent/convergent currents. The Testatika machine contains discharge tubes that consist of several concentric grid layers, similar to Gray's conversion element. Plenty of static charge in these devices should be present in order to induce a free energy effect. A charge build-up in the concentric grids can be achieved by means of electrostatic coupling with the high voltage central anode/kathode. During the discharge over the spark-gap in Gray's conversion element, the high voltage drops very rapidly, so the build-up charge Q in the tube-grids feel a very high voltage change dV/dt. This means that the grids are LES ray receivers.

Very interesting is the story about Nikola Tesla's Pierce Arrow car that was able to run without external fuel/energy sources, according to Tesla's nephew named Petar Savo. Tesla's car contained a special converter element that consisted of 12 vacuum tubes (perhaps some were used for triggering electric sparks across a spark gap) a mysterious '6 foot antenna rod' connected to the converter (perhaps a high voltage electrode similar to the high voltage anode in Gray's conversion element). The electric motor installed in Tesla's car became hot during operation, so I assume it was an 'ordinary' AC electric motor, and not the specially designed pulsed voltage motor of Edwin Gray that runs cool. It is likely that the 12Volt battery was recharged by the special energy receiving conversions element. Nikola Tesla more or less invented a complete technology that was characterized by spark gaps and abrupt voltage changes. Undescribed by Petar Savo are the necessary HV generator by means of a HV transformer and HV rectifier bridge. Tesla could have used the AC motor as a transformer by means of secondary coil circuits that make use of the AC-motor rotating magnetic field in order to induce high voltage AC. This HV AC can be turned into HV DC by means of a rectifier bridge consisting of several vacuum tubes. One or more of the remaining vacuum tubes can be used in order to trigger a spark gap for getting unidirectional pulses, similar to Edwin Gray's energy converter. Maybe Tesla used metal parts of the car as charge reservoir (analogous to Gray's tube shaped grids), since I believe the power conversion is described by $P = Q\,dV/dt$ (in Joule/s), where Q is the static charge in the metal parts, and dV/dt expresses the abrupt changes in voltage V. The 'antenna' rod should be coupled with these metal parts by means of the electro(static) HV.

Also the dePalma/Tewari N-machines (based on the Faraday disc) show divergent/convergent currents, therefore a hypothetical free energy effect could also be based on a generalisation of the Gauss and Ampère laws, rather than a fix of the Faraday law.

It does not offer a good explanation for free energy claims that involve permanent magnets, unless magnets are not just magnets but also sources of scalar fields. Some experimenters speculate about scalar effects induced by two magnets glued together: north pole agains north pole, or south pole against south pole. Then the magnetic fields cancel partially, which might reveal the presence of a scalar field. Except for a rotational magnetic potential a non-rotational magnetic potential might be induced by magnets. The secret of the mysterious Sweet magnets might not be based on magnetism at all: Sweet described the conditioning of the *motional electric field* in his essay "Nothing is Something". This means that the Sweet magnets could have been electrets as well, perhaps showed a permanent cylindrical electrical polarization and perhaps extra scalar field properties. Then the claimed free energy effect, the observed cooling effect and the observed reduced-weight effect by Sweet might all be based on electroscalar field effects.

Conclusions

After a simple adaptation of the Maxwell/Heavside equations by adding scalar terms to the Gauss law and the Ampère law, a much richer electrodynamics has been derived. Tom Bearden writes that Tesla's non-Herzian waves are "longitudinal scalar" waves, or "longitudinal EM" waves. However, a scalar field wave cannot be longitudinal nor transversal, since it does not have a direction like a vector field, and an electromagnetic wave is always transversal. This riddle has been solved by the definition of the longitudinal electroscalar wave, which has a longitudinal electric field component, as described by Nikola Tesla. The definition of the scalar field is such that it can explain unusual phenomena induced by high voltage high frequency devices, pulsed power systems and devices that show diverging/converging currents. These phenomena are: an unusual wired or wireless power flow in the form of longitudinal electroscalar waves, longitudinal forces that can give rise to charge density waves, applied electrostatic power, and thermoscalar effects such as cooled down conductors and jellification of metals.

Some devices that are labelled 'free energy device' might convert LES radiation input into electric energy. This conversion process always involves static electric charge and often very dynamical voltages, rather than dynamical electric charge currents and static voltage. Thus, the presented theory not only improves the official electrodynamics theory by ignoring the unempirical “gauge conditions”, it can be practically applied in the form of many unusual electrical devices that involve electroscalar effects. It explains the optimization of particular system characteristics, such as the product of voltage amplitude and frequency, or the divergence of currents. It represents the missing link between Tesla's most important practical results and theoretical physics.