Interaction of electrostatics with the ECE vacuum

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Abstract

The interaction of vacuum or background structures with electromagnetic processes is investigated. ECE electrodynamics allows the description of vacuum structures on a classical level. A model for matter-vacuum interaction is presented. By means of the rich structure of general relativity it is possible to describe ordinary electrostatic fields by a flux of the background vector potential. The scalar background potential is able to create enormous vacuum stress. The interaction method allows for describing weak structures in space which have been observed already over hundred years ago and re-confirmed recently. An explanation on the classical and quantum level is given which can account for many observed features.

Keywords: ECE theory, Maxwell equations, potential, vector potential, classical vacuum, vacuum structures

1 Introduction

The advent of ECE (Einstein-Cartan-Evans) theory [1] lead to a better understanding of electromagnetic structures and processes embedded into spacetime. Precisely, these are parts of spacetime itself which is described by concepts of general relativity. Conventional electromagnetism is considered in a context of special relativity which does not allow richer structures, for example structured background or vacuum states. It has been shown that electromagnetism and ECE spacetime background can be decoupled for many practical purposes [4]. This is the reason why Maxwell-Heaviside electrodynamics works so well. However, additional interesting effects are expected when a coupling can be inducted. Finding such mechanisms and describing them by theory is a current subject of AIAS research. In this paper we continue recent work concerning the ECE

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vacuum [2], [3]. In section 2 we present an approach for matter-vacuum interaction based on ECE theory. As a result it is shown that electric fields are accompanied by a vacuum flux described by a vector potential.

Friedrich H. Balck [10], [11] has found weak spatial structures around batteries, rotating magnets and even arbitrary bodies. This is a confirmation of extensive experiments of Reichenbach [8] and Korschelt [9] which were carried out more than hundred years ago. These findings cannot be explained by conventional physics and were ignored by the scientific community for a long time. In recent years, Joseph H. Cater [12], [13] has explained a lot of these and other findings by a qualitative theory of "soft electrons". These are vacuum structures combined with a charge so that they can be impacted by electric fields. Since a quantitative description does not exist, Cater argued with qualitative arguments only, which where logically consistent. In this paper we will try to give a scientific explanation of at least some of these effects. For this we developed a classical and a quantum mechanical model described in section 3. The results are compared with experimental findings of Balck.

2 Electrodynamic theory of vacuum

2.1 Equations from the ECE engineering model

The field equations of the electromagnetic sector of ECE theory can be written formally identical to the Maxwell-Heaviside equations but are valid in a curved and twisted spacetime, in contrast to conventional electromagnetic theory which is based on special relativity. In the engineering model [6] focus was laid on only one polarization direction which leads to the well known form

$$\nabla \cdot \mathbf{B} = 0, \tag{1}$$
$$\nabla \times \mathbf{E} + \dot{\mathbf{B}} = 0, \tag{2}$$
$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}, \tag{3}$$
$$\nabla \times \mathbf{B} - \frac{1}{c^2}\dot{\mathbf{E}} = \mu_0 \mathbf{J}, \tag{4}$$

where the dot denotes the partial time derivative. In extension of standard theory, the definition of the **E** and **B** fields not only depends on the scalar and vector potential ϕ and $\mathbf{A}$ but also on the scalar and vector spin connections ω_0 and $\boldsymbol{\omega}$:

$$\mathbf{E} = -\nabla\phi - \dot{\mathbf{A}} - \omega_0 \mathbf{A} + \boldsymbol{\omega}\phi, \tag{5}$$
$$\mathbf{B} = \nabla \times \mathbf{A} - \boldsymbol{\omega} \times \mathbf{A}. \tag{6}$$

It has been shown in previous papers that the spin connections can be eliminated in cases where the potentials behave smoothly which is the vast majority of all applications cases. Then the electric and magnetic field definitions can be reduced to the conventional form

$$\mathbf{E} = -\nabla\phi - \dot{\mathbf{A}}, \tag{7}$$
$$\mathbf{B} = \nabla \times \mathbf{A}. \tag{8}$$

This is a consequence of antisymmetry in the field equations. This does not mean, however, that the spin connections disappear. The spin connections are present because we use a theory of general relativity. They can be computed separately from the potentials via the equations

$$\omega_0 \mathbf{A} = \boldsymbol{\omega}\phi = \frac{1}{2}(-\dot{\mathbf{A}} + \nabla\phi). \tag{9}$$

This means, we can solve problems within the framework of conventional potential-based electromagnetic theory and study the spacetime structure of the problems a posteriori. From (9) we obtain

$$\boldsymbol{\omega} = \frac{1}{2\phi}(-\dot{\mathbf{A}} + \nabla\phi) \tag{10}$$

and by scalar multiplication of (9) with $\mathbf{A}$:

$$\omega_0 = \frac{\phi}{A^2}\boldsymbol{\omega}\cdot\mathbf{A} = \frac{1}{2A^2}(-\dot{\mathbf{A}} + \nabla\phi)\cdot\mathbf{A}. \tag{11}$$

Obviously both potenitals are not allowed to be zero, otherwise the spin connection diverges. However this case can be arranged intentionally to obtain spin connection resonance [1]. Obviously the existence of the scalar spin connection is bound to the existence of the vector potential (Eq.(11)) while the vector spin connection requires a scalar potential to exist (Eq.(10)).

As an example we consider the Coulomb potential of a single point charge q. The corresponding potential is

$$\phi_C = \frac{q}{4\pi\epsilon_0 r} \tag{12}$$

with r being the radial distance from the charge. With

$$\nabla\phi_C = -\frac{q}{4\pi\epsilon_0 r^2}\mathbf{e}_r \tag{13}$$

where $\mathbf{e}_r$ is the unit vector in spherical coordinates, we obtain from Eq.(10), assuming $\mathbf{A} = const$:

$$\boldsymbol{\omega} = -\frac{1}{r}\mathbf{e}_r, \tag{14}$$

i.e. the vector spin connection has only a radial component $-1/r$ and is a multiple of the potential. It should be noticed that this spin connection is a pure spacetime quantity and does not depend on the sign of the charge for example.

2.2 The vacuum structure

There are two kinds of vacuum we have to discern in ECE theory: a vacuum on the classical level (sometimes called empty space) and vacuum or background effects of spacetime on quantum level. The classical ECE vacuum is defined by the fact that all force fields vanish:

$$\mathbf{E} = 0, \tag{15}$$
$$\mathbf{B} = 0. \tag{16}$$

However this does not mean that the potentials vanish too. It has been shown [2] (again by applying the antisymmetry of the field equations) that, in the ECE vacuum, waves of potentials exist which are longitudinal in character. For example the vector potential of vacuum waves can be written in the form

$$\mathbf{A}_V = \hat{\mathbf{k}} \sum_n A_n \exp\left(i\ n(\mathbf{k}\cdot\mathbf{x} - \beta t)\right) \tag{17}$$

where $\hat{\mathbf{k}}$ is the unit vektor in propagation direction of the wave, $\mathbf{k}$ is the wave vector, β is a time frequency and A_n are Fourier coefficients. For an arbitrary direction this can be written in the form

$$\mathbf{A}_V = \sum_n \mathbf{A}_n \exp\left(i(\mathbf{k}_n\cdot\mathbf{x} - \beta_n t)\right) \tag{18}$$

with reciprocal lattice vectors $\mathbf{k}_n$ and frequencies β_n.

The ECE vacuum is non-empty and may contain a high number of waves of all frequencies, summing up to the huge background energy density inferred from well known quantum processes, for example pair creation. Thus a bridge exists between macroscopic and microscopic world.

2.3 Matter-vacuum interaction

In this paper we are interested in interactions between vacuum or background potentials and electromagnetic fields of ordinary electrodynamics. In earlier papers [3], [4] it was shown that both worlds can co-exist without interaction. Vacuum states can always be added to the solutions of Maxwell's equations without changing the results. Here we change focus and search for possible interaction effects. We choose an electrostatic problem as the simplest example which can be described by the Coulomb law (3). Since these effects can only be introduced by the potentials, we have to rewrite Eq.(3) with potentials by inserting Eq.(7):

$$\nabla\cdot\dot{\mathbf{A}} + \Delta\phi = -\frac{\rho}{\epsilon_0}. \tag{19}$$

The vector potential is normally discarded in electrostatic problems. Now we consider $\mathbf{A}$ to be the background potential $\mathbf{A}_V$ of spacetime. Then we get a coupling between the vacuum and the scalar potential ϕ_i which relates to vacuum as well as ordinary electromagnetic effets:

$$\nabla\cdot\dot{\mathbf{A}}_V + \Delta\phi_i = -\frac{\rho}{\epsilon_0}, \tag{20}$$

neglecting any backward dependence of the scalar potential ϕ_i on the vacuum potential $\mathbf{A}_V$. We can compute the scalar potential ϕ, which is not affected by the vacuum, by the ordinary Coulomb equation

$$\Delta\phi = -\frac{\rho}{\epsilon_0}. \tag{21}$$

To obtain a solution of ϕ_i as well as for the vector potential $\mathbf{A}_V$ we need an additional vector equation. This can be either the Faraday law or the Ampere-Maxwell law. The latter is equivalent to the Coulomb law and so gives no new information. Therefore we use the Faraday law, Eq.(2). Inserting the definitions (7-8) however gives a zero sum at the left hand side. Therefore we have to use the spin-connection versions of $\mathbf{E}$ and $\mathbf{B}$, Eqs.(5-6), directly, which leads to

$$-\nabla \times (\omega_0 \mathbf{A}_V) + \nabla \times (\boldsymbol{\omega} \phi_i) - \frac{\partial (\boldsymbol{\omega} \times \mathbf{A}_V)}{\partial t} = 0. \tag{22}$$

Here we assume that there is only one spin connection ω_0 respectively $\boldsymbol{\omega}$ which describes the curvature and torsion of space, i.e. vacuum and conventional electromagnetic effects. From (9) we have

$$\omega_0 \mathbf{A}_V = \boldsymbol{\omega} \phi_i \tag{23}$$

so that the first two terms in Eq. (22) cancel out. Inserting (10) for $\boldsymbol{\omega}$ then leads to

$$-\frac{\partial}{\partial t} \left(\frac{1}{2\phi_i} (-\dot{\mathbf{A}}_V + \nabla \phi_i) \times \mathbf{A_V} \right) = 0. \tag{24}$$

Time integration of the vector equation with integration constant $\mathbf{C}$ gives

$$(-\dot{\mathbf{A}}_V + \nabla \phi_i) \times \mathbf{A}_V = 2\, \phi_i\, \mathbf{C}(\mathbf{x}). \tag{25}$$

From the definition (17) it follows that $\dot{\mathbf{A}}$ is parallel to $\mathbf{A}$, resulting in

$$\nabla \phi_i \times \mathbf{A}_V = 2\, \phi_i\, \mathbf{C}(\mathbf{x}) \tag{26}$$

or, with assuming ϕ_i to be time independent,

$$\nabla \phi_i \times \dot{\mathbf{A}}_V = 0. \tag{27}$$

With the ordinary electric field

$$\mathbf{E} = -\nabla \phi_i \tag{28}$$

we can write then

$$\mathbf{E} \times \dot{\mathbf{A}}_V = 0, \tag{29}$$

which means that $\dot{\mathbf{A}}_\mathbf{V}$ and $\mathbf{A_V}$ are parallel to $\mathbf{E}$:

$$\mathbf{E} \parallel \mathbf{A}_V. \tag{30}$$

Consequently, when a time-varying background potential $\mathbf{A}_V$ invokes an electric field $\mathbf{E}$ (and vice versa), both fields are parallel to each other. In case of a curved and twisted spacetime, the vector spin connection $\boldsymbol{\omega}$ is also in parallel to $\mathbf{A}_V$ and $\mathbf{E}$ due to Eq.(23).

2.4 Electric vacuum stress

It has been shown ealier that vacuum potentials corresponds to a mechanical stress [5]. Denoting the scalar vacuum potential by ϕ_V, the vacuum condition $\mathbf{E} = 0$ leads to a condition between both the vacuum and vector potential according to Eq.(5):

$$-\nabla \phi_V - \dot{\mathbf{A}}_V - \omega_0 \mathbf{A}_V + \boldsymbol{\omega} \phi_V = 0, \tag{31}$$

which in case of stationary fields leads to

$$\nabla\phi_V - \boldsymbol{\omega}\phi_V = \omega_0 \mathbf{A}_V. \tag{32}$$

If a differential equation of second order is preferred, applying a gradient operation on this equation leads to

$$\Delta\phi_V - (\nabla\cdot\boldsymbol{\omega})\phi_V - \nabla\phi_V\cdot\boldsymbol{\omega} = \nabla\omega_0\cdot\mathbf{A}_V + \omega_0\nabla\cdot\mathbf{A}_V. \tag{33}$$

This can be considered as a forced oscillation with damped resonance if $\boldsymbol{\omega}$ is assumed to be negative. In one dimension this equation reads

$$\frac{\partial^2}{\partial x^2}\phi_V - (\frac{\partial}{\partial x}\omega_x)\phi_V - (\frac{\partial}{\partial x}\phi_V)\omega_x = (\frac{\partial}{\partial x}\omega_0)A_{Vx} + \omega_0(\frac{\partial}{\partial x}A_{Vx}) := f(x). \tag{34}$$

In this equation we can freely choose the terms at the right hand side by a suited choice of the spacetime functions ω_0 and A_{Vx}. Denoting the right hand side by $f(x)$ we can further assume certain forms of ω_x. Setting ω_x to a constant wave number κ and the right hand side of the equation to zero:

$$\omega_x = \kappa, \tag{35}$$

$$f(x) = 0, \tag{36}$$

we obtain the simple equation

$$\frac{\partial^2}{\partial x^2}\phi_V - \kappa\frac{\partial}{\partial x}\phi_V = 0 \tag{37}$$

which has the solution

$$\phi_V = \phi_0 \exp(\kappa\, x) \tag{38}$$

with an integration constant ϕ_0. This is an exponentially growing solution, indicating that the scalar vacuum potential can increase to very high values. A similar result had already been found in [2]. Of course this result depends on the sign of κ which was assumed positive here. The same result is obtained when we start from Eq.(32) directly without taking an additional derivative. According to [5] an electric potential is the equivalent to a mechanical stress. This means that it is possible to generate a very high vacuum stress. If ϕ_V comes to lie into the region of $10^{20}V$, more direct mechanical effects are expected, due to the mechanic-electric equivalence of ECE theory.

3 Comparison with unconventional experimental findings

In the following we try to give first explanations for experimentally found spacetime structures.

3.1 Derivation from ECE electrodynamics

It has been shown in the preceding sections that ECE theory predicts a "spacetime flux" in terms of potentials which can be attributed to structures of the electromagnetic vacuum. This non-empty vacuum, which is also supported by quantum mechanics, may be the reason for weak spatial structures for which no useable detectors exist. One main task in future would be to define and construct such detectors. So far these structures are only perceivable by sensitive people. Nevertheless the results are repeatable. As already discussed in section 1, these finding reach back to the 19th century [8], [9] and have ben acknowledged recently [10], [11].

Fig. 1 shows the force field of a dipole with possible vortex structures similar to fluid dynamics. Such structures have been found for example in static electric and magnetic fields [10]. In Fig. 2 the experimental result for a bar magnet are shown. The toroidal structure coincides with the suggestion of Fig. 1. The structure requires a rotation of the magnet and expands with increasing rotation rate. This reminds strongly to the rotational part of the ECE magnetic field:

$$\mathbf{B}_{rot} = -\boldsymbol{\omega} \times \mathbf{A}. \tag{39}$$

The spin connection $\boldsymbol{\omega}$ represents a rotation axis in the simplest case [6]. The magnetic field strength grows with rotation frequency. According to Cater [12], [13], magnetic field lines are sources of "soft electrons". This motivates a description based on spacetime geometry as inferred by ECE theory. The bar magnet creates a magnetic dipole field. This field serves as a "second source" for an electric structure. Exactly this can be formulated by the ECE field equations if the "second source" is identified with the homogeneous current of ECE theory. The extended Faraday law, Eq.(6), with vacuum field $\mathbf{E}_V$, then reads

$$\nabla \times \mathbf{E}_V + \dot{\mathbf{B}} = \mathbf{j}, \tag{40}$$

where $\mathbf{j}$ represents the homogeneous current which is magnetic in nature [6]. Setting this in proportion to the magnetic field of the magnet:

$$\mathbf{j} = \alpha \mathbf{B}, \tag{41}$$

and assuming a stationary state, leads to the equation

$$\nabla \times \mathbf{E}_V = \alpha \mathbf{B}, \tag{42}$$

which can be solved numerically. It is expected that a torus-like structure for the vacuum-generated "second electric field" $\mathbf{E_V}$ comes out. This is the first quantitative attempt to explain the weak structures found by Reichenbach, Korschelt and Balck. It is planned to continue this work by numerical calculations.

3.2 Derivation from quantum mechanics

Besides structures with rotational symmetry as shown in Fig. 2, there have also been found macroscopic asymmetric structures around symmetric bodies, for example cylindrical bodies, see Fig. 3 [11]. From a standpoint of classical mechanics or electrodynamics, it is not plausible how such a breaking of symmetry can occur. Such effects are only known for eigenstates of vibrations but here no exciting force of periodic kind has been detected. We therefore try an approach of an "extended quantum state". The weak vacuum states called soft electrons by Cater are assumed to be much bigger than ordinary electrons but have an elementary quantized charge of an electron. Therefore we handle these

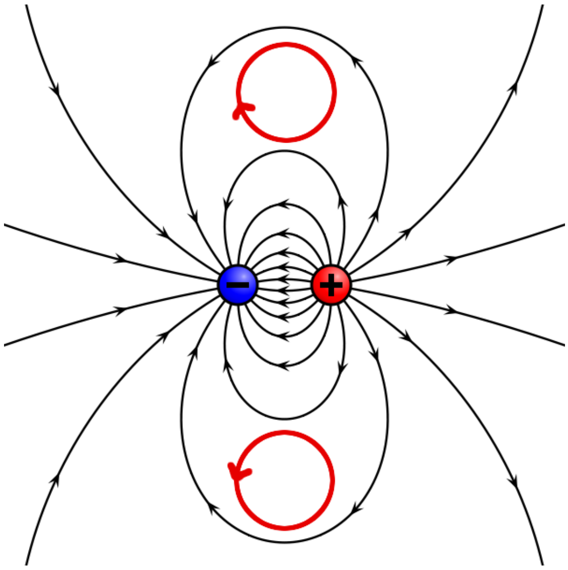

Figure 1: Force field of a dipole [7] with hydrodynamic vortex.

structures in a quantum picture. Electrons are fermions and, in the stationary, non-relativistic case, described by the Schroedinger Equation

$$\hat{H}\psi = E\psi \tag{43}$$

where the Hamilton operator $\hat{H}$ is defined by

$$\hat{H} = -\frac{\hbar^2}{2m_e}\nabla^2 + V(r). \tag{44}$$

$V(r)$ is the potential of the atomic nucleus. The solution of Eq.(43) for Hydrogen-like states with ordinal number Z is

$$\psi_{00} = \frac{1}{\sqrt{\pi}}\left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\frac{r\,Z}{a_0}} \tag{45}$$

for a $1s$ orbital. It is characterized by the Bohr radius a_0. In the following we will search for a re-scaling of the Schroedinger equation so that quantum solutions take a macroscopic size. The Bohr radius is defined by

$$a_0 = \frac{4\,\pi\,\epsilon_0\,\hbar^2}{e^2\,m_e}. \tag{46}$$

This allows replacing the factor $\hbar^2/2m_e$ in the Hamiltonian by an expression of the Bohr radius:

$$\frac{\hbar^2}{2\,m_e} = \frac{a_0\,e^2}{8\,\pi\,\epsilon_0}. \tag{47}$$

Please note that this expression does not depend on the electron mass m_e anymore. We consider a scaling of the Bohr radius replacing it by an arbitrary

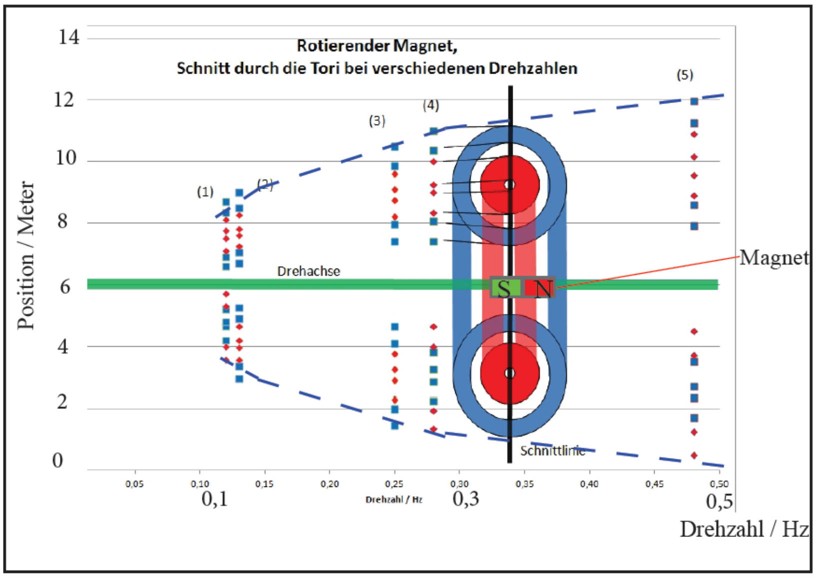

Figure 2: Toroidal structure observed around a rotating magnetic dipole [10].

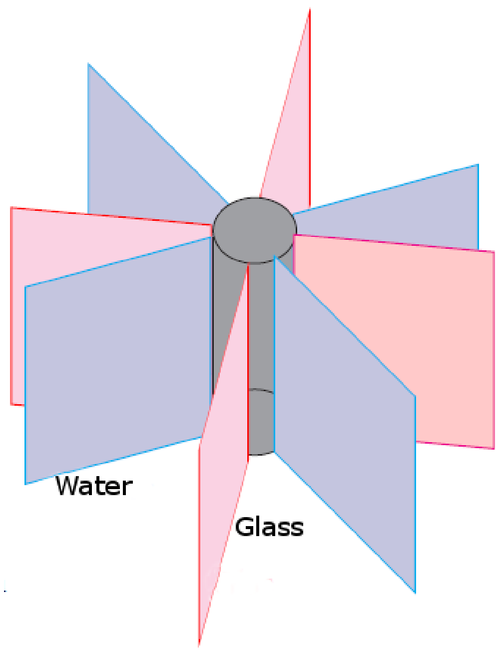

Figure 3: Spatial structures observed around a glass of water, evoked by the glass and the water material [11].

length L_0 and inserting the expression in the Hamiltonian:

$$\hat{H} = -\frac{L_0\, e^2}{8\, \pi\, \epsilon_0} \nabla^2 + V'(r) \tag{48}$$

where the potential has to be re-scaled appropriately. In this way we obtain a "Schroedinger Equation" valid for arbitrarily scaled dimensions. Effectively, the angular momentum has been re-quantized to larger values. Although this is a highly hypothetical operation, it may explain why structures like atomic orbitals with s, p, and d character have been found by Balck [10]. Unusual new results may require unusual explanations. Future research will hopefully show whether these attempts were justified.

4 Summary

The interaction of the ECE vacuum with static electric structures was investigated. Spacetime flux was described by a vacuum flux predicted by ECE theory. This is in line with Tesla's ether flux, which in turn can be described by a vector potential of the vacuum. Such results require existence of curvature and torsion of spacetime which is not contained in simple Maxwell-Heaviside theory.

First theoretical explanations for experimentally found spacetime structures were given. Unfortunately such structures are barely measurable by instruments, not because they are not physics, but because no suitable instruments have been developed for their detection. Therefore these effects are accessible only to persons who are sensitive enough to percept them. Such experiments have been executed in high number by several groups so that repeatability is guaranteed. It could be shown that essential structures are explainable by classical and quantum approaches.

A more detailed application of ECE theory could reveal the meaning of polarization indices in the engineering model [6]. There are four states of polarization for $\mathbf{E}, \mathbf{A}$, etc. named $\mathbf{E}^a, \mathbf{A}^a$, with polarization index a. Balck found four such states, and ECE theory predicts four.

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