Faraday or Maxwell?

Do scalar waves exist or not?

Practical consequences of an extended field theory

by:

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Introduction

Numerous phenomena of the electromagnetic field are described sufficiently accurate by the Maxwell equations, so that these as a rule are regarded as a universal field description. But if one looks more exact it turns out to be purely an approximation, which in addition leads to far reaching physical and technological consequences. We must ask ourselves:

- What is the Maxwell approximation?
- How could a new and extended approach look like?
- Faraday instead of Maxwell, which is the more general law of induction?
- Can the Maxwell equations be derived as a special case?
- Can also scalar waves be derived from the new approach?

On the one hand it concerns the big search for a unified physical theory and on the other hand the chances of new technologies, which are connected with an extended field theory. As a necessary consequence of the derivation, which roots strictly in textbook physics and manages without postulate, scalar waves occur, which could be used manifold. In information technology they are suited as a carrier wave, which can be modulated more dimensionally, and in power engineering the spectrum stretches from the wireless transmission up to the collection of energy out of the field.

Neutrinos for instance are such field configurations, which move through space as a scalar wave. They were introduced by Pauli as massless but energy carrying particles to be able to fulfil the balance sheet of energy for the beta decay. Nothing would be more obvious than to technically use the neutrino radiation as an energy source.

Vortex and anti-vortex

In the eye of a tornado the same calm prevails as at great distance, because here a vortex and its anti-vortex work against each other (Fig 1). In the inside the expanding vortex is located and on the outside the contracting anti-vortex. One vortex is the condition for the existence of the other one and vice versa. Already Leonardo da Vinci knew both vortices and has described the dual manifestations [1, chapter 3.4].

Fig 1: The Tornado shows the physical basic principle of Vortex and anti-vortex.

In the case of flow vortices the viscosity determines the diameter of the vortex tube where the coming off will occur. If for instance a tornado soaks itself with water above the open ocean, then the contracting potential vortex is predominant and the energy density increases threateningly. If it however runs overland and rains out, it again becomes bigger and less dangerous.

The conditions for the bathtub vortex are similar. Here the expanding vortex consists of air, the contracting vortex however of water. In flow dynamics the relations are understood. They mostly can be seen well and observed without further aids.

In electrical engineering it’s different: here field vortices remain invisible and not understood. Only so the Maxwell theory could find acceptance, although it only describes mathematically the expanding eddy current and ignores its anti-vortex. I call the contracting anti-vortex „potential vortex“ and point to the circumstance, that every eddy current entails the anti-vortex as a physical necessity.
Because the size of the forming structures is determined by the electric conductivity, in conducting materials the vortex rings, being composed of both vortices, are huge, whereas they can contract down to atomic dimensions in nonconductors. Only in semiconducting and resistive materials the structures occasionally can be observed directly [1, fig. 4.8].

Vortices in the microcosm and macrocosm

The approximation, which is hidden in the Maxwell equations, thus consists of neglecting the anti-vortex dual to the eddy current. It is possible that this approximation is allowed, as long as it only concerns processes inside conducting materials. If we however get to insulating materials the Maxwell approximation will lead to considerable errors and it won’t be able to keep it anymore.

If we take as an example the lightning and ask how the lightning channel is formed: Which mechanism is behind it, if the electrically insulating air for a short time is becoming a conductor? From the viewpoint of vortex physics the answer is obvious: The potential vortex, which in the air is dominating, contracts very strong and doing so squeezes all air charge carriers and air ions, which are responsible for the conductivity, together at a very small space to form a current channel.

The contracting potential vortex thus exerts a pressure and with that forms the vortex tube. Besides the cylindrical structure another structure can be expected. It is the sphere, which is the only form, which can withstand a powerful pressure if that acts equally from all directions of space. Only think of ball lightning. Actually the spherical structure is mostly found in microcosm till macrocosm. Let's consider some examples and thereby search for the expanding and contracting forces (Fig. 2).

Examples:	expanding vortex	contracting vortex
• quantum physics	collision processes (several quarks)	gluons (postulate!)
• nuclear physics	repulsion of like charged particles	strong interaction (postulate!)
• atomic physics	centrifugal force of the enveloping electrons	electrical attraction Schrödinger equation
• astro-physics	centrifugal force (inertia)	gravitation (can not be derived?!)

Fig. 2: Spherical structures as a result of contracting potential vortices [1,Chap. 4.3]

- In quantum physics one imagines the elementary particles to be consisting of quarks. Irrespective of the question, which physical reality should be attributed to this model concept, one thing remains puzzling: The quarks should run apart, or you should try to keep together three globules, which are moving violently and permanently hitting each other. For this reason glue particles were postulated, the so-called gluons, which now should take care for the reaction force, but this reaction force is nothing but a postulate!

- In nuclear physics it concerns the force, which holds together the atomic nucleus, which is composed of many nucleons, and gives it the well-known great stability, although here like charged particles are close together. Particles, which usually repel each other. Between the theoretical model and practical reality there is an enormous gap, which should be overcome by introducing of a new reaction force. But also the nuclear force, called strong interaction, is nothing but a postulate!

- In atomic physics the electric force of attraction between the positive nuclear charge and the negatively charged enveloping electrons counteracts the centrifugal force. In this case the anti-vortex takes care for a certain structure of the atomic hull, which obey the Schrödinger equation as eigenvalue solutions. But also this equation irrespective of its efficiency until today purely is a mathematical postulate, as long as its origin is not clear.

> Demokrit (460-370 BC) equated the vortex concept with „law of nature“! It is the first attempt to formulate a unified physics.

- In astrophysics centrifugal force (expansion) as a result of the inertia and gravitation (contraction) as a result of the attraction of masses are balanced. But the „gravitation“

puts itself in the way of every attempt to formulate a unified field theory. Also this time it is the contracting vortex, of which is said it can't be derived nor integrated.

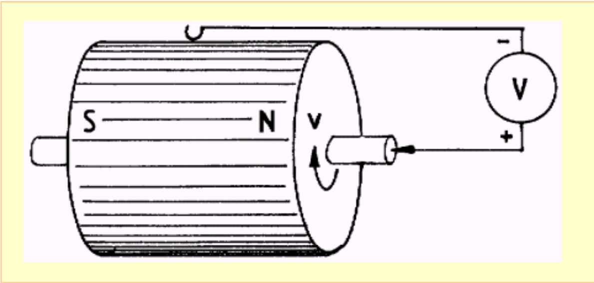
It is remarkable how in the domain of the contracting vortex the postulates are accumulating. But this hasn't always been the case. In ancient Greece already 2400 years ago Demokrit has undertaken an attempt to formulate a unified physics. He traced all visible and observable structures in nature back to vortices, each time formed of vortex and anti-vortex. This phenomenon appeared him to be so fundamental, that he put the term „vortex" equal to the term for „law of nature". The term „atom" stems from Demokrit (460-370 BC).

Seen this way the physicists in ancient times already had been further than today's physics, which with the Maxwell approximation neglects the contracting vortex and with that excludes fundamental phenomena from the field description or is forced to replace them by model descriptions and numerous postulates.
What we need is a new field approach, which removes this flaw and in this point reaches over and above the Maxwell theory.

Faraday's law and Maxwell's formulation

In the choice of the approach the physicist is free, as long as the approach is reasonable and well founded. In the case of Maxwell's field equations two experimentally determined regularities served as basis: on the one hand Ampère's law and on the other hand the law of induction of Faraday. The mathematician Maxwell thereby gave the finishing touches for the formulations of both laws. He introduced the displacement current **D** and completed Ampère's law accordingly, and that without a chance of already at his time being able to measure and prove the measure. Only after his death this was possible experimentally, what afterwards makes clear the format of this man.
In the formulation of the law of induction Maxwell was completely free, because the discoverer Michael Faraday had done without specifications. As a man of practice and of experiment the mathematical notation was less important for Faraday. For him the attempts with which he could show his discovery of the induction to everybody, e.g. his unipolar generator, stood in the foreground.
His 40 years younger friend and professor of mathematics Maxwell however had something completely different in mind. He wanted to describe the light as an electromagnetic wave and doing so certainly the wave description of Laplace went through his mind, which needs a second time derivation of the field factor. Because Maxwell for this purpose needed two equations with each time a first derivation, he had to introduce the displacement current in Ampère's law and had to choose an appropriate notation for the formulation of the law of induction to get to the wave equation.
His light theory initially was very controversial. Maxwell faster found acknowledgement for bringing together the teachings of electricity and magnetism and the representation as something unified and belonging together [5] than for mathematically giving reasons for the principle discovered by Faraday.
Nevertheless the question should be asked, if Maxwell has found the suitable formulation, if he has understood 100 percent correct his friend Faraday and his discovery. If discovery (from 29.08.1831) and mathematical formulation (1862) stem from two different scientists, who in addition belong to different disciplines, misunderstandings are nothing unusual. It will be helpful to work out the differences.

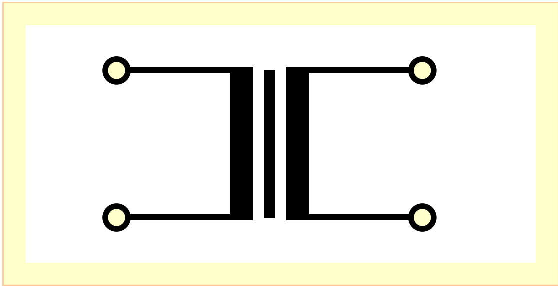
law of induction



unipolar generator

discovery of **Faraday**

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \quad (1)$$



e.g.: transformer

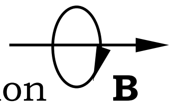
2^{nd} **Maxwell** equation

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt \quad (1^*)$$

Difference, e.g. in the (quasi-) stationary case ($d\mathbf{B}/dt = 0$):

$\mathbf{E} \neq 0$ | $\mathbf{E} = 0$

Electric and magnetic field in the stationary case are:

coupled:  **E**
mag. induction **B** (⊥)

Only **E** or **B** can form an open field line.
The other field line is a closed-loop field line

decoupled: → **E**
negligible **B**

Closed-loop field lines have no effect, can't be influenced and are neglected (Maxwell approximation!)

Fig 3: Two formulations for one law
As a mathematical relation between
the vectors of the electric field strength **E**
and the induction **B** (= magnetic flux density)

The discovery of Faraday

If one turns an axially polarized magnet or a copper disc situated in a magnetic field, then perpendicular to the direction of motion and perpendicular to the magnetic field pointer a pointer of the electric field will occur, which everywhere points axially to the outside. In the case of this by Faraday developed unipolar generator hence by means of a brush between the rotation axis and the circumference a tension voltage can be called off [2, Chap. 16.1].

The mathematically correct relation **E** = **v** x **B** I call Faraday-law, even if it only appears in this form in the textbooks later in time [6, pp. 76, 130]. The formulation usually is attributed to the mathematician Hendrik Lorentz, since it appears in the Lorentz force in exactly this form. Much more important than the mathematical formalism however are the

experimental results and the discovery by Michael Faraday, for which reason the law concerning unipolar induction is named after the discoverer.
Of course we must realize that the charge carriers at the time of the discovery hadn’t been discovered yet and the field concept couldn’t correspond to that of today. The field concept was an abstracter one, free of any quantisation.

That of course also is valid for the field concept advocated by Maxwell, which we now contrast with the „Faraday-law“ (Fig. 3). The second Maxwell equation, the law of induction (1*), also is a mathematical description between the electric field strength **E** and the magnetic induction **B**. But this time the two aren’t linked by a relative velocity **v**.
In that place stands the time derivation of **B**, with which a change in flux is necessary for an electric field strength to occur. As a consequence the Maxwell equation doesn’t provide a result in the static or quasi-stationary case, for which reason it in such cases is usual, to fall back upon the unipolar induction according to Faraday (e.g. in the case of the Hall-probe, the picture tube, etc.). The falling back should only remain restricted to such cases, so the normally used idea. But with which right the restriction of the Faraday-law to stationary processes is made?
The vectors **E** and **B** can be subject to both spatial and temporal fluctuations. In that way the two formulations suddenly are in competition with each other and we are asked, to explain the difference, as far as such a difference should be present.

Different formulation of the law of induction

Such a difference for instance is, that it is common practice to neglect the coupling between the fields at low frequencies. While at high frequencies in the range of the electromagnetic field the **E**- and the **H**-field are mutually dependent, at lower frequency and small field change the process of induction drops correspondingly according to Maxwell, so that a neglect seems to be allowed. Now electric or magnetic field can be measured independently of each other. Usually is proceeded as if the other field is not present at all.

That is not correct. A look at the Faraday-law immediately shows that even down to frequency zero always both fields are present. The field pointers however stand perpendicular to each other, so that the magnetic field pointer wraps around the pointer of the electric field in the form of a vortex ring in the case that the electric field strength is being measured and vice versa. The closed-loop field lines are acting neutral to the outside; they hence need no attention, so the normally used idea. It should be examined more closely if this is sufficient as an explanation for the neglect of the not measurable closed-loop field lines, or if not after all an effect arises from fields, which are present in reality.

Another difference concerns the commutability of **E**- and **H**-field, as is shown by the Faraday-generator, how a magnetic becomes an electric field and vice versa as a result of a relative velocity **v**. This directly influences the physical-philosophic question: **What is meant by the electromagnetic field?**

The textbook opinion based on the Maxwell equations names the static field of the charge carriers as cause for the electric field, whereas moving ones cause the magnetic field. But that hardly can have been the idea of Faraday, to whom the existence of charge carriers was completely unknown. The for his contemporaries completely revolutionary abstract field concept based on the works of the Croatian Jesuit priest Boscovich (1711-1778). In the case of the field it should less concern a physical quantity in the usual sense, than rather the „experimental experience“ of an interaction according to his field description.

We should interpret the Faraday-law to the effect that we experience an electric field, if we are moving with regard to a magnetic field with a relative velocity and vice versa.

In the commutability of electric and magnetic field a duality between the two is expressed, which in the Maxwell formulation is lost, as soon as charge carriers are brought into play. Is thus the Maxwell field the special case of a particle free field? Much evidence points to it, because after all a light ray can run through a particle free vacuum. If however fields can exist without particles, particles without fields however are impossible, then the field should have been there first as the cause for the particles. Then the Faraday description should form the basis, from which all other regularities can be derived.
What do the textbooks say to that?

Contradictory opinions in textbooks

Obviously there exist two formulations for the law of induction (1 and 1*), which more or less have equal rights. Science stands for the question: which mathematical description is the more efficient one? If one case is a special case of the other case, which description then is the more universal one?

What Maxwell's field equations tell us is sufficiently known, so that derivations are unnecessary. Numerous textbooks are standing by, if results should be cited. Let us hence turn to the Faraday-law (1). Often one searches in vain for this law in schoolbooks. Only in more pretentious books one makes a find under the keyword „unipolar induction". If one however compares the number of pages, which are spent on the law of induction according to Maxwell with the few pages for the unipolar induction, then one gets the impression that the latter only is a unimportant special case for low frequencies. Küpfmüller speaks of a „special form of the law of induction" [7, S.228, Gl.22], and cites as practical examples the induction in a brake disc and the Hall-effect. Afterwards Küpfmüller derives from the „special form" the „general form" of the law of induction according to Maxwell, a postulated generalization, which needs an explanation. But a reason is not given [7].
Bosse gives the same derivation, but for him the Maxwell-result is the special case and not his Faraday approach [8, chap. 6.1 Induction, S.58]! In addition he addresses the Faraday-law as ***equation of transformation*** and points out the meaning and the special interpretation.
On the other hand he derives the law from the Lorentz force, completely in the style of Küpfmüller [7] and with that again takes it part of its autonomy. Pohl looks at that different. He inversely derives the Lorentz force from the Faraday-law [6, S.77].

By all means, the Faraday-law, which we want to base on instead of on the Maxwell equations, shows „strange effects [9, S.31 comment on the Lorentz force (1.65)] from the point of view of a Maxwell representative of today and thereby but one side of the medal (eq. 1). Only in very few distinguished textbooks the other side of the medal (eq. 2) is mentioned at all. In that way most textbooks mediate a lopsided and incomplete picture [7,8,9]. If there should be talk about equations of transformation, then the dual formulation belongs to it, then it concerns a pair of equations, which describes the relations between the electric and the magnetic field.

The **new and dual field approach** consists of

equations of transformation

of the electric and of the magnetic field<i>

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \quad (1) \qquad \text{and} \qquad \mathbf{H} = -\mathbf{v} \times \mathbf{D} \quad (2)$$

unipolar induction — equation of convection

Fig. 4: **Formulation** of the equations of transformation according to the rules of duality

The field-theoretical approach

The duality between E- and H-field and the commutability asks for a corresponding dual formulation to the Faraday-law (1). Written down according to the rules of duality there results an equation (2), which occasionally is mentioned in some textbooks.
While both equations in the books of Pohl [6, pp. 76 and 130] and of Simonyi [10, p. 924] are written down side by side having equal rights and are compared with each other, Grimsehl [11, S. 130] derives the dual regularity (2) with the help of the example of a thin, positively charged and rotating metal ring. He speaks of „equation of convection“, according to which moving charges produce a magnetic field and so-called convection currents. Doing so he refers to workings of Röntgen 1885, Himstedt, Rowland 1876, Eichenwald and many others more, which today hardly are known.
In his textbook also Pohl gives practical examples for both equations of transformation. He points out that one equation changes into the other one, if as a relative velocity v the speed of light c should occur. This question will also occupy us.

We now have found a field-theoretical approach with the equations of transformation, which in its dual formulation is clearly distinguished from the Maxwell approach. The reassuring conclusion is added: **The new field approach roots entirely in textbook physics**, as are the results from the literature research. **We can completely do without postulates.**
Next thing to do is to test the approach strictly mathematical for freedom of contradictions. It in particular concerns the question, which known regularities can be derived under which conditions. Moreover the conditions and the scopes of the derived theories should result correctly, e.g. of what the Maxwell approximation consists and why the Maxwell equations describe only a special case.

Derivation of Maxwell’s field equations

As a starting-point and as approach serve the equations of transformation of the electromagnetic field, the Faraday-law of unipolar induction (1) and the according to the rules of duality formulated law (2).

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \quad (1) \qquad \text{and} \qquad \mathbf{H} = -\mathbf{v} \times \mathbf{D} \quad (2)$$

If we apply the curl (= rot) to both sides of the equations

$$\text{rot}\,\mathbf{E} = \text{rot}\,(\mathbf{v} \times \mathbf{B}) \quad (3) \quad \text{and} \quad \text{rot}\,\mathbf{H} = -\,\text{rot}\,(\mathbf{v} \times \mathbf{D}) \quad (4)$$

then according to known algorithms of vector analysis the curl of the cross product each time delivers the sum of four single terms.

$$\text{rot}\,\mathbf{E} = (\mathbf{B}\,\text{grad})\mathbf{v} - (\mathbf{v}\,\text{grad})\mathbf{B} + \mathbf{v}\,\text{div}\,\mathbf{B} - \mathbf{B}\,\text{div}\,\mathbf{v} \quad (3^*)$$

$$\text{rot}\,\mathbf{H} = -[(\mathbf{D}\,\text{grad})\mathbf{v} - (\mathbf{v}\,\text{grad})\mathbf{D} + \mathbf{v}\,\text{div}\,\mathbf{D} - \mathbf{D}\,\text{div}\,\mathbf{v}] \quad (4^*),$$

Two of these again are zero for a non-accelerated relative motion in the x-direction with

$$\mathbf{v}(t) = d\mathbf{r}/dt \quad , \quad (5)$$

$$\text{div}\,\mathbf{v} = 0 \quad , \quad (5^*)$$

and:

$$\partial \mathbf{v}(t)/\partial \mathbf{r} = \text{grad}\,\mathbf{v} = \mathbf{0} \quad . \quad (5^{**})$$

One term concerns the vector gradient (**v** grad)**B**, which can be represented as a tensor. By writing down and solving the accompanying derivative matrix giving consideration to the above determination of the **v**-vector, the vector gradient becomes the simple time derivation of the field vector **B**(**r**(t)) (eq. 6, according to the rule of eq. 7).

$$(\mathbf{v}\,\text{grad})\,\mathbf{B} = \frac{d\,\mathbf{B}}{d\,t} \quad \text{and} \quad (\mathbf{v}\,\text{grad})\,\mathbf{D} = \frac{d\,\mathbf{D}}{d\,t} \quad , \quad (6)$$

$$\frac{d\mathbf{V}(\mathbf{r}(t))}{dt} = \frac{\partial\,\mathbf{V}(\mathbf{r} = \mathbf{r}(t))}{\partial\,\mathbf{r}} \cdot \frac{d\mathbf{r}(t)}{dt} = (\mathbf{v}\,\text{grad})\,\mathbf{V} \quad (7)$$

For the last not yet explained terms at first are written down the vectors **b** and **j** as abbreviation.

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt + \mathbf{v}\,\text{div}\,\mathbf{B} = -\,d\mathbf{B}/dt - \mathbf{b} \quad (8)$$

$$\text{rot}\,\mathbf{H} = d\mathbf{D}/dt - \mathbf{v}\,\text{div}\,\mathbf{D} = d\mathbf{D}/dt + \mathbf{j} \quad (9)$$

With equation 9 we in this way immediately look at the well-known law of Ampère (1st Maxwell equation). The comparison of coefficients (9*) in addition delivers a useful explanation to the question, what is meant by the current density **j**: it is a space charge density ρ_{el} consisting of negative charge carriers, which moves with the velocity **v** for instance through a conductor (in the x-direction for example).

$$\mathbf{j} = -\,\mathbf{v}\,\text{div}\,\mathbf{D} = -\,\mathbf{v}\cdot\rho_{el} \quad , \quad (9^*)$$

The current density **j** and the to that dual potential density **b** mathematically seen at first are nothing but alternative vectors for an abbreviated notation. While for the current density **j** the physical meaning already could be clarified from the comparison with the law of Ampère, the interpretation of the potential density **b** still is due.

$$\mathbf{b} = -\,\mathbf{v}\,\text{div}\,\mathbf{B} \quad (= 0\ ?) \quad , \quad (8^*)$$

From the comparison with the law of induction (1*) we merely infer, that according to the Maxwell theory this term is assumed to be zero. But that is exactly the Maxwell approximation and the restriction with regard to the new and dual field approach, which roots in Faraday.

In that way also the duality gets lost with the argument that magnetic monopoles (div **B**) in contrast to electric monopoles (div **D**) do not exist and until today could evade every proof. It thus is overlooked that div **D** at first describes only eddy currents and div **B** only

the necessary anti-vortex, the potential vortex. Spherical particles, like e.g. charge carriers presuppose both vortices: on the inside the expanding (div **D**) and on the outside the contracting vortex (div **B**), which then necessarily has to be different from zero, even if there hasn't yet been searched for the vortices dual to eddy currents, which are expressed in the neglected term.
Assuming, a monopole concerns a special form of a field vortex, then immediately gets clear, why the search for magnetic poles has to be a dead end and their failure isn't good for a counterargument: The missing electric conductivity in vacuum prevents current densities, eddy currents and the formation of magnetic monopoles. Potential densities and potential vortices however can occur. As a result can without exception only electrically charged particles be found in the vacuum (derivation [1] in chapter 4.2 till 4.4).
Because vortices are more than monopole-like structures depending on some boundary conditions, only the vortex description will be pursued further consequently.

Let us record: **Maxwell's field equations can directly be derived from the new dual field approach under a restrictive condition.** Under this condition the two approaches are equivalent and with that also error free. Both follow the textbooks and can so to speak be the textbook opinion.
The restriction (**b** = 0) surely is meaningful and reasonable in all those cases in which the Maxwell theory is successful. It only has an effect in the domain of electrodynamics. Here usually a vector potential **A** is introduced and by means of the calculation of a complex dielectric constant a loss angle is determined. Mathematically the approach is correct and dielectric losses can be calculated. Physically however the result is extremely questionable, since as a consequence of a complex ε a complex speed of light would result (according to the definition $c \equiv 1/\sqrt{\varepsilon \cdot \mu}$). With that electrodynamics offends against all specifications of the textbooks, according to which c is constant and not variable and less then ever complex.
But if the result of the derivation physically is wrong, then something with the approach is wrong, then the fields in the dielectric perhaps have an entirely other nature, then dielectric losses perhaps are vortex losses of potential vortices falling apart?

Derivation of the potential vortices

Is the introduction of a vector potential **A** in electrodynamics a substitute of neglecting the potential density **b**? Do here two ways mathematically lead to the same result? And what about the physical relevance? After classic electrodynamics being dependent on working with a complex constant of material, in what is buried an insurmountable inner contradiction, the question is asked for the freedom of contradictions of the new approach. At this point the decision will be made, if physics has to make a decision for the more efficient approach, as it always has done when a change of paradigm had to be dealt with.

The abbreviations **j** and **b** are further transformed, at first the current density in Ampère's law

$$\mathbf{j} = -\mathbf{v}\,\mathrm{div}\,\mathbf{D} = -\mathbf{v}\cdot\rho_{el} \qquad (9^*)$$

as the movement of negative electric charges.

By means of Ohm's law:

$$\mathbf{j} = \sigma\cdot\mathbf{E} = \mathbf{D}/\tau_1 \qquad (10)$$

and the relation of material

$$\mathbf{D} = \varepsilon\cdot\mathbf{E} \qquad (11)$$

the current density **j** also can be written down as dielectric displacement current with the characteristic relaxation time constant for the eddy currents

$$\tau_1 = \varepsilon/\sigma \qquad (12)$$

In this representation of the law of Ampère (eq. 13) clearly is brought to light, why the ***magnetic field is a vortex field***, and how the eddy currents produce heat losses depending on the specific electric conductivity σ. As one sees we, with regard to the magnetic field description, move around completely in the framework of textbook physics.

$$\text{rot}\,\mathbf{H} = d\mathbf{D}/dt + \mathbf{D}/\tau_1 = \varepsilon\cdot(d\mathbf{E}/dt + \mathbf{E}/\tau_1) \qquad (13)$$

Let us now consider the dual conditions.

$$\mathbf{b} = -\mathbf{v}\,\text{div}\,\mathbf{B} = \mathbf{B}/\tau_2 \;, \qquad (14)$$

The comparison of coefficients (eq. 8, 14) looked at purely formal, results in a potential density **b** in duality to the current density **j**, which with the help of an appropriate time constant τ_2 founds vortices of the electric field. I call these potential vortices.

The completely extended law of induction reads with $\mathbf{B} = \mu\cdot\mathbf{H}$: (15)

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt - \mathbf{B}/\tau_2 = -\,\mu\cdot(d\mathbf{H}/dt + \mathbf{H}/\tau_2) \qquad (16)$$

In contrast to that the Maxwell theory requires an ***irrotationality of the electric field,*** which is expressed by taking the potential density **b** and the divergence **B** equal to zero. The time constant τ_2 thereby tends towards infinity. This Maxwell approximation leads to the circumstance that with the potential vortices of the electric field also their propagation as a scalar wave gets lost, so that the Maxwell equations describe only transverse and no longitudinal waves. At this point there can occur contradictions for instance in the case of the near-field of an antenna, where longitudinal wave parts can be detected measuring technically, and such parts already are used technologically in transponder systems e.g. as installations warning of theft in big stores.

It is denominating, how they know how to help oneself in the textbooks of high-frequency technology in the case of the near-field zone [12, S.335]. Proceeding from the Maxwell equations the missing potential vortex is postulated without further ado, by means of the specification of a „standing wave“ in the form of a vortex at a dipole antenna. With the help of the postulate now the longitudinal wave parts are „calculated“, like they also are being measured, but also like they wouldn’t occur without the postulate as a result of the Maxwell approximation.

There isn’t a way past the potential vortices and the new dual approach, because no scientist is able to afford to exclude already in the approach a possibly authoritative phenomenon, which he wants to calculate physically correct!

In addition further equations can be derived (from eq. 13 + 16), for which this until now was supposed to be impossible, like for instance the Schrödinger equation ([1] chap. 5.6-5.9). As a consequence of the Maxwell equations in general and specifically the eddy currents not being able to form structures, every attempt has to fail, which wants to derive the Schrödinger equation from the Maxwell equations.

The field equation (16) however contains the newly discovered potential vortices, which owing to their concentration effect (in duality to the skin effect) form spherical structures, for which reason these occur as eigenvalues of the equation. For these eigenvalue-solutions numerous practical measurements are present, which confirm their correctness and with that have probative force with regard to the correctness of the new field approach and the extended field equation.

The Maxwell field as a derived special case

As the derivations show, nobody can claim there wouldn’t exist potential vortices and no propagation as a scalar wave, since only the Maxwell equations are to blame that these already have been factored out in the approach. One has to know that the field equations, and may they be as famous as they are, are nothing but a special case, which can be derived.

The field-theoretical approach however, which among others bases on the Faraday-law, is universal and can't be derived on its part. It describes a physical basic principle, the alternating of two dual experience or observation factors, their overlapping and mixing by continually mixing up cause and effect. It is a philosophic approach, free of materialistic or quantum physical concepts of any particles.

Maxwell on the other hand describes without exception the fields of charged particles, the electric field of resting and the magnetic field as a result of moving charges. The charge carriers are postulated for this purpose, so that their origin and their inner structure remain unsettled and can't be derived. The subdivision e.g. in quarks stays in the domain of a hypothesis, which can't be proven. The sorting and systematizing of the properties of particles in the standard-model is nothing more than unsatisfying comfort for the missing calculability.

With the field-theoretical approach however the elementary particles with all quantum properties can be calculated as field vortices [1, chap. 7]. With that the field is the cause for the particles and their measurable quantisation. The electric vortex field, at first source free, is itself forming its field sources in form of potential vortex structures. The formation of charge carriers in this way can be explained and proven mathematically, physically, graphically and experimentally understandable according to the model.

Where in the past the Maxwell theory has been the approach, there in the future should be proceeded from the equations of transformation of the field-theoretical approach. If now potential vortex phenomena occur, then these also should be interpreted as such in the sense of the approach and the derivation, then the introduction and postulation of new and decoupled model descriptions isn't allowed anymore, like the near-field effects of an antenna, the noise, dielectric capacitor losses, the mode of the light and a lot else more.

The at present in theoretical physics normal scam of at first putting a phenomenon to zero, to afterwards postulate it anew with the help of a more or less suitable model, leads to a breaking up of physics into apparently not connected individual disciplines and an inefficient specialist hood. There must be an end to this now! The new approach shows the way towards a unified theory, in which the different areas of physics again fuse to one area. In this lies the big chance of this approach, even if many of the specialists at first should still revolt against it.

This new and unified view of physics shall be summarized with the term „theory of objectivity". As we shall derive, it will be possible to deduce the theory of relativity as a partial aspect of it [1, chapter 6 and 28].

Let us first cast our eyes over the wave propagation.

Derivation of the wave equation

The first wave description, model for the light theory of Maxwell, was the inhomogeneous Laplace equation:

$$\Delta \mathbf{H} \cdot c^2 = d^2\mathbf{H}/dt^2 \quad \text{with} \quad \Delta \mathbf{H} = \text{grad div } \mathbf{H} - \text{rot rot } \mathbf{H} \qquad (21)$$

There are asked some questions:

- Can also this mathematical wave description be derived from the new approach?
- Is it only a special case and how do the boundary conditions read?

- In this case how should it be interpreted physically?
- Are new properties present, which can lead to new technologies?

Starting-point is the field equation (13). This time we write it down for the magnetic induction **B** and consider the special case, that we are located in a badly conducting medium, as is usual for the wave propagation in air. But with the electric conductivity σ also $1/\tau_1 = \sigma/\varepsilon$ tends towards zero. With that the eddy currents and their damping and other properties disappear from the field equation, what also makes sense.

(13): $\text{rot}\,\mathbf{H} = \varepsilon \cdot d\mathbf{E}/dt$ with (15): $\boxed{\text{rot}\,\mathbf{B} = \mu \cdot \varepsilon \cdot d\mathbf{E}/dt}$ (22)

The derivation always is the same: If we again apply the rot operation to rot **B** also the other side of the equation should be subjected to the curl (= rot) with the speed of light c:

$$\boxed{\mu \cdot \varepsilon = 1/c^2} \qquad (23)$$

The term rot **E** is expressed by the extended law of induction 16:

$$\boxed{\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt - \mathbf{B}/\tau_2} \qquad (16)$$

The result is the well known description of electromagnetic waves with vortex damping:

$$\boxed{-\,c^2 \cdot \text{rot rot}\,\mathbf{B} = \frac{d^2\mathbf{B}}{dt^2} + \frac{1}{\tau_2}\frac{d\mathbf{B}}{dt}} \qquad (24)$$

There occurs the potential vortex term $(1/\tau_2) \cdot d\mathbf{B}/dt$, which using the already introduced relation (6)

$$\boxed{(\mathbf{v}\,\text{grad})\,\mathbf{B} = \frac{d\,\mathbf{B}}{d\,t}} \quad \text{resp.} \quad \boxed{\frac{1}{\tau_2}\frac{d\,\mathbf{B}}{d\,t} = \mathbf{v}\,\text{grad}\,\frac{\mathbf{B}}{\tau_2}} \quad , \qquad (6)$$

and (14) $\mathbf{B}/\tau_2 = -\,\mathbf{v}\,\text{div}\,\mathbf{B}$, (14)

involved with an in x-direction propagating wave ($\mathbf{v} = (v_x,\ v_y = 0,\ v_z = 0)$) can be transformed directly into $(1/\tau_2) \cdot d\mathbf{B}/dt = -\|\mathbf{v}\|^2 \cdot \text{grad div}\,\mathbf{B}$ (25).

The divergence of a field vector (here **B**) mathematically seen is a scalar, for which reason this term as part of the wave equation founds so-called „scalar waves“ and that means that potential vortices, as far as they exist, will appear as a scalar wave. We at this point tacitly anticipate [3, chapter 28], which provides the reason for the speed of light losing its vectorial nature, if it is correlated with itself. This insight however is valid in general for all velocities ($\mathbf{v} = d\mathbf{r}/dt$), so that in the same way a scalar descriptive factor can be used for the velocity ($v = dx/dt$) as for c.

From the simplified field equation (24) the general wave equation (26) can be won in the shown way, divided into longitudinal and transverse wave parts, which however can propagate with different velocity.

$$\boxed{v^2\,\text{grad div}\,\mathbf{B} - c^2\,\text{rot rot}\,\mathbf{B} = \partial^2\mathbf{B}/\partial t^2} \qquad (26)$$

longitudinal	transverse	wave
with v = arbitrary	with c = const.	velocity of propagation

Physically seen the vortices have particle nature as a consequence of their structure forming property. With that they carry momentum, which puts them in a position to form a longitudinal shock wave similar to a sound wave. If the propagation of the light one time takes place as a wave and another time as a particle, then this simply and solely is a

consequence of the wave equation. Light quanta should be interpreted as evidence for the existence of scalar waves. Here however also occurs the restriction that light always propagates with the speed of light. It concerns the special case v = c.
With that the derived wave equation (26) changes into the inhomogeneous Laplace equation (21).

$$\Delta \mathbf{B} = \text{grad div } \mathbf{B} - \text{rot rot } \mathbf{B} = (1/c^2) \cdot \partial^2 \mathbf{B} / \partial t^2 \quad (21)$$

The electromagnetic wave in both cases is propagating with c. As a transverse wave the field vectors are standing perpendicular to the direction of propagation. The velocity of propagation therefore is decoupled and constant. Completely different is the case for the longitudinal wave. Here the propagation takes place in the direction of an oscillating field pointer, so that the phase velocity permanently is changing and merely an average group velocity can be given for the propagation. There exists no restriction for v and v = c only describes a special case.

• From the dual **field-theoretical approach** are derived:	• From **Maxwell's field equations** can be derived:
⇒ **Maxwell's field equations**	⇒ Ø
⇒ the **wave equation** (with transverse and longitudinal parts)	⇒ only **transverse waves** (no longitudinal waves)
⇒ **scalar waves** (Tesla-/neutrino radiation)	⇒ Ø (no scalar waves)
⇒ **vortex and anti-vortex** (current eddy and potential vortex)	⇒ only **eddy currents**
⇒ **Schrödinger equation** (basic equation of chemistry)	⇒ Ø
⇒ **Klein-Gordon equation** (basic eq. of nuclear physics)	⇒ Ø
⇒ **theory of objectivity**	⇒ **theory of relativity**

Fig. 5: Comparison of the efficiency of both approaches.
(as an interim result, if it concerns the question, which approach of the two is the more efficient one and which one better should be discarded. The final balance is made in [3, chapter 28]).
It here concerns partial aspects of the following theories:

The new field approach in synopsis

Proof could be furnished that an approximation is buried in Maxwell's field equations and that they merely represent the special case of a new, dually formulated and more universal approach. The mathematical derivations of the Maxwell field and the wave equation disclose, of what the Maxwell approximation consists. The anti-vortex dual to the expanding eddy current with its skin effect is neglected. This contracting anti-vortex is called potential vortex. It is capable of forming structures and propagates as a scalar wave in longitudinal manner in badly conducting media like air or vacuum.

At relativistic velocities the potential vortices are subject to the Lorentz contraction. Since for scalar waves the propagation occurs longitudinally in the direction of an oscillating field pointer, the potential vortices experience a constant oscillation of size as a result of the oscillating propagation. If one imagines the field vortex as a planar but rolled up transverse wave, then from the oscillation of size and with that of wavelength at constant swirl velocity with c follows a continual change in frequency, which is measured as a noise signal.

The noise proves to be the in the Maxwell equations neglected potential vortex term, which founds scalar waves. If at biological or technical systems, e.g. at antennas a noise signal is being measured, then that proves the existence of potential vortices, but it then also means that the scope of the Maxwell theory has been exceeded and erroneous concepts can be the result.

As an answer to the question about possible new technologies is pointed to two special properties.

1st potential vortices for reason of their particle nature carry momentum and energy. Since we are surrounded by noise vortices, an energy technical use of scalar waves would be feasible, where the noise power is withdrawn of the surroundings. There is evidence that biological systems in nature cover their need for energy in this way. But at least an energy transmission with scalar waves already would be a significant progress with regard to the alternating current technology of today.

2nd the wavelength multiplied with the frequency results in the velocity of propagation v of a wave ($\lambda \cdot f = v$), and that for scalar waves by no means is constant. With that wavelength and frequency aren’t coupled anymore; they can be modulated separately, for which reason for scalar waves a whole dimension can be modulated additionally compared to the Hertzian wave. In that the reason can be seen, why the human brain with just 10 Hz clock frequency is considerably more efficient than modern computers with more than 1 GHz clock frequency. Nature always works with the best technology, even if we haven’t yet understood it.

If we would try to learn of nature and an energy technical or an information technical use of scalar waves would occur, then probably nobody wanted to have our today still highly praised technology anymore. In the course of the greenhouse gases and the electro smog we have no other choice than to scientifically occupy us with scalar waves and their technical use.

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Table of formula symbols

	Electric field			Magnetic field	
E	V/m	Electric field strength	**H**	A/m	Magnetic field strength
D	As/m^2	Electric displacement	**B**	Vs/m^2	Magnetic induction
ε	As/Vm	Dielectricity	μ	Vs/Am	Permeability
b	V/m^2	Potential density	**j**	A/m^2	Current density

ρ_{el}	As/m^3	Electric space charge density	
σ	Vm/A	Specific electric conductivity	
v	m/s	Velocity	
c	m/s	Speed of light	$c = 1/\sqrt{\varepsilon \cdot \mu}$

Bold print = field pointer (vector); div = Divergence; grad = Gradient; rot = curl = Rotation