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Scalar Wave Effects according to Tesla

Field-physical basis for electrically coupled bidirectional
far range transponders, such as Tesla's Wardenclyffe Tower

Abstract

With the current RFID technology the transfer of energy takes place on a chip card by means of longitudinal wave components in close range of the transmitting antenna. Those are scalar waves, which spread towards the electrical or the magnetic field pointer.

In the wave equation with reference to the Maxwell field equations, these wave components are set to zero, why only postulated model computations exist, after which the range is limited to the sixth part of the wavelength.

A goal of this paper is to create, by consideration of the scalar wave components in the wave equation, the physical conditions for the development of scalar wave transponders which are operable beyond the close range. The energy is transferred with the same carrier wave as the information and not over two separated ways as with RFID systems. Besides the bi-directional signal transmission, the energy transfer in both directions is additionally possible because of the resonant coupling between transmitter and receiver.

First far range transponders developed on the basis of the extended field equations are already functional as prototypes, according to the US-Patent No. 787,412 of Nikola Tesla, New York 1905 [1].

Key words

Longitudinal wave, scalar wave, Tesla radiation, RFID, field theory.

1. Introduction

Abstract of the practical setting of tasks

Transponders serve the transmission of energy e.g. on a chip card in combination with a back transmission of information. The range is with the presently marketable devices (RFID technology) under one meter [2]. The energy receiver must be in addition in close range of the transmitter.

The far range transponders developed by the first transfer centre for scalar wave technology are able to transfer energy beyond close range (10 to 100 m) and besides with fewer losses and/or a higher efficiency. The energy with the same carrier wave is transferred as the information and not as with the RFID technology over two separated systems [2].

A condition for new technologies is a technical-physical understanding, as well as a mathematically correct and comprehensive field description, which include all well known effects of close range of an antenna. We encounter here a central problem of the field theory, which forms the emphasis of this paper and the basis for advancements in the transponder technology.

Requirements at transponders

In today's times of Blue tooth and Wireless LAN one accustomed fast to the amenities of wireless communication. These open for example garage gates, the barrier of the parking lot or the trunk is lid only by radio.

However, in the life span limited and the often polluting batteries in the numerous radio transmitters and remote maintenance are of great disadvantage.

Ever more frequently the developers see themselves confronted with the demand after a wireless transfer of energy. Accumulators are to be reloaded or replaced completely. In entrance control systems (ski elevator, stages, department stores…) these systems are already successful in use.

But new areas of application with increased requirements are constantly added apart from the desire for a larger range:

- *in telemetry plants rotary sensors are to be supplied with energy (in the car e.g. to control tire pressure).*
- *also with heat meters the energy should come from a central unit and be spread wirelessly in the whole house to the heating cost meters without the use of batteries*
- *in airports contents of freight containers are to be seized, without these to having be opened (security checks).*
- *the forwarding trade wants to examine closed truck charges by transponder technology.*
- *in the robot and handling technique the wirings are to be replaced by a wireless technology (wear problem).*
- *portable radio devices, mobile phones, Notebooks and remote controls working without batteries and Accumulators (reduction of the environ-mental impact).*

A technical solution, which is based on pure experimenting and trying, is to be optimised unsatisfactorily and hardly. It should stand rather on a field-theoretically secured foundation, whereby everyone thinks first of Maxwell's field equations. Here however a new hurdle develops itself under close occupation.

Problem of the field theory

In the close range of an antenna, so the current level of knowledge is, are longitudinal -towards a field pointer, portions of the radiated wave present. These are usable in the transponder technology for the wireless transmission of energy. The range amounts to however only $\lambda/2\pi$ and that is approximately the sixth part of the wavelength [3].

The problem consists now of the fact that the valid field theory, and that is from Maxwell, only is able to describes transversal and no longitudinal wave components. All computations of longitudinal waves or wave components, which run toward the electrical or the magnetic pointer of the field, are based without exception on postulates [4].

The near field is not considered in vain as an unresolved problem of the field theory. The experimental proof may succeed, not however the field-theoretical proof.

Field equations according to Maxwell

A short derivation brings it to light. We start with the law of induction according to the textbooks

$$\boxed{\text{curl } \mathbf{E} = -\,\delta\mathbf{B}/\delta t} \tag{1.1}$$

with the electric field strength $\mathbf{E} = \mathbf{E}(\mathbf{r},t)$ and the magnetic field strength $\mathbf{H} = \mathbf{H}(\mathbf{r},t)$

and: $$\mathbf{B} = \mu \cdot \mathbf{H} \text{ (1. relation of material),} \tag{1.2}$$

apply the curl-operation to both sides of the equation

$$-\text{ curl curl } \mathbf{E} = \mu \cdot \delta(\text{curl } \mathbf{H})/\delta t \tag{1.3}$$

and insert in the place of curl **H** Ampere's law:

$$\text{curl } \mathbf{H} = \mathbf{j} + \delta\mathbf{D}/\delta t \tag{1.4}$$

with $$\mathbf{j} = \sigma \cdot \mathrm{E} \text{ (Ohm's law)} \tag{1.5}$$

with $$\mathbf{D} = \varepsilon \cdot \mathrm{E} \text{ (2. relation of material)} \tag{1.6}$$

and $$\tau_1 = \varepsilon/\sigma \text{ (relaxation time [5])} \tag{1.7}$$

$$\boxed{\text{curl } \mathbf{H} = \varepsilon \cdot (\mathbf{E}/\tau_1 + \delta\mathbf{E}/\delta t)} \tag{1.8}$$

$$-\text{ curl curl } \mathbf{E} = \mu \cdot \varepsilon \cdot (1/\tau_1 \cdot \delta\mathbf{E}/\delta t + \delta^2\mathbf{E}/\delta t^2) \tag{1.9}$$

with the abbreviation: $$\mu \cdot \varepsilon = 1/c^2. \tag{1.10}$$

The generally known result describes a *damped electro-magnetic wave* [6]:

$$\boxed{\underbrace{-\text{ curl curl } \mathbf{E} \cdot c^2}_{\text{transverse}} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{\text{wave}} + \underbrace{(1/\tau_1) \cdot \delta\mathbf{E}/\delta t}_{\text{vortex damping}}} \tag{1.11}$$

transverse – wave + vortex damping

On the one hand it is a transverse wave. On the other hand there is an damping term in the equation, which is responsible for the losses of an antenna. It indicates the wave component, which is converted into standing waves, which can be also called field vortices, that produce vortex losses for their part with the time constant τ_1 in the form of heat.

Where however do, at close range of an antenna proven and with transponders technically used longitudinal wave components hide themselves in the field equation (1.11)?

Wave equation according to Laplace

The wave equation found in most textbooks has the form of an inhomogeneous Laplace equation. The famous French mathematician ***Laplace*** considerably earlier than Maxwell did find a comprehensive formulation of waves and formulated it mathematically:

$$\boxed{\underbrace{\Delta \mathbf{E} \cdot c^2}_{\substack{\text{Laplace}\\ \text{operator}}} = \underbrace{-\,\text{curl curl}\ \mathbf{E} \cdot c^2}_{\substack{\text{transverse-}\\ \text{(radio wave)}}} + \underbrace{\text{grad div}\ \mathbf{E} \cdot c^2}_{\substack{\text{longitudinal-}\\ \text{(scalar wave)}}} = \underbrace{\delta^2 \mathbf{E}/\delta t^2}_{\text{wave}}} \quad (1.12)$$

On the one side of the wave equation the Laplace operator stands, which describes the spatial field distribution and which according to the rules of vector analysis can be decomposed into two parts. On the other side the description of the time dependency of the wave can be found as an inhomogeneous term.

The wave equations in the comparison

If the wave equation according to Laplace (1.12) is compared to the one, which the Maxwell equations have brought us (1.11), then two differences clearly come forward:

1. *In the Laplace equation the damping term is missing.*

2. *With divergence* ***E*** *a scalar factor appears in the wave equation, which founds a scalar wave.*

One practical example of a scalar wave is the plasma wave. This case forms according to the

3. Maxwell equation: $\text{div}\ \mathbf{D} = \varepsilon \cdot \text{div}\ \mathbf{E} = \rho_{el}$ (1.13)

the space charge density consisting of charge carriers ρ_{el} the scalar portion. These move in form of a shock wave longitudinal forward and present in its whole an electric current.

Since both descriptions of waves possess equal validity, we are entitled in the sense of a coefficient comparison to equate the damping term due to eddy currents according to Maxwell (1.11) with the scalar wave term according to Laplace (1.12).

Physically seen the generated field vortices form and establish a scalar wave.

The presence of div $\mathbf{E}$ proves a necessary condition for the occurrence of eddy currents. Because of the well known skin effect [7] expanding and damping acting eddy currents, which appear as consequence of a current density $\mathbf{j}$, set ahead however an electrical conductivity σ (acc. to eq. 1.5).

The view of duality

Within the near field range of an antenna opposite conditions are present. With bad conductivity in a general manner a vortex with dual characteristics would be demanded for the formation of longitudinal wave components. I want to call this contracting antivortex, unlike to the expanding eddy current, a potential vortex.

If we examine the potential vortex with the Maxwell equations for validity and compatibility, then we would be forced to let it fall directly again. The derivation of the damped wave equation (1.1 to 1.11) can take place in place of the electrical, also for the magnetic field strength. Both wave equations (1.11 and 1.12) do not change thereby their shape. In the inhomogeneous Laplace equation in this dual case however, the longitudinal scalar wave component through div $\mathbf{H}$ is described and this is according to Maxwell zero!

4. Maxwell's equation: $\operatorname{div} \mathbf{B} = \mu \cdot \operatorname{div} \mathbf{H} = 0$ (1.14)

If is correct, then there may not be a near field, no wireless transfer of energy and finally also no transponder technology. Therefore, the correctness is permitted (of eq. 1.14) to question and examine once, what would result thereby if potential vortices exist and develop in the air around an antenna scalar waves, as the field vortices form among themselves a shock wave.

Besides still another boundary problem will be solved: since in div **D** electrical monopoles can be seen (1.13) there should result from duality to div **B** magnetic monopoles (1.14). But the search was so far unsuccessful [8]. Vortex physics will ready have an answer.

2. The approach

Faraday instead of Maxwell

If a measurable phenomenon should, e.g. the close range of an antenna, not be described with the field equations according to Maxwell mathematically, then prospect is to be held after a new approach. All efforts that want to prove the correctness of the Maxwell theory with the Maxwell theory end inevitably in a tail-chase, which does not prove anything in the end.

In a new approach high requirements are posed. It may not contradict the Maxwell theory, since these supply correct results in most practical cases and may be seen as confirmed. It would be only an extension permissible, in which the past theory is contained as a subset e.g. Let's go on the quest.

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. 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 [9].

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.

In fluidics the connections are understood. They are usually also well visible and without further aids observable.

In electrical engineering it's different: here field vortices remain invisible. Only so a 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.

By this reconciliation it is ensured that the condition in the vortex centre corresponds in the infinite one, complete in analogy to fluid mechanics.

The Maxwell approximation

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. The transition to insulants however, which requires for the laws of the field refraction steadiness, is incompatible with the acceptance of eddy currents in the cable and a nonvortical field in air. In such a case the Maxwell approximation will lead to considerable errors.

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.

We imagine now a spherical vortex, in whose inside an expanding vortex is enclosed and which is held together from the outside by the contracting potential vortex and is forced into it's spherical shape. From the infinite measured this spherical vortex would have an electrical charge and all the characteristics of a charge carrier.

Inside:	expanding eddy current (skin effect)
Outside:	contracting anti-vortex (potential vortex)
Condition:	for coming off: equally powerful vortices
Criterion:	electric conductivity (determines diameter)
Result:	spherical structure (consequence of the pressure of the vacuum)

Figure 2. The electron as an electromagnetic sphere-vortex

The mistake of the magnetic monopole

With the tendency of the potential vortex for contraction, inevitably the ability is linked to a structural formation. The particularly obvious structure of a ball would be besides an useful model for quanta.

A to the sphere formed field-vortex would be described mathematically in its inside with the expanding vortex div **D**. For the potential vortex working against from the outside div **B** would apply.

The divergence may be set therefore neither with the electrical field (4th Maxwell equation) nor with the magnetic field (3rd Maxwell equation) to zero!

If however both equations are necessary for the derivation of an electron, then it is a mistake in reasoning wanting to assign one alone to an electrical and the other one to a magnetic monopole.

Since the radius, at which it comes to vortex detaching and with it the size of the sphere vortex depends on it's conductivity, electrical monopoles and among them rank numerous elementary particles, will be extremely small. Magnetic monopoles however would have to take enormous, no longer for us measurable dimensions.

The discovery of the law of induction

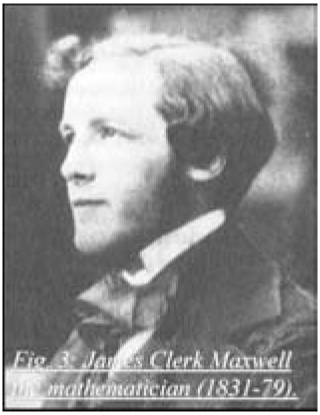

Fig. 3: James Clerk Maxwell the mathematician (1831-79).

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.

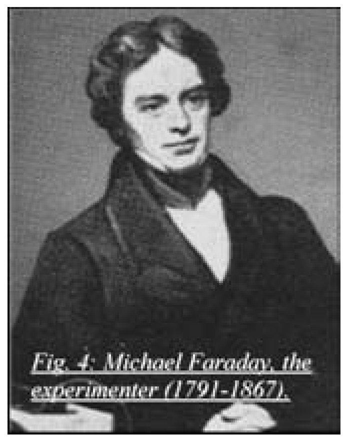

Fig. 4: Michael Faraday, the experimenter (1791-1867).

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 [10] 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.

The unipolar generator

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.

The mathematically correct relation

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \tag{2.1}$$

I call Faraday-law, even if it only appears in this form in the textbooks later in time [11]. 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. 5). The second Maxwell equation, the law of induction (2.2), 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**.

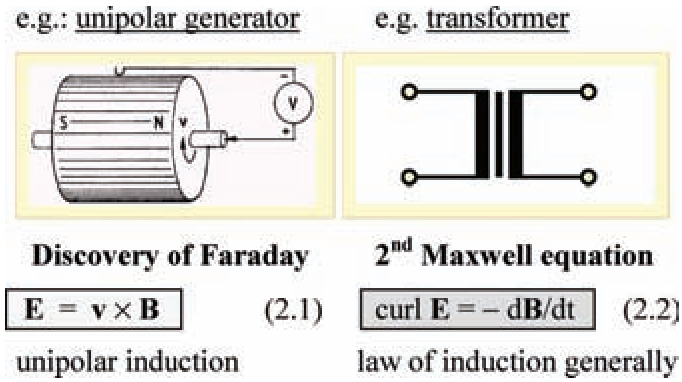

Figure 5. Two formulations for one law: As a mathematical relation between the vectors of the electric field strength **E** and the induction **B** (= magnetic flux density)

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 induction laws

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 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 [7, i.e.]. But that hardly can have been the idea of Faraday, to whom the existence of charge carriers was completely unknown. 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 (2.1 and 2.2), 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 (2.1). 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" [12], 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 [12].

Bosse gives the same derivation, but for him the Maxwell-result is the special case and not his Faraday approach [13]! 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 [12] 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 [14]. We should follow this very much convincing representation.

The equation of convection

If the by Bosse [13] prompted term "equation of transformation" is justified or not at first is unimportant. That is a matter of discussion.

If there should be talk about equations of transformation, then the dual formulation (to equation 2.1) 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

$\boxed{\mathbf{E} = \mathbf{v} \times \mathbf{B}}$ (2.1) and $\boxed{\mathbf{H} = -\mathbf{v} \times \mathbf{D}}$ (2.3)

unipolar induction equation of convection

Written down according to the rules of duality there results an equation (2.3), which occasionally is mentioned in some textbooks.

While both equations in the books of Pohl [14, p.76 and 130] and of ***Simonyi*** [15] are written down side by side having equal rights and are compared with each other, ***Grimsehl*** [16] derives the dual regularity (2.3) 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.

3. Derivation from text book physics

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 the field equations acc. to Maxwell

As a starting-point and as approach serve the equations of transformation of the electromagnetic field, the Faraday-law of *unipolar induction* (2.1) and the according to the rules of duality formulated law called *equation of convection* (2.3).

$$\boxed{\mathbf{E} = \mathbf{v} \times \mathbf{B}} \tag{2.1}$$

and

$$\boxed{\mathbf{H} = -\,\mathbf{v} \times \mathbf{D}} \tag{2.3}$$

If we apply the curl to both sides of the equations:

$$\boxed{\mathrm{curl}\ \mathbf{E} = \mathrm{curl}\ (\mathbf{v} \times \mathbf{B})} \tag{3.1}$$

and

$$\boxed{\mathrm{curl}\ \mathbf{H} = -\,\mathrm{curl}\ (\mathbf{v} \times \mathbf{D})} \tag{3.2}$$

then according to known algorithms of vector analysis the curl of the cross product each time delivers the sum of four single terms [17]:

$$\boxed{\mathrm{curl}\ \mathbf{E} = (\mathbf{B}\ \mathrm{grad})\mathbf{v} - (\mathbf{v}\ \mathrm{grad})\mathbf{B} + \mathbf{v}\ \mathrm{div}\ \mathbf{B} - \mathbf{B}\ \mathrm{div}\ \mathbf{v}} \tag{3.3}$$

$$\boxed{\mathrm{curl}\ \mathbf{H} = -[(\mathbf{D}\ \mathrm{grad})\mathbf{v} - (\mathbf{v}\ \mathrm{grad})\mathbf{D} + \mathbf{v}\ \mathrm{div}\ \mathbf{D} - \mathbf{D}\ \mathrm{div}\ \mathbf{v}]} \tag{3.4}$$

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

$$\mathbf{v} = \mathrm{d}\mathbf{r}/\mathrm{d}t \tag{3.5}$$

$$\mathrm{grad}\ \mathbf{v} = 0 \tag{3.5*}$$

and

$$\mathrm{div}\ \mathbf{v} = 0 \tag{3.5**}$$

One term concerns 'the vector gradient ($\mathbf{v}$ grad)$\mathbf{B}$, which can be represented as a tensor. By writing down and solving the accompanying derivative matrix giving consideration to the above determination of the $\mathbf{v}$-vector, the vector gradient becomes the simple time derivation of the field vector $\mathbf{B}(\mathbf{r}(t))$,

$$\boxed{(\mathbf{v}\ \mathrm{grad})\mathbf{B} = \frac{d\mathbf{B}}{dt}} \quad \text{and} \quad \boxed{(\mathbf{v}\ \mathrm{grad})\mathbf{D} = \frac{d\mathbf{D}}{dt},} \tag{3.6}$$

according to the rule [17]:

$$\frac{d\mathbf{V}(\mathbf{r}(t))}{dt} = \frac{\partial \mathbf{V}(\mathbf{r} = \mathbf{r}(t))}{\partial \mathbf{r}} \cdot \frac{d\mathbf{r}(t)}{dt} = (\mathbf{v}\ \mathrm{grad})\mathbf{V}. \tag{3.7}$$

For the last not yet explained terms at first are written down the vectors $\mathbf{b}$ and $\mathbf{j}$ as abbreviation.

$$\mathrm{curl}\ \mathbf{E} = -\, d\mathbf{B}/dt + \mathbf{v}\ \mathrm{div}\ \mathbf{B} = -\, d\mathbf{B}/dt - \mathbf{b} \tag{3.8}$$

$$\mathrm{curl}\ \mathbf{H} = d\mathbf{D}/dt - \mathbf{v}\ \mathrm{div}\ \mathbf{D} = d\mathbf{D}/dt + \mathbf{j} \tag{3.9}$$

With equation 3.9 we in this way immediately look at the well-known law of Ampère (1st Maxwell equation).

The Maxwell equations as a special case

The result will be the **Maxwell equations**, if:

- the potential density $\mathbf{b} = -\,\mathbf{v}\ \mathrm{div}\ \mathbf{B} = 0$, (3.10)
  (eq. 3.8 ≡ law of induction 1.1, if $\mathbf{b} = 0$ resp. $\mathrm{div}\ \mathbf{B} = 0$)!
- the current density $\mathbf{j} = -\,\mathbf{v}\ \mathrm{div}\ \mathbf{D} = -\,\mathbf{v} \cdot \rho_{el}$, (3.11)
  (eq. 3.9 ≡ Ampère's law 1.4, if $\mathbf{j}$ ≡ with $\mathbf{v}$ moving negative charge carriers, (ρ_{el} = electric space charge density).

The comparison of coefficients (3.11) in addition delivers a useful explanation to the question, what is meant by the current density $\mathbf{j}$: 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).

The current density **j** and the 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:

$$\mathbf{b} = -\,\mathbf{v}\ \mathrm{div}\ \mathbf{B}\ (= 0)\ , \tag{3.10}$$

From the comparison of eq. 3.8 with the law of induction (eq.1.1) 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.

The Maxwell approximation

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 has not 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.

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: $\quad c = 1/\sqrt{\varepsilon \cdot \mu} \quad$ (3.12).

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?

The magnetic field as a vortex field

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

$$\mathbf{j} = -\,\mathbf{v} \cdot \rho_{el} \tag{3.11}$$

as the movement of negative electric charges.

By means of Ohm's law

$$\mathbf{j} = \sigma \cdot \mathbf{E} \tag{1.5}$$

and the relation of material

$$\mathbf{D} = \varepsilon \cdot \mathbf{E} \tag{1.6}$$

the current density

$$\mathbf{j} = \mathbf{D}/\tau_1 \tag{3.13}$$

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

$$\tau_1 = \varepsilon/\sigma \tag{1.7}$$

In this representation of the law of Ampère:

$$\boxed{\mathrm{curl}\,\mathbf{H} = \mathrm{d}\mathbf{D}/\mathrm{dt} + \mathbf{D}/\tau_1 = \varepsilon \cdot (\mathrm{d}\mathbf{E}/\mathrm{dt} + \mathbf{E}/\tau_1)} \tag{3.14}$$

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.

The derivation of the potential vortex

Let us now consider the dual conditions. The comparison of coefficients looked at purely formal, results in a potential density

$$\boxed{\mathbf{b} = \mathbf{B}/\tau_2} \tag{3.15}$$

in duality to the current density **j** (eq. 3.13), which with the help of an appropriate time constant τ_2 founds vortices of the electric field. I call these potential vortices.

$$\boxed{\mathrm{curl}\,\mathbf{E} = -\,\mathrm{d}\mathbf{B}/\mathrm{dt} - \mathbf{B}/\tau_2 = -\,\mu \cdot (\mathrm{d}\mathbf{H}/\mathrm{dt} + \mathbf{H}/\tau_2)} \tag{3.16}$$

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.

There isn't a way past the potential vortices and the new dual approach,

1. *as the new approach gets along without a postulate, as well as*
2. *consists of accepted physical laws,*
3. *why also all error free derivations are to be accepted,*
4. *no scientist can afford to already exclude a possibly relevant phenomenon in at the approach,*
5. *the Maxwell approximation for it's negligibleness is to examine,*
6. *to which a potential density measuring instrument is necessary, which may not exist according to the Maxwell theory.*

With such a tail-chase always incomplete theories could confirm themselves.

4. Derivation of the wave equation

It has already been shown, as and under which conditions the wave equation from the Maxwell' field equations, limited to transverse wave-portions, is derived (chapter 1.4). Usually one proceeds from the general case of an electrical field strength $\mathbf{E} = \mathbf{E}(\mathbf{r},t)$ and a magnetic field strength $\mathbf{H} = \mathbf{H}(\mathbf{r},t)$. We want to follow this example [18], this time however without neglecting and under consideration of the potential vortex term.

The completed field equations

The two equations of transformation and also the from that derived field equations (3.14 and 3.16) show the two sides of a medal, by mutually describing the relation between the electric and magnetic field strength:

$$\boxed{\mathrm{curl}\ \mathbf{H} = \partial \mathbf{D}/\partial t + \mathbf{D}/\tau_1 = \varepsilon \cdot (\partial \mathbf{E}/\partial t + \mathbf{E}/\tau_1)} \tag{4.1}$$

$$\boxed{\mathrm{curl}\ \mathbf{E} = -\partial \mathbf{B}/\partial t - \mathbf{B}/\tau_2 = -\mu \cdot (\partial \mathbf{H}/\partial t + \mathbf{H}/\tau_2)} \tag{4.2}$$

We get on the track of the meaning of the "medal" itself, by inserting the dually formulated equations into each other. If the calculated **H**-field from one equation is inserted into the other equation then as a result a determining equation for the **E**-field remains. The same vice versa also functions to determine the **H**-field. Since the result formally is identical and merely the **H**-field vector appears at the place of the **E**-field vector and since it equally remains valid for the **B**-, the **D**-field and all other known field factors, the determining equation is more than only a calculation instruction. It reveals a fundamental physical principle. I call it the complete or the "fundamental field equation". The derivation always is the same: If we again apply the curl operation to curl **E** (law of induction 4.2) also the other side of the equation should be subjected to the curl:

$$-\,\mathrm{curl}\,\mathrm{curl}\,\mathbf{E} = \mu \cdot \partial(\mathrm{curl}\,\mathbf{H})/\partial t + (\mu/\tau_2) \cdot (\mathrm{curl}\,\mathbf{H}) \qquad (4.3)$$

If for both terms curl **H** is expressed by Ampère's law 4.1, then in total four terms are formed:

$$-\,\mathrm{curl}\,\mathrm{curl}\,\mathbf{E} = \mu \cdot \varepsilon \cdot [\partial^2\mathbf{E}/\partial t^2 + (1/\tau_1) \cdot \partial\mathbf{E}/\partial t + (1/\tau_2) \cdot \partial\mathbf{E}/\partial t + \mathbf{E}/\tau_1\tau_2] \qquad (4.4)$$

With the definition for the speed of light c:

$$\boxed{\varepsilon \cdot \mu = 1/c^2,} \qquad (1.10)$$

the fundamental field equation reads:

$$\boxed{\underbrace{-\,c^2 \cdot \mathrm{curl}\,\mathrm{curl}\,\mathbf{E}}_{a} = \underbrace{\partial^2\mathbf{E}/\partial t^2}_{b} + \underbrace{(1/\tau_1) \cdot \partial\mathbf{E}/\partial t}_{c} + \underbrace{(1/\tau_2) \cdot \partial\mathbf{E}/\partial t}_{d} + \underbrace{\mathbf{E}/\tau_1\tau_2}_{e} \qquad (4.5)}$$

(electromagnetic wave) + eddy current + potential vortex + I/U

The four terms are: the wave equation (a-b) with the two damping terms, on the one hand the eddy currents (a-c) and on the other hand the potential vortices (a-d) and as the fourth term the Poisson equation (a-e), which is responsible for the spatial distribution of currents and potentials [21].

A possible world equation

Not in a single textbook a mathematical linking of the Poisson equation with the wave equation can be found, as we here succeed in for the first time. It however is the prerequisite to be able to describe the conversion of an antenna current into electromagnetic waves near a transmitter and equally the inverse process, as it takes place at a receiver. Numerous model concepts, like they have been developed by HF- and EMC-technicians as a help, can be described mathematically correct by the physically founded field equation.

In addition further equations can be derived, for which this until now was supposed to be impossible, like for instance the ***Schrödinger equation*** (Term d and e). As diffusion equation it has the task to mathematically describe field vortices and their structures.

As a consequence of the Maxwell equations in general and specifically the eddy currents (a-c) not being able to form structures, every attempt has to fail, which wants to derive the Schrödinger equation from the Maxwell equations.

The fundamental field equation 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 fundamental field equation [21]. By means of the pure formulation in space and time and the interchangeability of the field pointers here a physical principle is described, which fulfills all requirements, which a world equation must meet.

The quantisation of the field

The Maxwell equations are nothing but a special case, which can be derived. (if $1/\tau_2 = 0$). The new 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.

With the field-theoretical approach however 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.

Let us first cast our eyes over the wave propagation.

The mathematical derivation (Laplace eq.)

The first wave description, model for the light theory of Maxwell, was the inhomogeneous Laplace equation (1.12):

$$\boxed{\Delta \mathbf{E} \cdot c^2 = d^2\mathbf{E}/dt^2}$$

with

$$\boxed{\Delta \mathbf{E} = \text{grad div } \mathbf{E} - \text{curl curl } \mathbf{E}} \tag{4.6}$$

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 fundamental field equation (4.5). We thereby should remember the interchangeability of the field pointers, that the equation doesn't change its form, if it is derived for **H**, for **B**, for **D** or any other field factor instead of for the **E**-field pointer. This time we write it down for the magnetic induction and consider the special case **B**(**r**(t)) [acc. to 19]:

$$\boxed{-\, c^2 \cdot \text{curl curl } \mathbf{B} = \frac{d^2\mathbf{B}}{dt^2} + \frac{1}{\tau_2}\frac{d\mathbf{B}}{dt} + \frac{1}{\tau_1}\frac{d\mathbf{B}}{dt} + \frac{\mathbf{B}}{\tau_1\tau_2}} \tag{4.7}$$

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 (eq. 1.7). With that the eddy currents and their damping and other properties disappear from the field equation, what also makes sense.

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

$$\boxed{\frac{1}{\tau_2}\frac{d\mathbf{B}}{dt} = \mathbf{v} \text{ grad } \frac{\mathbf{B}}{\tau_2}} \tag{3.6}$$

and

$$\boxed{\frac{\mathbf{B}}{\tau_2} = -\,\mathbf{v}\ \mathrm{div}\ \mathbf{B}} \qquad (3.10+3.15)$$

involved with an in x-direction propagating wave ($\mathbf{v} = (v_x, v_y = 0, v_z = 0)$) can be transformed directly into:

$$(1/\tau_2) \cdot \mathrm{d}\mathbf{B}/\mathrm{dt} = -\ \|\mathbf{v}\|^2 \cdot \mathrm{grad\ div}\ \mathbf{B}. \qquad (4.8)$$

The divergence of a field vector (div **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. To that extent the derivation prescribes the interpretation.

$$\boxed{\|\mathbf{v}\|^2\ \mathrm{grad\ div}\ \mathbf{B} - c^2\ \mathrm{curl\ curl}\ \mathbf{B} = \mathrm{d}^2\mathbf{B}/\mathrm{dt}^2} \qquad (4.9)$$

longitudinal with v = arbitrary (scalar wave)	transverse with c = const. (em. wave)	wave velocity of propagation

The simplified field equation (4.7) possesses thus the same force of expression as the general wave equation (4.9), on adjustment of the coordinate system at the speed vector (in x-direction).

The wave equation (4.9) can be divided into longitudinal and transverse wave parts, which however can propagate with different velocity.

The result of the derivation

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 (4.9) changes into the inhomogeneous Laplace equation (4.6).

The electromagnetic wave in general 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.

It will be helpful to draw, for the results won on mathematical way, a graphical model.

5. Field model of waves and vortices

In high-frequency technology is distinguished between the *near-field* and the *far-field*. Both have fundamentally other properties.

The far field (electromagnetic wave acc. to Hertz)

Heinrich Hertz did experiment in the short wave range at wavelengths of some meters. From today's viewpoint his work would rather be assigned the far-field. As a professor in Karlsruhe he had shown that his, the electromagnetic, wave propagates like a light wave and can be refracted and reflected in the same way.

Heinrich Hertz: **electromagnetic wave** (transverse)

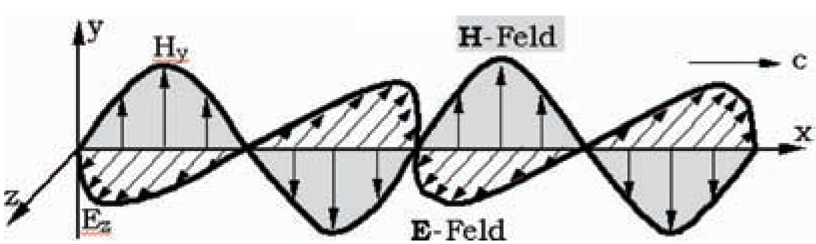

Figure 6. The planar electromagnetic wave in the far zone.

It is a transverse wave for which the field pointers of the electric and the magnetic field oscillate perpendicular to each other and both again perpendicular to the direction of propagation. Besides the propagation with the speed of light also is characteristic that there occurs **no phase shift** between **E**-field and **H**-field.

The near field (Scalar wave acc. to Tesla)

In the proximity it looks completely different. The proximity concerns distances to the transmitter of less than the wavelength divided by 2π. ***Nikola Tesla*** has broadcasted in the range of long waves, around 100 Kilohertz, in which case the wavelength already is several kilometres. For the experiments concerning the resonance of the earth he has operated his transmitter in Colorado Springs at frequencies down to 6 Hertz. Doing so the whole earth moves into the proximity of his transmitter. We probably have to proceed from assumption that the Tesla radiation primarily concerns the proximity, which also is called the radiant range of the transmitting antenna.

For the approach of vortical and closed-loop field structures derivations for the near-field are known [4].

The calculation provides the result that in the proximity of the emitting antenna a phase shift exists between the pointers of the **E**- and the **H**-field. The antenna current and the **H**-field coupled with it lag the **E**-field of the oscillating dipole charges for 90°.

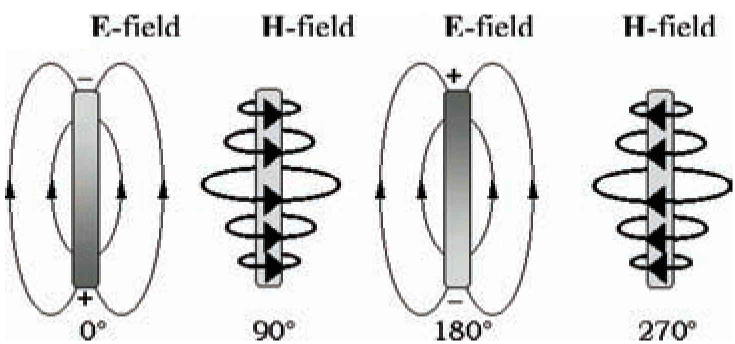

Figure 7. The fields of the oscillating dipole antenna

The near field as a vortex field

In the text books one finds the detachment of a wave from the dipole accordingly explained.

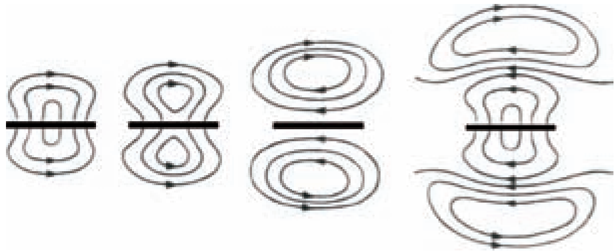

Figure 8. The coming off of the electric field lines from a dipole. The forming vortex structures found a longitudinal electric wave carrying impulse!

If we regard the structure of the outgoing fields, then we see field vortices, which run around one point, which we can call vortex centre. We continue to recognize in the picture, how the generated field structures establish a shock wave, as one vortex knocks against the next [see Tesla: 1].

Thus a Hertzian dipole doesn't emit Hertzian waves! An antenna as near-field without exception emits vortices, which only at the transition to the far-field unwind to electromagnetic waves.

At the receiver the conditions are reversed. Here the wave (a-b in eq. 4.5) is rolling up to a vortex (a-c-d), which usually is called and conceived as a "standing wave". Only this field vortex causes an antenna current (a-e) in the rod, which the receiver afterwards amplifies and utilizes.

The function mode of sending and receiving antennas with the puzzling near field characteristics explain themselves directly from the wave equation (4.5).

The vortex model of the scalar waves

How could a useful vortex-model for the rolling up of waves to vortices look like?

We proceed from an electromagnetic wave, which does not propagate after the retractor procedure any longer straight-lined, but turns instead with the speed of light in circular motion. It also furthermore is transverse, because the field pointers of the **E**-field and the **H**-field oscillate perpendicular to c. By means of the orbit the speed of light c now has become the vortex velocity.

Nikola Tesla: **electric scalar wave** (longitudinal):

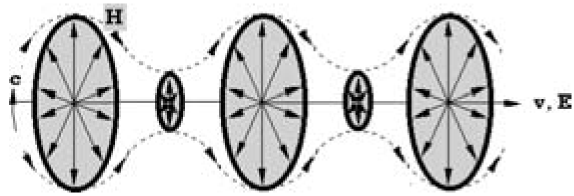

Figure 9. Magnetic ring-vortices form an electric wave.

Wave and **vortex** turn out to be **two** possible and **stable field configurations**. For the transition from one into the other no energy is used; it only is a question of **structure**.

By the circumstance that the vortex direction of the ring-like vortex is determined and the field pointers further are standing perpendicular to it, as well as perpendicular to each other, there result two theoretical formation forms for the scalar wave. In the first case (fig. 9) the vector of the **H**-field points into the direction of the vortex centre and that of the **E**-field axially to the outside. The vortex however will propagate in this direction in space and appear as a scalar wave, so that the propagation of the wave takes place in the direction of the electric field. It may be called an ***electric wave***.

In the second case the field vectors exchange their place. The characteristic of the magnetic wave is that the direction of propagation coincides with the oscillating magnetic field pointer (fig.10), while the electric field pointer rolls up.

magnetic scalar wave (longitudinal):

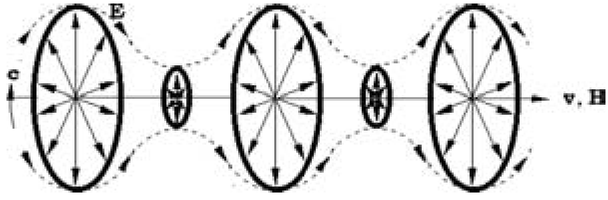

Figure 10. Electric ring-vortices form an magnetic wave.

The vortex picture of the rolled up wave already fits very well, because the propagation of a wave in the direction of its field pointer characterizes a longitudinal wave, because all measurement results are perfectly covered by the vortex model. In the text book of Zinke the near field is by the way computed, as exactly this structure is postulated! [20].

The antenna noise

Longitudinal waves have, as well known, no firm propagation speed. Since they run toward an oscillating field pointer, also the speed vector **v** will oscillate. At so called relativistic speeds within the range of the speed of light the field vortices underlie the **Lorentz contraction**. This means, the faster the oscillating vortex is on it's way, the smaller it becomes. The **vortex constantly changes its diameter** as a impulse-carrying mediator of a scalar wave.

Since it is to concern that vortices are rolled up waves, the vortex speed will still be c, with which the wave runs now around the vortex center in circular motion. Hence it follows that with smaller becoming diameter the wavelength of the vortex likewise decreases, while the natural frequency of the vortex increases accordingly.

If the vortex oscillates in the next instant back, the frequency decreases again. The vortex works as a ***frequency converter!*** The mixture of high frequency signals developed in this way distributed over a broad frequency band, is called ***noise***.

Antenna losses concern the portion of radiated field vortices, which did not unroll themselves as waves, which are measured with the help of wide-band receivers as *antenna noise* and in the case of the vortex decay are responsible for heat development.

Spoken with the fundamental field equation (4.5) it concerns wave damping. The wave equation (4.9) explains besides, why a Hertz signal is to be only received, if it exceeds the scalar noise vortices in amplitude.

6. Summary

The proof could be furnished that within the Maxwell field equations an approximation lies buried and they only represent the special case of a new, dual formulated more universal approach. The mathematical derivations of the Maxwell field and the wave equation uncover, wherein the Maxwell approximation lies. The contracting antivortex dual to the expanding vortex current with its skin effect is neglected, which is called potential vortex. It is capable of a structural formation and spreads in badly conductive media as in air or in the vacuum as a scalar wave in longitudinal way.

At relativistic speeds the potential vortices underlie 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 understands the field vortex as an even however rolled up transverse wave, then thus size and wave-length oscillation at constant swirl velocity with c follows a continual change in frequency, which is measured as a noise signal.

The noise proves as the potential vortex term neglected in the Maxwell equations. If e.g. with antennas a noise signal is measured, then this proves the existence of potential vortices. However if the range of validity of the Maxwell theory is left, misinterpretations and an excluding of appropriate phenomena from the field theory are the consequence, the noise or the near field cannot be computed any longer or conclusively explained.

View on the technical solution

If the antenna efficiency is very badly, for example with false adapted antennas, then the utilizable level sinks, while the antenna noise increases at the same time.

The wave equation following the explanation could also read differently: From the radiated waves the transversals decrease debited to the longitudinal wave components. The latter's are used however in the transponder technology as sources of energy, why unorthodox antenna structures make frequently better results possible, than usual or proven.

Ball antennas proved in this connection as particularly favourable constructions. The more largely the ball is selected, the more can the reception range for energy beyond that of the near field be expanded. This effect can be validated in the experiment.

So far high frequency technicians were concerned only with the maximization of the transversal utilizable wave, so that this does not go down regarding the noise. The construction of far range transponders however require false adapted antennas, the exact opposite of what is learned and taught so far in the HF technology, inverse engineers and engineering so to speak. And in such a way the introduction and development of a new technology requires first an extended view and new ways of training.

7. 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	Flux density
U	V	Tension voltage	I	A	Current
b	V/m^2	potential density	**j**	A/m^2	Current density
ε	As/Vm	Dielectricity	μ	Vs/Am	Permeability
Q	As	Charge	ϕ	Vs	Magnetic flux
e	As	Elementary charge	m	kg	Mass
τ_2	s	Relaxation time constant of the potential vortices	τ_1	s	Relaxation time constant of the eddy currents

Other symbols and Definitions:			
Specific electric conductivity		σ	Vm/A
Electric space charge density		ρ_{el}	As/m^3
Dielectricity	$\varepsilon =$	$\varepsilon_r \cdot \varepsilon_o$	As/Vm
Permeability	$\mu =$	$\mu_r . \mu$	Vs/Am
Speed of light	$c =$	$1/\sqrt{\varepsilon \cdot \mu}$	m/s
Speed of light in a vacuum	$c_o =$	$1/\sqrt{\varepsilon_0 \cdot \mu_0}$	m/s
Time constant of eddy currents	$\tau_1 =$	ε/σ	s
Concerning vector analysis: **Bold print** = field pointer			

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Appendix

More than 100 Years ago ***Nikola Tesla*** has demonstrated three versions of *transportation electrical energy*:

1. *the 3-phase-Network, as it is used today,*
2. *the one-wire-system with no losses and*
3. *the magnifying Transmitter for wireless supply.*

The main subject of the conference presentation will be the wireless system and the practical use of it as a far range transponder (RFID for large distances). Let me explain some expressions as used in the paper.

A "**scalar wave"** spreads like every wave directed, but it consists of physical particles or formations, which represent for their part scalar sizes. Therefore the name, which is avoided by some critics or is even disparaged, because of the apparent contradiction in the designation, which makes believe the wave is not directional, which does not apply however.

The term "**scalar wave"** originates from mathematics and is as old as the wave equation itself, which again goes back on the mathematician Laplace. It can be used favourably as generic term for a large group of wave features, e.g. for acoustic waves, gravitational waves or plasma waves.

Seen from the physical characteristics they are longitudinal waves. Contrary to the transverse waves, for example the electromagnetic waves, scalar waves carry and transport energy and impulse. Thus one of the tasks of **scalar wave transponders** is fulfilled.

The term "**transponder"** consists of the terms transmitter and responder, describes thus radio devices which receive incoming signals, in order to redirect or answer to them. First there were only active transponders, which are dependent on a power supply from outside. For some time passive systems were developed in addition, whose receiver gets the necessary energy at the same time conveyed by the transmitter wirelessly.