Consequences of the Extended Field Theory

Konstantin Meyl
Faculty of Computer and Electrical Engineering, Furtwangen University, Germany

Abstract— We all learned from our textbooks, that the field equations according to Maxwell do not describe potential vortices in the dielectric such as vortex losses in capacitors. But this was yesterday. Since Science and Nature have reported in 2009 about the development of magnetic monopoles by the German Helmholtz Society [12] the 3rd Maxwell equation ($\mathrm{div}B = 0$) is describing only a special case and we have to consider about the consequences and the impact to what we learned about electrodynamics.

In the contribution in PIERS 2012 in Moscow [1] from the new and extended field equations the pointing vector was derived with one loss term in addition, based on the new development but avoiding any postulates. The present contribution at PIERS 2013 is continuing the published ideas from 2012, with the aim, to prove the losses of capacities.

It will be shown, that still visible proves are published, like vortex spots in high voltage capacities. The frequency dependence of the loss factor, calculated by the Lorentz model, compared with calculations as vortex losses, according to the new and extended field theory show very clear the importance and power of this new theory.

Thus the calculated potential-vortex and its effect on the dielectric medium can be measured and its existence made evident through observable natural phenomena.

1. INTRODUCTION (ABOUT VORTEX LOSSES)

Conductive materials like silver, copper or aluminum heat up by electrical currents and eddy-currents. Dielectrics, as they are used in capacitors and insulating materials, distinguish themselves by a low electric conductivity which is why no eddy-currents are to be expected. Besides, potential-vortices and the accompanying vortex losses are totally unknown in the valid field theory which is why we must continue to search for the reasons why a non-conductor gets hot.

Electrets and other ferroelectric materials with distinctive hysteresis $D(E)$-characteristics [i.e., barium titan-ate] are extremely rare. Because the material should be blamed for the measurable losses, the polarization of the material still remains as a possible reason for losses.

As a consequence of change in polarity with high frequencies, the dielectric displacement D follows the electric field strength E time-delayed. The produced loss factor δ represents the dielectric losses. This is what we learn from our textbooks [2]. However, this entails a complex dielectric coefficient:

$$\varepsilon = \mathrm{Re}\{\varepsilon\} + j\mathrm{Im}\{\varepsilon\} \tag{1}$$

with the loss factor

$$\tan\delta = \mathrm{Im}\{\varepsilon\}/\mathrm{Re}\{\varepsilon\}. \tag{2}$$

which results directly in a complex speed of light c according to the definition

$$\varepsilon \cdot \mu = 1/c^2, \tag{3}$$

which is an offence against the basic principles of physics!

A transient hysteresis $D(E)$-characteristic would also have to appear in dielectric, but non-ferroelectric, materials. This is verified by the frequency dependency, because a direct proportionality to an increasing frequency would be expected. However, the technologically important insulating materials show a widely constant loss factor. Leaving the question, which physical phenomenon heats up an insulator?

In spite of offence against the constance of the speed of light, the complex epsilon belongs to the inalienable toolbox of every electrical engineer. He will not want this tool to be taken from him. Practical people think and act pragmatically: "*if no better theory is available*", many argue, "*then a wrong theory is still better than none*".

With this reasoning, even dielectric losses that have not jet been investigated, are considered and summed up under the loss factor (2).

2. THE FIELD THEORY FROM MAXWELL'S DESK

At least, this physically wrong model is in many cases able to deliver useful arithmetic values [2]. We can say, "*the description is harmlessly wrong*", from the mathematics' point of view.

However for a member of theoretical physics, who is confronted with a complex speed of light, the complex dielectricity ε marks the end of all efforts. If the result of a derivation turns out wrong the mistake is either in the approach or in the derivation.

The latter is presumably perfect, after generations of students had to check the calculations year after year. At some point a mistake had to appear. Under these circumstances the mistake quite obviously lies in the approach, in the basic acceptance of classical electrodynamics [3].

Here the vector potential $\mathbf{A}$ is introduced mathematically correct. Physically speaking, this is still a foreign body in the field theory. In addition, vector potential and potential-vortex exclude themselves mutually. We will have to decide whether to calculate dielectric losses with a complex Epsilon or with the vortex decay, because doing so both ways at the same time is mathematically impossible.

With his book "*A Treatise on Electricity and Magnetism*" [4] from 1865 *James Clerk Maxwell*, professor of mathematics, pursued an ambitious aim to derive the wave equation of *Laplace* from an equation sentence about the electric and magnetic field, to describe light as an electromagnetic wave.

The enlarged representation by means of quaternions from 1874 with its mathematical description of potential-vortices, scalar waves and many unconfirmed phenomena exceeded the physical phenomena experimentally provable in the past. Therefore, a vector potential was not necessary in the depiction.

Only in 1888 was one of the numerous phenomena proven experimentally by *Heinrich Hertz* in Karlsruhe (Germany), concerning the electromagnetic wave. Eddy-currents were also recognized together with the laws by *Ampère*, *Faraday*, and *Ohm*. This is why *Heaviside* suggested shortening the field equations of *Maxwell* to both proven phenomena. Professor Hertz agreed and professor Gibbs wrote down the truncated field equation in its currently still commonly used notation of vector-analyses.

Since then the field theory has not been able to describe longitudinal waves even though they had been proven by *Tesla* in 1894 [5]; and they had to be postulated over and over again, for example for the near field of an antenna [6].

3. THE VECTOR POTENTIAL

To describe other secured facts of electrodynamics, for example dielectric losses, *Maxwell* had already considered the introduction of a vector potential $\mathbf{A}$:

$$\mathbf{B} \; = curl\mathbf{A} \tag{4}$$

As a consequence of this mathematical statement the divergence of the magnetic flux density $\mathbf{B}$ is zero.

$$\mathrm{div}\mathbf{B} \; = \mathrm{div}\ \mathrm{curl}\mathbf{A} \; = 0 \tag{5}$$

J. D. Jackson [3] and his followers [11] thought curl $\mathbf{B}$ to be magnetic monopoles. As long as they do not exist, the field physicists want to see a confirmation for the correctness of Eq. (5) (3rd Maxwell equation). This has been the presumption until now.

On September 3rd 2009, the *Helmholtz centre* in Berlin, Germany, announced [9 Science, and others]: "*Magnetic monopoles proven for the first time*". With this discovery in a magnetic solid state the vector potential with all its calculations is no longer viable, in spite of the correctness and verifiability of all present results. One can also say, "*we must start all over again and consider a new approach*".

I suggest a vortex description completely without vector potential $\mathbf{A}$ and with

$$\mathrm{div}\,\mathbf{B} \; \neq 0 \tag{6}$$

With my approach even the *Aharonov Bohm* effect is explainable, generating scalar waves, that are verified after they have tunnelled through a screening. According to today's interpretation [11] this effect with no measurable field is assigned to the vector potential and even spoken of as evidential value.

4. HELMHOLTZIAN RING-LIKE VORTICES IN THE AETHER

The doubts about classical electrodynamics are not new. In 1887 *Nikola Tesla* demonstrated his scalar wave experiments to the theoretical physicist *Lord Kelvin* in his lab in New York. He told Kelvin about the meeting with the German Professor *Hermann von Helmholtz* on the occasion of the World's Fair in Chicago 1893. Kelvin knew him very well and had cooperated with him in the past. Now the vortex concept of his colleague and his model of stable vortex rings were very helpful.

In the case of a standing wave the impulse is passed on from one particle to the next. In the case of acoustics we are dealing with a shock wave where one air molecule knocks the next. In this way sound propagates as a longitudinal wave. Correspondingly the question is raised: "*What sort of quanta are the ones, which in the case of the Tesla radiation carry the impulse*?"

Lord Kelvin deduced: "*The Tesla experiments prove the existence of longitudinal standing waves in space*".

Through the question, what passes on the impulse, Kelvin comes to the conclusion: it is *vortices in the aether!* With that he had found an answer to his contemplations.

With his students he built boxes, with which he could produce smoke rings, to be able to study and demonstrate in experiments the special properties of ring-like vortices as a fluid dynamics analogy.

But he didn't have a suitable field theory. For a short time Germany exported vortex physics to England, before it was buried by the German quantum physicists. A primary advocate was *James Clerk Maxwell*, who held the vortex theory for the best and most convincing description of matter [8, 9: James Clerk Maxwell: "*... the vortex rings of Helmholtz, which Thomson imagines as the true form of the atom, fulfil more conditions than any other previous concept of the atom.*"].

As his successor at the *Cavendish laboratory in Cambridge J. J. Thomson* was appointed to a professorship. As a young man he received an award for a mathematical treatise about vortices. He discovered the electron and imagined it, how could it be otherwise, as a field vortex. [10: J. J. Thomson: "*the vortex theory is of much more fundamental nature than the usual theory of solid particles*"].

The crucial weakness of vortex physics, the lacking of an usable field theory, was of benefit to the emerging quantum physics. This could change fundamentally with the discovery of the potential-vortex, the vortex of the electric field.

In addition, the experimental proof of a vortex transmission as a longitudinal wave through air or a vacuum, as accomplished by Tesla already 100 years ago, is neither with Maxwell's field theory nor with the currently used quantum theory explicable or compatible. We are faced with an urgent need for a new field theory.

5. NOISE INTENSITY OF THE CAPACITOR

So we apply vortex physics to a dielectric with a suitable model representation.

The wave will now rotate around a stationary point, the vortex centre. The propagation with the speed of light c is maintained as the rotary-velocity. For a plane circular vortex, where the path for one revolution on the out-side is a lot longer than near the vortex centre, arises a longer wave length and as a consequence a lower frequency on the outside, then on the inside.

With this property the vortex proves to be a *converter of frequency:* the vortex transforms the frequency of the causing wave into an even spectrum, that starts at low frequencies and stretches to very high frequencies.

This property we observe as *"white noise"*. The consistent conclusion would be that this concerns the vortex of the electric field. Anyone can, without big expenses, convince him or her-self that the property to change frequency is dependent on position and of the circumstance that vortices can be very easily influenced and that they avoid or whirl around a place of disturbance (i.e., an antenna).

For that, one only needs to tune a radio receiver to a weak and noisy station and move oneself or some objects around, then one is able to directly study the effect of the manipulation of the receiving signal.

But already the fact that the use and measuring of signals is limited by noise, highlights the need to pay attention to the potential-vortex.

Within a limited frequency range the power of the Nyquist or resistance noise is *independent of frequency.*

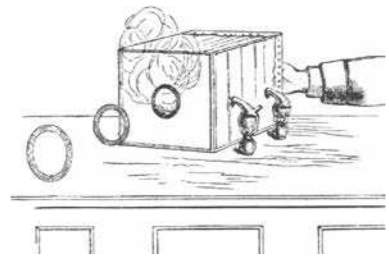

Figure 1: [7]: Vortex rings from a smoke vortex gun.

This should be clarified particularly by the term "*white noise*" analogous to white light, where all visible spectral ranges independent of frequency have the same energy density.

But this relation doesn't hold for high frequencies of any magnitude. Here another noise-effect appears that is said to have its cause in the quantum structure of energy [2]. Untouched by possible interpretations an increasing power of the noise is measured, that is more and more proportional to its frequency (Fig. 2, curve a). Interestingly this curve shows a remarkable *duality* to the power output curve of eddy currents, likewise plotted alongside the frequency, which can for instance be measured on eddy current couplings [13] (Fig. 2, curve b).

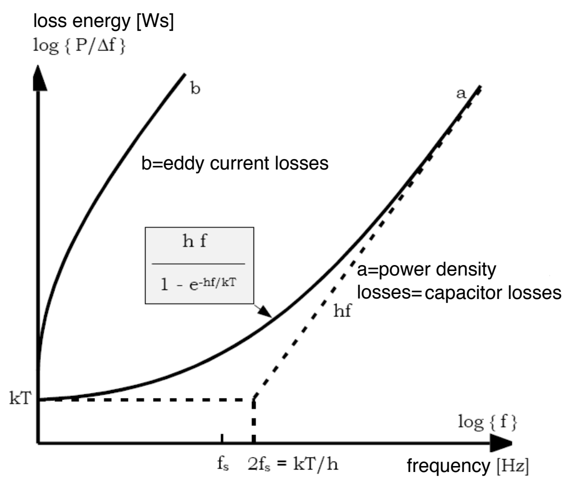

Figure 2: The power density shown against frequency (a) for noise according to Küpfmüller [2], as well as for dielectric losses of a capacitor (also a) and (b) for eddy current losses according to Meyl [13], (b in visible duality to a).

This circumstance suggests a dual relationship of the potential-vortex of the electric field in weakly conducting media on the one hand and the eddy current in conductive materials on the other hand [14].

6. CAPACITOR LOSSES

Next, the dielectric losses in a capacitor supplied with an alternating current, are measured and also plotted alongside the frequency. At first their progressions are independent of the frequency, but towards the higher frequencies they increase and show the same characteristic course of the curve referring to the power of the noise (Fig. 2, curve a).

This excellent correlation leads to the assumption that the dielectric losses are nothing but *vortex losses.*

These vortex phenomena, caused by time-varying fields, are not only found in ferromagnetic and conductive materials but equally as dual phenomena in dielectric and non-conductors.

Examples of practical applications are induction welding and the microwave oven. The process can be described in other words as follows: in both examples the cause is posed by high-frequency alternating fields that are irradiated into a dielectric as an electromagnetic wave, there roll up to potential-vortices and eventually decay in the vortex centre. The desired and used thermal effect arises during this diffusion process.

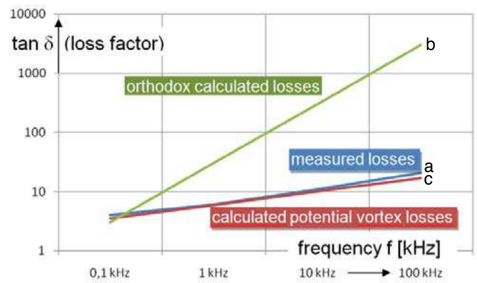

Figure 3: Experimental prove of calculated losses (qualitative comparison) with a MKT capacitor [17] (siemens). (a) Measured dielectric losses of the MKT-capacitor. (b) Standard calculation according to Lorentz-model. (c) Calculation as potential-vortex-losses acc. to Meyl-model.

The author, in collaboration with a college at the university for theoretical physics in Konstanz as part of a bachelor thesis, recently succeeded in finding a conclusive proof. For this purpose the measured dielectric losses of a standard MKT capacitor were calculated from their frequency dependence and compared. This systematically designed case deviates starkly from the conventionally derived characteristics in accordance with the Lorenz-model, the latter of which is at odds with reality and has long been known to be so and criticized by experts. In contrast to that, the characteristic of the potential-vortex losses come much closer to the truth (Fig. 3).

7. THE VISIBLE PROOF

The striving in the direction of the vortex center gives the potential-vortex of the electric field a *structure shaping property*. As a consequence of this *concentration effect* circular vortex structures are to be expected comparable to the visible vortices in flow dynamics (i.e., tornadoes and whirlwinds).

At the same time as the dual anti-vortex arises, so does the diverging eddy current. It takes on, as is well-known, the given structure of the conductor, which in the technical literature is referred to as "*skin effect*".

Now if conductor and non-conductor meet, as they do in a capacitor, then at the boundary area visible structures will form. Circles would be expected, if the eddy current on the inside striving towards the outside is as powerful as the compressing *potential-vortex* drawing in from the outside. Actually such circular structures are observed on the aluminium of high tension capacitors when they are in operation for a longer period of time. The formation of these circles, the cause of which until now is considered to be unsolved, is already experimentally investigated and discussed on an international level by scientists (Fig. 4, [16, 17]). These circular vortex structures can be seen as a visible proof for the existence of potential-vortices of the electric field [14].

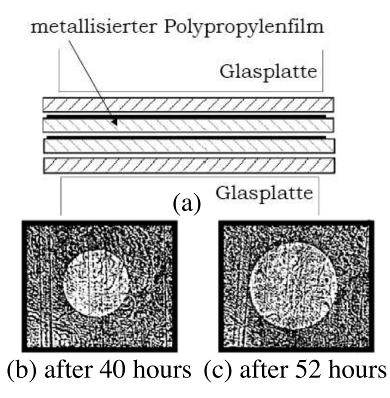

Figure 4: (a) Measurement set up and (b) and (c) photo of vortex structure in a metallized polypropylene layer capacitor at 450 V/60 Hz/100°C and 110 fold magnification observation of the formation of a vortex. According to Yializis et al. [16].

REFERENCES

1. Meyl, K., "Self-consistent electrodynamics," *PIERS Proceedings*, 172–177, Moscow, Russia, August 19–23, 2012.
2. Küpfmüller, K., *Einführung in Die Theoretische Elektrotechnik*, Springer, Verl. 12, Aufl. 1988.
3. Jackson, J. D., *Classical Electrodynamics*, 2nd Edition, Wiley & Sons, NY, 1975.
4. Maxwell, J. C., *A Treatise on Electricity and Magnetism*, Dover Publications, New York, Orig. 1873.
5. Meyl, K., *Scalar Wave Transponder*, 3rd Edition, Villingen-Schwenningen, INDEL Verlag, 2012.
6. Zinke, Brunswig: *Lehrbuch der Hochfrequenztechnik, Band 1*, 3rd Edition, 335, Springer-Verlag, 1986.
7. Ash, D. and P. Hewitt, *Science of the Gods*, Gateway Books, Bath, England, 1990.
8. Thomson, W., *Philosophical Magazine*, July 1887.
9. Maxwell, J. C., "Atoms," *Encyclopaedia Britannica*, Vol. 2, 467, 1798.
10. Thomson, J. J., *On the Motion of Vortex Rings*, London, 1883.
11. Lehner, G., *Elektromagnetische Feldtheorie*, 1st Edition, 541, Springer Verlag, 1990.
12. Morris, D. J. P., et al., "Magnetische monopole in magnetischem Festkörper entdeckt," Pressemitteilung vom 3.9.09 der *Hermann von Helmholtz-Gemeinschaft e.V. Berlin*, 2009.
13. Meyl, K., *Dreidimensionale Nichtlineare Berechnung Von Wirbelstromkupplungen*, Diss. Universität Stuttgart, (Wirbelströme, INDEL Verlag 1991), 1984.
14. Meyl, K., "Wirbel des elektrischen feldes," *EMC Journal*, Vol. 1, 56–59, 1995, 6. J, ISSN 0945-3857.
15. Treskatis, T., "Frequenzabhängigkeit der dielektris-chen Verluste eines metallisierten Kunststoff-Folienkondensators," University Konstanz, 2010.
16. Yializis, A., S. W. Cichanowski, and D. G. Shaw, "Electrode corrosion in metallized polypropylene capacitors," *Proceedings of IEEE, International Symposium on Electrical Insulation*, Bosten, Mass., 1980.
17. Taylor, D. F., "On the mechanism of aluminium corrosion in metallized film capacitors," *IEEE Transactions on Electrical Insulation*, Vol. EI-19, No. 4, 288–293, 1984.