

# **Turning Back to Coulomb's Law as a Basis for Electromagnetism**

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**ABSTRACT**

In this paper a number of apparently disparate discoveries within electromagnetism and related subjects are brought together into a coherent context. The intent is to gain momentum for a new electromagnetic field theory, based upon Coulomb's original force law of 1785. Throughout the paper it is repeatedly given support to the assumption that Coulomb's law is able to give credit to phenomena, which have thus far been explained using either new or completing laws.

The first -and simultaneously most crucial - issue is that of the potential functions used in order to derive the electromagnetic fields used today, often called the Liénard-Wiechert potentials. Referring to an earlier paper it is shown that these potentials have regrettably been fallaciously derived. The issue is crucial, since if the potentials are false, the rest of the electromagnetic theory must accordingly be rejected, due to its formal dependence of the former.

Reference is also being made to earlier results with Ampère's bridge, refuting the Lorentz force, simultaneously giving credit to Coulomb's law. Also electromagnetic induction can be explained using Coulomb's law instead of the 'Induction law'.

The fourth issue is that of 'photons'. Using again Coulomb's law, it is possible to classically explain the "wave-particle paradox"

A fifth issue is that of gravity. It is discussed, whether gravity might be able to explain as an electromagnetic effect.

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## 1. Introduction.

To be motivated to search for a new theory it is often convenient to see some cases of falsification of the currently, widely accepted theories.

This paper brings together recently made discoveries, all corroborating the supremacy of Coulomb's law, as far as charges are involved.

It may also be said that the paper is restricted to the 'classical' realm, thereby avoiding as well relativistic as quantum effects. It is preferably the task for articles to come to deal with these. Accordingly, neither of those is being judged in any direction in this paper. Concerning the papers being referred to, those by this author are available for the NPA members on the members' webpage.

## 2. The Liénard-Wiechert potential theory

The Liénard-Wiechert potentials are very crucial for the rest of electromagnetic theory, most commonly known as Maxwell's. The potentials constitute the logical beginning of a proof chain, whose first step is to derive the electric and the magnetic fields, the next step to derive Maxwell's equations and the final step to derive the wave equations with respect to the electric and the magnetic fields. This takes place through the successive differentiation of the potentials as well as numerous variable substitutions. All is presumably more that familiar to most of the audience.

### 2.1. To break the chain.

Two scientists, Wesley and Jonson, have, independently of each other, found reasons to believe that the Liénard-Wiechert potentials have been fallaciously derived. [1],[5].

Wesley is attacking the analysis by Liénard and Wiechert for introducing a dependence of the retarded distance  $\bar{r}'$  to a source point of action by the retarded time.  $t'$  [2]

He seems to stick to the fact that time in itself is independent of space, i.e. that there can be defines a kind of four-space, containing all possible combinations of time and space.

That's of course true, as far as non-relativistic cases are being regarded.

When deriving a retarded Coulomb potential, according to [3]

$$\Phi(\bar{r}, t) = \int d^3r' \int dt' \rho(\bar{r}', t') \frac{\delta(t - (t' - |\bar{r} - \bar{r}'|/c))}{|\bar{r} - \bar{r}'|} \quad (1)$$

he claims that it is wrong to treat the expression for the retarded time in delta function as a variable, dependent in turn on the distance between the sending and the observation points respectively, i.e. that [4]

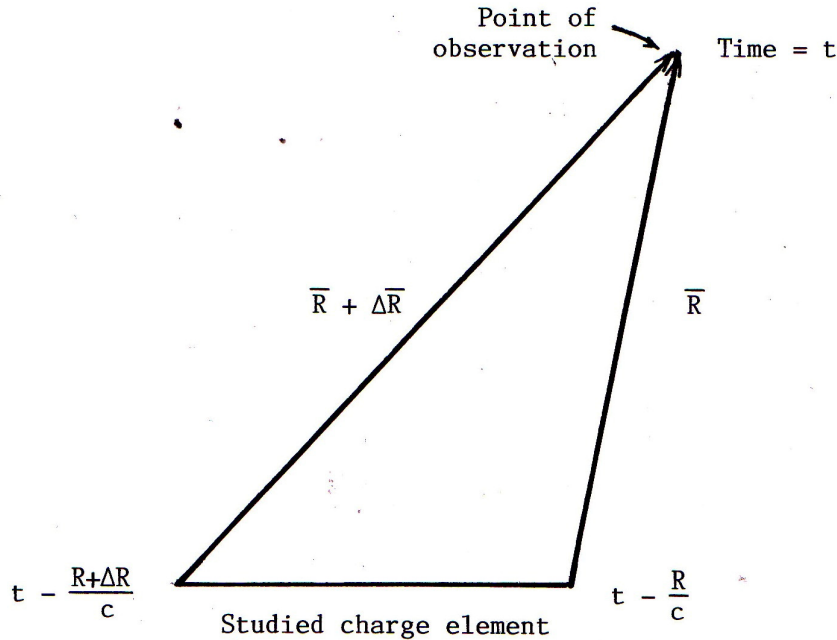
$$\delta(t - (t' - |\bar{r} - \bar{r}'|/c)) = \delta(t - t'(R)) \quad (2)$$

But what then is forgotten is that the use of time and space in the case of moving charges - or currents - refers to a series of events at a source point of actions that affect another point with a certain delay, due to the distance the 'effect' has to be propagated before the field (or potential) is established. And due to the specific geometry, the distance will vary, and accordingly, the time when the 'action' was sent out.

These matters of fact makes the Liénard-Wiechert approach correct.

However, Jonson finds that there is a fault inherited in the classical derivation.

Jonson analyses the famous derivation by Feynman [3] and shows through a rigorous analysis of the geometry of the spread of field lines from the charge elements towards an arbitrary field point that Feynman has failed in making the very geometry. He denotes every charge element a conductor is divided into a constant retarded time, whereas the author [1] allows the retarded time to vary continuously, due to the continuously varying distance with respect to the field point. That means a fundamental mathematical mistake, which in fact brings about a partial 'double counting' of charge elements of the conductor. The following figure will make the situation clear. Another figure is to be found in [2].



**Fig.1. Geometry defining the time delay.**

## 2.2. Conclusions of the refutation of the Liénard-Wiechert potentials

It seems quite reasonable to assume that such a fundamental fault within the very basis of the theory must require the rejection of the whole theory. One must return to the very basics of electromagnetism, to the first steps by Coulomb and electrostatics, before going any further. Even though among others Maxwell's equations are 'true' in that they are correctly relating electric and magnetic fields to each others, this does in the final sense only mean that there is a true logic chain between the participants in those equations, even though they are meaningless. The further extension to wave equations is equally meaningless, by the same reason.

## 3. The Lorentz force law

There exist however electromagnetic laws that are assumed not to require any preceding potentials.

Lorentz's force law is one. It derives the electromagnetic force between currents or moving point charges straightforwardly, using the electric, magnetic and velocity fields as

inputs. Using only the magnetic component, when analysing currents confined to conductors, there is the ‘magnetic force law’ as follows: [12]

$$\vec{F}_m = \frac{\mu_0 I_1 I_2}{4\pi} \int \int d\vec{s}_2 \times (d\vec{s}_1 \times \vec{R}) / R^3 \quad (3)$$

The reason for omitting the electric fields in the case of conductor currents is that there is claimed to be no static electric field due to the current.

### **3.1. The critical experiment refuting the Lorentz force law.**

Accepted and frequently used laws are best refuted by first finding a critical experiment that does not obey that law. This was done through the analysis of the experiments upon Ampère’s bridge [4] and related by Wesley [5].

This author succeeded also in corroborating another law, not a new one, but a thus far unknown application of an old one, Coulomb’s law [6]. In that paper it is being shown, how the basically electrostatic Coulomb’s law, through the application of retarded action with respect to a moving source, was able to account for the ‘magnetic force’ between currents. Short-to-speak the velocity of moving charges (i.e. electrons) relative to the immobile ones (positively charged ions) in a conducting wire is causing a difference in the electrostatic force with which they respectively affect a neighbouring current. However, the proof is rather tedious and therefore the reader favourably would profit from reading the original paper in its full extent [6]. The most interesting issue in that paper is that it succeeds in predicting the spatial behaviour of the force between the currents, whereas the Lorentz force does not.

## **4. The induction law and a discussion about ‘DC circuits’.**

### **4.1. The induction law.**

It has thus far been shown that the commonly accepted theory fails in two cases. A third will now follow. In a paper 1997 [7] it is thoroughly being shown that the Law of Electromagnetic Induction is false at crucial points of view. But again, it is possible to corroborate Coulomb’s theory, this time by applying the Continuity Equation for Electric Charges [8]. Accordingly, the induced current within the secondary circuit can be inferred. But the competing and commonly recognized Induction Law is a serious competitor, as it is able to predict a secondary current, too.

However, the analysis proceeds, showing that there has been made a fundamental mistake, concerning the phase shift between primary and secondary, more exactly 90 degrees!

And the new theory is able to fulfil the phase requirement.

#### **4.1.1. Prologue: Rejection of the very theory for DC voltages and currents.**

In the induction paper [7] it is shown that a direct current (DC) is physically impossible. The reason is that the very existence of a current simultaneously implies that the voltage source is being discharged. Since the battery in fact shares this property with a capacitor, it is convenient to use the same fundamental laws with respect to charge Q, capacitance C, voltage V and current I. For a capacitor is assumed to be valid:

$$Q = C \cdot V \quad (4)$$

Differentiating (1) with respect to time  $t$  gives an expression for the current  $I$  accordingly:

$$I = C \cdot \frac{dV}{dt} \quad (5)$$

The resistance  $R$  determines the magnitude of the current  $I$  in the DC case, according to

$$I = \frac{V}{R} \quad [\text{Ohm's law}] \quad (6)$$

Using (2) and (3) gives a differential equation for either of  $I$  and  $V$ , here  $V$ :

$$\frac{dV}{dt} + \frac{1}{RC}V = 0 \quad (7)$$

The solution to the homogeneous equation (4) is

$$V = V_0 \exp\left(-\frac{t}{RC}\right) \quad (8)$$

That matter of fact is commonly forgotten, when analysing a DC circuit, when the decrease of the voltage is so slow, that one does not think of it. Nonetheless one effect of the current is just that it removes charges from the delivering pole, hence causing an exponential decrease consists of the capacitance of the capacitor and the resistance of the connected circuit. Due to the exponential property of the voltage, also the current becomes exponential, thereby satisfying also Ohm's law, the current being proportional to the voltage, as shown by (3).

Hence, the reason for the constant relation between current and voltage is the fact that by differentiating an exponential function, that same exponential function appears again, times a constant. The fundamental, universal law connecting current and voltage, on the contrary, seems to be Eq.(2), valid also when it is believed to be a DC case. In the DC case the differential equation Eq. (2) only becomes "invisible", due to the extreme slowness, with which the current and the voltage is decreasing., and one easily believes that Ohm's law, Eq.(3), is the true one.

It may be remarked here that the neither collision processes nor quantum aspects are treated here, only the macroscopic properties, as defined above.

#### 4.1.2. A detailed description of the induction case.

Using the expression for the electromagnetic force between two currents, using i.e. Coulomb's law according to the method introduced by Jonson [11], it is possible to attain the electric field, if appropriately dividing by the charge element at the point of observation, principally written:

$$\vec{F} = Q \cdot \vec{E} \quad (9)$$

How this shall be done has been extensively derived in another paper by Jonson [14]. Especially it has to be noted that there is a varying electric field due to a conductor current and that this field is able to induce a current in another circuit; normally these two circuits are called primary and secondary respectively.

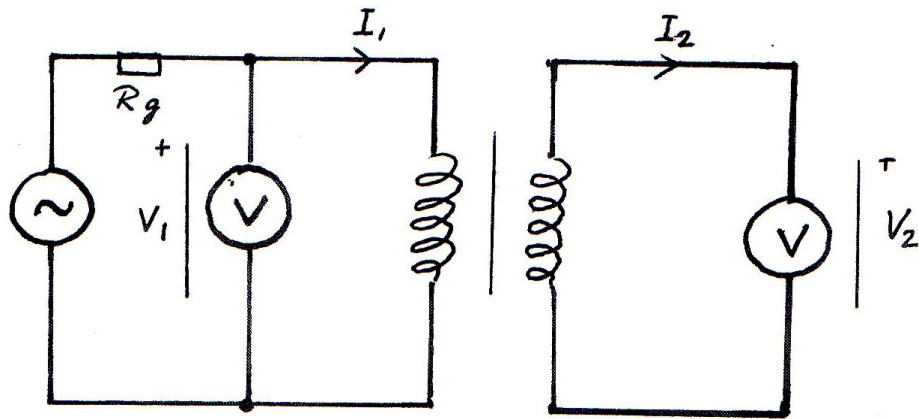
The result is that the induced current of the secondary circuit may be written:

$$I_2 = - \frac{\epsilon_0 \epsilon_r A}{L} \frac{\partial V_2}{\partial t} \quad (10)$$

For convenience it may be remarked that the constant term  $\frac{\epsilon_0 \epsilon_r A}{L}$  above corresponds to a capacitance. When it is impossible to define a capacitance in the circuit, it may be recalled that it is in the final sense it is a dimensional requirement. A DC circuit as in the preceding section does have at least one capacitance thanks to the voltage source. The fundamental issue is that it has been inferred from purely electrostatic relations and the ‘continuity equation of electricity’ that there will be induced a current in a distant closed circuit, provided the primary current is varying with time. Using the customary equivalent generator models according to Thévenin, the above equation is best described by a voltage generator with a serially attached capacitor.

This will soon be shown in Fig. 2, after a model of the measurement has been derived.

Describing both the secondary loop, where a current is induced from a primary circuit, and an attached volt meter (or oscilloscope or just any equivalent instrument), will lead to the following figure:



**Fig.2. Model of a simple transformer circuit.**

As has been shown in [14],  $\frac{\partial V_2}{\partial t} \sim - \frac{\partial I_1}{\partial t}$  (11)

and, hence  $I_2 \sim - \frac{\partial I_1}{\partial t}$  (12)

Now it is of special interest to show what is being measured by the respective measurement instruments, namely the volt meters (or oscilloscope inputs) of respectively the primary and the secondary circuit. The first one obviously is showing  $V_1$ .

What the second one is showing can be derived, if first recalling Eq. (9) above.

Further, in the case of the primary bobbin, as it consists of an inductance,



$$V_1 = L_1 \frac{\partial I_1}{\partial t} \quad (13)$$

$$\text{Hence, } I_2 \sim V_1 \quad (14)$$

$$\text{And, since } V_2 = R \bullet I_2 \quad (15)$$

$$V_2 \sim V_1 \quad (16)$$

just as expected.

That is what is usually being measured at the primary and secondary windings in the simplistic case above, with no active loading attached at the secondary circuit, and with equal amount of rows on each bobbin.

The fundamental new thing is that this result has been predicted using basically Coulomb electrostatics.

### 4.3. Conclusions.

The result above gives further support to the assumption made in chapter 2 that the falseness of the Liénard-Wiechert potentials implies that the whole old theory must be abandoned. As the Coulomb theory is now able to account for the effects that thus far have given credit to the ‘Induction law’, it remains a huge work to determine coupling constants in order to achieve numerically correct values of induced currents and voltages. Nonetheless this is the road that must be followed in order to establish the new electromagnetic theory.

## 5. The Poynting vector and ‘photons’.

### 5.1. General.

According to the Maxwell theory, radiation can be explained, using electric and magnetic fields. Thereby the nature of light is related to the electric and magnetic fields perpendicular to the direction of the spread. According to common theory an energy vector is defined, as the cross product of the ‘acceleration terms’ of the electric and the magnetic fields respectively. That is the so-called Poynting vector.

But as the whole theory has already been rejected in this article, when treating the Liénard-Wiechert potentials, also this part must inevitably be rejected, principally needing no further discussion.

However, it is the normal scientific practice not only to refute a theory. An alternative must also be provided In a number of papers that are especially focussing on deriving a mathematical explanation to ‘photons’, thereby using Coulomb’s law [8], [9], [10] it has been shown that what has thus far been treated as dually a ‘wave and a particle’ is a very rapid jump within an otherwise zero electric field due to a neutral atom. That jump is due to the de-excitation of an excited electron between two shells.

And it may also be said that the electric field is shown to be aligned with the movement of the photon. Neither a magnetic field is needed.

### 5.2. A mathematical basis for the proof.

In the referred papers the assumption is being made that an electron may orbit in a circular orbit, in a mechanistic, ‘classical’ way. Coulomb’s law is applied, thereby using the simplistic, classical formulation on a differential form [10]

$$\frac{d^2 \vec{F}}{dx_1 dx_2} = \rho_1 \rho_2 \vec{u}_R / 4\pi \epsilon_0 R^2 \quad (17)$$

In the analysis that follows, the effects of retarded action with respect to the propagation of the field lines (referring to force action) to a point of observation are rigorously taken

into account. In the paper just being referred to, the analysis of the force between two current carrying conductors were accordingly derived, thus leading to [11]

$$\frac{d^2 \vec{F}}{dx_1 dx_2} = (\mu_0 I_1 I_2 \cos \theta \cos \psi) \vec{u}_R / 4\pi \epsilon_0 R^2 \quad (18)$$

This applies to two current carrying conductors. How would that apply to the case of an electron that is undergoing a de-excitation process?

With respect to the sending point that is no mystery, since an electron attached to a positively charged nucleus *corresponds* to the conducting electrons in the metallic conductor. In the conductor case there are the free electrons (the 'cloud') that are moving along the conductor, the positive ions being immobile. In the atomic case here the difference is that one 'jumpable' electron is orbiting around the positive, immobile nucleus, simultaneously in that way in 'billions' of atoms, but suddenly making a jump down to a lower level, as the atom is being de-excited.

The important point of interest is the assumption of equivalence of currents, independently of whether the current is a traditional conductor current or locally confined 'currents' around atom nuclei.

In analogy with the case of two current carrying conducting wires, with a Coulomb force being the cause behind the force between them, as described above, a similar approach appears to be fruitful, when analysing what happens, when an orbit electron jumps to a lower orbit during its de-excitation, thereby causing a pulse in the otherwise zero electric field around a neutral atom.

Initially there seems to be very problematic to realize what 'current' that pulsed field is reacting with. But for convenience, call it an antenna.

Hence, Eq. (17) is relevant to that extent but the further analysis leads to Eq.(18).

The analysis succeeds with the help of a strictly defined geometry defining the situation of de-excitation. That is being made in the papers [8], [9] and [10].

But the problem with the character of an antenna then in the case of e.g. visible light, generated by a process of de-excitation, has to be understood. Most convenient would preferably be to think of the atoms the pulsed field touches as the 'antennas'. Therein there is a current, which will be a subject to the force.

However it is an intricate problem to derive an expression for the force between two atoms. In the most recent paper upon the subject [10] the focus is upon proving that the model **allows** for a sending out of energy obeying the same spatial dependence as the Poynting vector far away from the sender ( $\sim 1/R^2$ ). Hence, the requirement that refuting a theory awakes the need for a satisfying alternative has been satisfied.

## 6. Gravity.

### 6.1. An electrostatic approach.

An effort has also been done to find a plausible explanation to gravity, using the above Coulomb electrostatics [11] According to the traditional understanding of gravity, an electric explanation ought to be excluded, when regarding neutrally charged particles like i.e. neutrons. In that paper the argument is raised that neutrons contain third-charges, the so-called quarks, in a similar way as protons The only difference is the mixture, ddu and uud respectively, which causes the neutron to be net neutral and the proton to be net positive, with the same magnitude of charge as the electron, but of opposite sign.

What happens when neutrons gather can very well be a dipole structuring, as the negative edge of one neutron will feel attached by the positive edge of its closest neighbour.

This in turn would give rise to a dipole electric field according to classical electric theory, even though a rather deep-going theory for among others spin and isospin have been developed within elementary particle physics. Here, however the analysis stops there. Instead the basic consequences of having the equivalent of an electric dipole are being studied from a classical electrostatic point of view.

However, since the approach is very new and further uncorroborated, it would at this early stage be risky to draw too far-going conclusions. One immediate obstacle is the fact that dipole electric fields decrease  $\sim 1/R^3$ , which is in apparent conflict with the ( $\sim 1/R^2$ ).dependence of gravity. But neither the concept of gravity is unambiguous, which is shown by the on-going debate concerning dark matter.

Especially since the properties of quarks differ radically from those of the classical elementary particles, it is absolutely too early to either support or refute the electric explanatory model for gravity.

But it seems nonetheless unavoidable that the existence of quark charges necessarily must give rise to an electric field



**Fig.3. Model of a 'dipole structure' among neutral particles.**

### 6.2. Oscillating electric dipole the right solution?

From basic electromagnetism it is well-known that an oscillating dipole will give rise to radiation with a spatial dependence of the energy  $\sim 1/R^2$ . Even though this result has in that respect been attained using Maxwell's definitions, as becomes clear from chapter 5 above, even the Coulomb approach gives the same spatial dependence.

This means that provided it can be shown that there takes place continuous accelerations of the quarks within the neutron, there would appear an originally electric force upon other neutral particles, a force that has thus far been denominated for 'gravitational'. Of course, that same force would co-exist with the 'normal' electric force in the case charged elementary particles are involved.

Finally, about gravity it must be mentioned that the above proposed models just are **proposals**, though based upon well-established laws. It remains the huge task for the scientific community to continue searching for the most coherent and optionally simplest cause behind gravity. Nonetheless it must also be an important task for scientists to ask relevant open-ended questions.

## 7. Conclusions

Throughout the chapters above strong evidence is being given that the classical Coulomb theory is capable of explaining several related phenomena. A basis for this work has been

the failure inherent in the very derivation of the so-called Liénard-Wiechert potentials. They have otherwise been regarded as the very cornerstone of modern electromagnetism, the starting point from which the famous Maxwell's equations have been derived, and finally even the wave equation for respective field, the electric and the magnetic. Through the updated usage of Coulomb electrostatics it seems to be possible to prove just anything within electromagnetism, even to resolve the old 'wave-particle paradox'. And thanks to the new approach even a new understanding of the electric fields has been attained, simultaneously refuting the very existence of separate 'magnetic' fields. Short-to-say this means that the new theory is able of simplifying the conceptual understanding of electromagnetic phenomena, back to an original effective force. Taking into account that the medium that is transmitting 'effects' at far distances is best characterized by a continuous 'space-time', it seems also reasonable that the forces and other 'effects' transmitted therein are principally of equivalent nature and that there is not a question of four disparate forces.

This may be said with two important exceptions, the strong and weak interaction, two forces that due to their microscopic nature can not be understood using a time and space in a traditional way, and no effort have been made in this paper to explain them in another way than that commonly being accepted.

But since the 'wave 'particle paradox' has successfully been resolved in this paper, using a classical mechanistic approach, the scientific community shall by no means halt before those two forces.

### **8. List of used variables**

#### **(To be completed in connection with the publication of the proceedings)**

It has to be noted that most variables being introduced ought to be well-known for most readers. There may appear some differences between different practices and therefore a complete list will appear in the final document.

### **9. References.**

- [1] Wesley, J. P., A Mathematical Error in the Liénard-Wiechert Retarded Potentials, Physics Essays, VOL. 13, No. 4, 2000, pp. 1-4. *check page numbering!!!*
- [2] *ibid* p 3
- [3] *ibid*, parenthesis added for convenience, Eq. (16)
- [4] *ibid* Eq. (21)
- [5] Jonson, J. O. Refutation of Feynman's Derivation of the Liénard-Wiechert Potentials, Journal of New Energy, VOL. 7, No. 3, Fall 2003, pp. 42-44, : E-mail: [eemf@earthlink.net](mailto:eemf@earthlink.net)  
Phone: (801)466-8680
- [6] Feynman, R. P., Lectures on Physics (mainly Electromagnetism and Matter), 1989, Addison-Wesley, pp. 21-9 -11
- [7] Moyssides, P. G., J. Appl. Phys. 59, 19 (1986)
- [8] Wesley, J. P., Spec. Sci. Tech. 10, 47 (1987)
- [9] Jonson, J. O. 'The Magnetic Force between Two Currents Explained Using Only Coulomb's Law', Chinese Journal of Physics, VOL. 35, NO. 2, APRIL 1997, pp. 139-49,  
<http://psroc.phys.ntu.edu.tw/cjp>
- [10] *ibid* p. 140, Eq. (1)
- [11] *ibid* p. 144, Eq.(25)
- [12] *ibid* p. 144, Eq.(28)
- [13] Jonson, J. O., 'The Law of Electromagnetic Induction Proved to Be False Using Classical Electrostatics and Consequences for the Understanding of Ohm's Law',

Journal of Theoretics, VOL. 5-3, June 2003,

<http://www.journaloftheoretics.com>

[14] *ibid* p. 4f, Eq's (10) through (14)

[15] *ibid* p. 2-3, eq.s (1) through (9)

[16] Jonson, J. O., 'Towards a Classical Explanation to the Stable Electron Paths Around Nuclei and to Radiation in Connection with the De-Excitation of Excited Electrons, the VIII International Scientific Conference', August 16-20, S:t Petersburg, Russia, Baltic State technical University, Russian Academy of Applied Sciences and International Slavic Academy of Sciences, Education and Arts, pp. 111-118

[17] Jonson, J. O., 'Classical Explanation for Atomic Phenomena\*', Proceedings of the NPA, Storrs 2007.

[18] Jonson, J. O., 'Photon as a classical wave packet from classically stabilized electron orbits'. Proceedings of the SPIE, Vol. 6664, 'The Nature of Light: What Are Photons?', 2007, <http://www.spie.org>

[19] *ibid* Ch. 9

[20] Jonson, J. O., 'What Is Gravity?', Journal of Theoretics, Vol. 4-1, Comments section.