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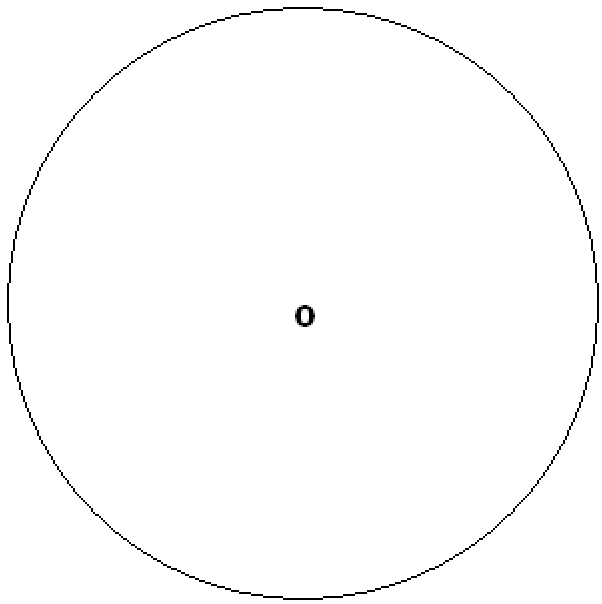

Figure 4. An electric charge at a center of a sphere. Propagation speed of electric fields according to Gauss's electricity flux law

Concerning Gauss's magnetic flux law in equation (A.5.4) - figure 5 presents a sphere being "illuminated" by a uniform magnetic induction vector field $\underline{\boldsymbol{B}}$ from right to left. The "illuminating" electromagnet is turned on at $\boldsymbol{t} = 0$.

If the propagation speed of the magnetic induction vector field $\underline{\boldsymbol{B}}$ is finite – then at a certain time $\boldsymbol{t}=\boldsymbol{t}_5$ the front of this vector field will arrive at the center of the sphere. At that instant the integral at the left hand side of equation (A.5.4) will obviously not equal 0, a clear violation of Gauss's magnetic flux law. The above mentioned violation is a corollary of the assumption that the speed of propagation is finite. Consequently, this assumption is proven wrong and the propagation speed of the magnetic induction vector field $\underline{\boldsymbol{B}}$ must be infinite.

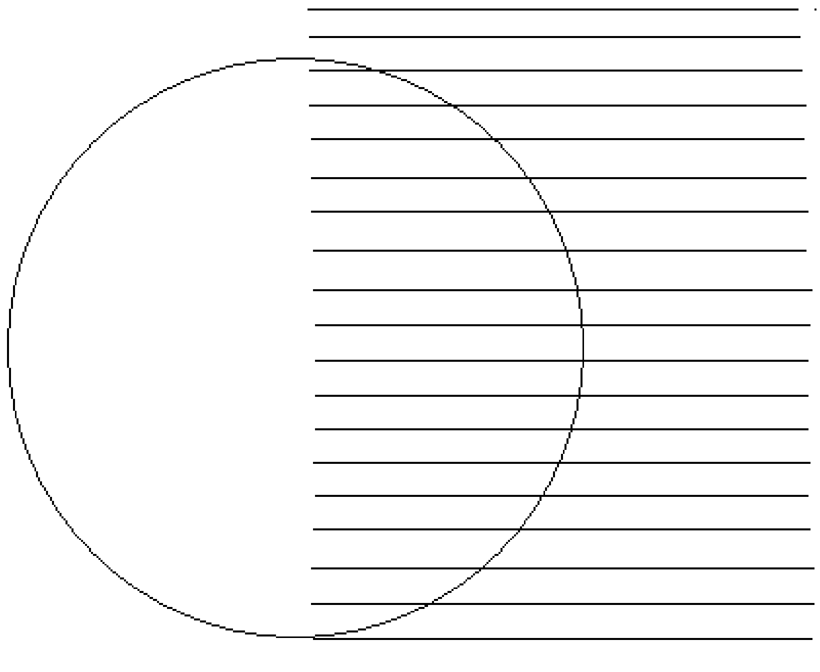

Figure 5. A uniform magnetic field illuminating a sphere. Propagation speed of magnetic fields according to Gauss's magnetic flux law

The last argument (concerning Gauss's magnetic flux law and figure 5) and the second before last (Faraday's law and figure 3) were seemingly disproved by professor Moshe Einat, in the name of professor Vladimir Bratman, both of the Ariel University, Ariel Israel. They pointed out that magnetic fields always consist of closed lines, and that during their propagation these lines inflate like a balloon. Therefore, the field lines never possess open ends - thus yielding the two above mentioned arguments invalid. However, this contention can also be rejected as follows: We place a round axisymmetric magnet rod in vacuum where there are neither conduction nor displacement currents. We then turn the magnet rod around its center point by 180 degrees thus swapping the location of its poles. The final magnetic field lines coincide with the initial lines while their direction is reversed. If the propagation speed of the magnetic field is finite – there exist three regions: The final region, the intermediate region (which corresponds to the time interval during which the magnet is rotated) and the initial region. The first two regions spread at the speed of light into the initial region.

We first prove that the vector $\underline{\boldsymbol{E}}$ vanishes in the intermediate region. The differential equation that determines the electric field in that region is equation

(1.20), namely: $\partial^2 \underline{\boldsymbol{E}} / \partial \boldsymbol{t}^2 = \boldsymbol{c}^2 \cdot \nabla^2 \underline{\boldsymbol{E}}$. Since the vector $\underline{\boldsymbol{E}}$ vanishes in the initial and final regions - $\underline{\boldsymbol{E}} = 0$ is a solution to the above differential equation. Since the solution to the EM equations is unique (as is proven in section A.7) – the electric vector field $\underline{\boldsymbol{E}}$ vanishes in the intermediate region, along with $\underline{\boldsymbol{D}} = \varepsilon \underline{\boldsymbol{E}}$.

We freeze the picture of the magnetic field at a certain time and select a closed line consisting of four segments: Two of them are located at the final and initial regions along magnetic field lines and being connected by the other two segments which are always normal to field lines. Since the magnetic fields on the first two above mentioned segments point in opposite directions - the line integrals over them have the same sign and add up in absolute value. The line integrals over the other two segments vanish since they are orthogonal to the field lines. Therefore, the integral of the magnetic field along the above defined closed contour does not equal zero in spite the fact that $\underline{\boldsymbol{J}} = 0$ (vacuum) and $\underline{\boldsymbol{D}} = 0$ (as was proven in the previous paragraph), clearly violating Ampere's law in equation (A.5.1). The above mentioned violation is a corollary of the assumption that the speed of propagation is finite. Consequently, this assumption is proven wrong and the propagation speed of the magnetic field must be infinite.

Maxwell's equations, as well as the corrected Maxwell equations, are based on the integral laws in equations (A.5.1) to (A.5.4). Arriving at a conclusion that any speed cannot exceed the speed of light, on the basis of the above four integral laws which imply an infinite speed of propagation of electric and magnetic fields, does not make sense. If it is ever proven that the speed of light cannot be exceeded, then the above mentioned four laws will have to be modified. As a matter of fact – through a simple laboratory experiment it can be checked whether Faraday's law in equation (A.5.2) is correct, including the aspect of the infinite speed of propagation. However, it should be carefully planned since it involves ultra-high frequency electric signals.

A.6 The Correct Version of Ampere's Law

Several forms or Ampere's law can be found in the literature. One of them is equation (A.5.1) which is presented here as equation (A.6.1).

$$\frac{d}{dt}\int_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} + \int_A \underline{\boldsymbol{J}} \cdot \underline{\boldsymbol{dA}} = \oint_s \underline{\boldsymbol{H}} \cdot \underline{\boldsymbol{ds}} \qquad \text{(A.6.1)}$$

Two more versions Ampere's law are the following:

$$\int_A \left(\frac{d\underline{\boldsymbol{D}}}{dt} + \underline{\boldsymbol{J}}\right) \cdot \underline{\boldsymbol{dA}} = \oint_s \underline{\boldsymbol{H}} \cdot \underline{\boldsymbol{ds}} \qquad \text{(A.6.2)}$$

$$\int_A \left(\frac{\partial\underline{\boldsymbol{D}}}{\partial t} + \underline{\boldsymbol{J}}\right) \cdot \underline{\boldsymbol{dA}} = \oint_s \underline{\boldsymbol{H}} \cdot \underline{\boldsymbol{ds}} \qquad \text{(A.6.3)}$$

The last two equations are based on the premise that $\frac{d\underline{\boldsymbol{D}}}{dt}$ is the "displacement current" which is added to the conduction current $\underline{\boldsymbol{J}}$ to obtain the total current.

Ampere's law as expressed in equation (A.6.3) is obviously wrong since it is limited to static cases only. Therefore, we have to determine whether equation (A.6.1) is the correct form of Ampere's law or equation (A.6.2).

Figure 6 is a cross section of a spherical surface $\boldsymbol{A}$ intersected by a circular plane (represented in the figure by the vertical line DU). The center of the spherical surface is **o** at which point a charge $\boldsymbol{Q}$ is located. The intersection between the spherical surface and the circular plane is a circle $\boldsymbol{s}$ which is the boundary of the spherical surface $\boldsymbol{A}$. The point **P** is the center of the circular plane.

We now move the point **P** away from **o** until the circular boundary $\boldsymbol{s}$ converges to a point. The integral on the right hand side of equations (A.6.1) to (A.6.3) converges to zero since the range of integration vanishes. Thus, in this particular case equation (A.6.1) becomes:

$$\frac{d}{dt}\oint_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} + \oint_A \underline{\boldsymbol{J}} \cdot \underline{\boldsymbol{dA}} = 0 \qquad \text{(A.6.4)}$$

Similarly, equation (A.6.2) turns into:

$$\oint_A \left(\frac{d\underline{\boldsymbol{D}}}{dt} + \underline{\boldsymbol{J}}\right) \cdot \underline{\boldsymbol{dA}} = 0 \qquad \text{(A.6.5)}$$

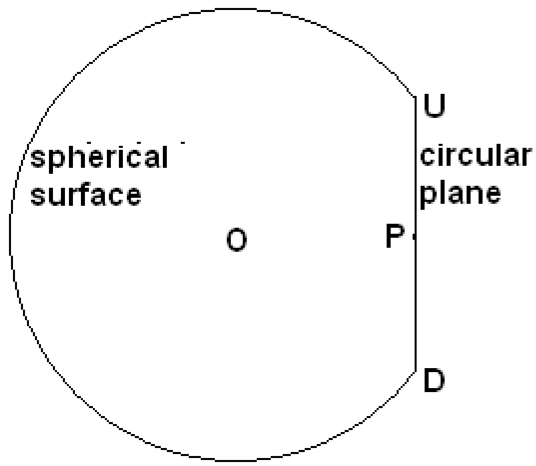

Figure 6. Circular plane intersecting a sphere. Determination of the correct version of Ampere's law

We make two further assumptions. The first is that the whole setup is located in vacuum, where the conductivity is zero, thus the conduction current $\underline{\boldsymbol{J}}$ vanishes. Therefore we are left with a closed sphere and a charge $\boldsymbol{Q} > 0$ at its center. The second assumption is that the radius $\boldsymbol{r}$ of the sphere is shrinking at rate of $\frac{\boldsymbol{dr}}{\boldsymbol{dt}} = -\boldsymbol{v}$.

In this case Ampere's law in equation (A.6.4) should satisfy:

$$\frac{d}{dt}\oint_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} = 0 \qquad \text{(A.6.6)}$$

And according equation (A.6.5) Ampere's law should be:

$$\oint_A \frac{d\underline{\boldsymbol{D}}}{dt} \cdot \underline{\boldsymbol{dA}} = 0 \qquad \text{(A.6.7)}$$

Due to symmetry – the electric excitation vector $\underline{\boldsymbol{D}}$ is normal to the spherical surface at all points and its magnitude $\boldsymbol{D}$ equals:

$$\boldsymbol{D} = |\underline{\boldsymbol{D}}| = \frac{\boldsymbol{Q}}{4\pi \boldsymbol{r}^2} \tag{A.6.8}$$

It follows from equation (A.6.8):

$$\frac{\boldsymbol{dD}}{\boldsymbol{dt}} = \frac{\partial \boldsymbol{D}}{\partial \boldsymbol{r}} \frac{\boldsymbol{dr}}{\boldsymbol{dt}} = (-\frac{\boldsymbol{Q}}{2\pi \boldsymbol{r}^3})(-\boldsymbol{v}) = \frac{\boldsymbol{Qv}}{2\pi \boldsymbol{r}^3} \tag{A.6.9}$$

We compute the integral $\oint_A \frac{\boldsymbol{d}\underline{\boldsymbol{D}}}{\boldsymbol{dt}} \cdot \underline{\boldsymbol{dA}}$ in equation (A.6.7). Again, due to symmetry:

$$\oint_A \frac{\boldsymbol{d}\underline{\boldsymbol{D}}}{\boldsymbol{dt}} \cdot \underline{\boldsymbol{dA}} = \frac{\boldsymbol{dD}}{\boldsymbol{dt}} 4\pi \boldsymbol{r}^2 = \frac{\boldsymbol{Qv}}{2\pi \boldsymbol{r}^3} 4\pi \boldsymbol{r}^2 = \frac{2\boldsymbol{Qv}}{\boldsymbol{r}} \neq 0 \tag{A.6.10}$$

Equation (A.6.10) clearly contradicts the requirement of equation (A.6.7), which means that equation (A.6.2) is not a correct version of Ampere's law.

We compute the integral $\frac{\boldsymbol{d}}{\boldsymbol{dt}} \oint_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}}$ in equation (A.6.6). In view of equation (A.6.8) and making use of symmetry again:

$$\frac{\boldsymbol{d}}{\boldsymbol{dt}} \oint_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} = \frac{\boldsymbol{d}}{\boldsymbol{dt}} (\boldsymbol{D} \cdot 4\pi \boldsymbol{r}^2) = \frac{\boldsymbol{d}}{\boldsymbol{dt}} (\boldsymbol{Q}) = 0 \tag{A.6.11}$$

The requirement of equation (A.6.6) is fulfilled; hence equation (A.6.1) is the correct form of Ampere's law.

A.7 Existence and Uniqueness of Solutions to the EM Equations

A necessary condition for the corrected Maxwell equations to be a well-defined mathematical problem (in other words: a requirement that these equations have a unique solution) is the equality between the number of independent equations and the number of variables. If the number of variables exceeds the number of independent equations – the solution is not unique. If the number of independent equations exceeds the number of variables – there is no solution.

From equations (1.1) to (1.8) we can determine the number of variables and equations.

The variables are the following: $\underline{\boldsymbol{B}}$, $\underline{\boldsymbol{D}}$, $\underline{\boldsymbol{E}}$, $\underline{\boldsymbol{H}}$, $\underline{\boldsymbol{J}}$ and ρ. We have five vector variables and one scalar variable. Each vector variable consists of three components; therefore the total number of scalar variables is 16.

Equations (1.1) to (1.8) consist of five vector equations and three scalar equations. Each vector equation consists of three scalar equations; hence the total number of scalar equations is 18. Since the number of independent scalar equations should equal the number of scalar variables – two of the 18 equations should be dependent on the other equations.

We first prove that Gauss's magnetic flux law [its integral form in equation (A.5.4), $\oint_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}} = 0$] depends on Faraday's law [equation (A.1.1) $\frac{\boldsymbol{d}}{\boldsymbol{dt}} \int_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}} = -\oint_s \underline{\boldsymbol{E}} \cdot \underline{\boldsymbol{ds}}$].

We select any volume $\boldsymbol{Vol}$ surrounded by a closed surface $\boldsymbol{A}$. Since the surface $\boldsymbol{A}$ is closed – all of its boundaries $\boldsymbol{s}$ converge to a point causing the right hand side line integral in equation (A.1.1) above to vanish. Therefore:

$$\frac{\boldsymbol{d}}{\boldsymbol{dt}} \oint_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}} = 0 \qquad \text{(A.7.1)}$$

It follows from equation (A.7.1) that if we divide the space into arbitrary volumes $\boldsymbol{Vol}$ with outer envelope surfaces $\boldsymbol{A}$ and these volumes move along according to the velocity vector field $\underline{\boldsymbol{V}}$ - the integral $\oint_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}}$ over the outer envelope surfaces $\boldsymbol{A}$ of each of these volumes remains unchanged. Gauss's magnetic flux law in equation (A.5.4), $\oint_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}} = 0$, serves as an initial condition to equation (A.7.1) stating that the initial value of these surface integrals cannot be selected arbitrarily. Their initial value must be 0, and since their value remains unchanged they must equal 0 at all times. We thus obtain that at all times:

$$\oint_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}} = 0 \tag{A.7.2}$$

Therefore, Gauss's magnetic flux law in equation (A.7.2) is not an independent equation. It is compatible with Faraday's law for closed surfaces [equation (A.7.1)] and serves as an initial condition to any closed surface integral $\oint_A \underline{\boldsymbol{B}} \cdot \underline{\boldsymbol{dA}}$. Since the time derivative of this integral vanishes [equation (A.7.1)] – its value equals 0 at all times. This dependence is valid in integral form [equation (A.5.4) on (A.1.1)] as well as in differential form [equation (1.3) on (1.1)].

We now prove that the charge conservation law in equation (1.5) is dependent on Ampere's law in equation (1.2) and Gauss's electricity flux law in equation (1.4). We do it by proving that equation (A.3.1), which is the integral form of the charge conservation law $\frac{\boldsymbol{d}}{\boldsymbol{dt}} \int_{Vol} \rho\, \boldsymbol{d}(\boldsymbol{Vol}) + \oint_A \underline{\boldsymbol{J}} \cdot \underline{\boldsymbol{dA}} = 0$, is dependent on equation (A.6.1), $\frac{\boldsymbol{d}}{\boldsymbol{dt}} \int_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} + \int_A \underline{\boldsymbol{J}} \cdot \underline{\boldsymbol{dA}} = \oint_s \underline{\boldsymbol{H}} \cdot \underline{\boldsymbol{ds}}$ which is the integral form of Ampere's law, and Gauss's electricity flux law in differential form $\nabla \cdot \underline{\boldsymbol{D}} = \rho$, equation (1.4).

We refer again to Figure 6, in the particular case where the point **P** is far enough from the center **o** of the spherical surface so that the circular area converges to a point [see the two paragraphs preceding equation (A.6.4)]. In this particular case the integral form of Ampere's law is presented in equation (A.7.3):

$$\frac{\boldsymbol{d}}{\boldsymbol{dt}} \oint_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} + \oint_A \underline{\boldsymbol{J}} \cdot \underline{\boldsymbol{dA}} = 0 \tag{A.7.3}$$

But according to Gauss's theorem:

$$\oint_A \underline{\boldsymbol{D}} \cdot \underline{\boldsymbol{dA}} = \int_{Vol} (\nabla \cdot \underline{\boldsymbol{D}})\, \boldsymbol{d}(\boldsymbol{Vol}) \tag{A.7.4}$$

Substituting equation (A.7.4) into equation (A.7.3):

$$\frac{d}{dt}\int_{Vol}(\nabla\cdot\underline{\boldsymbol{D}})\,d(Vol)+\oint_{A}\underline{\boldsymbol{J}}\cdot\underline{\boldsymbol{dA}}=0 \qquad \text{(A.7.5)}$$

According to Gauss's electricity flux law in differential form, equation (1.4):

$$\nabla\cdot\underline{\boldsymbol{D}}=\rho \qquad \text{(A.7.6)}$$

Substitution of equation (A.7.6) into equation (A.7.5) yields:

$$\frac{d}{dt}\int_{Vol}\rho\,d(Vol)+\oint_{A}\underline{\boldsymbol{J}}\cdot\underline{\boldsymbol{dA}}=0 \qquad \text{(A.7.7)}$$

Equation (A.7.7) is identical to the charge conservation law in equation (A.3.1), and is thus dependent on Ampere's law and Gauss's electricity flux law. This dependence is valid in differential form as well, namely: equation (1.5) is dependent on Ampere's law in equation (1.2) and Gauss's electricity flux law in equation (1.4).

We started out with 16 scalar variables and 18 scalar equations. Since two scalar equations are dependent on other equations – the number of independent equations equals 16. Therefore, the number of independent equations equals the number of variables and the necessary condition for the corrected Maxwell equations to be a well-defined mathematical problem is met. Consequently, for any particular problem a unique solution might exist which depends on the boundary and initial conditions.

It is important to note that had we applied equation (A.6.2) for Ampere's law – then, in the most general case where the velocity vector field varies space-wise, the charge conservation law (A.7.7) would not be dependent on the other equations. Consequently we would be stuck with 16 variables and 17 independent equations, where there would be no solution. This is another proof that equation (A.6.1), rather than equation (A.6.2), is the correct form of Ampere's law.

A.8 The Faraday Paradox

The Faraday paradox is resolved by reference to the corrected Maxwell equations. The significance of this section goes far beyond the resolution of the Faraday paradox. It is the basis for the resolution of many (most probably all) other paradoxes associated with Maxwell's equations. These paradoxes stem from the incompleteness of the common Maxwell's equations, i.e.: terms that they are missing. When the missing terms are restored to the corrected Maxwell equations – these paradoxes do not arise at the outset.

The common way of resolving the Faraday paradox in the literature is the application of the "Lorentz Force". So why is it still considered a paradox? The problem is that the Faraday paradox cannot be resolved based only on Maxwell's equations (which should be the universal EM laws) but must rely on the Lorentz force which was introduced separately from Maxwell's equations.

However, as is shown in section A.4, the fact that the Lorentz force is not predicted by Maxwell's equations is due to the incompleteness of these equations. When applying the corrected Maxwell equations, where the missing terms are restored, the Lorentz force is a direct consequence of the corrected equations as shown by equation (A.4.17), and the Faraday paradox does not arise to begin with.

Conclusion

The soundness of this article can be checked through the answer to the following question: "Are Maxwell's equations incomplete?", namely: are some terms missing from these equations? If the answer is "no" – this article is pointless. However, if the answer is "yes" – the theory of relativity collapses, as shown in the logical flow-chart of figure 7. Since the article demonstrates beyond any doubt that Maxwell's equations are incomplete – the theory of relativity is definitely refuted.

The theory of relativity was not readily accepted because it has contradicted common sense. But after more than a century of exposure to it the scientific community is absolutely certain about its unquestionable validity. However, we must go back to the good old Galilean transformation and Newtonian mechanics since this article clearly demonstrates that the theory of special relativity is based on incorrect notions, namely: forcing physical phenomena to comply with a wrong form of Maxwell's electromagnetic differential equations. Formulating the corrected Maxwell equations and solving them for planar EM waves in vacuum confirms (assuming that the integral laws which are the basis for Maxwell's equations are correct) that the Galilean transformation and Newtonian mechanics are valid, not only as low speed approximations but as exact laws. The corrected Maxwell equations might pave the way to the formulation of the long sought unified theory of mechanics and electromagnetism.

The theory of relativity is inconsistent (see flow-chart) which has led to many paradoxes and a large number of futile and costly experiments to "prove" its validity. [Nobody has found it necessary to prove Newton's laws or the laws of thermodynamics].

But the greatest damage of the theory of relativity may be related to the lack of progress in important engineering projects. The unavailability of commercial fusion energy, after many decades of intense efforts, is most probably due to the application of Maxwell's equations which are an inadequate form of the EM laws.

Definitions for the following flowchart:

Current Laws: The current version of the Faraday, Ampere and Gauss electric and magnetic laws.
Current Equations: The EM (Maxwell's) equations based on the **Current Laws** and the Lorentz transformation (i.e.: the current relativistic EM equations).
Corrected Laws: A corrected version of the **Current Laws** so that the speed of propagation of electric and magnetic fields does not exceed the speed of light (if they are ever formulated).
Corrected Equations: The EM equations based on the **Corrected Laws (**and, possibly, on the Lorentz transformation).

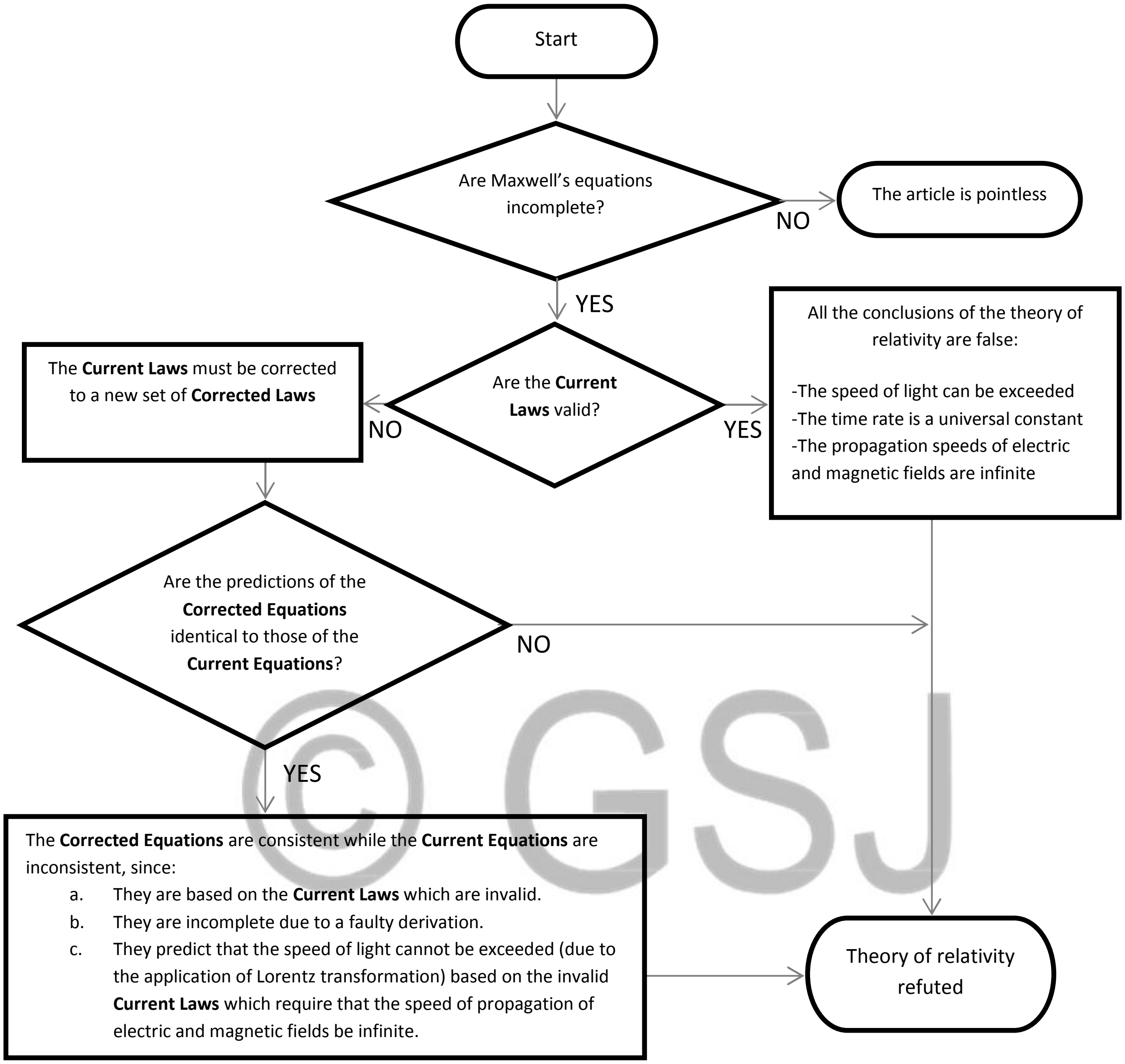

Figure 7. Theory of relativity logical validity check

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