Proof of the inconsistency of the Maxwell equations to the measurement result of the Maxwell-Lodge experiment

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Abstract

This short paper proofs mathematically that the Maxwell equations are not able to explain the Maxwell-Lodge experiment. Not even if the vector potential is used instead of the magnetic induction.

Note: This paper is only a stub and intended as assistance for [1] which in turn refers to [2].

1. Starting point

Starting point are the Maxwell equations and the Lorentz force. The formulas are

$$\nabla \cdot \boldsymbol{E} = \frac{\rho}{\varepsilon_0}, \tag{1}$$

$$\nabla \cdot \boldsymbol{B} = 0, \tag{2}$$

$$\nabla \times \boldsymbol{E} = -\frac{\partial}{\partial t}\boldsymbol{B}, \tag{3}$$

$$\nabla \times \boldsymbol{B} = \mu_0\, \boldsymbol{j} + \mu_0\, \varepsilon_0\, \frac{\partial}{\partial t}\boldsymbol{E}, \tag{4}$$

$$\boldsymbol{F} = q\, \boldsymbol{E} + q\, \boldsymbol{v} \times \boldsymbol{B}. \tag{5}$$

Insertion of the potentials

$$\boldsymbol{E} = \nabla\Phi - \frac{\partial}{\partial t}\boldsymbol{A}, \tag{6}$$

$$\boldsymbol{B} = \nabla \times \boldsymbol{A} \tag{7}$$

gives the equations

$$\nabla \cdot \nabla\Phi - \frac{\partial}{\partial t}\nabla \cdot \boldsymbol{A} = \frac{\rho}{\varepsilon_0}, \tag{8}$$

$$\nabla \cdot \nabla \times \boldsymbol{A} = 0, \tag{9}$$

$$\nabla \times \nabla\Phi - \frac{\partial}{\partial t}\nabla \times \boldsymbol{A} = -\frac{\partial}{\partial t}\nabla \times \boldsymbol{A}, \tag{10}$$

$$\nabla \times \nabla \times \boldsymbol{A} = \mu_0\, \boldsymbol{j} + \mu_0\, \varepsilon_0\, \frac{\partial}{\partial t}\nabla\Phi - \mu_0\, \varepsilon_0\, \frac{\partial^2}{\partial t^2}\boldsymbol{A}, \tag{11}$$

$$\boldsymbol{F} = q\, \nabla\Phi - q\, \frac{\partial}{\partial t}\boldsymbol{A} + q\, \boldsymbol{v} \times \nabla \times \boldsymbol{A}. \tag{12}$$

The equations (9) and (10) are always fulfilled, because for arbitrary fields $\boldsymbol{A}$ and Φ always $\nabla\cdot\nabla\times\boldsymbol{A} = 0$ and $\nabla\times\nabla\Phi = 0$ is valid. So only the equations (8), (11) and (12) remain.

2. Proof of inconsistency

The Maxwell-Lodge experiment measures the force $\boldsymbol{F}$ on charge carriers in a ring-shaped conductor outside around the coil cylinder. The following characteristics apply:

1. The charge density is everywhere and always zero, i.e. $\rho = 0$.
2. It can be shown that no magnetic induction $\boldsymbol{B}$ is present outside the coil cylinder and that because of equation (7) the equation $\nabla \times \boldsymbol{A} = 0$ applies.
3. The current density outside the coil cylinder is zero, i.e. $\boldsymbol{j} = \boldsymbol{0}$.

Only the area outside the coil cylinder is considered. By applying the points listed above to the equations (8), (11) and (12), one obtains

$$\nabla \cdot \nabla\Phi - \frac{\partial}{\partial t}\nabla \cdot \boldsymbol{A} = 0, \tag{13}$$

$$\boldsymbol{0} = \mu_0\, \varepsilon_0\, \frac{\partial}{\partial t}\nabla\Phi - \mu_0\, \varepsilon_0\, \frac{\partial^2}{\partial t^2}\boldsymbol{A}, \tag{14}$$

$$\boldsymbol{F} = q\, \nabla\Phi - q\, \frac{\partial}{\partial t}\boldsymbol{A}. \tag{15}$$

The derivative of equation (15) with respect to the time is

$$\frac{\partial}{\partial t}\boldsymbol{F} = q\, \frac{\partial}{\partial t}\nabla\Phi - q\, \frac{\partial^2}{\partial t^2}\boldsymbol{A}. \tag{16}$$

By applying the equation (14),

$$\frac{\partial}{\partial t}\boldsymbol{F} = \boldsymbol{0} \tag{17}$$

follows. The force must therefore be constant over time. But this is not the case in the Maxwell-Lodge experiment, what means that the measurements cannot be explained with the Maxwell equations. Not even then, if potentials are used instead of fields.

3. Further properties

Applying the divergence operator to the equation (15) gives

$$\nabla \cdot \boldsymbol{F} = q\, \nabla \cdot \nabla\Phi - q\, \frac{\partial}{\partial t}\nabla \cdot \boldsymbol{A}. \tag{18}$$

Because of equation (13) it follows

$$\nabla \cdot \boldsymbol{F} = 0. \tag{19}$$

By applying the curl operator to equation (15), one obtains

$$\nabla \times \boldsymbol{F} = q \nabla \times \nabla \Phi - q \frac{\partial}{\partial t} \nabla \times \boldsymbol{A}. \tag{20}$$

In the Maxwell-Lodge experiment, $\nabla \times \boldsymbol{A}$ is zero at any location outside the coil. Furthermore, $\nabla \times \nabla \Phi = 0$ always applies. This leads to

$$\nabla \times \boldsymbol{F} = \mathbf{0}. \tag{21}$$

Since curl and divergence are zero, the force can be either a harmonic function without time dependency, constant or zero. However, the only physically reasonable solution is that in which the force $\boldsymbol{F}$ disappears everywhere.

References

[1] R. Gray, "Experimental disproof of maxwell and related theories of classical electrodynamics," 09 2019.

[2] G. Rousseaux, R. Kofman, and O. Minazzoli, "The maxwell-lodge effect: Significance of electromagnetic potentials in the classical theory," *The European Physical Journal D*, vol. 49, no. 2, pp. 249–256, Sep 2008. [Online]. Available: https://doi.org/10.1140/epjd/e2008-00142-y