Qeios

Peer Review

Review of: "Wire Current"

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Review of the manuscript "Wire current" by Art Davis and Vladimir Onoochin

As I received an invitation from Qeios to review this paper, here are my observations about it:

- Although the authors claim, from the very abstract, that they are going to provide an answer to Catt's question, the first thing that caught my eye was that Catt is not cited anywhere in this paper, so some younger readers might be puzzled about the subject of the paper.
- Although, in the 2nd paragraph of page 4 of the paper, the authors seem to quote Catt, writing in quotation marks "*where does the charge come from at a point on the wire ?*", this quote sends us to reference 4, a reference which has nothing to do with Catt's question, being much older than it.
- In section 2 of the paper, by the order in which equations (1) - (7) are written and by citing references 6 and 8, the authors hint at Davis's older theory - "potentials first". As far as I know, this theory has already been proven to be erroneous by several authors (such as van Hees and Heras). In this sense, I think that the sentence written by Kirk T. McDonald in his paper "Is Faraday's Disk Dynamo a Flux-Rule Exception?", namely "*In 2024, Davis [584] lost track of the distinction between dΦ_B/dt and ∂Φ_B/∂t in his eq. (28)*", is particularly relevant.
- Assuming that the authors have no other intention than to work in the Lorentz gauge, their equations (1) - (7) are formally correct, so we can move on to the analysis of their reasoning in the following sections.
- Considering a one-dimensional conducting wire, along which the velocity of the conduction electrons is constant, the authors arrive at (13). Taking the Laplace transform of this transport equation, the authors arrive at equation (18). Then, to move from equation (18) to equation (19), **the authors assume that \rho_L(s,0)=0, which is absurd**, because that automatically means that \rho_L(\lambda,0)=0 (assuming \rho is a continuous function and using Lerch's Uniqueness Theorem). Yet, \rho_L(\lambda,0)=0 means that, **at the moment t=0, the wire does not contain any kind of**

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conduction electrons, but they appear at a later moment in the wire, and nobody knows where they could possibly come from.

- I think that the major conceptual error of the authors is made explicit in the text between equations (18) and (19), by the statement: "*assuming that the wire is initially uncharged*". Here, the authors seem to confuse the macroscopic electrical neutrality of a conductor (obtained through the perfect compensation between the negative charge of conduction electrons and the positive charge of the fixed ions) with the microscopic absence of electrical charges. Beyond the physical absurdity of this latter hypothesis, if \rho_L(\lambda,0)=0, it follows directly from Equation (9) that no conduction electrons exist in the wire at the initial moment. This makes their reasoning completely invalid, as **the authors nowhere explain how or at what specific moment these conduction electrons enter the wire** so that a non-zero current can exist at a later time t > 0. An electromagnetic signal cannot perturb or displace a medium of charges that has been mathematically eliminated from the start.

Due to the errors listed above, I cannot recommend the publication of this paper in its current form.

Declarations

Potential competing interests: No potential competing interests to declare.