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COMMENTS

Comments are short papers which criticize or correct papers of other authors previously published in the **Physical Review**. *Each Comment should state clearly to which paper it refers and must be accompanied by a brief abstract. The same publication schedule as for regular articles is followed, and page proofs are sent to authors.*

Comment on "Electric fields from steady currents and unexplained electromagnetic experiments"

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Ivezić [Phys. Rev. A **44**, 2682 (1991)] claims to have explained in a natural way some earlier unexplained electromagnetic experiments, using so-called "relativistic" electric fields. We find his approach to be not only confusing but also self-contradictory. In particular, we show here that his proposed theory does not explain the results of the experiments listed by him.

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Ivezić [1] claims that his recently proposed theory [2], where he has introduced "new Lorentz invariant charges," explains in a natural way results of some earlier unexplained electromagnetic experiments [3,4]. His starting point is that in the standard electromagnetic theory (SET), the macroscopic charge *contained in a section* of a current-carrying conductor (CCC) is not Lorentz invariant. He also finds it to be paradoxical in SET that while a CCC is section by section and globally charge neutral in one inertial frame (laboratory frame), its various sections may appear charged in another frame. To remedy these *shortcomings* of the SET, he has proposed a "modification" where the charge invariance for ions and electrons is defined only in terms of volume elements fixed in their respective rest frames. Further he "defines" the charge neutrality of a CCC in terms of these Lorentz invariant charges. From the requirement that a CCC be globally and locally (section by section) charge neutral *in every inertial frame of reference*, he arrives at a conclusion that the number density of electrons in their rest frame is the same as that of the ions in laboratory frame.

Many theoretical objections to Ivezić's proposed theory have already been raised [5] (see also [6] for Ivezić's response to these and to some other objections). We find Ivezić's modified definitions of the charge invariance and of the charge neutrality themselves to be unpalatable. Ivezić has claimed that his newly defined charge invariance is applicable to a CCC even section by section. But in order to measure the total charge in *a section*, he simultaneously employs *two different stretches* of the conductor length in any given reference frame, one for the ions and another for the electron subsystem. We do not see how Ivezić could claim his version of charge invariance to be now applicable even to a section of the CCC since a section could not imply simultaneously two different lengths in the same reference frame. The same confusion is present in Ivezić's definition of the charge neutrality. To ascertain the section by section charge neutrality of a CCC, he compares the relative numbers of ions and electrons, both contained in sections that are defined to be of equal length in *two different reference frames*. Thus he uses different volume elements for ions and electrons in any given inertial frame, and determines the charge neutrality *of a section* of the CCC. This way he *declares* a section of the CCC to be charge neutral while at the same time claiming it (the same section) to have an unequal number of ions and electrons and accordingly with a net charge on it. This is a self-contradictory definition of charge neutrality and to say further that in this way a CCC is charge neutral *in all inertial reference frames* does not convey any meaning.

Now we want to show that even if we assume that somehow there exists a net charge density on each section of the CCC in laboratory frame as claimed by Ivezić, one cannot still explain the results of the experiments quoted by him. Objections have already been raised [5] to Ivezić's claim (Ref. [1], bottom of page 2683) of having explained successfully the experimental results of Edwards, Kenyon, and Lemon [3], in which an unexplained electric field was observed outside a current coil made of superconducting material. In one of the variations in the experiment of Edwards, Kenyon, and Lemon, the current coil was enclosed in a "Faraday cage" without affecting the results and Ivezić's "explanation" does not hold good there (see also [7]). It should be further pointed out that in the later versions of the experiment of Edwards, Kenyon, and Lemon, no "unexplained" electric fields have been claimed [8].

To explain the exploding wire phenomenon in

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Graneau's experiment [4], in which a straight aluminium wire was shattered into many fragments when a particular pulse current level was reached, Ivezić has calculated the *longitudinal* component of force on elements of a straight wire. For this he has calculated the mutual force between any two current elements due to the net charge on each current element, and found the force to be finite and always repulsive (Ref. [1], Eq. (4)). It should be noted that this force is calculated from the electric fields at the "location" of each current element and is not some stress across the "interface" between pairs of *just adjacent* current elements (contrary to the inference drawn in Ref. [9]), and that the net force on a current element should be proportional to the algebraic sum of the electric field at its location due to all other current elements in the wire. Now every element of a straight wire is surrounded by current elements on either side along the wire length and any longitudinal force component should symmetrically get cancelled. Even in the case of a circular ring, with ions and electrons distributed assumedly [1] on two different-diameter circles, the circular symmetry immediately rules out any net *longitudinal* force component. It should be noted that since in a steady state there are no transverse currents, the sum of all electrical forces transverse to the motion of electrons is already inferred to be zero [1].

Thus, in our opinion, whatever another explanation of these curious electromagnetic experiments may be, the one suggested by Ivezić, in terms of "relativistic electric fields," does not appear to be valid.

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