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Peer Review

Review of: "The Sagnac Effect and General Relativity Foundations"

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REVIEW of the paper titled

"The Sagnac Effect and General Relativity Foundations"

Author: **Justo Lambare**

My compliments to Dr. Lambare for his interest in fundamental physics!

1- Does the Sagnac effect invalidate standard special relativity?

In the literature, there are many papers on the (circular) Sagnac effect. Many authors ([1]-[20]) have shown rigorously, experimentally and theoretically, that the Sagnac effect disproves light speed invariance and the Lorentz transformations.

Considering that after more than a century there are still authors, like Lambare, claiming that the Sagnac effect can be interpreted within standard special relativity based on light speed invariance, I have good reasons to believe that these authors did not read carefully the papers of the above-mentioned authors. After discussing Lambare's work, I consider below some of the reasons why many authors (e.g., Benedetto et al. in Ref. 31 of Lambare) still support the notion of light speed invariance despite the strong evidence against it.

Concerning the paper under review, I go directly to the point and indicate where the conceptual error of Lambare is. I rewrite his equation (8) as,

$$t = t_0,\ r = r_0\ ,\ \phi = \phi_0 - \Omega t,\ z = z_0 \qquad (1)$$

where the quantities with the sub-index $_0$ refer to the lab frame S_0 and the other to the rotating frame. Let us consider an inertial frame S instantaneously co-moving with the elementary arc $d\sigma = Rd\phi$ of the rotating platform with tangential speed $v = \Omega R$. For an infinitesimal transformation from the lab frame to the frame S, Lambare's approach implies,

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$$dt = dt_0, \quad d\sigma = Rd\phi = Rd\phi_0 - \Omega R dt_0 = d\sigma_0 - v dt_0 . \qquad (2)$$

With $d\sigma = dx$ and $d\sigma_0 = dx_0$, transformations (2) assume the familiar form, $dt = dt_0$ and $dx = dx_0 - vdt_0$. Hence, the transformations (2) from S_0 to S adopted by Lambare are nothing else than the usual Galilean transformations, which preserve simultaneity. Practically all the authors discussing the Sagnac effect agree that relativistic transformations based on absolute simultaneity interpret consistently the results of the Sagnac experiment. Hence, it is not surprising that Lambare's approach based on absolute simultaneity, developed after his equation (8), correctly foresees Sagnac's experimental results.

The problem is that, without mentioning the issue of synchronization, Lambare is assuming implicitly the Galileo transformations and the corresponding local velocity composition, $d\sigma/dt = d\sigma_0/dt - v$, corresponding to a tangential light speed $c(v) = c - v$. Because of such an assumption, it is conceptually incorrect to claim that Lambare's approach reflects the results foreseen by the standard Lorentz transformations (LT).

In fact, if we adopt the standard LT based on relative simultaneity, the transformations (2) must be written as,

$$dt = \gamma(dt_0 - v\, d\sigma_0/c^2) \qquad d\sigma = \gamma\,(d\sigma_0 - v dt_0) \qquad (3)$$

With the inverse transformations of (3) inserted in Lambare's Eq. (9), the metric reads,

$$ds^2 = c^2 dt_0^2 - d\sigma_0^2 = c^2\gamma^2(dt + v\, d\sigma/c^2)^2 - \gamma^2(d\sigma + vdt)^2$$

$$= c^2 dt^2 - d\sigma^2 = 0, \qquad (4)$$

which is invariant as expected, if light speed is invariant. In this case, $dt = d\sigma/c$ and, integrating over dt and $d\sigma$, we find $T+ = 2\pi R/c$ and $T- = 2\pi R/c$, giving

$$\Delta T = (T+) - (T-) = 0,$$

contrary to experimental observation.

Therefore, Engelhardt, Sagnac, Selleri, and all the other authors claiming the inconsistency of the LT in interpreting the Sagnac effect, are correct.

2- Why Lambare and many other physicists fail to see the inconsistency of the LT?

I discuss this point in the Appendix.

CONCLUSIONS

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I invite Lambare and the readers to read the recent developments on the theme of light speed invariance in the references below and particularly Refs: [18], [19], where the linear Wang-Sagnac effect is considered. The result of applying Einstein synchronization indicates that the standard LT leads to the violation of spacetime continuity, in the sense that, if the local light speed is *c* along the closed contour of the optical fiber, there is a "missing section" not covered by light in the measured round-trip interval T.

One point of interest is the claim of conventionalism that the one-way light speed is conventional because of the arbitrariness of synchronization. In this case, according to the conventionalist thesis, it is equivalent to adopt either absolute or relative synchronization. The missing section is then just an artifact of the theory and is not observable. However, this conclusion is invalidated by showing, as done in Refs. [18], [19] that the conventionalism does not hold because different synchronizations correspond to different physical theories and, moreover, the one-way light speed is observable and not conventional.

APPENDIX

Why Lambare and many other physicists fail to see the inconsistency of the LT?

There are many reasons. We mention here some of them, starting with the personal observation and experience that, presently, some of the mainstream journals (including editors and reviewers) are biased. In my opinion, the interest of these journals is to preserve the current paradigm because it is not of their economic, political, etc., interest to publish articles displaying critical thinking about the current paradigm.

Another reason is due to the "publish or perish" issue. Physicists need to publish to advance in their careers. Most mainstream journals favor the publication of articles supporting the present paradigm. According to my experience, I have the impression that editors and reviewers do not care much about the rigor of an article, as long as it supports the present paradigm, e.g., the current view about the invariance of the light speed.

Here are some of the main reasons why the physics community tends to oppose the shift of the present paradigm.

Perhaps, Dr. Lambare can kindly provide feedback about why he opposes the paradigm shift of light speed invariance.

Four key reasons why a scientific paradigm shift often faces resistance from the scientific community:

1. **Cognitive Inertia and Conservatism** – Scientists are trained within an existing framework, making it difficult to abandon familiar theories. Established paradigms shape research questions, methodologies, and interpretations, leading to resistance against radical new ideas that challenge the status quo.
2. **Institutional and Peer Pressure** – Academic careers, funding, and reputations are often tied to dominant theories. Researchers may resist paradigm shifts to avoid professional ostracism, loss of credibility, or denial of publication in prestigious journals that favor conventional views.
3. **Dogmatic Adherence to "Absolute Truths"** – Some scientists treat prevailing theories as unassailable doctrines rather than provisional models. This dogmatism can lead to dismissing anomalies or contradictory evidence outright, hindering the acceptance of revolutionary ideas (e.g., how quantum mechanics initially faced rejection from classical physicists).
4. **Sociopolitical and Ideological Factors** – Scientific communities can be influenced by broader cultural, religious, or ideological beliefs that align with the dominant paradigm. Challenging these can provoke backlash from groups invested in maintaining the existing worldview (e.g., resistance to Darwinian evolution on religious grounds).

These factors illustrate how scientific progress is not purely rational but also shaped by psychological, social, and institutional dynamics. Thomas Kuhn's *The Structure of Scientific Revolutions* (1962) famously explored this phenomenon, showing how paradigm shifts often require not just evidence but also generational change in the scientific community

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Declarations

Potential competing interests: No potential competing interests to declare.