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Peer Review

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

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In this review, I focus on Lambare's assertion regarding the applicability of special relativity to non-inertial frames. I will explain why I consider this assertion misleading and why, as a result, the subsequent arguments in Lambare's paper are invalid.

In **Section 4.1, "Relationship between noninertial frames, gravitation and special relativity,"** the author claims that "Noninertial frames can be wholly described with special relativity by 'implicitly' assuming that an accelerated frame is locally equivalent to a comoving inertial frame." To support this argument, Lambare cites Einstein (1905): "It is at once apparent that this result still holds good if the clock moves from A to B in a polygonal line, and also when the points A and B coincide." Lambare concludes that "partitioning a closed continuous path into a finite number of polygonal sections, and considering each section in inertial motion," is valid. Consequently, each infinitesimal line element of any spacetime (including spacetimes curved by gravity) should behave like the flat spacetime of special relativity.

In my view, both Einstein's equivalence principle (EEP) and Lambare's reasoning are misleading. The fundamental difficulty is that the concept of *local validity* of the physical laws of special relativity is inherently self-contradictory. No physical law can hold at a single spacetime point; it must apply over a finite spacetime interval. Once any physical process is considered over such an interval, its behavior in an inertial frame will inevitably differ from that in a non-inertial frame. These two processes cannot be made equivalent. The difference may be small, but its existence necessarily invalidates any claim of equivalence between inertial and non-inertial frames. Moreover, summing these differences over many intervals only amplifies the discrepancy.

An illustrative example, mentioned even by Lambare, clarifies this point. A curved line can be approximated by a finite number of straight-line segments, but the quantities calculated for the straight segments do not represent the true properties of the curved line. For instance, its curvature cannot be

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obtained in this way. Although such simplifications may appear attractive, they are fundamentally incorrect. Following Lambare's logic, one could argue that because no acceleration is felt in an inertial frame, acceleration should also be unobservable in non-inertial frames, since any motion can be approximated as a sequence of inertial segments. This would lead to the absurd conclusion that no force should ever be felt in a non-inertial frame because its motion could be fully described by a collection of inertial motions with zero acceleration.

Due to such logical inconsistencies, both special and general relativity produce numerous paradoxes (Vavryčuk and Křížek, 2024) and face fundamental difficulties when used to interpret physical measurements, including those of Sagnac-type experiments.

References:

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Declarations

Potential competing interests: No potential competing interests to declare.