Classical and Relativistic Derivation of the Sagnac Effect – answer to Sfarti's paper

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Editor's note. Following the publication of an article by A. Sfarti AFLB **42** p.379 (2017) presenting a critical analysis of W. Engelhardt's article on the Sagnac effect AFLB **40** p.149 (2015), we received the following answer which we gladly publish. We seize this opportunity to recall that liberty of expression and of discussion is essential in our eyes to the progress in science, as expressed by Louis de Broglie himself (see for instance his note "Nécessité de la liberté dans la recherche scientifique" AFLB **4** p.62 (1979)).

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The volume 42 of AFLB contains a "rebuttal" of my paper in Vol. 40 (2015) 149. The title "Rebuttal to W. Engelhardt Paper on the Relativistic Explanation of the Sagnac Experiment" is rather surprising, since Sfarti's article actually confirms Sec. 2 of my paper and arrives at the results (2.7) or (2.8) which are identical with my equations (5) or (8), respectively. The author stresses that this result is confirmed by experiment which I also emphasized by the sentence: "The linear dependence on the rotational velocity has been confirmed by many experiments..." It is obvious that Sfarti's own calculation deals also with the classical, not with the relativistic derivation of the Sagnac effect, as he does not use the Lorentz transformation (LT), but assumes $t' = t$ as

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"transformation" between the inertial system and the relatively moving rotating system. In other words, his calculations rest on the assumption of an absolute time in contrast to relativistic derivations which require a time transformation in accordance with the LT: $t' = \gamma(t - xv/c^2)$, see equations (7) or (8) in my paper.

Sec. 3 of my paper where I have carried through a truly relativistic derivation of the Sagnac effect is totally ignored by Sfarti. Thus, he misses the derivation of the relativistic velocity composition formula (10) that was already obtained and published by Malykin, e.g., and others (see my quotations [5-8]). It leads to the result (13) which Sfarti claims to be wrong, but he compares it with the classical, not with the pertaining relativistic treatment. A confusing, incomplete sentence: "A confusion between the inertial frame (where the velocity composition formulas are applied and where the phase detector is located) and the rotating frames attached to the fiber optic" cannot be held against my careful calculation in Sec. 3. Obviously, Sfarti has totally misunderstood the gist of my paper and nourishes even a wrong idea where the phase detector is located: Interference occurs at the beamsplitter which rotates with the interferometer and is not at rest in the inertial system.

(Lettre à l'éditeur reçue le 24 mars 2018)