Comment on "On the speed of light"

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Abstract

We make some comments on "a realistic experiment to determinate eventual anisotropies in the one-way speed of light independently of specific clock synchronization procedures. This establishes that we are not free to *define* either the one-way speed of light or time itself and must rely instead on further empirical observations to clarify these concepts, contrary to what was originally proposed in 1905" by Manuel Ricou [Physics Essays, 30, 4 (2017)].

In a paper published in this journal [1] Ricou claim that it is possible to "compare distinct explanations for the result of the Michelson- Morley experiment, including that of Einstein in Ref. 2" and intend to show that these alternatives do not result from "arbitrary choices" for clock synchronization procedures "since in reality, these "choices" do not exist" [1]. In a paper that Ricou referred [2] in a previous preprint of [1], [3], we stated about the same subject, the "arbitrary choices":

"The aim of this work is to accentuate the need for a general formulation of special relativity, by reconciling two apparently contradictory discourses. Hence, one should not speak about two philosophies, as they are different aspects of one and the same theory. In particular, one should not say that the results from special relativity can be derived either by following the ideas of Lorentz and Poincaré of the existence of a "preferred reference frame" or Einstein's "equivalence of all inertial frames," but rather use the word both. For instance, Lorentz's view is usually associated with the sentence "the speed of light in vacuum is c only in one reference frame," whereas Einstein's view with the seemingly contradictory sentence "the speed of light in vacuum is c in all inertial frames." These statements induce to think of a severe incongruity, that could be depicted schematically as in figure 1a). The conflict can be easily elucidated with the simultaneous use of different procedures for clock "synchronization," to which are associated different choices of the time coordinates used to describe physical events [13, 24]. A key concept is the notion of "Einstein-speed" previously introduced in [24] and reviewed in section 6. Within the proposed formulation of special relativity, the former sentences have to be rephrased to "the one-way speed of light in vacuum is c in one reference frame; the two-way speed of light in vacuum is c in all inertial frames" and "the one-way Einstein-speed of light in vacuum is c in all inertial frames," which could be represented as in figure 1b). One explicit case to exemplify this assertion can be found in section 5 from [24]. It shows that special relativity was developed under the shadow of a false dichotomy and that with a precise language all conflicts disappear at the onset".

Therefore the key concept of "Einstein speed" explain why the one-way Einstein speed of light is c without any experiment (since the value of the two-way speed in vacuum obtained experimentally is c [1-7]). And also why the one-way speed of light is not c also based on the same experiments [6]. And Ricou also does not refer this our

previous work [2] when he refer the "IST transformation" [1, 3] introduced also by us, introducing the key idea of intrinsic desynchronization. Therefore we explain how we can conceive using this previous theoretical work the physical meaning of the one-way speed of light, Einstein one-way speed of light, Einstein simultaneity and simultaneity [2, 6, 7]. Therefore we have a clear answer to the problem raised by Ricou about the independence of the "arbitrary choices" as he stated at V. p. 465 of [1]:

"However, it is equally obvious that these facts cannot be taken as "experimental verification" of the identity $\rho = 0$, since quite evidently, they are independent of the value of ρ. Clearly, if $\rho \neq 0$ then these observations are mere artifacts of our practical procedures rather than physical laws and the "velocities" mentioned should not be labeled as such, since they will not be faithful representations of reality" (Ricou is referring "velocities" in particular "Einstein´s velocities" when $\rho = 0$ introduced by us as previously referred [2, 3]). Therefore Ricou affirm that the "velocities" of Lorentz transformation should not be labelled as such and we partially agree since we labelled them as "Einstein´s velocities" as Ricou refer at [3].

About the "Two Clocks Experiment" that Ricou suggest, since we only have two counters at two locations we don´t have a common time between the "two clocks", therefore we can´t obtain any information about the one-way speed of light between the "two clocks". We only can verify, as expected, the equality of the number of "signals" emitted and received for the two locations. However as we recently show at [6, 7] we have a time gap with physical meaning that preserve the two-way speed of light. Several "synchronizations" are possible with several "one-way speeds" that have the harmonic mean that preserve the c value of the two-way speed of light. And since we can implement the Lorentz time [6, 7] we can test the gap with several others "one-way light speeds-like" (several values for ρ) signalling (several "synchronizations") and discover the value of the one-way way speed of light [6, 7] that correspond to the other extreme of the gap ($\rho = 1$). Of course with generality it is not c. This is what Special Relativity preview [2]. And Ricou is right, the speed of light is well conceived, it is not a convention [8]. It is the distance divided by the time of the journey [9]. Does not depend of the synchronization or not of the clocks at the departure and arrival as everybody know. We can´t continue to confuse time readings with clock rhythms [2] as standard interpretation does. Although Ricou recognize the desynchronization between frames he does not acknowledge the intrinsic desynchronization in a frame also necessary for the value c of Einstein speed of light, by definition as Einstein stated. And this conflict has been also pointed out by Iyer several years ago [10-12]. And has also been contemplated in our simple intuitive geometric analysis, *"... by taking into account the corrections in lengths and in rhythms (obtained through this example or otherwise), the expression has to be rectified to*

$$c_v^{\pm} = \gamma^2(c \mp v), \text{ with } \gamma = 1/\sqrt{1 - {v^2}/{c^2}}$$

One factor γ accounts for time dilation; the second one holds for space contraction. Note that many students actually believe that the two γ factors cancel each other out, which would justify the constant value of the one-way speed of light they use in relativity. This is not the case [13]". Therefore Ricou missed the crucial point of the constancy of the Einstein speed of light by definition and the subsequent non-constancy of the speed of light. With synchronized clocks at two locations we can measure the time of the trip. With Lorentz clocks we can´t. But we can measure the Einstein speed that we know for sure it is c for light. Special Relativity is undetermined [9]. Or not [6-37]!

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