Comment on the Paper "Non-kinematicity of the Dilation-of-time Relation of Einstein for Time-intervals" by S. Golden

G. Schäfer

Theoretisch-Physikalisches Institut der Universität Jena, D-07743 Jena

Reprint requests to Prof. G. S.; Fax: 49-3641-947102

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In a recent paper [1] S. Golden is trying an interpretation of Einstein's theory of special relativity solely based on the propagation of light-pulses which aims at circumventing the problems scientists sometimes do have with the "twin paradox", i.e. with the physical reality of the kinematical dilation-of-time. However it is well known that propagation of light does not cover the whole structure of relativistic spacetime because of the conformal invariance of the Maxwell equations. Thus the paper [1] is fundamentally incomplete in its applied physical tools.

In my comment it will be shown that the title of the paper is a misconception and that another aspect in the paper is false too. If S. Golden would have treated in the paper not only light-pulses but also decaying systems the shortcomings would not have occurred.

The sole tool of the author for relating inertial systems is the exchange of light-pulses (including reflections) between two inertial systems, called A-system and B-system, with time coordinates t and τ, respectively. The light-pulses are propagating either into the direction of the inertial-systems relative velocity or into the opposite direction. No doubt, the ratio $\Delta t/\Delta\tau$ of the time-intervals between fixed-position (origins of the systems) passage-times of the same two light-pulses in the A-system and in the B-system is given by, combine the Eqs. (6) and (12) in the paper in question,

$$\frac{\Delta t}{\Delta \tau}=\frac{\sqrt{1+v/c}}{\sqrt{1-v/c}}, \tag{1}$$

where the B-system is moving with the velocity v relative to the A-system, as measured in the A-system; the velocity of the light-pulses is pointing into the direction of v. This relation is the directly measurable longitudinal Doppler relation in terms of time-intervals instead of frequencies.

S. Golden is introducing the in the context of the exchange of light-pulses only (non-locally) calculable time-instants $t^*$and τ^* which are the equal-time reflection times as given in the each time other inertial system. For those times he obtains his Eq. (12), i.e.

$$\frac{\Delta t^*}{\Delta \tau}=\frac{1}{\sqrt{1-(v/c)^2}}. \tag{2}$$

It is correct that the time-interval Δt^* is solely achievable by calculations when exchanging light-pulses only, but it is not correct to oppose it to locally measurable time-intervals because it is truly the measurable (and measured! e.g., [2]) dilation-of-time relation of Einstein for time-intervals as measured by clocks. By use of light-pulses the time-differences ratio $\Delta t/\Delta\tau$ can be measured directly, by use of decaying particles or atoms at rest in the B-system the dilation-of-time ratio $\Delta t^*/\Delta\tau$ can be measured directly, where $\Delta\tau$ is the life-time in the B-system and Δt^* the one as measured in the A-system.

The title of the paper in question already reveals that the dilation-of-time relation of Einstein for time-intervals is understood in the paper as being of non-kinematicity type. This interpretation results from the following writing, see Eq. (13) in the paper in question,

$$\frac{\Delta t^*}{\Delta \tau}=\frac{1+L_2^*/L_1^*}{2\sqrt{L_2^*/L_1^*}}. \tag{3}$$

However, this equation is of kinematicity type too because it contains two different lengths at two different instants of time; quite apart from the fact that the ratio of lengths is directly related to the relative velocity, see Eq. (2) in Golden's paper.

The additional treatment of decaying systems in different inertial systems should have prevented the paper by S. Golden from the obvious shortcomings.

[1] S. Golden, Z. Naturforsch. **55a,** 563 (2000).
[2] D. S. Ayres et al., Phys. Rev. D **3,** 1051 (1971); J. Bailey et al., Nature London **268,** 301 (1977); M. Kaivola et al., Phys. Rev. Lett. **54,** 255 (1985); E. Riis et al., Phys. Rev. Lett. **60,** 81 (1988).

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