LETTERS TO PROGRESS IN PHYSICS

A Comment on "Can the One-way Speed of Light be Used for Detection of Violations of the Relativity Principle?"

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I show in this Letter that Spavieri et. al.'s clock transport delay calculations are incorrectly determined because of a sign error. Thus, the results of Roland De Witte (1991) should be considered significant.

1 Details

Assume for simplicity that what Spavieri et. al. [1] mean by $\mathbf{u}(t)$ is, a velocity of constant magnitude u, with a varying direction, yielding a total effective absolute velocity $\mathbf{V} \simeq \mathbf{v} + \mathbf{u}(t)$. Spavieri et. al.'s Equation (5) is reproduced here for convenience,

$$\delta\tau \simeq \frac{dt}{\gamma_V} - \frac{dt}{\gamma_v} \simeq \frac{(v^2 - V^2)\,dt}{2c^2} = -\frac{\mathbf{v}\cdot\mathbf{u}(t)\,dt}{c^2}\,. \tag{S5}$$

Notice that Equation (6),

$$\Delta\tau = -\frac{1}{c^2}\int_A^B \mathbf{v}\cdot\mathbf{u}(t)\,dt = -\frac{L}{c^2}\,v\,(\cos\theta_A - \cos\theta_B) \tag{S6}$$

is supposedly the integral of (5). Referring to Fig. 1 in [1] the projection of $\mathbf{u}(t)$ on $\mathbf{v}$ is $-u\cdot\cos(\pi/2-\theta) = -u\cdot\sin\theta$ and $|\,\mathbf{u}(t)\,| = L\omega = L\cdot\frac{d\theta}{dt}$ giving,

$$\Delta\tau = -\frac{1}{c^2}\int_A^B \mathbf{v}\cdot\mathbf{u}(t)\,dt = -\frac{L}{c^2}\,v\int_A^B -\sin\theta\cdot\frac{\mathrm{d}\theta}{\mathrm{dt}}\,dt = $$
$$= -\frac{L}{c^2}\,v\,(\cos\theta_B - \cos\theta_A). \tag{C1}$$

Thus, Spavieri et. al. does not correctly calculate $\Delta\tau$, a quantity which they call clock transport delay (CTD). A simple sign check on $\delta\tau$ in (S5) and $\Delta\tau$ in (S6) shows they aren't the same. $|\,\mathbf{V}\,| < |\,\mathbf{v}\,|$ thus (S5) is positive, whereas since $-[\cos 0 - \cos(0 - d\theta)]$ is negtive, (S6) is negative. Replacing (C1) with (S6), the signs now agree.

2 Comments

The De Witte effect is given by,

$$t_{OB} - t_{OA} = \frac{L}{c^2}\,v\,(\cos\theta_B - \cos\theta_A) \tag{C2}$$

and shows a decreasing effect as θ increases or decreases from its alignment with v (which we take as $\theta = 0$). Eqs. (C1) and (S5) show an increasing effect, whereas (S6), which is evidentally a harmonized version of (S5), shows a decreasing effect. So (S6), which supports Spavieri et. al.'s thesis, that the De Witte Effect is merely due to slow clock transport, is incorrect due to a sign error. The result is that if Spavieri et. al. is to be taken seriously the effect measured by De Witte will be due to twice what is derived in [1, 2, 4], which derivations do not ignore Fresnel drag. For instance Spavieri et. al's Equation (4) would be modified to,

$$\bar{t}_{OA} - \bar{t}_{OB} = \Delta\tau + \frac{L}{c^2}\,v\,(\cos\theta_A - \cos\theta_B) = $$
$$= \frac{2L}{c^2}\,v\,(\cos\theta_A - \cos\theta_B). \tag{C3}$$

It must be noted at this point that Spavieri et. al. cites [5] (ref. 16 at the end of §3 in [1]) in which they claim that CTD is equivalent to Einstein Synchronization (ES). Unfortunately, the derivation in [5] §2 is riddled with error. For example Eq. (2) should be $t = \frac{h}{w}$ instead of $t = \frac{h}{\Delta w}$ and Eq. (6) should be $t_1 = \frac{\gamma h}{c-v}$ instead of $t_1 = \frac{h}{c-v}$. Thus, CTD and ES agree in [5] up to second order only after a harmonization.

3 Comments on synchronization

The discussion in [1] on clock transport time delay would seem to be completely spurious. An Einstein clock synchronization (ES) performed from O to A will guarantee synchronization throughout rotation about O. Such a vacuum synchronization will give the same result no matter whether the clock is at A, B or any other point as long as the laboratory frame path length is the same. This is guaranteed by the constant propagation velocity of light in the ether and the Lorentz transformation (LT), as shown by Maxwell's luminiferous ether theory and confirmed by two-way speed of light measurements in vacuo. Thus, Einstein's 'On the Electrodynamics of Moving Bodies' is based on ether theoretical dogma, as any treatment needs to be in order to be predictive.

Consider the case where the lab frame is moving at velocity v wrt the ether and the dielectric rod in this frame is rotating at constant velocity u. By ES any clock at rest wrt O can be synchronized to O and all such clocks at distance L wrt O have the same synchronization. Any clock at velocity u and distance L wrt O has the same synchronization wrt O. Therefore, if A is synchronized with O it will remain synchronized.

According to [1] the CTD, due to time dilation as clock A moves slowly due to Earth's rotation, can be calculated from [1] using,

$$\frac{1}{\gamma_0} - \frac{1}{\gamma_0} = 0. \tag{C6}$$

since in the frame of the rotating clocks they have no relative velocity wrt each other. They do have relative velocity wrt each other in the ether frame but that leads to (C1) and (C3) instead of (S6). Since no measurements are made from the ether frame but are made from the frame of the atomic clocks we must refer synchronization to this frame, as LT teaches that the two synchronizations aren't the same. LT also guarantees that the time dilation effects of CTD are the same for the signal propagation time on De Witte's cable as they are for the measuring clocks, negating relative effect between the two.

Alternatively, since the CTD of A wrt to O equals, by symmetry the CTD of O wrt A, they must cancel. This is an example of The Clock Paradox and ensures that no dissynchronization will occur between O and A, as opposed to what is taught in [1].

One might also ask, How do we ascribe CTD as the cause of De Witte's effect in the vacuum case when there is no De Witte Effect in the vacuum? Too, in De Witte's Experiment [3] when the North-South signal and the South-North signal are subtracted any biases or dissynchronizations would cancel. Additionally, if De Witte's results could be ascribed to clock transport delay it would still obtain that a measurement of velocity wrt the ether had been made in contradiction to SR canon.

4 Closing comments

Using the sidereal rotation period of Earth,

$$\omega \simeq \frac{2\pi}{86164.1}\ \mathrm{s}^{-1} \simeq 7.3 \cdot 10^{-5}\ \mathrm{s}^{-1} \tag{C4}$$

and,

$$dt = \frac{L}{c} = 5 \cdot 10^{-6}\ \mathrm{s}; \quad u(t) = L\omega \simeq 0.11\ \mathrm{m/s} \tag{C5}$$

from (C2) and [3] the absolute motion velocity is,

$$v = \frac{\left(14 \cdot 10^{-9}\right)\left(9 \cdot 10^{16}\right)\left(\cos 0 - \cos \frac{\pi}{2}\right)}{1500} = 8.4 \cdot 10^{5}\ \mathrm{m/s}.$$

[As an aside, this absolute motion velocity of 840 km/s is larger than those stated in [3] for the De Witte Experiment, larger than Earth's velocity wrt the Cosmic Microwave Background and larger than most author's estimates. Also, since the declinations of De Witte's cable and the absolute motion vector of Earth wrt vacuum are estimated to be as much as about 25° apart we should expect a velocity from 840-930 km/s. Note that this result is stated with some reservation (see below).]

Some have expressed the belief [1, 4] that Fresnel drag may not be acting in certain cases where a refractive material is known to be present. Fresnel drag is a dogmatic phenomenon equivalent to the LT with excellent experimental confirmation. It shouldn't be possible to turn physics on or off like a light switch, it is always present with refractive materials but the effect is not always correctly anticipated formally. In fact according to detailed calculations by the author, De Witte cannot be explained by a predictive ether-based formalism (Michelson-Lorentz formalism) with a final transformation to the lab frame. Such calculations, be they for one-way, two-way, with or without refractive media, always return results which speak of no unusual effects. Thus the Roland De Witte Effect remains a mystery.

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