LETTERS TO PROGRESS IN PHYSICS

The Roland De Witte Experiment, R. T. Cahill, and the One-Way Speed of Light

Joseph Catania
E-mail: jcatania1@verizon.net

In "The Roland De Witte 1991 Experiment (to the Memory of Roland De Witte)" (*Progr. Phys*, 2006, v. 2(3), 60–65), R.T. Cahill gives us a briefing on his view that interferometer measurements and one-way RF coaxial cable propagation-time measurements amount to a detection of the anisotropy in the speed of light. However, while I obtain first order propagation delays in calculations for one-way transit which would show geometric modulation by Earth's rotation, I do not agree with Cahill's simplistic equation that relates the modulation solely to the projection of the absolute velocity vector **v** on the coaxial cable, called v_P by Cahill (ibid., p. 61–62). The reader should be warned that Cahill's equation for Δt (ibid., p. 63) is crude compared with a full Special Relativistic derivation.

1 Introduction

In *The Roland De Witte 1991 Experiment (to the Memory of Roland De Witte)* [1], R. T. Cahill gives us a briefing on his view that interferometer measurements and one-way RF coaxial cable propagation-time measurements amount to a detection of the anisotropy in the speed of light. This startling conclusion is difficult to swallow in the face of rigorous light speed in vacuo measurements which are reproducible and flaunt good experimental controls. For instance, in [2] Eisele et. al. were able to limit anisotropy in c to a fractional uncertainty of 10^{-17}. It would seem apparent that, to this precision, there is no first **or** second order anisotropy in the two-way speed of light.

2 The one-way speed of light

As regards the one-way speed of light, a point of confusion in regard to spurious claims of anisotropy might be exemplified by measurements with the Global Positioning Satellite (GPS) system, which can measure the rotational speed of the Earth, v, by the way it affects the propagation time of an electromagnetic signal used in the GPS system [3]. Thus, the *apparent* velocities $c + v$ and $c - v$ would be measured instead of c. But, certainly, GPS is not to be interpreted as capable of measuring c itself. As further clarification, let us say that, through some means I could set a train moving at 20 miles per hour along a railroad track in a due Easterly direction. At some point on the track to the East of the train I have stationed a measurement instrument which reads exactly 20 mph. If I now move this measuring instrument in an Easterly direction at 5 mph I should only measure the train speed as 15 mph. If I give the measuring instrument a Westerly motion of 5 mph, I should measure for the train 25 mph. Most of us have an intuitive familiarity with this situation. In no way should there be a temptation to assign the 15 or 25 mph speed to the train velocity which is obviously 20 mph. We should not confuse actual velocity with apparent velocity. Likewise, one-way propagation times of electromagnetic signals cannot be used to calculate c, which has already been assumed constant, but they would be useful in calculating the v in $c + v$ or $c - v$, if the distance of propagation were known.

Similarly, the Michelson-Morley interferometer measurements Cahill refers to in [1] were not developed to measure the speed of light, c, but to measure relative motion, v to a postulated luminiferous ether. That Cahill admits this measurement of v was successful [4] on the one hand would seem to defy his light speed anisotropy conclusion on the other. So, I find it difficult to reconcile propagation time calculations used in interferometer measurements which assume c, a well-known constant of nature, as the speed of light in vacuo, and the explicit solution for the variable v, the motion with respect to the ether, with light-speed anisotropy in any form.

3 First order effects

Nevertheless, as pointed out, there are fringe-shifts measured in many interferometers and there is De Witte's propagation time delay (which is correlated to sidereal time). It has been established in Michelson-Morley type interferometer measurements that there is a correlation of measurements of **v** with cosmic velocity (similar to the CMB dipole velocity) accompanied with amplitude modulations with respect to rotation and revolution of the Earth. This is expected on the basis of current theory which explains fringe-shifts in interferometers as due to dielectric in the light path (no fringe-shifts are expected in vacuum interferometers) [4]. However, while I obtain first order propagation delays in calculations for one-way transit which would show geometric modulation by Earth's rotation, I do not agree with Cahill's simplistic equation that relates the modulation solely to the projection of the absolute velocity vector **v** on the coaxial cable, called v_P by Cahill [1, p. 61–62]. The reader should be warned that

Cahill's equation for Δt [1, p. 63] is crude compared with a full Special Relativistic derivation. Also the period of the modulation based on a fixed absolute motion vector in the Miller direction would not be 12 sidereal hours but 24 as can be plainly seen from the geometry. Also apparent from the geometry is that Cahill's v_P would never go negative and indeed does not attain zero. In fairness Cahill states in (ibid., p. 63) that DeWitte's data is plotted with a false zero making the periodicity appear to be 12 hours sidereal. As well, there does not seem to be sufficient support of Cahill's use of $n = 1.5$ for De Witte's coaxial cable. It's more likely that $\epsilon = 1.5$.

4 Conclusion

In conclusion I can only say that although Cahill understands De Witte's result is first order and shows correlation to the Miller direction we must be cautious in ascribing this result to unconfirmed phenomena such as light speed anisotropy especially since SR would seem to be an apt predictor of the effect.

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References

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3. Gift S. J. G. One-way speed of light relative to a moving observer. *Applied Physics Research*, 2013, v. 5, no. 1.
4. Cahill R.T. and Kitto K. Michelson-Morley experiments revisited. *Apeiron*, 2003, v. 10(2), 104–117.