Somme Remarks About Starlight Aberration

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Abstract

Many physicists still do not accept the obvious conclusion that **(c + v)** and **(c - v)** are valid solutions when applied to moving observers. There are actually well known experimental proofs to validate those expressions. Besides the Sagnac effect, one experiment that has been hidden and given no publicity was a measurement of the orbital periods of the Jovian satellite (Io) performed by Ole C. Römer that shows just such a velocity composition as the Earth approaches the planet or recedes in its orbit. [1]
But, perhaps due to the pervading *lato sensu* interpretation of the second postulate of the Special Theory of Relativity in connection with the currently generalized opinion that any physical theory, to be valid, must conform to the TR, many physicists are reluctant to accept it. Whenever such a situation arises, they are eager to draw the Lorentz transformation from their pockets and apply it in some way to alleviate the discomfort.

Let's have a look at the stellar aberration phenomenon once again since, unbelievably as it may sound, it is still object of debate among astronomers and physicists.
First of all let us obey the KISS rule and keep it simple. Pick a star in the zenith and a laboratory on the Earth represented here by a closed box, moving with the Earth in a direction orthogonal to the direction of the incoming star light. Figs.(1) and (2) illustrate the situation. The hypothetic box has a small window facing directly to the star. When at rest, the star light will enter the window with speed **c** and shine straight on the back wall on a site directly opposing the window. Once the box starts to move with velocity **v** in a perpendicular direction to the direction of the incoming light, the star light will continue downward with velocity **c**, ignoring the box's translation but when hitting the back wall, the box isn't in the same position anymore and the light ray will land farther aft in relation to the box's moving direction.
There is no conflict about light speed limit. Light continues to travel at speed **c**, in a rectilinear direction, straight down across the moving system but, due to the systems proper movement, the incoming light simply lands farther behind the previous landing site, and Eddington's model of rain drops, if you like it or not, is still the only applicable model.

For an observer inside the moving system, light would be seen to move at an **apparent** $v' = \sqrt{c^2 + v^2}$. And there is nothing odd or magic about it since light has been moving all the time at speed **c**. The Sagnac effect is closely related in that it also implies a velocity composition without violating the constancy of the speed of light in the propagating medium.

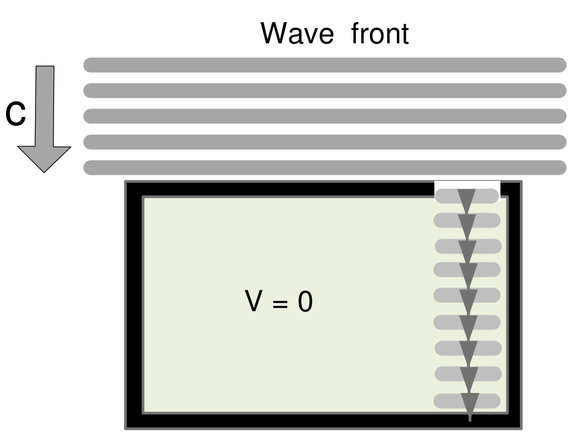


Fig. 1

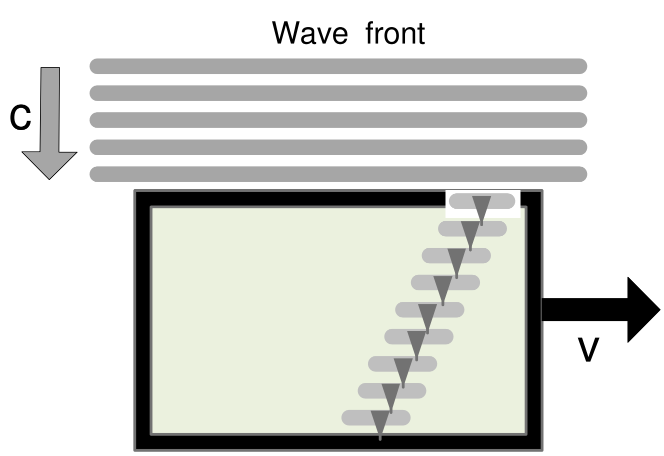
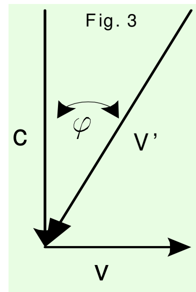
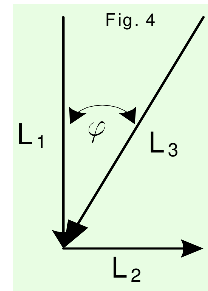


Fig. 2

Light is going straight down at speed **c**, so it must hit the back wall at the same time **t** in the moving box as in the motionless box. Unless we atribute some magic properties to light, all three times in the triangle fig.(4) must be equal





$$\frac{L_1}{c} = \frac{L_3}{V'} = \frac{L_2}{V} = t$$

So $L_1 = c \cdot t$

$$L_2 = v \cdot t$$

$$L_3 = t \cdot \sqrt{c^2 + v^2}$$

Referring to the vertical, the aberration angle φ must be

$$\varphi = \operatorname{atan}\left(\frac{v}{c}\right) = \operatorname{asin}\left(\frac{v}{\sqrt{c^2 + v^2}}\right) = \left(\operatorname{atan}\left(\frac{L_2}{L_1}\right) = \operatorname{asin}\left(\frac{L_2}{L_3}\right)\right)$$

For an Earth orbital speed of $v = 2.978 \cdot 10^4 \cdot \frac{m}{s}$ $\varphi = 20.489394 \cdot asec$

In the limit, for **v** approaching **c**

$$\lim_{v \to c} \operatorname{atan}\left(\frac{v}{c}\right) = 45 \cdot deg$$ <= correct result

If, otherwise, we chose side L_3 in the Pythagorean triangle of Fig (4) to have dimension c.t, light must be misteriously slowed down on leg L**1** and the result is an aberration angle equal to $\operatorname{atan}\left(\frac{v}{\sqrt{c^2 - v^2}}\right)$ which for small v is similar to the previous result but diverges with increasing v and in the limit when v approaches c:

$$\lim_{v \to c} \operatorname{atan}\left(\frac{v}{\sqrt{c^2 - v^2}}\right) = 90 \cdot deg$$ <= which is obviously inconsistent

SRT comes to no rescue and it doesn't also help to take hold of the Lorentz transformation to invoke time dilation in the moving system since the same local time has to be applied in measuring **v** and **c**.

[1] Démonstration touchant le mouvement de la lumière trouvé par O.C. Roemer de l'Académie des Sciences, published 7 December 1676 in the Journal des Savants.