Velocity of Light in a Moving Medium According to the Absolute Space-Time Theory

STEFAN MARINOV

ul. Elin Pelin 22, Sofia 21, Bulgaria

Received: 26 March 1973

Abstract

Proceeding from our absolute space-time conceptions and applying the 'hitch-hiker' model (so-called by us) for the propagation of light in a medium, we obtain the general formula for the light velocity in a moving medium including terms of second order in $v/c$. This formula is identified with that one obtained by proceeding from the Lorentz transformation.

What is light? What is the mechanism of propagation of light?—Despite the high level to which science has been developed in the last century, there has not been a firm and clear answer to these questions.

Now two substantially different models of light are common in physics and, although excluding each other, many phenomena are explained by the one model, many by the other and many by both. These models are:

(1) The corpuscular (Newton's) model.
(2) The wave (Huyghens') model.

In our absolute space-time theory we use only the corpuscular model. We introduce the notion of the 'period' of a photon (i.e., of any light corpuscle) as follows: The period $T$ is the time for which a given photon is emitted or absorbed, or the time for which we can assert with certainty that a photon propagating with velocity $c$ in vacuum (with respect to the reference frame used) and crossing a given surface has indeed crossed this surface. The quality $v$ inverse to the period is called the frequency.

Since there is a certain time $T$ during which the photon is emitted, we can imagine it as an 'arrow' or as a 'machine-gun burst' with length $\lambda = cT$, called the wavelength. Now the following question arises: When the source moves with a certain velocity $v$ in the reference frame used, would the 'arrow' (or the single bullets of the 'burst') move with a velocity different
from $c$? According to the answer given to this question there are possibly two different models:

(a) The 'arrow' (Ritz') model, according to which the photon moves with a velocity representing the vector sum of $v$ and $c$, while the wavelength remains constant.

(b) The 'burst' (Marinov's) model, according to which the photon moves always with velocity $c$ and only the wavelength (i.e., the distances between the single bullets of the 'burst') change.

For the mechanism of propagation of light in a medium we use the 'hitch-hiker' model (so-called by us). According to this model the photon is a hitch-hiker walking with velocity $c$ and the molecules (the atoms) of the medium are cars driving with velocity $v$ ($c > v$). Since the walker would be tired if he walked all the time (then his velocity will be the highest!), he takes any $m$th car on the road (we suppose that the distance between the cars are the same) and rests there a definite time (if he drove all the time his velocity will be the lowest!). If $v \ll c$, then the mean velocity of the hitch-hiker will be $c_m = c/n$, where $1/n$ is that part of the time during which, on average, the hitch-hiker walks and $1 - (1/n)$ is that part of the time which the hitch-hiker spends in the cars.

Now using this model for the propagation of the photons in a medium, we shall calculate their velocity when the medium moves with respect to the observer. The factor $n$ is called the refractive index of the medium; $c$ is the velocity of light in vacuum and $c_m = c/n$ is the velocity of light in the medium when it is at rest with respect to the observer. In the same manner as the hitch-hiker takes a rest in any $m$th car, so the photon is 'absorbed' by any $m$th molecule which it meets on its way and there is a definite time after which the photon is again 're-emitted'.

Let us suppose first that the medium rests in the frame of reference used and that the light propagating with velocity $c/n$ makes an angle $\theta'$ with the $x$-axis (Fig. 1). As supposed previously, any photon, on average, moves $1/n$th part of the time and $[1 - (1/n)]$th part of the time rests absorbed by the molecules.

Let us then suppose that the medium moves with velocity $v$ along the $x$-axis only during this time when the photon is absorbed by some molecule and let us suppose that during the time between the re-emission and next absorption the medium is at rest. If we consider the path of the photon between two successive absorptions, then this path could be presented by the broken line $ABC$ in Fig. 1. Supposing that the time between two successive absorptions is chosen for a unit of time, i.e., that

$$\frac{AB}{v} + \frac{BC}{c} = 1$$

we shall have

$$AB = \left(1 - \frac{1}{n}\right)v, \quad BC = c/n$$