

Constancy of the Velocity of Light in Vacuum

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Abstract: Recently a series of papers¹⁻¹⁵ have been published tending to discredit Einstein's principle on the constancy of the velocity of light in vacuum and to renew theories on the propagation of light abandoned long ago. Subsequently we rediscuss some of the arguments and inconsistencies presented in Refs. 1-15.

According to the three main theories about the velocity of light^{1,2}, we divide our discussion into three parts, attaching our statements to the corresponding section.

1. Corpuscular Theory

In Refs. 1 and 3 there is made the attempt to support the corpuscular theory by radar echo observations of the planet Venus. Our criticism is as follows:

(i) Equ. (1) from Ref. 1 is based exclusively on Newtonian concepts and cannot be used to determine the path of a photon in the gravitational Schwarzschild field of the Sun,^{16,17}

(ii) There are used but observations from the pioneer years of interplanetary radar echo technique, until 1966.

(iii) Later observations^{18,19}, showing an excellent agreement with General Relativity (and implicitly also with Special Relativity) are not mentioned.

A 500 m difference of Moon laser ranging data^{2,8,9}, which could favour a corpuscular theory may be evidenced very well by actual techniques²⁰. We have no information that such a difference has ever been observed.

The fact that photometric observations of eclipsing binaries indicate often circular orbits, whereas spectroscopic observations suggest highly eccentric orbits, does not favour the corpuscular theory, in opposite to the affirmation made by Wallace²: Investigating carefully the binary systems W Del and SW Cyg^{21,22}, Walter has shown that jet streams^{R)} of gases suggested by the spectroscopic observations, can well account for the observed differences in eccentricity.

Besides, there is put forward the idea that the Universe is nonexpanding and that the extragalactic redshift is due to an energy loss of photons². Indeed, the hypothesis of a nonexpanding Universe is compatible with observational data²³⁻²⁵ and has a theoretical foundation in de Broglie's double solution theory²⁶. But we are not able to realize that a nonexpanding Universe favours the corpuscular theory of light². Apparently, the one has no connection with the other.

Likewise we cannot consider physically plausible the efforts made to combine the corpuscular theory with a dynamic ether hypothesis as well as the ideas developed in microparticle structure².

It does not seem us correct to treat the evolution of galaxies, quasars, ordinary and variable stars, novae, pulsars etc. on several

pages. Refs. 27-31 give some idea on the immense complexity and uncertainty of the problems evoked in Ref. 2. Some statements contradicting current astrophysical views may be noted:

(i) It is by no means sure that galaxies evolve from the irregular type to elliptical galaxies, which end their lives as quasars^{27,28,30}

(ii) At present there are reasons to believe that pulsars are magnetic neutron stars³¹, and not as is claimed in ref. 2: "Neutron stars would not be expected to exist and pulsars are probably white dwarfs"...

(iii) Supernovae are not the normal way in which stars end their lives and white dwarfs must not become supernovae.²⁷

(iv) Population II stars have a low content of heavy elements in comparison with population I stars and are believed to be much older than population I stars²⁹, and not inverse as stated by Wallace².

2. Ether theory

Introductory it must be noted that ether has never been put experimentally in evidence, nor does exist any physical reason to introduce this artificial concept.

We cannot realize why the frame defined by the cosmic⁰ background radiation should be an "absolute" reference system³⁸, favouring a dynamic ether hypothesis.

The argument presented in favour of a dynamic ether hypothesis, namely that no close binary pairs of β Lyrae type stars have been detected beyond the limits of our Galaxy⁹, is not correct because in 1956 Kussel reported the discovery of β Lyrae type binaries in the

Magellanic Clouds³² and since 1962 there have been discovered such binaries in the Andromeda Nebula³³⁻³⁵.

We are not able to make any comments on the multitude of speculative ad hoc hypotheses of Wallace^{4,5}, which are often in contradiction with present day physical concepts.

3. Special Relativity

Even in the abstract of Eisner's³⁶ paper it is emphasized that binary stars would look widely separated and rapidly rotating if and only if the aberration of light were misinterpreted as depending on the relative velocity between source and observer and not as it would be correct on the variation of the relative velocity. Consequently, Dart's argument against relativity theory⁹ is not correct.

Dart and Kantor¹⁰ image Gedankenexperiments with two reference systems communicating by light signals, in order to prove that the speed of light depends on the velocity between source and observer. A general criticism of this kind of Gedankenexperiments may be pointed out here: A Gedankenexperiment can provide generally only a working hypothesis, which must still be proved by laboratory experiments, because the final statements of the Gedankenexperiment are determined in principle a priori by the physical conceptions of its author. Moreover, before reaching the final conclusion that Einstein's postulate is contradicted, Dart makes the erroneous affirmation that "the relative speed of the signals is about 10% greater than before". But according to Special Relativity the speed of light signals is constant.

We are not able to see a "subtle theoretical error" by neglecting in Kantor's Eqn. (4a)¹² the small second order quantity with

respect to the first order term, whereas his Equ. (3a) is essentially of second order. Similarly we cannot understand how the mixing together of such fundamentally different phenomena as the Doppler shift and the Compton effect could serve as an argument against relativity theory¹¹

Even by overestimating some of the inherent errors and difficulties of physical experiments, Kaator brings no decisive arguments against Relativity¹²⁻¹⁵. Referring to his statements that mass variation experiments¹⁰ as well as the relativistic Doppler effect¹² could be interpreted without using relativistic concepts, we would like to mention that even General Relativity effects can be derived only by Newtonian formalism³⁷ but physical foundation^y is of much greater importance than mathematical formalism. Summarizing, we do not believe that any constructive criticism of physical experiments is possible without a very detailed knowledge of the employed laboratory methods¹²⁻¹⁵

In principle our discussion has been directed only against (i) the erroneous statement that the velocity of electromagnetic radiation depends on the relative velocity between source and observer and (ii) against the artificial and physically incompatible concept of ether.

We are not so orthodox to believe that the velocity of light must be necessarily constant during cosmological time scales or in the vicinity of gravitating masses³⁸, or that it could not be exceeded³⁹. But such speculations have a high degree of hypothetical arbitrariness.

Our main conclusion is therefore that the concept of a constant velocity of light with respect to arbitrary moving reference frames offers actually the only and the best description of physical reality.

Acknowledgments: We regret the delay of our comments caused by bibliographical difficulties. We express our gratitude to Professor M. Drăgan for many helpful discussions. One of us (Gp.H.) acknowledges the encouragement of Dr. Todoran especially and of Dr. Ureche from the Astronomical Observatory and H.R. the interest of Prof. Tintea.

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Received October 6, 1972

Accepted November 7, 1972