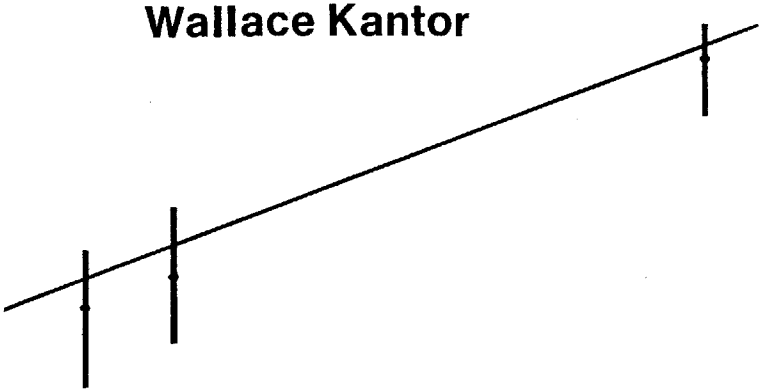
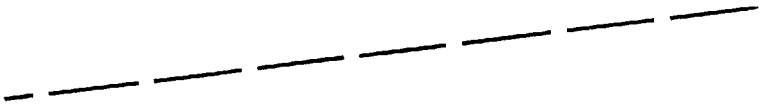
Wallace Kantor



RELATIVISTIC PROPAGATION OF LIGHT



Coronado Press 1976

SBN 87291-084-9

Set in 10 on 12 point Press Roman
and published in the United States
of America by Coronado Press
Box 3232
Lawrence, Kansas, 66044

Chapter 7

EXPERIMENTS ON THE ALTERATION OF THE RELATIVE SPEED OF LIGHT

Experiments alleged to confirm the Einstein second postulate on the absolute speed of decay gamma rays from high speed particles are shown to be inconclusive. The "proof" of the absolute speed of light in these experiments is based on a computation of an expected "extinction" length of a possible relative speed of light. There is no experimental evidence to support such a computation derived from an inappropriate hypothetical extinction formula suggested by J. G. Fox based on the Ewald-Oseen theorem of Maxwell-Lorentz electrodynamics, in which the speed of light is inherently absolute. The critiques of other past experiments as inconclusive for the discrimination of an absolute or a relative speed of light have clear *qualitative* merit; the hypothetical *quantitative* objections raised by Fox lack experimental confirmation or denial.

INTRODUCTION

In 1962 Fox[1] published a critique of the de Sitter argument on Einstein's second postulate of the absolute speed of light from a moving source. His critique was based on the so-called extinction theorem of Ewald and Oseen, from which it was inferred by Fox that a possible relative speed of light $c \pm v$ may have been altered to c as a consequence of its propagation through various intervening media.

Historically the idea seems to have been first suggested by Tolman[2] as a footnote in 1912 in a paper dealing with emission theories:

> Optical theories in which the velocity of light is assumed to change during the path are not considered in this article. It might be very difficult to test such theories in which the velocity of light is assumed to change on passing through narrow slits or near large masses in motion, or to suffer permanent change in velocity on passing through a lense.

This footnote was in a way Tolman's critique of his own experiment[3] in 1910 with a Lloyd mirror on the speed of light from the limbs of the sun. In this experiment, discussed in Chapter 4, light from the edge of the rotating sun received at the orbiting and rotating earth (large masses in motion) passed through a lens which focused the limb of the sun on a

narrow slit beyond which was a Lloyd's mirror. Tolman's footnote clearly shows that he recognized that his null result experiment–claimed to support the absolute speed of light–may have been invalid.

On the basis of Maxwell-Lorentz electromagnetic theory, Ewald[5] deduced in 1912 an extinction effect for the propagation of x rays in crystalline media; Oseen[6] considered the effect for the propagation in isotropic media in 1915. It is inherent in Maxwell-Lorentz electrodynamics, originally based on the ether concept, that the speed of light is absolute. The quantitative application of the Ewald-Oseen "extinction" theorem to situations in which the speed of light from a moving source is assumed to be relative and *not* absolute may not be valid as Fox noted. "Then one cannot prove the extinction theorem in the usual rigorous way because he has no theory to start from."[1] In a later paper, Fox[7] (p. 4) gave a different opinion. He addresses as erroneous an assertion by Pauli that light of relative speed $c \pm v$ could not interfere with light scattered by the dipoles of a medium in which the interstitial speed of the light was c. "The relevant property for the interference of two waves is not the equality of their velocities but of their frequencies." Fox[7] contends that the Ritz electrodynamics will lead to interference with "curious cosine periodicities" that "would be expected to wash out through superposition" and "thus, the process of Ewald and Oseen operates also on this emission theory."[7] Fox implies that there really is a "theory to start from" and that the quantitative Ewald-Oseen extinction theorem based on the absolute speed of light inherent in the Maxwell-Lorentz theory also operates in the Ritz theory based, as it is, on the relative speed of light. The *qualitative* merit of the concept of the alteration of the relative speed of light is quite clear; its *quantitative* manifestation as the Ewald-Oseen theorem is an obviously contradictory and confusing hypothesis.

Cullwick[8] (p. 57) suggested the *qualitative* modification of the relative speed of light by a medium in 1959 three years before Fox.

> Relativists consequently claim that the experiments, together with de Sitter's argument, prove the truth of the [absolutivity] principle. They seem to overlook the fact, however, that the experiments were not performed in vacuum, let alone a perfect one. Suppose that light is propagated not by aether transmission but by the travel of photons: then surely a reliable test of the principle [perhaps] requires a completely free path, devoid of matter, between source and receiver. This condition is not fulfilled even in the travel of light from a star to the earth, so it is evident [but not conclusively so] that the principle of constant light velocity *in vacuo* is *proved* neither by these experiments nor by observations of double stars.

Cullwick was an opponent of the Einstein theory, which probably accounts for his suggestions being ignored; whereas the same ideas presented later by Fox, a proponent, were regarded as deserving of serious consideration.

DE SITTER ARGUMENT

There has been a persistent history of a disposition to accept uncritically well-intended but erroneous logical rationalizations as "proof" of the Einstein postulate on the absolute speed of light. These arguments, such as that of de Sitter and also the extinction hypothesis, usually take the form of the introduction of another seemingly plausible hypothesis which is either not subject to experimental observation or has not been or cannot presently be experimentally observed. The diversionary hypothesis is then regarded as if it or its consequences were confirmed, in order to sustain the absolute speed of light hypothesis.

The de Sitter argument, which for a long time enjoyed acceptance as convincing, is an example of such untestable assumption. Fox[1] correctly objected to the de Sitter argument on the basis of a possible phenomenological alteration of the relative speed of light due to its propagation through light-years of intervening interstellar media of varying and quantitatively unknown density. In addition, the light emitted from a moving binary component had to pass through the relatively dense atmosphere surrounding the binary system which, at least in its outer portions, may not have partaken of the periodic motion of the binary components about their center of rotation. Thus, the relative speed of the light emitted from a stellar component may have been, for the little we know, altered to a speed c or to some other value that was not indicative of the motion of the binary star.

The hypothetical *quantitative* extinction arguments presented by Fox will be considered after the de Sitter argument is examined from the point of view of what could be reasonably inferred if there were no intervening media. The de Sitter argument (sometimes even referred to as an experiment) predicts the appearance of stellar ghosts and the distortion of the orbits of the double stars. The argument is utterly misleading in that it tacitly supposes an unambiguous knowledge of the stellar motions. The only *direct* knowledge of the stellar motion is provided by the light received from the stars. It is therefore circularly unproductive to infer the speed of propagation of the light emitted from the moving stars on the basis of the motion of the stars, since the only *direct*

knowledge of the stellar motion is provided by the very same light whose speed of propagation will have its effect in the observed motion of the stars. Thus the appearance of ghosts and distorted orbits could not be recognized as such, unless the speed of propagation of the light were known independently beforehand.

If the stellar motion were known independently of the received light, the "distorting" effect of the speed of the light could be recognized. Such knowledge is not available. The exact indirect inference of binary stellar motion from celestial mechanics is also circular, since all celestial motions are only known exactly by the light or other radiation received from the celestial bodies. Gravitation theories of motion must always conform to observation, and not vice versa. It is from the light messenger of the motion of celestial bodies that the system of celestial mechanics is erected. The independent determination that the speed of light was relative could clearly modify current celestial mechanics, at least for sufficiently high speed bodies. The actual presence of interstellar media and strong gravitational gradients would complicate matters. Thus the de Sitter argument is both wrong and inconclusive. Related arguments based on light or other radiative signals received from pulsating stars are also similarly circular unproductive speculations.

EXTINCTION

Fox[7] presented some very challengeable arguments on the "extinction" effect in a *quantitative* form as a basis from which he freely criticized many other experiments as inconclusive. He concluded (p. 16) that the Ritz form of emission theory was disproved by certain limited evidence.

> The constancy of the velocity of light transmitted through moving glass and of the decay γ rays from moving π^0 mesons and the measured time dilation of the lifetimes of π and especially μ mesons disprove the form of emission theory discussed here . . . . Unless something has been overlooked these seem to be the only pieces of experimental evidence that we have.

Fox's admission of the paucity of experimental evidence stands in enlightened contrast to his earlier assertion[1] (p. 299) of a "small gap in the experimental foundations of special relativity. . . ." Study of the subject leads to conclusions quite at odds with the consensus; the evidence is even less than Fox allows. The experiments on moving glass sources by Babcock and Bergman,[9] to which Fox refers, have been examined in Chapter 4. It was shown that the null results obtained in