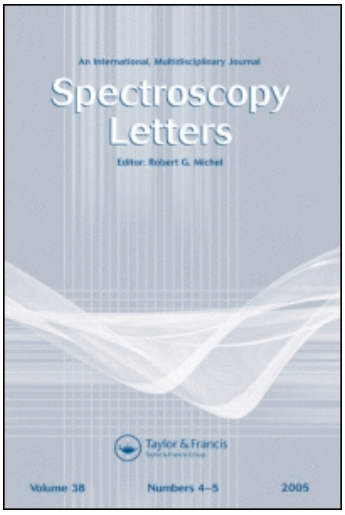

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THE EVIDENCE FOR AND AGAINST VARIOUS THEORIES OF LIGHT

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ABSTRACT

The ether-wave theory of light, suitably modified, is fully supported by all known evidence. Further observation and analysis will be required to determine which of its several forms accurately represents reality. On the other hand, the tactile theory, the Newtonian corpuscular theory, the Ritz extinction theory, and the Special Theory of Relativity are not supported by the evidence.

TESTS FOR LIGHT THEORIES

A theory, to be valid, must not be contradicted by observational evidence. If there is even one piece of evidence against it, the theory is not valid. In the case of theories concerning the nature of light, a multitude of observational tests must be met in order to validate any given theory. Reflection, refraction, diffraction, interference and every other optical phenomenon must be explainable by it and consistent with it. These are so numerous, however, that it would not be practical in a short paper such as this to discuss all phenomena with respect to all theories. It will suffice to show that all theories, except the ether-wave theory, are contradicted by at least one piece of observational evidence. When this has been done, the burden of proof will have been shifted to

those who might deny the validity of the ether-wave theory, suitably modified, of course, so as to conform with the Michelson-Morley experiment and other null experiments.

THE "TACTILE" THEORY

This theory postulates that the eye sends out invisible antennae or sensitive probes and is thus able to feel objects too distant to be touched. The theory cannot explain without intolerable complications why things cannot be seen in the dark unless heated or illuminated by a source independent of the eye. It has been generally abandoned since 1000 A.D. See Ditchburn.[1]

NEWTONIAN CORPUSCULAR THEORY

This theory, sometimes referred to as the ballistic theory, assumes that light is governed by Newtonian laws of motion, being propagated at constant velocity, c, with respect to a moving source, but at c + v with respect to an observer toward whom the source is moving with velocity, v.

The best evidence of the invalidity of corpuscular theory is the fact that we are able to detect sharp spectral lines in short period binary stars hundreds of light years away. This would be impossible if the speed of light from the approach phase of the star were different from its speed in the recessional phase. See deSitter.[2]

Furthermore, the standard corpuscular theory is in conflict with the moon laser measurements. See Dart[3] and Faller and Wampler.[4]

Finally, standard corpuscular theory is unable to explain reflection and refraction satisfactorily. See Ditchburn.[5]

RITZ EXTINCTION THEORY

This is an attempt to save the corpuscular theory by postulating that light starts out as a particle, travelling at c + v, and that it

subsequently collides with an electron which emits a wave travelling at c. All of the difficulties of corpuscular theory disappear under this theory, according to Fox, including deSitter's objection concerning the binary stars, since the particle becomes a wave shortly after emission. See Fox.[6]

But Fox did not mention at least one difficulty of corpuscular theory that does not disappear, namely, the effect on the measured position of the telescope in the moon laser experiment. Since Ritz theory calls for the laser pulse to approach the moon at c + v, but to be absorbed and reemitted at c by the reflector on the moon, the displacement of the position of the telescope at Lat 30° N will be only half that of standard corpuscular theory, or 250 meters instead of 500 meters. But no such displacement from the known position of the telescope has been detected. See references (3) and (4).

Fox could not have foreseen this difficulty since his paper was published before the moon laser measurements began. But he did overlook one difficulty presented by the Ritz Extinction Theory which is not present in standard corpuscular theory, namely, the Ritz theory is not consistent with the manner in which a radiometer operates.

This requires an explanation. A radiometer is a sort of optical water wheel consisting of a set of vanes which are black on one side and white on the other, and which are mounted on a needle inside of an evacuated transparent glass tube so that they can rotate easily. When light strikes the vanes, the black side moves away from the light, while the white side moves toward the light, indicating absorption by the black and reflection by the white. But under Ritz theory, the light should also be absorbed by the white

side, thus neutralizing the absorption on the black side. When reemission takes place from the white side, there is no force operating which might direct the white side toward the source. On the contrary, the white side, if anything, should move away from the source. But such is not the case.

Additionally, as Ockert has pointed out, the Ritz theory is not consistent with Fizeau's experiment, i.e., the measured speed of light passing through a tube of moving water. See Ockert.[7]

The perspicacious Ritz theorist will argue that none of the foregoing objections are valid. In the laser, the radiometer, and the tube of water, he will say, the particles are extinguished as soon as they touch any part of the apparatus. Thereafter we are dealing exclusively with waves, and the observed results are those predicted by wave theory.

But this makes us wonder what might be the purpose of postulating particles to begin with, and why the adherents of the theory continue to promote it with the zeal and persistence of a group of life insurance salesmen. Since Ritz theory attempts to avoid the difficulties of corpuscular theory by proposing that light particles are rather quickly converted into waves, it would appear even more desirable to propose that light starts out as a wave in the first place.

Perhaps what motivated Ritz, and what motivates his followers, is the fact that the Michelson-Morley experiment is readily explanable in terms of standard Newtonian theory without any necessity for shrinking rods and the slowing down of clocks. It is only when we consider other aspects of Newtonian theory that we must abandon it. The Ritz theory is an attempt to preserve the

advantages of both particle theory and wave theory. It fails to do so, however, because if, at the first mirror in the Michelson-Morley apparatus, the particle becomes a wave, then we still require shrinking rods and slowing of clocks to explain the null result of the experiment. Thus the only possible advantage in preserving the corpuscular idea is immediately lost by adoption of the extinction theory.

But even if the theory had been able to accomplish its supposed aim, the aim itself would have proved illusory. The Michelson-Morley experiment can be perfectly explained in an infinite number of ways if moving rods shrink in the right way and/or moving clocks slow down by the right amount and/or the speed of light is less than c by the right amount when emitted transversely to the path of a moving source. See Ives[8] and Dart[9,10].

THE SPECIAL THEORY OF RELATIVITY

The change of dimensions mentioned above was seen by the Dutch physicist, H.A. Lorentz, as the solution to the Michelson-Morley result as early as 1892. But Lorentz made it clear that he believed in a fixed ether through which the earth is moving. In a short paper published in 1895, he said:

> "Thus one would have to imagine that the motion of a solid body...through the resting ether exerts upon the dimensions of that body an influence which varies according to the orientation of the body with respect to the direction of motion." See Lorentz[11].

Albert Einstein, on the other hand, abandoned the idea of an ether. He employed identically the same concept of shrinking rods and slowing of clocks in the "moving system", but he went further to say that as between two systems moving relative to each other,

it matters not which we consider to be the moving one. It is only relative motion that counts. He postulated additionally that the speed of light is measured as a constant by all observers, whether moving or not. See Einstein[12].

Unfortunately for the theory, Einstein's postulates are contradictory and lead to absurdities, only two of which will be mentioned.

The first absurdity is that if the speed of light were constant, an observer moving toward a stationary source would not be able to detect the first order Doppler Effect. Assume the source is sending out signals at spatial intervals of 300 meters and at time intervals of 1 microsecond. If the observer is stationary relative to the source, the signals will be received separated by the same intervals. Now let the observer move toward the source at 1/10th c. We know from observation that we will now be receiving signals at shorter time intervals, i.e., approximately 0.9 microsecond between signals. But the signals are still 300 meters apart, and it now requires 10% less time for successive signals to pass a given point on the moving platform. This means that the relative speed of the signals is about 10% greater than before. In short, the first order Doppler Effect is, of itself, a measure of the speed of light relative to the observer, thus contradicting a basic postulate of Einstein. The small second order effects due to shrinking rods and the slowing of clocks simply cannot account for the large first order Doppler Effect without this basic contradiction.

The second absurdity of relativity is concerned with the observation of light from binary stars. Under Einstein's view all binary pairs having orbital speeds of 30 kilometers per second must

appear separated by 41 seconds of arc. Pairs with higher speeds must appear to be separated by even greater angles. Nevertheless, although such binaries are very common, none has ever been found to be separated by such an angle. Most high speed, short period binaries cannot be resolved into the individual stars even with a powerful telescope. Thus, since a basic prediction of special relativity is in conflict with observation, we may consider the theory to be proved wrong. See Eisner[13].

THE MODIFIED ETHER THEORIES

As stated above, Lorentz saw that alteration of physical dimensions by motion through the ether could be a solution to the Michelson-Morley experiment. Initially he saw only that change in the physical dimensions were required. The same idea had independently occurred to Fitzgerald. Lorentz did not envision shrinkage of dimensions necessarily. On the contrary, he saw only that if there were any alteration in the lengths, it mattered not if they were enlarged or shortened, provided only that the proper ratio between the longitudinal arm and the cross arm were maintained. Later, in his 1904 paper, he introduced the idea of time dilation as a supplement to the idea of dimensional changes. See Lorentz[14].

Much later, in the year 1937, Herbert E. Ives published a series of papers in which he elaborated the Lorentz idea that there are an infinite number of solutions to the Michelson-Morley experiment in theory, the theoretical solutions depending only upon the proper ratio between time and dimensional changes. See Ives[8]. The actual solution, as distinguished from theoretical solutions, must be determined by experiment. The famous experiment of Ives and Stilwell established that clocks in moving systems do in fact slow down by the

predicted second order effect. See Ives and Stilwell[15].

But nobody to date has produced any evidence to show that rods contract along the axis of motion, as predicted by Lorentz. Nor did anyone seriously suggest until 1969 that the speed of light might be direction dependent, and that a small second order reduction in the speed of light when emitted transversely to the path of source might explain the Michelson-Morley and other experiments when coupled with time dilation. In such event, the Lorentz contraction may be dispensed with entirely.

In 1969 the author of this paper did seriously propose such a solution, referring to it as the "ellipsoid theory". See Dart[9]. In 1970 the theory was supplemented by postulating a second order shrinkage of orbital radii. Without such shrinkage, the theory would have been quantitatively incompatible with time dilation as measured by Ives and Stilwell. See Dart[10].

There are two good reasons for introducing this alternative theory. First, in the absence of experimental or observational proof of the Lorentz contraction, it is generally helpful to explore all possible alternatives, notwithstanding such alternatives are equally devoid of proof. And secondly, in the present case, there seems to be some observational basis for the alternative proposal.

If light moves more slowly through the ether in an absolute sense when emitted transversely to the path of a moving source than when emitted along the path of motion, we may expect this to show up in an inability to detect spectroscopic binary stars and eclipsing variables at large distances. Now it so happens that because of dispersion and recognition problems not related to the speed of light, spectroscopic binaries are impossible to detect at distances beyond

a few thousand parsecs. But there is no reason why eclipsing binaries should not be seen at great distances if the speed of light is constant, these being recognizable by the periodic variations of their brightness. This is particularly true of very bright, close binary pairs, such as Beta Lyrae and Y Cygni. Yet stars of this type "which shine like beacons through a major part of our galaxy" have never been found beyond the boundaries of our Milky Way, notwithstanding they would have been well above the resolving limit of our largest telescopes for several decades. See Kopal[16].

Is it possible that there are no such stars in the Magellanic Clouds or in the great galaxy M-31 in Andromeda? Or is their presence rendered impossible to detect by virtue of the fact that their brightness variations are levelled out or eliminated because of the variable speed of light? The enormous improbability of the first alternative makes the second appear to be highly probable by comparison.

Nevertheless, it must be acknowledged that it would be improper to conclude that the speed of light is variable without undertaking a detailed and exhaustive study of all of the facts in order to ascertain whether there might be some other reason for our inability to detect bright eclipsing binaries at great distances. Final judgment must await such an analysis.

Meanwhile, however, it is proper to suggest that the ether-wave theory of light, in one or another of its many possible forms, is fully supported by all of the evidence, and that all other theories are in conflict with observation in one or more respects, and must, therefore, be considered invalid.

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