VELOCITY EFFECTS ON ATOMIC CLOCKS AND THE TIME QUESTION

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The experimental and theoretical work of Herbert Ives is presented as a logical alternative to Einstein's special theory of relativity. Rotational experiments are shown to indicate a light-bearing medium, refuting the foundations of special relativity. The relativity concept of time dilation is replaced by physically produced clock rate reduction when clocks move through the reference medium. The common sense concept of time is upheld as a fundamental quantity of science. The philosophy of relativism is shown to be detrimental to science.

1. Introduction

Although Einstein's relativity is defended vigorously in the halls of science, it rests on very shaky ground. What is worse, it has led science away from logical attacks upon important problems. The philosophy of relativism has diverted science, all to often, from common sense and rigorous logic to whimsical concepts that lead to paradoxes. That is particularly true for the concept of relative time. Many scientists have shown that Einstein's concept of time dilation is self-contradictory and have advocated logical alternatives.

Some scientists suggest that instead of time being altered by motion it is the measuring device that is altered, not time. For example, if an atomic clock is in high speed motion physical causes may make the clock run slow. A systematic error is introduced into the measurement of time, but time itself is not altered. To make this physical interpretation one must abandon Einstein's concepts. Fortunately a great Bell Telephone scientist and Rumford medalist, Herbert Ives, has done the ground work in setting up a logical alternative to Einstein's special relativity.[1] It is worthwhile to review some of his work.

2. Is There an Ether?

In his electromagnetic theory of light James Clerk Maxwell postulated a luminiferous ether, a medium that fills all space. He assumed that ether is a medium in which light waves are propagated. The famous Michelson-Morley experiment was designed to detect the motion of the earth through that medium and to measure its velocity with respect to that medium. In that experiment a light beam was split into two beams. One of those beams was directed out to a mirror and back in a direction transverse to the direction of the earth's motion. The other beam went straight ahead to a mirror and back. Both paths were the same length. It was expected that, due to the earth's motion through the ether, it would take longer for the round trip upstream and back than for the trip across stream and back. The difference in time would be due to the slow progress of the light when traveling against the ether stream. The result was that there seemed to be no time difference. This required some rethinking about Maxwell's theory.

Einstein abandoned the ether concept and introduced two postulates: 1) The absence of an absolute standard of rest, no ether. 2) The velocity of light in space is constant, whatever the motion of its source.

Ives showed that Einstein's treatment is inconsistent and leads to real paradoxes. He developed an alternative theory based on more experimental evidence and made a consistent case for ether as the light bearing medium. He refuted the Einstein conclusion that time is relative. He retained the common sense concept of absolute time.

Einstein claimed that time runs slower in a moving system. Ives contended there is a physical retardation in the frequency of a moving light source. This might be classified as a retardation in the clock rate, not a retardation of time itself. Both used the same equation, with source velocity v and light velocity c:

$$t = t_0(1 - v^2/c^2)^{1/2} \qquad (1)$$

Einstein interpreted t as the time. Ives interpreted t as the clock reading, not a precise measure of the actual time t_0. Equation (1) gives a measure of the clock dilation, not time dilation.

3. Ives-Stillwell Experiment

Ives studied all of the famous experiments related to the relativity question. He deduced a theory that is presumably consistent with those experiments and with the ether concept. He showed that the famous Sagnac experiment (Fig. 1) and the Michelson-Gale experiment support an ether concept. Those two experiments employed rotating systems in which light beams were sent around a circuit in opposite directions. The phase difference observed when the two beams came together support the concept of light having been propagated in a medium that did not rotate with the system. Ives assumed that this nonrotating reference medium is the ether. These experiments refute the Einstein concept of constancy of the speed of light. Some claimed that accelerations involved in those experiments provide a way out for Einstein, but Ives refuted that claim by showing that these arguments lead to contradictory results.

In order to complete the case Ives and Stillwell, his colleague at the Bell Telephone Laboratories, carried out an experiment with canal rays. These canal rays consist of a beam of positively charged hydrogen molecules that emit light containing various frequencies. [2,3] It was shown that the frequencies in this light source decrease with increase in speed of the hydrogen molecules. One would expect an observer to see a Doppler shift in the light from a moving source. However Ives contends that his experiment shows that there is a lowering of the frequency in the light source itself, as well as the expected Doppler shift. His observed lower-

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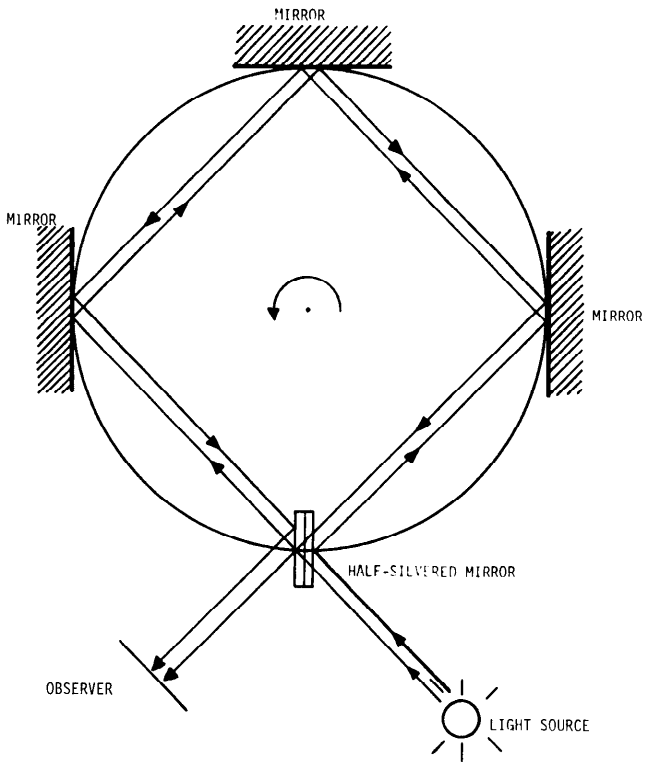

Figure 1. Sagnac's experiment. The whole system, including the source of light and the observer (which is a photographic plate, not a human) is mounted on a rapidly rotating platform.

The experiment by Michelson and Gale, mentioned in the text, was similar in principle; but the apparatus was set on the Earth, which, in its rotation, served as a rotating platform. Because the Earth's rotation is slower, Michelson and Gale's experiment had to be much greater in physical extent.

ing of frequency in the source is given by the equation

$$f = f_0(1 - v^2/c^2)^{1/2} \qquad (2)$$

where f_0 is the frequency of the source at rest. This amounts to a red shift of the center of "gravity" of the original frequencies in the light source.

The Doppler effect is the classical Doppler effect. It has a blue shift when the source is moving toward the observer. The net shift is the product of the frequency shift given by the equation (2) and the classical Doppler frequency shift. Ives interprets this as a physical effect on the light source plus the Doppler effect. Einstein gives no physical reason.

Ives' equations are similar to those of H.A. Lorentz. Einstein adopted Lorentz's equations but put a different interpretation on them. They are called the Lorentz-Einstein transformations. Lorentz never accepted Einstein's concept of time dilation nor his corollary concept of space contraction. Lorentz considered his equation to represent real physical effects, namely a change in clock rate and a contraction of rod length. That is also the view held by Ives. Ives' equation for length contraction is the same as the Fitzgerald contraction, a real physical shortening of the rod. Fitzgerald was contemporary with Lorentz and made the original suggestion of length contraction. (Or according to Dingle, originally transverse expansion.) Ives was able to explain the Michelson-Morley experiment in the same way that Lorentz and Fitzgerald explained it, with altered clock rate and altered lengths of the arms in the instrument. The clock rate change and contractions yield the null effect observed by Michelson and Morley.

4. The Clock Paradox

Einstein's theory leads to a well known clock paradox. He claimed that one clock moving at great speed would run slower than a clock at rest. However according to Einstein's other postulate one can not tell which clock is at rest. The result is that, in his illustration, the clock he claimed to run fast could equally be the one to run slow, an obvious absurdity. Ives evades that contradiction by having a standard of rest, the ether. All motion is with respect to that fixed reference.

Ives used the same reduction ratio for both clock retardation and length contraction. That ratio is

$$(1 - v^2/c^2)^{-1/2}:1 \qquad (3)$$

This is the same as the ratio proposed by Fitzgerald. Ives did not claim to be able to detect the absolute value of motion with respect to ether. He was not able to measure the total rate at which the earth is moving through space. However all of his results are consistent with an ether. The clock reduction and length contraction prevent him from detecting the value of *linear* motion with respect to the ether. That is what prevented Michelson and Morley from detecting the rate of motion through ether. However in the rotation experiments of Sagnac and Michelson-Gale the rotational motion with respect to the ether was measured. That is sufficient to refute Einstein's rejection of any standard of reference.

What this amounts to is that Ives has a valid theory that does not have self-contradictions, such as those in Einstein's theory. His theory deduces, in a straightforward way, a fundamental foundation for electrodynamics and checks with the basic experiments. He acknowledges the debt he owes to the early scientists by stating that his "views will be recognized as those of earlier students of the subject—Fitzgerald, Larmor, and Lorentz—but not of those who would shift the burden from variant measuring instruments to the nature of space and time."[4] This last remark shows his rejection of the Einstein philosophy.

5. Another Contradiction

V. Vergon points out the following contradictions between Einstein's special theory of relativity and the results of the Ives-Stillwell experiment.[5] In his original paper Einstein considered the case of an observer moving with velocity v at an angle ϕ with respect to light rays from a distant star, a source considered to be at rest.[6] He derived the equation for the "observed" frequency f in terms of source frequency f_0, namely

$$f = \gamma f_0(1 - \beta\cos\phi) \qquad (4)$$

where $\beta = v/c$ and $\gamma = (1 - \beta^2)^{-1/2}$

In the Ives-Stillwell experiment the source of light was moving and the observer was at rest. For simplicity, the comparison will be made for the orthogonal condition, that is to say the condition in which the angle ϕ between source or observer velocity and light rays is 90°. Einstein's equation (4) reduces to

$$f = \gamma f_0 \quad (5)$$

The comparable Ives-Stillwell result is given by equation (2) which is recast in the form

$$f = f_0/\gamma \quad (6)$$

The Ives-Stillwell experiment was done with a moving source and the Einstein equation applies to a moving observer. Einstein's first postulate demands that the result for both cases be the same. That postulate states that there is no standard of rest, all motion is relative. This relative motion is equal; relativity can not distinguish which one is at rest. Einstein's relativity demands that the results of these two cases be the same. Quite obviously equations (5) and (6) are not the same. Equation (5) is an increased frequency and (6) is a decreased frequency. Hence the experiment contradicts Einstein's theory.

6. Speed-altered Spectral Characteristics

Our particular interest in Ives' work is his experimental and theoretical evidence that there is a decrease in the "standard" frequencies associated with a hydrogen ion, H_2^+, when it is in high speed motion. Our explanation is:

1) That the electromagnetic fields are induced within the hydrogen as its charge components move through the reference medium.

2) That there is an interaction between the electromagnetic fields and the hydrogen's electrical components which reduces the frequency of its spectral lines.

This is consistent with the paper entitled *A Classical Foundation for Electrodynamics*[7] which shows that movement of an elementary charge through a reference medium will, through a feedback process, develop an electromagnetic field. That field is expressed by the same equation as the relativistic field in a "preferred" frame of reference. This presumably checks with experiment. No time dilation nor space contradiction is involved. That development was based on classical physics plus a reference medium and a feedback concept.

Each electrical component of the hydrogen is in the field of the other electrical components. Since those fields are altered by the movement of their associated charges through the reference medium, the interaction forces between the various charges is altered by this translational motion. The direction of these altered forces is governed by whether or not the two interacting charges are of like sign or of unlike sign. As a consequence of the two charges moving in the *same* direction, if the two charges are of like sign, the altered force (a magnetic force) is a pinch effect, an attraction. If the two charges are of unlike sign the altered force is a repulsion effect. This is analogous to the attraction between two parallel currents flowing in the same direction or the repulsion force between two parallel currents flowing in opposite directions.

To explain the lowering of the spectral frequencies in the Ives-Stillwell canal ray experiment, first consider radiation of the spectral lines to be the result of vibration of the oppositely charged electrical components in the hydrogen. Motion of these charges induces a repulsion force between those components. This repulsion force is not as large as the coulomb attraction force binding the charges together, but it does cause a weakening of that binding force. This weakening of the net force holding these components together explains the lowering of the vibrational frequency. It is well known that a weaker spring in a vibrating system yields a lower frequency of vibration. In this case it means a lowering of the spectral frequencies, the effect that has been observed experimentally.

7. Consequences of False Notions About Time

Science has its fads and foibles, but false notions about time have been in vogue too long. Even though top scientists have questioned both the logical consistency and the experimental validity of Einstein's relativity ever since it was first proposed, it still dominates the philosophy of science. Unfortunately the philosophy of relativism has spilled over into other "disciplines". The fruits of that distorted philosophy are evident in the ills of society today.

When one rejects such a fundamental entity as time, it is not surprising how far afield his logic may drift. The concept of relative time has led science into all sorts of nonsense. An illustration of the kind of nonsense inherited from Einstein's relativity can be found in the following quote from one of the leading textbooks in astrophysics: "If we first fall down the steps and then hurt ourselves, the universe is expanding, time flows 'forward', and physical systems tend toward randomness. If we first hurt ourselves and then tumble upstairs time is actually running 'backward', and the universe is contracting and physical systems are becoming more and more ordered. It may be just a matter of definition."[8]

With that kind of "logic" one can accept anything by changing the definition: after all everything is relative; there is no standard; make of it what you will. Needless to say that kind of relativism has been disastrous in science. That is one reason why cosmology has become less and less distinguishable from astrology.

Fortunately there is beginning to be an increase in the number of scientists who challenge Einstein's relativity. The works of Ives and Lorentz makes sense to them. They will be producers in science because they are on the right track.

8. Conclusion

From his two postulates Einstein developed his special theory of relativity which introduces the concept of time dilation. This theory contains logical inconsistencies. Furthermore it is not in accord with the experimental evidence from certain rotational experiments such as the Sagnac experiment. Those experiments imply a light bearing medium which Einstein rejected.

Ives suggested a logically consistent alternative: a light bearing medium and atomic clocks that run slower with speed; time itself is an independent entity that is unaltered by motion.

A qualitative explanation for this lowering of spectral

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