Dynamic Absolute Space: explanation of the null result of Michelson- Morley experiment

May 01, 2013

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Abstract

The theory of 'Dynamic Absolute Space' proposed here states that absolute motion is a *change* in state of motion rather than motion relative to some universal reference. This theory can explain the null result of Michelson-Morley (MM) experiment. This theory reconciles Galileo's invariance principle and the two postulates of special relativity with the concept of absolute space. An experiment has been proposed in which Michelson-Morley's interferometer is set into motion relative to the earth so as to detect the expected fringe shift. According to this theory and according to the null result of the MM experiment, the absolute velocity of the earth (hence Michelson Morley's interferometer) is much smaller than 30Km/s even though its velocity relative to the sun is 30Km/s. In view of the long standing confusion between the notions of absolute motion and relativity, the 'Dynamic Absolute Space' theory proposed in this paper sheds some light on the problem. However, the only way to check the correctness of this theory is through experiments. A Michelson-Morley interferometer accelerated to about 5 Km/sec relative to the earth is a crucial experiment to test this theory.

Introduction

According to the theory of special relativity (SR), all observers have the right to claim that they are at rest; hence SR denies the existence of absolute rest. The speed of light in vacuum is a constant independent of the speed of the source or of the observer.

The null result of Michelson – Morley experiment is perhaps the strongest evidence supporting Einstein's light postulate. Michelson – Morley's null result together with the favourite idea of (Galilean) relativity (and Einstein's two postulates) at first seem to get rid of the long standing problem of absolute motion.

It is when one considers Sagnac's and Michelson–Gale experiments equally supporting the validity of absolute motion that one understands that the principle of invariance (Galilean and Einstein's) is not the whole story and that the century old paradox and controversy still remains unsettled.

In this paper a new theory will be proposed that has the potential to reconcile the results of these experiments. Out of the theory of special relativity , only the two postulates of Einstein will be accepted in this paper; i. e the length (or space) and time relativity is not accepted.

Discussion

The 'null' results of Michelson-Morley experiment is explained as follows.

The null result of Michelson-Morley experiment shows that the absolute velocity of the earth in space is much smaller than 30 Km/s..

This means that, although the speed of the earth relative to the sun is about 30 Km/s, its absolute speed in space is much smaller. What does this mean?

To explain the null result of Michelson-Morley experiment, we need to redefine absolute motion. Let us develop the new theory step by step.

Absolute motion in space is a *change* of the state of motion of a body from its uniform rectilinear state of motion in which it has been for a long enough time. Absolute velocity can be defined as the integral of the acceleration of the body in space, for an acceleration that is not too small. The earth can be considered to be in an almost uniform rectilinear motion in the analysis of Michelson –Morley experiment and that is the cause of the observed null result. According to this theory, the absolute velocity of Michelson Morley's interferometer (of the earth) is much smaller than 30Km/s even though its velocity relative to the sun is 30Km/s. The state of motion of the MM device should be *changed* in order to detect a non-null fringe shift. The MM device should be accelerated to a velocity of 30Km/s relative to the earth to observe the expected 0.04 fringe shift.

However, as such a high (change in) velocity is practically difficult to attain, the MM device can be accelerated to about 5Km/s relative to the earth, say by mounting it on a space shuttle, to observe a fringe shift corresponding to 5Km/s.

One might say that the MM device was also being rotated and a fringe shift should have been observed. This can easily be explained by the MM interferometer being much less sensitive than Sagnac's interferometer.

Imagine a body has been in uniform rectilinear motion in free space for a long enough time, and that it is at rest in some inertial frame. According to the new theory of 'Absolute Dynamic Space' (and according to special relativity), the absolute velocity of the body in space is zero, i.e. it can be considered to be at absolute rest relative to space, even if it is

not at rest relative to other bodies.
Assume that the body starts accelerating and finally settles on some velocity, relative to that inertial frame in which it has been at rest for a long enough time. For an acceleration that is large enough, the absolute velocity of the body at any time will be the time integral of its absolute acceleration, with t=0 taken as the time at which the body started accelerating ,and its initial absolute velocity being zero because of the definition of absolute motion already presented. Assume that the body, after accelerating for some time, settles on a new velocity V_1 relative to that inertial frame. Thus, the absolute velocity of the body at the end of the acceleration period will be V_1.

Now we have to make improvement to our theory (make it clearer). Assume that the body remained in the same state of motion it attained in the above example, for a long enough time. According to the new theory, although the absolute velocity of the body was V_1 at the end of the acceleration period, it will gradually reduce back to zero as the body continues to remain in the same state of motion, i.e in a uniform rectilinear (unaccelerated) motion. This means that the absolute velocity of the body will 'discharge' gradually towards zero, analogous to a capacitor discharging gradually to zero voltage.

Therefore, the absolute velocity of a body in space is determined both by the acceleration of the body and the length of time the body remains in a uniform rectilinear motion. The longer the time a body remains in its state of uniform rectilinear motion, the more time available for the absolute velocity to 'discharge' back to zero. (Note that this doesn't mean that the velocity of the body relative to other bodies decreases)

This also means that the more the acceleration of the body the more accurately can the absolute velocity be determined as the integral of its acceleration at any instant of time. If a body accelerates slowly, not only will the absolute velocity of the body increase continuously, but also there would be time for the absolute velocity to ' discharge' or 'leak' away towards zero.

The above definition of absolute velocity as the time integral of absolute acceleration applies correctly for accelerations that are not too small and is correct for short intervals of time. Suppose that the body continuously accelerates for a long time. In this case, the absolute velocity cannot be determined accurately by integrating the acceleration over such a long time. Although the absolute velocity of the body continuously increases due to the acceleration, it will also 'leak' so that the absolute velocity is always less than the time integral of the acceleration taken over a long time interval.

To make this point more clear we use an analogy of a container that has a hole at the bottom (Fig.1). If the rate at which water is being poured into the container is too small, the water level in the container will not increase; we should pour more water than is leaking through the holes, or the water level will continuously decrease and the container will finally become empty. In this analogy, empty container means zero absolute velocity.

In the Michelson-Morley experiment, the assumption was that the absolute velocity of the earth in space is at least 30 Km/s . However, as indicated by the null result of Michelson –Morley experiment, the absolute velocity of the earth is much smaller. According to the new theory of ‘Dynamic Absolute Space’ , the absolute velocity of the earth is much smaller because it has very small (centripetal) acceleration. We can say that the earth is almost in a uniform rectilinear motion in its orbit around the sun, for a very long time, in discussing about this experiment.

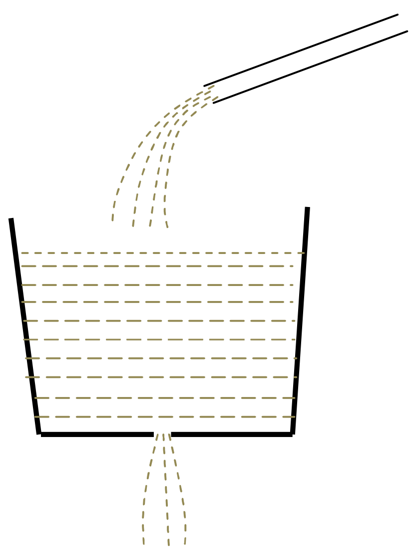

Fig.1

From the above discussions it follows that there is a time constant associated with the ‘charging’ or ‘discharging’ of absolute velocities.

Thus the greater the acceleration, the more accurately can the absolute velocity be determined as the integral of absolute acceleration. If the acceleration is very small, the absolute acceleration will be ‘discharged’ and the absolute velocity at any time will be less than the integral of absolute acceleration.

Then why did Sagnac’s and Michelson-Gale experiments not also show null results?

The non-null result of Sagnac interferometers is because, unlike Michelson-Morley's interferometer, they are continuously accelerating due to their rotation. Therefore, these devices are always in absolute motion and hence show the expected fringe shifts. However, according to this theory, the accuracy of Sagnac interferometers should deteriorate at very low rotation rates next to zero and for very large sizes. This is because the source, the detector and the mirrors approach uniform rectilinear motion at very low rotation rates and for very large size Sagnac interferometers.

The explanation and estimate of the time constant is not clear to the author yet. However, we know that Sagnac devices show absolute rotation accurately typically down to one degree per hour. So we can only guess that the time constant should be much greater than one hour, say thirty hours? The exact value might be determined experimentally, assuming the theory of 'Dynamic Absolute Space' is correct at all and assuming that it is possible to observe the effect at the very small rotation rates required by this theory. According to this theory, the accuracy of Sagnac interferometers will deteriorate for very small rates of rotation, with the device detecting no absolute motion at extremely small angular rates next to zero. At very low rotation rates and/or for very large Sagnac devices, the motion of the source and the detector approaches uniform rectilinear and hence the device fails to detect absolute motion. The rate of rotation for a sagnac device of typical size at which this effect becomes significant is unknown to the author yet: 1 degree per day? Per week? Per month? .....

Proposed experiment

To detect non-null result with Michelson-Morley's interferometer then, it should be accelerated rapidly enough to practically attainable high velocities, say 5 Km/s, relative to the earth, assuming that the resolution of the experiment can enable us to observe the fringe shift that results at this velocity. As a space shuttle can accelerate to these velocities, I guess it should be possible to detect a fringe shift by a Michelson-Morley interferometer mounted on it.

Galileo's relativity and absolute space

The 'Dynamic Absolute Space' theory reconciles Galileo's relativity with the idea of absolute space. Galileo's relativity (and Einstein's two postulates) hold in steady state conditions, i. e in systems that have been in uniform rectilinear motion for long enough time.

Speed of light and dynamic absolute reference frame

Dynamic absolute reference frame

From the definition of absolute motion discussed so far, absolute reference frame is the reference frame in which the velocity of the body is the absolute velocity of the body. This means that there is no universal static absolute reference frame. The absolute reference frame is the inertial reference frame in which the body has been at rest (uniform rectilinear motion) for a long enough time before it started acceleration. During and after the time of acceleration, the absolute reference frame continuously changes and finally settles to be the inertial reference frame in which the body is at rest (i. e when the body has been in uniform rectilinear motion for a long enough time, its absolute velocity in space becomes zero).

Inertial/ non-inertial source and observer

An inertial source/observer is a source/observer that has been in uniform rectilinear motion for a long enough time. An inertial source/observer can be considered to be at absolute rest in space. Thus the absolute reference frame for an inertial source/observer is a reference frame in which it is at rest.

A non-inertial source/observer is a source/observer that has not been in a uniform rectilinear motion for a long enough time. A non-inertial source/observer is considered to be in absolute motion in space. The absolute reference frame for a non-inertial source/observer is the reference frame in which the source/observer has been at rest for a long enough time before its acceleration. More accurately, the absolute reference frame is the dynamic absolute reference frame discussed above, a reference frame in which the velocity of the source/observer is the absolute velocity of the body.

'Inertial / non inertial' not only means absence or presence of acceleration, but also means that the source/observer has or has not been in uniform rectilinear motion for a long enough time (much greater than the time constant)

Inertial source and inertial observer

The speed of light from an inertial source is isotropic and equal to C in absolute reference frame (the rest frame of the source) for an inertial observer. And the speed of light is always equal to C as observed by an inertial observer. In this case, the source can be considered stationary with the inertial observer moving towards/away from the source or the observer can be considered stationary with the inertial source moving towards/away from the observer. In both cases the speed of light is isotropic and equal to C for all inertial observers and sources.

Non inertial source and inertial observer

A non-inertial source is considered to be in absolute motion and an inertial observer is considered to be at absolute rest. So the source is considered to be moving towards/away from the stationary observer. In this case, the speed of light relative to the observer will be independent of the speed of the source and is equal to C (as stated in the light postulate of special relativity).

As discussed above, the inertial reference frame in which the source has been at rest for a long enough time is taken as the absolute reference frame in which the source is moving absolutely. However, it should be noted that the inertial observer and the absolute reference frame of the source will also be in relative motion.

Inertial source and non-inertial observer

In this case the source is considered stationary with the observer moving towards/away from the source. The speed of light relative to the observer will be $C \pm V$, where V is the absolute velocity of the observer, as discussed previously. The absolute velocity V of the observer is the velocity of the observer with respect to the inertial reference frame in which it was at rest before acceleration. (Note that V is not the velocity of the observer relative to the source.)

Non inertial source and non-inertial observer

In this case both the observer and source are considered to be in absolute motion. The velocity of light relative to the observer is again equal to $C \pm V$, where V is the absolute velocity of the observer.

In all cases, the speed of light is always independent of any motion (relative or absolute) of the source. This is the common property of both light and sound waves. The speed of sound waves relative to air is independent of the speed of the sound source.

The speed of light becomes $C \pm V$ for all non- inertial observers.

In all cases Doppler shift exists whenever a source or an observer is in absolute motion or whenever a source and an observer are in relative motion.

For the last case, Doppler shift results from both the absolute motion of the observer and the absolute motion of the source.

To repeat the above discussion in a slightly different way, let us start from a source and an observer that are at rest relative to each other and have been in uniform rectilinear motion for a long enough time. In this case, the speed of light relative to the observer will obviously be equal to C.

Next suppose that the observer starts accelerating and finally settles in some constant velocity relative to the source. During the time of acceleration and after the acceleration (until steady state is reached), the speed of light relative to the observer will be C ± V. Assume that the observer stays long enough in the same velocity relative to the source. Gradually, the speed of light relative to the observer becomes equal to C.

Now assume that the source starts accelerating and finally settles in some constant velocity relative to the observer. In this case, we consider the observer to be at absolute rest, with the source in motion towards or away from the observer. Since the velocity of the source doesn't affect the velocity of light, the stationary observer will measure the speed of light to be equal to C.

First and second postulates of special theory of relativity

From the above discussions, it is clear that the absolute constancy of the speed of light holds only for the case of inertial sources and inertial observers.

Therefore, the second postulate of special relativity should be corrected as :

The speed of light is a constant C for all *inertial* observers and *inertial* sources. The word 'inertial' has been added. And the first postulate should be corrected as:

The laws of physics are the same for all *inertial* observers and *inertial* physical systems. Here 'inertial' does not only mean that there is no acceleration but also that the source/observer has been in uniform rectilinear motion *for a long enough time*.

Why is the speed of light the same for all inertial observers

The independence of the speed of light of the speed of its source is not strange because we know that the speed of sound relative to air also does not depend on the speed of the source. However, the constancy of the speed of light for all (inertial) observers is what has not been understood so far (for those who don't accept the length contraction and time dilation hypothesis). In my previous paper 'Relativity of Electromagnetic Fields' I have attempted to explain this by postulating that the light beam gets compressed back to or expanded away from the source for moving observers so that the speed of light for all observers is equal to C.

The constancy of the speed of light for all inertial observers simply follows from Einstein's conception of motion: all (inertial) observers have the right to claim that they are at rest. If an observer is at rest (inertial or in a uniform rectilinear motion for a long time) and a light source is moving towards him/her, what velocity will the observer detect? Obviously the velocity of light relative to the observer is equal to C because it is independent of the motion of the source. Now, instead of assuming the inertial source moving towards the inertial observer, assume that the inertial observer is moving towards the inertial source. In this case, as the inertial observer can still consider themselves to be at rest, they can say that they are at rest and the light source is moving towards them, thus getting the same velocity of light C as in the previous case.

Therefore, the constancy of the speed of light for all observers simply follows from the first postulate (the laws of physics are the same in all inertial frames).

Common source and observer acceleration

Assume an inertial source and an inertial observer that are at rest relative to each other. Assume that both start accelerating in space, but they are always at rest relative to each other, and they finally settle in some uniform rectilinear motion. What velocity of light will the observer measure during and immediately after the acceleration? And what Doppler shift?

The source and observer were initially at rest in an inertial reference frame. So when the source and observer start accelerating, this inertial frame will be the absolute reference frame with respect to which the absolute velocity of the source and the observer will be determined. In this absolute frame, the speed of light is always equal to C for an observer who is at rest in this reference frame because the speed of light is always independent of the speed of its source. However, for the non inertial observer who has been accelerating in this absolute frame, the velocity of light relative to him will be $C \pm V$, where V is the absolute velocity of the observer.

The Doppler frequency shift after the acceleration has ceased is zero because there is no relative motion between the source and the observer. During the acceleration, however, the observer will detect Doppler frequency shift although there is no relative velocity between the source and the observer. (This idea might have the potential to explain Hafele and Keating experiment.)

Conclusion

In view of the long standing confusion between the notions of absolute motion and relativity, the 'Dynamic Absolute Space' theory proposed in this paper sheds some light on the problem. However, the only way to check the correctness of this theory is through experiments. A Michelson-Morley interferometer accelerated to about 5Km/sec relative to the earth is the crucial experiment to test this theory.

References