On light propagation and the Special Theory of Relativity

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Summary

In this paper we demonstrate that physicists at the turn of the 20th century, including Lorentz, Poincare, and Einstein, have made a mistake while interpreting the famous "null" result of the Michelson-Morley experiment from 1887. Physicists have incorrectly assumed that the experiment measured the speed of light in space, when in actual fact it measured the speed of light inside the earth's atmosphere. Consequently, physicists have misconstrued the result of the experiment and the phenomenon of light propagation in general.

We show that when this mistake is recognized, light propagation proves to be fully compliant with classical wave physics, as evidenced by the said experiment itself and also by the satellite missions for mapping the Cosmic Microwave Background, among others. These findings in turn lead to the realization that the Special Theory of Relativity is not reflective of observation.

Note: this paper assumes familiarity with the Special Theory of Relativity and the theoretical problems that it solves.

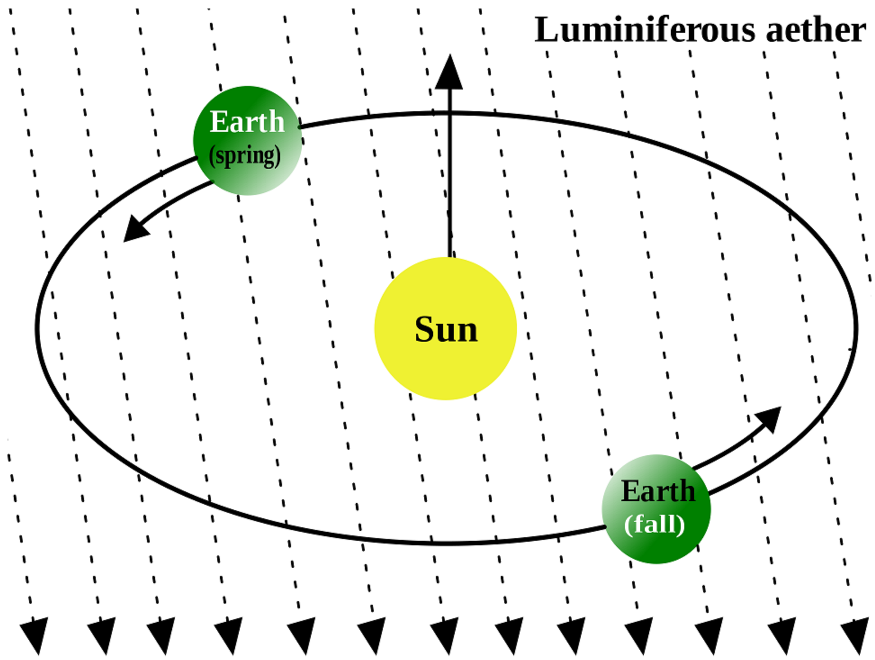
1. The Michelson-Morley experiment

The influential Michelson-Morley experiment from 1887, considered a pivotal point in our understanding of the nature of light propagation, sought to confirm the existence of the luminiferous (light-bearing) aether, the hypothesized medium for the propagation of light. The objective of the experiment was to detect the motion of the earth through the aether by measuring the speed of light in different directions.

The scientific foundation of the experiment was classical wave physics, which predicts that an observer in motion with respect to an optical medium will measure different speeds of light in different directions, whereas an observer at rest with respect to this medium will measure the same speed of light in all directions.

Since the earth is known to be moving through space - and thus through the space-permeating aether - the speed of light here on Earth was expected to be different in different directions, in line with the reasoning above. By measuring these differences, or the "aether wind", physicists were expecting to establish the exact velocity with which the earth is moving through space.

Accordingly, the Michelson-Morley experiment used a specifically designed optical apparatus that was capable of detecting the aether wind. Contrary to expectations, however, the experiment famously produced a "null" result. That is to say, the same speed of light was measured in all directions.



Aether wind. Source: Wikipedia.

2. The case of the misidentified optical medium

As per classical wave physics, the above result is an indication that the measuring apparatus used in the experiment was at rest with respect to the optical medium in which the speed of light was measured. But which medium was that?

Asked differently, which speed of light did the Michelson-Morley experiment measure:

- the speed of light in the aether - and thus the speed of light in space
- the speed of light inside the earth's atmosphere

We will now demonstrate that physicists at the turn of the 20th century have not realized that the experiment measured the speed of light inside the atmosphere.

3. The relativity of the speed of light

The optical medium at the surface of the earth, where the Michelson-Morley experiment measured the speed of light, is the earth's atmosphere.

When this fact is recognized, the result of the experiment is trivially explained with classical wave physics: the test apparatus used in the experiment was at rest with respect to the optical medium - the earth's atmosphere - and measured the same speed of light in all directions. This is fully expected, as pointed out earlier, and merely confirms the fact that the speed of light in an isotropic optical medium, such as atmospheric air, is isotropic as well.

At the same time, the experiment importantly shows that the speed of light inside the earth's atmosphere remains isotropic while the earth is moving through space. Ergo, this speed is also relative, in the Galilean sense.

Thus, when interpreted correctly, the result of the Michelson-Morley experiment serves as evidence that light propagation is compliant with classical wave physics and that the speed of light is relative with respect to the optical medium in which light waves are propagating.

The latter explains why the experiment could not detect the motion of the earth through space: by definition, the motion of a Galilean ship is undetectable from the inside, as "the ship's motion is common to all the things contained in it, and to the air also" (Galileo). Provided that the speed of light inside the atmosphere is relative, this analogy is fully applicable to the motion of the earth through space as well.

4. The invariance of the speed of light

As discussed in the previous section, the optical medium at the surface of the earth is the earth's atmosphere. Physicists at the time, however, did not realize that.

The goal of the Michelson-Morley experiment was to detect the motion of the earth through the space-permeating aether, so physicists took it as a given that the experiment measured the speed of light in space. They never questioned this implicit assumption and completely ignored the atmosphere, as if it did not exist. In effect, they assumed that the earth did not have an atmosphere, as far as light propagation was concerned.

Under this assumption, the "null" result of the experiment has two important implications. First, it implies that the earth is not moving through space, as only observers at rest with respect to the vacuum of space should measure an isotropic speed of light. Next, provided that the earth is in fact moving through space, the "null" result implies that the speed of light is independent of the motion of the observer, as apparently even observers in motion with respect to the vacuum of space measure an isotropic speed of light.

The first of these implications is clearly false, given that the earth is revolving around the sun. But rather than investigating the possible reasons for such an obvious contradiction, physicists accepted it as a law of nature, according to which the motion of the earth through space was undetectable. In the words of Henri Poincare (1905):

> "It appears that this impossibility to detect the absolute motion of the Earth by experiment may be a general law of nature; we are naturally inclined to admit this law, which we will call the Postulate of Relativity and admit without restriction."

The second implication noted above represents another contradiction. Speeds in Newtonian mechanics are relative and dependent on the motion of the observer, so the conclusion that the speed of light is independent of the motion of the observer is in obvious disagreement with Newtonian mechanics. Nevertheless, it too was accepted as a law of nature and took the form of the second postulate of Special Relativity, postulating that the speed of light is constant for all observers, irrespective of their motion.

Thus, after assuming that the Michelson-Morley experiment measured the speed of light in space, physicists had to accept obvious contradictions as laws of nature in order to explain the result of the experiment. These are the founding principles of Special Relativity that observers cannot detect their own motion (hence, motion is purely relative) and that the speed of light is constant for all observers, or invariant.

As we have shown, however, the experiment actually measured the speed of light inside the atmosphere. Once this is realized, it becomes clear that physicists have misconstrued the result of the experiment and that the above laws of nature are nonexistent.

5. The detectability of motion in space

Observation shows that the speed of light inside the earth's atmosphere is relative. Hence, we cannot use this speed for detecting the motion of the earth through space. For that, we need to measure the speed of light outside the atmosphere.

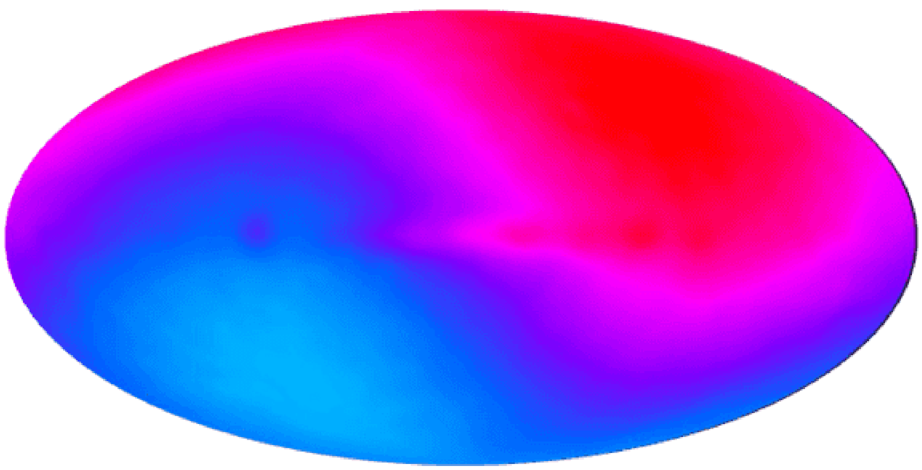
Since the discovery of the Cosmic Microwave Background (CMB) in 1964, there have been three satellite missions tasked with creating a detailed map of the CMB: the COBE mission (NASA, 1989-1993), the WMAP mission (NASA, 2001-2010), and the Planck mission (ESA, 2009-2013).

All of these missions have detected the very characteristic "dipole anisotropy" pattern in their CMB maps, caused by the motion of the earth and the solar system through space.

These findings confirm the prediction of classical wave physics that observers can detect their own motion in an optical medium by measuring the speed of light in different directions.

In the case of the CMB missions, the motion of the satellites through space was detected by measuring the Doppler-shifting of electro-magnetic waves that observers experience as they move through an optical medium.

It is also noteworthy that the dipole anisotropy pattern is purposefully removed from the CMB maps as a parasitic effect. That is to say, the CMB missions could not avoid detecting the earth's motion through space even though this has never been intended.



A CMB map with a dipole anisotropy pattern caused by the motion of the earth through space. Source: NASA

6. Conclusion

In this paper we have presented evidence that physicists at the turn of the 20th century, including Lorentz, Poincare, and Einstein, have collectively misconstrued the result of the influential Michelson-Morley experiment from 1887.

Physicists have erroneously assumed that the experiment measured the speed of light in space, when in actual fact it measured the speed of light inside the earth's atmosphere.

Unaware of their mistake, physicists have accepted obvious contradictions as laws of nature while interpreting the "null" result of the experiment, which then became the cornerstones of Special Relativity. An example of this is the conclusion that the speed of light is constant for all observers, irrespective of their motion. This is not only unrealistic, given the wave nature of light, but also implies that light propagation is a fundamentally different phenomenon from all other wave phenomena known to science, to the extent that it requires new physics in order to be explained.

In reality, once the aforesaid mistake is acknowledged, light propagation proves to be fully compliant with classical wave physics, akin to any other wave phenomenon.

This is further corroborated by the satellite missions for mapping the Cosmic Microwave Background. As predicted by classical wave physics, all of these missions have unmistakably detected the motion of the earth through space, thus disproving the founding principle of Special Relativity that observers cannot detect their own motion.

In light of the presented facts, we must conclude that the Special Theory of Relativity does not model the phenomenon of light propagation correctly and is therefore not reflective of observation.

References

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