STM JOURNALS

Research & Reviews: Journal of Physics
ISSN: 2278-2265 (Online), ISSN: 2347-9973 (Print)
Volume 8, Issue 2
www.stmjournals.com

Existence of Tachyons and their Detection

Bertrand Wong*
Research Professor, Department of Science and Technology, Eurotech, Singapore Branch, Singapore

Abstract
It is felt by many that faster-than-light particles (tachyons) exist though none has been detected so far; this lack of evidence raises some doubt as to whether such particles exist. However, it may not be possible to detect these faster-than-light particles even if they exist. Is there any possibility at all in detecting these particles, if they exist? This paper ponders the existence of tachyons and introduces some possibilities for their detection.

***PACS** 00-03*

***Keywords**: Constant velocity, detection, light, mass, relativity, tachyons, timer*

****Author for Correspondence*** E-mail: bertrandwong567@gmail.com

INTRODUCTION

Though theoretically no object could travel faster than the velocity of light because at the velocity of light the object's mass is infinitely great and it is thus unable to accelerate, an object without mass, or even with negative mass, possibly, a quantum particle which is somewhat similar to a photon (the photon is the quantum particle of light without mass always in motion) might be capable of traveling faster than the velocity of light. Such an object or objects might be waiting to be discovered. As it is, a theoretical particle which travels faster than the velocity of light, which is termed "tachyon", has been thought to exist [1, 3, 4, 6].

THE VELOCITY OF LIGHT AND THE POSSIBILITY OF FASTER-THAN-LIGHT TRAVEL

When speaking of the detection of tachyons, there should first be some consideration on whether there is any possibility at all of faster-than-light travel by a quantum particle. The velocity of light (which could be regarded as a wave as well as a particle), that is, 186,000 miles per second, is regarded as the ultimate velocity for any particle by the Special Theory of Relativity, as per the following equation which shows that no moving object could travel faster than the velocity of light:

$$v = (a + b) \div (1 + ab/c^2)$$

If we let a = velocity of moving train, b = velocity of light beam (which is sent from the back of the moving train to the front of the moving train) with respect to the moving train, which is the moving frame (that is, the velocity of the light beam (which is sent from the back of the moving train to the front of the moving train) is gauged from the moving train, which is the moving frame), v = velocity of the light beam (which is sent from the back of the moving train to the front of the moving train) with respect to the ground level, which is the stationary frame (that is, the velocity of the light beam (which is sent from the back of the moving train to the front of the moving train) is gauged from the ground level, which is the stationary frame), c = velocity of light = 186,000 miles per second, and, also let $a = b = c$, then:

$$v = (c + c) \div (1 + c.c/c^2) = 2c/2 = c! \text{ (And not } 2c!)$$

Though the above formulation may cleverly describe the velocity of light as the ultimate velocity for any quantum particle, the existence of the tachyon should not be discounted [1, 3, 4, 6].

The quantum particle of light, the photon, is rather similar to the other quantum particles such as the positron, electron, proton and neutron, etc. Though the Michelson-Morley experiment (and other experiments) did not find any evidence of the luminiferous ether (as the medium of transmission for light particles), it apparently from this “null” result of the experiment had concluded that the velocity of light is invariable, and that nothing could travel faster than the velocity of light. However, quantum particles have been found to be capable of “teleportation”, that is, transmit information from one location to another location in space instantaneously, to display “weirdness” (that is, appear strange and incomprehensible). This implies somehow the possibility of faster-than-light travel by quantum particles [1, 6].

According to the Special Theory of Relativity, the clock slows down and the length of the measuring rod contracts in the direction of motion on approaching the velocity of light, while at the velocity of light the mechanism of the clock and time are at a standstill and the length of the measuring rod is zero. Though the intense gravitational field caused by travel at almost the velocity of light might account for the slowing down of the clock (for which experimental evidence had been obtained) and therefore time, it evidently does not suffice as an explanation for the contraction of the length of the measuring rod in the direction of travel at almost the velocity of light (which is only an inference). All this has serious implications for the gauging of the velocity of light and similar particles [1, 3, 4, 6].

There have been a number of speculations pertaining to the variable speed of light (VSL), for example, one theory states that the velocity of light varies with the various stages of the evolution of the universe, exceeding 186,000 miles per second at certain points of time [5].

The following equation describes how the velocity of light (v) is derived:

$$v = d/t,$$

where d represents the distance traveled by the light beam and t represents the time taken by the light beam to travel the distance d

In accordance with the Special Theory of Relativity, for the velocity of light to remain constant, on approaching the velocity of light the clock must slow down to the same degree as the contraction in the length of the measuring rod. We describe the possible outcomes of the slowing down of the clock and the length contraction of the measuring rod, in the event that the velocity of light is variable (that is, not constant), as follows:

$$S^{\%} > C^{\%} \rightarrow I^{l} \quad \text{(i)}$$

$$S^{\%} < C^{\%} \rightarrow D^{l} \quad \text{(ii)}$$

$$S^{\%} = C^{\%} \rightarrow S^{l} \quad \text{(iii)}$$

where $S^{\%}$ represents the percentage of slowing down of the clock, $C^{\%}$ represents the percentage of contraction in the length of the measuring rod, I^{l} represents an increase in the velocity of light, that is, exceed 186,000 miles per second, D^{l} represents a decrease in the velocity of light, that is, go below 186,000 miles per second, S^{l} represents velocity of light, that is, 186,000 miles per second [1, 3, 4, 6].

Since light particles (photons) do not have mass or inertia, which prevents an object possessing it from accelerating beyond the velocity of light, namely, 186,000 miles per second, theoretically there is nothing to prevent light particles (photons) or other particles without mass or inertia, or even with negative mass, from traveling at a velocity greater than 186,000 miles per second. However, detection of these faster-than-light particles would be difficult, due to the reasons given below.

DIFFICULTIES IN DETECTING FASTER-THAN-LIGHT PARTICLES

There are some barriers to overcome if faster-than-light particles were to be detected. We need light to bring images to our eyes when seeing or detecting. Should a particle, for example, the theoretical tachyon, move at a velocity greater than that of light whereby light cannot catch up with it, how can this faster-than-light particle (tachyon) be detected? If such a faster-than-light particle does exist, we may never be able to detect it. Is there a solution? [2, 5].

The fact that tachyons have been brought up before means that there have been theories or speculations about faster-than-light travel, that is, some scientists believe tachyons exist though this is not proven. For example, one theory by a reputable scientist has stated that when the universe first formed the velocity of light had been greater than it is now. While tachyons theoretically may have negative mass, photons which are light particles have no mass. So tachyons and light seem very different. Unless tachyons can be confirmed by experiment everything about them is conjecture and not scientific truth. As is implied by the questions above, this experimental confirmation appears to be a great hurdle [2, 5].

The Special Theory of Relativity stipulates that the velocity of light is constant and nothing can exceed this velocity, which had been confirmed by experiment. There is however the possibility, no matter how remote, that faster-than-light particles exist, though detection might pose a great problem [1, 3, 4, 6].

Why is light necessary for detecting tachyons? Our eyes cannot see in the darkness; light is supposed to reflect the images into our eyes so that the images can be seen. In the case of the faster-than-light particle, if light particles are slower than it and cannot catch up with it, theoretically light cannot reflect its image back to our eyes or a sensitive detecting equipment (though it may not be correct in interpreting it this way). According to Einstein, a faster-than-light particle has negative mass/length, which implies that the faster-than-light particle has suddenly changed to the opposite direction in its travel path (which can be interpreted as traveling backwards in time). This seems weird and absurd. Perhaps this prompted Einstein to assert that the velocity of light is the maximum velocity any particle could travel at [1, 3, 4, 6].

The Special Theory of Relativity also stipulates the slowing down of time when approaching the velocity of light. For the velocity of light to remain constant relativity posits that the slowing down of time and the shortening of distance traveled or length contraction have to be so at the same rate, as is described above. The constancy of the velocity of light had apparently greatly puzzled Einstein. How can any particle not be able to exceed the velocity of light, when in quantum entanglement particles could inter-act instantaneously? In electronics, a TV signal transmitted from a broadcasting station can be received instantaneously in all the homes tuned to it at the same time. So far tachyons are only a speculation with no evidence of their existence, though some think they are not a crazy idea and can exist [1-6].

An interesting question: Though relativity shows that a tachyon travels back in time, couldn't it be forward in time? For example, a particle could transmit information to another particle instantaneously, that is, with faster-than-light velocity. Is this information transmitted through a carrier wave which travels faster than light, such as tachyons? [1, 3, 4, 6].

The difficulty of detecting tachyons cannot be understated. Perhaps quantum entanglement which had also stumped Einstein is a manifestation of the presence of tachyons which is yet to be proved. Tachyons either do not exist, or, are moving too fast to be seen, or, they could have negated or annihilated the light particles when encountering the latter. It is all still a mystery.

A tachyon could be a negative mass particle though there is still no proof that negative mass particles exist. On the other hand, if negative mass particles/negative mass tachyons do not exist (that is, only positive mass tachyons exist) there is a greater possibility of detecting tachyons, as light particles needed for the detection would not be negated or annihilated by these negative mass tachyons themselves (though if the light particles were indeed negated or annihilated it might be interpreted that negative mass tachyons exist, which explains why the light particles were negated or annihilated - this is only circumstantial evidence that negative mass tachyons exist).

If a tachyon is really a negative mass particle, there may be no way to detect it directly in the usual manner with light particles and the only way may be to use an indirect method of proof, that is, relying on some kind of circumstantial evidence. But how do we really affirm that a tachyon is a negative mass particle and not a positive mass particle? This seems problematic. Maybe we have to just assume that the tachyon is negative mass, or, positive mass, and reason from there and see whether either assumption leads to any problems or contradictions. Perhaps inference is sufficient for proving the existence of the negative mass tachyon as actual physical evidence may not be possible to have at all. There is some merit in this method [1, 3, 4, 6].

POSSIBILITY

Theoretically at least, it may be possible to detect the velocity of an object (tachyon) exceeding the velocity of light without the utility of light as a detector. If it is possible to create a tachyon in the laboratory, it may be possible to time the path taken by the tachyon from creation to destination, like timing an athlete from the starting point to the finishing line. For example, the tachyon’s creation activates a timer which stops when the tachyon hits an obstruction - the destination (synchronize the timer to perform this function). This time taken is the time the tachyon takes to travel from its propagator (creator - equipment) to its obstruction - destination. This is the most direct method of gauging the velocity of a tachyon.

CONCLUSION

In 2012 at CERN, it was thought that the superluminal motion of neutrinos (that is, tachyons) was found, but later investigation showed that this CERN experiment had been faulty (reportedly, there had been a cabling problem). However, detecting the elusive tachyon would be an important milestone in physics.

REFERENCES

1. Beiser A. *Concepts of Modern Physics***.** Fifth Edition. McGraw-Hill; 1995.
2. Bender A. L. *SlipString Drive: String Theory, Gravity, and “Faster Than Light” Travel***.** iUniverse; 2006/2007.
3. Einstein A. *On the Electrodynamics of Moving Bodies*. Annelen der Physik. 1905; 17: 891p.
4. Einstein A. *The Meaning of Relativity***.** Princeton; 2005.
5. Magueijo J. *Faster Than the Speed of Light: The Story of a Scientific Speculation.* Perseus; 2003.
6. Tipler P, Llewellyn R. *Modern Physics.* 4th. Edition. W. H. Freeman Company; 2002.

Cite this Article
Bertrand Wong. Existence of Tachyons and their Detection. *Research & Reviews: Journal of Physics*. 2019; 8(2): 23–26p.