Contradictions in the Application of Special Relativity Theory to the Problem of GPS and the Sagnac Effect

Henok Tadesse
Email: *entkidmt@yahoo.com*

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Abstract

The Sagnac effect and the GPS Sagnac effect are usually cited as evidence of special relativity, which assumes constant speed of light in all inertial reference frames. The GPS Sagnac effect arises because the observer is on a rotating reference frame. Since the point of light (signal) emission is fixed in the non-rotating inertial frame (ECIF) and since the observer is moving towards or away from that point, the time delay of light will increase or decrease depending on whether the observer and the light beams are moving in the same or opposite directions. This gives rise to the GPS Sagnac effect and agrees with the premise of special relativity that the speed of light is constant *c* in the ECI frame. However, a contradiction follows. Imagine an observer and two light sources in a closed lab on the surface of the Earth at the equator. One light source is to the East of the observer and the other light source to the West of the observer, with the observer at mid-point between the two sources. Therefore, the observer and the light sources are moving towards the East due to rotation of the Earth. Since the light sources and the observer are on a rotating frame, the observer will detect a difference in time delay of the two light beams, in accordance with special relativity. The light from the East arrives earlier than the light from the West. This contradicts the principle of relativity because it proves absolute motion, in accordance with Galileo's ship thought experiment.

Introduction

The Sagnac effect and the GPS Sagnac effect are usually cited as evidence of special relativity, which assumes constant speed of light in all inertial reference frames. The GPS Sagnac effect arises because the observer is on a rotating reference frame. Since the point of light (signal) emission is fixed in the non-rotating, inertial frame (ECIF) and since the observer is moving towards or away from that point, the time delay of light will increase or decrease depending on whether the observer and the light beams are moving in the same or opposite directions. This gives rise to the GPS Sagnac effect and agrees with the premise of special relativity that the speed of light is constant *c* in the ECI frame. However, a contradiction arises.

Prediction of GPS Sagnac effect by the special theory of relativity in the ECIF

Imagine an observer moving in a circular path around a center O, with two light sources at equal distances, one behind and one in front of the observer with respect to the direction of tangential velocity.

Let us assume O to be the center of the Earth. Points P, Q and A are points in a lab frame on Earth. P is to the West and Q to the East relative to point A. The observer is at point A , and the two light sources are at points P and Q. We consider two reference frames: inertial reference frame S (ECIF) and rotating reference frame S'.

Electrical engineer, BSc, Debrezeit, Ethiopia Mobile: +251 910 751339
or +251 912 228639 Alternate email: *wchmar@gmail.com*

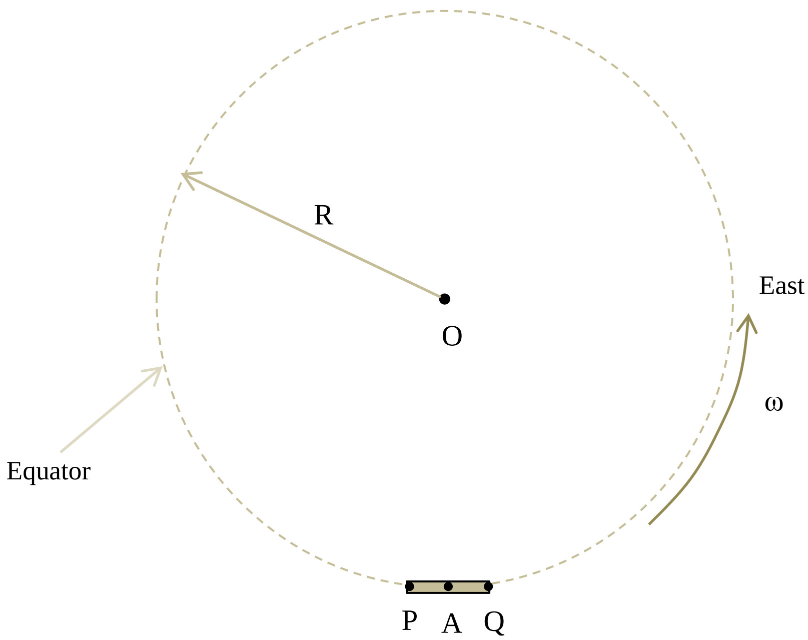

Fig. 1

Both S and S' have origins at O. Since the light sources and the observer are in a rotating frame, the observer at A will detect a difference in time delays of the counter-propagating light beams, in accordance with the second postulate of special relativity that the speed of light is constant *c* in all inertial reference frames. This is because, in the inertial frame S, the light emitted from point P travels longer distance than the light emitted from point Q, and hence the light from point P takes more time than the light from point Q to reach point A (the observer). In other words, the observer is moving away from the light emitted from point P and is moving towards the light emitted from point Q.

Contradiction of GPS Sagnac effect with the principle of relativity

But then this contradicts Galileo's principle of relativity. Imagine that points A, P, Q are all in a closed laboratory on Earth. Now, if the observer in the closed room detects difference in propagation times of the counter-propagating light beams, this proves absolute motion, in accordance with Galileo's ship thought experiment.

Prediction of special relativity in the lab reference frame

Yet another contradiction in special relativity theory is that it predicts that the GPS Sagnac effect cannot exist in the rotating reference frame with origin at point A, that is in the lab frame.

Let us consider the GPS Sagnac effect problem in the rotating frame with origin at A, instead of the Earth Centered Inertial Frame (ECIF). Let S be the inertial reference frame and S' be the rotating reference frame. In this case, both S and S' have their centers at point A in the laboratory, at the point of light detection/observation.

A possible counter- argument is that the rotating reference frame with center at A is a non-inertial frame. An inertial reference frame is one that:

1. Is not accelerating, and
2. Is not rotating.

The lab frame has very small acceleration. For example, the centripetal acceleration of a point on the surface of the Earth is about 0.02 m/s^2. The acceleration of the center of the Earth in its orbit around the Sun is about 0.006 m/s^2. Since these accelerations are small, both the ECI frame and our non-rotating lab reference frame (with origin at point A) approximately fulfill the first condition of an inertial reference frame.

However, our lab frame is rotating and cannot be considered inertial. In general, the (apparent) speed of light between two points on a rotating frame is different in opposite directions (Fig. 2a). However, this apparent anisotropy of the speed of light is just because of difference in distance travelled by light in opposite directions. This explains the Sagnac correction in the GPS.

However, a rotating frame will not affect the propagation time of light between two points on the frame if one of the points is at the origin of the rotating frame (Fig. 2b). In our lab frame above, both the inertial frame S and the rotating frame S' have their origins at point A, at the observer. Therefore, the propagation time of light from P to A is equal to that from Q to A, despite the fact that frame S' is rotating. This is because the observer is at the origin of the rotating frame. The speed of light is constant *c* in both directions in this case. Therefore, no Sagnac effect correction would be required in the GPS.

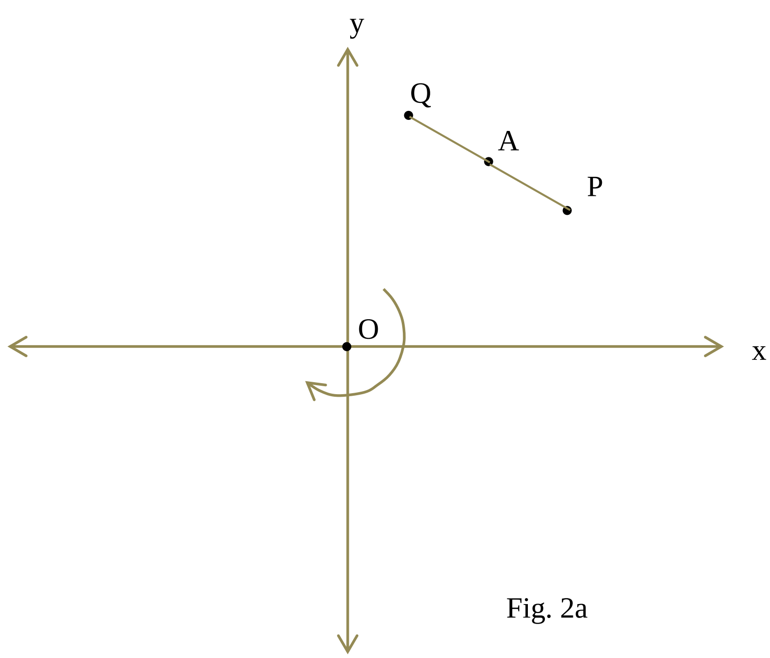

Fig. 2a

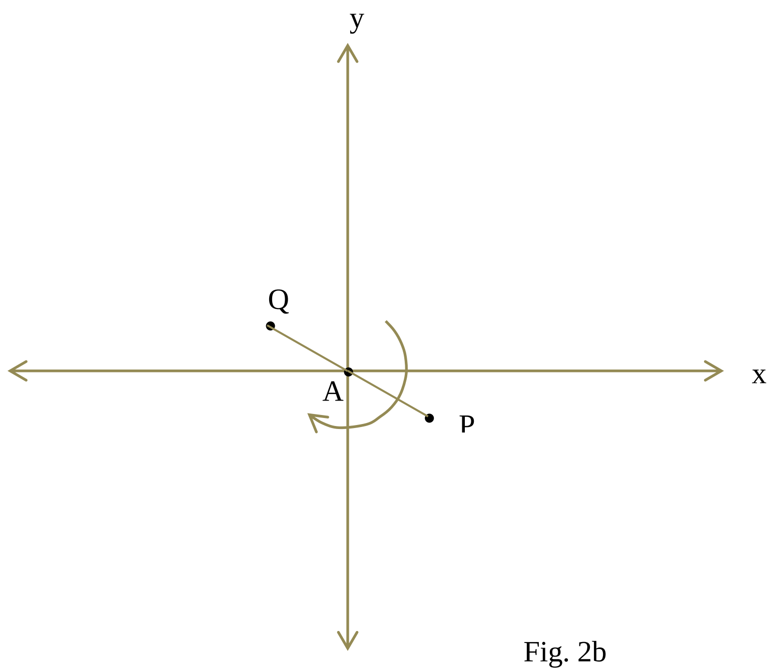

Fig. 2b

Therefore, we have seen that in a rotating reference frame with origin at O, special relativity predicts difference in propagation times of light in opposite directions between two points. However, in a rotating frame with origin at A, special relativity predicts that there will be no difference in time of the counter-propagating light beams. This is a contradiction.

Moreover, the accelerations and rotation rates of the frame S' can be reduced to arbitrarily small values by assuming arbitrarily large values of Earth radius R, and reducing ω by the same factor, to keep the tangential velocity the same. This further nullifies any counter-arguments claiming that the rotating lab frame is non-inertial and therefore the time delay of light between two points is different in opposite directions. We also know that the fringe shift in the Sagnac effect has a simple dependence on the tangential velocity ωR, not on acceleration.

The above arguments are for the problem of GPS Sagnac effect, that is the Sagnac effect observed in the GPS. These arguments also apply to the Sagnac experiment. In this case, O is the center of rotation of the device.

By the same argument, special relativity predicts a fringe shift in the lab frame in the case of Sagnac experiment, but predicts a null fringe shift in the rotating reference frame with origin at the detector.

The idea presented in this paper was inspired by the discussion on an internet forum [1].

Alternative theory

The principle of relativity has also been disproved in a number of 'ether' drift experiments, such as the Miller, the Marinov, the Silvertooth and several other experiments.

Although there are so many logical and experimental evidences against special relativity, to this date, there is no known theoretical model of the speed of light that is consistent with all experiments. The problem is not only the lack of a correct model of the speed of light; mainstream physicists do not believe in the failure of relativity theory and in the need for a new model.

I have proposed a new theory called Apparent Source Theory (AST) in a number of papers [2][3][4]. Apparent Source Theory is consistent with (or, has the potential to consistently explain) the Michelson-Morley, the Kennedy-Thorndike, the Silvertooth, the Marinov, the Bryan G Wallace, the Sagnac and other experiments. No single known theory has achieved this so far. Existing theories such as ether theories, emission theories and the special relativity theory have decisively failed on more than one experiments. An extensive explanation of Apparent Source Theory is found in [2][3][4].

Conclusion

The special relativity theory predicts the Sagnac effect and, in fact, absence of the Sagnac effect would disprove special relativity. But then the Sagnac effect leads to an immediate contradiction with the principle of relativity because it predicts that an observer at mid- point between two light sources, one in front and one behind the observer, in a closed room will detect a difference in propagation times of the counter propagating light beams, and this time difference is proportional to the tangential velocity.

Thanks to Almighty God Jesus Christ and His Mother Our Lady Saint Virgin Mary

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