Can the Michelson-Morley experiment be reconciled with the Sagnac effect?

Arieh Sher

Abstract

Michelson-Morley experiment and Sagnac effect were aimed to solve a long debated and crucial question in physics - does the aether exist? But the experiments resulted in two contradictory results –the Michelson-Morley experiment finding was that there is no aether whereas Sagnac showed that the aether exists. Current Physics has no clear answer to this basic and profound conundrum.

Current Status

Michelson-Morley experiment (MMX) (1897) and the Sagnac effect (1913) were aimed to solve a long debated and crucial question in physics - does the aether exist? The aether exitance is in accord with Newton's claim that the universe has an absolute frame of reference. On the other hand, disproving the aether exitance agrees with Einstein's SR that there is no absolute frame of reference but rather many non-privileged frames of reference. But the experiments resulted in two opposing results – MMX's finding was that there is no aether, whereas Sagnac showed that the aether exists.

Because of its importance, MMX has been repeated by many scientists at different times, that used various techniques of measurements. The result has been always the same - there is no aether.

On the other hand, the Sagnac experiment was initially advised by Sagnac to show that, contrary to SR proposed by Einstein, there is an aether. Sagnac's experiment, was repeated by Michelson-Gale (1925) and other similar experiments. All these experiments confirmed the aether's exitance, therefore refuting Einstein's SR. Between these two opposing theories, the SR theory was accepted by the majority of the physical community as the correct one. Ironically, people used SR postulates for explaining the Sagnac effect. The first explanation relying on SR of the phenomenon was provided by Paul Langevin in 1921. However, Langevin was disproved by the Dufour and Prunier experiments in 1942. The Sagnac effect has stimulated a century-long debate on its meaning and interpretation. Currently, there is no accepted theoretical explanation for the Sagnac effect.

Even though theoretical physics has no accepted explanation, the Sagnac effect has been used by engineers to build devices such as ring-lasers

gyroscopes. These gyroscopes are very accurate and are used routinely in navigation systems of satellites, aircraft, ships, submarines, etc.

Is it possible to reconcile MMX and Sagnac effect?

I claim that this is possible.

My explanation is based on another paper:
https://www.academia.edu/81829188/Does_the_universe_have_an_absolute_reference_frame

I claim that there is an aether (or vacuum space), that has physical properties.

Claiming this refutes SR that there is no aether. I claim that MMX data is correct, but not its interpretation. The reason for the null result is not that aether does not exist but results from the frame dragging of the aether. A similar idea was suggested by Stokes. However, Stokes's hypothesis was proven wrong, because he related only to the frame-dragging of Earth. I claim that the entire space in our universe is frame dragged by a huge neutron star, I designate the Pivot, located at the center of our universe.

I described the structure of the Pivot universe. Our matter universe is located in space. I conjecture that our matter universe composes of a spinning neutron star that drags the space around it. All celestial bodies (from dust to galaxies) are located in the dragged space and move together with it. In the above paper, I related only to MMX and explain how MMX results in a null result.

I briefly mention in the paper that in addition to dragging all celestial bodies with space, they simultaneously also spin on their axis. Now I would like to elaborate on the Sagnac effect.

Sagnac build an instrument that rotated on its axis. A source of light was placed on the edge of the instrument. The source sent simultaneously the light in two closed and opposing directions. Both rays of light arrived eventually at one detector. According to Sagnac the time difference between the light that is traveling in both opposite directions is:

https://en.wikipedia.org/wiki/Sagnac_effect

$$\Delta t = \frac{4 \cdot A \cdot \omega}{c^2}$$

Where:

A.....Area of the ring

ω.....Forced angular velocity

c....Speed of light

Fig.-1 shows the structure of our matter universe. (More details in the paper mentioned above). It shows the disk shape of the universe with spirals representing dragged space. The area that is within the event horizon is not considered because our matter universe cannot exist there. A rigid disk is placed in the dragged space. In addition to dragging the disk in the direction of space rotation, it also spins on its axis in a direction contrary to space direction.

Detail A shows the rigid disk. The velocities at points "a" and "b" differ. The velocity of point a – V2 is bigger than the velocity V1 at point b. Therefore, the rigid disk must rotate at its "natural" angular velocity $\omega_{disk} = \frac{V_2 - V_1}{R_{Disk}}$

The size of the rigid disk can differ. Its radius can vary from centimeters up to the sizes of celestial bodies. If the rigid disk is forced to rotate by an external moment (either clockwise or counter-clockwise) there is a deviation from the natural angular velocity $\omega_{Disk.}$ This deviation is expressed in the Sagnac effect. Fig.-1 also shows why the Sagnac effect is dependent on the area of disk A.

The reader is also referred to the experiment done by Prof. Taylor https://www.youtube.com/watch?v=QcBpDVzBPMk (start time: 3:38 min). In this experiment, it is shown how a rotating cylinder immersed in viscous fluid drags the fluid around it and solid objects that are placed in the fluid. What is important to the current discussion is how, simultaneously, the motion of the viscous fluid causes the rotation of a solid ring that is immersed in the fluid. The direction of rotation of the ring is contrary to the direction of the entire fluid.

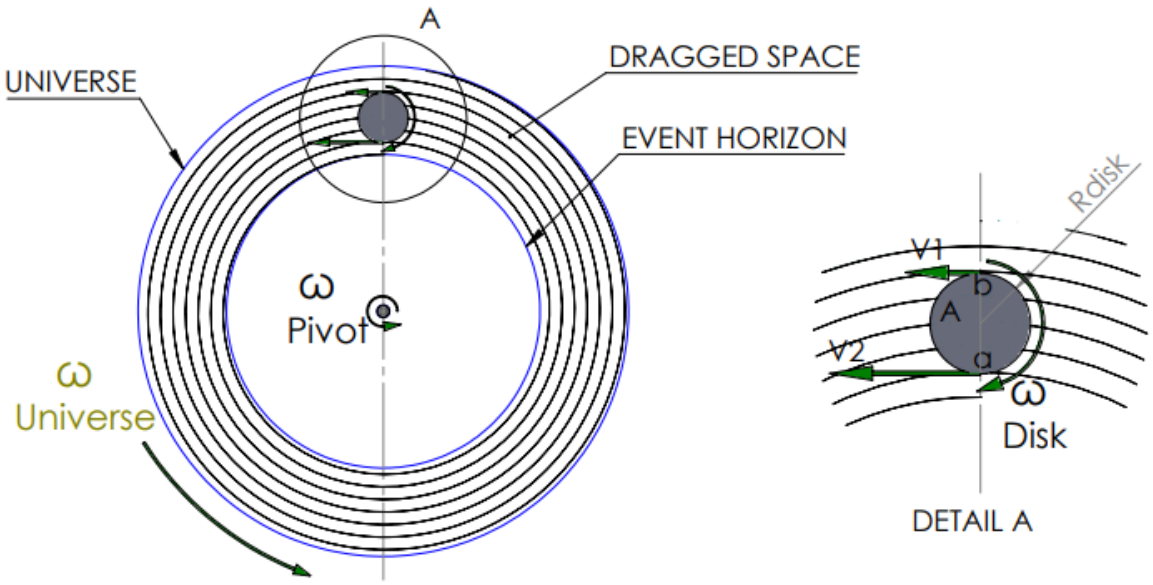

Fig. 1 – Sagnac effect

I would also to relate to the long-debated experiment designated “Newton’s bucket”. In Newton’s experiment, a bucket is filled with water and hung by a rope. If the rope is twisted around and around until it is tight and then released, the bucket begins to spin rapidly, not only with respect to the observers watching it, but also with respect to the water in the bucket, which at first doesn’t move and remains flat on its surface. Eventually, as the bucket continues to spin, the water starts to rotate as well, as can be seen from the concave shape of its surface. This concaving of the water shows that it is rotating, even though it is now at rest with respect to the co-rotating bucket. Newton pointed out it is not the relative motion of the bucket and water that causes the concavity of the water. The concaving of the water suggests that it is rotating with respect to something else, far more remote. In Newton’s thinking, this showed rotation relative to absolute space.

This explanation of Newton was disputed by Mach. Mach wrote that Newton’s experiment merely shows that the relative rotation of the water with respect to the sides of the vessel produces no noticeable centrifugal forces and that such forces are instead produced by its relative rotation with respect to Earth and the other celestial bodies.

I concur with Newton. The disk in Fig. 1 can represent the surface of the water in the bucket. In a steady state, the bucket and the water are spinning at the

natural frequency ω_{Disk}. When the bucket is forced by an external moment to rotate, it deviates from the natural frequency and its surface become concave.