

The ‘Ponderable’ Aether¹

Raymond HV Gallucci, PhD, PE
8956 Amelung St., Frederick, Maryland, 21704
e-mails: gallucci@localnet.com, r_gallucci@verizon.net

Despite the long-accepted claims by mainstream physicists that the 1887 Michelson-Morley interferometer experiment ‘proved’ that an aether did not exist, based on its alleged ‘null result,’ ‘dissident’ physicists have long contended that it proved the opposite, some citing the ‘null result’ as evidence of its existence due to ‘aether drag,’ others lending credence to the relevance of the alleged ‘noise’ that was dismissed when arriving at the ‘null’ conclusion. The latter group attest that the alleged null result was anything but, with an ‘aether wind’ on the order of 10 km/s detected but dismissed as “noise,” thereby opening the door to Einstein’s special relativity. Repeated interferometer experiments even more sensitive were performed by Dayton Miller, including several with Edward Morley, in the first part of the 20th century, allegedly confirming an ‘aether wind,’ again summarily dismissed as anomalous “noise” to preserve Einstein’s relativity. Now there may be as many aether theories as there are dissident physicists who postulate an aether, some believing it to be fixed against absolute space, others that it can be ‘dragged’ by massive bodies such as Earth (and hence the alleged ‘null result’), and some that believe it flows between ‘sources’ and ‘sinks’ throughout the universe. Some believe it comprises all matter and energy, with light just being one of its various manifestations. I know not whether there is an aether. All evidence appears to be circumstantial, as nothing material has ever been detected (if that is even possible), and I do not begin to claim to even know how such would be possible. My goal here is to examine some phenomena for which an aether, if it exists, could offer an alternate explanation, neither confirming nor denying its existence.

1. Introduction

There may be as many aether theories as there are ‘dissident’ physicists who believe in the aether. I have encountered some (for a synopsis of many of them see “Modern Scientific Theories of the Ancient Aether,” <http://www.mountainman.com.au/aetherqr.htm>), with the more popular themes being that it is ‘dragged’ by massive bodies, such as the Earth (with or without corresponding rotation), thereby ‘explaining’ the ‘null result’ from the Michelson Morley interferometer experiment of 1887, e.g., Ref. [1], or that it ‘flows’ from ‘sources’ throughout the universe (in some cases, such as Ref. [2], the ‘cosmic voids’ themselves) into ‘sinks’ (such as the Earth [2]). I refer to these as the ‘dragged aether’ and ‘aether flow’ models in subsequent discussion.

I do not know whether or not there is an aether. Various ‘relativistic’ phenomena, e.g., time dilation, cosmological redshift, ‘extended’ muon lifetimes, can be and have been explained ‘classically,’ with or without any aether being considered or the need to restrict light speed to a constant, maximum universal limit (e.g., see Refs. [3-8], which cite some of these sources). The purpose here is to examine three such phenomena, explained ‘relativistically’ by mainstream physics (and even some ‘dissidents’), assuming the presence of an aether to determine if an alternate explanation is plausible.

2. Cosmological Redshift – Due to ‘Aether Flow?’

The mainstream physics explanation for the cosmological redshift is expansion of the four-dimensional space-time universe due to the original Big Bang, where an infinitely dense non-volume of ‘whatever’ exploded, and its momentum outward continues today, possibly unchecked. Many ‘dissident’ explanations cite various forms of ‘tired light’ theories (for a synopsis of many, see Ref. [9]), whereby light interacts with particles, fields, etc., during its long inter-galactic journey from source to Earth such that it loses energy and thereby ‘reddens.’ Aether is specifically excluded in the mainstream explanation; it may or may not be included in some of the ‘tired light’ explanations. Might ‘aether flow’ be a plausible explanation for the cosmological redshift as well?

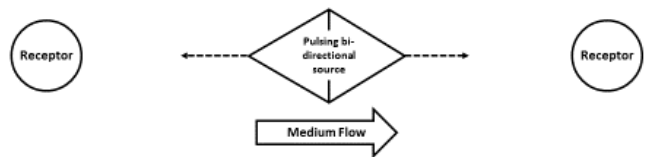


FIGURE 1. Pulsing, Bi-Directional (Light) Source Remains Stationary with Respect to Moving Medium (Aether)

In Figure 1 a stationary, bi-directional pulsing source emits (light) waves in the ‘positive’ (right) and ‘negative’ (left) directions toward a pair of equidistant, stationary receptors. If the medium of the waves (the aether) is not moving (i.e., remains stationary with respect to the source and receptors), waves that are not Doppler-shifted are received equally at each receptor. However, if the medium itself is moving, say at a velocity 33% that of the wave speed (constant) in the medium itself, in the positive direction as shown, the receptor in the positive direction will receive Doppler-shifted waves with a frequency 25% lower and a wavelength 33% longer (analogous to a ‘red-shift’ for light); the receptor in the positive direction will receive Doppler-shifted waves with a frequency 50% higher and a wavelength 33% shorter (analogous to a ‘blue-shift’ for light), as shown in Figure 2.

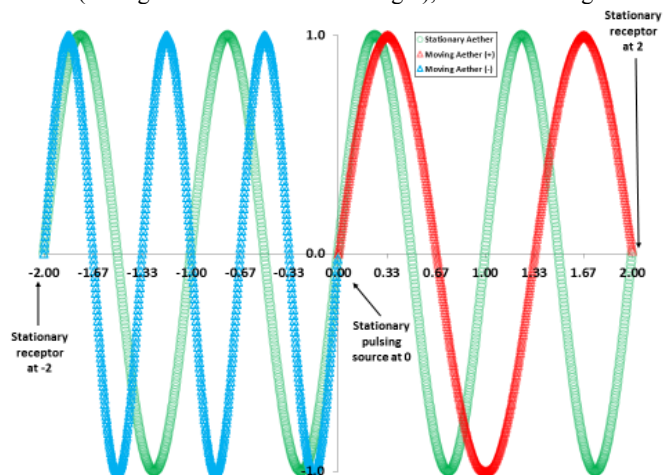


FIGURE 2. Red- (and Blue-)Shift from Stationary Source due to Moving Medium (Aether)

¹ The choice of ‘ponderable’ in the title is a play on words. It implies both something that is “capable of being weighted or measured” as well as the ability “to think about (something).” While I do not know if an aether can be weighed or measured, at least I can think about it.

The ‘aether flow’ explanation for this would be that Earth serves as a planetary ‘receptor’ toward (into?) which aether flows, such that all ‘sources’ are necessarily ‘upstream’ and, thus, light from these sources is red-shifted. Recognize that motion of the source relative to the medium can result in smaller red-shifts or even blue-shifts when the source approaches Earth (‘with the flow’), but larger red-shifts when it recedes from Earth (‘against the flow’).

3. ‘Time Dilation’ – Due to ‘Aether Drag?’

‘Aether drag,’ as used here, must not be confused with ‘dragged aether.’ The latter is a fairly popular theory that the aether is ‘dragged’ along with Earth during its motion around the sun (and with the sun around the Milky Way, and the Milky Way relative to other galaxies, etc.), with or without accompanying rotation due to Earth’s rotation. ‘Aether drag’ is used here in the classical sense of a resistive medium, such as air or water. Relativistic time dilation is often attributed to the mass increase of the particles that comprise a ‘clock’ (physical, atomic, etc.) as the clock approaches light speed, thereby slowing the motion of the particles due to increased inertia. As such, ‘moving clocks always run slower’ in the relativistic world. This does not necessarily imply any change in time itself (at least not to some dissident physicists), but is just a physical, or possibly only observational, phenomenon.

Most discussions of relativistic time dilation or mass increase focus on sub-atomic particles, such as those in particle accelerators or atomic clocks (e.g., Hafele-Keating experiment, Global Positioning System, ‘extended’ muon lifetimes). Although beyond the current capabilities of our technologies to accelerate macroscopic objects toward light speed, it might be instructive to imagine a physical, macroscopic clock at such high speeds, such as a water or pendulum clock, in the presence of air as an analogy with motion relative to an aether. Consider Figures 3 and 4 (at end of paper).

As these two examples show (substitute a resistive aether for the air), motion can speed up or slow down (or leave unchanged) ‘clock time,’ depending not only on the direction by which the ‘clock time’ is measured (e.g., uni-directional [water clock] or oscillatory [bi-directional, pendulum clock]), but also on the direction of motion of the clock relative to the direction by which the ‘clock time’ is measured. Not shown, but apparent by analogy, if either clock moves in a direction perpendicular to the direction by which the ‘clock time’ is measured, there is no effect on the resistive drag, and the ‘clock time’ remains unchanged relative to the stationary case.

4. Maximum Speed – Due to ‘Aether Drag?’

The speed of light is allegedly the maximum speed attainable by anything in the universe, be it matter or energy (some ‘relaxation’ is conveniently granted by mainstream physics to permit space-time itself to exceed this speed to preserve the current cosmological expansion model [as well as the occasional ‘inflationary’ period]). Does the concept of a limiting speed make sense in the absence of an aether? Does an aether imply a limiting speed?

Return to the ‘water clock’ example, where the net force was shown to be $\rho\pi r^2(4gr/3 - Dv^2/2)$, using ‘v’ instead of ‘w’ generically for speed. The first term is due to gravitational acceleration; the second due to air (aether) drag deceleration. Setting the constants = 1 for simplicity and using $F = ma = a = dv/dt$ (set $m = 1$), we can write this general expression as $dv/dt = 1 - v^2$, where ‘1’ is a unitized constant acceleration (analogous to gravity) and v^2 represents the drag. Solving this with initial condition (0,0) yields $v = \tanh(t)$. As shown in Figure 5, the answer is ‘yes.’

5. Conclusion

The only conclusion I can draw from these simple investigations is that, if there is an aether (be it “fixed,” “dragged,” “flowing,” etc.), it can provide alternate explanations to the allegedly relativistic phenomena examined here: ‘cosmological redshift’ (due to expanding space-time), ‘time dilation’ and limiting speed. While I do not specifically address the role of an aether in establishing a constant light speed (relative to an aether), I believe an aether would be necessary for such a constraint to exist. Otherwise, light speed should be variable with not only observer but also source velocity. Without ‘aether drag,’ what would limit the speed of matter or energy to the speed of light? But, my beliefs aside, it appears that at least these three phenomena, supposedly explained only by relativity and the current mainstream cosmological model, can have alternate explanations based on the existence of an aether.

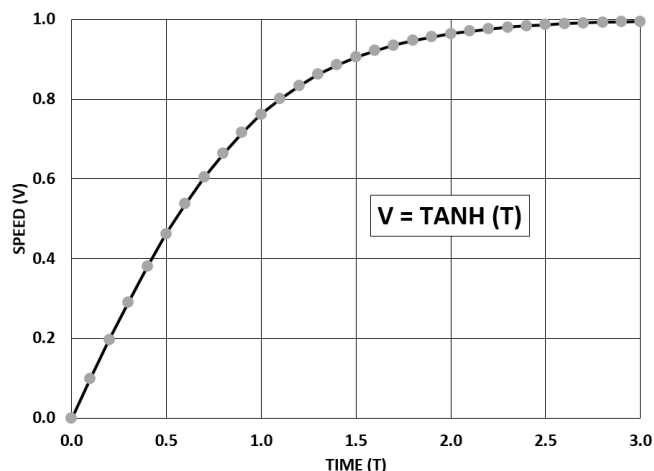
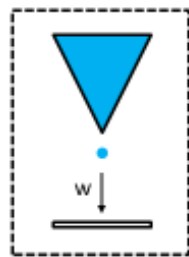


FIGURE 5. Effect of ‘Aether Drag’ on Maximum Speed

6. References

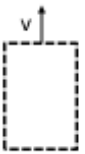
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A stationary water clock (water-filled pail + plate) drops water uniformly as droplets of radius 'r' and speed 'w' onto a plate under a gravitational field in air (assume $w =$ average speed of droplet during fall). The time interval between the droplet's emergence from the pail and striking the plate is the measured time unit. The net force on the droplet is Gravity minus Drag $= \rho g(4\pi r^3/3) - \rho w^2 D\pi r^2/2 - \rho \pi r^2(4gr/3 - Dw^2/2)$, where $\rho =$ water density, $g =$ gravitational acceleration and $D =$ drag coefficient (air).

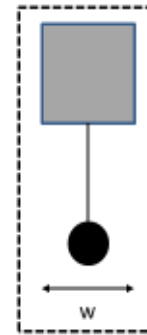


Now, move the water clock (pail + plate) downward (in direction of gravity) at uniform speed 'v,' such that the net speed of the droplet relative to the air is $w + v$. Since the distance between the pail and plate is unchanged, the gravity force is the same. However, the higher speed of the droplet relative to the air ($w + v > w$) translates into increased drag, slowing the speed at which the droplet falls to the plate relative to the water clock. The measured time interval is now longer, meaning the 'clock time' has slowed.

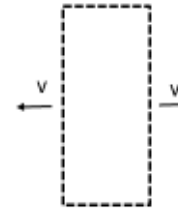


Finally, reverse the situation, moving the water clock upward (opposite to gravity) at v , such that the net speed of the droplet relative to the air is now $w - v$ (which can be positive, negative or zero, depending on v [note that it enters the equation only as a squared term, so its squared value is always non-negative]). This lower speed of the droplet relative to the air ($w - v < w$) translates into decreased drag, increasing the speed at which the droplet falls to the plate relative to the water clock. The measured time interval is now shorter, meaning the 'clock time' has sped up.

FIGURE 3. Water 'Clock,' Stationary and Moving



A stationary pendulum clock with a pendulum of radius 'r' and thickness 'h' measures time by the interval over which the pendulum, swinging with average speed 'w,' returns to its original position. Ignoring gravity, which acts uniformly downward on the pendulum throughout its swing, the only force acting in the direction of swing is the resistive drag from air, i.e., $\rho w^2 D(2rh)/2 - \rho w^2 Drh$, where $\rho =$ pendulum density and $D =$ drag coefficient (air). Since the average speed of the pendulum (w) relative to the air is the same in each direction, the drag force is the same in each direction, such that each 'back' and 'forth' time interval is the same (the total is the measured 'pendulum time').



Now, place the pendulum clock in uniform motion either right or left with constant speed v . When the pendulum is swinging in the direction of v , its speed relative to the air is $w + v > w$, and the resistive drag force increases. The time interval for this 'back' (or 'forth') swing is thereby increased, i.e., the 'pendulum time' slows for this portion of the swing. On its return (the 'forth' or 'back' portion), the speed relative to the air is now $w - v < w$ and the resistive drag force decreases. The time interval for this 'forth' (or 'back') swing is thereby decreased, i.e., the 'pendulum time' speeds up for this portion of the swing. However, note that the speed enters the drag force as a squared term. As a result, the drag force increase when the pendulum swings in the direction of the moving pendulum clock $(w + v)^2 - w^2 = v(2w + v)$ exceeds drag force decrease when the pendulum swings against the direction of the moving pendulum clock $(w - v)^2 - w^2 = v(v - 2w)$ by $v(2w + v) - v(v - 2w) = 4vw$. The net effect for the overall 'back' and 'forth' swing is increased drag, thereby slowing the swing speed relative to the air and increasing the measured time interval, i.e., 'pendulum time' slows.

FIGURE 4. Pendulum 'Clock,' Stationary and Moving

Addendum – Mass Increase?

A classicist, relativist and 'aetherist' stop off at a bar after watching a baseball game. The classicist asks: "Did you notice they were using a specialized catcher's mitt that records the force 'F' with which the pitcher throws the baseball? It measures the impulse (change in momentum, $\Delta P = \Delta[mv]$) during the contact time (Δt), thereby providing the force ($F = \Delta P/\Delta t = \Delta[mv]/\Delta t$). During pre-game warm-up, the pitcher threw with force F . However, during the game, he doubled this to $2F$, meaning he threw twice as fast during the game vs. warm-up, since the mass of the baseball 'm' and the contact time remained unchanged, so he had to have doubled the speed 'v' to $2v$." "Not so fast," countered the relativist. "Consider that the maximum speed at which a baseball can travel is not $2v$ but only $v\sqrt{3}$ ($= 1.73v$) according to relativity. Thus, the only way he could have doubled the force during the game would be if the mass of the baseball m itself increased to $2m/\sqrt{3}$ ($= 1.15m$) due to the now maximum speed of $v\sqrt{3}$, i.e., the mass of the baseball increased by 15%."

"But wait a minute," rebutted the classicist. "If the alleged maximum speed of a baseball were only $v\sqrt{2}$ ($= 1.41v$), then the alleged mass increase of the baseball would have been from m to $m\sqrt{2}$ ($= 1.41m$), or 41%. Thus, the mass would have increased even more for a lower maximum speed. Is this consistent with your theories?" "You both have a piece of it right," inserted the aetherist. "While it's true that there is a maximum speed at which a baseball can travel due to 'aether drag,' although my esteemed anti-aether relativist would not agree to this being the reason, there is no need to postulate a mass increase of the baseball due to increased speed. The baseballs used during the game were just heavier (more massive) than those used during pre-game. So, the pitcher threw a baseball of mass $2m/\sqrt{3}$ at speed $v\sqrt{3}$ during the game, vs. one of mass m at speed v during warm-up."

