

# The ‘Ponderable’ Aether<sup>1</sup>

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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 20<sup>th</sup> 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

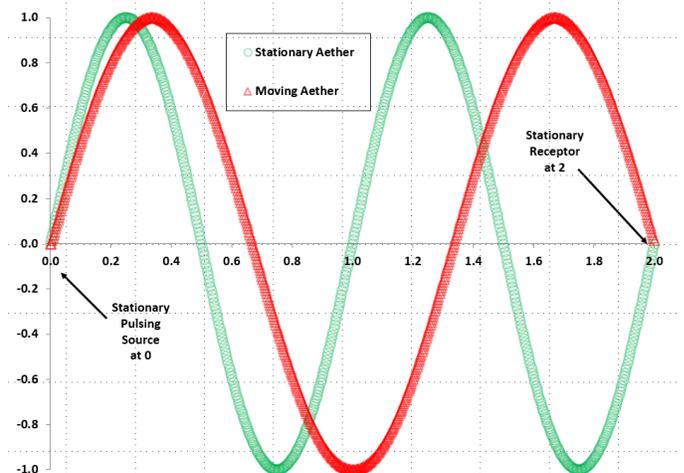
There may be as many aether theories as there are ‘dissident’ physicists who believe in the aether. I have encountered some (for a synopsis of many of them see “Modern Scientific Theories of the Ancient Aether,” <http://www.mountainman.com.au/aetherqr.htm>), with the more popular themes being that it 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 the first as the ‘dragged aether’ and introduce another concept, ‘aether stretch,’ 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 Stretch?’

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 stretch’ be a plausible explanation for the cosmological redshift as well?

Assume a stationary, pulsing source emits (light) waves toward a stationary receptor. If the medium of the waves (the aether) remains stationary with respect to the source and receptor, waves that are not Doppler-shifted are received by the receptor. However, if the medium itself is stretching, say at a velocity 33% that of the wave speed (constant) in the medium itself, the receptor will receive Doppler-shifted waves with a frequency 25% lower and a wavelength 33% longer (analogous to a ‘red-shift’ for light) as shown in Figure 1.



**FIGURE 1.** Red-Shift from Stationary Source due to Stretching Medium (Aether)

The ‘aether stretch’ explanation for this would be that Earth serves as a planetary ‘receptor’ toward which aether is stretched, 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 stretch’), but larger red-shifts when it recedes from Earth (‘against the stretch’).

To elaborate a bit on this concept, consider a star that emits light with frequency, wavelength =  $\nu_*$ ,  $\lambda_*$ . Assuming the aether in the immediate vicinity of the star is somehow ‘stretched’ (e.g., gravity or some other phenomenon), the starlight would be perceived by an observer in the interstellar medium, assuming the observer has no

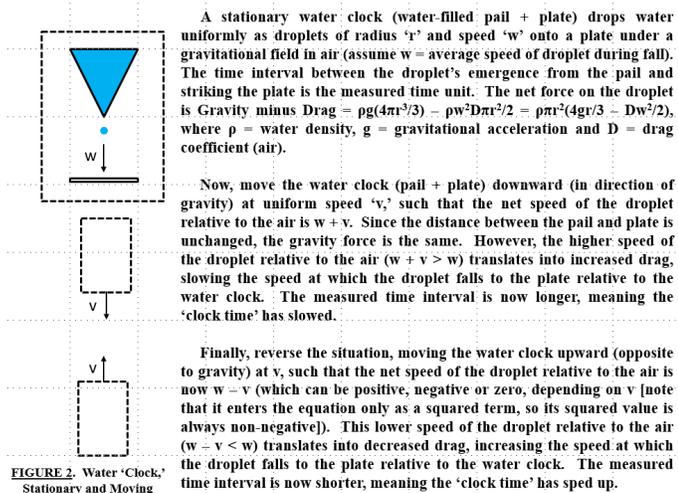
<sup>1</sup> The choice of ‘ponderable’ in the title is a play on words. It implies both something that is “capable of being weighted or measured” as well as the ability “to think about (something).” While I do not know if an aether can be weighed or measured, at least I can think about it.

'aether-stretching' effect, as having frequency, wavelength =  $\nu_0, \lambda_0$ , ostensibly 'blue-shifted' from the emission point but, in actuality, perceived as the 'true' frequency, wavelength, assuming no way to travel to the star to perceive the original  $\nu_-, \lambda_+$ . Now insert an observer, e.g., a planet or even another star, that can also 'stretch' the aether in its vicinity. The 'true' frequency, wavelength of the starlight as perceived in interstellar space,  $\nu_0, \lambda_0$ , is now perceived as  $\nu^-, \lambda^+$ , likely different from the original  $\nu_-, \lambda_+$  as emitted from the star (i.e.,  $\nu_-, \lambda_+ \neq \nu^-, \lambda^+$ ), but still 'red-shifted' relative to the light perceived in the interstellar medium in the absence of the 'aether-stretching' observer. Effectively, the original starlight is 'doubly-stretched,' although there is no way of gauging the 'original' stretch as it leaves the star (unless one were to travel to that star). Thus, the 'effective' red-shift is the decrease in frequency from  $\nu_0$  to  $\nu^-$  and increase in wavelength from  $\lambda_0$  to  $\lambda^+$ .

### 3. 'Time Dilation' – Due to 'Aether Drag?'

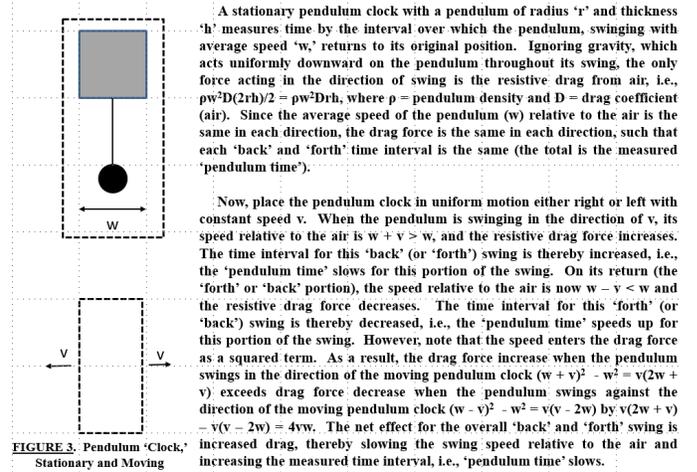
'Aether drag,' as used here, must not be confused with 'dragged aether.' The latter is a fairly popular theory that the aether is 'dragged' along with Earth during its motion around the sun (and with the sun around the Milky Way, and the Milky Way relative to other galaxies, etc.), with or without accompanying 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 2 and 3.



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.



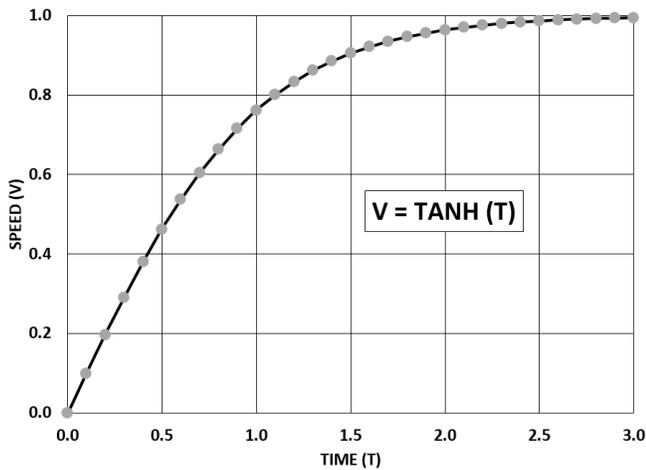
### 4. Maximum Speed – Due to 'Aether Drag?'

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  $\rho \pi r^2(4gr/3 - Dw^2/2)$ , 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 4, 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,' 'stretching,' 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 4. Effect of ‘Aether Drag’ on Maximum Speed**

## 6. References

1. R.W. Kehr, “The Detection of Ether,” 2002 (available at <http://www.teslapysics.com/>)
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## 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 ( $\Delta t$ ), 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.

# THE “PONDERABLE”\* AETHER

\* “Capable of being weighted or measured” as well as the ability “to think about (something).”

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## MICHELSON+MORLEY (M+M) VS. MILLER(+MORLEY)

- While mainstream physics has long claimed that the 1887 M+M Interferometer Experiment ‘proved’ the non-existence of aether, dissident physicists have claimed the opposite (‘null’ result suggests ‘dragged aether’).
  - ‘Null’ result was anything but – ‘aether wind’ as much as 10 km/s detected but dismissed as ‘noise.’
  - 20<sup>th</sup> century experiments by Dayton Miller (+ Morley, in some cases), using better controls and apparatus, ‘confirmed’ an ‘aether wind.’

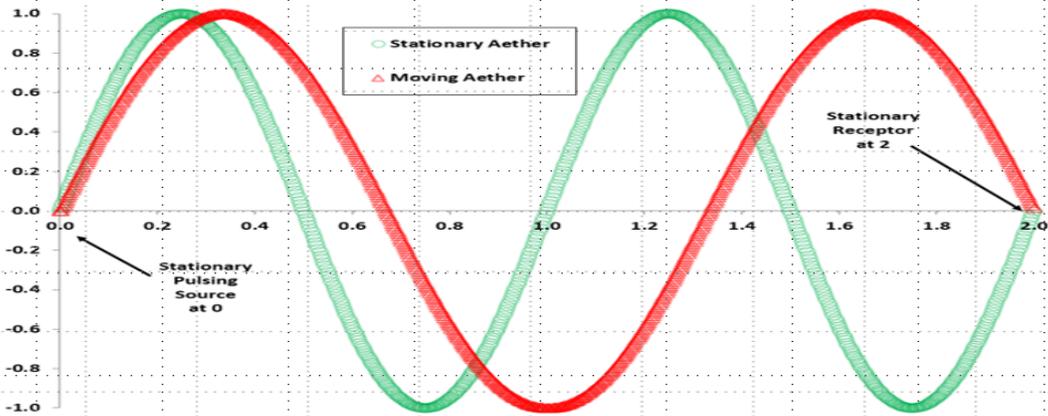
## AETHER THEORIES ABOUND

- There may be as many aether theories as there are dissidents who postulate an aether
  - Many contend aether is ‘dragged’ by massive bodies, including the Earth (‘dragged aether’) [e.g., R. Kehr, “The Detection of Ether,” 2002, at [www.teslaphysics.com](http://www.teslaphysics.com)]
  - Many contend it flows from ‘sources’ to ‘sinks’ (‘aether flow’) [e.g., C. Ranzan, “The Dynamic Steady State Universe,” at [www.cellularuniverse.org](http://www.cellularuniverse.org); S. Rado, “Aethro-Kinematics,” 1994, and “Aethro-Dynamics,” 2009]
- Examine three ‘relativistically-explained’ phenomena for possible explanation via an aether theory

## COSMOLOGICAL RED-SHIFT

- Explained ‘relativistically’ by space(-time) expansion, could it be due to ‘aether stretch?’
  - A stationary, pulsing source emits (light) waves toward a stationary receptor.
    - If the medium of the waves (the aether) is not moving, waves that are not Doppler-shifted are received by the receptor.
    - If the medium itself is stretching, say at a velocity 33% that of the wave speed (constant) in the medium itself, the receptor will receive Doppler-shifted waves with a frequency 25% lower and a wavelength 33% longer (analogous to a ‘red-shift’ for light).

# COSMOLOGICAL RED-SHIFT (CONT.)

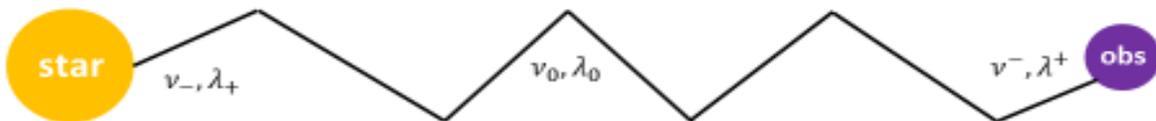


- ‘Aether stretch’ explanation is that Earth serves as planetary ‘receptor’ toward which aether is stretched, necessitating that all stationary or slowly-moving (relative to Earth’s motion) ‘sources’ are ‘upstream’ and, thus, all light is red-shifted

# COSMOLOGICAL RED-SHIFT (CONT.)



Star emits light with frequency, wavelength =  $\nu_-, \lambda_+$  that, in “interstellar space,” is perceived as light with frequency, wavelength =  $\nu_0, \lambda_0$ , i.e., with higher frequency and shorter wavelength since aether in interstellar space is not “stretched,” unlike in the vicinity of the star (due to gravity or some other phenomenon?). Any observer in interstellar space that does not cause a similar aether “stretch” perceives the “true” light from the star as having frequency, wavelength =  $\nu_0, \lambda_0$ .



Now insert an observer, e.g., a planet or even another star, that can also “stretch” the aether in its vicinity. The “true” frequency, wavelength of the starlight as perceived in interstellar space,  $\nu_0, \lambda_0$ , is now perceived as  $\nu^-, \lambda^+$ , likely different from the original  $\nu_-, \lambda_+$  as emitted from the star (i.e.,  $\nu_-, \lambda_+ \neq \nu^-, \lambda^+$ ), but still “red-shifted” relative to the light perceived in the interstellar medium in the absence of the “aether-stretching” observer. Effectively, the original starlight is “doubly-stretched,” although there is no way of gauging the “original” stretch as it leaves the star (unless one were to travel to that star). Thus, the “effective” red-shift is the decrease in frequency from  $\nu_0$  to  $\nu^-$  and increase in wavelength from  $\lambda_0$  to  $\lambda^+$ .

## 'TIME DILATION' – 'AETHER DRAG?'

- 'Aether drag' ≠ 'Dragged aether,' but considers 'drag' in the classical sense of a resistive medium.
- 'Time dilation' is 'relativistically' explained by mass increase ('clock particles' gain mass and move more slowly due to increased inertia, thereby slowing 'time').
  - "Moving clocks always run slower."
    - Hafele-Keating, GPS, 'extended' muon lifetimes, etc.
- Examine motion of a physical, macroscopic clock at high speed in the presence of air as a resistive medium.

## 'TIME DILATION' (CONT.)



- Stationary water clock drops water droplets of radius 'r' at average speed 'w' uniformly onto plate in air under gravitational field.

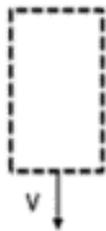
– Interval between emergence from pail and striking of plate = time unit

– Net force on droplet = gravity – drag:

$$\bullet \frac{\rho g(4\pi r^3)}{3} - \frac{\rho w^2 D \pi r^2}{2} = \rho \pi r^2 (4gr/3 - Dw^2/2),$$

$\rho$  = water density,  $g$  = gravitational acceleration,  $D$  = drag coefficient

## 'TIME DILATION' (CONT.)



- Move the water clock (pail + plate) downward at uniform speed 'v'

- Net speed of droplet is now  $w + v$

- Distance between pail and plate is unchanged, gravity is unchanged, so higher droplet speed relative to air translates into increased drag, slowing its descent and 'slowing' clock time (time interval now longer)

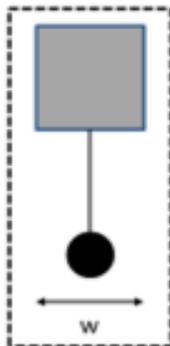


- Now move the water clock upward at 'v'

- Net speed of droplet is now  $w - v$  (while this could be  $< 0$ , since  $drag \propto speed^2$ , drag is never negative)

- Now lower droplet speed relative to air translates into decreased drag, speeding its descent and 'speeding' clock time (time interval now shorter)

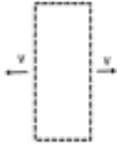
## 'TIME DILATION' (CONT.)



- Slightly more complex is a stationary pendulum clock with pendulum of radius 'r' and thickness 'h' swinging with average speed 'w' (ignore stem of pendulum)

- Ignoring gravity (uniform throughout), resistive drag from air while pendulum swings is  $\frac{\rho w^2 D(2rh)}{2} = \rho w^2 D r h$ ,  $\rho$  = pendulum density.

- Average speed 'w' is the same for 'back' and 'forth,' so drag force is equal in both directions and time interval 'back' and 'forth' is the same (total is measured as 'pendulum time').



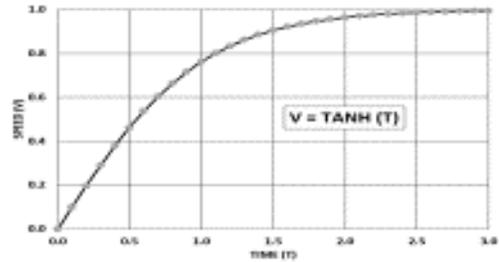
## 'TIME DILATION' (CONT.)

- Place the pendulum clock in uniform motion either right or left at constant speed 'v.'
  - When swinging in direction of v, pendulum speed relative to air is  $w + v > w$ , translating into increased resistive drag, longer time interval and 'slower' time.
  - On its return, pendulum speed is now  $w - v < w$ , i.e., decreased drag, shorter time interval and 'faster' time.
  - Because the speed enters the drag force as a squared term, the drag force increase when swinging in the direction of the moving pendulum is  $>$  decrease in opposite direction, a net overall increase in drag, longer time interval and 'slower' time (relative to stationary).
    - $([w + v]^2 - w^2) - ([w - v]^2 - w^2) = 4vw$

## 'TIME DILATION' (CONT.)

- Both examples show (substitute a resistive aether for the air) that 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 but also on the direction of motion of the clock relative to the direction by which the 'clock time' is measured.
  - 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.

# MAXIMUM SPEED – 'AETHER DRAG?'



- The speed of light is allegedly the maximum speed attainable by anything in the universe, be it matter or energy.
  - 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  $\rho\pi r^2(4gr/3 - Dv^2/2)$ , using 'v' instead of 'w' generically for speed.
  - First term is due to gravitational acceleration; the second due to air (aether) drag deceleration.
  - Setting the constants = 1 and using  $F = ma = a = dv/dt$  (set  $m = 1$ ), rewrite 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 - answer is 'yes.'

## CONCLUSION

- If there is an aether ( "fixed," 'dragged,' 'stretching,' etc.), it can provide alternate explanations to the allegedly relativistic phenomena examined here: 'cosmological redshift,' 'time dilation' and limiting speed.
  - I believe aether is necessary for constant light speed to exist. Otherwise, light speed should be variable with observer and source velocity. Without 'aether drag,' what would limit the speed of matter or energy to the speed of light?
  - At least these three phenomena, supposedly explained only by relativity and the current mainstream cosmology, can have alternate explanations based on the existence of an aether.

# AETHER BASEBALL

- 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 ( $\Delta t$ ), 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%."

## AETHER BASEBALL (CONT.)

- "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,' 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."

### Occam's Razor?