Interpretations of Physical Phenomena

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The behavior of light is analyzed in terms of the wave model for light. By strictly following the wave model it is demonstrated that changes in the ether's velocity are irrelevant in relation to the orientation of the wave-fronts in light. This ability of transverse light waves to conserve wave-front orientation is important for interpretation of the empirical background behind special relativity (SRT). Alternative interpretations are presented for the three most important phenomena related to SRT, namely: stellar aberration, Michelson-Morley's experiments (MMX) and the Sagnac effect. This results in support for the existence of an entrained ether.

1. BACKGROUND

The common opinion among scientists is that stellar aberration excludes the entrained ether. It has been assumed that this aberration would disappear if surrounding ether had the same state of motion as the observer. Einstein[1] expressed this opinion in a response to Gehrcke in 1918, where he also stated that an ether entrained in translation, but not in rotation, was impossible. The common opinion about the Sagnac effect is that it is caused by rotation and therefore not usable for ether-wind detection. Accepting stellar aberration but not the Sagnac effect had the effect that a third phenomenon, the Michelson-Morley experiment (MMX), has been the most debated phenomenon related to ether-wind detection.

2. THE WAVE MOTION OF LIGHT

Light is not observable and we are forced to draw conclusions about light by observing matter in the form of charged particles. Absorption of light is studied by means of negative particles in light-detecting diodes, in the study of the photoelectric effect or in the Compton effect. The retina in our eyes produces positive charges. Emission of light is studied by the behavior of positive kernels and negative electrons in the blackbody radiation. Planck's law of blackbody radiation contains a dualism regarding behavior at low and high frequencies. A possible interpretation of this phenomenon is that heavier particles dominate at lower frequencies and lighter at higher frequencies.

All information about light comes from matter. The energy relation between an atomic kernel and surrounding, aggregation of electrons is quantized due to shifts between different symmetric distributions. Changes in these energy relations are limited to jumps between discrete levels during extremely short time intervals. These very short intervals can not be measured, and must therefore with mathematical necessity be approximated by zero in our model. This does not exclude the possibility that these process times have finite values. But this quantization in our model of matter can not with certainty be proved to exist in light, due to indirect observations of matter, because light is not directly observable. We can therefore suspect light to be a pure wave motion. The particle-like behavior of light can be explained by quantum jumps in very short intervals and by indirect observations on discrete particles. The motivation of Einstein's Nobel Prize including only the mathematical *description* of the photo effect can therefore be correct. Einstein did not get the Prize for his light quanta *explanation* of it, and not for special and general relativity either.

The fact that light is a wave motion is supported by many phenomena. Two important phenomena are the double slit experiment and the extreme sharpness in images from fixed stars. A third support is the fact that light travels with only one velocity defined by the media, indicating that light is a transfer of a *behavior*, and not of matter. A fourth kind of support is the phenomenon called Crooke's radiometer, which the particle model cannot explain. However, the wave model can be explained by the reflected light from the white surface being in opposite phase near the surface. The reduction of the total field near the surface means less photo electrons and therefore less recoil on the white surface and the black surface moving away from the source in agreement with observation.

However, matter is a necessity in the ether due to the ether's capacity to transfer forces, like gravity. A physical model of the ether, based on subatomic particles, was described by Le Sage. His model describes gravity well and can perhaps also explain propagation of light as a wave behavior of the ether.

3. CONSERVED ORIENTATION OF WAVE-FRONTS

Light can be described by a velocity **c**, a vector, normal to a wave-front propagating with speed *c*, a scalar, in a right angle to the wave-front. Light is transverse oscillations, taking place inside the plane of the wave-front. When light moves from a region with zero ether-wind into a region with ether-wind **v**, a vector, we find **v** to be added to all points on the wave-front. The effect of changing **v** is just a coordinate transformation. *This means that the orientation of the wave-front is conserved in relation to changes in the ether-wind.* The vector **c** represents a process behavior inside the ether, but **v** represents a translation of an entity. Vector addition is not

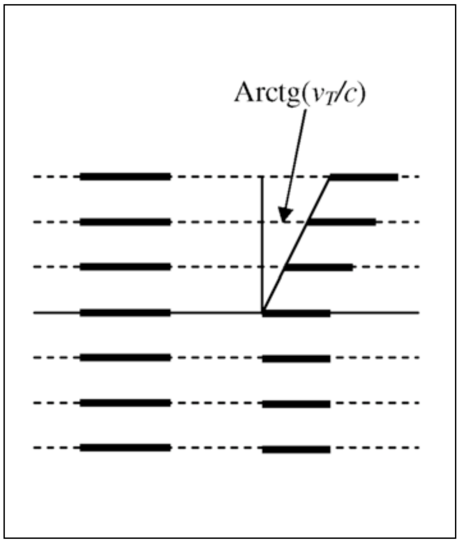

Figure 1. Transverse ether-wind and conserved wave-front.

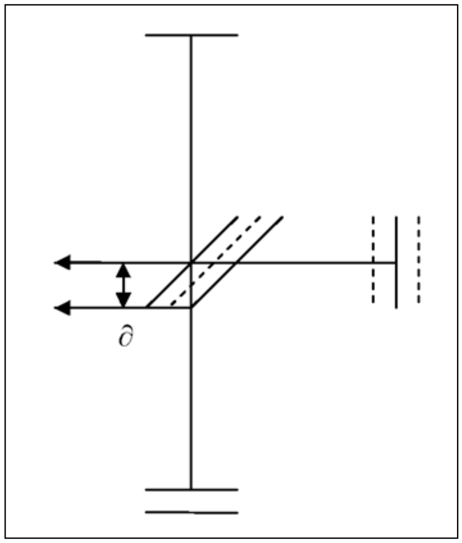

Figure 2. The light from the transverse arm is shifted sidewards ∂ = 10 μm (correct).

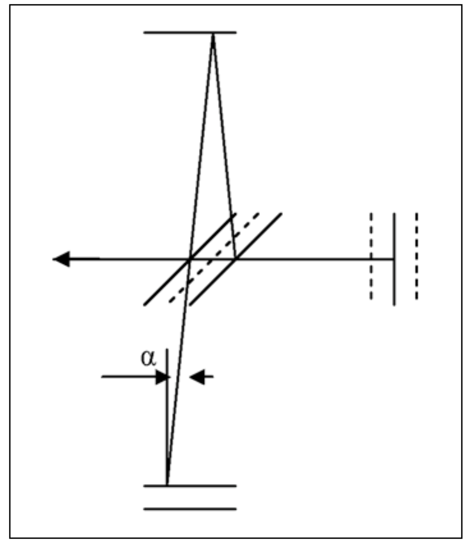

Figure 3. Light direction is supposed to change an angle α = 1 μrad (not correct).

self-evident between physically different objects. (The ether defines the *vector* **v** but only the *scalar* *c*.) Addition of **v** can *not* produce a rotation of the behavior inside the ether and only longitudinal component v_L of **v** has relevance for the wave motion. Vector addition of **v** and **c** can perhaps explain transport of energy, but wave motion *is* described by **c**$(1+v_L/c)$. Wave-front's orientation is conserved due to the same speed over the wave–front. Therefore, *velocity* of light **c** (and not only speed *c*, as in the common opinion) is conserved in relation to the ether-wind.

The possible effect of transverse ether-wind v_T on plane wave-fronts is described in Figure 1. Universal value on the scalar *c* implies that the vector **c** is conserved and the wave-fronts' orientations *can not change* due to the ether-wind. We do not need to know if transport of energy is unchanged (as in the left image) or affected by the ether-wind (right image). We can nevertheless conclude that the common interpretation of universal speed and changed direction by the ether-wind is *impossible*. Orientations of plane wave-fronts are conserved in relation to the ether-wind. This fact is very important regarding the interpretation of the empirical background behind SRT. Consequently, wave-front bending, *i.e.* refraction, can not be caused by transverse ether-wind, but only due to differences in longitudinal ether-wind velocities over the wave-front. We can therefore conclude that wave-fronts in light from a fixed star have a constant orientation in a right angle to the true star direction, independent of ether-wind **v**. Transverse ether-wind can therefore not change *observable* light direction in a telescope.

Coherent light generated in an optical cavity in a laser travels back and forth between two mirrors many times before leaking out through one of the mirrors. The wave-fronts are defined by the cavity and not changed by the ether-wind for the same reasons as we have seen regarding light from fixed stars. Light's vector **c** is conserved in a right angle to the cavity independent of **v**.

We conclude that all points on a plane wave-front from a fixed star or from an optical cavity move with the speed $c(1+v_L/c)$ and therefore the velocity **c**$(1+v_L/c)$ has conserved direction in relation to the transverse ether-wind v_T. We also conclude that the ether moves with the speed v_T inside the wave-front's plane, and that v_T has no influence on the wave motion.

4. TRANSVERSE ETHER-WINDS

Stellar aberration is observed in a telescope, and a telescope detects the orientation of the wave-fronts. A telescope is therefore blind to transverse ether-wind and detects **c**$(1+v_L/c)$, *i.e.* only longitudinal component v_L of ether-wind is relevant. Light moves therefore from an ether controlled by the Sun into an ether controlled by our planet *without any effect observable in a telescope*. The entrained ether has therefore the same aberration as the autonomous ether. Aberration is caused by changes in the observer's velocity **u**. A constant velocity of the total planetary system produces a constant aberration that we can not observe due to the lack of reference. But we can detect changes Δu_T in the transverse component u_T of **u**. Aberration is caused by the finite time interval between defining focus and light detection in the defined point equal to *arctg*(u_T/c). Aberration is a measure of the telescope's transverse motion during that interval, and contains no information about transverse ether-wind. The exclusion of entrained ether based on stellar aberration was therefore the most important error in the empirical background to SRT that was done by Einstein[1] and others. The reason was ignorance about conservation of wave-fronts and the reuse of knowledge from longitudinal waves on transverse waves.

The same error was made by Stokes when he reduced Michelson's prediction by 50% due to a supposed effect of transverse ether-wind v_T. The reduction of light speed by a factor $\gamma^{-1}=(1-v_T^2/c^2)^{1/2}$ is wrong, since light speed is constant c along the optical axis. See Figure 2, where the lines represent the normal to a wave-front. For two-way arm length of 10 m and ether-wind 10^{-6} x *c* from the rotation of our planet we get a sideward's shift of δ = 10 μm. Transport of energy is perhaps shifted an angle α = 1 μrad (Figure 3) but not normal wave-front, which has relevance for the wave motion.

The reason why Einstein and Stokes made these mistakes and missed conservation of the wave-front's orientations can be due to an influence from ballistics and the particle model for light. The common interpretation in Figure 3 would perhaps be correct if light were particles and lines represented the track of a particle. In the title to Einstein's 1905 paper he talks about "electrodynamics of moving bodies." Vector addition was probably done without realizing an important difference—**v** is the state of motion of an *entity*, the ether, but **c** is the motion of a *process*, a behavior, inside the ether. This can indicate that light is waves and ether is particles.

Einstein had a second argument against the entrained ether when he argued that entrained translation, without entrained rotation, is impossible. This argument does not hold. The simple reason is that we know far too little about the ether to draw such a conclusion. (Einstein applied potential theory to ether.)

Another test related to stellar aberration was done by filling water in a telescope. The intention was that a reduced speed of light would give an increased stellar aberration. However, this idea does not work since the refraction in the limit from light (and glass) into water reduces aberration to the same extent as the desired increase. This means that the total effect is unchanged—therefore, *unchanged* stellar aberration. This follows also from the fact that aberration is a raindrop effect, which means that light speed outside the telescope is relevant in relation to the telescope's transverse motion. This test does not prove if stellar aberration takes place outside or inside the telescope.

5. THERMAL LENGTH EXPANSION

Since MMX is assumed to detect second order effects of an ether-wind, we need high precision. This means that thermal variations of length can disturb the method, although probably *not* compensate the effect.

Atoms in a crystal use the ether to control their separations. A force field F is generated by the atoms and separations are defined by F being zero for a certain separation. Two nearby atoms are both positioned in the fields of each other. If the field $F(x)$ is not linear in separation x, but contains a second order term, there will arise a difference in position of the real zero point and an "effective" zero point represented by an approximating straight line in Figure 4. The reason for this is that the time average of F must be zero. The difference Δx is increasing with increasing atomic vibrations related to higher temperatures. Spatial information is communicated between two nearby atoms in the form of changes in the ether. The information moves with velocities $(c \pm v)$ between the atoms; v is the ether-wind.

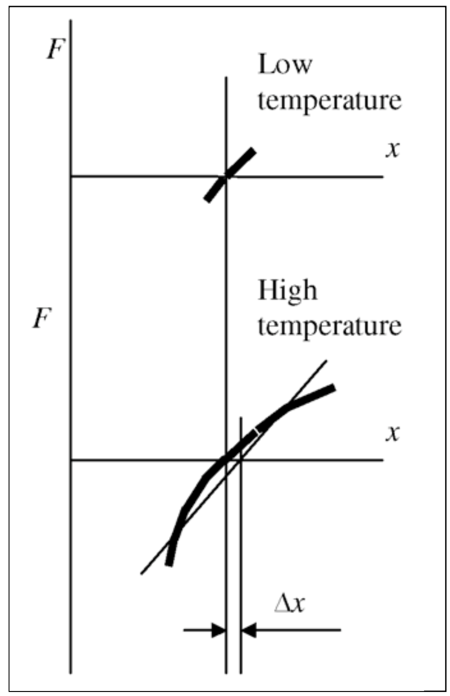

Figure 4. Nonlinearity in the field defining atomic separation creates thermal expansion.

6. CONTRACTION OF LENGTH BY THE ETHER-WIND

As an effect of the ether-wind, the fields that define atomic separations become dynamic and asymmetric. The fields are contracted in front of the moving atom and expanded behind. See Figure 5. The field asymmetries are proportional to the velocities, *i.e.* $(1 \pm v/c)$. Michelson sent light back and forth between mirrors that also were affected by the ether-wind by factors $(1 \pm v/c)$. Michelson used two-way light and the propagation times are added together. By inverting, addition and inverting again we find the total effect to be $(1-v^2/c^2)$ in two-way velocity. The fields controlling atomic separations are separate fields, but their effects on atomic separations are added together. Therefore, separations are controlled by two one-way, ether-based communications, and the effect searched between mirrors exists also between atoms and is therefore reduced, and perhaps compensated. MMX can therefore be silent about the ether-wind. This fact was verified by Antonini *et al.*[2], where the observed effect is found to be $<10^{-14}$. Propagation time, not speed, is probably constant in two-way light communication in MMX due to a physical contraction of length.

The effect $(1-v^2/c^2)$ means a contraction of only $\approx 10^{-12}$ due to the rotation of the Earth for an entrained ether. Michelson assumed an effect of $\approx 10^{-8}$ due to our planet's orbital velocity. This means a second explanation to Michelson's failure by accuracy problems.

7. ETHER-WIND DETECTION

The ether-wind can not be detected by transverse effects in stellar aberration due to conservation of wave-front's orientation. Second order effects in MMX can not be used due to a probable contraction of length, and perhaps also due to low sensitivity. The ether-wind must therefore be detected by first order, longitudinal effect. Doppler and Roemer effects demand relative motions between source and detector, which renders ambiguous interpretations. This is also the case for the Sagnac effect in rotating equipment, but the Sagnac effect can be used in translating systems as well. Such an application renders the most unambiguous interpretation. However, this means a conflict with the clock synchronization problem.

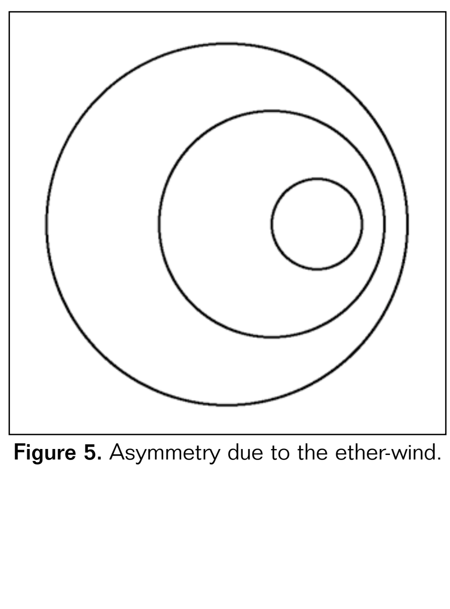
Figure 5. Asymmetry due to the ether-wind.

8. SAGNAC EFFECT

The Sagnac effect was discovered in 1913. Many scientists have since then tried to explain this effect from about twenty different approaches. Both classical and relativistic theories have been used, but have not resulted in any convincing explanation. The Sagnac effect has been classified as an effect of rotation since the effect was discovered in rotating equipment.

It has been found that the Sagnac effect (for one-way propagation) can be described as a time delay $\Delta t \approx 2A\Omega/c^2$, where Ω is angular velocity of the test equipment and A is area enclosed by a closed path of light. Assuming A as the area of a circle with radius R and circumference $L=2\pi R$ we find tangential velocity v to be $R\Omega$. This will give us $\Delta t \approx 2A\Omega/c^2 = vL/c^2$. This result can also be given by Stokes' rule. Instead of integrating Ω over the area A we can integrate v along the closed line L. This mathematical identity creates a confusing physical ambiguity: Is the Sagnac effect caused by a rotating area or by a translating line? We have to solve this dilemma by physical arguments. Mathematics has caused the problem and can not give the answer. Therefore, according to Stokes' rule, the Sagnac effect can be caused by either rotation or by translation.

Because the Sagnac effect was discovered in rotating equipment, the effect was classified as caused by rotation without much discussion. However, an important fact was missed: No light and no rotation exists in the enclosed area. Instead, all light exists along the line that is limiting the given area, and locked inside a fiber. The Sagnac effect must be distributed where the light is distributed, since the effect is a property of the light propagating process. The Sagnac effect is therefore produced in a translating line (not in a rotating area). The effect exists in a part of the line and therefore also in a straight line. Incorrect classification of the Sagnac effect is the reason for the difficulties in explaining the effect for almost 100 years.

Classification of the Sagnac effect as translational is very important, since it implies that the first order effect of an ether-wind is detected by the Sagnac effect. Therefore the translational description has an explanation in the ether-wind, but the rotational description has no good explanation. This also means that the effect in a rotating circle also exists in a straight line translating in its own direction in relation to the ether.

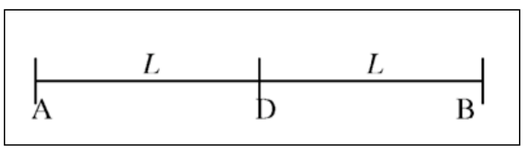

Figure 6. A simplified interpretation of the Sagnac effect.

If propagation time in a straight line changes from L/c into $L/(1-v/c)c$ we also get $\Delta t \approx vL/c^2$. Therefore we find that the Sagnac effect is translational and caused by the ether-wind. Verification on this point is done by Wang,[3] who detected the Sagnac effect from linear motion. Sagnac and Wang have detected artificial ether-winds. They found methods for circumvention of the clock synchronization problem. For two-way propagation (vacuum) we can get from Figure 6:

$$\Delta t = \frac{L}{c}\left[\frac{1}{1-v/c} - \frac{1}{1+v/c}\right]$$

$$\Delta t \approx \frac{2vL}{c^2} = \frac{4A\Omega}{c^2}$$

Here L can represent either the length of a straight line or the circumference of a circle. A and B are assumed synchronized clocks in the linear case, and A, D and B are in the same point in the circular case.

The Global Positioning System (GPS) introduces corrections for the Sagnac effect caused by the rotation of the Earth. This is an indication of a Sagnac effect from a natural ether-wind. The strongest, and most unambiguous, verdict can be found by detecting the translational effect of the ether-wind from the rotation of our planet in a laboratory. Su[4] has suggested a method for this (see Section 10 and Persson[5]).

9. GPS

The Global Positioning System (GPS) is a unique system in the sense that it is based on one-way light speed for high precision positioning. This is made possible by a circumvention of the clock synchronization problem through redundancy in the number of engaged satellites. A constant error in the receiver's clock can thereby be made irrelevant. Since the Sagnac effect is translational, the effect observed in the GPS system is relevant for the ether-wind.

The experiences of the Sagnac effect in GPS are documented by CCIR International Telecommunications Union[6] from 1990. This is a paper with very great relevance for physicists interested in special relativity. According to CCIR, the Sagnac effect in GPS is based on the relation $\Delta t=2A\Omega/c^2$. As we have seen earlier, this relation is mathematically correct but not explainable. An explainable, and physically correct, expression is instead $\Delta t=vL/c^2$, where v (as before) represents the motion of a point on the Earth in the eastern direction due to the rotation of our planet. This correction is used in GPS when comparing time readings in clock stations, and also in computing positions for stationary receivers on our planet. For calculations of positions in moving receivers the value v is changed to $v+u$, where u is the component in the eastern direction of the vehicle's motion in relation to Earth. These ideas were earlier expressed by Marmet.[7] Due to the extreme accuracy of the clocks in the GPS system, we can conclude with certainty that clock synchronization based on the Sagnac effect really works. The experiences from GPS[6] are therefore very important regarding propagation of light.

According to Marmet, the observer independent light-speed is an illusion caused by ignoring the first order effect of ether-wind by synchronization based on the half value of a two-way effect. The Sagnac effect gives light-speed ($c \pm v$) in relation to the surface of our planet, but c in relation to the planet's center. This can be interpreted as indicating that distribution of matter has relevance for the ether-wind, but rotation is irrelevant due to rotational symmetry. This is in contrast to Einstein's[1] statement that entrained translation without entrained rotation is impossible. SRT uses time dilation and space contraction to account for an effect 10^{-12} (assumed 10^{-8}), but ignores an effect on the order of 10^{-6}. The reasoning made here can be united with an ether translated, but not rotated, by our planet, stated in Persson.[8]

10. TO MEASURE THE ROTATION OF THE EARTH

This idea comes from a test with atomic clocks connected over some kilometers with coaxial cables. Su[4] suggested scaling down and connecting two gas lasers over a few meters with single mode optical fibers. The equipment is mounted on a slowly rotating platform with high mechanical stability. The measurements are made in such a way as to making a constant and small frequency difference between lasers irrelevant. Figure 7 demonstrates the method without synchronized clocks. It is probably the easiest method since light is transmitted in cables and not in open air. This perhaps makes sensitivity to vibrations less. The platform rotates slowly around a vertical axis, and the platform must have good stability to avoid vibrations. Two gas lasers (HeNe) with high frequency stability are used together with mono-mode optical fibers. The difference in laser frequencies is low enough to fall inside the bandwidth of the detector and following video amplifier driving a counter (N=Output from counter). Perhaps the lasers must be individually chosen for the purpose of producing low frequency difference. The equipment is rotated with constant speed. The phase difference between the two signals is a sinus function of azimuth angle or time plus a linear function proportional to the small and constant frequency difference between the two lasers. See Figure 8. The counter is not stopped, but output is registered as a function of time. To avoid the ether-wind's effect inside the lasers, they are mounted with their cavities in a vertical orientation. With λ = 0.63 μm (HeNe) D = 1 or 2 m should be enough to give significant result. The ether-wind v is derived from data according to the following (η=Refractive index>1). Ether-wind (v) is given by:

$$\Delta N_{2n} = N_{2n} - \frac{N_{2n+1} + N_{2n-1}}{2}$$

$$\overline{\Delta N} = \frac{1}{n}\sum_{n} \Delta N_{2n}$$

$$\frac{2v}{c} = \frac{\lambda \overline{\Delta N}}{\eta D}$$

where n is number of samples where two is taken during each period of the rotation. Sampling is *assumed* when the line between the lasers is pointing east to west or opposite. In reality the sampling must be done with a higher frequency.

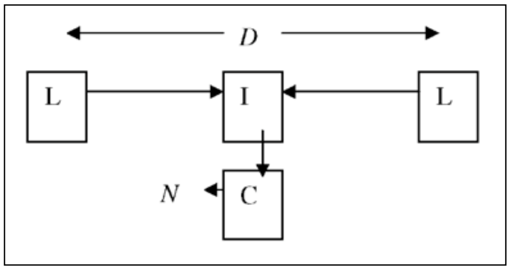

Figure 7. Detecting Sagnac effect on a rotating platform. L=laser, C=counter, I=interferometer, N=output from counter (or phase-detector).

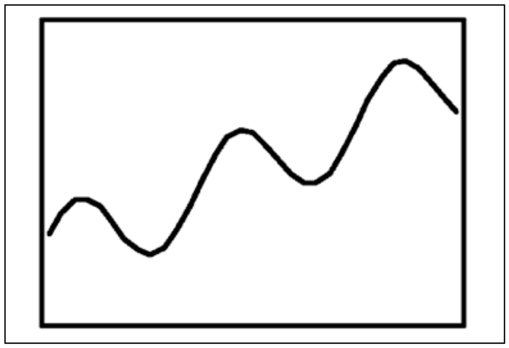

Figure 8. N(t)=phase difference (counts) as a unction of time (t).

The two lasers should be of single frequency type and stabilized in frequency. The frequency drift should be no more than about 2 MHz for a one hour period. The difference is then changed less then 4 MHz. The lasers should be individually chosen in order to have a difference in frequency that is between 5 and 10 MHz. The bandwidth of the light-detecting diode, amplifier and counter should be at least from 0.1 to 20 MHz. The counter can therefore be simple and must not be able to count both up and down. The counter's reading is registered by a computer as a function of time. To avoid the ether-wind's effect inside the laser cavities, the cavities are mounted in a perpendicular orientation in relation to rotation. The time function $N(t)$ is then processed by a Fourier transformation. This demands a *very* constant speed of rotation. The data for frequency stabilized HeNe lasers are good enough to make this method feasible. It is possible to use this equipment rotating in a vertical plane. However, the equipment must in such a case be designed to compensate for strain caused by stress from gravitation as much as can be possible.

The demand for constant angular velocity would be fulfilled easily in a low orbit satellite (if the astronauts are not moving to much). The available ether-wind would be 7.8 km/s instead of max 0.465 km/s. The satellite should be rotating around an axis perpendicular to the satellite orbit, and the transmission between the lasers should be in the plane of the satellite orbit. This experiment is very interesting since Michelson's method appears to be silent.

Figure 9 shows an alternative method, incompletely described by this author.[10] A laser with frequency F is illuminating, by means of fiber optics, movable equipment from two opposite directions. (Perhaps some kind of lens is needed in the ends of the cables.) The demands on the lasers are the same as in the previous method. Two interferometers compare light from that laser to light from another laser with frequency f. The interferometers are feeding two counters. The movable part of the equipment is moved a length, D. Both counters are sampled at time t_1, then moved slowly a length D and sampled at time t_2. After that, it is moved back to the first position and sampled at time t_3. A high precision timer must be used to keep $t_3 - t_2 = t_2 - t_1$ and v is given by:

$$\Delta N = N_2 - \frac{N_1 + N_3}{2} \quad \Delta n = n_2 - \frac{n_1 + n_3}{2}$$

$$\frac{2v}{c} = \frac{\lambda}{D}(\Delta N - \Delta n) \quad \text{test: } (\Delta N \approx -\Delta n)$$

11. REMARK I

The translated, not rotated, ether presented here appears to be related to gravity. This ether defines a reference (ether-wind, a velocity) for the wave-motion of light, and also a force (an acceleration) on a test mass. Two static properties of the ether thereby have relevance for the speed of light and the acceleration of (test-)bodies. These two properties depend on the distribution of matter and decrease with the distance to generating matter. Since the gravitation on the surface of our planet to a small extent ($\approx 0.6 \times 10^{-3}$) depends on the Sun, it is reasonable to assume that the planet's motion in relation to the Sun also has a very small influence on the ether-wind. This can perhaps have relevance for the GPS system, as stated in Persson.[5]

12. REMARK II

Results from the COBE satellite indicate an asymmetry in the frequency distribution of cosmic background radiation that can be interpreted as a Doppler effect from a motion of $\approx 10^{-3} \times c$. If this motion is real, it is our motion in relation to radiation sources on enormous distances and *not* a motion in relation to nearby ether. An ether-wind is *not* detected. Such an ether-wind would have ruined the functionality of the GPS system.

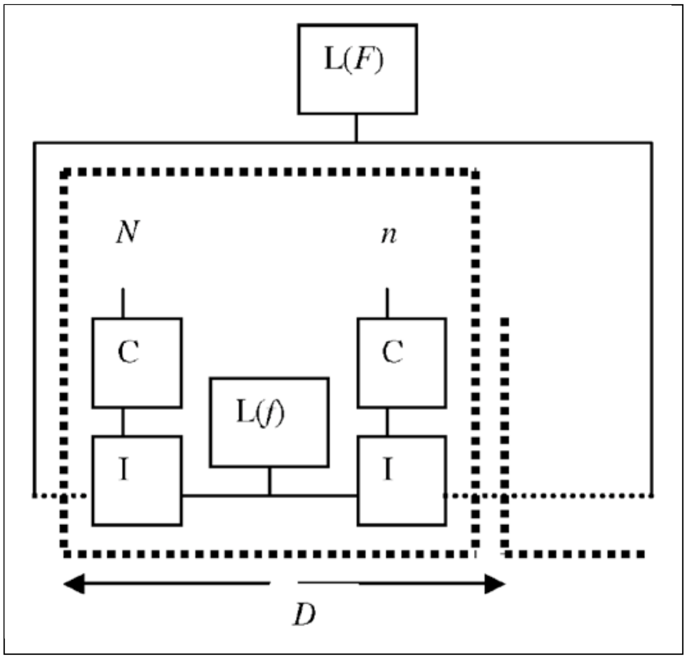

Figure 9. Method for detection of natural ether-wind. I=interferometer, L=laser, C=counter.

13. CONCLUSIONS

Stellar aberration is useless in relation to the ether-wind, since wave-front's orientations in light are independent of the ether-wind inside the wave-front plane.

Michelson-Morley's experiments are uncertain in relation to the ether-wind, since the searched-for effect can be compensated by length contraction and also due to the fact that the available effect is only $\approx 10^{-12}$ instead of $\approx 10^{-8}$.

The Sagnac effect is useful in relation to the ether-wind, since the effect is caused by translation, but abolished due to a incorrect classification as caused by rotation. The effect was described by a rotating area, mathematically identical to a translating line (Stokes' rule). The later description agrees with the distribution of light, and has an explanation in the ether-wind.

GPS[6] experiences indicate an existing ether translated, but not rotated, by the Earth, which means that the Lorentz transform and SRT are wrong. Such an ether has been suggested earlier, but is more probable with the new interpretations of stellar aberration and Sagnac effect presented here.

Confirmation of the indications given by Wang and GPS (ether-wind) and presented here (stellar aberration, Sagnac effect and MMX) can be reached by detecting the ether-wind from the rotation of our planet in a laboratory. If this method should be difficult, due to high demands on precision, we still have a possibility to do the test in a satellite.

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