The Special Theory of Relativity and the Sagnac Effect

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The theory of relativity is an ether-less theory. The reason for this is that aberration of starlight has been considered to rule out the entrained ether, and Michelson-Morley's (MMX) measurements are interpreted as refuting the absolute ether. Errors are found in both these two conclusions and entrained, as well as absolute, ethers are both possible. It is also demonstrated that a transverse ether-wind can not cause wave-front bending, and that Stokes' 'correction' to Michelson's prediction was without motivation. The existence of an ether has been demonstrated very clearly by the Sagnac effect for translational motion. It is therefore important to find out if the ether is entrained or absolute. The Sagnac effect **is** the ether-wind and can help us to find the answer. By using interferometry, instead of synchronized clocks, we can reach higher precision. Experience from GPS (global positioning system) seems to indicate that time dilation and clock bias must be abolished.

Background

For about hundred years SRT (the special theory of relativity) has dominated theoretical physics without having much impact on practical physics. Experience from GPS, reported by Ron Hatch in [1], have demonstrated a number of very serious inconsistencies in SRT refuting SRT. Translational motion in relation to a laboratory has been measured by Ruyong Wang in [2], with the ether as the only reference. Based on Sagnac effect this gave a clear verdict in favour of the ether's existence. The intention with this article is to draw conclusions from [1] and [2] and help to find out if the ether is entrained or absolute. Most ideas presented here have earlier been described in [3] and [4], although with not so many details.

The Ether

With the word 'ether' we mean a medium that can transfer light, gravity, electric and magnetic forces. The ether is not observable and its essence is not known. Light is a wave, oscillating in a plane transverse to the direction of propagation. The ether defines wave-speed (c) and provides also the reference for c. This reference velocity (**v**) is called ether-wind. c (the speed of **c**) is a constant of nature. c is the general solution to a second order differential

equation and we can therefore need **two** parameters (**r** and **v**) to define a particular solution. **v** has often been interpreted as a constant (inertial frame), but perhaps we need a preferred field instead if **v** is space dependent, **v(r)**. This means entrained ether (dragged, mass dependent and local) as alternative to the absolute (autonomous and universal) ether. Perhaps the ether can have a vertical component also (falling ether). Sagnac effect can answer these questions by detecting natural ether-wind (ether-drift).

Light

The ether can propagate sharp images of stars over billions of light-years. If light was massive particles controlled by inertia, the information in light would be disturbed by other particles like hydrogen atoms. Instead light is waves that are controlled by exactly the **same c** over enormous wave-fronts, whereby the normal to the wave-front is **conserved** independent of transverse ether-wind.
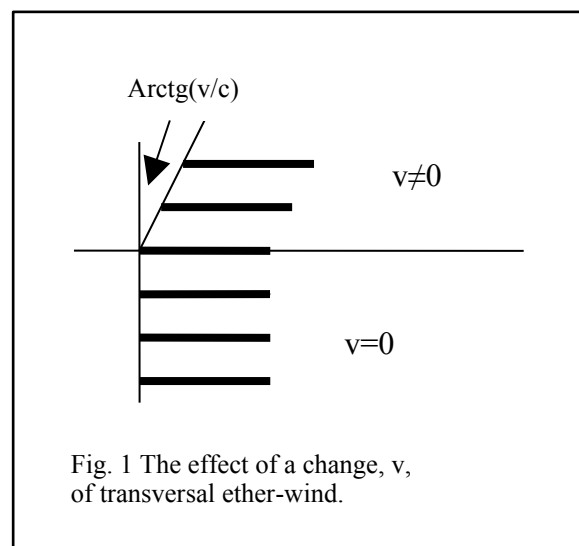

Fig. 1 The effect of a change, v,
of transversal ether-wind.

Fig. 1 describes light passing a limit where transverse ether-wind changes from zero to v. Since **c** and **v** represent two of each other independent processes velocity, wavelength and wave-front normal are **unchanged** in size and orientation. The influence of **v** just means a parallel transport of the wave motion. The plane of oscillations can not be altered by an ether-wind blowing **inside** that plane. This means that vector addition of **c** and **v** only can describe the direction of a focused beam, that is changed an angle arctg(v/c), when transverse ether-wind goes from zero to v. An observer inside the beam observes **no** effect of **v**, since he detects the normal to the wave-front and the wavelength to be unchanged. No wave-front bending is caused by a transverse ether-wind, blowing inside the plane of oscillations. Therefore, light passes the limit between sun-entrained and earth-entrained ethers with

conserved wave-front normal. This means that **observable** light has a one-dimensional dependency on the ether-wind (to the first order).

The effect of a transverse ether-wind is described in Fig. 2 also and compared to Stokes' interpretation according to Fig. 3. **c** is a moving and oscillating field, and **v** describes a condition constant in relation to time. We notice that the vector sum of **c** and **v** is a mathematical tool without physical meaning and independent of Einstein's (erroneous) taboo about velocities greater than c. Fig. 3 describes a vector difference?? Michelson's prediction was reduced by Stokes with 50% due to an effect of a transverse ether-wind. Since we have

Fig. 2 The effect of a transverse ether-wind.

$(c^2+v^2)^{\frac{1}{2}}$

c

v

c

$(c^2-v^2)^{\frac{1}{2}}$

v

Fig. 3 Stokes' interpretation of a transverse ether wind.
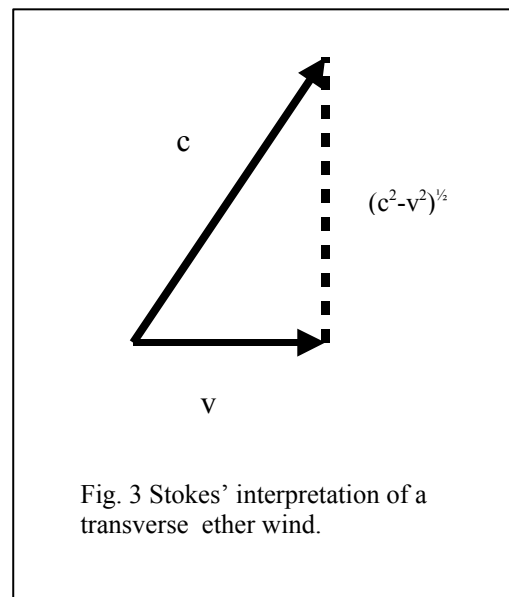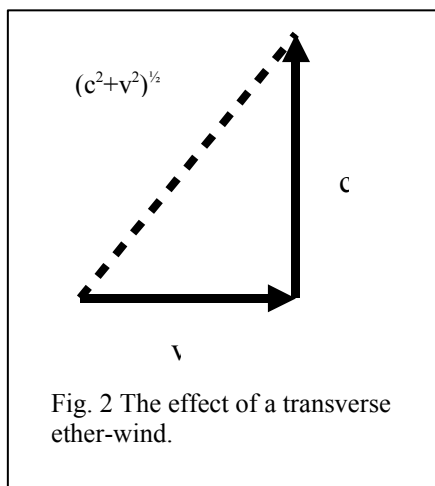
found transverse ether-wind to be irrelevant in relation to wave-front's orientation we can conclude that this 'correction' was not motivated, and Stokes made a mistake. A possible explanation to these errors is the use of a metaphor about a person swimming across a river. A metaphor that is usable for particles, but not for waves.

Although **transverse** ether-wind can not cause wave-front bending such bending can arise from **longitudinal** light velocities. This can happen if light velocities are not constant over the wave-front. However this is a second order very, very low effect, which only can be detected after integration over a long path. The bending of light around the Sun, in the order of 1 arcsec, can be explained in this way. Remembering that the mass of the Sun is about 300000 times greater than the mass of the Earth, we can conclude that such an effect can not be observable in the limit between sun-entrained and-earth entrained ethers. The bending around the Sun can be explained by refraction in the Sun's atmosphere, or as a consequence of

gravitation. However, this is very different from starlight aberration, which is a first order effect.

Wave-front Bending

We have seen that the transverse nature of light waves explains why transverse ether-wind can change the direction of a focused beam without causing wave-front bending. Nevertheless wave-front bending has got general acceptance. A probable reason to this error is an import of knowledge from theories about **longitudinal** waves in fluids. Stokes is said to be an expert in fluid mechanics, according to Antonis Agathangelidis. This can explain Stokes mistake. However, another reason can be that it later became difficult to discriminate between direction of a focused beam and normal to the wave-front after Einstein's denial of the ether.

Ether and Matter

The ether is not directly observable, so we are limited to observe its effects on matter instead. Gravitation is a static effect of ether on matter. Light is movable vibrations in the ether that can interfere with oscillating electrons and thereby cause observable effects on the electrons, for instance currents. Observations on discrete electrons (having quantized energy relations to atomic kernels) creates an illusion of quantization in light per se. Light is generated by the motion of charged particles. Electrons generate packets of light waves (not particles) when they change energy state. Atomic kernels vibrate and produce a noise-like light. Therefore, light has a dual nature seen in the duality in Planck's radiation law. This duality is a kernel/electron duality, not a wave/particle duality. **Light** is not quantized at the Planck level.

However, it can be productive to assume the **ether** to be constituted by neutrino-like particles and thereby quantized at a level lower than Planck's. Gravitation can thereby be described as a mutual shadowing in the flow of neutrinos. A kind of pushing gravity. The gravitational force gets an upper limit when the flow of neutrinos, near a giant body, goes to zero in one hemisphere. Black holes are perhaps not needed. To adapt nearby ether to the velocity of a massive body a wave function (matter-wave) is needed. Inertia can be explained as energy consumption needed to build up this wave-function. We can explain how static gravity does not demonstrate aberration, although **changes** of gravitation propagate with finite speed. Quantization a la Planck is limited to energy relations in the atom. This quantization in matter creates an illusion of quantization in radiation. Quantization at a lower level can be possible in the **ether.** These ideas are described in [3] and [4] also.
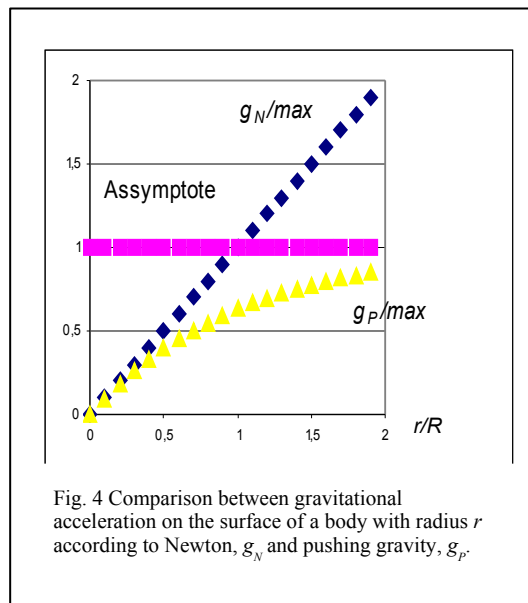
Pushing Gravity

We assume a homogenous sphere with radius r. Neutrino-like particles are attenuated when passing a very massive body thereby disturbing the symmetry in the flow of particles. Gravitational force on the body's surface is an effect of this asymmetry, and for a giant body this force approaches monotonically a constant value for increased radius. The value is defined by the fact that the flow coming from one hemisphere becomes almost zero. This should give, at least to the first order, an exponential function. Therefore, Newton's law of gravitational acceleration on the surface

$$g_N = k\rho r \qquad\qquad k = G\pi 4/3$$

is, for pushing gravity changed to

$$g_P = k\rho R[1 - exp(-r/R)] \qquad Max\ g_P = k\rho R$$

the asymptote *Max* g_P is a constant of nature. This is described in Fig. 4. The value of R is not known, and we do not know if it can prevent gravitational collapse. However, this idea is an important possibility. Pushing gravity is described in [5] also.

Fig. 4 Comparison between gravitational acceleration on the surface of a body with radius r according to Newton, g_N and pushing gravity, g_P.

Starlight Aberration

In an earth-related frame the Sun is moving and we observe where the Sun **was** 8.5 minutes ago due to propagation delay. The Earth has a sun-related velocity of ten thousand times less than light's velocity. Aberration is therefore 20 arcsec. In a sun-related frame our telescope is moving instead, and relevant time delay is **inside** the observing telescope. So we must tilt our telescope to compensate for this transverse telescope velocity (but not for transverse ether

velocity). Aberration is a pure kinetic effect also explainable with 'rain drop' model or 'duck hunter's model'. Described in [4].

Starlight has the same max aberration as sunlight due to two reasons. Aberration outside our planetary system is constant and not observable. The enormous distances to the stars make there velocities irrelevant and they produce a constant wave-front plane all over the planetary system. So starlight aberration is a consequence of our velocity transverse to the light's wave-front normal in our planetary system. Whether the ether near the Earth is earth-dominated or not is irrelevant, since light (after emission) is ether-dependent only in one dimension. This is true to the first order, and second order effects are too small to be observed. Therefore, the entrained ether has the same aberration as the absolute ether. This fact means that the entrained ether is unified with starlight aberration, which is an **important** conclusion. Many physicists have failed to do this unification for many years.

MMX

MMX uses two-way light between two mirrors. Therefore, two opposite effects of the ether-wind almost cancel and a very small second order effect remains. However, the separation of atoms in a crystal is controlled by two opposite fields. One atom is in the field of the other. Contra-directed fields react opposite on the ether-wind and almost cancel. A very small second order effect remains. So the ether-wind has the same effect on the two fields in the crystal as it has on the two-way measuring field between the mirrors. The effect is compensated and a zero effect is always the result. MMX is therefore **useless**. Length contraction is real and can be expressed by a scale factor, $(1-v^2/c^2)$. Time dilation is not needed.

The Lorentz' transformation splits this scale factor up in two parts where one part is abused to produce elastic time. Isotropic **two-way** light-speed is thereby created, by means of mathematical violence without physical motivation, and appearance, not reality, is described. No **cause** exists for introducing time dilation. Instead it is motivated by its effect. This is backwards reasoning. Different time in different frames is an absurd consequence of this. Since the function of GPS is based on **one-way** light speed it is found that we have isotropy even in one-way light speed, because compensation for Sagnac effect due to sun-related velocity is not needed in GPS. One solution to this dilemma is to explain this kind of isotropy as an illusion, created by time bias in clocks. However, elastic time and elastic clocks without any cause is still magic. These concepts can be abolished if we use behaviour of ether instead

to explain isotropy. This behaviour can be caused by the ether's entrainment. Many attempts to disprove SRT have **started** with the unmotivated dilation of time and thereby got into circular reasoning.

Introducing an ether means a possibility to make distinction between wave-front normal and beam direction. If the ether is entrained by the Earth we have one more reason for the MMX failure: The available ether-wind is hundred times smaller than Michelson's assumption.

Transformation of Coordinates

Lorentz transformation was first derived by writing a double equality

$$r^2-(ct)^2=R^2-(cT)^2=0$$

and than forgetting the last equality, thereby creating absurd consequences. Events can be simultaneous in one frame and not in another frame. Instead Palacios' transformation is theoretically correct. This is essentially Galilean transformation completed with contraction of length. If the ether is entrained we have a length contraction, on the surface of the Earth, as low as ten raised to the power of minus twelve, constant and irrelevant. Galilean transformation is in this case the only transformation of practical interest.

Cosmic Background Radiation

The cosmic background radiation has been considered to provide information about our planetary system's velocity in relation to distant sources. However, these distances are enormous and it is difficult to draw conclusions about the ether. Alternative explanations exist. Asymmetries in the distribution of mass are one example.

Detecting the ether-wind

By means of exclusion we can now see that we must use first order effect of light's velocity, not its direction, to detect the ether-wind. This means Roemer effect, Doppler effect and Sagnac effect. Roemer/Doppler effect is based on observer's velocity in relation to a source or a reflector. Sagnac effect is based on observer's velocity in relation to the ether. Sagnac effect **is** the ether-wind, and gives the most direct and unambiguous verdict about the ether. This is stated in [3] and [4] also. However, we want to detect absolute ether-wind. (Relative ether-wind is already detected.) See [2]! Translational and rotational velocities of the Earth are therefore of interest. Experience from GPS can be united with entrained ether. However, an alternative explanation based on clock bias is presented in [1]. Therefore more experiments should be done, with equipment not including clocks.

Sagnac effect

The Sagnac effect was discovered with light following a closed path, and after that light was forced to interfere with itself. When the equipment was rotated a phase shift was observed. This phase shift was caused by the manmade ether-wind in the light path, and a first order effect was detected. This phenomenon is exploited in fibre-optic gyroscopes. The described method demanded a closed path, and it was therefore not discovered that the effect was **translational** and not rotational. Consequently the method was described by a rotating surface. The produced one-way time delay, Δt, was described by

$$\Delta t = 2A\,\Omega/c^2$$

where Ω is the angular velocity of the rotating area, A, enclosed by the light path. For a circle this is equal to (Stokes' rule)

$$\Delta t = vL/c^2$$

where v is the tangential velocity of a light path of length, L, around a circle. For a straight, not rotating line, we get

$$\Delta t = -vx/c^2$$

where v is the ether-wind's component parallel to the line of length x. A curved, not rotating light path has the same Sagnac effect as a straight line between its endpoints. This means an observed light velocity of $c+v$ (and $c-v$) in relation to the surface of the Earth. The original description, based on a rotating surface, is physically misleading, although it is mathematically correct.

GPS

In systems measuring range with two-way signals the Sagnac effect is irrelevant due to compensation of first order effect. However, the GPS system is based on one-way signals and is therefore dependent on the Sagnac effect, and we could expect such an effect from the orbital velocity of the Earth. This would cause very serious problems for GPS. According to [1] such an effect is not observed and this can be interpreted as an indication of an entrained ether. However, Sagnac effect due to the rotation of the Earth around its own axis is observed.

But the problem is not that simple. In [1] an alternative interpretation exists, by means of clock bias, which is elasticity in clock speed of just the right size to compensate for Sagnac effect due to translation (but not due to rotation) of the Earth. So the question is: Is Sagnac effect eliminated by 'entrainment' or is Sagnac effect just hidden by elastic clocks? Referring to Occam's razor we conclude that the first interpretation is simple and the second one is

magic. We can get rid of that magic by abolishing time dilation and clock bias. Just introducing an ether is not enough. It is very reasonable to assume that the ethers behaviour can help us to detect earth-related motion without being disturbed by sun-related motion, but we can not expect the same capacity for clocks. This makes an ether entrained by the translation of the Earth, but not by its rotation, most plausible. We can call this ether generated. This idea can easily be tested by means of the Sagnac effect. Confirmation is positive if experiences from GPS are repeated in a system without clocks, and oscillator frequency is not behaving like clock bias.

Sagnac Effect and Ether Model

R Wang has demonstrated the ether's existence very clear in [2]. But instead of his differential method we need an absolute method to detect **natural** ether-wind and be able to decide between entrained or absolute ether models. So far GPS in [1] is our only evidence related to this decision, but the clock bias theory makes this evidence ambiguous. Therefore we should study Sagnac effect without using clocks, and try to detect earth-related velocity without being disturbed by sun-related velocity. The synchronisation problem can be avoided by using stabilised oscillators and detect changes in wavelength. An attempt to do this has been described by this author. However, this method was not feasible due to a compensating effect in cables. This fact was pointed out by Ron Hatch. To avoid this problem the method is modified and two interferometers are used instead of one.

Fig. 5 Method for detection of a natural ether-wind.   I= Interferometer
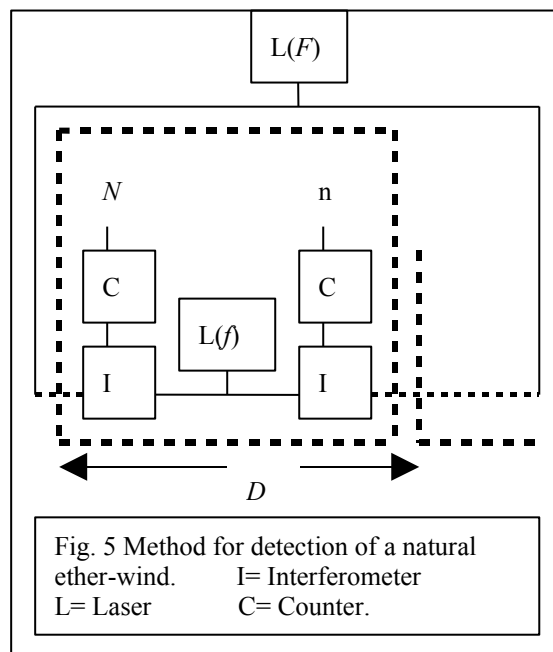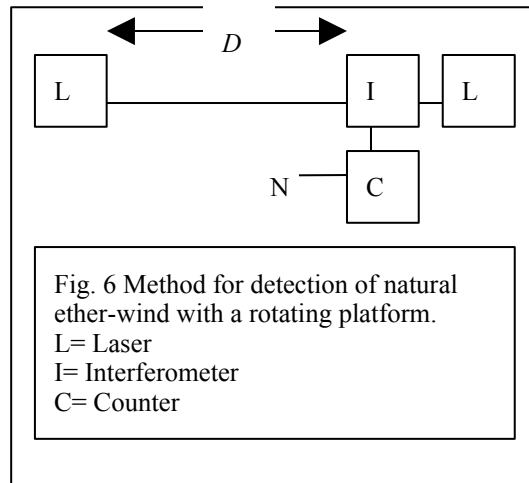L= Laser   C= Counter.

Fig. 5 describes this modified method. A laser with frequency F is illuminating, by means of fiber optics, a movable equipment from two opposite directions. (Perhaps some kind of lens is needed in the ends of the cables.) Two interferometers compare light from that laser to light from an other laser with frequency f. The interferometers are feeding two counters. The movable part of the equipment is moved a length, D, whereby the counters produce two counts, N and n. We can now find the ether-wind as

$$v/c=\lambda(N-n)/2D$$

High precision is needed, since we want to measure a velocity of one millionth of light speed. The use of two lasers means that a possible frequency dependency on ether-wind should be compensated. The lasers must have high frequency stability. To make influence from frequency drift small the equipment shall be moved in both directions. The average value of the two readings is than used.

Fig. 6 Method for detection of natural
ether-wind with a rotating platform.
L= Laser
I= Interferometer
C= Counter

An alternative method is described in Fig. 6. The equipment is mounted on a slowly rotating platform, which rotates around a vertical axis. The output, N, will contain a sinusoidal component with the platform's frequency of rotation. The peak to peak amplitude is ΔN and we get

$$v/c= \lambda*\Delta N/2D$$

where D is equal to the distance between the two lasers. The laser cavities should be oriented in a right angle to the plane of rotation to make the risk of velocity dependent frequency as small as possible. The output could be registered digitally and filtered by means of Fourier analysis.

Discussion

Detecting an ether-wind which has a speed of only one millionth of light-speed demands high precision. If this can be done we will find out whether we can see if earth-related velocity can be detected without disturbance from sun-related motion. We will then have strong support for the entrained ether. Hopefully this can be done without error from velocity dependent frequency.

The space stations Pioneer 10 and 11 have demonstrated an anomalous behaviour, which has been described as a **small** acceleration towards the Sun. An alternative explanation is a vertical and negative ether-wind (falling ether), that becomes zero at great distance. This idea may be plausible if the ether is entrained by the Earth as well as by the Sun. This would mean that two-way light-speed increases **very** slightly with distance and therefore creates an illusion that the space station distance is smaller than reality at great distances. In other words: gravitational anomaly is an illusion created by a light-speed anomaly, explainable as a two-way Sagnac effect. This is the same effect that is hidden by length contraction in MMX. Detecting one-way ether-wind in vertical direction is therefore of interest. One of the two methods earlier described could probably be modified to do this. However, gravitation can reduce precision.

The entrained ether can also explain the Pioneers' anomaly in a different way. We can see this by noticing that light velocity is sun related in most parts of our planetary system, but earth-related near the Earth.

Conclusions

Michelson-Morley's measurements are silent about ether model due to real length contraction without time dilation, and (if the ether is entrained) available length contraction is ten thousand times smaller than Michelson's prediction.

Starlight aberration is silent about ether model, since a transverse ether-wind causes no visible effect inside a beam, and therefore unification with entrained ether is possible.

Sagnac effect has demonstrated the existence of an ether and can also give clear verdict concerning the question of entrained or absolute ether.

Experiences from the **Global Positioning System** indicates an ether entrained in translation, but not in rotation, that we can call **generated**, but alternative interpretations exist, for instance one based on clock bias.

Space stations **Pioneer 10 and 11** demonstrate a very small anomalous gravitation towards the Sun that can be an illusion caused by a vertical ether-wind (falling ether), or by the velocity difference between earth-related and sun-related ethers.

Post Scriptum (Distributed January 2007)

A very important support for an entrained ether has been missed so far. It is a contribution from Taiwan by C.-C. Su in [6]. The theory in [6] is identical to the theory presented here, but [6] presents more empirical support and has a more detailed analysis. Results from a microwave link between Japan and USA via satellite and results from GPS are reported to indicate that light's velocity near the Earth is constant in relation to the **centre** of the Earth. Away from the Earth, but inside our planetary system, light's speed is said to be constant in relation to the **Sun.** This conclusion is drawn from radar measurements against planets and distant space stations. It is also concluded that inside our galaxy, but outside our planetary system, light's speed is constant in relation to some mass centre in the galaxy.

Although [6] is the same theory as the theory in this article an explanation to stellar aberration is missing in [6]. For many years it has been assumed that stellar aberration excludes the entrained ether. By assuming vector addition of ether's speed and wave speed of light a bending of light should arise of just the right size to compensate aberration. This statement would also be true if we could follow the direction of a focused beam. But in the practical case we detect the normal to the wave front in a point, and this normal is unchanged by transversal ether-wind. The wave front's speed is everywhere the same and the wave front's orientation **thereby conserved**. See Fig. 1! Therefore, transverse ether-wind has no effect on aberration, although it probably has effect on the direction of energy transport. Changing ether-wind effects therefore energy transport in 3 dimensions, but **observable** light in only 1 dimension. This means that the entrained ether has the same aberration as the absolute ether. Aberration is an effect of the velocity relation between observer and light, and independent of ether's motion transversal to light's direction (a so called raindrop effect). Aberration is silent about ether model, and hereby united with entrained ether.

A consequence of this is that transversal ether-wind can **not** cause wave front bending. Such bending can arise only as a second order effect when light's speed is **changing** over the wave front. This explains why light's bending around the Sun is 20 times smaller than first order aberration on the Earth, although the Sun has a mass that is 300 000 times bigger than the mass of the Earth.

Post post Scriptum (Distributed February 2007)

1. Light has only **one** velocity in relation to the ether. In vacuum is this velocity constant and universal. Polarization demonstrates that light is a transversal wave motion.

2. Since all points on the wave-front of light have the same velocity (c) the orientation of the wave-front can **not** change. This important fact explains sharp images from extreme distances.

3. Since transverse ether-wind can **not** change wave-front normal (but perhaps direction of energy transport) no wave-front bending caused by ether-wind exists.

4. Since aberration of starlight is an effect of a changed velocity relation between observer and light [arctg(v/c)] it is independent of ether's transverse motion. Raindrop effect is valid for waves and aberration therefore **silent** about ether model.

5. Michelson's results are **silent** about ether model due to real contraction of physical objects without dilation of time or clock speed. Objects are affected in one dimension only. Besides, ether-wind from entrained ether is about hundred times smaller than Michelson's assumption.

6. Lorentz transform and special relativity have no observable motivation. Misinterpretation of Bradley's observation (not Michelson's tests) has caused confusion in modern physics.

7. Light speed is constant, not in relation to observer or source, but something else. This **motivates** the ether's existence.

8. The Sagnac effect has measured speed of rotation and translation without external reference. This **demonstrates** the ether's existence.

9. Decision between entrained and autonomous ether can be done by detecting ether-wind on the surface of the Earth caused by the rotation of the Earth. **First** order Sagnac effect must be used, since this velocity is only about one ppm of c. A test with no relative motion between parts of the equipment means unambiguous interpretation of result.

10. Sagnac effect can verify with certainty if it is true, what GPS and a microwave link have indicated, that is, that the ether is entrained.

A failed test proves nothing, and not the opposite of the assumption
1. Michelson's failure does not prove impossibility and zero result, as Einstein thought. Instead it means hundred times less and a useless method.
2. The failure of Einstein's followers to unite stellar aberration with entrained ether does not prove impossibility. Instead unification of raindrop-effect and wave motion makes ether-wind irrelevant. Entrained ether is thereby united with stellar aberration and the method found useless instead.

Do not exclude 'the middle' in physics.
1. Michelson's dream was a universal reference for all velocities.
2. Einstein's standpoint was the opposite: No reference at all.
3. The third (almost forgotten) alternative is a local reference combined with universal relativity in the reference. This means that absolute space and time are possible.

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