

# Bradley, Sagnac & Entrainment

John-Erik Persson

Fastlagsvägen 2, 12648 Hägersten, SWEDEN

e-mail: mail0110261847@yahoo.com

New interpretations are given to stellar aberration and Sagnac effect. By strict following the wave model for light it is demonstrated that the wave motion depends on the ether-wind in one dimension only. This means that we cannot describe wave motion by the vector sum of ether-wind and wave velocity. Stellar aberration is therefore silent about the ether-wind, and the entrained ether is not ruled out. By utilizing the fact that the Sagnac effect can be locked in inside an optical fiber it is demonstrated that Sagnac effect is in reality a translational effect. The problem of synchronizing separated clocks forced Sagnac to use a rotating equipment to detect a translational effect. Together with the experiences from the Global Positioning System (GPS) we can find support for an ether that is entrained by our planet. Further confirmation can be found by detecting the ether-wind by translational equipment in a lab or in a satellite.

## 1. Background

Stellar aberration has since many years been regarded as impossible to unite with the entrained ether, although unification with the autonomous ether has been considered as possible. Very prominent scientists have advocated this idea. See [1] and [2]. The Sagnac effect has been difficult to explain although the effect was discovered as early as in 1913. About fifteen different theories, both classical and relativistic, have been tried as base for an explanation. The effect has been classified as caused by rotation, since the effect was discovered in a rotating equipment.

## 2. The wave motion of light

Many strong arguments support the wave model for light:

The double slit experiment.

Only one speed in a specific medium.

Different speeds in different media.

Extremely sharp images of fix stars.

The behavior of Crooke's radiometer.

Crooke invented the radiometer in 1853, but the phenomenon has not been well explained. The radiometer is a small 'light mill' with vanes, black on one side and white on the other. When illuminated it rotates with the *black* surface moving away from the light source. This behavior is in conflict with the light's particle model since the white surface should catch most momentum after decelerating *and* accelerating particles of light. However, the wave model can explain this phenomenon. The reflected light from the white surface is in opposite phase in relation to the incoming field. This means a reduction of the total field on the white surface. This fact leads to fewer photo electrons from the white surface, and therefore less recoil.

It is observed in atomic clocks that microwave signals can interfere with slow electrons at the greatest distance from the kernel. Such interference between faster electrons and higher frequencies in light opens a possibility to explain the photoelectric effect. *Existing* kinetic energy in an electron can be changed from orbiting form to linear motion by a disturbing transverse force. This fact can also explain how higher frequencies in light can produce faster electrons. This explanation does *not* demand quantization to exist in light. The assumption that kinetic effect

exists in the electron in advance is supported by the fact that the photo current starts without time delay when light is switched on. Needed energy can be provided by the ether, and not by the light. The same interpretation can explain the Compton effect at extremely high X-ray frequencies. This means that the Compton effect is the reverse process in relation to how X-rays are produced by extremely fast electrons. The reverse process should also demand very fast electrons very near the kernel. The Compton effect has therefore very low probability of occurrence.

The Compton effect is explained by the particle model also, and this interpretation is also supported by observing the angle between incoming X-ray and produced electron. This fact can also be explained by X-ray wave packets concentrated in space and time, and thereby producing the same effect as particles without containing any real particles. Microwaves in atomic clocks are hard to explain with the particle model. Compton effect and photoelectric effect can both be explained by the particle model as well as by the wave model for light. We must therefore conclude that these two phenomena are *silent* about light model. The arguments for the wave model are overwhelming. The property of polarization indicates that light is constituted by transverse waves.

Light from a fix star arrives as wave-fronts extremely plane across the planetary system. These waves are a *behavior* in the ether, that propagates with speed  $c$  in relation to the ether, These plane waves can propagate in one orthogonal direction only with the ether as the reference. The ether provides a reference in *one* dimension only, and ether-winds inside the wave-front plane are irrelevant for the wave motion. The ether-wind  $\mathbf{v}$  is the *motion* of the ether. Although vectors  $\mathbf{c}$  for wave motion and  $\mathbf{v}$  for ether-wind have the same mathematical representation we cannot use the vector sum  $\mathbf{c}+\mathbf{v}$  to describe light. If we add a velocity to a behavior we change the orientation of the wave-front, which is absurd. Instead the wave motion must be described as a scalar sum  $c(1+v_L/c)$ . Here  $v_L$  represents the component in  $\mathbf{v}$  that falls in the direction of  $\mathbf{c}$ . Transverse components in the ether-wind have the same effect everywhere on the wave-front and can therefore not affect the orientation of the wave-front. We can see this important fact by realizing that *changing the orientation of the wave-front demands different propagation speeds in*

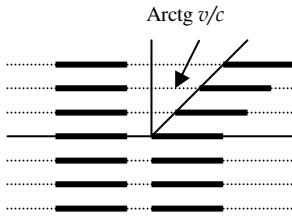


Fig 1 Transverse ether-wind does not change the wave motion although beam direction can be unchanged (left) or changed (right).

different points of the wave-front. The wave motion has its own definition in every point on the wave-front. Light bending due to the ether can therefore happen only as a consequence of a gradient in  $v_L$  different from zero. The orientation of a wave-front is controlled by an integration of the gradient in  $v_L$ . Light propagation can be described as  $\mathbf{c} + \text{integral grad } v_L$ . Transverse components (falling inside the wave-front plane) of ether-wind are irrelevant for the orientation of the wave-front. Light can move from an ether with the velocity of the Sun into an ether with the velocity of our planet with conserved wave-front normal. This fact is described in Fig 1. We can conclude that stellar aberration cannot rule out any ether model. Unjustified vector addition of a behavior and a motion is the reason to the fact that stellar aberration has been misunderstood for hundreds of years. The bending of light near the sun is about  $10^{-5}$  radians. There is a possibility that we can explain this effect by integral grad  $v_L$ . The corresponding effect for our planet would be between  $10^{-8}$  and  $10^{-9}$  radians (due to relations in masses and radius') for tangential light. For radial light the effect is zero. The effect is certainly not  $10^{-4}$  as would be demanded to rule out the entrained ether.

A plane wave-front has one degree of freedom and can therefore move only transverse to itself and longitudinal to light. Therefore, only longitudinal component  $v_L$  of  $\mathbf{v}$  is relevant for light and transverse components  $\mathbf{v}_T$  are irrelevant. This means that we cannot describe light motion as  $\mathbf{c}' = \mathbf{c} + \mathbf{v}$  but instead as  $\mathbf{c}' = \mathbf{c}(1 + v_L/c)$ . This means no bending. Bending of light occurs only when  $v_L$  is different in different points on the wave-front, or  $\nabla v_L \neq 0$ . We must therefore do an integration to include bending.  $\mathbf{c}'' = \mathbf{c}' + \int \nabla v_L dL$  reveals a bending that is many orders of magnitude smaller than the assumed effect from transverse ether-wind in the interpretation of stellar aberration.

The irrelevance of  $\mathbf{v}_T$  means that we do not need time dilation. Stokes correction to Michelson's prediction, a reduction by 50%, is not needed. See Fig 2 and 3. The orientation of mirrors and cavities define the orientations of wave-fronts in measuring light in MMX independent of motion.

### 3. Stellar aberration

Stellar aberration is independent of the ether's state of motion. The effect is instead produced by observer's motion in relation to light speed. Stellar aberration can be described as a raindrop effect or by the fact that a hunter must aim his gun towards a point about one meter ahead of a fast flying bird. Aberration happens when light propagates the focal length  $f$

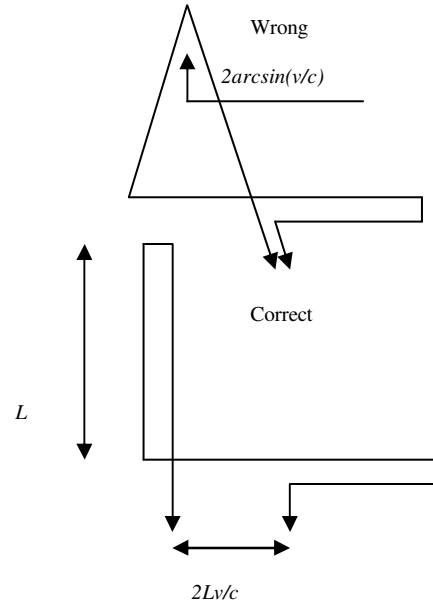


Fig 2 Wave-front normal is independent of transverse ether-wind in MMX.

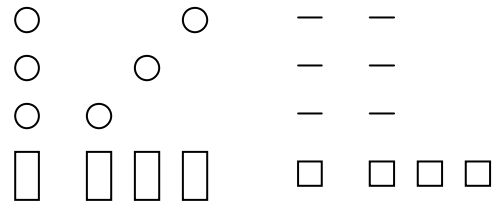


Fig 3 Vector addition is valid for a cannon ball from a moving platform, but not for light coming from a laser moving in the plane of the wave-fronts. Light is a behavior in the ether.

inside the telescope. Light is focused against one point on the detector, but hits another point on the distance  $d$  due to telescope motion. Aberration is therefore  $d/f$ , but this is also equal to  $u_T/c$ , where  $u_T$  is the component of telescope motion that is transverse to light propagation. We cannot detect  $u_T$  but only  $\Delta u_T$  caused by changes in telescope motion.

We have found stellar aberration to be silent about ether-wind. This explanation is also independent of light model. Stellar aberration reveals instead transverse motion of the observer. This interpretation was also Bradley's first interpretation. However the majority of most prominent scientists have had a different opinion for many years.

Planetary aberration is caused by transverse component, in relation to light, of relative velocity between observer and object. The Moon has an orbital speed of about 1 km/s. Lunar aberration is therefore 1/30 of stellar aberration caused by our planet's orbital velocity of 30 km/s.

### 4. Sagnac effect

Sagnac effect is described by an integration of angular velocity  $\Omega$  over an area  $A$ . The effect is a time delay in light propagation  $\Delta t = 2\Omega A/c^2$  for one way propagation. But according to Stokes' rule we can have the same result by integrating tangen-

tial velocity along the border of  $A$ . For circular form we get  $\Delta t = 2\Omega A/c^2 = vL/c^2$ .  $v$  is tangential velocity along circumference  $L$ . This mathematical identity produces a physical ambiguity, not enough considered. We must ask ourselves: Is Sagnac effect caused by a *rotating area* or by a *translating line*? This question must be answered by physical arguments. Mathematics has produced the problem. Sagnac effect can perhaps have been classified as a rotational effect without much discussions of this important issue. We find that the involved light can be limited to the interior of a very thin fiber. We also find that *no light, no rotation and no Sagnac effect exist* on the area in question. The Sagnac effect is distributed along a line and therefore caused by a *translating line*. The effect *must* be where the light is and we can therefore conclude that Sagnac effect is translational. It was only *detection* of the effect that demanded rotating equipment. This fact is a consequence of the difficulty in synchronization of separated clocks. This problem cannot be solved directly, but Sagnac found a way to circumvent the problem. He did this by a serious connection of a number of translational effects. This made it possible to realize two sources and one detector in the same point. These relations are described in detail in [3].

The fact that Sagnac effect is translational means that we can find the *same* effect in a rotating circle as in a straight line translating in its own direction in relation to the ether. The Sagnac effect in a not rotating curved line is equal to the effect in a straight line between its endpoints. Detection of an artificial ether-wind was done by Sagnac in a rotating equipment. R Wang did the same in a translating equipment. This can be seen in [4]. Positioning in the GPS system is based on one-way speed of radio signals. Redundancy in the number of engaged satellites means that the error in receiver's clock must not be zero, but only constant. Synchronization between time stations is done by means of correction for Sagnac effect due to the rotation of our planet. Such correction is also done in calculations of positions, also in differential GPS. This means that the calculations are done in reality in a not rotating frame with the same speed as the centre of our planet. No compensation is done for the Earth' orbiting speed. This fact can be interpreted as an indication of a constant light speed in a frame that is translated but not rotated by our planet. The fact that our planet's rotation is irrelevant can be explained by rotational symmetry in combination with a dependency only on the *density* of matter. This explanation is in conflict with [1]. Signals near our planet move with different speeds in eastern and western direction in relation to the surface of our planet. Even more clear evidence regarding these relations can be found by detecting Sagnac effect with translating equipment inside a laboratory. With rotating equipment this has been done with high precision. With translating equipment such precision is impossible, but a speed of about one millionth of light speed is possible by a method presented by Dr C C Su. See [5]. His idea is to use two gas lasers with high frequency stability, separated a couple of meters and connected to an interferometer. The equipment is mounted on a slowly rotating platform. The equipment is simple, but demands on the platform's stability are high.

The difficulties in finding a clear and simple explanation to the Sagnac effect are due to a wrong classification of the effect. It was therefore not realized that Sagnac had detected a first order

effect of *translational* motion. Such detection is not possible by stellar aberration or by Michelson-Morley's method.

### 5. Michelson-Morley's method (MMX)

Michelson-Morley's method is based on two-way propagation of light. This means that only second order effect of the ether-wind can be detected. The atoms in a crystal create fields in the surrounding ether. The combined effect of such fields defines the separation between the atoms by a zero force for a certain separation. Therefore, two nearby atoms in a crystal are in a two-way communication with each other. This means that the separation controlled by two-way communication can be sensitive to the second order effect of the ether-wind in the same way as the two-way light that Michelson used. If these two effects are equal, which is quite possible, we have the same contraction in the crystal as in Michelson's two-way light. This would mean that two-way propagation time is constant. It is therefore quite possible, although not proved, that Michelson-Morley's method is *silent*.

Since Michelson-Morley's method is of second order it is usable in relation to the autonomous ether but difficult to use in relation to the entrained ether. Michelson-Morley's method is therefore not the most important. It is ironic that this method has been the most debated method.

### 6. Dr Su's method

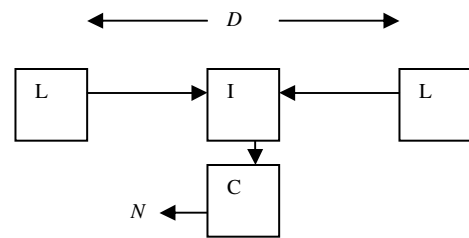


Fig 4 Detecting Sagnac effect on a rotating platform L=Laser C=Counter I=Interferometer N=Output from counter

This idea comes from a test with atomic clocks connected over some kilometers with coaxial cables. Dr Su [5] 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 the lasers irrelevant. This means a circumvention of the synchronization problem.

Fig. 4 demonstrates the method without synchronized clocks. It is probably the easiest method since light is transmitted in cables and not in open air. The platform rotates slowly around a vertical axis, and the platform must have good stability to avoid vibrations (optical table). 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 detector and the following video amplifier driving a counter. (N=Output from counter). Perhaps the lasers must be individually chosen to the purpose of producing low frequency difference. The equipment is rotated with constant speed. The phase difference between the

two signals is a sine function of azimuth angle or time plus a linear function proportional to the small and constant frequency difference between the two lasers. The counter is not stopped, but its 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  $\lambda=0.63\mu\text{m}$  (HeNe)  $D=1$  or  $2\text{m}$  should be enough to give significant result. The ether-wind  $v$  is derived from data according to the following. ( $\eta$ =Refractive index $>1$ ). Ether-wind ( $v$ ) is given by:

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

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

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

Here  $n$  is number of samples where two is *assumed* to be 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, and followed by a Fourier analysis.

The demand for constant angular velocity would be fulfilled easily in a low orbit satellite (if the astronauts are not moving too much). The available ether-wind would be about  $8 \text{ km/s}$  instead of max  $0.47 \text{ km/s}$ . 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.

The data for frequency stabilized HeNe lasers are good enough to make this method feasible. This question has been given an interesting discussion together with a person [6] having deep professional knowledge about laser technology. It is possible to use this equipment rotating in a vertical plane also. 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. This method is described on NPA homepage under "Experiments" also.

## 7. Conclusions

1. *Stellar aberration* has been accepted as relevant in relation to the ether-wind. However, ether-wind blowing transverse to light is irrelevant for wave motion, and the method is thereby *silent* about the ether-wind.

2. *Sagnac effect* has not been accepted as relevant in relation to the ether-wind. However, the effect is in reality translational and the effect is therefore *relevant* for the ether-wind.

3. *Michelson-Morley's experiment* has been the most discussed phenomenon in relation to the ether-wind. However, this method appears to be the least important, and probably also *silent*.

## 8. Discussion

The vector addition of wave motion and ether-wind in stellar aberration can be natural only in a mathematical context. By thinking in more physical terms we can see that propagation of light is defined in the same way in every point on the wave-front. This fact is not changed by adding the same transverse ether-wind to every point on the wave-front. From physical

aspects it easy to see that only *differences* in longitudinal ether-wind can alter the wave-fronts by means of the ether. Transverse ether-wind cannot be detected by the orientation of the wave-fronts. See Fig 1.

The interpretation of Sagnac effect was probably influenced more by the behavior of the equipment than by what happened in the light path. In fact the important difference between Sagnac effect and Michelson-Morley's method is only first order effect contra second order effect. Sagnac detected the *sum* of two one-way translational effects and Michelson failed to detect the *difference* between them. Dr Su's method combines the best of these two methods. Dr Su's translation detecting equipment cannot provide the same high precision as a rotating ring laser, but the interpretation of its result is very unambiguous.

The theory of relativity explains the Lorentz transforms by elasticity in time and space. This is absurd physically and philosophically, due to rendering of multiple time concepts. In the model based on autonomous ether the physical interpretation of Lorentz transforms by variations of length and clock speed is a little bit better philosophically. However, the three basic phenomena and physical interpretations of them given here indicate very clearly that the entrained ether model is the best model.

A mysterious fact is why we cannot observe any frictional force from our planet's motion in relation to space. Perhaps this can be explained by entrainment, due to the fact that the friction is outside the Earth and instead in the cold space.

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