

# The Pioneer anomaly according to Fatio

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## Abstract

Fatio's ether model is described. A possible explanation to the Pioneer anomaly and the fly-by anomalies is discussed.

## Fatio's model

Newton said that Fatio's hypothesis was not needed. So, apparently, Newton regarded Kepler's laws for planetary orbits to prove his law of gravity, since his derivation of that law was based on Kepler's laws. Therefore, Newton seems to have disregarded the fact that Kepler's laws also needed a hypothesis. The hypothesis that Fatio sent to Newton was later further developed by Le Sage.

Fatio's ether model is based on very small, and very fast, particles moving in all directions. These particles are assumed to be absorbed by matter. Therefore, these particles produce forces in each point inside a material body. The forces are acting in all directions. In deep space these forces can add up to zero due to spherical symmetry. However, a material body, A, absorbs a small part of these ether particles. Therefore, the spherical symmetry in the flow is disturbed by the attenuation produced by the absorption. So, the particle flow leaving A is reduced. This reduction means that another body, B, in the neighborhood of A gets a net force in direction towards A. This force is gravity. So, gravity is not a pulling force, and not a pushing force but a *reduction of a pushing force*.

In Fatio's days, and later also in Le Sage's days, an ether particle with such an extreme behavior was considered to be absurd. However, today we accept such particles and call them neutrinos.

## The falling ether

The absorption in A has also another effect in the position of B. Because Absorption in A means a reduction of the flow in point B coming from A, we can see that the average velocity of all particles in B is changed. Therefore, a mean velocity of all ether particles in B is produced, and pointing in direction towards A. Since the state of motion of the ether (the ether wind) can be regarded as the mean velocity of all ether particles we get an ether wind in B, blowing in the direction towards A. So, the gravitating body, A, creates an ether wind blowing in negative, radial direction to A. Therefore, a material body produces a *falling ether*, blowing in the same direction as the force of gravity from that body.

We have seen that 2 fields in spherical symmetry can explain gravity as well as ether wind. These 2 fields can also be united with the high precision in the global positioning system (GPS). This follows from the fact that GPS is also a spherically symmetric system. So, gravity is intimately related to the wave motion, as was stated by Petr Beckmann in [1]. The idea that 'light travels *down* faster than *up*' was first mentioned by this author in [2].

The radial ether wind changes light speed in radial direction only.

## The Pioneer anomaly

Since the ether wind,  $\mathbf{v}$ , can be assumed to be the reference for the wave velocity,  $\mathbf{c}$ , we can conclude that, in a Universe with only one body, light is moving with the speed  $c - v$  away from the body and with the speed  $c + v$  in direction towards the body. This means that in the radial direction we find that the 2-way speed of light is equal to  $c(1 - v^2/c^2)$ , with  $v$  *decreasing* with range. Therefore, 2-way light speed is *increasing* with range. It is reasonable to assume  $v^2$  to be proportional to the force of gravity. Unfortunately, we do not know the constant of proportionality.

The Pioneer anomaly is an observed increase in the frequency of the returned carrier signal. This result has been regarded as a 2-way Doppler effect caused by a decrease in the speed of the space station. This effect is assumed to be caused by a small acceleration directed towards our sun. However, this 2-way Doppler effect is caused by the relation between space station speed and the 2-way speed of light. It is therefore possible that, instead the *decrease* in space station speed can be an illusion caused by the *increase* in 2-way wave motion. So, we can see that Fatio's 300 years old model has capacity to explain the Pioneer anomaly.

Although 2-way light speed is needed for finding a numerical value on the speed of light we nevertheless can use 1-way propagation, if we only want to find *changes* in light speed caused by the ether wind. de Witte has demonstrated such a method, based on atomic clocks. This is described in [3]. However, his method depends on the rotation of our planet. This produces systematic errors. But it should be possible to scale down to laser wave length of about 1 micrometer. 2 lasers with high frequency stability should be connected with fiber optics over a couple of meters and phase comparison of their signals should be done in an interferometer. The direction of measurement should be changed in bearing and elevation. So, vertical and horizontal ether winds can be measured. Such measurements are discussed in [4]. This means that we have a possibility to test Fatio's hypothesis and also see if we have found an explanation to the Pioneer anomaly.

## Fly-by anomalies

Fly-by anomalies are detected for space stations passing close to a planet. At such short ranges the radial ether wind can be significant and therefore in the need for a correction of measurements. So, we should make a detailed analysis regarding what Fatio's model, with radial ether wind, has to say about fly-by anomalies.

## Gravity

Newton's law of gravity depends on the mass point approximation, meaning that all mass can be regarded as positioned inside the center point of the body. This is really true only for a body in perfect spherical symmetry regarding the distribution of matter. Since gravity produces spherical symmetry this approximation works well and it is difficult to find deviations from Newton's gravity.

We can do a thought experiment and split up a large body in small volume elements. Then we apply Newton's method to each element and integrate over volume. This means that we have found a more general form of Newton's law that no longer demands spherical symmetry. By assuming attenuation of the particle flow to be caused by absorption we have found Fatio's model. This means that Newton's model is just an approximation to Fatio's model and the difference between the 2 models is very difficult to see, since gravity is a weak force. Gravity seems to hide its secrets by producing spherical form. For perfect spheres the 2 models predict the same with a very small exception during a solar eclipse. This anomaly can be explained by Fatio's model only. So, it seems unhappy for science that Newton's mathematical approximate *description* was favored in relation to a physical *explanation*.

## Solar eclipses

Indications about anomalies in gravity are observed during solar eclipses. An attempt to explain these phenomena is as an assumption of gravity shielding. Since attenuation by absorption means an exponential decrease of the flow, we get a very small nonlinear effect that is causing the gravity effect of the Sun plus Moon system upon Earth to decrease a very small amount during a solar eclipse, when the 3 bodies are in line. This effect has been estimated to be just detectable with an advanced gravimeter. Such experiments have therefore been done. However, these experiments are not regarding the principle of equivalence between gravity and acceleration.

The equivalence principle means that the assumed decrease in gravity on Earth is not real, but instead converted into a motion of a part of our planet away from the Sun plus Moon system. The size of this part of Earth is defined by the size of the Moon. So, instead we should try to detect such a deformation of our planet. Since the effect on Earth is an average effect over a large region and the effect on a pendulum is more like a point value this difference can perhaps be detected in a long pendulum at rest. The test should be done during an eclipse in a low elevation angle, since the pendulum is movable in that direction. The largest indications can be expected to be observable just before and just after the eclipse. We can only expect to observe a small part of this effect.

Fatio's model seems to have capacity to explain solar eclipse anomalies. This is not possible to do with Newton's model.

## Conclusions I

- We should analyze Fatio's model in more detail in order to find out if it is possible to explain Pioneer anomaly and fly-by anomalies by means of Fatio's model and a radial ether wind.
- We should try to measure changes in the 1-way speed of light in vertical and horizontal directions in order to find the ether wind in 3 dimensions.
- Fatio's model has capacity to explain anomalies in gravity during a solar eclipse.

## Michelson-Morley's experiments (MMX)

Regarding the wave model means that we must think in terms of wave fronts, and not in terms of particles. Wave fronts are defined by the *ray* concept, a vector normal to the wave front. *The wave front is real – the ray is abstract*. The wave motion is defined by wave vector,  $\mathbf{c}$ , together with the ether wind's component in the direction of  $\mathbf{c}$ . We must observe the difference between this concept and the *beam* concept as the vector sum of ether wind  $\mathbf{v}$  and wave vector  $\mathbf{c}$ . The reason is that in a coherent system (based on reflectors and/or refractors) ether wind inside the wave fronts is irrelevant. So, light moves with ray – not beam – along optical axis in a coherent system. The beam direction can only tell us the direction of max intensity, if light is focused into a beam.

In MMX experiments a particle-based thinking is indicating an ether wind effect in the reference arm. Instead, according to the wave model, the orientations of the wave fronts is always unchanged, and defined by mirror orientations. The wave vector  $\mathbf{c}$  is therefore always transverse to mirrors and unchanged, and speed  $c$  is constant in relation to the ether. Therefore, no effect of ether wind in the reference arm. The ether wind is only translational and can therefore not rotate a wave front.

By the same reason the ether wind cannot produce stellar aberration. Stellar aberration is therefore an *illusion* caused by changes in the transverse (to light) *speed* of the observer.

In the measuring arm an effect of ether wind on 2 antiparallel motions of forces is assumed. However, the separation between 2 atoms in a crystal is, in the same way, controlled by 2 antiparallel motions

of forces. So, the effect in the measuring arm is real, but *compensated*. This effect is proportional to  $1 - v^2/c^2$ , that is, 2 times the FitzGerald contraction.

This means that we do not need dilation of time. Instead, we need an effect *inside* atomic clocks equal to  $1 - v^2/2c^2$ . This means a change that is the half value of the 2 effects in MMX's measuring arm. This phenomenon has confused scientists. We can explain this effect by regarding that orbiting electrons move in 2 antiparallel directions in 1 dimension of 2 in the plane of the orbits. Perhaps this effect also exists for light moving transverse to electron orbits. But this idea is not analyzed here.

## Conclusions II

- MMX has *nothing* to say about the ether wind.
- Stellar aberration has *nothing* to say about the ether wind.
- The theory of special relativity was based on important *mistakes*.

## Effect from Sun on motion of light

We assume radial ether wind to be equal to escape velocity and find:

$$\text{Relative change in 2-way light speed} = -\frac{v_{\text{esca}}^2}{c^2} = -20.6 \times 10^{-9}$$

Since  $v_{\text{esca}}=43.1 \cdot 10^3$  km/s at 1 AU from Sun.

The difference from 20 to 70 AU becomes:

$$\text{The difference} = -20.6 \times 10^{-9} \left( \frac{1}{70} - \frac{1}{20} \right) = 0.736 \times 10^{-9}$$

This increase in 2-way light speed has been regarded as a change in the space station motion  $\Delta v_{\text{pion}}$  and assumed to produce a 2-way Doppler effect. A mistake explainable by the fact that 2-way Doppler effect is a comparison between 2-way wave motion and space station speed. Therefore, *decrease* in space station speed can be an illusion caused by the *increase* in 2-way wave motion equal to:

$$\frac{\Delta f}{f} = \frac{\text{Increase in 2-way speed}}{c} = -\frac{2' \Delta v'_{\text{pion}}}{c} = 0.736 \times 10^{-9}$$

With a carrier frequency of  $2.3 \cdot 10^9$  Hz we get:

$$\Delta f = 1.7 \text{ Hz}$$

## Conclusion III

- The velocity of light is not invariant, and the change in light speed can explain the Pioneer anomaly.

## A hypothesis

We assume the radial ether wind to be equal to the escape velocity. In radial direction on the surface of Earth, we get: the relative effect of the ether wind on 2-way light speed equal to  $-\frac{v_{\text{esca}}^2}{c^2} \times c = -1.4 \times 10^{-9} \times c = -0.42 \text{ m/s}$ . In tangential direction we get no effect on 2-way light speed by radial ether wind.

In vertical direction we get the change in light speed on Earth as:  $\frac{\Delta c}{c} = \pm 11.2 \text{ km/s}$  and in horizontal direction we get no effect from ether wind. The effect in vertical direction can therefore explain red/blue shift on Earth as an effect of ether wind (vector), and not caused by the potential of gravity (scalar).

A hypothesis regarding a radial ether wind can also explain the cosmological red shift. The Big Bang idea can be an illusion. The illusion can be explained by the fact that at larger distances the objects must be larger in order to be visible.

## References

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