

# The Michelson-Morley Question – and the Ether

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## Abstract

This article is analyzing the famous experiments, (MMX), that Michelson did together with Morley. These tests have produced confusing and paradoxical results, and have been debated for about 140 years.

Questions regarding quantum jumping, quantization, gravity and entanglement are also discussed.

## Background

The most famous problem in physics is the old question how to explain the failures to detect a second order effect of an ether wind in the MMX equipment. The official explanation is based on an ad hoc assumption, regarding elastic properties in time and space to be related to relative velocities. An earlier ad hoc solution was based on elastic matter and time. In Michelson's time the effect was expected to be  $10^{-8}$  times  $c$ . This was motivated by our planet's sun-related *translation*. But the assumption of an ether entrained by our sun should logically mean that the ether also is entrained by our planet. Therefore, we should expect an ether wind as small as  $10^{-12}$  times  $c$  due to planetary *rotation*.

The behavior of hydrogen gas and Planck's constant has contributed to the concepts of quantization and quantum jumping, that also has caused much debate.

The wave-particle paradox and the concept of entanglement has also caused confusing discussions, leading to different possible explanations.

## Michelson's assumption

Michelson assumed that the forces in light move with speed  $c$ , in relation to the ether. With the ether moving with the speed  $v$  aligned with light motion we therefore get the speeds  $c+v$  and  $c-v$ , in relation to the equipment. Therefore, we find a 2-way speed of light proportional to  $(1-v^2/c^2)$ , in relation to the equipment. There seems also to be a *wrong*, and hidden assumption, that the necessity of using 2-way light for finding light speed,  $c$ , implied that 2-way light also was needed for finding ether wind,  $v$ .

However, Michelson forgot to regard how separations between atoms in crystal are controlled. We cannot accept instantaneous action at distance. Therefore, we must have a link between the atoms and the ether is the only possible solution. We assume, that the atoms cause longitudinal forces that move between the atoms and control separations. It is very reasonable to assume that these forces also move with the same speeds as forces in light. Therefore, we can conclude that separations between atoms also is proportional to  $(1-v^2/c^2)$ . This means that the expected effect is compensated, and therefore **not observable**.

The difference between the 2 cases above is that transverse forces in light only transmit *information*, but the longitudinal forces in between atoms can transfer *energy*. This means that forces in light are only potential, and become realized when the light reaches an electron. So, forces in light have a delayed realization, and this realization is possible by means of energy from the ether.

## The result

We can see that the effect, expected in MMX, is *real but compensated* by a contraction of matter. This contraction is 2 times the officially accepted FitzGerald contraction. This means that MMX is a *useless* method. However, we also can see that *time dilation is not needed*, and that MMX demonstrates Galilean invariance.

## The reference system

As a reference, Michelson used an equal system, mounted in a right angle to the previously mentioned measuring system. According to Pythagoras theorem, the assumptions  $c+v$  and  $c-v$  in measuring system imply  $(c^2+v^2)^{1/2}$  in the reference system, since speed is unchanged and equal to  $c$  in relation to the ether in a direction transverse to wave fronts according to the wave model. This is in accordance with Michelson's first prediction.

Unfortunately, the prediction was reduced by Potier and others, in objection to Michelson and was much debated between 1882 and 1887. This mistake was motivated by an idea that transverse ether wind should change light direction by a small angle of  $\arctg(v/c)$ . *This was an important mistake*, since mirrors reflect the wave front  $\mathbf{c}$  only, and are not related to ether wind  $\mathbf{v}$ . This means that when we apply the law of reflection in a mirror, we must use *the normal to the wave fronts*, and ignore ether wind inside the wave fronts, according to the wave model. Ether wind inside a wave front cannot tilt the same wave front. Therefore, particle-based thinking was infecting the wave model and this mistake produced the idea of  $\gamma$ , that was equal to  $(1-v^2/c^2)^{-1/2}$ . Therefore, **no effect in the reference arm**.

The introduction of  $\gamma$  caused physics to move in an absurd direction. Particle ideas in the wave model had the unhappy effect that particles appeared exist in light and this produced the *wave-particle paradox*, and the use of time dilation as a cover up for the error produced the *twin paradox*.

We can see a simple and clear explanation to what happens in the reference arm by regarding the fact that the distant mirror produces a virtual image of the light source at a doubled range. This virtual image is **fixed** in the equipment frame. This means that orientation of wave fronts in returned light is **fixed** in the equipment frame, and *no wave front tilting*. So,  $\mathbf{c}$  (not just  $c$ ) is unchanged in relation to the ether and transverse to mirrors. Describing this in the equipment frame means a speed of  $(c^2+v^2)^{1/2}$ . No effect of ether wind in the reference arm, and no dilation of time, since small motions *inside* a wave front are irrelevant if they are much smaller than the fringe size.

The reasoning regarding the reference arm can be applied to Stellar aberration, and demonstrate no effect of the ether wind. Instead, stellar aberration is caused by the difference in motion between our planet and our sun, since an *unchanged* wave front needs a *changed* representation in a moving frame.

## The mistake.

The vector sum of ether wind and wave vector represents the direction of max amplitude in a *beam* of light. This direction can only be detected with low accuracy by means of amplitude, and is seldom very important. The important light direction is the wave vector together with the longitudinal component of the ether wind only. Ether wind inside the wave fronts must be ignored in relation to mirrors since mirrors are not related to the ether wind. This direction is the *ray* direction and can be detected with extreme precision in coherent systems. The ray is not physical but a mathematical representation of a *real* wave front. In the law of reflection in a mirror we must use the ray concept. In MMX the beam concept was used in error. In the horizontal plane the difference between beam and ray is only about one part in a million. However, this small difference is important when we will explain MMX. This mistake means that we do not have swept out all particle ideas. We have more unlearning to do.

## Hydrogen radiation

It is empirically demonstrated, that the radius of electron orbits in a hydrogen atom only can have a value belonging to a specific set of discrete values. This means a possible energy state according to the relation  $\Delta E = hf$  with  $h$  as a constant of proportionality, and  $f$  is orbiting frequency. However, the radiation from hydrogen does *not* contain any of these frequencies. Instead, we can observe radiation from all frequencies, that are *difference frequencies* to these stable states. The official explanation to this phenomenon is that electrons are assumed to radiate only when they make *quantum jumps* between the stable states. So, we have a mathematical problem regarding continuity. In a physical sense we have no possibility to see whether there exists a continuous process that is too fast for observation or not. So, the debate in physics has been delayed by a pure mathematical problem. Instead, we should ask ourselves: Is a simpler and more natural explanation possible?

We can see a possibility, if we regard *all* atoms in a specific state instead of *just one* electron. They all radiate at the same frequency, and they are also all sensitive to that frequency. This means that they can cooperate and adjust individually orbiting phase in order to produce zero radiation *together*. This phenomenon is called destructive superposition. However, interference effects between different states also produce frequencies, that are differences between the stable state frequencies. These products are not likely to disappear due to destructive superposition. So, a more natural explanation exists, and therefore we do not need those magical quantum jumps. We find that bound electrons can generate **continuous** radiation.

## Light

An electron orbiting with frequency  $f$  can produce radiation with frequency  $f$ , as demonstrated in the blackbody radiation. The relation  $\Delta E = hf$  can be explained with  $h$  as a scale constant, indicating that electron charge is quantized.  $h$  can be an electron property, not a light property. Since blackbody radiation is explained as a phase dependent interaction between electron and ether it is reasonable to assume that this process also can act in opposite direction. This means that a bound electron can be sensitive to light with the same frequency as its orbiting frequency due to an interference effect. Light can produce a force in a right angle to motion and thereby change the electron's *potential* energy and the electron can escape with unchanged kinetic energy. So, the kinetic energy of the escaped electron is *not dependent* on the intensity in light, but instead of on the orbiting frequency. Such a phenomenon is well known and called photoelectric effect. Therefore, we find that we can explain the photoelectric effect as an effect in *opposite direction* to the blackbody radiation. This explanation is natural and simple in relation to the official version that is stating that particles moving *towards* a surface can cause other particles to move *away* from that surface by an exchange of kinetic energy only. The official explanation seems to be dominated by a preference for the particle model instead of the wave model. However, the wave model is better here.

The wave model can also explain the Compton effect in a simple way. An X-ray wave packet can cause an electron to escape in accordance with the photoelectric effect. When this electron is captured by another atom a second X-ray wave packet is generated in a process going in opposite direction. The wave model works.

To summarize in popular form, we can say that electrons act as:

- transmitters in blackbody radiation
- receivers in photoelectric effect
- receivers plus transmitters in the Compton effect.

An idea of  $h$  as an electron property is not in conflict to Einstein's Nobel prize, since this prize was given for an additive constant in photoelectric effect, and not for quanta in light.

Electrons can generate and absorb light. So, light is also an interaction between electrons, by means of the ether. But this interaction must take time and propagate – with speed  $c$ . The reason is that we cannot accept instantaneous action at a distance, and therefore we must assume light to propagate as a *potential* force, that is realized when an electron is reached. This realization can be based on energy from the ether. So, forces in light have delayed realization, and contain information only. The electron-ether interaction is defined by phase relations and can therefore go in both directions.

So, far we have needed only the wave model for light, since we have accepted the ether concept. Another important experiment with light is the use of a beam splitter to illuminate 2 equal photo detectors with equal amounts of continuous laser radiation. Since electrons are individuals the outputs from the detectors are not correlated. So, the particle model is not needed in this experiment either. The illusion of particles in light appears to be caused by misunderstandings regarding MMX and  $h$ , and also related to the denial of the ether concept, so Newton's denial of Fatio's ether concept seems also to be important.

## Photons

Photons are not needed. Light can be continuous waves from a laser, or in the form of wave packets in X-rays and not at all particles. Light can contain information without energy. With light generated as complementary pairs this information can be converted to energy in 2 different points at 2 different moments of time. We do not need to assume something to move at infinite speed and demonstrate entanglement.

## Atomic clocks

Since we abolished time dilation, we must explain clock behavior in the global positioning system inside the clocks. Since bound electrons move forth and back in relation to the ether wind in 1 dimension of 2, we have a reason to assume an ether wind effect to be half the effect in 2-way light speed. So, the frequency in the clocks may change in proportion to  $(1-v^2/2c^2)$ . Perhaps the ether wind transverse to the orbiting plane also follows this model, but this problem is not addressed here.

The relation above regarding clock speed can be used to explain behavior of atomic clocks in the global positioning system. By regarding the ether wind due to satellite motion, we get the same prediction as SRT. We can also predict the same effect as GRT by assuming an ether wind in radial direction equal to the escape velocity in relation to Earth. But regarding GRT we find that agreement is only in the radial direction. The reason is that ether wind is a vector,  $\mathbf{v}$ , and GRT explanation is by means of the scalar gravity potential. Our experience is limited to the radial direction. So, we can conclude that **one** ether model substitutes SRT **plus** GRT.

## The ether

Most of our knowledge about the ether emanates from the bookbinder Faraday's work over many years. Faraday was the first scientist to use the concept of field. So, he made a mathematical discovery. But he did not know that, since he had not studied mathematics. Therefore, his works were translated to mathematics by Maxwell. So, scientists of today use T-shirts with Faraday's ether-specification, but deny the ether. Fatio also contributed to the ether studies, but unfortunately his model was abolished by Newton. The apparent reason is that Newton, at that time, was a great name and Fatio was not. This was very unhappy since Fatio could *explain* gravity and Newton could only *describe*.

According to Fatio the ether is a flow of small and fast particles, moving in all directions. The flow is attenuated by matter, causing an asymmetry in the flow, leading to the fact that a smaller number of particles is leaving a body than the number of approaching particles. So, gravity is an asymmetry, caused by an ether wind in radial direction, or a falling ether. Just like gravity and ether wind the global positioning system has spherical symmetry, and this explains the high precision in the system. Since the system operates with 1-way speed of light we get the information about the ether as a falling ether, with an ether wind equal to the escape velocity. So, the global positioning system confirms the ether's existence where MMX failed, due to a compensation equal to 2 times the FitzGerald contraction.

The Sagnac effect is also a confirmation of an ether. But this fact has been explained away by describing the effect by a rotating area. The physically relevant description is instead by a translating line, that not necessarily must be closed, as seen in the Sagnac correction in the global positioning system.

So, particles in Fatio's model can be needed to explain the ether and gravity, but waves are all we need to explain light. We see this easily **if** we follow the wave model, accept the ether and eliminate all particle thinking, thereby fulfilling the transition from light particles to light waves that seems **not** to be finished yet, since beam instead of ray, was used in MMX, in conflict with the wave model.

### Pioneer anomaly

The idea about a falling ether can be used to explain the Pioneer anomaly. The ether wind, equal to the escape velocity in relation to the Sun, can produce different values on 2-way radial light speed at 20 and 70 AE (astronomical units). This means an increase in 2-way light speed and this *increase* can simulate a *decrease* in the motion of the space station. This can explain the Pioneer anomaly.

### Gravity and anomalies

Newton's gravity is built on mathematical idealism demanding bodies with a spherically symmetric density function. We can make this model more general by parting a generating body into small volume elements with a specific density and use the inverse square law on each element. Then we can find gravity by an integration over volume. This expression provides the unchanged result for spheres but does not demand spherical form. We have made Newton's model more general, but this model cannot explain the Allais effect.

We can now introduce causality to gravity by using Fatio's idea and assume an attenuation in matter. Attenuation means that the flow is decreasing in an exponential way, meaning a small deviation from linearity. This small deviation can explain a reality to observations when Sun and Moon are aligned in a solar eclipse. This effect has been roughly estimated to just be possible to detect with an advanced gravimeter. Failures to detect such an effect was done in USA some years ago in a solar eclipse in a high elevation angle.

The mistake can be explained by the principle of equivalence. Since our planet is in a free fall, gravity does not change, and instead this small change is converted to a small motion of our planet. This means that parts of our planet, of the size of our moon, are moved away from the Sun-Moon-system (maybe in the order of 1 meter). So, this phenomenon is difficult to observe. A very long pendulum *at rest* could perhaps be used in an eclipse in a *low elevation angle*. Effects should be expected primarily just before and just after the eclipse. The idea for expecting this effect is that the pendulum mass reacts to a point value, but surrounding parts of Earth are affected by an average effect over a large region. Results supporting this idea have been reported from China, by a gravimeter. (Perhaps this idea could be tested by photo-registration of motions in a chandelier in a church, during a solar eclipse in low elevation angle.) So, we find that by using Fatio's model we also can explain the Allais effect.

## Summary

Michelson was one of our most qualified experimental scientists, who gave us the optical definition of the unit of length. Ironically, he also was involved in an important failure in theoretical physics, namely the interpretation of Michelson-Morley's tests (MMX). The ether wind effect on atomic separations, in the measuring arm of MMX, was not observed, and in the reference arm, and in stellar aberration a false effect was introduced by assuming a transverse ether wind to be able to tilt a wave front and thereby cause the  $\gamma$ -factor. Instead we have seen that the ether wind cannot cause any observable effect in either of the arms in MMX and not in stellar aberration either. This means that the theory of special relativity was built on **illusions**, and this mistake gave us the wave-or-particle paradox and the twin paradox. By regarding these *mistakes*, accepting an *ether* and **strict** follow the wave model, we can conclude that MMX observations can be united with the Galilean transform, no dilation of time and a contraction of *matter* that is 2 times the FitzGerald contraction. So, we must use the *ray* concept in MMX. The behavior of an atomic clock is explained *inside* the clock.

The reason to the problems above was particle ideas infecting the wave model, but another reason is the interpretation of Planck's constant,  $h$ , as an evidence for quanta in light. However,  $h$  describes an electron/ether relation, so  $h$  can be an evidence for quanta in electron charge. So, when we have allowed the ether to exist, and perhaps also contain particles, we can see that waves are all we need to explain light **if** we follow the wave model.

It is possible to explain radiation from hydrogen by destructive superposition, instead of assuming quantum jumping.

Blackbody radiation, photoelectric effect and Compton effect are all electron/ether interactions. We can regard photoelectric effect as a process in opposite direction to the blackbody radiation. The Compton effect can be explained as a first step in agreement to the photoelectric effect followed by a second step in opposite direction. The role of Planck's constant,  $h$ , in these relations can demonstrate quanta of charge in electrons.

If forces in light are regarded as potential, we do not have to assume entanglement in light.

Newton's denial of Fatio's ether model has caused much harm to physics and abolished causality in gravity by a falling ether. Such an ether can explain atomic clock behavior, gravity, Allais effect and the Pioneer anomaly.