

Ongoing problems with special and general relativity, and solutions

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Abstract. It will be shown that a certain configuration of the Sagnac experiment disproves Einstein's theory of relativity. Consequently, there is no need for four-dimensional space-time. Euclidean geometry also applies when describing relativistic phenomena. This makes the visualization and mathematical treatment of those physical processes much easier. In addition, it explains physical phenomena which are not presently understood, particularly in the field of astronomy and cosmology.

1. Introduction

Einstein's theory of special relativity has been subject of controversy ever since it was first proposed. Serious objections were raised by Einstein's colleagues Ernst Mach and Hendrik Lorentz. They objected that Einstein's interpretation, the denial of an absolute frame of reference (i.e. ether), leads to logical contradictions with regard to circular motion. Einstein acknowledged this as being a problem, yet nevertheless refused to accept the necessity of an ether, while at the same time failing to give an answer to the arguments put forward by Mach and Lorentz.

The Lorentzian interpretation of relativity, which assumes a fixed reference frame, avoids these problems. In addition, the general approach of Lorentz, which does not depend on a modified interpretation of space and time but instead deduces relativistic phenomena from known physical reactions, gets around these problems as well as other known paradoxes of special relativity.

Furthermore, if Lorentz's basic approach is applied to general relativity, this leads to a different understanding of gravity. In this interpretation, the gravitational force does not depend on mass or on energy, but is a side effect of the forces acting inside elementary particles. As a result of this, a concept can be proposed in which every particle contributes equally to the gravitational field, independently of its mass. This approach solves the problem of dark matter without the need for special particles. The same general approach also solves the great problem of dark energy in a comparatively simple way.

2. Comparison Einstein vs. Lorentz

A long-standing debate surrounds the issue of whether to give preference to the Einsteinian and the Lorentzian interpretation of relativity. The Lorentzian version, though shown by many authors to be equivalent to the Einsteinian one, has only been adopted by a minority of physicists. The advantages of the Lorentzian interpretation as seen by this author are

- The avoidance of logically questionable assumptions about space and time
- The direct relation to physical processes
- The much easier mathematics and visualization - particularly with respect to general relativity.

Up to now, however, there have been no strict logical arguments in favor of the Lorentzian interpretation. This has now changed. In the following we will present an experimental proof which clearly refutes Einstein's interpretation.



2.1 The Sagnac fiber optic gyroscope

The Sagnac fiber optic gyroscope is a version of the Sagnac process which is currently used in navigation systems. Two light signals are sent around a fiber optic ring in opposite directions. Both signals meet at the end of the ring where they undergo interference, which is stable as long as the whole apparatus does not rotate. However, as soon as it rotates, the signals take different times to travel to the point of interference, depending on their direction. This changes the phase of the signal at this point, and the corresponding phase change can be used to determine the fact of rotation and the angular speed of the rotation. See figure 1 for the fiber optic version of Sagnac set-up.

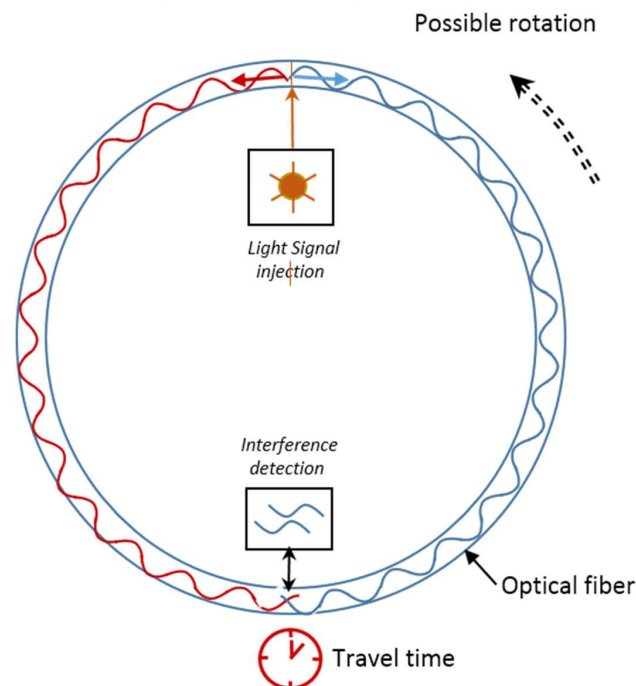


Figure 1: A fiber optic gyroscope (simplified view with a single half-loop)

2.2 The Sagnac fiber optic gyroscope

This experiment is based on the Sagnac effect. The Sagnac effect, particularly its technical application as a laser (fiber) gyroscope, stands in clear contradiction to Einstein's interpretation of special relativity. The compatibility between special relativity and the Sagnac experiment has been repeatedly investigated and in general confirmed. In these cases, however, the experiment was investigated for an observer who is at rest with respect to the experiment, i.e. he does not rotate. In this case, there is no problem. However, if the Sagnac process is investigated for an observer who is rotating with the set-up, this leads to a conflict in his frame of reference. This conflict is usually refuted by arguing that special relativity only applies to inertial systems in linear motion, not to rotating systems. It can, however, be shown that a continuous transition can be made from a rotating Sagnac set-up to a system in linear motion, during which the conflict does not change or disappear.

Imagine the following set-up: We envision a small section of the optical fiber in the Sagnac loop. Parallel to this section, we envisage a short, straight section of a light path that is not curved. This section moves tangentially in the direction of the section of the rotating fiber loop under investigation. The speed of the surface of the fiber is designated v , the straight section may move at the same tangential speed v . See fig. 2. For the sake of simplicity, we will assume that the speed of light in the fiber is the nominal c .

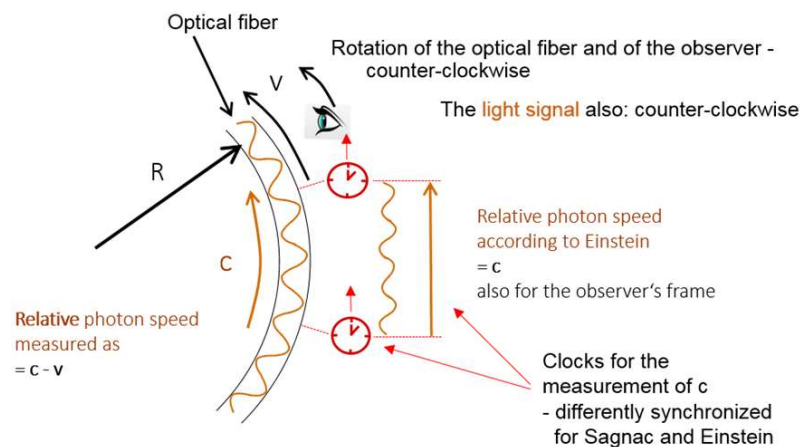


Figure 2: Section of the rotating Sagnac gyroscope

The observer moves following the surface of the fiber along a curved path and so almost parallel to the straight section also moving at the surface speed v .

What about the measured speed of light? As seen from an observer at rest, the speed of a light signal inside the fiber is in fact c . But as seen by the moving observer, the speed of the light signal is $c - v$ or $c + v$, depending on the direction of the signal in the fiber. This is the result of measuring the speed of light along the full circuit. By spatial symmetry, this speed has to be the same for any section of the circuit.

In the straight section (which is also moving at v), the speed of light is always c , according to Einstein. It is measured as a one-way measurement, which requires two clocks which are synchronized as described by Einstein. Here we see a discrepancy, namely v , between the Sagnac fiber and Einstein's prediction. This is normally not accepted as a discrepancy because the Sagnac system is rotating and special relativity does not cover rotating systems. However, we can allow the two cases to converge.

Let's assume that the Sagnac system is made larger and larger, i.e. its radius increases. Its rotation is adapted such that the speed at the surface remains v . The difference between Sagnac and Einstein then remains constant, at $\Delta = \pm v$. But now, the *physical* difference between the Sagnac section and the Einstein section will become smaller and smaller and will finally vanish as the radius of the Sagnac setup approaches infinity.

In this new situation, where the physical difference between the Sagnac section and the Einstein section undergoes any given difference, the measured speed of the light signal maintains its constant difference to Einstein's result, the two measurements become incompatible. One of the results must be wrong. So, which one?

2.3 The evaluation

The result for the Sagnac side must be correct because it is validated every day by navigation systems. Consequently, the Einstein-result must be wrong. – How is this explainable? – It is easily explained if we look at Einstein's famous paper of 1905 [1], introducing special relativity.

Here is Einstein's original text, with those parts relevant for this case (translated into English):

"If at the point A of space there is a clock, an observer at A can determine the time values of events in the immediate proximity of A by finding the positions of the hands which are simultaneous with these events. If there is another clock at the point B in space in all respects resembling the one at A, it is possible for an observer at B to determine the time values of events in the immediate neighborhood of B. But it is not possible without further assumption to compare, in respect of time, an event at A with an event at B. We have so far defined only an "A time" and a "B time." We have not defined a common "time" for A and B, for the latter cannot be defined at all unless we establish by definition that the "time" required by light to travel from A to B equals the "time" it requires to travel from B to A. Let a

ray of light start at the “A time” t_A from A towards B, let it at the “B time” t_B be reflected at B in the direction of A, and arrive again at A at the “A time” t'_A .

In accordance with definition, the two clocks synchronize if $t_B - t_A = t'_A - t_B$.

We assume that this definition of synchronism is free from contradictions, ...

(Underlining by the author of this paper.)

The result is that Einstein’s assumption of a constancy of c in any frame is physically clearly incorrect. And this has tremendous consequences, because the assumed constancy is the reason for his assumption of four-dimensional space-time. Why?

By assuming constancy in all frames, Einstein had to solve the equation

$$c + v = c \quad (1)$$

for any $v \neq 0$.

This equation cannot be solved within the framework of Euclidean geometry. However, Einstein was able to solve it by introducing a different geometry, i.e. he redefined the notions of space and time so as to become functions of the velocity:

$$x \rightarrow x(v); \quad t \rightarrow t(v). \quad (2)$$

Einstein defined these functions so as to satisfy the equation (1) above, which resulted in the “Lorentz transformation”.

So, if Einstein is wrong in this, what are the consequences for the theory of relativity?

The Sagnac experiment shows us that there is no need for four-dimensional space-time, but that we can continue to use Euclidean geometry to describe physical phenomena.

The interpretation of relativity, which uses Euclidean geometry and is based not on principles but on physical laws, is called the “Lorentzian interpretation of the theory of relativity”. We will describe this interpretation briefly in the following.

2.3.1 THE LORENTZIAN WAY

What is different in the Lorentzian interpretation of special relativity? The Lorentzian interpretation is characterized by the following differences:

- Euclidean geometry is adopted
- The speed of light c is not constant in all cases; velocities are added according to classical rules
- Contraction refers to the contraction of fields; the contraction of objects then follows by physical mechanisms
- Dilation is the slowing down of the internal oscillations of particles, which travel at a velocity c ; the slowing of clocks and other physical processes is a physical consequence of this.

More detailed explanations follow.

2.3.2 SUMMATION OF VELOCITIES

If the speed of a light signal is c in a reference system and an observer moves with velocity v with respect to the reference system in a direction parallel to the light signal, then the observer should in a classical view observe the velocity $c + v$ or $c - v$, depending on the direction of motion. But in practice, he will observe the speed c in both cases. In Einsteinian relativity, this is explained as a general principle. In Lorentzian relativity, which is based on a classical understanding, it is explained by the clock synchronization proposed by Einstein. As explained in section 2.2 and shown in figure 1, such one-way measurement needs two clocks, one at the beginning and one at the end of the distance being measured.

And two clocks that are synchronized according to Einstein necessarily measure the nominal value for c as explained above.

Another, special case is the two-way measurement where the signal is reflected by a mirror. In this case only one clock is needed. If the moving observer uses such a set-up, two effects are involved: this single clock runs more slowly when it is moving, and the distance measured contracts mechanically due to the contraction of moving fields. - This explanation also covers the Michelson-Morley experiment.

2.3.3 CONTRACTION

In Einstein’s interpretation space contracts, which can be taken as a philosophical statement. In the Lorentzian interpretation, any moving fields contracts and so every mechanical body does so. Historically, this followed from Maxwell’s theory of electrical fields; meanwhile it has also been proven for other fields. Both interpretations lead to similar experimental observations. (However, Einstein’s view runs into a philosophical problem because there is only one space and this contracts for the moving observer but at the same time does not contract for the observer at rest.)

2.3.4 DILATION

In Einstein’s interpretation, dilation is a property of the abstract notion of “time”. In the physics-related interpretation of Lorentz, dilation is caused by internal oscillations within elementary particles. This was postulated by Louis de Broglie in 1924 [2] and was deduced by Erwin Schrödinger in 1930 [3] from the Dirac function of the electron [4]. There is no reason to assume this is not the case for all fermions that are also the constituents of more complex particles. This internal oscillation is assumed to be circular in order to explain the spin and also the magnetic moment of electrically charged particles (figs 3a and b).

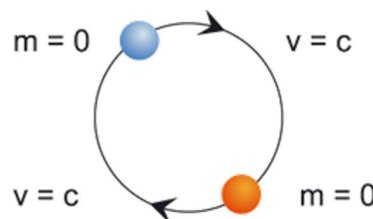


Figure 3a: Structure of an elementary particle as deduced from Lorentzian relativity

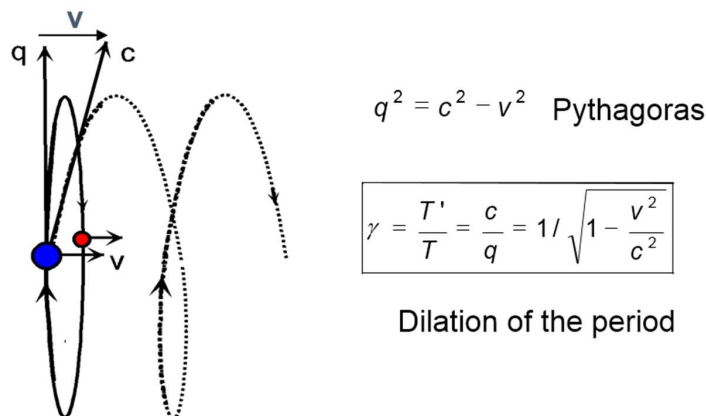


Figure 3b: Dilation in the context of the particle model

2.3.5 CONCLUSIONS FOR SPECIAL RELATIVITY

For the formal handling of special relativity, the assumptions based on Lorentz yield the same Lorentz transformation as Einstein’s assumptions concerning space and time, and so entirely fulfill the requirements of special relativity, leading to the same results as those of Einstein.

3. General Relativity the Lorentzian way

General Relativity, i.e. the relativistic understanding and treatment of gravitation, can also be fully explained without any recourse to Einstein's assumptions about space and time.

The first and simple step in this understanding is to realize that the speed of light changes (i.e. is reduced) in a gravitational field. That follows directly from appropriate measurements. In Einstein's understanding, space-time is curved in such a way that this apparent change in velocity is interpreted to be a consequence of the altered understanding of this notion. This makes it necessary to describe such processes by a Riemannian geometry with a curved four-dimensional space.

On the other hand, the Lorentzian approach of accepting the resulting measurement of a locally variable speed also permits the use of Euclidean geometry in this situation. If this is connected to the above-mentioned internal motion within particles at a velocity of c , then we have all the necessary tools to describe all the processes taking place in a gravitational field quantitatively correctly. The famous case of a light ray being deflected by the sun is easily - and quantitatively correctly - determined as a classical refraction process. Well known cosmologists (like Roman Sexl) have shown this in the past, so it is a well-known fact. The known result is:

$$\alpha = 4 \cdot \frac{GM}{c^2 d} \quad (3)$$

where G is the gravitational constant, M the mass of the gravitational source, d the distance to the vertex, and α the overall deflection angle. This is the result of Einstein's General Relativity as well as of the classical refraction process.

Whereas in the theoretical approach of Einstein gravitation is a geometrical property of four-dimensional space-time, in the view following Lorentz it is a physical phenomenon. So it may be a classical physical force. If we look at two specific features of the gravitational forces, namely

- The weakness of gravity, being > 30 orders of magnitude weaker than the electric force, and
- The fact that gravity is an attraction-only phenomenon

then gravity may be assumed to be a side effect of other forces. This approach leads to quite reasonable consequences. If the exchange particles of the underlying charges disturb the path of light-like particles, like photons or the constituents of elementary particles, this means a reduction in the effective velocity of those particles. This effect not only reduces the resulting speed of photons but also the speed of the sub-particles that make up elementary particles. This again explains the dilation in all time-related reactions and also the contraction of particles in a gravitational field and also of objects whose extension and shape are caused by different kinds of fields.

A consequence of this approach is that the effect of gravity does not depend on the mass of the matter which is the source of the gravitational field. The most plausible consequence is that every elementary particle contributes equally to a gravitational field.

4. Open problems in cosmology

Here we will address dark matter and dark energy.

4.1. Dark matter

Problems in connection with dark matter which allow concepts to be checked quantitatively include the rotation curves of rotating galaxies.

4.1.1. ROTATION CURVES

We have investigated the galaxy GNC 3198, for which extensive measurements exist. These are displayed in fig 4.

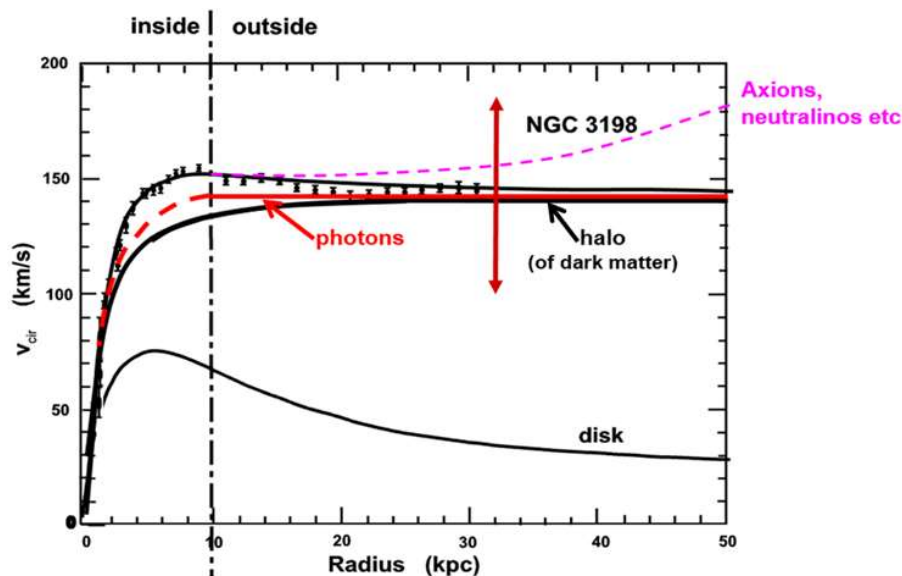


Figure 4: Rotation curve of NGC 3198

Stars in this galaxy are measured regarding their speed of rotation (the little bars) as a function of the radius. A solid line is drawn through these measurement points. The rotation curve for the case of no dark matter which follows from the gravitational concepts of Newton and Einstein is the lowest line (labelled “disk”).

The conflicting difference between this curve and the actual measurement is the curve further up, labelled “halo of dark matter”. (Note that the squares of the values have to be added here.) A little further up, the curve labelled “photons” follows from the concept that gravity does not depend on the mass of the originating object assuming a mass-independent influence of every elementary particle. This curve takes into account the contribution of photons and neutrinos as sources of the gravitational field. An error bar is shown which indicates the uncertainty in the photon stream in the galaxy in particular. This is the uncertainty due to the fact that the spectra of the stars in this galaxy are not known better. However, the shape of the “photon-curve” fits perfectly. The reason is the permanent generation of photons (and neutrinos) inside a galaxy and their spatial distribution following the density relation $1/r^2$.

4.2. Dark energy

The problem of dark energy is closely connected to Einstein’s theory of relativity. The Hubble curve shows in general a linear relationship between the distance of stars from us as observers and their speed in relation to us. In the year 1999, two astronomical research teams found that older stars in the Hubble curve deviate from the line in the direction of lower speeds. From this it was concluded that younger stars are relatively faster than the old ones, so an acceleration of their motion was deduced. This was detected through the investigation of type Ia supernovae, which can be used as standard lamps and therefore evaluated to determine of the distance. The speed was analyzed by using the stars’s red-shifted spectra.

The analysis of these experiments was done on the basis of the cosmological model of Georges Lemaitre, which is in turn based on Einstein’s theory of relativity. It assumes that the stars are not receding in a stable space, but that instead the stars are at rest with respect to an expanding space. The unknown cause of the assumed acceleration has been given the name “dark energy”.

If we follow Lorentz rather than Einstein, there is quite a simple solution. According to Lorentz, the universe is not evolving through a change of space, but the stars are receding in a steady space. There are arguments, also based on other reasons and aspects, suggesting that the speed of light changes with

time in a way that the value was higher in the past and is continuously decreasing by a small amount. If the speed of the supernovae is determined by the Doppler Effect, a higher value is used for former times, resulting in a higher speed of recession for those times. The Doppler shift is given by the equation

$$v = c \frac{\Delta\nu}{\nu + \Delta\nu} \quad (4)$$

Here ν is the frequency of the starlight, $\Delta\nu$ is the redshift of the light and v is the resulting speed of the star in relation to the observer. A higher speed of light c in the past leads to a higher value v for the stars in former times.

So, there is no increase in speed, and no acceleration of the stars. And the whole problem addressed by dark energy disappears.

5. Summary

We have shown that comparing Einstein's theory of relativity with the Lorentzian approach, Einstein's argument is experimentally disproved. The theory of relativity of Lorentz is based on physical processes and phenomena which are otherwise known. And by abandoning Einstein's four-dimensional space-time, the logical conflicts arising with Einstein's theory can be avoided, while at the same time it yielding an easier visualization of the connected physical processes and allowing for much simpler mathematics. There are no paradoxes like the Ehrenfest Paradox and the Twin Paradox. Open problems in cosmology, like dark matter and dark energy, have comparatively straightforward solutions. – The cosmological concept of Georges Lemaitre, which assumes an ongoing expansion of space in which the stars keep their positions with respect to space, is replaced by the view of a stable space in which the stars are receding.

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