The original explanation of the Lorentz-Fitzgerald contraction phenomenon - photon pressure model

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Abstract:

The paper explains the Lorentz-Fitzgerald contraction phenomenon on the basis of Special Theory of Ether (STE). Presented explanation is based on the construction of innovative technical model of this phenomenon, and not only on his classical mathematical description.

The model explaining the reason of the Lorentz-Fitzgerald contraction is based on the photon pressure and the properties of the light clock, so we called it the photon pressure model. In this model, the dimensions of bodies result from the equilibrium between the atoms that compose them, and this equilibrium is influenced by the photon pressure (i.e. electromagnetic interaction). In the Special Theory of Ether, physical bodies are contracted, not space-time. Therefore the model presented here combines the relativity theory with universal frame of reference (STE) and solid-state physics.

The model presented here shows how Michelson-Morley's experiment can be modified to allow detection of motion relative to hypothetical ether [76]. The Lorentz-Fitzgerald contraction measurement may have future applications in aviation and astronautics navigation, as it will allow determining direction in space.

The entire article includes only original research conducted by its authors.

Key words: Lorentz-Fitzgerald contraction, photon pressure, light clock, time dilation

1. Introduction

The content of this article is a continuation of the research on the light clock, therefore it is recommended to read the article [66] in advance, which discusses the light clock and time dilation, used in this article in the photon pressure model.

The Lorentz-Fitzgerald contraction [45] was proposed to explain the null result of the Michelson-Morley experiment [54], that is, the contraction is necessary to explain this result in the framework of relativity.

The considerations in this article are made in the framework of the Special Theories of Ether (STE) [67]-[73].

In the articles [70]-[71] the derivations of infinitely many Special Theories of Ether were shown, which are consistent with the measurements of the speed of light. In each STE there is a universal frame of reference (called the ether). Light propagates in this universal frame of reference. Thanks to the universal frame of reference it is possible to determine the absolute velocity of inertial frames of reference. In STE the velocity of movement relative to the universal frame of reference affects the time elapse. This phenomenon is time dilation. For example, in STE without transverse contraction, clocks stationary relative to the ether measure time the fastest. However, clocks moving relative to the ether measure time slowly. The faster the speed of a clock relative to the universal reference frame, the clock ticks slower. Time dilation was thoroughly investigated in the article [66]. It is a natural property of the light clock.

In any STE, the simultaneity of events is absolute, because in an STE all observers evaluate the relative elapsed time of any two processes in the same way.

Each body emits photons, the amount and energy of which depends on the body temperature. The emitted photons are not homogeneous but have a Planck distribution. This phenomenon is also described by the laws of Wien and Stefan-Boltzmann. Bodies in a state of thermal equilibrium irradiate each other with photons with the same distribution. In this article we assume that bodies emit photons in their entire volume, not just on the surface. Photons emitted inside the body are absorbed by atoms and re-emitted, i.e. they move from atom to atom. Some of the photons go outside the body and are registered as electromagnetic radiation from the black body (thermal radiation).

2. Model of longitudinal contraction (Lorentz-Fitzgerald) and transverse contraction

This chapter proposes a model explaining the Lorentz-Fitzgerald contraction mechanism of bodies moving in relation to the universal frame of reference, in which light propagates. According to the explanation given, the contraction of bodies in motion is caused by the influence of this motion on the state of equilibrium of atoms in a solid body. We assume at least two opposite interactions affect atoms. The average distance of atoms results from the state of equilibrium between these interactions. One of these interactions is related to the light clock (photon pressure).

Figure 1 shows two atoms of a solid body that are in thermal equilibrium. The considered atoms are at average distance D and move in relation to the ether at velocity v. The distances between atoms are D for the observer from the ether and D' for the observer from the inertial system where the body is located. The angle between the direction determined by atoms and the direction of velocity v has a value α (this is the angle measured in the ether system).

In the Special Theories of Ether between the values of D and D' there is a relationship derived in article [66]

$$D = \frac{D'\psi(v)\sqrt{1-(v/c)^2}}{\sqrt{1-(v/c)^2\sin^2\alpha}} \tag{1}$$

Each atom is under the influence of two interactions. One of them transmits momentum Δp_f to atoms and causes the atoms to repel each other. The other one acts on the atoms with force F_m and causes the atoms to attract each other. Figure 2 shows examples of the values of these interactions for a fixed value of speed v. The only stable distance between the atoms is the D_s distance. If this distance increases slightly, then the attraction force is greater than the repulsive

force. If this distance decreases, then the repulsive force is greater than the attraction force. If the distance of atoms increases above the distance D_n, then the intermolecular bond is permanently broken because the repulsive force becomes greater than the attraction force.

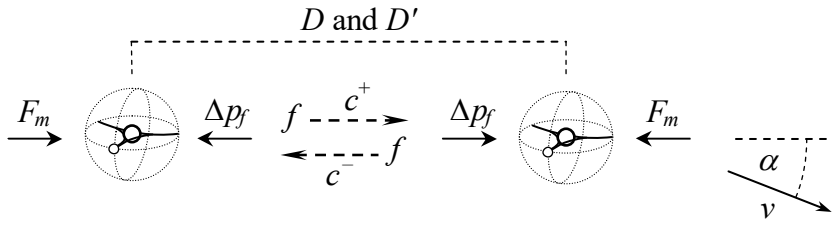

Fig. 1. There are two opposite interactions on atoms.
The average distance of atoms is the result of balance state between these interactions.

Now we will describe the repulsive effect. Atoms shown in Figure 1 emit and absorb photons with frequencies f that propagate in the ether. In the state of thermal equilibrium between atoms, n photons pass back and forth at time $\Delta t(v)$. So n is the number of photons that are in the space between the two atoms. For simplicity it is assumed that these photons reflect elastically from atoms. Atoms and photons that pass between them form a light clock. Each time when a photon reflects from an atom it transmits to it a momentum of the following value

$$\Delta p_f = 2\frac{h}{\lambda} = 2\frac{f\,h}{c} \tag{2}$$

where: λ is the wavelength attributed to the photon, f is the frequency of this wave, h is the Planck constant, while c is the speed of light in vacuum (average on the way back and forth).

That is, photons passing between atoms push them and create internal pressure (we will call them the photons pressure).

Force is the momentum change in time. Therefore, the average force with which n photons act on one atom is (it is an action from one fixed side)

$$F_f = \frac{n\,\Delta p_f}{\Delta t(v)} = 2\frac{n\,f\,h}{c\,\Delta t(v)} \tag{3}$$

It is assumed that the number of n photons does not depend on the distance of atoms D. The time $\Delta t(v)$ that a photon needs to travel between atoms, back and forth is described by the two equations derived in the article [66] in the form

$$t = \frac{2\,D}{c}\frac{\sqrt{1-(v/c)^2\sin^2\alpha}}{1-(v/c)^2} \tag{4}$$

and in an equivalent form

$$t = \frac{2\,D'}{c}\frac{\psi(v)}{\sqrt{1-(v/c)^2}} \tag{5}$$

After substituting these equations to (3) the following is obtained

$$F_f = \frac{n\,f\,h}{D}\frac{1-(v/c)^2}{\sqrt{1-(v/c)^2\sin^2\alpha}} \tag{6}$$

and in an equivalent form

$$F_f = \frac{n f h}{D'} \frac{\sqrt{1-(v/c)^2}}{\psi(v)} \tag{7}$$

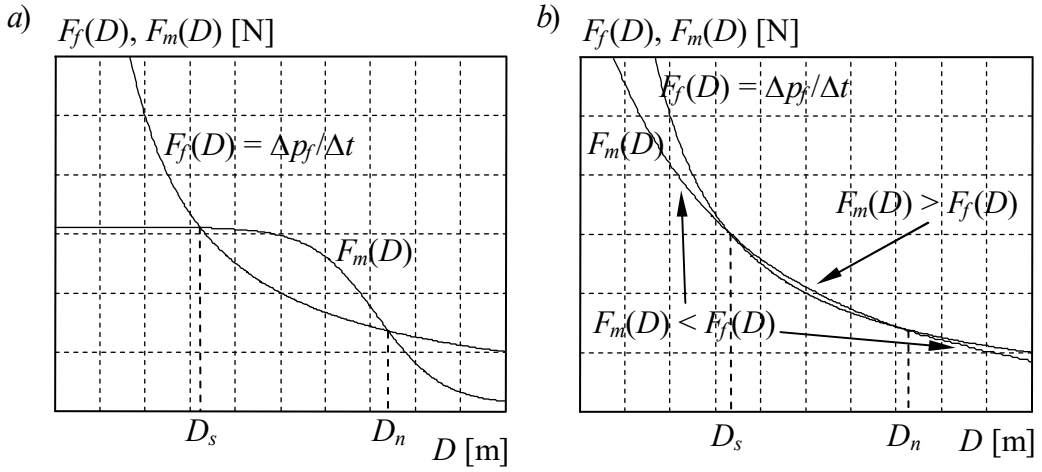

Fig. 2. Example of the values of interactions between atoms of solid body for a fixed value of speed v. $F_f(D)$ is repulsive force, $F_m(D)$ is an attraction force. The figure shows two example variants *a*) and *b*) differing in the function $F_m(D)$.

The force F_f is a function of the speed v of the body with respect to the ether and the distance D or D' between the atoms, so we will sometimes denote it with the symbols $F_f(v)$ and sometimes with the symbols $F_f(D)$. The repulsive force of atoms, written in the form (6), is inversely proportional to their distance D (measured in the ether reference frame), as shown in Figure 2. This force written in the form (7) is inversely proportional to their distance D' (measured in the body reference frame). This is due to the properties of light clock, which slows down the timing when the length of its arm increases [66]. Therefore, in Figure 2 the force $F_f(D)$ is presented in the form of a hyperbola.

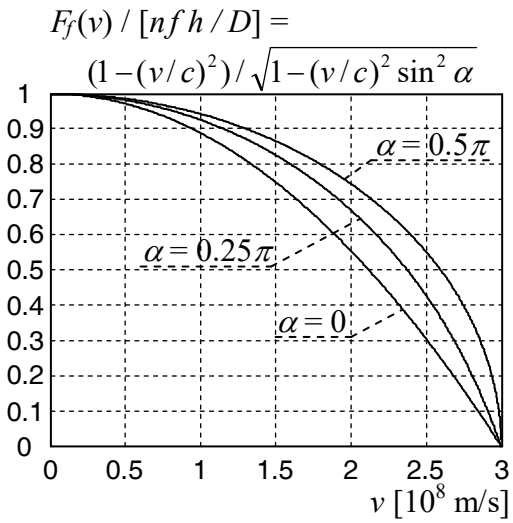

Fig. 3. Values of the repulsive force $F_f(v)$ as a function of speed v for the angles $\alpha = 0, 0.25\pi, 0.5\pi$ and fixed value of distance D.

Figure 3 shows the repulsive force $F_f(v)$ as a function of speed v, resulting from formula (6). As the body increases its speed v with respect to ether, then the value of this force decreases. This means that the photon pressure that repels atoms is decreasing. Therefore, when the body moves with respect to the ether, the function $F_f(D)$ shown in Figure 2 decreases and the equilibrium point

D_s shifts to the left. The force $F_f(v)$, shown in Figure 3, decreases more when the arm formed by the atoms is inclined at a smaller angle α to the velocity v. Therefore, bodies shorten more strongly in directions parallel to velocity v, than in directions perpendicular to velocity v. That is, the model presented in this article explains why the longitudinal contraction of bodies in motion is greater than the transverse contraction (of course, in STR the transverse contraction does not occur at all, it can occur in STE).

Now we will describe the attraction effect. The atoms shown in Figure 1 are compressed by the intermolecular force F_m. In this paper we do not discuss the nature of this interaction. We just want the atoms remain in equilibrium when they are at a distance D_s.

Atoms will be in equilibrium at a distance of D_s if the equilibrium of attraction and repulsive forces occurs.

$$F_m(v, D_s, \alpha) = F_f(v, D_s, \alpha) \tag{8}$$

The dimensions of body will change if its speed v in relation to the ether changes, as predicted by STE, if the speed v affects the value of the force F_f in a different way than the value of the force F_m.

After substitution of the equation (6) the following is obtained

$$F_m(v, D_s, \alpha) = \frac{n f h}{D_s} \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2 \alpha}} \tag{9}$$

Based on the relation (7), the equation for the attraction force F_m can be written in another form

$$F_m(v, D_s') = \frac{n f h}{D_s'} \frac{\sqrt{1-(v/c)^2}}{\psi(v)} \tag{10}$$

Equations (9) and (10) represent the value of intermolecular bond force only at the stable point D_s or D_s', shown in Figure 2. For the remaining values D, the function F_m can have different values. This means that in general we can save the following dependencies on the function F_m

$$\begin{cases} F_m(v, D, \alpha) = \dfrac{n f h}{D_s} \dfrac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2 \alpha}} g_m(v, D, \alpha) \\ g_m(v, D_s, \alpha) = 1 \end{cases} \tag{11}$$

or

$$\begin{cases} F_m(v, D') = \dfrac{n f h}{D_s'} \dfrac{\sqrt{1-(v/c)^2}}{\psi(v)} g_m(v, D') \\ g_m(v, D_s') = 1 \end{cases} \tag{12}$$

The function g_m appearing in equations (11) and (12) is positive and continuous function that has to fulfill the conditions specified in (11) and (12). For a fixed value of speed v and angle α, the values of this function depend only on the distance D or D' of atoms. It was the function g_m that decided about the exemplary shape of the force diagram F_m in Figure 2.

For such a forces $F_f(v)$ and appropriate F_m, the dimensions of body will change if its speed in relation to the ether changes, as predicted by STE.

3. Another use of the photon pressure model

The model presented in this article can be used to interpret the known physical properties of bodies. For example, Figure 4 shows examples of differences between a hard body and a soft body. The harder is the body for which deformation of the distance D_s causes greater differences in values of forces $F_m(D)$ and $F_f(D)$ (i.e. for which the inclination of function $F_f(D)$ is greater in point D_s).

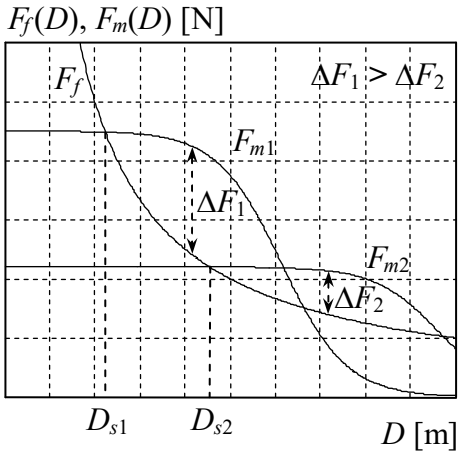

Fig. 4. Example of hard (F_{m1}) and soft body (F_{m2}).

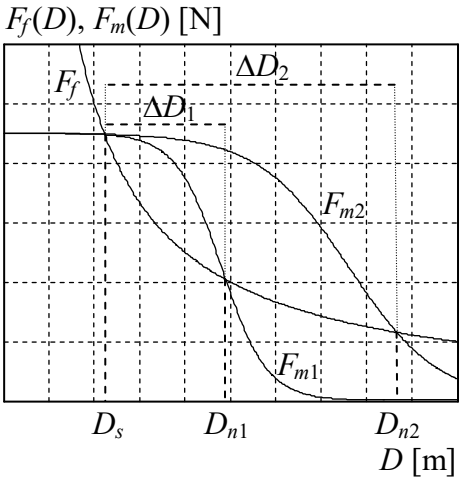

Fig. 5. Example of friable (F_{m1}) and malleable body (F_{m2}).

Figure 5 shows examples of differences between a fragile body and a malleable body. The fragile body is the one for which smaller changes ΔD cause permanent breaking of intermolecular bond, i.e. reaching the point D_n.

If the body temperature changes, the frequency f of photons causing the repulsive force changes (then it will be shown that their number n changes as well).

Figure 6 shows examples of differences between a cooler body and a warmer body. In a warmer body, the frequency of photons f is higher and the number n of photons is greater. This makes the repulsion force $F_f(D)$ in the equations (6)-(7) is greater and the diagram of this repulsion force rises upwards. If the diagram $F_f(D)$ is raised so that it no longer has any shared points with the diagram F_m, the body becomes liquid or gaseous. If the force diagrams $F_f(D)$ and $F_m(D)$ do not intersect, then there is no distance D_s of atoms for which the forces remain in equilibrium and form a rigid bond. Whether the body is liquid or gaseous depends on the external pressure and thus indirectly on the force of gravity. This is consistent with phase diagrams of equilibrium states.

The presented model also explains the mechanism of thermal expansion. For a warmer body, the graph of $F_f(D)$ function moves upwards (Figures 6). Then the stability point D_s moves to the right, i.e. the distance between atoms and the dimensions of solid body increases. In the presented model, thermal expansion and Lorentz-Fitzgerald contraction are based on the same mechanism, i.e. change of photons pressure inside the solid body. In case of thermal expansion, the pressure changes due to a change in temperature, because then the number of photons and their momentum changes. In case of Lorentz-Fitzgerald contraction, the pressure changes due to a change in the speed of body relative to the universal frame of reference, because then the frequency changes with which photons transmit the momentum to atoms of the solid body (frequency measured in the ether system).

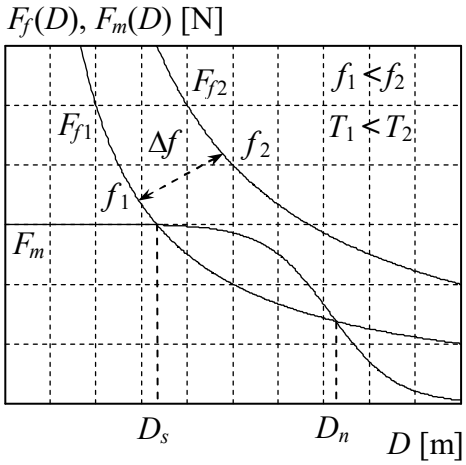

Fig. 6. Example of a body in solid state (F_{f1}) and a body in liquid or gaseous state (F_{f2}).

4. Estimation of the number of photons of thermal radiation

In the presented model atoms emit and absorb photons (electromagnetic radiation). It is expected that part of photons oscillating between atoms escapes from the body area. Such prediction is in accordance with the fact that each body emits electromagnetic thermal radiation called the radiation of a black body. The distribution of black body radiation was described by Max Planck, who postulated that it originated from the vibrations of harmonic oscillators that emit and absorb this radiation. Therefore, the model presented here is consistent with the analysis based on which Max Planck derived an equation for the distribution of black body radiation.

We will now calculate the density and intensity of the photons of thermal radiation near the surface of the body emitting this radiation.

According to Wien's law, as body temperature increases, the main wavelength of thermal radiation emitted by the body decreases proportionally. Wien's law enables to calculate the frequency of photons for which the distribution of all photons in the black body radiation has a maximum value (mode in statistics). That is

$$f_{\text{mode}} = \frac{c}{\lambda_{\text{mode}}} = \frac{c}{b/T} = \frac{c}{b}T \quad [1/\text{s}] \tag{13}$$

The photon energy has a value of

$$E_f = f\,h \quad [\text{J}] \tag{14}$$

Symbol ρ_T [1/m^3] designates the photon density that is the number of photons of thermal radiation that are in a volume of 1 m^3 (near the body surface and these are photons moving away

from the body) at temperature T. These photons have different frequencies described in the Planck distribution. For the purpose of this paper, for simplicity it is assumed that the frequency of all photons has a value (13). Then the energy of all photons in a volume of 1 m^3 is obtained after placing (13) to (14) and multiplying by ρ_T. Then the following is obtained

$$E_{m^3}(T) \approx \rho_T \frac{c}{b} T\, h \quad [\mathrm{J/m^3}] \tag{15}$$

The energy of photons of thermal radiation, which escapes to the outside through its unit surface per second, is described by the law of Stefan-Boltzmann radiation in the form of

$$E_{s\cdot m^2}(T) = \sigma T^4 \quad [\mathrm{J/(s\,m^2)}] \tag{16}$$

Since photons move at an average speed of c, thus in the unit volume there are photons with the energy that is obtained by dividing (16) by c

$$E_{m^3}(T) = \frac{E_{s\cdot m^2}(T)}{c} = \frac{\sigma T^4}{c} \quad [\mathrm{J/m^3}] \tag{17}$$

After comparing the equations (15) and (17), the following is obtained

$$\rho_T \frac{c}{b} T\, h \approx \frac{\sigma T^4}{c} \tag{18}$$

On this basis, an estimation of the photon density moving away from the body near the surface of a black body is obtained (the number of photons in the unit volume, which move away from the body emitting them)

$$\rho_T = N_S\, T^3 \approx \frac{\sigma b}{h c^2} T^3 \quad [\mathrm{1/m^3}] \tag{19}$$

For constant values

$$\begin{aligned} \sigma &= 5{,}670400 \cdot 10^{-8} && [\mathrm{J/(s\,m^2\,K^4)}] \\ b &= 2{,}897768 \cdot 10^{-3} && [\mathrm{m\,K}] \\ h &= 6{,}6260693 \cdot 10^{-34} && [\mathrm{J\,s}] \\ c &= 2{,}99792458 \cdot 10^{8} && [\mathrm{m/s}] \end{aligned} \tag{20}$$

we can calculate the value of the constant N_S. Equation (19) takes the form of

$$\rho_T = N_S\, T^3 \approx 2\,759\,179 \cdot T^3 \quad [\mathrm{1/m^3}] \tag{21}$$

For example, at room temperature (293 K) near the surface of the body, the density of thermal radiation photons is

$$\rho_{T=293\,K} \approx 6{,}9404 \cdot 10^{13} \quad [\mathrm{1/m^3}] \tag{22}$$

The intensity of thermal radiation photons, i.e. the number of photons passing per unit time through 1 m^2 of a black body surface, is obtained by multiplying the formula (19) by the speed of light c

$$I_T = c\, N_S\, T^3 \approx \frac{\sigma b}{h c} T^3 = 8{,}2718 \cdot 10^{14} \cdot T^3 \quad [\mathrm{1/(s\,m^2)}] \tag{23}$$

$$I_{T=1K} \approx 8{,}2718 \cdot 10^{14} \quad [\mathrm{1/(s\,m^2)}] \tag{24}$$

$$I_{T=293K} \approx 2{,}0807 \cdot 10^{22} \quad [1/(\mathrm{s\,m^2})] \tag{25}$$

5. Estimation of the photon pressure value

We will calculate the photon pressure inside bodies, assuming that the density of photons inside the bodies is the same as the density of the photons of thermal radiation, i.e. outside the bodies. The photon density (21) only takes into account photons moving away from the body in one of the six directions. Therefore, the number of photons moving back and forth is twice as high. Therefore, the number of n photons creating the force (6) in a volume of 1 $\mathrm{m^3}$ is $2\rho_T$.

According to the formula (6) the photon pressure is ($S = D^2$ is the surface occupied by the atom)

$$p_T = \frac{F_f}{S} = \frac{n}{S\,D} f\,h \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2\alpha}} = 2\rho_T f\,h \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2\alpha}} \tag{26}$$

After taking into account the equation (13) we obtain

$$p_T \approx 2\rho_T f_{\mathrm{mode}}\,h \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2\alpha}} = 2\rho_T \frac{hc}{b} T \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2\alpha}} \tag{27}$$

On the basis of (22) we obtain

$$p_{T=293K} \approx 2\rho_{T=293K} \frac{hc}{b} T \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2\alpha}} \tag{28}$$

$$p_{T=293K} \approx 2{,}78802 \cdot 10^{-6} \frac{1-(v/c)^2}{\sqrt{1-(v/c)^2 \sin^2\alpha}} \quad [\mathrm{Pa}] \tag{29}$$

Graphs of the fraction occurring in formula (29) are shown in Figure 3. The photon pressure does not depend on the type of body, but depends on its temperature T, the speed v of moving with respect to the ether and the angle α of the inclination of the direction of this pressure with respect to the velocity v.

The obtained value of the photon pressure (29) is very small in relation to the pressure necessary to crush the solid, which, for example, for steel is 200-1000 MPa, depending on the type of steel. Therefore, in order for the photon pressure model to fit the real data, it must be supplemented with an additional repulsive force of atoms. This additional repulsive force may have a value depending on the type of body. Its value is much greater than the photon pressure force. Its value does not have to depend on the movement of the body relative to the ether.

When the body is crushed, it is counteracted by photon pressure and this additional, much bigger, repulsive force. The movement of the body in relation to the ether affects the photon pressure, which is one of the forces that repels atoms, therefore the moving body deforms (Lorentz-Fitzgerald contraction).

It is also possible that the photons of photon pressure are something like a catalyst that activates the ability of atoms to repel, i.e. the photon pressure contributes to this additional repulsive force. In such a model, as the photon pressure decreases, then this additional force also decreases.

6. Proposals for experiments that can detect motion against the ether

If, in fact, change in body dimensions in motion relative to the ether is due to stresses in solid bodies, it is very likely that different substances will contract slightly in a different way. It may be that each substance has its own individual function $\psi(v)$. If both arms of the interferometer in the Michelson-Morley experiment are made of the same material, they will shorten proportionally as it described in the Special Theories of Ether [66], [70], [71]. This makes the experiment unable to detect motion relative to the ether. But if the arms are made of different substances, then perhaps the Michelson-Morley's experiment will be able to detect motion relative to the hypothetical universal frame of reference in which light propagates.

Therefore, Michelson-Morley's experiment should be carried out, in which each arm is made of a different material. It is necessary to investigate which materials give the greatest effect [76]. The model presented in this paper suggests that a beneficial effect would be expected if the interferometer arms were made of material with low thermal expansion, e.g., quartz glass (fused quartz, SiO_2), Invar or Zerodur [77], or composites with ceramics with negative thermal expansion, e.g. ZrW_2O_8, HfW_2O_8, ScF_3.

According to the Lorentz transformation and some STE transformations, the dimensions of bodies accelerated to speed c will be zero. It is to be expected that in reality this will not be the case. Each theory acts only to some limited extent. Theoretical predictions for inertial systems unavailable for experiments are the outcome of extrapolation results obtained in experiments in inertial systems available for experiment. In a body moving at high speeds relative to the ether, the photon pressure is very small. In such a body, the second repulsive force, which was mentioned in the previous chapter, becomes dominant. Further increasing the speed of the body will not result in a greater Lorentz-Fitzgerald contraction. Sufficiently densely packed atoms will not come close together even if the photons pressure does not act on them. However, in modern physics it is common that the results of extrapolation are treated literally and, for example, it is claimed that the Lorentz transformation shows that in the real world bodies accelerated to speed c will shorten to zero dimensions. We consider such a claim to be incorrect.

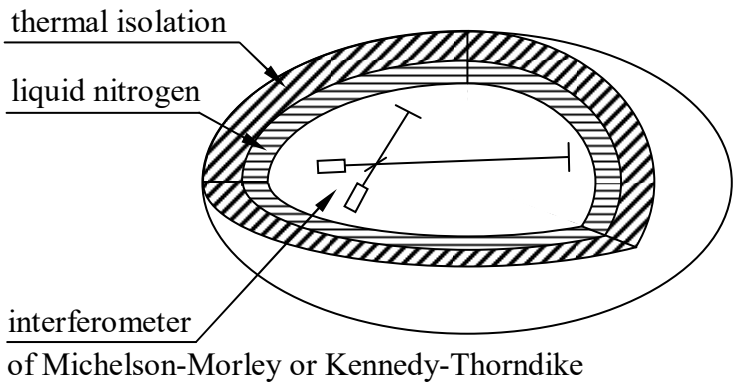

Fig. 7. A proposal for an experiment whose aim is to measure our velocity relative to the ether [76]. If the interferometer is cooled to low temperatures, then there is no photon pressure in its arms, which depends on the speed relative to the ether. The cooled arms will not be subject to Lorentz-Fitzgerald contraction, therefore a cooled interferometer may show a positive result of measurement of our velocity relative to the ether.

According to equations (15) and (21), the energy and number of photons forming photons pressure decreases to zero when the body temperature drops to absolute zero. This means that in bodies cooled to low temperatures, the photon pressure stops functioning. However, it is known that the dimensions of such bodies do not decrease to zero. It follows that at low temperatures, when the atoms are already close enough, another mechanism is revealed which does not allow the atoms to

come any closer. This is the same mechanism as that referred to in the previous paragraph, that is, the second repulsive force. This conclusion from the presented model can be very useful in planning an experiment that would enable to detect our motion in relation to the hypothetical ether [76], [77]. That is, the arms of interferometer should be cooled down to low temperatures (Figure 7). Perhaps the temperature of liquid nitrogen will be sufficient. At low temperatures, the interferometer arms should not undergo the Lorentz-Fitzgerald contractions, which compensated for the differences in time dilatation of the classical light clock, referred to in [66]. If there is indeed ether in which light propagates, such an experiment with the interferometer (figure 7) should give a positive result. A different effect can be expected when one arm of the interferometer is cooled to low temperatures and the other is not cooled to freely undergo contractions.

What is important is that the concept of the experiment with cooled interferometer arms [76], [77] results from theoretical research on relativity with a universal frame of reference (Special Theory of Ether, STE) [66], [70], [71] and is not just a random idea.

7. Final conclusions

The paper proposes a photon pressure model to explain the phenomenon of longitudinal contraction (Lorentz-Fitzgerald contraction) and transverse contraction (transverse contraction may occur in a Special Theory of Ether).

In the presented model, Lorentz-Fitzgerald contraction is a physical property of solid body, not a property of space-time, as it is today interpreted within the Special Theory of Relativity. It is the bodies that contract, not the space.

Contractions of bodies in motion are caused by a change in the electromagnetic interaction between atoms of a solid body (the photon pressure). In the presented model the balance of position between atoms is affected by the speed at which the body moves in relation to the ether (the movement of a body relative to the luminiferous ether influences the electromagnetic interaction between atoms). Therefore, the dimensions of solids depend on their velocity relative to the ether and are closely related to time dilation. The model presented here combines the properties of relativity theory with universal frame of reference (STE) and physics of a solid body.

Presented analysis shows that one of the ways to measure the movement in relation to the ether may be to conduct Michelson-Morley experiment using an interferometer, the arms of which are made of two different substances, or an interferometer which arms (or one arm) are cooled to low temperatures (perhaps liquid nitrogen temperature will be appropriate) [76]. The frozen arms of the interferometer are almost devoid of thermal photons creating photon pressure, therefore they will not be subject to Lorentz-Fitzgerald contraction. If this is indeed the case, then the Lorentz-Fitzgerald contraction phenomenon will have applications in the future in aviation navigation and astronautics, because the measurement of this contraction will allow us to determine the direction in space.

The article [66] explains what time is in physical theories. It's about time that physical theories use, not what time is in the real world. In the article [66] it was shown that in every physical theory the standard of time is a light (signal) clock. This is because in physical theories (e.g. Special Theory of Relativity or Special Theory of Ether) a light signal is used to synchronize clocks. Such synchronization automatically introduces such a time standard in these theories. Therefore, time is measured by a light clock in STR and STE. These theories describe measurements performed using light clocks. Time dilation, which occurs in these theories, is a natural property of the light clock. The article [66] also presents proof that light clocks do not operate in systems moving faster than light. This means that no physical processes can be described in these systems, but it does not mean that the speed of light is unsurpassable. The conclusion is that the mathematics of STR kinematics does not imply that the speed of light in a vacuum is the

maximum speed in nature. The common opinion that the speed of light in a vacuum is an impassable speed results from an overinterpretation (a misinterpretation) of the mathematics on which the kinematics of Special Theory of Relativity is based [70].

The predictions of the Special Theory of Relativity and the Special Theory of Ether are very similar. However, they are not identical. This may allow for experimental falsification of these theories in the future. In STR, all inertial frames are experimentally indistinguishable, i.e. they are equivalent. This means that in STR there is no universal frame of reference and there is no distinguished direction in space. This means that in STR, for every observer, space has the same properties in every direction (it is completely isotropic). The predictions of STE are different in this respect. An observer can use measurement to determine the direction of his motion relative to the universal frame of reference. This means that in STE, for observers moving relative to the ether, space has different properties in different directions (space is not isotropic, although for observers stationary relative to the ether, space is isotropic). This is the most important difference between Special Relativity and the Special Theory of Ether [69]. The effects of non-isotropy of space are very small in frames moving at low speeds relative to the universal frame of reference. Since the Solar System moves at a low speed, experimental falsification of these theories is not easy. Proposals for experiments to falsify the Special Theory of Relativity and the Special Theory of Ether are presented in the article [72] and the patent application [76].

In the Special Theory of Ether, the ether is in thermal equilibrium with all matter in the cosmos. It is very transparent to a wide range of electromagnetic radiation, so it does not obscure celestial bodies, and it heats up very little. It is in thermal equilibrium with a temperature of only 2.7 K [67]. Like any body in thermal equilibrium with its surroundings, the ether radiates as much energy as it absorbs. The thermal radiation of any body has a Planck distribution. Cosmic microwave background radiation (CMBR) also has a Planck distribution [65], so it is natural to conclude that cosmic microwave background radiation is thermal radiation of the ether. Such a hypothesis was proposed for the first time in article [67].

The cosmic microwave background radiation may be, in the Special Theory of Ether, the electromagnetic thermal radiation of hypothetical ether (i.e., black body radiation). This concept is consistent with the fact that the microwave background radiation has a Planck distribution, i.e. a distribution of thermal blackbody radiation [65]. Moreover, this radiation is very uniform, just like the hypothetical ether that would be the source of this radiation. There is no known body filling the entire universe, except for the hypothetical luminiferous ether, that is so highly homogeneous that it could be a source of thermal radiation in the form in which the cosmic microwave background radiation exists.

Today, it is generally believed that the microwave background radiation was created in the early days of the universe. However, if the microwave background radiation is thermal radiation of the ether, then it is also created in our immediate environment. It is created all the time, in the whole of space. Therefore, the distribution of galaxies is very poorly visible in this radiation. If the ether filling the universe is uniform, then the microwave background radiation should be uniform in the ether system. Numerous measurements have shown that in our frame of reference the microwave background radiation is very homogeneous, but has the dipole anisotropy [65]. Dipole anisotropy of this radiation is caused in our frame of reference by the Doppler effect, resulting from the motion of the Solar System relative to the ether.

That is, the dipole anisotropy of cosmic microwave background radiation can be naturally explained on the basis of the Special Theory of Ether. On this basis, the velocity at which the Solar System moves relative to the universal frame of reference can be determined. This speed is 369.3 km/s = 0.0012 c. This was shown in [68] and [70].

A huge breakthrough in physics would occur if our velocity relative to the ether, measured by a frozen interferometer [76], matched the velocity resulting from the dipole anisotropy of the

microwave background radiation [70]. It would require extremely bad will to ignore such evidence of the existence of the luminiferous ether.

There are infinitely many ether theories that are consistent with the null result of the Michelson-Morley and Kennedy-Thorndike experiments. This was shown in [70]. There is even an ether theory in which time is absolute.

Lorentz transformations should be assigned a different interpretation than that adopted in the Special Theory of Relativity. This was proven in the article [71]. The currently commonly accepted interpretation of STR mathematics is incorrect, because in reality it is a theory with desynchronized clocks. This is the cause of unrealistic measurements of the passage of time in inertial frames moving with respect to the observer. Incorrectly calibrated clocks cause numerous STR paradoxes.

The fact that mathematical formulas can be assigned different physical interpretations does not only apply to Lorentz transformations. For example, a gravitational wave should be interpreted as a simple modulation of the gravitational field intensity. This was shown in the article [75]. The oscillations of gravity that appear in the General Theory of Relativity are a property of a system of rotating bodies. This is not a property of the gravitational interaction, although it is commonly believed today. Therefore, these oscillations are modulations, not waves.

For each kinematics it is possible to derive many dynamics. The derivation of dynamics requires the adoption of an additional assumption introducing the concept of inertial mass into kinematics. Such an assumption can take various forms, which is why many dynamics are possible in the field of kinematics. The examples for Special Theory of Relativity were derived in the article [74]. One of the new dynamics for STR was shown in [61].

There are publications which show that the Michelson-Morley experiment gives a positive result [52], [55]. The measured effect is much weaker than originally predicted based on the kinematics of Galileo Galilei with a luminiferous eth, but it is measurable. Such studies confirm the existence of the luminiferous ether and the Lorentz-Fitzgerald contraction, which almost completely compensates for the effects originally predicted in the Michelson-Morley experiment. These studies are a significant argument in favor of the Special Theory of Ether, which can be very easily modified to be consistent with the non-zero result of the Michelson-Morley experiment. If these results are true, then even the average speed of light traveling a closed path in a vacuum is not constant. For now, these results are ignored by official physics.

There are many studies on relativistic physics with important theoretical results. The null result of the Michelson-Morley experiment, which results in the Lorentz-Fitzgerald contraction [4], [6], [46], [68] and [80] is analyzed. In [39] the original definition of acceleration in Special Theory of Relativity is presented. In [8], [34], [53], [56] and [57] important observations on time dilation in relativity are presented, while in [1], [7], [10], [11], [25], [58], [59] and [83] alternative ideas for relativity are presented. The article [47] discusses the problem that Newtonian mechanics has with the description of certain physical phenomena. There are publications in which tachyons are analyzed [12], [19] and papers, in which various relativistic aspects of gravity are analyzed [22], [23], [29], [32], [50]. Articles [13] and [48] discuss the relativistic Doppler effect. In articles [14], [15], [16], [26] the authors presents interesting issues concerning the General Theory of Relativity. In the articles [30], [31] the research on the Special Theory of Relativity concerning the De-Broglie wavelength of the particle and the electric and magnetic permeability is presented. There are also published works showing the paradoxes of the Special Theory of Relativity concerning rotating frames of reference [27], [28]. Research is carried out on practical aspects of relativistics. The article [5] examines cosmological models that include some considerations about gravitational energy density and pressure. The potential method is used to obtain approximate formulas describing the electromagnetic field [20]. In the paper [51] an analytical solution of the bound state for the relativistic modified Klein-Gordon equation is presented. In the paper [82] an original derivation of the Lorentz transformation is presented. In articles [36], [37] and [79] in the course of a research study on Lorentz transformation the fundamentals of the relativistic concepts of space

and time were studied, while in articles [17], [18] a critique of the Special Theory of Relativity was presented. In the paper [24] the topic of classification of the theory of relativity according to the classification of second-order partial differential equations was presented, while the articles [2], [3], [33], [38], [78] examines various aspects of the Special Theory of Relativity. Considerations on Maxwell's equations in the framework of relativism are presented in the article [35]. The article [60] discusses the invariance of the components of the electromagnetic field vectors with respect to the Lorentz transformation. Research is also being conducted on various aspects of ether [81]. The article [63] presents an analysis of the speed of light in materials in the model of the Special Theory of Relativity. Future research on the Special Theory of Ether should also concern issues related to electrodynamics, i.e. should be able to model issues such as those discussed in articles [9], [21], [40], [41], [42], [49], [64], [62]. Articles [43] and [44] present a critical analysis of negative opinions about STR.

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