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Questions concerning the foundation of the theory of relativity.

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Abstract:

In this paper I argue for the following assertions:

1. *Special Relativity* (SR) leads to predictions, which are in conflict with its own foundation.

2. There exist a scientific "approved" alternative theory which – probably – are in completely accordance with all the experimental results, which seems to have confirmed SR.

Keywords: relativity, inconsistent, Lorentz contraction, ether

Introduction:

In 1904 H. A. Lorentz published his final version of a theory, which were meant to be a possible explanation for the results of the Michelson-Morley experiments. According to this theory, physical objects are contracted, when they move through 'the ether' (the, at that time, supposed medium for electromagnetic waves). Lorentz perceived such contractions as 'physical', in contrast to Einstein's view, in which they are coordinate-dependent. – According to my interpretation of the theory of Lorentz, they are contractions in which objects, when they have their natural ('stress-free') lengths at a certain temperature, take up physically less space in the universe, than when they are at rest, relative to the ether.

In the following I will show, that even when SR / GR is your starting point, you will, by following the logic of certain thought experiments, come to the conclusion, that some Lorentz contractions must be physical, even in cases where the objects are at rest, relative to the local inertial frames of reference!

And I will argue that the theory of relativity is inconsistent with its own basis, when you analyze certain physical consequences of SR, using some thought experiments, which, in principle, could be the real experiments.

First I will give *my* explanation for, and definition of, the term 'physical contraction', using an example:

1. thought experiment:

Let us assume that we have a measuring rod with a rest length of 1 meter (at a specific temperature). Then we cut of a piece / slice, at one of the ends. By that process the measuring rod has become subjected to a 'physical shortening'. It takes up physically less space in the universe (and in a well-defined and unambiguous *part* of the universe) than before (at least if we assume that the physical size of the universe, or part of the universe, has not changed significantly during the process).

More generally: every object which, due to a process of contraction / shortening, have become *physically smaller*, in relation to the size of the universe (/ well-defined and unambiguous part of the universe), at the time concerned, have become *physically contracted* / *shortened*.

2. thought experiment:

In this thought experiment, I will use the normal interpretation of SR, as a starting point.

We have two identical trains, standing on separate railway tracks. These two tracks are parallel, straight and very long. And they are both at rest relative to the same inertial frame of reference. (It is assumed that neither the trains, nor the rails, are influenced by gravitational fields of importance!) On board both of the trains there is an 'observer', which measures the length of the train, in which he is a passenger. It turns out that both trains have a rest length of 100 meters. – One of the trains is then physically accelerated to a certain speed, in relation to the tracks and the other train. Then the rest lengths of the two trains are measured again, and are still 100 meters. Furthermore, both observers now measure the length of 'the other' train, and both get the result that the other train has become contracted, and to the same degree, as is to be expected if the laws of physics are identical in all inertial frames of reference. As the two rest lengths are still exactly alike, according to my interpretation of SR, there can't be any way in which one can 'observe' (measure), *or correctly deduce*, that the two trains do not have the same *physical* space-filling ability, in this situation. If there was, the 'symmetry' would be broken, and it could be clarified that the two inertial frames were not physically equal! And also there would be no consistent SR-explanation of why one train toke up less space than the other! But my assertion is that it, on a theoretical basis, can be shown that the symmetry inevitably must be broken in this case! This I will return to.

3. thought experiment:

We have two identical ring-shaped bars, A and B, both with a length of, say, 1000 meters. They are at rest, with respect to an inertial frame, IF-1. Both rings, which are perfectly circular, are made of 1 meter long sections, which constitutes a sort of measuring rods. We select one section in each of the two rings, section A-1 and B-1 (see fig. 1), to compare their lengths in different situations. (As clearly seen, their lengths, relative to the full lengths of the bars, are made much too large, in this illustration!)

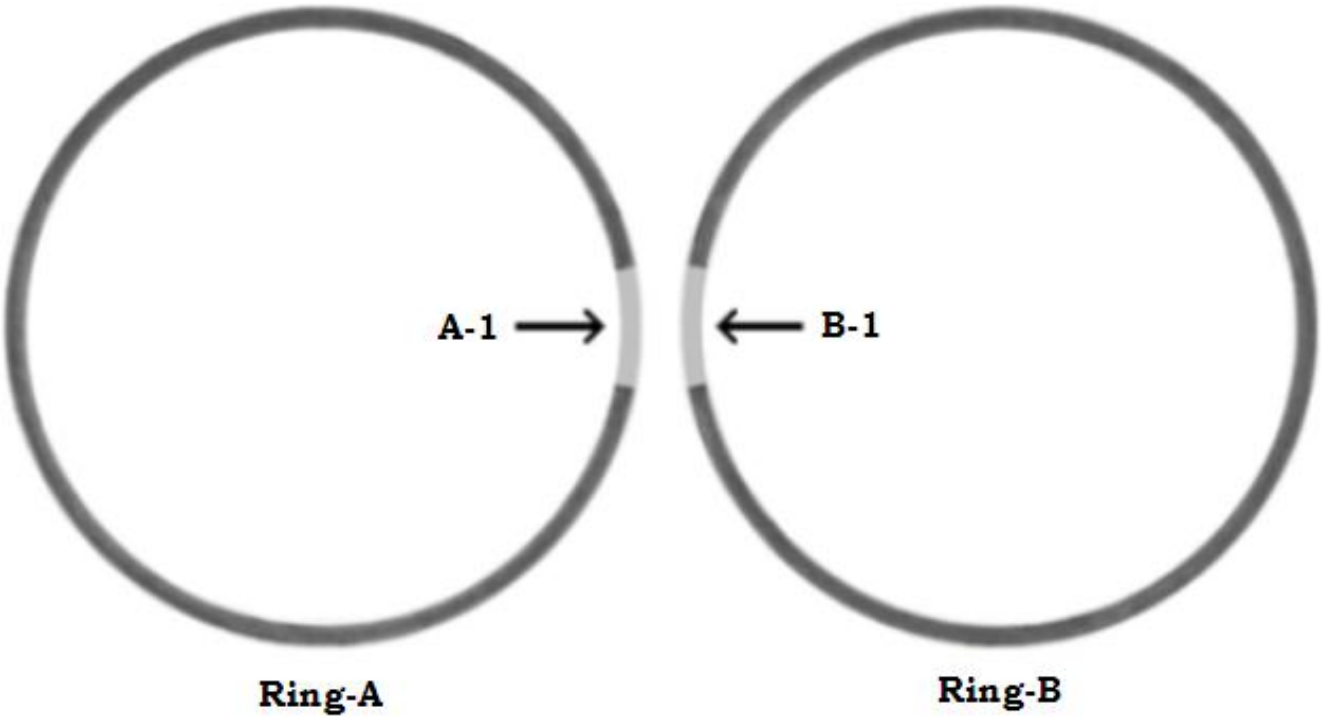

Fig. 1

Then we set ring-B in rotation (fig. 2), in such a way that the 'proper lengths' of the sections are constantly unchanged.

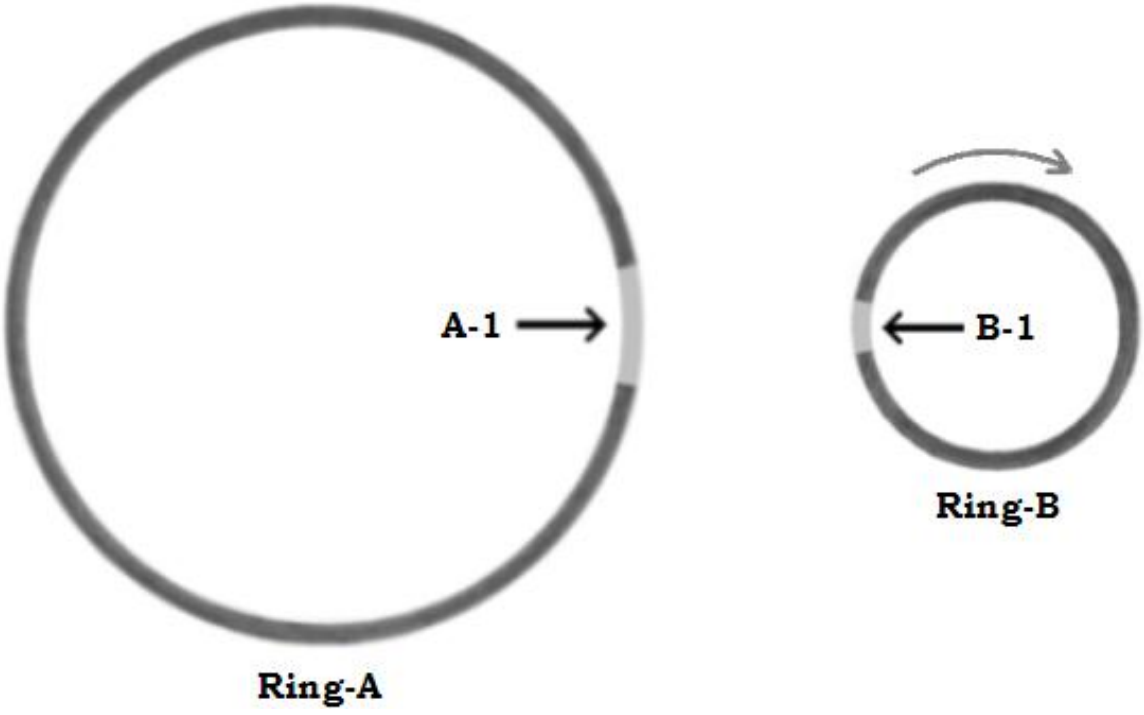

Fig. 2

From SR / GR, we then know that the bar, which the ring is made of, will be contracted in such a way, that ring-B becomes physically smaller than ring-A, and at sufficiently high rotational / tangential speed, ring-B could be inside the hole of the ring-A.

This shows very clear that ring-B has become physically smaller, and that the bar which the ring is made of, has become physically shorter. – But could it be that *B-1* only becomes *coordinate-dependent* contracted, if it is sufficiently short, and the entire ring sufficiently big, before the acceleration? My assertion is: as B-1, *physically*, constantly represents a specific part of the length of the entire B-bar, B-1 must be *physically* shortened, when the bar as a whole has become physically shortened! (If B-1 has not become physically shortened, none of the other sections have, because the sections and there situations are fully equivalent!)

Next question to resolve is whether it is due to inertial forces (due to the circulatory movement), that B-1 has become physically shortened. However, this can easily be clarified - you can just (as a thought experiment) make the two ring-shaped bars extremely long, for example 1 billion light years, in the starting position, while A-1 and B-1 keep their proper lengths of 1 meter. Then B-1 move – practically – straight on for a long time, and it will not be exposed to measurable inertial forces, even if its tangential speed has become so high, that its 'physical length' is halved. And it is obvious that it will become physically contracted in such a case, if it becomes physically contracted when the ring is small (the size of the orbit can, of course not, be decisive for the emergence of physical Lorentz contractions)!

If the B-1 is significantly physically shortened when it moves *nearly* 100% straight, then it must also be significantly physically shortened, if it moves *exactly* 100% straight, and therefore do not accelerate at all, with respect to the local inertial frames! So we can conclude that, according to SR / GR, B-1 is physically shortened, solely because it has become accelerated to a speed, relative to the inertial frame IF-1, although its 'proper length' is preserved!

If we use this result in the evaluation of the 2. thought experiment, in which one of the two trains was accelerated to a certain speed, in relation to the railway tracks and the other train, we then see that the train (T-2), which was accelerated (but subsequently was moving with completely constant relative speed), must have become physically shortened, solely because it had become transferred from one inertial frame to another.* But how can this be a prediction of a *consistent* theory, if the laws of physics are the same in every inertial frame of reference??

* It is then clear that the 'symmetry' is broken, and that it is (in principle) *impossible* that the observer in T-2, *with physically shortened measuring rods* (and synchronized watches), by correct measurements, can measure that T-1 is shorter than T-2, to the degree which is required by SR!

I have concluded that one of the preconditions in order that "SR" could be consistent, had to be that it predicted, that *the proper dimensions* of an object are *decisive* for how much space it fills up – physically – in the universe! The proper radius of the Sun is larger than the proper radius of the Earth – consequently SR should predict that the Sun takes up physically more space in the universe than the Earth, *regardless of their relative speed(s)*. It can however be shown that this is not always the case, if you analyze some imaginable situations.

4. thought experiment:

Imagine that a 4,4E + 29 km. long train is stationary at a platform on a 100% straight railway track, which is even longer, and at rest relative to an inertial frame. The train and the platform have exactly the same length in this situation, and the ends of the train are exactly beside the ends of the platform! – Then all parts of the train are simultaneously accelerated (as measured in the 'rail frame') to a, afterwards constant, speed of 10 km./hour. Let us say that the train move 2 meters before it reaches this speed. Since all parts of the train have moved in the same direction, and equally long, measured in the rail frame, the length of the train has not changed, measured in this frame. On the other hand, the rest length of the train (L_o) has become greater, according to the formula: $L = L_o * \sqrt{(1 - v^2/c^2)}$. – The rest length will then (according to my calculation) have become approximately 1,9E + 13 km. (representing approximately 2 light years) greater!

The rest length of the train could be restored, if the train becomes about 1,9E + 13 km. shorter, as measured in the rail frame, but it would then take at least 1 year (measured in the rail frame), even if the two ends of the train were moved toward the center, with almost light speed, after extremely short and powerful accelerations, which I will here call *contraction-accelerations*.

However, it could happen very quickly if the train alternatively consisted of short (e.g. 10 m. long), and *not* coupled, self-propelled wagons, which would require only weak and short-lived physical *contraction-accelerations*, to cause the same total contraction-effect. Assuming that there are no spacing between the wagons before the accelerations, there *have to* – by preserved rest lengths – arise spacings, after the accelerations (though of course only very small spacings, by a speed change from 0 to 10 km. / hour), because the length of the wagons, measured in the rail frame, must be less than measured in the rest frame, according to SR. The total sum of the spacings will then show how much the train, as a whole, has become *physically* contracted. Without spacings, there can be no contraction of the wagons, as measured in the rail frame!

Thus we see that the contractions of the wagons *must* be *physical* effects, when they are caused by the physical accelerations of the wagons, from one inertial frame to another. – If, on the other hand, the contractions were due to the physical acceleration of an observer (that he had become accelerated from 0-10 km. / hour, relative to the wagons and the inertial frame of the rails), then there would, of course not, arise spacings!

So we have thus demonstrated a crucial difference between the two contraction-effects *. – And it is shown that, according to SR, an object, which is accelerated into another inertial frame, must necessarily be *physically contracted*, if 'the rest length' is preserved – even if the object, before and after the acceleration, is 100% non-accelerating, in relation to the local inertial frames!??

Therefore we here see a case where the rest / proper dimensions of objects are *not* decisive for how much space they take up, physically, and where the physical 'space-filling ability' of objects are speed-dependent. **If the Sun was accelerated to an inertial frame, that had a sufficiently high speed, relative to Earth, it would take up physically less space in the universe, than the Earth, according to SR !??**

* In addition, there is the difference that the coordinate- / frame dependent contraction, is not limited by the vacuum speed of light! The moment an observer enters a new inertial frame, a specific measuring rod has exactly the length, which – by proper measurement, according to SR – is measured in this frame. However, the theoretically shortest possible time that is neccessary to change 'the physical length' of an object, depends on (among other things) the maximum possible speed (according to SR) of material objects / particles! This

can, as I have shown, have very large consequences for extremely long objects, which are possible, in principle.

5. thought experiment:

Let us imagine that we have a rail track that forms a circuit, with two long sides and two curves, where the long sides are perfectly straight, and much longer than the curves. Let's say that the long sides are 1 billion light years, and the curves 1 light-year, long.

On the whole rail track (inertial frame) are placed 10 meters long, not coupled, wagons, with no spacing between them. – At a certain moment, as measured in the rail frame, all the wagons are accelerated to such a high speed, that the wagons are only 5 meters long, measured in the rail frame – in such a way that the proper lengths of the wagons are preserved. Since, according to the theory of relativity, there *must*, by preserved proper lengths, arise spacings between the wagons, when they are accelerated with the same acceleration and in the same period, measured in the rail frame, there must also arise gaps between the wagons which have been located at one of the long sides, during the whole acceleration. (If that was not the case, then these wagons could not become shorter, measured in the rail frame, since the rails preserve their lengths, measured in this frame, of course!). We thereby see that these wagons must become *physically contracted*, just because they are accelerated from one inertial frame to another!

That they must be *physical* contractions, is easy to show: one could achieve just as much physical shortening of the wagons by purely mechanical means, by removing half of each wagon (e.g. by cutting each of them in two pieces) while they were at rest, in relation to the rails – and this clearly shows, that a SR Lorentz contraction caused by, that *a body* is accelerated from one inertial frame to another, differs fundamentally from a SR Lorentz contraction, caused by, that *an observer* is accelerated to another inertial frame !!

6. thought experiment:

The following thought experiment, which are here analyzed through the normal interpretation of SR, apparently shows a genuine paradox, and also a difference between SR and LET in their empirical predictions.

Suppose we have a square plate with wheels, which are positioned on two parallel and completely straight rails. While the plate is at rest relative to the rails, two of its *sides* are parallel to the rails, and are at this time located exactly vertically above each rail. An observer, 'O', who at this time is at rest relative to the rails and the plate, plots the situation in a Cartesian coordinate system, see fig. 3 (the two brown lines could symbolize measuring rods).

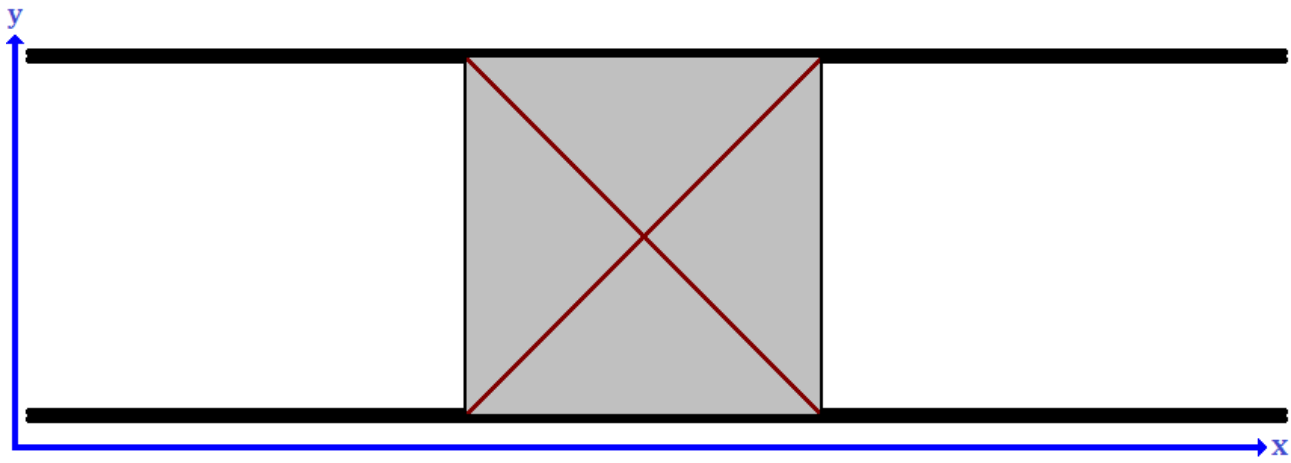

Fig. 3

The plate is then accelerated to nearly the speed of light (about 0,98 c), measured in the rail frame, (*so that the wheels are in contact – or very near contact – with the rails, all the time*), while O is accelerated to a speed of 0,7 c, relative to the rails, perpendicular to these.

Both the x and y component of the plate velocity are then 0,7 c, in the new 'O-frame', and the velocity direction is exactly parallel to one of the diagonals of the plate, and exactly at right angles to the other, which will not be Lorentz-contracted, according to SR. – O measures the velocity of the plate to be about 0,98995 c, and according to SR, this should result in, that one of the plate diagonals then only have about 1/7 of the length he measured, when he was at rest relative to the plate.

O then plots the expected situation in a coordinate system in which he is at rest, see fig. 4. – As can be seen, none of the sides of the plate are now parallel to the rails, and parts of the plate are located completely outside the rails, and the area between the rails!

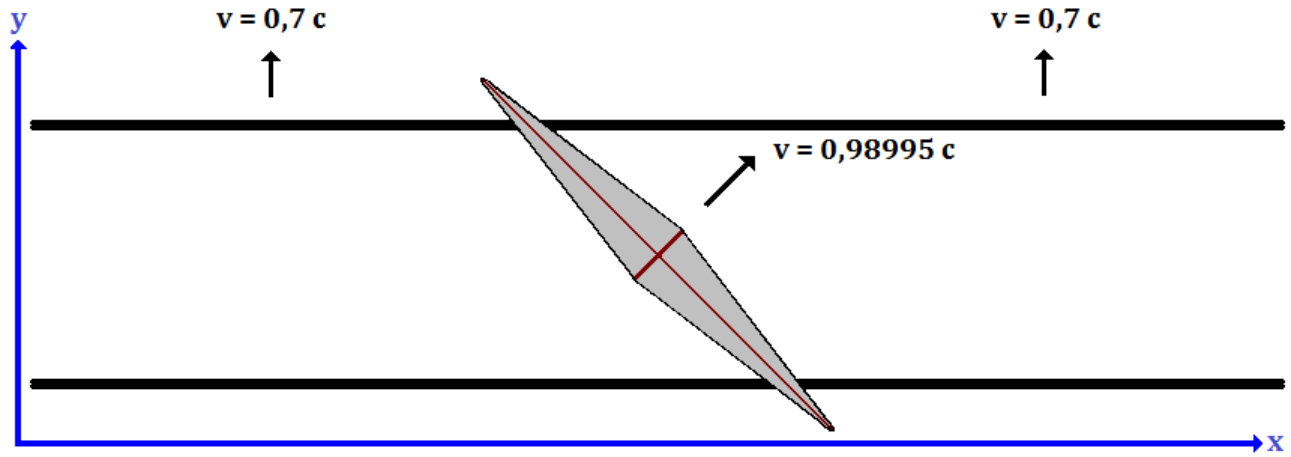

Fig. 4

However, in this result, observers who are at rest relative to the plate or the rails, do not agree! According to them, two of the sides of the plate are still parallel to the rails, and are still located vertically above these (because the wheels are in contact – or very near contact – with the rails, all the time)!??

Then it is obvious that O can't measure what is seen in fig. 4, and it seems that we here have a real paradox, because, if two sides of the plate are still parallel to the rails, and are still located vertically above these, then the length of the plate-diagonal, which are parallel to the direction of movement, can't possible have the length that O should measure, according to SR, if the relative speed of the plate is approximately 0,98995 c!

But if you analyze this thought-experiment through LET, instead of SR, there will be no paradox, because then it is the velocity of the plate, and the velocity of the rail-track, in relation to the ether, which solely determine how much they will contract, physically, in the directions of movement! And if the shown velocities in fig. 4, are in relation to the ether, and the observer accidentally is at rest in relation to the ether (and the wheels do not prevent it), he should measure what is seen in fig. 4! (This could – in principle – be used to test LET in experiments, but I can't see any possibility that you could test LET in this, or similar ways, in real experiments. Maybe others can?)

Comments to thought experiment 6:

Even though I assume that this thought experiment doesn't contain crucial errors, I'm not completely convinced, that this is the case! Nevertheless, I have chosen to include it in this paper, in the hope that relativity experts (or others) will help to clarify this question.

Comments to thought experiments 3,4 and 5:

In order to make 'the evidence' in these thought experiments stronger, I will here elaborate why I am convinced, that the relativistic length contraction is paradoxical / inconsistent:

If you shorten a measuring rod by cutting of a piece, both the 'physical length' and the 'rest length' become smaller. However, if the measuring rod is accelerated to another inertial frame, SR predicts that the physical length becomes smaller, when the rest length is preserved (as shown through those thought experiments). If some will say that this is no problem for the theories of relativity, I will argue for the opposite in the following way:

Two completely identical measuring rods, 1 and 2, are both at rest in 'inertial frame 1'. Then, measuring rod 2 is accelerated, in the longitudinal direction, into 'inertial frame 2'. Thus, according to SR, it becomes physically contracted! But what will happen to the physical length if measuring rod 2 is subsequently accelerated back to the inertial frame 1?

Since all inertial frames, according to SR, are equal, we can take the *physical* length of the measuring rod, while it is in inertial frame 2, as a "starting point". Since we have seen that SR predicts that measuring rods and other physical objects become physically contracted / diminished, when they change inertial frames, the same theory must predict that measuring rod 2 becomes even shorter by being accelerated back to inertial frame 1, when the rest length is preserved! When it is back in this inertial frame, you can compare the length

of the two measuring rods directly. According to SR, the consequence must be that measuring rod 2 has become physically shorter than measuring rod 1, if their rest lengths are unchanged (a clear paradox) **!??**

If you, on the contrary, assert that measuring rod 2 becomes physically *longer* during the acceleration back to inertial frame 1, so that it gets the same physical length as measuring rod 1, when the two measuring rods again are at rest in relation to each other, my counter argument will be that this would require, that the laws of physics in the two inertial frames could *not* be completely identical, in the sense that then any physical object always should, under equal conditions, be physically smaller in inertial frame 2, than in frame 1 !

By these considerations, I come to the conclusion, that one of the preconditions, that "SR" could be consistent, had to be, that *the physical length* always was the same as (equal to) '*the proper length*'!

7. and 8. thought experiments:

Two spheres are placed in outer space, with a distance of 1 meter (rest length). An observer, which initially is at rest in relation to the spheres, is accelerated to a certain speed, parallel to an imaginary line between them. As is well known, according to SR, this result in, that not only the two spheres become contracted, measured by the observer, but also the space between them, because, according to this theory, they are not physical contractions, but coordinate-dependent *space* contractions.

That such effects leads to *contradictions* in SR, can be seen through the following thought experiment:

Imagine that we have two very long and completely straight tubes, and that one of them is inside the other, so it can move freely, only in the longitudinal direction. The inner tube is accelerated to a certain speed, which is then kept constant. An observer, O, moves in the same direction as the inner tube (as measured in the inertial frame of the outer tube), also at a constant speed. The two tubes then have the same speed, but in opposite directions, measured in his inertial frame. If O is then accelerated to the same relative speed as the inner tube, this will, according to SR, result in that the outer tube, and thus also the space inside it, will be (coordinate-dependent) contracted, as measured by him. However, during the same acceleration process, the inner tube, and the space inside it, is *expanded*, as measured by O, according to SR (because the relative velocity between this tube and O becomes smaller and eventually 0) !!

This shows that *the same space* can expand and contract, *at the same time, measured by the same observer*, according to SR !??

Lorentz ether theory:

I find it remarkable that there seems to be a realistic alternative to SR, 'Lorentz ether theory', which probably never have been disproved, and which do not have the problems, I have just argued that SR has! One can, using the following quotes, argue that Lorentz ether theory is as well confirmed by physical tests, as SR:

"Lorentz and Einstein thus arrives at exactly the same Lorentz transformation. This means that whether you use contraction theory or the principle of relativity, as base for your considerations, they will lead to

the five sentences in the paragraph. 71, which is thus the foundation for any relativistic physical description." (From "Fysik for Teknika" (translated from Danish) **[1]**)

"... if two theories make identical predictions in all instances, as the Lorentz and the Einstein theories do, they are, in fact, the same theory." (From "Understanding Relativity" **[2]**)

"Lorentz's theory is so similar to special relativity that it has passed the same tests." (From "New Scientist" **[3]**)

(As I, with help of some thought experiments, believe I have demonstrated genuine paradoxes / inconsistencies in SR – inconsistencies that are not found in Lorentz ether theory, since this theory does not contain coordinate-dependent contractions, it is clear that I can't agree, that the two theories are in fact the same theory!)

Conclusions and comments:

SR and GR are partly inconsistent with their own basis, which can't be entirely in accordance with reality!

A crucial part of the foundation of *Special Relativity* – that the laws of physics are the same in every inertial frame of reference – is only *apparently* in accordance with reality!

The only cases in SR where objects can be coordinate-dependent Lorentz contracted, are those were the contraction is due to that *the observer* (who is measuring the effect) is accelerated from one inertial frame of reference to another! If the contraction is solely due to that *the object* is accelerated to another inertial frame, it must be a coordinate-independent and physical effect!

Einstein "mixed" two completely different kinds of contraction in SR, in a way that can't possibly be consistent!

But isn't the many scientific 'confirmations' of *general relativity* proof that SR must be in accordance with reality – and that the ether doesn't exist?

I think not, among other things, because even GR requires a kind of 'ether', as can be seen in the following quote from a lecture by Einstein (1920):

"Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked through time. The idea of motion may not be applied to it." **[4]**

Because I have concluded that SR contains basic errors, and because a *variant* of LET, with a compressible and dynamic ether, seems to be the only realistic alternative (?), I suppose that GR can be changed to an ether theory, which is not in fundamental conflict with LET, without changing the empirical predictions of the theory much. – I know that several physicists have tried to create an ether theory, using the mathematics of GR to a great extent, and here is a reference to an article about such a theory **[5]**. (I have not at all sufficient mathematical qualifications and knowledge of GR to decide whether the proposal of the authors is "realistic", or not.)

In a later paper I will argue for that it is possible to confirm or refute LET by experiments (contrary to the conclusions of experts), at least in principle, but probably also in real experiments!

References:

[1] Fysik for teknika, volume 1, p. 163, Gyldendal, Copenhagen, 1966 (1. edition)

[2] S. Goldberg: ”Understanding Relativity”, p. 117 (Copyright 1984 by Birkhäuser, Boston.)

[3] ”Catching the cosmic wind”, New Scientist, April 2, 2005, p. 34

[4] A. Einstein: "Ether and the Theory of Relativity", lecture at the University of Leiden, May 5, 1920 (translated from German), published by Methuen & Co. Ltd, London, in 1922.

[5] M. J. Dupré and F. J. Tipler: "General Relativity As an Æther Theory", arXiv:1007.4572, 26 Jul 2010.