Is relativistic length contraction consistent?

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Abstract:

An important part of *special relativity* (SR) is **length contraction**. According to this theory, it is a *coordinate-dependent* and *'symmetrical'* effect, such that two observers, moving relative to each other, both with their own measuring rod, can both rightly claim that the other observer's measuring rod is contracted, even though the rest lengths of the rods are exactly the same. However, with the help of thought experiments, it can be shown that this cannot be true in the real world – and that SR predicts two *fundamentally* different length contractions.

According to **Wikipedia**, *length contraction* can be defined as follows:

"In physics, length contraction is the phenomenon of a decrease in length measured by the observer, of an object which is traveling at any nonzero velocity relative to the observer. This contraction (more formally called Lorentz contraction or Lorentz–FitzGerald contraction after Hendrik Lorentz and George FitzGerald) is usually only noticeable at a substantial fraction of the speed of light. Length contraction is only in the direction parallel to the direction in which the observed body is travelling.**"**

And:

"… For the observer in relative movement, the length of the object is measured by subtracting the simultaneously measured distances of both ends of the object.**"**

And:

"The principle of relativity (according to which the laws of nature must assume the same form in all inertial reference frames) requires that length contraction is symmetrical: …**"**

http://en.wikipedia.org/wiki/Length_contraction

In several papers I have argued that relativistic length contraction is not consistent, e.g. via the following thought experiment (from ***Fundamental inconsistencies in the theory of relativity*** **[1]**):

"Let's imagine that we do the following experiment: In an inertial frame, IF-1, we have two transparent tubes, as shown in the illustration below. At the start of the experiment, the two tubes are completely filled with identical measuring rods, which are at rest relative to the tubes. Subsequently the rods in tube 2 are accelerated up to a relative speed of about 260000 km/s, so *gamma* is equal to 2.

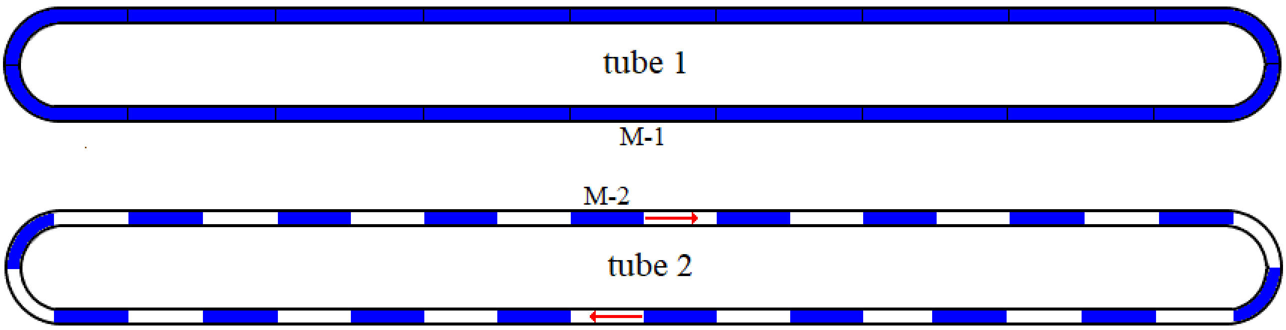

Fig. 1

We presuppose that the *rest lengths* of the 'moving' rods are preserved. Then we know that these rods have become shorter, as measured in IF-1, according to the theory of relativity. Since the length of tube 2 has not changed, as measured in this frame, it is inevitable that gaps between the rods in this tube will emerge! And by the relative speed concerned, the gaps will be just as large as the rods. It is then clear that they have become *physically* contracted, and it can thus be deduced, that SR have to predict, that all bodies and particles will be physically contracted, if they are transferred from one inertial frame to another (when the *rest lengths* are preserved).

As the illustration shows, one of the rods in tube 1 is named M-1, and one of the rods in tube 2 is named M-2. The inertial frame that M-2 is at rest relative to, in the illustrated situation, we call IF-2.

If we only take the length of M-2 as measured in IF-1, and the length of M-1 measured in IF-2 (in the illustrated situation) into consideration, this is according to the *special principle of relativity*, a 'symmetrical situation'. An observer in IF-1 will measure that the rod M-2 is shorter than M-1. An observer in IF-2 will measure that M-1 is shorter than M-2. (We presuppose that the two observers make their measurements while M-2 is in one of the straight parts of tube 2.)

My question is now: how can this be a symmetrical situation, when M-2 obviously has become physically contracted. (If there is space for x rods of the same *physical* length as M-1, in succession between the Earth and the Moon orbit, then obviously there must be space for 2x rods of the same *physical* length as the "moving" M-2, according to SR.) M-2 is contracted *in relation to* 'space', while M-1 is (coordinate dependent) contracted *together with* 'space'.**”**

But can we be *absolutely* sure that M-2 is really physically shorter than M-1 (according to SR) in the situation shown? Can it be ***proven****?* ***Yes*** – using the following thought experiments (which *partly* originates from the paper: ***Questions concerning the foundation of the theory of relativity*** **[2]**):

“We have two identical ring-shaped tubes, 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 A1 and B1 (see fig. 2), to compare their lengths in different situations. (As clearly seen, their lengths, relative to the full lengths of the tubes, are made much too large, in this illustration!)

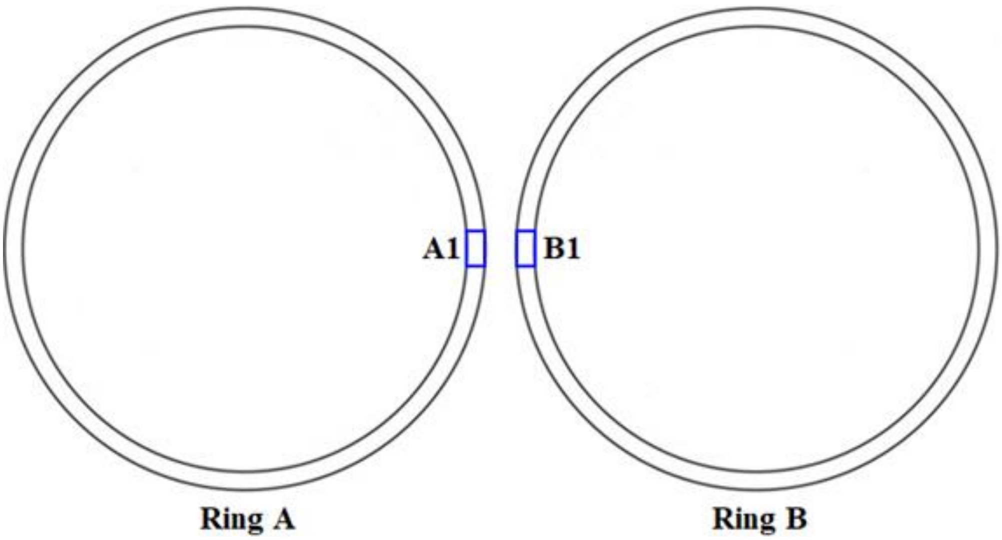

Fig. 2

Then we set ring B in rotation (fig. 2), in such a way that the 'proper lengths' of the sections are preserved. From SR / GR, we then know that the tube, 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 speed, ring B could be inside the hole of the ring A (Fig. 3).

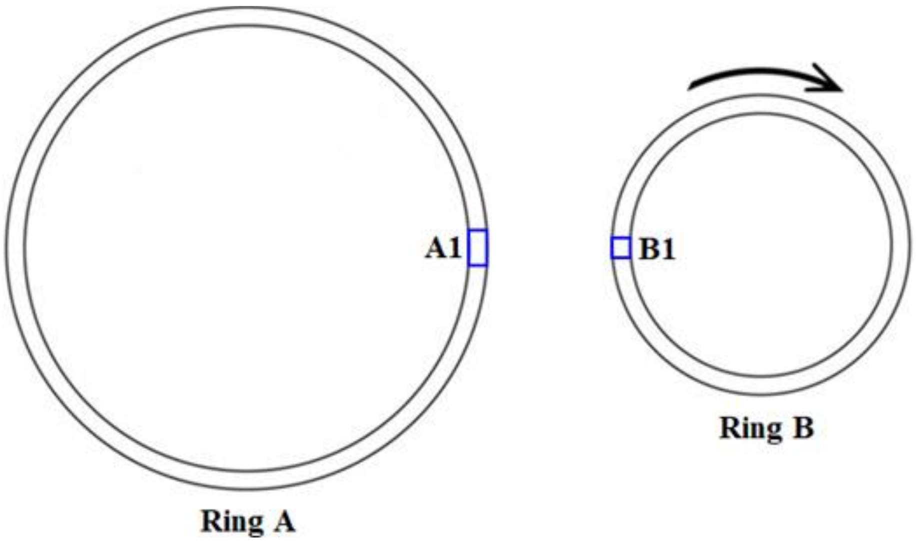

Fig. 3

This shows very clear that ring B has become physically smaller, and that the tube which the ring is made of, has become physically shorter. **…"**

But the proof can be made even stronger. At a sufficiently high rotational speed, ring B can become so small that there will be room for it *inside* the measuring rod A1, as shown in Fig. 4. This will, however, require that the B tube is significantly thinner than the A tube, of course – but this will have no bearing on the conclusion of the crucial question: are A1 and B1 of equal length, physically speaking, or not – is there *symmetry*, as the *special principle of relativity* requires?

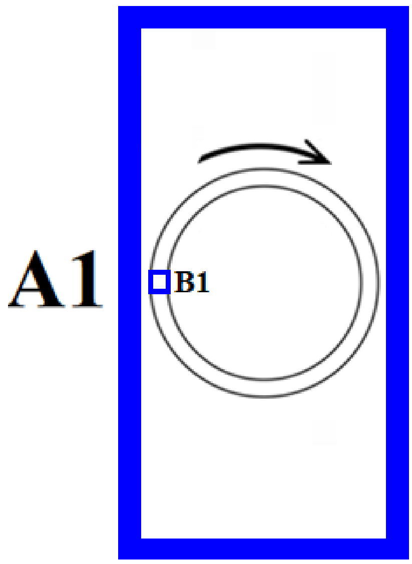

Fig. 4

An observer who is at rest relative to A1 can rightly claim that B1 is shorter than A1 in the situation shown, but an observer who is at rest relative to B1 *cannot* rightly claim that A1 is shorter than B1, because that is ***physically impossible*** in this situation, where B1 is permanently enclosed in the A1 measuring rod!

That the physical shortening of B1 is not due to acceleration can be realized if one imagines that both rings are extremely large, e.g. billions of light years (also *after* ring B is set in rotation). If B1's 'proper length' is still 1 meter, then it will not accelerate measurably, or be affected by measurable inertial forces in such a situation! (The same conclusion must be reached by analyzing the situation shown in Fig. 1, where there are clearly physical contractions of the measuring rods, regardless of whether they are in one of the curved sections, or in one of the straight! These effects are entirely determined by the speed!)

That some length contractions *must* be physical, I argued for in a different way, in the paper:
Questions concerning the foundation of the theory of relativity **[2]**:

"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 (Lo) has become greater, according to the formula: $L = Lo * \text{sqrt}(1 - v^2/c^2)$. – 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 [railcars], 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, when the front wagon and the rear wagon have moved equally far, and in the same direction, measured in this frame (under the precondition, that the lengths of all the wagons constantly are identical)!

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- / observer 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.”

I have the following addition to the above thought experiment:

If we assume that the *continuous* train (without wagons) had its *'natural length'* (at the temperature in question) *before* it was accelerated to 10 km / hour, then this would not be the case *after* the change in speed. In order for the train to regain its natural length, almost all parts of it would have to accelerate *physically* (i.e. with respect to the local inertial frames). The inertial forces caused by this would in principle be measurable! If you imagine, that there was no friction at all, then the train would naturally become shorter and shorter until it had achieved its natural length. This would happen due to molecular and atomic forces, which shows that it would then be a *fundamentally* different kind of contraction, than if it was caused by an observer being accelerated to another inertial frame!!

So, is relativistic length contraction consistent?

Other arguments against relativistic length contraction can be found in the paper:
Thought Experiments that [Critically Explore the Theory of Relativity] **[3]**

References:

[1] https://www.vixra.org/pdf/2207.0088v1.pdf

[2] https://vixra.org/pdf/1805.0411v3.pdf

[3] https://vixra.org/abs/2405.0013