the general science journal

The concealment of Asymmetric Time Dilation versus Symmetric Time Dilation

Roger J Anderton
R.J.Anderton@btinternet.com

Relativity texts talk of Time Dilation but usually gloss over the issue of two different types of Time Dilation: Asymmetric Time Dilation and Symmetric Time Dilation. This concealment is by bad writing that tries to hide this issue by being vague, such as by bad labelling of clocks: one clock as moving and the other clock as non-moving, this then suggests motion in an absolute sense, when Relativity theory is supposed to be motion in relative sense. I look at a typical type of example.

First of all from my point-of-view it is better to talk of Clock Dilation instead of Time Dilation. But most special relativity (SR) texts seem to talk of Time Dilation, and not Clock Dilation, so for the sake of this article I will refer to it as Time Dilation; despite what I deem as it being an effect on clocks and not an effect on time.

John D. Norton [1] gives in his confused writings on SR a muddle between Asymmetric time dilation and Symmetric time dilation. Maybe some people might consider other SR texts better than the one I am citing, but from my point-of-view all articles on SR have some defect or other.

In the section : light clock, he says:

"An inertially moving clock runs more slowly than one at rest."

First thing to note is that Norton does not say "who" is saying the moving clock is slower; "who" in the sense that can have a person moving with the moving clock and so be at rest with respect to that moving clock, and can have the other scenario of a person observing the moving clock moving relative to him.

People think in various ways, and I think I have had an encounter with a person that thinks only in terms of yes/no. Thus in the sense of moving objects; from such a person's thinking process: an object is either moving or not moving (but not both); this is contrary to how relativity deals with motion, whereby an object can move in one sense relative to some things, but relative to other things be at rest. In relative motion it is not the case of an object either moves or does not move; it is more flexible. Thus a thinking process restricted to either/or cannot comprehend relativity.

In Aristotelian logic the answers are either yes or no, but never yes and no which is the excluded middle.

Wikipedia says: “In logic, the law of excluded middle (or the principle of excluded middle) is the third of the three classic laws of thought. It states that for any proposition, either that proposition is true, or its negation is true.” [2]

So, a person restricted to thinking this way, thinks:

- Object moving, or
- Object not moving

And the third option that an object can move in some sense and not in other sense, is not an option allowed.

Having restricted to only two options and excluded third option, is what Wikipedia describes as a fallacy: “A false dilemma is a type of informal fallacy in which something is falsely claimed to be an "either/or" situation, when in fact there is at least one additional option.”[3]

This explains why some people have difficulty with relativity if their thinking process does not allow them the third option as possibility.

This type of thinking process has more difficulties than just with relativity, because then such a person might define concepts such as “irony” as lying. Their thinking process being either “irony” is lying or not lying, and they conclude it is lying; because that is what “irony” might seem closest to. Whereas I would hope most people would see the third option that it is not really lying, and is defined usually as : “the expression of one's meaning by using language that normally signifies the opposite, typically for humorous or emphatic effect.” [4]

Anyway, back to Norton saying: “An inertially moving clock runs more slowly than one at rest.”

This is badly said; it needs to be far better said with more explanation if talking about relative motion, because if an object is moving then need to say moving relative to what etc.

Norton doesn’t give enough explanation, so we are forced into trying to make sense of what he says from the little that he does say.

If a person observes a clock moving relative to himself then presumably by Norton, he then claims that the moving clock is slower.

But Norton does not deal with the reverse scenario, of a person moving along with the moving clock in which case it is at rest relative to him.

So, we need to go into more detail: Norton is dealing with two clocks; let us call them clock A and clock B.

Let us say clock B is moving relative to clock A, then for a person 1 at rest relative to clock A will say clock B is moving and thus slower.

Now for a person 2 moving with same motion as clock B, so that relative to him clock B is at rest; what is that person 2 saying?

Is it that person 2 agrees with person 1 that clock B is moving or is he now saying clock A is moving.

The possibilities are:

1) Person 1 and person 2 both agree the moving clock is clock B
2) Person 1 says the moving clock is clock B while person 2 says the moving clock is clock A.

By not addressing this issue, Norton has left it all vague. The hope would be by most people that further reading of what a writer such has written would clarify things, but of course it doesn't.

Most people on reading such a sentence by Norton would seem to opt for possibility (1) as what was meant. So taking Norton's sentence as meaning possibility (1), then both person 1 and person 2 are agreeing that the moving clock is clock B, and the clock that is not moving is clock A. Thus, clock B is slower than clock A, and both persons agree this. This is Asymmetric Time Dilation. In this scenario: Clock B is slower than clock A, and clock A is faster than clock B, with both persons agreeing this.

Norton then goes into explanation:

"To see how this comes about, we could undertake a detailed analysis of a real clock, like a wristwatch, a pendulum clock or a mechanical wind-up clock. That would be difficult and complicated--and unnecessarily so. All we need is to demonstrate the effect for just one clock and that will be enough, as we shall see shortly, to give it to us for all clocks. So let us pick the simplest design of clock imaginable, one specifically chosen to make our analysis easy."

"A light clock is an idealized clock that consists of a rod of length 186,000 miles with a mirror at each end. A light signal is reflected back and forth between the mirrors. Each arrival of the light signal at a mirror is a "tick" of the clock. Since light moves at 186,000 miles per second, it ticks once per second."

That is the end of that section; and could all be understood from Asymmetric time dilation, with one clock (i.e. clock B) moving and the other clock non-moving (i.e. clock A).

The next section is: Light Clocks are Slowed by Motion

He says: "It is easy to see without doing any sums that the light clock will be slowed down. That is, it will be slowed down in the judgment of someone who does not move with the light clock." – sentence (*).

That is now Symmetric Time dilation.

The vagueness of Norton's writing can lead the reader into contradiction of Asymmetric time dilation versus Symmetric time dilation; i.e. of one moment talking about Asymmetric time dilation and the next moment talking about Symmetric time dilation.

Not everyone sees the sentence (*) as meaning Symmetric time dilation, but it does as I will now explain:

Dissecting what he says. The part: "...that the [moving] light clock will be slowed down...." that can be interpreted as the Asymmetric time dilation that was being talked about in the previous section, but he then follows that with saying:

"That is, it will be slowed down in the judgment of someone who does not move with the light clock."

This is Symmetric time dilation, because:

(a) where for clock A at rest relative to moving clock B, according to person 1 (with clock A) it is clock B that has slowed; but
(b) person 2 at rest relative to clock B, it is the A clock that is moving and so it is clock B that is slowed.

Suddenly what could be interpreted as Asymmetric time dilation now becomes could be interpreted as Symmetric time dilation. It is the vagueness of the writing that has allowed this, and people reading this can declare different beliefs such as: it was supposed to be Symmetric time dilation that was always meant or that it was Asymmetric time dilation that was supposed to be always meant etc.

The problem in Norton's writing has been to not to address the Relativity Principle.

For the two possibilities:

1) Person 1 and person 2 both agree the moving clock is clock B

2) Person 1 says the moving clock is clock B while person 2 says the moving clock is clock A.

The first possibility is using a preferred frame (some say "absolute" but I prefer "absolute" to mean something else) scenario without Relativity Principle. While the second possibility has the Relativity Principle.

The writing in most SR texts just gloss these two different possibilities over, leaving the reader to make different attempts at interpretation as to what is supposed to be meant.

Add to that other problems such as the supposed transition from special relativity (SR) to general relativity (GR) and the relativity texts get even more confused. In the case of SR, it is sometimes believed that it only applies for inertial observers (i.e. constant velocity motion) and non-inertial motion must be dealt with by GR; but on such issues the relativity texts are also confused with their vagueness. Thus, the two theories SR and GR are used to hide things in the gaps between how vague they are.

Summary

There is inconsistency in most texts on Einstein's relativity in saying one clock is moving (and thereby slowed) and another is at rest, because it often made vague as to the issue of moving relative to what, and at rest relative to what.

Given:

Clock A is at rest relative to person 1.

Clock B is at rest relative to person 2.

Therefore, if there is to be motion, the motion is in respect to the other clock (and other person).

That is, Clock A is NOT at rest relative to clock B (person 2).

Clock B is NOT at rest relative to clock A (person 1).

So, which of the clocks will be slowed when there is motion; and is the essence of the Dingle paradox. [5]

It's resolution, even within SR implies that there is a state of rest from a preferred frame and by implication also motion relative to that preferred frame, something which SR seemingly denies by claiming of the Relativity Principle. (Of course, what is meant by "preferred" needs further discussion, which I gloss over here.)

Thus, people like Norton when they write about relativity hide the issue of such things as "Asymmetric time dilation" versus "Symmetric time dilation", by not even mentioning such concepts.

Norton starts: "The first change we will investigate has to do with time. An inertially moving clock runs more slowly than one at rest."

So, he is talking about two clocks: one clock moving and the other clock at rest. Of these two clocks the moving clock is the one going slower, and he seems to be saying this in some sort of absolute sense. (Where labelling one clock as moving and the other clock as non-moving; and not labelling each clock as sometimes moving and sometimes non-moving depending on frame of reference.) So, we have what appears to be "Asymmetric time dilation".

We still have him seemingly talking about "Asymmetric time dilation" up to sentence: "...the [moving] light clock will be slowed down."- sentence #1

But then with the sentence suddenly seems to be talking about "Symmetric time dilation", when he says: "That is, it will be slowed down in the judgment of someone who does not move with the light clock."- sentence #2

So, still with the scenario of two clocks that he started with, suddenly he is saying that yes from the frame of the non-moving clock the moving clock will seem slower BUT now from the stationary frame of the moving clock what we called the non-moving clock will appear to be moving, and hence will be slower as well.

There is flip from talking about "Asymmetric time dilation" to talking about "Symmetric time dilation" hidden in the vagueness of the writing.

If someone reads sentence#2 thinking it clarifies sentence#1 they have been deceived, because it seems more like he is talking about two different things.

I think it typical trick of politician to talk of X and carry on talking about X but suddenly change the meaning of X in mid-speech.

Same happens with relativists when they talk of concept X, such as X = time dilation; they will talk about X as "asymmetric time dilation" and then flip mid-speech to having X mean "symmetric time dilation."

i.e. they are talking badly about concepts and hiding the contradictions in the bad use of language.

When Dingle pointed out the contradiction between "asymmetric time dilation" and "symmetric time dilation"; the response of relativists seems to be is to hide this contradiction in their misuse of language rather than have it explicitly stated.

Norton does not even try to show things from the reverse perspective; and by not doing that creates the ambiguity. It is as Wittgenstein says: "What we cannot speak about we must pass over in silence." [6]

References

[1] Special Theory of Relativity: Clocks and Rods, John D. Norton, Department of History and Philosophy of Science, University of Pittsburgh at 04 May 2017

http://www.pitt.edu/%7Ejdnorton/teaching/HPS_0410/chapters_2017_Jan_1/Special_relativity_clocks_rods/index.html

For reference the article goes:

Special Theory of Relativity: Clocks and Rods

Einstein based his special theory of relativity on two postulates, the principle of relativity and the light postulate. If we adopt these two principles, we already know that things cannot remain as they have been in classical Newtonian physics. Imagine a light signal flying past us; and an inertially moving spaceship that speeds after it. An immediate consequence of the light postulate is that observers in the inertially moving spaceship will not judge the light signal to have slowed, no matter how fast they are moving past us. That is impossible according to classical Newtonian physics.

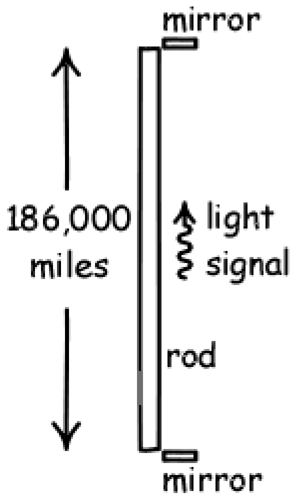
If we are to retain both of Einstein's postulates, we will have to make systematic changes throughout our physics. Let us begin investigating these changes. They will overturn our classical presumptions about space and time.

A Light Clock

The first change we will investigate has to do with time. An inertially moving clock runs more slowly than one at rest.

http://commons.wikimedia.org/wiki/File:2010-07-20_Black_windup_alarm_clock_face.jpg

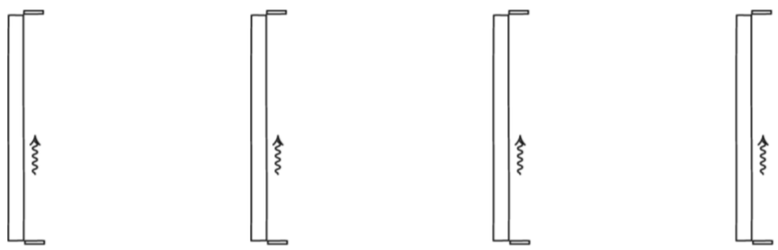
http://commons.wikimedia.org/wiki/File:Old_Pendulum_clock.jpg



To see how this comes about, we could undertake a detailed analysis of a real clock, like a wristwatch, a pendulum clock or a mechanical wind-up clock. That would be difficult and complicated--and unnecessarily so. All we need is to demonstrate the effect for just one clock and that will be enough, as we shall see shortly, to give it to us for all clocks. So let us pick the simplest design of clock imaginable, one specifically chosen to make our analysis easy.

A light clock is an idealized clock that consists of a rod of length 186,000 miles with a mirror at each end. A light signal is reflected back and forth between the mirrors. Each arrival of the light signal at a mirror is a "tick" of the clock. Since light moves at 186,000 miles per second, it ticks once per second.

Here are some light clocks ticking:



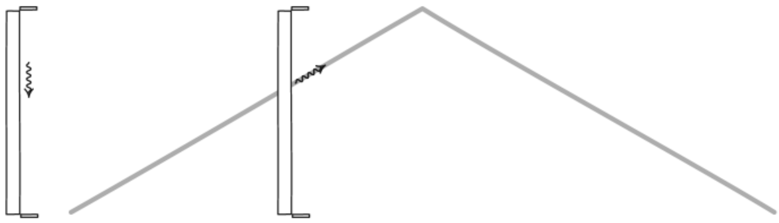
Light Clocks are Slowed by Motion

What happens when a light clock is set into rapid motion, close to the speed of light? It is easy to see without doing any sums that the light clock will be slowed down. That is, it will be slowed down in the judgment of someone who does not move with the light clock.

First, we will take the simple case of a light clock whose motion is perpendicular to the rod. The light clock will function as before. But now there is an added complication. The light signal leaves one end of the rod and moves toward the other end. But since the rod is moving rapidly, the light signal must chase after the other end as it flees. As a result, the light signal requires more time to reach the other end of the rod. That means that the moving light clock ticks more slowly than one at rest.

Remember the light postulate. It tells us that the light always travels at the same speed in any inertial frame of reference. That the rod along which it bounces is moving rapidly will not alter the speed of the light.

Here's an animation that shows a light clock at rest and a second light clock that moves perpendicular to its rod. The light signal in the moving clock chases after the rod. To reach the other end, it covers more distance and, as a result, requires more time.

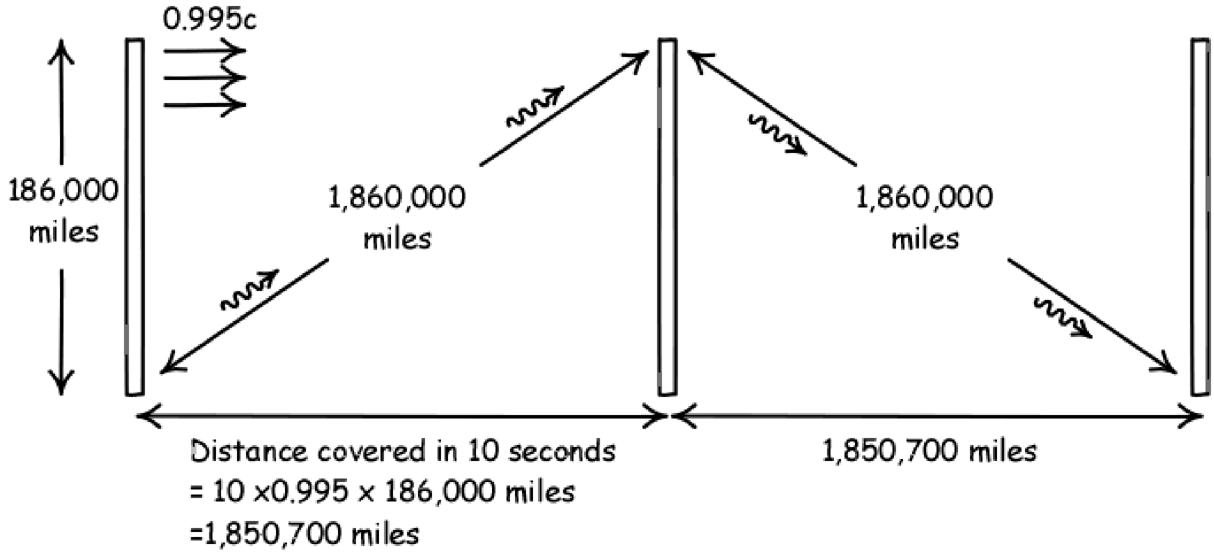


moving light clock

If you watch the animation carefully, you will see that the moving light clock ticks at exactly half the speed of the resting clock. That is because the light signal of the moving clock has to cover twice the distance to go from one end of the rod to the other. To get this doubling of the distance takes a careful adjustment of the speed of the moving clock. It turns out that the moving clock has to be traveling at 86.6% the speed of light.

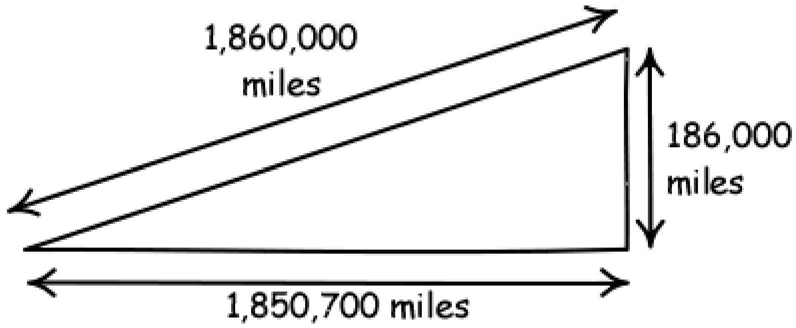
Just how much slowing do we get for some particular speed? That question turns out to be easy to answer with a little geometry. The trick is to figure out how much distance the light signal has to travel to reach the other end of the rod. Once we know that distance, we know the time taken, since light always travels at 186,000 miles per second.

To make things interesting, let's take a very high speed: 99.5% the speed of light. (We'll write this compactly as "0.995c.") An observer traveling with the clock will still find that the light signal bounces backwards and forwards between the mirrors as before. This process unfolds quite differently from the perspective of an observer who stays behind and does not move with the clock. The path traveled by the light will now be like this:



That observer at rest will agree with one that moves with the rod: a light signal leaves one end of the rod and arrives at the other end. But the observer at rest judges that end to be rushing away from the light signal at 99.5% the speed of light. A quick calculation shows that that the signal will now take 10 seconds to reach the other end of the rod.

To see this, note that in ten seconds the rod will move 1,850,700 miles, as shown in the figure above. So to get to the end of the rod, the light signal must traverse the diagonal path shown. A little geometry tells us that a right angle triangle with sides 186,000 miles and 1,850,700 miles will have a diagonal of 1,860,000 miles.



Pythagoras' theorem tells us the diagonal is 1,860,000 miles since

1,860,000 miles^2 = 1,850,700 miles^2 + 186,000 miles^2

Since light moves at 186,000 miles per second, it will need ten seconds to traverse the diagonal.

Setting the arithmetic aside, the result is simple. Since the light signal must travel so much farther to traverse the rod of a moving clock, it takes much longer to do it. Hence a moving light clock ticks slower. In this case, for a clock moving at 99.5% the speed of light, it ticks once each ten seconds instead of once each second.

All Moving Clocks Are Slowed by Motion

All light clocks slow when they move rapidly. What about other clocks? You might be tempted to say that light clocks are exceptional. They slow because they depend on light; and we are learning that light does odd things. So why not just say that light clocks slow when they are set in motion and that shows that light clocks are not good clocks after all? Why not just say that other, real clocks are not slowed? It is tempting to say this, but it does not work.

[The article continues, but nothing is clarified from what is existing said.]

[2] Wikipedia https://en.wikipedia.org/wiki/Law_of_excluded_middle 08 May 2017

[3] Wikipedia https://en.wikipedia.org/wiki/False_dilemma 08 May 2017

[4] https://en.oxforddictionaries.com/definition/irony

[5] Herbert Dingle, Science at the Crossroads 25 Sep 1972 ISBN-10: 0856160601, ISBN-13: 978-0856160608

[6] Stanford Encyclopedia of Philosophy https://plato.stanford.edu/entries/wittgenstein/

*This articled based on what Pentcho Valev says at: Is Lee Smolin the Only Doublethinker in Einstein's Schizophrenic World?
http://www.network54.com/Forum/304711/thread/1493574679/last-1493710098/Is+Lee+Smolin+the+Only+Doublethinker+in+Einstein%27s+Schizophrenic+World-