General Relativity For Teletubbys

The Special Relativity Section

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Starters

A motivation for special relativity lies in obtaining a more palatable understanding to the equations derived by Lorentz, i.e. the Lorentz Transformations. Briefly, these transformation equations came about from a study of Maxwell's Equations and were obtained in order to obtain a framework of understanding to how the speed of light might always be the same, independent of the source or observers velocity. Why this initial belief?. Apart from other theoretical reasons, it was found that the explanation of many, many experiments could be best described by this simple principle. It is true that most of these experiments could also have some other ad-hoc explanation, but none matched the simplicity of this one principle that applied to them all, no matter how strange the postulate seemed. The Lorentz Transformations were initially attributed with what was called, The Lorentz Ether Theory, or LET. These equations indeed gave the correct answers, but the rational for them was based on the supposed existence of a special substance, named ether or aether, that permeated all of empty space. In principle, there was nothing incorrect in this view. However, the properties of this ether were such that eventually people like Einstein expressed the view that the ether just simply did not exist, and that something more fundamental was going on. It was hard to rational that there existed the rest frame of an aether, but that the aether theory itself explicitly denied that you could ever determine any velocities with respect to such a purported reference frame. However, in principle, the EM aether can actually be dispensed with, and the concept of an absolute reference frame can still be retained.

Einstein examined these issues and discovered that, rather then having to use a detailed mathematical analysis using transformations of Maxwell's Equations, only 2 very simple assumptions were required in order to derive the Lorentz Transformations. These are of course the invariant speed of light, and the very well known postulate that all uniform motion is equivalent. It can easily be argued that the extreme simplicity of these two postulates is what makes the theory of SR so compelling. No matter what experiment is performed, any and all of the equations derived using SR as a base, and used within the region of applicability of S.R., always agree with experiment. No other assumptions are ever required.

Understanding SR

It would be nice to get a real feel of why the speed of light is an invariant. This may or not be possible. It may be essentially a new axiom, not derivable from any prior Newtonian concepts. The most striking aspect of lights invariance is the appreciation that if you head into the sun, no matter how fast you are going, the speed of the suns light is always measured to be the same. As the detailed sums show, the one rational for this to occur is that time itself must be relative and a function of relative velocity. This is really the key. Once the notion that time (relative) is dependent on velocity (relative) it can be straightforward to accept why the speed of light is always measured to be the same.

How does one define time? A little thinking about it and it is clear that the *only* way to determine time is if something moves. If absolutely everything stopped moving, so would time. Therefore it follows, that time must somehow be a function of motion (velocity), although by itself, this argument does not tell us what that function would be. So it follows then, that:

$T=F(v)$

If it were not for SR, time might be defined in some way from the relation v=dx/dt. However, the details of SR finally give a definition for time that links space and time together. SR tells us that as soon as an object moves relative to another object, the relatively moving objects rate at which it travels through time is not the same as the object taken as stationary. *This is automatically time travel into the future*. For instance, the relatively moving object could be advancing into the future at a rate of 2sec/sec, compared to the object taking as being stationary. So, traveling distance automatically means traveling at a faster rate in time. This effect is reciprocal in that the moving and stationary objects can be interchanged, although it might not be immediately clear as to why this is so, and is addressed elsewhere. The well known twin going away and coming back after travailing fast, might best be interpreted as the traveling twin traveling faster into the future rather then "aging less" as commonly explained. The traveling twin certainly does not notice that he is "aging less".

Now that the notion of *time travel into the future* has been introduced, it is easy now to see why, for example, a rod does not really shrink, but can still fit into a hole, that in its rest frame is smaller then it. Not only are relatively moving objects moving through time at a different rate, the front and back ends of objects are also at different points in time, as expressed by the Lorentz Transformations. This means that a rod "rotates" in time, i.e. its front and back end do not go through the hole at the same time, although it looks that way from the observers point of view. This is called the relativity of simultaneity. Happenings that occur at the same time at different positions in one frame do not occur at the same time in in another frame. This is really the crux of many misunderstandings in SR. Without the vx/c^2 term in the Lorentz Transform time equation, all of SR falls apart.

So, it's a no wonder why lights speed always looks the same, when one is moving relative to a light source, ones rate of time flow is simply not the same. Or think about the Tardis (Dr. Who) moving in time and trying to measure its length. Not surprising is it, that its length might measure "wrong" if bits of it are at different points in time.

Another point to note is the initial, apparent failure of the relative motion attribute of Newtonian Mechanics. It was well accepted that Newtonian Mechanics did not depend on any absolute reference frame for uniform motion. The search to detect an aether implies that one can actually measure such an absolute reference frame. This is at odds to the understanding of EM, for example, it does not appear to matter whether the wire or the magnet moves, or their velocity with respect to any other velocity, when generating a voltage.

Discussion:

Special Relativity is a subject that many cranks, loons, layman and non- Teletubbys like to dismiss as being false. There are many reasons for this.

1 Lack of Knowledge

Many individuals simply do not have any reasonable physics background with which to make any judgments at all.

2 Naiveté.

Typically an individual will not understand something correctly and will declare that there is some fundamental error or contradiction in the theory. The amazing thing about this, is that these bedroom piss artists honestly believe that *all* of the experts for the last 100 years have not got an f'ing clue. They fail to see the ludicrousness that, the likes of Fynman, Sagan, Einstein, Plank, Heisenberg, Dirac, Schrödinger, Pauli, Fermi, etc…etc… with all their extensive experience and knowledge, all missed something so obvious that some uneducated schoolboy could spot the error. These individuals simply do not know with what they are dealing with. If this reader is one of those, get real, if there was a basic flaw, or a better theory, it would have been discovered by now.

3 Poor Derivations/Explanations

Unfortunately, there are many references out there, even by Ph.D. Physicists, that have dubious or even wrong descriptions of why SR. This causes many individuals to reject the theory rather then realizing that it is only the explanation that is incorrect. Some typical errors are.

a) The Michaelson-Morley (MMX) experiment showed that the speed of light was independent of the relative velocity between the source and observers.

This is not correct. The source and observer in the MMX experiment were both moving together. The MMX experiment was designed to detect motion through the postulated aether. It showed that the speed of light did not depend on the earth's velocity through the solar system, indicating that light had no medium.

b) Light, just as *any* other wave motion, *should* be independent of the velocity of its source. So, this aspect of lights behavior, is initially no big deal at all. This fact is sometimes used on its *own* as a justification for SR, by inferring that this is in some way strange. It is decidedly not strange. It is to be expected from the conventional physics of the situation. It is only if there is no aether to make light behave that way that a problem appears.

4 Outdated Concepts

Unfortunately, many concepts that were introduced at the beginning of SR, including by Einstein, are not really useful, nowadays, and considered somewhat incorrect. Indeed, all of the main ones, i.e. mass , length, time, are generally considered to be inappropriate.

a) *Mass increase* -

In the modern approach to SR, mass does *not* increase, i.e. mass is an invariant. Much is written and explained by use of the relativistic mass increase formula. This should be ignored. In general this relativistic mass concept only complicates matters. The momentum equation:

$$\mathbf{p} = \frac{d}{dt}(m(\gamma\mathbf{v}))$$

Note, that the usual subscript 'o' is dropped since there is only one value for mass, and the gamma factor is now associated with the velocity or the Lorentz transform itself, not the mass. SR results in a modified equation for momentum, not modified masse values.

b) *Length Contraction* - The real length of an object does *not* change. It is defined by:

$$ds^2 = dx^2 + dy^2 + dz^2 - cdt^2$$

and, by SR, is an invariant. The analogy to this is this, if you hold a pole vertically that is larger then the height of a door, you can get the pole through the door, without it changing size, by tilting the pole either towards or away from you. In SR, you tilt the pole into the time dimension when getting it through the hole that is shorter then the pole. That is, due to the concept of relative simultaneity, the front and back ends of the pole are effectively at different points in time relative to different observers. This means the pole tilts in time when viewed by the observer taken as stationary, i.e. the back end goes through the hole before the front end. It does not therefore have to "shrink" in order to fit into the hole.

c) *Time dilation* - Relatively moving clocks do *not* tick slower. Proper time length is defined by:

$$cd\tau^2 = cdt^2 - (dx^2 + dy^2 + dz^2) = \frac{c}{\gamma}dt^2$$

and, by SR, is an invariant.

Reunited moving and non moving clock read differently in SR because the moving clock takes a longer path, much like a milometer can read different if it goes from London to Edinburgh via different routes. A relatively moving clock might be said to cover more time, i.e. instead of traveling into the future at a rate of 1sec/1sec, it might travel into the future at say, 2sec/1sec. Another way to get the thing into perspective is Dr. Who's Tardis. He jaunts off into the future, taking a certain amount of his time, to get further into the future then experienced by the non-jaunting observer.

Website last modified 31st May 2013

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