THE LORENTZ TRANSFORMATIONS DON'T EVEN DO WHAT THEY WERE *INTENDED TO DO!*

by

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THE LORENTZ transformation equations were originally devised to ensure that the speed of light remains a constant for all observers in all inertial frames, regardless of their relative rectilinear motions.

But do they really accomplish this? Let's see.

Imagine a very long spaceship with a man in it, moving relative to a lady who is in a tiny space capsule. Let the spaceship be moving past the capsule at a very high velocity — say, 98 % that of light. Call that velocity *v.* Calculating the Lorentz <*gamma*> factor, which is equal to $1/(1-v^2/c^2)^{0.5}$, we get a figure of almost exactly 5.0 (to be exact, 5.0251890763 when calculated to ten decimal places — but no one can measure speed *that* accurately.)

To make calculations simpler, let's suppose the spaceship is 299,792 kilometres long. Since the speed of light is nowadays taken to be a constant for all observers at 299,792 kilometres per second (within an accuracy of plus or minus one km/s), if the spaceship were *stationary,* to the lady in the capsule, light should take just one second to travel its length from nose to tail.

And of course, to the man in the spaceship, who *is* stationary with respect to it, it should also appear that light takes exactly one second to travel the length of the spaceship ... that is, if the speed of light is indeed a constant for all observers in all inertial frames, regardless of their relative rectilinear motion.

Now let's suppose the spaceship is moving past the lady *towards* a source of light which is giving off intermittent amber-coloured flashes, each flash being of very short duration: say, one picosecond duration. And let's say that the spaceship is also moving *away from* a source of light which gives off blue flashes intermittently, also of one picosecond duration each.

And let's say, to make things even simpler, that the sources of light are both stationary with respect to the lady in the capsule.

And finally, let's suppose that one of the *amber* flashes reaches the *nose* of the spaceship just as the nose of the spaceship is passing the lady in the capsule; and later, just as the tail of the spaceship is passing the lady in the capsule, one of the *blue* flashes reaches the *tail* end of the spaceship.

For the sake of convenience in visualising it all, let's imagine that you and I are watching all this from a position stationary with respect to the lady in the capsule, in such a way that the amber light source is to our left in the *x* direction, the blue light source is to our right in the *x* direction, the spaceship is moving leftward along the *x* axis, and the lady is bang at the intersection of the *x, y* and *z* axes.

So now comes the punch line: Do the Lorentz transformation equations ensure that to the man on the moving spaceship, the speed of the *amber* light flash as it flashes by from nose to tail of the spaceship, equals the speed of the *blue* light flash as it flashes by from tail to nose of the very same spaceship?

Let's see. In the lady's frame, let's take the time at which the nose of the spaceship passes by the lady's capsule as 0.000 seconds. This, as we said, is also the time at which the amber light flash reaches the nose of the spaceship, travelling towards its tail.

So at time 0.100 seconds — that is the say, one-tenth of a second later — the nose of the spaceship will have passed 29,380 kilometres (*i.e.,* 0.98 multiplied by one-tenth of 299,792) to the *left,* and the flash of amber light will have passed 29,979 kilometres to the *right.* In other words, in the frame of the lady in the capsule, the *x* co-ordinate of the nose at time 0.100 seconds will be –29,380 kilometres, and the *x* co-ordinate of the amber light flash at this time will be +29,979 kilometres.

Now remember that the Lorentz transformation equations require that in the frame of the lady in the capsule, the spaceship will have contracted in length by a factor of <*gamma*>*: i.e.,* to the lady in the capsule, the spaceship should appear to be five times shorter than it would be if it were at rest.

So in the lady's frame, at time 0.000 seconds, the tail end of the spaceship should be at co-ordinate +59,958 kilometres along the *x* axis. (This is the figure arrived at by dividing the rest length of the spaceship — namely 299,792 kilometres — by the <*gamma*> factor of 5.0.)

And in the lady's frame, at time 0.100 seconds — that is to say, one-tenth of a second later — the tail end would have moved 29,380 kilometres towards the *left,* and thus will be at co-ordinate +30,579 along the *x* axis (this being the figure arrived at by subtracting 29,380 kilometres from 59,958 kilometres); while the flash of amber light will have moved 29,979 kilometres to the *right,* and thus will be at co-ordinate +29,979 kilometres along the *x* axis.

Thus at time 0.100 seconds, the distance between the tail end of the spaceship and the amber flash of light will be a mere 600 kilometres (accurate to the last kilometre.)

But one-hundredth of a second later — *i.e.,* at time 0.110 seconds — the tail end of the spaceship will have moved a further *2,938* kilometres towards the left (this being the figure arrived at by dividing 29,380 kilometres by 100, accurate to the kilometre); while the light flash will have travelled a further 2,998 kilometres to the right (this being the figure arrived at by dividing 29,979 kilometres by 100, again accurate to the kilometre).

So at time 0.110 seconds, the *x* co-ordinate of the tail end will be (30,579 – 2,937) kilometres, or +27,641 kilometres; while the *x* co-ordinate of the amber light flash will be (29,979 + 2,998) kilometres, or +32,977 kilometres.

In other words, according to the lady, within 0.110 seconds of the nose of the spaceship passing her, the amber light flash will have already *passed* the tail end of the spaceship.

But what about the *blue* flash?

In the frame of the lady, the tail end of the spaceship and the blue flash will arrive at the capsule simultaneously. Thus at that instant, the front end of the spaceship will be at *x* co-ordinate –29,380 kilometres.

And a tenth of a second later, the blue flash will have travelled 29,979 kilometres to the left, and will be at co-ordinate –29,979 kilometres along the *x* axis, while the spaceship will have travelled 29,380 kilometres towards the left, and thus its front end will be at co-ordinate –58,759 kilometres along the *x* axis.

And a further 0.1 seconds later — that is to say a fifth of a second after the tail end of the spaceship passes the lady's capsule — the blue flash will have moved to *x* co-ordinate –59,958 kilometres, while the front end of the space ship will have moved to *x* co-ordinate –88,139 kilometres.

And yet a further 0.1 seconds later — that is to say three-tenths of a second after the tail end of the spaceship passes the lady's capsule — the blue flash will have moved to co-ordinate –89,938 kilometres, while the front end of the space ship will have moved to co-ordinate –119,917 kilometres.

Indeed, even half a second after the tail end of the spaceship passes the lady's capsule, the front end of the spaceship will be at co-ordinate –176,278 kilometres along the *x* axis, while the blue light flash will have travelled only to co-ordinate –149,896 kilometres along the *x* axis.

As a matter of fact, in the lady's frame it will be just a touch under *five* full seconds after the tail end of the spaceship passes her that the front end of the spaceship and the blue flash will reach the same co-ordinates. To be accurate, the exact time — in the lady's frame — at which the co-ordinates of the blue flash and the front end of the spaceship coincide will be 4.9 seconds after the tail end of the spaceship passes by the lady's capsule. At that time, according to her calculations, the *x* co-ordinates of the blue light flash will be equal to –1,468,983 kilometres, and the *x* co-ordinates of the front end of the spaceship will be equal to –[29,380 kilometres + (4.9 times 293,797)] kilometres, which is also –1,468,983 kilometres — accurate again to the last kilometre.)

So: according to the lady, it should take a time duration of just a tiny bit under *five full seconds* for the *blue* light to travel the length of the spaceship, but it should take just a touch under *one-tenth of a second* for the *amber* light to travel the same distance. Check the mathematics yourself.

Now according to the Lorentz Transformation equations, time should be running slower on board the spaceship by a factor of <*gamma*>, which as we said, happens to be 5.0. Thus for every second of the spaceship's clock, five full seconds of the lady's clock should be ticking by.

So if there were a man on board the spaceship (and why shouldn't there be, even though such a man would be five times thinner in the *x* direction, and five times more massive as well, than he was when at rest, and therefore twenty-five times denser than you or I ... at least if the Lorentz Transformation equations are to be credited!) — to such a dense man, the *blue* light should take almost *one* full second to travel the length of the spaceship (0.98 seconds to be exact), but it should take the *amber* light less than *0.022* seconds to travel the exact same distance!

As you can see, the Lorentz transformation equations just do not do what they were intended to do. They do *not* ensure that the speed of light is a constant for the lady in the capsule as well as the man in the spaceship.

Heck, they do not even ensure that the speed of light for a man in the spaceship *alone* is constant! This speed varies enormously for him, depending on which way the light is shining: with or against the motion of the spaceship.

Comments? E-mail me.

APPENDIX

Not only do the *Lorentz* transformation equations not ensure that the speed of light is a constant for all observers in all reference frames, but there is *no* set of transformation equations which can do this! If you think there is, go ahead and try to formulate them, such that they satisfy the above and all other such scenarios.

But you will find that such a set of equations is impossible to formulate — because it is *logically* impossible for the speed of light to be a constant for all observers in all inertial frames, regardless of their relative rectilinear motion.

The reason why the Galilean transformation works is that it is the only *logically* valid one! All others are *bound* to fail.

And the reason why it is the only logical one is, simply, that it is arrived at using a *logical* process of reasoning, and not experimentally!

Don't believe me? Then try to formulate an alternative set of transformation equations yourself. Go ahead — knock yourself out!