

Re: Is the speed of light really constant ?

Source: <http://sci.tech-archive.net/Archive/sci.physics.relativity/2004-11/0622.html>

From: Bill Rowe (readnewscix_at_earthlink.net.invalid)

Date: 11/03/04

Date: Wed, 03 Nov 2004 08:04:29 GMT

In article <WkNhd.14788\$bP2.14704@newssvr12.news.prodigy.com>, "Pax" <pax1@whitesweb.com> wrote:

> "Bill Rowe" <readnewscix@earthlink.net.invalid> wrote in message
> news:readnewscix-C0AA4B.18161501112004@news1.west.earthlink.net...
> > In article <Jpthd.11415\$bP2.2375@newssvr12.news.prodigy.com>,
> > "Pax" <pax1@whitesweb.com> wrote:

>>> Oh, you mean like the light from the headlights of two cars
>>> approaching each other on a dark road? Or two gold ions heading at
>>> each other then colliding with each other when each are both
>>> traveling at all but the speed of light? (Note: 1st example is
>>> light/light; 2nd example is mass/mass.)

>> No, these are not equivalent to the example of the bullwhip I gave.
>> In the case of the bullwhip, there is something physical (the tip of
>> the whip) moving faster than the speed of sound. In the examples you
>> give, the rate of closure exceeds c , but there is no physical thing
>> moving faster than c .

> And what frame of reference are you using to decide this? The local frame of
> either of the light emitting vehicles or the local frame of one or the other
> gold ion, or are you using a third frame external to all of them? If you're
> using a third external frame... which you are... why do you consider your
> conclusion valid, since Relativity addresses c wrt local frames?

If the analysis is done correctly, it does not matter which frame you choose.

> Using local frames for the light of the oncoming vehicles, c is c ; but,
> using local frames for the ions approaching each other the answer's not that
> simple. Those ions hit each other with a collision force equal to almost $2c$.
> You can't get around that, Bill. As far as either of those ions are
> concerned, an object of mass closing on them at all but $2c$ is a very real
> reality.

You need to be more careful here. Yes, the closure speed, i.e., the rate at which distance is decreasing in any frame but the rest frame of one

sci.physics.relativity: Re: Is the speed of light really constant ?

of the ions is nearly $2c$. But neither of the ions in any of these frames is moving faster than c . And in the rest frame of one of the ions, you cannot simply add the speeds to get the speed that will be measured for the other ion in that frame. Instead (in units of $c = 1$) the speed is given by $(u+v)/(1+uv)$. That is in some frame where each ion is moving at $.9c$ in a direction they will collide, the speed of one ion as seen by the other will be $1.8/1.81 c$ which is less than c .

Again, nothing physical is moving faster than c in any valid reference frame.

- > *I understand that global statements of absolutes are and have always been*
- > *unjustifiably made with expected-to-be unquestioned authority based upon*
- > *current limitations as construed from current observations.*

And this is **not** an accurate description of why c is accepted as a maximum possible speed.

As I posted before, the principle of relativity (the idea the laws of physics cannot depend on the choice of coordinate systems, a man made choice), the usual assumptions about space, time etc being homogenous and the requirement any coordinate transform must form a group limits the possible coordinate transforms to one of three cases. Of these one is non-physical, one is the Galilean transform and the last the Lorentz transform. Experimental observation confirms the Lorentz transform matches the universe in which we live.

- > *Going on your question of either/or above, one must conclude that, since*
- > *exactly such statements have always been made by experts in the past, Man*
- > *can't fly. Ignoring the actual present, far previous to the assertions of*
- > *those experts, and oblivious to the existence of any such irrefutable canon*
- > *of "actual facts", primitive Peruvians had been assembling large expanses of*
- > *cloth, oiling them, attaching a basket with ropes to the four corners,*
- > *trapping the hot air rising from a fire in the billows and floating away to*
- > *look at the pretty giant pictures they'd scratched out on the plains.*

Again, the examples you give where some experts got it wrong are statements about technological capabilities. That logic is quite different than the logic used to reason there must be a maximum speed limit and that maximum is c .

- >>>*And from what I've gathered from what Einstein wrote, he really*
- >>>*didn't draw that distinction either.*

- >> *I've no idea whether Einstein made the distinction above or not in his*
- >> *writings. Nor do I have any way to determine what Einstein would have*
- >> *thought one way or the other.*

- > *Why do make such statements? Of course you have a way. Einstein wrote a lot*
- > *of books, and they are brimming with his thoughts on just about everything.*

Re: Is the speed of light really constant ?

sci.physics.relativity: Re: Is the speed of light really constant ?

I make such statements because they are an accurate statement of my knowledge. I don't speak/read German. So, any of the original papers I read Einstein wrote are someone's translation of German which may or may not adequately capture Einstein's thoughts. And even if I read/spoke German there is still the issue that I may not read the words Einstein wrote in the manner he intended.

> > *What Einstein may or may not have written/thought on this issue is really*
> > *unimportant.*

> *And why is that? Has Relativity been "put in the dust" as Einstein so often*
> *said it might be "except...?"*

Hardly. Neither physics nor relativity has remained static, unchanging since Einstein. It is useful to read Einstein for historical context. But if you are interested in learning modern physics and relativity it is far more useful to read more modern texts. In the case of special relativity, an excellent text to start with is Spacetime Physics by Taylor and Wheeler.

> *Or is it simply Einstein when you need him, but to heck with him when*
> *it gets uncomfortable to hang with him? As far as you're concerned,*
> *either Einstein was right or he was wrong... which is it?*

This isn't the right question. The question you should be posing is either the predictions of relativity match experiment or they don't. It does not matter whether Einstein was right or wrong on some particular point.

>>> *He said Lorentz used it and Lorentz didn't make sense if you*
>>> *plugged in $v > c$. He constantly refers to the fact that c should be*
>>> *taken as infinite for all human considerations, since we could*
>>> *never attain it anyway.*

>>> *Why? Because, if we tried to push anything of mass to c , it would*
>>> *take all the energy in the universe. Sound familiar?*

> > *Yes, this chain of logic follows many popular accounts of relativity. But*
> *it doesn't represent Einstein's logic at all.*

> *Of course it does. He said it in the quote you cut: "Of course this feature*
> *of the velocity c as a limiting velocity also clearly follows from the*
> *equations of the Lorentz transformation, for these become meaningless if we*
> *choose values of v greater than c ."*

<sigh> Einstein wrote many things including some more popular accounts of relativity. It would not surprise me if you found a quote in something Einstein wrote that used that particular logic. But that isn't what is important. In his original paper on special relativity this is not the logic he used.

sci.physics.relativity: Re: Is the speed of light really constant ?

Further, even if Einstein did use that logic in his original paper it would be unimportant. It is quite possible to show the mathematical consequence of the principle of relativity coupled with the constancy of the local speed of light in vacuum is c is a maximum possible speed. And this logic makes no reference whatever to either mass nor energy.

>> *Einstein started with two very reasonable postulates. A direct mathematical consequence of these two postulates is c must be a maximum possible velocity.*

> *No. He stated the velocity of light must be *constant* in vacuo wrt all local frames. The Principle of Relativity and the constancy of the speed of light in vacuo wrt all local frames are what he based his Special Theory on, coupled with the work of Lorentz.*

Huh??? Those are exactly the two postulates I was referring to. Should I take your "No." above to mean you do not believe the logical mathematical consequence of these two postulates is c must be a maximum possible speed?

>> *In fact, one can reach this conclusion directly from the Lorentz transform making no mention of mass or energy at all.*

> *When did I bring in mass and energy with regard to the above?*

Look above. You made the comment the c is a maximum because it requires infinite energy to accelerate a mass to c . My comment is the idea c is a maximum can be derived from the Lorentz transform alone with no mention of mass or energy. That is while the the logic that concludes c is a maximum because infinite energy is required to accelerate a mass to c is not the fundamental basis for concluding c is a maximum possible speed.

>>> *There's a clash of principles going on. On one hand the laws of nature must remain "normal" within all local frames, regardless of velocity,*

>> *Huh??? What do you mean by "normal"? This certainly doesn't look to me like a correct statement of the principle of relativity.*

> *What I meant was exactly what Einstein meant by "general laws of nature". Is that not also what we would consider "normal"?*

How am I supposed to know what you meant? You didn't define "normal". You placed it in quotes indicating you probably meant something other than the usual dictionary definition. And finally, I am not aware of any specific usage of "normal" within physics. When you do this and fail to provide a definition I can either assume a standard definition or reply with a question to indicate confusion

>>> *on the other, the laws of nature break down at c ... which is exactly what insisting c is the universal speed limit says.*

Re: Is the speed of light really constant ?

sci.physics.relativity: Re: Is the speed of light really constant ?

- >> *Nothing in relativity says "the laws of nature break down at c".*
- > *True, Relativity doesn't say that, it says what can only be deduced to be*
- > *just the opposite, in fact.*
- > *Please explain how c as a definite, unattainable, impassable speed limit can*
- > *be maintained while at the same time maintaining the requirement of the*
- > *Principle of Relativity that "the formulation of the general laws of nature"*
- > *[...] "must be quite independent of the choice of mollusk."*

Why do you see a conflict here? The principle of relativity says in essence the results of any experiment I choose to do must be independent of my choice of reference frame. Specifically, must be independent of my velocity with respect any given reference frame.

The idea that c is a maximum speed merely states there is no physical experiment you can do where something with non-zero rest mass will have a local velocity of c. Where is the conflict?

- >> *Relativity does predict nothing with non-zero rest mass can ever*
- >> *attain a local velocity of c.*
- > *How would you go about testing that?*

Every time I observe the speed of light in vacuum is constant and the principle of relativity holds is a verification c is a maximum possible velocity. Or if you like, daily operation of particle accelerators are a verification c is a maximum possible velocity.

There is literally an overwhelming amount of experimental data confirming special relativity is correct. And it is already well known special relativity is mathematically consistent. Since one of the mathematical predictions of special relativity is that c is a maximum speed, any experiment confirming special relativity also confirms c is a maximum possible speed.

- >> *Also, it is non-sensical in relativity to try and formulate a*
- >> *description of any physical process with reference to something*
- >> *moving at c. That is it makes no sense to speak of a rest frame for*
- >> *a photon.*
- > *How about the rest frame of a gold ion? Two of them, in fact? Two heavy gold*
- > *ions about to kill each other nearly head-on at almost 2c?*

See my comments above. The closure speed measure in the same frame used to find the speed of each ion is nearly c will be measured as nearly 2c. But the speed of one ion as measured in the rest frame of the other ion will be less than c.

- >> *OK, let me be more explicit as to why I don't see this as*
- >> *meaningful. Start with what do you mean be "light rides itself".*

Re: Is the speed of light really constant ?

sci.physics.relativity: Re: Is the speed of light really constant ?

> *How is it commonly accepted that light gets from one place to another?*

When you say "commonly accepted" my answer would be I don't know. Commonly could include a great many people who have little if any knowledge of physics. But if you are asking for the common explanation used by competent physicists then the appropriate theory is quantum electrodynamics which is quite independent of relativity.

>> *Light is not a "massless thing with mass".*

> *How else would you describe a thing that has no mass but carries energy?*

I would use the concepts of quantum electrodynamics. I certainly wouldn't use an English phrase that appears to be self conflicting.

> *What is the Mass of a Photon?*

> http://math.ucr.edu/home/baez/physics/ParticleAndNuclear/photon_mass.html

> *Energy and mass are the same thing. Actually, you're right though, the photon itself doesn't have mass, but "light", which is the electromagnetic wave energy, does have mass.*

With all due respect to author of what you quoted, energy and mass are not the same thing. There is a clear relationship between mass and energy that enables me to say things like the mass of an electron is 512 KeV without causing confusion. But this is not the same as saying mass and energy are the same thing at all.

The mass of say an electron is independent of my reference frame. The energy of the same electron is dependent on my reference frame. This is a clearly observable difference between mass and energy which makes it clear they cannot be the same thing.

>> *And as for the rest of what you posted, it seems to me to be random thoughts with no clear relationship to physics much less relativity.*

> *That, Bill, must be considered to be your personal opinion.*

> *To clarify: random as it sounded, my previous closing statements were *all* based on an arm-chair version the "New Physics", which strikes me as disturbingly ambiguous in some instances... at least as it's been presented to the general populace.*

There are a great many popular texts on relativity and other aspects of modern physics that do a rather poor job of presenting the physics. From what you post above I strongly suspect you are reading one those texts. Again, if you really want to understand special relativity Spacetime Physics by Taylor and Wheeler is an excellent place to start.

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To reply via email subtract one hundred nine

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