

Re: definition of a clock in relativity theory

Source: <http://sci.tech-archive.net/Archive/sci.physics.relativity/2004-09/6826.html>

From: Eric Baird (eric_baird_at_compuserve.com)

Date: 09/27/04

Date: Mon, 27 Sep 2004 02:01:04 +0000 (UTC)

On Sun, 26 Sep 2004 07:18:18 -0000,
dubious@radioactivex.lebesque-al.net (Bilge) wrote:

> *Eric Baird:*

> >

> >FYI, the $E=mc^2$ relationship (where "m" is rest mass, and "E" is the
> >energy in the rest frame of that mass) also shows up as a consequence
> >of the equations of Newtonian theory.

>

> *In newtonian mechanics, $c = \text{infinity}$. Stop babbling and learn something
> about physics.*

Jeez, somebody told you that and you actually =believed= it?

<shakes head sadly>

So how do you square that with the idea that Newtonian emission theory
is based on the iodea that light was given off at "c" wrt the emitter?

Or that Newton quoted the speed of light as an approximate ratio wrt
the speed of sound, based on the known astronomical data at the time,
which showed that there were distance-dependent variations in the
times of the apparent eclipses of Jupiter's moons?

Or that Newton postulated that the light-transmission properties of
the medium included a "c-squared" term?

Or the range of writing by Newton that described refraction in terms
of a variation in lightspeed at a medium boundary?

Or his claim that gravitational bodies were associated with variations
in the speed of light, and that those variations could be used to
explain the action of a gravatational field?

Or Michell's "Newtonian" 1783 calculation of the gravitaitonal
weakening of light leaving high-gravity stars, and of the
non-visibility of stars with a surface velocity greater or equal to
lightspeed, published in the Royal Society journal in 1784 volume?

Or the Nienteenth century writings on Newton's theory of light?

Or Newton's Optiks?

Or Einstein's 1911 calculation of the effect of gravity on light, which chose to do the math using the "Newtonian mechanics" calculations, because they were simpler?

Or the idea that Newton's particulate description of light was considered disproved by the experiments at the beginning of the 1800s when it was found that Newton's arguments had included a bad calculation of the /variation/ of the finite speed of light at a glass/air boundary, and that light actually progressed more slowly in glass than air, instead of faster as Newton had reckoned? (faster-than-ininite would have been difficult to sell)

Have you ever actually read =anything= that Newton ever wrote about light?

?

=====

Newton's "ballistic light-corporcle" description of light depended on the idea that lightspeed was not only finite but variable, and it didn't depend on the idea of there being an absolute frame (because that would have destroyed Newtonian mechanics) -- his description of the deflection of light by a medium boundary as being due to a transition in lightpeed wouldn't have made sense of c was infinite.

Where things went squiffy (IMO) was when some of the aether theorists gained ascendancy, and started saying that Newton's "ballistic light" was wrong, and that light instead travelled at fixed speed wrt some sort of medium that did not have to be compatibvle with wave-particle duality ... then arguments multiplied about what the properties of the medium were, and how fast we might be moving wrt it, and the M&M experiment failed to show an aether drift ... then we ended up with the idea that since we couldn't detect an absolute lightpeed drift, the supposed absolute aether must be stationary wrt the observer, and it was THAT that led to a Doppler prediction of frequencies changing by

$$E'/E = \text{freq}'/\text{freq} = c/(c+v)$$

, where the /original/ Newtonian arguments had led to our expecting them to change by

$$E'/E = \text{freq}'/\text{freq} = (c-v)/c$$

Then, because the idea of an absolute Earth-centric aether didn't seem reasonable, and the light-ddragging theories seemed arbitrary, and because it dawned on people that an absolute fixed aether violated NM anyway, we got "LET&SR" as a new, "relativised" version of that absolute aether idea.

Now, compared to the absolute fixed aether predictions, SR includes a Lorentz term that goes away when velocity is set arbitrarily low, or when the speed of light is set arbitrarily high, so I suppose that if one misidentified the fixed-light-speed predictions as "Newtonian", one might say that the Lorentz deviation from those earlier predictions goes away when c is infinite, and therefore, with frame-based arguments that only describe the difference between frames in terms of those Lorentz relationships, with the propagation-based effects stripped away, we might be tempted to say that SR reduces to that earlier set of absolute-aether relationships when c is infinite. And from there, it's a small (incorrect) further step to say that previous theory can be compared to SR by saying that SR assumes finite c , whereas older theory assumes infinite c .

But that's an example of clever mathematics being "dumb" physics, because if c really /was/ infinite we wouldn't just lose Lorentz terms, we'd also lose conventional propagation Doppler shifts, because those disappear as well when v/c goes to zero, we'd lose great chunks of Newton's writing, great big sections of his stuff on light would not make sense (okay, so some of it didn't make sense anyway, but this would be worse) and Newton's theory would have been considered to be counter to the known experimental evidence all along, because infinite c wouldn't have agreed with the known variation of the timings of the eclipses of Jupiter's moons.

So if a mathematician says "Newtonian theory can be characterised in this context by the statement that c is infinite", then I'm inclined to be forgiving, and in some obscure mathematical comparisons, that sort of statement might even be correct in some arcane sense ... but when a physicist says " c is infinite in Newtonian mechanics", I don't think there's any excuse for it.

If there's still a dispute here, I'd suggest that rather than me going off to "learn something about physics", perhaps you might like to spend some time reassessing which of the "mathematical truths" that you may have been taught about spacetime geometry actually have some physical content to them, and which don't.

Not all geometry is physics, and a physicist learning advanced math has to be alert to the possibility that when one has an appealing mathematical "proof" it does not automatically translate into a "physics" result. That's why sanity checks are important:

[If you want to verify that NM needs to use the second equation rather than the first, take a look at "crude" Newtonian gravity ... it required that the energy lost by light climbing out of a gravity-well had to be total when the gravitational differential equalled c , which was the case with $E'/E=(c-v)/c$, but not with the other equation.]

Mathematicians are good at generating tools and techniques for use in all sorts of abstract situations, and they can give physicists a pile of results and methods that look to them as if they /might/ be of some use for physics. But not all of those results are going to be legal in the ill-defined subset of math that counts as "genuine" physics. It's the physicist's job to take that pile of "hopeful" mathematical results and throw back the ones that aren't appropriate, and give the mathematicians feedback on the sort of "character" of results that they are looking for.

If a physics community doesn't have an instinct for telling "physics math" from "math math", then they become less useful. If they really couldn't do it at all, we 'd get rid of theoretical physicists altogether and just hand the whole thing over to the mathematicians.

What I think I'm trying to say here, is that when you hear a mathematician say something about how two theories relate, that statement might be wrong, based on bad info supplied by a physicist, and dutifully worked up into a mathematical proof, or it may be mathematically correct in a very metaphysical sense, but still wrong or misleading in the context of the more common meanings of words.

Mathematicians aren't physicists (usually).

=Erk= (Eric Baird)

: " The bottom line for mathematicians is that the architecture has to be right. In all the mathematics that I did, the essential point was to find the right architecture. It's like building a bridge. Once the main lines of the structure are right, then the details miraculously fit. The problem is the overall design. "
: -- Freeman Dyson