

## Re: SR, curvature terms, and Realms of Validity

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On Wed, 27 Oct 2004 17:09:59 -0500, Tom Roberts <[tjroberts@lucent.com](mailto:tjroberts@lucent.com)> wrote, in message <[clp6bp\\$qum@netnews.proxy.lucent.com](mailto:clp6bp$qum@netnews.proxy.lucent.com)>:

>Eric Baird wrote:

>> On Fri, 8 Oct 2004 14:07:42 +0200, "Ole D. Rughede" wrote, in message

>> <[416680d8\\$0\\$310\\$edfadb0f@dread11.news.tele.dk](mailto:416680d8$0$310$edfadb0f@dread11.news.tele.dk):

>>>Pardon, but it seems we have a very serious problem. [...]

>>>Such conditions are found nowhere in the world, why

>>>the idea is false because of lack of reality. – But since

>>>SR is based on such conditions, we conclude that SR

>>>is a false theory of physics, [...]

>>

>> Yep, people sometimes talk about SR's "realm of validity", but I don't

>> think its immediately obvious that the special theory should have a

>> legitimate realm of validity when it comes to real-life physics and

>> theoretical validity (except the range in which SR is

>> indistinguishable from NM), since it seems to depend on simplified

>> assumptions that ought to be illegal under a more general theory of

>> relativity.

>

>Like NM, SR does indeed have a limited domain of validity, but this

>domain is in practice quite useful ("domain" is the usual word here, not

>"realm").

>

>Note that NM is a limiting case of SR, and SR is a limiting case of GR.

>For both NM and SR the way you determine whether or not a given

>measurement is within its domain of applicability is: use the more

>general theory to compute the corrections to the predictions of the

>limited theory -- if they are very small compared to your measurement

>resolution then they can be safely neglected.

>

>For NM one easily finds that if  $v \ll c$  then the correction terms due to SR

>are negligible compared to most practical measurement accuracies.

>

>For SR, the situation is a bit more complicated, but for the following

>types of experiments GR corrections are negligible:

> 1. tabletop optical experiments on earth with light paths <100m or so.

> 2. high-energy particle collisions on earth where all particles of

- > *interest have  $E \gg m$ , in a spatial region smaller than 100m or so.*
- >
- >
- >> *Let's suppose that we want to use SR to calculate the velocity–shift*
- >> *that we see on a "moving" high–gravity object (such as a neutron star)*
- >
- >*That is hopeless. GR is absolutely required for such a situation.*

Mmm, but the particular /type/ of hopelessness is important. ;)

If we are saying that calculating the motion shift on a moving neutron star is really complicated, because the star's field extends a long way and interacts with the fields of other nearby stars, and the energy associated with having that star moving wrt the cluster is going to depend on the placements and motions of the other stars in the cluster ... then yes, you'll need something like GR, and it's a horrid problem.

SR will not be up to the job, but the failure will be an "honorable" one.

OTOH, if we have our neutron star sitting in an "empty" region many hundreds of lightyears from the nearest other masses, with the very distant matter around it appearing to be uniformly distributed and combining to produce an "effectively flat" background to the star's own gravitational field ...

... if SR cannot give the correct velocity–dependent shift for the star's light in / that/ situation, then SR may be in very serious trouble

If SR is not correct for the velocity–shift on a moving neutron star, we can argue that perhaps it's not correct for anything. After all, if an astronaut in a spaceship looks out of the window at the frequency–shifted starfield and isn't allowed to work out their speed by measuring the shifts and then using SR, then the applicability of the theory is beginning to look a bit iffy.

#### GENERAL ARGUMENT:

Suppose that we have three "stationary" objects sitting alongside each other, an atom, a block of glass, and our neutron star.

The atom emits light at a particular known frequency, the block of glass contains a light–source set to emit at the same frequency, and the neutron star is also fitted with a lightsource, specially tuned to compensate for the gravitational redshift of the star, so that for a distant observer, all three signals have the same frequency

If all three sources are now advancing towards the observer at the same constant velocity, we can argue that the neutron star's shift ought to diverge from SR by a significant amount because the neutron star has a surrounding field that drags light, and that that

directional dragging should alter the light's momentum and energy, shifting its frequency and wavelength. If the effect of that field-dragging is additional to SR, then SR won't be giving the correct numerical predictions. And if we instead set SR aside and develop a "new" relativistic description that says that the light-dragging effect is simply the collisional shift effect smudged out in the form of a gravitational field, then this new form of curvature-compatible theory would not seem to be able to use the equations of SR.

So, either way, it seems that the the neutron star's velocity shift relationship shouldn't agree with what SR says

For the atom, we get a similar smudging out of the atom's mass-properties into the surrounding region, as a function of the quantum uncertainty of the atom's location, and once again, we seem to have a light-dragging effect.

We'd be tempted here to say either that SR is correct for the moving atom, or to say that if SR is "off", QM can make the necessary corrections to bring the SR predictions for the moving atom into line with reality

Then we have the glass block. Where SR calculates its effects by assuming that the speed of light is wholly independent of the speed of the source, a light-signal travelling through the block is typically described as travelling at an absolute speed referenced to the block's state of motion (not to the frame of the remote observer), and we also expect the influence of the block on light to extend outwards a bit ... the block's surface is a little "fuzzy" due to the QM effects of the atoms at its surface, and this edge effect means that the block drags light internally, but also drags light a little externally, and its escaping signal has to pass through this "fuzzy" boundary region. For the glass block we'd normally tend to decide that the "dragging shift" effect is probably miniscule, and doesn't have to be calculated, and SR is going to be pretty damned near correct for the block's external characteristics (because after all, if SR can't cope with the exterior surface of an everyday-sized object like a potato, its probably not going to be good for much at all, so I guess we'd tend to say that moving painted blocks and potatoes should obey SR, pretty well).

==BUT==

It would seem that all three objects – individual atom, glass block and high-gravity star -- have to show precisely the =same= frequency shift to the distant observer.

Here's why:

Lets say that our observer is sitting in a spaceship 100ly away, in the middle of a region devoid of matter 200ly across, and is initially "stationary" wrt our three objects. The observer notes that all three incoming frequencies are identical, then they fire up their

ship's engines, accelerate towards the signals for about a day , achieve some sort of absurdly-high relativistic velocity, and then coast.

All three signals will now appear to be approach-blueshifted (which is fair enough), but all three signal streams have to appear to be blueshifted by precisely the same amount.

Any signals caused by the acceleration of the ship have not had enough time to reach our three objects, and the ship's acceleration cannot have a causal influence on how the light is emitted ... and even if it did, the blueshift is seen immediately when the ship accelerates. So (in a light-metric-compatible theory) when the ship decides to run through the light generated by the distant neutron star, the glass block and the atom, all three signal streams ought to shift by precisely the same amount, because the light itself doesn't care where it came from.

So, if the velocity blueshift for the neutron star is /different/ from that predicted by SR, the shifts on the other objects (and probably, any sort of object whatsoever) ought to depart from the SR predictions by precisely the same amount, for a given velocity. If SR is not valid for the star, it is apparently also not valid for any other form of emitting particulate matter in our universe.

End of theory.

So unless anyone can find a real flaw in the gravity-dragging arguments (and I don't just mean saying that they have to be negligible because we know SR is right), or can come up with a brand new way of deriving the SR "relativistic Doppler" relationships in the context of a theory that allows all moving objects to significantly drag light in their immediate vicinities, then we seem to have lost not just the geometrical basis of SR, but also the theory's numerical predictions, for any form of moving matter. Which leaves us with the perplexing problem of what to put in SR's place if we no longer have any obvious rules to tell us what shape the metric is when it contains objects with high relative velocities.

When I tried to tackle this some years back, I fully expected to be recreating the SR relationships. The question that I put myself was: if moving objects drag light, and we have a hypothetical theory of relativity that incorporates this effect, and the theory has to reduce down to Newtonian theory as a limiting case, then what is the minimal modification that we need to make to NM to get it to fit a curved metric and get this model to work.

I then expected to find (and be able to prove) that the minimal modifications to NM would be the same Lorentz relationships and Lorentz redefinitions used by SR.

Instead I found that in the curved-metric context the original NM emission-theory Doppler relationships didn't seem to need any

modifications at all, thank-you-very-much, and seemed to be very happy just the way that they were.

So I tried for a few months to crack the NM set and prove that they couldn't work, and I couldn't (I later found that Einstein had also seemingly tried for years and failed).

So I gave up, and decided instead to sneak a peek at the experimental evidence to see how the experimenters had managed to rule out the NM set by experiment.

And I found that they hadn't.

The NM set were typically ruled out by saying that we "know" that spacetime is flat, and that lightspeed is fixed wrt the observer, so the NM set are automatically wrong, and don't have to be tested for. So then I started going through all the relationships and effects that I'd been told were unique to the SR set, like  $E=mc^2$ , and transverse redshift effects, and found that they were all present in the NM-based model as well.

I then went through every theoretical and experimental proof of SR's superiority to classical theory that I could find, but when you took away the assumption of flat spacetime, the number of successful arguments or results on this subject seemed to be zero. On this one topic, the conventional disproofs of "non-SR" theory seemed to have a 100% failure rate.

So I figure ... maybe SR is simply geometrically and numerically wrong, and maybe the correct energy and momentum relationships are the NM set that SR supposedly made obsolete.

Maybe instead of modifying NM to make it compatible with flat spacetime (to produce SR), and then extending some of the results of SR to produce a third-generation theory (GR), and then appending QM effects onto GR to force it to come into agreement with QM ... perhaps all we had to do back at "stage 1" was to modify the metric to make it compatible with NM, and then declare the thing finished.

If all relative motion between particles warps the metric, perhaps curvature is an intrinsic part of conventional inertial physics, and provides the mechanism for local lightspeed constancy, and perhaps the declared domain of validity of SR, "non-gravitational physics", is an empty set.

Perhaps there's simply no such thing as non-gravitational physics.

It's something to think about, anyway.

=Erk= (Eric Baird)

: " We are all agreed that your theory is crazy. The question which divides us  
: is whether it is crazy enough to have a chance of being correct. "

: -- Niels Bohri