Re: Accelerating rocket/light beam question

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Daryl McCullough wrote:

[...]

I hope you don't mind my snipping all of the above, but I think
answering what you have below will clarify my point.

> Let me try one more attempt. Suppose that at time t=0, we have
> the following situation: (Let's switch from rockets to cars
> to make it more concrete)
>
> 1. There is a car in the rear traveling at velocity −v
> (so it's traveling in the negative x−direction).
>
> 2. There is a car in the front traveling at velocity +v
> (so it's traveling in the positive x−direction).
>
> 3. There is a string connecting the two cars. We'll
> assume that the center of the string is at rest, while
> the front of the string is being pulled in the +x direction,
> and the rear of the string is being pulled in the −x direction.
>
> Wouldn't you expect that the string would be stressed, in such
> a situation?
>
> This doesn't have to be a purely theoretical issue.
> You can try it out yourself: Take two cars, and have one car
> traveling at speed 10 miles per hour along a road, and have
> the other car traveling at speed 10 miles per hour in the
> opposite direction. Try it yourself: the string will break.

Of course, but that has nothing to do with the situation we're discussing.

> Now, let's put some acceleration in. Suppose that both
> cars are undergoing identical acceleration. The front car
> is accelerating in the +x direction, so that its speed is

> increasing, while the rear car is accelerating in the +x
> direction so that its speed is decreasing. Their rates
> of acceleration are the same (so that the relative
> velocity remains 2v). In that case, do you think the
> string will break? Try it for yourself. It will.

Sure, but this doesn't have anything to do with the situation we're discussing, either.

Think, for a moment, about a system consisting of two rockets B and C with a string S connecting them. If the system undergoes a Lorentz contraction, due to a Lorentz transformation, it might look something like this.

B S C
Rockets+string at rest: −−−−−−−−−>.....−−−−−−−−−>

B S C
Rockets+string in motion: −−−−−>.....−−−−−>

Neither the rockets nor the string are stressed. The same is true if the system undergoes an _expansion_, due to a coordinate transformation, like this.

B S C
Rockets+string at rest: −−−−−>.....−−−−−>

B S C
Rockets+string in motion: −−−−−−−−−>.....−−−−−−−−−>

Again, neither the rockets nor the string are stressed.

You can kind of look at it like this. Make a drawing of two rockets connected by a string. Hold the plane of the drawing perpendicular to your line of sight, with the rockets pointing horizontally. That's the system of rockets+string, at rest. Now rotate the drawing around a vertical axis, so that it makes an acute angle with your line of sight. This perspective view of the rockets+string system would represent the contracted system in motion. Does the contraction result in stress to the rockets or string? Of course not.

Now imagine that the drawing, rotated at the acute angle, is the system at rest. Turn it back to its original position, so that it is again perpendicular to your line of sight. It now represents the expanded rockets+string system in motion. Does that mean that the rockets or string are stressed, or that the string breaks? Again, the answer is no.

Although this is not an exact analogy, I think it emphasizes that contractions or expansions, due to coordinate transformations, are closer to an optical illusion than a physical compressing or stretching due to a force (which would result in stresses).

> So after you've tried it out, let's assume the following fact about cars and strings: Let F be the frame of your cars.
>
> 1. Fact: If in frame F, two cars have equal and opposite velocities, and they are accelerating in such a way that their separation speed remains constant, then a string stretched between them will eventually break.
>
> 2. Assumption: Applying the relativity principle, we conclude that for *any* inertial frame F', if two cars have equal and opposite velocities, and there is a string stretched between them, then the string will eventually break.
>
> 3. Fact: According to the Lorentz transforms, if two cars are undergoing identical acceleration from rest in frame F, then at a later time, let F' be some frame in which the point on the string halfway between the two cars is momentarily at rest. Then in frame F', the two cars are traveling in opposite directions. So by assumption 2, the string will break in frame F'.

Your cars+string system is not equivalent to the rockets+string system. The fundamental difference between your system and the rockets+string system is that, in your system, no comoving inertial frame can be found, in which your system is momentarily at rest.

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"New Transformation Equations and the Electric Field Four−vector"
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Applications:
"4/3 Problem Resolution"
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