

Re: Are SR effects real or not? Simplified case.

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Uncle Ben says...

Tom Roberts <tjroberts...@xxxxxxxxxxxxxxxx> wrote:

If you never discussed "physical length", or "real length", but always said "projected length" or "measured length", I doubt very much that Einstein (or anybody else) would object to the result.

What's wrong with being precise in terminology?

Tom Roberts

IMHO, it's not being precise. It's being wishy-washy.

How is it being wishy-washy?

Length of a moving object is perfectly well defined. You mark the coordinates of the two ends at the same time.

And how is "at the same time" determined?

I think that you mean that if you have *already* set up a coordinate system, then the length of an object relative to that coordinate system is well-defined.

What you are trying to do is to preserve a pre-relativistic idea.

How in the world is he doing that? He's *rejecting* the

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pre-relativistic idea of "length" as not being meaningful.

That's attractive and comforting. The thing is, relativity is uncomfortable to common sense. But we need to get used to it, not to dodge it.

Once again, this has to do with two different ways of understanding special relativity. One way is to focus on relative quantities that have different values in different coordinate systems, and the other way is to focus on covariant quantities that have the same meaning in any coordinate system. The latter is really the more modern approach, and is more convenient to use for General Relativity.

If you want to concentrate on the *real* differences between Newton's physics and Einstein's physics, I think that the coordinate-dependent approach is *not* the best way. People always argue about whether coordinate-dependent effects are "real" or just an artifact of using a weird coordinate system. (For instance, you have the various cranks complaining about Einstein's synchronization procedure.) The real differences between Newton's physics and Einstein's physics is in terms of experiments: If you do X, then Y will happen, according to Einstein, while Newton predicts Z will happen. The Bell paradox is a good example.

People, even physicists, may have a hard time with it, but as far as we can tell, moving objects do shrink; moving clocks run slow, but only w.r.t. the frame of reference in which they are moving.

I don't believe that is the best way to think about it. The problem with the statement "moving objects shrink" or "moving clocks run slow" is that they are *only* true if you set up your coordinate system in a particular way. Yes, the conventions used by Einstein are particularly convenient for Special Relativity (but *not* General Relativity), but they are still just conventions. The beauty of expressing the laws of physics in covariant form is that then the predicted results are completely independent of what conventions you use to set up a coordinate system.

There are four intertwined concepts that *cannot* be untangled without adopting a convention, and those are: (1) clock synchronization, (2) the rate of a moving clock, (3) the velocity of moving objects, and (4) the length of moving objects.

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To measure the length of an object, you can do two things: (A) You can note the location of the two ends of the object at a specific time, but that requires clock synchronization. (B) You can time how long it takes for the object to pass a single point (that is, how long between the time the front passes and the time the rear passes), but that requires that you can measure velocities accurately.

So how do you measure velocities? Well, you can use radar, and measure the Doppler shift, but that assumes that you already know the velocity of the radar signal. You can note the time that it takes for the object to pass between two points, but that assumes that you already have a means to synchronize clocks.

So how do you synchronize clocks? You can bring the clocks together, set them to the same value, and then bring them back to their original locations, but that assumes that the act of transporting the clock doesn't affect its synchronization. Alternatively, you can use light signals (or any other communication mechanism relying on a known velocity) to synchronize distant clocks, but that assumes that you already know the velocity of light (or whatever synchronization signal you are using).

The four different concepts are inherently circular in their definitions. To break out of the circularity, something has to be true "by definition". Einstein boldly proposed that light always has the same constant speed, which simplified his analysis, but it is still just a *definition*. The physical content of Special Relativity does not depend on that definition.

The rate of a clock is defined relative to a frame of reference, no matter what your intuition tells you. Try to get used to it.

More precisely, it is defined relative to a convention for how clocks are synchronized and how velocities are measured, etc.

—
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