Re: SR Length Contraction − how do physicists explain this

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From: jem (*xxx_at_xxx.xxx*)
Date: 12/01/04

Date: Wed, 01 Dec 2004 08:31:45 −0500

dseppala@austin.rr.com wrote:
> On Tue, 30 Nov 2004 08:35:59 −0500, jem <xxx@xxx.xxx> wrote:
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>>dseppala@austin.rr.com wrote:
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>>>On Mon, 29 Nov 2004 08:22:47 −0500, jem <xxx@xxx.xxx> wrote:
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>>>>dseppala@austin.rr.com wrote:
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>>>>>On Sun, 28 Nov 2004 08:11:28 −0500, jem <xxx@xxx.xxx> wrote:
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>>>>>>dseppala@austin.rr.com wrote:
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>>>>>>
>>>>>>>Do you agree that a stretched rod has a different amount of energy
>>>>>>>than an identical rod with zero relative velocity that isn't
>>>>>>>stretched?
>>>>>>
>>>>>>If the stretched rod requires external force to maintain its shape (and
>>>>>>the unstretched rod doesn't), then yes.
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>>>>>>>Do you agree that SR leads to situations in which a rod remains the

>>>>>>>same length in one frame and no stretching occurs, while another frame
>>>>>>>measures the length of the same rod to increase, and to change shape?
>>>>>>
>>>>>>No. Changes to the rod don't occur in one reference frame but not in
>>>>>>another. Changes to the rod either occur or they don't occur, period.
>>>>>>
>>>>>>Consider the situation, discussed in this thread, where the rod is
>>>>>>accelerated so that observers in the rod's original FOR measure no
>>>>>>change in its length as it moves. These observers realize that the rod
>>>>>>is being stretched, since otherwise their measurements of its length
>>>>>>would be decreasing.
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>>>>>>>(See my response to Tom Roberts in this thread regarding the rotating
>>>>>>>cylinder)
>>>>>>
>>>>>>I don't know how you figure that attaching the rod to a rotating
>>>>>>cylinder will cause it to stretch, but the point I've been trying to
>>>>>>make to you is that it doesn't matter what causes the rod to deform,
>>>>>>since that aspect isn't addressed by SR. SR deals only with how the rod
>>>>>>will be measured from different perspectives subsequent to its deformation.
>>>>>
>>>>>Your comment that changes in the rod occur in one reference frame but
>>>>>not in another is what I believe, but I couldn't make that notion
>>>>>true with Einstein's theory (shown in the rotating cylinder problem I
>>>>>posted a couple of years ago.) Here's the situation.
>>>>> For simplicity, lets consider a rod that is a single row of atoms
>>>>>connected together in a strait line, of length L, positioned along the
>>>>>y−axis. And consider a rotating cylinder of length L whose
>>>>>longitudinal access is also on the y−axis. Let the rod be just above
>>>>>the rotating surface of the cylinder, and let the end points of the
>>>>>rod and cylinder share the same y coordinates. At time t0, we attach
>>>>>all points of the rod to the surface of the cylinder along the y−axis.
>>>>>The rod rotates in conjunction with the surface of the cylinder its
>>>>>on, but the length of the rod remains L. It doesn't stretch as
>>>>>measured by observers in this rest frame, nor does it change shape.
>>>>>And if we have an inertial frame, moving in x direction with velocity
>>>>>V wrt to this frame, they also agree that the rod doesn't stretch.
>>>>>Observers in this moving frame, agree the length of the rod remains L
>>>>>and the length of the rotating cylinder remains L.
>>>>> However, repeat this same experiment with the rod and rotating
>>>>>cylinder oriented with their longitudinal axes along the x−direction,
>>>>>instead of the y direction. Again, observers in the rest frame say
>>>>>the rod did not stretch when it was attached to the rotating cylinder.
>>>>>However, this is not the case for observers moving with velocity V
>>>>>along the x−axis. In that moving frame, the two end points of the rod
>>>>>were attached to the rotating cylinder at different times as measured
>>>>>in their frame. The attached rod is no longer a straight rod. It

>>>>>curves around the surface of the cylinder as measured in this moving
>>>>>frame. The length of the rod must be longer than L. The rotating
>>>>>cylinder did not change length, but the attached rod now spans a
>>>>>distance greater than the length of the rotating cylinder as measured
>>>>>in the moving frame, but not as measured in the original rest frame.
>>>>>The two frames do not agree on whether the rod was stretched or not.
>>>>>David
>>>>>
>>>>>
>>>>
>>>>OK I get the picture. Let's make the assumption that nothing remarkable
>>>>happens to the rotating rod or cylinder (e.g. they don't become
>>>>separated or break). Then you're right, the length of the rod as
>>>>measured by a horizontally moving observer would exceed the length of
>>>>the cylinder, but that's to be expected, since the velocity component of
>>>>the rod in the direction of its length has been reduced (due to the
>>>>non−simultaneous attachment of rod and cylinder from the pov of the
>>>>moving observer).
>>>>
>>>>The rotation does introduce transverse stresses in the rod, but there's
>>>>no longitudinal force acting to lengthen it.
>>>>
>>>>Consider the simpler siruation in which a horizontal rod is
>>>>simultaneously attached to the sides of a vertically moving elevator.
>>>>In this case, even though one end of the rod is attached before the
>>>>other end (from the pov of a horiontally moving observer), the rod
>>>>doesn't stretch.
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>>>
>>>I don't follow why you say it isn't stretched. One end of the rod is
>>>accelerating while the other end is not. Its length is different than
>>>that of an identical rod that is not attached to the vertically moving
>>>elevator. I don't know know what you mean when you say the rod
>>>doesn't stretch since its longer than its identical unattached twin.
>>>Can you clarify in real simple terms why you say its not stretched?
>>
>>Suppose an observer is moving along the length of a rod, and then
>>changes direction. The observer will measure the length of the rod to
>>increase (since the SR length contraction factor will be reduced). Is
>>the rod being stretched? If you answer that it is, ask yourself how the
>>observer's motion could affect the rod.
>>
>>This is the sense in which the rod attached to the sides of the elevator
>>is changing its length − the direction from which the moving observer is
>>viewing it is changing.
>>
>>Suppose you go to a baseball game and sit behind home plate. Later, if
>>you run into someone who sat in the outfield bleachers, you wouldn't
>>think to ask "what was the score from where you watched the game", would
>>you? Same thing here − whether the rod stretches or not doesn't depend
>>on the perspective from which it's viewed.

>
> *In this response, the way you presented thingsin your eaxmples, the*
> *change in length doesn't indicate the rod is stretched. The length*
> *change is indeed just a measurement consequence of Einstein's theory*
> *in your examples. But attaching the rod to a vertically moving*
> *elevator, or to a rotating cylinder is something different. In both*
> *these cases its not a measurment phenomena that is occurring. Instead*
> *a force is being exerted on one end of the rod and not the other.*
> *That results in stretching.*

Yes well, because in the real world there are no absolutely rigid rods, some stretching actually would occur, and it would be observed from *every* FOR. The amount of stretching would depend in complicated ways on the materials involved, the dimensions of the rod, and the forces applied to the rod, but it's completely irrelevant for understanding the relativistic effects in these examples.

Although the stretching aspect isn't relevant, you seem to have a misconception regarding it. I think you're willing to assume (e.g. in the case of the elevator) that no stretching occurs in the elevator FOR, but you believe that stretching does occur when viewed from reference frames that are in motion wrt the elevator. Is that right?

If so, picture a person in the elevator holding an idential (but unattached) rod right next to the attached rod. From the pov of a horizontally moving observer, these essentially coincidental rods have to be viewed the same. So what causes the unattached rod to stretch?