Re: Einstein's math and physical objects

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From: Todd (*nope_at_nospam.com*)
Date: 01/09/05

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Date: Sun, 09 Jan 2005 03:53:41 GMT
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−−−−− Original Message −−−−−

From: <dseppala@austin.rr.com>

Newsgroups: sci.physics.relativity

Sent: Saturday, January 08, 2005 5:59 PM

Subject: Re: Einstein's math and physical objects

> On Thu, 06 Jan 2005 02:55:59 GMT, "Todd" <nope@nospam.com> wrote:
>
>>
>>"Todd" <nope@nospam.com> wrote in message
>>news:j3WCd.282655$5K2.75608@attbi_s03...
>>>
>>> Now imagine that somehow the cylinder is accelerated along the x−axis
>>> such
>>> that each point of the cylinder has identical acceleration relative to
>>> the
>>> earth frame for the same amount of time (relative to the earth frame).
>>> This will cause tensile stress to build up in the cylinder, ...
>>
*>>Not just tensile stress, but also *torsional* stress. After all, the*
>>cylinder will now be 'twisted' (as well as stretched) in its own rest
>>frame.
>>
>>That's kind of neat − a twisted version of the Bell spaceship 'paradox'!
>>
>>Todd
>>
> If we are in a frame that has zero velocity wrt to the disks and the
> wires are attached and stretched as described in my original post ,
> you must agree if the disks aren't rotating that the wires will cross
> (touch) if the relative rotation angle of the two disks is 180
> degrees. Its real easy to do this experiment with short wires or
> rubber bands.

I agree that the wires must touch in the case where the disks aren't rotating.

>Furthermore, if the disks are rotating, and the disks
> develop a relative rotation angle of 180 degrees or more, the two
> wires will cross just as they did in the case where the disks are not
> rotating. This too can be confirmed by experiment. The wires cross
> because if they are stretched, they try to follow the shortest
> connection path between the two disks. This steady−state condition
> may take awhile to achieve if the wires are long, but each wire will
> eventually take the shortest path connecting its two attachment
> points. When this occurs the wires will cross. And for each 180
> degrees of relative rotation angle between the disks, the wires will
> wrap around each other.
>
> In the problem I posted, the situation that I just described in the
> previous paragraph is the situation that occurs when the acceleration
> of the disks has stopped. The two disks have a relative rotation
> angle greater than 180 degrees, and the wires are stretched between
> the two disks. Therefore, as we know from experiments, the two wires
> must cross when a steady−state condition is achieved. But observers
> in the original reference frame never observe these wires crossing
> each other and wrapping around each other as they must do in the final
> reference frame. The only way the wires get "braided" is by having
> the relative rotation angle 180 degrees or greater. This never occurs
> in the original reference frame. Einstein's notions of space and time
> seem to lead to a physically impossible situation.
>
> Several people who posted a response think that the wires remain as if
> they were on the surface of a cylinder before, during and after the
> acceleration as viewed by observers in the final reference frame.
> This cannot be because Einstein's theory actually requires a physical
> stretching of the wires during the acceleration because the two disks
> are accelerated in an identical fashion as measured in the original
> reference frame.
> David

I don't agree with this. When the disks are rotating the wires will not be able to take the shortest path. A flexible string that is under tension and also accelerating will assume a shape such that the tension forces acting on the ends of any infinitesimal segment of the string provide the necessary force to accelerate that segment. For example, a jump rope assumes sort of a revolving 'parabolic' path between the hands of the children holding the ends of the rope. Even though the rope has tension it does not assume the shortest path between the points of attachment. The curvature of the 'parabolic' path is needed so that the tension forces acting at the ends of any small segment of the rope provide the centripetal force on that segment as it moves in a circle.

In your apparatus with the disks I believe that in the final rest frame (after the acceleration) the wires will assume a rotating helix shape such that any segment of either wire will have an acceleration that is in accord with the laws of (relativistic) mechanics. Of course I haven't done the calculation, but that is what I believe will be true. If you assume the wires are flexible strings, then in the original frame before the acceleration, the strings would have to bow outward somewhat (like the jump rope) as the disks rotate. The amount of bowing, however, can be reduced to a very small amount by having lots of tension in the strings. If this outward bowing can be neglected, then in the final rest frame the strings would wind around a cylinder − they would not cross or touch.

It's sort of like taking a rope, stretching it out, and then moving one end rapidly in a circle so that a helical ('circularly polarized') wave travels down the rope. As this wave travels down the rope, each segment of the rope moves in a circular path. The sum of these circular paths for all segments of the rope can be thought of as forming an imaginary surface of a cylinder that the rope stays on. Thus, it seems possible for a rope with tension to assume a revolving helical shape rather than take the shortest path between the points of attachment.

Todd