Re: Help with SR time dilation

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dseppala_at_austin.rr.com
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On Mon, 07 Feb 2005 03:11:43 GMT, "Todd" <abc@zzz.com> wrote:

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><dseppala@austin.rr.com> wrote in message
>news:4204cc44.146952872@news−server.austin.rr.com...
>> Can anyone please explain the following, supposedly simple, SR problem
>> to me.
>>
>> Let there be two identical water troughs parallel to the x−axis. Let
>> them move in opposite directions along the x−axis with a velocity
>> V=0.866c. Let each water trough have a pump attached to it that
>> pumps 10 liters of water per second, as measured in the frame of the
>> trough that its attached to. The pumps are initially off, and the
>> water troughs are nearly filled with water. At time t0, lets say the
>> the two pumps are at the same x coordinate. At that point in space
>> and time, both pumps are turned on. The pump on trough A pumps water
>> from trough A into trough B, and the the pump on trough B pumps water
>> from trough B into trough A.
>>
>> As viewed from the trough A frame, according to SR, pump B is pumping
>> at half the rate that pump A is pumping. The question I have, is how
>> do observers in frame A explain why trough B never overflows?
>> (We can have a series of pumps, and turn them on as each pump passes a
>> pump on the other trough. This will hopefully minimize posting that
>> have to do with the length of the troughs).
>> Thanks,
>> David Seppala
>
>David,
>
>Your original problem has one pump in frame A and one pump in B. Due to the
>continually increasing distance of separation from the pumps, there is the
>complication that it takes time for the water dumped in the A−trough by pump
>B to spread out and affect the level of the water in the A−trough at the
>location of the A−pump and vice−versa.
>
>For any slice of simultaneity of frame A, there would be more water in
>trough B than in trough A. (But it is difficult to describe how the level

>of the water in each trough depends on the position in the trough because of
>the time it takes the pumped water to spread along the trough.) Likewise,
>for any slice of simultaneity of frame B, there would be more water in
>trough A compared to trough B.
>
>If both pumps are preset to shut off after one hour of time as measured in
>their own frame, then each trough will end up with the same amount of water
>after both pumps shut off. Each frame will claim that the other frame's
>pump shuts off 'late', which is how they can agree that the final amount of
>water is the same in each trough even though they each claimed that the
>other guy's trough was gaining water at a faster rate than their own trough
>while both pumps were running.
>
>Your modified problem has one pump in frame A and a series of pumps in frame
>B so that frame B can always pump water into A at the location of the pump
>in A. Now we could just as well let the trough in frame A be a bucket
>located at the origin of A. The pump in frame A pumps water out of the
>bucket at N gallons per minute according to time as measured in frame A.
>Water in frame B is pumped into the bucket in frame A at a rate of N gallons
>per minute according to time as measured in frame B. Then the question
>would be, what happens to the water level in the bucket? Does it rise,
>sink, or stay the same?
>
>According to frame B, pump A is pumping at less than N gallons per minute.
>This follows from standard 'time dilation'. Thus, observers in B conclude
>that the water level will rise in the bucket (eventually overflowing the
>bucket).

If there is just one pump in each frame, you conclude that for any
slice of simultaneity of frame B, there would be more water in trough
A compared to B. And you say, the amount of water is only equalized
when the pumps shut off, one pump shutting off before the other. So
if we ignore the complication of how the water is distributed in the
trough, you think the water level will rise. If the pumps are
identical, and turned on at the same time and at the same position, I
don't follow why the water level will rise. Can you clarify that
concept for me.
Thanks,
David

>
>What do observers in frame A predict? The mistake that can easily be made
>here is to assume that from the perspective of frame A, 'time dilation'
>requires that the pumps in B are pumping water into the bucket at less than
>N gallons per minute and so the water level should go down! But, in fact,
>this is a wrong conclusion based on a hasty application of the concept of
>'time dilation'.
>
>The standard time dilation formula relates the time between two events as
>measured in two different frames assuming that the events occur at the _same
>place_ in one of the two frames. The time between the events is less for the
>frame where the events occur at the same place. Pump A is always pumping at
>the same place in frame A, so time dilation predicts that frame B observers

>will see the A−pump pumping 'slow' (less than N gallons per minute).
>
>However, the water pumped from B into the bucket in frame A is being pumped
>from different pumps located at different positions in frame B. It is not
>correct, then, to conclude that frame A observers will see the pumps in B as
>pumping slow. In fact, the pumping from B to A takes place at the same
>place in A, not B. The time dilation formula then shows that the pumping
>rate from B to A according to observers in frame A is _greater_ than N
>gallons per minute. Thus, both frames predict that the level of water in
>the bucket will rise.
>
>Todd.
>
>