A thought experiment to test Lorentz symmetry

Following is a simple thought experiment with matching Lorentz transform that clearly breaks Lorentz symmetry…. Or maybe I've just got my numbers wrong.   Questions are at the end.

Keywords: special-relativity, inertial-frames, coordinate-systems, Lorentz-symmetry

Here is the formula for a Lorentz Boost:

If an observer in F records an event t, x, y, z, then an observer in F' records the *same* event with coordinates[11]

Lorentz boost (*x direction*)

$$t' = \gamma\left(t - \frac{vx}{c^2}\right)$$
$$x' = \gamma\left(x - vt\right)$$
$$y' = y$$
$$z' = z$$

where v is the relative velocity between frames in the x-direction, c is the speed of light, and

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

(lowercase gamma) is the Lorentz factor.

Here are the background links describing the phenomena:

Lorentz Transform: https://en.wikipedia.org/wiki/Lorentz_transformation

Lorentz Covariance: https://en.wikipedia.org/wiki/Lorentz_covariance

Minute Physics: Lorentz Transform, Length Contraction and Time Dilation explained: https://www.youtube.com/watch?v=-NN_m2yKAAk

Feynman Lorentz Transform Lecture: http://www.feynmanlectures.caltech.edu/I_15.html

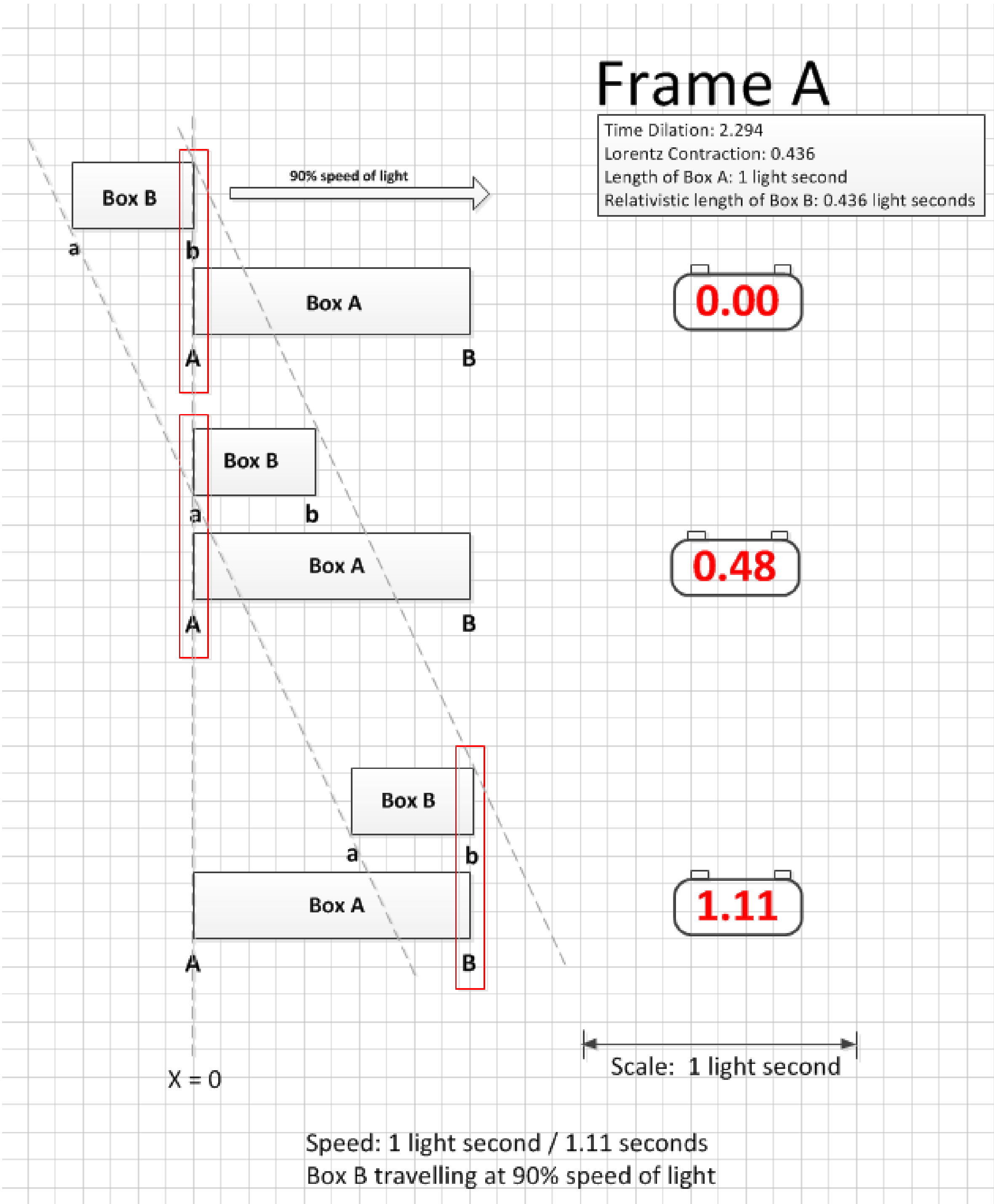
Lorentz Transform Equations: http://www.youtube.com/watch?v=KKAwpEetJ-Q&list=PL3zkZRUI2IyBFAowlUivFbeBh-Mq7HdoQ

Deriving the Lorentz Transformation: https://physics.stackexchange.com/questions/12829/deriving-the-lorentz-transformation

Albert Einstein: The Relativity of Simultaneity: https://www.bartleby.com/173/9.html

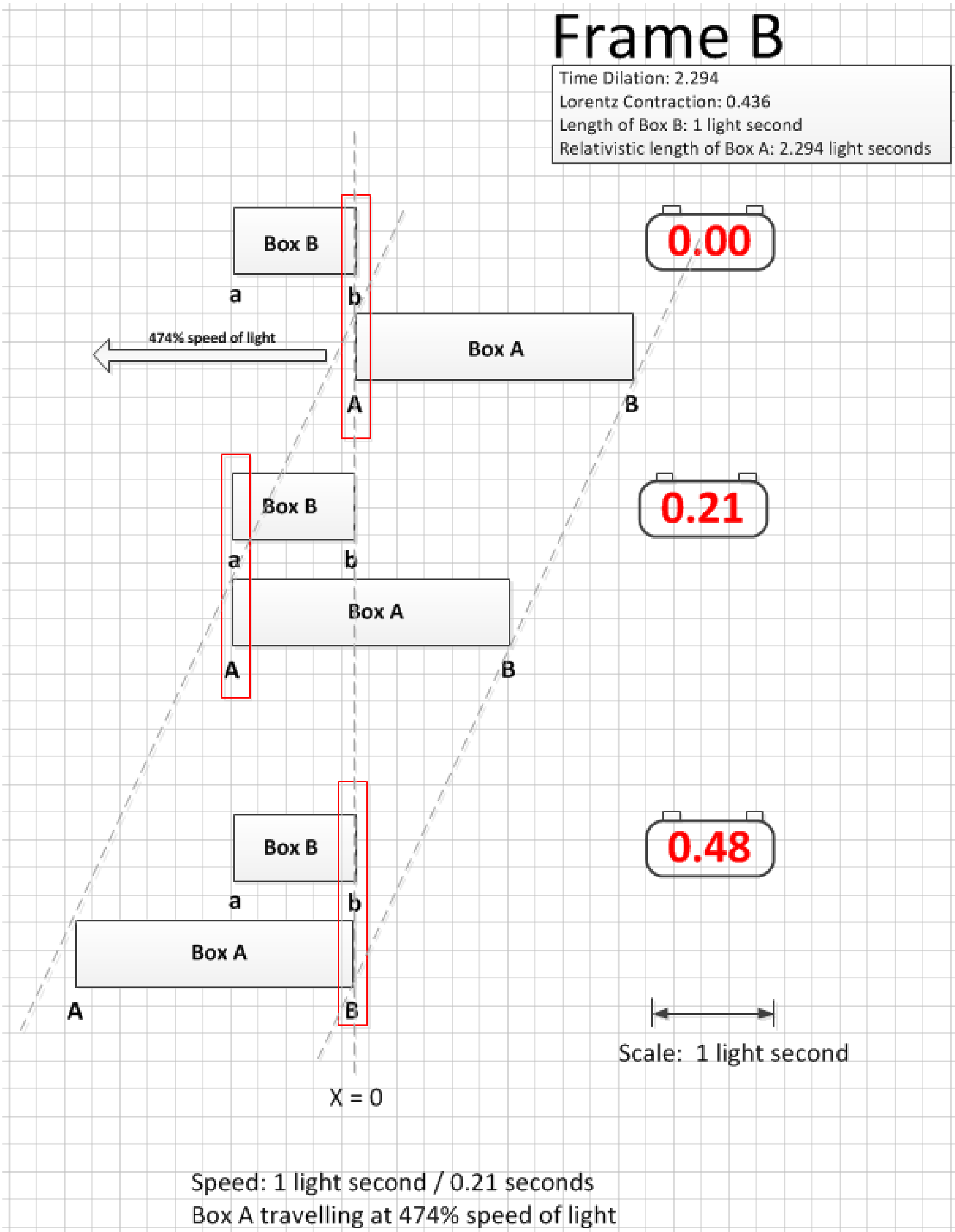
Here's the Setup:

Frame A: Two boxes, Box A and Box B, both 1 light second in length (about the distance from the earth to the moon). Box B is accelerated to 90% the speed of light, and is measured with a stop-watch by Box A as it passes by.



Frame B: Relativity of Simultaneity. Box B is now the fixed frame, and Box A appears to be traveling at 475% the speed of light in the opposite direction (as measured with a stop-watch by Box B).

Note: Stopwatch values taken by Box B are Box A values, divided by the Lorentz Time Dilation factor. Box B time runs slower than Box A time because of relativity.



The Lorentz Transform:

Below, I've constructed a Lorentz transform between Frame A (Box A is not moving), and Frame B (Box B is not moving). The values calculated match the diagrams for the two Frame references (indicating I'm likely close to correct). I used the diagram values to help identify what Lorentz Factor number to use in which formula, and what velocity value to use in each frame.

Fixed values:

c	1	speed of light
vA	0.9	Box B in Frame A is travelling at 90% speed of light
_gamma	2.294	Lorentz Time Dilation Factor for 90%c (inverse compression)
_beta	0.43589	Lorentz Compression Factor for 90%c
absolute	1	Box A and B length at rest (in light seconds)
vB	-4.7368	Box A in Frame B is travelling at 474% speed of light
x	0	?? no idea what value of x to use in t' calculation

Calculation table: Left columns are the diagram values. Right columns are the Lorentz Transform calculated numbers. The Lorentz transform numbers appear to match the diagram values.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Frame A											
2		Visual x position in Frame A						Lorentz Transform values for Frame B				
3		Seconds	A	B	a	b		t'	A'	B'	a'	b'
4		0.000	0.000	1.000	-0.436	0.000		0.000	0.000	2.294	-1.000	0.000
5		0.484	0.000	1.000	0.000	0.436		0.211	-1.000	1.294	-1.000	0.000
6		1.111	0.000	1.000	0.564	1.000		0.484	-2.294	0.000	-1.000	0.000
7												
8												
9	Frame B											
10		Visual x position in Frame B						Lorentz Transform values for Frame A				
11		Seconds	A	B	a	b		t'	A'	B'	a'	b'
12		0.000	0.000	2.294	-1.000	0.000		0.000	0.000	1.000	-0.436	0.000
13		0.211	-1.000	1.294	-1.000	0.000		0.484	0.000	1.000	0.000	0.436
14		0.484	-2.294	0.000	-1.000	0.000		1.111	0.000	1.000	0.564	1.000

Lorentz Transform from Frame A to Frame B:	Lorentz Transform from Frame B to Frame A:
t' = _beta * t x' = _gamma*(x-0.9t)	t' = _gamma * t x' = _beta*(x-4.74t)

_beta = 0.436 _gamma = 2.294

For reference, here are the actual spreadsheet formulas I used to calculate the Lorentz Transform table:

H	I	J	K	L
Lorentz Transform values for Frame B				
t'	**A'**	**B'**	**a'**	**b'**
=_beta*(B4)	=_gamma*(C4-vB*$B4)	=_gamma*(D4-vB*$B4)	=_gamma*(E4-vB*$B4)	=_gamma*(F4-vB*$B4)
=_beta*(B5)	=_gamma*(C5-vB*$B5)	=_gamma*(D5-vB*$B5)	=_gamma*(E5-vB*$B5)	=_gamma*(F5-vB*$B5)
=_beta*(B6)	=_gamma*(C6-vB*$B6)	=_gamma*(D6-vB*$B6)	=_gamma*(E6-vB*$B6)	=_gamma*(F6-vB*$B6)
Lorentz Transform values for Frame A				
t'	**A'**	**B'**	**a'**	**b'**
=_gamma*(B12)	=_beta*(C12-vA*$B12)	=_beta*(D12-vA*$B12)	=_beta*(E12-vA*$B12)	=_beta*(F12-vA*$B12)
=_gamma*(B13)	=_beta*(C13-vA*$B13)	=_beta*(D13-vA*$B13)	=_beta*(E13-vA*$B13)	=_beta*(F13-vA*$B13)
=_gamma*(B14)	=_beta*(C14-vA*$B14)	=_beta*(D14-vA*$B14)	=_beta*(E14-vA*$B14)	=_beta*(F14-vA*$B14)

Notes:

To get the transform numbers to match the diagram, in some cases I use beta (Lorentz Compression factor = 0.4359), and in other cases I use gamma (Lorentz Time Dilation factor = 2.294).

For Frame A I used a velocity value of 90% of the speed of light (vA). For Frame B, I had to use a velocity value of -474% the speed of light (vB). From the diagram, the 474% number appears to be correct, and the transformation appears to match the numbers on the diagram.

When calculating **t'**, the formula requires a value for ***x***. That would imply a different time value for each end of the moving box. As ***x*** approaches 1, there is a significant decrease in ***t'***, which intuitively does not make any sense to me. After some research, (Feynman lectures), my understanding is that the **x** adjustment was put there to account for clock synchronization issues. Accordingly, for the purpose of this discussion, I've assumed that the fore and aft clocks are synchronized (advanced technology has solved that problem), and have set **x** to be 0.

Finally, here are my questions:

1) From the perspective of Box B's frame of reference, the leading edge of Box A travels 1 light second in 0.21 seconds, or 474% the speed of light. That can't be right…. That is faster than light travel. Doesn't this break Lorentz symmetry? What needs to be changed in my logic to get a speed of 90%c in Frame B?

2) There is a well-known Paradox involving a ladder that is travelling at 90% the speed of light, fitting into a garage that is smaller than the ladder, with the reverse simultaneity of a garage travelling at 90% the speed of light in the moving ladder's frame of reference, not being able to

accommodate the ladder.   I don't see this happening. In both Frame A and Frame B, Box B's length is always 0.436 times Box A's length. Does this mean the ladder paradox is solved?

Ladder Paradox: https://en.wikipedia.org/wiki/Ladder_paradox
StackExchange Explanation: https://physics.stackexchange.com/questions/310924/variation-of-ladder-barn-paradox-can-observer-on-ladder-see-that-barn-was-too-s

3) The Frame B Lorentz transforms uses a gamma based on 90% the speed of light to calculate the Lorentz Factor, but uses a velocity based on 474% of light to calculate x'.   Frame A uses 90% both for calculating the Lorentz Factor, and for calculating x'. Why the difference?   Am I missing a basic physics concept that I've failed to incorporate into the diagram?

Thanks to the physics community for taking the time to review my questions.

If someone can point me in the right direction, I'll update the spreadsheet, and post the correct calculations.

The actual spreadsheet can be downloaded from: http://one-way-lightspeed.com