The Problem with the Relativity of Simultaneity

Abstract

Relativity claims that the simultaneity between two (or more) observers, each traveling in different Inertial Reference Frames (IRFs) is such that “Both observers consider the clock of the other as running slower”. This is shown on a Minkowski diagram in the section titled “Time dilation” on the Wikipedia page given in my Reference [2]. However, as I will explain, this interpretation leads to an inconsistency which cannot be true. I point out the error being made in the interpretation of Minkowski diagrams that leads to this inconsistency, and how the diagram should be interpreted to correct this error.

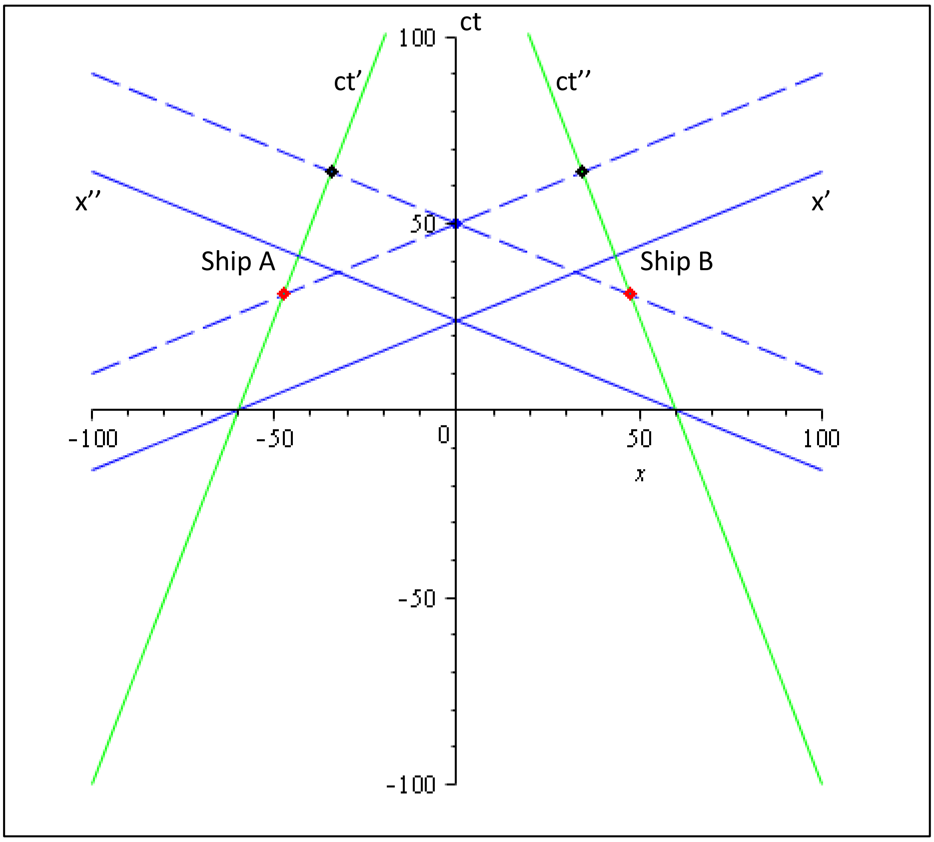

Figure (1)

This diagram (Figure 1) is a Minkowski diagram depicting two spaceships approaching each other at 40% of the speed of light. Ship A is moving from left to right and ship B from right to left. The Black axes are for a stationary observer between ships A and B (y axis is ct, x axis is distance). The Green axes are ct’ and ct’’ respectively and the blue axes are x’ and x’’ respectively. The dashed blue lines are parallel to x’ and x’’ and are lines of simultaneity for each of the ships (A and B). These dashed lines pass through an event on the stationary observer’s ct axis (at coordinates 0,50), where the event is indicated by a blue dot.

Introduction

Relativity would have you believe that where the lines of simultaneity of ships A and B pass through the other ships ct axis (indicated by Black dots) indicate what time on the other ship (B and A) is simultaneous with the first ships ct intersect is. Therefore, so Relativity claims, ship A observes a different time on ship B, and vice-versa. However, it is easy to prove that this interpretation is wrong: If each of the three observers (ship A, ship B and the stationary observer in the middle) send signals to each other indicating their own current time, then each of the signals form ship A and ship B arrive at the event on the stationary observer's ct axis (indicated by a blue dot).

Simultaneously, the stationary observer's time signal travels from the blue dot to each of ships A and B ct axes (indicated by the Red dots). As all three of these points are connected by lines of simultaneity, all readings correspond to the same moment (although each observers clock may show a different time). Each ship sends its current time to the observer at the Blue dot and he displays the times on a screen visible to each ship, each ship sees the screen at a time simultaneous with its Red dot. So, as the Red dot points are simultaneous with the blue dot event on the stationary observer's ct axis, the Black dot points CANNOT also be simultaneous with these events as Relativity claims.

So, to correctly determine the time that is simultaneous on ship A from ship B's point of view (and vice-versa), one must follow the dashed blue line of simultaneity from ship B up to the point where it intersects with ship A's line of simultaneity (the other dashed Blue line) - one could draw a stationary IRF (drawn on the diagram as orthogonal x and ct axes) at this point. Then one must follow ship A's line of simultaneity until it intersects with ship A's ct axis.

Determining signal emission times

Analysing this situation with actual light signals, which take time to propagate, means that on reception of a signal by an observer, he must apply a correction to the arrival time in order to determine what the emission time (in his own reference frame) was. As the Minkowski diagram is drawn from the point of view of the stationary observer, he must take his own motion into consideration in order to apply the correction properly. First, he must determine the travel time of the light signal (as determined from the Minkowski diagram using the stationary observer's axes).

As the light signal travels at 45 degrees in any IRF on a Minkowski diagram, the observer on Ship B simply traces the light path back in time until it intersects the known trajectory of Ship A. This point must then indicate where and when the light signal was emitted. Then he must determine the distance on the Minkowski diagram (drawn from the stationary observer's perspective) to trace back along his ct axis. This can be done by multiplying the time interval dt by the length along his ct axis corresponding to one unit of time on the stationary observer's ct axis (h_B, the length of the hypotenuse of a triangle with side lengths of 1 and β).

To determine his actual time at the moment the light signal was emitted, he must divide the distance along his ct axis (just determined) by the unit time length on his ct axis (given by U). For moving inertial reference frames, U will be greater than 1. Once this is done, he must subtract this result from his measured light arrival time in order to know what his own time was when the light was emitted.

The time correction to determine Ship B's time is:

$$\Delta t = -\frac{h_B \cdot dt}{U_B} = -\frac{dt}{\gamma}$$

Where:

dt is the travel time of the light signal (using the stationary observer's axes).

B refers to values for the observer of the light signal.

h_B refers to the length of the hypotenuse of a triangle with side lengths of 1 and β.

$$\beta = \frac{v}{c}$$

$$h_B = \sqrt{1+\beta^2}$$

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

$$U_B = h_B \cdot \gamma = \sqrt{\frac{1+\beta^2}{1-\beta^2}}$$

Note: For source and destination reference frames that have different non-zero speeds, in order to map from one to the other and get the correct distance to move back along the observer's ct axis, one must account for the time shift from one IRF coordinate system (the origin of the signal) and another IRF coordinate system (the observer's frame). This difference is due to the difference in the angles of each frame's x axis (due to their different speeds), thus the different points at which each intersects with the stationary observer's ct axis. So, to map from one IRF to another on the Minkowski diagram, the dt value used in the above equations must have this mapping adjustment t_{AB} added to it:

If $\beta_A \neq 0 \quad and \quad \beta_B \neq 0$

$$t_{AB} = (|\beta_B| - |\beta_A|) \cdot |x_B - x_A|$$

Where: x is the distance from the origin along the x axis
A refers to the sender of the signal
B refers to the observer of the signal

Thus, the full form of the time correction equation is:

$$\Delta t = -\frac{h_B \cdot (dt + t_{AB})}{U_B} = -\frac{dt + (|\beta_B| - |\beta_A|) \cdot |x_B - x_A|}{\gamma}$$

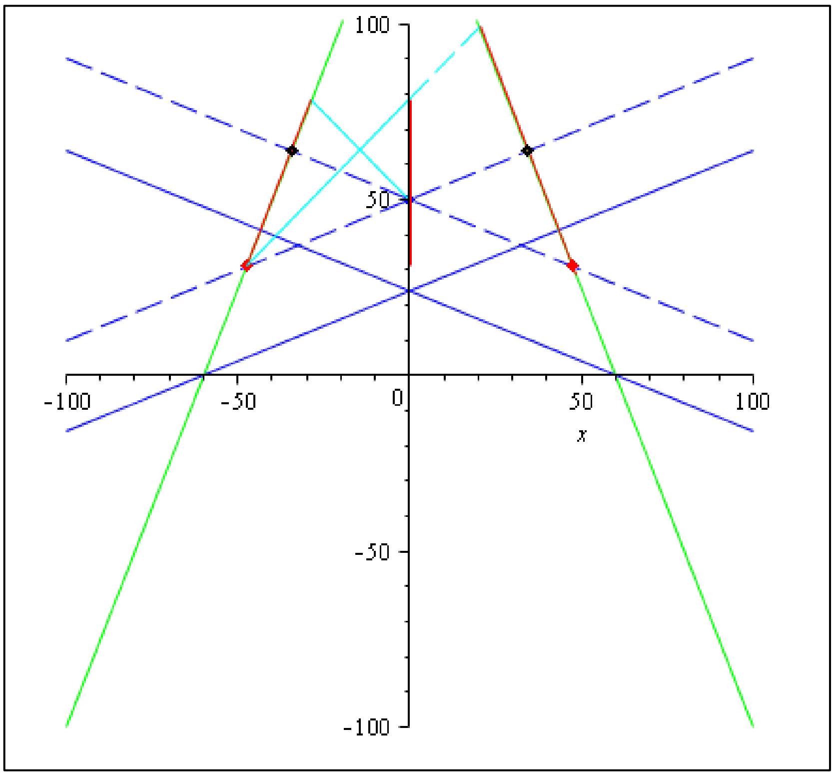

Figure (2)

This diagram shows two light signals (in Cyan). One from Ship A to the stationary observer at coordinate (0,50), and another from the stationary observer to Ship A. Also shown in Red is the correction made by each observer to the time of the received light signal, such that he can determine when the signal was sent. Also shown is the light signal from Ship A continuing to reach Ship B after passing the stationary observer (dashed cyan line). Then on Ship B's ct axis he applies his time correction for the entire travel time of the light signal (the time to go from Ship A to the stationary observer, plus the time to go on from there to Ship B's ct axis). As you can see, the observer on Ship B determines that the time on Ship A is the same as his own.

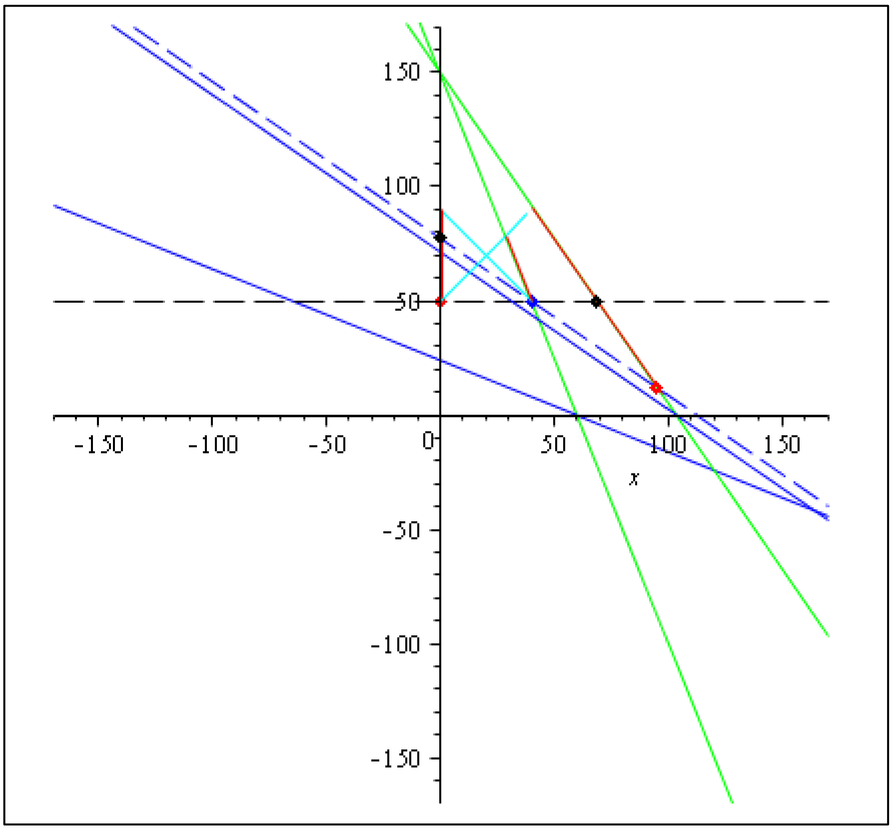

Figure (3)

This diagram shows the same information as in Figure (2) but re-drawn from the point of view of Ship A (Ship A's Inertial Reference Frame).

Discussion

Furthermore, if the claim is made that the different time observed from one ship to the other are just what is OBSERVED rather than ‘real’ time differences, then that too is incorrect as the lines of simultaneity depict actual simultaneity of events and there is no propagation delay due to the travel time of light included in the diagram. For the difference in time to be just an observational difference one would have to explain the difference between observed time and actual time to be due to the time taken for the light signal to travel from one ship to the other., but I have just shown that even if real light signals are used, both ships determine that their times, and rates of time are the same.

The rate of time of each IRF (relative to the observer's IRF) can be determined, even without clock synchronization, by comparison of two or more readings of the other's times over a known local time interval in the observer's IRF. If this is done, then ship A's observer will see the same rate of time (as his own) on ship B.

So, if ship A & B can determine that they have the same rate of time when they move towards or away from each other at the same speed through the space/medium field, then they are free to move together until they are both at a point on the Black ct axis. Their respective times on their clocks at that point provides each with a reference point to which they can calibrate all the time observations they have made and continue to make on their journey towards & away from each other. After synchronizing their clocks to the same time, they then continue past each other whilst observing each other's time continually. They will then deduce that the red dots are simultaneous, not one Red and one Black dot.

PROOF THAT SHIP A & B TIMES ARE AT THE SAME RATE USING THE LORENTZ TRANSFORMATIONS:

That Ship A and B have the same rate of time is easily proved using the Lorentz Transformations:

Transforming each ship to the IRF of the central observer, then eliminating the central IRF by substituting one LT into the other:

Note:

For Ship A (single primed ') :   v is positive, Δx is negative

For Ship B (double primed '') :   v is negative, Δx is positive

For Time:

$\Delta t' = \gamma[\Delta t - v/c^2 (-\Delta x)]$ (1)

$\Delta t'' = \gamma[\Delta t - (-v)/c^2 \Delta x]$ (2)

$\Delta t = \Delta t''/\gamma - v/c^2 \Delta x$

$\Delta t' = \gamma[(\Delta t''/\gamma - v/c^2 \Delta x) + v/c^2 \Delta x]$

$\Delta t' = \gamma[\Delta t''/\gamma]$

$\Delta t' = \Delta t''$ (3)

Thus, the rate of time for Ship A is the same as for Ship B.

For Space:

$\Delta x' = \gamma(-\Delta x - v \Delta t)$ (4)

$\Delta x'' = \gamma(\Delta x - (-v) \Delta t)$ (5)

$\Delta x = \Delta x''/\gamma - v \Delta t$

$\Delta x' = \gamma(-(\Delta x''/\gamma - v \Delta t) - v \Delta t)$

$\Delta x' = -\gamma(\Delta x''/\gamma)$

$\Delta x' = -\Delta x''$ (6)

This we know to be true, as each ship is at a point equidistant on either side of the origin.

Conclusion

This misunderstanding about the Relativity of simultaneity stems from Einstein's mistaken assumption that the speed of light is ***really*** constant in any IRF and moves through space at speed c with respect to that IRF, rather than just ***measured*** to be so (as I have shown in previous work [1]) and actually has a fixed speed of c with respect to the space/medium field. The problem in the interpretation of Minkowski diagrams is due to the failure to recognize that each ship's axes represents a different coordinate system and one must map from one coordinate system to the other coordinate system when drawing inferences between the two systems.

REFERENCES

[1] Traill. D. A. "Relatively Simple? An Introduction to Energy Field Theory" The General Science Journal, 2001-2008.

http://gsjournal.net/Science-Journals/%7B$cat_name%7D/View/1105 Last accessed 4/10/2019

[2] Wikipedia. "Minkowski diagram".

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[3] Wikipedia. "Relativity of simultaneity".

https://en.wikipedia.org/wiki/Relativity_of_simultaneity Last accessed 4/10/2019