the general science journal

On The Speed of Light in the Theory of Special Relativity

A Thought Experiment on the Axiom of a Constant Light Speed 'c'

It is widely accepted in physics that the velocity of light is a constant at speed 'c' in an Inertial Referee Frame (IRF) where there is no acceleration or gravity and the velocity of light is the same for all IRFs regardless of the velocity of the IRF or the light source. Is this true?

On The Speed of Light in the Theory of Special Relativity 12/15/2017

A Thought Experiment on the Axiom of a Constant Light Speed 'c' ©

The Current Standard

It is widely accepted in physics that the speed of light is a constant at speed 'c' in an **Inertial Reference Frame (IRF)** where there is no acceleration or gravity and the velocity of light is the same for all IRFs regardless of the speed of the IRF or the light source. However, Einstein never provided any proof for the establishment of this Special Relativity (SR) axiom or postulate that has become a foundation for the theories of physics.[1]

Thera are many explanations[2,3] of the standard thought experiment that presents an observer **B** in his IRF with a mirrored Light Clock (LC) and an external observer. The external observer **A** sees **B** move horizontally at a constant velocity. Observer **A** sees that the light path in the Light Clock gives a triangular pattern across his path while **B** sees only a straight vertical line light path. Thus, the length of the light path for **A** is longer than for **B** and since the axiom states the speed of light 'c' is a constant we must conclude that **B's** clock is slower from **A's** perspective. We now have time dilation. Is this correct?

Yes, there is collected data on changing atomic clocks in aircraft, muon half live, and the GPS. But those examples involve acceleration and gravity; energies that are very different than what are the stated conditions in the theory of Special Relativity. These issues were discussed in a previous paper that suggests an alternative explanation for those observations.[4]

In the SR thought experiment that leads to time dilation, it involves both a moving and positioning spatial change. The standard presentation states observer **A** will see a triangle pattern for the light path as **B** moves across his path; thus having a longer path distance than the Light Clock; he then must accept time dilation since if 'c' is constant, the longer path distance in itself could not be possible. According to the application of Einstein's second axiom, observer **B's** clock must be slow according to **A** although **B** thinks his clock is fine.

A has observed a longer light path. He must accept that the path distance he sees is correct, but something is wrong because he must accept that 'c' is a constant and that the light could not have traveled that distance at speed' c'. [5] Then, to resolve it all he must accept that **B's** clock has slowed down even though **A** cannot see **B's** clock. This seems somewhat to be a case of circular logic and a stretch to accept Einstein's second postulate. Never the less, the triangle argument is still used here to see where it leads to with the modifications involved with this thought experiment.

An Alternative Perspective

The thought experiment detailed here will show that to insist on a constant light speed will inevitably be at odds with the simple mathematics that develops from the situation presented here and thus results in an unavoidable contradiction invalidating the axiom that the speed of light is the same for all conditions and all observers regardless of their frame of reference.

The usual argument against the Theory of Special Relativity is because it is relativity; both observers could make the same conclusion about the other as argued by Dingle.[6] This experiment examines SR from that very perspective in depth. Since there is an equivalence of Inertial Reference Frames, that is, no frame of reference is more correct than another, the experiment is set up so that both IRFs are identical in all respects. Only their relative velocity, or speed vector, is different from each other by 180º.

This experiment has each observer measure three timed events simultaneously; and then finding that all the times are equal, they must conclude that the Triangle Light Distance ($\mathbf{T_{LD}}$) has not changed, but 'c' has changed.

In this thought experiment neither observer makes any judgments about the others clock. Each measures with their own Inertial Reference Frame (IRF) clock the time to travel the distance **D** (see figure 1). This turns out to also be the same time for the path distance of the Light Clock (LC) and the same time for the path distance for the observed Triangle Light Path because the system is set up to start the clocks at the same time and then stop the clocks for all at the same time.

First to establish the materials and conditions involved:

- There are two observers, A and B.
- Each is contained in his own IRF (one rocket ship is at constant velocity or at rest in space).
- Each observer can equally claim his IRF is the stationary one and the other is moving.
- Neither believes, nor can detect, he is the one who is moving.
- The observers move parallel to each other.
- Neither observer is accelerating or in a gravitational field.
- Each possesses one Time Clock (TC). (Both clocks are identical).
- Each ship contains a Light Clock (LC). (Two parallel mirrored surfaces that permit light to bounce back and forth vertically. The mirrors are separated by the distance **d.** $\mathbf{d_A}$ for observer **A** and $\mathbf{d_B}$ for observer **B**. $\mathbf{d_A = d_B}$**.** Each **LC** is positioned the same at a window that can be seen by the other observer.
- The setup is designed so the Time Clocks for each IRF will turn on when the rockets are aligned as shown in Figure 1; and also turn off together when the ends of the ships are in alignment. This is done to obtain the same elapsed time for the Light Clock, the Triangle Light Path, and the distance **D**.

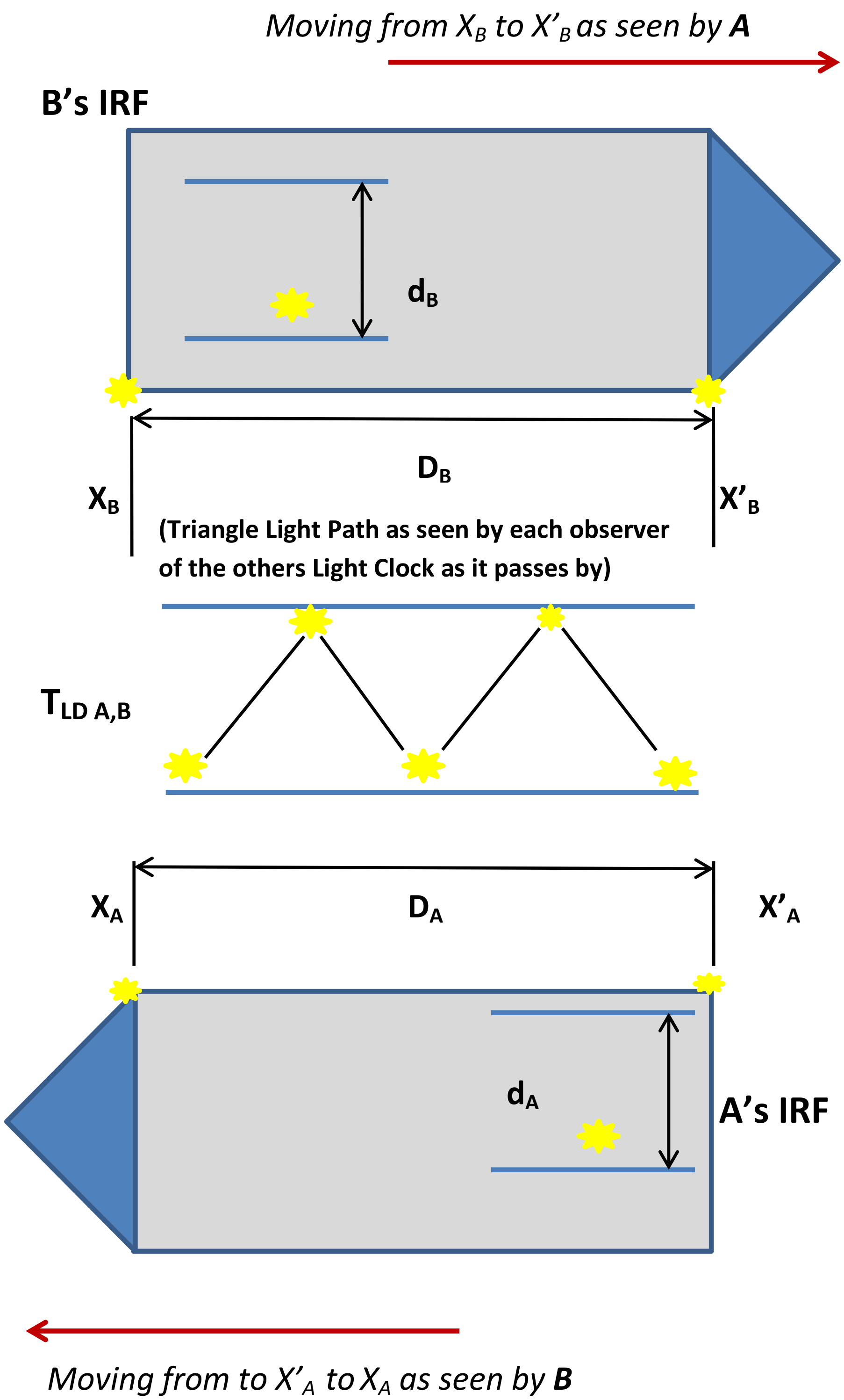

Figure 1

The Experiment Setup

- This Sun shape symbolizes the light bouncing between the mirrors in each **Light Clock (LC)**.
- It also denotes the light beam/mirrors at the two corners of the facing sides of each ship. When the light beams are reflected back indicating an alignment, the **Light Clock (LC)** and **Time Clock (TC)** for each observer will start.
- As the ends of each ship pass each other, the light beams/mirrors will again signal an alignment and stop the **LC** and **TC** for each ship. ***The figure left shows the starting position as A or B is observed to be passing by A or B.***
- The **LC** has recoded the number of clicks to determine the distance.
- The T**C** has the time for each ship to transverse the distance D and the time for the **LCs**.
- $D_A = D_B$; $D_A \neq d_A$ & $D_B \neq d_B$
- $d_A = d_B$;
- The time for each should be the same.
- The time **for A's** LC should equal the time **for B's** LC.
- The time for A to cover the distance **D** should equal the time for **B** to cover the distance **D**.
- The time for the Triangle Light Path (t_{TLP}) should be the same for both A & B.
- All the times are the same.
- $\mathbf{t_{LC} = t_{TLP} = t_D}$
- Both observers should determine the same distance value for their LCs & the Triangle Light Distance (**T_{LD}**) value for the Triangle Light path; **$T_{LD\ A}$, $T_{LD\ B}$.**

The Results

The measured time is the same for both observers A & B. The principle of equivalence of IRFs is that all reference frames are equal. No one is more correct than another. **The time for the Light Clock (LC) equals the time for the Triangle Light Path (TLP) equals the time for the ships to cover the distance D.**

$$t_{LC} = t_{TLP} = t_D$$

Both observers get the same result.

Distance (LC) = Rate (LC) x time (LC)

Distance (TLP) = Rate (TLP) x time (TLP)

The time (LC) = time (TLP)

The Distance (LC) does ≠ Distance (TLP)

based on the Triangle Light Path from the given traditional standard arguments for Special Relatvity[2]

Then the Rate (LC) ≠ Rate (TLP) Q.E.D.

Conclusion

The rate for the Light Clock is the light speed **'c'** if it is solely part of each observer's own Inertial Reference Frame. An isolated IRF in a vacuum without acceleration and/or gravity should find the light speed as 'c' since the IRF cannot confirm it is at constant speed or at rest. External observer **A** has judged the light speed has changed only from his perspective of **B**, but the time is the same.

The results of the Experiment as presented here have found the times are all equal and thus **the rate for the Triangle Light Path (TLP) must be something different than 'c' since the Triangle Path Distance must be logically longer than the Light Clock path distance.** Since the distance for the TLP is greater than the distance for the Light Clock, **the rate for the TLP must also be greater than 'c'. The claim for a constant light speed does not hold.**

Both **A & B** can come to the same conclusion without making any judgement about the other's clock speed. Both could conclude that the others clock must run slow if they embrace the constant light speed. This would cancel each other out and no real change in clock time is seen or needed. Nothing here would suggest that a clock is running slow. It is a conclusion that is made if it is decided that the speed of light must be constant.

When traveling in a plane at a constant velocity in the darkness of night one has no sense of moving. When driver **A** is on the road moving at 40 mph and another vehicle goes by at 60 mph past him, driver **A** could make the judgement that vehicle **B** is going only 20 mph relative to him. That is certainly the actual perception, but it is still an illusion. The truth is that there is another reference frame, the road, that will bring one back to reality. Constant speed can be deceptive.

Local Space is the grounding Reference Frame (RF) to bring observer A back to reality. Both rocket ship observers see their own Light Clock beam as speed ‘c’ for their own RF relative to the Local Space just as each car driver correctly finds his true velocity when referencing the road, but judging the other’s speed in either case leads to a deception. Reality appears to be changed by choosing the incorrect Reference Frame and judging another’s RF clock to have changed is an additional error.

Einstein’s equivalency principle[7] says it is not possible for us to distinguish between acceleration and gravity. Space also cannot distinguish between acceleration and gravity as both cases involve the movement of mass in space of a non-inertial RF. When mass is at rest or a constant velocity, it is an inertial reference frame and space has a uniform response; the speed of light is measured as ‘c’. But under the influence of acceleration or gravity space is now a part of a system where the velocity, by definition, is changing and the response of space is not uniform.

It is possible, even reasonable to expect that **under the conditions of acceleration and/or gravity the speed of light can be other than ‘c’ and clocks could have a real physical change** because of the energies from these conditions, and not due to a mathematical time dilation derived from a constant ‘c’ in Special Relativity. If light cannot escape the confinement created by a black hole, it is understandable that light would be affected to some degree in any gravitational or accelerating field. These two terms do seem more and more to be one and the same as they both are represented by an accelerating mass. Hence, we have the equivalency principle.

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