The Neo-classical Theory of Relativity

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Introduction to the Neo-classical Theory of Relativity

The **Neo-classical Theory of Relativity** (NCTR) uses concepts of Classical Mechanics and Classical Electromagnetism to describe the relativity of inertial motion better than it is described in the **Special Theory of Relativity** (STR) conceived by Albert Einstein in 1905.

The **Neo-classical Theory of Relativity** reveals the conceptual errors of Einstein's **Special Theory of Relativity** and also explains why the STR doesn't have a valid experimental basis.
Also NCTR confirms the works of several physicists of the last century which showed that the absolute nature of space and the absolute frame of reference are valid concepts which can be proved experimentally and used practically.

This is the second edition of the document which presents the **Neo-classical Theory of Relativity**, featuring a reorganized and more clear presentation in comparison to the first edition (May 2010). The goal of this reorganization was to restructure and to detail better the critical aspects that invalidate Einstein's theory, and to describe further a Classical foundation for a new theory of space, time and motion.

This edition also contains more cross-references, more graphical representations which now include several animated simulations, in order to relate properly all the aspects discussed here. The format and the quality of this presentation will be evolving in the future in the next editions of this document.

1. The conceptual errors of Einstein's Special Theory of Relativity

Our thorough analysis of Einstein's Special Theory of Relativity (STR) revealed so far four groups of conceptual errors:

1.1. Conceptual errors - part 1: Ignoring the independence of the motion of light from the observer

In the beginning of the first document of the Special Theory of Relativity (STR) Einstein postulated that the velocity of light is a constant value which is independent of the state of motion of the emitting body:

*"[…] light is always propagated in empty space with a definite velocity **c** which is independent of the state of motion of the emitting body."* **[1]**

We will explain here why that first postulate of STR is incorrect:

1.1.1. Einstein didn't relate the velocity of light to the motion of the **observer**, as he related it only to the motion of the emitter.

The motion of the observer is very important because the observer is the one who measures the velocity of light in a certain reference frame, and his motion influences that measurement. The inertial motion of an observer of a photon can be:

- **a.)** towards the photon on the same straight line with the photon's motion, or
- **b.)** away from the photon on the same straight line with the photon's motion, or
- **c.)** away out of the path of the photon; this case is equivalent to the "Aberration of Light".

Let's set up imaginary experiments which reveal the motion and the path of light **as perceived** in two reference frames, for each of the cases **a**, **b** and **c** mentioned above. We will also use animated simulation of such experiments to represent them even better.

We set the first reference frame to be **stationary**. However, this frame will be conceptually different from the stationary frame used by Einstein in STR, as we need to specify clear attributes to the meaning of the word "stationary" to show why it is special and different from other reference frames:
A **stationary reference frame** means here a frame in which:

- the velocity of light has a measured value of ***c*** , constant in any direction;
- the "Aberration of Light" is zero in any direction for any observer which is at rest within this frame.
  (That means the distance between the observer and the path of any photon is a constant;
  or, in other words, the observer is not in motion, relative to any ray of light.)

We set the second reference frame as an inertial frame which moves linearly with a velocity ***v*** away from the stationary frame. We will name this second frame 'the **mobile reference frame**'.

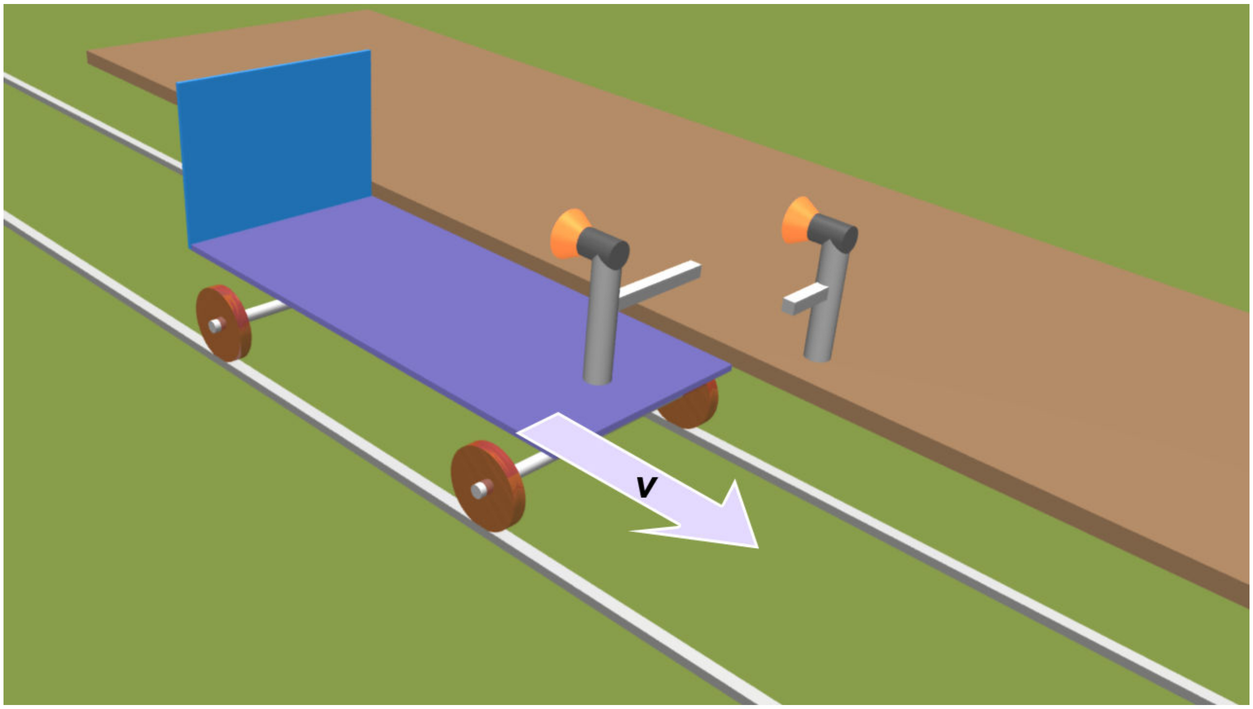
In an imaginary experiment, let's assign the stationary frame to a platform of a railroad station, and the mobile frame to a car which passes by the platform moving uniformly and linearly with a constant velocity ***v*** .

Case a.) – the observer moves towards the photon, on the same line:

We mount a light source on the car at one end, and a light source on the platform as in Figure a-1 here. We arrange an ideal double switch which will turn both light sources on, in the moment they pass by each other. Also we arrange that each source will emit one photon in the direction opposite and parallel to the direction in which the car moves.

For an animated simulation of this case please see the video at: http://youtu.be/aZ0-JBq7IlA .

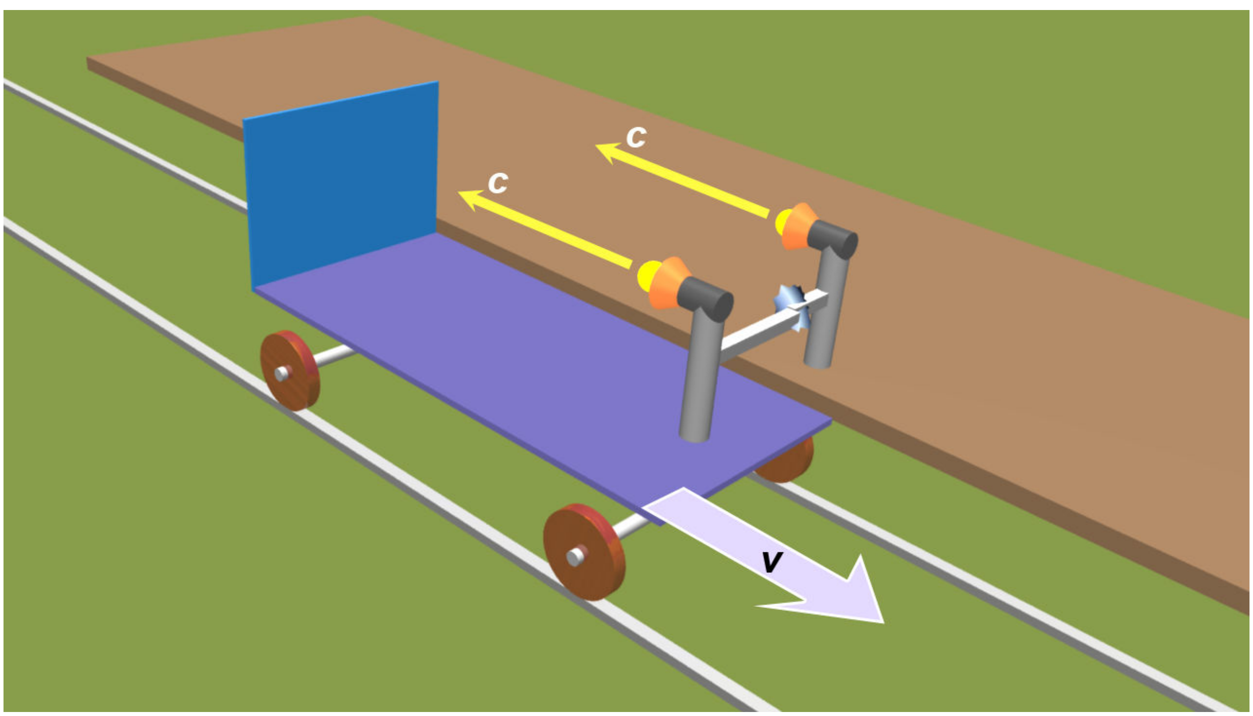
Figure a-1



Once the double switch is activated as in Figure a-2, we observe the motions of the two photons:

- the photon emitted from the car; and
- the photon emitted from the platform.

Figure a-2

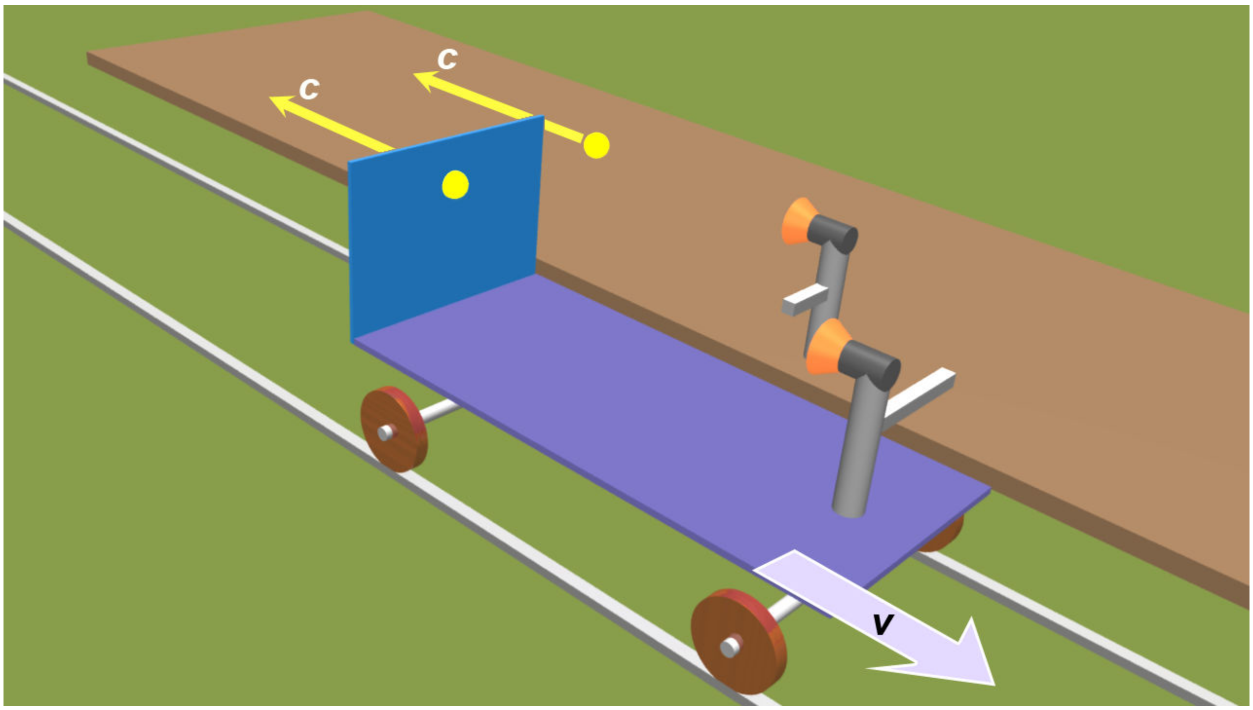


As the photons are generated in the same moment and oriented in the same direction, their motions are parallel.

Also, in a time unit both photons travel together the same distance measured in a particular reference frame.

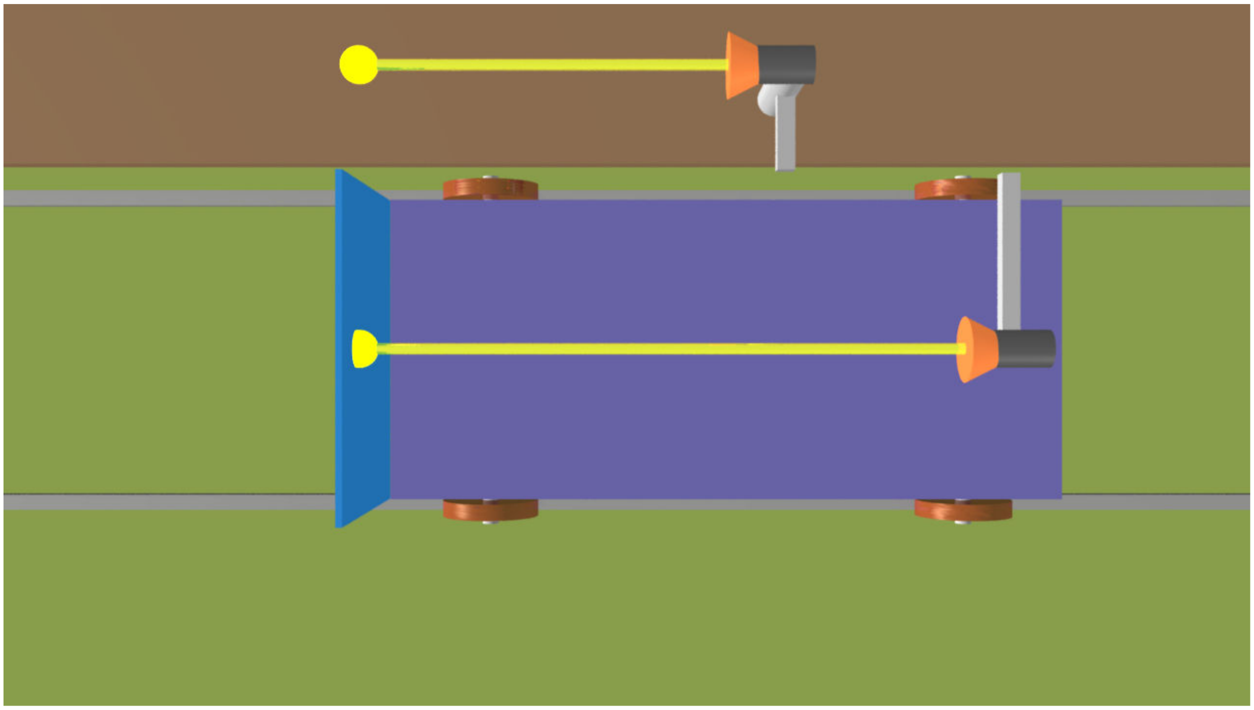
Let's consider the motion of the photons until the photon in the mobile frame reaches the wall mounted at the end of the car, as we see in Figure a-3.

Figure a-3



If we compare the paths traveled by the two photons, as observed from within each of the two different reference frames (the stationary frame, and respectively the mobile frame), we observe that those paths do not have equal lengths, as we see in Figure a-4, and also in the video aforementioned:

Figure a-4



Let's consider the time interval between these 2 events:

- $\mathbf{t_0}$: the moment the photons get emitted.
- $\mathbf{t_1}$: the moment the photons reach the other end of the car. (Please read section 3.3. to see how we can detect that event in both frames).

Following the same reasoning that Einstein thought in STR, section *"§ 2. On the Relativity of Lengths and Times"* [1], we find that the distances traveled by the photons in both frames, between $\mathbf{t_0}$ and $\mathbf{t_1}$ are:

In the stationary frame (the platform's frame) the distance $\mathbf{D_s}$ traveled by the photons is:

$$\mathbf{D_s} = (\mathbf{t_1} - \mathbf{t_0}) \cdot c$$

In the mobile frame (the car's frame) the distance $\mathbf{D_m}$ traveled by the photons is:

$$\mathbf{D_m} = (\mathbf{t_1} - \mathbf{t_0}) \cdot (c + v)$$

According to Classical Mechanics, the velocity of light $\mathbf{c_{m\text{-}opposite}}$ measured in the mobile frame, when the direction of frame's motion is opposite to the direction of light, is:

$$\mathbf{c_{m-opposite}} = \frac{\mathbf{D_m}}{(\mathbf{t_1} - \mathbf{t_0})} = c + v \qquad \text{which means:} \qquad \mathbf{c_{m\text{-}opposite}} \neq c$$

The velocity of light c_m measured in the mobile frame is not equal to the velocity of light c measured in the stationary frame.

As we will demonstrate in the next sections, it is correct and practical to share the same length units and time units between the two reference frames, and that means in different reference frames we will measure and observe different values for the velocity of light.
In short for this case, we can simply notice that the distance between the rails can be used as a common length unit between the stationary frame and the mobile frame. Also here, the time interval $\mathbf{t_1 - t_0}$ (between the events t_1 and t_0) can be used as a common time unit between the two reference frames.

Case b.) – the observer moves away from the photon:

We apply a similar reasoning as in the case **a.)** , and as the car and the photon move on the same direction, we find that the velocity of light measured on the mobile frame is:

$$\mathbf{c_{m-same}} = \frac{\mathbf{D_m}}{\mathbf{(t_1 - t_0)}} = \boldsymbol{c} - \boldsymbol{v}$$

And so in this case, the conclusion is again that: $\mathbf{c_{m\text{-}same}} \neq \boldsymbol{c}$.

For an animated simulation of the cases **a.)** and **b.)** see the video at:
http://youtu.be/XZ9hPwoTyC0

Surprisingly, Einstein himself used the same reasoning and the same equations (as in the cases **a.)** and **b.)** here) to show that the clocks in the mobile frame cannot be synchronized. We will explain in the section **1.2.2.** why his conclusion about synchronization is wrong. With that provision, for the case here we notice that Einstein ignored his own definition of velocity:

He wrote (in *"§ 2. On the Relativity of Lengths and Times"* **[1]**):

$$\textbf{velocity} = \frac{\textbf{light path}}{\textbf{time interval}}$$

And then his equations were:

$$\mathbf{t_B - t_A} = \frac{\mathbf{r_{AB}}}{\boldsymbol{c} - \boldsymbol{v}} \qquad \text{and} \qquad \mathbf{t'_A - t_B} = \frac{\mathbf{r_{AB}}}{\boldsymbol{c} + \boldsymbol{v}}$$

Notice how the velocities of light $\mathbf{c_m}$, **measured** by Einstein's reasoning, have respectively the same values with the velocities of light $\mathbf{c_m}$, **measured** in our cases **a.)** and **b.)** mentioned above:

$$\mathbf{c_{m-same}} = \boldsymbol{c} - \boldsymbol{v} = \frac{\mathbf{r_{AB}}}{\mathbf{t_B - t_A}} \qquad \text{and} \qquad \mathbf{c_{m-opposite}} = \boldsymbol{c} + \boldsymbol{v} = \frac{\mathbf{r_{AB}}}{\mathbf{t'_A - t_B}}$$

with the same conclusion which we found above, that:

$\mathbf{c_{m\text{-}same}} \neq c$ and $\mathbf{c_{m\text{-}opposite}} \neq c$

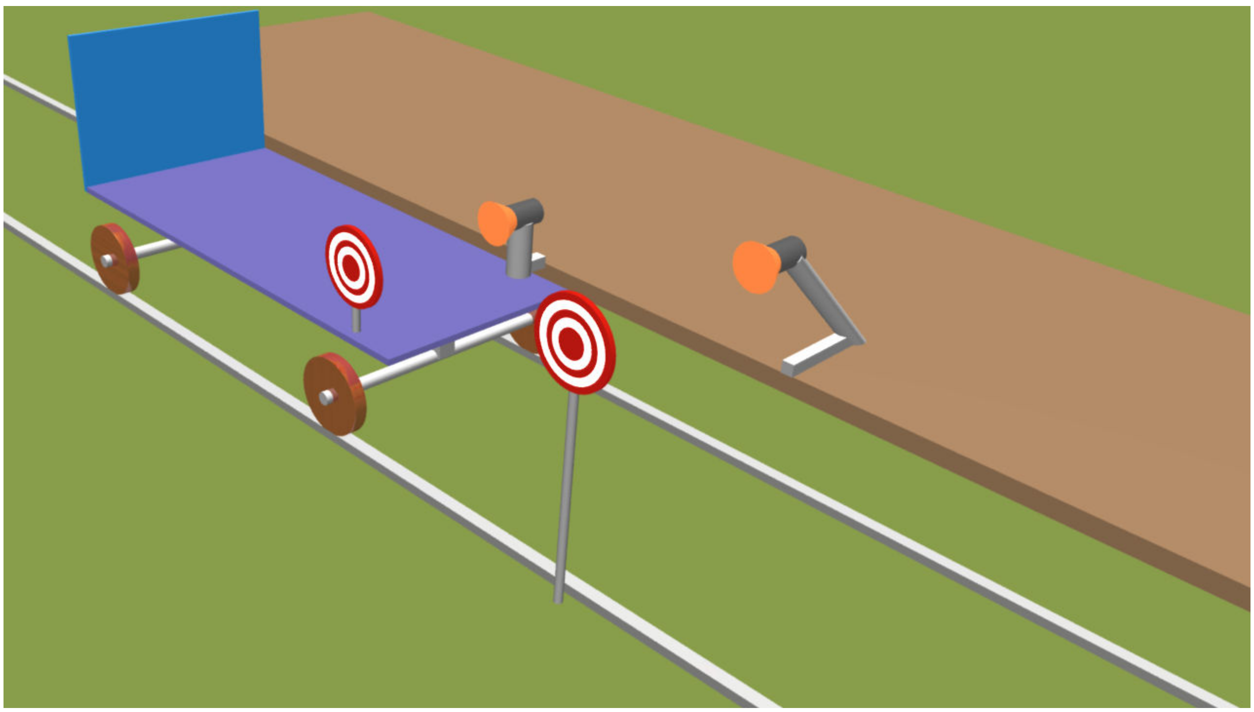
Therefore Einstein ignored the fact that the **measured** velocity of light is not a constant across different reference frames.

We will explain in the section **1.2.4.** why Einstein ignored that fact, and also we will note it in the section **1.3.** as one of the contradictions of his theory.

Case c.) – the observer moves away out of the path of the photon:

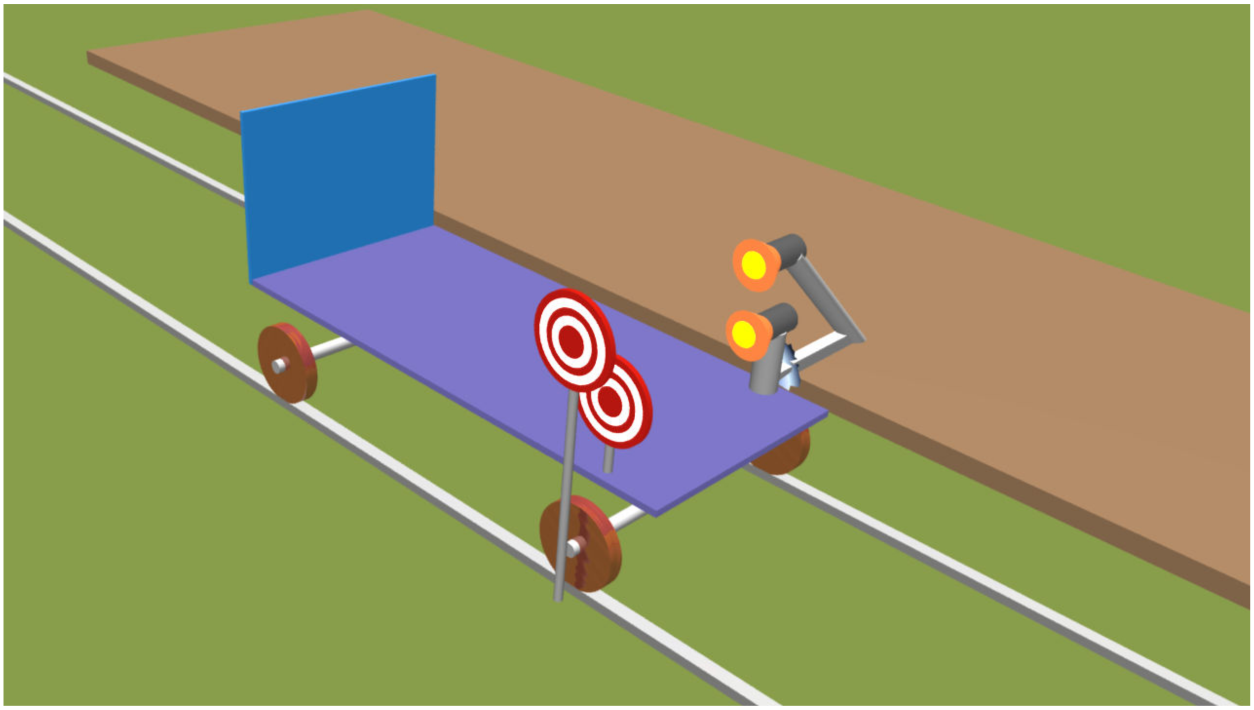
In this case we adjust the sources of light so they emit the photons on a direction perpendicular to the direction of car's motion, as in Figure c-1 and the video at: http://youtu.be/wo2F_b-kSsM :

Figure c-1



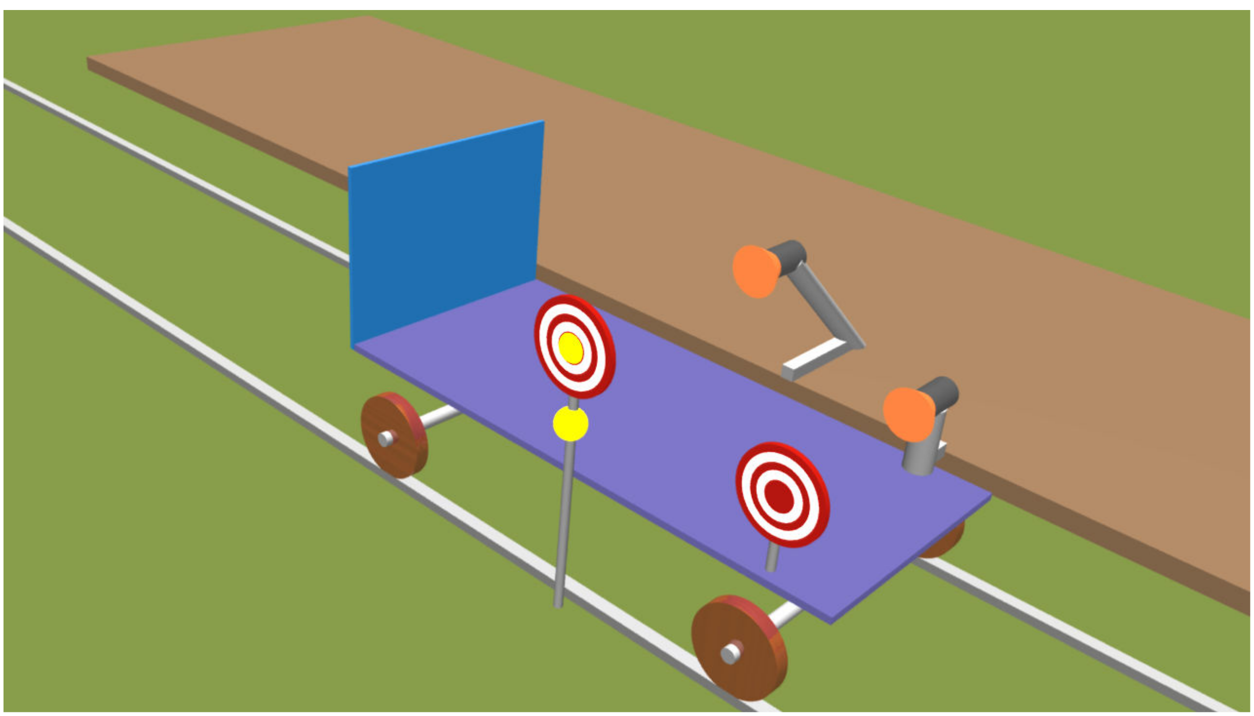
The sources are turned on simultaneously when a double switch is activated as they pass by each other, and at that moment each of them emits one photon - as represented in Figure c-2 :

Figure c-2



Once emitted, the photons move independently from the emitters (the sources of light) and independently from the observers who are attached to the stationary frame and respectively to the mobile frame. The observers (represented as targets in Figure c-3 and Figure c-4) are placed so the line segments between them and the sources are perpendicular to the direction of the car's motion.

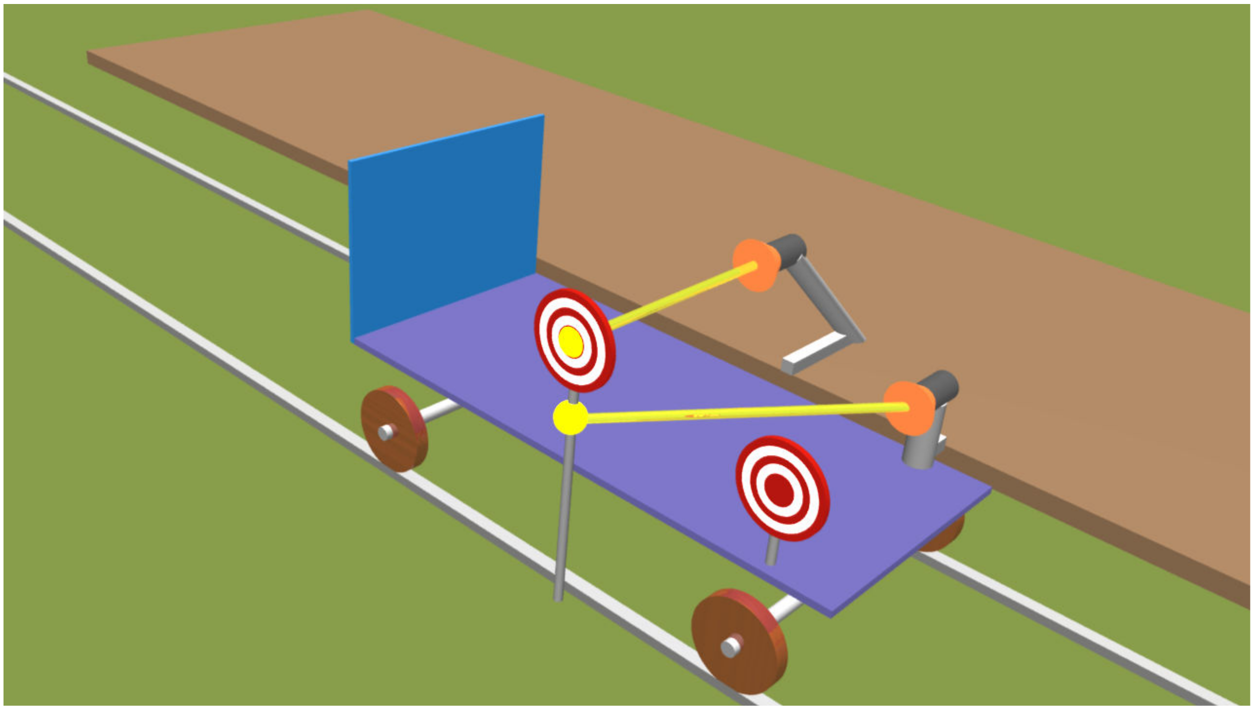
Figure c-3



In the stationary frame the photon moves on the segment between the source and the target which are attached to the stationary frame, and that is because by definition there is no aberration of light in the stationary frame.

In the mobile frame (the car) it appears that the photon moves away from the segment between the source and the target which are attached to the frame. What actually happens is that the car moves out of the way of the photon, and so the observer on the car does not receive the photon as intended.

Figure c-4



In Figure c-4 we can also see that the paths of the photons observed in the two frames are unparallel and that they have different lengths.

If the two paths would be translated so that the destination points of the photons would coincide, then the two paths would be the sides of a right triangle. The path $\mathbf{P_m}$ on the mobile frame would be the hypotenuse of that triangle, and that means it is longer than the path $\mathbf{P_s}$ on the stationary frame. If we consider the time interval $\mathbf{\Delta T}$ between the emission of the photons and the reception of the photons on the other side across the car, then the measured velocities of light in the two frames are:

In the stationary frame: $\mathbf{c_s} = \dfrac{\mathbf{P_s}}{\mathbf{\Delta T}} = \boldsymbol{c}$

In the mobile frame: $\mathbf{c_m} = \dfrac{\mathbf{P_m}}{\mathbf{\Delta T}}$

As $\mathbf{P_m > P_s}$ it is clear that $\mathbf{c_m > c_s}$, and again we observe that $\mathbf{c_m} \neq \boldsymbol{c}$.

Based on all the related experiments, on our simulations and also on the phenomenon of aberration of light **[6]** , we can affirm that the motion of light is not only independent from the emitting body; it is also independent from the observer. Therefore a correct postulate on the motion of light should read:

The motion of light in vacuum is independent from the emitter and from any observer located in any inertial reference frame.
The velocity of light has a measured value which is independent from the emitter, and which is dependent on the motion of the observer who measures it.

1.1.2. The concepts of velocity and motion are **different**, although intrinsically related

Motion means the fact that an object's distance from other objects is changing in time.
Velocity means the measure of motion, i.e. the measure of the change of distance in time.

As shown in the section **1.1.1.** , while the motion of light is independent from the observer, the velocity of light (i.e. the measurement of that motion) depends on the observer's motion.

By convention and for purely practical reasons, we all measure the velocity of an object by considering how many length units are traveled by the object in a time unit.

Unfortunately, Einstein did not consider this aspect of practically measuring the velocity of light, and he did not investigate critically the experiments regarding the measurement of the velocity of light, which had been done prior to his work of the year 1905.

He just stated that: *"In agreement with experience we further assume the quantity […]* ***c*** *to be a universal constant—the velocity of light in empty space."*
The big issues of his assumption are that by the time of his initial work on STR (1905):
- there were no experiments performed simultaneously in two different reference frames,
- there were no concepts of synchronizing time units and translating length units **experimentally** between two such different reference frames,
- there were no experiments designed to measure the velocity of light one-way in different directions of a reference frame.

Therefore, Einstein's mistake was that in his work about the transformation of velocities from one reference frame to another, he neglected to consider first **practically** the transformation or even the sharing (between the two frames) of the measurements of time and space.
Time and space are fundamental aspects of the physical reality which help us compose the concept of motion, and then to measure motion by mathematically relating their units into the values of velocity.

Einstein's choice to keep the velocity of light ***c*** as a universal constant meant that the **measured** values of the time and space, as "components" of ***c*** , are being "obliged" to be different when they are translated from one frame to another, in a way that keeps ***c*** to be the same number (!) in that another frame (provided the two frames move with a certain constant velocity v from each other).

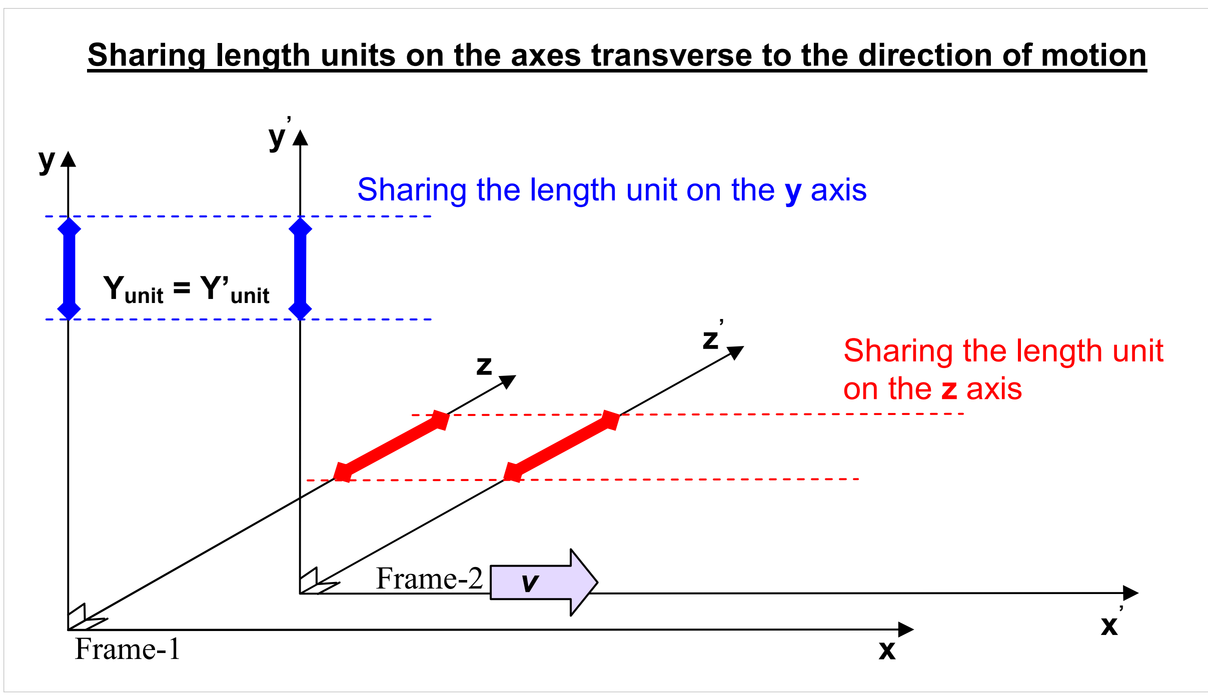
We will prove here that there is no need to change the length units and the time units from one frame to another, and that such change would be incorrect in the practice of measuring lengths and time:

1.1.3. Errors in the concept of measurement – Ignoring the transverse dimensions:

Even though Einstein considers the motion of an object on the same direction with a ray of light (let's choose that direction as the **x** axis of a Cartesian system), he omits the **three-dimensional** aspect of space: there are two other dimensions of the space which are transverse to the direction of motion of the object observed.
In a Cartesian system the dimensions transverse to **x** would be described along the **y** and **z** axes.

We can choose the **x** and **x'** axes of the two Cartesian systems attached to the stationary frame (Frame-1) and respectively to the mobile frame (Frame-2), so that they are parallel to the line of velocity ***v*** of the relative motion of the frames as in Figure 1 .

Figure 1



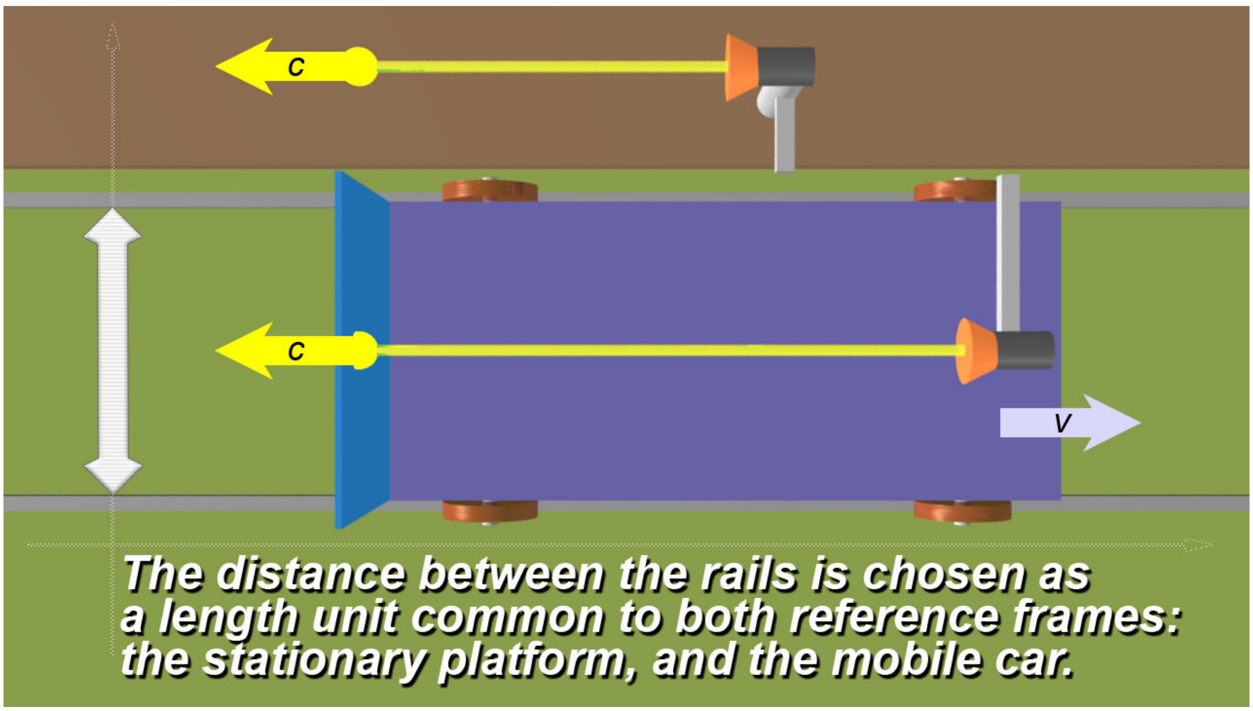
We notice that on the axes **y** and **y'** the two frames have zero velocity from each other. Also, on the axes **z** and **z'** the two frames have zero velocity from each other.

That means (according to both Classical Mechanics and Einstein's STR) that **the lengths measured on the axes y and z of the stationary frame have the same value if they are measured on the axes y' and z' of the mobile frame**.

Practically we do not need to transform the length units between the two frames, since an observer located in any of the two frames can choose a common length unit from the transversal dimensions **y** and **y'**, or from **z** and **z'**.

For example, in our video simulations we can choose the distance between the rails as a common length unit between the platform's frame (Frame-1), and the car's frame (Frame-2). See Figure 2 (which is based on the Figure a-4). Then, if we compare the paths traveled by the two photons, as observed from within each of the two different reference frames (the stationary frame and respectively the mobile frame), we measure (using the common length unit) that those paths do not have equal lengths, as we see in Figure 2 and in the video at: http://youtu.be/aZ0-JBq7IlA .

Figure 2



According to Einstein's theory, the unit lengths on one axis (**x'**) must change (as the frames move from each other on that **x'** axis), while the unit lengths on the other axes **y** and **z** do not change.

That does not make any sense in **practice**, because if both frames choose their length units to be on **y || y'** or **z** || **z'**, then internally - inside of each frame those units would be used as well on the **x** || **x'** axis as well. By mathematical transitivity we have:

$\mathbf{X_{unit} = Y_{unit} = Y'_{unit} = X'_{unit}}$ and so we obtain: $\mathbf{X_{unit} = X'_{unit}}$ which again shows an error in Einstein's theory, as it implied that any length would be differently measured on **x** in comparison to **x'** .

1.1.4. Errors in the concept of measurement – **Measuring on the wrong direction**:

Measuring space means comparing certain distances to certain length units. Although that is a well know fact, it is important to find the correct method of comparison.

An important aspect which Einstein did not notice when he wrote the section "*§ 2. On the Relativity of Lengths and Times*" **[1]** is that his proposed methods of measurement use **different directions of observation**. (This is another conceptual error of STR):

> ***(a)*** *The observer moves together with the given measuring-rod and the rod to be measured, and measures the length of the rod directly by* ***superposing*** *the measuring-rod, in just the same way as if all three were at rest.*
>
> ***(b)*** *By means of stationary clocks set up in the stationary system and synchronizing in accordance with § 1, the observer ascertains at what points of the stationary system the two ends of the rod to be measured are located at a definite time.*

In the method **(a)**, the moving observer **superposes** a measuring-rod and the rod to be measured. That means the moving observer observes on a direction perpendicular to the direction of motion (of the rod to be measured).

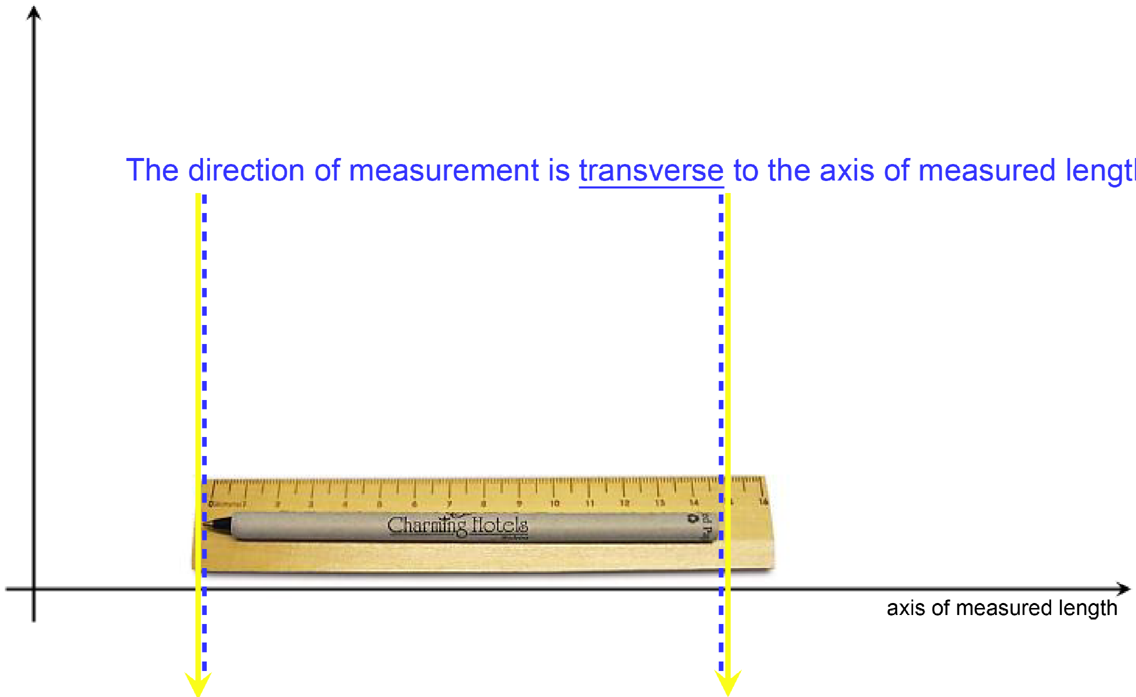
In the method **(b)**, the two moving observers, placed each at one of the ends of the rod, observe into the direction of motion (of the rod to be measured):

> *"We imagine further that at the two ends* ***A*** *and* ***B*** *of the rod, clocks are placed which synchronize with the clocks of the stationary system […]*
> *We imagine further that with each clock there is a moving observer […]*
> *Let a ray of light depart from A at the time* t_A*, let it be reflected at B at the time* t_B*, and reach A again at the time* t'_A *."*

The problem now is to decide which method of measuring lengths is better: the **transverse** one, or the **longitudinal** one?

In practice we usually determine the length of an object transversely, considering both of its ends simultaneously (!) as you can see in Figure 3 .
It is not practical to determine the length of an object by looking into one of its ends (in a direction parallel to its length) towards the other end.

Figure 3



Therefore the method of measurement **(b)** proposed by Einstein is impractical and incorrect, as nothing guarantees that the means of measurement (light signal in that case) is carried together with the object to be measured (the rod in that case). (In fact we know for sure that the motion of light is independent from any inertial reference frame; light does not move "connected" to any motion of a reference frame.)

For any practical purpose it doesn't make sense to send a signal between the ends of an object, on the same direction with the object's motion, while the signal's motion is **not correlated** (linked, carried, or translated) with the object's motion in any way (!) As it was shown above, the motion of light cannot be correlated with the motion of any other object.

For more observations and examples on the subject of measuring lengths correctly across reference frames see section 3.3. further in this document.

1.1.5. Einstein's postulate on the constancy of velocity of light has an **incorrect experimental background**:

Let's consider again Einstein's statement: *"In agreement with experience we further assume the quantity […] **c** to be a universal constant […]"*

Unfortunately Einstein's assumption was wrong. There has **never** been an experiment done to measure the velocity of light strictly from a point A to a point B in any reference frame.

In short, an experiment which can measure the velocity of light strictly in one direction (**one-way**) has never been performed. Until such an experiment is performed successfully, it is incorrect to postulate anything about the velocity of light.
So far, the only measurements performed to determine "accurately" the velocity of light were all round-trip (**two-way**).

We will dedicate a next section (**2.**) to revealing the lack of experimental support in Einstein's STR. We will explain there why the round-trip experiments show the velocity of light as a constant, and how that constant is in fact not equal to the velocity of light in one direction measured inside of a mobile frame.

The point here is that it is conceptually incorrect to assume the velocity of light is a constant between any two different reference frames, without having a solid experimental support for that.

1.2 Conceptual errors - part 2: Using a non-inertial synchronization method in an inertial reference frame.

Another conceptual error of Einstein's STR is that it uses a **non-inertial** phenomenon (the light) to synchronize two clocks in an **inertial** frame of reference.

1.2.1. Synchronization and Simultaneity

Einstein reached the conclusion that "*two events which, viewed from a system of co-ordinates, are simultaneous, can no longer be looked upon as **simultaneous** events when envisaged from a system which is in motion relatively to that system.*" **[1]**

He considered two events to be **simultaneous** if each of the two observers located respectively near the places of those events would observe the same time value indicated by his clock. And of course, in order to be sure that the clocks will always indicate the right time values, the observers need to **synchronize** them using the method indicated by Einstein (!).

The issue (according to his reasoning) would appear when the observers move from each other, as his theory concludes that once they are in motion from each other it is impossible to synchronize their clocks.

We will discuss next how Einstein chose to synchronize the clocks, and what was wrong with that:

1.2.2. A wrong method of synchronizing clocks

According to Einstein:
"*If at the point A of space there is a clock, an observer at A can determine the time values of events in the immediate proximity of A by finding the positions of the hands which are simultaneous with these events. If there is at the point B of space another clock in all respects resembling the one at A, it is possible for an observer at B to*

determine the time values of events in the immediate neighborhood of B. But it is not possible without further assumption to compare, in respect of time, an event at A with an event at B. We have so far defined only an "A time" and a "B time." We have not defined a common "time" for A and B, for the latter cannot be defined at all unless we establish by definition that the "time" required by light to travel from A to B equals the "time" it requires to travel from B to A. Let a ray of light start at the "A time" $\mathbf{t_A}$ *from A towards B, let it at the "B time"* $\mathbf{t_B}$ *be reflected at B in the direction of A, and arrive again at A at the "A time"* $\mathbf{t'_A}$.

In accordance with definition the two clocks synchronize if

$$\mathbf{t_B - t_A = t'_A - t_B}$$

[…]

"*The "time" of an event is that which is given simultaneously with the event by a stationary clock located at the place of the event, this clock being synchronous, and indeed synchronous for all time determinations, with a specified stationary clock.*" **[1]**

In short, in this method a light pulse travels forth and back between a clock in point **A** and a clock in point **B**. Then, if the times recorded $\mathbf{t_A}$, $\mathbf{t_B}$, and $\mathbf{t'_A}$ satisfy the equality: $\mathbf{t_B - t_A = t'_A - t_B}$ then the clocks would be considered synchronized.

There are multiple errors in Einstein's method of synchronizing clocks:

Error #1:

Let's ask ourselves, what does actually a clock do? The answer itself can invalidate Einstein's method:

A clock is a device which counts time units.

Einstein didn't notice that prior to the experiment the clocks should have been set to use the same time unit.

The experiment should have clearly defined first a method of synchronizing the time unit used by the two clocks while they are located apart and within an arbitrary "stationary" frame.

If a time unit had been defined prior to the clocks being set in motion, then, assuming the clocks are ideal devices, the setting them in motion would have affected both clocks indentically, regarding their time units and the counting of their time units. That means after the clocks are set in motion, there is no need for synchronization, as the remain synchronized (!).

Also, this synchronization of the time unit would have been crucial later in Einstein's reasoning in the section *"§ 2. On the Relativity of Lengths and Times"* **[1]** , where Einstein placed the two clocks at the end of a rigid rod and then set that rod in inertial motion.

There, he put the clocks in motion without setting their time unit to be common between them and between them and the clocks in the stationary system.

In Einstein's own setting of his experiment, it is pointless to compare the values of "time" shown by each clock, especially after the clocks are set in motion.

Error #2:

Einstein did not notice that the clocks are inertial devices moving with an inertial frame:

The problem with Einstein's synchronization method, is that the means of synchronization (light signals) are not carried along with the frame which contains the clocks, as the motion of light is independent from any frame or reference.
He kept the clocks in motion without maintaining their time unit synchronized between them and between them and the clocks in the stationary system.

To prove that this was an error, we will show here what happens when the means of synchronization are not carried along with the frame:

A.) - if the direction of motion of the frame is the same as the motion of the signal:

As shown for cases a.) and b.) of the previous section (**1.1.1.**), and also as shown by Einstein himself, the time to travel the segment **AB** is different from the time to travel the segment **BA**:

So practically Einstein affirms that once we set in motion the two clocks, they cannot be synchronized using light signals: $\mathbf{t_B - t_A \neq t'_A - t_B}$

The problem with that is that we could choose the moving frame of the clocks to be the "stationary" frame, as according to Einstein's postulates any frame can be set to be "stationary", and simply synchronize the clocks within that moving frame using light signals. So, according to Einstein's STR the clocks can be synchronized within a frame and appear unsynchronized from any other frame.

What Einstein ignored was the uniqueness of measuring time across different reference frames. A clock just counts time units, and that count is unique and independent from any reference frame. It's a number which can be shared among different reference frames, so it cannot present two different values for two different reference frames.

Einstein didn't realize this aspect even though he presented it (!): he placed a moving observer attached to the moving clocks, and the clocks showed the observer the stationary time because they were from the beginning synchronized to the stationary clocks (and again, by setting them in motion Einstein didn't care if their time unit changes or not):

"*[…] a uniform motion of parallel translation […] is then imparted to the rod.*
*[…] at the two ends A and B of the rod, **clocks** are placed which **synchronize with the clocks of the stationary system** […]*
*[…] We imagine further that **with each clock there is a moving observer** […]*" **[1]**

That means that Einstein thought exactly the same way we think when we say that the **time values indicated by clocks are unique and independent from any frame**. However that also makes Einstein's time transformation equations useless, because the time intervals are also unique.

For an animated simulation of this case please see the video at:
http://youtu.be/H2qYCvw1UiE

B.) - if the direction of motion of the frame is different from the direction of the signal:

In this case we have the effect of the aberration of light. Simply put, in the mobile frame, after the light signal leaves the emitting clock, it will pass by the other clock and miss it.

Let's have a mobile frame containing two clocks **C** and **D** and moving away from a stationary frame so that the direction of motion of the mobile frame is not parallel to the segment **CD.** For representation see the clocks on the car in Figure 4A and Figure 4B and also the video at: http://youtu.be/0ed5CCP0eMg .

Figure 4A

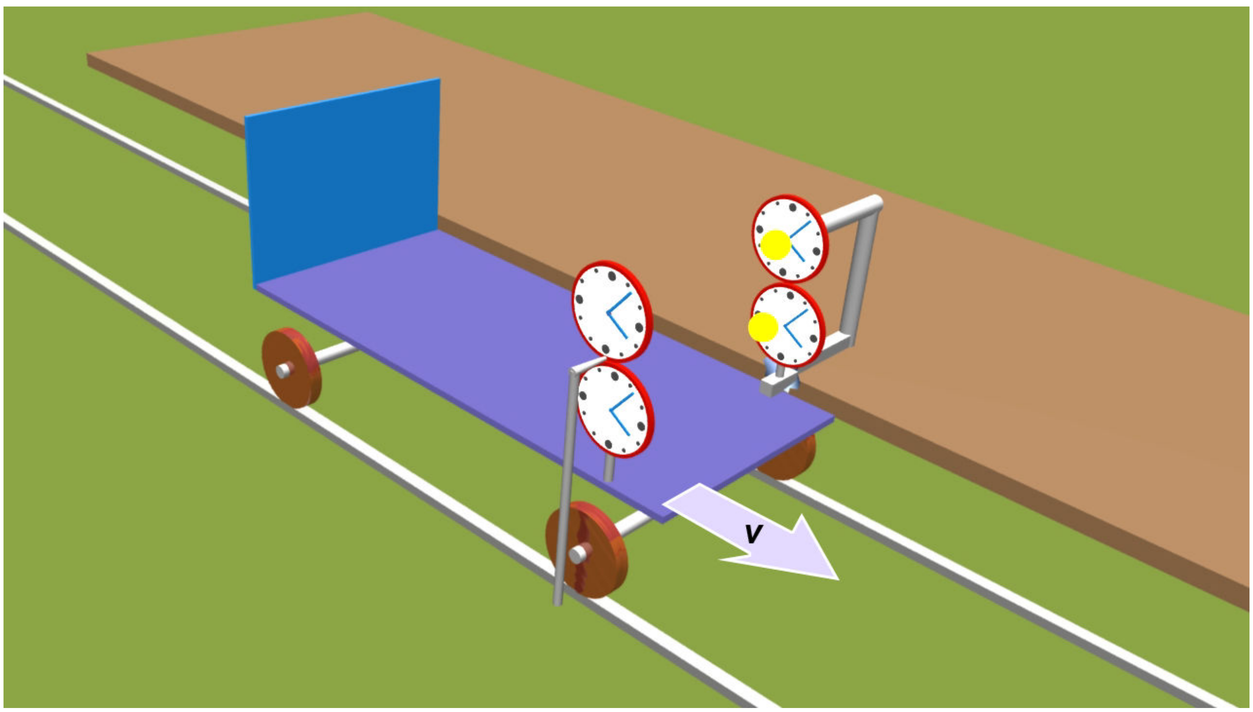
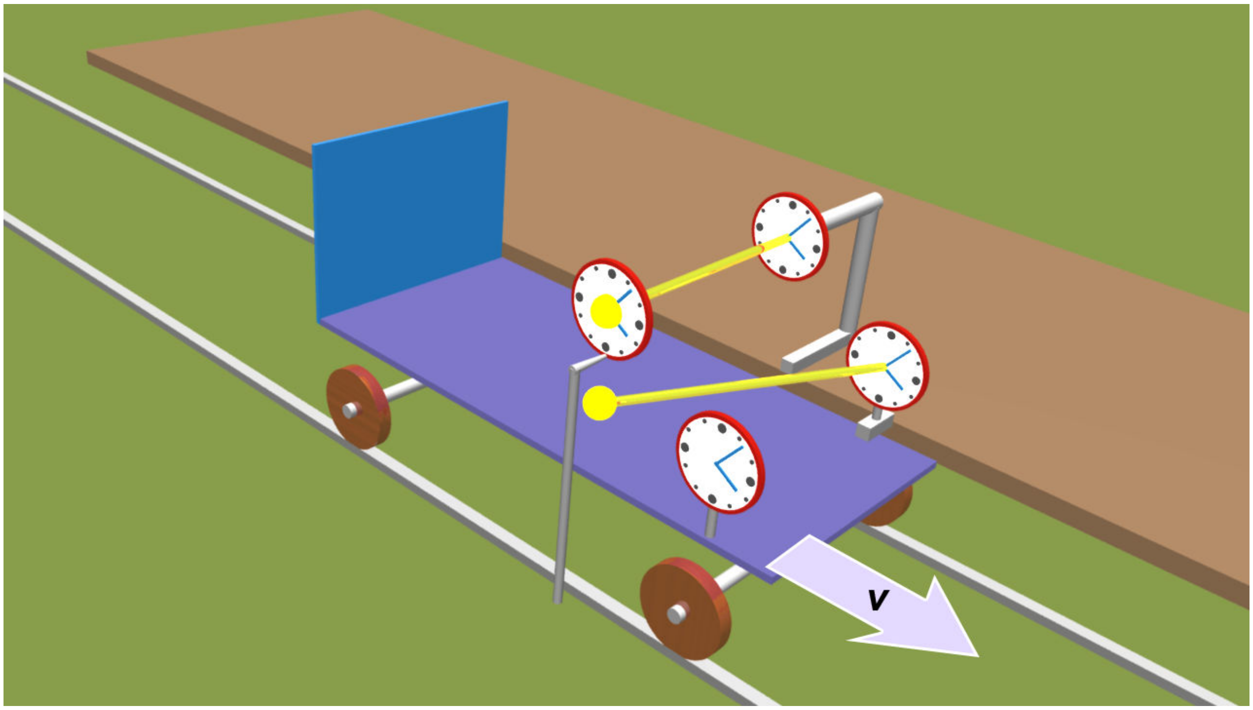


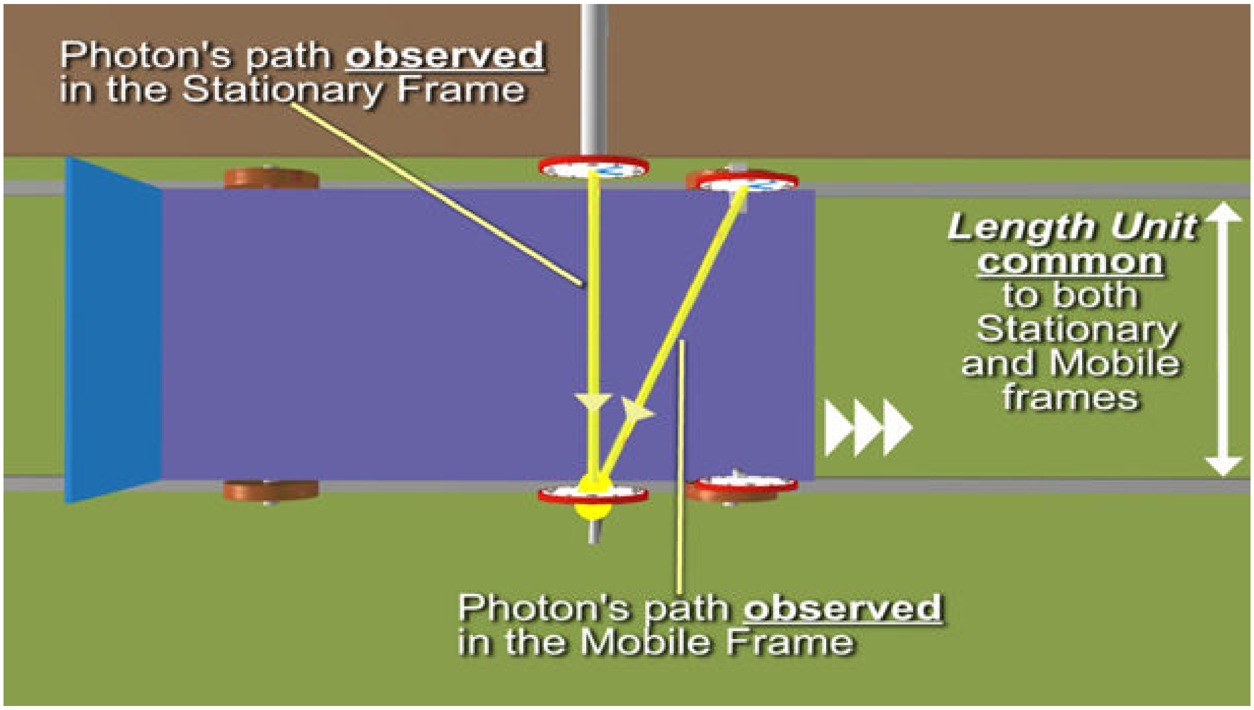
Figure 4B



Considering our definition of a stationary frame (as different from Einstein's), any clocks in the stationary frame can be synchronized because the aberration of light is zero in the stationary frame.
As we can see in the simulation video, two clocks **A** and **B** of the stationary frame, positioned so that the segment **AB** is parallel to the segment **CD**, can be synchronized using light signals, while the clocks **C** and **D** cannot be synchronized using light signals.

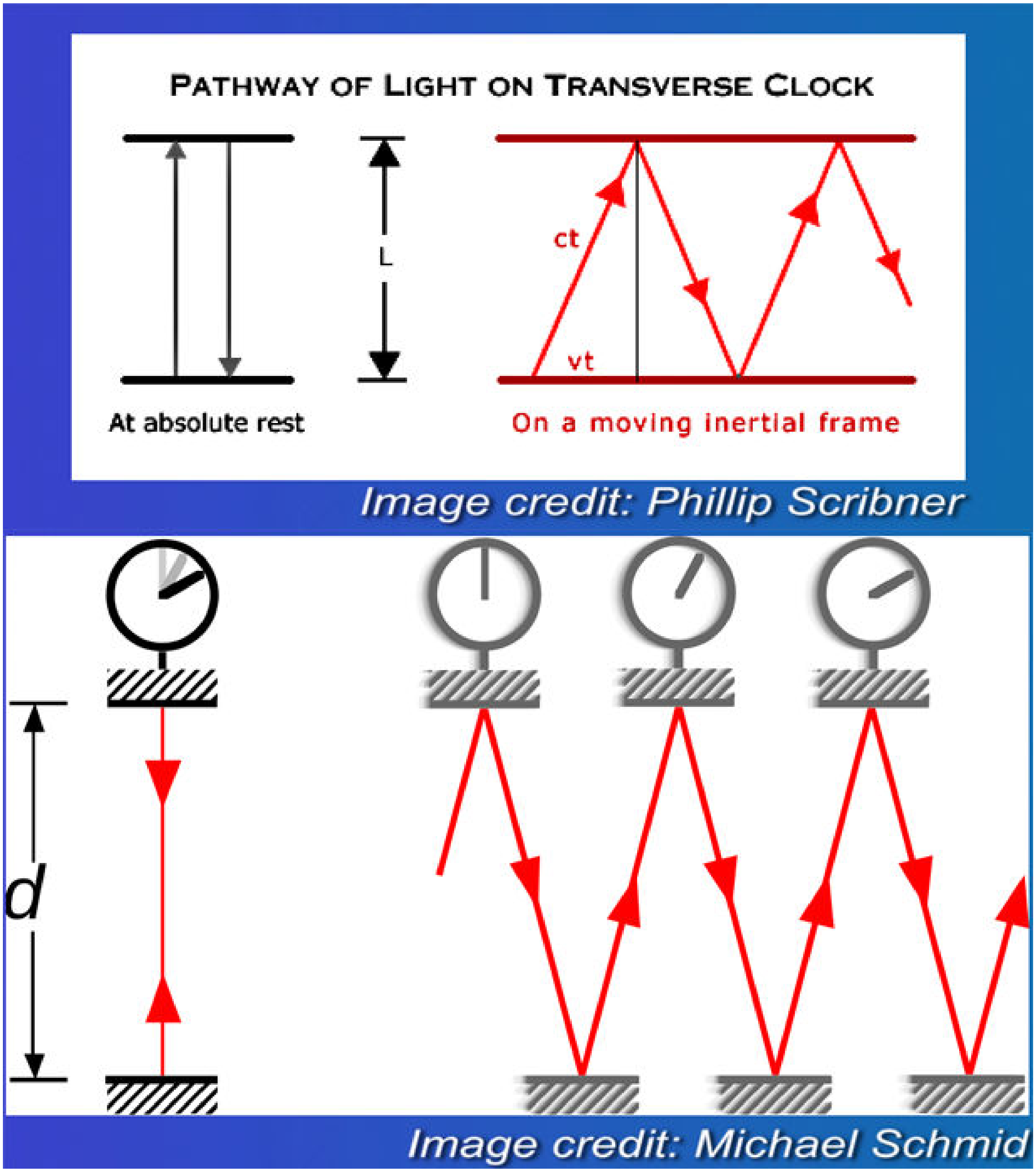
We have to mention at this point that most of the texts about relativity described incorrectly the transverse path of a photon perceived from the mobile frame:
For comparison, please see first our correct representation in Figure 4C (which is a snapshot from the simulation video at: http://youtu.be/0ed5CCP0eMg) :

Figure 4C



Then, please see two incorrect representations in Figure 4D. We can clearly see that the paths of the light are represented as if they move along with the mobile frame, and that is incorrect because light moves independently from any frame. In order to obtain the paths in the mobile frame as in the two pictures of the Figure 4D, the emitter should change the **direction of emission** (a case which is also simulated in the video at: http://youtu.be/0ed5CCP0eMg). However in that case the direction of the path seen in the stationary frame would be different from the representations as well, which proves our point: those representations are wrong (and unfortunately they appear in almost every text that presents or supports Einstein's theory):

Figure 4D

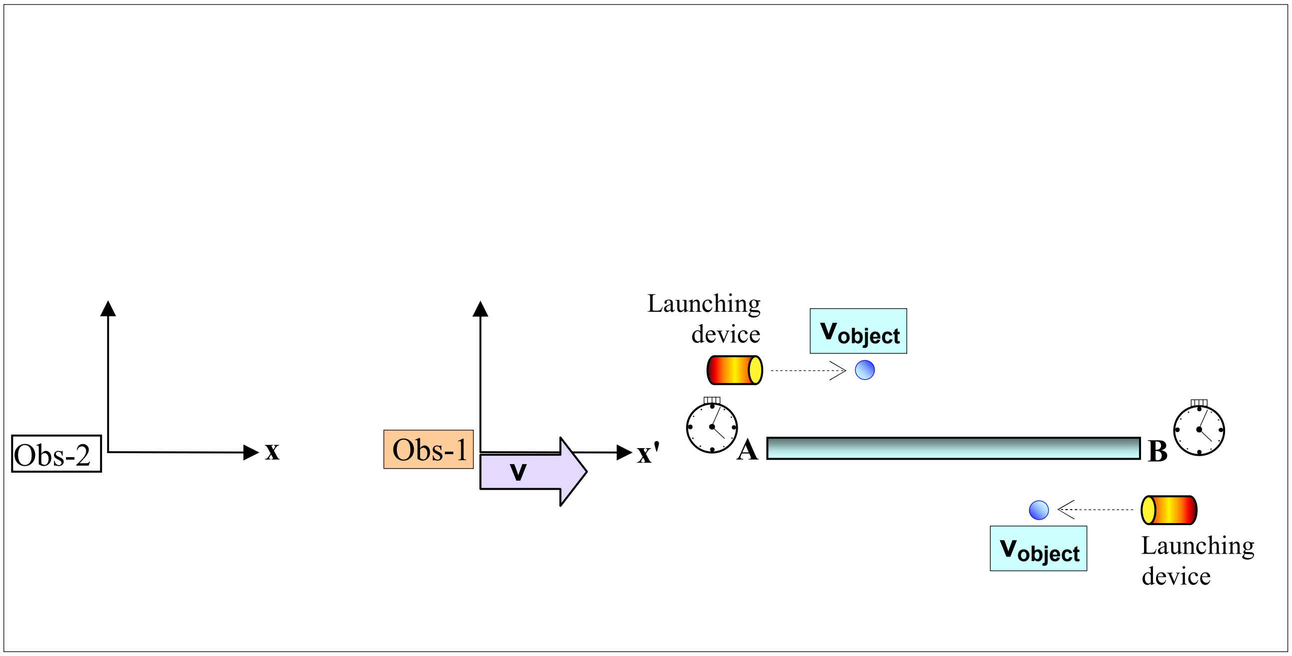


<u>**1.2.3.** A correct method to synchronize two clocks</u>

In order to have a correct synchronization method valid in any reference frame **we need to transport the means of synchronization along with that frame**.

An example of such a method would use two identical mechanical devices placed one in point A, and the other one in point B, and each device would launch an inertial object (such as a projectile) in uniform linear motion towards the other device, as in Figure 5 :

Figure 5



The fact that the frame of Obs-1 is moving with a velocity **v** from another frame's perspective (Obs-2), is not affecting the synchronization method. The projectiles, as inertial objects within an inertial reference frame, are carried along with that frame.

The inertial objects will reach the clocks respectively, and they will travel the path between the clocks in equal period of times, provided their velocities are equal in magnitude within the frame of the clocks.

For more realistic representations see the videos at http://youtu.be/0ed5CCP0eMg , http://youtu.be/H2qYCvw1UiE , and also Figure 6A and Figure 6B.

Figure 6A

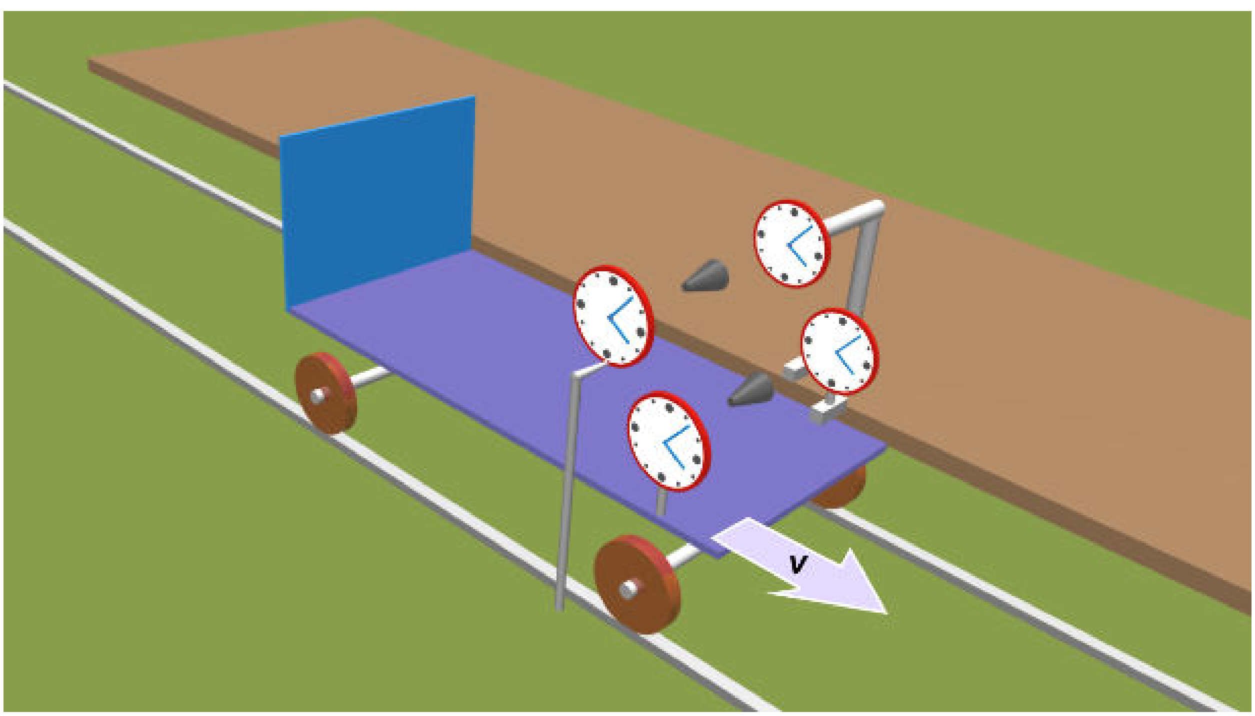
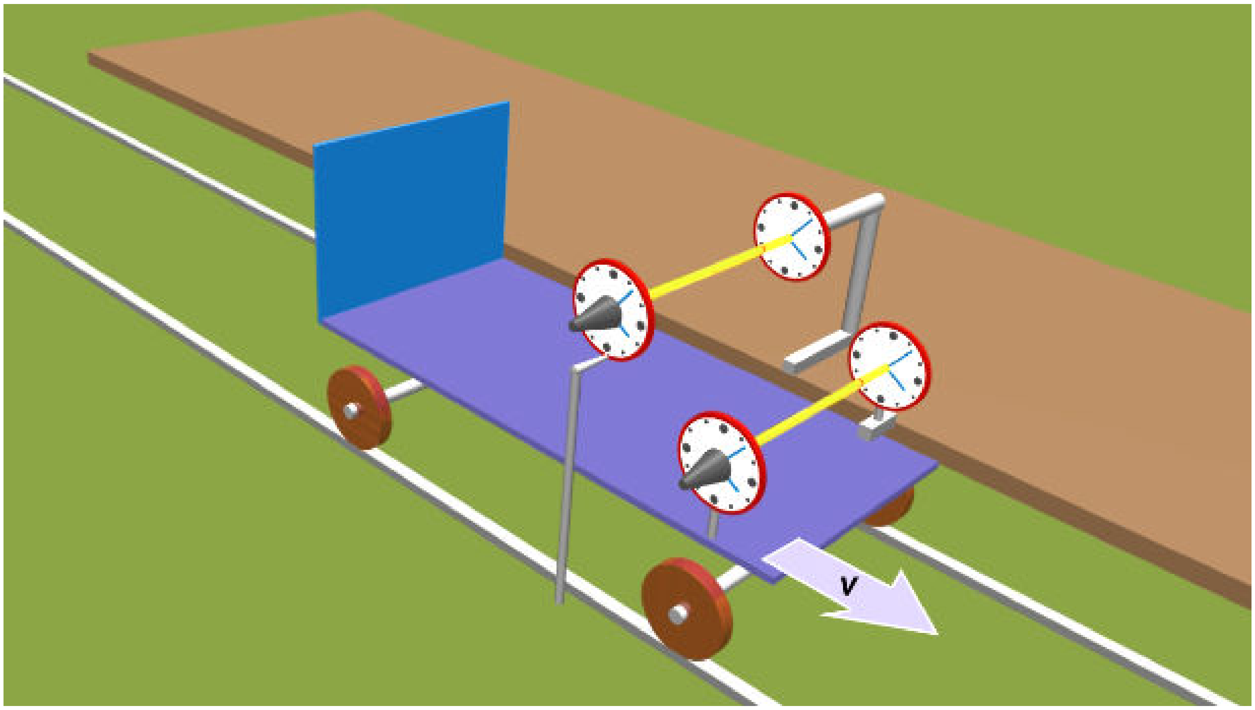


Figure 6B



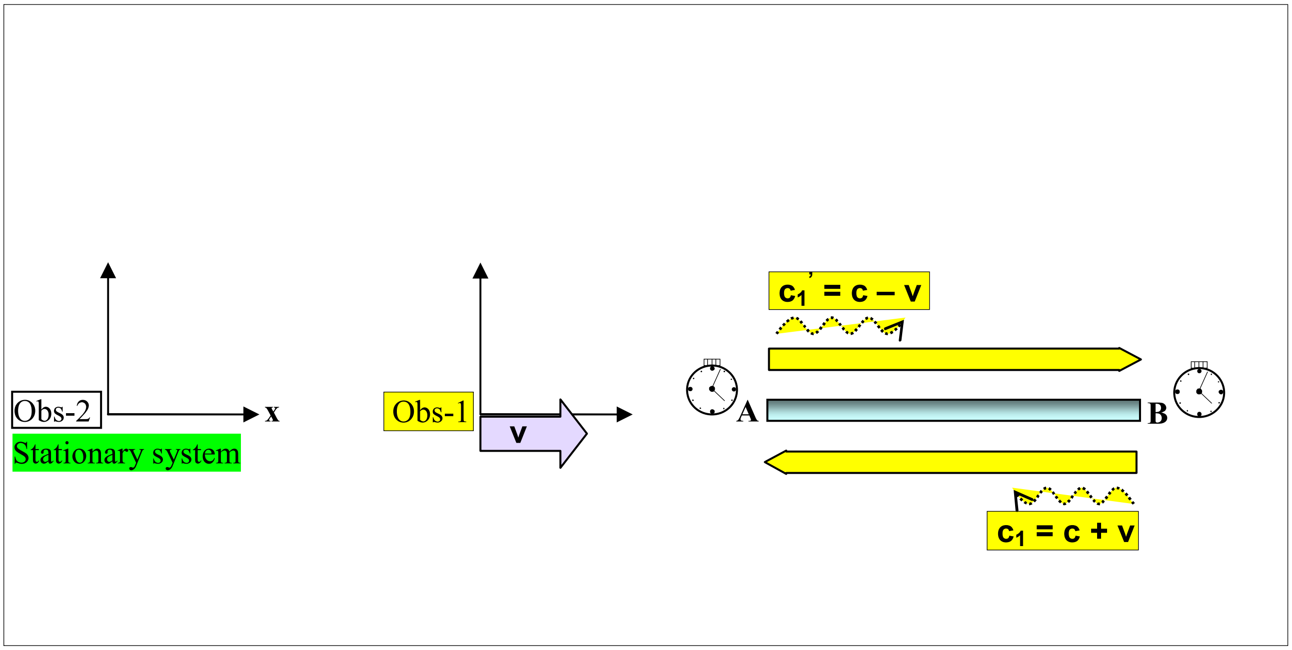
1.2.4. Simultaneity of two events

After defining the synchronization method in STR, Einstein brought into discussion the motion of an object relative to the "*stationary*" system (see the section "*On the Relativity of Lengths and Times*" **[1]**), with the very purpose of demonstrating that the events happening in two different frames cannot be considered **simultaneous** in both frames (because in his findings the clocks could not be synchronized across the frames, based on his synchronization method, which we already found as being incorrect).

Basically, the length of a rigid rod is measured in the "*stationary system*" and it is assigned the value L. Then the rod is set in "*uniform motion of parallel translation with velocity v along the axis of x*" of the **stationary** system of co-ordinates.

The observer mentioned by Einstein (in the section *"On the Relativity of Lengths and Times"* of STR **[1]**) is noted as Obs-1 in Figure 7 here.

Figure 7



Applying the synchronization method based on the motion of a ray of light, Einstein noticed that in the moving system the time taken by light to travel from point A to point is not equal to the time taken to travel form B to A:

$$t_B - t_A = \frac{r_{AB}}{c - v} \qquad \text{and} \qquad t'_A - t_B = \frac{r_{AB}}{c + v}$$

As Einstein found, and as we also found in section 1.2.2. , it is obvious that

$$t_B - t_A \neq t'_A - t_B$$

And as mentioned before, surprisingly Einstein found that the Obs-1 in the mobile frame measures different velocities of light:

c + v is the velocity of light on the direction from A to B
c – v is the velocity of light on the direction from B to A

However, in Einstein's view, those velocities cannot be "correct" or valid in the mobile frame because: as the clocks have been synchronized in the stationary system, they indicate the stationary system's "time", but within the mobile frame the clocks can no longer be synchronized with each other (again, that was in Einstein's view, using his synchronization method).

Our argument to that is again the definition of a clock as a counter of time units:
Even though they have been set in motion and presumably their time units and counting process might have become different within the mobile frame, both clocks are identically affected in their new state (in motion, along with the mobile frame), therefore they function identically: **they still show the same count, after each and every time unit, therefore they remain synchronized to each other**.

That means their time counts are still simultaneous, and so, considering the expressions above, the measured velocities of light in the mobile frame are not equal; they are not constant.

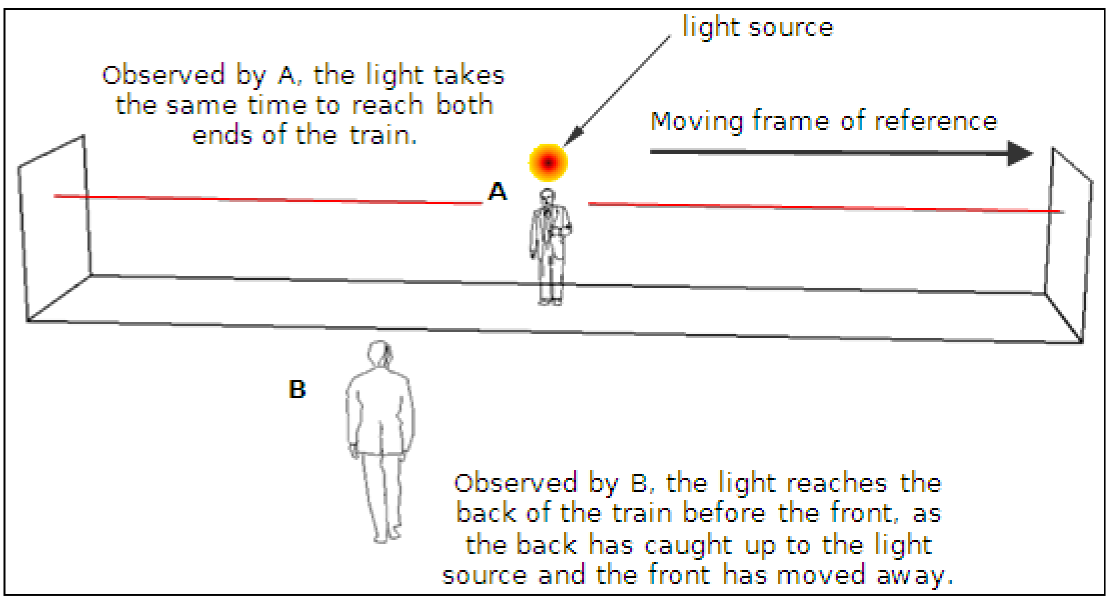
We must also add that, as proved in section **1.2.3.** , the clocks in the mobile system can be further synchronized in the mobile frame, using an inertial method.

That means the mobile system has the means to synchronize the clocks, to determine correctly the velocity (which can be variable on different directions within the frame), and finally to determine correctly the simultaneity of events in synchronicity with determinations made within other reference frames.

One important observation on the subject of simultaneity:

Many texts which present Einstein's STR use an imaginary experiment involving the emission of light from the middle of a car into two opposite directions towards its ends, respectively, as the car moves from a "stationary" platform.
In the pictures which accompany those text, we can always see **an incorrect representation of the paths of the light** (therefore an incorrect consideration, which invalidates those texts). Those texts claim that the observer on the car would perceive both light signals as reaching the opposite ends of the car simultaneously.
For example, see Figure 7A here:

Figure 7A



*(**image source**: http://www.boredofstudies.org)*

We are able to contradict that idea, as we can see in our video simulation (http://youtu.be/XZ9hPwoTyC0) that the photons emitted and observed on the car would never reach both ends of the car at the same time.

Therefore a correct representation of that fact, (which invalidates Einstein's considerations as well) would be one as in Figure 7B and Figure 7C here:

Figure 7B

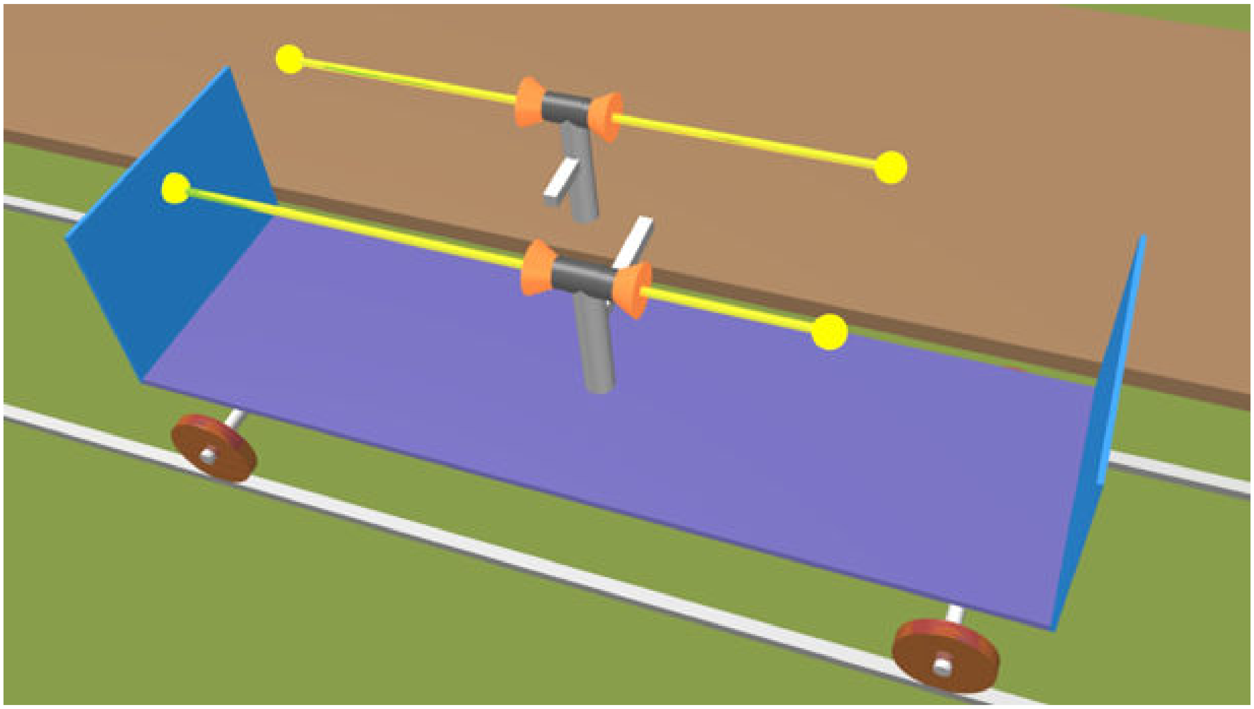
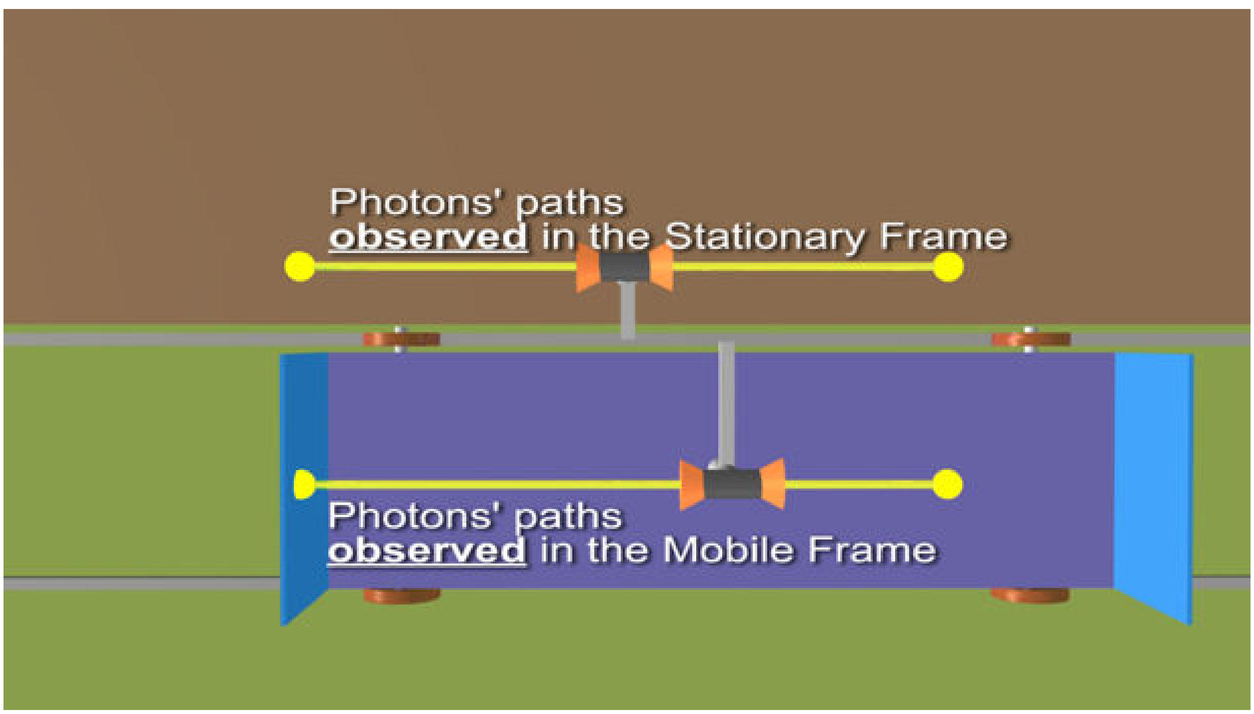


Figure 7C



1.3. Conceptual errors - part 3: Contradiction in using the velocity of light both as a constant and as a variable

The sequence of contradictions in Einstein's text **[1]** is puzzling:

1. First he stated that the velocity of light is a universal constant, and he chose light as a method of synchronization.

2. Then he concluded that two clocks cannot be synchronized because their reference frame is moving away from another reference frame, and as a consequence the times taken by light to travel the distance between the two clocks are different in the two opposite directions of the line between the two clocks. However that means something which Einstein overlooked: that **the velocity of light is not constant, as measured in two opposite directions in the moving system**, as showed in the section **1.1.1.** above. This contradicts point 1 aforementioned.

3. Then he assumed that time must have different values in those two different reference frames respectively, following the wrong conclusion that the clocks cannot be synchronized in the moving frame as they would be in a stationary frame.

4. Further he developed the equations for transforming time values and space coordinates between two reference frames in motion from each other; but by transforming the time values between a reference frame and itself, Einstein found that **the velocity of light would be constant in the moving system**, which means the clocks could actually be synchronized in the moving reference frames, and that contradicts point 2 aforementioned.

1.4 Conceptual errors - part 4: The paradoxes

1.4.1. The famous "Twin Paradox"

In the "twin paradox" **[11]**, two clocks (Clock-1 and Clock-2) would be initially together and synchronized in point **A**, and then the Clock-2 is set in motion from the place they were together. The Clock-2 makes a trip to a point **B**, and then it returns back to the initial point **A** to be again together with Clock-1.

According to Einstein's theory, any motion of the Clock-2 away from Clock-1 would incur a lag on its "own time":

"*From this there ensues the following peculiar consequence. If at the points A and B of K there are stationary clocks which, viewed in the stationary system, are synchronous; and if the clock at A is moved with the velocity* **v** *along the line AB to B, then on its arrival at B the two clocks no longer synchronize, but the clock moved from A to B lags behind the other which has remained at B by* ½ $\mathbf{tv^2/c^2}$ *(up to magnitudes of fourth and higher order),* **t** *being the time occupied in the journey from A to B.*" **[1]**

As in the "twin paradox" setting, we move the Clock-2 on two trips (**A**-**B** and then **B**-**A**), and according to STR we should observe a lag of Clock-2 on each trip, and so, in the end we will notice a sum of those lags on Clock-2 when it is back together with Clock-1.

In short, Einstein's theory finds that the time "flows" slower for the objects in motion from other objects.

There are no valid explanations to this paradox, as all the attempts made so far tried using non-inertial concepts and methods (e.g. Hafele–Keating experiment **[12]**). In our opinion such an explanation is conceptually wrong, since STR is referring to inertial reference frames only – that is, there is **no acceleration involved**.

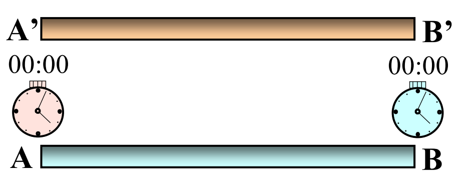
As the lack of explanations wouldn't be enough to disprove STR, we notice here another aspect of this paradox: the mathematical contradiction involved in Einstein's conclusion seems to be systematically ignored.

As Clock-2 moves away from Clock-1, that means Clock-1 moves away from Clock-2 and their respective reference frames are equivalent (see Figure 8).

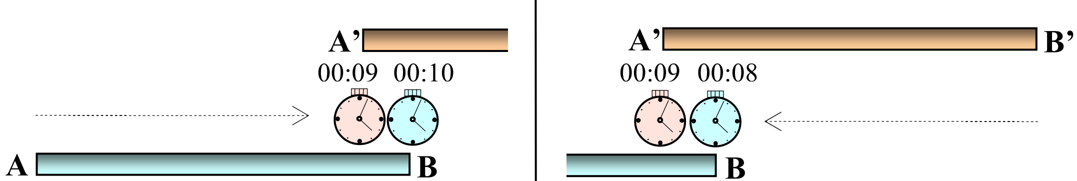
We can choose either frame to be the "stationary" while the other is the "mobile" frame. Even Einstein mentioned it:
"[…] the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good." **[1]**

That means that if we apply Einstein's conclusion aforementioned, in the end (when the clocks are back together) the time $\mathbf{T_2}$ of the Clock-2 will be delayed from the time $\mathbf{T_1}$ of the Clock-1 ($\mathbf{T_2 > T_1}$). And **also**, the time $\mathbf{T_2}$ of the Clock-2 will be delayed from the time $\mathbf{T_1}$ of the Clock-1 ($\mathbf{T_1 > T_2}$).
So when the clocks are back together we will have: $\mathbf{T_2 > T_1}$ **and** $\mathbf{T_1 > T_2}$, and that is mathematically impossible!

Figure 8



*The clocks' frames of reference are **equivalent**: the clock at **A** moving toward the clock at **B** is equivalent with the clock at **B** moving toward the clock at **A**.*
In the end we should obtain only one pair of time values, not two!



In another scenario, it would be perfectly possible to have, **by chance** in the beginning, the two clocks being apart and their time units and time values being identical; just like that, by **coincidence**. According to Einstein's reasoning, when the clocks are brought next to each other, their time values should be delayed in the past from each other. Which means they should be, from both each other clock's perspective, in the future from each other. And that is, again, mathematically impossible.

1.4.2. The Reciprocal Lengths Paradox

According to Einstein, if we measure a length in two different inertial reference frames, the values of that length in each frame are not equal. Let's consider $\mathbf{L_A}$ the value of the length in the first frame, and $\mathbf{L_B}$ the value in the second frame, and we will find that $\mathbf{L_A > L_B}$. However according to the first postulate of STR, the frames are equivalent to each other, so applying Einstein's equations we will find that $\mathbf{L_B > L_A}$ as well:

In short, $\mathbf{L_A > L_B}$ **and** $\mathbf{L_B > L_A}$

This is another mathematical contradiction which disproves Einstein's STR as well.

1.5 Conceptual errors of STR - Conclusions

A few important conclusions of this section:

- The purpose of measurement is practical: to determine lengths, time intervals and velocities inside of a reference frame. The same **length units** and the same **time units** can be used in 2 different reference frames.

- Time is measured by counting. A clock is a device that counts time units. Two identical clocks that were synchronized while stationary within an inertial frame will remain synchronized if both of them are set in inertial motion along with a different frame, as the laws of physics affect their counting functionality identically.

- The synchronization method used by Einstein is incorrect, because light is an independent non-inertial phenomenon which is not correlated to anything belonging to an inertial reference frame. Instead of it, NCTR proposes here the inertial synchronization, as a correct method.

- The value of velocity of light is not a constant among different reference frames, because it depends on the motion of the observer who measures it. Even Einstein used inadvertently a variable velocity of light in one reasoning of his.

- Einstein overlooked the experiments that were meant to put in evidence the motion of Earth relative to an absolute frame of reference (e.g. Michelson-Morley type of experiments). Other physicists had been considered them for decades **[5]** .

Practically the matter of the Neo-Classical Relativity theory, as well as the matter of Einstein's Special Relativity Theory, is just about expressing the velocity of an object in different reference frames.

Simply put, Einstein concluded that the times and lengths vary from a reference frame to another, while the velocity of light remains the same.

On the contrary, the Neo-Classical Theory of Relativity (NCTR) here proves that the time values and lengths can be **shared** by any two inertial reference frames, while keeping the composition of velocities as it was defined in the Classical Mechanics.

NCTR is conceptually correct and also correct for the practice of measurement.

Also NCTR shows the independence and the non-inertial characteristics of light, opening a way to understand the actual phenomenon of propagation of light through space.

Einstein's theory is incorrect conceptually, logically and practically, and offers no physical explanation on "why" the things are in the way stated in his theory. It hinders the understanding of propagation of light through space, and it hinders the understanding of the propagation of particles or macroscopic objects at velocities close to the velocity of light in magnitude.

The Neo-Classical Relativity theory relies on the concepts of Classical Mechanics, and it proves the utility of the idea of an Absolute Frame of Reference – which is the Stationary Frame that we define here, along with suggested procedures for determining it experimentally.

2. The experimental basis of Einstein's Special Theory of Relativity revisited

Einstein's STR begins directly with an abrupt rejection of "the idea of absolute rest": "…*unsuccessful attempts to discover any motion of the earth relatively to the "light medium," suggest that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest.*" **[1]**

Although Einstein did not specify what those "*unsuccessful attempts*" were up to that date, most of the textbooks that followed Einstein's theory have considered the experiment performed in 1887 by Albert Michelson and Edward Morley **[2]** as the only experiment that represents (in their views) the failure of searching for the absolute frame of reference.

In reality, many experiments similar to the Michelson-Morley's (M-M) experiment had been performed in the first 30 years of the 20th century.
Here are two very important (yet quasi-unknown) facts about those experiments:

- Most of the M-M type of experiments had non-null results. That means, generally speaking, that the **M-M type of experiments were never complete failures**.

Fortunately, this affirmation has been diligently proved by Professor Héctor A. Múnera (Centro Internacional de Física, Bogotá, Colombia). In his articles, Professor Múnera describes the errors that accompanied the major M-M experiments **[3]**, **[4]** . Please read those articles for more details and for his demonstrations and considerations on the absolute space.

- The fact that the results of the M-M experiments were not even close to the theoretical expectations led most of authors to the false conclusion that all the M-M experiments failed.

Therefore, this class of experiments (named of "**second-order effect**") had the same fate with other experiments (of "**first-order effect**"), as described by Lorenz in 1927: "*The conviction that first-order effects do not exist became by and by too strong. We even got, finally, into the habit of looking only at the summary of the experimental papers which dealt with such effects. In case the result was properly negative we felt perfectly satisfied*." **[5]**

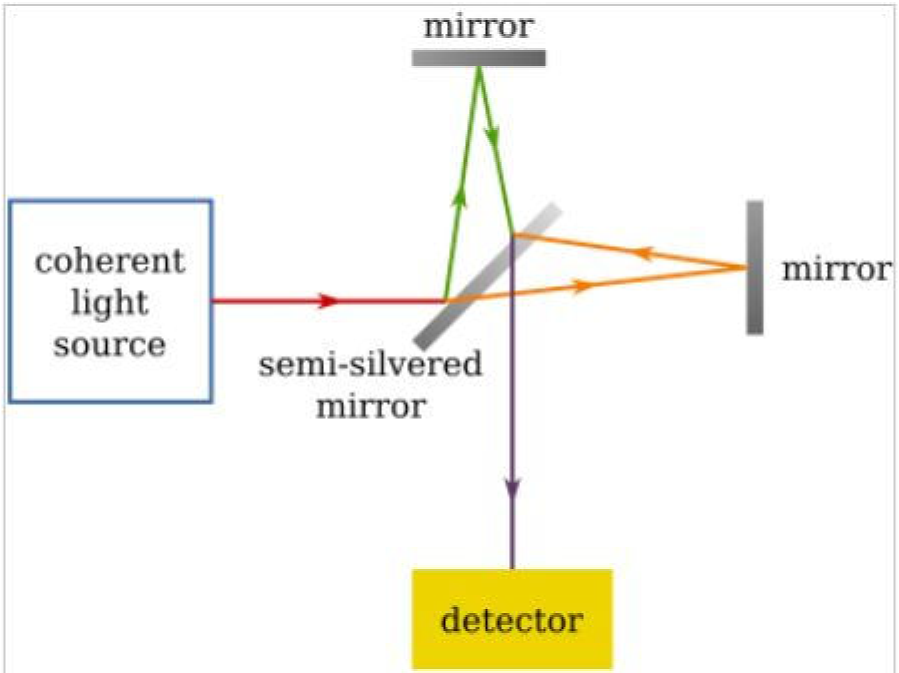
A clear description of this situation can be found in the same article **[5]**, given by Dayton C. Miller (p.354):

"*We had definite pictures in our minds as to what should happen. We calculated the magnitude and azimuth of the effect from the theory and discussed our experimental results in relation to these specific expectations. In every case we found that the result was negative as to these expectations. But* ***it was never numerically zero, not even in the original Michelson and Morley experiment****. It was zero in so far as the motion of the earth in its orbit is concerned.* ***The remaining effect, however, was large enough to be measured****. Experiments were performed to prove that it was not due to magnetic deformation of the frame, nor to temperature disturbances, since the effect was systematic.*"

2.1. Why did the M-M experiments' results have a too small magnitude?

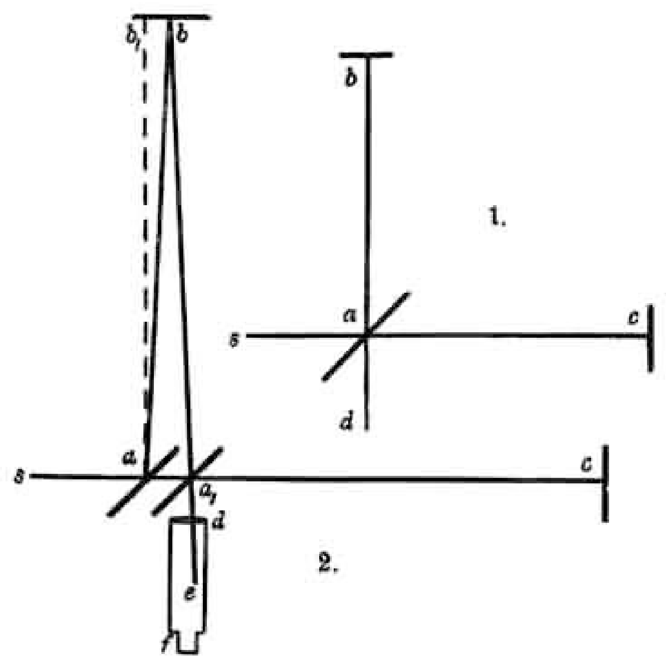
Many textbooks and articles (e.g. **[7]**) which describe the Michelson-Morley experiment show a diagram similar with this one in Figure 9 :

Figure 9



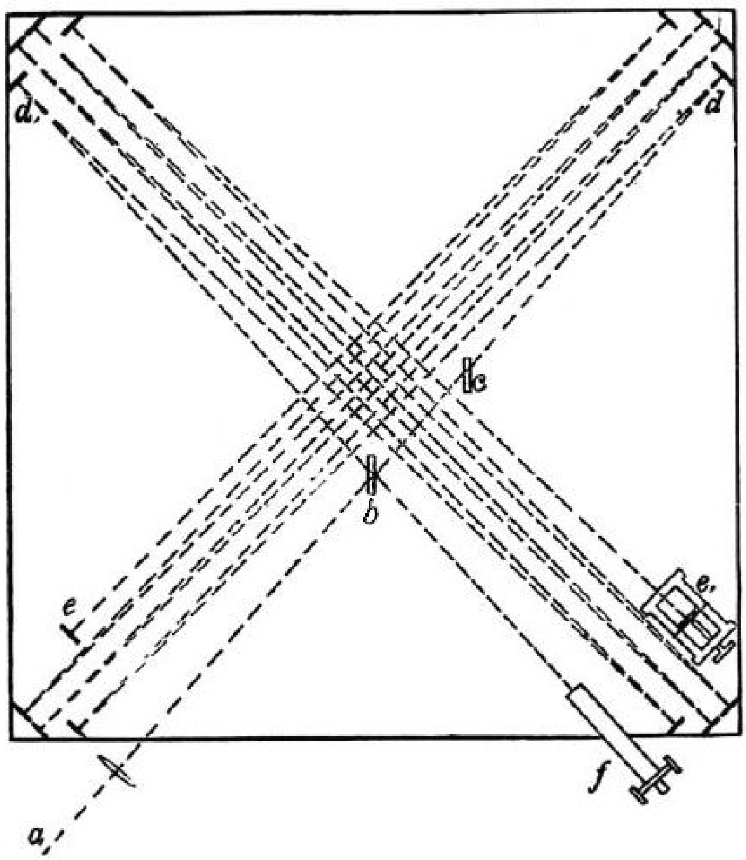
We can also see a picture similar to the original one which described the experiment, as in Figure 10 here:

Figure 10



Both Figure 9 and Figure 10 are useful to understand the experiment, however, in reality the device used in the M-M experiment was quite different, as we can see it in the picture of the original article of Michelson and Morley **[2]**, reproduced here as Figure 11 :

Figure 11



As we can see in Figure 11 , the structure of the real device was much more complex.

From point ***a***, the initial beam is split in 2 beams by the half-silvered mirror in point ***b***, so the 2 beams will follow 2 long paths: Path-1: ***bdedbf*** and respectively Path-2: $bd_1e_1d_1bf$. In point ***f*** there is a telescope for observing the 2 beams interfering.

Let **ΔT** be the difference between the total time that light takes to travel Path-1 and the total time that light takes to travel Path-2.

It *seems* obvious that the device contained so many mirrors for the purpose of making the paths of the beams longer. In theory, the longer the paths are, the greater the difference **ΔT** is. And from that, the displacement in the interference fringes is greater, which means that the displacement is observed and measured better.

The intention of simulating long paths was good, but did the experimenters really obtain long paths for the interference effect which they wanted? Not really, unfortunately.

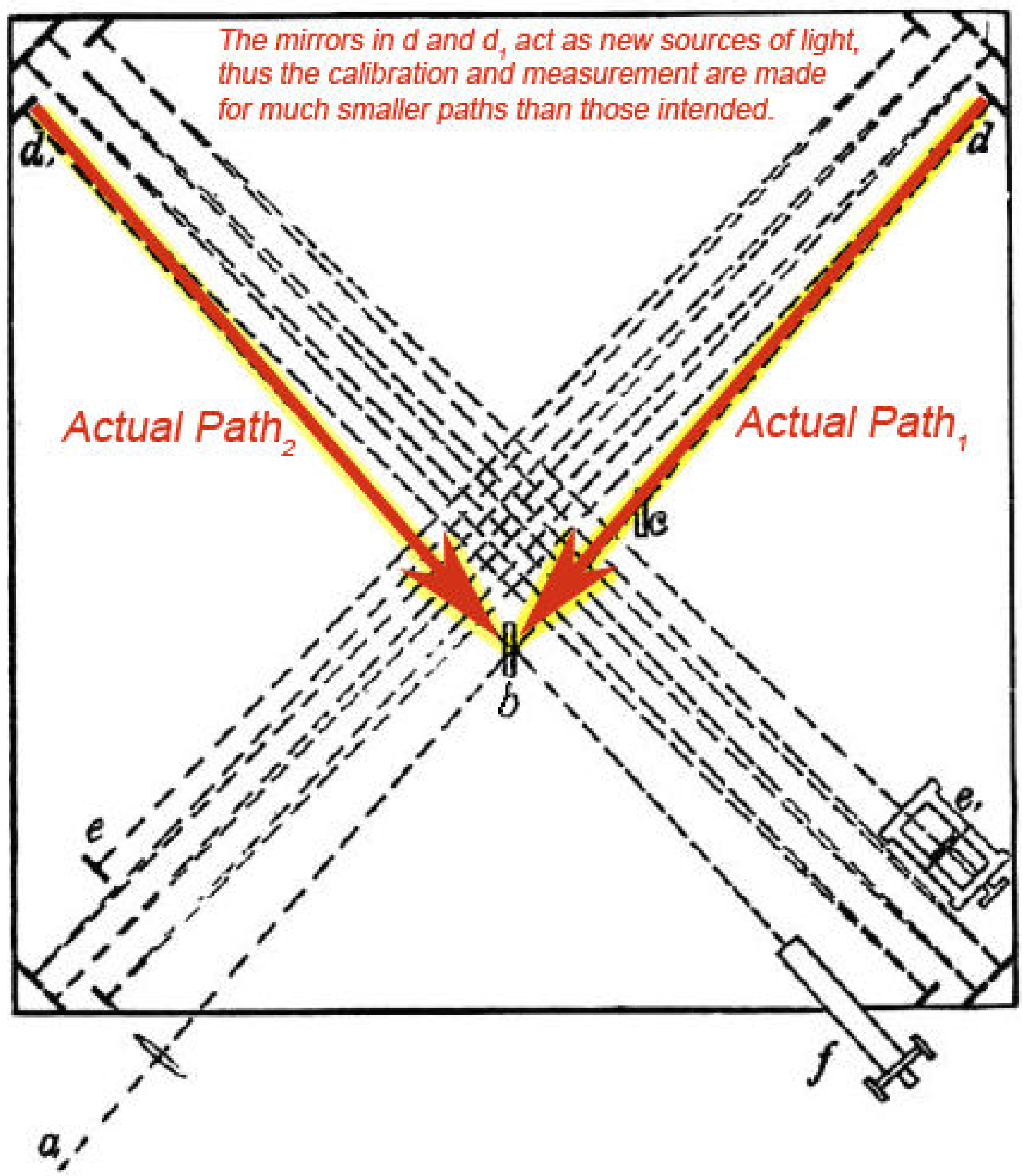
Our explanation here is that the experimenters actually calibrated the device for two much shorter paths:

Actual $Path_1$ - the path ***db*** of a photon intended to go on the segments ***dbf***, and
Actual $Path_2$ - the path d_1b of a photon intended to go on the segments d_1bf.

Generally speaking, the photons of visible light don't just bounce against the mirrors – they are absorbed and then immediately generated by the mirrors.

Therefore in the M-M experiment the last reflections on points ***d*** and respectively ***d_1*** act as **new sources of light**. The reflected photons are newly generated there, and they move towards point ***b*** where they interfere – see Figure 12 .

Figure 12



The total time difference **ΔT** between the rays traveling those 2 long paths (each measuring about 16 times a diagonal) is actually composed by the **sum** of the smaller time differences **Δt** between pairs of perpendicular rays corresponding to each pair of mirrors.

However, the **calibration was made for the last segment**, where the new photons generated in points ***d*** and ***d_1*** had interfered in ***b*** and produced the initial fringe pattern whose position was set as reference – and which had a zero displacement from itself, logically.

After rotating the device by 90^o, the fringe displacement corresponds to the last **Δt**, not to the whole **ΔT** incorrectly expected by M-M.

Consequently, instead of having an interference pattern displaced for the total **ΔT** corresponding to the light traveling on paths, we actually obtain a displacement corresponding to the much smaller paths Actual $Path_1$ and Actual $Path_2$ which measure about half of a diagonal each:

$$\mathbf{\Delta t} = \frac{\frac{\mathbf{\Delta T}}{\mathbf{16}}}{\mathbf{2}} = \frac{\mathbf{\Delta T}}{\mathbf{32}}$$

Therefore the observed fringe displacement should actually be about the thirty-second part of the displacement expected incorrectly by M-M.

In their article **[2]** Michelson and Morley noted that their observed fringe displacement was "*probably less than the fortieth part*" of the expected displacement.

That means our explanation here covers significantly the discrepancy between the expectation and the observation.

It is also important to note that the M-M experiment incurred other systematic errors, as professor Múnera **[3]** demonstrated in his article. Some of the errors involved the component of the velocity of Earth on the very plane of the device. Other errors were related to the way the observations' data were processed.

We can conclude here that a Michelson-Morley type of experiment can actually show and prove the relation between the velocity of Earth and the measured velocity of light, provided that the findings of this document and professor Múnera's document are taken into consideration before building a device for such an experiment.

Also our findings here support professor Múnera's and other physicists' works regarding the evidence of an absolute frame of reference. We affirm that the motion of Earth within an absolute frame of reference was shown even in the original M-M experiment, but it was miscalculated since the inception of the experiment and it was carelessly misinterpreted afterwards.

(It is also worth mentioning here the work of Paul Marmet **[9]** which affirms that a null result of the M-M experiment was actually in agreement with Classical Mechanics. Although it is contrary to our results presented here, Paul Marmet's demonstration is important for showing the complexity of the phenomena involved in the Michelson-Morley experiments, a complexity that has been ignored or overlooked for more than a century now.)

2.2. Was the velocity of light ever measured correctly?

We showed in the section **1.** here that in theory and in simulations the velocity of light is not a constant across different reference frames.

However we should still ask if experimentally the velocity of light was ever measured correctly, because ultimately an experiment dedicated to this question should decide whether we are right or Einstein is right in his second postulate of STR ("*… light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body*." **[1]**)

Unfortunately, the answer is that the velocity of light has never been measured **accurately** from a source of light to an observer (**one-way**).

To be clear in this document, **one-way** means: "one photon of light emitted, one time interval measured, one way measured".

In our opinion, the experiments that use multiple electromagnetic (EM) pulses sent **approximately** in the same direction shouldn't be considered one-way experiments. For example (see **[10]**), the experiment involving radio waves coming from pulsars fails to even realize that 2 separate pulses coming from the same source in 2 distinct moments behave exactly like 2 separate pulses coming from 2 different EM sources. The big conceptual error there is that we don't know for sure what exactly happens with those 2 EM sources (in this case their equivalent - a pulsar).

So far, all the precise determination of the velocity of light either:

- extremely minimized the effect of the observer's motion (as a *first-order effect*), by measuring on a round-trip (two-way) path: **source -> distant mirror -> observer** (and the observer is very close to the source), or
- disregarded the path entirely and determined the wavelength by interferometry procedures.

In conclusion, the second postulate of Einstein's STR has **never** been verified **experimentally**.

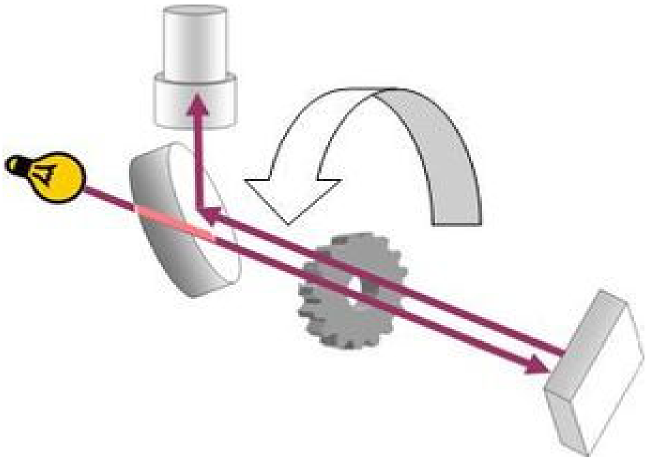
The lack of experiments also induced erroneous consequences in the conception of the Special Theory of Relativity.

2.2.1. Why the value of ***c*** measured in **two-way** experiments is a constant

Let's consider an observer who is trying to measure the velocity of light by using the Fizeau–Foucault apparatus **[8]**. We can see a simple and good schematic of that apparatus in Figure 13:

This is a classic **two-way** experiment: the photon of light goes from the source to the mirror, and then back to the observer (which is located close to the source).

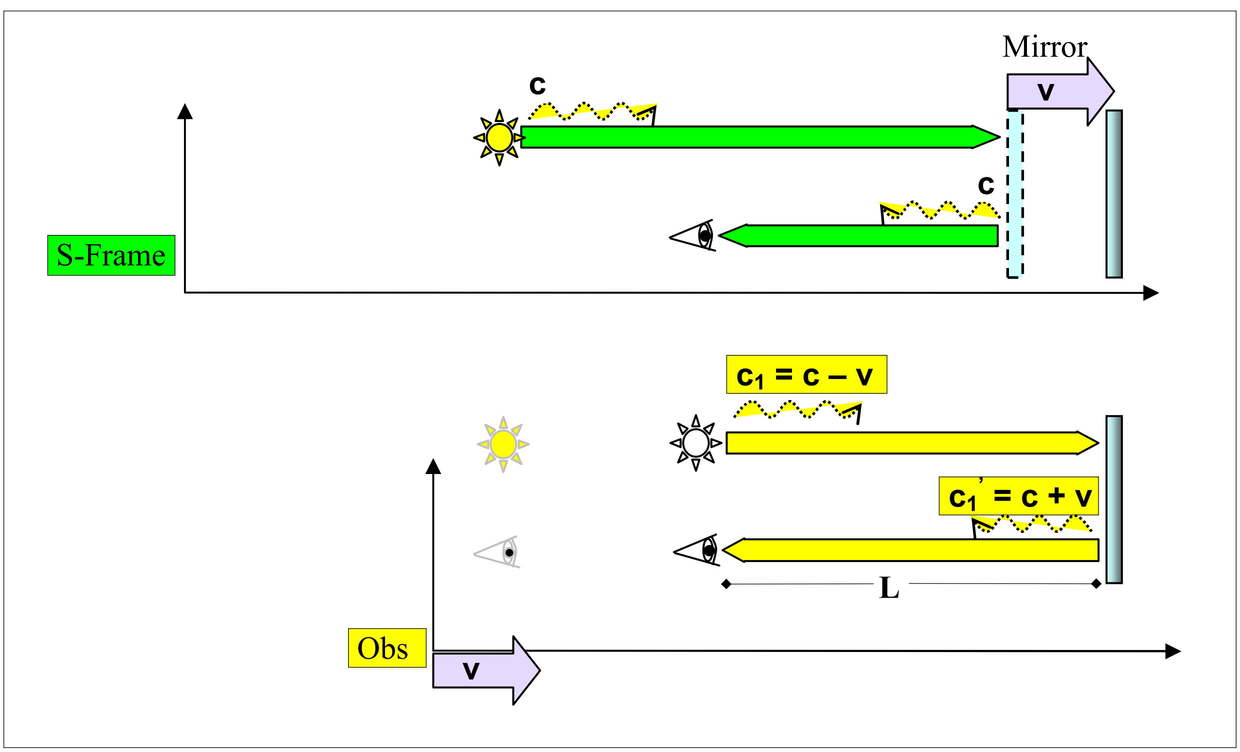
Figure 13



We are assuming that the observer (Obs), the source of light and the mirror are within a mobile frame which moves with the velocity **v** away from a stationary frame (S-Frame), in the same direction with the photon emitted by the source.

Also, we know from section **1.1.1.** that in the stationary frame the value of the velocity of light is constant in any direction of the stationary frame, and let's note that value as ***c*** .
In Figure 14 we can see how the trajectory of the photon appears in a stationary frame: the part from the source to the mirror is longer than the part from mirror to observer, as the mirror moves away from the photon, and the observer moves towards the photon.
In the observer's frame both parts of the trajectory aforementioned appear equal, as the distance between Obs and the mirror is not changing.

Figure 14



In the reference frame of Obs we will measure an effect proportional with **ΔT**, the total time taken for the time pulse to go on the whole path: source – mirror – observer.

$$\Delta T = \frac{L}{c+v} + \frac{L}{c-v} = \frac{2L}{c\left(1-\frac{v^2}{c^2}\right)}$$

It is obvious that ΔT will contain a value that will depend on **c**, but it will vary very little with **v**.

For example, if **v** would be 30 km/sec as it would be assumed for Earth, and **c** would be 300000 km/sec, then v^2/c^2=0.00000001 . That is a very negligible component in this kind of experiment, and practically it is hard to distinguish it from other observational errors of the experiment.

So from the equation above, the measured velocity of light in this kind of experiment is always:

$$c_m \cong \frac{2L}{\Delta T} \cong c$$

In other words, the velocity of light determined on Earth by **two-way** experiments is always very close in value to the velocity of light in a stationary frame, however it does not represent correctly the actual value of velocity of light sent and observed in only **one direction** from Earth – which value should be composed with the component of **v** on that direction, as shown above.

2.2.2. The absolute velocity of light: *c*

Let's have an observer Obs-1 who measures the velocity of light c_1 of a pulse which comes towards him, and let's have an observer Obs-2 who moves away from Obs-1 with the velocity **v** and against that pulse of light, as in Figure 15.

The velocity of light measured by Obs-2 will be:

$$c_2 = c_1 + v$$

Now from Obs-2 perspective it seems that that pulse of light and Obs-1 go in the same direction with each other.
It's easy to imagine that another observer Obs-2' who moves in an opposite direction from Obs-2 with a velocity greater than **v**, will get away from Obs-1 but will perceive that Obs-1 and the c_1 pulse of light move in opposite directions (!)

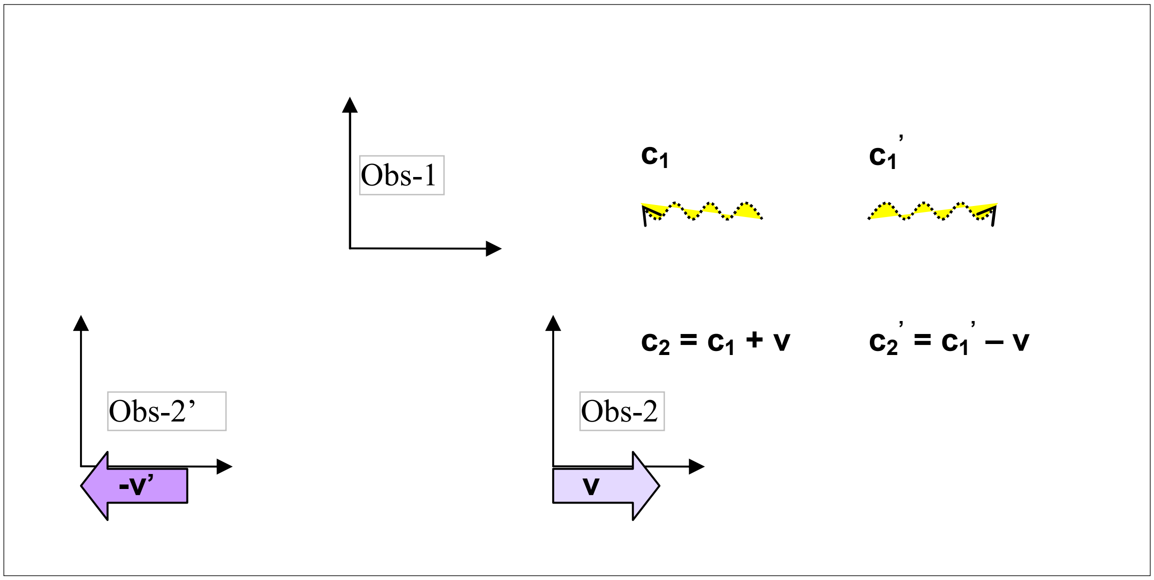
Therefore it seems that in this configuration we cannot describe well **the motion of a frame relative to the light pulse**, even though we use observers in two distinct frames.

For that reason we will attempt to find a **special frame of reference** that allows us to describe the motion of any other particular frame in relation to the motion of the light pulse, once the velocity of light is measured in that particular frame.

Let's consider a pulse of light that goes on the same line in an opposite direction to the one measured as $\mathbf{c_1}$ (see Figure 15). Its velocity will be measured as $\mathbf{c_1'}$ in Obs-1 frame and $\mathbf{c_2'}$ in Obs-2 frame, and we will find this relation between those two velocity values:

$$c_2' = c_1' - v$$

Figure 15



In this example $\mathbf{c_1}$ and $\mathbf{c_1'}$ can be different values that are just measured by Obs-1; we don't know yet if they are equal or not.

However, we notice this:

$$c_1 + c_1' = c_2 + c_2'$$

In other words, **the sum of the velocities of light measured in two opposite directions of the same line is a constant independent of any frame of reference.** Let's name that constant **W**.

$$c_1 + c_1' = c_2 + c_2' = W$$

So, for Obs-2, we can write:

$$c_1 = c_2 - v$$
$$c_1' = W - c_1 = W - (c_2 - v)$$

As a phenomenon, light presents certain constancy in many of its aspects, so we wonder if in a case similar to that of Figure 15 we can have a special frame where the velocity of light has an identical magnitude in any 2 opposite directions:

$$\mathbf{c_1 = c_1'}$$

We notice that the values of $\mathbf{c_1}$ and $\mathbf{c_1'}$ can be expressed using the values of $\mathbf{c_2}$, $\mathbf{c_2'}$ and $\mathbf{v}$, however, as $\mathbf{c_2}$ and $\mathbf{c_2'}$ are just values measured by Obs-2 which is within an arbitrary reference frame, we need only to see what the value of $\mathbf{v}$ is in this relation, in other words what is the actual velocity $\mathbf{v}$ of a frame (which measures $\mathbf{c_2}$ and $\mathbf{c_2'}$ within itself) that moves away from the special reference frame (which measures $\mathbf{c_1 = c_1'}$ within itself):

$$\mathbf{c_2 - v = W - (c_2 - v)}$$

$$\mathbf{c_2 = \frac{W}{2} + v} \quad \text{and of course,}$$

$$\mathbf{c_1 + c_1' = W} \quad \text{together with } \mathbf{c_1 = c_1'} \text{ implies that } \mathbf{2c_1 = W} \quad \text{and so} \quad \mathbf{c_1 = c_1' = \frac{W}{2}}$$

Let's note the constant $\mathbf{\frac{W}{2}}$ as $\mathbf{c}$.

We can write now:

$$\mathbf{c_2 = c + v}$$
$$\mathbf{c_2' = c - v}$$

This simply shows that the frame of Obs-2 moves on a line with the velocity $\mathbf{v}$ relative to a special reference frame in which the velocity of light has equal values $\mathbf{c}$ measured in both directions of that line.

As described before, $\mathbf{\frac{W}{2} = c}$ is a constant, so it is <u>useful</u> to relate the motion of any frame to that special frame. Thus, if we measure $\mathbf{c_2}$ and $\mathbf{c_2'}$ in the opposite directions of any line within an arbitrary frame then we can easily find out $\mathbf{c}$ and $\mathbf{v}$:

$$\mathbf{c = \frac{c_2 + c_2'}{2}}$$

$$\mathbf{v = \frac{c_2 - c_2'}{2}}$$

If we consider that the propagation of light happens in an identical fashion in any direction of the empty space (i.e. light as a phenomenon is isotropic), and also as we discussed all the above on an arbitrary line of an arbitrary reference frame (Obs-2), we can extend the above findings to conclude that it is possible to determine a special frame of reference in which the velocity of light measured in any direction is equal to $\mathbf{c}$.

We can name that special frame as the Absolute Frame of Reference (AFoR) and the velocity of light in AFoR as the absolute velocity of light noted as ***c.*** AFoR is the same frame with the stationary frame defined here in the section **1.1.1.** .

2.2.3. Measuring the velocity of light properly in any inertial reference frame

2.2.3.1. Measuring the velocity of light in a one-way experiment.

This method seems simple; however the enormous value of the velocity of light raises big technological challenges for this kind of experiment:
A light pulse is sent from a point A to a point B, and we need to mark the *exact time in A* when the pulse is generated, and the *exact time in B* when the pulse is received. Knowing the *exact distance* between A and B we can obtain the velocity of light on the direction AB between time-in-A and time-in-B:

$$\mathbf{c_1 = \frac{D_{AB}}{T_{AB}}}$$

Whether or not the current technologies allow us to do such determinations remains to be researched.

2.2.3.2. Measuring the velocity of light using the aberration of light.

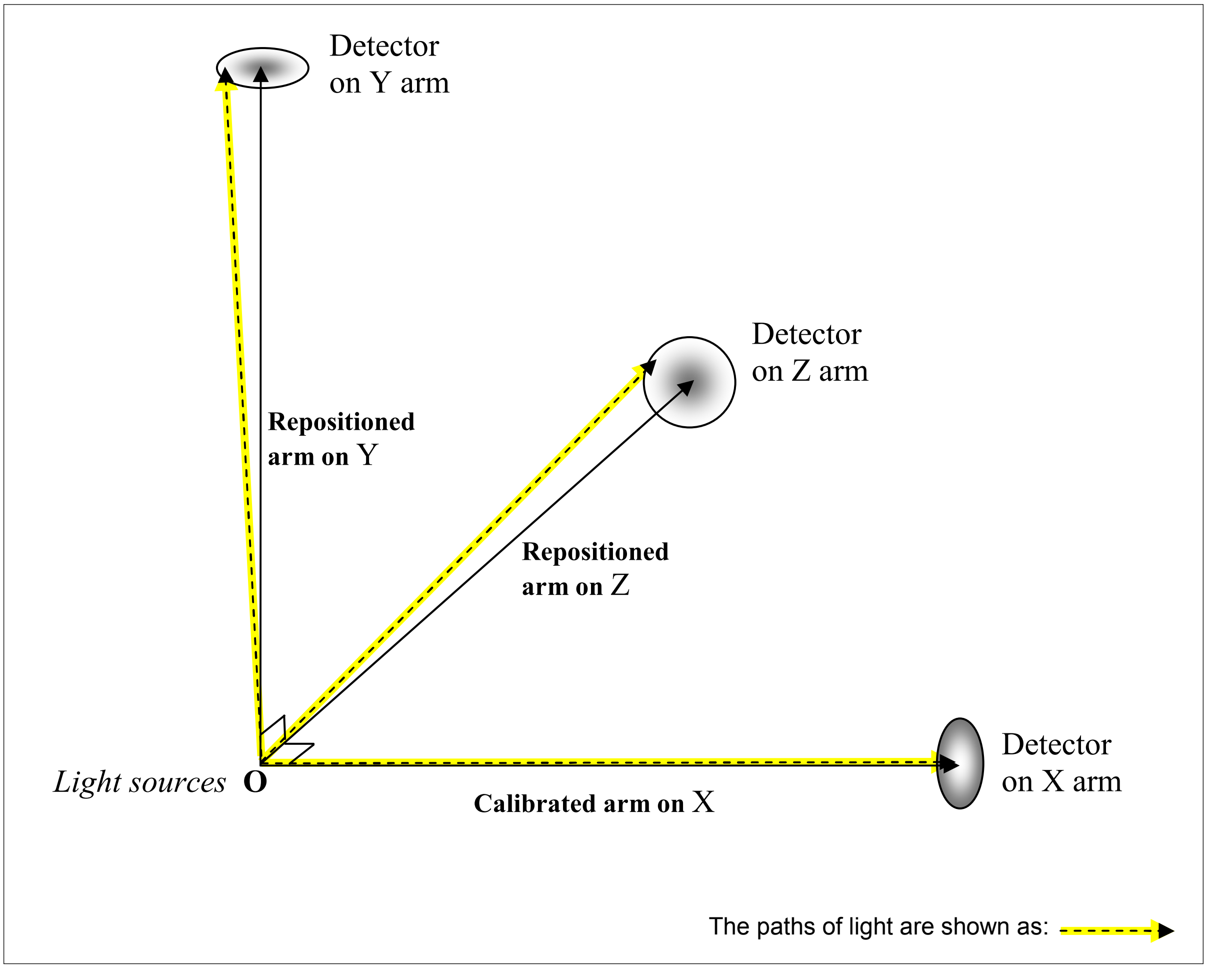
In the stationary frame defined in section **1.1.1.** any observer at rest within the frame will not experience the aberration of light.

Intuitively, such an observer will not move out of the path of any ray of light coming to him from any direction. That means that the observer within the stationary frame has a **null transverse velocity** in relation to any light pulse coming from any direction to him.

In a mobile frame in motion with velocity **v** from the stationary frame, the aberration of light will be non-null for any direction of a ray of light which is not parallel to **v**, as you can see in **1.1.1.** .

That gives us a method of measuring the absolute velocity **v** of an object, using the aberration of light:

Figure 16



The proposed device (see Figure 16) has 3 long rigid linear arms of equal lengths. Initially all the arms are aligned on the same direction Ox. For each arm, a light pulse is sent along it from a **point source** located at one end of the arms, to the other end of the arm which contains a detector similar to a screen. The calibration aims to get each light pulse on a path that is parallel with the arm and very close to the arm.

After the calibration, two of the arms will be repositioned by rotating them 90^o around the place which contains the light sources, so that all three arms will be perpendicular to each other like the axes in a Cartesian system. The remaining arm will be noted as the X arm, and the repositioned arms will be noted as the Y and the Z arm respectively.

The expected effect should be that the pulses of light received by the detectors at the end of the Y and Z arms would appear displaced from their initial positions established by the initial calibration.

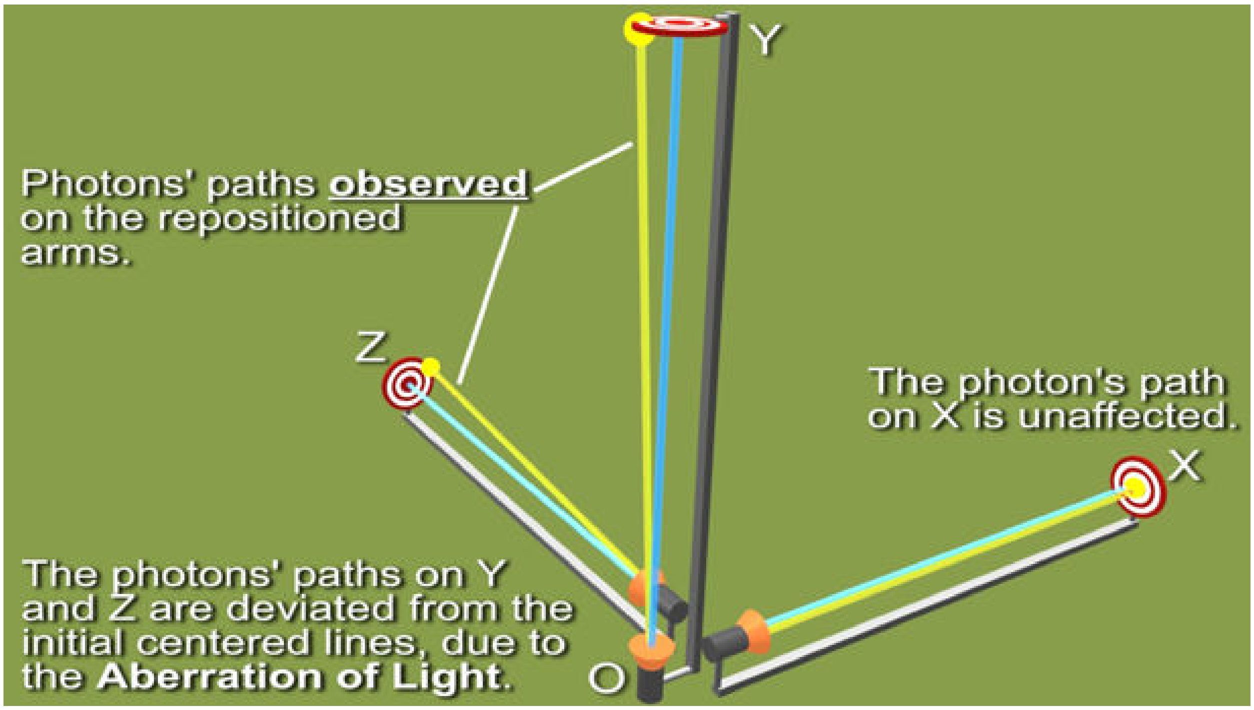
This effect is caused by a component of the motion of the repositioned arm away from AFoR, component which is transverse to the path (or trajectory) of the light pulse. In other words, the arm gets aside from (away out of) that path of the light pulse.

The displacement of the light pulse on the detector allows us to calculate a component of the absolute velocity **v** that the respective arm has within AFoR. By rotating the whole device around the place of the light sources we will be able to determine all the necessary components that we need for obtaining the direction and the magnitude of that velocity **v**.

Determining the velocity of light in various directions in the reference frame of the device is fairly simple once we know the absolute velocity **v** . For example, in the same direction as **v** the velocity of light will have the value $\mathbf{c_1} = c - \mathbf{v}$.

For a better representation of this device please see the simulation video at: http://youtu.be/xxFCGj9Zq3Y , and a snapshot of it here in Figure 16B :

Figure 16B



2.3. The experimental basis of Einstein's STR revisited - Conclusions

- The Michelson-Morley experiment had too small results because of the incorrect estimation of the paths which the light traveled through the device, and also because of certain systematic errors. However the M-M experiments have never had a null result. Their results were always positive, but unfortunately they were mostly ignored or left unexplained, as their magnitudes were much smaller than expected.
- **The sum of the velocities of light measured in two opposite directions of the same line is a constant independent of any frame of reference.**
- The velocity of light has never been measured correctly **one-way**.
- It is possible to determine correctly the velocity of light in a certain direction of a reference frame, by using a device which measures the aberration of light on the Cartesian axes of a device proposed here. As a consequence, it is possible to determine the absolute velocity of the frame (containing that device) from a **stationary (absolute) frame of reference**.

3. Fundamental concepts of the Neo-classical Theory of Relativity

Any theory of Physics relies on fundamental concepts. NCTR observes **the necessity** of having accurate definitions of all the fundamental concepts that it uses: space, time, and velocity.

Throughout the history of ideas there have been numerous attempts of defining space and time, regarded from various philosophical perspectives. The opinions on space and time may differ on whether or not space and time are objective traits of reality, independent of our perception and knowledge, or just results (or products) of our ways of perceiving and conceiving the reality.

Another problem of the attempt to define the concepts of time and space is that those two concepts depend on each other. That may appear logically incorrect, however, we search not only for fundamental causes; we search also for fundamental relations. (Note how, in the previous proposition, the concept of time is implied by the word "causes", and the concept of space is implied by the word "relations".)

We cannot talk about time without considering all the objects which exist and change; we cannot talk about space without considering the objects and their interactions, which interactions ultimately imply (or determine) changes – which changes represent time.

We can try to define the concepts separately but in the end we will find related concepts that support (or complete) each other.

3.1. Time

What we name "time" is a sequence of changes (or events) that we observe around us. In this document we prefer the notion of change (of an object) because it involves at least 2 states of an object, or to be more precise, 2 different states of a physical property of that object. That physical property can be anything, like: position in space, temperature, electric charge (for macroscopic objects), etc.

From direct experience, when we observe a sequence of changes of an object, we also notice other changes of other objects ***along*** with it.
We establish repetitive changes, which we name units of time, we count them with devices which we name clocks, and finally we record (or associate) the numbers of our counting with any other changes of objects that we observe.

Measuring time is essentially comparing changes with other changes.
It is our perception that puts the observed changes in a certain order, ***in a sequence***, and even gives us a sense of continuity in all the changes around us.
Notice that our representation (and perception) of time would not be possible without our abilities of counting and comparing numbers for having that sequence as a certain order.

Since everything that we observe is given by changes of things, it is useless to doubt the reality of those changes. The problem for our discussion is whether we have the correct and the complete image of those changes.

For example, we can ask this about the motion of an electron: is it given by small changes of its position in space (let's say similar to some very small slides), or by disappearance from a certain position followed by an appearance in a different position in space?
Of course, anyone can invoke Heisenberg's uncertainty principle and say that we cannot know two consecutive positions of an electron, and therefore such questions are useless since we can never answer them.
However, our point here is that we need to know such small details about the finest changes possible in the known Universe, in order to have a better understanding of time.

Let's notice that there are aspects of objects that do not change. If we consider the elementary particles as fundamental objects, then their physical attributes (or constituents) do not change. For example the mass and the electric charge of an electron do not change.
With such cases of immutability we can observe our ability of detecting the difference between mutable and immutable.

So far in the discussion we used the term "change", but the question is: "what aspect, or what property of an object changes?".

Considering the microscopic structure of the material objects, every change of an object involves always at least this aspect: the positions in space of the "components" of that object. Everything changes "in space".
Inevitably, in this discussion about time, we need to bring up the concept of space.

3.2. Space

The objects that surround us and their changes give us the perception of space.
However, it seems that we are caught in a circular logic, since we just mentioned that the changes of an object are ultimately given by the fine changes of their components' positions in space.

But even without considering the concept of time, it is really difficult to describe in words the concept of space. However, we can notice that we are capable of having notions that can help us describe the concept of space. As in the case of time, we are capable of counting objects. We can also distinguish ***unity*** from ***plurality***.

It seems that the objects hold their own unique positions in space. We cannot distinguish two different objects that hold exactly the same place in space. Also, the changes happen because there is space (in the sense of "there is room") for changes.

However, that is valid only for what we call matter. For what we call fields, the observations are different, and the coexistence of fields of the same kinds or different kinds seems possible. We need to investigate better the coexistence constraints of the elementary particles, as well as the coexistence laws for fields.

We can think that objects describe or define the space around them. Indeed, the idea of space without objects seems useless. However, what allows us to distinguish an object from another may be exactly the space between them.

So it seems that our concept of space depends on the way we perceive the objects around us, and the way we distinguish them from each other.

We need to consider also the fact that some aspects (or properties) of the objects do not change. The electric charge, the inertial mass and the gravitational field of an electron do not change.
Although those aspects of electron do not change, they seem to have a spatial distribution, in our idea of three-dimensional space. That observation may indicate an objective nature behind the concept of space, i.e. space exists for objects that do not change, i.e. space can be thought separately from time (time as the sequence of changes).

Time, on the other hand, remains a subjective concept, that is, it depends on our ability to count and put in an order (sequence) the changes that we observe..

3.3. Measuring time and space in different frames of reference

As mentioned above, measuring time is essentially comparing changes with other changes. However we do comparisons using numbers, and in this case we associate numbers to changes by simply counting them.
Thus, measuring time means, counting a number of identically repetitive changes that occur between two chosen events.

Essentially an event is also a change of an observed part of a system, but we prefer to use here the term “event” as something chosen to be observed. However a linguist could argue that in our definition measuring time means comparing a number of changes of a certain nature with another number (usually two) of other changes - usually of a different nature. That would be a correct interpretation as well.

The hypothesis that time may be different in two different frames is an important problem which Hendrik Lorentz, Henri Poincaré and Albert Einstein treated in various ways in their works.
In NCTR we need to ask this question: can we establish a type of change which can be repeated identically in any two different frames, in order to obtain eventually a universal time unit?

As a time unit is essentially defined by two distinct events, if the events are observed in the two reference frames then the time interval between the events can be used as a common time unit.

NCTR does not consider any two reference frames as fully equivalent to each other. To correctly transform times and coordinates between the two frames we need first to relate (transform times and coordinates of) each frame to the Absolute Frame of Reference (AFoR).

In practice, when compare the lengths of two objects we place them side by side, so each other’s ends are as close as possible, and on the same direction so they can overlap as much as possible. We measure the length of an object by comparing it transversally with the length of another object - that is the best practice we can use, as shown in the previous sections here (**1.1.4.**).

Therefore, a good method of comparing lengths between two frames should use a direction transverse to the direction that contains the measured length. For illustration see Figure 17 and Figure 18.

Note that the signals sent from Frame-2 to Frame-1 can be light rays, and that is useful because the motion of the light is independent from the motion of both frames, so the distance between the rays remains unchanged by the relative motion between the frames. However, the moments at which the signals are sent must be synchronized internally in Frame-2 by mechanical methods, not by light rays, for the reasons shown in the section [1.2.3.](#) here.

Figure 17

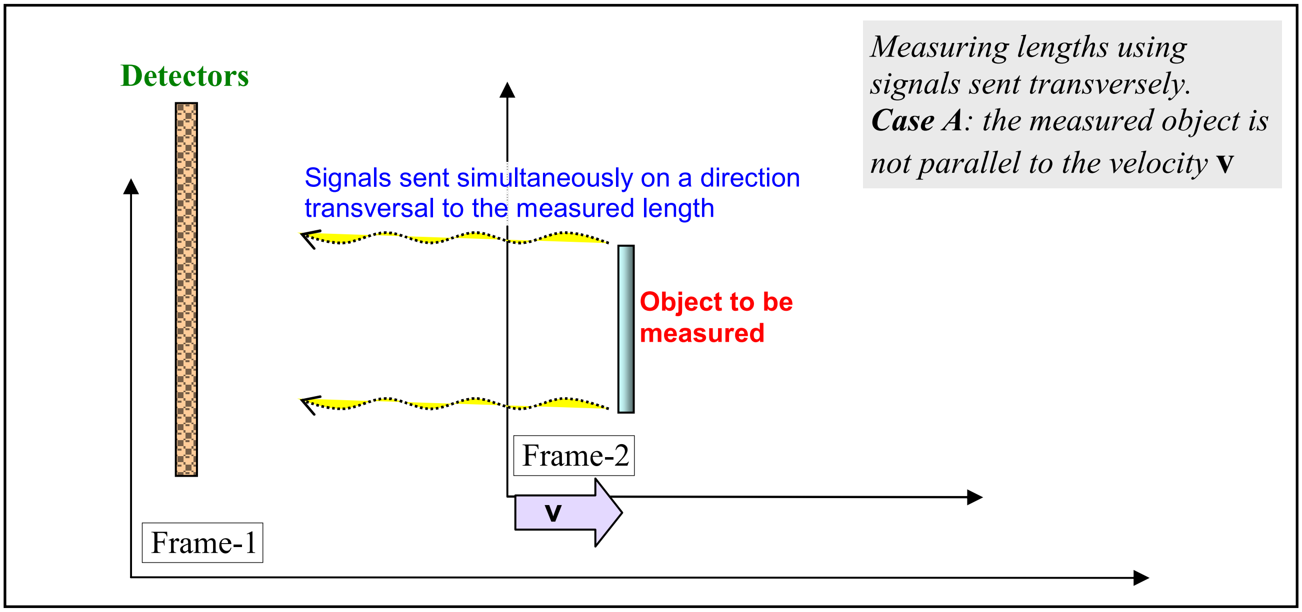
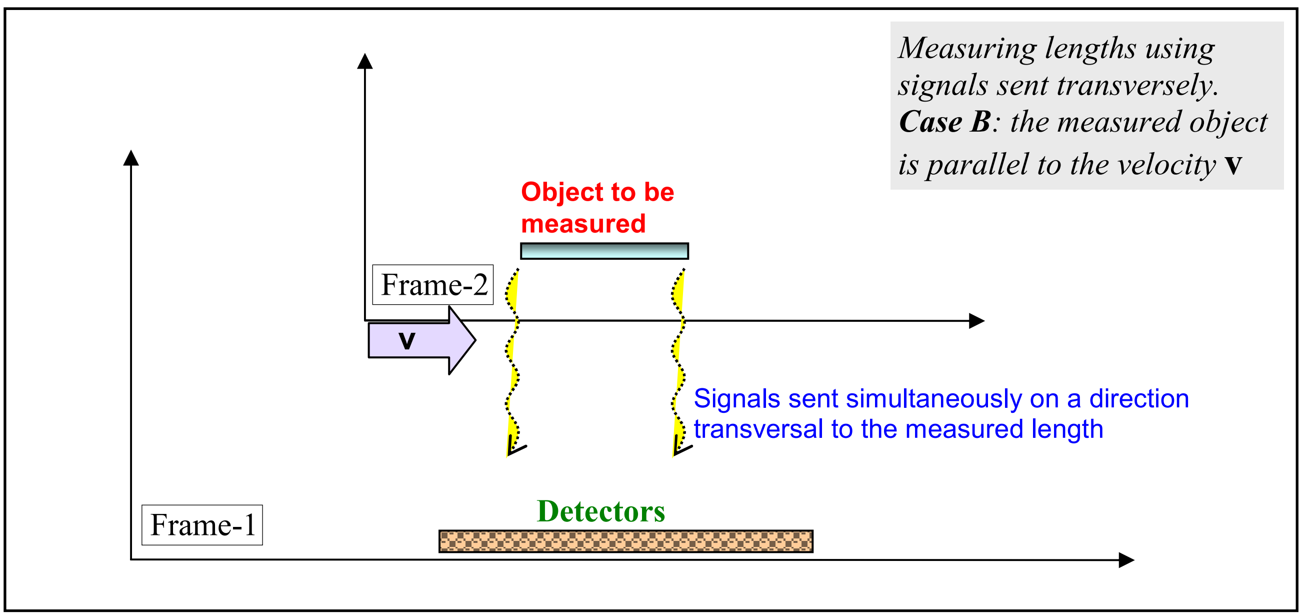
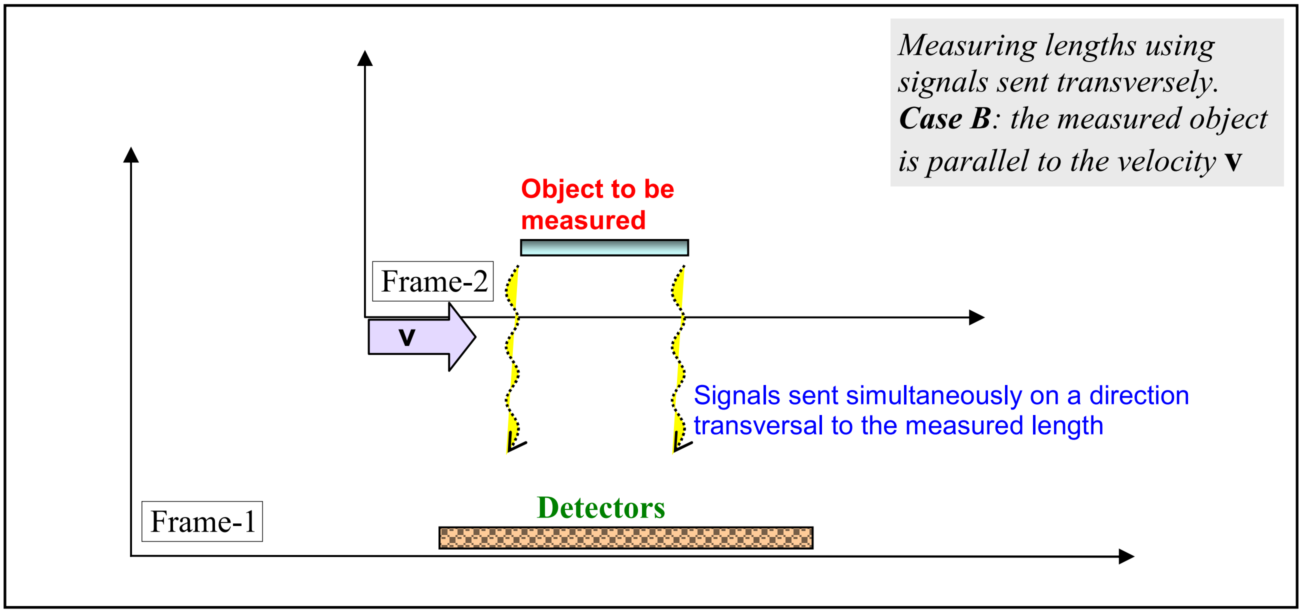


Figure 18



Measuring time in different frames of references can be done using the method illustrated in Figure 19 . This way time units can be shared between two reference frames, using specific procedures.
An animated simulation of an example of sharing a time interval between two frames can be seen in the video at: http://youtu.be/mLI-tVQZQ2o .

Figure 19



The advantage of this method is that the velocity **v** of Frame-2 relative to Frame-1 does not cause an additional time delay to the signal sent between the two frames.
The signal sent from Frame-2 to Frame-1 can be a light ray, for the reasons explained previously.

3.3.1. Variations of the time units and space units

If some of the STR's predictions are proved by experiments, those are not necessarily a proof of the correctitude of reasoning in STR. As an example, if STR predicts different rates of the clocks in systems of different velocities, it does not mean that other theories cannot predict the same thing. Therefore, an experiment like the Hafele–Keating experiment **[12]** cannot prove that STR is entirely correct, not even mostly correct.

In particular about the Hafele–Keating experiment, it is worth to mention our suggestion that when evaluating the results of that experiment the Doppler effect in relation to an Absolute Frame of Reference should be considered, as well as other factors such as the cosmic radiation, that could affect all the electronics involved in the experiment (the times of exposure to cosmic radiation would differ between the eastward flights and the westward flights).

We can expect or imagine that diverse physical conditions may affect the processes and the links of the objects that are subjected to those conditions. The conditions that we are referring to here are the velocities with magnitudes close to the speed of light.

The electromagnetic interactions are the links that hold the atomic and molecular structures, so we can imagine that moving with a velocity greater than ***c*** would mean that those electromagnetic links would be somehow left behind the material particles (electron, protons, etc.).
As approaching or surpassing ***c*** means affecting all the atomic and possibly sub-atomic links involving matter and fields, it is reasonable to expect variations of distances and rates of processes in objects of such high velocities. However, the NCTR offers a better setting for modeling the laws involved in such variations, by establishing the Absolute Framework of Reference and involving absolute time and space units, and absolute velocities.

We also need to mention here that the variation of a rate of a process with the velocity of the system that hosts that process does not automatically mean a change of the way time "flows". A simple example of a mechanical clock that is subjected to different temperatures would be a good analogy. As such a clock speeds up or slows down depending on its temperature, that doesn't mean time "flows" differently for everything in the system that surrounds the clock.

However, the subject is open for research. Let's remember that the only property of light which led STR to the wrong demonstration (on the ***c*** as a limit) was actually the independence of light from the motion of its source.

In other words, if we discover another interaction that would have an independent motion and a velocity ***d*** greater that ***c***, then ***d*** would perfectly replace ***c*** in the STR, adding another contradiction to STR: **two independent interactions of different velocities would both be the upper limits of velocities in Universe**. And that would be absurd, of course.

In conclusion, since STR cannot correctly prove that ***c*** is the upper limit, NCTR here considers this subject to be open to investigations especially regarding the fundamental fields, and the relations between fields and the elementary particles.

3.4. Frame of reference, and velocity

"Frame of reference" and velocity are two important concepts for Kinematics and Mechanics.

A frame of reference (in short frame) attached to an observer means a virtual space in which all the points are viewed at rest by that observer.
If a Frame-1 moves within another Frame-2, then all the points of the virtual space of Frame-1 will move within Frame-2. Let's name that motion of all points as "frame motion".

If an object is in motion (and let's name that as "object motion") within Frame-1, that motion will appear in Frame-2 as a combination between the "frame motion" and "object motion".

In other words, as already every virtual point of Frame-1 moves within Frame-2, any move away of the object from that virtual point can increase/decrease the motion effect perceived in Frame-2.

As velocity describes the motion of an object, namely the rate of change of position in a frame, it is logical that the velocity-1 measured in Frame-1 will appear in Frame-2 as a different velocity-2 which will be expressed by a combination between velocity-1 and a velocity-F (the velocity of Frame-1 measured within Frame-2).

As mentioned before, velocity is an association that we make between time and space in order to describe motion.
The fact that we **divide** space by time has only a practical and conventional meaning:
We need to know how **many meters** per second an object covers in its motion.
Would it be incorrect to ask how **many seconds** per meter that object takes? Logically, no. That could also be a valid representation of the motion of an object.

Then the question is, why do we prefer to use “time units per length unit” instead of “length units per time unit” as a measure for motion (i.e. velocity)?
One explanation may be that the numbers that we use for expressing time have a more compact range and cyclical occurrence, which gives the impression of reference, or the impression of a base.

Therefore, when we **compare** the motions of two objects it is easier to relate them to a time interval, than to relate two different time intervals to two different traveled distances (possibly on two different directions).

3.5. The Absolute Frame of Reference

Let’s consider the waves on the surface of a lake, as they move away from their source point. Notice that the water at the surface does not move (much) along with the waves, in the direction of propagation, away from the source point. The water moves mainly vertically, on the direction that gives amplitude to the wave.
In a similar way, let’s consider the fields that actually compose a ray of light. The varying electric field is generated in space by a varying magnetic field and vice versa. The variation of the field in space is like a wave. However, that variation does not mean that the fields are dragged or pushed along with the ray, because as far as we know, the fields do not have inertial properties. We can assume that the fields are created and destroyed ***in space*** by each other’s variation, but we don’t know anything which can move (i.e. displace) such a field away from the region of space in which it appeared.

Therefore, that region of space in which the electric field (or the magnetic field) appears can be considered an indicator of the Absolute Frame of Reference, as the “section” of the field present there has a zero velocity relative to any other section of a different ray of light present at that moment in space.

In short, light itself, as well as any electromagnetic wave, indicates the Absolute Frame of Reference.

Thus, NCTR considers light to be a perfect way to describe the Absolute Space. The variable electric and magnetic fields of light, which generate each other consecutively, have a fixed position in space: they are not dragged by anything away from each position in which they appear.

Any observer will have a certain velocity relative to those fields, and that implies two facts (which were demonstrated in section **1.1.1.**):

1. The measured velocity of light depends on the velocity of the observer.
2. An observer attached to the Absolute Frame of Reference will perceive any ray of light from any direction as having no Aberration of Light. An observer in motion within the Absolute Frame will perceive all rays of light coming from any direction as affected by the Aberration of Light, except any ray that travels within the Absolute Frame on the same line of motion as the observer's line of motion.

That means a mobile observer is able to determine his absolute velocity based on the Aberration of Light which he measures.

A simulation of such device that would determine the absolute velocity of a frame is presented in the video at: http://youtu.be/xxFCGj9Zq3Y .

4. NCTR – Renewed conclusions of an old theory

The Neo-classical Theory of Relativity shows that it is possible to define theoretically and determine experimentally an Absolute Frame of Reference.
At this moment we observe a similarity between the concept of an absolute frame of reference (or stationary frame by our definition here) and the concept of an objective absolute space used in Classical Mechanics since centuries ago. For practical purposes the two concepts have an identical meaning.

The motion of an object relative to an arbitrary frame of reference can be uniquely expressed if the motion of that frame of reference is determined in the Absolute Frame of Reference.

For that purpose, it is important to envision and use correct methods for comparing (and transferring) times and coordinates between frames of reference, such as the transverse methods proposed here. Thus NCTR is more suitable for practical purposes than Einstein's theory, as we found that:

- we can perfectly share time units and length units between reference frames;
- we can synchronize clocks inside any reference frame if we use phenomena correlated to that frame's motion;
- we can determine an absolute frame of reference, and then relate the motion of any other reference frame to it.

The Neo-classical Theory of Relativity does consider Classical Mechanics to be sufficient for describing motions that have velocities of magnitudes much lower than the speed of light, in the Absolute Frame of Reference.

For objects of velocities comparable to the speed of light (in the Absolute Frame of Reference) it is necessary to develop proper new models for the field theories, which will consider the velocities as calculated in the absolute frame of reference.

Since we do not find ***c*** to be the maximum limit in the Universe, we enable other theories of Physics to be developed using velocities with values greater than ***c*** ; also, we can explore the real causes of the velocity of light as an upper limit for the velocities of inertial objects.

As the electromagnetic interactions are present in every macroscopic object, they may influence the times and distances that characterize the internal structure of an object (or the external interactions between objects), in relation to the velocity of that object in the Absolute Frame of Reference.
It is important to develop a theory that explains what happens internally in the atomic and elementary structures of an object, when the object has different velocities in the absolute space.

In the Neo-classical Theory of Relativity the laws of transformations for times and coordinates between the Absolute Frame of Reference and the frame of the object in motion will depend on the laws of interaction between the elementary particles and fields. We can anticipate that the transformations will have nonlinear mathematical expressions, possibly similar to those of Einstein's Special Theory of Relativity.
However such similarity with the Special Theory of Relativity will be coincidental.

The Neo-classical Theory of Relativity has conceptual grounds different from the Special Theory of Relativity, and it will keep clarity and logical consistency as "sine qua non" principles of research, advancing in understanding without being complacent about any contradictions and paradoxes.

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[1] Albert Einstein: "On the Electrodynamics of Moving Bodies". June 30, 1905.
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