# The Return of Absolute Simultaneity and its Relationship to Einstein's Relativity of Simultaneity

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**Abstract**

In this paper we show how Einstein's relativity of simultaneity is fully consistent with anisotropic one-way speed of light. We get the same end result and observations as predicted by Einstein, but with a very different interpretation. We show that the relativity of simultaneity is an apparent effect due to an Einstein clock synchronization error, which is rooted in assuming that the one-way speed of light is the same as the well-tested round-trip speed of light. Einstein's relativity of simultaneity leads to several bizarre paradoxes recently introduced by Haug (2016a,b).

Still, relativity of simultaneity is indeed what one will observe with Einstein synchronized clocks, while absolute simultaneity is the deeper reality that can be observed when synchronizing clocks in a way that avoids the Einstein error. Relativity of simultaneity and absolute simultaneity exist at the same time.

## 1 The True One-Way Speed of Light and the Einstein Clock Synchronization Error

Before Einstein abandoned the ether, it was assumed by most physicists that the true one-way speed of light was isotropic only against the ether. If an object moved with speed $v$ against the ether, then the one-way speed of light relative to the moving object would be $c-v$ in the same direction as the object and $c+v$ in the opposite direction, as measured from the ether frame. Velocity is basically a measurement of distance and time.

$$\text{Speed} = \frac{\text{Observed distance traveled}}{\text{Observed time interval}}$$

To measure the one-way speed of light, two clocks are needed in general. Further, the two clocks must be synchronized before they can be used to measure the one-way speed of light. One method of synchronization is to adopt the procedure suggested by Einstein and Poincaré, namely by sending a light signal between the two clocks.

The problem with this method is that in order to measure the one-way speed of light, we need to synchronize both clocks, and to synchronize both clocks, we need to know the one-way speed of light. We end up with a circular problem. This may be the reason Poincaré assumed that we could never measure the one-way speed of light and therefore we could never detect motion against the ether. (For if one did measure the true one-way speed of light and found it to be anisotropic, then this would be strong evidence towards the motion of the laboratory frame (the earth) through the ether.)

Poincaré went on to assert that the only observable motion was of ponderable matter relative to ponderable matter, and not to the ether[1]. In 1905, Poincaré explained his view on the earth's motion against ether:

> *It seems that this impossibility of establishing experimentally the absolute motion of the earth is a general law of nature: we are, of course, set towards admitting this law that we will call the Postulate of Relativity and to admit it without restrictions.* – Henri Poincaré

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[1]See Miller (1998) for more details on this.

In the year of 1898 Poincaré published a philosophical paper titled: *The Measure of Time*. In this paper, Poincaré points out how astronomers often assume that the speed of light is both constant and the same in every direction:

> *When a astronomer tells me that a stellar phenomenon, which his telescope reveals to him at this moment, happened, nevertheless, fifty years ago, I seek his meaning, and to that end I shall ask him first how he knows it, that is, how he had measured the velocity of light.*
>
> *He has begun by supposing that light has a constant velocity, and in particular that its velocity is the same in all directions. That is a postulate without which no measurement of this velocity could be attempted. This postulate could never be verified by direct experiment.*

Poincaré indicates here that it would be impossible to detect the true one-way speed of light in any type of experiment. It is unclear if Einstein got the idea of assuming isotropic one-way speed of light from reading Poincaré. However, Einstein seems to go one step further. In 1905, Einstein simply abandoned the ether altogether and in doing so he also assumed that the one-way speed of light is isotropic. Therefore, when Einstein was synchronizing clocks with light signals, he assumed that the one-way speed of light was the same as the well-known round-trip speed of light $c$.

However, if the true one-way speed of light can be detected and shown to be anisotropic, then the Einstein way of synchronizing the two clocks will lead to a synchronization error. Over the years, various researchers have produced a series of studies that claim to have measured the one-way speed by getting around having to rely on clock synchronization; further, they have found that the one-way speed of light is anisotropic. In particular, Marinov (1974), Torr and Kolen (1984), and Cahill (2012) claimed they have been able to measure the one-way speed of light without relying on Einstein synchronization or slow clock transportation. We will not conclude here if these experiments are right or wrong, but these experiments should be repeated to confirm the findings or to reject them. Instead the work has, to a large extent, been ignored.

In this paper we will show that anisotropic true one-way speed of light is fully consistent with Einstein's relativity of simultaneity. However, as we will show, Einstein's relativity of simultaneity is an apparent effect due to clock synchronization procedure and is an incomplete theory

Assume for the moment that the true one-way speed of light is anisotropic. Even if the speed against a moving object as observed from the ether frame is $c \pm v$, this is not the true one-way speed of light as observed from the moving frame itself. The measuring stick in the moving frame is contracting according to the suggestion made by FitzGerald and Lorentz, so in this frame, we will have both length contraction and time dilation. The true one-way speed of light in the moving frame is travelling in the same direction as the frame is moving against the ether:

$$\hat{c}_{ab} = \frac{c - v}{1 - \frac{v^2}{c^2}}$$

and in the direction opposite the one in which the frame is moving, it is

$$\hat{c}_{ba} = \frac{c + v}{1 - \frac{v^2}{c^2}}$$

where $v$ is the velocity of the moving frame relative to the ether, as observed from the ether, see Haug (2014) for in detailed derivations and discussion of the one-way speed of light. Bear in mind that $v$ is not the velocity of the frame moving against the ether as observed from the moving frame. Only in the ether frame is it assumed that the one-way speed of light is isotropic. This means only in the ether frame can we synchronize clocks without introducing a clock synchronization error, (when the synchronization is based on the assumption that the one-way speed of light is $c$ and isotropic.) In every other frame, there will be a clock synchronization error that must be equal to

$$\begin{aligned}
\hat{\Delta}_{ab} &= \hat{t}_{ab} - \hat{\tau} \\
\hat{\Delta}_{ab} &= \frac{L}{\hat{c}_{ab}} - \frac{1}{2}\left(\frac{L}{\hat{c}_{ab}} + \frac{L}{\hat{c}_{ba}}\right) \\
\hat{\Delta}_{ab} &= \frac{1}{2}\left(\frac{L}{\hat{c}_{ab}} - \frac{L}{\hat{c}_{ba}}\right) \\
\hat{\Delta}_{ab} &= \frac{1}{2}\left(\frac{L}{\frac{c-v}{1-\frac{v^2}{c^2}}} - \frac{L}{\frac{c+v}{1-\frac{v^2}{c^2}}}\right) \\
\hat{\Delta}_{ab} &= \frac{1}{2}\left(\frac{L\left(1-\frac{v^2}{c^2}\right)}{c-v} - \frac{L\left(1-\frac{v^2}{c^2}\right)}{c+v}\right)
\end{aligned}$$

$$\begin{aligned}
\hat{\Delta}_{ab} &= \frac{1}{2}\left(\frac{L\left(1-\frac{v^2}{c^2}\right)(c+v)-L\left(1-\frac{v^2}{c^2}\right)(c-v)}{(c-v)(c+v)}\right)\\
\hat{\Delta}_{ab} &= \frac{1}{2}\left(\frac{2Lv\left(1-\frac{v^2}{c^2}\right)}{c^2-v^2}\right)\\
\hat{\Delta}_{ab} &= \frac{Lv\left(1-\frac{v^2}{c^2}\right)}{c^2\left(1-\frac{v^2}{c^2}\right)}\\
\hat{\Delta}_{ab} &= \frac{Lv}{c^2}. \qquad (1)
\end{aligned}$$

This synchronization error has been derived by Prokhovnik (1967), Lévy (2003) and has also been discussed in great detail by Haug (2014). Be aware that $v$ is not the relative speed between two frames, but rather the speed of a frame relative to the ether (void) as measured from the void. This synchronization error is very hard to detect and requires special experimental set-ups. To detect the Einstein synchronization error is basically the same as detecting the motion against the ether. Let us turn to how Einstein's relativity of simultaneity can be derived and the deeper interpretations behind it.

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## 2 Apparent Relativity of Simultaneity with Einstein Synchronized Clocks

Here, we will look at relative simultaneity when using Einstein synchronized clocks. Assume the earth is moving at speed $v_1$ against the void, as measured from the void frame. (For simplicity, we will ignore the rotation of the earth, as we are not interested in the rotation effects here.) If the true one-way speed of light is anisotropic, then two signals within the same frame that are sent out simultaneously as measured with Einstein synchronized clocks should arrive at the middle point simultaneously. Below is a derivation of the prospective time difference between these two light signals arriving at the midpoint:

$$\begin{aligned}
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= \frac{\frac{1}{2}L_{1,1}}{\frac{c-v_1}{\left(1-\frac{v_1^2}{c^2}\right)}}-\frac{\frac{1}{2}L_{1,1}v_1}{c^2}-\left(\frac{\frac{1}{2}L_{1,1}}{\frac{c+v_1}{\left(1-\frac{v_1^2}{c^2}\right)}}+\frac{\frac{1}{2}L_{1,1}v_1}{c^2}\right)\\
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= \frac{\frac{1}{2}L_{1,1}\left(1-\frac{v_1^2}{c^2}\right)}{c-v_1}-\frac{\frac{1}{2}L_{1,1}v_1}{c^2}-\left(\frac{\frac{1}{2}L_{1,1}\left(1-\frac{v_1^2}{c^2}\right)}{c+v_1}+\frac{\frac{1}{2}L_{1,1}v_1}{c^2}\right)\\
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= \frac{L_{1,1}}{2c}\left(\frac{c^2\left(1-\frac{v_1^2}{c^2}\right)}{c(c-v_1)}-\frac{v_1(c-v_1)}{c(c-v_1)}\right)-\frac{L_{1,1}}{2c}\left(\frac{c^2\left(1-\frac{v_1^2}{c^2}\right)}{c(c+v_1)}+\frac{v_1(c+v_1)}{c(c+v_1)}\right)\\
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= \frac{L_{1,1}}{2c}\left(\frac{c^2-v_1^2-v_1c+v_1^2}{c(c-v_1)}\right)-\frac{L_{1,1}}{2c}\left(\frac{c^2-v_1^2+v_1c+v_1^2}{c(c+v_1)}\right)\\
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= \frac{L_{1,1}}{2c}\left(\frac{c(c-v_1)}{c(c-v_1)}\right)-\frac{L_{1,1}}{2c}\left(\frac{c(c+v_1)}{c(c+v_1)}\right)\\
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= \frac{L_{1,1}}{2c}-\frac{L_{1,1}}{2c}\\
\hat{t}_{e,1,1,am}-\hat{t}_{e,1,1,bm} &= 0 \qquad (2)
\end{aligned}$$

Next assume a train is moving at speed $v_2$ against the void, as measured from the void frame. On the ground (the embankment) are two clocks, A and B, each with a light source that can be set to turn on by a timer. The distance between the two clocks as measured from the ground frame is $L_{1,1}$. These two clocks are Einstein synchronized, thus introducing the following Einstein synchronization error between the two clocks:

$$\hat{\Delta}_{1,1}=\frac{L_{1,1}v_1}{c^2}.$$

This error is not directly observable when we are only using Einstein synchronized clocks, but it will have an indirect effect on how we observe simultaneity. This synchronization error, when converted into the time of frame two (the train), is

$$\hat{\Delta}_{1,2} = \frac{L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}.$$

This Einstein synchronization error will soon be used as part of another derivation.

Now we will place a third clock on the ground, at the midpoint between clocks A and B. This third clock does not need to be synchronized with the other clocks, but it can be. The middle clock has two light detectors. When we have the original two clocks emit signals simultaneously, they will be received at the same instant at the midpoint detector, so long as the midpoint detector is placed in the same frame as the two signaling clocks. The Einstein synchronization error conceals the fact that the two light signals were not actually emitted simultaneously, even if they arrive at the midpoint clock at the same time. In other words, the Einstein synchronized clocks make it appear that the one-way speed of light is isotropic and equal to $c$ (in a vacuum).

Einstein's relativity of simultaneity comes into play when two events that appear to be simultaneous in one frame of reference are observed from another frame of reference. Then the two events will no longer appear to happen simultaneously. The reason for this is that the true one-way speed of light relative to a moving frame must be different in another moving frame. Clocks synchronized in one frame via Einstein synchronization cannot conceal the fact that the two light signals are emitted at different times as observed from another frame, because the Einstein synchronization error is different in each frame; it can only conceal the anisotropy in the one-way speed of light in the same frame as the clocks are Einstein synchronized. This is the correct interpretation of Einstein's relativity of simultaneity based on the much deeper understanding obtained from Haug (2014) mathematical atomism[2].

Assume the two light signals from the two original ground clocks A and B are emitted exactly when a fourth clock on board a train is lining up with the middle clock on the ground. That is, they are sent out simultaneously as observed from the Einstein synchronized clocks in the ground frame. Such an experiment is illustrated in figure 1, which shows the two light-emitting clocks stopping at the moment they emit the light signals. This allows us to check if they emitted the light signal simultaneously (apparent simultaneity).

Due to the Einstein synchronization in frame 1, the light signal actually starts to emit from the laser in location A before the midpoint clock in frame A reaches the former position of the clock in frame 2. This means that the light signal must travel the following true distance as observed from frame 2.

$$D_{A,M} = \frac{1}{2}L_{1,2} - \frac{\frac{1}{2}L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}\frac{(v_2-v_1)}{\left(1-\frac{v_2^2}{c^2}\right)}$$

The same holds true for the distance from the laser clock in location B. This is because the clock will emit the signal late, also due to the Einstein synchronization error.

$$D_{B,M} = \frac{1}{2}L_{1,2} - \frac{\frac{1}{2}L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}\frac{(v_2-v_1)}{\left(1-\frac{v_2^2}{c^2}\right)}$$

These distances need to divided by the true one-way speed of light in the A to B direction and then in the B to A direction, we get

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{D_{A,M}}{\frac{c-v_2}{\left(1-\frac{v_2^2}{c^2}\right)}} - \frac{1}{2}\Delta_{1,2} - \left(\frac{D_{B,M}}{\frac{c+v_2}{\left(1-\frac{v_2^2}{c^2}\right)}} + \frac{1}{2}\Delta_{1,2}\right)$$

[2]However, Haug (2014) made a small mistake when initially completing his derivations on Einstein synchronized clocks in his chapter on simultaneity. He came to the right conclusions in the book, but the mathematical end results were not correct in this case. The mathematical end results in the other chapters of the book are generally correct, except for a few additional areas in the experimental chapter.

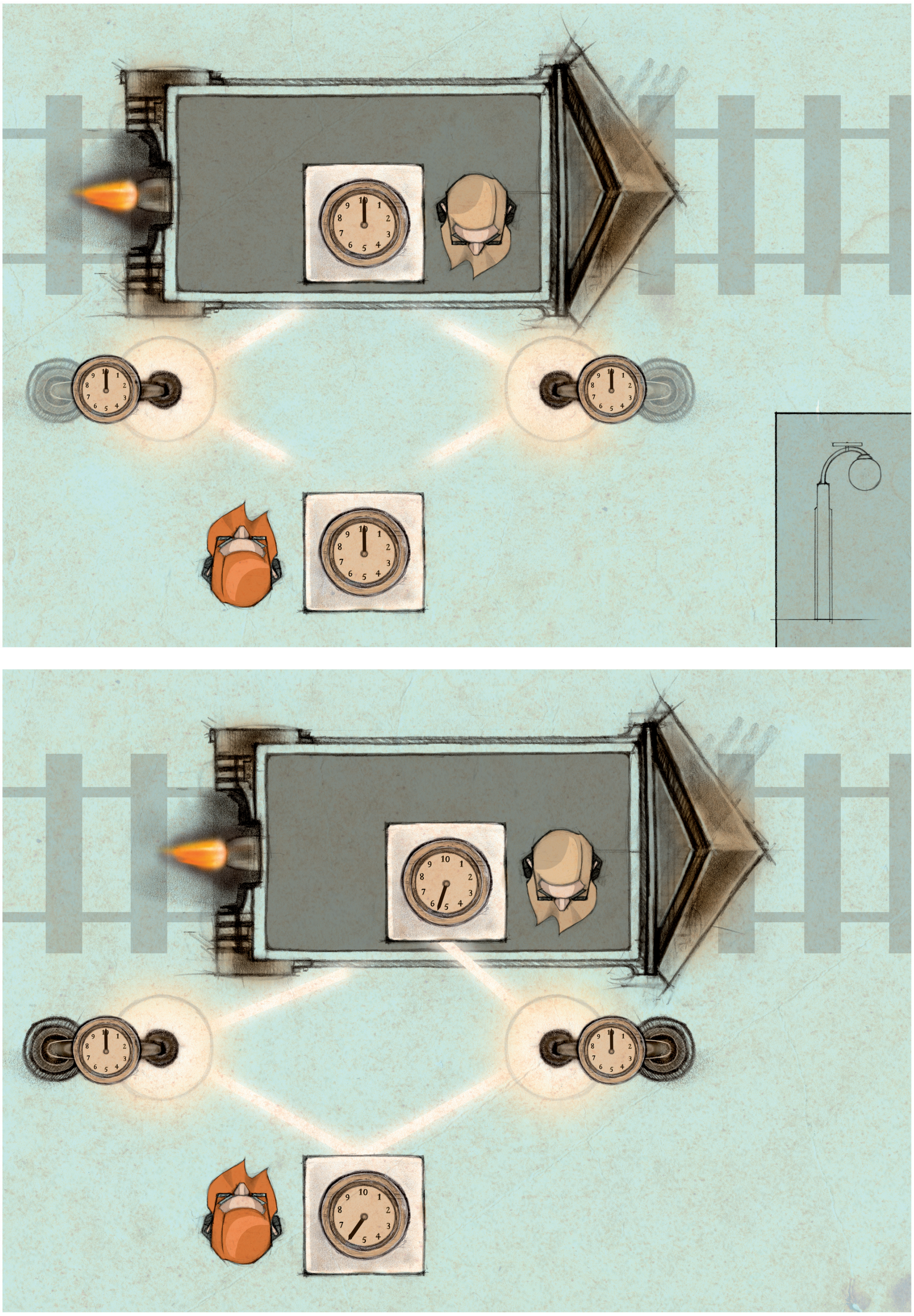

Figure 1: Relativity of simultaneity is illustrated in this figure. Two separately located events that appear to happen simultaneously in one frame will not appear simultaneously from another frame when using Einstein synchronized clocks.

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{\frac{1}{2}L_{1,2} - \frac{\frac{1}{2}L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}\frac{(v_2-v_1)}{\left(1-\frac{v_2^2}{c^2}\right)}}{\frac{c-v_2}{\left(1-\frac{v_2^2}{c^2}\right)}} - \frac{\frac{1}{2}L_{1,2} - \frac{\frac{1}{2}L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}\frac{(v_2-v_1)}{\left(1-\frac{v_2^2}{c^2}\right)}}{\frac{c+v_2}{\left(1-\frac{v_2^2}{c^2}\right)}} - \Delta_{1,2}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{\frac{1}{2}L_{1,2}\left(1-\frac{v_2^2}{c^2}\right)(c+v_2) - \frac{\frac{1}{2}L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}(v_2-v_1)(c+v_2)}{(c+v_2)(c-v_2)}$$

$$- \frac{\frac{1}{2}L_{1,2}\left(1-\frac{v_2^2}{c^2}\right)(c-v_2) - \frac{\frac{1}{2}L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}(v_2-v_1)(c-v_2)}{(c+v_2)(c-v_2)} - \Delta_{1,2}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,2}\left(1-\frac{v_2^2}{c^2}\right)v_2 - \frac{L_{1,1}v_1v_2}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}(v_2-v_1)}{c^2-v_2^2} - \Delta_{1,2}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}\left(1-\frac{v_2^2}{c^2}\right)v_2 - \frac{L_{1,1}v_1v_2}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}(v_2-v_1)}{c^2\left(1-\frac{v_2^2}{c^2}\right)} - \Delta_{1,2}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}v_2 - \frac{L_{1,1}v_1v_2}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}(v_2-v_1)}{c^2\left(1-\frac{v_2^2}{c^2}\right)} - \Delta_{1,2}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\sqrt{1-\frac{v_1^2}{c^2}}v_2 - \frac{L_{1,1}v_1v_2}{c^2}\frac{1}{\sqrt{1-\frac{v_1^2}{c^2}}}(v_2-v_1)}{c^2\sqrt{1-\frac{v_2^2}{c^2}}} - \Delta_{1,2}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\left(1-\frac{v_1^2}{c^2}\right)v_2 - \frac{L_{1,1}v_1v_2}{c^2}(v_2-v_1)}{c^2\sqrt{1-\frac{v_2^2}{c^2}}\sqrt{1-\frac{v_1^2}{c^2}}} - \frac{L_{1,1}v_1}{c^2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\left[v_2\left(1-\frac{v_1^2}{c^2}\right) - v_1\left(1-\frac{v_2^2}{c^2}\right)\right] - \frac{L_{1,1}v_1v_2}{c^2}(v_2-v_1)}{c^2\sqrt{1-\frac{v_2^2}{c^2}}\sqrt{1-\frac{v_1^2}{c^2}}}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\left(v_1\left(1-\frac{v_2^2}{c^2}\right) - v_2\left(1-\frac{v_1^2}{c^2}\right) - \frac{v_1v_2}{c^2}(v_1-v_2)\right)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\left(v_1 - \frac{v_1^2v_2}{c^2} - v_2 + \frac{v_1v_2^2}{c^2} - \frac{v_1v_2^2}{c^2} + \frac{v_1^2v_2}{c^2})\right)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}(v_1-v_2)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}} \tag{3}$$

The derivation above indicates that observers from the train frame would claim that the two ground-based light signals could not have been emitted simultaneously. Einstein referred to this as relativity of simultaneity, claiming that absolute simultaneity was impossible. Under atomism our derivations point to observations that are the same as predicted by Einstein's special relativity theory when using Einstein synchronized clocks, but the interpretation is very different. From atomism, and its indivisible relativity theory, we know that Einstein synchronized clocks contain a synchronization error. The correct interpretation is that the Einstein error is different in each frame, and that the synchronization error built into the clock in one frame cannot conceal the anisotropy in the one-way speed of light as observed from another frame. Therefore, relativity of simultaneity is merely apparent, but has a real effect in the physical world.

Now let's switch the arrangement, this time with the light-emitting clocks in the back and front of the train. Each clock is fitted with timer that can turn the light source on. These two clocks are Einstein synchronized while the train is travelling at speed $v_2$ against the void. If we are unaware of the true one-way speed of light, we will not know the speed of the frame's movement against the void, and we will only be able to observe the speed of the train relative to the ground by using Einstein synchronized clocks:

$$v_e = \frac{v_2 - v_1}{1 - \frac{v_1 v_2}{c^2}}.$$

The speed of the train relative to the ground is the same as observed from the train or from the ground when measured with Einstein synchronized clocks.

At the midpoint between the back clock (A) and front clock (B), we place a third clock that does not need to be synchronized with the other two clocks in this frame, but it can be. This clock has two light detectors. If clocks A and B emit a light signal simultaneously, as measured with these Einstein synchronized clocks, then the two light signals will reach the train's middle clock at the same point in time.

Assume the two light signals from the train clocks are emitted exactly when a clock on the ground is lined up with the train's middle clock — thus the two light signals are emitted simultaneously as observed from the Einstein synchronized clocks in the train frame and as observed from the train's middle clock. What would the time difference be between the two light signals arriving at the ground clock? Remember that the ground clock does not need to be synchronized with any other clock.

The time difference between receiving the two light signals emitted from the train clocks, as observed from the ground clock, must be

$$\begin{aligned}
\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} &= \frac{D_{A,M}}{\frac{c-v_1}{\left(1-\frac{v_1^2}{c^2}\right)}} - \frac{1}{2}\Delta_{2,1} - \left(\frac{D_{B,M}}{\frac{c+v_1}{\left(1-\frac{v_1^2}{c^2}\right)}} + \frac{1}{2}\Delta_{2,1}\right) \\
\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} &= \frac{\frac{1}{2}L_{2,1} - \frac{\frac{1}{2}L_{2,2}v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}\frac{(v_1-v_2)}{\left(1-\frac{v_1^2}{c^2}\right)}}{\frac{c-v_1}{\left(1-\frac{v_1^2}{c^2}\right)}} - \frac{\frac{1}{2}L_{2,1} - \frac{\frac{1}{2}L_{2,2}v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}\frac{(v_1-v_2)}{\left(1-\frac{v_1^2}{c^2}\right)}}{\frac{c+v_1}{\left(1-\frac{v_1^2}{c^2}\right)}} - \Delta_{2,1} \\
\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} &= \frac{\frac{1}{2}L_{2,1}\left(1-\frac{v_1^2}{c^2}\right)(c+v_1) - \frac{\frac{1}{2}L_{2,2}v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}(v_1-v_2)(c+v_1)}{(c+v_1)(c-v_1)} \\
&\quad - \frac{\frac{1}{2}L_{2,1}\left(1-\frac{v_1^2}{c^2}\right)(c-v_1) - \frac{\frac{1}{2}L_{2,2}v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}(v_1-v_2)(c-v_1)}{(c+v_1)(c-v_1)} - \Delta_{2,1} \\
\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} &= \frac{L_{2,1}\left(1-\frac{v_1^2}{c^2}\right)v_1 - \frac{L_{2,2}v_1v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}(v_1-v_2)}{c^2-v_1^2} - \Delta_{2,1} \\
\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} &= \frac{L_{2,2}\frac{\sqrt{1-\frac{v_2^2}{c^2}}}{\sqrt{1-\frac{v_1^2}{c^2}}}\left(1-\frac{v_1^2}{c^2}\right)v_1 - \frac{L_{2,2}v_1v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}(v_1-v_2)}{c^2\left(1-\frac{v_1^2}{c^2}\right)} - \Delta_{2,1}
\end{aligned}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{2,2}\sqrt{1-\frac{v_2^2}{c^2}}\sqrt{1-\frac{v_1^2}{c^2}}v_2 - \frac{L_{2,2}v_1v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}(v_1-v_2)}{c^2\left(1-\frac{v_1^2}{c^2}\right)} - \Delta_{2,1}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{2,2}\sqrt{1-\frac{v_2^2}{c^2}}v_1 - \frac{L_{2,2}v_1v_2}{c^2}\frac{1}{\sqrt{1-\frac{v_2^2}{c^2}}}(v_1-v_2)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}} - \Delta_{2,1}$$

$$\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} = \frac{L_{2,2}\left(1-\frac{v_2^2}{c^2}\right)v_1 - \frac{L_{2,2}v_1v_2}{c^2}(v_1-v_2)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}} - \frac{L_{2,2}v_2}{c^2}\frac{\sqrt{1-\frac{v_1^2}{c^2}}}{\sqrt{1-\frac{v_2^2}{c^2}}}$$

$$\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} = \frac{L_{2,2}\left[v_1\left(1-\frac{v_2^2}{c^2}\right) - v_2\left(1-\frac{v_1^2}{c^2}\right)\right] - \frac{L_{2,2}v_1v_2}{c^2}(v_1-v_2)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}}$$

$$\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} = \frac{L_{2,2}\left(v_2\left(1-\frac{v_1^2}{c^2}\right) - v_1\left(1-\frac{v_2^2}{c^2}\right) - \frac{v_1v_2}{c^2}(v_2-v_1)\right)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}}$$

$$\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} = \frac{L_{2,2}\left(v_2 - \frac{v_1^2v_2}{c^2} - v_1 + \frac{v_1v_2^2}{c^2} - \frac{v_1v_2^2}{c^2} + \frac{v_1^2v_2}{c^2})\right)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}}$$

$$\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm} = \frac{L_{2,2}(v_2-v_1)}{c^2\sqrt{1-\frac{v_1^2}{c^2}}\sqrt{1-\frac{v_2^2}{c^2}}} \tag{4}$$

Since $L_{1,1} = L_{2,2} = L$, [3] we then have

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = -(\hat{t}_{e,2,1,am} - \hat{t}_{e,2,1,bm}). \tag{5}$$

In other words, the relativity of simultaneity is reciprocal between the two frames. The time difference between the two arrangements will naturally have opposite signs. Observers on a train traveling westward relative to the ground can claim that the ground is in fact traveling eastward relative to the train as observed from the train. Again, relativity of simultaneity is an apparent phenomena derived from using Einstein synchronized clocks that contain an Einstein synchronization error. With this error, Einstein synchronized clocks cannot mask the anisotropy in the one-way speed of light in two frames simultaneously, where observers in one frame will always be able to discern the lack of simultaneity between the arrival of two light signals. Atomism yields the same observed result as predicted by Einstein when using Einstein synchronized clocks, but from atomism we obtain a much deeper and very different interpretation. We know that it is an apparent effect due to incorrectly assuming that the one-way speed of light is isotropic in any frame. When using this assumed isotropic one-way speed of light for clock synchronization, we are building Einstein synchronization errors into the clocks, thus making two events appear to be simultaneous in one frame, but not from another frame.

This has also been addressed indirectly by Lévy (2003, 2010), as he has shown that the Lorentz transformation can be derived from anisotropic one way speed of light when using Einstein synchronized clocks. And from the Lorentz transformation we can easily derive the relativity of simultaneity time equation.

[3] I am here using $L$ simply as the distance between the two clocks as observed from the same frame in which the clocks are at rest. For the two frames to be as equal as possible, they must agree that the distance between the two clocks is arranged in the same way as measured from the frame the clocks are at rest in.

## 3 The Relationship Between Einstein's Relativity of Simultaneity and Ether- Based Apparent Relativity of Simultaneity

Let us look more closely at the predictions from Einstein's relativity of simultaneity and the apparent relativity of simultaneity derived from anisotropic one-way speed of light when using Einstein synchronized clocks. The Einstein relativity of simultaneity can be derived from the Lorentz transformation. The time it takes for the light signal for going from A to the midpoint clock in frame 1 is

$$\hat{t}_{1,e,am} = \frac{\frac{1}{2}L}{c}$$

From frame two, this time is given by the Lorentz transformation and is

$$\hat{t}_{2,e,am} = \frac{\hat{t}_{1,e} + \frac{\frac{1}{2}Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}} = \frac{\frac{\frac{1}{2}L}{c} + \frac{\frac{1}{2}Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}}$$

For the light signal going from B to A, we have

$$\hat{t}_{2,e,bm} = \frac{\hat{t}_{1,e} - \frac{\frac{1}{2}Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}} = \frac{\frac{\frac{1}{2}L}{c} - \frac{\frac{1}{2}Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}}$$

The two light signals are reaching the midpoint with a time difference of

$$\hat{t}_{2,e,am} - \hat{t}_{2,e,bm} = \frac{\frac{\frac{1}{2}L}{c} + \frac{\frac{1}{2}Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}} - \frac{\frac{\frac{1}{2}L}{c} - \frac{\frac{1}{2}Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}} = \frac{\frac{Lv_e}{c^2}}{\sqrt{1-\frac{v_e^2}{c^2}}} = \frac{Lv_e}{c^2\sqrt{1-\frac{v_e^2}{c^2}}} \tag{6}$$

This is a well-known result from special relativity, see for example Comstock (1910), Carmichael (1913)[4], Dingle (1940), Bohem (1965), Prokhovnik (1967), Shadowitz (1969), and Krane (2012).[5] The question is: how is this potentially related to the apparent relativity of simultaneity given above. The apparent relativity of simultaneity using Einstein synchronized clocks is given by equation 6. We have the following relationship between absolute velocities, $v_1$ and $v_2$ against the ether and the relative velocity as measured by Einstein synchronized clocks $v_e$

$$v_e = \frac{v_2 - v_1}{1 - \frac{v_1 v_2}{c^2}}$$

From this we can further explore the apparent relativity of simultaneity using Einstein synchronized clocks under atomism

$$\begin{aligned}
\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} &= \frac{L_{1,1}(v_2 - v_1)}{c^2\sqrt{1-\frac{v_2^2}{c^2}}\sqrt{1-\frac{v_1^2}{c^2}}} \\
\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} &= \frac{L_{1,1}(v_2 - v_1)}{c^2\sqrt{1-\frac{v_1^2}{c^2}-\frac{v_2^2}{c^2}+\frac{v_1^2 v_2^2}{c^4}}} \\
\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} &= \frac{L_{1,1}\frac{(v_2-v_1)}{\left(1-\frac{v_1v_2}{c^2}\right)}}{c^2\frac{1}{\left(1-\frac{v_1v_2}{c^2}\right)}\sqrt{\left(1-\frac{v_1v_2}{c^2}\right)^2 - \frac{(v_2-v_1)^2}{c^2}}} \\
\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} &= \frac{L_{1,1}\frac{(v_2-v_1)}{\left(1-\frac{v_1v_2}{c^2}\right)}}{c^2\sqrt{\frac{\left(1-\frac{v_1v_2}{c^2}\right)^2}{\left(1-\frac{v_1v_2}{c^2}\right)^2} - \frac{\frac{(v_2-v_1)^2}{c^2}}{\left(1-\frac{v_1v_2}{c^2}\right)^2}}}
\end{aligned}$$

[4]page 41.

[5]Krane (2012) has an error/typo in his derivation, but his end result is correct.

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}\frac{(v_2-v_1)}{\left(1-\frac{v_1 v_2}{c^2}\right)}}{c^2\sqrt{1-\frac{\frac{(v_2-v_1)^2}{\left(1-\frac{v_1 v_2}{c^2}\right)^2}}{c^2}}}$$

$$\hat{t}_{e,1,2,am} - \hat{t}_{e,1,2,bm} = \frac{L_{1,1}v_e}{c^2\sqrt{1-\frac{v_e^2}{c^2}}} \tag{7}$$

This is exactly the same result as given by special relativity, but here it is derived from anisotropic one-way speed of light. Based on this we find that Einstein relativity of simultaneity is an apparent effect that contains Einstein synchronization errors.

# 4 Conclusion: The Return of Absolute Simultaneity

We have shown how Einstein's relativity of simultaneity is fully consistent with the anisotropic one-way speed of light when using Einstein synchronized clocks. Einstein's special relativity theory leads to several bizarre paradoxes recently introduced by Haug (2016a,b). Einstein's special relativity is mathematically sound but incomplete and Einstein's two postulates are likely wrong, although all of Einstein's formulas provide correct predictions when using Einstein synchronized clocks. The true one-way speed of light cannot be isotropic and the strict relativity principle does not hold. There is a hierarchy of reference frames. We have a true absolute simultaneity. Further, we have apparent relativity of simultaneity when using Einstein synchronized clocks.

If we can detect the true-one way speed of light and thereby also detect motion against the "ether" by using experiments as indicated by Marinov (1974), Torr and Kolen (1984), and Cahill (2012), then we can detect and measure anisotropy in the one-way speed of light, and we can use the knowledge of this speed to synchronize clocks over a distance. Then we will observe absolute simultaneity as mathematically described by Lévy (2003) and Haug (2014).

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