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## **The Einstein / Pythagoras Light-Clock hypothesis demolished**

### **ABSTRACT**

Einstein's 'thought experiment', of the 'Light Clock', gave rise to the idea that time itself must be different between observers. His hypothesis has become the foundation of the worldwide belief in the notion that time is not Universal.

This imagined device measures time based on the reflection of a beam of light between two mirrors. This simple (yet impossible to construct) idea is erroneously used to illustrate how *time dilation* occurs as an object approaches the speed of light. It is a fundamental tool in the teaching of, and the understanding of, special relativity. In this short paper I demolish the whole notion.

### **KEY WORDS**

Einstein, Pythagoras, hypotenuse, observers.

### **CONTENTS**

Page 2	Einstein's hypothesis
Page 4	A correct interpretation of the Light-Clock hypothesis
Page 7	NOTES

## The Einstein / Pythagoras Light-Clock hypothesis demolished

The light clock is an imagined device that measures time based on the reflection of a beam of light travelling between two mirrors. The images below show Einstein's erroneous hypothesis.

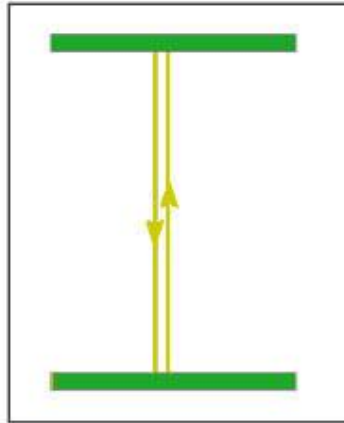


Image 1; Einstein's mirrors. (still)

In the above image we have two parallel, horizontal mirrors, (the green boxes) one above the other. A single pulse of light (not being refreshed) bounces between them. (according to theory).

Each downward and each upward movement of the pulse is taken as being 'two ticks'

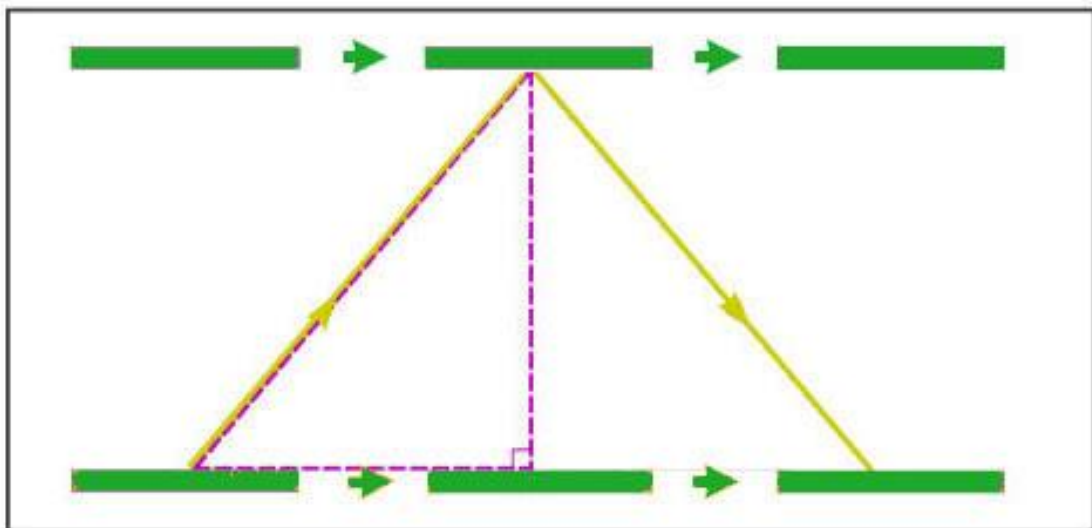


Image 2; Einstein's mirrors. (in motion)

Next, image 2 shows the mirrors apparently in motion. They are travelling to the right. The light pulse, in order to keep bouncing between the mirrors, has now to follow a diagonal path.

Any observer travelling with the mirrors is regarded as being 'within the reference frame of the mirrors' and is, therefore, *not moving*, relative to the mirrors.

This assertion, as applied to a *real* situation, gives;  
An 'observer' in a travelling train carriage continues to see the light-pulse travelling up and down, vertically.

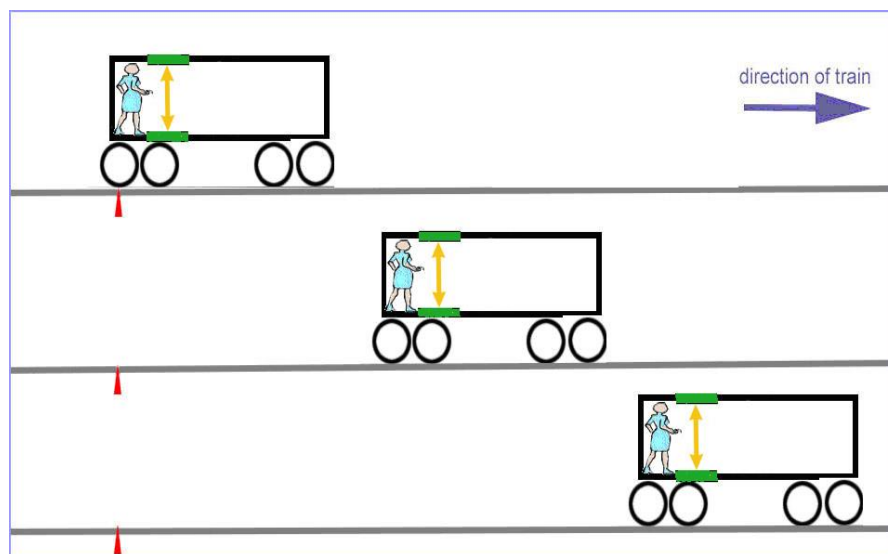


Image 3; The suggested experience of the travelling observer.

However, an 'outside observer' would *perceive* that the light pulse follows a *diagonal* route.

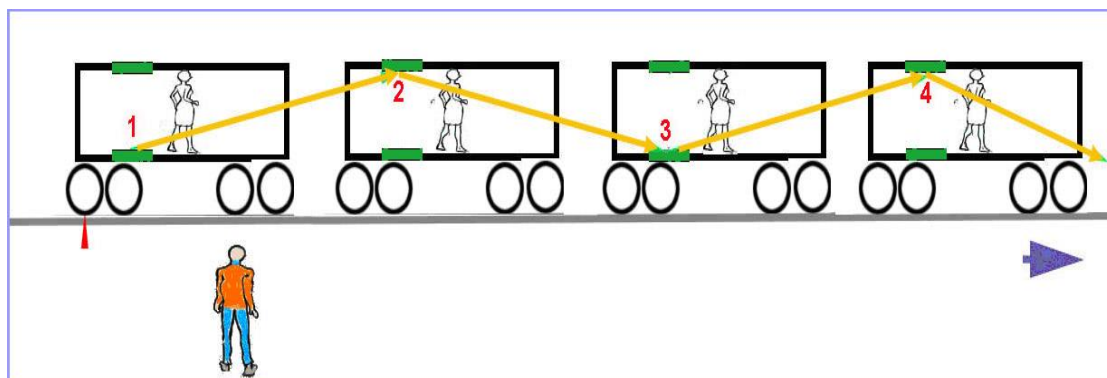
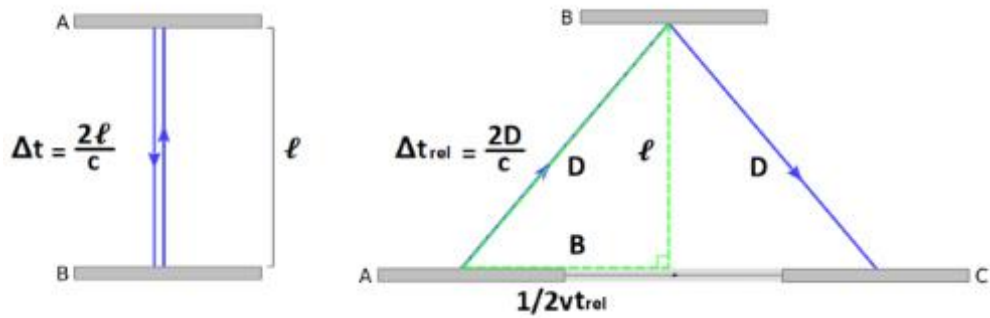


Image 4; The suggested experience of the outside 'static' observer.

To these circumstances Einstein employs Pythagoras. One tick for the traveller is the length of the upright. One tick for the outside observer is the length of the diagonal line. And the mathematics are given, with their calculations, as follows.



As the speed of light *is constant*, it must take *longer* for light to traverse the *diagonal* line than the *upright* line. (the hypothesis maintains) So, the interval of the *traveller's* time, as perceived by the outside observer, is *stretched*, to be of a longer duration than the traveller herself, experiences it. Therefore, the *mathematics* conclude that time is *slowed down* for the traveller. (according to the outside observer).

### A correct interpretation of the Light-Clock hypothesis

Looking at Einstein's initial concept....

(and ignoring that a pulse of light can *never* be trapped between two horizontal parallel mirrors; See NOTES)

..... the theoretical hypothesis claims that image 1 represents what is experienced by an observer in the *same reference* frame as the mirrors.

But looking more closely at Image 2, where the two mirrors are asserted to be in motion, we find a terrible error. This does not show mirrors in motion; it shows them in two, or three, static positions.

Below, my matching concept begins with the accepted theoretical assumption of a pulse of light bouncing between these two, static, horizontal mirrors.

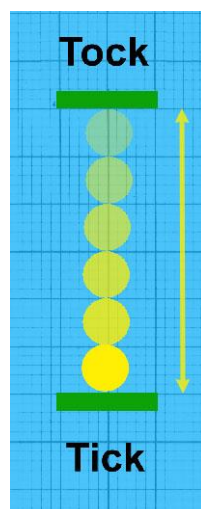


Image 5; Two parallel, horizontal mirrors continue to reflect a pulse of light

Here I add a clock noise made with every upward and every downward movement of the light-pulse, giving a "tick-tock, tick-tock, tick-tock" etc. The sequence being in the same spatial position. (Before moving).

However, either deliberately, or naively, or even disingenuously, Einstein's diagram is conceived to confuse.

With regard to 'reference frames', of course, the observer, the mirrors and the train carriage in which they are all situated, are considered as a *single* reference frame. Although this reference frame can be, and is, considered to be static by the hypothesis, it is, of course moving *relative to the train tracks*.

As in image 6, I show the movement of the mirrors as they *should* have been depicted by Einstein, as experienced by the travelling observer.

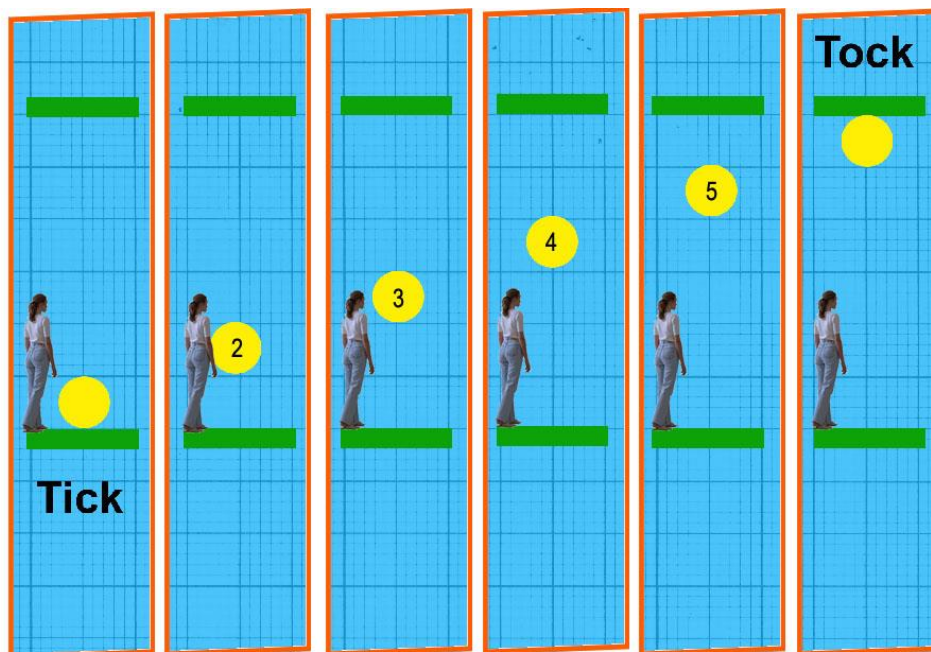


Image 6; Travelling *with* the mirrors this observer sees the light-pulse travel up (then down) in a single *vertical* movement between the mirrors, (as it is doing in image 5).

This travelling observer is watching the yellow pulse of light moving upward from "tick" to "tock" as she, *and* the 2 horizontal, parallel, green, mirrors, move across the page to the right, *with* the carriage.

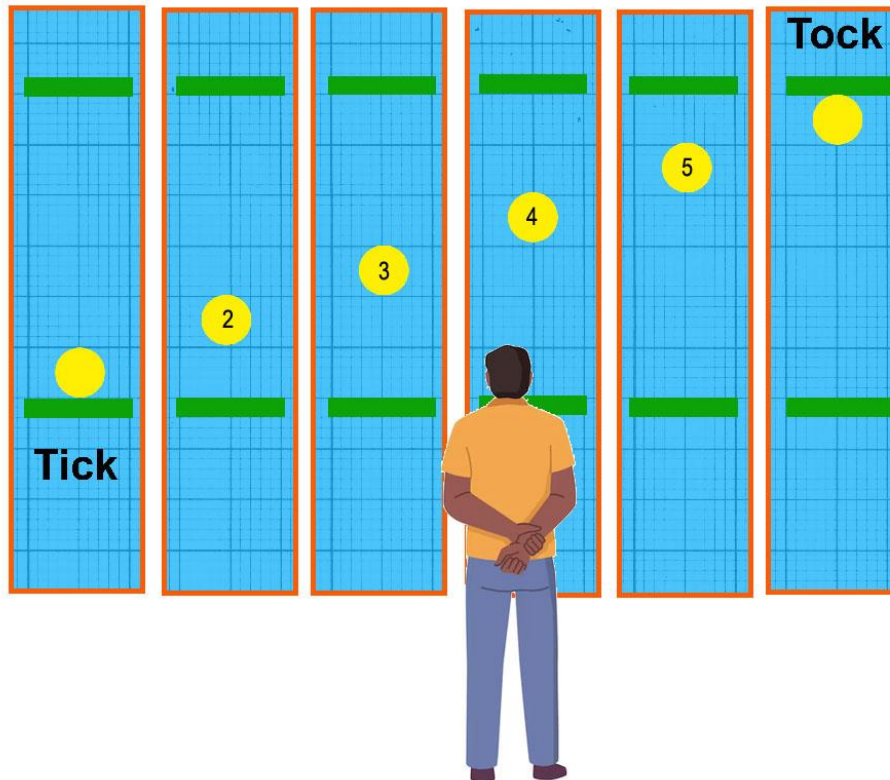


Image 7; An outside observer does see the mirrors travelling to the right, where, from *his* point of view the pulse *appears* to travel in a diagonal line.

This outside observer is clearly looking at the *same* 2 horizontal, parallel, green mirrors, as move across the page to the right. But Einstein's hypothesis maintains that *his* view, of a diagonal line for the light pulse, implies a significant change in the two observer's time.

However, this is a nonsense as;

The travelling observer sees; TICK, 2,3,4,5, TOCK

The outside observer sees, TICK, 2,3,4,5, TOCK

The CRUCIAL POINT, you will note from this, is that for *both* observers the "tick" occurs at the same moment, and the "tock" *also* occurs at the same moment, for both. Thus, the *time-period* for both equates.

Clearly, there can be no stretching of time, no *time dilation*, for the travelling observer, *in the opinion* of the outside observer.

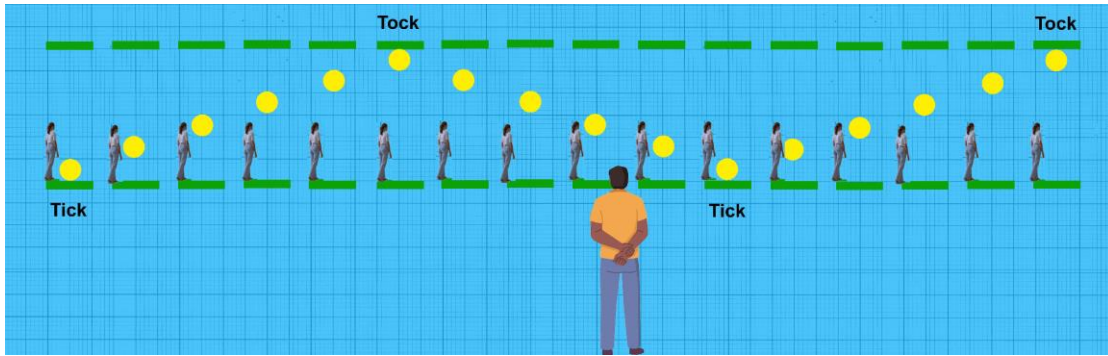


Image 8; The 'ticks', 'tocks' and the duration of travel is common to both observers.

Pythagoras's theorem does not apply as there is no consistent triangle to provide measurements.

If "tick-tocks" had been applied to Einstein's notion from Image 2, then the whole idea of the *diagonal* journey for the pulse of light *taking longer* than the *upright* light-pulse path would have been seen as totally false, and any maths that appeared to prove otherwise just has to be totally deceptive and sham.

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NOTES. Why a single pulse of light cannot ever continue to bounce between either still, or moving, mirrors.



Image 9; The impossible situation.

The Earth is rotating on its axis at almost a *thousand miles an hour*. (The rate is higher at the equator and lower at the poles). Earth orbits the Sun at an average speed of *67,000 mph*. The Sun, the Earth, and the entire solar system are orbiting the centre of the Milky Way at *140 miles a second*. Our Local Group of galaxies, is travelling towards the centre of our cluster at *25 miles a second*, whilst hurtling at *375 miles a second* toward the Virgo Cluster.

Thus, the Earth is travelling extremely quickly through the cosmos.

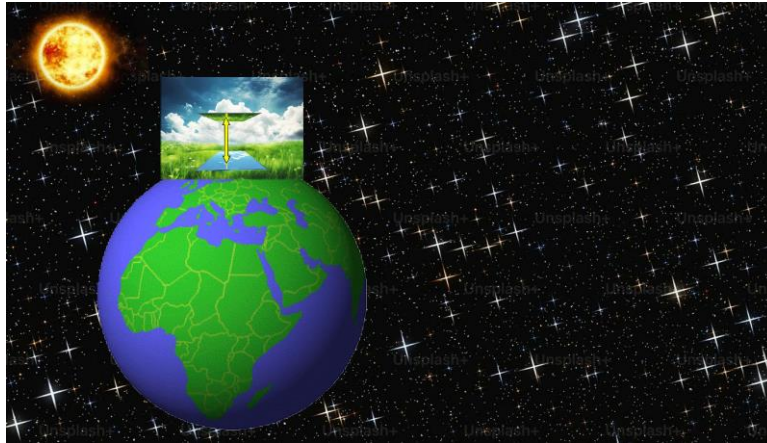


Image 10; the light-pulse is emitted

Therefore, if a light-pulse is emitted, anywhere on earth, any mirrors constructed so as to trap that pulse between them, would swiftly move away from the *vicinity* of that light's *origin*, thus the photons would *completely miss* the second mirror that is meant to reflect it.

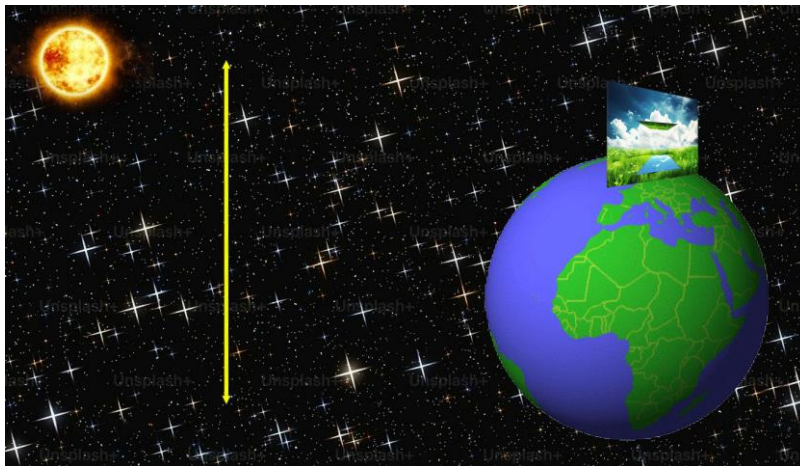


Image 11; The world has moved on, away from the light pulse.

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