A PHYSICAL EXPERIMENT WHICH REPUDIATES ALL THEORIES BASED ON EINSTEIN'S LIGHT-CLOCK

ABSTRACT

The mathematics of Time Dilation has as its root Einstein's thought experiment of a light-clock measuring differing time experiences between two observers witnessing, or being present, at the same event.
In previous essays I have claimed that the 'results' of his hypothetical 'experiment' are totally unfeasible and that any subsequent theories predicated on his Pythagorean approach to calculating time differences are also false. My claim was based on the application of logic, which has not been accepted by all readers.
Here I demonstrate a practical experiment which *proves* the light-clock explanation of time dilation to be a fallacy.

KEYWORDS

Observers, mirrors, Lorentz, horizontal deflection, laser, photon, mass.

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PART ONE

Einstein's hypothesis

Einstein posited a 'thought experiment' involving two observers; one travels in a train, another sees the train pass, whilst waiting on a station platform.

The train carriage has within it a light beam bouncing between two parallel mirrors.
The travelling observer, it is argued, sees the light continually bounce back and forth, always travelling the fixed distance between those mirrors whilst the train is in motion.

However, because the train is moving, relative to the outside observer, the latter sees the light path as being a longer *diagonal* line, as the mirrors are no longer, for him, directly above one another when they receive the bounced light.

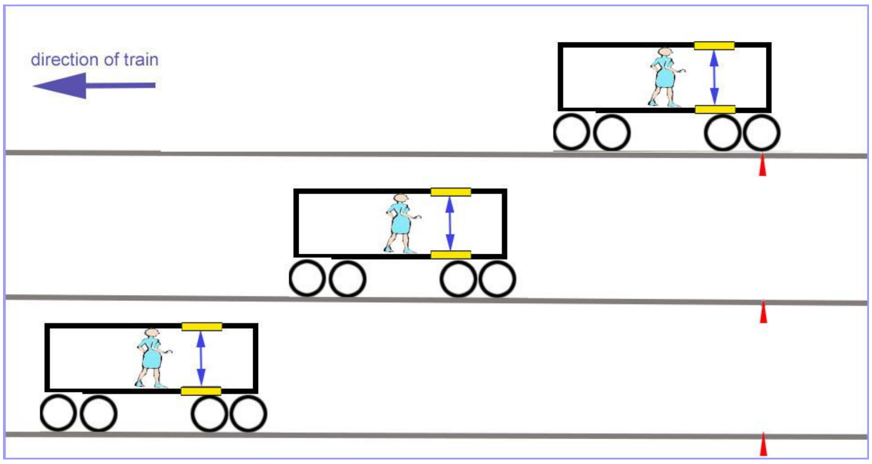


Diagram 1; The suggested experience of the travelling observer

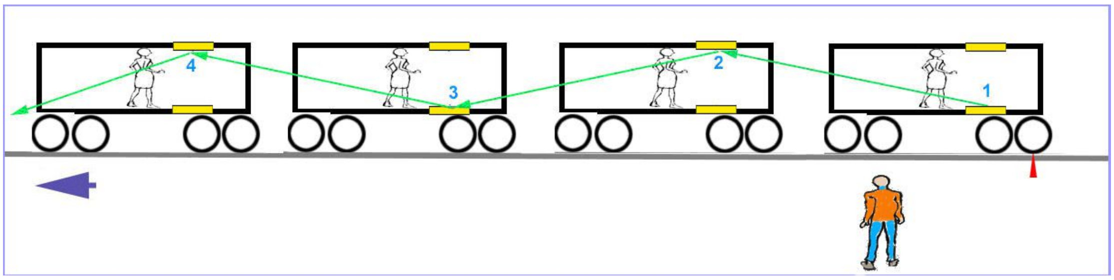


Diagram 2; The suggested experience of the outside 'static' observer.

The Resultant Theory

From this, Einstein produces the following calculation employing the theorem of Pythagoras;

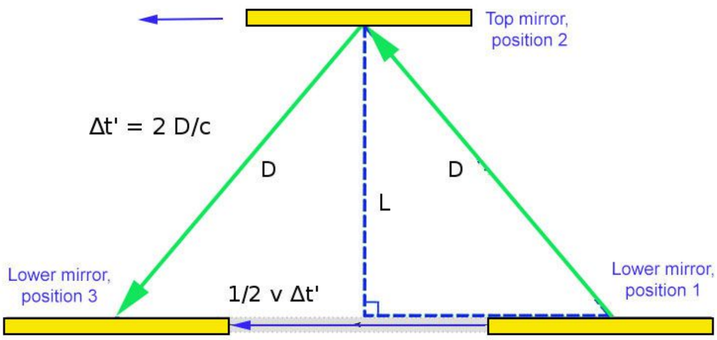


Diagram 3; Pythagoras applied to the theory

As the speed of light is constant, this idea demonstrates that the bounced light D, as seen by the '*static*' observer, has *further* to travel than the upright distance L as seen by the traveller. The conclusion being that the light beam takes *longer* to bounce between the mirrors for the 'static' observer (D) than it does for the travelling observer (L). If these bounces are 'ticks' of a clock, then time is *relative* between these two observers, with the clock *in motion* ticking more slowly than the *static* version.

Current conclusions from this theory

1) Time dilation is the fact that moving clocks run more slowly than stationary clocks. (And, extrapolated from that, a moving observer will therefore age more slowly than a stationary observer!)

2) An accurate clock at rest, with respect to one observer, may be measured to tick at a *different rate* when compared to a second observer's own, equally accurate, clock.

3) The Lorentz transformations connect the space and time coordinates of an event as measured by an observer in any particular reference frame
In each reference frame, an observer can use a local coordinate system (most exclusively Cartesian coordinates in this context) to measure lengths, and a clock to measure time intervals. This accepts that time intervals will differ, as above, for each individual, acknowledging such an event.

4) The length of any object in a moving frame will appear foreshortened in the direction of motion, or contracted. The amount of contraction can be calculated from the Lorentz transformation.

PART TWO

The behaviour of mass

Should a speeding ball be directed, at right-angles, against a moving surface the bounce-back trajectory will be influenced by the speed of that 'hit' surface and by the smoothness or roughness of that ball and surface.
Friction on impact has caused the ball to absorb some of the forward motion of the travelling surface such that the ball's ricocheted direction will not be along the line of its approach to that surface, as it would have been, had that surface been still.

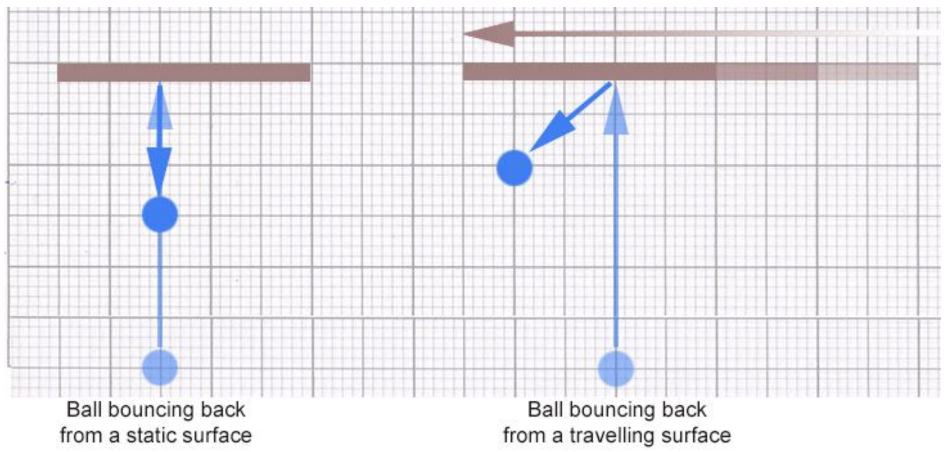


Diagram 4; ball bouncing back from a static and a moving surface.

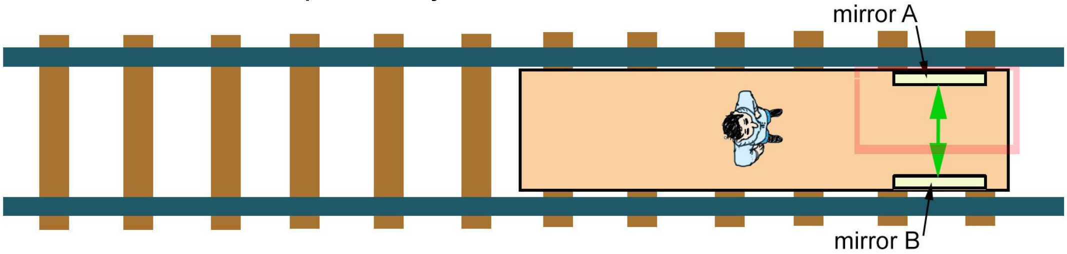
Photons are considered to be mass-less, and as such could not be affected by coming into contact with a moving surface as did the ball above. The only way that light could behave in the way described by Einstein, with regard to his light-clock, would be if light particles *had mass*, capable of being affected by friction or impact.

PART THREE

Physical proof that repudiates the validity of Einstein's Light-Clock.
Experimental set-up to rebuff Einstein's hypothesis.

It is not possible, *physically*, to set up two opposing mirrors with a trapped reflecting pulse of light bouncing between them, as drawn in green below, and as imagined by Einstein. Consequently Einstein kept this idea as a 'thought experiment'. However, as many subsequent theorems are predicated on this light-clock experiment it is necessary to validate or dismiss it.

In order to initiate such an experiment I replicate *half* of this speculated idea in order to demonstrate, practically, the whole notion.



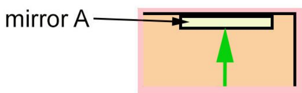


diagram 5; Einstein' train carriage and light-clock- and the second frame, below, displaying the top half of the light-clock (just mirror A)

Therefore, I have taken this single mirror (A) from the train carriage, as outlined in pink above, to investigate in what circumstances light could be encouraged to 1) travel *with* the mirrors, as asserted by Einstein, (to be the circumstance and experience of a travelling passenger), and 2) to determine if light could ever be encouraged to bounce, in any direction other than perpendicularly from a mirror, when moving, (to be the circumstance and experience of an outside observer).

To consider this I have arranged a set of rails on which a mirror (representing mirror A) can either be drawn slowly, or propelled quickly, from one side to the other. A laser is pointing towards the rails, such that mirror A will receive a triggered pulse when aligned with the laser. The laser's *vertical* angle is adjusted so that the beam, when in contact with the mirror, is not reflected upon its own path, but is directed slightly upwards so that the reflected beam can be recorded on a screen. In this way any change in its *horizontal* direction can be exactly noted.

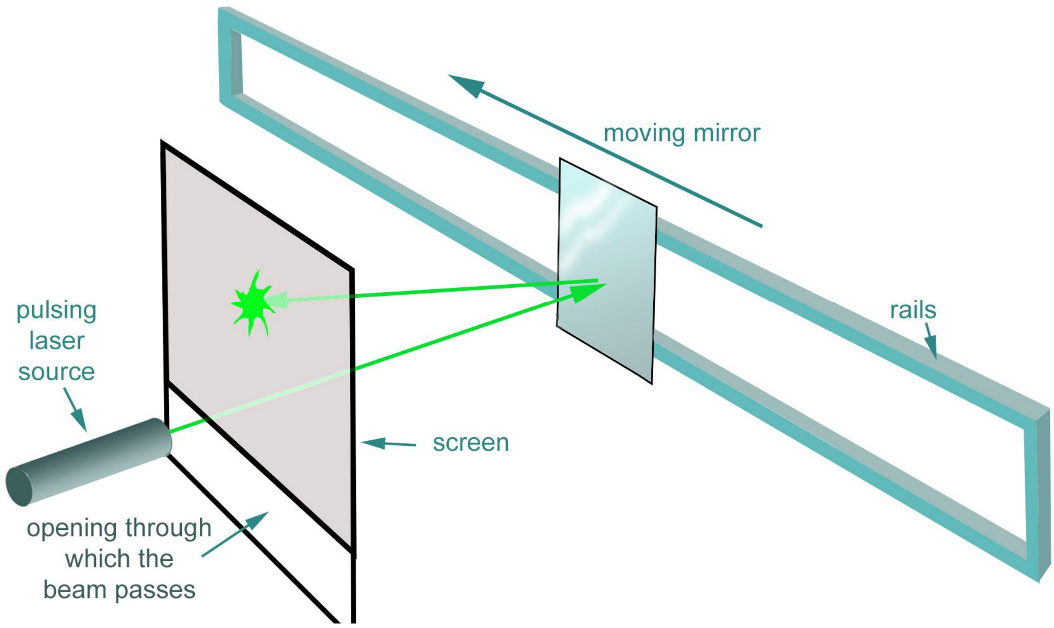


Diagram 6; the experimental apparatus using a single moving mirror.

With the apparatus in place, I filmed a laser pulse being directed at that mirror in various states of movement.

1) with the mirror stationary and directly in the path of the laser's beam, subsequently being drawn to the left.

2) with the mirror being drawn continuously across the field of the laser's beam, and with the triggering of the laser's pulse coinciding exactly with the mirror being in a position to be struck by that beam.

3) with a slow-motion camera, whilst the mirror was being propelled very quickly through the predicted path of the laser's beam, its pulse again being triggered to coincide with the mirror being exactly in its way.

To view this experiment in motion please go to the following YouTube link from which the still that follow are taken. There are 3 events to view.

https://youtu.be/TrMtseB10wY

To explain how *half* of the light-clock design is being used here, let's look at a relevant part of that train carriage from diagram 4. We will then examine a pulse's path from one mirror (A) travelling towards its opposite (B) whilst that carriage is stationary, during frames 1 to 10.

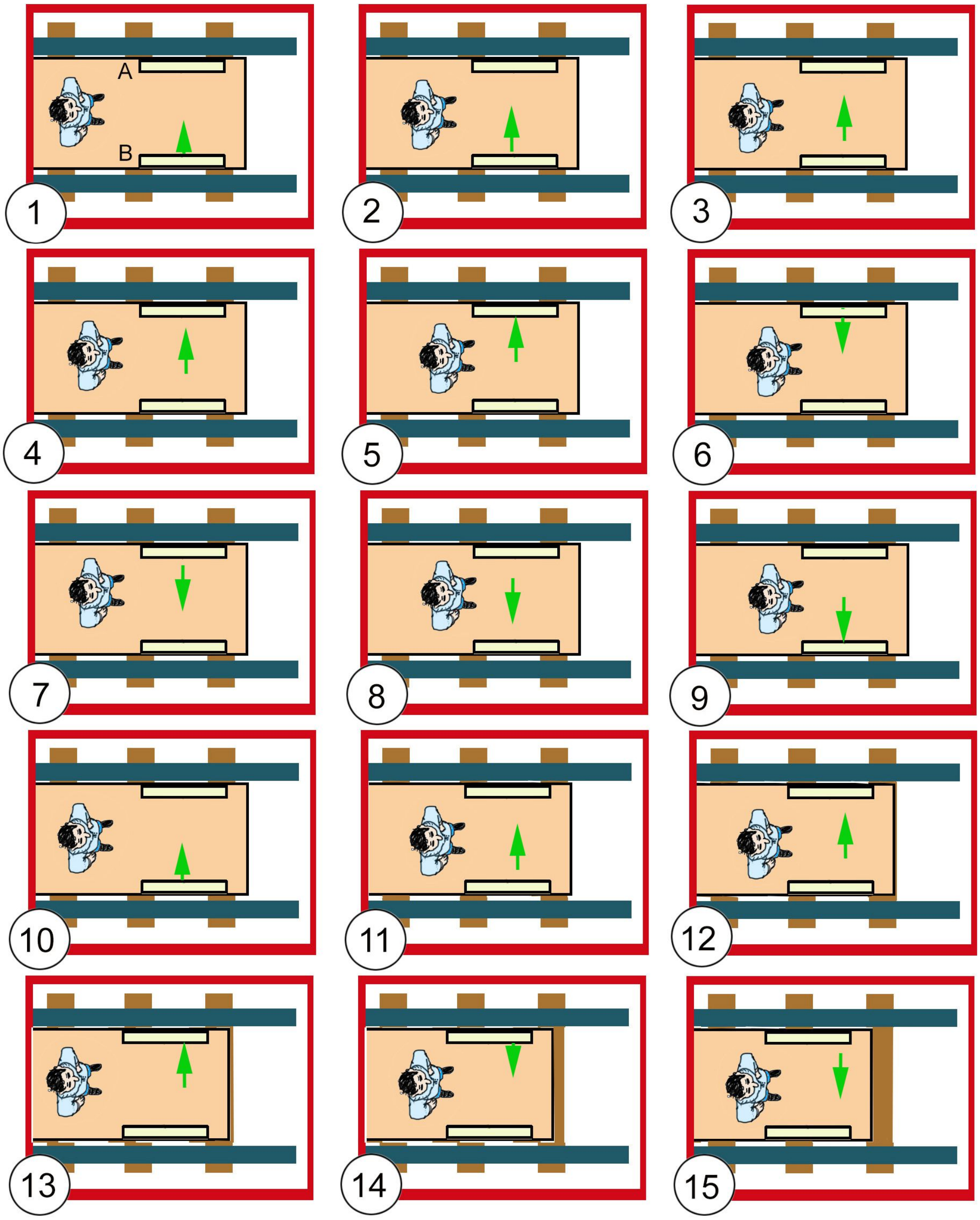


Diagram 7; the carriage with its opposing, parallel mirrors (A and B) reflecting a trapped light pulse.

Over frames 1 to 10, the train carriage is stationary, and I accept that Einstein's pulse bounces back and forth, precisely, between mirrors A and B.

From the first event of my YouTube video, we have my single static mirror (A) receiving and reflecting a pulse of light exactly as depicted between frames 3 and 8, (where second mirror (B) is, as yet, uninvolved.)

Although my pulse is not a beam sent from another mirror, there can be no difference in the physical properties of a pulse of light proceeding towards my mirror (A), and being reflected back from it, in frames 3 to 8, no matter how that particular pulse was, *at that singular moment*, generated.

So my image below (a still from the video) *must* exactly represent frame numbers 3 to 8, shown above. My reflected pulse is recorded on the screen as being, *horizontally* in line with the initiating, approaching beam, as it is in Einstein's light-clock, when static.

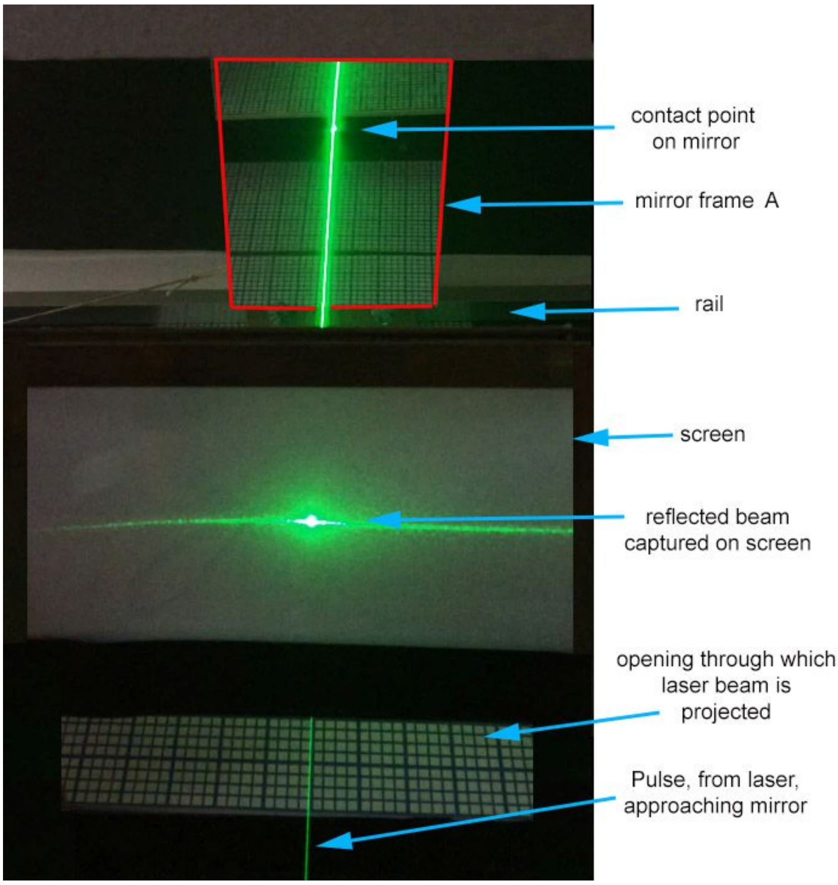


Diagram 8; a frame from event one of the video, showing the original pulse and its reflected beam along the same *horizontal* path, from a *static* mirror.

I have added a red outline to the mirrors in this, and the following still frames, as the mirrors are less clear in these stills than they appear in the video, where their motion makes their shapes far more evident.

Now, below, a later frame from event one shows the mirror slowly being drawn to the left. This relates to Einstein's train *starting to move*, (and, of course, his carriage's interior parallel-mirrors move along with it.)

Frames 11 to 15 (above, diagram 7) show the train's mirrors in motion whilst the diagrammatic beam continues on its path between them.

And this is where Einstein is completely wrong, when he maintains that the observer, *travelling with the moving train*, will continue to see the pulse bounce back and forth between the mirrors, as they were when still.

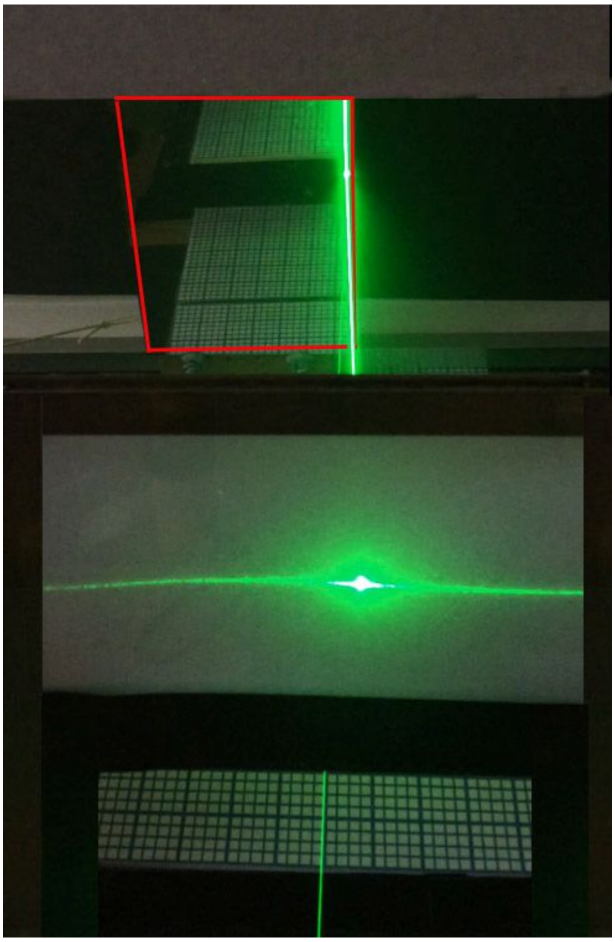


Diagram 9; a latter frame from event one, shows the very last pulse to hit the moving mirror before that mirror is drawn out of the path of the beam.

The movement of the mirror does not deflect the horizontal path of the pulse, nor does the mirror take the pulse along the rail with it.

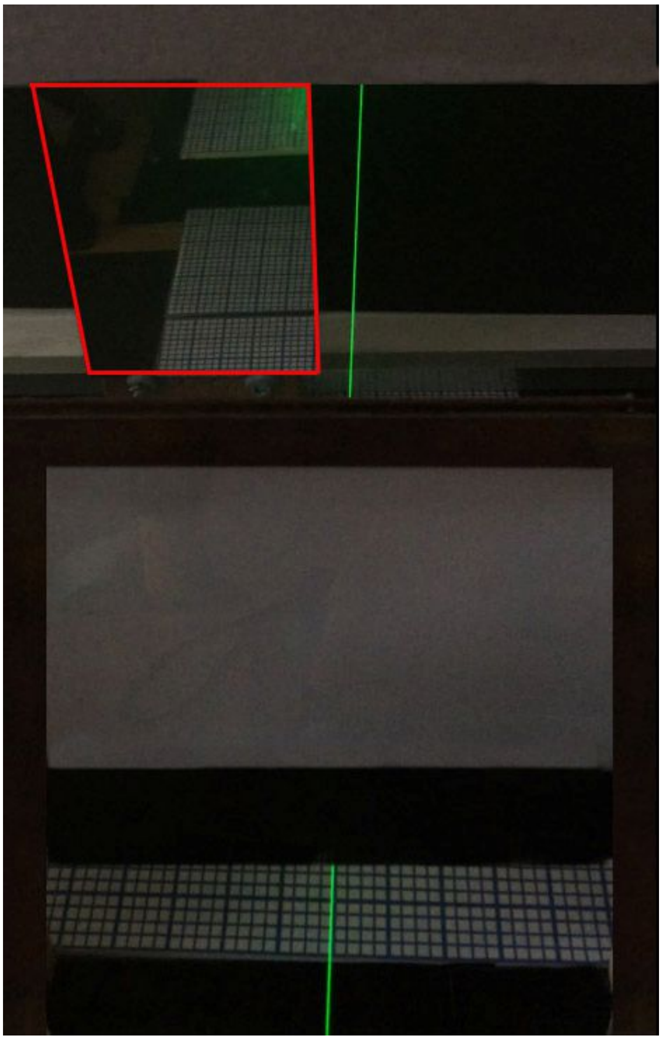


Diagram 10; a final frame from event one, showing, obviously, that the pulse will no longer be reflected, now the mirror has moved out of the way of the beam.

The pulse cannot 'know' that the mirrored surfaces, towards which it is being projected, are moving. Nor can the mirror drag a pulse along with it.

Next we come to Einstein's considered experience of 'the outside observer' and how that person 'sees' a reflected beam.

Event two of the video shows that the reflected beam of a pulse of light returning from a continuously travelling mirror is also not deflected from the original horizontal path of its emission.

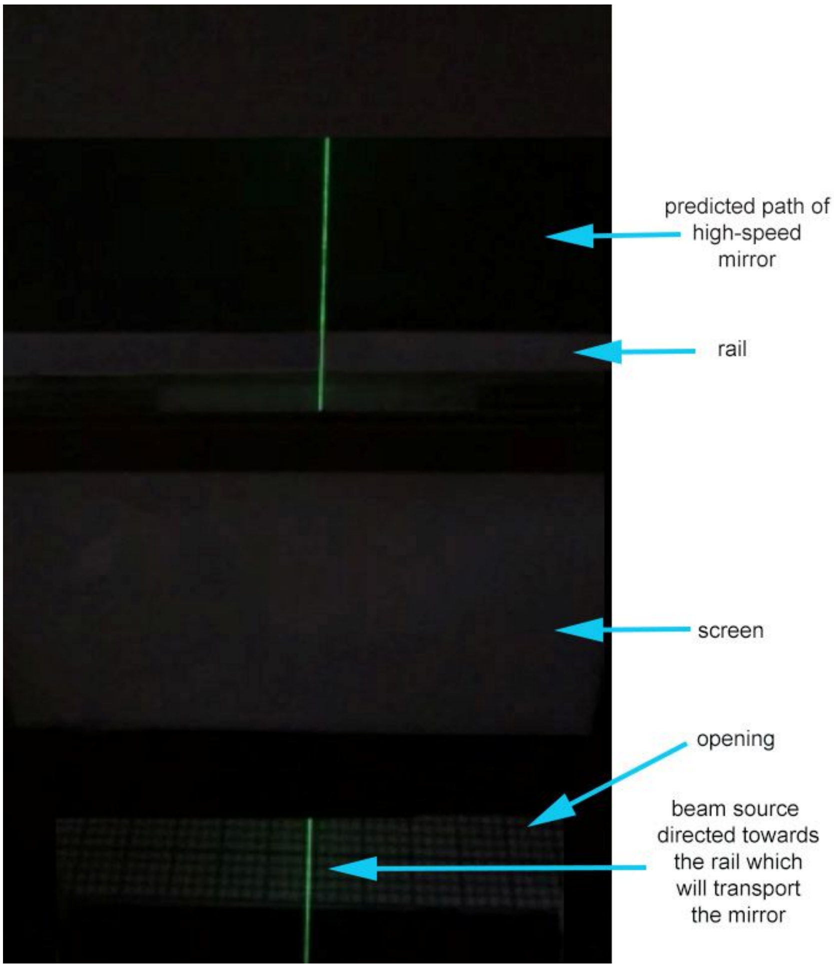


Diagram 11; a frame from the event three slow-motion video prior to the mirror's arrival.

Event three of my video was filmed in slow-motion so as to display, more clearly, fast-action events.
The laser is positioned to fire as many light pulses at the mirror as possible, whilst the mirror's moving position coincides with that of the laser's field.
Mirror (A) is propelled at considerable speed through the area across which the laser beam is directed. Triggered pulses from the laser hit the mirror and are *still* reflected back to the screen in a perpendicular direction..

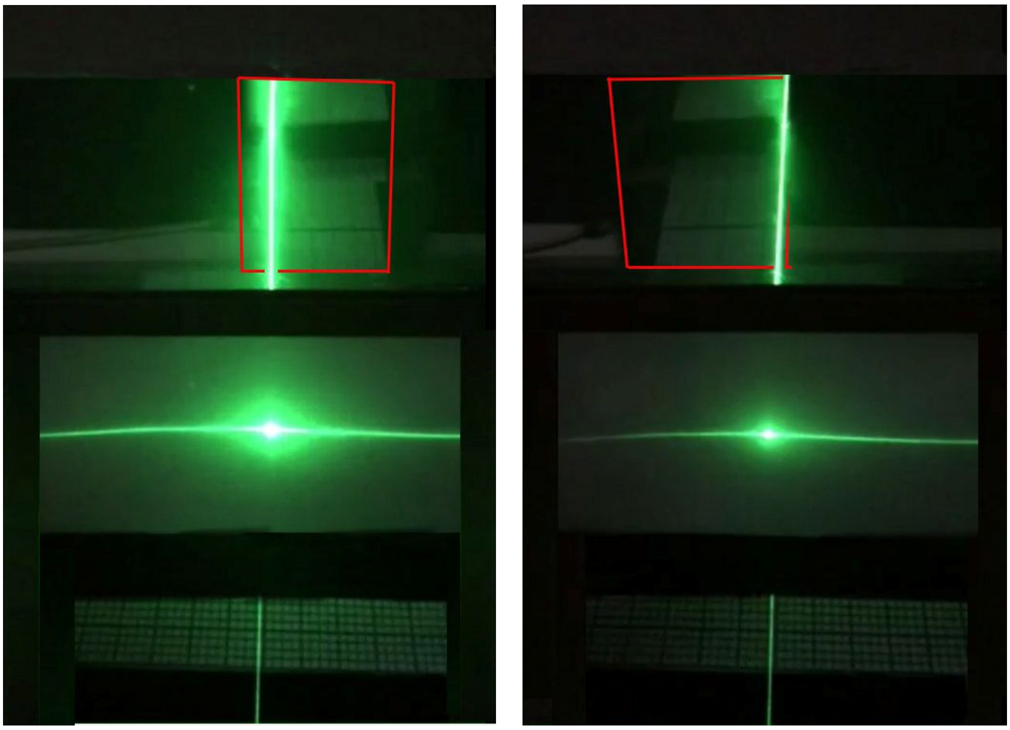


Diagram 12; from event three, showing two reflected pulses from the speeding mirror as they appear on the screen.

The slow-motion camera catches the two moments when mirror (A) is in the path of the light pulse. The location of those reflected pulses on the screen coincide, irrespective of the position of the mirror.
Again, from the record of reflections on the screen it is clear, that the pulses are again reflected perpendicularly from the speeding mirror.

As explained- my pulse source, is, in this case, a laser. However should an *identical* beam be sent from a parallel mirror, the results above, inevitably, will be identical.

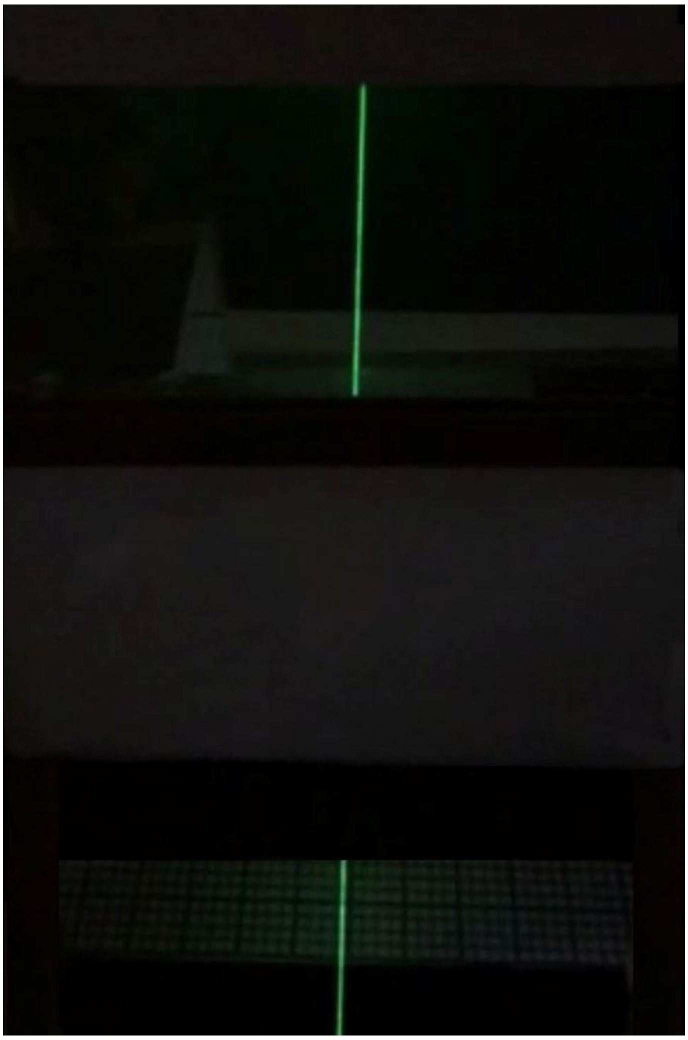


Diagram 13; from event three, with the mirror gone, the last pulse flies off into infinity!

Had the pulse been sent by an accompanying fast travelling parallel mirror (B) then no further pulses would be sent anyway.

Now let's see how the above experiment can be made to relate exactly to Einstein's light-clock.

We know from the above experiments that no pulse has been *deflected* by the mirror, whilst either still, or moving, so let's remove the screen and tilt the laser down so that the laser's beam hits the mirror and then reflects *directly* along its emission path.

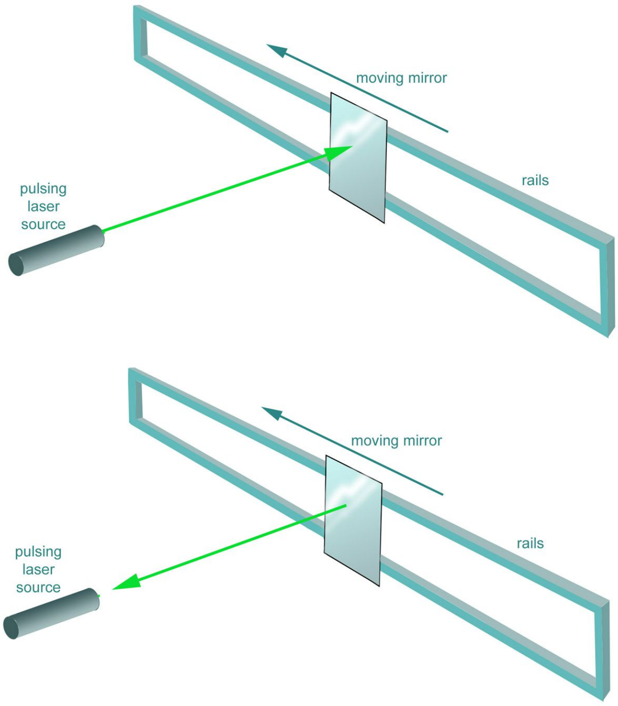


Diagram 14; the screen is removed, the laser refocused for a direct return of a reflected beam.

Next, omitting for a moment the depiction of the laser, the diagram below looks at this same experiment, but from a different viewpoint; that is, from the *back* of the rails.
So far we have introduced nothing that has influenced our practical results from the earlier video events, whereby no horizontal deflection has been caused by the moving mirror.

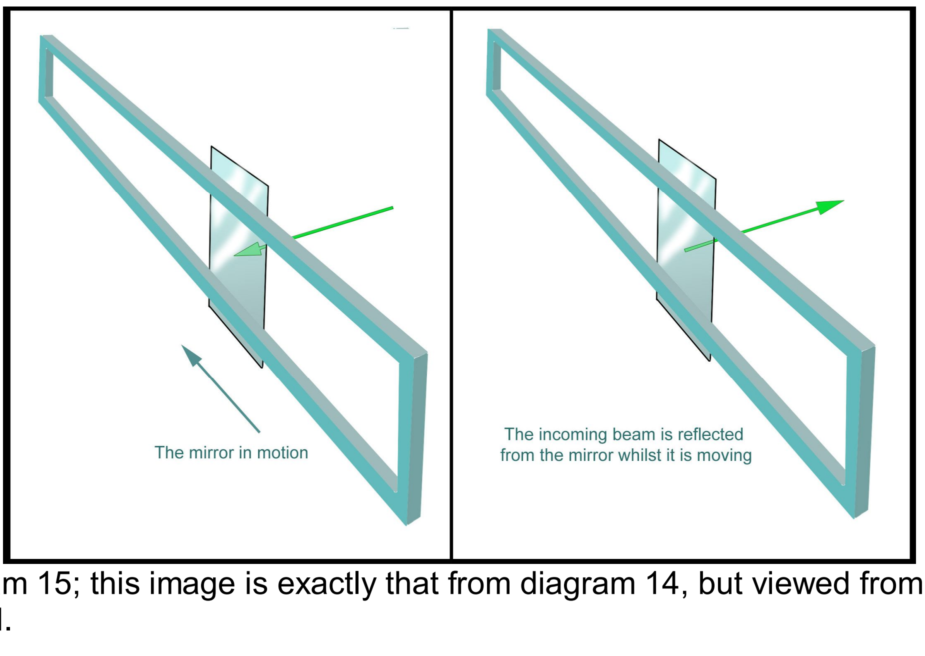


Diagram 15; this image is exactly that from diagram 14, but viewed from behind.

With the mirror in motion, diagram 15 captures the moment when the path of the mirror coincides with the beam of the laser, which, again as in diagram 14, is reflected exactly back along the emission path.

As the reflecting event is identical, in diagrams 14 and 15, whether viewed from the front or the back of the rails, we can *now* call these two *"matching* experiments" and can place them together such that the two mirror's movements are uniform; travelling in parallel.

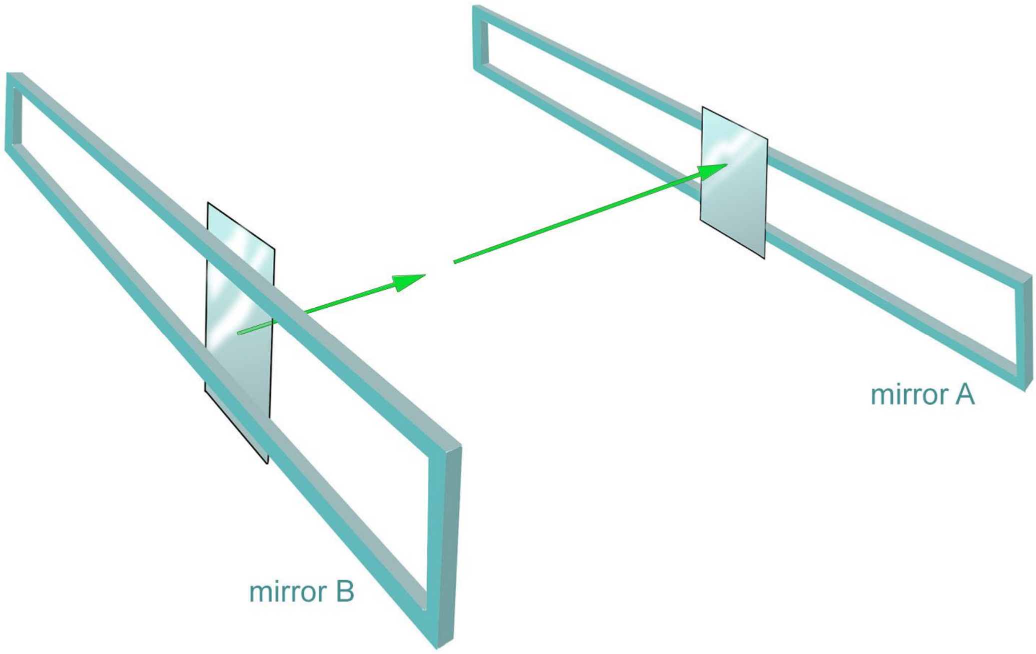


Diagram 16; the same experiment seen from two matching positions.

Although, up until now, I have been generating the pulses with a laser, should we join together the images from both the front and rear of the rails such that their layout is as in diagram 16, we can, unquestionably, substitute what was the *laser's* beam, with the beam being reflected from the opposing mirror. We can now label the rear viewed mirror as mirror (B) with the front viewed mirror being mirror (A)

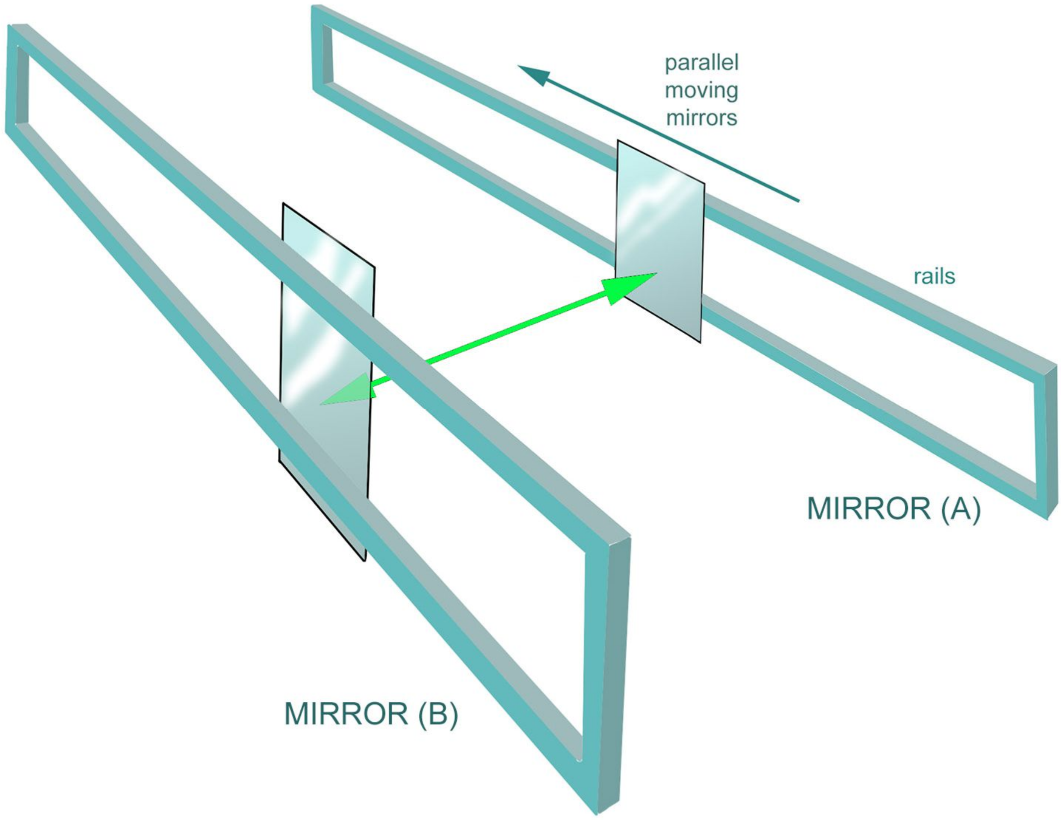


Diagram 17; The experiment is duplicated and the results matched.

And this looks very much like Einstein's light-clock *except* that we know from the experiments above that *any* pulse hitting a *moving* mirror will not track along with the mirrors, not will it ever be reflected at an angle no matter at what speed the mirrors are travelling.

Therefore Einstein's claim that an outside observer would see, or experience, the reflecting light travelling a *diagonal* path, as described in the 'hypothesis' paragraph at the beginning of this essay, is *completely* incorrect. Nor would the travelling observer *continue* to see the pulse bounce between those mirrors.
The beam will be lost!

PART FOUR

Conclusion

Consequently my conclusion is that *any theory* predicated on Einstein's Pythagorean approach to calculating a hypotenuse for a static observer is also *totally false*.
Furthermore, therefore, the *Lorentz transformation,* which has as its mathematical root this erroneous calculation, is also *completely flawed*.

For those who need further explanatory diagrams, firstly we have(18) the movement on a graph of one small square per frame for the mirrors, and four small squares of movement for the much faster green-light-pulse. Once more we see the mirrors lose the beam which, as we have proved, can only reflect at right-angles from a mirror.

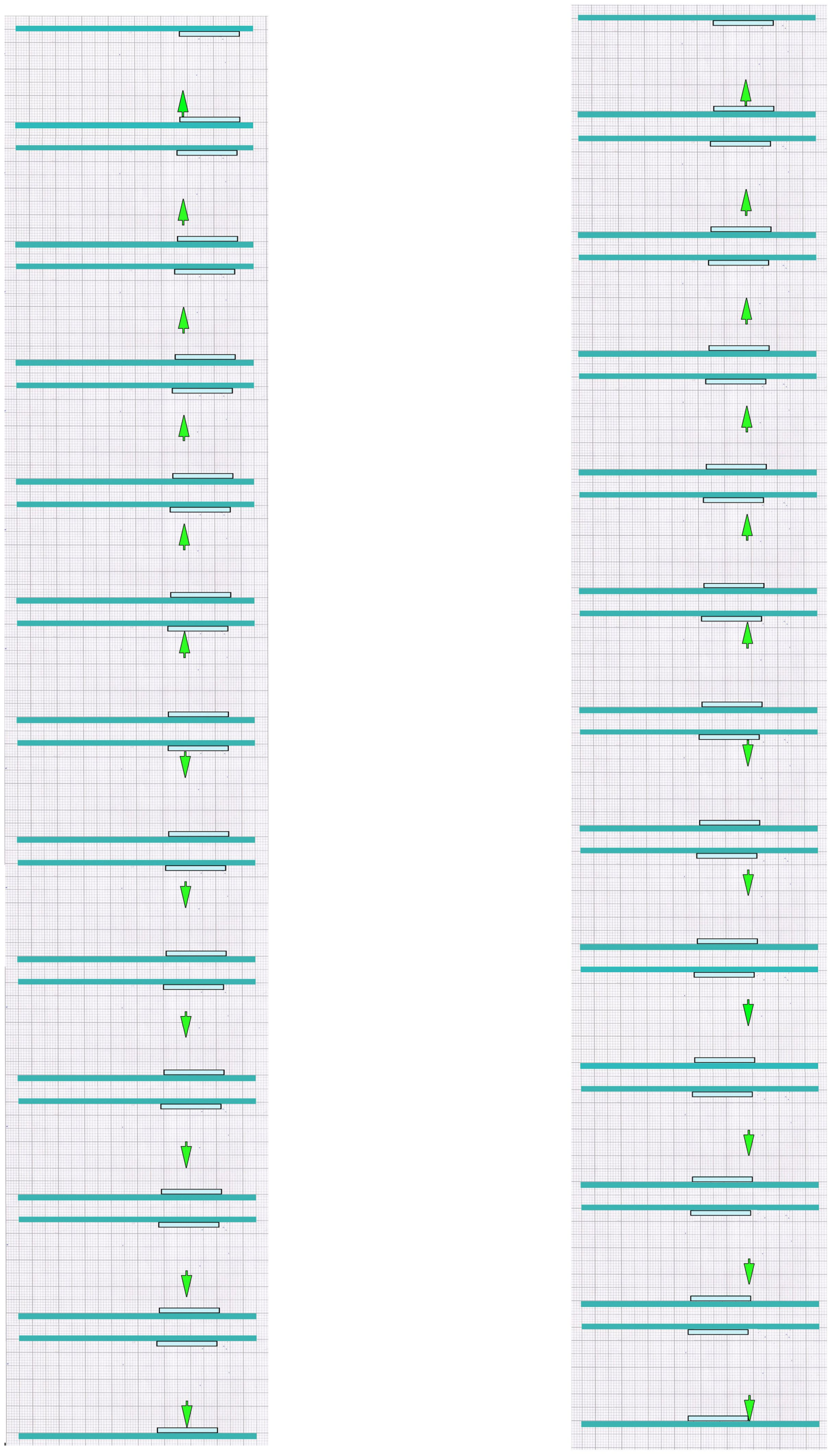


Diagram 18; Mirrors move to the left as a pulse of light is reflected between them.

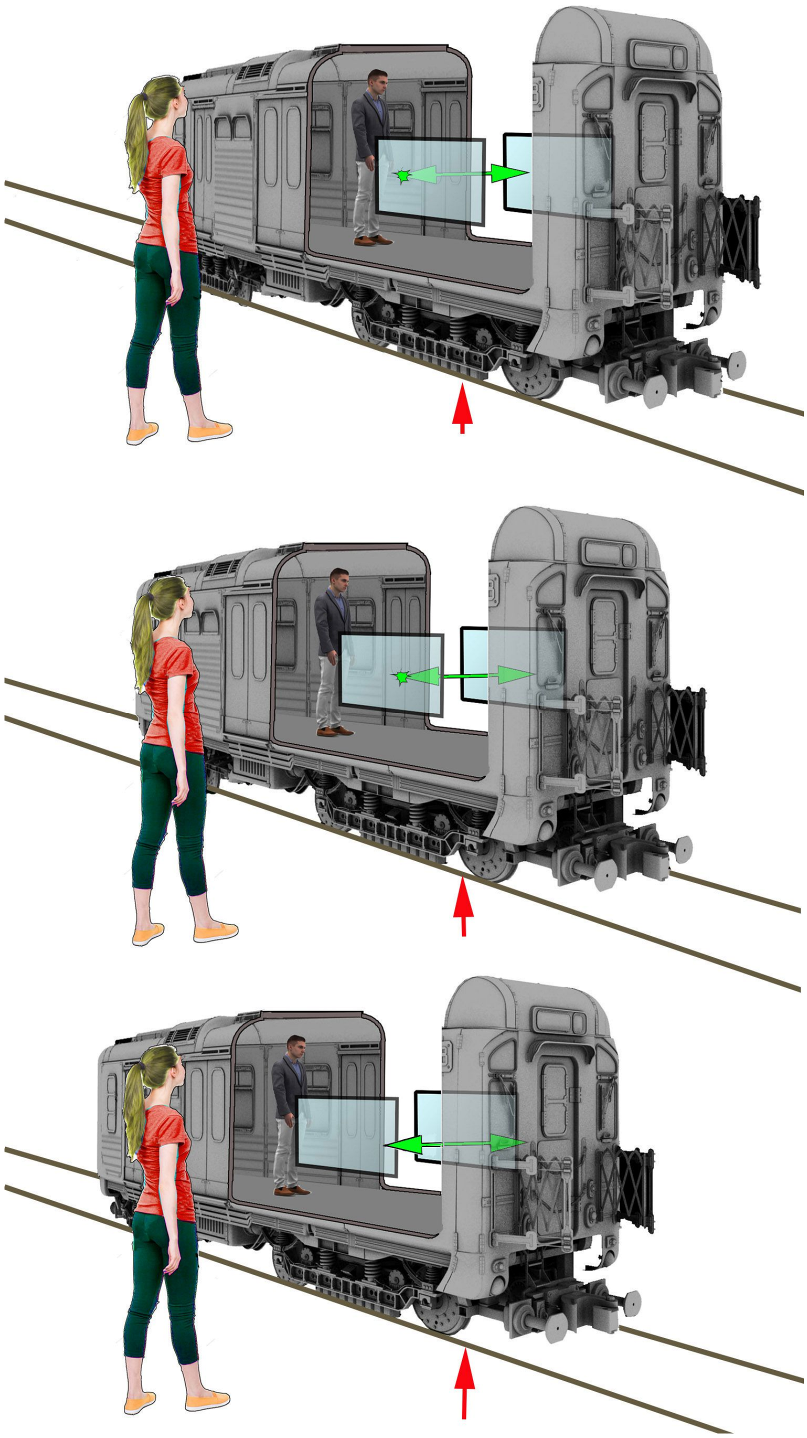


Diagram 19; As the train moves away to the left, the pulse of light (bouncing between two parallel, facing mirrors, located in the train carriage), maintains its global position, relative the red arrow below it. Thus inevitably, finally, the light pulse escapes, falling off the right-hand-edge of those mirrors. And this experience is viewed *identically* by the travelling observer and the "static", exterior observer.