What Twin Paradox?

by Uli Kaup

If one opens a modern source of information like Wikipedia in order to check on the current state of the famous twin paradox, one is not really amused to learn that the physics community still adheres to the nonsensical belief that a space traveller will turn out younger than his twin brother on earth, and a clock will lag, on return from a journey at velocities close enough to the speed of light, but rather be apalled by the article‘s typically beginning with offending phrases suggesting that meanwhile even the slowest minds should have understood that the twin paradox was resolved by the theoretical fact that the relativistic time integral depended on acceleration, concluding that, because one of the twins was accelerated more than the other, he would certainly experience a relative dilation of clock time which is age compared to his brother. It is all too easy to check on this assertion by means of Einstein’s law of invariance of the distance of two events in 4-space,

$$s=\sqrt{c^2t^2-x^2-y^2-z^2}.$$

Let us insert into this formula, as the two events to be considered, just those very two moments, before and after the journey, when the twins compare their clocks. But the paradox was dead before the first moment, because, since on both clocks the 4-distance is pure time-like ($x=y=z=0$), it needs no further comment that the clocks will show equal time. Invariance of event distance must hold for any pair of events regardless of their respective history. Arguments based on individual accelerations can play no role in here. A time-like 4-distance s is time on all clocks, and thus reads the same. The time coordinate itself, on the other hand, is not identical with clock time, as is clearly displayed by the so called twin paradox which is a good example of how easy it is to confuse categories.

Even the slowest minds should be able to imagine a mirror positioned at rest at a very large distance, say, a thousand light years out in space, relative to the ground based twin. Right before the travelling twin takes his start, they send a light signal towards that mirror. After two thousand years some of this light might return from the mirror to earth. Now let us assume that the travelling twin returns to earth right before the light returns, aged by only twenty years, in accordance with standard relativity, finding his brother’s ancient grave stone waiting for him. Reading the time off his clock when the light signal arrives though he must conclude that the light had travelled at an average speed of a hundred times the constant c relative to his clock. So, why relativity. But this is modern theory after Einstein.

This is all so obvious that one must wonder about the source of a mental confusion so deeply rooted and so widespread as it is in the big science community. One source turns out quickly to be Einstein’s own theoretical treatment of the consequences of his discovery of a new law of invariance that can explain the constancy of the speed of light against all moving frames of reference. The problem with it is the confusion of time and clock time, which is time up to a clock dependent gauge that depends on velocity. So let us repercuss in short Einstein’s argument concerning the dilation of clock time. The dilation of time itself does indeed follow from the well known formula for the time component of the 4-distance between two events observed in their own rest frame, and from a moving frame of reference, respectively,

$$t'=\sqrt{1-\frac{v^2}{c^2}}t \quad ,$$

where the moving frame is represented by primed coordinates. Obviously, more time must pass in the moving frame compared to the rest frame, when the events considered are strokes of the clock at rest, but the same equation can be applied as well to the moving clock which is at rest in its moving frame, leading to the twin paradox provided one takes off to the same failure as Einstein did, who extracted a dilation of clock time from the dilation of time. Let us, just in order to make the point, for the moment assume that both frames of reference move at constant velocity, and rewrite the two different time spans on both sides of the last equation in terms of a number of clock strokes n and the clock's gauge, τ,

$$t = n\tau \quad , \quad t' = n\tau' \quad ,$$

and so, in order to satisfy the dilation formula,

$$\tau' = \sqrt{1 - \frac{v^2}{c^2}}\tau \quad .$$

In this form, the correct outcome of the twin *Gedankenexperiment* is guaranteed by our setting the integer number of clock units equal. In other words, although time is dilated, clock time is the same. However, this is in sharp contrast with Einstein's construction which amounts to setting

$$t = n\tau \quad , \quad t' = n'\tau \quad ,$$

because this is how he stumbles into finding that

$$n' = \sqrt{1 - \frac{v^2}{c^2}}n \quad .$$

So, according to Einstein, integer clock time is not conserved. It is important to note that, in order to get out different clock times, or ages, we had to enter equal clock gauges on both sides of the equation. Einstein's argument then goes on with concluding from the once boldly established dilation of integer clock time that the gauges weren't equal, although this had been tacitly prerequisite to it, as is clearly displayed by our rewriting time in terms of clock strokes and gauges. As a matter of fact, the argument goes on and suggests that quite obviously the clock displaying a lesser number of strokes must have been walking at a slower pace through time. In ever more other words, as a second step, it changes the gauge in an act of self-contradicting aftermath, although it had to be chosen equal in order to find that the respective numbers of clock strokes weren't, and tries to explain the lagging of clocks by putting, in hindsight,

$$\tau = \sqrt{1 - \frac{v^2}{c^2}}\tau' \quad ,$$

i.e. the opposite of what's the case, because then the twins can still reunite in time, if not in clock time or even within a lifetime, such as to render, silently,

$$t' = t$$

at the very end, which directly amounts to repudiating time dilation altogether, in straight and adverse contradiction with its own assertions, while maintaining the non-conservation of the number of clock stroke events, and thus the non-invariance of the 4-distance of events, as shown in the first paragraph, in absurd, rather than paradoxical, antagonism with the axiomatically formulated start of the argument.

This was a sad end for a great idea, better known as the *Theory of Special Relativity*. I propose that we do away with it right now and start from scratch.

It is worthwhile, as a sidestep into philosophy, to inquire into the meaning of two observers travelling at some relative velocity and counting, on the moving clock of the respective moving partner, a greater number of events than on the respective own clock, and vice versa so for the other observer observing him. It is nothing but a dispute between two objective observers over objectivity what's at the heart of the so-called twin paradox. What's under suspicion here is the objectivity of observed events, some of which have or have not happened for one or the other twin, depending on their respective perspective. But what's in an event if it wasn't objective. It is the objective *per se*, by category. It is for this reason that we had to move the apostroph in the above such that from $t' = n'\tau$ we changed the picture to $t' = n\tau'$. This much of a change seems enough to settle the dispute over, and it saves the principle of, objectivity.

It is not so difficult to see that there can be no such dispute in objectivity. Just imagine two spaceships taking simultaneous starts from some space point and moving, with equal constant accelerations, into opposite directions. They also flash light signals backwards towards the other spaceship, say, one per second. But whatever then the respective rates might be these signals are received at by the spaceships, it is already clear from the very symmetry of the setup that they are identical at any value of velocity. But we should notice too that, for the same reason, the respective receiving, on both spaceships, of any pair of corresponding signals identified within a sequence of sent signals numbered by the clock of the sender must be synchronous again in clock time, that is, happen on both clocks at strokes numbered by the same integer value n, although synchronicity is lost in time where it is as relative as the gauge is. In other words, what is synchronous becomes a matter of the gauge when it is synchronous in clock time anyway. Synchronicity persists because the time-like distance of events, s, is an invariant of the gauge. This is why the speed of light must be constant. Otherwise there would be no clocks, and no objectivity in physical observations too. But, as a result of our bookkeeping of numbered events, we are now sure that there must be no doubt about the objectivity of an observer's clock events for any other observer. Defenders of the twin paradox usually raise the point that in a less symmetrical setup the respective observers cannot claim equal rights when it comes to deciding whose counting of events on the clock of the respective adversary was more objective. But already the most symmetric situation we could think of, namely two observers moving with constant relative velocity had that dispute over objectivity built in, so why follow Einstein beyond a point which has no counterpart in objectivity.

It has to be said at this point that, although the time coordinate is for now and forever after Einstein a relative quantity containing a velocity dependent gauge, clock time is absolute, an so is synchronicity. This might seem paradoxical, because clocks are man-made machines. What is absolute about clocks, though, is that they cause events that are objective. The fact that the time-like distance of events, s, is invariant is why ideal clocks can be gauged upon one another. But then, clock time was in the world before the clock was. It was Albert Einstein who showed that it is the constancy of the speed of light that makes the 4-distance of events an invariant of the gauge. But then the clock was in the world from its beginning and, as lies open to the eye of logics, by conception. Can the objective which is supposed to be the world of physics exist without objectivity? This is why synchronicity must rather be absolute and a gauge must exist. That's what he overlooked.

Let us design another *Gedankenexperiment* in order to rederive the relativistic equation of motion on these new terms. The one thing to keep in mind is that, apart from quantum systems, every motion is observed against the clock, and clock time, being an invariant 4-distance of events, is synchronous at identical values for all observers, although the time coordinate is not. That is, all strokes happen in all clocks and correspond to one another which was not the case in Einstein's world. Imagine then we had

given one clock to each of a number of observers numbered by some integer n, all accelerated by the same, constant force through space. The motion begins in a linear chain aligned on the ground at t=0. At every new clock stroke the force acting on one observer, starting with the leftmost observer in the row, n=1, and repeating on to the right, is turned off, having him move on with constant speed from then. After one observer was cut off the force, the previous one measures his relative velocity, which is constant now, and ever so on, proceeding to the next in the row. Obviously these differences are all equal as long as the force is constant, because they are all measured against another new observer's rest frame. It doesn't even matter if they are small or of appreciable size compared to the speed of light. All we need to see is that each measurement represents indistinguishably the same situation, and therefore the velocities measured must all be the same too, $\Delta v = const.$ Now we can apply the relativistic law of adding two velocities to sum it all up, recursively, and find, for the resulting velocity of an observer n relative to the ground based observer 0, or equally for the velocity of any observer n+m relative to observer n, employing the well-known hyperbolic transformation from velocity v to dimensionless rapidity α, i.e. the Lorentz Transformation

$$v = c \tanh \alpha$$

with

$$\alpha = n \beta$$

when

$$\Delta v = \tanh \beta = const \quad , \quad \beta = const \quad .$$

Obviously then a constant acceleration results in a linear increasing of rapidity which unlike velocity has no upper bound. In other words, Newton's law still applies in its new relativistic form

$$F = mc^2 \frac{d\alpha}{ds}$$

where the derivative is to be taken with respect to the time-like event distance s which is clock time and has the dimension of a length, rather than ungauged time t, and thus the linear momentum is

$$p = m \alpha c \quad .$$

There is no problem with matching the dimensionless rapidity in this equation with the dimensionless form of the Dirac-Operator thus recovering the same mathematical structure in relativistic mechanics as in quantum physics.

This is it, straightforward rather than mysterious and dark, and therefore probably less fascinating than Einstein's heavy mass circus and lapsing times were. It's surely lacking the attractivity of a black hole, but nothing but the structure logically necessary for a relative gauge to exist for all clocks such that the number of clock events, or strokes, is the same in all moving frames. The rest will be theory.

The reason why more than ninety percent of the mass of the universe is missing has been named *dark matter*, and it is another one of the numerous mysteries that come along with the relativistic misery of clocks after Einstein that cannot be gauged upon one another, because some clock events get lost. Not to speak about *black energy* here, another euphemism covering up the same dilemma which resembles a learnt helplessness, speaking in well established psychological terms. As it is right now, the invisible seems to outweigh the visible by about a factor of nine. It is straightforward to forecast that the nature of this modern form of medieval spook will be recognized soon to be a highly evolved wrong theory.