Einstein's Snapchat Error

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2023-12-27.15:00 EST Wed [Addendum 2023-12-28: Image, references]
Email Excerpt

Abstract: With computers, we know more about illusions now than a century ago. For physics, it's time to develop maths that capture this critical difference and stop oversimplifying reality. In the case of Einstein's special relativity, his overly simple maths work beautifully when applied locally, but descend into non-physical chaos and needlessly untestable, non-physical reasoning when applied at cosmic scales.

Figure 1. ***The Pancake Paradox.*** *Creating Lorentz-compressed "pancakes" in accelerated systems requires energy, non-zero creation times, and pre-compression in the travel direction. Other pancakes are data-interpretation illusions with no more substance than a Snapchat Lens effect. Pancaking of the full universe — Lorentz compression of the outside universe in the direction of travel — always falls in this latter group. Failing to distinguish carefully between energy-consuming physical pancaking due to acceleration, which* always *slows the pancaked clocks, and illusory pancaking, which* never *slows the pancaked clocks, is the source of Twins Paradoxes.*

Hi Ron,

I can no longer answer special relativity questions without first addressing several conceptual and mathematical issues. Please bear with me, and I'll try to explain why.

Have you ever used Snapchat Lenses on a smartphone? It's a delightful little app that takes a short video stream and changes it in some amusing fashion, such as by adding elephant ears to the person in the image. Are the resulting ears real, however? Of course not. Acquiring real elephant ears would require some, ah… *major* surgery.

Einstein's Snapchat error was that he placed too much trust in overly simplistic pre-computer maths at a time when many inexplicably claimed their naïve mathematics were more real than reality. Notably, this problem has not gotten better in the decades since.

Einstein mistook Snapchat-like distortions for reality. He correctly recognized that a highly accelerated observer would see the universe flattened like a pancake (Fig. 1), but he incorrectly interpreted this as meaning the universe around him flattened in a *physically meaningful* fashion. Alas, the cosmic "surgery" required to make that change real and self-consistent requires vastly more time and energy than exists in the universe. The only body flattened is the one energized by adding momentum: the traveler, whose body undergoes real, dramatic, and energy-hogging transformations when pushed to near lightspeed.

Another impact of those energy-induced physical changes is that all clocks on that body, all the way down to the particle level, slow down immediately, continuously, and in a profoundly physical fashion. This slowdown is no more "relative" than placing food in a refrigerator to slow down bacteria growth, and the resulting slowdown has no impact on how unaccelerated (or unrefrigerated) clocks keep track of time. This immediate and continuously applicable slowdown is not an abstract concept, either. For example, accurate GPS *requires* modeling clocks in fast-moving satellites as operating slower.

A useful image for understanding the impact of these physical changes to fast-moving observers is that the changes "reprogram" their "perception apps" to reinterpret data from the surrounding universe as flattened in their direction of travel. However, Einstein made another math error — an omission this time — in trying to understand how the moving observer would see time in the outside universe. Clocks in front of the moving observer move *faster*, not slower. Thus, he didn't get the app part of the equations quite right since saying that the traveler "sees" the outside universe as "slower" is wrong and hugely oversimplified. Clocks look faster in front, slower behind, and *briefly* slower by an intermediate (Lorentz) amount if they happen to pass *through* the spaceship, which puts them into the coordinates of that ship for the brief transition [1]. It's all messy and impossible to model correctly using only the overly simplistic algebraic equations of his 1905 paper [2]. At the very least, use of non-slow (Doppler) external aging is needed [3].

Notably, the instant the traveler slows down, guess what happens? The universe loses its elephant ears since *it never had them*. The pancaking perceived by the traveler was never anything more than their personal, Snapchat-like interpretation of the universe's incoming photons. To travelers with clocks slowed severely by high levels of momentum energy, the universe looks flatter (and *faster*, not slower) simply because the travelers traverse more distance in that outside universe during each tick of their slower clocks.

In contrast to the Snapchat illusion of a flattened universe, travelers close to lightspeed *really are flatter*. There's nothing relative about this since the flattening was part of the process required to create a self-consistent definition of space and time in their new high-momentum state. Lorentz contraction is an entirely real and conspicuously physical process for the accelerated body. However, for travelers, the observed flattening of the universe is an entirely *fictitious* process, literally nothing more than a Snapchat-like transformation of the data received by the traveler.

But what about the impossibility of performing physics experiments with different results inside a highly accelerated spaceship?

Einstein nailed the identicality of this bit of physics perfectly! That is, there truly are *no* experiments one can do *inside* a momentum-energized (accelerated) room that can detect any difference in physics from experiments performed in a room that never accelerated.

What Einstein missed — and this trickier to see, more than just a matter of using naïve, overly simplified maths or not getting the time dilation right — was that moving bodies have identical physics *because they create their local-only definitions of space and time*. Moving bodies do not see some superficial emulation of space and time, but a local-only *creation* of space and time that applies only to the accelerated systems. The full definition of this local space and time is defined — in a bloated and inefficient fashion — by quantum field theory. Einstein "got" the idea that different frames have identical physics, and saw the implications better than anyone before or since. However — and critically for what came after — he failed to see the "local-only" aspect of his identical-per-system sets of new coordinates. The new definitions of *x'y'z't'* apply *only* to those components that underwent the same messy momentum-induced transformations and data exchanges that created the new *x'y'z't'* set of coordinates, and those take both time and energy.

Applying speed-of-light limits to special relativity results at cosmic scales in a *brecciated universe* [4]. A breccia (I like watching geologist Shawn Willsey on YouTube) consists of multi-scale rock chunks (*clasts*) cemented together, each consistent only within itself. Once you fix special relativity, that's the more accurate representation of the spacetime structure of the universe at cosmic scales. It becomes a vast collection of multi-scale systems that, after up to billions of years and huge energy costs (e.g., in star systems that form in quasar jets), end up at least approximately sharing the same large-scale definitions of *xyzt*, though with complicated hierarchies of sub-clasts in with each such system. Sub-clasting continues down to the atomic and particle levels, where "particle-ness" becomes a matter of setting up a self-consistent spacetime frame using only the sparsest amounts of energy possible. That's where the quantum side merges fully with special relativity. This minimal domain is also where the Standard Model pops up, specifically through the creation of various incomplete local packages of space and time that, when viewed from our own local "app" version of *xyzt*, look like "particles" [5].

A profound irony is that by assuming that his algebraic *t*ransformations of space and time applied throughout the universe, Einstein inadvertently severely violated the unforgiving speed-of-light velocity limit he proposed *in the same paper* [2]. Wow!

The problem occurred when he wrote down the simple (and badly incorrect) algebraic expressions for defining the coordinate system *x'y'z't'* of an accelerated system. His coordinate transformation formulas work great for local systems where all components had the time and energy to "agree" to the local coordinate set. That local applicability of his algebraic approximations is why they are so incredibly useful in everyday physics.

However, the *x'y'z't'* approximation is nonsense for the rest of the universe, meaning it should be strictly avoided in astrophysics. The *x'y'z't'* coordinates of a newly accelerated system expand *no faster than lightspeed* and, even then, have meaning only if other systems in the universe have the time, energy, and provocation to participate in these new definitions, which must compete with many other similarly competing new momentum states. In particular, no one else makes their clocks tick slower without also accelerating, which is why the twin at home *continues to age normally*. The Twins Paradox is nothing more than a matter of assuming, as Einstein unfortunately did, that the expression *x′y′z′t′* has an "instantaneous" meaning throughout the universe and thus impacts how the twin at home ages. It doesn't, and making that faster-than-light scope assumption is where Einstein severely violated his own speed-of-light limit. Coordinate systems are information, and information *must* travel slower than light.

Enough. I'm working on the correct math for special relativity — it involves an expanding bi-conic intersection [6], for whatever that's worth — and I'm itching to get to the far more interesting, deeper maths beneath all of these clasts. These are necessarily maths in which all forms of "certainty" and "absolute precision" are emergent and incomplete. Also — and even more fun — our usual single-frame-only *xyzt* definitions of limits such as light speed become oddly specious down at the deep space level, where, for example, the entire universe shares only *one* definition of an "electron," though that one definition gets imaged more than a few times. Deep physics requires an approach that contrasts sharply and diametrically with the unconsciously arrogant "take everything to the limit first" maths of prior millennia. Yet it's also easy to see how centuries of mathematicians and physicists fell accidentally into worshipping the classical limit since we would not be having this conversation if deep physics had not arrived at an *approximately* classical universe capable of large instances of mostly self-consistent space, time, and history.

I'm unsure how the problems and outright errors in special relativity — particularly when applied at cosmic scales — impact general relativity. General relativity uses a much more sophisticated framework that I suspect has helped to immunize it from the scale-naivety of special relativity.

I hope you and your family are doing well. These are troubled times for us all. If you happen to get to the States again this year, we need to spend another day at Peet's Coffee!

Cheers, Terry

References

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