The LADs and LASSes Solution to the Twin's Paradox

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https://youtu.be/vnGWDYfweTI&lc=UgzDfTOdi1lL2Rq73lZ4AaABAg

A Comment on the Fermilab post:
Does acceleration solve the twin paradox? (Mar 8, 2023)
https://youtu.be/vnGWDYfweTI

In time, folks likely will view Sabine Hossenfelder as one of the current period's best and most influential theoretical minds. (And shh, please don't tell Sabine I said that.) You, Don Lincoln, are spot on in your emphasis on the irrelevance of gravity and how rapid acceleration precludes any concept of "all at once" time dilation. Still, you both — come on, admit it — struggle to find that trivially understandable explanation of the twins' paradox. The cause is a minor algebra error, or omission, made about a century ago.

The error is easy to describe. Folks should have noticed that the inverse-Lorentz-factor multiplier in length contraction and the Lorentz-factor multiplier in time dilation cancel. The omission, which reflected the biases of their time and ours, creates four independent parameters when the actual information content allows only three. Each of these three mixes and jointly transforms *both* space and time. Minkowski conceptually nailed this critical merger of space and time, but his insight only partially entered his algebra.

This simple reduction of the large-scale universe from 4D to 3D means there's no block universe, no worldlines, and no Minkowski "substance" because *there is no xyzt universe.* The universe instead exists and evolves as a well-defined state machine whose bottom-up causality bits and pieces are separated from each other not by linear xyz distances but by squared spacetime *areas,* Lorentz areas as I prefer to call them.

The grid and place cells in our brains cannot comprehend distances measured in squared areas. However, with the right simplifying conditions, our neural systems can reinterpret the square roots of these Lorentz areas as the construct we call xyz space. Those limiting conditions, which *always* involve return loops, also create what we think of as the speed of light. That's why Einstein notoriously could never eliminate loops when defining *c.*

Time *only* emerges locally and only between sets of finite energies and particles. Most of the seeming paradoxes of relativistic motion arise from directly or indirectly assuming the time and space definitions of some recently created ("accelerated") system somehow apply to the entire universe. They don't, and they can't, due to light speed. Any rigorous application of xyzt special relativity figures that out, eventually. It's just that a minimally redundant LxLyLz Lorentz area state representation makes life easier and less mystical.

Due to the locality of all xyzt interpretations, accelerating the clocks for a system slow their ticking down immediately. All acceleration does is reprogram how the system *interprets* the rest of the universe. I used the word "reprogram" since this process is closer to what happens than "boosting" the ship into some "new" version of non-existent spacetime. That casual-sounding boosting idea is fraught with more peril than it might seem since it makes it too easy to view the ship as "connecting" with some new, universe-

spanning version of spacetime. Its influence travels no faster than lightspeed, with the larger universe not caring or knowing. (And then there's the Mach rotation issue… oh my.)

The Poincare symmetries are fully respected because the ship is not isolated from the universe by rigid little xyz vectors but by voluminous squared-area LxLyLz distances — Lorentz area distances, LADs — with more than enough room to play games with any set of localized xyzt coordinates. Fascinating issues arise, including the inevitable age gradients ($\alpha=-\beta\gamma/c$) accompanying all Lorentz ship and space contractions.

Regarding the twins' paradox, the short, easy-to-remember solution is this: Whoever gains energy gets the slowest clock, period. That's because energy addition necessarily *transforms* the shape of whatever is accelerated. Focusing on energy addition and subtraction always gives the same answer: The energized system's clocks slow down.

I've mostly stopped using the phrase "rest frame" and switched to "launch frame" since this terminology better emphasizes that the system that receives the energy is the system whose clocks slow down due to reconfigurations required to accept that energy. These physical changes include physical contraction and the introduction of an age gradient, which are physical events that can occur in multiple ways. Synchronized dust in the launch frame can continually monitor the moving clock and show that its slower motion is no fluke that happens only at the beginning or end.

It also doesn't matter if the spaceship turns around. If there are launch-frame clocks in front of the moving ship — clocks motionless relative to the launch and previously (often slowly) synchronized with launch clocks — then the ship observes those clocks *speed up* by a factor of $R=\sqrt{[(1+\beta)/(1-\beta)]}$, where R describes the eccentricity of the ship's new coordinates relative to launch. R is also e to the power of the rapidity of the ship and tends to work more cleanly than the Lorentz factor, which is an average of R and 1/R.

Enough. The main points are: (1) The universe has a single fully causal state; (2) The state of the universe is three-dimensional, not four, but uses squared distances that are challenging for our linear brains to imagine; and (3) What we think of as "time" emerges through a chaotic, multi-scale, bottom-up process involving looped exchanges of data between rest-capable, fermion-containing entities. Bottom-up time also necessarily means causality is bottom-up: no Schrodinger cats, ever. (Don't get me started on the intriguing quantum field, particle physics, gravity, and dark-matter-vs.-MOND implications.)

If I haven't already bored you to sleep by droning on about the long-term consequences of some itty-bitty century-old algebra boo-boo that occurred a century ago — and if you prefer visual math explanations — three derivation figures for Lorentz area metrics are available at sarxiv dot org slash apa. I think the title is... hold on; I'm looking it up: "Derivation of the Unit Lorentz Area, Meter Lorentz Area, and Lorentz Meter." A longer article on the same topic, also recent, is "LADs, LASSes, and Fractal Time."

Finally, Don Lincoln, thanks for standing up for Sabine.

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PDF: https://sarxiv.org/apa.2023-03-09.2258.pdf