Scalar Lorentz-Minkowski Topology Through Five Dimensions

Levinus Haines

Abstract-- This paper is an examination of the principles of differential topology, and a model that compensates for quantum mechanical exceptions. The model combines Lorentz-Minkowski space with principles and properties of a hypercube, making predictions that align closely with theorized particles. The proposed model offers suggestions that could be used to calculate relativistic relationships in five dimensions.

I. INTRODUCTIONS

An analysis of Lorentz Transforms can identify various relativistic relationships between vectors and points. Though this may be applicable as an introductory concept, the model is insufficient in visualizing or mapping real-world relativity, particularly when attempting to compensate for unintended curvatures or probability.

This is because the Lorentz and Minkowksi models are not adapted to change with the system they are used to analyze. Theoretical models themselves, are highly dependent upon construct, perspective and application of the theorist. Who, in turn, is subject to initial conditions and causal relationships.

An examination of the application of causality through a multi-disciplinary lens can provide a comprehensive understanding of theoretical models and explanations of variation in stochastic systems, despite its necessary reductionism. The idea that a catalytic event effects change on a system is so fundamental to the construction and understanding of the physical world, that it is often overlooked as a conditional variable. The construct even regulates language [1], inherently altering scientific methodology.

Causality, when under close examination through quantum mechanics, begins to highlight paradoxes in our interpretations. Retrocausal activity through Quantum Eraser experiments seem to complicate our understanding. If a model existed that could scale appropriately, it would calculate differences between retrocausality and the observer.

II. DEFINITIONS OF CAUSALITY

Principally, causality is the explanation of an effect on a system. In space-time geometry, causality has contiguity that propagates no faster than light in Minkowski space. [2] This expansion of Euclidean space is amended with time dilation and relativity. [3]

In logic, causality can be examined through necessary and sufficient conditions.[4] In which a necessary condition requires the existence of a cause if its effect exists, and sufficient conditions imply a possible cause that will, if present, initiate a causal relationship. This may also include probabilistic causation, which allows for a variable of probability. Instead of $\{B|A\} = \{B\}$ wherein event A necessarily causes B, we see a variable for calculated probability $P\{B|A\} \geq P\{B\}$ where the probability for an event is a variable in both the cause and outcome.[5] This can be expanded into Bayesian statistics.

The scientific method, alternatively, emphasises temporal relationships. Such that cause and effect are isolated in a precursor relationship to logical analysis. Variables are systematically eliminated through the scientific method [6], and the necessity of replication is established as a foundational value. It is necessary to mark this particular bias in systems analysis when considering probabilistic outcomes.

In physics, efficacy of a cause is restricted so that an observed effect cannot happen before a cause.[7] This would be particularly egregious in the Lorentz transform, where points of reference would be folded over, inverting spacetime. It is important to note there are possible exceptions in very specific systems. Quantum mechanical principles can seemingly isolate local system, then violate the causality of the system. Even further Bell tests have been done to violate bilocal causality. [8]

III. LORENTZ-MINKOWSKI SPACE

One of the most useful tools for examining general relativity is the Lorentz transform. Relationships between perspectives based on parameters of velocity, (or more exotically) spatial expansion. Most importantly, it can be used to make testable predictions about an event and its perceived simultaneity. [9]

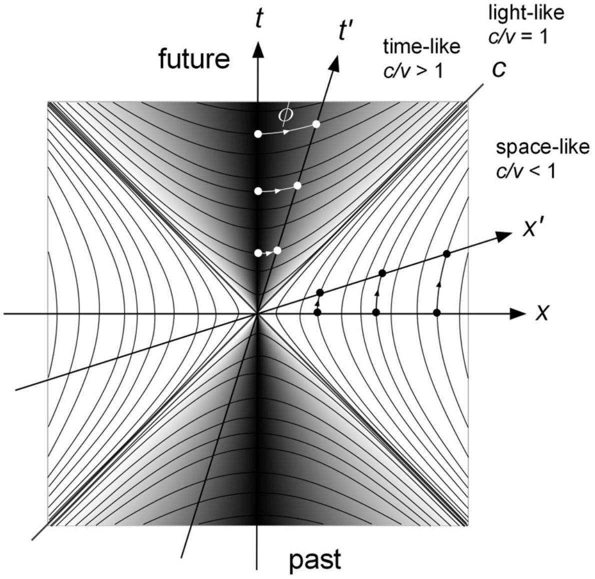


Figure 1

It would suggest then, that using it as a theoretical model to explore negative temporal relationships might also produce interesting predictions regarding retrocausality. In order to do this, the Lorentz Transformation needs to be revised to accommodate multidimensionality.

In Minkowski space, a plane of hypersurface is intercepted perpendicularly by two inversely expanding cones of light. In which one cone represents a future light projection, and the inverse is a past light cone. [10] It is important to note that the light cone does not specifically refer to propagation of photons, but of causal structures. [11]

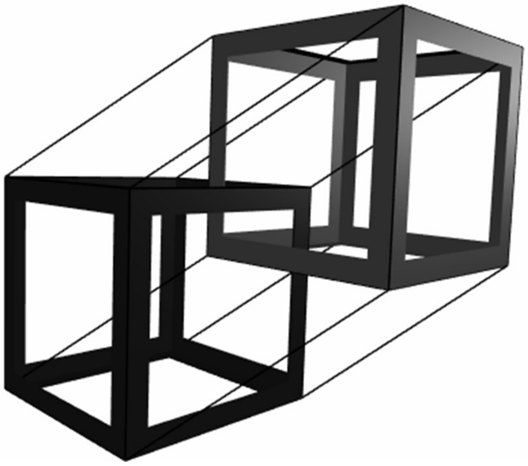


Figure 3

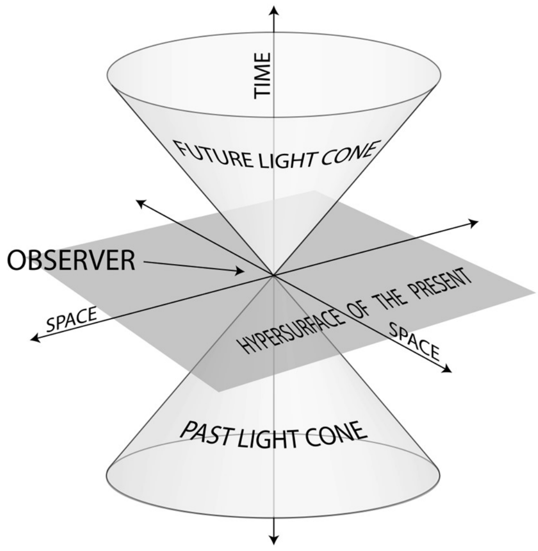


Figure 2

Again, however, another problems in this model surfaces. The Lorentz Transformation prohibits any violations of causality, and expresses a compressed version of dimensionality. The Minkowski model likewise expresses space in a limited way.

A correction for this would be to express a Lorentz Transform in a four-dimensional shape as a combination of Lorentz and Minkowski. In this construct, space and time would operate in a real-world application. Physics students may recognize this unique pairing to be fundamental to Einstein's theory of General Relativity.

Yet these “light cones”, and subsequently the C constant prohibit the results observed in the Quantum Eraser experiments. Unless we explore a more complex topology.

IV. SCALAR LORENTZ-MINKOWKSI TRANSFORMATION (SLMT)

The abstraction is difficult to convey, even graphically. Simplistically, one could imagine the Minkowski space, in which the apex of each cone overlapped. The vertices of a hypercube would be representative of the edge of the light cone in Minkowski space, or the C-line in the Lorentz transform, in which the time-dilation of the hypercube cannot exceed a speed of causality. The hypersurface, in this regard, would be an instantaneous measurement in three dimensions of space with t_n.

When visualizing this transition it is important to remember key details:

1. Coordinates on the Lorentz Transformation would require a 5D-ODETLAP, or Five Dimensional Over-Determined Laplacian Partial Differential Equation. [12]
2. The original orientation of matter and energy would not have a single outcome, but would, in many cases, have infinite outcomes. In the case of the double-slit experiment, the hypercube of a single particle would have a typical interference pattern across the shape. The totality of which would be a fifth dimensional hypercube. A structure that allows for probability.
3. Minkowski hypersurface would also have possible original conditions (the past light cone.) If the totality of this hypercube initial probable conditions, hypersurface itself, and the possible causal outcome are all viewed at once, we have a sixth dimensional hypercube.

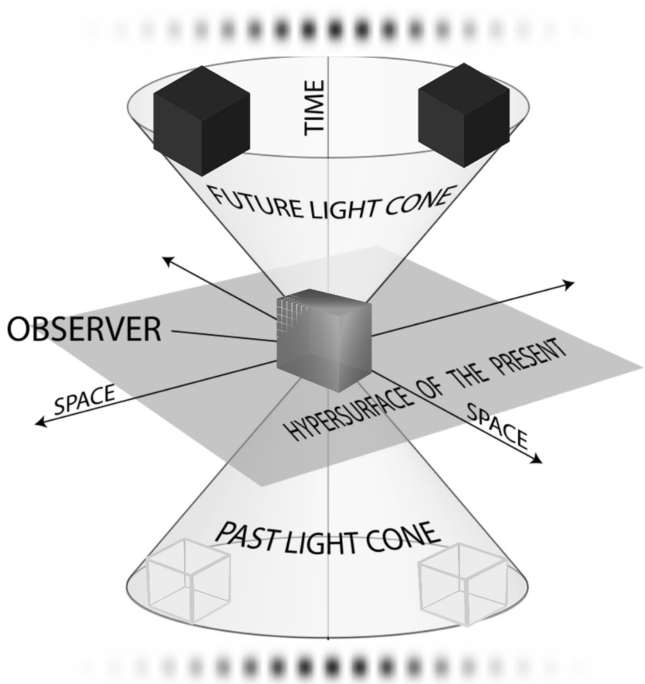


Figure 4

This SLMT can be expanded further for many more spatial dimensions. Regarding the figure 4, if the view were to "zoom in" on the 3D hypersurface, the number of possible outcomes and possible orientations would asymptotically approach a single event, though, as described in the Heisenberg uncertainty principle, but unable to accurately predict them to entirety. Which would contradict the topology of a temporal singularity dividing causal and retrocausal events.

$$\Delta x \Delta p > \frac{h}{2\pi}$$

It is modeled that the Minkowski hypersurface of the present meets at the apex of each light cone. It is the topology of the light cone that must next be revised. The shape should instead resemble an hourglass, instead of two separate cones. The thinnest point of the hourglass would be contiguous bottleneck and have a diameter no thinner than the planck length.

$$\ell_{\mathrm{P}} = \sqrt{\frac{\hbar G}{c^3}}$$

It would have a diameter of this size for the height of no longer (as we are making a temporal measurement) than the planck time.

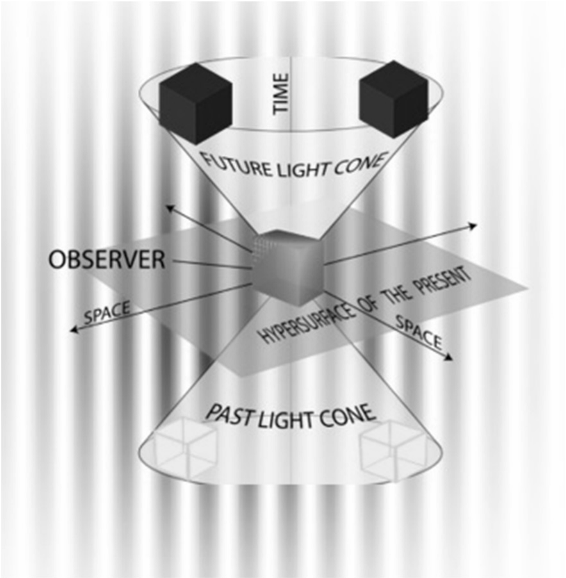
$$t_{\mathrm{P}} \equiv \sqrt{\frac{\hbar G}{c^5}}$$

The reason for this is that cones suggest a definitive temporal barrier, when in fact, some retrocausality seems to be possible at the submicroscopic level. A concept proposed by Stephen Hawking. [13] It may be interesting to note that the bottleneck of the hourglass is scalar as well, with a diameter that could fit something 20 million times the mass of an electron. [14] Topologically, this has interesting ramifications. Without a singularity, it would suggest that spacetime by virtue of retrocausal instances, has a new topological possibilities as demonstrated by the Generalized Poincaré conjecture.

Exploring the Lorentz Transform relationships between reference points would need a scalar Laplace operator. This is not a new idea, and scalar Laplacians have been used in computer modeling.[15] It is important to note that the computational difficulty of this model is also scalar, particularly when scaling to the spatial and probabilistic dimensions in M-theory. [16]

For example, the Copenhagan and De Broglie-Bohm interpretations can be re-examined with this topology. The Copenhagan interpretation states that particles stay in wave form until measured. [17] This model would suggest that the waveform never collapses. We are, instead, through the process of particle detection, "narrowing" the bottleneck of the hourglass. As an analogy, we are using experimentation as a probabilistic magnifying glass to examine very closely, only one individual outcome. The possible orientations from the past, present, and future outcomes are still there. It is critical to understand that, just as matter and energy move through spacetime, they also move through probability. It is also likely, though speculative, that a massive amount of matter and energy does not have wave function collapse as S5 propagates. The more interactions matter and energy have, the more likely they are "narrowed." De Broglie-Bohm theory suggests that this orientation caused by interactions of matter and energy may have configurations even when unobserved. This is reinforced as new information suggests the theorem is accurate [18] Even so, the guiding equation, derived from principles of Schrödinger equation (below) affords a Ψ (psi) for the wave function position.

$$i\hbar \frac{\partial}{\partial t}|\psi(t)\rangle = \hat{H}|\psi(t)\rangle$$



V. PREDICTIONS

At the quantum level, it may be possible using 5D-ODETLAP to "graph" the probability cone of the modified Minkwoski space, as long as variability is controlled, most easily with single particle emissions. This would allow some measure of topological integrity for the propagation of light and quantification of small amounts of energy. The expression of a modified topology could incorporate relativistic relationships between probabilistic outcomes, actively calculating the distance between two probable outcomes.

REFERENCES

1. Copley, Bridget (27 January 2015). *Causation in Grammatical Structures*. Oxford University Press. ISBN 9780199672073. Retrieved 30 January 2016.
2. Naber, G.L. (1992). *The Geometry of Minkowski Spacetime: An Introduction to the Mathematics of the Special Theory of Relativity*, Springer, New York, ISBN 978-1-4419-7837-0, pp. 4–5.
3. Landau, L.D.; Lifshitz, E.M. (2002) [1939]. *The Classical Theory of Fields*. Course of Theoretical Physics. **2** (4th ed.). Butterworth–Heinemann.ISBN 0 7506 2768 9.
4. Epp, Susanna S.: "Discrete Mathematics with Applications, Third Edition", pp. 25–26. Brooks/Cole – Thomson Learning, 2004. ISBN 0-534-35945-0
5. Gelman, Andrew; Carlin, John B.; Stern, Hal S.; Dunson, David B.; Vehtari, Aki; Rubin, Donald B. (2013). *Bayesian Data Analysis, Third Edition*. Chapman and Hall/CRC. ISBN 978-1-4398-4095-5.
6. Born, M. (1949). *Natural Philosophy of Cause and Chance*, Oxford University Press, Oxford UK, p. 18: "... scientific work will always be the search for causal interdependence of phenomena."
7. Einstein, A. (1910/2005). 'On Boltzmann's Principle and some immediate consequences thereof', unpublished manuscript of a 1910 lecture by Einstein, translated by B. Duplantier and E. Parks, reprinted on pp. 183–199 in *Einstein,1905–2005, Poincaré Seminar 2005*, edited by T. Damour, O. Darrigol, B. Duplantier, V. Rivasseau, Birkhäuser Verlag, Basel, ISBN 3-7643-7435-7, from *Einstein, Albert: The Collected Papers of Albert Einstein*, 1987–2005, Hebrew University and Princeton University Press; p. 183: "All natural science is based upon the hypothesis of the complete causal connection of all events."
8. Gonzalo Carvacho et al. "Experimental violation of local causality in a quantum network." *Nature Communications*. **DOI: 10.1038/ncomms14775**
9. Einstein 1905, pp. 891–921
10. Minkowski 1907–1908, pp. 53–111 The Fundamental Equations for Electromagnetic Processes in Moving Bogdies.
11. Ehlers 1973, sec. 1.4, Schutz 1985, sec. 5.1
12. Stookey et al., 2008, Xie et al., 2007
13. Hawking, S. W. (1992). "Chronology protection conjecture". Phys. Rev. D. 46 (2): 603. Bibcode:1992PhRvD..46..603H. doi:10.1103/physrevd.46.603.
14. Eibenberger S, Gerlich S, Arndt M, Mayor M, & Tüxen J (2013). Matter-wave interference of particles selected from a molecular library with masses exceeding 10,000 amu. Physical chemistry chemical physics : PCCP, 15 (35), 14696-700 PMID: 23900710
15. You Li, Tsz-Yam Lau, Peter Fox and W. Randolph Franklin. (2005) 5D-ODETLAP: A NOVEL FIVE DIMENSIONAL COMPRESSION METHOD ON TIME_VARYING MULTIVARIABLE GEOSPATIAL DATASET. Rensselaer Polytechnic Institute. Commission IV/4
16. Zwiebach 2009, p. 8
17. Werner Heisenberg, *Physics and Philosophy*, Harper, 1958
18. MacIsaac, Dan (January 2017). "Bouncing droplets, pilot waves, the double-slit experiment, and deBroglie-Bohm theory". *The Physics Teacher*. **55** (1): 62. Bibcode:2017PhTea..55S..62.. doi:10.1119/1.4972510. ISSN 0031-921X.