On the Origin of Space

Part 11: The Speed of Light, an Absolute Base for a Relational Reality

© 2004 Roger Y. Gouin
Independent Scholar
[Revised May 14th, 2004]
rgouin@mindspring.com  http://rgouin.home.mindspring.com/

Abstract
The speed of light is identified as a fundamental base for a relational reality. Through Feynman’s attempt at justifying the Dirac equation for the electron by seeing everything going at the speed of light, we are then justifying the need to go past the formalism of the path integral (or any formalism) into a purely relational approach to reality.
Introduction - Why is the speed of light a barrier and a constant?

The constancy of the speed of light (really the speed of any electromagnetic radiation as well as the spread of any disturbance of space) as measured by any observer at any location of space is a fundamental characteristic of reality, and at the origin of Einstein working out his theory of principle called Special Relativity. Yet the origin of such a constant universal maximum speed is so far unknown, to the point that to this day there are still speculations about a speed of light variable with time (for example, Ranada, 2004).

As described in Gouin (2004a), we have seen that a space continuum rejecting the Axiom of Choice, leading to a relational reality, is a logical necessity: I cannot pick an object out without picking its relations with others. The speed of light as a barrier is also a logical necessity within such a reality. This can be seen via a well-known paradox. As the Banach-Tarski paradox led to a many-realities space continuum in the reference given above, a paradox from Zeno of Elea, the famous ancient Greek, leads to the necessity for a constant universal base, defining maximum speed from which time and “motions” can be constructed. It is called the paradox of the Stadium (Bunch, 1997). Briefly, there are three rows where the A row consists of spectators, and the B and C rows consist of runners in opposite directions. Row B moves in the shortest possible time T left and row C moves in the same time T right. Within this time row C will have passed two runners of row B, so passing one runner takes T/2. But time T was assumed to be the shortest possible, thus T/2=T, and I can only conclude that T=0. This tells us that time intervals cannot be consistently defined, and thus time cannot exist, which is the conclusion of Zeno, but I will add: for moving objects going at the fastest speed. Therefore, in a consistent relational reality where everything goes at the same speed (like the runners above), time can only exist for objects that constantly reverse their direction of travel versus others, and thus average speeds must be less than a base speed of objects for which time cannot exist.

A consistent reality also demands that this base speed must be observed as always the same anywhere across space and time, as the relational understanding followed above identifies time itself through relative motions between separated material objects, and thus across space. This base speed is of course understood here as unaltered by an intermediate material medium that would affect its perceived measurement.

Feynman’s hypothesis

Feynman toyed in the 1940s and 50s with the idea that everything in fact goes at the speed of light and we must work out our reality from there (Schweber, 1986). Without knowing what they truly are, “particles” with a mass can be pictured merely performing a sort of Brownian motion changing constantly direc-
The Speed of Light, an Absolute Base for a Relational Reality

tion of travel in proportion to their “mass.” Under such a picture, inertia is locally defined by the make-up of the massive particle, not by its cosmic origin (whatever that was) as Mach’s Principle envisioned (Mach, 1883). This principle is non-constructive in the sense that it hides the connection of the common monadic space manifold to the matter/radiation manifolds as discussed in Gouin (2004b). Then any particle “proper time” does not exist since it is always going at the speed of light. Time for a particle gets defined only through its constant relations with the “particles” it “interacts with,” across the space generated by the multiple trajectories of these particles. At this fundamental level time cannot be defined independently of the particle, and thus cannot be a coordinate as conceived in the spacetime of Relativity.

And so it is for space, as the mathematical notion of “neighborhood,” as found in the foundation of classical Topology (Hocking and Young, 1988), cannot be applicable here. Space is defined through the infinite set of trajectories of interrelated entities called particles, trajectories which cannot be space-filling curves a la Peano (Hocking and Young, op. cit. p. 123), that is, locally defined and part of a “flat” reality, but non-local “space-generating curves” in the sense that they define the space of the relations of the particle with the other particles. At this point I am reaching an apparent contradiction through the terms “particles” and “trajectories” as they require that a space exists beforehand. Next section below will replace this inadequate picture with another concept, monadic relations, which can only be imagined by denying the Axiom of Choice, whereby I cannot pick one part of the relations without picking a sub-part of the same cardinality as the whole.

To connect this relational reality with its transitory aspect I take the simple example described by Feynman (Feynman and Hibbs, 1965; Schweber, 1986) of a particle “moving” in one dimension going only forward or backward at the speed of light. Feynman defines the unit of time as \( \frac{h}{mc^2} \), being the interval between “events” when the particle may change direction. This unit of time is specific to the particle and gets smaller with a larger mass such that there are more events for a given “total time,” which is yet to be defined. Mass then appears as defining the particle “propensity” to experience events where a motion reversal can occur, and thus is an inherent character of the particle. Feynman does not go further in explaining this propensity. Gaveau and Schulman identify this as a “hypothesis non fingo” position (Gaveau and Schulman, 1987, 1989). Yet it is fundamental to the dynamics of the particle. Feynman also does not identify the reference frame in which the “total time” is measured. I could infer that it is the particle “rest” reference frame if I follow Special Relativity, but the particle goes at the speed of light where time does not exist, and thus this inference leads to a contradiction.
Is reality some kind of computation?

The only way I can see out of this dilemma is to understand the “evolution” of the particle as a step process, i.e. a computation where the outcome is defined by the particle’s prior relations with the other particles, themselves performing their computation through which they are laying out the space for the particle under consideration. We are then dealing with discrete “events,” joint (“non-local”) happenings where there is a “before” and an “after” defined by the change in configuration within the system the particle belongs to at the event. This picture is another way of seeing the continuum defined as a stack of “discrete volume frames” (Gouin, 2004a). A superposition, or stack of such frames, represents the system having the discrete “events” above, and a “step” then follows each event.

In this picture, and as Gouin (2004b) further describes, ordinary space is a computational space, which is inherently transient in existence (only the NOW exists) through an uncountable infinitude of parallel computations made with chains and trees of “monadic” relations. A monadic relation has an input and an output defining the before and the after for that relation, the before being the input, and the after being the step. Gouin (2004b) looks at the nature of such a computation (of course only qualitatively within a physical viewpoint).

The problems with Feynman’s approach

Then Feynman introduces an electromagnetic field acting on the particle. This can only be interpreted as a “mean interaction” with the “surrounding,” not specific relations between particles. But fields are “continuous” entities in the classical sense of the term, requiring the Axiom of Choice for their formulation. Therefore the use in that sense is inconsistent and I shall only take the term as an assembly of things to be defined further. Using the classical meaning of the continuum, Feynman comes up with the electron relativistic Dirac equation in one dimension, thus advancing that his picture may have nevertheless some physical basis. This thesis however can only be a crude mathematical description because:

1) It assumes a “flat space” since the unit of “proper time” only reflects Minkowski’s spacetime of Special Relativity, not Einstein’s curved spacetime,
2) There is no spin in one-dimension space, i.e. one-dimensional spacetime has no true physical basis,
3) The particle propensity to experience motion reversals is unexplained,
4) The origin of the process total time is not relationally defined.

All these shortcomings, except for the second, cannot be handled without considering monadic spaces as developed in Gouin (2004b).
A minor fix ultimately leading away from any formal approach

Gaveau and Schulman (1987, 1989), after others’ work (Jacobson, 1984), have addressed the second shortcoming, i.e. Feynman’s picture in 3-dimension space. In the case of the electron, a fermion, there are four “internal” components (the term “internal” is used in present-day physics without a description of its meaning – Gouin, 2004c, gives it one), each two with a dynamics that would follow the Weyl equation of a massless neutrino (Gottfried and Weisskopf, 1986) if they were not coupled via terms corresponding to the mass of the particle. These four “spinor” components of the electron have a resulting dynamics collectively following Dirac’s equation. A neutrino in turn is a particle with a “helicity” (the projection of the spin on the momentum vector), like the photon, but has a half integer spin like the electron, and is “left-handed” instead of being evenly handed. Only a positive helicity has been observed, making the space-matter system of our galaxy “non-chiral.” (We refer here to the cosmology developed in Gouin, 2004d, for the reason why this can be so.)

Then, within a particle trajectory, time gets defined for the particle through direction reversal events at light speed, a process formalized as an average of a statistical Poisson process parameterized by its mass. Besides direction reversals coming from its mass, the particle has a stochastic motion through a contiguous series of two rotations in twice-connected SO(3) spaces, or SU(2) spaces as they are usually identified within the Lie group algebras of “local transformations” (Joshi, 1977; Wybourne, 1974). Each set of two rotations is then found equivalent to a translation within “ordinary” space.

The notion of time is independent from this algebraic description as the proper time of the particle cannot be defined by such a stochastic process. In the spirit of Feynman’s paths and Everett’s many-realities (Gouin, 2004a), these two different processes can be viewed as a set of chains in lieu of trajectories for the particle. But then ordinary space can be seen as constantly being generated by these chains of elementary SO(3) rotations, and identified to what has been called a “super-manifold” by Berezin (1987). The fundamental consequences are that (1) there is a “fine structure” to ordinary space and (2) more than 3 dimensions are needed for this structure. We are dealing with a Lie algebra of rotations, giving a Grassmann algebra of translations instead of translational “magnitudes.” A picture of this world is drawn in Gouin (2004c).

The picture of a topological continuum for space is then incorrect, space being dynamically generated through an infinite superposition of chains of rotations in dimensions that are outside the ordinary space dimensions. This continuum cannot be defined locally, and present-day mathematical topology cannot be used as it considers “neighborhoods” in its definition (Gouin, 2004a). A given “particle” (a manifold of monadic relations) could be within one reality at a distance from another of its realities outside the light cone of Special Relativity. Then the
particle may have, through its various realities, relations with other distant particles, thereby relating itself to parts of the world outside its own light cone ("spacelike" events with no causal connections).

There is no information that can be passed between classical observers that way, so classical causality is not violated, but if one remains within the quantum level there is a single “extended” system that “knows” instantaneously what happens to its various realities - this fact has been experimentally proven as a feature of reality through Aspect’s experiments (Aspect, 1982). Non-locality beyond the causality limitations of Einstein’s relativity fits Bruno’s picture of the monads, “as independent infinite entities, each comprises the all in itself, as each is a necessary constituent of the all” (Gouin, 2004a). The many-realities monadic space view described in Gouin (2004b) gives a tentative (and constructive) origin for this feature. Gouin (2004e) discusses some of the physical effects.

**Conclusion - The old formalism can’t be fixed, so let’s go on!**

The other shortcomings of Feynman’s picture have not been so far addressed by physics. In effect a speed less than the speed of light is the result of a statistical Poisson process, as if there was a “medium” through which the particle goes through, “slowing it down.” It is a scalar process separate from the stochastic rotations through the SO(3) spaces, which do not affect the time of the particle evolution.

The SO(3) spaces naturally support collectively the phenomenological picture of an electromagnetic field (virtual photons) generated by the particle, and interacting with the particle itself, as well as generated by other particles. The set of trajectories or chains, or computational tracks, have each a separate time for their evolution as a result of the “mass process.” This is where Feynman’s path integral approach is incomplete, and Gaveau and Schulman’s picture is also incomplete. The path integral cannot be on a time definition common to all the paths. Each path has its own time evolution. But then a Lagrangian can no longer be defined, and the entire formalism of an “equation of motion” unravels. Physics therefore can no longer use this centuries-old formalism, as it is simply inadequate for a process that generates its own space and time.

Bypassing this question of formalism and resorting to a purely logical and physical exposition, Gouin (2004b) describes how the scalar process of time definition not only can lead us to the origin of mass/inertia, and consequently gravitation, but also to the origin of the existence of the quantum world (Gouin, 2004f). To this effect, there is no other way but to obtain a logical picture that can explain the standard model of particles physics using fundamental elements, i.e. monadic relations, instead of using the set of formal (non-constructive) principles of today’s physics (Gouin, 2004c).
References


Bunch, B., 1997, Mathematical Fallacies and Paradoxes, Dover


Hocking, J. G. and G. S. Young, 1988, Topology, Dover

Jacobson, T., 1984, Spinor Chain Path Integral for the Dirac Equation, J. Phys. A 17, 2433

Joshi, A. W., 1977, Elements of Group Theory for Physicists, 2nd ed., Wiley


Schweber, S. S., 1986, Feynman and the Visualization of Space-Time Processes, Rev. Mod. Phys. 58(2), 1

Wybourne, B. G., 1974 Classical Groups for Physicists, Wiley