The Law of Conservation of Direction

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1 Introduction

Some students of the Reciprocal System (RS) have been disputing the explanation of the intrinsic structure of the photons, given by Larson, the originator of the RS. No amount of discussion, so far, seemed to throw additional light in overcoming the logical objections raised. An examination of the situation undertaken by the present investigator revealed that a crucial fact of fundamental nature is being missed hitherto, both by the originator and the other students. It is found that a recognition of this fact not only clarifies the photon situation entirely but also throws light on many collateral issues where gaps in the logical development of the theory exist, thus rendering the theory more cogent. Some of these new developments are reported in this paper.

2 The Difficulties with Larson's Account of the SHM

In the outline of the deductive development of his theory Larson states: "The continuity of the progression within the units enables the existence of another type of scalar motion of physical locations. This is a motion in which there is a continuous and uniform change from outward to inward and vice versa; that is, a *simple harmonic motion*."[1] A little earlier (item 5 of Reference 1) he defines "outward" and "inward" as being the scalar directions and representing motion away from and toward a reference point in the stationary three-dimensional spatial reference system, respectively. The former results in increasing intervening distance while the latter in decreasing intervening distance.

Since there is nothing like more outward (inward) or less outward (inward) the question arises as to the meaning of the statement "a continuous and uniform change from outward to inward"? Outward and inward, as applied to scalar motion, are *discrete* directions: the scalar motion could be *either* outward *or* inward. There are no intermediate possibilities. Larson is quite clear about this, at another juncture: "When the progression within a unit of motion reaches the end of the unit it either reverses or does not reverse. There are no intermediate possibility."[2] As such, the idea of a "constant and uniform change" is logically incompatible with this concept of "outward-inward motion." It must be remembered that the *magnitude* of the motion is constant, being unity.

Since simple harmonic motion (SHM) does seem to underlie the structure of photons, the crux of the problem of understanding the nature of the photon is the explanation of the genesis of the SHM given only uniform scalar speed. If a vibration of the type Larson proposes is to exist, it can not be a SHM. The speed has to be a *square wave*. SHM seems possible only if one of the components (space or time) progresses non-uniformly while the other progresses uniformly. In fact, SHM will be the result under the two circumstances:

(i) when a *constant magnitude* is continuously and uniformly changing its *direction* in the conventional reference system (as in rotation) and its *projection* in a constant direction is being considered; or

1 Larson, Dewey B., "Outline of the Deductive Development of the Theory of the Universe of Motion," *Reciprocity* XVII(1), Spring 1988, p. 8 (item 16)

2 Larson, Dewey B., *Nothing but Motion*, North Pacific Publishers, Oregon, U.S.A., 1979, p. 98.

(ii) when there is a *constant direction* and the magnitude is continuously and *non-uniformly* changing. The second alternative is precluded by definition (see item D of the "Basic Principles" in the Outline[3]).

3 Is Rotation Primary?

A scalar motion has magnitude only, and no inherent spatial direction. It therefore has to be given a direction in order to be represented in a spatial reference system. Now a "constant and uniform change" envisaged by Larson can only happen if the representation in the reference system changes the vectorial direction uniformly as in rotation. As a matter of fact, SHM will be the result if two such rotations, mutually opposite in direction, are vectorially combined.

But Larson does not posit the possibility of rotation prior to the existence of photons. Thus he states: "While motion is possible without anything moving, rotation is not possible unless some physical object is available to be rotated."[4] The logical basis for this conclusion is hard to find. Rotation is as much a motion as translation is, and logically it must be as much possible without any "thing" rotating, as far as the primary motions are concerned. One wonders, in this context, if the author is completely free of the unconscious leanings to the frame of mind that underlies the view of the universe of matter as against the universe of motion!

Rotation is precluded only if space is one-dimensional. Just as soon as it is established that the stationary spatial reference system is three-dimensional, rotation becomes a possibility. Larson himself, while discussing the status of the uncharged electron, refers to the general nature of space which includes rotation as much as linear translation. "Thus the electron is essentially nothing more than a rotating unit of space. This is a concept that is rather difficult for most of us when it is first encountered, because it conflicts with the idea of the nature of space that we have gained from a long-continued, but uncritical, examination of our surroundings… The 'space' of our ordinary experience, extension space… is merely one manifestation of space in general…"[5] Therefore, what is not being explicitly recognized is that, in general, space has two intrinsic traits: *translational* and *rotational*.

The translational trait manifests to us as the familiar "extension space," whereas the rotational trait—which manifests as difference in directions—is not so readily regarded by common experience as manifestation of space. Hence the representation of a uniform scalar motion in the conventional reference system can take either the form a uniform and continuous change of linear magnitude with a constant direction, or the form of a uniform and continuous change of direction, with a constant linear magnitude, that is, a rotation.

4 Conservation of Direction

As already pointed out, a scalar motion does not have a vectorial direction. The latter is a property acquired due to the *coupling* with the conventional stationary three-dimensional spatial reference system, which involves also the identification of a reference point. A point of universal significance that needs to be recognized is that *the representation of a scalar motion in the conventional reference system conserves direction*. This is accomplished by the representation by substituting two opposite directions—what we will call a 'bidirection'—for the original lack of direction.

3 Larson, Dewey B., "Outline of the Deductive Development of the Theory of the Universe of Motion," *op. cit.*, p. 6.
4 Larson, Dewey B., *Nothing but Motion*, *op. cit.*, p. 57.
5 Larson, Dewey B., *Basic Properties of Matter*, ISUS, Inc., Utah, U.S.A., 1988, pp. 102-103.

For example, consider the motion of a point O that is made the reference point. Consider two locations, A and B, on a straight line passing through O, and situated on opposite sides of O (Figure 1). In the case of an outward scalar motion we find both A and B receding from O (Figure 1 (a)). On the other hand, if O's motion is vectorial we find B (or A) receding from O, and A (or B) approaching it (Figure 1 (b)). Thus a scalar motion gets represented as a 'bivector' and not merely as a vector. The appearance of a bivectorial motion in the conventional reference system, therefore, serves to distinguish an intrinsically scalar motion from vectorial motion.

(a) Bivector (b) Vector

Figure 1: Representation of Linear Motion in the Reference System

An analogy might help to demonstrate the universality of the Law of Conservation of Direction. Imagine a long solid cylinder with a cross-sectional area of an arbitrary shape. If the cylinder is now divided into two by cutting with a plane, two new surfaces, S_1 and S_2, will be generated as the ends of the two halves of the cylinder where there were none prior to the cutting. Adopting the right hand cork-screw representation of areas, we can see that the two intersection surfaces, S_1 and S_2, will be of equal area but opposite directions (one being the mirror image of the other). The original lack of (exposed) area is substituted by two equal areas of opposite vectorial directions. It is simply not possible to carry out the intersection such that only one new surface is generated. In an identical manner, the representation in the conventional spatial reference frame of a scalar motion, with its inherent lack of direction, is not possible with the ascription of only a single direction—it requires the imputation of two mutually opposite directions, in other words, a bidirection.

5 Photon: an Intrinsic SHM?

In case the representation of a scalar motion in the stationary three-dimensional reference system is rotational motion instead of translational motion, the requirement of the conservation of direction still holds good, the representation taking the form of a *birotation*. The birotation is a vectorial combination of two equal and opposite rotations, clockwise (CW) and counter-clockwise (CCW).

Some students of the RS have argued that the CW or CCW direction of rotation is the algebraic sign, the sense, of the rotation and not really a direction. Therefore they concluded that rotation has no true direction. But they are missing the point. What their conclusion means is that rotation does not have a direction in the sense of a direction of linear motion. The CW or CCW sense of rotation is relative to the axis of rotation, but the axis itself can be oriented in any direction in the three-dimensional spatial reference system. Adopting the right hand cork-screw representation of rotation, the latter can be vectorially depicted.

Because of the discrete unit limitation a mere change of direction (as in rotation) without any magnitude is not possible. Hence a unit of birotation involves half a unit of one-dimensional space element in each of its component rotations. As shown in Figure 2, let one component rotation be CW, and the reference point for this rotation be O, OA being the radius of rotation with the axis of rotation perpendicular to the plane of the paper. The reference point for the second component rotation, which is CCW, will be A, with AB as radius and axis parallel to that of the first rotation. Since the angular speeds of the two rotations are of equal magnitude, the visible result of this birotation is a SHM, with location B oscillating in the XX' direction. This, therefore, is how the SHM is engendered by uniform motion—the basis of photon structure.

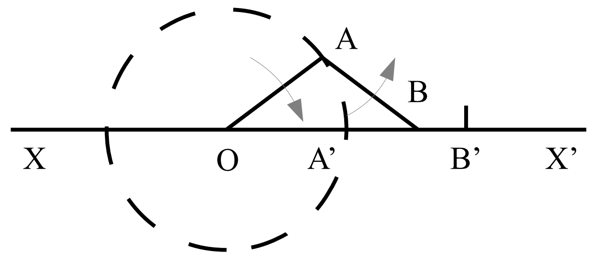

Figure 2: Simple Harmonic Motion as Birotation

At this juncture it might be mentioned that, in this Paper, we are endeavoring to discuss some logical difficulties occurring in the present development of the RS and to clarify them in the light of the discovery of the *Law of Conservation of Direction*. It is not possible, however, to undertake here the full development of the aspects we discuss beyond supplying the missing links in the logic. It is assumed that the reader is sufficiently familiar with the account of the development of RS as given by Larson in his works.

5.1 Polarization

Suppose now that a light beam is passed through a polarizer and one of the component rotations of the photons is filtered out. The outcoming photons will be constituted of a continuous uniform rotation, with the axis of rotation lying parallel to the direction of propagation. If a blackened disk is suspended by a fine filament and is irradiated by such a circularly polarized beam of radiation such that the beam travels parallel to the suspension and strikes the disk normally, a torque should appear. This, of course, is experimentally verified. It might be noted that in Larson's account of the structure of the photon there is no explanation of this fact.

5.2 Vibration vs. Translation

Since each unit of motion, by the reciprocal postulate, consists of one unit of space in association with one unit of time, all motion takes place at unit speed. However, by a sequence of reversals of the progression of either time or space, while the other component (space or time) continues progressing unidirectionally, an effective speed other than unity can result. Explaining this, Larson gives a tabulation[2] for the example of an effective speed of 1/3.

Table 1: Direction

unit	**vibration**		**translation**	
number	**scalar**	**vectorial**	**scalar**	**vectorial**
1	inward	right	inward	forward
2	outward	left	outward	backward
3	inward	right	inward	forward
4	inward	left	inward	forward
5	outward	right	outward	backward
6	inward	left	inward	forward

It may be seen that in the case of the translational situation the vectorial direction reverses *in unison* with the scalar direction. But in the case of the vectorial vibration it is not so: it is perplexing why the scalar and vectorial directions *do not maintain* a constant relationship in the case of the vibrational motion (compare, for example, the third and the fourth units in the tabulation).

Larson comes up with an explanation of a sort, which sounds more like an apology: "… in order to maintain continuity in the relation of the vectorial motion to the fixed reference system the vectorial direction continues the regular reversals at the points where the scalar motion advances to a new unit of space (or time)."[6] On the principles of probability, the alternative possibility, namely, the vectorial directional reversals occurring in unison with the scalar directional reversals appears more logical.

The present recognition of the fact that the linear vectorial vibration is really the manifested result of a birotation now clarifies the situation. Both in the case of the vibration and in the case of the translation the vectorial directional reversal is in unison with the scalar directional reversal. In the vibrational case, the two component rotations involved in the birotation do promptly reverse their respective directions at the time of the reversal of the scalar direction. However, this does not produce any effect on their vector resultant, which continues uninterrupted as the SHM.

Referring to Figure 2, let A reach the position A' and B the position B'. This is one extreme position of the oscillation of B. From this position whether OA' continues rotate in the original CW direction or reverse and rotates in the CCW direction (with the sense of rotation of the second rotation always being opposite to that of the rotation of OA) hardly matters—in either case the observable result is the *same* oscillatory motion of B.

6 Conclusions

Summarizing some of the conclusions reached:

1) The representation of a scalar motion in the these dimensional spatial reference system conserves direction by substituting bidirection for its inherent lack of direction unit vibration translation.
2) The primary displacement from the background condition of the space-time progression takes the form of a uniform birotation, the vector resultant of which manifests as a SHM. This is identified as the photon.
3) Circular polarization is the result of filtering out one of the component rotations of the photon.

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6 Larson, Dewey B., *Nothing But Motion*, *op. cit.*, p. 50.