On the Nature of Rotation and Birotation

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In an earlier paper entitled "The Law of Conservation of Direction,"[1] I have introduced the concept of *birotation*. I discussed there the difficulties with Larson's account of the intrinsic nature of photon and shown how birotation underlies the photon structure. Thomas Kirk, in a communication,[2] refers to this paper and raises two questions. The present article is written as a response to these, realizing that more detailed explanations are necessary than were given earlier, in view of the maiden nature of our explorations of the *Reciprocal System*.

1 The Two Intrinsic Traits of Vector Space

I shall begin by answering Kirk's first question: "How does the simple displacement from the natural progression become a rotational motion, or if a photon is rotational, what phenomenon is the negative of the outward progression?"

I have anticipated this category of difficulty that a reader might feel and included in my exposition a discussion explaining the nature and primacy of rotation (see pp. 3-4 of Reference 1). The real difficulty here stems from the tacit assumption made by the questioner that the only way a primary displacement from the space-time progression can manifest is as a uniformly increasing linear magnitude with constant direction (that is, *translation*). Quoting Larson: "The only inherent property of a scalar motion is its positive or negative magnitude, and the representation of that magnitude in the spatial reference system is subject to change in accordance with the conditions prevailing in the environment. The same scalar motion can be either translational, rotational, vibrational, or a rotational vibration…"[3] What distinguishes them is the coupling to the reference system and this changes according to the circumstances.

I emphasized that space has two intrinsic traits—translational and rotational. In translation we have uniform and continuous change of linear magnitude with constant direction, whereas in rotation we have uniform and continuous change of direction with constant linear magnitude. Both are equally possible. Moreover, "…a constant and uniform change of position or *direction* [my italics] is just as permanent and just as self-sustaining as a condition of rest."[4]

Letting the linear magnitude be x and the angular magnitude θ, we can succinctly describe the representation of a unit of scalar motion in the conventional spatial reference system as

$$\begin{bmatrix} dx/dt \\ d\theta/dt \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} or \begin{bmatrix} 1 \\ 0 \end{bmatrix} \tag{1}$$

where t denotes time. The first represents rotational space while the second translational space.

If space were not to have the rotational trait it would not have had the solidity or the "volumeness" aspect. For example, if we were to have a "cube" of side 2 units in such a "space" of three dimensions, its total magnitude would be 6 *linear* units. It cannot have the volumetric aspect of 8 *volume* units. As

1 K. V. K. Nehru, "The Law of Conservation of Direction," *Reciprocity* XVIII (3), Autumn 1989, pp. 3-6.
2 Kirk, Thomas, *Reader's Forum*, *Reciprocity* XIX (2), Summer 1990, pp. 20-21.
3 Larson, Dewey B., *Basic Properties of Matter*, ISUS, Inc., Utah, USA, 1988, p. 280.
4 *Ibid.*, p. 135.

such, it should be clear that its angularity nature is as fundamental as its linearity nature.

The difficulty of imagining the existence of rotational motion without it being the rotation of *something* is just like the difficulty of imagining the existence of motion without it being the motion of *something*. Both these difficulties originate from our long-standing habit of regarding matter as primary in this physical universe and treating motion only as a predicate of matter. The moment we realize that the most primary entity of the universe of motion is motion, both these difficulties should dissolve together.

There is another reason why it might be difficult for some people to see the equal primacy of the rotational aspect of space as against its translational aspect. Larson points out[5] that present-day science does not recognize the existence of any motions that cannot be represented in the conventional reference system. This reference frame is deficient in more than one way. While some of the true characteristics of scalar motions cannot be represented in the conventional three-dimensional spatial reference system at all, some others could be represented only with the help of some auxiliary devices. "Rotational motion, for instance, is represented in the spatial reference system with the aid of an auxiliary quantity, the number of revolutions. Ordinary vibrational motion can be accurately defined only by a similar expedient."[6]

With the benefit of the above explanations it can now be seen that the genesis of a simple harmonic motion from uniform motion is only possible through rotation. Since the emergence of a single rotation from the scalar motion does not conserve angular momentum, the only logical alternative for the manifestation of the simple harmonic motion is the birotation delineated in my paper.[1] To those who have been following the development so far, it might be apparent by now that the Law of Conservation of Linear Momentum, the Law of Conservation of Angular Momentum, and Newton's Third Law of Motion, are all corollaries of the Law of Conservation of Direction.

In a separate paper I am presenting several experimental facts that demonstrate in a direct manner the existence of birotation in photons. I have already alluded[1] to the experimental determination of the angular momenta of photons. This work[7] was brought to my attention by Edwin Navarro. Kirk proposes that the photon comprises of an inward linear displacement in a second scalar dimension and that the linear inward unit is rotationally distributed. But this model is inadmissible for two reasons. Firstly, a rotationally distributed linear motion does not give rise to angular momentum. Secondly, the way in which Kirk envisages the displacement to manifest is not valid (for reasons I have given in a separate communication).

2 The Scalar Direction of Rotation

The answer to the latter part of Kirk's question, "… if a photon is rotational, what phenomenon is the negative of the outward progression?" also emerges from what has been said above about the deficiencies of the conventional reference system. See for example, how it becomes necessary to introduce the concept of positive and negative reference points to distinguish between the inward/outward scalar directions of a motion, since the representation in the conventional reference system cannot distinguish between them, and same vectorial direction may represent both depending on

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5 *Ibid.*, p. 139.

6 *Ibid.*, p. 152.

7 Beth, R. A., "Mechanical Detection and Measurement of the Angular Momentum of Light," *Physical Review*, Vol. 50, July 15, 1936, pp. 115-125.

the situation.[8]

To ask for “the negative of the outward progression” in connection with rotational motion would be absurd if we mean by “progression” a linear motion. However, if we remember that the term “progression” is used to connote “continuing motion,” and as the scalar motion is basically a magnitude, its scalar direction in the case of rotation can be represented by clockwise (CW) or counter-clockwise (CCW) sense of the rotation. Since this is a matter of the coupling to the conventional reference system it is purely contingent on the circumstances prevailing.

For example, the two counter-rotations, +ω and -ω, of a photon are both inward (scalar). We may attempt to understand this seeming enigma by considering the analogous case of linear translation. In order to represent a linear movement we require a reference point and a moving point. In Figure 1 we depict a bivector by two points A and B, moving uniformly toward a reference point R (with velocities -*v* and +*v* respectively). Now, in order to represent a rotational movement we require a reference direction and a moving (that is, changing) direction. In Figure 2 we depict a birotation by two directions OE and OF, rotating uniformly toward a fixed direction, OD (with angular speeds -ω and +ω respectively).

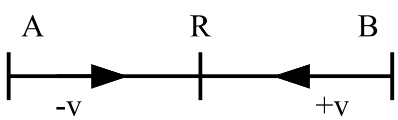

Figure 1: Inward Bivector

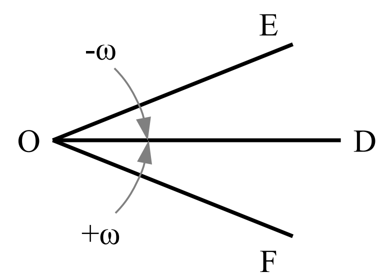

Figure 2: Inward Birotation

While the decreasing lengths AR and BR represent inward motion in the translational situation, the decreasing angles EOD and FOD represent inward motion in the rotational situation.

It is important to understand that what constitutes an inward motion in rotation is the decrease in this angle and not always its CW or CCW sense as viewed by us. In this particular example we see that both the CW and the CCW rotations happen to be representing inward motion, as the corresponding angles are decreasing. Moreover, just like the possibility that the bivectorial motion may have additional motion components superimposed on it, it is possible that the birotation that we are considering may have additional rotational motion components. Suppose that an additional rotation of +2ω is superimposed. Then in the new situation we see both OE and OF rotating in the same (CCW) sense (at angular velocities +ω and +3ω respectively).

Now one might argue that when OF eventually coincides with OD and continues to rotate, the inward rotation would have to become outward as the angular distance between OF and OD then goes on increasing. But as already pointed out, since the conventional reference system cannot represent rotation directly, we cannot distinguish between an angular position of θ° from that of θ+360°, or from that of θ-360°. Under these circumstances it can be seen that the continued rotation of OF past OD could be in the same scalar direction (inward) despite the fact that the angle represented in the conventional reference system seems to increase.

Suppose that the angle FOD is θ°. For all that we know it could also be θ+360°, θ+720° or θ+360*n*

8 Larson, Dewey B., *Basic Properties of Matter*, *op. cit.*, p. 151.

degrees, where *n* could be as large an integer as we please. With this latter possibility, we can easily see that the rotation of OF may continue in the same sense with its angular distance from the fixed direction decreasing continuously and indefinitely, thereby retaining its inward character.

3 The HF versus LF Photons

The intrinsic speed of a photon (that is, its frequency) could be less than 1/1, say $1/n$, or greater than 1/1, say $n/1$. The former are referred to as the LF (low frequency) photons while the latter as the HF (high frequency) photons. Some students tended to call the HF photons the "cosmic photons," and regarded them as not being within the purview of the material sector or the conventional reference system. They presume that neither the unit frequency nor the HF is observable. This is a serious mistake commonly committed by many a student of the Reciprocal System.

Larson says: "When considered merely as vibrating units, there is no distinction between one photon and another except in the speed of vibration, or frequency. The unit level, where speed $1/n$ changes to $n/1$ cannot be identified in any directly observable way."[9] Subsequent research enables him to identify this unit level. "Inasmuch as the natural unit of vibrational motion is a half cycle, the cycle is a double unit. The wavelength corresponding to unit speed is therefore two natural units of distance, or 9.118×10^{-6} cm. The distribution over 128 positions increases the effective distance to 1.167×10^{-3} cm. This, then, is the effective boundary between motion in space and motion in time, as observed in the material sector."[10] From this the natural unit of frequency, which demarcates the LF from the HF, turns out be 2.569×10^{13} Hz. This should make abundantly clear that, as a matter of actual fact, both LF and HF vibrations are observable either from the material sector or from the cosmic sector.

Probably what throws the student off course in this connection is the general statement of the fact that a speed greater than unity (the speed of light) cannot be represented as motion in space with reference to the conventional reference system. The catch here is that this is true of translational motion in space. The situation, however, is different in the case of rotation, since the conventional reference system cannot represent rotation accurately. We, for example, not only can observe a rotational time displacement (like a material particle) but also a rotational space displacement (like a cosmic particle as in the cosmic rays). The following additional explanation should make it clear.

All *independent* motion (as against the fictitious motion of the space-time progression) has to be inward in scalar direction. In the case of the LF photon the vibrational speed being a time displacement (speed $1/n$), the motion is inward in *space*. On the other hand, in the case of the HF photon the vibrational speed being a space displacement (speed $n/1$), the motion is inward in *time*, which is tantamount to outward in space. As far as rotation in space is concerned, we have already seen that the conventional reference system cannot distinguish whether an angle is increasing from θ° or is decreasing from an indefinitely large angle θ° + 360*n*. This fact renders the representation of both the LF and the HF vibrations (that is, the corresponding birotations) in the conventional reference system possible. The same fact also makes it impossible to observationally distinguish between these two types of vibration.

4 Mechanism of Circular Polarization

I shall now turn to Kirk's second question . He enquires: "How does a phenomenon which is compound

9 Larson, Dewey B., *Nothing But Motion*, North Pacific Publishers, Portland, OR, USA, 1979, p. 53.
10 Larson, Dewey B., *Universe of Motion*, North Pacific Publishers, 1984, p. 202.

rotation exist after half of its component rotation is removed as in the postulated polarization? How is this the same phenomenon, a photon?"

This is simple: it can occur in two different ways. Let us represent the photon birotation by P(+ω,-ω), where +ω and -ω are the two rotational component speeds. On entering the polarizing medium let it encounter a rotation R(+ω,+ω) pertaining to a particle. The result would be the replacement of the -ω component of the photon as shown below.

$$\begin{aligned} P(+\omega,-\omega)+R(+\omega,+\omega) &\rightarrow P(+\omega,(-\omega,+\omega),+\omega) \\ &\equiv P(+\omega,+\omega) \end{aligned} \tag{2}$$

It must be understood that the rotation pair inside the inner parentheses, (-ω,+ω), reduces to zero since the interaction here is vectorial. This produces the circularly polarized photon P(+ω,+ω). The disappearance of the rotation R(+ω,+ω) in the medium is tantamount to the production of net angular momentum.

Alternatively, the incoming photon P(+ω,-ω) might encounter an existing birotation B(-ω,+ω) in the atomic system, instead of a rotation R as above. The result would be

$$P(+\omega,-\omega)+B(-\omega,+\omega)\rightarrow P(+\omega,+\omega)+R(-\omega,-\omega) \tag{3}$$

If we remember that the net angular momentum associated with a birotation is zero, we can at once see that the creation of R(-ω,-ω) produces an angular momentum that is identical in effect to the destruction of R(+ω,+ω). In either case the net result would be the circular polarization of the photon in the CCW sense and the production of net angular momentum in the CW sense.

It must be pointed out that the actual situation of the interaction between two rotations in the time region is much more diverse than is depicted above. This stems from several factors, which may be summarized as follows: (i) Each rotation could be either inward (as in the case of independent motion) or outward (as in the case of an outward component of a compound motion with net inward direction). (ii) The conventional reference system is insensitive with regard to the fixed reference direction insofar as it cannot distinguish between whether an angle is increasing from 0° or is decreasing from an indefinitely large initial angle. Consequently, both inward and outward scalar motions could be represented either as CW or as CCW. (iii) The conventional reference system is subject to the limitation that it can differentiate not more than 360° of angle. Consequently there is an imputed cyclicity and a "phase" associated with each representation.

Schematic representations of the several possible cases are shown in Figure 3. We depict the two rotational components of the photon birotation (P+ and P-) by two arrows drawn below the horizontal line pointing inward toward zero, respectively from -∞ to +∞ values. It is taken that the arrow pointing from left to right represents CW rotation and its reverse the CCW. "B" stands for birotation and "R" for rotation and both are drawn above the horizontal line to differentiate them from the components of P. On the left hand side we have indicated the phase difference between the simple harmonic motion of the photon P and that of the interacting motion B or R by 0° (in phase) or 180° (phase opposition). The result of the interaction is mentioned on the right hand side of each diagram; ±L indicating the angular momentum created in the medium due to the circular polarization of the photon. In cases (a) through (d), it must be understood that when the phase difference is 0°, P+ or P- interacts with that component of B which is situated on the same side of the ±∞ to 0 range as itself, whereas for 180° it interacts with the B component that is situated on the opposite side.

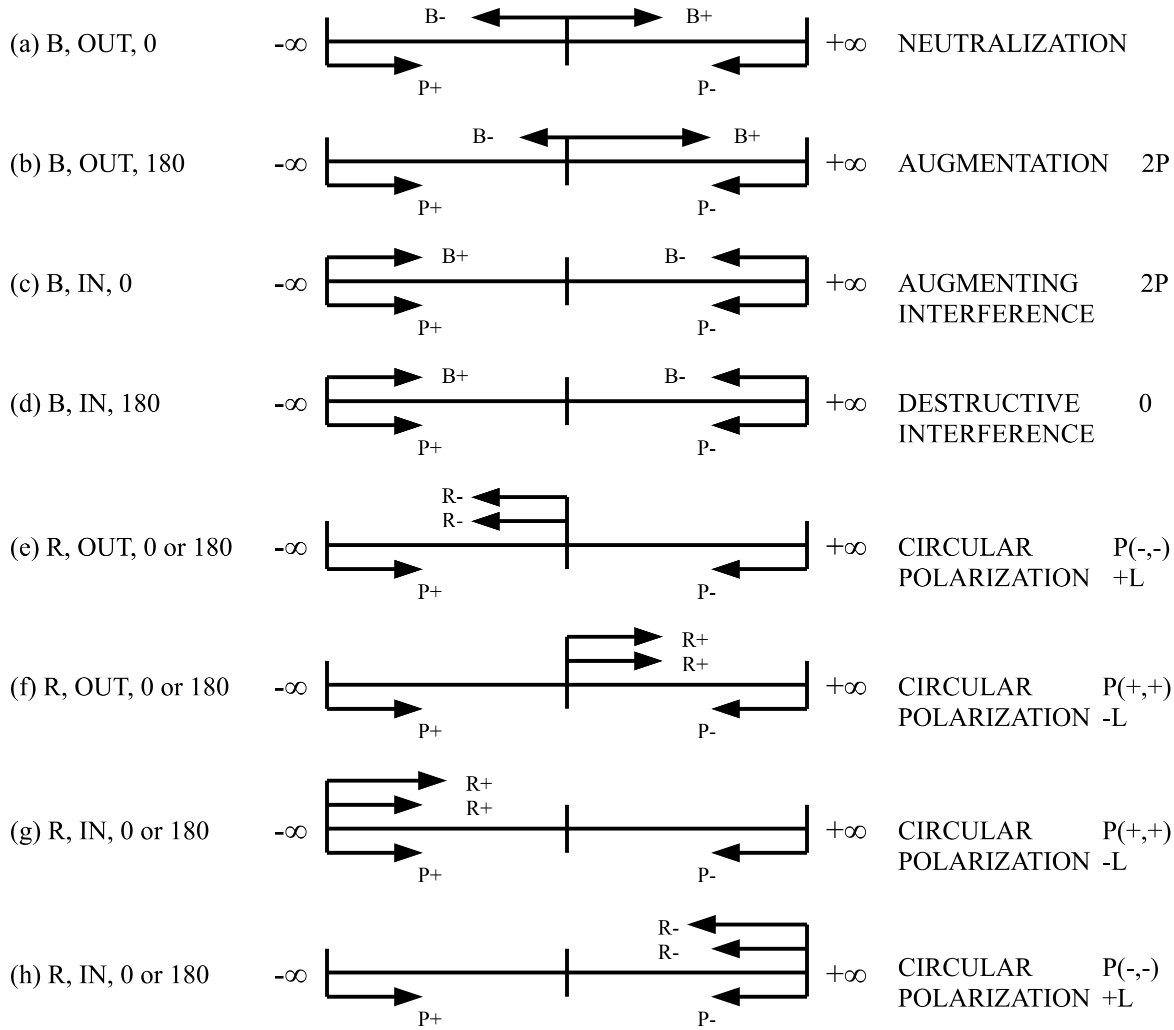

Figure 3: Schematic Diagrams of Interactions of Rotations

5 Conclusions

The Paper basically attempts at elucidating the nature of rotation in the context of the Reciprocal System, and correcting some likely misconceptions. Some of the important conclusions are summarized as follows:

1) It is emphasized that rotational motion is as primary as linear motion and that the simple harmonic motion (which is apparently an accelerated motion) inherent in photons is uniform birotation.
2) The inability of the conventional reference system to represent rotation completely and correctly results in a failure to distinguish between the inward and outward scalar directions of a rotational representation, and renders both the LF and the HF vibrations observable in the reference system.
3) The circular polarization of photons is the result of interaction with existing rotation/birotation in the medium and is accompanied by angular momentum.