Is Space Extending or are Galaxies Moving Apart?

"In cosmology lectures by Dr. Edward R. Harrison and Dr. William Kaufman I have heard each say that the galaxies are not moving apart. They are stationary. The space between them is expanding. I asked each of them how to do an experiment to differentiate between the two possibilities: galaxies moving apart or the space between them expanding. Neither person could answer and I suspect that question had not previously entered their minds. Since the idea that the galaxies are at rest in an expanding space is now quite widespread, I would like to put my request for an experiment to a wider audience. Can any theoretician, researcher, cosmology book author, astronomy teacher, student, or laymen think of an experiment to differentiate between the two possibilities?"

- Prof. Lewis Epstein,
American Journal of Physics, Vol. 55, No. 11, Nov. 1987, pg. 970

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* Notice of 16th Annual ISUS, Inc. 1991 Convention *
The Cosmic Background Radiation: Origin and Temperature
K.V.K. Nehru

1. The Cosmic Sector

One of the outstanding achievements of the Reciprocal System of Theory is the discovery of the fact that the physical universe is not limited to our familiar world of three dimensions of space and one dimension of time, the material sector as Larson calls it. By virtue of the symmetry between the intrinsic natures of space and time, brought to light by Larson, he demonstrates the existence of a cosmic sector of the physical universe, wherein space-time relations are inverse of those germane to the material sector.

The normal features of the cosmic sector could be represented in a fixed three-dimensional temporal reference frame, just as those of the material sector could be represented in a fixed, three-dimensional spatial reference frame. In the universe of motion, the natural datum on which the physical universe is built is the outward progressional motion of space-time at unit-speed (which is identified as the speed of light). The entities of the material sector are the result of downward displacement from the background speed of unity (speeds less than unity), while those of the cosmic sector are the result of upward displacement from unit (speeds greater than unity). But entities like radiation — that move at the unit speed, being thereby at the boundary between the two sectors, are phenomena that are common to both these sectors.

Gravitation, being always in opposition to the outward space-time progression, is inward in scalar direction in the three-dimensional spatial or temporal reference frames. Since independent motion in the material sector (three-dimensional space) is motion in space, gravitation in our sector acts inward in space and results in large-scale aggregates of matter. Gravitation in the cosmic sector acts still inward but it is inward in three-dimensional time rather than in space. Consequently the cosmic sector equivalents of our stars and galaxies are aggregates in time rather than in space.

Further, as Larson points out, "... the various physical processes to which matter is subject alter positions in space independently of positions in time, and vice versa. As a result, the atoms of a material aggregate, which are contiguous in space, are widely dispersed in time, while the atoms of a cosmic aggregate, which are contiguous in time, are widely dispersed in space..."

"Radiation moves at unit speed relative to both types of fixed reference systems, and can therefore be detected in both sectors regardless of where it originates. Thus we receive radiation from cosmic stars and other cosmic objects just as we do from the corresponding material aggregates. But these cosmic objects are not aggregates in space. They are randomly distributed in the spatial reference system. Their radiation is therefore received in space at a low intensity and in an isotropic distribution. Such a background radiation is actually being received."\(^1\)

2. The Radiation Temperature

An approach to the derivation of the temperature of this cosmic background radiation is described now. This can be seen to involve the consideration of several other previously derived items like the relative cosmic abundances of the elements and their thermal destructive limits. To this extent, therefore, the present analysis has to be treated as provisional — a revision in the derivation of these items would entail a corresponding modification in the present derivation. Notwithstanding this, the general approach to the derivation described herein continues to be valid as far as it goes.

The basis for a quantitative enquiry into the properties of the phenomena of the cosmic sector, in general, is the fact that the space-time relations are inverted at the unit level. For instance, "... the cosmic property of inverse mass is observed in the material sector as a mass of inverse magnitude. Where a material atom has a mass of \(Z\) units on the atomic number scale, the corresponding cosmic atom has an inverse mass of \(1/Z\) units which is observed in the material sector as if it were a mass of \(1/Z\) units."\(^2\)

"Because of the inversion of space and time at the unit level, the frequencies of the cosmic radiation are the inverse of those of the radiation in the material sector. Cosmic stars emit radiation mainly in the infrared, rather than mainly at the optical frequencies .. and so on."\(^3\) Therefore, we expect the background radiation to be at a low temperature (that is, high inverse temperature).
2.1 Averaged Energy Density

We shall attempt to calculate the temperature of the background radiation by adopting the energy density approach. The energy density in space of blackbody radiation at a temperature of T Kelvin is given by

\[ U = b \times T^4 \text{ erg-cm}^{-3} \]

(1)

where \( b = 7.5643 \times 10^{-15} \text{ erg-cm}^{-3} \text{ K}^{-4} \).

The major contribution to the background radiation is from the cosmic stars. As such, we shall attempt to arrive at the average energy density of the cosmic star radiation by finding the lumped average of the energy density of the radiation from all the stars in the material sector and then taking its inverse. At this juncture we should recognize a point of crucial importance which renders the analysis simple: to an observer in the cosmic sector the atoms at the center of a material sector star are as much exposed as the ones at its periphery, and the radiation from the interior atoms is as much observable as that from the outer atoms. This is because, as already mentioned, the locations of the atoms of a spatial aggregate are randomly and widely dispersed in the three-dimensional temporal reference frame. Analogously, to an observer in the material sector all the atoms of the cosmic sector star are observable. Since (i) the temperatures in the stellar core are larger by many orders of magnitude — nearly a billion times — than the temperatures in the outer regions of a star and (ii) energy density is proportional to the fourth power of temperature (eq. 1), no appreciable error would be introduced if the energy density of the stellar radiation, originated in one sector but as observed in the opposite sector, is calculated on the basis of the central temperature alone.

The temperature prevailing at the center of a star is determined by the destructive temperature \( T_d \) of the heaviest element in it that is currently getting converted to radiation by the thermal neutralization process. On theoretical grounds we expect stars 'burning' — that is, undergoing thermal neutralization — elements with atomic numbers ranging all the way from 117 down to a limiting value, \( Z_a \), to occur. \( Z_a \) is the atomic number of the element which, as explained in detail elsewhere, when it arrives at the center of the star, leads to a chain of events culminating in the thermal destruction of the Co/Fe group of elements, in other words, in Type I supernova explosion. No star burning an element with atomic number less than \( Z_a \) is possible because it would have disintegrated in the supernova explosion. Theoretical considerations suggest that \( Z_a \) could be between 30 and 26. The relevant energy density of the radiation of a star burning element \( Z \) at its center is

\[ U_Z = b \times (T_{d,Z})^4 \text{ erg-cm}^{-3} \]

(2)

where \( T_{d,Z} \) is the thermal destructive limit of element \( Z, \) in kelvin.

Now it becomes necessary to estimate the proportion each of the stars with central temperature the same as the destructive limit of the element \( Z, \) for \( Z = 117 \) to \( Z_a \). Since the more abundant an element happens to be, the larger would be the number of stars burning it, on the basis of the cosmic abundance of the elements that is taken to be uniform throughout the universe, we can deduced the ratio of the number of stars burning element \( Z \) to the total number of stars as

\[ f_z = a_z / S(a_z) \]

(3)

where \( a_z \) is the relative cosmic abundance of element \( Z \) and \( S(\cdot) \) stands for,

\[ \sum_{Z_2}^{117} (\cdot) \]

Hence the expected energy density of the radiation from all the stars can be given by

\[ U = S(f_z \times U_Z) = (b / S(a_z)) \times S(a_z) \times (T_{d,Z})^4 \text{ erg-cm}^{-3} \]

(4)

2.2 The Inverse Energy Density

Because of the reciprocal relationship between corresponding quantities of the material and cosmic sectors, the energy density of the radiation from the cosmic stars would be the inverse of this quantity. But before taking the inverse we must convert the concerned quantities into the natural units from the conventional units. Thus the energy density in natural units is

\[ u = U / (E_n \times S_n^{-3}) \]

(5)
Where \( E_n = \) natural unit of energy expressed in conventional units\(^5 \)
\[ = 1.49175 \times 10^{-3} \text{ erg} \]
and \( S_n = \) natural unit of space expressed in conventional units\(^6 \)
\[ = 4.558816 \times 10^{-6} \text{ cm} \]

We need to recognize now that radiation in the cosmic sector is dispersed in three-dimensional time whereas the material sector progresses linearly in one-dimensional time. A one-dimensional progression in the cosmic sector has two mutually opposite 'directions' in time (say, AB and BA), only one of which is coincident with the 'direction' of the time progression of the material sector. The total radiation from the cosmic sector is distributed equally between the two temporal directions and consequently the energy density apparent to us would be only half of the total. That is

\[
u_{\text{app}} = \frac{u}{2} \tag{6} \]

Larson brings out this point of the relationship between the actual and the apparent luminosities while discussing the quasar radiation.\(^6 \) Finally, the energy density of the radiation from the cosmic stars as observed by us is in the inverse of this quantity,

\[
u_c = \frac{1}{\nu_{\text{app}}} = \frac{2}{u} \text{ in natural units} \tag{7} \]

2.3 Thermal vs. Inverse Thermal Distribution

At this juncture a question that naturally arises is that whether the nature of this radiation from the cosmic sector would be thermal or not. Especially, recalling what has been quoted from Ref.[3] earlier, it is clear that this radiation is of the inverse thermal type. Under these circumstances the adoption of eq. (1) is questionable since it pertains only to thermal radiation.

On examining the values of the thermal destructive limits of the elements, we find them all larger than the unit temperature, that is, the temperature corresponding to unit speed.\(^4 \) If we remember that the demarcations of the speed ranges of the material sector are as much applicable to the linear vibratory speeds (thermal motion) as to the linear translational speeds, it becomes apparent that the central temperatures of the material sector stars are in the intermediate range, that is, on the time-zero side of the one-dimensional range (see fig. 8 of Ref.[7]).

Quoting from Larson: "... ordinary thermal radiation is ... produced by matter at temperatures below that corresponding to unit speed. Matter at temperatures above this level produces inverse thermal radiation by the same process, ... with an energy distribution that is the inverse of the normal distribution applicable to thermal radiation."\(^8 \)

From the foregoing the following syllogism suggests itself:

1. The energy distribution of a cosmic sector phenomenon would be the inverse of the energy distribution of the corresponding material sector phenomenon.

2. The phenomenon under consideration is the distribution of radiation from the core of a cosmic sector star.

3. The distribution of the radiation from the core of a material sector star is inverse thermal, since it originates in the intermediate temperature range.

4. Hence the distribution of the radiation from the core of a cosmic sector star would be the inverse of inverse thermal, that is, thermal.

2.4 Comparison with Observations

Reverting to the conventional units, we have the apparent energy density of the background radiation as

\[
u_c = \nu_c \ast (E_n \ast S_n^{-3}) \text{ erg-cm}^{-3} \tag{8} \]

Finally the derived temperature of the background radiation, with the energy density given by eq. (8) is (adopting eq. (1))

\[
T_c = (\frac{\nu_c}{b})^{1/4} \text{ K} \tag{9} \]

Substituting from eqs. (4), (5), (7) and (8) in eq. (9) and simplifying

\[
T_c = 5.4257 \times 10^{13} \ast [S(a_4) / S(a_2 \ast (T_d z))^{4}]^{1/4} \text{ K} \tag{10} \]

Adopting the theoretically calculated values of \( a_2 \), the relative cosmic abundance\(^9 \) and \( T_d z \), the thermal destructive limits\(^4 \) of the elements, the background temperature \( T_c \) is worked out for \( z = 117, 116, ..., 26 \). The listing of a Pascal program for this calculation is given in the Appendix. Some of the computed values of \( T_c \) are listed in Table 1 for \( z \) values ranging from 31 to 26.
Table 1. Computed Values of the Cosmic Background Radiation Temperature

<table>
<thead>
<tr>
<th>( Z_\alpha )</th>
<th>( T_c ) (Kelvin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>2.989</td>
</tr>
<tr>
<td>30</td>
<td>2.798</td>
</tr>
<tr>
<td>29</td>
<td>2.614</td>
</tr>
<tr>
<td>28</td>
<td>2.435</td>
</tr>
<tr>
<td>27</td>
<td>2.587</td>
</tr>
<tr>
<td>26</td>
<td>2.739</td>
</tr>
</tbody>
</table>

The most probable candidate for \( Z_\alpha \), either from the theoretical considerations or from the empirical cosmic abundance data turns out to be 30. The expected temperature of the background radiation corresponding to \( Z_\alpha = 30 \) can be seen to be 2.798 kelvin. The observed values reported in the literature range from 2.74 to 2.9 kelvin. It is instructive to note that the value of this temperature calculated on the basis of the element Fe (that is, \( Z_\alpha = 26 \)) which according to Larson is the element responsible for the supernova explosion, turns out to be 2.74 kelvin. This is in fair agreement with the recently published value of 2.75 kelvin estimated from accurate observations. Even though the derivation of the temperature of the background radiation described herein is cursory, if suffices to demonstrate that it could be derived from theory alone in the context of the Reciprocal System.

3. Conclusions

To highlight some of the important points brought out:

3.1 The stars of the cosmic sector of the physical universe are aggregates in time and are observed atom by atom, being randomly distributed in the three-dimensional space.

3.2 The radiation from these is observable as the cosmic background radiation: its absolute uniformity and isotropy resulting from item 3.1 above.

3.3 The distribution pattern of this radiation is inverse of inverse thermal, that is, thermal.

3.4 Since the radiation originating from the cosmic stars gets equally divided between the two opposite 'directions' of any single time dimension, the apparent luminosity as observed from the spatial reference system of our material sector (which progresses 'unidirectionally' in time) is half of the actual luminosity.

3.5 The energy density of the background radiation is the apparent energy density of the cosmic star radiation, which is the reciprocal of the energy density of the material star radiation after accounting for item 3.4 above.

3.6 The temperature of the background radiation computed for \( Z_\alpha = 30 \) is 2.798 kelvin and for \( Z_\alpha = 26 \) is 2.739 kelvin (where \( Z_\alpha \) is the atomic number of the element at stellar-core responsible for Type I supernova). These are in close agreement with the observational value of 2.75 Kelvin.

References

2. Dewey B. Larson, Nothing but Motion, North Pacific Pub., 1979, p. 190
4. K.V.K. Nehru, Intrinsic Variables, Supernovae and the Thermal Limit, Reciprocity, XVII (1), Spring 1988, p. 20
5. Dewey B. Larson, Nothing but Motion, op. cit., p. 160
6. Dewey B. Larson, The Universe of Motion, op. cit., p. 341
7. Ibid., fig. 8, p. 72
8. Ibid., p. 246

Appendix

The program that Dr. Nehru refers to in his paper is available to any member who may have a need for it. Simply contact the editor.
The Reciprocal System

Two Postulates as to the nature of space and time are the basis from which all of the conclusions of this new theory are derived. A development of the consequences of these postulates, without any supplementary assumptions and without calling upon any information from observation, accounts for the existence of the major physical entities, defines their properties, establishes the relationships among them, and provides the information from which numerical magnitudes applying to these properties and relationships can be calculated. For the first time in the history of science, a general physical theory is derived from a single set of postulates.

The Reciprocal System, Developed by Dewey B. Larson over a 40 year time period, is at once revolutionary and conservative. It is the first unified theory and the first general theory, but its central ideas have been expressed by philosophers through the ages. From just two general postulates, Larson has derived an all-embracing theoretical universe, from sub-atomic particles to supergalaxies, answering simply and reasonably such questions as:

What is the fundamental component of the Universe?
Why is the Universe expanding?
Why does Light behave sometimes as a particle and sometimes as a wave?
What holds the parts of an Atom together?
Why do Electrons and Positrons annihilate one another to produce photons?
What is the origin and nature of Gravitation?
What is the origin of Supernovas, Pulsars, and Solar Systems?
What is the connection between Galaxies and Quasars?
What is the origin of Cosmic Rays?
Is the Universe finite or infinite?
Is the Universe in a steady state, or is it evolving?

Motion is the Fundamental Entity

The thesis of the Reciprocal System is that the universe in which we live is not a universe of matter, but a UNIVERSE OF MOTION, one in which the basic reality is motion, and all physical entities and phenomena, including matter, are merely manifestations of motion. The atom, on this basis, is simply a combination of motions. Radiation is motion, gravitation is motion, an electric charge is motion, and so on.

The physical universe is not a universe of matter existing in a framework provided by space and time, as seen by conventional science, but a universe of motion, in which space and time are simply the two reciprocal aspects of motion and have no other significance. Mr. Larson determined the properties that space and time must necessarily possess in a universe composed entirely of motion, and expressed them in the form of a set of postulates. He then showed that development of the consequences of these postulates by logical and mathematical processes, without making any further assumptions or introducing anything from experience, defines, in detail, a complete theoretical universe that coincides in all respects with the observed physical universe.

According to the Scientific Australian, the Reciprocal System is "The True Theory of the Physical Universe - from Microcosmos to Macrocosmos."

We Can Tell You About It

The International Society of Unified Science, Inc. is a group of scientists, engineers, and others who are trying to call attention to Dewey B. Larson’s theory of a universe of motion. The objective of the Society is the advancement of the Reciprocal System which makes use of two fundamental postulates, together with everything that can be derived from these postulates by logical or mathematical processes. The editors of Reciprocity, Journal of the International Society of Unified Science, welcome papers, ideas, and experiments, especially from new contributors.

Membership is open to all persons interested in the advancement of scientific knowledge.
Comments on the MS of Edwin Navarro's Reciprocal Algebra  
K.V.K. Nehru

1) One wonders if it is justifiable to take
\[ D(a/b) = b-a \]
since it leads to the result that different reciprocals, say, 5/6, 3/4 and 1/2, end up with the same displacement. From what I understand of Larson, there is only a one-to-one mapping between speeds and the corresponding displacements; not a many-to-one mapping. Therefore, it is mandatory that the author clarifies this matter at the very outset in his article. Otherwise the whole treatment becomes invalid.

2) There is an error in the definition of the inverse displacement. It should be corrected as
\[
\begin{align*}
D^{-1}(n) &= (1-n)/1 \quad \text{for } n \leq 0 \\
D^{-1}(n) &= 1/(n+1) \quad \text{for } n \geq 0
\end{align*}
\]

3) The symbol \( \oplus \) used for the reciprocal addition operator is already in use for representing the logical operation of exclusive or. It is suggested that he adopt another symbol, like or \( \odot \) or \( \odot \).

As a corollary to the definition of reciprocal addition, the author may wish to define reciprocal subtraction as
\[ a/b \oplus c/d = (a-(c-1))/(b-(d-1)) \]
when \( a>c \) and \( b>d \)

4) It must be noted that the reciprocal addition, as defined, is not, and is not like, the algebraic addition. Therefore, to claim from\[ D(a/b \oplus c/d) = D(a/b) + D(c/d) \]
that the displacement operator, \( D \), is distributive over reciprocal addition is not admissible. It is distributive only if either of the following is satisfied or defined:
\[ D(a/b \oplus c/d) = D(a/b) \oplus D(c/d) \]
or
\[ D(a/b + c/d) = D(a/b) + D(c/d) \]
which is not the case since + and \( \oplus \) are not operationally identical. The author may wish to add.
\[ D(a/b \ominus c/d) = D(a/b) - D(c/d) \]

5) The question raised in item (1) above is again pertinent to the case of the definition of Reduction of reciprocals.

6) The author may wish to add in the section on Reduction the following corollaries:
\[ R(a/b \oplus c/d) = R(a/b) \oplus R(c/d) \]
if \( a<b \) and \( c<d \) or if \( a>b \) and \( c>d \); otherwise
\[ R(a/b \oplus c/d) = R(R(a/b) \oplus R(c/d)) \]
and
\[ R(a/b \ominus c/d) = R(R(a/b) \ominus R(c/d)) \]

7) In p.3 of his MS, left column, line 5 from bottom: '2' may be replaced by 'two'.

8) In p.3, right column, line 12 from bottom: the second '+' should be replaced by '4'.

9) In p.4, line 15 from bottom, it is asserted that the Reciprocal Algebra is a commutative mathematics. But the operators \( D \) and \( D^{-1} \), for example, are not commutative.

10) Finally, all the occurrences of the words 'Reciprocal Theory' may be replaced either by 'Reciprocal System' or 'Reciprocal System of Theory.'

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Navarro's Response to Nehru's Comments

Thank you very much for your comments on my paper on a Reciprocal Algebra. I appreciate the time that you have taken to read through and work through the details of the paper. I wanted to let you know what changes I have made to the article in response to your comments.

Numbers 2, 7, 8, and 10 were made just as you suggested. In regards to items 1 and 5, it is my feeling that this Reciprocal Algebra presents a general case. Even if reciprocals of the form 3/4 do not exist in the Reciprocal System, that does not preclude the validity of the algebra when dealing with reciprocals of the form 1/n or n/1. I did make one change in this regard which was to replace the line on the last page which said,
(all units of motion) \( \subseteq (A^3) \)

with
\( (each \ unit \ of \ motion) \in (A^3) \)

This makes it clearer, I believe, that there is not necessarily a one-to-one mapping between units of motion and reciprocals, but that every unit of motion can be represented by a 3-dimensional reciprocal.

In 3, first paragraph, I decided to continue to use the \( \oplus \) symbol even though it has another mathematical meaning. Since I would not expect Exclusive Or would appear in the use of the mathematics, I do not perceive a conflict.

In regards to 3, second paragraph, and 6, these are both valid extensions to the algebra. I decided not to add them at this time but could add them when it becomes useful to have them.

I completely agree with number 4. This is really not a true distributive law. However, I feel that the property that I am describing is very important. I have therefore replaced "The Distributive Law" with merely "Distributing". This should maintain the rigor of the mathematics while allowing that a distributive-like property does exist.

I do not agree with number 9. My understanding of a commutative mathematics is that all binary operations are commutative. Since I have only introduced two binary operations, reciprocal addition and scalar multiplication, both of which are clearly commutative, then I feel it is safe to refer to it as a commutative mathematics. The displacement operator is a unary operator, just like the determinant matrix algebra. Matrix algebra is non-commutative because the binary operator, multiplication, is not commutative, not because the determinant is not commutative. If I have missed something here, I would appreciate a clarification.

Once again, thank you for your in depth comments.

Edwin Navarro

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Publication Policy

The editors of Reciprocity welcome papers, especially from new contributors. The requirements that a contributed paper must meet in order to qualify for publication are clarified below. Editorial assistance is available in those cases where a limited amount of revision will enable a paper to meet the requirements.

As stated in the by-laws of the International Society of Unified Science, the objective of the Society is the advancement of the Reciprocal System of physical science. This theory, as it is defined, consists of two fundamental postulates, together with everything that can be derived from those postulates by logical and mathematical processes, without introduction from any other source.

The unitary character of the theory, resulting from the derivation of all its conclusions from the same set of premises, is its most essential feature. It is this status of this theory as a general physical theory - the only thing of its kind - that enables extension of the theory into areas inaccessible to observation.

The purpose of Reciprocity is to contribute toward the accomplishment of the objective of the organization. Acceptance of items for publication shall therefore be determined by the following criteria:

1. All items must have relevance to the stated objective of the International Society of Unified Science.
2. Original technical articles must deal with the Reciprocal System of Theory, as defined above, or aspects thereof; that is, the propositions supported must purport to be derived from the postulates of the Reciprocal System, or from previously published reached on that basis, without introducing further assumptions.
3. Arguments advanced against previously published material must be similarly based.

Papers should be sent to one of the editors. All published papers become property of ISUS, Inc.

Alternatively, you may now, if you wish, submit your papers on 3.5 inch disks for the Macintosh computer, in Word 4.0 or MacWrite (version 2, 4.5. and 5.0) formats. This helps to eliminate the errors that may occur in transcription and reduces the amount of time it takes us to put the journal together.
On the Nature of Rotation and Birotation
K.V.K. Nehru

In an earlier paper entitled 'The Law of Conservation of Direction' I 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, 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.

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 ref.[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 ..." 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." Letting the linear magnitude be \( x \) and the angular magnitude \( \theta \), we can succinctly describe the representation of a unit of scalar motion in the conventional spatial reference system as

\[
\begin{bmatrix}
\frac{dx}{dt} \\
\frac{d\theta}{dt}
\end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}
\]

where \( t \) denotes time. The first represents rotational space while the second represents 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 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 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."
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 paper¹ 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 alluded¹ to the experimental determination of the angular momenta of photons. This work⁷ was brought to my attention by Edwin Navarro. Kirk proposes that the photon comprises an inward linear displacement in a second scalar dimension and that the 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).

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 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 counterclockwise (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 fig. 1 we depict a bivector by two points A and B, moving uniformly toward a reference point R (with velocities -ν and +ν respectively). Now, in order to represent a rotational movement we require a reference direction and a moving (that is, changing) direction. In fig. 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).

\[ \begin{array}{c}
A & R & B
\end{array} 
\]

\[ \begin{array}{c}
\nu \\
\nu
\end{array} 
\]

\[ \begin{array}{c}
\omega \\
\omega
\end{array} 
\]

Fig. 1 Inward Bivector

\[ \begin{array}{c}
O & E
\end{array} 
\]

\[ \begin{array}{c}
\omega \\
\omega
\end{array} 
\]

\[ \begin{array}{c}
D & F
\end{array} 
\]

Fig. 2 Inward Birotation

*The linear inward unit is rotationally distributed. But this model is inadmissible for two reasons. Firstly, a rotationally distributed.*

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 +\(\omega\) and +3\(\omega\) 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 angular position of \(\theta\) from that of \(\theta+360^\circ\), or from that of \(\theta-360^\circ\). 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 \(\theta\). For all that we know it could also be \(\theta+360^\circ\), \(\theta+720^\circ\) or \(\theta+360n^\circ\) 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.

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." 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 x 10^{-6} cm. The distribution over 128 positions increases the effective distance to 1.167 x 10^{-3} cm. This, then, is the effective boundary between motion in space and motion in time, as observed in the material sector." From this the natural unit of frequency, which demarcates the LF from the HF, turns out to be 2.569 x 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 a 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 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 \(\theta\) or is decreasing from an indefinitely large angle \(\theta+360n^\circ\). 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 observational distinguish between these two types of vibration.

Mechanism of Circular Polarization

I shall now turn to Kirk's second question. He inquires: "How does a phenomenon which is compound 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(\(\omega, -\omega\)), where \(\omega\) and \(-\omega\) are the two rotational component speeds. On entering the polarizing medium let it encounter a rotation \(R(\omega, +\omega)\) pertaining to a particle. The result would be the replacement of the \(-\omega\) component of the photon as shown below.

\[
P(\omega, -\omega) + R(\omega, +\omega) \rightarrow P(\omega, -\omega, +\omega) + \omega = P(\omega, +\omega)
\]

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

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

\[
P(\omega, -\omega) + B(-\omega, +\omega) \rightarrow P(\omega, +\omega) + R(-\omega, -\omega)
\]

If we remember that the net angular momentum associated with a birotation is zero, we can at once see that the creation of \(R(-\omega, -\omega)\) produces an angular momentum that is identical in effect to the destruction of \(R(\omega, +\omega)\). 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\(^\circ\) 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\(^\circ\) of angle. Consequently there is an imputed cyclicity and a 'phase' associated with each representation.

![Fig. 3 Schematic Diagrams of Interaction of Rotations](C 20.1-11)
Schematic representations of the several possible cases are shown in fig. 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 \(-\infty\) to \(\infty\) 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 \(0^\circ\) (in phase) or \(180^\circ\) (phase opposition). The result of the interaction is mention on the right hand side of each diagram; \(\pm L\) 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 \(0^\circ\), P+ or P- interacts with that component of B which is situated on the same side of the \(\pm \) range as itself, whereas for \(180^\circ\) it interacts with the B component that is situated on the opposite side.

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.

References

2. Thomas Kirk, “Reader’s Forum”, Reciprocity, XIX (2), Summer 1990, pp. 20-21
4. Ibid., p. 135
5. Ibid., p. 139
6. Ibid., p. 152

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Space and Time come from Motion

The concept of velocity understood as the ratio distance/time, is an integration of space with time. The metrizable variables of distance and time are united in velocity. That this union is not at all self-evident was shown by Piaget when he demonstrated that ideas of space and of time arise out of the child’s perception of motion, not that the idea of motion is synthesized from prior perception of distance and time.


***
Derivation of Reciprocal System Mathematics
Tom Kirk

The task of setting down in writing the fundamental mathematics of the Reciprocal System is certainly a worthwhile undertaking. Mr. Edwin Navarro's article on Reciprocal Algebra in the Winter, 1990 issue of Reciprocity was very inspiring. I believe however it would be best to begin with the fundamental postulates and then rigorously derive the mathematics. The presentation by Navarro begins with mathematics and then discusses postulates. It can be shown therein lies the reason there are significant anomalies in his development.

Postulates are statements that are accepted as true without proof. Unless further developments are deduced from postulates, then any new developments must be characterized as postulates also. It is unclear how many additional postulates are assumed by Navarro, but if the problem is properly approached, there is no need for any additional ones beyond Larson's first two.

Such an approach is developed below. Two definitions are required for concepts used frequently in RS. Corollaries are specific cases of postulates and their corollaries. The postulates, the corollaries and the theorems represent the mathematics of the Reciprocal System to the extent that Navarro's presentation takes us.

Larson's first postulate is actually 4 postulates:

Postulate 1A:

The physical universe is composed entirely of on component, motion.

Corollary 1A.1:
The absence of any phenomena or "nothing" is equivalent to motion, because the physical universe encompasses such realms of non-phenomena.

Postulate 1B:

Motion exists in 3 dimensions

Postulate 1C:

Motion exists in discrete units.

Corollary 1C.1:

The minimum motion is one unit.

Definition:

Two quantities, n and m, are reciprocal when related by the expression n/m wherein their relation is directly inverse proportional.

Postulate 1D:

Motion has two reciprocal aspects, space (s) and time (t).

Corollary 1D.1

Motion is either t/s or s/t. (There being no postulate to the contrary.)

The second postulate is actually 3 postulates:

Postulate 2A:

The physical universe conforms to the relations of ordinary mathematics.

Corollary 2A.1:

The dimensional units of motion and its two reciprocal aspects remain unchanged under operations of addition and subtraction.

Corollary 2A.2:

The dimensional units of motion and its two reciprocal aspects become direct products of the original multiplication unit factors, under operations of multiplication.

Postulate 2B:

The primary magnitudes of the physical universe are absolute.

Postulate 2C:

The geometry of the physical universe is Euclidean.

Theorems related to mathematical operations can now be extended:

Theorem 1:
The absence of any phenomena, "nothing", is unit motion.

Proof: Nothing is motion (Cor. 1A.1)
Minimum motion is one unit (Cor. 1C.1)
Therefore, nothing is unit motion.

**Theorem 2:**
Motion only exists as n/1 or 1/n, where n is an integer.

Proof: Motion only exists in discrete units (Pos. 1C)
Motion is s/t or t/s (Cor. 1D.1)
Therefore, motion, either t/s or s/t, only exists as n units or from and inverse reference 1/n.

**Theorem 3:**
1/n + 1/1 = 1/n and n/1 + 1/1 = n/1

Proof: Nothing is unit motion. (Theorem 1)
Adding nothing does not change the value. (Pos. 2A and 2B)

**Definition:**
Displacement is the number of units of motion greater than unit motion that are contained in a single motion.

**Theorem 4:**
Each motion n/1 is composed of n-1 displacements from the minimum motion plus the minimum motion, 1/1.

Proof: Nothing is 1/1 (Theorem 1)
Increasing motion to n/1 units requires addition of n-1 units (Pos. 2A and 2B)

**Theorem 5:**
n/1 + m/1 = (n + m - 1)/1

Proof: Total displacements are n + m (Pos. 2A)
[(n + m) - 1]/1 is the total motion (Theorem 4)
[(n + m) - 1]/1 = (n + m - 1)/1 (Pos. 2A)

**Theorem 6:**
The sum of the displacements of two motions equals the displacement of the sum of two motions.

Proof: The displacements of two motions, n/1 and m/1 are n-1 and m-1, respectively. (Theorem 4)
The total of the displacements of the two motions is (n-1) + (m-1) or m + n - 2 (Pos. 2A)
The total of two motions n/1 and m/1 is (n + m - 1)/2 (Theorem 5)
The displacement of motion (n + m - 1)/1 is (n + m-1) - 1 or n + m - 2 (Theorem 4 and Pos. 2A)

Therefore, the displacement of the total motion and the sum of the displacements of the two motions are the same.

**Theorem 7:**
The displacements of two motions 1/n and m/1 can not be combined into a single motion.

Proof: 1/n + m/1 = (m + 1 - 1)/(n + 1 - 1) = m/n (Theorem 5) A motion m/n can not exist. (Theorem 2)

**Theorem 8:**
c multiplied times a motion equals [c x n - (c - 1)]/1 where n/1 is the motion and c is an integer.

Proof: c x n/1 = the sum of n/1 added c-1 times to a cumulative total beginning with n/1. (Pos. 2A)
2 x n/1 = n/1 + n/1 = (n + n - 1)/1 = (2n-1)/1 (Pos. 2A)
3 x n/1 = (2n-1)/1 + n/1 = [(2n-1) + n - 1]/1 = (3n-2)/1 (Pos. 2A)
c x n/1 = [(c-1)n - 1]/1 + n/1 = [(c-1)n + n - 1]/1 (Pos. 2A)

**Theorem 9:**
c x 1/n = 1/[c x n - (c-1)] where 1/n is a motion and c is an integer.

Proof: There is nothing in the postulates to indicated which reciprocal aspect is in the numerator of a motion n/1 or 1/n; it is therefore completely arbitrary. As such Theorem 8 applies to both t/s or s/t motions of n/1 and an integer times such a motion will have the same numerical resultant in either case. The choice to invert the resultant of the multiplication is again strictly arbitrary. (Cor. 1D.1)

At this point in the development, essentially all of Navarro's presentation has been replaced by a mathematically rigorous derivation from the original postulates:

Reciprocal has been redefined to establish the nature of the relationship embodied in the concept.

Dimensional units were established by definition conforming to normal mathematical definitions and the effect of addition and multiplication operations on dimensional units are established in Corollary 2A.1 and 2A.2.
Displacement operations were derived in Theorem 4, except Navarro has gone ahead and defined a mathematical operator for the process, which may be a useful tool. However, the displacement operation on a/b is meaningless because individual scalar motions only exist as 1/n or n/1. The idea that a motion of 1/2 has the same displacement as a motion of 3/4 cannot be correct. A motion of 3/4 cannot be an individual scalar motion. It would have to be combination of two or more individual scalar motions which add in a way not in conformance with the principle of scalar motion addition presented herein or by Navarro.

Addition conforms to the derived Theorem 5 herein except again the addition of a/b with c/d is meaningless. Any speed where neither a or b are one, is the combination of two independent motions, not an individual scalar motion.

Distributing the Displacement Operator is an extension of the displacement operator as a tool. The essential property of distribution is Theorem 6.

Additive identity is simply a new phrasing of the concept of unit motion which is the equivalent of nothing or no phenomenon as such is the base beginning or reference for all other motions.

Reduction of reciprocals is entirely unnecessary because motions only exist as 1/n and n/1 as established in Theorem 2.

Scalar multiplication concerns multiplication of motions by an integer. This process is established in Theorem 8 and 9.

Dimensions are what give motion as defined by the postulates the capacity to be altered from their most fundamental nature to abstractions based on reference systems. This is a very involved and difficult topic, one which I will decline to venture forward with at this time. As presented by Navarro, his approach as far as it goes seems accurate in defining a system of symbols for the three dimensions of motion established in the first postulate. These dimensions would indeed be scalar, as Navarro indicates, since no geometrical principles are brought into consideration within the first postulate. In fact, if these three dimensions in Postulate 1 were geometrical dimensions, then the postulates would contain redundancy, in that the 3 dimensions of space are encompassed within Euclidean geometry as presented in Postulate 2. It is clear that Larson reduced the postulates to be as concise as possible. A redundancy would be extremely unlikely in two such short simple statements.

Representation of the geometric dimensions is not presented by Navarro, though they are clearly established via the Euclidean geometry reference in the second postulate.

These dimensional considerations are at the root of why Navarro contradicts Larson in stating that the most fundamental unit of motion is (s/t)^3. Larson always took s/t as the fundamental unit of motion. In geometrical motion, it takes three independent magnitudes to define a one dimensional motion. This does not mean a one dimensional motion is (s/t)^3.

I would suggest a similar though different principle applies to the three independent magnitudes of scalar motion. Each of the independent magnitudes is an independent motion in a separate scalar dimension (as opposed to an independent direction in geometry) and therefore can be considered independently. Though all motions have a value in each of three scalar dimensions, the motion in each scalar dimension is a complete and independent motion, thus the dimensions of any one of them is s/t. Each can be independently displaced. The simplest most fundamental motion is motion in one scalar dimension with units s/t.

Navarro's question about the ordinariness of Reciprocal System mathematics is answered through derivation of RS mathematics from principles within the postulates, in conjunction with the principle of conformity with ordinary mathematics itself. Indeed, when the principles in the postulates are properly applied, ordinary mathematics are proper for manipulation of quantities in RS.

We are greatly indebted to Mr. Navarro for showing us the direction of his pursuit and providing the motivation to explore this area. The development continues.

***
Derivation of the Hydrogen Spectra Equations
Tom Kirk

The energies of photons are absorbed and emitted by the hydrogen atom at frequencies represented by the equation:

\[ f = \frac{R \times (1/a^2 - 1/b^2)}{\text{units of energy when natural units are used. Now in that case, the energy was contained within a unit of space. So, the interregional ratio had to be used to bring the energy value to the level experienced outside the unit of space where it is measured:}}

\[ E = \hbar \times \text{frequency} \]

where \( h \) is the interregional ratio.

In the motion of hydrogen in a gas, there are generally a few thousand molecules per unit of three dimensional space. This can be seen from a calculation:

Minimum Pressure \( P \):
- one tenth of an atmosphere = 1.45 psia

High Temperature \( T \):
- 1000 deg. F = 810 degrees kelvin

Gas Constant \( R \):
- with volume in cc's = 1206

Moles
- \( n \):
  - one mole

\[ V = \frac{nRT}{P} = 1 \times 1206 \times 810 / 1.45 = 6.74 \times 10^5 \text{ cc} \]

Atoms/cc = (Avagadro's) \( 6.02 \times 10^{23} / 6.74 \times 10^5 = 8.93 \times 10^{18} \)

Units of space/cc = \( 1 / (0.4459 \times 10^{-5})^3 = 1.13 \times 10^{16} \)

Atoms/Unit of Space
\[ = 8.93 \times 10^{18}/1.13 \times 10^{16} = 790 \]

Even in this highly rarified atmosphere, there are still nearly 800 atoms in a three dimensional unit of space. With this number of molecules moving in random directions within unit space, the net motion of the space location, i.e. the unit of space, will be zero. The motions of the gas molecules in each unit of time begin within unit space and remain within unit space, because their location does not move in space; all of their kinetic motion is in time.

As such their energies will be subject to the interregional ratio, which is equivalent to Planck's constant as established in numerous papers by a number of authors. Equation (3) becomes:

\[ E = \hbar M/2 \times (1/a^2 - 1/b^2) \text{ or,} \]

\[ E/\hbar = M/2 \times (1/a^2 - 1/b^2) \]
The energy of a photon equals frequency times Planck’s constant, so

\[ E/h = \text{frequency} = M/2 \times (1/a^2 - 1/b^2) \]  \hspace{1cm} (6)

The mass of the hydrogen atom is one natural unit of mass so:

\[ f = 1/2(1/a^2 - 1/b^2) \]  \hspace{1cm} (7)

There is clearly no correlation of physical units between the two sides of the equation since frequency and energy are not the same entity. There is just a simple correspondence of quantity between the two entities. The equation now has frequency as the resultant.

Now if frequency were simply substituted for energy in the original equation (5), the equation on a physical basis would yield frequency equal to \( t/s \) units. These \( t/s \) units are units of energy as would be expected, since the base equation (1) was an energy relation. Actually as discussed in my photon papers, frequency does not equal energy, that is they are not the same thing.

There is a simple correspondence of quantity between the energy of the photon and its frequency. This happens to be a unit-by-unit correspondence in the natural reference system. The direct linkage of units is inverted, \( s/t \) instead of \( t/s \), and the spatial aspect is lost when making motion in time and motion in space. When frequency was substituted in equation (6), it was based on this correspondence of quantity of natural units between these two quantities, not by any means that frequency and energy are the same.

There are a number of ways to handle the units in the equation:

1. All of the necessary units can be installed in the Rydberg constant, which would then have units of \( t/s^2 \) where the units of values in parentheses remain speeds squared.

2. All values in the equation can be left dimensionless as is common practice with the Rydberg constant having units of \( 1/t \)

The Rydberg constant has been assumed by many to be unit frequency, but in fact it is \( 1/2 \) unit frequency. This agrees completely with the development of the photon as a displacement in a second scalar dimension (see “Photon: Displacement in a Second Scalar Dimension, Reciprocity Summer, 1990”). This development established each unit of frequency as the inverse of the unit period which is in turn equal to the natural unit of time and the reciprocal of unit space.

Larson maintained that the Rydberg constant was the unit frequency and that to obtain the natural unit of time, it had to be multiplied by two after inverting it. He stated that this was because two units of frequency were included in a unit of time, the second unit of frequency being the reversal of direction of a sinusoidal cycle. This it turns out is an unnecessary contrivance; and frequency must include a complete cycle. The photon is not sinusoidal; each of its fundamental units are encompassed in one unit of time. These fundamental units are the units of period, units of frequency, and units of wavelength and they all transpire within one unit of time. The Rydberg constant is just not equal to unit frequency, it is equal to one half the unit frequency.

Larson’s assumption that the Rydberg constant was unit frequency was made based solely on the hydrogen spectra formula discussed herein. The assumption is otherwise entirely arbitrary. But as has been shown by the derivation here, coupled with the derivation of the non-sinusoidal photon, this was an erroneous assumption. Therefore, the derivation of the hydrogen spectra formula becomes:

\[ f = R(1/a^2 - 1/b^2) \]  \hspace{1cm} (8)

where \( R = 1/2 \) unit frequency, or the inverse of twice the unit period, unit period being equal to the natural unit of time.

It is important to consider the importance of this development, in that without establishing the value of unit time in seconds, no other physical values can be converted anywhere in the universe to natural values. The comprehensive derivation of the hydrogen spectra equation within RS allows such a determination. However, such a derivation rests on one key principle; the principle that the numerator of equation (7) outside parenthesis represents the incremental natural unit of frequency.

Mathematically it is simple to move all units to the numerator of the equation outside parenthesis, and as we know, the units are frequency. Essentially the units can take the place of the “one” in the equation, a single unit. The other variables may vary as the difference of squares yet the unit of the resultant
maintains its position in the numerator of the equation.

The nature of the "2" in the denominator began as simply a constant. It never had any units at any point in the derivation and would not so in the final equation. It is independent of the units 1/t. The one in the numerator therefore represents the value 1/t, or the inverse of unit time. The value R does in fact represent 1/2t or one half unit frequency.

Another unresolved matter remains to be discussed, the fact that the hydrogen atom always exists as a hydrogen molecule in the situation under discussion. This is a mass 2 particle whereas in equation (7) mass of one unit was used.

The hydrogen atom is a completely unique particle. It is the only atom whose mass is not equal to double its atomic number (isotopic masses will be ignored in this discussion). The reasons for this cannot be fully explained in this paper, though they can be derived through a detailed analysis of subatomic structure within the RS.

Actually, the reason for the 2 unit mass increment between masses of different atoms is at the root of the question. Mass displacements are similar to photon displacements in that they are inward unit displacements. As such their value is a 3 dimensional inverse speed of 1/2 or one unit displacement from the 1/1 progression. The natural progression is a 3 dimensional motion and a one unit displacement in 3 dimensions is possible, though more complex than the one unit dimensional displacement of 1/2 for the photon.

For our purposes, mass acts in space, i.e. the displacement is inward in space relative to our spatial reference system. As discussed in my papers on the photon, such an inward displacement viewed from a spatial perspective acts only in alternating time units. The natural progression of the location (unit of space) occupied by the atom acts in the alternating non-effective unit of time, just as for the alternation seen in the photon.

Atoms other than hydrogen are matching equal pairs, i.e. double rotating systems of mass units acting alternately in alternate units of time, creating uniform inertial and gravitational motion, in all units of time. If they were not so balanced, their two mass components would separate and propagate away from each other. The molecule of H₂ acts in the same way, creating a pair of balanced inward motions at a single space-time location. Each atom acts as the matching pair of the other, though the H₁ atom does not actually have a matched double rotating system within itself.

It must be recognized that all the motion under consideration here is within a unit of space as discussed earlier. The space location in the natural reference system is the same therefore whatever the motion being discussed, all motion being within unit space or in time. Therefore the term space-time location will be used to specify the point under consideration in the natural reference system. The hypothetical speed of location in a 3-D space reference system with units less than unit space is purely an abstraction and actually will always remain imperceivable.

The difference of H₁ atoms from atoms with masses equal to double their atomic numbers is that each hydrogen atom is a double rotating system, but the second system of each H atom, in the alternating unit of time, is equivalent to a unit of space and has no mass. This component can occupy the same space-time location as the other hydrogen atom when it is effective much as an electron or neutrino can. Therefore, the mass of the hydrogen atom only exists in alternating units of time, because it only has one unit of mass. A minimum of two units of mass are required to maintain a continuous inward motion at a single location in all units of time. This is the reason hydrogen atoms are not found outside of molecules, unless they are charged. Single hydrogen atoms do actually translate outward at unit speed during units of time when mass is non-effective. Therefore they are extremely rare as they would move outward similar to a photon at one half unit speed if one was to occur. A unit charge is a displacement in the same scalar dimension as the unit mass and thereby distributes the mass displacement to both units of time. Obviously, this charge concept is far beyond our discussion here and must be left aside for now.

In the H₂ molecule, the atoms have their units of mass effective in alternating units of time, making the inward motion at that location in space-time effective in all units of time. The location of the molecule therefore does not propagate with the natural progression and remains in its space unit in the fixed reference system, except for any independent motion (in time) due to its kinetic energy.
Now since only one atom actually exists from a spatial (our spatial reference) perspective at any one time, the energy (spatial reference) of the photon absorbed by the hydrogen atom is effective only on that one atom. The other atom does not in fact attain the translational speed of the first. It simply maintains the space-time linkage to the non-mass rotating system of the translating atom. Though both atoms would likely have translational speed, the one which accepted the photon energy will be termed the “translating atom” to simplify discussion.

The non-mass rotation, the second rotating system of the translating atom, has no mass, and therefore no kinetic energy. Yet it is in the same space-time location as the “non-translating” atom. These two compound motions are integrated, because alone they are each an integration of the space and time which is their location. Being an integration of the same space and time units, they are integrated with each other. Of course, having no mass the alternate component has no independent momentum and its location progresses easily with the non-translating H1 atom.

When the other atom again becomes effective, the location of the molecule is translated with the kinetic energy transferred by the photon. Only the one unit mass is translated, the other being ineffective. Yet the location of the entire molecule is translated just as in the alternate unit of time when the roles of the atoms were reversed. When the second atom again becomes effective, it simply moves with its independent momentum without any further translation in that unit of time from the photon’s energy.

There is one last concern about photon frequencies which has been recognized as a problem by many but apparently never seriously addressed except by Larson perhaps in his private work. When asked about the problem by Chris Halverson at the 1989 conference, Larson stated that the frequencies of light which do not match a 1/n value (n=integer) are superpositions of more than one photon. This problem is not unique to the hydrogen spectra, but is certainly shared by it and in some ways highlighted by the equation.

A value \((1-a^2 - b^2)/2\) when a and b are integers certainly does not always yield values of 1/n where n is an integer. The solution here is as Larson suspected. There is a superposition of photons. This is essentially impossible to explain based on a simple harmonic vectorially vibrating photon, so the problem was never broached by Larson in any of his published works. However, when approached from the vantage of a photon which is a simple inverse speed in a second scalar dimension, the solution yields itself to analysis.

As demonstrated in the discussion of polarized light in my papers on the photon, the motion which is the photon itself has a potential direction within unit space, though that direction is not manifested in 3-D space. This potential direction will coincide precisely with the direction of the potential direction of the photon in a vectorial space property whether it is manifested in 3-D space or not. If two such vectorial speeds are located at the same space-time location and are precisely “colinear” (colinear means aligned with the same potential direction) then they will remain essentially superimposed. If not colinear, they will inevitably separate due to their disparate motions in the second scalar dimension.

When hydrogen emits or absorbs a photon, its frequency matches the formula \(1/2a^2 - 1/2b^2\), or \(1/n - 1/m\) where a and b and n and m are integers, and n and m equal 2a^2 and 2b^2 respectively. These two photons with speeds \(1/n\) and \(1/m\) are precisely colinear, because they were formed at the same space-time location and by the same translational motion event. Actually, perhaps all photons in our environment are formed in this manner and this explains two things:

1. The vast majority of photons are of this type when their frequencies are measured.

2. As a result of the finding in 1., there are a multitude of these compound photons available for the absorption that evidently occurs in hydrogen.

Now the mechanics of this type of photon can be further explored. The inverse speed which is the photon itself, \(1/n\) will be added to the other photon inverse speed, \(1/m\). These two photons do not combine as one photon; it is still superposition we are dealing with. Therefore the sum of the speeds is normal algebraic. Reciprocal algebraic sums (see Derivation of RS Math article in this issue) are perfectly valid when inverse speeds are added to form a single scalar motion, but not in other cases generally for additions of net speeds or other vectorial quantities.

The sum of these inverse speeds is therefore \((1/n - 1/m)\). Likewise the space progression
distortion is n-1 for one photon and m-1 for the other. Once again each makes its own independent vectorial contribution. The sum of the space progression distortion is again normal algebraic or n-1 - (m-1) or n-m. This value is the wavelength of the superimposed compound photon based on principles established in my previous papers on the photon. The time for this wavelength to pass a point in space at unit speed is n-m units of time. The frequency is then 1/n-m, or 1/2(1/a^2 - 1/b^2), agreeing with the Rydberg equation.

The hydrogen spectra equation sheds considerable light on photon properties, translational motion concepts and subatomic/atomic motion combinations. Many of the principles revealed by the formula discussed in this paper will be very useful for study in these other areas. For example, when we focus our analysis on the link between the two rotating systems in alternating time units in atoms of atomic mass greater than one, it seems very likely that this is simply the inverse of the linkage between the non-mass component of one H atom and the mass component of its molecular partner. The linkage is across time rather than space as for the linkage in the H₂ molecule discussed above.

The development of rotational motion in the time region, which constitutes atomic structure, is very complex. More so than Larson seemed to allude to, though he did state that much work remained to be done in this area. Launching from solid foundations, such as the correct photon model and the development herein, is essential for exploring these uncharted regions. If these regions were easily penetrated, Dewey Larson surely would have presented his impenetrable barriers extending from not so well founded previous developments. Four inaccurate assumptions come to mind:

1. The sinusoidal photon was a pure and wholly unfounded assumption and it clearly contradicted many of his later findings.

2. That the nature of the three scalar dimensions was a direct reflection of the three dimensions of space, though he consistently alluded to the contrary by maintaining that the three dimensions of space could only represent one scalar dimension and that the three scalar dimensions were three independent magnitudes irrespective of this fact.

3. That the Rydberg constant was unit frequency, though that was purely an intuitive assumption.

4. That space and time are symmetrical entities, each having the same properties as the other but in a reciprocal way. The primary synonym of reciprocal is inverse. This would seem closer to opposite than symmetrical. Would not space be non-progressive and time be non-dimensional? I dare say the verdict is still out on this, yet it is a key assumption Larson used to extrapolate forward from the fundamental postulates.

Larson's overall development closely parallels reality in the vast majority of instances, but there is certainly plenty of room to roam within his basic framework. That framework establishes multitudes of indispensable footholds within the daunting frontiers of physical science. Using a few somewhat different deductions and with the aid of some logical extensions backed up by corresponding physical phenomena, a summary of new findings established by this present work follows:

1. The motions of atoms in a gas are entirely within the time region, inside unit space, and their translation energies are subject to the interregional ratio.

2. A valid derivation of the value of unit time has been set forth which creates the imperative link between natural units and other systems of units.

3. The hydrogen atom (uncharged) unit mass is effective only in alternating units of time.

4. The nature of the mass displacement is revealed as an inward 3-dimensional displacement, and in its most basic properties as a displacement in a scalar dimension, it is in many ways equivalent to the one dimensional displacement of the photon.

5. The explanation of photon frequencies not conforming to the 1/n type is revealed, and many of the physical properties of superimposed photons are extended.

With this valuable new ammunition, we will find our assault on the frontiers of physical science to be much easier and more productive.
16th Annual Convention of the
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August 8, Thursday: Arrival and pickup at the Philadelphia International Airport or the Railroad Terminal; sightseeing and dining in the afternoon and evening (optional).

August 9, Friday: Presentation of Papers, morning; break for lunch; presentation of papers, afternoon. Special dinner celebration, evening.

August 10, Saturday: Business session, morning; break for lunch; business session, afternoon; party at Ron Satz’s home, evening.

August 11, Sunday: Farewell breakfast; departure.

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