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Absolute Velocities:

The Detailed Predictions of the Emission Theory of Light

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***Abstract*:**

In the present exposition, the predictions of the emission theory of light, concerning absolute velocities of isolated physical systems relative to immobile three-dimensional space, have been computed and discussed in detail. In addition, the related aspects of this theory have been reviewed and investigated at length. The aim is to explore and to determine precisely those theoretical predictions, in order to facilitate the tasks of possible experimental testing, in the future, and to dispel long-standing errors and numerous misconceptions surrounding this important subject.

Keywords:

Doppler effect; light aberration; relative velocity; absolute velocity; parallax; absolute space; superluminal speeds; emission theory; reflection; variable speed of light; Galilean transformation.

Introduction:

The term of *'absolute velocity'* can be defined as the common uniform linear velocity of the various components of a physical system, relative to absolute space.

Absolute space, in turn, can be defined as the immobile three-dimensional physical void that exists independent of material bodies.

Despite frequent claims to the contrary, the notion of absolute space is one of the simplest, most intuitive and self-evident concepts ever encountered in natural philosophy, in general, and science, in particular. Homo sapiens aside, rational beings who lack a clear perception of absolute space are highly unlikely to exist anywhere in the entire infinite universe. In fact, if all the obscurities of matter vanished, and the notions of matter were as crystal clear and clear cut as the concept of absolute space, there would have been no need, in that case, for this special kind of science called '*physics*' at all.

Since the days of Sir Isaac Newton, it has been recognized that measuring rotational and non-uniform velocities of isolated physical systems, on the basis of Newtonian dynamics and Galilean kinematics, presents no great difficulties.

By contrast, the determination of uniform linear velocities, with respect to absolute space, is, from a practical standpoint, fraught with all sorts of obstacles. But the main stumbling blocks are, undoubtedly, the immense blind spots induced by theoretical prejudices and historical controversies.

Right from the start, the supporters of the Copernican theory had set out to demolish the ancient and medieval Ptolemaic astronomy. However, they encountered a startling but fundamentally erroneous objection, namely, "*a moving Earth would fling non-attached bodies to its surface away into space*".

And, naturally, of course — as might be expected — Signor Galilei was compelled to respond to the above major objection of contemporary Ptolemaists by over-hyping, all the time, constantly promoting, and expounding, in great detail, the kinematics of relative velocities; without paying due attention to the kinematics of any other type of velocities.

But as is often the case with great teachings and truths, however, all motions have been arbitrarily assumed to be relative only to material frames of reference. And subsequently unmitigated dogmatism prevails in the end. And to the point that many of Galileo's successors have, actually, gone too far in this direction and postulated, out of hand, the absolute impossibility of finding out uniform linear motions relative to absolute space under any conceivable circumstances. That is in spite of the fact that such determination, is not only possible; but it's, also, an immediate and straightforward consequence of none other than the Galilean and Newtonian relativity itself.

The widely publicized failure of the classical wave theory's predictions, regarding velocities relative to the aether, has made the above dogmatism even stronger; and so much so, that the supposed impossibility of measuring absolute velocities has become a fundamental principle of physics; i.e., the so-called '*relativity principle*'. And eventually, A. Einstein has chosen this principle to be one of the two main postulates of his Special theory. But, ironically, even here, absolute velocities, '*beautifully* *unexpected*', show up as a consequence of this supposedly *'relativity-principle-based'* theory.

Nonetheless, it should be pointed out, within the present context, that there are more daunting aspects of the aforementioned problem than mere collective biases, theoretical distortions, and cognitive blind spots. Here, we shall discuss, primarily, only those aspects related to the emission theory of light.

First and foremost, wrestling with the kinematic principle of relativity can be an unpleasant experience; and it shouldn't be recommended for the theoretically fainthearted! Like a whirlpool, it would draw you deeper and deeper into an incredible abstract world where infinities upon infinities are everywhere; and where many brilliant breakthroughs can be made and destroyed in matter of minutes.

The relativity principle, in this respect, is quite unique among other principles of physics. Try, for instance, to disprove Newton's first law; and you won't go far in that direction, before your attempt at disproof is crushed under a heavy load of internal contradictions. That is not the case with the much weaker relativity principle, where a successful disproof always appears to be just over the horizon.

More importantly, the theory under discussion, does not invalidate the relativity principle. It, merely, restricts the scope of its application.

As will be shown in this investigation, the common linear velocity of an isolated physical system with respect to absolute space, can be determined, within the framework of the current theory, if and only if two or more of its parts are in relative motion with respect to each other. And accordingly, the principle of relativity has to be recast and restated, on the basis of the emission theory, as follows:

A. It is neither theoretically nor practically possible, by employing the present methodology, within the framework of the emission theory, to determine the common uniform linear velocity, relative to empty space, for isolated physical systems whose components are at rest with respect to each other.

B. It is neither theoretically nor practically possible, within the framework of the emission theory, to determine the common uniform linear velocity, relative to empty space, for isolated physical systems whose components have only relative-velocity vectors along the common-velocity vector of those moving systems, through the use of the optical methods, as employed in the current investigation.

In addition, the predicted magnitudes of observable effects of comparatively slower absolute velocities, based upon this theory, can be, extremely small. For example, the observable variations, as predicted by the most generalized form of the emission theory of light, concerning two bodies with absolute velocity of $300\ kms^{-1}$ and local relative velocity of $30\ kms^{-1}$, can be no greater than $30\ ms^{-1}$. The predicted numerical magnitudes of observable effects can be, of course, more significant and much easier to measure, if the given absolute velocities are equal to or greater than $1{,}000\ kms^{-1}$.

Nevertheless, in principle, velocity measurements relative to immobile absolute space, can always be carried out, within the framework of the emission theory of light, and within the framework of every other physical theory in this field, as well; for the following reasons:

- Mathematically, all of the velocity vectors of a moving physical object, relative to free space, and regardless of how many those velocity vectors actually are, can have, at all times, no more than one instantaneous velocity resultant, in one direction, at a time.

- Physically, the images of nearby as well as faraway light sources, between the time of emission and the time of reception, are always at absolute rest with respect to immobile empty space.

- And furthermore, effects, introduced by the immobility of the image of the light source, before the time of reception, persist and remain unchanged and the same, after the time of reception and the resumption of mobility by the image of the light source relative to absolute space.

But first of all, since the emission theory whose predictions, in this field, are the main subject, in the current discussion, is itself, to some extent an obscure and less known theory; it's necessary, in this context, to begin the present exposition with a brief discussion of the relevant aspects of this theory.

1. General Remarks:

The synonymous terms "*emission theory*", "*ballistic theory*", and "*corpuscular theory*" of light have been used in the published literature to refer to a collection of closely related theories that have been based firmly right from the start upon the basic principles of Galilean and Newtonian kinematics.

To avoid vagueness and redundancy, the term of '*emission theory*' will be used consistently throughout this discussion to denote the most generalized version of those closely interrelated physical theories.

The published works on the emission theory are substantial; and they go as far back as Newton's *Opticks* in the 17th century. Consequently, no attempt at the survey of such extensive literature is made in the current investigation. And only references, to it, will be specified here when appropriate.

Although the emission theory of light has its roots in studies of optical and electromagnetic phenomena, its most revolutionary consequences are way more startling and conspicuous in the field of astronomy. As a matter of fact, this particular physical theory, literally, turns the entire science of astronomy — from antiquity to modern times — completely on its head. And so much so that not even one single explanation or interpretation of any physical phenomenon in modern astronomy will withstand or remain unchanged, if the speed of light is taken for granted to be additive and variable in the Galilean sense, in accordance with the generalized version of the emission theory of light.

In short, if ever there is going to be a second Copernican revolution in astronomy, it would most likely be based upon the emission theory of light or some other physical theory very close to it. And that is, clearly, because right from the beginning, astronomy has been built entirely upon the assumption that speed of light is independent of the speed of the light source. To catch glimpse of this, just place the old assumption of '*Earth at rest*' beside or next to the currently held assumption of '*constant light speed*'; and it should be obvious, at once, what the overthrow of the latter assumption would entail and actually mean for the past, the present, and the future of the science of astronomy, as a whole.

At first glance, the science of astronomy — in its current stage of development — appears, very much, to have become increasingly cluttered with many useless kludges and artificial hypotheses similar to the old kludges and ad hoc hypotheses of the Ptolemaic astronomy, which, by the way, as judged by the standards of ancient and medieval times, and in the eyes of ancient and medieval astronomers, themselves, was, without a shadow of a doubt, the ultimate paragon of science and the cream of the crop of rational thinking, itself. The only apparent difference, in this regard, is that while ancient and medieval astronomers put theirs in one basket together; modern astronomers, by contrast, have wisely dumped most of their illusory findings, faulty interpretations, and ad hoc hypotheses into a new second basket called '*cosmology*'.

And all in all, a second astronomical and cosmological revolution of the Copernican type might not be out of the question; even if there is still enough inertia, left in modern astronomy and modern cosmology, to keep both of them on the current status-quo trajectory for the next 1,500 years, or so, as it had actually happened in the the ancient and the medieval case.

In any case, the following general remarks can be made, in advance, on the various steps of the main procedures employed, in the current investigation, for sorting out the relevant phenomena and calculating the magnitudes and the directions of uniform and linear velocities relative to absolute space:

1. If the speed of light is finite, then it must be deemed as self-evident, that, during the travel time of light emitted by the source to reach the observer, the image of the light source has to be completely frozen and at absolute rest with respect to immobile space.

2. If the image of the light source, during the travel time of light from its emitting source to the receiving observer, is absolutely at rest relative to the immobile three-dimensional space, then the observer, in an isolated system moving with a uniform velocity, must make a finite displacement, during the same interval of time, with respect to the immobile image of the light source, even though the true position of that observer remains unchanged and exactly the same with respect to the instantaneous position of the actual light source.

3. The magnitude of the displacement made by the moving observer, during the travel time of the emitted light, is proportional to and dependent upon the magnitude of the common velocity of the observer and the light source relative to absolute space.

4. The displacement made by the receiving observer, during the light travel time, rotates the image of the light source, in the opposite direction of the common motion, by an amount that depends on the position of the light source with respect to the same observer, at the time of emission, and on the magnitude and the direction of the common absolute velocity of the light source and the observer relative to absolute space.

5. If the light source and the observer are at rest relative to each other and moving only with their common uniform velocity relative to absolute space, then the rotation of the image of the light source, due to the displacement of the observer during the light travel time, can have no local relative velocity vectors to rotate; and hence it can produce no observable kinematic effects.

6. However, if the light source or the observer or both are in motion relative to each other, then the displacement of the observer, due to the common absolute velocity, must rotate the local relative velocity vectors by a certain amount in the opposite direction; and subsequently, it can, in principle, produce measurable optical and kinematic effects.

7. The rotation of the image of an emitting light source, due to the displacement of an observer moving with the shared absolute velocity, is a true rotation that can reveal new aspects of the light source and produce real effects, because the displacement, made by the moving observer in this case, is a true parallax in every respect.

8. If an emitting light source and a receiving observer are moving with a common uniform linear velocity relative to absolute space, then the resultant of the instantaneous absolute velocity of the observer, during the time of reception, and the velocity of the received light must have a direction that points to the exact position of the actual light source and rotates the image of the light source in the forward direction from its shifted position at the time of emission, by the parallax, to the exact instantaneous position of the actual light source at the time of reception.

9. The direction of the resultant of the instantaneous absolute velocity of the observer, during the time of reception, and the velocity of the received light, represents the precise definition of light aberration, within the framework of the emission theory.

10. Since light aberration is, by definition, the direction of the vector sum of the velocity of the received light and the instantaneous velocity of the receiving observer, at the time of reception, the rotation of the image of the light source, due to light aberration, is only an apparent rotation that neither reveals new aspects of the image of the light source nor rotates the vectors of the local relative velocities between the emitting light source and the receiving observer.

11. Because the effect of parallax, due to the displacement of the observer, and the effect of light aberration, due to the resultant of the relative velocity between the incident light and the observer, are always equal in magnitude and opposite in direction, the mathematical formula for calculating the angle of light aberration can be used to obtain the angle of parallax, due to the absolute velocity of the observer.

12. And finally, since the main effect of parallax, in the case under discussion, is to rotate the local relative velocity vectors by a certain amount, the angle of parallax, as calculated by using the formula of light aberration, can be used to compute Doppler shifts caused by the rotation of local relative vectors due to the effect of parallax. And therefore, it's practically possible to determine the magnitude and the direction of the absolute velocity of an isolated physical system, with respect to immobile space, by measuring the Doppler shifts of local relative velocities and comparing the obtained results to the results expected theoretically, for the same isolated system, on the assumption of being at complete rest relative to absolute space.

2. Change of Velocities upon Reflection:

The Stewart-Thomson Law:

In the reference frame of the laboratory, light is always reflected from a moving reflecting surface with the resultant velocity of its relative velocity with respect to the reflecting surface and the velocity of the reflecting surface relative to the laboratory, [*Ref. #1*].

This physical law is a generalization of Snell's law of reflection. And it plays an important role in the treatment of optical phenomena on the basis of the physical emission theory of light. In its precise mathematical form, the Stewart-Thomson law can be derived and formulated mathematically by treating reflection of light as a special case of elastic collision and applying the conservation laws of linear momentum and kinetic energy, for moving bodies, to the incident light and the reflecting surface.

But, the quantitative treatment of this subject can be significantly simplified by assuming that the ratio between the mass of the incident light and the mass of the reflecting surface is infinitesimally small and practically equal to zero. And therefore, the recoil caused by the incident light on the reflecting surface can be neglected without affecting the exactness and precision of the quantitative treatment.

Consider the simple case of a plane mirror approaching or receding from a stationary light source along the normal to its reflecting surface with a uniform linear velocity, v. If the angle of incidence with the normal, i, is measured counterclockwise with respect to the velocity vector of the mirror, then the magnitude of the velocity of the incident light relative to the moving mirror, c', can be computed by applying the law of cosines:

$$c' = \sqrt{c^2 + v^2 + 2vc\cos i} \qquad 2.1$$

where c is the intrinsic speed of light in a vacuum.

The direction of this relative velocity, i', can be obtained by applying the law of sines to the above arrangement:

$$\sin i' = \frac{c}{c'} \sin i \qquad 2.2$$

where the angle i' is the true angle of incidence as measured in the reference frame of the moving mirror.

From the law of reflection, the angle of reflection for reflected light, in the reference frame of the moving mirror, must be equal to the direction of the relative velocity of the incident light, i'; and hence, by using this trigonometric relation:

$$\sin^2 i' + \cos^2 i' = 1$$

we obtain:

$$\cos i' = \sqrt{1 - \sin^2 i'} = \sqrt{1 - \frac{c^2}{c'^2}\sin^2 i} = \frac{c\cos i + v}{c'} \qquad 2.3$$

And therefore, by applying the law of cosines once again to compute the speed of the reflected light in the reference frame of the laboratory, we obtain c'':

$$c'' = \sqrt{c'^2 + v^2 + 2vc'\cos i'} \qquad 2.4$$

By combining equations [2.1], [2.3], and [2.4], we obtain for the general case:

$$c'' = c\sqrt{1 + \frac{4v^2}{c^2} + \frac{4v}{c}\cos i} \qquad 2.5$$

The direction of the above velocity resultant, i'', can be obtained by applying the law of sines one more time:

$$\sin i'' = \frac{c'}{c''}\sin i' = \frac{c}{c''}\sin i = \frac{\sin i}{\sqrt{1 + \frac{4v^2}{c^2} + \frac{4v}{c}\cos i}} \qquad 2.6$$

where the angle i'' is the true angle of reflection as measured in the reference frame of the laboratory.

When a mirror approaches directly a light source along the normal to its reflecting surface, Equation #[2.5] is reduced to this simple algebraic equation:

$$c'' = c + 2v \qquad 2.7$$

And likewise, when a moving mirror recedes directly from the light source along the same line, we obtain the following equally simple algebraic equation:

$$c'' = c - 2v \qquad 2.8$$

If one insists on taking into account the vanishingly small recoil of an approaching or receding mirror under the effect of incident light, the following two exact equations of linear elastic collision should be used in the case of approach and in the case of recession, respectively:

$$c'' = c\left(\frac{m_m - m_c}{m_m + m_c}\right) + v\left(\frac{2m_{mc}}{m_m + m_c}\right) \qquad 2.9$$

and

$$c'' = c\left(\frac{m_m - m_c}{m_m + m_c}\right) - v\left(\frac{2m_m}{m_m + m_c}\right) \qquad 2.10$$

where m_c and m_m are the mass of the incident light and the mass of the moving mirror, respectively.

Equation #[2.5] can be generalized further, through the rotation of the normal to the surface of the plane mirror by an angle, *j*, around the velocity vector of the mirror and applying the laws of cosines and sines in each case.

One important special case is when the normal to the surface of a moving mirror makes an angle of 90^o with its velocity vector; i.e.,

$$j = 90^o$$

Consider the case of a plane mirror approaching or receding from a stationary light source along its reflecting surface, i.e., $j = 90^o$, with a uniform linear velocity v. If the angle of incidence with the normal, i, is measured counterclockwise with respect to the velocity vector of the mirror, then the angle, θ, between the velocity vector of the incident light and the velocity vector of the mirror is

$$\theta = 90^o - i$$

when

$$j = 90^o$$

and the mirror is approaching the source; and

$$\theta = 90^o + i$$

when

$$j = 90^o$$

and the mirror is receding from the source.

It follows, therefore, that, when $j = 90^o$, the velocity resultant of c & v in the case of approach is,:

$$c' = \sqrt{c^2 + v^2 + 2vc\cos\theta} = \sqrt{c^2 + v^2 + 2vc\sin i} \qquad 2.11$$

And the direction of c', in the reference frame of the approaching mirror, is θ':

$$\sin\theta' = \frac{c}{c'}\sin\theta = \frac{c}{c'}\cos i \qquad 2.12$$

And by using θ', we can compute the angle θ'' between the velocity vector of the reflected light and that of the approaching mirror:

$$\theta'' = 180^o - \theta' \qquad 2.13$$

Then we can use c' & θ'' to obtain the velocity of the reflected light c'' with respect to the reference frame of the laboratory:

$$c'' = \sqrt{c'^2 + v^2 + 2vc\cos\theta''} \qquad 2.14$$

From equations [2.12] & [2.13], we calculate $\cos\theta''$:

$$\cos\theta'' = -\cos\theta' = -\left(\frac{c\sin i + v}{c'}\right) \qquad 2.15$$

Inserting the values of c' & θ'' into Equation #[2.14], we obtain c'':

$$c'' = c \qquad 2.16$$

where c'' is the speed of the reflected light relative to the reference frame of the laboratory.

It follows, from the above equation, therefore, that a mirror moving at right angles to the normal to its surface does not change, upon reflection, the speed of incident light from a stationary source.

And now, by applying the law of sines, we obtain the direction i'' of c'' with respect to the velocity vector of the moving mirror:

$$\sin i' = \frac{c'}{c''}\sin\theta'' \qquad 2.17$$

And by using equations [2.12], [2.16], & [2.17], we obtain:

$$\sin i' = \cos i \qquad 2.18$$

And to obtain the angle of reflection i'' with respect to the normal to the mirror surface, we use the relation

$$i'' = i' - 90^o$$

and Equation #[2.18]:

$$\sin i'' = \sin\left(i' - 90^o\right) = \cos i' = \sin i \qquad 2.19$$

where i'' is the angle of reflection as measured in the reference frame of the laboratory.

And therefore, in the case of (approach & $j = 90^o$), we have ($c'' = c$ & $sini'' = sini$), which are the same values as in the case of reflection from a stationary mirror.

Finally, to calculate the resultant of c & v in the case of reflection from a mirror receding at right angles to the normal to its surface; i.e., $j = 90^o$), we use the relation

$$\theta = i + 90^o$$

to obtain:

$$c' = \sqrt{c^2 + v^2 + 2vc\cos\theta} = \sqrt{c^2 + v^2 - 2vc\cos i} \qquad 2.20$$

The direction of c', in the reference frame of the receding mirror, is θ':

$$\sin\theta' = \frac{c}{c'}\sin\theta = \frac{c}{c'}\cos i \qquad 2.21$$

and accordingly,

$$\cos\theta' = -\left(\frac{c\sin i - v}{c'}\right)$$

By the use of θ', we obtain the angle θ'' between the velocity vector of the reflected light and that of the receding mirror:

$$\theta'' = 180^o - \theta' \qquad 2.22$$

Then we use c' & θ'' to obtain the velocity of the reflected light c'' with respect to the reference frame of the laboratory:

$$c'' = \sqrt{c'^2 + v^2 + 2vc\cos\theta''} \qquad 2.23$$

From equations [2.21] & [2.22], we calculate θ'':

$$\cos\theta'' = -\cos\theta' = \frac{c\sin i - v}{c'} \qquad 2.24$$

Inserting the values of c' & θ'' into Equation #[2.23], we obtain c'':

$$c'' = c \qquad 2.25$$

And by using the law of sines, we obtain the direction i' of c'' with respect to the velocity vector of the mirror:

$$\sin i' = \frac{c'}{c''}\sin\theta'' = \frac{c'}{c''}\sin\theta' \qquad 2.26$$

By using equations [2.21], [2.25], & [2.26], we obtain:

$$\sin i' = \cos i \qquad 2.27$$

To obtain the angle of reflection i'' with respect to the normal to the mirror surface, we use the relation

$$i'' = i' - 90^o$$

and Equation #[2.27]:

$$\sin i'' = \cos i' = \sin i \qquad 2.28$$

And hence, in the case of (recession & $j = 90^o$), we have ($c'' = c$ & $\sin i'' = \sin i$), which are the same results as in the case of reflection from a stationary mirror.

It has to be concluded, therefore, that in the special case of a plane mirror approaching or receding from a stationary light source along its reflecting surface (e.g. $j = 90^o$) with a uniform linear velocity v, the speed of the reflected light is always equal to the speed of the incident light (e.g. $c'' = c$) regardless of its angle of incidence; and its direction is governed by Snell's law of reflection (e.g. $\sin i'' = \sin i$) as in the stationary case.

And so, if the velocity vector of a moving mirror is at right angles to the normal to its surface, then the angle of reflection is equal to the angle of incidence, in accordance with Snell's law; and the speed of reflected light is, always, equal to the speed of incident light.

In general, the following qualitative statements can be made about the speed of reflected light from a moving mirror:

- If the normal to the surface of a moving mirror makes an angle of 0^o with its velocity vector, then the velocity of reflected light increases to its maximum values for all angles of incidence.
- If the normal to the surface of a moving mirror makes an angle greater than 0^o and less than 90^o with its velocity vector, then the velocity of reflected light increases to its intermediate values for all angles of incidence.
- If the normal to the surface of a moving mirror makes an angle of 90^o with its velocity vector, then the velocity of reflected light has the same values as those of incident light for all angles of incidence.
- If the normal to the surface of a moving mirror makes an angle greater than 90^o and less than 180^o with its velocity vector, then the velocity of reflected light decreases to its intermediate values for all angles of incidence.
- And finally, if the normal to the surface of a moving mirror makes an angle of 180^o with its velocity vector, then the velocity of reflected light decreases to its minimum values for all angles of incidence.

It should be noted, from Equations #[2.7] & #[2.8], that the speed of reflected light, each time, is increased by twice the speed of a directly approaching mirror, along the normal to its surface, and decreased by twice the speed of a directly receding mirror, in the same direction.

The process can be repeated indefinitely. This, as a matter of fact, is one of the most remarkable predictions of the physical theory under discussion. In principle, at least, it implies no less than the complete control over the speed of light by increasing or decreasing its numerical values to any desirable level through the use of the method of multiple reflections from moving mirrors in the reference frame of the laboratory. And by virtue of the high speed of light, the desired numerical results can be achieved by the employment of this method, even in the cases of slowly moving mirrors, in a fraction of a second.

Consider, for example, a mirror moving directly with velocity of $100\ ms^{-1}$ towards a stationary mirror located 20 m away. By making multiple passes, through this optical loop, the reflected light can, in theory, reach a superluminal speed of $2c$ in less than 0.2 of a second.

In practice, however, for superluminal speeds over $2c$, the phenomenon of Doppler effect poses a serious problem. As it will be shown later in this discussion, each time the speed of the reflected light is doubled, its frequency is doubled as well due to the Doppler effect on light whose speed is boosted to higher superluminal levels by the use of the method of multiple reflections from approaching mirrors. In practical terms, this Doppler shift to higher frequencies means that every part of the visible light will be shifted to the ultraviolet region of the spectrum; by the time its superluminal speed is closer to $3c$.

And since ordinary mirrors are inefficient ultraviolet reflectors; the process of speed boosting through the use of the method of multiple reflections from those mirrors would fail for speeds greater than $2c$.

Is there any way out of this Doppler-boosting problem?

Well, believe it or not; notwithstanding the horrific miasma of "*Tunneling*", "*Exiting-before-entering*", and similar theoretical nonsense, the pioneering experimenters of the so-called '*Photonic Revolution*' have — since the beginning of the present century — amassed an impressive array of experiments, techniques, and data on the superluminal speeds of various parts of the electromagnetic radiation, through the use of anomalous dispersion in carefully-prepared materials.

Their finding, in itself, is certainly one of the most striking discoveries in experimental physics in recent years, and most likely bound to sweep away, in due time, long-held false beliefs and errors in this field. See, for instance, [*Ref. #8*].

Nonetheless, neither anomalous dispersion, nor photonic crystals, nor specially prepared refractive media, can have any potential use within the context of the Doppler-boosting problem encountered here. And that is because refractive indices, simply, cannot be used to boost the speed of light outside their artificially prepared media. Since it's to be expected all along that light whose speed has been boosted, through the employment of this particular method, upon exiting such a carefully prepared medium, very simply, restores, at once, its standard Maxwellian speed, c, in the vacuum.

It is not out of the question, however, that the observed superluminal speeds of light, in those experiments, might have been caused by multiple reflections from moving layers of atoms inside those carefully prepared materials. If this is indeed the case, then upon exiting such artificial media, the electromagnetic radiation can, in principle at least, retain its superluminal speeds in the vacuum. But then this possibility, of course, does not solve the Doppler-boosting problem.

In a nutshell, the method of multiple reflections from approaching mirrors is, by far, the only theoretically feasible technique for achieving very high superluminal speeds of light in free space. But, unfortunately, the Doppler boosting to higher frequencies and the unavoidable absorption of electromagnetic radiation, by the materials of reflecting mirrors, impose severe limitations on the practicality of this particular method.

Let's suppose, for a moment, that perfect mirrors capable of reflecting electromagnetic radiation of any frequency repeatedly and with nearly 100% efficiency are technically feasible.

Is it practicality possible that the superluminal speeds of light, produced by using such perfect mirrors, can be employed somehow in long range communications?

If such perfect mirrors are possible to be manufactured; and if the most generalized form of the emission theory of light is indeed correct and universally applicable, then the answer to the above question should be, emphatically and unequivocally, '*yes*'.

Not only that, but one also, in this case, it would be all but certain that advanced civilizations, across the universe, are talking to each other over the terrestrials' heads, all the time. But thanks to the '*non-additive-speed-of-light'* dogma of modern physics, the *'sumperluminally unaware'* terrestrials, have been, so far, virtually oblivious of such an incredibly swift and highly advanced sort of extraterrestrials' telecommunications.

Anyway, for the time being, we can only hope that, someday, *'Homo sapiens'* shall live up to their illustrious name and join those advanced cosmic civilizations, in the not too distant future. And let's just, right now, try our best to figure out, on our own, for ourselves, how exactly the superluminal signaling can be achieved in practice, in the real world:

- Given a perfect mirror, it's surely possible to start with the radio portion of the electromagnetic spectrum; and to code your message using standard methods in radio communications.

- Having coded the message, you can use the perfect mirror to boost the speed of the coded electromagnetic radiation to the desirable superluminal speed level.

- Of course, it can be done the other way around; i.e., to boost the speed of the signal first, and code the information second. But because of the Doppler effect, the former method of coding can transfer more amount of information per unit time, on the same signal, than the latter one. And so, it's economically frugal to code the information first and boost the speed of the electromagnetic signal second.

- To minimize the effect of the inverse square law on the coded signal, maser and laser techniques should be used. However, to maximize the chances of reception, the inverse square law should be allowed to work as required, during light travel time, to enlarge the cross section of the carrier superluminal beams just enough to encompass the entire targeted area by the time of their arrival at the intended targets.

- In brief, your tasks as a sender, in superluminal telecommunications, are, to code firstly, boost secondly, collimate thirdly, and send at last.

- Receivers of superluminal coded signals have, in turn, to be equipped with perfect mirrors, as well, in order to be able to tune in. Perfect mirrors, here, have to be used to convert the received superluminal radiation to its original form, which so that it can be fed to a regular radio receiver to decode the sender's message in a standard fashion.

It should be mentioned, in this context, that a team of the Italian Council of Research reported, at the start of the current century, achieving superluminal speeds in air by bouncing a microwave beam off a mirror, [*Ref. #6*]. From the viewpoint taken in this section, their experiment is very interesting, although it is not clear from their report how exactly and how efficiently their microwave mirror works.

3. The Characteristics of the Corpuscular Photon:

The concept of the corpuscular photon is an essential and integral part of the emission theory of light.

In the published literature, the corpuscular photon is defined in two different ways:

A. The corpuscular photon is defined as one single corpuscle whose mass is in direct proportion with its frequency across the electromagnetic spectrum. This concept of the corpuscular photon, as defined in the 18th century by the proponents of the corpuscular theory, is extremely rigid and inadequate in dealing with the wave aspects of light. For this reason, it is often used as a '*straw-man'* argument against the emission theory. How on Earth, its opponents ask, can it account correctly for interference and diffraction phenomena? However, this old objection sounds increasingly hollow after the discovery of similar phenomena related to electrons and other subatomic particles. Nevertheless, the inadequacy of the *'one-corpuscle'* photon is obvious. And its fundamental flaws cannot be weeded out by simply pointing out more serious flaws in the concept of the conventional wave photon.

B. The corpuscular photon can, also, be defined as a group of corpuscles whose number and spatial separation (*e.g. wavelength*) vary in direct proportion with frequency across the electromagnetic spectrum. The total number of corpuscles, in the corpuscular photon, is determined only by its frequency and the duration of its pulse during the time of its emission. Its energy and momentum, in turn, depend solely on the number and the speed of its corpuscles. For a *non-polarized* photon, the linear trajectories of its corpuscles form randomly its cross section. And hence, it should be clear that a corpuscular photon whose cross section consists of only one single geometrical point, though appealing, is a mere idealization that can hardly be realized in actual situations.

The corpuscular photon, when defined in terms of distinct groups of corpuscles on the basis of frequencies, is a versatile and powerful concept. It, practically, transforms the emission theory from an outdated and timid hypothesis to a revolutionary tool of the first order. And this is how:

I. The notion of distinct groups of corpuscles allows the theory, under discussion, to account for interference, diffraction, polarization, and related phenomena, in a natural and satisfactory manner, and to dispose of the old objections, along with their w*ave-particle* duality, at once.

II. Since subatomic particles emit photons, and since photons consist of corpuscles, it follows as a natural consequence of this theory that the subatomic particles themselves are structured aggregates of corpuscles. The idea of particles composed of aggregates of corpuscles, analogous to aggregates of stars in galaxies, has the potential of opening new avenues for probing deeper into the nature of matter, and revolutionizing the field of elementary particles.

III. The concept of corpuscular photons enables the emission theory of light to include precise formulas for the Doppler effect, the Fresnel convection, the law of aberration, and similar optical phenomena, derived on a basis more solid and intuitive than that of any other theory in this field.

IV. This concept of photons, in conjunction with the *Stewart-Thomson* law, enables the emission theory of light to explain effectively and more realistically the *Michelson-Morley* experiment and related optical experiments..

V. Redefining the photons in terms of distinct groups of corpuscles leads to the inclusion of the J. G. Fox's '*re-radiation*' hypothesis as a special case, and disposing, at the same time, of its undesirable consequences, [*Ref. #4*]. Notwithstanding its success in explaining away the current inventory of observations and experimental data, the application of the *re-radiation* hypothesis, has the misfortune of making no new predictions at all. That is because the *re-radiation* mechanism, as applied by J. G. Fox in his extended Ritz theory, leads to de facto constant speed of light, banishes superluminality, and renders the application of the Galilean transformations to electromagnetic phenomena, for the most part, sterile and useless. See [*Ref. #7.a*], and, [*Ref. #7.b*].

VI. The definition of photons, as independent groups of corpuscles, enables the emission theory to give a clear and natural explanation of the cosmological red-shift of distant galaxies and to do away with the hypothesis of '*expanding universe*' along with its unrealistic consequences. By merely taking accelerations of the emitting atoms of a light source, at the time of emission, into account, one can easily obtain the exact formula of the Hubble law as a natural consequence of this theory; [*Ref. #1*].

VII. And finally, the definition of photons, as independent groups of corpuscles, leads, necessarily, to this revolutionary and, at the same time, controversial part of the emission theory. Undoubtedly, the empirical classification of stars on the basis of their luminosity, size, and spectral type, constitutes the concrete part of modern astronomy. In addition, it's the foundation upon which stellar evolution; one of the most attractive theories in astrophysics has been built. The emission theory, under discussion, does not contradict outright the theory of stellar evolution. It, simply, creates, on purely kinematic grounds, an exact replica of its concrete foundations. It's easy to see that systematic and continuous variations in the velocity of a light source, lead, according to this theory, to systematic and continuous variations in the velocity of its radiation output. And these variations in the velocity of the output, inevitably, lead to changes in the spectrum and the radiant flux of the light source, which vary linearly with distance. And hence, it's possible to produce the entire characteristics included in stellar classification by simply using a '*hypothetical sun*' and varying its orbital configurations at various distances from the observer. Take, for instance, the spectacular phenomenon of supernova explosion. As spectacular as it is, the supernova phenomenon is one of the easiest phenomena to duplicate using nothing more than a '*hypothetical sun*'. Increasing its velocity by an extremely tiny but continuous amount, which the far-side half of its orbit around some distant galaxy can do, this '*hypothetical sun*' can pour its output of radiation, during one hundred million years, in just only few days, and fools naive observers that they have just witnessed a stellar explosion on a gigantic scale. In the same way, the variability of speed of light can make out of the same '*hypothetical sun'* every star of every size and spectral type in the *Hertzsprung-Russel* diagram. And it can, convincingly, mimic every star in the general catalogue of variable stars. In short, the observational basis of modern astronomy has been undercut. And serious doubts have been cast upon its dynamical reality. This, of course, does not mean that all the stars are identical to the sun, nor their classification is physically baseless. All what the above considerations imply is that if the speed of light is variable in accordance with the emission theory, then a thick cocoon of mirages and optical illusions must be removed first, before the real dynamical phenomena underneath can be unveiled. Then, and only then, a true understanding of the physical universe can follow from the observation.

4. The Doppler Effect:

As pointed out earlier, the corpuscular photon, according to the emission theory of light, is composed of a finite number of corpuscles whose primary source emits them one after the other at regular intervals of time. This definition makes the task of deriving precise formulas, on the basis of the Doppler principle, straightforward and simple. To clearly see this, just compare the following easy steps to the convoluted methods of deducing the Doppler equations on the basis of the **one-corpuscle** emission theory or on the basis of the Einstein-Lorentz theory, for exaple:

1. The Case of Direct Approach:

Consider the simple case of a light source approaching directly with velocity v_s an observer at rest in the reference frame of the laboratory. Let the wave period of the emitted corpuscles of a photon be T as measured in the inertial frame of their source, and T' as measured in the reference frame of the laboratory.

Since the wave frequency f, by definition, is the reciprocal of the wave period T, we obtain:

$$f = \frac{1}{T} \qquad 4.1$$

and

$$f' = \frac{1}{T'} \qquad 4.2$$

where f and f' are the frequencies as reckoned in the inertial reference frame of the light source and the reference frame of the laboratory, respectively.

And since the light source is approaching directly, it follows that the velocity of its light c', relative to the laboratory is equal to the following amount:

$$c' = c + v_s \qquad 4.3$$

where c is the velocity of light in the inertial reference frame of the light source.

Next, we use T, v_s, and c to compute T':

$$T' = \frac{T(c+v_s) - Tv_s}{c+v_s} = \frac{Tc}{c+v_s} \qquad 4.4$$

From Equations # [4.2] and # [4.4], we obtain the Doppler formula for this special case:

$$f' = \frac{1}{T'} = f\left(1 + v_s/c\right) \qquad 4.5$$

If an observer approaches with velocity v_o a stationary source of light, we obtain:

$$T' = \frac{Tc - T'v_o}{c} = \frac{Tc}{c+v_o} \qquad 4.6$$

and hence,

$$f' = \frac{1}{T'} = f\left(1 + v_o/c\right) \qquad 4.7$$

where f' is the frequency in the inertial reference frame of the observer.

2. The Case of Direct Recession:

Repeating the above steps, we obtain for a light source receding directly from an observer at rest:

$$f' = f\left(1 - v_s/c\right) \qquad 4.8$$

And we obtain for an observer receding directly from a source of light at rest:

$$f' = f\left(1 - v_o/c\right) \qquad 4.9$$

3. The General Case:

In order to obtain the Doppler formula in the general case, let the angle i, between the line of sight and the velocity vector of the light source v_s, be measured counterclockwise.

And let the angle j that the velocity vector of the observer v_s makes with the line of sight be measured clockwise and corrected for light aberration. Since the line of sight is the direction of the resultant velocity of light c' from a moving light source, we obtain:

$$c' = c\sqrt{1 - \left(v_s^{\,2}/c^2\right)\sin^2 i} + v_s \cos i \qquad 4.10$$

For light emitted with a wave period T and frequency f in the inertial reference frame of the light source, we compute the wave period as measured by the observer:

$$T' = \frac{Tc' - Tv_s \cos i - T'v_o \cos j}{c'} = T\left(\frac{c' - v_s \cos i}{c' + v_o \cos j}\right) \qquad 4.11$$

By taking the reciprocal of T'', we obtain the general formula for Doppler effect in the reference frame of a moving observer:

$$f' = f\left(1 + \frac{(v_s/c)\cos i + (v_o/c)\cos j}{\sqrt{1-(v_s^2/c^2)\sin^2 i}}\right) \qquad 4.12$$

Let's now compare the Doppler formulas for the first two simple cases of direct approach and direct recession, according to the emission theory of light, with the Doppler formulas for the same two cases according to Maxwell's aether theory and Einstein's Special relativity, respectively.

A. Maxwell's Aether Theory:

1. For a light source approaching directly an observer at rest, this theory gives:

$$f' = f\left(1 + \frac{v_s}{c - v_s}\right) \qquad 4.13$$

By comparing this equation with Equation #[4.5], we find that the Doppler shift of approaching light sources, i.e., $(f' - f)/f$, as computed on Maxwell's Aether theory, is always greater than that of the emission theory by a factor of $[1 - v_s/c]^{-1}$.

2. For an observer approaching directly a stationary source of light, the Maxwell's Doppler formula is:

$$f' = f\left(1 + \frac{v_o}{c}\right) \qquad 4.14$$

By comparing the above equation with Equation #[4.7] of the emission theory of light, we conclude that the Doppler effect, in this case, is the same as calculated on the basis of both theories.

3. For a source of light receding directly from an observer at rest, Maxwell's theory gives:

$$f' = f\left(1 - \frac{v_s}{c + v_s}\right) \qquad 4.15$$

By comparing the above equation with Equation #[4.8] of the emission theory of light, we find that the Doppler shift of receding light sources, as calculated on the basis of Maxwell's theory, is always less than that deduced from the emission theory by a factor of $[1 + v_s/c]^{-1}$.

4. For an observer receding directly from a stationary source of light, Maxwell's Doppler formula is:

$$f' = f\left(1 - \frac{v_o}{c}\right) \qquad 4.16$$

By comparing the above equation with Equation #[4.9] of the emission theory of light, we conclude that the Doppler effect, in this case, is the same as calculated on the basis of both theories.

B. Einstein's Special Theory:

This theory has two different sets of equations for computing Doppler effect:

1. According to Einstein:

Special relativity, as expounded in Einstein's 1905 paper, takes the Maxwellian Doppler formulas for the moving observer, and divides them by the factor $\{1 - v^2/c^2\}^{1/2}$, where v stands for v_s, v_o, or both. And then, it uses these new formulas in all the four simple cases above:

For directly approaching light sources:

$$f' = f\sqrt{\frac{c + v_s}{c - v_s}} \qquad 4.17$$

For directly approaching observers:

$$f' = f\sqrt{\frac{c + v_o}{c - v_o}} \qquad 4.18$$

For directly receding light sources:

$$f' = f\sqrt{\frac{c-v_s}{c+v_s}} \qquad 4.19$$

For directly receding observers:

$$f' = f\sqrt{\frac{c-v_o}{c+v_o}} \qquad 4.20$$

And for the general case:

$$f' = f\,\frac{1-\frac{v}{c}\cos\phi}{\sqrt{1-v^2/c^2}} \qquad 4.21$$

where v stands for v_s, v_o, or both, and ϕ stands for i, j, or both, [*Ref. #3*].

2. According to Ives & Stilwell:

These Ives-Stilwell equations for Doppler effect were originally derived on the basis of the Larmor-Lorentz theory.

Special relativity, according to Ives & Stilwell, takes the Maxwellian Doppler formulas for the moving light source, and multiplies them by the factor $\{1 - v^2/c^2\}^{1/2}$, where v stands for v_s, v_o, or both. And then, it uses these new formulas in all the simple cases above and gives in the general case:

$$f' = f\,\frac{\sqrt{1-v^2/c^2}}{1-\frac{v}{c}\cos\phi} \qquad 4.22$$

where ϕ stands for i, j, or both [*Ref. #5*].

The Einstein and the Ives-Stilwell general formulas give the same numerical results at $\phi = 0^o$ and $\phi = 180^o$; but they produce different numerical results, at all other angles; and make contradictory predictions at $\phi = 90^o$ with regard to the transverse Doppler effect.

Now, by comparing the above equations with those of the emission theory of light, we obtain:

$$\frac{f'_E}{f'_R} = \sqrt{1 - v_s^{\,2}/c^2} \qquad 4.23$$

where f'_E & f'_R are the observed frequencies as predicted by the emission theory and Einstein's relativity, respectively.

Therefore, we conclude that in all cases of approach, Einstein's theory predicts Doppler shift, i.e., $(f'-f)/f$ greater than the one predicted by the emission theory. And in all cases of recession, it predicts Doppler shift less than that predicted by the emission theory. Thus, from the perspective of the emission theory, Einstein's Special relativity makes the correct Maxwell's Doppler formulas of the moving observer erroneous by a factor of $\{1 - v^2/c^2\}^{-1/2}$; but, at the same time, it restores the symmetry and reduces the error in the case of the moving light source by using the same formulas for both the light source and the observer.

5. The Law of Aberration:

Within the framework of the emission theory, light aberration is defined as the angle between the true position of the source, at the time of emission, and the direction of the relative-velocity resultant of the velocity of the incident light, from that source, and the velocity of the observer, at the time of reception. In other words, the angle of light aberration represents always, according to the emission theory, the difference between the direction of the velocity of the incident light, j', and the direction of the velocity resultant of the combined velocity of the incident light and the velocity of the observer, j.

Accordingly, if the direction of the resultant relative velocity of the incident light and the observer is j, and the true position of the source, at the time of emission, is j', then the light aberration b is the difference between j' and j:

$$b = \Delta j = j' - j \qquad 5.1$$

Notice that the angle j' can be computed, but can never be observed in the inertial reference frame of a moving observer.

Two forms of the law of light aberration will be discussed here:

1. The Standard Form of the Law of Light Aberration:

Let's consider, first, the simple case of a stationary source of light and an observer moving with a uniform linear velocity v_o. By applying the law of sines to this case, we obtain the well-known form of Bradley's law of light aberration:

$$\sin \Delta j = \frac{v_o}{c} \sin j \qquad 5.2$$

where c is the speed of light with respect to the reference frame, in which its source is at rest.

For small values of Δj:

$$\Delta j \approx \frac{v_o}{c} \sin j \qquad 5.3$$

Within the context of wave theories of light, the phenomenon of light aberration is decidedly asymmetrical. That is because the shift, in the true position of the light source, caused by the motion of the observer, and the shift, in the same position, caused by the motion of the light source, are not equal. And as a result, the symmetry of relative motions is shattered. See [*Ref. #2*].

By comparison, on the basis of ballistic theories of light, the shift caused by the light aberration is exactly equal to the shift caused by the light travel time introduced by a light source moving with the same speed as that of the observer but in the opposite direction. Consequently, the symmetry of relative velocities is retained. This conclusion can be illustrated by comparing, for example, Maxwell's theory with the emission theory, in this regard.

Take, for instance, the case of $j = 90^o$.

Let v be the velocity of the observer, with respect to a source of light at rest.

Using Equation #[5.2], we obtain the shift of light aberration Δj_o, on both theories:

$$\sin \Delta j_o = \frac{v}{c} \qquad 5.4$$

Now let v be the velocity of the source with respect to an observer at rest.

Light, emitted by the light source at the time of emission, takes an interval of time t to reach the stationary observer at the time of reception. By then, the light source has moved, at right angles to the line of sight, a distance vt. From the right triangle of ct and vt, we obtain, on the basis of Maxwell's theory, the light-travel-time shift Δj_s:

$$\tan \Delta j_s = \frac{vt}{ct} = \frac{v}{c} \qquad 5.5$$

And from trigonometry:

$$\sin \Delta j_s = \frac{\tan \Delta j_s}{\sqrt{1+\tan^2 \Delta j_s}} = \sqrt{1+\cot^2 \Delta j_s} \qquad 5.6$$

And by combining Equation #[5.5] and Equation #[5.6], we get:

$$\sin \Delta j_s = \frac{v/c}{\sqrt{1+v^2/c^2}} \qquad 5.7$$

By comparing Δj_s in Equation #[5.4] with Δj_s in Equation #[5.7], we conclude that the shift caused by light aberration is always greater than the shift caused by light travel time, when the two effects are calculated on the basis of Maxwell's aether theory.

Let's turn next to the emission theory of light. According to this theory, light, emitted by a moving light source, moves along the line of sight with the combined velocity c'. Since the light source, in the case under discussion, is moving at right angles to the line of sight, then $i = 90^o$. Using this value of i in Equation #[4.10], we obtain:

$$c' = c\sqrt{1-v^2/c^2} \qquad 5.8$$

From the right triangle of $c't$ and vt, we obtain, on the basis of the emission theory, the light-travel-time shift Δj_s:

$$\tan \Delta j_s = \frac{v}{c'} \qquad 5.9$$

From the equations #[5.6], #[5.8], & #[5.9], we obtain:

$$\sin \Delta j_s = \frac{v}{c} \qquad 5.10$$

Therefore, by comparing this equation with Equation #[5.4], we conclude that the shift of light aberration is always equal to the shift of light travel time, when the two effect are calculated on the basis of the emission theory of light.

2. The General Form of the Law of Aberration:

Now, we consider the general case in which both the light source and the observer are in motion.

Let the velocity vector of the light source v_s make an angle i with the observer's line of sight.

And let the velocity vector of the observer v_o make an angle j with the line of sight. Let c' denote the combined velocity of the velocity of light c and the velocity of its source $v_{s,}$, in the reference frame of the observer:

$$c\sqrt{1-\frac{v^2{}_s}{c^2}\sin^2 i} + v_s \cos i \qquad 5.11$$

Applying the law of sines to the above case, we obtain:

$$\sin \Delta j = \frac{v_o}{c'} \sin j \qquad 5.12$$

From Equations #[5.11] and #[5.12], we obtain the general form of the law of aberration:

$$\sin \Delta j = \frac{v_o \sin j}{c\sqrt{1-\frac{v^2_s}{c^2}\sin^2 i} + v_s \cos i} \qquad 5.13$$

where Δj is the shift of light aberration.

Finally, it should be pointed out that the shift, in the position of the light source due to light aberration, represents only an instance of apparent rotation. And so the image of the light source, at the time of reception, remains as it was at the time of emission. No aspect of the image at the time of emission is hidden; and no new aspect of the source is revealed at the time of reception, by this apparent shift, in the source position, due to light aberration. More importantly, the rotation of the line of sight, in the forward direction, by an angle Δj, does not affect the angle i that the velocity vector of the light source makes with the observer's line of sight. In other words, the angle i, in Equation #[5.13], is unchanged and invariant under the process of light aberration.

6. Velocities Relative to Absolute Space:

Having discussed the essentials of the emission theory of light, we can, now, proceed to examine its predictions with regard to uniform motions relative to absolute space.

It should be mentioned at the outset that, from the standpoint of kinematics, the space motion of any physical body can have potentially an infinite number of components in an infinite number of directions. But, at any instant of time, those velocity components can only have one instantaneous velocity resultant in only one direction.

The term '*absolute velocity*' will be used throughout this discussion to refer to the instantaneous resultant of the various velocity components of a moving object with respect to immobile space.

The basic rationale, behind the physical feasibility of finding out the magnitude and the direction and measuring precisely linear and uniform velocities relative to immobile space, is the self-evident fact that the image of a light source, between the time of emission and the time of reception, is always immobile and at rest with respect to absolute space.

The Doppler principle, the law of aberration, the notion of parallax, and the concept of relative motion, are the only required input for determining absolute velocities on the basis of the emission theory of light. The basic method of inference, used here, is to calculate the Doppler shift and the Bradley shift for a given value of relative velocity of two or more objects on the assumption of a common absolute velocity equal to zero, and to compare the final results with the results obtained by assuming non-zero common velocity relative to absolute space. In its broad aspects, this procedure is analogous to the methods used in dynamics to infer rotations relative to absolute space from the effects of the Coriolis force and related phenomena. As stated at the start of this discussion, in order to deduce the values of absolute velocities from the given quantities, the absolute value of the given relative velocity of two parts of the moving system, at least, must be greater than zero. In other words, if all the components of the system in question are at rest relative to each other, then the absolute velocity of that system cannot be determined on the basis of the emission theory of light. Any type of relative velocity can be used for this purpose. Here, we shall discuss the two important cases of uniform translational motion and uniform circular motion.

A. The Case of Uniform Translational Motion:

Let an isolated system consist of two independent bodies in uniform linear motion relative to each other. And let the reference frame of one of these two bodies be the inertial reference frame in which the observer is at rest. In the context of the physical theory under discussion, this system can only be in one of three distinct states, at a time:

1. The Observer at Rest:

Let the common absolute velocity of the system be $v_A = 0$.

And let the second body of the system be the light source, and its velocity v_s make an angle i with the line of sight. Since the observer is at rest, we set v_o and j to zero in Equation #[4.12]:

$$f' = f\left(1 + \frac{\frac{v_s}{c}\cos i}{\sqrt{1-\left(v_s^2/c^2\right)\sin^2 i}}\right) \qquad 6.1$$

where f' is the observed frequency in the inertial frame of the observer.

Equation #[6.1] is the Doppler equation, in the special case of a moving source and an observer at rest, for a system whose absolute velocity is nil, i.e., $v_A = 0$.

Now, let's assume that the absolute value of the above system's absolute velocity is greater than zero, i.e.,

$$v_A \neq 0$$

Let the vector v_A be parallel to the vector of the relative velocity of the light source v_s, in order to make the calculations simple.

And hence,

$$v_o = v_A$$

and

$$v_s' = v_A + v_s$$

where v_o is the velocity of the observer, v'_s is the vector sum of the absolute velocity of the system and the velocity of the light source relative to the observer. And hence, by inserting the values of v_o and v'_s into Equation #[4.12], we obtain:

$$f' = f\left(1 + \frac{\frac{v_A + v_s}{c}\cos i + \frac{v_A}{c}\cos j}{\sqrt{1 - \left(\frac{v_A + v_s}{c}\sin i\right)^2}}\right) \qquad 6.2$$

Since v_A, by definition, is the common velocity of the light source and the observer, and by the above configuration:

$$j + i = 180^o$$

the term:

$$\frac{v_A}{c}\cos j$$

and the term:

$$\frac{v_A}{c}\cos i$$

in the above equation, cancel each other out.

And, therefore, by rewriting this equation, we obtain:

$$f' = f\left(1 + \frac{\frac{v_s}{c}\cos i}{\sqrt{1-\left(\frac{v_A + v_s}{c}\sin i\right)^2}}\right) \qquad 6.3$$

where f' is the observed frequency in the inertial reference frame of the observer.

Equation #[6.3] is the Doppler equation, in the special case of a moving light source and an observer at rest, for a system whose absolute velocity v_A is:

$$v_A \neq 0$$

Let

$$z = \frac{\Delta f}{f}$$

And compute z_o from Equation #[6.1] and z_A from Equation #[6.3], and then divide z_A by z_o:

$$\frac{z_A}{z_o} = \sqrt{\frac{1-\frac{v_s^2}{c^2}\sin^2 i}{1-\frac{(v_A + v_s)^2}{c^2}\sin^2 i}} \qquad 6.4$$

Therefore, we conclude that the Doppler shift of a moving light source as measured in a system moving with a non-zero linear absolute velocity is greater than the Doppler shift of the same local motion as measured in a system at rest with respect to absolute space. And consequently, the ratio between the observed Doppler shift z_A and the Doppler shift expected theoretically z_o for a system at absolute rest, can be always used, in principle, to determine the absolute velocity of an isolated system with respect to immobile space, from inside that system, and without any reference to anything else in the universe.

2. The Light Source at Rest:

Let $v_A = 0$, and the velocity of the observer v_o make an angle j_o with the apparent position of the light source. And since the light source is at rest, we set v_s and i to zero in Equation #[5.13]:

$$\sin \Delta j_o = \frac{v_o}{c} j_o \qquad 6.5$$

where Δj_o is the shift of light aberration.

From Equation #[6.5], we obtain the true position of the source j'_0, where:

$$j'_o = j_o + \Delta j_o$$

and then we insert j'_0 instead of j into Equation #[4.12]:

$$f' = f\left(1 + \frac{v_o}{c}\cos j'_0\right) \qquad 6.6$$

where f' is the observed frequency in the inertial reference frame of the observer.

Equation #[6.6] is the Doppler equation, in the special case of a moving observer and a light source at rest, for a system whose absolute velocity is nil, i.e, $v_A = 0$.

Now, let's assume that the absolute value of the above system's absolute velocity is greater than zero.

And let the vector v_A be parallel to the vector of the relative velocity of the observer v_o, in order to simplify the calculations.

And hence,

$$v'_o = v_A + v_o$$

and

$$v_s = v_A$$

where v_s is the velocity of the light source, and v'_o is the vector sum of the absolute velocity of the system and the velocity of the observer relative to the light source.

Inserting the values of v_s and v'_o into Equation #[5.13], we obtain the shift of light aberration Δj_A:

$$\sin \Delta j_A = \frac{v_A + v_o}{c'} \sin j_A \qquad 6.7$$

where j_A is the apparent position of the light source; and c' is defined by this equation:

$$c' = c\sqrt{1 - \frac{v_A^2}{c^2} \sin^2 i} + v_A \cos i$$

And then we use

$$j'_A = j_A + \Delta j_A$$

in Equation #[4.12] to obtain f':

$$f' = f\left[1 + \frac{(v_A + v_0)\cos j'_A + v_A \cos i}{c\sqrt{1 - \left(\frac{v_A}{c}\sin i\right)^2}}\right] \qquad 6.8$$

Since v_A, by definition, is the common velocity of the light source and the observer, and by the above simplifying assumption:

$$j'_A + i = 180^o$$

the terms $v_A cosj'_A$ & $v_A cosi$ in Equation #[6.8], therefore, cancel each other out.

And by rewriting this equation, we obtain:

$$f' = f\left(1 + \frac{\frac{v_o}{c}\cos j'_A}{\sqrt{1-\left(\frac{v_A}{c}\sin i\right)^2}}\right) \qquad 6.9$$

where *f'* is the observed frequency in the inertial reference frame of the observer.

Equation #[6.9] is the Doppler equation, in the special case of moving observer and light source at rest, for a system whose absolute velocity is:

$$v_A \neq 0$$

Let

$$z = \frac{\Delta f}{f}$$

and then compute z_o from Equation #[6.6] and z_A from Equation #[6.9], and divide z_A by z_o:

$$\frac{z_A}{z_o} = \frac{cosj'_A / \cos j'_o}{\sqrt{1-\left(\frac{v_A}{c}\sin i\right)^2}} \qquad 6.10$$

Therefore, we conclude that the Doppler shift of a moving observer as measured in a system moving with a non-zero linear absolute velocity is greater than the Doppler shift of the same relative motion as measured in a system at rest with respect to absolute space.

Let us, now, compare the shift of light aberration in Equation #[6.5] to that in Equation #[6.7]. For an observer and light source moving with a common absolute velocity v_A, the shift of light aberration, due to their common absolute velocity, is exactly canceled out by the shift of the secular parallax, due to the displacement of the observer. To demonstrate that is indeed the case, let the line joining the light source and the observer make a right angle with the vector of their common velocity v_A, so that:

$$j = i - 90^o$$

Light emitted by the light source, at the time of emission, takes an interval of time t to reach the observer, at the time of reception. During that time, the observer has moved a distance $v_A t$ parallel to that of the light source's image. From the right triangle $v_A t$ and $c't$, we obtain:

$$\sin \Delta j = \frac{v_A}{c'} \qquad 6.11$$

where Δj is the angle of the secular parallax. This angle is exactly equal to the angle of light aberration as calculated from Equation #[5.13], but in the opposite direction. Light aberration, therefore, takes this shifted image of the light source, in the backward direction, and shifts it by an equal amount, in the forward direction, to coincide exactly with the true position of the light source at the time of reception. Thus, these two effects of the velocity component v_A cancel each other out, and we obtain from Equation #[6.7]:

$$\sin \Delta j_A = \frac{v_o}{c'} \sin j_A \qquad 6.12$$

Therefore, by dividing $\sin\Delta j_A$ from Equation #[6.12], by $\sin\Delta j_o$ from Equation #[6.5], we obtain:

$$\frac{\Delta j_A}{\Delta j_0} = \frac{c}{c'} \qquad 6.13$$

where c' is obtained from this equation:

$$c' = c\sqrt{1-\left(\frac{v_A}{c}\sin i\right)^2} + v_A \cos i$$

Therefore, we conclude that the shift of light aberration as measured in a system moving with a non-zero linear absolute velocity is greater for

$$j \leq 90^o$$

and less for

$$j > 90^o$$

than the shift of light aberration for the same relative motion as measured in a system at absolute rest with respect to immobile space..

It should be pointed out, within the present context, that, unlike the light-aberration shift, the parallax shift represents a true rotation of the light source's image with respect to the observer. And accordingly, it changes the viewing angle and the angle i that the velocity vector of the light source v_s makes with the line of sight. Since the parallax shifts the source image to the opposite direction to that of the observer's motion, then

$$i' = i - \Delta j$$

where i' is the direction of the velocity vector of the light source; and Δj is the parallax shift.

The angle i' is observable in the inertial reference frame of the observer. It's, simply, the angle that the observer measures and refers to as the angle i in the previous equations. However, if the angle i is given or deduced from dynamical considerations, for example, then the angle i' must be used instead of the angle i in all the cases in which the above parallax shift is involved.

3. The Light Source and the Observer in Motion:

Let the absolute velocity of the system, v_A, be:

$$v_A = 0$$

and the absolute values of v_o & v_s be greater than zero; i.e :

$$v_o \neq 0$$

for the observer; and

$$v_s \neq 0$$

for the light source.

And let v_o & v_s make, respectively, angles j_0 & i with the line of sight.

By inserting the above assumed values into Equation #[5.13]; we obtain Δj_0:

$$\sin \Delta j_0 = \frac{v_o}{c'} \sin j_0 \qquad 6.14$$

where c' is given by this equation:

$$c' = c\sqrt{1 - \left(\frac{v_s}{c}\sin i\right)^2} + v_s \cos i$$

From Equation #[6.14], we obtain the true position of the source j'_0, where

$$j'_0 = j_0 + \Delta j_0$$

and then we use j'_0 instead of j in Equation #[4.12]:

$$f' = f\left[1 + \frac{v_o \cos j'_0 + v_s \cos i}{c\sqrt{1 - \left(\frac{v_s}{c}\sin i\right)^2}}\right] \qquad 6.15$$

where f' is the observed frequency in the inertial frame of the observer.

Next, let's assume that the absolute value of the above system's absolute velocity is greater than zero; and let the vectors v_s & v_o be parallel to the vector v_A and make angles i & j_A respectively with the line of sight, in order to simplify the calculations; and hence:

$$v'_o = v_A + v_o$$

and

$$v'_s = v_A + v_s$$

Inserting the values of v'_s & v'_o into Equation #[5.13], we obtain the shift of light aberration Δj_A:

$$\sin \Delta j_A = \frac{v_A + v_o}{c''} \sin j_A \qquad 6.16$$

where c'' is:

$$c'' = c\sqrt{1 - \left(\frac{v_A + v_s}{c}\sin i\right)^2} + (v_A + v_s)\cos i$$

Since v_A is the common velocity of both the light source and the observer, the shift of its light aberration is canceled out in the above equation by the shift caused by the parallax; and we rewrite Equation #[6.16]:

$$\sin \Delta j_A = \frac{v_o}{c''} \sin j_A \qquad 6.17$$

And then we insert

$$j'_A = j_A + \Delta j_A$$

into Equation #[4.12] to obtain f':

$$f' = f\left[1 + \frac{(v_A + v_o)\cos j'_A + (v_A + v_s)\cos i}{c\sqrt{1 - \left(\frac{v_A + v_s}{c}\sin i\right)^2}}\right] \qquad 6.18$$

Since v_A, by definition, is the common velocity of the light source and the observer, and by our simplifying assumption:

$$j'_A + i = 180^o$$

the terms $v_A \cos j'_A$ & $v_A \cos i$ in Equation #[6.18], therefore, cancel each other out.

And by rewriting the above equation, we obtain:

$$f' = f\left[1 + \frac{v_o \cos j'_A + v_s \cos i}{c\sqrt{1 - \left(\frac{v_A + v_s}{c}\sin i\right)^2}}\right] \qquad 6.19$$

where f' is the observed frequency in the inertial reference frame of the observer.

Let:

$$z = \frac{\Delta f}{f}$$

And compute z_0 from Equation #[6.15] and z_A from Equation #[6.19].

Let:

$$\beta_0 = v_o \cos j'_0 + v_s \cos i$$

and:

$$\beta_A = v_o \cos j'_A + v_s \cos i$$

and then divide z_A by z_0:

$$\frac{z_A}{z_0} = \left(\frac{\beta_A}{\beta 0}\right)\sqrt{\frac{1 - \left(\frac{v_s}{c}\sin\right)^2}{1 - \left(\frac{v_A + v_s}{c}\sin i\right)^2}} \qquad 6.20$$

And therefore, we conclude that the Doppler shift as measured in a system moving with a linear absolute velocity is greater than the Doppler shift of the same local relative motion as measured in a system at rest with respect to absolute space.

Let us, now, compare the shift of light aberration in Equation #[6.14] to that in Equation #[6.17].

Let:

$$b_0 = \sin \Delta j_0$$

for Equation #[6.14], and

$$b_A = \sin \Delta j_A$$

for Equation #[6.17], and divide b_A by b_0:

$$\frac{b_A}{b_0} = \frac{c'}{c''} \qquad 6.21$$

Therefore, we conclude that the shift of light aberration as measured in a system moving with a non-zero linear absolute velocity is greater for:

$$j \le 90^o$$

and less for:

$$j > 90^o$$

than the shift of light aberration for the same relative motion as measured in a system at absolute rest.

B. The Case of Uniform Circular Motion:

We have now to consider the important special case of uniform circular motion. The magnitude of the tangential velocity, in this case, is constant, but its direction is changing continually around the circular orbit. Let an isolated system consist of two independent bodies revolving clockwise with a uniform circular motion relative to each other. And let the inertial reference frame of one of these two bodies be the reference frame in which the observer is at rest. In the context of the theory under discussion, this system can only be in one of the following states:

1. The Source in Motion:

Let the common absolute velocity of the system be v_A, and $v_A = 0$; and let the light source revolve clockwise with a tangential velocity v_s, around the observer. Because the light source is moving in a circular trajectory, its velocity vector v_s, always forms an angle of 90^o with the observer's line of sight. And hence, according to the emission theory, no Doppler shift, caused by this motion, can be observed in the inertial reference frame of the observer.

Now let's assume that the absolute value of the above system's absolute velocity v_A, is greater than zero, and the vectors of v_A & v_s, are in the same plane. Since the observer is, now, moving with the common velocity of the system, $v_o = v_A$. Let v'_s denote the vector sum of v_A & v_s, and α denote the angle between these two vectors. The effect of the parallax, caused by the observer motion, is to rotate the line of sight counterclockwise by an angle of Δj. Accordingly, each angle, made with the line of sight by the velocity vector of the light source, v_s, is decreased by an angle Δj, when the light source is revolving in the direction of v_A, and increased by the same amount, when the source is revolving in the opposite direction.

By contrast, the effect of the light aberration, which is also caused by the observer motion, is to rotate the line of sight clockwise by an angle Δj to its initial position. But because this rotation is not real, it does not affect the velocity vectors rotated by the parallax.

The parallax shift of the light source's velocity components leads to a corresponding Doppler shift in the light of the source received by the observer. To calculate this change in the observed frequency, v'_s, c', and Δj must be determined.

By applying the law of cosines, we obtain:

$$v'_s = \sqrt{v_A^2 + v_s^2 + 2 v_A v_s \cos\alpha} \qquad 6.22$$

and from the given geometry above:

$$\cos\alpha = \sin j \qquad 6.23$$

where j is the direction of the observer's absolute velocity vector $v_o = v_A$.

Substituting j for α in Equation #[6.22]:

$$v_s' = \sqrt{v_A^2 + v_s^2 + 2 v_A v_s \sin j} \qquad 6.24$$

The direction of v'_s is the angle i. Both i and j are observable and can be used to compute the velocity of light c' in the inertial frame of the observer:

$$c' = c\sqrt{1 - \left(\frac{v_s'}{c}\sin i\right)^2} + v_s' \cos i \qquad 6.25$$

where v'_s is calculated from Equation # [6.24].

Since both effects are equal in magnitude, light aberration can be used to determine the parallax shift of the velocity components of the light source, Δj, by using Equation #[5.13]:

$$\sin \Delta j = \frac{v_A}{c'} \sin j \qquad 6.26$$

where c' is determined by Equation #[6.25].

Because v_A is the common velocity of the system, the direction of the source's velocity component v_A , and the direction of the observer's velocity component v_A, always, form an angle of 180° with each other. As a result, the Doppler shift of the two components cancels out and cannot be observed in the inertial frame of the observer. And therefore, only the light source's velocity component v_s can produce an observable Doppler shift with respect to the observer frame of reference. As implied by the definition of uniform circular motion, the vector v_s always, makes an angle of 90° with the line of sight in the inertial reference frame of the observer. But because of the parallax, this angle is decreased by Δj, when the source is revolving in the direction of the vector v_A, and increased by the same amount, when the source is revolving in the opposite direction. To compute the Doppler shift of this velocity component, z, we take its radial projection with respect to the observer, and divide it by the velocity term;

$$c\sqrt{1 - \left(\frac{v_s'}{c}\sin i\right)^2}$$

of light received from the revolving source:

$$z = \frac{\Delta f}{f} = \frac{v_s \sin \Delta j}{c\sqrt{1 - \left(\frac{v'_s}{c}\sin i\right)^2}} \qquad 6.27$$

where Δj is computed from Equation #[6.26].

And therefore, for a light source revolving clockwise, the maximum Doppler blue shift, as measured by an observer at the center of the orbit, is at $j = 90^o$, and the maximum Doppler red shift is at $j = 270^o$. And the Doppler shift is equal to zero at $j = 0^o$ and $j = 180^o$. For small values of v_A and v_s, the Doppler shift, computed from the above equation, can be extremely minute. For example, for $v_A = 300\ kms^{-1}$ & $v_s = 30\ kms^{-1}$, Equation #[6.27] gives a maximum Doppler shift, on both sides of the circular orbit, of only $\pm 30\ ms^{-1}$. The Doppler shift, however, can be higher for higher values of v_A and v_s.

Therefore, we conclude that in an isolated system moving with a linear absolute velocity:

$$v_A \neq 0$$

a source of light in a uniform circular motion around an observer at rest shows regular variations in its Doppler shift as measured by the same observer; and that the observer, therefore, can use those measured variations to deduce the magnitude and the direction of the uniform linear velocity of an isolated system relative to absolute space.

2. The Observer in Motion:

Let the common absolute velocity of the system $v_A = 0$; and let the observer revolve clockwise with a tangential velocity v_o around the light source. Because the observer is moving in a circular trajectory, around the stationary light source at the center, the velocity vector v_o always forms an angle of 90^o with the line of sight to the stationary source. And hence, according to the emission theory of light, no Doppler shift, caused by this motion, can be observed in the inertial frame of the observer.

Now let's assume that the absolute value of the above system's absolute velocity v_A is greater than zero, and the vectors of v_A & v_o are in the same plane. Since the source is, now, moving with the common velocity of the system, $v_s = v_A$. Let v'_o denote the vector sum of v_A & v_o, and α denote the angle between these two vectors.

The effect of the parallax, caused by the observer motion, is to rotate the line of sight to the light source counterclockwise by an angle of Δj. Accordingly, each angle, made to the line of sight by the velocity vector of the observer, is increased, with respect to the light source's image, by an angle Δj, when the observer is revolving in the direction of v_A, and decreased by the same amount, when the observer is revolving in the opposite direction.

By contrast, the effect of the light aberration, which is also caused by the observer motion, is to rotate the line of sight clockwise by an angle Δj to its initial position. But because this rotation is illusory, it does not affect the vectors rotated by the parallax.

And therefore, the parallactic shift of the observer's velocity components leads to a corresponding Doppler shift in the light of the source received by the observer.

To calculate this change in the observed frequency, v'_o, c', and Δj have to be computed.

From the law of cosines, we compute v'_o:

$$v'_o = \sqrt{v_A^{\ 2} + v_o^{\ 2} + 2v_A v_o \cos\alpha} \qquad 6.28$$

From the given geometry above:

$$\cos\alpha = \sin j \qquad 6.29$$

where j is the direction of the observer's velocity vector v_A.

Substituting j for α in Equation #[6.28]:

$$v'_o = \sqrt{v_A^{\ 2} + v_o^{\ 2} + 2v_A v_o \sin j} \qquad 6.30$$

Since the direction of v_A of the source is the angle i, we use it to compute the velocity of light c' in the inertial reference frame of the observer:

$$c' = c\sqrt{1 - \left(\frac{v_A}{c}\sin i\right)^2} + v_A \cos i \qquad 6.31$$

Since both effects are equal in magnitude, light aberration can be used to determine the parallax shift, Δj, by using Equation #[5.13]:

$$\sin \Delta j = \frac{v'_o}{c'} \sin j \qquad 6.32$$

where v'_o is calculated from Equation #[6.30] and c' from Equation #[6.31].

Because v_A is the common velocity of the system, the direction of the light source's velocity component v_A, and the direction of the observer's velocity component v_A always form an angle of 180° with each other. And as a result, the Doppler effect of the two components cancels out and cannot be observed in the inertial frame of the observer. And therefore, only the observer's velocity component v_o can produce an observable Doppler shift with respect to the observer frame of reference. As implied by the definition of uniform circular motion, the vector v_o always makes an angle of 90° with the line of sight to the light source in the inertial frame of the observer. But because of the parallax, this angle is increased by Δj, when the observer is revolving in the direction of the vector v_A, and decreased by the same amount, when the observer is revolving in the opposite direction.

To compute the Doppler shift of this velocity component, z, we take its radial projection with respect to the light source's image, and divide it by the velocity term:

$$c\sqrt{1-\left(\frac{v_A}{c}\sin\right)^2}$$

for light received from the source by the revolving observer:

$$z = \frac{\Delta f}{f} = \frac{v_o \sin \Delta j}{c\sqrt{1-\left(\frac{v_A}{c}\sin i\right)^2}} \qquad 6.33$$

where Δj is computed from Equation #[6.32].

Thus, for an observer revolving clockwise around a light source at the center of a circular orbit, the maximum Doppler red shift, as measured by the same observer, is at $i = 90^o$, and the maximum Doppler blue shift is at $i = 270^o$. And the Doppler shift is equal to zero at $i = 0^o$ and $i = 180^o$.

Therefore, we conclude that in an isolated system moving with a linear absolute velocity

$$v_A \neq 0$$

an observer's uniform circular motion around a source of light at rest shows regular variations in its Doppler shift as measured by the same observer, and that the observer, subsequently, can use those observed variations to determine the magnitude and the direction of the uniform linear velocity of an isolated system relative to immobile space.

3. The Source and the Observer in Motion:

Let the common absolute velocity of an isolated system $v_A = 0$; and let the light source and the observer revolve clockwise with tangential velocities v_s and v_o respectively around a common center. Because both are moving in a circular trajectory, each of their velocity vectors v_s and v_o always forms angle of 90^o with the line of sight. And hence, the radial components of v_s and v_o are nil; and no Doppler shift, due to the motion of the light source and the motion of the observer, can be observed in the inertial reference frame of the observer, according to the emission theory, in this special case.

Next, let's assume that the absolute value of the above system's absolute velocity v_A is greater than zero, and that the vectors of v_A, v_s and v_o are in the same plane. Both the light source and the observer are, now, moving with the common absolute velocity of the system v_A.

Let v'_s denote the vector sum of v_s and v_A, and use α_s to denote the angle between these two vectors. And let v'_o denote the vector sum of v_A and v_o, and use α_o to denote the angle between these two vectors.

The effect of the parallax, caused by the observer's displacement, due to the velocity v_A, during the travel time of light from its source to the observer, is to rotate the line of sight counterclockwise by an angle of Δj. Consequently, each angle, made to the line of sight by the velocity vectors of both the light source and the observer, is increased, as measured in the inertial reference frame of the observer, by an angle Δj, when the observer is revolving in the direction of v_A, and decreased by the same amount, when the observer is revolving in the opposite direction.

By contrast, the effect of light aberration, which is also caused by the observer motion, is to rotate the line of sight clockwise by an angle Δj to its instantaneous position, at the time of reception. But because this rotation is only apparent, it does not affect the velocity vectors rotated by the parallax.

And therefore, the parallax shift of the velocity components of the light source and the observer leads to a corresponding Doppler shift in the light of the source received by the observer.

To calculate the Doppler shift in the observed frequency, v'_o, v'_s, c', and Δj have to be obtained first.

By using the law of cosines, we calculate the velocity resultant v'_o:

$$v'_o = \sqrt{v_A{}^2 + v_o{}^2 + 2v_A v_o \cos\alpha_o} \qquad 6.34$$

where v'_o is the velocity resultant of the observer.

And the velocity resultant v'_s:

$$v'_s = \sqrt{v_A{}^2 + v_s{}^2 + 2v_A v_s \cos\alpha_s} \qquad 6.35$$

where v'_s is the velocity resultant of the light source.

The direction of the vector v'_s is the angle i, and the direction of v'_o of the observer is j. Both i and j are observable in the reference frame of the observer.

And, therefore, we use the angle i to calculate the resultant velocity of light c':

$$c' = c\sqrt{1-\left(\frac{v'_s}{c}\sin i\right)^2} + v'_s \cos i \qquad 6.36$$

where v'_s is computed from Equation #[6.35].

Since both effects are equal in magnitude, light aberration can be used to determine the parallax shift of the velocity components of the source, Δj, by using Equation #[5.13]:

$$\sin \Delta j = \frac{v'_o}{c'}\sin j \qquad 6.37$$

where v'_o is calculated from Equation #[6.34] and c' from Equation #[6.36].

Because v_A is the common velocity of the system, the direction of the source's velocity component v_A and the direction of the observer's velocity component v_A, always, form an angle of 180^o with each other. And as a result, the Doppler effect of the two components cancels out and cannot be observed in the inertial frame of the observer. Therefore, only the velocity components v'_o and v'_s can produce an observable Doppler shift with respect to the observer's frame of reference.

And as implied by the definition of uniform circular motion, both vectors, v'_o and v'_s always, make an angle of 90^o with the line of sight in the inertial reference frame of the observer.

However, because of the parallax, that angle is increased by Δj, when the observer is revolving in the direction of the vector v_A , and decreased by the same amount, when the observer is revolving in the opposite direction.

To compute the Doppler shift of these two components, z, we take their radial projections with respect to the light source's image, as measured in the inertial reference frame of the observer, and then divide the two by the velocity term

$$c\sqrt{1-\left(\frac{v_s'}{c}\sin i\right)^2}$$

for light received from the source by the revolving observer:

$$z=\frac{\Delta f}{f}=\frac{(v_o+v_s)\sin\Delta j}{c\sqrt{1-\left(\frac{v_s'}{c}\sin i\right)^2}} \qquad 6.38$$

where Δj is computed from Equation #[6.37].

Therefore, for an observer and light source revolving clockwise, in a circular orbit, around a common center, the maximum Doppler red shift, as measured in the reference frame of the observer, is at $\alpha_o = 0^o$, and the maximum Doppler blue shift is at $\alpha_o = 180^o$. And the Doppler shift is equal to zero at $\alpha_o = 90^o$ and $\alpha_o = 270^o$; where α_o is the angle between the velocity vector of the observer v_o and the vector of the system's absolute velocity v_A.

By considering, in the three cases above, a system whose two components are in uniform circular motion with respect to each other, we conclude that a system, moving with linear absolute velocity

$$v_A \neq 0$$

produces a Doppler shift that can be measured in the inertial frame of the observer. The Doppler shift, produced in this manner, varies differently from that caused by the motion of the system's components in elliptical trajectories and $v_A = 0$. And consequently, it can be always used, in principle, to determine the absolute velocity of an isolated system with respect to absolute space, from within and without any reference to anything else outside that system.

7. Concluding Remarks:

As demonstrated, in this discussion, velocity measurements, with respect to absolute space, are feasible and theoretically and practically possible, within the framework of the emission theory of light.

And in principle, velocity measurements, with respect to immobile space, can be demonstrated to be feasible and theoretically and practically possible, within the framework of every other physical theory in this field. That is because Doppler effect, parallax, and light aberration, required for carrying out those velocity measurements relative to absolute space, are treated in the same way and by similar methods within the context of every physical theory.

In the above investigation, only the Doppler effect and light aberration, due to velocities relative to absolute space, are considered and treated in detail.

But it should be clear, however, that motions, relative to immobile space, can have measurable dynamical effects on kinetic energy, momentum, and radiant flux of light as well.

And furthermore, projectiles, in general, ought to show, based on the current treatment of light as a special case within this class of physical objects, similar observable effects caused by uniform motions with respect to absolute space.

Now, based on the above discussion, can the absolute velocity of the earth, relative to immobile space, be measured and precisely determined from inside a closed laboratory?

If the velocity of light is dependent on the velocity of its emitting source, during the time of emission, then it should be possible, in principle, to measure the instantaneous velocity of the earth, with respect to absolute space, from inside a closed laboratory, located on or deep below its surface, and without any reference to anything at all outside that laboratory:

Let a bright and small source of light revolve in a perfect circular trajectory around a stationary and highly sophisticated spectroscope at the center of this circular trajectory, with a tangential velocity of *0.5 km/s*.

And let's assume, for example, that the instantaneous velocity vector of the earth, relative to immobile space, is in the same plane as the tangential velocity vector; and it has a magnitude of *1000 km/s*.

Based on the previous calculations, therefore, the stationary spectroscope is going to measure variations in the Doppler shift within the following range:

$$\frac{\Delta f}{f} = \pm 5.56 \times 10^{-9}$$

and hence, variations in the tangential velocity within the numerical range:

$$\Delta v = \pm 1.668 \quad ms^{-1}$$

The actual uniform velocity of the earth, relative to immobile space, potentially, of course, can have any value between zero and infinity; but as soon as the variations, in the local relative velocity, are measured, the observer should be able to carry out the above steps, in reverse, and to determine the magnitude and the direction of the isolated system's uniform velocity relative to absolute space.

REFERENCES:

1. ***Cyrenika, A. A.***,
"Principles of Emission Theory".

2. ***Dogra, R.***,
"Apparent Lack of Symmetry in Stellar Aberration and Euclidean Space Time".

3. ***Einstein, A.***,
"On the Electrodynamics of Moving Bodies".

4. ***Fox, J. G.***,
"*Evidence Against Emission Theories*", Am. J. of Phys, 33, 1, (1965).

5. ***Ives, H., et al***,
(1938). J. Opt. Soc. Am., 28, 215-226.

6. ***Weiss, P.***,
"Light Pulses Flout Sacrosanct Speed Limit".

7. ***Waldron, R. A.***,
a.) (1980). Speculations in Science & Technology, 3, 4, 385-408.
b.) (1979). Speculations in Science & Technology, 2, 3, 303-312.

8. W***ang, L .J., et al***,
"Gain-Assisted Superluminal Light Propagation".

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