Confirmation of Helical Travel of Light through Microwave Waveguide Analyses

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Abstract

The essence of this theory is that photons are small particles of ponderable mass that travel in set helical trajectories. For any photon, the diameter of its helix may be calculated by dividing its wavelength by π ($d = \lambda/\pi$). Further, a photon travels at a speed that is the square root of two times the speed of its helical wave, $\sqrt{2} \times c$.

Key words: light, microwave waveguides, superluminal velocities

1. INTRODUCTION

Although certain characteristics of light are known, other qualities are not well defined. Based on experimental data, what is generally accepted concerning light is that a photon in a vacuum, free from all fields, travels at a constant translational velocity, c. The wavelength of photon travel is $\lambda = c/v$, where v is wave frequency; the energy carried by a photon is defined by $E = hv$, where h is Planck's constant; and a photon possesses linear momentum $p = hv/c$ and angular momentum $L = \pm h/2\pi$ [1]. This helical travel theory accepts all of the above tenets and supports a zero charge for the photon. However, the theory is revolutionary because it refutes the notions of electromagnetic mass, relativistic mass, photon zero mass, and group/phase velocities but accepts superluminal signals.

Helical travel provides answers to the following questions. Is a photon a particle of mass? Why does its travel have a wave quality? Why is its travel discontinuous? Why does it have a zero charge? Why is it so easily reflected? What is the amplitude of its wave? Further, why do waveguides have cut off frequencies? Why does the speed of light reach a maximum in free space? Are superluminal speeds possible? Finally, what causes light polarization, interference and diffraction?

2. HELICAL TRAVEL THEORY

2.1 Photons - Small Ponderable Mass Particles
Traveling in helical trajectories

It is proved, with the correlations developed, that as with neutrons, protons and electrons, the mass of a photon is ponderable. This theory was developed by visualizing possible paths for photon travel. It was known that a photon could not travel in a straight line because each microwave waveguide size has a different low cutoff frequency. Of the possible modes of photon travel, helical travel seemed to be the most likely.

Early on, a review of work by Feynman provided support to the helical travel of light. In *Q.E.D.—The Strange Theory of Light and Matter*, Feynman made the statement that light was a particle, not a wave, and not a combination of the two. In a lecture to his students he said, "*I want to emphasize that light comes in this form —particles. It is very important to know that light behaves like particles, especially for those of you who have gone to school, where you were probably told s omething about light behaving as waves. I'm telling you the way it does behave —like particles!*" [2]

Photomultiplier tubes, devices that can detect a single photon, were used in an experiment [2] to see if a photon could be split. Backing up Feynman's statement, the data showed that photons never split but travel intact in one direction or another. Feynman used laws of probability to explain the possible path of photon travel. The end result was a drawing that resembled a two-dimensional view of three-dimensional helical travel. [3] Although abstract space travel may have been intimated here, with the present theory the drawing fits nicely within known physical space. Newton refuted the abstract notion by stating, *"To tell us that every species of things is endowed with an occult specific quality by which it acts and produces manifest effects, is to tell us nothing."* [4]

If a photon is a particle of ponderable mass as Newton believed, then reconciliation must be made between kinetic and electromagnetic energy. The kinetic energy correlation for slow-moving particles (Newtonian mechanics) based on the particle's rest mass, m_o, is

$$E = \tfrac{1}{2}m_o v^2. \qquad (1)$$

With electromagnetic energy (Maxwellian mechanics), the total energy of the photon based on its electromagnetic mass is twice as large (if all of the energy were translational) as would be expected with Newtonian mechanics [5],

$$E = m_{elm}c^2. \qquad (2)$$

Electromagnetic mass appears correct based on the assumption that the measured speed of light is the speed of the photon. The essence of this theory is that a photon is traveling in a helical trajectory and that the measured speed of light is not the speed of the photon, but the speed of its helical wave. Further, kinetic energy is valid for both slow and fast-moving particles. This being true would mean that electromagnetic mass is a misreading of the experimental data. If the photon speed is greater than its wave speed, electromagnetic mass and ponderable mass could be identical ($m_o = m_{elm}$); here they are considered identical. Based on these premises, the correlation for high-speed particles was modified by replacing electromagnetic mass with the photon rest mass, $E = m_o c^2$. The velocity of the photon was then calculated by equating kinetic energy, based on photon speed, to the energy-mass correlation based on its wave speed.

$$\tfrac{1}{2} m_o v_p^2 = m_o c^2$$
$$v_p = \sqrt{2} \times c \qquad (3)$$

Where, v_p is the photon velocity, and c (speed of light) is the velocity of the apparent wave created by its helical trajectory

Knowing the photon speed and the speed of its wave, the diameter of the photon's helical wave was calculated. A right triangle analysis was used to determine its wave helical diameter. For one wavelength λ of travel, the photon travels a distance equal to the $\sqrt{2} \times \lambda$ and this distance is the hypotenuse of a right triangle. Further, both legs of the triangle are equal to the wavelength. One leg is the wavelength, and the other is the cylindrical circumference of the helical wave, $\lambda = H_c$, see Fig. 1a.

The helical diameter for the travel of any photon in free space may now be calculated by dividing the circumference of its helical wave, H_c, by π, the universal constant.

$$d = H_c/\pi = \lambda/\pi \qquad (4)$$

where, d is the diameter of the helix, H_c is the circumference of the helix, λ is the wave length, and π is equal to 3.1416.

When this correlation was first developed, it was not known if it could be proved from the existing experimental database. It was later found that microwave waveguide experience might be used to prove or disprove the theory. Microwaves may be transmitted through rectangular, triangular or circular waveguides. For each guide of set dimensions there is a specific low frequency cutoff wave. If this theory were correct, it would have to accurately predict the low cutoff frequencies. Rectangular waveguides were selected to minimize any guide wall effects on the photon's travel. With this theory, the inside width of the rectangular guide sets the helical diameter of the lowest frequency wave that may be transmitted. Using $d = \lambda/\pi$, cutoff frequencies were predicted for twenty-five RS-261-A (EIA Waveguide Designation Standard) rectangular waveguides[6].
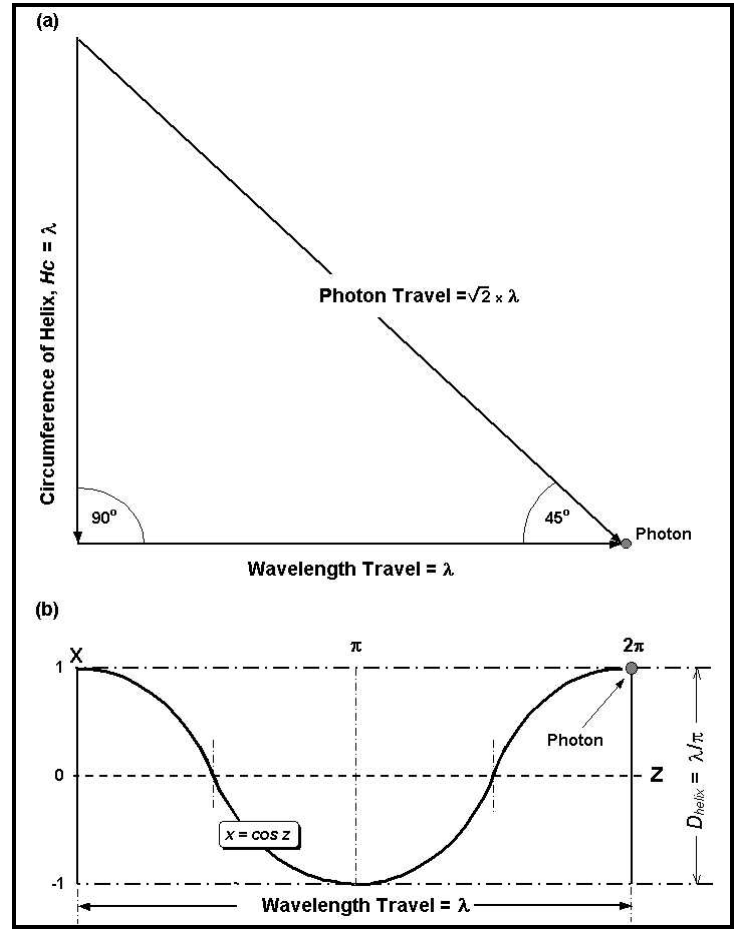

Fig. 1a Right triangle analysis of photon travel.
Fig. 1b. Sinusoidal wave of a photon helix.

These predictions were compared to the measured values for the low frequency cutoff waves. The results of the comparison are shown in Table I. Predicted cutoff frequencies were within an average accuracy of deviation of less than a percent (+0.90%) of the actual cutoff frequencies.

These accurate predictions provided the proof sought. The equating of the redefined electromagnetic energy correlation to the kinetic energy is based on a photon having a rest mass. The proof that a photon has a rest mass and that kinetic energy is valid for both slow and high speed particles, is shown through the accurate predictions when using the $d = \lambda/\pi$ correlation. If a photon did not have a rest mass and kinetic energy did not apply, the correlation would not have correctly predicted the low cutoff frequencies.

Knowing the diameter of the photon's helix relative to its wavelength, a two dimensional view of its wave may be calculated. A helical curve in space is defined by $x = a \cos kt$, $y = a \sin kt$, and $z = ct$. By eliminating t (time) between the various pairs of equations one obtains; $x^2 + y^2 = a^2$, $x = a \cos (kz/c)$, and $y = a \sin (kz/c)$ showing that a helix lies on a circular cylinder. The projection on the xz-plane is a cosine curve.

TABLE I. Microwave waveguide cutoff frequency waves. Predicted cutoff frequency, $v = c/\lambda = c/(\pi \times d)$; $c = 2.9979 \times 10^{10}$ cm/sec; $\lambda = $ wavelength, cm; and $d = $ smallest inside dimension of waveguide, cm (diameter of photon helix @ cutoff frequency). Average accuracy for 25 waveguides = + 0.90%.

EIA Waveguide Designation Standard RS-261-A[6]	Outer Dimensions & Wall Thickness[6] (in.)	Smallest Inside Dimension (cm.)	Published Actual Low Frequency Wave Cutoff[6] (cycles/sec)	Predicted Low Frequency Wave Cutoff (cycles/sec)	Accuracy %
WR-2300	23.25 x 11.750 x 0.125	29.21	3.20E+08	3.27E+08	2.09
WR-2100	21.25 x 10.750 x 0.125	26.67	3.50E+08	3.58E+08	2.23
WR-1800	18.250 x 9.250 x 0.125	22.86	4.25E+08	4.17E+08	-1.78
WR-1500	15.250 x 7.750 x 0.125	19.05	4.90E+08	5.01E+08	2.23
WR-1150	11.750 x 6.000 x 0.125	14.61	6.40E+08	6.53E+08	2.09
WR-975	10.000 x 5.125 x 0.125	12.38	7.50E+08	7.71E+08	2.75
WR-770	7.950 x 4.100 x 0.125	9.779	9.60E+08	9.76E+08	1.65
WR-650	6.660 x 3.410 x 0.080	8.255	1.12E+09	1.16E+09	3.21
WR-510	5.260 x 2.710 x 0.080	6.477	1.45E+09	1.47E+09	1.61
WR-430	4.460 x 2.310 x 0.080	5.461	1.70E+09	1.75E+09	2.79
WR-340	3.560 x 1.860 x 0.080	4.318	2.20E+09	2.21E+09	0.45
WR-229	2.418 x 1.273 x 0.064	2.908	3.30E+09	3.28E+09	-0.57
WR-159	1.718 x 0.923 x 0.064	2.019	4.90E+09	4.73E+09	-3.56
WR-137	1.500 x 0.750 x 0.064	1.580	5.85E+09	6.04E+09	3.25
WR-75	0.850 x 0.475 x 0.050	0.953	1.00E+10	1.00E+10	0.19
WR-62	0.702 x 0.391 x 0.040	0.790	1.24E+10	1.21E+10	-2.58
WR-51	0.590 x 0.335 x 0.040	0.648	1.50E+10	1.47E+10	-1.78
WR-34	0.420 x 0.250 x 0.040	0.432	2.20E+10	2.21E+10	0.45
WR-28	0.360 x 0.220 x 0.040	0.356	2.65E+10	2.68E+10	1.27
WR-22	0.304 x 0.192 x 0.040	0.284	3.30E+10	3.35E+10	1.65
WR-19	0.268 x 0.174 x 0.040	0.239	4.00E+10	4.00E+10	-0.08
WR-15	0.228 x 0.154 x 0.040	0.188	5.00E+10	5.08E+10	1.54
WR-10	0.180 x 0.130 x 0.040	0.127	7.50E+10	7.51E+10	0.19
WR-4	0.103 x 0.0815 x 0.030	0.055	1.70E+11	1.75E+11	2.79
WR-3	0.094 x 0.0770 x 0.030	0.043	2.20E+11	2.21E+11	0.45

For a cosine curve, when $x = cos\ z$, the distance for one period (wavelength) along the z-axis is 2π radians. The amplitude of the wave x, which is the radius of the helix or the amplitude of its wave, equals one and the diameter equals two. The distance traveled for one wavelength is $\lambda = 2\pi$, therefore,

$$d/\lambda = 2/(2\pi)\ , \text{ or } d = \lambda/\pi. \tag{5}$$

The two-dimensional side view of photon travel will appear as a sinusoidal wave, refer back to Fig. 1b.

$$x = cos\ z. \tag{6}$$

One must question what causes a photon to travel in a helical trajectory. Newton's first law of motion, as translated from the Latin in which the Principia was written, was as follows, "*Every body contin ues in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed on it* ." It could be argued that this theory violates Newton's first law of motion. However, there is no violation if a force is imposed on the photon. It is proposed that the photon's high velocity in combination with its high angular momentum or gyroscopic spin quality, yields a three-dimensional $45°\angle$ skewed gravitational field restraining force. This skewed gravitational field and force, henceforth called the Rama mass and force (named after the great warrior of the Ramayana), compel the photon into helical travel rather than uniform motion in a straight line (see Fig. 2). The Rama force is not mysterious; it simply represents the restraining force of the photon's skewed gravitational field.

In reference to Fig. 1a, it is interesting that the photon always strikes an object at a $45°\angle$ relative to its incidence of travel. This explains why photons are so easily reflected and present undistorted views of the objects observed. Light polarization and interference, discussed later, supports that a photon always hits a surface at a $45°\angle$ relative to its incidence of travel. The experiment by He [7] also shows that photons travel in helical trajectories.

2.2 Relativistic mass and the Rama mass

When discussing the mass of a photon, Einstein's relativistic mass must be considered. Relativistic mass approaches infinity as a particle of ponderable mass nears the speed of light. The present theory is based on a photon having a rest mass. With this theory, Einstein's correlation applied to the photon therefore yields an infinite relativistic mass at the speed of light.

$$m_r = m_o /[\ 1 - (\ v/c\ )^2\ ]^{\frac{1}{2}}, \tag{7}$$

where, m_r is the relativistic mass, m_o is the particle rest mass v is the velocity of the particle, and c is the speed of a light wave.

Although relativistic mass works for a photon in free space, it negates superluminal travel. It is proposed that the Rama mass and force is what increases with speed, not the mass of the photon. When the photon reaches its maximum speed $\sqrt{2} \times c$ in free space, the restraining Rama force equals the photon's forward force and limits the photon's velocity accordingly,

$$F_p - F_R = 0. \qquad (8)$$

where F_p is the Photon force and F_R is the Rama force. The photon's gravitational field (aggregate mass) and the photon itself are considered to be ponderable mass particles. They are also radiant energy particles, so in free space they must be traveling at light wave speed. At light wave speed, half the photon rest mass wants to travel in one direction and the other half, the Rama mass, in the opposite direction (refer back to Fig. 2). Therefore, at light speed, the mass of the photon and the Rama mass must be identical.

$$m_p = \tfrac{1}{2}m_p + m_R. \qquad (9)$$

where m_p is the photon rest mass and $m_R = \tfrac{1}{2}m_p$ is the Rama mass.

2.3 Superluminal velocities

Many physicists have negated superluminal signals for fear of causality violations (e.g., communication with the past). Based on first principles, for observation purposes photons are merely signal carriers. For example, suppose that there is a tree on a distant planet ten light years away and that a powerful telescope allows us to observe that tree. When we look at the tree we see it not as it appears now, but as it appeared ten years ago. The reason for this delay is due solely to the speed of the signal. Now suppose that the speed of light is infinite. What happens now if we looked at the tree? We do not have a mechanism to communicate with the past, we merely see the tree as it is in the present. On this basis, superluminal speeds can in no way violate causality.

In recent times, many researchers have measured superluminal velocities, so it is known that they exist. One might refute superluminal velocities by saying that they are phase velocities and not signal (group) velocities. We now know that this is not the case. Further, the present theory negates the notion of group and phase velocities as a misreading of experimental data.

Ranfagni and his colleagues at the National Institute for Research into Electromagnetic Waves measured superluminal velocities. Experiments[8] were performed with microwave launchers and receivers that duplicated the earlier work of Ishii and Giakos [9]. In the Ranfagni experiments, a microwave frequency of 9.5 GHz was transmitted. The accuracy of time measurement was ±0.1 nanosecond. When the launcher and receiver pyramidal horns were in axial alignment, light wave speed was measured. When they were offset from axial alignment, shorter delay times were measured that translated into superluminal velocities. Many experiments were performed and the tests resulting in the fastest velocities were those when the launcher and receiver were the closest together in an offset configuration.
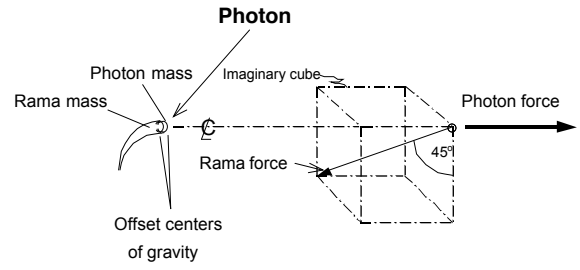
Rama Force - 3 dimensional 45 ° angle restraining force opposes photon force. Force is created by high speed of photon, and angle of force is created by photon high angular momentum or spin.
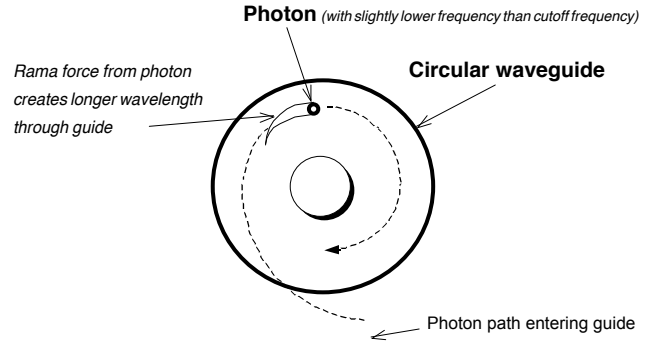

Fig. 2. Rama force effect of photon traveling through a circular guide.

The Rama force provides insight into why such high velocities occur. The free space helical diameters of the transmitted microwaves were about 1 cm and the waveguide inside width was 2.286 cm. With the frequency transmitted, the microwaves had degrees of freedom to bounce back and forth off the launcher waveguide walls. Waves transmitted when the horns were aligned showed light wave speed, so these waves did not bounce off the walls but were transmitted in straight lines from launcher to receiver. When the horns were offset, it is proposed that the waves that were bouncing off the launcher guide walls were measured. These bouncing waves would have traveled through the launcher guide at speeds less than c. This phenomenon is seen for microwaves with wavelengths less than twice the width of the guide (so-called group velocity waves). It is proposed that the repulsive Rama force provides added thrust to the bouncing photons as they exit the guide and repel off the angled bottom plate of the launcher horn, (see Fig. 3). This postulation is supported based on the fact that the greater the distance between the offset horns, the slower the superluminal speeds measured.

From the Ranfagni data, one could roughly plot the distance between launcher and receiver versus superluminal velocity.
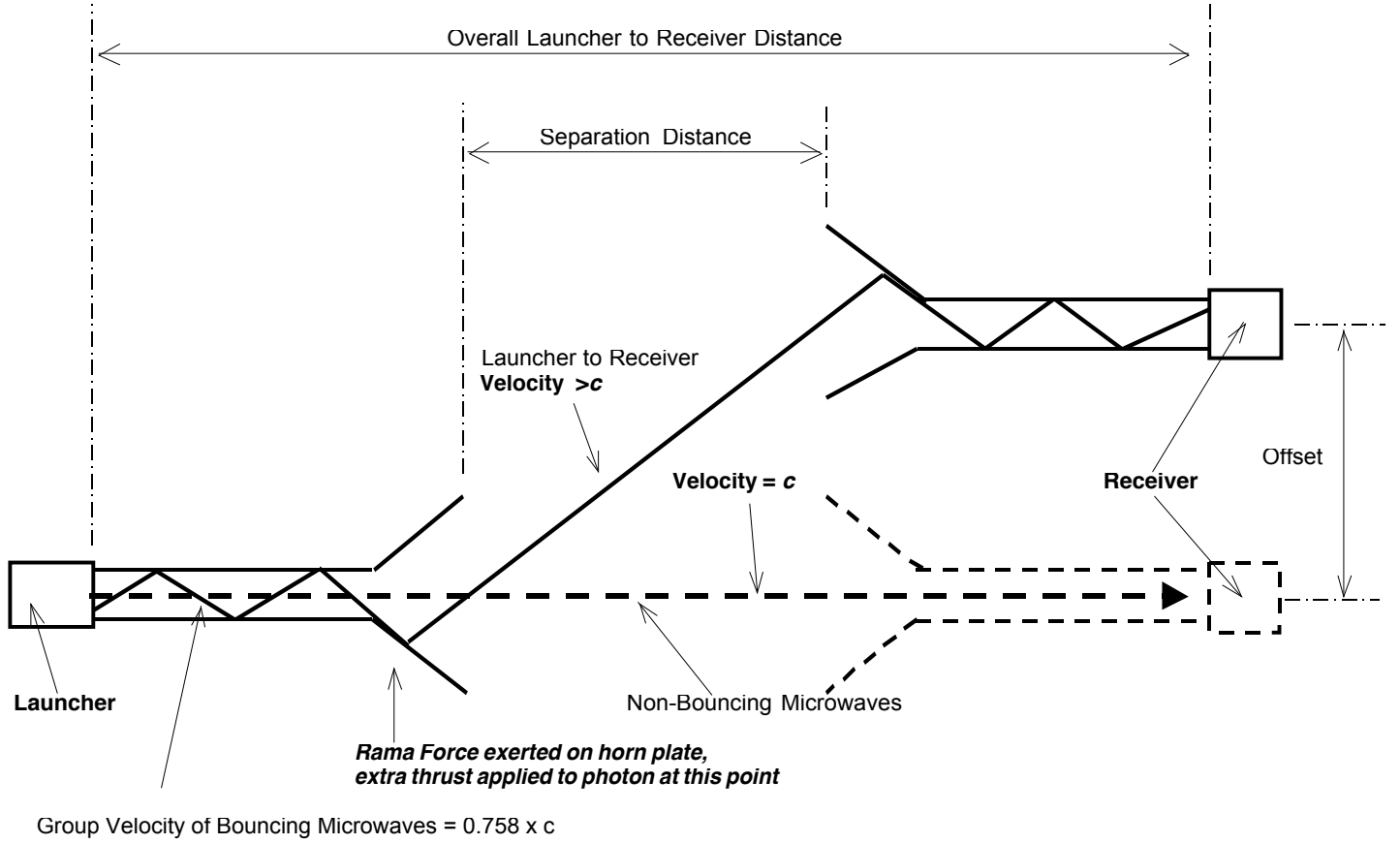
Figure 3. Ranfagni experiment [8] schematic showing Rama force effect on bouncing microwaves.

The reported value of 0.785c was used for the bouncing photon waves through the launcher waveguide. The hypotenuse distance between launcher and receiver was based on the separation of the waveguide centerlines and their offset distances. The speed through space and the receiver waveguide were considered identical. This may not be the case but the photon speed through the receiver waveguide is unknown. Various regression analyses were completed for two horn configurations. A power analysis gave the best curve fit for the data, see Fig. 4.

$$Vs/c = 13,417/d^{1.9426} \qquad (10)$$

where, Vs is the superluminal velocity, c is the velocity of a light wave in free space, and d is the distance between launcher and receiver.

The R^2 coefficient of determination for this curve was 0.9093 and the closer this value is to 1.0, the more accurate the fit. The curve is a very good data fit.

Since radiation reduces as the square of the distance, another plot was developed based on this assumption. The best fit to the trendline (see Fig. 4) was the following correlation,

$$Vs/c \cong 17,500/d^{2}. \qquad (11)$$

With either correlation (10) or (11) the thrust of the Rama force is infinite at zero time.

$$F_R = m_R \times a = m_R \times v/t, \text{ or}$$

$$F_R = m_R \times (\sqrt{2} \times c)/t \qquad (12)$$

where F_R is the Rama force, m_R is the Rama mass, v is the velocity ($\sqrt{2} \times c$) of the photon, and t is time. Therefore, when $t \to 0, F_R \to \infty$.

The added thrust to the photon initially yields a photon superluminal speed, but in its subsequent free space travel, the restraining Rama force quickly slows the photon to its equilibrium wave speed. The photon and its Rama mass can never be separated.
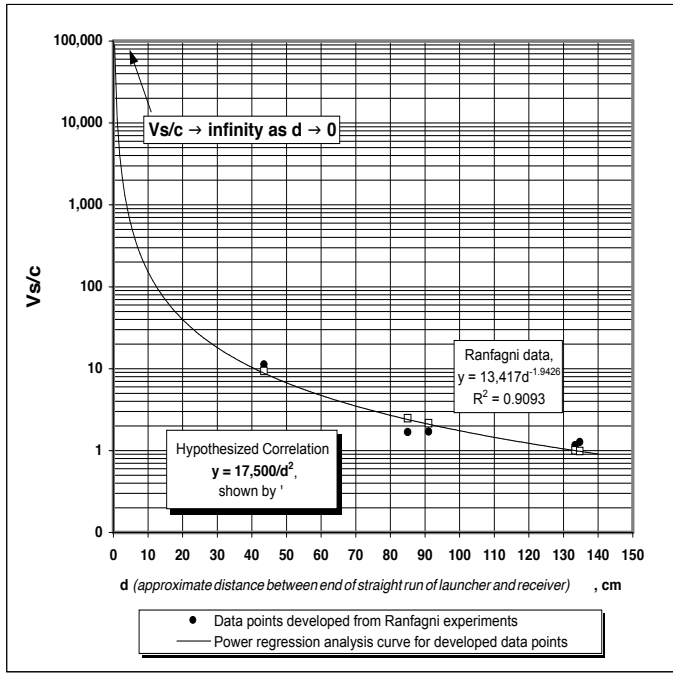
Fig. 4. Superluminal velocity versus distance between microwave launcher and receiver.

The Rama mass (gravitational field) is superimposed over the photon and would have the same center of gravity as the photon, if the photon were at rest. At a rest position, d is zero and the gravitational pull is infinite.

$$F = (Gm_p m_R)/d^2, \qquad (13)$$

where, F is the attractive force between masses, G is the gravitational constant, M_p is the Photon mass, M_R is the Rama mass, and d is the distance between the masses.

There is much more evidence of superluminal travel. Desalvatore [10] stated that low frequency cutoff waves exceed the speed of light. The waveguide analysis presented earlier supports this observation. For most guides, predicted cutoff frequencies were slightly higher than published values, showing that the helical diameters of the cutoff frequency waves might be slightly larger than the inside width of the guide. A linear regression analysis of the inside width of the waveguides compared to their respective cutoff wavelengths was completed for 24 of the 25 waveguides shown in Table 1. The trendline fit was

$$\lambda = 3.2098 \, d, \qquad (14)$$

where d is the inside width of the guide.

This correlation yielded an R^2 coefficient of determination of 1.0000, an exact data fit (see Fig. 5). Published data for the eliminated guide could be in error, reported cutoff frequencies for certain guides historically have not been precise. The correlation shows that larger helical waves may be transmitted through waveguides than one would predict based on free space travel. Using the free space correlation, $\lambda = \pi d$, with the waveguide correlation, $\lambda = 3.2098d$, the superluminal speed of the cutoff wave through a guide may be calculated. A photon in free space with a wavelength of 3.2098 can be transmitted through a rectangular guide with an inside width of 1.0. If there were no wall effect, the cutoff wavelength would be π, not 3.2098. The speed of the low frequency cutoff wave through the guide is $(3.2098/\pi) \times c$. The speed of the wave is equal to λv, so the cutoff wave travels through the guide 2.2% faster than the measured speed of light.

The reason that lower frequency waves may be transmitted is postulated to be due to the Rama force. As a photon with a helical diameter slightly larger than the inside width of the guide, starts to enter and approach the wall of the guide, the three dimensional 45 ° $\angle$ Rama force on its trailing side will push it away from the wall, refer to Fig. 2. The helical diameter of the wave will then be slightly smaller, and the wavelength longer than it is in free space. Other evidence that this force will accelerate a photon is that the free space correlation, $d = \lambda/\pi$, is less accurate in predicting cutoff waves for circular guides. For circular guides the following empirical correlation [11] is used.

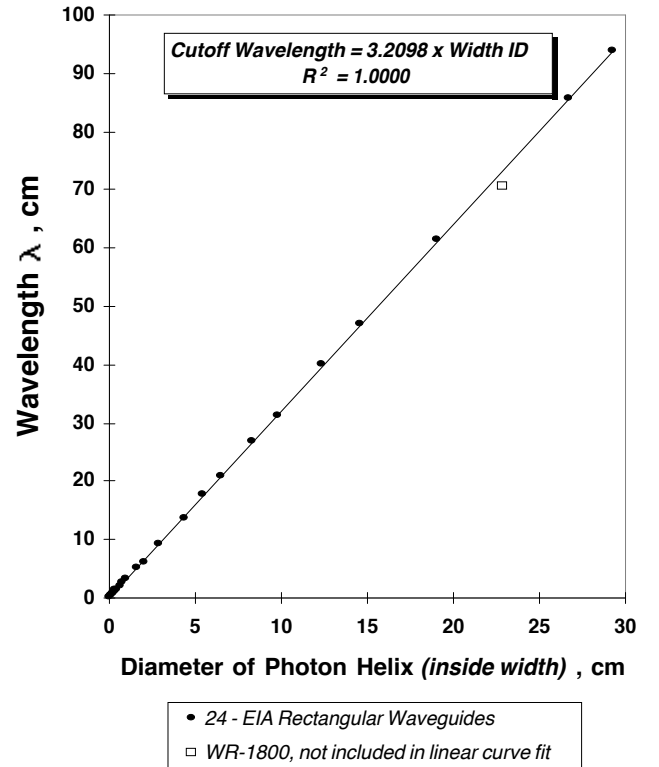$$d = \lambda/3.412 \qquad (15)$$

Fig. 5. Regression analysis of cutoff wavelength versus diameter of photon helix.

Using $\lambda = \pi d$ for free space travel with the circular waveguide correlation $\lambda = 3.412d$ and assuming constant frequency, the speed would be $(3.412/\pi) \times c$, some 8.6% faster than the speed of light. Unlike a rectangular guide, with a circular guide the Rama force comes into play completely around its inside circumference. This allows even lower frequency waves to be transmitted. The Rama force is probably what allows waveguides to work in the first place, photons being shoved away and propelled through the guide rather being absorbed into the guide walls. By adding a coned entry to a circular guide, microwaves with even lower frequencies could be transmitted and even faster guide superluminal speeds measured.

Still others have measured superluminal speeds. Nimtz[12] announced in March, 1995 that microwave signals (Mozart's 40th symphony) moved through 12 cm of space at a speed of $4.7c$. Chiao[13] measured superluminal tunneling photon (visible light) travel, recording speeds of $1.7c$. Herbert states [14], "*Inside a plasma light itself (radio waves construed as low - frequency light) travels faster than light!* ". The following statement [15] was made concerning a specific quasar, "*The source appears to have expanded in size about 35 l.y.* (light years) *in only four years. This is an example known as superluminal radio sources.* "

2.4 Confirmation of helical travel through fiber optics analysis

Fiber optics technology was examined to see if helical travel applied to light transmission. Maxwell's equations for homogeneous core dielectric cylindrical waveguides are used to determine the optical fiber sizes for the transmission of light. For single light wave mode propagation, the equations may be reduced to provide the working equation [16],

$$a = (V\lambda) \div [\ 2\pi n_1 (\ 2\Delta\ )^{\frac{1}{2}}\ ]. \qquad (16)$$

Although not previously recognized, the helical travel correlation is incorporated into this equation; by rearranging the working equation and solving for the diameter of the core d, one obtains

$$d = (\lambda/\pi)\ \times [\ V \div n_1 (\ 2\Delta\ )^{\frac{1}{2}}\ ]. \qquad (17)$$

Where, a is the radius of the fiber core, d is the diameter of the fiber core, λ is the wavelength of light in free space, V is the value of the fiber, n_1 is the refractive index of the fiber, and Δ is the relative refractive index difference between the fiber core and cladding (fraction) The helical diameter of a light wave in free space (λ/π) is the only constant in this working, adding more validity to the helical travel mechanism.

The helical diameter of a light wave in free space (λ/π) is the only constant in this working, adding more validity to the helical travel mechanism.

2.5 Helical travel, experiments by others

When this theory was conceived in the early 1980's, little support could be found concerning helical travel. Only the photomultiplier tube experiments and Feynman's probability analysis of photon travel were somewhat supportive.

In the mid-eighties and now in the nineties, others have provided more support. In 1986, Engler[17] completed experiments on the transmission of microwaves through rectangular aluminum slits. His findings showed that the width of the slit, relative to the longest wavelength that could be transmitted, was defined as λ/π. The accuracy of this correlation was within ±0.5 percent error, not dissimilar in accuracy although slightly better than that found for rectangular waveguides, refer to Table 1. With a slit there is less wall effect on photon travel than that for a rectangular guide so the increased accuracy is very understandable.

In 1995, H. He[7] investigated the transfer of angular momentum by laser photons. In the experiments, a coherent light beam was passed through kerosene containing dispersed 1 to $2\ \mu\ Tc$ superconductor ceramic powder. Microscopic holography was used to observe the rotation of the absorptive ceramic particles. The holographic camera showed that angular momentum was transferred from the laser photons to the particles. This proved that a circularly polarized beam of light carries angular momentum. The present theory is based on a photon having a rest mass; it fits nicely within the results of this experiment.

A computer generated three-dimensional view of the laser travel showed two helical waves intertwined with one another. He[18] relayed, "*This figure shows the energy flux. As a result, we have two peaks. When you work out the contour of intensity, you would get two peaks but it is just one helical wave.*" The present theory dictates that there are two intertwining photon waves with one wave 90° out of phase with the other but within the same helical diameter. If the two helices represented only one photon wave then the photomultiplier tests would have shown that a photon could be split.

2.6 Other helical travel theories

Based on Engler's experiment in 1989, Hunter and Wadlinger [19] developed a model for the photon, a so-called "wavicle" model that defined the photon as having a diameter of λ/π. In the same year, Deutsch[20] developed a theory that a photon was a dipole with spacial dimensions defined within the travel constraints of λ/π. Hautot[21] in 1990 also described the photon as an electric doublet whose travel was defined within the helical constraint of $d = \lambda/\pi$. Meno[22] described a photon as having a diameter of λ/π.

This theory is different than the above models. It is based on a photon having a rest mass and a velocity that is the $\sqrt{2}$ times the speed of its helical wave, c. The photon speed, relative to its wave speed is what sets the diameter of its helical wave of travel. *The reason that λ/π works is that the circumference of the photon's helical wave and its wavelength are identical.* Further, the other theories provide no explanations for the photon's discontinuous nature or superluminal speeds.

2.7 Discontinuous nature of photons

The following postulation is presented to provide a reason why photons appear and disappear. Based on the premise that all measurable mass, including photons, has gravity, if a particle of mass is spherical, stationary and of homogeneous density, the gravitational pull into the particle should be uniform around its surface. When particles travel at very high velocities the gravitational field effect changes. For example, a high speed electron traveling through a conductive wire creates a force outside the wire and in the opposite direction of its travel. This force (current) is repulsive and mass is pushed away from the speeding electron. An electrical solenoid provides a simple working example of this repulsive force effect.

Gravity shows that the same phenomenon applies to small photons. For visualization purposes, consider the earth as an example. It is postulated that small subatomic particles (photons) are continually being ejected from the atoms that make up the earth's mass. When these small photons are ejected, they travel outward in very large helical diameters from the earth's surface. Like that postulated for high speed electrons, smaller photons are emitted from the trailing sides of of these photons. The smaller photons, traveling in helices back toward the earth, create the "current-like" Rama force that pushes downward on the earth's surface to produce the gravity effect.

It is generally agreed that a photon is electrically neutral. Therefore, any small particles absorbed by the photon must be immediately radiated away for it to maintain its neutral charge. With this theory, radiation from a photon can only occur on its trailing side. The photon and the smaller particles trying to escape from it are traveling at the $\sqrt{2} \times c$. Smaller particles could never escape the leading edge of the photon because the photon would always overtake them to prohibit their escape.

This means that a photon cannot be detected when it travels toward an observer. There is no transport mechanism that allows observation. When traveling toward an observer, a photon is completely non-detectable (the ultimate black hole in its direction of travel). The photon can only be observed as it travels away from an observer. Therefore, from a side view its travel will appear to be discontinuous - appearing and then disappearing! Since a photon is traveling at the $\sqrt{2} \times c$ the side view detectable arc has to be less than one-half of its total wavelength.

2.8 Photon zero charge

As mentioned, it is generally accepted that a photon is electrically neutral. It is postulated that a strong opposing Rama force is created in the opposite direction of photon travel. This force creates the condition that when any small particle hits a photon it will be quickly spewed out of its lagging side. The strong pull created on the photon by the Rama force provides an explanation of why a photon cannot retain a charge.

2.9 Polarization of light

One way to show the polarization of light is the process of reflection. When light strikes a reflective surface, there is a preferential reflection of those waves perpendicular to its plane of incidence. At the polarizing angle no light is reflected except that which is perpendicular to its plane of incidence. Of the photons hitting the surface, about 15% are reflected if the reflecting surface is glass. The reflected light is weak but completely polarized.

Sir David Brewster discovered that if n is the index of refraction of the material in which light is traveling before reflection, and n' is the index of refraction of the reflecting material, the polarizing angle ϕ_p follows the correlation,

$$\tan \phi_p = n/n' \quad \text{(Brewster's Law)}. \tag{18}$$

If n is equal to n', then the reflecting surface must be at a $45°\angle$ relative to the angle of incidence of the light striking the surface. This angle of refection supports the postulation of a three-dimensional $45°\angle$ restraining Rama force. The only other way that light could be reflected in this manner is that photons would have to be traveling in straight lines. Waveguide experience refutes straight-line travel.

Vertical lines of reflection are set by the molecular arrangement of glass. Although the makeup of glass is complicated, for ease of visualization assume that its molecular structure is a simple cubic lattice. Photons reflected from molecules located along horizontal planes will show reflected lines of light in vertical planes. Between these molecules, photons will pass through and show the weak polarization effect in horizontal planes due to part of the source light being removed.

2.10 Light interference

The phenomenon of interference is used in the production of so-called "non-reflecting" glass where a thin transparent film is deposited on the glass surface. Based on the normal incidence of monochromatic light, when the film thickness is equivalent to one quarter of the photon wavelength, photons reflected from the first surface are 180° out of phase with those reflected from the second surface and complete destructive interference occurs.

With helical travel, this is explainable. At one quarter of a wavelength, the photon is 90° out of phase with its 0° position and is reflected in a measurable plane that is perpendicular to the

source light. Since light waves, due to its discontinuous nature may be measured longitudinally only, the waves from the second surface are measured as being 180° out of phase with the waves reflected from the first surface. The photon helices intersect, the photons collide, and no light is reflected.

2.11 Diffraction of light

According to geometric optics, when a beam of parallel monochromatic light passes through a narrow slit in an opaque plate onto a screen, the light should be illuminated uniformly on the screen, having an identical cross section to the slit.

However, that is not what happens, instead the beam spreads out and the diffraction (Fraunhofer) pattern consists of a central bright band, which may have a greater cross section than the slit, bordered by alternating dark and bright bands of decreasing intensity. With helical travel, a photon that hits the edge of the slit will be reflected at the same angle that it hits it, thus providing for a wider cross section of illumination. The alternating dark lines are due to the light interference created by photons hitting the edge thickness at various points in their helical arcs of travel. Certain helical paths will then destructively interfere with one another.

2.12 Photon characteristics

The energy carried by the photon is defined by $E = hv,$ with h being Planck's constant and v the frequency of the wave. With helical travel it is easy to see why Planck's constant works. Energy is directly proportional to mass and so is wave frequency. With acceptance of this theory, all three energy correlations; $E = \frac{1}{2}m_o v_p^2$, $E = m_o c^2$, and $E = hv$ become one, the only differences are the frames of reference. With this theory, for a photon with lesser mass, the energy level is less, the wavelength is longer and the helical diameter is larger. Radio waves can have helical wave diameters that are greater than 3×10^5 cm, approximately two miles. At the other end of the spectrum, x-rays can have helical waves that are less than 3×10^{-9} cm, three billionths of a centimeter.

3. FURTHER EXPERIMENTAL CONFIRMATION OF HELICAL TRAVEL

The present theory can be further verified through a simple laboratory test. The test apparatus will include an annular cylindrical waveguide consisting of an outer tube with a solid inner cylindrical core. A limited range of microwaves will be generated for entry into the guide. The low limit will be set to a frequency slightly lower than the low frequency cutoff. The high limit will be set at a frequency to yield helical diameters that are smaller than the inner core diameter but larger than the radial distance between the core and the inside of the outer tube. Measurements of the wave frequencies entering will be compared to those exiting the guide. If waves close to the cutoff frequency travel through the guide, and ones with frequencies yielding helical diameters less than the diameter of the inner core do not, the only explanation is that the photons traveled around the core in helical trajectories.

4. CONCLUSIONS

This helical travel theory is premised on a photon being a small particle of ponderable mass that is traveling faster than its measured helical wave, c. Further, kinetic energy, applies to all particles regardless of speed. By equating kinetic energy to a redefined electromagnetic energy, a photon speed of $v_p = \sqrt{2} \times c$ was obtained. Based on the relative speed of a photon to its helical wave, a correlation was developed $(d = \lambda/\pi)$ that defined the helical wave diameters of all photons traveling in free space. This correlation was used to accurately predict the low cutoff frequencies for a wide range of microwave waveguides. This provided proof that the theory was correct. The theory was further confirmed through assessment of optical fiber light transmission, and by experiments by others.

With helical travel, the discontinuous nature of light, superluminal signals, light reflection, polarization, interference and diffraction are all explainable. The fact that all of the known phenomena of light fit within this one simple theory adds greatly to its validity. Einstein [23] once said, "*The grand aim of all science is to cover the greatest number of empirical facts by logical deduction from the smallest possible number of hypotheses or axioms* ." This is in concert with the wisdom of the great philosophers of the world who state, "*Simplicity and profundity are one* ."

Helical travel presents a clear understanding of the nature of light that was once considered by noted physicists such as Neils Bohr [24] as too complex for human comprehension. The present theory will be difficult for many to accept for it negates the esoteric aspects of particle physics. In agreement with Newton, a prime tenet of this theory is that anything within the physical realm, that can be repeatedly measured or observed, can be explained within the constraints of three dimensions and time. Once accepted, this theory will revolutionize particle physics and developments within cosmology, electricity and magnetism should be rapid and dramatic.

Résumé

L'essentiel de cette théorie est que tous les photons sont des particules de masse finie qui se déplacent dans des trajectoires hélicoïdales bien définies. Pour chaque photon, le diamètre de l'hélice peut être calculé en divisant sa longueur d'onde par p ($d = l/p$). De plus, une particule de lumière se déplace à une vitesse qui est égale à la racine carrée de deux fois la vitesse de son onde hélicoïdale, $\sqrt{2} \times c$.

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