Exponential Law of Light – A Mystery

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Abstract

This paper reveals a mysterious exponential law governing the observed behavior of light. A new term is introduced: $e^{V/c}$. Existing theories of light involve the terms like $c + V$, $c - V$, $c^2 - V^2$, $(c^2 - V^2)^{1/2}$. No existing theory of light gives a complete, clear and explicit explanation for values of $V \geq c$ and the significance. Special Relativity Theory (SRT) imposes an artificial constraint that nothing can move faster than the speed of light. Ether and emission theories do not address the case of $V \geq c$. In emission theory, $V \geq c$ implies a bizarre consequence of light being dragged by its source. A formula of a true law of nature should return valid values representing real physical quantities for all valid values of its variables. It should allow all valid values of its variables. This has never been the case for light. For material waves, the condition $V \geq c_m$ represents real physical quantities and phenomena. For sound waves, this represents shock waves and supersonic flight. Therefore, a true theory of light should at least fulfill the following conditions: 1. should be able to explain all conditions: $V = 0$, $V < c$, $V = c$, $V > c$, $V = \infty$, both for receding and approaching source observer relative motions, with a single formula. 2. Doppler effect: $\lambda' = \lambda$ for $V = 0$, $\lambda' = \infty$ for $V = \infty$ (receding) , $\lambda' = 0$ for $V = \infty$ (approaching) 3. Constant phase velocity: $\lambda \cdot f = \lambda' \cdot f' = c$. I already proposed the following theories in my previous paper[1]: 1. Both notions of motion and space (absolute and relative) are valid. But the ether doesn't exist. 2. A universe without matter (massive cosmic objects) is Galilean space and Galileo's principle of relativity applies to such a space. 3. Our real universe contains billions of stars and galaxies. Every massive cosmic object (galaxies, stars, planets, ..) defines the space in its vicinity, with its influence diminishing with distance. Thus all cosmic objects in our universe have collectively created an absolute space. Many experiments have already detected absolute motion, including the Silvertooth, Marinov, CMBR frequency anisotropy measurement, Ronald de Witte experiments. 3. The effect of absolute motion is to create a change in path length, and not the speed, of light. The speed of light is constant relative to the apparent source, not relative to the real source. The effect of absolute motion is to create an apparent change in the *past* position of the light source, relative to an observer. This theory reveals the fallacy in the conventional and modern Michelson-Morley experiments. 4. This theory explains why the measured speed of light was always independent of the velocity of its source, for source and observer in relative motion. The effect of absolute motion of the source is exactly canceled by the change in path length of light. 5. The phase velocity of light is always constant, both in Galilean space and in absolute space, where as the group velocity is variable. These theories explained most of the century old problem of absolute vs. relative and the puzzle of the speed of light. However, a few experiments and facts remained 'anomalous' . One of this is the red shift in the Ives Stillwell experiment. Related ones are the 'GPS correction' and 'time dilation' experiments. The effort to resolve this anomaly led to the discovery of the problem with the terms such as $c + V$, $c - V$, $c^2 - V^2$, $(c^2 - V^2)^{1/2}$ in existing theories of light. It has been discovered that it is impossible to explain all possible conditions mentioned above (i.e. $0 \leq V \leq \infty$, ..) with theories and formulas involving these terms. Search for the alternative single formula finally led to the discovery of the term: $e^{V/c}$ governing all observed behavior of the speed of light.

Doppler effect: $f' = f \cdot e^{V/c}$, $\lambda' = \lambda \cdot e^{V/c}$

Absolute motion: $D' = D \cdot e^{V/c}$

For $V \ll c$, the above formulas give the same result as conventional formulas containing the terms $c + V$, $c - V$, $c^2 - V^2$, $(c^2 - V^2)^{1/2}$, with a typical error of 0.00017 % (for absolute velocity Vabs = 390 Km/s) . The new formula for Doppler effect predicts exactly the same red shift as Special Relativity : $\frac{1}{2} \beta^2$, in the Ives Stillwell experiment.

Introduction

So far there is no theory of the speed of light that can truly explain *all* experiments and observed phenomena on the speed of light. Special Relativity Theory (SRT) is claimed to have been tested to a high degree of precision. On the other hand, many experiments have detected absolute motion and hence have shown that SRT is wrong, such as the Sagnac and Michelson -Gale, the Silvertooth, the Marinov, the CMBR frequency anisotropy measurement, the Ronald de Witte and many others.

The biggest failure of SRT is that it is counterintuitive, becoming a source of paradoxes and unrealistic (imaginary or abstract, mathematical) things.

The ether hypothesis was conclusively disproved by the null result of the Michelson- Morley experiment (MMX) and this has been also taken as non-existence of absolute motion. The 'ether' and 'absolute space' have always been (wrongly) perceived to be the same and the two terms being used interchangeably. Many people feel that the ether hypothesis was unnecessary in the first place. The notion of absolute motion existed since Newton but its real meaning remained obscure, i.e. the 'relative to what' puzzle. Galileo's principle of relativity was another view of the universe. The two views existed together for centuries.

The emission theory was disproved with the many experiments that confirmed the independence of the velocity of light of the velocity of its source. Einstein also abandoned the emission theory due to 'complications' it creates.

Despite their failures, the three main theories of light, namely SRT, emission theory and ether theory and the two notions of space and motion, absolute and relative, were each successful in special cases. In SRT, Einstein's light speed thought experiment is extremely compelling and beautiful. Galileo's principle of relativity is also very attractive. Emission theory is a natural, logical explanation of the null result of Michelson-Morley experiment. Ether theory is the most straight forward explanation of moving source experiments and the Sagnac effect. Unlike SRT, the ether and emission theories are intuitive, logical and natural.

Clearly, we see that each of these theories has both compelling and intolerable or unsatisfactory features.

Ever since the null result of the MMX, a great controversy went on between the proponents of each theory, with one rejecting the other theories. Apparently, SRT has long won the battle and the ether and emission theories have already receded into the background. Today the minority proponents of ether and emission theories are labeled as 'cranks'.

In spite of all claimed successes of SRT, however, the mystery of absolute vs. relative and the puzzles with the speed of light remains unresolved to this day.

But no one ever asked an important question:
is it possible that a single theoretical framework exists that seamlessly unites all existing views and theories of space, motion and the speed of light?

While working to reconcile the Michelson-Morley experiment and the Sagnac effect, I came across an idea that turned out to be a fusion of the ether (absolute space) and emission theories.

The effect of absolute motion is to create a change in the path length, and not the speed, of light.
The effect of absolute motion is to create an apparent change of <u>past</u> position of a light source, relative to an observer.

Pursuing this single idea I was able to understand, explain and reconcile the many experiments and phenomena of the speed of light which have always been seen as contradictory to each other, in a compelling way. A full explanation of the theory is given in my previous paper [1]. We refer to the theory as Apparent Source Theory (AST).

If the proponents of the three theories made an early effort to reconcile their views and theories, this may have changed the history of physics of the last century.

Despite its compelling successes, however, a few experiments and facts remained anomalous to the Apparent Source Theory. One of these is the Ives Stillwell experiment and it was the attempt to explain this experiment that led to the discovery of the Exponential Law of Light (ELL). The other related 'anomalies' are the 'GPS correction' and 'time dilation' experiments and I hope that the ELL theory can explain these too . In this paper, however, we examine only the Ives Stillwell experiment.

Next a brief review and summary of my paper [1] will be made before going to the new discovery that is the subject of this paper. The AST is presented here briefly to give a complete picture of the whole proposed solution. This paper simply completes the AST theory.

1. The notions of absolute space / absolute motion and (Galilean) relativity are both valid. However, the ether hypothesis is unnecessary and the ether does not exist.
2. Universe without matter (cosmic massive objects) is Galilean space and Galileo's principle of relativity applies to such a space.
3. The space in our real universe is absolute. Every cosmic massive object (galaxy, star, planet, ..) defines or 'fixes' the space in their vicinity, with their influence diminishing with distance. Therefore, all massive objects in our universe collectively formed the absolute space. This theory resolves the centuries old puzzle: relative to what is the absolute velocity of an object determined? To answer this question, imagine a universe in which only a single massive object (e.g. the Sun) and a small comet exist. Assume that the Sun and the comet are near to each other and in relative motion. Which one is in motion: the Sun or the comet ? Suppose that the mass of the comet is only 10, 000 Kg. It is the comet that is in (absolute) motion, not the Sun ! The mass of the Sun is 1.988×10^{30} Kg !!! Due to its enormous mass, the Sun defines or 'fixes' the space in its vicinity and any small object in motion relative to the Sun (in the vicinity of the Sun) will *also* be in absolute motion ! If it was possible to fix two devices capable of detecting absolute motion to each object, the device fixed to the sun would read zero absolute velocity,

where as the device fixed to the comet would read an absolute velocity that is nearly the same as the relative velocity in the vicinity of the Sun. Note that if the comet is far away from the sun, i.e. outside the sphere of influence of the Sun, the absolute velocity of the comet will reduce towards zero even if the relative velocity remained the same.

The absolute velocity of an object is the mass and distance weighed vector sum of the velocity of the object relative to all massive objects in the universe.

4. The effect of absolute motion of co-moving light source and observer is to create an apparent change in the position (distance and direction) of the light source relative to the observer. The effect of absolute motion is to create a change in path length, and not the speed, of light. The speed of light is constant relative to the apparent source and not relative to the source.
Consider a light source S and an observer O co-moving absolutely to the right.
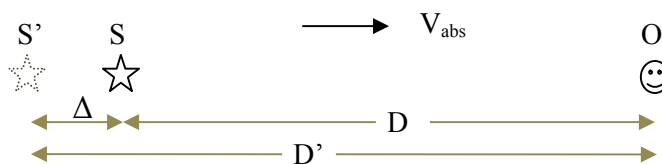
The new interpretation is as follows: since there is no common medium relative to which both the light wave and the observer are in motion, the observer is considered to be at rest if he/she is at rest relative to the light source, hence if at rest relative to the apparent source. With regard to this experiment, any motion of the observer has effect only if there is source observer relative motion. Therefore, the absolute velocity of the light source and the source observer relative velocity determine the outcome of the experiment. In the present case, there is no source observer relative motion. A simple and important way to study this theory is to follow the next procedure:
1. Determine the apparent position of the light source *relative to the observer*.
2. Replace the real source with the apparent source, at the apparent position.
3. Analyze the experiment by assuming emission theory (Galilean relativity)

We determine the apparent position of the source as follows. During the time that the source 'moves' from position S' to position S, the light moves from position S' to the observer O. Therefore,

$$\Delta / V_{abs} = (D' - D) / V_{abs} = D' / c \qquad D' = D. c / (c - V)$$

Note that the word "moves" is quoted to avoid confusion with the ether theory. We may understand this as: Δ is the distance the source moves during the time that light starts from position S' and reaches the observer O, if the ether theory *was* true. This is only an interpretation.

For the case of an observer and source absolutely co-moving to the left:
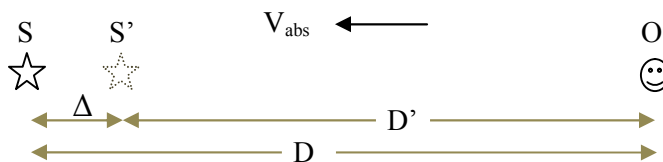
$$\Delta \, / \, V_{abs} = (\, D - D' \,) \, / \, V_{abs} = D' \, / \, c \qquad D' = D \cdot c \, / \, (\, c + V \,)$$

Now we can apply this principle to construct a device capable of detecting absolute motion, using *two* light sources.

$$V_{abs} \longleftarrow$$
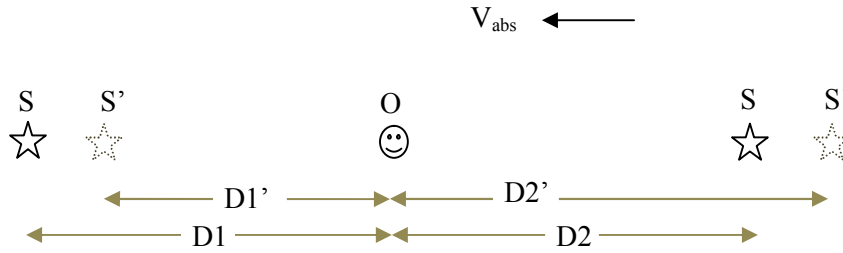
We see that D2' > D1' , hence a fringe shift will be observed. This shows the fundamental flaw with the Michelson-Morley experiments: the use of a single light source.

Now we can easily apply the above theory to explain the Sagnac effect and the null result of the Michelson-Morley experiment.
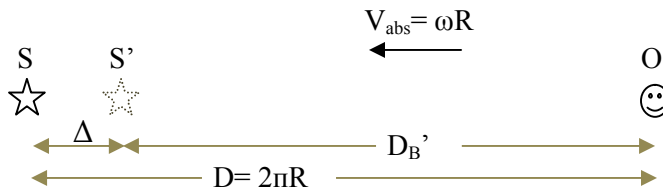
Consider the Sagnac device.
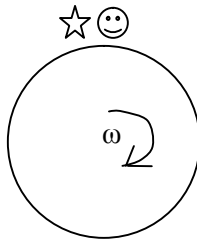
We can see the Sagnac effect as two different cases:

1. An observer chasing the light source (for the backward beam)
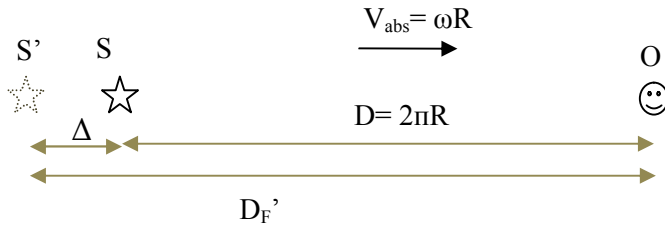2. A light source chasing an observer (for the forward beam)

The backward beam

We "unwind" the device assuming that the effect is the same as for translational motion.

$$V_{abs} = \omega R$$

From the previous equation, therefore,

$$D_B' = D \cdot c \, / \, (\, c + V_{abs} \,) = 2\Pi R \cdot c \, / \, (\, c + \omega R \,)$$

The forward beam

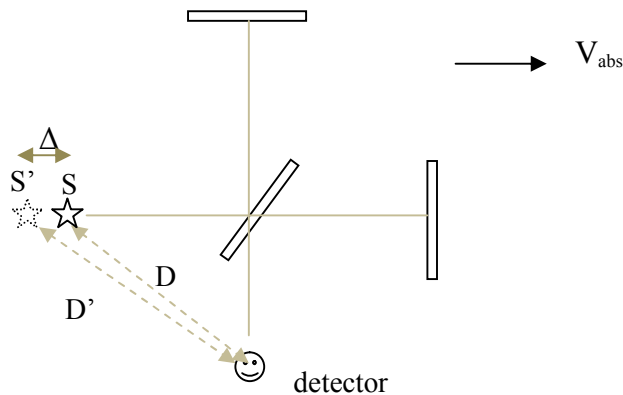$$D_F' = D \cdot c / (c - V_{abs}) = 2\Pi R \cdot c / (c - \omega R)$$

The path difference between the two beams is:

$$\Delta = D_F' - D_B' = [\, 2\Pi R \cdot c / (c - \omega R)\,] - [\, 2\Pi R \cdot c / (c + \omega R)\,]$$

$$= 2\Pi R c\, [\, 1/(c - \omega R) - 1/(c - \omega R)\,] = 4\omega A c / (c^2 - (\omega R)^2)$$

$$= (4\omega A / c) / (1 - (\omega R / c)^2)$$

which is a modified version of the conventional formula for path difference in Sagnac effect.

The Michelson – Morley experiment

The null result can easily be understood from the diagram above. The effect of absolute motion is to create an apparent change in the position of the source *relative to the observer*.

We restate the procedure of analysis:

1. Determine the apparent position of the light source *relative to the observer*.
2. Replace the real source with the apparent source, at the apparent position.
3. Analyze the experiment by assuming emission theory (Galilean relativity)

To determine the apparent position D' of the source, we *always* use the *direct* distance between the source and the observer, even when no direct light goes from the source to the observer.

We will not go into the detail analysis in this paper as it is already presented in my previous paper [1].

A simple way to understand the theory is to consider the effect of absolute motion as follows. Will actually (physically) changing the position of the source from S to S' result in a fringe shift ? No ! This is obviously because the forward and the lateral beams are affected identically. This was the fallacy of the Michelson-Morley experiment! The conventional Michelson-Morley apparatus is not capable of detecting absolute motion and modern Michelson-Morley type experiments compare frequencies, which are not affected for commoving source and observer, and not phases, which are affected by absolute motion for co-moving source and observer.

The principle of a device capable of detecting absolute motion is shown below.

$$\Delta 1$$
S1' S1

$$V_{abs}$$

D1'

$$\Delta 2$$
S2' S2

D1

D2'

D2
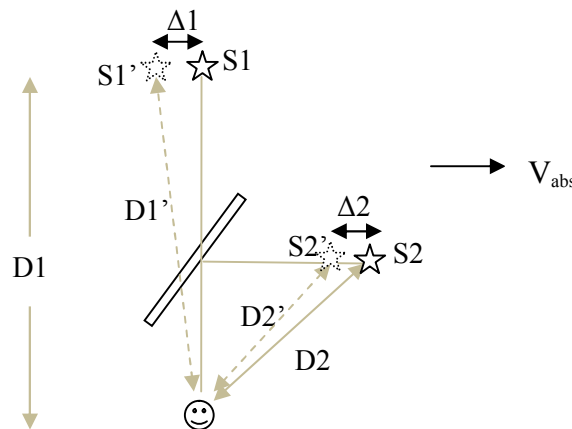
The single source and the two mirrors in the conventional MMX are replaced with two coherent (laser) light sources, S1 and S2. The only problem with the above kind of experiment is that the coherence time of current lasers is limited to the order of one millisecond, where as we need minutes of coherence time. To detect absolute velocity of the earth, we put the device in two orthogonal angular positions and note if a fringe shift occurs and this requires a coherence time of several minutes.

The good news is that this experiment has already been carried out by Ronald de Witte by using Cesium stabilized 5 MHz signal generators and coaxial cables, with positive result.

5. In Galilean space, emission theory holds for *group* velocity. However, the phase velocity is always constant. In our real absolute space the speed of light is independent of the velocity of the source. The paper[1] applies the Apparent Source Theory to explain this.

6. Constant phase velocity and variable group velocity of light.

Assume a light source that is at absolute rest, for simplicity. Consider an observer moving at a velocity c directly away from the source. Einstein's beautiful thought experiments tells us that the light still goes at speed c past the observer. But Einstein never made a crucial distinction in his thought experiment. This

paper[1] proposes this distinction: for an observer moving at the speed of light directly away from a light source, the *phases* still go past the observer with speed c , but the *group* will be frozen. According to paper[1] the wavelength observed by such observer is 2λ . But the new Exponential Law of Light theory proposed in this paper corrects this to be: $e\lambda$, where e is Euler's constant.

The above summary of the paper[1] (Apparent Source Theory) successfully explains the many contradicting experiments and phenomena related to the speed of light and resolves the centuries old confusions surrounding the absolute and relative notions. (I would like to notify the reader that my previous paper requires some corrections as a consequence of the new ELL theory proposed in this paper. Readers are kindly requested to read the latest version, one which will be posted after this paper).

Despite all successes of the Apparent Source Theory, though, a few experiments and facts remained 'anomalous'. The red shift in the Ives Stillwell experiment could not be explained by the AST theory.

Continued effort to resolve this problem resulted in a crucial discovery: the Apparent Source Theory, and all existing theories of the speed of light, do not address or explain the case of $c \geq V$. Special Relativity simply imposes an artificial constraint that nothing can move faster than light.

These led me to define the criteria to be fulfilled by a true theory of light.

1. The formulas should return valid values for all possible valid conditions and valid values of V.
   a. $V = 0$, $V < c$, $V = c$, $V > c$, $V = \infty$ b. approaching and receding source observer relative velocity   c. for all possible absolute velocities

   with a single formula

2. Doppler effect: $\lambda' = \lambda$ for $V = 0$, $\lambda' = \infty$ for $V = \infty$ (receding) , $\lambda' = 0$ for $V = \infty$ (approaching)

3. Constant phase velocity : $\lambda \cdot f = \lambda' \cdot f' = c$

In an attempt to find a single formula that can fulfill the above criteria, I discovered that it is impossible to achieve this with formulas containing the terms $c \pm V$, $c^2 \pm V^2$, $(c^2 \pm V^2)^{1/2}$ e.t.c.

This finally led me to the discovery of the mysterious term: $e^{V/c}$.

The conventional formulas such as

   Doppler effect: $\lambda' = \lambda \cdot (c \pm V) / c$ $f' = f \cdot c / (c \pm V)$

Absolute motion (Apparent Source Theory) : $D' = D \cdot c / (c \pm V_{abs})$

can now be written as :

1. Doppler effect:

   $f' = f \cdot e^{V/c}$ $\lambda' = \lambda \cdot e^{-V/c}$ (V is positive for approaching)

2. Absolute motion (Apparent Source Theory): $D' = D \cdot e^{V_{abs}/c}$

   (V_{abs} is positive for observer in front of source as seen in the direction of absolute velocity.

Next we show that conventional formulas are simply approximations of the exponential formulas given above, for $V \ll c$.

We know that

$$e^x = 1 + x + \tfrac{1}{2}\ x^2 + 1/6\ x^3 + \ldots\ (\text{ for } -\infty < x < \infty)$$

Therefore

$$e^{V/c} = 1 + V/c + 1/2(V^2/c^2) + \ldots$$

Now consider the formula for absolute motion, for commoving source and observer
(Apparent Source Theory, for observer in front of source, as seen in the direction of absolute velocity)

$$D' = D\ e^{Vabs/c} = D\ [\ 1 + V_{abs}/c + \tfrac{1}{2}\ V_{abs}^2/c^2 + \ldots\ ]$$

$$\approx D\ (\ 1 + V_{abs}/c\ ),\ \text{ for } V_{abs} \quad c$$

$$= D\ (\ c + V_{abs})\ /\ c$$

But our 'conventional' formula was

$$D' = D.\ c\ /\ (c - V_{abs})$$

Next we show that $c\ /\ (c - V_{abs}) \approx (\ c + V_{abs})\ /\ c$,
with a typical error of only 0.000169 for Vabs = 390Km/s.

$$c\ /\ (\ c - V_{abs}) = 1\ /\ (1 - V_{abs}\ /c\ )$$

We know that

$$1\ /\ (1 - x) = 1 + x + x^2 + x^3 + \ldots$$

Therefore,

$$c\ /\ (\ c - V_{abs}) = 1\ /\ (1 - V_{abs}\ /c\ ) = 1 + V_{abs}\ /c + V_{abs}^2/\ c^2 + \ldots$$

$$\approx 1 + V_{abs}\ /c \quad,\ \text{for } V_{abs} \quad c$$

$$= (\ c + V_{abs})\ /\ c$$

We conclude that

$$D' = D\ e^{Vabs/c} \approx D.\ c\ /\ (c - V_{abs}) \quad,\ \text{ for } V \quad c$$

Next we see Doppler effect

$$f\ ' = f\ .\ e^{V/c} \qquad (\text{ new formula})$$

$$f\ ' = f\ c\ /\ (\ c - V\ )\quad (\text{ conventional formula})$$

where V is the source observer relative velocity.

We show that the two formulas give the same value for $V \ll c$, with a very small percentage error.

$$f' = f \cdot e^{V/c} = f \left[1 + V/c + \tfrac{1}{2}(V^2/c^2) + \dots \right) \approx f \left[1 + V/c \right], \text{ for } V \ll c$$

$$= f \, (c + V)/c$$

$$\approx f \cdot c/(c - V), \quad \text{for } V \ll c$$

Next we apply the new formula to explain the red shift in the Ives Stilwell experiment.

Doppler shift for approaching ion:

$$\lambda'_A = \lambda \cdot e^{-V/c}$$

Doppler shift for receding ion:

$$\lambda'_R = \lambda \cdot e^{V/c}$$

Average wavelength

$$\Lambda = \tfrac{1}{2}\,(\lambda'_A + \lambda'_R) = \tfrac{1}{2}\left[\lambda \cdot e^{-V/c} + \lambda \cdot e^{V/c}\right]$$

$$= \tfrac{1}{2}\lambda\left[1 - V/c + \tfrac{1}{2}V^2/c^2 + \dots + 1 + V/c + \tfrac{1}{2}V^2/c^2 + \dots\right]$$

$$\approx \tfrac{1}{2}\lambda\left[1 - V/c + \tfrac{1}{2}V^2/c^2 + 1 + V/c + \tfrac{1}{2}V^2/c^2\right], \text{ for } V \ll c$$

$$= \lambda\left[1 + \tfrac{1}{2}V^2/c^2\right]$$

$$\Delta\lambda = \Lambda - \lambda = \lambda\left[1 + \tfrac{1}{2}V^2/c^2\right] - \lambda = \tfrac{1}{2}V^2/c^2 = \tfrac{1}{2}\beta^2$$

This is exactly the value predicted by SRT and confirmed by the Ives Stilwell experiment.

Conclusion

This paper has revealed a mysterious exponential law governing the behavior of light. The Ives Stilwell experiment has always been considered as a crucial evidence for SRT. The theory of Exponential Law of Light (ELL) together with the Apparent Source Theory (AST) can now explain most of the experiments and phenomena of the speed of light, including those which are really inaccessible to SRT.

Thanks to God and His Mother, Our Lady Saint Virgin Mary

References

1. Apparent Shift of Past Position of a Light Source due to Absolute Motion; Absolute Space as Defined by Cosmic Massive Objects; Constant Phase Velocity and Variable Group Velocity of Light*, Henok Tadesse , Vixra

* Some of the equations for Doppler effect need to be corrected in my previous paper.