Exponential Law of Doppler Effect of Light – an Explanation of Ives-Stilwell Experiment

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21 January 2018

Abstract

This paper reveals a mysterious law governing the Doppler effect of light. A new exponential term is introduced: $e^{V/c}$. Einstein's thought experiment (chasing a beam of light) is very compelling and can be considered as self-evident. It is an immediate consequence of the non-existence of light carrying medium (ether). The speed of light should be constant *c* independent not only of source velocity, but also of observer velocity. However, Einstein made a serious mistake when he tried to explain this. He misinterpreted the constancy of the speed of light as the relativity of space and time. This is an extraordinary, farfetched claim. Therefore, relativistic Doppler effect formula is based on a wrong foundation. Moreover, all existing theories of light (special relativity, ether theory, emission theory) fail to explain Doppler effect for source- observer relative velocities greater than the speed of light. Although special relativity imposes that no (relative) velocity is greater than the speed of light, it is easy to obtain relative velocities greater than the speed of light without violating the universal speed limit. This can be done by an arrangement consisting of light source, observer and a mirror. Suppose that a light source and an observer are at rest relative to each other and located close to each other. Light emitted by the source goes to a distant mirror and is reflected back to the observer, while the mirror is moving towards the source and observer with velocity close to the speed of light. In this case, the velocity of the mirror image of the source relative to the observer is equal to *2c*, for which the relativistic Doppler effect formula will be undefined because $\beta = V/c$ will be greater than 1, resulting in a square root of a negative number. Theoretically, it is possible to get unlimited relative velocity between the mirror image of the source and the observer by using multiple moving mirrors. Therefore, a new theory of the real law governing the Doppler effect of light is required. Einstein's thought experiment can be understood as the constancy of *phase* velocity, not *group* velocity. The phase velocity of light is always constant *c* irrespective of source and observer motion. The group velocity of light behaves in a more conventional way: it is independent of source velocity, but dependent on observer velocity. The constancy of the phase velocity requires, unconventionally, not only change in frequency, but also change in wavelength for a moving observer. Even though this is also counter intuitive, it is not as farfetched as 'length contraction and time dilation'. Therefore, $\lambda . f = \lambda' . f' = c$. This theory invokes another problem: then what is the law governing the Doppler effect of light. The new law of Doppler effect of light is proposed as: $f' = f . e^{V/c}$, $\lambda' = \lambda . e^{-V/c}$, where V is positive for source and observer approaching each other. This theory explains the Ives-Stilwell experiment.

Introduction

The Ives-Stilwell experiment is considered as one of the most important experimental proofs of the special Theory of Relativity (STR). It is claimed that the Ives-Stilwell experiment confirms 'time-dilation'. Even though it is remarkable that STR correctly predicts the outcome of the Ives-Stilwell experiment (coincidentally), STR has been disproved logically, experimentally and theoretically[1]. Therefore, an alternative explanation of the Ives-Stilwell experiment is required. This paper reveals a mysterious law of nature governing the Doppler effect of light.

Requirements for a new theory of the real law governing Doppler effect of light

There are two requirements for the new theory (formula) of Doppler effect of light:

1. The new formula should be defined for and explain the case for $V \geq c$
2. The new formula should satisfy the condition:

$$\lambda \cdot f = \lambda' \cdot f' = c$$

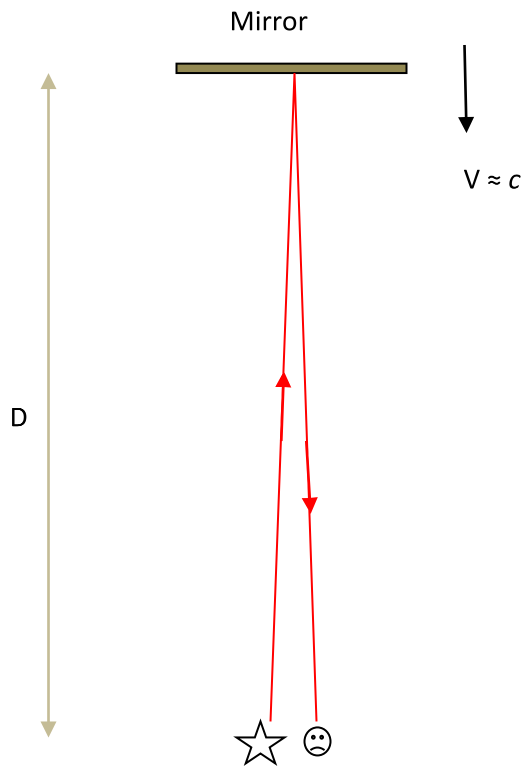
which is a requirement for the constancy of the phase velocity of light, described below.

Doppler effect for V > c

All existing theories of light (special relativity, ether theory, emission theory) provide formulas for Doppler effect of light that become undefined for source-observer relative velocities greater than the speed of light, $V > c$. While ether theory and emission theory have nothing to say about this case ($V > c$) , special relativity theory imposes that no (relative) velocity can reach or exceed the speed of light. However, it will be shown here that a relative velocity greater than the speed of light can be theoretically obtained by using an arrangement of light source, observer and moving mirrors.

Suppose that a light source and an observer are at rest relative to each other and are located close to each other. Light emitted from the source goes to a distant mirror and is reflected back to the observer, while the mirror is moving towards the source and the observer with velocity equal to (close to) the speed of light *c*.

We will show that the relative velocity of the mirror image of the source and the observer will be equal to *2c*.



Let the total distance between the source and the observer be S, along the light path.

Therefore,

$$S = 2D$$

From which

$$\frac{dS}{dt} = 2\,\frac{dD}{dt} = 2V \approx 2\,c$$

It can be seen that the relative velocity between the mirror image of the source and the observer is twice the speed of light, for which the relativistic Doppler effect formula will become undefined.

Special Relativity uses Lorentz transformations or the relativistic velocity addition theorem and asserts that the velocity of the mirror image of the source is:

$$U = \frac{2V}{1 + \frac{V^2}{c^2}}$$

For a mirror velocity equal to *c*

$$U = \frac{2V}{1 + \frac{V^2}{c^2}} = \frac{2c}{1 + \frac{c^2}{c^2}} = c$$

Hence the velocity of the mirror image of the source never exceeds the speed of light.

Since STR has already been disproved logically, experimentally and theoretically, the STR assertions are therefore invalid and the mirror image of the source can attain superluminal velocities.

Constant phase velocity and variable group velocity of light

Einstein's thought experiment ('chasing a beam of light') is compelling and beautiful. This follows directly from non-existence of the ether. The speed of light is always constant *c* independent of source or observer velocity. It is not surprising that the speed of light is independent of the source velocity, because we are familiar with this. The speed of sound is also independent of the velocity of the sound source. But how can the speed of light be independent of the velocity of the observer? This is so counter intuitive. It was at this point that Einstein was misled to the wrong conclusion. Einstein misinterpreted the constancy of the velocity of light as relativity of space and time. This was a farfetched, extraordinary claim.

The constancy of the speed of light could be interpreted as follows. It is the *phase* velocity of light, not the *group* velocity, that is always constant *c*. Einstein never made this distinction. The group velocity of light behaves in a more conventional way: it is independent of source velocity, but depends on observer velocity.

The constancy of the phase velocity requires that:

$$\lambda \,.\, f = \lambda' .\, f' = c$$

This is the simplest possible interpretation of Einstein's thought experiment (chasing a beam of light).

This theory immediately gives rise to another problem: then how are λ and λ' , f and f ' related ? The new law governing the Doppler effect of light should satisfy the condition:

$$\lambda \,.\, f = \lambda' .\, f' = c$$

I searched for and discovered a new formula satisfying this condition. Conventional formulas of Doppler effect of light do not satisfy this condition.

Exponential law of Doppler effect of light

I found that all conventional formulas containing the terms $c \pm V$ fail to explain the case for source-observer relative velocity, (more accurately, the relative velocity between mirror image of the source and the observer) greater than the speed of light. Therefore, a new theory (formula) of the Doppler effect of light should satisfy the above two conditions.

The mysterious law governing the Doppler effect of light is proposed as follows.

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

We can see that the above formula is defined for all V , including V > c and also satisfies the condition:

$$\lambda \cdot f = \lambda' \cdot f' = c \,.$$

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

We know that

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

Therefore

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

Next we see Doppler effect

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

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

where V is the source observer relative velocity.

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

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

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

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

Now let us apply the new formula to explain the red shift in the Ives Stilwell experiment.

Doppler shift for approaching ion:

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

Doppler shift for receding ion:

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

Average wavelength

$$\Lambda = ½ (\lambda'_A + \lambda'_R) = ½ [\lambda . e^{-V/c} + \lambda . e^{V/c}]$$

$$= ½ \lambda [1 - V/c + ½ V^2/c^2 + \ldots + 1 + V/c + ½ V^2/c^2 + \ldots]$$

$$\approx ½ \lambda [1 - V/c + ½ V^2/c^2 + 1 + V/c + ½ V^2/c^2] \text{, for } V \ll c$$

$$= \lambda [1 + ½ V^2/c^2]$$

$$\Delta\lambda = \Lambda - \lambda = \lambda [1 + ½ V^2/c^2] - \lambda = ½ (V^2 / c^2) \lambda = ½ \beta^2 \lambda$$

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

Conclusion

This paper has revealed a mysterious law governing the Doppler effect of light. The Ives Stilwell experiment has always been considered as a crucial evidence for SRT. The theory of Exponential Law of Doppler effect of light, together with the Apparent Source Theory (AST) [1] , 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. Absolute/Relative Motion and the Speed of Light, Electromagnetism, Inertia and Universal Speed Limit *c* - an Alternative Interpretation and Theoretical Framework, by Henok Tadesse, Vixra