Two Strong Simple Proofs That All Doppler Shifts (including the Axial) Impact Observed Time, and All the Transverse Does

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Abstract

The first proof (Sections 2 - 4), applies Doppler shifts to the Fourier time sine series. It shows if $K = f'/f$ (frequency ratio of the shift, f' the shifted frequency), then the value of the series at time = t occurs in the shifted series at time = t/K. That is because in each harmonic the $\sin(f't)$ and $\cos(f't)$ became $\sin(Kft)$ and $\cos(Kft)$. The original series could be the number of photons in area of a beam with encoded information. Therefore the number of observed photons and information has the same resultant Doppler shift as frequency. Resultant is total effect of axial, transverse and gravitational shifts. Mass and energy of light do not have the same Doppler shift which may indicate missing parts that Doppler shift and that mass traveling at the speed of light is different from other mass and energy. The second proof (Section 5) the vector equations of space time require observed time to have 3 dimensions if the speed of light is constant in all directions, but the Doppler shift in each direction is not the same. The blue shift (compression) of time has paradoxes. If time has many dimensions, that would solve the paradoxes, but break conservation laws. No solution of that is given here. It is not expected that radical a solution will have any followers.

Keywords

Doppler, Relativity, Aether, Fourier Series, Time Travel Paradox, Invariants

1. Introduction

The analysis below applies Doppler shifts (axial, transverse and gravitational) to the Fourier time trigonometric series. It shows if $K = f'/f$ (frequency ratio of the shift, f' the shifted frequency), then the value of the series at time = t occurs in

the shifted series at time = t/K. The original series could be the energy of a photon beam with encoded information.

The blue shift (compression) of time, energy and mass has paradoxes. Time having many dimensions, would solve one of the paradoxes, but most still break conservation laws and that sort of time will not have many believers, although string theories have extra dimensions. No solution of the blue shift paradoxes is given here. But that is a reason to believe there are unknown physical effects operating here because the Fourier series proof of the above is direct and the Fourier time series is well established mathematics.

2. Analysis (Based on Known Testable Properties of Fourier Trigonometric Time Series) [1] [2]

Take any signal $F(t)$ with encoded information measured at a stationary instrument (observer) measuring the photon flux (number passing an small area) of a beam of photons from time = $t = 0$ to $t = r$. It is well known that any piece wise continuous function $(F(t))$ from time = 0 to r of time can written as a Fourier sine series of the form [1] [2]:

$$F(t) = A_0/2 + \sum_{n=1}^{\infty} \left(A_n \cos(n2\pi t/r) + B_n \sin(n2\pi t/r) \right) \tag{2.1}$$

where:

$$A_n = (1/r)\int_0^r F(t)\cos(n\pi t/r)\,dt \quad \& \quad B_n = (1/r)\int_0^r F(t)\sin(n\pi t/r)\,dt \tag{2.2}$$

The optical Doppler shift multiplies the frequency $[n2\pi/r]$ of each of the harmonics by a factor of K to get $[Kn2\pi/r]$. So the value of each harmonic at time $t = T$ now happens at $t = T/K$. Therefore, the value of the sum of all harmonics at T (by superposition) also now occurs at T/K. That means that the whole function of a time period = G now has a period of G/K, not G. The reader to verify the above by calculation on a computer. Also for T greater than G or less than zero, the values of the Fourier series representation simply repeat the original wave and do the same for values of T greater than G/K in the shifted function or wave. The wave or function has been compressed or dilated in time depending on K being greater than one, or less than one. $K > 1$ in the blue shift and $K < 1$ in the red shift. Take the case of a repeater (a mirror with a small time delay) is moving to both the source and observer (they near each other), the Doppler shift at the final observer is K squared of the above K, which is at the repeater. Therefore, the Doppler shift affects information (modulation) in a signal not just the carrier frequency. The reader is invited to make a Fourier series of any function, then multiply all the harmonics' frequency by a factor (K), then plot the original series and the shifted series to verify the above by mathematical experiment. It would be simpler to just say by definition frequency = 1/time period, therefore anything that changes frequency alone changes time. But that has not been obvious in regard to the optical axial Doppler shift for over a hundred years, the proof by Fourier analysis may be more convincing.

As far as the photon flux is concerned, they have a Fourier time trigonometric series of the function of F have the same value as the Doppler shifted (F') function at time = t/K as the original $F(t)$ did at t. A_n and B_n have the same value in original series and the shifted series. The same holds true for mass and energy of the photons because energy by Planks' law is proportional to frequency. But the observed beam energy and mass is the product of observed photon energy and the observed number photons. Note since the observed distance (in either time or space) between the photons also changed not just the frequency of each because the observed axial time between changed. This should be the same effects should be found in the energy transferred by a gravitational field as in the beam of photons above. That error old omission is very obvious, but was only mentioned here because, it is an error of omission in the four optics and electrodynamics textbooks [3] of this author owns and a slide show of a university's research [4], and therefore there is significant probability the reader may make that error. Although one text book does have a correction for the relativistic change in cross-sectional area. Other textbooks may not have that omission. Also looking over reference [4] it apparent the mass of the charged particles the beam is given the right relativistic correction in the equations but the axial time between them not mentioned slide presentation. But reference [4] appears to be slides for a course on accelerators for engineers and users posted online by the university, but the actual lectures may make mention of the Doppler effect of axial time between particles.

3. Conservation Paradox

1) From the above, if there is a red shift ($K < 1$) of energy and mass in the beam is dilated in time and space (space = $c \times$ time). Time travel of energy or mass is violation of the conservation laws. From the above, if there is a blue shift ($K > 1$) of energy or mass in a beam in the beam is compressed in time and space (space = $c \times$ time). Time travel of mass or energy is a violation of the conservation laws.

2) If the information is dilated (time dilation), it is going into the future from the past. If information is compressed (time compression) it is coming from the future it would not have been in the past yet. But the uncertainty principal, other noise and lack of energy in the source for generating photons of very high frequency, limits time travel to small values.

4. Paradox of Information Time Travel [2]

If someone has information about an event someone can change because it is not completely determined from the past. If it is undesirable for him, he would do whatever he can to negate (reverse) it. Then the information would not have come in the first place if there was only one future. That seems to indicate either Doppler shifts are very noisy or there is lots of futures (time having more than one dimension). But the uncertainty principal, other noise and lack of energy in

source for generating photons of very high frequency, limits time travel to small values. Be aware if are already are many theories of more dimensions. Most are trying to explain the uncertainty in quantum mechanics. A good many them are string theories. Reference [5] is a textbook on theories of extra space and time dimensions.

The law of conservation of energy and mass does not allow time travel of mass or energy. The second law of thermodynamics does not allow compression of energy without putting more or at least the same amount energy as work in.

5. Modification of Space Time to Have the Axial and Transverse Doppler Shift

Assume: The axial and gravitational Doppler shift is along the Z axis and on that axis the resultant Doppler shift frequency ratio is K_R. Let x, y, z, t be vector coordinates as observed; x', y', z', t' be the vector coordinates of source (the observed); $K_T = .$ transverse shift's frequency ratio.

The vector sums:

$$
\begin{aligned}
&xK_T + yK_T + zK_R + ct_X + ct_Y + ct_Z \\
&= x' + y' + z' + ct'_X + ct'_Y + ct'_Z \\
&\text{or } \sum_{n=1,2,3}\left(x_n K_n + ct_n\right) = \sum_{n=1,2,3}\left(x'_n + ct'_n\right)
\end{aligned}
\tag{5.1}
$$

For the speed of light c to be the same in all directions and for the axial shift K_R to be different from the transverse shift K_T: Therefore, time must have different values in different directions $v = c = \partial s/\partial t$ & $s = x, y, z$. For example; take the 3 cases of $x = 1$, $y = 1$ & $z = 1$ and right side of Equation (5.1) is 0, 0, 0, ct_X, ct_Y, ct_Z. Then $c = xK_T/t_X$, $c = yK_T/t_Y$ & $c = zK_R/t_Z$ since the x, y, z are equal and c are equal, but the K's and are not equal neither are the c's unless t_Z is different from t_Y & t_X. Therefore time has more than one dimension. The number of time dimensions gets reduced to 2 if one uses this form of the axial Doppler shift formula:

$$
K_A = \left[1 + (V/c)\cos\theta\right]\Big/\left[1 - (V/c)^2\right]^{1/2}
\tag{5.2}
$$

where: $\cos\theta = V$ dot $n/\mathrm{abs}\,V$, $n =$ a unit vector from observer to the observed, V is the three dimensional velocity vector.

In which case instead of having three observed time dimensions, and nine space dimensions needed to fix a point on the observed object due to change in the observers position; one has a θ or $\cos\theta$ dimension and an observed time dimension and 3 observed space dimensions for a total of 5. Also it is more visual for understanding than the three time dimensions. If the observation angle was not used one would have three observer location dimensions, three observed dimensions and observer's time to fix points on the observed object. Most optics books use the observation angle and most writings on relativity prefer to use the long hand of more dimensions but neither say they are now using more than four dimensions to fix points on the observed object.

That is fundamentally different from classic relativity in that time has three dimensions like space at relativistic velocities. That should show up in velocity addition theorem and invariance [6] of

$$s^2 = \sum_{n=1}^{4} \Delta x_n^2, \text{ where, } x_4 = ict \ \& \ i = \sqrt{-1} \tag{5.3}$$

Note Equation (5.1) is for light going in the opposite directions form 5.3 so is not the difference, the difference is that is a different t in each of the two space directions in (5.1) and only one t in (5.3).

6. Einstein's Mass Velocity Relation: [7] [8]

Note numerical checks of Einstein's mass' velocity formula shows it in very good agreement with Newtonian formula for kinetic energy for low (in the relativistic sense) velocities below 0.3 c. If the Doppler shift formula of frequency ratio of light is used for mass ratio there are poor numerical results for velocities below 0.3 c. So the gravitational charge and inertia of things moving at the speed of light should have some name different from all other mass. The difference the two is in the Doppler shift of light's energy and that of mass moving at lower speeds. As said in Section 5, some of its assumptions are seemed require one dimensional time. So the details of the derivation is in question in this authors mind particularly velocity addition.

7. Conclusions

The first proof, Sections 2 - 4 above, applies Doppler shifts to the Fourier time trigonometric series. It shows if $K = f'/f$ (frequency ratio of the shift, f' the shifted frequency), then the value of the series at time = t occurs in the shifted series at time = t/K. The original series could be the number of photons in area of a beam with encoded information. Therefore the number of observed photons and information has the same resultant Doppler shift as frequency. Resultant is total effect of axial, transverse and gravitational shifts. Mass and energy of light do not have the same Doppler shift which may indicate missing parts that Doppler shift and that mass traveling at the speed of light is different from other mass and energy. The second proof (Section 5) the vector equations of space time (tensor can be used) require observed time to have 3 dimensions if the speed of light is constant in all directions, but the Doppler shift in each direction is not the same.

The blue shift (compression) of time has paradoxes. If time has many futures (hence more than one dimension), that would solve the paradoxes, but break conservation laws. No solution of that is given here. It is not expected that radical a solution will have many believers even if many theories have hidden or extra space-time dimensions such as the string theories and Ref. [5] is a textbook on the subject.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix

Comparison of Moriconi's work [9] and the above:

The author of the above was asked to provide, by the reviewer of the above paper, a comparison to Ref. [9] Moriconi, M. (1 November 2006) Special Theory of Relativity through the Doppler Effect, European Journal of Physics. 27(6). A paper not seen by the author before. It is a general discussion of the highlights of special relativity starting with Doppler shifts. The paper you are reading is about some new, important, interesting impacts of Doppler shifts, partially the axial shift and is not anyway a text on all special relativity.

Moriconi's paper states in the introduction and almost to the same extent in the abstract, that he is trying to prove form Einstein's precepts and some formulas for the frequency ratio of Doppler shifts and from that all of important parts of special relativity. In his introduction he said he uses these two postulates of Einstein to derive the Doppler shifts:

1) "The laws of physics are the same in all inertial frames of reference."

2) "The velocity of light is the same for all inertial observers."

The above of paper you are now reading is about new insights in Doppler shifts and their applications primarily but also used those two postulates. It is not meant as a text of all relativity. In fact it starts with known well proven formulas and ideas from texts on optics, electrodynamics and advanced calculus. It did not start with Einstein's postulates with exception of those two. It did use Einstein's and Lorentz's formula for the transverse shift but wherever possible just used K_T.

Some starting points of this paper are the standard formulas for the Fourier series and for evaluating its constants [1] and knowledge of vector calculus. Also, this writer of the above avoided using formulas for the frequency ratio Doppler shifts instead just used K, K_A, and K_T for them because of the difficulty in measuring the transverse shift there may be slight changes in the future. Some of the difficulty is high energy particle accelerators and cosmic rays are the only place on Earth where there is relativistic velocities, and that high energy particle beams are very noisy. Charged particle give energy to standing waves among other things like bremsstrahlung radiation at the target, the beam is in pluses, etc. and users and designers have to use experience, filters, etc. Ref. [6] chapter 14 (a chapter on radiation from accelerated charges) points to a 10 Gev Cornell electron synchrotron where the r-f voltage per turn is 10.5 MV which by his equation should have a power loss 8.85 Mev to radiation. Reference [5] shows there is also some dynamic (changing with time) error in the path and focus of beams in even the best accelerators. That will also cause noise. The writer also noted as another reason for avoiding using specific transverse Doppler shift formulas was Lorentz derived his transformation assuming axial aether winds cancel (he was writing in aether winds). Some later writers (not all) substituted the words "Doppler shift" for aether winds after the aether idea was more or less abandoned (variations of it get reborn from time to time). But in the Michelson-Morley experiment all the

mirrors where fixed to the Earth and its reference frame. Hence at most one Doppler shift and no cancelations. Ref. [6] [10] [11] still uses aether winds discussing Lorentz's work in some part of the books. When this writer tried to derive the transverse shift with Doppler shifts not winds he had to assume the transverse shift was only in the transverse direction. That is not how it is used. In any case there is experimental verification of the transverse shift and the MM experiment does not reflect the whole world exactly. Therefore, it is safer to just use K_T for the transverse Doppler shift.

This paper talks about length, time and information compression and expansion. The abstract, introduction and Sections 2 to 5 are derivations of time, length and information compression and expansion. First in Section 2 from the very nature of the Fourier time series of light beams encoded with information then the same series with the frequency of each the harmonics (each sine and cosine terms) having frequencies K times that of the original series. K being the Doppler shift frequency ratio; so the altered series represents the Doppler shifted encoded beam. People (professors spoken to) think of Doppler shifts just affecting carrier frequencies of beams not the whole signal in a light beam and all its contents (information, mass, energy). Section 5 talks about the effects on space time form that and the invariance of the speed of light with direction. Either to fix a point on the observed object one has: an observation angle dimension, a time dimension and three space dimensions or three observer positon dimensions, three observed position dimensions and time to fix the same thing or nine position dimensions and three time dimensions. Having the observation angle gives the minimum number of dimensions and it is more visual. A big result of time having different values in each direction and the speed of light invariant in each direction is Equation (5.1).

But Moriconi's paper limits space time to four dimensions. But the paper you are reading in Sections 2 and 4 both show, at relativistic velocities, observed time is different in different directions and therefore has more than one dimension also implying distance does as well.

Also Moriconi's paper in Section 4 talks of time dilation but not time compression. In Section 5 of that paper he talks of length contraction but not expansion. He does not talk on information compression and expansion by Doppler shifts. The paper you just read talks extensively on that and in Section 4 gives reasons why information compression will not happen in the blue shift. The fact the Fourier series expanding of a blue shift beam indicates it does mathematically means there are unknown physical effects not in the mathematics to be discovered. The Fourier series is pure mathematics and cannot prove what seems to be physically impossible. Hence, the proof of the blue shift information is proof of an unknown physical effect or that is multiple futures (time having more than one dimension). Multi-dimensional time is too radical to be accepted but other than writing the form of the Fourier series of some signal and the Fourier series of its Doppler shift did nothing so the mathematics is direct and strong not the result of a lot of manipulating. Also it easily verified numerically by summing

the first say 25 terms of the Fourier series of a few functions then do the same when the frequency each harmonic is multiplied by the same Doppler shift ratio of frequency. This can easily be programed on a PC most have the computer language of Basic in them or using a program like MatLab. I did that. The Doppler shift therefore changes more than a carrier frequency it changes all harmonics.

The paper you are reading pints out in beams (both particle and photon) not just the energy of the photon or particle is changed by Doppler shifts but also the time and space between them. Implying there is an error of omission in optics and electrodynamics texts in not including that effect in energy flux (intensity, Poynting vector). Such effects are missing form Moriconi's paper.