Significance of the axial Doppler shift shown by observing items on a conveyor belt

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Relativity, axial Doppler, encoding, time, time dilation, Doppler, modulation

0.0 Abstract:

The following shows three reasons to consider the axial Doppler shift dilation or compression of time for the observer as opposed to just considering the transverse Doppler shift as that. At present most writing call only the transverse that. Because high energy beams are noisy for various reasons and it is impossible to make control experiments on objects light years away, the error remains. The following also shows the Doppler equations apply to motion of all periodic things (objects on conveyor belt or a beam of bullets not just waves).

The three reasons are: One, the axial shift in only dependent on the geometry and velocities, which are relations between various time and space dimensions between the source and the observer. Two, the axial shift affects the rate of periodic things in a moving line are observed and rate (frequency) = 1/time. Three, there are no exceptions; the axial shift changes all rates observer sees from the source.

The lack of an axial shift is the only error or inconsistency addressed by this paper. With the exception that this paper will prove that length of anything along any axis appears to a moving observer to be 1/K times as big as to a stationary observer. Where K is the resultant shift of frequency of both axil and transverse Doppler shift that light moving along that axis would have. Because frequency times wave length= c velocity if light (same in all reference planes) and wave length is distance. Most writers just assume only the moving direction changes.

1.0 Analysis of a conveyor belt:

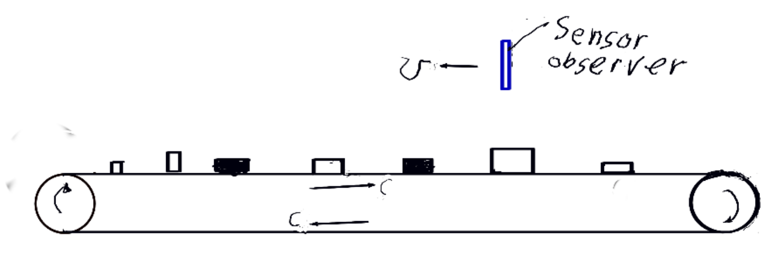

Fig. 1

Given:
An object every $1/\omega$ seconds is placed on a conveyor belt moving with some velocity c (a vector) taken relative to a stationary observer and the items are to be detected by a downward looking detector moving above the belt with a vector velocity v relative to the same stationary observer. Positive direction being a velocity moving the source to the observer. c is used because the belt speed has the same effect as the group velocity of light in the optical Doppler effect. Let $v \cdot c = \|c\| \|v\| \cos \theta$. θ being the angle between the two velocities. The closing velocity (the sum of the components of c and v moving the items toward the detector) is $c - v \cos \theta$. As a result, in one second, $[\omega (c - v \cos \theta)/c]$ items are detected. That is the same equation as the axial Doppler shift of frequency for waves moving with a speed c and an observer with a velocity v an angle θ to c.

Likewise, the classic Doppler shift equation applies to all moving periodic items such as conveyor example and machine gun bullet stream not just waves. The term classic here is axial Doppler Shift. If information is encoded such that a black item is a dot and a polished metal item a dash on the conveyor belt, the rate of Morse coded information observed by a reflected light sensor (the detector) also (like the other frequency) is changed by the same shift factor $(c - v \cos \theta)/c$. Since all detectable properties of the items on the conveyor have their rate of detection shifted by the same factor. Time appears to have been compressed or dilated depending on the sign of v. Because the axial Doppler shift occurs in all waves and many other things like conveyor belts or a beam of bullets, Doppler shifts are due to the geometric properties (topology) of time and space not the physical properties of the observed items or mediums except that the latter determines the group velocity (C) that the conveyor belt, bullets, or waves move.

By extension the observation rate of all information in the type observations above have been changed by the same Doppler factor as frequencies above. It therefore, like the relativistic optical shift, the axial factor of all Doppler shifts is also time dilation or compression depending on it is a red or blue shift. Because all observables about the stream of objects or waves is compressed or dilated depending if it is red or blue shift. Since the propagation velocity of light and sound is a constant independent of any Doppler shift, when time (1/frequency) is multiplied by a factor 1/K the space dimension (c/frequency) along the propagation axis is multiplied by 1/K.

Only the transverse shift is said to be time dilation by writers on relativity. But by the above conveyor belt example it is plain the all detectible rate properties (1/time period properties) of waves and periodic moving objects see a classic axial Doppler shift. As a result, a significance of the axial shift is that the axial shift is time is compression or dilation (change in the observed length of time segments).

Because high energy beams are noisy for various reasons and it is impossible to make control experiments on objects light years away, the error remains. Various people have made some corrections.

This paper is about the axial Doppler shift's significance and not the exact formulas for the magnitudes of the transverse Doppler shift (K_t), the axial Doppler shift (K_a) or the total Doppler shift (K). Therefore, transverse Doppler shift's magnitude will be $\omega'/\omega=K_t$, without defining the equation for K_t (were ω=frequency of a moving source as measured moving with it and ω' magnitude of ω as detected by a stationary observer). This will avoid any error due to the difficulty in measuring light coming from objects going at significant portions of light velocity. Another difficulty in the measurement of K_t, for most angles the axial Doppler shifts are much larger then transverse Doppler shifts. Equation 11.30 of Jackson shows the most commonly writen combination of axial and transverse shift as the just the product of the two. Let Ka for the magnitude of the axial shift and $K = K_a K_t$ for the total shift. This paper also shows a non-linear combination will result if one avoids assumptions in the Lorenz transformation. The paper also notes that any significant result of body forces acting on photons should be put in

2.0 Einstein's Second Postulate with both axial and transverse motion of the moving reference frame:

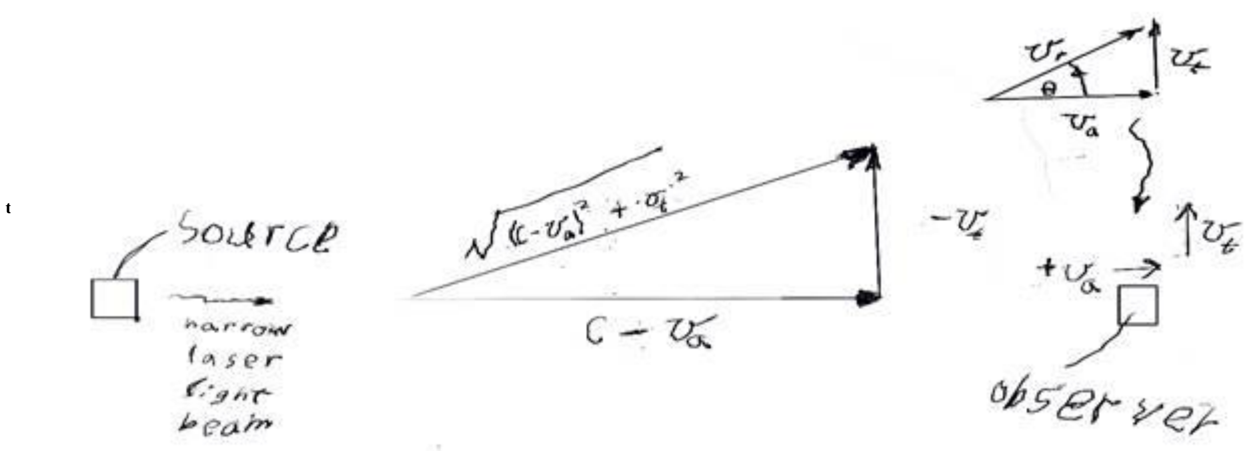

Fig. 2

The source of light will have a reference plane indicated by no superscript. Let primed values refer to the moving observer's reference plane. The observer is moving with a transverse velocity v_t to the light and with a velocity v_a parallel to the light. In the case of a narrow beam the velocity of the observer cannot always be aligned with that of the beam. Also there is no reflection here to cancel v_a.

$c\Delta t= ((c-v_a)^2+v_t^2)^{1/2}\ \Delta t'$ and let $v_r=(v_t^2+v_a^2)^{1/2}$ the resultant velocity, let $v_a = v_r \cos\theta$ and $v_t = v_r \sin\theta$.

Einstein's second postulate (c=c') speed of light appears to be same in all reference planes.

Therefore, $c'=((c-v_a)^2+v_t^2)^{1/2}$

Note writers on relativity take the special case of no v_a, by canceling v_a out by reflection. That becomes an error of omission if it is presented as the general case. There is no reflection in this analysis.

$c\Delta t=c'\Delta t'$ $\Delta t/\Delta t'= ((1-(v_a/c))^2+ (v_t/c)^2)^{1/2} =(1-2(v_a/c)+(v_a/c)^2+(v_t/c)^2)^{1/2}= (1-2(v_a/c)+(v_r/c)^2)^{1/2}$
In terms for frequencies: $\omega/\omega'=\Delta t'/\Delta t=1/(1-2(v_a/c)+(v_r/c)^2)^{1/2}$ time contraction factor. If the direction of v_a is opposite the time dilation factor $1/(1+2(v_a/c)+(v_r/c)^2)^{1/2}$.
If $v_a=0$ one has the common equation for transverse Doppler shift: $\Delta t/\Delta t'=\nu'/\nu = (1-(v_t/c)^2)^{1/2}$
If $v_{t=}0$ one has the common equation for the axial Doppler shift $\omega'/\omega= (1-(v_a/c))$ which this paper says is also $\Delta t/\Delta t'$ for $v_t=0$.

If $\theta = \pi/4$: $\omega'/\omega=\Delta t/\Delta t'=(1-2 (v_a/c)+ (v_r/c)^2)^{1/2}$

If one uses spherical coordinates instead of the polar above and v_r in the Z direction the equation is the same but θ becomes ϕ.

Note: now time value changes with value of the angle between the light beam and the resultant velocity of the moving reference frame. There is now a time component in X direction, time component in Y direction and one in Z direction. Therefore (t) time is now a vector.
Velocity now becomes L ⟌ T $=\Sigma_i$ ($|L_n$⟌$|T_n|$) 1_n , where 1_n is the unit vector in the n direction. A derivative is obviously dL ⟌ dT. ⟌ will called directional division or directional quotient.

In the above transformation the axial and transverse Doppler shifts do not combine by just addition or multiplication. For the rest of the paper it will be assumed they combine by multiplication since some others did (Jackson eq. 11.30). But the best guess for the most general case is the above equation.

For the speed of velocity to be a constant all reference planes wave length λ and by extension all lengths L are given by: $c= \omega\lambda=c'=\omega'\lambda'$ which implies $\omega'/\omega=\lambda/\lambda'=L/L'=K$=the Doppler shift.
In all directions $L'/L=1/K$, where K= the total Doppler shift for light in that direction.

3.0 Fourier series proof of the effect of all Doppler shifts on modulation in time periodic objects:

Any set of periodic objects or events (including any modulation on them) observed for a length of time G is a piece wise continuous function and therefore has a convergent Fourier series representation. The value of each n^{th} harmonic has the form $A_n \sin (n\,\omega_0 T +c)$, where ω_0 is the fundamental frequency and A_n are constants. The optical Doppler shift multiplies the frequency of each of the harmonics by a factor K. So the value of a harmonic at time T now happens at T/K. Therefore the value of the sum of all harmonic at T (by superposition) also now happens at T/K. That means the whole function, of a time period =G, now has a period of G/K not G. It is left to the reader to verify by calculation that for T greater than G the values of the Fourier series representation just 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. In the blue shift K >1 and K<1 in the red shift.

4.0 Any significant effect of body forces on the frequency of light should not be forgotten:

General Relativity deals with effect on light by body forces and should not be forgotten. If B=a conservative body force, Cv=vector velocity of light: $h\,\Delta\omega=\int(B\cdot Cv/c)dr$ where: c=abs(Cv), r =a distance in the direction of B, h=Planck's constant. $K_b= 1+\{\int(B\cdot Cv/c)\cdot dr\}/h$ = body force shift factor in the light's source's reference plane. This K_b should multiply the K (resultant of Doppler shifts) to get the resultant frequency shift with body forces acting on photons. Note, the components of B perpendicular to Cv changes the direction of Cv but not the abs Cv because light has a mass = $h\omega/c^2$.

Equations motion for a photon:

Let the subscript o be at time zero:
Energy=$h\omega_o+\{\int(B\cdot Cv/c)\cdot dr$; with a constraint equation of c=abs (Cv)

Appendices:

Appendix 1.0 Significance of the axial shift being time dilation like the transverse shift:

1.1 For a light beam:

For energy and mass in a light beam (assume steady state waves except for encoding and boundaries far from the example, positive v and c; the source is moving to the observer):

The axial shift has an angle term. The most common equation (Jackson) that the total shift for light is: $\omega/\omega'=K_aK_tK_b=[1+(v/c)\cos\theta]\,K_t\,K_b=K$. Where K= the total shift, K_b=body force shift, K_t = the transverse shift and K_a = the axial shift and θ is the angle between light beam and the closing velocity between the observer and the source. v= closing velocity of the observer to the source, c= speed of light, ω'=frequency observed by the observer, ω = frequency relative to the source. Since time=1/frequency=t'/t=ω/ω'= 1/K.
The energy in one photon (e) is proportional to ω: e'/e = ω'/ω=K. But from section 2.0: the real $K=1/(1-2(v_a/c)+(v_r/c)^2)^{1/2}$ should be used not K_tK_a.

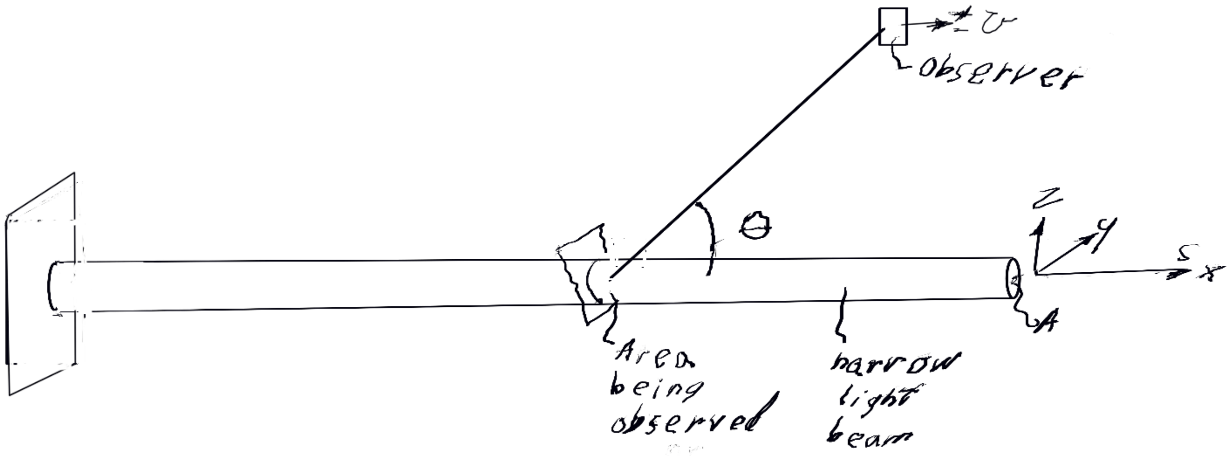

Fig. 3

For the Poynting Vector S: S=energy/(time x area)= ω x energy/area. The crosssectional area of the beam at the point being observed is the product of the two transverse lengths. $S'=K_d{}^2\omega$ energy/$(A/K_q{}^2)=(K_d\ K_q)^2$ S. Where K_d is total Doppler shift of the beam and K_q is the total Doppler shift a beam traveling transverse to the Poynting vector would have if it existed.

1.2 For a mass:

Atoms interact and are measured by their electromagnetic fields and their gravitational fields and they travel at the velocity of light. Therefore, the Doppler shift should be the same as for light. Let E= energy and m=mass.

$$m'/m= E'/E = \omega'/\omega=K$$

By mathematical induction the same rules works for v=0. For v=1 the rules work and for v=1/2 they work, also for v=1/n for all n>1. Therefore they work for v=0.

Kinetic energy = $(m'-m)c^2 = (K-1)m\ c^2$. This should go into the Hamiltonian in developing relativistic quantum mechanics.

Since a K with a non-zero axial Doppler shift is directional (varies with angle of motion), mass is directional not a scaler. To find momentum one has to use the equivalent A Ł B= $\Sigma_i\ |a_i|\ |b_i|\ 1_i$ where 1_i is a unit vector in the i direction.

Momentum= M Ł V, where M=mass vector, V=velocity vector. A good name for Ł would be direction product so as not to confuse it with cross product sometimes called vector product. An integral form is obviously ∫A Ł dB.

Since the Hamiltonian is energy H'/H=K. Which for particles interacting with fields become $H=\{(cP-eA)^2+m^2 c^4\}^{1/2} +e\phi_e+m\phi_g$ Where P is momentum, A is magnetic vector potential, e= electric charge, m=mass, ϕ_e is electric potential, ϕ_g is gravitational potential. Therefore $K=P'/P=A'/A=m'/m= e'\phi_e{}'/e\phi_e=m'\phi_g{}'/m\,\phi_g$.

Note equations using electric charge, or gravitational charge do not lend themselves to dimensional analysis. Because the permeability constants need to have dimensions to get the right dimensions in the equation results. Determining Doppler shifts for those charges are not straight forward. For example: potential energy of two charges e (gravitational or electric charges) r distance apart is $E= \mu$ e x e /r, where μ = permeability. Without μ having dimensions, e would have dimensions = (energy x length)$^{1/2}$. It is universally accepted that mass= gravitational charge.

Since there is energy in an electric or gravitational field proportional to the charge, it is a good guess that electric and gravitation charges have the same Doppler shift as light.

1.3 Effect on wave function equations

Because the probability for finding a particle must be the same in all reference planes the wave function must be invariant under change of reference point (observers).

Appendix 2.0 A new law of time (to be used on blue shift):

Exact observations of the future is impossible because of some unknown noise or multiple futures.

The reason is: In a universe with only one future, any group that had a future observing device, would try to negate undesirable avoidable events. But in the macroscopic world with only one future an event and its negation cannot exist at the same time. So that group could not get an exact observation of an avoidable undesirable event until at least that event is no longer avoidable. Therefore, there exists some undocumented noise or multiple futures in the nature of time

A2.1 Problem with information reflected from repeater:

If a modulated beam of duration G is reflected by moving repeater (a mirror or other object absorbs before sending a repeat) back to the source, the source sees a Doppler shift factor not just K but K^2. The existence of Doppler radar proves reflections have a Doppler shift. In the case that a repeater moves toward both source and observer, the observer sees K^2 is a double blue shift. Which means if there was no built in noise and there is only one future, information would be seen faster by the observer than it is sent by the source. That is the observer seeing information coming out of the future. But from the new law of time: an observer on the source cannot see an avoidable event until at least the event is no longer avoidable. The existence of any time travel idea such as worm holes would this reason for such noise also.

Appendix 3.0 Application to Compton Effect as an Example:

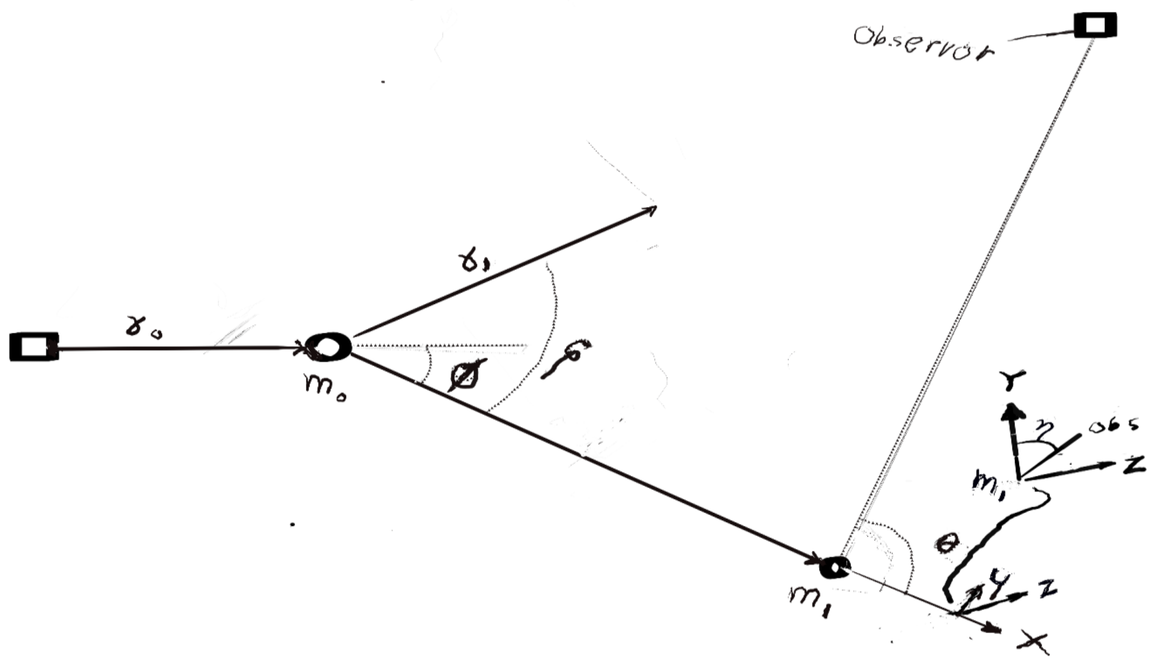

Fig. 4

From momentum considerations: Υ_o, Υ_1, and the locus of m are in one plane. There is also a Z direction out of the paper. Although Υ_1 and the path of m define a plane which Υ_o is in, the observer in not in it in the general case. Let Ƞ be the angle the X- Y plane makes with the line between the observer and the electron, such that Y·A=A cos Ƞ and Z·A=sinȠ.
Let x be an axis in the direction of the electron after collision (m_1) and y a normal to it in the plane of it's velocity v and the observer. The electron before collision (m_o) and the measuring equipment (observer) will be assumed to be stationary.

Let Υ_o be the initial gamma ray and Υ_1 be the gamma ray after collision. Let m_o be the rest mass and initial mass of the electron and K be the total Doppler shift seen by stationary equipment measuring the properties of the electron after the collision.

The initial energy or frequency of Υ_o is known. Also known is the positon of the observer and initial position of the electron. That means the angle θ is known as a function of the electron velocity (including direction) and time. $\phi = \arctan (v_y/v_x)$.

Conservation of Energy:
$h\ \omega_o = h\ \omega_1 + m_o\ c^2\ (K-1)$

Conservation of Momentum:

Momentum= ∂Energy Ł ∂Velocity= $\Sigma\, \partial E/\partial V_a$ a {That is $\partial E/\partial V_x\, i + \partial E/\partial V_y j + \partial E/\partial Vz\, k$} i,j,k are unit vectors in the x,y,z directions.

That gives 4 equations, the energy equation, and 3 momentum equations. θ goes out of the paper, it is the total angle of the electron's velocity with a line from the electron to the observer. K is the one thing that varies in the Z direction.

z

The momentum of the gamma rays in their direction propagation is taken to be $h\omega/c$ (which is their energy/speed). Because there is no velocity component in the Z direction it can be ignored except it is part of K (Doppler shift factor) and θ.

In the x direction: $(h\, \omega_o /c) \cos \phi= [(h\, \omega_1/c) \cos \varphi] + \partial\, [m_o\, c^2\, (K-1) \cos \phi]/\partial(v_r \cos \theta)$

$\omega_o \cos \phi= \omega_1 \cos \varphi+ [m_o\, c^3 /(h\, v_r)][(K-1)(\partial\cos \varphi /\partial\, (v_r \cos \theta))+ \cos \varphi\, \partial K/\partial\, (v_r \cos \theta)]$ Note: K is a function of v_r and $\cos \theta$

In the y direction:

$0= (h\, \omega_1 / c) \sin \varphi - \partial\, [m_o\, c^2\, (K-1) \sin \varphi]/\partial(v_r \sin \theta \cos\eta)$

$\omega_1 \sin \varphi =m_o\, (c^3 /h)[(K-1)\, \partial(\sin \varphi)/ \partial\, (v_r \sin \theta \cos\eta) + \sin \varphi\, \partial K/\partial\, (v_r \sin \theta \cos\eta)]$

In the Z direction: Since there is no velocity in the Z direction, Z momentum=0.

0=0

That is 3 equations for the unknowns from conservation of momentum and energy; plus θ and ϕ are known as functions of the electron velocity and equipment geometry.

Appendix 4 Effect on Partition Functions Hot Plasmas:

Since axial Doppler shift affects kinetic energy and has non zero variance due to than angle term, it will spread the partition function range.

The axial Doppler shift value is $1-(v/c) \cos\theta$, The $(v/c) \cos(\theta)$ part of the axial Doppler shift {θ=angle between the velocity of an atom and a line from the atom to the observer} has a mean value (over all angles of the axial Doppler shift) = zero. But square deviation from the mean is the average of $(\cos(\theta)-0)^2$ over a spherical surface of radius r: $\int 2\pi\, [(r \sin \theta)][r \cos^2 \theta]\, d\theta /(4\, \pi\, r^2)$

$=\int(1/2)\, (\sin \theta)\, (\cos^2)\, d\theta = -(2/2)[\cos^3(\pi/2)-\cos^3 (0)]/3=1/3$. Therefore the variance is 1/3 of v/c part axial Doppler shift. The variance of axial Doppler shift is therefore (v/c)/3 since the variance of 1 is zero.

8.0 Summary:

The total Doppler shift (product of axial and transverse Doppler shifts) not just the transverse shift changes the observed duration of events (size of time segments). The magnitude of mass is determined by measuring the effects of the mass' gravitational field or other fields, therefore the mass and those fields have the same Doppler shift. Therefore, the observed magnitude of a moving mass changes with the position angles and velocity by same fraction as the total Doppler shift K including angular changes. The Doppler shift does affect encoded information. Something in the nature of time acts as uncertainty, noise, or jamming preventing information about future events being transmitted to the present.

9.0 References showing the majority view only the transverse shift is time dilation:

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