TITLE: The Contracting Universe

Abstract:

According to Hubble's law, when we detect light from a distant galaxy, the light has a red shift proportional to the distance of the Galaxy from Earth. However, astronomers' observations of supernovae intensity indicate that the Universe is expanding at an accelerating rate. Nonetheless, recent supernovae observations by Milne indicate that the red shift of supernovae increases by a greater amount than the decrease in supernovae intensity due to increasing distance accounts for. If this additional redshift is considered to be additional velocity added with time and the additional redshift is subtracted from the galactic redshift dimension for the linear regression of galactic radii versus galactic redshift, then the galactic radii verses galactic red shift (galactic distance) linear regression will show an increasing galactic radii for increasing galactic distance (galactic redshift). Accordingly, astronomers' observations of the Universe demonstrate that galaxies are getting smaller in time. Indeed, the radii of all massive objects in the Universe decreases as a function of time and increases as a function of distance from Earth. However, we observe the Universe to be expanding because our rate of time increases when we contract along with the Universe and because the speed of light decreases with time in accordance with the decrease in the magnitude of the G00 element of the metric tensor, where the G00 element decreases as the mass density of the Universe increases because the same amount of mass and energy is squeezed into a smaller space.

Introduction:

Astronomers' observations of 1SA supernovas has caused them to hypothesize that the expansion of the Universe is accelerating.[1] I show that the astronomers' observations have been misinterpreted and that those observations are exactly what we would expect if the Universe was contracting. The contraction of the Universe is a necessary consequence of our observations and of the following two postulates: (1) Photons do not change their energy from when they are emitted until they are absorbed (a photon is like a time capsule of the state of the Universe for when and where the photon was emitted); and (2) Massive objects are changed by the expansion or the contraction of the Universe. The logical consequence of those two postulates include the following assertions:

(1) The energy density of the Universe increases when the Universe contracts, resulting in a decreased magnitude for the G00 element of the metric tensor.

(2) All massive objects acquire velocity away from the observer with time, such that galaxies closer to Earth will have greater velocity than galaxies farther from Earth, provided that they are not gravitationally bound to the Milky Way.

(3) The redshift of a photon emitted from a galaxy is dependent upon the Goo level of the time and space where and when it was emitted, such that a galaxy's redshift has a time component and a velocity component and such that the distance to a galaxy cannot be properly determined unless the velocity red shift component is separated from the galactic red shift component.

(4) All massive objects shrink (their radii decrease) at the same relative rate as the Universe when the Universe contracts and all objects shrink when they move upwards in a gravity well.

(5) The rate of time of an object (its reaction rate) is determined by the rest energy of the object, which is determined by the square root of the G00 element of the metric tensor and by the object's rest mass and by the special relativity gamma factor, where the rest mass increases when the Universe contracts.

(6) There is no dark energy because the apparent effect of dark energy is caused by increasing galactic velocity with time, which is caused by the reduced magnitude of the G00 element of the metric tensor.

(7) There is no dark matter because nearby non-gravitationally bound galaxies have very large velocities away from the Earth that cause us to believe that nearby galaxies are much farther away than they actually are and that they have much greater galactic radii than they actually have, where the rest mass of galaxies also increases with time because of the contracting of the Universe and where rest energy is equal to rest mass multiplied by the square root of the G00 element of the metric tensor.

(8) Entropy and Enthalpy are conserved in the Universe.

Galactic radii will decrease as a function of time and increase as a function of distance from the Earth, since a galaxy observed farther from the Earth than a second identical galaxy will have a larger galactic radius than the second galaxy. However, the linear regression of galactic radii to galactic redshift discloses a slight decrease in galactic radii to galactic distance.[11] That linear regression would need to be corrected for the added velocity away from the observer caused by the contraction of the Universe, which is shown in Milne .[11] Milne discloses that the change in red shift from far supernovae to near supernovae is greater than the expected change in redshift due to the change in intensity. Milne proposes that this change is due to a change in supernovae precursor type ratios. However, the difference is actually caused by increasing supernovae velocity away from Earth with time, which is caused by the contracting Universe and the decreasing magnitude of the g00 element of the metric tensor. If the additional redshift from Milne is subtracted from Fig 2 of Cayon, then the galactic radii are seen to increase with increasing galactic distance. I also predict that differential gravitational red shift will increase with time and decrease with distance.

By examining how the expansion or the contraction of the Universe would affect the objects in the Universe and how it would affect astronomers' observations of those objects, I show that the Universe is contracting. The work of Julian Schwinger and Lev Okun that explains gravitational redshift is extended to galactic redshift to show that Okun's conclusion "the phenomenon known as the red shift of a photon is really the blue shift of an atom" applies to Galactic redshift. The consequence of this unified treatment of redshift is that the radii of all massive objects in the Universe decreases as a function of time and increases as a function of distance from Earth. However, we observe the Universe to be expanding because our rate of time increases when we contract along with the Universe and because the speed of light decreases with time in accordance with the decrease in the magnitude of the G00 element of the metric tensor. Dark Energy is shown not to exist, since the effects attributed to dark energy are the result of increased velocity due to the decrease in the magnitude of the G00 element of the metric tensor. There is no dark matter because the non-gravitationally bound galaxies closest to the Milky Way have the greatest velocity, which causes us to believe that nearby galaxies are much farther away than they actually are and that they have much greater galactic radii than they actually have. Indeed, some of the closest observed galaxy clusters are reported to be comprised mostly (90%) of dark matter because of this velocity affect. However, more distant galaxies are reported to have less dark matter than closer galaxies, even though we have less data on distant galaxies. Tests are proposed to verify the contraction of the Universe.

Main Text:

Objects exist as wave functions and mass density that are distributed throughout space-time. Accordingly, our wave functions (our probability density) and our mass density extend throughout the entire Universe, although changes to our mass density or our wave functions propagate at the speed of light. Any expansion or contraction of the space that contains an object's wave function and mass density will necessarily change the object, since it will concentrate or dilute the object's wave functions and its mass density.

Instead of adding or destroying space, the expansion or contraction of space causes each piece of space to stretch or to shrink like a balloon stretches or shrinks. If the space contracts, the probability density (wave function) and the mass density are concentrated into a higher density per 3D surface area. The objects in the Universe contract along with the Universe, much like a picture of the objects drawn on a balloon would contract if you let the air out of the balloon.

The concepts of constancy and invariance are at the core of physics. The most basic expression of constancy is that an object's inherent nature cannot change, unless the object undergoes an interaction with another object. Macroscopically, interactions usually take the form of an applied force. Microscopically, forces are typically applied to objects through the emission and absorption of gauge bosons.

In classical physics, constancy and invariance are embodied in the conservation of energy, mass, momentum, and angular momentum. Those quantities cannot change for that object unless the object is acted upon by an external force.

In Special Relativity, constancy is defined by the concept that the inner products of certain vectors describing an object are constant regardless of the reference frame that the object is viewed from. Constancy in special relativity is embodied in the Lorentz transforms, where we can use a Lorentz transform to change the view that an observer has of a vector, which changes the individual elements of the invariant vectors while leaving the inner products of those vectors constant.

The energy momentum vector **P** and the position vector **X** of an object S can be combined together to represent the state of object S, where **S** = (**P; X**), where the inner products of **P** and **X** with themselves is shown below:

$\mathbf{P} \cdot \mathbf{P} = -E^2/C^2 + P_x^{\,2} + P_y^{\,2} + P_z^{\,2} = E_0^{\,2}/C^2,$

$\mathbf{X} \cdot \mathbf{X} = -(CT)^2 + x^2 + y^2 + z^2 = D^2$

where E is the total energy of the object, including its rest energy and its momentum energy. D is the distance of the object S from a reference point $\mathbf{X}_0 = (0, 0, 0, 0)$. An energy momentum

Vector $\mathbf{P_1}$ is inherently the same vector as the vector $\mathbf{P_2}$, if the inner product of $\mathbf{P_1}$ with itself is the same as the inner product of $\mathbf{P_2}$ with itself. $\mathbf{P_1}$ is inherently the same vector as the vector $\mathbf{P_2}$, if $\mathbf{P_1 \cdot P_1 = P_2 \cdot P_2}$. Accordingly, the energy momentum vector (3, 2, 1, 0) is inherently the same vector as the vector (3, 0, 1, 2), since both vectors have the same inner product.

Lorentz transforms are a type of symmetry transformation, which means that a Lorentz operator **L** can act on a vector without changing the vector's inherent nature as defined by the vector's inner product with itself. Accordingly, the formula, **LS** = **S'** shows the Lorentz operator transforming the vector **S** into the vector **S'**. Since the vectors are invariant under a Lorentz transform, the inner product $\mathbf{S \cdot S = S' \cdot S'}$. Lorentz transforms can rotate a vector, change its position, change its velocity or any combination thereof, without changing the inner product of the vector with itself. Accordingly, the Energy momentum vector and the distance vector can be transformed to any non-accelerating reference frame without changing the inherent nature of the vector. However, Lorentz transforms don't actually apply any forces to the vector or to the object the vector represents. They are just a mathematical technique not a means of applying a force to an object.

Special Relativity enhanced the concept of constancy to include the concept that the speed of light is constant for all observers. If a Special Relativity space was expanding, then the value D in the inner product of the vector **X**, $\mathbf{X \cdot X} = -(CT)^2 + x^2 + y^2 + z^2 = D^2$, would not be a constant but would get larger as a function of time, since the space dimension would get larger with respect to the time dimension. This same concept of expansion carries over into General

Relativity, except that the concept of a conserved inner product is more complicated in General Relativity.

General Relativity is an extension of Special Relativity and it differs from Special Relativity principally in the nature of metric tensor used to measure vectors in space-time. The metric tensor defines the inner product of a vector. In both General Relativity and Special Relativity, the metric tensor is a 4X4 matrix G, where the sixteen elements of the tensor are used to weight the components of the inner product, such that an inner product done using the matrix will provide the appropriate constant measurement of value for a vector that hasn't been acted on by a force and such that the vector can be measured in a consistent way through space-time.

In Special Relativity, only the diagonal terms of the metric tensor are non-zero, where the g00 term is -1 and the other diagonal terms are 1. The Special Relativity metric tensor provides a constant inner product for all space in the form shown above.[2,3]

However, in general relativity, all 16 elements of the metric tensor can be non-zero, unless limiting restrictions are placed on the mass distribution or on the intensity of the gravity field. The value of the matrix elements of the metric tensor are determined by the distribution of mass density in the Universe. Determining the metric tensor elements based on this mass distribution in non-symmetric high field intensity situations is mathematically difficult. For analysis purposes, simplified mass distributions are often used. In weak gravity fields, the metric tenser can be approximated by applying a metric tensor having non-zero elements only along the diagonal.[2, 3] Further, by representing the diagonal elements of the tensor as the infinite sum of linear basis functions, you can reduce the matrix to a matrix that has only non-zero elements on the diagonal.

Since we observe the redshift phenomenon from the weak gravity field of the Earth, we can use a weak field approximation to analyze the expansion or contraction of the Universe as viewed from earth.[2,3] Also, since a scalar times our weak field metric tensor is the same as the metric tensor, the real work of the weak field metric tensor comes in the ratios between the diagonal elements. The g00 element of the metric tensor is the element in the upper left hand corner of the matrix that defines the tensor. The g00 element operates on the time dimension and the energy dimension of the respective vectors when the vectors are multiplied by the tensor. The g00 element of the metric tensor can have a value of from -1 to zero. Where a value of minus one corresponds to a location infinitely far from our gravity well and a value of zero represents a location at the surface of a black hole.

The other three diagonal elements of the metric tensor describe the asymmetry of the inner products, where the inner product asymmetry is caused by the asymmetry of the mass distribution, since the mass density distribution determines the necessary correction to our measurements to maintain constancy of measure for all locations in space. The g11 element of the metric tensor corresponds to the x dimension, the g22 term corresponds to the y dimension, and the g33 corresponds to the z dimension. If the field is also spherically symmetric, then the g11 term, the g22 term, and the g33 term can all be made equal to one and the whole tensor can be effectively described by the g00 element. If the mass distribution is asymmetrical, the values of the elements g11, g22, and g33 will each be different from 1. However, the sum of g11, g22, and g33 will always be 3. For ease of analysis, we will assume the symmetric case. However, the results of the analysis are applicable to all mass distributions.

If the Universe was expanding, the mass density would decrease and the value of the g00 element of the metric tensor would get closer to negative 1, while the value of the g00 element would get closer to zero if the universe was contracting. Accordingly, we can determine the effect of the contraction of the universe on the objects in the Universe by showing how a reduction in the magnitude of g00 towards zero affects the objects in the Universe as observed by us on Earth. In hypothetical case one, the gravitational field strength is zero and the g00 element = -1, the metric tensor is the special relativity metric tensor, which yields the inner product $\mathbf{P \cdot P = -}E^2 + P_x^2 + P_y^2 + P_z^2 = E^2_{0.}$ In hypothetical the case two, the value of g00 = 0.5 and the other diagonal elements of the metric tensor all equal 1, the inner product is $\mathbf{P \cdot P = -(1/2)}E^2/C^2 + P_x^2 + P_y^2 + P_z^2 = E^2_{0.}$ Accordingly, the value of E^2/C^2 must be reduced from its initial value in the calculation for the inner product to provide constancy of measure with the inner product of the special relativity inner product. This is indicative of a decrease in the rest energy of the object as the object goes deeper into gravity well and it shows that the metric tensor changes the relationship between rest energy and momentum energy in the inner product to account for this change in rest energy.[2,3] The relationships between rest energy, and mass, and time, and g00 are discussed in more detail below.

Accordingly, the contraction of the Universe causes all massive objects in the Universe to acquire kinetic energy relative to an observer on Earth, since it increases the energy density at all locations in the Universe. The effect caused by a contracting Universe is reminiscent of the effect caused by a container of gas being compressed and indicates that contraction of the Universe conserves enthalpy as opposed to the expanding Universe model which changes enthalpy through the insertion of Dark Energy.

In addition to increasing the overall energy density of the Universe, contraction of the Universe and the corresponding decrease in the magnitude of the metric tensor, causes the energy density of every object in the universe to increase, the physical size of every object in space to correspondingly decrease because it concentrates our wave functions and mass density into a smaller 3D surface, and the speed of light to decrease. The contraction of the Universe also causes all massive objects in the Universe to shrink (have decreasing radii with time) at the same relative rate as the Universe and to have increased mass density and to have an increased rate of time, which causes humans to perceive light as traveling farther when it goes from a first object to a second object and thereby causes us to perceive the Universe as expanding. However, our observations of galactic radii confirm that the Universe is contracting because we see larger galaxies farther away from us, which means that galaxies had greater radii in the past.

This reduction of an object's physical size (volume) and its increase in rate of time as a consequence of its increase in rest energy will now be explained using exactly the same method Lev Okun used to show that "the phenomenon known as the red shift of a photon is really the blue shift of an atom" in gravitational red shift. This relationship necessarily implies that we contract in time and that our rate of time increases as the Universe contracts over time. Accordingly, it shows that our measurements change as a function of time because we change as a function of time. If we want to determine how the Universe has objectively changed, we need to consider how our subjective measuring sticks have changed.

Imagine identical clocks (Clock 1 and Clock 2) and two identical observers (observer 1 and observer 2) in a valley. Observer 1 wearing Clock 1 takes an elevator to the top of the mountain and then gets off and then sits there. Clock 1's rest energy becomes greater than Clock 2's rest energy by an amount W_{ec1} equal to $\int F_{(clock\ 1)}(R)$ dot dR when it is moved up the mountain by the distance h to location $R_o + h$, in the Earth's gravity field. [2,3] The work applied to clock 1 is equivalent to the increase in the energy of clock 1, which equals $(E_0(R_0)gh/c^2)$ for the weak gravity field of the earth. Since Clock 1 was originally stationary in the valley and since it is also stationary on the mountain, all of the increase in energy (E_0gh/c^2) went into the rest energy of the clock. [2,3,7] In general, any force applied in line with the gradient of energy density only increases the object's rest energy and any force applied perpendicular to the gradient of energy density only increases the object's momentum energy (its energy due to velocity), although we need to consider the gamma factor for relativistic speeds.[5] All elements of the clock, including its electrons and nucleons, will have a corresponding increase in rest energy.[2,3,4]

The rest mass of an object is the rest energy that the object would have if it was located in a hypothetical location outside the gravity field. Rest mass is invariant when the object is measured from different observation frames. The rest mass is the value of rest energy at a hypothetical co-moving location where g00 = -1.[2,3] Rest mass is given by the following equation $m_o = E_0(loc) = E^R{}_0(R)/\sqrt{(g00(R))}$, where $E^R{}_0(R)$ is the rest energy at a location R. [2,3]

Accordingly, rest energy varies from a value of rest mass at g00 = -1 and a value of zero at the surface of a black hole.

When a photon having a wavelength $\lambda_{(R)}$ is emitted from Clock 2 in the valley and the photon is absorbed by Clock 1 on the mountain top, the photon will be measured to have had a wavelength $\lambda_{(R + h)}$ that is greater than the wavelength $\lambda_{(R)}$ when measured by Observer 1. The photon did not increase the energy of Clock 1, as measured at location R + h, by as much energy as the photon decreased the energy of Clock 2 as measured by the change in energy of Clock 2 by observer 2. Accordingly, Observer 1 observes the photon as having a red shift of $-gh/c^2$. [2,3,4]

However, photons never change their inherent nature regardless of where they are in the gravity well because no force can act on them (a photon can't absorb a gauge boson).[2,3] Accordingly, "the phenomenon called the red shift of a photon is actually the blue shift of an atom".[2] The apparent red shift of the photon is caused by Observer 1 and Clock 1 being physically smaller than Observer 2 and Clock 2, which is caused by Observer 1 and Clock 1 having greater rest energy than Observer 2 and Clock 2.[2,3,4]

The Bohr radius describes the radius of an atom such that the radius is inversely proportional to the mass (rest energy) of the electron.[4] Since the applied force was in line with gravity field, all of the energy went into increasing the electron's rest energy and none went into increasing the electron's velocity. [2,3,4] Accordingly, the radius of the atoms of the clock and the size (volume) of the clock decreased by an amount proportional to the increase in rest energy, which is proportional to the square root of g00.

The postulates of General Relativity require that an observer cannot tell that he is free falling in a gravity well by observing herself or her atoms. If the characteristics of your atoms changed in a way observable to you, then you would violate a postulate of General Relativity. Accordingly, all measurable nuclear properties of Clock 1, as measured by observer 1, must vary in lock step with the variance of clock 1's rest energy, rate of time, change in size and with the atom radius, as the clock 1 moves from location R_0 to location $R_0 + h$. If the observable nuclear properties, such as nuclear radii or reaction rates, did not vary in lock step with $\sqrt{g00}$, the photon wavelength, and the rate of time, then observer 1 would be able to tell that she was moving in a gravity well simply by observing the properties of her atoms.

Gluons are the gauge bosons that transmit the strong nuclear force.[6,7] According to the postulates of General Relativity, the nuclear radii must be inversely proportional to rest energy, such that the nuclear radii will follow the same equations for change in radius as the electron radius of the atom. Otherwise, an observer could tell that she was free falling in a gravity well by comparing the atomic radii to nuclear radii of her own atoms. Thus, the nuclear radii will vary in exactly the same manner as the atomic radii when Clock 1 is moved to the top of the mountain, as observed by observer 2 in the valley. This inverse size/radius relation holds for all particles in the nucleus. The proportional decrease in radii for increasing rest energy automatically conserves angular momentum as observed from any specific reference frame. If objects did not shrink as they rose in a gravity well, then angular momentum would not be conserved.

However, Hilo et al. have shown that the speed of light is not actually a constant and varies in accordance with √g00 so that non massive particles will have a greater velocity higher in the gravity well.[8] With the application of basic algebra, the G00 term can be applied to the speed of light squared term in equations 1-4 of Hilo. Accordingly, the massive particle velocities of Clock 1 will have increased due to the decreasing gamma factor. However, the increase in momentum as measured by Observer 2 is still proportional to √g00 as measured by Observer 2, since the combined increase in momentum due to increased rest energy and due to increase velocity equals the change in √g00. Since applying a force in line with the gradient of energy density increases the rest energy Clock 1's massive particles by √g00 as measured by Observer 2, the radius of the atoms and of the nuclei and of the particles have all decreased by √g00 as measured by Observer 2. Further since the velocity of Clock 1's particles have slightly increased due to the gamma factor, the amount of time for an interaction to occur has also decreased by slightly more than √g00 and the reaction rate has increased by slightly more than √g00 for Clock 1 as measured by Observer 2.

All interactions will occur faster for Clock 1 than for Clock 2 as observed by observer 2 and as observed by observer 1. Observer 1 will observe that Clock 2 has increased in volume, gotten lighter, and gotten slower. Likewise, Observer 2 will observe that Clock 1 has decreased in volume, gotten heavier, and gotten faster.

If we were able to change the metric tenser element g00(mountain top) to the magnitude g00(valley), all of the internal energy/rest energy that we added to Clock 1 when we moved it up the mountain would translate into momentum energy/kinetic energy and cause Clock 1 to acquire a relative velocity away from us and to have a greater space difference from us. This effect is exactly what happens to all massive objects in the Universe when the universe contracts and causes the g00 value everywhere in the Universe to get closer to zero. All massive objects in the Universe, including humans on Earth, change size at the same relative rate as the Universe. However, our rate of time increases as we contract with the Universe. Accordingly, we automatically normalize our measurements of the universe based upon our own contraction so that we perceive the universe to be expanding.

Our observations of red shift match Hubble's law because the photon emitted by a galaxy does not change its inherent nature from when it is emitted by the distant galaxy until it is absorbed by us on Earth. The amount by which we contracted is determined by the time it took the photon to reach us, which is determined by the distance to the distant galaxy. Accordingly, we see a larger redshift for galaxies that are farther away from us because we shrink by a greater amount in the time it takes the photons emitted from the more distant galaxies to reach us than it takes for the photons emitted from closer galaxies to reach us. The traditional explanation for galactic red shift is false because it assumes that photons change after being emitted by a galaxy and since Universal expansion does not provide any real velocity. The component of red shift that accounts for the observed increasing red shift in time is provided by the kinetic energy added to the massive objects in the Universe as a consequence of Universal contraction. This added red shift has an accelerating component because the contraction alters the relationship between the 3D surface and the 4D volume.

However, our observations of galactic radii confirm that the Universe is contracting because we see larger galaxies farther away from us, which means that galaxies had greater radii in the past.

observations by Milne indicate that the red shift of supernovae increases by a greater amount than the decrease in supernovae intensity due to increasing distance accounts for. If this additional redshift is considered to be additional velocity added with time and the additional redshift is subtracted from the galactic redshift dimension for the linear regression of galactic radii versus galactic redshift, then the galactic radii verses galactic red shift (galactic distance) linear regression will show an increasing galactic radii for increasing galactic distance (galactic redshift). Accordingly, astronomers' observations of the Universe demonstrate that galaxies are getting smaller in time. I also predict that differential gravitational red shift will increase with time, since the contraction of the Universe will increase the kinetic energy of the stars in the galaxies.

Equations:

$\mathrm{Delta}(\text{Ø}(h)) = \text{Ø}(R_0 + h) - \text{Ø}(R_0)$. (1)[2,3]

Ø is the gravitational potential, R_0 is a location is space in a gravity well, and $R_0 + h$ is a second location in the gravity well.

$\mathrm{Delta}(\text{Ø}_{weak}(h)) = \text{Ø}_{weak}(R_0 + h) - \text{Ø}_{weak}(R_0) = gh$. (2) [2,3]

$\text{Ø}_{weak}(R) = - GM/r$, $g = - GM/r^2$

G is the gravitational constant, M is a centrally located mass, r is the radius from the mass to the location R, and g is the filed strength in the weak field.

$g00(R) = 1 + 2\text{Ø}(R)/c^2$. (3) [2,3]

This equation provides a valid approximation for the g(0,0) element of the metric tensor in a weak gravitation field like we have on Earth. This could be expanded by additional terms for a more precise approximation.

$\sqrt{(g00(R))}\, E_0(loc) = E^R{}_0(R)$. (4) [2,3]

$E_0(loc)$ is rest energy of an object or particle at a hypothetical co-moving location where there is no gravitational potential (Ø = 0, and g00 = -1) and $E_0(R)$ is the rest energy at the location R.

$m_o = E_0(loc)$. (5) [2,3]

This defines the concept of rest mass.

$\sqrt{(g00(R)E_\gamma^R(R) = (E_\gamma^{loc}(_{loc}))$. (6) [2,3]

$E_\gamma^R(R)$ is the energy of a photon γ emitted at R and measured at R and $E_\gamma^{loc}(loc)$ is the energy that an observer at a co=moving reference frame infinitely far from mass (g00 = -1) would measure the photon.

$\sqrt{(g00(R)\,\epsilon_\gamma^{loc}(loc) = \epsilon_\gamma^R(R)$. (7) [2,3]

$\epsilon_\gamma^R(R)$ is the amount of energy detected at R for a photon γ emitted by an atom or an atomic nucleus at location R as measured at R. $\epsilon_\gamma^{loc}(loc)$ is the amount of energy as measured from R that the same atom would emit if the atom was at loc.

Red shift = λshift = (λ(observe) - λ(emit)) / λ(emit) = (ω(emit) - ω(observe)) / ω(observe). (8) [2,3]

$(E_0(R_0 + h) - E_0(R_0))/ E_0(R_0) = - gh/c^2$. (9) [2,3]

$(E_\gamma (R_0 + h) - E_\gamma(R_0))/ E_\gamma (R_0) = gh/c^2$. (10) [2,3]

$(\epsilon^{(R + h)}(R_0 + h) – \epsilon^R(R_0))/ \epsilon^R(R_0) = - gh/c^2$ (11) [2,3]

Equations 8-10 describe a red shift, which is the relative amount by which a photon’s wavelength has increased, while a blue shift is the relative amount by which a photon’s wavelength has decreased. A longer photon wavelength provides lower energy. Equations 10-12 are applicable in a weak field.

$E^{(R0)}(R) = (E_0(loc))\,(g00(R_0))/\sqrt{(g00(R_0)) - (v^{(R0)}(R_0 + h))^2/c^2)}$. (12)[5]

$Y_{SpecialGeneral} = (g00(R_0))/\sqrt{(g00(R_0)) - (v^{(R0)}(R_0 + h))^2/c^2)}$ (13)[5]

E(R) is the energy of an object, v is the velocity of the object, where the object is traversing a gravity well with a velocity v relative to an observer at R_0 and where the object mass, energy, and velocity are all measured from R_0. Equation 18 is the combined special relativity/general relativity gamma factor that allows for calculating many relativistic effects of gravity and special relativity simultaneously.

$r_{(atom)}^{(R0)}(R) = a/E_e^{(R0)}(R)$ (14)[4]

$r_{(atom)}^{(R0)}(R)$ is the radius of an atom at the location R as measured at the location R_0, where the atomic radius is inversely proportional to the electron energy according to the Bohr model.

$\mathbf{P \cdot P} = -E^2/C^2 + P_x^2 + P_y^2 + P_z^2 = E_0^2/C^2$ (15)

$\mathbf{X \cdot X} = -(CT)^2 + x^2 + y^2 + z^2 = D^2$ (16)

Equations 15 and 16 provide the inner products for the energy momentum vector and the Time Space vector for an object in the Universe.

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