Extending Julian Schwinger's interpretation of Gravitational Redshift to Galactic Redshift Implies a Contracting Universe

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Abstract

In his book, “Einstein's Legacy”, Julian Schwinger explained that gravitational redshift is really the blue shift of the massive object that absorbs the photon. Photons do not change energy when moving in a gravity well, but massive objects do change their energy, size, speed, and mass when moving in a gravity well. Likewise velocity redshift can only be adjusted by adjusting the speed of the massive objects. If we extend this concept to galactic redshift and postulate that the apparent redshift of the photon is really a blue shift of the absorbing atom, then it implies that photon energies never change after a photon is emitted and it implies that all massive objects in the universe are getting smaller, getting a faster rate of time, and acquiring additional energy as a function of time. It is proposed that the universe can be modeled as a 4D elastic shell similar to a balloon, where the shell is comprised of energy density and where the surface forms our normal 3D coordinates. When the Universe contracts the galaxies and stars in the universe would contract in a manner similar to what they would if they were drawn on the balloon. This model indicates that the energy for contracting the objects in the Universe comes from the elasticity of space, which gets relaxed as the Universe contracts.

Key words: Redshift, General Relativity, Dark Energy, Rest Mass, Speed of Light

Introduction and Background

In our normal day to day experience, we observe space-time to be comprised of three space dimensions and one time dimension. We also observe objects in space, where these objects comprise mass-less gauge bosons and massive particles. Additionally, every object in space is comprised of energy 'E', where massive objects have both rest energy (also known as internal energy) and momentum energy (also known as kinetic energy). Accordingly, each object in space has an energy density 'P_E' associated with that object for each point in space, where the energy density at each point X in space is approximately equal to the object's energy divided by the distance squared from the object to the point X. The total energy density at a point in space is equal to the sum of the energy densities for all objects at that point in space and the energy density changes as a function of time depending upon how the distribution of energy changes as a function of time, where the magnitudes of energy, distance, and time are also dependent upon the observer's reference frame.

$P_E(X, t) \approx E/r(X, t)^2$. (1).

$P_{E(tot)}(X, t) = \sum P_E(X, t)$ (2).

The rest energy is all of the energy that a massive object has when it is not moving. It is the total energy minus the kinetic energy. Rest energy is designated $E^X{}_0(X, t)$, which provides the rest energy of the object at a point X and time t. $E_0(loc)$ is rest energy of an object or particle at a hypothetical co-moving location where there is no gravitational potential and the g_{00} element of the metric tensor equals one ($Ø = 0$, and $g_{00} = 1$) and $E_0(R)$ is the rest energy at the location R. The rest mass 'm_o' is defined to be equal to $E_0(loc)$.

$m_o = E_0(loc) = E^X{}_0(X)/ \sqrt{(g_{00}(X))}$ Eqn. 4 [2, 3].

$\sqrt{(g_{00}(X))}E_0(loc) = E^X{}_0(X)$ Eqn. 5 [2, 3].

Accordingly, rest energy of an object varies from a value equal to its rest mass at $g_{00} = 1$ and a value of zero at the surface of a black hole. However, the rest mass of an object is a constant.

A weak gravitational field can be described by a gravitational potential φ, and g00 is related to the gravitational potential:

$g00 = 1 + 2\varphi/c^2$ [2, 3] Eqn. 6.

Gravitational redshift is the increase in the measured wavelength of a photon emitted at a height *x* in a gravity well and detected by a detector at a higher height *x + h* in that gravity well as compared to a photon emitted at height *x* and detected at height *x*. In his book "Einstein's Legacy", Julian Schwinger provided the appropriate interpretation of gravitational redshift in General Relativity [1, 2, 3]. The difference in the measured wavelengths is not due to a change in the photons, but instead is due to a change in the atoms of the massive objects [1]. Photons never change their energy after they are emitted, but massive objects change their internal energy when they move in a gravity well [1].

Work must be applied to a massive object to move the object up in a gravity well and that work changes the clock and its atoms such that they detect the unchanged photon to be at a lower energy and have a higher wavelength than the identical lower height detector would have measured [1, 2, 3]. As Lev Okun observed, "the phenomenon known as the red shift of a photon is really the blue shift of an atom" [2, 3]. Accordingly, photons retain a constant energy as they move in a gravity well while all massive objects get more massive and smaller and acquire a faster rate of time as they move up in a gravity well.

We would expect the mechanisms of velocity redshift, galactic redshift, and gravitational redshift to all be similar. A defining characteristic of both velocity redshift and gravitational redshift is that changing the massive object results in a change in the detected wavelength of the photon, even though the photon does not change in either gravitation or velocity redshift. Accordingly, it would seem more likely that galactic redshift works by changing the massive objects instead of by changing photons, since it would work similarly to other types of redshift.

If we apply the Schwinger interpretation of gravitational redshift to Galactic redshift, it implies that the massive objects in the Universe are contracting while photons remain inviolate, which implies that the Universe is contracting to make the atoms smaller as compared to the photons. Additionally, all massive objects acquire velocity away from the observer as a function of time, since the contracting universe increases the energy density at all points in space and since increased energy density causes internal energy to be translated into kinetic energy.

2. Gravitational redshift thought experiment

Okun uses a thought experiment to explain how redshift or blue shift occur and how an object changes when it moves in a gravity well [3]. We are going to expand upon Okun's thought experiment by extending it from one object to two identical objects and examining how they differ when one of them is moved in the gravity well.

Imagine two identical clocks (Clock 1 and Clock 2) and two identical observers (observer 1 and observer 2) in a valley adjacent a mountain. Observer 1 wearing Clock 1 takes an elevator to the top of the mountain and then gets off and then sits down. 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. 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. All elements of the clock, including its electrons and nucleons, will have a corresponding increase in rest energy.

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 $-gh/c^2$.

However, photons never change their energy regardless of where they are in the gravity well because no force can act on them (a photon can't absorb or emit another photon or any other particle). Accordingly, what appears as the red shift of a photon is actually the blue shift of the atom absorbing the electron. The apparent red shift of the photon is caused by Observer 1 and Clock 1 being heavier, and 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.

Since the applied force to Clock 1 was in line with the gradient of the gravity field and the object is at zero velocity, all of the energy went into increasing the electron's rest energy and none went into increasing the electron's velocity. Accordingly, the radius of the atoms of clock 1 must have decreased by an amount proportional to the increase in rest energy so as to conserve angular momentum for the electron as observed by observer 2, since the rest energy (mass) went up and the velocity stayed constant. The changes in rest energy and radius are proportional to the change $\sqrt{g_{00}}$ element of the metric tensor.

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. 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 atomic 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 $\sqrt{g_{00}}$, 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. Accordingly, the magnitude of the nuclear radii must be inversely proportional to rest energy and the $\sqrt{g_{00}}$, such that the nuclear radii will follow the same equations for change in radius as the atomic radius. 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. This inverse size/radius relation must hold for all particles in the nucleus.

As observed by observer 1, the tip speed of a hand of clock 1 will still be the same, but the hand will complete a rotation more quickly because the clock face has a smaller circumference.

All observers measure the speed of light as being C in their reference frame.[1] However, as noted by Einstein, they will not measure the speed of light as C in other reference frames.[1] M. H. M. Hilo has shown that the speed of light in a vacuum varies proportionally to $\sqrt{g_{00}}$ [4, 5]. Hilo generalizes the Special Relativity gamma factor such that it can be applied in the presence of gravity in accordance with General Relativity, where the generalized gamma factor is given by the following equation.[2, 3]

$$Y_{SpecialGeneral} = 1/ \sqrt{(g_{00} – (v^2/c^2))} \qquad \text{Eqn. 8.}$$

It is known that the gamma factor approaches infinity as the velocity of an object approaches the speed of light. Accordingly, the velocity must be approaching the speed of light when the denominator equals zero.

$g_{00} - (v^2/c^2) = 0$ Eqn. 9

$c^2 g_{00} = v^2$ Eqn. 10

$\sqrt{(g_{00})}c = v$ Eqn. 11

Since the generalized gamma factor approaches infinity as v approaches $\sqrt{(g_{00})}c$, the speed of light in a vacuum must be proportional to $\sqrt{(g_{00})}$ such that the speed of light equals C when measured in the observer's reference frame and is greater than C at locations higher in the gravity well and is less than C at locations lower in the gravity well. However, the generalized gamma factor is set up such that C equals the speed for light in the special relativity/Minkowski space where g00 = 1.

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 size, gotten lighter, and gotten slower. Likewise, Observer 2 will observe that Clock 1 has decreased in size, gotten heavier, and gotten faster.

If we were able to decrease the metric tenser element g_{00}(mountain top) to the magnitude g_{00}(valley), all of the rest energy that we added to Clock 1 when we moved it up the mountain would transform into momentum energy (kinetic energy) and cause Clock 1 to acquire a relative velocity away from us and to have a greater distance from us. This increase in kinetic energy is what would happen to all massive objects in the Universe if the Universe was contracting and causing the g_{00} value at all points in the Universe to get closer to zero.

Indeed, we have observed that closer supernovae have a greater redshift than expected, but have attributed it to an accelerating expansion of the Universe. However, it is actually added velocity in the direction away from the observer caused by the decrease in the value of g00, which is caused by the increase in mass density as the universe contracts.

3. The contracting Universe

The Universe must be contracting because photons can never change their energy after they are emitted and before they are absorbed and since the only way to change the apparent energy of a photon is to change the atom absorbing the photon and since we perceive a redshift from all non-gravitationally bound galaxies.

Since all massive objects in the Universe are contracting together along with space and since the speed of light is slowing down and since our rate of time is speeding up, we perceive the Universe to be expanding even though it is contracting. Contraction of the Universe causes all massive objects to shrink, as well as the space between them to shrink. It causes galaxies to acquire velocity away from the observer by transferring rest energy into kinetic energy, since the g00 element gets smaller as the energy density increases. The energy density increases as the Universe contracts because it is dispersed over a smaller volume and because additional rest energy is added to all massive objects as a function of time, which must occur because the smaller version of the object is necessarily a higher energy version. This increasing energy density corresponds to a decreasing g00, which causes rest energy to translate into kinetic energy and which is what we perceive as dark energy.

The additional rest energy provided by that energy further increases mass density in the Universe and causes all massive objects to have an even greater increase in velocity. The increased energy also makes the objects smaller and faster (a galaxy's outer stars will rotate at the same speed but will complete a revolution faster because they are at a smaller radius), and heavier.

It is proposed that the universe can be modeled as a 4D elastic shell similar to a balloon, where the shell is comprised of energy density, where the surface of the balloon is the normal 3D space that we perceive and where the energy density provides the thickness and elasticity of the shell. This model indicates that the energy for contracting the objects in the Universe comes from the elasticity of the space and is manifest in the thickness and density of the energy that comprises the elastic shell.

Photons and massive particles are the elastic medium as well as being particles and waves. For an example, an electron can act like a particle oscillating in a localized area, while the energy density of other distant electrons and protons provides the elastic medium for the electron to oscillate as a particle. Meanwhile, the electron's wave nature can be used to predict the probability of its future location.

A universe contracting at a constant rate would appear to the observers as an expanding universe with an increasing expansion rate because of the increase in the velocity away from the observer added to all massive objects over time due to the increase in energy density, as well as because of the observer's increased rate of time and the decreased speed of light. The increased velocity causes an increasing redshift factor in the apparent redshift of photons for galaxies closer to us. This increase in the redshift has been observed and interpreted as increasing universal expansion.

However, universal expansion is based upon the false premises that photons can change their energy without interactions and that expansion only occurs in galactic rifts, but not to ordinary massive objects. Since the physical constants applicable to atoms change when the massive objects are exposed to higher mass density, they can contract along with the Universe, just like they do with gravitational redshift.

If we correct our measurements of galactic redshift to remove the velocity redshift caused by galactic contraction, then our measurements of galactic radii should show decreasing galactic radii with time even though galaxies have been merging and growing.

4. A heuristic analysis of how a contracting universe relates to Big Bang cosmology.

Given the apparent elastic nature of space and given that it consists of the energy density extended from all of the objects in the Universe, we can think of space as being a spherical four dimensional elastic shell comprised of energy density, where the shell can stretch or shrink as a function of time. Accordingly, the Universe is similar to a dimpled 4D balloon, where the dimples are caused by thicker rubber that corresponds to galaxies and dark matter. The surface of the balloon provides our normal 3D world. The radius of the Universe equates to time. The thickness and density of the shell increases when the Universe contracts because the energy density is compressed into a smaller area. The objects in the Universe expand or contract along with the Universe when the Universe expands or contracts in a way similar to the pictures of the objects drawn on a balloon would expand or contract if you blew up the balloon or let the air out.

Since light bends towards the normal when it slows down due to increased mass density and since massive objects bends toward the normal when they slow down due to increased mass density, it indicates that gravity may fundamentally be a type of refraction. Also, the differential equations for a photon in space are essentially identical to the equation for a shear wave in 3D anisotropic elastic media.

A gravity well is a volume of space where the total energy density increases as you approach the center of the volume. Accordingly, light will refract towards the normal in accordance with Snell's law when it travels into a gravity well, since the g_{00} element of the metric tensor gets smaller for greater energy density.

$N = c/v = c/\sqrt{(g_{00})}c = 1/\sqrt{(g_{00})}$ Eqn. 12

$N_1 Sin(Ø_1) = N_2 Sin(Ø_2)$ Eqn. 13

$Ø_2 = Ø_1(invsin(\sqrt{(g_{00}(X_2)}/ \sqrt{(g_{00}(X_1)})))$. Eqn. 14

'N' is the index of refraction in a vacuum; 'c' is the speed of light in the observer's reference frame, where the speed of light will always be measured at c for light traveling in the same G_{00} level as the observer; 'Ø' is the angle with respect to the normal, where the normal is provided by the gradient of energy density; 'X' is the location of the object on the 3D surface of space at the appropriate time.

In his book, "Introduction to Seismology", Peter Shearer derives the differential equations for shear waves and compression waves in the Earth, which is a 3D elastic anisotropic media [6]. The likelihood that gravity can be modeled as a form of refraction and the near identity of the photon differential equation and its solutions to the simplified differential equation and solutions for a shear wave in 3D anisotropic media (Shearer eqn. 3.32) seems to validate our heuristic guess that the Universe is a 4D elastic shell comprised of energy density. We are able to use the simplified equations for all empty space situations because the lame' factors are constant for empty space and the speed is determined solely by the energy density as represented by the square root of the g00 term of the metric tensor, which makes the first two terms of Shearer eqn. 3.18 zero.

If space is a 4D elastic media, then elementary particles should be solutions to a second order hyperbolic partial differential equation for the elastic media that comprises space, where gauge bosons are travelling wave solutions and massive particles are standing waves comprised of two travelling waves or a linear combination of elementary massive particles.

$$(\partial^2F/\partial x^2 + \partial^2F/\partial y^2 + \partial F^2/\partial Z^2 + \partial^2F/\partial w^2) – 1/C^2\ (\partial^2F/\partial t^2) = 0. \qquad \text{Eqn. 9.}$$

In the equation, x, y, and z are the normal space dimensions that form the surface of the sphere and w is the coordinate for measuring distance in the energy density dimension (the thickness of the 4D shell).F is the function and C is the speed, which can be different for shear, compression, and surface waves. C is a non-linear function of time and space that can be solved for using Einstein's equations and that can be determined from the g00 element of the metric tensor, where $g00 = 1 + 2\varphi/c^2$ in a low gravity environment like the earth. Accordingly, the equation is linear within single g00 levels like in special relativity, but non-linear across g00 levels. The c^2 term could also be applied as a product to the gradient term instead of as a denominator to the time derivative term, which is traditional form of the photon equation, where the w term is zero for a photon.

For a gluon, one of the x, y, or z terms would be zero and a proton would be a standing wave comprised of two gluons. Neutrinos would likely be scalar, like seismic P-waves. Surface waves could form some of the more exotic particles.

Also, the zero on the right had side of the equation is really non-zero since the collapsing balloon of space is providing energy to the massive objects as space contacts. Accordingly, the equation has a non-zero source term that provides energy to particles other than gauge bosons, like photons.

We should be able to use an eikonal method, such as D'Alembert's solution, to provide a plane wave solution to Eqn. 9 that can be wave traced to meet the curved paths identified by the Einstein equations.

5. Changes to the Big Bang

Since the Universe is presently contracting, it must have expanded at some point in the past for some finite period of time. It is likely that the primary source term that existed during the expansion did not allow for the presence of stable massive objects during the expansion phase. However, once all of the energy was put into the universe (mostly in the form of the elastic energy of the shell) and the primary source term disappeared, contraction began. Once contraction began, the more stable present source term allowed for stable massive particles, where the present source term translates energy from the elasticity of the Universe into energy of the massive objects on the Universe. Since there were no massive particles during the expansion epoch, there was no substantial concentration of energy during the expansion. Thereby, yielding the rather homogenous universe we perceive. The microwave background is likely the remnants of the expansion epoch.

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