THE COMPLETE THEORY OF QUANTUM GRAVITY

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ABSTRACT
This paper presents a complete quantum field theory of gravity (QFTG), developed through a derivation that first demonstrates the role that γ plays in the classical equations of orbital mechanics and concludes with a set of field equations that define gravitational fields in terms of graviton exchange between field and mass in the field. This development is not based upon the conjecture of hypothesis to offer explanation, rather the underlying structure of gravitational fields is a conclusion derived from the core equations of the standard model. QFTG offers two views of gravitational fields: relativistic and invariant.

The relativistic view is what is seen and measured by an observer in a gravitational field at any point in the field. Einstein's field equations, the classical equations of orbital mechanics, and QFTG's relativistic field equations are all based upon this perspective of gravitational fields. The relativistic view is dominated by gravitational time dilation which masks the underlying processes that define these fields. The invariant view normalizes gravitational fields to the constant clock tick rate of an observer beyond the field. In the gravitational fields of planets and stars, QFTG's relativistic equations yield results that are consistent with the classical equations of orbital mechanics. In the Milky Way galaxy, these equations accurately predict the orbital velocity of stars using only the observed mass without the postulation of dark matter. Furthermore, these equations lead to an explanation of why Einstein's field equations and Newton's universal gravity equation cannot be used in the gravitational fields of the galaxies. These equations reveal Hawking radiation to be extraordinarily trans-Planckian in the range of Schwarzschild radii where it purports that micro black holes are the least stable.

QFTG's invariant field equations define gravitational fields as a distribution of gravitons in the space surrounding all sources of field in which an exchange of gravitons between mass and the field results in a fall in the potential energy of this mass and an increase in its kinetic energy accelerating it towards the center of the field. The total energy of invariant mass becomes the sum of the potential and kinetic energy of the field. In this relationship, the energy of the mass viewed as creating the field is the potential energy of the field. Invariant mass is transformed into a black hole by compressing its radius to the point that its potential energy has been completely converted into the kinetic energy of field. The infinities that are the consequence of the stoppage of time at the event horizon cease to exist and what lies to its interior is defined. QFTG's invariant field equations lead to the conclusion that the universe is in transition and moving from a state where there is the potential energy of mass and the kinetic energy of mass and photons in three-dimensional space to a state where there is only field. This process is shown to underlie the creation of all momentum observed in the universe. The formation of a micro black hole in a star or planet allows this process to proceed spontaneously at the maximum rate possible in the universe. The formation of one micro black hole is found to collapse a star the size of the sun in less than two months. The slowing clock of the falling observer in three-dimensional space masks these processes from view and is responsible for the formulation of theories that are dominated by gravitational time dilation. The invariant view steps beyond this local perspective and offers the first glimpse of what an observer beyond the field sees and measures.

INTRODUCTION
In 1916 Albert Einstein introduced his model of gravitational fields based on the assumption that

the curvature of space by mass is the underlying cause of gravity. In the fields of discrete mass, such as planets and stars, it predicts what is observed including gravitational time dilation and the red shift in photons moving away from a source of field. In 1999 it was discovered that the orbital velocities of stars in the spiral and elliptical galaxies do not agree with what is predicted by Einstein's field equations or Newton's universal gravity equation. Correcting this discrepancy requires that additional quantities of unseen mass be added to the fields of these galaxies. There is no convincing empirical evidence to support doing this other than the notion that Einstein's field equations and Newton's equation must describe these fields. The success of a theory or an equation is dependent upon how well it predicts what is observed in nature. When the failure of theory to predict becomes the path to the invention of the invisible and undetectable, scientific advancement is impeded. The development of QFTG was undertaken because Einstein's curved space and Newton's equation fails the test of predicting what is observed until the existence of dark matter can be demonstrated empirically. The development of QFTG and the derivation of its equations offer an alternative theory of gravity that is predictive of what is measured and observed in all gravitational fields.

Quantum field theory QFT has successfully defined three of the four known forces in the universe in terms of a quantum exchange of particles. The fourth force gravity has not been adequately described in terms of a quantum exchange. When such a theory is developed, it will have successfully unified all of the forces and the universe will be described solely in terms of quantum mechanics. The development of QFTG, as presented in this paper, is based upon the classical equations of orbital mechanics, Einstein's definition of γ in terms of the ratio between relativistic mass and invariant mass, and his definition of relativistic mass, as the sum of invariant mass and four-momentum. With no preconceptions or assumption made, this derivation leads to a set of field equations that define gravitational fields in terms of a quantum exchange. The derived field equations become the implication of the equations from which they are derived, so QFTG becomes the theory of gravitational fields of the classical equations, which are at the core of the standard model.

QFTG is a derived theory. Its first test is the adequacy of derivation. Recognizing this, each new definition developed is demonstrated to be consistent with pre-existing theory.

The Derivation of Field Gamma

The Lorentz factor, the basis of Einstein's Special Relativity, is shown below:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad (1)$$

Currently gravitational field theory does not place γ in a central role in defining the various attributes of such fields. This first section of the paper derives the relationship between γ and the classical equations, starting with the definition of escape velocity v_e in terms of orbital velocity assigned as v_o. This equation appears below:

$$v_e = \sqrt{2} \cdot v_o \qquad (2)$$

Orbital velocity v_o is defined in terms of gravitational acceleration designated as ga and the distance R from the center of the field as follows:

$$v_o = \sqrt{ga \cdot R} \tag{3}$$

Substituting the definition of orbital velocity v_o in equation (3) into equation (2) and squaring yields:

$$v^2{}_e = 2 \cdot ga \cdot R \tag{4}$$

Substituting the Newtonian definition of ga or $G.M/R^2$ in equation (4) and simplifying.

$$v^2{}_e = \frac{2 \cdot G \cdot M}{R} \tag{5}$$

Re-organizing equation (5) yields:

$$R = \frac{2 \cdot G \cdot M}{v^2{}_e} \tag{6}$$

Multiplying the right hand side of equation (6) by c^2/c^2 results in:

$$R = \frac{2 \cdot G \cdot M}{c^2} \cdot \frac{c^2}{v_e^2} \tag{7}$$

The Schwarzschild radius which will be identified as R_s is defined as follows:

$$\mathrm{R_s} = \frac{2 \cdot \mathrm{G} \cdot \mathrm{M}}{\mathrm{c}^2} \tag{8}$$

Replacing the definition of the Schwarzschild radius in equation (7) with R_s and re-organizing:

$$\frac{R}{R_s} = \frac{c^2}{v^2{}_e} \tag{9}$$

Although equation (9) is quite simple, it defines a fundamental relationship in gravitational fields relating escape velocity to distance from the event horizon. Multiplying both sides of equation (9) by R_S then subtracting both sides from $R^{\cdot}c^2$ yields:

$$R \cdot c^2 - R \cdot v^2{}_e = R \cdot c^2 - R_s \cdot c^2 \tag{10}$$

Segregating the terms expressed in terms of distance from those expressed in terms of velocity in equation (10) results in:

$$\frac{R}{R-R_s} = \frac{c^2}{c^2-v_e^2} \tag{11}$$

Taking the square root of both sides and re-organizing the right hand term:

$$\frac{\sqrt{R}}{\sqrt{R-R_s}} = \frac{1}{\sqrt{1-\frac{v_e^2}{c^2}}} \tag{12}$$

In equation (12) the right hand term is the Lorentz factor defined in terms of escape velocity v_e instead of the observed velocity v of mass. In a gravitational field, mass freely falling from the perimeter of the field will have a velocity v that equals v_e at every point in the field as long as it does not import velocity from beyond the field. Therefore, the term on the right is the field based definition of the Lorentz transform which is also true of the left term. The Lorentz factor is now defined in terms of attributes of the field itself: escape velocity v_e and the speed of light c on the right and distance R from the center of the field and the distance $R–R_S$ from the event horizon on the left. When γ is defined in terms of attributes of field, it will be referred to as field γ.

The field γ based analogue of any of the classical equations defining the attributes of gravitational fields, as shown in Table I, can be derived by setting either side of equation (12) equal to field γ. Setting the left hand term equal to field γ and then solving for R_S yields the definition of the Schwarzschild radius in terms of field γ as shown below:

$$R_s = R \cdot \left(1 - \frac{1}{\gamma^2}\right) \tag{13}$$

Gravitational acceleration ga in terms of field γ can be derived by setting the field γ based definition of R_S in equation (13) equal to the classical definition of R_S shown below:

$$R_s = \frac{2 \cdot G \cdot M}{c^2} \tag{14}$$

Substituting the definition of R_S for R_S in equation (13) yields:

$$\frac{2 \cdot G \cdot M}{c^2} = R \cdot \left(1 - \frac{1}{\gamma^2}\right) \tag{15}$$

The Newtonian definition of gravitational acceleration ga is shown below:

$$ga = \frac{G \cdot M}{R^2} \tag{16}$$

When both sides of equation (15) are multiplied by $c^2 / (2 \cdot R^2)$, the left hand side becomes ga as defined in equation (16) and the following is found:

$$ga = \frac{c^2}{2 \cdot R} \cdot \left(1 - \frac{1}{\gamma^2}\right) \tag{17}$$

Equations (13) and (17) are the first two equations presented in Table I. The other equations in this table can be derived through similar simple algebraic steps from either the distance form of the definition of field γ or the escape velocity definition as found in equation (12) above.

Table I

Equation	**Gamma Based**	**Classical**
Schwarzschild Radius R_s	$R \cdot \left(1 - \frac{1}{\gamma^2}\right)$	$\frac{2 \cdot G \cdot M}{c^2}$
Gravitational acceleration ga	$\frac{c^2}{2 \cdot R} \cdot \left(1 - \frac{1}{\gamma^2}\right)$	$\frac{G \cdot M}{R^2}$
Orbital velocity v	$\frac{c}{\sqrt{2}} \cdot \left(1 - \frac{1}{\gamma^2}\right)^{0.5}$	$(ga \cdot R)^{0.5}$
Escape velocity v_e	$c \cdot \left(1 - \frac{1}{\gamma^2}\right)^{0.5}$	$(2 \cdot ga \cdot R)^{0.5}$
Mass of source of field M	$\frac{c^2 \cdot R}{2 \cdot G} \cdot \left(1 - \frac{1}{\gamma^2}\right)$	$\frac{ga \cdot R^2}{G}$
Gravitational force F	$\frac{M \cdot c^2}{2 \cdot R} \cdot \left(1 - \frac{1}{\gamma^2}\right)$	$M \cdot ga$
Potential and kinetic energy PE and KE	$\frac{M \cdot c^2}{2} \left(1 - \frac{1}{\gamma^2}\right)$	$M \cdot ga \cdot R = \frac{1}{2} \cdot M \cdot v^2$
Einstein's gravitational time Dilation	$\frac{1}{\gamma}$	$\left(1 - \frac{2 \cdot G \cdot M}{R \cdot c^2}\right)^{0.5}$

Table II summarizes the relationships that define field γ allowing it to be calculated from a known variable defined in column (1) using the defining equation found in column (2). The first two definitions in this table can be derived from the appropriate equation in Table I. The third is the basic definition of field γ as found in equation (12) with the remaining three definitions found in the literature.

Table II

Known Variable	**Value of gamma**	**Variables**
Escape velocity	$\left(\frac{1}{1-\frac{v_E^2}{c^2}}\right)^{0.5}$	v_E = escape velocity
Orbital velocity	$\left(\frac{1}{1-\frac{2 \cdot v^2}{c^2}}\right)^{0.5}$	v = orbital velocity
Distance to event horizon	$\left(\frac{R}{R-R_s}\right)^{0.5}$	R = distance to center field R_s = Schwarzschild radius
Energy or mass in field and beyond field	$\frac{E_o}{E_e}$	E_o = energy or mass in field E_e = energy or mass beyond field
Wavelength beyond field and in field	$\frac{\lambda_e}{\lambda_o}$	λ_e = wavelength beyond field λ_o = wavelength in field
Clock tick rates	$\frac{t_f}{t_o}$	t_f = clock tick rate beyond field t_o = clock tick rate in field

When the field γ based equations are compared to their classical analogues in terms of numerical results, they are always identical. This is because they are merely simple algebraic derivatives of the classical equations. That this is the case is demonstrated in the numerical examples found in the Appendix.

Four-Momentum based Gravitational Fields

The definition of γ in terms of distance R from the center of a gravitational field and the distance from the event horizon $R-R_S$ as derived in equation (12) is shown below:

$$\gamma = \left(\frac{R}{R - R_s} \right)^{0.5} \tag{18}$$

This relationship defines both a value and a location to field γ in the space surrounding all sources of field. How field γ exerts an influence over mass in the field can be determined by starting with the Lorentz factor found in equation (1) and solving it for v as done below:

$$v = c \cdot \sqrt{1 - \frac{1}{\gamma^2}} \tag{19}$$

This equation is the same as used by Einstein to define the relativistic mass M associated with a velocity v of an invariant mass m relative to a stationary observer, but it is stated in terms of v instead of γ. Therefore the ratio between relativistic mass M and invariant m can be substituted for γ in this equation or:

$$v = c \cdot \sqrt{1 - \frac{1}{\frac{M^2}{m^2}}} \tag{20}$$

In Table I, the definition of escape velocity v_e from a gravitational field is shown to be:

$$v_e = c \cdot \sqrt{1 - \frac{1}{\gamma^2}} \tag{21}$$

The definitions of both v_e in equation (21) and v in equation (19) are identical, so, as long as the definition of field γ in both equations is based upon distance as defined by equation (18) they both define escape velocity. This can be demonstrated by substituting the right side of equation (18) for field γ in equation (19), simplifying, and then replacing R_s with its definition found in equation (8) to yield:

$$v = \sqrt{\frac{2 \cdot G \cdot M}{R}} \tag{22}$$

This is the classic definition of escape velocity. As a result, when γ in the Lorentz factor shown in equation (19) is defined by field γ in equation (18), mass in a gravitational field has a velocity v that is always equal to the escape velocity. The value of γ in the Lorentz velocity equation (19) can also be replaced with the ratio of relativistic mass M to invariant mass m as shown in equation (20) and this ratio can be substituted for γ in equation (18) and solved for M or:

$$M = m \cdot \sqrt{\frac{R}{R - R_s}} \qquad (23)$$

Equation (23) defines the relativistic mass M of invariant mass m in free fall at any point R in a gravitational field in terms of the ratio between the distance R from the center of the field and the distance R-R_S from the event horizon of the mass creating the field. This relationship is not based upon mass m actually being a black hole and defines the relativistic mass M in the gravitational fields of discrete mass such as planets and stars. When m is the invariant mass of the source of the field and R is the radius defining the surface of this mass, equation (23) defines the relativistic mass M of the source of the field. The relativistic mass M of the source of the field becomes defined by ratio of its current radius R and the difference between this radius and its Schwarzschild radius R_S. When the current radius R equals the perimeter of the field, R-Rs approaches R and M = m. When the current radius R equal Rs, the relativistic mass M of the source of the field equals infinity. The degree to which the radius R of the source of the field is compressed determines its relativistic mass M. Mass in free fall in the field at a point R has the same ratio of relativistic mass M to invariant mass m as does the source of the field when its radius equals R; therefore, mass in free fall goes through the same compressive process in moving to the surface of the source of the field that the mass already there has gone through. Consequently, the radius R of the mass in free fall and its Schwarzschild radius R_S can replace the radius of the source of the field and its Schwarzschild radius in equation (23).

When the definition of field γ in terms of escape velocity replaces its definition in terms of distance in equation (23) the following is found:

$$M = m \cdot \sqrt{\frac{c^2}{c^2 - v_e^2}} \qquad (24)$$

The relativistic mass M of the source of the field becomes a function of the escape velocity v_e from the field at any point R. The relativistic mass M in this equation also equals the invariant mass m at the perimeter of the field where the escape velocity v_e equals zero and the current radius R is the distance to the perimeter of the field. At the event horizon where the escape velocity v_e equals the speed of light c and R = Rs, the relativistic mass m also goes to infinity. In this definition, the degree to which the mass of the source of the field is relativistic becomes a function of how close the escape velocity v_e from the surface of this mass is to the speed of light. The relativistic mass defined in terms of field γ in equations (23) and (24) is new and not the same as that defined by Einstein, because it is the consequence of the compression of the radius R containing mass m and the increasing escape velocity associated with this compression. Consequently, it will be referred to as gravitational relativistic mass.

The relativistic nature of gravitational fields is demonstrated by the empirically measured differential clock tick rates at different distance from the source of the field. Clocks closer to the source of the field have a slower tick rate t_o than more distant clocks with a tick rate t_f. The ratio between these differential clock tick rates is defined in terms of field γ in Table I as follows:

$$\frac{t_o}{t_f} = \frac{1}{\gamma} \tag{25}$$

When t_o is assumed to be the clock tick rate beyond the field, the definition of field γ in terms of the ratio between the gravitational relativistic mass M of the source of the field and its invariant mass m replaces field γ, and the resulting equation solved for t_o the following is found:

$$t_o = t_f \cdot \frac{m}{M} \tag{26}$$

The clock tick rate t_o of the mass creating the field becomes defined as the product of clock tick rate t_f of this mass beyond the field and the ratio of its invariant and relativistic mass. This definition is the same as the definition of the clock tick rate t_o of mass m at velocity v when t_f is its clock tick rate at rest. The slowing clock tick rate of mass as the radius R containing that mass is reduced offers empirical evidence of increasing relativistic mass just as it does for increasing velocity. Later in the paper Einstein's relativistic mass and gravitational relativistic mass are combined into one definition.

Einstein defined relativistic mass M as being composed of invariant mass m and four-momentum or p_4 as shown below:

$$M = p_4 + m \tag{27}$$

It will be assumed that this definition applies to both Einstein's relativistic mass and gravitational relativistic mass M. Replacing M in equation (28) with $m^{\bullet}\gamma$ and solving for p_4 yields:

$$p_4 = m \cdot (\gamma - 1) \tag{28}$$

This definition of p_4 merely defines it as the relativistic mass $m^{\bullet}\gamma$ less the invariant mass m or the increase in the invariant mass.

Solving equation (28) for γ yields:

$$\gamma = \frac{p_4}{m} + 1 \tag{29}$$

Substituting the definition of γ in terms of escape velocity for γ in equation (28) results in:

$$p_4 = m \cdot \left(\frac{c}{\sqrt{c^2 - v_e^2}} - 1 \right) \tag{30}$$

Substituting the definition of γ in equation (22) for γ in equation (28) results in

$$p_4 = m \cdot \left(\frac{\sqrt{R}}{\sqrt{R - R_s}} - 1 \right) \tag{31}$$

Equations (30) and (31) define the four-momentum p_4 of mass in free fall, when the value of m used in either equation equals invariant mass m of this mass. In equation (31) when the mass of the source of the field is substituted for m, the four-momentum of the source of the field is defined at every point R in the surrounding space. This leads to the conclusion that p_4 is not local to the mass m creating the field and that the gravitational field is the distribution of four-momentum p_4 in the surrounding space defined by equation (31). Four-momentum has an associated four-vector that is perpendicular to three dimensional space that is actualized in three dimensional space as a vector pointing towards the center of the field, which means that a gravitational field based upon four-momentum is a vector field.

The ratio between four-momentum and mass m as defined in equations (30) and (31) is independent of the absolute value of m, so the ratio between the four-momentum p_{4f} and mass m_f in free fall at R will always equal the ratio of four-momentum p_4 and mass m of the source of the field at R or:

$$\frac{p_{4\,f}}{m_f} = \frac{p_4}{m} \tag{32}$$

This suggests that a four-momentum p_4 based gravitational field will exert its influence over mass in the field by contributing four-momentum p_{4f} to this mass from the four-momentum p_4 of the field at R or:

$$p_{4\,f} = \frac{p_4}{m} \cdot m_f \tag{33}$$

In order to illustrate how this contribution controls the velocity of mass in the field, equation (31) is re-organized as follows:

$$\sqrt{\frac{R}{R - R_s}} = \frac{p_4}{m} + 1 \tag{34}$$

When the left hand term in this equation was substituted for γ into the Lorentz factor, as shown in equation (19), it was found that this substitution resulted in the derivation of the Newtonian definition of escape velocity as shown in equation (22). The right hand term in equation (34) can similarly be substituted into the Lorentz definition of velocity v in terms of γ to yield:

$$v = c \cdot \sqrt{1 - \frac{1}{\left(\frac{p_4}{m} + 1 \right)^2}} \tag{35}$$

This equation also defines escape velocity from any point R in a gravitational field when the value of four-momentum p_4 equals that of the source of the field at R and m equals its mass. As long as the contribution of p_4 from the field to the mass in the field is defined by equation (31), the ratio between the four momentum and mass will be the same for the source and mass in free fall at R and the velocity v of this mass as defined in equation (35) will always equal the escape velocity at every point R in the field.

The velocity v of mass in free fall in Equation (35) can be defined solely by the four-momentum p_4 of the source, when it is re-organized, stated in terms of mass m_f in the field, and the definition of p_{4f} in equation (33) replaces p_{4f} as shown below:

$$v = c \cdot \sqrt{\frac{\left(\left(m_f + p_4 \cdot \frac{m_f}{m}\right)^2 - m_f^2\right)}{\left(m_f + p_4 \cdot \frac{m_f}{m}\right)^2}} \qquad (36)$$

The velocity v of mass m_f in free fall becomes only a function of its mass m_f, the mass m of the source, and the four-momentum p_4 of the source at R, which is defined by field γ. The contribution of four-momentum p_4 from the field completely defines velocity v at every point in the field. The contributed four-momentum $p_4 \cdot m_f/m$ brings with it the four-vector, which is in the direction of the center of the field, so the velocity is in that direction.

When equation (36) is written in terms of the mass m of the source and its four-momentum p_4, it becomes the definition of escape velocity v_e as shown below:

$$v_e = c \cdot \sqrt{\frac{(m + p4)^2 - m^2}{\left(m + p_4\right)^2}} \qquad (37)$$

Equation (37) is Einstein's mass expansion equation with velocity defined in terms of gravitational relativistic mass M = m + p4 and the invariant mass m of the source of the field. The escape velocity v_e at any point R in the field is the same as the escape velocity from the surface of mass m when the radius containing this mass equals R because the relativistic mass M defined in equation (23) equals m + p_4 in equation (37). This relationship implies that, as the radius R containing mass m is reduced, four-momentum p_4 from the surface remains behind as the surrounding field. Mass in free fall was shown to go through the same process as the mass creating the field. Consequently, four-momentum p_4 from its surface also remains behind in the surrounding space as its radius contracts in moving towards the source of the field. Four-momentum local to mass in free fall is therefore returned to the field. This exchange is discussed in-depth later in the paper in terms of a quantum exchange of gravitons. The definition of escape velocity in equation (37) can be converted to orbital velocity v_o by merely dividing this equation by the square root of 2 or:

$$v_o = c \cdot \sqrt{\frac{\left(m + p_4\right)^2 - m^2}{2 \cdot \left(m + p_4\right)^2}} \qquad (38)$$

This equation is used in the numerical examples in the appendix to determine the orbital velocity of the Earth and also to model the orbital velocities of the stars in the Milky Way galaxy using only the visible mass of the galaxy. The conceptual basis to using this equation in the galaxies will be developed later.

When mass is in a circular orbit, the four-momentum p_4 contributed by field has an equal perpendicular component contributed by force. This means that the four-momentum of a mass m in orbit and in free fall at R is equal and so doubling the value of p_4 in equation (38) must also define escape velocity or:

$$v_e = c \cdot \sqrt{\frac{\left(\left(m + 2 \cdot p_4\right)^2 - m^2\right)}{2 \cdot \left(m + 2 \cdot p_4\right)^2}} \qquad (39)$$

This is demonstrated in the numerical examples in the appendix.

The Appendix offers numerical examples to demonstrate that the four-momentum based equations presented above yield identical results to the classical equations when used to calculate the attributes of field found in Table I, when the mass creating the field is a discrete mass such as planet or star. These attributes become defined as a function of the four-momentum of the field between any point R in the field and the perimeter of the field. The definition of mass in the field is widened to include what is viewed as the source of the field with the difference between it and other mass in the field being only location with the mass creating the field defining the region of highest four-momentum in the field. The four-momentum from the surface of the source of the field to its center is constant. Consequently, the mass viewed as creating the field is in constant uniform acceleration.

These examples also demonstrate that the graviton based equations are cumbersome to use when compared to their classical analogues. It is not intended that these equations be used for this purpose, but to go places where the classical equations and curved space cannot, which is the subject of this paper that begins in the next section.

Derivation of the Invariant View of Gravitational Fields

The view of gravitational field through four-momentum p_4 is by definition a relativistic view of these fields. This relativistic view is the only view presented in the three dimensional space time underlying Einstein's curved space, the classical equations, and four-momentum based field theory as presented up to this point. This view accommodates descriptive theories of field and nothing more, leading to little understanding of the fundamental nature of these fields. In order to move from theories that are purely descriptive to the next level, it is necessary to eliminate the relativistic aspect of what is observed. Once it is understood that these fields are four-momentum based, it becomes possible to derive the view of these fields from the perspective of invariant mass m instead of gravitational relativistic mass M. In terms of time, the differential clock tick rate across the field is transformed into the invariant clock tick rate beyond the field normalizing the field to reveal the underlying fundamental process.

In equation (27) the definition of gravitational relativistic mass is shown to be:

$$M = p_4 + m \tag{40}$$

When $m \cdot \gamma$ replaces M in equation (40) and both sides are divided by γ, the following is found:

$$m = \frac{m}{\gamma} + \frac{p_4}{\gamma} \tag{41}$$

If m/γ is assigned as mass m_o and p_4/γ assigned as g_4, then equation (41) becomes:

$$m = m_o + g_4 \tag{42}$$

Invariant mass m becomes defined as the sum of two forms of mass: mass m_o and gravitons g_4. Four-momentum p_4 and g_4 are the relativistic and invariant views of the quantum exchange underlying gravitational fields. The quantum exchange particle g_4 takes the units of what it defines and is without units itself in a three dimensional space time. The mechanics of this quantum exchange are explained completely in the next section.

In equation (28), p_4 was defined as follows:

$$p_4 = m \cdot (\gamma - 1) \tag{43}$$

If both sides of this equation are divided by γ and g_4 replaces its definition p_4/γ, then the following is found:

$$g_4 = m \cdot \left(1 - \frac{1}{\gamma}\right) \tag{44}$$

When the above definition of g_4 replaces g_4 in equation (42) and the resulting equation simplified the following is derived:

$$m_o = \frac{m}{\gamma} \tag{45}$$

Equation (45) indicates that at the event horizon where γ goes to infinity $m_o = 0$, while at the perimeter of the field where γ equals 1, the mass m_o equals m. This relationship indicates that mass m_o is invariant mass m at the perimeter of the field and that this portion of the mass falls to zero at the event horizon. Because the invariant mass m is a constant, mass g_4 does the opposite equaling zero at the perimeter of the field and becomes equal to the invariant mass at the event horizon or $m = g_4$.

The new relationships developed above eliminate the effect of field γ from the four-momentum field equations. Therefore, the slowing clock tick rate of the field from its perimeter to the event horizon is neutralized and the gravitational field can be viewed in terms of invariant time. In order for this temporally invariant view to be valid, the new definitions must be consistent with the relativistic view of gravitational fields from three dimensional space and cannot have an impact upon the classical equations, because these equations are consistent with what is observed. In order to prove the consistency of these definitions, they are substituted for what they define in known relationships and shown to be without impact upon the original equation. Equation (38), defining orbital velocity v_o in terms of four-momentum p_4 is shown below:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{\frac{\left(\left(m + p_4\right)^2 - m^2\right)}{\left(m + p_4\right)^2}} \tag{46}$$

This equation yields consistent results with its classical analogue in the numerical examples in the appendix. If instead of substituting numerical values into this equation, the definition of p_4 in equation (43) is substituted for p_4 in equation (46), then the right hand side of the equation should simplify to the definition of orbital velocity in terms of field γ:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{\frac{\left((m + m \cdot \gamma - m)^2 - m^2\right)}{(m + m \cdot \gamma - m)^2}} \tag{47}$$

When this equation is simplified the following is found:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{1 - \frac{1}{\gamma^2}} \tag{48}$$

This equation is the definition of orbital velocity found in Table I in terms of γ. If defining p_4 as $p_4 = g_4 \cdot \gamma$ and γ as $\gamma = m/m_o$ has no impact upon equation (46), then substituting $g_4 \cdot m/m_o$ for p_4 in the right hand term of equation (46) will also simplify to the same result as above:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{\frac{\left(m + \frac{g_4 \cdot m}{m_o}\right)^2 - m^2}{\left(m + \frac{g_4 \cdot m}{m_o}\right)^2}} \tag{49}$$

Combining the terms of the squared sum on the right into one fraction and simplifying:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{\frac{\left(\frac{m \cdot (g_4 + m_o)}{m_o}\right)^2 - m^2}{\left(\frac{m \cdot (g_4 + m_o)}{m_o}\right)^2}} \tag{50}$$

Recalling the definition of m:

$$m = g_4 + m_o \tag{51}$$

Replacing $g_4 + m_o$ with its definition m:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{\frac{\left(\frac{m^2}{m_o}\right)^2 - m^2}{\left(\frac{m^2}{m_o}\right)^2}} \tag{52}$$

Dividing the denominator and numerator inside the square root on the right by $(m^2/m_o)^2$ and simplifying:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{1 - \frac{m_o^2}{m^2}} \tag{53}$$

Recall the definition in equation (45) which is shown below:

$$\gamma^2 = \frac{m^2}{m_o^2} \tag{54}$$

Substitute γ^2 for its definition:

$$v_o = \frac{c}{\sqrt{2}} \cdot \sqrt{1 - \frac{1}{\gamma^2}} \tag{55}$$

Equation (55) is the orbital velocity equation found in Table I. This derivation demonstrates that the definition m = mo + g_4 with $g_4 = p_4 \cdot \gamma$ is consistent with the definition of orbital velocity and the classical equations, which can be derived from this relationship.

The definition of gravitational relativistic mass $M = \gamma \cdot m$ can be stated in terms of the new definition of invariant mass, $m = m_o + g_4$, and the new definition of γ, $\gamma = m/m_o$, by substituting the new definitions of m and γ into this equation to yield:

$$M = \frac{m \cdot \left(g_4 + m_o\right)}{m_o} \tag{56}$$

Einstein's mass expansion equation is shown below with velocity v as the dependent variable:

$$v = c \cdot \sqrt{\frac{M^2 - m^2}{M^2}} \tag{57}$$

When the definition of M in equation (56) replaces M in this relationship and is simplified in a set of steps similar to those followed with orbital velocity, starting with equation (46) the following is found:

$$v = c \cdot \sqrt{1 - \frac{1}{\gamma^2}} \tag{58}$$

This is the velocity form of the Lorentz factor, which is derived from the mass expansion equation when the definition of relativistic mass M in equation (56) replaces M in this equation. This demonstrates that the new definition of relativistic mass M in equation (56) is indistinguishable from Einstein's original definition.

The Lorentz transform just derived from the mass expansion equation can be used to derive the mass expansion equation by first replacing γ with its new definition m/m_o to yield:

$$v = c \cdot \sqrt{1 - \frac{m_o^2}{m^2}} \tag{59}$$

Substituting m^2/m^2 for 1, dividing both the numerator and denominator with γ^2, and recognizing that $m_o^2/\gamma^2 = m^2$ yields:

$$v = c \cdot \sqrt{\frac{M^2 - m^2}{M^2}} \tag{60}$$

This is Einstein's mass expansion equation demonstrating that the definition of $\gamma = m/m_o$ can be viewed as the underlying basis to the mass expansion equation. More importantly mass m_o cannot exist without the offsetting mass g_4 that conserves the invariant mass m. Therefore, it must be concluded that the derived definition of invariant mass as $m = m_o + g_4$ where $g_4 = p_4/\gamma$

and $m_o = m/\gamma$ is consistent with the standard model. Although these new definitions have no impact upon the existing equations of the standard model and in fact can be used to derive these equations, they will have a major impact upon the current understanding of gravitational fields and the nature of black holes, which will be explored next.

The Implications of the Invariant View

The definition of g_4 in terms of m and γ found in equation (44) can be converted to a more usable form by replacing γ with its fundamental definitions in terms of either distance from the event horizon or escape velocity as follows:

$$g_4 = m\cdot\left(1-\sqrt{\frac{R-R_s}{R}}\right) \tag{61}$$

And:

$$g_4 = m\cdot\Big(1-\left(\sqrt{\frac{c^2-v_e^2}{c^2}}\right) \tag{62}$$

Equation (61) defines the geometry of g_4 in terms of its distribution in the space surrounding mass m. At the perimeter of the field of mass m, where R is large relative to R_S, the fraction within the square root approaches 1 with g_4 approaching zero, while at the event horizon g_4 equals the total mass m. This suggests that all of the invariant mass m that makes up a black hole has been disbursed as g_4 when the event horizon is reached with no mass left to move to the interior of the event horizon. Consequently, only empty space without field or mass exists here. The infinities and singularity interior to the event horizon as proposed in curved space do not exist. The Schwarzschild radius becomes the radius to which mass must be compressed in order to completely convert invariant mass m to gravitons g_4.

In order to return to the relativistic view both sides of equation (61) are taken times field γ and it is found that $p_4 = M - m$, clocks again slow in moving through a gravitational field to stop at the event horizon, the infinities return, and the mask to reality is again in its place. The transformed equations define field mechanics and not what is measured in three-dimensional space. In order to use these equations to define what is observed in a gravitational field, they must be transformed back into the relativistic view

The product of m and the square root on the right of equation (61) is defined to equal m_o in equation (44). This definition is repeated below:

$$m_o = m\cdot\sqrt{\frac{R-R_s}{R}} \tag{63}$$

When mass m used in equation (63) is that of the source of the field, the portion of the invariant mass m that has not been converted to gravitons or mass m_o becomes a function of the degree to which mass m has been compressed. At any radius R containing the mass m_o, equation (61) defines the distribution of gravitons g_4 from R to the perimeter of the field, while equation (63) defines the portion of invariant mass m that has not been disbursed as gravitons or mass m_o. Equation (61) and (62) cannot be used interior to the radius R defining the perimeter of mass m_o because this presumes greater compression of mass m_o than exists. Therefore, g_4 in equation (61) becomes a constant from the perimeter of the mass m_o to its center. When equation (61) is used with values of R greater than or equal to the current radius of mass m, it defines the gravitons g_4 disbursed between its surface and the perimeter of the field for all degrees of compression of this mass. The gravitational field at any point R is therefore the gravitational field that would be observed at the surface of mass m when the perimeter of its mass is defined by R. Consequently, equation (61) defines g_4 in terms of the difference between the mass creating the field compressed to a radius R and when it is compressed to its Schwarzschild radius R_s.

When the mass m in equation (61) is that of mass in free fall, the radius R is the distance from the center of the field to the location of mass m. R_s is the Schwarzschild radius of the mass of the source of the field. The ratio between g_4 and m is the same for both the source of the field and mass in free fall at any point R in the field, because they are both defined by the inverse of field γ. Therefore, the mass in free fall contributes g_4 to the field in the same proportion to its mass as the mass creating the field has already contributed. The ratio of m_o to m is also the same for both mass in the field and the mass creating the field at every point R in the field; therefore both are equally compressed at every point from the perimeter of the field to the event horizon. Consequently, the radius R of the mass in free fall and its Schwarzschild radius R_s can replace those of the source of the field in equations (61) and (62). The only difference between mass in free fall and the source of the field becomes location in the field. The mass in free fall contributes gravitons from the perimeter of the field to its current location and therefore participates in defining only this portion of the field.

When energy is released through nuclear fusion in a star, the mass m_o and m of the star will decrease, because a portion of this mass is converted to photons and the kinetic energy of particles, while the gravitons contributed by the field to photon or particle will be smaller than the decrease in m_o and m, if they escape the field. In equation (61), when g_4 remains constant or decreases less than m and mo, the difference between the current radius R and R_s must decrease. Consequently, the production of energy by stars is associated with the mass m_o of the star moving to lower levels of potential energy, as its radius R contracts and its gravitational field increases. Therefore, the release of energy is a part of a general process in which invariant mass m is disbursed as gravitons g_4 in the space surrounding all sources of field, which leads to the potential energy of the universe decreasing and its kinetic energy of field increasing. The movement of mass from the perimeter of the field to the surface of the mass creating the field and the creation of energy in stars become unified through the increase in field and decrease in radius that is the consequence of both. This suggests that the fundamental process in the universe is the conversion of mass to field and the universe moving from a state in which it contains the potential energy of mass to a state in which this potential energy has been converted into the kinetic energy of field. This process would appear to underlie much of what is observed in the universe. It will be shown later how the kinetic energy of photons and mass relate to this process.

Equations (61) and (62) can be used to describe the mechanics of gravitational collapse of large clouds of interstellar gas. When such a cloud is first described by one unified gravitational field, the radius R equals the perimeter of the field with the gas filling the volume defined by R. The distribution of g_4 is uniform throughout the cloud, as it is to the interior of all sources of field, and decreases from its perimeter as described by equation (61). In all isolated systems where there is no barrier to a fall in potential energy and an increase in kinetic energy, the system will spontaneously move to the state of higher kinetic energy and lower potential energy. When the radius R defining the perimeter of the cloud contracts, the potential energy $m \cdot c^2$ of the mass in the cloud will fall to $m_0 \cdot c^2$ and the kinetic energy of field will increase to $g_4 \cdot c^2$. The contraction of R should therefore be anticipated to take place spontaneously with the cloud experiencing gravitational collapse until it no longer produces a global fall in potential energy or an energy barrier arises as a consequence of the compression. The formation of stars in the cloud and the resulting radiation pressure from these stars represent such a barrier. This process is driven by an increase in the kinetic energy of field and a fall in the potential energy of the universe.

Equation (62) can be integrated and the result of such integration is stated in the terms of momentum and therefore conforms to Einstein's view of four-momentum and the implied fundamental nature of gravitons. Integration of the right hand term of this equation from the perimeter of the field where $v_e = 0$ to the event horizon where $v_e = c$ sums the difference between total mass m in a black hole and the portion of this mass disbursed as g4 in the field. The result is the residual momentum of the core of a black hole. The left side of equation (62) is integrated from the perimeter of the field where gravitons g_4 equals zero to the event horizon where it equals the invariant mass m or:

$$\int_0^m f(g)\ \mathrm{d}g = \int_0^c m \cdot \left(1 - \frac{\sqrt{c^2 - v_e^{\,2}}}{c}\right) \mathrm{d}v_e \tag{64}$$

Substituting the values and integrating yields:

$$\int_0^m f(g)\mathrm{d}g = \int_0^{2.99792458\mathrm{e}08} m \cdot \left(1 - \frac{\sqrt{299792458^2 - v_e^2}}{2.99792458\mathrm{e}08}\right) \mathrm{d}v_e \tag{65}$$

$$\int_0^m f(g)\mathrm{d}g = 6.433601209\mathrm{e}07 \cdot m \tag{66}$$

This defines the momentum of the gravitons associated with the event horizon of black holes.

The momentum of the gravitons disbursed in the field can be determined by integrating the negative term in equation (65) as follows:

$$\int_{m}^{0} f(m_o)\mathrm{d}m_o = \int_{0}^{2.99792458e08} m \cdot \left(\frac{\sqrt{299792458^2 - x^2}}{2.99792458e08} \right) \mathrm{d}x \tag{67}$$

$$\int_{m_o}^{g} f(m)\mathrm{d}m = 2.354564459e08 \cdot m \tag{68}$$

Equation (68) defines the momentum of the graviton mass found in the field of a black hole of mass m. When the gravitons associated with the core in equation (66) are added to the graviton mass of the field shown on line (68), the following is observed:

$$m \cdot c = 6.433601209e07 \cdot m + 2.354564459e08 \cdot m \tag{69}$$

Or:

$$c = 6.433601209e07 + 2.354564459e08 \tag{70}$$

The velocities in equation (69) when summed in equation (70) equal the speed of light. The sum of the momentum of the graviton mass associated with the event horizon and the field of a black hole equals the product of its invariant mass and the speed of light. The product of momentum and velocity by definition is kinetic energy. The sum of the kinetic energy of the field and the core of a black hole therefore equals $m.c^2$, which is the total energy equivalent of the invariant mass m in a black hole. This leads to the conclusion that mass m beyond a gravitational field is the potential energy side of the kinetic energy of the mass disbursed as field. Consequently, Einstein's definition of energy is a relativistic definition of the potential energy $m \cdot c^2$ of mass or $m \cdot \gamma \cdot c^2$. Energy E is defined to be the sum of kinetic energy KE and potential energy PE. As previously demonstrated, invariant mass m equals the sum of m_o and gravitons g_4 which leads to the following definition:

$$E = PE + KE = m_o \cdot c^2 + g_4 \cdot c^2 \tag{71}$$

In this definition potential energy PE equals zero when mass is disbursed as field in a black hole, because m_o equals zero and the kinetic energy KE equals $g_4 \cdot c^2$. When equation (71) is multiplied by field γ the following is derived:

$$E \cdot \gamma = PE \cdot \gamma + KE \cdot \gamma = m \cdot c^2 + p_4 \cdot c^2 \tag{72}$$

Dividing both sides of this relationship by c^2, replacing M with its definition $E \cdot \gamma / c^2$, and eliminating the middle term yields:

$$M = m + p4 \quad (73)$$

The result found in equation (73) is equation (27), which is the definition of gravitational relativistic mass in terms of invariant mass m and four-momentum p_4. Therefore, equation (69) is only the fundamental definition of gravitational relativistic mass. In equation (72), the kinetic energy term $p_4 \cdot c^2$ cannot be used to perform work, because this is a measure of the potential energy that has been consumed in performing work. Consequently, it is not intrinsic to the definition of usable energy in Einstein's definition of the energy of mass at rest in gravitational field, or $E = m \cdot c^2$. This view of energy E is the view of a local observer, whose clock is ticking at the same rate as the mass m is being converted into energy E. Equation (71) is the global view and the actuality of what is taking place. Einstein's energy equation is a local view of energy making it an indispensible tool to a local observer. However, this equation cannot be used to draw global inferences in strong gravitational fields; the general definitions of energy in equations (71) and (72) must be used.

How gravitational fields accelerate mass due to the fall in the potential energy $m_o \cdot c^2$ as mass m moves to the source of the field can be derived starting with the definition of gravitational relativistic mass M in equation (56) as repeated below:

$$M = \frac{m}{m_o} \cdot \left(m_o + g_4 \right) \quad (74)$$

When m is replaced with its definition $(m_o + g_4)$, this equation becomes:

$$M = \frac{m_o + g_4}{m_o} \cdot \left(m_o + g_4 \right) \quad (75)$$

When mass m falls from a state of rest at the perimeter of a gravitational field to the surface of the source of field, g_4 in equation (75) becomes the graviton mass in the field at R that is local to mass m. This increase in g_4 locally will cause m_o to decrease in order preserve the constancy of the invariant mass m. The consequence of the fall in potential energy $(m-g_4).c^2$ is defined by the first term on the right of equation (75) which was previously shown to equal field γ or:

$$\gamma = \frac{\left(m_o + g_4 \right)}{m_o} \quad (76)$$

The fall in m_o will cause field γ to rise because the denominator in equation (76) is a constant equal to the invariant mass m. The velocity v of mass m is defined by the velocity form of the Lorentz transform which was demonstrated to always equal escape velocity when γ was defined by distance from the event horizon. The definition of field γ above is identical to the definition of field γ in terms of distance, because m_o and g_4 are defined by this relationship. Therefore, this relationship also defines mass m falling at a velocity of v_e in a gravitational field. Substituting the above definition of γ into the Lorentz velocity relationship yields:

$$v = c \cdot \sqrt{1 - \frac{1}{\frac{\left(m_o + g_4\right)^2}{m_o^2}}} \qquad (77)$$

In this relationship $m_o + g_4$ is a constant m, so the value of m_o for any m defines the velocity of freely falling mass m in the field at any R as equaling the escape velocity v_e at R.

When mass m imports kinetic energy into the field, the value g_4 in the first term on the right of equation (75) must include the gravitons g_i associated with this energy and the term on the left must include its four-momentum p_i. If p_i and g_i are included in this equation, m subtracted from both sides and p_4 substituted for its definition M-m, the following is found:

$$p_4 + p_i = \left(\frac{\left(m_o + g_4\right) + g_i}{m_o} \cdot \left(m_o + g_4\right) \right) - m \qquad (78)$$

This equation defines the relationship between four-momentum p_i that is a consequence of force contributing g_i to mass m and four-momentum p_4 that is the consequence of a quantum exchange of g_4 between field and mass in the field. This equation ties together Einstein's relativistic mass and gravitational relativistic mass, which was first introduced in equation (23). In order to demonstrate the correctness of this relationship, the first term in the bracket on the right of equation (78) will be identified as γ_t or:

$$\gamma_t = \frac{\left(m_o + g_4\right) + g_i}{m_o} \qquad (79)$$

The first term in the denominator on the right is the definition of invariant mass m and when divided by m_o equals field γ defined in terms of field. Substituting field γ for its definition yields:

$$\gamma_t = \gamma + \frac{g_i}{m_o} \qquad (80)$$

When it is recognized that $m_o = m/\gamma$, that $g_i \cdot \gamma = p_i$ and that p_i = M-m, then the following equation evolves:

$$\gamma_t = \gamma + \left(\gamma_i - 1\right) \qquad (81)$$

This equation states that the total value of γ_t is equal to the sum of field γ contributed by field and γ_i contributed by force less 1. Beyond a gravitational field γ equals 1 and equation (81) becomes:

$$\gamma_t = \gamma_i \qquad (82)$$

When mass is beyond a gravitational field or the four momentum associated with field is neglected, equation (78) becomes the mass expansion equation stated in terms of four-momentum. When mass is at rest in a gravitational field γ_i equals 1, equation (81) becomes:

$$\gamma_t = \gamma \qquad (83)$$

In this circumstance equation (78) becomes the definition of the four-momentum associated with field. Equation (78) defines the four-momentum of force or field when either one is neglected; therefore, it defines the total four-momentum when both are included. This means that force does not impact the invariant mass m in terms of its potential energy $m_o \cdot c^2$ and its kinetic energy of field $g_4 \cdot c^2$ with its contribution only affecting kinetic energy in three-dimensional space. Therefore, force contributing kinetic energy $g_i \cdot c^2$ to mass m cannot create a black hole irrespective of the magnitude of this kinetic energy, because m_o must be compressed to the point that it is completely converted to g_4 in order to do so and increasing $g_i \cdot c^2$ does not result in such contraction. The only way to create micro black holes is through high energy head-on collisions between protons, because these collisions, if energetic enough, will result in compressive forces large enough to completely convert m_o to g_4. Collisions between atomic nuclei of greater mass require more energy to compress the larger mass sufficiently to completely convert it to g_4. The larger the value of field γ at the point of collision, the smaller mass m_o becomes, and the less energy is required to complete the necessary compression.

Micro Black Hole Induced Field Collapse

Micro black holes that form in planets or stars define regions in their gravitational field because they are created from a part of the field, mass m_o, by completely converting it into gravitons g_4 disbursed from the radius R of the planet or star to the event horizon. This introduces a region of much lower potential energy into this field. When a region of high potential energy is brought into direct contact with a region of low potential energy in the absence of an energy barrier, the high potential energy region universally will spontaneously move into the region of low potential energy. The greater the differential gradient between the two regions in terms of potential energy, the more powerful and rapid is the process. Very little of the mass m_o of a planet has been converted to the kinetic energy of field, so the potential energy of this mass is very close to equaling $m \cdot c^2$, where m equals the mass of the planet or star, while the potential energy in the region containing the micro black hole equals zero. The differential between these two regions represents the extreme of what can exist in the universe. Consequently, the movement of the high potential energy region into the low potential energy region will also represent an extreme in terms of power and velocity.

When a micro black hole forms in a planet's gravitational field, it initially only dominates a small portion of the field defined by the point where the value of field γ in the micro black hole's portion of the field equals that of the greater field, which is also the point where the escape velocity in both regions of the field is the same. The reason for this is that escape velocity is defined solely by field γ. From this point inward towards the event horizon, the potential energy of the gravitons in the field decreases. In the opposite direction, potential energy is constant, because field γ is a constant in the core of the planet. Movement of gravitons from the micro black hole's region of the field further into the field of the planet cannot take place without energy input, because gravitons of low potential energy cannot move into a region of high potential energy anymore than water runs uphill. Gravitons of the planet's field increase in kinetic energy as they move into the region of the micro black hole from the point of equal escape velocity. Since the total energy of the planet must be conserved, the potential energy of the mass m_o of the planet must decrease at the same rate that the kinetic energy increases. Consequently, the radius R defining the surface of the planet starts to contract converting mass m_o to gravitons, as gravitons move from the innermost part of the greater field of the planet into the region of the micro black hole. The process of gravitational collapse that created the planet and its star resumes.

In order to approximate the time required for one micro black hole to accrete a plane the size of the Earth, it is only necessary to develop an equation that defines the graviton mass transferred into the micro black hole in some increment of time. This mass can then be summed with the mass of the black hole at the beginning of this time interval and the equation solved recursively until the sum of the mass accreted equals that of the Earth. The shorter the time interval chosen to compound the mass of the micro black hole, the more accurate the result; however the purpose here is only to get a general idea of the time scale involved in such an accretion and so compounding will be done on a daily basis. If a micro black hole with a mass of 2056 protons is assumed at the surface of the Earth, the number of days to accrete the planet can be determined by starting with the Schwarzschild radius equation shown below:

$$R_s = \frac{2 \cdot G \cdot M}{c^2} \qquad (84)$$

Equation (10) is repeated and shown as equation (85):

$$\frac{R}{R_s} = \frac{c^2}{v_e^2} \qquad (85)$$

Solving the above equation for R, substituting the definition of R_s found in equation (14), and simplifying yields:

$$R = \frac{2 \cdot G \cdot M}{v_e^2} \qquad (86)$$

When mass M is that of the micro black hole and the escape velocity v_e is equal to that found at the Earth's surface, R is the distance from the center of the micro black hole where the escape velocity from its field equals the escape velocity from the surface of the Earth. Interior to the radius R is the region where the field of the micro black hole is dominant to the greater field.

The area A surrounding the micro black hole that the radius R defines is:

$$A = \pi \cdot \left(\frac{2 \cdot G \cdot M}{v_e^2} \right)^2 \tag{87}$$

The four-momentum at the Earth's surface is derived in the examples in the appendix and used to calculate the escape velocity v_e from the Earth's surface. Because the value of γ at the Earth's surface equals 1.00000000072163, the four-momentum p_4 and the gravitons g_4 are essentially equal, so there is no meaningful difference in replacing p_4 with g_4. When the gravitons g_4 at the Earth's surface are divided by the surface area A_e of the Earth, the graviton density g_D at the surface is the result. If g_D is next taken times the area A derived above, the gravitons g_A of the Earth's field within this area are defined, or:

$$g_A = g_D \cdot \pi \cdot \left(\frac{2 \cdot G \cdot M}{v_e^2} \right)^2 \tag{88}$$

The time required for gravitons to move from the perimeter of the area A to its center is merely the radius R of area A divided by the speed of light c or R/c. The speed of light c must be presumed because this is an internal adjustment in a gravitational field, which cannot take place at a rate less than the rate of action of the field, which is the speed of light. It further must be recognized that the local gravitational time dilation that is the consequence of the field does not impact the field itself, because the field is global. If this were not the case, the field near the event horizon would cease to have any temporal connection with the greater field. When equation (88) is divided by R/c, the rate R_t of transfer of graviton mass per second from the field of the Earth to the field of the micro black hole is defined, or:

$$R_t = g_D \cdot \pi \cdot c \cdot \frac{2 \cdot G \cdot M}{v_e^2} \tag{89}$$

This transfer rate can be converted into a daily rate by taking the right side of this equation times the number of seconds in a day or (60).(60).24 which is the final step in this derivation and shown below:

$$R_t = g_D \cdot \pi \cdot c \cdot 60^2 \cdot 24 \cdot \frac{2 \cdot G \cdot M}{v_e^2} \tag{90}$$

Equation (90) defines the graviton mass transferred from the gravitational field of the Earth per day to the field of a micro black hole. The initial values used in this equation are defined as follows: graviton density g_D equals the quotient of the graviton mass 4.31353e15 kg at the Earth's surface, as found in the examples, the surface area of the Earth which equals 4.75e14 meters^2, escape velocity v_e from the surface of the Earth is 11,389 meters/sec, and the mass M of the micro black hole is assumed to equal 2056 protons each with a mass of 1.67e-27 kg. If this equation is initially parameterized with these values and solved recursively summing the graviton mass R_t accreted on each day with initial mass M of the black hole on that day, until the mass M of the black hole equals the mass of the Earth, then it will be found that the Earth has been completely accreted on the 49^{th} day. However, since the compounding is done at the end of each day and not on each accretion cycle, this significantly understates the time required to complete this process. Regardless, within the limitations of this model, this process will not involve billions of years. When this equation is applied to the larger mass found in stars, it is found that a single micro black hole requires 54 days to accrete the sun and 75 days to accrete a star 20 times the mass of the sun.

The process just described is gravitational collapse as a consequence of micro black hole formation. This process involves the distribution of the total energy of the mass in a planet or star as the kinetic energy of field in a black hole. The formation of the micro black hole removes the barrier between regions of high and low potential energy in an isolated system. Without exception such systems will spontaneously move from the state of high to low potential energy. Once this process starts it is irreversible.

The Relationship between Energy and the Quantum Field Theory of Gravity

Einstein's mass expansion equation can be written in terms of relativistic momentum p_r in a gravitational field and momentum p beyond the field as follows:

$$\frac{p_r}{p} = \gamma \tag{91}$$

In this discussion, momentum imported into a gravitational field will be assumed to be towards the center of the field as is the four-vector p_4. This simplification allows the following discussion to be made in terms of scalar quantities instead of vectors. The relativistic momentum p_r can be viewed as the sum of momentum p beyond the field and the four-momentum p_4, contributed by the field, just as the relativistic mass M can be viewed as the sum of the invariant mass m and the four-momentum p_4 or:

$$p_r = p_4 + p \tag{92}$$

Combining equations (91) and (92) results in:

$$\gamma = \frac{p_4 + p}{p} \tag{93}$$

Solving for p_4 yields:

$$p_4 = p \cdot (\gamma - 1) \qquad (94)$$

The above equation is identical to equation (41) other than p_4 is now defined in terms of momentum and not mass m. Four-momentum always takes the units of what is being used to define it, because it is without dimension in three-dimensional space.

If equation (92) is divided by γ, p_4/γ is assigned the label g_{4p}, and simplified the following is found:

$$g_{4p} = p \cdot \left(1 - \frac{1}{\gamma}\right) \qquad (95)$$

This is the momentum analogue of equation (44) defining gravitons g_4. However, this equation describes the distribution of the momentum g_{4p} of photons in the field as they move from the perimeter of the field to the event horizon at which point they have been completely converted to field. This is the same process as the distribution of the potential energy $m_o \cdot c^2$ of mass m in the field, only instead of potential energy equation (95) defines the distribution of the kinetic energy of electromagnetic radiation in the field. If equation (95) is solved for p and p/γ is assigned the label p_o just as m_o was previously assigned to m/γ the following is found:

$$p = \left(p_o + g_{4p}\right) \qquad (96)$$

This relationship describes the invariant momentum p of a photon at all points in a gravitational field, which means that the momentum of the photon beyond the field is conserved by the field. Beyond the field g_{4p} equals zero and p equals p_o and as the photon moves to the event horizon the field contributes momentum in terms of g_{4p}, which must be returned to the field in order to hold p constant so $p_o = p - g_{4p}$. The value of p_o therefore falls to zero at the event horizon with p completely disbursed in the field, which is precisely the same thing that takes place with mass m_o. Mass m and momentum p are both conserved in the kinetic energy of the field for all mass m and momentum p that travel to the event horizon.

When the value of momentum p is substituted into the definition of relativistic momentum found in equation (92), it is found that:

$$p_r = p_4 + \left(p_o + g_{4p}\right) \qquad (97)$$

An observer in three-dimensional space can only observe and measure the relativistic momentum p_r of the photon. What is observed is the sum of the four-momentum p_4 of the field and invariant momentum (po $+g_{4p}$) of the photon, which becomes increasingly field based as the event horizon is approached. At the event horizon p_r disappears when p_o equals zero because all that is observed is field. This leads to the conservation of the momentum in the kinetic energy of field and because the momentum imported into field by mass m is no different than that brought in by electromagnetic radiation, this will be conserved in the same way. Black holes represent only field, so a black hole conserves all of the mass and momentum that has ever traveled from the perimeter of its field to the event horizon. If the universe is ultimately destined to become populated with only black holes, these black holes will conserve all of the energy that ever existed in the universe as the kinetic energy of field and the universe will not have lost the momentum of one photon in the process. Rotation within the system has been neglected.

Earlier, it was shown that the fundamental process of the universe is the conversion of invariant mass into gravitons with the potential energy of this mass falling to zero, as it is converted into the kinetic energy of field. The creation of energy in three-dimensional space was also shown to be a part of the process of invariant mass becoming disbursed as gravitons. The momentum of mass and photons is also converted into gravitons as it moves from the perimeter of a field to the event horizon. Therefore, the universe is moving from a state in which three-dimensional space contains both potential and kinetic energy to a state in which it only contains the kinetic energy field.

In the spiral and elliptical galaxies the orbital velocities are much higher than can be explained in terms of the visible mass using curved space or Newton's universal gravity equation. In order to explain these velocities, it has been proposed that there is an invisible form of mass contained within and beyond these galaxies that cannot react with normal mass and energy except through gravity which has been labeled dark matter with an associated energy, dark energy. In the Milky Way it has been proposed that the visible mass and energy represent only a small percentage of the total found in the galaxy with the bulk of the galaxy composed of dark matter. Using equation (38) and the concepts in the previous section, it is possible to explain these orbital velocities in terms of the observed mass eliminating the need to artificially inflate the mass of the spiral and elliptical galaxies along with the basis of dark matter.

The Gravitational Field of the Milky Way

The mass m_o defining the field of a planet or star is located at the lowest level of potential energy in the field and the greatest value of γ. From the surface of the planet or star to its center graviton density is a constant. This is also true of an interstellar cloud of hydrogen, if it has one unified gravitational field, with the radius defining the perimeter of its mass the point where graviton density changes from a constant to being described by equations (62) and (63). The galaxies are not an exception with the perimeter of the mass creating the field defining the point where constant graviton density starts to fall, as described by the transformed field equations. The mass within this radius is mass m_o which is located at the lowest level of potential energy in the field.

In the region from the center of the Milky Way galaxy to approximately 1 parsec from the center, the mass of the stars defining the field drops to effectively zero. Just as the perimeter of the mass in the galaxy defines the point at which the graviton density becomes constant, the interior perimeter defines a similar boundary, which is the end of the common field of the galaxy. The black hole at the center cannot be a part of this common field, because it does not exchange gravitons with normal mass. This exchange involves mass m_o falling as g_4 of the field increases locally with the decrease in m_o contributed to the common field as g_4. In a black hole mass m_o does not exist. Consequently, quantum exchange does not take place. Instead the gravitons local to the black hole from a surrounding larger field are permanently accreted, which transfers the kinetic energy of these gravitons to the black hole in the same way that a decrease in mass m_o would. The increase in the kinetic energy of the accreted gravitons is offset by a fall in the mass m_o of the source which returns the graviton levels to what they were prior to the accretion and conserves the total energy in the combined system of the black hole and normal mass. The field interior to the common field of the galaxy is the field of the black hole at the center with the graviton densities in that field defined by the transformed field equations. At a distance of 1 parsec from the event horizon of a black hole composed of 100 million solar masses the value of γ is close to one and so stars moving from the common field into the field of the central black hole will have their orbital velocities fall to effectively zero, which is what is observed in the Milky Way galaxy.

Equation (38) was used to calculate the orbital velocity of the Earth in its orbit around the sun and in calculating the gravitational acceleration at the surface of the Earth. It also serves as an excellent model of the orbital velocities of stars in the Milky Way galaxy when it is recognized that four-momentum interior to the perimeter of the galaxy is constant and that the common field does not extend to the center of the galaxy. This equation is shown below:

$$v_o = c \cdot \sqrt{\frac{\left(m + p_4\right)^2 - m^2}{2 \cdot \left(m + p_4\right)^2}} \qquad (98)$$

When this equation is used to describe the orbital velocities of mass in orbit around stars and planets, the mass m of the star or planet is a constant from its surface to the perimeter its field with changes in four-momentum p_4, as defined by equation (31), being the sole variable defining the orbital velocity v_o. In equation (31), four-momentum p_4 decreases with increasing values of R. When these decreasing values are substituted into equation (98), orbital velocities must fall as R increases, which lead to these velocities being inversely correlated with distance.

In the galaxies, planets and stars, the graviton densities are a constant interior to the radius R containing the mass that defines the field, while at values of R greater than this radius the four-momentum p_4 drops off as defined by equation (31). In equation (98), when four-momentum p_4 becomes a constant, there is one variable left that can affect orbital velocity and that is variations in the density of mass m between the center of the field and a more remote location in the field. Increasing mass density with increasing distance from the center of the field when four-momentum is constant will cause the orbital velocities to fall with the opposite also holding true, which leads to these velocities ceasing to be directly correlated with the distance from the center of the field. Graviton densities are constant to the interior of the surface of solid mass as they are in the Milky Way interior to the mass creating the field, so the theoretical orbital velocities there are also only a function of mass density.

The affect of mass density between the center of a planet and theoretical orbits to the interior of its surface can be demonstrated by calculating these velocities using equation (98) and the mass of the Earth assuming that: the Earth is flattened into a plate, graviton densities remain constant throughout the plate, and that the relative density of the Earth's mass is distributed from the perimeter of the plate to the center in the same percentages as found in the Milky Way galaxy. The graph of these theoretical orbital velocities is identical in shape to the predicted velocities in the galaxy shown in Chart I, differing only in magnitude, because of the differences in mass between the Earth and the galaxy. The relative density of the mass from the surface to the center of the Earth can be assigned any set of values and the surface any shape leading to a simple model of the orbital velocities found in the spiral and elliptical galaxies. When the theoretical orbital velocities calculated using solid mass as a model of the galaxy are used in Newton's equation to calculate the mass interior to any radius, it is found that Newton's equation does not correspond to the actual mass in the solid model.

To construct a graviton model of the orbital velocities in the Milky Way galaxy, the orbital velocity at the perimeter of the mass defining the field must be measured. This distance will be assumed to be located a radius R of 15 parsecs from the center, where the orbital velocity has been measured at 2.40e05 meters per sec. If the mass of the Milky Way is assumed to equal 2.25e41 Kg [which excludes dark matter], then the total four-momentum of the mass creating the field can be determined from equation (30) in terms of orbital velocity and shown below:

$$p_4 = m \cdot \left(\frac{c}{\sqrt{c^2 - 2 \cdot v_o^2}} - 1 \right) \tag{99}$$

$$p_4 = 2.24e41 \cdot \left(\frac{299792458}{\sqrt{299792458^2 - 2 \cdot 240000^2}} - 1 \right) \tag{100}$$

$$p_4 = 1.44e35 \text{ Kg} \tag{101}$$

The four-momentum defined here is that of the mass creating the field of the galaxy, which is disbursed evenly between the center and the perimeter of the galaxy; therefore the ratio between four-momentum p4i of the galaxy at a radius of Ri equals the ratio of the four-momentum p4 between the center of the field and R or:

$$\frac{p_{4\,i}}{R_i} = \frac{p_4}{R} \tag{102}$$

Solving for p4i yields: $$p_{4\,i} = p_4 \cdot \frac{R_i}{R} \tag{103}$$

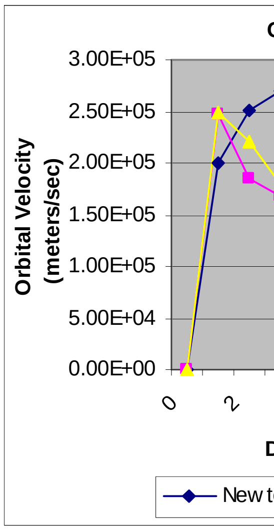
Below in Table III, the observed distribution of mass in the Milky Way is used in conjunction with equations (98), (101), and (103) to model the observed orbital velocities. In this table, the distance in parsecs from the center of the Milky Way galaxy appears in Column A. In Column B, the distance in parsecs is converted into meters. In Column C, the four momentum p_{4i} predicted at the distance from the center found in Column B is calculated using equation (103). Column D contains the mass empirically measured at the distances from the center of the galaxy found in Column B. Column E contains the orbital velocities predicted by substituting observed mass into the Newtonian form of the centripetal orbital velocity formula shown as equation (104) shown below:

$$v_o = \sqrt{\frac{G \cdot M}{R}} \tag{104}$$

The orbital velocities predicted by quantum gravity using equation (98) are found in column F and are calculated by substituting the mass interior to the orbit found in column D and the graviton mass found in column C into equation (98). The actual observed orbital velocities are found in column G.

Table III

In Chart I below the Newtonian orbital velocities based upon observed mass are graphed in blue, the graviton value in pink, and the observed values in yellow.



A	B	C	D	E	F	G
Parsecs Center	**Meters center**	**Four-momentum p_4i**	**Mass Observed**	**v_o Newton**	**v_o Quantum**	**v_o Observed**
0	0	0	0	0	0	0
1	3.08e19	1.26e34	1.85e40	2.00e05	2.47e05	2.50e05
2	6.17e19	2.22e34	5.78e40	2.50e05	1.86e05	2.20e05
3	9.25e19	3.18e34	1.01e41	2.70e05	1.68e05	1.80e05
4	1.23e20	4.14e34	1.45e41	2.80e05	1.60e05	1.90e05
5	1.54e20	5.10e34	1.56e41	2.60e05	1.71e05	2.10e05
6	1.85e20	6.06e34	1.73e41	2.50e05	1.77e05	2.20e05
7	2.16e20	7.02e34	1.86e41	2.40e05	1.84e05	2.25e05
8	2.47e20	7.98e34	1.87e41	2.25e05	1.9e05	2.20e05
9	2.78e20	8.94e34	1.92e41	2.15e05	2.04e05	2.10e05
10	3.08e20	9.90e34	1.94e41	2.05e05	2.14e05	2.10e05
11	3.39e20	1.09e35	2.04e41	2.00e05	2.19e05	2.15e05
12	3.70e20	1.18e35	2.11e41	1.95e05	2.24e05	2.20e05
13	4.01e20	1.28e35	2.17e41	1.90e05	2.30e05	2.30e05
14	4.32e20	1.37e35	2.22e41	1.85e05	2.36e05	2.40e05
15	4.63e20	1.47e35	2.25e41	1.80e05	2.42e05	2.40e05

Chart I

The graviton based forecast is a reasona ble represen tation of the orbital velocities in the Milky Way. The orbital velocities fall to effectively zero interior to the central bulge as the common field of the galaxy is exited and the field of the central black hole is entered. The orbital velocities are inversely correlated to the mass m interior to any orbit because of the constant graviton densities. The reason why Einstein's field equations and Newton's equation fail to define orbital velocity in the galaxy and to the interior of the surface of planets and stars can be understood by solving the equation defining M found in Table I for G or:

$$G = \frac{c^2}{2 \cdot M} \cdot R \cdot \left(1 - \frac{1}{\gamma^2}\right) \tag{105}$$

In the fields of planets and stars, field γ is defined as follows:

$$\gamma = \sqrt{\frac{R}{R - R_s}} \tag{106}$$

As long as field γ is defined as it is in equation (106), G can be calculated from equation (105) at any point R in a gravitational field and it will always equal the accepted value of Newton's constant. However, in the galaxy and to the interior of discrete sources of field, field γ equals a constant and G calculated from equation (105) ceases to be a constant and becomes a variable with different values at every point in the field. Every equation containing G makes the implicit assumption that equation (106) defines field γ, and therefore these equations are invalid when it becomes a constant.

The fact that both the velocities predicted by QFTG in Chart I bottom one data point later than the empirically measured velocities when moving out of the central bulge suggests that the mass densities used to calculate these orbital velocities may be inaccurate. The actual orbital velocities measured in the Milky Way will be more reliable than the data relating to the distribution of mass between the center of the galaxy and points recorded in Table III. This mass is difficult to estimate because of the dust and gas that obscures the view. This is particularly true in estimating the mass towards the center of the galaxy. Chart II below shows the orbital velocities when the adjustments to mass are made. The graviton base forecast can be brought into perfect

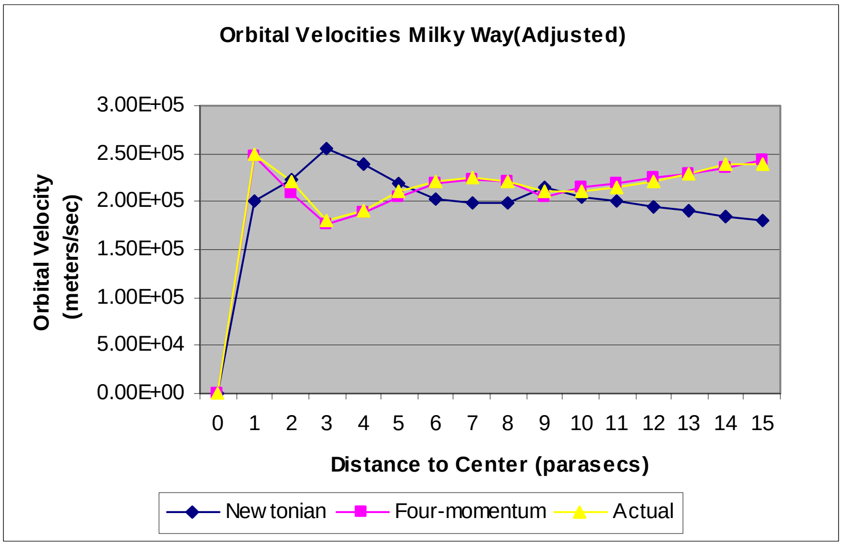


Chart II

alignment with additional minor adjustments; however perfect alignment is not the objective of this exercise.

Chart III below shows the adjustments made to the distribution of mass in the galaxy where the total mass remains unchanged.

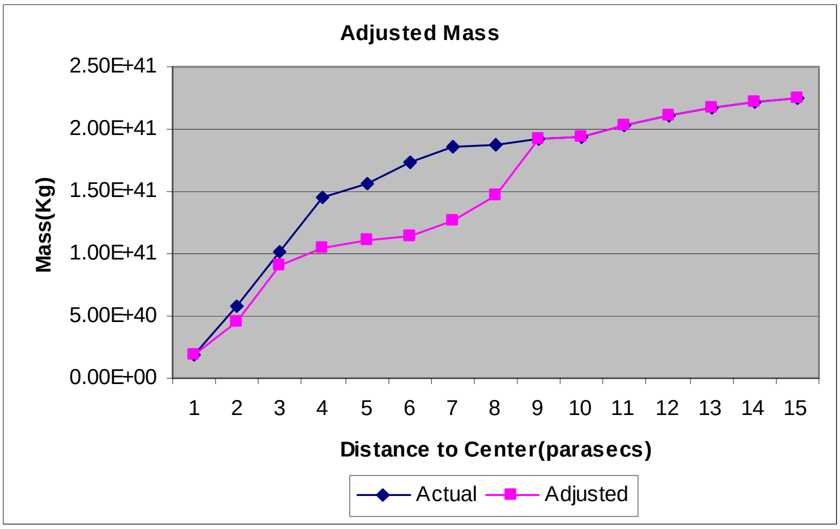


Chart III

Without making the adjustments found in Chart III, the orbital velocities predicted by QFTG match the direction of change in these velocities thirteen of the sixteen data points available. The only information required to predict these velocities is the orbital velocity at the perimeter of the mass creating the field of the galaxy and the distribution of mass in it. In order for curved space to be descriptive of these velocities, it requires that the mass of the galaxy be at least five times greater than what can be observed. Newton’s universal gravity equation also requires this extraordinary increase in mass in order to describe the orbital velocities found in the Milky Way;

however, the reason why Newton's equation is invalid has been derived. Both Newton's equation and curved space make the assumption that the field of the galaxy is the same as the field of the Sun, which has been demonstrated to be invalid.

Hawking radiation will be analyzed in the following sections. This analysis based upon an equation derived from the definition of field γ in terms of distance, because by proceeding in this way it is possible to show that this process is invalid in terms current theory. In terms of QFTG, it is invalid because it extracts energy from the interior of the event horizon, where there is no energy.

Developing the Framework to Analyze Hawking Radiation

Hawking radiation proposes to extract energy from a black hole through quantum fluctuations taking place near the event horizon. These fluctuations result in the formation of virtual photon pairs composed of positive and negative energy, the sum of which equals zero. The negative energy member of the pair becomes trapped to the interior of the event horizon, where it neutralizes positive mass. The conservation of energy elevates the positive energy member of the pair to real, which then escapes the field and in the process removes energy form the black hole. The distance from the event horizon where the two virtual photons in Hawking radiation become separated can be determined by starting with the definition of field γ in terms of distance, which is shown below:

$$\gamma = \frac{\sqrt{R}}{\sqrt{R - R_s}} \tag{107}$$

The definition of field γ in terms of the energy E_e of a photon at the perimeter of the field and its observed energy E_o in the field is shown below:

$$\gamma = \frac{E_o}{E_e} \tag{108}$$

Substituting the definition of γ in equation (108) into equation (107) and re-organizing:

$$E_o = E_e \cdot \frac{\sqrt{R}}{\sqrt{R - R_s}} \tag{109}$$

When energy in equation (109) is converted to wavelength, the following is found:

$$\frac{\lambda_o}{\lambda_e} = \frac{\sqrt{R - R_s}}{\sqrt{R}} \tag{110}$$

If both sides of equation (110) are squared and then solved for the distance from the event horizon, the following evolves:

$$R - R_s = R \cdot \frac{\lambda_o^2}{\lambda_e^2} \tag{111}$$

The distance R can be viewed as the sum of R_s and the difference between R and R_s or:

$$R = R_s + (R - R_s) \tag{112}$$

If the difference (R - R_s) is very small relative to R_s, then R_s can replace R on the right side of equation (112) resulting in equation (113):

$$R - R_s = R_s \cdot \frac{\lambda_o^2}{\lambda_e^2} \tag{113}$$

If the wavelength λ_o of a photon near the event horizon is known and the wavelength λ_e of this photon at the perimeter of the field can be determined, then the distance R- R_s from the event horizon where this photon originated can be estimated from equation (113). This distance however is only an approximation due to the assumption in equation (112). If an exact solution is required, the first estimate of R- R_s can be used to estimate R, which then can replace R_s on the right hand side of equation (113) and the equation solved once again. Recursively solving equation (113) in this manner will always yield a solution to any degree of required accuracy as long as the solutions converge, which they do. However, when the initial calculation demonstrates that R- R_s is many orders of magnitude less than R_s**,** then the recursive solutions are unnecessary. In order to make use of equation (113) in evaluating Hawking radiation, the wavelength λ_o of the photons at the point of origin must be derived from Hawking radiation. This derivation takes place in the next section.

Deriving the Hawking Wavelength

The wavelength of Hawking radiation can be derived from the Hawking temperature T_H relationship as shown below:

$$T_H = \frac{h \cdot c^3}{8 \cdot \pi \cdot G \cdot M \cdot k_B} \tag{114}$$

In this relationship k_B is the Boltzman constant, which when multiplied by temperature T_H equals energy E_H. Multiplying both sides of equation (114) by k_B results in:

$$E_H = \frac{h \cdot c^3}{8 \cdot \pi \cdot G \cdot M} \tag{115}$$

Replacing the definition of the Schwarzschild radius with R_s in equation (115) yields:

$$E_H = \frac{h \cdot c}{4 \cdot \pi \cdot R_s} \tag{116}$$

Recalling the general definition of energy in terms of wavelength:

$$E_H = \frac{h \cdot c}{\lambda_H} \tag{117}$$

Replacing E_H with its definition in equation (117) leads to:

$$\frac{h \cdot c}{\lambda_o} = \frac{h \cdot c}{4 \cdot \pi \cdot R_s} \tag{118}$$

Or: $$\lambda_o = 4 \cdot \pi \cdot R_s \tag{119}$$

The definition of Hawking radiation in terms of temperature leads to the conclusion that the wavelength of the photons forming at the event horizon is the product of a simple constant and the Schwarzschild radius.

Invalidating Hawking Radiation as a Theoretical Process
When equation (113) is combined with equation (119), the following equation is developed:

$$R - R_s = R_s \cdot \frac{(4 \cdot \pi \cdot R_s)^2}{\lambda_e^2} \tag{120}$$

When a micro black hole with a Schwarzschild radius of 1.0e-52 meters is first considered and it is assumed that the wavelength of the radiation escaping from the gravitational field is gamma radiation with a wavelength λ_e of 1.0e-12 meters, then substituting the values into equation (120) produces:

$$R - R_s = \frac{1.0e{-}52 \cdot (4 \cdot 3.1414 \cdot 1.0e{-}52)^2}{(1.0e{-}12)^2} \tag{121}$$

$$R - R_s = 1.58e{-}130 \ meters \tag{122}$$

The escaping photons are found to evolve 1.58e-130 meters above the event horizon. A distance of 1.58e-130 meters is approximately 1.0e80 orders of magnitude less than where trans-Planckian processes are deemed to begin. The separation between the escaping photon and the event horizon is therefore zero and Hawking radiation is extracting energy directly from the event horizon. This is in direct conflict with the standard model and the definition of the Schwarzschild radius in whose terms the Hawking wavelength is formulated. The separation between the virtual photons themselves cannot be much greater than the distance from the event horizon where they de-couple, which leads to the conclusion that the virtual photons never existed in the first place, because in order to exist, the positive and negative energy of the pair must be separated by a real distance, which they are not.

If the output wavelength λ_e is increased from 1.0e-12 meters to 1.0e-24 meters then the following evolves:

$$R - R_s = \frac{1.0e{-}52 \cdot (4 \cdot 3.1414 \cdot 1.0e{-}52)^2}{(1.0e{-}24)^2} \tag{123}$$

$$R - R_s = 1.58e{-}106 \quad meters \tag{124}$$

When the energy of the escaping photon is increased from gamma radiation to the equivalent energy of 1.0e09 protons, Hawking radiation is 1.0e50 orders of magnitude below the distance scale of the universe. With a wavelength of 1.0e-24 meters, the photon escaping the field is a black hole itself. It is therefore not possible to reduce the output wavelength enough to make this process non trans-Planckian when extracting energy from a black hole with Schwarzschild radius of 1.0e-52 meters.

If it is assumed that the wavelength λ_e of the escaping photon remains constant at $\lambda_e = 1.0e{-}12$ meters, as the Schwarzschild radius R_S is increased, and R - R_S is assigned an assumed trans-Planckian boundary value of 1.0e-52 meters, then solving equation (120) for R_S and substituting these values will define the Schwarzschild radius at which Hawking radiation ceases to be beyond the distance scale of the universe or:

$$R_s = \left(\frac{(R - R_s) \cdot \lambda_e^2}{4 \cdot \pi} \right)^{\frac{1}{3}} \tag{125}$$

$$R_s = \left(\frac{(1.0e{-}52) \cdot (1.0e{-}12)^2}{4 \cdot 3.1414} \right)^{\frac{1}{3}} \tag{126}$$

$$R_s = 2.0e{-}26 \quad meters \tag{127}$$

Under these assumptions, Hawking radiation ceases to be trans-Planckian at a Schwarzschild radius of 2.0e-26 meters. The range of R_S where Hawking radiation is extracting energy interior to an assumed trans-Planckian boundary of 1.0e-52 meters is therefore:

$$0 < R_s < 2.0e{-}26 \; meters \tag{128}$$

The range of R_S in which Hawking radiation claims enormous transfer rates of energy out of micro black holes is also the range in which the energy is being extracted directly from the event horizon by virtual photon pairs in which the negative and positive members of the pair exist in the same location in three dimensional space without neutralizing each other. When it was first formulated, Hawking radiation made use of trans-Planckian vibration modes in Einstein’s field equations. Later, it was possible to make arguments that did not rely upon a trans-Planckian process. However, despite clever arguments, the process remains enormously trans-Planckian as shown and is invalid in terms of the standard model.

In terms of QFTG, Hawking radiation extracts energy from the space interior to the event horizon, where there is neither mass nor field, and so the virtual photons that sum to zero energy extract energy from empty space.

Conclusion

QFTG's relativistic field equations produce consistent results with the classical equations in the local gravitational fields of stars and planets, while predicting the orbital velocities of stars in the Milky Way galaxy without the need to postulate dark matter and dark energy. Einstein's field equations and Newton's universal gravity equation offer excellent models locally in the gravitational fields of stars and planets. In the gravitational fields of the spiral and elliptical galaxies they cease to be correlated with empirical observation. These relationships can be brought back into correlation with observation by assuming that there is much greater mass disbursed throughout these galaxies than what is observed. QFTG defines G as a local constant that finds application only in the gravitational fields of discrete mass beginning at its surface and extending to the perimeter of its field. Newton's G ceases to be a constant interior to the surface of discrete mass and in the gravitational fields of the galaxies, because graviton densities are uniform in this setting. Einstein's field equations and Newton's equation are both dependent upon the constancy of G, limiting their application to the fields of discrete mass only. Artificially inflating the mass of the galaxies offsets the changes in the value of G throughout the galaxy, making it appear that these relationships can model what is observed.

QFTG's relativistic field equations and Einstein's field equations offer local views of gravitational fields that are dominated by gravitational time dilation. Drawing inference from these equations in high gravitational environments near the event horizon is not meaningful because the field effects that are measured are not descriptive of the underlying processes. Certainly, the infinities experienced by an observer at the event horizon are very real; however, globally these infinities simply do not exist and are only a local artifact of slowing time. The only equations that lead to valid inference in this setting are QFTG's invariant field equations, because they represent the global view.

QFTG's relativistic field equations are transformed into their invariant form by eliminating gravitational time dilation. These transformed equations define the energy of invariant mass as the sum of its potential energy and kinetic energy of field. When the potential energy of the invariant mass defining a field is completely converted into the kinetic energy of field, a black hole occurs. Therefore, the Schwarzschild radius is the radius to which mass must be compressed to completely convert it into the kinetic energy of field. Consequently, to the interior of the event horizon there is only empty space and no singularity with a black hole containing only the kinetic energy of gravitons. The creation of all momentum and energy in three-dimensional space is part of a process in which the universe is changing from a state where there is kinetic and potential energy to one where there is only field. Mass accelerating in a gravitational field through the conversion of its potential energy into field is illustrative of this process. The kinetic energy of mass derived from force and the kinetic energy of photons is also converted into the kinetic energy of field as mass and energy move to the event horizon. The creation of energy in the form of the kinetic energy of particles and photons is based upon a decrease in the potential energy of the universe and an increase in its kinetic energy of field. Micro black hole formation in a star or planet enables this process to take place spontaneously because a stable region of zero potential energy is introduced into a high potential energy field which is not separated from it by an energy barrier. In all isolated systems observed in three-dimensional space, regions of high and low potential energy not separated by an energy barrier will adjust to a state that minimizes the potential energy and maximizes the kinetic energy within the system. The potential energy difference between the field of the star or planet and that of the micro black hole represents the maximum possible in the universe. Consequently, the adjustment also takes place at the maximum possible rate. QFTG indicates that one micro black hole will collapse a planet the size of the Earth in 49 days and a star the size of the Sun in 54 days.

QFTG's field equations are readily adapted to determine the location where photons of any wavelength evolve in the gravitational field of a black hole. This makes them well suited to analyze Hawking radiation because the precise location where its proposed virtual photons evolve can be determined. Hawking radiation is found to be extraordinarily trans-Planckian in the range of Schwarzschild radii, where it claims micro black holes are the least stable. In a micro black hole with a radius of 1.0e-52 meters, Hawking radiation's virtual photons evolve 1.58e-130 meters from the event horizon. Trans-Planckian processes are deemed to be invalid.

The test of theory is its ability to describe what is observed in nature. QFTG describes every observed aspect of gravitational fields. Furthermore, it describes the fundamental processes responsible for the current state of the universe and offers insight into what came before and what to expect in the future. When compared to Einstein's curved space, QFTG offers greater mathematical simplicity, flexibility, and predictability. QFTG is the only theory able to accurately describe and predict what is observed within all gravitational fields and should be considered as a new general theory of gravity.

APPENDIX

In the first example equations (37) and (36) will be used to calculate the orbital and escape velocities at the orbital of the Earth in the sun's gravitational field. In order to do this the Schwarzschild radius R_S of the sun needs to be first calculated using the defining equation found in row (2) of Table I. In this equation, the mass of the sun is assumed to be 1.98892e30 Kg and the speed of light c to equal 299,792,458 meters/sec. Assigning values and solving for R_S yields:

$$R_s = \frac{2 \cdot 6.67\text{e}{-11} \cdot 1.98892\text{e}30}{(299792458)^2} \tag{1a}$$

$$R_s = 2952.10 \; meters \tag{2a}$$

The value of γ^2 in the gravitation field of the sun at the Earth's orbit is next calculated using the defining equation found in row (4) of Table II, assuming the radius of the Earth's orbit R = 1.495e11 meters and using the value of R_S just calculated.

$$\gamma^2 = \frac{1.495e11}{1.495e11 - 2952.10} \qquad (3a)$$

$$\gamma^2 = 1.00000001974649 \qquad (4a)$$

The value of γ^2 just calculated is substituted into equation (26) in order to calculate the four-momentum between the Earth's orbit and the perimeter of the sun's gravitational field:

$$p_4 = 1.98892e30 \cdot \left(\sqrt{1.00000001974649} - 1\right) \qquad (5a)$$

$$p_4 = 1.9637e22 \text{ kg} \qquad (6a)$$

The portion of this four-momentum that is associated with the orbital velocity of the Earth is the product of this mass and the ratio between the mass m_e of the Earth and the mass m_s of the sun or:

$$\frac{p_{4e}}{m_e} = \frac{p_{4\,s}}{m_s} \qquad (7a)$$

Solving equation (7a) for the four-momentum p_{4e} of the Earth and substituting the values yields:

$$p_{4e} = \frac{1.9637e22 \cdot 5.98e24}{1.98892e30} \qquad (8a)$$

$$p_{4e} = 5.907e16 \text{ kg} \qquad (9a)$$

Substituting the p_{4e} contributed to the Earth from the sun's field found in equation (9a) and the mass of the Earth, 5.98e24 Kg, into equation (37) results in:

$$v_o = 299792458 \cdot \left(\frac{(5.98e24 + 5.90417e16)^2 - (5.98e24)^2)}{2 \cdot (5.98e24 + 5.90417e16)^2} \right)^{0.5} \qquad (10a)$$

$$v_o = 2.9788562176e04 \text{ meters/sec} \qquad (11a)$$

When the total four-momentum between the Earth's orbit and the perimeter of the sun's field is used instead of that contributed to the Earth and its mass, then the following results:

$$v_o = 299792458 \cdot \left(\frac{(1.98892e30 + 1.98637e22)^2 - (1.98892e30)^2)}{2 \cdot (1.98892e30 + 1.98637e22)^2} \right)^{0.5} \quad (12a)$$

$$v_o = 2.97996e04 \text{ meters/sec} \quad (13a)$$

Calculation of the orbital velocity of the Earth using either the four-momentum contributed to the Earth by the sun or the total four-momentum between the perimeter of the sun’s field and the Earth’s orbit leads to consistent results.

To calculate the orbital velocity v_o of the Earth using the definition of centripetal acceleration found in equation (3), the gravitational acceleration of the sun at the Earth's orbit must first be derived from Newton's acceleration equation:

$$ga = \frac{G \cdot M}{R^2} \quad (14a)$$

Assuming the same values for the mass of the sun and the radius of the Earth's orbit and substituting these values into equation (14a) yields.

$$ga = \frac{6.67e-11 \cdot 1.98892e30}{(1.495e11)^2} \quad (15a)$$

Solving for ga yields:

$$ga = 5.935547e-03 \text{ meters/sec}^2 \quad (16a)$$

The orbital velocity v_o can then be calculated from equation (3) by substituting the value found in equation (16a) and the radius of the Earth 1.495e11 meters or::

$$v_o = \sqrt{5.935547e-03 \cdot 1.49e11} \quad (17a)$$

$$v_o = 2.9789e04 \text{ meters/sec}^2 \quad (18a)$$

The differences between the calculated orbital velocities using the Newton's equation and those using four-momentum is not consequential demonstrating the consistence of the four-momentum model of gravitational fields with the standard model.

When the four-momentum contributed by the sun's field to the Earth is doubled in equation (10a), equation (19a) results:

$$v_e = 299792458 \cdot \left(\frac{(5.98e24 + 2 \cdot 5.90417e16)^2 - (5.98e24)^2}{2 \cdot (5.98e24 + 2 \cdot 5.90417e16)^2} \right)^{0.5} \qquad (19a)$$

$$v_e = 42127.38807 \text{ meters/sec}^2 \qquad (20a)$$

If the total four-momentum of the sun's field between the Earth's orbit and the perimeter of the field and mass of the Sun are used in equation (19a), the following is found:

$$v_e = 299792458 \left(\frac{(1.98892e30 + 2 \cdot 1.98637e22)^2 - (1.98892e30)^2)}{2 \cdot (1.98892e30 + 2 \cdot 1.98637e22)^2} \right)^{0.5} \qquad (21a)$$

$$v_e = 42135.02 \text{ meters/sec}^2 \qquad (22a)$$

The escape velocity from the sun's gravitational field is essentially the same when the four-momentum between the perimeter of the field and the Earth's orbit is used in conjunction with the mass of the sun or the four-momentum contributed to the Earth by the field of the sun is used in conjunction with the mass of the Earth.

The classic definition of escape velocity v_e is that it equals the product of the orbital velocity and the square root of two. Assigning orbital velocity the value derived in equation (26) from Newton's relationship and forming the product of this value and $\sqrt{2}$ results in:

$$v_e = \sqrt{2.0} \cdot 2.9789e04 \qquad (23a)$$

$$v_e = 42128.0078 \text{ meters/sec}^2 \qquad (24a)$$

The differences between the three values calculated are not meaningful which means that orbital velocity and escape velocity when defined in terms of the four-momentum of mass in the field at R or the four-momentum of the source of the field at R is consistent with the classical equations. It further supports the view that the ratio of p_4/m is the same for both the source of the field and mass in the field at R.

In the next example the gravitational acceleration at the surface of the Earth will be calculated using four-momentum associated with the lowest quantum level in the field of the Earth, its surface. In order to do this the radius R_E of the Earth can be determined from its circumference, 24,000 miles, as follows:

$$R_E = \frac{(24000 \cdot 1.61 \cdot 1000)}{2 \cdot \pi} \quad (25a)$$

$$R_E = 6.149928378e06 \text{ meters} \quad (26a)$$

The Schwarzschild radius R_S of the Earth can be calculated as it was in equation (1a) for the Sun by replacing the mass of the sun with the mass of the Earth, 5.98e24 Kg as follows:

$$R_s = \frac{2 \cdot 6.67e-11 \cdot 5.98e24}{299792458^2} \quad (27a)$$

$$R_s = .008875965546 \text{ meters} \quad (28a)$$

Gamma can be calculated as it was previously for the sun using the distance definition of field γ found in Table I, however the numerator and denominator of the right hand term are divided by R in order to reduce digits lost to rounding associated with the small value of R_S:

$$\gamma = \sqrt{\frac{1}{1 - \frac{.008875965546}{6.149928378e06}}} \quad (29a)$$

$$\gamma = 1.00000000072163 \quad (30a)$$

The four-momentum p4 defining acceleration at the surface of the Earth can be calculated from equation (26) by inserting the value of γ calculated above and the mass of the Earth or:

$$p_4 = 5.98e24 \cdot 1.00000000072163 - 5.98e24 \quad (31a)$$

$$p_4 = 4.31536e15 \text{ kg} \quad (32a)$$

If the definition of γ in terms of gravitons found in equation (27) is substituted for γ in the definition of gravitational acceleration found in row (2) of Table I then the following equation evolves:

$$ga = \frac{c^2}{2 \cdot R} \cdot \left(1 - \frac{1}{\left(\frac{p_4}{m} + 1 \right)^2} \right) \quad (33a)$$

Substituting the speed of light for c, the radius R of the Earth found on line (26a), p4 developed in equation (32a), and the mass of the Earth 5.98e24 results in:

$$ga = \frac{299792458^2}{2 \cdot 6.149928378e06} \cdot \left(1 - \frac{1}{\left(\frac{4.31536e15}{5.98e24} + 1\right)^2}\right) \qquad (34a)$$

Solving yields: ga = 10.54598584 meters/sec2 (35a)

This same value can be derived from Newton's equation found in row (3) of Table I as follows:

$$ga = \frac{(6.67e-11 \cdot 5.98e24)}{(6.149928378e06)^2} \qquad (36a)$$

ga = 10.54597899 meters/sec2 (37a)

The difference in the gravitational acceleration calculated at the surface of the Earth using either Newton of four-momentum is not consequential. The remaining relationships in Table I also yield identical values when calculated using four momentum p4 or the classical analogue. Four-momentum based field theory is completely consistent with the classical equations upon which it is based.