A Simple Scalar Field Model Based on Classical Newtonian Mechanics Provides a Fundamental Bridge Between General Relativity Effects and Quantum Mechanics

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Abstract

As part of my doctoral thesis I researched a novel method to introduce General Relativity as a continuation of Newtonian physics, with the hope of keeping the method at a high school academic level. The method resulted in calculating many General Relativity effects without utilizing differential geometry. These effects aligned to a minimum first order precision of Schwarzschild's solution to Einstein's field equations. As a continuation of this methodology I hereby introduce a simple scalar field for mapping gravitational relativistic effects of orbital mechanics. These effects are then applied to a classical model of the Hydrogen atom resulting in a relativistic effect equal to the binding energy of the Hydrogen atom. The model is not presented as a replacement for current theory, rather it is for inspection and illustration of how a simplistic model may offer a fundamental bridge between the more complex, time proven theories of General Relativity and Quantum Mechanics.

1 Introduction

As part of my doctoral thesis a method was derived for introductory teaching of General Relativity (GR) via starting with Newtonian laws [1]. From Newtonian laws GR effects are derived to first order equality in Schwarzschild's solution to Einstein's field equations. The derivation methodology follows the same method as when Special Relativity is derived by limiting the speed of particles to the speed of light in a vacuum [2]. In a continuation of the study I introduce here a scalar field S derived from Newtonian Gravitational potential and classical kinetic energy. By applying Newtonian mechanics over S , it is shown GR effects are included in the Newtonian calculations. This method when applied to celestial orbits predicts a perihelion advance. The results of the calculations provide high fidelity compared to known measurements and mainstream theories.

Next, the field S is applied to a classical notion of an electron orbiting a proton. In this application of S , an electron orbital advance is predicted. The model shows in addition to the classical Coulomb binding energy, an additional binding energy resulting from the orbital advance. The total binding energy is evaluated when an interacting photon has a wavelength equal to the reduced Compton wavelength for the electron. At this equality, the additional binding energy due to the advance is equal the binding energy of Bohr's Hydrogen model for the atom [3], 27.2 eV.

2 The Scalar Field Model

Here a scalar field derived from Newtonian gravitational potential and classical kinetic energy is introduced. The gravitational potential[4] is mapped to the field by considering a virtual point particle (m_v) equal to the mass (M) generating the gravitational potential. The gravitational potential of m_v is calculated for all space with radial distance greater than or equal to the radius of M . The potential value at each point is equated by:

$$V_g = -\frac{GMm_v}{r^2} \quad (1)$$

Where G is the Newtonian Gravitational constant, M is the mass generating the gravitational field, m_v is the virtual mass, and r is the radial distance from the center of mass M to the point mass m_v . The second step in deriving the scalar field is to include the kinetic energy of m_v relative to M . The classical kinetic energy[4] of a particle is:

$$T_g = \frac{m_v v^2}{2} \quad (2)$$

Where v is the instantaneous velocity of m_v relative to M . The energies in equations (1,2) when combined form the total energy of m_v (Kinetic T_g and potential V_g).

The investigative approach of generating a scalar field based on m_v is to understand the mass M 's effect to surrounding space-time. As is the combined values produce an energy quantity, not a dimensionless scalar value. One more step is needed to complete the scalar field mapping. Here consider Einstein's early path to General Relativity (GR) where he derived Special Relativity (SR). Einstein's derived invariant energy of a mass (rest energy)[5] is the final addition in the calculation of the scalar field. The total energy of m_v proportional to the rest energy of M . The proportionality equates to a dimensionless scalar value. The sum of V_g and T_g , as a ratio to the rest energy E_0 of M :

$$A = 1 + \frac{T_g - V_g}{E_0} \quad (3)$$

For rigor equation 3 fully extended is:

$$A = 1 + \frac{v^2}{2c^2} + \frac{GM}{rc^2} \quad (4)$$

It is hypothesized the value A represents the scalar time rate of a location in the field, proportional to the time rate at a location where no gravitational influence exist. To formulate the time dilation at a given point, apply equation 3 to transform the location's observed time rate to the observed time rate at infinity, beyond the influence of a gravitational field.

$$t_\infty = A \cdot t_{local} \quad (5)$$

Introducing the term Exemplar space, for convenience, to represent any space where there is no gravitational influence. In Exemplar space, the value of A by definition is 1.

$$A_{Exemplar} \equiv 1 \quad (6)$$

Of note, there is no special physical attribute to Exemplar space other than the mathematical boundary found at the location where the value of A is one. In Exemplar space Newtonian physics (mathematically) apply. Physically this space is not known to exist (a location without gravitational influence), as such it is a construct (as with the virtual point particle) to represent a mathematical space (a location of absolute time and space) at the boundary of $A = 1$.

In following Einstein's concept of a clock located at every location in space [5], locally observed measurements of time and length are determined by the distance a ray of light travels in one unit of time as measured at that location. The unit of time is measured by a local physical based system such as a cesium clock.

$$\hat{l} = c \hat{t} \quad (7)$$

Where $\hat{l}$ is the unit length, $\hat{t}$ is the unit time and c is the speed of light in a vacuum. This methodology for measurement holds for all observers in all spaces. From any location the unit length and unit time are related to the unit length and unit time in Exemplar space by

$$\hat{l}_{exemplar} = A_{local} \hat{l}_{local} \quad (8)$$

Where A is calculated locally. For a vector transformation from a local vector to an equivalent vector in exemplar space:

$$\vec{X} = A_x \vec{Y} \quad (9)$$

Where $\vec{Y}$ is the local space vector and $\vec{X}$ is the Exemplar vector. The reverse transformation is

$$\vec{Y} = A^{-1} \vec{X} \quad (10)$$

From this relatively non-complex scalar field and transformations (mapping from local field to Exemplar field) General Relativity effects are investigated.

3 Newtonian Gravitational Mechanics Applied Over the Scalar Field S

Isaac Newton introduced the science of gravitational mechanics as a central force governed by three laws [6]. Newton's laws are based on the concept of absolute space and time. A clock ticks at the same rate in all locations and a measuring device measures the same length at all locations. Einstein later showed absolute space and time does not exist when there is a gravitational effect [7]. None-the-less, Newton's contribution changed the world and brought science to the forefront as a powerful tool for understand and predicting nature. In the next sub sections, Newton's gravitational laws are applied to the scalar field in local space and transformed to Exemplar space by equations 9 and 10 and the results are compared to General Relativity.

3.1 Radial Time Dilation

In a model of absolute time and space (Newtonian Laws), there is no difference in the rate of a clock at a distance r from the center of a massive object to the rate of a clock at distance r' . Einstein's SR and GR predicted there would be a difference in time rate. Over the past century this effect has been well documented experimentally as with GPS [8]. Applying this scenario to the model, one transforms time in the model's local space to Exemplar space and compares each locations translated rate.

Using equation 9, a clock c_1 at radial distance r_1 when compared to a clock c_{E1} in Exemplar space runs at a rate of:

$$c_{E1} = A_1 c_1 \quad (11)$$

Where A_1 is the calculated scalar field value at location r_1 . The second clock c_2 at a different radial location of r_2 when compared to a clock c_{E2} in Exemplar space is:

$$c_{E2} = A_2 c_2 \quad (12)$$

The ratio of c_{E1} to c_{E2} is

$$\frac{c_{E1}}{c_{E2}} = \frac{A_1}{A_2} = \frac{1 + \frac{v_1^2}{2c^2} + \frac{GM}{r_1 c^2}}{1 + \frac{v_2^2}{2c^2} + \frac{GM}{r_2 c^2}} \quad (13)$$

Where v_1 and v_2 are the velocities of the clock relative to M . In this case the velocities are zero and equation 13 becomes:

$$\frac{c_{E1}}{c_{E2}} = \frac{1 + \frac{GM}{r_1 c^2}}{1 + \frac{GM}{r_2 c^2}} \quad (14)$$

In Schwarzschild's metric (a static solution to Einstein's field equations of GR)[9], at a radial distance r from a mass the local clock rate as compared to a clock an infinite distance from the mass is:

$$t = \frac{1}{\sqrt{1 - \frac{GM}{rc^2}}} \tau \quad (15)$$

Where τ is the local clock at distance r , and t is the time an infinite distance from the mass M . Performing a binomial expansion on equation 15 for $\frac{GM}{rc^2}$:

$$t = \tau \left(1 + \frac{GM}{rc^2} + \dots \right) \quad (16)$$

Thus for Schwarzschild's metric to first order precision for two clocks at r_1 and r_2 their ratio is:

$$\frac{c_{E1}}{c_{E2}} = \frac{1 + \frac{GM}{r_1 c^2}}{1 + \frac{GM}{r_2 c^2}} \quad (17)$$

Equations 14 and 17 are identical, thus the scalar field model produces a minimum first order equivalence to Schwarzschild's metric in GR.

3.2 Planetary Orbital Mechanics within the Scalar Field Model

Consider a circular orbit (a fixed radius) in the scalar field about a massive object. As calculated from exemplar space the orbiting particle appears to maintain a pure Newtonian based orbit, starting at one point and returning to the same point every revolution. To calculate the orbital transformation from a non-exemplar space to exemplar space requires squaring the value of A . This is due to both distance and time (period of orbit) being transformed (distance multiplied by time). The transformation of the circumference takes the form:

$$C = 2r\pi = 2\pi Ar \rightarrow 2\pi \left(1 + \frac{GM}{2rc^2} + \frac{GM}{rc^2} \right)^2 r \quad (18)$$

Where the potential is calculated from a gravitational orbit. Of interest about this transformation is the circular orbit will have a first order advance of:

$$advance = 2\pi \left(1 + \frac{3GM}{c^2} \right)^2 \quad (19)$$

Note the radial value r cancels out and one is left with a constant advance in length for all circular orbits regardless of radial distance from the central massive object. For orbits that are not circular but elliptical, the radial distance can be calculated as a dependency on the angle of rotation[7] by setting r equal:

$$r = \frac{a(1-e^2)}{1+e\cos(\theta)} \quad (20)$$

Where a is the semi-major axis, e is the eccentricity, and θ is the angle of rotation. Integrating the value for r over the angle of 2π yields the advance. The full calculation to first order of the model is:

$$\int_0^1 \int_0^{2\pi} \left(\left(1 + \left(\frac{GM}{2 \left(\frac{a(1-e^2)}{1+e\cos(\theta)} \right) c^2} \right) + \left(\frac{GM}{\left(\frac{a(1-e^2)}{1+e\cos(\theta)} \right) c^2} \right) \right)^2 - 1 \right) d\theta dP \quad (21)$$

The -1 is applied such that only the advance is calculated and not the entire elliptical circumference. If equation 21 is applied to the planet Mercury, it predicts an advance of 42.98 arc seconds per century which agrees closely with observations [10]. With the full (not just first order) calculation performed, it increased the calculated advance by less than 2.1×10^{-8} arc seconds per year. This is a trivial amount for this small of gravitational field. Charting the advance calculation for each planet, the predicted advance to observed advance [11] is shown in Figure 1:

Figure 1: Planet's Perihelion Advance

Of note, Figure 1 only takes into account the gravitational field produced by the sun. As the radial distance increases, other planets' mass will have an impact, thus a plausible reason for some discrepancy in the predicted vs observed. This is most noticeable beyond Jupiter.

4 Investigating the Hydrogen Atom Over the Scalar Field S

The next consideration for applying the model is the Hydrogen atom. It is important to note this is a classical approach. The only consideration of quantization outside of the model is in calculating the energy of an interacting photon, $E_\gamma = \frac{hc}{\lambda}$, where h is Planck's constant and λ is the wavelength of the photon. In the classical approach, the electron is modeled to orbit the proton in the same way a planet orbits the sun. The main difference is the overwhelming influence of the Coulomb electric charge of each particle.

4.1 Hydrogen Atom Orbital Mechanics in the Scalar Field Model

The Hydrogen atom composed of one proton and one electron has the following classical based governing equation in the scalar field for equating time and length effects due to the mass of the proton and velocity of a classically orbiting electron (derived from equation 4):

$$A(r, m, v) = 1 + \frac{e^2}{8\pi\epsilon_0 m_e r c^2} + \frac{GM_p}{2rc^2} + \frac{GM_p}{rc^2} \quad (22)$$

Where M_p is the proton mass, ϵ_0 is vacuum permittivity, r the radial distance from the center of the proton, e is the elementary charge, and c is the speed of light. Equation 22 squared as it was in the celestial orbit derivation is:

$$A(r, m, v)^2 = 1 + \frac{e^2}{4\pi\epsilon_0 m_e r c^2} + \frac{3GM_p}{rc^2} \quad (23)$$

The second order contributions have been omitted as their contributions are very small compared to other contributions. As with the gravitational orbit, when calculating an advance in orbit, the length traversed over the circumference in a circular orbit is:

$$Advance = 2\pi r + 2\pi \left(\frac{e^2}{4\pi\epsilon_0 m_e c^2} + \frac{3GM_p}{c^2} \right) \quad (24)$$

The second part of 24 has a value on the order of 10^{-54} while the first part has an order of 10^{-45} . Thus, it will be omitted for this calculation. The remaining contribution predicts an advance of:

$$Adv = 2\pi \left(\frac{e^2}{4\pi\epsilon_0 m_e c^2} \right) \quad (25)$$

per revolution.

Equation 25 is for a circular orbit. It is assumed an advance in a circular orbit is not observable for measurement. It is presumed impossible to tell at what point in a circular orbit an orbiting particle's advance returns after completing one orbit. It is therefore assumed any observed measurement will predict a return to the same location each completed orbit. This inability to observe an advance in a circular orbit gives way to an unobserved energy within the orbital system. The total binding force of the orbit will be greater than the classically predicted binding energy.

4.2 Electron Binding Energy of the Hydrogen Atom in the Scalar Field Model

Since any circular orbit has an advance, it is assumed there is an unobserved (hidden) binding energy of the electron to the proton in this classical approach. The classical Coulomb potential energy is:

$$E_C = \frac{e^2}{4\pi\epsilon r} \quad (26)$$

Using the value for the advance from equation 25, if one simply takes the ratio of the advance to the circumference of the orbit it is:

$$ratio = \frac{adv}{2\pi r} = \frac{\left(\frac{adv}{2\pi}\right)}{r} \quad (27)$$

Equation 27 is the advance of the orbit in radians. Use equation 27 and multiply it by the Coulomb energy, a derived total energy is (classical orbit plus the extra energy due to the orbital advance):

$$E_T(r) = E_C(r) + E_A(r) = \frac{e^2}{4\pi\epsilon r} + \left(\frac{e^2}{4\pi\epsilon r} \right) \left(\frac{\left(\frac{adv}{2\pi}\right)}{r} \right) \quad (28)$$

where r is the radial distance between the proton and electron, and the additional energy due to the advance is:

$$E_A(r) = \left(\frac{e^2}{4\pi\epsilon r} \right) \left(\frac{\left(\frac{adv}{2\pi}\right)}{r} \right) \quad (29)$$

Considering photon energy with wavelength r is:

$$E_\gamma(r) = \frac{hc}{r} \quad (30)$$

Setting equation 30 equal to $E_T(r)$ with K equaling the value of the proportionality between $E_\gamma(r)$ and $E_T(r)$ (Note: if they are equal, the value of K will be one):

$$K \left(\frac{hc}{r} \right) = \frac{e^2}{4\pi\epsilon r} + \left(\frac{e^2}{4\pi\epsilon r} \right) \left(\frac{\left(\frac{adv}{2\pi}\right)}{r} \right) \quad (31)$$

solving for K :

$$k = \left(\frac{\left(\frac{e^2}{4\pi\epsilon r} \right)}{\left(\frac{\hbar c}{r} \right)} \right) + \left(\frac{\left(\left(\frac{e^2}{4\pi\epsilon r} \right) \left(\frac{adv}{r} \right) \right)}{\left(\frac{\hbar c}{r} \right)} \right) \quad (32)$$

Reducing and rearranging equation 32 and using equation 25 for advance value:

$$K = \frac{1}{2\pi} \left(\frac{e^2}{2\epsilon_0 \hbar c} + \frac{e^2}{2\epsilon_0 \hbar c} \left(\frac{adv}{2\pi r} \right) \right) \quad (33)$$

From equation 31, the photon energy equivalent to $E_T(r)$ as a function of λ is:

$$E_\gamma(\lambda) = \overbrace{\frac{E_C(\lambda)}{K(\lambda)} + \frac{E_A(\lambda)}{K(\lambda)}}^{\text{Total Binding Energy}} \quad (34)$$

Coulomb/K Advance/k

When one investigates $\lambda = \lambda_e$ (the reduced Compton wavelength) equation 34 generates the following values:

1. $\lambda = \lambda_e$ (Where λ_e is the reduced Compton wavelength for an electron)
2. Advance = $2\pi r_e$ (Where r_e is the classical electron radius)
3. Ratio (from equation 27) = α (The Fine Structure Constant)
4. $r = \frac{r_e}{\alpha}$
5. $E_\gamma(\lambda_e) = 2\pi m_e c^2$
6. $E_C(r) = \alpha m_e c^2$
7. $E_A(r) = \alpha^2 m_e c^2$

If an investigator examined the energy from $E_A(r)$ it is logical to imagine they would consider it a Coulomb based energy. As such, from a classical viewpoint the energy would relate to equation 26. To remove ambiguity the new Coulomb based equation representing an investigator's evaluation of $E_A(r)$ will be marked by a prime symbol. Relating equation 26 to equation 29:

$$E'_C(r') = \frac{e^2}{4\pi\epsilon r'} = E_A(r) = \left(\frac{e^2}{4\pi\epsilon r} \right) \left(\frac{\left(\frac{adv}{2\pi} \right)}{r} \right) \quad (35)$$

The value of $E_A(r)$ when $\lambda = \lambda_e$ is:

$$E_A(r) = \alpha^2 m_e c^2 \quad (36)$$

This energy in equation 36 is equivalent to the binding energy of the electron to the proton in the Hydrogen atom (27.21 eV). Visually figure 2 displays a Coulomb binding energy as predicted by the model consisting of two parts: the classical Coulomb binding energy E_C (shown in blue) and an additional binding energy due to the electron's orbital advance E_A (shown in red). Recall from the model, the advance of the electron is an invariant distance r_e . If one steps the radial

Figure 2: Coulomb Potential Well

magnitude by integer multiples of r_e , discrete energy levels are generated. Using equation 35 and solving for r' (when $\lambda = \lambda_e$):

$$r' = \frac{\left(\frac{r_e}{\alpha}\right)^2}{r_e} \quad (37)$$

Discretize r_e by adding n to the equation where $n = \{1, 2, 3, \dots, n\}$:

$$r' = \frac{\left(\frac{nr_e}{\alpha}\right)^2}{r_e} \quad (38)$$

One can now ascertain the conversion of $E'_C(r')$ into a step function of r_e (the gravitational induced effect of the electron orbital advance) by:

$$\frac{e^2}{4\pi\epsilon r'} = \frac{e^2}{4\pi\epsilon r} \rightarrow r' = \frac{\left(\frac{nr_e}{\alpha}\right)^2}{r_e} = \frac{n^2 r_e}{\alpha^2} \quad (39)$$

Thus the energy in equation 35 has discrete allowable energy magnitudes via the following equation:

$$E'_C(n) = \frac{e^2}{4\pi\epsilon \frac{n^2 r_e}{\alpha^2}} = \frac{\alpha^2 e^2}{4\pi\epsilon_0 n^2 r_e} \quad (40)$$

Interpreting equation 40 the total binding energy of the Hydrogen atom may only take on discrete values due to the advance of the electron (a gravitational effect). Thus, the following binding energies are allowed for the electron-proton:

$$E'_C(1) = \frac{\alpha^2 e^2}{4\pi\epsilon_0 (1^2) r_e} \quad (41)$$

$$E'_C(2) = \frac{\alpha^2 e^2}{4\pi\epsilon_0 (2^2) r_e} \quad (42)$$

$$E'_C(3) = \frac{\alpha^2 e^2}{4\pi\epsilon_0 (3^2) r_e} \quad (43)$$

$$\dots \quad (44)$$

$$E'_C(n) = \frac{\alpha^2 e^2}{4\pi\epsilon_0 n^2 r_e} \quad (45)$$

According the Virial theorem [4] the average kinetic energy of an orbiting particle will have half the average potential energy of the bound system [12]. Thus, to remove an electron from an n state energy, $\frac{1}{2}E'_C(n)$ is required. Listed below are the values for the first three states.

$$\left(\frac{1}{2}\right)E'_C(1) = 13.6 \text{ eV} \quad (46)$$

$$\left(\frac{1}{2}\right)E'_C(2) = 3.40 \text{ eV} \quad (47)$$

$$\left(\frac{1}{2}\right)E'_C(3) = 1.51 \text{ eV} \quad (48)$$

$$(49)$$

If one considers the difference between energy levels, the differential energies match the Hydrogen spectral emissions [13]:

$$\left(\frac{1}{2}\right)E'_C(1) - \left(\frac{1}{2}\right)E'_C(2) = 10.20 \text{ eV} \quad (50)$$

$$\left(\frac{1}{2}\right)E'_C(1) - \left(\frac{1}{2}\right)E'_C(3) = 12.09 \text{ eV} \quad (51)$$

$$(52)$$

These are representative of the Lyman series. Other series may be derived in a similar manner.

4.3 Hydrogen Atom's Electron Angular Momentum in the Scalar Field Model

A natural continuation of analyzing the model is to classically calculate the angular momentum of an electron in orbit of a proton. In order to calculate angular momentum, velocity is required. From deriving equation 22 the velocity is:

$$v = \sqrt{\frac{e^2}{4\pi\epsilon_0 m_e r}} \quad (53)$$

Using the value of $r = \frac{r_e}{\alpha}$ (from the above list 4.2) in equation 53, v is:

$$v = \sqrt{\frac{\alpha e^2}{4\pi\epsilon_0 m_e r}} \quad (54)$$

Combining the radius, mass, and velocity the classically derived angular momentum at r is:

$$\mathcal{L}_T = r m_e v \quad (55)$$

Sub $\alpha\hbar c = \frac{e^2}{4\pi\epsilon_0}$ into equation 55 one obtains:

$$\mathcal{L}_T = \sqrt{r_e m_e \hbar c} \quad (56)$$

Recall from the model, the advance of the electron is an invariant distance $2\pi r_e$. If one steps the radial value by integer multiples of r_e the following equation is generated:

$$\mathcal{L}_T = \sqrt{n r_e m_e \hbar c} \quad (57)$$

Where n is an integer value. Next, convert the value of $E_A(r)$ to reflect the r_e steps from equation 57, again using $\alpha\hbar c = \frac{e^2}{4\pi\epsilon_0}$:

$$\mathcal{L}_A = \frac{\alpha\hbar c r_e}{\left(\frac{r_e}{\alpha}\right)^2} = \frac{\alpha^3 \hbar c r_e}{(n r_e)^2} \quad (58)$$

Lastly, equate the angular momentum $\mathcal{L}'$ using equation 37 for r' (again using $\alpha\hbar c = \frac{e^2}{4\pi\epsilon_0}$):

$$\mathcal{L}' = \left(\frac{\left(\frac{n r_e}{\alpha}\right)^2}{r_e}\right) m_e \sqrt{\left(\frac{\alpha\hbar c}{m_e \left(\frac{n r_e}{\alpha}\right)^2}\right)} = n\hbar \quad (59)$$

5 Discussion and Conjectures

Equation 59 provides a straight forward understanding of the model's prediction. The angular momentum of the system must step in discrete increments of energy. When $\lambda = \lambda_e$ this discrete energy step is $\hbar$. This correlation is a one to one relation between the gravitational induced advance of the electron and the discrete angular momentum levels allowed. This is a direct link from gravitational effects to a causal effect of quantum discrete energy levels in the angular momentum of an electron proton system.

Figure 3 shows the breakout of equation 34. The equation is derived from the predicted advance of the electron orbit. The advance causes an additional energy $E_A(r)$ equated as traditional Coulomb energy $E'_C(r')$. The binding energies allowable and the angular momentum states allowable are discrete energy levels.

Figure 3: Coulomb Potential Well With Additional Advanced Orbital Energy

5.1 Contracting Space-Time

As a possible explanation for why only the E_A energy interacts with the photon in a way to absorb and create a photon. It is here conjectured that photon energy interaction with the system only creates or absorbs photons when space-time is contracting or expanding, and at a proportional energy level to the additional energy due to the contracting or expanding of space-time. This conjecture leads to a postulate for the model: Photon creation and absorption only happens when there is a change in the curvature of space-time. Mathematically:

$$\Delta C = \begin{cases} \text{absorption,} & \text{When } \Delta C \text{ is positive} \\ \text{creation,} & \text{When } \Delta C \text{ is negative} \end{cases} \quad (60)$$

Where C is the curvature of space-time. When the change in curvature is positive (increasing - away from zero curvature) there is an energy increase in the system causing the change in space-time curvature, thus the energy was adsorbed. When the change in curvature is negative (decreasing - toward zero curvature) there is an energy decrease in the system causing the change in space-time curvature, thus energy is created (photon). If over a period of time $\Delta C = 0$ there is no change in space-time curvature thus no absorption or creation of photons. Providing a possible explanation as to way an electron can be in motion (orbital motion) and not emit a photon. Therefore the following postulate is proposed for the model.

Postulate 1. *Photon creation and absorption only happens when there is a change in the curvature of space-time.*

For clarity, the postulate states when a change of the curvature of space-time happens (an event), the event generates either an absorption or creation a photon. If there is not event (i.e. change in the curvature of space-time) then no photon is absorbed or created.

6 Conclusion

In conclusion it has been shown a simple scalar field model based on Newtonian mechanics produces results comparable to Schwarzschild's solution to Einstein's field equations. In applying Newtonian mechanics to a classical model of the Hydrogen atom within the field S , an unexpected prediction arose. The model predicted an additional binding energy to the classical model that is equivalent to the binding energy of the Hydrogen atom when the energy of the system is equated to the rest mass of the electron. In addition, when discretized, provides accurate spectral emissions for the Hydrogen atom and a one to one relation between Planck's reduced constant $\hbar$ and the orbital advance caused by the gravitational effect.

The reason(s) the model presents accuracy to empirical data when the system's energy is equivalent to the rest energy of the electron needs more research and understanding. Although by adding a strong and far reaching postulate, an explanation may exist. The postulate is, photons can only be created in the process of expanding/contracting space-time, possibly an even stronger statement would be, only contracting space-time. This postulate would explain why only the gravitational predicted effect generates photons, and only generates them when space-time contracts (energy which "warps" space-time). This is a postulate of great impact across many disciplines and needs much research, vetting, before implementing it into the field model.

Another area of investigation is the amount of energy the model predicts that is not representative of a photon-matter interaction. Recall the model only shows the gravitational effect generating a photon, as such there is predicted a ratio of $\frac{1}{\alpha^2}$ of photon measured energy to unseen energy. If such an energy proportionality exists it may prove beneficial in the hunt for dark matter or dark energy. These conjectures coupled with the models initial agreement with empirical data warrants deeper investigation, as well as if there are any physical relevancy to the model's predictions.

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