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THE RELATIVISTIC QUANTIZED FORCE: NEWTON'S SECOND LAW, INERTIAL AND GRAVITATIONAL

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Abstract
In this paper we derived the relativistic quantized force, where the force is given as a function of frequency[1]. Relativistic momentum is defined as a function of frequency equivalent to the energy and time of a body, then the quantized force is given as the first derivative of momentum with respect to time. Subsequently, we introduce in section one, a relativistic quantization of Newton's second law, and the relativistic quantized inertial force in section two. This is followed by the relativistic quantized gravitational force and quantized gravitational time dilation.

1- Newton’s Second Law in Quantum
The Relativistic Quantized Force

Introduction
Newton’s Second Law of motion stated that the force acting on a body equals the product of the rest mass of the body and its acceleration[9]. The acceleration is given as the second derivative for distance with respect to time.

When Einstein introduced his special theory of relativity in 1905, it included the measurement of relativistic mass, indicating that the mass of a body increased with its increasing speed[4,7,15]. Einstein's relativistic equations depend on classical physical concepts, which depend on determinism, causality and continuity[11,12]., They also depend on the possibility of measuring the velocity and position simultaneously, where the velocity according to Einstein's derivation, equals the first derivative of distance with respect to time[4,7,11,12,15]. But Heisenberg's uncertainty principle assures the impossibility of measuring velocity and position simultaneously. Then the requirement that the speed equals the first derivative of distance with respect to time is not correct, since it requires the simultaneous measurement of both velocity and position[1,2,5,12,14].

For that reason, we conclude that we should know the energy of the body or the equivalent frequency for the energy, to measure its velocity and momentum. Since, the uncertainty principle allows measuring the momentum and energy simultaneously, it is possible to express the momentum in terms of the equivalent frequency of the energy of the body[1,2,5,12,14].

The force that affects a body is given through the first derivative of the momentum with respect to time. Subsequently, we can express the momentum of the body in terms of frequency and time, and then we can get the applied force as the first derivative of the momentum with respect to time. The applied force is then derived in terms of the equivalent frequency of the energy of the body.

Theory

The number of cycles of a standing electromagnetic wave in terms of time[8] is given by the relation

$$n = \nu \ t \qquad (1)$$

Where n is the cycle number at a time t, and ν is the wave frequency[8]. The time t in equation (1) is defined by the relation

$$t = N\left(\frac{1}{2\nu}\right) \qquad (2)$$

where

$N = 1,\ 2,\ 3,\ ....,\ \dfrac{2\nu}{\nu_u}$

Where ν_u is the frequency unit, where $\nu_u = \dfrac{1}{t_u}$, and t_u is the time unit. From the equations (1) and (2) we get

$$n = \frac{N}{2} \qquad (3)$$

We find from equation (3) that n takes the values $\frac{1}{2},\ 1,\ \frac{3}{2},\ 2,\ .....,\ \frac{\nu}{\nu_u}$. Since the frequency is defined as the number in the unit of time, subsequently, when $t = t_u$ in equation (2) we get

$$N = 2\ \nu\ t_u \qquad (4)$$

and from this we get

$$n = \frac{\nu}{\nu_u} \qquad (5)$$

The energy of the electromagnetic wave is defined by the relation

$$E = h\nu \qquad (6)$$

Where E is the energy and h is Plank's constant[5,6], and from equations (4) and (5) we get

$$E = \frac{N}{2}\ h\nu_u = nh\nu_u$$

And by putting $H = h\nu_u$, we get

$$E = N\frac{H}{2} \qquad (7)$$

And also

$$E = nH \qquad (8)$$

Equation (7) indicates that, the energy of the standing electromagnetic wave takes the integral value of $\frac{H}{2}$, and from that we can get the minimum energy $E_{\min}$ for the stated electromagnetic wave, and that when $N = 1$, we get

$$E_{\min} = \frac{H}{2}$$

when the energy value equals H, it is called $H - energy$, where $H = 6.626 \times 10^{-34}$ joule, and the equivalent mass to the $H - energy$ is given by

$$m_H = \frac{H}{C^2} \tag{9}$$

Where m_H is the equivalent mass for $H - energy$, and the equivalent mass is called $H - particle$. The relativistic kinetic energy E_k [15] for a body moving with constant velocity V is given by

$$E_k = \frac{m_0 C^2}{\sqrt{1 - \frac{V^2}{C^2}}} - m_0 C^2$$

And by substituting the value $E_k = nH$ in the last equation we get

$$nH = \frac{n_0 H}{\sqrt{1 - \frac{V^2}{C^2}}} - n_0 H \tag{10}$$

And from equation (10), we get

$$\frac{n_0}{\sqrt{1 - \frac{V^2}{C^2}}} = n_0 + n \tag{11}$$

multiplying both sides of equation (11) by m_H, we get

$$\frac{n_0 m_H}{\sqrt{1 - \frac{V^2}{C^2}}} = m_H \left(n_0 + n\right) \tag{12}$$

and from equation (12) $m = \frac{n_0 m_H}{\sqrt{1 - \frac{V^2}{C^2}}}$, where m is a relativistic mass of the moving body, therefore we get

$$m = m_H \left(n_0 + n\right) \tag{13}$$

and by solving equation (11) in terms of the velocity, we get

$$V = \pm \sqrt{\frac{n^2 + 2nn_0}{\left(n + n_0\right)^2}}\ C \tag{14}$$

Now, when a body absorbs energy with frequency ν so the velocity of this body in terms of time is given by substituting the value of n from equation (1) in the equation (14), we get

$$V = \pm\left[\frac{(\nu\ t)^2 + 2(\nu\ t)n_0}{[(\nu\ t) + n_0]^2}\right]^{\frac{1}{2}} C \tag{15}$$

and also we can express equation (13) in terms of time, where we get

$$m = m_H\,(n_0 + \nu\ t) \tag{16}$$

The relativistic momentum[21] for a body moving with constant velocity V is given by the relation

$$P = mV$$

where P is the momentum, and from equation (15) and (16) we can get the momentum in terms of time, where we have

$$P = \pm\ m_H\ C\sqrt{(\nu\ t)^2 + (\nu\ t)n_0} \tag{17}$$

Newton's second law of motion is given by the relation

$$F = \frac{dP}{dt}$$

where F is the force. and by a deriving equation (7) with respect of time, we get

$$F = \pm m_H C\left[\frac{\nu^2 t + \nu\ n_0}{\sqrt{(\nu\ t)^2 + 2(\nu\ t)n_0}}\right] \tag{18}$$

and by multiplying equation (18) by $\frac{C}{C}$ we get

$$F = \pm\ m_H C^2\left[\frac{(\nu\ t) + n_0}{\sqrt{(\nu\ t)^2 + 2(\nu\ t)n_0}}\right]\frac{1}{C} \tag{19}$$

and from equation (15) we have $\frac{1}{V} = \left[\frac{(\nu\ t) + n_0}{\sqrt{(\nu\ t)^2 + 2(\nu\ t)n_0}}\right]\frac{1}{C}$, and from equation (9), we have $H = m_H C^2$. Now by substituting these value in (19) we get

$$F = \pm\frac{H\nu}{V} \tag{20}$$

Equation (20) expresses the effective force on a body, when the body changes its velocity from zero to V, when it absorbs a photon with frequency ν, and we find the dimensions of equation (20) is MLT^{-2} which means force, and by taking the positive value of equation (20), we get

$$F = \frac{H\nu}{V} \tag{21}$$

Now suppose a body started at rest $(V = 0)$, and after it absorbed a photon with frequency ν_1, its velocity became V_1, and according to the equation (21), the force affecting the body is F_1, where $F_1 = \frac{H\nu_1}{V_1}$ and then after it has absorbed another photon with frequency ν_2, the body should move with a total velocity V (because of the absorption of the two photons ν_1 and ν_2). So the total effective force on the body is $F = \frac{H(\nu_1 + \nu_2)}{V}$. The effective force on the body as a result of the absorption of the second photon ν_2 is F_2 where

$$F_2 = F - F_1 \tag{22}$$

2- The Relativistic Quantized Inertial Force, The Relativistic Quantized gravitational Force

Introduction

As we know from Quantum Theory, the energy is of photons having a rest mass equal to zero[1,2,5,12,14]. We can express the photon energy by the relation

$$E = h\nu \tag{23}$$

Where E is the photon energy, h is plank's constant and ν is the wave frequency[5,6]. And from the equivalent of mass and energy, we can get the equivalent mass m to a photon having energy E as

$$m = \frac{h\nu}{C^2} \tag{24}$$

Now suppose a train moving with constant velocity V. As we have from the special relativity theory of Einstein, the clock motion of this train should be slower than the clock motion of the earth observer according to thereference frame of the earth's surface, whereas if the earth observer measured the time interval Δt via his earth clock, then he will measure the time interval $\Delta t'$ via the clock of moving train, where $\Delta t' = \sqrt{1 - \frac{V^2}{C^2}}\,\Delta t$ [16]. And the wave frequency is defined as the cycle number in the time unit. Subsequently, the wave frequency which exists on the earth's surface according to the earth observer is given by the relation

$$\nu = \frac{1}{\Delta t_0} \tag{25}$$

And now if this wave entered inside the moving train, then, the wave frequency becomes ν' according to the earth observer, where

$$\nu' = \frac{1}{\Delta t} = \frac{\sqrt{1 - \frac{V^2}{C^2}}}{\Delta t_0}$$

And from that we get

$$\nu' = \sqrt{1 - \frac{V^2}{C^2}}\ \nu \tag{26}$$

Equation (26) indicates that the wave frequency inside the moving train should be less than outside the train by the factor of $\sqrt{1 - \frac{V^2}{C^2}}$. Subsequently, the endured energy E' through this photon inside the train is given by

$$E' = h\nu' = \sqrt{1 - \frac{V^2}{C^2}}\ h\nu$$

And from equation(23), we get

$$E' = \sqrt{1 - \frac{V^2}{C^2}}\ E \tag{27}$$

Equation (27) represents the energy inside the frame of the moving train according to the reference frame of the earth's surface, in terms of the photon energy E. The difference of the energy ΔE of the train from its rest on the earth's surface and its motion with constant velocity V is given by the relation

$$\Delta E = E\left[1 - \sqrt{1 - \frac{V^2}{C^2}}\right] \tag{28}$$

Theory

2.1 The Relativistic Quantized Inertial Force

We have reached in section 1, a new formula for understanding the quantization of force, where the force acts on the body when its velocity changes from zero to V. It is given by the relation $F = \frac{H\nu}{V}$

Now suppose a stationary train on the earth surface and a rider inside. If this train absorbs an energy of frequency ν, then its speed will change from $0\ to\ V$. Thus, the effective force on this train is given by the relation $F = \frac{H\nu}{V}$ according to the fixed earth observer. In this case, there is a force on the rider, pushing him in the opposite direction to the train's speed. This force is called "inertial force". Subsequently, according to this force the rider's speed should be changed from $0\ to\ V_r$, whereas in this case, V_r should be equal to V (the speed of the train). We can get this change of the velocity of the train rider from $0\ to\ V_r$ under the effect of inertial force whereas V_r should be equal to V by applying the two conditions

1- The kinetic energy E_k that equivalent to the rider speed V_r is given as

2-

$$E_k = E_0(1 - \gamma^{-1})$$

Where $\gamma^{-1} = \sqrt{1 - \frac{V^2}{C^2}}$, and E_0 is the equivalent energy of the rider rest mass, where $E_0 = m_0 c^2$. We can express the kinetic energy in the last equation in the terms of the number of $H - energy$, where we have

$$n = n_0(1 - \gamma^{-1}) \qquad (29)$$

Where n is the number of $H - energy$ which is equivalent to the kinetic energy, and n_0 is the number of $H - particle$ or the number of the $H - energy$ which equivalent to the rider's rest mass.

3- The endured rest mass inside the train in terms of the rider's rest mass is m_0' given according to equation (27), where we have

4-

$$m_0' = \gamma^{-1} m_0$$

And we can express the last equation in terms of $H - particle$ or $H - energy$, where we have

$$n_0' = \gamma^{-1} n_0$$

Where n_0 is the number of $H - particle$ or the number of $H - energy$ which equivalent to the endured rest mass , thus, from equation (29) we can write the last equation as

$$n_0' = n_0 - n$$

Now according to these two conditions, we can get the measured speed V_r of a rider under the effect of the inertial force according to the observer inside the train by equation (14), where we have

$$V_r = \sqrt{\frac{n^2 + 2nn_0'}{(n + n_0')^2}}\ C = \sqrt{\frac{n^2 + 2n(n_0 - n)}{[n + (n_0 - n)]^2}}\ C$$

by substituting $n_0' = n_0 - n$, we get

$$V_r = \sqrt{\frac{2nn_0 - n^2}{n_0^{\ 2}}}\ C = \sqrt{\frac{2n}{n_0} - \frac{n^2}{n_0^{\ 2}}}\ C$$

And from equation (29) we get

$$V_r = \sqrt{\frac{2n_0(1 - \gamma^{-1})}{n_0} - \frac{n_0^{\ 2}(1 - \gamma^{-1})^2}{n_0^{\ 2}}}\ C$$

And from that we get

$$V_r = \sqrt{1 - \gamma^{-2}}\ C \qquad (30)$$

And by substituting the value of $R^{-2} = 1 - \frac{V^2}{C^2}$ in the last equation we get

$$V_r = V \tag{31}$$

We get from equation (31) that the change in the measurement of the train rider's speed under the effect of the inertial force is from $0 \ to \ V$ and it is the same change in the train speed but in the opposite direction. Therefore we get the inertial F_i which acts on the train rider, whereas from equation (21) we have

$$F_i = \frac{H\nu}{V} = \frac{H\nu_0(1-\gamma^{-1})}{V} \tag{32}$$

2.2 The Relativistic Quantized Gravitational Force and the Quantized Gravitational Time Dilation

The quantized inertial force is given according to the equation (32), where

$$F_i = \frac{H\nu_0(1-\gamma^{-1})}{V}$$

Now, according to the equivalence principle of Einstein[17,18], the gravitational force is equivalent to the inertial force, thus we can use equation (32) for computing the gravitational force. Now if a body is located in a gravitational field, the energy that is held by the body is E given by the equation (28), where

$$E = m_0 C^2 (1-\gamma^{-1}) \tag{33}$$

Now if we consider this energy is equal to the gravitation potential energy, from that we get

$$\frac{GMm_0}{r^2} = m_0 C^2 (1-\gamma^{-1})$$

G is the gravitational constant
M is the mass of the gravitational field
m is the mass of the body
r is the distance between the body and the mass M

Thus we can solve the equation above to get the factor γ^{-1} of the gravity where

$$\gamma^{-1} = 1 - \frac{GM}{C^2 r} \tag{34}$$

From that we can get the gravitational time dilation, whereas if a clock is located at a distance r from the center of the mass M, the time that is measured by this clock is $\Delta t'$ as compared to the time Δt of a clock located far away from mass M, where

$$\Delta t' = \gamma^{-1} \Delta t$$

Thus

$$\Delta t' = \left[1 - \frac{GM}{C^2 r}\right]\Delta t \tag{35}$$

Now if we consider $\gamma^{-1} = 0$, then we can compute the radius that the mass should be compressed to be transformed into a black hole. This is known as the Schwarzschild radius. Thus

$$1 - \frac{GM}{C^2 r} = 0$$

Thus

$$r_s = \frac{GM}{C^2}$$

Whereas r_s is Schwarzschild radius[22].

Now we can compute r_s for the earth where

$$r_s = 0.00443184\text{m}$$

Schwarzschild's calculated gravitational radius differs from this result by a factor of 2 and is coincidently equal to the non-relativistic escape velocity expression.

Whereas for the earth $\gamma^{-1} = 1 - \frac{GM}{C^2 R}$, where R is the radius of the earth, and M is its mass. Thus by taking

$$M = 5.98 \times 10^{24} kg$$
$$G = 6.67 \times 10^{-11} N \;\; m^2 kg^{-2}$$
$$R = 6.38 \times 10^{6} m$$
$$C = 3.0 \times 10^{8} m/s$$

Then $\gamma^{-1} = 1 - (6.95 \times 10^{-10}) \approx 0.9999999993053535$

From that we can get the gravitational time dilation of clock1 located on the earth's surface compared to clock2 located far a way from earth's gravity as in equation (3) where

$$\Delta t' = 0.9999999993053535\Delta\text{t}$$

From that, if clock2 registered one second, at this moment clock1 will register 0.9999999993053535 seconds. In this case the difference of time is 6.94646×10^{-10} seconds.

The escape velocity of a body from earth's gravity is given by equation (30), where $V_{escape} = \sqrt{1-\gamma^{-2}}\,c$. Thus the escape velocity on the earth is $V_{escape} = 11182$ m/s

The force that is exerted on a body of mass of 1 kg to move from zero to V_{escape} is given by equation (32) where

$$F = 5590.98 \text{ newtons}$$

This result is half the classical result. That is in reference to the relativistic quantized derivation of the velocity[5,6].

Conclusion

Our formulas that describe the quantized force are comprehensive and agree with the classical and relativistic formulas. That means they agreed in both the macro and micro world. This indicates the laws of the macro and the micro world are the same.

Our derivation of the quantized force is in agreement with Heisenberg's uncertainty principle since we defined that force as the first derivative of relativistic momentum with respect to time, and this momentum is given as a function of time and frequency, thus the force is given as a function of frequency and that is what Heisenberg was seeking[1]. Also our introducing the relativistic quantized inertial force and then the relativistic quantized gravitational force and quantized gravitational time dilation are considered attempts to unify quantum mechanics and general relativity.

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