Quantum Gravity via Newton

Ron Pearson
UK
e-mail: pearson198@googlemail.com

Since relativity theories are unsatisfactory and cannot provide quantum gravity an alternative approach is presented based on Newtonian concepts. Since the latter is only suitable for use at low values of v/c and in weak gravity it can only be regarded as an approximate theory in need of revision. Extension to an exact mechanics is provided to extend application to extreme conditions. Instead of time dilating as in relativity theory clocks lose time as speeds increase for electromechanical reasons. Instead of gravitational time dilation it is the speed of light that reduces as a massive object is approached and yields the identical equation but with a different interpretation. The effects Einstein puts down to 'curved spacetime' are caused by the non-uniformity of the density of the background medium that extends to the very edge of space. In this way the end equations are found to match all the achievements for which Einstein is famous. There is no need to question the validity of the experiments involved. Then since the assumptions are fully quantum compatible it is an easy matter to provide a satisfactory theory of quantum gravitation.

1. Introduction

It is impossible to achieve a theory of quantum gravity from Einstein's theories of relativity owing to the incompatibility of assumptions. Since all relativity theories contain internal contradictions as soon as mass increase due to speed is considered it is clear that it is not quantum theory that has to be modified.

Unfortunately it is not possible to return to an unrevised Newtonian mechanics as soon as it is accepted that $E= mc^2$. The reason is that the acceleration of a mass needs to be considered and energy has to be supplied to accelerate that mass. Then since this energy cannot be lost it follows that, since its energy is increased, then its mass must also rise.

This proves the mass increase is real and not the illusion some people imagine it to be and also shows a replacement theory has to be based on absolute speeds. If as in special relativity speeds have to be considered relative to the observer then two observers in relative motion will not agree on the mass increase of any other object both simultaneously observe. Hence it is necessary to accept the existence of a background medium such as the quantum vacuum said to consist of a seething mass of virtual particles. Then all speeds, for the purpose of assessing mass increase and electromagnetic fields, have to be measured from the vacuum. Then since the vacuum has fluid properties and is in a state of accelerating expansion it follows that the measurement has to be taken where the object, whose speed is being measured, is located. This will be called 'local space' or the 'local frame'. It requires a modification to the concept of 'absolute speed' since a different situation exists from the original based on rigid non-expanding ether.

The alternative presented in this paper is based on Euclidean geometry and universal time and so is fully compatible with the quantum field theories of Richard Feynman [1]. The theory of quantum gravity that is offered is at least compatible with that formulation which satisfactorily describes the other three forces of nature.

The theory now to be presented was first published by the Russian Academy of Sciences by Pearson [2] in 1991 and Pearson [3] in 1994. A complete book is available Pearson [5] see www.pearsonianspace.com.

2. Derivation Showing Objects Cannot Exceed the Speed of Light

2.1. Photon Mechanics

For application at the macroscopic level the behaviour of light had to be considered in the new approach. The particle nature rather than the wave nature of light had to be adopted for the methodology selected for derivation. Photons carry momentum, mc as otherwise they could not produce radiation pressure when they hit a surface. The photon mass m has therefore to be considered real, but photons have no rest mass. So they have a 'kinetic mass' (instead of an indeterminate 'effective mass'). They are therefore considered as if made from kinetic energy.

Although $E = mc^2$ has been derived from both Newtonian mechanics and special relativity, these derivations cannot be utilized since the former is inexact and the latter starts from a different set of assumptions. It is therefore necessary to obtain another derivation that avoids the criticism that would otherwise be invited. The simplest way of achieving this end is to start from experimental observations, even though these may have been predicted from earlier theories. Then Newton's three laws of motion form the starting point, though with a more sophisticated second law.

Experiments have shown radiation pressure to be directly proportional to the product of the rate at which photons arrive on unit area of surface and the frequency of their associated electromagnetic waves. Now from Planck's study, that initiated quantum theory, photon energy is directly proportional to their wave frequency. This combination means that the kinetic mass of photons is proportional to their kinetic energy.

It follows that the kinetic mass of any object must be proportional to its kinetic energy for consistency with photons.

2.2. The Horizontal Acceleration of an Object

The energy supplied to produce acceleration of a massive object increases the object's kinetic energy.

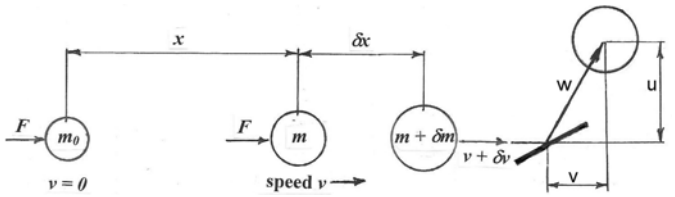

Fig. 1. The horizontal acceleration and deflection of an object

Then since the kinetic mass of an object is proportional to its kinetic energy the mass m of the object must also increase from its rest mass m_0. It can be inferred that the energy increase must be added to an initial rest energy E_0 since it breaks the rules of logic to add things having different units.

The term 'sum energy' E of a massive object will be defined as: $E = E_0 + E_K$, where E_0 is the rest energy of the object and E_K its kinetic energy. Correspondingly inertial mass $m = m_0 + m_K$. Then E can be related to the object's inertial mass m by the relation:

$$m = BE \qquad m = BE \tag{2.1}$$

where B is a constant to be determined.

Both v and m, as well as E are variables and so Newton's second law has to be used in form: force = rate of change of momentum:

$$F = \frac{d(mv)}{dt} \tag{2.2}$$

Using (2.1) this can be written as:

$$F = B\frac{d(Ev)}{dt} \tag{2.3}$$

Differentiating by parts and multiplying both sides by dx we have:

$$Fdx = BE\frac{dv}{dt}dx + Bv\frac{dE}{dt}dx \tag{2.4}$$

Now $Fdx = dE$ and $dx/dt = v$, and so (2.4) can be written:

$$dE = BEv\,dv + Bv^2\,dE \tag{2.5}$$

Re-arranging (2.5) we have:

$$dE\left(1 - Bv^2\right) = BEv\,dv \tag{2.6}$$

This can be arranged for integration as:

$$\int_0 \frac{dE}{E} = B\int_0 \frac{v\,dv}{\left(1 - Bv^2\right)} \tag{2.7}$$

Put $z = 1 - Bv^2$ and then $dz = -2Bvdv$. Substituting in (2.7) and integrating we obtain:

$$\log_e\left(\frac{E}{E_0}\right) = -\frac{1}{2}\log_e\frac{\left(1 - Bv^2\right)}{1} \tag{2.8}$$

This can be re-arranged to read:

$$\frac{E}{E_0} = \frac{1}{\sqrt{1 - Bv^2}} \tag{2.9}$$

Now as v increases E/E_0 increases according to (2.9) until $Bv^2 = 1$ when E becomes $1/0$ which is infinite. This indicates that an ultimate speed exists that will be defined as $v = c$, the speed of light, since it is known that photons travel at this speed. Hence from (2.9), $B = 1/v^2$, which now becomes:

$$B = 1/c^2 \tag{2.10}$$

Substituting (2.10) in (2.1) and (2.9) yields:

$$\frac{E_0}{\sqrt{1 - \left(v/c\right)^2}} = E = mc^2 \tag{2.11}$$

In this way two important equations have appeared simultaneously. Next when $v = 0$ then $E = E_0$ and $m = m_0$. These are the rest energy and rest mass respectively and it follows that $E_0 = m_0c^2$. The equations of (2.11) look like two of those derived by special relativity but there are subtle differences:

1. The frame of reference is the local background medium: not the observer as in Einstein's relativity theories. Consequently the inertial mass m and the sum energy E are both higher than rest values by real amounts due to a real increase in kinetic energy, whilst in relativity this kinetic energy has no definite value since it can be different for each observer.

   In special relativity theory two observers in relative motion see the other as having greater mass and this is logically impossible. Furthermore observers in motion relative to one another accredit different values of kinetic energy to any object they both observe. Consequently kinetic energy is regarded as having no specific value and neither can the mass increase be given a definite value.

   In the new approach both kinetic energy and kinetic mass have definite values showing both are fully real.
2. Furthermore in relativity these equations appear with time dilation and a 'Lorentz contraction' of both matter and space as fundamentally incorporated. These are absent in the present derivation. However, this is of no consequence since the equations involved are very similar to the first term in (2.11) except that they are the inverse of each other. They cancel out!

   This does not mean that relative effects do not exist. Two objects having different absolute velocities will have relative velocities and relative momenta with respect to one another but the mass of each object must remain as given by equation (2.11) with v measured from the local frame.
3. Furthermore kinetic energy becomes exactly specified regardless of observer motion as $E_K = E - E_0$ or using (2.11) becomes:

$$E_K = E_0\left(1 - \left(v/c\right)^2\right)^{-1/2} - E_0 \tag{2.12}$$

In consequence the dilemma of whether mass increase is real or not is fully resolved: the mass increase is fully real.

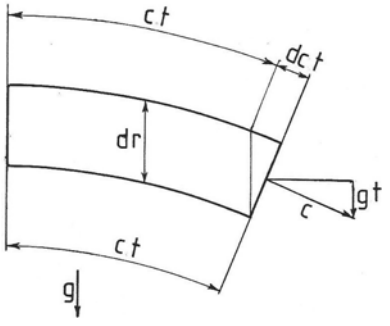

Fig. 2. Gravitational light bending ($c\,dc = g\,dr$)

If the accelerated object then makes an ideal bounce from an inclined plate, as shown in Fig.1 the same speed is retained. This shows the theory to be applicable to motion in any direction in a gravitational field - provided that acceleration due to that field is subsequently taken into account.

3. Gravitational Bending of a Beam of Light

What will be presented here is a simple approach but yields the identical result to that provided using total rigor by Pearson (5). Bending is assumed caused by the force of gravity acting on the kinetic mass of the photon with propagation of light always maintained perpendicular to the wave front. It follows that the photon will fall and accelerate to speed gt in the field direction. Clearly from Fig.2 there are two similar triangles of sides $dc.t:dr$ and $gt:c$ Equating these yields:

$$cdc = gdr \tag{3.1}$$

The assumption of a wave always remaining perpendicular to its direction of propagation is shown to be fully consistent in the complete text provided in Pearson [5].

4. Energy is the Universal Substance, not Mass

Equation (3.1) shows that the speed of light must increase with distance from the Sun. So the speed of light has to be considered as another variable and $E = mc^2$ no longer means that energy and mass are equivalent since if c increases then m must reduce if E remains constant.

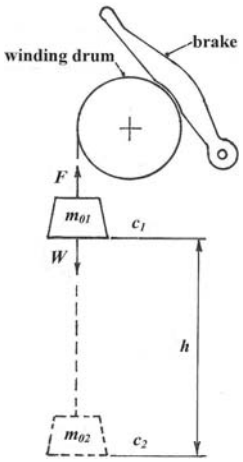

Fig. 3. Lowering an object on a cable

To decide whether rest energy or rest mass remains constant in a gravitational field a thought experiment needs to be explored.

First it is important to understand that in this exact theory the concept of gravitational potential energy GPE has to be abandoned and regarded as a useful mathematical stratagem limited to the inexact Newtonian. Instead as an object rises freely it is losing kinetic energy by pushing against the field to transfer energy to the quantum vacuum. When it falls back energy from the vacuum flows back to the object. This means that when the object is considered in isolation its energy is not conserved. In other words GPE is to be ignored altogether.

A bucket is to be imagined lowered on a cable from a winding drum. The winding drum is fitted with a brake to stop acceleration so that lowering takes place at a negligible constant and very slow speed.

Then all the energy released by the fall is absorbed by the brake and released as heat: non remains to change the energy of the lowered object. Alternatively the force F on the cable is seen to carry out negative work during lowering and this exactly cancels the positive work done by gravity.

Whatever test is applied it is seen that it is the rest energy of any object that remains constant as it changes level in a gravitational field and so E_0 is a universal constant for a given object.

It follows that the rest mass, m_0 with suffix $_D$ representing the primary datum taken arbitrarily at average Earth orbital radius, varies according to the relation:

$$m_0 = m_{0D}\frac{{c_D}^2}{c^2} \tag{4.1}$$

Since c reduces as an object is lowered so rest mass increases, even though no energy has been added.

Inertia, being a function of mass, has also increased. A mass hanging on a spring vibrates at lower frequency when the mass is increased. Analysis gives an equation identical to one Einstein attributes to 'gravitational time dilation'. Experiment has therefore already provided powerful support to the present methodology.

This also shows that mass cannot be regarded as a measure of substance but instead governs the dynamics of energy: the true substance.

The relation between inertial mass m and sum energy E is:

$$m = m_0 + m_K = \frac{E_0 + E_K}{c^2} = \frac{E}{c^2} \tag{4.2}$$

If a mediator flux of some kind, such as a stream of gravitons, acts on an object to produce a gravitational force, then the absorption cross section of the object has to be proportional to its sum energy, since this is the only substance from which it is made and clearly the energy of motion is just as important as rest energy when defining 'substance'. This rule then applies equally to massive objects and particles having no rest energy (like photons and possibly neutrinos)

A new law of physics can now be stated:

Sum energy is the building substance of the universe and so couples with any kind of gravitational flux to produce a force, but inertial mass governs the acceleration of that sum energy when any kind force is applied, inclusive of the gravitational.

5. General Relation of Light to Sum Energy

It will be assumed at this stage that some kind of mediator flux ϕ couples with sum energy E whose absorption cross section is proportional to that sum energy, to produce a force F, following the conclusion reached in § 4. Then:

$$F = -\phi E \tag{5.1}$$

This is -ve since F is opposite the flux direction.

5.1. Change of Sum Energy with Distance Element *dr*

If sum energy E moves a distance dr further from the Sun, then the energy gain will be $dE = Fdr$. Substituting from (5.1) yields:

$$dE = -\phi E\, dr \tag{5.2}$$

Now for the general case the quantity ψ is to be defined as:

$$\psi = \int_D \varphi\, dr \tag{5.3}$$

Then:
$$\int_D \frac{dE}{E} = -\int_D \varphi\, dr = -\psi \tag{5.4}$$

5.2. Change of Light Speed with Distance Element *dr*

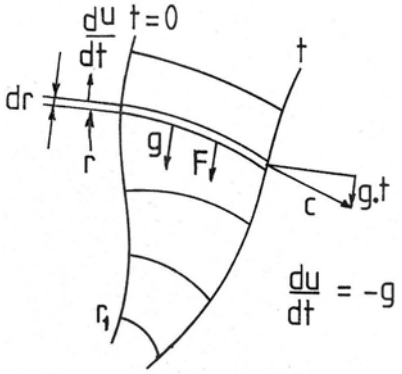

Fig. 4. A stack of light beams each of small thickness

Now the problem addressed in the previous case of §3, in which a single element *dr* was considered is to be extended to a multiplicity of elements. The work done by the force *F* of gravity acts on an element of thickness *dr* of a very wide beam of light as illustrated in Fig.4 showing a stack of such elements of light beams. The problem now is to summate the effect of an infinite stack of such elements in changing the speed of light over a finite radial distance.

Now since $E=mc^2$:

$$g = \frac{F}{m} = \frac{Fc^2}{E} \tag{5.5}$$

And substituting for F from (5.1) this gives:

$$g = -\varphi c^2 \tag{5.6}$$

In (3.1) g was considered positive measured downwards and so needs a negative sign before equating with (5.6). So we can write:

$$g = \frac{c\,dc}{dr} = \varphi c^2 \tag{5.7}$$

Rearranging and putting in integral form, the result is:

$$\int_D \frac{dc}{c} = \int_D \varphi\, dr = \psi \tag{5.8}$$

Both sides of equation (5.4) need to be multiplied by –1 to make ψ positive. Then equation (5.4) can be equated with (5.8) above. Expressed in integral form the result becomes:

$$\psi = \int_D \frac{dc}{c} = \log_e\left(\frac{c}{c_D}\right) = -\int_D \frac{dE}{E} = \log_e\left(\frac{E_D}{E}\right) \tag{5.9}$$

It follows that for any kind of gravitational field, including those arising from multiple attracting objects (since the variation of ϕ with r was not specified) the relation between the c and E variation, for an object or particle in free fall, inclusive of photons, is always:

$$\frac{c}{c_D} = \frac{E_D}{E} \tag{5.10}$$

This is a very important relationship applying in any kind of gravitational field provided the object is in free rise or fall i.e. without involving friction of any kind.

6. The Equation for Gravitational Force

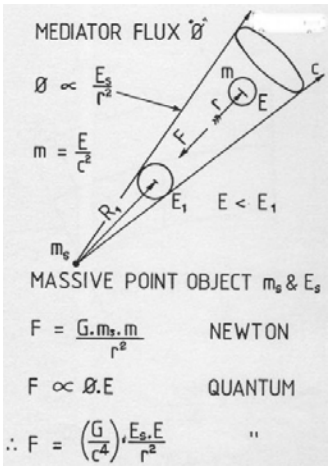

Fig. 5. The inverse square law of gravitational flux

Since energy has been shown to represent the substance from which the universe is made, but not mass, it follows that objects will couple with energy: not mass. And since rest mass varies with altitude, but rest energy does not, this makes a difference. Furthermore the kinetic energy of photons has been shown to couple with gravity in order to cause the bending of light. It follows that the kinetic energy of any object must couple with gravity just as does its rest energy. Consequently it is the sum energy E of all objects that couple with the gravitational flux: not their rest mass. The converse follows that such a flux must be proportional to the sum energy E_S of the attracting object causing the emission of that attracting flux. Such a flux will have an intensity varying with an inverse square law since it spreads out radially over a spherical surface whose area is proportional to the square of its radius measured from the central massive attracting object.

The distance between the centers of mass of the two objects will be denoted d. Then if E/E_S is not negligible the objects will orbit about their barycenter that lies between the mass centers of the two. The orbital radius of the smaller object will be denoted r. (In Fig.5 the difference between d and r is ignored.) Hence we can deduce that the force F of gravity will be given by:

$$F = -\frac{G}{{c_D}^4}\frac{\left(E_{0S}+E_{KS}\right)\left(E_0+E_K\right)}{d^2} = -G_C\frac{E_S E}{d^2} \tag{6.1}$$

The negative sign means the force acts opposite the radial distance. Here G_C is the new gravitational constant. Its value can be deduced from the Newtonian constant G by putting $E_S/c_D^2 = m_{S0}$ *and* $E/c_D^2 = m_0$ in the Newtonian equation. Then:

$$G_C = \frac{G}{{c_D}^4} = \frac{6.67259\times10^{-11}}{\left(2.997925\times10^{8}\right)^4} = 8.260596\times10^{-45}\ \ N m^2 J^{-2} \tag{6.2}$$

The datum speed of light c_D is to be measured at Earth orbit where G and c_D are measured. It is important to note that G has to vary as gravitational potential changes if $G_C = G/c^4$ since c changes. Hence G_C is the true gravitational constant but G has now become another variable.

Equation (6.1) unifies light and matter since it is equally applicable to both. Indeed it applies to neutrinos and everything else. (So the entire energy of neutrinos couples: not its minute mass.)

Equation (6.1) is also highly significant since sum energies E_S and E have replaced the rest masses m_{0S} and m_0 of the original Newtonian equation. Then since E increases as r reduces, it follows that the law of gravitational force will have, in effect, a higher index than two in the denominator. This will produce part of the precession of elliptical planetary orbits.

Extension to consider cases where $r = d$ is inaccurate are covered in the complete text see Pearson [5]. To summarize the mass energy of the Sun E_S is changed to an equivalent energy E_{Sm} placed at the barycenter that would produce the same force on the orbiting planet.

7. The Energy Equation for Planets

Since the barycenter remains stationary and the hypothetical object E_{Sm} is centred there, to replace the massive object of sum energy E_S, that hypothetical object can be considered to maintain its energy value constant. The only variables then reduce to E and r for the motions of even very large planets. The energy increment dE of the planet is $dE = Fdr$ and so (6.1) can be substituted with r replacing d so that $dE = G_C E_{Sm} dr/r^2$ and can be re-arranged in the integral form:

$$\int_D \frac{dE}{E} = -G_C E_{Sm} \int_D \frac{dr}{r^2} \tag{7.1}$$

And this integrates to give:

$$\log_e\left(\frac{E_D}{E}\right) = G_C E_{Sm}\left(\frac{1}{r_D} - \frac{1}{r}\right) \tag{7.2}$$

Now the 'gravitational radius' r0 is conventionally defined as G×mS/c2 but now is equivalent to:

$$r_0 = G_C E_{Sm} \tag{7.3}$$

ψ has already been defined in (5.4) and so can be written as:

$$\psi = \frac{r_0}{r_D} - \frac{r_0}{r} \tag{7.4}$$

Then substituting from (5.10) and combining (7.2), (7.3) and (7.4) and also re-arranging in a more convenient form the result is:

$$\frac{c}{c_D} = e^{\psi} = \frac{E_D}{E} \tag{7.5}$$

Note that e^{ψ} is often written $exp(\psi)$.

8. Non-Uniformity of the Quantum Vacuum Density

Novikov [4] (1983) showed that the virtual particles of the quantum vacuum existed, on average each within a cube of side L as illustrated in Fig. 6. Hence L is also the average distance of separation of these virtual particles and is equal to something like the Compton wavelength given by:

$$L = \frac{\hbar}{mc} \tag{8.1}$$

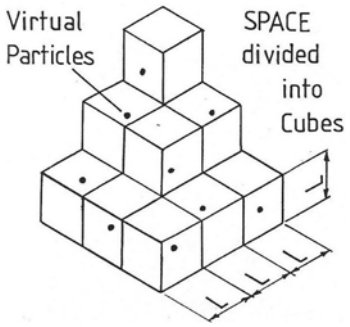

Fig. 6. Novikov's space cubes ($L = \hbar/mc$)

Planck's constant is h but this constant is of no interest to our derivation.

So equation (8.1) can be divided by datum equivalents to yield:

$$\frac{L}{L_D} = \frac{m_D c_D}{mc} \tag{8.2}$$

The ratio of m to m_0 of the virtual particles will be constant anywhere in space and so it is of no consequence whether either of these is used in (8.2). Now their average sum energy E will be uniform over the entirety of space and so can be regarded as a constant. Then since $E = mc^2 = m_D c_D^2$:

$$\frac{m_D}{m} = \frac{c^2}{{c_D}^2}$$

Substituting in (8.2) for m_D/m yields:

$$\frac{L}{L_D} = \frac{c}{c_D} \tag{8.3}$$

This shows the average separating distance of primaries in the quantum vacuum to increase with increase of altitude in the same proportion as the speed of light increases. It also follows that the density of space must reduce with distance from any object.

9. The Observed Speed of Light c_T

The L variation will affect the speed of light that is observed and so this is denoted c_T. However, the speed c still needs to appear in the final basic equation since (5.10) remains unchanged.

In order to proceed further it is necessary to consider the motion of the photon as if it made a series of instantaneous jumps of distance ΔS_D at datum position with a time delay Δt_D between each jump.

Then at greater distance r from the Sun the dwell changes to Δt. Hence:

$$c = \Delta S_D/\Delta t \text{ and } c_D = \Delta S_D/\Delta t_D \tag{9.1}$$

In 'flat' space i.e. without an L variation, then there is no ΔS variation. To account for the increase in c as r increases Δt must

fall in inverse proportion to the increase in c and so the two parts of (9.1) can be divided one into the other to yield:

$$\frac{\Delta t_D}{\Delta t} = \frac{c}{c_D} \tag{9.2}$$

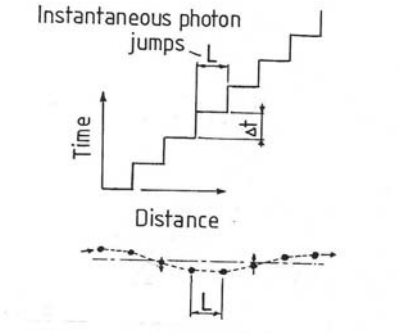

Fig. 7. Structured electromagnetic wave

This time variation will not change if L changes but now the 'observed speed of light' is to be defined as c_T where:

$$c_T = \Delta S/\Delta t \tag{9.3}$$

The equation (9.3) can now be divided by (9.1) to yield:

$$\frac{c_T}{c_D} = \frac{\Delta S}{\Delta t}\frac{\Delta t_D}{\Delta S_D}$$

Now $\Delta S/\Delta S_D = L/L_D$ by definition and from (9.2) $\Delta t_D/\Delta t = c/c_D$. So substituting in the above and also using (7.3) and LHS of (7.5) a composite equation results for the case of orbiting planets or satellites yielding:

$$\frac{c_T}{c_D} = \frac{L}{L_D}\frac{c}{c_D} = \left(\frac{c}{c_D}\right)^2 = e^{2\psi} \tag{9.4}$$

10. The First Composite Summary Equation of ECM Theory

10.1. Modify the Ultimate Speed of Eq. (2.11)]

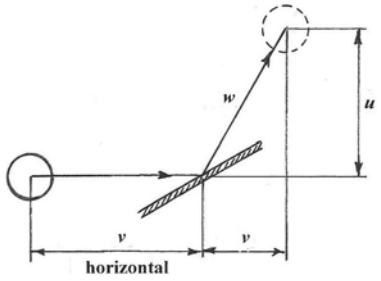

Fig. 8. Velocity v from horizontal acceleration deflects to w

The velocity transverse to the field direction was called the horizontal direction v for the derivation of equation (2.11). In general there will be both transverse and radial components of velocity, the latter being denoted by symbol u. The vector sum of u and v will be given the symbol w so that $w^2 = u^2 + v^2$.

Now after accelerating from rest to speed v and with $u = 0$ as imagined for deriving equation (2.11) it is now reasonable to imagine the object making a perfect bounce from a plate inclined to the horizontal. Then, as illustrated in Fig.1 and in Fig.8, it will have the velocity w but at the same speed as the original v. Hence equation (2.11) is still applicable to w in that kinetic energy and kinetic mass have the same relation to one another regardless of direction of motion in a gravitational field.

The ultimate speed, however, can no longer be regarded as c as in (2.11). At datum level this is c_D but at any other level it is c_T. So for the general case where non-datum levels are considered c_T must replace c in (2.11)

Hence the equation represented by (2.11) can now be presented as:

$$\frac{E_D}{E} = \frac{\sqrt{1 - \left(w/c_T\right)^2}}{\sqrt{1 - \left(w_D/c_D\right)^2}} \tag{10.1}$$

This completes all factors needed for presenting the complete composite basic equation of the ECM theory and can be written by combining, (2.11), (5.10), (7.3), (7.4), (7.5), (8.3), (9.4) and (10.1) to yield:

10.2. The First Composite ECM Summary Equations

Nomenclature:

L	Average separating distance of virtual particles of the quantum vacuum (QV)
c	Speed of light in flat space i.e. QV of uniform density
c_T	Observed speed of light inclusive of non-uniform vacuum density
D	Suffix meaning 'datum', eg. Eq. (9.4)
E_0	Rest energy of the object (constant)
E_K	Kinetic energy (variable)
E	'Sum energy' $E_0 + E_K$ of objects (variable)
m	Inertial mass (variable)
m_0	Rest mass (variable)
w	Velocity of object relative to the sun's barycenter when at radius r from that barycenter

Note: w has a radial component u and tangential component v (all variables). Note that w_D is the velocity at the datum and when w_D>0 meaning the apogee of the orbit has to be at least as high as the datum radius r_D.

When this is not the case, as for the orbit of Mercury, then a secondary datum is chosen, suffix $_1$, at the perihelion and the relation between the two datums found from the general equation that follows this list.

$G_C = 8.260596\times10^{-45}$ N m^2 J^{-2} is the new gravitational constant.

$G_C = G/c^4$ Where G is the old Newtonian gravitational 'constant' - now seen as a variable since c is a variable.

However G_C can be inconveniently small but can be replaced by the 'gravitational radius r_0 defined as $r_0 = G_C E_S = G\times m_S/c^2$.

The following equation is applicable to all cases of free fall/rise of both light and matter. Note that light is always in a state of free fall/rise but for matter resistive forces like friction or air resistance can exist and then the following will not apply. The ideal case is:

$$\frac{L}{L_D} = \frac{c}{c_D} = \sqrt{\frac{c_T}{c_D}} = f\psi = \frac{E_D}{E} = \frac{m_D c_D^2}{mc^2} = \frac{\sqrt{1-\left(w/c_T\right)^2}}{\sqrt{1-\left(w_D/c_D\right)^2}}$$

where $$f\psi = \exp\left[\frac{r_0}{r_D} - \frac{r_0}{r}\right] \tag{10.2}$$

The only universal constants are G_C, r_0 and E_0. Equation (10.2) is derived from the gravitational force equation (6.1) where the new gravitational constant G_C is derived.

All measurements of distance, such as r are based on Euclidean geometry with universal time t as a separate dimension.

Since L the average separating distance between virtual particles of the quantum vacuum QV are also measured by the same Euclidean geometry, the energy density of the QV ε varies as the inverse cube of L so that:

$$\frac{\varepsilon}{\varepsilon_D} = \left(\frac{L_D}{L}\right)^3 \qquad (10.3)$$

Note that for weak fields an expansion has to be used for e^{ψ} since the value is very close to unity. This is:

$$\exp(\psi) = e^{\psi} = 1 + \frac{\psi}{1!} + \frac{\psi^2}{2!} + \frac{\psi^3}{3!} + \frac{\psi^4}{4!} + \ldots \qquad (10.4)$$

Has the reader noticed that in one place the derivation was not sufficiently rigorous?

The derivation turned out to be not quite exact so that inconsistencies arose when investigating extreme fields such as those at the surface of a neutron star. However, (10.2) is accurate to 8 decimals for fields as strong as those at the surface of a white dwarf star.

Space does not permit comparison with experimental checks but the full treatment given by Pearson [5] shows equations identical with those of general relativity arise for the doubling of the deflection of starlight grazing the Sun, the gravitational red shift and the anomalous perihelion advance of Mercury. In the latter case ¾ of the shift is due to the mass increase as the planet falls from apogee to perigee whilst the remainder is caused by the density increase of the QV. The difference in the equation for the Shapiro time delay as given by GR is negligibly small but both fall far short of the measured values. Fortunately I discovered in 2007 (Pearson [6]) that if the measured speed of light in vacuum on Earth was in error by only 6 m/s an exact match was obtained. This is only 2 parts in 10^8 so it appears that the effects being explored experimentally are close to resolution of the apparatus.

Later full rigor was achieved but the only effect was to increase the perihelion shift of Mercury in the ratio 4/3. Now, however, it became possible to more accurately investigate neutron stars and black holes.

11. Conclusion

An alternative to both special and general relativity has been presented that yields most of the same end equations and so satisfies the experimental checks equally well. However, starting from totally different and quantum compatible assumptions all end equations had different interpretations. It has advantages of being free from internal contradiction and incompatibility with quantum theory so that, in fact, a satisfactory theory of quantum gravity had emerged by 1989. Unfortunately all scientific journals refused publication on grounds, to quote a typical rejection saying that "Relativity has withstood the test of time so no alternative is required." So the first presentation had to appear in Russia in 1991.

This is a revision of Newton's approximate mechanics to make it exact. It shows mass increase due to speed is fully real and so diffuses the uncertainty arising from relativity theory. Instead of gravitational time dilation a gravitational mass increase appears that has the same effect in causing clocks to lose time. This mass increase is not necessarily accompanied by an energy increase. Mass increase due to speed has a similar effect. So there is no need to consider time as a variable. Instead it is the speed of light that becomes the variable and increases with altitude.

Sum energies, being the sum of rest and kinetic energies, replace the masses used in Newton's equation for the gravitational force and a new gravitational constant makes the old one obsolete since it is shown to be a variable changing with altitude.

The effect Einstein considers to be due to 'curved spacetime' is replicated by non-uniform density of the quantum vacuum.

The concept of gravitational potential energy has to be discarded when formulating exact mechanics so objects considered in isolation lose energy in rising and gain it when falling. Conservation is restored by interaction with the quantum vacuum.

Some theorists are questioning the validity of all the experiments considered to support relativity theory. The reason is to justify a return to an unrevised Newtonian mechanics. From the perspective of this paper that approach is totally invalid.

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