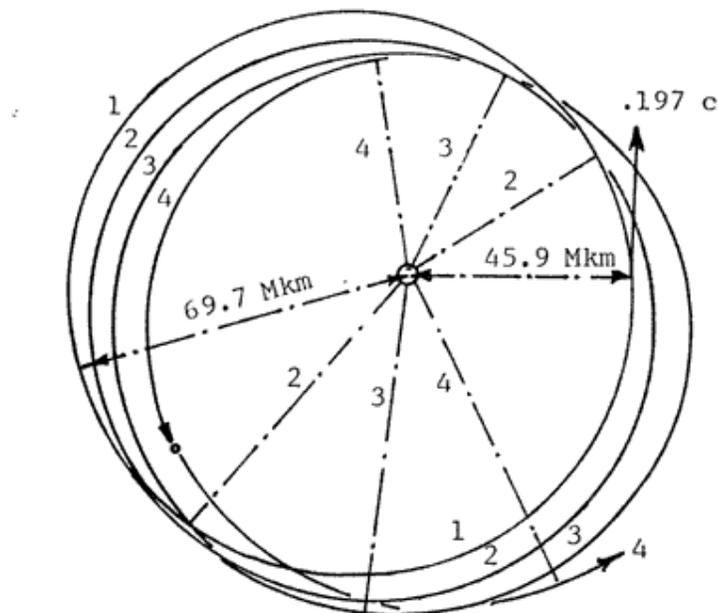


An Exact Classical Mechanics leads toward Quantum Gravitation

Ronald D. Pearson (October 1997; revised May 2003)

This pamphlet suggests that misconceptions in classical mechanics are responsible for blocking progress in physics. Refinements are described which spill over into quantum theory and appear to provide answers to vexed questions. For example, it leads to alternatives to both special and general relativity which match the achievements of both. Unlike relativity, however, the new solution is fully quantum-compatible, being consistent with the concept of the quantum vacuum.

It needs critical analysis to judge the value of the changes made and promote three experiments in orbit for verification/falsification.



Computed orbit of Mercury with 10^6 times the Sun's mass

An Exact Classical Mechanics leads toward Quantum Gravitation, October 1997
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ISBN 0 9517558 8 9

The Author

Ronald Pearson started his career as a Scientific Officer at the N.G.T.E. Whetstone assisting in the development of jet engines. He invented a "gas wave turbine" and demonstrated a working prototype. The rest of his career was spent as a university lecturer, first at Liverpool and finally at Bath, in the fields of thermodynamics and fluid mechanics. These specialisations formed the ideal springboard for tackling problems in Cosmology where misconceptions in classical mechanics have, as will be shown, prevented gravitation being incorporated into quantum physics.

Contents

AN EXACT CLASSICAL MECHANICS LEADS TOWARD QUANTUM GRAVITATION.....	1
The Author	2
1.0 INTRODUCTION	4
2.0 AN ALTERNATIVE TO SPECIAL RELATIVITY	6
2.1 The radiation pressure of light re-defines Inertial Mass.....	6
2.2 METHOD 1: BY LINEAR ACCELERATION	7
2.3 Method 2: Rest-energy Assumed to BE Kinetic Energy (Independent of Method 1).....	9
2.4 SPECIAL RELATIVITY VERSUS THE REVISED NEWTONIAN	12
2.5 TIME DILATION	13
2.6 VIBRATION OF A HYPOTHETICAL MATTER CLOCK.....	14
3.0 DOES REST-ENERGY VARY WITH POTENTIAL ENERGY? DOES IT VARY WITH BINDING ENERGY?	20
4.0 QUANTUM GRAVITATION	24
4.1 A preliminary formulation of basic equations	24
4.2 Compressibility of the i-ther	27
4.3 The true speed of light c_T in the compressible i-ther	28
4.4 The gravitational red-shift -Two Methods	29
4.5 The conservation of angular momentum.....	30
4.6 The first contribution of John Day M.Sc. - The perihelion advance of planets	31
4.7 The Shapiro Time Delay.....	33
4.8 The Metric	35
4.9 Gravity as a Negative Buoyancy Force	37
4.10 Further Refinements.....	42
5.0 CONCLUSION	43
6.0 ACKNOWLEDGEMENTS	44
7.0 REFERENCES	45

1.0 Introduction

Newton's classical mechanics are only applicable at speeds low compared with that of light and so have to be regarded as inexact. Einstein developed what physicists consider to be an exact alternative in his theories of relativity and these have become established. For over sixty years, however, theoreticians have been trying to match Einstein's general relativity, his theory of gravitation, to quantum theory: they have not succeeded. Worse still, a clever analysis by H. Aspden(1) of the interferometer experiments of Brillet and Hall(2) have shown that absolute speeds can be measured: something which the postulate of special relativity forbids! This apparatus, unwittingly, included a novel feature which Aspden showed to be responsible for what the experimenters considered a "persistent anomaly". They were actually measuring the surface speed of the Earth about its axis and the latter, as will be shown, was co-moving with a background fluid, something incompatible with relativity theory.

It seems prudent, therefore, to return to Newtonian concepts and revise them to remove false aspects. The changes need to lead to a theory which replicates all the achievements claimed to be unique to both classical theories of relativity. They also need to match up with quantum theory at appropriate interfaces.

This pamphlet summarises part of a study which began in 1984 after an article had appeared in New Scientist by Professor Tryon(14). He proposed that, since gravitational potential energy was negative, it could balance the mass-energy of the universe. Then everything could have arisen ex-nihilo. However, this depended on taking the datum for gravitation at infinity, merely because this was customary. Clearly the mass-energy would remain at infinity where the gravitational energy had been fixed as zero: so completely invalidating the concept.

If such a simple misconception had been accepted, as it had, by the system of peer-review, then clearly a close look at other aspects of classical mechanics needed to be initiated. A number of other misconceptions were soon discovered and it is the aim of this presentation to highlight some of these and offer, for the critic, what appear to be paradox-free alternatives.

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It should be noted that in previous publications by this author(6,7,8,9,10&11) a modified background substrate had always to exist. To differentiate it from other concepts, such as space, quantum vacuum, ether or aether, it has been called the "**nuether**". Unfortunately this has been found too clumsy and so the name has now been changed to "**i-ther**", pronounced eye-ther and short for "intelligent ether". That it has the potential to evolve a conscious intelligence has already been justified in previous publications(7,8,10&11). It comprises a seething mixture of primary particles to be called, "primaries" and this replaces the name "cosmons" used previously(7).

In these publications, the i-ther was shown to have a simple basis assumed as the ultimate reality where electromagnetism gravitation and nuclear forces do not exist. The aether is generated by waves from the i-ther to produce the observed complexity, matter and the four forces of nature.

The new approach, to be presented, is steadily gaining acceptance by physicists. It has been peer-reviewed by the Russian Academy of Sciences and Arts and appeared in three publications of their conference proceedings two of which are quoted(9&10). A further 4,500 word article by this author(11) has also appeared in the scientific journal "Frontier Perspectives". This received a commendation from the editor.

A start will be made by extending Newtonian physics to replace special relativity. The critic should note that the resolution of problems to do with the null result of the Michelson and Morley experiment will appear late in the derivation. This experiment was responsible for discrediting the idea that an all-pervading medium, called "ether", existed. Michelson himself never agreed with this deduction.

2.0 An Alternative to Special Relativity

2.1 The radiation pressure of light re-defines Inertial Mass

The quanta of light, the photons, are emitted instantly when electrons drop from higher to lower orbits in atoms. However, for the present analysis it will be imagined that it would be possible to apply a force in some way in order to increase the kinetic energy of a photon from zero, measured from local space, (i-ther) to some finite value E_K . If a force F is applied at constant speed c , then Newton's second law must be changed from:

$$F = m \frac{dv}{dt} \quad \text{to} \quad F = \frac{d(mv)}{dt} \quad [1]$$

The energy supplied by force F moving distance dx will be Fdx equal to dE , so multiplying equation[1] by dx and expanding by the standard method of differentiation by parts the first result yields the factor dx/dt which is velocity v : so we obtain:

$$dE = \left[m \frac{dv}{dt} + v \frac{dm}{dt} \right] dx = v m dv + v^2 dm \quad [2]$$

Here $dv = 0$ and $v = c$ so we can write the integral:

$$E_K = \int_0^{m_K} c^2 dm = m_K c^2 \quad [3]$$

Since all the work $\int Fdx$ is supplied at constant speed c it is entirely absorbed as kinetic energy i.e. E_K and clearly there is an equivalent "kinetic mass" m_K .

Furthermore each photon of mass m_K will carry momentum $m_K c$ and so if there is a flux per unit area ζ in numbers of photons per second falling on unit of absorption area, then the resulting rate of change of momentum per unit area will exert a pressure P_r given by:

$$P_r = \zeta m_K c = \zeta E_K / c = w_p / c \quad w_p \text{ is radiated power} \quad [4]$$

This is the radiation pressure formula which has been fully confirmed by experiment, so proving that light carries momentum and therefore carries the kinetic mass m_K .

From this point it is possible to take two alternative approaches for obtaining an equivalent energy corresponding with rest mass m_0 and a revised inertial mass.

2.2 Method 1: By Linear Acceleration

An undefined object of rest mass m_0 is to be considered accelerated from rest with respect to a fluid i-ther to a speed v so that its inertial mass increases to m .

Equation[4] for radiation pressure has already established that kinetic mass m_K is equivalent to kinetic energy E_K as given by [3]. A massive object, when accelerated from rest, also acquires kinetic energy and so its inertial mass must increase as speed increases. It is reasonable to assume that this inertial mass m is directly proportional to a total energy E though with a constant of proportionality needing to be determined. This assumption will be seen fully justifiable after method 2, based on the conservation of angular momentum, has derived the identical end equation. No other assumption could have provided this consistency. With B as the constant of proportionality to be determined, we can write:

$$m = B E \quad [5]$$

Also Newton's second law, for accelerating force F with mass as an extra variable has to be expressed as the "rate of change of momentum", which can now be written in two forms:

$$F = \frac{d(mv)}{dt} = B \frac{d(Ev)}{dt} \quad [6]$$

Expanding [6] using differentiation by parts:

$$F = B E \frac{dv}{dt} + B v \frac{dE}{dt} \quad [7]$$

Now the work done by force F in an element of distance dx is Fdx and is equal to the gain in kinetic energy dE of the object. Hence multiplying both sides by dx we have:

$$dE = F dx = B E dv \frac{dx}{dt} + B v dE \frac{dx}{dt} \quad [8]$$

Putting $v = dx/dt$ this becomes:

$$dE = BEv dv + Bv^2 dE \quad [9]$$

Rearranging & noting that $E = E_0$ when $v = 0$:

$$\int_{E_0}^E \frac{dE}{E} = B \int_0^v \frac{v dv}{1 - Bv^2} \quad [10]$$

Now this is a standard form of integral readily solved by putting:

$z = 1 - Bv^2$, so that $dz = -2Bv dv$. Integration yields:

$$\ln E - \ln E_0 = -\frac{1}{2} \ln(1 - Bv^2) \quad [11]$$

Which can be re-written:

$$\frac{E}{E_0} = \frac{1}{\sqrt{1 - Bv^2}} \quad [12]$$

Clearly as v is increased so E increases according to equation[12] until $Bv^2 = 1$. At this point E becomes infinite and so no further increase in v is possible. Let this limit be defined as the speed of light c . Hence $B = 1/c^2$. Substituting for B in equation[5] & [12] results in:

$$mc^2 = E = \frac{E_0}{\sqrt{1 - v^2/c^2}} \quad [13]$$

Note: The author has been informed that this method was at least partly anticipated about 100 years ago by Whittaker.

Where $c = 2.997925 \times 10^8$ m/s. The kinetic energy of the moving object is clearly given by:

$$E_K = E - E_0 \quad [14]$$

With E given by equation[13]. So light must have $E_0 = 0$ and $m_0 = 0$.

It is necessary to see how well these predictions are supported by observation and compare them with the achievements of an alternative classical approach.

2.3 Method 2: Rest-energy Assumed to BE Kinetic Energy (Independent of Method 1)

It seems possible that the universe could be constructed entirely from kinetic energy E_K . For example, two particles connected by a weightless chain can be imagined in orbit about one another. Each could be made of pure kinetic energy so that it moved at the speed of light, as proved in method 1. The pair would, however, appear as a single stationary particle possessing a rest energy corresponding to the sum of the kinetic energy of the components. A pion might be modelled in this way. The quantum model will not be the same but the hope is to see if this (incorrect) classical model can provide the required classical/quantum interface; just as the classical Bohr radius of the hydrogen atom forms such an interface for electromagnetism.

Bohr proposed a model in which the electron orbited the nucleus like a planet going round the Sun in a circle. This was later replaced by the quantum model due to Schrödinger, in which electrons existed in a spherical "orbital" with a random distribution. It had a probability of being found at any radius which increased with distance from the nucleus up to a certain value and then fell off again. However, the peak of the probability curve coincided with the Bohr radius. In this way it seems reasonable to consider the Bohr radius as a classical/quantum interface because a residue of classical theory can be said to have a useful existence.

A pion consists of a pair of quarks, to be imagined rotating about one another like a spinning dumbbell, each at radius r about a common centre. Then the orbiting pair will be observed as a single stationary particle having rest mass m_0 . In a first simplified model, **to be refined later**, each quark will be assumed made entirely of photon-like orbiting kinetic energy E_K , where $E_K = m_K c^2$, moving at the speed of light. The pair is now assumed accelerated to a speed v by a force directed along the axis of rotation.

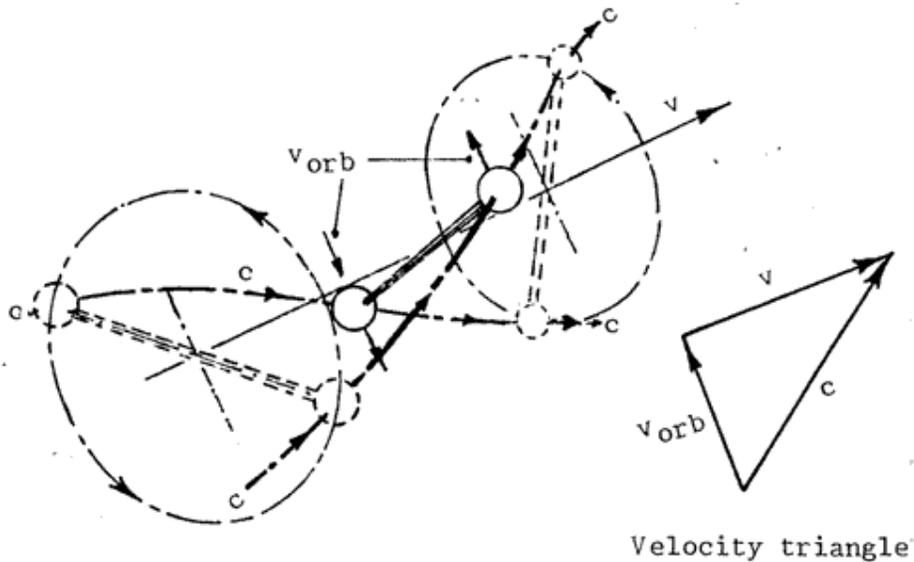


Fig.1 Pion at speed v

Modelled as a rotating dumb-bell the orbital speed of each quark (shown as small spheres) falls from c , when the pion is at rest, to v_{orb} as the linear speed is increased to v . The condition needing to be satisfied is that each member moves at unchanged speed c . (This is for the unrefined model in which each quark has no rest-energy)

The combined rest energy will be:

$$E_0 = m_0 c^2 \quad \text{where} \quad m_0 = 2 \times m_K \quad [15]$$

If the pion is accelerated bodily to a linear speed v , then firstly, the axis of rotation will line up with the direction of acceleration due to gyroscopic forces. Secondly the orbital speeds will fall to v_{orb} as shown in FIG.1. It will be assumed that the orbital radius remains constant, a condition which Method 1 will show to be justified.

$$c^2 = v_{orb}^2 + v^2 \quad [16]$$

This derives purely from the geometrical theory of Pythagoras. Each member of the pair will follow a helical path at a speed c , directed along this path, since as shown in Method 1, when $m_0 = 0$ absolute speed = c .

Conservation of angular momentum p_r given by $p_r = mvr$ then dictates that, assuming r to remain constant:

$$m v_{orb} r = m_0 c r \quad \text{So:} \quad \frac{m}{m_0} = \frac{c}{v_{orb}} \quad [17]$$

Then substituting for v_{orb} from [16] in [17] yields:

$$\frac{m}{m_0} = \frac{E}{E_0} = \frac{1}{\sqrt{1 - v^2/c^2}} \quad [18]$$

Since this is identical with a re-arrangement of equation [13] derived by method 1, the assumption that r remains constant is justified. Furthermore an expression for the angular velocity ω for the orbiting quarks can be compared with the rest value ω_0 and, since r is constant becomes, since $\omega r = v_{orb}$:

$$\frac{\omega}{\omega_0} = \frac{v_{orb}}{c} = \sqrt{1 - \frac{v^2}{c^2}} \quad [19]$$

A more refined model would make the orbital speed of each quark of the stationary pion equal to ηXc where $\eta < 1$ to allow for non-orbital components of energy, such as a spinning motion of each quark about its own axis. For example, a quark could be made up of sub-quarks of pure kinetic energy orbiting at speed v_q about the centre of gravity of the quark. Then:

$$v_{orb}^2 = c^2 - v^2 - v_q^2: \quad \text{Then putting } v_q^2 = (c^2 - v^2)(1 - \eta^2) \quad [20]$$

This simplifies to:

$$v_{orb} = \eta \sqrt{c^2 - v^2} \quad [21]$$

Hence η will appear on both sides of equation [17] and so will cancel leaving the value of m/m_0 unchanged.

A quantum description would show that, instead of orbiting, the quarks would seem to jump about over the surface of a sphere of radius r . The pion would then be spherical instead of disc-shaped but the foregoing classical approach should yield the required classical/quantum interface.

2.4 Special relativity versus the revised Newtonian

Equations [13] and [18] are effectively identical and replicate the famous Einstein equation obtained from special relativity, but here it has appeared, from both Methods 1 and 2, without any reference to relativity at all. Both have been entirely derived from our first refinement of Newtonian physics - the need to incorporate the mass equivalent of kinetic energy in the definition of inertial mass. Method 1 depended on acceleration, which can be regarded as following Whittaker.

In relativity these equations arise as a direct result of its postulates without reference to acceleration. Indeed, accelerated states are outside the scope of special relativity theory.

The mathematical similarities mean, however, that most experimental verification of special relativity will support the revised Newtonian equally well.

The mathematical similarities are, however, illusory because v is now the speed of any object relative to the local i-ther: not the observer as in relativity! The consequence is that other differences are inherent. In relativity an observer moving with any object only sees the rest mass m_0 and rest energy E_0 of that object, because no absolute frame of reference is permitted. In the extended Newtonian such an observer sees the full inertial mass m and total energy E because these now have absolute, not relative values.

Furthermore, in relativity, the observer judges the kinetic energy of any other object in terms of its observed speed. Hence the kinetic energy of a given object will be accredited different values by observers in different frames of reference, i.e. in motion relative to each other. Hence in relativity theory, kinetic energy, total energy and inertial mass, take on an illusory quality, whilst for the revised Newtonian this is not the case.

This removes the uncertainty concerning the actual energy of any object and permits, in principle, the total energy of the universe to be assessed. Relativists have said this quantity is impossible to define!

2.5 Time dilation

Muons resulting from the impact of cosmic rays in the upper atmosphere are detected at ground level. Muons moving slowly decay with half-lives of 2.2×10^{-6} s and it is estimated that their lives need to be extended about nine times to explain ground level observation. For this reason they have been used to verify Einstein's prediction of time dilation. The muon is structured more like an electron, however, and so is not a good example for our purpose: so we will study the pion we modelled in Method 1 instead. Charged pions have the shorter half-life of 1.8×10^{-8} s.

The analysis given in Method 2, using Newtonian theory, could equally apply to relativity with v now defined as relative to the observer. For simplicity we will assume $\eta = 1$.

If the observer moves with the pion differences in these theories now appear. The relativist expects exactly the same mechanics to apply and so sees the quarks orbiting at speed c , just as if both observer and pion were stationary. However, observing a pion moving at relative speed v the quarks would be seen orbiting at speed v_{orb} . The way these are reconciled, in relativity, is by assuming time has dilated in ratio c/v_{orb} for the observer moving with the pion.

The Newtonian moving with the pion would, however, observe exactly the same orbiting speed v_{orb} as he did when he was stationary (observing the pion in linear motion at speed v). He would, however, use his Brillet and Hall interferometer to measure his absolute speed and find it was v . Then he would add v to v_{orb} vectorially and discover the vector sum to be c : equal to the orbiting speed with both observer and pion stationary. No time dilation is now required.

However, the angular velocity of the orbiting quarks would reduce with speed according to equation[19]. If the lifetime of an unstable particle is measured in the number of rotations before decay, then both theories will predict the same life extension.

For mechanisms based on atoms a different approach is needed and this will now be considered. This time the vibration of a hypothetical matter clock will be investigated.

2.6 Vibration of a hypothetical matter clock

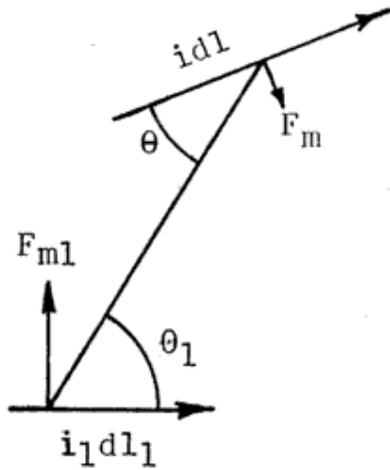


Fig. 2 Magnetic force on current elements

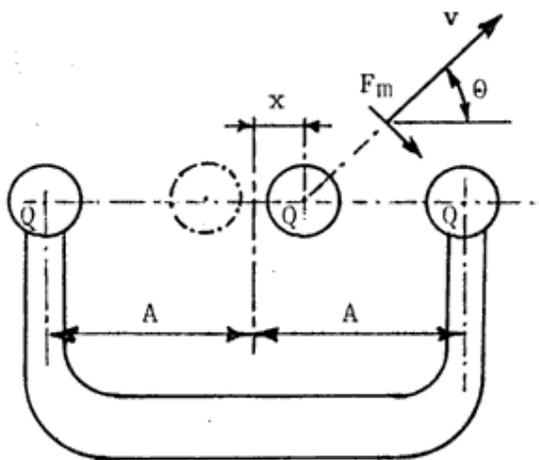


Fig. 3 Hypothetical matter clock

For the revised Newtonian, it is necessary to define two kinds of clock: "light clocks" and "matter clocks". Light clocks will depend on photons, generally involving laser beams, whilst matter clocks will depend on mechanical vibrations, such as those of quartz crystals. Vibration of crystals is made complex by an induced motion, perpendicular to the direction of main excitation caused by the so-called "Poisson's ratio". A hypothetical matter clock, which is mathematically less complex, will therefore be considered in detail.

A special clock is to be imagined built from three identical spheres arranged in a straight line, as shown in Fig. 3. The outer spheres are fixed to a frame and the centre one is allowed one degree of freedom so that it can vibrate only along the line of centres. Its rest position is centrally located at distance A from each end sphere. All spheres carry identical electrostatic charge Q and, at absolute rest, a restoring force is produced proportional to the net electrostatic force. Additional magnetic forces, caused by the linear motion of all charges, will come into play at absolute speed v .

When the central sphere vibrates it will generate electromagnetic waves, so the resulting motion will be a damped oscillation. Forced at resonance, however, this energy loss can be offset so that the effect of wave generation can be completely ignored.

The magnetic force for each of two short lengths of wire dl and dl_1 carrying currents i and i_1 is illustrated in Fig.2. Each reacts to the magnetic field produced by the other so that forces are perpendicular to motion. It is interesting to note that Newton's third law, action and reaction are equal and opposite, is apparently violated when the line joining these elements have angles θ and θ_1 relative to directions of current flow. It is restored when reaction against the background medium is considered. For complete circuits there is not even apparent violation.

The motion of the charges relative to the i -ther is equivalent to a current such that current $i = vQ/\delta l$. Furthermore since the magnetic μ_0 and electrostatic ϵ_0 constants are linked to the speed of light c such that:

$$\mu_0 \epsilon_0 c^2 = 1 \quad [22]$$

It is convenient to convert entirely to electrostatic units so that the magnetic force F_m on the upper moving charge can be expressed as:

$$F_m = -\frac{\mu_0 i \delta l_i \delta l_1}{4\pi r^2} \sin\theta = -\frac{Q Q_1}{(4\pi \epsilon_0) r^2} \frac{v v_1}{c c} \sin\theta \quad [23]$$

The arrangement of the clock is illustrated in Fig. 3 together with its absolute motion at speed v , at an angle θ with respect to the in-line direction and in which the centre sphere has displacement x .

The net force F on this sphere, after binomial expansion with second and higher order terms ignored, becomes:

$$F = -\frac{4Q^2}{(4\pi \epsilon_0) A^3} \left[1 - \left(\frac{v}{c} \right)^2 \sin^2(\theta) \right] x \quad [24]$$

If the mass of the centre sphere is m then, together with equations [8] & [24] a simple harmonic motion is specified which yields the angular velocity ω :

$$\omega^2 = \frac{4}{(4\pi \epsilon_0) m_0 A^3} \sqrt{1 - \left(\frac{v}{c} \right)^2} \left[1 - \left(\frac{v}{c} \right)^2 \sin^2(\theta) \right] \quad [25]$$

By putting $v = 0$ the value ω_0 for the vibration of the clock at rest is obtained and this can be divided into equation [25] to yield ratios for finding how frequency changes with linear speed v , i.e.:

$$\frac{\omega}{\omega_0} = \frac{Q}{Q_0} \left(\frac{A}{A_0} \right)^{\frac{3}{2}} \left(1 - \left(\frac{v}{c} \right)^2 \right)^{\frac{1}{4}} \left[1 - \left(\frac{v}{c} \right)^2 \sin^2(\theta) \right]^{\frac{1}{2}} \quad [26]$$

This expression can be used to investigate the way the clock will change frequency as it is accelerated to a higher speed. It has been derived from a Newtonian basis but is equally applicable to special relativity since, in the latter case, the observer can always be considered at rest. It is convenient to define $\beta = v^2/c^2$. The two cases are compared below for $v \ll c$:

Special relativity for $\theta = 90^\circ$ then $A/A_0 = 1$ and $Q/Q_0 = 1$ has to be assumed. For $\theta = 0$ the Lorentz contraction has to be applied so that $A/A_0 = 1 - 1/2\beta$. The two results yield $\Delta \omega / \omega_0$ of $-3/4\beta$ and $1/2\beta$ respectively so that the arithmetic mean is $-1/4\beta$.

Revised Newtonian. In both cases $A/A_0 = 1 = Q/Q_0$ is assumed giving:

$\Delta \omega / \omega_0 = -3/4\beta$ and $\Delta \omega / \omega_0 = -1/4\beta$ respectively. In this case, for $v \ll c$ an integration yields an exact average for a smoothly rotating clock which becomes $-1/2\beta$. Only this value is consistent with experimental observation.

For the case of special relativity an inconsistency is evident because, from a time dilation prediction, the result has to be $\Delta \omega / \omega_0 = -1/2\beta$.

No practical clock could be expected to show the full anisotropy suggested by the revised Newtonian case. For caesium-beam clocks the atoms would be rotating and so only the average would appear. The nearest approximation to the hypothetical clock analysed would be a quartz crystal oscillator. It could not be expected to give the complete anisotropy, however, owing to Poisson's ratio. When materials are compressed they expand laterally by between $1/4$ and $1/3$ of the direct strain and this will tend to reduce the anisotropy.

It will not be eliminated, however, and so a new experimental check has emerged! It could only be measured for an experiment in orbit because terrestrial speeds would not give adequate resolution. A pair of identical quartz crystals with axes arranged mutually perpendicular would be required with output signals added to produce a beat frequency. They could be mounted on a rotating table and then the beats should cycle when the clock is in Earth orbit.

Calculations show that at an absolute speed of 7.79 km/s and using 460 MHz oscillators, a beat frequency of $.155 \text{ Hz}$ should be returned. It is known that such clocks can achieve stabilities better than 10^{-10} s/s when in temperature controlled environments but this is about equal to the signal. At least a tenfold improvement is required but this only applies to the difference signal and so should not pose an insoluble problem.

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Unfortunately a problem arises for both relativity and the Newtonian in that the value of A will vary in direct proportion to the size of atoms and this size cannot be assumed fixed simply by assuming electric charge invariant.

Indeed the Bohr radius can be investigated. Fitzgerald made a similar study on atoms. He found that a lateral expansion $\Delta x/x$ equal to $1/2\beta$ would occur taking the magnetic force into account. He suggested this could be the reason for the null result given by the Michelson Morley experiment.

Michelson and Morley had used an interferometer to measure the absolute speed of the Earth, expecting a value of at least 30 km/s to be shown. This depended on the speed of light appearing different for two mutually perpendicular directions and the theoretical difference would be $-1/2\beta$. Hence the Fitzgerald expansion would just cancel the effect. (Lorentz had suggested a contraction in the direction of motion to do the same and this idea, despite the lack of any theoretical basis, was adopted: presumably because it fitted in better with the predictions of Special Relativity)

When this expansion is allowed $\Delta \omega/\omega_0$ becomes $-3/2\beta$ for the transverse direction. If this were accompanied by a Lorentz contraction then the correct average value would arise but the anisotropy is still further increased. Such a contraction is not disallowed by the revised Newtonian but will apply only to objects built of atoms: it will not apply to empty space, in addition, as it does in relativity.

To keep A constant Q has to increase as speed increases. If e is the electronic charge then $\Delta e/e_0 = 3/4\beta$. Some basic quantum analysis along the lines of the Schrödinger wave model seems to be required backed by experiment to discover exactly what really happens.

No such modifications can be accommodated by the relativistic approach because this has to maintain A constant in the transverse direction and ignore the inconsistency with charge also remaining invariant. The Lorentz contraction must also be accepted in the direction of motion. This inflexibility is due to the absence of preferred frames of reference, with the consequent need for the observer to see the same mechanics whether travelling with a moving object or not. Fortunately for the revised Newtonian, not needing this constraint, some flexibility is allowable and any changes needed could be accommodated in this case.

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For adequate sensitivity only experiments in orbit could resolve the issue, using a practical version of the electromagnetic clock previously analysed. If transverse charge does in fact vary it could have serious implications for high energy physics and so its investigation would be worthwhile. To achieve a high enough clock vibrational frequency, however, the charged spheres (Fig.3) would need to be about the size of C_{60} buckyballs.

The next problem to be resolved, however, is the manner in which rest-energy varies with potential. This will take us into a minefield of misconception.

3.0 Does rest-energy vary with potential energy? Does it vary with binding energy?

An electron accelerated by an electrostatic field provides a useful initial example. Any potential change $\Delta\psi_e$ is given by the work done in moving an object distance x against a field of force F from one position to another: i.e. $\Delta\psi_e = \int Fdx$. If it is then released and allowed to accelerate freely in the field its potential will be lost as kinetic energy is gained. For example, an electron of $m_0 = 9.1091 \times 10^{-31}$ kg is assumed falling through 10^6 volts. (1 electron-volt = 1.6021×10^{-19} joule) Equation[20] then shows energy ratio $E/E_0 = 1.957$ and the electron will reach a value of $v/c = .85958$.

It is now to be imagined that this high speed electron is allowed to slow down without change of electric potential. This can be done by allowing it to pass through a cloud chamber, for example, where it loses energy by knocking electrons off atoms to produce a trail of ions. We will suppose the electron is stopped. Its maximum kinetic-energy was $E - E_0$ equal to $\Delta\psi_e$ but all this kinetic energy is subsequently lost. The final rest energy will be $E - (E - E_0)$: the original rest-energy has been recovered!

Overall the rest-energy has not changed but potential has been lost: so rest-energy cannot be affected by electrostatic potential!

A similar argument can be applied to the gravitational field. An elastic object is allowed to fall freely onto a rigid deflector inclined at 45 degrees to the horizontal. Its initial vertically downward velocity is converted to a horizontal one without change of kinetic energy. Its total energy E is then $E_0 + E_K$. Then it is stopped gradually by friction so that all E_K is lost. Clearly the original rest-energy must be recovered.

The same conclusion is reached if an object is considered lifted on a cable. The force of gravity is cancelled by the force on the cable so that, in lifting, zero work is transferred to the object. Its rest-energy must therefore remain invariant even though potential has increased.

It follows that rest-energy must remain invariant in the gravitational field.

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Now we come to the nub of the issue. The foregoing conclusions mean that no binding energies, whether gravitational, chemical or nuclear, can be reflected as differences between the rest-masses of separated particles and their combined masses! It is true that atomic nuclei have different masses from the sum of the protons and neutrons of which they are composed. The difference, however, has to be due to loss of particles like photons or neutrinos associated with nuclear reaction: they cannot be equated with potential change! And binding energies **are** potential change.

It follows that gravitational binding energies, contrary to established opinion, cannot be equated with change of mass. For example, Clifford Will(15), says on page 24 (of The New Physics edited by Paul Davies) when referring to the neutron star,

"...the observed mass is less than the total mass of all the neutrons in the star, because of the sizeable negative gravitational binding energy".

He was referring to the theory of general relativity which does not accept the existence of any real force of gravity. Instead objects move along geodesics in curved space-time and accelerate toward ponderous masses without a force being involved. On this theory it is true that some rest-mass has to transmute into kinetic energy as gravitational potential is lost. In this case, however, gravitation must be treated as totally different in nature from electromagnetism or the strong nuclear force because, as already proved, there can be no loss of rest-mass due to loss of potential if real forces are involved.

Unfortunately theorists attempting to match general relativity to quantum theory obviously consider gravity as a real force as Chris Isham³ indicates. On page 87, of the same book, he shows how gravitons and gravitinos are postulated which interact with matter and themselves to produce a real gravitational force. They are copying the methods, developed so successfully by the late and famous Richard Feynman in his theory of quantum electrodynamics (QED), which considers electromagnetism as a real force.

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Clearly a total incompatibility exists which does not appear to have been recognised! In fact, if a neutron star were built entirely from accreted hydrogen, it would be heavier than its initial constituents owing to degeneracy pressure increasing electron velocities. If these fuse with protons to make neutrons, then a mass increase is again involved. This time it is because energy has to be added. This would derive from part of the excess kinetic energy which the hydrogen needs to shed on impact.

Another concept needing to be assessed is the idea that, for the universe as a whole, its mass-energy is cancelled by its "negative gravitational potential energy". Clearly this idea is invalidated by the forgoing argument and something else needs to provide the balance.

It is necessary to deduce the basic mechanics behind the concept of any type of potential energy but with curved space-time geometry disallowed, since it is not necessary, as §4 will demonstrate. In engineering mechanics, for example, total energy is defined as the sum of kinetic and potential energy, a useful concept because total energy can then be considered to remain constant. Potential energy is simply regarded as energy stored "somehow" in space due to the position of an object in the field of force. But how is it stored? Nobody ever seems to know: so let us probe deeper.

A clue was given in my previous books(6, 7 & 8) and article(10 & 11). These showed how a sub-quantum fluid, now to be called the "i-ther" (intelligent ether), has to exist as a balance of positive and negative energies. These each comprise a seething mass of primary particles (primaries) constantly colliding like the atoms of a noble gas. An asymmetry has to exist in that the rest-energy of the positive primaries exceeds that of their negative partners with the latter having the greater kinetic energy (see §4.9). In consequence a small net negative pressure of the vacuum remains. Any density gradients result in net negative pressure gradients which act on positive matter to produce negative buoyancy forces. These are the source of the universal attractive force of gravity according to §4.9.

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For such a mixture the existing first law of thermodynamics is inapplicable. It is not wrong but has to be considered as a special case of a more general law which now reads, "Energy can only be created or destroyed in equal and opposite amounts". Hence both creation and destruction can proceed but only in such a way as to leave the net energy of the universe unchanged. Our special case has seemed to be universally applicable only because in most processes, such as chemical reactions, the negative component is not altered. But it does alter in free-fall!

On this basis when a ball is thrown into the air it is losing energy by pure annihilation of amount equal to the product of the force of action of gravity and height moved. An equal positive force of reaction acts on the net negative kinetic energy of the i-ther and so does positive work on that fluid. But positive work done on negative energy is equivalent to reducing the quantity of negative energy. Hence both the object and the i-ther lose energy of their own kind in equal amounts by mutual annihilation. When the ball falls back again, mutual creation occurs, so restoring initial values.

This, according to the present theory, is the real explanation for changes in potential not being reflected in changes of an object's rest-energy. Potential energy is not stored at all: it does not really exist! It has to be regarded as a pseudo-energy form: an artifice useful only for calculation purposes. The "total energy" of an object will, henceforth, be defined as the sum of rest and kinetic energies alone. Clearly, this sum will **not** be conserved in the potential field.

4.0 Quantum Gravitation

4.1 A preliminary formulation of basic equations

Since kinetic energy and kinetic mass have been shown equivalent it follows that kinetic energy as well as matter will couple with the gravitational force. The photons of light are pure kinetic energy: it follows that light must fall, just like matter, in a gravitational field. If a horizontal beam of light of depth dr is considered, bent by gravity, then clearly the photons will need to travel further on the outside of the bend than on the inside in order that its waves will always be normal to the direction of propagation. This is illustrated in Fig.4 showing how the change in light speed dc with dr arises due to gravitational acceleration g acting for time t . This results in the following equation:

$$cdc = gdr \quad [27]$$

(A totally rigorous derivation yields exactly the same result.)

Clearly as the distance from a ponderous object is increased, so c must increase. At some datum level, suffix D, its value will be c_D and it will be c at another level. Then since rest-energy is a constant $E_0 = m_0c^2 = m_{0D}c_D^2$.

In consequence it follows that:

$$\frac{m_0}{m_{0D}} = \frac{c_D^2}{c^2} \quad [28]$$

The equivalence between energy and mass is now clearly restricted to constant gravitational potential, to be designated ψ . Rest mass now appears as a variable with respect to ψ ! Clearly only energy can now be regarded as the constructional material of the universe. Mass now appears as only a convenient **property** of energy; something which helps govern motion by providing inertia.

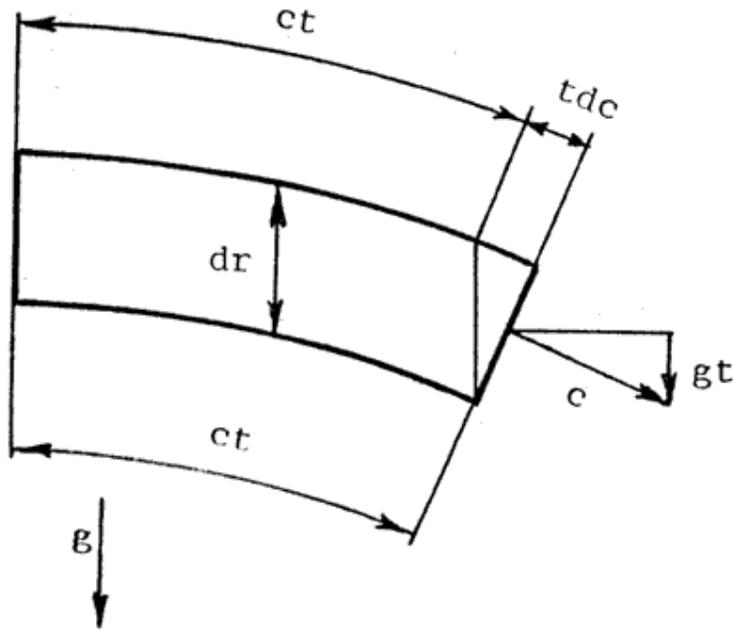


Fig. 4 Gravitational light bending

Inertial mass is now to be defined as:

$$m = m_0 + m_K = \frac{E}{c^2} = \frac{E}{c_D^2} \left[\frac{c}{c_D} \right]^{-2} \quad [29]$$

In consequence, and since kinetic-energy as well as rest-energy feel gravity, total energy E must couple with any gravitational flux ϕ so that a force $F = -\phi E$ is produced. Furthermore, by simple Euclidean geometry ϕ must satisfy an inverse square law of intensity when emanating from some massive point object at distance d and so, with d_0 as some chosen datum distance, it must obey the expression:

$$\phi = \phi_D \frac{d_D^2}{d^2} \quad [30]$$

By symmetry this flux must itself be proportional to the value E_S the total energy of that massive object. So when a constant of proportionality G_c is introduced the law for quantum gravity becomes:

$$F = -G_c \frac{E_S E}{d^2}; \quad G_c = \frac{G}{c^4} \quad [31]$$

Where, by comparison of equations[30] & [31] it can be seen that another useful constant, the "gravitational radius" r_0 emerges, given by the identity:

$$r_0 = \phi_D d_D^2 = G_C E_S \quad [32]$$

The constant of gravitation is now G_C whose value is $8.2615 \times 10^{-45} \text{ Nm}^2\text{J}^{-2}$ when determined from the Newtonian constant G as shown by equation[31]. It differs from the Newtonian gravitational equation in two ways. Firstly G_C has to be the true constant not G ! The latter must vary as c^4 varies so that G_C remains constant. Secondly E varies with speed w and so replaces the constant rest-mass of the Newtonian. (w is the vector sum of u and v where u will be used for the field component and v the velocity component transverse to the field i.e. horizontal) These two effects go part way to giving the same predictions as general relativity. For example, F no longer obeys an exact inverse square law: it is slightly steeper. This difference produces precession in the orbits of planets.

Next it is necessary to find how both c and E vary with gravitational potential ψ . It is best to obtain a general expression assuming ψ to have any profile, then:

$$g = \frac{-F}{m} = \frac{-F c^2}{E} = \phi c^2: \text{ Since } F = -\phi E \quad [33]$$

Used with equation[27], putting ϕc^2 for g , since $g = -F/m = -F c^2/E$, the variation in light speed can be found by integrating across an infinite number of elements such as that illustrated in Figure 4. A precise definition of ψ now emerges which is:

$$\int_D \frac{dc}{c} = \int_D \phi dr = \psi: \text{ So } \frac{c}{c_D} = e^\psi \quad [34]$$

Since $dE = Fdr$ then $dE = -\phi E dr$. So the variation in E with ψ becomes:

$$\int_D \frac{dE}{E} = -\int_D \phi dr = -\psi: \text{ So } \frac{E}{E_D} = e^{-\psi} \quad [35]$$

Equation[34] is universally valid, but [35] is valid for free-fall only.

For the special case of a single massive attractor with ϕ defined by equations[30] & [32] the value of ψ becomes:

$$\psi = \frac{r_0}{r_D} - \frac{r_0}{r} : \quad \text{Noting: } \psi = \phi_D r_D^2 \int_D \frac{dr}{r^2} \quad [36]$$

The radial distance r has replaced d since the massive attractor is assumed so large that its orbital motion can be ignored.

4.2 Compressibility of the i-ther

So far only "flat" space has been considered, meaning that the i-ther is assumed to be of exactly uniform density. This is, however, incompatible with an expression from quantum theory given by Novikov(5) who says that space is filled with virtual particles which, on average, occupy cubes of side L given by the expression: $L = (h/2\pi)/(m_0c)$. Substituting from [28] this gives $L = (h/2\pi)c/(m_0c_D^2)$: so $L/L_D = c/c_D$ showing that the i-ther has non-uniform density. Then combining with [34] and [35] it follows that the general expression for motion in free-fall in a compressible fluid i-ther is:

$$\frac{m_D c_D^2}{m c^2} = \frac{E_D}{E} = \frac{c}{c_D} = \frac{L}{L_D} = e^\psi \quad [37]$$

4.3 The true speed of light c_T in the compressible i-ther

The propagation speed of light will be affected by the change of L with ψ as will now be shown. It is best to imagine the photons moving as if in instantaneous jumps of distance L followed by a dwell of time Δt before the next jump where $c = L_D/\Delta t$ and $c_D = L_D/\Delta t_D$. If then c_T , the true light speed, is defined as $c_T = L/\Delta t$ then its ratio with c_D becomes:

$$\frac{c_T}{c_D} = \frac{c_T c}{c c_D} = \frac{L \Delta t c}{\Delta t L_D c_D} = \frac{L}{L_D} \frac{c}{c_D} = \frac{c^2}{c_D^2} = e^{2\psi} \quad [38]$$

Series expansions show that for flat space the change in light speed in weak gravity will be almost equal to ψ whereas in the compressible i-ther it will be 2ψ . This means that the bending of light will be doubled from the original Newtonian prediction and so will accord exactly with that of general relativity.

Velocities are also affected so that the energy equation becomes modified to:

$$\frac{E}{E_0} = \frac{1}{\sqrt{1 - \left[\frac{w}{c_T}\right]^2}} = \frac{1}{\sqrt{1 - \left[\frac{w c_D}{c_D c_T}\right]^2}} = \frac{m c^2}{m_{0D} c_D^2} \quad [39]$$

4.4 The gravitational red-shift -Two Methods

1. The energy E of a photon is given by $E = (h/2\pi)\nu$ where ν is its frequency. Then from [35] $E = E_D \text{EXP}(\psi)$: ($(h/2\pi) =$ Planck's constant). Hence the red-shift can be expressed as $\nu/\nu_D = \text{EXP}(-\psi)$: *i.e.* $\Delta\nu \approx -\psi \times \nu_D$

So the photon reduces in ν as it rises from low level.

2. A pair of equal masses connected by a spring have a vibrational frequency inversely proportional to the square root of their rest-masses. It also follows by substituting for c/c_D from equation [34] in [28] that rest mass $m_0 = m_{0D} \text{EXP}(-2\psi)$. It follows that $\Delta\omega/\omega_D \approx \psi$. This means that the object will vibrate at lower frequency when lowered in the gravitational field. This is consistent with method 1 and both are identical with general relativity.

4.5 The conservation of angular momentum

For free-fall equation[37] shows $m/m_D = EXP(-3\psi)$. However, all velocity ratios u/c_D , v/c_D & w/c_D are altered in ratio L/L_D i.e. in ratio $EXP(\psi)$. These can be combined to yield the following expression for the new law of conservation of angular momentum. Exhaustive checks have been made using trajectories computed in Cartesians: an example is illustrated on the cover. The following equation has been found to hold exactly:

$$vr = v_1 r_1 e^{4\psi} \quad [40]$$

When equations[28],[37],[38],[39] and [40] are combined, exactly the same equation for the precession of the perihelion of planets arises as is given by general relativity. The original solution presented in the book(6) involved many pages of algebra but the mathematician John Day wrote to say he had found a simple solution which will now be presented.

4.6 The first contribution of John Day M.Sc. - The perihelion advance of planets

Planets move in elliptical orbits about the Sun according to the original Newton inverse square law of gravity. The modified law causes the axes of the ellipse to rotate slowly and, measured from the line joining the point of closest approach to the Sun, this defines the perihelion advance. It is necessary to start, for the case of free-fall, by combining equations[37] and [39] and re-arranging to yield the following equation quoted from page 278 of the book(6):

$$\left(\frac{w}{c_1}\right)^2 = \left[1 - \left(1 - \left(\frac{w_1}{c_1}\right)\right)e^{2\psi}\right]e^{4\psi} \quad [41]$$

A "secondary datum", suffix 1 is used taken at the perigee and this replaces D. At this datum w_1 is the speed of the planet and, being tangential, can be replaced with v_1 , which changes to w at potential ψ .

John's first letter arrived dated May 13, 1993. He graduated with first class honours in mathematics at the University College in London in 1952 and held three M.Sc's. In this letter he stated that he had devised a much simpler method than the one I had used. This solution will now be presented based only on energy and angular momentum. Hence it starts from equations[40] & [41]. He defines $u = 1/r$, then, puts $h = v_1 r_1$ to define $d\theta$ from the above equation[40] as:

$$d\theta = hu^2 e^{4\psi} dt \quad [42]$$

Then he quotes from standard works:

$$w^2 = \frac{1}{u^4} \left(\frac{du}{dt}\right)^2 + \frac{1}{u^2} \left(\frac{d\theta}{dt}\right)^2 \quad [43]$$

Now by substituting from equation[41] the result is:

$$\begin{aligned}
 \left(\frac{du}{d\theta}\right)^2 + u^2 &= \frac{c_1^2}{h^2} \left(e^{-4\psi} - \left(1 - \left(\frac{w_1}{c_1}\right)^2 \right) e^{-2\psi} \right) \\
 &= \frac{c_1^2}{h^2} \left(1 - 4\psi + 8\psi^2 + \dots - \left(1 - \left(\frac{w_1}{c_1}\right)^2 \right) (1 - 2\psi + 2\psi^2 + \dots) \right) \\
 &= \frac{c_1^2}{h^2} (-2\psi + 6\psi^2) + \frac{w_1^2}{h^2} (1 - 2\psi) + \dots \\
 &= A + Bu + Cu^2 + \dots \left(\because \psi = \frac{r_o}{r_1} - \frac{r_o}{r} = \frac{r_o}{r_1} - r_o u \right)
 \end{aligned}$$

The solution of this must be a precessing conic. Constants $A + B$ govern only the size and shape, which can be found on evaluation to be only the conventional values with only minute correcting terms. The constant C alone governs the rate of precession (omitting from consideration of course the higher order evanescent terms of $+$...). On evaluation the result is:

$$\frac{6c_1^2 r_o^2}{h^2} = \frac{6c_1^2 G^2 m_s^2}{h^2 c_A^4} = \frac{6G^2 m_s^2}{h^2 c^2} \quad [44]$$

This will give a precession per orbit of πC , i.e. $6\pi(Gm_s/(hc))^2$

The light-speed c varies by a negligible amount within the solar system and so an average value of c_1 can be used without significant error in equation[44]. The value of v_1 can be obtained from Newtonian mechanics to adequate accuracy. The radius of closest approach, at "perigee" is r_1 and the radius at greatest distance is r_2 at "apogee". A slightly more refined version of equation[44] is:

$$\beta = 6\pi \left[\frac{G_c c_1^4 E_s}{v_1 r_1 c^3} \right]^2 \approx 6\pi \left[\frac{G m_s}{v_1 r_1 c} \right]^2 \text{ radians / orbit} \quad [45]$$

The result is identical with that given by General relativity.

4.7 The Shapiro Time Delay

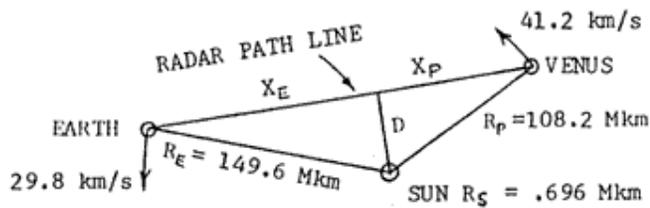
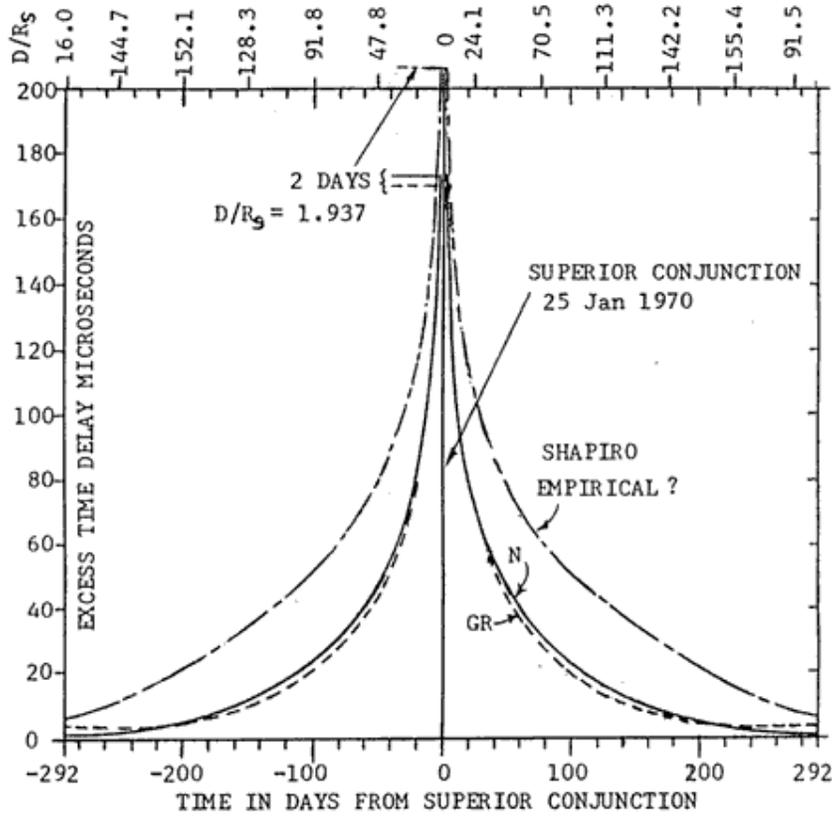


Fig. 5 Radar reflections from Venus to Earth

The Shapiro time delay needs a special mention. Equations[36] and [38] show that c_T will reduce as light, including radar beams, approaches the Sun. A radar beam bounced from a planet like Venus will therefore take slightly longer to return than if it moved at constant speed: this excess is the Shapiro Time Delay ΔT_S .

The extended Newtonian yields by simple integration:

$$\Delta T_S = \frac{4r_0}{c} \left\{ \text{Log}_e \left[\frac{(R_E + X_E)(R_P + X_P)}{D^2} \right] - \frac{X_E + X_P}{R_E} \right\} \quad [46]$$

Nomenclature is defined in the lower diagram of Figure 3 showing the Earth and Venus orbiting the Sun. The plot shows equation[46] as solid line N, in close agreement with the plot marked GR called the Schwarzschild solution of general relativity and quoted by Shapiro(12) prior to his experimental programme. After the tests he(13) quotes the upper chain dashed curve marked "Shapiro Empirical?". It is this, not the others, which fit the experimental observations!

Since only an unpublished source was given it seemed that this curve must be just an empirical match, which is why it is so marked.

I found that if the i-ther rotated in a vortex motion centred on the Sun, then a further extra time delay would arise. This was due to light being helped on one path but hindered more on the other, resulting in a small net extra "vortex delay". To fit the discrepancy a velocity distribution was computed described by:

$$\begin{aligned} v\sqrt{r} &= v_E\sqrt{R_E} \text{ beyond Earth orbit,} \\ v r &= v_E R_E \text{ from Earth to just inside Venus and then:} \\ v &= 119 - 33 \log_e(r/R_E) \text{ km/s to the Sun} \end{aligned} \quad [47]$$

Consequently, since the centre of the Earth is moving at the same speed as the i-ther the null observations of Michelson and Morley no longer seem inexplicable.

Furthermore the stellar aberration observed by the astronomer Bradley can also be accommodated. His observations showed stars to move in small circles with annual periodicity. This was consistent with light appearing to be deflected by the orbital motion of the Earth about the Sun, at a speed of 29.7 km/s. The effect was similar to the apparent deflection of raindrops as viewed from a moving vehicle.

The Earth would have no apparent speed relative to a co-moving fluid but would be in orbital motion relative to any star.

On Christmas Eve 1996 a letter arrived from John Day. It contained a mathematical proof showing he had derived the "Shapiro empirical?" equation from the fundamental metric equation of general relativity. So the latter can provide two solutions but only one is satisfied.

4.8 The Metric

Letter from John Day dated January 8, 1997

He starts off, "You might need reminding it is possible to reconcile the different points of view and make yours an explanation of relativity rather than a contestant". Then he goes on to show how a metric can be obtained from the revised Newtonian equations starting with the Lorentz form as follows.

$ds^2 = dt^2 - (dx^2 + dy^2 + dz^2)/c^2$ from the centre of a spherical centre will be equivalent to:

(dX, dY, dZ) distance r from the same centre where:

$(dX, dY, dZ) = \text{EXP}(-\psi)(dx, dy, dz)$ & $\psi = r_0/r_1 - r_0/r$

We also note that it is reasonable to assume time is affected so that everything at r is slower than at r_1 by a factor $\text{EXP}(\psi)$ i.e. if $(dx, dy, dz) = 0$ then we would have simply $ds = \text{EXP}(\psi) dt$. So we can now see that if (dx, dy, dz) are non-zero then:

$$ds^2 = \text{EXP}(2\psi) dt^2 - (dX, dY, dZ)/c_1^2 \quad \text{Hence:}$$

$$ds^2 = \text{EXP}(2\psi) dt^2 - \text{EXP}(-2\psi)(dx^2 + dy^2 + dz^2)/c_1^2$$

This should be sufficient for determining formulae for all four tests of general relativity. The three involving photons for which $ds = 0$ are straightforward of course and involve only first order approximations of type $\text{EXP}(\psi) = 1 + \psi$

Day then mystifies me by going on to say this yields:

$$ds^2 = c^2 e^{2\psi} dt^2 - e^{-2\psi} (dr^2 + r^2 dv^2 + r^2 \sin^2 v d\psi^2) \quad [48]$$

Where ψ is given by equation[36]

He then says, "This is a remarkably good approximation to relativity's isometric form":

$$ds^2 = c^2 \left(\frac{1 - m/2r}{1 + m/2r} \right)^2 dt^2 - \left(1 + \frac{m}{2r} \right)^4 (dr^2 + r^2 d\vartheta^2 + r^2 \sin^2 \vartheta d\varphi^2) \quad [49]$$

John Day never explained to me the last two equations[48] and [49] and some assistance from a mathematician is needed to resolve this issue since, unfortunately, John passed away early in 1997.

However, it is highly likely that the sophisticated tensor mathematics is giving solutions for both a stagnant and a vortex case. More theoretical work is needed to fully resolve this question.

A Sun-centred vortex implies the existence of a multiplicity of star-centred absolute frames embedded in galaxy-centred frames. All will be energy-related to a single primary reference frame. Only a single value for the total positive energy of the universe is then implied.

It does not appear that there can be an Earth-centred i-theric vortex otherwise the absolute surface speed of the Earth would not have been detected by the Brilliet and Hall interferometer. There must be a minimum critical mass for vortex formation and this requires further study. It would be most informative if an absolute speed measurement could be made close to the planet Saturn to see if an i-theric vortex existed around this object.

It seems that a whole new field of space exploration could be opening. Unfortunately certain physicists contacted have dismissed the anomaly found by Brilliet and Hall on the grounds that nobody seems to have repeated their experiment. It would be advantageous to carry out this repeat near the equator where Earth surface speeds would be about 30% greater than at Boulder. Then it is very likely that NASA would be interested in mounting the first orbital flight of a Brilliet and Hall device.

4.9 Gravity as a Negative Buoyancy Force

The derivation began by assuming the presence of a force producing flux ϕ without specifying what this could be. Now that the energy density has been found to vary with ψ , however, it is worth pursuing the idea that the force might be generated by energy density gradients instead.

Energy density ϵ will vary inversely as the cube of L and so, incorporating equation[37] we can write:

$$\frac{\epsilon}{\epsilon_D} = \left[\frac{L}{L_0} \right]^{-3} = e^{-3\psi} \quad [50]$$

Differentiating both equations[36] and [50] with respect to r we have:

$$\frac{d\psi}{dr} = \frac{r_0}{r^2} \quad \& \quad \frac{d\epsilon}{dr} = -3\epsilon_D e^{-3\psi} \frac{r_0}{r^2} \quad [51]$$

This author's previous publications(6 to 11) have shown that the i-ther has to exist as a composite of positive and negative energy states. This is because attractive forces cannot be modelled, without freedom from paradox, unless the gauge particles which mediate such forces carry negative momentum. This means that the arrow, representing momentum, needs to point in a direction opposite that of motion. The accelerating force of action needs to be reversed so that negative work is done in acceleration: so specifying a negative inertial mass. It follows that such particles are constructed from negative energy. If then a mixture of particles, called, "primaries" is considered, all moving close to the speed of light and constantly colliding, it was shown, by the author's publications (7,8,10&11) (historical order) that curious effects appear. (Note that the primaries were first called, "cosmons". Since this name was already in use for a model by Adolphe Martin, which did not include negative energy states, it had to be changed).

A mathematically-based solution showed, that in order to conserve momentum at each pair collision, each primary gained energy in an equal but opposite amount to its partner. Collisions of opposites therefore result in a breeding effect so that the i-ther tends to grow continually in both size and density! Most of this is cancelled by mutual annihilation at centres where high density prevails, resulting in a filamentous structure. This had the ability to store energy imbalances, later released to generate quantum waves of real energy. Energy conservation meant that the positive and negative phases of the mixture needed to co-exist in a close balance.

An asymmetry of rest-energies between opposite types of primary also had to be present . The positive kinds needed to have the greater rest-energy and, to preserve conservation of energy, the negative primaries needed to be produced with the greater kinetic energies. Without this asymmetry the filaments could not generate the required quantum waves.

It is useful to define ε as a reference energy density: the value which would obtain if rest energies were zero. Then if the average speed of positive primaries is v_+ the corresponding energy density will be ε_+ . The kinetic theory of gases can be refined to yield the pressure P_+ as a function of the number n_+ of primaries per cubic metre, the total energy per primary E (equal for both positive and negative kinds) and v_+ yielding:

$$P_+ = \frac{1}{3}n_+mv^2 = \frac{1}{3}n_+E\left(\frac{v}{c}\right)^2 = \frac{1}{3}\varepsilon_+\left(\frac{v}{c}\right)^2 \quad [52]$$

Since the rate of production of primaries is equal for both phases it follows that the number crossing unit area per second ξ must also be equal for both. Now the positive primaries can be imagined as at the centres of cubes of side L filling a cubic metre so that their number $n_+ = 1/L^3$. If these all move toward a surface at speed v_+ there will be $1/L^2$ rows in motion and the number crossing per second in each row will be v_+/L . Allowing for three-dimensional motion it follows that:

$$\xi_+ = \frac{v}{3L^3} = \frac{n_+v_+}{3} \quad [53]$$

Since v will be close to the speed of light c it is convenient to write:

$$v_+ = c - \delta_+ \text{ then } 3\zeta = nc = n_+(c - \delta)$$

Then noting that

$$E_+ = |E_-|$$

we obtain:

$$P_+ = \frac{1}{3}\epsilon_+ \left(1 - \frac{\delta_+}{c}\right)^2 = \frac{1}{3}\epsilon \left(1 - \frac{\delta_+}{c}\right) \quad [54]$$

A similar expression applies for the negative phase and ϵ is the datum value common to both. Hence by addition the net pressure P_n becomes:

$$P_n = -\frac{1}{3}\epsilon \left(\frac{\delta_+}{c} - \frac{\delta_-}{c}\right) \quad [55]$$

It being assumed that $\delta_+ > \delta_-$. Then equation[55] can be differentiated and equated to [51] to yield:

$$\frac{dP_n}{dr} = -\frac{1}{3}\left(\frac{\delta_+}{c} - \frac{\delta_-}{c}\right) \frac{d\epsilon}{dr} = \epsilon_D \left(\frac{\delta_+}{c} - \frac{\delta_-}{c}\right) e^{-3\psi} \frac{r_0}{r^2} \quad [56]$$

Now the buoyancy force F on a particle of volume V_p when combined with equation[56] becomes:

$$F = -V_p \frac{dP_n}{dr} = -V_p \epsilon_D \left(\frac{\delta_+}{c} - \frac{\delta_-}{c}\right) e^{-3\psi} \frac{r_0}{r^2} \quad [57]$$

The sub-atomic particle of volume V_p will have a net energy density which is the sum of two values differing from ϵ so the net value will be $\epsilon_{p+} - \epsilon_{p-}$ yielding a mass m equal to:

$$m = \rho V_p = \frac{\epsilon_{p+} - \epsilon_{p-}}{c^2} V_p \quad [58]$$

Then the gravitational acceleration $g = F/m$ is given by dividing [57] by [58]. It is also given by dividing equation[31] by E/c^2 . Then with r_0 given by equation[32] it follows that:

$$g = -\frac{G_c E_s c^2}{r^2} = -\frac{r_0}{r^2} c^2 \quad [59]$$

Equating equation[59] with [57]/[58] the result becomes:

$$\frac{\epsilon_{p+} - \epsilon_{p-}}{\epsilon_D} = e^{-3\psi} \left(\frac{\delta_+}{c} - \frac{\delta_-}{c} \right) \quad [60]$$

Since $\text{EXP}(-3\psi)$ is close to unity in weak fields like those in the solar system it follows that the differential density inside the particle boundary must equal that outside to provide the observed gravitational acceleration.

When the properties of a mixture of positive and negative energies are analysed they are found to be unlike those of fluids of everyday experience. Focused quantum waves enhance the breeding effect to produce density humps in both phases on which the waves are superimposed. Close to the focus the ultimate density can readily be approached: the i-theric liquidus state in which the primaries occupy about one quarter of the total volume. At lower densities creation slightly exceeds annihilation but at higher values the converse is true: because multiple collisions favour annihilation. The liquidus is the "black hole" condition of this theory, even though the speed of light never falls quite to zero. It is black because light and matter will simply dissolve as they enter. It is, however, totally unlike the black hole predicted by relativity, in which an elevated event horizon appears and a central singularity exists.

Our black hole has a fuzzy edge but otherwise behaves like a solid object in the field of force generated by the external pressure gradient. This is because impinging primaries cannot penetrate and are reflected back. In the external fluid, where primaries are well-separated, pair-collisions result in the partners passing through one another without change of momentum in their directions of incident motion. Transverse scatter occurs with both moving in the same direction and this effect is responsible for breeding. However, the net negative pressure does not cause the positive primaries to move toward increased density: only the filaments or our black holes are accelerated in this direction.

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In a companion publication¹⁶, under preparation, it is shown how focused quantum waves can produce the required density increases for sub-atomic particle formation: as the new black holes.

What this analysis shows is that gravity could be produced entirely as a result of the density gradients of the *i*-ther acting as a negative buoyancy force. There seems no need of any supplementary force produced by the hypothetical graviton. There seems no need for the vast mathematical sophistication which has developed over the last sixty years in efforts to integrate general relativity with quantum gravitation.

There are two bonuses from the solution just advanced. Any graviton absorption model would inevitably involve the formation of gravitational shadows. For example, there would be a change in gravity within the shadow of the moon during an eclipse of the Sun. Efforts have been made to detect such shadows but none have been found which exceed the resolution of the apparatus used. Buoyancy forces do not produce shadows. Furthermore absorption models would generate tangential forces on planets. The gravitons would stream out radially from the near-point source of the Sun but the planet is in orbital motion. It will run into the gravitons, just as moving vehicles run into vertically falling raindrops: the latter appear to slant. A tangential force equal to *radial force* $\times v_{orb}/c$ will add energy to the moving planet, causing it to continually gain energy and spiral out of orbit. No such phenomenon has been observed.

4.10 Further Refinements

The formulation presented here was ultimately found not to be exact due to two effects which had not been taken into account. One of these was the space taken up by the primary particles of which the i-ther is composed and the other is more subtle. However, an exact solution was finally obtained using an energy-creating quantum-wave approach. This will be published in a companion volume(16). A mechanism for generating the energy-density gradients of the i-ther is now provided and, even more satisfying, as a by-product of the maintenance of sub-atomic particles. The Novikov equation also now appears as a prediction and also shows the previous formulation accurate to 10^{-8} in fields as strong as those at white dwarf stars. It shows that the density of the i-ther at the surface of the neutron star is about 1.68 times that at the Earth. This is a very small ratio as compared with the relevant matter densities. The matter density of a neutron is about 3×10^{14} that of water.

What is important at present is that Aspden's analysis has already shown that absolute speeds can, after all, be measured. The hope is that the barriers in communication can be overcome so that NASA is made aware of the huge new field of exploration which is now opening. If a Brilliet and Hall interferometer could be flown on every deep space mission the velocity structure of the i-ther could be mapped. It would be particularly interesting to find out if an i-theric vortex was centred on Saturn. No Earth-centred vortex could exist otherwise Brilliet and Hall would not have observed their "anomaly". It follows that a critical mass for vortex formation must exist and Saturn might exceed criticality.

If the first orbital flight also carried a Michelson Morley apparatus and gave a confirmatory result then there could be no Lorentz contraction, as required by special relativity. The more advanced apparatus depends on an asymmetry of reflection at a mirror, caused by absolute motion, and this is not affected by the Lorentz contraction.

Finally a pair of mutually perpendicular quartz crystal vibrators need to be tested in orbit to detect the predictions given here for anisotropy of vibrational frequency caused by absolute motion. This apparatus would weigh only a few grams. So three new experiments have arisen as spin-off from the analysis. There are others but they will not be considered here.

5.0 Conclusion

A long-held view, that Newtonian mechanics has been permanently overturned by Einstein's relativity theories, was shown to be a misconception: the predictions of both special and general relativity can be paralleled when Newtonian mechanics is sufficiently refined. This does not mean the idea of time dilation is supported. Instead equivalent frequency shifts, caused by either high speed motion or change in gravitational potential, are produced in a universal time frame. These effects are caused by changes of inertial mass.

The latter is the sum of rest and kinetic masses but the equivalence with total energy is limited. This is because, although $E = mc^2$ is derived from purely Newtonian principles, c increases with gravitational potential.

Then the inertial mass of an object becomes a variable even when its total energy remains constant. This showed mass to be only a **property** of energy which controls dynamical behaviour. Total energy alone, probably entirely kinetic in the ultimate analysis, turned out to be the only true constructional substance of space, (the i-ther) matter and motion.

Used to explore the meaning of "potential energy", the new approach proved that the rest-energy of an object is unaffected by changes of potential as it moves in any field of force, nuclear, electromagnetic, or gravitational. This meant that another misconception was highlighted: binding energies cannot be equated to changes in rest-mass or rest-energy.

These paradigm-shifting changes need critical appraisal because they appear to solve the major difficulties of producing a satisfactory theory of quantum gravitation. This is important because general relativity is recognised by theorists to be incompatible with quantum theory. The new approach led straight to a quantum solution which needed no gravitons. This meant it predicted a complete absence of gravitational shadows. It was also fully consistent with the existence of a background compressible fluid medium, as required for explaining certain so-called anomalous phenomena. The latter are considered elsewhere (6,7,8,10&11).

Finally three new experiments in orbit were proposed. Two of them would use proven interferometers, one having already detected absolute speeds. They could open up a whole new field of space exploration which might dwarf, in scientific importance, anything yet attempted by NASA.

6.0 Acknowledgements

The contributions of the late mathematician and ardent relativist John William Robert Day M.Sc. proved invaluable: he became a most valued critic. His first letter, dated May 13, 1993, gave in a few lines, a solution for the perihelion advance derived from my basic equations. He had obtained these from my book(6) which effectively gave the same solution but had involved many pages of algebra.

Mostly his efforts were directed to turning me into a relativity convert: to turn the theory into some kind of relativity/Newtonian hybrid. This was fiercely resisted. However, his critiques triggered new insights as recorded in the above text.

The author is also indebted to Michael Roll, who heads "The Campaign For Philosophical Freedom", and to his many supporters for their untiring efforts in helping break through the barriers preventing communication.

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The Campaign for Philosophical Freedom

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based on the work given here. The quantum waves produce the required i-
theric density gradients after being first focused to produce the sub-atomic
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Dynamics" of the i-ther.
All is created by the background mind of i-ther (intelligent ether) which
spontaneously forms from a filamentous structure described by the
mathematical model. This theory of everything predicts the survival of
consciousness after death and so supports the totally convincing experimental
evidence now available.