A New Electrodynamics of Moving Bodies

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Abstract

A re-examination of physics from Maxwell to Einstein leads to a new unified theory of electricity, magnetism, inertia and gravity in which gravitational potential slow clocks, and motion at near light speeds produces real causal effects of increases in mass and slowing of clocks. The magnetic field is seen as a real entity having energy density, directional properties, position, and motion. Light travels at a constant speed relative to a local background created by the presence of the electric fields of all charged particles and is a weighted average of their velocities. Space and time are regarded as Newtonian; time dependent processes slow and photons are acted upon by gravity curving their path. Magnetic fields draw their energy from work done altering the motion of charges involved in their generation and magnetic forces result from the exchange of energy. Inertia is thus explained as an electromagnetic phenomenon. Electric fields are 4 dimensional with potential as the fourth dimension and gravity is a by-product of the distortion of space by their combined internal stress.

Introduction

Retired form teaching mathematics at 46 through stress, overwork and a political system wanting to reduce teacher numbers, I returned to the study of physics, the subject I had graduated in 1968. The first shock was that modern physics had progressed way beyond the limits of my degree course. The second was that important areas no longer seemed to make sense while others simply were not believable. I came to the conclusion that something had gone wrong with the development of physics in the period Maxwell to Einstein. That the transition from Maxwell's equations based on the fluid mechanics of the aether, to Einstein’s tensor description of the electromagnetic field had gone wrong.

Time and time again, I had to throw away old concepts and form new ones. What has emerged is a new understanding of the way in which matter is constructed and interacts. Everything is governed by the very simple laws of electric and magnetic fields and their interaction. Nature is unable to do difficult mathematics. She is limited to simple geometry and iterative processes. Nature does not know that the earth has an elliptical orbit, she only knows how to get it from one point to next infinitely close point along its path. In inventing the calculus and deriving the equation of an ellipse, Newton goes beyond nature, but is justified because he is only mimicking nature. The difference being that Newton's solution includes a historical record of the past path of the orbit. Nature is unaware of this knowing only what is happening now. In mathematics, we can define and do anything, but in physics, we may only use mathematics where we understand its one to one correspondence with the way in which nature actually performs the task. Understanding this, we no longer fall prey to the theorist who uses mathematics in the way a priest uses robes and ceremony.

Everything in this paper is backed by sound mathematical derivations which use a lot of vector calculus, much in curvilinear co-ordinates. Space does not permit its inclusion, but it is all published on my web site and referenced in this paper.

New concepts take a long time to form. Conveying them to others is not quite as time consuming, but the reader will need to spend some time acquiring the concepts before the simplicity and beauty of these theories becomes apparent.

I hope the reader has noted the similarity between the title of this paper and that of Einstein 1905d.

Magnetism

Maxwell derived his equations on the assumption that electric and magnetic fields are stationary in the aether. They move through the aether by a process of decay behind, energy transmission and building in front. While this is no longer taught, it lies at the heart of our interpretation of the way in which electromagnetic radiation is transmitted and lingers on in the Poynting vectors of energy transfer and electromagnetic momentum. The crunch point for Einstein was that different processes were required to account for the e.m.f. in a wire when moved in relation to a magnet, than when the magnet was moved in relation to the wire. Einstein's solution was to emasculate the magnetic field and rob it of its substance. Several authors have derived Electromagnetics from static electric theory and special relativity claiming that the Lorentz force between any pair of charges can be accounted for by transforming the electric field of one form its rest frame to the rest frame of the other. This appears to work well in certain contrived situations, but the same methods applied to a simplified model of the television tube and its field coils fails. Indeed, an uncharged block of copper with its conduction band electrons in random motion with a Dirac distribution should, according to these methods exert a magnetic force on a passing electron. Forces on moving charges can only be correctly calculated under SR by first transforming the fields of the conduction band electrons to the rest frame of the magnetic field, in which they are summed to find the electric and magnetic fields. With zero electric field, the magnetic field may than be transformed to the rest frame of a passing electron to determine the resulting force. This process involves identifying and using a privileged frame, but the non existence of privileged frames is one of the axioms on which relativity is based.

Indeed the SR derivation of the magnetic effect seen in the force between two parallel conductors carrying currents is a mathematical fiddle. From their rest frame the electrons of one current are said to see the lattice of the other conductor Lorentz contracted which results in a higher charge density than that of the co-moving electrons of the other current. This results in an attractive force which we explain from the reference frame of the wires as the result of a magnetic field. The problem with this is that real conduction band electrons are constantly suffering changes in their motion due to collisions. At each change in velocity their position in any reference frame is the same as the position in that frame of the lattice ion with which they have collided. Thus the conduction band electrons and the lattice ions will always have the same charge density as viewed from any particular frame.

A more satisfactory solution is afforded by the hypothesis that the electric fields of electrons, up quarks, and down quarks all coexist in space and that their motion through one another generates magnetic intensity $\vec{H}$ (microscopic). In effect, the myriad of electric fields creates a local background presence against which the motion of an individual charge generates magnetic intensity $\vec{H}_i = \vec{v}_i \wedge \vec{D}_i$. That the individual $\vec{H}_i$ sum and magnetic fields form in space according to $\vec{B} = \mu_0 \sum \vec{H}_i$ subject to limitations of continuity of $\vec{B}$ and rate of formation. The substance of a magnetic field should be thought of as its energy content, not its flux.

We define the vector quantity: $\vec{Q}_m = \frac{1}{2}\left(\vec{B} \cdot \vec{H}\right)\hat{B}$ as the magnetic energy density vector and its scalar Q_m and use the phrase "magnetic energy density flux" to describe the substance of the magnetic field. On performing the expansion:

$$Q_m = \tfrac{1}{2}\vec{B} \cdot \vec{H} = \tfrac{1}{2}\vec{B} \cdot \Sigma\, \vec{H}_i = \Sigma\, \tfrac{1}{2}\vec{B}_i \cdot \vec{H}_i$$

we see that the energy density of a volume element of the magnetic field is the sum of the contributions of all the individual charges. The motion of most charges is such that the changes in their contribution to the magnetic intensity are too quick to allow for any energy exchange. We can partition the set of all charges into those involved in local electric currents and those responsible for the magnetic properties of local materials. (We must include with each conduction band electron, the $+e$ of a corresponding lattice ion.) I have in this way accounted for the behaviour of an inductance with magnetic core and air gap showing that Faraday's law applies. (Though, note that $\vec{H}$ is the microscopic magnetic intensity, not the magnetic intensity calculated

from the current threading the magnetic circuit.)

Inertia

The real significance comes from looking (in our imagination) closely at the magnetic field in the region of space surrounding a moving charge. Here its magnetic intensity dominates and the local magnetic field is almost entirely due to the motion of the charge. This field contains energy and it is a simple matter to sum this and show that the energy corresponds to the kinetic energy of the charge if the charge has a certain finite radius $r_0 = \frac{\mu_0 q^2}{6 \pi m}$. This result was known to Lorentz, but his model of the electron was unable to satisfactorily explain the increase in mass as the velocity of light is approached. Lorentz assumed that the electron and its $\vec{D}$ field suffer Lorentz contractions, but had to introduce a fiddle factor in the form of internal energy which was said to alter resulting in no change in the total electric energy. I have been able to correct this by noting that Lorentz's derivation of the contraction applies to electric potential. By assuming that the relationship between $\vec{D}$ and $\vec{E}$ is broken as $\vec{D}$, the surface of the electron and the equipotential surfaces of its electric field suffer Lorentz contractions, we find that the energy content of the electric field remains constant while the energy content of the magnetic field is increased by a factor γ(as seen from the stationary system). We can calculate the inertial force from energy considerations for linear acceleration.

$$Q_e = \frac{1}{2}\begin{pmatrix} D_x \\ \gamma D_y \\ \gamma D_z \end{pmatrix} \cdot \begin{pmatrix} \gamma E_x \\ E_y \\ E_z \end{pmatrix} \qquad Q_m = \frac{1}{2\mu_0}\begin{pmatrix} v \\ 0 \\ 0 \end{pmatrix} \wedge \begin{pmatrix} D_x \\ \gamma D_y \\ \gamma D_z \end{pmatrix}^2$$

$$\mathscr{E}_m = \int \frac{1}{\gamma} Q_m \, d\tau$$

We can account for the inertial force if we further assume that magnetic energy generated by the motion of a charge moves to and from the charge parallel to its electric field. From a surface element, we imagine a conic tubule projected outwards parallel to the electric field and calculate changes in the magnetic energy content of the tubule. Knowing the energy density at the surface of the charge, we can calculate a velocity with which magnetic energy density flux moves into or out of the surface element. Using this velocity and the value of $\vec{B}$ we can calculate the electric field generated (By Faraday's law) and the force on the surface element. Integrating over the whole charge gives the correct inertial force.

The generation of inertial force in response to centripetal acceleration is harder to account for, but we can do so by making further assumptions about the nature of magnetic fields. By assuming that the directional property of magnetic energy flux can only be altered by adding or subtracting energy density flux with a perpendicular directional property, we find that the rotation of the magnetic field must involve the movement of magnetic energy both into some regions and out of other regions of the charge's surface. Calculating the electric field felt by the surface elements and integrating then yields the correct result.

$$\vec{F} = \frac{\mu_0 q^2}{16 \pi^2 r_0} \gamma \int_0^{2\pi} \int_0^{\pi} \hat{r} \wedge \left(\begin{pmatrix} \gamma^2 a_x \\ a_y \\ a_z \end{pmatrix} \wedge \hat{r} \right) \sin\theta \; d\theta \; d\phi$$

$$= -\frac{\mu_0 q^2}{6 \pi r_0} \gamma \begin{pmatrix} \gamma^2 a_x \\ a_y \\ a_z \end{pmatrix}$$

The presence of a background

If the kinetic energy of an electron is contained in the magnetic field generated by its motion, we are left

wondering whether or not the velocity of the electron is an absolute quantity to be measured against some background. Special Relativity, without Lorentz's fiddle or my solution is faced with a predicted increase in the energy content of the electric field. By careful definition of the transforms for electric and magnetic fields, the two changes are equal and a Lorentz invariant quantity can be defined by subtracting magnetic energy density from electric energy density. Very neat, but is it believable. Less believable is the presence of an all pervading aether. When Einstein's 1905 paper was published, aether theory was in disarray.

The principle of superposition is used to justify the mathematical treatment of $\vec{E}_1$ and $\vec{E}_2$ as separate entities while also maintaining that in fact only $\vec{E} = \vec{E}_1 + \vec{E}_2$ exists. This is necessary because the energy density of the electric field is given by $Q_e = \frac{1}{2}\varepsilon_0 E^2$ and $(\vec{E})^2 = (\vec{E}_1 + \vec{E}_2)^2 \neq (\vec{E}_1)^2 + (\vec{E}_2)^2$. However, the magnetic field surrounding a solenoid is perfectly accounted for by assuming that it is generated by the motion of the electric fields of the conduction band electrons and their respective lattice ions in the surrounding region. This would seem to be prima face evidence that the electric fields have individual existence. We therefore describe the principle of superimposition as the assertion that the electric fields of all charges have separate existence and coexist in space.

It seems unreasonable that the actual inertial mass of an object should depend on the number of charged particles in the universe. So while crediting the presence of their fields with providing a background against which the motion of individual charges generates magnetic intensity, we assume that this presence expresses itself as a weighted average of their velocities. This allows any observer to calculate a vector quantity which we I call "stasis". Subtracting this vector from velocities measured by the observer renders them into a locally absolute form.

There are three candidates for the weighting factor: energy density, electric field strength and electric potential. For a long time, I considered electric field strength to be the correct factor giving an inverse square law by which to weight the velocities. This allows the earth to dominate "stasis" and gives an alternative reason for the null results of Michelson Morley type experiments. Indeed, the Brillet and Hall experiment recorded a persistent anomaly which could well be due to the predicted stasis vector at the earth’s surface which is 16 m/s back along the earth's orbit plus half the surface speed due to rotation. However, there is one big problem.

If the earth can dominate local stasis and if kinetic energy is generated by velocity through stasis, then it cannot possess kinetic energy due to its velocity around the sun. The problem is even more acute when we consider an approaching space craft which would find that its kinetic changes as it moved into the earth's influence. I am just not satisfied with any of the possible solutions to this problem which I have hypothesised. On the other hand, if electric potential is the weighting factor, then the earth has little influence compared to the sun. But then the galactic core has 6 times the influence of the sun. With estimates of a total galactic mass including dark matter of as much as 10^{12} solar masses, it is not hard to realise that local effects can be neglected under this scenario.

The fabric of space

Maxwell showed us the vacuum of space is not empty, but has the physical properties of permittivity and permeability. Q.E.D. sees the vacuum as a seething caldron of particles, anti particles and photons able to burst in temporary existence through the generosity of the uncertainty principle. I struggle to make some sense of something which I believe to beyond total comprehension.

The best analogy I can find for the nature of space comes from the chemistry experiment to produce a polymer in the production of synthetic fibres. The reaction takes place at the interface of two liquids and the polymer is drawn off. Space has a property like that which enables energy to be deposited or stored in an electric field. Once formed, the electric field, like the strand of fibre, has an existence of its own. Unlike the fibre, an electric field has more than three dimensions. The phenomena we call electric polarisation is the extension into our R3 world of an at least four dimensional reality with electric potential as the fourth dimension. We know from the behaviour of dielectrics that electric polarisation exerts an internal tension on the dielectric. Does space have some property equivalent to the rigidity of the dielectric which prevents it being crushed by the internal tension of the electric fields which pervade it. The assumption that it does leads

to a simple unified theory of electrostatics and gravity.

I use the phase "fabric of space" to sum up these properties of permittivity, permeability and rigidity which the vacuum seems to possess.

Einstein's special relativity

One of my main reasons for adopting a stasis theory based on electric field strength as a weighting factor was that it explained the null result of the Michelson Morley experiment and negated the need for Einstein's relativity. Since, then I have spent a lot of time studying and arguing about relativity.

In presenting relativity as Einstein's great discovery, few teachers and authors give the historical context. Lorentz had by a simple combination of one of Maxwell's equations and Poisons equation for electric fields deduced the Lorentz contraction in a few lines. From this, the Lorentz transforms follow. Lorentz believed the transforms to apply only to a transform from the aether to the laboratory, but Poincare had shown that the Lorentz transforms could also be applied to transforming between the observations of observers moving at different velocities through the aether. There is no indication in Lorentz's 1906 lectures on the theory of electrons that he had heard of Poincare's work. The historian Whittaker is at pains to describe "The relativity of Poincare and Lorentz" limiting Einstein's achievement to discovering the relativistic transverse Doppler effect and bringing the theory to public notice. Poincare was a prodigious producer of papers which were mostly too far ahead of his contemporaries to be appreciated at the time of publication. The relativity of Lorentz and Poincare failed to be recognised and is not taught, but while sharing the same equations, it is fundamentally different from Einstein's relativity.

According to Einstein, length contraction, mass increase and time dilation are not physical effects, but the result of the effect of relative motion on observation. According to Lorentz, length contraction, mass increase and the slowing of clocks are real physical effects caused by motion through the aether. The twins paradox of Einstein's relativity is irrelevant to Lorentz Poincare relativity. The twin who travels finds his space craft and biological clocks slowed by his motion through the aether.

To understand Einstein's relativity, we have to understand that, on the whole, it is taught by people who do not understand it, but believe that accepting the resulting paradoxes is the supreme sign of intelligence. What is presented is not science, but doctrine. This is not to say that some good science does not lie at the heart of Einstein's work, but that it is generally lost in the presentation. I will now explain the theory of special relativity in one paragraph:

We take it as an experimental fact that the speed of light from a point to a mirror and back is always measured to be same. We also note that observations of binary stars show variations in brightness and Doppler shifts of spectral lines which can only be observed over such a distance if light travels through space at a constant speed independent of the speed of the star which emitted it. We simply cannot tell whether or not these facts add up to a universal speed of light, but the solution of Maxwell's equations predicts the transmission of radio waves at a universal speed. It might seem reasonable to time light over a one way journey and find its speed in both directions. Indeed this was the first method ever used explaining the variation in time of eclipses of Jupiter's moons. Unfortunately, we need a distance that can be accurately measured and two clocks at either end which are perfectly synchronised. Moving clocks affects their time keeping and we are left with no way of arranging for two synchronised clocks at either end of the measured path to the required degree of accuracy. Faced with this situation Einstein says two things. First, we have no choice but to synchronise the clocks by timing a light pulse over a there and back distance, halving the time taken and using that to synchronise the clocks. Secondly, that he is of the opinion that God would be rather pleased about the speed of light and want all observers to get the same answer. This is Einstein's method of clock synchronisation. Once we adopt it, the consequences are that our relative motion against some undeterminable background in which light actually travels at a constant speed distorts the synchronisation of our clocks. Two observers in relative motion to each other will not be able to agree about synchronisation. When they try to measure objects and times, they get different answers. But all is not lost because the

Lorentz transforms allow them to compare their records of the time and position of events.

Critics of SR should note that this is a perfectly correct scientific procedure and the resulting theory is true in the sense that it does allow observes moving relative to one another to explain discrepancies in their measurements of time and place of events. Where Einstein and his followers deviate from good science is in making the claim that the universe works in this way.

Most presentations of relativity start with the constancy of the speed of light as an act of faith. The second act of faith is the claim that all observers have equal status. This is a denial that any background such as an aether might exist. In SR, there is no special reference frame in which the speed of light is actually constant. Indeed, if we consider two binary stars one moving away from the earth and the other towards it. According to SR, photons from each star travel at the speed of light in the reference frame which their star occupied at the moment of their emission. But due to the nature of space time, whatever frame those photons are observed from, they are seen to travel at the same speed. Presenters of SR explain that this is so because any speed added to or subtracted from the speed of light still gives the speed of light as the answer. Critics will argue that this contradicts Einstein's own use of $c + v$ and $c - v$ in 1905d.

All these theoretical results and the objections raised against them are just a side show and fail to address either the meaning of relativity or the problems posed by that theory.

The first and deepest problem relates to the nature of time. SR and GR claim the existence of a four dimensional space time continuum saying that the division of it into R3 + time depends on an observers state of motion. This differs from the view inherited from the Greek philosophers which regarded the universe as being in a state of now, its past existing only as memory and record with its future yet to exist. We do need to modify this definition slightly to overcome the problem they had with the flight of an arrow by conceding that "now" has an infinitesimal duration in which the arrow may move an infinitesimal distance. While numerous science fiction writers may promote the idea that time is an extended dimension and time travel possible, all experience points in the other direction. The later philosophical arguments about causality and the ordering of events which were taken up by relativity are simply irrelevant to a universe which functions though moment by moment causality at a point. The emission of a photon by one atom and its passage to another where it is adsorbed hold no mystery. It is just part of the action of a 3 Dimensional universe in a state of flux.

The second problem is its treatment of magnetic fields which I have already discussed above.

The third problem relates to synchronisation. If there is no background and all motion is relative, then the Lorentz contraction is just an artefact of Einstein synchronisation. Under these condition, two reference frames in relative motion beat out a universally synchronised Newtonian time as unit grid lines pass one another. This can be used to calibrate and synchronise clocks. Within one of the frames, the one way speed of light can then be measured in each direction giving Einstein's $c + v$ and $c - v$ of 1905d. This then gives the velocity of that reference frame relative to the background. This constitutes a proof by reduction ad absurdum that there must be a background through which the speed of light is constant. The interesting point is that a Lorentz Poincare relativity with real Lorentz contractions makes it impossible to establish Newtonian synchronisation. Never the less, Newtonian time and Euclidean space are the mathematical frameworks against which the universe must be described. Clocks run slow and the paths of photons are bent by gravity against this framework.

Charges and electric fields

One of the great problems of natural philosophy is explaining action at a distance. The forces of electricity, magnetism and gravity seem to defy the everyday experience that it is impossible to move an object without pushing it with a stick, pulling it with a string or going over to it and touching it. Feynman has tried to

answer this problem with Q.E.D. in which the electron sends out a quantum wave which travels through space. Whenever the quantum wave meets another charge, that charge sends a reply backwards in time to the electron conveying information about distance and direction. (Note, I use the words electron and charge simply to distinguish between two charges.) The electron then calculates the energy content of a virtual photon which can be borrowed under the uncertainty principle and sends the photon out. The charge receiving the virtual photon must send it straight back, first sending out a quantum wave to find out where the electron will have moved to. The electron on receiving this sends a reply backwards through time and the charge receives the information about the direction in which it must send the photon back. It then sends the photon back. The electron receives the returned virtual photon and pays back the energy just in time to satisfy the uncertainty principle. To get really accurate answers, Feynman has to consider probabilities of his virtual photons splitting in two, three, etc. on route. He said that it takes five years to train a graduate how to do the maths.

Lacking five years training, my first humble calculations showed that the wave length of the virtual photon has to be four times the distance between the electron and the charge. I am still trying to imagine what a photon one quarter of a wave length long looks like! I notice the text books always show photons with 4 or 5 phases in their Feynman diagrams. When I think about an electron belonging to the surface charge on a capacitor plate, I am also quite at a loss to understand how the electron can do all the paperwork needed to keep track of all the transactions it must be performing at any one moment. (Good physicists will have noted that my calculation is wrong. I should have used $\bar{h}$ instead of h, so I should have said “four pi times the distance between the electron and the charge”. I am still trying to imagine what a photon one twelfth of a wave length long looks like!” If the reader did not spot this, then it serves to illustrate my point that we accept these theories without really thinking about them.)

I think the problem comes from the fact that before ever Thompson discovered the electron, the theory of a charged metal sphere in a dielectric medium was well established. This meant that the concept of a localised charge and the response of the surrounding medium was already in the mind. It would appear that an electric field in a vacuum polarises space in the same way that a dielectric is polarised. If space is polarised in a spherical pattern, the polarisation cannot extend to a central point because that would involve infinite energy, field strength and polarisation. It must terminate at a surface which is in effect a raw edge of the polarisation. This raw edge is a "displacement charge". There is no need to conceive some object inside this with mass and charge. The electric field by itself has these properties. The electric field is an extended entity reaching towards infinity. When we consider an electron and a charge, The electron is in fact an electric field which exists everywhere including the region in which the centre of the charge resides. The "displacement charge" on the inner raw edge of the polarisation of the charge sits within the polarisation of the electron's field and consequently feels a force exerted on it.

There is no unexplained action at a distance, just a local action resulting in a force on the inner surface of the charge. In fact the charge sits in the polarisation fields of a myriad of other charges and each exerts a force on it. These forces add vectorially. In this model, nature only uses two geometrical actions to make her calculations. The first is the geometry of the expanding sphere in which flux density follows an inverse square law and the second is the vector addition of forces at a point.

I call this the "Pure Charge Model". By setting the charge and inner radius, it is possible to model electrons, up quarks and down quarks.

The beauty and appeal of this model is that it is so simple, but there are drawbacks. The most obvious is that a single electron moving alone through space cannot possess a magnetic moment. We must question whether or not any of the current experimental determinations of electron spin actually meet this criterion. For instance, the Stern-Gerlach experiment with silver atoms most certainly looks at an orbital magnetic moment. One very good argument against the electron having such a high intrinsic magnetic moment is the fact that magnetic dipoles attract one another with an inverse fourth power law. There is a critical distance which if another dipole comes within, all other forces are overcome and the two must collide.

On the plus side is the fact that the electric field radiates outward from each surface element and does not meet any other surface element so that there is no self energy stored in the charge by virtue of its being confined to a small region. This overcomes another problem with the metal sphere model of the electron in which its self energy can be accounted for in either the polarisation of its field, or in its self proximity. This has previously been dealt with by ignoring the obvious conclusion that it must reside in both and be twice its true value.

Moving charges

One of the myths of physics is that the electric field at a point P of a moving charge comes not from the charge, but from the point O occupied by the charge a time $\frac{OP}{c}$ ago. Those willing to wade through 5 pages of Lienard-Wiechert potential calculations only then discover that the sum of the retarded field and the electric field of the accompanying electromagnetic disturbance is indeed a radial field pointing to the current position of the charge. Jackson produced the same result through Lorentz transforms in fewer pages. The myth comes from a Maxwellian concept of fields that are stationary in the aether and require energy to be radiated at the speed of light to move the field through the aether.

The "pure charge" I have described has none of these problems. It is simply an electric field terminating at an inner surface of charge. The whole thing has mass, but that mass is located in its surface where the inertial force is generated. Away from the surface, the electric field which is the extended presence of the charge has no mass and cannot resist acceleration. The electric field moves with the charge.

Now classical theory has always maintained that acceleration of a charge radiates energy. The fact that vast numbers of electrons happily orbit their atoms suffering vast centripetal accelerations without radiating energy failed to dispel this view. When a pure charge suffers acceleration, changes occur in the magnetic field generated by its motion. These changes require that magnetic energy moves within the electric field towards or away from the charge. For a single electron in deep space, the velocity with which the magnetic energy must move is proportional to the distance from the charge. (Although it also depends on the angular position relative to the line of motion.) At a critical distance from the charge, the velocity reaches the speed of light and the moving magnetic flux generates its own electric field and becomes electromagnetic radiation. However, the charges we are familiar with do not have magnetic fields reaching out towards infinity. Their magnetic fields are only distinct close to them. Moving away from the charge, its magnetic field is lost in the pervading terrestrial magnetic field, if not in some local stronger field. This means that only under condition of very violent acceleration will it radiate energy. Antenna theory remains unaltered because it involves the co-ordinated acceleration of vast numbers of electrons and the magnetic field generated by their combined motion. For an electron bound to an atom, the critical distance is much less because of the strength of the atoms internal magnetic fields.

Into the atom

The astute reader will have guessed that the one issue over which I do agree with Einstein is his distaste for quantum theory. When respectable scientists start talking about un-dead cats, alternative universes and quantum waves that go backwards in time; something is wrong.

I think it best to say that Bohr needed two tools which were not available: chaos theory and super computers. Without these, he was forced to assume that the individual electrons of an atom could not "see" each other and were only affected by each others time averaged electric fields. Quantum theory is best understood as being equivalent to statistical thermodynamics which avoids the problem of individual atomic motion and obtains results for a volume of gas. So it is not to be disregarded as a tool for making predictions, but neither should it be thought of as a description of the way in which nature works. The uncertainty principle applies to the act of observing the position of an electron, but the electrons of an atom do not need us to bounce photons off them so that we can tell them where they are. They sit in each others electric fields and experience

electrostatic forces which do not require them to know each others positions.

Oddly enough, Einstein's expression of his objections "God does not play dice" has been proved wrong by chaos theory.

The thing to appreciate about the pure charge theory is that while the laws remain very simple and consistent, at different scales, they have different effects. At one scale, we investigate terrestrial magnetism and the passage of radio waves. At another scale, we find the individual charge surrounded by a magnetic field containing its kinetic energy. We have not yet looked at an intermediate scale, at an atom of gas in a vapour discharge lamp giving off the spectral lines which gave the first clues to atomic structure.

It is not fair to expect a replacement for quantum theory at this early stage in the life of a theory which has received only a thousand or so man hours of work, but the vital ingredients are beginning to come together. I have described how we can account for the behaviour of an inductance. The individual behaviour of myriad conduction band electrons in a dance of energy exchange gives life to the magnetic field. If we consider the motion of a single electron, every change in its motion alters its contribution to the magnetic intensity of the field and its contribution to the energy of the magnetic field. This produces flows of magnetic energy to and from the charge all the time generating forces resisting any change in its motion. But the contribution of energy from each charge is affected by the motion of the other charges. When the i th electron changes its motion, there is a change in the contributions of all the other n electrons and forces are generated to try to change their motion so as to compensate for the change in motion of i th electron. These forces are of the order of $\frac{1}{n}$ of the magnitude of the force on the i th electron. This is the microscopic view of the phenomena we call inductance.

Now apply this to the motion of the electrons of an atom. We have a small set of electrons moving at very high velocity and we have some as yet undetermined magnetic field at the atomic scale. The interactions we have described in the previous paragraph still occur, but now scale and numbers come into the equation. The atom is an inductance maintaining the motion of its electrons so as to sustain its magnetic field structure. The forces exerted on the electrons by the exchange of magnetic energy are now much greater. This is the missing piece of the jigsaw needed for a quantum chaos model of the atom.

I would suggest that the starting point for developing the theory should not be the atom, but the three quark model of the nucleon. The process will not be easy. Chaos theory requires us to start with many different sets of initial conditions and follow the motion of the quarks by iteration. But calculating the magnetic forces for each iteration will be a considerable exercise. Having developed the techniques in this simple 3 body system, it should then be possible to apply them to the atom. Hopefully, the stable sates which emerge from the chaos theory will correspond to the allowed states of quantum mechanics.

Gravity

Another myth of physics is that gravitational mass and inertial mass are the same thing. Since we use a constant of proportionality in the equation for gravitational attraction, the requirement is simply that they be in the same ratio for electrons, up quarks and down quarks. Since the inertial mass of a pure charge is proportional to the energy content of its electric field, it is sufficient to achieve this and its gravitational mass is proportional to the energy content of its electric field. Thanks to the geometry of spherical symmetry of the electric field of a charge, this is the same as the electric potential of the surface of the charge.

The three quark model of the nucleon is the key to an understanding of how gravity is a by-product of the electrical properties of matter. The problem was insoluble before this model was accepted. That Einstein managed to produce a theory of gravity so long before this discovery is to his great credit.

It is very simple to model the principle by which gravity works in a two dimension mechanical system. We imagine a room with a rigid concrete floor and a ceiling hung on bendable wooden beams. We fix two smooth parallel rails to floor and ceiling, one above the other. Then stretch two strong springs between smooth sliders on the rails. The ceiling distorts. The two distortion patterns are additive and each gives the gradient of the top rail in the region of the other spring's fixing point a slope towards itself. This gives the tension in each spring at the ceiling a component pulling the springs together. Since the small distortions involved cause only a very small change in the tension of the spring, the distortion is proportional to changes in potential energy. Analysis shows that when energy is stored in a spring by stretching it between the two rails, an amount of energy is stored in the distortion of the structure on which the rails are mounted. The energy stored in the spring is less than what it would be in a rigid system by twice this amount. The difference is available to do work moving the springs towards each other.

It follows that we can use this principle to model three dimensional gravitational fields if gravity is a four dimensional phenomena. All the visualisation we need to understand this has already been described many times in the general theory of relativity. But we have another model of such a system in the electric field of a charge. We can account for electric force as due to the gradient of its scalar potential and we represent this by two dimensional diagrams very similar to the model described above. The final clue comes from the behaviour of a charged parallel plate capacitor when we vary the distance between the plates. An electrostatic voltmeter connected across the plates will show the voltage varying as the distance between the plates. This is no longer a theory about a mathematical artefact, it is a real phenomena. Microscopic examination of the plate surfaces and the electric field show nothing changing except the distance between the plates and the recorded voltage. This means that the electric potential is a real part of the structure of a charge's electric field. We must think of the electric field as a four dimensional (R3 + electric potential) entity.

Thinking in terms of the rubber sheet model of gravity, potential is the fourth dimension in which a distortion occurs. Although we, as three dimensional beings, cannot actually understand these things, we can get some idea of what is happening if we see the charge as a deposit of energy stored in an electric polarisation of space. The internal tension of the electric polarisation has to braced against the fabric of space. If that fabric is not infinitely rigid, then we have the four dimensional reality of which the spring and rail model is a 2D analogue.

If we now consider two hydrogen atoms in deep space which are approaching one another. The electrical forces between them sum to zero. However the energy stored in the electric fields of the four component charges of each atom is slightly less than it would be if the fabric of space were perfectly rigid, In addition to the distortion of space caused by one atom's four electric fields, space is also distorted by the proximity of the other atom with its four constituent charges. As they approach, this distortion increases releasing energy from the electric fields of each atom's constituent charges. This energy does work on the atoms accelerating them towards each other. This is gravity; but how does it work?

Attempts to model this action on the assumption that R3 space is distorted fail. At best a gravitational force proportion to the sum of mod(charge) is derived. It is only when we assume that the distortion is in the fourth dimension that the answer pops out. We have to consider each volume element of a charge's electric field separately and determine the energy changes in it. Then when we integrate over the volume of the electric field we get a result proportional to the total energy of the electric field. This gives us the correct dependence on electric potential at the charge surface.

One two dimensional picture of this model of gravity is like a very long wooden plank on a flat floor. We mark of a section to represent the earth and attach thousands of elastic threads to it lifting it from the floor. We now get an upside down representation of the potential diagram. If instead, we used a slinky spring, each elastic thread would lift only a few coils from the floor and instead of a smooth curve, we would have a flat line with many spikes. For the gravity model to work, space has to have a form of rigidity equivalent to the rigidity of the plank. Indeed, it is this rigidity which enables the gravitational influence of the earth to reach

out through space. But the implication of this is that the inverse square law of gravitational attraction may not be readily extendable from its know range of a few centimetres to a fraction of a light year, outwards to infinity and inwards to the infinitesimal.

The behaviour of clocks

That is to say the effect of motion and gravity on the rate of time dependent processes. First let us consider a space craft, accelerating from rest against stasis, with a number of different clocks on board. We have an Einstein light clock, a quarts crystal digital watch, a revolving cylinder mounted with its axis vertical (i.e. in the direction of the acceleration) in a frictionless set up and lastly a mass moving in a straight horizontal (i.e. perpendicular to the direction of the acceleration) line along a frictionless track. Einstein's argument for the light clock holds good, but we need a deeper understanding of the Lorentz contraction to explain the behaviour of the others.

In deriving the inertial force of an accelerating charge, the magnetic field surrounding the moving charge is given by $\vec{B} = \gamma \frac{\mu_0 \vec{v} \wedge \hat{r}}{4 \pi r^2}$ and the energy density is increased by a factor of γ^2. In calculating the energy content of the field, we find that it is contracted in the direction of motion by a factor γ with the net result that the energy content is only increased by a factor of γ. However, within the moving system, this contraction in length is not apparent and the energy content behaves as if it is increased by a factor of γ^2. Thus we find that within the system moving relative to the background "stasis", inertial mass is increased by a factor of γ^2. This is not apparent and cannot be detected without reference to events in the background stationary system because mass can only be measured with reference to other mass using a beam balance, or by its resistance to acceleration which must be measured using a clock. But all clocks, except the light clock, depend on mass for the moderation of their time dependency, so the increase in mass is undetectable. It is only when the observer in the moving system can compare his clock with synchronised clocks in the stationary system that it becomes apparent that his clock has slowed. (At first this seems to contradict the normal assertion that each sees the others clocks to run slow, but that will be the case if the moving observer sets up two Einstein synchronised clocks with which to compare a single clock in the stationary system.) The explanation for the slowing of the moving clock is that mass within the moving system has increased by a factor of γ^2. However, within the moving system, the electric fields of charges are unchanged.

The mass of the quarts crystal is increased by a factor γ^2 while the elasticity remains the same because the Lorentz contractions of $\vec{D}$ and the equipotential surfaces cannot be seen. Thus the angular velocity of the SHM of the crystal is reduced by a factor γ^2 and its period increased by a factor γ.

The spinning cylinder also suffers the mass increase, but no work can be done in increasing its angular kinetic energy. Conservation of energy requires that $\frac{1}{2} I \omega^2$ remains constant and ω^2 be reduced by a factor γ^2. The cylinder's period of rotation is consequently increased by a factor γ. The same argument applies for the sliding mass. No work is done on it which might increase its kinetic energy along the track. Thus v^2 must be reduced by a factor γ^2 and the time period for it to travel unit distance is increased by a factor $\gamma 1 + \frac{\Phi}{c^2}$.

The effect of gravity on clocks has also been accurately observed and Einstein's derived time dilation factor $1 + \frac{\Phi}{c^2}$ shown to be correct. (where Φ is gravitational potential and is negative) Even on earth, this effect is great enough to make atomic clocks sensitive to small changes in height above sea level requiring them to be recalibrated after shipment from the factory. The model of gravitational attraction which we have seen can account for the slowing of clocks by gravitational potential. As a clock is brought from a region of low gravitational potential into a region of higher gravitational potential, energy passes from the electric fields of the electrons and quarks of the clock. Half of that energy goes into the increased distortion of the fabric of space and half is available to do work as the clock descends. This loss of energy reduces the electric potential at the surface of each charge and reduces the strength of its electric field. The inertial mass of material objects is unaffected because the magnetic fields are generated by moving charges depend on their electric charge, not upon their electric field strength. Thus the effect of gravitational potential is to reduce the

strengths of all of the forces which hold matter together and affect the action of one body upon another. This slows all time dependent processes.

The important thing to understand is that the energy change we associate with gravitational potential energy is only half of the energy change within the electric fields of the constituent elementary particles matter is constructed from. So the fractional change in energy is $\frac{\delta \mathscr{E}_e}{\mathscr{E}_e} = \frac{2\,\Phi}{c^2}$. Clock rate is proportional the square root of the force involved in its oscillation and the electric forces are proportional to the electric potential, so the time dilation factor is

$$\frac{t_\Phi}{t_0} = \sqrt{\frac{V}{V_0}} = \sqrt{1 - \frac{\delta \mathscr{E}_e}{\mathscr{E}_e}} = \sqrt{1 + \frac{2\,\Phi}{c^2}} = 1 + \frac{\Phi}{c^2} + \ldots$$

which is the observed effect.

General relativity

We have found that we can easily account for both gravitational forces and the slowing of time dependent processes by gravitational potential. To use Einstein's words, we have shown that the theory of general relativity "is superfluous". It would however not be fitting to dismiss a theory so much used without looking into the reasons why it has worked so well.

Accounting for gravitational force in a mathematical model is really quite a simple matter because gravity obeys an inverse square law of force and a consequent inverse law of potential. Any model which finds a reason to impose either of these conditions will produce a pseudo explanation of gravity. The really hard part is to produce a model which will account for the observed effect of gravitational potential on clocks.

Just as the difference between Lorentz Poincare relativity and Einstein's relativity is one of the reality of the effects, so the difference between my theory of gravity and Einstein's is the nature of the effect. Einstein says that clocks run at different speeds because time runs at different speeds. I say that time remains unchanged, but describe an electromagnetic process by which time dependent processes are slowed. My clocks are slowed by the drain of electric potential energy into gravitational potential energy. Einstein's clocks keep perfect time and measure changes in the space time continuum.

Our starting point should be Einstein's turntable world from which he derives the link between gravity and time. It works by a happy coincidence and has mathematical validity. The first part of this happy coincidence trades elsewhere as the virial theorem. This is a general theorem about energy in systems which when applied to orbital mechanics gives the result that the kinetic energy of an orbiting satellite is equal to half its potential energy.

$$-\frac{G\,M\,m}{2\,r} = \frac{1}{2}\,m\,v^2 - \frac{G\,M\,m}{r} \Rightarrow v^2 = |\Phi|$$

Since the time dilation factor is $\frac{t'}{t} = \sqrt{1 - \frac{v^2}{c^2}} = 1 - \frac{1}{2}\frac{v^2}{c^2} + \ldots$ the connection is obvious and all Einstein needed was to find an interpretation of gravitational potential which would allow the substitution for v^2.

As the turntable rotates with constant angular velocity, we write the centrifugal force as $m\,a = m\,\omega^2\,r$ and note that $v^2 = \omega^2\,r^2$. All that remains is to find a mathematical method of turning r into $\frac{1}{2}\,r^2$ which is accomplished by integrating the centrifugal force from 0 to r. Thus, the happy coincidence is completed. Both the virial theorem and the integration of $r\,dr$ involve the fraction $\frac{1}{2}$.

$$\Phi_T = -\int_0^r \omega^2\,r\,dr = -\frac{1}{2}\,\omega^2\,r^2 = -\frac{1}{2}\,v^2 \Rightarrow v^2 = 2\,\Phi_T$$

$$\frac{t'}{t} = \sqrt{1 + \frac{2\Phi}{c^2}} = 1 + \frac{\Phi}{c^2}$$

The first comment to make is that the transformation from the real situation in which gravitational potential is found by integrating from infinity to one of integrating from the centre of the turntable would not seem so odd to a mathematician versed in projective geometry where an infinite plane is happily mapped onto a finite sphere with the whole of infinity in every direction represented by a single point on the sphere. The second is that although I have set out the argument rather like the thoughts of a student fiddling a result, there is no reason to assume that Einstein was motivated by anything other than naivety.

Understanding of general relativity becomes difficult at the point where Christoffel symbols of the second kind are introduced and the texts jump to the final result. The point to understand is that it is not the mathematics of tensor algebra which we should be questioning, but the nature of space and time. Is time an extended dimension? Since all experience indicates that it is not, and we can explain the existence of gravity and its effect on clocks far more simply, there seems little justification in continuing to promote such a complicated alternative.

Tensors

One of the backbones of relativity is the use of tensors in electromagnetism. Let us start by looking at the electric stress tensor [S]. The concept of a stress tensor comes from the study of the elastic deformation of solids. This is a complicated subject because of the way stresses are transmitted through solids. It is impossible to apply a single stress. Even the simple example of a stretched wire results in lateral compression of the wire as well as longitudinal tension. The bending of a beam supported at its ends causes tension in its underside and compression above, but these are accompanied by shear stress which, because of the nature of torque, occur in both horizontal and vertical planes. The use of a 3 by 3 matrix rather than a vector to represent such complex behaviour is logical. Its extension to electric field theory was justified by belief in a rigid aether with similar physical properties to solid matter. Given that we no longer believe in the existence of an aether, let alone a solid aether, this would seem to be a foolish notion.

To its credit, the electric stress tensor has a successful application. It can be used to calculate forces between systems of charges. If we can construct a boundary separating a system of charges from the rest of the universe, we can find the force exerted on the system by a surface integral of the electric stress tensor operating on the normal unit vector to the surface [T][n]. This works because the integrand includes a term relating to the divergence theorem and therefore sums the net charge within the boundary. However, the matrix product [T][n] does not represent any physical entity or property. It is just a mathematical device.

The assertion that the electromagnetic field tensor [F] is the natural descriptor of the electromagnetic field because of its transformation properties is perhaps not so well founded. The problem lies in the fact that it ascribes define values to the vectors $\vec{B}$ and $\vec{E}$ distributing their components into the matrix. However $\vec{E} = \Sigma \vec{E}_i$ and the individual $\vec{E}_i$ each originate from a different charge with its own state of motion. Each $\vec{E}_i$ requires its own Lorentz transformation to a particular reference frame. What textbook examples do is to use the principles of relitivity in carefully chosen reference frames in such a way as to imitate the classical theory which relativity denies. So that if we take the situation of an electron passing through the centre of the magnetic field generated by Helmholtz coils, classical physics uses Biot Savart to calculate the magnetic field and then assumes that the electron is moving through the field at the given velocity and calculates the force on it. By choosing the reference frame of the Helmholtz coil “for convenience” the author is able to make reference to the principles of relativity to derive the magnetic field and put the components of this into [F]. Then using the transformation $[L][F][L^{-1}]$ he is able to calculate the force on the electron and claim success for relativity and tensor analysis. However, if we point out that the magnetic effect is in fact due to the action of a subset of conduction band electrons with velocities outside of the Dirac distribution sphere and ask him

to account for the action of each of them these by an individual Lorentz transformation and then perform the summation, his results will in no way match the experimental observation.

In fact, we will be lucky if the author is able to recognise the fact that the Lorentz transform only works between co-ordinate systems whose origins are coincident at a mutual time $t = t' = 0$ requiring translations to be performed before and after the rotations.

Gravitational effects on light

We still have to explain the strange behaviour of light in gravitational fields. Einstein's starting point in his analysis of gravity was the work done by photons in climbing through the sun's gravitational field. Newtonian mechanics gave him an expression for the work done and he used this to calculate the gravitational red shift. However, his equivalence principle told him that the same effect would be seen on an accelerating space craft with photons climbing through the apparent gravitational field caused by the acceleration. In this situation, no work can be done by the photon and Einstein concluded that the observed red shift would result from the change in velocity of the space craft in the time the photon took to travel "up" towards the nose of the craft. This argument led him to conclude that time ran faster at the nose of the accelerating space craft than it did at the tail. Arguing continuity of the wave train, he concludes that a red shift will be observed.

This train of argument led Einstein to conclude that time runs slower with increased gravitational potential. The photon is red shifted by its climb through the gravitational field because time runs at different rates. The assumption of continuity of phase ensures that as a continuous radio wave beamed to a satellite and reflected back will appear red shifted on its way up and blue shifted on the return, the counting of phases will be consistent.

Although doctrine states that this situation is equivalent to the Newtonian concept that the photon does work against gravity, classical analysis shows that it does not do any work because the observed frequency loss disappears when we allow for the change in clock rate.

Einstein's great success with the theory of general relativity was his prediction of the bending of light by the sun's gravitational field. Although in his 1911 paper, he derived a bending equal to that predicted by Newtonian theory, he amended this in his 1916 paper to give twice the angle and it was this result which was confirmed.

Having accounted for the gravitational effect on clocks as a real physical effect and nothing to do with time running at different speeds, from a Newtonian point of view, the behaviour of light is strange indeed. It can climb through a gravitational field without doing work, yet is bent twice as much as predicted when passing the sun. It is as if the ratio of its inertial and gravitational masses depends on the direction of its path! This brings us to considering the nature of gravitational mass and gravitational action.

Gravitational mass

Understanding that gravity results from the internal stress of the electric fields of the constituent charges from which gross matter is built, we find that the active gravitational mass depends on the energy content of the fields of the charges. I had assumed that the passive gravitational mass is equal. The main difference between a photon and a charge is that the electric fields of a photon have cylindrical symmetry about its direction of motion while the electric field of a charge has spherical symmetry. If gravitational action on the internal tension of an electric field depended on the direction of the electric field relative to the gravitational field, then photons might well behave in an odd fashion. Since the internal tension, like the energy density, depends on $\vec{E}^2$, we assume that its components depend upon $(E\cos\theta)^2$ and $(E\cos\theta)^2$ resolving into cos^2 and sin^2 components.

If the gravitational field acts on the component of energy density in its direction, and is equal to some constant *k* multiplied by the internal tension, then:

$$\delta F \;=\; k\, Q_e \cos^2\theta\, \delta\tau$$

This quantity $k\,\vec{Q}_e \sin^2\theta$ is a force per unit volume, and one might wonder what this has to do with the internal tension of the electric field which is surely force per unit area. The answer is that *k* has the dimensions [L^{-1}] because it is derived from $\frac{g}{c^2}$. The total force may be found by integrating over the field.

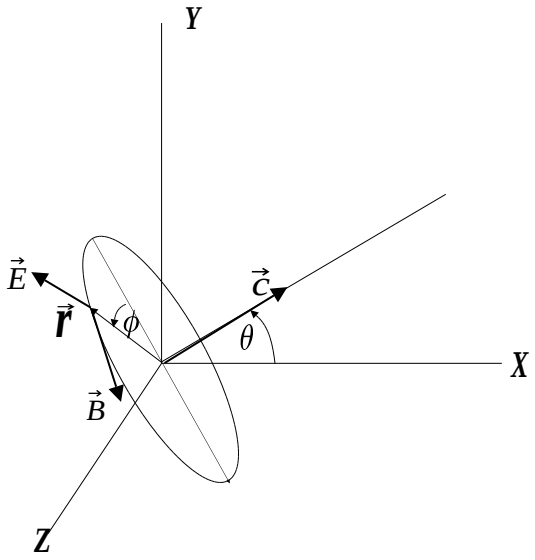
$$F \;=\; k \int_0^{2\pi} \int_0^{\pi} \int_r^{\infty} \frac{q^2}{32\,\pi^2\,\varepsilon_o\, r^4} \cos^2\theta\, r^2 \sin\theta\, dr\, d\theta\, d\phi$$

$$= \; k \frac{q^2}{24\,\pi\,\varepsilon_o\, r}$$

If we now take the force to be given by the gravitational field times the inertial mass.

$$m_i\, g \;=\; \frac{\mu_0\, q^2}{6\,\pi^2\, r}\, g \;=\; k\, \frac{q^2}{24\,\pi\,\varepsilon_o\, r} \;\Rightarrow\; k \;=\; 4\,\frac{g}{c^2}$$

By itself, this is fairly meaningless, but we now have a value for *k* which we can use in applying this method to the fields of a photon whose path makes an angle θ with the horizontal.



The electric field is $\vec{E} \;=\; E \begin{pmatrix} -\sin\theta\cos\phi \\ \cos\theta\cos\phi \\ \sin\phi \end{pmatrix}$ and the magnetic field is $\vec{B} \;=\; B \begin{pmatrix} \sin\theta\sin\phi \\ -\cos\theta\sin\phi \\ \cos\phi \end{pmatrix}$

The vertical components of the unit vectors are $-\cos\theta\cos\phi$ and $\cos\theta\sin\phi$ giving vertical components of the energy density vectors of $\cos^2\theta\cos^2\phi$ and $\cos^2\theta\sin^2\phi$. Since the average values of $\cos^2\phi$ and $\sin^2\phi$ are both $\frac{1}{2}$, we can avoid further integration and write the answer in terms of the total energy content of the electric field and magnetic fields of the photon.

$$F \;=\; \frac{k}{2}\,\left(\mathscr{E}_e + \mathscr{E}_m\right)\,\cos^2\theta \;=\; 2\,\frac{g}{c^2}\, m_E\, c^2 \cos^2\theta$$

If we now define the Einstein mass of the photon as $m_E \;=\; \frac{E}{c^2}$ then

$$F \;=\; 2\, m_E\, g \cos^2\theta$$

Thus we see that the gravitational mass of a photon is twice its Einstein mass, but that the action of a gravitational field depends on the direction of the photon being greatest for a horizontal path and zero for a vertical path.

This perfectly explains the lack of gravitational red shift against Newtonian time and the bending of light by gravity. It is also interesting to note that the gravitational and inertial masses of a spherical charge are both $\frac{4}{3}$ of its Einstein mass. The spherical symmetry being responsible for producing factors of $\frac{2}{3}$ in the integrations.

Overview

We have seen that electrons, up quarks and down quarks can be modelled as spherically symmetric electric fields terminating at an inner surface. The elementary particle has no existence other than its electric field with the inner raw edge of its polarisation appearing as charge and I call this structure a "pure charge". The charge should be thought of as a deposit of energy in the form of an electric polarisation of space and must be considered as a four dimensional entity of R3 + electric potential. In the polarisation of the vacuum, we see the protrusion into R3 of a four dimensional process. We take the fact that the magnetic field surrounding a conducting circuit may be described by $\vec{B} = \mu_0 \sum \vec{v}_i \wedge \vec{D}_i$ as prima face evidence that the electric fields of the individual charges have separate existence in space surrounding the circuit.

We note from the observation of binary stars that as, light travels through space, the photons must all have the same speed within any given local region through which they travel. This leads us to believe that some background presence might exist which moderates the speed of light to a constant local value. The null result of Michelson Morley type experiments leads us to either Lorentz's proposed physical contraction and its consequences, or to Einstein's Special Relativity or some other theory in which the speed of the earth's surface through the background is too small to detect.

An understanding of the way the pure charge behaves under a Lorentz contraction leads to the prediction that it has inertial mass and obeys Newton's $\vec{F} = m\vec{a}$ at non relativistic speeds, but at relativistic speeds behaves as if its longitudinal mass is increased by a factor of γ^3 and its transverse mass by a factor of γ matching the observed behaviour of high energy particles. The nature of the Lorentz contraction is such that within a moving system, mass is increased by a factor of γ^2 and all time dependent processes are consequently slowed by a factor γ such that within the moving system, the effects cancel and neither may be observed.

By assuming that space must have some form of rigidity resisting the internal tension of electric fields and that this results in minute distortions of space in its fourth dimension, we can explain the gravitational force. As charges are brought together to form massive bodies, the distortions of space add together. As the distortion increases, so the electric potential at the surfaces of the charges and the energy contained in their fields is reduced. Half of this energy is stored in the distortion of space, the rest manifests itself in the release of gravitational potential energy. Realising that the loss of surface potential results in a reduction of the field strength of a charge, we find that time dependent processes are again affected and that clocks slow by a factor $\frac{t_\Phi}{t_0} = 1 + \frac{\Phi}{c^2}$. ($\Phi$-ve)

We have made no commitment to the nature of the background presence which moderates the local speed of light, but have speculated on possible ways in which the presence of the myriad electric fields of individual charges which permeate space might form this function.

We have also seen that the laws of electricity and magnetism depend on the obedience of individual charges to a simpler set of laws such that the established laws apply at the scale in which individual atoms

and charges are no longer seen. At the subatomic scale, magnetic forces can now be seen to depend on energy transfers and take on a far greater significance. We are left wondering whether or not this is the key to a new Quantum Chaos Theory in which the electrons of an atom are in chaotic pseudo orbital motion, moment by moment having exact positions and velocities and feeling the forces they exert on each other. That by exploring such motion through iteration, we might use chaos theory to explore the steady states and the transitions between them in a new way.

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