The Theory of the Gravitation Constant

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Abstract

This summary account of the author's theory of gravitation enables the reader to calculate G in terms of the electron charge-mass ratio. A classical approach to electrodynamics adapted to relate to lepton interactions yields the unifying link with the gravitational interaction. The tau-lepton is found to be a primary "graviton" mediator. The theory has a common foundation with methods of deriving the fine-structure constant and the proton-electron mass ratio, already published in summary form.

Key words: gravitation, electrodynamics, tau-lepton, graviton, Neumann potential, ether theory

1. INTRODUCTION

For many years the author has been developing a theory of gravitation based on earlier research connected with an explanation of Planck's quantum of action h in terms of a tenuous structured lattice characteristic of the vacuum state. Published reports on these developments have been piecemeal, and it has not hitherto been attempted to bring the basic features of the gravitational theory together in one single, self-contained account. However, this has now proved possible in this text and in the light of the inspiration afforded by the stated objectives of *Physics Essays*.

The approach taken aims directly at the object of deriving a verifiable theoretical formulation for the constant of gravitation G in terms of a standard charge-mass ratio, such as that of the electron. This does not mean that the many facets of gravitational theory, such as the anomalous orbital motion of planets, are ignored. It is just that the primary thrust of the paper addresses something very basic that other theories have failed to access and so, what to specialists versed in conventional gravitational theory is deemed of primary significance, is here seen as a secondary issue. Indeed, having regard to the length of the paper otherwise and the fact that these peripheral aspects of the theory are already of published record elsewhere, the author has chosen to cover them by a summary of references as an addendum to the main text.

The crucial question concerning gravitation is that of relating the force to an electric or electrodynamic action, while reconciling its incredibly small magnitude and its ever-attractive nature with its noninteraction with electric charge and the relatively gigantic interaction forces between charges.

This is a difficult challenge and, having regard to the fact that no solutions have been found by following the orthodox theoretical routes, the reader is asked to accept guidance along a scientific path that will be most unfamiliar but which leads to the desired objective. Upon retracing the steps several times, it will be seen that the solution found is not contrived or based on arbitrary assumption, and so it will be realized that it could well be founded on the truths of nature. Much, then, depends upon how the theory fits with the peripheral phenomena that are more familiar to those studying gravitational theory. Hence the need to study the references to that other work and perhaps share in the work of consolidation and verification of what is here presented as a wholly new approach to the problem of gravitation.

In introducing the theory it is stressed that in order to present the physical arguments in as concise a way as possible, several approximations are made that are avoided in the fully developed version of the theory. The author apologizes in advance for writing this paper in a style that suggests that the physics of gravitation can be so simple. Gravitation unavoidably has a characteristic that is obscure. However, this paper will have served its purpose if it provides a coherent basis for deducing G in a way permitting general assessment by the physics community.

2. THE ELECTRODYNAMIC INTERACTION

The starting point in an effort to relate G to the properties of fundamental particles has to be the law governing electrodynamic interaction of charge. This law is by no means a settled question in physics. The situation has not changed since Maxwell wrote his thesis on electricity and magnetism. The empirical evidence could not resolve the question of the unique law of electrodynamic interaction between two discrete charges in motion. The debate on this subject is as active now as it ever was, as one can see from Graneau's book on Ampère-Neumann electrodynamics.[1]

An issue involved, particularly in the research since Maxwell's time, is the question of retarded action or instantaneous action-at-a-distance. The author has consistently affirmed that the coulomb action involves instantaneous action-at-a-distance, even if the charges are moving. This may be judged by some as nonphysics and Newtonian heresy, a reason for rejection, but surely no longer in the light of what is now known from experiment in the world of quantum optics. Indeed, the author is gratified to find in a book by Bell (of Bell inequality fame) the statement that: "In the Coulomb gauge the scalar potential propagates with infinite velocity."[2]

So, taking two electric charges as interacting instantaneously at a distance, how do we progress to an explanation of their mutual electrodynamic potential?

Suppose that they are subject to a balanced mutual interaction force F acting directly along the line joining them, but F being supplementary to the coulomb force and related to their states of motion. This force will imply that photons are being emitted or absorbed, or that there is an equivalent process which allows us to write F as $(1/c)dE/dt$, where dE/dt is the energy transfer rate at each charge.

For an instantaneous action it follows that $2(dE/dt)$ is the rate at which energy is being borrowed from the zero-point energy background field. Now, although the force action is instantaneous this does not mean that energy can travel at infinite speed. That zero-point energy is replenished by a retarded energy transfer as energy is shed from the distributed coulomb field. The energy in transit in this way no doubt travels at the speed of light and so can be written as the modulus of $\tau(dP/dt)$, where P is the coulomb energy potential. For two unit charges of the same polarity at spacing r, P is $1/r$ in a classical vacuum of unit dielectric constant. Therefore,

$$2E = \tau(dP/dt) = -\tau(1/r^2)(dr/dt) \tag{1}$$

if dr/dt is negative.

The force F can then be found by writing τ as r/c and using the formula for F as $(1/c)dE/dt$. The reader can verify that what emerges is a force of magnitude:

$$F = (1/2r^2)(V/c)^2, \tag{2}$$

where V is the relative velocity between the two charges. The corresponding energy potential is found by multiplying F by r.

This potential is identical to the electrokinetic potential of classical theory, as used by Maxwell to derive the Neumann potential by appeal to the Fechner hypothesis.

The modern equivalent of the Fechner hypothesis is provided by regarding an electron in motion as really an electron-positron creation in the forward field, coupled with annihilation of the forward positron and the original electron. This involves balanced countermotion of opposite polarity charges at half the speed we see as that of the isolated electron.

As far as the two-charge interaction is concerned, as between charges moving at v and v' relative to the electron-positron creation frame, this involves four interactions: two of relative velocity $(v - v')/2$ and two of relative velocity $(v + v')/2$. Two involve like charge polarity interaction and two involve unlike charge polarities, with the associated sign reversal. These four interactions sum to give, from the energy term deduced from (2), the Neumann potential:

$$W = -(1/r)(v \cdot v')/c^2. \tag{3}$$

This is simple classical physics, but the point of interest to our onward argument is that this Neumann potential only applies for actions involving, as one of the charges of the interaction, leptons, such as electrons and positrons, muons, or tau particles. Otherwise, we cannot advance from the electrokinetic potential corresponding to Eq. (2). This point has important experimental implications which are being addressed in active research at this time but do not affect the following analysis.

3. NEWTON'S RULE

The very important point that has emerged is that the electrodynamic interaction between charges in motion is a summation of interactions involving electrokinetic energy proportional to relative velocity squared. Thus two electrically neutral bodies in loss-free collision, each comprising numerous electric charges, must collide in such a way that the electrokinetic energy at the moment of impact is conserved. This means that their relative velocity squared is unchanged by the collision if there is no loss. For there to be any change of state, therefore, the relative velocity after impact must be opposite but equal to that before impact.

This is Newton's rule, a rule deduced from energy conservation and Newton's third law of motion. By arguing electrodynamically, we have found that the rule is more basic than the third law, and by energy conservation we can deduce that action and reaction are equal and opposite. If energy involved in the collision can be drawn from spin motion of a fundamental particle or from non-Newtonian field sources, the action can develop an out-of-balance linear force, contrary to Newton's third law of motion.

We have discovered by electrodynamic argument that the mechanical law of action and reaction is not sacrosanct in physics, as is the law of conservation of energy.

This is the basis of the antigravity precessing offset gyroscope devices based on the pioneer work of Professor Laithwaite. Two machines that have been demonstrated to scientific experts are those of Kidd[3] and Strachan.[4] These devices produce a demonstrable lift force that defies Newton's laws.

This, however, is not a direct step on our route to explain the basis of G, but it is physics at its most fundamental level. It is important indirectly as we shall now see.

4. THE NATURE OF THE FORCE OF GRAVITY

The familiar electrodynamic law is that known as the Lorentz force. It is characterized by the fact that it does no work in the sense that it always acts on charge at right angles to its motion. It is a law that suits steady-state current conditions but one that is totally inadequate to cope with the phenomenon of electromagnetic induction. It is usually formulated as a vector product, but mathematically this splits into two

scalar product terms that are vectors, one of which corresponds to the Neumann potential. The mystery of the electrodynamic law discussed in Maxwell's treatise centers on the addition of a third term of a form that integrates to zero for actions produced by closed-circuit currents. This third term is, undoubtedly, the term that accounts for induction, but it was not so regarded by Maxwell. The problem is that, as an induction term, it leads to an out-of-balance force in the general electrodynamic case. This would defy Newton's third law of motion, a fact well accepted in textbooks discussing the Lorentz force in a fundamental context. Accordingly, Maxwell favored the use of a third term which gave linear force balance. However, this author is searching for the answer to the gravity problem, realized that Newton's third law could be breached and so came to deduce, by a symmetry and energy-conserving argument, a term that not only accounts for induction but cancels all but the Neumann potential term when the interacting charges move in parallel.

The Neumann potential is all that we need to consider in discussing gravitation. It means that the charges accounting for gravitation share a universal parallel motion, and they must be leptons.

5. THE ETHER MODEL

If there is an ether it is likely to comprise a neutral aggregation of electric charge. The author had reason to imagine the ether as a uniform sea of positive charge populated by discrete negative charges which mutually repelled to take up positions in a structured lattice. This ether was not a solid but a system like that of a liquid crystal, responsive to field conditions in a way that can allow the structure to form or dissolve according to the physical constraints.

For our present purpose, it suffices to analyze this ether model on the assumption that the negative charges are electron-valued charges e in a background continuum of charge density σ. Rigorous analysis can be applied to determine the structure of the lattice, but we will ignore that for our present objective, which is merely to estimate σ. We will do that by taking note of the Bohr magneton, which has a magnetic moment corresponding to that of an electron in orbit with an angular momentum of $h/2\pi$, where h is Planck's constant. The author argued that h was determined by the discrete structural properties of the ether. It was thought that the ether charges e would move in synchronism in orbits of radius commensurate with the lattice spacing, at a speed characteristic of the light speed c and at the Compton electron frequency.

Thus, writing m as electron mass and using R as the radius of the ether charge orbit, mc^2/h is the frequency at which a charge e describes an orbit of radius R. This implies a magnetic moment of $\pi(e/c)R^2mc^2/h$ which is equal to the Bohr magneton $he/4\pi mc$ if R is $h/2\pi mc$.

The next observation is that if these lattice ether charges move in synchronism in orbits of radius R about cell centers to which they are attracted, they must be displaced against an electrical restoring force owing to interaction with σ. Now, it was clear that if the charges were not in motion but were at rest, each at the center of their own cell, they would lie at positions of negative electrostatic potential, which seemed to be impossible for an ether model. It was deemed essential that they should be at positions of least potential consistent with the non-negative situation. Hence the zero potential state was seen as determining R.

To estimate σ imagine each cell to be equivalent to a sphere of total charge canceling e and position e at the center of the sphere. Then find the negative potential. Next, take the multicell system and imagine the charge e to be displaced to the radius R in the infinitely extending σ background. The work done in this displacement is assumed to add to the negative potential to bring it exactly to zero.

The result of this analysis is that for a sphere of radius S, the negative base potential is $-2\pi\sigma eS^2$ and the displacement energy for a charge e, now deemed to lie in a continuum of charge of density σ and be subject to a restoring force rate of $4\pi\sigma e$ is $2\pi\sigma eR^2$. For zero net potential, we find that R is approximately of the same size as S, where $4\pi\sigma S^3/3$ is e. Given R as $h/2\pi mc$, we then know S and so can deduce σ in terms of e.

Now, in a rigorous analysis related to full calculation over an infinitely extending cubic structured lattice of lattice spacing d, it was found that R was $0.6058d$. Here σd^3 balances e. The above rough estimate of R leads to a corresponding value of R of $0.620d$. The reader is asked, therefore, to keep this in mind in using the following derived expression for σ:

$$\sigma = e(0.620/R)^3, \tag{4}$$

because this is really an overestimate by about 7 percent.

6. THE GRAVITON SYSTEM

Our task in explaining why two masses have a force of mutual attraction now concerns how the electrodynamic effect comes into play. Firstly, we are speaking of electrically neutral matter. However, we know that all matter is subject to a zitterbewegung activity which has some relationship with the Heisenberg uncertainty principle. Indeed, the author regards this as due to matter tending to share that synchronous motion of the ether lattice already mentioned. For an electron, for example, to move in an orbit of radius R equal to $h/2\pi mc$ at the Compton electron frequency mc^2/h, it must have a position that is uncertain by the distance R and a momentum that is uncertain by mc. The product of these uncertainties is $h/2\pi$.

The clue now followed is the supposition that all matter is swept into this synchronous orbital state of the ether lattice. This means that it is dynamically out-of-balance unless there is something moving in juxtaposition with the lattice. The lattice was deemed to be a structure that defines the local electromagnetic reference frame, inasmuch as the distortion of the lattice seemed a logical basis for propagating a disturbance in the ether medium. However, what is important here is not the light propagation reference frame but that which sets the reference for v and v' in the Neumann potential expression. This appears to be set by the lattice. Therefore, whatever moves in juxtaposition to balance the mass of matter present must always move relative to the electrodynamic reference frame in a universally synchronous and ever-parallel motion.

These conditions are exactly what are needed to develop a mutual force of electrodynamic attraction that acts according to the Neumann potential and so has the characteristic we associate with gravity. The frequency of the motion is the Compton electron frequency, which is too high to be of concern in terms of normal electromagnetic interactions that we can observe.

The mystery of gravitation centers on the nature of whatever it is that provides dynamic mass balance in the ether itself. These are the "gravitons" of this theory. They comprise a lepton field that the ether can produce as part of its equilibrium sea of energy.

7. EVALUATION OF G

The graviton population, being leptonic in character and not part of real matter, will inevitably be electrically neutral in an overall perspective.

This cannot develop a direct electrodynamic interaction. However, if these leptons are not point charges but have a finite volume, their motion through the charge continuum of density σ could develop the electrodynamic interactions. The motion of the σ voids occupied by the graviton population occurs at the displaced distance R and at speed c relative to the electromagnetic reference frame. Thus we can simply declare, from (3), that the force of attraction between two masses at unit separation distance is σ^2 times the product of the related graviton volumes.

These volumes are those of a number of gravitons that can balance in equal measure the mass of the gravitating objects. Let M be the mass of a graviton and let V be the volume of σ charge displaced by its existence. Then we can write

$$G = (V\sigma/M)^2. \tag{5}$$

The task, now, is to establish the physical size of a lepton of mass M. Here, we use the classical formula for the electron radius a, as used by Thomson:

$$a = 2e^2/3mc^2. \tag{6}$$

Applying this to leptons generally we can write the charge volume V as

$$V = (4\pi/3)(2/3M)^3(e/c)^6. \tag{7}$$

This allows us to eliminate V from Eqs. (5) and (7), and we should then have evaluated G in terms of an effective graviton mass M, which ought to be that of a lepton. However, it is not that simple, because we have first to resolve a physical problem, which is to explain why the leptons involved are able to survive mutual annihilation for periods long enough to allow them to act in this gravity process.

8. THE GRAVITON GROUP

Imagine that the gravitons are denoted $(+g)$ and $(-g)$ to signify their charge polarity, and let g be their mass measured in electron mass units. We are interested in the charge volume-to-mass ratio and a stability consideration.

If there exists a g-lepton form the problem is that a cluster of three leptons $(+g)$, $(-g)$, and $(+g)$ could involve pair annihilation. There would be energy released and a single g-lepton would remain with the unit mass M; but the "σ void" volume would suddenly be three times that of the single g-lepton. This was seen as important to the gravity argument, because the theory relies upon σ being absolutely uniform. Its charge content could not change by small amounts, just as the electron charge e cannot change.

Compared with the volume-to-mass ratio of the electron, the ratio of the volume-to-mass ratio of the three g-lepton cluster after pair decay is given by

$$3(1/g)^3/g = 3/g^4. \tag{8}$$

Now, there is another way in which leptons decay. They can become leptons of smaller mass just as a muon can decay into an electron. This decay occurs for single leptons with a probability set by a mean lifetime. Thus another decay process would be one in which the two $(+g)$ gravitons have become two $(+\tau)$ leptons, where τ denotes the tau-lepton. This would leave a three-lepton cluster that is quasi-stable in that there could be no internal pair annihilation.

The corresponding volume-to-mass ratio in electron units, with τ as the ratio of tau mass to electron mass, is

$$[(1/g)^3 + 2(1/\tau)^3]/(g + 2\tau). \tag{9}$$

Note that what we now have is a quasi-stable system, whereas the three-g-lepton cluster was unstable. Note, also, that it needs three leptons in a minimal group configuration to allow pair annihilation or pair decay to leave at least one nucleating lepton to determine a residual mass for association with the σ void. Physically, in the equilibrium processes that must occur, not all the g-lepton clusters can develop into a corresponding mixed g and τ lepton system. What can occur, however, is a state in which there is a perfect match of the volume-to-mass ratio of the g-system after pair annihilation and the quasi-stable mixed g and τ system.

The physical picture of the heavy lepton world thus portrayed is characterized by the equality of the two expressions (8) and (9).

The reader will realize that this theory is evolving towards a commitment that determines the V/M ratio needed to evaluate G. There are so few leptons in the known particle spectrum that there is no way in which we can avoid settling on a unique value of G by having a multiple choice of a particle to settle the V/M ratio.

Equating and rearranging expressions (8) and (9) gives

$$(g/\tau)^3 - 3\tau/g - 1 = 0. \tag{10}$$

This has a mathematical solution, which is

$$g = 1.452\,627\tau, \tag{11}$$

and it allows the indicated V/M ratio to be determined in electron units as

$$V/M = (0.673\,759)/\tau^4. \tag{12}$$

9. THE ULTIMATE G EVALUATION

To this stage, the author believes that the reader has not seen anything but true physics. What has been said might be viewed with suspicion, especially the references to ether, but that is not "numerology"; it is a question of what constitutes the zero-point field of empty space. The ether is no longer the taboo subject that it was when this theory was first developed.

It remains now to put some numbers into the physical equations that have been derived.

The value of R is $h/2\pi mc$, which physical tables give as $3.861\,59 \times 10^{-11}$cm.

The value of e in absolute electrostatic units is 4.8032×10^{-10}.

From Eq. (4) we then obtain σ as 1.988×10^{21} esu per cm cube.

The V/M ratio of the electron, as given by (7) with an electron mass of $9.109\,39 \times 10^{-28}$ g, is 3.049×10^{-11} in cubic cm per g.

From (5) and (12) we then determine G as

$$G \simeq (1.668 \times 10^{21})/\tau^8 \tag{13}$$

in cgs units. The approximation signifies the error involved in the approximate determination of σ.

Now, as to the choice of lepton, we have only the electron, the muon, or the tau. The author has discovered a role for the muon in the more general development of the theory and neither the electron nor the muon has

enough mass to be present in the dynamic balancing gravitational role in the ether without distorting the lattice unduly. This leaves only the tau as the particle conducive to order, which was why that was assumed in the above analysis. The tau has a rest-mass energy of approximately 1.782 GeV, meaning that in electron terms τ is 3487. The reader can then see, from (13), that this gives G as roughly 7.6×10^{-8}, which is about 14 percent too high, consistent with the statement made above that the rough estimate of σ deduced here was too high by about 7 percent.

It is beyond the scope of this very simple analysis to show that the lattice dimension d is 72π times the classical electron radius or 108π times the Thomson electron radius a used in Eq. (6). This is, however, very easily proved, and it determines σ with very close precision. The classical electron radius is known to be $2.817\ 940 \times 10^{-13}$ cm. Thus σ is really 1.8547×10^{21}. If this is used instead of the estimated value given above, the 1.668 factor in Eq. (13) becomes 1.452 and G becomes 6.64×10^{-8} cgs units, which is very good accord with the measured value.

Note that the value of τ is not known from experiment with sufficiently high precision to allow a perfect verification. However, here the author can claim the further advance of having deduced τ from first principles. It is found to be greater than the proton mass by the factor 3 raised to the power 7/12, which makes τ equal to 3485.2146. When this is used G comes into precise accord with its measured value.

10. CONCLUSION

The author has shown how G can be explained in terms of the measured charge-mass ratio of the electron. The physics has been presented and is self-contained in this paper as far as arriving at an approximate G value is concerned. At the end of the discourse the author has noted how the precise value of G can be calculated from a correspondingly precise estimate of σ and even declared that the tau lepton mass is calculable in terms of the electron mass. Without the reader looking up the relevant physics papers showing how these are derived, it might be easy to suspect some misapplied numerology, but the reader can be assured by checking the references to see the physics leading to these statements.

The history of the development of the theory predates the discovery of the tau-lepton. In the mid-1960s the theory was built on the recognition that the g-lepton had to exist. This pointed to a 2.587 GeV lepton, but the connection with the tau did not emerge until independent analysis of mesons showed how both the tau and g-leptons were produced in high-energy particle reactions.

Even so, it remains a firm prediction of this theory that there is a lepton at 2.587 GeV, and this has yet to be recognized by particle physicists. Looking at the class of particles having lifetimes in the region of 10^{-13} s, which includes the tau, there is a reported decay time stated to be "the longest lived entry . . . giving a fitted mass of 2583 ± 26 MeV/c^2 . . . ."[5] This is the clue needed to take this theory's predictions further. Otherwise, it seems that physicists generally are reluctant to believe that gravitation has yielded its secrets in terms of an ether theory. They see little point in evaluating the number G, given that its value is known, and, in accusing the author of indulging in numerology, forget that to derive G one has to keep in mind its physical dimensions, without which that number means nothing.

The other obstacle that made the advancement of this theory quite difficult was the belief that Einstein had solved the gravity problem by explaining the perihelion motion of the planet Mercury. Since adherents to Einstein's theory do not accept the need for an ether and choose to interpret ether as "that which should have been detected by the Michelson-Morley experiment," the very word "ether" prevents them from even reading what the author's theory has to offer.

As a result, the author had to come to terms with the minor adjustments to gravitation actions needed to explain perihelion effects and be seen as a heretic challenging Einstein's theory. The intention was to break new ground by offering a theory that was verifiable by its derivation of G. This was something that Einstein's theory had not been able to offer. In any event, the work on the planetary perihelion motion was duly published, but it is peripheral and in the author's opinion unimportant when set alongside the explanation of G as given above. The perihelion motion is nothing more than an effect of retarded energy transfer for radial perturbations of the planetary orbit, compared with the instantaneous action devoid of energy transfer in regulating the truly circular planetary orbit.

As the reader might suspect, it was not possible to develop the theory outlined above without coming to terms with the processes determining Planck's constant h. That is another subject. It was really the starting point for the theory and preceded the gravitational theory by several years.

Before giving some of the basic references to this work, the author concludes this exposition with the hope that the reader will come to share the author's belief that what has been described is the true theory of gravitation.

APPENDIX

The basis of the theory was first published in a booklet early in 1960.[6] The booklet gave the basis of the electrodynamic law involved and showed how σ was determined. The constant G was explained in terms of the minute charge displacement from a hole in the continuum as regulated by a proton sized mass M. By 1966 the second edition of this work was published.[7] The 2.587 GeV lepton (the graviton of the above theory) had appeared, and the full formula for the precise derivation of G in terms of this graviton was presented. This work presents a first-principle derivation of g as 5062.75 electron mass units. By 1969 a comprehensive version of the theory to date was published in a book *Physics without Einstein*, a title reflecting the objective of showing how far one could progress without bringing in the relativistic argument.[8] Indeed, the book attracted commendation in its review by *Nuovo Cimento* for offering a standby position which could prove useful if Einstein's theory were to collapse owing to some improbable, but yet possible, decisively adverse experiment. An updated version of the theory in its pure G-derivation context appeared in 1975[9], and a more comprehensive updated edition of the 1969 work appeared in 1980.[10]

These books were all published to put the theory on record as it developed, in its early phases. Since 1983 many research papers dealing with specific ramifications of the theory have appeared. They are too numerous to list here. The key references that will help the reader to trace the full basis of the gravitational theory are those listed as Refs. 11 to 18. Reference 11 gives a concise derivation of the formula showing that d is 72π times the classical electron radius. This allows precise calculation of the value of σ. Reference 12 gives the full physical account of how the theory affects the meson spectrum and, in particular, discusses the related basis of the tau-lepton and g-lepton connection. The same reference shows how the tau-lepton mass is calculated in terms of the proton mass.

Reference 13 gives the author's justification for saying that the perihelion motion of Mercury can be explained without recourse to the theory of relativity. The same equation emerges as is derived from Einstein's theory.

It would be inappropriate to conclude without mentioning the related research concerning the evaluation of Planck's constant and the proton-electron mass ratio. The author owes a great deal to D.M. Eagles, who is one of the few who did take a close look at the author's early research. Indeed, it was a result of a computer check on the author's ether structure analysis at the National Measurement Laboratory in Australia that led him in 1972 to suggest a coauthored paper.[14] This presented the full part-per-million evaluation of the fine-structure constant given by the theory. Later, in 1975, a similar cooperation resulted in the equally precise determination of the proton-electron mass ratio, using techniques that now feature in the derivation of the graviton-tau relationship.[15]

It was thanks to the initiative of W.M. Honig that a brief but relevant paper concerning the graviton of the theory was published in 1978.[16]

More recently, this association with Mr. Honig, thanks also to the initiatives of E. Panarella, gave opportunity to present a fairly comprehensive account of the author's theory for Planck's constant and the photon at a NASA Advanced Research Workshop.[17] Also, to complement this effort, a summary self-contained derivation of the precise proton-electron mass ratio was recently published in this same journal.[18]

Postscript

This note was added when the manuscript of this paper was revised on 4 November 1988.

The statement made in the text indicating that Newton's third law of motion has been breached by both the Kidd machine[13] and the Strachan machine[14] is now further confirmed by the following circumstances.

On 23 October 1988 both the *Sunday Times* and *Sunday Express* newspapers in U.K. carried the story that confirmed that the Kidd machine had proved loss of weight in rigorous independent laboratory tests commissioned by a research company in Australia.

Arising from this media publicity, British Aerospace, after consulting with this author on 27 October, arranged for independent testing of the Strachan machine by experts from Edinburgh University. The machine and another in Strachan's possession clearly demonstrated a lift force contravening Newton's third law of motion. The action of gravitation was not accompanied by a commensurate reaction in the mass acted upon. As a result of these affirmative tests British Aerospace has funded arrangements for a scientific meeting to take this matter further. The results of these activities will no doubt become public knowledge shortly after this paper appears in print, but this background information is relevant to the context of this paper and may be helpful to readers.

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Résumé

Grâce à cet exposé sommaire de la théorie de la gravitation présenté par l'auteur, le lecteur est en mesure de calculer G *en termes du rapport entre la charge et la masse de l'électron. Une approche classique de l'électrodynamique centrée sur les relations d'interactions leptoniques conduit à mettre en évidence un lien unificateur avec l'interaction gravitationnelle. On trouve ainsi que le lepton tau est un médiateur "graviton" primaire. La théorie a une base commune avec les méthodes permettant la dérivation de la constante à structure fine et du rapport de masse proton-électron, déjà publiée sous forme succincte.*

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