The physics of the missing atoms: technetium and promethium

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Technetium ($Z = 43$) and promethium ($Z = 61$) are by far the least abundant of all atoms below the radioactive elements ($Z = 84$ onwards). Their scarcity confirms theoretical predictions emerging from a theory of the photon derived from synchronous lattice electrodynamics. This theory has given precise theoretical values for the fine-structure constant and the constant of gravitation G and is now shown in this paper to indicate resonant interactions between the vacuum lattice oscillations and technetium and promethium. In the case of promethium there is strong reason for believing that this atom can assume supergravitational or antigravitational properties, accounting for its scarcity. This paper not only adds support to the earlier theoretical work on the photon and gravitation, but suggests a research route that might lead to new technology based on controlled interactions with gravity fields.

I. INTRODUCTION

From a 3-space analysis of synchronous oscillations in a notional vacuum lattice of cubic configuration, with lattice sites located at zero potential, the author has gradually established a theoretical basis for the nature of the photon.[1] The current effort by IBM, using extremely powerful computing facilities,[2] uses techniques of quantum chromodynamics referred to relativistic 4-space and seeks to calculate the proton-electron mass ratio. These calculations involve a hypercubic space lattice, but the results have yet to be announced. In contrast, the 3-space method of the author's theory has already given a result accepted by Van Dyck *et al.*,[3] who have measured this quantity directly, as being precise to within one part in 10^7. The author's theory was checked by rigorous computer calculation performed by Dr. Eagles and Dr. Burton of the National Measurement Laboratory at CSIRO in Australia[4] in the full analysis of the photon theory in 1972, which also gave the correct value to within part-per-million precision.

Very recently (1986), advances in the theory were published.[5-7] These included an evaluation of the constant of gravitation G in terms of the electron charge-mass ratio, showing how the predictions of earlier theory of long standing[8-10] were holding up on this very fundamental question.

Essentially, gravitation arises because there is a vacuum energy fluctuation when matter is present in the synchronous lattice. Energy is deployed into a tau-graviton system to provide a dynamic balance to the matter energy (mass), accompanied by a local energy deficit in the (muon) lepton background which is gravitationally neutral. The muon leptons feature strongly in the theory[5-7] by which the proton, the tau, and the numerous fundamental particles are all created. The action of gravity arises electrodynamically between the tau-graviton quanta (see particularly Ref. 7), which are all moving relative to the matter frame and in synchronism, with constant relative spatial relationship. Although the matter frame does oscillate at the universal frequency involved, such oscillations have no electrodynamic effect, because the effective, or mean, matter frame is the operative frame so far as the gravitational effects are concerned. It is these oscillations that effectively give the physical basis for Heisenberg's principle of uncertainty, in relating uncertainty of momentum with uncertainty of position in terms of Planck's constant.

The oscillation frequency of the vacuum is the frequency we associate with electron and positron creation and annihilation in the vacuum field. Accordingly, if we are looking for experimental possibilities by which to verify this gravitational theory, we need to explore the scope for causing electrons to oscillate so as to resonantly interact with that known vacuum frequency.

The prospective consequences of setting up such an interaction are enormous, even if the interaction is virtual and limited to small statistical periods and a small statistical section of the electron population in a substance. This is because the direct electrodynamic effect of an electron, measured in terms of its charge-to-mass ratio, is well known to be an extremely large force compared with the normal gravitational action.

The practical and commercial consequences of an advance in physics that could establish such an interaction are immense, especially as the controlled entry into the ordered interaction state, resulting from the resonance, will release energy from the oscillatory condition. It should tap the "zero-point" energy of the oscillating mass sharing the lattice motion. Energy released as high-temperature heat could be returned at lower temperature in a reverse cycle, so as to constitute a gravitational heat pump, with the vacuum as the primary energy source. As gravitational potential energy is released by such an action, so the amplitude of the oscillations in the surrounding vacuum lattice will be reduced, and, as the corresponding speed is proportional to the light speed, so gravitational potential implies a slowing down of light. This is verified by observation. An exact analogy to the resonance state is the onset of order in a ferromagnet on cooling through its Curie temperature. The transition involves the release of energy, which makes the specific heat abnormal in such a situation. However, in the controlled interaction with the gravitation field, the prospect is a spontaneous release of energy related to the local gravitational potential. The problem here is that such energy release can be so enormous that its deployment might well retard the ordering of the motion of the electrons in the resonant mode. Obviously, that is a matter for speculation, and it is more relevant to engage in practical research to probe what can be achieved.

This paper is an introduction to a research project (Project G) which the author will be pursuing on this basic question. The scope of this paper will be confined essentially to an investigation into whether there is natural evidence showing that resonant interactions of the kind contemplated account for the scarcity of candidate substances, which would otherwise be ideal for supergravitational cells in the practical research project.

II. SPECIFICATION OF THE PROBLEM

In order to develop primary electron oscillations at the Compton electron frequency one would need to use atoms with a nuclear charge Z equal to the reciprocal of the fine-structure constant (137). The oscillation frequency of the innermost electrons in an atom is determined by the Rydberg constant and is proportional to Z^2.

Since no atoms exist naturally at this Z level, owing to their radioactive nature at high Z values of about two-thirds of 137, we cannot look to a direct primary action. Artificial "atoms" are now being created in high-energy physics by driving two heavy atoms into one another.[11] The $Z = 137$ condition has been surpassed and positrons are driven out from the field close to the nucleus. Hopefully, one might eventually see evidence of gravity locking in such work. It would, for example, be interesting if the $Z = 137$ "atom" were anomalous in some way in the spectrum of data available from such research. Anomalous energy indications or a weaker quasistability or even total absence would be indicators helpful to the theory under study. However, our attention here must turn to the more easily available natural environment.

The next point to consider is whether the innermost electron oscillations in the wave-mechanical picture of the atom can develop harmonics which could resonantly interact with the primary frequency. The problem then is how such harmonics could be set up, because something has to distort the normal field pattern in which the electron moves. However, putting this aside until later, let us suppose that this occurs in nature. Symmetry considerations suggest that only odd harmonics need be considered. So we are led directly to look at atoms for which Z relates to 137 as the inverse square root of an odd number.

The lower the order of the harmonic, the more likely the resonance, because analysis of typical waveforms (e.g. a triangular wave, taken as an extreme case) gives a strength inversely proportional to the square of the order of the harmonic. Even for this extreme distortion, which must be far higher than any we can expect to occur naturally, the amplitude of the harmonic component will diminish, therefore, as the fourth power of Z. When the electrodynamic interaction is considered, the effective harmonic component speed of the electron is also reduced in proportion to Z. All these factors militate in favor of reliance on a very low-order harmonic, say the third or fifth.

For the third harmonic, the resonance will come closest to occurring in the atom with $Z = 79$, that is 137 divided by $\sqrt{3}$. This is the element gold. This substance is scarce, but not exceptionally scarce in the sense of this study.

For the fifth harmonic, the resonance of interest indicates $Z = 61$, that is, 137 divided by $\sqrt{5}$. This is the element promethium, a substance which handbooks[12] tell us is of unknown abundance, but certainly less abundant than gold by a factor of at least 100,000. Only technetium ($Z = 43$), amongst all the elements below the high-Z values, is recorded as equally scarce. Promethium and technetium stand in isolation, as being scarcer than any other element from $Z = 1$ to $Z = 83$, by a factor of at least 1000.

There is a strong indication that there is some special physical reason accounting for the virtual absence of the $Z = 61$ element from the Earth's crustal composition. The theory has led us directly to this substance and so looks extremely promising.

The problem then faced is how one can cause the more abundant samarium rare earth ($Z = 62$), which is nearly 10,000 times more abundant than gold and is adjacent to promethium in the Z scale, to become artificially resonant with the gravitational frequency. This is a matter for technological research, but the pathway to this objective might be found in the thoughts presented below.

The reader should keep in mind that the rare earth promethium stands in the atomic scale between adjacent rare earths and yet, in spite of its general similarity and similar classication, it, exceptionally, is more than one billion times more scarce in the Earth's crustal composition. This paper explains why this is so.

III. THE PHYSICS OF TECHNETIUM

We will later see why other factors help to single out promethium for resonance at the gravitational frequency. First, it is relevant to discuss the scarcity of technetium, for which $Z = 43$.

Now, there are two reasons which indicate that a particle having the charge number 43 will be exceptional. The first reason is fully discussed elsewhere by the author[13] by reference to some empirical meson data analyzed by MacGregor.[14] Certain quark masses which feature in hadron structure (particularly proton structure) become theoretically explicable if a $Z = 43$ value is involved in the formative stages. Such processes might work to reduce the population of atomic nuclei with this charge value. The quantity $Z = 43$ arises as the nearest integer obtained from a calculation of the square root of the proton-electron mass ratio, in a situation for which mass or energy can be said to be proportional to charge squared. This effect has no bearing upon our gravity situation and would make the scarcity of technetium a false lead if its scarcity alone were to be taken as a guide.

The second reason is even more relevant. This is based upon the consideration of an electron moving around a charge nucleus at a distance determined by the half wavelength at the Compton electron frequency. This is the natural cavity-resonant wavelength to be expected in the vacuum field. What we are looking for here is the possible radial perturbation of the electron at the gravitational frequency. To picture the action, imagine that the electron describes a classical Bohr orbit in a circle. If the radial pulsations are at the high Compton electron frequency, there is scope for resonance with the orbital period. We require equality, or near-equality, between an integral number of such pulsations and a low integral number of orbital oscillations. In effect, we are seeking to obtain a radial perturbation component of an electron, which perturbation is along a nonrotating axis, so as to develop the general gravitational interaction. Now, one point is clear: such a condition is inevitable, in theory, because the two integers can be determined, according only to the degree of approximation needed to bring about the frequency-locking condition. This means that the atom in which this occurs has to be the atom for which the Bohr radius of a K-shell electron is nearest to half of the Compton wavelength of the electron.

To be rigorous in this matter, we should qualify what has just been said very slightly to allow for the fact that the radial oscillations do not emanate from a point. The proper inner cavity radius for such oscillations is, in the case of the electron, for example, known to be as small as $\frac{1}{373}$ times the half wavelength at the Compton frequency.[15] This is because the inner cavity radius is related to the scattering cross section of the electron. For the atomic nucleus, the scattering cross section is somewhat larger, the radius being of the order of 10 fm. Taking this as a guide, we should look for a Z value smaller by something of this order of $\frac{1}{100}$.

Without this correction, we find from conventional theory simply $Z = 137/\pi$, or 43.6. It requires a reduction of just about the estimated 1% to bring Z to a value of 43, which singles out technetium for the gravity resonance condition just outlined.

This is an extremely remarkable combination of circumstances. The two outstandingly scarce elements, technetium and promethium, are both uniquely specifiable supergravitational elements on the author's theory. It follows, therefore, that not only is the gravitational theory supported, but we can see a route for exploitation of the theory to practical ends. All that has to be done is to find a way of artificially reproducing the gravity-locking oscillations in substances that are more readily available than these two "missing" substances.

Alternatively, we have to find a way of synthesizing a substance that lends itself to ready and controllable resonance in phase or in antiphase with the gravitational oscillations. Such a project could not be conceived unless the basic viability of the research looked promising on the theoretical evidence. It is submitted that we already have such evidence, provided firstly by the rigorous and precise calculation of the constant G, and secondly by the solution of the mystery of the missing elements technetium and promethium. We therefore turn next to the possibility that photon spin can be a factor conducive to setting up the state of resonance.

IV. THE PHOTON SPIN LATTICE AS A NATURAL TUNING DEVICE

In the author's theory of the photon, by which the fine-structure constant has been evaluated as the reciprocal of 137.0359148 in free space,[4] the essential element was a $3 \times 3 \times 3$ cubic lattice defining sites which could be occupied by electric charges neutralized by a continuum of charge of opposite polarity forming a background. The release of an energy quantum by an atom develops oscillations in two dimensions at the natural vacuum frequency. These require angular momentum in proportion to the energy of the propagating quantum. This angular momentum has to be balanced, and that is the role of the photon spin unit. In spinning this perturbs the surrounding lattice and imparts the wave character to the propagation. The frequency of the photon produced is four times that of the spin unit, because the latter is cubic and nudges the lattice four times per revolution. This is extremely relevant to the task at hand, because we are looking for a process which can develop the harmonics in the primary oscillation of the electrons close to the atomic nucleus.

The optimum conditions will arise where the radius of the K shell is a little less than the diagonal (edge to edge) radius of the photon spin unit, measured from a spin axis through three central lattice sites. This is simply $\sqrt{2}\,d$, where d is the lattice spacing. Under these circumstances the electron will tend to be sequentially repelled radially from the center of a spin unit centered on the atomic nucleus and repelled inwards by charges in the lattice at four times the spin frequency.

It is outside the scope of this paper to show how d is determined. It is deduced in Ref. 16 in a brief summary form and found to be 72π times the classical electron radius.

From these simple facts, we can show that the optimum condition we seek occurs when $Z\sqrt{2}$ is a little greater than $137^2/72\pi$. Then, if we can set a photon unit spinning at the necessary frequency, we can control the frequency of that fifth harmonic that we seek to bring into gravity resonance. This argument tells us that we should expect the stronger harmonic components in the electron oscillation perturbed by lattice spin in the nucleus to occur at Z values just a little above 59.

This, therefore, must be the criterion which singles out the fifth-harmonic resonance at $Z = 61$ and excludes the third-harmonic resonance in gold ($Z = 79$). This quite remarkable circumstance gives more support for the author's photon theory, and it further confirms the gravity-locking theory. In addition, however, it causes us to hope that excitation of photon spins in standing-wave photon energy exchanges close to the nucleus could be a means for securing gravity-locking in substances such as samarium ($Z = 62$) or neodymium ($Z = 60$).

It is with such research in mind that the author has begun to investigate the de Broglie matter-wave possibilities. This has led to an interpretation of single-electron and single-neutron diffraction based on the author's photon theory, coupled with the derivation of the de Broglie wave formula.[17] The concept implicit in this theory is that there are photon spin units containing standing waves and associated with the migration of the electron in its free motion or in its motion in the atom.

Similarly, the field cavity-resonance theme, which led to the $Z = 43$ condition, has been explored in a recent paper discussing the anomalous magnetic moment of the electron.[15] The dual-resonance analysis gave a result in accord with the quantum electrodynamic calculations to within 30 parts per 10^{12}, itself an astonishing discovery.[18] The extension of such field cavity-wave resonance to the hadron and the atomic nucleus can be justified on two counts. Firstly, there is the very recent proposal by Jennison *et al.*[19] that argues, from 4-space relativistic analysis, that field cavity resonance can occur in all fundamental particles, the proton being specifically mentioned. Secondly, the present author[20] has recently shown that the proton gyromagnetic ratio can be deduced from such a theory, to obtain a value within one part in 10^7 of the measured value.

V. CONCLUSIONS

The object of this paper has been to show that a new and potentially extremely important avenue of technological research has opened up, bringing controlled interaction with the gravitational field within sight. Until now, the general opinion has been that gravitation is something arising from a distortion of a four-dimensional space-time metric. Einstein's theory has been seen as the only route by which to understand gravitation. Yet, no practical or commercial outcome in the gravity field can be contemplated if we rely on the theory of relativity.

The position has now changed dramatically. The author's theory has been ignored, overshadowed, as it is, by the established general theory of relativity. Critics, if they exist, have not bothered to publish any reason arguing against the author's work in the gravity field. It seems not to have been appreciated that the theory achieved the objective in which Einstein failed, namely the task of discovering the unifying connection between electrodynamic law and the law of gravitation. The applicable electrodynamic law in its gravitational context was published in a technical journal in 1965.[21] The first derivation of G from pure theory, using the graviton concept, was first published in 1966.[8] The perihelion precession of the planet Mercury, which if acclaimed as proof of Einstein's theory, is relatively unimportant when set alongside the task of explaining the very nature of gravitation and deducing G. Even so, the author addressed the precession problem as well, to discover that the same law follows from a mere analysis of classical retardation effects arising from energy transfer between sun and planet in its radial perturbations. This was published,[22,23] as was a paper showing that the general theory of relativity contains a major paradox in supposing that planetary mass is invariant with change of speed in orbit.[24] On the face of it, this is a direct contradiction with the tenets of the Einstein theory of gravitation. However, in their quest to find the answer to field unification, the physicists specializing in gravitational topics are unlikely to turn away from their exploration of the early creation stages of the universe. The situation must, however, change if due account is now taken of the discoveries reported in this paper.

It seems quite clear that there are forces of nature occurring in the elements technetium and promethium which point to the anomalous supergravity condition. Such a finding could never have emerged from the theory of relativity. Gravitation is now seen simply as an electrodynamic interaction. It arises from oscillations of charge, relative to the electromagnetic reference frame shared by matter. These oscillations are necessarily at the high frequency we associate with the creation and annihilation of electrons and positrons in the vacuum field. The practical research task ahead is to find a way of inducing oscillation harmonics at this frequency and controllably segregating the in-phase and out-of-phase contributers to such oscillations, with a view to harnessing the force of gravity.

It follows that the subject of gravitation, to the extent that is has physical significance other than just a force we all feel, can now move from the theoretical world to the technological arena. By understanding the true nature of gravitation we can hope to devise machines that can controllably interact with the gravitational field. The author will be looking for support in pursuing this endeavor and hopes that readers of this paper will share in the exciting effort involved.

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