Synchronous lattice electrodynamics as an alternative to relativistic time dilation

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(Received 5 March 1987)

In view of the very strong indications that the time rate of atomic clocks dilates in dependence upon motion relative to a preferred cosmic frame, an alternative to relativistic time dilation is needed. It is shown that atomic clock rates are affected by motion relative to the preferred frame, according to the synchronous lattice electrodynamics as used by the author to explain the nature of the photon and the elementary particle spectrum in recent *Hadronic Journal* papers.

I. INTRODUCTION

Supporters of the Einstein relativistic doctrine, who have regarded the verification of the time dilation formula

$$\tau = \frac{\tau_0}{\sqrt{1 - v^2/c^2}} \tag{1}$$

as one of the strongest supports of the theory of relativity, are now faced with defending their position. Experimental evidence is pointing to the fact that this formula as applied to atomic clocks requires that the speed v should be referred to the preferred cosmic frame, through which the earth appears to be moving at a speed of 390 km/s compounded with its 30-km/s motion around the sun. Essentially, though the laboratory tests on fast-moving atoms suggest that v in Eq. (1) should be referred to the laboratory frame, the application of the equation to actual clocks reveals discrepancies which put this in doubt. Actual clocks involve tests spread over days and years, rather than nanoseconds as for the atoms.

Experimental data obtained by comparing the rates of two atomic clocks known to move at different speeds are providing evidence of anisotropy in the speed at which signals travel between the clocks. In addition, a recent experiment performed under U.S. Air Force sponsorship has shown that the nodal spacing in a standing wave set up by a laser beam and not constrained, as in the laser itself, does vary with the orientation of the apparatus and reveals the earth's motion through cosmic space. This clearly disproves Einstein's basic principle of relativity, provided the reported results are confirmed.

Before discussing these various experiments, it is appropriate to review the underlying theory of synchronous lattice electrodynamics. This allows us to keep in mind the alternative interpretation of the phenomena involved as we discuss the experimental evidence.

II. THE PRINCIPLE OF SYNCHRONOUS LATTICE ELECTRODYNAMICS

Galilean relativity according to Newtonian principles confirms that self-acting dynamical systems transported through space at a steady velocity exhibit no evidence of that translational motion to comoving observers. Thus, in a three-dimensional space metric, it has long been recognized that pure dynamical considerations will allow no way in which we can measure motion relative to the presumed absolute frame of reference, the notional preferred frame of cosmic space. A purely dynamical system formed by the frame having sites around which elements move at velocity u in orbits subject to a balance of a centrifugal force against a mechanical restoring force (e.g. provided by elastic strings) is an example of a system that can be transported at a translational velocity v in conformity with the Galilean relativity principle.

The action must, however, be different if the frames of two such systems move relative to one another and there are action-at-a-distance forces between the elements of the two systems. Such forces could arise once we see the elements as electric charges or consider the effects of gravitation.

A special situation, which lends itself to rigorous analysis, arises where the orbital motion of all the elements is subject to synchronizing constraints applicable within each frame system and between the two systems. This is the condition we describe by the expression *synchronous lattice electrodynamics*. The essential point is that the synchronous motion sets up mutual potentials between the elements which do not vary in response to that motion. This means that there is no continuous exchange of energy and so no retardation to consider. Action at a distance then assumes more meaning. An aspect of this is exemplified by the motion of a planet around the sun. The tangential orbital motion component assures that energy is not changing; it involves no continuous exchange between mutual gravitational potential and kinetic energies. Hence this action is unretarded. The radial motion component in an elliptical orbit does involve energy transfer and so is subject to retardation. Accordingly, the planet has a slower radial oscillation than its orbital period. It then exhibits an advance of perihelion. It does not need Einstein's general theory of relativity to explain the 43″ advance of the perihelion of Mercury per century. This explanation was first proposed by Gerber in 1898,[1] and an updated analysis, which overcomes a problem with Gerber's calculation, is provided elsewhere by the author.[2] A full derivation, coupled with the action-at-a-distance theme of analysis, has been published also recently by the author.[3]

Another simplifying feature of synchronous lattice electrodynamics is the fact that the constant time rate of the oscillations ensures that any mass associated with the lattice elements is constrained to be constant. A free particle has its mass augmented by the energy acquired in kinetic terms. This leads to the usual formula

$$M = \frac{M_0}{\sqrt{1 - v^2/c^2}}, \tag{2}$$

where v represents the speed of the mass M relative to whatever can correctly be regarded as the frame of reference. We should not suppose that all elements of matter must comply with this mass-increment formula. Indeed, if the planet Mercury were deemed to have a mass varying with its speed in orbit, the rate of advance of its perihelion would vary in a way inconsistent with that measured. This is well established and has been a subject of much controversy in the past. Even the relativistic theory requires the velocity moment and angular momentum to remain constant and involves a paradox if we persist in using Eq. (2) to view the planet Mercury from our Earth observer's frame of reference. This paradox has been discussed elsewhere.[4]

It is the action-at-a-distance feature and the constant-mass feature that, in combination, give us a very easy mathematical task in addressing the dynamics of the synchronous lattice.

III. THE INTERACTION OF TWO SYNCHRONOUS LATTICES IN RELATIVE MOTION

An astonishing property, which is extremely important to our consideration of the vacuum state, is that a synchronous electrodynamic lattice, when transported under the influence of a dominant enveloping synchronous lattice, will experience an induced electric displacement. What happens is that the orbits are displaced in their planes laterally with respect to the direction of the translational motion.

When we work out the energy density of this displacement, it is found that it corresponds to $\frac{1}{2}(v/c)^2$ times the energy density of the lattice system. This leads us to some very interesting properties, as we shall see when we discuss the basis of Eq. (1).

First, it is mentioned that, for the bulk rotation of the lattice (as with the whole Earth, for example), the effect of the synchronizing action is to induce electric displacement radial to the axis of rotation. However, the electric field in this case is merely balanced by charge displacement in matter that cannot be detected, except via its magnetic field effects, seen by the author as giving a basis for the geomagnetic field. The synchronizing constraints operate to take up the electric strain, but permit magnetic effects.

The author's theory of the photon[5,6] recognizes that an energy quantum augmenting the energy in the cubic vacuum lattice system (kinetic energy plus related potential energy) must involve a proportional angular momentum. This is balanced by the spin of a small $3 \times 3 \times 3$ lattice unit, which nudges the surrounding lattice at a frequency proportional to the angular momentum and so proportional to the energy quantum. This allows us to deduce the fine-structure constant from the geometry of the lattice.

Now, if, as indicated above, a proportion $\frac{1}{2}(v/c)^2$ of the energy quantum is deployed into electric displacement energy in matter, to keep the balance associated with the translational motion at speed v, then we can only have the proportion $1 - \frac{1}{2}v^2/c^2$ deployed into the frequency-determining process.

An atomic clock, to the extent that its frequency is set by the Rydberg constant, must therefore experience "time dilation" in the sense that its frequency is reduced by the fractional amount $\frac{1}{2}(v/c)^2$. Equation (1), so far as it is used to test atomic-clock behavior, is explained, because these clocks are never transported at speeds for which v/c is large enough to make the distinction between the equation and the term linear in $(v/c)^2$. For references to research on this subject see Refs. 7, 8. For an explanation of meson lifetime independent of the relativistic interpretation see Refs. 9, 10.

Our case here concerns clock rates—both the theoretical support for this new proposition and the experimental data that now militate in favor of the explanation using synchronous lattice electrodynamics. The theoretical basis has been outlined and will be treated in detail in the Appendix. The task now is to examine the experimental evidence which enables us to say that the v term in Eq. (1) is referred to the preferred frame, that of the all-enveloping metric of a universally synchronous lattice. A lattice coextensive with the body of the earth and its atmosphere, which rotates with and moves forward with the earth, is quite conceivable provided we acknowledge that the vacuum is a sea of leptons. At collision boundaries between separate lattice systems the energy can be redeployed between different lepton forms to ensure that there is no buildup of surplus lattice elements or corresponding shortage of elements where lattices separate. The lattice is essentially a fluid crystal system comprising the most degenerate lepton form, and no doubt the neutral combination of this lepton form can be identified as the neutrino. In contrast, the muon type of lepton provides the background 'gas', the energy sink, of the vacuum state, a system in random migratory motion in the inertial frame, but having no structure and no role directly affecting Planck's constant. The dynamic properties of the lattice elements and any matter that shares the synchronous motion of the lattice produce the imbalance that demands a heavier lepton form to act as the counterbalance. This is the role of the tau-graviton complex discussed in the theory by which the constant of gravitation G has been determined.[11] The presence of matter deploys energy from the muon state to the tau-graviton state. Thus the forward translational motion of matter involves no net transport of vacuum energy, but the presence of matter has deployed energy in the vacuum from the random disordered state into the synchronous ordered state which develops the gravitational interaction. At collision boundaries, where lattice vacuum structures involve a surplus of energy in the lattice form, the muons are supplemented by the transition of the degenerate vacuum lepton form into muons to become part of the background energy sea. Where lattice boundaries separate, the muons can restore equilibrium by mutual annihilation and creation of the degenerate lepton form.

The experimental support for these various propositions must now be considered.

IV. TIME RATES OF MOVING ATOMIC CLOCKS

Consider an atomic clock in the earth laboratory frame and used to monitor the rate at which the earth rotates. Before atomic clocks were discovered, the observation of the earth's speed of rotation relative to the stars and as judged by chronometers was recognized as being subject to inexplicable fluctuations. Variation of the length of the day by as much as 3 parts in 10^7 is mentioned in the handbooks.[12]

Now, a chronometer with a mechanical movement keeps time by a natural oscillation period which varies as the square root of a term linearly proportional to the mass of the oscillating element. If this mass varies according to Eq. (2), we shall find that the clock period varies inversely as the fourth root of $1 - v^2/c^2$. Such clocks would be discrepant from atomic clocks by 6.5 parts in 10^8 at times in the annual cycle, if v is referred to the preferred frame and is compounded from the 390-km/s cosmic motion and the 30-km/s motion of the earth around the sun.

Supposing that Earth mass does vary according to Eq. (2), the constancy of its physical size plus conservation of angular momentum about its axis will mean that the length of the day varies as the earth mass. In other words, an atomic clock would keep the same time as the earth, if the latter is used as a clock. It is no wonder then that when atomic clocks came to be used to monitor the length of the day, the discrepancies over the annual cycle were reduced to about 0.5 ms per day or 6 parts in 10^9. There is no logic in relying upon atomic clocks to tell us that the rate of Earth rotation is constant to within this small amount. The atomic clocks could well be changing rates in an annual cycle in step with the earth itself and in conformity with Eq. (1) as referred to the preferred frame.

However, if we take two atomic clocks at different latitudes on earth, having calibrated them at the same place to assure that they keep identical time, the earth's rotation must affect their count of time over long periods. Such clocks, if placed at the pole and at the equator, should reveal that the polar clock runs faster. Furthermore, there should be a daily variation related to the cosmic speed v, and it should be possible to probe this condition to establish the point in issue. The daily variation could even be monitored if the clocks are not set to be perfectly identical in performance, because it should be greater at latitudes nearer to the equator.

A very relevant factor is that clocks at different latitudes will, according to the relativistic interpretation, keep different times depending on which clock is taken as the reference clock. The other clock should then run more slowly, a seeming absurdity discussed at length by Essen.[13] However, the experimental evidence does show that the clock at the higher latitude does gain steadily in time as if its period is faster than the other by the fractional amount $\frac{1}{2}(s_1^2 - s_2^2)$, where s_1 is the eastward speed of the clock at the lower latitude and s_2 is the eastward speed of the clock at the higher latitude.[14] When this test was first reported it was said to be a test supporting Einstein's general theory of relativity, because the expression involving s_1^2 and s_2^2 terms relates to centrifugal acceleration, whereas the special theory of relativity concerns the much smaller expression $\frac{1}{2}(s_1 - s_2)^2$, for the latitude separation used. However, the authors of Ref. 14 later realized that the tests were supposedly referred to to the same altitude, and what they had forgotten was that the gravitational acceleration cancels any variation of the centrifugal acceleration on the geoid surface. The same authors conceded this point in a later paper[15] and declared that the time drift between the clocks, which had been taken to support the term $\frac{1}{2}(s_1^2 - s_2^2)$, would need some other explanation. Recent comment on a similar theme has been made by Scott Murray, who argues against the theory of relativity.[16] The point, of course, is that the answer lies in the referring Eq. (1) to the preferred frame.

The experiment which needs to be performed to detect possible motion through cosmic space involves two atomic clocks at the same longitude but at different latitude, with a third clock intermediate between the two test clocks that sends a signal at a test frequency to both of the other clocks. The fluctuation of rate of the two clocks as monitored through the daily cycle should show up in relation to this test signal. The latter cancels from the data when the two sets of fluctuations are compared, and so a measure of the variation due to motion in cosmic space should be possible.

Until such an experiment is performed, we are left to extract evidence from experiments performed with the less direct objective of verifying the theory of relativity. One such experiment that is very important is that reported by Vessot and Levine.[17] Here an atomic clock was transported to an altitude of 10 000 km and its time rate compared with an earth-based atomic clock. A special Doppler mixing technique was used to show that provided Eq. (1) is referred to the Earth frame, there is an unambiguous indication that signal speed of Earth to rocket was within 3 parts in 10^9 of the return signal speed of rocket to earth. This rules out the existence of the preferred frame unless we can hold to the view that Eq. (1) is referred to the preferred frame. In this latter case it is found, on working through the analysis used by Vessot and Levine, that their test is nullified as an indication of light-speed isotropy in the preferred frame.

The choice is to accept that the Earth is the valid frame of reference for light speed over the 10 000-km range to the rocket and that the time rate of the rocket-borne clock depends upon the rocket speed relative or earth, or to accept that atomic clocks must have v in Eq. (1) referred to that preferred frame that common sense suggests to our intuition.

V. SPEED-OF-LIGHT ANISOTROPY TESTS

Any interest in the preferred frame has to address the question of the Michelson-Morley experiment. In this experiment standing waves are set up over the test lengths of the interferometer. In standing waves the light ray moving one way travels through the energy field of the ray moving the opposite way. The isotropic speed of light along this direction of the ray path appears then to change to c' given by $c(1 + v^2/c^2)$, where v is the component at which the standing wave system is transported through the preferred frame in the beam axis. When $v = 0$ then $c' = c$.

The reason for this is the fact that, from the viewpoint of the preferred frame, the standing-wave system is seen as amplitude modulated at a frequency which can be identified as the de Broglie frequency mcv/h, where m is the mass equivalent of the energy of a photon quantum in the standing-wave system. The beat frequency is therefore v/c times the standing-wave frequency.

Then, using the classical formula for the Doppler effect in a medium through which a source moves at speed v, whilst the propagation speed is c', we find that the beat frequency in terms of the standing-wave frequency is the difference between half of $c'/(c'-v)$ and half of $c'/(c'+v)$, which is v/c only if, ignoring fourth-order terms in v/c, we can say that c' is $c(1+v^2/c^2)$.

The experimental support for this depends upon a combination of the Michelson-Morley experiment and a new experiment reported by Silvertooth. For a round trip of a light wave over unit distance in the direction of v, the journey time will be $1/(c'-v)+1/(c'+v)$. To second order in v/c this is $(2/c')(1+v^2/c^2)$, because c is approximately equal to c'. This expression is simply $2/c$, which is independent of v, as was evident from the Michelson-Morley test.

However, if one investigates the spacing of the nodes of the standing waves, one finds a first-order dependence upon v. It was in this way that Silvertooth[18,19] established that the speed of light is, in fact, given by

$$\frac{c}{1+v/c} \tag{3}$$

in the direction in which an apparatus creating the standing-wave condition moves through the preferred frame at velocity v.

Silvertooth has detected motion of the solar system in the direction of the constellation Leo at a speed which one test estimated as 378 km/s. Detection of such motion has been confirmed by a revised version of the experiment, and it is understood that other research groups are projecting a verification of such experiments.

The secret of the Silvertooth experiment appears to depend upon the partial absorption by the detector in scanning along the standing wave beam. Related to this sensing there are wave components travelling freely one-way at speed referenced on the preferred frame. These have a modulating effect on a standing wave condition comprising equal and oppositely moving wave components that by resonance are referenced on the moving frame of the apparatus.

In these circumstances, the evidence favors the clear existence of the preferred frame. This is further confirmed by the earlier research of Torr and Kolen,[20] which demonstrated that, as two free-running atomic clocks were juxtaposed in the direction of our cosmic motion by the Earth's rotation, the speed of the signal sent between them indicated invariance averaged over the return trip, but anomalies of 0.1% or more of light speed for the one-way propagation.

VI. EVIDENCE FROM MEASUREMENTS OF THE FINE-STRUCTURE CONSTANT

The preferred frame can also be sensed in the precision measurements of the fine-structure constant, and particularly by resolving the problem of why the values measured by different methods, or even the same method, give different results at different times and at different locations. The discrepancies, which can be several standard deviations at the one-part-in-10^7 level, are in this author's opinion due to the effects of our changing motion in cosmic space.

The very nature of the precision measurement of the fine-structure constant gives a quantitative basis on which to estimate the Earth's motion through space. The results rival the method used by Silvertooth[19] and look more promising than the techniques involving repositioning of atomic clocks, such as those of Torr and Kolen.[20] Such experiments suffer from a need to make special allowance for the phase changes occurring as the clocks are repositioned, and monitoring over several hours can lead to drift factors that make the findings uncertain.

The measurement of the fine-structure constant α presupposes that it is a true constant. This can be questioned. As the earlier theory indicated, the release of energy from a photon event is apportioned so that all but the fraction $\frac{1}{2}(v/c)^2$ goes into the frequency-determining process, the rest being stored by electric displacement. In effect, analysis based on the relationship with frequency should consider Planck's constant h as increased by the factor $1+(v^2/c^2)$ to give a new constant h_v for use in the source energy relationship.

Petley[21] has argued that α cannot vary, even by as much as 1 part in 10^{12} per year, by appealing to the fact that atomic clocks and an oscillation in a resonant cavity keep the same time, whereas their ratio is a function of α. The weakness of this argument lies in the assumption that the physical dimensions of the superconductive cavity oscillator are proportional to the radius of the electron orbit in the Bohr atom. This assumption requires that this radius does not depend upon translational motion at the speed v. The same assumption, taken together with the experiment discussed by Petley, would deny that atomic clocks suffer time dilation when in motion at speed v. Hence, the present author has chosen to ignore the argument that α, at least as measured, must be invariant with v.

Considering, therefore, the quantized Hall-effect method of measuring the fine-structure constant, we can argue that the basic flux quantum of hc/e really should be replaced by $h_v c/e$. It is derived by considering the inductive energy fed into a photon quantum connected with an electrostatic charge e orbiting the flux quantum at the photon frequency.

The quantum Hall resistance in electrostatic units is then altered from hc/e^2 to $h_v c/e^2$, and it is this that is measured experimentally. What this amounts to is that the derivation of values of hc/e^2 from such experiments will be higher than they should be by the factor $1 + \frac{1}{2}v^2/c^2$. The measured values of α^{-1} will be higher than the true base constant for $v = 0$. This should allow us to deduce v from these data on α measurement, provided we are prepared to accept the author's 1972 showing[22] that the free-vacuum lattice value of α^{-1} is exactly 137.0359148. This uses the theory of synchronous lattice dynamics.

It is then seen that a value of v of, say, 380 km/s would suggest that α^{-1} should be measured as 137.036024(18), where the error range corresponds to the 30-km/s motion of the earth about the sun.

Now, a typical measure using the weak-field proton gyromagnetic ratio and the Josephson measurement gives a value of 137.035965(12), as reported by Williams and Olsen.[23] This agrees with the same formula as that used above, because the flux quantum of the Josephson effect is mixed with a Rydberg frequency expression which brings h_v into the equation for α in the following way:

$$(\alpha^{-1})^2 \propto \frac{2e/h_v}{R_\infty} \propto \frac{2e/h_v}{1/h^2 h_v}. \tag{4}$$

Williams and Olsen's value is slightly low, but close enough to support the proposition under discussion. However, the recent measurements of the quantized Hall-resistance values[24] give α^{-1} as 137.036012(11), which is very close indeed to the result expected. This gives a speed of 357 km/s for v with an uncertainty estimated as about equal to that of the earth's motion around the sun.

Another check on the theory for the fine-structure constant emerges if we use a result based on the measurement of the electron g factor.[25] It has been shown that a cavity-resonant interpretation of the electron g factor fits a value for α^{-1} of 137.0359894 to within 34 parts per 10^9. The g factor, on this interpretation, would be affected, as a function of α, if the cavity radius were increased in proportion to c' by the standing wave condition. The electron has to be seen to be at rest in the preferred frame for this purpose, because it really moves as a lepton by successive annihilation and recreation, as discussed elsewhere.[26] The effect of this, since c' is extended to $c(1 + v^2/c^2)$ in only the v direction, is to reduce the anomalous g-factor component by the factor $(v/c)^2/3$. In other words, since this component is proportional to α to adequate approximation, α^{-1} has been overestimated by this method. Again using the theoretical value of 137.0359148 as the base, we can deduce from the g-factor data that v is 383 ± 12 km/s. This suggests that the very high precision of electron g-factor measurements may well be already adequate for us to look for the annual variation as the earth moves around the sun, so as to verify the theory presented.

VII. CONCLUSIONS

These findings lead the author to contend that the theory[27] which has already given a precise determination of the proton-electron mass ratio, to at least one part in 10^7 accuracy, has now proved equally successful in giving a good account of the fine-structure constant.

The paper has shown how the discrepancies in such measurements may be attributed to the variations in our cosmic motion through space, and the quantitative indications support the findings by other methods. Notable amongst these is the experiment of Silvertooth,[19] which is a direct measurement yielding 378 m/s by optical interferometry tests based on standing-wave phase variations in a linear scan along a free system of standing waves set up by the same laser.

Such results are completely contrary to the expectations from the theory of relativity, which, as we have seen, is now in trouble owing to the indications of a time-rate dependence of atomic clocks upon motion through the preferred frame. Tests are possible, though apparently impracticable at present, for the direct measurement of the earth's cosmic motion from the diurnal variation of clock rates at different latitudes. However, there is enough of a record from the long-range drift of clock rates for us to see that time-rate differences are not simply related to the relative velocities of the clocks.

The most important statement in this paper is that atomic clocks, which we assume to be stable, are subject to an annual variation which also affects the earth's rate of rotation. This has emerged from an in-depth analysis of the nature of the photon and its dependence upon the translational-motion effect of the interacting synchronous lattice vacuum states.

Finally, the author seeks to clarify what the reader might see as being an inconsistency concerning the

This is independent of θ provided

$$V\sigma = k\delta. \quad (10)$$

which it is, because conventional electrostatic theory tells us that $V = 4\pi\sigma\delta$, $k = 4\pi\sigma^2$, and because $V^2/8\pi = \frac{1}{2}k\delta^2$. Not surprisingly, therefore, the total energy density additional to $\frac{1}{2}\rho v^2$ becomes

$$\tfrac{1}{2}E + \tfrac{1}{2}k\left[(2r)^2 + \delta^2\right], \quad (11)$$

which, from (5) and (6), is

$$2\rho\Omega^2 r^2 + \tfrac{1}{4}\rho\Omega^2\delta^2. \quad (12)$$

To find δ we note that when θ is 0 or π, the velocity of a lattice element, as seen from the preferred frame, is $\Omega(r - \delta)$ or $\Omega(r + \delta)$, respectively. These are also $\Omega r - v$ and $\Omega r + v$, respectively. Hence $\Omega\delta$ is v.

The photon theory brings c into the lattice system as the relative speed of the lattice and the system moving in juxtaposition with it. Thus $2\Omega r = c$. From this and (12) it is seen that the fractional increase in the intrinsic energy of the lattice moving at speed v is $\delta^2/8r^2$, which is $\frac{1}{2}(v/c)^2$.

It is very important to realize that this additional energy is electric field energy and corresponds to an electric field acting lateral to the motion at speed v. The synchronizing constraint asserted between lattice systems in relative motion is therefore analogous to a centrifugal action. Now, when centrifugal actions are compounded with a linear translational motion at steady speed, we know from Galilean relativity principles that there is an energy balance that avoids effects related to cross products of the two velocities involved. The same argument applies to this energy factor $\frac{1}{2}(v/c)^2$, when incorporated in Eq. (1).

This means that if an atom, as a clock, moves within and relative to an enveloping lattice coupled with the earth, and the earth moves through an enveloping free-space lattice, then Eq. (1) will include two separate terms of the form $\frac{1}{2}(v/c)^2$, one relating to clock motion relative to the earth and one relating to earth motion through the preferred frame. It follows from this that the Ives-Stilwell[28,29] experiment or that performed by Mandelberg and Witten[30] will reveal no indication of a preferred frame, except possibly in the minor $(v/c)^4$ adjustments. This, of course, is an active research field (see Refs. 7 and 8).

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applicability of Eq. (2) to the motion of a planet. As stated in Ref. 4, the translational motion of a planet is coupled with the vacuum lattice system, and the leptons of this system assure a balance which precludes any mass increase, according to Eq. (2), from evidencing itself in the sun-planet interaction. Indeed, just as the presence of rest mass causes energy transfer from the muon to the tau-graviton system, so its kinetic energy can itself be said to involve such a transfer. This means that the kinetic energy cannot exhibit mass on a planetary scale for translational motion. However, such energy can share the rotation of the planet and exhibit its mass in this mode, because the deficit mass of the muon-lepton gas does not share this rotation. Equilibrium is sustained without any migration of the gas in the rotation mode, whereas there has to be a balancing momentum condition for translational motion.

APPENDIX: ANALYSIS OF THE EFFECT OF TRANSLATIONAL MOTION IN SYNCHRONOUS LATTICE ELECTRODYNAMICS

The vacuum metric is supposed to comprise a population of lattice elements of mass density ρ and electric charge density $-\sigma$ subject to a restoring-force rate k per unit volume and moving in circular orbits of radius r at the natural angular frequency Ω. We write, therefore,

$$\rho\Omega^2 = 2k. \qquad (5)$$

The factor 2 arises from the balancing action of a mass density ρ describing similar orbits in a diametrically juxtaposed position.

The essential property of such a system is that, in its undisturbed state for which r is constant, the angular momentum density $2\rho\Omega r^2$ and the energy density E are proportional. E is twice the kinetic energy density $\frac{1}{2}\rho\Omega^2 r^2$ plus the potential energy density $\frac{1}{2}k(2r)^2$, so that, from (5), we have

$$E = (2\rho\Omega r^2)\Omega. \qquad (6)$$

This is the basic relationship used to explain photon radiation. It merely says that a photon energy quantum W will involve an angular momentum W/Ω, where Ω is the natural angular frequency of the vacuum metric, a universal constant.

When the whole lattice system is transported at a velocity v under this universal synchronizing constraint, the center of the orbit is shifted from O to O', perpendicular to the velocity v and in the orbital plane (see Fig. 1).

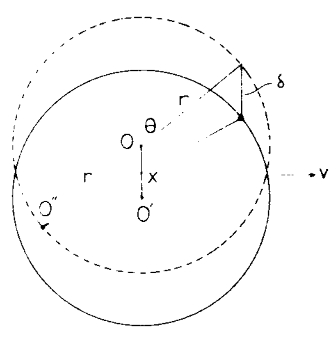

FIG. 1. Effect of motion at velocity v in displacing orbits of the lattice in the vacuum metric.

Apart from adding $\frac{1}{2}\rho v^2$ to the kinetic energy density of the lattice, as judged in the preferred frame, this cannot affect the orbital kinetic energy of the moving frame. Here, we appeal to the Galilean relativity condition. Note also that we have not added translational kinetic energy for the balancing term involving ρ, because, as already stated, this mass energy is provided by the tau-graviton system, which is matched by a deficit mass energy in the muon gas in the inertial frame.

The potential energy of the orbital motion is modified, because the restoring force still acts towards a point O'' in the system in juxtaposed motion with the original orbit (broken-line circle). Thus the potential energy density is changed from $\frac{1}{2}k(2r)^2$ to $\frac{1}{2}kx^2$, where, with $OO' = \delta$,

$$x^2 = (2r)^2 + \delta^2 - 2(2r)\delta\cos\theta. \qquad (7)$$

Note that in order to displace the orbit the synchronizing constraints have to develop electric forces tending to separate the lattice of charge density $-\sigma$ and the background continuum charge density $+\sigma$ in the juxtaposed system through a distance δ.

The term $\frac{1}{2}k\delta^2$ is then a measure of the energy density $V^2/8\pi$ of an electric field of intensity V induced by this process. This electric field does other work during the orbital cycle, represented by the expression

$$V\sigma(r\cos\theta) - V(-\sigma)(-r\cos\theta) = 2V\sigma r\cos\theta. \qquad (8)$$

As a result, the energy density additional to the kinetic energy density of the lattice system is

$$\frac{1}{2}k\left[(2r)^2 + \delta^2 - 4r\delta\cos\theta + 4\frac{V\sigma}{k}r\cos\theta\right]. \qquad (9)$$