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Overview of theoretical considerations and problems related to the putative existence of repulsive gravitation, charge-mass repulsive force and unification

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Abstract. We use a torsion balance scale to measure the attraction between two large lead balls and two smaller brass balls, connected with an up-side down T bar that is hung with a string. The vertical part of the T bar is attached with a mirror that reflects a laser beam to provide a light spot that shows how much the T bar has turned. It is observed that the gravitational forces between the lead balls and the brass balls are reduced when the temperature of the lead balls increased. Thus, this experiment shows clearly the existence of a repulsive gravitational force that increases as the temperature of the lead balls increase. This supports that the charge-mass interaction is the reason that the theories of Galileo, Newton, and Einstein failed to explain the Anomaly of the Space-Probes and flybys, and the fact that not all the neutral subjects necessarily fall with the same acceleration. In other words, the Newtonian law of gravitation is only approximately valid. Thus, the attempts such as J. Luo (罗俊)'s to obtain an accurate gravitational coupling constant with just improved skill are futile. The physical picture of Galileo, Newton, and Einstein on gravitation needs extension beyond the Standard Model (SM).

1. Introduction

Although we lack any reasonable theory, there are sufficient open questions to allow even highly speculative, at this time, explorations of repulse gravity. It has yet to be summarily demonstrated that repulsive gravitation is untenable; Einstein himself speculated on the possibility of negative gravitation. As well-known general relativity is a classical formulation; and the standard model is far from complete, leaving the door open for an eventual discovery of repulse gravitation. Notables like Feynman suggested that gravity may not be quantized. There exists no a priori reason to suggest it is. M-Theory has extended gravity to brane topology. Some form of mirror-symmetric inversion, when there is experimental access to higher dimensionality, could be when the issue is finally settled. Dark energy/matter aficionados claim repulsive gravitational conditions are hinted at in multiverse cosmology. In 2018, astrophysicist J Farnes proposed a "dark fluid" theory that included notions of gravitationally repulsive negative masses, that could help understand, in a testable manner, the huge amount of cosmological dark matter/energy.

In 2006 Barrow and Webb discussing “Inconsistent constants” said theory suggests that varying the fine-structure constant makes objects fall differently. Galileo predicted bodies in a vacuum fall at the same rate no matter what they are made of - the weak equivalence principle, demonstrated by Apollo 15 astronaut D. Scott dropping a feather and a hammer that hit the lunar dirt at the same time. But that principle no longer holds precisely. Variations generate a force on all charged particles. The more protons in an atom, the more strongly it feels this force. If quasar observations are correct, accelerations of different materials differ by about one part in 10^{14} - large enough for detection in missions such as STEP (space-based test of the equivalence principle).

Gravitation is the first force in nature discovered by mankind. Due to the limitation of our knowledge, gravitation was thought of as a force between masses only. Galileo was the first to show experimentally that the gravitational acceleration on a piece of neutral matter is independent of its mass. However, in Einstein's time, it was discovered from special relativity that mass and energy can be related. Therefore, the relation between gravitation and energy must be investigated further. Einstein [1] claimed that $E = mc^2$ is generally valid and thus an increment of energy on matter must have led to an increment of its weight.

Experimentally, in contrast to Einstein's claim, it is known that a charged metal ball has reduced weight [2], and a charged capacitor has reduced weight [3] and a piece of heated-up metal also has reduced weight [4,5]. Theoretically, we also derived that the weight reduction is due to the existence of a repulsive force toward mass [4]. However, the skeptics, believing in the relation $E = mc^2$, are not convinced. Although it is apparent that part of the mass has converted to energy in the atomic bomb, the proof for the conversion of a single type of energy to mass has never been proven. In fact, Einstein [6] tried very hard from 1905 to 1909 to show this, but failed. Moreover, it is found that the gravitational acceleration of a neutral object is not necessarily the same [7].

One might argue that the photonic energy can be converted into mass [8]. Moreover, such a conversion is supported by the fact that the π_0 meson can decay into two photons. However, since the addition of electromagnetic energies is still an electromagnetic energy, the electromagnetic energy, which has a traceless electromagnetic energy-stress tensor cannot be converted into a mass, which has a non-zero trace energy-stress tensor. Moreover, the formula $E = mc^2$ is also inconsistent with the Einstein equation, because it implies that the traceless electromagnetic energy-stress tensor cannot affect the Ricci curvature R, but the mass can [9]. This conflict is resolved because the photonic energy must include gravitational energy [10.11].

Some argued that the weight reduction of a charged metal could be due to electric effects, but the static electric effect can only increase the weight; and that the weight reduction of a charged capacitor could be due to the leaked-out electricity, but the charged capacitor is in a metal box. Moreover, metals such as gold has nothing to lose.

Recently an experiment on the temperature dependence of gravitation was done by Li Hua-Wang [12] inside a large vacuum can in China. Although it confirms the dependence of the gravitational force, the oscillating of the two brass balls make an elaborated theoretical explanation necessary. Here, we present a verification conducted in the air. Moreover, this verification is direct and thus there is no room for doubt (see Appendix A).

Prof. A. Napier attempted to measure the change of gravitation due to temperature increment. However, owing to the external interference for the passing of a subway near by, the data of the periodic changes is not reliable. Thus, this paper on the existence of gravitation reduction is published first. An accurate reduction due to temperature increase will be published in the future.

2. Measurements with the Li apparatus

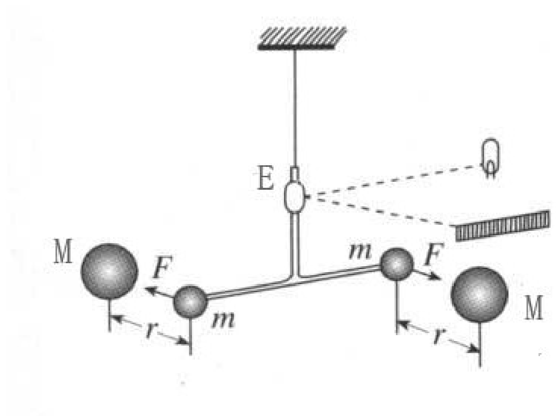
Li's torsion balance was housed in a large can with an inner radius of 1.8 meters and inner height of 1.8 meters. This can has two windows. The round one is for observations inside the can, and the meter next to it is the vacuum meter connected to a powerful vacuum pump. The rectangle window is for the in and out of a light beam.

This setup can isolate influences such as air movements. Moreover, the can is located in an insulated chamber inside a cave, and thus effectively also eliminates the outside vibrations and temperature changes. To control the temperature of the chamber, the chamber is isolated and equipped with an air heater and a powerful air cooler.

In comparison, our equipment is a bare torsion balance scale, but the large lead balls are placed in a carrying bar with the length of the T-bar that connects the two brass balls. The carrying bar can be rotated around the mirror to adjust the distance between that large lead ball and the smaller brass ball. An advantage of a bare torsion balance scale is that the oscillation of the brass balls can be controlled easier. To avoid the influence of out-side disturbances; the experiment was conducted in an isolated room that does not have the interference of air flows. It is fortunate that our method of experiment can resist the interference of a subway passing nearby.

2.1 The Torsion Balance Scale

We also use the torsion balance scale as Li except that the distance of the two brass balls is extended from 30 cm to 40 cm. The forces between brass balls and lead balls are measured with a torsion balance scale as follows:



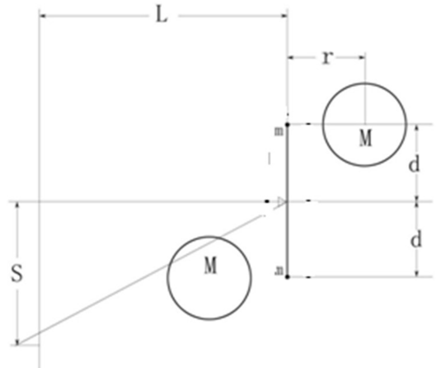


Figure 1 The torsion balance scale Figure 2 Details of the distances

1. The small brass ball has a mass m = 0.575kg and the large lead ball has a mass M = 1.5kg.
2. The two brass balls are connected with a bar of 2d = 0.40 meter, and suspended from the middle in a horizon orientation by a fine wire (“torsion balance”) as shown in Fig. 1 and Fig. 2.
3. A mirror E is attached to the bar to reflect a light beam shined in the mirror.
4. A white board is placed at distance L = 10.3 meter from the mirror as shown in Figure 2.
5. A light spot is shown in the board at a distance S from the middle (the moving distance of the light spot).
6. The distance between the center of the brass ball and the lead ball is r = 10 cm as shown in Figure 2.
7. The natural period of the torsion balance is T.

Then, according to Newtonian approximate theory, the gravitational force is $F = \pi^2 mdS/T^2L$. Thus, the torsion balance can be very sensitive since the sensitivity will increase with the distance L. Then, the Newtonian coupling constant would be $G = \pi^2 r^2 dS/MT^2L$. However, since Newtonian theory is only approximately valid, this formula is not useful to deal with the repulsive gravitation.

Although the period T could increase as the temperature increases, it is difficult to measure an accurate T due to external interferences. Besides the small difference could be mistakenly considered as due to experimental errors.[2] Thus, we decided to do the experiment in two ways. First, we prove directly the existence of a reduction of gravitation due the increment of temperature of the lead balls. Second, we used the traditional method to see the differences between the periods between before and after the lead balls are heated. However, the latter is not accurate enough to be conclusive.

2.2 Experimental Steps

So, a new way must be found the verify the gravitational reduction due to temperature increase. Our method is to find a balance point between gravitation and the torsion force first. Then, we show that the gravitational force is reduced when the lead balls are heated-up. The steps are as follows:

A) Determine the balance position
1) Take away the lead balls from the scale and leave the two brass balls in the T bar.
2) Adjust the torsion to the minimum.
3) Reduce the oscillation of the light spot at the screen to the minimum to about 15 cm.

B) Measuring the gravitational force in the room temperature.
4) Place the large lead balls inside thermal containers on the carrying bar, which is in a perpendicular position to the T bar.
5) Turn the carrying bar so that the lead balls are in a close position with the brass balls. Then, fix the position of the carrying bar in this angle. Adjust the torsion such that the brass balls barely touch the lead balls. Thus, the gravitational force is in an almost balance position with the torsion force.

C) Measuring the gravitational force after the lead balls are heated-up in boiling water, which is about 97^0C.
6) Take the lead balls away from the scale and heat them up in boiling water. After about 20 minutes, put the lead balls back to the thermal containers. Then place them in the previous positions.
7) Then one would find the brass balls cannot be in touch positions with the lead balls. This shows that the gravitational force has been reduced because the temperature of the lead balls has increased. These successful operations were repeated five times.

Thus, the experiment shows the temperature dependence of that gravitational force that would reduce the gravitational forces between the brass and the lead balls as temperature increases. The merit of this experiment is that it shows the temperature reduces the gravitational force directly even the temperature increment is small.[3)] Another merit of this method that it is not influenced by the normal air movements.

This method also resists the influence of a passing subway nearby. Moreover, since the electromagnetic force is not involved, the existence of repulsive gravitational force seems to be the only possibility.

3. Conclusions and discussions

Now, it is clear that the attractive gravitational force reduces as the temperature increases. However, while the experiment confirms the temperature dependence of the gravitational force, it did not provide a numerical value for such changes. Nevertheless, it confirms the existence of a repulsive gravitational force. For the numerical value of such a repulsive gravitational force, whose existence can be derived from the static Einstein equation [13], is complicated and thus requires to design a new experiment. For the related theoretical consideration (see Appendix A).

In the experiment of Li [12], the temperature of everything is changed simultaneously, and thus the temperature effects on the brass balls and the hanging string must be considered although they are neglegible. In our approach, only the temperature of the lead balls has been changed.

However, the experiments on the weight reductions of charged metal ball and the charged capacitor, had not been completely trusted because of the involvement of other forces [3,4,14]. The weight reductions of the heated-up metals were mistaken as a reduction of mass [4,5]. (The pendulum experiments would show that mass does not change [7].) From this experiment, the existence of repulsive gravitation is no longer questionable although the details of such a repulsion force due to heat is not yet clear. To explain this, one must understand the charge-mass interaction [4,15].

Thus, the American Physical Society (APS) should have recognized that they are lacking behind in the field of gravitation. However, in the April 2015 APS Meeting, the top executive still does not know that there are three experiments that support the existence of repulsive gravitation and invalidity of E =

mc^2 [14] because Eric J. Weinberg, the editor of the Physical Review D has not accepted them. Because of inadequacy in mathematics and physics, it never occurred to him that the gravitation is actually a combination of effects [4] (see Appendix A).

Moreover, the 2016 award of APS Medal for Exceptional Achievement in Research was awarded to E. Witten, without the necessary supports of any experiment [16]. Apparently, the APS Awarding Committee does not know that just as Yau [17], Witten [18] has made serious mathematical and physical errors on general relativity [19]. Thus, it is clear that APS has a problem on her competence in mathematics and physics of gravitation [14].

At the beginning of this research, we could not find a physicist who is willing to do the experiments that would show Einstein wrong. This is so because the physical community generally but incorrectly believed that Einstein could not be wrong in classical theory!! It turns out, however, many experiments that are, in fact, against Einstein's predictions have been done because those who did such experiments did not know their actually physical mean [4, 16]. Moreover, we must be grateful to the US Department of Defense, who allows the publication of the experimental results done under their contracts [20].

Many theorists, just as Einstein, have a blind faith on $E = mc^2$ [3, 4] because of the atomic bomb. [4)] Another problem is that they do not understand pure mathematics, and non-linear mathematics in particular [9,14]. According to Dr. Daniel Kulp, Editorial Director of APS, no editor of APS has a background in pure mathematics. In fact, there are incorrect papers on general relativity published in the Proceeding of the Royal Society A, Classical and Quantum Gravity, General Relativity and Gravitation, and the Annals of Physics, in addition to the Physical Review. They all are at best speculations without rigorous theoretical or experimental supports. These problems in gravitation have been pointed out and our APS CEO Kate Kirby has promised to deal with these issues in this year (see Appendix B).

These journals accepted that the Einstein equation has dynamic solutions because they have mistaken that linearization of the Einstein equation would produce approximate solution for the Einstein equation even for the dynamic case [21]. Due to such confusion, the claim of Christodoulou and Klainerman [22] was incorrectly accepted [23]. Thus, the announcement of the 1993 Nobel Committee for Physics [24] contains invalid statements [25].

Newton's inverse-square law of gravitation is the oldest mathematical description of a fundamental interaction. Experimental tests of gravity's distance-dependence define a frontier between our understanding of gravity and many proposed forms of new physics. The invited talk of Charles Hagedorn [26] by APS surveys the past, present, and near-future of the experimental field, with substantial emphasis on precision sub-millimeter laboratory experiments. However, Hagedorn also did not know that the measured weight of testing matter actually depends on its temperature [3, 4]. Although Faller [27] is aware that error budgets in the measurements of the Newtonian coupling constant are fundamentally flawed because one cannot make allowances for error sources that have not been thought of. However, he also did not know that the current measurements to obtain the Big G could not be accurate due to ignorance on the influence of heat to weight [3, 4].

In conclusion, a common error in gravitational measurement is that many failed to see that the gravitational effect is not a single effect as many believed, but is a combined effect of at least three factors, i.e. 1) the mass-mass attractive interaction, 2) the charge-mass repulsive interaction,[5)] and 3) the current-charge attractive interaction. Thus, the measurement of gravitation is still in its infancy.

For instance, believing in that the most accurate G can be obtained by current method of measurements alone, J. Luo (罗俊) hopes to be able to obtain the most accurate G soon [28]. However, such efforts are futile because of the temperature dependency, but he can direct his efforts to measure the temperature dependence of gravitation. However, to verify this gravitational force reduction is due to the charge-mass interaction, more experiments are needed to see the nature of such gravitational force reduction.

Based on the notion that gravity is always attractive, a popular speculation on gravitation is the existence of black holes. Now, since it is proven that there exists repulsive gravitation, naturally the notion of black holes is questionable. Moreover, because the Einstein equation is not valid for the dynamic case [14] there is actually no theoretical basis for the existence of black holes.[6)]

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Appendix A: Some theoretical considerations related to the repulsive gravitation
The first theoretical existence of the repulsive gravitation actually comes from a solution of the static Einstein equation for a charged particle Q, the Reissner-Nordstrom metric [29] as follows:

$$ds^2 = \left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right) dt^2 - \left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right)^{-1} dr^2 - r^2 d\Omega^2, \quad \text{(A1)}$$

(with c = 1) where q and M are the charge and mass of a particle, and r is the radial distance (in terms of the Euclidean-like structure [30]) from the particle center. In metric (A1), the gravitational components generated by electricity have not only a very different radial coordinate dependence but also a different sign that makes it a new repulsive gravity in general relativity.

However, owing to the belief that the electric energy had a mass equivalence, theorists including Einstein, consider the mass M would include the electric energy, i.e.,

$$M = m(r_0) + q^2/r_0 \quad \text{(A2)}$$

where $m(r_0)$ is the mass of the particle and q^2/r_0 is the electric energy of the particle outside the radius r_0 of the particle. Thus, in the net effect, there would be no repulsive gravitation since

$$\frac{1}{2}\frac{\partial}{\partial r}\left(1 - \frac{2M}{r} + \frac{q^2}{r^2}\right) = (M - \frac{q^2}{r})\frac{1}{r^2} = \left(m(r_0) + q^2(\frac{1}{r_0} - \frac{1}{r})\right)\frac{1}{r^2} > 0\,. \quad \text{(A3)}$$

Nevertheless, Tsipenyuk & Andreev [13] observed a weight reduction of a charged metal ball.

Thus, the existence of repulsive gravitation is confirmed by experiments. This mistake in (A2) [31] is due to that the effect of the electric energy has been incorrectly counted twice in the Reissner-Nordstrom metric.

A1. The charge-mass repulsive force and unification
Another problem for the existence of repulsive gravitation in the Reissner-Nordstrom metric is that it makes clear that general relativity is incomplete. To show the static repulsive effect of a charged particle, one needs to consider only g_{tt} in metric (A1). According to Einstein [8], the equation of motion is

$$\frac{d^2x^\mu}{ds^2} + \Gamma^\mu{}_{\alpha\beta}\frac{dx^\alpha}{ds}\frac{dx^\beta}{ds} = 0, \quad \text{where} \quad \Gamma^\mu{}_{\alpha\beta} = (\partial_\alpha g_{\nu\beta} + \partial_\beta g_{\nu\alpha} - \partial_\nu g_{\alpha\beta})g^{\mu\nu}/2 \quad \text{(A4)}$$

and $ds^2 = g_{\mu\nu}dx^\mu dx^\nu$. Consider the static case. (One need not worry whether the gauge is physically valid because the gauge affects only the second order approximation of g_{tt} [32].) The force on a test particle P with mass m at **r** is

$$(-m\frac{M}{r^2} + m\frac{q^2}{r^3})\hat{r} \quad \text{where } \hat{r} \text{ is a unit vector} \quad \text{(A5)}$$

in the first order approximation because $g^{rr} \cong -1$. Thus, the second term is a repulsive force.

If the particles are at rest, then the force generated by p acting on the charged particle Q would be

$$\left(m\frac{M}{r^2} - m\frac{q^2}{r^3}\right)\hat{r}, \qquad \text{where } \hat{r} \text{ is a unit vector} \tag{A6}$$

because the action and reaction forces are equal and in the opposite directions. However, for the motion of the charged particle with mass M, if one calculates the metric according to the particle P of mass m, only the first term is obtained. Thus, the geodesic equation is inadequate for the equation of motion. Thus, it is necessary to have a repulsive force with the coupling q^2 to the charged particle Q in a gravitational field generated by masses. It thus follows that, force (A6) to particle Q is beyond current theoretical framework of gravitation + electromagnetism. Lo, Goldstein, & Napier [33] predicted that general relativity leads to a realization of the inadequacy of general relativity, just as electricity and magnetism lead to the exposition of their shortcomings.

The charge-mass repulsive force mq^2/r^3 for two point-like particles is inversely proportional to the cube power (instead of the square) of the distances between the two particles. This would mean that such a repulsive force is much weaker faster than gravity at long distance, although it would be much stronger at very small distance. Moreover, this force is proportional to the square of the charge q, and thus is independent of the charge sign. Such characteristics would make [34] a concentration of charged particles would increase such repulsion.

The repulsive force in (A1) comes from the electric energy [31]. An immediate question would be whether such a charge-mass repulsive force mq^2/r^3 is subjected to electromagnetic screening. It is conjectured that this force, being independent of a charge sign, would not be subjected to such a screening although it should be according to general relativity. From the viewpoint of physics, this force can be considered as a result of a field created by the mass m and the field interacts with the q^2. Thus, such a field is independent of the electromagnetic field.

A2. Extension of Einstein's equivalence principle and five-dimensional relativity

If we consider the coupling with q^2, this naturally leads to a five-dimensional space. Kaluza [35] proposed a five-dimensional general relativity, and his cylindrical condition reduced the five variables to four. This maintains the equation of motion as being a geodesic equation, and this theory reproduces the Einstein equation and the Maxwell equation if the "extra" metric elements are considered as constant or negligible. Subsequently, Einstein and Pauli [36] wrote a paper to continue the work of Kaluza. However, their five-dimensional relativity does not have the coupling with the square of a charge since the "extra" metric elements are neglected. This theory also cannot account for the radiation reaction force because the cylindrical condition is imposed [33].

One may ask what the physical meaning of the fifth dimension is. Many theorists claimed that those high dimensions are curl up. Their position [33] is that the physical meaning of the fifth dimension is not yet very clear, except some physical meaning is given in the equation, $dx^5/d\tau = q/Mc^2K$ where M and q are respectively the mass and charge of a test particle, and K is a constant. This equation relates the fifth variable x^5 to τ.

The fifth dimension is assumed [33] as part of the physical reality, and the metric signature is (+, –, –, –, –). We shall denote the fifth axis as the w-axis (w stands for "wunderbar", in memorial of Kaluza), and thus the coordinates are (t, w, x, y, z). Our approach is to find out the full meaning of the w-axis as our understanding gets deeper.

For a static case, we have the forces on the charged particle Q in the ρ -direction

$$-\frac{mM}{\rho^2} \approx \frac{Mc^2}{2}\frac{\partial g_{tt}}{\partial \rho}\frac{dct}{d\tau}\frac{dct}{d\tau}g^{\rho\rho}, \qquad \text{and} \qquad \frac{mq^2}{\rho^3} \approx -\Gamma_{\rho,55}\frac{1}{K^2}\frac{q^2}{Mc^2}\,g^{\rho\rho} \tag{A7a}$$

and

$$\Gamma_{k,55}\frac{q}{KMc^2}\frac{dx^k}{d\tau}=0, \quad \text{where} \quad \Gamma_{k,55}\equiv\frac{\partial g_{k5}}{\partial x^5}-\frac{1}{2}\frac{\partial g_{55}}{\partial x^k}=-\frac{1}{2}\frac{\partial g_{55}}{\partial x^k} \tag{A7b}$$

in the (*-r)*-direction. The meaning of (A7b) is the energy momentum conservation. It is interesting that the same force would come from a different type of metric element depending on the test particle used. Thus,

$$g_{tt}=1-\frac{2m}{\rho c^2}, \quad g_{55}=\frac{mMc^2}{\rho^2}K^2+\text{ constant.} \tag{A8}$$

In other words, g_{55} is a repulsive potential. Because g_{55} depends on *M*, it is a function of local property, and this is different from the metric element g_{tt} that depends on a distant source of mass m.

On the other hand, because g_{55} is independent of q, $(\partial g_{55}/\partial\rho)/M$ depends only on the distant source m. Thus, this force, though acting on a charged particle, would penetrate electromagnetic screening. From the above, it is possible that a charge-mass repulsive potential would exist for a metric based on the mass *M* of the charged particle *Q*. However, because *P* is neutral, there is no charge-mass repulsion force on *P*.

That the repulsive gravitational potential to charge can be generated from a mass, would explain the fact that a charged capacitor can also have the repulsive force [34], but such a force is absent from the current four-dimensional theory. This is why many theorists would not accept the existence of the repulsive gravitation. They are so involved in current theoretical consideration that they forget that physics is based on experiments.

A3. The charge-mass interaction and the question of weight

It is found that a charge may generate a gravitational static field that repulses a mass [3]. Since the discovery and the prediction are based on general relativity, Einstein's theory would have another important confirmation to be verified [13]. Thus, there is a new neutral charge-mass interaction that is beyond electromagnetism and gravitation, and thus Einstein's unification is a necessity [31].

In general relativity, there is no field that couples with the square of a charge. Moreover, since this new force is independent of the charge sign, it should not be subjected to electromagnetic screening although general relativity would imply that any electromagnetic interaction does. Nevertheless, such a coupling exists in the five-dimensional relativity of Lo, Goldstein and Napier [33]. In addition, their theory would support that such a neutral force is not subjected to electromagnetic screening. It thus follows that the existence of this static neutral repulsive force can be tested by weighing a capacitor to see whether its weight is reduced after being charged [3]. The existence of such a force on a capacitor was first verified by Liu [3] although such weight reduction has been found much earlier [37].

Thus, it is found that a weight reduction of a neutral object is not due to a reduction of mass, but a neutral repulsive force, which was unknown to Galileo, Newton, and Einstein [7].

If the electric energy leads to a repulsive force toward a mass, according to general relativity, the magnetic energy would lead to an attractive force from a current toward a mass [38]. The existence of such a current-mass attractive force has been verified by Martin Tajmar and Clovis de Matos [39] from the European Space Agency. They found that a spinning ring of superconducting material increases its weight much more than expected. Thus, they incorrectly believed that general relativity had been proven wrong. However, according to quantum theory, spinning superconductors should produce a weak magnetic field. Thus, they are also measuring the interaction between an electric current and the earth.

The existence of the current-mass attractive force would solve a puzzle, i.e., why a charged capacitor exhibits the charge-mass repulsive force since a charged capacitor has no additional electric charges? In a normal situation, the charge-mass repulsive force would be cancelled by other forms of the current-mass force as Galileo, Newton and Einstein implicitly assumed. This general force is related to the static charge-mass repulsive force in a way similar to the Lorentz force is related to the Coulomb force. One

may ask what is the formula for the current-mass force? However, unlike the static charge-mass repulsive force, which can be derived from general relativity, this general force would be beyond general relativity since a current-mass interaction would involve the acceleration of a charge, this force would be time-dependent and generates electromagnetic radiation. Moreover, when the radiation is involved, the radiation reaction force and the variable of the fifth dimension must be considered [33].
Thus, we are not ready to derive the current-mass interaction yet. Nevertheless, we may assume that, for a charged capacitor, the resulting force is the interaction of net macroscopic charges with the mass [34].

A4. Weight reduction by heat
This current-mass interaction also explains a phenomenon, which is also reported by Liu [3, 4] that it takes time for a capacitor to recover its weight after being discharged. A discharged capacitor needs time to dissipate the heat generated by discharging. Then, the motion of its charges would recover to normal. Thus, it should be expected that the heated-up metals would reduce their weight. It is conjectured that the heat would additionally convert some orbital electrons to random motion, but the increased mass due to heat energy is negligible as Einstein [1] pointed out. If this explanation of weight reduction is valid, then a metal would reduce its weight as the temperature increases. This should be further tested such that the physics can be understood in depth.

Moreover, since a heated-up metal is a solid, one can in principle test its mass by acceleration. (Another way to do this is to compare the periods of a pendulum before and after the metal is heated.) One can also verify the existence of the repulsive gravitation by measuring the reduction of attractive gravitation with a torsion balance scale after the metal is heated. Note, however, that the reduction of gravitation by heat also depends on the metal [4].

Appendix B: Open letter to Kate Kirby, CEO of American physical society
Dear Dr. Kate Kirby:

It was a pleasure to meet you in the APS Meeting at New Orleans, LA in March 16, 2017. It is remarkable that you promise to improve the mathematics of the APS editors and related problems in gravitation. As shown in my report "American Physical Society and Errors in Gravitation" to the APS March meeting, there are ten major problems and errors in gravitation. I admire your exceptional ability to lead and have the courage to deal with problems and errors in gravitation of over 100 years old. I do not know where such a strength of your comes from, I guess that this must come from years of your experience in leadership. Here, I would like to introduce myself related to gravitation since I am the one who discovers and raises the problems to APS. This information would help you to understand where my strength comes from.

I earned my undergraduate degree in physics. However, I was very unsatisfied on the mathematical education for physicists because it essentially makes physicists in the dark when a problem related to pure mathematics appears. I believe that this problem must be fixed since I am interested theoretical physics. A current problem of most physicists is that they are not aware this problem could be serious as shown by the American Society in the area of gravitation which I pointed out in my article presented to the APS Business Meeting, 2017. Since this is not a problem of American physicists alone, it is a world-wide problem. (For example, none of the books in general relativity, except Einstein's own [1], gives the correct assertion to Einstein's equivalence principle. The reason is that, for instance, Editor of Physical Review D, Eric J. Weinberg as well as W. Pauli 1) did not understand the mathematics related to this principle [2].) Consequently, almost all the physicists of world make the similar mistakes in gravitation without knowing their errors. This would, of course, involve the 1993 Nobel Committee [3]; and surprisingly also the Fields Medal committee for mathematics [4]. It should be noted that the errors of the Fields Medal Committee are not in mathematics, but they deepen the errors because they do not understand physics and thus used the wrong conclusion of the physicists as their starting assumption. For instance, the misleading positive mass theorem of Schoen and Yau [5] had prevented the progress of general relativity for at least 13 years2).

Luckily, I had my opportunity to learn pure mathematics from the start in Canada before I went to

MIT. I was exceptionally fortunate to have my pure mathematical training under Professor I. Halperin for my degree in mathematics. Professor Halperin is a Fellow of the Canadian Royal Society (CRSF), who got his degree from the worldly famous mathematician John von Neumann. Because of my rigorous training and my very careful nature, I have never made any mistakes in my published work in mathematics. Moreover, I have been known to correct obscure errors of pure mathematicians all over the world, and calculation errors of well-known physicists in MIT and Harvard. These corrected calculation results have been published in the Physical Review [6, 7] because the ability of the APS editors in applied mathematics is generally pretty good. Then, I was known for being an applied mathematician with exceptional ability who is better than anybody in long calculations. However, the exception did occur because the ability in pure mathematics of APS editors such as Eric J. Weinberg is very poor, he even failed to understand Einstein's equivalence principle [2]. When I realized that this is not an individual problem of APS alone but a general problem of physics, I started to publish my papers in other journals.

My first break though in gravitation is my paper [8], " *Einstein's Radiation Formula and Modifications to the Einstein Equation* " published in 1995 in Astrophysics Journal, when Nobel Laureate, S. Chandrasekhar was the editor-in-chief. Based on this, I subsequently show that there is no dynamic solution for the Einstein equation [9]. For this, I was questioned by Professor P. Morrison of MIT for a month. Then he went to Princeton University to question J. H. Taylor on his justification for his calculation on gravitational radiation. When Taylor admits that he was unable to justify their calculation as expected, Morrison advised me to write a book on this issue [10]. However, I feel that we must solve also related problems. One reason is that many physicists had claimed that they have dynamic solutions for the Einstein equation. I went through all such claims and find they are due to various mathematical mistakes or errors in physics [11]. What surprised me is that some errors such as those from Misner, Thorne and Wheeler [x)] are in the undergraduate level of calculus [2]. What is stranger is that these three gentlemen used Einstein's abandoned 1911 invalid assumption of equivalence of acceleration to gravitation [12][3)] and Pauli's misinterpretation as the references of Einstein's equivalence principle, but they ignored Einstein's 1916 paper and his book, both of which stated Einstein's equivalence principle clearly.

It is even more surprising that the 2016 Award of APS Medal for Exceptional Achievement in Research was given to E. Witten, whose errors in mathematics is well-known because he does not understand even Einstein's equivalence principle[4)]. Moreover, this award of achievements in mathematical physics actually has no support from the experiments [13]. Since the award committee consists of the mathematical talents of APS, it is clear that APS has big trouble in mathematics.

The second break though on gravitation is my discovery of the repulsive gravitation [14] that Einstein rejected because he incorrectly believed in $E = mc^2$ as generally valid[5)]. An unexpected problem was that no experimental physicists were willing to try any experiment that would show that Einstein was wrong in classical physics. Fortunately, such experiments have been done with the support of the US Defense Department although these experiments have been interpreted wrong [15,16]. Thus, a new revolution of physics has born. More important, Einstein's claim of unification between gravitation and electromagnetism has been proven correct [15,16].

Unfortunately, the APS executives were not aware of these new developments mainly because the Editor of Physical Review D, Eric. J. Weinberg is incompetent in mathematics as well as in recent developments in physics. For instance, the Einstein equation and the formula $E = mc^2$ are not consistent[6)]. In fact, I have pointed out these in my 2015 paper [17]. It seems to be necessary to have statistics on the wrong papers that APS published each year.

I have promised you to keep the errors of APS on gravitation private and to wait for some time such that APS can respond properly. However, more than a month have been passed and I have not heard anything from you. Moreover, I am going to participate in a conference in gravitational wave in Korea in May 22-26. This means that some errors of APS in gravitation must be known to the world.

For your perusal, the draft of my speech is attached herewith. Any comments and suggestions that you may have will be appreciated. Thank you.

Now, it should be clear that it is not easy to correct the errors in gravitation of APS and the world. I considered myself very fortunate that I have discovered these problems. I hope that you are just as fortunate enough that you can solve these issues for the APS. If you have any questions, I shall be happy to answer them. I am looking forward to hearing from you.

Sincerely yours,

C. Y. Lo

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Endnotes to APS letter:

1) W. Pauli and Eric J. Weinberg cannot tell the difference between the existence of a local Minkowski space at a point and the existence of local Minkowski space in a very small neighborhood.

2) Schoen and Yau [5] assumed the metric is asymptotically flat without realizing that this would exclude all the dynamic solutions since the Einstein equation implies that all the dynamic solutions are unbounded.

3)The 1911 assumption of Einstein has been proven incorrect by observation.

4)Witten made the same mistakes as Schoen and Yau [5]. They both were awarded the Fields Medal in 1982 and 1990 because the mathematicians do not understand physics.

5)There exist at least three types of experiments that shows $E = mc^2$ is not valid. They are: 1) the weight reduction of a charged metal ball; the weight reduction of a charged capacitor; 3) the weight reduction of a piece of heated-up metal.

6)The mass and the electromagnetic energy have very different effects according to the Einstein equation.

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Endnotes

1) Dmitriev, Nikushchenko & Snegov [4] has mistaken that weight reduction is due to mass reduction.
2) The period T of our torsion balance is about 91.2 seconds. It is difficult to see the small changes for T after the lead balls have been heated-up.
3) The merit of Li's experiment is that the temperature can be changed continuously. However, we can also do this by heating the lead balls directly.
4) One cannot expect a theorist to fully understand what he proposes; Einstein is also not an exception.
5) Since the charge mass interaction is absent form current quantum mechanics, quantum mechanics is not a complete theory just as Einstein claimed.
6) A popular error in general relativity is the belief that general relativity has superseded Newtonian gravity. This is not true since the Einstein equation has no two-body solution whereas Newtonian gravity does [40].

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