RESEARCH ARTICLE

The electrical nature of gravity

Scott Sibley

Sibley S. The electrical nature of gravity. J Mod Appl Phy. 2023;6(3):1-8.

ABSTRACT

Gravity was established as electrical in nature because the unit electrical charge calculated for gravitation based on measured G ($1.4396077 \times 10^{-34}$ C), adjusted for composition, agrees nearly perfectly (within 0.014%) with the calculated gravitational charge ($1.4399644 \times 10^{-34}$ C), based on the square of the velocity of light, where c^2 = ($8.8.9875518 \times 10^{-16}$ m^2/s^2 × primary electrical charge ($1.602176487 \times 10^{-19}$ C), the product of which is entirely electrical. $c^2 \times 10^{-32}$ m^2/s^2 was calculated and derived, a priori, as the ratio of secondary to primary electrical charge (e_2/e_1). Gravitational charge (e_2), a new constant ($1.4399644 \times 10^{-34}$ C), was calculated in Coulombs to 8 significant figures. G was calculated and derived to within 0.05% of its measured value, using c^2; primary charge; the electrical constant; the magnetic constant; and the weighted average mass number to atomic weight ratio of the Milky Way Galaxy. The composition dependence of G was established. G, with new units, were restored as: $G=6.6775860 \times 10^{-11}$ $N_N \times (C^2)(s^2)(m^{-2})$. Gravity is a probable source of electromagnetism. Gravity was calculated to be net attractive. The variability of G in the Milky Way Galaxy is explained.

Key Words: *Gravity; Electrical charge; Coulombs; Milky Way Galaxy*

INTRODUCTION

Includes the calculation of c^2, G, and the net attraction of gravity

Experiments related to gravity have brought mixed results over the centuries and often raised more questions than answers have been found. Although some scientists have suggested gravity's root cause, none of the theories, including the currently popular claimed detection of gravity waves have conclusively proven gravity's origin or shown how, or whether, the velocity of light may be involved [1-4]. The findings in this paper are predicated on the application of 2 mutually corroborating, separate, equations for the value of gravitational, electrical, charge (e_2). c^2 appears in the equations derived and results from the great difference between the magnitude, in Coulombs, of primary and secondary electrical charge. Historical research on gravity has often been constrained by the contention that mass represents an inherent force, overlooking the fact that all mass is comprised of quantum units of electrical charge which are constantly interacting, according to Millikan [5]. Therefore, researchers, past and present, have not been seeing the "forest" of electrical interaction for the "trees" of mass interaction. People once believed that the Earth is flat and that the Sun revolves around the Earth. Such mistaken beliefs were resolved by scientific research and simple observation. Similarly today, most believe that gravity's origin is in mass. While gravity is closely associated with mass, gravity's electrical characteristics are independent of the mass that contains them. This paper shows in great detail the electrical origin of gravity and why gravity does not and cannot give substance to mass.

MATERIALS AND METHODS

No materials were used in preparation of this paper. However, one preliminary experiment was conducted using a torsion beam balance to try to determine, by the velocity of weight rotation, if different metals, including aluminum, copper, and lead, react differently, in a gravitational manner, to a nearby much larger mass. The conditions were not ideal, and the results were inconclusive.

Derivation of G

This section shows, step by step, how G, the universal constant of gravitation, can be dissected into its component factors, all constants, predetermined and generally accepted by the scientific community, the product of which, within the errors of measurement, agrees with G's measured value.

Since Newton's 1687 discovery and identification of G, as a proportionality constant, subsequently measured by Cavendish in 1798 [6,7], this constant has been the subject of many other studies to try to determine its exact value [8-18].

Assuming gravity is fundamentally electrical, the explication of G, as derived in this paper, is an extraction of all constants from an equation for gravitational force between two units of mass based on a count of a fundamental, hypothetical, quantum unit of electrical charge, (e_2), herein referred to as "electrogravic charge," involved in net attractive secondary electrical interactions (equivalent to "n", the

Retired, Department of Mineral Resources, U.S. Geological Survey, Reston, Virginia, United States.

Correspondence: Scott Sibley, Retired, Department of Mineral Resources, U.S. Geological Survey, Reston, Virginia, United States. E-mail: sfsibley@gmail.com

Received: 02-Jun-2023, Manuscript No. Puljmap-23-6496; Editor assigned: 04-Jun-2023, Pre QC No. Puljmap-23-6496 (PQ); Reviewed: 16-Jun-2023, QC No. Puljmap-23-6496 (Q); Revised: 22-Jul-2023, Manuscript No. Puljmap-23-6496 (R); Published: 30-Sept-2023, DOI:10.37532/puljmap.2023.6(3).1-8.

number of pairs of primary attractive charge interactions) in each neutral mass unit (19). This count (n) can be expressed by the commutative principle as:

[mass/(atomic weight)](Avogadro's constant)(mass number) =

[mass (mass number/(atomic weight)] × (Avogadro's constant) (1)

For this paper, neutrons are treated as single pairs of positive and negative charges that do interact electrically with surrounding electrons or protons in each atom. The constants in the second half of the latter equation form the core of an equation for G. Because G is universal, mass must be calculated as a weighted average, and the weighted average mass number to atomic weight ratio (R_M) must be that of the universe (R_U), or an acceptable substitute, based on the mass number of principal elements in the universe and their measured concentration [19, 20-33] (Table 1).

TABLE 1
Milky Way Galaxy element relative abundance and weighted average mass number to atomic weight ratio

Element	R_M ratio	Abundance (ppm)*	R_M × ppm	Percent of total shown
Hydrogen	0.992063492	739,000	733134.9206	73.83
Helium	0.999349923	240,000	239843.9815	24.15
Oxygen	1.000062504	10,400	10400.65004	1.05
Carbon	0.999084173	4,600	4595.787195	0.46
Neon	0.991095011	1,340	1328.067315	0.13
Iron	1.002775539	1,090	1093.025338	0.11
Nitrogen	0.99950025	960	959.52024	0.1
Silicon	0.996973473	650	648.0327575	0.07
Magnesium	0.987451142	580	572.7216622	0.06
Sulfur	0.998128509	440	439.176544	0.04
	Total =	9,99,060	993015.8832	100
			Weighted average R_{MW} =	**0.993016**

**Parts per million by weight [35].*

For purposes of calculating universal moles, individual bodies of mass are part of one whole universal body, each mass segment of which contains elements of different proportions, but those proportions are insignificant compared with the proportions of elements in the universe as a whole. The calculation is similar to that of determining moles of a unit of mass of mixed composition, except applied in this case on a universal scale. Therefore, mass is multiplied by mass number, the product of which is divided by atomic weight to obtain moles, which is multiplied by Avogadro's constant to obtain a count of e_2, an extremely small quantum amount of charge generated by primary electrical charge field interactions. Even a slight change in relative composition of the universe will change R_U and therefore G. Operationally, G appears to be independent of composition because the universal, weighted average, and overarching, mass number to atomic weight ratio is nearly constant in time. Nevertheless, the variability in R_U is likely one of the reasons researchers have not been able to measure G more precisely than to about 5 significant figures, as compared with most other universal constants. However, in different regions of the universe, concentration of different elements that contribute to R_U, especially hydrogen and helium, will be different and therefore G will be different. Other reasons have been proposed [17], and other theories have been advanced [13, 14, 20, 23].

Equation (2) shows how G is partially determined by R_U^2, which, in turn, is determined by the weighted average mass number to atomic weight ratio of location (the Milky Way Galaxy), and measured concentration of different elements of the Milky Way Galaxy at that location. Location in the universe is an important consideration in determining G. R_U is incorporated, Equation (4), and adjusts e_2 calculated from measured G for comparison with e_2 calculated completely electrically. R_U, as a separate factor, does not apply to the electrical calculation of e_2 on, Equation (5), or Equation (19).

EQUATION FOR G

The following electrically-based equation applies to two units of mass (A and B)

If gravity is basically electrical, the universal constant of gravitation, G, must be calculable from its electrical components, and from that the constant value of the fundamental unit of electrical charge (e_2) (unit charge, referred to above) can be obtained. This value is fixed and can be calculated because any other factors in the equation for G are known constants [27]. This is a redefinition of G, but this redefinition enables the precise calculation of the gravitational charge (e_2) that the author believes to be the source of gravity. The structure of G is based on Newton's structure [6], with mass being replaced by e_2. The other components are those used to make a count of electrical charge that would be present at the atomic level. Part of that calculation is the moles of any interacting mass that contains charge units, which involves the ratio of mass number to atomic weight (1): thus, the universal R value (R_U) that is included in the equation for G (2). An electrical equation based on measured G can then be:

$$G = (k_e = c^2k_m)(e_1)^2[R_{UA})^2(N_{NA})^2(e_{2A})*(e_{2B})(N_{NB})^2(R_{UB})^2 \quad (2)$$

Equation (3), where R_U = weighted average mass number to atomic weight ratio of the Milky Way Galaxy, used as a proxy for that of the

universe for greater accuracy. (R_U = 0.994 +/- 0.001, rounded up to account for elements not included in Table 1; and e_{2A}=e_{2B}); e_1= 1.602176487 × 10^{-19} C [27]; (Figure 1 and Table 1). From Equation (2) and from Equation (3), e_2 can be back-calculated in Coulombs because the other factors in the equation are known.

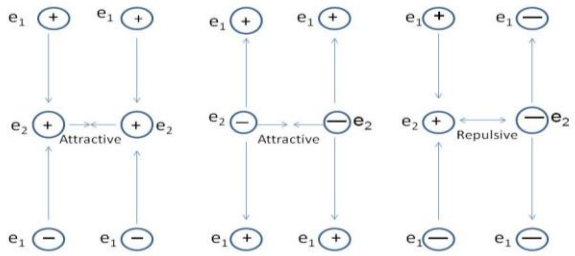

Figure 1) *Three H's*

Three H's: A schematic of the fundamental structure of gravitational force, showing the basic types of electrical interactions; the sign of secondary charge (e_2) generated by attractive and repulsive primary charge (e_1) field interactions; and the attractive or repulsive gravitational interaction resulting from those secondary charges generated. How gravity is linked with electrical force is demonstrated in Figure 1. Net gravitational secondary electrical interactions are manifested as attractive, whereas primary electrical charge. Interactions are manifested as equally attractive and repulsive, that is, neutral (Table 2). The latter is the reason for the usual electrical neutrality of mass. Gravity and electrical charge can be linked if primary electrical interactions produce secondary charge (e_2, as described above) that is many orders of magnitude weaker than primary charge (in this case, 16 orders of magnitude weaker). That great difference (by a factor of 10^{16}) in strength between secondary and primary charge (ΔC) is the reason for the connection between gravity and the square of the velocity of light. The extremely small value of secondary charge is one of the reasons secondary charge has not been discovered earlier. Electrical (gravitational) attraction between mass units is based on the interaction of primary electrical fields.

TABLE 2
Formulas for number of electrostatic (primary) and electrogravic (secondary) interactions in mass

	Number of Interactions between mass units	
	Electrostatic	**Electrogravic**
Attractive	n^2	$2n^2(n^2 - n) + n^2$
Repulsive	n^2	$2n^2(n^2 - n)$
Net attractive	0	n^2
	Number of Interactions within mass units	
	Electrostatic	**Electrogravic**
Attractive	n^2	$\sum_{1}^{n^2-1} + \sum_{1}^{n(n-1)-1}$
Repulsive	$n(n-1)$	$n^3(n-1)$
Net attractive	n	$\left[\sum_{1}^{n^2-1} + \sum_{1}^{n(n-1)-1}\right] - n^3(n-1)$

Calculation of e_2 from Measured G

C=Coulomb;
N_N = Newton
SQRT = Square root of
N_A = Avogadro's constant = 6.02214179 (30) × 10^{23} atoms/kg-mole (Uncert. 5 × 10^{-8}) [27]
R_U = 0.994 (rounded up to account for elements not in Table 1); R_U^2 = 0.988036
G = 6.67428 (67) × 10^{-11} (N_N-m^3kg^{-1}) [27]
e^2 (based on Equation (2) =Secondary quantum charge in Coulombs (C) (an unknown)

$$e_2 = \text{SQRT}\,[G/[(c^2k_m) \times (RU)^2 \times (N_A)^2] \quad (3)$$

$$e_2 = \text{SQRT}\,(66.7428 \times 10^{-12})/\text{SQRT}\,[(8.9875518 \times 10^{16} \times 10^{-7}) \times (0.988036)) \times (6.02214179 \times 10^{23})^2] = 321.407458 \times 10^{55} = 32.1407458 \times 10^{56}]$$

1st Calculated e_2 (based on measured G)

$$(8.1696266 \times 10^{-6})/\text{SQRT}(32.204465 \times 10^{56})$$
$$= (8.1696266 \times 10^{-6})/(5.674898 \times 10^{28}) \quad (4)$$
$$= 1.439544 \times 10^{-34}\ \text{C}$$

2nd Calculated e_2 (electrically based)

$$c^2 \times e_1 = e_2 = 1.4399644 \times 10^{-34}\ \text{C}, \quad (5)$$

Where, c^2 = 8.9875518 × 10^{-16}, and
e_1=1.602176487 × 10^{-19} C

So, why is Equation (5) so significant?
Equation (5) is important and significant because, it is based on an

entirely electrical equation for e_2. where e_1=1.602176487 × 10^{-19} C, and c^2 =8.9875518 × 10^{-16} m^2/s^2 and it puts e_2 calculated entirely electrically within 0.014% of e_2 (electrical charge) calculated from measured G (Equation (4) that includes an incorporated R_U and is just outside the range of uncertainty determined for G (1×10^{-4}) [27], or 0.01%, thereby proving that gravity's origin is electrically based. Given e_2 factors' diversity, the probability of e_2 in Equations (4) and (5) being nearly equal would have to be almost zero unless those e_2 factors were equal. The proximity between e_2 in Equations (4) and (5) is greater than that between measured G and calculated G. Therefore, the derivation of c^2 is shown by:

e_2/e_1 = (1.4399644 × 10^{-34} C)/1.602176487 × 10^{-19} C=8.9875518 × 10^{-16} m^2/s^2 = c^2 x 10^{-32} m^2/s^2 (6)

Calculation of e_2

c = 2.99792458 × 10^8 m/s (in a vacuum) [27]

c^2 = 8.9875518 × 10^{16} m^2/s^2 [27]

e_1 (charge of the electron (primary charge)) = 1.602176487 × 10^{-19} C (uncert. 2.5 × 10^{-8}) [27]

e_2 = 1.4399644 × 10^{-34} C

e_2^2 = 2.0734975 × 10^{-68} C^2

e_1^2 = 2.5669695 × 10^{-38} C^2

G = 6.67428(67) × 10^{-11} (N_N-m^3) kg^{-1}-s^{-2} (Uncert. 1 × 10^{-4}) (measured) [27]

c^6 = c^2 × c^2 × c^2 = [(8.9875518 × 10^{+16})^3 = 725.97913 × 10^{48}] × 10^{-2} = 7.2597967 × (10)^{48} $m^6(s)^{-6}$

k_m =1 × 10^{-7} N_N-s^2(C^{-2})

k_e =c^2 k_m = 8.98755 × 10^{16} m^2s^2 × 10^{-7} N_N-s^2(C^{-2}) = 8.98755 × 10^9 N_N-m^2-s^2(C^{-2})

"e_2" is fixed and can be determined from Equation (3) because any other factors in the equation for G are known, measurable, physical constants.

e_{2G} = 1.439544 × 10^{-34} C (Equation (4), is quantification of Equation (3), [e_2 calculated from measured G]

e_{2L} = 1.4399644 × 10^{-34} C (Equation (5) is e_2 calculated from the square of the velocity of light): (c^2 × e_1), where c^2 = 8.9875518 × 10^{-16} m^2/s^2.

e_2/e_1 = c^2 × 10^{-16} = c^2 × 10^{-32} (See Equation (18) (7)

c^2 = k_e/k_m = e_2/e_1 × 10^{32}

e_2 = e_1 × c^2 = 1.4399644 × 10^{-34} C, where c^2 = 8.9875518 ×10^{-16} m^2/s^2

e_2^2 = e_1^2 $(c^2)^2$

c = SQRT((k_e)(k_m)$^{-1}$) = SQRT(8.9875518 × 10^{+16} m^2/s^2) = 2.99792458 × 10^8 m/s

What is the meaning of e_2/e_1?

Technically, e_2/e_1 is only a ratio without units because the units of the numerator and denominator are both in Coulombs, but the numerical value of the ratio is a very important number, the square of the velocity of light (c^2). When multiplied by mass, the ratio is equivalent to energy. Not only that, but because the ratio is nearly identical to the measured value of c^2, the ratio may be considered a derivation of c^2 as well as contributing to the derivation of G, which it accurately helps to determine. Neither of these constants (c^2 and G) has previously been calculated (a priori) as far as known. The ratio may also represent the rate of charge generation, most likely of secondary charge because secondary charge is only a fraction of primary charge (by 16 orders of magnitude). Another interesting finding is that the units of c^2 calculated from Coulombs are in m^2/s^2. The ratio e_2/e_1=c^2 × 10^{-32} is calculated to be in m^2/s^2. The value calculated for e_{2G} (1.4396077 × 10^{-34} C) in Equation (4), based on the measured value of G, is nearly identical to e_2 (within 0.025% of e_{2L}) calculated in Equation 5, (1.4399644 × 10^{-34} C), using a different, alternative, approach based on the square of the velocity of light. Because e_2 calculated by a separate method is nearly identical, this implies that there are no other factors in e_2, beside e_1 and c^2 in the equation for G, and therefore that gravity is electrical. As compared with Equation (4); Equation (5) contains the factor with the least uncertainty (e_1). Therefore, Equation (5), must have the most accurate unit value for gravitational charge:

e_2 = 1.4399644 × 10^{-34} C, a new constant. (8)

The charge found, in Coulombs, probably occurs as a quantum unit, like e_1 and is the same whether negative or positive. (See discussion). In 1927, Arthur H. Compton was one of the principal scientists who helped to lay the foundation, experimentally, for the calculation of e_2 [8]. The differential factor for $e_2(e_1)^{-1}$ is 8.9875517×10^{-16} = c^2×10^{-32}. The orders of magnitude of charge between primary and secondary charge, or ΔC, are significant (16 orders of magnitude); determine the square of the velocity of light; and are represented by the ratio $e_2(e_1)^{-1}$ ×10^{32}. The presence of ΔC explains how gravity is related to the square of the velocity of light because e_2 (gravitational charge) is the product of (primary charge) and c^2, (Equation (5), and again. The velocity of light, or c, is controlled by the square root of ((e_2) (e_1)$^{-1}$×10^{32}), as shown in Equation 18. If primary and secondary charge could interact directly, secondary charge would instantaneously supplement primary charge, and there would be no gravitational effects. In generation of secondary charge, the quantum primary electrical charge and the quantum secondary (gravitational) electrical charge are prevented from interacting with each other because they are different in kind. Primary (e_1) and secondary quantum charge (e_2) fields can still function similarly because they are likely generated by interaction of primary electrical fields, but they must obey a different rule, by which they can interact independently of primary charge and interact with other secondary charge (Figure 1).

$F = k_e(q_1q_2)r^{-2}$ (9)

(e_1) or (q) is the basis of k_e in Equation (9) above for electrical force. Likewise, (e_2 (gravitational charge) is the basis of c^2k_m in Equation (2), whereby c^2x10^{-32} was calculated from $e_2(e_1)^{-1}$, thus validating the electrical origin of gravity and its operation.

CALCULATION OF G

A detailed explanation of the calculation of G

G has only been determined experimentally because it is assumed that the factors that comprise it are independent of it, but suppose that G is actually electrically based. How can it be calculated? For purposes of illustration, the factors that are believed to comprise G are grouped into 2 parts: I. and II, which, when multiplied together, comprises G. The basis for calculation of G is in Equation (2) and is the square of secondary gravitational charge ((e_{2A}) × (e_{2B})), or e_2^2. e_2 is defined as c^2 × e_1. For the square of that

e_2/e_1 = (1.4399644 × 10^{-34} C)/(1.602176487 × 10^{-19} C) = 8.9875518× 10^{-16} = c^2 x 10^{-32} (9)

c^2 = 8.9875518 x 10^{+16} m^2/s^2

e_1 x c^2 = e_2 = 1.4399644 × 10^{-34} C, where c^2 = 8.9875518 × 10^{-16}, as

shown in Equation (5).

I. The charge of the electron, herein referred to as e_1, naturally would be a part of any electrical equation for G, just as the square of the velocity of light (c^2) is a part of the electrical constant (k_e), and the magnetic constant, k_m, similarly is part of that equation. Therefore:

$e_1^2k_m = 2.5669695 \times 10^{-45}k_m$

The square of mass A and mass B, in detail, includes (e_2^2), which is:

$(e_1c^2)^2 = (e_1^2k_mc^4) = (e_1^2k_m(c^2)^3 \times c^2$

$(c^2)^3 = 725.9 \times 10^{48} \times [(e_1c^2) \times 10^{-34}]^2$

$=725.9 \times 10^{48} \times [(e_1^2k_m(c^2)^2 \times 10^{-68}]$

$=725.9 \times 10^{48} \times [e_1^2k_m(c^4 = 10^4)) \times 10^{-68}]$

$=725.9 \times 10^{-20}\ [e_1^2k_m[10^4]$

$=725.9 \times 10^{-16}\ [e_1^2k_m]$

$=7.2597913 \times 10^{-14} \times 2.5669695 = 18.63566284$ (10) Why should G be so affected by c^2? That is the natural result of the square of the factors in Equation (2), but also, to help answer that question, we need only turn to Albert Einstein [1] for a very significant similar application of c_2.

II. Lastly, proportions of mass in the universe affect G because each unit of mass, electrically, is different. Fortunately, thanks to Selbin [34,35] (Table 1), we have an idea of those proportions for the weighted average mass number to atomic weight ratio of the 10 most abundant elements in the Milky Way Galaxy (R_U). This factor is used in calculating moles. Those moles are needed to calculate the quantity of charge involved, using Avogadro's constant. Therefore,

II. $= (0.994)^2 \times (6.02214179\text{^}10\text{^}23)^2 = 3.5832303 \times (10)^{47}$

Therefore,

I. $= 2.5669695 \times 10^{-45} \times 7.2597913 \times 10^{-14} = 18.63566284 \times 10^{-59}$

II. $= 3.5832303 \times (10)^{47}$

Half of e_2 would be charge units positive in sign and half would be charge units negative in sign, and the force between the two mass units (A and B) would be the same, but because the interactions between charge units are greater (by $+n^2$) for attraction than repulsion; as shown in Table 2, gravity is always net attractive. How sign is determined is another subject for research. In this transition to a completely electrically based G, there are no units shown for I., and II. Units are restored in Equations (11) and (12).

I. × II. = $6.6775872 \times 10^{-11}\ C^2\ (m^2/s^2)$ (1. 05% ×1.0005), of measured G] (11)

Which again falls slightly out of the uncertainty determined for measured G (1×10^{-4}), or 0.01%, and includes k_e, k_m, e_1^2, c^2, and e_2^2? Measured G=6.67428(67) $\times 10^{-11}$ [Unc. 1×10^{-4}] [27]. Factors that were involved in calculation of e_2 are also involved in calculation of G. It is important to remember that units for G no longer include mass (Kg) but only include interacting charge (C^2), velocity (m^2/s^2), and force (N_N). Therefore:

$G = 6.6775872 \times 10^{-11}\ N_N(C^{-2})(s^2)(m^{-2})$ (12)

Therefore, it can be stated unequivocally: Gravity is electrical. It is no coincidence either that measured R_U (=0.994), used as a substitute for that of the universe for greater accuracy, is one of 5 constants on which the Gravitational constant depends (R_U, k_e, k_m, e_1, and c_2). R_U determines an accurate measured e_2. Ten elements (more than 99.4%, by weight) in the Milky Way Galaxy and their measured concentration determine R_U and are key to determination that G is composition-dependent (Table 1). The weighted average of R_M, or R_U, is close to that of hydrogen and helium (Table 1). When e_2 is squared, as required by line 516 (Equation 20), that product is a key factor in calculation of G (Equation 11). Table 1 is the source of R_U, is essential in calculating G accurately and provides proof that G is composition-dependent because R_U accurately electrically adjusts e_2 calculated from measured G.

Mechanism for generation of gravitational charge

Figure 1 was developed by the author in order to illustrate the types of electrical interactions that take place continuously in mass.

How gravity is linked with electrical force is demonstrated in Figure 1. Net gravitational secondary electrical interactions are manifested as attractive, whereas primary charge interactions are equally attractive and repulsive. The latter is the reason for the usual electrical neutrality of mass (Table 2). Gravity and electrical charge can be linked if primary electrical interactions produce secondary charge (e_2, as described above) that is many orders of magnitude weaker than primary charge (in this case, 16 orders of magnitude weaker). That great difference (by a factor of 10^{16}) in strength between secondary and primary charge (ΔC) is the reason for the connection between gravity and the square of the velocity of light. The extremely small value of secondary charge is one of the reasons secondary charge has not been discovered earlier. Electrical (gravitational) attraction between mass units is based on the interaction of primary electrical fields within those mass units and the interaction between cumulative secondary quantum charge units thereby generated within those mass units.

Formula for primary electrical interactions between mass units For primary interactions between mass units, after the rule that like charges repel and unlike charges attract, where n=1 positive-negative primary unit of charge interactions:

Number of attractive, primary (electrostatic) charge, interactions (positive-negative pairs) = n^2

Number of repulsive primary electrostatic interactions (positive-positive and negative-negative pairs) = n^2

Net attractive interactions = $n^2 - n^2 = 0$ (13)

Formula for secondary electrical interactions between mass units

Like electrogravic charges (e_2) are mutually attractive and unlike electrogravic charges (e_2) are mutually repulsive. (14)

This rule explains precisely the attractive and repulsive interaction between two current-carrying parallel wires (Figure 2). This is direct evidence of the link between secondary (gravitational) charge and electromagnetism (Table 2), demonstrating the artificial generation of gravitational charge, oriented and amplified as electromagnetism [24, 36].

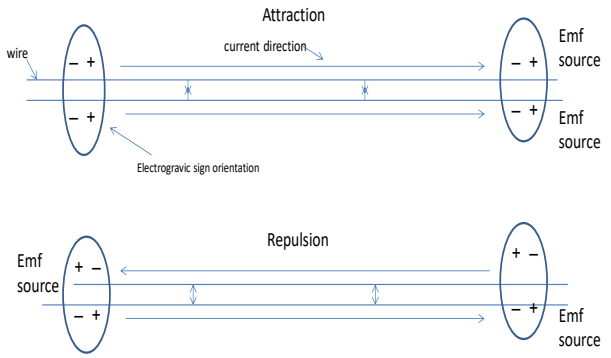

Figure 2) *shows how orientation of gravitational charge, amplified in parallel current-carrying wires as electromagnetism, follows exactly the rule of attraction and repulsion for secondary charge.*

Figure 2 shows how orientation of gravitational charge, amplified in parallel current-carrying wires as electromagnetism, follows exactly the rule of attraction and repulsion for secondary charge hypothesized, and exactly obeys this rule for interaction of such wires in practice (orientation of electromagnetic force, in which magnetic (gravitational) charge is oriented by like charge for attraction, and magnetic (gravitational) charge is oriented by opposite (unlike) charge for repulsion) [35].

From the above rule, in terms of pairs of primary positive-negative electrostatic interactions (n) in each mass unit, between two units of mass, the number of attractive electrogravic interactions between mass units is: $[(n^2)^2 = n^4] + \{[n(n - 1)]^2\} = 2n^4 - 2n^3 + n^2$ [Attractive (like) (+) interactions in Mass 1 + (like) (-) interactions in Mass 2] and the number of repulsive electrogravic interactions is: $[2n(n - 1)]\ (n^2) = 2n^4 - 2n^3$] (Repulsive interactions in Mass 1) × (Attractive interactions in Mass 2)(unlike)^2

Therefore, the net number of attractive electrogravic interactions is:

$$2n^4 - 2n^3 + n^2 - (2n^4 - 2n^3) = +n^2 \quad (15)$$

And they are net attractive, thereby satisfying Newton's Law that includes attraction and proportionality. A pair of positive (+) and negative (-) field interactions gives rise to a positive (+) (attractive) gravitational electrical field, and pairs of positive or negative fields (repulsive) give rise to negative gravitational (electrical) charges that will attract (or repel) each other, but attraction is greater than repulsion because the number of attractive interactions is greater (by $+n^2$, as shown in Table 2) than repulsive interactions. That excess attraction applies to all mass, and its amount may be calculated in the same way R_U was counted: as a weighted average of the interacting elements. Of course, the important point for all mass is that the gravitational charge is net attractive, (by $+n^2$). This means that the universal constant of gravitation is really not constant but may vary depending on the concentration of the elements at a particular location. For the Earth, "n" is nearly constant because there are so many elements involved and their proportions are often not known.

HIGHLIGHTS

- Gravity was established as electrical in nature because the unit electrical charge calculated for gravitation based on measured G (1.4396077×10^{-34}C), adjusted for composition, agrees nearly perfectly (within 0.025%) with the calculated gravitational charge (1.4399644×10^{-34} C) based on the square of the velocity of light, where $c^2 = 8.9875518\times10^{-16}$ m^2/s^2),×(primary electrical charge ($1.602176487\times10^{-19}$ C), the product of which is entirely electrical.
- $c^2 \times 10^{-32}$was calculated and derived, a priori, as the ratio of secondary to primary electrical charge.
- Gravitational charge (e_2), a new constant (1.4399644×10^{-34} C), was calculated, in Coulombs, to 8 significant figures.
- G was calculated and derived, to within 0.05% of its measured value, using c^2; primary charge; the electrical constant; the magnetic constant; and the weighted average mass number to atomic weight ratio of the Milky Way Galaxy.
- The composition dependence of G was established.
- G and units for G were restored as: $G = 6.6775857 \times 10^{-11}$ $N_N(C^{-2})\ (s^2)\ (m^{-2})$.
- Gravity is a probable source of electromagnetism (Figure 2).
- Gravity was calculated to be net attractive.
- The variability of G in the Milky Way Galaxy is explained.

RESULTS & DISCUSSION

The question remains, how is gravity generated in mass? There are several basic facts known to be true, and from those facts, we can deduce how gravity is generated:

- It has been demonstrated that gravity must be electrical and operate by electrical rules.
- Those rules include electrical charge that is positive in sign and electrical charge that is negative in sign.
- Direct evidence of that is the attraction and repulsion of mass that contains those charge units at the atomic level.
- Gravity is so closely associated with mass that gravity is mistakenly attributed to mass instead electrical charge.
- Secondary electrical charge (e_2) is comparable to primary electrical charge (e_1). Primary charge is apparent as electricity but is much greater than secondary (gravitational) charge in magnitude on a unit basis (1.6×10^{-19} C vs. 1.44×10^{-34} C).
- The number of positive and negative charges being near equal in the nucleus makes it the perfect environment for generation of gravitational (electrogravic) charge. This number provides the pairs of positive and negative charge and from which it can be calculated that gravity is net attractive, as shown in Table 2. The orientation of electrogravic charge is shown in Figure 2, manifested as electromagnetism.
- The ratio of secondary charge to primary charge $(e_2/e_1) \times 10^{32} = c^2$ (Equation 18).

So, how is secondary charge generated?

- Clearly, secondary charge must be produced by interaction between two distinctly different electrical fields. In the atom, those fields are the fields of the electron and the proton.
- The electron, traveling at nearly c, provides the dynamic needed to generate secondary charge.
- Therefore, the electrical field of the electron interacting

with the electrical field of the proton in the nucleus, which is essentially relatively stationary, may produce electrical (gravitational) charge valued at 1.4399644×10^{-34} C (positive); and the electrical field of the electron interacting with the electrical field of other electrons in the nucleus (e.g. neutrons) will also produce gravitational charge valued at $1.4399644 \times 10^{-34}$ C (negative). How sign is determined should be another subject for consideration and analysis.

- The positive or negative gravitational (electrogravic) charge interactions constitute gravity. However, there are more attractive than repulsive gravitational charge interactions (Table 2, (by +n2)) so that gravity is always net attractive.
- The mechanism shown in Figure 1, and formulas developed in Table 2, agrees perfectly with the natural behavior of gravity and with Newtonâ€™s Law. No other configuration has been advanced that would do so, as far as known.
- The calculation of secondary charge (e2) is based on Equation (2), and Equation (5). Secondary charge is divided by the known quantum unit of primary charge and multiplied by 10-32, the product is equal to the square of the velocity of light (Equation 18). That calculation demonstrates the validity of that equation and determines the exact values for e2 and c2. All factors in the equation for G have meaningful, logical, and purposeful presence in those equations, including the weighted average mass number to atomic weight ratio of the universe (RU). RU is not to be confused with the geologic terms resources and reserves. Resources are related to the content of different elements in the Earthâ€™s crust. Reserves are related to economically recoverable elements in the Earthâ€™s crust. Nevertheless, RU is affected by changes in the concentration of different elements in the Milky Way Galaxy, as shown by Table 1. Those changes will affect RU, even if only slightly, and therefore will affect e2, as shown from Equation (2), and Equation (11). The fact that e2 calculated in Equation (4), agrees within 0.025% with e2 calculated separately in Equation (5), and results in the correct calculation of G (Equation 12), is proof that the correct 5 factors are used in the calculation of G.
- The ratio of the electrical to magnetic constants correlates with the gravitational to electrical charge ratio showing how units of the square of velocity of light are applicable to the charge ratio e2(e1)-1 = c2 Ã— 10-32 Equation (18). This correlation corroborates the square of the velocity of light calculation because of units thereby determined and virtually eliminates any possibility of that calculation being a chance occurrence of the same number. In addition, the nearly identical calculation of e2 in separate Equations (4) and (5) validates Equation (2), the electrical origin of gravity, and the application of square of the velocity of light to the equation. e2 must be a quantum unit because its value can be calculated directly as the product of c2 and e1. Considering the electrical fields from which it is generated and the behavior of gravity, it seems likely and only natural that e2 would be a quantum unit. In addition, there likely would be tertiary or higher level tiers, like those of the secondary gravitational charges that would echo them, but perhaps follow a different rule for their generation or operation. Another great opportunity for research is the proximity to and perhaps velocity of nearby electrical fields necessary for generation of gravitational charge.
- The so-called universal "constant" of gravitation, G, is not actually constant but depends on the concentration of elements in the universe, especially hydrogen and helium where G is measured. Equation (2) shows how G is determined, with contribution from R_U. Net attraction applies to each element. The relative strength of charge is dependent on the (mass × mass number) to atomic weight ratio}. This is another reason why researchers have had so much difficulty in determining a fixed G [16]. However, Table 1 provides the key evidence for these differences in R_U and therefore G, depending on location. Hydrogen and helium concentrations and proportions, in particular, dominate in most regions of the Milky Way Galaxy.
- The expansion or contraction of the universe, or parts of the universe, may be partially explained by the lower half of Table 2, "Number of interactions within mass units," another opportunity for further research [37,38].

Therefore, the foregoing statements prove the validity of the electrical origin of gravity. The exact nature of secondary charge generation is another opportunity for further research.

Electrical interactions within mass units

Given that the universe is expanding [38], this fact should be evident from the equations in the lower half of Table 2. Repulsion within mass should be greater than attraction. With increase in mass, the difference in electrogravic interactions between those that are attractive and those that are repulsive may become greater (Tables 1 and 2). A mitigating factor is that between separate mass units, there is net attraction, as demonstrated by our Solar system, where separate bodies of mass (e.g. the planets and the Sun) are mutually attractive. Otherwise, the universe might keep expanding almost without limit.

Implications for force, light, and energy

Equations (16 and 17), show why the square of the velocity of light, and energy, are what they are: a function of the ratio of the strength of secondary quantum electrical (gravitational) charge to the strength of primary quantum electrical charge $\times10^{32}$. That ratio remains constant in nature so long as these charges exist as quantum units. Equation (17) also shows why energy is a function of c^2. Energy is really a function of the ratio on which the square of the velocity of light is based [Equation (18)]. Equation (19) shows that gravitational charge (e_2) is the product of primary charge (e_1), and the square of the velocity of light (where $c^2 = 8.987 \times 10^{-16}$), and is within 0.025% of e_2 calculated in Equation (4), by a different approach (calculating e_2 from measured G).

If,

$E = mc^2$ (16)

Then: $E=m((e_2)(e_1)^{-1}) = m(c^2 \times 10^{-16} \times 10^{32})$ (17)

$c^2 = 8.9875518 \times 10^{16} = [(e_2)(e_1)^{-1} \times 10^{32}]$ (18)

$e_2 = e_1(c^2) = 1.4399644 \times 10^{-34}$ C,

where $c^2 = 8.9875518 \times 10^{-16}$ m^2/s^2 (19)

$e_2^2 = (e_1^2c^4)(c^2)^3) = [(729.9 \times 10^{48})(\times 10^{-68})(c^2)^2 = 7.29 \times 10^{-14}\ C^2$ (20)
and $e_2/e_1 = c^2 \times 10^{-16}$ (21)

CONCLUSION

The fact that secondary (gravitational) charge [$(1.4399644 \times 10^{-34}$ C) (within 0.014% of e_2 based on measured G)] divided by primary (electrical) charge ($1.602176487 \times 10^{-19}$ C) is equal to the square of the velocity of light to the negative power of 10 ($8.9875518 \times 10^{-16}\ m^2/s^2$) is a priori derivation of c^2 and proof that gravitational charge (e_2) is electrical and equal to the quantity of Coulombs shown (1.4399644 C). G is calculated to within 0.05% of the measured G by multiplication of the using the count of primary electrical charge interactions; the square of gravitational charge generated from those primary electrical charge interactions; the square of the velocity of light (c_2) the electrical constant; and the magnetic constant. Gravitational charge was adjusted for composition using of the square of the weighted average mass number to atomic weight ratio of the Milky Way Galaxy $(R_U)^2$.

Most of the Figures and tables presented were developed by the author and are verifiable. An explanation of gravity has long been sought. This paper provides that explanation and examines the source, origin, and operation of gravity that is in agreement with its operation in nature. Such a consistent explanation has not previously been found. These clarifications are also expected to lead to practical control of gravity and further unification of the forces and fields that comprise it. Whoever would have thought that the product of 2 familiar and common constants, c^2 and e_1, would contribute so directly to unraveling of the mystery of gravity and result in the confirmation of the composition-dependence of G?

ACKNOWLEDGEMENTS

The author would like to thank Dr. Philip Sutter, Emeritus Professor of Physics, Franklin and Marshall College, Lancaster, Pennsylvania, whose early encouragement eventually led to writing of this paper.

REFERENCES

1. Einstein A. The field equations of gravitation. Meet rep R Prussian Acad. Sci. 1915:844-47.
2. Stacey FD, Tuck GJ. Geophysical evidence for non-Newtonian gravity. Nature. 1981;292(5820):230-32.
3. Abbott BP, Abbott R, Abbott TD, et al. GW170817: Measurements of neutron star radii and equation of state. Phys rev lett. 2018;121(16):161101.
4. Castelvecchi D, Witze A. Einstein's gravitational waves found at last. Nat news. 2016;11.
5. Millikan RA. On the elementary electrical charge and the Avogadro constant. Phys Rev. 1913;2(2):109.
6. Newton I. Sir Isaac Newton's mathematical principles of natural philosophy and his system of the world. Univ of California Press; 2022.
7. Henry Cavendish . Rights in Property and Property in Rights: Privacy, Contract and Ownership of the Body in Anglo-American Political and Constitutional Thought.
8. Arthur Holly Compton EU Condon: Science, religion, and the politics of world peace. Phys Perspect. 2008;10(1):4-55.
9. Armstrong TR, Fitzgerald MP. New measurements of G using the measurement standards laboratory torsion balance. Phys rev lett. 2003;91(20):201101.
10. Sibley SF. The Electrical Nature of Gravity.
11. Gundlach JH. A rotating torsion balance experiment to measure Newton's constant. Meas Sci Technol. 1999;10(6):454.
12. Gundlach JH, Merkowitz SM. Measurement of Newton's constant using a torsion balance with angular acceleration feedback. Phys Rev Lett. 2000;85(14):2869.
13. Holding SC, Tuck GJ. A new mine determination of the Newtonian gravitational constant. Nature. 1984;307(5953):714-16.
14. Kuroda K. Does the time-of-swing method give a correct value of the Newtonian gravitational constant?. Phys Rev Lett. 1995;75(15):2796.
15. Luther GG, Towler WR. Redetermination of the Newtonian gravitational constant G. Phys Rev Lett. 1982;48(3):121.
16. Holzschuh E, Kündig W. Determination of the gravitational constant with a beam balance. Phys Rev Lett. 2002;89(16):161102.
17. Speake CC, Gillies GT. Why is G the least precisely known physical constant? Z Naturforsch A. 1987;42(7):663-69.
18. Walesch H, Meyer H, Piel H, et al. The gravitational force at mass separations from 0.6 m to 2.1 m and the precise measurement of G. IEEE. 1995;44(2):491-93.
19. Zee A. Quantum field theory in a nutshell. Princet univ press; 2010.
20. Schinasi LD. Teaching the Portraits, Mosaics and Themes of the Federal Rules of Evidence. Miss CL Rev. 2010;29:83.
21. Sibley SF. The Electrical Nature of Gravity.
22. Freitas RC, Gonçalves SV. Observational constraints of the gravitational waves in the Brans–Dicke theory: Einstein frame and Jordan–Brans–Dicke frame. Phys Lett. B. 2012;710(4-5):504-15.

23. Chown M. Where matter fears to tread. New sci. 2009(2699):38-41.
24. Higham NJ. Handbook of writing for the mathematical sciences. Soc Ind Appl Math; 2020.
25. Hayt WH, Buck JA. Engineering electromagnetics. Erlangga; 2006.
26. Sibley SF. The Electrical Nature of Gravity.
27. Lide DR. CRC handbook of chemistry and physics. CRC press; 2004.
28. Sutherland W, Emerson J, Dalton G, et al. The visible and infrared survey telescope for astronomy (VISTA): design, technical overview, and performance. Astron Astrophys. 2015;575:A25.
29. Brochure SI. The International System of Units: Bur Int Poids Mes;2016.
30. Lefton, L. Mathematician calculates the real chances of winning Powerball's largest jackpot, Georgia Institute of Technology; 2019.
31. Sibley SF. The Electrical Nature of Gravity.
32. Kaufmann WJ, Comins NF. Discovering the Universe: From the Stars to the Planets. MacMillan; 2008.
33. Sibley SF. The Electrical Nature of Gravity.
34. Porterfield WW. Inorganic Chemistry. A Unified Approach, Addison-wealey. Reading, MA. 1984.
35. Selbin J. The origin of the chemical elements. J Chem Educ. 1973;50(5):306.
36. Sibley SF. The Electrical Nature of Gravity.
37. Serway RA, Jewett JW. Physics for scientists and engineers. Cengage learning; 2018.
38. Rollins PC. America reflected: language, satire, film, and the national mind. New Acdemia+ ORM; 2021.