

Quantum Magnetodynamics of Gravity

David W Gold

Torquay, Devon, England UK

Email: david.gold@scienceau.uk

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Abstract

Assessment was given to the *quasi*-magnetic monopoles experimentally discovered in tetrahedral crystal structures of spin ices, as conforming functionally to the hypothetical particles theorised by Paul Dirac to retain duality symmetry between the electromagnetic unified fields. This serendipitously led to an association that existence of the hypothetical graviton would constitute to hypothetical magnetic monopole dual particles from which form hypothetical ‘Gravity Strands’; the *modus operandi* as to the *vera causa* of the gravitational force. This pivotal premise readily developed; in consequence realizing a solution for quantum gravity in perfect unity with *magnetic* and *electrical fundamental* forces, thereby forming a foundation for Quantum Magnetodynamics.

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1. Introduction

In 1931 Paul Dirac discovered that when using Maxwell’s equations for electromagnetism, by removing the electrically charged particles from the equations, produced duality symmetry whereby the electric and magnetic fundamental fields can be interchanged without changing their form. Adding the electrically charged particles back into the equations destroyed the duality symmetry. Dirac proposed the existence of hypothetical magnetic monopole particles and their inclusion in the equations, together with electrically charged particles, reinstated the duality symmetry, which in this instance must manifest in some topological form. The quantization condition Dirac concluded was if hypothetical magnetic monopole particles existed would justify electric charge, which must be quantized in certain units and, due to the duality symmetry, the elementary magnetic charge of magnetic monopoles must be quantized in units inversely proportional to the elementary electric charge [1].

¹ This work is ongoing by evolving processes of development and enhancements in an open and transparent communication of continuing progress.

2. Hypothetical ‘Gravity Strands’

Premise: Rationalises that magnetic monopoles would emanate from non-confinement in QCD (in furtherance of [2]); as cause, the by-product of quark/gluon interactions. The effect will be continuous streams of polar charged magnetic monopole ‘*graviton*’ particles expelled, in opposite polar directions, from nucleons’ nuclei along their axes of spin.¹ Nucleons will naturally pair together as a consequence of their continuous streams of gravitons self-organising into ‘strands’ of alternating charged particles, whereby initiating a gravitational force (see figure 1.1); hence the name ‘Gravity Strand’. The force of attraction manifests from continuum head-on attraction and annihilation of opposite charged gravitons.² Single/unpaired nucleons (or paired nucleons where protons’ spin orientations readily invert in response to an electrical or magnetic field or magnetized state) will produce same charged gravitons flowing in the same direction, thereby instigating a magnetic force³ (see figure 1.2). The gravitational and magnetic forces are normally distinct in that they retain non-interaction⁴, whereas their interchangeability will formalize in unification: in Gravitymagnetic unified fields.

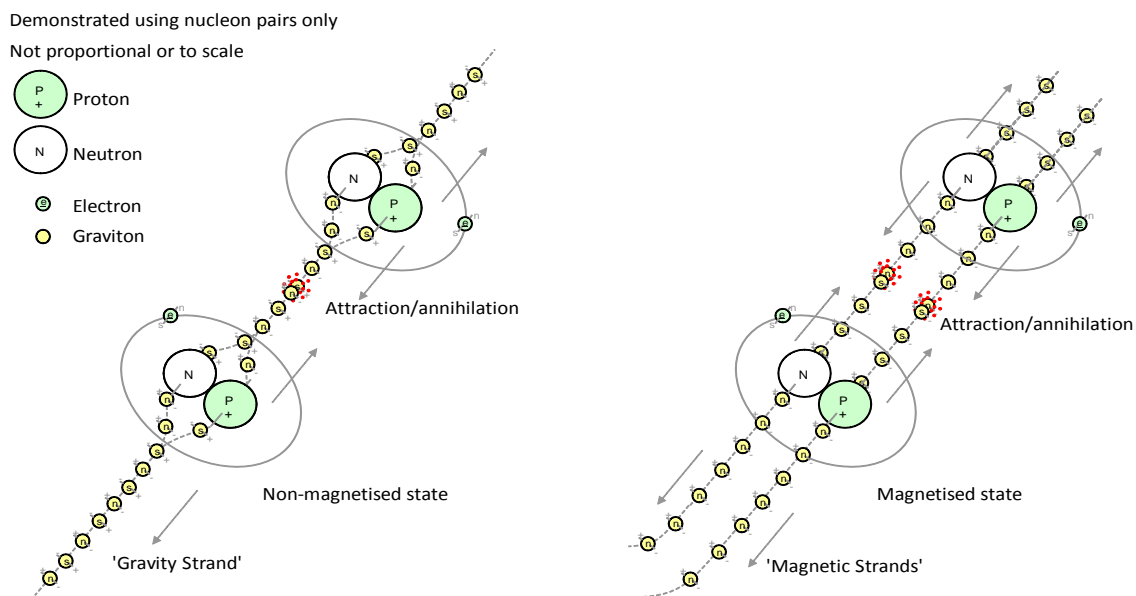


Figure 1.1: Gravitational Force

Figure 1.2: Magnetic Force

¹ It defines all forms of hadronic matter to be the only sources of gravitons. It will quantify the masses of black holes to extremely dense quark-gluon plasma interiors. Correspondingly, neutron stars’ sources of gravitons are limited to the neutrons constituent in these stars. (Gravitons duality utilization will then go on to explain both the very strong gravitational and magnetic fields of these compact cosmic objects.) In regard to particles, only nucleons (as the only stable hadron particles) can have gravitational interactions to the exclusion of all other subatomic particles.

² It infers monopole gravitons are massless gauge-bosons comprising of opposite charged particle and antiparticle, which facilitates annihilation. Head-on attraction/annihilation of leading particles, in opposite travelling gravity strands, exposes the next pair of opposite charged particles in continuation of the process. The pulling force generated by the leading particles, is transferred via each opposing strand formation to the source objects.

³ It is deduced that the magnetic monopole will have a electric moment, enabling interaction by interconnection of fields between magnetic monopoles, travelling in magnetic strands, and electrically charged subatomic particles. (In gravity strands, the overall affects of electric moments and magnetic charges are neutralized throughout the length of each strand with only the leading particle retaining a net surplus magnetic charge.) It is plausible that lines of magnetic flux, when made visible, are displaying same charged monopoles in traceable streams curved progressively apart by their mutual repulsion (and where opposite charged streams meet in head-on attraction/annihilation).

⁴ Exception arises within very powerful magnetic fields resulting in localize interference of gravity strand activity [3]

The disclosure by Richard Feynman is that the proton's magnetic moment should be close to 1, but is instead 2.79, and the neutral neutron, which should not have any magnetic interaction, has a magnetic moment of 1.93 [4]. This is central to nuclear magnetic resonance where, in essence, spectra are produced in atomic nuclei that have at least one unpaired proton or neutron. These unexplained anomalies in the magnetic moments are significant and potentially attributable to the emission of magnetic monopoles as posited.

3. Foundation for magnetodynamics

In the past, Ptolemy's geocentric model required increasing complexity in order to accurately describe astronomical observations and in predictive capabilities. The complexity was an indication of incompleteness in past understanding and confirmed in a paradigm shift by Copernicus' heliocentric model, subsequently followed by Kepler's planetary laws and Newton's gravity [5].

Present day, the complexity involved in condensed matter physics and the inability to accurately compute many-body interactions beyond three particles [6] in describing the heterogeneity of matter, is analogous to the above. In that this present complexity is potentially indicative of incompleteness in current understanding and, as such, prime for a paradigm shift in exposition. The origin of this, like Ptolemy's model, would predominantly centre on a false assumption.

The continuing discussion is an introduction to magnetodynamics in which the fundamental interactivity of quantum gravity is elucidated. It will become apparent as to the thermodynamic aspect of this force. This underlying phenomenon will be consistent with the thermodynamical properties of matter.

3.1 Relative aspects of matter

External to matter, gravitational interactions are directly related to the masses of hadronic objects. Mass major components are volume and density. Internally, at the atomic level, volumes, together with masses of objects, with respect to the gravitational force, become irrelevant and so, therefore, gravitational interactions will only be directly related to mass densities. In obtaining consistency between the different mass densities of individual elements and substances is achieved by conversion to a 'Relative Matter Density':

$$R_\rho = \rho / (uN) \quad (1.0)$$

where ρ = mass density, u = atomic mass units and N = molecular element factor (atoms forming an molecular element, else 1). Precise 'Molar Relative Volume' is established from the reciprocal of relative matter density:

$$R_v = 1/R_\rho \quad (1.1)$$

Used statistically, there is proportionality between the square root of molar relative volume and the interactive strengths of electrical and gravitational forces, referred to as the 'Mean Interactive Molecular Distance':¹

$$\langle r \rangle = M \sqrt{R_v} \quad (1.2)$$

where 'Transition Molecular Distance Constant' $M = \sqrt{e^2 / (2\pi\epsilon_0 G)}$.

¹ Has a similarity to but distinct from mean inter-particle separation, the distinction arises from molecular kinetic motion. (Molecular will, in addition, be used as a generic term referring to either atoms or molecules.)

3.2 Intermolecular forces

With all atomic nuclei the two electrons in the innermost orbital are strongly bound to the nucleus, and whose cloud originates nuclear screening. Their stability is central to the reasoning that they are the only two electrons effective in atomic negative charge electrostatic repulsion, and thereby determines the Coulomb interaction between two atoms:¹

$$F_e = \frac{(2e)^2}{4\pi\epsilon_0\langle r \rangle^2} \quad (1.3)$$

As disclosed in the initial premise, the gravitational force is instigated by gravitons self-organising into gravity strands that culminate in distinct outward multi-vectorial radiation of gravity strands from atomic nuclei. The attraction/annihilation of gravitons in the mediation of the gravitational force, of single opposing gravity strands between two atomic nuclei, produces the resultant Gravitational interaction:

$$F_g = 2GR\rho \quad (1.4)$$

where G is the gravitational constant. The opposing Coulomb and Gravitational interactions then attain equilibrium that will sustain the position of atoms and molecules within the heterogeneity (topology) of matter:²

$$F_e - F_g = 0 \quad (1.5)$$

(Table in appendix A contains a list of Coulomb-Gravitational interactions in relation to different elements and sample substances at STP.) Beyond the exotic state of quark-gluon plasma, nucleons are the only stable hadron particles predicted to produce gravitons and, thereby, are the only particles able to interact gravitationally. Electrons, like all remaining subatomic particles, are posited not to produce gravitons and, therefore, are unbound to the gravitational force; electron retention is bound by electrostatics. In consequence, this will conclude that mass is not *universally* bound to the gravitational force. Moreover, application of Newton's classical gravitational law in equivalence to a quantum law has inherently been a false assumption.

Proposition 1: Atomically, solids are consolidated by continuous alignment of gravity strand interactions between atomic nuclei. Liquids are synthesized by distinguishable combinations of alignment and intermittent interaction of gravity strands. And gases are synthesized purely by intermittent interaction of gravity strands, due to the random kinetic motion and orientation of atomic nuclei. All gravity strand interactions will be inversely proportional to molecular kinetic motion/energy, which is dependent upon temperature.

The above proposition illustrates a crucial underlying dynamical phenomenon of the gravitational force whereby it is dependent upon temperature and, as such, relevant in respect of gravitational attribution to the thermodynamical properties of matter. Equivalence in interactions between these two opposing intermolecular forces will produce equilibrium of state within a closed system, equating to symmetry between the two forces, whereby, any loss of equilibrium will correspond to differential in force strengths arising from spontaneous symmetry-breaking.

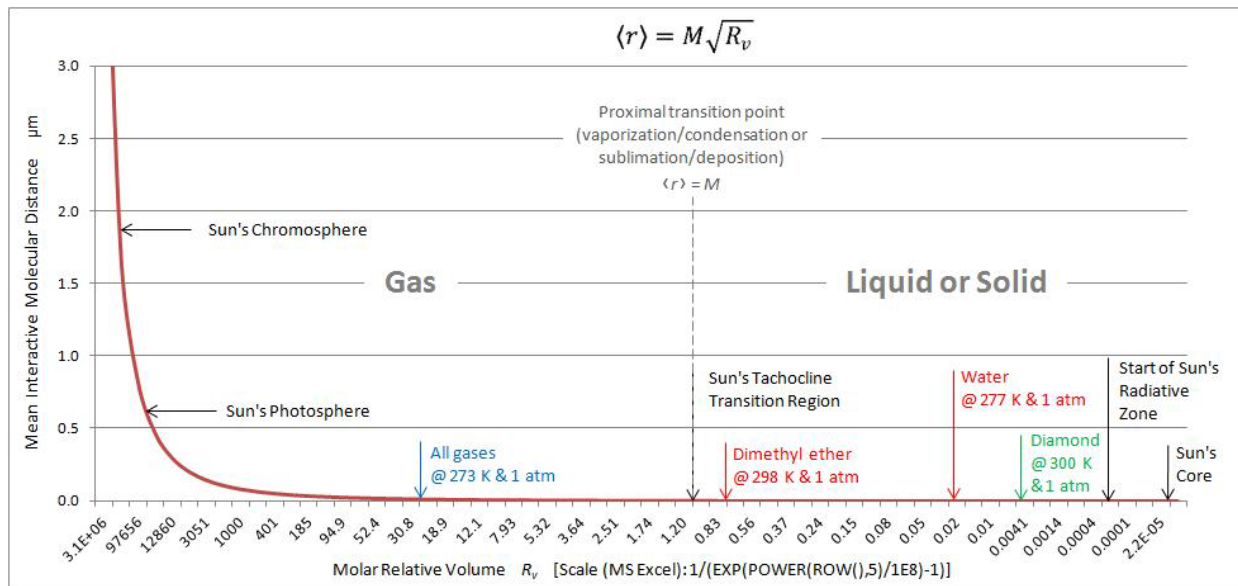
¹ All remaining electrons of atomic nuclei occupy higher orbitals and, due to initial screening, are less stably bound to the nucleus. Hence these electrons are more fluid (and are instrumental in chemical dynamics instigated by outer orbital electron/s sharing or donation with adjoining atoms, or otherwise are prone to wander); and as such, due to this fluidity, these electrons are reasoned non-contributory to electrostatic repulsion between atoms.

² Example: Diamond, in which all the carbon atoms forming the crystalline structure are uniformly spaced 0.154 nm apart, corroborates Dirac's duality symmetry: $F_e = 3.9118743(77) \times 10^{-8}$ - $F_g = 3.9118743(82) \times 10^{-8}$.

Asymmetry in these force strengths will be the cause of expansion or contraction in matter, until equilibrium of state is re-established, and any restricted asymmetry in the gaseous states, arising from change in initial temperature, will determine the pressure within a specific gas. This can be fundamentally demonstrated by the following example where volume is constant and pressure of the gas is in relation to atmospheric pressure:

$$p = \frac{F_e}{F_g(T_i/T)} p_a \quad (1.6)$$

Explanation for mean interactive molecular distance, as formulated in Eqn. 1.2, is encapsulated in proposition 1.



Graph 1: Mean Interactive Molecular Distance

Note: the mean interactive molecular distance tends towards but remains greater than zero, $\langle r \rangle > 0$, as molar relative volume decreases. At the Sun's Tachocline Transition Region the temperature is greater than the critical point for the gas plasma to transform into a liquid state.

The magnetic field strength of each magnetically charged monopole will give gravity strands elastic ability, which is empirically evidential in certain materials, and is expository in the tensile strengths of solids.

3.3 Molecular thermodynamical processes

There is a distinction between two fundamental forms of pressure: accumulative and induced pressure. Accumulative pressure is the result of gravitational influence and which attributes to matter. It is consequential to atmospheric pressure and increasingly accumulating within matter where it can ultimately culminate, at the quantum scale, in the degeneracy pressure of electrons (or neutrons in the case of neutron stars). Induced pressure, however, is the result of thermodynamical or induced physical effects and, is later shown, does not attribute to matter but remains as a thermodynamic attribution.

Asymmetry in intermolecular force strengths within the gaseous state will be the cause of induced pressure, which then opposes the kinetic theory notion that pressure results from the accumulative kinetic energy of atoms or molecules striking the internal container's surface/s. It will be consistently demonstrated that induced pressure is not a direct consequence of kinetic energy but constitutes to potential energy of a gaseous system in direct proportionality with the asymmetry in the intermolecular force strengths. The composition of Eqn. 1.6, for a fixed volume of a specific gas, is specifically expressed:¹

$$p = \left\{ \left[\frac{(2e)^2}{4\pi\epsilon_0(M\sqrt{1/R_\rho})^2} \right] / \left[\frac{2GR_\rho T_i}{T} \right] \right\} p_a \quad (2.0)$$

The left bracketed numerator of Eqn. 2.0 expresses the electrostatic repulsion force and, due to the fixed volume, remains constant in value. The right bracketed denominator of the equation expresses the gravitational attraction force and will alter in value depending upon change in temperature. Reduction of Eqn. 2.0 will represent an ideal gas at the quantum level:

$$p = \frac{e^2 T}{2\pi\epsilon_0 M^2 G T_i} p_a \quad (2.1)$$

The cancelling out, in Eqn. 2.1, of relative matter density equates to $R_\rho = 1$, and correspondingly $R_v = 1$ litre, which, within the bounds of a critical temperature and irrespective of pressure, momentary occurs at the approximate mean point during a phase transition involving vaporization/condensation or sublimation/deposition and is applicable for all elements and substances. (When, within the above bounds: $R_v < 1$ for liquids and solids and $R_v > 1$ for gases.) This is supported by the transition molecular distance constant M as corresponding to the mean interactive molecular distance for all elements and substances at this same transitional point and is presented in the duality symmetry of the coulomb-gravitational interactions:

$$\frac{(2e)^2}{4\pi\epsilon_0 M^2} - 2G = 0 \quad (2.2)$$

This forwards Rule 1: *At or below a critical temperature and irrespective of pressure, the proximal phase transition between a liquid or sublimation of a solid to a gas or vice versa of an individual element or substance (or in their summing) occurs at the point when their molar relative volume transcends 1 litre.*

Eqns. 2.0 & 2.1 presents induced pressure within a fixed volume of a gas. In considering variable volume of a fixed quantity of a specific gas that ranges from compressed to unsuppressed volume as a result of change in absolute temperature and/or induced pressure is presented, without reduction, to demonstrate the precise processes taking place:

$$V = \left[\frac{(2e)^2 n R_v (T/T_i) p_a}{4\pi\epsilon_0 (M\sqrt{R_v(T/T_i)})^2 p} \right] / \left[\frac{2GR_\rho T_i}{T} \right] \quad (2.3)$$

volume
density

¹ The relative matter aspects are, in addition, dependent upon atmospheric pressure, i.e. $R_v(p_a/p'_a)$ & $R_\rho(p'_a/p_a)$, and so, to minimize complexity, p_a will remain constant throughout.

where $n = V_i/R_v$ moles. The right side of the equation expresses change in relative matter density; equating to dynamical change in the gravitational force strength that then establishes change in mass density: $\rho = uNR_\rho(T_i/T)$. On the left side of the equation, taking into account any change in induced pressure (formed from restriction in the electrostatic repulsion force pursuant of equilibrium), potential change in the mean interactive molecular distance is expressed by the denominators and the numerators express corresponding potential change in molar relative volume. (The R_v potentials are inversely proportional to the induced pressure: $R_v[(T/T_i)(p_a/p)]$.) Reduction of Eqn. 2.3 fully develops Eqn. 2.1, for an ideal gas, to that of a specific gas as presented at the quantum level (recalling: $R_v = 1/R_\rho$):

$$pV = \frac{e^2 n R_v T}{2\pi \epsilon_0 M^2 G T_i} p_a \quad (2.4)$$

The coulomb and gravitational attributes are equivalent, and as such, are consonant with the duality symmetry of their interactions:

$$\frac{e^2}{2\pi \epsilon_0 M^2 G} = 1 \quad (2.5)$$

The equivalence produced in Eqn. 2.5 will further reduce Eqn. 2.4 and, as a consequence, will reconcile the quantum aspect with the classical; in giving rise to a new classical equation of state for gases and, in the omission of a gas constant, is then specific for any given gas:

$$pV = nR_v(T/T_i)p_a \quad (2.6)$$

Law 1: In relation to atmospheric pressure, the product of induced pressure and volume of a given gas is directly proportional to its molar relative volume in which is proportional to any change in absolute temperature.

Thus far, the heterogeneous state of gases has been the simplest state to analyse with regard to the duality symmetry of the coulomb-gravitational interactions. As to heterogeneous states of liquids and solids, they atomically differ in structures and hence respond by different extents to change in temperature. This underlying complexity is currently resolved by use of relevant thermal expansion coefficients at the classical scale and where exposition, at the quantum scale, of these coefficients will correlate with differentiated asymmetries in the coulomb-gravitational interactions; and where symmetry, in all instances, concludes in equilibrium of state.

The above outline in complexity is exemplified with regard to negative thermal expansion in which certain materials expand on cooling; ice is an example. In explanation, not all magnetic monopoles radiating from atomic nuclei integrate by self-organising into gravity strands i.e. nuclei that have at least one unpaired proton or neutron or where paired nucleon spins are not inversely orientated. Non-integrated magnetic monopoles form individual magnetic strands that mediate the magnetic force. Hydrogen is a prominent example. Whereas molecular hydrogen (H_2) form gravity strands and interact gravitationally, atomic hydrogen (H) only emit magnetic strands (see figure 1.2 with respect to a single proton) and therefore can only interact magnetically. The forming of hydrogen bonds will arise from Coulomb-Magnetic interactions in which short bonds are attraction alignment of magnetic strand interactions between the hydrogen's proton and an unpaired proton or neutron within the nucleus of the atom, or between atoms, it is bonded to.

The Coulomb interaction will result from the negative charge of the single electron of the hydrogen atom in a repulsion interaction with the two innermost orbital electrons of the bonded atom/s. These duality symmetrical bond/s are maintained by electron sharing between the bonded atoms. Long bonds by inference will be autonomous attraction or repulsion alignment of magnetic strand interactions between atomic nuclei. This in furtherance will posit that negative thermal expansion is where reducing temperature and hence reducing molecular kinetic motion allows increasing sustainment between atomic nuclei (rigidity) by continuous alignment of gravity strand interactions (evolving from intermittent interactions) and, as a consequence, results in proportional increase in autonomously opposing repulsion alignment of magnetic strand interactions that effectuate expansion.

3.4 Correlation of mass density with equilibrium of state

Eqn. 2.0 is re-presented to reconcile an apparent paradox in the mass density ratio of mass and volume:

$$p = \left\{ \left[\frac{(2e)^2}{4\pi\epsilon_0\langle r \rangle^2} \right] / \left[\frac{2GR_\rho T_i}{T} \right] \right\} p_a \quad (2.7)$$

If volume for a specific gas, as expressed by the left side of the equation, remains constant then mass and mean interactive molecular distance of the gas will also remain constant, whereas, mass density, as expressed by the right side of the equation, will fluctuate with change in temperature; hence the paradox. Fixed volume equates to a fixed quantity of a given gas of constant mass and will extend to variable volume where, in such instances, the mean interactive molecular distance alters accordingly with volume. Eqn. 2.7 can be expressed in the following form:

$$\frac{m p_a}{V p} = \rho \quad (2.8)$$

Eqn. 2.8 forms Proposition 2, whereby, for volumetric mass density to remain consistent as a ratio between mass and volume then variability in mass density is accounted for in the following theorem:

Theorem 1: In relation to atmospheric pressure, mass density of a given gas is proportional to the mass of the gas and inversely proportional to the product of volume and induced pressure.

Lemma 1: In the case of unsuppressed volume of a gas, change in temperature will cause change in volume but pressure remains constant to atmospheric pressure; in conformity with Charles law [7]. Resultant change in mass density of Eqn. 2.8 is consistent with theorem 1.

Lemma 2: In the case of fixed volume of a gas, change in temperature will cause change in pressure but volume remains constant; in conformity with Gay-Lussac (Amontons) Law [8-9]. Resultant change in mass density of Eqn. 2.8 is consistent with theorem 1.

Lemma 3: In the case of compressed volume of a gas, in which initial constant temperature is reattained, will cause change in pressure and volume; in conformity with Boyle–Mariotte law [10]. Resultant mass density of Eqn. 2.8 remains constant and is consistent with theorem 1.

	Mass of Gas	Initial Temperature	Specimen Temperature	Initial Volume	Resultant/Specimen Volume	Initial Mass Density	Resultant Mass Density	Resultant Pressure	Constant $\rho' T'$
Volume	g	K	K	L	L	g/L	g/L	atm	
Lemma 1: Unsuppressed	222	273	573	22.816	47.889	9.73	4.636	1	2656.290
Lemma 2: Fixed	222	273	573	22.816	22.816	9.73	4.636	2.099	2656.290
Lemma 3: Compressed	222	273	273	22.816	15	9.73	9.73	1.521	2656.290

Table 1: Mass Density of a Gas ¹

From the above lemmas it can be obtained from deduction that change in density only occurs when there is change in temperature:

$$\frac{1}{V_i} \left(\frac{\partial V}{\partial T} \right)_p = \frac{1}{p_i} \left(\frac{\partial p}{\partial T} \right)_V = -\frac{1}{\rho} \left(\frac{\partial \rho}{\partial T} \right)_m \quad (2.9)$$

Lemma 1 Lemma 2 Lemmas 1 & 2

The deduction is further substantiated by the fact that for a given gas of constant mass the product of density and temperature remain constant. *In addition to accumulative pressure, mass density is dependent upon temperature:*

$$\rho_1 T_1 = \rho_2 T_2 \quad (3.0)$$

Theorem 1 has been validated and is furthered by the fact that the product of volume and induced pressure is consistent with the unsuppressed volume of a gas. Although the cause is shown to be a consequence of quantum gravity, nevertheless the effect is manifested at the classical level, as presented in proposition 2, and hence validation of theorem 1 concludes in the following classical laws:

Law 2: *In relation to atmospheric pressure, mass density of a given gas remains proportional to the mass and inversely proportional to the unsuppressed volume of the gas irrespective of change in volume and/or induced pressure.*

Law 3: *For a given gas of constant mass, mass density is inversely proportional to change in absolute temperature and in which the product of density and temperature remain constant.*

Element (gases)	Data		Eqn. 2.7				Proposition 2			Law 3			
	Atomic Mass Units	Molecular Element Factor	Critical Pressure P_c (atm)	Critical Temperature T_c (K)	Mean Interactive Molecular Distance $\langle r \rangle = M \sqrt{R_p}$ (nm)	Relative Matter Density R_p @ T_c	Reaffirms Critical Pressure P_c (atm)	Molar Relative Mass R_m (g/mol)	Molar Relative Volume R_v (L/mol)	Mass Density ρ (g/L or kg/m ³)	Reaffirms Critical Pressure P_c (atm)	Constant $\rho_1 T_1 = \rho_2 T_2$	
Hydrogen	H ₂	1.00794	2	12.80	33.2	1.213	0.36691	12.80	2.01588	0.21293	0.73964	12.80	24.55619 24.55618
Helium	He	4.00260	1	2.24	5.19	1.147	2.34709	2.24	4.0026	0.19021	9.39447	2.24	48.75728 48.75727
Nitrogen	N ₂	14.00670	2	33.50	126.2	1.461	0.09666	33.50	28.0134	0.30883	2.70769	33.50	341.7107 341.7106
Oxygen	O ₂	15.99940	2	49.80	154.6	1.326	0.07890	49.80	31.9988	0.25450	2.52478	49.80	390.3314 390.3313
Fluorine	F ₂	18.99840	2	51.50	144.3	1.260	0.08449	51.50	37.9968	0.22982	3.21041	51.50	463.2624 463.2624
Neon	Ne	20.17970	1	27.20	44.4	0.962	0.27438	27.20	20.1797	0.13399	5.53682	27.20	245.835 245.835
Chlorine	Cl ₂	35.45270	2	76.00	416.9	1.750	0.02970	76.00	70.9054	0.44305	2.10579	76.00	877.9041 877.9041
Argon	Ar	39.94800	1	48.10	150.8	1.333	0.08089	48.10	39.948	0.25701	3.23143	48.10	487.2996 487.2996
Krypton	Kr	83.80000	1	54.30	209.3	1.477	0.05840	54.30	83.8	0.31534	4.89399	54.30	1024.313 1024.312
Xenon	Xe	131.29000	1	57.60	289.8	1.683	0.04236	57.60	131.29	0.40988	5.56102	57.60	1611.585 1611.585
Radon	Rn	222.00000	1	61.98	377	1.874	0.03176	61.98	222	0.50809	7.04973	61.98	2657.75 2657.749
Substance (sample gases)													
Methane	CH ₄	16.04276	1	45.79	190.8	1.537	0.06389	45.79	16.04276	0.34180	1.02503	45.79	195.5754 195.5754
Ammonia	NH ₃	17.03052	1	111.30	405.5	1.428	0.03046	111.30	17.03052	0.29501	0.51868	111.30	210.3255 210.3255
Steam (373.15 K)	H ₂ O	18.01530	1	217.70	647.096	1.286	0.01921	217.70	18.0153	0.23918	0.34599	217.70	223.89 223.89
Carbon dioxide	CO ₂	44.00980	1	72.80	304.19	1.533	0.04040	72.80	44.0098	0.34001	1.77796	72.80	540.837 540.837

Table 2: Critical Point of Gases

¹ Accuracy in computation will entail the use of a higher degree of precision i.e. $V_i = m/\rho_i$. Calculated results are displayed rounded to three decimal places.

Data for the critical point of gases is used to further substantiate Eqn. 2.7 (for variable volume), proposition 2 and law 3. Constant mass for a given gas is uniformly expressed by its molar 'relative' mass:

$$R_m = uNm_u N_A \quad (3.1)$$

where m_u = atomic mass constant in grams and N_A = Avogadro constant. Molar relative volume, initially established at STP in table of appendix A where $T_i = 273.15$ K (Steam: $T_i = 373.15$ K) and $p_a = 1$ atm, is updated to include critical temperature and critical pressure:

$$R'_v = R_v[(T_c/T_i)(p_a/p_c)] \quad (3.2)$$

From proposition 2:

$$\rho = \frac{R_m p_a}{R'_v p_c} \quad (3.3)$$

Equivalent mass density is derived from relative matter density, updated from table A, using critical temperature only:

$$\rho = uNR_\rho(T_i/T_c) \quad (3.4)$$

(By rearrangement of proposition 2: $p_c = (R_m p_a)/(R'_v \rho)$.) Eqn. 3.4 reaffirms that induced pressure does not attribute to relative matter density, and, consequentially, mass density, which is only attributable to gravitational interactions where force strength, being inversely proportional to molecular kinetic motion/energy, is dependent upon temperature. This asserts that deviation from expected to actual mass density correlates to deviation from restricted to natural volume and both emanate from, and correlates to, asymmetry in strengths of the electrostatic repulsion force that determines volume, and the gravitational attraction force that determines mass density.

Table 2 shows that molar relative volume has transcended the 1 litre threshold, as stated in Rule 1, at a transitional critical point, as in the above examples, where the gas transforms into a liquid (in compliance with critical temperature: $R_v < 1$ for liquids and solids and $R_v > 1$ for gases).

Equilibrium of state manifests in unsuppressed volume; in relation to accumulative pressure, is the product of volume and induced pressure. This in conjunction with law 2 asserts that volumetric mass density is not just a straightforward ratio of mass and volume but is a representation of a true ratio when heterogeneous states of matter are in equilibrium of state. This paradigm shift is comprehensibly demonstrated by the sudden increase in temperature produced in an exothermic reaction, as in an explosive combustion, that will cause spontaneous drop in mass density, as the result of spontaneous increase in molecular kinetic motion and proportional decrease in molecular gravitational force strength, which allows rapid expansion in volume generated by the accumulative electrostatic repulsion force of each atom or molecule, till equilibrium of state is reinstated. This quantum gravity effect is then explicable for the work produced in heat engines and in chemical explosions.

Proposition 3: Within the heterogeneity of matter, invariant consistency of the electrostatic force determines volume, whereas variable dynamics of the gravitational force determines density.

3.5 Unification of fundamental forces

The above proposition realizes importance, not only relating to the major components of mass, in the same way interactions between *electrical* and *magnetic fundamental* forces formalize in unification, the presented unity of interactions between electrical and gravitational fundamental forces would infer a more integrated unification.¹

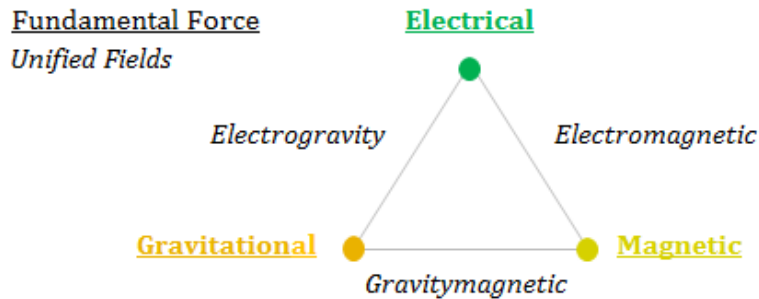


Figure 2: Integrated Unification

If this presentation for quantum gravity were substantiated, the import will conceivably give rise to Quantum Magnetodynamics and, in placing it between the well established quantum dynamic theories of QCD and QED, will advance the potential to realize further integrated unification; as indication of Nature’s ultimate economic utilization of fundamental forces.

Unified Fields Type	Form	Range	Unified Fields	Fundamental Force	Gauge Boson	Fundamental Force Type	Range
Repulsion	Internal	Short	Strong-inflation	Inflationary	?	Repulsion	Long
Attraction	Internal	Short	Strong-gravitational	Strong	Gluon (octet)	Attraction	Short
Attraction	External	Long	Gravity-magnetic	Gravitational	Graviton (magnetic monopole pair)	Attraction	Long
Neutral	External	Long	Electro-magnetic	Magnetic		Attraction/Repulsion	Short
Neutral	External	Long	Electro-magnetic	Electrical	Photon	Attraction/Repulsion	Long
Neutral	Internal	Short	Electro-weak	Weak	W^{\pm} & Z^0	Repulsion	Short
Repulsion	External	Long	(Formerly known as Dark Energy)	Weak-inflation	?	Repulsion	Long
Unified Extrapolation			Grand Unification			Fundamental Extrapolation	

Figure 3: Potential Baseline for a Principle Model of Forces²
(To be viewed as a cylindrical representation)

¹ Conceptual realization arose naturally after development of initial premise. A concept investigated, without success, by Faraday then Einstein, where in the later case, endeavoured to unify general relativity with electromagnetism.

² The neutral unified fields types refer to the cumulative neutralizing effect in respect to opposite charged particles: magnetic or electrical.

Appendix A

Table A: Coulomb-Gravitational Interactions

Element	Periodic Table Symbol	Protons (Element: Atomic number)	Neutrons	Nucleon Number	Atomic Mass Units u	Molecular Element Factor N	Mass Density ρ (g/L or kg/m ³)	Relative Matter Density $R\rho = \rho / (\mu\text{N})$	$R\rho$ % of Diamond	Molar Relative Volume $Rv = 1/R\rho$ (L/mol)	Mean Interactive Molecular Distance $\langle r \rangle = M\sqrt{Rv}$ (nm)	Coulomb Interaction $\frac{(2e)^2}{4\pi\epsilon_0 \langle r \rangle^2}$ (N)	Gravitational Interaction $-2GR\rho$ (N)
Hydrogen (H ₂)	H	1	0	1	1.00794	2	0.0899	0.045	0.015%	22.424	12.451	5.95E-12	-5.95E-12
Helium	He	2	2	4	4.00260	1	0.1785	0.045	0.015%	22.424	12.451	5.95E-12	-5.95E-12
Lithium	Li	3	4	7	6.94100	1	530	76.358	26%	0.0131	0.301	1.02E-08	-1.02E-08
Beryllium	Be	4	5	9	9.01218	1	1850	205.278	70%	0.0049	0.184	2.74E-08	-2.74E-08
Boron	B	5	6	11	10.81100	1	2340	216.446	74%	0.0046	0.179	2.89E-08	-2.89E-08
Carbon	C	6	6	12	12.01100	1	2260	188.161	64%	0.0053	0.192	2.51E-08	-2.51E-08
Diamond		6	6	12	12.01100	1	3520	293.065	100%	0.0034	0.154	3.91E-08	-3.91E-08
Graphene		6	6	12	12.01100	1	4120	343.019	117%	0.0029	0.142	4.58E-08	-4.58E-08
Nitrogen (N ₂)	N	7	7	14	14.00670	2	1.251	0.045	0.015%	22.393	12.442	5.96E-12	-5.96E-12
Oxygen (O ₂)	O	8	8	16	15.99940	2	1.429	0.045	0.015%	22.392	12.442	5.96E-12	-5.96E-12
Fluorine (F ₂)	F	9	10	19	18.99840	2	1.696	0.045	0.015%	22.404	12.445	5.96E-12	-5.96E-12
Neon	Ne	10	10	20	20.17970	1	0.900	0.045	0.015%	22.422	12.450	5.95E-12	-5.95E-12
Sodium	Na	11	12	23	22.98977	1	970	42.193	14%	0.0237	0.405	5.63E-09	-5.63E-09
Magnesium	Mg	12	12	24	24.30500	1	1740	71.590	24%	0.0140	0.311	9.56E-09	-9.56E-09
Aluminium	Al	13	14	27	26.98154	1	2700	100.068	34%	0.0100	0.263	1.34E-08	-1.34E-08
Silicon	Si	14	14	28	28.08550	1	2330	82.961	28%	0.0121	0.289	1.11E-08	-1.11E-08
Phosphorus (White)	P	15	16	31	30.97376	1	1820	58.759	20%	0.0170	0.343	7.84E-09	-7.84E-09
Phosphorus (Red)	P	15	16	31	30.97376	1	2200	71.028	24%	0.0141	0.312	9.48E-09	-9.48E-09
Phosphorus (Black)	P	15	16	31	30.97376	1	2700	87.171	30%	0.0115	0.282	1.16E-08	-1.16E-08
Sulphur	S	16	16	32	32.06600	1	2070	64.554	22%	0.0155	0.327	8.62E-09	-8.62E-09
Chlorine (Cl ₂)	Cl	17	18	35	35.45270	2	3.214	0.045	0.015%	22.061	12.350	6.05E-12	-6.05E-12
Argon	Ar	18	22	40	39.94800	1	1.784	0.045	0.015%	22.392	12.442	5.96E-12	-5.96E-12
Potassium	K	19	20	39	39.09830	1	860	21.996	8%	0.0455	0.561	2.94E-09	-2.94E-09
Calcium	Ca	20	20	40	40.07800	1	1550	38.675	13%	0.0259	0.423	5.16E-09	-5.16E-09
Scandium	Sc	21	24	45	44.95590	1	2990	66.510	23%	0.0150	0.322	8.88E-09	-8.88E-09
Titanium	Ti	22	26	48	47.87000	1	4540	94.840	32%	0.0105	0.270	1.27E-08	-1.27E-08
Vanadium	V	23	28	51	50.94150	1	6110	119.942	41%	0.0083	0.240	1.60E-08	-1.60E-08
Chromium	Cr	24	28	52	51.99600	1	7190	138.280	47%	0.0072	0.224	1.85E-08	-1.85E-08
Manganese	Mn	25	30	55	54.93800	1	7440	135.425	46%	0.0074	0.226	1.81E-08	-1.81E-08
Iron	Fe	26	30	56	55.84500	1	7874	140.997	48%	0.0071	0.221	1.88E-08	-1.88E-08
Cobalt	Co	27	32	59	58.93320	1	8900	151.018	52%	0.0066	0.214	2.02E-08	-2.02E-08
Nickel	Ni	28	31	59	58.69340	1	8900	151.635	52%	0.0066	0.214	2.02E-08	-2.02E-08
Copper	Cu	29	35	64	63.54600	1	8960	141.000	48%	0.0071	0.221	1.88E-08	-1.88E-08
Zinc	Zn	30	35	65	65.39000	1	7130	109.038	37%	0.0092	0.252	1.46E-08	-1.46E-08
Gallium	Ga	31	39	70	69.72300	1	5910	84.764	29%	0.0118	0.286	1.13E-08	-1.13E-08
Germanium	Ge	32	41	73	72.61000	1	5320	73.268	25%	0.0136	0.307	9.78E-09	-9.78E-09
Arsenic	As	33	42	75	74.92160	1	5780	77.147	26%	0.0130	0.299	1.03E-08	-1.03E-08
α -Arsenic	As	33	42	75	74.92160	1	2000	26.695	9%	0.0375	0.509	3.56E-09	-3.56E-09
Selenium	Se	34	45	79	78.96000	1	4790	60.664	21%	0.0165	0.338	8.10E-09	-8.10E-09
Bromine (Br ₂)	Br	35	45	80	79.90400	2	3120	19.523	7%	0.0512	0.595	2.61E-09	-2.61E-09
Krypton	Kr	36	48	84	83.80000	1	3.75	0.045	0.015%	22.347	12.430	5.97E-12	-5.97E-12
Rubidium	Rb	37	48	85	85.46780	1	1532	17.925	6%	0.0558	0.621	2.39E-09	-2.39E-09
Strontium	Sr	38	50	88	87.62000	1	2540	28.989	10%	0.0345	0.488	3.87E-09	-3.87E-09
Yttrium	Y	39	50	89	88.90590	1	4470	50.278	17%	0.0199	0.371	6.71E-09	-6.71E-09
Zirconium	Zr	40	51	91	91.22400	1	6510	71.363	24%	0.0140	0.311	9.53E-09	-9.53E-09
Niobium	Nb	41	52	93	92.90640	1	8570	92.243	31%	0.0108	0.274	1.23E-08	-1.23E-08
Molybdenum	Mo	42	54	96	95.94000	1	10220	106.525	36%	0.0094	0.255	1.42E-08	-1.42E-08
Technetium	Tc	43	55	98	98.00000	1	11500	117.347	40%	0.0085	0.243	1.57E-08	-1.57E-08
Ruthenium	Ru	44	57	101	101.07000	1	12370	122.390	42%	0.0082	0.238	1.63E-08	-1.63E-08
Rhodium	Rh	45	58	103	102.90550	1	12410	120.596	41%	0.0083	0.239	1.61E-08	-1.61E-08
Palladium	Pd	46	60	106	106.42000	1	12000	112.761	38%	0.0089	0.248	1.51E-08	-1.51E-08
Silver	Ag	47	61	108	107.86800	1	10500	97.341	33%	0.0103	0.267	1.30E-08	-1.30E-08
Cadmium	Cd	48	64	112	112.41000	1	8650	76.950	26%	0.0130	0.300	1.03E-08	-1.03E-08
Indium	In	49	66	115	114.82000	1	7310	63.665	22%	0.0157	0.330	8.50E-09	-8.50E-09
Tin (White)	Sn	50	69	119	118.71000	1	7310	61.579	21%	0.0162	0.335	8.22E-09	-8.22E-09
Tin (Grey)	Sn	50	69	119	118.71000	1	5800	48.859	17%	0.0205	0.376	6.52E-09	-6.52E-09
Antimony	Sb	51	71	122	121.76000	1	6690	54.944	19%	0.0182	0.355	7.33E-09	-7.33E-09
Tellurium	Te	52	76	128	127.60000	1	6240	48.903	17%	0.0204	0.376	6.53E-09	-6.53E-09
Iodine	I	53	74	127	126.90450	1	4930	38.848	13%	0.0257	0.422	5.19E-09	-5.19E-09
Xenon	Xe	54	77	131	131.29000	1	5.9	0.045	0.015%	22.253	12.403	6.00E-12	-6.00E-12
Caesium	Cs	55	78	133	132.90540	1	1870	14.070	5%	0.0711	0.701	1.88E-09	-1.88E-09
Barium	Ba	56	81	137	137.33000	1	3590	26.141	9%	0.0383	0.514	3.49E-09	-3.49E-09

Element	Periodic Table Symbol	Protons (Element: Atomic number)	Neutrons	Nucleon Number	Atomic Mass Units u	Molecular Element Factor N	Mass Density ρ (g/L or kg/m ³)	Relative Matter Density $Rp = \rho / (uN)$	Rp % of Diamond	Molar Relative Volume $Rv = 1/Rp$ (L/mol)	Mean Interactive Molecular Distance $\langle r \rangle = M\sqrt{Rv}$ (nm)	Coulomb Interaction $\frac{(2e)^2}{4\pi\epsilon_0 \langle r \rangle^2}$ (N)	Gravitational Interaction $-2GRp$ (N)
Lanthanum	La	57	82	139	138.90550	1	6150	44.275	15%	0.0226	0.395	5.91E-09	-5.91E-09
Cerium	Ce	58	82	140	140.12000	1	6770	48.316	16%	0.0207	0.378	6.45E-09	-6.45E-09
Praseodymium	Pr	59	82	141	140.90770	1	6770	48.046	16%	0.0208	0.379	6.41E-09	-6.41E-09
Neodymium	Nd	60	84	144	144.24000	1	7010	48.600	17%	0.0206	0.377	6.49E-09	-6.49E-09
Promethium	Pm	61	84	145	145.00000	1	7220	49.793	17%	0.0201	0.373	6.65E-09	-6.65E-09
Samarium	Sm	62	88	150	150.36000	1	7520	50.013	17%	0.0200	0.372	6.68E-09	-6.68E-09
Europium	Eu	63	89	152	151.96400	1	5240	34.482	12%	0.0290	0.448	4.60E-09	-4.60E-09
Gadolinium	Gd	64	93	157	157.25000	1	7900	50.238	17%	0.0199	0.371	6.71E-09	-6.71E-09
Terbium	Tb	65	94	159	158.92530	1	8230	51.785	18%	0.0193	0.365	6.91E-09	-6.91E-09
Dysprosium	Dy	66	97	163	162.50000	1	8550	52.615	18%	0.0190	0.362	7.02E-09	-7.02E-09
Holmium	Ho	67	98	165	164.93030	1	8800	53.356	18%	0.0187	0.360	7.12E-09	-7.12E-09
Erbium	Er	68	99	167	167.26000	1	9070	54.227	19%	0.0184	0.357	7.24E-09	-7.24E-09
Thulium	Tm	69	100	169	168.93420	1	9320	55.169	19%	0.0181	0.354	7.36E-09	-7.36E-09
Ytterbium	Yb	70	103	173	173.04000	1	6970	40.280	14%	0.0248	0.414	5.38E-09	-5.38E-09
Lutetium	Lu	71	104	175	174.96700	1	9840	56.239	19%	0.0178	0.351	7.51E-09	-7.51E-09
Hafnium	Hf	72	106	178	178.49000	1	13310	74.570	25%	0.0134	0.304	9.95E-09	-9.95E-09
Tantalum	Ta	73	108	181	180.94790	1	16650	92.015	31%	0.0109	0.274	1.23E-08	-1.23E-08
Tungsten	W	74	110	184	183.84000	1	19300	104.983	36%	0.0095	0.257	1.40E-08	-1.40E-08
Rhenium	Re	75	111	186	186.20700	1	21000	112.778	38%	0.0089	0.248	1.51E-08	-1.51E-08
Osmium	Os	76	114	190	190.23000	1	22600	118.804	41%	0.0084	0.241	1.59E-08	-1.59E-08
Iridium	Ir	77	115	192	192.22000	1	22600	117.574	40%	0.0085	0.242	1.57E-08	-1.57E-08
Platinum	Pt	78	117	195	195.08000	1	21450	109.955	38%	0.0091	0.251	1.47E-08	-1.47E-08
Gold	Au	79	118	197	196.96650	1	19300	97.986	33%	0.0102	0.266	1.31E-08	-1.31E-08
Mercury	Hg	80	121	201	200.59000	1	13550	67.551	23%	0.0148	0.320	9.02E-09	-9.02E-09
Thallium	Tl	81	123	204	204.38300	1	11850	57.979	20%	0.0172	0.345	7.74E-09	-7.74E-09
Lead	Pb	82	125	207	207.20000	1	11350	54.778	19%	0.0183	0.355	7.31E-09	-7.31E-09
Bismuth	Bi	83	126	209	208.98040	1	9750	46.655	16%	0.0214	0.385	6.23E-09	-6.23E-09
Polonium	Po	84	125	209	209.00000	1	9300	44.498	15%	0.0225	0.394	5.94E-09	-5.94E-09
Astatine	At	85	125	210	210.00000	1	7000	33.333	11%	0.0300	0.455	4.45E-09	-4.45E-09
Radon	Rn	86	136	222	222.00000	1	9.73	0.044	0.015%	22.816	12.559	5.85E-12	-5.85E-12
Francium	Fr	87	136	223	223.00000	1	1870	8.386	3%	0.1193	0.908	1.12E-09	-1.12E-09
Radium	Ra	88	138	226	226.00000	1	5000	22.124	8%	0.0452	0.559	2.95E-09	-2.95E-09
Actinium	Ac	89	138	227	227.00000	1	10070	44.361	15%	0.0225	0.395	5.92E-09	-5.92E-09
Thorium	Th	90	142	232	232.03810	1	11720	50.509	17%	0.0198	0.370	6.74E-09	-6.74E-09
Protactinium	Pa	91	140	231	231.03590	1	15400	66.656	23%	0.0150	0.322	8.90E-09	-8.90E-09
Uranium	U	92	146	238	238.02900	1	18950	79.612	27%	0.0126	0.295	1.06E-08	-1.06E-08
Neptunium	Np	93	144	237	237.00000	1	20200	85.232	29%	0.0117	0.285	1.14E-08	-1.14E-08
Plutonium	Pu	94	150	244	244.00000	1	19840	81.311	28%	0.0123	0.292	1.09E-08	-1.09E-08
Americium	Am	95	148	243	243.00000	1	13700	56.379	19%	0.0177	0.350	7.53E-09	-7.53E-09
Curium	Cm	96	151	247	247.00000	1	13500	54.656	19%	0.0183	0.356	7.30E-09	-7.30E-09

Key:
Non-metal
Semi-metal
Metal
Lanthanide
Actinide
Gas
Liquid
Solid
Synthetic

Mass Density @ 300 K (gases @ 273.15 K) and 1 atm.

Mean Interactive Molecular Distance: Constant $M = 2.629\ 362\ 029 \times 10^{-9}$ m

Criterion: Accuracy of computation entails high precision

Source of Data: Cross-checked from various sources

Substance (samples)

Ice (273 K)	H ₂ O	10	8	18	18.01530	1	917	50.901	17%	0.0196	0.369	6.79E-09	-6.79E-09
Water (277 K)	H ₂ O	10	8	18	18.01530	1	999.973	55.507	19%	0.0180	0.353	7.41E-09	-7.41E-09
Steam (373.15 K)	H ₂ O	10	8	18	18.01530	1	0.60	0.033	0.011%	30.026	14.408	4.45E-12	-4.45E-12
Air (4N ₂ + O ₂) (Approx.)					14.45000	2	1.29	0.045	0.015%	22.403	12.445	5.96E-12	-5.96E-12
Ozone (O ₃)		8	8	16	15.99940	3	2.144	0.045	0.015%	22.387	12.441	5.96E-12	-5.96E-12
Methane	CH ₄	10	6	16	16.04276	1	0.716	0.045	0.015%	22.406	12.446	5.96E-12	-5.96E-12
Ammonia	NH ₃	10	7	17	17.03052	1	0.77	0.045	0.015%	22.118	12.366	6.04E-12	-6.04E-12
Carbon dioxide	CO ₂	22	22	44	44.00980	1	1.98	0.045	0.015%	22.227	12.396	6.01E-12	-6.01E-12
Dimethyl ether (298 K)	CH ₃ OCH ₃	26	20	46	46.06904	1	72.72	1.579	0.539%	0.6335	2.093	2.11E-10	-2.11E-10

Liquid Gas (samples)

Oxygen (90 K) (O ₂)	O	8	8	16	15.99940	2	1140	35.626	12%	0.0281	0.441	4.76E-09	-4.76E-09
Methane (109 K)	CH ₄	10	6	16	16.04276	1	464.54	28.956	10%	0.0345	0.489	3.87E-09	-3.87E-09

Appendix B: Gravitational coupling strength

In determining the precise coupling strength of the gravitational force, as comparison in relative magnitude of force strengths, it is essential to present gravitational interactions as magnetic interactions, by reason of magnetic monopoles interactions occurring between opposing gravity strands. This requires determining the elementary magnetic charge of a magnetic monopole:

$$\frac{e^2}{\epsilon_0} = \mu_0 \eta^2 \quad (\text{B.0})$$

therefore, it can be taken that the elementary unit of magnetic charge in SI base units is:

$$\eta = \sqrt{\frac{e^2}{\epsilon_0 \mu_0}} = 4.803\,204\,671 \times 10^{-11} \text{ A}\cdot\text{m} \quad (\text{B.1})$$

and is consistent with Maxwell's conclusion:

$$\frac{\eta}{e} = \frac{1}{\sqrt{\epsilon_0 \mu_0}} = c \quad (\text{B.2})$$

Magnetic charge will be comparable with electrical charge where, in both instances, field strength will decrease in magnitude with increasing distance from the point charge in accordance with the inverse-square law. This accordance applies to the gravitational interaction of Eqn. 1.4 when presented as a magnetic interaction and in retaining the duality symmetry in relation to the coulomb interaction:

$$\frac{(2e)^2}{4\pi\epsilon_0\langle r \rangle^2} - \frac{\mu_0 \eta^2}{\pi\langle r \rangle^2} = 0 \quad (\text{B.3})$$

As previously stated in a topic of subsection 3.3, not all magnetic monopoles radiating from atomic nuclei integrate by self-organising into gravity strands, but, instead remain as magnetic strands which give rise to Coulomb-Magnetic interactions. Using the prominent example of atomic hydrogen, bonds are formed by attraction alignment of magnetic strand interactions between atomic nuclei. The Coulomb interaction result from the negative charge of the single electron of the hydrogen atom in a repulsion interaction with the two innermost orbital electrons of the bonded atom, with respect to the separation of both nuclei:¹

$$\frac{2e^2}{4\pi\epsilon_0 R^2} - \frac{\mu_0 \eta^2}{2\pi R^2} = 0 \quad (\text{B.4})$$

The magnetic interactional term of the above equation expresses the quantum equivalence to Ampere's law and, furthermore, will determine the coupling strength for the magnetic force:

$$\frac{e^2}{2\epsilon_0 hc} = \frac{\mu_0 \eta^2}{2hc} = \alpha \quad (\text{B.5})$$

where h = Planck constant, c = speed of light and α = fine-structure constant. The gravitational coupling strength is determined by:

$$\frac{\mu_0 \eta^2}{hc} = 2\alpha \quad (\text{B.6})$$

¹ Coulomb interactions are denoted as: repulsion is positive and attraction is negative. This is also applicable to magnetic strand interactions. Correspondingly, gravity strand interactions are always negative.

Elementary units of charge are then derived from:

$$e = N\sqrt{2\varepsilon_0 h c \alpha} \quad (\text{B.7a})$$

$$\eta = N \sqrt{\frac{2 h c \alpha}{\mu_0}} \quad (\text{B.7b})$$

where, in the above, $N = \text{integer: } (\neq 0) \pm 1, \pm 2, \pm 3, \dots$ etc. Together with Eqn. B.2, Eqns. B.7a & B.7b complies with the Dirac quantization condition. Eqn. B.5 ascertains magnetic and electrical force coupling strengths are equivalent, whereas Eqn. B.6 ascertains the gravitational force coupling strength is twice as strong and is a manifestation of the ‘Strong-gravitational unified fields’ as presented in figure 3; the outcome of unification between the strong and gravitational forces that emerges from QCD coupling in which magnetic monopole *gravitons* emanate from non-confinement in QCD (in furtherance of [2]) as a by-product of quark/gluon interactions within the strong nuclear force. The significance of the gravitational force coupling strength, in the strength of the gravitational force at the quantum scale, is also tenable by the fact of the difference in configurations of magnetic monopoles in magnetic and gravity strands, where in the later the magnetic monopoles are in a stronger configuration and hence reflected in the coupling strength. Also, the significance is prevalent in the collapse of massive stars, in that it explains gravity’s *accumulative* ability to overcome the *accumulative* degeneracy pressure of electrons in the formation of neutron stars, and again will be instrumental in ultimately overcoming the *accumulative* degeneracy pressure of neutrons in the formation of black holes.

Applied constants

<http://physics.nist.gov/cuu/Constants/index.html>

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