Showing the Planck and Gravitational constants *h* and *G* to be dimensionless ratios

MICHAEL LAWRENCE

Maldwyn Centre for Theoretical Physics, Cranfield Park, Burstall, Suffolk, IP8 3DT, United Kingdom
lawrence@maldwynphysics.org
9 March 2014

By showing that the Planck and Gravitational constants are dimensionless, they can be understood to be unit-dependent ratios which can be eliminated from all equations by merging them within new adjusted units. This requires first that the current units be analysed and their inconsistencies rectified. The reinterpretation of *G* and *h* implies the equivalence of the strength of charge and gravitational fields, as shown by the proposed new adjusted-Planck units. Further, the elimination of *G* and *h* implies that mass and charge sizes, and distance, are not the properties which separate quantum and classical gravitational systems and eliminates the need to test the equivalence of gravitational and inertial mass. A new type of dimensional analysis is employed to describe adjusted-Planck size property dimensionality and to uncover any law of nature or universal constant. By adjusting currently misaligned SI units to be self-consistent and consistent with the proposed adjusted-Planck sets of units, greater clarity will ensue. Only by solving these existing issues in our current units is it possible to show that supposedly different equations describing relationships between mechanical properties and between electromagnetic properties are actually identical, allowing the reinterpretation of electromagnetic properties in terms of mechanical properties. The new dimensional analysis shows that the current set of properties of nature is missing two from the set, whose dimensions and probable units can be inferred.

1. Introduction: Background and methodology

Classical physics started with Newtonian gravity [1] and quantum physics with Planck's constant [2]. The different classical relativistic and quantum frameworks revolve around the use of *G* and *h* respectively.

This paper shows, using very simple manipulation of formulae based around Planck units, that both h and G can be eliminated from all formulae as being dimensionless ratios – numbers set by the choice of units.

However, this paper is not directed at simply changing units, as in the case of the misalignments existing in current SI units, but aims to show how clearing up and simplifying those units enables the hidden deeper relationships between properties to be uncovered.

The elimination of *h* and *G* undermines current notions of where the quantum world ends and the classical world starts. Without the misguided emphasis on large/small distances and masses and differential strength of charge and gravity fields, it is not clear what properties define where the quantum world becomes classical and vice versa.

The different energy equations in classical and quantum system have confused attempts at unifying current

interpretations, so the route taken in this paper is via force equations, which are the same in both frameworks, as shown below, although the quantum force equation is not usually seen.

It might be reasonably asked why the seemingly simple rearrangements of Planck mass $M_p = \sqrt{\hbar c / G}$ into adjusted-Planck mass $M_T = M_p \sqrt{G / \hbar} = \sqrt{c}$ and Planck length $L_p = \sqrt{\hbar G / c^3}$ into adjusted-Planck length $L_T = L_p / \sqrt{\hbar G} = \sqrt{c^{-3}}$ as the base cases should need so much explanation.

Amongst the issues are the units of *h* and *G*, which are not obviously dimensionless ratios, the deeper dimensionalities of properties which allow the new maximum value of mass and minimum value of length to be described in terms of powers of *c* and the parallel treatments of two sizes of Planck charge based on either an observational basis or a symmetry argument.

In order to understand why these transformations of mass, length and charge can be done, and why they have not been uncovered before, each stage needs to be considered in depth. The underlying symmetry has been hidden by two misalignments within SI units.

No indications of the accuracy of any property values

are given in the paper because the main final values are all powers of $\sqrt{c}$ which is defined in SI units as being exact. The only factor remaining within the paper with any experimental error is the value of the fine structure constant α .

1.1. Route followed in the paper

The route to the implications and the subsequent deductions of the paper are outlined here first.

The main arguments will be clearly marked in the paper.

1.1.1. Equations Used

The two basic force equations, used initially in generally accepted Planck units, are manipulated in three stages which sequentially merge a) 2π , then b) G and finally c) h into the normally accepted Planck units of mass, charge and distance. This is novel because usually G is considered only to be mass-specific and h has never before been subject to elimination in this manner. Also the Planck charge is usually taken to be the electronic charge size, rather than the larger size implied through symmetry by the Planck mass, but here it is the latter that is used as the ultimate maximum size, with the two different sizes leading to two different sets of adjusted-Planck units.

The two force formulae are:

$$F = G\ M^2/L^2 = Q^2 c^2/L^2 = M\ c^2/L \qquad (1)$$

from the gravitational side, and:

$$F = h\ \omega\ /L = M\ c\ \omega = M\ c^2/L \qquad (2)$$

from the quantum side, although the latter usually known through its angular momentum form

$$h = M\ c\ L \qquad (3)$$

which is how it will be used in this paper.

Since only the dimensionality, explained later, of each property in these Planck-size based equations is what matters initially, the use of c rather than v for velocity is not an issue and each property in the Planck formulae takes its appropriate and accepted initial Planck value, apart from charge which here is the larger size, not electronic size.

The main Planck charge unit is taken to be the maximum possible compared through symmetry with the Planck mass unit, rather than the actual charge size that is experimentally observed which is $\sqrt{\alpha/2\pi}$ smaller.

The main Planck charge is the basic for a 'larger' set of Planck units. The actual electron charge size is used to create a second 'smaller' set of Planck units, some of whose constituents are shown to have been experimentally measured to very high accuracy.

The whole basis of the analysis rests on the insight that the formulae say more than is usually appreciated and that simple manipulation uncovers deeper relationships, in the case of the Planck sizes of the properties of nature, a symmetry that is not apparent when using h, G and SI units as currently constructed.

1.1.2. von Klitzing and Josephson constants

These two experimentally measured 'smaller' Planck unit constituents can only easily be shown to be members of that set if the current misalignment of SI units is corrected initially into New SI units (NSI) and then finally into Brand New SI units (BNSI).

This is shown in both formulaic and numerical comparisons. The route necessary to realign SI units is shown and used to uncover the underlying symmetry in the NSI and BNSI unit values for all the adjusted-Planck size properties of nature.

1.1.3. Dimensionality

The original basis for merging h and G into the mass, charge and distance units is verified by a new type of dimensional analysis in which all universal constants, other than c, have powers of zero in the underlying dimension, whilst the adjusted-Planck sized properties we observe have non-zero powers. The new dimensionality goes deeper than considering properties in terms of mass, length and time by uncovering a dimension in which adjusted-Planck sizes of mass, length and time are themselves only powers of a single underlying property.

The existence of undiscovered physical properties is deduced from gaps in the table of dimensions.

1.1.4. Electromagnetic properties as mechanical

The table of dimensions is also used to show that many electromagnetic properties can be interpreted as mechanical properties when they have similar dimensionalities.

1.2 Significance and objectives

This paper sets out with a number of objectives. The starting point is a discussion of units and the lack of consistency within and between current SI units and Planck units. It is shown below that the current set of SI units does not have a consistent relationship with the second most fundamental set of Planck units, described as Double-adjusted Planck units (DAPU units), and is not internally self-consistent.

By showing the changes needed to SI units in order to gain consistency, it becomes possible to better understand the relationships between properties such as mass, length, charge, magnetic flux, resistance and time. Only then does it become clear that G and h are only dimensionless ratios that can be eliminated from all our equations.

It is only by ironing out the units which we use that

the underlying symmetry becomes apparent.

This paper is emphatically not an exercise in numerology. Although, by necessity, it manipulates numbers and relationships to produce self-consistent values for all the adjusted-Planck sized properties considered in terms of the new NSI units, and eventually BNSI units, that is not a major objective.

1.2.1 Units

The paper by Mohr et al. [3] explains the current state, where SI units are being bought more into the quantum measurement realm. The excellent paper by M. J. Duff et al. [4] includes a broad and varied introduction to the problems of fundamental units and also covers their relationship with SI units. The issue is not new [5,6].

To paraphrase Dr Okun [7]– "The use of fundamental units h and c in SI has introduced greater accuracy in some of the units, but some electromagnetic units are based on pre-relativistic classical electrodynamics and so their measurement is not as accurate as other units. The use of permeability and permittivity spoils the perfection of the special relativistic spirit and, whilst this is useful for engineers, it results in the four physical properties D, H and E, B having four different dimensions".

It is only by starting with the most basic, symmetrical and simple physical maximal sized set of Planck type units - and maintaining the integrity of the relationships within that set by not stretching property space unequally - that it is possible to see that the electromagnetic and mechanical properties are misaligned versus each other and that the current value of permeability (and thus permittivity) results in a further misalignment.

The new form of dimensional analysis underpins this and allows both mechanical and electromagnetic properties to be treated on an identical basis. It addresses Dr Okun's concerns in that the pairs D, H and E, B are shown each to have only one single property, each in the pair separated only by the dimensionless ratio $\sqrt{|G|}$.

2. Foundations

Initially this analysis will consider only how to arrive at the intermediate stage of DAPU units by simple manipulation of the two most basic formulae between Planck properties, one from each of the quantum and classical relativistic frameworks.

After that, the analysis will consider why it is possible to do this without regard initially to any units and will show that to be a constant of nature implies that, other than c, the constant has no dimensions or units, but is simply a ratio set by SI units. Although this analysis uses only the two basic formulae, it can be extended to any formula.

All the equations in the paper use only Planck values, unless specifically mentioned otherwise. The Planck, or adjusted-Planck, values are call 'maximal' in that they represent either the largest (eg velocity, c) or smallest (eg distance, L_p) that is possible for that property. The Planck unit sets are eventually based on the maximal values using either Q_T as explained below for the 'larger' set and q_{eT} for the 'smaller' set.

The analysis will be done in three stages:
a) Eliminating 2π for simplicity from the generally accepted Planck equations denoted X_p to give Adjusted Planck Units (APU), denoted X_o
b) Eliminating G to give Double-Adjusted Planck Units (DAPU), denoted X_*
c) Eliminating h to give the final Triple-Adjusted Planck Units (TAPU), denoted X_T

The main comparisons done will use DAPU units because these show most simply the comparison between the von Klitzing and Josephson constants, R_k and K_j, and the q_{e*} set of properties.

The most basic two formulae for defining a Planck unit sized system are the gravitational force equation $F = G\, M^2/L^2 = Q^2 c^2/L^2$ and the quantum angular momentum equation $h = M\, c\, L$. The normal usage of the latter is to define a Planck mass M_p and Planck Length L_p such that $\hbar = M_p c\, L_p$ and $M_p = \sqrt{\hbar\, c\, /G}$. Unfortunately this introduces the 2π factor in many equations, where it serves only to confuse.

The preferred definition, to be used here as a starting point, is to define the system without the 2π factor, which is the first adjustment. This adjustment is innovatively split equally between the mass and length units.

Initially the APU mass M_o and APU length L_o are related by $h = M_o c\, L_o$ and M_o is defined to be

$$M_o = M_p \sqrt{2\,\pi} = \sqrt{h\, c\, /G}\ ,$$
$$L_o = L_P \sqrt{2\,\pi}$$
$$Q_o = Q_P \sqrt{2\,\pi}\ .$$

In the second stage, however, to achieve the right relationship between M and L in property space, as described below, requires looking at the force equation at the same time.

Rearranging to give $F\, L^2 = G\, M^2 = (Q\, c\,)^2$ provides the simple relationship that the APU mass M_o and APU charge Q_o are related such that $M_o \sqrt{G} = Q_o c$. Since the latter equation does not include L_o it is not immediately apparent that compared

with the Planck properties M_p and L_p there is a need to adjust both by the factor $\sqrt{G}$ in addition to the $\sqrt{2\ \pi}$ factor, so that now

$$h = M_o c\ L_o = (M_p \sqrt{2\ \pi\ G}\,)c\ (L_p \sqrt{2\ \pi\ /G}\,)$$ if

the latter factors are distributed in the same way as $\sqrt{G}$.

As mentioned, this innovatively stretches property space equally along the mass and length properties, rather than just the mass property as is usually done when trying to eliminate G [8].

It is possible now to define the second adjustment such that

$$M_* = M_o \sqrt{G}\ = M_p \sqrt{2\ \pi\ G}\ ,$$
$$Q_* = Q_o = Q_p \sqrt{2\ \pi}$$
$$L_* = L_o / \sqrt{G}\ = L_p \sqrt{2\ \pi\ /G}$$

with $h\ = M_* c\ L_*$, the basic DAPU units, where Q_* is the DAPU charge. This is the maximum charge based on symmetry with the maximum mass and is not the electron charge, which is considered later.

The result is the foundation of a DAPU property set and units based on

$$h\ = M_* c\ L_* \tag{4}$$

and

$$F_* L_*^2 = M_*^2 = Q_*^2 c^2 = h\ c \tag{5}$$

which was the objective of the second adjustment, in that the formulae exclude G. The dimensionality of G will be shown to be zero later.

This is the most basic set of Planck properties that can be devised using only two universal constants h and c. However, as shown in the third adjustment stage, this is not the minimum number of constants required to establish relationships between the properties.

The relationship between M_* and Q_* is simply $M_* = Q_* c$ **with the deeper relationships** $M_* = \sqrt{h\ c}$ **and** $Q_* = \sqrt{h\ /c}$.

Considering inertial and gravitational mass, the starting point is the APU relationship

$$F_o L_o^2 = G\ M_o^2\ = Q_o^2 c^2 = M_o c^2 L_o = h\ c \tag{6}$$

This is converted into DAPU where $F_* = F_o G$ and the relationship becomes

$$F_* L_*^2 = M_*^2\ = Q_*^2 c^2 = M_* c^2 L_* = h\ c \tag{7}$$

Here now there is no need to differentiate between the M of the gravitational side of the equation and the M of the inertial side because the treatment of both M's is identical and the result independent of G.

The innovative subsuming of G within the mass and distance units eliminates the difference between

gravitational and inertial masses, since there is no longer any gravitational mass.

This is not equivalent to making $G=1$, as will be shown below, because the effect of subsuming G into M_* and L_* is to stretch current property space into the more symmetric DAPU properties space, which does not occur when simply setting $G=1$.

The result of eliminating G is also that the field strength of any fractional charge q_f / Q_* is equal to the same strength of gravitational field of an equal fractional mass m_f / M_* , the actual value of the ratio between the two being c.

The base property space consists of M, h, L, c and Q. Since Q can be related to M and c only, the minimum property space now is just M, h, L and c . Because h and c are the two basic universal constant remaining, to maintain the topology and symmetry of the base property space requires that the other two properties M and L are stretched proportionately together. Provided Q is treated in the same way as M, it will stay symmetric. Any non-symmetric stretching results in an asymmetric set of properties and will require the use of factors such as $\sqrt{\alpha\ /2\ \pi}$ in the relationships between the stretched properties.

2.1 SI units and DAPU

The above two relationships hold in the new DAPU system in DAPU units, but unfortunately in SI units the first misalignment becomes apparent. To align the charge and mass side of the Planck equation in SI units requires that the base unit size Planck charge is altered by the factor $\sqrt{1 \times 10^{-7}}$ relative to the mass side since

$$G\ M_o^2\ / L_o^2 = Q_o^2 c^2 (1 \times 10^{-7}) / L_o^2 \text{ in SI units.}$$

To identify this difference, each equation in future may, where it might otherwise confuse, be identified either as being in DAPU or SI units, so that

$$Q_* = M_* / c\ (DAPU) = M_* \sqrt{1 \times 10^7} / c\ (SI) \tag{8}$$

It is useful for display purposes, as will be used liberally later, to define a factor

$$d\ = \sqrt{\alpha\ /2\ \pi} \tag{9}$$

which represents the ratio $d\ = q_{e*} / Q_*$, where q_{e*} is the DAPU size of the electronic charge.

The second SI misalignment appears when comparing electromagnetic and mechanical SI units that have material content requiring permeability or permittivity.

The use of permeability u_* as $4\ \pi \times 10^{-7}$ causes the factor $4\ \pi \times 10^{-7} / \sqrt{|\ G\ |} = 6.501$ to appear in some properties when compared with what their DAPU based value should be. This arises from some properties whose SI

units may mix electromagnetic and mechanical properties within their definition, such as the Farad. So the second SI re-alignment is to define u_* to be equal to the ratio $\sqrt{|G|}$ rather than the usual $4\,\pi\times10^{-7}$, which relegates $|G|$ from gravitational to permeability use, so that it represents a measure of the strength of interactions within materials, not between masses. It will be shown below that u_* and $\sqrt{|G|}$ both have the same units, in that they are both dimensionless. The value of permittivity also needs to be adjusted to maintain the value of its product with permeability.

The result is that the proposed new adjusted-SI units (NSI) which should be used are either the same as the normal SI units or are different to normal SI units by a power of either the ratio $\sqrt{|G|}$, the $\sqrt{1\times10^{-7}}$ factor, the 6.501 factor or a combination of these. Wherever there is a factor q_{e*} used, the same power of $\sqrt{1\times10^{-7}}$ is used. Where there is no q_{e*} or u_* factor, the NSI and SI values are the same. In this paper, where the current SI unit is adjusted by a power of the $\sqrt{1\times10^{-7}}$ factor, the property

unit has a cedilla above it $\hat{U}$, or as a subscript in the

tables thus $U_\wedge$. So the SI unit Watts, W becomes $\hat{W}$ in

NSI where $\hat{W}=\sqrt{1\times10^{-7}}\,W$. Note that NSI units include h, but will be changed to Brand New SI units on the elimination of h later.

Because most of the property examples used in this paper do not have any specific material dependence, as would be the case for the magnetic field H, there is no use of permeability u_* or permittivity ε_* within most of the property examples given, except to show that Magnetic Field H and magnetic inductance B have the same underlying units. For the examples used here, there are no complications of additional 6.501 usage or identification of double adjusted SI units, other than in the permittivity ε_* and capacitance C_*, where the SI unit the Farad F is adjusted by that factor to be $F^{\#}$ in NSI with $F^{\#}=F\,/6.501$ ·

So the adjustment of SI units to make them self-consistent across both mechanical and electromagnetic properties, and to ensure that they have the same overall shape in property space as the underlying DAPU units allows the direct comparison of all properties in either DAPU or NSI units, with the only difference being the actual number value in each set of units.

For the Q_* set of properties, in DAPU the maximal values are always one multiplied by the combination of h and c representing that property, except where $\sqrt{|G|}$ is

needed. For the q_{e*} set of properties, the maximal values are always powers of d multiplied by the h, c combination, again except for $\sqrt{|G|}$.

For both these sets, the NSI values are shown in tables 1 and 2, with translation factors between units in table 3.

3. Dimensionality of *h* and *G*

The subsuming of G within the APU mass M_o to produce the DAPU mass M_*, and the APU length L_o to produce the DAPU length L_*, would seem to ignore the units of G, effectively treating G as being without units. But this is not the case. For G the units are $m^3kg^{-1}s^{-2}$.

A consideration of the standard laws of nature and the fundamental constants through a form of dimensional analysis shows that if each property at its Planck size is assigned an appropriate dimensionality, every fundamental constant, other than *c*, will have a total dimensionality of zero, or to state the reverse – every property that has dimensionality of zero is a fundamental constant.

The dimensional analysis consists of solving for a basis vector in vector Planck property space which produces zeroes of dimension for four important constants of nature, *h*, *G*, Permeability (*u*) and Boltzmann's constant k_B.

Using h and G in the analysis may appear circular, but the analysis supports their use. It also shows that Boltzmann's constant, like h and G, is simply a factor that can be discarded in the correct units and that there may exist other properties, as yet unrecognized, that correspond to missing dimensionalities.

The dimensionalities of the main SI, NSI, APU, DAPU or TAPU properties in terms of a hypothetical dimension Y that emerge from the consideration are:

Mass $M_*=Y^{+1}$	**Velocity** $c=Y^{+2}$
Length $L_*=Y^{-3}$	**Energy** $E_*=Y^{+5}$
Charge $Q_*=Y^{-1}$	**Time** $T_*=Y^{-5}$
$h=Y^0$	$G=Y^0$

The units of G are $m^3kg^{-1}s^{-2}=Y^{-9}Y^{-1}Y^{+10}=Y^0$ dimensionality and h has units of $m^2kg\;s^{-1}=Y^{-6}Y^{+1}Y^{+5}=Y^0$ dimensionality. So the units of both *h* and *G* are actually irrelevant because they represent fundamental constants with zero dimensionality. Similarly Boltzmann's constant has units of $J\;K^{-1}=Y^5Y^{-5}=Y^0$ dimensionality as well.

Thus adjusting the APU mass to the DAPU mass, and APU length to DAPU length, involves only multiplying or dividing by the ratio $\sqrt{|G|}$ as a dimensionless number, and does not affect the

dimensionality of the units of mass, charge or length, other than changing the sizes of the base Planck mass, charge and distance units. This stretches the current property space into the more symmetric DAPU property space, which is different to treating G to be equal to one, which does not affect the current property space topology at all.

The same analysis can be done for permeability to give units of $u_* = N\ A^{-2} = m^{-1} kg\ s^{-2}(\sqrt{kg\ m\ s^{-1}})^{-2} = Y^0$ dimensionality which shows that the replacement of u_* by $\sqrt{|G|}$ does not affect the units used because they are both dimensionless.

The independence and dependence of the properties in terms of Planck unit sizes and fractional Planck values needs to be considered. What the dimensional analysis indicates is that the Planck values of the properties can be related by the dimension Y but the fractional Planck values cannot. If a fractional Planck value of a property is defined as the fraction ρ of a Planck value ($\rho \neq 1$) then, for example, the velocity v can be described as $v = \rho c$.

First, considering only the Planck values in, for example, $c = L_*/T_*$ the dimensionalities will be $c = Y^{-3}/Y^{-5}$. The equation can be differentiated with respect to the dimension Y to produce $\partial c/\partial Y = -3Y^{-4}/Y^{-5} + 5Y^{-3}Y^4 = 2Y$ which is what would be expected since $c = Y^2$. So all the Planck values are dependent through their powers of Y . However, this is not the case for the fractional values, unless there is a relationship between them because they form a law of nature, otherwise the fractional values are independent. The example here would be the relationship described usually in SI units as $v = L/T$. Now if $v = \rho c = \sigma L_*/\varsigma T_*$ when σ is a Planck fraction of L_* and ς a Planck fraction of T_* then $\rho = \sigma/\varsigma$, which is the same formula written in fractional Planck values. It is these fractional values which are independent of each other, except when related in a law of nature, such as this example.

3.1 Digression a) - Producing laws of nature

This hypothetical dimensionality tool can be used to produce any law of nature by creating equations where the dimensionalities are equal on both sides.

One example from the tables would be $F = M\ a$, where force is Y^{+8} and is equal to the product of mass Y^{+1} and acceleration Y^{+7}, so that both sides have Y^{+8} dimensionality. Another example would be the product of volume and viscosity which produces Y^0 on one side and could represent a new constant of nature on the other. To produce a constant of nature, aside from c, the minimum that is required is that it has Y^0 dimensionality. In this instance, there is no need for a new constant since the

product of volume and viscosity is equal to h, through $V_* \eta_* = h$ in DAPU.

However, producing laws of nature through dimensional analysis of Planck unit sizes does not provide the exact relationship between the fractional Planck property values, because these depend on the specific context in which the properties are being considered. An example would be the kinetic energy of a particle in motion $E_{ke} = (\gamma_v - 1)m\ c^2 \cong 0.5\ m\ v^2$ compared with the rest mass energy of the same particle $E_{rm} = m\ c^2$. Dimensionally, at Planck unit sizes, these two formulae exhibit the same relationships between mass, energy and velocity but as fractional Planck values they describe different specific aspects of that relationship.

3.2 Values of the Q_* set of properties

Table 1 provides a list of the main Q_* property set and their NSI values at their maximal Planck sizes. The set is produced by starting with the base property space M, h, L, c and Q and extending through the use of standard formulae to find each additional property value in this 'larger' set. The column headed 'NSI units' means that where the current electromagnetic SI units appear they have been adjusted by a power of the factor $\sqrt{1 \times 10^7}$ mentioned earlier and their use is denoted by a cedilla above the unit or $F^{\#}$ describes the SI unit F adjusted by the 6.501 factor. Note that the factor d does not appear in table 1 because these values are all based on the DAPU charge Q_*

3.3 Digression b) – von Klitzing and Josephson constants

The discovery that the von Klitzing constant $R_k = h/q_e^2$ [9] and the Josephson constant $K_j = 2q_e/h$ [10] could be measured directly has improved the precision of measurement of h and some SI electromagnetic units [11]. It is unfortunate that the misalignment of SI units between mechanical and electromagnetic properties has not been addressed before.

What emerges from the q_e set are values in the new fundamental units for R_k and K_j. These two constants are members of the set of q_{e*} units, as should be expected, although K_j appears inversely and twice the anticipated size. From these two observable constants (which are not universal constants because their dimensionalities are not equal to zero) all the other q_{e*} set of adjusted-Planck property values can be constructed.

The dimensional analysis used to subsume G and h is

employed to show that R_k can be considered as equivalent to a velocity, and that many of the electromagnetic properties can similarly be considered equivalent to mechanical properties. This invites a reinterpretation of not just R_k and K_j, but of all electromagnetic properties.

The measured value of R_k is shown to equate to a speed greater than light speed. Although it is not clear whether this increased maximum velocity applies to either physical objects, the media through which the physical objects travel or patterns created by subluminal physical objects, this can be experimentally tested.

The final output is to display all the Q_T property set as powers of only $\sqrt{c}$ and all the q_{eT} property set as powers of only $\sqrt{2\pi c/\alpha}$. This highlights how the adjusted-Planck sized properties are linked and dependent and shows that the laws of nature would be constructed in the same way regardless of the relative sizes of G, h, c and α.

The dimensional analysis enables new laws to be constructed and new constants of nature to be uncovered, although it is not clear that there are any of the latter needed since c is all that is required to generate all the Q_T fundamental property set.

3.4 Digression c) - Why this is not numerology

What is important here is that the relationships between the properties in both tables are easily displayed in terms of only h and c for the Q_* set in table 1 and in terms of only h, c and d for the q_{e*} set in table 2 (other than permeability, permittivity and H which have $|G|$ content). So each adjusted-Planck sized property has a simple relationship to each other one. The actual NSI values of these adjusted-Planck sized properties bear out these relationships numerically, but they are only a confirmation of what the fundamental constants already show.

3.5 R_k and K_j - members of the q_{e*} property set whose values can be measured directly

Within the q_{e*} set in table 2 are the two properties that deserve further consideration, R_k and K_j. The maximal value for Resistance R_{e*} is equal to the von Klitzing constant R_k,

$$R_{e*} = R_k (DAPU) \tag{10}$$

and the value of the Magnetic Flux ϕ_{e*} is equal to twice the inverse of the Josephson constant K_j,

$$\phi_{e*} = (2/K_j)(DAPU) \tag{11}$$

Table 3 shows that the NSI values of R_k and K_j are identical to R_{e*} and $2/\phi_{e*}$ when translated into DAPU units by multiplying by the factor 1×10^{-7} for R_k $(2.58128076 \times 10^4 \Omega \ (SI))$ and $\sqrt{1 \times 10^{-7}}$ for K_j $(4.835870 \times 10^{14} H \ V^{-1}(SI))$. To ensure clarity, new properties will be defined

$$R_k^{"} = R_{e*} = R_k (DAPU) \tag{12}$$

and

$$K_j^{"} = 2/\phi_{e*} = K_j (DAPU) \tag{13}$$

where $R_k^{"}$ and $K_j^{"}$ denote the DAPU interpretations of R_k and K_j which can be more easily compared with other constants in DAPU units. This will be explored further later.

3.6 Values of the q_{e*} set of properties

In DAPU the value of each property in table 1 is one multiplied by the constants factor containing h and c, except where $\sqrt{|G|}$ is needed. To arrive at the maximal real values that can be found experimentally, the list needs to be adjusted to use q_{e*} instead of Q_* since we do not observe Q_* charges usually. As before, the base property space is extended using standard formulae to produce the maximal values in this new 'smaller' set. The maximal values in NSI units of some properties under this limitation are listed in table 2. Note that the power of the factor d is inversely proportional to the dimensionality of every property.

4. Properties, physical constants and laws of nature

Some of the q_{e*} set of properties, such as velocity v_{e*}, appear to be larger than their Q_* set versions. As will be shown below, it is possible to interpret R_k as equivalent to a velocity and, if so, this suggests either that faster than light travel by physical objects, or patterns produced by subluminal physical objects, through media may be a possibility or that in order to pass through such maximal media an unachievable speed faster than light is required. Which is the case should be investigated. Properties where $X_{e*} > X_*$, will be considered further below.

All the properties above have been produced using standard relationships and formulae. It is interesting to observe that some properties on the mechanical side have identical size and dimension partners on the electromagnetic side, for example mass M_* and magnetic flux ϕ_*. One interpretation could be that magnetic flux is the equivalent of the mass in an

electromagnetic system, and that resistance R_{e*} is the equivalent of velocity v_{e*}. Dimensional analysis supports this and the appropriateness of this interpretation will be considered later.

To ensure that the above values can be understood properly, the following series of relationships at the Q_* level can be culled from standard laws and the results confirmed to be correct using their NSI values in table 1 as:

$$F_* = (M_*/L_*)^2 = (\phi_*/L_*)^2 = M_*a_* = \phi_*B_* = i_*^2 \qquad \textbf{(14)}$$

It is also possible to use the same relationships at the q_{e*} level, using the property values from table 2 thus:

$$F_{e*} = (M_{e*}/L_{e*})^2 = (\phi_{e*}/L_{e*})^2 = \phi_{e*}B_{e*} = i_{e*}^2 \qquad \textbf{(15)}$$

Since the values of some electromagnetic properties are identical to the values of some mechanical properties, it suggests that mechanical formulae could be used with electromagnetic properties substituted instead, and vice versa.

One example would be the simple $L_{e*} = v_{e*}T_{e*} = \angle_{e*}$ which suggests that in some way electromagnetic inductance is equivalent to a mechanical distance. Were this only done in SI units, the mix of mechanical and electromagnetic properties would not show that the properties were interchangeable because of the misalignment of those two types of property in the SI units system.

The tables show that most electromagnetic properties can be reinterpreted in terms of mechanical properties. It requires a complete reinterpretation of what is understood by the terms magnetic inductance (acceleration), magnetic flux (mass), inductance (distance), current density (mass density) and other electromagnetic properties.

5. Describing all properties using only two from the set of properties

Now it is possible to reinterpret the two fundamental constants h and c, aside from the factor d which defines the electron charge-based system that we experience because of the relative size of the charge on the electron q_{e*} versus the DAPU Planck charge Q_*, in term of the two base properties which have only dimension $Y^{\pm 1}$ which are charge Q_* and mass M_*. We have:

$$M_*Q_* = h \qquad \textbf{(16)}$$

$$M_*/Q_* = c \qquad \textbf{(17)}$$

So the two constants h and c represent the only two possible ratios of the DAPU mass and DAPU charge,

each used once.

Also important is that the same reinterpretation can be done for h and c using R_k and K_j. However, for consistency, the DAPU constants $R_k^{''}$ and $K_j^{''}$ will be used, but the same relationships remain.

$$R_k^{''}(K_j^{''}/2)^2 = h^{-1} \qquad \textbf{(18)}$$

$$d^2 R_k^{''} = c \qquad \textbf{(19)}$$

The comparison with M_* and Q_* is not identical. $K_j^{''}$ is an inverse magnetic flux and so equivalent to a mass of size $2/K_j^{''}$. However, $R_k^{''}$ is not a charge, but is a resistance or velocity. But by using the same product relationship between equivalent mass and charge, with the factor of two, the value of h can be recovered as:

- Equivalent mass x electron charge = $(2/K_j^{''})q_{e*} = h$

And the same can be achieved with the ratio of equivalent mass to charge to recover the velocity c/d^2 or $R_k^{''}$ as:

- Equivalent mass /electron charge is = $(2/K_j^{''})/q_{e*} = R_k^{''} = 2\pi c/\alpha$

This shows that if inverse magnetic flux can be considered as equivalent to a mass, then resistance can be considered as equivalent to a velocity.

5.1 Digression d) - Properties as ratios of $R_k^{''}$ and $K_j^{''}/2$

It is possible to generate examples of the usual constants of nature or DAPU properties, other than G which was subsumed into M_* and L_*, using just $R_k^{''}$ and $K_j^{''}/2$ (or with powers of d included for the Q_* set) as follows:

$$M_* = d/(K_j^{''}/2)$$

$$Q_* = 1/(R_k^{''}(K_j^{''}/2)d)$$

$$L_* = 1/(R_k^{''2}(K_j^{''}/2)d^3)$$

$$c = R_k^{''}d^2$$

$$M_{e*} = 1/(K_j^{''}/2) = \phi_{e*}$$

$$i_{e*} = R_k^{''2}$$

$$q_{e*} = 1/(R_k^{''}(K_j^{''}/2))$$

$$\nabla_{e*} = R_k^{''3}$$

$$L_{e*} = 1/(R_k^{''2}(K_j^{''}/2))$$

$$T_* = 1/(R_k^{''3}(K_j^{''}/2)d^5)$$

$$E_* = R_k^{''2}d^5/(K_j^{''}/2))$$

These adjusted-Planck size relationships can be checked by using the following standard law formulae, in either Q_* or q_{e*} form, and the DAPU values of the properties in table 1 or 2: $\nabla_{e*} = i_{e*} \times R_k^{''}$ or $B_{e*} = \phi_{e*} / A_{e*}$ or $E_{e*} = m_{e*} \times v_{e*}^2$ or $q_{e*} = i_{e*} \times T_{e*}$ or $E_{e*} \times T_{e*} = h$

Many properties have been left out of the list for brevity, including those based on materials which require the permeability factor u_e and would mean the inclusion of the ratio $\sqrt{|G|}$ in the formula of constants producing those properties. Of particular interest is the value of $i_{e*} = R_k^{''2}$ which suggests that the SI unit of Ampere could be defined using the DAPU value of $R_k^{''2}$ as its sole reference point.

It may be possible to improve the accuracy of measurement of some of the constants by using the new relationships uncovered between $R_k^{''}$ and $K_j^{''}$. It is not only h that can be made more precisely from ratios of R_k and K_j if it's retention is required. There are many more composites of $R_k^{''}$ and $K_j^{''}$ that produce other properties which may not have been measured to as great an accuracy as R_k and K_j have been.

5.2 Digression e) - How to translate between SI and APU/DAPU units

Table 3 shows the relative factors required to translate between DAPU/APU/SI. The SI values should be multiplied by the factors in the appropriate column to produce the DAPU or APU values of that property.

5.3 Digression f) - Faster than light speed?

The adjusted-Planck size properties in table 2, based on q_{e*}, that have $X_{e*} > X_*$, have sizes greater than their Q_* DAPU set values in table 1. This leads to properties like $v_{e*} = c / d^2 = 2 \pi c / \alpha$ which is greater than light speed. It is the d factor, the ratio q_{e*}/Q_*, that alters the property values in table 2.

Where the adjusted-Planck size property has d^{+x} the property will be smaller than its Planck parent and where the property has d^{-x} it will be larger - the whole q_{e*} property space has been stretched out of symmetry when compared with the Q_* property space topology, even though the same laws and relationships still apply.

For all physical objects at the maximal adjusted-Planck size values for each q_{e*} property possessed, the actual value of d is immaterial. Such objects obey the same laws regardless of the relative size of the electron charge q_{e*} to DAPU charge Q_*. It is only at the lower levels, below maximal values at fractional Planck values, that the ratio of d to, for example, the masses of the particles will produce varying sizes of physical effect, such as differing electron energy levels in atoms, dependent on the mass of the electron and its orbital velocity.

Whether the maximal values $X_{e*} > X_*$ can actually be attained is a question for experimental verification or rebuttal. That R_k and K_j have been measured to be the sizes that they are [12] makes it certain that some of them can, since $R_k = c / d^2 = 2 \pi c / \alpha$. So although equivalent to a velocity, it is not clear if $R_k > c$ means that q_{e*} based physical objects can exceed c in velocity.

The interpretation preferred here is that the factor v / d^2 represents a limitation on the minimum velocity required for electrons to pass across the media.

5.4 Digression g) - Simplifying expressions

An example of the use of simplification enabled by the use of DAPU units would be to compare the standard expression for the principal energy levels of the one-electron atom with the same in DAPU units, where each observed property is displayed in fractional DAPU values. It is not suggested that this is the only way to arrive at the simplification, but it shows how thinking in DAPU units enables simplicity to emerge.

The simplest example of a standard equation for the allowed energy levels, to use as an example, is the Bohr SI equation which provides that

$$E_{nmass} = -1 / n^2 (k^2 m e^4 / (2 \hbar^2)) = -R_B / n^2 \qquad (20)$$

Where R_B is the Rydberg constant and the other properties are as usually described. The factor k has the value $k = 8.988 \times 10^9 N m^2 C^{-2}(SI)$ and can be converted into DAPU units by dividing by $(\sqrt{1 \times 10^{-7}})^2 = 1 \times 10^{-7}$ to produce the value $k = 8.988 \times 10^{16}(DAPU) = c^2$. The formula can be manipulated using

$$F = e^2 c^2 / r_e^2 = m v_e^2 / r_e = \hbar v_e / r_e^2 \qquad (21)$$

so that in DAPU terms this becomes a simpler to understand kinetic energy-like ratio

$$E_{nmass} / E_* = -0.5 m v_e^2 / n^2 \qquad (22)$$

Whilst the DAPU equation is admittedly not so easy to measure, it does bring out that what is being measured is simply different variations in the kinetic energy balance of the electron. Had the Bohr example started with the potential energy separated out, then so would the DAPU presentation.

Another simplification providing greater clarity might be based on the expression for the magnetic moment of an

orbiting electron, usually described in SI units as

$$\mu_e = e\ h\ /2\ m \tag{23}$$

but which can be recast using the same equations as previously to become

$$n\ \mu_e / \mu_{e*} = 0.5\ e\ v_e r_e \tag{24}$$

so that

$$E_{ncharge} / E_{e*} = \mu_e c\ \omega_e / n^2 = 0.5\ (ec)\ v_e^2 / n^2 \tag{25}$$

which implies that in the same way that moving mass occurs in units of orbital angular momentum in $n\ \hbar\ = m\ v_e r_e$ so does charge although in units of orbital magnetic momentum as $n\ \mu_e c\ = 0.5\ (e\ c\ )v_e r_e$ in DAPU, using the same form as the $\hbar$ angular momentum equation by increasing the magnetic moment equation dimensionality to $\mu_e c\ = Y^{-2} Y^2 = Y^0$, mirroring the dimensionality of $\hbar$. And that the form of the equation for energy of motion of charge is comparable with that for the kinetic energy of the mass, but with ec replacing the mass m in the kinetic energy equation.

6. Equivalence of electromagnetic and mechanical properties in experiments

The new law of nature mentioned earlier, producing Planck's constant h as the product of DAPU volume V_* and viscosity η_*, together with the equivalence in DAPU units of viscosity η_* and electric field ξ_*, provide two interesting possibilities, one already experimentally hinted at.

Firstly, that any fundamental physical framework based on a single fundamental particle of one volume size, which combines with others in a composite structure, would have constant viscosity acting on the motion of every such component particle. This would be equivalent to the action of air resistance on a skydiver, providing a terminal velocity.

The same type of action on such fundamental particles could be the underlying reason for the terminal velocity that we describe as light speed, the irreversible arrow of time as energy is lost to overcome viscosity and could also provide an additional redshift factor to the passage of photons, almost completely directly related to their distance travelled, reducing the size and expansion rate of the universe.

Secondly, and having potential experimental justification, is that viscosity η_* and electric field ξ_* could be the same property in different disguises. A recent paper [13] mentioned that the 'stickiness' of spiders' silk could be turned on and off through the application of an electric field. If such stickiness and viscosity are related, then this would show directly how viscosity is related to electric

field and vice versa. This effect would not the same as the creation of magnetorheological fluids [14] with dual fluids, but would be describing a deeper level of equivalence.

7. Triple-adjusted Planck units

Having retained h earlier in order to show clearly the link between the q_{e*} set of property maximal values and R_k and K_j, it is now necessary to make the final third adjustment to produce the most simple definitions possible of mass and charge, that is the TAPU definitions

$$M_T = M_* / \sqrt{h}\ = \sqrt{c}$$

$$Q_T = Q_* / \sqrt{h}\ = 1\ / \sqrt{c}$$

$$L_T = L_* / \sqrt{h}\ = 1 / \sqrt{c^{-3}}$$

and to show their simple relationships to all other properties through a new ratio $\vartheta\ = \sqrt{c\ /d}\ = \sqrt{2\ \pi\ c\ /\alpha}$.

The base formulae are now:

$$1\ = M_T c\ L_T \tag{26}$$

and

$$F_T L_T^2 = M_T^2 = Q_T^2 c^2 = c \tag{27}$$

It is now considered here what it means to have those properties, also described as parameters, as ratios of ϑ .

The starting point is to consider how each of the parameters could be most simply described in terms of the product the normal length, velocity and time parameters (LvT) and respectively ϑ^1 (mass m) and ϑ^{-1} (charge q) parameters. This is done to understand better what the electromagnetic properties represent when considered as mechanical properties. This analysis is the reversal of the way that the description of the properties was parameterised into powers of c and d, and now ϑ .

The new TAPU sets are based around the X_T set $M_T = \sqrt{c}$ **and** $Q_T = 1\ / \sqrt{c}$ **and the X_{eT} set** $m_{eT} = \sqrt{c\ /d}\ = \vartheta^1$ **and** $q_{eT} = \sqrt{d\ /c}\ = \vartheta^{-1}$.

It is also worth noting how the current equation relating energy and time, instead of position and momentum in the original Heisenberg relationship [15], in APU was $E_o T_o = \hbar$ and now becomes $E_T T_T = 1$ in TAPU, and that our original starting base has now been reached in terms of manipulating and simplifying formulae.

8. Comparisons

Tables 1 and 2 should be compared with table 4 for understanding. The q_{eT} set is the observable set of TAPU

parameters which can be compared with the maximal Q_T TAPU set. Although the Q_T set is described as maximal because it is based on all adjusted Planck unit sizes, it does contain smaller values when $\mathcal{G}$ takes positive powers.

Note that the LvT groups used may not correspond to the normally accepted set due to the inclusion of m or q in every parameter formula.

9. Unit foundations

It is clear from a comparison of table 4 columns 1-3 and 4-6 that the same grouping of LvT parameters with mass m and with the product qc can be described identically. The two sets have the same powers of $\mathcal{G}$ which should make the properties the same. However it is not clear that, for example, Shear Viscosity (η) and Electric Field (ξ) are the same properties, or Acceleration (a) is equivalent to Magnetic Inductance (B).

The alternative interpretation has the same LvT groups with mass m compared with charge q only, omitting c, so comparing columns 1-3 and 7-9 in table 4. This misaligns the powers of $\mathcal{G}$ and can be shown to be incorrect by considering the $\mathcal{G}^0$ constant angular momentum parameter in the mass set which aligns with $\mathcal{G}^{-2}$ conductance in the electromagnetic parameters set. It cannot be the case that a constant in the mass set matches with a variable in the electromagnetic set. So the only possible alignment between mass and charge parameters sets is by comparing m with qc, rather than m with q.

The accepted definitions of the electromagnetic properties are therefore shown to be incorrect. They should all be adjusted by the extra c factor.

One difficulty in considering the alignments across all possible powers of $\mathcal{G}$ is that there are gaps where no known properties exist for that power of $\mathcal{G}$, at powers $\mathcal{G}^{15}$ and $\mathcal{G}^{-8}$.

These gaps are properties that we have not yet realised actually exist. Doubtless they will be uncovered experimentally in due course, although it is not clear what set of parameters or units would best describe them since there are many different ways to produce their dimensionalities. The simplest set has been used in table 4.

The best possible descriptions for these two properties would be: for the $\mathcal{G}^{15}$ property 'Kinetic Intensity' since it can be formed from the product of velocity and intensity and for the $\mathcal{G}^{-8}$ property 'Time and Distance' since it can be formed from the product of time and distance, although it could also be described as 'Inverse Force'.

10. Brand new SI units

In translating between DAPU units used above in tables 1 and 2 and TAPU units used in table 5, it is helpful to show the adjustments to each of the properties in the parameter sets. The results are displayed in table 5 which combines the two parameter sets and shows both the BNSI values of the TAPU parameters and their values in terms of ratios of c, or of c and $d = \sqrt{\alpha / 2 \pi}$ or $\mathcal{G} = \sqrt{c / d}$.

The changes can be split into six groupings, where X_T / X_* is the relationship between the TAPU units in BNSI and the DAPU units in NSI when eliminating h content with the description of the units in table 5 given as BNSI units (h-adjusted).

The parameters Mass (m), Magnetic Flux (ϕ), Charge-mass (qc), Momentum (mv), Energy (E), Temperature (K), Charge (q), Distance (L), Inductance ($\angle$), Capacitance (C) and Time (T) change in the form $X_T = X_* / \sqrt{h}$.

The parameters Angular Frequency (w), Frequency (f), Acceleration (a), Magnetic Inductance (B), Magnetic Field (H), Electric Field (ξ) and Viscosity (η) change in the form $X_T = X_* \sqrt{h}$.

The parameters Velocity (v), Resistance (R), Current (i), Action (m/L), Potential Difference (∇), Force (F), Power (P), Conductance (ς) and Permittivity (ε) remain in the form $X_T = X_*$.

The parameters Moment (mL), and Area (A) change in the form $X_T = X_* / h$.

The parameters Mass Density (ρ), Current Density (J), Pressure (p) and Energy Density (ψ) change in the form $X_T = X_* h$. The parameter Volume (V) changes in the form $X_T = X_* / h^{3/2}$.

11. Discussion

What, for example, does it mean that the maximal value of the TAPU of observable adjusted-Planck unit energy is $\mathcal{G}^5$ whilst that of mass is $\mathcal{G}^1$?

This tells us that regardless of the relative size of the electronic charge in the q_{eT} set to its maximum value in the Q_T set, the relationship between the maximal values of the two adjusted-Planck unit properties energy and mass in terms of one being the fifth power of the other will always be the same, only the actual measurable value in whatever units are used will differ, dependent on the value of α .

It is also possible to infer that the underlying reason for the value of the fine structure constant must be motional,

because it is part of the ratio $\vartheta = \sqrt{2\pi c/\alpha}$. This would be more obvious if the inverse $b = 1/\alpha$ were used instead, because then the ratio would be $\vartheta = \sqrt{2\pi b c}$ and $2\pi b$ would simply be a dimensionless ratio adjusting velocity *c*. Because the relationship is inverse, it does not necessarily mean that α is a translational velocity, instead it could be linked to rotational motion.

Beyond these two points, it is difficult to make much more progress without an underlying theory of the structure of matter. But the hints are that what we observe at the most fundamental level is based on motion.

Assuming this to be the case, it might be possible to use a metaphor based on length L to infer a similar relationship for ϑ. We call L a length, L^2 an area and L^3 volume, each increase representing a different dimension based on length. It may be possible to consider ϑ^1 as mass, ϑ^2 as $mass^2 = velocity$ and so on with each property at the adjusted-Planck unit sizes, where each different power is a different mass dimension, in 26 dimensional space, and a different property. The actual value of the adjusted-Planck unit property along that dimension is what is observed.

The total dimensionality is based on the observation that there must be at least 16 + 9 + 1 = 26 dimensions existing to accommodate all the properties that we currently observe, even if we do not have names for either the mechanical or electromagnetic properties at some values of powers of ϑ, where they have not yet been recognized to exist.

Note that, other than for *m* and *q* parameters, the formulae used to provide the appropriate powers of ϑ for each parameter in table 4 do not use the target parameter in the formula, so velocity *v* does not have *v* in its formula, for example.

It is now clear that the use of *h*, *G* and the omission of the $\sqrt{1 \times 10^7}$ and 6.501 factors in SI units serve to hide the underlying symmetry within the current set of Planck units. Only in their final TAPU form in BNSI units is it clear that the set of TAPU units have adjusted-Planck unit property values {TAPU} = Y^x with $14 \geq x \geq -9$ where for the larger set $Y = \sqrt{c}$, with the smaller set having $Y = \sqrt{2\pi c/\alpha}$.

Whilst the elimination of *h* and *G* provides advantages in terms of simplification of units and improved understanding of how properties are related, it undermines the idea that the quantum realm belongs to small distances and small masses, with the classical relativistic world to large distances and large masses.

Since the paper shows that there is no difference in field strengths for identical fractional Planck values of mass and gravity, it asks the question why are quantum effects seen

in the world of the small and not in the world of the large. The answer appears to be that nature prefers to balance out the larger effects first. So the naturally occurring fractional Planck size of charge is significantly larger than the normal fractional Planck size of any of the basic building blocks of matter. The preference is to reduce the effect of charge first, even though this may increase the amount of mass. The primary example is the neutralising of the charges on a proton and electron to form a neutron. The existence of positive and negative units of charge enables the balancing.

So as the mass size of grouping particles increases towards equality with the field strength of a unit of charge on these masses, the existence of unitised positive and negative charges allows the net charge effect to become the easier one to balance. The attractive-only gravitational field then becomes the stronger overall as mass increases, but has no ability to balance because there is no negative gravitational effect.

So below a certain size of mass, unitised and balanceable systems will exist, where gravity plays little role – even though its field strength is the same as that of charge its actual strength is much smaller. Above a certain size of mass, gravity will dominate because its actual strength then exceeds that of individual charges.

This does not mean that charge fields do not play a role in gravitational systems, nor that gravity does not act in charge balanced systems, only that the relative effect will be small.

There ought to exist at the size where the two forces balance in actual strength, some systems where the gravity and charge actions both need to be considered equally in their dynamics.

It is also evident that quantum effects such as superposition ought to occur at what has been previously considered classical levels. Possibly it is only the complexity of the objects being considered that has stopped such effects being observed so far.

12. Conclusions

This paper presents new ways of understanding the relationships between properties whilst undermining the current interpretation of where the quantum and classical worlds diverge. The novel insights and predictions include:

i. If our current units are simplified and corrected for two misalignments, the underlying symmetry of the maximal values of all properties can be seen. It is only through this simplification that the symmetry becomes apparent.

ii. The elimination of *h* and *G* implies that size and distance are not the properties which separate quantum and classical gravitational systems.

iii. The interpretation of the gravitational constant *G* as a dimensionless ratio and its relegation from gravitational to permeability use as a ratio enables it

iv. The elimination of G eliminates the need to test the equivalence of gravitational and inertial masses.

v. The strength of equal fractional adjusted-Planck sized charge and gravitational fields has been shown to be equal.

vi. The interpretation of Planck's constant h as a dimensionless ratio enables its elimination from all formulae.

vii. A self-contained and consistent new Planck unit set of maximal Q_T based properties from which all observed values can be produced and easily combined in equations.

viii. A self-contained and consistent new Planck unit set of electron charge-size q_{eT} based properties can be produced, some of which are directly observable in experiments.

ix. That all properties can be displayed in terms of only c for the Q_T property set and in terms of only c and α for the q_{eT} set (other than permeability, permittivity and H which have $|G|$ content), which was previously considered impossible.

x. There exists a new hypothetical dimensionality analysis that can be used to describe adjusted-Planck unit property dimensions and to uncover any law of nature or any universal constants.

xi. All that is required to produce a law of nature is to create an equation where the adjusted-Planck unit dimensionalities are equal on both sides.

xii. To produce a constant of nature, aside from c, the minimum that is required is that it has Y^0 dimensionality.

xiii. That most of the Q_T and q_{eT} property sets can be described solely in terms of ratios of the R_k and K_j (and d for the Q_T set) and so will benefit from the precision of measurement of these two properties.

xiv. That the experimentally observed value of R_k implies either that the velocity of a current within certain electromagnetic materials could be in excess of light speed, the patterns produced by subluminal physical objects could have a maximum velocity of $c\,/d^2$ or that such a minimum velocity is required in order to pass through those material. This is open to further experimental work to confirm which is the case.

xv. That most electromagnetic properties can be reinterpreted in terms of mechanical properties. It requires a complete reinterpretation of what is understood by the terms magnetic inductance (acceleration), magnetic flux (mass), inductance (distance), current density (mass density) and other electromagnetic properties. One possible experimental verification exists in equating viscosity and electric field.

xvi. That the reinterpretation of R_k and $K_j/2$ with their current excellent precision of measurement, should enable increased accuracy in the estimation of the values of other adjusted-Planck unit properties and fundamental constants identified as novel composite functions of $R_k^{''}$ and $K_j^{''}/2$.

xvii. A universal method of discovering laws of nature that applies regardless of any stretching of property space. A unit with $q_{eT}/\,Q_T \neq \sqrt{\alpha\,/\,2\,\pi}$ would still have the same relationships between adjusted-Planck unit properties although the numerical values of the results would be different.

xviii. Physics can be better understood when stripped to its bare essentials using a repaired system of SI units that are currently misaligned across the electromagnetic and mechanical properties. By adjusting SI units to be self-consistent and consistent with TAPU units, greater clarity will ensue.

xix. The adjustments necessary to align and make SI units self-consistent and also consistent with the simplicity of TAPU units have been proposed, producing a system of Brand New SI units.

xx. The new dimensional analysis shows that the current set of properties is missing two from the set, whose dimensions and probable units can be inferred and are suggested be called 'Kinetic Intensity' and 'Time and Distance'.

Appendix A. References

1. Isaac Newton "The Mathematical Principles of Natural Philosophy", Volume 1 of John Machin's English translation published 1686.

2. Planck, Max (1899). "Uber irreversible Strahlungsvorgange". *Sitzungsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin* 5: 440–480.

3. P. Mohr "Recent progress in fundamental constants and the International System of Units" *Third workshop on Precision Physics and Fundamental Physical Constants* (6 December 2010)

4. M. J. Duff, L. B. Okun, G. Veneziano Comments: "Trialogue on the number of fundamental constants" *JHEP 0203 (2002) 023* arXiv:physics/0110060

5. G. Fiorentini (1), L. Okun (2), M. Vysotsky (2) ((1) INFN, Sezione di Ferrara, Ferrara, Italy, (2) ITEP, Moscow, Russia) "Is G a conversion factor or a fundamental unit?" arXiv:physics/01120068.

6. G. Fiorentini (1), L. Okun (2), M. Vysotsky (2) ((1) INFN, Sezione di Ferrara, Ferrara, Italy, (2) ITEP, Moscow, Russia) "Is G a conversion factor or a fundamental unit?" arXiv:physics/0112006

7 L. B. Okun Comments: "Fundamental units: physics and metrology" Talk at the Seminar "Astrophysics, Clocks and Fundamental Constants" (302. *WE-Heraues-Seminar*, Bad Honnef, Germany, 16-18 June 2003) arXiv:physics/0310069

8. G. Fiorentini (1), L. Okun (2), M. Vysotsky (2) ((1) INFN, Sezione di Ferrara, Ferrara, Italy, (2) ITEP, Moscow, Russia) "Is G a conversion factor or a fundamental unit?" arXiv:physics/0112006

9. von Klitzing, K.; Dorda, G.; Pepper, M. "New method for high-accuracy determination of the fine-structure constant based on quantized Hall resistance" *Physical Review Letters*, vol.**45**, no.6, p. 494-7 (1980)

10. B. D. Josephson. "The discovery of tunnelling supercurrents." *Rev. Mod. Phys.* 1974; **46**(2): 251-254.

11. Mohr, Peter J.; Taylor, Barry N.; Newell, David B. (2008). "CODATA Recommended Values of the Fundamental Physical Constants: 2006". *Rev. Mod. Phys.* **80**: 633–730. doi:10.1103/RevModPhys.80.633. http://physics.nist.gov/cuu/Constants/codata.pdf.

12. Mohr, Peter J.; Taylor, Barry N.; Newell, David B. (2008). "CODATA Recommended Values of the Fundamental Physical Constants: 2006". *Rev. Mod. Phys.* **80**: 633–730. doi:10.1103/RevModPhys.80.633. http://physics.nist.gov/cuu/Constants/codata.pdf.

13. Hu Tao, Mark A. Brenckle, Miaomiao Yang, Jingdi Zhang, Mengkun Liu, Sean M. Siebert, Richard D. Averitt, Manu S. Mannoor, Michael C. McAlpine, John A. Rogers, David L. Kaplan, Fiorenzo G. Omenetto, "Silk-Based Conformal, Adhesive, Edible Food Sensors". *Advanced Materials*, **Volume 24**, Issue 8, pages 1067–1072, February 21, 2012.

14. Andrade, E. N. Da C.; Dodd, C., "The Effect of an Electric Field on the Viscosity of Liquids". Proceedings of the Royal Society of London. *Series A, Mathematical and Physical Sciences*, **Volume 187,** Issue 1010, pp. 296-337

15. Heisenberg, W. (1930), *Physikalische Prinzipien der Quantentheorie*, Leipzig: Hirzel English translation *The Physical Principles of Quantum Theory*. Chicago: University of Chicago Press, 1930.

Table 1. Values of the Q_* set of properties

Property X_*	Q_* DAPU set's NSI Value	NSI Units	DAPU equivalent	As Constants
Gravitational Constant G	none	$m^3 kg^{-1} s^{-2}$	none	none
Permeability u_*	$\sqrt{6.67428 \times 10^{-11}}$	$N\ A^{-2}$	none	$\sqrt{|G|}$
Boltzmann's Constant k_B	none	$J\ K_\wedge^{-1}$	none	none
Angular Momentum h	$6.62606896 \times 10^{-34}$	$J\ s$	$m^2 kg\ s^{-1}$	h
Mass M_*	$4.45695580 \times 10^{-13}$	kg	kg	$\sqrt{hc}$
Magnetic Flux ϕ_*	$4.45695580 \times 10^{-13}$	$W_\wedge$	$\sqrt{mkg}\,m\,s^{-1}$	$\sqrt{hc}$
Charge-mass $Q_* c$	$4.45695580 \times 10^{-13}$	$C_\wedge m\ s^{-1}$	$\sqrt{mkg}\,m\,s^{-1}$	$\sqrt{hc}$
Velocity v_*	2.99792458×10^8	$m\ s^{-1}$	$m\ s^{-1}$	c
Resistance R_*	2.99792458×10^8	$\Omega_\wedge$	$m\ s^{-1}$	c
Momentum $M_* v_*$	$1.33616173 \times 10^{-4}$	$m\ kg\ s^{-1}$	$m\ kg\ s^{-1}$	$c\sqrt{hc}$
Current i_*	$8.98755179 \times 10^{16}$	$A_\wedge$	$\sqrt{mkg}\ s^{-1}$	c^2
Action M_*/L_*	$8.98755179 \times 10^{16}$	$m^{-1} kg$	$m^{-1} kg$	c^2
Angular Frequency W_*	$6.04538246 \times 10^{37}$	Hz	s^{-1}	$c^2\sqrt{c/h}$
Frequency f_*	$6.04538246 \times 10^{37}$	Hz	s^{-1}	$c^2\sqrt{c/h}$
Energy E_*	4.00571211×10^4	J	$m^2 kg\ s^{-2}$	$c^2\sqrt{hc}$
Temperature K_*	4.00571211×10^4	$K_\wedge$	$K_\wedge$	$c^2\sqrt{hc}$
Potential Difference ∇_*	$2.69440024 \times 10^{25}$	$\nabla_\wedge$	$\sqrt{mkg}\,m\,s^{-2}$	c^3
Acceleration a_*	$1.81236007 \times 10^{46}$	$m\ s^{-2}$	$m\ s^{-2}$	$c^3\sqrt{c/h}$
Magnetic Inductance B_*	$1.81236007 \times 10^{46}$	$A_\wedge m^{-1}$	$m\ s^{-2}$	$c^3\sqrt{c/h}$
Magnetic Field H_*	$2.21841235 \times 10^{51}$	$A_\wedge m^{-1}$	$m\ s^{-2}$	$c^3\sqrt{c/h|G|}$
Force F_*	$8.07760871 \times 10^{33}$	N	$m\ kg\ s^{-2}$	c^4
Electric Field ξ_*	$5.43331879 \times 10^{54}$	$\nabla_\wedge m^{-1}$	$\sqrt{mkg}\,m^{-2} s^{-2}$	$c^4\sqrt{c/h}$
Viscosity η_*	$5.43331879 \times 10^{54}$	$P_a s$	$m^{-1} kg\ s^{-1}$	$c^4\sqrt{c/h}$
Mass Density ρ_*	$3.65466491 \times 10^{75}$	$kg\ m^{-3}$	$kg\ m^{-3}$	c^5/h
Current Density J_*	$3.65466491 \times 10^{75}$	$A_\wedge m^{-2}$	$\sqrt{mkg}\,m^{-2} s^{-1}$	c^5/h
Power P_*	$2.42160617 \times 10^{42}$	$J\ s^{-1}$	$m^2 kg\ s^{-3}$	c^5
Pressure p_*	$3.28464901 \times 10^{92}$	$N\ m^{-2}$	$m^{-1} kg\ s^{-2}$	c^7/h
Energy Density ψ_*	$3.28464901 \times 10^{92}$	$J\ m^{-3}$	$m^{-1} kg\ s^{-2}$	c^7/h
Charge Q_*	$1.48668043 \times 10^{-21}$	$C_\wedge$	$\sqrt{mkg}$	$\sqrt{h/c}$
Conductance ς_*	$3.33564095 \times 10^{-9}$	$\Omega_\wedge^{-1}$	$m^{-1} s$	c^{-1}
Moment $M_* L_*$	$2.21021870 \times 10^{-42}$	$m\ kg$	$m\ kg$	h/c
Distance L_*	$4.95903212 \times 10^{-30}$	m	m	$c^{-1}\sqrt{h/c}$
Inductance $\angle_*$	$4.95903212 \times 10^{-30}$	$H_\wedge$	$\sqrt{mkg}\,m^{-1} s^{-1}$	$c^{-1}\sqrt{h/c}$
Permittivity ε_*	$1.36193501 \times 10^{-12}$	$F\#m^{-1}$	$m^{-2} s^2$	$c^{-2}\sqrt{|G|}$
Time T_*	$1.65415506 \times 10^{-38}$	s	s	$c^{-2}\sqrt{h/c}$
Area A_*	$2.45919996 \times 10^{-59}$	m^2	m^2	h/c^3
Volume V_*	$1.21952516 \times 10^{-88}$	m^3	m^3	$h\ \sqrt{h/c}/c^4$

Table 2. Values of the q_{e*} set of properties

Property X_{e*}	q_{e*} DAPU set's NSI Value	NSI Units	DAPU equivalent	As Constants
Permeability u_{e*}	$\sqrt{6.67428\times10^{-11}}$	$N\ A^{-2}$	none	$\sqrt{|G|}$
Boltzmann's Constant k_B	none	$J\ K_\wedge^{-1}$	none	none
Angular Momentum h	6.62606896×10^{-34}	$J\ s$	$m^2 kg\ s^{-1}$	h
Mass m_{e*}	1.30781284×10^{-11}	kg	kg	$d^{-1}\sqrt{hc}$
Magnetic Flux ϕ_{e*}	1.30781284×10^{-11}	$W_\wedge$	$\sqrt{mkg}\,m s^{-1}$	$d^{-1}\sqrt{hc}$
Charge-mass $q_{e*}c$	1.30781284×10^{-11}	$C_\wedge m\ s^{-1}$	$\sqrt{mkg}\,m s^{-1}$	$d^{-1}\sqrt{hc}$
Velocity v_{e*}	2.58128076×10^{11}	$m\ s^{-1}$	$m\ s^{-1}$	$d^{-2}c$
Resistance R_{e*}	2.58128076×10^{11}	$\Omega_\wedge$	$m\ s^{-1}$	$d^{-2}c$
Momentum $m_{e*}v_{e*}$	3.37583212×10^{00}	$m\ kg\ s^{-1}$	$m\ kg\ s^{-1}$	$d^{-3}c\sqrt{hc}$
Current i_{e*}	6.66301034×10^{22}	$A_\wedge$	$\sqrt{mkg}\,s^{-1}$	$d^{-4}c^2$
Action m_{e*}/L_{e*}	6.66301034×10^{22}	$m^{-1}kg$	$m^{-1}kg$	$d^{-4}c^2$
Angular Frequency W_{e*}	1.31510410×10^{45}	Hz	s^{-1}	$d^{-5}c^2\sqrt{c/h}$
Frequency f_{e*}	1.31510410×10^{45}	Hz	s^{-1}	$d^{-5}c^2\sqrt{c/h}$
Energy E_{e*}	8.71397049×10^{11}	J	$m^2 kg\ s^{-2}$	$d^{-5}c^2\sqrt{hc}$
Temperature K_{e*}	8.71397049×10^{11}	$K_\wedge$	$K_\wedge$	$d^{-5}c^2\sqrt{hc}$
Potential Difference ∇_{e*}	1.71991004×10^{34}	$\nabla_\wedge$	$\sqrt{mkg}\,m s^{-2}$	$d^{-6}c^3$
Acceleration a_{e*}	3.39465292×10^{56}	$m\ s^{-2}$	$m\ s^{-2}$	$d^{-7}c^3\sqrt{c/h}$
Magnetic Inductance B_{e*}	3.39465292×10^{56}	$A_\wedge m^{-1}$	$m\ s^{-2}$	$d^{-7}c^3\sqrt{c/h}$
Magnetic Field H_{e*}	4.15521180×10^{61}	$A_\wedge m^{-1}$	$m\ s^{-2}$	$d^{-7}c^3\sqrt{c/h|G|}$
Force F_{e*}	4.43957068×10^{45}	N	$m\ kg\ s^{-2}$	$d^{-8}c^4$
Electric Field ξ_{e*}	8.76255225×10^{67}	$\nabla_\wedge m^{-1}$	$\sqrt{mkg}\,m^{-2}s^{-2}$	$d^{-9}c^4\sqrt{c/h}$
Viscosity η_{e*}	8.76255225×10^{67}	$P_a s$	$m^{-1}kg\ s^{-1}$	$d^{-9}c^4\sqrt{c/h}$
Mass Density ρ_{e*}	1.72949881×10^{90}	$kg\ m^{-3}$	$kg\ m^{-3}$	$d^{-10}c^5/h$
Current Density J_{e*}	1.72949881×10^{90}	$A_\wedge m^{-2}$	$\sqrt{mkg}\,m^{-2}s^{-1}$	$d^{-10}c^5/h$
Power P_{e*}	1.14597784×10^{57}	$J\ s^{-1}$	$m^2 kg\ s^{-3}$	$d^{-10}c^5$
Pressure p_{e*}	1.15236684×10^{113}	$N\ m^{-2}$	$m^{-1}kg\ s^{-2}$	$d^{-14}c^7/h$
Energy Density ψ_{e*}	1.15236684×10^{113}	$J\ m^{-3}$	$m^{-1}kg\ s^{-2}$	$d^{-14}c^7/h$
Charge q_{e*}	5.06652691×10^{-23}	$C_\wedge$	$\sqrt{mkg}$	$d\sqrt{h/c}$
Conductance ς_{e*}	3.87404585×10^{-12}	$\Omega_\wedge^{-1}$	$m^{-1}s$	$d^2 c^{-1}$
Moment $m_{e*}L_{e*}$	2.56696950×10^{-45}	$m\ kg$	$m\ kg$	$d^2 h/c$
Distance L_{e*}	1.96279576×10^{-34}	m	m	$c^{-1}\sqrt{h/c}$
Inductance $\angle_{e*}$	1.96279576×10^{-34}	$H_\wedge$	$\sqrt{mkg}\,m^{-1}s^{-1}$	$d^3 c^{-1}\sqrt{h/c}$
Permittivity ε_{e*}	1.83707675×10^{-18}	$F_\# m^{-1}$	$m^{-2}s^2$	$d^4 c^{-2}\sqrt{|G|}$
Time T_{e*}	7.60396075×10^{-46}	s	s	$d^5 c^{-2}\sqrt{h/c}$
Area A_{e*}	3.85256718×10^{-68}	m^2	m^2	$d^6 h/c^3$
Capacitance C_{e*}	2.94580926×10^{-57}	$F_\#$	$m^{-1}s^2$	$d^7 c^{-3}\sqrt{h/c}$
Volume V_{e*}	$7.56180251\times10^{-102}$	m^3	m^3	$d^9 h\sqrt{h/c}/c^4$

Table 3. How to translate between SI and APU/DAPU NSI units

Property NSI	Property	DAPU value	DAPU factor X_*	APU factor X_o	SI value for Planck unit	SI Name
$6.62606896 \times 10^{-34}$	h	h	2π	2π	$1.0545716 \times 10^{-34}$	$\hbar$
$4.45695580 \times 10^{-13}$	M_*	$\sqrt{hc}$	$\sqrt{2\pi G}$	$\sqrt{2\pi}$	2.1764374×10^{-8}	M_{planck}
$1.48668043 \times 10^{-21}$	Q_*	$\sqrt{h/c}$	$\sqrt{1 \times 10^{-7}}$	$\sqrt{1 \times 10^{-7}}$	$4.7012963 \times 10^{-18}$	Q_{planck}
$5.06652691 \times 10^{-23}$	q_{e*}	$\sqrt{\alpha/2\pi}\sqrt{h/c}$	$\sqrt{1 \times 10^{-7}}$	$\sqrt{1 \times 10^{-7}}$	$1.6021765 \times 10^{-19}$	e
$4.95903212 \times 10^{-30}$	L_*	$\sqrt{h/c^3}$	$\sqrt{2\pi/G}$	$\sqrt{2\pi}$	$1.6162525 \times 10^{-35}$	L_{planck}
none	G	none	none	1	6.67428×10^{-11}	G
2.99792458×10^8	c	c	1	1	2.99792458×10^8	c
$2.58128076 \times 10^{11}$	R_{e*}	$2\pi c/\alpha$	1×10^7	1×10^7	2.58128076×10^4	R_k
$1.52927081 \times 10^{11}$	$2/\phi_{e*}$	$2\sqrt{\alpha/(2\pi hc)}$	$\sqrt{1 \times 10^{-7}}$	$\sqrt{1 \times 10^{-7}}$	$4.83597891 \times 10^{14}$	K_j

Table 4. Comparison of the parameterisation of properties at each power of ϑ

1	2	3	4	5	6	7	8	9
X_{eT} mass set as powers of ϑ	Mass Parameter (Accepted)	Mass Formula	X_{eT} qc set as powers of ϑ	Charge Parameter (Proposed)	Charge (qc) Formula	X_{eT} q set as powers of ϑ	Charge Parameter (Implied by grouping without c, but incorrect)	Charge (q) Formula
0	Angular Momentum	mvL	0	Magnetic moment x2/c	$qcvL$	-2	Magnetic moment x2	qvL
1	Mass	m	1	Magnetic Flux	qc	-1	Charge	q
2	Velocity	$m\ L^{-2}T$	2	Resistance	$qc\ L^{-2}T$	0	Resistance	$q\ L^{-2}T$
3	Momentum	mv	3	-	qcv	1	-	qv
4	Action	m/L	4	Current	qc/L	2	Current	q/L
5	Energy	$m\ v^2$	5	Energy	$qc\ v^2$	3	Energy	$q\ v^2$
6	-	mv/L	6	Potential Difference	qcv/L	4	Potential Difference	qv/L
7	Acceleration	$m\ L^{-2}$	7	Magnetic Inductance	$qc\ L^{-2}$	5	Magnetic Inductance	$q\ L^{-2}$
7	Acceleration	$m\ L^{-2}$	7	Magnetic Field	$qc\ L^{-2}/\sqrt{|G|}$	5	Magnetic Field	$q\ L^{-2}/\sqrt{|G|}$
8	Force	$m\ v^2/L$	8	Force	$qc\ v^2/L$	6	Force	$q\ v^2/L$
9	Shear Viscosity	$m\ v\ L^{-2}$	9	Electric Field	$qc\ v\ L^{-2}$	7	Electric Field	$q\ v\ L^{-2}$
10	Mass Density	$m\ L^{-3}$	10	Current Density	$qc\ L^{-3}$	8	Current Density	$q\ L^{-3}$
11	Luminance	$m\ T^{-2}$	11	-	$qc\ T^{-2}$	9	-	$q\ T^{-2}$
12	Kinetic viscosity	$m\ v\ L^{-3}$	12	-	$qc\ v\ L^{-3}$	10	-	$q\ v\ L^{-3}$
13	Intensity	$m\ v\ T^{-2}$	13	-	$qc\ v\ T^{-2}$	11	-	$q\ v\ T^{-2}$
14	Pressure	$m\ v^2 L^{-3}$	14	-	$qc\ v^2 L^{-3}$	12	-	$q\ v^2 L^{-3}$
15	**Undiscovered**	$m\ v^2 T^{-2}$	15	**Undiscovered**	$qc\ v^2 T^{-2}$	13	-	$q\ v^2 T^{-2}$
16	Radiance	$m\ T^{-3}$	16	-	$qc\ T^{-3}$	14	-	$q\ T^{-3}$
-1	-	m/v	-1	Charge mass	qc/v	-3	-	q/v
-2	Moment	mL	-2	Conductance	qcL	-4	Conductance	qL
-3	Distance	$m\ /v^2$	-3	Inductance	$qc\ /v^2$	-5	Inductance	$q\ /v^2$
-4	-	mT	-4	Permittivity	$qcT/\sqrt{|G|}$	-6	Permittivity	$qT/\sqrt{|G|}$
-5	Time	$m\ L^2$	-5	Time	$qc\ L^2$	-7	Time	$q\ L^2$
-6	Area	mT/v	-6	Area	qcT/v	-8	Area	qT/v
-7	-	mTL	-7	Capacitance	$qcTL$	-9	Capacitance	qTL
-8	**Undiscovered**	$m\ L^3$	-8	**Undiscovered**	$qc\ L^3$	-10	-	$q\ L^3$
-9	Volume	mTL/v	-9	Volume	$qcTL/v$	-11	Volume	qTL/v

Table 5. Values of parameters in BNSI, ratios of c and d and powers of ϑ

Parameter X_-	X_T TAPU set's BNSI Value	X_{eT} TAPU set's BNSI Value	X_T as Constants	X_{eT} as Constants	BNSI Units (h-adjusted)	X_{eT} set as powers of ϑ
Permeability u_-	$\sqrt{6.67428\times10^{-11}}$	$\sqrt{6.67428\times10^{-11}}$	$\sqrt{|G|}$	$\sqrt{|G|}$	$N\ A^{-2}$	ϑ^0
Boltzmann's Constant k_B	none	none	none	none	$J\ K_\wedge^{-1}$	ϑ^0
Angular Momentum h	none	none	none	none	$J\ s$	ϑ^0
Mass M_-	1.73145158×10^{04}	5.08063063×10^5	$(\sqrt{c})^1$	$d^{-1}(\sqrt{c})^1$	kg	ϑ^1
Magnetic Flux ϕ_-	1.73145158×10^{04}	5.08063063×10^5	$(\sqrt{c})^1$	$d^{-1}(\sqrt{c})^1$	$W_\wedge$	ϑ^1
Charge-mass Q_-c	1.73145158×10^{04}	5.08063063×10^5	$(\sqrt{c})^1$	$d^{-1}(\sqrt{c})^1$	$C_\wedge m\ s^{-1}$	ϑ^1
Velocity v_-	2.99792458×10^{08}	2.58128076×10^{11}	$(\sqrt{c})^2$	$d^{-2}(\sqrt{c})^2$	$m\ s^{-1}$	ϑ^2
Resistance R_-	2.99792458×10^{08}	2.58128076×10^{11}	$(\sqrt{c})^2$	$d^{-2}(\sqrt{c})^2$	$\Omega_\wedge$	ϑ^2
Momentum M_-v_-	5.19076126×10^{12}	1.31145341×10^{17}	$(\sqrt{c})^3$	$d^{-3}(\sqrt{c})^3$	$m\ kg\ s^{-1}$	ϑ^3
Current i_-	8.98755179×10^{16}	6.66301034×10^{22}	$(\sqrt{c})^4$	$d^{-4}(\sqrt{c})^4$	$A_\wedge$	ϑ^4
Action M_-/L_-	8.98755179×10^{16}	6.66301034×10^{22}	$(\sqrt{c})^4$	$d^{-4}(\sqrt{c})^4$	$m^{-1}kg$	ϑ^4
Angular Frequency W_-	1.55615108×10^{21}	3.38522944×10^{28}	$(\sqrt{c})^5$	$d^{-5}(\sqrt{c})^5$	Hz	ϑ^5
Frequency f_-	1.55615108×10^{21}	3.38522944×10^{28}	$(\sqrt{c})^5$	$d^{-5}(\sqrt{c})^5$	Hz	ϑ^5
Energy E_-	1.55615108×10^{21}	3.38522944×10^{28}	$(\sqrt{c})^5$	$d^{-5}(\sqrt{c})^5$	J	ϑ^5
Temperature K_-	1.55615108×10^{21}	3.38522944×10^{28}	$(\sqrt{c})^5$	$d^{-5}(\sqrt{c})^5$	$K_\wedge$	ϑ^5
Potential Difference ∇_-	2.69440024×10^{25}	1.71991004×10^{34}	$(\sqrt{c})^6$	$d^{-6}(\sqrt{c})^6$	$\nabla_\wedge$	ϑ^6
Acceleration a_-	4.66522356×10^{29}	8.73822761×10^{39}	$(\sqrt{c})^7$	$d^{-7}(\sqrt{c})^7$	$m\ s^{-2}$	ϑ^7
Magnetic Inductance B_-	4.66522356×10^{29}	8.73822761×10^{39}	$(\sqrt{c})^7$	$d^{-7}(\sqrt{c})^7$	$A_\wedge m^{-1}$	ϑ^7
Magnetic Field H_-	5.71044889×10^{34}	1.06959938×10^{45}	$(\sqrt{c})^7/\sqrt{|G|}$	$d^{-7}(\sqrt{c})^7/\sqrt{|G|}$	$A_\wedge m^{-1}$	$\vartheta^7/\sqrt{|G|}$
Force F_-	8.07760871×10^{33}	4.43957068×10^{45}	$(\sqrt{c})^8$	$d^{-8}(\sqrt{c})^8$	N	ϑ^8
Electric Field ξ_-	1.39859884×10^{38}	2.25558188×10^{51}	$(\sqrt{c})^9$	$d^{-9}(\sqrt{c})^9$	$\nabla_\wedge m^{-1}$	ϑ^9
Viscosity η_-	1.39859884×10^{38}	2.25558188×10^{51}	$(\sqrt{c})^9$	$d^{-9}(\sqrt{c})^9$	$P_a s$	ϑ^9
Mass Density ρ_-	2.42160617×10^{42}	1.14597784×10^{57}	$(\sqrt{c})^{10}$	$d^{-10}(\sqrt{c})^{10}$	$kg\ m^{-3}$	ϑ^{10}
Current Density J_-	2.42160617×10^{42}	1.14597784×10^{57}	$(\sqrt{c})^{10}$	$d^{-10}(\sqrt{c})^{10}$	$A_\wedge m^{-2}$	ϑ^{10}
Power P_-	2.42160617×10^{42}	1.14597784×10^{57}	$(\sqrt{c})^{10}$	$d^{-10}(\sqrt{c})^{10}$	$J\ s^{-1}$	ϑ^{10}
Pressure p_-	2.17643109×10^{59}	7.63566217×10^{79}	$(\sqrt{c})^{14}$	$d^{-14}(\sqrt{c})^{14}$	$N\ m^{-2}$	ϑ^{14}
Energy Density ψ_-	2.17643109×10^{59}	7.63566217×10^{79}	$(\sqrt{c})^{14}$	$d^{-14}(\sqrt{c})^{14}$	$J\ m^{-3}$	ϑ^{14}
Charge Q_-	5.77550080×10^{-5}	1.96825960×10^{-6}	$(\sqrt{c})^{-1}$	$d^1(\sqrt{c})^{-1}$	$C_\wedge$	ϑ^{-1}
Conductance ς_-	3.33564095×10^{-9}	3.87404585×10^{-12}	$(\sqrt{c})^{-2}$	$d^2(\sqrt{c})^{-2}$	$\Omega_\wedge^{-1}$	ϑ^{-2}
Moment M_-L_-	3.33564095×10^{-9}	3.87404585×10^{-12}	$(\sqrt{c})^{-2}$	$d^2(\sqrt{c})^{-2}$	$m\ kg$	ϑ^{-2}
Distance L_-	1.92649970×10^{-13}	7.62512793×10^{-18}	$(\sqrt{c})^{-3}$	$d^3(\sqrt{c})^{-3}$	m	ϑ^{-3}
Inductance $\angle_-$	1.92649970×10^{-13}	7.62512793×10^{-18}	$(\sqrt{c})^{-3}$	$d^3(\sqrt{c})^{-3}$	$H_\wedge$	ϑ^{-3}
Permittivity ε_-	1.36193501×10^{-12}	1.83707675×10^{-18}	$(\sqrt{c})^{-4}/\sqrt{|G|}$	$d^4(\sqrt{c})^{-4}/\sqrt{|G|}$	$F_\# m^{-1}$	$\vartheta^{-4}/\sqrt{|G|}$
Time T_-	6.42611129×10^{-22}	2.95400952×10^{-29}	$(\sqrt{c})^{-5}$	$d^5(\sqrt{c})^{-5}$	s	ϑ^{-5}
Area A_-	3.71140109×10^{-26}	5.81425760×10^{-35}	$(\sqrt{c})^{-6}$	$d^6(\sqrt{c})^{-6}$	m^2	ϑ^{-6}
Capacitance C_-	2.14352000×10^{-30}	1.14439683×10^{-40}	$(\sqrt{c})^{-7}$	$d^7(\sqrt{c})^{-7}$	$F_\#$	ϑ^{-7}
Volume V_-	7.15001309×10^{-39}	4.43344580×10^{-52}	$(\sqrt{c})^{-9}$	$d^9(\sqrt{c})^{-9}$	m^3	ϑ^{-9}