Eliminating two defining constants of SI units and simplifying the foundations of physics

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Using the concept of dimensionality, where properties each have a specific dimension, rearranging the treatment of two of the SI defining constants h and k_B in equations relating properties and adjusting the value of the third defining constant the electron charge e , for a historic wrong choice, it is possible to eliminate two of the seven defining constants of SI units. The additional elimination of the gravitational constant G, in the same way as the Planck constant h , enables the maximal values of all properties to be defined as powers of the speed of light c and of c and the fine structure constant $\propto$. The resulting new SI units are shown in fractional triple-adjusted Planck units and compared with their current values in fractional SI Planck units. The adjustment of SI Planck units into triple-adjusted Planck units simplifies the understanding of the relationships between properties and how new laws of nature may be uncovered.

Key words: SI units; Dimensionality; Defining constants; Defined constants; Planck's constant; Gravitational constant; Boltzmann's constant; Planck units; Properties;

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Introduction

The change to a fixed set of SI defining constants in 2019 [1] missed the opportunity at that time to improve SI units further.

The seven defining constants include two that can be eliminated completely, one which requires adjustment for consistency and omits one which is currently required in gravitational systems – although this too can be eliminated after accurate measurement.

The defining constants to be eliminated are Planck's constant h and Boltzmann's constant k_B . The former, now defined precisely, can be eliminated by absorption within the mass and distance units. The latter can either be set to unity and instead defining the energy and temperature units to be identical or simply eliminated.

The electron charge e needs to be adjusted by the factor $\sqrt{1x10^{-7}}$ which is the result of a mistaken choice between the old electrostatic CGS-ESU and electromagnetic CGS-EMU system definitions of that charge.

The gravitational constant G , although not a defining constant, is currently a core factor in gravity and cosmology, but can be eliminated by absorption within the mass and distance units, although it then appears in some material properties.

However, compared with the now-defined value of h, the value of G is less well defined. The result of the latter's absorption could be viewed either as a positive or a negative, in that either G becomes a factor in only some material properties or all mass and distance properties are infected with the less defined value of G.

The paper explains how to achieve the greater simplicity in physics enabled by the eliminations and adjustments proposed here. It then explains the effect of the reduced number of defining constants on SI base units and the redefinition of those base units, via triple-adjusted Planck units, into triple-adjusted new SI units.

The underlying assumption is that SI derived units are currently not internally consistent with each other, because they have not been adjusted as proposed here. They produce units that appear to be different, but under dimensional analysis, deeper than mass, length and time, can be shown to be the same. This paper shows how to adjust SI units into new SI (NSI) units whose maximal adjusted-Planck values are all powers of c, or of $\sqrt{2\pi c/\alpha}$, which values are defined to be triple-adjusted Planck units (TAPU).

Methodology

The starting point is to eliminate Planck's constant h , the gravitational constant G and Boltzmann's constant k_B from all equations and to show they are dimensionless constants, whose values are set by the units used. Although their elimination makes the resultant NSI and TAPU values initially more obscure compared with our usual experience, it provides a deeper understanding of the relationships between all properties.

There are also two adjustments to make in order to produce consistency across all Planck properties, so that they are all powers of a base value.

The final stage is to show how the existing SI defining constants and base units relate to the new NSI units. The existing frequency, time and length defining constants are used as the starting point, but are adjusted by the eliminated factors h and G so that the latter are no longer factors in the new derived base units. The defining constants and derived base units are then quoted for comparison as fractional values of their NSI TAPU and SI PU unit values.

Initial Stage

The elimination of h and G is done using standard Newtonian equations, although the latter has been shown to be possible for relativistic equations [2] and the former previously [3]. Using the usual SI force equation

$$F = GMM/L^2 = M\,v^2/L$$

Let

$$M_* = M\sqrt{G/h}$$

and

$$L_* = L/\sqrt{hG}$$

which gives

$$F_* = M_*M_*/L_*^2 = M_*\,v^2/L_* = GF$$

There is no G factor any more in the new X_* units, nor is there an h factor. The former suggests that there is no difference between gravitational and inertial mass.

The same can be done for the quantum relationship

$$h = MvL$$

such that

$$1 = M_*v_*L_*$$

Dimensionality

In order to show that h, k_B and G are dimensionless, it is necessary to ascribe to each property a dimensionality, which is a measure of how many powers of an underlying dimension each property has.

The assumption is that mass and charge are the base properties from which all other can be obtained. Thus

$$M_* = Y^1$$

and

$$Q_* = Y^{-1}$$

such that, rather than the usual Planck mass $M_p = \sqrt{hc/G}$, using Planck's constant h rather than the reduced Planck constant $\hbar$, and initially avoiding defining the new units used, the adjusted-Planck mass will be

$$M_* = \sqrt{c}$$

and so

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

This adjusted-Planck charge Q_* is not the size of the charge of the electron , but a more fundamental size symmetric with the adjusted-Planck mass M_* such that $M_* = Q_* c$. The electron charge in TAPU is $q = Q_* \sqrt{\propto/2\pi}$.

To begin with the units of mass could be called 'units of mass' and those of charge 'units of charge' even though it is clear that each is here defied to be a factor of the square root of velocity c . The analysis using dimensionality will show that this is indeed the case, such that all maximal property values are powers of the basic square root of velocity , regardless of what they are called or what they are currently defined to be representing.

Extending the dimensionality to other mechanical properties through standard relationships produces

$$v_* = c = Y^2 \qquad L_* = Y^{-3}$$

$$T_* = Y^{-5} \qquad E_* = Y^5$$

$$F_* = Y^8 \qquad a_* = Y^7$$

The relationships in maximal Planck terms may be exact, but do not represent the actual values which can be observed because most observables do not have maximal Planck sizes. However, the relationships between the fractional property values, as fractions of their adjusted-Planck maximals, are exact. Thus

$$c = L_*/T_*$$

in adjusted-Planck sizes, whereas

$$v/c = l/L_*/t/T_*$$

becomes

$$v = l/t$$

Charge Adjustment

This adjusted-Planck set of values is still incomplete. The electron charge q here is different to the accepted electron charge e by a factor of $\sqrt{1x10^{-7}}$. This is due to the choice made when originally agreeing the SI charge unit size [4]. The factor is the same difference as existed for the unit of charge between the two older competing electromagnetic CGS-EMU and electrostatic CGS-ESU systems. SI units were chosen to align with the wrong one.

The relationship is that $q = e\sqrt{1x10^{-7}}$

The other issue which needs to be adjusted occurs when comparing mechanical and electromagnetic SI units where there is material content. The properties of permeability u_* and permittivity $\mathcal{E}_*$ have to be redefined so that

$$u_* = \sqrt{|G|}$$

rather than the usual $4\pi x 10^{-7}$and so

$$\mathcal{E}_* = 1/\sqrt{|G|}c^2$$

The overall result of these changes is two internally consistent sets of triple-adjusted Planck units (TAPU), one for the major values and one for the minor values. The major value set all have the designation X_* and the minor values have X_e. Note that the use of the major/minor designations for the sets does not mean that the values in each set for their respective properties are all larger or smaller. Note also that some of each set are unphysical, for example, the minor set velocity which exceeds . The values have been shown as if they logically exist, even though some may not.

Although the following equations use the X_* set, the dimensionality relationships are still valid for any fractional TAPU values of either set.

The dimensionalities of the electromagnetic properties can be found through the generalised force equation and other standard equations as

$$F_* = (M_*/L_*)^2 = (\varphi_*/L_*)^2 = M_* a_* = \varphi_* B_* = i_*^2 = E_*/L_*$$

Some electromagnetic properties thus have the following dimensionalities, others are shown in the tables below

$i_* = Y^4$ $\nabla_* = Y^6$

$B_* = Y^7$ $\xi_* = Y^9$

$\eta_* = Y^9$ $K = Y^5$

A fuller list is provided in Table 1 showing the TAPU values and their value in powers of *c* or of $\sqrt{2\pi c/\propto}$. The first set of columns are for the major TAPU sizes where Q_* is the relevant parameter whereas the second set of columns are based on the observables limited by the minor TAPU electron charge q.

The differences between some of the SI Planck values for electromagnetic properties and their TAPU values will be combinations of the above adjustments, being $\sqrt{1x10^{-7}}$, $\sqrt{G}$ and $4\pi x 10^{-7}/\sqrt{|G|}$.

Dimensionless Universal Constants

That G , k_B and h are dimensionless emerges from the original equations [5] in that

$$F = GMM/L^2 = M\,v^2/L$$

can be stated dimensionally as

$$Y^8 = G\,Y^1\,Y^1/\,Y^{-6} = Y^1\,Y^4/\,Y^{-3}$$

so that $G = Y^0$

and

$$h = MvL$$

can be stated dimensionally as

$$h = Y^1\,Y^2\,Y^{-3}$$

so that $h = Y^0$

For k_B , since energy E_* and temperature K_* have the same dimensionality, the usual equation relating energy and temperature

$$E_* = k_B K_*$$

can be stated dimensionally as

$$Y^5 = k_B Y^5$$

so that $k_B = Y^0$

These two SI defining constants h and k_B , plus G , are universal constants because their dimensionality is zero, meaning that they have no proportionality to any properties. But this also means that their actual values are set by the units which are used to define them.

By absorbing h and G within the mass and distance properties, or in the case of k_B

effectively setting it to unity, the units themselves are stretched to eliminate them.

However, to absorb them completely, their values – dimensionless ratios - still need to be known accurately. In the case of h, this is practical and accurate. In the case of G , it is arguable, but does lead to improved visibility of the relationships between properties and of the relative strength of gravitational versus charge fields. This change of property in which G occurs to the material, rather than gravitational, properties may enable the more accurate estimation of its value in future.

Defining Constants

Note should be taken that the defining constants are not all dimensionally derived directly from the same set of TAPU units. This adds complexity when deriving other new SI (NSI) units because some mechanical derivations use properties all from the major set whilst some electromagnetic derivations use properties from both sets. There are two different time units that could be used as a defining constant, either from the major or the minor TAPU sets. The SI values of the von Klitzing constant R_k and Josephson constant K_j are each based on only the minor TAPU set, for example.

Considering the TAPU sets of properties, each property in the major set is a power of only $\sqrt{c}$ (and in the case of permeability u_* , permittivity $\mathcal{E}_*$, electric displacement field D_* and magnetic field H_* of $\sqrt{G}$ as well).

For the minor set of TAPU properties, each property is a power of $\sqrt{2\pi c/\alpha}$ (and in the case of permeability u_* , permittivity $\mathcal{E}_*$, electric displacement field D_* and magnetic field H_* of $\sqrt{G}$ as well).

This dimensionality analysis suggests that the defining constants need to be adjusted to align with their size changes due to the elimination of the dimensionless factors h, G and K_B before being used to deliver the NSI base unit values. Each defining constant will be considered in turn.

1 Time - In property terms, time is the inverse of energy with $E_* T_* = 1$ in the major TAPU set. Note that so far in the dimensionality analysis, no change has been made to the size or dimensionality of velocity v_* . This is partially because the maximum velocity $v_* = c$ is not actually a constant, supported by its Y^2 dimensionality. This means that the maximum speed c of any particle, in relativistic space, may take any value from the empty space value down to zero near a massive black hole.

So when considering the relationship between energy and velocity as $E_* = M_* c^2$, the mass adjustment is the only one to be considered. This means that instead of the second s as the base NSI time unit, the adjusted-mass value requires the use of the larger value from

$$T_* = 1/E_* = 1/(M_* c^2)$$

$$= 1/(\sqrt{G/h} M c^2) = T/\sqrt{hG}$$

because $ET = h$, so that the NSI second

$$s_N = s/\sqrt{hG}$$

is larger by the $\sqrt{hG}$ factor.

2 Frequency – The time adjustment requires that the hyperfine transition frequency of Caesium used currently be adjusted by the same factor as the time unit, to match the new NSI s_N definition, or alternatively that a different appropriate physical matching frequency is found. So $w_N = w\sqrt{hG}$.

3 Length – Since $L_* = L/\sqrt{hG}$, the current metre also needs to be adjusted by the factor $\sqrt{hG}$ to become the NSI metre L_N. This confirms the constancy of the dimensionality of velocity v_* since

$$v_* = L_*/T_* = L/\sqrt{hG}/(T/\sqrt{hG}) = L/T$$

These two interlinked NSI defining constants combine to produce light speed c and can then use the same processes as current SI methodology to arrive at their respective values. Effectively each is just adjusted by the dimensionless factor $\sqrt{hG}$.

Beyond these, defining the remaining NSI defining constants, other than Mol and Candela, is different to the standard SI methodology – because two of them have been eliminated.

4 Mass – The kilogram is adjusted by the $\sqrt{G/h}$ factor as was used in the initial definition of mass above, but Planck's constant h is no longer required since it has been absorbed into the first three NSI defining constants.

5 Ampere – The value of the SI derived unit of charge e has been adjusted by the factor $\sqrt{1x10^{-7}}$ to become the NSI charge unit q , but the second has also been adjusted, so that the NSI unit of current is $A_N = A\sqrt{1x10^{-7}}\sqrt{\text{hG}}$.

6 Kelvin – Since dimensionally $E_* = K_*$ and $k_B = Y^0$, it is possible to set $k_B = 1$ and use the energy scale instead. This effectively eliminates Boltzmann's constant.

7 Mole– no need to adjust this.

8 Candela – since this is a measure of power, the adjustment required is the combination of energy divided by time, so the NSI candela will be

$$K_{cdN} = K_{cd}\sqrt{G/h}\,\sqrt{hG} = GK_{cd}$$

Resulting Implications

There are some interesting features that emerge from the above analysis.

- Laws of nature can be produced by equating property dimensionalities since any equation where the sum of the powers is the same on both sides of an equation sign defines a law of nature.
- Universal constants can be found when equations containing them are otherwise equated on each side of an equation. An example is Boltzmann's constant.
- Effectively the power relationships require stretching the current mass and distance properties equally but inversely for G and identically for h .
- Eliminating G shows that equal sized fractional TAPU values of mass and charge have equal strength fields. It is the size of the generators of those properties that is very different in our normal environment
- Electromagnetic properties that have the same dimensionality as mechanical properties can be interpreted in mechanical terms. Examples would be Magnetic Field B Y^7 as an acceleration a Y^7 or Electric Field ξ Y^9 as shear viscosity η Y^9 or resistance R Y^2 as a form of velocity v Y^2 , likely to mean the minimum velocity required to move across a resistant material.
- The current definition of the SI units of H and B suggest that they are different properties. The TAPU interpretation shows that they are the same property, but one has a material component that the other does not.
- The property Electric Displacement D has also been misidentified within SI. TAPU shows that D is an energy.
- The product of two properties which produces a universal constant such as shear viscosity Y^9 or Electric Field ξ Y^9

and volume Y^{-9} (two new laws of nature) suggests that a composite composed using a unitary sized fundamental particle system would experience the same viscosity in motion regardless of its actual physical composite size. This suggests that frequency independent tired light could be a factor currently ignored within red shift observations.

- The von Klitzing and Josephson constants are shown to be two properties from the minor list, although the latter is inverted and doubled.
- That there is a major TAPU set based on the major charge Q_* suggests that a particle-based fundamental system may exist on which our current quarks and leptons are built [6].

Conclusion

That two of the defining constants of the SI system of units, h and k_B , can be eliminated shows that the system has not been optimised. The misalignment of the electron charge also contributes to the lack of simplicity that property relationships currently have numerically. Eliminating the gravitational constant further confirms that the units need stretching to become the most simple maximal values possible, as powers of $\sqrt{c}$ or of $\sqrt{2\pi c/\alpha}$, dependent on which of the mahor or minor NSI property sets are considered.

The use of the new SI system of units, whilst producing presently obtuse values that may become more acceptable over time, does serve to simplify the understanding of how properties are related and how new laws of nature can be uncovered.

References

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Table 1 – The X_* major and X_e minor TAPU sets by value and constants

TAPU Parameter X_-	X_* TAPU set's NSI Value	X_* as Constants	X_e TAPU set's NSI Value	X_e as Constants	NSI Units (h, G, q-adjusted X_N)
Planck's constant h	none	none	none	none	none
Gravitational Constant G	none	none	none	none	none
Boltzmann's constant K_B	none	none	none	none	none
Permeability u_-	$8.1696x10^{-6}$	$\sqrt{\|G\|}$	$8.1696x10^{-6}$	$\sqrt{\|G\|}$	$N_N\ A_N^{-2}$
Mass M_-	$1.7314x10^{04}$	$(\sqrt{c})^1$	$5.0806x10^5$	$(\sqrt{2\pi c/\alpha})^1$	kg_N
Magnetic Flux φ_-	$1.7314x10^{04}$	$(\sqrt{c})^1$	$5.0806x10^5$	$(\sqrt{2\pi c/\alpha})^1$	W_N
Charge-mass Q_-c	$1.7314x10^{04}$	$(\sqrt{c})^1$	$5.0806x10^5$	$(\sqrt{2\pi c/\alpha})^1$	$C_N\ m_N\ s_N^{-1}$
Velocity v_-	$2.9979x10^{08}$	$(\sqrt{c})^2$	$2.5813x10^{11}$	$(\sqrt{2\pi c/\alpha})^2$	$m_N\ s_N^{-1}$
Resistance R_-	$2.9979x10^{08}$	$(\sqrt{c})^2$	$2.5813x10^{11}$	$(\sqrt{2\pi c/\alpha})^2$	Ω_N
Momentum M_-v_-	$5.1098x10^{12}$	$(\sqrt{c})^3$	$1.3115x10^{17}$	$(\sqrt{2\pi c/\alpha})^3$	$m_N\ kg_N\ s_N^{-1}$
Current i_-	$8.9876x10^{16}$	$(\sqrt{c})^4$	$6.6630x10^{22}$	$(\sqrt{2\pi c/\alpha})^4$	A_N
Action M_-L_-	$8.9876x10^{16}$	$(\sqrt{c})^4$	$6.6630x10^{22}$	$(\sqrt{2\pi c/\alpha})^4$	$m_N^{-1}\ kg_N$
Angular Frequency w_-	$1.5562x10^{21}$	$(\sqrt{c})^5$	$3.3852x10^{28}$	$(\sqrt{2\pi c/\alpha})^5$	Hz_N
Frequency f_-	$1.5562x10^{21}$	$(\sqrt{c})^5$	$3.3852x10^{28}$	$(\sqrt{2\pi c/\alpha})^5$	Hz_N
Energy E_-	$1.5562x10^{21}$	$(\sqrt{c})^5$	$3.3852x10^{28}$	$(\sqrt{2\pi c/\alpha})^5$	J_N
Temperature K_-	$1.5562x10^{21}$	$(\sqrt{c})^5$	$3.3852x10^{28}$	$(\sqrt{2\pi c/\alpha})^5$	K_N
Electric Displacement D_-	$1.9048x10^{26}$	$(\sqrt{c})^5/\sqrt{G}$	$4.1437x10^{33}$	$(\sqrt{2\pi c/\alpha})^5/\sqrt{G}$	$C_N\ m_N^{-2}$
Potential Difference ∇_-	$2.6944x10^{25}$	$(\sqrt{c})^6$	$1.7199x10^{34}$	$(\sqrt{2\pi c/\alpha})^6$	∇_N
Acceleration a_-	$4.6652x10^{29}$	$(\sqrt{c})^7$	$8.7382x10^{39}$	$(\sqrt{2\pi c/\alpha})^7$	$m_N\ s_N^{-2}$
Magnetic Inductance B_-	$4.6652x10^{29}$	$(\sqrt{c})^7$	$8.7382x10^{39}$	$(\sqrt{2\pi c/\alpha})^7$	$A_N\ m_N^{-1}$
Magnetic Field H_-	$5.7104x10^{34}$	$(\sqrt{c})^7/\sqrt{G}$	$1.0696x10^{45}$	$(\sqrt{2\pi c/\alpha})^7/\sqrt{G}$	$A_N\ m_N^{-1}$
Force F_-	$8.0776x10^{33}$	$(\sqrt{c})^8$	$4.4396x10^{45}$	$(\sqrt{2\pi c/\alpha})^8$	N_N
Electric Field ξ_-	$1.3986x10^{38}$	$(\sqrt{c})^9$	$2.2556x10^{51}$	$(\sqrt{2\pi c/\alpha})^9$	$\nabla_N\ m_N^{-1}$
Viscosity η_-	$1.3986x10^{38}$	$(\sqrt{c})^9$	$2.2556x10^{51}$	$(\sqrt{2\pi c/\alpha})^9$	$Pa_N\ s_N$
Mass Density ρ_-	$2.4216x10^{42}$	$(\sqrt{c})^{10}$	$1.1460x10^{57}$	$(\sqrt{2\pi c/\alpha})^{10}$	$kg_N\ m_N^{-3}$
Current Density J_-	$2.4216x10^{42}$	$(\sqrt{c})^{10}$	$1.1460x10^{57}$	$(\sqrt{2\pi c/\alpha})^{10}$	$A_N\ m_N^{-2}$

Power P_{-}	$2.4216x10^{42}$	$(\sqrt{c})^{10}$	$1.1460x10^{57}$	$(\sqrt{2\pi c/\alpha})^{10}$	$J_N\ s_N^{-1}$
Pressure p_{-}	$2.1764x10^{59}$	$(\sqrt{c})^{14}$	$7.6357x10^{79}$	$(\sqrt{2\pi c/\alpha})^{14}$	$N_N\ m_N^{-2}$
Energy Density ψ_{-}	$2.1764x10^{59}$	$(\sqrt{c})^{14}$	$7.6357x10^{79}$	$(\sqrt{2\pi c/\alpha})^{14}$	$J_N\ m_N^{-3}$
Charge Q_{-}	$5.7755x10^{-5}$	$(\sqrt{c})^{-1}$	$1.9683x10^{-6}$	$(\sqrt{2\pi c/\alpha})^{-1}$	C_N
Conductance ς_{-}	$3.3356x10^{-9}$	$(\sqrt{c})^{-2}$	$3.8470x10^{-12}$	$(\sqrt{2\pi c/\alpha})^{-2}$	Ω_N^{-1}
Moment $M_{-}L_{-}$	$3.3356x10^{-9}$	$(\sqrt{c})^{-2}$	$3.8470x10^{-12}$	$(\sqrt{2\pi c/\alpha})^{-2}$	$m_N\ kg_N$
Distance L_{-}	$1.9265x10^{-13}$	$(\sqrt{c})^{-3}$	$7.6251x10^{-18}$	$(\sqrt{2\pi c/\alpha})^{-3}$	m_N
Inductance $\mathcal{L}_{-}$	$1.9265x10^{-13}$	$(\sqrt{c})^{-3}$	$7.6251x10^{-18}$	$(\sqrt{2\pi c/\alpha})^{-3}$	H_N
Permittivity $\mathcal{E}_{-}$	$1.3619x10^{-12}$	$(\sqrt{c})^{-4}/\sqrt{G}$	$1.8371x10^{-18}$	$(\sqrt{2\pi c/\alpha})^{-4}/\sqrt{G}$	$\mathrm{F}_N\ m_N^{-1}$
Time T_{-}	$6.4261x10^{-22}$	$(\sqrt{c})^{-5}$	$2.9540x10^{-29}$	$(\sqrt{2\pi c/\alpha})^{-5}$	s_N
Area A_{-}	$3.7114x10^{-26}$	$(\sqrt{c})^{-6}$	$5.8143x10^{-35}$	$(\sqrt{2\pi c/\alpha})^{-6}$	m_N^2
Capacitance C_{-}	$2.1435x10^{-30}$	$(\sqrt{c})^{-7}$	$1.1444x10^{-40}$	$(\sqrt{2\pi c/\alpha})^{-7}$	F_N
Volume V_{-}	$7.1500x10^{-39}$	$(\sqrt{c})^{-9}$	$4.4334x10^{-52}$	$(\sqrt{2\pi c/\alpha})^{-9}$	m_N^3

Table 2. Converting NSI values to SI values for some constants and properties

Property	NSI Value	TAPU factors	SI factors	SI value for Planck unit	SI Name
h	none	none	none	$6.6261x10^{-34}$	h
G	none	none	none	$6.6743x10^{-11}$	G
M_*	$1.7314x10^{4}$	$(\sqrt{c})^{1}$	$\sqrt{hc/G}$	$5.4562x10^{-8}$	M_p
Q_*	$5.7755x10^{-5}$	$(\sqrt{c})^{-1}$	$\sqrt{h/(c\ 1x10^{-7})}$	$4.7013x10^{-18}$	Q_p
q_e	$1.9683x10^{-6}$	$\sqrt{\alpha/2\pi c}$	$\sqrt{\alpha h/(2\pi c\ 1x10^{-7})}$	$1.6022x10^{-19}$	e
L_*	$1.9265x10^{-13}$	$(\sqrt{c})^{-3}$	$\sqrt{hG/c^3}$	$4.0508x10^{-35}$	L_p
c	$2.9979x10^{08}$	c	c	$2.9979x10^{08}$	c
R_e	$2.5813x10^{11}$	$(\sqrt{2\pi c/\alpha})^{2}$	$(\sqrt{2\pi c/\alpha})^{2}$	$2.5813x10^{11}$	R_k
$2/\varphi_e$	$3.9365x10^{-6}$	$2\sqrt{\alpha/2\pi c}$	$2\sqrt{\alpha/(2\pi hc\ 1x10^{-7})}$	$4.8360x10^{14}$	K_j

Table 3. Converting NSI values to SI values for defining constants

Defining Constants	NSI Value	TAPU factors	SI factors	PU value for SI defining unit	SI Name
s_N	$1.5562x10^{21}$	$(\sqrt{c})^5$	$\sqrt{c^5/hG}$	$7.4008x10^{42}$	s
c	$2.9979x10^{08}$	c	c	$2.9979x10^{08}$	c
h	none	none	none	$6.6261x10^{-34}$	h
k_{BN}	none	none	none	$1.3806x10^{-23}$	K_B
N_{AN}	$6.0221x10^{23}$	$6.0221x10^{23}$	$6.0221x10^{23}$	$6.0221x10^{23}$	N_A
K_{cdN}	$4.5574x10^{-8}$	GK_{cd}	K_{cd}	683	lm/W

Table 4. Converting NSI values to SI values for derived base units

Derived base units	NSI Value	TAPU factors	SI factors	PU value for SI derived unit	SI Name
s_N	$1.5562x10^{21}$	$(\sqrt{c})^5$	$\sqrt{c^5/hG}$	$7.4008x10^{42}$	second
m_N	$5.1098x10^{12}$	$(\sqrt{c})^3$	$\sqrt{c^3/hG}$	$2.4686x10^{34}$	metre
kg_N	$5.7755x10^{-5}$	$(\sqrt{c})^{-1}$	$1/\sqrt{hc/G}$	$1.8328x10^{7}$	kilogram
A_N	$1.0659x10^{-31}$	$1/\sqrt{\alpha c^4/2\pi}$	$1/\sqrt{\alpha c^4/2\pi G\ 1x10^{-7}}$	$8.4336x10^{-25}$	ampere
K_N	$6.4261x10^{-22}$	$(\sqrt{c})^{-5}$	$1/k_B$	$7.2432x10^{22}$	kelvin
mol_N	$1.6606x10^{-24}$	$1.6606x10^{-24}$	$1.6606x10^{-24}$	$1.6606x10^{-24}$	mole
cd_N	$2.1942x10^{7}$	$1/(GK_{cd})$	$1/K_{cd}$	$1.4641x10^{-3}$	candela