the general science journal

The ST system of units

Leading the way to unification

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First electronic edition published as part of the Unified Theory Foundations (Feb 2005) [1]

Abstract

This paper shows that all measurable quantities in physics can be represented as nothing more than a number of spatial dimensions differentiated by a number of temporal dimensions and vice versa. To convert between the numerical values given by the space-time system of units and the conventional SI system, one simply multiplies the results by specific dimensionless constants. Once the ST system of units presented here is applied to any set of physics parameters, one is then able to derive all laws and equations without reference to the original theory which presented said relationship. In other words, all known principles and numerical constants which took hundreds of years to be discovered, like Ohm's Law, energy mass equivalence, Newton's Laws, etc.. would simply follow naturally from the spatial and temporal dimensions themselves, and can be derived without any reference to standard theoretical background. Hundreds of new equations can be derived using the ST table included in this paper. The relation between any combination of physical parameters, can be derived at any instant. Included is a step by step worked example showing how to derive any free space constant and quantum constant.

Dimensions and dimensional analysis

One of the most powerful mathematical tools in science is dimensional analysis. Dimensional analysis is often applied in different scientific fields to simplify a problem by reducing the number of variables to the smallest number of "essential" parameters. Systems which share these parameters are called similar and do not have to be studied separately. Most often then not, two apparently different systems are shown to obey the same laws and one of them can be considered to be analogous to the other.

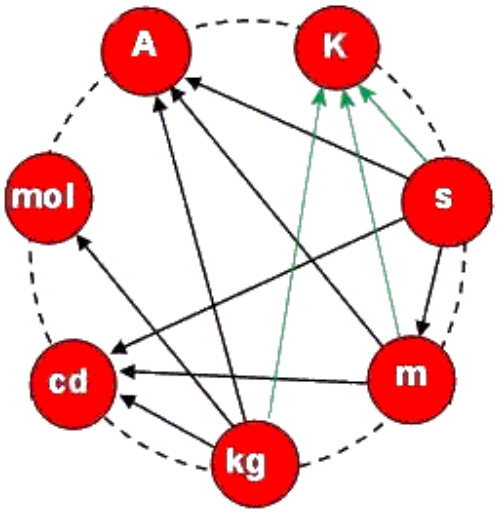
Unfortunately, the term ' dimension' , has two completely different meanings, both of which are going to be used in this paper, so the reader should be aware of both meanings in order to apply the correct meaning of the word according to the context in which it is being used. In mathematics the ' dimension' of a space is roughly defined as the minimum number of coordinates needed to specify every point within it. For example the square has two dimensions since two coordinates, say x and y, can be used to specify any point within it. A cube has three dimensions since three coordinates, say x,y, and z, are enough to specify any point in space within it. In engineering and physics terminology, the term ' dimension' relates to the nature of a measurable quantity. In general, physical measurements that must be expressed in units of measurement, and quantities obtained by such measurements are dimensionful. Quantities like ratios and multiplying factors, with no physical units assigned to them are dimensionless. An example of a dimension is length, expressed in units of length, the meters, and an example of a dimensionless unit is π. An engineering dimension can thus be a measure of a corresponding mathematical dimension, for example, the dimension of length is a measure of a collection of small linked lines of unit length, which have a single dimension, and the dimension of area is a measure of a collection or grid of squares, which have two dimensions. Similarly the mathematical dimension of volume is three. The prefix ' hyper- ' is usually used to refer to the four (and higher) dimensional analogues of three-dimensional objects, e.g. hypercube, hypersphere...

The dimension of a physical quantity is the type of unit, or relation of units, needed to express it. For instance, the dimension of speed is distance/time and the dimension of a force is mass×distance/time². Conventionally, we know that in mechanics, every physical quantity can be expressed in terms of MLT dimensions, namely mass, length and time or alternatively in terms of MLF dimensions, namely mass, length and force. Depending on the problem, it may be advantageous to choose one or the other set of fundamental units. Every unit is a product of (possibly fractional) powers of the fundamental units, and the units form a group under multiplication.

In the most primitive form, dimensional analysis is used to check the correctness of algebraic derivations: in every physically meaningful expression, only quantities of the same dimension can be added or subtracted. The two sides of any equation must have the same dimensions. Furthermore, the arguments to exponential, trigonometric and logarithmic functions must be dimensionless numbers, which is often achieved by multiplying a certain physical quantity by a suitable constant of the inverse dimension.

The Buckingham π theorem is a key theorem in dimensional analysis. The theorem states that the functional dependence between a certain number n of variables can be reduced to the number of k independent dimensions occurring in those variables to give a set of p = n - k independent, dimensionless numbers. A dimensionless number is a quantity which describes a certain physical system and which is a pure number without any physical units. Such a number is typically defined as a product or ratio of quantities which DO have units, in such a way that all units cancel. **A system of fundamental units (or sometimes fundamental dimensions) is such that every other unit can be generated from them.** The kilogram, metre, second, ampere, Kelvin, mole and candela are supposed to be the seven fundamental units, termed SI base units; other units such as the Newton, joule, and volt can all be derived from the SI base units and are therefore termed SI 'derived units'. The choice of dimensionless units is not unique: Buckingham' s theorem only provides a way of generating sets of dimensionless parameters, and will not choose the most ' physically meaningful' .

What's wrong with SI ?



We know that measurements are the backbone of science. A lot of work has been done to get the present self-coherent SI system [2] of physical parameters, so why not choose SI as the foundation of a unifying theory? Because if the present science is not leading to unification, it means that something in its foundations is really wrong, and where else to start searching if not in its measuring units. The present SI system of units have been laid out over the past couple of centuries while the same knowledge that generated them in the first place have changed, making the SI system more or less a database of historical units. The major fault in the SI system can be easily seen in the relation diagram shown here, officially issued by BIPM (Bureau International des Poids et Mesures)[3]. In the original diagram issued by BIPM, the Kelvin was the only isolated unit, but as I will describe shortly, it should be well interconnected as shown by the additional green arrows. One would expect to see the seven base units totally isolated, with arrows pointing towards derived units, instead, what we have is a totally different picture. Here we see that the seven SI base units are not even independent, but totally interdependent into a complex web structure, and so do not even qualify as fundamental dimensions. If for instance, one had to change the definition of the kilogram unit, the 'fundamental' units candela, mole, Amp and Kelvin would change as well. So one cannot say there are seven fundamental SI units if these units are not independent of each other. The other big fault is the obvious redundancy of units. Although not very well known to all of us, at least two of the seven base units of the SI system are officially accepted to be redundant, namely the mole and the candela. These two units have been dragging along, ending up in the SI system for no reason other than historic ones.

The mole is merely a certain number of atoms or molecules, in the same sense that a dozen is a number; there is no need to designate this number as a unit.

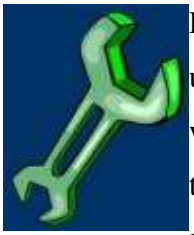
The candela is an old photometric unit which can easily be derived from radiometric units (radiated power in Watts) by multiplying it by the optical frequency response curve of the human eye. The candela unit, together with its derived units as lux and foot-candelas serve no purpose that is not served equally well by watt per steradian and its derivatives.

Temperature, is yet another base unit that can be made redundant by adopting new definitions for its unit. Temperature could be measured in energy units because, according to the equipartition theorem, temperature is proportional to the energy per degree of freedom. It is also known that for a monatomic ideal gas the temperature is related to the translational motion or average speed of the atoms. The kinetic theory of gases uses statistical mechanics to relate this motion to the average kinetic energy of atoms and molecules in the system. For this case 11605 degrees Kelvin corresponds to an average kinetic energy of one electron volt, equivalent to 1.602E-19Joules. Hence the Kelvin could also be defined as a derived unit, equivalent to 1.3806E-23Joule per degree of freedom, having the same dimensions of energy. Every temperature T has associated with it a characteristic amount of energy kT which is present in surroundings with that temperature at the quantum and molecular levels. At any given temperature the characteristic energy E is given by kT, where k (=1.3806E-23m^2kg/sec^2/K) is Boltzmann constant which is nothing more than a conversion factor between characteristic energy and temperature. Temperature can be seen as an alternative scale for measuring that characteristic energy. The Joule is equivalent to Kg/m^2/sec^2, so for the Kelvin unit we had to add the three green arrows pointing from Kg, metres and seconds which are the SI units defining energy.

Furthermore, the definitions of the supplementary units, radian and steradian, are gratuitous. These definitions properly belong in the province of mathematics and there is no need to include them in a system of physical units. So what are we left with? How many dimensions can the SI system be reduced to? Looking again at the SI relations diagram, let us see which units DO NOT depend on others, that is, which are those having only outgoing arrows and no incoming arrows. We see that in the SI system, only the units seconds and kilogram are independent. So, this means that the SI system can be reduced to no more than two dimensions, without loosing any of its physical significance of all the involved units. But we know that there are a lot of other combinations that can lead to the same number of fundamental dimensions, and that kilogram and seconds might not be the most physically meaningful independent dimensions. Strictly speaking only Space and Time are fundamental dimensions .... so what

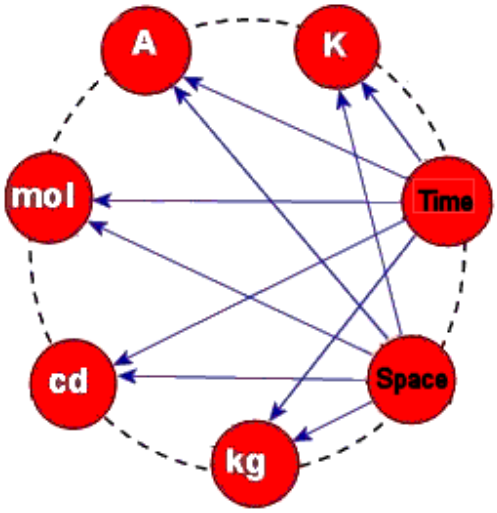
are the rest? Just patches in physics covering our ignorance, our inability to accept that hard particles, or worse, point particles, with the fictitious Kg dimension, do not exist.

Present maintenance and transitions in the metric SI system of units



Even though such transitions are hard to implement and the inertia of the SI system of units is huge, a few transitions towards better definitions are successfully finding their way into the present SI metric system, so all is not lost. On such idea is the transition towards definitions based solely on the unit of time, taking the atomic clock second as reference and adopted exact values of certain constants. A notable step was taken in 1983 when the meter was defined by specifying that the standard speed of light be exactly 299792458 meters per second. In 1990 the BIPM established its voltage standard by specifying that Josephson' s constant be exactly 483597.9 billion cycles per second per volt. Although this standard is already in use the official definition for voltage has not yet been changed to be consistent with the method of measurement, leaving the voltage and related quantities in a state of patchwork. In 1999 the CGPM called for a redefinition of the kilogram along the lines of the 1990 standards, and the following year two leading members, Mohr and Taylor, supplied the following proposed redefinition: *The kilogram is the mass of a body at rest whose equivalent energy equals the energy of a collection of photons whose frequencies sum to 135 639 274×1042 Hz.* Mohr and Taylor also suggested that the larger Planck' s constant be made exactly equal to 2997924582/135 639 274 × 10-42 joule second. This value follows from their suggested definition of the kilogram, which is the most problematic to define mainly due to the lack of knowledge about ‘matter’.

Introducing the ST system of units - The Rosetta stone of a new physics



Here we will go a step further over the conventional SI dimensions and its patch work and will further reduce all scientific units into the real fundamental dimensions, namely Space (metres) and Time (seconds). As shown in this diagram, all SI units have been re-mapped onto the two fundamental units. We can therefore re-map the rest of the SI-derived units onto our ST system as well. At first it seemed an impossible mission, but as I went through all equations currently known, I found out that we' ve got a lot of different branches of science that are equivalent to each other. In this paper, space takes a slightly different meaning than the conventional three dimensional property of the universe in which matter can be located, and in fact is no longer restricted to three dimensions. One starts off with the dimensions of distance as the one dimensional unit of Space S, area becomes the 2 dimensional unit of space S^2, volume becomes the 3 dimensional unit of space S^3, speed is distance/time which becomes S/T. To move onward to define energy related units, I make use of the knowledge presented in the standing wave EM structure of matter [4] , which enabled me to continue the conversion work on parameters in all the other fields. Without a proper understanding of matter, any new system of units will be no better than the present SI system. The core of the ST system is based on the recognition of mass as a three dimensional form of electromagnetic energy. Surprisingly, once you have the ST units for mass, one is able to put up a full self-coherent table of ST dimension conversions for all known physical quantities, while eliminating all the non-sense webbing of the conventional SI system.

Such a system sets up a much stronger foundation for a new science, and helps you visualise how scientific parameters relate to each other through space and time. Once you grasp the whole concept, you will easily understand why RC is a time constant, why mass is a volume of energy, why $f=1/[2\pi\sqrt{(LC)}]$, and how all 'mechanical' & Newton's laws are intimately related to electrical laws. Use this table to dimensionally check all your physics equations, and compile new ones yourself! Some will look really weird, but some will definitely make a lot of sense. Note that the SI system is not less weird,

for example Resistance in SI is measured in $m^2kg/sec^3/Amp^2$ (we call this Ohms). In most cases, the units will look simpler when converted to ST, in this case resistance will be measured in sec^2/m^3, though you cannot call this Ohms since you will require a dimensionless conversion factor. You will be able for the first time to clearly see that the ratio of Energy to mass is velocity squared ($E/m = c^2$). Using the following table, it might also be an interesting exercise to relate different parameters through integrations or differentiations of their ST parameters. You may differentiate or integrate either with respect to S or T. This is basically the Rosetta stone translating between classical theory and the new unified system of units which I am hereby introducing.

Parameter	*Units*	*SI units*	*ST Dimensions*
Distance S	metres	m	S
Area A	metres square	m^2	S^2
Volume V	metres cubed	m^3	S^3
Time t	seconds	s	T
Speed/ Velocity u	metres/sec	m/s	ST^{-1}
Acceleration a	$metres/sec^2$	m/s^2	ST^{-2}
Force/ Drag F	Newtons	kgm/s^2	TS^{-2}
Surface Tension γ	Newton per meter	kg/s^2	TS^{-3}
Spring constant κ	Newton per meter	kg/s^2	TS^{-3}
Energy/ Work E	Joules	kgm^2/s^2	TS^{-1}
Power P	Watts or J/sec	m^2 kg/s^3	S^{-1}
Density ρ	kg/m^3	kg/m^3	T^3 S^{-6}
Mass m	Kilogram	kg	T^3 S^{-3}
Momentum p	kg metres/sec	kgm/s	T^2 S^{-2}
Impulse J	Newton Seconds	kg m/s	T^2 S^{-2}
Moment *m*	Newton metres	m^2 kg/sec^2	T S^{-1}

Torque τ	Foot Pounds or Nm	m^2 kg/sec^2	T S^{-1}
Angular Momentum L	kg m^2/s	kg m^2/s	T^2 S^{-1}
Inertia *I*	kg m^2	kgm^2	T^3 S^{-1}
Angular velocity/frequency ω	Radians/sec	rad/sec	T^{-1}
Pressure/Stress P	Pascal or N/m^2	kg/m/sec^2	T S^{-4}
Specific heat Capacity c	J/kg/K	m^2/sec^2/K	S^3 T^{-3}
Specific Entropy	J/kg/K	m^2/sec^2/K	S^3 T^{-3}
Resistance R	Ohms	m^2kg/sec^3/Amp^2	T^2 S^{-3}
Impedance Z	Ohms	m^2kg/sec^3/Amp^2	T^2 S^{-3}
Conductance S	Siemens or Amp/Volts	sec^3 Amp^2/kg/m^2	S^3 T^{-2}
Capacitance C	Farads	sec^4Amp^2/kg/m^2	S^3 T^{-1}
Inductance L	Henry	m^2 kg/sec^2/Amp^2	T^3 S^{-3}
Current I	Amps	Amp	S T^{-1}
Electric charge q	Coulomb	Amp sec	S
Electric flux ϕ	Vm	Volt metre	T S^{-1}
Magnetic charge q_m	Am	Amp metre	S^2 T^{-1}
Magnetic flux ϕ	Weber or Volts Sec	m^2 kg/sec^2/Amp	T^2 S^{-2}
Magnetic flux density B	Tesla /gauss/ Wb/m^2	kg/sec^2/Amp	T^2 S^{-4}
Magnetic reluctance R	R	Amp^2 sec^2/kg/m^2	S^3 T^{-3}
Electric flux density	Jm^2	kg m^4/sec^2	ST
Electric field strength E	N/C or V/m	m kg/sec^3/Amp	T S^{-3}
Magnetic field strength H	Oersted or Amp-turn/m	Amp/m	T^{-1}
Poynting vector S	Joule/s/m^2	kg/sec^3	S^{-3}
Frequency f	Hertz	sec^{-1}	T^{-1}
Wavelength λ	metres	m	S

Wavenumber $\tilde{\nu}$	reciprocal centimetre	m^{-1}	S^{-1}
Voltage EMF V	Volts	m^2 kg/sec^3/Amp	T S^{-2}
Magnetic/Vector potential MMF	MMF	kg/sec/Amp	T^2 S^{-3}
Permittivity ε	Farad per metre	sec^4 Amp^2 /kg/m^3	S^2 T^{-1}
Permeability μ	Henry per metre	kg m/sec^2/Amp^2	T^3 S^{-4}
Resistivity ρ	Ohm metres	m^3kg/sec^3/Amp^2	T^2 S^{-2}
Temperature T	° Kelvin	K	T S^{-1}
Enthalpy H	Joules	kgm^2/s^2	T S^{-1}
Conductivity σ	Siemens per metre	Sec^3Amp^2 /kg/m^3	S^2 T^{-2}
Thermal Conductivity	W/m/° K	kg m /sec^3/K	$S^{-1}T^{-1}$
Thermal Resistivity	° K m/W	sec^3K/kg/m	ST
Thermal Conductance	W/° K	kg m^2 /sec^3/K	T^{-1}
Thermal Resistance	° K/W	sec^3K/kg/m^2	T
Energy density	J/m^3	kg/m/sec^2	T S^{-4}
Ion mobility μ	$Metre^2$/ Volts seconds	Amp sec^2/kg	S^4 T^{-2}
Radioactive dose Sv	Sievert or J/kg	m^2/s^2	S^2 T^{-2}
Dynamic Viscosity	Pa sec or Poise	kg/m/s	T^2 S^{-4}
Kinematic Viscosity	Stoke	cm^2/sec	S^2 T^{-1}
Fluidity	1/Pascal second	m sec/kg	S^4 T^{-2}
Effective radiated power ERP	Watts/m^2	kg/m/sec^3	S^{-3}
Luminance	Nit	Candela/m^2	S^{-3}
Radiant Flux	Watts	kg.m/sec^3	S^{-1}
Luminous Intensity	Candela	Candela	S^{-1}
Gravitational Constant G	Nm^2/kg^2	$m^3/kg/s^2$	S^6 T^{-5}
Planck Constant h	Joules second	kg m^2/sec	T^2 S^{-1}

Coefficient of viscosity η	n	kg/m/s	$T^2 S^{-4}$
Young' s Modulus of elasticity	N/m^2	$kg/m/s^2$	$T S^{-4}$
Electron Volt eV	1eV	$kg\ m^2/sec^2$	$T S^{-1}$
Hubble constant H_o	H	Km/sec/Parsec	T^{-1}
Stefan' s Constant σ	$W/m^2/K^4$	$kg/s^3/m/K^4$	$S T^{-4}$
Strain ε	-	-	$S^0 T^0$
Refractive index η	-	-	$S^0 T^0$
Angular position *rad*	Radians	m/m	$S^0 T^0$
Boltzmann constant k	Erg or Joule/Kelvin	$kg.m^2/s^2/K$	$S^0 T^0$
Molar gas constant R	J/mol/Kelvin	$kg.m^2/s^2/K$	$S^0 T^0$
Mole n	Mol	kg/kg	$S^0 T^0$
Fine Structure constant α	-	-	$S^0 T^0$
Entropy S	Joule/Kelvin	$kg.m^2/s^2/K$	$S^0 T^0$
Reynolds Number Re	-	-	$S^0 T^0$
Newton Power Number N_p	-	-	$S^0 T^0$

Here is a simple example showing you how to validate any equation into ST dimensions:

Equation to test : Casimir force $F= hcA/d^4$

First convert each parameter to its ST dimensions from the table:

F= force= $T S^{-2}$

c= speed of light= $S T^{-1}$

h= Planck' s constant = $T S^{-1}$

A= area = S^2

d= length = S

So the equation becomes:

$T S^{-2} = T^2 S^{-1} * S T^{-1} * S^2 * S^{-4} = T^{(2-1)} S^{(-1+1+2-4)}$

$T S^{-2} = T S^{-2}$... dimensionally correct.

Science tail chasing

... the mechanism that guarantees getting to nowhere

The space-time conversion table introduced here is a great leap towards unification, and makes obvious the redundancy of the conventional scientific laws just by a general approach to its foundations - its measuring system. If the measuring system of science is full of redundant units, then, it surely means that much of the laws based on those units are redundant or circular.

The notion of redundancy of the scientific laws has been well expressed by the late Professor JL Synge and made public in the series of lectures at the Dublin Institute of Advanced Studies delivered in 1949. Quoting Synge in the following passage:

..... Thought is difficult and painful. The difficulties and pain are due to confusion. From time to time, with enormous intellectual effect, someone creates a little order - a small spot of light in the dark sea of confusion. At first we are all dazzled by the light because we are used to living in the darkness. But when we regain our senses and examine the light we find it comes from a farthing candle - the candle of common sense. To change the metaphor, the sages chase their own tails through the ages. A little child says 'Gentlemen, you are chasing your own tails.' The sages gradually lose their angular momentum, and, glancing over their shoulders, see what they are pursuing. But most of them cannot believe what they see, and the tail chasing does not die out until a generation has passed.....

Forty years ago Schroedinger wrote *(in his article recently reprinted in the Special Issue 1991 of Scientific American, "Science in the 20th century", p.16)*:

"Fifty years ago science seemed on the road to a clear-cut answer to the ancient question which is the title of this article [Our Conception of Matter]. It looked as if matter would be reduced at last to its ultimate building blocks - to certain sub microscopic but nevertheless tangible and measurable particles. But it proved to be less simple than that. Today a physicist no longer can distinguish significantly between matter and something else. We no longer contrast matter with forces or fields of force as different entities; we know now that these concepts must be merged... . We have to admit that our conception of material reality today is more wavering and uncertain than it has been for a long time. ... Physics stands at a grave crisis of ideas. In the face of this crisis, many maintain that no objective picture of reality is possible. However, the optimists among us (of whom I consider myself one) look upon this view as a philosophical extravagance born of despair. We hope that the present fluctuations of thinking are only indications of an upheaval of old beliefs which in the end will lead to something better than the mess of formulas that today surrounds our subject."

It is astonishing, but also frustrating, to see how topical are the remarks still today. Weinberg, Feynman, Wolff and certainly other well known science explorers, have more than once drawn our attention to the same inadequate foundations for natural laws.

In the ST system together with the description of the electromagnetic standing wave model of the atom described in the particle section [4], I have investigated the head and tail of science. As you should have followed, the units candela, kg, mole, Ampere and Kelvin are the teeth holding tight the tail of science, with the kg unit being the main problem. Our present mainstream science books and lectures are the force driving the circular motion of the tail chasing. The ST conversion table stops this vicious loop in quite an abrupt way and attempts to put back some order.

What looks so unconventional in the ST unification table is the fact that matter is a 3D version of energy, and that energy or mass in its 1D form, is the inverse of velocity. Once cleared these two weird links, it becomes immediately clear that the ST table should be the real fundamental measuring system of science, and what we presently regard as scientific anomalies, will be found to be direct predictions from this system.

Understanding the ST system of units does not require any advanced knowledge, and can be introduced at an early level in scientific education. Let' s start from what everybody should know: 1D space dimension S is a unit of length, and 1D time dimension T is a unit of time. It also follows that the unit of velocity should be S/T and that of acceleration is its differentiation with respect to time, that is ST^{-2}. Also the two dimensional form of space is not 2S but S^2. Now, anybody who tried out known equations and worked out their dimensions according to the ST table, would agree, that the rest of the table is to say the least SELF COHERENT, but the link between length, time, velocity or acceleration to energy and all the rest of the parameters may not be obvious. For this analysis I' ve used the quite elementary yet powerful equations of motion given by Jeans J, from ' An introduction to the Kinetic theory of gases' , Cambridge Univ press 1960, and will try to derive the mass unit in its one dimensional form, in terms of length and time.

We will here consider the impact of two elastic bodies masses m_1, m_2 in a simple 1 dimensional space. The velocities before impact are u_1, u_2 respectively. The velocities after impact are v_1, v_2. Since we will consider mass in one dimension (a point moving along a line), we will assume movement is taking place only in the x-direction, to the left and right. You can choose any x-direction of motion to be positive velocity and the other will be the negative.

Energy is Inverse velocity (T/S)

We' ll here consider a totally isolated system, in which we know that total system momentum is conserved. The momentum lost by one object is equal to the momentum gained by another object. For collisions occurring in an isolated systems, there are no exceptions to this law.
momentum before impact = momentum after impact

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ .....(1)
Looked at hierarchically, velocity may be viewed as existing at two levels, a high order velocity V averaged over equal intervals of time before and after impact and defined by the equation:
$V = 1/2\ (u_1 + v_1) = 1/2\ (u_2 + v_2)$ .....(2)
and low order velocities obtained by subtracting the high order velocity, V, from the individual velocities, u_1, u_2, v_1, v_2:

$\mu_1 = u_1 - V$ .....(3)

$\mu_2 = u_2 - V$ .....(4)

$\upsilon_1 = v_1 - V$ .....(5)

$\upsilon_2 = v_2 - V$ .....(6)

From equation (2):

$\mu_1 = -\upsilon_1$ .....(7)

$\upsilon_2 = -\mu_2$ .....(8)

The individual velocities can now be seen as the sum of the low order, ' within batch' velocities $\mu_1,\mu_1,\upsilon_1,\upsilon_1$ and the higher order, ' between batch' velocity V. Now from equations (3) to (8):

$u_1/\mu_1 + u_2/(-\mu_2) = v_1/(-\upsilon_1) + v_2/\upsilon_2$ .....(9)

Substituting from equations (7) & (8) and re-arranging:

$(1/\mu_1)\, u_1 + (1/\upsilon_1)\, u_2 = (1/\mu_1)\, v_1 + (1/\upsilon_1)\, v_2$ .....(10)

Equation (10) is isomorphic to the equation of conservation of momentum, equation(1):

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ .....(1)

The 1D masses m_1 and m_2 have been replaced by the reciprocal internal 1D velocities $(1/\mu_1)$ and $(1/\upsilon_1)$. Numerically, these reciprocal terms will differ from the mass values in Kg units, for the reason that the kg SI unit is an arbitrary unit defined in 3D, whereas the reciprocal terms are in seconds per metre units. This implies that the 1D form of mass has dimensions $(S/T)^{-1}$ or T/S. The concept of 3D mass can thus be replaced by the concept of reciprocal 3D internal velocity both at the macro and the micro scale, leading to a 3D mass dimension of T^3/S^3. The concepts of stepping up dimensions can be easily understood when one considers any space time parameter to be a ratio of two spatial dimensions. We can easily understand that 2D space is S^2, 3D space is S^3. This rule applies to the spatial time dimension as well as to combination units as velocity, and mass. For example, the nth dimensional unit of a space time parameter S^xT^y will be equal to $S^{nx}T^{ny}$. Thus units for different dimensions of mass will be of the

form $T^{n1}S^{-n1}$ all being the same entity in different dimensions. The Newtonian kg which defines the quantity of matter is just one of these entities for the condition n=3, giving the 3D version of energy, which is mass having space time dimension T^3/S^3.

From the kinetic energy equation $E=1/2mv^2$, or $E=mc^2$ we get $E= T^3S^{-3}*S^2T^{-2} = T/S$, re-confirming Einstein's statement : ' It followed from the special theory of relativity that mass and energy are both but different manifestations of the same thing -- a somewhat unfamiliar conception for the average mind' . One could easily replace the kg by Joules[3] by simply introducing a conversion dimensionless factor between the two units. It is quite impressive, that we arrived to the same conclusion, without reference to Einstein's equations or special theory of relativity. All we did was in fact equating velocities in the elementary equation of conservation of momentum. Indeed, the equation $E=mc^2$ even though it's mathematically correct, is not the best way to show mass to energy equivalence, and the ST system clearly indicates that the equivalence relation is given by $m=kE^3$. From the above we have proved that energy is a one dimensional form of mass, and that it has dimensions T/S, which are those of inverse velocity! The consequences of this are very interesting, especially in zero point energy research. Simply stated, it means, that if one creates an area in which the background ZPE is shadowed, thus reducing the ratio T/S, than, the inverse ratio S/T, known as the speed of light would increase. The inverse relation between background energy (T/S) and speed of light (S/T) is crystal clear. In fact, this direct prediction of the ST system has been mathematically derived and known as the Scharnhorst effect, which is a hypothetical phenomenon in which the speed of light is slightly greater between two closely-spaced conducting plates than it is in a normal vacuum. It was predicted by Klaus Scharnhorst of the Humboldt University of Berlin, Germany, and Gabriel Barton of the University of Sussex in Brighton, England.

Replacing SI with ST units

Other ST units can be easily derived using our present knowledge as follows:

Planck constant $h= E/f = T/S * T = T^2/S$
From $E=mc^2$, $m = E/c^2 = T/S * (T/S)^2 = T^3S^{-3}$
For momentum = $mv = T^3/S^3*S/T = T^2S^{-2}$
For angular momentum $L = mvr = T^3/S^3*S/T*S = T^2/S$ ... same as Planck constant

For Moment of Inertia $I=L/w = T^2/S * T = T^3/S$

From F=ma, we get Force= $T^3S^{-3}*S\ T^{-2}= TS^{-2}$

Electromotive force (Voltage) = TS^{-2}

For power, P=Fv, we get $P=TS^{-2}*S/T = S^{-1}$

For current, $I= P/V = S^{-1}/(TS^{-2}) = S/T$

For resistance, $R = V/I = TS^{-2}/ (S/T) = T^2S^{-3}$

For mass flow rate $mdot = dm/dt = (T^3S^{-3})/ T = T^2S^{-3}$

For Pressure = $F/A = TS^{-2}*S^{-2} = TS^{-4}$

Frequency = $v/\lambda= S/T*S^{-1}= T^{-1}$

Temperature = E/k = T/S * 1 = T/S

For charge q=It = S/T * T = S

For Capacitance $C = Q/V = S/(TS^{-2}) = S^3T^{-1}$

From V=L(dI/dt), Inductance $L= TS^{-2} * T * T/S = T^3/S^3$...same as mass!

Interesting things to note:

Newtons law: F=ma=m(dv/dt)

Comparing with V= L(dI/dt), where voltage has the same dimensions of force, Inductance the same dimensions of mass and current same dimensions of velocity. It is clear that the equations are actually the same, and that V=L(dI/dt) is actually Newtons law of motion.

Power = Force * Velocity

Comparing with Power = V*I, where voltage has the same dimensions as force, and current has dimensions of velocity. Again it' s the same equation.

Kinetic energy = $1/2mv^2$

Energy stored in inductor = $1/2LI^2$, where L has dimensions of mass and I of velocity.

Work (Energy) = Force * distance

Compare with Energy = Vq, where voltage has dimensions of force, and charge dimensions of length.

Now compare the time constant of a simple pendulum given by $(L/g)^{1/2}$

If we replace pendulum length L by charge (dimension S), and gravitational acceleration by (a=dv/dt=dI/dt) current acceleration, we have:

Time constant = $(qT/I)^{1/2}$... but q=CV and R=V/I so:

$T=\sqrt{(RCT)}$

$\sqrt{(T)}=\sqrt{(RC)}$

T=RC... time constant for RC circuit...derived from mechanical pendulum

---

From Force = Rate of change of momentum = m (dv/dt)

Compare to EMF = L (dI/dt)... means that product LI is in fact the momentum of the electrical system.

Energy = Force * distance

Energy = ma * d

E = mvd/t .... but mvd is momentum*distance which has the same dimensions as Energy*time same as the well known quantum of action : Planck constant h, so:

E = h/t .... 1/t= frequency, thus

E = hf

From Thrust = Velocity * Mass flow rate

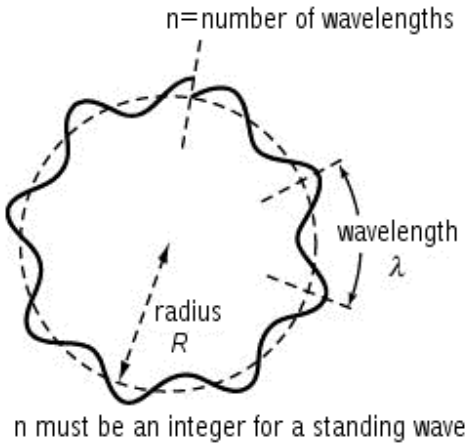
Replacing Thrust (force) by voltage, velocity by current, and mass flow rate by resistance, we get Ohms Law:

V = IR .... so, Ohms law is nothing more than the thrust equation and shows that a resistor controls

MASS flow rate NOT charge flow rate. This clearly shows one of the major misconceptions of the present electrical theory, in which it is assumed that a resistor has an effect on charges, which is clearly not the case. Resistance is in fact acting on the MASS of the flowing electrons and not on their charge.

A note on h and h-bar

Arguments showing why h-bar (Dirac's constant $\hbar$) should NOT be used to derive Planck units. Unfortunately, a lot of scientific literature state Planck units expressed in terms of $\hbar$ (=h/(2π)) known as Dirac's constant, or the reduced Planck's constant. THIS IS INCORRECT. The 2π factor in fact leads to totally different (and wrong) numeric values for Planck units, than the original values set out by Planck himself. The 2π factor is a gratuitous addition, coming from the failure to address the Hydrogen atom's stable orbits as defined by the orbital path length being an exact multiple of the orbital matter (standing wave) wavelength.



The statement that the orbital electron's angular momentum is quantized as in:

m.v.R = n.(h/2π) = n.$\hbar$ for integer values of n, is just a mis-statement of
2π.R = n.h/(mv) .... which when substituting for h=E/f, v=f.λ, and m=E/(f.λ)^2... we get:

2π.R = n.λ ..... which means that the 2π factor has nothing to do with h as such, and that the orbital path is just an integer number of wavelengths as described by Louis De Broglie! (see diagram above). Dirac's

$\hbar$ was thus defined due to lack of understanding of the wave structure of matter and its use should be discouraged.

Some physicists still prefer to use h-bar, not for any scientific reason, but mostly for the sake of simplicity in their calculations. Their main point of view about the argument is that preferring h to h-bar amounts to preferring a circle whose circumference is 1 to a circle whose radius is 1, and that setting h equal to 1 instead of hbar = 1 amounts to working with a circle of unit circumference instead of unit radius.

Planck length and time values based on Planck constant h

$$L_P \equiv \sqrt{\frac{G\hbar}{c^3}} = 4.05096 \times 10^{-35}\ \text{m} \qquad t_P \equiv \sqrt{\frac{G\hbar}{c^5}} = 1.35125 \times 10^{-43}\ \text{s}$$

Planck length and time values based on Dirac's constant $\hbar$

$$L_P \equiv \sqrt{\frac{G\hbar}{c^3}} = 1.6161 \times 10^{-35}\ \text{m} \qquad t_P \equiv \sqrt{\frac{G\hbar}{c^5}} = 5.39072 \times 10^{-44}\ \text{s}$$

Though this may look simple and true when one views the problem in Euclidean (plane) geometry, one has to keep in mind that the Euclidean geometry is only an approximation to the properties of physical space, and Einstein showed that space gets elliptically curved (non-Euclidian) in the regions where matter is present. The shortest path in a non-Euclidean space is a curved path, and though it does not seem logical, the straight line joining two points may be a longer way to go than the curved path between the same two points. The matter wave (De Broglie wave) shown above is not being forced to loop round the circle, it is just following the easiest and shortest path in its non-Euclidean space. Planck's work was not about electromagnetic waves travelling in free space, in which Euclidean geometry is a good approximation, but on the interaction of such waves with matter. Matter plays an important role in all Planck's work, and thus, a non-Euclidian space has to be preferred for all Planck units, and so, a circumference value must be used in favour of a radius value as the shortest length, whether or not normalised to unity.

For this reason, in all my work, I've chosen to use the original Planck units which are expressed in terms of h, Planck constant. The following derived values in fact are in perfect agreement with Planck's values. Using Planck values based on h for S (L_p) and T (t_p), and simply plugging their value in the ST

system of units, one can in fact DERIVE the numeric values for constants such as free space impedance, Von Klitzing constant, Quantum conductance, Josephson constant and more (see next page). If one tries to do the same thing using the numerical values for Planck's length and time based on ħbar, all derived values for the mentioned constants will be wrong!

An important note about PHOTONS

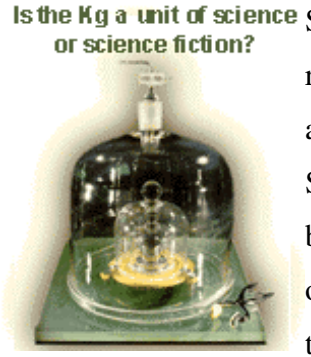
Unfortunately, today, the photon is treated as a mass less particle which flies from source to target, and whose presence is justified by the momentum exchange. This is wrong, and I shall directly quote Max Planck, the originator of light quanta regarding this particular issue. In his recorded remarks which took place during 1909 in an audience at Einstein's talk we see him resisting Einstein's hypothesis of atomistic light quanta propagation through space. *"If Einstein were correct, how could one account for interference when the length over which one detected interference was many thousands of wavelengths? How could a quantum of light interfere with itself over such great distances if it were a point object? Instead of quantized electromagnetic fields, one should attempt to transfer the whole problem of the quantum theory to the area of interaction between matter and radiation energy"*. **That is, only the exchange of energy at the point of interaction between the source/target matter and the classical electromagnetic field is quantized. The exchange takes place in units of Planck's constant times the frequency, but the fields remain *continuous and classical.*** Quantization can be considered like one trying to measure a time varying analogue signal with an analogue to digital converter, or with a digital voltmeter, the quanta is equivalent to the least significant digit, but that doesn't mean that the signal is varying in steps. So we have quantized or analogue to digital process interactions taking place between continuous electromagnetic fields and matter. This approach to quantum theory handles very well all of the problems of quantum optics including Einstein's photoelectric effect, without the requirement of the actual matter-like photon flying around. Note that the quite misleading term *photon* was not introduced by Planck, but by a chemist, Gilbert Lewis in 1926. Unfortunately with Einstein's support, the term photon is still misused in most scientific literature to described a fundamental and yet undetected mass less particle that carries the quanta of electromagnetic energy and travels at the speed of light! This is all wrong, as electromagnetic energy does not need a particle to propagate in space. The same Einstein tells us that nothing, can be accelerated to the speed of light, except of course EM waves.

It is important that one understands, that matter-like photons do not fly from source to target, in fact no photon has ever been detected during its alleged travel. We never experience a photon, but only its effect at source and target. Propagation is a property of electromagnetic radiation, and photons are the quantized effect of the momentum released at the interface between either source matter or target matter and the electromagnetic wave. We see light at the source and at the target matter, but we never see light travelling its path. Literally speaking, photons are only what and where you experience their effect. I believe that as Willis E. Lamb stated, the word photon should be stricken from the dictionary since there is no need for it. The photon is an *effect* and not a thing. To describe the entity that is travelling from source to target, it is enough that we use the term *wave*.

The Space time free space constants & Fine structure constant

In the ST system of units table ALL physics constants and parameters have space and time in common. Space and time are inter-related, in that dimension S can be differentiated (observed) with respect to dimension T, and vice versa, depending which dimension is taken as reference by the observer. The whole universe can be explained in terms of these two interacting dimensions S and T which have unique values. Note that in this unification theory, unlike what we perceive as human beings, both Space and time have the same number of dimensions, and are both SPATIAL. In such a theory a volume of time T^3 with respect to S for an observer in the spatial dimension S, has the same properties of a volume of space S^3 with respect to T for an observer in the spatial dimension T. This may sound strange for most of us, because we are used to view the universe with respect to time, and perceive the spatial dimension T only as our temporal dimension. The condition for the universe to exist is that we have TWO such spatial dimensions interacting together. As we say ' It takes two to tango' .

Natural Units (also known as Planck or God' s units)



So, as we have shown in the conversion table, both mass and current can be reduced to space time equivalents with no requirement for any hard particle unit as the kg. However, one cannot expect to put natural values for S and T in the ST equivalent of mass and get a result in kg. The kg unit is not a natural unit, but a fictitious man made unit. It is in fact the last SI base unit to be still based on a prototype, which despite all preservation efforts is still loosing mass over the years. In 1889, the 1st CGPM sanctioned the international prototype of the kilogram, made of platinum-iridium, and declared: 'This prototype shall henceforth be considered to be the unit of mass'. The picture at the right shows the platinum-iridium international prototype, as kept at the International Bureau of Weights and Measures under conditions specified by the 1st CGPM in 1889. This is a worrying fact for NIST, and in fact, we found that resolution 7 of the 21st General Conference on Weight and Measures, had in fact called for a redefinition of the kilogram, and offered to redefine the kg as *The mass of a body at rest whose equivalent energy equals the energy of a collection of photons whose frequencies sum to 135639274E42 Hz.* Such redefinition has not yet taken place. In fact all physical units such as Candela, Joules, heat capacity, etc... where set-up to different standards for historical reasons.

During his lifetime, Planck had derived a set of standard units. As opposed to the SI standard, these units are based on the natural constants : G (gravitational constant), h Planck constant, c Speed of light, k Boltzmann constant and permittivity. They are based on universal constants and thus known as Planck' s natural units. The two basic Planck units can be easily derived from my ST conversion table as follows:

$h = [k]T^2/S$

$c = S/T$

$G = [1/k]S^6/T^5$

k = kg conversion factor (read following paragraph)

So, $h = [k]T/c$ and $G = Tc^6/[k]$

$Gh = T^2c^5$

$T = \sqrt{(Gh/c^5)}$

Substituting S=Tc, we get:

$S = \sqrt{(Gh/c^3)}$

Natural Length (S)	$\sqrt{(Gh/c^3)}$	= 4.051319933E-35 m
Natural time (T)	$\sqrt{(Gh/c^5)}$	= 1.351374868E-43 s

Knowing the natural values for S and T we can now easily define a conversion ratio between the ST units and the man-made unit we call the kg. This constant works out to be equal to $(hc^7/G)^{1/2}$ or k_Q=1.469944166E18 and is dimensionless. So :

Mass (kg) = 1.469944166E18 (T^3/S^3) = k_Q (T^3/S^3)

This dimensionless factor has therefore to be applied to all those units quoting the kg SI unit, for example, for Force (Newtons) we know that its SI units are $kg.m/s^2$ so to convert the ST values into Newtons, we have to apply the same conversion equation that we use for the kg.

The above conversion constant will also be applied to energy. Although the Kelvin unit in ST has the same dimensions as energy, the conversion constant for Kelvin is not the same due to the different way by which the Kelvin has been defined in SI. We know that 11604.499 Kelvin is equivalent to 1eV, which is equal to 1.602E-19 Joules. One Kelvin is equal to 1.3806E-23 Joules, where 1.3806E-23 is Boltzmann constant k. It follows that the conversion ratio from Space Time parameters to Kelvin units is given by:

Kelvin (K) = $[k_Q/k](T/S)$ .... k=Boltzmann constant

This factor has therefore to be applied to all those units quoting the Kelvin SI unit, for example, for Thermal conductivity we know that its SI units are $kg.m/s^3/K$ so to convert the ST values into SI units, we have to apply factor k_Q for the kg unit and $[k_Q/k]^{-1}$ for the $Kelvin^{-1}$ unit.

The ampere is the next redundant unit introduced in the SI due to lack of knowledge of the EM nature of matter. This unit is defined as that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2 x 10-7 Newton per meter of length. In my ST conversion, current simply translates to the much neater definition of velocity of EM energy: S/T.

Now Natural Current= electron charge per unit time = $q/\sqrt{(hG/c^5)} = j*(S/T)$
Dimensionless conversion factor j= 3.954702562E15. So :

Current (Amps) = 3.954702562E15 (S/T) = j (S/T)

Derived Planck Units

Using the above calculated unit conversion factors, and the ST conversion table, we can derive many other natural units and constants.

For Natural length we have: Length = S = 4.05132E-35m = Planck' s length, sometimes also quoted as $S/\sqrt{(2\pi)}$ = 1.61624E-35m

For Natural time we have: Time = T = 1.35137E-43 sec = Planck' s time, sometimes also quoted as $T/\sqrt{(2\pi)}$ = 5.391E-44 sec

For Natural speed we have: Speed = S/T = 4.05132E-35/1.35137E-43 = 299.79E6m/s = speed of light

For Planck constant or Natural Angular Momentum we have: $h = k_Q (T^2/S)$

$h= 1.469944166E18 * (1.351374868E-43^2/ 4.051319933E-35) = 6.626E-34$ kg m^2/sec

For Gravitational constant G we have $G = (1/k_Q)(S^6/T^5)$ works out to 6.672E-11 $m^3/sec^2/kg$
This time we used $1/k_Q$ since we have kg^{-1} in the SI units of G.

Now from units of energy kg m^2/s^2, we know that the same constant k_Q has to be applied to energy equations. So for energy we have:

$E= k_Q (T/S) = 1.469944166E18/ 299.792E6 = 4.9032E9$ Joules = Planck energy.

For Natural mass we have: $Mass = k_Q(T^3/S^3)$ works out to = 5.456E-8 kg = Planck mass, sometimes also quoted as $M/\sqrt{(2\pi)} = 2.17645E-8$ kg

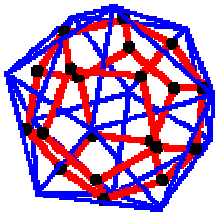
For Natural Power we have: $Power = k_Q(1/S) = 1.469944166E18/4.051319933E-35 = 3.6283E52$ Watts = Planck Power

For Natural charge we have: Charge = j (S) = 3.954702562E15 *4.051319933E-35 = 1.602E-19C = electron charge

For Natural current we have: Current = j (S/T) = 3.954702562E15 * c = 1.18559E24 Amps = Planck current

For Natural Temperature we have : $Temperature = [k_Q/k](T/S) = (1.469944166E18/1.380662E-23)(1/c)$ = 3.551344E32 Kelvin
A comprehensive list of numeric values for all known physical units has been worked out on the next page.

The FINE STRUCTURE CONSTANT ENIGMA



So far all parameters get the exact known natural values by using the derived constants k (for kg unit) and j (for Amp unit). Now for the tricky part: The free space constants. In the SI system of units we note a few units like permittivity, permeability, impedance, conductance, etc... that for some weird reason have the kg as part of their SI units. For example permittivity is defined as $Amp^2.sec^4/kg/m^3$, Impedance = $m^2kg/sec^3/Amp^2$. Since during the development of the SI system, nobody ever wondered that the kg unit was actually representing a standing wave electromagnetic structure, we see that this unit has been applied also to units which, although represent a volume of 3D energy (T^3/S^3), are NOT standing waves. The space time dimensions for a 3D outgoing or incoming travelling volume of energy is the same as that of a 3D standing wave, but the conversion constant for the kg in these two cases is different.

Let us take an example to make everything clear:

We know that Free space Impedance = 376.73 Ohms ... Radio engineers know this very well
Now the ST equivalent for Impedance = $T^2\ S^{-3}$ and its SI units are: $m^2kg/sec^3/Amp^2$

To calculate the natural Impedance, we first put in the natural values for S and T, then multiply by the kg conversion factor k_Q, and divide by the square of the Amp conversion factor j.

We get a value for natural Impedance = 25812.807 Ohms, also known as Von Klitzing constant R_k.

In 1985, a German physicist Von Klitzing was awarded the Nobel Prize for Physics for his discovery that under appropriate conditions the resistance offered by an electrical conductor is quantized; that is, it

varies by discrete steps rather than smoothly and continuously.

And here we have got the interesting discrepancy between Natural & Free space impedance. This is no mathematical mistake, as we know that both the free space impedance and the natural impedance have been experimentally confirmed under different conditions. This discrepancy comes from the fact that natural values apply to a standing wave 3D energy structures, whilst free space impedance applies to travelling waves as we know.

Working out the ratio Z_0/Z_{NAT} = 376.7303/25812.807 = 1/68.518 = 2/137.036

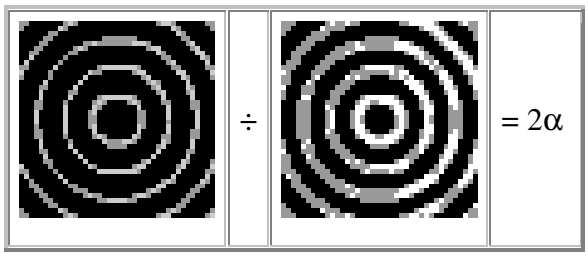
The ratio of these two impedances is given exactly by:

Free space $Z_0 = Z_{NAT} * 2\alpha$

Where α is the well known Fine structure constant, given by = $\alpha = \mu_0.c.e^2/(2h) = 1/137.036$

From this we deduce that although the SI system does not recognise two types of kg units (having the same dimensions $T^3 S^{-3}$) we have a relation between the kg used in ' matter' equations and the kg used in free space ' wave' equations:

$$kg_{freespace}/kg_{matter} = 2\alpha$$



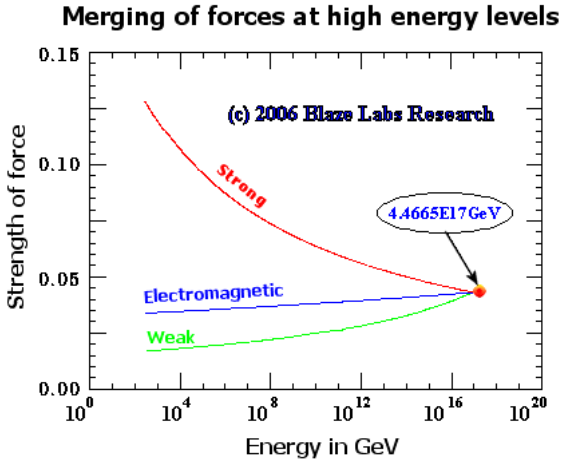
This means that for units defining a travelling EM volume of energy, the kg conversion constant k_Q, has to be multiplied by 2α. We will call this new product of constants k_F denoting it for free space EM waves. Thus, for all free space parameters, we have:

$$kg_{freespace} = 2.145340167E16\ (T^3/S^3) = k_F.(T^3/S^3)...\text{where } k_F = 2\alpha\ k_Q$$

This sheds light on the actual significance of the fine structure constant. It is well known that Alpha, the fine structure constant, which is a dimensionless number, is difficult to fit into a rational scheme of physics. Max Born stated *"There seems to be little doubt that the existence of this dimensionless number, the only one that can be formed from e, c and h, indicates a deeper relation between electrodynamics and quantum theory than the current theories provide, and the theoretical determination of its numerical value is a challenge to physics."* Richard Feynman (4) writes, *"It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it".*

Now with the aid of the unified ST table, we have a further clue on what alpha might represent. It measures the strength of the electromagnetic interaction between incoming and outgoing spherical waves within the structured standing spherical wave (or matter). It is a ratio of volume of energy between the travelling spherical waves and the standing wave EM structure. It is worth noting that the fine-structure ' constant' maintains its value as long as the entity of matter is at stand still. The effective electric charge of the electron actually varies slightly with energy so the constant changes a bit depending on the energy scale at which you perform your experiment. For example, 1/137.036 is its value when you do an experiment at very low energies (like Millikan' s oil drop experiment) but for experiments at large particle-accelerator energies (like 81GeV) its value grows to 1/128. This is not the same as saying that Alpha is not constant. In fact, in April 2004, new and more-detailed observations on quasars made using the UVES spectrograph on Kueyen, one of the 8.2-m telescopes of ESO' s Very Large Telescope array at Paranal (Chile), puts limits to any change in Alpha at 0.6 parts per million over the past ten thousand million years. So we might say that Alpha measured at zero Kelvin is a constant of exceptional stability. The reason for its change at high energy levels is that when the standing EM wave starts radiating heat (EM waves), part of the electron' s internal EM energy starts travelling outwards, and the travelling wave conversion constant k_F changes. If the standing wave is somehow changed all into pure travelling waves, this constant will increase to unity, and thus k_F and k_Q will be equal, and so

$kg_{freespace}$ will be equal to kg_{matter}. This is the main reason why forces seem to unify at high energy levels as shown below:



Fine structure constant is one of the most wonderful physical constants, $\alpha = 1 / 137.036..$ The quantity α was introduced into physics by A. Sommerfeld in 1916 and in the past has often been referred to as the Sommerfeld fine-structure constant. It splits some spectral lines in hydrogen atom such that $\Delta E = (\alpha/4)^2 E_i$. In order to explain the observed splitting or fine structure of the energy levels of the hydrogen atom, Sommerfeld extended the Bohr theory to include elliptical orbits and the relativistic dependence of mass on velocity. The quantity α, which is equal to the ratio v_e/c where v_e is the velocity of the electron in the first circular Bohr orbit and c is the speed of light in vacuum, appeared naturally in Sommerfeld' s analysis and determined the size of the splitting or fine-structure of the hydrogenic spectral lines. α is simply the ratio of the circumference of the first circular Bohr orbit to the electromagnetic wavelength of the electron' s internal energy $E=m_ec^2$. It is the ratio between the two fundamental velocities c the speed (S/T) of EM energy in free space and αc, the speed (S/T) in the quantum world. Feynman wrote:

There is a most profound and beautiful question associated with the observed coupling constant, e the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to -0.08542455. (My physicist friends won' t recognize this

number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.) Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It' s one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don' t know how He pushed his pencil."

Let' s now consider:

Classical radius of an electron r_e=2.8179403E-15 m

Compton wavelength of an electron, λ_c=2.42631021E-12 m

Bohr radius of an electron, a_o=5.29177208E-11 m

Rydberg constant, Ryd=10973731.5685 m^{-1}.

In order to see the relation between each of the above radii and wavelengths we must express these values in a similar form, for example, as wavelengths or orbit circumferences:

$\lambda_{class} = 2\pi r_e$ = 1.77056410E-14 m

$\lambda_{Compton}$ = 2.42631021E-12 m

$\lambda_{Bohr} = 2\pi a_o$= 3.32491846E-10 m

$\lambda_{Rydberg/2}$ = 1 / (2Ryd) = 4.55633525275E-08 m

The numerical values for wavelengths clearly show that:

$\lambda_{class} / \lambda_{Compton} = \lambda_{Compton} / \lambda_{Bohr} = \lambda_{Bohr} / \lambda_{Rydberg/2} = \alpha$.

We can also work out the frequencies from f= c/λ

$f_{class} = c/2\pi r_e$ = 1.693203E22Hz

$f_{Compton}$ = c/2.42631021E-12 m = 1.23559E20Hz

$f_{Bohr} = c/2\pi a_o$= 3.32491846E-10 m= 9.016536E17Hz

$f_{Rydberg/2}$ = c / (2Ryd) = 4.55633525275E-08 m = 6.57968E15Hz

So we have a similar relation for frequencies:

$f_{Rydberg/2}/f_{Bohr} = f_{Bohr}/f_{Compton} = f_{Compton}/f_{class} = \alpha$

Knowing that Energy E=h*f*, we get the following energy values:

$E_{class} = hc/2\pi r_e = 1.121946E\text{-}11$ J

$E_{Compton} = hc/2.42631021E\text{-}12$ m $= 8.187236E\text{-}14$ J

$E_{Bohr} = hc/2\pi a_o = 5.974515E\text{-}16$ J

$E_{Rydberg/2} = hc / (2Ryd) = 4.359811E\text{-}18$ J

$E_{Rydberg/2}/E_{Bohr} = E_{Bohr}/E_{Compton} = E_{Compton}/E_{class} = \alpha$

We usually define one wavelength of motion around a circle as $2\pi r$, and one cycle of travelling wave λ as going through 2π radians. However, it is well known that in standing waves, the distance from node to node at its fundamental resonant frequency does not occur at 2π, but rather at π. This explains the factor of 2 attached to α. Thus we can re-write our previous kg units comparison as:

$$kg_{travellingwave}/kg_{standingwave} = \alpha$$

$$E_{Rydberg/2}/E_{Bohr} = \alpha$$

$$E_{Bohr}/E_{Compton} = \alpha$$

$$E_{Compton}/E_{Class} = \alpha$$

From the above we see that the relations for the different energy units of Rydberg, Bohr, Compton and classical orbits obey the same relation as the travelling to standing waves we described previously. The relation between each of these levels, is highly indicative of a knotting mechanism taking place between each level. For a 1D string can be knotted into a 2D form, and many such 2D forms can be knotted into a 3D form. As we step up one dimension, the wavelength of the travelling wave becomes longer, and its frequency lower. The fine structure constant reveals that the knotting mechanism is the same at every stage. Looking at the ST table, we see that T/S is manifested as energy, $(T/S)^2$ is manifested as momentum, and $(T/S)^3$ as 3D mass, but all three are actually variants of knots or structures of energy.

It now becomes clear that each energy form, for example $E_{Compton}$ (the photon) co-exists as both a travelling wave in 3D and as a standing wave in 2D. This solves the enigma for the wave-particle duality of light. Light will behave as a travelling wave in 3D, but will act as a standing wave (perceived as momentum) when it is projected on a 2D surface, that is, when hitting the surface of a target or sensor. It will also behave as matter when a sequence of photons knot over themsleves in 3D, forming a 3D electromagnetic standing wave.

Derivation of Free space constants

I will now reconfirm the generalization of the above relation between travelling and standing wave energy factor Alpha by deriving some of the well known free space parameters:

Plugging in these values according to the space-time dimensions given in the table, we get:
Free space speed = S/T = 299.792458E6 m/s = speed of light
Free space impedance = $[k_F/j^2]*T^2\ S^{-3}$ = 376.7303 Ohms
Free space conductance = $S^3\ T^{-2}/[k_F/j^2]$ = 2.6544E-3 Siemens
Free space permittivity = $[j^2/k_F]*S^2\ T^{-1}$ = 8.854187E-12 F/m
Free space permeability = $[k_F/j^2]*T^3\ S^{-4}$ = 1.256637E-6 H/m

The above values agree with the known values for these parameters and thus re-confirm the correctness of the ST system of units.

The Universal Limits

Using this unified theory of space time units, we find that the calculated units above, coincide exactly to the well accepted constants found in all conventional physics textbooks and define free space. Since all accepted physics laws conform to the conversion table, we now have the advantage to go further to deduce some more interesting data for free space. So is free space (vacuum) a sea of energy, and can we get a value for the power and frequency we can get from the so called vacuum energy / aether energy / ZPE / radiant energy? Is there a limit to the electromagnetic spectrum? Is there a limit to the maximum density of matter? The answers are positive, and can easily be worked out using the space time conversion for power:

Free space power limit $P_o = k_F / S = 5.2968E50$ Watts
Free space electromagnetic frequency limit $f_o = 1/T = 7.39987E42$ Hz = Planck frequency
Free space grand unification energy limit $E_o = k_F T/S = 71.56085E6$ Joules or 4.466477E17 GeV
Maximum permissible mass density = $k_Q T^3 S^{-6} = 8.208E95$ kg/m^3
Free space Entropy $S = [k_Q/(k_Q/k)] T^0 S^0 = +1.380662E-23$

Free space power is the maximum rate of transfer of energy that can flow through free space at any point in space or time. These units clearly show the existence and values for the upper boundaries for power, EM spectrum frequency, grand unification energy and mass density at the present ratio of T/S. Unlike standard theory, this system allows for all constants to be dynamic, with their values changing according to the cosmic background radiation energy which sets the fundamental ratio T/S. Note that k_F relates to the fine structure constant, Planck constant and gravitational constant. These values are thus relating the quantum relativistic physics of electromagnetism to quantum gravity. So, of particular interest is the derivation of the Energy of Unification from this work:

$$E_{unification}\,(eV) = (2\alpha/e) * \sqrt{(hc^5/G)} = 44.66477 \times 10^{16}\ GeV$$

Comprehensive list of scientific constants for the Unified ST system of units

Slowly but surely, active minorities such as the string theorist and cosmologists have started to abandon the metric SI units in favour of systems which very indeed resemble the ST system of units being proposed here, which in a way can be considered a continuation of Planck' s work. Powers of ten can be introduced to make the values more practical, and as I have already done in this system, conversion constants will be introduced to provide exact metric conversion to keep the existing value for the metre length. This kind of work does happen every not-so often in science, and we are reaching the point where science will come to a halt if we do not implement such a system. Judging from his 1899 paper in which he proposed them, Planck seems to have had exactly this idea in mind.

Natural Length (S)	$(Gh/c^3)^{1/2}$	= 4.051319933E-35m
Natural time (T)	S/c	= 1.351374868E-43 sec
Fine Structure constant	α	= 1/137.03599911
Free space kg conversion factor	$k_F = kg:(T^3S^{-3}) = 2\alpha\sqrt{(hc^7/G)}$	= 2.145340167E16
Quantum kg conversion factor	$k_Q = kg:(T^3S^{-3}) = \sqrt{(hc^7/G)}$	= 1.469944166E18
Amp conversion factor	$j = Amp:(ST^{-1}) = e/S$	= 3.954702562E15
Kelvin conversion factor	k/k	= 1.553848927E39
Radians conversion factor	2π	= 6.283185307

Unified dimensions
Dimensionless Physical constants
ST to SI dimensionless conversion ratios

Unified dimensions

The unified ST system of units, as already described, is based on the two fundamental dimensions; space and time. It may be argued that time can be defined in terms of space, in which case it becomes an extra space dimension, and our ST system unifies itself further into space dimensions. Some scientists do agree with this, whilst others do not. The problem of declaring time as a spatial dimension, with no other way to distinguish it from any one of the other three spatial dimensions, is that most units loose their physical interpretation, since our mind can never perceive time as length. One way to identify the temporal dimension is to use the complex notation T= *i*S, to indicate that the spatial dimension of time is always orthogonal to the conventional space dimension. It is important to understand that the actual values one decides to assign to these fundamental units are purely arbitrary. We selected the shown values in order to keep the equivalence of the conventional metre and second units in our ST system. However, things would be further simplified if the natural length and natural time values are chosen to be equal to unity. Of course this can only be done at the expense of loosing the present significance of the metre and the second. In the system presented here, both these units have been retained.

Dimensionless Physical constants

The most important of all dimensionless physical constants is the fine structure constant denoted by α whose value is NOT arbitrary and totally independent of the man made units selected. A dimensionless constant is a ratio of quantities. Even if we change the numerical values of the fundamental length, time, or any of the constants c, h, or G, the value α would remain unchanged. This is the value that makes our universe and physics laws the way they are.

Dimensionless conversion ratios

The ST to SI conversion ratios are necessary due to the huge redundancy of units in the present SI system. These ratios will convert between the ST values in metre and second units and the variety of SI units which we are used to. Conversion is not really necessary to work out any physics problem, its only use can be compared to changing a foreign currency value of money into your own currency. This

would not be necessary if all people used the same currency, that is to say, if all scientists used the ST unified system of units.

How to convert between the two systems : Worked example

So, armed with our ST conversion table which did away with all problems present in the SI system, we are now in a position to PREDICT all physical constants, in both unified ST units and the messy SI units. As opposed to the SI system, all values shown above can be ASSIGNED to any precise value, such as the ones shown. The ' error' or level of ' uncertainty' as we are accustomed to in the present SI system, becomes a thing of the past. That is, we can SET a value for natural S and T, and that would automatically set the rest of all parameters. Now, for the sake of clarity, I will explain how to work out such values using resistance as an example.

Let' s try to work out the natural constants for resistance. Since SI based quantum and SI based relativistic science are not unified in SI, mainly due to lack of knowledge on mass, we will have two types of SI constants for each fundamental physical parameter which involves the SI kg unit, one is the free space value, the other is its quantum (knotted) value. The ST system requires only one natural value for each parameter. Resistance is presently measured in Ohms, which in the SI system has units $m^2kg/sec^3/Amp^2$. In the unified ST system, resistance is measured in sec^2/m^3 and has dimensions T^2S^{-3}. By simply plugging in the natural values of S and T, we will get the natural constant for resistance:

$R_{ST\text{-}Natural} = T^2S^{-3} = 2.746389015E17\ sec^2/m^3$

To convert this constant into the conventional SI system of units, you have to apply the conversion factors in order to convert from metres and seconds, into $m^2kg/sec^3/Amp^2$. So, metres and seconds do not need any conversion, but we have to multiply by the kg conversion unit, and divide by the square of the Amp conversion unit. So we get:

$R_{Freespace} = R_{ST\text{-}Natural} * K_F / j^2$

$R_{Freespace} = 2.746389015E17 * 2.145340167E16 / 3.954702562E15^2$

$R_{Freespace} = 376.7303135\ m^2kg/sec^3/Amp^2$ *or Ohms*

Similarly, for the quantum constant for resistance, we do the same but apply the conversion factor K_Q instead of K_F

$R_{Quantum} = R_{ST\text{-}Natural} * K_Q / j^2$

$R_{Quantum} = 2.746389015E17 * 1.469944166E18 / 3.954702562E15^2$

$R_{Quantum} = 25812.80745\ m^2kg/sec^3/Amp^2$ *or Ohms*

You can recognise these two values as the Characteristic impedance of free space, and Von Klitzing constant $R_{K\text{-}90}$. In a similar way, you can work out all physics constants to a great precision and moreover, predict their values before they have been experimentally found! Below is the table of constants for all parameters which we know about, worked out in the way illustrated above. The same conversion factors k_F, k_Q and j, that we used in our resistance calculation, lead to the correct values of all other known constants, proving again that the ST conversion table is correct. Some of the derived constants have been discovered and are well known, while others have yet to be discovered. All predicted values agree perfectly with the known constants.

The ST unified system constants converted to SI units

Parameter	*SI units*	*ST Dims.*	*Unified ST constant converted to free space SI units*	*Unified ST constant converted to quantum SI units*	*Remarks*
Distance S	m	S	4.0513199E-35	4.0513199E-35	Planck length
Time t	sec	T	1.3513749E-43	1.3513749E-43	Planck time
Area A	m^2	S^2	1.641319E-69	1.641319E-69	Planck Area
Volume V	m^3	S^3	6.649510E-104	6.649510E-104	Planck Volume
Speed/ Velocity u	m/s	ST^{-1}	299.792458E6	299.792458E6	Speed of light
Acceleration a	m/s^2	ST^{-2}	2.218426E51	2.218426E51	Planck Acceleration
Force/ Drag F	kgm/s^2	TS^{-2}	1.7664E42	1.2103E44	1.2103E44=Planck Force
Surface Tension γ	kg/s^2	TS^{-3}	4.3615E76	2.9884E78	Not yet discovered
Energy/ Work E	$kg\ m^2/s^2$	TS^{-1}	71.56085E6	4.9041E9	Grand Unification energy (J)
Electron Volt eV	$kg\ m^2/s^2$	$T\ S^{-1}$	4.466477E26	3.060341E28	Grand Unification energy (eV)
Moment *m*	$kg\ m^2/s^2$	$T\ S^{-1}$	71.573E6	4.9041E9	See energy
Torque τ	$kg\ m^2/s^2$	$T\ S^{-1}$	71.573E6	4.9041E9	See energy
Power P	$kg\ m^2/s^3$	S^{-1}	5.2968E50	3.6293E52	Planck Power
Density ρ	kg/m^3	$T^3\ S^{-6}$	1.1979E94	8.2080E95	Max Black hole density
Mass m	kg	$T^3\ S^{-3}$	7.9636E-10	5.4565E-8	Not yet discovered
Momentum p	kg m/s	$T^2\ S^{-2}$	0.2387	16.358	See magnetic flux

Impulse J	kg m/s	$T^2 S^{-2}$	0.2387	16.358	See magnetic flux
Angular Momentum L	kg m^2/s	$T^2 S^{-1}$	9.670553E-36	6.626069E-34	Planck constant
Inertia *I*	kg m^2	$T^3 S^{-1}$	1.3067E-78	8.9530E-77	Not yet discovered
Angular velocity/freqω	rad/sec	T^{-1}	4.6502E43	4.6502E43	Not yet discovered
Pressure/Stress P	kg/m/s^2	$T S^{-4}$	1.0767E111	7.3770E112	Radiation pressure
Specific heat Capacity c	m^2/sec^2/K	$S^3 T^{-3}$	5.7814E41	3.9613E43	Not yet discovered
Specific Entropy	m^2/sec^2/K	$S^3 T^{-3}$	5.7814E41	3.9613E43	Not yet discovered
Resistance R	kg m^2/sec^3/Amp^2	$T^2 S^{-3}$	376.7303	25812.807	Freespace impedance Von Klitzing constant R_{K-90}
Impedance Z	kg m^2/s^3/Amp^2	$T^2 S^{-3}$	376.7303	25812.807	Free space impedance Von Klitzing constant R_{K-90}
Conductance S	s^3 Amp^2/kg/m^2	$S^3 T^{-2}$	2.6544E-3	3.8740E-5	Free space conductance Half of known conductance quantum
Capacitance C	s^4Amp^2/kg/m^2	$S^3 T^{-1}$	3.5871E-46	5.2353E-48	Not yet discovered
Inductance L	m^2 kg/s^2/Amp^2	$T^3 S^{-3}$	5.091038E-41	3.488278E-39	Not yet discovered
Current I	Amp	$S T^{-1}$	1.18559E24	1.18559E24	Not yet discovered
Electric charge/flux q	Amp sec	S	1.60218E-19	1.60218E-19	Electron charge
Magnetic charge/flux ϕ	m^2 kg/sec^2/Amp	$T^2 S^{-2}$	6.035885E-17	4.135667E-15	Not yet discovered
Magnetic flux density B	kg/sec^2/Amp	$T^2 S^{-4}$	3.677459E52	2.519721E54	Not yet discovered
Coefficient of viscosity η	kg/m/s	$T^2 S^{-4}$	1.4543257E68	9.9647487E69	Not yet discovered
Magnetic reluctance R	Amp^2 sec^2/kg/m^2	$S^3 T^{-3}$	1.964236E40	2.866744E38	Not yet discovered

Electric flux density	kg m^4/sec^2	ST	1.174542E-61	8.047727E-60	Not yet discovered
Electric field strength E	m $kg/sec^3/Amp$	T S^{-3}	1.1024745E61	7.5539348E62	Not yet discovered
Magnetic field strength H	Amp/m	T^{-1}	2.926429E58	2.926429E58	Not yet discovered
Frequency f	sec^{-1}	T^{-1}	7.399871E42	7.399871E42	Limit of EM spectrum
Wavelength λ	m	S	4.0513199E-35	4.0513199E-35	Planck length
Voltage EMF V	kg $m^2/sec^3/Amp$	T S^{-2}	4.466477E26	3.060341E28	Not yet discovered
Magnetic potential MMF	kg/sec/Amp	T^2 S^{-3}	1.489856E18	1.020820E20	Not yet discovered
Permittivity ε	sec^4 Amp^2 $/kg/m^3$	S^2 T^{-1}	8.854187E-12	1.292243E-13	Permittivity of free space
Permeability μ	kg $m/sec^2/Amp^2$	T^3 S^{-4}	1.256637E-6	8.610226E-5	Permeability of free space
Resistivity ρ	$m^3kg/sec^3/Amp^2$	T^2 S^{-2}	1.526255E-32	1.045759E-30	Not yet discovered
Temperature T	K	T S^{-1}	5.183082E30	3.551344E32	Planck Temperature
Enthalpy H	kgm^2/s^2	T S^{-1}	71.56085E6	4.903206E9	Not yet discovered
Conductivity σ	Sec^3Amp^2 $/kg/m^3$	S^2 T^{-2}	6.551985E31	9.562429E29	Not yet discovered
Thermal Conductivity	kg m $/sec^3/K$	$S^{-1}T^{-1}$	2.5218253E54	2.5218253E54	Not yet discovered
Energy density	$kg/m/sec^2$	T S^{-4}	1.0761823E111	7.3737857E112	Not yet discovered
Ion mobility μ	Amp sec^2/kg	S^4 T^{-2}	2.7192689E-53	3.9686927E-55	Not yet discovered
Fluidity	m sec/kg	S^4 T^{-2}	6.8760389E-69	1.0035376E-70	Not yet discovered
Effective radiated power ERP	$kg/m/sec^3$	S^{-3}	3.2263133E119	2.2106053E121	Not yet discovered
Gravitational Constant G	$m^3/kg/s^2$	S^6 T^{-5}	4.573028E-9	6.674200E-11	Gravitational constant
Planck Constant h	kg m^2/sec	T^2 S^{-1}	9.670553E-36	6.626069E-34	Planck constant
Young's Modulus E	$kg/m/s^2$	T S^{-4}	1.0761823E111	7.3737857E112	Not yet discovered

Stefan Boltzmann constant E	$kg/K^4/sec^3$	$S\ T^{-4}$	1.3896940E-9	4.3202129E-15	$=(15/2\ \pi^5)$ Stefan Boltzmann constant
Hertz volt relationship $(Hz/V)K_j$	$sec^2Amp/kg/m^2$	$S^2\ T^{-2}$	1.656758E16	2.417989E14	Half Josephson constant

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Java SI - ST converter available online at: http://www.blazelabs.com/si-stconv.asp