A Geometric-Mathematical Link to Physical Constants

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Introduction

All of our basic measurement definitions have evolved from usages that are of geocentric origin. Our modern definitions for physical units are maintained by an organization with the title “The International System of Units”, universally abbreviated SI. There are on-going efforts to identify a unified system of units based upon fundamental constants. There exists a mathematical methodology to link the most basic physical constants by using a geometric-mathematical relationship. The unique element of this geometric-mathematical relationship is that of dimensional neutrality, which allows the use of an existing dimensional system, like those defined by SI, or a unit system. The two keys to this geometric-mathematical relationship are the use of Thomas Young’s 1801 formula that identified the relationship between frequency, wavelength and the speed of light, and secondly, a wavelength can be represented by both linear and angular values.

Identifying the Geometric Relationship

During the analysis of an unconventional waveguide cavity structure a symmetrical geometric relationship using Young’s formula was empirically identified. A computation process identified that a right triangle with an angle of 26.25400+ degrees created a symmetry between the components of the cosecant of a triangle that can only occur with the precise value for the SI definition for the speed of light and specific hypotenuse dimensions. In metric, the hypotenuse dimension has to be a tens multiple or division of the digits 47714 to achieve the cosecant of the stated angle, 2.2606. It was determined that the triangle with a cosecant value of 2.2606 was a special case, whereas a triangle with a cosecant of 1.4142 (45 degrees) was the general case.The original computation used a precision greater than what is presented herein.

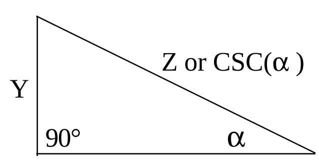

Figure 1.

Symmetrical Characteristics

The triangle notation is shown in Figure 1. In the formulation’s concept stage it was found that the original triangle value of Z, when converted to the cosecant value, then multiplied by 2π, had the same numerical value of theY dimension after it had been converted to a frequency. It was found that this symmetrical relationship existed only if the frequency conversion of the dimensional value of Z gave a base numeric value of 6.2831, that is 2π. In metric, the Y dimension value will have the digits 21106. It was recognized that these were the numerical digits for the wavelength of the precession emission of neutral hydrogen. The symmetrical relationship holds true whether using metric, English or any other measurement system, the only change is the numeric value of the digits. It is recognized that the secant is the other trigonometric function that will give symmetrical results.

Time Dependent

In Young’s formula, $f = c/\lambda$, the numeric variables are defined singularly or in combination by a length dimension and a time segment. Different measurement systems use their own definition for what is a standard length, but the “time segment” remains constant. Figure 2 identifies the formulation matrix. It was found that multiplying the value of Y and Z by both 2π and a dimension that represents a specific wavelength, in metric or English units, would result in a matrix that gives numeric values that are symmetrically mirrored. The 2π value is identified as the radian multiplier and the λ_U value the wavelength multiplier. The value of the wavelength multiplier can be either a dimension that represents the wavelength of the precession emission of neutral hydrogen or “one”.

$f_1 = 2\pi * Y$	$\lambda_1 = c/f_1$
$f_2 = 2\pi * Z$	$\lambda_2 = c/f_2$
$\lambda_3 = \lambda_U * Y$	$f_3 = c/\lambda_3$
$\lambda_4 = \lambda_U * Z$	$f_4 = c/\lambda_4$

Figure 2.

To avoid large numbers in the wavelength column a 10^6 multiplier was applied to the frequency values, as no attempt was made to extend the precision. The variables identified in Figure 2 and their associated values are shown below.

λ_U = 21.106 centimeters (Choose precision)
2π = 6.2831 (Choose precision)
c = 29979245800 (centimeters/second)
Z = 2.2606 (Choose precision for 26.25400 degrees)
Y = 1
f_1, f_2, f_3 or f_4 - Frequency MHz
λ_1,λ_2,λ_3 or λ_4 - Wavelength in centimeters

6.2831 MHz	4771.4 cm
14.204 MHz	2110.6 cm
21.106 cm	1420.4 MHz
47.714 cm	628.31 MHz

Figure 3.

The results shown in Figure 3 reflect the symmetry that exists for a right triangle with an angle of 26.25400 degrees.

Precession Wavelength Dimension Redefined

It was noted that the value of **Y** equal to 1 also represents the equivalent of the precession wavelength, but not in SI units. It is known that the symmetry will exist at the precise angle of 26.25400 degrees only if the SI unit of time (second) remains constant, irrespective of metric, English or another defined set of units. Since the length dimension will change from metric to a unit value this would have to be reflected in the speed of light and its dimensional descriptor, which results in a hybrid system, part SI (second) and a unit length system, which will use the descriptor **L_U**. There is no real value in calculating the result for the hybrid system as the numerical value for the speed of light would be the current speed of light divided by 21.106 cm, giving a value of about 14.204 (10^6) L_U/sec.

SI Unit of Time Redefined

It is known that if the angle of the triangle changes this reflects in the duration of the time segment. In this case, change it to what? The process looked at the formulation within the geometric framework of a 45 degree triangle and its characteristics when expressed as a cosecant value, a point of symmetry. Because the time segment will be different from the SI second, it will be given the designator **T_N**. The formulation will change slightly because the duration of the time segment is embedded in the numeric value for **c**. The formulation uses SI metric lengths, thus a hybrid system is still being used.

$f_1 = 2\pi * Y$	$\lambda_1 = c_U/f_1$
$f_2 = 2\pi * Z$	$\lambda_2 = c_U/f_2$
$\lambda_3 = \lambda_U * Y$	$f_3 = c_U/\lambda_3$
$\lambda_4 = \lambda_U * Z$	$f_4 = c_U/\lambda_4$

Figure 4.

In Figure 4, the value of **c_U** will be equated to **c*m**, where **m** is the multiplier that reflects the difference between the SI second and **T_N**. The frequency will not be in MHz, but will be (10^6) cycles/**T_N** or megacycles/**T_N**. This will be abbreviated to Mc/T_N in Figure 5. The value of **Z** will be changed to the square root of 2, and the numeric values of **c** and **λ_U** will be the same as those used for Figure 3. The computation was setup to vary the value of **m** until the matrix results became symmetrical, although varying the value of **c** could have been used.

Figure 5 illustrates the calculations that result when using a 45 degree angle and its related time segment. The only value in this exercise is to show that **m** is simply the ratio between the cosecant of the 45 degree triangle and that of one with an angle of 26.25400 degrees. The value of **m** or the ratio between the two cosecant values indicates that the SI second is about 1.598 times longer than **T_N**. The value for the speed of light that gives the numeric values in Figure 5 is 18752 (10^6) cm/T_N. This exercise indicates that a method of identifying the rotation characteristics of a planetary body can be expressed as a cosecant value or compared as a ratio relative to a particular cosecant reference.

6.2831 Mc/T_N	2984.8 cm
8.885 Mc/T_N	2110.6 cm
21.106 cm	888.5 Mc/T_N
29.848 cm	628.31 Mc/T_N

Figure 5.

SI Definition of Length and Time Replaced with Unit Values

Instead of using a mix of SI and unit values, the characteristics of the geometric-mathematical relationship suggested that unit values could be used for both length ($\mathbf{L_U}$) and time ($\mathbf{T_U}$). The Figure 4 formulation is still relevant, but the value for the speed of light would be expressed as $\mathbf{c_U}$ in $\mathbf{L_U}$ / $\mathbf{T_U}$, and frequency as megacycles/$\mathbf{T_U}$ or Mc/$\mathbf{T_U}$. Like the previous calculation, the value of $\mathbf{c_U}$ will be equated to $\mathbf{c*m_U}$, where $\mathbf{m_U}$ is the multiplier to iterate to achieve symmetry in the geometric-mathematical relationship. The value of $\boldsymbol{\lambda_U}$ will equate to one. The multiplier in this case produced a value of 0.33739..., giving a numeric value for the speed of light of 888.5 (10^6) L_U/T_U.

6.2831 Mc/T_U	141.42 L_U
8.885 Mc/T_U	100.00 L_U
1.0000 L_U	888.5 Mc/T_U
1.4142 L_U	628.31Mc/T_U

Figure 6.

The Figure 6 results look exceedingly simplistic as it is based upon the basic elements of a 45 degree right triangle and generic units. This configuration using generic units results in a natural symmetry. If one desired to have a mathematically defined reference value for the speed of light, using the above process, its precision would be limited only by the existing computational capability.

Unit of Length, Time and Speed of Light Redefined

Within the totality of the above process it is apparent that assigning values to a length or a time segment in a measurement system is to a degree arbitrary. The time duration assigned to an SI second really has nothing to do with the rest of the universe, it is basically provincial. It would be, to a degree, much more rational to use the wavelength of the precession emission of neutral hydrogen as a natural universal physical length ($\mathbf{L_U}$) and give it a value of **one.** A universal time segment ($\mathbf{T_U}$) could be defined as that duration it takes the speed of light to traverse one universal physical length, and this would have a value of **one**. In comparison, the SI second has a very large duration, essentially emulating the 1/86,400th division of earth’s rotation.

The angle α reflects the time base within the formulation. Using the SI values for the speed of light and wavelength, and substituting CSC(α) for Z in the calculations, an angle value can be derived that reflects the known precision of the physical constants.

Conclusion

The earth second is perfectly useable for everyday purposes, but there is a need in the quantum scientific community to define a measurement system that has a basis in absolute physical constants, and is mathematically defensible. The formulation described herein provides a method for linking physical constants to a mathematical basis and may provide a tool in developing a comprehensive “quantum metrology” system of units.

There is no need to replace SI units, their geocentric origins have many uses beyond those of science. In the future there can be a new set of units designated as SU units, an abbrevation for “The Universal System of Units”. If one uses the definition for $\mathbf{T_U}$ given above, the number of universal time segments in an earth second would be about 1420.40 (10^6) $\mathbf{T_U}$/sec, and for length there would be about 4.737 $\mathbf{L_U}$/meter.

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