Original Research Article

Prediction and Derivation of a high accuracy Hubble Constant from the neutron, electron, Bohr radius, and the hydrogen ionization energy

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ABSTRACT

Aims: A high precision Hubble constant, H_0, is an important physical constant. The goal of this work is to derive and predict the H_0 from subatomic physical data related to solely the neutron and hydrogen properties only, excluding any standard astronomy measurements.
Study design: Purely computational.
Methodology: The harmonic neutron hypothesis assumes that the fundamental constants represent a unifed harmonic system. It has demonstrated that harmonic integer fractions plus small derived δ exponents of annhilation frequency of the neutron (v_ns) as a dimensionless coupling constant represent other physic constants as freqency equivalents. It is logical that H_0 should represent one of these values. In this case the derived H_0 equals $(2.2718591 \times 10^{23})^{\text{exponent H0}}$ s^{-1}. This model is based on classic physical and mathematical foundations including: a consecutive integer series, a natural unit system, speed of light, Planck's constant, unit charge, and the exponent of the neutron all equal 1, dimensionless coupling constants, conversion of one standard unit to frequency, a harmonic fraction series, (n±1)/n and 1/±n for n = 1 to ∞, a fundamental frequency, v_n, if the fundamental frequency is known then all of the discrete harmonic frequencies can be derived from the harmonic fractions, this is analogous to predicting the ionization energies of unmeasured elements from the hydrogen ionization energy, exponential distribution of energy over time, exponent values plotted on a 2D vector plane, and symmetry, The model has derived and published a high accuracy Planck time, t_P, and the gravitation constant, G from solely high precision physical data: the neutron, electron, Bohr radius, and ionization energy of hydrogen as frequency equivalents. It is shown that H_0, falls on this previously published t_P line. It is logical that H_0 is associated with gravity. The positive even number denominator harmonic fractions ½, ¾, 5/6, 7/8 have been shown and published to be related to the kinetic energy lost in the neutron beta decay process. It is logical that one of these symmetric negative even fractions -½, -¾, -5/6, -7/8 should be related to cosmic kinetic constants including H_0.
Results: The derived velocity is 70.886247 km s^{-1} Mpc^{-1}.The experimental values range from 67.3, to 76.9 km s^{-1} Mpc^{-1}. The derived H_0 is $2.2972668 \times 10^{-18}$ s^{-1}. The reported value is approximately 2.3×10^{-18} s^{-1} with an exponent of -0.75518 which must be related to the harmonic fraction -3/4. The Hubble constant, H_0, was derived utilizing the harmonic fraction of -3/4 on the t_P line. The derived δ_{H0} value from the t_P line at x axis, -3/4-1, equals $-5.20211236 \times 10^{-3}$. The derived exponent of H_0 equals -3/4 +δ_{H0}, -0.75520211.

Conclusion: The Hubble constant can be derived from subatomic data accurately and is logically related to the neutrinos, neutron beta decay, hydrogen, Planck time, gravity, and the neutron. These computations were made from utilizing previously published data related to the t_P^2 line supporting the hypothesis. This is an example of a method that simultaneously scaled quantum and cosmologic physical

constants.

Keywords: [Hubble constant, gravity, Planck time, neutron, hydrogen, unification models)

1. INTRODUCTION

Hubble's law refers to the observation that objects at greater than 10 megaparsecs have a Doppler shift interpretable as relative velocity. The Doppler shift is most commonly quoted as a velocity in km s^{-1} Mpc^{-1}. Galaxies appear to be receding at a rate proportional to their distance from the Earth. This is normally interpreted as evidence of expansion of the universe. A high precision Hubble constant, H_0, is an important physical constant. [1-6] Hubble's Law relates velocity to H_0 as a proportionality constant with units of s^{-1} times the proper distance, D. The reciprocal of H_0 is Hubble time. An approximate reported estimate of H_0 is 2.3×10^{-18} s^{-1}. Hubble time, H_0^{-1}, equals approximately 4.35×10^{17} s or 13.8 billion years. The approximate Hubble length equals cH_0^{-1} or 13.8 billion light years. At one Mpc the velocity is reported to be approximately 70 km s^{-1} Mpc^{-1}. The reported velocities vary with the model and published values include: $76.9^{+3.9}_{-3.4}{}^{+10.0}_{-8.0}$ km s^{-1} Mpc^{-1}, 69.32±0.80 km s^{-1} Mpc^{-1}, 74.3 ±2.1 km s^{-1} Mpc^{-1}, 67.3±1.2 km s^{-1} Mpc^{-1}. [3-6]

The goal of this work is to derive a high precision H_0, Hubble length, and Hubble time from the high precision subatomic data of the neutron, n, hydrogen ionization energy, Rydberg constant, R, Bohr radius, α_0, and the electron, e. The harmonic neutron hypothesis assumes that the fundamental constants represent a unifed harmonic system. This method has demonstrated that harmonic integer fractions plus small derived δ exponents of annihilation frequency of the neutron times one second ($v_n s$), 2.2718591×10^{23}, as a dimensionless coupling constant represent other physic constants as frequency equivalents. This pattern is obvious on review of the empiric data. [7-11]

The following is a brief review of the harmonic neutron hypothesis. It was initially proposed in 2009 [7]. None of the individual elements of the hypothesis are new or a radical departure from standard physics or mathematical methods. The standard components of the hypothesis will be highlighted in italics. The combined hypothesis is not a standard method, but is valid. The model is not in conflict with the Standard Model or overturns any of its methods or tenants. The actual physical values used are equivalent to *standard unit values*, but they are all transformed into *frequency equivalents.* They are evaluated as *dimensionless coupling constant ratios*. For example, it is common for the mass of a particle or boson to be quoted as eV/c^2 unit, and not in kg. Converting the units of physical constants does not change their physical significance. This is the essence of *Einstein's mass energy, and Planck's energy frequency equations*. Any common physical unit of mass, energy, distance, frequency, or time could be utilized and it would not change any of the concepts or results of the harmonic neutron hypothesis. For example the ratio of the mass of the electron divided by the mass of the neutron equals the frequency equivalent of the electron divided by the frequency equivalent of the neutron.

The combined components of the hypothesis are controversial because they are not well understood and new. The concepts and mathematics are not complicated, but require a different conceptual synthesized approach, and a significant investment to comprehend. The value of the method is that it can derive and predict physical constants beyond what can be experimentally measured, and also explains their origin and interconnection to other physical entities from only four subatomic physical values: n, R, α_0, and the e. The Standard Model today cannot logically or mathematically unify or scale quantum and cosmic phenomena together. This method does, and the derivation of H_0 from subatomic data supports the validity of the hypothesis. The derived values have high precision since the calculations are based on *high precision subatomic data* to begin with, and not experimental data directly related to the physical constant. In this case no astronomy data is utilized in the H_0 derivation. Many physical constants are *derived* from other physical constants. A classic example is the *Bohr radius*.

The hypothesis is based on classic *harmonic fractions*, 1/±n and *partial harmonic fractions*, (n±1)/n for n = 1 to ∞. This is a tremendously powerful predictive attribute of the model since associating a physical constant with a specific harmonic fraction creates an infinite series of other discrete harmonics and characterizes the whole system from a very limited data set. This is analogous to the quantum numbers associated with the elements. This is why H_0 can be derived with no direct physical measure. A good spectral analogy is the Moseley's law. If one knows the ionization energy of hydrogen it is possible to predict the maximum ionization energy of any other element in absence of any actual physical data related to that specific element. These types of quantum systems are related to a specific energy and a consecutive integer series function. This is most commonly associated with the *harmonic characteristics* of a vibrating string, but is a universal mathematical and physical system. *Planck's equation* of energy and frequency is a classic example of this type of quantum harmonic system. If one knows the energy associated with any single n value then one can derive all of the possible values including Planck's constant.

A *fundamental frequency* of a harmonic system is the central frequency (*unison*) that all others are related to and associated with an n of 1. All other harmonic frequencies are integer ratios. If the *fundamental frequency* is known then

an infinite number of the only possible *discrete* harmonic frequencies can be derived. This is identical to this derivation of H_0. In this case is associated with an n of -4 and a harmonic fraction of -3/4.

Another important concept is *resonance* and products of harmonic numbers. *Resonance* is the tendency of a system to oscillate with greater amplitude at some frequencies than at others. If two sinusoidal systems have common frequency components there will be greater coupling and potential transfer of energy between them. *Magnetic resonance* is a quantum example. In a harmonic system the product of two frequencies can represent the common next harmonic frequency that leads to resonance. For a musical example, two prime number music frequencies can only resonant at the product of the two *prime* frequencies. This property is an important factor in this model that defines the *hierarchy* of physically associated entities. The n number products of the electron antineutrino kinetic energy, 2, the electron, 7, and W or Z, 12, define the quantum numbers of the muon, 24, 2 x 12, and Tau, 84, 7 x 12. [7]

The hypothesis is a *natural unit system*. A natural unit system incorporates *known physical units* rather than arbitrary units. Classic examples transpose the speed of light, Planck's constant, and electrical charge all to be equal to 1. This is true in this model as well. The exponent of the neutron is 1 in this model. The *natural unit models* greatly simplify the mathematics without altering the final results. All arbitrary units are avoided in this model.

This model is based on the *annihilation frequency of the neutron*, v_n, as the *fundamental frequency* similar to *Planck units*. In *Planck units* all of the different fundamental constants are converted into a single common standard unit such as Hz, seconds, kilograms, or meters. The neutron is a logical fundamental physical entity that is centered between atomic and subatomic entities, and is related to all of the forces.

All of the physical constants are evaluated as *dimensionless ratios, coupling constants.* Each physical constant as a frequency equivalent is divided by v_n creating a specific coupling constant of those two entities. The different unit systems are irrelevant and transformation to a single unit allows for direct comparisons of physical constants as *coupling constants*. Coupling constants are common in physics. π is the most classic, as well as, the *fine structure constant*, α. and the *electron g-factor*. This is essential for comparisons between different physical entities with different units. In a unification model the minimum impact of arbitrary conflicting unit systems is a great advantage.

All of the physical constants are evaluated as exponent of v_ns The classic conversion of on exponential base value to another is done by dividing the $\log_e$ frequency of any constant by $\log_e$ v_ns. The exponents of the fundamental constants are not exactly equal to harmonic fractions, but all very close. The known exponent minus the harmonic fraction is referred to as the δ. These δ shift the fundamental frequency of a specific constant slight away from v_n and are in the range of 10^{-3}. An empiric review of these exponents shows an obvious harmonic fraction pattern.

The hypothesis was initially based on the empiric observation that gravitational, electromagnetic and strong forces were all scaled by integer exponent multiples of v_ns for the frequency equivalents of the neutron, Planck's constant times 1 second, and the 2 times the gravitational binding energy of the electron in hydrogen. The 2 arises from gravity being a kinetic force. The gravitational binding energy of the electron in hydrogen is assumed to be as important as the ionization energy of hydrogen. This is true since it is associated with Planck time squared, t_P^2. [9] Two times the gravitational binding energy of the electron in hydrogen as a frequency equivalent times v_ns is almost identical to the frequency of 1. This is associated with the energy equivalent of Planck's constant times 1. 1 times v_ns equals the frequency equivalent of the neutron. This pattern is similar to classic harmonic systems where the scaling factor is raised to a consecutive integer exponent series for each generation. In the physical domain, the v_ns exponents -1, 0, 1 are related to gravitational energy and the gravitational force, Planck's constant and the electromagnetic force, and the neutron and the strong force.

This is an *exponential* system rather than the classic musical harmonic system. They have identical harmonic fractions and can be analyzed in similar fashion. The distribution of energy over time is *exponential* for many physical systems including *magnetic resonance relaxation times*, and *radioactive half-lives* so this also is classic.

If this initial observation was valid then the classic partial harmonics fraction exponent values should also represent physical entities. These n values are referred to as *principal quantum numbers*, just as in *classic quantum spectrum*. n can be related to 1/±n or (n±1)/n for n equal 1 to ∞, therefore four different possibilities. Since 2009 many physical constants have been documented to be closely related to v_ns raised to *harmonic fractions*. v_ns raised to the harmonic fractions represent the degenerate values of the physical constants and are all within a few percent of the actual values [7, 9, 10]. v_ns raised to the harmonic fractions should not be exactly equal to the actual values logically just as the masses of the elements are not exactly equal to the number of neutrons, protons, and electrons in an element. Other factors need to be taken into account, but the overall integer pattern is obvious.

Physical constants that represent products and divisions of other constants represent sums and difference of their harmonic fractions and δs. All of the classic physics equations are converted into exponential equivalent equations. This

does not alter the final calculations. For example, the classic *gravitational energy equation* is translated into the sum of the exponents for the two masses, the distance, and t_P^2. The output is the exponent of the gravitational energy equivalent.

Following is a list of the physical entities and their documented harmonic fractions: Planck time squared, -163/35; Hubble constant, -3/4; h, 0; n, 1; kinetic energy lost in the neutron beta decay process, ½; hydrogen ionization energy, 2/3; kinetic energy lost in the neutron beta decay process,3/4; Bohr radius, 4/5;; kinetic energy lost in the neutron beta decay process, 5/6; electron, 6/7; kinetic energy lost in the neutron beta decay process,7/8; up quark, 9/10; top quark, 11/10; down quark, 10/11; reciprocal of the fine structure constant, α^{-1}, 1/11; Higgs boson, 12/11; W, 13/12; Z, 13/12; muon, 23/24; $pion^+$, $pion^0$, 27/28; strange quark, 27/28; bottom quark, 33/32; $kaon^0$, 83/84; $kaon^+$, 84/85; Tau, 84/83; charm quark, 109/110. There are other classic harmonic fraction and number properties demonstrated between the physical constants. In the quark series the three base principal quantum numbers are 3, 9, 10, and 11. Their products are seen in higher order quarks: strange, (3 x 9)/28, charm, 109/(10 x 11), and bottom (3 x 11)/32. [10]

In the simplest possible exponential harmonic series all of the possible frequency values could be defined related solely to the *fundamental frequency* and the *harmonic fraction series* only. The harmonic neutron hypothesis and the physical reality are more complicated. This arises from a mathematical imperative. Known fixed number values of the products of 2 and π are associated with specific integer fraction values. These are not harmonic fractions. These arise from the product ratio relationships of R, α_0, e, and, α [11]. There are four product ratio relationships of these hydrogen entities. For example the integer fraction associated with 2 must be related to v_ns raised to (10/1155). Also 2π must be related to v_ns raised to (39/1155). 2 raised to (1/(10 / 1155)) is 5.8744×10^{34}, and (2π) raised to (1/(39/ 1155)) is 4.34916×10^{23}. There is no common *fundamental frequency* that can fulfill these conflicting mathematical imperatives. The only solution is to have minor δ values added to the quantum fractions that "shim" these various values to a common fundamental frequency, v_n. This makes the system more complicated, but resonant.

Each physical constant is plotted on a harmonic fraction minus one for the x axis and the y axis is the δ. This represents an infinite number of possible fundamental frequencies. Each point has the identical value as its standard exponent value, and therefore standard unit value as a frequency equivalent. The difference between two points on the 2D plane represents a proportionally constant. This is also a classic vector relationship on the 2D plane. A line connecting any two points defines a composite proportionality relationship of two or more physical constants. For example gravity is associated with two masses, a distance and the gravitational energy to define t_P^2.The y intercept at x equals 0 of a line connecting a specific physical constant point and the (-1, 0) point defines its specific fundamental frequency, v_f, and is not v_n. Each harmonic fraction is associated with a possible physical constant. It is possible to derive any harmonic value from the slope and y intercept of a line and v_ns if the harmonic faction is known. This is how H_0 is derived from the t_P^2 line. Different forces are associated with different δ lines and different proportionality constants. The proportionally constant of H^0 is the same as t_P^2.

Many of the physical δ values can be derived from the initial data of n, e, α_0, and R [7]. These define two lines on the exponent harmonic fraction minus 1 δ exponent plane. Their slopes and y intercepts along with v_ns are all that is necessary to derive all of the other physical constants in this model. One line is related to the weak kinetic entities, and one related to the electromagnetic entities. The harmonic fractions, both their positive and negative values can be associated with physical entities. For example, the up quark's harmonic fraction is 1-(1/10) while the top quark's harmonic fraction is 1+(1/10). Different forces can be associated with different lines, but they are all initially derived solely from the slopes and intercepts of the initial two fundamental weak kinetic and electromagnetic lines, and the hydrogen points.

The Hubble Law is a dimensionless when both sides are divided by the speed of light so standard dimensionless harmonic neutron hypothesis methods of analysis is possible. This derivation also generates new insights into the connections of between the quantum subatomic kinetic entities of neutron beta decay leading to the expansion of the neutron in beta decay, the neutron, t_P, gravity, H_0 and the apparent expansion of the universe.

2. METHODS, RESULTS

I. Conversion of physical constants to frequency equivalents

The harmonic neutron hypothesis states that fundamental constants as frequency equivalents are related to the annihilation frequency of the neutron, v_n, 2.2718591×10^{23} Hz, relative error of 2.2×10^{-8} as a dimensionless number, v_ns. [4-8] Frequency is the ratio of a distance (wave velocity x unit time) divided by a circumference of a unit circle, a distance divided by a distance, is dimensionless. The floating point (the number of accurate digits) is based on known experimental data which is near relative error of 5×10^{-8} for the subatomic data, but only 10^{-2} for H_0. All of the known fundamental constants are converted to frequency equivalents, v_k, Equations 1-4. The masses are converted by multiplying by c^2 (speed of light squared) then dividing by h (Planck's constant). The distances are converted by dividing the wavelength into c. Energies in Joules are converted by dividing by h. The eV value for the neutron is $939.565378(21) \times 10^6$. Hz is

converted to eV by multiplying by the constant, 4.1356675 × 10^{-15} eV/Hz. eV was converted to Hz by multiplying by the constant 2.4179893 × 10^{14} Hz/eV. All of the data for the fundamental constants were obtained from the websites (http://physics.nist.gov/cuu/Constants/ and www.wikipedia.org. Some of the values have slightly changed since the original paper since the values for the fundamental constants have been updated since 2009. The differences are not significant.

$$v_n = \frac{m_n c^2}{h} = 2.2718591x10^{23}\,Hz \quad (1)$$

$$v_e = \frac{m_e c^2}{h} = 1.2355899x10^{20}\,Hz \quad (2)$$

$$v_{\alpha_0} = \frac{c}{\alpha_0} = 5.6652564x10^{18}\,Hz \quad (3)$$

$$v_R = cR = \frac{c}{1/R} = 3.2898419x10^{15}\,Hz \quad (4)$$

II. Association of individual physical constants to harmonic fractions and their degenerate frequency equivalents

The harmonic neutron hypothesis assumes that harmonic integer fraction exponents of v_ns are the degenerate values in a symmetric pattern, not the frequency values themselves. v_ns is raised to exponents of a consecutive harmonic quantum fraction (qf) series (n±1)/n for the principal quantum numbers n=1 to ∞ represents many of the degenerate exponent values of the fundamental constants, Equation 5. The degenerate ratios of the constant's frequencies and v_ns represent v_ns raised to qfs, harmonic quantum fraction exponents of 1/±n for n=1 to ∞, Equation 6.

$$(v_n s)^{(qf)} = (v_n s)^{\frac{n\pm1}{n}} \quad \text{for principal quantum number n=1 to } \infty \quad (5)$$

$$(v_n s)^{(\frac{1}{\pm n})} = \frac{v}{v_n s} \quad \text{for principal quantum number n=1 to } \infty \quad (6)$$

III. Calculation of known exponents, exp_k, and known δ_k values

The exponents of known entities are the ratio of the $\log_e$ of the v_k divided by the $\log_e$ of v_ns, Equation 7, Figure 1. The qf are plotted at qf-1, x axis location since they are related to the ratio of the known frequency and v_n Hz, Equation 6. v_ns raised to the known exponent of a physical constant equals its frequency equivalent, Equation 8. This can be written in a number of different equivalent forms. The one to the reader's right demonstrates the shift in the fundamental frequency for different δ lines. A line connecting the h point (-1, 0) and any other specific point will shift its fundamental frequency to v_ns raised to 1 plus the y intercept at x equals 0. A line connecting the n point (0, 0) and any other point will shift its fundamental frequency to v_ns raised to the y intercept at x equals -1 with an exponent of 1-qf. The difference between the known exponent and the quantum fraction equals δ, Equation 9. There are small derivable δ values that "shim" the qf to their exact exponent values from force δ lines, Equation 9. A common force is associated with its own δ line. These δ lines are frequently simple functions of bwk, awk, and bem as in this case for the line that defines t_P^2 and H^0.

$$\exp = \frac{\log_e(v_k)}{\log_e(v_n s)} = \log_{v_n s}(v_k) \quad (7)$$

$$v_k = (v_n s)^{\exp_k} = (v_n s)^{qf+\delta} = [v_n s^{(1+\delta_{y\,intercept\,at\,x0\,from(-1,0)})}]^{qf}\, x[v_n s^{(\delta_{y\,intercept\,at\,x-1\,from(0,0)})}]^{1-qf} \quad (8)$$

$$\exp_k - qf = \frac{\log_e(v_k)}{\log_e(v_n s)} - qf = \delta = \Sigma qf + func(bwk, awk, bem) \quad (9)$$

IV. Transformation of known exponents plotted to a quantum fraction-1 δ exponent plane and calculation of the composite physical constant line slopes and y intercepts

Each fundamental constant is plotted, transformed, on to the qf-1, δ exponent plane Figure 1. This value is identical to the known exponent. The harmonic fraction exponent minus 1 is the x axis value, Equation 10. Usually the closet qf to the known exponent is its associated qf. The y axis is δ, Equations 9 for specific points.

$$x = \pm\frac{1}{n} = qf - 1 = \frac{n \pm 1}{n} - 1 = \sum qf - 1 \quad \text{n=1 to } \infty \quad (10)$$

The slopes and intercepts of two lines have been published and were derived from the properties of hydrogen and the neutron, Table 1, FIG 1, Equations 11 -13. These lines with v_ns scale the 2D vector plane. One line is related to weak kinetic, wk, entities, which are referred to as the wk line. This is defined by the points for the mass of the e, (-1/7, δ_e) and the Bohr radius α_0, (-1/5, $\delta_{\alpha 0}$) Equations 11, 12. The slope is awk, 3.0003655 x 10^{-3} and the y-intercept is bwk, 3.5163835 x 10^{-3}. Their respective principal numbers are 7 and 5, qfs 6/7, 4/5, and x axis values of -1/7 and -1/5. The frequency equivalent of the α_0, $v_{\alpha 0}$, is 5.6652564 ×10^{18} Hz; $\exp_{\alpha 0}$ is 0.80291631. The qf is 4/5 and its δ is 2.9163104×10^{-3}. The frequency equivalent of the e, v_e, is 1.2355900 ×10^{20} Hz; $\exp_e$ is 0.86023062. The qf is 6/7 and its δ is 3.0877598 ×10^{-3}.

The electromagnetic, em, line is defined by the points for Planck's constant, (-1, 0) and R (-1/3, δ_R), FIG 1, Equation 13. This is the second line that was previously published. It slope and y intercept, bem, are identical and equal -3.4516836 x 10^{-3}. This line is related to the principal quantum number 3, qf, 2/3. The ionization energy of hydrogen is related to the Rydberg constant, R. The frequency equivalent of the hydrogen ionization energy, v_R, is 3.2898419 ×10^{15} Hz; $\exp_R$ is 0.66436554. The qf is 2/3 and its δ is –2.3011223 ×10^{-3}. The line formed from the qf-1, δ point for Planck's constant (h) is plotted at (–1, 0) by definition (FIG 1). The frequency of Planck's constant is 1 Hz.

$$awk = \frac{(\exp_e - \frac{6}{7}) - (\exp \alpha_0 - \frac{4}{5})}{(\frac{6}{7} - \frac{4}{5})} = 3.0003655x10^{-3} \quad (11)$$

$$bwk = (\exp_e - \frac{6}{7}) + (awk)x\frac{1}{7} = (\exp_{\alpha_0} - \frac{4}{5}) + (awk)x\frac{1}{5} = 3.5163835x10^{-3} \quad (12)$$

$$bem = aem = \frac{3}{2}(\exp_R - \frac{2}{3}) = -3.4516836x10^{-3} \quad (13)$$

Table 1

physical constant	value
v_ns	2.2718591 x 10^{23}
$\log_e(v_n s)$	53.7800556
bwk: y intercept, weak force, wk line	3.5163835 x 10^{-3}
awk: slope, weak force, wk line	3.0003655 x 10^{-3}
bem: y intercept, electromagnetic, em line	-3.4516836 x 10^{-3}

aem: slope, electromagnetic, em line	-3.4516836 x 10^{-3}

Table 1 lists the values utilized in the derivation of H_0. The data includes the annihilation frequency of the neutron, and the published slopes and y intercepts of the wk and em lines.

Figure 1

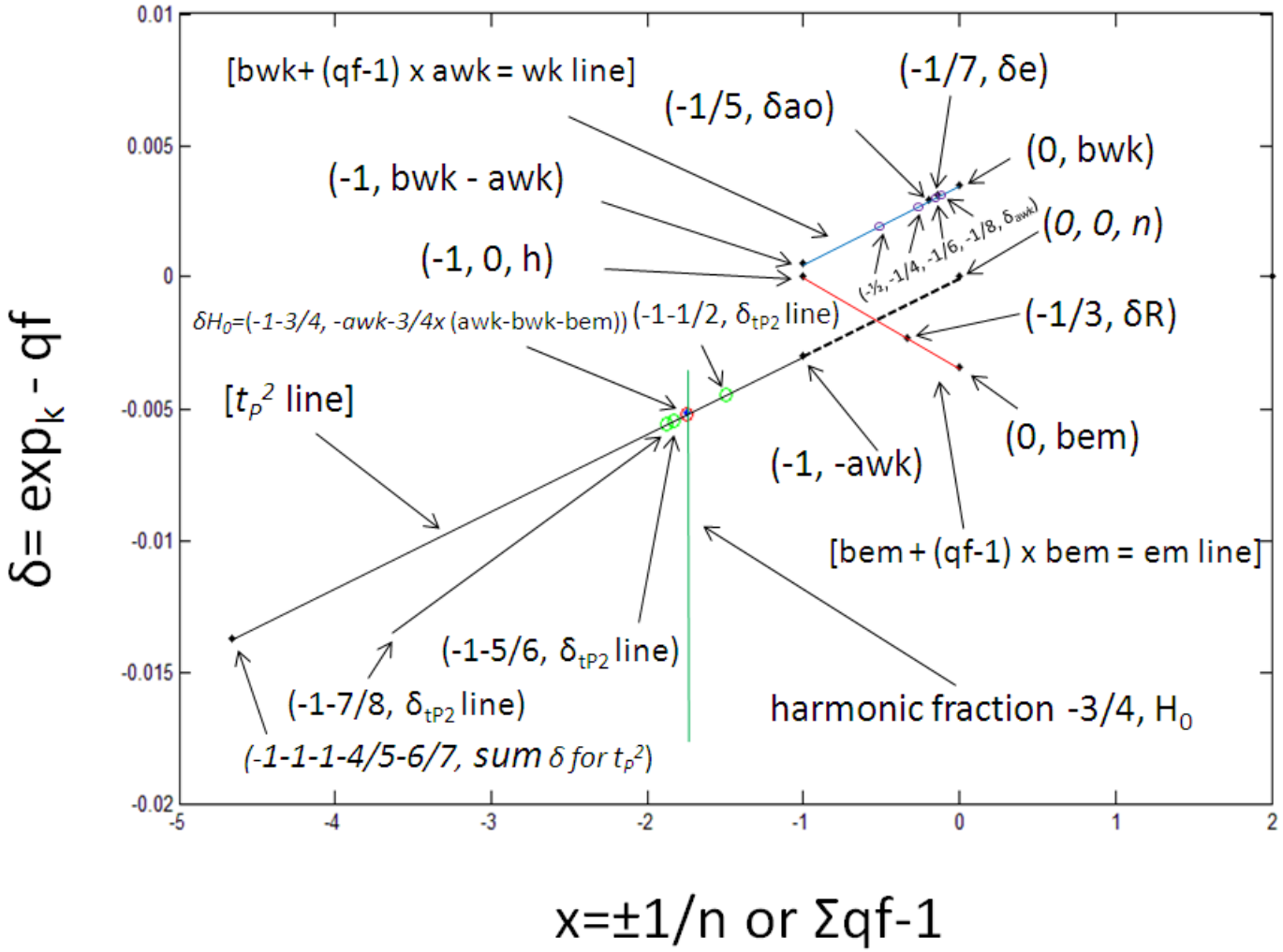

Figure 1. This is a qf-1, δ exponent plot of the relevant physical constants. The x axis equals the qf-1 or sum of qf - 1. The y axis is the difference between the known or derived exponents and their qfs, δ. The slopes and y intercepts of the three lines are sums and difference of the three published values. The previously published points related to h, n, e, R, α_0, t_P^2 are plotted. These points define three lines. e and α_0 define the wk line with slope of awk and y intercept of bwk (blue solid line). The em line is defined by h and R (red solid line). The solid black line defines t_P^2. The t_P^2 slope is the sum of awk - bwk -bem. From x equals 0 to -1 the dashed line at x equals 0 has a y value of -(bwk+bem). From x equals -1 to -163/35 the t_P^2 line is solid black. t_P^2 is plotted at an x value of -163/35. This is related to the sum of the qfs for the proton, electron, the Bohr radius, and the gravitational binding energy of the electron in hydrogen. The vertical green line at x axis -3/4-1, is centered at the qf for H_0. The H_0 qf x axis location for the -3/4 qf is -1 -3/4. It intercepts the t_P^2 line at the derived H_0 δ, the red circle. This is nearly identical to the experimental value, the blue dot. The derived H_0 equals 2.2972688 x 10^{-18} s^{-1}. The reported approximate value is approximately 2.3 x 10^{-18} s^{-1}. Three other possible qf points along the t_P^2 line are shown as green circles. These are at the inverse neutrino kinetic energy qf values of -1/2, -5/6, and -7/8. These obviously do not correspond to the H_0. The purple circles are the qf, ½, ¾, 5/6, 7/8, used for the derivation of the kinetic energy lost

in the neutron beta decay process, and are also related to the neutrino expectation masses. These are plotted at x axis values of -1/2, -1/4, -/16, and -1/8.

V. Composite physical constants and their δ lines

Composite fundamental constants are related to the products and ratios of multiple different constants. The sum difference exponent equivalent equations of these classic physics' equation are associated with composite δ values. These are linear relationships on the qf-1, δ exponent plane and are commonly simple sum and difference functions of the slopes and y intercepts of the em and wk lines, Equation 14.

$$\delta = \exp_k - qf = f[(\Sigma awk, bwk, bem) + (\Sigma awk, bwk, bem)x(qf - 1)] \quad (14)$$

VI. The t_P^2 composite line

The sums and differences of these slopes and intercepts represent other force lines including t_P^2, Equations,154, 165. t_P^2 has been derived from these same physical data. [9] The t_P^2 line extends from the point (-1, -awk) to the point (-163/35, -awk-128/35 x (awk-bwk-bem), FIG 1, Equation15. The generalized t_P^2 line is shown in Equation 16, and was used for the derivation of H_0 with qfs of -1/2, -3/4, -5/6, and -7/8. Note that t_P^2 is not derived directly from the subatomic data, but from the scaling of the unified harmonic plane.

$$\delta_{t_P^2} = -awk + \frac{-128}{35}x(awk - bwk - bem)) \quad \text{for qf <0 and for x < -1} \quad (15)$$

$$\delta = -awk + (qf)x(awk - bwk - bem)) \quad \text{for qf < 0 and for x < -1} \quad (16)$$

~~V~~VII~~I~~. Transformation of Hubble's law to a dimensionless one

Hubble's Law is Equation 17. An approximate estimate of H_0 is approximately 2.3 x 10^{-18} s^{-1}. Its value is not known accurately and varies with the associated velocity. At one Mpc the velocity is in the general range of 70 km/s. An approximate Hubble time, $1/H_0$, equals 4.35 x 10^{17} s or 13.8 billion years.

$$v = H_0 x D \quad (17)$$

In the harmonic neutron hypothesis all physical constants are evaluated as dimensionless ratios. Dividing both sides of Hubble's Law, Equation 17, by the speed of light transforms this to a dimensionless ratio relationship, Equation 18. The results of the derivations can be translated back to standard units by multiplying by c.

$$\frac{v}{c} = H_0\left(\frac{D}{c}\right) \quad (18)$$

VIII. qf-1 δ exponent plotting and calculation of the approximate reported H_0

The $\exp_k$ of the known approximate H_{0k} is $\log_e(2.3 \times 10^{-18})/ \log_e(v_n s)$, -0.75518. The values for the qfs -1/2, -3/4, -5/6, and -7/8 are interrogated to see if they are related to H_0, Equations 19-21. The qf of H_0 must be -3/4 with a δ_{H0} of approximately -5.18 x 10^{-3}, -0.75518 x 10^{-1} minus -3/4. The point (-3/4-1, -5.18 x 10^{-3}) plotted on the qf-1, δ exponent plane falls almost exactly on the published t_P^2 line, FIG 1.

IX. Derivation and plotting of hypothesized qf values of -1/2, -¾, -5/6, -7/8 and H_0 from the harmonic neutron hypothesis

The derived δ, exponents, and s^{-1} calculated values from the t_P^2 line for the possible qfs of -1/2, -3/4, -5/6, -7/8 are respectively for -1/2: -4.4681966 x 10^{-3}, -5.0446820 x 10^{-1}, 1.6498650 x 10^{-12} s^{-1}, for -3/4: -5.2021124 x 10^{-3}, -7.5520211 x

10^{-1}, 2.2972688 x 10^{-18} s^{-1}, for -5/6: -5.4467515 x 10^{-3}, -8.3878008 x 10^{-1}, 2.5652661 x 10^{-20} s^{-1}, for -7/8: -5.5690708 x 10^{-3}, -8.8056907 x 10^{-1}, 2.7107717 x 10^{-21} s^{-1}.Equations 16, 19-21 are examples of the qf of -3/4. The other qf were evaluated using the same equations, but substituting the different qf values. The derived δ_{H0} from this method is the intercept of the t_P^2 line at an x value of -3/4-1. This is the harmonic fraction x location of -3/4. The specific derivation of these factors for H_0 are shown in Equations 19-21. The other qf values were utilized in the same equation for derivation of the other possible values. Substituting the other harmonic fractions derive the other qf possibilities, Equation 16.

$$\delta_{H_0} = (\text{-}awk + \frac{-3}{4}x(awk - bwk - bem)) = -5.2021124 \text{ x } 10^{-3} \quad (19)$$

$$\exp_{H_0} = -3/4 - awk + \frac{-3}{4}x(awk - bwk - bem) = -7.5520211 \text{ x } 10^{-1} \quad (20)$$

$$H_0 = v_n s^{(-\frac{3}{4} - awk + \frac{-3}{4}x(awk - bwk - bem))} \text{ s}^{-1} = 2.2972688 \text{ x } 10^{-18} \text{s}^{-1} \quad (21)$$

The derived inverse of H_0 equals 4.3529989 x 10^{17} seconds, derived Hubble time. There are 3.1556926 x 10^7 seconds per year. The derived Hubble time equals 13.794116 x 10^9 years. The derived Hubble length is 13.794116 x 10^9 light years. The reported value is approximately 13.8 x 10^9 light years.

3. DISCUSSION

A robust physics model that explains many of the mysteries of today remains elusive. [12] A dominant mystery is how to scale sub-atomic quantum entities and cosmologic entities simultaneously in a coherent mathematical and physical model. The harmonic neutron hypothesis answers some of these questions and actually derives accurate values of the physical cosmologic constants that cannot be accurately experimentally measured. [7-11] A high accuracy H_0 is an important physical constant for astronomy. This method is a not speculative, but simple, logical, and purely computational. It is a –very highly accurate technique since it is based on subatomic quantum values, as well as established harmonic neutron hypothesis methods. Some suspect that this finding is a coincidence. The harmonic neutron hypothesis is highly restricted. There are only four starting frequency equivalents used for all of the derivations, neutron, electron, Bohr radius, and the ionization energy of hydrogen. These translate into the slopes and intercepts of two lines. This data scales the 2D vector exponent harmonic plane. The derivations are not made directly from this subatomic data, but from the unified scaling of the whole harmonic 2D system. This space represents an infinite number of continuous possible v_f values. Therefore it is incorrect to interpret that H_0 was derived from a product ratio relationship of these subatomic constants. This method is not analogous to standard physic's methods of product ratio relationships. The predictive power is imbedded in the combination of the scaled 2D exponent space and the fixed harmonic fraction nature of harmonic systems. The only other variables are the quantum fraction possibilities and these are fixed and exact. The hypothesis states that related physical constants will all fall on a single line. This means they are all related to a common proportionality constant which is a classic physics property. There are only four possible hypothesized qf values for H_0. These are related to the kinetic energy lost in the neutron beta decay process. Most even numbered denominator qf are related to kinetic entities. The qfs must be inter-related logically and mathematically as either a consecutive integer series as in this case, or by the product of lower order principal harmonic numbers as has been shown with the leptons and quarks. For example, the hypothesis states that the quarks must fall on lines defined by bem solely and their qf must be products of the principal quantum numbers 3, 9, 10, , and 11. This was hypothesized in 2009.[7] This was been shown to be true in 2013. [10] All of these requirements must be fulfilled simultaneously, and are beyond what can be considered coincidence.

Some have stated that the model is conjecture. The values used in the calculations are transformed from the standard units, and the results can be converted back to standard units. All of the standard physics equations are completely maintained, but translated into exponential ones. It is impossible to manipulate the results since all of the components are fixed by valid physical values, and harmonic fractions that cannot be altered. A perspective of the fundamental constants as a unified harmonic system is what is new. The logic and calculations are innovative, but represent classic valid physics and mathematics.

These same strict criteria are fulfilled in the derivation of H_0 as well. There are multiple fixed variables of this derivation that have been previously published and were not manipulated, including, the values for v_ns, slopes and y intercepts of the wk and em lines, slope and y intercept of the t_P^2 line, the qfs associated with the kinetic energy of neutron beta decay ½, ¾, 5/6, and 7/8. Just as it is possible to derive all lines of the Rydberg series line if one knows the wavelength, and n_1,

n_2 values of just one, it is possible to derive H_0. This is a classic powerful characteristic of harmonic systems that is well understood in the analysis of quantum spectrum, but this approach for the fundamental constants as a unified system is unique.

It is logical that the H_0 should be in some way related to gravity and therefore t_P^2. t_P^2 is the identical proportionality constant as the Newtonian gravitational constant in the frequency domain. [9] H_0 is related to an expansive kinetic phenomenon, and so is the neutron beta decay process. The harmonic neutron hypothesis has shown multiple examples of symmetric inverse sign qf relationships. The top quark is 1+1/10 and the up quark is 1-1/10. The Higgs boson is related to 1+1/11, and the down quark is 1-1/11. This is an identical relationship is seen with the Rydberg series and the Moseley's law which exponentially are inverses. Therefore it is logical to hypothesis that one of the inverse sign qf of neutron beta decay is related to H_0. The only possible variables in this complete derivation were the quantum fractions and they are predefined. These four qfs translate into widely divergent possible derived H_0 values that range from $1.6498650 \times 10^{-12}$ s^{-1} for qf -1/2 to $2.7107717 \times 10^{-21}$ s^{-1} for qf -7/8. A minute change on the qf-1 δ exponent plane point can be a huge change in the actual frequency equivalent. This is not coincidence since it is the identical pattern seen with the quarks, and the kinetic energy lost in the neutron beta decay process.

This derivation of H_0 is the second example of continuous scaling from quantum to cosmic fundamental constants. The Standard Model fails to bridge this gap. The success of this derivation should raise the interest in the method to explore other fundamental constants. The harmonic neutron hypothesis also explains H_0 precise logical origin and unification with other fundamental constants including the neutron, neutrinos, t_P, G, the kinetic energy lost in the beta decay process. The +¾ qf is associated kinetic energy lost neutron beta decay. This is also associated with the muon antineutrino, expectation value, unpublished data. H_0 is logically associated with its negative –integer fraction, -3/4. On the qf-1, δ plane these are symmetric. This is a remarkable unification and pairing of subatomic and cosmic physical constants.

4. CONCLUSION

H_0 can be derived from subatomic data only. H_0 is logically related by harmonic fractions to the kinetic expansive beta decay process based on a common harmonic fraction, 3/4, but with opposite signs. The derived H_0 can be evaluated in the future to see if this is an accurate prediction. This derivation supports the validity of the neutron harmonic hypothesis that now includes three of the most important astronomy physical constants t_P, H_0, and G. All are defined utilizing solely v_ns and the published values for the slopes and intercepts of the em and wk lines. This supports the concept that the fundamental constants represent in simplest terms a classic harmonic system.

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DEFINITIONS, ACRONYMS, ABBREVIATIONS

bwk: y intercept of the weak kinetic line, wk
awk: slope of the weak kinetic line, wk
bem: slope and y intercept of the electromagnetic line, em
v_ns: dimensionless constant related to the annihilation frequency of the neutron times on second
H_0: Hubble constant in s^{-1}
e: electron
α_0: Bohr radius
R: Rydberg constant
α: fine structure constant
qf: a quantum integer fraction
δ: the difference of the known exponent minus the qf