

The Calculation of the Planck Circumference and the Planck Length via the Inverse of the Elementary Charge, Utilizing π

V. R. D'Angelo (vrd156@aol.com) April 15, 2015

Table of contents

ABSTRACT	3
INTRODUCTION	3-4
ASSUMPTIONS	5
DISCUSSION	6
Utrixical theory	6
Fundamental unit, Y'	6
Groupings	7
Planck circumference, \textcircled{P}	7-8
Planck length	7-8
Infinities	9
Blueprint	10-17
Standard and Utrixical theory values list	18-21
Half reduced Planck constant	22
Ratio of attribute constant	22-26
Subset of new (riser) constants ratios	27-28
Fibonnaci connection	29
Hierarchical electron mass equation	30
Characteristic impedance of vacuum equation	31
Rydberg constant equation	32
Elementary charge	33
Inverse elementary charge	33
Inverses	33
Speed of light equation (via inverses)	34
Inverse fine structure constant	35
Pi	36
Terminating decimal constants	36
Musical chairs equations	37
Time	38
Higgs boson	39
Gravity	40
Fractal universe	40
CODATA (NIST) values errors	41
Proton charge radius conundrum	42-47
CONCLUSION	48-49
REFERENCES	50

The Calculation of the Planck Circumference and the Planck Length via the Inverse of the Elementary Charge, Utilizing π

V. R. D'Angelo (vrd156@aol.com)(1-646-369-2506) April 15, 2015

Abstract

The theoretical calculation of the Planck circumference and the Planck length, with a result that is in agreement with the uncertainty limits set by the 2010 (NIST) CODATA values. [1] The author posits the Planck circumference as the first π , and theorizes a new profound meaning of the inverse of the elementary charge as the number of a postulated fundamental unit Y' ; within the framework of a proposed *finite fundamental particle grouping theory --- Utrixical theory*.

Key words: Planck length, elementary charge, pi, time, inverses, inverse fine structure, infinities, Higgs boson, (Utrixical theory: fundamental unit Y' , groupings, Planck circumference, riser ratios, blueprint, hierarchical equation)

Introduction

It has been twenty-five hundred years since humanity, by way of Democritus, embarked on its quest to find the smallest indivisible particle. Today, the quest continues with the standard model as its torch bearer. The standard model with quantum chromodynamics (QCD) as its central feature, proposes sixty one (sub-atomic) fundamental units.[4][33][34] Not exactly satisfying as a fundamental theory. The author proposes a theory whose framework utilizes one fundamental unit (the only hypothetical in Utrixical theory), called Y' , with attributes of: charge, energy, mass, length, speed, magnetism, temperature, etc., as the adhesives in the construction of the universe. The postulation of the natural Planck circumference constant, where its diameter is the Planck length. (pgs.7-8)

In the one hundred plus years of fundamental particle physics, not *one* fundamental constant has been enumerated based on first principles. The values of all constants have been derived solely by experimental measurement. [1][3][7] Utrixical theory enumerates the Planck length to a rational, terminating decimal (pg.8); providing a framework to calculate the constants to exact values. (limited only to the computing power of the computer, akin to π)

There is no doubt, we live in an interconnected universe. [7] An all-encompassing fundamental theory must provide a framework connecting *all* the dots. A progressive connection is shown in the hierarchical electron mass equation (pg.30), where a schematic of seven connecting constants is presented. Also, a sequence is constructed utilizing the Planck circumference (the first π / first structure), providing a blueprint of fundamental constants. (pgs.10-17) And an introduction to a subset of new constants as connectors to the standard model's constants.

Pi, π --- defined as the ratio of a circle's circumference to its diameter. Calculated to more than a billion decimal places! More than thirty-five hundred years after its discovery, π is still not understood in terms of a definable function within the context of fundamental equations, albeit ubiquitous. [2] A satisfactory theory must be able to define such a function. Utrixical theory posits, that nature utilizes the first π as the catalyst of the first structure, i.e., the Planck circumference constant, $\textcircled{P} = l_p * \pi = 5.077383865 \times 10^{-35}$ m. (pg.7-8)

It is assumed, when a great theory is presented, the physics community will immediately recognize it. Unfortunately, I do not believe that will be the case. Albert Einstein's theory of relativity, arguably the greatest scientific theory of the twentieth century, took nearly five years before it received recognition. And, that was only because Max Planck the leading academic of the time, gave his endorsement. Though Einstein was a physicist, he was outside of the mainstream establishment. Sir Arthur Eddington, a leading scientist of the day, was asked if it was true that only three people in the world understood relativity. He was quoted: "And who is the third?" [19]

I would like to bring to light an issue between the 2006 and the 2010 (NIST) CODATA values of the constants. The equations of Utrixical theory state that some of the 2010 values are incorrect. The 2006 values are correct within their respective uncertainty limits. As of yet, there has been no response to a letter sent to the National Institute of Standards and Technology. (pg.41) Throughout the course of this paper, the 2006 and some of the correct 2010 values will be used. For General purposes the differences are superficial, but for precision calculations, correct uncertainty values are invaluable. Though at first it would seem a bit of a quagmire for this paper; I am extremely confident that Utrixical theory will be vindicated by the reassessment of the erroneous 2010 CODATA values. [1]

Infinities – the plague of particle physics for nearly a century. In his book, QED, the strange theory of light and matter, Richard Feynman puts it in perspective, *"The problem is, when we try to calculate all the way down to zero distance, the equation blows up in our face and gives meaningless answers --- things like infinity. This caused a lot of trouble when the theory of quantum electrodynamics first came out. People were getting infinity for every problem they tried to calculate! One should be able to go down to zero distance in order to be mathematically consistent,"*. It is the author's contention that the 12th assumption, the introduction of the fundamental unit Y' , in conjunction with Utrixical theory equations, such as the calculation of the Bohr magneton render the infinities moot. Therefore, Utrixical theory equations are infinities free, by virtue of their non-zero distance calculations, albeit incredibly small ($8.134865168 \times 10^{-54}$ m) [6][21][28]

Assumptions

1) The existence of a fundamental unit / building block, denoted Y' , which is more than 35 orders of magnitude smaller than the elementary charge. (The only hypothetical in Utrixical theory)

a) the attributes of the fundamental unit, Y' : charge, energy, mass, length, speed, magnetism, temperature, etc., as the binding adhesives of creation.

b) The charge attribute as the *one* force. Defining the four forces: gravity, the electromagnetic, weak and the strong forces as manifestations of the *one* charge force, within a classical framework.

c) The double function of the charge force: 1) the binding force in atomic structure (matter). 2) The collective charge pressure of Y' units in between subatomic particles, planets, stars, galaxies, etc. The voids with the greatest concentration of Y' units pressure (dark energy) as the mechanism of galactic stability.

2) The equivalency principle of the fundamental unit, Y' - at the fundamental level, the attributes of matter, (i.e., charge, energy, mass, length, speed, magnetism, temperature and by extension all units) are equivalent. All units equate to the same value: 8.134865168^{-54} .

3) Groupings of fundamental units Y' , give rise to the fundamental constants. I.e., all fundamental constants can be derived purely from specific groupings of fundamental units, Y' . The constants also function as ratios. (see speed of light and musical chairs equations, (pg34,37)

4) The value of the inverse of the elementary charge as the number of fundamental Y' units, gives rise to the Planck length.

5) The dual role of π as the catalyst of structure and beginning of time.

6) The theoretically enumerated Planck length to manifest its value as a terminating decimal. (the inverse of the elementary charge, e ; multiplied by the fundamental unit, Y' ; then divided by π , i.e., $lp = (\frac{1}{e} * Y') / \pi$

7) The simplification / reduction of the four dimensions to three. Elucidating time, not as a dimension, but as a process of decay. Time defined as structure dependent.

8) Postulating a ground state universe of absolute 0, prior to time and after time. In its short period of existence since its birth, (13.7 billion years) the universe has managed to reverse its temperature from the Planck temperature ($1.416785(71) \times 10^{32}$ Kelvin) to 2.7 K above absolute zero!

9) Introducing a new constant, the Planck circumference, $\textcircled{P} = (\frac{1}{e} * Y')$, the inverse of the elementary charge multiplied by the fundamental unit Y' . The first π , first structure, first time.

10) Re-introducing, half of the reduced Planck constant, $\frac{1}{2}\hbar$. "The Forgotten constant".

11) Subset of new constants (ratios), that provide the connectedness to the relationships of fundamental constants.

12) Zero does not exist. The fundamental unit, Y' , as the smallest entity in nature. This addresses the issue of infinities moot. There necessarily always has to be a unit between two particles by definition. (pg.9) Zero as a human construct.

Discussion

Utrixical theory --- Though it is not the intent of this paper to present a fundamental theory; the author is compelled, in the course of its writing to touch upon key assumptions and present equations that serve as the infrastructure of a classical finite fundamental particle grouping theory --- called Utrixical theory. The contents in the assumptions section serve as a basic outline of Utrixical theory tenets. Utrixical theory posits everything conceivable to be comprised of fundamental units Y'.

Fundamental unit, Y' --- Democritus's smallest indivisible particle found! The universal building block with the physical attributes of: energy, charge, mass, length, speed, magnetism, temperature, etc., as the binding adhesives of nature. Akin to the electron possessing the same exact attributes. Thought experiment: Let us say that a steel ball bearing is the (blown-up) fundamental unit Y'. In analysis, we find it has mass and arbitrarily measure it in kilograms, it has energy and measure it in joules; it has length and measure it in meters; it has charge and measure it in Coulombs, and so on. By virtue of being the fundamental unit, one can see how the various units can have the same numerical value. Therefore, exempt from dimensional analysis.

The fundamental unit Y', as the smallest entity in nature. Zero does not exist. There necessarily always has to be a unit between two particles by definition. *If two particles had nothing separating them, (and you had the temperament of a physicist) it would be one particle!*

$$Y' = l_p * \pi * e$$

Utrixical theory value: 8.1348651681005514475463894507389 x10⁻⁵⁴

where: $l_p = 1.61618148047550 \times 10^{-35}$ m (Planck length, terminating decimal)

$e = 1.60217651115315018265897 \times 10^{-19}$ C (elementary charge)

$\pi = 3.1415926535897932384626433$ (pi)

Groupings --- Utrixical theory posits groupings of fundamental units Y', as the foundational scaffolding of the constants. The constants defined as groupings (exact values) of Y' units. The Planck circumference, \textcircled{P} , as the first grouping. Half of the reduced Planck constant, ($\frac{1}{2}\hbar$), second. The reduced Planck constant, \hbar , third. The Planck constant, h , fourth. The electron mass, m_e , fifth. And, the proton mass, m_p , sixth. Actually, a technicality, the inverse of the elementary charge, $\frac{1}{e}$, with a value of: $6.241509554 \times 10^{18}$ units, (would be the, structure less first grouping); when multiplied by the fundamental unit, Y' ($8.134865168 \times 10^{-54}$, gives rise to the Planck circumference (the structured first grouping), \textcircled{P} (its diameter being the Planck length, l_p).

Planck circumference, \textcircled{P} --- "The first grouping", "First pi", "First structure", "First time". A natural outcome by postulating the value of the inverse elementary charge as the number of fundamental units, Y'. Time is conjoined to the Planck circumference, .i.e., time is structure dependent. No structure, no time. (The National Institute of Standards and Technology, CODATA group, does not list or acknowledge the Planck circumference constant.) [1]
Planck circumference - The product of two very well-known constants, the Planck length and pi:

$$\textcircled{P} = l_p * \pi$$

Planck length, l_p --- has been given high prominence in fundamental particle physics. But according to Utrixical theory, it's nothing more than the natural Planck circumference divided by pi.

$$l_p = \frac{\textcircled{P}}{\pi}$$

The calculation of the Planck circumference and the Planck length via the inverse of the elementary charge, utilizing π

$$\mathbb{P} = \frac{1}{e} * Y'$$

$$lp = \frac{\frac{1}{e} * Y'}{\pi}$$

Postulating the inverse of the elementary charge, i.e.,

$$\frac{1}{e} = 6.241509553028337757162816786103 \times 10^{18}$$

where: $e = 1.6021765111531501826556617650347 \times 10^{-19}$ (elementary charge)

when multiplied by the fundamental unit Y'

$$Y' = 8.134865168005514475463894507389 \times 10^{-54}$$

gives rise to the Planck circumference \mathbb{P} ,

$$\mathbb{P} = 5.0773838659297066558144945927867 \times 10^{-35}$$

when divided by π ,

$$\pi = 3.1415926535897932384626433832795$$

gives rise to the Planck length,

$$lp = 1.61618148047550 \times 10^{-35} \text{ m}$$

a rational , terminating decimal (within the (NIST) 2010 CODATA value: $1.616199(97) \times 10^{-35}$ m

Equations of the Planck length(National Institute of Standards and Technology)

$$lp = \hbar/mpc = (\hbar G/c^3)^{1/2}$$

(NIST) 2010 CODATA value: $1.616199(97) \times 10^{-35}$ m

Infinities

In his book, QUANTUM, Jim Al-Khalili states: “An electric charge will generate around it an electric field, but how do we work out the effect this field has on the charge that generated it in the first place? This is only a problem at the place where the charge is situated, but here we would get an infinite answer. This is because we would need to divide a certain quantity by the distance between the point we are interested and the position of the charge. In this case, that distance is zero. And dividing anything by zero gives us infinity. “ [21]

Let us review the 12th assumption, that the fundamental unit, Y' is the smallest entity in nature. And that zero does not exist. This would render the issue of infinities moot . There necessarily always has to be a unit between two particles by definition. Therefore a particle cannot be measured down to zero. If two particles had nothing separating them, it would be *one* particle! *Thought experiment:* take your thumb and index finger and approximate the distance of one inch, now reduce that to half an inch, repeat the process to a ¼ of an inch, and so on, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, 1/512, 1/1024, 1/2048, 1/4096, 1/8192, 1/16384, 1/32768, 1/65536, 1/131072, 1/262144, 1/52488, 1/1048576, 1/2097152, 1/4194304, 1/8388608, 1/16777216, 1/33554432, 1/67108864, 1/1342177228, 1/268435456, 1/536870912, 1/1073741824, we are down to our fingers not touching by over one billionth of an inch. A simple mathematical exercise expounding a principle of nature. If our thumb and index finger were to touch, then the definition of the hand would have to be redefined as having four appendages.[6][17] Analogy: basketball players do not play on a wooden floor --- They play on varnish.

Overcoming infinities via the Bohr magneton equation:

$$\mu_B = \left(\frac{Y'}{m_e} \right) * \left[\frac{1/2 \hbar}{\textcircled{P}} \right]$$

(NIST) CODATA value: 927.400915(23) x10⁻²⁶ J T⁻¹

Utrixical theory value: 927.40092963534952499928179530912 x10⁻²⁶ J T⁻¹

Where: m_e = 9.10938206542160392 x10⁻³¹ kg (electron rest mass)

Y' = 8.1348651680055144754 x10⁻⁵⁴ (fundamental unit)

(1/2)ħ = 5.27285810088126840 x10⁻³⁵ (half of the reduced Planck constant)

Ⓟ = l_p * π = 5.077383865929706655 x10⁻³⁵ m (Planck circumference, Planck length multiplied by π)

$\frac{(1/2)\hbar}{\textcircled{P}}$ = 1.038499006 (ratio of attribute)

Fundamental constants blueprint

Can anyone imagine a skyscraper or a nuclear power plant that did not have a blueprint? The answer is no. There are numerous laws of physics that must be applied in order to bring such structures to fruition. By the same token, it would be ludicrous to think that the universe just happened to be. The workings of the universe are bound and constricted by physical laws to a precision of better than one part per billion. As the big bang, stellar nucleosynthesis and the field of chemistry can attest to. [22][33]

The scaffolding of the fundamental constants via a subset of new constants (ratios). The seven foundational constants, from which all constants are derived. Fundamental unit, Y' ; Planck circumference, \mathcal{P} ; half of the reduced Planck constant, $\frac{1}{2}\hbar$; the reduced Planck constant, \hbar ; the Planck constant, h ; electron mass, m_e ; and the proton mass, m_p .

(note: the Planck circumference as the core of all constants)

$$\text{The Planck circumference, } \mathcal{P} = \frac{Y'}{e} = lp * \pi = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]$$

, grouping, and subsets of new constants as the foundation of all constants:

(note: equations in brackets and prentices, subject to non-canceling / non-simplifying)

$$Y' = 8.1348651681005514475463894507389 \times 10^{-54}$$

(Fundamental unit) (the only hypothetical in Utrixical theory)

$$\mathcal{P} = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]$$

(Planck circumference) (the product of two very well-known constants, the Planck length and π)

$$\left(\frac{1}{2}\right)\hbar = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{\frac{1}{2}\hbar}{\mathcal{P}} \right]$$

(half of the reduced Planck constant) (the forgotten constant)

$$\hbar = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{\frac{1}{2}\hbar}{\mathcal{P}} \right] 2$$

(reduced Planck constant)

$$h = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right] 13$$

(Planck constant)

$$m_e = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{me}{\mathcal{P}} \right]$$

(electron mass)

$$m_p = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{me}{\mathcal{P}} \right] \left[\frac{\frac{Y'}{mec}}{\left[\frac{h}{13\pi} \right]} \right]$$

(proton mass)

$$m_e c = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{me}{\mathcal{P}} \right] c$$

(natural unit of momentum)

$$E_h = [Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] c \left(\frac{c}{\left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\mathcal{P}} \right]} \right]} \right)$$

(Hartree energy)

$$l_p = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]}{\pi}$$

(Planck length)

$$t_p = \frac{[Y'c^2 2\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^2 2\pi(\alpha^{-1})} \right]}{\pi c}$$

(Planck time)

$$T_p = \frac{[Y'c^2 2\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^2 2\pi(\alpha^{-1})} \right] \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right] 2\pi c}{k}$$

(Planck Temperature)

$$h/me = \frac{[Y'c^2 2\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^2 2\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right]^{13}}{\left[\frac{me}{\mathcal{P}} \right] \mathcal{P}}$$

(quantum of circulation times 2)

$$h/mec = \frac{[Y'c^2 2\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^2 2\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right]^{13}}{\left[\frac{me}{\mathcal{P}} \right] \mathcal{P} c}$$

(Compton wavelength)

$$\hbar/mec = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right]^2}{\left[\frac{me}{\mathcal{P}} \right] \mathcal{P} c}$$

(Compton wavelength over 2 pi)

$$h/2me = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right]^2}{\left[\frac{me}{\mathcal{P}} \right]^2}$$

(quantum of circulation)

$$h/2e = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right]^2}{\left[\frac{Y}{\mathcal{P}} \right]^2}$$

(magnetic flux quantum)

$$a_0 = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{\frac{1}{2}h}{\mathcal{P}} \right]^2}{\left[\frac{h}{a_0} \right]}$$

(atomic unit of length)

$$\hbar/a_0 = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\mathcal{P}} \right]} \right] c}{\alpha}$$

(atomic unit of moment)

$$\alpha = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right] c}{Eh}$$

(fine structure constant)

$$E_h/c^2 = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]}{\left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\mathcal{P}} \right]} \right]}$$

(Hartree- kilogram relationship)

$$R_K = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{h}{13\mathcal{P}} \right] 13}{e^2}$$

(von Klitzing constant)

$$e = \frac{Y'}{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]}$$

(elementary charge)

$$Z_0 = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]^{120}}{3*10^8 tp}$$

(characteristic impedance of vacuum)

$$\mu_0 = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]^{120}}{3 x 10^8 lp}$$

(magnetic constant)

$$\epsilon_0 = \frac{1}{\left[\frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right] \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right]^{120}}{3 x 10^8 lp} * c^2 \right]}$$

(electric constant)

$$\alpha G = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{(\frac{1}{2})h}{\mathcal{P}} \right]^2 \right]}{\left[\frac{me}{\mathcal{P}} \right] \left[\frac{h}{13\mathcal{P}} \right]}$$

(α^{-1} to gravitational coupling constant = $5.900648676 \times 10^{-39}$)

$$\alpha G = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{(\frac{1}{2})h}{\mathcal{P}} \right]^2 \right]}{\left[\frac{me}{\mathcal{P}} \right] \left[\frac{h}{13\mathcal{P}} \right] \alpha^{-1}}$$

(proton to proton gravitational coupling constant = $8.086012903 \times 10^{-37}$)

$$\alpha G = \frac{[Y'c^22\pi] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] \left[\frac{(\frac{1}{2})h}{\mathcal{P}} \right]^2 \right]}{\left[\frac{me}{\mathcal{P}} \right] \left[\frac{h}{13\mathcal{P}} \right]} \frac{1}{\left[\frac{h}{\mathcal{P}} \right]}$$

(electron to proton gravitational coupling constant: $4.5215144 \times 10^{-40}$)

where: $[Y'c^22\pi] = 4.593795239 \times 10^{-36}$

$$\left[\frac{\alpha^{-1}}{\left[\frac{h}{\varnothing} \right]} \right] = 10.50011401$$

$$\left[\frac{h}{Y'c^22\pi(\alpha^{-1})} \right] = 1.052566740$$

$$\left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\varnothing} \right]} \right] = 1.046695664$$

$$\left[\frac{1/2\hbar}{\varnothing} \right] = 1.038499006$$

$$\left[\frac{h}{13\varnothing} \right] = 1.003858723$$

$$\left[\frac{me}{\varnothing} \right] = 17941.093890\dots$$

$$\left[\frac{mp}{me} \right] = \left[\frac{\left[\frac{Y'}{mec} \right]}{\left[\frac{h}{13\pi} \right]} \right] = 1836.022568$$

$$\left[\frac{Y'}{\varnothing} \right] = 1.602176511 \text{ e-19}$$

$$\left[\frac{h}{\varnothing} \right] = 13.0501634$$

Utrixical theory constants values list (partial)

(note: Utrixical theory utilizes both standard and linear formats)

$$Y' = 8.1348651681005514475463894507389 \times 10^{-54}$$

(fundamental unit, the only hypothetical in Utrixical theory)

$$\textcircled{P} = l_p * \pi = 5.0773838659297066558144945927867 \times 10^{-35} \text{ m}$$

(Planck circumference)

$$(\frac{1}{2})\hbar = 5.2728581008812684084733719741316 \times 10^{-35} \text{ J s}$$

(half reduced Planck constant)

$$\hbar = 1.0545716201762536816946743948263 \times 10^{-34} \text{ J s}$$

(reduced Planck constant)

$$h = 6.6260689092600086850614780798372 \times 10^{-34} \text{ J s}$$

(Planck constant)

$$m_e = 9.1093820654216039252125761912071 \times 10^{-31} \text{ kg}$$

(electron rest mass)

$$m_p = 1.6725031063199770699390935829639 \times 10^{-27} \text{ kg}$$

(proton rest mass, Utrixical theory, Drs. Pohl, Antognini et al, 4% smaller)

$$m_p = 1.672621777(74) \times 10^{-27} \text{ kg}$$

(proton rest mass, 2010 NIST CODATA value – not a Utrixical theory calculation)

$$t_p = 5.391001132108200000148102458264 \times 10^{-44} \text{ s}$$

(Planck time)

$$l_p = 1.61618148047550 \times 10^{-35} \text{ m}$$

(Planck length - terminating decimal)

$$E_h/c^2 = 4.8508693013832200102820222831018 \times 10^{-35} \text{ kg}$$

(Hartree relationship)

$$h/a_0 = 1.99285154858783677213339845740 \times 10^{-24} \text{ kg m s}^{-1}$$

(atomic unit of momentum)

$$e = 1.602176511153150182656617650351 \times 10^{-19} \text{ C}$$

(elementary charge)

$$1/e = 6.2415095530283377571628161786103 \times 10^{18}$$

(inverse elementary charge)

$$\mu_B = 9.27400929635349524999281795309 \times 10^{-24} \text{ J T}^{-1}$$

(Bohr magneton)

$$E_h = 4.359743906563135562018993531986 \times 10^{-18} \text{ J}$$

(Hartree energy)

$$\hbar/(eV \text{ s}) = 6.5821188416826590925360107620 \times 10^{-16} \text{ eV s}$$

(natural unit of action in eV s)

$$m_e c^2 = 8.1871043063899546761521994117567 \times 10^{-14} \text{ J}$$

$$\epsilon_0 = 8.854187817620398505365630550455 \times 10^{-12} \text{ F m}^{-1}$$

(electric constant)

$$G = 6.6736938662948276496080231881 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$$

(Newtonian constant of gravitation)

$$a_0 = 0.52917720887114661254501952636802 \times 10^{-10} \text{ m}$$

(atomic unit of length)

$$m_p = 2.176532973278763130658187101974 \times 10^{-8} \text{ kg}$$

(Planck mass)

$$eE_h/\hbar = 0.0066236177298784361623512927036455 \text{ A}$$

(atomic unit of current)

$$c = 299792458$$

(speed of light)

$$N/S = 288678617.98181253300491110405564$$

$$N/S = 286417980.14461008737456272212449$$

$$R_{\infty} = 10973731.5685479918130 \text{ m}^{-1}$$

(Rydberg constant - rational, terminating decimal)

$$e/\text{Ⓟ}/c^2(?) = 10525667.792751664887274171774089$$

$$R_K = 25812.807543395783932315986990988 \text{ } \Omega$$

$$(\alpha^{-1})^2 = 18778.865187780$$

$$\left[\frac{me}{\text{Ⓟ}} \right] = 17941.093890$$

$$Z_0 = 376.73031346177065546814840042032 \text{ } \Omega$$

$$\alpha^{-1} = 137.03599960514025454656360890729$$

$$E_h/e = 27.211383241570895372091825780637 \text{ V}$$

$$\left[\frac{2h}{\text{Ⓟ}} \right] = 26.100326799091548725591722764986$$

$$\left[\frac{h}{\text{Ⓟ}} \right] = 13.050163399545774362795861382493$$

$$\left[\frac{\alpha^{-1}}{\frac{h}{\mathcal{P}}} \right] = 10.500711401890182223632842837839$$

$$\frac{\left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right]}{\left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\mathcal{P}} \right]} \right]} = 10.03224887595042669322300776857$$

$$Ue_r = 1.0525667792751664887274171774089$$

$$UE_{hr} = 1.0466956643177123465797770260702$$

$$U^{1/2}\hbar_r = 1.0384990065973215460208465845696$$

$$Uh_r = 1.0038587230419826432919893371148$$

$$\left[\frac{c}{\left(c - \left(\frac{me}{\mathcal{P}} \right) \right)} \right] = 1.0000598486291468837152378796495$$

$$K = 1.3806488(13) \times 10^{-23} \text{ J K}^{-1}$$

(Boltzman constant, 2010 NIST CODATA value – not a Utrixical theory calculation)

Half of the reduced Planck constant, $\frac{1}{2}\hbar$

“The forgotten constant”, During the quantum revolution, Neils Bohr proposed that the reduced Planck constant, symbol $\hbar = h/2\pi$, was the smallest attribute of a particle, .i.e., the quantization of its orbital angular momentum. Then, in 1925, physicists Sam Goudsmit and George Uhlenbeck discovered that the electron also possessed spin angular momentum, with a magnitude of half of the reduced Planck constant, symbol $(\frac{1}{2}\hbar)$. This gave Dirac the fourth quantum number to his equation. [4][17] Though, the importance of spin cannot be over-stated. Utrixical theory will demonstrate that half of the reduced Planck constant, $(\frac{1}{2}\hbar)$, is a crucial player (above and beyond its definition of spin) in the scheme of fundamental physics. It will be shown to have a prominent role in the hierarchical order of the constants. [pg.30] The National Institute of Standards and Technology (NIST) does not list half of the reduced Planck constant, $(\frac{1}{2}\hbar)$. [1]

Ratio of attribute constant --- Utrixical theory introduces a new, invaluable constant, the ratio of half of the reduced Planck constant symbol, $(\frac{1}{2}\hbar)$, divided by the Planck circumference, \textcircled{P} . Perhaps, the most important of the new subset of constants. It is shown that it gives sequential rise to the constants. The ratio of attribute is an intrinsic part of most fundamental Utrixical theory equations (pgs.22-26) It endows particles with attribute. The missing link constant, its ratio, along with other offshoot ratios, form the foundation of the relationships and enumeration (exact values) of fundamental constants and forces of nature.(see hierarchical equation, pg.30)

Ratio of attribute equation:

$$\left[\frac{(\frac{1}{2})\hbar}{\textcircled{P}} \right] = 1.038499006$$

Equations utilizing ratio of attribute:

The ratio of attribute constant (missing link)

$$\left[\frac{(\frac{1}{2})\hbar}{\varrho} \right] = \frac{\left(\frac{c^4}{G}\right)tp}{2\pi} = \frac{mpc}{2\pi} = \frac{(\frac{1}{2})\hbar * e}{Y_1}$$

Utrixical theory value: 1.038499006

Planck mass

$$m_p = \frac{2\pi \left[\frac{(\frac{1}{2})\hbar}{\varrho} \right]}{c}$$

Please perform this simple calculation (scientific mode):

$$2\pi * 1.038499006 / 299792458 = 2.176532972 \times 10^{-8} \text{ kg}$$

Note: within the 2010 (NIST) CODATA value: $2.17651(13) \times 10^{-8} \text{ kg}$

The NIST lists the Planck mass equation (standard model) as: $m_p = (\hbar c/G)^{1/2}$ [1]

The author demonstrates that Utrixical equations are novel, simpler, and accurate to an unprecedented degree, than the standard model equations.

Planck energy

$$E_p = 2\pi \left[\frac{(\frac{1}{2})\hbar}{\varrho} \right] c$$

half of reduced Planck constant

$$\frac{1}{2}\hbar = \mathcal{P} \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]$$

Reduced Planck constant

$$\hbar = 2 \mathcal{P} \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]$$

Planck Constant

$$h = l_p * 4\pi^2 \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]$$

Electron substructure

$$m_e / \mathcal{P} = \left(\frac{e}{\mu_B} \right) \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]$$

Compton wavelength over 2π

$$\lambda_c = \hbar/mec = \frac{2 \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]}{\left[\left(\frac{me}{\mathcal{P}} \right) c \right]}$$

Inverse fine structure constant

$$\alpha^{-1} = 4\pi \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right] \left[\frac{\alpha^{-1}}{\left[\frac{\hbar}{\mathcal{P}} \right]} \right]$$

Proton charge radius

$$r_p = \frac{8}{\left[\frac{me}{\mathcal{P}} \right] \left(\frac{mp}{me} \right) \left[\frac{c}{\left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]} \right]}$$

Planck temperature

$$T_p = \frac{2\pi \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right] c}{k}$$

Planck time

$$t_p = 2\pi \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right] \left(\frac{G}{c^4} \right)$$

Newtonian constant of gravitation

$$G = \frac{lp * c^3}{2\pi \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]}$$

Subset of new (riser) constants ratios

Newly discovered ratios that opens a new chapter in fundamental particle physics. These new constants as well as the known constants are predicated on ratios of Y' prime units. Analogy: think of the known constants as the steps in a staircase and the subset of new constants (ratios) as the risers between the steps. Giving a framework of sequential progression in the enumeration of the constants, as the hierarchical electron mass equation demonstrates. (pg.30) Examples of new constant ratios: the characteristic impedance of the vacuum (pg.31) and the Rydberg constants equations.(pg.32)

Subset of new fundamental dimensionless constants (partial list)

$$\left[\frac{e}{c * \mathcal{P} * 10^7} \right] \text{-----} = 1.05256677927$$

$$\left[\frac{h}{Y' c^2 \alpha^{-1} 2 \pi} \right] \text{-----} = 1.05256674016$$

$$\left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\mathcal{P}} \right]} \right] \text{-----} = 1.04669566431$$

$$\left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right] \text{-----} = 1.03849900659$$

$$\left[\frac{\left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]}{\left[\frac{h}{13 \mathcal{P}} \right]} \right] \text{-----} = 1.03450713009$$

$$\left[\frac{h}{13 \mathcal{P}} \right] \text{-----} = 1.00385872304$$

$$\left[\frac{c}{c - \left[\frac{me}{\mathcal{P}} \right]} \right] \text{-----} = 1.00005984862$$

$$\left[\frac{e}{\mathcal{P}c} \right] \text{-----} = 10525667.7927$$

$$\left[\frac{me}{\mathcal{P}} \right] \text{-----} = 17941.093890$$

$$\left[\frac{h}{\mathcal{P}} \right] \text{-----} = 13.0501633995$$

$$\left[\frac{\alpha^{-1}}{\frac{h}{\mathcal{P}}} \right] \text{-----} = 10.5007114018$$

$$\frac{\left[\frac{\alpha^{-1}}{\left[\frac{h}{\mathcal{P}} \right]} \right]}{\left[\frac{(\alpha^{-1})^2}{\left[\frac{me}{\mathcal{P}} \right]} \right]} \text{-----} = 10.0322488759$$

The utilization of Fibonacci numbers in Utrixical theory equations

Fibonacci series: 0. 1. 1. 2. 3. 5. 8. 13. 21. 34. 55. 89. 144... [35]

(the Fibonacci ratio, is the connector between particle physics and chemistry)

Fibonacci (Utrixical theory ratio):

$$\left[\frac{\left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]}{\left[\frac{h}{13\mathcal{P}} \right]} \right] = \left[\left[\frac{13}{8} \right] * \frac{2}{\pi} \right] = \frac{13}{4\pi} = \text{-----} = 1.03450713009$$

Compton wavelength over 2π :

$$\lambda_c = \hbar/mec = \frac{2 \left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]}{\left[\left(\frac{me}{\mathcal{P}} \right) c \right]}$$

Proton charge radius:

$$r_p = \frac{8}{\left[\frac{me}{\mathcal{P}} \right] \left(\frac{mp}{me} \right) \left[\frac{c}{\left[\frac{(\frac{1}{2})\hbar}{\mathcal{P}} \right]} \right]}$$

Compton wavelength:

$$\lambda_c = \frac{h}{mec} = \frac{13}{\left[\frac{me}{\mathcal{P}} \right] \left[\frac{c}{13\mathcal{P}} \right]}$$

Hierarchical electron mass equation

The hierarchical calculation of seven constants within the context of one equation. (*Planck time, Planck length, Planck circumference, half of the reduced Planck constant, the reduced Planck constant, the Planck constant h and the electron rest mass*)

(note: Utrixical theory equations subject to non-canceling and non-simplifying . Also, the progressive order of unit groupings must be preserved)(values within 2006 CODATA uncertainty limits)

Equations below expressed in linear format, to show the progression of the constants.

$$\begin{array}{ccccccc}
 [\leftarrow] & \text{tp} & \rightarrow] & [lp] & [\textcircled{P}] & [\frac{1}{2}\hbar] & [h] & [h] \\
 & \downarrow & & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
 m_e = & \frac{Y' * c^2 * [h / (Y' c^2 2 \pi \alpha^{-1})] * [\alpha^{-1} / [h / \textcircled{P}]] * c * \pi * [\frac{1}{2}\hbar / \textcircled{P}] * 2 * 2 \pi * \alpha^{-1} * [\alpha^{-1} / [h / \textcircled{P}]]}{[(\alpha^{-1})^2 / (e / \mu_B * (\frac{1}{2}\hbar / \textcircled{P}))]}
 \end{array}$$

(Utrixical theory value: $9.10938206 \times 10^{-31}$ kg) (CODATA value: $9.10938215(45) \times 10^{-31}$ kg)

The enumeration of the elementary charge via the inverse of the partial electron mass equation:

$$e = 1 / [c^2 * [h / (Y' c^2 2 \pi \alpha^{-1})] * [\alpha^{-1} / [h / \textcircled{P}]] * c * \pi]$$

(Utrixical theory value: $1.602176511 \times 10^{-19}$ C) (CODATA value: $1.602176487(40) \times 10^{-19}$ C)

The enumeration of the Bohr magneton via the inverse of the partial electron mass equation:

$$\mu_B = 1 / [c^2 * [h / (Y' c^2 2 \pi \alpha^{-1})] * [\alpha^{-1} / [h / \textcircled{P}]] * c * \pi * [m_e / \textcircled{P}]] / [\frac{1}{2}\hbar / \textcircled{P}]$$

(Utrixical theory value: $927.400929 \times 10^{-26}$ J T⁻¹) (CODATA value: $927.400915(23) \times 10^{-26}$ J T⁻¹)

The enumeration of the characteristic impedance of the vacuum based on Utrixical theory's subset of new constants

$$Z_0 = \mu_0 c$$

exact value (CODATA) : 376.7303134617706554681984004203... [1]

Utrixical theory value: 376.7303134617706554681984004203...

$$\begin{array}{cccccc}
 \mathbf{Z_0 =} & [32\pi^2] & \left[\frac{e}{c * \textcircled{\pi} * 10^7} \right] & \left[\frac{(\alpha^{-1})^2}{\frac{me}{\textcircled{\pi}}} \right] & \left[\frac{(\frac{1}{2})\hbar}{\textcircled{\pi}} \right]^2 & \left[\frac{h}{13 \textcircled{\pi}} \right] & \left[\frac{c}{(c - (\frac{me}{\textcircled{\pi}}))} \right] \\
 & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
 & 315.8273408 & * 1.052566779 & * 1.046695664 & * 1.038499006^2 & * 1.003858723 & * 1.000059849
 \end{array}$$

(Note: Utrixical theory equations, non-canceling, non-simplifying. The Planck circumference denoted $\textcircled{\pi} = l_p * \pi$, as a representation of a new constant, albeit the product of two very well-known constants, pi and the Planck length.)

(Thirty digit calculation required, use Utrixical theory values list, pgs.18-21)

Rydberg constant via Utrixical theory's new subset constants

$$R_{\infty} = \alpha^2 m_e c / 2h$$

$$\text{standard value (CODATA '10): } 10973731.568539(55) \text{ m}^{-1} \quad [1]$$

$$\text{Utrixical theory value: } 10973731.5685479918130 \text{ m}^{-1}$$

(terminating decimal)

$$R_{\infty} = \left[\frac{e}{\varnothing c} \right] * \left[\frac{(\frac{1}{2})\hbar}{\varnothing} \right] * \left[\frac{h}{13 \varnothing} \right] * \left[\frac{c}{c - (\frac{me}{\varnothing})} \right]$$

$\downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow$
 10525667.79 * 1.038499006 * 1.003858723 * 1.000059849

$$R_{\infty} = \frac{\frac{c}{c - \left[\frac{(\alpha^{-1})^2 me}{\varnothing} \right]}}{\left[\frac{2h}{\varnothing} \right]} = \frac{\frac{c}{\left(c - \left[\frac{(\frac{1}{2})\hbar}{\varnothing} \right] \right)}}{\left[\frac{(\alpha^{-1})^2 me}{\varnothing} \right]} = \frac{\frac{Eh}{\left[\frac{(\frac{1}{2})\hbar}{\varnothing} \right]}}{\frac{c}{8\pi}} = \frac{Eh}{8\pi c}$$

(Utrixical theory equations are non-canceling, non-simplifying, see: Utrixical theory values list, pgs.18-21)

The elementary charge, e

From one end of the universe to the other, electrons and protons have exactly one elementary charge, truly a universal constant. There is no known equation for the elementary charge. It is simply defined as a measured value in Coulomb units. [1]

Codata value: $e = 1.602176511 \times 10^{-19} \text{ C}$

Utrixical theory defines the value of the elementary charge as the fundamental unit Y' , divided by the Planck circumference.

$$e = \frac{Y'}{\mathcal{P}}$$

The inverse of the elementary charge, $\frac{1}{e}$. It is hard to imagine (albeit true) that the inverse of such a profound entity (elementary charge), would have no significance in the contemporary framework of fundamental physics. Utrixical theory defines *the function of the inverse of the elementary charge as the number of fundamental units, Y' , that gives rise to the Planck circumference.* Providing a sequential connectedness to the constants. (see: hierarchical equation (pg.30))

$$\frac{1}{e} = \frac{\mathcal{P}}{Y'}$$

Inverses --- The inverse of a constant is not an isolated entity, but rather an intrinsic part of its definition. Akin to a coin, where the heads and tails sides are both part of the same entity. And both sides having a contribution to its meaning.

Speed of light equation (via inverses)

The speed of light equation demonstrates the fruition of inverses. Please note, the exact value of c (2299792458) could not have been achieved without the precise values of the Planck length, Planck mass and the reduced Planck constant beyond the uncertainty limits set by (NIST) CODATA.

Once again, the author asks the reader to perform a simple calculation:

$$c = \frac{\left(\frac{1}{l_p}\right) \left(\frac{1}{m_p}\right)}{\left(\frac{1}{\hbar}\right)}$$

where: $c = 299792458$ (speed of light)

$(1/l_p) = 6.187423952 \times 10^{34}$ (Planck length inverse)

$(1/m_p) = 45944629$ (Planck mass inverse)

$(1/\hbar) = 9.482523338 \times 10^{33}$ (reduced Planck constant inverse)

Inverse fine structure constant, 137.0359996 --- Addressing the most revered of the inverses - the inverse fine structure constant, symbol, α^{-1} . For one hundred years it has been the subject of mysticism for cultic adherents and intellectual contortion for academics. Richard Feynman, in his book, QED, the strange theory of light and matter, writes: *“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 137.03597 with 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. 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”.* [6] According to Utrixical theory, the inverse fine structure has two ground-breaking attributes: 1) Its square as a rational, terminating fourteen digit number: 18778.865187780... . 2) the product of two Utrixical theory ratios. (see equation below:)
 (Please note: Utrixical theory equations subject to non-canceling / non-simplifying)

$$\alpha^{-1} = \left[\frac{h}{\textcircled{P}} \right] \left[\frac{\alpha^{-1}}{\left[\frac{h}{\textcircled{P}} \right]} \right]$$

Utrixical theory value: 137.03599960514025454656360890729

(NIST) CODATA value: 137.035999679(94)

Where: $[h/\textcircled{P}] = 13.050163399545774362795861382493$
 $[\alpha^{-1}/[h/\textcircled{P}]] = 10.500711401890182223632842837839$

$$(\alpha^{-1})^2 = \mathbf{18778.865187780}$$

π --- In the thirty-five hundred years since its discovery, physicists have been unable to give pi a definable function within the context of fundamental equations. It has been stated in simple generic terms, i.e., the ratio of a circle's circumference to its diameter, period. [2] The author posits the first application of pi to structure --- the Planck circumference, \textcircled{P} . Utrixical theory gives π a fundamental double function: 1) the advent of structure. 2) the advent of time. Therefore, time is structure dependent.

First pi, equation:

$$\pi = \frac{\textcircled{P}}{lp}$$

Fundamental equations utilizing π :

$$\hbar = h/2\pi \text{ (reduced Planck constant)}$$

$$\alpha = e^2/4\pi\epsilon_0\hbar c \text{ (fine-structure constant)}$$

$$G_{\mu\nu} = 8\pi T_{\mu\nu} \text{ (Einstein's gravity field equation)}$$

Terminating decimal constants:

$$\text{Planck length, } lp = 1.61618148047550 \times 10^{-35} \text{ m}$$

$$\text{Rydberg, } R_{\infty} = 10973731.5685479918130 \times 10^{-35} \text{ m}$$

$$\text{Inverse fine structure squared, } (\alpha^{-1})^2 = 18778.865187780$$

$$\text{Electron mass / Planck circumference ratio, } [m_e/\textcircled{P}] = 17941.093890$$

Constants as ratios --- Constants as ratios that define their relationships in a new perspective. Postulating inherent exact values of all constants. The calculations listed below are within CODATA uncertainty limits. [1] The exact values could not have been achieved without precise thirty digit Utrixical Theory values. The equations below verify the exactitude of the constants.

Note: all six equations have the same constants, but in different order.

Musical chairs equations:

$$c = \frac{2R_{\infty}(\alpha^{-1})^2 h}{m_e} \quad 2 = \frac{m_e c}{R_{\infty}(\alpha^{-1})^2 h} \quad R_{\infty} = \frac{m_e c}{2(\alpha^{-1})^2 h}$$

$$m_e = \frac{2R_{\infty}(\alpha^{-1})^2 h}{c} \quad (\alpha^{-1})^2 = \frac{2R_{\infty} h}{m_e c} \quad h = \frac{m_e c}{2R_{\infty}(\alpha^{-1})^2}$$

(Thirty digit calculation required, using Utrixical theory values list, pgs.19-22)

Time

Though a plethora of literature has been written on the subject; time according to Utrixical theory is simply a process of *decay*. [28][29][36]... Decay is universally inherent, everything decays; with the exception of the fundamental unit, Y' (ground state). The standard model predicts atomic decay, by virtue of proton decay. [4] Utrixical theory takes it a step further by postulating sub-nuclear decay to the fundamental unit Y' (ultimate ground state).

Time is inextricably linked to structure. No structure no time.

Sub-nuclear decay:

$$m_p \rightarrow m_e \rightarrow h \rightarrow \hbar \rightarrow \frac{1}{2}\hbar \rightarrow \textcircled{P} \rightarrow Y' \text{ (ground state / no time)}$$

Therefore: time is structure dependent.

In his book, Quantum theory, David Bohm describes the Schrödinger's equation as three-dimensional and time-dependent. [30] I believe that that lends itself in supporting Utrixical theory's 7th assumption, which states: *The simplification / reduction of the four dimensions to three. Elucidating time, not as a dimension, but as a process of decay. Time defined as structure dependent.* (pg.5, assumption 5)

Utrixical Theory postulates a ground state universe prior to the beginning of time and after time. The ultimate ground state Y', in a motionless, absolute zero degree state. The ground state universe may be interpreted as time stopping. [7] Or, some may interpret it as the timeless attribute of the Grand Ole Designer. Utrixical theory posits black hole centers as states of the universe prior to time and structure, i.e., no-time, no-structure, no-motion, absolute 0 degree state.

Let us evaluate the universal temperature at the instant of creation, i.e., the Planck temperature of 1.4167859(71)³² degrees Kelvin. [1] Given the present universal temperature of 2.7 degrees above absolute zero; one can conclude, that nature is doing a great job in returning to its ground state of absolute zero, in a relative short period of time (13.7 billion years). [25][27]

Utrixical theory describes the universe prior to and after time, analogous to a translucent solid block of ice "the ice cube universe". Having the attributes of: a timeless, motionless, absolute zero state; ultimate decay mode of Y' units. [24][29]

Higgs boson --- The celebrated “God particle”, after an expenditure of billions of dollars / Euros and the incalculable time and effort of a multitude of the world’s brightest minds --- the “God particle” is a flop. No great discovery. No great insight. No new physics.[4][28]

And the nonsensical saga continues - In a Science News article, by Andrew Grant - *Evidence for new particle vanishes – a fresh analysis of data from the particle collider that delivered the Higgs boson has dashed physicists’ hope that another new particle had emerged from the sub-atomic shrapnel. “We’ve learned that there’s no obvious Godzilla particle hiding with the Higgs,” says Tim Tait, a theoretical physicist at the University of California, Irvine. “Now we’re going to look for more subtle signs of new particles.”* Godzilla particle? Really? What happened to the “God particle”, aka, the Higgs boson, touted as the capstone of the standard model? Wasn’t a Nobel Prize awarded for that? Are physicists now looking for a Nobel Prize for the “Godzilla” particle? The author fears that high energy physics is wading in the waters of Japanese horror movies. [14]

As a one-time staunch supporter of high energy colliders, it pains me to put forth an insight as to what I believe actually happens. Perhaps, an analogy can best describe the events in high energy collisions. First, let us understand the make-up and environment of the experiment. Huge powerful accelerators, colliding particles close to the speed of light, replicating energies produced in an infinitesimal region, during the first few milliseconds after the big bang (equivalent to 100 million tons of TNT). Back to the analogy: After the dust settled from the first atomic bomb detonation at Trinity site, New Mexico, scientists were befuddled when they found mysterious greenish crystal-like rocks in and around ground zero. The mystery was solved when scientific scrutiny identified the green crystals as the product of sand being fused by the extremely high temperature of the atomic blast. The crystals were appropriately named trinitite. Utrixical theory states: that the high energy collisions that take place in accelerators are producing energy signatures misidentified as short lived massive particles called bosons, such as, W, Z, Higgs, etc. Utrixical theory identifies the signatures as energy seepage from the vacuum. In other words, *the extreme high energy impact is punching a hole through the vacuum (teeming with virtual particles), allowing energy seepage.* The “Higgs boson” (albeit short lived) analogous to trinitite. [23]

Gravity

Again, somewhat outside the scope of this paper, But, I feel I should at least touch upon one attribute of gravity. That is, the function of the collective charge pressure of Y' units, (assumption,1c) as an attribute of gravity (dark energy). The cosmic force emanating from what is thought to be empty space. Perhaps I can best describe it with an analogy: The collective charge pressure as shrink wrap. Now let's shrink wrap the earth and moon as a unit. But, before doing so, let us smear petroleum jelly all around earth, allowing it to rotate. What we find is, that the earth is almost entirely constricted --- except at the point where the earth and moon are at their closest points. Given that they were shrink wrapped as a unit, a funnel formed, where there was no pressure from the plastic wrap (at the earth-moon closest points). Now, as the earth rotates and the ocean comes in the funnel area, where there is no containment (by the shrink wrap), the ocean bulges out --- Voila' the tides! Finally an acceptable description of the tides. Where we do not have to invoke Newton's crazy instantaneous attraction of the moon. Nor, Einstein's curvature of space-time, which never made sense when applied to the tides. Mind you, this is a simple analogy, a more sophisticated analogy would involve shrink wrapping the entire solar system, especially the sun, which is an important player in the tides, as well. [32]

Fractal universe

"Mother Nature is a lazy old broad; once she finds something that works, she keeps repeating herself ".

The fractal (self-similarity) universe, "the round" --- this geometric attribute of nature is evident in the construction of the universe. From the **first structure, the Planck circumference, \textcircled{P}** , to nature's perfect form, the sphere. As represented by the universal constituents, i.e., electrons, protons, atoms, spherules, ice cream dots, soap bubbles, moons, planets, solar systems, stars, black holes, globular clusters, galaxies, voids and the universe. [9]

In his article, 'On Being Round', Neil DeGrasse Tyson gives this subject matter great perspective: *"Apart from crystals and broken rocks, not much else in the cosmos naturally comes with sharp edges. While many objects have peculiar shapes, the list of round things is practically endless and ranges from simple soap bubbles to the entire observable universe. Spheres tend to take shape from the action of simple laws" [31]*

CODATA (NIST) values errors ---

In February of 2012, a letter was sent to the National Institute of Standards and Technology. The issue was errors in the uncertainty of some of the 2010 Codata values. The question was asked, why some of the 2010 values were not within the uncertainty limits of the old 2006 values. NIST, has to explain the discrepancies or acknowledge errors in either the 2006 or the 2010 values. The question that begs to be asked, did the highest authority on the values of the constants (NIST) CODATA group, get the 2006 values so unprecedentedly wrong, or is it that the 2010 values are so wrong? [1]

2/29/12

Director et al,

Please be advised, that after careful review of the 2010 CODATA values; gross inaccuracies have been found in a number of the fundamental constants values. The most egregious being the fine structure constant. Consequently, the constants dependent upon the fine structure constant value have been adversely affected.

The 2006 CODATA values are correct within their respective standard uncertainty adversely affected constants (2010) (partial list)

	2010	U-t calculations	2006
Fine structure:	7.2973525698(24) e-3;	7.2973525415 e-3;	7.2973525376(50) e-3
Elementary charge:	1.602176565(35) e-19;	1.602176511 e-19;	1.602176487(40) e-19 C
Planck, h:	6.62606957(29) e-34;	6.626068909 e-34;	6.62606896(33) e-34 J s
Hartree energy:	4.35974434(19) e-18;	4.359743906 e-18;	4.35974394(22) e-18 J
Bohr radius:	0.52917721092(17) e-10;	0.529177208871 e-10;	0.52917720859(36) e-10 m
Bohr Magneton:	927.400968(20) e-26;	927.4009296353 e-26;	927.400915(23) e-26 J T ⁻¹
Compton wave l :	2.4263102389(16) e-12;	2.4263102201275 e-12;	2.4263102175(33) e-12 m

correct approximations (2010)

	2010	U-t calculations	2006
Planck length:	1.616199(97) e-35;	1.61618148047550 e-35	1.616252(81) e-35 m
Rydberg :	10973731.568539(55)	10973731.5685479918130	10973731.568527(73) m ⁻¹
Gravitation:	6.67384(80) e-11	6.6736938662948 e-11	6.67428(67) e-11 m ³ kg ⁻¹ s ⁻²
Planck mass:	2.17651(13) e-8	2.1765329732787 e-8	2.17644(11) e-8 kg
Planck time:	5.39106(32) e-44	5.3910011321082 e-44	5.39124(27) e-44 s

Thank You,

The proton charge radius conundrum

In July of 2010, Dr. Pohl et al published the results of an experiment measuring the proton rms charge radius. The experiment entailed using a muon (200 times heavier) instead of an electron to probe the proton. The results show the proton radius [0.84184(67) fm] to be smaller by a factor of five, beyond the CODATA value [0.8768(69) fm] of acceptable uncertainty limits. The physics community is not embracing Dr. Pohl's results. To do so, would mean that the sacrosanct theory of quantum electrodynamics has at least some aspect that is not so sacrosanct. The consensus is that there is an error in the calculations. [11][12][13]

In February of 2013, two-and-a-half years later, Dr. Antognini et al (co-authors of the first paper) performed a new measurement, using for the first time laser spectroscopy of muonic hydrogen. The results were in good agreement with the 2010 value, but 1.7 times as precise, [0.84087(39) fm]. Therefore, the smaller value of the proton charge radius has been reaffirmed. The consensus is starting to shift in considering new physics beyond the standard model or challenging the present understanding of quantum electrodynamics (QED).[10][14][15]

My contention is that the muonic experimental results of Drs. Pohl, Antognini et al are correct; based on Utrixical theory's ability to theoretically enumerate the proton radius [0.84129 fm] and related constants (based on first principles).

Utrixical theory prediction: As a consequence of a smaller proton radius, the associated constants, such as, the proton mass, proton/electron ratio, etc., will manifest their values proportionally smaller. Please note: there seems to be an anomaly with the nuclear magneton Utrixical equation. The result is a 4% greater value then the other proton related constants (counter intuitive). I believe the issue of the proton charge radius conundrum, lies within the nuclear magneton process.

Enumeration of the proton rms radius and related constants

Proton rms charge radius

r_p

2010 CODATA value: 0.8775(51) fm [1]

Dr. Pohl's value: 0.84184(67) fm

Dr. Antognini's value: 0.84087(39) fm

Utrixical theory value: 0.841295246681... fm

$$r_p = \frac{8}{[m_e/\textcircled{P}](m_p/m_e)[c/[(1/2)\hbar/\textcircled{P}]]} = \frac{4\hbar}{m_p c}$$

Please note: the second equation describes the proton charge radius as 4 units of the reduced Planck constant divided by the proton mass multiplied by the speed of light. Assuming a 4% smaller proton mass value.

where: $m_e = 9.109382065 \times 10^{-31}$ kg (electron mass)

$\textcircled{P} = l_p * \pi = Y' / e = 5.077383865 \times 10^{-35}$ m (Planck circumference)

$l_p = 1.61618148047549 \times 10^{-35}$ m (Planck length)

$\pi = 3.141592654$

$m_p = 1.672503107 \times 10^{-27}$ (proton mass, assumed and by extension, 4% smaller value)

$c = 299792458$ m s⁻¹ (speed of light)

$\hbar = h/2\pi = 1.05457162 \times 10^{-34}$ J s (reduced Planck constant)

$Y' = 8.134865168 \times 10^{-54}$ C (fundamental charge / the only hypothetical in Utrixical theory)

$e = 1.602176511 \times 10^{-19}$ C (elementary charge)

subset of new constants (ratios):

$[m_e/\textcircled{P}] = 17941.093890$ (electron / Planck circumference ratio)

$[m_p/m_e] = 1836.02256891$ (proton mass - electron mass ratio)

$[1/2\hbar / \textcircled{P}] = 1.038499006$ (ratio of attribute)

$[c/[1/2\hbar / \textcircled{P}]] = 288678618.1$

proton mass

m_p

2006 CODATA value: $1.672621637(83) \times 10^{-27}$ kg [1]

Utrixical theory value: $1.67250310610\dots \times 10^{-27}$ kg

$$m_p = \frac{Y'}{c \left(\frac{h}{13\pi} \right)}$$

where: $Y' = 8.134865134 \times 10^{-54}$ C (fundamental charge --- Utrixical theory prediction)

$c = 299792458$ m s⁻¹ (speed of light)

$h = 6.626068909 \times 10^{-34}$ J s (Planck constant)

(not within 2010 CODATA values --- within A. Antognini's experimental value – assumed, 4% smaller)

proton mass energy equivalent

$m_p c^2$

2006 CODATA value: $1.503277359 (75) \times 10^{-10}$ J [1]

$$m_p c^2 = \frac{Y' c}{h/13\pi}$$

Utrixical theory value: $1.5031708280621329174050754112177 \times 10^{-10}$ J

where: $Y' = 8.134865168 \times 10^{-54}$ C (fundamental charge - the only hypothetical in Utrixical theory)

$c = 299792458$ m s⁻¹ (speed of light)

$h = 6.626068909 \times 10^{-34}$ J s (Planck constany)

proton / electron mass ratio

$$m_p/m_e$$

2006 CODATA value: 1836.15267247(80) [1]

Utrixical theory value: 1836.02256891...

$$m_p/m_e = \frac{Y'/m_e c}{h/13\pi}$$

where:

$m_p = 1.672503106 \times 10^{-27}$ kg (proton rest mass)

$m_e = 9.109382065 \times 10^{-31}$ kg (electron rest mass)

$Y' = 8.134865168 \times 10^{-54}$ C (fundamental charge – the only hypothetical in Utrixical theory)

$c = 299792458$ m s⁻¹ (speed of light)

$h = 6.626068909 \times 10^{-34}$ J s (Planck constant)

$\pi = 3.141592654...$ (pi)

(within Drs. Pohl and Antognini's muonic hydrogen experimental values)

Bohr magneton

$$\mu_B = e\hbar/2m_e$$

2006 CODATA value: $927.400915(23) \times 10^{-26} \text{ J T}^{-1}$

Utrixical theory value: $927.4009296353495 \times 10^{-26} \text{ J T}^{-1}$

$$\mu_B = \frac{Y'[\frac{1}{2}\hbar/\textcircled{P}]}{m_e}$$

(Utrixical theory magneton (μ) formula: fundamental unit (Y') multiplied by the ratio of attribute [$\frac{1}{2}\hbar/\textcircled{P}$], divided by the mass of the particle (m))

$$\mu = \frac{Y'[\frac{1}{2}\hbar/\textcircled{P}]}{m}$$

where: $Y' = 8.134865168 \times 10^{-54}$ (fundamental unit / only hypothetical in Utrixical theory)

$\frac{1}{2}\hbar = 5.27285810 \times 10^{-35} \text{ J s}$ (half of the reduced Planck constant)

$\textcircled{P} = (lp*\pi) = 5.077383865 \times 10^{-35} \text{ m}$ (Planck circumference / new constant)

$m_e = 9.109382065 \times 10^{-31} \text{ kg}$ (electron rest mass)

groupings: $[\frac{1}{2}\hbar/\textcircled{P}] = 1.038499006$ (ratio of attribute)

Nuclear magneton

$$\mu_N = e\hbar/2m_p$$

2006 CODATA value: $5.05078324(13) \times 10^{-27} \text{ J T}^{-1}$

Utrixical theory value: $5.051141227 \times 10^{-27} \text{ J T}^{-1}$

$$\mu_N = \frac{Y' [\frac{1}{2}\hbar / \textcircled{P}]}{m_p}$$

(Utrixical theory magneton (μ) formula: fundamental unit (Y') multiplied by the ratio of attribute [$\frac{1}{2}\hbar / \textcircled{P}$], divided by the mass of the particle (m))

$$\mu = \frac{Y' [\frac{1}{2}\hbar / \textcircled{P}]}{m}$$

where: $Y' = 8.134865168 \times 10^{-54}$ (fundamental unit / only hypothetical in Utrixical theory)

$\frac{1}{2}\hbar = 5.27285810 \times 10^{-35} \text{ J s}$ (half of the reduced Planck constant)

$\textcircled{P} = (1p^*\pi) = 5.077383865 \times 10^{-35} \text{ m}$ (Planck circumference / new constant)

$m_p = 1.672503107 \times 10^{-27} \text{ kg}$ (proton mass, assuming a 4% smaller value)

groupings: $[\frac{1}{2}\hbar / \textcircled{P}] = 1.038499006$ (ratio of attribute)

Conclusion

Utrixical theory is based on only one hypothetical entity, Y', as the universal fundamental building block, with its attributes of: charge, energy, mass, length, magnetism, speed, temperature, etc., as the adhesives of creation. Which give rise to a bricks and mortar, bottom up scheme of particle mass endowment (as opposed to the Higgs mechanism of top down). The postulation of the Planck circumference constant, \mathbb{P} , as the foundation of all constants, giving rise to, structure, time and status of the first pi. Reintroducing half of the reduced Planck constant, $(\frac{1}{2})\hbar$, "the forgotten constant", when divided by the Planck circumference constant, ushers in the first of a new subset of constants ($[(\frac{1}{2})\hbar/\mathbb{P}]$), connecting and sequencing the schematic of universal construction. (see: ratio of attribute equations, pgs.22-26)

Utrixical theory brings rationality back to physics by simplifying the four dimensions to three, by removing time from space-time and redefining time as a process of decay. Elucidating the force of gravity as a classical dual function of inherent particle charge attraction (atomic scale) and space as fundamental charge pressure (cosmic scale).

Beauty has been a long standing, guiding principle in the quest of fundamental understanding. Dirac an early pioneer of quantum mechanics, felt strongly in the principle; as a text between Heisenberg and himself shows – Dirac writing to Heisenberg: *"My main objection to your work is that I do not think your basic ... equation has sufficient mathematical beauty to be a fundamental equation of physics."* [3] I share Dirac's sentiment that fundamental equations should have attributes such as beauty and simplicity. On that note, the author submits Utrixical theory equations do have such qualities.

A famous quote by Alan Guth (the author of inflation) *"It is often said that you can't get something for nothing, but the universe may be the ultimate free lunch"* According to Utrixical theory, nothing could be further from the truth. The universe is bought and paid for in full; in accordance with the immutable laws of energy conservation. The universe is the product of energy extracted (in one way or another) from the vacuum. Never is one iota of energy ever created or destroyed. Energy is, always was, and always will be. Predicting a ground state, Absolute 0 degree universe prior to and after time. [22]

This paper makes bold, unprecedented claims; many opinionated and subjectively intuitive. And understandably, subject to skepticism. What is not subject to skepticism is the results of the equations presented. Attention must be given to Utrixical theory's ability to calculate constants values to thirty digit accuracy (see: characteristic impedance of vacuum, pg.31), and by invoking a new subset of constants (ratios) as the Rydberg and characteristic impedance of the vacuum constants equations demonstrate.

This paper has been written in part to answer or at least to put in perspective questions put forth in Lee Smolin's best seller, *The Trouble with Physics*. I would like to share two relevant quotes from his book: *"No one knows anything about why these constants have the values they do. As in particle physics, the values of the constants are taken from observations but are not yet explained by any theory"* and *"I am extremely concerned about a trend in which only one direction of research (string theory) is well supported while other promising approaches are starved. It is a trend with tragic consequences if, as I will argue, the truth lies in a direction that requires a radical rethinking of our basic ideas about space, time and the quantum world."*

Two issues that will validate Utrixical theory:

- 1) The theoretical calculation of the proton charge radius and related proton constants, that are in agreement with the muonic experiments of Drs. Pohl and Antognini et al. [10][11] [12][13][14][15]
- 2) The acknowledgement of errors in some of the (NIST) 2010 CODATA values. [1]

Utrixical theory does not violate any physical laws.

References

- [1] CODATA group, National Institute of Standards and Technology
- [2] David Blatner, The Joy of π , Walker and Company, USA
- [3] John D. Barrow, The Constants, Pantheon Books, USA (2002)
- [4] Jim Baggott, The Quantum Story, Oxford University Press, New York (2011)
- [5] Kenneth W. Ford, The Quantum World, Harvard University Press, USA (2004)
- [6] Richard P. Feynman, QED, Princeton University Press, USA (1985)
- [7] Lee Smolin, The Trouble With Physics, First Mariner Books, USA (2007)
- [8] Albert Einstein, Relativity, Crown Publishers, Inc. USA
- [9] Robert L. Oldershaw, A Fractal Universe? roldershaw@amherst.edu
- [10] Antognini, A. et al. Science 339, 417-420 (2013)
- [11] Pohl, R. et al. Nature 466, 213-216 (2010)
- [12] Geoff Brumfiel, The proton shrinks in size, Nature, 7 July 2010
- [13] Kate Ravilious, National Geographic News, July 7, 2010
- [14] Science Daily, Proton Size Puzzle, Jan. 24, 2013
- [15] Science News, Proton's radius revised downward, Feb. 23, 2013
- [16] Paul Davies, Superforce, Simone and Schuster, New York (1985)
- [17] Scientific American, A matter of time, volume 23, number 4 (2014)
- [18] Science News, Evidence for new particle vanishes, Oct. 18 (2014)
- [19] Arthur Eddington, Space, time and gravitation, University Press, 1920
- [20] Discover, Genius, Great Minds of Science, winter 2011
- [21] Jim Al-Khalili, Quantum, Weidenfeld & Nicolson, U. K., 2003
- [22] Riordan and Schramm, Shadows of creation, Freeman, USA (1991)
- [23] Nelson Eby, Trinitite, PDF, University of Massachusetts, Lowell MA
- [24] Discover, Special Issue, March 2009
- [25] abyss.uoregon.edu/~js/21st_century_science/lectures/lec27.html
- [26] Reviews of modern physics, Volume 84, October-December 2012
- [27] Alan Lightman and Roberta Brawer, Origins, Harvard University Press
- [28] Frank Close, The Infinity Puzzle, Basic Books, USA, (2011)
- [29] Coveney and Highfield, The Arrow of Time, Ballantine Books, USA, 1990
- [30] David Bohm, Quantum theory, Dover Publications, USA (1989)
- [31] Neil DeGrasse Tyson, On Being Round, Natural History Magazine, Mar. '97
- [32] Encyclopedia of Science and Technology, 5th edition (1987)
- [33] Heinz R. Pagels, The Cosmic Code, Bantam Books, N.Y., (1987)
- [34] Braibant, Giacomelli and Spurio, Particles and Fundamental Interactions, 2009
- [35] Maths.Surrey.ac.uk/Fibonacci/fib.html
- [36] Robert M. Wald, Space, Time and Gravity, U.C. Press, 1977