QUANTUM TOPOLOGY OF SUBATOMIC METRIC SPACE

                                                                      Eugene Machusky

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ABSTRACT

 The unified informational-entropy-energy paradigm of quantum metrics, quantum calculus and quantum information processing was analytically developed and metrologically justified using the fundamental calculus theorem and the abductive mathematical logic of recursive functional analysis. As a result, only thirteen simple wave parametric equations are necessary and sufficient to determine the absolute limits of computational and informational entropy of symbolic and digital functional analysis and to calculate the fundamental quantum units of a standard physical model with extreme accuracy, limited only by the memory capacity of computing device.

INTRODUCTION

 The new SI-2019 measuring system and all branches of modern quantum physics are based on careful measurement of the energy and the observed path length of subatomic particles in the vacuum-like space of powerful accelerating systems with subsequent mutual coordination and fitting of the parameters of the wave equations of the observed transfer of heat, charge and mass using energy diagrams developed by R. Feynman for classical quantum (discrete by nature) electrodynamics on the mathematical basis of classical symbolic (continuous by nature) thermodynamics. The main logical error of all modern theories of quantum physics and standard (symbolic) functional analysis is that irrational numbers are considered as mathematical constants. In reality, only integer and rational numbers can be true constants, but all irrational numbers are actually variables – they are endless digital waves (continuous functions of the wave parameters of the recursive motion of subatomic particles) that can never be completely written into the finite memory block of any real computing device.

 Britannica.com defines a recursive function as a type of function or a predicate property of the expression of one or more variables defined by a procedure that returns the values ​​of an instance of this function, repeatedly applying this relation to known values ​​of the function. G.Cantor founded the theory of sets and introduced the concept of transfinite numbers, infinitely large, but different from each other. The theory of recursive functions was developed by T.Skolem as a means of avoiding the so-called paradoxes of infinity that arise when applied to functions that encompass infinite classes. G.Peano noted that the addition of natural numbers can be defined recursively, and K.Gödel expanded this concept to subsets of natural numbers and, using a simple arithmetic technique, to sets of lines of words in a language. Gödel was able to argue that the set of theorems of mathematics is recursively enumerable, and the linguist Noam Chomsky says that the set of grammatical sentences of a natural language is recursively enumerable. It is easy to show that all primitive recursive functions can be calculated with a pencil and paper, or, even more primitively, by moving pebbles from one place to another using some finite set of instructions, currently called a program. And vice versa, only recursive functions can be calculated or calculated using the theoretical machine presented by A.Turing. The Church-Turing thesis states that the informal concept of computability is completely covered by the formal concept of recursive functions and, therefore, is reproducible by a machine. Gödel’s incompleteness theorem proved that any useful formal mathematical system would contain unsolvable propositions – propositions that could neither be proved nor disproved. Church and Turing proved that such an algorithmic method was not possible for first-order predicate logic. Church-Turing's theorem on unsolvability combined with the result of A.Tarski on the unsolvability of truth precludes the possibility of a purely mechanical device replacing mathematicians. Skolem gave an explicit construction of what is now called a non-standard arithmetic model containing “infinite numbers” and infinitesimal numbers, each of which represents a certain class of infinite sequences.

 The mathematical category of infinitesimals ​​was introduced by I.Newton as a means of “explaining” his procedures in calculus. Before the concept of limit was officially introduced and understood, it was not clear how to explain why calculus works. In fact, Newton regarded the infinitesimal as a positive number, which is somehow less than any positive real number. In fact, it was the concern of mathematicians with such a vague idea that led them to develop the concept of limit. The status of infinitesimal numbers fell even further as a result of Richard Dedekind's definition of real numbers as “abbreviations”. The section splits the line of real numbers into two sets. If there is the largest element of one set or the smallest element of another set, then the cut determines a rational number; otherwise, the cut determines the irrational number. As a logical consequence of this definition, it follows that there is a rational number between zero and any nonzero number. Therefore, infinitesimal numbers do not exist among real numbers. This does not prevent other mathematical objects from behaving like infinitesimal ones, and mathematical logicians have actually shown how such objects can be constructed. A.Robinson also used non-standard models to create an environment in which infinitesimal arguments of early calculus could be rehabilitated. He found that old arguments can always be justified, usually with less difficulty than standard justifications with limitations. He also found the infinitesimal useful in modern analysis and proved some new results with their help.

 The physical sciences are based on mathematical expressions for the transfer of mass, electric charge and heat in Euclidean metric space (the classical physical laws of Newton, Coulomb, Maxwell, Kelvin), and all of them contain the general part 1/r^2, where r is the hypothetical radius of subatomic particle of elementary subatomic mass (proton) or hypothetical radius of elementary subatomic charge (electron). Coulomb’s law states that the force between two electric charges varies as the inverse square of their separation. Direct tests, such as those performed with a special torsion balance can be approximate at best. But a very sensitive indirect test, first carried out by H.Cavendish, relies on the mathematical demonstration that no electrical changes occurring outside a closed metal shell produce any effect inside if the inverse square law holds. This test can be extremely sensitive. It is typical of the class of null measurements in which only the theoretically expected behavior leads to no response and any departure from theory gives rise to a response of calculated magnitude. It has been shown that if the force between charges is proportional not to 1/r^2 but to 1/r^2+x, then x is less than 2×10^(−9). According to the relativistic theory of the hydrogen atom proposed by P. Dirac, there should be two different excited states exactly coinciding in energy. Accurate measurements of the spectral lines hinted at slight discrepancies, but later W.Lamb and R.Rutherford were able to measure it quite accurately. The difference in energy compared with the energy above the ground state is only 4 parts per 10 million, but this was one of the most important evidence that led to the development of quantum electrodynamics, a central feature of the modern theory of motion of fundamental particles in the subatomic topological space.

 Britannica.com defines a topological space as a generalization of Euclidean spaces in which the idea of ​​proximity or limits is described in terms of relations between sets, and not in terms of distance. Each topological space consists of many points; from a class of subsets defined axiomatically as open sets; from a variety of union and intersection operations. The class of open sets must be defined in such a way that the intersection of any finite number of open sets is itself open, and the union of any possibly infinite set of open sets is also open. The notion of a limit point is fundamental in topology; a point p is called a limit point of the set S if each open set containing p also contains some point (s) S (points other than p if p is in S). The concept of a limit point is so basic to topology that it can itself be used axiomatically to define a topological space by specifying limit points for each set in accordance with the rules known as closure axioms of K.Kuratowski. Any set of objects can be turned into a topological space in various ways, but the usefulness of the concept depends on how the limit points are separated from each other. Topological spaces often have the property of F.Hausdorff, which states that any two points can be contained in non-overlapping open sets, ensuring that a sequence of points can have at most one limit point. The metric space in mathematics, especially in topology, is an abstract set with a distance function called a metric, which defines a non-negative distance between any two of its points in such a way that the following three properties are satisfied: the distance from the first point to the second is zero if and only if when the points coincide; the distance from the first point to the second is equal to the distance from the second to the first and the sum of the distance from the first point to the second and the distance from the second point to the third is greater than or equal to the distance from the first to third (the so-called triangle inequality). The ordinary distance function on a real numerical line is a metric, like the ordinary distance function in Euclidean n-dimensional space. For any set of points, the discrete metric indicates that the distance from the point to it is 0, and the distance between any two different points is 1. The so-called “taxi metric” on the Euclidean plane announces the distance from the point (x, y) to the point (z, w) to be | x - z | | y - w | This “taxi distance” gives the minimum path length from (x, y) to (z, w), built from horizontal and vertical segments. Thus, the metric generalizes the concept of the usual distance to more general parameters. In addition, a metric on a set X defines a collection of open sets, or a topology, on X when a subset U of X is declared open if and only if for each point p of X there is a positive (possibly very small) distance r such that the set of all points from X of a distance less than r from p is completely contained in U. A metric space is called complete if each sequence of points at which the members are ultimately pairwise arbitrarily close to each other (the so-called Cauchy sequence) converges to a point in a metric space. The usual metric on the rational numbers is not complete since some Cauchy sequences of rational numbers do not converge to rational numbers. For example, the rational number sequence 3, 3.1, 3.14, 3.141, 3.1415, 3.14159> converges to pi, which is not a rational number. However, the usual metric on the real numbers is complete, and, moreover, every real number is the limit of a Cauchy sequence of rational numbers. In this sense, the real numbers form the completion of the rational numbers. The proof of this fact, given by Hausdorff, can be generalized to demonstrate that every metric space has such a completion.

 It will be shown below that modern quantum physics, analytical chemistry and materials science as a natural synthesis of quantum metrology, vector-tensor dynamic integer-differential calculus and recursive single-photon information processing can be combined into a single resonant concept of metric space based on abductive (associative and intuitive) higher order mathematical logic, first introduced in [1] - [5].

INFORMATION ENTROPY OF QUANTUM METRICS AND QUANTUM CALCULUS

 The new SI-2019 metric system is technologically limited by possible for today accuracy of measuring energy, speed, frequency and especially the length of microwaves and has an unsatisfactory level of exactness for working with microwaves at subatomic (monoelectronic) and subnuclear (monophotonic) distances, where the wavelength can be many decimal orders of magnitude less than 10^(-15) meters:

 The Planck constant is exactly 6.62607015×10^(-34) joule-second;

 The elementary charge is exactly 1.602176634×10^(-19) coulomb;

 The Boltzmann constant is exactly1.380649×10^(-23) joule per kelvin;

 The Avogadro constant is exactly 6.02214076×10^(+23) reciprocal mole;

 The speed of light is exactly 299792458 meters per second;

 The hyperfine structure transition frequency of the caesium-133 is 9192631770 hertz;

 The frequency of light at the peak sensitivity of the human eye is 683 lumens per watt.

The elementary mathematical logic of primitive recursive arithmetic clearly shows that large gaps of the informational entropy (long intermediate sequences of zeros) appear in the normalized decimal positional calculation system of basic metric units on the infinitesimal scales:

 :

 9.192631770000000000000000000000000000000000\*10^8 hertz(inverse second);

 6.830000000000000000000000000000000000000000\*10^2 lumens per watt;

 6.022140760000000000000000000000000000000000\*10^8 reciprocal mole;

 2.997924580000000000000000000000000000000000\*10^8 meters per second;

 0.000000000000000000160217663400000000000000\*10^0 coulomb;

 0.000000000000000000000013806490000000000000\*10^0 joule per kelvin;

 0.000000000000000000000000000000000662607015\*10^0 joule-second.

This can lead to catastrophic errors (such as the so-called "ultraviolet" and "gravitational" in classical physics) if a standard functional analysis is used for calculations.

 It is very easy to show that the results of engineering and scientific computing of inverse exponential functions in the symbolic [pi...e] and digital [PI...E] records can catastrophically differ (by more than 100 power orders):

 1/pi^32 = 1/e^37 = 1/10^16 but 1/pi^33 = 1/е^38 = 0,

 1/3.14^129 = 1/2.71^148 = 1/10^64 but 1/3.14^130 = 1/2.71^149 = 0.

Informational entropy of exponential functional analysis can reach [64-16] = 48 decimal orders. This is a vivid illustration of the informational entropy of primitive recursive arithmetic when the entries of inverse natural numbers in a decimal normalized system of positional calculations have insufficient digital length. And this is really the main logical fallacy of standard symbolic functional analysis and the only reason for the observed so-called quantum entanglement in quantum calculus. And there is only one logical way out of this informational dead end: any existing and hypothetic quantum computer is actually an analog machine, physically built on memory elements in the form of molecules, atoms, electrons, photons, neutrinos, quarks and any other small particles of substance. Such a computing machine potentially can work with the stroboscopic speed of recursive (progressive and inverse) motion of a single photon in a free space, but only with computational accuracy, limited by the exactness of setting the parameters of used subatomic elements, both really observed and virtual – or in mathematical language – the mutual complementary components of complex numbers.

QUANTUM ARITHMETICAL KEYS TO DIFFERENTIAL CALCULUS

 It was firstly established here that the Quantum arithmetical keys (in short – Quarks) to the naturally normalized differential system of calculations (in short – Nanodisc) are Bessel functions. Britannica.com defines: “Bessel function, also called Cylinder Function, any of a set of mathematical functions derived by F.Bessel during an investigation of solutions of Kepler’s equations of planetary motion. Particular functions of the set had been formulated earlier by D.Bernoulli, who studied the oscillations of a chain suspended by one end, and L.Euler, who analyzed the vibrations of a stretched membrane. After Bessel published his findings, other scientists found that the functions appeared in mathematical descriptions of many physical phenomena, including the flow of heat or electricity in a solid cylinder, the propagation of electromagnetic waves along wires, the diffraction of light, the motions of fluids, and the deformations of elastic bodies. Lord Rayleigh, also placed the Bessel functions in a larger context by showing that they arise in the solution of Laplace’s equation when the latter is formulated in cylindrical (rather than Cartesian or spherical) coordinates. Specifically, a Bessel function is a solution of the differential equation x^2\*d2y/dx2 + x\*dy/dx + (x^2-n^2))\*y = 0 which is called Bessel’s equation. For integral values of n, the Bessel functions are:

 Jn(x) = x^n /(2^n\*n!)\*[1 – x^2/(2\*(2\*n+2)) + x^4/(2\*4\*(2\*n+2)\*(2\*n+4) – …].

The graph of J0(x) looks like that of a damped cosine curve, and that of J1(x) looks like that of a damped sine curve. Certain physical problems lead to differential equations analogous to Bessel’s equation; their solutions take the form of combinations of Bessel functions and are called Bessel functions of the second or third kind.”

 The expression for Bessel functions contains only natural numbers, powers of a prime number, and arbitrary decimal fractions. There is also the first discovered an unique SMS function (the square sum of four average values ​​– the root mean, arithmetical mean, geometrical mean and harmonic mean), where we have only arbitrary truncated decimal records of transcendental numbers pi and e and the number 2:

 :

 SMS = [Sqrt((pi^2+e^2)/2) + (pi+e)/2 + Sqrt(pi\*e) + 2/(1/pi+1/e)]^2 = 136.9938985020083597

which is very close to the unique prime number 137 = Lim{1/Sum [729927/10^(8\*N)]}. Weighted average calculations relatively the number 137 will later allow us to estimate the absolute boundaries of the informational entropy of quantum calculus and quantum metrics.

VECTOR-TENSOR GEOMETRY OF SUBATOMIC METRIC SPACE

Hyperbolic functions compress a progressive natural set (N+1) into the space [0 ... 1 / (N+1)].

The usual cosine and sine functions compress any set into the space [(-1) ... (+1)].

The multiplexed cosine Cos(Cos ... Cos(N)) compress any set to the point x = cos(x), tending to an absolute value of 0.739085133215.

The multiplexed sine Sin(Sin ... Sin(N)) compress any set to the point x = sin(x), tending to an absolute value of 0.00000001 = 1/10 ^ 8.

Multiplexed root functions compress any set into the space [1.000000 ... x] if there is x > 1.

Multiplexed root functions compress any set into the space [0.999999 ... x], if there is x < 1,

The function Lim{2\*Sum [1/N\*Sqrt(1-1/N^2)] compresses any set to the point "pi" - the absolute perimeter unit of Pythagoras.

The function Lim{1+1/N)^N} compresses any set to the point "e" - the basic unit of the natural logarithm of Euler.

The unique quantum function XE = Root{X\*e^X/(e^X-1) = 5} compresses any set to an infinite aperiodic number XE = 4.96511423174427629999999999999 ... is the X-factor of blackbody radiation of Wien.

The function C = (Integer{10^8\*(C/10^7)}/10^8 + 4\*pi\*C/10^18)^64\*10^7 compresses any set to a finite number C = [299792457.86759133843368398914990500927337258665405914040533114633 ] – this is the firstly discovered absolute stroboscopic value of the speed of light in free space, first presented in [1].

Recursive angular rotations of the above listed numbers relatively to the decimal point generate a unified vector-tensor resonant frequency field (radial web network), which fully describes the quantum topology of the subatomic metric space.

FUNDAMENTAL INFORMATIONAL UNITS OF QUANTUM METRIC

 The set of basic units of quantum metric, first introduced in [1], is defined below with the greatest possible accuracy and identified by the names of the first researchers:

          Resonant recursive speed unit of Maxwell C = [R/10^8+4\*pi\*C/10^18)^64\*10^7]

 R = Integer{10^8\*(C/10^7)^(1/64)} = 105456978 – final integer of Dirac-Maxwell

 C = [299792457.86759133843368398914990500927337258665405914040533114633]

          Resonant recursive temperature unit of Kelvin K = [(e\*10^64)/10^64+AS+BS]

          K = [2.7315999984590452353602874713526624977572470936999595749669676277]

 AS = Lim{Sum{[A+(A-100)\*N]/10^(3\*N+2)}} = 729/10^5 – final ratio of Schrödinger-Sommerfeld

 A = 1/Lim{Sum{729927/10^(8\*N)}} = 137 – final integer of Sommerfeld-Schrödinger

 BS = Lim{Sum{B/10^(3\*N+8)}} = 602817/10^8 – final ratio of Dalton-Avogadro

 B = Lim{602214183/(1+4\*pi/10^(8\*N)} = 602214183 – final integer of Avogadro-Dalton

 Recursive wavelength-frequency displacement factor and eccentricity of Wien

 Factor XE = [Root{X\*e^X/(e^X-1) = 5}], eccentricity AX = 5/X-1

 X = [4.9651142317442762999999999999999999999999999999999999999999999999]

 AX = [0.0070261763632109038284968175949445852817197239145427400032486007]

:

Decimal denormalization and the consequent factorization of X will later give us recursive arithmetic keys to the quantum calculus:

X06 = Integer{X\*10^05} = [496511] 6-digit prime

X09 = Integer{X\*10^08) = [496511423] 9-digit prime

X27 = Integer{X\*10^26} = [496511423174427629999999999] 27-digit prime

X49 = Integer{X\*10^48} = [4965114231744276299999999999999999999999999999999] 49-digit prime

From a geometric point of view, the quantum unit of rotation speed C is the recursively calculated (stroboscopic) upper limit of the translational velocity of harmonic circular motion of the outer part of the pulsating Euler spiral and in the decimal system of positional calculation we cannot determine C with an accuracy better than 1/10^64. Unit K is the stroboscopic upper limit of the vibrational velocity of the radial movement of the inner part of the pulsating Euler spiral and should also be estimated with an accuracy of 10^(-64). Therefore, with the appropriate level of accuracy, we must trim the transcendental numbers pi and e when separately evaluating the parameters of the recursive circular and recursive radial movement, and this truncation procedure, shown below, can be called the “irrationality rationalization algorithm”:

          Decimally normalized recursive spatial unit of Pythagoras PI = [Integer{pi\*10^64}/10^64],

           PI = [3.1415926535897932384626433832795028841971693993751058209749445923].

           Decimally normalized recursive temporal unit of Euler E = [Integer{e\*10^64}/10^64],

           E = [2.7182818284590452353602874713526624977572470936999595749669676277].

On the other hand (classic metric of mathematical physics, analytical chemistry, materials science and bioinformatics), the unit of the reference resonant speed C = 2.99792458\*10^8, the unit of the reference resonant temperature K = 2.7316, the reference unit of relative molar mass M = 12/10^3 (carbon-12), all of them were carefully determined by various experimental methods and mutually coordinated by calculating the relative thermal, electrical, magnetic and mechanical energy of continuously moving subatomic particles and waves. Obviously, all the reference metric units can be considered as "exact" only by a compromise agreement of the scientific community. But in fact, the last figures of experimentally defined units cannot be absolutely accurate due to the experimental errors and the computational entropy of mutual coordination of parameters of motion equations of subatomic waves and particles. Obviously, a nine-digit length of decimal fractional number C limits the computational accuracy of the inverse speed at the level 10^(-8), a five-digit length of K limits accuracy of the thermal metric at the level 10^(-4), and a four digit lengths of M limits the accuracy of mass metric at the decimal level 10^(-3). At the same time, the modern physics successfully works with quantum units at the Planck energetical level 10^(-34), the Boltzmann level 10^(-23), the Avogadro level 10^(+23), therefore the accurate quantum metric must operate with decimal fractions inside the digital field from 10^(-34) up to10^(+23), or in the band of decimal fraction orders from 0 to 10^57.

 The recursive calculations of the motion parameters of harmonic waves presented below derive C and K from the gradients of the perimeter of the circle relative to the gradient of the radius of the circle and vice versa. The intuitive geometric definition of Planck units as the decimally normalized outer perimeters of a pulsating spiral [P] = 2\*pi\*(1+2/100\*(e+[A]\*(1+Sqrt(2\*pi\*e/100)))) and the corresponding units of the relative inverse eccentricity [A] = (100\*([Pi]/(2\*pi) -1)/2-e)/(1+Sqrt (2\*pi\*e/100)), of the Boltzmann units as the relative inverse radii of a core of a pulsating spiral [K] = Cos(12- [A]/10)-Sin(12-[A]/10), the Dalton and Avogadro units as the recursive relative densities of the translational velocity [D] = 10/[N], [N] = 10/[D], we can exclude metric artifacts meter, second, kilogram as optional and, therefore, logically redundant units. This redefinition was recently done in the SI-2019 metric system, but without changing the conventionally “exact” values of C and K. It is obvious that using of very short decimal sequences for temperature and speed, when the wave frequencies are many decimal orders higher, is a very serious logical fallacy of the SI quantum metric and, therefore, of all contemporary theories of quantum physics.

 Obviously, we will never be able to completely eliminate the errors in measuring temperature, speed and frequency, but we can accurately calculate the natural boundaries of their normal dispersion using “fair recursive arithmetic”, which naturally generates the computational loops, knots and corresponding dynamic entropy of information, as shown below:

                                        C(PI) = (R/(10^8) + 4\*PI\*C(PI)/(10^18)) ^ 64 \* (10^7) = C

                                            ­­­­PI(C) = (10^18) \* ((C/(10^7) ^ (1/64) - R/(10^8))/4/C

                PI = 3.14159265358979323846264338327950288419716939937510582097…49445923

           PI(C) = 3.14159265358979323846264338327950288419716939937510582097…15624830

    PI – PI(C) = 0.00000000000000000000000000000000000000000000000000000000…33821093

The final difference [PI - PI (C)] has a decimal order of 10^(-57), and we can consider this value as a natural computational horizon for the informational entropy of a quantum metric. In the standard physical model, the decimal order 57 is the sum of the absolute Boltzmann and Planck unit decimal orders, and therefore the energy entropy in the quantum metric can be considered as the equivalent (not equality) of informational entropy in quantum calculus. In addition, using this concept, we can consider sub-molecular (atoms) and subatomic particles (protons, neutrons, electrons, neutrinos, photons, quarks, etc.) as the condensed states of matter or as static patterns of shadows (results of interference and superposition) of harmoniously moving waves of matter, and this naturally coordinates analytical chemistry and materials science with quantum mechanics.

COMPUTATIONAL LIMITS OF RECURSIVE INFORMATION PROCESSING

 As it was shown above the computational results of quantum information processing in symbolic [pi…e] and digital [PI…E] notations strongly depend upon the digital length of records of irrational numbers.

 We define the computational operator Median (Med) as the arithmetical average of five mean values ​​- the root mean square MR = Sqrt [(x^2 + y^2)/2], the arithmetical mean MA = (x + y)/2, the geometrical mean value MG = Sqrt (x \* y) and two different, but logically seeming equivalent records of harmonic values MH1 = 2/(1/x + 1/y) and MH2 = 2\*pi\*e/(pi + e), Med = Sum{MR + MA + MG + MH1 + MH2}/5. Standard functional analysis (symbolic) gives the result MR > MA > MG > MH1 = MH2 when [x > y]. But this does not apply to the case of discrete quantum calculus, where we can obtain the “knots and loops”, such as MH1 > MH2 = MA = Med > MG = MR for PI with 64-bit mantissa, or MR < Med < MA = MG = MH1 = MH2 for the mantissa 32 bit, MR < Med < MA = MG = MH1 = MH2 for the length of mantissa 16, and MR = MA = MG = MH1 = MH2 = Median for the 15-bit mantissa:

PI = 3.1415926535897932384626433832795028841971693993751058209749445923 – 64-bit mantissa

 3.1415926535897932384626433832795028841971693993751058209749445922 = MR

 3.1415926535897932384626433832795028841971693993751058209749445922 = MG

 3.1415926535897932384626433832795028841971693993751058209749445923 – Median

 3.1415926535897932384626433832795028841971693993751058209749445923 = MA

 3.1415926535897932384626433832795028841971693993751058209749445923 = MH2

 3.1415926535897932384626433832795028841971693993751058209749445925 = MH1

PI = pi\*10^32/10^32 = 3.1415926535897932384626433832795 – mantissa 32 digits

             MR = 3.141592653589793

 3.1415926535897931907701147066236 – Median

             MA = 3.1415926535897932384626433832795

            MG = 3.1415926535897932384626433832795

           MH1 = 3.1415926535897932384626433832795

 MH2 = 3.1415926535897932384626433832795

PI = pi\*10^16/10^16 = 3.1415926535897932 – mantissa 16 digits

 MR = 3.141592653589793

 3.14159265358979316 – Median

 MA = 3.1415926535897932

 MG = 3.1415926535897932

 MH1 = 3.1415926535897932

 MH2 = 3.1415926535897932

The computational loops and the entropy of the weighted averages disappear when the digital length of the mantissa becomes 15 or less, and we always obtain the equality MR = MA = MG = MH = MH2 = Med. This result can be regarded as an actual infinitesimal point of symbolic functional analysis corresponding to the singular decimal order of proton radius in quantum physics and analytical chemistry.

PI = pi\*10^15/10^15 = 3.141592653589793 – mantissa 15 digits

 MR = 3.141592653589793

 MA = 3.141592653589793

 3.141592653589793 – Median

 MG = 3.141592653589793

 MH1 = 3.141592653589793

 MH2 = 3.141592653589793

Weighted averages and autocorrelation of speed unit C in various decimal notations:

C = 299792457.86759133843368398914990500927337258665405914040533114633

 299792457.8675913 MR

 299792457.867591330746947191319924007418698069323247312323437410274992 Median

 299792457.86759133843368398914990500927337258665405914040119361238496 MH1

 299792457.8675913384336839891499050092733725866540591404053311463299999999 MG

 299792457.86759133843368398914990500927337258665405914040533114633 MA

 299792457.86759133843368398914990500927337258665405914040533114633 MH2

CN = C/10^8 – decimally normalized value of C

 2.9979245786759133843368398914990500927337258665405914040533114632 MR

 2.9979245786759133843368398914990500927337258665405914040533114632 MG

 2.9979245786759133843368398914990500927337258665405914040533114633 MA

 2.9979245786759133843368398914990500927337258665405914040533114633 Median

 2.9979245786759133843368398914990500927337258665405914040533114633 MH2

 2.9979245786759133843368398914990500927337258665405914040533114635 MH1

CD = CN\*10^64 – denormalized value of C

 29979245786759133843368398914990500927337258665405914040533114633 MR

 29979245786759133843368398914990500927337258665405914040533114633 MA

 29979245786759133843368398914990500927337258665405914040533114633 MG

 29979245786759133843368398914990500927337258665405914040533114633 MH2

 Infinity – Error: Dividing By Zero MH1

Continue the calculations of autocorrelation of basic quantum units:

E = e\*10\*64/10^64 – decimally normalized value of e

 2.7182818284590452353602874713526624977572470936999595749669676276 MR

 2.7182818284590452353602874713526624977572470936999595749669676276 MG

 2.7182818284590452353602874713526624977572470936999595749669676277 MA

 2.7182818284590452353602874713526624977572470936999595749669676277 Median

 2.7182818284590452353602874713526624977572470936999595749669676277 MH1

 2.7182818284590452353602874713526624977572470936999595749669676277 MH2

K = [K] – decimally normalized value of K

 2.7315999984590452353602874713526624977572470936999595749669676276 MR

 2.7315999984590452353602874713526624977572470936999595749669676276 MG

 2.7315999984590452353602874713526624977572470936999595749669676277 MA

 2.7315999984590452353602874713526624977572470936999595749669676277 Median

 2.7315999984590452353602874713526624977572470936999595749669676277 MH2

 2.7315999984590452353602874713526624977572470936999595749669676278 MH1

X = [X] – decimally normalized value of X

 4.9651142317442762999999999999999999999999999999999999999999999998 MR

 4.9651142317442762999999999999999999999999999999999999999999999998 MG

 4.9651142317442762999999999999999999999999999999999999999999999999 MA

 4.9651142317442762999999999999999999999999999999999999999999999999 MH2

 4.9651142317442763 Median

 4.9651142317442763000000000000000000000000000000000000000000000007 MH1

X49 = 4965114231744276299999999999999999999999999999999 – 49-bit prime number

 4965114231744275825829109166100547748494130456169 Integer part of MH1

 4965114231744276205165821833220109549698826091233 Integer part of median.

 4965114231744276299999999999999999999999999999999 MR

 4965114231744276299999999999999999999999999999999 MA

 4965114231744276299999999999999999999999999999999 MG

 4965114231744276299999999999999999999999999999999 MH2

X27 = 4965114231744276299999999999 – 27-bit prime number

 496511423174427629999999998.999999999996616328800447858863 MH1

 496511423174427629999999998.9999999999993232657600895717726 Median

 496511423174427629999999999 MR

 496511423174427629999999999 MA

 496511423174427629999999999 MG

 496511423174427629999999999 MH2

X09 = 496511423 – 9-bit prime number; MR = MA = MG = MH1 = MH2 = Median

X06 = 496511 – 6-bit prime number; MR = MA = MG = MH1 = MH2 = Median

Denormalized MH1 in dependence upon digital length X(N)

 49651142317442762999999999.00000000000004411535312690404 X26

 4965114231744276299999998.999999999999999851966846956 X25

 496511423174427629999999.00000000000000001096705693 X24

 49651142317442762999998.9999999999999999999960242 X23

 4965114231744276299999.0000000000000000000010608 X22

 496511423174427629999.000000000000000000000006 X21

 49651142317442762999 X20

 4965114231744276299 X19

 496511423174427629 X18

 49651142317442762 X17

 4965114231744276 X16

 496511423174427 X15

 49651142317442 X14

 4965114231744 X13

 496511423174 X12

 49651142317 X11

 4965114231 X10

 496511423 – prime number X09

 49651142 X08

 4965114 X07

 496511 – prime number X06

 49651 X05

 4965 X04

 496 X03

 49 X02

 4 X01

.

The computational effect of the floating median can be observed only during the careful calculation process and only when the digital length of X-factor exceeds 20 bit.

RECURSION AND CONVERSION IN SYMBOLIC FUNCTIONAL ANALYSIS

 At first it was found intuitively, and then it was computationally and experimentally confirmed that the basic equations of classical and quantum physics can be combined into a single structure of decimal normalized recursive arithmetic of relative space-time [PI-E] and relative speed-temperature [C-K], where the parameters are functions of the argument of information entropy Sqrt(2\*pi\*e) of the Gaussian normal distribution. Despite the amazing simplicity, the equations obtained completely coordinate various sections of mathematics (recursive arithmetic, geometry, trigonometry, algebra, logarithms, vector and tensor calculus, big data statistics) in a universal information system, drawing a shadow picture of the wave interference and superposition, which from a physical point of view is a two-dimensional radial matrix hologram of the eigenvalues ​​of the wave parameters of the three-dimensional harmonic motion of quantum particles and waves in a logarithmically compressed space near (slightly above and slightly below) a unique recursive point of central and mirror symmetry of reference value of relative eccentricity Integer{10^64/137} = 72992700729927007299270072992700729927007299270072992700729927.

Radius-eccentricity recursion of Dirac-Sommerfeld-Gauss

   [R] = 1+2/100\*(e+[A]\*(1+Sqrt(2\*pi\*e/100))) – distribution of the inverse radius.

   [A] = (100\*([R]-1)/2-e)/(1+Sqrt(2\*pi\*e/100)) – distribution of the inverse eccentricity.

Perimeter-radius recursion of Planck-Dirac-Heisenberg

                  [P] = 2\*pi\*[R] – distribution of the inverse perimeter of pulsating sphere.

                  [R] = [P]/(2\*pi) – distribution of the inverse radius of pulsating sphere.

Perimeter-eccentricity recursion of Newton-Planck-Sommerfeld:

                 [G] = [P]\*(1+[A]) – distribution of density of inverse perimeters.

                 [P] = [G]/([A]+1) – distribution of the inverse perimeter.

Velocity-radius recursion of Maxwell-Kelvin-Dirac:

                 [V] = [R]^64\*10^7 – distribution of the translational speed.

                 [R] = {[V]/(10^7)}^(1/64) – distribution of the inverse radius.

Amplitude-phase conversion of Boltzmann-Amagat-Sommerfeld:

                 [M] = 12-[A]/10 – distribution of relative amplitude.

                 [K] = Cos[M]-Sin[M] – distribution of relative phase.

Eccentricity-entropy conversion and recursion of Avogadro-Sommerfeld-Dalton:

  [A] = 1000\*(100\*Sqrt(8\*pi\*e/(8\*pi\*e+137^2))/([N]+5/10^6)-1)/2 – relative inverse eccentricity.

   [N] = 100\*(Sqrt(8\*pi\*e/(8\*pi\*e+137^2))/(1+2\*[A]/1000)-5/10^8) – entropy of inverse eccentricity.

   [D] = 10/[N] – distribution of inverse entropy of eccentricity.

 [N] = 10/[D] – distribution of entropy of eccentricity.

The presented set of decimally normalized parametric equations was first derived intuitively by means of projective geometry based on the observable shadows of the stereometric images of a pulsating spherical spiral (in the form of a soft fuzzy ball of many twisted strands), and then recorded using standard functional analysis and hyperbolic geometry.

COMPUTATIONAL ENTROPY OF STANDARD FUNCTIONAL ANALYSIS

   We can immediately demonstrate the informational entropy of harmonic mean calculations in various notations that first seemed logically equivalent, such as MH1 = 2/(1/pi + 1/e) and MH2 = 2\*pi\*e/(pi + e) when the length N of digital entries [PI] and [E] are changed from 1 to 18:

 MH1 = 2/(1/pi+1/e) N

 2.4000000000000000                                                             01

   2.8862068965517241                                                                                                   02

   2.9091965811965812                                                                                                   03

   2.9142304147465438                                                                                                   04

   2.9145605747734526                                                                                                   05

   2.9146452959536645                                                                                                   06

   2.9146467315424754                                                                                                   07

   2.9146474496431801                                                                                                   08

   2.9146474826586594                                                                                                   09

   2.9146474885485554                                                                                                   10

   2.9146474889936798                                                                                                   11

   2.9146474890568518                                                                                                   12

   2.9146474890658988                                                                                                   13

   2.9146474890662000                                                                                                   14

   2.91464748906626178                                                                                                 15

   2.914647489066265942                                                                                               16

   2.9146474890662661432                                                                                             17

   2.91464748906626617338                                                                                           18

Unexpected computational fact is observed – always digital length of MH1 < MH2 when N > 1

MH2 = 2\*pi\*e/(pi+e) N

    2.9146474890662661733836877634297139370899665719276731004859726984   18

   2.9146474890662661432271340487896641497502285350809052429652886066   17

   2.9146474890662659421834426178559988188888904480263412523209212224   16

   2.9146474890662617768318350202910202020875281750671576926127529108   15

   2.9146474890662000495765944390045076482272134233627659307058572759   14

   2.9146474890658987903392328767740518340192743930461333095041856566   13

   2.9146474890568518242248408701108514245299963504003429453470654923   12

   2.9146474889936797911944367103116806437819478305300319541986058526   11

   2.9146474885485553744235567014357692007362298994608789129795696728   10

   2.9146474826586594098149682718373999571359418557647020721930242987   09

   2.9146474496431800654293887254648324885598230569583539000000000000   08

   2.9146467315424754085967392126075087292847472974243600000000000000   07

   2.9146452959536645010896146160239049671750397193111792600000000000   06

   2.9145605747734525658310152396880386367902793658378420000000000000   05

   2.9142304147465437788018433179723502304147465437788018000000000000   04

    2.9091965811965811965811965811965811965811965811965812000000000000   03

   2.8862068965517241379310344827586206896551724137931030000000000000   02

   2.4000000000000000000000000000000000000000000000000000000000000000   01

The appearance of trivial zeros in sequence MH2 ​​for N = (1...8) demonstrates a direct relationship between the argument Sqrt(2\*pi\*e) of Gauss normal distribution function and Riemann zeta-function.

 From Britannica.com: “Riemann zeta function was defined as ζ(x) = 1+2^(-x)+3^(−x)+4^(−x)+…

When x = 1, this series is called the harmonic series, which increases without bound, its sum is infinite. For values of x larger than 1, the series converges to a finite number as successive terms are added. If x is less than 1, the sum is again infinite. Riemann’s formula depended on knowing the values at which a generalized version of the zeta function equals zero. The Riemann zeta function is defined for all complex numbers, except for the line x = 1 and that the function equals zero for all negative even integers -2, -4, -6, -8… (so-called trivial zeros), and that it has an infinite number of zeros in the critical strip of complex numbers between the lines x = 0 and x = 1, and Riemann also knew that all nontrivial zeros are symmetric with respect to the critical line x = 1/2. Riemann conjectured that all of the nontrivial zeros are on the critical line, a conjecture that subsequently became known as the Riemann hypothesis. D.Hilbert called the Riemann hypothesis one of the most important questions in all of mathematics. G.Hardy proved that an infinite number of zeros occur on the critical line x = 1/2. Euler proved that ζ(2) = pi^2/6 and discovered a relation between the value of the zeta function for even integers and the Bernoulli numbers, which are the coefficients in the Taylor series expansion of x/(e^x−1)…”, which is general part of classic equation for blackbody irradiation in physics.

 In quantum physics the expression [x/(e^x-1)] is the main part of the Wien's expression for the relative wavelength-frequency displacement [X = Root {X\*e^X/(e^X-1) = 5}], and the finite difference of the partial Planck units P1 and P0 shows an infinite set of trivial zeros, starting at the 17th place of the mantissa:

 P1 = 2\*pi\*(1+2/100\*(e+1/137\*(1+Sqrt(2\*pi\*e/100)))) = 6.6260710055755005 – 17 digits

 P0 = 2\*pi\*(1+2/100\*(e+(pi\*e/100)^2\*(1+Sqrt(2\*pi\*e/100)))) = 6.6260698398254579 – 17 digits

 Finite Planck difference PDF = P1-P0 = 0.0000011657500426 – 17 digits

The calculation results for algebraic and trigonometric notations of angles differ, starting from the 23rd place of the mantissa. This is direct evidence of the informational entropy of standard functional analysis, where cos (pi/6) should be equal to Sqrt(3)/2. An unexpected fact can be observed below – the mutual entropy of trigonometric and algebraic calculations is 48 decimal orders.

 PDA = 4\*pi/10^7\*(2\*e/(pi+e) - Sqrt(3)/2/10^4 - 1/10^7 + 5/10^10) – algebraic notation

 PDA = 0.0000011657500426292648060980373169215771911335953413611052194231 – 65 digits

 PDF = 0.0000011657500426

 PDT = 0.0000011657500426292648612200153342676195353831556794871202368666 – 65 digits

 PDT = 4\*pi/10^7\*(2\*e/(pi+e) - Cos(pi/6)/10^4 - Tan(pi/4)/10^7 + Cos(pi/3)/10^9) – trigonometric notation

Computational results for decimally denormalized and normalized algebraic notations of angle pi/6:

 [10^64\*Sqrt(3)/2)] =

 8660254037844386467650000000000000000000000000000000000000000000 – 64 digits,

 [10^64\*Sqrt(3)/2/10^64] =

 0.8660254037844386467637231707529361834714026269051903140279034897 – 65 digits.

Euler’s trigonometric conjunction for angle pi/6:

 ET = 10^64\*Cos(pi/6) =

 [8660254037840000000000000000000000000000000000000000000000000000] – 64 digits,

 10^64\*Cos(pi/6)/10^64 = 0.866025403784 – 13 digits.

Fibonacci trigonometric conjunction for “golden ratio” angle pi/5:

 FT = 10^64\*2\*Cos(pi/5) =

 16180339887500000000000000000000000000000000000000000000000000000 – 65 digits,

 10^64\*2\*Cos(pi/5)/10^64 = 1.61803398875 – 12 digits.

Fibonacci algebraic conjunctions for two different (+1 and -1) notations of “golden ratio”:

 FA(+1) = 10^64\*(Sqrt(5)+1)/2) =

 [16180339887498948482045000000000000000000000000000000000000000000] – 65 digits,

 F(+1)/10^64 =

 1.6180339887498948482045868343656381177203091798057628621354486227 – 65 digits,

 [F(+1)]/10^64 =

 1.6180339887498948482045 – 23 digits .

 FA(-1) = 10^64\*(Sqrt(5)-1)/2) =

 [6180339887498948482045000000000000000000000000000000000000000000] – 64 digits,

 F(-1)/10^64 =

 0.6180339887498948482045868343656381177203091798057628621354486227 – 65 digits,

 [F(-1)]/10^64 =.

 0.6180339887498948482045 – 23 digits.

This is the first discovered direct evidence of the hidden internal connection of quantum physics, quantum metrics and quantum calculus with the Riemann zeta function (critical vertical line x = 1/2 or x = 5/10) and the harmonic extension of Taylor [x/(e^x-1)] , since the radian expression [4\*pi/10^7] is the designation of magnetic constant from the classic Maxwell equations, and the expression [X = Root{X\*e^X/(e^X-1) = 5}] is the designation of the wavelength-frequency displacement factor from the classic Wien equation for the irradiation of black body. In addition, the arithmetical fact of computational nonequivalence has been first discovered in algebraic and trigonometric notations for the angle [pi/6] with zeta function ζ(2) = [pi^2/6] of Euler and with the Gaussian prime A = [137 = 11^2+2^4], starting from the 23rd place of the mantissa (and this is the absolute decimal order for the Boltzmann and Avogadro quantum constants). Too many coincidences to be accidental.

SINGULARITY AND INFORMATIONAL ENTROPY OF QUANTUM CALCULUS

 Singularity, also called singular point, of a function of the complex variable z is a point at which it is not analytic (that is, the function cannot be expressed as an infinite series in powers of z) although, at points arbitrarily close to the singularity, the function may be analytic, in which case it is called an isolated singularity. In general, because a function behaves in an anomalous manner at singular points, singularities must be treated separately when analyzing the function, or mathematical model, in which they appear (Britannica.com).

 PI = 3.1415926535897932384626433832795028841971693993751058209749445923

 E = 2.7182818284590452353602874713526624977572470936999595749669676277

(PI - E) = 0.4233108251307480031023559119268403864399223056751462460079769646

 N DN = (PI - E)\*(PI/E)\*(E/PI) – natural differential by definition

1. 1.
2. 0.4 – first singularity of differential and difference DN = (PI – E)
3. 0.4299999999999999999999999999999999999999999999999999999999999999
4. 0.4229999999999999999999999999999999999999999999999999999999999999
5. 0.4232999999999999999999999999999999999999999999999999999999999999
6. 0.42331 – second singularity of differential and difference DN = (PI – E)
7. 0.4233109999999999999999999999999999999999999999999999999999999999
8. 0.4233107999999999999999999999999999999999999999999999999999999999
9. 0.4233108299999999999999999999999999999999999999999999999999999999
10. 0.4233108249999999999999999999999999999999999999999999999999999999
11. 0.4233108250999999999999999999999999999999999999999999999999999998
12. 0.4233108251299999999999999999999999999999999999999999999999999999 same 13
13. 0.4233108251299999999999999999999999999999999999999999999999999999 same 12
14. 0.4233108251306999999999999999999999999999999999999999999999999999
15. 0.4233108251307499999999999999999999999999999999999999999999999999
16. 0.4233108251307479999999999999999999999999999999999999999999999999 same 18
17. 0.4233108251307479999999999999999999999999999999999999999999999999 same
18. 0.4233108251307479999999999999999999999999999999999999999999999999 same 16
19. 0.4233108251307480029999999999999999999999999999999999999999999999
20. 0.4233108251307480030999999999999999999999999999999999999999999999 same 21
21. 0.4233108251307480030999999999999999999999999999999999999999999999 same 20
22. 0.4233108251307480031019999999999999999999999999999999999999999999
23. 0.4233108251307480031023999999999999999999999999999999999999999999 abs max
24. 0.4233108251307480031023599999999999999999999999999999999999999999
25. 0.4233108251307480031023559999999999999999999999999999999999999999
26. 0.4233108251307480031023558999999999999999999999999999999999999999
27. 0.4233108251307480031023559099999999999999999999999999999999999999
28. 0.4233108251307480031023559119999999999999999999999999999999999999
29. 0.4233108251307480031023559118999999999999999999999999999999999999
30. 0.4233108251307480031023559119199999999999999999999999999999999999
31. 0.4233108251307480031023559119269999999999999999999999999999999999
32. 0.4233108251307480031023559119268999999999999999999999999999999999
33. 0.4233108251307480031023559119268399999999999999999999999999999999 same 34
34. 0.4233108251307480031023559119268399999999999999999999999999999999 same 33
35. 0.4233108251307480031023559119268403999999999999999999999999999999
36. 0.4233108251307480031023559119268403899999999999999999999999999999
37. 0.4233108251307480031023559119268403869999999999999999999999999999
38. 0.4233108251307480031023559119268403863999999999999999999999999999 loc min
39. 0.4233108251307480031023559119268403864399999999999999999999999999 same 40
40. 0.4233108251307480031023559119268403864399999999999999999999999999 same 39
41. 0.4233108251307480031023559119268403864398999999999999999999999999
42. 0.4233108251307480031023559119268403864399199999999999999999999999
43. 0.4233108251307480031023559119268403864399219999999999999999999999
44. 0.4233108251307480031023559119268403864399222999999999999999999999 same 45
45. 0.4233108251307480031023559119268403864399222999999999999999999999 same 44
46. 0.4233108251307480031023559119268403864399223059999999999999999999 loc max
47. 0.4233108251307480031023559119268403864399223056999999999999999999
48. 0.4233108251307480031023559119268403864399223056799999999999999999
49. 0.4233108251307480031023559119268403864399223056759999999999999998
50. 0.4233108251307480031023559119268403864399223056751999999999999999
51. 0.4233108251307480031023559119268403864399223056751499999999999999
52. 0.4233108251307480031023559119268403864399223056751459999999999999
53. 0.4233108251307480031023559119268403864399223056751462999999999999 loc max
54. 0.42331082513074800310235591192684038643992230567514625 – 3rd singularity
55. 0.4233108251307480031023559119268403864399223056751462459999999999 same 56
56. 0.4233108251307480031023559119268403864399223056751462459999999999 same 55
57. 0.4233108251307480031023559119268403864399223056751462460099999999 loc max
58. 0.4233108251307480031023559119268403864399223056751462460079999999 same 60
59. 0.4233108251307480031023559119268403864399223056751462460079999999 same
60. 0.4233108251307480031023559119268403864399223056751462460079999999 same 58
61. 0.42331082513074800310235591192684038643992230567514624600798 – 4th singularity
62. 0.4233108251307480031023559119268403864399223056751462460079768999
63. 0.4233108251307480031023559119268403864399223056751462460079769699 loc max
64. 0.4233108251307480031023559119268403864399223056751462460079769649
65. 0.4233108251307480031023559119268403864399223056751462460079769645

Computational “stairs” of informational entropy of differential calculus appear, starting from N = [12, 13], later appear in places [16, 17, 18], [20, 21], [33, 34], [39, 40], [44, 45], [55, 56], [58, 59, 60]. Singularity points (equality of difference and differential) are N = 2, N = 6, N = 54, N = 61. Local extremes appear at point N = 23 (absolute maximum), N = 38 (absolute minimum) and as local maxima at points N = 46, N = 53, N = 57, N = 63. If it is “chaos”, it should be considered as deterministic, determined by the algorithms of recursive functional analysis. Geometrically, singularity points can be called “digital strings”, and points with long sequences of digit 9 can be called “digital springs”.

SPEED OF LIGHT IN QUANTUM MULTIVERSE

   Multiverse, a hypothetical collection of potentially diverse observable universes, each of which would comprise everything that is experimentally accessible by a connected community of observers. The observable known universe, which is accessible to telescopes, is about 90 billion light-years across. However, this universe would constitute just a small or even infinitesimal subset of the multiverse (Britannica.com). Consider the mathematical multiverse as a set of partial functions [Ci] = [C(N\*pi)]:

        N\*pi                                                               [Ci]

       +4\*pi    299792457.86759133843368398914990500927337258665405914040533114633

       +2\*pi    299792423.59665663248376226231081777919356930996545001005836181873

       +1\*pi    299792406.46119366396584077309834867624656763543007780021999152550

       +0\*pi    299792389.32573361841809854874363142602544838624276139015179771702

           +0    299792389.3257336184181

       Zero     299792389.32573362 – “zero computational knot” [C(+0)] < ZERO > [C(-0)]

            -0    299792389.3257336184181

        -0\*pi    299792389.32573361841809854874363142602544838624276139015179771702

        -1\*pi    299792372.19027649583965035127708901961006604028365659618783613189

        -2\*pi    299792355.05482229622961094312166125705089930534076037616922998012

        -4\*pi    299792320.78392266591121754639849152308315833303084172472274810799

The main characteristic feature of the presented [Ci]-matrix is the fact that no scientific or engineering calculator working in the discrete digital domain of standard functional analysis can sense the human logic of equality [+0\*pi] = [+1\*0] = Zero = [-1\*0] = [-0\*pi] and therefore gives different results for different designations of absolute zero. This is the so-called "machine zero problem" caused by the inability to completely write down the infinite irrational numbers in the final computer memory. In quantum physics, this logically corresponds to the problems of black energy, black matter and black-body radiation. Another feature of the [Ci]-matrix is the fact that Integer{C(+4\*pi)} – Integer{C(-4\*pi)} = 137 = A. This was first observed by A. Sommerfeld, and later A. Eddington, M. Born, R. Feynman and many others deeply discussed the fact as the so-called "mystery of the prime number 137".

QUANTUM TOPOLOGY OF METRIC SPACE.

 The set of "trident" fractal matrices presented below combine standard [pi...e] and non-standard [PI…E] functional analysis with the basic branches of physics (thermo-, electro-, chromo- and gravidynamics) within the framework of the relative space-time metric (metric of average speed) and of their natural derivative – relative speed-temperature metric (metric of instantaneous speed).

   Two-dimensional distribution of the inverse eccentricity of the pulsating spherical spiral (where A = 137; B = 602214183) gives a partial set [N] of decimal normalized Avogadro units and describes the limits of the entropy for the ideal crystalline state of matter (a shadow pattern of a rotating polyhedron):

   A4 = 4/137-3\*(PI\*E/100)^2

                                                 Median{AH...A4} = AH4

   AH = 1/16/PI/E                     Median{AHL...AH4) = AL4 –> NE...NA...NB <– [B/(1+4\*PI/10^8)/10^8]

                                                 Median{AH...AL} = AHL

   AL = 1/(1+59\*Ln(10))

   Two-dimensional distribution of the inverse perimeter of the pulsating spherical spiral gives a partial set [P] of decimal normalized Planck units and describes the boundaries of the information entropy of calculations for the ideal liquid state of matter (a shadow pattern of a rotating polygon):

 A1 = 1/137

                                                  Median{A0...A1} = A01

   A0 = (PI\*E/100)^2                 Median{A0S...A01} = AS1 –> PP...PQ...PF <– [AF = 1/(A+36/1000)]

                                                  Median{A0...AS} = A0S

   AS = 1/100/(10/(10-1))^3

   Two-dimensional distribution of the inverse radius of the pulsating spiral (where K = [e + AS + BS], BS=Sum{B/10^(3\*N+8)}; gives a partial set [R] of decimal normalized Dirac units and Maxwell-Kelvin units [C, V, T, K] and describes the boundaries of the information entropy of the ideal gas state of matter (a shadow pattern of a rotating helix):

 RE = (R+1/E)/10^8

                                                 Median{RA...RE} = RAE

    RA = (R+1/(E +AS))/10^8  Median{RAK...RAE} = RKE –> VT...V...VC <– [RC = (C/10^7)^(1/64)]

                                                 Median{RA...RK} = RAK

    RK = (R+1/K)/10^8

   Two-dimensional distribution of the density of perimeter of the core of the pulsating helix (where Root{X\*e ^X/(e ^X -1) = 5} = X is a Wien’s factor of  the wavelength displacement) gives a set [Gi] of decimal normalized Newtonian units for the idealized solid state GN, for the liquid-crystal state GQN, for the idealized liquid state GQ, for the liquid-gas state GQV, for the ideal gas state GV, for the gas-vacuum (vapor) state GVX, for the vapor-vacuum state GX, and for the average gravitation G (a shadow pattern of a rotating core of pulsating helix):

    GN = PN\*(1+AN)

                                                  Median{GQ...GN} = GQN

    GQ = PQ\*(1+AQ)                Median{GQV...GQN} = GVN...G...GX <– [AX = 5/X -1]

                                                  Median{GQ...GV} = GQV

    GV = PV\*(1+AV)

FUNDAMENTAL QUANTUM UNITS OF STANDARD PHYSICAL MODEL

 The main logical error of the new SI metric and partial theories within the framework of the standard physical model is the conclusion about the presence of fixed absolute values of fundamental quantum constants. Recursive functional analysis does not show constants, but quasi-harmonic variables, inside a logarithmically compressed space around the mirror symmetry point of the inverse eccentricity 10^64/A.

 The relative entropy units of Avogadro [N], the relative atomic mass units of Dalton [D], the relative eccentricity units of Sommerfeld [A], the relative perimeter units of Planck [P], the relative speed units of Maxwell-Kelvin [V], the relative amplitude-phase conversion units of Boltzmann [K], the relative gravity units of Newton [G] are shown below in comparison with values of CODATA from 1986 to 2020 year:

Entropy quaternion of Avogadro-Dalton (6.0221367…6.02214199)\*10^23

   N4 = 602214100258192265954542.790639264054910632971429625386573637623000

   NH = 602214100539028838674670.359666642830819375385139115731597073948000

   NB = 602214107323543381768832.372080781545789391818054856435188473944780

   NL = 602214114501517301123100.966725291786865948242313092851729415813000

Atomic mass quaternion of Dalton-Avogadro (1.660538728015…1.660540186675)/10^27

   D4 = 0.00000000000000000000000000166053900028455274097806768721948511000

   DH = 0.00000000000000000000000000166053899951017684826713682104760528000

   DB = 0.00000000000000000000000000166053898080262607098333573871629545000

   DL = 0.00000000000000000000000000166053896101015490624058825437118610000

Eccentricity quaternion of Sommerfeld-Schrodinger (only AF = 0.007297352533…0.0072973525698)

   A1 = 0.00729927007299270072992700729927007299270072992700729927007299270

   AF = 0.00729735252050556058262062523716395691643071893517032020782859970

   A0 = 0.00729270605939021127239560919002866590988158609611640456003218830

   AS = 0.00729000000000000000000000000000000000000000000000000000000000000

Perimeter quaternion of Planck-Sommerfeld (6.62606876…6.62607015)/10^34

   P1 = 0.00000000000000000000000000000000066260710055755005275632306808575

   PF = 0.00000000000000000000000000000000066260706650236630325309129069319

   P0 = 0.00000000000000000000000000000000066260698398254578760346654559012

   PS = 0.00000000000000000000000000000000066260693592370495339258460404705

Translational velocity quaternion of Maxwell-Kelvin (only C = 299792458)

   VC = 299792457.86759133843368398914990500927337258665405914040533114633

   VE = 299792456.25727418828688602730303276133755256562854721737070348839

   VA = 299792456.07825451280712483094527546296531941425460307995898805333

   VK = 299792455.93094319778705725499466562864791705139878708251387344693

Amplitude-phase conversion quaternion of Kelvin-Boltzmann (1.380649…1.380658)/10^23

   KC = 0.0000000000000000000000138064845028400000000000000000000000000000

   KE = 0.0000000000000000000000138064845018800000000000000000000000000000

   KA = 0.0000000000000000000000138064845017700000000000000000000000000000

   KK = 0.0000000000000000000000138064845016800000000000000000000000000000

Gravity matrix of Newton-Wien (6.67259…6.67430)/10^11

 G4 = 0.000000000066745704910750265485376520841945674109436315576651411

 GH = 0.000000000066745689043376525769289720333765430722301010754854777

 GB = 0.000000000066745305715772324347842697781456256959532800717312072

 GL = 0.000000000066744900157701819328593528677963771946315335088156190

 G1 = 0.000000000066744364873680224292185910483000481884177319277195916

 GF = 0.000000000066744234384921214159611943953611634645758144315309572

 G0 = 0.000000000066743918194962957193271732313472748453752700748755735

 GS = 0.000000000066743734048658876250281654581055184731467225455554924

 GC = 0.000000000066739140452062992860293936167978444193636663660125695

 GE = 0.000000000066739140238977399203350181712938924917247912961769965

 GA = 0.000000000066739140215288578693056001955271762539009208673810927

 GK = 0.000000000066739140195795574401178024788041027602493412757457591

 GX = 0.000000000066725781076198223768643093336888740997069675170845242

 In engineering practice, never before have the complete spectrum of distribution of basic quantum units been coordinated analytically without previous accurate measurements. The physical and mathematical coincidence of the results presented here cannot be considered random, since all estimates lie at the center of the confidence interval of the normal distribution. Analytically defined sets of quantum constants allow us to exclude all artifacts from the metric system and avoid measurements at all by replacing the Feynman’s energy diagrams with diagrams of information entropy of recursive functional analysis in a gauge fields of relative space and time and their natural derivatives – of relative speed and temperature.

Moreover, for the first time in engineering practice the Planck, Boltzmann and Newtonian gravitational units have get the clear geometrical interpretation. And the main remark: quantum matrices with great confidence reflect the hidden mathematical structure of subatomic and hyper-atomic space and time.

 The algorithms for calculating the fractal matrices of trident-quaternions allow us to accurately calculate the variance of the elementary electric charge units and clearly show the equivalence but not the equality of informational and energetical electric charge entropy:

 P1 = 6.6260710055755005275632306808575000000000000000000000000000000000

              6.6260704227005050000000000000000000000000000000000000000000000000

              6.6260704227004792017989480683793500000000000000000000000000000000

   P01 = 6.6260704227004664237035923766586880917776381545723576019644469458 – Median

              6.6260704227004535649381231688451870171105526182894304078577877830

              6.6260704227004279280772982694102153500000000000000000000000000000

     P0 = 6.6260698398254578760346654559012000000000000000000000000000000000

     P0 = 6.2606983982545787603466545590120000000000000000000000000000000000

              6.6260695995312580000000000000000000000000000000000000000000000000

             6.6260695995312537049802557481858500000000000000000000000000000000

  P0S = 6.6260695995312515108870528696260795246609454867389482461959114382 – Median

             6.6260695995312493478494038261671509986437819469557929847836457526

              6.6260695995312449907185519041513171000000000000000000000000000000

    PS = 6.6260693592370495339258460404705000000000000000000000000000000000

 P01 = 6.6260704227004664237035923766586880917776381545723576019644469458

              6.6260700111158717502789623113614819843918105571369090898108612470

              6.6260700111158589672953226231423838082192918206556529240801791920

      P = 6.6260700111158525758035027790205042836557231241773681600339772623 – Median

              6.6260700111158461843116829348986247590921544039112623353533088225

              6.6260700111158334013280432466795265829196357150056482908915597877

   P0S = 6.6260695995312515108870528696260795246609454867389482461959114382

Recursive resonant value of the Planck constant:

 P = 6.6260700111158525758035027790205042836557231241773681600339772623/(10^34).

Recursive resonant value of the fine structure constant:

 AF = 10^64/Integer{1000\*Sqrt(137^2+10)/1000}/10^64 =

 0.0072973525205055605826206252371639569164307189351703202078285998

.

Above mentioned Maxwell-Kelvin quaternion for translational velocities:

    VC = 2.9979245786759133843368398914990500927337258665405914040533114633\*(10^8)

   VE = 2.9979245625727418828688602730303276133755256562854721737070348839\*(10^8)

   VA = 2.9979245607825451280712483094527546296531941425460307995898805333\*(10^8)

 VK = 2.9979245593094319778705725499466562864791705139878708251387344693\*(10^8).

 Quantum electrodynamics define the unit of charge of electron as Q = Sqrt(AF\*P/C/(2\*pi)) where AF is the fine structure constant, P is the Planck constant and C is speed of light in free space. Dispersion of CODATA values of elementary charge since 1986 is (1.60217733…1.602176634)/10^19. Calculated by algorithms of recursive arithmetic dispersion of charge is showed below for comparison:

 Q(VK) = 1.6021766178197831653899113834088177064857454321746347958012599387/(10^19)

 Q(VA) = 1.6021766174261462680811573076820454264169567930402960958488034957/(10^19)

 Q(VE) = 1.6021766169477800981372976225119931530135118595672136585209698628/(10^19)

 Q(VC) = 1.6021766126447824416063734931207643495165914877389276249620920002/(10^19).

The excellent coincidence of the measured and calculated values ​​with respect to the absolute unit of Kelvin vibrational temperature and the absolute unit of Maxwell rotational speed, clearly shows the limits of information entropy and the coordination of classical thermodynamics with classic electrodynamics.

DISCUSSION

 We cannot derive and explain the presented computational algorithms from any partial physical theory of matter, but we can clearly show that all existing theories, such as supersymmetry, loop gravity, strings, multiverse, correspond to the results of recursive calculations of energetical and informational entropy. This is the only reason for the lack of mention of modern authors here. All of them are partly right, but the presented Information-Entropy-Energy paradigm of quantum physics really needs a primary base of abductive (fuzzy, intuitive and associative) logical thinking, which begins with the simplest measurement and elementary calculation of relative intervals and gradients of space and time, but also ends with the same calculations.

 Classic physics combines harmonic recursive continuous functional analysis (Newton-Leibniz-Euler- Bessel-Gauss-Lobachevsky-Riemann-Lorenz-Cantor) with harmonic resonance quantum discrete energy metrics (Coulomb-Stoney, Avogadro-Dalton, Maxwell-Kelvin, Stefan-Boltzmann, Wien-Planck-Einstein-de Broigle-Sommerfeld-Dirac-Schrödinger-Heisenberg-Nyquist-Shannon-Feynman) through the fuzzy instant values ​​of mass m, progressive velocity v, polarization angle k, vibrational temperature t, electric charge q, electric voltage u, action h, frequency f:

 Gravidynamics energy quanta QG = (m\*v^2/2)\*[1+j\*(v/C)^2] – from Newton to Einstein

 Thermodynamics energy quanta QT = (k\*t)/[1+j\*(v/C)^2] – from Boltzmann to Kelvin

 Electrodynamics energy quanta QE = (q\*u)/[1+j\*(v/C)^2] – from Stoney to Dirac

 Chromodynamics energy quanta QC = (h\*f)\*[1+j\*(v/C)^2] – from Planck to Nyquist

The instantaneous mass, charge, frequency and temperature really are functions of translational velocity of harmonically moving subatomic particles and rise 2 times (not to infinity) when instantaneous velocity changes from 0 to C. This fact illustrates the appearing of antimatter particles and closes the problem of the "dark matter and dark energy". The presented equations reflect the harmonic mathematical structure of sub-molecular space and naturally coordinate classical physics (thermodynamics, electrodynamics, chromodynamics and gravidynamics) with quantum mechanics. Moreover, replacing the number 2 with any integer N or inverse 1/N in the expression j\*(v/C)^2 combines the special and general theory of relativity. This is simply a translation of the multi-parabolic ratio of speeds into exponential one without changing the initial and final results. From the point of view of elementary mathematical logic, all of this we should consider as a natural parametric synthesis of standard functional analysis, non-standard analysis, quantum metrics and quantum calculus. The ultimate matrix [Ai] and the final rational value of C mutually coordinate the recursive super-symmetry arithmetic (combined mirror and central symmetry) with the dynamic "ring-spring-string" differential geometry of the multiverse, since the recursive calculations do not depend upon the initial approximation for C, but depend only upon the product N\*pi\*C, which can be considered as a set of cylindrical hoops (tori) in a space of arbitrary order.

 And the last three remarks without comment:

 Standard functional analysis e^(j\*pi) +1 = 0 – continuous (natural symbolic) mathematics of Euler;

 Non-standard analysis E^(j\*PI) +1 = 1/10^64 – discrete (binary digital) mathematics of Gauss;

 Quantum physics E^(j\*PI) +1 = [A]/10^57 – discrete (quantum bits) vector-tensor mathematics.

CONCLUSION

 The materials presented above confirm with great confidence the basic principles of the standard physical model, but at the same time show the methodological errors of the new SI-2019 measuring system and the corresponding limitations of modern theories of quantum physics, where quantum constants conditionally have exact values ​​without natural experimental and computational entropy.

 Consideration and discussion of partial features of the information-entropy-energy paradigm of physics can be endless as the history of science, but in fact the materials shown can be considered as a real quantum renaissance of classical physics.

 Quantum physics is indeed an universal mathematical language, an universal calculation system, the finite holographic selfie of an infinite dynamic Universe, observed by the collective mind of Mankind.

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