REVISED FUNDAMENTAL CONSTANTS

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The discovery of loss-term as a fundamental constant in the famous energy-mass relation warrants a review of the system of constants used in the description of physical processes. Since this discovery was possible only by reverting to the ancient colliding atoms representation here we try to give a complete replacement set of fundamental constants fit to this. We introduce two new fundamental constants and some secondary constants to describe the physical processes, represented in the colliding atoms domain. One of the new constants is the ε restitution coefficient or energy loss at the transition from mass to energy – proposed here to replace the fine-structure constant α – and the second is the ρ virtual mass-energy density of vacuum far from massive bodies. The later – in combination with the speed of light – allows us to define the natural units of space and time. We show a few replacement pairs of fundamental constants, indicating the basis for the successful description of natural processes with the prior set of constants: it already contained the necessary specifics of collision progression structure. We show some modified constants as they are being elevated to the level of fundamentals, like the Hubble wavelength doubling time constant Hd, representing the photon energy loss rate in this representation – and replacing the ill-fated H_0 Hubble constant, used extensively in the recent past. Finally, we arrive to a fine-structure constant – or replacing it restitution coefficient – defined from first principles.

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I. Collision structures

In the ancient – everything is constructed of collision events between the first beginnings – representation the empty space is filled with spontaneous collisions. The density of these collisions in deep space ρ is the first fundamental constant we have to define. Its value is based on the observed nuclear density and a ratio between the nuclear and virtual densities, developed from the specific representation of nuclei of atoms in the collisions are constructing everything representation. The spontaneous collision density is introduced as a virtual mass or a virtual photon or a virtual energy density of the vacuum in deep space. The connection to the nuclear density observed is assumed to be a multiplication factor, defined from the number of collision events on the surface of ^{25}Mg, where the onset of constant density is observed. It is assumed that two collisions spontaneously falling within the volume of Magnesium 25 nucleus produce all the collisions on its surface.

$$m_f = \frac{3}{32} \times \left(3 \times 2^9\right)^2 = 221184 \qquad (1)$$

This multiplication factor is preserved for every nuclear object: one spontaneous collision produces inside of a nucleus 221 184 collisions. Also, the onset of stability at ^{9}Be could be associated with the fact that the mass and the size of nuclei start to conform the natural spontaneous collision density at about this strange nucleus.

The smaller nuclei should be seen as somewhat oversized or less defined in spatial extent.

The detailed description of these structures is outside the scope of this article, here we just state that the nuclei of chemical elements are located at 6–10 shells and the atomic masses of shell closing isotopes are $A(s) = 4^{(s-6)}$, the mass corresponds to the number of collision events as 1 collision event = $= 3.373\ 851\ 851 \times 10^{-32}$ kg and a regular part of any of 7–10 shells is constructed of 49 152 collision events. Indeed, in this representation the mass is a measure of collision events always present within a self-regenerating collision event progression system, constructed of overlapping shells, hence we fix the mass of an electron at 9.1094e–31 kg and 27 collision events. The photons thought to have two not always present – except the mass-equivalent photon – interlocked collisions.

II. Shape of nuclei

To calculate the fundamental collision density constant's value from the nuclear density we need to make another comment relating to the shape of the nuclei. It is well known that all the nuclei are constructed with a so called density transition layer and a constant density core. We contribute this observation to a deformed spherical shape, developed from the collision progression representation.

As seen on Figure 1 we have to reconsider the usual half-way radius and transitional mass density representation and select the outer radius for governing shape, considering the deformed shape like two hats cut off.

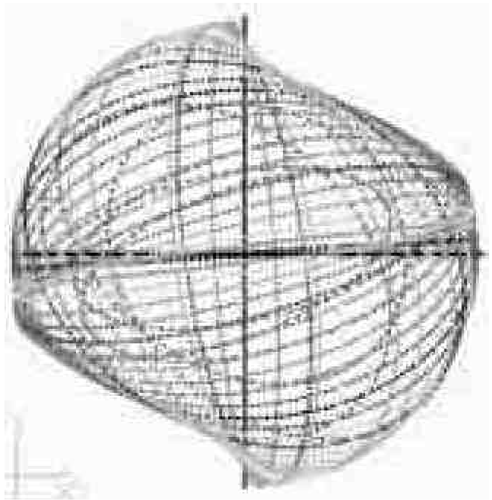

FIG. 1: Nuclear shape from collision progression.

III. New fundamental constants ρ and ε

We find that as a first approximation an extent of ¾ of radius could be assumed for the position of missing hats. We place the entire mass of nucleus inside the truncated sphere and assume a uniform density within that volume. It gives us the following equations, if we use atomic mass constant 1.660 538 86e–27 kg and – modified to represent the outer – nuclear radius constant 1.42e–15 m. The nuclear mass density for the truncated spherical volume of nuclei calculated as:

$$\rho_{nu} = \frac{3\times 1.66054\times 10^{-27}}{3.656\pi\times\left(1.42\times 10^{-15}\right)^{3}} = 1.515\times 10^{17} \quad \left[kg * m^{-3}\right] \tag{2}$$

We get the first new fundamental constant's value from it:

$$\rho = \frac{\rho_{nu}}{m_f} = 6.848\times 10^{11} \quad \left[kg * m^{-3}\right] \tag{3}$$

The first new fundamental constant shows a very dense void. Its physical meaning is that up to this mass-energy density the present in the volume spontaneous collisions are able to transfer photons from every direction. Since this constant is used to define the natural units of space and time we will address the possibility of direct experimental verifications later.

For the determination of the second new coefficient, the ε restitution coefficient representing the energy loss during transition from mass to energy of photons until a direct experimental determination, verification is performed we will rely on the value, found from the fine structure constant α, using the theoretical equivalence between them. Here we introduce a corrected and defined from first principles fine-structure constant value, based on the found and reported here geometry, seen in the electron clouds.

$$\alpha = \frac{2}{27}\left(\frac{\varepsilon}{\pi}\right)^{2} = \frac{\pi^{2}}{2\times 26^{2}} = \frac{1}{136.986240} \tag{4}$$

$$\varepsilon = 3\pi\sqrt{1.5\alpha} = \frac{3\sqrt{3}\pi^{2}}{52} = 0.98623017 \tag{5}$$

This new – and offered as replacement for the fine-structure constant α – restitution coefficient ε reveals the fact that the Quantum Mechanics and Relativity theories already were combined by the constants used – just this fact was covered, since the energy loss during transition from mass to photons was not realized – and still awaits the experimental verification by the direct modified equation of mass-energy equivalence:

$$E = mc^{2}\varepsilon^{2} = \frac{27\pi^{4}}{52^{2}}mc^{2} = 0.972649947mc^{2} \tag{6}$$

Indeed, the success of QED could be contributed to the fact that its foundation was laid on the fine-structure constant, the very constant representing the energy loss coefficient ε in most direct way.

IV. New fundamental replacement constants

Further illustrating the validity of used prior constants to represent the collision progressions constructed reality – even this reality was not realized – we present the set of replacement fundamental constants. We show that the wavelength, frequency and radius of mass-equivalent photon directly correlates to the Bohr radius, Compton wavelength and Rydberg constant times c in Hz. We use changed from the currently accepted value of the speed of light constant c to conform to the existing values of constants as much as possible. The here presented set of constants is coherent, based on the new theoretical value of fine structure constant and the accepted value of rest-mass of an electron. A number of variants were tried to incorporate these values in a coherent set and the least deviation from the currently accepted values was found if the change of the speed of light in the vacuum was allowed. It indeed has to be changed anyway to conform to the rigorous requirement that it has to be defined in the deep intergalactic space. Another identified problem still exists: the definition of time standard is not rigorously follows the same, away from masses, far in the intergalactic space environment. Also, considering the low precision of definitions of the Newtonian gravitational constant and of the new spontaneous collision density – virtual mass-energy density of empty space – this effort is just the humble first step on the long road of Fundamental Physical Constants determination.

Let's start with the set of new fundamental constants of mass-equivalent photon frequency, wavelength and radius – using the modified fine-structure constant and speed of light c:

$$\nu = \frac{2m_e c^2 \varepsilon^2}{27h} = 52^2 R_\infty c = 8.895733\times10^{18} \quad [Hz] \tag{7}$$

$$\lambda_\gamma = \frac{c}{\nu} = 3.368843\times10^{-11} \quad [m] \tag{8}$$

$$r_\gamma = \frac{c}{4\nu} = 8.422108\times10^{-12} \quad [m] \tag{9}$$

The replacement compatibilities for Bohr radius, Compton wavelength and Rydberg constant times c in Hz follow:

$$a_0 = 2\pi r_y = 5.291767\times10^{-11} \quad [m] \quad or \quad r_\gamma = \frac{a_0}{2\pi} \tag{10}$$

$$\lambda_C = \frac{2\varepsilon^2\lambda_\gamma}{27} \quad or \quad \lambda_\gamma = \frac{\lambda_C}{\pi^2\alpha} \tag{11}$$

$$R_\infty c = \frac{\nu}{52^2} \quad or \quad \nu = \frac{2\pi^2}{\alpha} R_\infty c = 52^2 R_\infty c \tag{12}$$

We could say the compatibilities are evident: the Bohr radius is the perimeter of an equatorial circle on the surface of a mass-equivalent photon, the Compton wavelength is a well defined fraction of mass-equivalent photon's wavelength as well as the Rydberg constant times c is a well defined fraction of the mass-equivalent photon's frequency. The additional multiplication of mass-equivalent photon's wavelength with the loss term of ε^2 means a compensation in the Compton wavelength understandable from the physical processes, associated with this constant, or its definition. Moreover, it makes sense in the collision progression domain and further underlines the validity of discovery of the loss term in mass to energy transition.

We found that the $2\pi^2/\alpha$ could be set equal to 52^2 – which involves corrections to the effected fundamental constants of fine-structure constant, and the very speed of light. The stipulation to make such corrections follows from the collision structure representation: the electron cloud becomes a rotating set of available collision places in the regular hexagonal collision progression pattern – which results in 26 places on a spherical surface, associated with the natural mass-equivalent photon. Than a doubled pattern is squared to cover the surface of a sphere with a multitude of available places of collisions, constructing the electrons in the cloud. It is a rotated and tilted collision pattern, returning to the starting position. These places can capture the right photons, the electrons fill-up only a small fraction of places in ground state, but can incorporate quite large amounts of kinetic energy-representing collision events, hence the 52^2 transition from mass-equivalent photon to the Rydberg constant.

The corrected accordingly value for the speed of light c in the vacuum, far from masses is calculated as:

$$c = \frac{1}{\alpha}\sqrt{\frac{2hR_\infty c}{m_e(1-\Phi)^2}} = 299683301.8 \quad \left[ms^{-1}\right] \tag{13}$$

There are several other possibilities to present a coherent set of constants with the new fine structure constant value. Any one or combination of electron mass, Planck constant and Rydberg constant – or the assumed gravitational potential at its determination – could be changed to preserve the speed of light, and indeed the magnetic constant could be preserved instead of electrical charge unit, but we ended our trials on this combination because it resulted the least number of changed constants from the currently accepted set. Indeed, a rigorous experimental verification effort can justify or falsify the correctness of our representation.

V. Natural units of space and time

The found collision density of void defines the units of space, distances between neighboring collision events and using the constant of light propagation velocity, speed of light c to get from one collision event to the next we de-fine the unit of time. We use the electron mass and the fundamental assumption that it is constructed of 27 collisions always present to define the spontaneous collision density of empty space far from massive bodies from the fundamental constant of virtual mass-energy density ρ.

The resulting equations and the natural units of space and time follows:

$$\bar{l} = \frac{1}{3}\sqrt[3]{\frac{m_e}{\rho}} = 3.665958549 \times 10^{-15} \quad [m] \tag{14}$$

$$\bar{t} = \frac{1}{3c}\sqrt[3]{\frac{m_e}{\rho}} = 1.223277549 \times 10^{-23} \quad [s] \tag{15}$$

These natural units appear to be very reasonable and could be compared to the observations of atoms, nuclei of atoms and particles as well as to the observed highest frequencies of electromagnetic rays. We propose to replace the currently employed Planck constant based values with these.

The introduction of virtual mass density relied on a series of assumptions and the value should undergo extensive experimental verification. One possible way is to design experiments to verify the natural units of space and time.

VI. Power relations

The introduction of mass-equivalent photon allows us to write a balance for the gravitational deformation power, the natural zero-point energy generation and annihilation rate and the photon conservation power:

$$\frac{m_e c^2 \pi^4}{3H_d 26^2} = Gh\rho = \frac{2h\nu}{3H_d} \tag{16}$$

From here we define the Hubble wavelength doubling time constant Hd:

$$H_d = \frac{2\nu}{3G\rho} = 1.298 \times 10^{17} \quad [s] = 4.115 \quad [Gyr] \tag{17}$$

The above equation 16 is true everywhere and it is the equation of state for the steady state Universe. On this basis, we will show the effect of mass in the following section VIII.

The newly defined Hubble wavelength doubling time constant is shown as a truly fundamental constant, defining not only the photon energy loss rate, but the power necessary to maintain the gravitational field. We have to note that the effect of loss regarding the gravitational power could be interpreted as a source for mass-energy generation rate within the massive body producing the gravitational field – like the stars and planets – which in turn could lead to the supernova explosions.

$$\frac{\Delta E}{\Delta t} = \frac{2mc^2\left(1-\varepsilon^2\right)}{3H_d} \tag{18}$$

It results about 2 ppm mass-energy generation in every 400,000 years, which indeed has to be released, radiated or ejected for maintaining a stabile state...

VII. Constants kept

Besides the already used in our evaluation h Planck constant, π ratio of circle's perimeter to its diameter we keep the Newtonian constant of gravitation G, but we are offering a secondary determination equation for this, which could be used in the future, after experimental verifications of nuclear mass density, Hubble wavelength doubling time constant and of mass-equivalent photon's frequency.

$$G = \frac{2\nu}{3H_d\rho} = 6.6742 \times 10^{-11} \quad \left[m^3 kg^{-1} s^{-2}\right] \tag{19}$$

The characteristic impedance of vacuum is changing with the new determination of fine structure constant:

$$Z_0 = \frac{\pi^2}{26^2}\frac{h}{e^2} = 376.867159 \quad [\Omega] \tag{20}$$

Using the steady state equation 16 we also able to redefine the Hartree energy E_H and we found it unchanged:

$$E_H = \frac{2}{52^2}\nu h = 4.359743\times10^{-18} \quad [J] \tag{21}$$

Here we recalculate the magnetic and electric constants:

$$\mu_0 = \frac{Z_0}{c} = 1.257551\times10^{-6} \quad \left[NA^{-2}\right] \tag{22}$$

$$\varepsilon_0 = \frac{1}{\mu_0 c^2} = 8.854196\times10^{-12} \quad \left[Fm^{-1}\right] \tag{23}$$

Several other relations and secondary constants also could be reconstructed using the new fundamental constants.

VIII. Effect of mass

To represent the effect of a concentrated massive object at a distance r from its center of mass M we use the gravitational potential Φ and using the 16 Equation of Steady State Universe we define the changes of units of space and time and all the effected fundamental constants.

We find that the Planck constant, the π and the new energy loss or restitution coefficient ε as well as the multiplication factor m_f do not change in presence of mass.

$$\Phi = \frac{GM}{c^2 r} \tag{24}$$

Light propagation velocity:

$$c(M,r) = c(1-\Phi) \tag{25}$$

Density of spontaneous collisions

$$\rho(M,r) = \frac{\rho}{(1-\Phi)^2} \tag{26}$$

Therefore the units of space – length – and time:

$$\bar{l}(M,r) = \bar{l}(1-\Phi)^{2/3} \tag{27}$$

$$\bar{t}(M,r) = \frac{\bar{t}}{(1-\Phi)^{1/3}} \tag{28}$$

Gravitational constant and the Hubble wavelength doubling time constant as well as the mass-equivalent photon's frequency are changing together:

$$G(M,r) = G(1-\Phi)^2 \quad H_d(M,r) = H_d(1-\Phi)^2 \tag{29}$$

$$\nu(M,r) = \nu(1-\Phi)^2 \tag{30}$$

The observed gravitational redshifts are also well explained by the resulting changes of orbital geometry. The changes of secondary constants could be found from the above fundamental changes.

IX. Nuclear mass-radius relation

As an example of use of new constants in FIG. 2 we present the graphical solution of nuclear mass-radius relation with mass-effect feedback:

$$M = \frac{3.65625\pi R^3 m_f \rho}{3\left(1-\frac{GM}{c^2 R}\right)^2} \tag{31}$$

The resulting Daisy-petal shaped graph shows a maximum possible mass at around six solar masses near 15 km radius and a maximum radius around 18.5 km near 4.2 solar masses. The shape itself explains the trigger for the supernova explosions and indicate the most probable neutron star masses and radii, just under the mass peak.

It very well correlates to the observations of Gamma Ray Bursts as well.

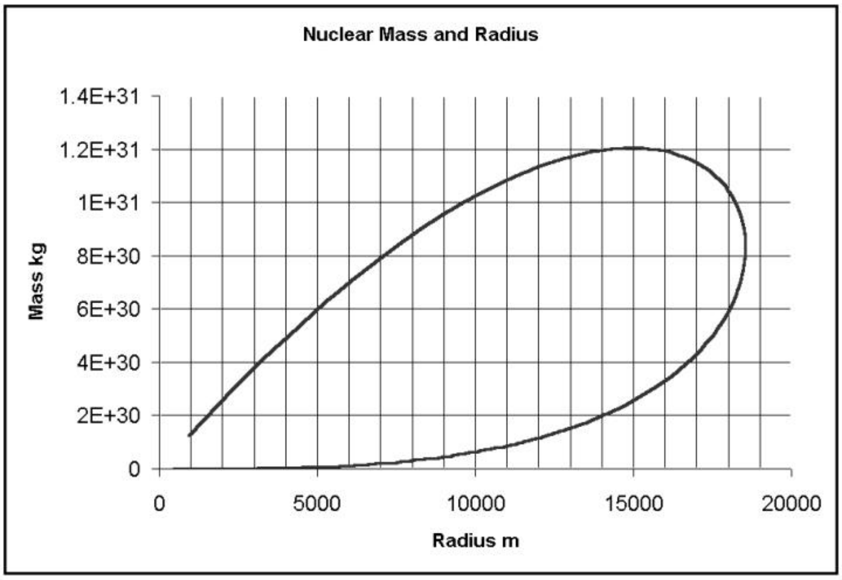

FIG. 2: Daisy-petal graph of Neutron stars

X. Summary

With the discovery of loss at the transition from mass to energy we found it possible to represent the massive nuclei, electrons and the photons as collision progressions.

A hexagonal rotated and tilted pattern on a spherical surface gave a determination of fine-structure constant from the first principles. The fixing of the electron mass – like the speed of light – gives us a unit of mass but requires the change of speed of light itself. In table 1 we represent a coherent set of constants, which also fit well to the measured nuclear masses and their structures as collision patterns. However, the required changes of constants from the currently used ones [1] require extensive experimental verifications. For defining a more precise value of gravitational constant and for direct verification of Hubble wavelength doubling time constant we call for more precise space experimentation with the consideration of the effect of mass.

We introduced here a new standard of mass-energy and corrected one standard, the length standard by modifying the speed of light constant, which in turn moved the Ampere standard as well. We caution about the possibility of correcting the time standard for the really empty space.

Table 1 Fundamental constants

Name	Symbol	Value	Units	Change from [1]	Formula	Reference
Planck Constant	h	6.626069×10^{-34}	Js	0	–	[1]
Speed of light	c	299683301.8	m/s	–364 ppm	$\frac{1}{\alpha}\sqrt{\frac{2hR_\infty c}{m_e\left(1-\Phi\right)^2}}$	Eq. 13
Electric constant	ε_0	8.854197×10^{-12}	F/m	+1 ppm	$\frac{1}{\mu_0 c^2}$	Eq. 23
Magnetic constant	μ_0	1.257551×10^{-6}	N/A^2	+728 ppm	$\frac{Z_0}{c}$	Eq. 22
Impedance of vacuum	Z_0	376.867159	Ω	+363 ppm	$\frac{\pi^2}{26^2}\frac{h}{e^2}$	Eq. 20
Gravitational constant	G	6.64742×10^{-11}	$\frac{m^3}{kgs^2}$	0	–	[1]
Bohr radius	a_0	5.291767×10^{-11}	M	–1 ppm	$2\pi r_\gamma$	Eq. 10
Compton wavelength	λ_C	2.427189×10^{-12}	M	+362 ppm	$\frac{2\varepsilon^2\lambda_\gamma}{27}$	Eq. 11

Elementary charge	e	1.602176×10^{-19}	C	0	–	[1]
Fine structure constant	α	0.007300	–	+363 ppm	$\frac{2\pi^2}{52^2}$	Eq. 4
Restitution coefficient	ε	0.98623017	–	–	$\frac{3\sqrt{3}\pi^2}{52}$	Eq. 5
Mass of electron	m_e	9.1094×10^{-31}	Kg	+2 ppm	Exact	–
Rydberg constant times c	$R_\infty c$	3.289842×10^{15}	Hz	0	–	[1]
Hartree energy	E_H	4.359743×10^{-18}	J	0	$\frac{2}{52^2}\nu h$	Eq. 21
Josephson constant	K_J	4.835979×10^{14}	Hz/V	0		[1]
Von Klitzig const	R_K	2.581281×10^{4}	Ω	0		[1]
Hubble doubling time	H_d	4.115	Gy	–	$\frac{2\nu}{3G\rho}$	Eq. 17
Multiplication factor	m_f	221 184	–	–	$\frac{3}{32}\times\left(3\times2^9\right)^2$	Eq. 1
Virtual mass density	ρ	6.848×10^{11}	kg/m^3	–	$\frac{\rho_{nu}}{m_f}$	Eq. 3
Mass-eq. photon frequency	ν	8.895733×10^{18}	Hz	–	$52^2 R_\infty c$	Eq. 7
Mass-eq. photon wavelength	λ_γ	3.368843×10^{-11}	m		$\frac{c}{\nu}$	Eq. 8
Mass-eq. photon radius	r_γ	8.422108×10^{-12}	m		$\frac{c}{4\nu}$	Eq. 9

REFERENCE

1. P. J. Mohr and B. N. Taylor, "The 2002 CODATA Recommended Values of the Fundamental Physical Constants, Web Version 4.0," available at physics.nist.gov/constants (National Institute of Standards and Technology, Gaithersburg, MD 20899, 9 December 2003).