Corrections of sections 3.1 and 3.2 of "Brief introduction to Basic Structures of Matther theory and derived atomic models"[1]. They should be replaced by sections 6 and 7 respectively from the article "A Physical Model of the Electron According to the Basic Structures of Matter Hypothesis (accepted in Physics essays v. 16, No. 2, 2003) [2]. The sections 6 and 7 are given below.

6.Quantum motion of the electron in a closed loop trajectory. (This paragraph includes

The orbital motion of the electron in atoms could be regarded as a motion in a closed loop, whose trajectory follows the equipotential surface of an electrical field defined by one or more positive charges.

Let considering a repetitive motion in a closed loop. The modulation properties of the internal RL(T) lattice in a repetitive motion may cause distortion of the MQs (that is a normal state of the SPM vector) converting them into EQs. This will affect the orbital conditions defined by the proximity field of the proton. Let assuming that the orbital motion of the oscillating electron tends to adjust itself to this change by exchanging some reactive energy with the CL space, that is hidden for the external observer. Then we may analyse the phase repetitions of the two proper frequencies of the electron and the conditions of their match to the phase of the SPM frequency of the CL nodes. In such way we may assume that the stability of a repetitive motion in such loop will depend on the phase repetition for both, the first and the second proper frequencies of the electron.

We will try to find the smallest path length at which the quantum loop conditions for an electron moving with a velocity corresponding to $n=1$ (13.6 eV) is fulfilled. **Initially we will ignore the relativistic effect for simplicity.** It is reasonable to look for a path length defined by some CL space parameter. One such parameter is the Compton wavelength λ_c, related to the Compton frequency ν_c by the simple expression $\lambda_c = c/\nu_c$. For one orbital cycle in a closed loop with length λ_c, the number of turns (electron structure rotations), N_T, is:

$$N_T = \lambda_c / s_e = 137.03235 \qquad (16)$$

The value of N_T could be regarded as a condition for a phase repetition for two consecutive passages through a chosen point in the loop, keeping in mind a confined (screw-like motion) of the electron. The trace length of $\lambda_c = 2.4263\times10^{-12}$ (m), however, is quite small, when comparing to the Bohr orbit length of $2\pi a_0 = 3.325\times10^{-10}$ (m). Therefore, we may look for a phase repetition conditions at larger loop length. From Eq. (16) we see that N_T is close to $1/\alpha = 137.036$ and this seams not occasional. Then, we may substitute N_T in Eq. (16) by $1/\alpha$ and multiply the result by λ_c. The latter is a CL space parameter from one side (a length of SPM phase propagation for one SPM cycle) and from the other - the circumference length of the electron structure. In such case we obtain:

$$N_T\lambda_c = \frac{1}{\alpha}\lambda_c = 3.24918460\times10^{-10} \quad \text{(m)} \qquad (17)$$

We see that the obtained value of Eq. (17) having a dimension of length is equal to the Bohr orbit length given by CODATA 98 (see Table 2) up to the 9th significant digit.

$$2\pi a_0 = 3.24918460 \times 10^{-10} \quad \text{(m)} \quad \text{CODATA 98} \tag{18}$$

where: $a_0 = 0.5291772083 \times 10^{-10}$ (m) - is the radius of the Bohr atomic model of hydrogen.

The expression (17) is not something new. The important, fact, however, is the way of its derivation related with the suggested physical model of the electron. The obtained loop length appears equal to the orbit length of the Bohr atom, defined by Bohr atomic radius, a_o. The latter is one of the basic parameters used in Quantum mechanics. From the BSM point of view, however, the physical meaning of this parameter appears different.

According to BSM concept, the well known parameter a_0 used as a radius in the Bohr model, appears defined only by the quantum motion conditions of the electron moving in a closed loop with an optimal confined velocity corresponding to an electron energy of 13.6 eV. Then the main characteristic parameter of the quantum loop is not its shape, but its length.

The identity of Eq. (17) and (18) also indicates that **the signature of the fine structure constant is embedded in the quantum loop.**

Now we may use the new obtained meaning about the quantum loop associated with the Bohr orbit, and more specifically the orbital length $2\pi a_0$. For a motion with an optimal confined velocity, the number of electron turns in the quantum orbit is equal to the orbital length divided by the helix step (s_e).

$$\frac{2\pi a_0}{s_e} = \frac{\lambda_c}{\alpha s_e} = 18778.365 \quad \text{turns} \tag{19}$$

Let find at what number of complete orbital cycles (for orbit length of $2\pi a_0$) the phase repetition of the first and second proper frequencies of the electron is satisfied (in other words the smallest number of orbital cycles containing whole number of two frequency cycles). The analysis of the confined motion of the electron in Chapter 3 and 4 of BSM indicates that its secondary proper frequency is three times higher than the first one (the first one is equal to the Compton frequency). Equation (19) shows that the residual number of first proper frequency cycles is close to 1/3. If assuming that it is exactly 1/3 (due to a not very accurate determination of the involved physical parameters), then the condition for phase repetition of both frequency cycles will be met for three orbital cycles. The whole number of turns then should be $3\lambda_c/(\alpha s)_e$. Substituting s_e by its expression given by Eq. (7) we get

$$\frac{3(1-\alpha^2)^{1/2}}{\alpha^2} \tag{20}$$

We have ignored so far the relativistic correction, but for accurate estimation it should be taken into account. The relativistic gamma factor for the electron velocity of $V_{ax} = \alpha c$ is $\gamma = (1-\alpha^2)^{-1/2}$. Multiplying the above expression by the obtained gamma factor we get.

$$3/\alpha^2 = \text{int}\,eger \tag{21}$$

The validity of Eq. (20) and (21) could be tested by the following simple procedure: calculating these expressions by using the best experimental value of α, rounding the result to the closer integer (satisfying the condition for two consecutive phase repetitions) and recalculating the corresponding value of α. The rounded integer (a whole number of turns) could be correct only if the recalculated value is in the range of the accuracy of the experimentally determined α. Let using the recommended value of experimentally measured α according to CODATA 98.

$$\alpha = 7.297352533(27)\times 10^{-3} \qquad \text{(CODATA 98)}^{16} \qquad (22)$$

where, the uncertainty error is denoted by the digits in the brackets.

The calculated values of α from Eq. (20) and (21) exceeds quite a bit the uncertainty value of experimentally determined α given by Eq. (22). Consequently, the condition for phase repetitions of the two proper frequencies is not fulfilled for three orbital cycles with total trace length of $3\times 2\pi a_0$. Therefore, we may search for the next smallest number of orbital cycles in which the phase repetition conditions are satisfied. It stands to reason that the approximate value of the orbital cycles could be about 137 ($1/\alpha$). Then if not considering relativistic correction, the corresponding number of electron turns is $(1-\alpha^2)/\alpha^3$. When applying a relativistic correction (multiplying by the estimated above gamma factor for the kinetic energy of 13.6 eV) the number of the electron turns becomes $1/\alpha^3$. The phase repetition conditions will be satisfied if this number is integer: $1/\alpha^3 = \text{int}\,eger$

Substituting α by its value from CODATA 98 (Eq. (22)) we get $1/\alpha^3 = 2573380.57$

It is interesting to mention, that the closest integer value of 2573380 is obtained by Michael Wales, using a completely different method for analysis of the electron behaviour (See Michael Wales book "Quantum theory; Alternative perspectives")[17].

We may use one additional consideration, for validation the above obtained number. The number of turnes multiplied by the time for one turn (the Compton time) will give the total time on the orbit (or the lifetime of the excited state, according to the Quantum Mechanics terminology). If accepting that the total number of turns are 2573380 then we obtain a lifetime of $2.0827\text{x}10^{-14}$ (s), that appears to be at least two order smaller than the estimated lifetime for some excited states of the atomic hydrogen.

Following the above analysis we may check for phase repetition at $1/\alpha^4$ turns. The participation of α at power of four is in agreement also with the following consideration: In the analysis of the vibrational mode of the molecular hydrogen, an excellent match between the developed model and observed spectra (section 9.7.5 in Chapter 9 of BSM) is obtained if the fine structure constant participates at a power of four. In such case we may accept that the phase repetition conditions is satisfied for a number of turns given by the closest integer in Eq. (23).

$$1/\alpha^4 = \text{int}\,eger \qquad (23)$$

Using the CODATA value of α we obtain $1/\alpha^4 = 352645779.39$. Rounding to the closest integer we obtain an expression for the theoretical value of α (if its experimental estimation is accurate enough).

$$\alpha = (352645779)^{-1/4} = 7.2973525298 \times 10^{-3} \quad (24)$$

The small difference of the theoretically obtained value of α from the experimental one could be caused by an experimental error. One of the methods for accurate experimental estimation of α is based on the measurement of the Josephson constant, K_J. Its connection to α is given by the expression

$$K_J = \frac{2}{c}\left(\frac{2\alpha}{\mu_0 m_e \lambda_c}\right)^{1/2} \quad (25)$$

where: μ_0 - is the permeability of vacuum, m_e - is the electron mass, c - is the light velocity, λ_c - is the Compton wavelength.

The accuracy of α according to this method depends mostly on the accuracy of the Josephson constant measurement, because all other parameters are accurately known. The recommended value for this constant according to CODATA 98 is $K_J = 483597.898(19) \times 10^9$ (Hz/V). If replacing α in Eq. (25) with the value given by Eq. (22) we will obtain the value of K_J that is in the uncertainty range given by the CODATA 98.

The conclusion that the orbital time duration may depends only on α is reinforced also by the consideration that the Compton wavelength, λ_c, was initially involved in the analysis (Eq. (15), (17), (19)), but it disappeared in the derived Eq. (23). Consequently, the phase repetition condition is satisfied not only for the two proper frequencies of the electron, but also for the SPM frequency of the CL nodes included in the quantum orbit (λ_c is the propagated with a speed of light phase of the SPM vector for one SPM cycle of the CL node (SPM frequency = Compton frequency)).

7. Quantum orbits.

It is apparent from the provided analysis that a stable quantum loop is defined by the repeatable motion of oscillating electron. The shape of such loop, however, is determined by external conditions. Such conditions may exist in the following two cases:

- a quantum loop obtained between particle with equal but opposite charges and same mass, as in the case of positronium (see Chapter 3 of BSM)

- a quantum loop obtained between opposite charged particles but with different masses (a hydrogen atom as a most simple case and other atoms and ions as more complex cases).

In both options the quantum loops are repeatable and we may call them **quantum orbits**. A single quantum orbit could contain one or few serially connected quantum loops (in both cases the condition for phases repetition is preserved). It is obvious that the shape of the quantum orbit is defined by the proximity field configuration of the proton (or protons). The vacuum space concept of BSM allows unveiling not only the electron

structure but also the physical shape of the proton with its proximity electrical field (chapters 6 and 7 of BSM). The shape of any possible quantum orbit is strictly defined by the geometrical parameters of the proton.

Let considering now the induced magnetic field of the electron motion in a quantum orbit by using the elecron magnetic radius. The magnetic radius of the electron moving with different subharmonic numbers n is analysed in section 3.1, Chapter 3 of BSM. Its value for $n=1$ (a kinetic energy of 13.6 eV) matches the estimated magnetic radius corresponding to the magnetic moment of the electron. For larger numbers (decreased electron energy), however, the magnetic radius shows an increase. The physical explanation by BSM is that at decreased rate of the electron rotation its IG field of the twisted internal RL structure is able to modulate the surrounding CL space up to a larger radius until the rotating modulation of the circumference reaches the speed of light. Keeping in mind that the circumference of the electron is equal to the Compton wavelength (with a first order approximation) the circumference length of the boundary (defined by the rotation rate) should be a whole number of Compton wavelengths. Then the integer number of the Compton wavelengths corresponds to integer subharmonic number. In such case, the orbiting electron with optimal or sub-optimal velocity could not cause external magnetic field beyond some distance from the nucleus. This provides boundary conditions for the atoms, if accepting that in any quantum orbit the electron is moving with optimal or sub-optimal confined velocity (integer sub-harmonic number). Here we must open a bracket that the higher energy levels in heavier elements come not from a larger electron velocity but from the shrunk CL space affected by the accumulated protons and neutrons. Such CL space domain is pumped to larger energy levels in comparison to the CL space surrounding the hydrogen atom.

The existence of the IG law changes significantly the picture of the orbiting electron in a proximity field of the proton. In Chapter 7 of BSM an analysis of Balmer model of Hydrogen atom is developed based on the BSM concept of the electron and proton and the IG law influence on the orbital electron motion in the proximity to the proton. It appears that the limiting orbit has a length of $2\pi a_0$ while all other quantum orbits are inferior. This conclusion is valid not only for the Balmer series in Hydrogen but also for all possible quantum orbits in different atoms, if they are able to provide line spectra. Therefore, the obtained physical model of Hydrogen puts a light for solving **the boundary conditions problem of the electron orbits in the atoms.**

8. Time duration for a stable orbit (lifetime of excited state).

The following analysis could be valid only for the hydrogen, where the influence of the proton mass on the surrounding CL space appears to be negligible.

Keeping in mind the screw-like confined motion, the axial and tangential velocities will be inverse proportional to the subharmonic number. Then the condition for phase repetitions for a motion with a subharmonic number *n* will be satisfied for *n* times smaller number of electron turns, or the quantum orbit will be *n* times smaller. It is reasonable to consider that the first and second proper frequencies of the electron are stable and not dependant on the subharmonic numbers. Then for estimation of the time duration of the orbit (the lifetime of excited state) it is more convenient to use the number of the cycles of the first proper frequency of the electron. It is equal to the number of electron turns for $n=1$. In such way we arrive to the conclusion:

(a) If conditions for stable quantum orbit are defined only by the phase repetition conditions and the whole number of Compton wavelengths, the time duration (lifetime) of the orbiting electron does not depend on the subharmonic number of its motion.

(b) If (a) is valid, the lifetime of the excited state will be equal to the product of the total number of the first proper frequency electron cycles (according to Eq. (23)) and the Compton time (the time for one electron cycle with the first proper frequency)

According to condition (b) the theoretical lifetime for an excited state of hydrogen is

$$\tau = t_c / \alpha^4 = \lambda_c / (c\alpha^4) = 2.85407 \times 10^{-12} \text{ (s)} \qquad (26)$$

where: t_c - is the Compton time**.**

Note: **The obtained Eq. (26) does not take into account the possible modification of the surrounding space in a close proximity to the proton. Such modification (a slight shrinkage, or a space curvature) may cause aliasing for the phase repetition conditions due to affected SPM frequency and Compton wavelength, while the first and second proper frequencies of the electron are obviously stable. For heavier atoms such modification may appear much stronger. For elements with more than one electron the mutual orbital interactions also may lead to increase of the real lifetime.**

References:

[1]. S. Sarg, Brief introduction to Basic Structures of Matter theory and derived atomic models, Journal of Theoretics (Extensive papers), January, 2003

[5]. Stoyan Sarg, A Physical Model of the Electron according to the Basic Structures of Matter Hypothesis, Physics Essays, vol. 16 No. 2 June 2003 (accepted, but will be out of print in 2004).