2.11 Light velocity in CL space

2.11.1 Energy balance between CP and TP components of the NRM vector of CL node

When two systems of matter are involved in a common oscillation, the time duration of the oscillation process is very dependent of their ability to exchange equal energy momentum. In a common oscillation system, we may distinguish different subsystems by their interactions, even if they look physically inseparable. In such aspect we may provide analysis of CL node oscillations, as a process in which the following two subsystems are involved:

- Central Part (CP) of the prisms.
- Twisted Part (TP) of the prisms.

Now let applying this kind of separation to the CL nodes assuming that the prisms properties of CP and TP IG interactions are transferred to the CL node properties. Then we may assigned the mentioned properties to the NRM(CP) vector and NRM(TP) vector, respectively. Let to find what are the main distinguishing properties of these two vectors.

From the previously discussed prisms to prisms interactions, (more detailed analysis in Chapter 12) we know, that, the CP of the prism exhibits a low inertial factor, while the TP has a higher one. In the node oscillations, the CP is involved mostly in parallel motions, while the TP in rotational motions. If we consider the complex motion, of which the two system is involved, we may expect, that the total interaction factor of the TP is larger than the total interaction factor of CP. However, the volume of the TP is about 10% of the total volume (for the twisted prism model). Then we may expect that the following balance is relevant for a CL space domain:

$$[V_n(CP)] \times [F_n(CP)] = [[V_n(TP)] \times [F_n(TP)] \quad (2.24A$$

where: V_n - is the node intrinsic matter volume of the corresponding part

F_n - is the node inertial factor of the corresponding part

The above relation is only a guess, that is difficult to be proved. However its logically possible existence may provide a key for understanding the stability of the self sustained cosmic lattice. For right and left handed prisms with defined dimensions the relation (2.24A) may be fulfilled at defined node distance.

Another distinguishing feature between CP and TP interactions is the angular momentum of the oscillating node.

The NRM MQ has four bumps, indicating the directions of increased linear momenta. These momenta are same for the neighbouring right and left handed nodes.

If considering the linear momenta of NRM(CP) MQ along the positive and negative direction of any axis passing through the central point of MEQ, they are equal in the case of:

- the equivalent diametrically opposite motions during the resonance cycle
- the right and left handed nodes.

If considering the linear momenta of NRM(TP) MQ along the positive and direction of a similar way defined axis, they are different for the cases of:

- the equivalent diametrically opposite motions during the resonance cycle
- right handed and left handed nodes

If considering the EQ nodes, the momentum magnitudes in the orthogonal axes are affected, but the NRM(CP) and NRM(TP) have similar features as for the MQ nodes.

In domains of MQ nodes, the above mentioned features contribute to the formation of magnetic protodomains. In domains of EQ nodes, the above mentioned features contribute to the propagation of EM waves. In this case the momentum possessed by EQs appears as excess momentum. The IG forces acting on the node in such conditions are not conservative and the excess momentum is propagated by *abcd* axes of the CL nodes, which are interconnected.

While the CP component of NRM vector is hidden for electrical and magnetic property, it is not hidden for the inertial and gravitational mass properties of the matter. It is involved in the relativistic increase of the body mass, when approaching the light velocity This tissue is discussed in Chapter 10.

We may conclude that:

- The electrical, magnetic, and electromagnetic fields in CL space are contributed by the interactions in which the twisted part of the prisms are involved. The central parts of the prisms support the CL structure integrity and its features are hidden for these fields.

- A stationary EQ node involved in a quantum wave is not able to keep the excess angular momentum.
- The excess node momentum is propagated as EM field due to the not conservative force conditions. The energy is carried by the TP type of IG interactions.
- The central part of the prisms is directly involved in the gravitational and inertial mass property of the matter.

2.11.2 Momentum propagation in the quantum wave

2.11.2.1 Excess node energy and corresponding momentum

Let accepting that the CL node has inertial mass. Then we may provide a simplified analysis of the CL node dynamics, regarding it as a rotating mass point around a fixed point, connected to it by massless rod. For dynamics involving operation of whole cycles of NRM the full cycle trace could be replaced by equivalent circle. Then the angular momentum of the oscillating NRM vector for MQ node is given by Eq. (2.25).

$$L = m_n \omega_R r^2 \qquad (2.25)$$

where: L - is the node angular momentum at the resonance frequency.; m_n is the intrinsic inertial mass of the oscillating node; ω_R is the resonance frequency;

r - is the equivalent radius of the node trace per one resonance cycle

The inertial mass m_n, could be regarded as an average value of the intrinsic inertial mass of quite large number of MQ type of nodes. In such case it obtains very accurate value, depending only of the node distance. Consequently m_n **is a constant for a steady state CL space.**

When all CL nodes from a space domain have a normal ZPE, their angular momentum is constant. We may call it a normal angular momentum. Such type of node may be included only in MQ nodes of a quantum wave, but not in the EQ nodes. The EQ nodes of the quantum wave, obtain ZPE above E_{cr}, and their momentum is larger, than the normal one. In order to preserve the lattice from destruction, they transfer the **excess momentum** very fast. Therefore, the energy transfer could be expressed by the angular momentum change ΔL.

2.11.2.2 Energy and resonance period analysis for MQ and EQ type of node.

Note: In a global aspect, the CL space is interconnected. Then it contains two types of energy (discussed in Chapter 5): a connection energy - called DC type and kinetic (oscillation) energy - called AC type (like AC current). In a normal not disturbed CL space the DC type of energy is hidden, while the AC type appears as a ZPE recognized by the Modern physics. In the following analysis the AC type of energy is only considered.

Let making some energy analysis of a single CL node. We may simplify the analysis by using a simple analogical model, whose parameters are able to represent approximately the dynamics of CL node. Two classical models could be used: a three dimensional harmonic oscillator and a conical pendulum. Here the model of the conical pendulum is used, because it is more convenient for some illustrations for energy propagation in CL space.

The conical pendulum may have two types of motions: circular one and elliptical one. **The circular motion of the pendulum fits to the trajectory of MQ node, while the elliptical motion - to the trajectory of EQ node.** In order to fit the parameters of the conical pendulum, we will use the equivalence between the node energy and pendulum energy. More correctly we will use the energy dependence of the displacement from the equilibrium position.

The node energy in relative units, can be estimated by the return force curve given in Fig. 2.24. While the equation for this curve is pretty complex, it is replaced, by a fitted curve, given by the equation (2.26) and valid only for a displacement range of: $0.21 < r < 0.6$.

$$F_{ret} = (3.025 - 3.8269 e^{-r})^2 \qquad (2.26)$$

where: F_{ret} - is the normalized return force, and r is the displacement from the geometrical equilibrium.

Let considering first the **MQ case, corresponding to a circular pendulum.** In the node displacement, the return force is aligned to the axis passing through the geometrical equilibrium point. This force is equivalent to the force aligned with the cenrapetal acceleration. Then the tangential velocity for a circular motion is:

$$\upsilon^2 = \frac{rF_{ret}}{m_n}$$

The kinetic energy is:

$$E_K = \frac{m_n \upsilon^2}{2} = \frac{r(3.025 - 3.8269e^{-r})^2}{2} \qquad (2,26.b)$$

The plot of the node kinetic energy (in relative units) in function of the displacement is shown in Fig. 2.43A. The amplitude of $r = 0.39$ (calculated by modelling the ZPE of CL node), corresponds to a displacement along xyz axes at normal ZPE.

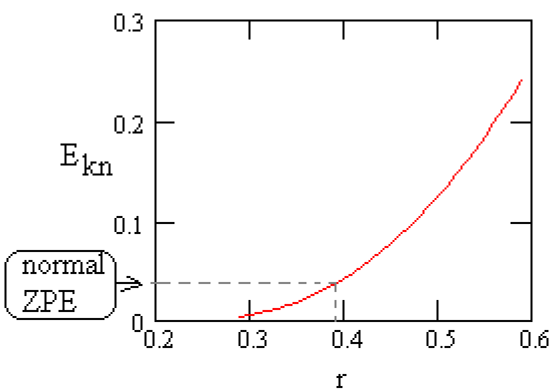

Fig. 2.43A

Kinetic energy of the oscillating CL node (in relative units) in function of node displacement along xyz axis

The equivalent trace of the oscillating MQ node has a radius of r = 0.39, corresponding to a normal ZPE.

Fig. 2.43.B shows the pendulum with its parameters.

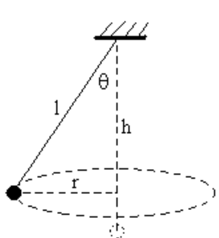

Fig. 2.43.B

The kinetic energy (E) for a circular pendulum (without friction losses), could be expressed by the potential energy, dependant on the height from the central potion, but expressed by the displacement r.

$$E = mg(l - \sqrt{l^2 - r^2}) \qquad (2.26.c)$$

where: m - is the pendulum mass, g - is the Earth acceleration, l - is the arm length, r - is the displacement.

In order to fit the equation (2.26.c) to Eq. 2.26.b in a limited range of displacement, we normalize it to mg and introduce adjustable parameters a and b, for energy scaling and displacement.

$$E = [l - \sqrt{l^2 - r^2}]a - b \qquad (2.26.d)$$

where: a - is a scaling parameter, b is displacement parameter.

The Eq. (2.26.d) is suitable for simulation of the MQ node energy, considering a relative displacement up to 0.39 along anyone of the xyz axes.

The plot of Eq. (2.27.d) for l = 0.53, a = 0.4 and b = 0.035, for a range $0.2 < r < 0.5$, is shown in Fig. 2.43.C.

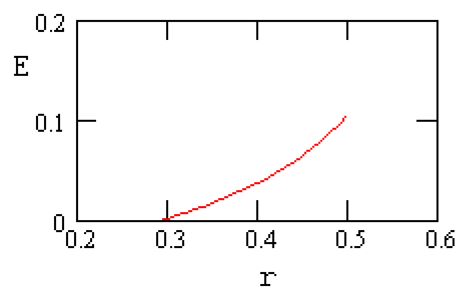

Fig. 2.43.C

Node equivalent energy in function of the displacement (model by circular conical pendulum)

In case of EQ node, the equivalent trace obtains elliptical shape corresponding to radius larger than r = 0.39. From the energy plot, shown in Fig 2.43.A, it is evident, that, for equal deviations around 0.39, the slope has different steepness. Then an EQ node with larger eccentricity of the NRM trace will have a larger energy. If considering not equivalent but real trace shape, this difference is even larger. This case could be analysed by the model of elliptical conical pendulum. There are two important parameters in this case to be considered: the node inertial mass and the trace length.

The separation of the inertial mass from the velocity is difficult task, because the inertial mass may not be constant during the node cycle. For this reason, we will consider that the node inertial mass is a constant, only if estimated for a full cycle and averaged on large number of nodes.

The trace length is important parameter, because it defines the duration of the cycle. Having in mind the influence between the neighbouring nodes, we may assume, that any node has a tendency to keep its cycle duration equal to the cycle duration of its neighbours, so this will provide a stable constant value for the period of NRM MQ. Then the following question is reasonable:

Is it possible the elongated trace of EQ node to have the same NRM frequency as the MQ node?

We will try to reply to this question by analysing the oscillation of the elliptical conical pendulum. Initially we will estimate the period dependence of the displacement *r*. The periods for a circular conical pendulum $T_{con(cr)}$, and a planar pendulum T_{pl}, are given respectively by the equations (2.26.e) and (2.26.f)

$$T_{con(cr)} = 2\pi\sqrt{\frac{h}{g}} = \frac{2\pi}{\sqrt{g}}(l^2 - r^2)^{1/4} \qquad (2.26.e)$$

$$T_{pl} = 2\pi\sqrt{\frac{l}{g}}\left(1 + \frac{1}{4}\sin^2\left(\frac{\theta_1}{2}\right) + \frac{9}{64}\sin^2\left(\frac{\theta_1}{2}\right)\right) \qquad (2.26.f)$$

Using up or down arrow index, for annotation of the increasing or decreasing of the parameter, we have the following dependence from *r* and θ according to Eqs. (2.26.e) and (2.26.f):

Circular pendulum (MQ case): When: r/|\ T\|/ L_{tc} /|\ (26.g)
Planar pendulum: When: θ/|\ T/|\ L_{tp}/|\ (2.26.h)

where: L_{tc} and L_{tp} are the trajectory lengths for both types of pendulums, respectively

Now we have to determine, how the period changes, when the trace becomes elliptical (corresponding to MQ conversion to EQ). This is more complicated task, but we may simplify it by examining the **two options**: a circular pendulum and a planar pendulum. The planar pendulum could be regarded as a degenerated circular pendulum for very large eccentricity. In such aspect, the mentioned two options appear as boundary cases, when changing the elipticity. We can formulate the task: What is the ratio between the periods of the planar and the conical motions for one and a same pendulum if the trajectory length in both cases is equal?

In order to get a simple expression, we will use the deviation angle θ, knowing that the increasing of the displacement ***r*** leads to increase of θ. Equating the trajectory lengths we get $\theta_1 = \pi\sin\theta_2$. where: θ_1 and θ_2 is the angle of the planar and conical pendulum, respectively. The period of the planar pendulum for a large angle is determined by a sine series. Then we obtain the ratio between the periods for the planar and the conical pendulum.

$$\frac{T_{pl}}{T_{con}} = \frac{1}{\sqrt{\cos\theta_2}}\left(1 + \frac{1}{4}\sin^2\left(\frac{\pi\sin\theta_2}{2}\right) + \frac{9}{64}\sin^4\left(\frac{\pi\sin\theta_2}{2}\right)\right) \qquad (2.26.i)$$

The source of the return force g disappears from the period ratio. The plot of the period ratio is shown in Fig. 2.43.D.

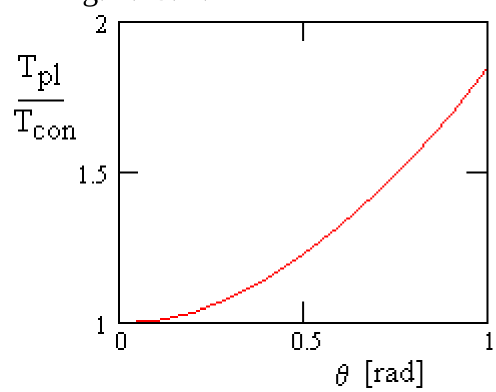

Fig. 2.43.D

Period ratio between planar and conical pendulum for equal trajectory lengths

Having in mind, that the planar pendulum is a degenerated elliptical conical pendulum, it is reasonable to expect, that the period ratio changes a continuous function between the two pendulum cases. Consequently, the ratio between the period of the elliptical conical pendulum and circular conical pendulum will be also a growing function.

Based on the provided analysis by the conical pendulum we arrived to the following conclusions:

The increase of the node energy causes increase of the displacement according to Eq. (2.26.d).

When considering a MQ node, (circular conical pendulum), the increase of the displacement. leads to decrease of the period, according to Eq. (2.26.e). When considering a EQ node, the increase of displacement leads to increase of the period, according to the Eq. (2.26.i). Consequently, the node with excess energy may obtain the same resonance period as the normal ZPE node, if its resonance trace has a proper eccentricity and trace length. **Such node could be only a running EQ node, included in a quantum wave.** The condition of the same resonance frequency between the MQ and EQ nodes in the quantum wave is very important factor for the wavetrain integrity.

The single EQ node could be regarded as a carrier of a very small fraction of the electrical charge. The unite charge of a single charge particle (electron, positron or any unstable particles) is a constant due to the IG forces of the particle that influence the EQ's. In the same time the IG field assures the equalization of the proper frequencies of the EQs and their synchronization (by SPM vector). In such way the charge integrity and a constant unite charge are assured.

We can summarise the following conclusions about the EQ and MQ properties in a CL space at normal ZPE.

- **The main distinguishing feature of the EQ is that it possesses an excess kinetic energy over the normal (AC type) ZPE of MQ.**
- **The degree of the EQ eccentricity is determined by the node excess energy. The maximum value of the eccentricity is limited, due to the CL space resistance to destruction (this intrinsic property of the CL space is analysed in Chapter 12).**
- **A spatial formation of EQ and MQ nodes possessing one and a same proper resonance is expected to be stable.**
- **The EQs forming the E-field of the elementary particles are stationary (in respect to the particle coordinate system). They are kept by the IG field of the particle.**
- **The EQs involved in the wavetrain of the quantum wave are of running type.**

While the above made analysis is simplified it is evident that more complicated analysis of the 3D NRM and SPM vectors is needed. This is out of the scope of the present course of BSM theory. In the next chapters we may touch this problem again, because it is related with number of physical aspects: the integrity of the quantum wave, the integrity of the electrical charge around the elementary particle, the electron motion in quantum loops in electrical field and so on.

2.11.2.3 Excess momentum of EQs involved in a quantum wave. Quasishrink effect of CL space.

In the previous paragraph we saw that the interactions from the (CP) of the prisms do not contribute to the energy of the EM wave. So we will not take them into account in the provided below analysis.

In a free space environments, if EQ and MQ nodes have one and a same NRM frequency, their SPM frequency should be also the same. The modulus of the NRM, however is different for MQ and EQ nodes. In case of MQ, the NRM vector has a central point of symmetry for the whole cycle and exhibits a rotational momentum with not linear angular momentum. The rotational momentum contributes to the synchronization of the magnetic protodomains. In case of EQ, the NRM vector exhibits also a linear momentum, due to the quasisphere polarization (elongation), and simultaneous rotational momentum. It is evident, that the linear momentum depends of the degree of EQ polarization (elongation).

Let consider a CL domain of normal CL space away from any particle and any external electrical and magnetic field. In this case the node inertial mass and the NRM frequency are constant, so may express the MQ and EQ momentums by some equivalent common parameters.

Knowing the EQ distribution in the quantum wave configuration, we may introduce a constant, that depends only of the distance of the EQ from the wave axis. It is convenient to introduce multiplication factor for the MQ node radius of rotation in a form: $\sqrt{e/2}$ for a reason, that will be explained below. Then the Eq. (2.25) for the angular momentum takes the form

$$L = m_n \omega_R \left(r \sqrt{\frac{e}{2}} \right)^2 \qquad (2.27)$$

where: e is a linear eccentricity of the equivalent elliptical trajectory

From the quantum wave configuration, we know, that the eccentricity of the EQ is dependent of the radial distance from the central axis of the wavetrain. For a helical trajectory with constant radius, the eccentricity e is a constant. According to the above analysis, ϖ_R is constant for any quantum wave. We assume also that, the node inertial mass averaged for one resonance cycle is a constant. For a given radial distance, the excess node momentum, could be expressed as a change of the angular momentum. Then differentiating (2.27) on r we obtain the excess node momentum.

$$\Delta L = m_n(\omega_R e) r \qquad (2.27.a)$$

For a neutral quantum wave, r changes from some initial value r_o to the boundary radius r_b, at which the eccentricity e of EQ becomes zero (or it converts to a boundary MQs). Consequently, for $r = r_b$, ΔL becomes also zero.

From Eq. (2.27.a) we see, that the excess momentum is a product of a constant linear momentum $m_n r$, multiplied by the factor $\omega_R e$. Then the linear momentum for a constant radius is also a constant. Assuming a constant node inertial mass averaged for one resonance cycle, the velocity of the momentum transfer between the neighbouring nodes along one helical trajectory is also a constant.

We may express the equivalent excess momentum for the radial cross section of the wavetrain, when using the eccentricity e_{eq} corresponding to one equivalent radial distance r_{eq}. Then the equivalent excess momentum is:

$$\Delta L_{eq} = m_n(\omega_R e_{eq}) r_{eq} \qquad (2.27.b)$$

If comparing the central point of the EQ node motion with the Keplerian motion of planets it is different. For the oscillating EQ node, the return forces along the major axis are larger than the minor one and the velocity change is much faster. The real trajectory shape contributes additionally to this effect. In the same time the node trajectory could not obtain very large eccentricity, because the maximum and minimum radii of the node trace are restricted within a limited range. This restriction is imposed by the resistance of the CL structure to destruction. **Therefore, we may expect that maximum of the IG(TP) field of the prisms interactions occurs in a finite sector of the trace around the major semiaxis. Then the transfer of the excess momentum evidently takes place in that sector.** The NRM quasisphere is aligned to the *xyz* axes. **Then the transfer of excess momentum could be considered as a vector composed of components along *xyz* axes.** The actual momentum transfer, in fact is provided by the *abcd* axes during the resonance cycle, but this is not in contradiction with the above made considerations, using *xyz* coordinates.

There is one additional feature of the momentum transfer in the quantum wave. The helical trajectories (within the wavetrain) containing EQs with one and a same eccentricity, can be left handed or right handed. This obviously must be valid for a case of polarized and unpolarized quantum wave.

Let find out what may determine the correct conditions for the excess momentum transfer?

The motion of every CL node involved in the quantum wave, is characterised by both vectors NRM and SPM. The trajectories of these vectors are 3 dimensional, and consequently, they posses a handedness. The handedness momentum of the SPM vector have much larger weighting factor. than the NRM momentum. Therefore, it is responsible for keeping the wave handedness. The CL space provides equal conditions for propagation of left and right handed wave. Once the quantum wave is generated and the CL space domain in homogeneous the handedness is self supported.

The EQ node resonance trajectory and the excess momentum are illustrated in Fig. 2.44. The case **a.** shows the real NRM trajectory, where 1 - is the zone of the maximum momentum change, and

2 is the zone of maximum kinetic energy. The case **b**. shows the equivalent ellipse.

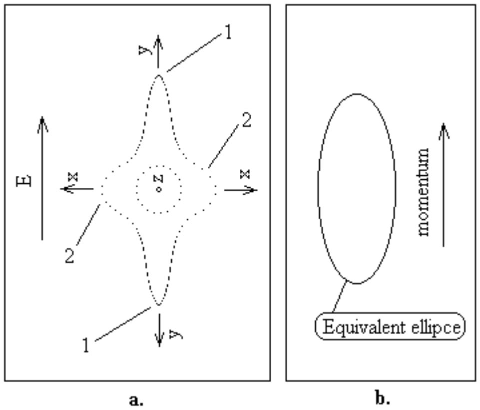

Fig. 2.44
EQ node momentum during the resonance cycle

The maximum linear momentum, shown in Fig. 2.44 has a direction of *y* axis. Let assuming that some external forces, having components only along $\pm y$ direction and acting always against the maximum linear momentum are applied, however, their magnitudes are smaller. In result of this, the vector of linear momentum will be affected as shown in Fig. 2.45, while the energy balance of the system must be preserved. Its new value of linear momentum will have a direction at angle respectively to y and z axes (see the explanation below). This effect exactly appears in the neutral quantum wave, where the electrical quasispheres are affected by the Coulomb forces. We may call this a **quasishrink effect of CL space**. The term quasishrink is used, because it does not affect the node distance, but only the components of NRM vector. Fig. 2.45 illustrates how this effect changes the transfer momentum direction of the oscillating node.

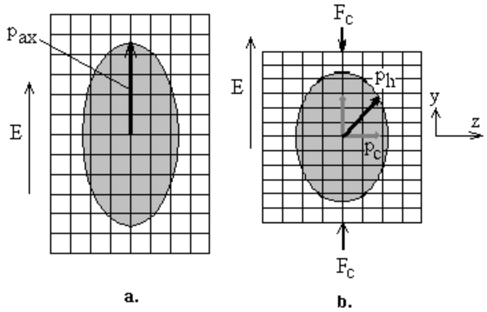

Fig. 2.45
Change of the transfer momentum direction due to the **quasishrink effect** of the CL space

In case **a.** the equivalent momentum is shown without the quasishrink effect. In case **b.** the quasishrink effect of the space is provided by the Coulomb forces F_c. The energy for this forces is taken from the total momentum of the quantum wave and more accurately from its twisting features. In result of this, the apparent NRM momentum along axis y is reduced, but an equivalent momentum P_h appears at angle in respect to the E direction. In fact, if considering the point position of the CL node in the wavetrain, the direction of P_h coincides with the tangent of the helical trace passing through this point. One of the components of P_h provides the balance between the Coulomb forces F_c and centripetal acceleration, while the other one, P_c, provides the velocity for the energy propagation in direction *Z*. If conditions for not conserved angular momentum for the considered CL node exist, the new component of the linear momentum will be propagated between the neighbouring nodes.

The induced Coulomb forces are moving with the running EQs. They are responsible for keeping a finite transverse width of the quantum wave, in order to assure the boundary conditions. They assure also the transversal compactness of the quantum wave by narrowing the radial energy distribution, as was discussed in § 2.9.4.4. According to that analysis, the most suitable width was estimated to be in order of $\delta\lambda = \lambda/16$. During the detection process, however, the Coulomb forces are destroyed and the transverse width appears as $\Delta\lambda = \lambda/8$. This value matches well with the relation between, c, μ_o, ε_o, *h*, in the expressions, derived in the next paragraphs.

2.11.3 Light velocity equation and relation between the CL space parameters and the fundamental physical constants.

It was assumed in the previous paragraphs, that the energy between neighbouring nodes is transmitted per one resonance cycle. Then the change of the axial momentum and its components P_h and P_c can be expressed by number of resonance cycles. This will greatly facilitates the derivation of the light equation. Having in mind the configuration of the quantum wave, we may also simplify the task by analysing the vector of the running EQ node.

Fig. 2.46 illustrates the orientation of the running EQ, where: A - is a 3D view showing two consecutive positions of the running EQ; B - is a view showing the helical path and EQ in a perpendicular plane; C - a view of the two positions of EQ in another plane. Any running EQ node at distance R_h from the axis Z will have constant momentum components P_h and P_c for an instant time. If considering consecutive time points, separated at time distance of t_r, the running node will pass a curve linear distance d_n along the helical trajectory.

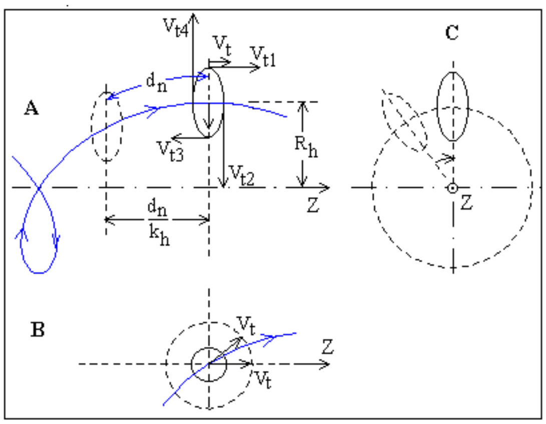

Fig. 2.46

Momentum propagation expressed by a running EQ through a helical trajectory

The long axis of the running EQ is always normal to the axis of propagation Z, while its centre is at distance R_h. The vectors from V_{t1} to V_{t4} are the tangent momentum velocities of the oscillating node. The change of the angular momentum due to the Coulomb forces in discussed in §2.11.2.3 (having some radial gradient in the quantum wavetrain) provides a velocity component for moving the EQ in a helical trajectory instead of straightforward. If referencing to the laboratory rest frame the V_{t1} velocity will contain an advancing velocity component aligned to the direction of the quantum wave propagation. For this reason V_{t1} is shown larger than V_{t3}. The advancing velocity component could be translated to the central point of the quasisphere, because it is always parallel to the Z axis. View B shows that the velocity V_t has one and same magnitude for the tangential axis and the Z axis, because of the circular symmetry of the electrical quasisphere in this plane. We have a right to apply this consideration, because the momentum transfer occurs per one resonance cycle.

For the running EQ, the NRM vector carries an energy momentum along the helical trace, which we may call a helical momentum

$$p_h = m_n \upsilon_h \tag{2.28}$$

where: p_h is a helical momentum (momentum along the helical trace), υ_h is a helical component of velocity, m_n is a node inertial mass.

The defined helical momentum does not need to be compensated for a centripetal acceleration, because it is already compensating by the Coulomb forces and the lattice quasi shrink effect. Therefore, the total helical momentum from all EQs carries all the photon energy. For simplification of the analysis we may consider the total photon energy is caries by an equivalent helical momentum of one equivalent EQ at equivalent radius from the central axis of the wavetrain.

Knowing that the integrity of the propagated quantum wave is preserved, we have to find the corresponding velocity, υ_z, in a straight direction along Z axis. There is **one important consideration**: the excess momentum is propagated by the right and left handed nodes, which interact between themselves. In such case, the quantum wave momentum could not be considered as a sum from the right and left handed nodes momentums. The same consideration is valid for the propagation velocity, of the photon. According to the present concept of Modern Physics this velocity carry the whole "photon mass". In order to comply to this consideration, but using the presented concept and having in mind the complimentary interactions between the right and left handed CL nodes, the propagation velocity could be regarded as a square root of the product from the right and left handed velocity contributions.

$$c = \sqrt{\upsilon_R \upsilon_L} \tag{2.29}$$

where: c - is the light velocity (propagation velocity), υ_R and υ_L are respectively the linear velocity components contributed by the right and left handed nodes.

Considering the integrity of the whole E-field of the quantum wave, we can replace the radial energy distribution whose shape is shown in Fig. 2.38 by a rectangular function having the same area. Then the sum of the individual NRM vectors at one moment will be replaced by one equivalent NRM vector, corresponding to equivalent electrical quasisphere at a radial distance corresponding to the half maximum of the radial E-field. The equivalent helical path can be defined by a radial distance at half maximum equal to $\delta\lambda$ (see Fig. 2.38). As a result, we may relate the energy properties of the individual running EQ, but via some **equivalent EQ** located at equivalent radial distance from the central axis of the wavetrain.

The introduced equivalent EQ will carry the whole energy of the quantum wave (photon) while moving through an equivalent helical path centred around the direction of the quantum wave propagation.

Let estimating the components υ_R and υ_L by the division of the equivalent helical path, on the time for this path. We may use the first harmonic wave, for simplicity, and to show later that the result is valid for all harmonics. Knowing that in the Earth local field $\nu_{SPM} = \nu_c$, we may use the Compton parameters for the SPM vector. Then the equivalent helical path for one SPM cycle is

$$\lambda_{he} = \lambda_c k_{he} \tag{2.30}$$

$$k_{he} = \sqrt{1 + 4\pi^2(\delta\lambda/\lambda_c)^2} \tag{2.31}$$

where: k_{he} - is the coefficient for the equivalent helical path

Applying the Eq. (2.30) for the boundary radius we have:

$$\lambda_{hb} = \lambda_c k_{hb} \tag{2.31.a}$$

where

$k_{hb} = 4$ - is the boundary coefficient according to Eq. (2.20.a):

Without confusing with the node distance of CL, that is a constant, in order to distinguish the calculated distances for both helical traces, we will use the distances: d_{nb} - corresponding to boundary path (the helical path at the boundary radius, where MQs form the boundary conditions of the wavetrain) and d_{ne} - corresponding to the equivalent path (the helical path at the equivalent radius valid for the equivalent quasisphere, defined above and carrying the total photon energy).

Fig. 2.47.a shows the resonance traces for magnetic and electrical quasisphere respectively. Fig. 2.47.b shows the same traces, but presented as equivalent circles (for simplification of the following analysis). Let expressing the node distances d_{nb} and d_{ne} by their equivalent radii r_{db} and r_{de}, which are shown in the same figure. We may accept, that the following ratio is valid:

$$\frac{r_{ne}}{d_{ne}} = \frac{r_{nb}}{d_{nb}} = k_{rd} \tag{2.33}$$

Assuming that the energy is transferred between the neighbouring nodes per one resonance cycle we can write:

$$\lambda_{he} = N_{RQ} d_{ne} \tag{2.34}$$

where: N_{RQ} is the number of resonance cycles per one SPM MQ cycle.

The Compton time t_c is related to the node resonance time according to the relation:

$$t_c = t_R N_{RQ} \tag{2.35}$$

Then the resonance frequency is

$$\nu_R = \nu_c N_{RQ} \tag{2.36}$$

where: N_{RQ} - is the number of resonance cycles in one SPM MQ cycle (must not be confused with cycles per second).

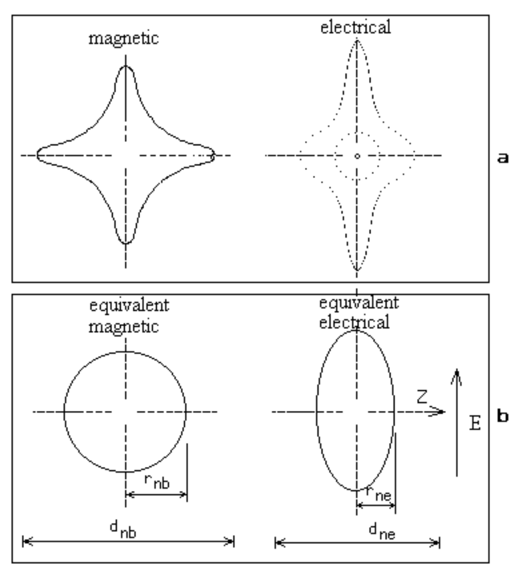

Fig. 2.47

Trace projections of resonance cycles (a.) and their equivalent presentations (b.)

It is evident, that the following relations are valid.

$$\omega_R = 2\pi\nu_R = \frac{2\pi}{t_R} = 2\pi\nu_c N_{RQ} \qquad (2.37)$$

The momentum velocity projection on the Z axis can be estimated by the path along Z axis per one SPM cycle, that is equal to λ_c. Therefore, the light velocity component, contributed by the right handed nodes is:

$$\upsilon_R = \frac{\lambda_c}{t_c} = \frac{\lambda_{he}}{t_c k_{he}} = \frac{d_{ne}}{t_R k_{he}} = \frac{r_{ne}\omega_R}{2\pi k_{he} k_{rd}} \qquad (2.38)$$

If using not the first harmonic, but any subharmonic, the Eq. (2.37) gives the same result (because λ_c and t_c get multiplication by one and a same number). The velocity component, contributed by the left handed nodes υ_L is a same as υ_R Then according to (2.29), the equation for the light velocity is

$$c = \sqrt{\frac{r_{ne}^2\omega_R^2}{4\pi^2 k_{rd}^2 k_{he}^2}} = \frac{\omega_R d_{nb}}{2\pi k_{hb}} \qquad (2.39)$$

The Eq. (2.39) is not still in final form. Although it will help us to identify the relation between the well known parameters of the physical vacuum (permeability and permittivity) and the CL space parameters. Substituting *c* in Eq. (2.39) with $(\mu_o\varepsilon_o)^{-1/2}$ and rasing on square we get

$$\mu_o\varepsilon_o = \frac{4\pi^2 k_{rd}^2 k_{he}^2}{r_{ne}^2\omega_R^2} \quad \left(\frac{s^2}{m^2}\right) \qquad (2.39)$$

The dimensions of the expression (2.39) are easily determined, having in mind the expression (2.37). Now the task is to find the expressions of the separate parameters of the product. The simple separation of the parameters in two terms could not give the correct result, because μ_o and ε_o may contain common parameters, that are eliminated in their product. However, we may guess what are the eliminated parameters, by examining the dimensions of μ_o and ε_o. Working in SI system, we can manipulated the dimensions of the $\mu_o\varepsilon_o$ product, by eliminating the common dimensions, until obtaining the dimensions of Eq. (2.39).

$$\mu_o\varepsilon_o \equiv \left(\frac{N}{A^2}\right)\left(\frac{A^2\ \mathrm{s}^2}{N\ \mathrm{m}^2}\right) = (\mathrm{kg})\left(\frac{s^2}{kg\ \mathrm{m}^2}\right) \qquad (2.40)$$

Eliminated dimensions for μ_o: $\left(\frac{m}{A^2 s^2}\right)$ (2.41)

Eliminated dimensions for ε_o: $\left(\frac{A^2 s^2}{m}\right)$

Some eliminated parameters that are dimensionsless are not directly apparent. Some other parameters, as the electron charge, for example, are defined at special conditions.

From dimensional expression (2.40) we see, that some mass should participate in μ_o and ε_o, while it is eliminated in their product. Let for this reason we multiply the nominator and denominator of Eq. (2.39) by the mass parameter m_n. The correctness of the obtained expression will be verified later. Then providing a proper grouping in brackets we get:

$$\mu_o\varepsilon_o = \left(\frac{4\pi k_{rd}^2 m_n}{N_{RQ}}\right)\left(\frac{k_{he}^2}{2\nu_c m_n r_{ne}^2\omega_R}\right) \qquad (2.42)$$

We will see later that m_n is a constant. Then all the parameters in the left bracket are constants, not depending on the energy of the propagated wave. The term $4\pi/N_{RQ}$ also could be regarded as a solid angle corresponding to one resonance cycle . It is a dynamical parameter of NRM vector implemented in the SPM vector which forms the MQ. Consequently the left bracket shows features indicating that it corresponds to μ_o. Then the right bracket should be the expression for ε_0. The latter could be presented also as:

$$\varepsilon_0 = \frac{k_{he}^2}{2\nu_c(\Delta L)} \qquad (2.43)$$

where: ΔL - is the angular momentum change of NRM vector, i. e. the momentum that carries the energy. This momentum multiplied by the **number of SPM cycles in all wavetrain** will give the total energy.

We have to find what is the reaction of the CL space to disturbance pulse with infinite small duration. The response of such disturbance will be equal to the relaxation time constant. The relaxation time constant will likely define the transition envelope of the photon wave at the start. A more detailed discussion of the relaxation time constant, later referenced also as a space-time constant of CL space is given in §2.13.A. Its apriopry accepted theoretical value is:

$$t_{CL} = \frac{(c)}{\nu_c} = 2.426\times10^{-12} \quad \text{(sec)} \qquad (2.44)$$

Due to the space-time considerations of the relaxation time constant the light velocity put in brackets is used as a dimensionsless factor. This consideration is later used in Chapter 3 for definition of Dynamic CL pressure which is used successfully in Chapter 5 for derivation of the background temperature of CL space as a signature of the Zero Point Energy, a well known parameter in Modern Physics.

We will use the equivalence between the first harmonic energy (511 keV) and the electron mass in order to determine the m_n. parameter. In Chapter 3 the charge to mass equivalence principle also will be explained. Applying this principle, we can estimate the inertial node mass by the equation:

$$\Sigma m_n = \frac{h\nu_c}{c^2} \tag{2.45}$$

For this reason we need to estimate the number of involved nodes, from the expression:

No of nodes = [(photon volume)/(node cell volume)] (2.46) The node cell volume should be determined from the boundary conditions: $d_{nb} = \lambda_{hb}/N_{RQ}$.

In order to estimate the volume we need the **wavetrain length. This is in fact a length**, that could be practically measured by Michelson interferometer with adjusted path length. The maximum path length at which the interferogram is still possible will provide this length that we may call a coherent length.

The coherent length l_{coh} and coherent τ_{coh} time are related by the simple relation:

$$l_{coh} = c\tau_{coh} \tag{2.46.a}$$

The coherence time could be considered as the elapsed time, between the front and back end of the passing quantum wave, measured by a stationary observer.

The coherent times for a monochromatic thermal source and for lasers are very different. In our case we will consider only the first one. For best monochromatic thermal sources the coherent time is in order of 10^{-8} sec.

Notes:

(a) The above definitions of a coherent length ant time are for a not correlated single photon. They should not be confused with the coherent length and time parameters of the lasers, where the photons are correlated by time (time instant of emission) and space (mutual spatial interactions).

(b). We should not confuse the coherence time with the detection time. The latter is much smaller, because, **the photoelectron in the detection process appears after all wavetrain energy is transferred to the detector.** The detection process in fact follows the end of the wavetrain.

If considering the relaxation constant as a transition time, the transition length l_{tr} of the wavetrain is:

$$l_{tr} = ct_{CL} \tag{2.46.b}$$

The estimation of the coherent time or length for a single 511 keV gamma photon is a difficult task. For this reason we will use the CL pumping time for generation of this quantum wave. It is equal to the lifetime of the parapositronium 1'S_o (p-Ps). (This is discussed in Chapter 3). Its value in vacuum is 125 psec. Here **we will assume that the pumping time is equal to the coherence time in this case.**

According to Eq. (2.46.a) and (2.46.b) the ratio between the coherent and transition length of the wavetrain is

$$k_d = \frac{125\times10^{-12}}{t_{CL}} = 51.52 \tag{2.47}$$

The total wavetrain length is $t_{CL}k_dc$, while its cross sectional area, defined by the boundary radius of $\lambda/2$ is $\pi(\lambda_c/2)^2$ (0.5λ is used instead of 0.6164λ, because of possible EQ slope change near the boundary). Then the volume of the wavetrain can be expressed as:

$$V = \pi\left(\frac{\lambda_c}{2}\right)^2 t_{CL}k_dc = \frac{\pi}{4}\frac{(c)c^3k_d}{\nu_c^3} \tag{2.47.a}$$

Substituting the volume from Eq. (2.47.a) in Eq. (2.46) and dividing the total mass of 511 keV by the number of nodes, we get the equation of the **node inertial mass** m_n, expressed by the CL parameters.

$$m_n = \frac{4h\nu_ck_{hb}^3}{\pi(c)c^2N_{RQ}^3k_d} \tag{2.48}$$

The node inertial mass, m_n, could be regarded as an equivalent parameter. This is because the CL node distance defines the boundary of the distance scale in CL space, so the inertial properties we are familiar with are valid only for larger distances than this one. The equivalent node inertial mass, however, is useful for finding the relation between the intrinsic CL space parameters and the fundamental physical constants.

The parameters μ_o and ε_o in system SI are estimated by using the Coulomb unit of the charge. However the terms of Eq. (2.42) are more convenient to be referenced to the charge of the electron. Then the following expressions are valid:

$\mu_o = 4\pi \times 10^{-7} \quad \left(\frac{N}{A^2}\right) = \left(\frac{N}{C^2 s^2}\right)$ - referenced to Coulomb

$\mu_{oe} = \frac{\mu_o}{(q^2)}$ - referenced to electron charge q (2.49)

$\varepsilon_o = 3.854 \times 10^{-12}$ - referenced to Coulomb

$\varepsilon_{oe} = \varepsilon_o q^2$ - referenced to electron charge q (2.50)

Applying some substitutions in the second term of Eq. (2.42), and referencing to the electron charge we obtain:

$$\mu_{oe}\varepsilon_{oe} = \left(\frac{4\pi m_n k_{rd}^2}{N_{RQ}}\right)\left(\frac{N_{RQ}}{4\pi m_n c^2 k_{rd}^2}\right) \qquad (2.50)$$

From the dimensional Eq. (2.41) we identify the eliminated parameters for μ_o

$$\left(\frac{m}{A^2 s^2}\right) \to \left(\frac{\lambda_c}{(qt_c)^2 t_c^2}\right) \qquad (2.51)$$

The reason to use λ_c and t_c in the guessed parameters is that they are the basic parameters of the SPM effect, which is responsible for the constant light velocity. Multiplying the left term of the bracket of (2.50) by the eliminated parameters according to Eq. (2.51) and by q^2, according to Eq(2.49), we get the final equation for μ_o.

$$\mu_o = \frac{4\pi m_n k_{rd}^2 c \nu_c^3}{N_{RQ}} \qquad (2.52)$$

In a similar way the final equation for ε_o is obtained.

$$\varepsilon_o = \frac{N_{RQ}}{4\pi m_n \nu_c^3 c^3 k_{rd}^2} \qquad (2.53)$$

If knowing the factor k_{rd}, we can determine the parameter N_{RQ}, and consequently the resonance frequency of the CL node. The factor k_{rd}, given by Eq. (2.33) could be approximately estimated by the return forces plot of the node displacement, shown in Fig. 2.24 in Chapter 2. From this figure the node displacements along *abcd* and *xyz* axes are respectively: 0.2 and 0.4 values, normalised to the d_{abcd}, which is the node distance along one of the *abcd* axes. Then the average displacement, *r* is: $r \approx 0.5(0.4 + 0.2)d_{abcd} = 0.3d_{abcd}$

$$k_{rd} = \frac{r}{d_{xyz}} = \frac{0.3d_{abcd}}{2d_{abcd}} = 0.15$$

For a value of $k_{rd} = 0.15$, we get the following results for the Cosmic Lattice:

$N_{RQ} = 0.88431155 \times 10^9$ - number of resonance cycles for one SPM cycle (2.54)

$\nu_R = 1.092646 \times 10^{29}$ (Hz) - node resonance frequency (2.55)

$d_{nb} = 1.0975 \times 10^{-20}$ (m) - CL unite cell size (along xyz axes) at boundary (2.56)

$m_n = 6.94991 \times 10^{-66}$ (kg) - CL unit cell inertial mass (2.57)

Note: ν_R is valid for *xyz* CL unit cell and node resonance frequency, while d_{nb} and m_n are defined for CL unit cells only. For approximate calculations, m_n could be considered valid for a single CL node, because any CL *xyz* cell includes sharing nodes from the neighbouring cell.

From eq. (2.48) we can directly express the Plank's constant by others fundamental constants and CL node parameters.

$$h = \frac{\pi(c)c^2 m_n N_{RQ}^3 k_d}{4\nu_c k_{hb}^3} \quad \text{(N m s)} \qquad (2.58)$$

where: (c) - is a light velocity as a dimensionsless factor.

k_d - is a dimensionsless factor given by Eq. (2.47)

The unit electron charge expressed by CL space parameters is:

$$q = \frac{N_{RQ}^2}{2\nu_c^2}\sqrt{\frac{c\alpha k_d}{2k_{rd}^2 k_{hb}^3}} \quad \text{[C]} \qquad (2.58.a)$$

Summary and conclusions:

- The introduced parameter of node inertial mass allows to find the relation between the CL space parameters to the fundamental physical constants.

- The CL node parameters: the node distance, the proper resonance time and the inertial mass are the three basic parameters defining respectively the space, the time and the inertial property of the macroworld of the elementary particles.
- The weak dependence of the node distance by the gravitational field of the matter (Newtonian gravitation) causes a small change of the CL space parameters. This is behind the General Relativity effects, observed in the macro world scale.
- The relativistic properties affect directly the quantum motion of the electron.

Detailed analysis of the quantum motion of the electron is provided in Chapter 3.

2.12 Relation between the intrinsic and the inertial mass of the CL node.

The inertial factor defined by the Eq. (2.6.a) is a ratio between the interaction energy and average gravitational energy.

The CL node interaction energy is in fact the kinetic energy of the node oscillations. The node moment of inertia is $m_n r^2$, so the interaction energy is:

$$E_I = \frac{m_n r^2}{t_R^2} \qquad (2.59)$$

The average gravitational energy, can be expressed as a gravitational potential between two neighbouring node. In fact every node, regarded as a central one, has 4 neighbours (connected along the *abcd* axes), so we may consider that the central node interacts with 1/4 of every neighbouring nodes. In such case, the magnitude of the gravitational potential could be regarded as between two nodes at distance of d, defined for *abcd* axes. This potential is obtainable by integrating on a distance the IG forces between two nodes in a void space.

$$E_{ig} = \int \frac{G_{od} m_{no}^2}{x^3} dx = \frac{G_{od} m_{no}^2}{2d^2} \qquad (2.60)$$

where: G_{od} - is a gravitational constant in empty space between the two deferent types of intrinsic matter; m_{no} - is the intrinsic mass of the node, (averaged between the right and left handed nodes); d - is the node distance along *abcd* axes.

Substituting (2.59) and (2.60) in Eq. (2.6.a) and having in mind that $d = d_{nb}/3$, we get the expression of the inertial node mass.

$$m_n = \frac{9 I_F t_R^2 G_{od} m_{no}^2}{2 d_{nb}^4 k_{rd}^2} \qquad (2.61)$$

where: I_F is the intrinsic inertial factor of the CL node

The inertial factor is a function of the node shape, the node distance d_{nb} and the resonance time t_R.

From equation (2.61) we see that for CL spaces with different node distances, the parameters, affecting the inertial node mass are: I_F, t_R and d_{nb}. All other parameters are constants.

2.12.A. Plank's constant estimated by the parameters of the intrinsic matter and the CL space

Substituting m_n from (2.61) in (2.58), we get for the Plank's constant:

$$h = \frac{9\pi I_F N_{RQ}^4 G_{od} m_{no}^2 k_d}{8 d_{nb} k_{hb}^6 k_{rd}^2} \qquad (2.62)$$

Note: The dimension of God is not equivalent to the dimension of G (universal gravitation constant). This is because G_{od} is involved in IG equation, where the distance participates in a cubic power instead of square). For this reason, in order to avoid any confusion in the analysis in BSM a SI systems of units is always used.

The Equation (2.62) could be useful for estimation of the quantum energy exchange between two different gravitational fields. This is a problem that is related to the General relativity. For this reason the inertial factor I_f, however, is necessary to be analysed. This is a complicated task, requiring number of unknowns, so it is not discussed in the present course of the BSM theory.

2.13 Physical meaning of the Planck's constant, by using the basic parameters of CL space.

The physical meaning of the Planck's constant appears more apparent if using the basic parameters of the CL space.

Analysing ε_o by Eq. (2.43) we see that the term ΔL has the same dimensions as the Planck's constant: (m^{2}kg sec). Then the product $\nu_c \Delta L$ have a dimensions of energy. We see also, that the expression (2.58) that we derived for the Planck's constant, contains ν_c in the denominator. If multiplying this equation by the first SPM harmonic frequency ν_c, we obtain $h\nu_c/q = 511$ (KeV) (division on electron charge provides energy in (eV). This energy value is equivalent to a integral momentum change of the CL nodes, when a first harmonic wave is propagated. Following the same logic we may apply this for n-th subharmonic. **The frequency of the n-th subharmonic quantum wave (photon) is equal to the SPM frequency divided on n.** Then the photon energy is

$$E_{ph} = (first \text{ harmonic energy}) \times n = \frac{(first \text{ harmonic energy})}{\nu_c}\nu \quad (2.63)$$

where: ν - is photon frequency

The Eq. (2.58) could be presented also as a torque at SPM (Compton) frequency.

$$h = \frac{Torque}{\nu_c} \qquad \frac{kg\ m^2}{Hz} \qquad (2.64)$$

where:

$$Torque = \frac{\pi(c)c^2 m_n N_{RQ}^3 k_d}{4k_{hb}^3} \qquad (2.65)$$

Consequently the Plank's constant could be regarded as a specific torque, measured at the SPM frequency. In such case it is expressed only by the CL space parameters.

The Equations (2.64) and (2.65) provide useful link for estimation of the Plank's constant by the Compton frequency, which is experimentally determined value of the SPM frequency. The Compton frequency (discovered by the great america physicists Compton) is simultaneously the first proper frequency of the oscillating electron.

The obtained expression of the Planck's constant gives a possibility to estimate not only the quantum wave features of CL space, but also to find its basic parameters: **the static and the dynamic pressure**. These two parameters are directly related to the following physical parameters and relations:

- the Neutonian (apparent) mass of the atomic particle and macrobodies in CL space

- the energy balance between ZPE of CL space and the minimum kinetic energy of the elementary particles

The determination of the static and dynamic pressure is discussed in Chapter 3.

We can summarize that:

- **The Plank's constant expresses the equivalent angular momentum change of all electrical quasispheres for a first harmonic quantum wave.**
- **The Plank constant can be measured as a specific torque resistance, at the SPM frequency.**

2.13.A. Zero Point Energy uniformity and CL space relaxation time constant

The measurable parameter of the ZPE (AC type) according to BSM is the temperature, estimated by the Cosmic Microwave Background (CMB). We may call it a CL background temperature. The BSM theory shows the relation between the background temperature, the proton volume and the ideal gas constant. Chapter 5 provides theoretical estimation of the background temperature obtaining a result, that differs only by 0.06 K. from the measured temperature by the CMB method. In the calculations, the CL space-time constant is used in a sense of relaxation time, characterizing some fluctuations of CL domains, responsible for ZPE uniformity of CL space. These fluctuations are very low energy waves, related with spontaneous creations and destructions of magnetic protodomains with length of whole number of Compton lengths. Such fluctuations are called Zero Point Waves (introduced by BSM). The energy of these waves is very low and they are not possible to be detected directly. Although very rarefied gas substances and especially the Hydrogen, distributed in the space, obtain dynamical equilibrium. Then the ZPE of the space is estimated indirectly by the emission spectrum of these atoms and especially the Hydrogen. Without the existence of the zero point waves, the uniformity of the Cosmic background temperature is not possible to be explained. **There is quite logical consideration, that the average time of the magnetic protodomains recombination is equal to the relaxation time constant of CL space.**

The CL relaxation constant, perhaps is involved also, in the transition process of the wavetrain formation. For this reason this constant was, also, used in Eqs. (2.47) and (2.48) for determination of the node inertial mass.

There is one value of the relaxation constant, as a theoretical guess, that fits well to the equations used in BSM. It is defined by the expression.

$$t_{CL} = \frac{(c)}{\nu_c} = 2.426\times10^{-12} \text{ sec} \tag{2.66}$$

where: (c) is a light velocity used as a dimensionsless factor.

The use of the light velocity as a dimensionsless factor in (2.66) comply with the adopted space-time consideration particularly, assuming that at such motion the electron oscillation, for example, must be stopped. This is a theoretical consideration only because at relativistic velocity the quantum interaction efficiency is decreased, while the mass is increased. At particular velocity, for example a synchrotron radiation effect of the electron beam takes place.

The value of the relaxation constant given by Eq. (2.66) is valid only in SI units. This does not mean that the relaxation constant is dependent of the system unit of measurement. This is easy to be proved by checking the dimensions identity.

$$\frac{(c)}{\nu_c} \equiv \frac{(m/\text{sec})}{1/\text{sec}} = (m) \tag{2.66.a}$$

$$\frac{(c)}{\nu_c} \equiv \frac{(cm\times100)/\text{sec}}{1/\text{sec}} = (cm)100 \equiv (m) \tag{2.66.b}$$

The dimensional equation (2.66.a) is for a SI measurement system, where, the length unit is 1 m. The equation (2.66.b) is for a measurement system, where the unit length is 1 cm. From the two equations we see, that **the relaxation time could not be considered as an absolute parameter, but a space- time parameter of CL space.**

The reciprocal of the relaxation time appears as a relaxation frequency parameter. Its value is:

$$\frac{\nu_c}{(c)} = 4.12148\times10^{11} \quad [\text{Hz}] \tag{2.66.c}$$

Both the time relaxation constant and the relaxation frequency are parameters of the zero point wave. These waves are responsible for equalizing the ZPE of CL domains. In such aspect they are important real parameters. In Chapter 3, the relaxation frequency is used to define the dynamical pressure of CL space.

The relaxation time constant is defined only for motion event in CL space and is directly related to the light velocity according to Eq. (2.66). For this reason it is more appropriate to be called a space-time constant. This definition is in closer relation to the space-time concept of the physical vacuum.

2.13.B. Fundamental time based constants and their connections to the levels of matter organisation

Some of the fundamental constant are given in frequency, others in time units. In order to make comparison we may regard the periods of some fundamental frequencies as a time constant and v. s. versa. In such aspect we may express the periods of the CL node resonance frequency t_R and the SPM (Compton) frequency t_c as a time constants.

One fundamental time constant, that we may use is the Plank's time, for which there is not so far a physical explanation. It is given by the equation:

$$t_{pl} = \sqrt{\frac{Gh}{2\pi c^5}} = 5.39\times10^{-44} \text{ (sec)} \tag{2.67}$$

where: G - is the universal gravitational constant

Comparing to the other time constants, the Plank's time is the smallest one. Let to use the reciprocal value of these time constants, and express them as frequencies. The parameters t_R and t_c are related with periodical oscillations. Then the Planck's time might be also a parameter of periodical oscillations. The value of the three frequencies are given in Table 2.2

Levels of matter organization **Table: 2.2**

Level x	Time (sec)	Frequency, ν (Hz)	$\ln(\nu)$	Type of oscillation
0	5.39E-44	1.855E43	99.629	
1				
2	9.152E-30	1.0926E29	66.86	CL resonance
3	8.093E-21	1.236E20	46.26	SPM, Electron

If drawing a fitted line function of $\ln(\nu)$ vs the "Level" number we see that the line become pretty close to a robust line if one level of matter organization is missing. This level is identified as a level

1 in Table 2.2. (The possibility of such level is discussed in Chapter 12 Cosmology).

Fig. 2.74A shows a plot of ln(ν) versus the level of matter organization , *x*.

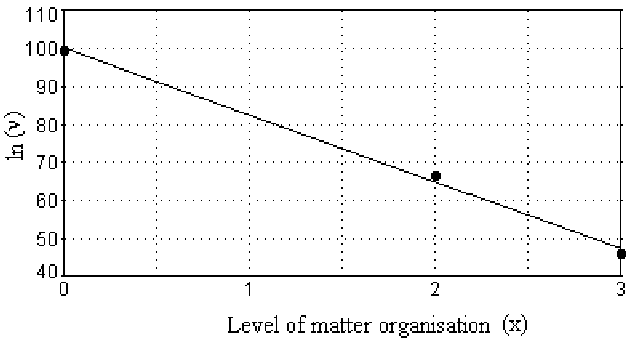

Fig. 10.1

The CL space exists in 2 and 3 level of the matter organisation, but not in level 0 or 1.

The very steep falling trend (having in mind the logarithmic scale) might be explained by the change of the inertial factor of the structures corresponding to the particular level of the matter organization. We see that the relation between the trend and the inertial factor (defined in Chapter 2) follows the rule: a larger inertial factor - a lower frequency. Then we come to a logical conclusion that the level zero should correspond to a matter organisation with a smallest inertial factor. For now, we may accept that this level corresponds to the bulk primordial matter. Although, in Chapter 12 (Cosmology) we will see that it could be attributed to the a simplest material structure that possess oscillation properties.

It has been mentioned. in number of paragraphs from the previous analysis, that the intrinsic matter should have its time constant. In such aspect we may accept that:

- **The Plank's time is probably the mean value of the time constants of the both substances of intrinsic matter from which the prisms are built.**

The obtained relation between the fundamental time constants and inferred guess about the Plank's time could put more light about the properties of the intrinsic matter. It may, also, help to understand the very basic fundamental law - the law of intrinsic gravitation.

2.14. Basic measurable parameters of the CL space.

The cosmic lattice is able to occupy a definite volume in empty space without need of boundary conditions.

Static pressure of CL space

When a complex helical structure is put in CL space, the CL nodes are displaced only by the volume of the first order helical structure, because this volume is occupied by RL, which has much larger stiffness. When such structure is in motion, the CL node fold, deviate, pass, and restore their positions, so they passes through the stronger local field of the structure, but not through the volume of its FOHS. Consequently, for any complex helical structure, the CL space could exercise a pressure only on its FOHS's. We call this parameter a **static CL pressure**. When the structure is in motion, the CL space behaves partially as a real gas and partly as an ideal gas for FOHS's. The latter state is due to the electrical and magnetic fields.

Dynamic pressure of CL space

The CL space exercises forces on the envelopes of the helical structure (the proton, for example) in form of Zero Order Waves. The reason, that these forces are exercised on the envelopes, but not only on the more dens FOHSs, is that the wavelength of these waves is much longer, than the fine geometrical parameters of the FOHSs. As a result, the external shell of the proton feels a **dynamic pressure exercised by the smallest waves of the CL space - the Zero Point waves. It is an alternative type of pressure with frequency equal to the recombination frequency of the magnetic protodomains. (reciprocal to the CL relaxation constant).**

The static pressure gives a possibility to formulate the apparent mass of the elementary particles, made of helical structures. The dynamic pressure helps to estimate the energy equilibrium between the CL space and the atoms.

The static and dynamic pressure are both measurable parameters. Their values are determined in Chapter 3, where the mass equation is derived.

Background temperature of CL space

Another important parameter of the CL space is the Zero Point Energy (ZPE) (dynamic type or AC). Its measurable parameter is the CL space background temperature. According to BSM, the cosmic microwave background radiation is the background temperature of the deep space. It is formed by the the emission from atoms and molecules in the deep space, as they are in dynamical equilibrium with the ZPE of the space. The background temperature of the Earth local field can be calculated by using the universal gas constant, the static CL pressure and the proton dimensions. Its value is calculated in Chapter 5. It appears about 0.07 K higher than the measured CMB from the deep space, but this is reasonable (see the discussion in Chapter 5).

The **basic parameters of the CL space** are the following:

- resonance time: t_R, (corresponding to the proper resonance frequency of the CL node, ν_R;
- SPM frequency ν_{SPM}, (Compton frequency for Earth gravitational field ν_c);
- number of resonance cycles per one SPM cycle: N_{RQ};
- light velocity (for quantum wave propagation): c;
- static pressure: P_S;
- dynamic pressure: P_D
- apparent mass of particle of helical structures (in CL space only): m;
- node inertial mass: m_{ni};
- background temperature parameter of ZPE: T_{BG}
- relaxation time constant of CL space: t_{CL}
- Palnk’s constant: h
- unit electrical charge: q

Some of the derived basic equations (see Chapter 3**)** expressed directly by the CL parameters are the following:

The **static CL pressure**, when using the SPM (Compton) frequency is:

$$P_S = \frac{g_e^2 h \nu_c^4 (1-\alpha^2)}{\pi \alpha^2 c^3} \quad \left[\frac{N}{m^2}\right] \qquad [(3.53)]$$

where: α - is the fine structure constant; g_e is the gyromagnetic factor of the electron

The **static CL pressure**, when using the CL resonance parameters is:

$$P_S = \frac{h g_e^2 (1-\alpha^2) \nu_R k_{hb}^3}{\pi \alpha^2 N_{RQ}^4 d_{nb}^3} \quad \left[\frac{N}{m^2}\right] \qquad [(3.54)]$$

where: d_{nb} - is the node distance in xyz axes of the node coordination system

k_{hb} - is the quantum wave boundary condition factor, given by Eq. (2.20.a): $k_{hb} = \sqrt{1 + 4\pi^2(0.6164^2)} = 4$,

0.6164 - is a factor complying to the Rayleigh criterion

The **dynamic CL pressure** is:

$$P_D = \frac{g_e h \nu_c^3 \sqrt{1-\alpha^2}}{2\pi\alpha c^3} \qquad [(3.62)]$$

The newtonian mass of any particle of helical structures in CL space is determined by the volume of its FOHSs. The mass equation allows to calculate the newtonian mass of the atomic particles, if the configuration of their helical structures are known.

$$m = \frac{g_e^2 h \nu_c^4 (1-\alpha^2)}{\pi \alpha^2 c^5} V \quad \text{[kg]} \qquad [(3.57)]$$

where: V - is the volume of the FOHS’s included in the particle

Note: If a first order positive structure is included in first order negative one, the external volume only should be considered.

The inertial mass of the oscillating node is:

$$m_{ni} = \frac{4 h \nu_c k_{hb}^3}{\pi (c) c^2 N_{RQ}^3 k_d} \quad \text{[kg]} \qquad (2.73)$$

where: (c) - is the light velocity as a dimensionless factor

k_d - is a factor given by Eq. (2.47).

The light velocity by the resonance CL parameters is:

$$c = \frac{\omega_R d_{nb}}{2\pi k_{hb}} = \frac{\nu_R d_{nb}}{k_{hb}} \qquad (2.75)$$

where: ω_R - is the resonance angular frequency; d_{nb} and k_{hb} - are respectively the node distance and the boundary factor for a quantum wave.

Zero Point Energy discussed above, has its measurable parameter: a **temperature background.** Its value for a deep space is provided by the Cosmic Microwave Background. In the local field the temperature background can be calculated. This is demonstrated in Chapter 5.

The current model of BSM theory, provides the following estimates for some of the CL space parameters:

$N_{RQ} = 0.88431155 \times 10^{9}$

$t_R = 9.152093 \times 10^{-30}$ $[sec]$ $\nu_R = 1.092646 \times 10^{29}$ $[Hz]$

$m_n = 6.94991 \times 10^{-66}$ $[kg]$

$P_S = 1.373581 \times 10^{26}$ $\left[\frac{N}{m^2}\right]$

$P_D = 2.025786 \times 10^{3}$ $\left[\frac{N}{m^2 Hz}\right]$

$d_{nb} = 1.0975 \times 10^{-20}$ $[m]$ - node distance along xyz axes

$d_{na} \approx d_{nb}/2 = 0.54876 \times 10^{-20}$ $[m]$ node distance along abcd axes

2.15. Gravitational law in CL space

The gravitational law in CL space is the Newton's universal law of gravitation. Why the inverse power of 3 law in empty space becomes inverse power of 2 law in CL space?

The answer of this question is not simple enough, in order to be provided in this chapter. But some useful consideration, related with this aspect are the following:

a. A unit volume of cosmic lattice around a massive object has a specific weight.

b. For the first order structures, the cosmic lattice behaves as a real gas at constant temperature, defined by the ZPE.

c. When a particle, (comprised of huge number of helical structures with different spatial arrangement and dynamics) is in a gravitational field of a massive body it feels an attractive force, that is defined by the Newton's law of gravitation.

d. The gravitational forces acting on the helical structures are propagated by the central part of the prisms.

e. The lattice pressure around the mass object is slightly higher than in the open space. The macrobodies, however, in comparison to the first order helical structures are very rarefied. For this reason the effect of the space shrink (CL node distance) is very weak.

The feature **c**. may lead to the following conclusions:

1) The gravitational forces defined by the Newton's law of gravitation are manifestation of the intrinsic gravitational forces in CL space environment.

2) The gravitation is not defined by the node resonance frequency and consequently of the light velocity.

The provided above logical considerations leads to a conclusion, that the Newtonian gravitation is a propagation of the Intrinsic Gravitation in conditions of CL space environment. While the propagation of the IG field between prisms that are not in motion could be quite fast its propagation through the oscillating CL nodes might be delayed and limited by the oscillation period of NRM. This is so, because the proper resonance frequency is much smaller than the Planck frequency (or the frequency of the envisioned level 1 of the matter organization as shown in Table 2.2). This envision may not seem enough convincing here, but it is supported by the later analysis and especially by the analysis of some observational data in Chapter 12.

2.15.0. Mass - energy - charge equivalence principle.

The matter and mass are quite different categories according to BSM. The matter we are familiar with, appears as a Newtonian mass. The intrinsic and the Newtonian mass are different attributes of the matter. For simplicity we may reference to the Newtonian mass as an apparent mass (or simple a mass), and to the intrinsic mass as a IG or intrinsic mass. The principle of mass-energy-charge equivalence, discussed below is valid only for the particles exhibiting apparent (Newtonian) mass in CL space.

2.15.1 Mass-energy equivalence

The mass - energy equivalence, according to BSM, uses the Einstein's equation $E = mc^2$, but with a remark, that the intrinsic matter does not disappear, when the apparent mass vanishes. Instead of that, the matter undergoes one of the two types of conversion:

- the matter becomes hidden as a whole helical structure;
- the matter is disintegrated into prisms and RL nodes that finally may recombine into CL nodes.

The both processes are related with energy release, but the prisms are unchanged. The BSM theory shows that, there is not annihilation of the matter at all, even at the temperature of the nuclear fusion and the high energy cosmological phenomena that are directly detected.

2.15.2 Energy equivalence principle for the electrical charge and charge unit equality

2.15.2.1 Considerations and principles

The static electrical charge could be regarded as a kind of energy distributed in form of electrical field around the particle. Indeed, the electrical quasispheres around the particle contain larger energy, than the magnetic quasispheres. In Chapter 6 it will be discussed, that the neutron to proton conversion is related with creation of pair charges: one static and one dynamic as a quasiparticle wave. The proton gets mass deficiency, because its toroidal shape is twisted. In this process the internal rectangular lattices (RL) of all FOHSs get partially twisting, which leads to a small volume shrinkage. The energy equivalence of this volume shrinkage according to the mass equation is equivalent to the sum of the energies of the static charge and the quasiparticle wave. The both are reaction of CL space in order to preserve the energy balance.

Then applying the energy conservation law, the charge-energy equivalence principle can be formulated. Instead of universal formulation, which requires mentioning of lot of conditions, we can reference the principle to the neutron - proton conversion process (see details in Chapter 6).

- **The total energy of the created electrical charges, in the neutron to proton conversion in free CL space, is equal to the energy equivalence of the newtonian mass change.**

The term free CL space is used to emphasize, that ideal conditions are considered in order to neglect the influence of external gravitational, electric and magnetic interactions. The formulated above principle allows to provide a logical explanation of the processes of the neutron-proton and proton-neutron conversions. (Details are given in Chapter 6).

As a consequence from the above conclusion it follows that a static (not moving) charge could exists only around a particle, possessing a matter. Having in mind the energy conservation law and the analysis of the electron oscillations in CL space (Chapter 5) we arrive to the following **conclusion:**

- **The electrical field energy of the electron (positron) is equal to its mass equivalent energy.**

This principle will be discussed and proved in Chapter 3. In the same Chapter it is shown, also, that:

- **The charge value of any kind of helical structure in CL space, is one and same, equal to the charge of the electron (unit charge equality principle)**

In fact the above principle is well known by the QED, but BSM is able to explain, why different size elementary particles have one and a same value of electrical charge. In Chapter 3 we will see, that, when the electrical charge is expressed by the intrinsic CL parameters, the Plank’s constant does not participate in the expression. Consequently the unit charge is intrinsic feature of CL space.

When the process of creation or annihilation of a static charge does not involves a particle destruction, the following rule is valid:

In CL space, electrical charges could be created or annihilated only in pairs.

The latter rule is a result of the intrinsic behaviour of the CL space. Knowing, that the electrical charge causes a creation of spatial configuration of EQs around the FOHS, the sudden appearance of such domain in CL space, causes an opposite reaction. The space reacts by creation of opposite charge. The birth of electrical charge, for example, may be a result of: unlocking of near field (neutron - proton conversion); or exiting of some internal FOHS from the RL(T) hole of external one. But this two cases do not exhaust all the possibilities. The processes related with particle destruction show quite more diversified reactions between the destructed helical structure and the CL space. This is due to the complicated interaction that takes place between the released internal RL structures and the CL space.

In case of FOHS destruction, it is possible one new born charge from destruction of FOHS to interact with one charge of not destructed FOHS (case of J/ψ and τ lepton decay are discussed in Chapter 6).

2.15.2.2 Physical explanation of the unit charge constancy.

The unit charge constancy and some features of the near locked field can be explain physically, when analysing the spatial configuration of the electrical field lines. Fig. 2.47.A illustrates the electrical field lines of a single coil FOHS. Two views are shown. Such structure made by positive prisms with internal axial core of negative prisms, really exists. This is the positron.

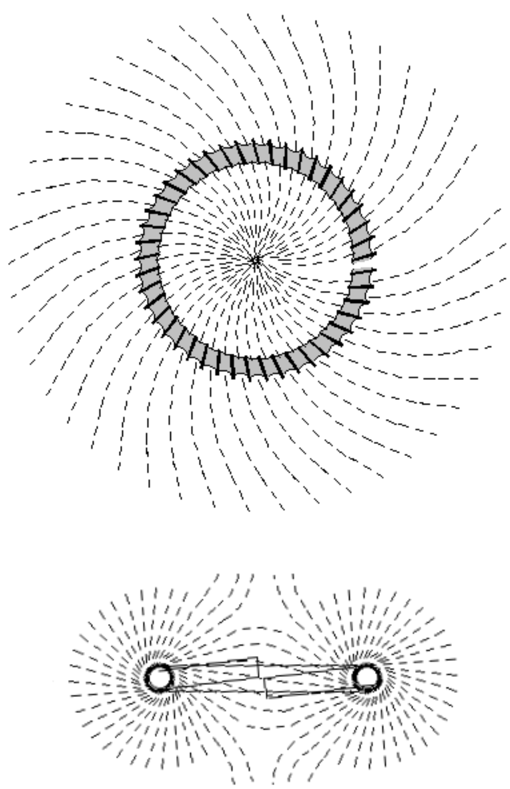

Fig. 2.47A
Electrical filed lines of single coil FOHS

The internal RL(T) lattice of the electron is shown as gray shaded in the top view of Fig. 2.47.A. In the same view the E filed line alignment to the intercoil zones of the RL(T) is shown. Only the lines normal to the boundary of RL(T) will modulate the CL space. Lines exiting from the RL(T) at angles much smaller than 90 deg (not shown in the figure) will be locked by the IG (CP) field of the structure (including the internal RL(T)). In the bottom view of same figure we see, that lines, closed to the structure plane are connected between themselves, despite that the lines are result of EQs of same handedness. In first gland, the explanation of the proximity connected E lines seems to contradict the BSM explanation of the E field between charges of same polarity. Although the above discussed case is valid only for field lines generated by a single charge particle, whose RL(T)s are in synchronization. **In a case of separate charge particles the E fields of both particles are not synchronized, and the EQs of CL nodes between them could not get adequate synchronization. In the case, shown in Fig. 2.47.A, the CL node EQs in the proximity are synchronized by one and a same field, induced by the commonly synchronized internal RL(T)**. The proximity synchronization is also facilitated by the strong IG(CP) field. **Due to these two features. the neighbouring quasispheres of opposite handedness get induced complimentary motion, and behave as an opposite quasispheres included in the normal E-field lines.**

In the same time the proximity connected lines exit and enter into the RL(T), so they are not open. Therefore, they could not be able to interact with external field lines created by another charge particle. In this case we consider, that these lines are locked by the IG(CP) field. The energy of the E-field is part of IG energy balance. But the IG field of the helical structure in CL space defines simultaneously two parameters of the this structure: the confined shape of the helical structure (the radius of FOHS envelope and the helical step) and the balance between the locked and unlocked E filed lines. Consequently:

The constant value of the electrical charge of single helical structure in CL space is a result of self regulating process in which a total IG energy balance is involved. This balance includes the internal particle IG energy (of its RL(T) lattice) and the energy of the surrounding CL space (including ZPE and e-field energy).

The above made conclusion helps to explain the following cases:

- the locked near field of the neutron
- the unit charge equality for helical structures with different size
- the locked near field between two single coil FOHS's in superconducting state of the matter

The last case is discussed in the superconductivity state of the matter (Chapter 4.).

If the created E filed lines are completely symmetrical, then the ability of the IG(CP) field to lock the whole charge in the near field is stronger. But if the structure is twisted, this ability is degraded. When a particle with locked E-filed is in optimal confined motion, the electrical field could become unlocked. **This is the case with the moving neutron exhibiting a magnetic moment despite its neutrality when it is in rest.**

The explanation of the unit charge equality for structures with different sizes is illustrated by the Fig. 2.47.B. The figure shows a multiturn structure, comprising of four turns.

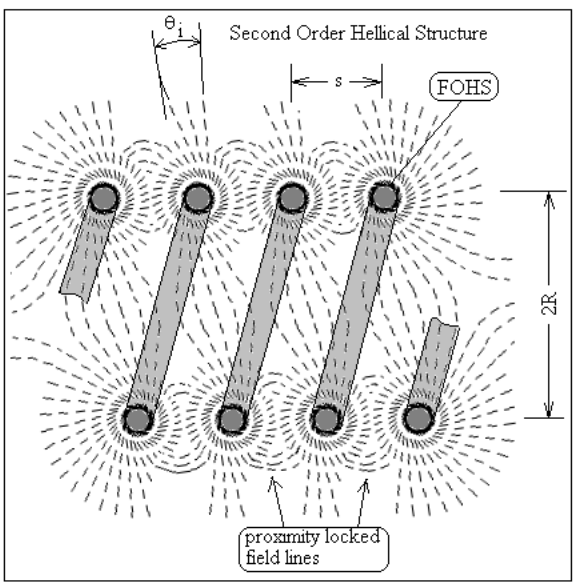

Fig. 2.47.B

E field lines of multiturn second order helical structure

We see, that the multiturn SOHS can be regarded as a composed of single coil structures. The proximity intermediate space between the coils contains a large number of proximity connected lines. Adding more single coils makes the proximity IG(CP) field stronger and more lines are locked (proximity connected). Some of the escaped lines are curved by the IG filed. Only the lines that are within angle θ_i are able to escape and modulate the external CL space. They namely contribute to the detected external charge. The angle θ_i is one and a same for any intermediate coil. The angles of the lines from the two ends have a similar configuration as the single coil structure. Adding more single coils affects the angle θ_i, making it narrower. Larger IG field also curves more lines and makes them locked in a near field. In result of all this factors, the charge constancy is preserved. We may conclude, that:

The charge constancy is intrinsic feature of the CL space. It is self regulated by a complex dynamical balance between the CL space from one side, and the helical structure with its internal RL(T), from the other.

2.16 Confined motion of the helical structures in CL space.

Let considering a single coil structure of type SH_1^2:-(+(-) shown in Fig. 2.17.a, moving in CL space under some electrical force. This structure could be regarded also as a cut toroid. We can consider now (and later will be proved) that the toroidal radius is much larger than the node spacing. The structure have internal RL(T), whose density is much larger, than CL density. Therefore, the CL nodes could not pass (even partially folded) through the much denser rectangular lattice, so they will be displaced. Then the motion could be regarded as a motion in a fluid. It is obvious that the screw type of motion will exhibit a smaller resistance. In this case the main resistance is from the radial sectional area at the helix ends. We may call this type of motion a **confined motion.** A confined motion with peripheral speed equal to the light velocity is named **optimal confined motion.** The axial velocity for optimal confined motion is named **optimal confined velocity** and is much lower, than the peripheral one.

When moving with the optimal confined velocity, the electrical field of the helical structure becomes locked in some distance from the external shell, because the modulation properties of the RL(T) of the structure could not exceed the speed of light. The picture is similar like the electrical quasispheres in the first harmonic quantum wave. At this distance a boundary surface is formed. The quasispheres at the boundary surface and beyond it, are of magnetic type and are synchronised at SPM frequency of not disturbed CL nodes. So the magnetic quasispheres at boundary layer serves as a bearings of the moving helical structure with its local electrical field. This situation is illustrated by Fig. 2.48.

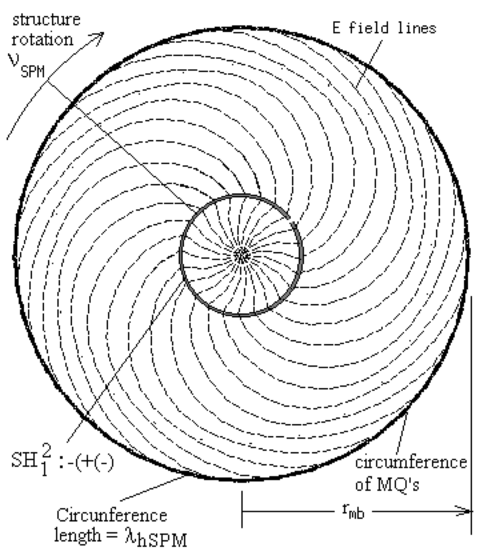

Fig. 2.48.
Electrical field in optimal confined motion of SH12:-(+(-) helical structure

The helical circumference length is equal to the helical SPM frequency λ_{hSPM} of the magnetic (not disturbed) quasispheres. In such conditions the structure exhibits an optimal screw like motion with less resistance. The boundary magnetic radius r_{mb}, for such motion is defined also by the SPM frequency of the magnetic quasispheres. In the next chapter we will see, that this helical structure is the external shell of the electron.

Second order structure with helical shape also have well defined optimal confined velocity. The structure could move also with axial velocity larger than the optimal one (but always smaller than the speed of light, however, this is not completely screw type of motion. In the limiting case, when the linear velocity approaches the light velocity, the rotational motion tends to zero. In some conditions (accelerating by magnetic field) such structure may even rotate in a reversed direction.

Multiturn second order helical structures, as those shown in Fig. 2.10 and 2.12, also exhibit confine type of motion. Twisted toroidal structure as this shown in Fig. 2.18b., will have also a confined motion, characterized by some equivalent step. The folded structure, shown in Fig. 2.14.b have also some equivalent step for confine motion. The both structures from Fig. 2.14 however do not exhibit so sharp feature of confine motion as the structures with a helical shape.

For motions in which the peripheral velocity exceeds the helical light velocity a Cherenkov - Vavilov type of radiation occurs. In this case the motion causes generation of shock waves.

So far we have discussed helical structures as a static combinations of simple structures. Dynamical combinations between some kind of these structures are also possible. They may interact due to their electrical and IG fields and may appear more or less as a stable oscillating system. Dynamical combinations between some structures are very stable, and may appear externally as neutrals, despite the fact, that they are composed of structures possessing a charge. All these combinations we could classify under the name **ordered helical systems.**

One important feature of the ordered helical systems is that they could be composed by structures, having different external shape and size, but possessing equal opposite charges. For example a dynamical pair combined of structures shown in Fig. 2.13.a and 2.14.b, where the size of the second one is much larger, can appear neutral in the far field, but not neutral in the near field. In such case the electrical field is compensated in the far field. This kind of charge neutralization in the far field is possible, if the cycle time of the small particle is smaller, than the CL relaxation constant. Detailed description of this process is given in Chapter 6.

We can summarize the dynamical features of the helical structures and ordered systems by definition of the following rules:

- **All kind of ordered systems, having external helicity or twisting, posses optimal confine velocity in CL space**

- **The effect of confined motion for particles with external helical shape is much stronger**
- **The optimal confine velocity of a second order helical structure in a lattice space is completely determined by the diameter of the helix, the helical step, and the speed of light.**
- **In a normal confine motion the peripheral velocity of the helical structure could not exceed the light velocity**
- **The lattice space is able to influence the helical step of some opened structures when they move with higher velocity.**
- **Charged particles with different sizes, involved in common motion, may appear neutral in the far field, if the duration of the common motion cycle is shorter than the CL relaxation time.**

2.17 Basic CL space parameters and their connections to some fundamental properties of matter

The properties of the ordered helical structures of primordial matter in CL space, provide a clue for definition of the basic physical parameters and properties of the matter we are acquainted with: time, space, inertia, mass, light velocity, Zero Point Energy. Consequently the mentioned above basic parameters are a not arbitrary, but tightly connected to the property of the intrinsic matter.

Table 2.12 shows some known fundamental properties of the matter we are familiar with, and their connections to CL space parameters.

Table 2.12

Basic parameter	Defined by CL parameter
Space distance:	**node distance, d_{nb}**
Time:	**Cl node NRM period, t_R**
Inertia:	**node inertial mass, Eq. (2.61)**
Light velocity:	**quantum wave velocity, Eq. (2.39)**
Particle mass (Neutonian mass)	**Static CL pressure exercised on the FOHSs volume;**
Background temperature: (CMB)	**signature of ZPE of CL space (kinetic type of ZPE)**