Chapter 10. Time, Inertia and Gravitation

10.1 Origin of time

Regarded as structures, the prisms are not in the lowest level of matter organization. They are comprised of substructures organized in hierarchical orders. The possible configurations and properties of the lower level structures will be discussed in Chapter 12 of BSM. In the same chapter, the fundamental structure carrying the primary frequency etalon (defining the primary time base) and the physical mechanisms assuring the consecutive division of the primary frequency in the upper order structures will be discussed. The presented analysis will put a light on the most fundamental law, unveiled by the BSM concept - the law of Intrinsic Gravitation. Here, some aspects about the time base and time scale will be apriory given.

The **primary time base** corresponds to the theoretically known Planck's time. According to the BSM concept it is a period of the oscillation mode of the lowest level structure, which is embedded in all upper orders structures of the matter organization. The configuration of that lowest level structure possesses also an embedded fine structure constant (also discussed in Chapter 12 of BSM). The Planck's time is given by Eq. (10.1), while its reciprocal value is known as a Planck's frequency.

$$t_{pl} = \sqrt{\frac{Gh}{2\pi c^5}} = 5.39\times10^{-44} \quad \text{(sec)} \qquad (10.1)$$

where: G - is the classical gravitational constant in CL space, related with the Newton's low of gravitation

It is a question should G be used or G_o (the latter is the IG constant in empty space).

We may make analogy between the primary clock frequency in the computer (providing the primary time base) and the secondary frequencies (time bases), obtained by division (the bus time period, the period of memory refreshing and so on). While the Planck's time is accepted as a primary time base, a specific natural mechanisms assure secondary time bases by division of the Planck's frequency on large numbers. The mechanisms assuring such division are based on specific properties of the lowest level structures below the prism level. These structures and their properties are presented and discussed in Chapter 12 of BSM.

The level of matter organization above the prism's level was already discussed in the previous chapters. The CL node proper frequency, for example, and the SPM frequency could be considered as upper level frequencies (time bases) above the prism's level. In Chapter 2 it has been preliminary accepted that the CL node frequency belongs to a next level of matter organization, but the analysis about the IG origin in Chapter 12 (Cosmology) indicates, that there is one intermediate level between the primary time base and the CL node resonance (proper) frequency. For this reason, a zero number is assigned for the primary time base.

Table 10.1 shows that secondary time bases are likely connected to the primary one, defined by the Planck's frequency, as a result of some natural process of frequency division. The reciprocal parameters of these time bases are frequencies. The difference between the four time bases (and frequencies respectively) is quite large, so a natural logarithm of the frequency, $\ln(\nu)$, is used.

Levels of matter organization **Table: 10.1**

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

Fig. 10.1 shows a plot of $\ln(\nu)$ versus the level of matter organization , x.

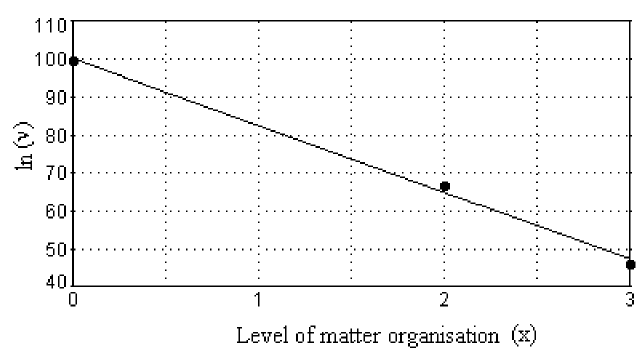

Fig. 10.1

A robust line is fitted to the data of three points, corresponding to the identified levels of the matter organization. Despite the missing data for level 1, it will be shown in Chapter Cosmology, that this assignment is logically correct. The CL space exists in levels 2 and 3 of the matter organisation, but not in level 0 or 1. The three data points lies closely to a straight line if the frequency is plotted as natural logarithm.

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 simplest material structure that possess oscillation properties.

The time base that we use in our observations and experiments is a **secondary time base**. It is defined by the CL space and more accurately by the proper CL node resonance frequency. The latter defines the light velocity and is also involved in the permittivity and permeability of the free space (CL space). While the primary time base is a constant, **the secondary time base is subjected to relativistic phenomena** as they are known by the General and Special Relativity.

The physical origin of the primary time base is discussed in Chapter 12.

10.2 Inertia

The inertia of the matter we are familiar with (from elementary particles to astronomical body) is one of the most controversial and tough issue in physics. BSM allows a deeper insight into this feature of the matter.

10.2.1 General considerations

The stable elementary particles are formations of helical structures. The external size of the elementary particles are many orders larger than the internode distance of the CL space or the individual prisms. Even the electron that is the simplest helical structure contains many thousands of prisms.

The inertia, we are acquainted with, is a phenomenon related with the motion of the stable particles in CL space environments. Having in mind the finest helical structure formations with their internal lattices, it is apparent that the motion of any elementary particle in CL space invokes unimaginable number of fine interactions between the ordered fine structure of the particle and the CL space. These fine interactions are behind the Newton's inertia. The Newton's first law, known as a law of inertia is a macro effect from these interactions (valid for particles, atoms, molecules and macrobody formations of atomic matter) above the level 2 of matter organization.

Body at rest remains at rest and a body in motion continue to move at a constant velocity unless acted upon by an external force.

In the inertial considerations about the Intrinsic Matter (IM) provided in Chapter 2 it was shown that the definition of the Newton's law of inertia is not able to explain some interactions between bodies of IM in empty space. For this reason the inertial factor was introduced by Eq. (2.7) and different prism to prism interactions were discussed. It has been mentioned that the inertial factor between separate prisms is quite small. It arises to some level, when the prisms are combined in nodes and the nodes - in gravitational lattice. The CL (cosmic lattice) space is a global formation of such lattice filling a huge void space (in a classical meaning) that is the observable Universe. For helical structures moving in CL space the inertial factor is much larger. This is a result of higher orientational order of the twisted structures comprised of FOHSs with their internal RL(T) structures.

The atom is a complex system comprised of oriented helical structures whose electrical field is neutralized in the far field due to a permanent dynamical interactions, as a result of the electrons motion in quantum orbits. Due to the quantum features of such system the orbital changes of electrons does not affect the inertial property of the system. The system inertial properties, however, are inseparable from the CL space properties.

It is apparent from BSM concept that the atomic matter (a matter we are familiar with) is distinctive from the Intrinsic Matter (IM) by some basic physical attributes considered so far as fundamental. These are: the mass and the inertia. In order to distinguish them from the similar (but different) properties of the intrinsic matter we will refer to them as mass and inertia (considering Newtonian type), and Intrinsic Matter (IM) mass and inertia. They are quite different.

The inertial mass could be detected only in motion. From a point of view of the twisted prism model, the motion interaction between prisms could be attributed to the IG(TP) filed interactions, while the gravitational interactions - to the IG(CP) interactions. Similar interactions could be attributed also to the CL nodes. The elementary particles are built of ordered helical structures, which are built of the same type prisms in well defined spatial order. Then the gravitational interactions between the elementary particles could be attributed to the IG(CP), while their inertial interactions - to the IG(TP) of the prisms, having in mind that the RL(T) of any helical structure contains the essential fraction of all prisms, from which they are built.

The same considerations could be further propagated to the atoms, molecules and a macro body, keeping in mind the very complex but well organized helical structures assembly. **In such aspect we may consider that the gravitational mass of any object (of atomic matter) is caused by the IG(CP) field interactions between two or more bodies, containing a large number of helical structures. In this case the CL space serves as a mediator. It propagates the interactions between the two bodies by its IG(CP) field.**

The CL space parameter related to the inertia is the equivalent inertial mass of the CL node (m_{node}). In Chapter 2, §2.11.3, this parameter was theoretically estimated by the fundamental physical constants and the derived parameters of the quantum wave. (Eq. 2.48 in Chapter 2). The same expression is shown here.

$$m_{node} = \frac{4h\nu_c k_{hb}^3}{\pi(c)c^2 N_{RQ}^3 k_d} \qquad [(2.48)]$$

The estimated value of the CL node equivalent inertial mass for the local Earth field is about 6.95E-66 (kg). It seams that Eq. (10.5) involves only CL space parameters, however, the Planck constant (h) and the Compton frequency (ν_c) are characteristic parameters of the electron, as well. From the other side, the electron (positron) structure could be regarded as a building element of the stable elementary particles as the proton and neutron (including their internal helical structures). **Consequently, the equivalent inertial mass could serve as a relation parameter between the CL space and the elementary particles from which the atomic matter is built.**

The relation parameter m_{node} is called equivalent, because it lies on a breaking point in a length scale where the IM inertial properties are from one side of the scale and the Newtonian inertial properties are from the other side.

This consideration is verified by some theoretical calculations (not provided here) for estimation the number of prisms involved in the electron structure, indicating that the classical inertial moment for example is not applicable for the internode distance length scale.

The above highlighted consideration means also that the equivalence principle, formulated by Einstein, possessing a length scale limit. This microscale limit is reached when approaching the internode distance of the CL space. For this reason the discussed below considerations related to this principle are referred to the length scale above this limit.

10.2.2. Equivalence between gravitation and inertia in CL space

The Newtonian gravitational mass, according to BSM, is an attribute of the atomic matter detectable due to the attraction forces between two objects of atomic matter immersed in CL space. Behind these attraction forces are the IG forces propagated in CL space by the *abcd* interconnection axes of the CL nodes. While the time constant of the IM is much shorter than the proper frequency of the CL node (related to the speed of light), the propagation of IG forces for a complex formation (even such as an elementary particle) exhibits the limitation factor of the CL node oscillation. That's why the propagation of the Newtonian gravitation may exhibit the limit of the speed of light. In the case of CL node synchronization as in a closed magnetic line for example, this limit might be exceeded. This means a superluminal propagation of some information (some recent experiments about a phenomenon called "quantum teleportation" are manifestation of such effect according to BSM analysis). In a normal CL space, the IG forces may leak in very close distances of dens atomic objects (some Van der Walls forces between atoms and molecules) or in a case of very well polished surfaces in proximity (Casimir forces).

The equivalence between gravitational and inertial mass (both of Newtonian type) is established and verified principle in contemporary physics. From the point of view of BSM we may add, that it is valide for particles comprised of helical structures containing a second order of helicity and placed in CL space environment.

The gravitation-inertia equivalence principle means that there is a balance between IG(CP) and IG(TP) fields for the system comprised of the interacting bodies and the CL space involved as mediator.

From the above considerations it follows, that the mass equivalence principle from a BSM point of view may be formulated as:

- **In CL space environment the gravitational mass of particle comprised of helical structures is equal to its inertial mass**

10.2.3 The involvement of the fine structure constant in the motion interactions between the elementary particles and CL space

From the Newtonian inertial and gravitational considerations in the previous paragraph it is apparent that the IG(CP) and IG(TP) prisms interactions are involved. Then we may use the relation between these two parameters initially adopted in Chapter 2 §2.9.6.B (Eq. 2.A.17.C) that was later validated in Chapter 9 of BSM from the analysis about the molecular vibrations (section 9.7.5.C) and the binding energy between the proton and neutron in the Deuteron (section 9.12.1).

$$E_{IG}(TP) = 2\alpha E_{IG}(CP) \qquad (2.A.17.C)$$

where: α - is the fine structure constant, IG(TP) - is the intrinsic energy in which the twisted part of twisted prisms (model) is involved, and IG(CP) - is the intrinsic energy in which the central part of the prisms (model) is involved.

The fine structure constant is a characteristic feature of the electron confined motion. In Chapter 3, where it was shown that it could be expressed by the CL space parameters and the electron geometrical parameters (equations (3.9), (3.10, (3.11), (3.12).

It has been shown in Chapter 3 that one of the electron structure parameters - the helical step, for example, is completely defined by the CL space parameters

$$s_e = \frac{\alpha c}{\nu_c\sqrt{1-\alpha^2}} \qquad [(3.13.b)]$$

where: s_e - is the helical step of the electron structure, ν_c - is the Compton frequency (primary proper frequency of electron) , c - is the light velocity.

From the cited above equations it is also apparent that the fine structure constant is related to another important parameter of the CL space - the Compton wavelength (or frequency). The Compton frequency appears simultaneously a parameter of the SPM vector (CL node parameter) and a first proper frequency of the oscillating electron. The second proper frequency (the frequency of the internal positron) appears to be three times the Compton frequency (according to the analysis of the electron behaviour in Chapter 3 and the Quantum Hall experiments in Chapter 4).

The fine structure constant is related also to other important characteristics of the orbiting electron: the orbital length and time (lifetime of excited state). It was shown in Chapter 3 and 7 that the quantum loop is defined by the Compton wavelength, while the time duration (lifetime) by the conditions of two consecutive phase match between the two proper frequencies of the electron), taking into account the relativistic gamma correction.

10.3. Analysis of the inertial interactions of the atomic matter in CL space

In the analysis of the inertial interactions of the atomic matter in CL space, the gravitational field must be taken into account. Let assume that every object of atomic matter is able to modulate the surrounding CL space. We may consider two types of CL space modulation:

(a) relativistic CL space modulation
- GR effect of space curvature
- SR effect of mass increase and time dilation

(b) gravitational (Newtonian) modulation

The space curvature of GR effect is obviously caused by a slight change of the internode distance due to the gravitational influence of the body mass. The effect is very weak due to the small influence of the very rarefied atomic matter of the body in comparison to the high density matter of the prisms, from which the CL nodes are formed. The slight change of the internode distance respectively causes a slight change of the CL space parameters including the light velocity.

The SR effect of the mass increase and time dilation is a result of the changed conditions of the confined motion of the electron at very high velocities.

One of the problems of the Special Relativity is the lack of an absolute reference inertial frame. In such case any inertial frame could be selected as a reference. This provides an ambiguity in the explanation of the so called “twin paradox”. If the first twins is on the Earth, while the second one is travelling with a relativistic velocity, from the point of view of the first twins the second one will be left younger. From the point of view of the second twins, however, the first one is travelling with a relativistic velocity and he (first twin) must be left younger. This paradox does not exists in the BSM concept about space.

In Chapter 12 (Cosmology) it becomes apparent that **there is an absolute reference point in the space, this is the centre of the local Galaxy**. This conclusion matches the quite logical scenario of the Universe and galaxy evolution presented in Chapter 12, supported by considerable number of observations and experimental analysis.

The gravitational modulation of the CL space could be regarded as a formation of a local CL space conditions.

Someone may rase a question that the provided concept contradicts to the established so far vision about the speed of light independence from the object motion. Here we must emphasize that the Michelson-Morley experiment is inconclusive from the point of view of the alternative vacuum concept. This experiment and many similar rely from one side on a Doppler shift effect (1) and from the other on a possible aberration (2).

(1) In CL space environments the Doppler shift is explainable quite well. If we have emitter and detector moving with one and a same not relativistic velocity the positive (or negative) Doppler shift of the emitter will be fully compensated by the negative (or positive) Doppler shift of the detector. This is valid for the arm of the Michelson-Morley experiment aligned with the Earth velocity. For the perpendicular arm the Fizserald effect takes place due to the SR influence of the Earth motion. From the BSM point of view it is reasonable, because in fact the CL space grid determines the positions between the atoms and molecules even for a rigid body and the light propagation coordinates, as well. In such case the searched effect of the light velocity from the motion is undetectable. Further the Earth rotational velocity of 458 (m/s) is comparatively smaller than the Earth motion around the Milky way 238 (km/s).

10.3.1. Gravitational field and local CL space. Definition of Equivalent Separation Surface (ESS).

In Chapter 12 (Cosmology) quite strong arguments are provided for the stationary Universe. It is shown that the two basic arguments of the concept of the Big Bang and expanding Universe are wrong: the assumption that the Universe space is homogeneous from which automatically follows that the galactic red shift is of Doppler type. The BSM concept about the physical vacuum, however, leads to the conclusion that the Universe is stationary. This is supported by numerous observational results, when properly interpreted from the point of view of the new concept of the physical vacuum.

All galaxies contain own CL space, connected to the CL space of the neighbouring galaxies, so the CL spaces of the connected galaxies are stationary each other. The galaxy matter is rotated within the own galaxy space around the point of the largest mass identified recently as a supermassive black whole. The galactic CL space is strongly influenced by this mass and consequently it may serve as an absolute reference point. (This is confirmed in the observational analysis provided in Chapter 12).

The solar system with all planets and satellites is immersed in the Milky way galaxy CL space. It is evident that the rotational velocity of the solar system could be detected if observing extragalactic sources. The average rotational velocity according to Duari (1992) is 238 km/sec. This velocity is quite away from a relativistic velocity, but it means that every object even at the microscale range down to the helical structures of the elementary particles is ablated by flying CL nodes. One may raise a question how this could be possible. However, when we take into account that the IG forces are propagated in a pure void space practically instantly (because the relaxation constant of the low level matter organization corresponds to the range between the CL node oscillation period and the Planck time) this assumption looks quite reasonable. Now taking into account only the influence of the Newtonian gravitation on the surrounded CL space we may accept the following approximation:

The CL space surrounding the atomic matter behaves like a stationary one

For atomic matter moving through the galaxy space the CL nodes are disconnecting in the proximity of the RL(T) envelopes of the helical structure (of the elementary particles) following a displacement and after that - a return and reconnection to the CL space. The disconnected nodes are partly folded while the energy of their displacement is preserved as a rotational moment (keeping in mind the intrinsic inertial factor of the prisms). Such envisioned process is in fact behind the inertial properties of the atomic matter in CL space.

In the analysis of the inertial interactions of the atomic matter in CL space, the effects of the General Relativity (GR) and the Special Relativity (SR) could not be ignored. The operation in Minkowski space, however, makes the analysis very complicated. BSM found a way to analyse the inertial interactions without ignoring the GR and SR effects.

First, let explain how the formulated by GR space curvature phenomenon is understood from the point of view of BSM. We may use an imaginary absolute scale (discussed in Chapter 2) whose unite vector is unshrinkable. The estimated (unshrinkable) size of the proton, for example may serve for this purpose. If considering that the CL space around some material object (of atomic matter) is stationary, the space curvature will means a gradually shrinkage of the internode CL distance when moving from a larger to closer distance to the object. This shrinkage is quite small, due to the week influence of the object atomic matter (with a lower spatial density) on the highly dens matter of the prisms from which the CL nodes are formed. The small shrinkage, however, will influence also the proper resonance frequency of the CL node. This means change of the light velocity and other other parameters (permittivity and permeability) of the shrunk CL space. **We may refer this space as a local CL space, accepting also that every body possessing a Newtonian gravitational field could be regarded as possessing a local CL space.**

The above conclusion will allow to analyse inertial interactions between massive bodies, applying the inertial interactions between elementary particles and CL space which will be discussed in this chapter.

In order to simplify the analysis of gravitational and inertial interactions between massive bodies at distances larger than their radius we will introduce a simplified model of a local CL space with a constant internode distance, but having an equivalent separation surface at which the internode distance changes sharply. Let considering an ideal case of a heavy spherical material object with own gravitational field immersed in the Galactic CL space but very away from any other gravitational field (practically undetectable). We may regard the space curvature of GR as an influence of the gravitational field of the object on the internode distance of the surrounding CL space. The internode distance of this space will be slightly shrunk with a gradient decreasing with the distance from the object. This of cause will change slightly the proper resonance frequency and the SPM frequency of the CL nodes. For a massive spherical body (with spherical density symmetry) the space curvature can be presented as usually as a surface plot having a bell shape. The section of such plot with a normal plane is a bell shape curve as shown in Fig. 10.2.

The bell shape curve could be approximated by a rectangular function possessing the same area as shown in the figure. Then the three dimensional space curvature according to GR could be represented as an **equivalent sphere** characterized by:

- a constant space grid density, corresponding to the parameter *h* of the rectangular curve

- an equivalent separation surface with a shape of sphere with a radius *r*

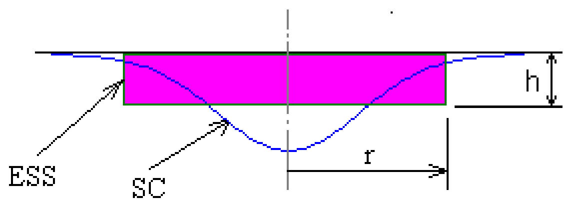

Fig. 10.2. Bell shape curve SC obtained as a section of the space curvature with a normal plane. The rectangular function with a same area has a height *h* and radius *r*. The latter defines the Equivalent Separation Surface (ESS) of a sphere enclosing an imaginary space with a constant internode distance

The CL node distance in the equivalent sphere will have a sharp difference at its edge in comparison to the galaxy CL space in which it is immersed. For this purpose we introduce the term **Equivalent Separation Surface (ESS) of the local CL space of the object.** For a spherical body (with a spherical symmetry of its matter density) the size of EES is defined by the radius r as shown in Fig. 10.2.

The adopted assumption simplifies the analysis of a single body, by association of the properties of the gravitational field to some properties of the surrounded CL space called a local CL space. In a case when a less massive body is in the gravitational field of a more massive one it appears that the CL space of the less massive one is immersed in the CL space of the more massive one, however, both of them, in fact, are immersed only in the galactic CL space. **For this reason we need to keep in mind that the local CL space is also imaginary, meaning that the surrounding galactic CL space is locally modulated by the local gravitational field.**

The analysis of number of cosmological phenomena, observations and experiments in Chapter 12 indicates that the CL spaces of the galaxies are stationary. Then the galactic CL space can be considered as an absolute reference frame.

10.3.2 Relation between gravitational local field and CL local space

A. Atoms and molecules in a gas substance

Single particles, atoms and molecules are attracted by the Earth gravitational field, according to the Newton's gravitational law. We may accept that they posses a local gravitational field but only in close proximity which is undetectable. We may consider, that they are immersed in external CL space. If they are quite away from any massive body, they appear immersed only in the Global (galaxy) CL space. Otherwise they are immersed in some massive body CL space. The helical structure, however, possesses its own quantum quasishrunk space due to the own electrical field (see Chapter 2 and 9). This is valid also for a particles with a proximity locked electrical field (such as the neutron, and the pair pions inside the proton and neutron).

B. Atoms and molecules included in a massive body

The atoms and molecules included in a massive solid body do not possess freedom as in a gas substance. They may vibrate around a fixed point, but their average positions are fixed. Their individual gravitational fields contribute to the local gravitational field of the massive body. This body has a local CL space contributed by all individual particles. The involved single particle could only modulate the local gravitational filed and consequently may possess a local CL space in their proximity, but this effect is much smaller in comparison with the local field. So they could be considered as immersed in the common CL space of the massive body. The particle also possesses own quantum quasishrunk space in proximity, as in the case A.

10.3.3 Inertial interactions of moving FOHS

Let analyse the inertial interaction of simple FOHS (first order helical structure), taking for example the external positive shell of the proton. The structure is immersed in the CL space of a massive body, for example the Earth. We will consider two cases, where FOHS is in rest or in motion in respect to the external CL space (of the Earth). One single turn of the external proton shell is a same as the positron.

A. FOHS in rest: The structure is subjected to pressure forces exercised by the static pressure of the massive body CL space. This defines its newtonian mass, that could be estimated by the mass equation. While the mass equation was defined for the inertial mass of the electron (positron) and could be applied for any elementary particle it is quite clear that it is equal to the gravitational (newtonian) mass.

B. In motion: The structure has the same gravitational mass according to the postulated definition of the equivalence between the inertial and the gravitational mass. The displaced CL nodes from the FOHS volume of the structure do not preserve their normal shape. They are partially folded and spinning. So the particle motion is related with continuous process of folding and unfolding of CL nodes. The folded nodes are not any more connected to the CL space and are displaced from their original position. They return to their previous position and become again connected to the CL space after their unfolding, when the particle is passed.

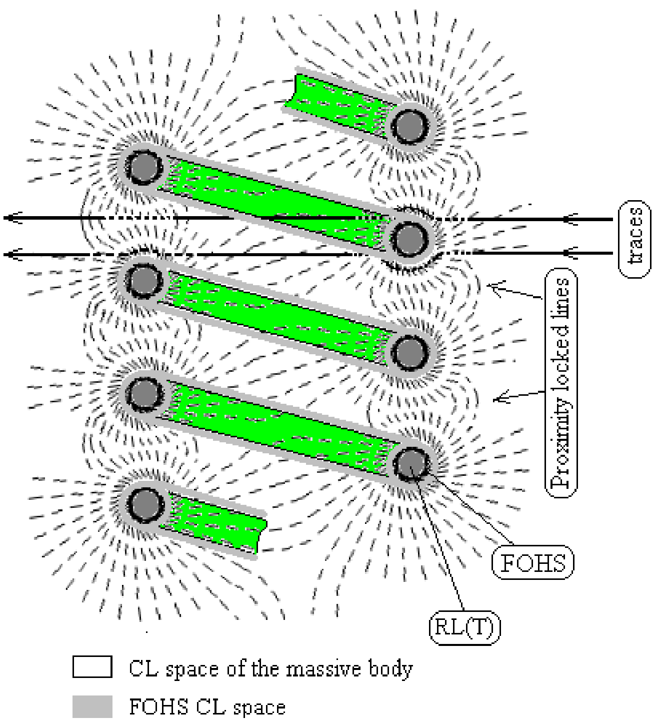

Fig. 10.3
Relative trace of two CL nodes in the reference frame of moving second order helical structure. The folded state of the nodes through the quasishrunk quantum space of the structure is shown by dashed lines

The process is illustrated by Fig. 10.3, where second order helical structure (containing FOHS) is shown.

The E-field lines around the sections of the FOHS are shown by dashed lines. They define the quantum quasishrunk space of the particle. (Some of the lines are proximity locked as a result of the regulation effect of IG(CP) providing a charge unity). The two dark lines in the figure show two traces of CL nodes, which become disconnected and folded in the curved section of the trace. The folded nodes intercept the denser E-field lines in the local space at angle close to 90^{o}. **In this case the interaction with the local QE quasispheres is minimal. In such way the proximity E-field of the structure is able to guide the passing folded nodes.** Even the neutron has a proximity E-field, that is not apparent in the far field, but has its signature - the neutron's magnetic moment. So the proton and neutron proximity E-fields perform a guiding of the passing folded nodes.

The local CL space of single particles depends on the matter quantity in the participating helical structure. For single charge particle, however, the local space is not neutral but populated by EQ type of CL nodes. In Fig. 10.3 this space is illustrated by a gray colour. The E-field of charge particle, however, is extended much beyond its local field.

The particle may be a part of a large solid body that has a local CL space. Then it is immersed in this local space and simultaneously contributes to it.

We may generalize some of the single particle features to a massive solid body. Then we arrive to the following conclusions:

(a) For helical structure in motion, the energy state of the folded nodes is changed in comparison to the normal nodes. The energy spent for folding in the "entrance" is returned back to the system it in the "exit". So in case of uniform linear motion or motion in equipotential surface there is not any loss of energy.

(b) The folded nodes of solid body are distributed in the volume of its local space according to the local CL space gradient. The CL space gradient, however, is much smaller than the gravitational one due to the difference between inverse cubic IG law (valide for CL node distance) and Newton's gravitational law (valide for the gravitational field)

(c) The process of folding and guiding is assisted by the proximity field provided by the internal RL(T) of the FOHS.
(d) The folded nodes posses spin momentum and interact weakly with the CL nodes of the local field. In such way they are able to provide an uniform interaction in the whole volume of the body local space.
(e) The folded shape of the nodes is kept by a dynamical interactions with the normal nodes of the local space.
(f) The number of the folded nodes passing through the local space for a non zero velocity is proportional to the velocity of the structure. Larger kinetic energy corresponds to a larger number of passing folded nodes per unit time.
(g) For not relativistic motion the inertial mass appears constant for different velocities. In such case the time for folding and unfolding is much larger than the resonance period of normal CL node. For relativistic velocity the folding/unfolding time becomes comparable to the resonance period of the normal CL node. Then the motion exhibits resistance that contributes to a relativistic mass increase.

10.3.4 Relativistic effect as a physical phenomena

From the above considerations it is apparent, that the folding and unfolding time depends on the structure velocity. The structure shape is unchanged, so the both times are equal. It is evident, that for not relativistic and relativistic velocity the following conditions are valide:

$t_F \ll t_R$ - for not relativistic motion (10.6)

$t_F < t_R$ - for relativistic motion (10.7)

where: t_F - is the folding (unfolding) time, t_R is the resonance period of normal CL node

The resonance period determines the light velocity according to light equation (Chapter 2). The trace of the resonance cycle of a single node shown in Fig. 2.26, Chapter 2 is almost a flat curve and may have a finite resonance width. The resonance cycles between the nodes in the local field volume are synchronized by the Zero Point Waves but this is not very strong connection between the individual nodes. As a result of this some domains may exhibit drag of their resonance frequency affected by the interaction with the spinning folded nodes. Such interaction provides effect of increased inertial mass of the moving structure. Note, that due to the spatial distributed features of the interacting domains the effect appears continuously dependent on the increasing velocity. **This phenomenon stays behind the relativistic increase of the mass according to the relativistic equation**:

$$m = m_o\gamma \qquad (10.8)$$

where $\gamma = (1 - V^2/c^2)^{-1/2}$ (10.9)

The gamma factor used in the relativity was derived in BSM by the analysis of the electron confined motion (Chapter 3, section 3.11.A).

From the physical analysis of the relativistic effect, it is evident, that the mass increase is a result of the quantum forces. These forces, however, have some limiting holding range. For a small single particle as the electron, for example, they may succeed to hold the continuity of Eq. (10.8) for large relativistic velocities. If the particle, however, is very fast accelerated by a large pulse energy, the Eq. (10.8) may break. The natural conditions for such event in free CL space, however, are not so common. One example of partial break of Eq. (10.8) is the synchrotron effect in the particle accelerators. However, in any conditions of partial break of Eq. (10.8) the principle of the energy conservation is preserved. The energy balance of the system particle - CL space is preserved by releasing of gamma photons by CL space that surrounds the particle.

10.3.5 Body with own local field in rest

Let analyse the motion of massive body with its local field (CL space) immersed in external local field (CL space).

The provided concept of inertia requires a special attention for a body with a local CL space at rest. The problem may be referenced again to the proton in a massive body, when latter possesses a own CL space. Let consider a body motion with continuously decreased velocity. We see that consideration (e) of §10.3.3 provides some problem for zero velocity. According to this conclusion, when approaching zero velocity it will be some moment, when all folded nodes should be expelled from the volume of the local field. But where they will go?

If the expelled folded nodes convert to normal nodes, then the CL static pressure in the surrounding domain will be increased. The CL space could not tolerate also a not uniform distribution of the folded nodes because this would cause large gradients of the background temperature and consequently the ZPE. Such effect is not observed, because the ZPE is kept constant due to the zero point waves. Obviously, the system provides a feedback assuring the energy carried by the folded node in a unit volume of CL space to be a constant value. This will be proved later by the theoretically found optimal ratio between the normal and folded CL node pressures. This effect means that some number of folded nodes always exist in the volume of the local space. But then one problem needs a solution: When the body with a local space is in rest, the folded nodes could not have zero velocity, because this contradicts to the consideration (d) and (e) of §10.3.3. So they must circulate inside the body local field. But if they have a finite velocity they should circulate only inside the local field volume. This means that when the velocity is decreased from some finite value to zero, the state of the motion of the folded nodes will be changed in some point, i. e. the individual velocity vectors will be changed. As a result of this some threshold must exist when accelerating a body from rest, but this is not reasonable. *Consequently the option of circulating folded nodes in a body local field in rest does not provide a satisfactory solution from energetic point of view.*

Practically, the discussed inertial behaviour of a solid body could not be observed in our solar system since it moves with a velocity more than a two hundred km through the Milky way CL space.

Phenomena related with this motion are analysed later in this chapter.

10.3.6 *Conclusions:*

(a) There is not a body in the Earth and in the Solar system, that is in absolute rest in respect to the Milky way Global CL space.

(b) The internal space of a body in a rest in respect to the Earth contains passing folded nodes from external CL spaces (Sun's and home galactic CL space) in which the Earth is immersed.

(c) When operating with local CL spaces (imaginary, but defined for convenience) the equivalent velocity vector of the folded nodes is a vector sum of the velocities of every upper level of local spaces until the final one - the home Global space of the Milky way.

(d) the number density of the folded nodes does not depend on the number of upper local levels, but of the vector sum of their absolute velocities referenced to the motion in respect to the global CL space.

(e) The absolute amount of folded nodes in the local field in rest could be determined if knowing the following parameters: the local field volume, the node density and the resultant velocity from all above levels.

(f) It is more convenient to operate with the energy of the folded nodes instead of their number, because the spin momentum of the folded node is taken into account. In this case the expressions are referenced to the relative velocity in Earth local space in which way the physical constants that are valid for Earth local field could be used.

10.4 Theoretical analysis of the inertia in CL space. Partial CL pressure and force moment

From the conclusions made in §10.3.6 it follows, that we need a reference frame. All the physical constants related to CL space parameters are valid for the Earth local space. For this reason, we must use the imaginary defined local CL space of the Earth, so our analysis and equations about the inertia should be referenced to this frame. In this case the consideration (f) of §10.3.6 is valide.

The basic CL space parameters involved in a definition of the newtonian mass of the particles is the CL static pressure. Relying on the considerations discussed in §10.3.6 we may express, the inertial interaction as a partial CL pressure. This parameter should characterise the interaction between the folded nodes and the particles involved in the moving body. From consideration (e) of §10.3.3 it follows, that this pressure should be proportional to the body velocity referenced to the external CL space. According to §10.3.3 (g) the motion analysis depends on the velocity range due to the relativistic effect. For simplicity, we may separate the analysis into a not relativistic and relativistic case.

10.4.1 Partial CL pressure for a motion with not relativistic velocity and force moment of the folded nodes

The static CL pressure was defined as a real physical parameter of CL space (Chapter 3) by using the geometrical parameters and oscillating properties of the electron. Then this parameter was used for definition of the mass equation. We may define a partial pressure as a parameter of the folded nodes passing through the normal CL structure.

Let provide initially a definition of the Partial Pressure whose validity will be later proved in sections §10.4.2, §10.4.2. We may assign this parameter as an attribute of the amount and the rate of the folding CL nodes when the elementary particles (comprised of helical structures) moves through CL space. It is apparent that this parameter could depend on the particle velocity, so it should not be a constant like the Static and Dynamic CL pressure. However, it may have an optimal value that is dictated by the optimal interactions between the particle of motion and the CL space. In this aspect we will use again the electron whose geometrical and dynamical parameters were identified in Chapter 3. From its motion behaviour we found that it has a preferable velocities. Then we may expect that the partial pressure of CL space for not relativistic velocities may have also an optimal value. Let define this parameter in a way to have a dimensions of pressure and call it a **Partial Pressure of CL space**. Since it depends on velocity, it is not constant, but could be regarded as an optimal value of pressure.

$$P_P = P_S \frac{\upsilon}{c} \alpha \quad \left[\frac{N}{m^2}\right] \tag{10.10}$$

where: $P_S = \frac{h\nu_c}{V_e}$ - is the static CL pressure (3.51)

where: P_P - is the partial pressure (optima pressure value), υ - is a velocity of the structure referenced to the external CL space, V_e is the electron volume, P_S is one of the form of the static CL pressure equation defined in Chapter 3 (in one of modified form the product $m_e c^2$ could be used instead of $h\nu_c$).

While the parameter P_S is defined for the electron, we may expect to use it also for other elementary particles, in a similar way as the Static and Dynamic CL pressures. This expectation is supported by the considerations that the electron (positron) structure is implemented in the structure of any elementary particles. One major difference, to be taken into account, is that the electron possesses oscillation freedom, while the proton and the neutron do not possess such. However, everyone of them exhibits a well defined Broglie wavelength, when in motion that is an indication of interaction with the CL space.

The defined parameter Partial CL pressure expresses the relation between the energy of the folded nodes and the particle velocity referenced to the electron.

10.4.1.A. Inertial force moment of folded nodes (moment of force)

Multiplying Eq. (10.10) by the electron volume we get a parameter with dimensions [Nm]. This is a dimension of energy, but it could be considered also as a **force moment**.

So the inertial force moment for the electron is given by Eq. (10.10.a)

$$E_{IFM} = P_P V_e = h\nu_c \frac{\upsilon}{c} \alpha \quad [Nm] \equiv [J] \tag{10.10.a}$$

where: E_{IFM} - is a force moment (posessing a same dimensions as energy), V_e - is an electron volume, υ - is the relative velocity between the electron and the CL space.

We prefer to use a force moment definition (instead of energy) in order to distinguish its specific nature. It is implicitely valid for the folded nodes only. Physically, it expresses the work for deviation of the folded nodes from their straight trajectory. (Remeber that for a structure with stable geometry moving with a constant velocity, the work for folding the CL nodes in the entrance is exactly retutned at the exit).

We see that the right side of Eq. (10.10.a) contains one vector parameter - the velocity (υ), while all others are scalars. **Consequently the force momentum is a vector**.

From the Newton's low of inertia it follows that the inertial mass could be estimated only during accelerated or decelerated motion. Only in such case the inertial force appears, according to the Newton's law: $F = ma$. Let estimate the momentum of this force by using the defined parameter of partial pressure. The dependence of latter from the velocity requires the estimation to be done for a small deviation at some selected velocity. It is convenient to use the first harmonic velocity of the electron, equal to αc. The choice of this velocity matches also the conditions for derivation of the CL static pressure and the mass equation in Chapter 2. In order to eliminate the velocity dependence we will estimate the force moments for two close velocities $(\alpha c + d\upsilon)$ and $(\alpha c - d\upsilon)$, where $d\upsilon$ is a small velocity change. The forces corresponding to these velocities are respectively F_1 and F_2. Substituting the velocity υ in Eq. (10.10.a) with these two velocities (in brackets) we get respectively the force moments corresponding to the two cases:

$$E_{F1} = h\nu_c\alpha^2 + \frac{h\nu_c\alpha}{c}d\upsilon \tag{10.11}$$

$$E_{F2} = h\nu_c\alpha^2 - \frac{h\nu_c\alpha}{c}d\upsilon \tag{10.12}$$

The force moment difference is:

$$E_{F1} - E_{F2} = 2\frac{h\nu_c\alpha}{c}d\upsilon \tag{10.13}$$

The kinetic energy for the two cases expressed in a classical way are respectively:

$$E_{K1} = \frac{1}{2}m_e(\alpha c + d\upsilon)^2 \tag{10.14}$$

$$E_{K2} = \frac{1}{2}m_e(\alpha c - d\upsilon)^2 \tag{10.15}$$

The kinetic energy difference is

$$E_{K1} - E_{K2} = 2m_e\alpha c d\upsilon \tag{10.15.a}$$

Now comparing (10.13) and (10.15.a) we see that they are equal, because after simplification they lead to equivalent equation (known as electron-positron "annihilation").

$$h\nu_c = m_e c^2 \tag{10.16}$$

Conclusion:

The equality between the force moment difference $(E_{F1} - E_{F2})$ and the kinetic energy difference $(E_{K1} - E_{K2})$ indicates that the concept of the force moment defined by Eq. (10.10.a) is correct.

The correctness of the force moment definition is confirmed also later in this chapter, where it is used successfully for a motion analysis of astronomical objects, like the planets and satellites in the solar system.

Discussion*: The obtained equivalence by Eq. (10.16) matches the "annihilation" energy for the electron rest mass, despite using the velocity value of αc, that approaches the relativistic motion. However, this is the velocity of the optimal confined motion of the electron. The static CL pressure and the mass equation are defined for the same conditions of particle motion. The application of such conditions for derivation of the mass equation in Chapter 3 and its successful application in Chapter 6 confirms the equivalence between the newtonian mass and the "annihilation energy". While the meaning of the "annihilation" is broadly used in the modern physics it is logically incorrect according to BSM theory.*

Knowing the newtonian mass relation between electron structure and any other particle comprised of FOHSs, we may express the **force momentum of any particle** by the equation:

$$E_F = P_P\Sigma V_{SC} \quad [Nm] \equiv [J] \tag{10.16.a}$$

where: V_{SC} - is a volume of a single coil FOHS, but multiplied with a proper factor (1 for a negative; 2.25 for a positive external shell of FOHS).

10.4.1.2 Partial pressure for relativistic motion and relativistic mass increase

From the definition equations of the static and partial CL pressure we see, that the parameter velocity is involved only in the partial pressure. Then the factors influencing the relativistic velocity become separated. Such kind of separation will be of great importance for the physical understanding of some relativistic phenomena. Let provide a verification test about such important outcome.

It is known from the theory of Special Relativity that the dependence of the mass from the velocity is equal to the rest mass multiplied by the relativistic gamma factor. Using again the electron as a reference particle we have:

$m_{eR} = m_e\gamma$, where: $y = (1-\upsilon^2/c^2)^{-0.5}$

m_{eR} - is the electron mass at relativistic velocities

Using the mass energy equivalence $m_e c^2 = h\nu_c$, we see that partial pressure for relativistic velocity will get multiplication factor γ. Let obtain the partial CL pressure at the optimum quantum velocity of the electron corresponding to energy 13.6 eV. Its axial velocity is $\upsilon = \alpha c$. Substituting this value for the velocity and in the multiplying factor γ we get the partial pressure expressed by electron geometrical parameters at its optimal confined motion.

$$P_P = P_S \frac{\alpha^2}{\sqrt{1-\alpha^2}} = \frac{h\nu_c}{V_e}\frac{\alpha^2}{\sqrt{1-\alpha^2}} \qquad (10.17)$$

It is evident right away that we may obtain the ratio between the Static and Partial pressure at such conditions (of optimal confined motion of electron).

$$P_P/\mathrm{P}_S = \alpha^2/\sqrt{1-\alpha^2} \qquad (10.18)$$

To verify the physical validity of the obtained equation (10.18) let calculate its reciprocal value. We get:

$$P_S/\mathrm{P}_P = 18778.4$$

We get very close number to the electron revolutions in one quantum orbit corresponding to the a_o quantum orbit. determined in Chapter 3 by Eq. (3.43.h)

$$\frac{2\pi a_o}{s_e} = \frac{\lambda_c}{\alpha s_e} = 18778.362 \qquad [(3.43.h)]$$

Having in mind that the second proper frequency of the electron is $3\nu_c$ (the frequency between the shell of internal positron and the central negative core) it is evident that the second proper frequency will have a whole number of cycles if the fractional value is 1/3 (condition for standing waves in the short magnetic line conditions see Chapters 3 and 7). Equalizing the equations (10.18) with [(3.43.h)] we arrive to the equation of the helical step of the electron (s_e, that has been derived by different physical approach in Chapter 3.

$$s_e = \frac{\alpha c}{\nu_c\sqrt{1-\alpha^2}} \qquad (3.13.b)$$

There are two important additional conclusions from the provided analysis:

- the helical step of the electron is completely defined by the CL space parameters
- having in mind the energy mass equivalence equation applied for the electron, ($m_e c^2 = h\nu_c$) the ratio P_P/P_S defines also the parameters of the first harmonics quantum wave (511 keV).

We may summarize:

- **The Partial pressure is a parameter characterizing the folded nodes. It is directly involved to the definition of the inertial properties of the atomic matter by the vector parameter Inertial Force Moment, E_{IFM}.**
- **The definition concepts of the static and partial CL pressure are in full agreement with the relation between Newtonian mass and inertial properties of the electron. All kind of helical structures included in the proton's (neutron's) structure could be referenced to the electron structure. Consequently the derived concept should be valide for all kind of atomic matter.**
- **The ratio between the partial and static pressure P_P/P_S of the CL space is a constant value determined entirely by the fine constant according to Eq. (10.18). This ratio defines completely the helical step of the electron structure according to Eq. (3.13.b).**
- **The ratio P_P/P_S is a self standing CL space parameter valide for a first harmonic quantum wave (511 keV).**

10.4.3 Specific partial pressure

The CL static pressure expressed by the electron mass density (see §3.13.3 Eq. (3.55) and (3.56), Chapter 3) is given by the expression:

$$P_S = \rho_e c^2 \qquad (10.19)$$

where: $$\rho_e = \frac{m_e}{V_e} = \frac{g_e^2 h\nu_c^4(1-\alpha^2)}{\pi\alpha^2 c^5} \qquad (10.20)$$

is the electron's density

Applying the general Eq. (10.7) for a not relativistic motion and using the specific partial pressure ρ_e one obtains:

$$P_P = (\alpha c\rho_e)v \qquad (10.21)$$

Eq. (10.21) shows that the partial pressure is proportional to the velocity of the electron structure, because the product in the bracket is a constant. (Note that this is valid for any value of not relativistic velocity). This product depends only on the CL space parameters and the electron density. Knowing that the volume of any FOHS structure could be referenced to the electron's volume, the product in the brackets in Eq. (10.21) can be regarded as a specific parameter of the motion of any particle consisted of FOHSs. We may call it a **specific partial pressure, denoted by p_p.** Expressed by the physical constants it is

$$p_p = \alpha c \rho_e = \frac{g_e^2 h \nu_c^4 (1-\alpha^2)}{\pi \alpha c^4} = 3.34348 \times 10^{15} \left[\frac{N\ \mathrm{sec}}{m^3}\right] \quad (10.22)$$

Having in mind that gyromagnetic factor g_e of the electron is determined by the CL space, it is apparent that the new defined parameter p_p is completely defined by the CL space. From the additional considerations:

(1) both parameters: the static pressure and the specific partial pressure of CL space are referenced to one and same structure - the electron, using the volume of its FOHS.

(2) any FOHS could be referenced to this volume

(3) the volume of any FOHS of a stable particle is a constant in CL space environment

We may conclude:

(a) The specific partial pressures estimated by the electron geometrical parameters is valide for all types of helical structures with second order helicity

(b) The total force moment of any complex particle consisted of helical structures could be estimated if knowing the total volume of its FOHSs.

10.4.4 Force moment of the neutron and proton

From the mass equation we know that the neutron to electron mass ratio is equal to the ratio of their FOHSs volumes with proper correction factors for positive FOHSs and kaons.

$$V_\Sigma / V_e = m_n / m_e$$

For case of not relativistic velocity, applying Eq. (10.10.a) and substituting P_P by its definition in Eq. (10.10) we get:

$$E_{IFM} = h\nu_c \frac{V_\Sigma}{V_e} \alpha \frac{\upsilon}{c} = h\nu_c \frac{m_n}{m_e} \alpha \frac{\upsilon}{c}$$

Substituting $m_e = h\nu_c / c^2$ one obtains:

$$E_{IFM} = (m_n c \alpha)\upsilon \qquad \text{for neutron} \qquad (10.23)$$
$$E_{IFM} = (m_p c \alpha)\upsilon \qquad \text{for proton} \qquad (10.24)$$

Eq. (10.23) and (10.24) are the force moments for neutron and proton, respectively. The parameter in the bracket is a constant. Its values for a neutron and proton is pretty close, so it could be named a **specific force moment of hadron** (proton or neutron).

If using the envelope volume of the proton or neutron (estimated in Chapter 6 as 71.72 times larger than the total volume of all FOHSs of the neutron), the force constant could be expressed by the specific partial pressure, whose relation to the CL space parameters is given by Eq. (10.22). Then the force moment of a moving neutron is given by:

$$E_{IFM} = p_p \frac{V_n}{71.72} \upsilon \qquad (10.25)$$

where: the factor 71.72 is the ratio of the volumes

V_n / V_Σ estimated in Chapter 6, and V_n is the envelope volume given by

$$V_n \approx V_p = \pi (R_c + r_p)^2 L_{pc}$$

where: R_c is a Compton radius, r_p - is the small radius of the positive FOHS, L_{pc} - is the length of the proton (neutron) core.

Both equations (10.23) and (10.25) provides exactly the same value in the case of neutron.

For relativistic motion the force moment is multiplied by the gamma factor.

The force moments given by Eq. (10.23) and (10.24) are more convenient for practical applications. Eq. (10.25) provides an useful connection to the fundamental physical constants.

10.4.5 Inertial properties of the atoms and molecules

The local field of a portion of FOHS contained in the proton was shown in Fig. 10.2. From the analysis and derived equations of inertial interactions for electron and neutron (and proton as well) it is evident, that the energy of the node displacement from the FOHSs is only involved. It is reasonable to consider, that additional energy of folding in the entrance is also involved, but it is returned to the system in the exit where the folded nodes are unfolded to their normal shape, becoming again part of the CL space. **Particles as electron, neutron and proton are hardware structures whose dimensions are not affected in result of the motion. The same assumption could be accepted for a single atomic nuclei. Therefore, for a single particle of the above type we may ignore the folding - unfolding energy in our calculations.** If ignoring, in first, the general relativistic effect of CL shrink around a mass object, we arrive to the following conclusions:

(A) The inertial force moment of a moving atom is a sum of the force moments of its protons and neutrons.

When the general relativistic effect is taken into account:

(B) Considering the general relativistic effect in atomic nucleus requires a correction of the inertial force moment by the nuclear binding energy. The latter is expressed by the equivalent mass deficiency (difference between total mass of neutrons and protons minus the atomic mass).

The binding energy expressed by the mass deficiency is: $E_B = m_d c^2$

The atomic force moment could be obtained by applying considerations (A) and (B) with Eqs. (10.23) and (10.24).

$$E_{IFM} = c\alpha\upsilon(Zm_p + Nm_n - E_B/c^2)$$

where: Z - is the number of protons, N - is the number of neutrons, E_B is the nuclear binding energy.

The atomic mass is: $Au = (Zm_p + Nm_n) - E_B/c^2$, so the obtained expression of the atomic force moment is:

$$E_{IFM} = (c\alpha Au)\upsilon \quad \text{for atom} \qquad (10.26)$$

where: A - is the atomic mass, u - is the atomic mass unit.

10.4.6 Inertial properties of macrobody in motion with constant velocity

In order to provide a bridge between the inertial properties of a single particle and material object containing large number of atoms we need to give definition of a macrobody (massive body):

A macrobody is a material object containing a large number of atoms (or molecules) whose integrity is kept by a Newtonian type of gravitation.

The provided definition is quite broad. It may refer to:

- a self contained gas volume or liquid in a cosmic space.
- a gas volume enclosed in some volume in the Earth gravitational field (a balloon)
- a liquid in container
- a solid body

A special case of interest is the solid body. From the point of view of the inertial properties two of its characteristics are mostly important: **its integrity** (all atoms a moving together) and its **mass.** The latter parameter is proportional to the quantity of the atomic particles (if neglecting the mass deficiency in the atom expressed by the nuclear binding energy). The expression of the mass by the quantity of atomic particles appears to be quite useful approach for transferring the inertial properties of a single particle to a solid body. At the same time it becomes apparent that a solid body may posses a proper (or local) CL space. The possible existence of such space depends on:

- is the solid body immersed in external gravitational field and how strong is it?
- does the solid body possess enough mass (matter quantity) in order to have the necessary proper gravitational field?

It is also apparent (and will be confirmed later) that a macrobody with quite large mass may contain extended CL space whose Equivalent Separation Surface is beyond its surface.

A massive macrobody with extended external CL space appears as astronomical object, defined later in this chapter. (The main distinctive feature of the astronomical object (or body) from a macrobody is that its shape is close to a sphere due to its large mass).

Inertial interactions for a macrobody.

In the general case the macrobody is consisted of large number of interconnected atoms or molecules, moving as a common volume.

From the conclusions in the previous paragraph it follows, that the force moment of the inertial interaction of macrobody could be regarded as a sum of the inertial interactions of the involved atoms. If ignoring the general relativistic effect, it is evident, that the force moment of folded nodes inside the body will be proportional to the number of protons and neutrons in one atom and to the number of atoms in a unit volume. Taking into account the general relativistic effect, it is the atomic mass that determines the inertial interactions.

According to general definition of macrobody it is necessary to distinguish the two quite different cases: a volume of gas and a solid macrobody.

10.4.6.1 Inertial properties of a gas enclosed in a finite volume

The number of atoms (molecules) in unit volume (for example 1 m^3) is strongly dependent on the pressure and temperature due to the effect of the Brawnian motion. For conditions of ideal gas this dependence is given by the equation:

$$PV = nRT \tag{10.27}$$

where: P - is a gas pressure, V - is a volume of the vessel, R is an ideal gas constant, T - is a temperature in [K], n - is a number of $kmoles$.

In case of atmosphere around a planet (or gas volume around an astronomical object) the volume is determined by gravitational conditions.

The conclusions in §10.4.5 are fully consistent with the relation between the mass of 1 kmol of gas substance and the number of atoms (molecules) given by the Avogadro's number:

$$N_A = 6.022142\times10^{26} \text{ [numbers/kmol]} \tag{10.28}$$

The gases in the Earth atmosphere could be regarded as ideal gases. Eq. (10.27) is not very accurate for a temperature close to the absolute zero, because it takes into account the collision interactions between the molecules (atoms).

10.4.6.2 Solid body

According to the conclusions in §10.4.4 the force moment (of the folded nodes) in the solid body will depend on two factors:

- the atomic mass number
- the number of atoms in unit volume (1 m^3 in SI)

The first factor is one and a same for a gas or a solid body. The second one, however, is dependable on the crystal structure of the solid substance. It also may vary between bodies made of different atoms. This variation is a result of the different spatial configurations of the atomic nuclei. So it is dependable on the number and positions of the valence protons, as they are involved in the connections between the atoms in the crystal structure. There are essential differences also between the crystal structures of metals and insulators.

In order to show how much the second factor influences the force moments, a simple analysis is made by comparing of similar physical parameters of two cases of homogeneous matter substances.

Case A. Comparison between silver and gold

Table 10.3

element	Z	N	Z+N	A (u)	$\rho\times10^3$ (kg/m^3)
Ag	47	61	108	107.87	10.5
Au	79	118	197	196.97	19.32

$$\frac{(Z+N)Ag}{(Z+N)Au} = 0.5482 \qquad \frac{A(Ag)}{A(Au)} = 0.54764 \qquad \frac{\rho(Ag)}{\rho(Au)} = 0.54347$$

Case B. Comparison between Al and Si.

Table 10.4

element	Z	N	Z+N	A (u)	$\rho\times10^3$ (kg/m^3)
Al	13	14	27	26.98	2.7
Si	14	16	30	28.09	2.33

$$\frac{(Z+N)Al}{(Z+N)Si} = 0.9 \qquad \frac{A(Al)}{A(Si)} = 0.96 \qquad \frac{\rho(Al)}{\rho(Si)} = 1.158$$

In Case A: The two elements are quite distant by their Z number, but they have very similar configurations especially about the valence proton (see Atomic Nuclear Atlas). So it is reasonable to expect that they have a similar metallic crystal structure. This is confirmed by the pretty close ratio value between their atomic masses and densities.

In Case B: The two elements are distinguishable only by one proton and two neutrons. Their atomic mass ratio, however is quite different than their density ratio. Such difference may come only from the crystal structure. The hadron density in unit volume for Al is higher, than for Si. This indicates also that the interatomic connections for metals and nonmetals are different. The molecular binding system of Deuterons, described in Chapter 9 should be valid for a solid silicon. But such binding system, evidently, is not involved in all type of interatomic connections between Al atoms in the crystal structure of solid aluminum.

The provided two examples are in good agreement with the consideration, that the force moment for a solid body is proportional to the sum of the volumes of its FOHSs.

Ideal solid body

Definition: A solid body possessing a local CL space for which the volume of its ESS (see Fig. 10.2) is equal to its body volume.

The concept of ideal solid body allows us to analyse the inertial interactions by a model, according to which the whole volume of the ideal solid body is filled by its own CL space and the external CL space does not penetrate inside. It might be also said that the **ideal solid body does not possesses cavities.**

Practically such body does not exist. All real solid bodies contain cavities. (The local CL space of real solid body is discussed in the next paragraphs). The definition of ideal solid body, however, allows to transfer the force moment conditions of folded nodes from single particle or atom to a small solid body. The force moment of a homogeneous solid body (comprised of one atomic substance) with mass of 1 kgmol, can be expressed by multiplying the atomic force moment (given by Eq. (9.26)) by the Avogadro number:

$$E_{IFM} = (c\alpha N_A Au)\upsilon \quad \text{[J/kgmol]} \qquad (10.29)$$

where: $N_A Au = m$ - is a mass of 1 kgmol

The force moment of any substance of mass 1 kg is:

$E_{IFM} = (c\alpha N_A u)\upsilon$ but $N_A u = 1$, so:

When working in SI system, the inertial force moment of a body of normal matter, possessing a mass of 1 kg is given by:

$$E_{IFM} = (c\alpha)\upsilon \quad \text{[J/kg] per 1 kg substance} \qquad (10.30)$$

Note: The term normal matter means the body is composed only of protons, neutrons and electrons. In latest paragraphs of this chapter it could be discussed that, “crushed” matter in form of kaons, may exist in the nucleus of heavy astronomical objects.

While Eq.(10.30) appears referenced to 1 kg newton’s mass, a solid body of *m* kg (but still complying to ideal solid body definition) will have an inertial force moment of

$$E_{IFM} = c\alpha m\upsilon \quad \text{[J] referenced to the mass} \qquad (10.31)$$

$$E_{IFM} = c\alpha\rho V\upsilon \quad \text{[J] referenced to the volume at constant } \rho \qquad (10.31.a)$$

where: V - is the body volume, ρ - is the density

The final equations (10.31) and (10.31.a) are quite simple and convenient for use for not relativistic motion. In relativistic motion the right side should be multiplied by the relativistic gamma factor.

The Eq. (10.31) shows one important feature of the force moment:

The inertial force moment referenced per one kg of substance is independent from the atomic and molecular composition of the substance.

10.4.7 Relation between the inertial force moment and first Newton’s law of inertia.

Let demonstrate the relation for the electron accelerating by a constant force for not relativistic motion. According to the first law of inertia we have $F = m_e a$

where: F - is the force with a constant value, m_e - electron mass and a is the obtained constant acceleration.

According to the general equation for the inertial force moment of body with mass m (Eq. (10.31)) we have $E_{IFM} = c\alpha m_e\upsilon$ (10.32)

whose dimensional equivalence is:

$$[\text{N m}] \equiv \left[\frac{m}{s}kg\frac{m}{s}\right] \qquad (10.33)$$

If Eq. (10.32) is divided by some specific CL space parameter with linear space dimension, we can obtain equation with dimensional equivalence of Eq. (10.32). Such specific CL space parameter is the space-time constant λ_{SPM}. In the Earth local space we have $\lambda_{SPM} = \lambda_c$. So dividing Eq. (10.32) by λ_c we get:

$$\frac{E_{IMF}}{\lambda_c} = \alpha m_e \frac{c}{\lambda_c} \upsilon = \alpha m_e \nu_c \upsilon = \alpha m_e \frac{\upsilon}{t_c} = m_e \left(\frac{\upsilon}{t_c/\alpha} \right) \quad (10.34)$$

The obtained Eq. (10.34) has the same dimensional equivalence as the first Newton's law of inertia. The bracket therm $\frac{\upsilon}{t_c/\alpha}$ is the obtained acceleration. Eq. (10.34) confirms the validation of the introduced inertial force moment (for folded nodes). Its validity for the electron as a single coil structure is propagated automatically for proton and neutron.

10.4.8 CL space inside of real body

Note: It must be kept in mind that the concept of the Local CL space was introduced for convenience. In fact all kind of bodies (comprised of atomic matter) are immersed in the galactic CL space.

Two concepts will be briefly discussed
- frame reference
- CL space continuity in one specific case

10.4.8.1 Frame reference

Case A: A massive body possessing a local gravitational field, which is larger that any external gravitational field in any point of its local CL space.

The extent of the local field around the protons and neutrons depends on the amounts of accumulated atoms. The local space of a massive real body will be a three dimensional manifold, but still continuous. All FOHSs will look as a three dimensional grid immersed in the local CL space of the body. If the body possesses microcavities, they are still part of the body CL space. An example of such massive body is a planet in a solar system. The body is characterized with the following important features:

- **when a massive body is in a relative motion in respect to external gravitational field, the own atoms and molecules are carried by the local field of its proper CL space and do not feel the motion**

Case B. A massive body which local gravitational field is smaller than the external gravitational filed in any points of its volume.

In this case the CL space of the external gravitational field is a three dimensional manifold penetrating into the atomic matter of the body down to the level of helical structures. The inertial interactions of atoms and molecules in this case when the body is in motion are different:

- **when the body is in relative motion in respect to external gravitational field, the own atoms and molecules feel the motion**

Example: moving objects in earth gravitational field: thrown stone, car, train, aeroplane, rocket, satellite.

10.4.8.2 Continuity of the penetrated CL space

The concept of continuity of penetrating CL space is valid, when the local gravitational field in any point of the body volume is smaller than the gravitational field of external more massive body. The most important feature is:

- **The penetrating CL space inside the solid body is a continuous three dimensional manifold**

Example: any body in Earth gravitational field whose mass may range from single crystal, to large iceberg, artificial satellite and so on. The Moon, however, is not included in this category.

The concept of continuity could be demonstrated by the example of two flywheels, as shown in Fig. 10.4. The first one is solid, while the second one is hollow inside.

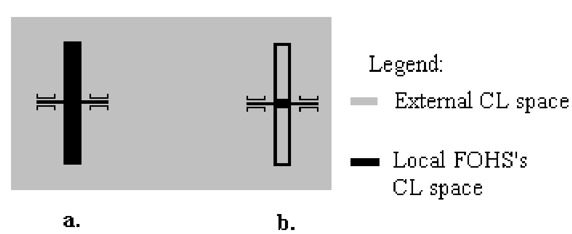

Fig. 10.4
Two flywheels and their local fields

The solid flywheel *a* has a larger moment of inertia than flywheel b. Let consider that the flywheel b. contains some small parts inside the hollow volume. If this volume is vacuumized and there is not any friction forces between the internal walls and the small parts, they will be always attracted by the Earth gravitational field, independently of the motion conditions of the flywheel. If applying a linear acceleration of the flywheel b. in direction coinciding with the rotational axis, the small parts in the internal inertial hollow volume also feels the acceleration. The inertial properties of the small parts also does not depend of the thickness and matter density of the walls. So they exhibit the same adequate inertial properties as the solid volume. All these considerations lead to a conclusion, that the penetrating external CL space is continuous. This is so because the volume of all FOHSs in the atom is much smaller than the atomic nuclear volume. The interatomic distances are also larger than the atomic nucleus even for most dens metals (for example gold, lead, platinum etc.). The element Ar possesses one of the most dens atomic nucleus (that is also part of other heavy nuclei). Let calculate the **ratio between the envelop volume of Ar nucleus and the volume of all of its FOHSs**. The envelope volume radius according to Michigan Institute technology data is 0.88 A. The volume of all FOHSs in a single proton (neutron) is $[\pi(R_c + r_p)^2 L_{pc}]/71.72$. Then the **volume ratio** for Ar atom is

$$volume\ \ ratio = 65110$$

Then the similar volume ratio for any metal could exceed few hundred thousands. **In such conditions we may apply the concept of a free proton (neutron) for a solid body.** The folding and deviation of the CL space nodes in such case is caused by the obstruction of their straight relative motion by FOHSs volumes. This concept is in agreement with the application of Avogadro theory in the case of solid state of the matter.

The presented concept of small body (case B) excludes the possibility of possession of proper CL space. In fact, a small local space may exist around any FOHS, but it is not larger enough to fill even the gaps between the external coils of the proton (neutron).

10.5 Using the concept of the local CL space and ESS for massive objects

For a massive body with a detectable gravitational field it is convenient to use the concept of the local CL space with its presentation as an Equivalent Separation Surface (ESS) defined in §10.3.1.

10.5.1 Relation between the gravitational field and the local CL space

A local (proper) CL space by definition is possible only around a matter. In a normal state this matter is composed of helical structures. The shape of the local field of a single proton could be an envelope around all of its FOHSs without closing the gaps between their second order windings. This is in agreement with the concept of continuous three dimensional manifold presented in §10.4.8.

Accumulation of large number of atoms and molecules may form, for example, a spherical body whose local field is also a sphere but its ESS is extended beyond the volume of the solid body. So we need to define a **massive real solid body** from a point of view of a local CL space concept:

A massive real solid body is a such object for which the ESS of the local CL space is extended beyond its solid surface. The continuous three dimensional manifold in this case could be considered as occupied by the own (equivalent) CL space.

In the process of real body building from atoms and molecules the local gravitational field also arises and in some point it becomes detectable. So we may formulate the following general definition of a local CL space.

(A) If a real body has domains for which the local gravitation field exceeds any external gravitational field, it possesses a local CL space.

It is evident from the above formulation, that the possession of local CL field depends on number of conditions:

- the mass of the body
- the mass of the external (more massive) body providing the external gravitational field
- the distance between the body of consideration and the external more massive one
- the matter density of the body

10.5.2 Local CL space of large astronomical object

In order to analyse and explain some inertial phenomena in astronomical scale we must define a criterion for considering the object as astronomical.

For this purpose the following criterion could be used:

A real body could be considered as astronomical object if posessing a detectable gravitational filed, extended beyond its solid surface or self contained gas volume

According to above criterion, large astronomical bodies are: stars, planets, planet's satellites (moons) and asteroids.

10.5.3 Concept of separation surface between local CL spaces

Body with small gravitational field is usually immersed in another gravitational field of a larger body. Then if the smaller body possesses own CL space it is immersed in the CL space of the larger body. Even a single body with a local CL space quite distant from other bodies is still immersed in the Global CL space of the home galaxy.

For single astronomical body (as idealistic case) with spherical shape the ESS of its local CL space will be also a spherical. In a general case the spin rotation could be considered as a normal state. It is reasonable to accept, that the local CL space will rotate with a same angular velocity. Then for a case of spin rotation the following boundary conditions are valide:

(a) The radius of the local field becomes limited by the light velocity at the boundary surface. Then the separation surface becomes defined by the ideal separation radius R_S, satisfying the condition:

$$R_s\omega = c \qquad (10.35)$$

where: ω -is the angular velocity and c - is the light velocity

(b) ZPE threshold cut: The radius of the local field becomes limited by the Zero point energy of the free (galaxy) space playing a role of a threshold.

In a real world it is not possible to find a case for a single macrobody, where there is not a second body in the range of the ideal separation radius of the first one. This also means, that the second body affects the size of the CL space of the first one by its gravitational field. Conclusion:

In the real world the ideal case of ESS of a single body is disturbed by another body with local gravitational field (possessing a local CL space) in the range of the separation radius defined by the ZPE threshold cut.

10.5.4 Two bodies at rest in respect to the upper level CL space - idealised condition

In this case (possible also in idealised conditions) we consider only two massive bodies in the global (galactic) CL space, both in rest in respect to this CL space. Both bodies are in gravitational interaction, but we may consider an initial moment after they has been hold in rest. In such conditions the inertial force moment could not be defined and only newtonian gravitational forces are considered. If the distance between both bodies is smaller than the radius restricted by the ZPE threshold (considered in the previous paragraph), both bodies will have a common ESS, for every point of which the Newtonian gravitational forces will be equal. If one of the bodies is much less massive, its ESS will have a shape of an egg immersed inside of the ESS of the other (more massive one).

If trying to analyse the folded nodes of the more massive body, penetrated in the CL space of less massive one, a problem appears: the folded nodes are not in motion! This is in conflict with the inertial definition and even the partial pressure could not be defined. This is another reason that make the case idealistic, so the two bodies could not be at fixed distance.

10.5.5 Two bodies with a constant distance between them but in a common motion referenced to the upper level CL space.

This is a realistic case in which both bodies will rotate around a common centre, whose position depends on their mass ratio. Therefore the definition of local CL spaces and ESS is reasonable and could be used for a motion analysis. In a general case when both bodies are with different masses and close enough so their local CL spaces could not be limited by the ZPE threshold, the ESS has a form of egg and encloses the less massive body. This case could be applied for a planet in a solar system. The separation surface is defined by the condition that the two vectors of the gravitational forces in any point of the system (not taking into account the centripetal forces) have equal magnitudes. For a planet in a solar system the condition defining the separation surface is expressed by Eq. (10.35.a) (based on the Newton's gravitational law).

$$\frac{M_S}{(d-r_s)^2} = \frac{M_P}{r_s^2} \qquad (10.35.a)$$

where: M_S is the solar mass, M_P is the planetary mass, d - is the distance between them, r_s is the distance of the separation surface from the planet.

10.5.6 Two bodies with changeable distance between them.

The two bodies will have elliptical orbits around a common centre of rotation. The CL space of the less massive body is always immersed in the CL space of the more massive one. The ESS enclosing the less massive body will have a shape of egg as in the previously discussed cases, but its size and shape will vary with the distance change between them.

10.6 Total energy balance of moving macro-body

In the previous paragraphs, the force moment of the folded nodes was discussed for a single particle, for an atom or for an ideal solid body. Now we need to examine the validity of Eq. (10.31) for real solid body.

Let accepting initially that: Eq. (10.31) is valide for a large body and even astronomical object. In order to find out is this true or not we will analyse the relation between gravitational and inertial interactions of a real body in different gravitational fields. For this purpose some data about the solar system planets (and some of their moons) will be used.

10.6.1 Force moment of real body in a free fall motion

Let analyse how the energy of a free fall body with mass m near the surface of an astronomical body (planet or moon) is changing per unit time by comparing its motion energy and its gravitational potential. To simplify the analysis we will consider that the planet has a perfectly spherical shape, so the centre of mass coincides with its geometrical centre. Let the body is initially kept in rest near the planets surface and at moment zero it is released for a free fall motion. By using the definition of inertial force moment (for folded nodes) $E_{IFM} = c\alpha m\upsilon$ we may find the work for deviation of the folding nodes for a small time interval. The force moment is proportional to the velocity change for a unit time interval for any moment of the motion. For a motion range much smaller than the planet radius, the gravitational acceleration could be considered as a constant. Then the change of the force moment is a constant for a small time interval Δt in any moment of the motion. At initial time moment of zero, the velocity is zero, so the force moment is also zero. At the end of the time interval Δt the velocity is equal to $g\Delta t$ and the force moment is $\alpha cmg\Delta t$, where g is the gravitational acceleration. Then the change of the force moment of the real body with mass m per unit time is:

$$\Delta E_{IFM} = \alpha cmg \quad [\text{J/s}] \qquad (10.36)$$

Let the planet is characterised by the following features:

- perfect spherical shape
- constant or linear change of the solid matter density with distance from the centre
- all the mass is enclosed below the solid surface of the planet (the mass of atmosphere is ignored)
- ignoring the free fall influence from the planet sideral rotation, when the body is closed to the planet surface (practically valid for all planets of the solar system)

The gravitational potential at the same level (considered near the surface of the planet) is given by:

$$U_G = G\frac{Mm}{R} \quad [\text{J}] \qquad (10.37)$$

where: G - is the gravitational constant, M - the mass of the planet, R - a spherical radius of the planet

The gravity at the level defined by R is:

$$g = \frac{F}{m} = G\frac{M}{R^2} \qquad (10.38)$$

Ignoring the centrifugal force, according to the above mentioned consideration and using Eq. (10.36), we obtain the expression for the ratio $U_G/\Delta E_{IMF}$:

$$U_G/\Delta E_{IMF} = \frac{1}{\alpha c}R \qquad (10.39)$$

Let define the above ratio as a factor K_E.

$$K_E = U_G/\Delta E_{IMF} \quad (10.39.a)$$

***Note**: The change of force moment ΔE_{IMF} in Eq. (10.39) is a parameter of a real small body in gravitational field of astronomical object. It should not be confused with a force moment of the massive astronomical object.*

Eq. (10.39) leads to some interesting results:

(a) From a pure theoretical point of view

Let estimate Eq. (10.39) for a time interval Δt equal to the Compton time t_C, which inverse of the Compton frequency, ν_c. We obtain:

$$R = (\alpha c)/\nu_c = 1.7706 \times 10^{-14} \text{ (m)}$$

Amazingly, this value is quite close to twice the small radius of the electron structure, r_e, which was derived in Chapter 3.

$$2r_e = 1.7685 \times 10^{-14} \text{ (m)}$$

Conclusion:

- **The obtained coincidence confirms the envisioned concept that CL nodes partly folds and deviates from the moving through space helical structures (possessing impenetrable for CL nodes internal RL lattice)**.

The above result is valide for all negative elementary particles since they have a similar FOHS as the electron. It is valid also for the positive particles including the proton's (neutrons's) external shell) using the same correction factor as for the mass equation for positive helical structures (or particles).

(b) From a practical point of view of a system comprised of real astronomical objects:

Eq. (10.39) is very useful theoretical expression that could be tested for the planets and moons from the solar system. The parameters U_g and ΔE_{IMF} can be separately calculated by the data available for them. If the astronomical body (planet or moon) does not have a perfect spherical shape the radius R could be replaced by a volumetric radius R_V. One important feature of the ratio given by Eq. (10.39) is that the planet mass is eliminated. However it participates in the separate parameters U_g and ΔE_{IMF}.The parameter K_E could be ploted against the planetary volumetric volume for convenience, because it is fully defined by the planetary radius. The planets, however, possesses additional sideral rotation and its possible contribution should be taken into account.

For astronomical body with significant spin rotation the falling body near the solid surface will get rotational energy that should decrease U_G. If assuming that an unit mass of atmosphere (1 kg) is uniformly distributed as a thin shell at radius R_V, its rotational energy is

$$E_R = \frac{1}{2}I\omega^2 \quad (10.40)$$

where: $I = \frac{2}{3}mR_V^2 - \frac{1}{2}R_V^2$

and ω - is the angular velocity determined by the sideral period

Then for a real astronomical body (planet or moon) the ratio k_E becomes:

$$k_E = \frac{U_G - E_R}{\Delta E_{IMF}} \quad (8.41)$$

The ratio (8.41) in a measurement system unit of SI is estimated for number of planets and moons in the solar system, for which the volumetric radius of the solid surface is known. This condition excludes the largest planets Jupiter, Saturn, Uran and Neptun, for which the radius is estimated at 1 mbar pressure. But all other planets, most of the moons and one asteroid with spherical shape are included. All data are taken from NASA fact data sheets about the planets and moons of the solar system: (http://nssdc.gsfc.nasa.gov/planetary/planetact.html).

For estimation of ΔE_{IMF}, the surface gravity, from the "fact data sheet" is used if it is available. If not available, it is calculated by Eq. (10.38). Some of the necessary data and the calculated parameters are given in Table 10.4. The rotational energy (for 1kg atmosphere) calculated by Eq. (10.40) for the planets of the solar system is quite small, so it is not given in the table. For example: E_R parameter (from the sideral rotation) for Mars and Earth is respectively 1.925E4 and 7.194E4, while U_G is respectively 12.63E6 and 6.256E6. So E_R for this two planets are respectively 0.15% and 1.14% of U_G and could be ignored. For other planets the E_R contributions are much smaller, so they are ignored. Then with a quite good approximation, the Eq. (10.42) could be accepted to be valid for the planets of the solar system:

$$K_E = \frac{U_G}{\Delta E_{IMF}} \quad (10.42)$$

The plot of K_E versus the volumetric radius R_V is shown in Fig. 10.5.

The planets and moons for which the surface gravity is provided by the fact data sheets are drawn by green (or gray) points. For other objects (mostly moons) the surface gravity is calculated by Eq. (10.38). All planets and moons lie very closely to the theoretical line given by Eq. (10.39).

Planet (moon) data ***Table 10.4***

No Planet (moon)	$M \times 10^{23}$ (kg)	R_v (km)	g (m^2/s)	T_{sid} (hr)	k_E
1. Nereid	0.0002	170			0.077
2. Vesta	0.000301	265			0.121
3. Umbriel	0.0117	584.7			0.267
4. Charon	0.019	593			0.27
5. Oberon	0.0301	761.4			0.348
6. Titania	0.0352	788.9			0.36
7. Pluto	0.125	1195		153.3	0.546
8. Triton	0.2147	1352.6		141	0.618
9. Europa	0.4797	1569		85.2	0.706
10. Moon	0.7349	1737.4	1.62	655.7	0.796
11. Io	0.8933	1815		42.48	0.837
12. Calisto	1.076	2403		400.5	1.1
13. Titan	1.345	2575			1.173
14. Ganimede	1.482	2634		171.6	1.21
15. Mercury	3.302	2439.7	3.7	1407	1.11
16. Mars	6.418	3390	3.69	24.62	1.562
17. Venus	48.685	6051.8	8.87	5832	2.766
18. Earth	59.736	6371	9.78	23.934	2.92

Note: The surface gravity from the fact sheets only are shown.

The rotational energy E_R (for 1 kg mass) is quite small and not listed in Table 10.4.The position of planet (moon) is numbered according to *No* given in Table 10.4.

From the analysis of the ploted data, the following conclusions are apparent:

(a) The planets and moons generally align well to the theoretical curve given by Eq. (10.39)

(b) The planets and moons for which more experimental data are available exhibit some small deviation from the theoretical curve. The reason for this could be the difference between their mean density and the theoretical mean density of the small body used as a reference (having a mass of 1 kg).

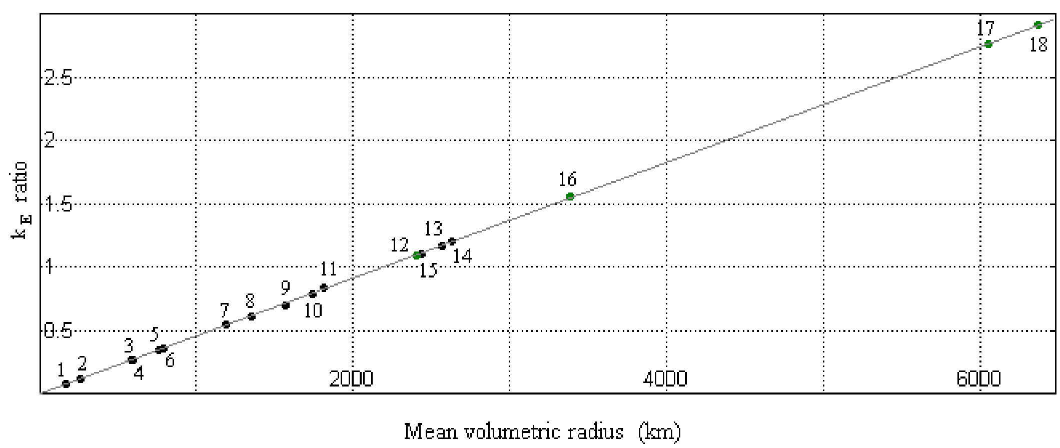

Fig. 10.5

10.6.2 Anomalous position of Mercury in the plot of the ratio k_E as a function of mean radius

The planets (moons) in Tables 10.4 and their assigned numbers follows the trend of mass increase. From the data points ploted in Fig. 10.5, however, we see that Mercury (point number 15) does not follows the trend but takes a reversal direction. In order to study this anomaly we analyse the trend of the matter density of astronomical body, when a large mass is accumulated. For this reason we will analyse the trend of the planetary (and moon's) masses in function of their volumes. Fig. 10.6 shows the trend in full scale, while Fig. (10.7) shows a portion of the trend with increased vertical resolution.

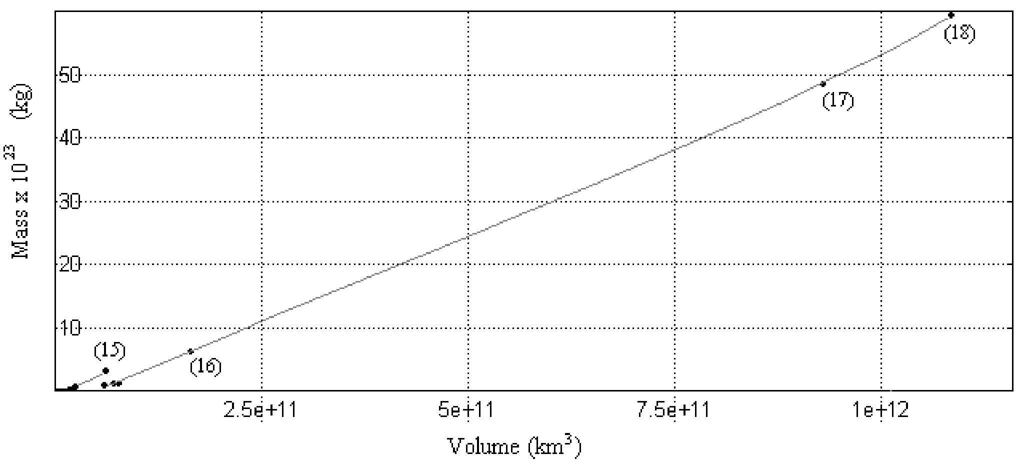

Fig. 10.6

The plots in Fig. 10.6 and 10.7 clearly show that the common trend of matter density breaks into two trends. The first trend for planets (moons) with smaller mass ends up at Mercury. The second trend begins with Calisto and continues for the larger planets (for which the solid surface volume is known).

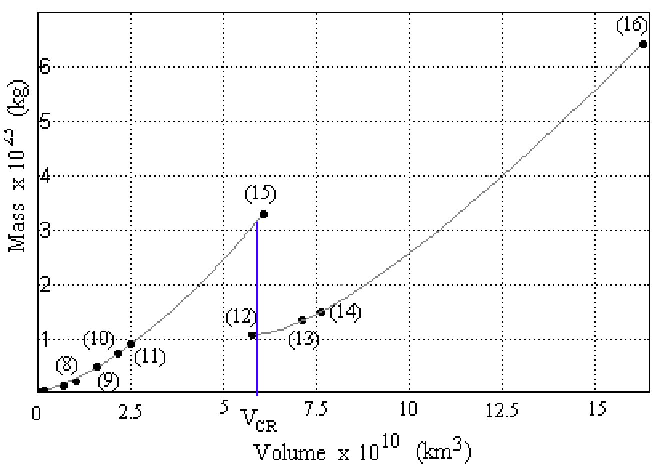

Fig. 10.7. Initial section of the plot shown in Fig. 10.6 with better scale resolution, showing the break zone of the trend

The break of the common trend appears in the region close to $V_{CR} = 5.2 \times 10^{10}$ (km^3). The object 15 (Mercury) is still in the strong gravitational field of the Sun.

The break of the trend has some similarity with the mass efficiency (binding energy) in atomic nuclei in function of Z number. The possible explanation of the observed effect is the following:

Due to the enormous gravitational pressure the structure of the protons and neutrons in the central zone may brake. The internal pions may convert to straight structures - kaons getting alignment to the central kaon. The obtain bundle of kaons in such enormous pressure might be stable. They may shrink additionally the internal CL space, providing the same effect of mass deficiency as in the atomic nuclei. At the same time the internal RL(T)s of all kaons appear axially aligned. They can modulate strongly the external CL space, providing an excellent conditions for a strong magnetic field.

The above explanation is additionally discussed in the magnetic field hypothesis for the planets proposed in §10.14 and for the stars (discussed in chapter 12).

The suggested explanation may also give an answer, why Mercury overpasses the theoretical break zone. This planet is very close to the Sun and exhibit pulling forces, that are additionally constantly changing due to the elliptical orbit. In such condition the gravitational pressure in the central zone of the planet is decreased. Additional factor may be the continuously changed conditions in respect to the strong magnetic field of the Sun.

The theoretical threshold separates the common trend into two zones: a zone above, and a zone below the threshold value V_{CR}, which could be considered as an average between the volume of points 15 and 16.

$$M_{CR} \approx 2.189 \times 10^{23} \text{ (kg)} \qquad (10.47)$$

The corresponding critical matter density for this case (average for the whole volume) is:

$$\rho_{CR} = \frac{3M_{CR}}{4\pi\alpha^3 c^3} \qquad (10.47.a)$$

10.6.2.A. Theoretical concept for dynamical equilibrium of moving astronomical object in CL space.

Let a planet with a mass M_P is in a stable circular orbit around a star with mass M_S. Then the gravitational attraction is equal to the centripetal acceleration: $GM_S M_P/r^2 = M_p \upsilon^2/r$. The tangential velocity is

$$\upsilon = \sqrt{\frac{GM_S}{r}}$$, where r is a distance

The energy ratio between the inertial force moment (of folded nodes) and the kinetic energy of the planet is

$$\frac{E_{IFM}}{E_K} = \frac{\alpha c M_P \upsilon}{0.5 M_p \upsilon^2} = \frac{2\alpha c}{\sqrt{GM_S}}\sqrt{r}$$

Rising in quadratures we get:

$$\left[\frac{E_{IFM}}{E_K}\right]^2 = \frac{4\alpha^2 c^2}{GM_S} r = C_E r \qquad (10.47)$$

where: $$C_E = \frac{4\alpha^2 c^2}{GM_S} = 1.44238\times10^{-7} \qquad (10.48)$$

The obtained theoretical Eq. (10.47) is very useful. The left side is a linear function of the distance r. The constant C_E is obtained by using the solar mass value

$M_S = 1.9891\times10^{30}$ (kg)

The planetary motion in the solar system is quite stable. This fact is based on accurate astronomical observations for many years. Then some dynamical equilibrium should exist. Using the golden rule of energy conservation we may try to express some of the parameters by energy ratio and observe the obtained trend. Such opportunity is provided by the theoretical expression (10.47).

The expression (10.47) could be verified by the planetary data of the solar system. Using the planetary fact sheets data the calculation of E_{IFM} and E_K is a straight forward process. Most of the planet orbits exhibit quite small orbital eccentricity. For planets with larger eccentricity the energy E_K is approximately estimated by using the mean orbital velocity.

The input data from the planetary fact sheets are given in Table 10.5. The mean distance of every planet from the Sun is given as d in astronomical units (1 au = 1.496E11 (m) is the mean distance between Earth and Sun). The distance d corresponds to the radius r in Eq. (10.47).

Planetary data Table 10.5

No	M_P x 10^{23} [kg]	υ (mean) [km/sec]	d (mean) [au]	ρ (mean) [kg/m^3]
1 Mercury	3.302	47.87	0.387	5427
2 Venus	48.685	35.02	0.723	5243
3 Earth	59.736	29.78	1	5515
4 Mars	6.418	24.13	1.524	3933
5 Jupiter	1431280	13.07	5.203	1326
6 Saturn	5684.6	9.69	9.539	687.26
7 Uranus	868.3	6.81	19.18	1270
8 Neptune	1024.3	5.43	30.06	1638
9 Pluto	0.125	4.72	39.53	1750

The calculated parameters E_{IMF} and E_K show quite large variation for different planets (a few orders), although the square values of their ratio exhibits a perfectly linear dependence of mean distance from the Sun. The plot of this ratio is shown in Fig. 10.8.

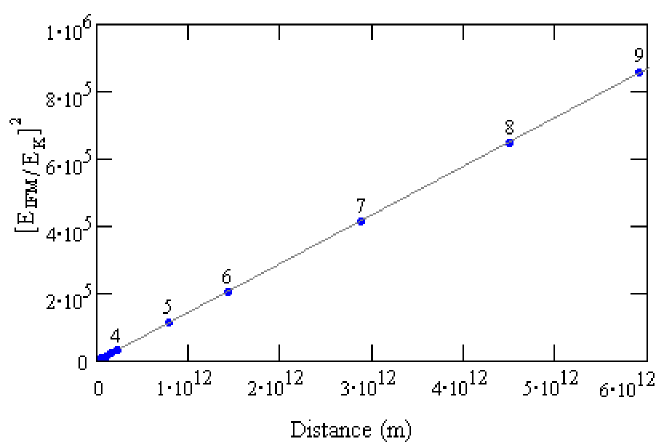

Fig. 10.8

Square value of energy ratio for the planets of the solar system in function of their mean distance from the Sun

The plot of Fig. 10.8 shows excellent alignment of the planets along the theoretical line. By fitting to a robust straight line the experimental value of the slop is obtained. Its value is 1.44322×10^{-7}. The difference between this value and the theoretical one given by Eq. (10.48) is only 0.06%.

10.6.3 Folding/unfolding energy of CL nodes for astronomical body with external CL space

Radius of equivalent separation surface

Folding/unfolding energy of CL nodes for atomic particles and atoms is borrowed from the CL space, so the energy spent in the entrance is equal to the energy received back in the exit. Let find out is this principle valid for astronomical object. The plot given in Fig. 10.8 shows a linear dependence of the square value of the energy ratio E_{IMF}/E_K in function of orbital radius, but one have to keep in mind, that the area of the ESS depends on the distance from the Sun. The ESS has a shape of egg but for $M_P \ll M_S$ and larger orbital radii it tends to approach the spherical shape. Therefore, we may replace the shape of the egg by a sphere with equivalent radius equal to the average value of larger and smaller radii (of the egg shape). Applying the definition for ESS according to Eq. (10.35.a), these two radii can be obtained. The average value between both radii (for egg shape) provides the radius of the equivalent sphere, presenting the ESS.

$$r_s = \frac{d\sqrt{M_S M}}{M_S - M} \qquad (10.49)$$

where: M_S is a solar mass, M is a planet mass, d - is an average distance from the Sun, r_s - is the equivalent sphere radius of ESS.

We will express the inertial interactions by the energy interactions of the folding/unfolding process of CL nodes deflected by the helical structures of all matter involved in the body under consideration. The physical parameter of the body involved in this process is its total mass.

Assumption: Let assume that the folding/unfolding energy referenced per 1 kg of newton's mass is equal to the intrinsic forces work, obeying the inverse cubic law, but expressed by the work carrying this mass (1 kg) from distance *d* to infinity. This is an estimation of the intrinsic energy with its inverse cubic law but expressed by the newton's gravitational parameters (G and M_S).

$$U^{IG}{}_{GS} = \int_d^{\infty} \frac{GM_S}{x^3}dx = \frac{GM_S}{2d^2} \quad \text{(J)} \qquad (10.50)$$

Now considering that the work expressed by Eq. (10.50) is relevant for the unit surface area of 1 m^2, we may express the total separation work by multiplying the area of the ESS by this value.

$$E_S = 4\pi r_S^2 U^{IG}{}_{GS} \qquad (10.51)$$

Let use the estimated value of the critical mass M_{CR}. By substituting the parameters given by Eq. (10.50) into (10.51) we obtain E_S for a small astronomical object with mass approaching M_{CR}.

$$E_S = \frac{2\pi G M_{CR} M_S^2}{(M_S - M_{CR})^2} = 9.177\times10^{13} \quad \text{[J/kg]} \qquad (10.52)$$

The energy E_S is intrinsic energy involved in folding/unfolding process. It is borrowed from the CL space, so it could be considered as a **reactive energy**. The distance parameter in Eq. (10.52) is eliminated, but we have neglected the general relativity effect of the CL space shrunk (space curvature) around the massive body.

Eq. (10.52) could be checked by experimental planetary data but their parameters should be properly normalized. In order to satisfy the trend link to the atomic particles and atoms (the first trend of the plot in Fig. 10.7) the planetary mass should be divided by the first critical mass M_{CR1}, and the matter density must be normalised to the critical density. The properly normalized expression is:

$$E_{Sn} = \frac{2\pi G M_P{}^* M_S^2}{(M_S - M_P{}^*)^2} \qquad (10.53)$$

where $M_p{}^*$ - is a **normalised "mass"** of the astronomical body, given by the expression:

$$M_P{}^* = \frac{M_P}{M_{CR}} \frac{\rho}{\rho_{CR}} \qquad (10.54)$$

where: ρ - is a planetary average density, ρ_{CR} - is a critical matter density given by Eq. (10.47.a).

Note: M* according to Eq. (10.54) is a dimensionsless parameter.

Table 10.6 shows the value of some parameters involved in E_S and the calculated value of E_{Sn} for the planets of the solar system. While the shown parameters exhibit quite large variation in a range of few orders, the variation of E_{Sn} between different planets is quite smaller, ranging from 0.724E14 to 2.245E1

Some of involved parameters and E_{Sn} in function of distance Table 10.6

No	Planet	r_s [m]	ρ [kg/m^3]	U^{IG}_{GS} [J/m2]	E_{Sn}
1	Mercury	2.3589E7	5427	0.0198	8.44E13
2	Venus	1.6922E8	5243	5.672E-3	8.736E13
3	Earth	2.5926E8	5515	2.965E-3	8.306E13
4	Mars	1.2951E8	3933	1.276E-3	1.165E13
5	Jupiter	2.4071E10	1326	1.095E-4	3.461E14
6	Saturn	2.4132E10	687.26	3.258E-5	6.669E14
7	Uran	1.8959E10	1270	8.060E-6	3.607E14
8	Neptun	3.2273E10	1638	3.2814E-6	2.797E14
9	Pluto	4.688E8	1750	1.8975E-6	2.617E14

We see that E_{Sn} is close to the theoretical value E_S given by Eq. (10.52) , but not exactly equal. E_{Sn} exhibits also some variation from the distance between the planet and Sun. The obtained discrepancy from the theoretical value might be a result of ignored General relativity effect of space curvature (CL space shrinkage). Such conclusion is in agreement with the analysis, provided in the next paragraph.

10.6.3.A. Signature of General relativity and folding nodes from the Global CL space.

Let use Eq. (10.47) in a form

$$\left[\frac{E_{IFM}}{E_K}\right]^2 = C_E r \text{, where } C_E = \frac{4\alpha^2 c^2}{GM_S}$$

This equation was derived by neglecting the General relativity effect and the factor C_E is obtained as a constant. The General relativity, however, is an effect characterized with increased stiffness of CL space around a massive astronomical object. In Chapter 2 it was shown that a very small change of the CL node distance could cause increase of CL space stiffness due to the inverse cubic IG law. This will affects the node resonance frequency, the SPM frequency and consequently the light velocity. The index of refraction in the local CL space of heavy astronomical object is slightly higher than the free CL space. The parameter α is a constant for the whole galaxy CL space. The question is about G and M_S. The Newton's gravitation is propagated by the IG(CP) forces and one may expect that it is also affected. The theoretical analysis of this issue by the physical constants is difficult because they are interdependent in CL space environment. **Although we may investigate the variation of the experimentally calculated value of this factor by the planetary data.**

For this reason we express the calculated equivalent parameter C_E* by the expression:

$$K_E{}^* = \frac{1}{r}\left[\frac{E_{IFM}}{E_K}\right]^2 \qquad (10.55)$$

where: $r = d$ - is the mean distance of the planet from Sun

The plot of Eq. (10.55) in function of distance from the Sun is shown in Fig. 10.9.

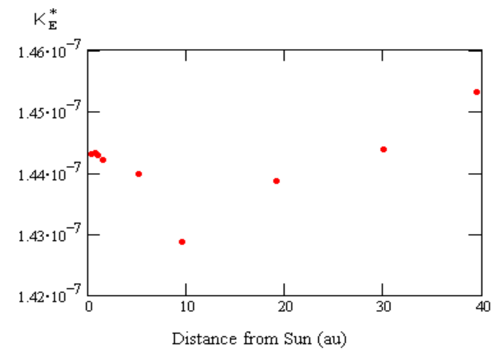

Fig. 10.9

Analysing the folding/unfolding energy in &10.6.3 we found that E_{Sn} is distinguished from the constant theoretical value given by Eq. (10.47). But the theoretical Eq. (10.46) does not take into account the General Relativity effect of a space curvature. Fig. 10.10 shows a plot of fold/unfold energy, calculated by the planetary data (see Table 10.6).

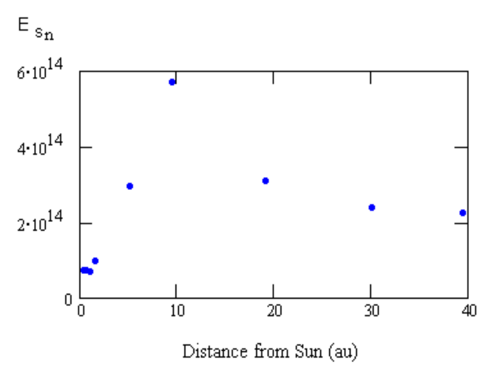

Fig. 10.10

The following planetary data has been used:

- for K_E plot: - planetary mass, orbital velocity, distance from the Sun

- for E_{Sn} plot: - planetary mass, planetary density, distance from the Sun

If connecting the points of the plots if Fig. 10.9 and 10.10 we see that they posses a similar trends, but inverted.

First conclusion: The similarity between both plots shows a strong correlation between the orbital velocity and the mean planetary density. But what could be the physical phenomena staying behind such connection? The possible answer is: **The strong correlation could be provided by the folded nodes from the Global CL space - the Milky way.** They pass through all astronomical bodies of the solar system, including all macrobodies they are consisted of, in a scale down to the level of protons and neutrons and even inside of their external shell (between the helical structures of the internal pions and kaon).

Second conclusion: The change of the experimentally determined C_E* is a signature of General relativity effect, caused by the large solar mass.

Third conclusion: The common trend, apparent in both plots, could not be caused by a continuous variation of single parameter. Variations of two parameters are obviously involved. From the theoretical expression of C_E it is evident, that the parameters α, c, G and M_S are involved. α is a prism parameter, so it is a constant for the whole Milky way galaxy in any conditions. The trend from point 6 to point 8 has a quadratic shape and matches the light velocity dependence on the distance in a strong gravitational field. The trend from point 1 to point 4 in Fig. 10.10 is contributed by the parameter $U^{IG}{}_{GS}$ estimated by Eq. (10.50) and involved in (10.51). This parameter is related to the product GM_S. It is difficult to determine which of both parameters of this product is affected. The planetary mechanics allows estimation of the product GM_S with much better accuracy than the involved separate parameters. In a similar way the product $GM_E = 0.39860044\times10^{15}$, where M_E is the Earth mass is known with better accuracy than the separate components.

Fourth conclusion: The planet Saturn (point 4) is in the break point between the both curve trends. This appears in both plots. The special position of this planet may have relation with some of its specific features:

- the lowest mean matter density of Saturn in comparison to other planets

- coincidence between the polar axis and magnetic dipole axes

- well defined planetary ring with Cassini gaps

- satellites with orbital period equal to sideral one

The orientation of the Sun and planetary magnetic axes in respect to the velocity vector of the solar system motion in the Milky way is additionally discussed in later in relation with the formulated Feromagnetic hypothesis.

10.6.4 Some theoretical aspects of the solar system motion in the global CL space

The motion of the solar system around the Milky way centre provides the necessary folded node motion for all bodies in the system. We may conclude that: **the inertial interactions and the total dynamical equilibrium is defined for the total solar system.**

In the previous analysis we found that using the critical mass provides theoretical expressions, that could be verified by observational data. Let considering a single astronomical body with critical Mass M_{CR2} moving in the global space with the optimal velocity $\upsilon = \alpha c$. Then its kinetic energy is:

$$E_{CR} = 0.5M_{CR2}\alpha^2c^2 = 2.393\times10^{35} \tag{10.57}$$

The total energy from the orbital rotation of all planets of the solar system is: $\Sigma E_K = 1.9857\times10^{35}$

The ratio between both energies is:

$$\Sigma E_K/E_{CR} = 0.8298 \tag{10.57.a}$$

The total kinetic energy from the planets is about 83% of the theoretical one estimated by Eq. (10.56) but the rotational energies of all moons and asteroids are not included.

The close value of the above ratio to unity might serve as a criterion for long term stability of the solar system. These feature is a subject for discussion in many international workshops.