1. Chapter 1 Introduction

Our vision about the micro-cosmos and Universe is formed through the prism of the space-time concept, which is defined by the concept of the physical vacuum. The latter has been changed four times during the history of Physics. Is the currently adopted concept a final truth? The time according to the Theory of Relativity is not absolute. Then what defines the space-time properties of the physical vacuum and why the velocity of light propagation is postulated? These and other similar questions could not be found in the textbooks. Presently our understanding of micro-cosmos and Universe is full of enigmatic problems. In the cosmology, the Big-Bang "theory" relies on the presumption that the observed red shift is of Doppler origin and the space in the Universe is homogeneous. The concepts of the Big Bang and the black wholes contain unexplainable problem of singularity. In few words, this means that the enormous matter of the Universe originate from (or end-up into) a mathematical point containing an unimaginable enormous energy. If so, one may accept an independent existence of other such points whose explosion will lead to a Universe disaster, but such phenomenon is not observed. The Big Bang concept is plagued by many observational puzzles, such as: existence of stars (located usually in the Globular clusters) older than the "age of the Universe", a signature of hidden matter, called "a dark matter", existence of a supermassive black hole in the center of every well developed galaxy and so on. Recent observations of how the Hubble "constant" changes with the z-shift led to a new enigmatic problem for the cosmologists: an "open" (disintegrating) Universe. To save the ill Big Bang concept now a distributed dark-energy component with a "negative pressure" is invented. It seems that any possible attempts are made to avoid the admission that some underlying material structure of the space (physical vacuum) may exist. At the present time, such option is avoided from discussion because this means a death of the Big Bang theory.

In the microscale range, the Particle Physics proposes an enormous number of sub-elementary particles and contradicting rules. The "quark", for example, is a substructure of the proton but its mass is estimated as about 185 times larger than the proton's mass. Many interactions provide infinities (in an energy aspect) that are unexplainable. All these facts point to some misunderstanding of the Universe and microcosmios. Apart of this, it is not possible to connect the Quantum Mechanics with the theory of Special and General Relativity. Despite a century long efforts a satisfactory unified theory is not available. In the experimental fields the discrepancies are even more obvious. In the article "Those Scandalous Clocks", R. R. Hatch [1], a distinguished pioneer in the GPS system provides evidence of discrepancies between the observational facts (from the GPS system, the Very Long Based Interferometry and the pulsar detections) and some formulations in the Special Relativity. He provides analysis showing that such discrepancies do not exist if using the Lorenz Ether Theory (LET). His analysis led to revealing one very important effect: the speed of light is velocity dependent, but in the experiments it appears independent, because the Doppler shift and the relativistic effect of clock rate change cancel each other. Such effect means a reconsidering of light velocity experiments. This includes also the Michelson-Morley experiment, which is cited in text books as a basic proof of not existing Ether. Now not only new experiment confirm the detection of our motion through a space medium, but the original data from Michelson-Morley experiment has been reanalyzed by M. Consoli and E. Constanzo [4] using a correct method and two velocities are clearly identified: the Earth orbital velocity around the Sun and the solar system velocity around the centre of Milky Way. Among the early modern experiments are those suggested and performed by Prof. Stefan Marinov [33,34,35]. In the period of 1976 to 1986 he successfully detected and measured the orbital motion of the Earth around the Sun and the Solar system motion around the Milky Way center, using pure

laboratory experiments. One of his experiments is repeated by E. W. Silvertooth (1986) and the results are confirmed. These and number of other experiments prove the existence of absolute frame, which for us is the space of the Milky Way galaxy. This requires a redefinition of the inertial frame postulated by Special Relativity (SR). At the same time, the redefinition of some postulates does not contradict to the existence of the SR effects, such as the time dilation and the relativistic mass increase.

The accumulated problems and discrepancies could not be resolved without revision of some adopted fundamental rules and postulates in Physics. All of them are dependable on the adopted concept of the physical vacuum.

The revision of the vacuum concept requires some acquaintance with the developments in pre-modern Physics. Until the 17th century, the vacuum concept was influenced by the ancient Greek philosophers Aristotle, Leucippus and Democritus [1,2]. It has been redefined after the invention of the barometer by the Evangelista Torrichelli in 1644 and the vacuum became regarded as a pure empty space for a while. After the discovering of the electromagnetic radiation, however, the Ether concept became dominant in the 19th century Physics. The 17, 18 and 19th centuries gave great physicists whose contribution to the science and the vacuum concept is enormous. In this aspect it is worth mentioning Isaac Newton, Andre-Marie Ampere, Michael Faraday, William Thomson, James Clerk Maxwell. In the beginning of 20 century, the Ether concept has been abandoned and in 1925 a space-time concept was accepted as a result of adopted Quantum mechanical postulates, known as Copenhagen formalism. The Theory of Relativity played an important role for the introduced space-time concept but Einstein did not agree with some formulations of the Copenhagen interpretation in 1925. This is evident from his article "Can Quantum-mechanical Description of Physical Reality be Considered Complete" [3], with co-authorship with B. Podolsky and N. Rosen. In the beginning of 20th century, Einstein initially denied the existence of the Ether, but later changed his opinion. In the article of Galina Granec, Haifa University, Israel an authentic material from Einstein about the physical vacuum is collected: In a letter to Lorenz dated 17 June 1916, Einstein wrote (quoted in Miller, 1986, p.55 [38]; see also Kostro, 1988, p. 238 [39]):

I agree with you that the general relativity theory admits of an ether hypothesis as does the special relativity theory. But this new ether theory would not violate the principle of relativity.[40].

In 1920 at lecture in Leiden, Einstein says [40,41]

... there is a weightly argument to be adduced in favour of the eher hypothesis. To deny the ether is ultimately to assume that the empty space has no physical qualities whatever. The fundamental facts of mechanics do not harmonized with this view.

While Einstein introduced a cosmological constant in his earlier equations, later he removed it claiming that this has been the "greatest blunder" of his career. Despite of this, the Big Bang supporters today use namely this constant as a last life belt for saving the sinking Big Bang concept.

In fact, even the enigmatic space-time concept and all relativistic effects could be better explained by an alternative but correct vacuum concept, which is closer to the Ether one than to the void space. In the last decade, the interest to the vacuum properties is significantly increased due to the unexpected results from non-conventional experiments, which are unexplainable from the point of view of contemporary Physics.

When beginning a revision of the adopted concept of the physical vacuum we must take into account the rational achievements in Classical Physics. The father of Modern Electrodynamics, James Clerk Maxwell built his famous theory with the presumption for the existence of Ether. In his "Treatise on Electricity and Magnetism" vol. II [5] he writes:

The theory I propose may therefore be called a theory of Electromagnetic Field, because it has to do with the space in the neighbourhood of the electric or magnetic bodies, and it may be called a Dynamical theory , because it assumes that in that space there is a matter in motion , by which the observed electromagnetic phenomena are produced.

... If something is transmitted from one particle to another at a distance, what is its condition after it has left the one particle and before it has reached to the other?... Hence, all these theories lead to the conception of a medium in which the propagation takes place, and if we admit this medium as an hypotreatise, I think it ought to occupy a prominent place in our investigations, and that we ought to endeavor to construct a mental representation of all the details of its action, and this has been my constant aim in this treatise

The original Maxwell's equations, defined for 20 field variables, are formulated in a quaternion form [6,7]. Later other physicists (Oliver Heaviside and William Gibbs, Lawrence etc.) transformed them into the known today vectors form. While the vector equations are very compact, Maxwell has not recommended them, because they are not able to describe completely physical phenomena. These tailored Maxwell equation are in all textbooks today. They are convenient but do not describe the whole truth. Recently K. J. van Vlaenderen and A. Waser in the article "Electrodynamics with scalar field" [8] shows that the electrodynamics can be efficiently formulated in biquaternion form in which the original Maxwell's concept is preserved. The major profit from this is the prediction of existence of longitudinal electroscalar waves in vacuum. A similar result is obtained independently by K. P. Butusov [9]. Longitudinal waves firstly introduced and observed by Nikola Tesla and recently confirmed by many experiments are not apparent when using the vector form of the Maxwell's equations.

The acceptance of Ether existence automatically leads to the conclusion that it should possess **two kinds of states: a steady state and a transient one.** One of the consequence from tailoring the original Maxwell's equations is the exclusion of the transient state properties of the physical vacuum. That's why some physical phenomena may look like paradoxes and some experiments are regarded as a contradiction to the "laws of Physics". In other words, the transient state of the vacuum is outside of the filed of view of Modern Physics today. One of the features of this state is the possibility for transmission of energy in a way unexplainable by the currently adopted space concept. The radiant energy discovered by Nikola Tesla 100 years is one proof for the transient state of the space. The Tesla's famous experiments about wireless and single-wire power transmission were regarded for many years as "exotic", but now they are confirmed [10,11]. Presently, the search related to the hidden vacuum energy and the effects related to Ether disturbances reached unprecedented level [12,13].

The existence of hidden energy in space, for which experimental proofs exist, could not be explained by the presently adopted concept of the physical vacuum, so a new model must be found. Such task should go parallel with a more universal one – a building of unified theory, because the new physical model about space and matter must fit to the unified vision about the forces in Nature. In order to avoid any departure from reality, some of the adopted so far rules of the Copenhagen formalism must be ignored and the principles of causality, objective reality and logical understanding must be accepted as rules. In such aspect, instead of the traditional way of studying the vacuum properties as energetic interactions, a new approach was introduced – a building of detailed physical model of the underlying structure of the physical vacuum whose elements must be also involved in the possible structures of the elementary particles. Such physical

model with unveiled fundamental interactions must provide explanation about the known physical fields, forces and interactions in a real 3+1 space-time. It also must provide a vision about the connections between the different fields – gravitational, electrical and magnetic. It must find also the relation between Classical Mechanics, Quantum Mechanics and Einstein's Theory of Relativity.

In Cosmology, it was found that a supermassive black whole (with size of billion solar masses exists in the center of every galaxy and any such "hole" is in a balance with the total mass of the visible matter of the host galaxy [14]. Additionally, an existence of a hidden "dark" matter whose signature is apparent from the galactic rotational curve is rather a rule than an occasional fact [15]. These new discoveries together with many others lead to the idea that the indirectly detectable "dark" matter is in fact a signature of an underlying material structure of the physical vacuum. Such structure should exist around us and within us.

The search for the correct space-time concept required extensive study on some features of the physical vacuum such as the Zero Point Energy, the quantum fluctuations, the vacuum polarization, the Plank's length and frequency and so on. In such aspect, the theoretical articles provided by T. H. Boyer [16], H. E. Puthoff [17,18,19] H. E. Puthoff et al [20], B. Haisch et al. [21] and F. M. Meno [2] were quite useful. The articles "Experimental evidence that the gravitational constant varies with the orientation" by M. M. Gershteyn et al [22] and the "Speed of gravity revisited" by M. Ibison et al. [23] lead to the idea that the Newton's law of gravitation might be derivable instead of postulated. This idea obtained some theoretical treatment by H. E. Puthoff [17] (1989) who show that the Newton's law of gravitation is related to Planck's frequency, $\omega = [2\pi c^5/(hG)]^{1/2}$. Using one hypothesis of Sakharov he shows that the Newton's law is derivable. In the development of BSM theory, an idea was conceived that the Planck's frequency could be an intrinsic parameter of some fundamental particle (or pair particles) interacting in a pure empty space by a fundamental law of Super Gravitation.

Concept of the Basic Structures of Matter (BSM) treatise

The treatise Basic Structures of Matter, a Super Gravitation Unified Theory unveils the relation between the forces in Nature by adopting of the following framework:

- Empty Euclidian space without any physical properties and restrictions
- Two super dens fundamental particles, able to vibrate and congregate
- A fundamental law of Super Gravitation (SG) – an inverse cubic law valid in empty space.

Enormous abundance of these particles, driven by the fundamental SG law into self-organised hierarchical levels of geometrical formations, leads deterministically to creation of space with quantum properties - physical vacuum and a galaxy as observable matter.

The underlying structure of created space (physical vacuum) is called Cosmic Lattice (CL). It is built of two super dens sub-elementary particles, which are geometrical formations from the fundamental particles hold by SG law. The two sub-elementary particles with a shape of elongated prism are arranged in flexible nodes, each one formed by 4 prisms. Additionally, the SG field of the prisms exhibits an axial anisotropy with a right or left-hand twisting component, respectively for both types of prisms, due to their lower level structure. The observable space is filled by CL grid of alternatively arranged nodes, forming a lattice similar as the diamond atomic lattice. The estimated node distance is in order of $(1\sim2)\text{x}10^{-20}$ (m), while the intrinsic matter density of the prisms is about $1\text{x}10^{13}$ time higher than the average density of the atomic matter. The individual node of the CL structure possesses a flexible geometry, a freedom to oscillate in a complex spatial mode and energy well. The complex dynamics of CL node oscillations is related to the parameters

permeability and permitivity of free space. The common mode oscillations with a running phase synchronization are related to the parameters Compton wavelength and define the light velocity. The CL space exhibits quantum features and provides conditions for existence of fields: gravitational, electrical and magnetic. These fields are defined by the static and dynamic parameters of the CL nodes. The elementary particles also possess a structure in which helical formations of prisms are identifiable and called helical structures. The lowest order helical structures have denser (than CL) internal lattices with a twisted component. The SG field of this internal lattice is able to modulate in a specific way some of the oscillating parameters of the surrounding CL nodes, creating an electrical field. The same denser internal lattice causes a partial folding and displacement of the CL nodes when the particle moves in CL space. This process, in which proximity fields are also involved, defines the intrinsic inertial properties of the elementary particle. Some of the main CL space parameters are the following: a Static CL pressure, a Dynamical CL pressure and a Partial CL pressure. They are related respectively to: the mass of the elementary particles, the CL space background temperature (2.72K), and the inertia of the atomic matter. Theoretical equations of these parameters are found and expressed by the known physical constants. A mass equation applicable for the elementary particles is derived by analysis of the dynamical interactions of the electron in CL space environment. The Planck's constant and the rules of the Quantum mechanics obtain physical explanations. The velocity of light is a derivable parameter. The relativistic concept of an inertial frame obtains a logical physical explanation and the effects of the General and Special relativity are understandable. The CL space allows also a creation and propagation of virtual particles, corresponding to the Dirac's idea of virtual particles. Possessing only a charge without intrinsic matter, they could be easily confused with the real particles, which possess matter. The results from the developed models are in excellent agreement with the experiments and observations in the range from a micro to macro Cosmos.

The proposed BSM models are verified by cross validation of their output results with experimental data from different fields of physics. The unveiled low-level structures, involved in the physical vacuum and the elementary particles, further allow deciphering the structures of the atomic nuclei. It appears that the rows and column pattern of the Periodic table is a signature of the atomic nuclear configuration – the spatial arrangement of the protons and neutrons in the nucleus. The electronic orbital shapes are strictly defined by the nuclear configuration. In this aspect, one of the most useful results from the BSM theory is the illustrative appendix titled **Atlas of Atomic Nuclear Structures (ANS).** It shows the unveiled configurations of the atomic nuclei for the elements from Hydrogen to Lawrencium (Z = 103) [27].

The alternative vacuum concept changes our vision about the micro Cosmos. It appears to be well organized due to well-defined and logically consistent natural rules. The new concept leads also to alternative cosmology: The Universe must be stationary. This is in good agreement with the accumulated cosmological data. For example: The red shift periodicity in the observation of Q-stellar objects [28,29,30] that is explainable only if the galactic red shift is not of Doppler type; the observed dipole shape of the cosmic microwave background; the Lyman alpha forests [31]; the observable deviation of the Hubble law from the expected one for redshifts above 0.8; the galactic rotational curves; many observations indicating an enormous percentage (over 90%) of hidden "dark matter" and so on. A careful analysis of the observational data, based on the new space concept, leads to the conclusion that the galactic red shift is a result of small energy losses that photons exhibit when passing from one galactic space to another. According to the new space concept, this is a result from the small differences between the underlying vacuum space structures of the different galaxies, because they are from different evolutional formations. This particular result, is in a good agreement with the alpha forest observations [31]. While this phenomenon is unexplainable enigma for the Big Bang model, it excellently fit to the BSM concept (see section

12.B.12 Chapter 12 of BSM). All these cross-related phenomena change significantly our vision about the Universe. Instead of searching for a hypothetical Big Bang, the focus is moved on the individual galaxy as a family member of the Universe. In such different scenario, every galaxy should have a cycle comprised of phases, such as an active life, a collapse and a rebirth. **While the active life is only visible, the other phases are completely invisible, but they are indirectly identifiable by some cosmological phenomena.** In the hidden phases, a complete recycling of the old matter and a crystallization of a new one takes place, but some low level structures of the intrinsic matter could not be destroyed and they preserve the information defining the existence of "matter instead of antimatter". The hypothetical concept of this cycle and its phases are presented in Chapter 12 of BSM, where some insight about the fundamental SG law is also discussed. The underlying vacuum structure from the consecutive cycle periods may obtain some small differences, because the total matter of the galaxy plays a role in the formation of the new sub-elementary particles – the prisms. It is known that our galaxy contains older stars than the "age of the Universe" and they are located in the globular clusters. These formations appear to be remnants from the previous galactic life. They have escaped the galactic collapse due to the CL space break-up during this cosmological event. The Cepheids from these clusters exhibit different features. Even the motion of the stars in these clusters exhibits a strange behavior, which is explainable if they have a "lower Maxwellian energy", according to I. R. King [32]. (see section 12B.7.2.1, Chapter 12 of BSM).

It is well known that some physical phenomena in Quantum Mechanics, Particle Physics and Relativity could not be logically explained. As a result, it is accepted that the human logic fails. This is a big obstacle for building of successful unified theory. BSM theory is free of such problem. This permits to build a comprehensive logical scenario about the evolution of the matter covering the range from micro cosmos to the Universe, while using a new interpretation of the observed phenomena. Such scenario is free from the paradoxes and problems, which currently plague the Big Bang theory. Figure 1 provides a comparison between the currently existed concept about the Universe and the concept envisioned by BSM theory. In the latter case, the principles of causality and unperturbed human logic are strongly observed.

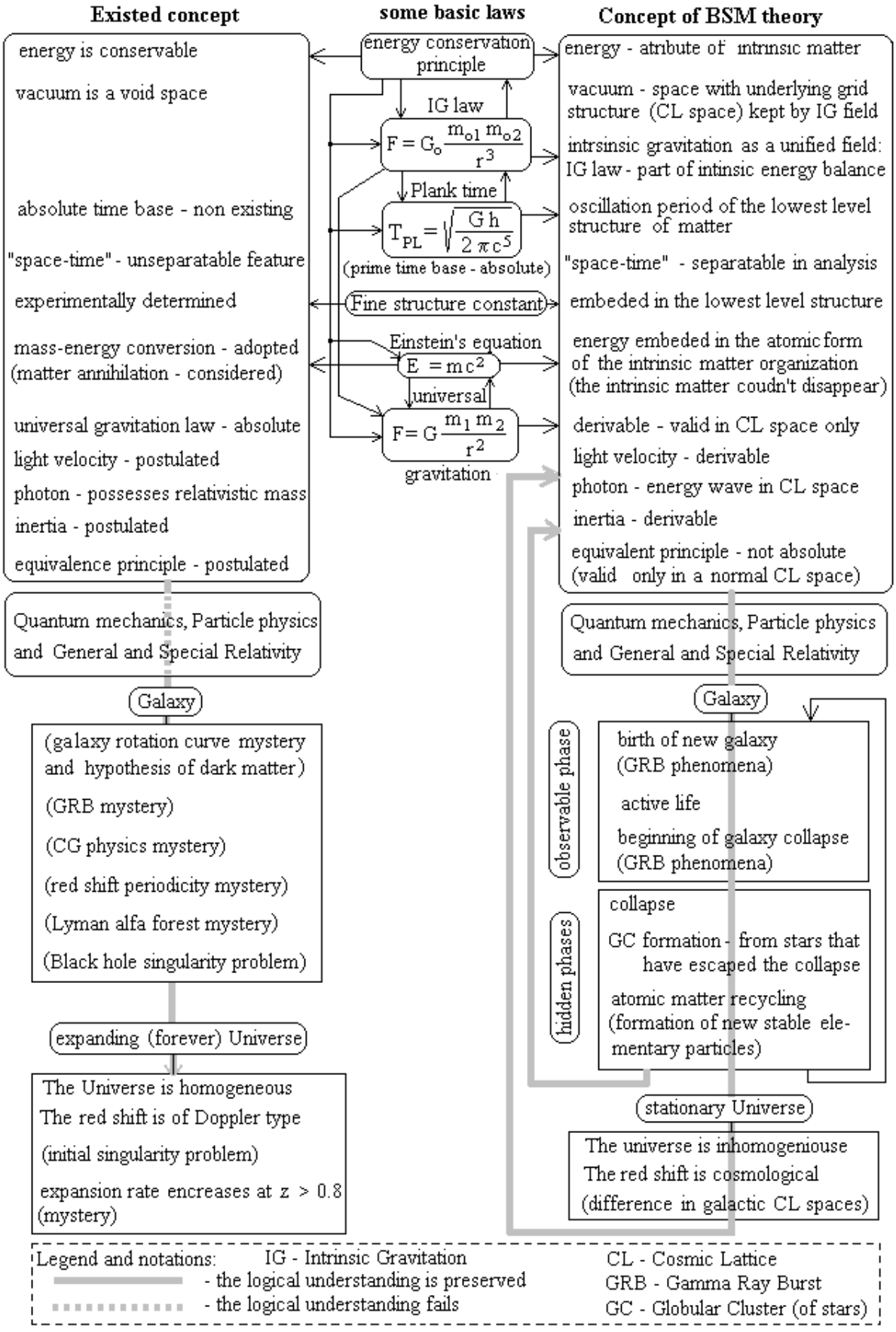

Fig. 1. Difference between the present and the new vision about the Universe according to BSM

The unveiled structural formations and the derived physical models are illustrated by a large number of drawings. In their analysis a straightforward mathematical methods are used. A number of new features, parameters and interactions mechanisms are discovered. They are denoted and explained in the first time they appear, while later are only referenced. For this reason the reader is advised to follow the Chapters order.

The Basic Structures of Matter monograph contains 13 Chapters and a few Appendices. The most important appendix is **The Atlas of Atomic Nuclear Structures (ANS)**

Part I of ANS provides the geometry and internal structure of the basic elementary particles, consisting of helical structures. Part II of ANS provides the atomic nuclear structure of the elements up to Z = 103. In order to simplify the complex three-dimensional configuration of the atom, symbolic notations are used for the proton, neutron, deuteron and helium. The electronic orbits are not shown, but their positions are well defined by the position and the proximity electrical field of the protons (or deuterons). The raw and column signature of the periodic table is well matched; the Hund's rules and Pauli exclusion principle are identifiable. Due to a drawing complexity, the twisting feature of the proton, neutron and atomic nuclei are not directly shown.

In the last Chapter 13 a summary of the potential applications is presented, while some of them are apparent from the analysis in previous chapters. In this chapter three Special applications are also discussed, which are results of the very original predictions of BSM theory: a hidden space energy of EM type – a primary source of the nuclear energy, a possibility for control the gravitation and inertia of material object, and a supercommunication by using a new type of waves.

The full version of BSM and some related articles are published initially in www.helical-structures.org (S. Sarg, 2001) and archived to the National Library of Canada [24] (first edition, 2002, second edition, 2005). A brief introduction to BSM and other related articles are published in Journal of Theoretics [26] (S. Sarg, 2003), in http://lanl.arxiv.org [25] and in Physics Essays [37].

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