Basic Structures of Matter – Supergravitation Unified Theory Based on an Alternative Concept of the Physical Vacuum

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The Basic Structures of Matter - Super Gravitation Unified Theory (BSM-SG) shows the relation between the forces in Nature by adopting the following ideas:

- Empty Euclidian space without any physical properties and restrictions
- Two fundamental particles of superdense matter with parameters associated with Planck's scale and with the ability to vibrate and congregate
- A Fundamental law of Super Gravitation (SG) – an inverse cubic law of forces between the fundamental particles in pure empty space.

Driven by the SG law, an enormous number of the two particles, with vibrational energy above some critical level, are able to congregate into self-organized hierarchical levels of geometrical formations. A self-organizing process in a supermassive astronomical object of primordial matter leads deterministically to crystallization of sub-elementary and elementary particles followed by creation of space with quantum properties, known as the physical vacuum, and development of a galaxy. The underlying superfine structure of the physical vacuum called a Cosmic Lattice (CL) is built by two types of sub-elementary particles. All known laws of physics are embedded in the properties and interactions between the CL structure and the structure of the elementary particles. The static and dynamic properties of the individual CL nodes provide the relations among the gravitational, electric and magnetic fields.

1. Introduction

James Clerk Maxwell developed Classical Electrodynamics with the assumption of a material Ether [1]. After the inconclusive Michelson-Morley experiment, Einstein formulated in 1905 his postulate of Relativity that led to overthrowing the idea of the Ether. After development of General Relativity in 1920, Einstein partly reversed his opinion in favor of the Ether. In his book "Sidelights of Relativity he says "Without Ether the General Theory is unthinkable" [2]. At the same time Einstein did not present any proof that the concept of the material Ether is impossible.

2. Basic Structure of Matter – Supergravitation Unified Theory (BSM-SG)

BSM-SG unveils the relation between the forces in Nature by adopting the following framework [3,4,5,6]:

- There are two spherical superdense indestructible fundamental particles (FPs) of two different substances of intrinsic matter with a radius ratio of 2:3 and different densities. The bell-shape curve radial dependence of their density permits vibration of the mass center at super-high proper frequency with an average value (for both types of FPs) associated with Planck's frequency, F_{PL}:

$$F_{PL} = [(2\pi c^5)/(Gh)]^{1/2} = 1.855 \times 10^{43}\ (Hz) \quad (1)$$

- There is a fundamental law of Super Gravitation (SG), according to which FPs interact by a force inversely proportional to the cube of the distance. The SG law in empty space is given:

$$F_{SG} = G_O \frac{m_{01} m_{02}}{r^3} \quad (2)$$

where: F_{SG} is the SG force, m_{01}, m_{02} are intrinsic matter mass, r is distance; G_0 is a SG constant, which is different for each matter substance and may change sign for the case of imbalanced geometrical formations made from both FPs.

- Vibrational energy and SG law: FPs preserve a limited freedom of vibration in geometrical formations made from the same type of substance. In a complex 3D structure, FPs vibrate within a saturation limit – an energy well of the structure. The SG law is associated with the necessary energy for filling the well. The SG constant has a frequency dependence on the density of structural formations and may change sign, which mean that SG forces could be attractive or repulsive.
- Signature of SG forces – Casimir Forces – attractive and repulsive - and some Van der Waals forces.

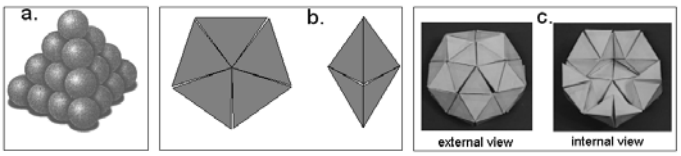

Fig. 1. Structures of lowest level. a. Tetrahedron (TH), b – Quasipentagon, c. – Quasiball (QB)

An enormous number of the two FPs interacting by SG forces and possessing energy above some critical level causes formation of self-organized hierarchical levels. A unique crystallization process leads deterministically to creation of space with quantum

properties – a physical vacuum and elementary particles forming the observable matter of an individual galaxy.

Fig. 1 shows three consecutive types of 3D formations at the lowest order of the crystallization process. They are denoted as Tetrahedron (TH), Quasipentagon (QP) and Quasiball (QB).

The embedded FPs causes common mode spatial oscillations in TH with properties defined by the TH geometry. It is found that the ratio between the frequency of common mode oscillations of TH and the Planck frequency of FP is equal to the fine structure constant α . Equation (3) is derived in §12.A.5.3 [6].

$$\alpha = 2/[(n^2 + 2\pi^2)^{1/2} + n] = 7.29735194 \times 10^{-3} \quad (3)$$

$$\alpha = 7.297352533 \times 10^{-3} \quad \text{CODATA 98} \quad (4)$$

The vibrational SG modes in QP exhibit an axial anisotropy due to its geometrical shape. The gaps between the THs in QP are combined in a common gap of 7.355^0, which is preserved in QB. This allows a left or right hand twisting of the QB - a lowest level memory carrying the cirality (handedness). The next higher order contains the same type of formations, while the TH is formed by QBs of the previous order. For all orders the following equation for quantity of embedded FPs is valid.

1 QB = 12 QP = 60 TH

The frequency of common mode vibrations decreases from TH to QP to QB and for subsequent orders. Consequently, the well-defined hierarchical level of structural formations serves as an accurate divider of the superhigh Planck frequency.

The sectional view of QB shows that this formation encloses an internal empty space. The same is true for the upper hierarchical orders of QBs. Consequently if such QBs are compressed in a shell they will be molded into hexagonal prisms with internal structure carrying left and right handed twisting. The two types of prisms are respectively made from the two types of FPs.

Fig. 2 illustrates the hypothetical evolution stages of the primordial matter from both FPs leading to formation of internally twisted prisms followed by their crystallization into helical structures from which elementary particles are built [6].

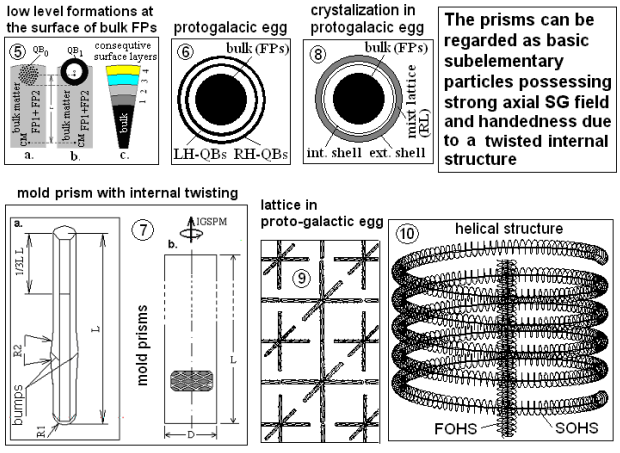

Fig. 2. Evolution stages of primordial matter and structures

The crystallization process occurs in a hidden phase of evolution of an individual galaxy. The remnant of the enormous abundance of FPs is in the center of the galaxy, now identified as a supermassive black hole. The galaxies have a cycle comprised of a hidden phase of particle crystallization, an observable active life, and a collapse with particle recycling. Globular clusters are remnants from a past galaxy life. The birth and collapse of an individual galaxy with an average active life of 12 billions years has a detectable signature – a Gamma Ray Burst. The galactic red shift is not of Doppler type but cosmological due to a small difference in molded prisms and contained energy. The universe is stationary and everlasting. These conclusions agree with the accumulated observations discussed by the Alternative Cosmology Group [7].

The free prisms form a spatial structure called a Cosmic Lattice (CL), while the stable particles - protons, neutrons and electrons - initially form simple atoms, such as hydrogen, deuterium, tritium, helium and the first molecules. The newborn space has all the known properties of the physical vacuum, while the elementary particles interacting with the CL structure exhibit quantum mechanical features. The main properties of CL space are:

- The CL structure is formed of alternately arranged CL nodes made of 4 prisms of the same type aligned along the four apex axes of the tetrahedron they form. They have an intrinsically small inertia in a void space.
- The individual CL nodes are separated by gaps due to the specifics of the SG forces.
- The SG field between the elementary particles in CL space is propagated by the abcd set of axes (see Fig. 3) of the CL nodes and appears as Newtonian gravitation.
- The Electrical and Magnetic fields are types of CL space modulations, based on the dynamic properties of the CL nodes involving momentums along the xyz set of axes.
- The gaps between CL nodes and their proper frequency slightly depend on the mass of a material object, defining in this way the space properties according to General Relativity.
- Since the CL nodes are flexible, the nodes of a rarefied CL structures (with weaker internode forces) could fold and pass through a denser one. This gives a new vision of the inertial frame suggested by Einstein.

Fig. 3 illustrates the CL node dynamics under SG forces.

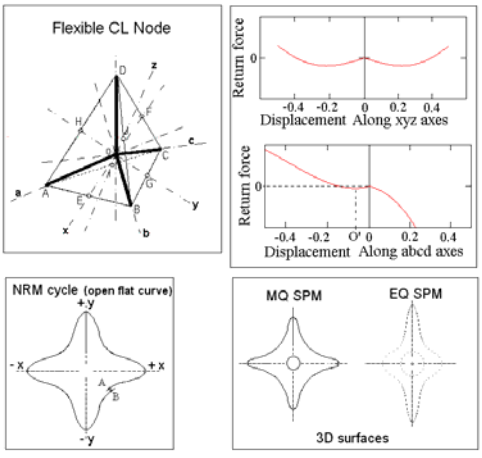

Fig. 3. CL node and its dynamics under SG law
MQ SPM has a central symmetry, EQ SPM is elongated

The dynamical behavior of the CL node is described by two vectors: Node resonance momentum (NRM) and Spatial Precession Momentum (SPM). The hodograph of NRM (cycle) is an

open flat curve, as shown at the left bottom side of Fig. 3. A large number of NRM cycles forms a closed 3D surface of the SPM vector called a Quasisphere. It has 6 bumps (along the xyz axes) and 4 depressions (along the abcd axes). The magnetic field lines are formed by aligned quasipheres called MQs, while electrical lines – by aligned EQs. The MQs and EQs are synchronized with slightly different SPM frequencies. The photon is a specific wave in the CL space possessing a helical configuration from orthogonally arranged EQs and MQs with a boundary of MQs. The energy momentum from every CL node included in the photon wavetrain transfers to a neighboring one in one NRM cycle – this defines the velocity of light. The velocity of light (EM propagation) is additionally stabilized by the effect of self synchronization between the CL nodes, which is with the SPM (Compton's) frequency, and it is involved in the definition of the permeability and permittivity of the physical vacuum (Chapter 2 of BSM-SG).

Elementary particles are built of prisms arranged in **helical structures** in a crystallization process preceding a galaxy's birth.

The Electron is one coil of a First Order Helical Structure (FOHS) - an oscillating 3-body system with two proper frequencies [5]. The first one is the Compton frequency equal to the SPM frequency of the CL node. Fig. 4 shows its overall shape and dimensions, internal lattice structure (impenetrable by the CL structure) and its modulation of the CL nodes, appearing as an electrical charge.

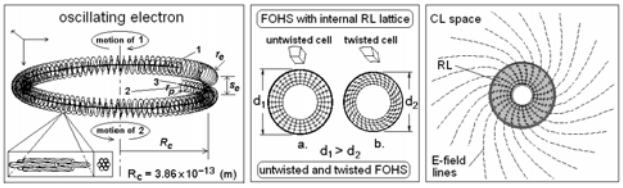

Fig. 4. Electron and its internal lattice modulating CL space. Calculated dimensions: (m): $R_C = 3.86\times10^{-13}; r_e = 8.8428\times10^{-15}$

The fine structure constant is embedded in the helical step s_e:

$$s_e = (\alpha c/\nu_c)(1-\alpha^2)^{1/2} = 2r_e = 1.7706\times10^{-14}\ (m) \tag{5}$$

The denser internal lattice of FOHS modulates the CL space, creating aligned EQ SPM – electrical field lines. When moving and rotating, they cause formations of loops of phase synchronized MQs – magnetic lines.

Confined motion: The screw-like motion of the rotating and oscillating electron and its interaction with the SPM frequency of the CL nodes causes a confined motion with preferred velocities, corresponding to (13.6/n) eV, where n matches the principal quantum number of the Bohr atomic model. In a closed loop motion, n defines the real length of the quantum orbit [21], because the loop length contains a whole number of quantum magnetic lines (See §7.7.1, Chapter 7 of BSM-SG).

Using the structure and oscillating properties of the electron, the following physical parameters of the CL space are derived:

- **Static CL pressure, P_S:** defines the Newtonian mass of an elementary particle (Equation 7) as a pressure exercised on the volume of its impenetrable internal lattice.

$$P_S = \frac{m_e}{V_e}c^2 = \frac{2h\nu_c^{\,4}(1-\alpha^2)}{\pi\alpha^2 c^3} = 1.3735\times10^{26}\ (\mathrm{N/m^2}) \tag{6}$$

$$m = (P_S/c^2)V_H\ (\mathrm{kg}) \tag{7}$$

where V_e = volume of denser internal lattice of the electron and V_H = a similar volume of a stable elementary particle.

- **Partial CL pressure, P_P:** related to the inertial properties of the elementary particles in CL space at their confined motion

$$P_P = P_S\alpha\upsilon/c\ (\mathrm{N/m^2})\ \text{where}\ \upsilon\ \text{is velocity} \tag{8}$$

- **Dynamical CL pressure, P_D:** exercised on atoms and molecules by ZPE waves responsible for equalization of the CL space background energy.

$$P_D = \frac{h\nu_c}{cS_e} = \frac{g_e h\nu_c^{\,3}(1-\alpha^2)}{\pi\alpha c^3} = 2.0258\times10^3\quad(\frac{N}{m^2 Hz}) \tag{9}$$

The signature of P_D is the observed Cosmic Microwave Background (CMB). Therefore, the estimated temperature of 2.72K (by fitting of CMB to a blackbody curve) in fact is a CL space background parameter. The derived theoretical expression (see Chapter 5 of BSM-SG) is:

$$T = \frac{N_A^{\,2}}{S_W}\frac{h\nu_c(R_C+r_p)^3 L_{PC}^{\,2}}{2cR_C r_e R_{ig}}\frac{\mu_e}{\mu_n} = 2.6758K \tag{10}$$

where Lp, shown in Fig. 5 is estimated by analysis in §6.12.2, Chapter 6 of BSM-SG [6].

Other identified CL space parameters:

- **CL node distance** (at xyz axes) ~ $1.0975\text{x}10^{-20}$ (m)
- **NRM (resonance) frequency**: $1.0926\text{x}10^{29}$ (Hz)
- **SPM frequency** = Compton frequency: $1.2356\text{x}10^{20}$ (Hz)

The CL space contains two types of energy – dynamic and static. The dynamic one is envision by Quantum Mechanics. According to BSM-SG its signature is the background temperature of 2.72K given by Eq. 10 which corresponds to the CMB radiation. The static type of energy is the energy of connection between CL nodes. Its estimation given by (11) is possible by application of Eq. (6) to the unveiled structure of the electron (Chapter 5 of BSM-SG). It is many orders larger than the dynamic one.

$$\text{ZPE-S} = 1.373\text{x}10^{26}\ (\mathrm{J}) \tag{11}$$

Fig. 5 shows the material structures of proton and neutron composed of helical structures. The torus shape shown in the left side called a protoneutron is unstable in CL space and converts to a proton or neutron. The proton has the same structure but is twisted in the shape of an 8, as shown in Fig. 5 so it is stable. The neutron also has the same structure but is double folded, as shown in Fig. 5. The neutron is more stable when over the proton, forming in such way a deuterium nucleus, as shown in Fig. 6. The CL space modulation by the proton (CL node dynamics) appears as a charge, but for the neutron it is closed in a near field. This is so because the modulation caused by its internal structure compensates symmetrically in the far field. Therefore the neutron's charge appears "locked" in a proximity field, but has a magnetic moment when in motion. This is an unsolved enigma for Modern Physics. The structure of the antiproton is not the same as the proton, so attempts to make stable antihydrogen with properties similar to hydrogen are doomed to fail. Billions of dollars have been spent without success.

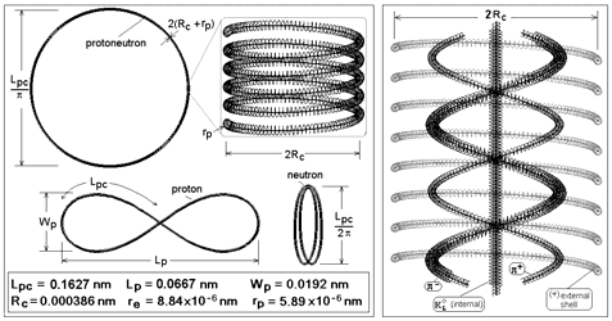

Fig. 5. Overal shape (left side) and internal structures of proton and neutron (right side). The outside helical structure is positive. Inside it are 3 helical structures - two pions (+) and (-) and a central kaon. All helical structures are stable because they are closed tori. If the external positive structure is broken (in particle colliders) the internal pions and kaon are cut and decay. More often they are cut in one place preserving the total mass so it is accurately estimated. The kaon has a different inertial property, so its estimated mass appears larger.

The left side of Fig. 6 shows the spatial arrangement of the protons and neutrons and the quantum orbits for H, D, and He. The right side shows the proton and neutron arrangement in the atomic nuclei according to BSM-SG.

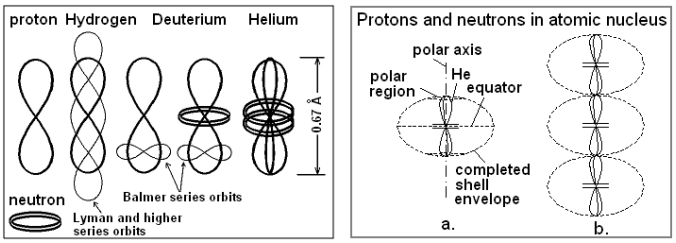

Fig. 6. Protons and neutrons arrangement in atomic nuclei

The unveiled nuclear structures of stable elements are presented in the Atlas of Atomic Nuclear Structures – Appendix A of the BSM-SG book [8]. The protons and neutrons are shown by symbols for simplifying the drawings, but 2D projections can be made, and these are shown for some selected elements in Fig. 7.

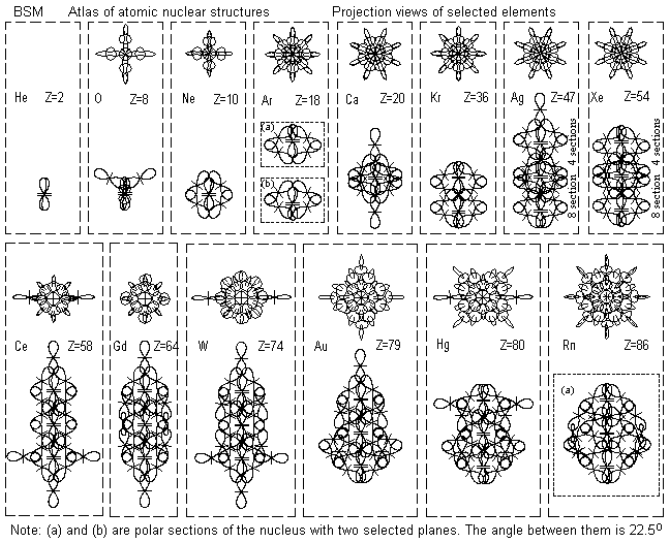

Fig. 7. Atomic nuclei of some elements

In a neutral atom each proton has its own bound electron, so the positions of the electron quantum orbits are completely defined by the nuclear structure. The atomic nuclei are slightly twisted along the polar axis due to the twisted 3D shape of the proton. This feature is in agreement with transmission Lauer patterns of elements (see §8.4.2.4 of BSM-SG, Chapter 8).

Fig. 8 shows the shape of the H_2 – ortho molecule and calculated vibrational levels compared to the measured ones.

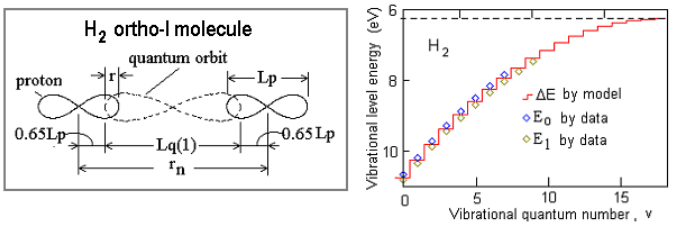

Fig. 8. A physical model of the H_2 – ortho molecule and calculated vibrational levels (step curve)

The parameters of the H_2 molecule (shown in Fig. 8) were obtained by analysis of the optical and photoelectron spectra. The value of one important factor of the SG law denoted as CSG is obtained by fitting the vibrational levels (calculated by derived Eq. 9) to the QM vibrational levels (§9.7, Chapter 9 of BSM-SG).

$$E_V = \frac{C_{SG}}{q[[L_q(1)(1-\alpha^4\pi\Delta^2)]+0.6455L_p]^2} - \frac{2E_q}{q} - \frac{2E_k}{q} \quad (12)$$

$$C_{SG} = G_0 m_0^2 = (2h\nu_c + h\nu_c\alpha^2)(L_q(1)+06455L_p)^2 = 5.2651\times10^{-33} \quad (13)$$

where: q –electron charge, $L_q(1)$ –quantum orbit length for electron velocity of 13.6 eV, L_p – proton length, Δ - vibration level, E_q = 511 KeV, E_k – electron kinetic energy, ν_c – Compton frequency, α - fine structure constant, G_{SG} – SG gravitational constant, m_0 – SG mass of the proton (also neutron).

The derived factor C_{SG} is additionally verified by calculating the binding energy between the proton and neutron in Deuterium (Chapter 6 of BSM-SG, p. 6-52).

The structural analysis of simple molecules indicates that the H_2 – ortho molecule is imbedded as a chemical bond system in molecules, having a vibrational rotational spectra. An equation similar to (12) was derived also for the D_2 molecule, which is a more common system in chemical bonds. For a simple diatomic molecule, a universal expression (12) for internuclear distance r_n, is derived. In section 9.75.D (Chapter 9 of BSM) it is shown that the vibrational range distance is negligible in comparison to the internuclear distance r_n, due to the involvement of the SG law (this is an unsolved problem in Quantum Mechanical models).

$$r_n = (A-p)[(2\alpha C_{SG})/(pB_{D2}(n))]^{1/2} \quad (14)$$

where: A - mass in atomic mass unit (per one atom), p – number of protons involved in the chemical bond (per one atom), n – subharmonic quantum number of the orbit, B_{D2} – energy of D_2 bonding system; α - fine structure constant.

In the next sections some applications are discussed based on the atomic models derived by the BSM-SG theory.

3. The Structure of Molecules

Using BSM atomic models and the length of possible quantum orbits, synthetic structural models of molecules could be built. The angular directions of their chemical bonds agree with the VSEPR models used in structural chemistry. This is demonstrated for the simple molecules O_2, O_3 (ozone), CO_2 and H_2O.

The bond lengths are calculated by using the equations in Chapter 9 of BSM-SG [6]. They agree to experimentally known ones. The structure of these molecules are shown in Fig. 9.

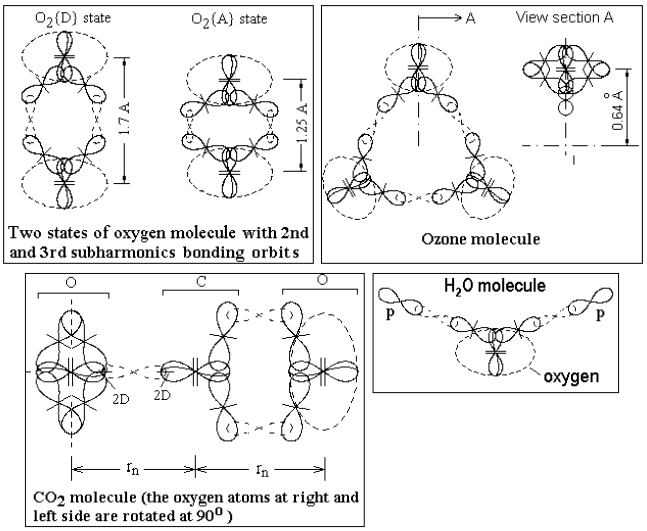

Fig. 9. Synthetic images of O_2, O_3, CO_2 and H_2O molecules

4. Atoms in Metal Lattices

Fig. 10 shows two different planes of the metal lattice of gold obtained by a tunneling electron microscope [9]. Fig. 11. shows the synthetic model of these planes using BSM atomic models.

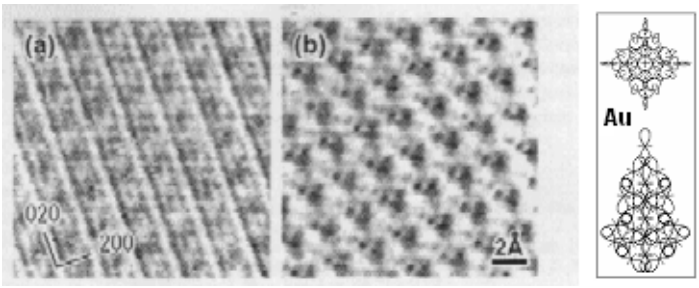

Fig. 10. Images of two different planes of Au lattice by tunneling microscope. Courtesy of T. Kawasaki et al. [9]

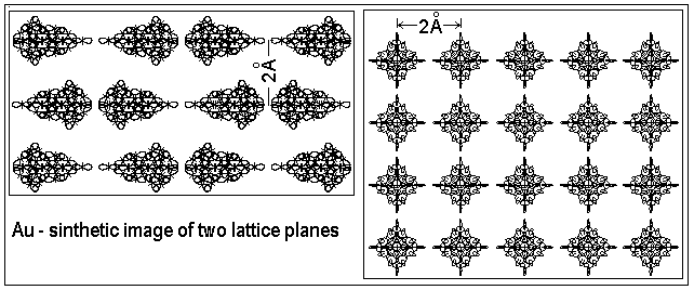

Fig. 11. Synthetic images of two different planes of Au lattice using BSM atomic models

5. Modeling in Nanotechnology

The BSM-SG atomic models open an opportunity for synthetic modeling in nanotechnology and new materials by using 3D atomic models. Fig 12 illustrates the carbon atom. Its valences (participating in chemical bonds) are in pairs lying not in one, but in two orthogonal planes with slightly displaced points of connection at the nucleus. Using this 3D shape, a synthetic 3D model of a carbon sheet (grapheme) is built and shown in Fig. 13. The model shows that the neighboring carbon atoms lie in two parallel planes with a distance between them of about 0.05 nm. Such resolution is close to the limit of electron microscopy.

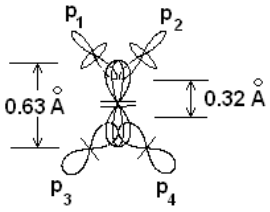

Fig. 12. 3D view of Carbon atom. Protons p3 and p3 lie in the drawing plane, while p1 and p2 are in a perpendicular plane.

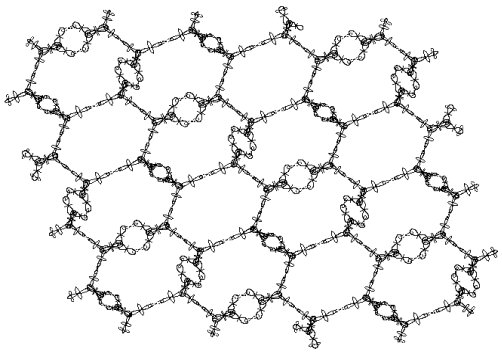

Fig. 13. Synthetic model of Carbon sheet (graphene). Neighboring atoms lie in two parallel planes at distance smaller than 0.05 nm.

The existence of two displaced planes in the carbon sheet is apparent from the recently obtained high resolution electron microscope image shown in Fig. 14. a. [10]. The brightness processed image shown in Fig. 14.b clearly indicates the existence of two displaced planes. This feature is not explainable by the currently adopted standard model of atoms based on Bohr's atom.

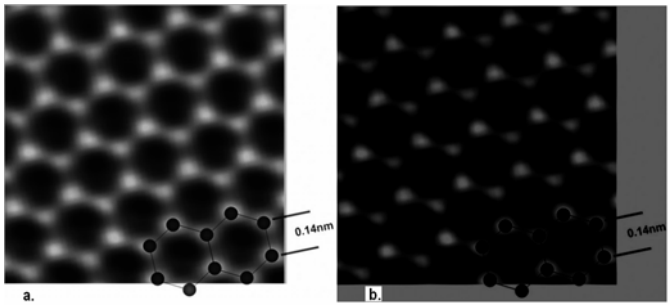

Fig. 14. a. Single wall Carbon sheet with TEAM microscope [10]
b. Processed image by brightness adjustment showing a signature of two displaced planes

The 3D structure of Carbon nuclei is apparent also from the image of a carbon nanotube shown in Fig. 15 (see the left edge).

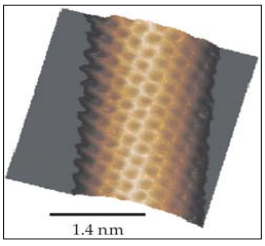

Fig. 15. Single-wall nanotube (Courtesy of A. Javey et al. [11]

6. Alpha Decay as a Fusion Reaction at Room Temperature

The BSM atomic models permit understanding of the process of alpha decay, more particularly the formation of a He nucleus by fusion of two deuterons. This is illustrated in Fig. 16 for the alpha decay of Gadolinium.

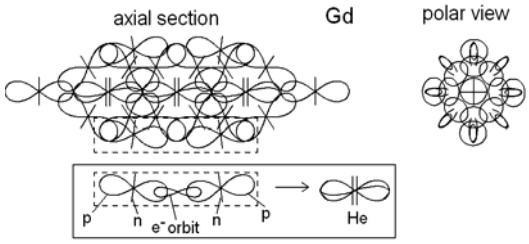

Fig. 16. The dashed line shows the two proton positions in the nucleus. They fuse to a He nucleus at room temperature [6].

7. New Vision of the Universe

The individual galaxies have their own cycle with observable active life and unobservable hidden phases. The hidden phases take place in completely empty space with no physical properties to transmit EM waves. During these phases the atomic matter including elementary particles recycle to lower order formations after which a crystallization of new elementary particles takes place. The transition events between the observable and hidden phases are the Galactic Collapse and Galactic Birth, which have detectable signatures – the Gamma Ray Bursts (GRB). Some galactic matter, escaping the collapse, forms the Globular Clusters and "Irregular galaxies", such as Sagittarius. During the formation of the prisms (subelementary particles), all galactic matter participates. The galaxies have different masses, so prisms from different formations will have a small variation of their length to radius ratio. Then a photon passing through different galactic CL spaces will exhibit a small energy loss due to refurbishing of its wavetrain. The observable effect is a cosmological redshift – different from the Doppler one. If expressing the difference between two galactic spaces as an average quasirefractive index, $\tilde{n}$, the ratio between the observed and emitted wavelength of the photon is $\lambda_i/\lambda_0 = (\tilde{n})^N$, which leads to the expression

$$(\tilde{n})^N = z+1 \tag{15}$$

where z is the cosmological redshift from N crossed galaxies.

One detectable signature of this phenomenon is the Lyman Alpha Forest, providing an estimate of the number of crossed boundaries. Then the new corrected distance to a galaxy with a redshift of z is given by

$$r = \frac{c^2 \ln(\tilde{n})}{\tilde{L}H_0}\int_0^z \frac{x}{\ln(1+x)}dx \tag{16}$$

where $\tilde{n}$ is determined from the mean density of the Lyman alpha forest lines for signal emitted by a distant quasar, $\tilde{L}$ is an average distance between the neighboring galaxies, H_0 = Hubble constant, c = velocity of light.

Fig. 17 shows a Hubble plot from experimental data for z up to 1.75 [28], while Fig. 18 shows the theoretical plot of Eq. 16, normalized to the constant $(c^2 \ln(\tilde{n})/\tilde{L}_0 H_0)$. The Big Bang model has a big problem for explaining the observed curve.

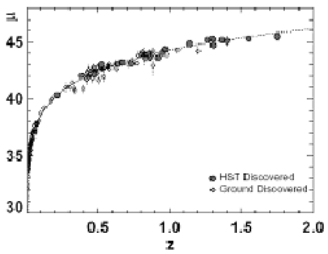

Fig. 17

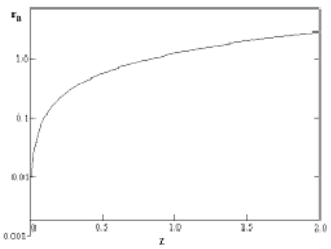

Fig. 18

Conclusion

- A new vision about the microcosmos and the universe
- Unveiled structure of elementary particles, atomic nuclei and angular freedom of chemical bonds
- BSM atomic models could be used for modeling in nanotechnology
- Hidden energy of non EM type – a primary source of nuclear energy
- Alpha decay – an example of fusion reaction at room temperature
- Mass is not equivalent to matter but it is a measurable parameter
- Gravitational forces on a material object could be modified by proper modulation of the CL space (physical vacuum)
- A possibility for superluminal communications.

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