Ring structures of atoms and molecules

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ABSTRACT

Knowledge of structure rules of the atomic nucleus and the properties of vortex electromagnetic field allow us to create relatively precisely the structures of individual atoms and molecules. Properties of atoms are largely described by the structure of their electron shells. However, the standard model of atoms does not allow define this structure exactly. New theory VFRT (vortex-fractal-ring-theory) can solve this lack. Theory VFRT uses fractal ring structure of the electron, the proton and the neutron, and can describe the inner structure of atomic nuclei. Fractal descriptions of Nature are very promising. The atomic nucleus can be built from the ring protons and neutrons. This new theory assumes that the arrangement of electron shells arises from the structure of the atomic nucleus. Electrons are not in orbit around the atomic nucleus, but each electron levitates with the corresponding proton of the nucleus. The levitation bond between the electron and the proton is formed by an electromagnetic vortex structure. Theory VFRT expands understanding of nature through a new perspective on the evolution of lifeless nature using a vortex, fractal and ring substructures with self-organization, from quarks, electrons, protons and neutrons, atoms, molecules, to the structure of complex organic compounds.

Keywords: vortex-fractal-ring-structures, covalent bond, models of atoms and molecules, atom of hydrogen, molecule of water, ring structure of graphene

1. INTRODUCTION

A scientific theory is a well-substantiated explanation of some aspect of the natural world that is acquired through the scientific method, and repeatedly confirmed through observation and experimentation. Typically, before a scientific theory can be created, a hypothesis must be developed which is a supposition or proposed explanation that is formed on the basis of limited evidence as a starting point for further investigation. In physics, the term theory is generally used for a mathematical framework, which is capable of producing experimental predictions for a given category of physical systems.

Most of our knowledge of the electronic structure of atoms has been obtained by the study of the light given out by atoms when they are exited. The light that is emitted by atoms of given substance can be refracted or diffracted into a distinctive pattern of lines of certain frequencies and create the line spectrum of the atom [1].

Fractals seem to be very powerful in describing natural objects on all scales. Fractal dimension and fractal measure are crucial parameters for such description. Many natural objects have self-similarity or partial-self-similarity of the whole object and its part [2].

The classical approach in particle physics is based on the fact that the electron has some parameters like charge, mass, etc. but does not have a structure. The electron is calculated as point particle having magnetic properties. First and second ionization energies and electron shells are described in [1] and basics of fractal physics are described in [2]. Theory VFRT [3] uses the electron as fractal particle with a toroidal (ring) shape, which is formed by ring fractal substructures connected to each other by vortex electromagnetic fields. The atomic nucleus can be built from the ring protons and neutrons. Protons and neutrons consist from quarks which are inside their rings. Gluon bond between proton

and neutron quarks is shown on Fig.1. Substructures of atoms created from protons and neutrons are on Fig.2 (red rings are protons, yellow rings are neutrons). Nuclei of atoms with substructures on Fig.2 are shown on Fig.10.

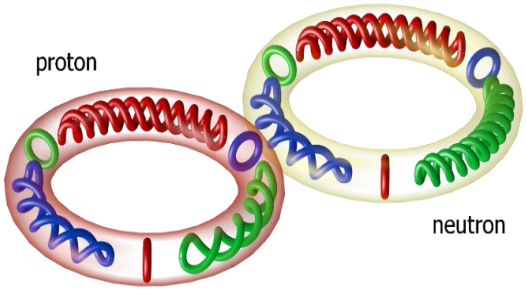

Fig.1 Gluon bond between proton and neutron

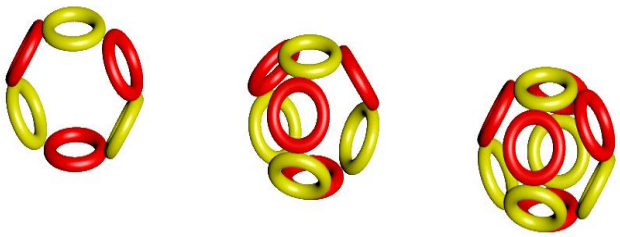

Fig.2 Substructures of atoms created from protons and neutrons

2. INNER AND OUTER SPIN

In the ring structure of the particles it is possible to unambiguously define their own (inner) spin of each particle. It is based on the direction of rotation of the ring and the direction of rotation of its ring substructures (see Fig. 3).

Direction of rotation of substructures is identical to the direction of electric field lines. It determines the direction of electrical energy flow in the axis of rings. Electrons, protons and neutrons have the same inner spin. In atoms the same direction of the flow of energy allows to assemble the particles on a common axis. Antiparticles have the opposite inner spin (see Fig.3).

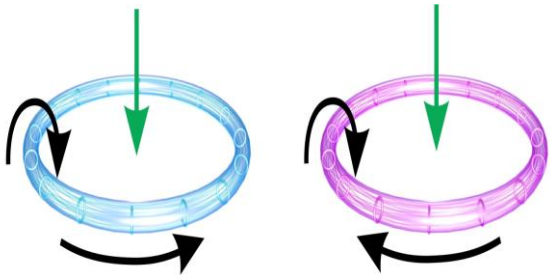

Fig. 3 Inner spins of electron and positron

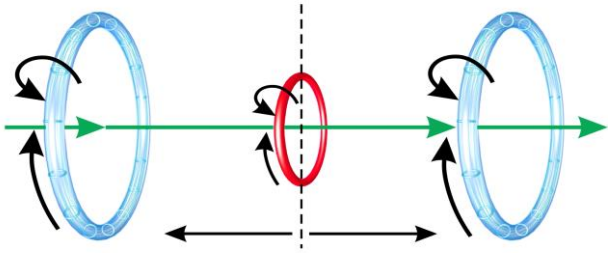

Fig. 4 Outer spins of 2 electrons (spin-out, spin-in)

Besides to own inner spin of rings, which we call "internal", we can define the spin of "external", which determines the spin relationship between two ring particles.

All three rings in Fig 4 have the same inner spins. Electric field lines passes through in the same direction. Relative to each other they have the opposite outer spins. From the perspective of the middle ring (proton), we see the energy going out (spin-out) from the electron on the left and going into the central ring (spin-in). When we look from the middle ring of the proton to the ring electron on the right, we see the energy output from the middle ring (spin-out) and the energy entering the right ring (spin-in).

Thus we see that two particles with the same inner spin can have the opposite outer spins (a different perspective from the proton to two electrons in Fig.4). For the construction of the atoms is crucial to have the structure of atomic nuclei. Therefore, we will determine the external spin from the perspective of the proton. The left and right levitating electrons have the opposite outer spins (see Fig.4). It is Pauli‘s exclusion principle. Elementary particles with opposite outer spins attract each other regardless of the sign of their charges, if there is common flow of energy through them.

3. LEVITATION OF THE RING ELECTRON

The ring electron levitates with the ring proton at a distance which is determined by a balance between attractive (electrical) and repulsive (magnetic) forces and with magnetic influence of the neutron.

The position of the electrons in the electron shells is not determine only by forces of the corresponding proton, but also by other influences like force effect of other electrons in the surrounding shells, forces of attraction of the other positive protons, and repellent forces of neutrons by their magnetic fields.

In a new ring model of the hydrogen atom with a levitating electron there is attractive Coulomb's force F_+ and repellent magnetic force F_- between the proton and the electron:

$$F = F_+ - F_- = \frac{e^2}{4\pi\varepsilon_o}\left(\frac{1}{d^2} - \frac{n^2 d_o}{d^3}\right), \tag{1}$$

where d is a distance between the electron and the proton, n is quantum number.

For levitating distance $d = d_o = 5.29\ 10^{-11}$ m and $n = 1$ [3] is $F = 0$. Eq. 1 is valid for point electrons and protons. For the electron with radius r_e :

$$F = F_+ - F_- = \frac{e^2}{4\pi\varepsilon_o}\left(\frac{d}{\sqrt{(d^2 + r_e^2)^3}} - \frac{dn^2 d_o}{\sqrt{(d^2 + r_e^2)^4}}\right). \tag{2}$$

The hydrogen atom can have special levitation state (F=0) with d=0. Size of the hydrogen atom is determined by radius of the electron r_e =2.6 10^{-11} m (see Eq. 15). This unusual levitation with d=0 has the atom of helium, too. There is magnetic repellent influence of two neutrons (see Fig .5).

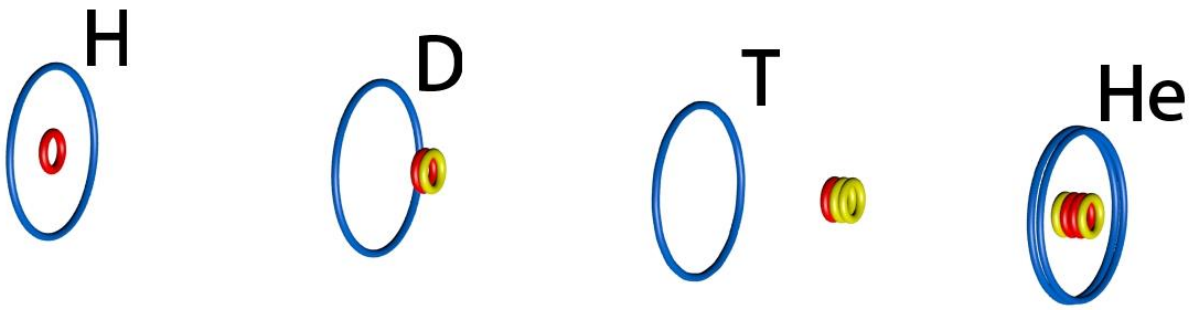

Fig.5 Levitating electrons in the hydrogen atom, deuterium, tritium and the helium atom (red rings are protons, yellow rings are neutrons, blue rings are electrons)

Ionization energy *Eio* which must be added to the electron of the hydrogen to be free:

$$E_{io} = \frac{e^2}{4\pi\varepsilon_o}\int_d^\infty\left(\frac{1}{d^2} - \frac{n^2 d_o}{d^3}\right)dd = \frac{e^2}{4\pi\varepsilon_o}\left[-\frac{1}{d} + \frac{n^2 d_o}{2d^3}\right]_d^\infty = -\frac{e^2}{4\pi\varepsilon_o}\left(\frac{1}{d} - \frac{n^2 d_o}{3d^2}\right). \tag{3}$$

For n=1 and d=d_o is E_{io}:

$$E_{io} = -\frac{e^2}{4\pi\varepsilon_o}\left(\frac{1}{d_o} - \frac{d_o}{2d_o^2}\right) = -\frac{e^2}{4\pi\varepsilon_o}\frac{1}{d_o}\frac{1}{2} \approx -27.2\frac{1}{2}eV \approx -13.6eV \tag{4}$$

4. QUANTUM MODEL OF THE RING ELECTRON

On the circumference of the double loop inside of the toroidal electron with the radius r_e [3, 4] have to be n of de Broglie's wavelengths λ (n is quantum number) which are created by N sub-electrons with mass m_e/N:

$$2 \cdot 2\pi r_e = 4\pi \frac{e^2}{8\pi\varepsilon_o m_e} \frac{1}{v_{en}^2} = n\lambda = n\frac{h}{m_e v_{en}} = n^2 \frac{h}{m_e v_{e-\max}}, \tag{5}$$

where v_{en} is velocity of the sub-electron with mass m_e/N and on quantum level n:

$$v_{en} = \frac{1}{n}\frac{e^2}{2\varepsilon_o h} = \frac{1}{n} v_{e-\max}. \tag{6}$$

For n=1 on the ground state the electron has maximal rotational velocity $v_{e\text{-}max}$:

$$v_{e-\max} = \frac{e^2}{2\varepsilon_o h} = \alpha c \cong 2180 km/s, \tag{7}$$

where α is the couple constant:

$$\alpha = \frac{e^2}{2\varepsilon_o hc} \tag{8}$$

$$\frac{c}{v_{e-\max}} = \frac{2\varepsilon_o hc}{e^2} = \frac{1}{\alpha} \approx 137.036 \tag{9}$$

Energy E_{rn} of rotation of the electron on quantum level n:

$$E_{rn} = \frac{1}{2}\frac{m_e}{N} N \cdot v_{en}^2 = \frac{1}{n^2}\frac{m_e e^4}{8\varepsilon_o^2 h^2} \approx \frac{1}{n^2} 13.6eV. \tag{10}$$

Energy E_{io} in Eq. 3 for levitation distance d_{on} on level n [3, 4]:

$$d = d_{on} = n^2 d_o \tag{11}$$

$$E_{io} = -\frac{e^2}{4\pi\varepsilon_o}\frac{1}{d}\left(1 - \frac{n^2 d_o^2}{2d^2}\right) = -\frac{e^2}{4\pi\varepsilon_o}\frac{1}{n^2 d_o}\frac{1}{2} = -\frac{1}{n^2}13.6eV. \tag{12}$$

Energy E_{io} of ionization is in balance with kinetic energy E_{rn} of rotation. For the levitation distance d_o in the hydrogen molecule-ion H_2^+:

$$E_{rn} = -\frac{1}{n^2}13.6eV = -\frac{1}{n^2}\frac{m_e e^4}{8\varepsilon_o{}^2 h^2} = -\frac{e^2}{4\pi\varepsilon_o}\frac{1}{n^2 d_o}\frac{1}{2} \tag{13}$$

$$d_o = \frac{\varepsilon_o h^2}{\pi m_e e^2} = r_B \tag{14}$$

The Bohr radius r_B has the same size as the distance d_o = 5.29 10^{-11} m in our vortex-fractal-ring model [3]. The distance D between the two protons in H_2^+ is $D = 2d_o$ = 10.6 10^{-11} m.

For n=1 the radius r_e of the electron is:

$$r_{e1} = \frac{e^2}{8\pi\varepsilon_0 m_e} \cdot \frac{1}{v_{e-\max}^2} = \frac{e^2}{8\pi\varepsilon_0 m_e} \cdot \frac{4\varepsilon_o{}^2 h^2}{e^4} = \frac{1}{2}\frac{\varepsilon_o h^2}{\pi m_e e^2} = \frac{1}{2} d_0 = 2.645 \cdot 10^{-11} m \tag{15}$$

The calculated radius of the hydrogen atom is in the range of experimentally measured values: 2.5 – 2.8 x 10^{-11} m. The electron is not orbiting the proton but it is a system of fractal substructures of the electron which rotate around the proton with the double-loop structure [3].

For higher *n* the electron can be wrapped into *L* double loops (1 <= *L* <= *n*). This wrapped electrons (see Fig.6 and Fig.8) with *L*=*n* can have a smaller radius r_{ew} :

$$r_{enw} = \frac{n^2}{2L} d_0 = \frac{n^2}{L} r_{e1} = \frac{n^2}{n} r_{e1} = n r_{e1} \tag{16}$$

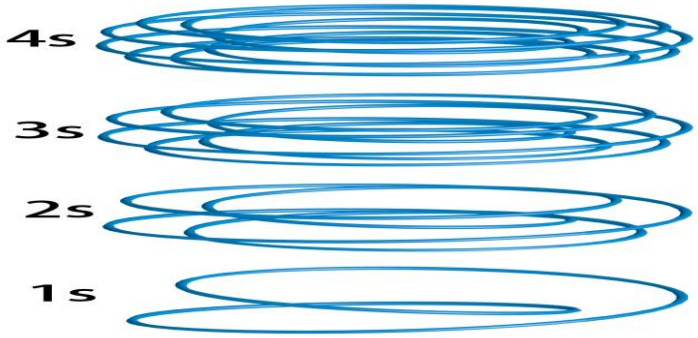

Fig.6 Wrapped electron double-loops with quantum number from n=1 to n=4

5. THE SPIN OF THE RING ELECTRON

It was discovered in 1925 that the electron has properties corresponding to its spin *S*. The spin of the electron is defined as angular momentum:

$$\vec{S} = m_e(\vec{r}_e \times \vec{v}_e) \tag{17}$$

For the spin on axis *z*:

$$S_z = \pm N \frac{m_e}{N} r_e v_e = \pm m_e r_e v_e \tag{18}$$

where m_e is the mass of the electron, r_e is the radius of the electron and *N* is number of substructures inside the structure of the electron. For quantum number *n*=1:

$$r_{e1} = \frac{e^2}{8\pi\varepsilon_0 m_e} \cdot \frac{1}{v_{e-\max}^2} \tag{19}$$

$$v_{e-\max} = \frac{e^2}{2\varepsilon_0 h} \tag{20}$$

$$S_z = \pm m_e \frac{e^2}{8\pi\varepsilon_0 m_e} \cdot \frac{1}{v_{e-\max}^2} v_{e-\max} = \pm m_e \frac{e^2}{8\pi\varepsilon_0 m_e} \cdot \frac{1}{v_{e-\max}} = \pm m_e \cdot \frac{e^2}{8\pi\varepsilon_0 m_e} \cdot \frac{2\varepsilon_0 h}{e^2} = \pm \frac{1}{2} \cdot \frac{h}{2\pi} = \pm \frac{1}{2} \hbar = m_s \hbar \tag{21}$$

$$m_s = \pm \frac{1}{2} \tag{22}$$

The result in (22) is in coincidence with the generally equation for the spin, where m_s is spin quantum number.

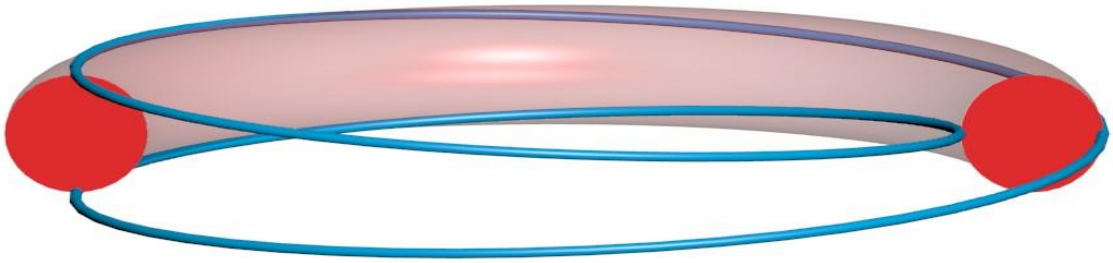

Fig.7 Double loop of the electron

The structure of double loop electron for n = 1 is on the ring surface (see Fig. 7). On Fig. 8 is wrapped electron which is as well on the ring surface.

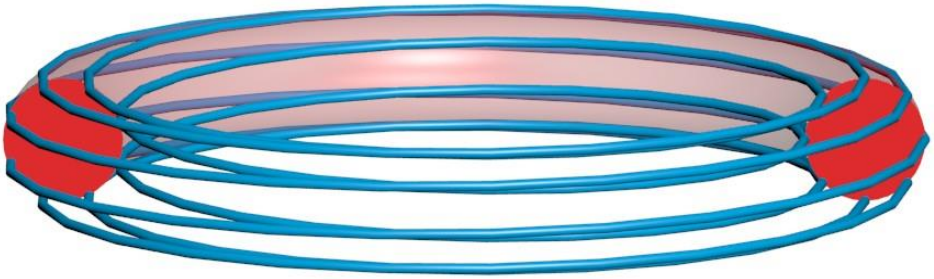

Fig.8 Topology of the wrapped ring electron (L = 4)

6. WAVE–PARTICLE DUALITY

Wave–particle duality is the fact that every elementary particle (for example the electron) or quantum entity (for example the photon) exhibits the properties of not only particles, but also waves. For example, the electron has both properties at once.

Fractal ring structure of the electron has mass and inner kinetic energy which is accumulated in the rotation of the electron and its substructures. Rotation of the electron induces the creation his vortex magnetic field. An electron has matter (with mass) and energy of vortex electromagnetic field at the same time. When an electron passes through the two holes its mass passes only through one hole. Its vortex electromagnetic field passes through both holes simultaneously. Electromagnetic fields then interfere behind holes. Interference of vortex field affects the position of the electron behind holes. Electromagnetic vortex field is divided into two vortex substructures. Each vortex substructure passes through one hole.

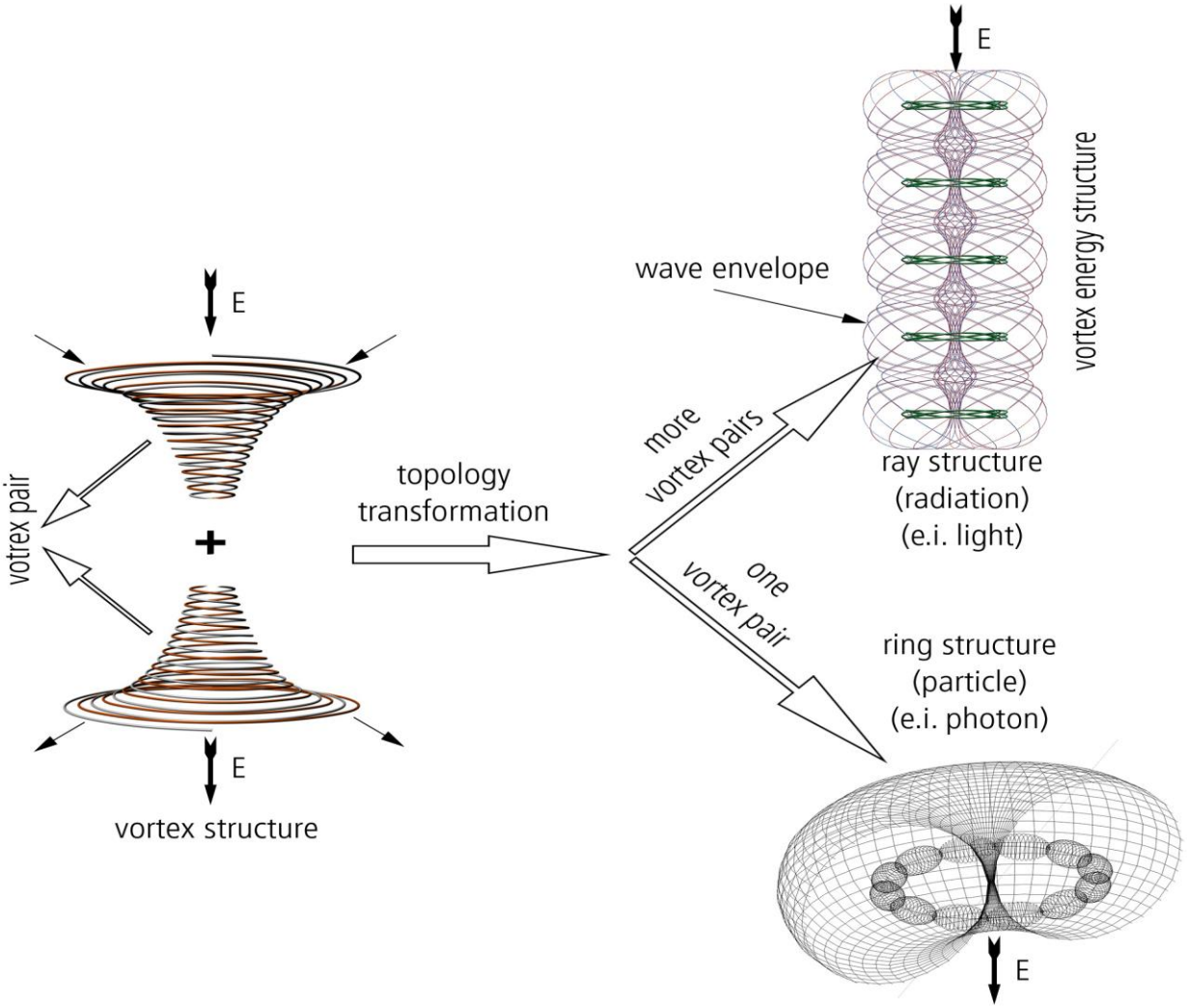

Fig. 9 Wave–particle duality of the photon

Two electromagnetic vortex pair can create a ring structure of one photon (see Fig.9). More vortex pairs can create vortex energy structure of light. The envelope of this vortex energy structure has wave behavior.

7. NUCLEI OF ATOMS

The atomic nucleus can be built from the ring protons and neutrons using the following rules [3]:

1) Two parallel protons with opposite outer spins are connected on the same axis. They are connected together by nuclear forces.
2) Two protons with different axes can be connected via the coupling neutron.
3) On one axis can be maximally two protons and two neutrons and two electrons with opposite outer spins.
4) Between two parallel protons can be inserted next one or two neutrons to form isotopes.

The combination of these four basic rules can create any real structure of the nucleus. Nucleons in the nucleus are not arranged in the shells as in case of electrons, but form spherical substructures with a maximum of 10 nucleons. Nuclear forces can bind only a small number of neighboring nucleons. Spherical substructures of the nucleus (GS globe sub-structures) are sequentially occupied by pairs of proton-neutron with 2, 3, and 4 pairs (see Fig.2 and Fig. 10). These GSs are connected via two parallel protons into more complex units. GS with a maximum occupation of nucleons is an extremely stable part of the nucleus. They create the atom with a completely filled electron levels (in nobel-gases).

Direction changes of first ionization energies [1] follow changes in the spherical substructures GS in Fig.10. There is relationship between the size of ionization energy and the structure of nucleus.

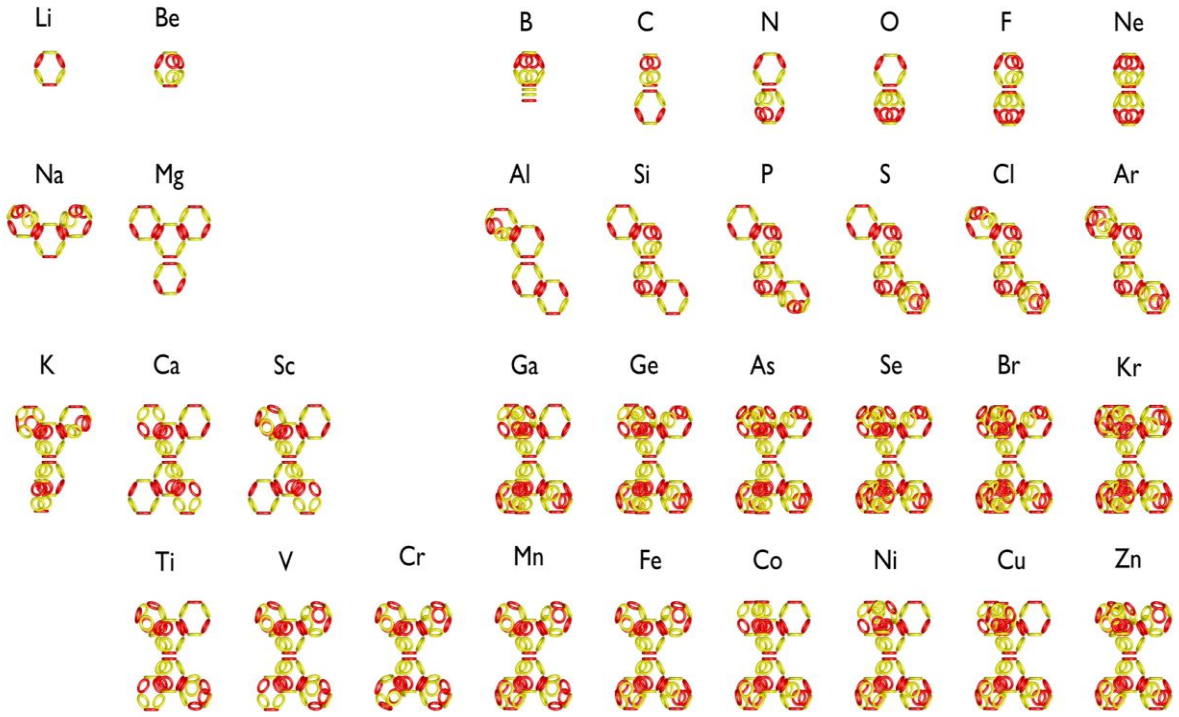

Fig.10 Nuclei of atoms from Li to Kr (red rings are protons, yellow rings are neutrons)

8. MOLECULES

To the chemical bonds belongs a covalent bond between atoms in the molecule of hydrogen. Both equally rotating electrons with opposite outer spins are bound together by a common vortex electromagnetic field see Fig.11.

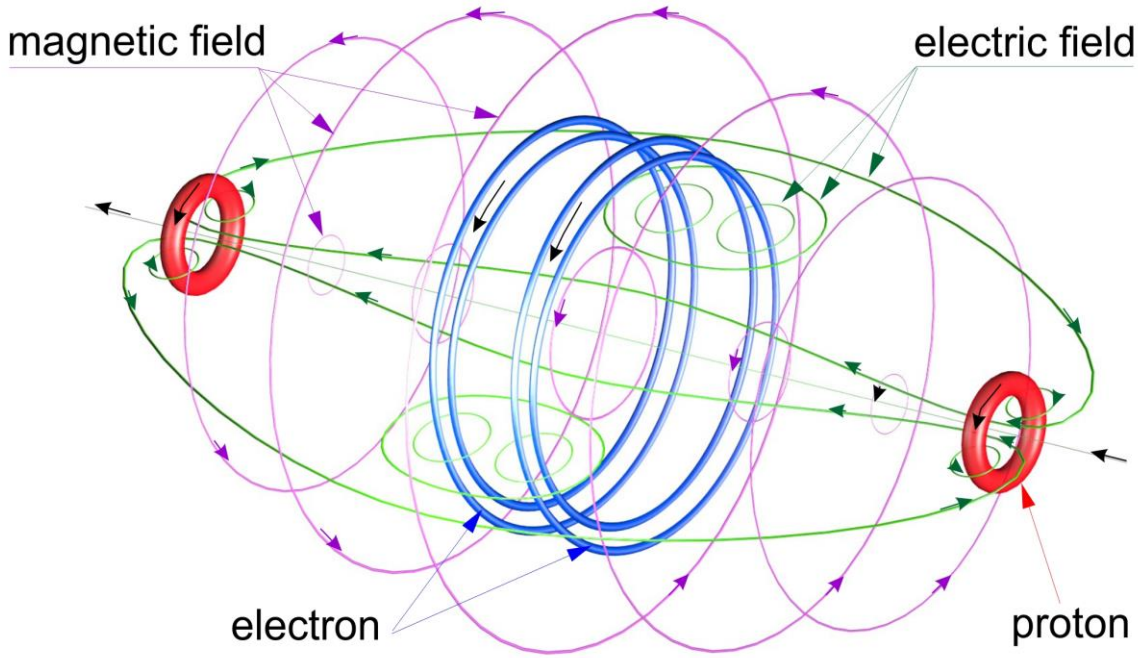

Fig.11 Covalent bond in the hydrogen molecule (topological model with two double loop electrons)

At covalent bonds we can distinguish two types of bonds, bond: σ and π bond (see Fig. 12). Bond sigma σ consists of two electrons with the same radius and π bond consists of two unequal radii of electrons. Different radii of electrons affect the levitation distance (see Fig.12).

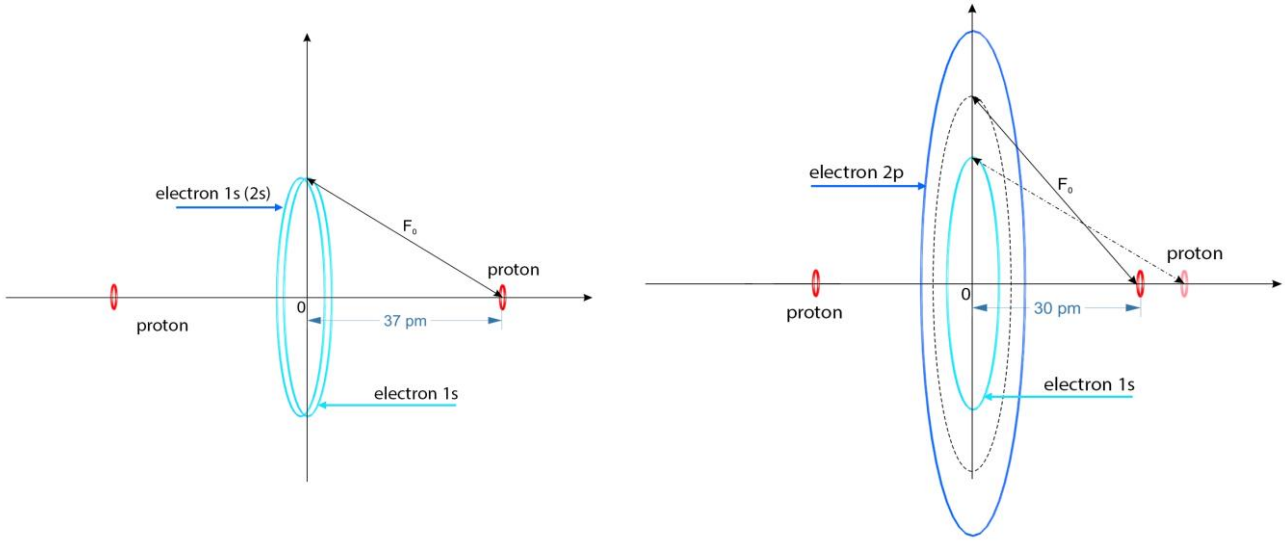

Fig.12 Two types of covalent bond: σ and π

Current knowledge shows the water molecule by several models. We know from experiments the exact distances between the hydrogen atoms and the oxygen atom, and their mutual angle. None of these models is able to explain their mutual position, distances and this angle.

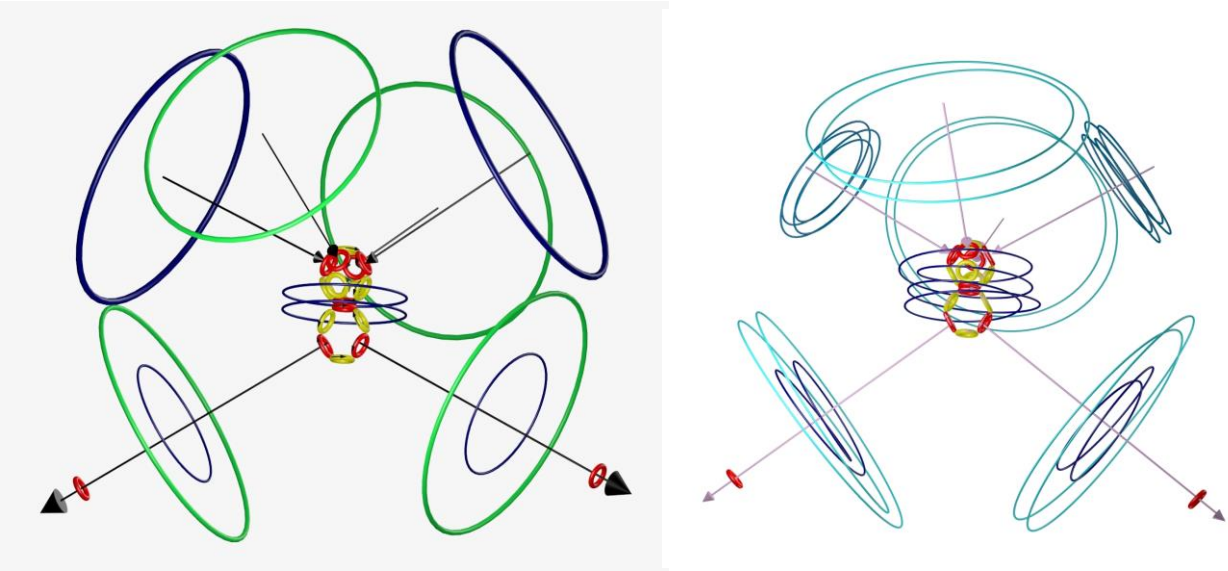

Fig. 13 Topological models of water molecule with unwrapped and wrapped electrons (red rings are protons, yellow rings are neutrons, blue and green rings are electrons)

VFRT theory can view the structure of the nuclei of oxygen. Now we are able to understand and explain the position of the individual electrons in the shells of the oxygen atom and the hydrogen atoms. In Fig. 13, the angle between the hydrogen atoms is not 120 °, because additional attractive forces acting between the pairs of bound electrons and two protons with the same outer spins are not included. This angle is 105º.

Animation of water molecule can be found on https://youtu.be/TrlnHqBvnl8

Recently, a reference material is the graphene. Classical chemistry shows us the graphene as spheres arranged into hexagons, but it does not explain his exceptional qualities. Ring display of atoms and their connection in a side view shows us the electrons which are located in one plane above and below the nuclei of carbon atoms (see fig.14). This parallel placement in one plane allows easy movement of these electrons across the surface of the graphene.

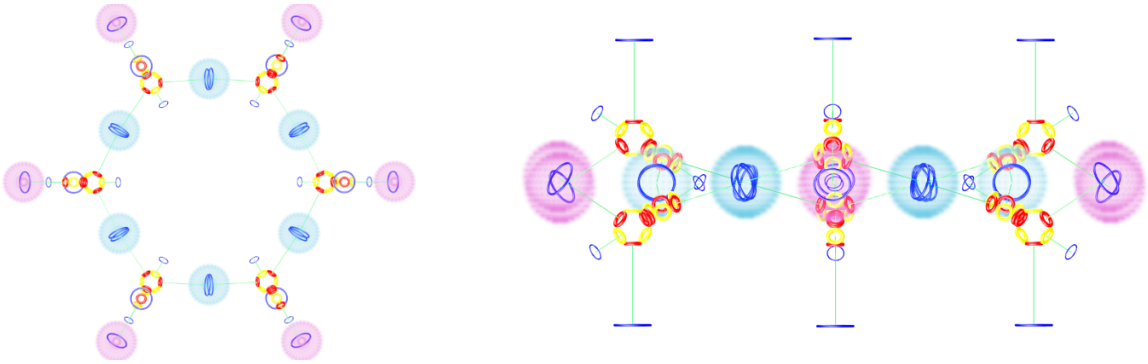

Fig.14 Topological structure of the grapheme (top and side view)

9. SUMMARY

Theory VFRT (vortex-ring-fractal theory) is a new and original view of elementary particles and the structure of atomic nuclei, atoms and molecules. Its basics are simple for understanding through comprehensive topological structure that does not need for their description very complicated mathematical apparatus. This theory, based on the use of the vortex, fractal and ring structures, interconnects all the current knowledge, based on quantum theory and quantum fractal theory. Theory VFRT is trying to achieve some progress in understanding the phenomena related to the physics of elementary particles and atomic structures that we have not been able to clarify within existing theories. It allows us to understand the fundamental physical and chemical reasons for the stability and reactivity of atoms and molecules. Theory VFRT gives us a tool that helps us explain phenomena so far unexplained and meet new laws, phenomena and processes that we are not able in detail to know. We believe that this theory will allow us expand our horizons of knowledge and push the frontiers of knowledge.

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REFERENCES

[1] L. Pauling.: General Chemistry, Dover publication, Inc, New York, 1988

[2] O. Zmeskal, M. Nezadal, M. Buchnick: Fractal-Cantorial geometry, Hausdorf dimension and fundamental laws of physics, Chaos, Solitons and Fractals 17, 2003, pp. 113-119

[3] Osmera, P.: Fractal Dimension of Electron, Proceedings of MENDEL2012, Brno, Czech Republic, 2012, pp. 186-191

[4] More about VFRT theory can be found on http://www.pavelosmera.cz/public/public.html