Atoms connected in molecules by electronic bonds

Selected material from BSM thesis:
(www.helical-structure.org)

Note: The numbers of the figures and equations shown in square brackets match the numbers in BSM thesis.

Short introduction: The known physical laws and postulates are obtainable if the classical empty space is filled by unique material structure. A model called a Cosmic Lattice (CL) is suggested according to which the vacuum possesses an underlying structure built of two types super dens sub-elementary particles arranged in nodes. These particles called twisted prisms are from two different intrinsic matter substances. In empty space the prisms of same type are attracted by forces inverse proportional to the cub of the distance. The nodes are with flexible geometry and possess energy wells. The CL space exhibits quantum features and creates conditions for fields: gravitational, electrical and magnetic. It is also responsible for the constant light velocity, the relativistic effects and the inertia. The elementary particles are complex helical structures built of twisted prisms in a unique process of crystallisation. The protons and neutrons in the atomic nuclei follow a strict order. The suggested physical models are successfully applied for explanation of dozens of physical effects and phenomena in a large range from micro to macro Cosmos.

The unveiled structure of the electron is shown in Fig. 1. It is a 3 body oscillation structure consisting of central core (from a right hind twisted prisms) internal helical structure (left hand twisted prisms) and external helical structure (right hand twisted prisms). The both helical structures possesses internal lattices from same type of prisms, that are more dense of the CL space. The lattice of most external structure modulates the CL nodes and create the electrical field of the electron. The internal core and helical structures are centred by the IG field and oscillates in conditions of ideal bearing.

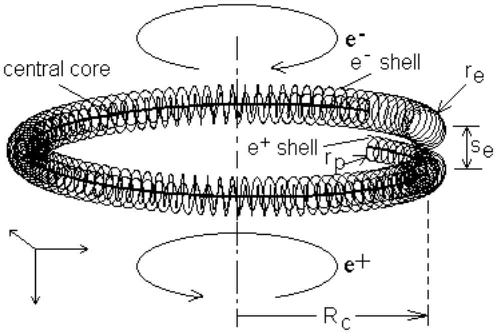


Fig. 1

Oscillating electron

The confined screw like motion of the oscillating electron in Cosmic Lattice (CL) space is characterized by strong quantum interactions with the oscillating CL nodes. They are related with phase matches of the involved cycles and the conditions of integer number of Compton wavelengths for boundary conditions of the induced magnetic field from the rotating electron. So the strong quantum effects appear at particular velocities corresponding to the energy set: 13.6 eV, 3.4 eV, 1.51 eV, 0.85 eV and so on.

The characteristic parameters of dynamical interactions of oscillating electron are shown in Table 1.

Table 1

No	E (eV)	V_{ax}	V_t	r_{mb}	l_{ql}	L_q (A)
1	13.6	αc	c	$\sim R_c$	$2\pi a_0$	1.3626
2	3.4	$\alpha c/2$	$c/2$	$2R_c$	$2\pi a_0/2$	0.6813
3	1.51	$\alpha c/3$	$c/3$	$3R_c$	$2\pi a_0/3$	0.4542
4	0.85	$\alpha c/4$	$c/4$	$4R_c$	$2\pi a_0/4$	0.3406
5	0.544	$\alpha c/5$	$c/5$	$5R_c$	$2\pi a_0/5$	0.2725

where: E - is the electron energy, V_{ax} - is the axial velocity, V_t - is the tangential velocity of the rotating electron structure, r_{mb} - is the value of the boundary electron magnetic radius in plane normal to V_{ax} vector, c - is a light velocity, R_c - is the Compton radius, a_o - is the Bohr radius, l_{ql} - is the trace length of motion in closed loop (single quantum loop), L_q - is the length size of the quantum loop as Hippoped curve with parameter $a = \sqrt{3}$.

Fig 2 shows the spatial geometry of the Deuteron, where: p - is the proton and n - is the neutron. The neutron is centred over the proton saddle and kept by the Intrinsic Gravitation (IG) field and the proximity electrical fields of the neutron and proton. In such conditions the neutron is kept stable (it could not be unfolded and converted to a proton).

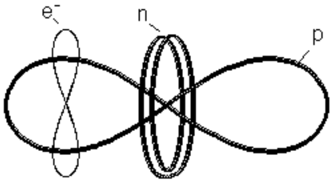


Fig. 2. Deuteron with electron in Balmer series according to BSM physical model

Fig. 3 illustrates the protons and neutrons arrangement in the nucleus of He. In such close distance the internal lattices of the proton's helical structures are kept by IG forces that are inverse proportional to the cube of the distance. The He nucleus is the most compact atomic structure. So its influence on the CL space parameters is strongest. As a result the helium nucleus possesses the largest binding energy between the involved protons and neutrons..

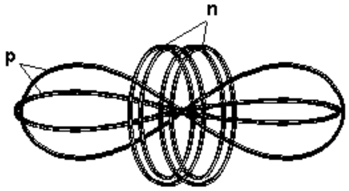


Fig. 3. Helium nucleus according to BSM physical model

When taking into account the two features of the proton: a finite geometrical size and the distributed proximity electrical field it is evident that the Coulomb law is valid down to some limit, defined by the finite size of the proton structure. This is verified by the model of Balmer series in Hydrogen presented in Chapter 7. The idealized shape of Balmer series orbit is shown in Fig. [7.7].

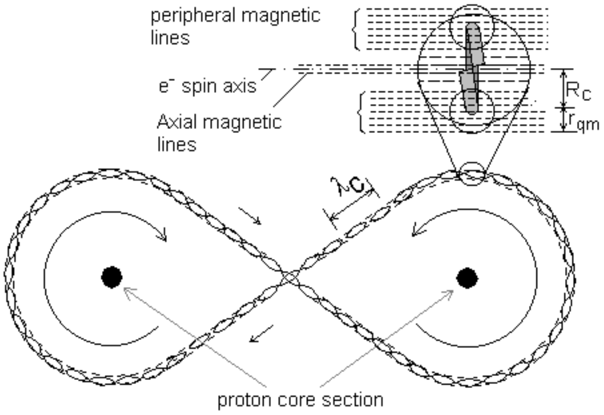


Fig. [7.7]. Idealized shape of Balmer series orbit. R_c - is the Compton radius, r_{qm} - is a magnetic radius of electron at sub-optimal quantum velocity. The compton wavelength λ_c is not in scale for drawing clarity.

Fig. 4 shows the patterns used for the proton, deuteron, tritii and helium, while the right part shows the most common shapes of the quantum orbits. The dimensions of the quantum orbits and the proton and neutron are given in one and a same scale.

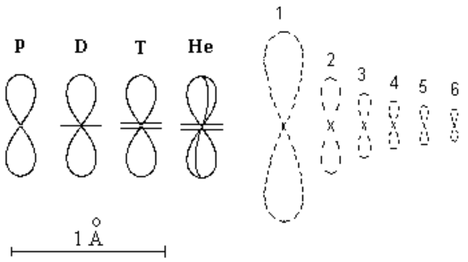


Fig. 4

Patterns for simple elements and quantum orbits

Polar axis can be identified in any atomic nucleus. It is defined by the long symmetrical axis of one or more He nuclei in the middle of atomic nucleus. The atomic nuclei posses also twisting features due to the proton twisting (not shown in the drawings). In the Atlas of ANS additional symbolic notations are used for the unveiled types of protons bonding and pairing in which IG (Intrinsic Gravitation) and EM fields are involved. It is evident from the nuclear structure that the positions of the electron orbits are strictly determined by the protons positions with their proximity electrical fields and the conditions of quantum orbits provided by Table 1. **So the electron orbits are not shown in the Atlas of ANS but their positions are easily identifiable. Having in mind the above consideration the well defined orbital positions are characterized by the same first ionization potential known experimentally and embedded in the Quantum mechanical models.**

3. Electronic bonds between atoms in molecules

It is evident that the BSM model of the atom allows identification of the orbital planes and chemical bond orientation of the atoms in the chemical compounds. Additionally the quantum mechanical spin of the electron circling in orbit around the proton is also identifiable. The proton envelope is twisted torus, so it possess a helicity. If the electron in the orbit shown in Fig. 2 circling in two different direction in respect to the proton helicity, the two type of energy interactions are characterized by slightly different energies. This corresponds to line doubling in the atomic spectra.

The intrinsic conditions of the quantum orbits defined by the two proper frequencies of the electron and CL node dynamics are valid also for the bonding electrons in molecules. Fig. [(19.2)] shows the Structure of the most simple H_2 molecule identified as ortho-I state.

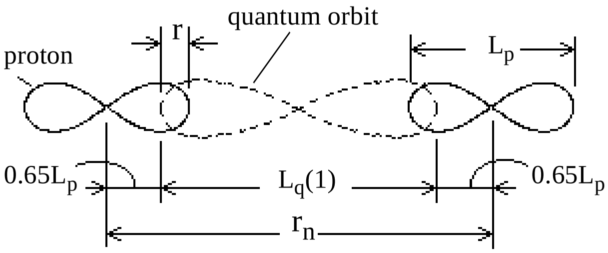


Fig. [9.12]

Structure of H_2 - ortho-I state molecule

L_p - is a proton length

$L_q(1)$ is a long side of first harmonic quantum orbit

r_n - is the distance between the Hydrogen atoms

r - distance between the electron and the proton core in the circular section (most external) of the orbital trace

Note: The quantum orbit quasiplane does not coincide with the quasiplanes of the protons. It passes through the locuses of the proton clubs.

Fig. [(9.15)] shows the vibrational diagram of H_2 - ortho-I state molecule and the relation between the optical and photoelectron spectrum

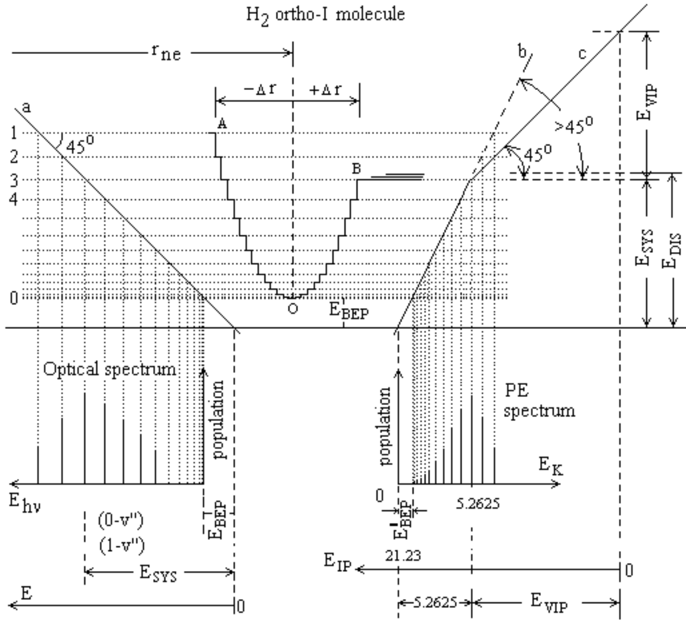


Fig. [9.15]

Vibrational diagram of H_2 ortho-I molecule

E - is a momentary energy scale

$E_{h\nu}$ - is a photon energy scale (not starting from zero)

$(0-\upsilon'')$ and $(1-\upsilon'')$ optical vibrational transition bands from Lyman system

r_{ne} - is an internuclear distance at equilibrium point

$-\Delta r$ and $+\Delta r$ are the ranges of displacement

E_{SYS} - is a system energy at point B, before dissociation

E_{DIS} - is a dissociation energy

E_{VIP} - is a Vertical Ionization Potential

E_{IP} - is a PE spectrum parameter (Ionization Potential)

E_K - is a PE spectrum parameter (“electron kinetic energy”)

E_{BEP} - is a bound energy at equilibrium point

E'_{BEP} - is a “bound energy” estimated by PE spectrum

The numbering 1 to 3 and 0 is used by BSM in order to match the accepted by QM numbering of optical vibrational bands $(0-\upsilon'')$ and $(1-\upsilon'')$.. The parameter Δ in Eq. (9.23) corresponds to the same vibrational levels but referenced to the equilibrium internuclear distance (corresponding to the bottom of the vibrational curve).

The analysis of the simple H_2 molecule allows to unveil the vibrational model of simple diatomic molecule in which the hidden so far Intrinsic Gravitation participates in the total energy balance of the system, including the energy embedded in the electrical charge of the participated electrons and protons. The parameter E_{BEP} is determined by cross-analysis of the optical and photoionization spectra. The obtained equation for the vibrational levels of H2 ortho-I molecule based on a total intrinsic energy balance is:

$$C_{IG} = (2h\nu_c + h\nu_c\alpha^2 + E_{BEP}q)(L_q(1) + 0.6455)L_p) \quad [(9.17)]$$

$C_{IG} = G_0 m_{n0}^2$ - intrinsic factor

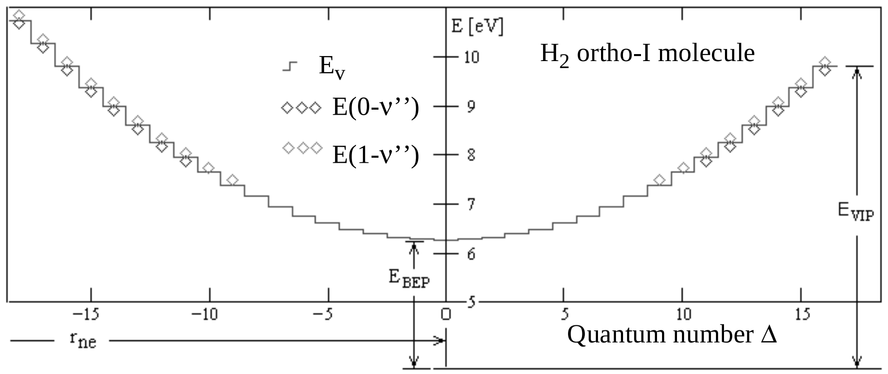
where: E_{BEP} [eV] - boundary energy at equilibrium point , h - Planck constant, ν_c - Compton frequency, α - fine structure constant, L_P - proton length (of the Hippoped curve), L_q - quantum orbit length as Hippoped curve (see Table 1), G_0 - intrinsic gravitational constant, m_{no} - intrinsic neutron mass (the proton have the same mass plus the mass-energy equivalence of the electrical charge it possessing.)

The C_{IG} factor is cross-validated by calculation of the binding energy between the neutron and proton in deuteron (Chapter 9) and by the comparison between the calculated vibrational levels by

BSM models and the experimentally obtained spectra for some molecules.

Fig. [9.24] shows the energy levels E_V, calculated by Eq. [(9.23)] and vibrational levels of the optical transitions E(0-ν'') and E(1-ν'') according to Dabrowski (1984). The fractional error of calculated levels E_V, from the optical data is within +/- 0.035%.

Fig. [9.24]. Energy levels E_V, calculated by Eq. (9.23) and vibrational levels of the optical transitions E(0-ν'') and E(1-ν''), c responding to two QM spin values. The calculated levels are shown by step line, while the optical transitions by diamonds.



The calculated vibrational levels shown in Fig. 9.24 corresponds to the measured optical spectrum from the system $(B\,^1\Sigma_u^+ - X^1\Sigma_g^+)$, known also as a Lyman system. (Accurate experimental measurements of this system are provided by I. Dabrowsky, Can. J. Phys., 62, 1639 (1984)Cook G. K. and Ogawa M., Can J. Phys., 43, 256 (1965) (1984)). The parameter $E_{BEP} = 6.2627$ eV is determined from the condition of minimum difference between the measured and calculated levels. It is used for accurate calculation of C_{IG} factor in Eq. [9.17].

Following similar analysis and based on the successful results from the analysis if H2 molecule an analytical expression for vibrational levels for heavier simple diatomic molecules is obtained.

$$E_V = \frac{C_{IG}}{q[[[L_q(1)](1-\alpha^4\pi\Delta^2)]+0.6455L_p]^2} - \frac{2E_q}{q} - \frac{2E_K}{q} \quad [9.23$$

$$\Delta r = L_q(1)\alpha^4\pi\Delta^2 \qquad [9.26]$$

where: $E_q = h\nu_c$ - is the IG energy spent for creating the positive unit charge of the proton, E_K - is the kinetic energy of the electron, Δ - is a quantum vibrational number referenced to the equilibrium point (see Fig. [9.15]).

.

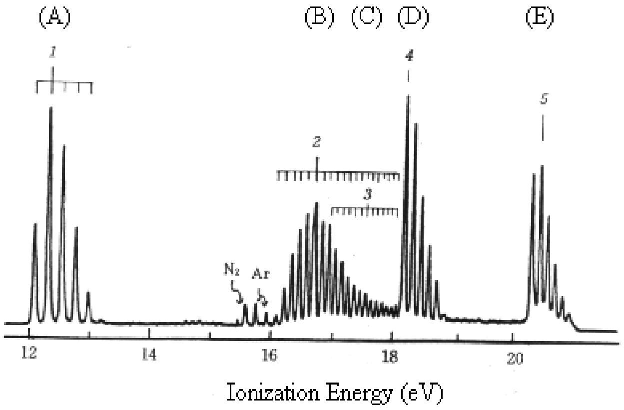


Fig. [9.42]. PE spectrum of oxygen molecule excited by He I radiation (Turner et all., courtesy of K. Kimura et al., (1981))

It is found that the first harmonics quantum orbit $L_q(1)$ is possible only for H_2 and D_2 molecules. For diatomic molecules from heavier atoms the intrinsic balance is obtained only for larger subharmonics of the rotating and oscillating electron (corresponding to lower quantum velocities of the electron), or $L_q(2)$, $L_q(3)$, $L_q(4)$ and so on. Based on derived Eq. [9.23] and the data from optical and photoionization spectra the possible configurations of simple diatomic molecules are identified. Fig. [9.42] shows the photoelectron spectra of O_2 molecule. They corresponds to different internuclear distances. Table 9.6 shows the calculated antinuclear distances for different quantum orbits L_q using Eq. [9.42] and the estimated distances by the drawing method, using the known dimensions of the proton (neutron) and the quantum orbit from the possible set of quantum orbits. The proton and neutron dimensions are estimated by cross-analysis. The proton envelope volume is involved in the theoretical estimation of the background temperature of CL space (2.72 K) (Chapter 5) and in the proton mass balance analysis (Chapter 6). The proton core length is cross-validated by the Balmer series model and vibrational models of the molecules (Chapter 9). Table 9.6 shows also the corresponding possible state denoted by capital letters in bracket (BSM notation).

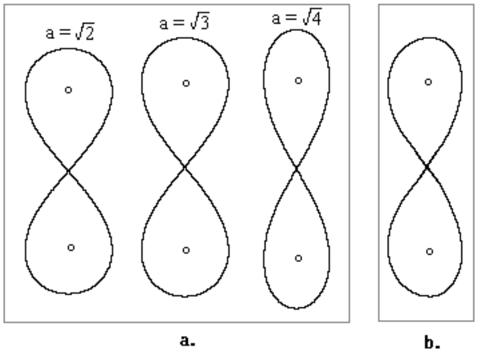
Calculated by Eq. (9.55) values for r_n for O$_2$ states. The values are given in Angstroms (A). **Table 9.6**

r_n (A)	$L_q(2)$ (1 bond)	$L_q(2)$ (2 bonds)	$L_q(2x)$ (2 bonds)	$L_q(3)$ (2 bonds)
calculated	2.57 A	1.698 A		1.219 A
match drawing	2 A	1.7 A	1.74 A	1.25 A
possible state	{B}, {C}	{D}	{E}	{A}

The considered electronic type of chemical bonds allows vibrational type motion of the involved nucleus. The rotational components in the vibrational rotational spectra are result of distortion of the electronic orbits. The possible distortions of the bonding orbit are two:

- symmetrical distortion
- asymmetrical distortion

The both type of distortion are shown respectively in Fig. 9.16, a. and b.



a.

b.

Fig. 9.16

a. - symmetrical and b. - asymmetrical distortion of the bonding orbit

The symmetrical distortions contributes to the rotational components of the optical spectra with not folded branches. The asymmetrical distortions contribute to the spectra containing folded branches. All the atomic nuclear structure possess polar twisting. In confine motion in CL space they rotates. This rotation contributes to the pure rotational spectra.

The molecular vibrations are characterized by additional effect not existing in the atoms. The IG forces are able to modulate the spatial configuration of the proximity E-field of the protons involved in the chemical bond. As a result the vibrational quantum conditions occur at intrinsically small changes of the internuclear distance. For H2 ortho-I molecule, for example, the vibrational range is only 4E-16 (m) while the internuclear distance is 2.23E-10 (m). This effects in fact facilitates the unveiling of the possible configuration of any the molecule, because it allows using the estimated dimensions of $L_q(n)$. From the energy point of view $L_q(n)$ are are valid for the limit orbits. **But the intrinsically small change of the internuclear distance allows to apply them in the drawing method for unveiling the internuclear distances.**

4. Examples of some molecular structures

Note: In the following drawings the protons and neutrons in the central polar section of the atomic nucleus are only shown.

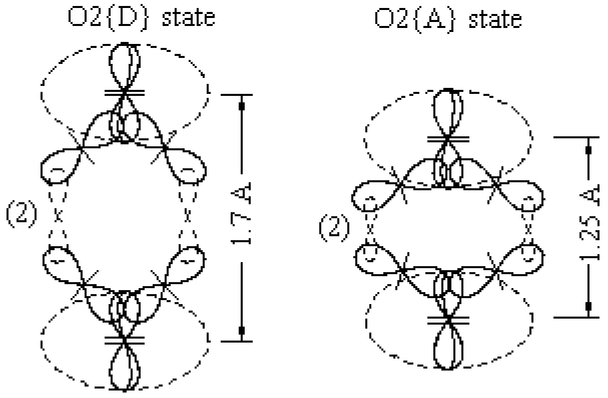


Fig. 9.43 Possible configurations of O$_2$(D) and O$_2$(A). {D} and {A} are states of O$_2$ according BSM model. The orbital planes of electrons does not lie in the drawing plane, but are shown in this way for convenience. The number in bracket indicates the subharmonic number of the quantum orbit.

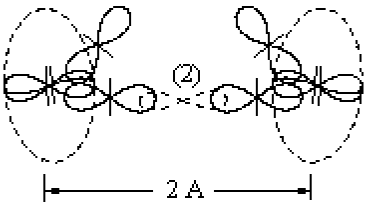


Fig. 9.44 Possible configuration of O_2 in {B} state

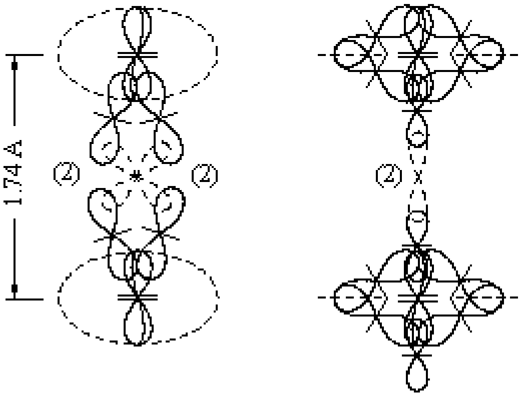


Fig. [9.45] Possible configuration of O_2 molecule in {E} state

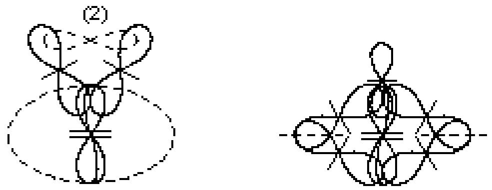


Fig. 9.53 Two views of the possible configuration of oxygen atom in Airglow state responsible for line emissions at 5577 A and 6300 A.

.

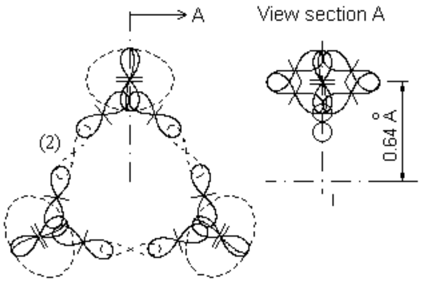


Fig. 9.53.A

Ozone molecule with second subharmonic bonding orbits Every one of three bonding orbits contains two electrons with opposite quantum mechanical spin

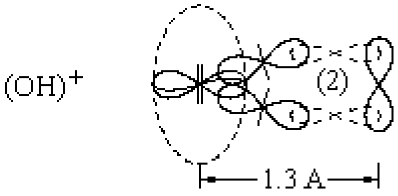


Fig. 9.54

Possible configuration of $(OH)^+$ (the planes of bonding orbits are shown rotated at 90 deg, but in the real physical model, they are normal to the drawing plane)

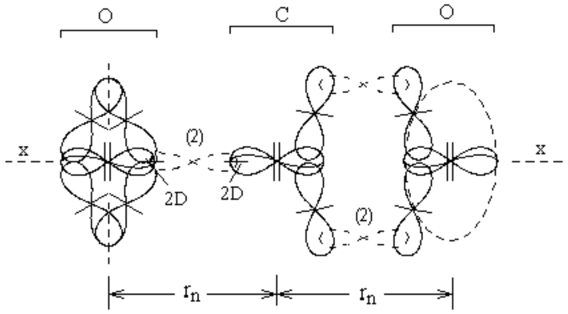


Fig. 9.56

One view of CO_2 molecule. The oxygen atoms looks differently in both ends because the right-side one is rotated at 90 deg around the *xx* axis in respect to the left-side one.

.

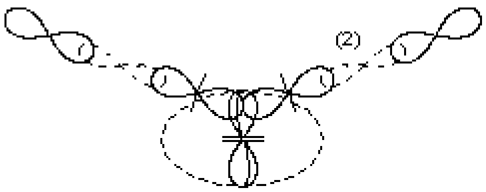


Fig. 9.59

Water molecule

.

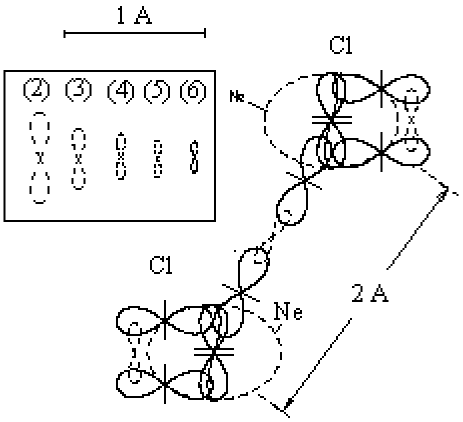


Fig. 9.7 Cl_2 molecule. The dashed oval is the envelope of Ne nucleus. The set of possible quantum orbits are shown in the square box, the number in bracket is the subharmonic number of electron quantum velocity. The experimental value of internuclear distance between Cl atoms is 1.98 A.

6. References

1. Sarg, S., Basic Structures of Matter (thesis on matter, space and time), Electronic collection in National Library of Canada: ISBN 0-9730515-0-7
http://collection.nlc-bnc.ca/100/200/300/stoyan_sarg/basic_structures_of_matter/index.htm
Temporally available also in: www.helical-structures.org

2. Sarg. S., Atlas of Atomic Nuclear Structures, Electronic collection of National Library of Canada:
ISBN 0-9730515-1-5
http://collection.nlc-bnc.ca/100/200/300/stoyan_sarg/atlas_of_atomic_nuclear/index.htm
Temporary available also in www.helical-structures.org