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Table 1: The elements are indexed by their Z number

4. Periodic table of atomic nuclear structures (poster)

Element notations and parameters used in the atlas
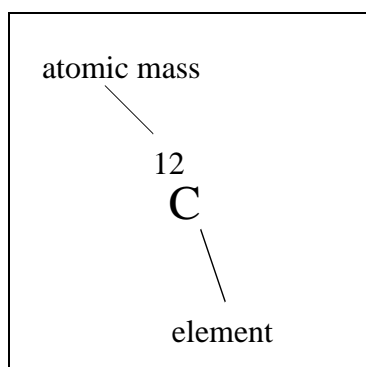
November 20, 2001

Introduction

The Atlas of Atomic Nuclear Structures (ANS) is one of the output results of the BSM theory. It may serve as an independent educational tool if the BSM concept is accepted. In such case it could be a useful tool for understanding the nuclear structure of the elements and their spatial positions in the chemical compounds. The spatial geometry of the nuclear structures and the limited angular freedom of the valence protons may provide explanation about the angular positions of the chemical bonds. Test examples for some simple molecules are in quite good agreement with the VSEPR model used in the structural chemistry.

The atlas contains two parts. Part I illustrates the geometry and the internal structure of the basic atomic particles, built of **helical structures**. Part II illustrates the three dimensional atomic nuclear structures of the elements in the range $1 < Z < 103$. Only the stable isotopes given in the Periodic table are shown. In order to simplify the complex views of the nuclei they are presented by plane projections of symbols. For this purpose two type of symbols are used: symbols for hadron particles (proton, neutron and He nucleus) and connection symbols. The real spatial structures could be imaginary restored from the presented drawings.

The rules upon which the protons and neutrons are arranged in the nucleus are discussed in Chapter 8. The trend of consecutive nuclear building by Z-number follows the row-column pattern of the Periodic table. The protons (deuterons) shells get stable completion at column 18 (noble gases). The separate rows of the Lantanides and the Actinides are characterised with consecutive grow and completion of different shells. All atomic nuclei possess clearly identified polar axis of symmetry where one or more He nuclei are positioned. The growing limit for stable high Z-number elements is also apparent.

The electronic orbits are not shown in the nuclear drawings, but their positions are identifiable from the attached positions of the protons (or deuterons). The Hund's rules and Pauli exclusion principle are identifiable features influencing respectively the plane orientation and combinations of the quantum orbits. The possible quantum numbers for the different orbitals in any element are restricted by the spatial configuration of its nucleus.

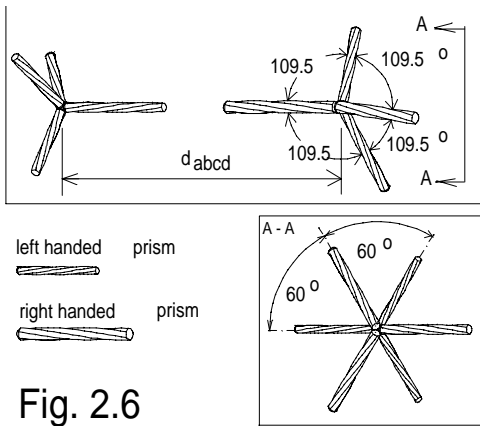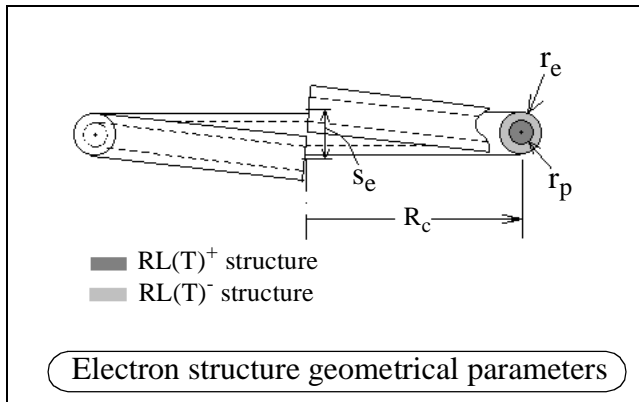ISBN 0-9730515-1-5

atomic mass

12

C

element

Z - number of protons

N - number of neutrons

Fig. 2.6

left handed   prism

right handed   prism

Core node from prisms of same type
(building element of the helical structure)
Note: The twisted prisms model is used

Fig. 2.8.B

RL(T)$^+$ structure
RL(T)$^-$ structure
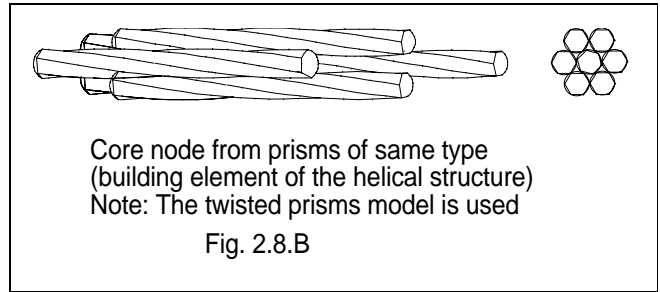
Electron structure geometrical parameters

negative
central core   e$^-$ e$^-$ shell

e$^+$

e$^+$

e$^+$
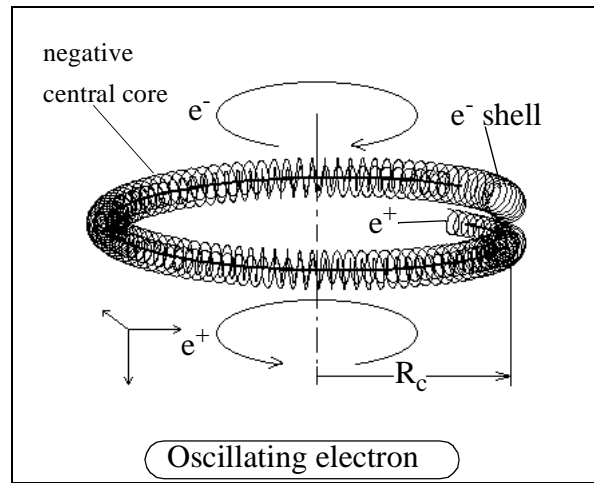
Oscillating electron
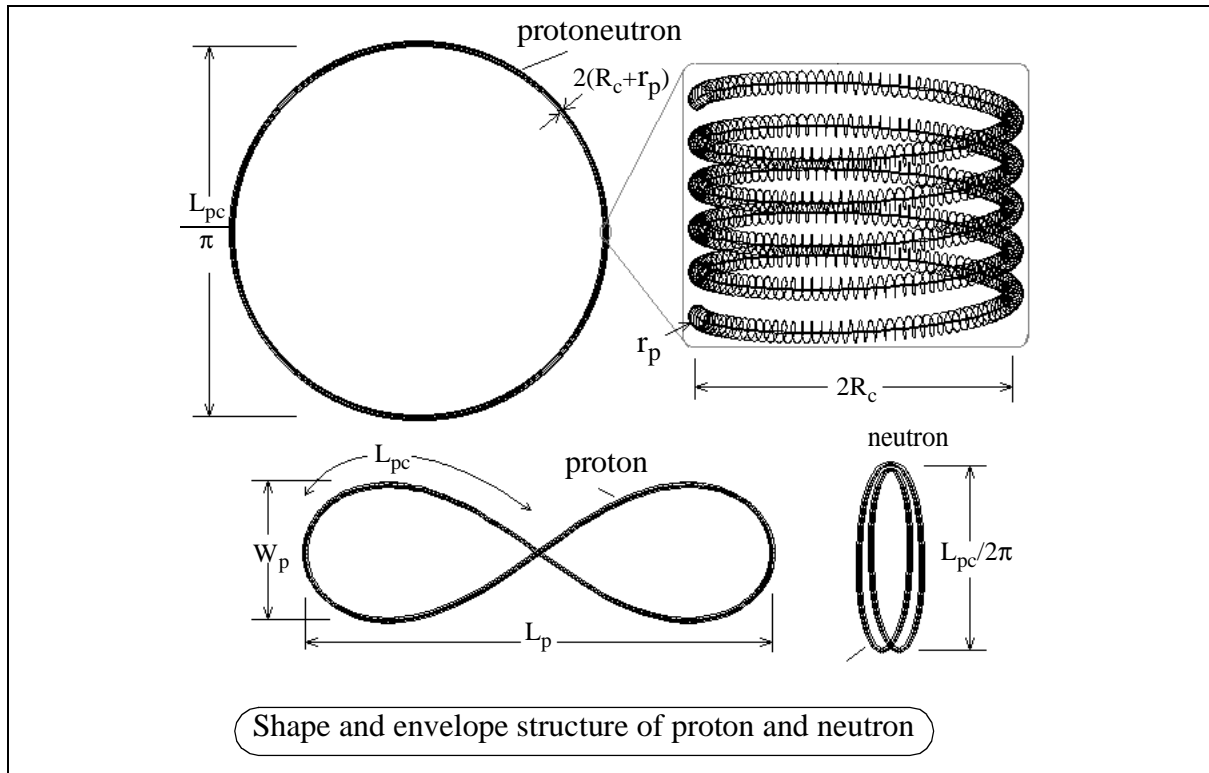
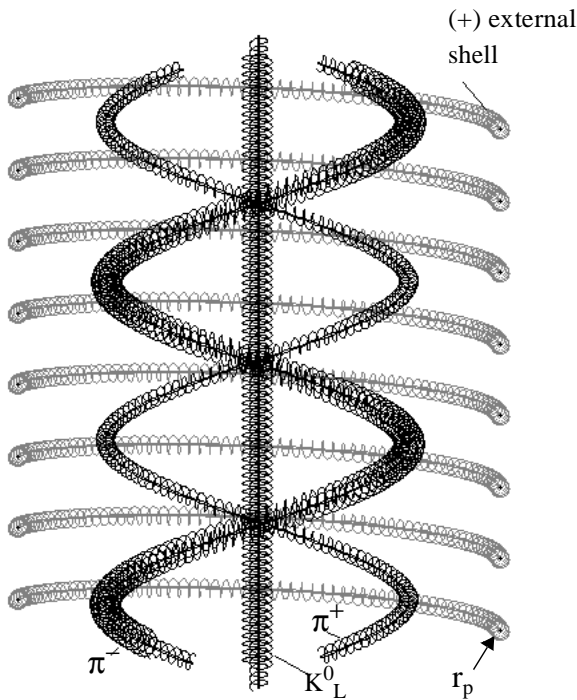Shape and envelope structure of proton and neutron

Fig. 2.15.B. Axial sectional view of proton (neutron) showing the external positive shell (envelope) and the internal subatomic particles. All of them are formed by helical structures with internal RL structures (not shown).
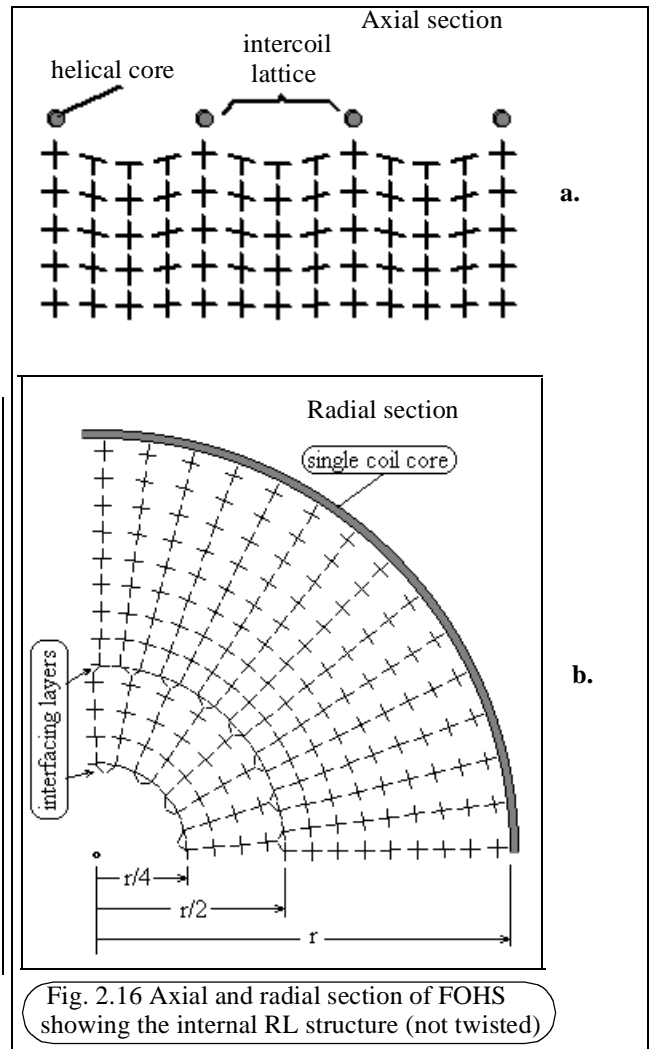
Fig. 2.16 Axial and radial section of FOHS showing the internal RL structure (not twisted)
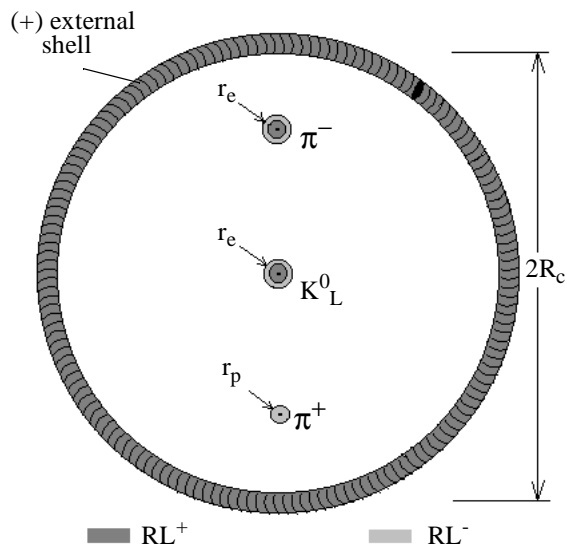
Fig. 2.15.A. Radial sectional view of proton (neutron) core with internal subatomic particles and their internal RL structures. The RL structures are not twisted for the kaon, partly twisted for the pions and fully twisted for the external shell.

Fig. 2.29.E. Radial section of positive FOHS with twisted internal RL(T)$^+$ structure generating E-field in CL space. The radial section of the FOHS envelope core and the

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central core is formed of 7 prisms. r_p - is a radius of the FOHS envelope.

Deuteron with Balmer series orbital

He nucleus

Simple quantum orbit (n - is the subharmonic number)

Orbit in Balmer series

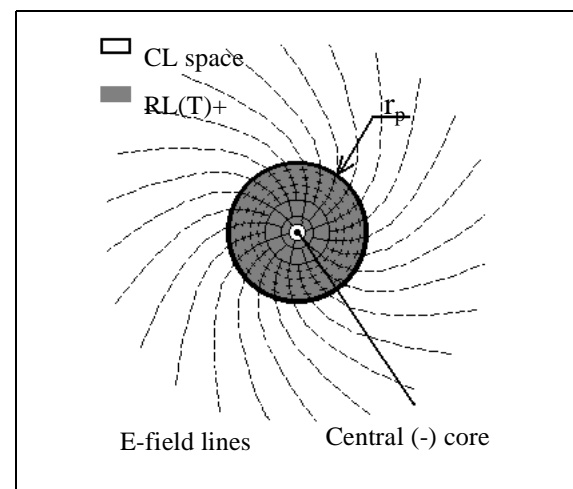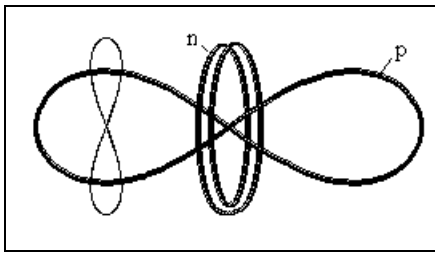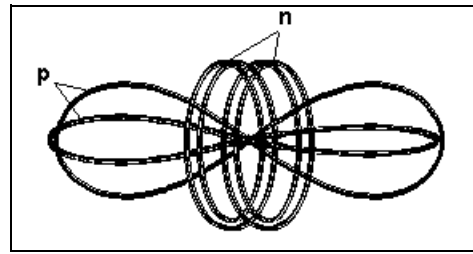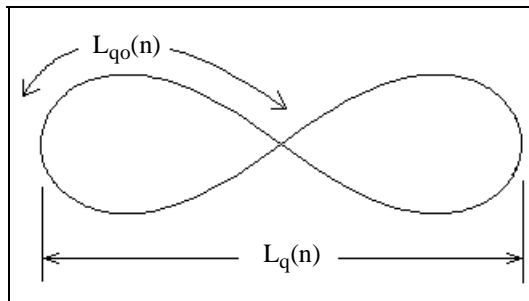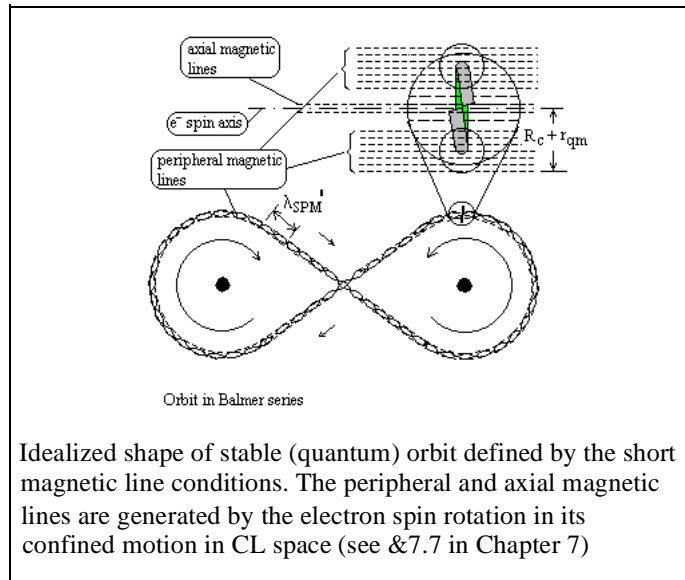Idealized shape of stable (quantum) orbit defined by the short magnetic line conditions. The peripheral and axial magnetic lines are generated by the electron spin rotation in its confined motion in CL space (see &7.7 in Chapter 7)

The equation of the quantum orbit trace length, L_{qo} is derived in &3.12.3 (Chapter 3).

$$L_{qo}(n) = \frac{2\pi a_o}{n} = \frac{\lambda_c}{\alpha n} \qquad (3.43.i)$$

where: n is the subharmonic number of the quantum orbit; λ_c - is the Compton wavelength; α - is the fine structure constant; $2\pi a_o$ - is the length of the boundary orbit (a_o - is the Bohr model radius)

The shape of the orbit is defined by the proximity E-field of the proton. The most abundant quantum orbit has a shape of Hippoped curve with parameter $a = \sqrt{3}$. Orbits of such shapes are also used as electronic bonds connecting atoms in molecules (see Chapter 9).

The trace length L_{qo} and the long axis length L_q of the possible simple quantum orbits (formed by single quantum loops) are given in Table 1.

The estimated distance between the CL nodes in abcd axis is: $d_{abcd} \approx 0.549 \times 10^{-20}$ (m).

Table 1:

n	L_{qo} [A]	L_q [A]	e^- energy [eV]
1	3.3249	1.3626	13.6
2	1.6625	0.6813	3.4
3	1.1083	0.4542	1.51
4	0.8312	0.3406	0.85
5	0.665	0.2725	0.544
6	0.5541	0.2271	0.3779

The calculated geometrical parameters of the stable atomic particles: proton, neutron, electron and positron are given in **Table 2**. The last reference column points to the BSM chapters mostly related to the calculations and cross validations of the parameters.

Table 2:

Parameter	Value		Description	Calculations and cross validations in:
L_{PC}	1.6277	(A)	proton (neutron) core length	Chapters 5 and 6
L_P	0.667	(A)	proton length	Chapters 6, 7, 8, 9
W_P	0.19253	(A)	proton (neutron) width	Chapters 6, 7 ,8 ,9
r_e	8.8428E-15	(m)	small radius of electron	Chapters 3, 4, 6
s_e	1.7706E-14	(m)	electron(positron) step	Chapter 3
r_p	5.8952E-15	(m)	small radius of positron	Chapters 3, 4, 6
$2(R_c + r_p)$	7.8411E-13	(m)	thickness of proton (neutron)	Chapters 6, 7, 8, 9

Notes:
(1) $R_c = 3.86159 \times 10^{-13}$ (m) is the Compton radius of electron.
(2) $1A = 10 \times 10^{-10}$ (m) is the Amstrong unit for length

Shape symbols of nuclear atomic structures

n   p   D   T   He
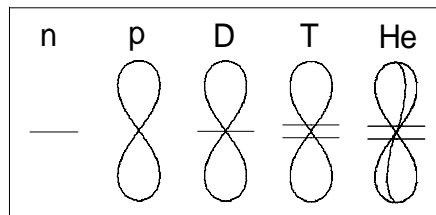
Sketch symbols of nuclear atomic structures

n   p   D   T   He

front view

bottom view
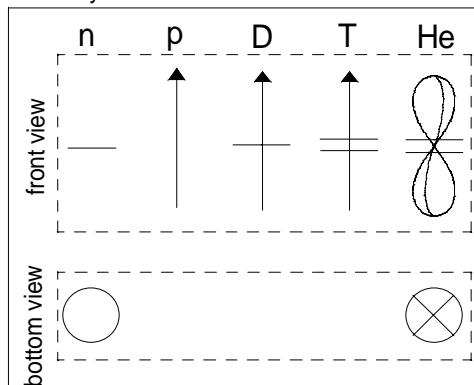
scale for structures and quantum orbits

1 Å
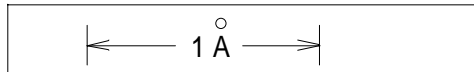
Notations:

n - neutron
p - proton
D - deuteron
T - Tritii
He - Helium
Ar - Argon

EB - electronic bond (weak)
GB - (intrinsic) gravitational bond (strong)
GBclp - (proton) club proximity GB
GBpc - polar clamped GB
PC - polar connection or clamp for Ar polar GB

Polar section of Ar
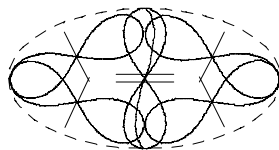
Polar section of Ar for
a polar GB in the bottom
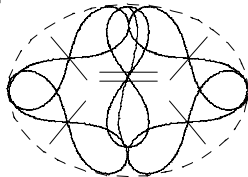
Polar section of Ar
for two polar GBs
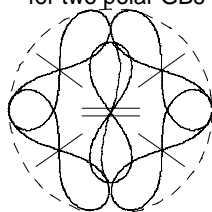
Simple quantum orbits (QOs)

(2)   (3)   (4)   (5)   (6)

(1)
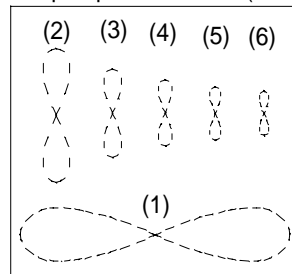
(1) first harmonic QO (13.6 eV)
(2) second subharmonic QO (3.4 eV)
(3) third subharmonic QO (1.51 eV)
(4) fourth subharmonic QO (0.85 eV)
(5) fifth subharmonic QO (0.544 eV)
(6) sixth subharmonic QO (0.377 eV)

Connection symbols

EB   GBclp   GBpc   PC

front view

bottom view

H2 - para state

(1)

(1)
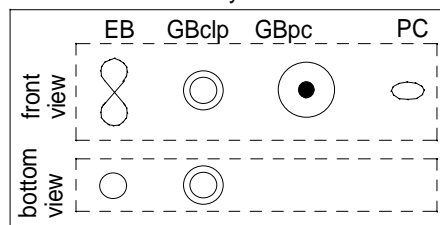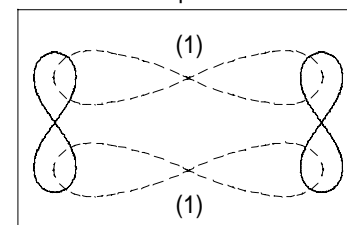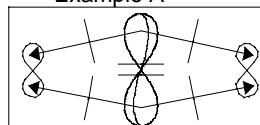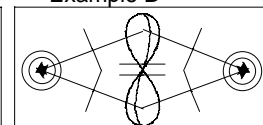
Example A   Example B

Example A: Two pairs of Ds connected by EB bonds
Example B: Two pairs of Ds conncted by GBclp bonds

H2 - ortho state (2 e- with oposite spins in respect to the proton twisting)

(1)
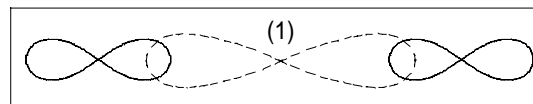
Note: QOs for para and ortho states of H2 are normal to the proton's quasiplanes

p

H

H

D

He

n

Trace from Balmer
series orbital

Trace from Lyman and
higher series orbitals

*Note: The higher series orbitals of H atom are
formed by serial quantum loops*

^{6}Li	^{7}Li	^{9}Be	^{11}B	^{12}C	^{14}N
Z=3 N=3	Z=3 N=4	Z=4 N=6	Z=5 N=6	Z=6 N=6	Z=7 N=7

^{16}O	^{19}F	^{20}Ne	^{23}Na	^{24}Mg	^{27}Al
Z=8 N=8	Z=9 N=10	Z=10 N=10	Z=11 N=12	Z=12 N=12	Z=13 N=14

^{28}Si	^{31}P	^{32}S	^{35}Cl	^{40}Ar	^{40}Ar
Z=14 N=16	Z=15 N=16	Z=16 N=16	Z=17 N=18	Z=18 N=22	Z=18 N=22

(Ar)

Atlas of Atomic Nuclear Structures   Part II

?

^{39} K	^{40} Ca	^{45} Sc	^{48} Ti	^{51} V	^{52} Cr
Z=19 N=20	Z=20 N=20	Z=21 N=24	Z=22 N=26	Z=23 N=28	Z=24 N=28

(Ar) (Ar) (Ar) (Ar) (Ar) (Ar)

?

^{52} Cr	^{55} Mn	^{56} Fe	^{59} Co	^{59} Ni	^{63} Cu
Z=24 N=28	Z=25 N=30	Z=26 N=30	Z=27 N=32	Z=28 N=31	Z=29 N=34

(Ar)   (Ar)   (Ar)   (Ar)   (Ar)   (Ar)

^{65.4}**Zn** Z=30   N=36

^{69.7}**Ga** Z=31   N=39

^{72.6}**Ge** Z=32   N=41

^{74.9}**As** Z=33   N=42

⁷⁹**Se** Z=34   N=45

^{79.9}**Br** Z=35   N=45

(Ar)   (Ar)   (Ar)   (Ar)   (Ar)   (Ar)

92.9 **Nb**	95.9 **Mo**	98.9 **Tc**	101.1 **Ru**	102.9 **Rh**	106.4 **Pd**
Z=41 N=52	Z=42 N=54	Z=43 N=55	Z=44 N=57	Z=45 N=58	Z=46 N=60

$^{107.9}$Ag	$^{112.4}$Cd	$^{114.8}$In	$^{118.7}$Sn	$^{121.7}$Sb	$^{127.6}$Te
Z=47 N=61	Z=48 N=64	Z=49 N=66	Z=50 N=69	Z=51 N=71	Z=52 N=76

126.9 **I** Z=53 N=74

131.3 **Xe** Z=54 N=77

131.3 **Xe** Z=54 N=77

132.9 **Cs** Z=55 N=78

137.3 **Ba** Z=56 N=81

| 150.4 **Sm** Z=62 | 152 **Eu** Z=63 | 157.2 **Gd** Z=64 | 158.9 **Tb** Z=65 | 162.5 **Dy** Z=66 | 164.9 **Ho** Z=67 |

167.3 **Er**
Z=68

168.9 **Tm**
Z=69

173 **Yb**
Z=70

175 **Lu**
Z=71

178.5 **Hf**
Z=72

178.5 **Hf**
Z=72

| 180.9 **Ta** Z=73 | 183.5 **W** Z=74 | 186.2 **Re** Z=75 | 190.2 **Os** Z=76 | 192.2 **Ir** Z=77 | 195.1 **Pt** Z=78 |

| 197 **Au** Z=79 | 200.6 **Hg** Z=80 | 204.4 **Tl** Z=81 | 207.2 **Pb** Z=82 | 209 **Bi** Z=83 | 209 **Po** Z=84 |

| (247) Cm Z=96 | (247) Bk Z=97 | (251) Cf Z=98 | (252) Es Z=99 | (257) Fm Z=100 | (258) Md Z=101 |

Atlas of Atomic Nuclear Structures   Part II

(259) **No**
Z=102

(262) **Lr**
Z=103

(262) **Lr**
Z=103

≡

Atlas of Atomic Nuclear Structures   Part II