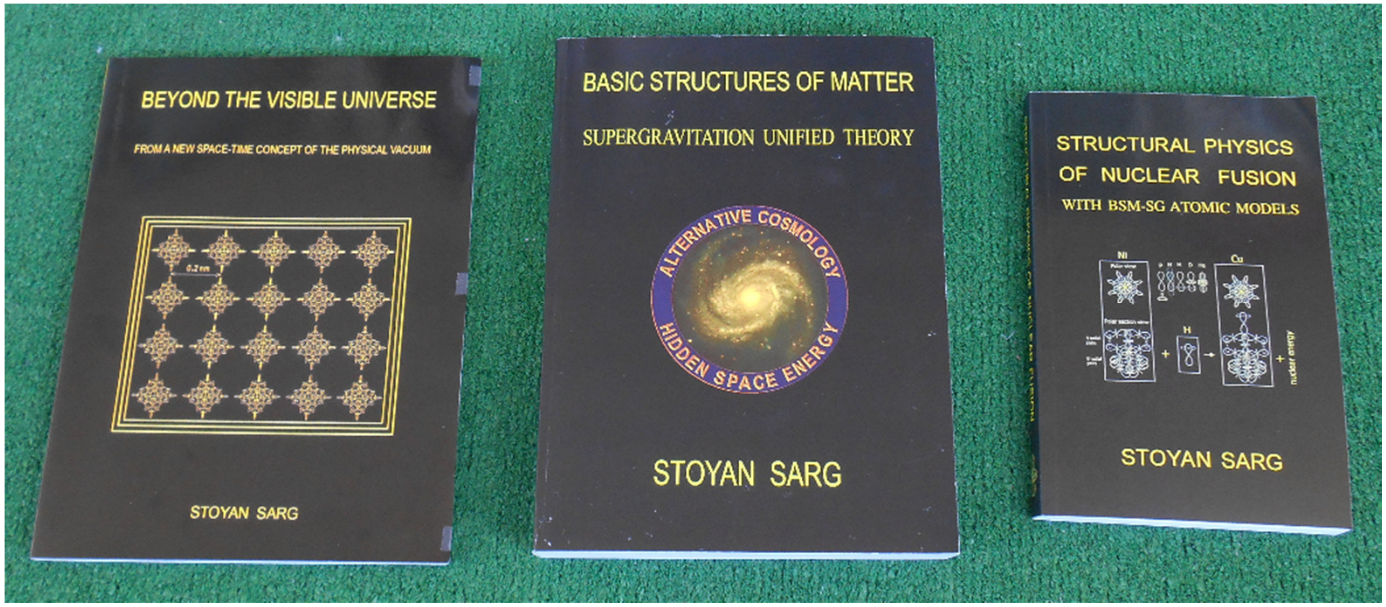
# Graphical 3D Modeling of Molecules and Nanostructures in Sub-nanometer Scale with the BSM-SG Atomic Models

*Stoyan Sarg Sargoytchev,*
*Toronto, Canada*

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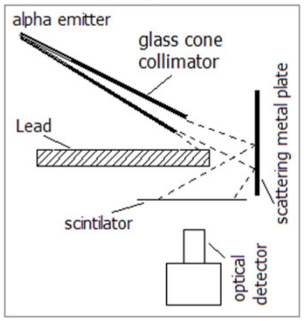
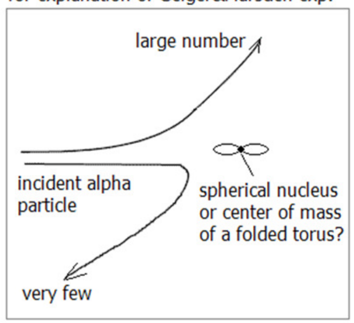
# Scattering experiments: Deviation from Rutherford scattering theory at alpha particles with energy above 25 MeV

H. Geiger and E. Marsden experiment (1909)



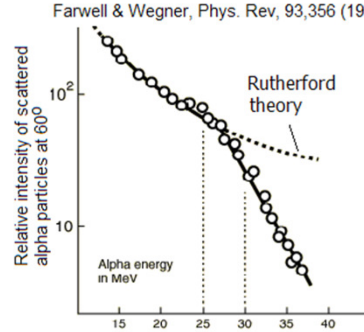

Elastic scattering model of Rutherford for explanation of Geiger&Marsden exp.




Note: Folded torus model is by Sarg

Sharp departure from Rutherford model for energy > 27.5 MeV

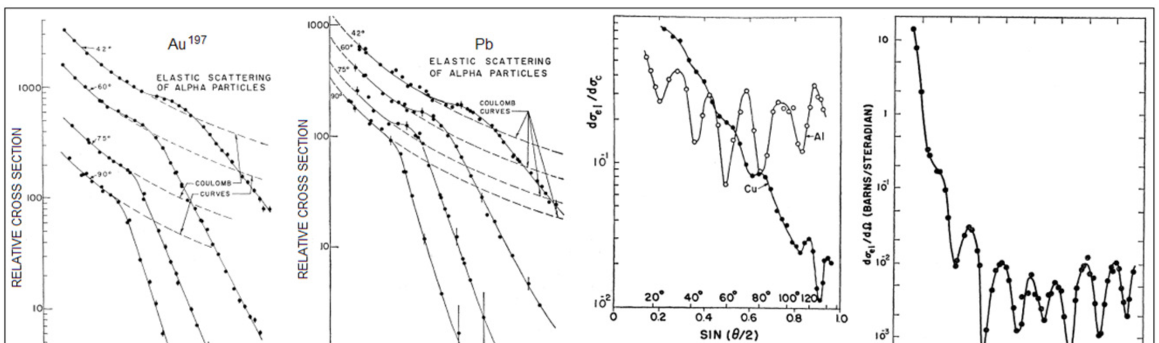
Farwell & Wegner, Phys. Rev, 93,356 (1954)




Courtesy of Eisberg, R. M. and Porter, C. E., Rev. Mod. Phys. 33, 190 (1961)

The problem was firstly discovered by E. S. Bieler (1924), then investigated by Farwell & Wegner (1954) and other researchers

## Scattering by alpha particles




(Data from Farwell and Wegner (1954))

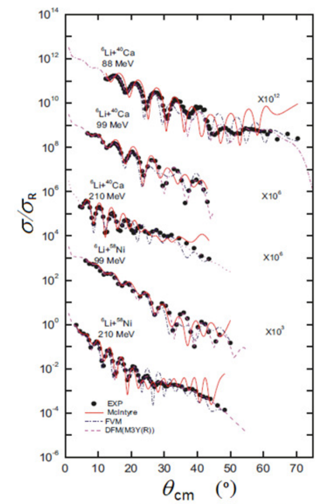
(Data from Farwell and Wegner (1954))

Ratio of differential scattering crossection to the Coulomb crossection for Al and Cu at 19 MeV alpha particles (Data from Bleuler and Tendam (1955))

Differential crossection against scattering angle for Ne at 18 MeV alpha particles (Data from Gailer, Bleuler and Tendam (1958))

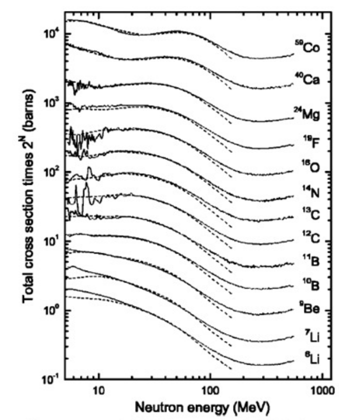
Courtesy of Eisberg & Porter, Rev. Mod. Phys, 33, 2, 190-230 (1961)

## Scattering by Li nuclei




Courtesy of R.I. Badran and Dana Al-Masr
http://dx.doi.org/10.1139/cjp-2012-0466

## Scattering by neutrons



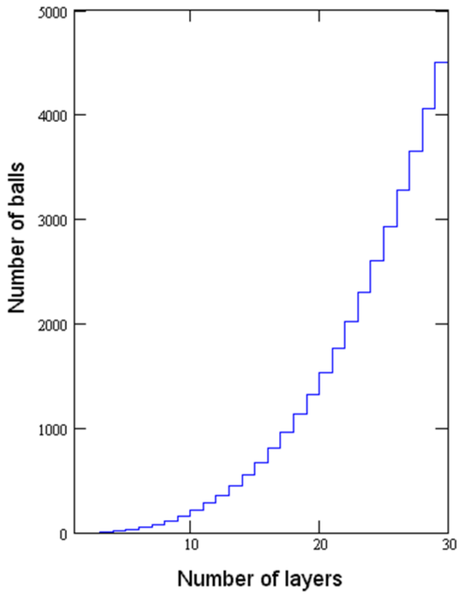

Courtesy of Abfalterer et al. (2001) by combined data of Finley (1993) and Abfalterer et al. (1999)

Reference: http://gsjournal.net/Science-Journals/Essays/View/5281

# Starting point of BSM-SG theory

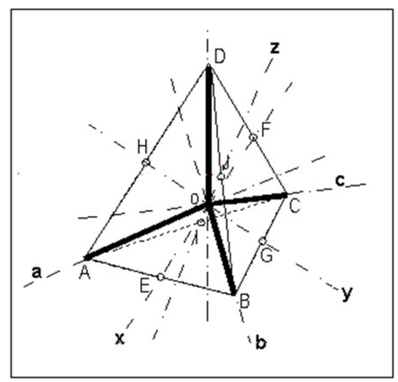
Fundamental particles at Planck scale and Supergravitational law (SG)

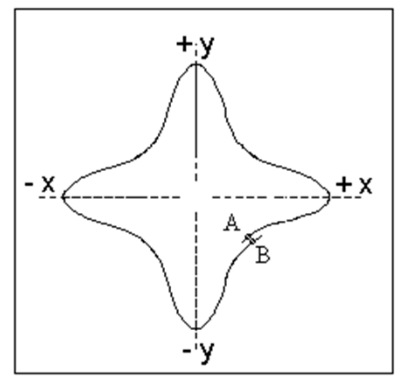
$$F_{SG} = G_{SG} \frac{m_{sg1} m_{sg2}}{r^3}$$ - in classical empty space




$$L_{PL} = \sqrt{\frac{hG}{2\pi c^3}} = 1.616 \times 10^{-35}\ (m)$$ - Planck length

$$t_{PL} = \sqrt{\frac{hG}{2\pi c^5}} = 5.39 \times 10^{-44}\ (s)$$ - Planck time




The fine structure constant - a signature of the number of sub-cycles of the common mode oscillations in one full cycle (BSM Chapter 12)

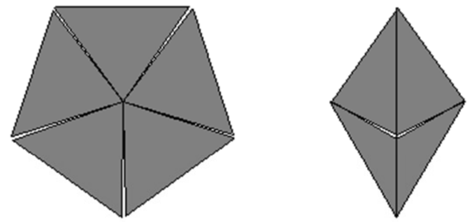
$$\alpha = 2 / [(n^2 + 2\pi^2)^{1/2} + n] = 7.29735194 \times 10^{-3} \quad - derived$$ For n =137

$$\alpha = 7.2973525 \times 10^{-3} \quad (CODATA\ 98)$$

# Hypothetical crystallization at the lowest level of matter organization

(TH)

**Primary Tetrahedron**

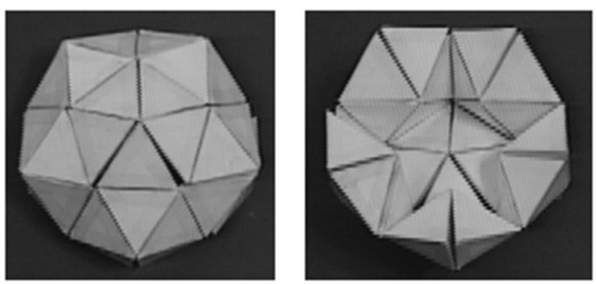


**Quasi Pentagon (QP)**

Planck units:

$$L_{PL} = \sqrt{\frac{hG}{2\pi c^3}} = 1.616\times10^{-35}\ (m)$$

$$t_{PL} = \sqrt{\frac{hG}{2\pi c^5}} = 5.39\times10^{-44}\ (s)$$



external view internal view

**Quasi Ball (QB)**

1 QB = 12 QP = 60 TH

The QP angular gaps combine in one gap of 7.355$^0$, so QB can be left or right-hand twisted. This is a 2-bit memory carrying the chirality at the lowest level of matter organization.

Why the Periodic table of elements has such a shape?

Isn't define by some structural arrangement of the protons and neutrons in the atomic nuclei?

## Periodic table of elements

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| hydrogen 1 H 1.0079 | | | | | | | | | | | | | | | | | | helium 2 He 4.0026 |
| lithium 3 Li 6.941 | beryllium 4 Be 9.0122 | | | | | | | | | | | | boron 5 B 10.811 | carbon 6 C 12.011 | nitrogen 7 N 14.007 | oxygen 8 O 15.999 | fluorine 9 F 18.998 | neon 10 Ne 20.180 |
| sodium 11 Na 22.990 | magnesium 12 Mg 24.305 | | | | | | | | | | | | aluminium 13 Al 26.982 | silicon 14 Si 28.086 | phosphorus 15 P 30.974 | sulfur 16 S 32.065 | chlorine 17 Cl 35.453 | argon 18 Ar 39.948 |
| potassium 19 K 39.098 | calcium 20 Ca 40.078 | | scandium 21 Sc 44.956 | titanium 22 Ti 47.867 | vanadium 23 V 50.942 | chromium 24 Cr 51.996 | manganese 25 Mn 54.938 | iron 26 Fe 55.845 | cobalt 27 Co 58.933 | nickel 28 Ni 58.693 | copper 29 Cu 63.546 | zinc 30 Zn 65.39 | gallium 31 Ga 69.723 | germanium 32 Ge 72.61 | arsenic 33 As 74.922 | selenium 34 Se 78.96 | bromine 35 Br 79.904 | krypton 36 Kr 83.80 |
| rubidium 37 Rb 85.468 | strontium 38 Sr 87.62 | | yttrium 39 Y 88.906 | zirconium 40 Zr 91.224 | niobium 41 Nb 92.906 | molybdenum 42 Mo 95.94 | technetium 43 Tc [98] | ruthenium 44 Ru 101.07 | rhodium 45 Rh 102.91 | palladium 46 Pd 106.42 | silver 47 Ag 107.87 | cadmium 48 Cd 112.41 | indium 49 In 114.82 | tin 50 Sn 118.71 | antimony 51 Sb 121.76 | tellurium 52 Te 127.60 | iodine 53 I 126.90 | xenon 54 Xe 131.29 |
| caesium 55 Cs 132.91 | barium 56 Ba 137.33 | 57-70 * | lutetium 71 Lu 174.97 | hafnium 72 Hf 178.49 | tantalum 73 Ta 180.95 | tungsten 74 W 183.84 | rhenium 75 Re 186.21 | osmium 76 Os 190.23 | iridium 77 Ir 192.22 | platinum 78 Pt 195.08 | gold 79 Au 196.97 | mercury 80 Hg 200.59 | thallium 81 Tl 204.38 | lead 82 Pb 207.2 | bismuth 83 Bi 208.98 | polonium 84 Po [209] | astatine 85 At [210] | radon 86 Rn [222] |
| francium 87 Fr [223] | radium 88 Ra [226] | 89-102 * * | lawrencium 103 Lr [262] | rutherfordium 104 Rf [261] | dubnium 105 Db [262] | seaborgium 106 Sg [266] | bohrium 107 Bh [264] | hassium 108 Hs [269] | meitnerium 109 Mt [268] | ununnilium 110 Uun [271] | unununium 111 Uuu [272] | ununbium 112 Uub [277] | | ununquadium 114 Uuq [289] | | | | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lanthanide series | lanthanum 57 La 138.91 | cerium 58 Ce 140.12 | praseodymium 59 Pr 140.91 | neodymium 60 Nd 144.24 | promethium 61 Pm [145] | samarium 62 Sm 150.36 | europium 63 Eu 151.96 | gadolinium 64 Gd 157.25 | terbium 65 Tb 158.93 | dysprosium 66 Dy 162.50 | holmium 67 Ho 164.93 | erbium 68 Er 167.26 | thulium 69 Tm 168.93 | ytterbium 70 Yb 173.04 |
| * *Actinide series | actinium 89 Ac [227] | thorium 90 Th 232.04 | protactinium 91 Pa 231.04 | uranium 92 U 238.03 | neptunium 93 Np [237] | plutonium 94 Pu [244] | americium 95 Am [243] | curium 96 Cm [247] | berkelium 97 Bk [247] | californium 98 Cf [251] | einsteinium 99 Es [252] | fermium 100 Fm [257] | mendelevium 101 Md [258] | nobelium 102 No [259] |

# BSM-SG models of atomic nuclei as 3D fractal formations of protons and neutrons

Proton and neutron posses one and the same superdens material structure but with a different shape

**proton** a twisted torus with externally detectable E-field

**neutron** a double folded torus with a proximity locked electrical field

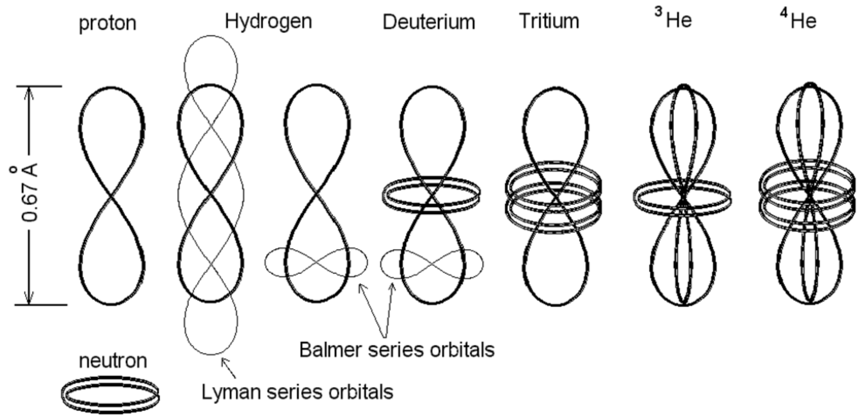


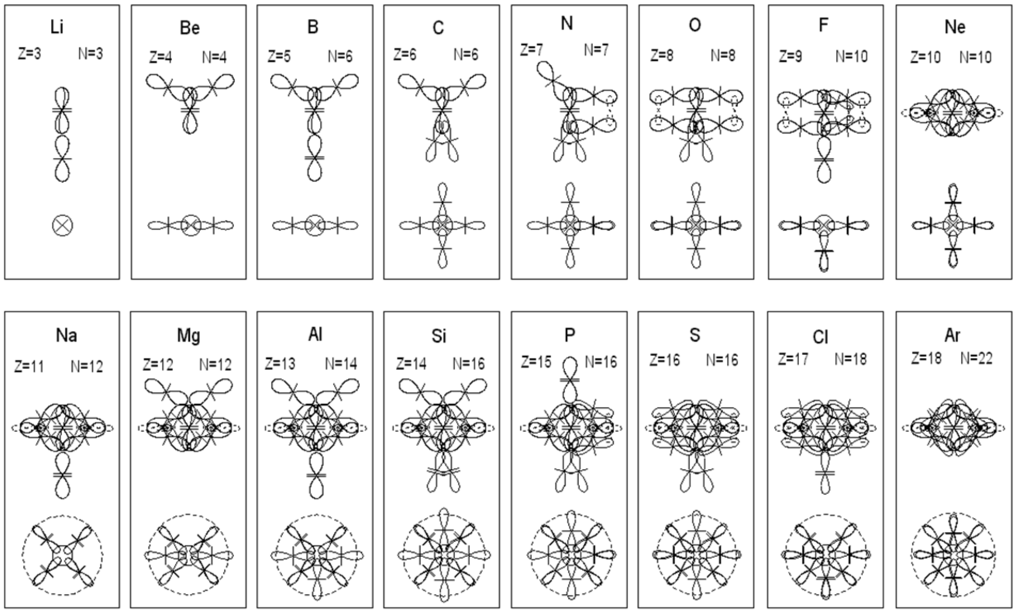

Fig. 1 Simple atomic nuclei

$F_{SG} = G_{SG}m_0^2/r^3$ - Supergravitation Law (SG forces are detectable as Casimir Forces)

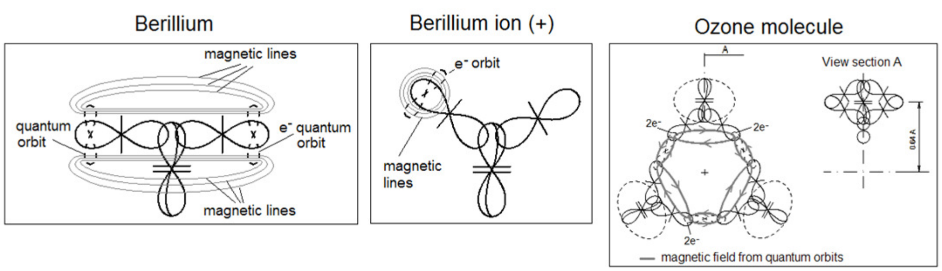
- Protons and neutrons possess one and a same superdens matter having only a different external shape.
- At close distance they interact with Super Gravitational (SG) forces which appear as nuclear forces.
- The analysis of $H_2$ and $D_2$ spectra using BSM-SG models allows to determine the product

  $G_{SG}m_o^2 = 5.2651 \times 10^{-33}$ **[Nm³]** (§9.7 of BSM-SG).
- The obtained constant was verified by theoretical estimate of the binding energy of deuterium nucleus, using a **simplified** method. The obtained value is 2.158 (MeV). (The experimental value is 2.2246 (MeV).
- According to BSM-SG, the superdense nuclear matter makes a space microcurvature. Nuclear reactions causes a change of this micro-curvature and the energy stored in the lattice structure of physical vacuum is released as nuclear energy. The stored energy is equal to the mass deficit expressed by the Einstein equation $\boldsymbol{E = mc^2}$.

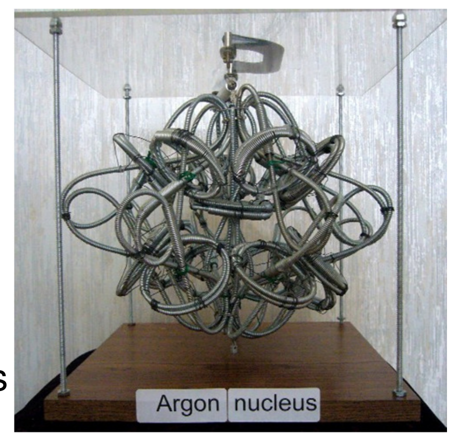
**Panel 3.** Atomic nuclei of second and third rows of the Periodic Table and magnetic field interactions between the electron orbitals

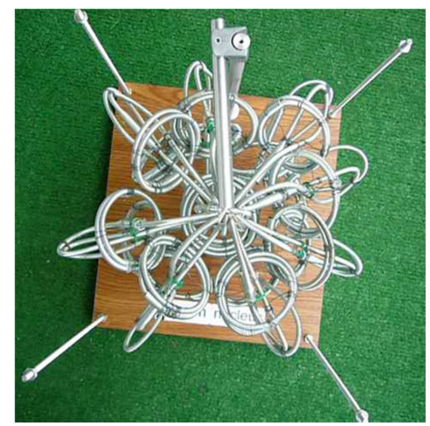



Note: The principal chemical valence increases with z-number until the deuterons (protons) from the two poles are at different planes passing through the polar axis. In further z increase the deuterons (protons) are bound at equatorial region and excluded from principal valence. At noble gases all deuterons are bound at equatorial region by SG forces and excluded from any chemical valence.

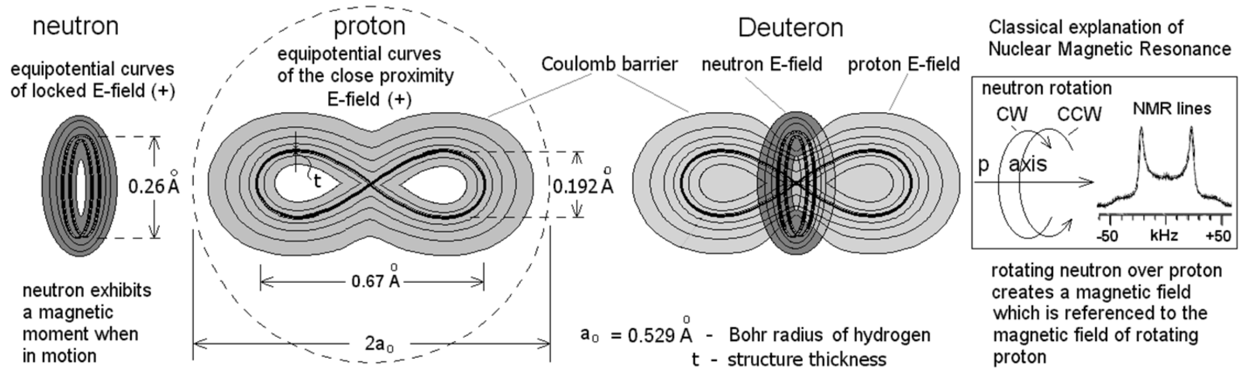



Magnetic field interactions between the different orbitals in atoms and molecules

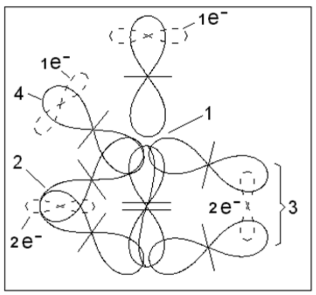


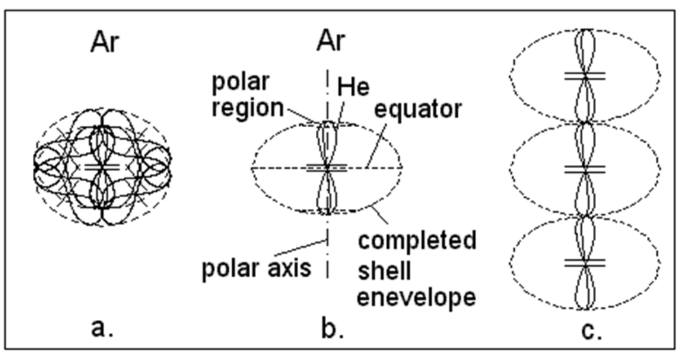
# **Panel 2.** Build-up trend of protons and neutrons apparent from Periodic table

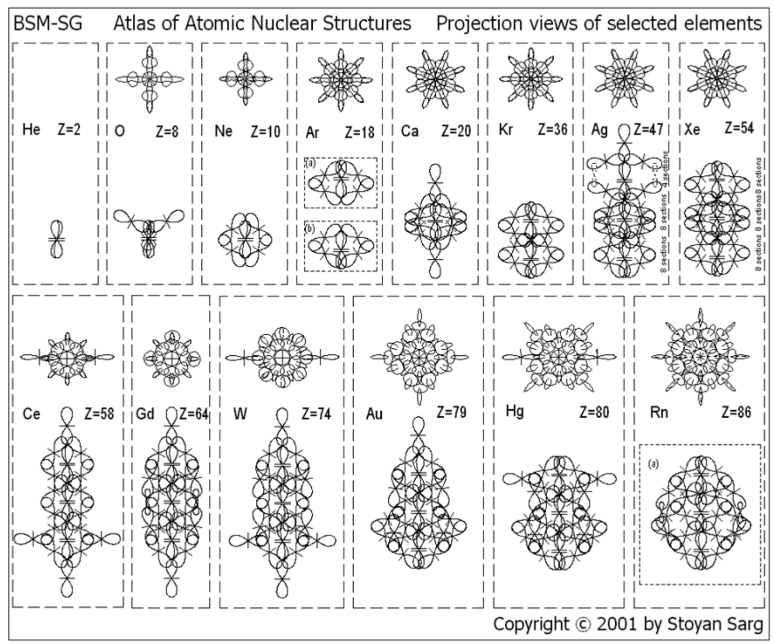



Types of nuclear bonds (Chapter 8 of BSM-SG)



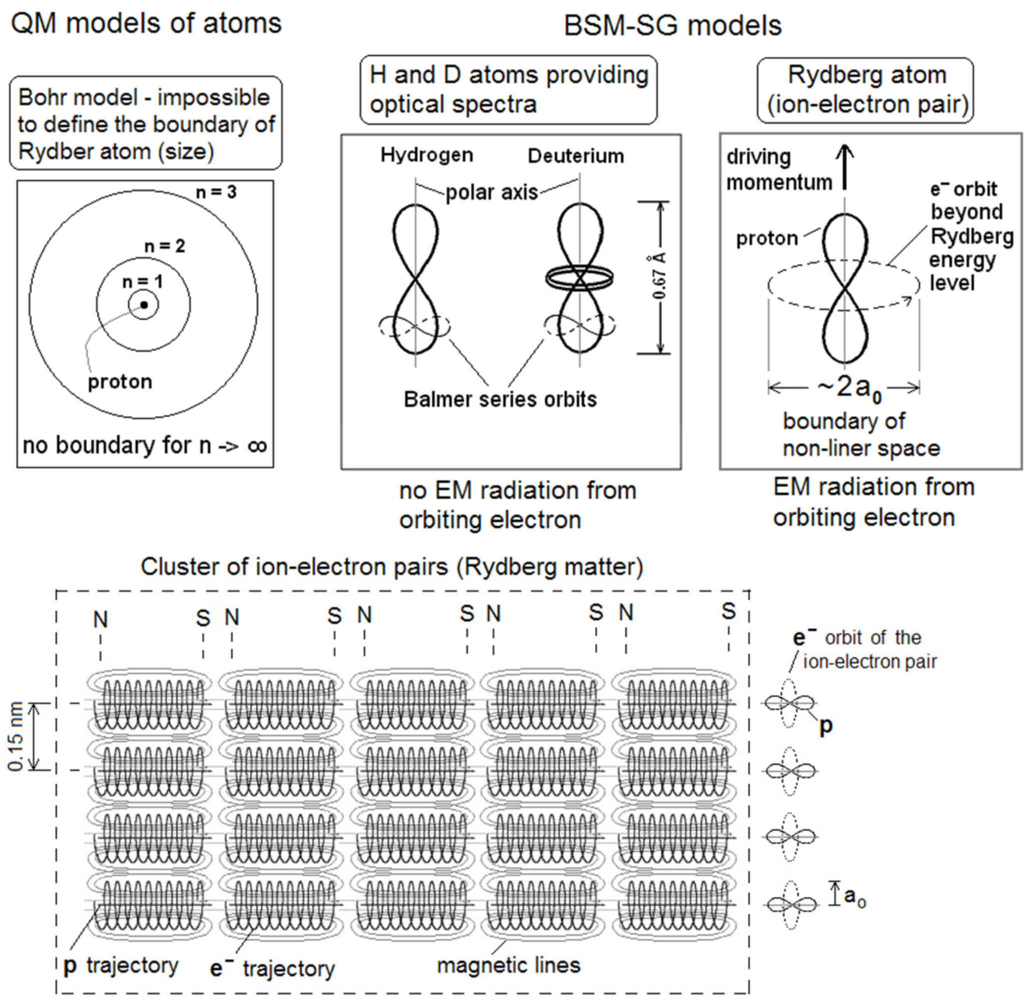

Polar axis and chain structure of atoms with z > 18




Atomic nuclei of some selected elements

# Panel 8. Rydberg state and Rydberg matter in EM activated plasma

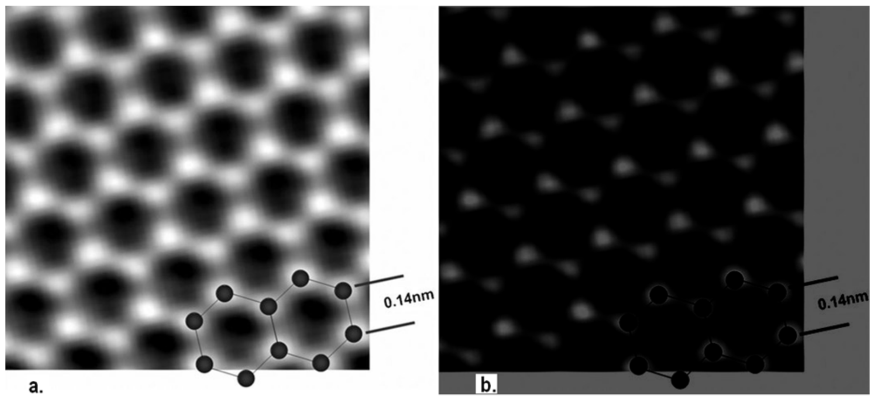



The anomalous magnetic momentum of the electron at its confined motion velocity of 13.6 eV provides a constant driving momentum. This provides a significant driving momentum to the Rydberg atom due to the helical trace of the electron. This momentum become much more stable if an external magnetic field is applied.

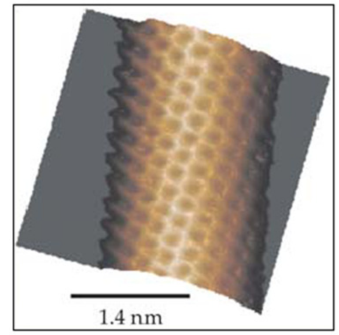
The Rydberg matter from hydrogen or deuterium exhibits a strong EM signature (experimentally observed)

## **Panel 5.** BSM-SG atomic models and nanotechnology

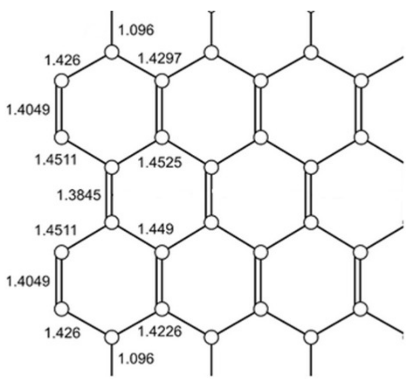
Example of analysis of Single sheet graphene

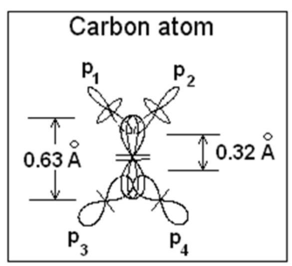



a. TEAM microscope image of a single wall Carbon sheet
b. Processed image showing a signature of 2 parallel planes




Nanotube, Courtesy of A. Javey et al. Nano Lett., 4, 1319, (2004




Note:

The plane of P1 & P2 is perpendicular to the plane of P3 &P4. This provides a slight displacement of the locations of the electronic orbits. This feature is detectable by the TEAM microscope.

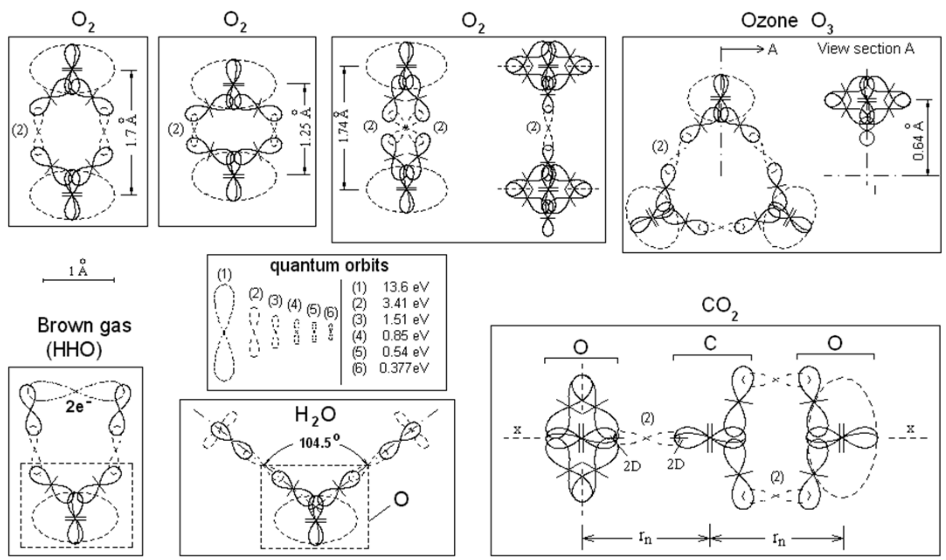



**Fig. 6.** Atomic arrangement in some simple molecules.

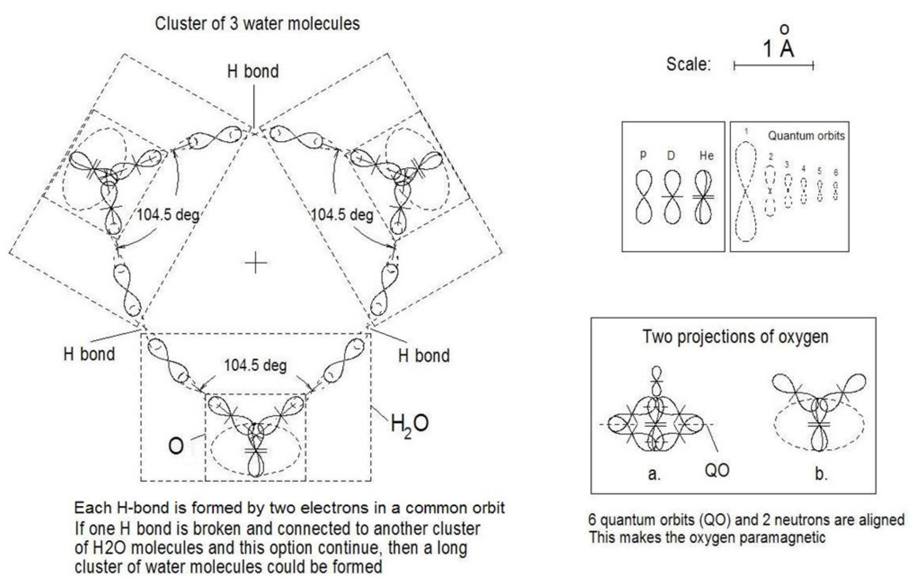
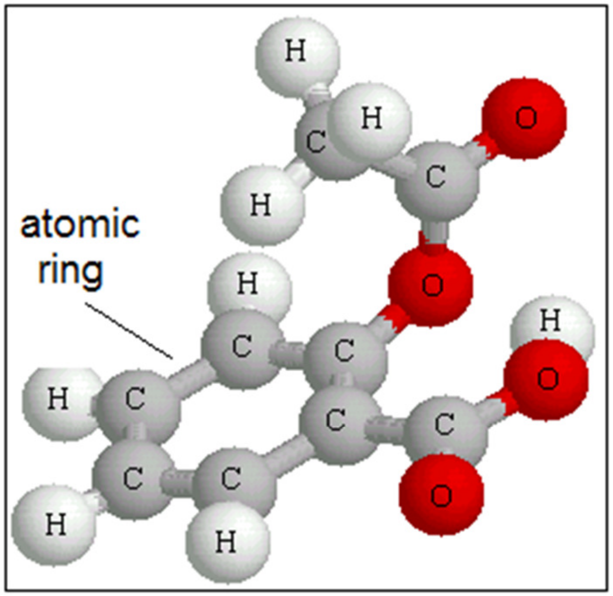



**Fig. 7.** (Left) A cluster of three water molecules, as envisioned by BSM-SG theory. The existence of this cluster is proofed by FIR spectroscopy

Aspirin molecule




Aspirin by BSM-SG models

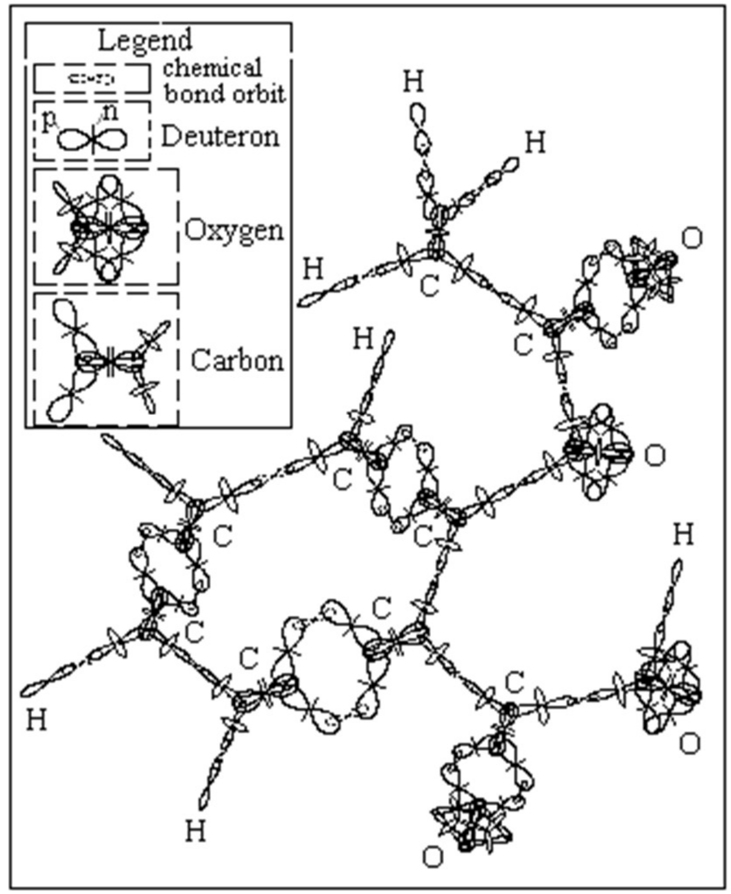



Fig. 8. Aspirin molecule with a ring atomic structure: possesses an energy storing mechanism as rotating quantum states

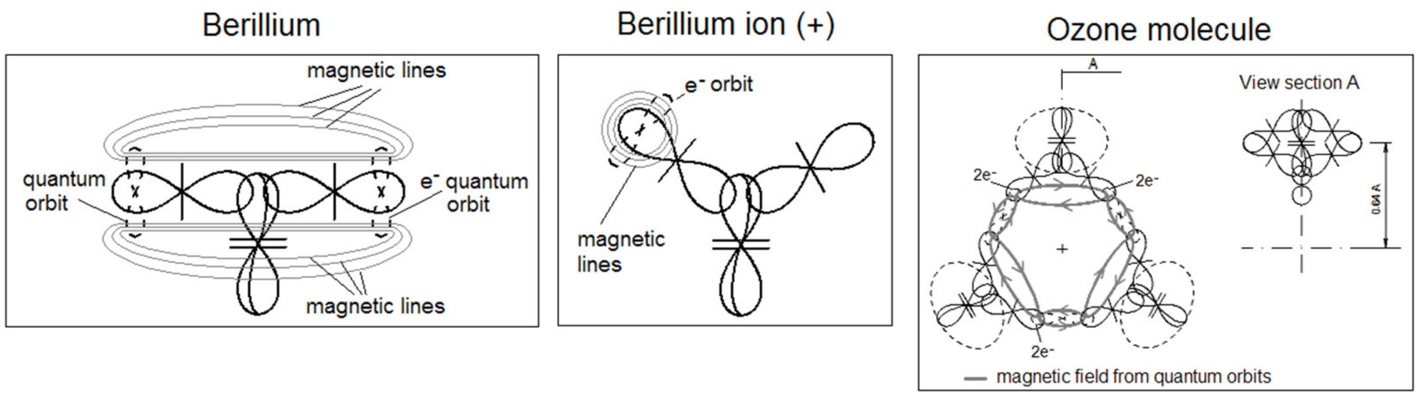



**Fig. 9**. Magnetic field interactions between different orbitals in the atoms and molecules

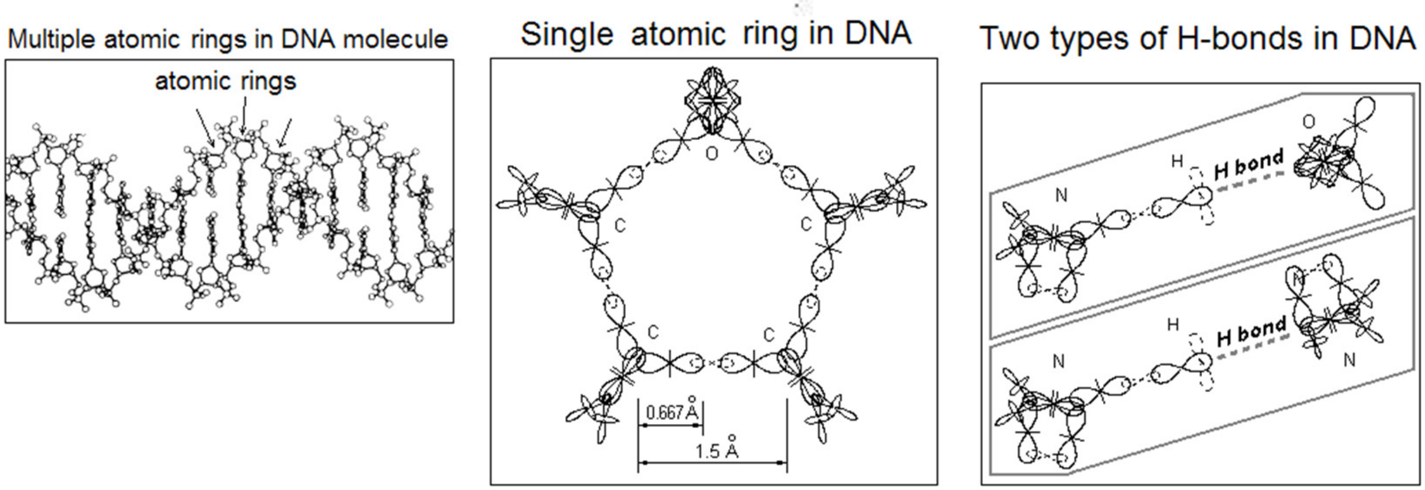
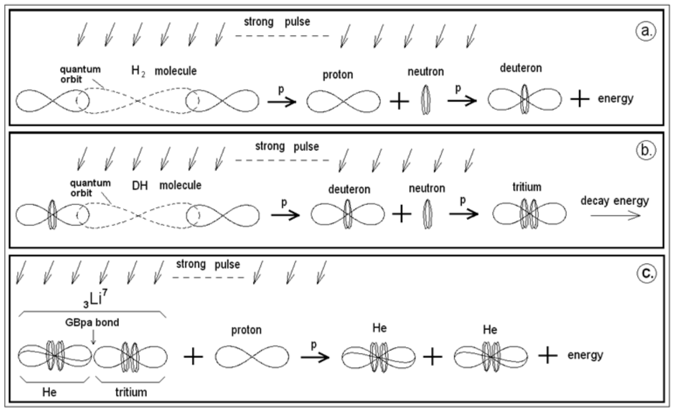


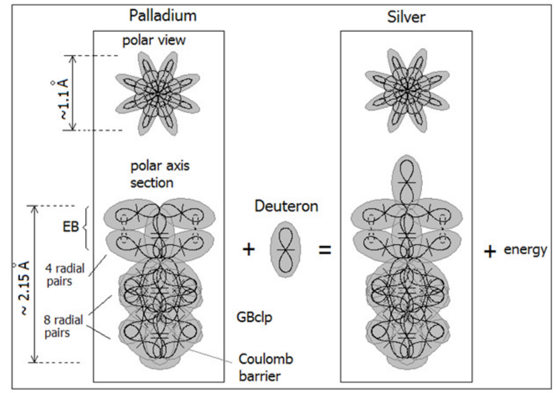

**Fig. 10.** Atomic rings in DNA molecules and the H-bonds. The atomic rings have energy storage feature as rotating quantum states.

# Panel 11. Graphical modeling of some nuclear transmutations and cold fusion reactions

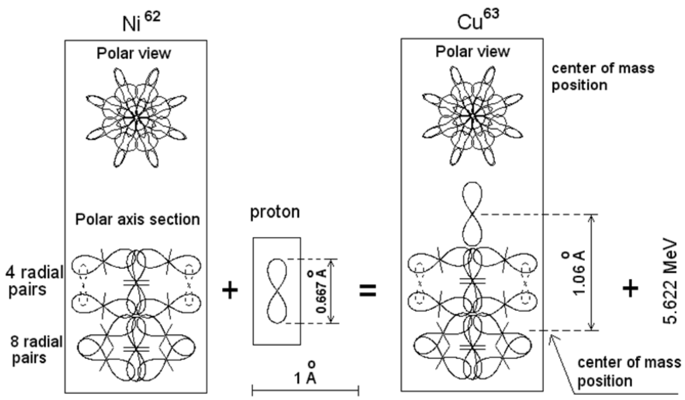
(Experimentaly Verified)



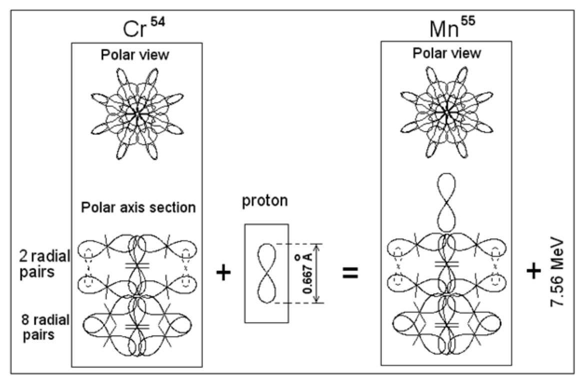

$Pd + D \rightarrow Ag$ (Exp. Verified)




$Ni + H \rightarrow Cu$ (Exp. Verified)



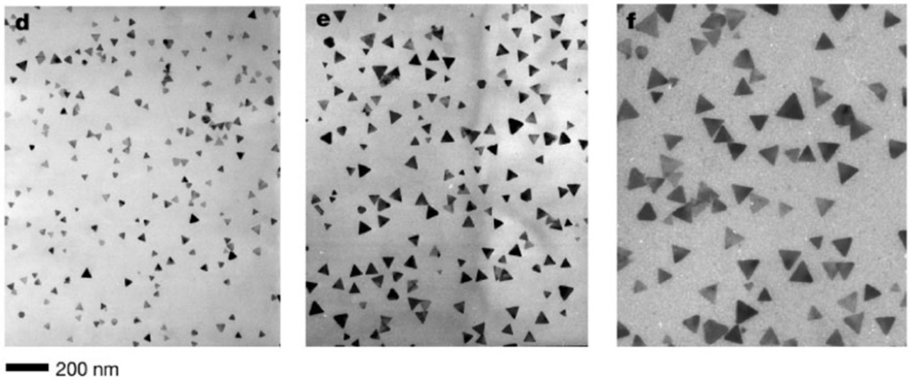

$Cr + H \rightarrow Mn$ (Predicted by Sarg)

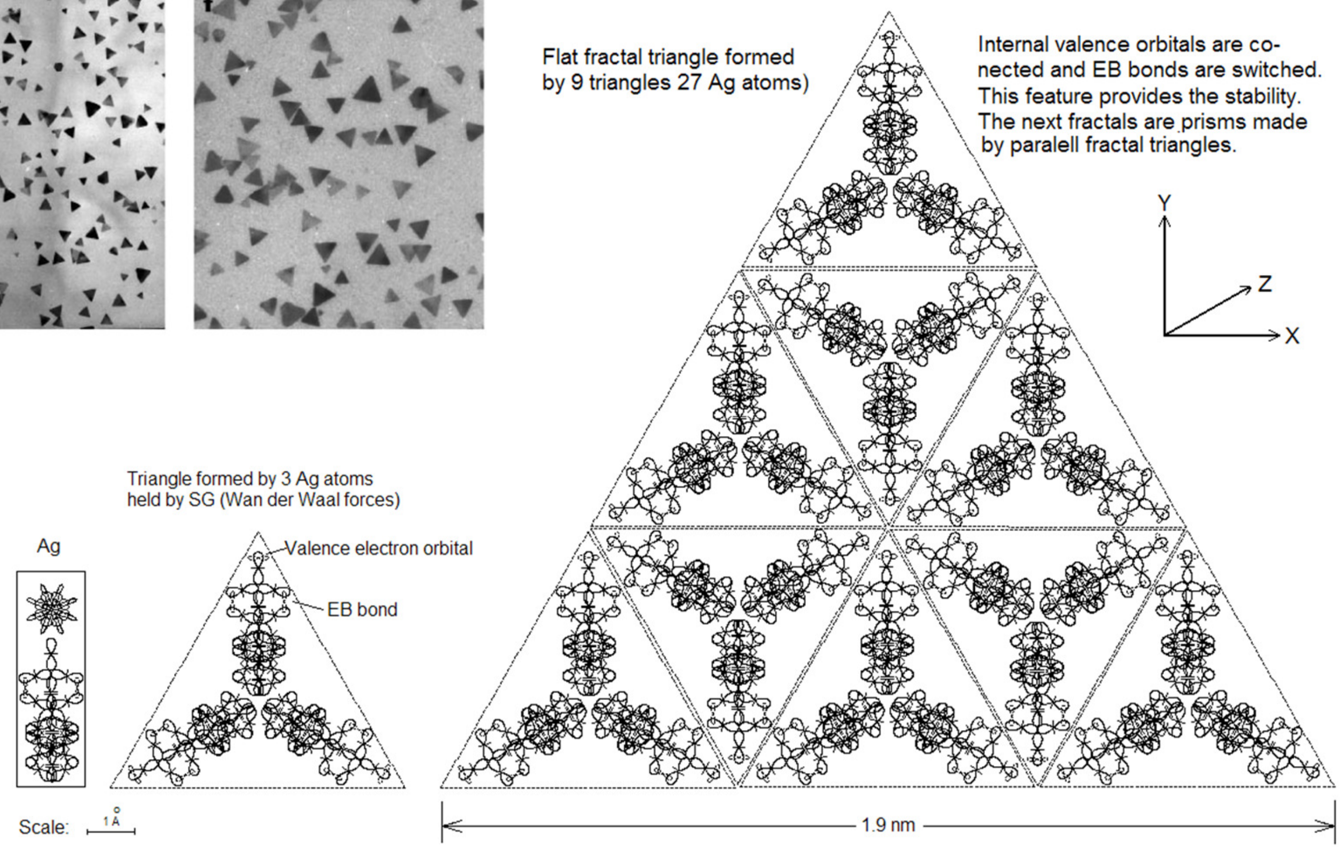



**In the book STRUCTURAL PHYSICS OF NUCLEAR FUSION a method is shown for identification the position of the fused proton (deuteron) by estimation the change of the center of mass of the recipient nucleus. The method uses the derived constant $C_{SG}$ and the dimensions of proton and neutron.**

## Panel 12. Colloidal silver nanoprisms: Experimental observations and BSM –SG models

Silver nanoparticles. Courtesy of R. Jin et al.
Nature 2003 Oct 2;425(6957):487-90.




The trend continues in the upper level fractal formations in XY plane and in Z axes as stacks. This leads to formation of triangular prisms or piramids in the nanoscale range.

# Potential application of the BSM-SG atomic models.

- BSM-SG theory provides atomic models with 3D geometry and dimensions.
- BSM-SG models permits classical explanations of the boundary size of excited states, nuclear spin, angular restriction of chemical bonds and mutual magnetic interactions between orbitals.
- The Atlas of Atomic Nuclear Structures (ANS) provides BSM-SG models for the elements in the range 1<Z<103, using symbolic shapes for protons and neutrons. The derived models perfectly match the shape of the Periodic table.
- **BSM-SG models could be used for 3D graphical modeling in chemistry, nanotechnology and LENR with a sub-angstrom resolution**

**Selected articles available online:**

http://vixra.org/author/stoyan_sarg