New vision about a controllable fusion reaction with efficient energy yield

1. Short overview

We live in time of energy deficiency and ecological problems. In the same time we know that unlimited energy is locked by the Nature. Each litter of water contains about 2 gram of deuterium, that is equivalent to the energy of 3000 litters of gasoline if controlled fusion reaction of type $D + D \rightarrow He$ is achieved. Such process with positive energy yield has not been achieved so far, despite some 40 years of worldwide efforts. The current attempts are mostly concentrated on achieving of high temperature plasma in a range of hundred millions of degrees in order to create conditions close to those in the stars.

According to the existing scientific concept this type of reaction is not possible at lower temperature. But an alternative physical study indicates that such reaction is possible.

A new theory titled Basic Structures of Matter (BSM) led to successful logical explanations of number of phenomena in the fields of Quantum Mechanics, Relativity, superconductivity and Cosmology. This success, however, was achieved, after correction of one of the initial space time conditions adopted in the modern physics. Instead of postulating the constancy of light velocity as an initial condition, a model of unique vacuum structure has been adopted. Then the quantum features of the space, charge and magnetic features become explainable, while the constancy of the light velocity is derivable parameter. A mass equation is also derived and successfully used for estimation of the geometry of the elementary particles. The scattering experiments has been reconsidered for correction of the missing initial condition. Finally the new analysis led to the conclusion that the most effective fusion reaction $D + D \rightarrow He$ is possible at room temperature.

2. The new point of view of BSM theory

BSM theory provides a different view about the vacuum, and the matter. It presents a scientific proof about existence of vacuum structure with unique features, referenced in BSM as a CL (Cosmic Lattice) structure. Applying a new physical approach and using the discovered CL space structure as a frame of reference BSM succeeded to provide logical explanation of the rules in Quantum mechanics and the Relativistic effects. In the same time it uncovered the real physical structures of the atomic and subatomic particles. The Bohr atomic model appears to be only a mathematical model providing correct energy levels, but it is not identical to the physical one. When taking into account the vacuum structure and the structure of elementary particles, the physical model of the Hydrogen and all stable elements looks quite differently. Having a frame of reference and using a new approach the BSM theory was able to separate the space from time parameters at low level of matter organization and to perform physical analysis in a real three dimensional space. From BSM point of view, the interpretation of the scattering experiments does not provide correct real dimensions, because both: the vacuum structure and particle structures are not taken into account. BSM theory found that the stable particles like proton, neutron and electron (and positron) posses well defined spatial geometry. They are built of complex but understandable helical structures whose building blocks are the same as those forming the vacuum structure. Analysing the interaction between the vacuum and matter structures, the BSM theory was able to derive number of useful equations, like the light velocity, Newtonian mass (the mass we are familiar with), vacuum energy (zero point energy) and so on. It succeeded also to explain the physical sense of the electrical and magnetic fields. One of the most useful outcome of the BSM theory is the Atlas of Atomic Nuclear Structures (ANS). It shows that the protons and neutrons follow a strict spatial order in the nuclei with well defined nuclear building tendency related with Z number. The signature of this tendency matches quite well the row-column arrangement of the Periodic table, the Hund's rules and the Pauli exclusion principle. Fig 1 shows the spatial geometry of the Deuteron, where *p* -s is the proton and *n* - is the neutron. The neutron is centred over the proton saddle due to the Intrinsic Gravitation (IG) field and the proximity electrical fields.

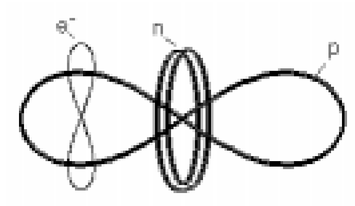

Fig. 1. Deuteron with electron in Balmer series orbital (according to BSM)

The nucleus of the Helium is shown in Fig. 2

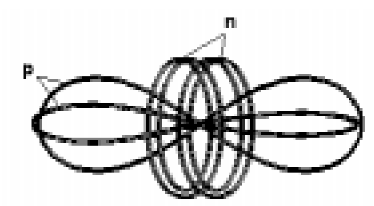

Fig. 2 Helium nucleus (according to BSM)

3. Physical mechanism of alpha decay.

BSM theory provides a physical evidence about some of the natural processes of fusion reaction. Such evidence becomes apparent even from the Atlas of ANS. For a drawing simplification of the nuclear structure the protons and neutrons are presented by symbolic patterns as they are shown in Fig. 3. Two types of symbolic notation is adopted in the Atlas of Atomic Nuclear Structures. They could not show, however, the nuclear helicity (twisting) around the polar axis.

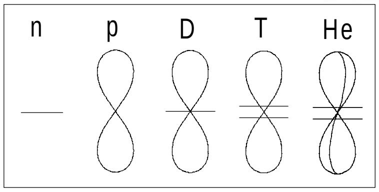

Fig. 3 Symbolic notations used in the Atlas of ANS

Fig. 8.6 and 8.7 (from Chapter 8 of BSM) show respectively the axial sections and polar views of the nucleus of Gd and Rn. In the polar section the protons and neutrons lying in proximity to the section plane are only shown (by their symbolic notations)..

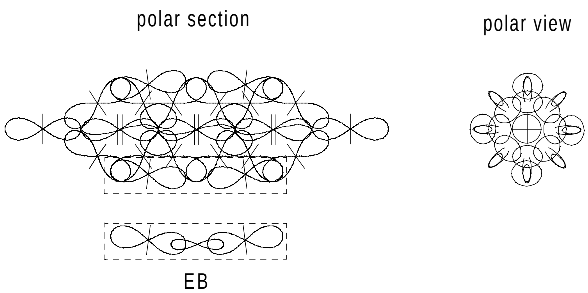

Fig. 8.6 of BSM. Nucleus of Gd

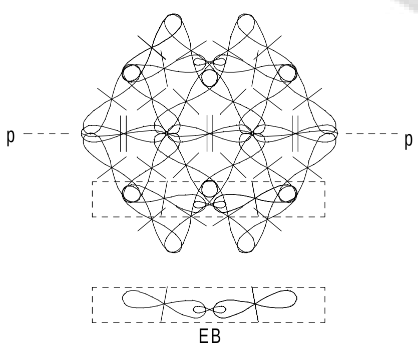

Fig. 8.7 of BSM. Nucleus of Rn (section)

In both figures two axially aligned deuterons are shown in the extracted box below the axial views of the nuclei These deuteron pairs occupy the equatorial region of the nuclei for the elements with Z > 59. If investigating the building tendency with Z number of the elements, we see that this equatorial structures are built in the Lantanides. After Hf they are still in the same positions but partly overlapped by a new external shell of deuterons, as shown in Atlas of ANS. These pairs of axially aligned deuterons namely provide emission of alpha particles in radioactive decay. The possible sequence of formation of alpha particles (He nuclei) from deuterons is the following.

The two deuterons are polar bonded, while their second clubs are connected by electronic bonds (a quantum orbit containing a pair of electrons with opposite QM spins). The polar bonding means that the Intrinsic Gravitational (IG) energy modes of the internal RL(T) structures of FOHS (see Chapters 2, 6 and 8) of the protons in polar range are in synchronization. For the whole atomic nuclear system, however, the intrinsic energy balance (the balance between the intrinsic gravitational field and the EM fields) is not stable for a long term (statistically related to the half time decay). In some particular moment the polar bond fails. The released IG energy is quite big in comparison to the EM fields energy. It disturbs the vacuum structure parameters for a short moment and the repulsive electrical forces between the two oriented protons are also disturbed. Then the IG forces that are inverse proportional to the cube of the distance (in a classical empty space) attract the axially alined deuterons and they merge into a He nucleus. The bonding electrons are lost due to the deteriorated vacuum space conditions mentioned above. So the obtained He nucleus is a positive ion. Part of the released IG energy goes for emission of gamma radiation, while another part is spent for momentum contribution to the He nucleus and released electrons.

4. Experimental evidence about the positions of the aligned deuterons

The structures of all atomic nuclei posses well defined polar axis of rotational symmetry and twisting. The twisting is defined by the twisting of the single proton and this feature is propagated in all stable nuclei. The polar symmetry is quite evident from the Atlas of ANS, while the twisting is not shown due to the drawing difficulties. The both features however play important role in the confined motion of the atom and especially for the motion of accelerated atoms in focusing magnetic field. In the confined motion of the atomic nucleus its polar axis is well aligned to the tangent of its trajectory and it possesses a spin momentum. In such condition the Broglie wavelength is a characteristic parameter.

The ternary fission effect is well known in the fission experiments with heavy atoms. Number of such experiments clearly show that the released alpha particles are predominantly emitted in a spatial angle centred (with some shift) around the equatorial plane with respect to the fission axis. Fig. 4. presents a typical angular distribution of the emitted alpha particles in respect to the fission axis.

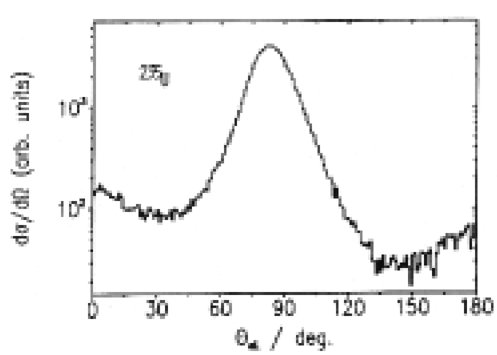

Fig. 4
Ternary alpha particle yields as a function of the

emission angle with respect to the direction of light fission fragments. (From Theobald, J., Report IKDA 85/22 Technische, Darmstadt. FRG, 1985)

The observed angular distribution, from the point of view of BSM model, indicates that the emitted alpha particles originate from the axially aligned deuterons existing for all elements with Z>59. Consequently a fusion process have taken place contributing to the emission of alpha particles with such angular distribution. In the fission experiments such process is actively provoked, but the concept of fusion from aligned deuterons is the same as in the alpha radioactive decay. Then the alpha production in both cases: the natural and the provoked one indicates that the fusion reaction of deuterons could be achieved at room temperature.

The envelope shape, the structure and dimensions of the stable particles (proton, neutron, electron and positron) are obtained and cross-validated by the analysis presented in BSM. The proton envelope shown in Fig. 1 is a twisted torus with a shape close to a figure 8, while the neutron is a same structure but in shape of double folded torus. More accurately the plane projection of the proton is quite close to a Hippoped curve with parameter $a = \sqrt{3}$. The interactions between the proton, neutron and electron as physical entities with the vacuum structure are investigated and their geometrical parameters are expressed by the known physical constants. The dimensions are given in the Atlas of ANS, part I. (for the proton: length 0.667 A; width 0.1925 A, thickness 0.0078 A). The electrical field of the neutron is locked by IG field in the proximity range to its envelope and is not detectable in the far field. This is a result of the overall shape symmetry. The locking mechanism, however, does not work well when it is in confined motion in the structured vacuum and the neutron exhibits a magnetic moment. The electrical field of the proton is unlocked. So in the far range it appears as emerging from a point charge, but in the near field it is distributed over the proton envelop. 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 not valid in the range of near field. Then in proper axial alignment and spin the integration energy for fusion of deuterons into He should not by calculated by the classical way with a classical Coulomb law down to a range of 10E-15. This makes a huge difference in the theoretical estimation of the necessary energy for successful fusion reaction.

5. Conditions and requirements for successful fusion reaction at room temperature

The binding energy of proton and neutron into a deuteron is calculated by approximative method in Chapter 9, &9.12.1 of BSM theory. The calculated energy, according to BSM concept is 2.145 MeV. This is pretty close to the experimental binding energy of 2.2245 MeV. The calculation method applies a disintegration approach of the neutron along the proton polar (long) axis. The binding energy has been obtained by using of IG energy balance in which one of the needed IG parameter has been obtained by the analysis of molecular vibrations in Chapter 9 of BSM. The applied method also indicates that the energy of the interacting proximity electrical field of the neutron (locked) and the proton (unlocked) is part of the IG energy.

One approximate method (of BSM) for calculation of the necessary energy for the fusion is based on the use of the classical Coulomb law but the distributed charges of the two protons in the He nucleus configuration are preliminary converted to two point charges with a proper distance between them. Then the necessary energy is obtainable by integrating from the initial finite distance to infinity. The obtained total energy is below 1 MeV. This result however is valid if the following requirements are fulfilled:

(a) The deuterons are axially aligned and posses opposite linear momentums

(b) The difference between the spin momentum of both deuterons is close to zero:

$\omega_1 - \omega_2 \to 0$

The conditions for opposite linear momentums could be better achieved if positive D^+ and negative D^- deuteron ions are accelerated and collided as counter propagating beams.

The requirements (a) and (b) are demonstrated by Fig. 5 where two counter propagated D^+ and D^- are shown (p - proton, n - neutron).

Attempts for fusion of deuterons projectiles has been performed perhaps quite extensively, but the requirement (b) has not been obvious, before the BSM theory. If this requirement is not fulfilled a process of scattering instead of fusion will take place. Additional consideration related with the relaxation constant of the vacuum structure are also important, but they are not presented in this document.

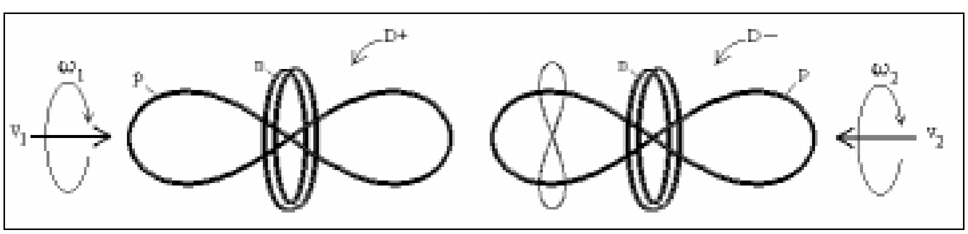

Fig. 5. Axial orientation and spin momentum conditions for counter propagated deuteron ions.

References:
1. S. Sarg, BSM theory, 2001
2. S. Sarg, Atlas of Atomic Nuclear Structures, 2001

www.helical-structures.org (BSM theory and Atlas of ANS)
www.heliconstruct.com (educational site)
(A larger list of references is included in the BSM theory)