II. ON THE MECHANISM OF COLD NUCLEAR FUSION

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Let us try to consider from the viewpoint of Jones's the epoch-making experiments of Fleischmann and Pons' group and others. The results of these works can be briefly summarized as follows: the cold nuclear fusion (CNF) phenomenon exists but nobody knows how to explain it. In spite of the fact that the number of fantastic theories explaining CNF mechanisms increases, only a few believe them. Let us give some estimation of these experiments. The minimum classical distance X_{clas}, at which deuteron nuclei may approach each other, equals X_{clas} = [unreadable] = 14(a)/E(eV). The deuteron nucleus size is about $4x10^{-12}$ cm, the nuclear force range is $4x10^{-13}$ cm (deuteron is very friable [sic]). The solution of equation 5 from (1) for these initial conditions X_0 = 3A and [unreadable] = 1.57079632 shows that nuclear reactions can occur with the energy more than 1 eV. If the phase approximates /2 (sic) the energy value may decrease by hundreds of times. Fig. 1 shows the dependence of X_{min} on the energy value in some fixed phases.

One shouldn't think that the phase precipice phenomena causes the nuclear reaction in the wide range of the precipice. The Coulomb's repulsion at this moment may happen to be less than the attraction of the small interaction, but nobody knows when it may happen, because the phase may similarly influence the value of nuclear forces. Besides, sometimes the particle arrives at the turning point X_{min} having "thinned" sufficiently. Will it be able to take part in full-scale nuclear reaction or will it pass through rapidly as an electron usually does when in an S-atom state? But there exist very narrow ranges of the phase, where particle charge increases rapidly and the particle accelerates after stopping. The charge may amount to maximum value in the nuclear force action range. Apparently a narrow phase range is responsible for the cold nuclear fusion. These data are essential for the development of the new-generation nuclear reactors. Interaction D-D takes place in three channels (energy in MeV):

$D + D \rightarrow T\ (1.01) + p\ (3.03)$ (1 channel)
$D + D \rightarrow {}^3He\ (0.82) + n\ (2.45)$ (2 channel)
$D + D \rightarrow {}^4He + \text{gamma}\ (5.5)$ (3 channel)

All of them are exothermic, have no threshold (now it is clear why) and may occur even at very small relative energies.

For example in D molecule the balance distance between atoms 0.74 Å, in conventional theory the interaction rate being very slow 10^{-64} per sec. But at a distance of 0.1Å this value is sufficient for cold fusion events according to the classical theory.

The rate of reaction ratio for tritium and neutron channels is close to a unity according to classical theory, but in numerous cold fusion experiments [the tritium/neutron ratio is large]. Let us try to explain the cause of the phenomenon. At a small velocity in a phase precipice the nuclear forces of attraction act on neutrons and the electrostatic forces of repulsion act on protons. Two deuterons are turned with the neutron parts facing each other under the influence of these forces. The nuclear forces saturation occurs after the neutrons approach each other. So the proton connections grow weak and because of the electrostatic repulsion one of them leaves the nuclear system. It is like the Oppenheimer-Philips effect. It is easy to estimate that for E > 10 KeV deuterons have no time for turning, in this case the 2nd and 3rd channel reactions may occur.

The increase of the neutron channel may be due to the secondary neutrons birth in the reaction $T + D \rightarrow {}^3He + n$ (14.1 MeV). In the environment rich with deuterons the majority of the emerged tritons are transformed into neutrons by 5 barn cross-section reaction for E = 70 KeV. According to the estimations (3) the number of such secondary neutrons to the unit triton equals 7.9×10^{-12}; 1.7×10^{-9}; 2.7×10^{-6} for E = 10; 20 and 100 KeV respectively. So the predominance of $T/n = 10^6$ may only be expected in those reactions, where triton emerges with the energy of E < 40 KeV.

It should be noted that there is still a possibility to explain one of the nuclear physics anomaly, the existence of which nobody seems to notice. For nucleon energy of 1 MeV, $v = 10^9$ cm/s, $R_{nuclear} = 10^{-12}$ cm; $t = R/y\text{-}10^{-21}$ sec.; the time range of nuclear disintegration is anomalously large - 10^{-14} sec. Apparently at strong nuclear forces the phase precipice mechanism is working also, i.e. the nucleon is very slowly crawling into the nuclear system.

All the programs for the controllable nuclear fusion are based on heating and squeezing of the reacting material. In spite of the progress achieved in this field Dr. Alan Gibson, the head of the research in England, said that it would take at least 50 years to build the first demonstrative model of the reactor. It should be noted that such a reactor would be extremely sophisticated, expensive, and harmful to ecology. No classic approach to this problem has hitherto given any positive results, and this in spite of the billions of dollars spent and the enormous number of research workers and other personnel employed (physicists, engineers, managers, laboratory staff, etc.). It is only natural that such a huge army of scientific workers should potentially be antagonized by any other alternative project of nuclear fusion. It has been noticed that the "creativity" of any scientific theory stands in direct proportion to the number of researchers employed and the money spent. The reaction itself was experimentally confirmed in 1989 by M. Fleischmann and S. Pons in the US, where the two researchers were met with a strong opposition.

All the programs for controlled thermonuclear fusion are defined by the adjective "controlled", though in reality there is no control as such. For this reason the provided quantity of reaction material is taken extremely small. For instance, a lithium deuteride ball is no more than 1-2 mm in diameter. The direct approach being used at the fusion process is absolutely natural, because there are no means to influence this process in quantum mechanics. UQT provided us with such an opportunity. UQT equations show that the minimum distance to which the deuterons may approach each other depends greatly on the wave function phase. The future of the really controllable nuclear fusion system is not in primitive squeezing and heating of the material, but in collision of small energy nuclei with fine adjustment of wave function phase.

In principle, this can be achieved by applying the external controlling electromagnetic field upon the reacting system that contains quasi-fixed-ordered deuterium atoms and free (unbound) deuterons. The same properties may be also manifested by the special geometry of atomic frames. The diffractional scattering of deuteron flow on such frames will result in deuteron automatic selection in accordance with their energy and phasing. In this case the energy of colliding nuclei may be less than 1 eV.

Analysis of experiments made so far in CNF produces an impression that the reaction is effective only in cases of at least weak phasing, determined by either the inner structure of the environment or applied variable external fields. Apparently, in the course of their electrochemical experimentation M.

Fleischmann and S. Pons discovered this ordered system and observed occasional incomplete phasing that explained the experimental results.

In future reactor models, in contrast with the existing ones, only a very small portion of all deuterons will react simultaneously, their automatic selection being carried out by phase correlations. This will result in discharging small quantities of energy in a prolonged period of time until the reaching light nuclear source is exhausted. It is doubtful that such kind of nuclear fusion could be rightfully defined as "controllable".

Is it possible that the considered Vendee and Austerlitz of the eq. 3 will collide with Waterloo in Bohr-Sommerfeld problem and other cases, moreover taking into consideration my reasonable ignoring of the mass? What happened with the mass under the changing of the wave function phase? I can't give the precise answer. It has been assumed implicitly that the mass is either constant or a specific charge which depends on the phase. An application of the eq. 3, which was done for D-D interaction ad hoc doesn't result in failure of Bohr-Sommerfeld and scattering models. The states with $l > 0$ correspond to the electron trajectory similar to some beautiful flowers of buttercup sort. All results remind very much of the radial wave function, divided by spheric harmonics and can be used for good amusement at the computer during long nights.

If to calculate the electric field intensity E(r) for the spatial charge in term of the equation resolution of the UQT (1) and to observe the problem of the electron, passing through such a field (S-state), so there arise typical pendulum orbits, passing through the nucleus. Those orbits had been excluded in the classic Bohr-Sommerfeld model as absurd. As all of that doesn't contribute any new knowledge to atom physics, but has only art interest; we shall not dwell on it.

Apparently in atomic physics there are some situations when all the above said will not work. It doesn't mean the UQT failure, but means the eq. 3 roughness solely. Anyone can say: "if it is not the truth, it is a good invention". I would be very much surprised if God has ignored the beautiful chance of using the phase. If all that was said above is true it means that the resolving of the nuclear fusion problem is to be dealt with in a quite a different fusion already in 1983 (2) and all that is said above is the development of my old ideas. But the problem of nuclear fusion is the theme for further investigations.

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