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Experimental Evidences for the Harmonic Oscillator Resonance and Electron Accumulation Model of Cold Fusion.

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Abstract

Cold Fusion outside any substratum is again considered from the Harmonic oscillator resonance and electron accumulation (HOREA) model point of view. If one adds Fractal theory, one gets a more straigthforward agreement with the experimental growth of fusion burst after the apex I of a fast current, and varying approximately like the tenth power I^{10}. Then it is shown that the model could account for the solar neutrino discrepancy. The paper ends up by a short reminder of two experimental data, in agreement with the HOREA point of view: experimentally noticed Electron accumulations, and Top-Table soft X-ray Laser operation.

1. Introduction

The fusion process in a deuterated medium, outside any substratum has been told previously as being a particular one, among the various process, famed as being Cold Fusion processes [1]. The process described by the HOREA model is probably the most general process underlying the experimental observations, even in the case where the phenomenon occurs in a substratum like Palladium, Nickel, or in any other substrat which can absorb Hydrogen [2]. Inspite experimental data are still scarce and sometimes questionable,in the case of the process without substratum, if coupled with the HOREA model, they are leading to a quantitative description. This Cold Fusion approach has links with some frontier problems, like the fractality of a medium, the operation of a star like the Sun, and also with the validity of the Heaviside Fitzgerald and Lodge interpretation the Maxwellian Electrodynamics, which came out in 1888 [3].

2. The Fractal Point of view: A new insight into the fusion experiments by fast transitory currents.

The fractal point of view gives a more striking picture of the agreement between the Kiel and NRL experiments [2] and the HOREA model. During the leading edge of the current pattern, the medium was ionized; and as soon as the peak was reached, the neutron burst occured, which is conjectured to be only a testimony-like of the $D+D \rightarrow {}^4He$ reactions. According this model, the phenomenon is marked by a Poisson distribution of two colliding deuteron places and it is possible to take into account, as a good representative parameter, the De Broglie wavelength of the Deuteron. This distribution is the mark of the fractal character [4] of the fusible medium. Using the Schrödinger equation, it has been obtained, a linear relationship in logarithmic scale, of the fusion production term T, in function of the Deuteron energy, which has the same slope, than the one in function of the De Broglie wavelength [1]. The box counting dimension, practical approximation of the Hausdorff dimension [4], is obtained by dividing the fusible medium into a three-dimensional mesh, composed of boxes or practically of cubes, whose side length is δ; it is the limit of the logarithm of the number N_δ of boxes containing an element of the medium, in function of the logarithm of the cube size inverse $1/\delta$. Practically, one uses only an approximation of D, with a finite size δ, determined by Physics. In the specific case of the electron accumulation fusion medium, one can convert the D expression into one depending on the mean rate μ of Deuteron in a cubic box of side δ, given by the Poisson law. The probability P_1 for a boxe containing one Deuteron is thus, n being the number of Deuteron per volume unit.

$$P_1 = e^{-\mu}\,\mu = \delta^3 n \qquad (1)$$

And the probability P_2 for a boxe containing two Deuterons:

$$P_2 = \frac{1}{2} e^{-\mu} \mu^2 = \frac{1}{2} \delta^6 n^3 \qquad (2)$$

The number of boxes with two Deuterons being $\frac{1}{2} \delta^6 n^2$, and as δ is typically in the range of 10^{-9} cm, for colliding Deuterons, and n of the order of $10^{23}/cm^3$, μ is low, and $e^{-\mu}$ can be replaced by one. So the practical expression of the fractal dimension D is:

$$D = \lim \frac{\frac{1}{2} \delta^6 n^3}{\text{Log } 1/\delta} \qquad (3)$$

The mean ratio between the number of boxes, and containing two Deuterons, and the number of boxes containing one Deuteron is very close to $\mu/2$. Given that all boxes containing one unique Deuteron are supposed to give up their electron to the boxe containing two Deuterons, one can express the fractal dimension D in function of the ν number of the electrons accumulated around the two colliding Deuterons [1] ($\nu = 2/\mu$), n and taking into account the relationship,

$$\delta = (\mu/n)^{1/3} \qquad (4)$$

the fractal dimension is thus:

$$D = \frac{\text{Log } 2n/\nu^2}{1/3 \text{ Log } n\nu/2} \qquad (5)$$

This D expression, makes a link with the quantum calculation, which was fulfilled for some specific values of ν [1]. The NRL I^{10} power law, surprising at first sight, is directly linked with the fractality of the fusible medium. A medium which would be submitted to thermonuclear conditions, would not give such a power law, given that the fratal dimension would be evidently equal to 3. The figure 1 gives the fractal dimension D variations in function of the logarithm of the density n, for 3 values of the electron number accumulated around two colliding Deuterons. It is interesting to emphazize on the agreement of those values with the ones resulting from Schrödinger calculations. For example, for $n=10^{22}/cm^3$, the fractal dimension deduced from Schrödinger calculations is 1.92, the electron number being equal to $\nu = 1.3 \times 10^3$, whereas the direct calculation gives 1.94 for the fractal dimension. The agreement between the two ways to get the fractal dimension has a deep physical significance, which needs to be still digged deeper.

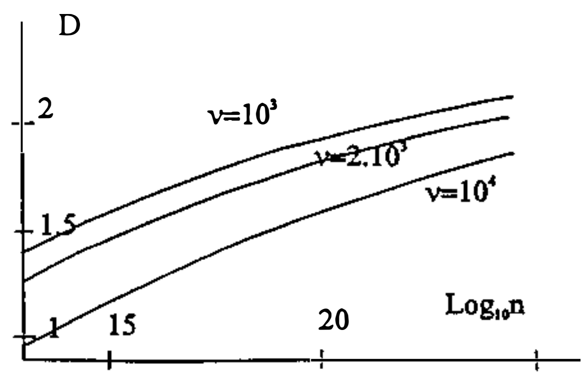

Figure 1: Plot of the fractal dimension D vs the number n of particle/cm^3, and for 3 values of the electron number ν.

3. Account for the solar neutrino discrepancy.

The solar neutrino counting reveals a discrepancy of approximately 30 percents, confirmed recently [5] between the 123 SNU, predicted by the standard model, and the 83 SNU, effectively detected with a uncertainty of 21 SNU (One Solar Neutrino Unit (SNU) corresponds to 10^{-36} neutrino interaction per atom of the detector and per second). The solar standard model describes the sun as being roughly constituted of three parts: the core, the radiative zone, and the convection zone [6]. It is characterized by some physical parameters: the solar luminosity: $L_{\odot} = 3.826\ 10^{33}$ erg s^{-1} , the solar radius: $R_{\odot} = 6.9598\ 10^{10}$ cm, the inner convection zone radius: 0.73 $R_{\odot}$, corresponding to a temperature of $1.3 x 10^{6}$ K, to a density of 0.15 g cm^{-3} [7], and to a pressure of $6 x 10^{12}$ dynes/cm^3.

In the convection zone there is no possiblity of thermonuclear reaction, but there should be some possibilities of fusion reactions, by the HOREA process. This hypothesis is in agreement with the effect of electron accumulation bringing about the fusion process, which can only occur in an ionized medium, submitted to turbulence, for example during the trailing edge of a fast current pattern[2].

The cold fusion process in solar convection zone is supposed essentially due to nuclear reactions between Deuterons. With the above parameters, the number of nuclei per cm^3 is in the range of some units of 10^{22}, and given the relative great rate of Hydrogen [7], the Hydrogen particle number n is close to this value. Taking into account the mass fraction of Hydrogen and Helium, one has approximately n(H) =0.92 n, so one can take in first approximation $n = 1.0 x 10^{22}/cm^3$, for the mean hydrogen nuclei number in the convection zone, and as the Deuterium/Hydrogen ratio is $D/H < 4 x 10^{-5}$, the Deuterium density is approximately determined by $n(D) < 4.0 x\ 10^{17}/cm^3$.

The expression of the Fusion energy production of the HOREA model is rather different from the one deduced from the Lawson criterium [8].

$$E = n^2/4\ T\ e\ \Delta t \qquad (6)$$

E is the energy produced during the Δt lapse of time, n is a particle number, able to participate to the fusion nuclear reaction, T called "the production term", describes the crossing of the "screened" Coulomb barrier, e is the energy, given off by one nuclear reaction.

The T value is obtained from the relationship, depending on the fractal dimension D, between the "production term" T and the Deuteron energy ε ($T/T_0 = (\varepsilon/\varepsilon_0)^D$). Supposing a Deuteron energy given by the Boltzmann equality ($\varepsilon = 3/2\ k\ \theta$), one gets ε = 129 eV. But the interesting parameters of the laboratory experiment T_0 and ε_0 are in fact poorly known. The ion energy mean value ε_0 is largeley superior to the thermal one (less than 1 eV in Kiel conditions), at the time of the fast current decrease, by resonance effect [2]. With D around 1.5, T_0 should be estimated in the range 10^{-27} -10^{-26} cm3/sec, and T in the solar convection zone ,should be in the maximum range 10^{-25} -10^{-24} cm3/sec.

But the behaviour of the medium cannot be described completely by the above expression of the energy E, whereas the number of fusible Deuterons is very low in comparison with the number of the other ions. One has in fact to multiply the "production term" T, by the probability for fusible ions, to be in touch. This probability can be evaluated considering a volume V of the medium containing two Deuterons and 2xH/D non fusible ions. If V is cubic, for the simplicity of calculation, and containing ζ cells, one can show that this probability p_f of collision for a possible fusion process in the elementary box is:

$$p_f = 2x26(\zeta - 6\zeta^{2/3}) (\zeta - 2)!/ (\zeta)! \qquad (7)$$

The E fusion rate of formula (6) has thus to be multiplied by p_f. With the above numerical values, one gets $p_f < 8.6\ 10^{-4}$, and for the total energy production per second W, in the convection zone:

$$1.0\ 10^{33} \text{ erg/sec} < W < 1.0\ 10^{34} \text{ erg/sec}$$

This range includes the third of solar luminosity. One ought get a value close to $L_{\odot}/3 = 1.2753 x 10^{33}$ erg s^{-1}. New well instrumented experiments, a little similar to the Kiel ones, and new complete computer calculations, could let us to conclude, but the rough estimate, utilizing the mean values, does not gives a great discrepancy. In fact the solar central inner core could a little cooler than is usually estimated.

3. Non Fusion Experiments in agreement with the HOREA model

Electron clusters, as great as $2 x 10^{10}$ are told to be produced by a variety of sources. In the ref.[9], is given the description of a specific one. Nevertheless the possible existence of those cluster is linked with the question of physical validity of the so called Maxwell equations, which are in fact the result of an interpretation of Maxwell theory by Heaviside and Al [3]. Assigning a physical value to the vector potential, like in Schrödinger calculations for HOREA, a possible explanation could based on a possible energy oscillation with the De Broglie wavelength, of the Faraday field, like has been claiming P.Beckmann [9].

Another experiment is a lasing one at 46.5 nm: it has been achieved recently by J.J.Rocca et Al [10]. The basic idea was to perform a direct excitation of the plasma medium by a pulsed discharge, instead of exciting it by an exterior flux: it has consisted of running a pulsed current through the lasing medium. The current pulse had an amplitude of 40 kA and a half period of 60 ns. Diagnostics using a 5 ns detector gate indicate that lasing occurs near the moment of maximum compression, shortly after the peak of the current pulse. This observation has to be brought nearer wit a similar observation made in the Kiel and NRL experiments, showing that neutron production occurs shortly after the peak of the current pulse [1] [2]. Apart the fact that nuclear reactions cannot occur, it seems that the process leading to lasing phenomenon could be described by the HOREA model.

5.Conclusion

Even if the experimental data are still too scarce and imprecise, there is an growing agreement with HOREA model. Firstly, the tentative fusion pulsed experiments, considered from the fractal point of view, reveal the existence of a dispersed process in a cold medium. In another terms it is an indirect proof of the Cold Fusion existence. As for the application of the model to the solar case, reveals that it could account for the thirty percent deficiency of solar neutrinos, inspite the approximative knowledge of the Deuteron density and of the production termT, the inner solar core being cooler than usually estimated.

All those experimental facts, linked with the HOREA model, constitute a network of non contradictory elements revealing the effectiveness of Cold Fusion outside any specific substratum. Those elements are moreover non contradictory with non fusion experiments, like electron accumulation experiments, and Table-Top X-ray laser experiments.

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