Comments on the Widom/Larsen Working Hypothesis Presented to Explain Experimental Observations in the Field of LENR

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Introduction:

Starting at the end of 2005, a series of 4 papers [1],[2],[3] and [4] have been presented by Allan Widom and Lewis Larsen, in view of explaining experimental facts observed in the low energy nuclear reactions (LENR).

This ***Working Hypothesis*** is based on the weak nuclear interaction: the oscillations of electrons and protons at the surface of a metallic lattice under the influence of an electromagnetic field (IR radiations), would favor the production of ultra low momentum neutrons, that would in turn, react with nucleus in the lattice, thus explaining LENR reactions.

After a brief comment on the assumptions made to finally arrive at the "Theoretical Standard Model Rates of protons to neutrons Conversions Near Metallic Hydride Surfaces" [4], the confrontation, presented by the authors, of their Working Hypothesis, with the main experimental facts required or observed, will be commented.

The theoretical approach:

Equations and rules of the standard model of the weak electro-nuclear interaction are used in the computations. They are often used in situations where they have not yet been validated by experiments. This is acceptable, provided an irrefutable check with experimental results validates these assumptions. In the next paragraph, it will be seen that this has still to be done.

The confrontation with experimental observations:

Three main requirements/predictions of the model will now be compared with experimental results.

The IR radiation issue

In [4] (p.9), arguments are presented to justify the presence of copious IR radiations on the surface of metals used in LENR (which is a must for proton to neutron conversion to occur according to the theoretical standard model). In the case of an electrolysis experiment, the intensity of these radiations is stated to be evidently equal to P=VI (V voltage difference between the electrolyte and the surface of the cathode, I current density through the cathode surface). Experimentally, most of the power supplied to an electrolytic cell (measured as P'=V'I, V' being the voltage across the cell), is dissipated by conduction in the bulk of the cathode and by convection within the electrolyte. The intensity of the IR radiation actually emitted by the cathode is quite impossible to obtain experimentally by measuring V (as proposed by the authors). Referring to [5], (where the effects of electrolysis on metal coated micro-spheres are experimentally studied), it can be seen (p.630) that the mean power input used is stated to be 0,060 W. Current practice in electrochemical cells calibration shows that the temperature of the cell deviate from a linear function

of the power input when the temperature of the cell starts to rise. This is obviously due to the cell radiating IR and the IR power thus emitted is in the order of some 5 to 10% of the total power input to the cell (at 60 to 70°C). Thus, given the total surface of the microspheres used (30*10-4 m2) the mean IR radiation flux at the surface of the cathode can be estimated to be in the order of 2 W/m2. This is extremely low. A "concentration mechanism of the IR power" is thus needed for neutron production to occur.

This "concentration" is said to happen in small domains and is modeled by a noise temperature, accounting for hot spots on a cathode, otherwise in thermal equilibrium with the electrolyte. No precise description of the "concentrating mechanism" is given. Although it is not clear from p.9 of [4] if the increase of temperature on hot spots is said to be due either to the "concentration mechanism" or to the subsequent nuclear reactions occurring (or both), this experimental argument is totally ambiguous: any other mechanism yielding nuclear reactions could show the same "hot spots" macroscopic pattern. The conclusions stated p.11 of [4], suffer the same weakness, being also totally ambiguous, Even the activation of a cathode by direct laser irradiation can be ascribed to a very different mechanism: see [6] (quoted as [2] in [4]).

The fit with transmutation rates issue:

A series of measurements of the yields of reaction products obtained by submitting micro-spheres, coated with various metals (Ni,Pd), to the action of an electrolyzing current have been presented in [5]. Experiments were achieved by placing the micro-spheres between the electrodes (Titanium) of a cell operating with a 1 molar Lithium sulfate solution.

In [2), it is stated (p.5) that "In all such experimental runs, the agreement between the multi-peak transmutation yields and the neutron scattering strength is quite satisfactory". In figures 2 and 3 the variations of the neutron absorption cross sections with the mass number A of the target element are compared with the variations with A of the yield of reaction products experimentally measured in [5]. Two main objections to this affirmation can be considered: the first concerns the way the comparison is made between the predictions and the experimental results (I) and the second the total absence of statistical elements (II)

I/ It is not appropriate to compare the neutron scattering strength, which applies to the elements initially present in the cathode (target) with the yield of reaction products observed. The yield of transmutation of the elements initially present in the cathode, can only be deduced from the yield of reaction products, if the paths between the elements initially present and the reaction products are known. This is absolutely not the case, despite the very vague justification presented "The variations (of the transmuted nuclear yields) will depend on the isotopic composition of the metallic hydride cathode and anode, various ions found in solution and the nano-scale uniformity of the electrode fabrication processes" (in [2], p.5). Just imagine the number of (not proven) assumptions needed to determine these (hypothetical) paths… In fact, given the over-helming amount of Nickel as target element in the case studied, one could expect, in first approximation, a huge pick of reaction products round Copper isotopes at mass number (63, 65). This is not observed.

II/ Comparing experimental results with the predictions of a working hypothesis, requires that the error bars on the measurements are known and that a correlation coefficient between the measurements and the predictions is evaluated. Given the scatter of the experimental points (even if accepted as being the transmutation yields of the initial elements present in the cathode), compared to the narrow picks predicted, this correlation coefficient is likely to be extremely small.

The gamma Ray absorption issue:

In [1] a mechanism is proposed to explain a puzzling observation made in the field of LENR: the absence of γ Rays emission when nuclear reactions occur. The interaction of the γ Rays with the heavy electrons present in the lattice (following a neutron capture nuclear reaction), could lower their path to less than a nanometer, thus preventing them to escape from the lattice.

Indeed, it is stated in [5] p.634, that no γ Rays emission was observed during the runs, despite the expectation of an intensity of some 10^{13} Bq. This seems to be in accordance with the Widom/Larsen working hypothesis: heavy electrons and protons producing ultra low momentum neutrons that in turn react with elements present in the cathode, yielding transmuted products and γ Rays, their emission being not detectable because absorbed by the lattice. But γ Rays should be detectable after dismantling the experiment: the Widom-Larsen process resembles NAA analysis in terms of γ Rays emission, and at least for NAA elements, some sizeable and lengthy emission should be observed. This not the case, no emission being detected after dismantling of the experiment [5] p.635

This is a third aspect in which the Widom-Larsen working hypothesis is not confirmed by experiment.

Conclusion:

The Widom-Larsen model is a nice, coherent and elegant intellectual construction. But for this ***Working Hypothesis*** to become an ***Accepted Theory***, it is still needed that the authors present an indisputable experiment with unambiguous results, justifying without any doubt all the assumptions made in the model.

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[1]A. Widom and L. Larsen Absorption of Nuclear Gamma Radiation by Heavy Electrons on Metallic Hydride Surfaces arXiv:cond-mat/0509269 v1 10 September 2005

[2]A. Widom and L. Larsen *Nuclear abundances in metallic Hydride Electrodes of Electrical Chemical Cells* arXiv:cond-mat/0602472 v1 20 Feb 2006

[3] A. Widom and L. Larsen *Ultra low momentum neutron catalysed nuclear reactions on metallic hydride surfaces* The European Physical Journal C, 9 mars 2006

[4] A. Widom and L. Larsen *Theoretical Standard Model Rates of Proton to Neutron Conversions Near Metallic Hydride Surfaces* arXiv:nucl-th/0608059 v2 25 Sep 2007

[5]GH, Miley, G. Narne, M.J. Williams, J.A. Patterson, J. Nix, D. Cravens and H. Horat *Quantitative observation of transmutation products occurring in thin-film coated microspheres during electrolysis* Proceedings ICCF6, October 13-18 1996 Japan **p.629-643**

[6]V. Violante, E. Castagna, C. Sibilia, S. Paolini, F. Sarto *Analysis of Ni-Hydride thin film after surface plasmons generation by laser technique* Proceedings 1CCF 10 Cambridge USA 2003.