Electrons Ejected Due of Laser Irradiation of Deuterons Layer on Metals Surface - A New Source of Instant Electrical Energy

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Abstract
Some recent experiments signalize the high-energy particles due of laser irradiation of Deuterium layer absorbed (adsorbed) on metals surface.
Based on the previously author works about models on nucleons structure and on the bias current inside valence nucleons during β - *decay* stimulation by a laser, in the present one is analyzed the feasibility of these experiments. Thus, by using QM&MD programme: fhi96md is confirmed the apparition of high D coverage (~0.5) of the surface of Pd lattice. Also is proved the author's model of vortex assisted photon beta decay, when a laser photon makes this process much more probable by creating a spot (melt) in nucleon with suppressed order parameter that lowering the energy barrier for vortex crossing together with an heavy electron (*bias current* $e^{\pm}$) as resulting from the decay of the permanent rate of bosons pairs $W^{\pm} \cong 10^{-8}$ as produced inside nucleons by a Schwinger effect. Thus, the obtained electrical current have a power $P_w=2x10^9$ w<<P_{laser} ~2Pw for a laser spot of size $1\mu m$, that corresponds with ELI laser characteristics, that means not energy gain for this laser type. But if we use others lasers of much smaller power when we have per photons ~10^{-5}w x1ns(T=10^9K)~10^{-14} J of duration ~*1ns* and, respectively ~10^{-14} Jx10^{13} ~0.1J~10^8 [w] for a pulse composed of ~10^{13} ph/s, in this case it can appears a net gain of $2x10^9/10^8$=20. If these remains in stage of muons (100MeV) collected into a metallic sphere that means ~$1.6x10^8$w.

1. The state of art

Motivated on the very recent experiments to study a new type of nuclear reactions, in this paper a theoretically check of these findings is done. Thus, the attention is focussed on the most recently one [1], when it results that are produced almost no neutrons but instead fast, heavy electrons (muons), since it is based on nuclear reactions in D on metal surface. Thus, " a considerable advantage of the fast heavy electrons produced by the new process is that these are charged and can therefore produce electrical energy instantly".

The adsorption and absorption of hydrogen on palladium wires cleaned by treatment in oxygen to remove surface impurities have been studied using flash filament desorption [2a]. The initial hydrogen sticking coefficient was found to be 0.13 and independent of temperature from 100 to 300 °K. With the filament temperature initially at 200 °K, three states, β1, β2, and β3 with apparent second order desorption kinetics and binding energies of about 22, 25, and 35 kcal/mole were observed. For hydrogen pressures less than 10^{-7} Torr, these states saturate at less than one hydrogen atom per surface palladium atom. The saturation coverage at 300 °K was 0.39 H/Pd and at 200 °K this value was increased to 0.95 H/Pd. These states thus appear to correspond to hydrogen adsorbed on the palladium surface. When the filament temperature was decreased to 100 °K, another state, α, was observed with a desorption activation energy of 13–14 kcal/mole. The sticking co-efficient for this state was about 10^{-3} , and the amount of hydrogen taken up in the α state greatly exceeded that of the β states. It is felt that the α state corresponds to solution of the hydrogen in the palladium wire, and the experimental results are shown to be consistent with this hypothesis.

It is known that the absorption of hydrogen produces two different phases, both of which contain palladium metal atoms in a fcc lattice, which is the same structure as pure palladium metal. At low concentrations up to $PdH_{0.02}$ the palladium lattice expands slightly, from 3.889 Å to 3.895 Å. Above this concentration the second phase appears with a lattice constant of 4.025 Å. Both phases coexist until a composition of $PdH_{0.58}$ when the alpha phase disappears [2b]. Neutron diffraction studies have shown that hydrogen atoms randomly occupy the octahedral interstices in the metal lattice (in a fcc lattice there is one *octahedral* hole per metal atom). The limit of absorption at normal pressures is $PdH_{0.7}$, indicating that approximately 70% of the octahedral holes are occupied. The absorption of hydrogen is reversible, and hydrogen rapidly diffuses through the metal lattice. Metallic conductivity reduces as hydrogen is absorbed, until at around $PdH_{0.5}$ the solid becomes a semiconductor.

The process of surface absorption of hydrogen has been shown by scanning tunneling to require aggregates of at least three vacancies on the surface of the crystal to promote the dissociation of the hydrogen molecule [3].

About the interaction of hydrogen with palladium surfaces, although bulk palladium can absorb large amounts of hydrogen, the most favorable position for hydrogen is on the surface, not in the bulk [4]. Here, in Fig. 2 we found the plotted of the adsorption energy of atomic H on Pd(100) in the fourfold hollow ~ 0.45 eV and in the bridge position ~0.15 eV that are near constant as a function of the coverage (0.25÷1), that were determined by density functional theory calculations within the local density approximation (LDA) using the FP-LMTO method and by DFT calculations employing the generalized gradient approximation (GGA) for the exchange-correlation functional and using ultrasoft pseudotentials (US-PP). The coverage is defined as the number of hydrogen atoms per primitive surface unit cell. Adsorption in the fourfold hollow position is much more favorable than at the bridge position. This is a general trend for hydrogen adsorption on low-index Pd surfaces: hydrogen generally prefers to adsorb at the highly coordinated sites.

Potential energy (chemisorptions) of a H atom over a fcc hollow site of a Pd(111) surface as a function of the distance from the surface for a frozen substrate is given in figure 7 of [4]. The energies have been determined by DFT-GGA calculations as of ~-0.23÷0.3÷0.2eV for distances ~-1÷0÷1 Å, for a coverage of θ= 1, and of θ= 1/3.
In present work a similar calculation is done with the program **fhi98md** [5], [6].
In the following being calculated the electrical current as resulting from laser irradiation of these H(D) Pd coverage.

2. The evaluation of Pd-D reactions with QM&MD programme: fhi96md

This it was demonstrated by using a code package **fhi98md** which is an efficient code to perform density-functional theory (DFT) total-energy calculations for materials ranging insulators to transition metals [5], [6], [7]. The package employs first-principles pseudo-potentials, and a plane-wave basis-set, and is used to done a special calculus for some metals (Pd) where are depozided on the surface and implanted interstitially 1;2;3 H ions. The package **fhi98md** is an efficient code to perform density-functional theory total-energy calculations for materials ranging insulators to transition metals. The package employs first-principles pseudopotentials, and a plane-wave basis-set. For exchange and correlation both the local density and generalized gradient approximations are implemented.

In Polly-atomic systems as for example molecules, crystals, defects in crystals, surfaces, it is highly desirable to perform accurate electronic structure calculations, without introducing uncontrollable approximations.

The emergency functional the key variable in DFT is the electron density n (**r**). Consequently, the complementary tool from the all package FHIPP it was used to obtain the pseudo-potentials of H(D), Pd.

The input is obtained with fhi98start applied to files start.inp and inp.mod, that obtaining inp.ini as an input to fhi98md plus the pseudopontetials fort for each species. In figure 1(a,b,c,d,e) are presented the *quart-octahedral* holes in Pd lattice where are placed H(D) atoms. Thus, the main results of application are for: a),b),c) : respectively, simple *quart-octahedral* Pd4 we have : (non-eq) total energy = -78.991727 a.u., for Pd4H2 we have -(non-eq) total energy = -104.048664 a.u. and for high distances (non-eq) total energy = -103.702052 a.u., for 1 D atom (non-eq) total energy = -88.405565 a.u., see fig. 1(c) At higher distance , figure 1.(d), it results (non-eq) total energy = -86.857264 a.u. 1H , and for 2, 3 H we have:

(non-eq) total energy = -99.862519 a.u. 2H, figure 1. (b)

(non-eq) total energy = -114.776924 a.u. 3H

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But, the right results are for D position near Pd atom, thus:
(non-eq) total energy =   -79.917111 a.u.(0.576Bohrs)
non-eq) total energy =   -78.611315 a.u.(<0.5Bohrs)
non-eq) total energy =   -79.166176 a.u.(0.544Bohrs)
(non-eq) total energy =   -79.004603 a.u.(0.5382Bohrs)
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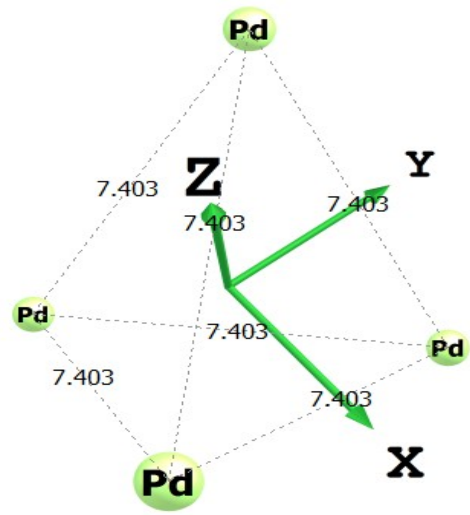
The significative difference being: -79.004603 a.u.- (-78.991727 a.u.) = -0.012876 a.u.*27.2=0.35 eV~8 kcal/mol, that copy very well with [2a÷4].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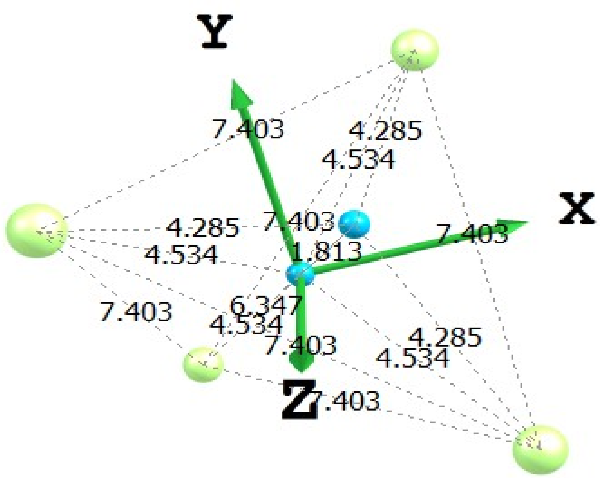
a)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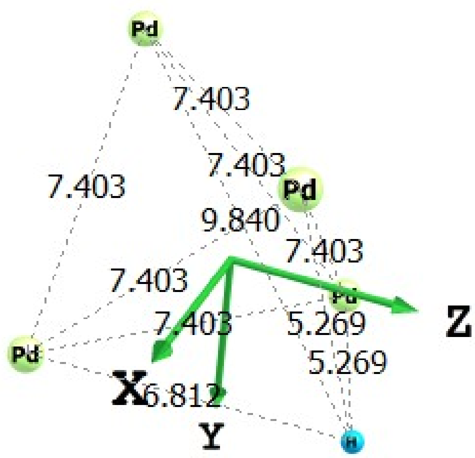
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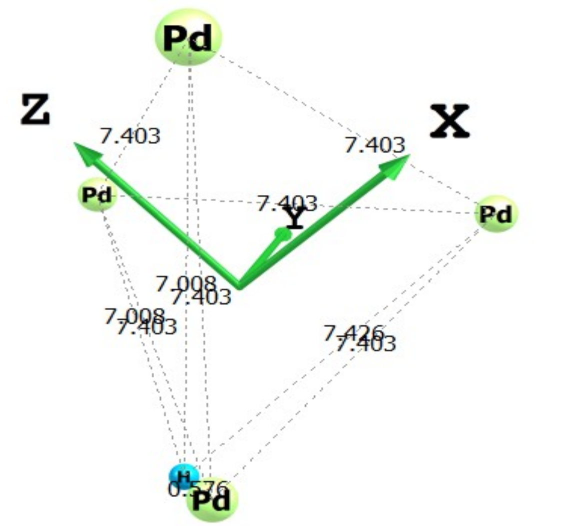
c)



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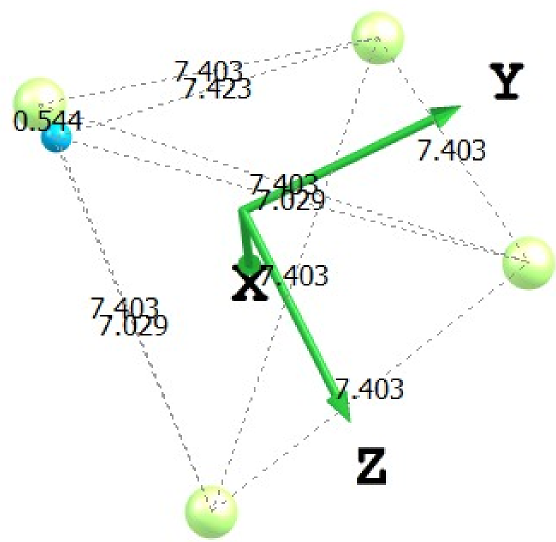
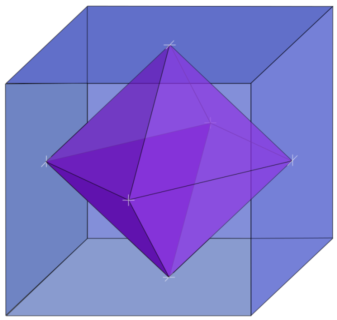
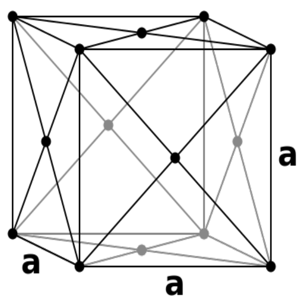


e)

Fig.1. The *quart-octahedral* hole of Pd-H coordinates.



a)



b)

Fig.2 Paladium structure

3. How can obtain an electrical current on metallic support of D LAYER as induced by laser pulses

As it was mentioned High-energy particles are detected from spontaneous processes in an deuterium D(0) layer on metal surface[1].

Here, the Muons are conventionally measured by a plastic scintillator–photomultiplier detector. Muons from this processes are detected here by a novel type of converter in front of a photomultiplier.

3.1 The bias current model of $\beta - decay$ **stimulation by a thermal spike of a photon**

In order to accelerate the $\beta - decay$ by a single photon reaction, a new model it was proposed in [7], [8], [10] to calculate a *direct reaction of single photon with one of nucleon of the valence n-n; p-p; n-p pairs (see IBM model [30,31]cited in [7]) of the nucleus, that being in the unstable state (a* $\beta - decay$ *nuclide), they are the most susceptible to react with the photon, see some of model's results from [7], figures* $1 \div 4$*, respectively.*

The interaction between a photon of high energy and of low band width $\Delta E/E \leq 10^{-3}$ and of nucleon into state of excitation has been characterized by the beta decay energy Q_{β} from the nuclei, that is viewed as a *direct reaction,* without the formation of a compound nucleus.

Essentially, the general picture of this model described in details in [8], [9], [10a], [10b] is that the vortex (boson W, figure 3.) crossing may trigger the $s \to n$ transition. A photon makes this process much more probable by creating a spot (melt) with suppressed order parameter and thus with lower energy barrier for vortex crossing. A sketch of the strip and of the belt across are shown in Figure 4, the induced vortex crossing together with an electron (*travel current* $e^{\pm}$), which turns superconducting hot belt into the normal state resulting in a vortex assisted photon beta decay.
As a consequence of the Lorentz force acting on a vortex crossing a thin and narrow current-biased strip the energy $\Phi_0 I/c$ is released, which for currents I > 0.6Ic suffices to create a normal belt across the entire width w of the strip (extending to a few correlation lengths ξ along the strip).
Therefore, by using the same nucleon model we can account for a vortex (W boson) assisted photon count rate, as in [8], [9a], [9b]:

$$R_{pc} = R_h\left[1 - \exp(-\Re)\right]$$

,where:

$$R_v(I, v_h) = \frac{4k_B T R_{eff}}{\pi \Phi_0^2}\frac{\xi}{w}\left(\frac{v_h}{2\pi}\right)^{1/2}\left(\frac{I}{I_{ch}}\right)^{v_h+1}$$

$$\Re \approx \frac{\tau_{GL} R_v}{v_0 - v_h}\frac{1-\left(I_{ch}/I\right)^{v_h - v_1 - 1}}{\ln\left(I_{ch}/I\right)}$$

The current being

$$I_{ch} = I_{c0}\left(v_h/v_0\right)^{3/2}$$

$$I_{c0} = \frac{\pi c^2 \Phi_0 \varepsilon_0}{8\left(2\pi^3 x\lambda^5\right)^{1/2}} e^{-x/\lambda} \times 10^{15}[A/fm^2]$$

The effective ohmic resistance is $R_{eff} = R_s R/(R_s + 2\pi(\xi/w)^2 R)$.
We can suppose than along the hot belt induced by the incident photon , the charge $e^- + W^-$ creates a *bias current*$(I > 2/3e[\left(1/(v_h/v_0)^{3/2}\right) \cong 3] \Rightarrow 2e$, see below, who circulates due of the potential difference between the vortex and the rest of isotope.

At the first sight, the ohmic resistance of this ad-hoc electrical circuit created by the *bias current* is given as:

$$R^{-1} = \frac{U_\beta}{\tau_{GL}}\frac{1}{V_{vortex}^2}$$

,where the vortex potential is $V_{vortex} = H_0 \xi$,

H_0-an "external" electro-magnetic field of a dipole created by the pair $u\bar{u}$ (the chromoelectrical field)

$$H_0 = E_0 = \frac{de}{4\pi\varepsilon_0 r^3} = 8.33e24\left[\frac{N}{C}\right]$$

,where, $r \cong 0.05[fm]$-is the electrical flux tube radius, $d = 0.7[fm]$-the distance between the two quarks charges, usually $H[A/m]$, but here is used as $B = \mu_0 H\left[\frac{J}{Am^2}\right]$

, and the characteristic distance $\xi \leq \lambda$, the coherence length,

and the power is $U_\beta/\tau \cong \varepsilon_{vortex(W^\pm)}/\tau$, with $\tau_{GL} = \pi\hbar/(8k_BT_c) = 1.5e-24[s]$-the Ginzburg-Landau life time of $W^\pm$ bosons.

Numerically, with $T_{c\_11} = 5\times10^{11}K$ (ELI laser); and $T_{c\_9} = 10^9K$ (Nd:YAG laser), $E_{prag\_11} = k_BT_{c\_11} \cong 43MeV$; $E_{prag\_9} = 0.09MeV$, result $\nu_0 = \varepsilon_W/k_BT_c = 1.e-09/(1.38e-23*2.e12) = 36.2$, where $T_c = 10^{12}K$ at confinement, and where ε_W results from eq. (2) from [8] as $\varepsilon_W = \varepsilon_{\text{int}}(d = x-\lambda; x = 0.14)*0.117[fm] \cong 1.e-09[J]$; $R^{-1} = 143\Omega$; $R_s = 1000\Omega$; $R_{eff} = 141\Omega$, $w \cong 1fm$.

With $\Phi_0 = 2\times10^{-15}[Tm^2]$; $\lambda = 0.117fm$; $x \cong \lambda$, it results $I_{c0} \cong 3.6\times10^7[A/fm^2]$, $I_{c0W}=I_{c0}.W_{rate}=3.6x10^7.10^{-8}=0.36[A/fm^2]$

$\nu_{h\_11} = \varepsilon_{0h}/E_{prag\_11} = 5\times10^{-11}/E_{prag\_11} = 6.9$,

$\nu_{h\_9} = \varepsilon_{0h\_9}/E_{prag\_9} = 9.6\times10^{-14}/E_{prag\_9} = 6.9$; that results $R_\nu = 3.7\times10^{18}s^{-1}$

The total power per pulse of Nd:YAG laser is $P_{tot} = 9.6\times10^{-14}\cdot5\times10^{13} = 4.6[J]$

$I_{ch} = I/I_{c0}\cdot3.6\times10^7\times area\times rate\_W^\pm = 5\times10^6\cdot10^{-8} = 50[mA]$, $area = 1fm^2$; the production rate of $W^\pm=10^{-8}$, $U = R_{eff}I \cong 7[V]$; $I/I_{c0} = 0.138$ as obtained by trials (figure 5), and where ε_{0h} is obtained by using the lower critical field

$$B_0 = H_{c1} = \frac{2\Phi_0}{2\pi\lambda^2}\log\left(\frac{\lambda}{\xi}\right) = \frac{\pi\hbar c}{\pi\lambda^2 c}\log(\kappa) = 1.e15\left[\frac{J}{Am^2}\right]$$

, and with $x \cong \xi = 0.107[fm]$;

respectively: $\varepsilon_{0h} = Vc^2\varepsilon_0(2H_{c1})^2/8\pi = 5.3e-11[J]$

In our first case of *muons born* due of hot spot $\nu_h = 330MeV/E_{prag} = 7.68$ which is obtained by trials. Thus we obtain the average (dc) voltage $V_{dc} = \Phi_0/c\cdot R_\nu \to 7400V$. We obtain

$\tau_0 \approx d^2\,\Phi_0/(2\pi\xi^2\,2cR_{eff}\,I)$, I=50mA, d=1pm, $\tau_0 = 9ns$, the time-of-flight. In fact, this estimate coincides with the time it takes a vortex to cross the strip being pushed solely by the Lorentz force. With these it results $R_v=10^{18}/s$.

The value of E_{prag} is determined by trials in order to have $R_{pc}/R_h \cong 1$, see figure 5.

The model results show that in order to have *instant rates(100% decay)*, or a beta decay rate of $R_{pc} = 5\times10^{13}counts/s$, with the incident of single photons rate of $R_{ph} = 5\times10^{13}counts/s$, $R_{pc}/R_h \cong 1$, for all beta-decay isotopes, i.e. these rates are not dependent of the nuclide type, the photons energy needs to be above a threshold energy value of very precise value $5\times 10^{11}K\rightarrow 43MeV$, but in this case we don't have a net energy gain due of the small current $I_{ch}=5\times 10^{-2}[A]$ due of permanent rate of bosons as the source for further electrons (muons) production by Schwinger effect $W^{\pm}\cong 10^{-08}$ inside the nucleon (see section 3.2 below), which can decay into heavy-electrons (muons) but more sure into electrons.

In the second case of Nd:YAG laser when $T\cong 10^{9}K$, the power released by the electrical current is $P_W=RI_{ch}^2=0.35[w]$ for each deuteron spike, but for an entirely laser wave (10^{13}photons) when pass along a $30\mu m$ (Nd:YAG) it means a total power $P_{tot}=0.35\times(30\mu m/8Bohrs)^2\cong 2\times 10^{9}[w]$, for an absorption coverage area of Pd/H~1; 1 Bohr=5.29x10^{-11}[m], or about *~2x10⁹/10⁸ =20* than the power used to produce a such laser spot. These values are in case of ELI-laser when: the power is ~2Pw, the flux ~10^{13}ph/s; flux~10^{24}w/m^2, or the extracted power is lower~ 1.4x10^8/2x10^{15}=0.7x10^{-7} times that used by the laser, or without any energy gain. But we can obtain a net energy gain if we use, for example, a smaller laser Nd:YAG when the flux ~10^{13}ph/s, or $T=10^{9}K$, but not smaller than this lower limit value, since the current through the "hot belt" is the same i.e. ~ I_{ch}.

A Nd:YAG laser with pulse energy of < 0.2 J was used, with 5 ns pulses (or $P_W=0.1J/5ns=10^{8}[w]$) at 532 nm and normally 10 Hz repetition rate [1], of 0.2 J pulses with 5 ns pulse length ejects ions with energies in the MeV range. The *ns*-resolved signal to a collector can be observed directly on an oscilloscope, showing ions arriving with energies in the range 2-14 MeV/u at flight times 12-100 *ns*, mainly protons from $n\rightarrow p$ transformation (not from a fusion process like in [1]) and deuterons ejected by proton collisions. Electrons and photons give almost no contribution to the fast signal. The observed signal at *several mA peak current* corresponds to 1×10^{13} particles released per laser shot and to an energy release > 1 J assuming isotropic formation and average particle energy of 3MeV as observed, or

$\cong 1J/10^{13}\cong 10^{-14}\cong \varepsilon_{0h\_9}=9.6\times 10^{-14}[J]\rightarrow 0.6MeV$, and $\tau\cong \hbar/10^{-14}J\cong 10^{-20}s$, or in term of pulse duration $\tau=5ns/10^{13}\cong 5\times 10^{-22}[s]\rightarrow \tau_{W^{\pm}}=3\times 10^{-25}s$, see the next section.

The Nd:YAG ns-pulsed laser is focused onto a metallic target plate with a thin layer of D [1]. The focusing length of the lens is 40 cm, giving a spot size of *30 μm* (for a Gaussian beam) and a power density of 3×10^{12} W/cm^2 . The laser is used with 532 nm light at maximum 120 mJ pulse energy, 5 ns pulse length, or $532/c\cong 10^{-18}s$.

But as results from our calculation, in fact the proton signalized in the experiment it could be due of the transformation a neutron of deuteron into proton ($n\rightarrow p+e^-$) by the laser stimulated beta decay, so there is "not any fusion", see below. Therefore, it is for the first time when these experimental findings confirm author's models [7], [8], [10], the most important are, the particles energy in MeV range, and the electrical current of *~few mA*, remaining to be confirmed the number of particles, respectively of ~10^{10} per laser shot.

This vortex-assisted mechanism may be verified by application of magnetic fields, which effectively enhance I_{ch} along with the vortex crossing rates but do not affect the creation of hot spots by photons.

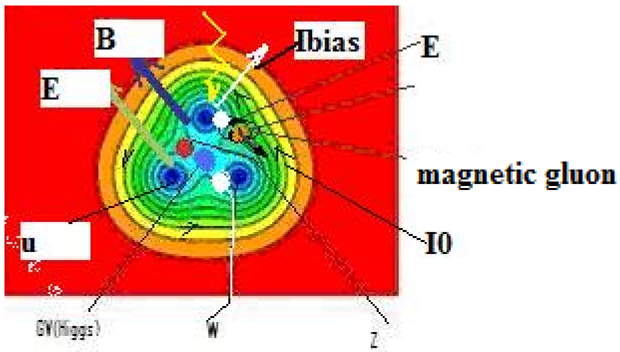


Fig.3. Abrikosov's triangular lattice for a nucleon (author's proposal [8], [9],[11], [12])

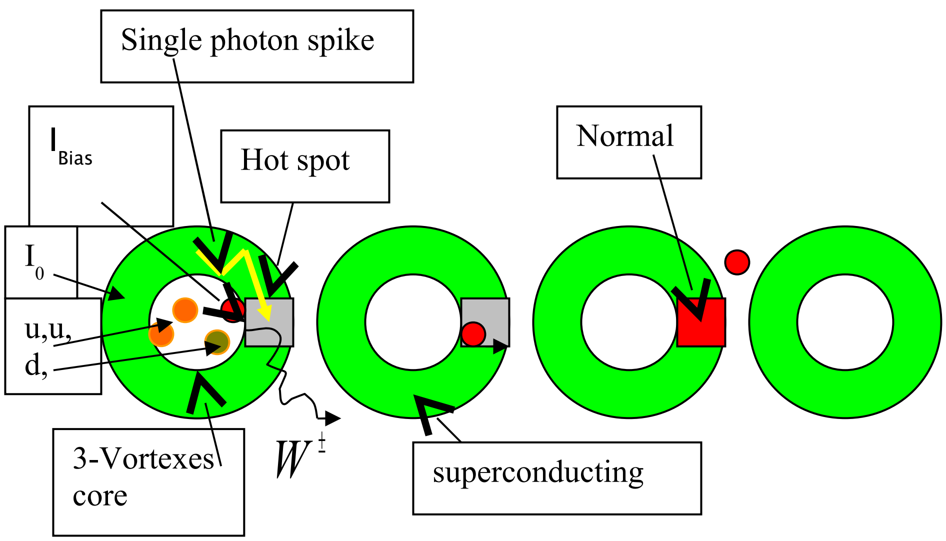


Fig.4. The photonuclear mechanism. From left to right, illustration of incident photon creating superconducting hot spot (hot belt) across nucleon, followed by a thermally induced vortex crossing together with an electron (*bias current*), which turns superconducting hot belt into the normal state resulting in a vortex assisted photon beta decay.

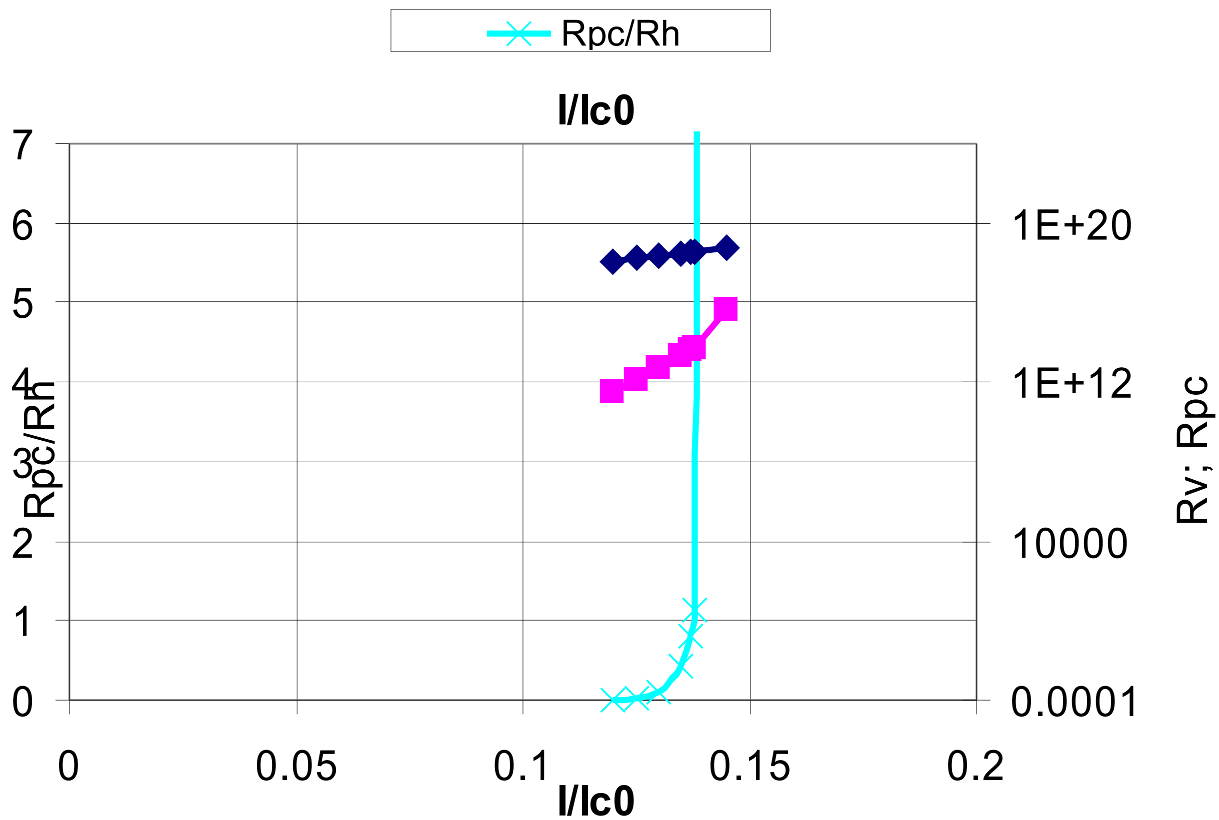


FIG.5. The vortex-assisted photon count rate R_{pc}/R_h vs. *bias current.*

3.2. A strong prove of the model for the free neutron decay calculation

In the following, we will use some results of section 4.1a from [8] when the Compton length is $\lambda_C = \hbar/m_* c = 2.3e-18[m]$, the effective mass is $m_* = 1.44\times 10^{-25}kg \to V = 81GeV \to E = 1.1\times 10^{28}$, the *critical field* being $E_c = \dfrac{m_*^2 c^3}{e\hbar} \cong 3.5\times 10^{28} > E = 1.1\times 10^{28}[N/C];\ B = E/c = 3.7\times 10^{19}[T]$.

From the section (4.1b) of [8], are used the bosons $W^{\pm}$ pairs generated *inside the nucleons* as due of one quark $u\bar{u} \leftrightarrow u$ as a resultant of $\times 3$ flux tubes vortex potential , see figure (1.b) of [8], respectively $\varepsilon = mc^2 \cong 81GeV$ - which after the release of an electron that it getting the final beta energy as been equally to the out of barrier turning point after the tunneling, and accounting for the valence nucleons interactions (shell-energy levels). The number of *assaults* of the barrier, like in Gamow theory [20, 21] cited in [6] is $n_a = v_b/R_{inner}$; where the velocity is $v_b \cong (2\varepsilon/m)^{1/2} = 2.3\times 10^8\ m/s$, where, the inner radius of the barrier is $R_{inner} \cong b = 3.5\times 10^{-17}[m]$, see below. For only one of the three vortex-flux tubes ($q\bar{q}g$) we have: $\varepsilon = \hbar eB/m \cong 4\times 10^{-9}[J] \to \cong 25GeV$, with the above (B) which is obtained from eq.(1.a) from [8] with the resultant potential

$V = 81GeV$, that corresponds to $m_{q\bar{q}} \cong 29GeV$ from 4.1a of [8], the energy of the particle for the first Landau level (as above), and we can see that it results to be equally with $\approx 1/3$ rest mass of the $W^{\pm}$, that resulting $n_a \cong 7.5\times 10^{24} s^{-1}$.

In case of WKB [20] cited in [6], the transmission coefficient is $T = 2\frac{\sqrt{2m|V - Q|}}{\hbar}\Delta r$,

and the decay constant $\Gamma = n_a e^{-T}$.

For the thick barrier the transmission coefficient is $T = 2\pi \frac{Qb}{\hbar v} = 2\pi \frac{\sqrt{2mQ}}{\hbar} b$;

, where, the kinetic energy of the particle after the barrier at b is $Q \equiv \frac{1}{2} mv^2$,

$b = d_b/2\pi = 3.5\times 10^{-17}[m]$, see below, that results $T = 63$; and the decay constant $\Gamma = 3\times 10^{-3} s^{-1} \to \cong 324s$

To "materialize" a virtual $e^+ - e^-$ pair in a constant electric field E the separation d must be sufficiently large $eEd = 2mc^2$

Probability for separation d as a quantum fluctuation

$$P \propto \exp\left(- \frac{d}{\lambda_{Compton}} \right) = \exp\left(- \frac{2m^2c^3}{e\hbar E} \right) = \exp\left(- \frac{2E_{cr}}{E} \right)$$

The emission (transmission through barrier) is sufficient for observation when $E \approx E_{cr}$,

with $Q = 1/2\, mc^2$, results $T = 2\pi \frac{mcb}{\hbar} \cong \frac{2\pi b}{\lambda_C}$, or

$b \cong d_b/2\pi$.

Now, by using the Schwinger effect as in section 2.1 of the companion author's paper [8] , the number of $W^{\pm}$ pairs produced inside the nucleon (more inside of the only one resultant flux tube , see figures 1.a; 1.b from [8]) due of the potential resultant $u\bar{u} \leftrightarrow 3\times vortex(q\bar{q}g)$ of $V = 80GeV$, results as $R/s = R/V \times V_{vol} = 2.3\times 10^{18} s^{-1} \approx n_a$, where $R/V = 2\times 10^{71}[1/m^3 s]$ and the volume is $V_{vol} \cong (\lambda_C)^3 \cong 1.24\times 10^{-53}[m^3] \geq V_b$, the penetration length being the Compton length $\lambda_C = 2.3\times 10^{-18}[m]$, and for a four-volume of $V_{Compton} = \lambda_C^4/c \cong 9.5\times 10^{-80}[m^3 s]$, that results a *permanently rate* $R \cong R/V \cdot V_{Compton} = 10^{-8} W^{\pm}\ pairs$. Thus, it results a main conclusion of this investigation, namely, that the "interacting" potentials inside the nucleons are that were already established in [8], respectively $\cong 80GeV$ around the valence quarks (u, d) which it seems to be "locked" at the electroweak symmetry breaking ($\approx 100GeV$); that of the Giant Vortex (see the insert in fig. 1.a from [8]) at the center of the triangle-the Higgs boson $H = 125GeV$; and that resulting from interaction of $2\times$ inter-pairs of flux tubes as been the neutral boson $Z = 90GeV$.

Therefore, in other words is proved that all the time inside the nucleon are *available* $10^{-8} W^{\pm}$ pairs that seems to corresponds to the "weak interaction" coupling constant 10^{-7} , which is absorbed or emitted by the quarks , resulting an e^+, or e^- which help the

quarks transformation like $(u \to d)$, respectively $(d \to u)$ for beta-decay. In our understanding, the created electron takes the energy at the *turning point* out of the barrier equally with the electron itself for unbounded neutrons, or that of the binding energy of nucleon in isotope nucleus, when it *passes* the barrier of gluon condensate characterized by an *quantum tunneling* suppression given as: $\exp(-\Delta E\tau/\hbar) \cong 7.3\times 10^{-22}$, where, as the lifetime of $W^{\pm}$ being $\tau \cong 3\times 10^{-25}s$. Here, ΔE corresponds to the height of gluon condensate barrier, due of the *phase slip* with $2\pi - \varphi$ and of a Φ_0 energy release as: $\Delta E = c^2\Phi_0^2\varepsilon_0/d_b$; $d_b \cong k\lambda_C = 1.98\times 10^{-16}$, $k = 85$, where the Compton length is just the penetration length for $W^{\pm}$ pair $\lambda_C = 2.3\times 10^{-18}[m]$, or in other words just the barrier size, and $\Delta E = 1.6\times 10^{-8}[J] \to 100GeV \approx 3\times 25GeV$ as for $\times 3$ sea quarks color flux tubes, see figures 1.a; 1.b. The value of the resulting flux tube it remains as in (4.2.a) of [8], respectively of $0.4GeV$ as the string strength.
Thus, the probability (rate) to produce $W^{\pm} \to e^{\pm}$, into a more simple way- without the external interactions of the neutron (free-not bounded), is given as:
$RV\exp(-\Delta E\tau/\hbar) \cong 1.7\times 10^{-3}s^{-1} \to \tau_{1/2} \cong 582[s] \approx 612s$, that corresponds for *free neutrons decay* (β^-) by emission of an electron and an electron antineutrino to become a proton $n^0 \to p^+ + e^- + \overline{\nu}_e$, with half-life of $611s$, and $Q_{\beta^-} = m_e v^2 = 0.5MeV$.
In the classic understanding of β^- disintegration $n \to p + e^- + \overline{\nu}_e$, in ours understanding this occurs when one of the down quarks (d) in the neutron (udd) transforms into an up quark (u) due of interacting with the charge of W^+ boson of the pair $W^{\pm}$, transforming the neutron into a proton (uud). In mean time the other part of this pair W^- boson decays into an electron and an electron antineutrino $udd \to uud + e^- + \nu_e$. Probable the claimed energy of boson W^- is the same as to be the necessarily energy to traverse the gluonic barrier, when it decays into e^- at the end.
The free neutron decay
Consequently, for the β^- decay process, the energy combines well with the existing one, that releasing an electron which penetrates the barrier:
$d \to u + W^+ + W^- \to u + e^- + \overline{\nu}_e$
$d(-1/3e) + e^+(+3/3e) = u(+2/3e) + e^-(-3/3e)$
, since $W^- \to e^-$, and $W^+ \to e^+$
In case of β^+ decay, it can only happen inside nuclei when the daughter nucleus has a greater *binding energy* (and therefore a lower total energy) than the mother nucleus. The difference between these energies goes into the reaction of converting a proton into a neutron, a positron and a neutrino and into the kinetic energy of these particles.
Thus, an opposite process to the above negative beta decay, β^+ decay of nuclei (only bounded proton) when $p \to n + e^+ + \nu_e$, or $energy + uud + W^+ + W^- \to udd + e^+ + \nu_e$, or, $u(2/3e) + e^-(-3/3e) + energy = d(-1/3e) + e^+(3/3e)$.

For free proton decay an *added energy* it seems to be necessarily to reduce the barrier width to $d_b = 9\times 10^{-17}[m]$, when the production rate is:

$RV\exp(-\Delta E\tau/\hbar) \cong 7\times 10^{-29}s^{-1} \to \tau_{1/2} \cong 10^{28}[s]$, respectively, an increase to $\Delta E = 3.5\times 10^{-8}[J] \geq 225GeV$ from $\Delta E = 1.6\times 10^{-8}[J] \to 100GeV$, as for the free neutron, or near $\geq v.e.v = 247GeV$, like at LHC when the gluonic "cover" of protons it was "melted (at least 2 gluons)", and the resulted difference $(\cong 225 - 100 = 125GeV)$ being just that of the Higgs boson (a quanta of energy!) which it was, in this spectacular way "released" [10] as $2g \to 2\gamma$.

In the process of electron capture, one of the orbital electrons, usually from K or L electron shell, is captured by a proton in the nucleus, forming a neutron and an electron neutrino.

$$p + e^- \to n + \nu_e$$

About others calculations of beta decay processes of different isotopes, see the author's work [7].

4. Conclusions

In the work by using QM&MD programmes: fhi96md is confirmed a high coverage H/Pd~1.

There are confirmed L. Holmlid et all. experimental works by using the prior author models of vortex assisted photon beta decay, when a laser photon makes this process much more probable by creating a spot (melt) in nucleon with suppressed order parameter that lowering the energy barrier for vortex crossing together with an heavy electron (*bias current* $e^{\pm}$) as resulting from the decay of the of bosons pairs rate $W^{\pm}$ $\cong 10^{-8}$ as produced inside nucleons by a Schwinger effect. The electrical power results as P_w=2x10^9 w<<P_{laser}=2Pw for a laser spot of size $30\mu m$, that corresponds with ELI laser characteristics, or without a any net gain of energy.

For the prior author's models validation are used the results of L.Holmlid et.all. as were obtained with a Nd:YAG laser with pulse energy of < 0.2 J, with 5 ns pulses (or $P_W = 0.1J/5ns = 10^8[w]$) at 532 nm and normally 10 Hz repetition rate. Thus in this case of much smaller power lasers when per photons is obtained ~10^{-5}w x1ns(T=10^9K)~10^{-14} J of duration *~1ns* and, respectively ~10^{-14} J.10^{13} ~0.1J~10^8 [w] for a pulse composed of ~10^{13} ph/s. The net energy is much higher of 2x10^8/10^8=20. Therefore, it is for the first time when these experimental findings confirm author's prior series models , the most important are, the particles energy in MeV range, the current of *~few mA*, voltage on the shunt 7[V], and the time-of-flight 10^{-8} s.

If these electrons are collected either in the metallic plate in serried into an electrical circuit, or into a spherical conductive cover , we can constitute a reliable source of direct electricity with the period equally that of laser pulse frequency. It is possible that the neutron of D do not transforms into proton, since the *open hot belt* created due of the laser photon incidence to *close* after electron passage, therefore it is not a consume of D. To obtain a D LAYER layer the author calculated that is necessary a thermal energy of 2-3eV to be deposited on the Pd plate in the vacuum chamber containing the D gas, this being in serried into an electrical circuit.

References

1. L. Holmlid and S. Olafsson, "Spontaneous Ejection of High-Energy Particles from Ultra-Dense Deuterium D(0)". International Journal of Hydrogen Energy 40 (2015) 10559-10567.
2. a) A.W. Aldag, L.D. Schmidt, Interaction of hydrogen with palladium, Journal of Catalysis, Volume 22, Issue 2, August 1971, Pages 260–265; b) *Manchester, F. D.; San-Martin, A.; Pitre, J. M. (1994). "The H-Pd (hydrogen-palladium) System". Journal of Phase Equilibria* ***15****: 62. doi:10.1007/BF02667685*
3. T. Mitsui, M. K. Rose, E. Fomin, D. F. Ogletree, M. Salmeron, Dissociative hydrogen adsorption on palladium requires aggregates of three or more vacancies, Nature, Volume 422, Issue 6933, pp. 705-707 (2003).
4. Markus Lischka and Axel Groß, Hydrogen on palladium, A model system for the interaction of atoms and molecules with metal surfaces, Recent Developments in Vacuum Science and Technology, 2003: 111-132.
5. M. Bockstedte, A. Kley, J. Neugebauer and M. Scheffler: "Density-functional theory calculations for polyatomic systems: Electronic structure, static and elastic properties and Abinitio molecular dynamics", Comp. Phys. Commun. 107, 187 (1997).
6. Fuchs, M. Bockstedte, E.Pehlke, and Scheffer, Physical Rev. B, 57, No.4 (1998) 2134-2145
7. Stefan Mehedinteanu, ON THE NUMERICAL ANALYSIS OF DECAY RATE ENHANCEMENT IN METALLIC ENVIRONMENT, ACTA PHYSICA POLONICA B No 10, Vol. 38 (2007)
8. Stefan Mehedinteanu, On the Photonuclear Rates Calculation for Nuclear Transmutation of Beta Decay Nuclides by Application of the Ginzburg-Landau Theory, Journal of Nuclear and Particle Physics 2012, 2(3): 57-70 DOI: 0.5923/j.jnpp.20120203.05, http://www.ijnese.org/paperInfo.aspx?ID=4865 , and http://article.sapub.org/10.5923.j.jnpp.20120203.05.html.
9. Stefan Mehedinteanu, The Numerical Analysis of Beta Decay Stimulation by the High Thermal Spike of Photon Incidence to Valence nucleons, 2015, http://www.researchgate.net/profile/Stefan_Mehedinteanu/publications
10. **a)**L.N. Bulaevskii, M.J. Graf, C.D. Batista, V.G. Kogan, Phys. Rev. B 83,144526 (2011).b)L. N. Bulaevskii, Matthias J. Graf, V. G. Kogan, Vortex-assisted photon counts and their magnetic field dependence in single-photon superconducting detectors, arXiv:1108.4004v3 [cond-mat.supr-con], 2012
11. **Stefan Mehedinteanu,** A NEW MODEL FOR W,Z, HIGGS BOSONS MASSES CALCULATION AND VALIDATION TESTS BASED ON THE DUAL GINZBURG-LANDAU THEORY(revised-2015), http://www.researchgate.net/profile/Stefan_Mehedinteanu/publications

12. Stefan Mehedinteanu, The Quantum Vacuum and the Light Quanta at the Origin of Matter (+Dark Matter) Creation and of Universe Expansion, 2015, **http://www.researchgate.net/profile/Stefan_Mehedinteanu/publications**
13. **Stefan Mehedinteanu, What is Gravity and How is Embedded in Mater?-Last Version, 2015, http://www.researchgate.net/profile/Stefan_Mehedinteanu/publications**