Effective LENR in Weakly Ionized Gas Under the Action of Optimal Pulsed Magnetic Fields and Lightning (Theory and Experiments)

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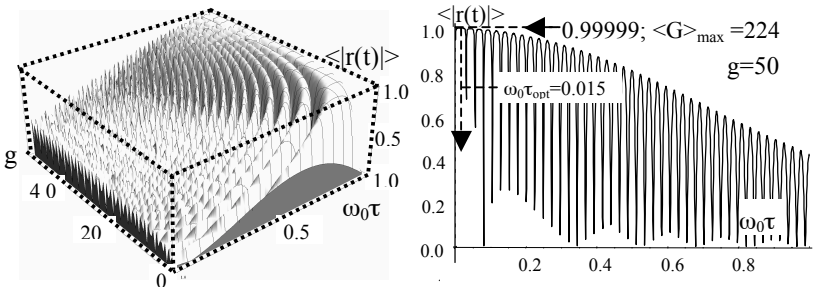
Numerous successful LENR experiments, some of which have confidently emerged from the "child" age of laboratory experiments and have manifested themselves at the industrial level, up to now are not based on a reliable theoretical model that adequately explains non-trivial results that are not consistent with the traditional models of nuclear physics. In [1], a general and universal mechanism for LENR optimization based on coherent correlated states (CCS) of interacting particles was considered. In this regime the particle state is characterized by very large synchronized fluctuations of momentum and kinetic energy that can reach many tens of keV. The physical basis of this method is related to the Schrödinger-Robertson uncertainty relations $\delta p \delta x \geq \mathrm{h}/2\sqrt{1-r^2} \equiv G\mathrm{h}/2$, $\delta E \delta t \geq G\mathrm{h}/2$, where |r|≤1 is a *correlation coefficient* and $G = 1/\sqrt{1-r^2}$ is the *coefficient of correlation efficiency*. In a correlated state, the value G can reach very large values $G \geq 10^3 ... 10^4$ and it leads to a very significant increase of the tunneling probability

$$D_{r\neq 0} \approx \exp\left\{-\frac{2\sqrt{1-r^2}}{\mathrm{h}} \int_R^{R+L(E)} \sqrt{2M\{V(q)-E\}}dq\right\} = \left(D_{r=0}\right)^{\sqrt{1-r^2}} \equiv \sqrt[G]{D_{r=0}}$$

at any low energy. Usually these effects are considered in condensed systems with controlled interaction between guest particles and matrix nuclei that is similar to nonstationary oscillator.

Another alternative method of CCS formation is connected with a pulsed change of the frequency of an equivalent harmonic oscillator under the action of a pulsed magnetic field on free charged particles [1]. A typical example of such external action is an electric discharge in a gas or liquid. The current J(t) of the discharge is accompanied by the formation of a pulsed azimuthal magnetic field in which the motion of the ions corresponds to tunable cyclotron resonance, and the system itself is a complete (formal) analog of the nonstationary harmonic oscillator with the same Hamilton operator, wave functions and energy spectrum. Used in [1,2] formalism for the formation of a CCS in such oscillator can be fully applied to magnetic system, taking into account the obvious change of the frequency $\omega(t) = |q|H(t)/Mc = \omega_0\{1 + ge^{-(t-t_0)^2/\tau^2}\}$. It was shown that the optimal condition for CCS formation at such pulse action is the following: $g\omega_0\tau \equiv \tau|q|H_{\max}/Mc \approx 0.6 \div 0.7$. On Fig. (left) the 3D plot of the time-averaged correlation coefficient <|r(t)|> versus the duration τ and amplitude g of the symmetric Gaussian pulse magnetic field acting on the particle and (right) the same coefficient <|r(t)|> for the case g=50 is presented. The maximal value of correlation coefficients at such condition is $|r|_{\max} \approx 0.9999997$ and $G_{\max} \approx 1290$. It was shown also that at pulse duration τ=0.1÷1 μs the optimal magnetic field pulses with $H_{\max} \approx 0.6 \div 6$ kOe are required. For such parameters $D_{G\approx 1290} \approx 1$. These results explain the realization of LENR both in laboratory experiments with pulse discharge and in processes stimulated by lightning very well [2].



[1]. V.I.Vysotskii and M.V.Vysotskyy, *Eur. Phys.J.* A 49, 99 (2013).
[2]. V.I.Vysotskii, M.V.Vysotskyy. *Jour. of Experimental and Theor. Phys.*, V.125, 195-209, (2017)