SuperWaves™ as the Natural Origin of Excess Heat

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Abstract. Energetics Technologies has had excellent reproducibility of its own experimental results on cold fusion; significantly, its work has been replicated at independent laboratories, at SRI and ENEA. We believe that one of the most important reasons for these results is the use t of complex fractally nested current excitation From this perspective, these results in replicating the production of excess heat are a further confirmation that natural phenomena, including the electrochemical processes for producing excess of heat, can be correctly described by these fractal dynamics. . In this paper I describe basic concepts of the *SuperWaves*™ theory, which is an original general approach to model and understand natural phenomena.

1. Introduction

According to our current understanding of Cold Fusion, we are faced with a paradox. On one hand, we get positive results for excess heat. But on the other hand, there is no theory to back it. The following is a short overview of *SuperWave*™ Reality, which clarifies this issue on two fronts: it is a new understanding of nature, and therefore a new approach of how to go about understanding nature in the first place. The production of excess heat becomes not an anomaly but something expected and natural. This is because *SuperWaves*™ reveals something new: an underlying truth about the details in science and in nature. It does not negate the findings of science but places them firmly in a new context. It is not an alternate view, but a way to imbed what we already know into an entirely new framework. It is the ultimate underlying reality of nature. And, it is exceedingly simple.

I derived this new understanding from life. Life is the most complex thing that we know of, and it offers vastly different insights from what is considered to be simple, *i.e.* the reductionist, scientific approach to understanding physical reality. I had dealt with the problems of disease and death as a vascular surgeon, and dealt with life, human performance, and health as founding Chairman of the United States Olympic Sports Medicine Council. While working in these capacities, I discovered an entirely new approach for understanding the dynamics of biological systems in terms of their *rhythms*.

First, we must understand that all motion and all processes in a living organism are rhythmic. Everything moves in waves: from the circadian rhythms of day and night to the behavioral cycles of exercise and recovery or anxiety and relaxation, to organ cycles such as the heart beating or the lungs breathing, to the cell cycle, to molecular oscillations and the metabolism. Everything in the human body is oscillatory. This simple, extraordinary discovery is that the heart beat itself cycles simultaneously within the exercise-recovery cycles of the entire organism --waves waving within waves. Thus, our familiar view of the heart rate, graphed as linear motion in an electrocardiogram, misrepresents nature. In nature, the heartbeat follows no line, but rather accelerates up and down, speeding/intensifying then slowing/relaxing, in synchrony with the whole body as it makes a larger cycle of exercise and recovery. That which we separate conceptually into two scales is inextricably joined in nature. The heart and blood vessels pulsate in cyclic patterns of waves of contraction and relaxation, which simultaneously nest as an inherent continuum within the exercise and recovery cycles of the organism as a whole. No boundaries separate the different modes of function – they merge into each other. I call this the HeartWave.

2. Fractal properties of natural phenomena

The concept of HeartWave incorporates many features of “fractal” dynamics. “Fractal” objects, in nature, are the same on different observation scales; in particular, properly fractal objects are the same if the scale changes are the same in all directions; intermediate fractal or “self-affine” objects are the same if the scale changes are different in each directions.

Fractal structure in the human body may be easily recognized by observing, for instance, the lungs and the circulatory system. A fractal motion shows similar patterns on different time scales, just as in the

case of the heartbeat. The heart beat is a complex motion, made of an extended set of oscillations, whose amplitudes vary continuously over the full frequency scale. The measurement of such a kind of motion with a standard instrument inevitably fails to give a complete description of it, due to the limitations of scale and sensitivity of the instrument. The right approach to measure / describe such a "complex" (*i.e.* fractal) motion, is to extract from the single measurements, each on a limited scale, the scale-invariant relationship embedded in them.

There are three major characteristics of the HeartWave, all properties of the inherent continuity of the cross-scalar relationships of waves waving:

1. Frequency and amplitude are a continuum across scales. The standard approach of treating waves using orthogonal dimensions including amplitude and frequency, allowing linear deconvolution via Fourier transforms, are practical means of working with waves that nonetheless fail to capture important ways in which waves interact. A shift of frequency in one scale simultaneously influences amplitude on the next scale, and vice versa, as an inherent continuum across all scales. Waves waving necessitates that these waves are ultimately not linear on any scale*;* waves waving are responsible for what science has been calling the ubiquity of non-linearity in nature

2. Since waves waving within waves occurs simultaneously across scales, we have what science calls non-locality or action-at-a-distance. The continuity of nested waves simultaneously affects each other across scales, top-down and bottom-up as they move forward, and change in time. They exhibit action-at-a-distance, at the same time that they change causally. I call this "simulcausality".

3. This unremitting pattern of nested waves is an unbroken fractal phenomenon of order. The sharper the slope of the carrier wave, the faster the inner waves accelerate, which simultaneously increases frequency and amplitude of the inner waves, and thereby increases their density as they climb the carrier wave. Therefore, within the peak of the carrier wave is the highest density and motion, of inner waves – what we call attraction. Conversely, towards the trough, the waves slow down, flatten, and disperse – what we call repulsion. All of this arises from the cross-scale continuum of the fractal order of nature.

This powerfully constructive order of the HeartWave is present down through all levels of physiology, chemistry, and molecular biology, and in particular, what we call energy metabolism. The same three points outlined above: (1) frequency-amplitude as a continuum; (2) simulcausality; (3) the inherent fractal order of waves waving. The fractal order of the HeartWave explains why Brownian motion in a living organism exhibits highly elevated degree of order in its many levels of cybernetic feed-forward and feed-back loops [1]. This motion becomes enfolded and constrained within all the rhythms of the organism as a whole.

With the increased wave density and motion in the peak of exercise, the chemistry and metabolism exhibit an increase of heat. In contrast, there is a cool down in the troughs of recovery. Where there is motion, there is heat, therefore it can be understood that waves waving is the origin of temperature differences throughout nature.

In summation, the HeartWave encompasses the whole organism, the organs, cells, the molecular biology, and the metabolism. They all exhibit the same pattern of motion as waves waving within waves. If we take this down another level of scientific investigation, we reach the world of the atom and quantum physics. It is here that I concluded that all nature is, in reality, an inherent continuum of waves waving. This is in sharp contrast to our current thinking. The HeartWave, when followed down through all scales of nested oscillatory motion, tells us by logical extrapolation that the particle recognized by science as a wave packet (or wavicle) is not boundaried independently in space but is nested as an inherent continuum within a carrier wave.

Recently fractal waves have been involved in approaching and solving quantum mechanics problems. It has been demonstrated that fractal waves are fractal solution of the Shrodinger equation for a wide class of quantum problems, including the infinite potential well, harmonic oscillator, linear potential and free particle [1]. Fractal mathematics was also applied to other complex fields of physics, as, for instance, in investigating the fractal structure of the universe [2] and the fractal structure of surfaces. Fractal concepts apply also in chemistry, as for instance to the structure and chemistry of porous solids and to the growth of polymers and colloids. Fractal science is in progress and is extending across an increasing number of disciplines.

We extend such a concept to fractal modulated electric currents applied to electrochemical and glow discharge cells, since the signal can be traced back to a self similar shape. The signal is composed by several nested waves (SuperWaves™ see Fig.1) characterized by the same amplitude frequency ratio (the fractal dimension in this picture).

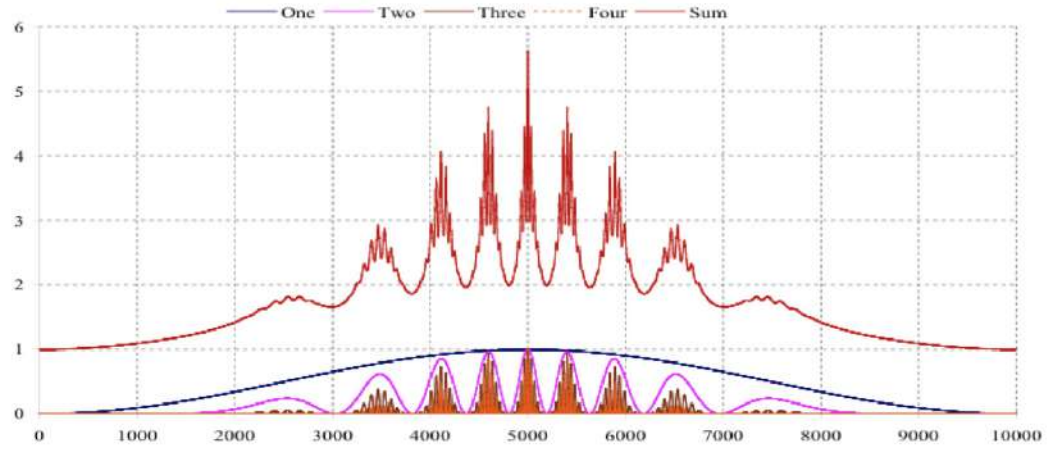

Fig. 1. - Showing nature and synthesis of fractally nested SuperWaves™.

The organization of fractal waves (*SuperWaves*™) in our electrochemical, glow discharge (and other) experiments were intended to bring this principle to bear by stimulating cyclic processes across scales. Peaking of *SuperWaves*™ is the natural origin of what is termed excess heat. Clear evidence of the SW effect in controlling the excess of power production during electrochemical loading of palladium with deuterium is described in the appendix.

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3. Appendix

An example of one of the ways that *SuperWaves*™ can contribute to enhancing LENR excess heat effects can be demonstrated from the advantage of pulsatile (rather than dc) current or pressure driven loading of hydrogen (and its isotopes) into metals that has been demonstrated to be a necessary condition for the occurrence of the effect.

The dissolution of hydrogen isotopes into a metal lattice is not only a problem of thermodynamic equilibrium between the hydrogen inside the lattice and the hydrogen in the external phase (gas or liquid) it is also a problem of dis-equilibrium produced by mass transfer. Both aspects of the phenomenon are correlated since the equilibrium concentration of the solute is achieved when the chemical potentials of the hydrogen in both phases are equal.

The chemical potential of the hydrogen in solid solution in a metal lattice is strongly influenced by all field force, like the stress field, modifying the free energy of the system [3]. Hydrogen isotopes dissolved into a metal (*i.e.* palladium) occupy interstitial positions causing lattice expansion. This process generates a stress field when remarkable concentration differences (strong gradients or coexistence of different phases) are created.

Therefore the loading process can be inhibited by an opposing stress gradient, particularly adjacent to the external surface. When a stress field is created is the hydrogen chemical potential into the metal lattice, increased by the product between the molar volume of the hydrogen in the lattice and the trace of the stress tensor.

$$\mu_s = \mu^* + V_s \sigma_h \qquad [1]$$

Also the flux equation modify :

$$J = -D(\nabla C - \frac{C\overline{V}}{RT}\nabla\sigma) \qquad [2]$$

Compared with Fick's law there is an additional term involving the stress gradient. Equation [2] shows that a zero flux condition may occur even if the concentration gradient has a non zero value (if the two terms into the brackets have the same value). A mass transfer equation has been obtained to describe the evolution of the hydrogen concentration profile during the loading of H into Pd [3]:

$$\frac{\partial \overline{c}}{\partial \tau} = \frac{\partial^2 \overline{c}}{\partial \overline{x}^2} - (1-\eta) b \frac{\overline{V}E}{RT}\left(\frac{\partial c}{\partial x}\right)_j^2 - (1-\eta) b \frac{\overline{V}E}{RT}\overline{c}\frac{\partial^2 \overline{c}}{\partial \overline{x}^2} \qquad [3]$$

Appropriate metallurgical treatments may help in reducing the concentration gradients (*i.e*. the stress) in loading palladium with deuterium. In addition a proper loading dynamics can contribute to have a better loading.

We may explain this with an example. Figure A1 shows the H concentration profile evolution when the effective pressure is changing between two pressure levels arbitrarily labeled Hi and Low. When the pressure is high (Hi) a strong concentration gradient is created close to the surface of the sample to be loaded. A reduction of the pressure followed by a further increasing, destroys the gradient close the surface and move the region of high loading further into the sample, while relaxing the surface condition. If we again repeat the same operation using a new period that is comparable with the diffusion time required to move the hydrogen from the surface to the inside position were the gradient exists we may destroy the gradient again moving it into further inside, and so on.

The problem is that the real systems we are working with are made up of polycrystalline materials with distributed grain size. This requires many periods and amplitudes to make effective the process above described across the whole domain. A fractal wave (SW) can perform this task and provide a strong enhancement to both the loading and flux, both conditions that are known or believed to be important preconditions for LENR excess heat in the Fleischmann-Pons Effect. The experimental evidence of the effect of Super Waves on Deuterium loading is shown in Figure A2

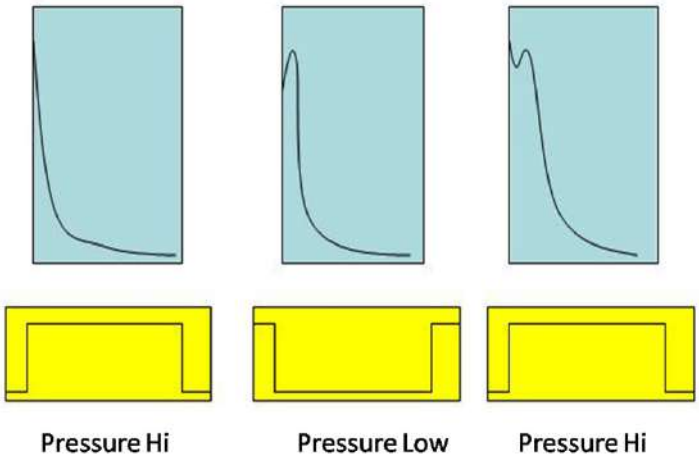

Fig. A1 - Concentration profile evolution under high-low pressure cycling

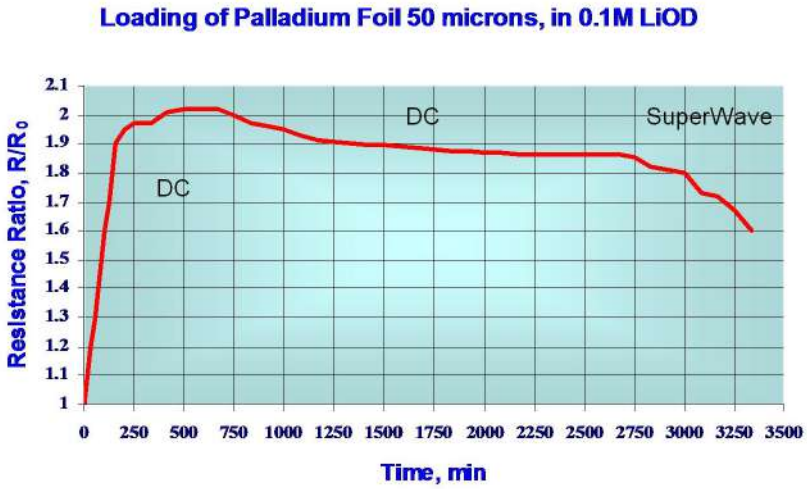

Fig. A2 - Experimental evidence of the SuperWave effect on loading.

4. References

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