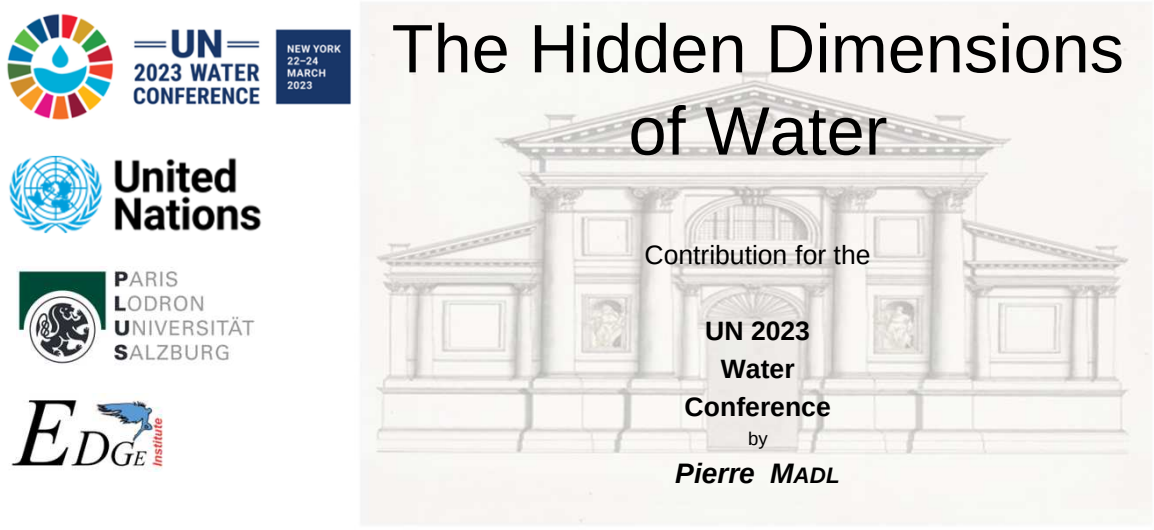


Pierre MADL (PhD in biophysics, MSc in biology, Electronics Engineer)
Edge institute
Holzerfeld 395 / A-5440 Golling

University of Salzburg
Dep. of Biosciences & Medical Biology @ Paris Lodron University
Hellbrunnerstr. 34 / A-5020 Salzburg
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URL: edge-institute.org/talk/Why_QFT_matters-UN-teaser.pdf

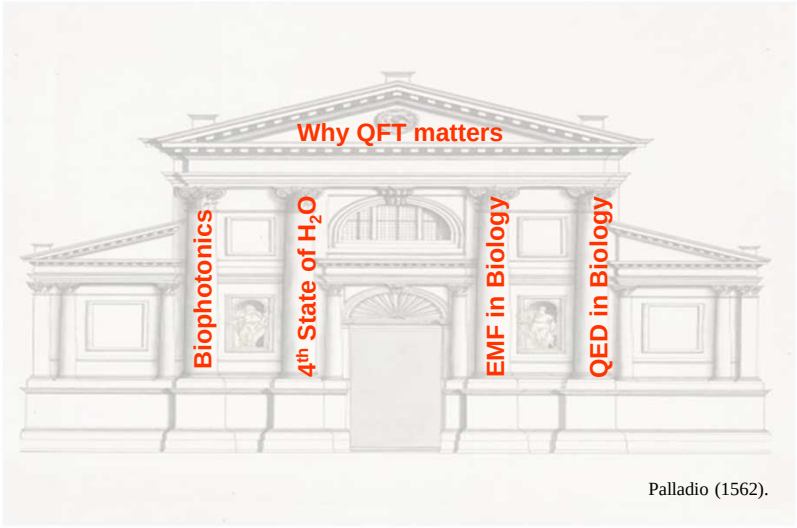
v.2023.1.1

# The Approach

Brief introduction:

An extract of a (4+1 parts) lecture series in:

1. Bio-Photonics (ultra-weak photon emissions)
2. Bi-phasic Water (4th phase)
3. Field properties of water and Biota (EMF)
4. Quantum-Biology (QED)




Palladio (1562).



**A short note to the reader:**

This lecture series consists of 4 (+1) modules. While each can be regarded as an independent entity, references therein (due to the multidisciplinary approach of the issues raised and because the issues are much better embedded therein) often refer to topics in one of the three other modules. Hence the five modules should be seen as a full package. Due to the sheer size, each module is offered individually (see below).
The entire lectures series is headed by a relatively short overview and provides a quick "dive" into the main subjects and acts as a teaser for the actual modules. Thus, the introductory module entitled ***Why QFT matters***, should be regarded as an enclosing envelop that tickles the reader by presenting unsolved riddles in biology that will be lifted once the reader dares to proceed further on to one or all the four modules.
In accordance with the that introductory module, the following four modules deepen the initially raised arguments and deals with the following topics:

0. **Why QFT matters - Introduction**
http://edge-institute.org/talk/Why_QFT_matters.pdf

1. **Biophotonics - The Light of Life**
http://edge-institute.org/talk/Why_QFT_matters-BP.pdf

2.**Liquid Crystalline State (or Fourth State) of Water**
will be available at http://edge-institute.org/talk/Why_QFT_matters-H2O.pdf

3. **Electromagnetic Fields and Life**
will be available at http://edge-institute.org/talk/Why_QFT_matters-EMF.pdf

4.**Quantum Biology**
will be available at http://edge-institute.org/talk/Why_QFT_matters-QED.pdf

Each of these four modules are in themselves split up into several sub-categories and typically cover a brief historical section, which are then deepened with related issues that build on the initially presented principles.
The author hopes that this brief introduction does not deter the reader from proceeding, but rather raises interest to such an extent as to become aware that there is a paradigm shift in biology and medicine that will turn upside down our current understanding of reality. With these words, I wish you a pleasant read …. For comments and criticism, please do not hesitate to contact me at: pierre.madl(at)sbg.at.ac

Image: Alzado de la fachada de San Francesco della Vigna de Andrea Palladio (1508–1580)
http://viajarconelarte.blogspot.co.at/2013/06/la-fachada-de-palladio-en-san-francesco.html

# *Photons and Water*


Palladio (1562).

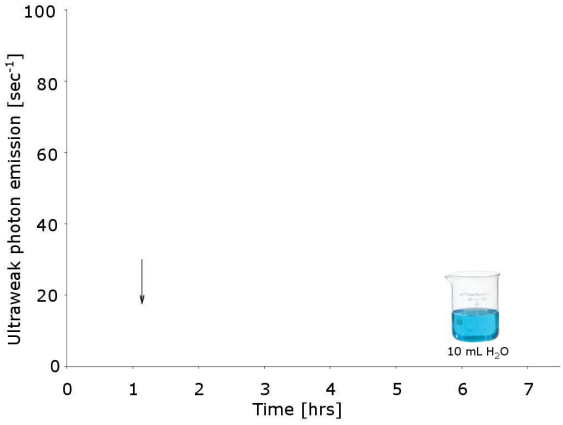
# *Neg-Entropic Pumping*

Ultraweak Photon Emission of
i) solid water
ii) liquid water

Gudkov et al., 2011

Setup:
i) 10 mL $H_2O$ sample
i) Detection via PMT (w/n 380-710 nm)
i) 1264 nm NIR laser (5 mW for 5 min)

→






**Abstract**: A 5-min exposure of air-saturated bidistilled water to low-intensity laser infrared radiation at the wavelength of the electronic transition of dissolved oxygen to the singlet state ($^3\sum_g \rightarrow {}^1\Delta_g$) induces, after a long latent period, auto-oscillations of water luminescence in the blue-green region, which last many hours. Laser irradiation causes the accumulation of hydrogen peroxide, which depends on the concentration of dissolved oxygen. The auto-oscillations do not arise if water is irradiated beyond the oxygen absorption band and if the oxygen is removed from water. The wavelet transform analysis of luminescence records indicates that there are two characteristic periods of pulsations of about 300 and 1150 s. The results obtained suggest that auto-oscillations are triggered by photoinduced singlet oxygen $^1\Delta_g$, and this phenomenon is closely related to formation of hydrogen peroxide.

Source: Gudkov SV, Bruskov VI, Astashev ME, Chernikov AV, Yaguzhinsky LS, Zakharov SD (2011) Oxygen-dependent auto-oscillations of water luminescence triggered by the 1264 nm radiation. J Phys Chem B. 2011 Jun 16;115(23):7693-8. doi: 10.1021/jp2023154.

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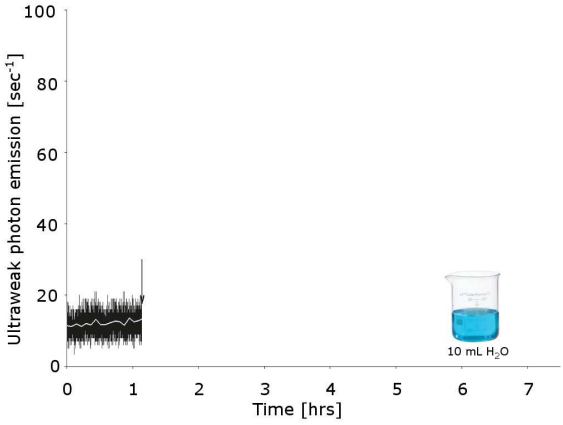




Measurement of Luminescence. A vial with an irradiated sample was placed in a high-sensitivity chemiluminometer Biotoks-7AM (Ekon, Russia) operating in the regime of a photon counter with a sensitivity band at 380-710 nm. The time of signal accumulation and the periodicity of recording the data was 1 s. The efficiency of photon counting was about 10%, as determined by calibration against Cherenkov radiation from isotope $^{32}P$. The region of the luminescence spectrum was estimated using blue or red optical filters with 99% transmission of light flow at 380-520 and 590-800 nm, respectively.

Source: Gudkov SV, Bruskov VI, Astashev ME, Chernikov AV, Yaguzhinsky LS, Zakharov SD (2011) Oxygen-dependent auto-oscillations of water luminescence triggered by the 1264 nm radiation. J Phys Chem B. 2011 Jun 16;115(23):7693-8. doi: 10.1021/jp2023154.

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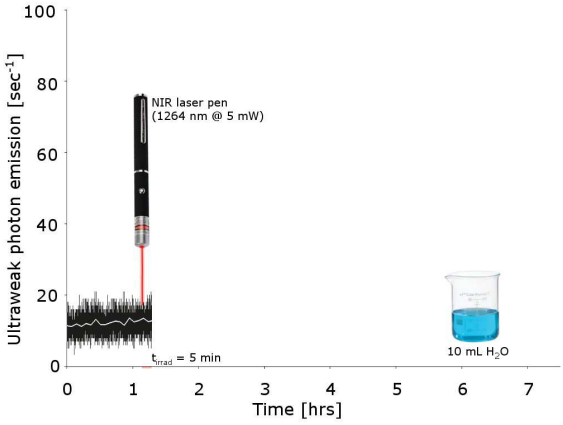




Irradiation. A sample of bidistilled water (10 mL; electrical conductivity 120 µS/m, pH 5.6) in a 20-mL polypropylene vial for liquid scintillation counting (Beckman, United States) was irradiated in the dark at room temperature with a 5 mW diode laser through the open surface by a quartz light guide. The distance from the light guide end to the water surface was about 10 mm, and the mean density of the light flux on the water surface was 1 mW/cm$^2$. A laser beam cross section was visualized using an IRDC-AS-22 card.

Source: Gudkov SV, Bruskov VI, Astashev ME, Chernikov AV, Yaguzhinsky LS, Zakharov SD (2011) Oxygen-dependent auto-oscillations of water luminescence triggered by the 1264 nm radiation. J Phys Chem B. 2011 Jun 16;115(23):7693-8. doi: 10.1021/jp2023154.

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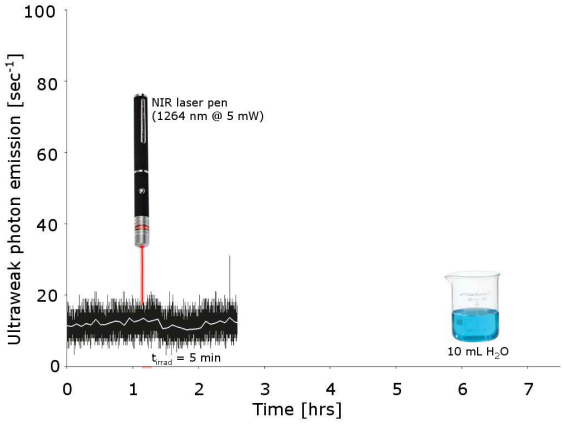




The effect induced by 1264 nm laser irradiation of an aqueous sample did not manifest itself within 1.5 to 2.5 h after exposure: the intensity of luminescence of the sample did not exceed the background level (10 ±5 counts per second, cps). Then the luminescence began to increase and reached 42 ± 3 cps (n = 16) over a period of 20-40 min with the subsequent transition to the auto-oscillation mode. The process continued for 16-22 h.

Source: Gudkov SV, Bruskov VI, Astashev ME, Chernikov AV, Yaguzhinsky LS, Zakharov SD (2011) Oxygen-dependent auto-oscillations of water luminescence triggered by the 1264 nm radiation. J Phys Chem B. 2011 Jun 16;115(23):7693-8. doi: 10.1021/jp2023154.

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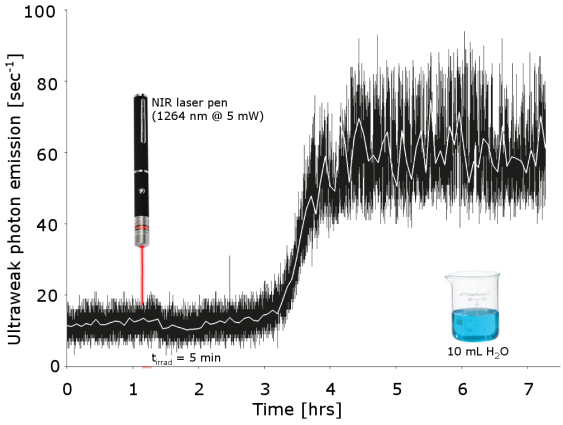
→ auto-catalytic pumping of NIR (low-grade energy)
→ photon emission in the blue range of VIS (high-grade energy)






Effect of laser radiation on water luminescence. The data of a representative experiment are shown. Water was exposed to an infrared laser (λ= 1264 nm, power 5 mW) for 5 min. The time of exposure is shown by a vertical arrow. To the left of the arrow is a record of the background water luminescence before the onset of laser irradiation. The white line on the basic plot presents the macrostructure of a signal obtained using the smoothing option of the program SigmaPlot.

Source: Gudkov SV, Bruskov VI, Astashev ME, Chernikov AV, Yaguzhinsky LS, Zakharov SD (2011) Oxygen-dependent auto-oscillations of water luminescence triggered by the 1264 nm radiation. J Phys Chem B. 2011 Jun 16;115(23):7693-8. doi: 10.1021/jp2023154.

*The 4th State*

*Liquid-Crystalline-or Biological Water*


Palladio (1562).

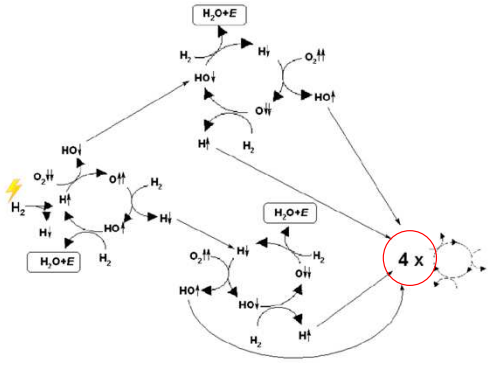
# *Branching Chain Reaction*

How is the IR-pumping possible?

From a **single** IR-photon to a massive event (blue light) via ROS-mediated Water respiration

$4(O_2 + e^- + H^+) \rightarrow 4HO_2\bullet + E$
$2(HO_2\bullet + HO_2\bullet) \rightarrow 2H_2O_2 + 2O_2 + E$
$H_2O_2 + H_2O_2 \rightarrow 2H_2O + O_2 + E$
$4O_2 + 4e^- + 4H^+ \rightarrow 2H_2O + 3O_2 + h\cdot\nu$ (~8 eV)

Voiekov, 2010




simplified **B**ranching **C**hain **R**eaction (BCR)

$4O_2 + (e^- + \ldots. + e^- + e^- + e^-) + 4H^+ \rightarrow$

$\rightarrow HO_2\cdot, H_2O_2, HO\cdot, {}^1O_2$, etc. $\rightarrow$

$\rightarrow 2H_2O + 3O_2 + h\cdot\nu$ (~8 eV)

Merger of $2H^+ + O^-$ releases huge amounts of E !

Voiekov, Del Giudice 2009



**Branching Chain Reactions (BCR)** in $H_2O$ providing energy is initiated by an introduction of only a few active particles (free radicals, atoms) into a reaction mixture …. A mixture of oxygen and hydrogen may stay for a long time without any visible changes until an active particle such as a hydrogen atom emerges in it …. Under the appropriate conditions a hydrogen atom may react with an oxygen molecule producing a hydroxyl radical and an oxygen atom. The former reacts with a hydrogen molecule producing a new hydroxyl radical, and the latter oxidizes a hydrogen molecule to water and regenerates a hydrogen atom, which starts a new tum of the cycle ....

Note that when all radicals either "rotate" in cycles or generate new ones practically no energy is released from the system. But, the reaction of hydrogen oxidation with oxygen is a "detonating gas" reaction, releasing an enormous quantity of energy (happens when the BCR breaks due to radicals' recombination ....

What is the source of this energy? It is initially "locked" in the oxygen molecules ($O_2$) as it has two electrons with parallel spins (unpaired electrons) on its valence molecular orbitals ($M\uparrow\uparrow$, where $\uparrow$ represents an electron with a certain spin, termed triplet state). Triplet $O_2$ is able to release >180 kcal/mole (= 7.805 eV/particle) upon its reduction to two water molecules after gaining 4 electrons (together with their carriers - protons). Furthermore, triplet state particles are paramagnetic (attracted into the magnetic field, which in singlet state oxygen ($M\uparrow\downarrow$, paired electrons) is missing .... Energy from the BCR are released in the form of light (photonic quantum equivalent of ~200 nm), rather than heat (so called "cold flame"). Strong luminescence is observed even though the temperature of the BCR is relatively low .... [1]

A similar process takes place when EZ-water comes in contact with bulk water containing dissolved oxygen is a donor-acceptor pair; under appropriate conditions, the complete oxygen-reduction reaction may proceed as: $2H_2O$ (EZ-water) + $O_2 \rightarrow O_2 + 2H_2O$ (Bulk water) + $n\cdot\hbar\upsilon$ (Energy)

Although the molecular species on the left and right sides of this equation are the same (water and oxygen), a high-grade, highly condensed energy of electron excitation (a total of up to 8 eV per $O_2$ molecule) may be donated by this reaction.[3]

**Source**: [1] Voeikov VL (2003) Mitogenetic radiation, biophotons and non-linear oxidative processes in aqueous media. In: Popp FA, Beloussov LV (eds) Integrative Biophysics - Biophotonics, Springer, Heidelberg, FRG.

[2] Voeikov VL (2001) Reactive Oxygen Species, Water, Photons, and Life. Rivista di Biologia Vol. 94: 193-214

[3] Voeikov VL, Ha, DM Vilenskaya ND, Malishenko SI, Bouravleva EV (2011) Are Carbonate Solutions Alive. 21st Centiry Science & Technology: http://21sci-tech.com/highlights/Fall_2011.html

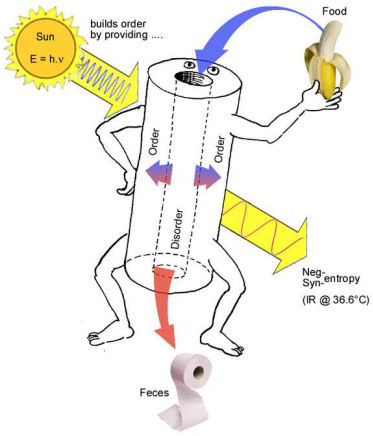
## *Peculiar prop's of Water*

i) Chemical:

ii) Optical:

iii) Electrical:

iv) Mechanical:




Madl & Egot-Lemaire, 2010



**Water is biphasic**: In the early 1900's a new approach emerged aiming for a better understanding of a biological organism. This perspective accepted a field of organization with properties specific to the totality of the form, not solely about the particles that make up the form. In searching for a non-mechanical/non-particle regulatory principle, an alternative principle developed: a morphogenetic field based on radiation. Although this part of the journey offers many fascinating scientific explorations, it took a long time and many developments in physics before biology definitively and internationally, in the 1970's, accepted the existence of universal ultra-weak biological radiation. At that time, one could finally begin to document the richness of information from measurements of biological photon emission. The new photovoltaic and multiplier technologies connected photon emission with the biochemistry of oxygen and oxygen reactions. The field concept also inspired Roentgen to the intuitive two-phase model of water (i.e.: micro ice crystals immersed in a normal fluid).[1], giving birth the to 4 states of water (solid, liquid, liquid crystalline, and gaseous) This notion solidified as with the emergence of quantum physics at the time.

Image: The transducing effects of aqueous systems when exposed to EMR. Only a fraction of the potential energy delivered by EMR is available to do work. The huge bulk of absorbed energy is re-emitted – particularly as infrared radiation. Food for example likewise contributes to increased ordering and at the same time provides the material precursors needed for biomolecular synthesis. Water - in particular, organismic water - is an energy transducer for the following pathways.[2]

Source: [1] Roentgen WK (1892). Ueber die Constitution des flüssigen Wassers. Annalen der Physik, 281(1):91–97. doi: doi.org/10.1002/andp.18922810108|.

[2] Madl P, Lemaiere S (2010) The Field and the Photon from a physical point of view. Conference Proceedings on Fields of the Cell, Basel (CH); ISBN: 978-81-308-0544-3

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Klimov & Pollack, 2007
Ochinnikova & Pollack, 2009

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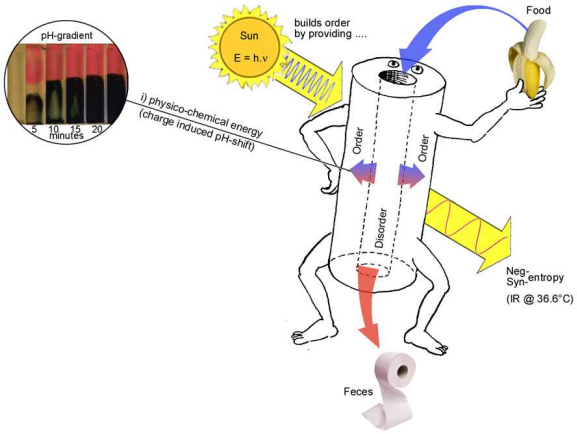


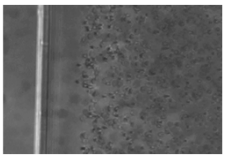

Membrane induced Exclusion Zone
Pollack, 2013



**Chemical**: The electrical properties of water (b/w parallel electrodes) were investigated using pH indicator dyes. Different pH values corresponded to different colors, which could be registered by a video camera. Imposition of electrical current was able to produce zones of constant pH around, and well beyond each electrode: extremely low pH around the positive electrode and extremely high pH around the negative electrode. The border between alkaline and acid zones was jagged and separated by only a narrow layer of water with neutral pH.[1]

We find here that these pH gradients reflect a genuine separation of charge: at times well after disconnection of the power supply, current could be drawn through a resistor placed between the charging electrodes or between pairs of electrodes positioned on either side of the midline between original electrodes. In some experiments, it was possible to recover the majority of charge that had been imparted to the water. It appears, then, that water has the capacity to store and release substantial amounts of charge.[2] Separated positive and negative charges experience an attractive force, which should result in immediate movement and reasonably quick neutralization, limited by viscosity. However, the results showed that charge separation was well maintained for lengthy periods of time. Even if some barrier were formed between the respective charged zones, one might have expected a huge charge accumulation immediately across the barrier, as in a capacitor; however, the charges were reasonably well distributed over the full extent of the respective zones. Hence, it appears that the separated charges are constrained in some fashion, as though confined in some kind of lattice, like n- and p-regions of semiconductors .... Regions of low pH had excess positive charge, whereas regions of high pH had excess negative charge. If that were not the case, then the charge should not have been so easily recoverable. The question arises whether the correlation between pH and charge seen here might be more general. [2]

Source: [1] Klimov A, Pollack GH (2007) Visualization of charge-carrier propagation in water. Langmuir 23(23): 11890-5. doi: 10.1021/la701742v

[2] Ovchinnikova K, Pollack GH (2009) Can water store charge? Langmuir 25, 542-547.

[3] Pollack J (2013) The fourth Phase of Water. Ebner & Sons. Publ. Seattle (WA). ISBN: 978-0962689543

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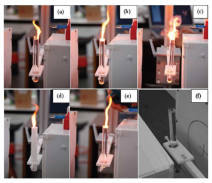
ii) Optical: hydrosol (PSL-spheres) separation by IR-light

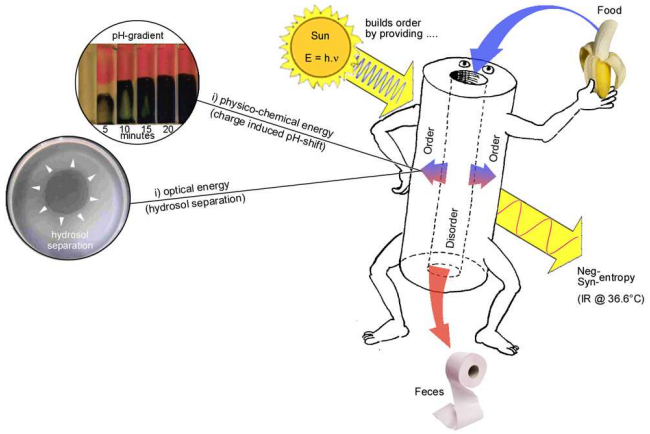
Ochinnikova & Pollack, 2009

iii) Electrical:

iv) Mechanical:



Salt-water burning induced by EMF-stimulation, Roy et al., 2008





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**Optical**: water samples that are stored in dark-rooms absorb and store IR or microwave radiation, which becomes re-emitted as visible light that can be detected by PMTs. Interestingly, exposure of saltwater to radio-frequency (13.56 MHz @ 300W) leads to spontaneous combustion of along with the emission of visible light.[1] Shorter wavelength exposure for several hours of a water sample containing 2 μm microbeads on the other hand results in absorption of IR using and leads to phase-separation. Directed migration of this particle-free zone can be augmented by unilaterally shining light on it .... Among the various observations we made, perhaps the most dramatic was that once the cylinder had formed and side-incident light was turned on, the cylinder moved resolutely away from the light source.[2] This effect is of vital importance for metabolic activity for shifting gradients of dissolved molecular species. Interestingly, the wavelengths most responsible for building this zone are the very wavelengths most strongly absorbed by water (NIR-range). Hence, in a more general context, it may be that a good fraction of the electromagnetic energy absorbed by water is used to build order and separate charge.[3]

Source: [1] Roy R, Rao ML, Kanzius J (2008) Observations of polarised RF radiation catalysis of dissociation of H2O–NaCl solutions. Mat. Res. Innov. 12(1): 3-6

[2] Ovchinnikova K, Pollack GH (2009a) Cylindrical phase separation in colloidal suspensions. Phys Rev E 79(3): 036117.

[3] Chai, B. H., Yoo, H. and Pollack, G. H. 2009 Effect of Radiant Energy on Near-Surface Water. J.Phys.Chem.B, 113, 13953–13958.

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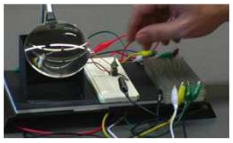
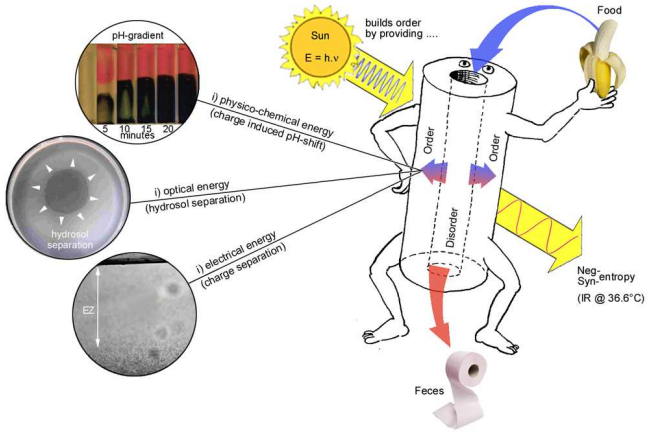


Water battery
Kung, 2014






**Electrical**: By passing current between immersed electrodes, pH gradients reflect a genuine separation of charge: at times well after disconnection of the power supply, current could be drawn through a resistor placed between the charging electrodes or between pairs of electrodes positioned on either side of the midline between original electrodes. In some experiments, it was possible to recover the majority of charge that had been imparted to the water …. Perhaps the most significant aspect of the results is that stored charge could be recovered. This was shown by placing a resistive load between electrodes and drawing current through this load. The recovered-current magnitude depended on many factors. Although no systematic attempt was made to map the range of recovery over the full domain of possible factors, we did find that recovery as high as 70% of input charge was not difficult to obtain. This implies that, as a storage medium, water is quite effective …. Furthermore, clouds, essentially water, contain vast regions of net charge. In the present experiments as well, half-chambers with net charge could be sustained for long periods. Hence, the law of electroneutrality is not necessarily inviolable over restricted volumes, and the possibility that acidic/basic solutions might contain net charge should not be reflexively dismissed.[1]

Source: [1] Ovchinnikova K, Pollack GH (2009b) Can water store charge? Langmuir 25, 542-547.

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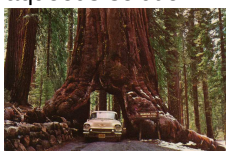
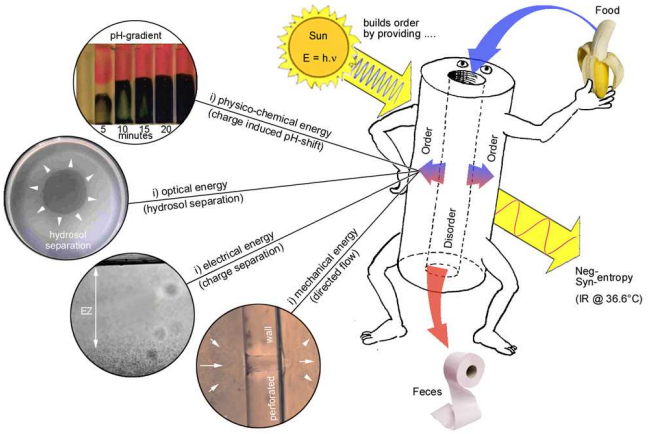
iv) Mechanical: perforated gels reveal spontaneous mass transfer of aqueous solution
O'Rouke et al., 2011
Li & Pollack, 2020



→ Californian Redwoods „draw" water120m up into their canopy !
→ Capillary blood-flow



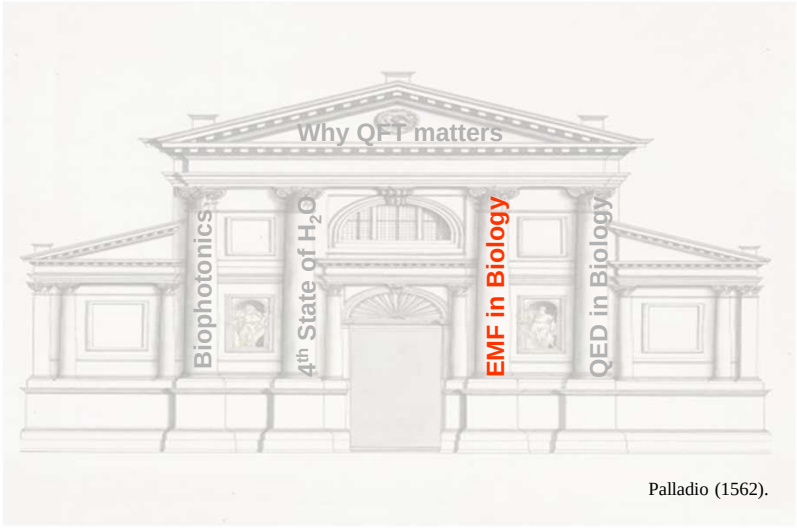



**Mechanical**: When a Nafion tube is immersed in water and a small hole is punched in the tube's wall, an unexpected phenomenon occurs: Water flows continuously into the tube through the hole. The phenomenon has proved repeatable, and dynamic aspects were therefore explored, including the effects of altered pH and introduction of a second hole. It appears that the flow is closely tied to the recently discovered "exclusion zone" that forms as an annulus inside the Nafion tube. These zones generate protons in the core of the tube, which exert pressure on the menisci; once a hole is punched, the pressure is relieved by sucking water through the hole. This hypothesis is consistent with the observed experimental evidence and may be relevant to the mechanism of water transport in trees from root to canopy via xylem (see 100 m tall redwoods) …. Immerging a hydrophilic membrane arranged in tubular form into water reveals a directed spontaneous flow through the tube [1]. Light augments this effect; i.e. incident radiant energy fuels EZ expansion, that energy may likewise fuel the self-driven flow. Application of ultraviolet-containing white light could boost flow velocity by up to 500%. Thus, the self-driven flow mechanism can convert radiant energy into kinetic energy.[2]

Source: [1] O'Rourke C, Klyuzhin I, Park JS, Pollack GH (2011) Unexpected water flow through Nafion tube punctures. Phys. Rev.E Stat. Nonlin. Soft Matter Phys. 83(5/2), 055305-055310.

[2] Li Z, Pollack GH (2020) Surface-induced flow: A natural microscopic engine using infrared energy as fuel. Sci Adv. 6(19): eaba0941. doi: 10.1126/sciadv.aba0941

*Electro-Magnetic Field effects mediated by Water*



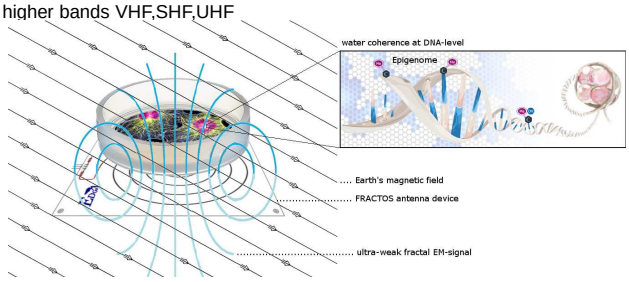

Palladio (1562).

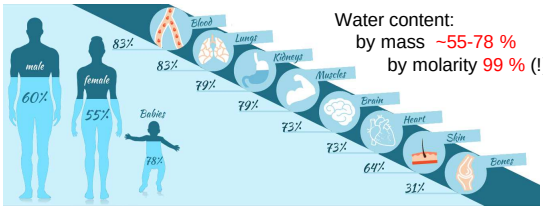
## *Hormesis mediated by water*

BCR makes hormetic effects (via ultra-weak em-signals) plausible

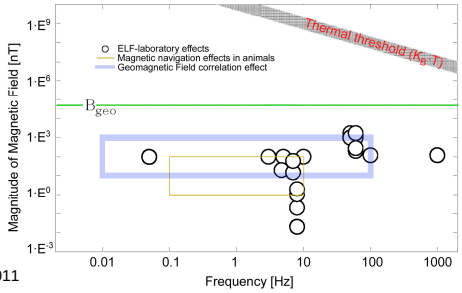
- 
- 

Effect not restricted to the VLF-band – includes also modulation in higher bands VHF,SHF,UHF




Water content:
by mass ~55-78 %
by molarity 99 % (!)




Binhi, 2002, 2011



In addition to the mentioned laboratory experiments, it is reasonable to include magnetic navigation effects into the group of superweak MF effects, because, for example, migrating birds should be able to detect changes of average MF value at least at the level of 10-100 nT for the interval of about ten minutes of flight. The effects of biospheric correlations with variations of geomagnetic field (GMF), is attributed to the effects of super-weak fields.[1]

Hormetic effects (ELF-lab experiments, GMF, MF-navigation) are visible in the frequency-amplitude diagram. It can be seen that magnetic fields, which supposedly cause these effects, significantly differ in their parameters from magnetic fields, which can lead to heating (thermal threshold, $k_B \cdot T$) of biological tissues. It is relevant to highlight that results of laboratory experiments do not contradict observational data …. Similar effects occur in the frequency range of microwaves, when the power of EM-radiation is far from that at which thermal effects are possible.[1]

Image: Parameters of super-weak magnetic fields supposedly causing the observed biological effects. The amplitude-frequency intervals are approximate orders of magnitude.[2]

Source: [1] Binhi VN (2011) Principles of Electromagnetic Biophysics (in Russian). FIZMATLIT Moscow (RUS), 592 p. ISBN 978-5-9221-1333-5.

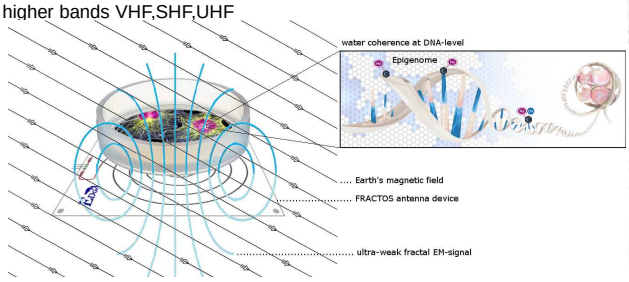
[2] Binhi VN (2002) Magnetobiology. Academic Press, London (UK), 484 p. ISBN: 200-109-59-15

# *Hormesis mediated by water*

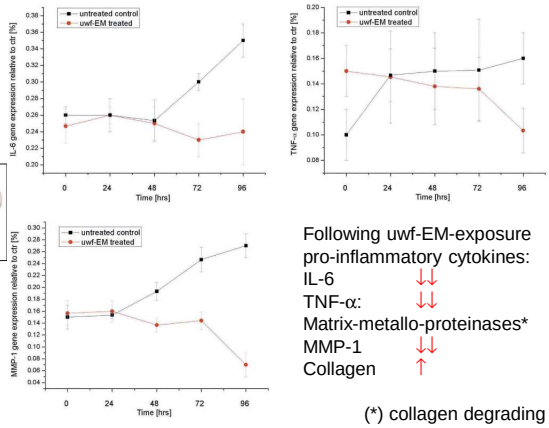
BCR makes hormetic effects (via ultra-weak em-signals) plausible

- **Fibroblasts**:
-

Effect not restricted to the VLF-band – includes also modulation in higher bands VHF,SHF,UHF




Static (geogmagnetic) field 48 µT
applied alternating fractal field <13 nT




Following uwf-EM-exposure
pro-inflammatory cytokines:
IL-6 ↓↓
TNF-α: ↓↓
Matrix-metallo-proteinases*
MMP-1 ↓↓
Collagen ↑

(*) collagen degrading



Skin aging is primarily associated with the alterations in dermal extracellular matrix, in particular a decrease in collagen type-1 content. Recent studies have shown that collagen-degrading matrix metalloproteinase (MMP-1) is produced by fibroblasts in response to chronoaging, which in human dermal fibroblasts leads to the release of proinflammatory cytokines. Past studies showed that anti-inflammatory capabilities could be induced via non-chemical means. One of these methods makes use of ultra-weak fractal electromagnetic (uwf-EM) signals. Such ultra-/very-low frequency (U/VLF) signals (few nT in intensity and within 0.5–30 kHz) interact with aqueous solutions in living systems. The fractal nature of such EM-signals relates to the self-similar property by which a “cut-out” and magnified piece of this signal reveals again the original. Thus, the aim of this study is twofold, to i) investigate the extent of this modulating effect using Human Dermal Fibroblasts (HDF)-cells, and ii) analyse molecular rejuvenation markers therein. We could demonstrate that a 10 min uwf-EM exposure (prior to incubation) increases type-1 collagen and modulates elastin in human fibroblasts cultured up to 96 h, while at the same time reduces IL-6, TNF-α and MMP-1 (the later three being statistically significant). Such up- respectively down-regulation of corresponding genes are strong indicators of an EM-induced hormetic effect that influences the epigenomic landscape of HDFs. In the Appendix, we present, in the framework of Quantum Field Theory (QFT), water as a biphasic liquid and how its coherent fraction can be affected by uwf-EM signals while at the same time resolving the “kT paradox”.

Source: Madl P, De Filippis A, Tedeschi A (2020) Effects of Ultra-Weak Fractal Electromagnetic Signals on the Aqueous Phase in Living Systems: A Test-Case Analysis of Molecular Rejuvenation Markers in Fibroblasts. Electromagnetic Biology and Medicine, 39, 227-238. doi: 10.1080/15368378.2020.1762634

# *Hormesis mediated by water*

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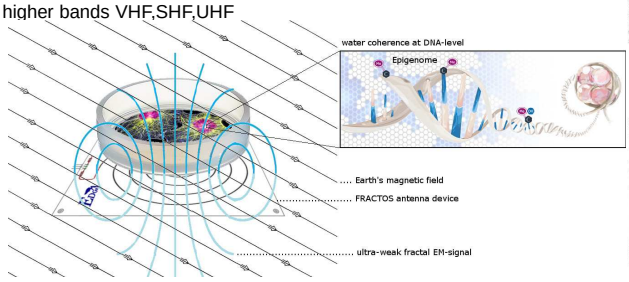


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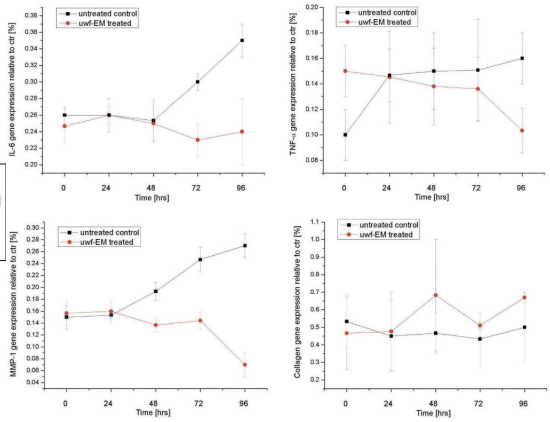





**Image**: After 96 h of culture incubation, pro-inflammatory cytokines gene expression (IL-6 and TNF-α) in HDF was found to be increased. In particular, we have observed an enhancement of IL-6 gene expression in the order of 46% and an increase of TNF-α gene expression by 39%. In samples that have been uwf-EM treated we observed a reduction of IL-6 and TNF-α gene expression by 28% and 32%, respectively.

HDF cultured for 96 h showed and increasing of MMP-1 until 35% and a reduction of collagen type-1 and elastin gene expression until 38% and 30%, respectively. In HDF stimulated with the uwf-EM signal, a modulating effect of these genes became evident. MMP-1 gene expression was reduced by 28%, while collagen and elastin showed an increase of 35% and 33%, respectively. Major gene expression modulation was observed even beyond 96 h of culture.

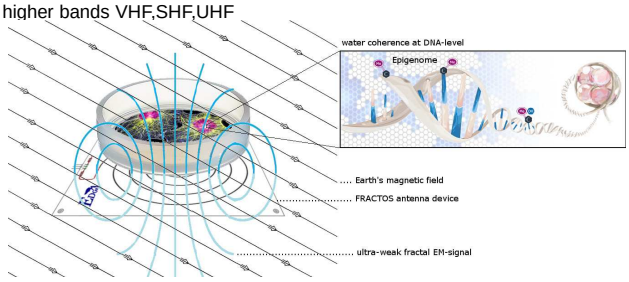
Source: Madl P, De Filippis A, Tedeschi A (2020) Effects of Ultra-Weak Fractal Electromagnetic Signals on the Aqueous Phase in Living Systems: A Test-Case Analysis of Molecular Rejuvenation Markers in Fibroblasts. Electromagnetic Biology and Medicine, 39, 227-238. doi: 10.1080/15368378.2020.1762634

# *Hormesis mediated by water*

BCR makes hormetic effects (via ultra-weak em-signals) plausible

- Fibroblasts:
- **HaCaT-cells infected w/ *Malassezia furfur*:**

Effect not restricted to the VLF-band – includes also modulation in higher bands VHF,SHF,UHF

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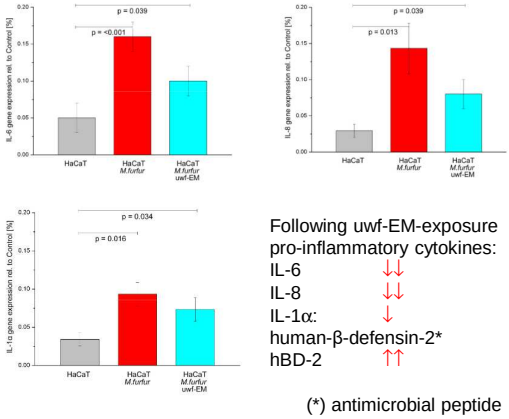


Following uwf-EM-exposure pro-inflammatory cytokines:
IL-6 ↓↓
IL-8 ↓↓
IL-1α: ↓
human-β-defensin-2* hBD-2 ↑↑

(*) antimicrobial peptide

23-03-28 pierre.madl@plus.ac.at EDGE Institute 19

Malassezia spp. are dimorphic, lipophilic fungi that are part of the normal human cutaneous commensal microbiome. However, under adverse conditions, these fungi can be involved in various cutaneous diseases. In this study, we analysed the effect of ultra-weak fractal electromagnetic (uwf-EMF) field exposure (12.6 nT covering 0.5 to 20 kHz) on the growth dynamics and invasiveness of M. furfur. The ability to modulate inflammation and innate immunity in normal human keratinocytes was also investigated. Using a microbiological assay, it was possible to demonstrate that, under the influence of uwf-EMF, the invasiveness of M. furfur was drastically reduced ($d = 2.456$, $p < 0.001$), while at the same time, its growth dynamic after 72 h having been in contact with HaCaT cells both without ($d = 0.211$, $p = 0.390$) and with ($d = 0.118$, $p = 0.438$) uwf-EM exposure, were hardly affected. Real-time PCR analysis demonstrated that a uwf-EMF exposure is able to modulate human-β-defensin-2 (hBD-2, synonymous with skin-antimicrobial peptide 1) in treated keratinocytes and at the same time reduce the expression of proinflammatory cytokines in human keratinocytes. The findings suggest that the underlying principle of action is hormetic in nature and that this method might be an adjunctive therapeutic tool to modulate the inflammatory properties of Malassezia in related cutaneous diseases. The underlying principle of action becomes understandable by means of quantum electrodynamics (QED). Given that living systems consist mainly of water and within the framework of QED, this water, as a biphasic system, provides the basis for electromagnetic coupling. The oscillatory properties of water dipoles modulated by weak electromagnetic stimuli not only affect biochemical processes, but also pave the way for a more general understanding of the observed nonthermal effects in biota.

Source: Madl P, Germano R, Tedeschi A, Lettner H (2023) Effects of Ultra-Weak Fractal Electromagnetic Signals on *Malassezia furfur*. *Int. J. Mol. Sci. 24*, 4099. doi: 10.3390/ijms24044099

# *Hormesis mediated by water*

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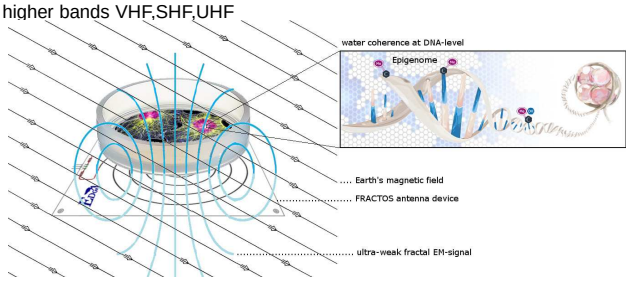


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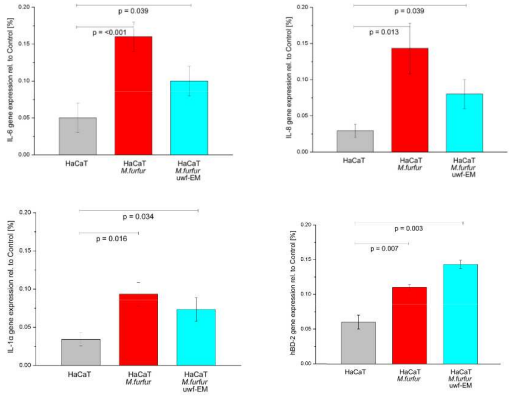





**Image**: To investigate the potential of uwf-EM exposure to modulate the inflammatory response, we also evaluated gene the expression of cytokines in noninfected HaCaT cells as well as in infected ones with and without uwf-EM pre-treated Malassezia. As shown in, we detected a marked increase in the IL-6, IL-8, and IL-1α gene expression in the HaCaT cells following an infection with M. furfur after 24 h of incubation; the infection boosted IL-6 and IL-1α by a factor of ≈3 compared to uninfected HaCaT cells, while IL-8 increased almost by a factor of ≈5.

To investigate the expression of hBD-2, keratinocytes were infected for 24 h with and without uwf-EM pre-treated M. furfur. Following the 24 h incubation period, as shown, the batch infected with M. furfur that did not undergo uwf-EM exposure resulted almost in double the hBD-2 compared to the HaCaT controls. The batch infected with pre-treated M. furfur that did undergo uwf-EM treatment almost tripled with respect to the HaCaT infected with M. furfur only.

Source: Madl P, Germano R, Tedeschi A, Lettner H (2023) Effects of Ultra-Weak Fractal Electromagnetic Signals on *Malassezia furfur*. *Int. J. Mol. Sci. 24*, 4099. doi: 10.3390/ijms24044099

*Quantum Electro- -Dynamics & Water*

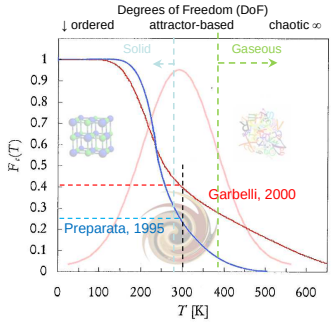

Palladio (1562).

# Water in Biota

i) Coherence among $H_2O$-molecules
- $F_{coh} + F_{non\text{-}coh} = 1$

→ water is biphasic ( 4th phase)

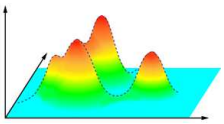
Garbelli, 2000
Preparata, 1995




The "coherent fraction" $F_{Coh}(T)$ vs. T

Classical QM-Transition:
- particle-like (ensemble of quanta in a coarse-grained structure)

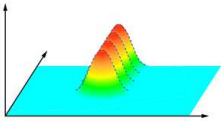
→ w/ limitless DoFs !
→ highly entropic



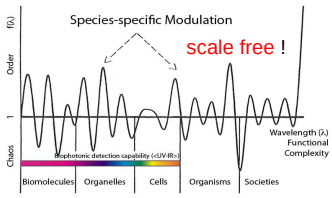
$\delta N \cdot \delta\varphi \geq \frac{1}{2}$ .... no units → scale free !

Coherence Theory:
- wave-like (phase-correlation grouping particle-wave-function together): delocalized coherent EMF .... modern QED-approach → conversion t/w single DoF

→ purely neg-entropic !



Bischof & DelGiudice, 2013




Remember: Water content in biota:
~65% (mass) but 99% (molarity → N) !



The relation between these two representations is expressed by the uncertainty relation, similar to the Heisenberg relation between position and momentum, connecting the uncertainty δN of the number of quanta (particle structure of the system) and the uncertainty δφ of the phase (which describes the rhythm of fluctuation of the system). Consequently, the two representations we have introduced above correspond to the two extreme cases:[3]

(1) If, the number of quanta is well defined, so that we obtain an atomistic description of the system but lose the information on its capability to fluctuate, since becomes infinite. This choice corresponds to the usual description of objects in terms of the component atoms/molecules.

(2) If, the phase is well defined, so that we obtain a description of the movement of the system but lose the information on its particle-like features which become undefined since becomes infinite. Such a system having a well-defined phase is termed coherent in the physical jargon.

The Bohm-Aharonov effect is relevant only when the phase of oscillation is well defined, thus only in coherent systems, and it is crucial in keeping correlations within a living (super-coherent) system.[4]

Image: Calculated trend of the coherent fraction, $F_{coh}(T)$, as a function of T.[1,2]

The morhogenetic field bridges the explicate orders of bio-molecules all the way up to societies. Abscissa “1” represents the Balance of Operation (homeostasis) - from left to right: Functional Complexity. Not only tissues and organs are tied together to form an organism, also members of a group, of a culture, a society. [5]

Source: [1] Preparata G (1995) QED Coherence in Matter, Ch.10. World Scientific, Singapore

[2] Garbelli A (2000) Proprietà termodinamiche e dielettriche dell'acqua alla luce della teoria complessa delle interazioni molecolari elettrodinamiche ed elettrostatiche, PhD-Thesis, Univ. of Milan (IT)

[3] Bischof M, DelGiudice E (2013). Communication and Emergence of collective Behavior in Living Organisms: A Quantum Approach. Mol.Biol.Int. Vol. 2013, Article ID 987549, 19 pages. doi:10.1155/2013/987549

[4] Renati P (2021) QED coherence in Condensed and Living Matter - Theoretical frameworks, experimental results, and epistemological implications. PhD-Thesis, University of Catania (IT).

[5] Popp FA (1992) Evolution as the Expansion of Coherent States; Ch.21. In: Popp FA, Li KH, Gu Q, (eds) Recent Advances in Biophoton Research and its Applications; World Scientific Publishing – Singapore;

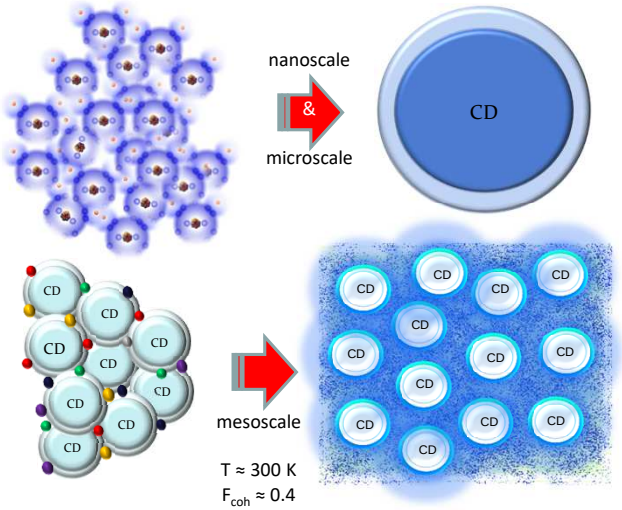
## Water in Biota

i) Coherence among $H_2O$-molecules

i) Macroscopic Coherence
- phase coupling among $H_2O$'s nano- to microscale (PHz-range)
- phase coupling CDs mesoscale (kHz-range) → organisms
- supercoherence, II, III etc. macroscale (Hz-range) → ecosystems
- cold vortex excitations

→ the various levels of coherence give rise to fractal systems
→ multilevel holographic
→ living systems: em-homeostasis
→ phase velocity (φ) >> speed of light (c)

DeNinno, Pregnolato, 2016
Brizhik et al., 2009
Renati, 2021






A coherent system is one that has a precise rate of oscillation (phase, φ) and regards $H_2O$-molecular dimensions. A super-coherent condition emerges from the molecular level and gives rise to huge space-time structures (from molecule, to cell, to living being, to ecosystem, to planet, etc.). The extension of coherence to higher and higher levels is rooted in the Principle of Indetermination: $\delta N \cdot \delta\varphi \geq ½$ …. For a living system to live, the overall number of phase-locked oscillators must be stabilized in *homeostasis* (meant as their ability to cope with stimuli which drive them out of their balance). Such a balance, made of a dynamical self-maintenance through energy/matter cycles and feedbacks, has been defined as *homeorhesis* by *Waddington*.[1] All cells interact with both chemical and electromagnetic signals and the homeostasis of the whole system is continuously regulating the chemical reactions, the solutions concentration and the EM signals within and outside the cells in both coexisting eukaryotic and prokaryotic realms. This complexity makes the system vulnerable to any agents able to "disturb" the fundamental mechanisms that underpin the exchange of information in such a complex network. The understanding of human disease and healing processes in this context cannot avoid considering both the chemical reaction and the electromagnetic transmission within all the superorganism cells and the interaction between them.[3]

Image: Sketch of the biphasic structure of pure liquid water at T=300K; the periodicity of the electric potential experienced by an electron along the radial direction of the extended (excited) molecular orbitals, which justify "H-bonds". This periodicity is fixed by the size of a water molecule (about 3 Å in diameter). For a water molecule the electric potential is well defined up to the ionization threshold $I_{th}$, but of course, within a CD electrons of coherent molecules spend 13% of their time at the excited level, pretty close to $I_{th}$; this allow them to do tunnelling across a very thin barrier (only 0.5 Å thick, the distance between two neighbouring packed molecules) allows local, internal, super-currents: the so called cold vortexes.[1]

Source: [1] Renati P (2021) QED coherence in Condensed and Living Matter - Theoretical frameworks, experimental results, & epistemological implications. PhD-Thesis, Univ.of Catania (IT).
[2] Brizhik L, Del Giudice E, Jørgensen SE, Marchettini N, Tiezzi E (2009) The role of electromagnetic potentials in the evolutionary dynamics of ecosystems. Ecological Modelling, Vol.220: 1865–1869
[3] De Ninno A, Pregnolato M (2016). Electromagnetic homeostasis and the role of low-amplitude electromagnetic fields on life organization. Electromagnetic Biology and Medicine, 36(2): 115-122.

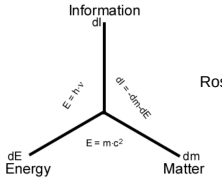
*Concluding remarks ….*

*…. In view of the paradigm shift ahead*

## *Unlocking the hidden properties of water*

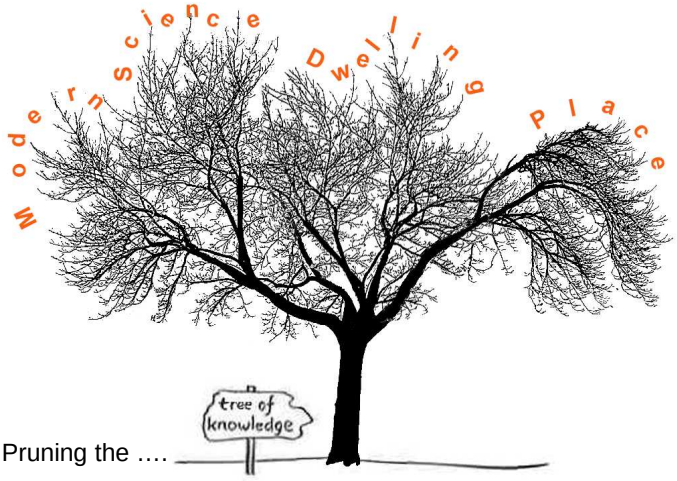
Why has this remained uncovered for so long?

…. science today mainly focuses on **matter issues**, massively neglecting **field effects** & **Information**.




Rossi et al., 2010

Pollack, 2013




Pruning the ….



So far, field phenomena in biota are still only partially answered – open issues remain and regard the mechanisms through which Information Matter and Energy (EmI) are able to tune a stochastic system (with infinite degrees of freedom, DoFs) to become stabilized and to aim for a common organismic goal (DoF=1) …. The "essence of life" must be linked to both information (I) and static as well as dynamics fields (E). Since transformations of matter within biotic systems do not occur randomly, the mediations of signs & signals are coupled to mass and energy. While free energy (E) is codified by vibrations, matter (m) in this respect can only be envisioned in its condensed form. The entity that bridges energy and matter relates to the purposeful coupling via information-based catalytic activities. Inevitably, this leads to a system-theoretical definition of information, which can be subsummized as the »bit« of information constituting the difference that makes a difference.

Image: EmI-Triad as a key concept to better comprehend the phenomenon of life. The energy aspects representing "the potential for causing change", is a concept used to understand the dynamics of most physico-chemical processes.

Source: Rossi C, Madl P, Foletti A, Mocenni C (2015) Equilibrium and far-from equilibrium states, Ch.4. In: Fels D, Cifra M, Scholkmann F (eds), Fields of the Cell,. ISBN: 978-81-308-0544-3, p. 71–94.

## *Unlocking the hidden properties of water*

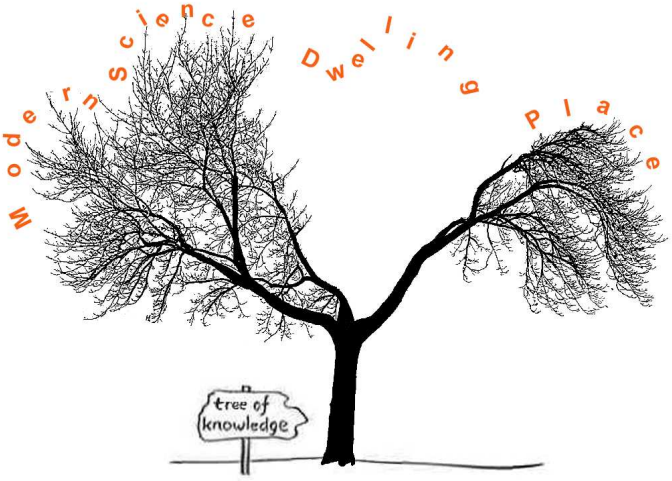
Why has this remained uncovered for so long?

…. science today mainly focuses on **matter issues**, massively neglecting **field effects** & **information**.

i.e.: gazing at the twigs of the tree of knowledge with incremental detail (**specialization**).

assuming that the supporting structure is solid (→ knowledge base) ….

Pollack, 2013






**The culture of Science**: Until the modern era, scientists focused on seeking foundational mechanisms. They tried to understand how the world works. If their efforts uncovered paradigms that could explain diverse phenomena in simpler ways, then they knew they were onto something meaningful. Thus, Mendeleev's periodic table could predictably account for the multitude of known chemical reactions, and Galileo's sun-centered solar system obviated the need to invoke complex epicycles to describe planetary orbits.

The principles outlined can be viewed as rules of nature, formerly obscured in some remote corner and now unveiled in a dearer light . These principles seem rich with explanatory power. They help answer simple "why" and "how" questions: Why do gels hold water? How can champagne bubbles proliferate in streams seemingly without end? How can simple hydrated wedges split apart massive boulders? How does water rise to the tops of giant redwood trees? Why clouds don't fall apart? Why do you see clouds of vapor above your hot coffee? Why does ice make you slip and fall on your face? The principles can explain many other questions whose answers have remained elusive.

Image: Pruning the *tree of knowledge* by asking the right questions. This inevitable will unearth wrong assumptions made in the past that lead to prevailing misconception in many fields of science.

Source: Pollack J (2013) The fourth Phase of Water. Ebner & Sons. Publ. Seattle (WA). ISBN: 978-0962689543

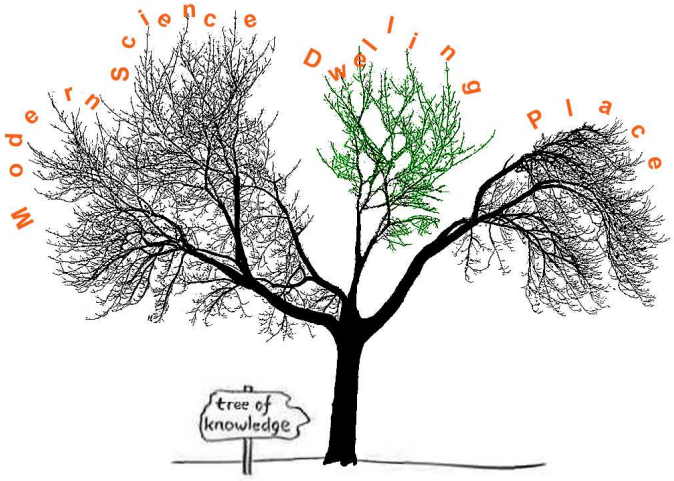
## *Unlocking the hidden properties of water*

Why has this remained uncovered for so long?

…. we need new guiding principles:

(i) questioning mainstream views in search for the hidden;
(ii) once pseudoscience, now solid science;
(iii) tackling the essence of water in the living state;
(iv) encompassing also fields and information;

Pollack, 2013






**Why have these principles remained obscured?**

• First, the slow emergence of understanding is water's ubiquity: water is everywhere. Surely someone must have worked out those basics, probably a century or two ago. This perception keeps scientists away. If anything, their reluctance has only intensified: today's science rewards those who focus narrowly on trendy areas, leaving little room for questioning widely taught foundational science. Especially for something as deeply rooted and common as water, the incentive to question fundamentals has all but vanished.

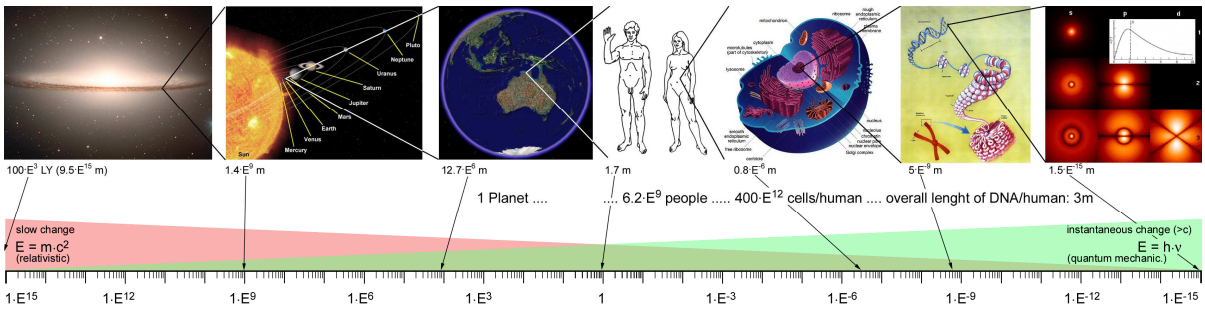
• Second, *water science has had a checkered history.* The polywater debacle left scars, along with the hefty debate about water memory. Such incidents kept curious scientists away from water-science for decades.

• Third, intellectual timidity is a fundamental principles plagues all of science. *Relying on received wisdom feels safer than dealing with the uncertainties of revolutionary disruption.* Most scientists feel more comfortable restricting themselves to minor deviations from the *status quo*.

• Fourth, *outright fear.* Challenging received wisdom means stepping on the toes of scientists who have built careers on that wisdom. Unpleasant responses can be anticipated. A child might be forgiven for such apostasy a senior scientists may risk his/her career.

Source: Pollack J (2013) The fourth Phase of Water. Ebner & Sons. Publ. Seattle (WA). ISBN: 978-0962689543

# Thank you for your attention !




23-03-28 pierre.madl@plus.ac.at

Our body is not a supercell, but has this cellular composite structure, because simply the information flow must be fast enough so that once damage occurs a restructuring process is immediately initiated. If the inflicted damage is too large, neighboring cells will drive the damaged cell into apoptosis …. [1]

The cellular structure can be found throughout the 3D-reality – be it on a galactic scale or all the way down to the atomic scale. However, it is all about interdependence of the involved entities and their relations on the approriate scale. This are the driving forces that generate and determine "form and shape" at any given level. [3]

Dürr worked as a particle phycisist with Werner Heisenberg. During his 50-year investigation into the structure of the atom, he realized that the **matter as such does not exist** – there is just shape and gestalt (form und gestalt). The **particle is an artifact** – it is the result of the information and the corresponding energy involved.[2]

Source: [1] Kupiec JJ, Sonigo P (2008) Né dio né genoma (italian, Neither God nor genome. For a New Theory of Inheritance. Elèuthera eds. Milan (IT). ISBN: 9-788-889-490-631

[2] Dürr H.P. Jungk R.; (1999) Ökologische Revolution. Transcript of the Austrian Broadcast Cooperation, Vienna (AT);

[3] Dürr HP (2005) Substance and Form: from Reality to Potentiality,. Plenary Lecture given at the 60th LMHI World Medical Congress, Berlin (FRG);