

# Taos hum, stochastic resonance, and sensory perception

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### Abstract

Taos hum is an experimentally well-established anomalous phenomenon which has escaped rational explanations. Very concisely, taos hum seems to be apparently a subjective experience without identifiable objective counterpart and could thus provide an application for the sensory canvas hypothesis.

The TGD based model for EEG is based on dark Josephson radiation generated by cell membrane Josephson junctions in the energy range of visible and UV light and covering a wide frequency range. The model explains bio-photons and EEG photons as manifestations of one and the same thing. Taos hum might be perhaps understood in terms of this kind of Josephson radiation at microwave frequencies generated by living matter during night-time and possibly providing some organisms with an active vision. The emission of negative energy dark photons could also make it possible for plants to suck metabolic energy from the environment in the absence of solar radiation.

Also other interpretations might be considered and the most recent idea suggests a connection with quantum gravitation which plays a key role in TGD inspired quantum biology. The proposed generalization of the notion of stochastic resonance inspired by the zero energy ontology of TGD could also serve as a mechanism of Taos hum. The bistable state would be replaced by a pair of states with an opposite arrow of time so that the mechanism would be universal. Zero energy ontology would explain the thermodynamically questionable ability of the system to extract energy from white noise assumed in the standard model of stochastic resonance. Stochastic resonance also allows to construct a more precise model of sensory perception.

## 1 Introduction

Taos hum (see this) is an experimentally well-established anomalous phenomenon which has escaped rational explanations (in the article [I3] a thorough review about nocturnal taos hum is given and the following representation relies on this article). Very concisely, taos hum seems to be apparently a subjective experience without identifiable objective counterpart and could thus provide an application for the sensory canvas hypothesis.

The TGD based model for EEG [K3] is based on dark Josephson radiation generated by cell membrane Josephson junctions in the energy range of visible and UV light and covering a wide frequency range. The model explains bio-photons and EEG photons as manifestations of one and the same thing. Taos hum might be perhaps understood in terms of this kind of Josephson radiation at microwave frequencies generated by living matter during night-time and possibly providing some organisms with an active vision. The emission of negative energy dark photons could also make it possible for plants to suck metabolic energy from the environment in the absence of solar radiation.

Also other interpretations might be considered and the most recent idea suggests a connection with quantum gravitation which plays a key role in TGD inspired quantum biology.

### 1.1 Basic facts

Taos hum is perceived in and around Taos, New Mexico but similar phenomena are experienced also in Northern America and Northern Europe. The hum is mostly heard during night time. Most people experience the hum as irritating and it causes nocturnal disturbances. From the tests based on psychophysical matching the frequency range of the hum has been deduced to be 40-80 Hz and whereas amplitude is around 60 dB. The hum is a regional phenomenon. The hum does not usually appear between sunrise and sunset. The pitch and intensity of the hum varies inside house and finds the largest magnifications on lower floors. Rooms modify the hum by adding distinctive harmonics to it. The pitch of the hum changes when one moves from outer wall to the interior rooms. Hallways and small alcoves raise the pitch considerably. The wavelengths involved vary between 3.9-7.8 meters for 40-80 Hz frequency range which suggests that resonance effects could be involved. It has been however impossible to identify any acoustic origin for the phenomenon. The presence of effectively acoustic effects suggests that gigantic amplification by the physical (and em!) body of the patient is involved.

Hum can involve also an experience about whirling or roaring wind, kind of vortex although nothing moves around, and coming from all directions. Also a strange amplification of distant sounds can be experienced. White light in the horizon in the direction where hum comes from

can be also perceived. Experiences analogous to hum have been reported also in past, even in antique (“Aeolian wind” ), but nowadays the number of victims of the hum has increased, which suggests a connection with the emergence of electronics and computers. The direction which hum is experienced to come from seems to be random.

The hum can be accompanied by irritating tactile sensations and neuralgic pain. The unfortunate individual who suffers of extreme HUM disturbances, seems to be controlled by very fundamental and autonomic response-reflexes when in its grips. Such sufferers may behave in semiconscious modes, modelling behavioral patterns seen only in animals. Typically the victim tends to get underground believing that this allows to get him rid of the hum. The victims of hum indeed tend to wake up with the realization that they have very strong and painful muscle tenure.

An important hint as regards to mechanism of hum is the fact that the temporal patterns of the shortwave radio static detectable by shortwave receivers correlate strongly with those associated with the hum. It is also known that the static has a biological origin: the warbling sounds characterizing the static resemble those produced by plants and galvanic skin response sensors. And most importantly, the statics is present during night time.

All attempts to detect the hum instrumentally and to identify its source have failed. This has inspired various kinds of conspiracy theories about the nature of the phenomenon, for instance, the proposal the strong ELF power feed by submarine radars alone could explain the phenomenon.

## 1.2 Phenomena possibly related to taos hum

It is appropriate to discuss first some phenomena possibly related to the taos hum before considering the model for the phenomenon itself.

### 1.2.1 Microwave hearing

During the collaboration with Joaquim Fernandez related to the construction of a a model for so called Fatima miracle [H1] I learned about the phenomenon of microwave hearing [I2] in which microwaves generate an audible sensation. There is evidence that microwave hearing does not involve ears as receivers of the primary signal [I1] and that the sensation of hearing could result as back-projection from cortex to ears.

This, and the correlation with microwave static suggest that taos hum could be a particular case of microwave hearing. The model of sensory representations implies that brain acts as a sending microwave antenna: a natural implication is that brain can act also as a receiving microwave antenna. The size of the brain hemisphere corresponds to a microwave frequency of order 3 GHz and smaller structures inside brain correspond to higher radio frequencies. If primary sensory organs are the seats of the sensory qualia and that back-projections cannot induce physical pain, the presence of the painful tactile sensations means that microwaves must interact also with the sensory receptors at the skin.

Why taos hum? Could animals use microwaves for “seeing” in absence of sunlight? But for what purpose plants would use microwaves? Could organisms send negative energy  $h_{eff} = n \times h$  [?] microwaves to environment and suck metabolic energy quanta with energy around .5 eV in this manner? Remote metabolism! Or maybe time reversed photosynthesis in dark! Biophotons indeed have energy spectrum in visible and UV as also sunlight does. This would require non-standard value of Planck constant.

This hypothesis would explain why the microwaves causing taos hum not hum are not observed directly. And if something is sucking metabolic energy from you, it is would be rather natural to experience very unpleasant feelings and try to find a place to hide as many sufferers of taos hum try to do!

### 1.2.2 Physiophonic effect

Physiophonic effect is a phenomenon accidentally discovered by Antonio Meucci in 1842, in which vocal signals are electrically transmitted directly into the neurology of listeners [I3]. Physiophonic sound can be often amplified to an enormous volume. A possible interpretation is as externally stimulated internal sound but one can of course wonder whether the transduction to sound is necessary.

Since the body (especially collagen network) is liquid crystal allowing piezoelectric effect in which mechanical vibrations are transformed to electric signal, external sounds could be transformed to electric fields. On course, LC property implies that also genuine sound is generated so that both ELF em fields and ELF sounds can act as amplified signals. One can ask whether strong back-projection to the ears is generated so that sound percept results. This would imply oto-acoustic sounds directly detectable by microphones not found in the case of taos hum.

### 1.2.3 Microwave static and taos hum

It is known that the temporal patterns of the shortwave static detectable by shortwave receivers correlate strongly with those associated with the hum. It is also known that the static has a biological origin: the warbling sounds characterizing the static resemble those produced by plants and galvanic skin response sensors. And most importantly, the fact that the static is present during night time would explain why hum is experienced at night time.

## 2 Possible ingredients for the model for taos hum

The facts about the role of the musculature, shortwave radio noise, and the role of acoustic environment combined with the model of microwave hearing based on the notion of dark photons [K6] pose strong constraints on the model of taos hum.

### 2.1 Taos hum as sensitivity to alien control commands

Magnetic bodies control biological body by sending control commands to brain and body where they are transformed to nerve pulse patterns and various physiological waves. Also the lower levels of self hierarchy should control the respective levels of the hierarchy, in particular muscle cells, in a similar manner. In the case of hum patient the normal control signal could be replaced by a control signal from some external biological source, say plants, and would be responsible for the muscular vibrations amplified to the hum. In the worst situation the behavior of hum patients reduces to simple reflex actions: these reflex actions would be initiated by fake control signals.

The fact that the taos hum begins after the sunset would conform with the interpretation as sucking of metabolic energy with energy quanta in visible and UV range. The loss of metabolic energy could explain why the experiences of patients are so unpleasant. Since motor action is based on negative energy signals affecting directly neuronal membranes by the same mechanisms as ordinary motor actions the signals would also induce reflex actions.

The situation would be due to the failure of the em (or rather, electro-weak) immune system of the patient. In order to understand what is involved a brief discussion of model of motor control based on charge entanglement induced by  $W$  MEs is necessary: a detailed model is discussed in [K5, K6].

1. The exotic ionization of dark matter induced by  $W$  MEs generates dark plasma oscillations inducing electric fields which by many-sheeted variant of the Faraday law induce electric fields also at the space-time sheets where ordinary matter resides. Various ionic waves, in particular  $\text{Ca}^{2+}$  waves and nerve pulse are examples of the physiological responses resulting in this manner.
2. Dark plasma frequency corresponds to a microwave photon with energy above the thermal threshold and the system must be able to provide dark photons with this energy to generate plasma oscillation patterns serving as control commands.

The electro-weak immune system could fail in the following manner.

1. In the healthy situation em immune system takes care the body is tuned to the personal dark plasma frequencies and does not respond to control commands from alien magnetic bodies associated with say plants.
2. In an un-healthy situation persons plasma oscillation frequencies are tuned to some frequencies in the microwave static and microwave static provides the energy needed to generate

plasma wave patterns and thus to realize control commands from the alien magnetic bodies. The plasmoids would induce microwave hearing and generalized motor actions at cellular level exhausting the personal metabolic sources and leading to the painful experiences and fatigue.

## 2.2 Taos hum and microwave hearing

The identification of the audible sensation associated with taos hum is in terms of microwave hearing explains the failure of the attempts to identify the source for taos hum. Amplitude modulation by ELF frequencies naturally associated with motor control would give rise to sensation of sound.

Concerning the model for microwave hearing, a good guideline is that the effect is expected to be possible as quantum effect only if the energies of the microwave photons are above the thermal threshold. This would require dark microwave photons for which 5 GHz photons have energy above thermal threshold (6 cm wavelength). Same applies to other effects caused by dark microwave photons.

Microwave hearing itself would rely on hearing of dark microwave photons at visible and UV frequencies. These dark microwave photons could accompany the microwave signal automatically or could be generated by cells via a phase transition increasing the value of Planck constant.

## 2.3 Taos hum and microwave seeing

The de-coherence of microwave photons to ordinary photons would produce the biological effects. This could explain also the reported perception of white light as resulting from the de-coherence of the microwave photons at the upper end of the spectrum: 1 mm microwave wavelength would correspond to 2.5 eV photon energy.

The de-coherence of dark microwave static to ordinary visible photons could make possible microwave vision during night time. This could explain why the static emerges after the sunset. Plants could also generate negative energy dark microwave photons with energies in the frequency bands of visible photons involved with photosynthesis to satisfy their metabolic needs when they do not receive sunlight. One can of course wonder whether the quartz in the rock heated during day-time could generate dark microwave photons during night-time serving as a metabolic source.

## 2.4 Taos hum as a failure of the electromagnetic immune system

Taos hum starts immediately after the sunrise and stops after the sunset and seems to have a biological origin. The magnetic bodies of (say) plant cells could send dark energy photons at microwave frequencies above 5 GHz: one reason is that they become visible in this manner.

Negative energy  $W$  MEs in the same frequency range and responsible for quantum bio-control in the time scale of microwaves could be involved. Due to the failure of the electro-weak immune system the surrounding biosphere could induce generalized motor actions and these would exhaust the metabolic energy resources of the victim. This would explain why the hum is intolerable and the extreme fatigue caused by it.

The radio noise generated by computers and other sources of radio waves should not cause troubles if these radio waves correspond to ordinary photons. If not, then the microwaves in question could provide the energy needed to realize alien control commands based on ELF modulation.

## 2.5 An explanation for 40-80 Hz modulation

The model of biological evolution and evolution of nervous system based on dark matter hierarchy [K3] leads to a detailed identification of the values of Planck constant associated with EEG identified as of dark Josephson radiation with energies in visible and UV range and EEG frequencies. This level is involved with all life forms capable of genetic expression, in particular plants. Therefore the ELF modulation of microwave frequencies could be due to the control commands from the levels of the magnetic body normally meant to control the genetic expression of say plants. The modulation of the microwaves with EEG frequencies, in particular with the frequencies in the 37 – 44 Hz thalamo-cortical resonance band, could force the patient to stay awake by not allowing

the dominant EEG frequencies to drop down to theta and delta region of EEG as occurs during sleep.

## 2.6 Is stochastic resonance involved?

One could also ask whether the microwave static of victims of taos hum is anomalously amplified by some mechanism so that control commands from alien magnetic bodies can be realized. The transduction of weak microwave signals to mechanical oscillations by piezo-electric body liquid crystals, and the amplification of this signal in the presence of a metabolic energy feed to the musculature, could lead to this kind of situation.

Stochastic resonance with white noise generated by body provides one possible amplification mechanism. Micro-wave frequency would correspond to the amplified frequency. If so, one could perhaps understand why only some persons experience the hum and why the effect is strong at night time. White noise would be generated by body. White noise induces jumps between the states of the 2-state system with an average frequency  $f_K$  (Kramers frequency) which depends on the autocorrelation function of the white noise and the properties of the 2-state system [K7]. If the Kramers frequency satisfies  $f_R = 2f$ , where  $f$  is the frequency of the signal, a resonant amplification occurs. The dependence  $f_K \propto \exp(-\Delta V/D)$ , where  $\Delta V > 0$  is the height of the potential barrier separating the states of the 2-state system, implies an exponential sensitivity of  $f_K$  on  $1/D$ , where  $D$  is the intensity of the white noise. Hence the failure of the em immune system could be due to the too intense white noise produced by the body of the victim or due a too low height of the potential barrier.

## 2.7 Are electronic systems involved with the hum?

The fact that the number of victims of hum has rapidly increased during the era of radio communications and computers and suggests that both radio noise and computers might be actively involved with the hum. Also ELF noise from electronic systems might be important if these systems generate dark ELF photons.

Electronic instruments generate also frequencies in the range 40 – 80 Hz, in particular the 50 Hz frequency associated with the household electricity. Also submarine radars generate very strong ELF signals. The liquid crystal character of human body implies that besides weak sound signals also these ELF signals can contribute to the signal amplified by musculature. If these signals correspond to the lowest level of dark matter hierarchy, they should not have biological effects but whether this is the case is not all clear.

The strong coupling between magnetic flux tube structures associated with computer networks and sensory canvases might be created by the magnetic reconnection process during night time when the shape of the flux tube structures changes. Also whole-daily use of a computer could generate magnetic mirror bridges between the computer and user's musculature and allow computer to feed fake control signals to muscles.

## 2.8 Is hum possible in other sensory modalities?

The model of hum based on magnetic sensory canvas suggests that the effect is involved with all sensory modalities. Tactile sensations, in particular pain, are certainly involved. It was already mentioned that hum experiences can involve also perceptions of white light in the horizon in the direction from which hum came. In the model explaining the sensation of hum as being caused by the muscular sound, this sensation could result as a kind of cross-modal association accompanying very intense auditory sensation. In the model explaining the effect as ESP the presence light sensation could be understood as visual aspect of the ESP.

My personal experiences provide a candidate for the counterpart of taos hum in visual field. While closing eyes in a calm state of mind, I see a strange and complex flow consisting of small dots: for the first time I had this experience during my great experience roughly 15 years ago. The effect is easiest to achieve with lightly closed eyes but appears after some time also with tightly closed eyes. For lightly closed eyes the flow is more complex whereas for tightly closed eyes there is just a sink in the middle representing what I would call "third eye", which is present practically

always. Vortices and spiral vortices (compare with the whirling winds associated with hums) are typically involved and flow can have also weak coloring.

Could this flow be the visual counterpart of the taos hum? The very fact that the experience is pleasant and the appearance of diffuse white light during taos hum suggests that this interpretation need not be quite correct.

1. The effect is caused by the de-coherence of dark microwave photons or perhaps dark EEG photons above alpha band to visible photons (during calm states of mind alpha band is very strong).
2. This effect is strongest when the eyes are only lightly closed. Perhaps ELF em waves from some source could provide the input to the retina which is magnetic structure and generate the visual sensation somehow (note that rotating non-colored Benham top can generate sensations of color). The de-coherence of dark ELF photons to ordinary visible photons could be the mechanism.
3. I have proposed an interpretation for the flow in terms of the magnetic flux tube structure emerging from the retina. One can however wonder why just single central vortex rather than two? Could it be that pineal gland, which is also a magnetic structure and contains retinal pigments and is “third eye” in rather literal sense, could be responsible for the “third eye” component of the flow, and that during eyes lightly closed conditions turbulent retinal and single vortex like pineal contributions superpose? Could pineal vision be based on the de-coherence of EEG waves above alpha band to ordinary visible photons?

What is perhaps remarkable that the ability to have the flow experience has stabilized during last year or two, which is also the period during which various hum symptoms have developed. However, I experience the flow also when the computer is off: as a matter fact, I experienced the flow for 15 years ago when I did not work with computers.

### 3 The recent TGD view of Taos hum

#### 3.1 Personal experiences about Taos hum

While learning about taos hum, I suddenly realized that I am perhaps not an objective outsider at all! I cannot tolerate the humming noise of the refrigerator: in order to sleep at all I try to insulate myself from the kitchen by cloth (I do not have door between) and use pillows on my ears in order to get rid of this extremely irritating sound. Even this is not enough and I wake-up very often during night-time. I also used to have terrifying experiences in which the noise of the refrigerator started to increase in volume and my body started to float and was attracted by the refrigerator as if it were a conscious creature wanting to fuse with, or rather steal, my consciousness (by the way this suggests that magnetic selves strongly interacting with my magnetic body might be really involved). I can also hear sounds, such as cracks from wall, as amplified to completely abnormal intensity (in fact I have always had abnormally sensitive ears).

I suffer also from almost intolerable hum of my computer at day-time and only while learning about taos hum, I realized that similar mechanism might be at work also here (note however that taos hum is strongest during night time, between 9 P.M. and 9 A.M.). Remarkably, the hum amplifies when I become conscious of it: I can work long times without noticing its presence at all. Neither am I aware of the refrigerator at daytime. To complete the picture, two years ago I began to suffer from chronic pain in head, neck and back which are due to strong muscle tensions. These pains correlate very strongly with working at the computer terminal. I have believed that this is due to the bad working ergonomics and poor quality of eye glasses. However it turned out that this was not the reason of pains. I have even suffered from temporal dizziness when pains have been worst and even lost my consciousness once: strangely enough, I heard before the loss of consciousness a strange whirling wind to blow (sic!), and realized only later that weather had been completely calm.

It seems that all these symptoms fit with those of a hum patient. Now only the source of radio waves would be my own computer and would act also at daytime via direct radio wave magnetic mirror bridges connecting the oscillating circuits of the computer to my musculature. When I

am not aware of the noise, my brain does not project sensory input from muscles to the auditory canvas and I am saved from the hum sensation. I however feel the pain coming from the body all the time.

On basis of what has been said, it would seem that there is high time to consider the possibility that the electric pollution of environment is gradually making our life increasingly intolerable. One cannot even exclude demon like conscious virus like entities generated by the electronics and computers and fighting for survival with us.

This was however not the full story yet. I suffered from taos hum in my previous hometown. After I moved to my recent hometown, I believed that I had got rid of this problem. But also here I have been tormented from time to time by an unpleasant sensation of sound. Always at night and summertime. The sound source did not move. As if someone were keeping the car idling or even screaming the car engine to drive his fellow men to the brink of rage.

What gave the stimulus to write an article was that after a long period the experience came back at winter time and lasted for several hours. Once again I tried to figure out what it could be. The interpretation as hallucinations didn't seem likely. Another interpretation was as sensory memories. Such are possible and can be induced by electrically stimulating the temporal lobes. For example, some previously experienced pain due to some real cause can be chronically repeated as a sensory memory.

Then I suddenly realized that it was my old friend Taos hum! The reason why I had not realized this from the beginning was that in my new hometown my friend has been much more aggressive and created the impression of intentional bullying so that the unavoidable first impression was that some-one is terrorizing his neighbors by gassing his car at night-time.

### 3.2 Taos hum and quantum gravitation

The latest experiences with taos hum led to an identification of new pieces, which seem to fit the puzzle of taos hum.

If taos hum corresponds to microwave hearing, the natural question is what the range of the carrier frequencies is and whether there are some special carrier frequencies.

1. In quantum biology based on TGD quantum gravity is essential [L4, L3]. Nottale's hypothesis [E1] is generalized and assigns macroscopic and even astrophysical quantum coherence to classical gravitational fields created by astrophysical objects.

In the Earth's gravitational field, the gravitational Compton wavelength is  $\Lambda_{gr} = GM_E/\beta_0$ , where the velocity parameter satisfies  $\beta_0 = v_0/c < 1$ .  $\Lambda_{gr}$  and the corresponding frequency  $f_{gr}$  do not depend on the mass of the particle (Equivalence Principle). For  $\beta_0 = 1$  one has  $\Lambda_{gr,E} = .45$  cm. It corresponds to the microwave frequency  $f_{gr,E} = 67$  GHz. This would be some kind of universal clock frequency of quantum biology.

2. I have considered also the possibility that computers [L8, L7, L9] could acquire some characteristics of a biological organism, if their clock frequency is higher than this frequency, because then the statistical determinism would no longer apply. In fact, the corresponding wavelength associated with the Sun is half the radius of the Earth and corresponds to the frequency  $f_{gr,S} = 50$  Hz which is EEG frequency, which inspires many questions.
3. For biomolecules, microwave frequencies play an essential role. Microwaves are associated with many strange effects such as ball lightning and light balls that have often been interpreted as UFOs. The creation of crop circles [K1, K2] [L9] could be based on the same mechanisms as the explosion of a tomato in a microwave oven, which can be also used to produce this kind of light balls. There are also reports of lightballs in the act of building a crop circle.
4. Could the amplitude modulation of the radiation with gravitational Compton frequency  $f_{gr,E}$  of the Earth produce the taos hum?! The modulating frequencies are in the EEG range and quite low, which brings in mind the gravitational magnetic body of the Sun with  $f_{gr,S} = 50$  Hz.



5. What would give rise to the impression of an idling diesel engine? Could it correspond to some kind of random noise but what about the impression of deliberate gassing? What comes to mind is a boxer who is in a state of maximal alertness ready to attack at any moment. This suggests a quantum critical state in which bursts of metabolic energy are randomly occurring. Note that the carrier frequencies would be microwave frequencies and by a factor of 67 higher than in the Frey effect, which has been associated with the microwave hearing.

There is also another important microwave frequency. The maximum for the frequency distribution of the cosmic microwave background is at the frequency 160 GHz and to wavelength .2 cm. This frequency is roughly twice the gravitational Compton frequency for Earth. This is close to the upper limit of microwave frequencies of 300 GHz. Is it a coincidence that these two frequencies are so near to each other?

### 3.3 Taos hum and TGD based generalization of stochastic resonance

Stochastic resonance [D1] [J2] occurs in the brain [D2] and its quantum analog serves as a candidate for the mechanism behind the perception of taos hum.

Consider first the classical variant of the stochastic resonance, which I have considered in [K7].

1. Classical stochastic resonance is an amplification mechanism for a signal represented as an amplitude modulation of a carrier wave with a basic frequency  $f$  acting as a harmonic perturbation of a bistable system, which is also subject to a white noise. In the recent case the message could correspond to the amplitude modulated signal with frequency  $f$  in the microwave range.  $f = f_{gr}$  is an interesting option. One might say that the system manages to extract the energy of the noise, which creates the question whether the mechanism conforms with the second law of thermodynamics.
2. In the resonance, the signal frequency  $f$  must be one half of the average frequency  $f(spont)$  for the jumps between two states of the bistable system:  $f = f(spont)/2$ . This condition has a simple physical interpretation: the height of the potential barrier separating the two potential wells varies periodically with a period which is half of the period defined by  $f$ , and the best opportunity to get to another potential well is to hop when the potential barrier is lowest possible.
3. For the mechanical analog system the rate  $f(spont) = r_0 A$  is proportional to an "Arrhenius factor"  $A = exp(-\Delta V/D)$ , where  $\Delta V$  is the height of the potential barrier and  $D$  characterizes the intensity of the white noise.  $f(spont)$  is also proportional to a factor  $r_0 = \omega \omega_b / \gamma$  where  $\omega$  is the frequency of small oscillations at either bottom of the symmetric potential well,  $\omega_b$  is the analogous quantity at the top of the barrier (for harmonic oscillator potential one would have  $\omega = \omega_b$ ), and  $\gamma$  characterizes the linear dissipative force (overcritical damping is assumed).
4. Thus, when the white noise has a correct intensity, a weak harmonic perturbation with a given frequency is amplified in the sense that the Fourier expansion of the system's time development regarded as jumps between the two states contains a peak at the multiples of the frequency of the amplitude modulated harmonic perturbation. Neuroscientists refer to this phenomenon as phase locking. The peaks for the higher multiples of the input frequency  $f$  are exponentially suppressed. The notion of stochastic resonance makes sense also in the quantum context: now quantum tunnelling would replace the jumps induced by the stochastic noise.

In stochastic resonance the system extracts energy from the environment to amplify the signal. Does this really conform with the second law of thermodynamics: it would seem that the second law temporarily fails but is true with an opposite arrow of time. The TGD view of stochastic resonance could be motivated by this question.

Could stochastic resonance generalize to a quantum situation but with the ordinary ontology of quantum theory replaced with the zero energy ontology (ZEO) of TGD [K8]? What would be new is the identification of the ordinary quantum jump as a "big" state function reduction (BSFR) in which the arrow of time changes. One can consider two interpretations.

1. Consider first the TGD analog of the standard interpretation. The jump between the potential wells corresponds to a quantum tunnelling as a transition of states with the same arrow of time and therefore involves two subsequent BSFRs. In stochastic resonance, the frequency  $f(spont)$  for these tunnellings should satisfy  $f = f_{spont}/2$ . Each period  $T = 1/f$  would correspond to two pairs of BSFRs. In the TGD framework, this interpretation looks too complicated.
2. For the second option, a single BSFR defines the counterpart for the hopping between two potential wells and 2 BSFRs define quantum tunnelling. Bistability has nothing to do with the details of the dynamics and is universal and corresponds to the two arrows of time.  $f(spont)$  is identified as the rate for BSFRs rather than their pairs and characterizes external perturbations.

In the stochastic resonance, the rate  $f(spont)/2$  for a pair of BSFRs would be equal to the carrier frequency  $f$  so that quantum tunnelling is in synchrony with the driving frequency  $f$  and each period corresponds to a quantum tunnelling. The intensity of the noise could be used to induce this synchrony.

This synchronization mechanism applies to all transitions and to all frequencies  $f$  but  $f = f_{gr,E}$  would be in a special role since  $f_{gr,E}$  defines a universal gravitational Compton frequency of the Earth. For instance, EEG with frequencies in the range 1-100 Hz could involve this mechanism and the halves of the EEG period would correspond to different arrows of time as I have indeed proposed in [K7] on basis of observations of brothers Fingelkurts [J1]. As already noticed, the gravitational Compton frequency  $f_{gr,S} = 50$  Hz of Sun is EEG frequency and EEG frequencies appear as modulation frequencies in Taos hum.

### 3.4 Stochastic resonance and sensory perception

In the TGD framework, subjective existence corresponds universally to the sleep-wakeup cycle defined by the periods of wake-up with opposite arrows of time defined by a sequence of "big" state function reductions (BSFRs) changing the arrow of time. In BSFR, a self with a given arrow of time dies (or falls asleep) and reincarnates as a self with an opposite arrow of time.

The TGD view, the stochastic resonance would synchronize the signals realized as amplitude modulated carrier waves with the sleep-wakeup cycle. The wakeup period would correspond to  $T(spont) = 1/f(spont)$ . Stochastic resonance would correlate the rhythms of subjective and physical existence.

The basic prediction is that this synchrony is optimal when the noise level is optimum. Taking the ordinary sleep-wake-up cycle as an example, one can understand what this means. If the stimulus level is too high, concentration to a given task is difficult and problems with sleep appear. If the stimulus level is too low, drowsiness becomes the problem and the resonance with the circadian rhythm tends to be lost.

Concerning the identification of the counterpart of the white noise, there are several guidelines.

1. White noise could correspond to any signal for which the frequency distribution is constant in the time scale of modulations. The rate of BSFRs should be  $f(spont) = 2f$ . In stochastic resonance, the white noise would keep the system in optimal wakeup state.
2. Many neuroscientists believe that the rate of nerve pulses codes for the sensory input. This need not be quite true but inspires the question whether the nerve pulses define the white noise and whether a single nerve pulse wakes up the neuron. If so, then the rate of nerve pulses could correspond to  $f = f(spont)/2$  since only the nerve pulses with a standard arrow of time are observed.

Nerve pulse duration is about 1 ms and defines the maximum rate of nerve pulses. On the other hand,  $f = 1$  kHz frequency is a resonance frequency of the brain synchrony and also the average mechanical resonance frequency of the skull.

3. This observation brings to mind an interesting old observation. For electrons with mass .5 eV the secondary p-adic time scale  $T_2(e)$  corresponds to frequency 10 Hz, alpha frequency. The mass estimates for the light quarks u and d vary in the range 2-20 MeV.  $T_2$  scales like mass scale squared so that the mass scale estimate for quarks is  $T_2 \sim$  kHz.

The TGD inspired quantum biology indeed predicts that QCD allows dark variants with same masses but Compton length scaled up by  $\hbar_{eff}/\hbar$ . Does this mean that the kHz frequency scale of nerve pulses corresponds to  $T_2$  for quarks and 10 Hz EEG frequency scale corresponds to  $T_2$  for electrons? If this is the case, secondary p-adic length scales for electrons and quarks are fundamental for the brain.

This raises some questions.

1. It would seem that cyclotron pulses inducing BSFRs correspond to the white noise behind stochastic resonance. The rate of the detected nerve pulses would correspond to  $f = f(spont)/2$  and to a frequency of modulated carrier wave. Can one imagine a general mechanism for producing the noise realized as nerve pulses?
2. One can also ask whether a system could keep itself awake and in stochastic resonance in presence of the necessary metabolic energy feed. Could the system itself produce the white noise as pulse patterns and stay in a stochastic resonance with it. If so, the amount of metabolic energy could control the level of noise in turn controlling the presence of the stochastic resonance.
3. A nontrivial question is what one means with a system. In TGD, the system involves both the biological body and the magnetic body (MB) carrying dark matter associated with it. MB has a hierarchical structure with levels labelled by the values of  $h_{eff}$ .

The model for the communication of sensory input from the cell membrane to the magnetic body and for the control of the biological body suggests itself as a mechanism transforming sensory input at the cell membrane to pulse patterns.

1. At the level of the cell membrane, sensory input corresponds to the oscillations of the membrane potential and to nerve pulses.
2. This sensory input is communicated to the MB as a generalized Josephson radiation modulated by the variation membrane potential representing sensory input. The generalized Josephson frequency is the sum of two parts. The first part corresponds to the ordinary Josephson frequency  $f_J = ZeV/h_{eff}$ . The second, usually dominating, part corresponds to the difference of the cyclotron frequencies of monopole flux tubes at the two sides of the cell membrane and transverse to it. The energies involved are of the order of ZeV and just above the thermal energy as required by the minimal consumption of metabolic energy. Josephson frequencies are in the EEG range.
3. At the MB, the dark Josephson radiation generates cyclotron resonance, which transforms the frequency modulated Josephson radiation to a sequence of pulses, which define a feedback to the brain. A natural proposal is that the cyclotron pulse sequences generate nerve pulse patterns serving as the white noise.

The rate of nerve pulses would dictate the resonant frequency  $f$  which can vary from its maximum value of kHz down to 1 Hz and even below it. The cyclotron frequencies for the body parts of the MB would thus select, which frequencies from the frequency spectrum of the Josephson radiation are amplified. Essentially, a Fourier analysis of the sensory input is performed and the spectrum would be represented at the MB.

4. The nerve pulse patterns would in turn generate a response as modulations of generalized Josephson frequency sent to the MB. There the response of the system to the white noise generates the white noise. This feedback loop would define a nearly autonomous system staying in a stochastic resonance in presence of a suitable metabolic feed.
5. Only the frequency modulation by the sensory input appears in this mechanism. Frequency modulation however reduces to the amplitude modulation for the membrane potentials.
6. The generalized Josephson frequency must be equal to the cyclotron frequency at a given body part of the MB. It can control by a variation of the flux tube thickness whether it receives information from the cell membrane at a given generalized Josephson frequency.

7. The failure of the communication line between the brain and the MB could cause various disorders since the MB cannot anymore take care of BB. Since the cyclotron frequencies of the biologically important ions in  $B_{end} = .2$  Gauss are in a key role, the concentration of these ions in biomatter is an important factor. Lithium ions serve as a basic example. Its cyclotron frequency is 50 Hz, which corresponds to  $f_{gr,Sun}$ . The depletion of lithium ions in the soil is known to induce depression and even suicides.

How does sensory perception relate to the stochastic resonance in the proposed sense? The stochastic resonance would be associated with the communications with the MB and the information representable as a modulation of the carrier wave.

1. Sensory qualia would be labelled by quantum numbers measured repeatedly during the sequences of "small" state function reductions (SSFRs) between BSFRs. Primary sensory qualia would be associated with the sensory organs and the feedback from the MB of the brain to the sensory organs could generate virtual sensory input explaining hallucinations and dreams. This picture fits nicely to vision, olfaction and tactile senses, which are spatial.
2. The generation of sensory qualia at the level of sensory organs could involve stochastic resonance amplifying the primary sensory input. The sensory input would be transformed to dark Josephson radiation to the MB of the sensory organ and returned back as a pattern of cyclotron resonance pulses in turn generating BSFRs and a modified Josephson radiation but without modification due to nerve pulses.

When the membrane potential is reduced below the critical value, a nerve pulse would be generated and lead to a processing of the signal at the higher levels of the hierarchy. The rate of the nerve pulses would determine the intensity of the signal at the higher levels of the hierarchy. Similar feedback loops with the local magnetic bodies would take place at the higher levels of the hierarchy and generate higher level representations of the sensory input. The virtual sensory input from MB would lead to the generation of standardized mental images as a pattern completion and recognition.

3. Stochastic resonance for the sensory receptors would allow code for various characteristics of the sensory input (such as colors, intensity and frequency of light or sound,...) to cyclotron frequencies characterizing parts of the MB. Essentially a generalized Fourier analysis of the sensory input locating Fourier components to different parts of MB would be in question.

Hearing is an exceptional sense in that the temporal aspect is essential.

1. It would be natural to identify the intensity and frequency of auditory qualia with the cyclotron frequencies labelling the magnetic body parts. In the case of speech and "almost heard" internal speech, the meaning of the speech represents a higher level element related to the temporal aspects, and could be associated with the communications to the MB rather than being purely spatial quale.
2. If the heard sound frequencies correspond to Josephson frequencies, why are the other qualia not accompanied by an auditory experience? A partial answer is that hearing involves the sensation of the pitch and intensity of the sound as non-temporal qualia at the neuronal level. The temporal aspects of hearing responsible for the meaning of the speech would naturally correspond to the modulations of the membrane potential and of Josephson frequencies. But also other senses involve this aspect. Could these aspects correspond to internal speech providing a cognitive interpretation of the experience, its naming? Could this aspect be universal and accompany all experiences? This would also conform with the fact that the oscillations of magnetic flux tubes are analogous to acoustic waves.

The 12-note scale defines a set of very special frequencies in that these frequencies have a deep emotional meaning. Also octave equivalence is a fascinating phenomenon. Could this be due the fact that these audible frequencies appear as resonance frequencies in the spectra of the cell membrane Josephson frequencies and cyclotron frequencies for the magnetic flux tubes? If this is the case magnetic flux tubes would define an analog of an organ played by the sensory input to MB. How do these special frequencies relate to the gravitational Compton frequencies?

1. The model for bioharmony, leading to a model for the genetic code [K4] [L2, L5], leads to a proposal that Pythagorean scale defines a spectrum of preferred cyclotron frequencies and thus a spectrum of strengths of the endogenous magnetic field  $B_{end}$ . Quint cycle  $(3/2)^n$  of fundamental frequency and octave equivalence would yield the 12-note scale.
2.  $\beta_0 \simeq 1$  has been assumed for the Earth and  $\beta_0 \simeq 2^{-11}$  for the inner planets of the Sun. Could  $\beta_0 \leq 1$  have a spectrum? Could this spectrum explain in the case of the Sun the EEG spectrum below 50 Hz frequency spanning 7 octaves (DNA corresponds to 1 Hz), and in the case of the Earth the microwave spectrum in the range .5-67 GHz?
3. I have considered the possibility that  $\beta_0$  is for number-theoretical reasons quantized as an inverse integer:  $\beta_0 = 1/n$  [L1]. Number theoretical constraints allow a more general quantization as rational numbers:  $\beta_0 = m/n$ . The spectrum of the gravitational Compton frequencies would resonate with the spectrum of the cyclotron frequencies if  $\beta_0$  in  $f_{gr} = \beta_0/GM$  obeys a quantization producing the 12-note scale. It would be interesting to check whether EEG exhibits 12-note scale as a finite structure realized as preferred frequencies.

Consider next the microwave hearing as a possible explanation of taos hum.

1. In microwave hearing the carrier wave amplitude, modulated in the frequency scale of audible frequencies with typical frequency in the range of EEG frequencies and therefore below 100 Hz, creates a sensation of sound. The electromagnetic signal would be amplified by stochastic resonance to a variation of neuronal membrane potentials in turn generating an acoustic signal by piezoelectric effect.

This acoustic signal could serve as a virtual auditory input to the ear and generate a sensation with auditory qualia. The mechanism would be the same as in the case of hallucinations and dreams.

2. Assume that the frequency spectrum associated with the gravitational body of Earth ( $f_{gr} = 67$  GHz) spans as many octaves as that for the Sun. Assume that the frequency spectrum for Sun ( $f_{gr} = 50$  Hz) corresponds to that for EEG assumed to span 7 octaves (1-128 Hz). The scaling gives in the case of the Earth for the microwave scaled variant of EEG realized at biomolecular level the range .5-149.5 GHz: the upper bound corresponds to energy 1.5 meV and is somewhat below the maximum frequency 160 GHz for the frequency distribution of CMB. Note that miniature membrane potentials correspond to meV energy scale.

If one replaces EEG range with the range of frequencies 20 Hz-20 kHz audible for humans spanning 10 octaves the upper bound for scale frequency spectrum would be 12 THz which corresponds to energy of .1 eV which is the energy of Cooper pair for cell membrane Josephson function with voltage .05 V. For bats the audible frequencies extend to 110 kHz and the upper bound would be now .510 THz and correspond to energy of .5 eV which is the nominal value of the metabolic energy quantum.

3. There are indications that also the gravitational body of Moon (with mass 1/83 times that of Earth) [L6, L9] could play a key role in quantum biology. The proposed analog of the EEG range for the Earth would be scaled up by factor 83 with an upper bound corresponding to .12 eV, which corresponds to the energy of the Cooper pair for the cell membrane. For the range of audible frequencies the upper bound would scale up to 8.3 eV covering visible and UV frequencies.

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