

Implications of Biophotons to Consciousness

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Abstract

The different wisdom traditions employ semi-classical framework of description and describe the Great Chain of being as a holarchy. The properties of the lowest level and some properties of higher levels of the Great Chain are describable by the properties ascribed to non-living matter. The indescribable properties may be considered to constitute the consciousness class of properties. This is an extended definition for it includes macroscopic properties of living system that requires co-operative functioning of biomolecules. In particular, it includes biophoton emission. The experimental evidence is constantly growing for the supposition “A biophoton signal is a quantum photon signal in a squeezed state”. The supposition brings out the inadequacies of the semi-classical framework and opens up four new avenues for explaining the properties of the consciousness class. Firstly, a living system becomes a macroscopic quantum system possessing counterintuitive non-local holistic properties. Secondly, the supposition opens up new planes of awareness for exploration that may make many properties of the consciousness class as quantum properties of matter. Thirdly, the capability to detect biophoton signals will confer the power of remote sensing in space and time. Finally, the capability to produce biophoton signal coded with desired information will confer the power of remote intervention in a suggestive mode. The examples associated with different avenues are discussed.

Implications of Biophotons to Consciousness

§1. Introduction: The issues of consciousness and life have remained at the top of the agenda in art, metaphysics and philosophy for ages. These issues have started appearing in the agenda of science and technology as well. The philosophers have struggled with the eternal mystery of consciousness and life for many millennia and discovered the Great Chain of being and its multi level structure. The Great Chain is essentially the same in different wisdom traditions¹. A minor difference occurs in the structure because some higher levels are either subdivided or grouped. The Christian wisdom tradition visualises four levels in the Great Chain. The ordering of these levels is body-psyche-soul- spirit. The lowest level is of body or matter and has a special significance because its properties are amenable to scientific investigations. This level is identical in all wisdom traditions. The properties of higher levels are incomprehensible in the semi-classical approach employed for description. These properties are thought to be beyond scientific investigations and are clubbed together in a special class called consciousness. The semi-classical framework and level structure of the Great Chain belong to our cultural heritage. The organisation of various levels is also a part of heritage. It is believed that different levels of the Great Chain are organised in a holarchy, which means that a higher-level property requires lower level properties for its description but is not reducible to them. The non-reducibility of the properties of the consciousness class to properties of matter is the inherent basis of the organisation of the Great Chain. The advancement of Science is questioning the validity of the organisation and improving upon the traditional wisdom. Some properties of the consciousness class are now amenable to scientific investigation and have become the properties of matter. The shifting of level of these properties suggests the possibility of the levels of the Great Chain are organised in a hierarchy and not in a holarchy. A hierarchy of levels means that any property of a higher level is expressible and reducible to the properties of the lowest level. The establishment of hierarchy requires many scientific investigations and will take long time. A milder and pragmatic form of hierarchy is advocated by the concept of supervenience of levels², which requires a property of the higher level to be reducible, in principle, to the properties of the lowest level. The immediate task is to demonstrate the supervenience of higher levels of the Great Chain and hope that non-supervening properties of these levels will turn out to be unnecessary cultural baggage to be discarded.

The problem is how to handle the properties of consciousness class that appear even in principle non reducible to the properties of matter. There are three approaches to tackle this problem:

1. Accept that these properties are indeed (and not apparently) not reducible and hence their explanation requires some grace of supernatural entity.
2. Believe that the non-living matter has some unknown attributes, which when discovered will explain these properties.

3. Wonder if some incorrect premises were inadvertently made in earlier attempts to explain these properties.

The first approach negates the efforts made in the shifting the level of some properties to the matter class. It maintains the old position that the core of consciousness will remain beyond the reach of Science. It insults Science and is unpalatable to scientists. The second approach is not likely to be true because of a very high degree of success of quantum theory in describing all known properties of matter and the formulism does not have much scope for hidden attributes. The third approach appears desirable but needs evidence of wrong or forgotten premises. The evidence is provided by the unusual properties of a purely material system of photons called biophoton³ signal and emitted incessantly by all living systems. A biophoton signal is a photon signal of biological origin and shows counter intuitive and non-local features. These features are unexplainable even in principle in the semi-classical framework of photon emission. But these features become comprehensible in the quantum framework⁴. Perhaps, the same trick will work in living systems as well and some counter intuitive and non-local properties of the consciousness class will describable as the properties of matter. The ubiquitous association of biophotons with living systems prompts us to speculate that a living system is a macroscopic quantum system and its many properties of the consciousness class are consequences of the incomplete and partial description provided by the semi-classical framework. It appears that we have identified an incorrect premise as insistence on describing all observed properties of living systems in the semi-classical framework. The semi-classical framework succeeds in describing the properties of the matter level and fails in describing the properties of other levels. It is a neat solution. Let us examine the evidence of the quantum nature of biophoton signals that is the genesis of speculation.

§2. Hard facts of Biophotons: All living systems continuously emit photons with many unexpected features. It has not been possible to determine the mechanism and need of emission. The uncertain situation is acknowledged by adding the prefix “bio” to photons. The prefix indicates both incomprehensibility of properties and biological connection. The unexpected features of biophoton signals are routinely measured in laboratories scattered through out the world. Popp suggested that unexpected features manifest a special property of living systems. It is called “coherence”. The word coherence is derived from a Greek word *cohere* that means to act together. Coherence of a system therefore, implies that the system has sub units, which act together to produce one or more observable effects⁵. The sub units need not be identical and may not act simultaneously. The concept has been extended to include acts of different characters by different sub units. Coherence in the extended form is essentially the observation of correlation of some quantity at different space-time points. The concept in the extended form was first formulated in the context of photon signals, where it is classified into two categories-spatial and temporal. The spatial coherence is detected by measuring the intensity at different spatial locations as in interference and diffraction experiments, and temporal coherence is detected by measuring the number of photons at different time in a fixed detector as in single photon counters in biophoton experiments.

The coherence of photons is also classified by its mechanism. If the mechanism is identifiable in the semi classical framework e.g. as an arrangement of paths or a method for transferring information to sub units, then it is called classical coherence. Its nature is also considered classical and the photon signal can be described in the semi-classical framework. However, if the mechanism is not so identifiable e.g. in correlation among events connected by space like separation, then

the coherence is called quantum coherence. The nature of the photon signal showing quantum coherence is quantum and it is described by a pure quantum state. The semi-classical framework has to invoke some ad hoc mechanism for information transfer. The quantum framework does not require any mechanism. It is inherent in the connectedness of a quantum system. Laser is a well-known example of quantum coherence. The identification of quantum coherence requires elaborate procedure to rule out all possible mechanisms of information transfer among cohering sub units. The clean examples of quantum coherence are the observable effects of correlation among space like events, which shows up only in the behaviour of conditional probabilities of photon detection and photo count distribution. The influence of quantum coherence is more pronounced in weak signals where it is much easier to identify coherent and incoherent photon signals.

The conditional probability $P_0(\Delta, k)$ of not detecting a subsequent photon in a small time interval Δ after the detection of a photon in signal of strength k counts in time Δ is the most discriminating probability. It nearly equals to one in weak signals. The difference from one i.e. $[1 - P_0(\Delta, k)]$, gives the conditional probability of subsequent photon detection and is measurable by a simple coincidence technique. The technique directly measures this probability without detecting the outcome of individual events. The calculated expressions of this probability for different states of a photon signal are given in many books on quantum optics⁶⁻⁷. Its limiting value as $k \rightarrow 0$ is the same in any pure quantum state of a photon signal. The limiting value for a classical photon signal in thermal equilibrium is twice of its value in a quantum state. This behaviour of quantum signals is known as anti bunching of photons. The probability $(1 - P_0(\Delta, k))$ remains discriminatory for signals with strength k around 1. The measurements of this probability in this range were used to distinguish between laser and thermal signals. This probability has been measured in many biophoton signals as well. The measurements affirm the quantum coherence of biophoton signals. In one experiment, the probability was measured in a leaf and in a light emitting diode one after the other for values of Δ in the range (10 μ s -10ms). The choice of Δ allowed the measurement of probability in different ranges of k varying from 0.01 to more than 10. The measured values of the probability were nearly identical in both systems for $k > 10$ but were different for $k \sim 1$. The signal emitted by the leaf showed photon anti bunching but not by the lamp. The quantum coherence is observable for a long time in biophoton signals, which implies that a biophoton signal remains in a pure quantum state for a long time⁸. It is an unexpected result and it requires the living system emitting biophoton also remain in a quantum state for a long time.

A non-living system, if prepared in a quantum state, remains in the quantum state for less than a few milliseconds. The system loses its quantum coherence because of de-cohering interactions of the environment. This is the reason why a laser device emits coherent photons only in pulses of small durations. The reason for the long life of a biophoton emitting living system is still to be discovered, which makes some people sceptic about the observed quantum nature of biophotons and they prefer to ignore the consequences of what's observed in favour of what's desirable. The observed result makes a subtle shift in the perspective of a living system by reducing the mystery of life to the mechanism neutralising de-cohering interactions. A living system is to be viewed as a material system that retains its quantum nature.

A photon signal contains an imprint of the emitting process and the state of the emitting system. It retains it for a long time even millions of years. A biophoton signal is, therefore, a continuous broadcast of the state of the living system. Anyone

with capability and resource can receive the broadcast and learn about the system. This capability of photon signal is responsible for another set of consciousness properties depending on information transfer among different systems. Many people have observed a strong link between biophoton signal and metabolic processes. Even minute changes in physiological and environmental conditions of the system find a reflection in its biophoton signal. The properties of biophoton signals are measurable which means that many qualities of living systems are now measurable. The investigators of this field consider biophoton emission and life to be two facets of one coin. The study of one will uncover the mystery and splendour of other.

The observed properties of biophoton signals give indications of the possible types of quantum state. A remarkable feature of many biophoton signals is the non-decaying shape of signal i.e. the average intensity remains constant for a long time. This portion of a biophoton signal is usually called spontaneous biophoton emission. The constant average intensity is also a characteristic feature of coherent and squeezed states⁹. One complex parameter α specifies a coherent state and two complex parameters α and ξ specify a squeezed state. The formulation and properties of both states are similar and coherent state is a special case of squeezed state with $\xi=0$. We shall, therefore, consider only squeezed states. The two complex parameters are expressed in terms of four real parameters as $\alpha = |\alpha| \exp(i\phi)$ and $\xi = r \exp(i\theta)$. The four real parameters take arbitrary values and specify different squeezed states. A squeezed represents an interacting photon field. The interaction is of a specific type, describable by a Hamiltonian quadratic in creation and annihilation operators. The Hamiltonian determines the evolution of the squeezed state and the values of its four parameters. The evolution maintains the squeezed nature of the state and many measurable features of the signal e.g. intensity, and photo count distribution. The values and constancy of these features can be considered as evidence of a squeezed state. The observed values of these quantities can be used to determine the four parameters specifying the squeezed state. It is pointed out that a squeezed state does not have a classical analogue and so the constancy of signal intensity is a purely quantum effect. The average number of counts $\langle n \rangle$ detected in a measuring interval is directly related to the signal intensity and is given by $\langle n \rangle = |\alpha|^2 + \sinh^2 r$ in a squeezed state. The observed constancy of signal intensity, therefore, only means the constancy of $|\alpha|$ and r . The same intensity signal may represent different squeezed states with a different photo count distributions

The photo count distribution is a collection of the probabilities of detecting different numbers of photons in a signal. The probabilities are determined by making repeated measurements of fixed duration in a signal. The duration of a measurement is called bin size. The parameters of the squeezed state can be estimated by comparing the measured and calculated probabilities. The estimations of the parameters were made in the biophoton signal of a quasi-stable system for 14 different bin sizes ranging from 50ms to 500ms¹⁰. The estimations used the constancy of intensity fix $|\alpha|$ as a function of r and $\langle n \rangle$. So that, only three parameters r , θ , and ϕ were estimated by minimising the sum of the square of differences between observed and calculated probabilities. The values of parameters were same for different bin sizes. The biophoton signal of these measurements was emitted by a sample of lichen of species *Parmelia.tinctorum*. The sample emits an intense and stable biophoton signal for many hours. The sample has two easily accessible metabolic states, dry and wet. These states emit different biophoton signals. The transition between the states is

reversible. The parameters of the squeezed state of biophoton signals emitted in dry and wet states were different. The estimation of parameters demonstrates the richness of the structure of a biophoton signal that remains unaltered in this system at least for the duration of measurements of nearly 9h in either state. It is possible to uncover this structure in about 10m. It is pointed out that similar structure has been observed in biophoton signals of many systems where the classical perspective used in the analysis failed to quantify the structure in a consistent manner. The analysis of the earlier data based on the quantum perspective would produce a squeezed state description of biophoton signals. All properties of biophoton signals can be summarised by the supposition “ A biophoton signal is emitted in a quantum squeezed state whose four defining parameters are measurable in a small but finite time”. The supposition implies that inferences based on constant intensity biophoton signals of the classical type miss out a lot of information and needs revision. It is our contention that the supposition will shift the properties of the consciousness class into the properties of matter.

§3.Implications of biophotons to life and consciousness: The supposition has profound implications for life and consciousness. Let us divide the supposition into small parts and elaborate the implications of each part. The parts are:

- Biophoton signal is a photon signal in a pure quantum state.
- The quantum state is a squeezed state of light.
- Four parameters specify a squeezed state.
- The parameters take continuous values.

A pure quantum state of biophoton signal implies that the living system emitting it must be a quantum system and only the quantum framework can provide its correct description. The semi-classical framework describes a living system as a composite structure of bio-molecules that maintain separate identity. Its description is partial and incomplete. It explains only bio-molecule centric properties but fail in the description of holistic properties that depend on correlation among bio-molecules. It may explain a few holistic properties after invoking cooperative and coordinated functioning of bio-molecules caused by some unspecified reason. The bulk of the holistic properties appear counter intuitive and non-local in character, whose description requires superluminal communication. The quantum framework does suffer from these problems as it allows a portion of reality beyond the classical visualisation.

An immediate consequence of quantum nature is many quantum states of a living system. These states have the same non-living matter but behave differently and emit different biophoton signals. The states will appear in the semi-classical framework, as moods of the living system and the connection of states to biophoton signals will be inexplicable. A biophoton signal is known to change with the mood of a living system and offers the possibility of measuring the mood. It amounts to squaring a circle and will shift many properties of the consciousness class into the fold of quantum properties of living matter.

The metabolic processes can take quantum route, which is probably the reason behind their efficiency and fast rates of enzymatic reactions. The selection processes taking place in fundamental biological processes like transcription and protein synthesis can be quantum, which can provide an explanation¹¹ of the basic facts of genetic code namely 4 types of nucleotide bases and codons of 3 nucleotides coding for 20 amino acids. The explanation is based on the observation that a state can select the correct state from 4 states in one matching operation and from 20 states in three matching operations in quantum selections¹². Many properties of biophoton signals

can be explained in a semi classical visualisation of living system as a collage of intermittent and scintillating quantum patches of bio-molecules.

The formulation of squeezed state can be extended to include time dependent field life interaction of photon and living system. The resulting solution is time dependent and depends on intrinsic dynamics and initial conditions. It makes a biophoton signal situation specific and capable of tracking both physiological and environmental factors¹³.

A squeezed state is a minimum uncertainty state and it transmits information in almost loss less manner with the speed of light. The information contained in biophoton signal is accessible from anywhere and is also preserved for posterity. Anyone with appropriate detector can pick the information from anywhere. It will confer him with the capability of remote sensing in space and time.

The four parameters of a squeezed state add four new dimensions of knowledge to fathom. The reality of a living system is much more deeper. The parameters take values in a continuous range, which gives a biophoton signal immense diversity to capture the mood of a living system and its working. More investigations are needed to ascertain how the diversity is reflected in biophoton signals. These investigations require new models and phenomenology. As an example, the parameter ϕ has nearly the same value in biophoton signals emitted by dry and wet states of one sample of lichen. This is a new aspect of reality that needs exploring.

\$4. Possible Scenario: A quantum biophoton signal opens up many other planes of information, experience and awareness and unlocks many more mysteries of life and consciousness. It has the potentiality of remote intervention. The potentiality depends upon the capability to identify a specific biophoton signal in a multitude of signals, to decipher its information content, to code a biophoton signal and to induce changes in other systems via biophotonic intervention. These are physical capabilities and any human being or living system could possess them. A few living systems possess them and inform us generating measurable response to specific biophoton stimuli e.g. onion roots, yeast cells and amphibian eggs¹⁴. The detection mechanism of these systems could be holistic and is not only intensity based. Other living systems might also be sensing some biophoton signals but may not be responding in ways known to us. It is a lack of communication and may not the lack of detection capability. The detecting capabilities can legitimise the concept of morphogenic field and its many variants. One may ask about the capability of a fellow human being that communicates. It needs an explanation. Perhaps, we do have the innate ability to detect biophoton signal but we forgot about it while learning how to communicate our experiences.

A newborn child probably has the innate ability to feel the signals received from sensory channels and biophoton signals. The child does not know how to extract meaning from these signals; she has to learn it. The signals of the sensory channels are classical in nature and straightforward to interpret. She is taught the meaning of these signals and is provided with appropriate fabric for expression. The biophoton signals are quantum in nature and hence difficult to interpret. No technique of extracting meaning from a quantum signal is taught. As a result, after an initial bewilderment, she learns to concentrate on classical sensory signals and filter out biophoton signals. She starts associating meaning only to classical signals. She and the society judge her proficiency by the acquired capability to ignore obstructions caused by biophoton signals. She starts associating biophoton signals with unnecessary but unavoidable noise. Her innate ability to detect a biophoton signal remains intact but is brushed aside. She may discover this ability any time and may start communicating about its efficacy and results to others. It will be a new capability

that will make the invisible visible to her. It will set her apart. The biophoton channel will connect her to the entire world and she will be in communion with the world. Using a paradigm of religion, she will become spiritual. The attainment of spirituality is an important aspiration in all religions. The religions prescribe paths and techniques to fulfil the aspiration and claim that it will uplift a follower beyond sensory allurements (caused by sensory detection) and get one connected with the entire world. Perhaps spirituality amounts to realising the capability to detect and interpret the quantum state of biophoton signals. Realisation of this capability is not always relishing. Imagine the horror of a person who come to know about it by chance and starts observing the fiercely guarded secrets of acquaintances. Even a true narration of the splendour and beauty of nature observed via biophoton channel will fetch him the epithet paranormal. He will become nonconformist. The society packs nonconformists to solitary confinement whether in jail or in jungle.

Quantum detection is a big drain on resources. A single measurement is sufficient to characterise a classical state while the characterisation of a quantum state requires many measurements either by a detector or by many detectors. The results of all measurements need to be compiled and analysed for obtaining the characteristics of a quantum state. Greater the number of measurements better the characterization. Since each measurement costs some energy, a reasonable characterisation of a quantum state is becomes costs a lot of energy. In addition, some energy is also spent in selecting a specific biophoton signal and focussing on it. All these factors make quantum detection a big drain on resources. Continuous measurements of quantum states may strain a system to the point of breakdown. An intelligent living system will avoid quantum detection and will resort to inferences based on measurements with classical channels as often as possible. It is a survival strategy.

The capability to detect all biophoton signals confers the power of remote sensing in space and time. A living system with this capability will get access of the happenings of living world. It is a passive power in the sense that a living system is only an observer and cannot influence a happening. The influence emanating from the quantum nature of its observations is incidental and should be considered passive. The active power to influence a happening in the classical sense comes only if it acquires the capability to code biophoton signals with the desired information. A coded biophoton signal could trigger a response in some other system. It is remote intervention but is limited to a suggestive mode because the trigger sent may not elicit the requisite response. Both of these capabilities are at the root of hitherto bewildering behaviour of mind observed in cognition, perception, memory transcendence, paranormal perception, remote sensing and remote healing. The occurrences of these phenomena suggest that a human being can indeed acquire both these capabilities. Whether prayer, meditation, breathing exercises and drugs help in acquiring these capabilities is now a matter of scientific investigations through biophotonic techniques. So is the truth behind various alternative therapies. The objective of scientific investigations in the biophoton era is not to seek an explanation of consciousness but to search for methods of navigating, altering and extending it. We shall not be content with the supervenience but shall try to establish the hierarchical organisation of the Great Chain of being.

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APPENDIX:

Lichen species used was *Parmelina. Wallichiana*. It was collected in Shillong, India in the first week of August 2003 and kept in a polythene bag. The measurements were made on August 30, 2003. A sample of lichen emits stable biophoton signal for many hours. The signal is different in its dry and wet states. The transition between dry and wet states is reversible and externally controlled. The sample was made wet by soaking with water 10m before the experiment. The temperature of the sample chamber was 20°C and outside probably 25°C.

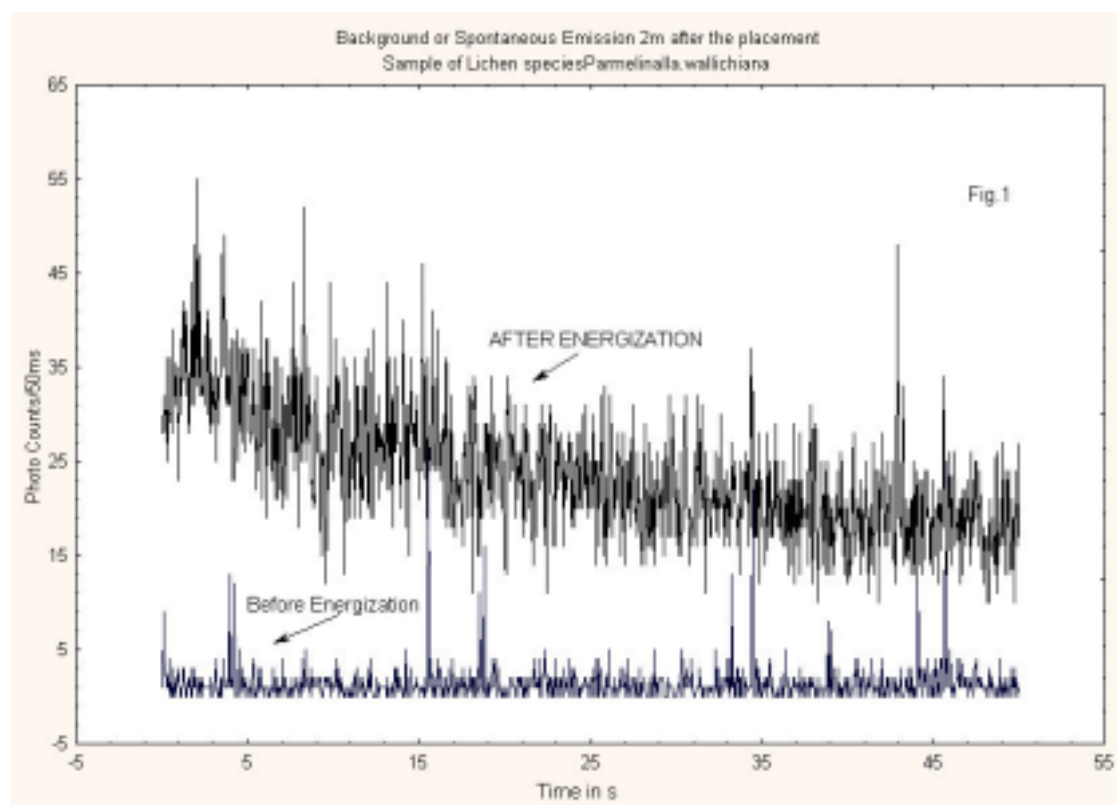
Before Energization: PROTOCOL

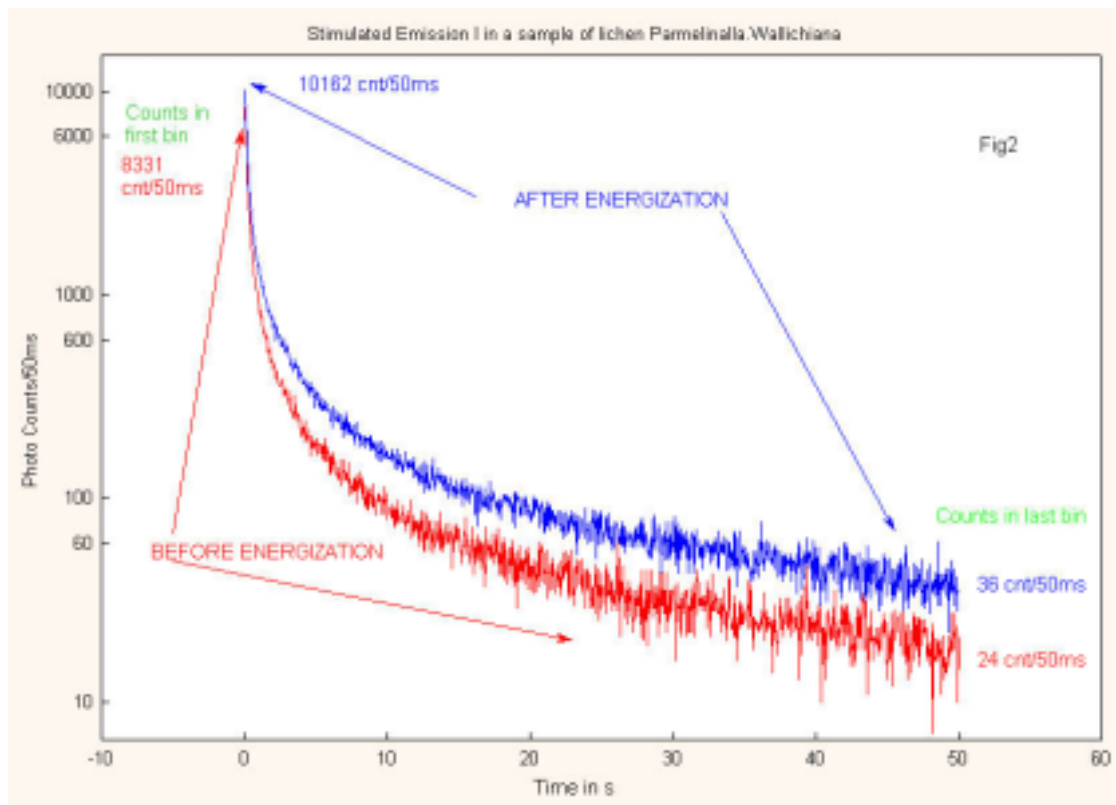
- 1.No measurements for 2m after the placing the sample in a quartz cuvette in the chamber.
- 2.1000 successive measurements of photo counts in intervals of 50ms (**Spontaneous signal or background**)
- 3.Excitation of the sample by white light for 5s
4. 1000 successive measurements of photo counts in intervals of 50ms (**Stimulated emission I**)
5. Pause of 5m
6. Excitation of the sample by white light for 5s.
7. 1000 successive measurements of photo counts in intervals of 50ms (**Simulated emission II**)

Sample holder was taken out and the sample was energized from a distance of around 5cm for 5m by Prof.Traian Stanciulescu , Professor of Philosophy in a Romanian University and then the sample holder was placed in side the chamber to repeat the measurements following the above protocol.

*****RESULTS*****

1. Spontaneous signals II and I are nearly identical (both in pre and post-energized measurements).
2. Energization changes biophoton signal :Both Spontaneous and stimulated signals are different in pre and post-energized measurements. It is possible to attribute the change in spontaneous emission to the change in back ground coming from exposure to light during energization.
3. The difference in the stimulated signal is in its initial value (counts in the first bin of 50ms) and probably not in decay shape.
4. Fig1 gives background , Fig2 gives Stim I and Fig3 gives StimII obtained BEFORE and AFTER ENERGIZATION.





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