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Experimental Evidence That Specific Photon Energies Are "Stored" in Malignant Cells for an Hour: The Synergism of Weak Magnetic Field-LED Wavelength Pulses

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Abstract

According to the Trushin hypothesis, light emissions between cells and microorganisms could be a major mechanism for "interunit" communication. The capacity for particularly patterned electromagnetic magnetic fields with specific temporal parameters to remain or to be "trapped" within the cell's aqueous environments that facilitate interfacial water was postulated by Del Giudice and Preparata and shown experimentally by us. We reasoned that specific pulsing patterns of photon energies coupled to weak magnetic fields would facilitate photon representations within cells. We found that melanoma cells *in vitro* exposed for 1 h to a specific temporally complex pattern of weak magnetic fields coupled with LED 470 nm (blue) light flashes (1 ms point durations) demonstrated this capacity. During the 120 min following the 1 h of exposure this magnetic-light paired stimulation 100-1,000 fold increases in emissions of photons from cells were measured compared to any of the other field patterns which did not differ from sham field conditions. The delayed emissions began about 30-40 min after field+light termination, peaked around 70 min later, and approached the values of other conditions after about 100 min. The total photon energy emitted was quantitatively similar to the energy induced by the effective magnetic field. Additional measurements by fluorescence spectrophotometry indicated that the wavelengths of the photons during this post-stimulation interval peaked around the 470 nm which corresponded to the wavelength to which the cells had been exposed in combination with a magnetic field. The emission peak for sham field exposed cells was around Pollack's value of ~270 nm for interfacial water. These results are consistent with models predicting that, under special conditions, coupled magnetic fields and pulsed photons can be maintained within the aqueous state of living tissue and can be re-emitted long after that stimulation has been terminated. The results suggest a potential mechanism for intercellular communication that is applicable to biology and medicine.

Keywords

Biophotons; Photon storage; Cancer cells; Interfacial water; 470 nm; Weak-patterned magnetic fields

Introduction

The capacity for aqueous systems such as those found within living cells to maintain specific patterns from applied electromagnetic energy as well as information for protracted periods has both theoretical and practical implications. Although "flickering clusters" of transient structures of water molecules with half-lives in the tens of picoseconds have been inferred for decades [1], the maintenance of quasi-stable structures for periods of kiloseconds was considered highly unlikely due to the intrinsic thermal agitation. This argument was reviewed and refuted by Cifra [2]. The brilliant reasoning and insights of Del Giudice and Preparata [3] indicated that classical electromagnetic fields could become constrained "or trapped" within the ensemble of atoms oscillating in phase with transitions between ground states and particularly excited states. The duration of this "entrapment" could be significant for influencing the biomolecular pathways that control cellular dynamics and intercellular communication as well as Trushin's "conversations" among microorganisms [4].

The representation of "photon temporal patterns" as information within the cells is particularly relevant in light of recent theoretical, quantitative and experimental evidence of "molecular resonance recognition" as defined by Cosic [5]. Specific combinations of narrow-band wavelengths within the visible [6] and paravisible (near infrared and near ultraviolet) may connect the different discrete structures of molecules that constitute these pathways such as JAK-STAT [7] and MAP-ERK [8]. The flux densities of light emissions from cells are usually within the 10^{-12} W·m^{-2} range [9] but can be enhanced pharmacologically by adding morphine [10] or appropriately patterned magnetic fields within the 1 μT range. Recently, Dotta *et al.* [11] applied the equation for the magnetic moment of a Bohr atom to the plasma cell membrane. The quantitative solution for the lateral diffusion of charges of lipids within the plasma membrane around the cell's perimeter resulted in a "membrane magnetic moment" which when multiplied by a specific-intensity magnetic field resulted in energy that would be expected for photons within the visible wavelength.

The repeated demonstrations of the ordered structure of interfacial water that can exist for kiloseconds or more near surfaces, such as cell membranes, by Pollack and his colleagues [12,13] indicate that there are aggregate conditions that could maintain optimal patterns of applied electromagnetic fields. The property of thixotrophy, whose physical mechanisms have been reviewed recently by Persinger [14], whereby water maintained in the dark and not disturbed produces stable aggregates of water molecules that can be maintained for days, reiterates the potential for this "solvent of life" to represent applied energies for protracted periods. Murugan *et al.* [15] demonstrated an intensity-dependent (within the 1 μT range) increase of the "holding effect" in spring water in which small aliquots of protons were added

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while the solution was exposed to a specific type of magnetic field. Whereas sham-field-exposed-water displayed the expected incremental decreases in pH with each addition of protons, the water exposed to the specific magnetic fields exhibited no such shift until a sudden change occurred after a "holding" latency of 6-15 min. They inferred that this latency reflected the maintenance of the proton injections within water structure before the charge accumulation exceeded the intrinsic domains within water molecules induced by the energy from the applied magnetic fields.

Murugan *et al.* [16] showed that undisturbed spring water maintained in the dark and continuously exposed to weak (μT) physiologically patterned, frequency-modulated magnetic fields displayed enhanced photon emissions as measured by spectrophotometer within the range of 320 nm to 470 nm, with most of the shift occurring between 400 nm and 455 nm. Spectral analyses indicated a specific, enhanced peak of power in photon emissions around 10 nm, the width of a plasma membrane. The shift in energy was equivalent to about 10^{-20}J. Neither the shift nor the SPD was evident in double distilled water exposed to the same conditions. Del Giudice and Preparata's theoretical approach extended Hepp and Lieb's discovery that above a specific atomic density and within biologically temperatures, a spontaneous phase transition emerged that could maintain the electromagnetic A vector potential within the coherent domain of liquid water. The ground state, whose frequency was assumed to be ~0.26 eV or the scaled equivalent of 4.2×10^{-20} J, is within the range of the energy associated with the second shell of hydrogen that is directly involved with the mobility of protons within the hydronium ion [17]. Murugan *et al.* [18], employing the same patterned magnetic fields as those that produced the enhanced spectrophotometer measurements, found that spring water displayed progressive shifts towards alkalinity over 2 or 3 h and that the shifts occurred in increments of about 20 ms.

Emissions of photons from cells have been considered the primary means by which intercellular communications modulate aggregate behaviour [4,19]. The demonstration that cells can "store" photons as virtual representations as suggested by Popp [20] or the information associated with specific wavelengths of photons could be "represented" for protracted periods only to be re-emitted hundreds of seconds to minutes later would alter perspectives of cell-to-cell communication. The maintained state could create the condition for information within the storing cell to affect the substrate that is transiently maintaining the photon energies and superimpose its characteristics onto the re-emitted photon field. Here we present experimental evidence for protracted photon storage and markedly delayed re-emission within malignant cell cultures.

Methods

General light emission as measured by digital photometers

We employed the same procedure as that which resulted in diminished growth of malignant cells but not normal cells in several previous studies [21]. In the present experiments, plastic plates (5.5 cm wide) of 10^5-10^6 (95% confluence) B16Bl6 maintained at 37°C were exposed to different weak magnetic fields and blue LED (470 nm) light that were flashed in synchrony from the top of the plates within a standard (dark) incubator (Figure 1). The device that generated the magnetic fields or LED patterns is shown in Figure 2. The structures of the different patterns (Figures 3-5) were programmable from the outside of the incubator by a personal computer [22]. The different patterns were generated by converting columns of numbers between 0 and 256 to between −5 to +5 V (with 127=0 V). The duration in which each number (and voltage) was generated was called the point duration. The point duration, usually 1 ms or 3 ms, has been shown to produce significant alterations in calcium influx via T-type calcium channels [23], slowing the cancerous cell and not the normal cell growth, and affecting analgesia in rodents [24] and invertebrates [25]. We [26,27] have shown the potential cosmological sources of these temporal values

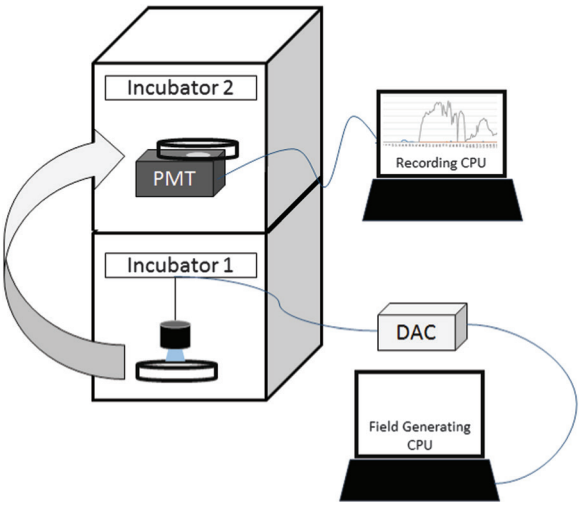

Figure 1: Exposure and measurement diagram. The cells were first placed in incubator 1 and exposed to the magnetic field, light pulses, or both magnetic field and light pulses simultaneously for 1 h. They were then placed without treatment into incubator 2 where photon counts were measured for 2 h

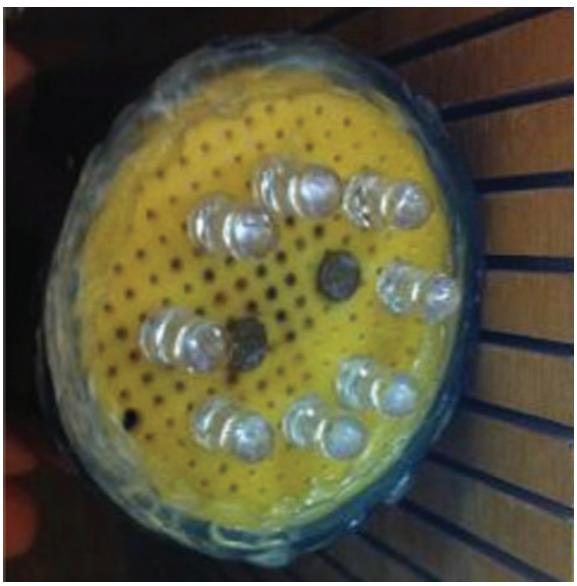

Figure 2: The actual exposure device. The 8 LEDs (each 470 nm) were placed over the plate of cells (Figure 1). The nails heads which served as the source of the magnetic field could be activated singly, the LEDs could be activated singly, or both the field and LEDs could be activated simultaneously

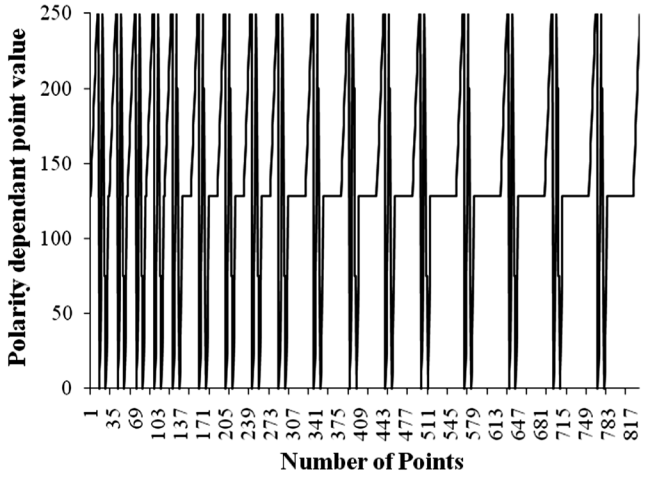

Figure 3: The frequency-modulated or "Thomas" pattern. Vertical lines indicate the value between 0 and 256 that was transformed to voltage to produce the pattern. Horizontal axis indicates the sequences of points, each with a value between 0 and 256

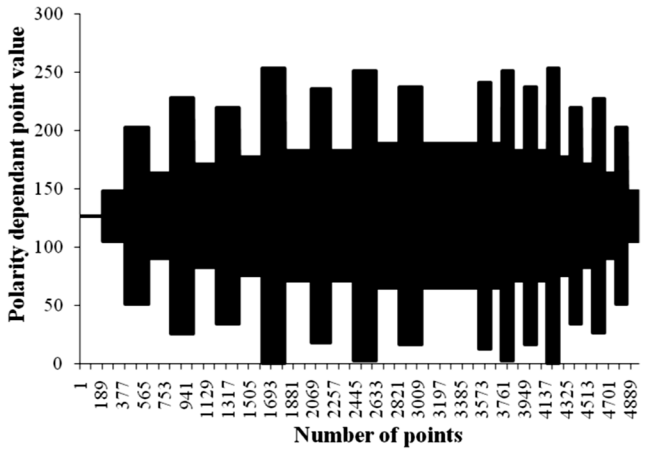

Figure 4: The general shape of the "geomagnetic pattern" which was an amplitude-modulated pattern composed of over 5,000 points (horizontal axis). The vertical axis indicates the values between 0 and 256 that were transformed to voltages

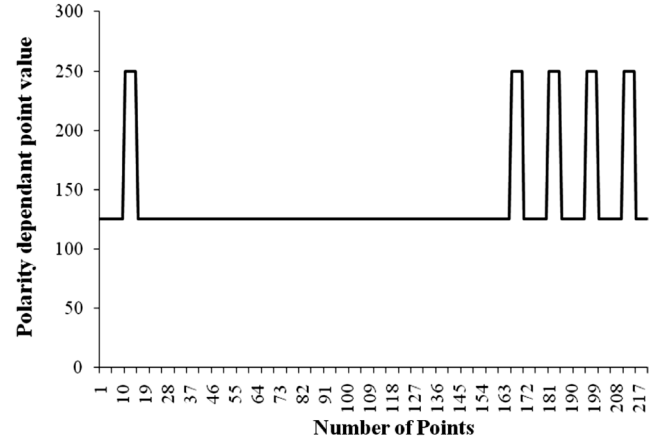

Figure 5: The "LTP" pulse derived from Rose *et al*. [30] for stimulating hippocampal slices but was generated here as a magnetic field. Vertical axis is the values between 0 and 256 transformed to voltages. The horizontal axis refers to the sequence of numbers

and their relationships to the intrinsic properties of the electron and the proton both quantitatively and by experiment. They are associated with point durations of ~1 ms and ~3 ms, respectively.

Examples of the different shapes of the field patterns delivered to the cells are shown in Figures 3 to 5. They included a frequency-modulated pattern often described as the Thomas pattern. It was composed of 849 points (values from 1 through 256). The second pattern was the geomagnetic pattern composed of 5,071 points that had been intended to be applied as 69 ms point durations to imitate the amplitude modulation in mHz range of a 7 Hz fundamental variation for a duration of 6 min to simulate an average sudden impulse [28]. However, when Murugan *et al*. [29] shifted the point duration to 1 ms, they found that this pulse duration produced complete fragmentation and dissolution of planarian when they were exposed to combinations of this field and the Thomas pattern.

The third was the LTP (Long Term Potentiation) pattern that was the magnetic field equivalent of the electrical current pattern developed by Rose *et al*. [30] to induce long-term potentiation in hippocampal slices. Whole body exposure of rats to the magnetic field equivalent of that pattern resulted in marked disruption of behaviors that required LTP [31]. This "LTP" pattern facilitates the formation of the aggregate cellular substrate that synthesizes or alters synaptic spines. The spatial patterns of the volumetric distribution of these novel spines in the brain are considered the physical correlate of memory formation.

In summary, the cells were exposed to one of three different patterns of signals, each of which were composed of point durations of either 1 ms or 3 ms. The output from the digital-to-analogue converter from the computer containing the number sequences was delivered to the custom-constructed device shown in Figure 2. As the computer program progressed in discrete temporal steps through each of the numbers between 0 and 256 that composed the pattern-specific voltages (and hence electric currents) were delivered to the LED/solenoid points. The output was directed to 1) the LEDs only, 2) the magnetic circuit only or 3) the LEDs and the magnetic field circuit. This means that both the LED and magnetic field pulsed for the same duration along the series of values that defined the complex pattern.

The final variable was intensity for the magnetic field only, the light only or the coupled magnetic field and light. The low-intensity condition was associated with a magnetic field strength (as measured by a 3-axis power meter) of ~2.7-2.8 μT within the volume (3 cc) containing the cells and simultaneous flux power density from the LED between ~51 and 66 lux for all conditions. For the high-intensity condition, the magnetic field strength averaged ~7 μT and the radiant flux density from the LED ranged between 932 and 1,774 lux. The total exposure time for each pattern was 60 min. Each pattern was tested at least three times (triplicate).

When the 60 min of exposure had been completed, the dish was removed and placed within 10 s into another incubator (same size and company and in which the cells were exposed) that was maintained at

37°C (Figure 1). The aperture of a 2.5 cm^2 type digital photomultiplier sensor (Sens Tech LTD DM0090C) was placed over the top of the covered dish containing the cells that had been exposed to one of the patterned fields or to no field (the sham condition) during the previous 1 h. The numbers of photon counts per 20 ms (the upper limit for the software of the equipment), that is, 50 times per second were recorded externally as photon counts per second for 120 min. The data were averaged into blocks of 1 min and 10 min for convenience of analyses. The single most persistent and largest effect was repeated at least five times on different days.

Specific wavelength emission as measured by fluorescence spectrophotometer

After the most optimal pattern (geomagnetic pattern), point duration (1 ms) intensity (low) and coupled patterns of light (470 nm, 50 Lux, 1 uT) were discerned that generated the greatest number of post-exposure photons, the procedure was repeated but measured by fluorescent spectroscopy to isolate the specific wavelengths of the photon emissions. The cells were removed and placed in a fluorescence spectrometer (Olis RS M1000 F1) where photon emission counts per second between 200 and 600 nm were measured as described previously by Murugan *et al.* [16]. The results (mean of triplicates) of the profiles for the media, cells only, and cells that had been exposed to the field and the light pattern were calculated. The data for each of the triplicates for each condition (media only, cells only, cells after exposure to the light+magnetic field) were z-scored. The mean of the z-scores for each condition were then averaged.

Results

The experimental design involved three types of field patterns, two point durations, two amplitudes, and either magnetic field only, light (450 nm) only, or a combination of both light and magnetic field. There were a total of 36 experimental conditions. The results were conspicuous and reliable. Only the cells that had been exposed to the low intensity, 1 ms, geomagnetic pattern *and* 450 nm LED simultaneously displayed evidence of delayed photon emissions during the subsequent 100 min of removal from these conditions. The effects were so large that the raw photon data emissions were $\log_{10}$ transformed. The results are shown in Figure 6.

The light+magnetic field effect for the geomagnetic pattern with 1 ms point durations and low intensity was associated with total photon emissions exceeding 1,000 per minute compared to the other variations of combinations. There was a significant increase in delayed photon emissions for the low-intensity 3 ms point duration for the magnetic field-light combination. However the high-intensity light flash-magnetic field intensity was not associated with any significant emissions of photons. These values did not differ appreciably from any of the other treatments, which did not differ significantly from the sham field conditions.

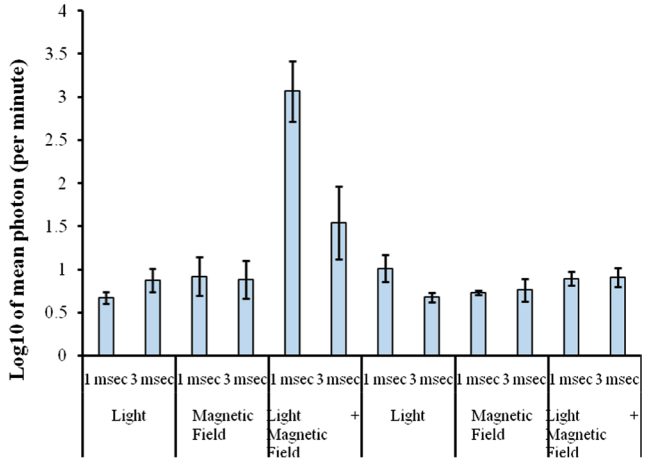

Figure 6: Log base 10 of the mean numbers of photons per minute from the cell plates for the 100 min after the 60 min exposure to geomagnetic pattern with either 1 ms or 3 ms point durations for the low-intensity and high-intensity conditions for the light only, magnetic field only or light+magnetic field condition. Note the low intensity, 1 ms light+magnetic field exposure was associated with a subsequent 1,000-fold increase in photon emissions from the cells over the subsequent approximately 100 min

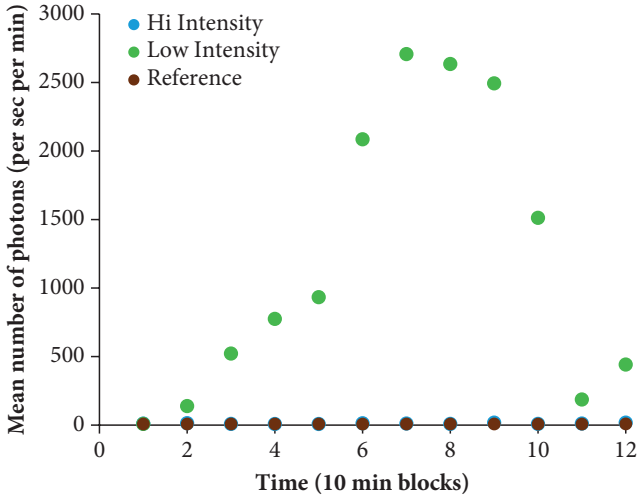

Figure 7: The mean number of photon emissions per second per minute for successive 10 min blocks after 60 min exposure to the low intensity, 1 ms point durations, geomagnetic patterned field and light (green). In comparison, the high-intensity treatment (blue) did not differ from a random average of all other conditions, including sham field exposures which, at this scale, overlapped

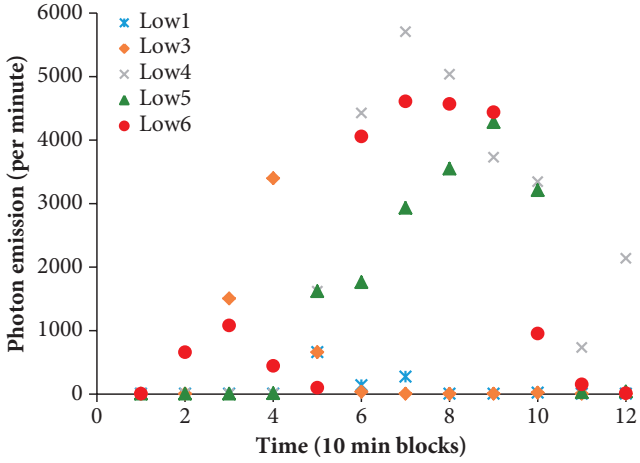

Figure 8: Emission values (photons per minute) for five separate trials for the effective condition to demonstrate the variability within the subsequent 120 min. By 120 min, the numbers of photon emissions were approaching that of all other treatment groups

Figure 7 shows the timing of the photon emissions from the cells that had been exposed to the low-intensity light+magnetic field patterns (green) and to the higher intensity light+magnetic field configuration (blue). Samples from the other conditions (brown), which all ranged from seven to eight photons per minute for the serial blocks of 10 min, overlapped with the previous group. Approximately 30 min elapsed before the delayed release of photons occurred. The peak occurred approximately 60-80 min after termination of exposure. Within about 110 min, the photon emissions had declined to near reference group levels.

Figure 8 shows the distribution of photon emissions over the 10 serial 10 min blocks for each trial so that the individual variability can be appreciated. On average, the re-emissions did not begin until about 30-40 min after the exposures had been stopped. Although for most trials the photon emissions were declining after 80 min, photon "re-emissions" were still increasing in one of the trials.

Specificity of light emission

Fluorescence spectrometry confirmed and extended the results of the specific treatment. The fluorescence (raw photon) counts for the media only are shown in Figure 9. There was no specific "power peak", although 260 nm cannot be excluded if the criteria of $z > +2.0$ is applied for the individual points.

On the other hand, the distribution of photon emissions from the cells that had been exposed to sham field conditions within the same media displayed a marked symmetrical maximum around 270 nm (Figure 10).

Figure 11 shows the clear and reliable increase in "spontaneous" photon emissions that occurred around 470 nm from the cells that had been exposed to paired geomagnetic field synchronized with 470 nm light flash for about 1 h previously. In other words, when the cells had been exposed to the combination of light and magnetic field, there were still photon emissions from those cells at least 60 min after the exposures had been terminated. There was also a much smaller peak around 300 nm.

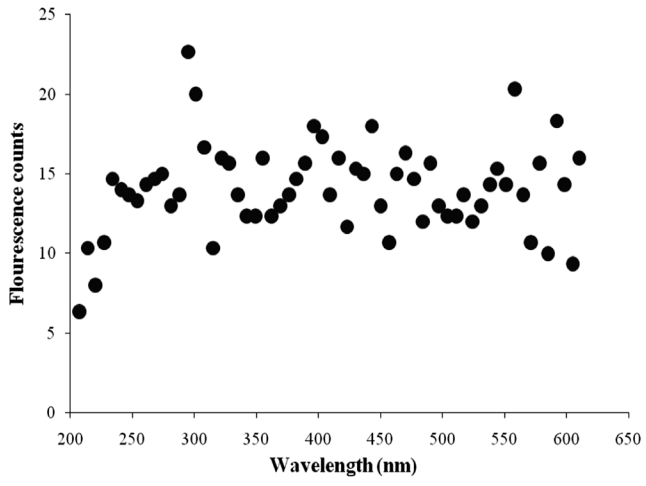

Figure 9: Vertical axis indicates the numbers of photon counts by fluorescent spectrometry measurements for the media only as a function of wavelength of emissions

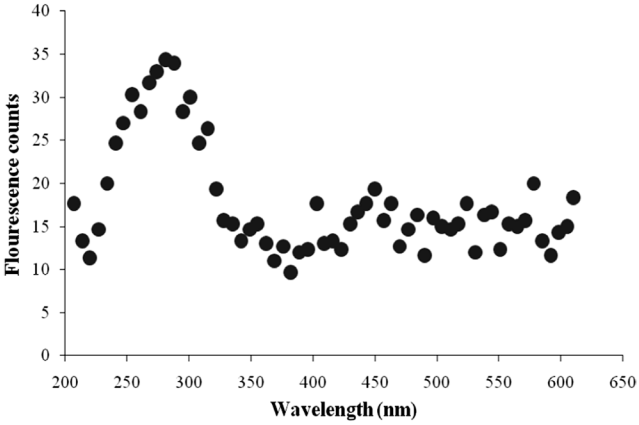

Figure 10: Vertical axis indicates the number of counts by fluorescence spectrometry for cells only (sham field) as a function of the wavelength of emissions

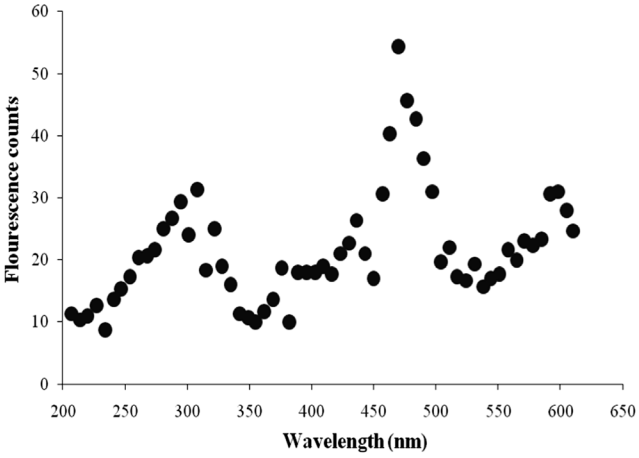

Figure 11: Vertical axis indicates the number of photon counts by fluorescence spectrometry as a function of wavelength of the emissions for the cells that had been exposed to the specific parameters of the low-intensity magnetic field and light (470 nm) conditions. Note the peak of emission at 470 nm

Discussion

The results of these experiments may be the first to demonstrate that the combination of the appropriate wavelength of light within the visible spectrum and complex patterned magnetic field induces the condition to maintain photon energies within cells. The specificity of the magnetic-field pattern is indicated by the absence of any delay in photon emissions from the cells that were exposed to the frequency-modulated (Thomas) pattern or LTP pattern. The specificity of the timing of the point durations was indicated by the conspicuously different magnitude of photon emissions from the same "geomagnetic" pattern when it and the coupled 470 LED blue light were presented as 1 ms point durations but not at 3 ms point durations.

The narrow interval of the appropriate magnetic field intensity was clearly indicated by the presence of the effect around 2.8 μT fields but complete absence of the effect around 7 μT. The difference in amplitude

of the photon emissions over protracted periods was approximately a factor of 100-1,000. This is the largest effect we have ever measured in our biophoton research. Only the specific combination of the geomagnetic field pattern, the point durations of 1 ms, low-intensity magnetic field (2.8 μT) and light (~60 Lux) produced this extraordinary effect.

The latency for the beginning of the "re-release" of photons was about 30 min. This suggests that the condition that had "held" or "maintained" the photons (or more likely some process associated with the representation within the cells) and their aqueous environment began to dissociate after this period. The peak in the re-release of the photons was about 60-80 min after the termination of the 60 min exposure. By approximately 110 min after the termination of the exposures the photon emissions had declined to that of any of the other combinations that remained remarkably stable over the 120 min following removing from the different non-effective configurations of field patterns, intensities, and point durations. Consequently the phenomenon is not likely to have been related to artifact drift but to an actual quantity of energy that was maintained within the aggregate of cells and their aqueous solvent.

That the wavelength equivalent represented in some manner or "stored" within the aggregate of cells exposed to the optimal pattern of light and magnetic field was specific to the applied 470 nm was strongly suggested by this same peak-emission wavelength as measured by the more precise fluorescence spectrometry. The photomultiplier units only measured the number of photons within the range of the sensors (near-ultraviolet through the visible boundary to near-infrared) and did not reflect the specific wavelength of the photons that were "re-emitted". The validity of this emission is indicated by the shape of the distribution of the number of photons emitted at wavelengths around 470 nm for the cells that had been exposed to the light and magnetic field.

Cells that had been exposed to sham conditions displayed peak photon emissions around 270 nm, which is the value often reported for interfacial water by Pollack and his colleagues [12,13]. Because the standardized power distribution over the range of wavelengths appeared to be displaced from the 270 nm emissions associated with interfacial water to those associated with the LED wavelength of 470 nm, we suggest that the intrinsic energy within the water and cell aggregate may have been recruited into the representation of the substrate by which the 470 nm energy was maintained as a quantity of energy. If this occurred, then the 1 ms point durations of the geomagnetic field at weak intensity could have created the coherent domains for this maintenance as hypothesized by Del Giudice and Preparata [3].

If the energy associated with the magnetic field was related to the energy of the total photon emissions, their quantities should be similar. The median total number of photons emitted during the 120 min after the optimal exposure was 2×10^5 photons per average minute or 1.2×10^7 photons per second. If the cross-sectional area of the plate is accommodated with the area of the sensor for the photomultiplier unit, the actual values would have been around 1.2×10^8 photons per second. If the peak wavelength was around 470 nm, then the energy per photon would have been 4.2×10^{-19} J and hence the total photon energy released per plate would have been $\sim 5 \times 10^{-11}$ J. In comparison, the energy from the applied effective magnetic field of 2.8×10^{-6} T within the 3 cc volume of the cells and surrounding fluid (3×10^{-6} m^3) would have been according to:

$$J = B^2 (2\mu)^{-1} m^3 \quad (1)$$

where B is the field strength in Tesla, μ is magnetic permeability ($4\pi \times 10^{-7}$ N·A^{-2}) and m^3 is volume, $\sim 1 \times 10^{-11}$ J. This is within the same order of magnitude as the photon energy release. Hence this is strong evidence that the amplitude of the "re-emission" photon effect was controlled by the intensity of the magnetic field.

If the total energy emitted during the subsequent 120 min was 5×10^{-11} J and there were $\sim 5 \times 10^5$ cells (10^5-10^6 for 95% confluence), then there would have been $\sim 10^{-16}$ J per cell. However, the energy would have been distributed over the duration of the "release", which averaged about 80 min (4.8×10^3 s). This would be equivalent to about 2×10^{-20} J per second. This value is similar in coefficient and magnitude to estimated emissions from these cells when they were removed from incubation and placed in room temperature for several hours [32]. During this time, shown by Dotta *et al*. [6], there was a shift in predominant wavelengths across the near-infrared to near-ultraviolet boundaries as the cells responded to the ambient rather than incubation temperatures.

In comparison, the cells that were exposed to the other combinations of fields, point durations and intensities emitted about 500 times fewer photons. The total number of photons emitted from these aggregates of cells were in the order of 900-1,100 during the 120 min per. This would be equivalent to 0.4×10^{-22} J per second per cell. The temperature equivalent according to the Boltzmann constant of 1.38×10^{-23} J·K^{-1} would be about 2.8°K, which is remarkably proximal to the cosmic microwave background temperature. This value has been shown to be a potential rate-limiting value that maintains the small effect size for experimental demonstrations of excess correlation and entanglement [33,34].

Clearly subsequent experiments must be completed to isolate the mechanisms for the specificity. However some rational possibilities can be discussed. The generation of the massive post-exposure photon emissions for the 1 ms point duration of the geomagnetic field configuration when the intensity of the field was 2.8 μT but not 7 μT indicates that magnetic energy available to the volume was not the critical variable. Persinger and Lafrenie [35] have shown that the magnetic field strength equivalent to the approximately 27 mV resting membrane potential of cancer cells in general is about 2.7-2.8 μT. From their perspective, such matching between field strength and resting membrane potential would facilitate the "cohesive" or "condensate" effects within all of the cells to behave as a single unit.

The fact that 1 ms point durations and not 3 ms point durations were associated with this powerful phenomenon may reveal the physical mechanisms. Koren and his colleagues [26,27] had shown that 1 ms was the theoretical time required for an electron to expand one Planck's length on the basis of the present Hubble parameter. Experiments involving the measurement of photon flux densities from chemiluminescent reactions or LEDs between two loci sharing similar rotating magnetic fields with specific changing angular velocities have indicated that point durations of 1 ms may affect electrons while 3 ms point durations are more involved with protons [36]. If these measurements and inferences are correct, then the 1,000-fold increase in photon emissions noted in the present experiments would have primarily involved electrons or their movements within coherent domains.

There are several potential applications of these powerful effects in biology and medicine. First, one experimental test of the Trushin [4] hypothesis is to discern if microorganisms or cells displayed enhanced alterations in their interactive behaviour within the present

experimental condition which should elevate photon emissions. Second, the coupling of specific temporally patterned magnetic fields with "quantum well" like point durations and a "single" wavelength might be employed as a carrier upon which more specific information could be coded which then penetrates into the cells and remains within their boundaries for at least an hour. This may be sufficient time to directly affect the molecular mechanisms that control cell proliferation and aberrance. Third, if the energy of the total photon "storage" and release simply reflect the magnetic energy from the applied field within the target volume, then experimental or clinical manipulation of these amplitudes might be employed to titrate the treatment effects.

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Declaration of Interests

The authors report no declaration of interests.

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