Predicting random events from background photon density two days previously: implications for virtual-to-matter determinism and changing the future

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Abstract. We tested the hypothesis that discrete energies from entropic-like processes immersed within background photon densities of ~10^{-11} W·m^{-2} were coupled to the occurrence of changes in random events that lead to specific consequences about two days later. This latency was obtained from the ratio of the summed equivalent energies associated with a Bohr electron divided by the value for the fluctuation of background photon density within the likely area of the gap junctions mediating the electron tunneling. Hourly values for 30 days for background photon densities and deviations on random number generators involved lags between 0 and 72 hours. Multiple regression equations indicated that deviations from random number variations were only correlated with photon densities approximately 48 hr (2 days) previously. Convergent quantitative values were consistent with source energies from virtual particles at the level of entropic thresholds. The delay of approximately two days between the emergent energies that influence an event and the manifestation of the event in physical time or the specious present suggest that technology could be developed to predict or modify actual events in real time. Implications for causality and determinism are considered.

Key Words: Entropy photons semiconductor quantum random number generation causality specious present

1. Introduction

First approximations of magnitude relate the increments of space (Δs) and the increments of time (Δt) to perceptual processes (Persinger, 1999). For example, to discern phenomena dependent upon processes at the level of the atom (10^{-12} m) Δts in the order of 10^{-12} s are required. To discern phenomena at the level of the proton or electron (10^{-15} m) shorter intervals in the femtosecond (10^{-15} s) are more optimal. At larger scales, in the order of megameters, that are encountered by geophysicists investigating seismicity, the Δts required to identify the most reliable and predictable patterns are in the order of 10^{6} s. If the optimal Δt is not employed, the phenomenon may not be detected because of excessive fragmentation, such that intercorrelations approach zero (when Δts are too narrow) or multiple phenomena are summated into aggregates as if they were singular events (when Δts are too wide).

From subatomic particles to celestial aggregates, the functional Δt is neither discrete nor fixed across levels of scientific discourse. Although artifacts of measurement or conceptual limitations of human perceptions cannot be totally eliminated, the shape of the distribution of the optimal Δt appears to be Gaussian-like. This perspective is consistent with the central limit theorem that states that if an infinite number of the means of samples of random numbers were plotted, they would display a normal distribution. Consequently the processes that contribute to the present (the vertical line in Figure 1) can display a wider increment than the Δt by which events are measured serially or sequentially. In this instance specious present is defined as the short time span in which duration and change are experienced or measured directly. It implies there are antecedent conditions that may display Bayesian characteristics with respect to an event when a field or flow metaphor is employed.

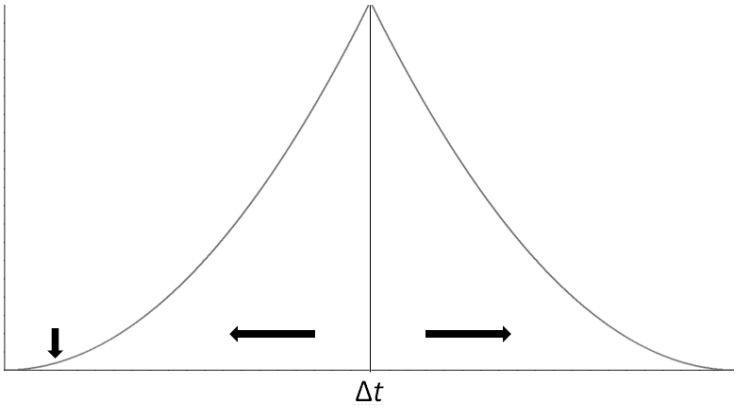

Figure. 1. Representation of the specious present (vertical line) and the theoretical distribution of energies from processes that contribute to the physical event at Δt. The arrow indicates the hypothetical occurrence of energy represented as photons that emerge from "virtual" particles within background entropy. In this instance the vertical axis refers to the qualitative probability of the event occurring with a maximum at Δt.

One of the implications of this approach is that a process coupled to entropy that occurs during the initial elevations of a probability (the arrow in Fig. 1) above the random background that precedes an actual event: 1) is entangled with the consequent manifestation of the actual event, and, 2) determines actual events that occur as changes in the organization of matter in the specious present. The result is the occurrence of the event within the "now" temporal frame. The

approach is also consistent with the concept of "the specious present" which implies that what constitutes the causal moment is actually wider and composed of subtle energetic sequences that systematically precede the physical event. The analogy might be the elevation of local electrical gradients seconds to minutes before the actual manifestation of the initiation of a leader for a lightning discharge (Persinger, 2012b).

For several years we have been measuring background photon emissions ($\sim 10^{-11}$ W/m^2) in a very dark basement laboratory (Dotta et al., 2011). The spectral profiles of these emissions are concurrent with the free oscillations of the earth-atmospheric interface (Persinger, 2012a) that range between 3 and 5 mHz. Marked elevations by a factor of 10 or more in the intensity of this photon density have been measured more than a week before very large $M > 8.0$ earthquakes that occurred later at distances of several thousands of km (Persinger et al., 2012).

We have assumed that any observable event, from the collapse of a building to the failure of a biological system, begins with a quantum of energy equivalent to a discrete value such as the shift in an electron shell or the differential between the spin and orbital magnetic moment of an electron ($\sim 10^{-26}$ Am^2). Because this quantity is almost identical to the magnetic moment of a proton, this concept may be relevant to processes that determine causality and the arrow of temporal sequences that might emerge from entropic sources. We designed an experiment that could potentially test the hypothesis that deviations from random variations are preceded by perturbations in the background photon emissions.

2. The Model

Random Number Generators (RNGs) are based upon the concept of electron tunneling between the Δs separating two areas in the order of approximately 1 μm^2. The standard RNG collects 200 samples of 0,1 events per second. When these devices are allowed to run continually in non-disturbed settings, there is the occasional deviation from chance. Random samples of 84,408 RNG events were collected and the computed total number of events that were greater than $\pm$ 20 away from the mean of 100 was 478. Assuming this relation over an hour of 3600 events results in an average of approximately 20.38 times per hour occurrence. Therefore the mean for this occasional deviation change occurring per hour, which is qualitatively distinctive, is about 20 events. Quantitatively, assuming the sample mean of 100, and a standard deviation of 7, the value of occasional deviation corresponded to single scores with a z-score exceeding the absolute value of 2.86.

If what will happen, viewed as the actual event, is preceded by patterns of energy that can be measured as perturbations in photon density, then the temporal extent of this anticipation should be calculable. Based upon the asymptote of accurate predictions for complex systems such as the local manifestations of air masses (weather prediction) and the dominant numbers of "temporal" distortions reported for centuries under questionable rubrics and explanations, (Dotta & Persinger, 2009) the width of the specious present should be in the order of between 2 and 3 days. A similar duration should occur between the energy emerging from entropic processes as a quantified energy and the photonic exchanges that produces the events.

The total energy of the electron moving at the fine-structure velocity around a Bohr radius is 4.37 x 10^{-18} J. We assumed that one significant deviation ($z > \pm 2.86$) within the RNG was approaching or equal to this quantum. Assuming a total of 20 such deviations the total energy would be 8.74 x 10^{-17} J. For the antecedent photon density our photomultiplier tubes (PMTs) displayed peak-to-peak background variations of 4 to 5 x 10^{-10} W/m^2. With the cross-sectional area of the electron tunneling across the boundary in the RNG of 10^{-12} m^2 this means that there would be 4 to 5 x 10^{-22} J/s. The ratio of the total energy associated with the deviations from chance divided by the former value is ~1.6 x 10^5 s or ~2 to 3 days. If this formulation is veridical, then deviations in photon density approximately two to three days previous to deviations from random variation should be most correlated. We would expect the effect sizes, the amount of shared variance, to be small and for the statistically significant variations in photon densities to *precede* rather than succeed the variation in RNG values.

3. Relevance of Electron Tunneling in RNGs

The concept of a local hidden variable is commonly used in the EPR paradox and Bell's inequality (Bell, 1964). In quantum entanglement theory, the hidden variable explains the Schrödinger wave function state vector collapsing from a probability (before measurement) into a certainty (after measurement). According to Korotaev et al. (2005) nonlocal dependence of dissipative processes can reflect entropy productions within detectors and the environment which may also serve as a basis for quantum non-locality. Considering the recent arguments that the rest mass of photons is not zero (Tu et al, 2005), there are emergent properties that could facilitate the extraction of information from the entropic domain as well as zero point fluctuation potentials into the traditional physical realm of matter of its respective Δt. In other words, before an actual event occurs in physical space-time there would be energetic antecedents one or two days previously that are entangled with and determinants of the occurrence of the event.

RNGs from Psyleron, a company that has focused on the precise development of these devices, involve quantum tunneling of electrons. Following the Heisenberg Uncertainty Principle, the probability of an electron randomly occurring on the opposite side of the gap junction barrier, translates into a varying voltage level. The varying voltage (white noise) generated by quantum tunneling electrons is sampled from two reverse-biased transistors. The unpredictably 'high' and 'low' voltages are due to more or less electrons tunneling across the barrier (gap junction), with a spectrum +/- 1dB, from 50Hz to 20kHz. A 1 kHz cutoff attenuates frequencies, signal amplification and clipping to produce a rectangular wave with random temporal spacing. Gated sampling yields a regularly spaced sequence of random bits.

To eliminate environmental biases, the two streams from both chips undergo Boolean Exclusive-OR logic gate operation procedures, applied in alternating 1/0 patterns. Further, the entire circuit is shielded by an outer aluminum enclosure, and with an inner perm alloy mu-metal which isolates both electrical and magnetic effects from inside and outside the REG device. Esaki (1976) noted that the current in the reverse diode might only be carried by internal field emission. The barrier breakdown occurs at less than the threshold voltage for electron-hole pair production, and so an avalanche should be excluded. In short, the Psyleron REG is a

professional, non-classical coin flipper with data accessed by computer via USB port. Due to the extensive shielding and calibration testing of the Psyleron REG-1 device (1 billion bits), classical physical interactions can be ruled out as the source of deviation from statistical randomness.

The velocity of an incident tunneling electron wave packet approaches infinity inside a zero-time space barrier. With wave number *k* as imaginary, the duration of time for the incident electron wave packet to tunnel across a potential barrier approaches zero. This tunneling phase change is a special solution of the Schrodinger wave function. During tunneling in the barrier region (II), the corresponding wave function solution undergoes absorption. Although the energy of the instantaneously tunneled electron remains consistent, the probability amplitude is no longer the simple addition of oscillating functions, but combinations of exponential ones (Martin & Landauer, 1992).

The phase change solutions to the special Schrodinger equations violate Einstein causality for signal transmissions through a vacuum. For: $W^2 = c^2p^2$ where; W = (energy), and p = (momentum), the instantaneous tunneling electron is faster than the speed of light (Stahlhofen & Nimtz, 2006). There exists the quantum wave function state possibility of a transition of electrons from the valence band, into quantum states of like energy in the conduction band. Quantum tunneling is therefore known as the finite probability, as determined by the ratio of coefficients of the special Schrodinger equation, of finding particles at the inflection points between regions (I) & (II), and regions (II) & (III) (Landauer, 1989).

Photomultiplier tubes also employ the p-n junctions and the photoelectric effect of incident photon current measurement, just as the RNG harnesses quantum mechanical tunneling to produce a varying current. Absorption of photons in the PMT leads to excess electrons in the n-side and excess holes in the p-side, generating a voltage drop across the p-n barrier junction. Lenses are used to enhance the light sensitivity, such that the PMT can be inferred to measure direct-hit photons.

However influence from vacuum fluctuations which include Casimir (Bordag et al, 2001) and Van der Waals force can be considered during inherent pair-particle creation due to quantum vacuum fluctuations. An upper limit on vacuum energy density in quantum field theory is usually represented by $< 10^{-26}$ kg/m^3 as the residual energy of oscillators at absolute zero (Landauer, 1989). These oscillators should have wavelengths of the order of the Compton wavelength of the proton or h/m_pc or ~1.3 x 10^{-15} m. This interconnection between vacuum energy phenomena, the yet-to-be-described predictable equations for "random" processes, photon-mediated energies, loss and gain of information from entropy, and the manifestation of particles within the physical world, are intrinsic components of the model.

4. Methods and Procedures

To test the hypothesis an inclusive database from our minute-to-minute PMTs was extracted for a one month interval (19 January - 19 February, 2013). For ease of analysis the mean photon density, RNG Zscore, and global geomagnetic aa (average antipodal) index values

over this interval (743, hourly increments) were computed. The aa values (nT) were included to ensure that this important third factor, which has been correlated weakly with photon emission densities in our laboratory, was not a confounding variable. Because the aa values are 3-hr increments (8 per 24 hr period) and we employed Δts of 1 hr, there was repetition within the successive 3 hr periods for this variable. However we assumed that if the geomagnetic interactions were conspicuous they would still be evident.

The consideration of geomagnetic activity is also relevant to its potential coupling to subtle gravitational fluctuations. Vladimirskii (1995) measured enhancements in the order of 10^{-3} within G (the gravitational constant) during lower geomagnetic activity. Minakov et al. (1992) have described the conversion of a plane gravitational wave into electromagnetic radiation within a terrestrial context and recently Rowlands (1992) reiterated that gravity displays a magnetic inertial component. Korotaev et al. (2005) also showed that there is a non-local dependence of dissipative processes that is reflective in geomagnetic activity. The potential interaction is important because calculations have suggested that there may be a quantitative equivalence between gravity and light (Persinger, 2012d). Several empirical studies have indicated an inverse correlation between global geomagnetic activity and local photon flux densities. In general we have found that for every 1 nT increase in global geomagnetic activity (aa values) there has been an associated decrease of 0.9×10^{-12} W/m^2 in photon flux density. However the standard errors of the estimates are too large to allow predictive precision.

The RNG device was purchased from Psyleron Inc. (hardware ID: RGZD750) and is designed to generate random numbers based on quantum principles. As described by Psyleron's technicians, two environmentally shielded, Fairchild NPN Epitaxial 0.048mg Silicon Transistors (BCX70K), under a reversed biased current employed heavily doped electrons to quantum tunnel across a classical channel barrier. The authors assumed the proprietary distance of the gap junction barrier is of the order of 1 μm. The RNG was located about 20 m distance from the Photomultiplier Tube (PMT) system which was composed of a Model 15 Photometer from SRI Instruments (Pacific Photometric Instruments) and the PMT housing (BCA IP21) for a RCA electron tube that had been employed in several other experiments involving photonic phenomena. The distance is well within the domain of non-local effects described by Korotaev et al. (2005).

The sensor of the PMT was housed in a thick wooden black box covered with several layers of black terry cloth (towels). It was connected to the photometer (scale 1 to 100) whose voltages has been recorded by a IBM laptop computer once per minute, 24 hr per day for the last three years. Two different methods of calibration have indicated that a 1 unit change is equivalent to $\sim 5 \times 10^{-11}$ W/m^2. At the typical setting the range from "background" variations over several days, assuming there are no very intense imminent large (Magnitude > 8.0) global earthquakes, is between 45 and 55 units. Within a single hour the range variation around the central tendency was between 5 and 6 units. The room, in which the PMT was maintained, was sealed from light.

A total of 72 lags (3 days) were computed by software (SPSS 16 PC) for each variable. Because there were 743 cases (serial numbers of adjacent hours), this not considered a significant challenge of the degrees of freedom. Pearson (parametric) and Spearman rho (non-

parametric) correlations were obtained for these lags and the other zero-lagged variables. To minimize redundancy, multiple regression analyses were completed with the numbers of deviations for the RNG as the dependent variable and the lags for the PMT as independent variables (and visa versa). Covariance for geomagnetic activity was also completed between the RNG and photon flux density data. Because of the larger number of variables involved we set the p value for entry and statistical significance into the equations at $p < 0.01$.

Hourly	Mean	SD	Max	Min
Value per second (of 200 1s or 0s)	99.9945	.1228	100.3397	99.6606
SD Value 1s per second	7.0693	.0806	7.3152	6.8155
Stouffer's Cumulative Zscore	-.0467	1.0411	2.8826	-2.8803
Max value per second	125.3100	2.1310	135	121
Min value per second	74.7000	2.2580	80	65
PMT photon units	51.8549	2.3707	59.0100	45.5300

5. Results

The grand means, standard deviations, maximum occurring and minimum occurring values for the 743 hourly cases are listed in Table 1.

Table 1

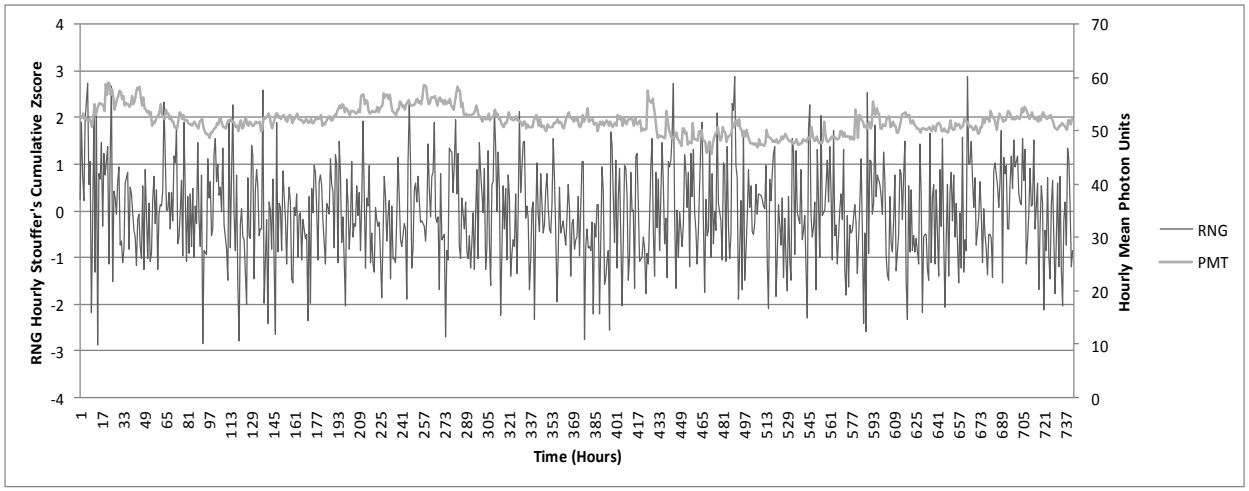

Figure 2. Display of the hourly values from January 19th, 2013 – February 19th, 2013 for the Stouffer's Cumulative Zscore of the Random Number Generating REG Psyleron device and the Model 15 Photometer from SRI Instruments (Pacific Photometric Instruments).

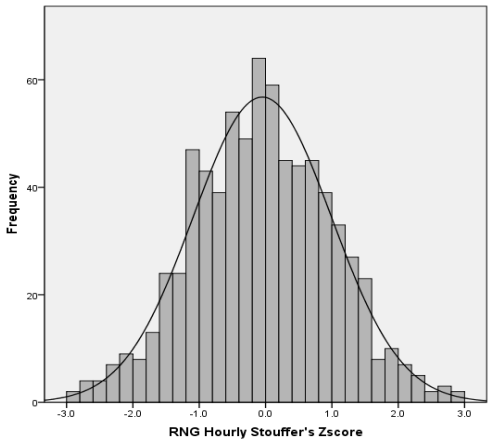

Figure 3. Display of the hourly RNG Stouffer's Cumulative Zscore frequency of occurrence for the 743 cases from January 19th, 2013 – February 19th, 2013.

The results of the stepwise multiple regression analysis for hourly RNG z-scores and the photon power density of that hour and for each of the 72 previous hours showed that 4 variables entered the equation. These reflected the power density of photons 41, 47, 48, and 71 hours before any hourly RNG value over the 30 days. The multiple R was 0.185 and the equation [r^2 = .034, $F_{(4,666)}$ = 5.910, p < .001, R = .185, SEE = 1.021] accommodated ~3% of the variability in the z-scores for the hourly RNG variations. The partial slopes (partial regression coefficients) and standard errors (in parenthesis) for the four predictors were -0.075 (0.025), -0.097 (0.04), 0.136 (0.04), and 0.03 (0.016), respectively. On the other hand when the PMT data (photon flux density) was employed as the dependent variable and the RNG data for the same hour and each of the 72 hours before were entered into the multiple regression, there was *no entry* of variables. In other words photon power density primarily during the period 41 to 48 hours previously was significantly correlated with deviations in random number generation; however the hourly variation in photon measures was not significantly correlated with any of the previous hours for random number variations. Only one (lag 32) of the 72 lags for geomagnetic activity significantly predicted the RNG variations (r = -0.09).

To understand the relationship between local photon flux density and general global geomagnetic activity, their relationships were explored. When a symmetrical lag/lead equation was generated by entering the lag 24 of the hourly PMT data and 72 lags of the geomagnetic data (entry of lags <24 would indicate that future geomagnetic activity entered while lags >24 would indicate that antecedent geomagnetic activity entered) two variables entered the equation [$F_{(1,699)}$ = 16.31, p < 0.001): geomagnetic activity during the *same* hour and 10 hrs previously (multiple r = 0.23). The equation (multiple r = 0.24) generated when geomagnetic data was employed as the dependent variable showed that photon flux density (partial slopes in parentheses) 10 (0.53), 28 (-0.98) and 39 (-0.73) hours previously aggregated to predict the geomagnetic (aa) values [$F_{(3,691)}$ = 14.49, p < 0.001].

By definition the correlation between the predicted values of the equation containing the four hours of previous photon data was correlated 0.19 with the hourly RNG scores. When the shared variance between the predicted geomagnetic (aa) values from photon flux density was first removed from the correlations with the actual RNG scores and predicted RNG scores, the

correlation was still significant statistically (partial r = 0.18, p < 0.001). Removing the shared variance with the actual RNG scores between the predicted RNG score and predicted aa values did not significantly change the strength of the correlations (partial r = 0.17, p < 0.001). However first removing the shared variance with the predicted RNG scores (from antecedent photon density 41, 47, 48 and 71 hours previously) reduced the partial correlation (partial r = 0.01, n. s.) between the RNG scores and the predicted aa values to a non-statistically significant level. Such results strongly suggest that recondite associations between geomagnetic activity and photon flux density were not responsible for the weak but nonetheless significant association between RNG scores and the antecedent photon fluctuations particularly about two days earlier.

The average slope for the four key hourly variables (41, 47, 48, and 71) was about 0.07. This means if valence were ignored and absolute values are only considered, every 1 unit change in photon density per minute produced a random variation changed by z = 0.08 of the total population per hour. Assuming 5 x 10^{-11} W/m^2 and the ~10^{-12} m^2 per area involved with the electron tunneling, the energy would be 5 x 10^{-23} J. For a unit z shift that would be equivalent to ~6.3 x 10^{-22} J. This is the value predicted for the energy associated with numbers of equivalent Bohr electron energies for a deviation of more than 20 units from random number background per hour.

6. Discussion and Implications

One of the most important implications of this approach to causality of events and their influence by quantum-level energies within the two to three days before their occurrence is that single increments of energy could be the initiating sequence that could ultimately lead to the occurrence of a physical event. In other words, the collapse of a building or the failure of a biological system, such as a human being, would begin with a single, extremely small quantum of energy. If the direction of this evolving process is not disrupted within the subsequent two to three days, the event occurs in the physical time frame (the middle line in Fig. 1). We would expect that as the statistical time approaches the manifestation of the event greater and greater amounts of energy would be required to alter or stop the occurrence of the event. Within a few moments before the event is manifested the energy requirements would approach extremely large values and hence the event would be inevitable. This phenomenon is considered in the microscopic scale where an interaction and process can evolve. Because a physical or biological system is comprised of many evolving processes, there are many small quanta of energy that emerge, and ultimately culminate into events.

Identification or isolation of the origin of the initiating quantum of energy would significantly affect our current concepts of causality and determinism. We suggest that the origin involves the Casimir effect which is most frequently described as:

$$F_c = \hbar c\,(\pi^2/240)\,(1/a^4)\,(A) \qquad (1)$$

where ħ is the modified Planck's constant, c is the velocity of light in a vacuum, "a" is the separation distance between the two plates or surfaces, and A is the area of the surfaces.

Assuming a separation between the gaps to be similar to that of the neuronal synapse (10 nm), the Casimir force (F_c) would be in the order 0.52 x 10^{-6} N and when applied over 10 nm would be 0.52 x 10^{-14} J. The frequency associated with this energy when multiplied by Planck's constant is 7.8 x 10^{18} Hz. The wave length for this frequency, assuming c, is 38 pm. This Δs is within the range of the width of a hydrogen atom and the Bohr radius.

The Casimir force has been considered to be one of the most conspicuous macroscopic manifestations of the zero point vacuum oscillations from which virtual particles become physical matter. According to Bordag et al. (2001) the geometric conditions such as the Δs associated with the electron tunneling in the RNG allow quantum electrodynamics to affect the virtual photons which constitute the field. The creation of particles from this presumed infinite vacuum energy requires the application of external fields, such as the ones employed to produce electron tunneling. Energy is transferred from this external field to the vacuum fluctuations that are the virtual particles, to transform them to actual physical entities. The boundary conditions depend upon temporal variation to produce particle creation.

The manifestation of a discrete quantum of energy (10^{-18} J) equivalent to only one particle, such as the electron, has the capacity to begin the sequence of processes that ends with a physical event. At the point of this transformation from virtual to real particle there would be a substantive bifurcation of sequences. One of them reflects the results of the bifurcation in this physical world; the other would reflect what would have occurred if the transformation had not occurred. The philosophical challenge is whether or not these particles that are transformed from virtual particles have an initial determined structure that can be inferred or more optimally modified by the appropriate technology. If an electromagnetic field with a changing boundary (Bordag et al, 2001) is required to facilitate the transformation from a virtual to real particle, then circularly rotating magnetic fields with intrinsically changing angular velocity, which would accommodate the temporal-spatial requirements for this condition, could be applied to affect this "causality".

Dotta and Persinger (2009) have described a model by which an "energetic" pattern exists within the specious present during the early stages of the ~2 to 3 days that is ultimately manifested as the physical event. Dotta and Persinger correlated the global geomagnetic activity on the days of and ±3 days of events of death and crisis, or catastrophic changes in biological systems, with the global geomagnetic activity on the day of cognitive prescience of these events. Because geomagnetic activity is intercorrelated over two to three day periods, only those verified cases where the time between prescience (usually manifested as an intense dream) and the later event exceeded 5 days were explored for analyses.

Unlike the predictions one would expect if space-time were a tesseract and a geometric "twist" or back-loop occurred in this line, the maximum correlation (r~0.55) between global geomagnetic activities was not for the day of the event and the day of the experience. Instead the largest and most reliable correlation occurred between the geomagnetic activity on the day of the experience and what the geomagnetic activity would be two days *before* the event. These results, initially difficult to explain, are now quite consistent with the relationship we measured in the present experiments. The information presumably discerned a priori by a form of prescience

would not have been a function of the actual event but of the energetic process or field that preceded the actual manifestation of the event.

The detection of the hypothetical energetic antecedent pattern that precedes the actual event (rather than the actual physical processes associated with the event) appears to require an altered state, such as dreaming, where photon emission and detection would be more probable. There is recent evidence that during periods when subjects are instructed to imagine white light while sitting in complete darkness, there are measurable increases in photon emissions *(*~10^{-11} W/m^2) from the right hemisphere but not the left hemisphere. The effect is very replicable and involves energies that are within the range generated by a few million neurons, each discharging at about 10 Hz with each action potential representing ~10^{-20} J (Persinger, 2010). This fundamental quantum also represents the energy associated with the distances between the potassium charges along the surface of the cell membrane that generate the resting membrane potential as well as the energies involved with the sequestering of ligands to various receptors. This value is the universal quantum unit when the estimated total force within the universe divided by the total number of Planck's voxels (unit "string" volumes) is distributed across the distance of the hydrogen line or wavelength of about 10.8 cm (Persinger et al, 2008).

The involvement of the right hemisphere as the primary source of these biophotons while imagining white light is relevant with respect to the widening of the Δt experienced as "present", because this hemisphere is preferentially activated during dreaming (Gordon et al, 1982). This was the primary state in which people reported the prescience experiences during geomagnetic conditions that was most correlated with the geomagnetic activity that preceded the actual event by about two to three days (Dotta & Persinger, 2009). This association could indicate that there is some property of photons that precede future events, which is accessible to or entangled with the photons associated with the marked visualization and imaginary processes involved with the right hemisphere during altered states such as dreaming.

A conceptually challenging implication of this approach is that the source of this "energetic" photon-related field (that can affect the cognitive, neuronal energy) that is entangled with and potentially determinant of the manifestation of the physical event may emerge from entropy within the universe. Application of the classic description of entropy of $S = ln\ g\ kT$, where k is the Boltzmann constant, T is temperature *(*~ 4ºK) and g is the degrees of freedom is the system, is revealing. If we assume the numbers of photon equivalents in the universe is the mass of the universe ~10^{52} kg (Persinger, 2009) and the upper limit of the rest mass of a photon is ~10^{-52} kg there would be 10^{104} photons (Persinger, 2009) or degrees of freedom. The ln value is 239.47. Hence the energy associated with the threshold for entropy is about 1.3 x 10^{-20} J, or the energy associated with the action potentials coupled to thinking.

That thought or intention itself (which would include observation and measurement) can influence the manifestation of events or matter has been considered a viable possibility from many different perspectives. Burst spiking of a *single* cortical neuron can modify the entire global brain state (Li et al, 2009). This trigger, which would involve energies within the range of 10^{-20} J, switches cortical states from slow wave to rapid-eye-movement (dream) states. The quantum required is certainly within the threshold of the Landauer limit (ln 2 kT), or 2.97 x 10^{-21}

J which is the energy involved with the loss or gain of a one bit of information or the convergence of two operations at brain temperature (*37° C*) .

Although the results of this experiment cannot fully address the energies involved with the physical process of the Δt in Figure 1 that constitutes the "now" of perception, there is a solution of potential relevance. Koren and Persinger (2010) applied the Casimir equation to the dimensions of the entire universe. Assuming classic total energies in the order of 10^{69} J and a median value for the surface area of the horizon, they calculated the estimated separation between this surface and a second concentric surface. The value was ~54 μm.

The estimated mass emerging per second throughout the universe would have an estimated energy equivalence between 10^{53} and 10^{54} $J{\cdot}s^{-1}$, or (assuming a volume of 10^{78} m^3 for the volume (Persinger, 2013)), about 10^{-25} to 10^{-26} J per cubic meter. When divided by Planck's constant, the resultant frequency is remarkably congruent with the GHz band of the hydrogen line. The cubic meter unit is consistent with the assumption that the general density is about 1 proton per m^3 (Persinger, 2009). These general quantitative values could indicate that the energy associated with the physical features of "events" is mediated universally through some discrete feature of the hydrogen atom. Considering Ernst Mach's principle of the *immanence of the universe* whereby properties of local matter depend on the presence of the remainder of the universe, such intricate and pervasive connections between the local "now" and the whole would be consistent.

From this perspective the occurrence of the physical "now" would be our local measurement and perception of the continuous transition of virtual particles of what will happen into what is happening. The product of the gravitational constant (6.6×10^{-11} $m^3/kg\ s^2$) and the average density (10^{-27} kg/m^3) of the universe results in a duration in the order of 90 billions of years (Persinger, 2012c) or about 14% of the total age of the universe. The remaining time "yet to occur" represents the estimates for the proportion of dark matter and dark energy in the universe. If as suggested (Persinger, 2012c) dark energy and matter represent energy and matter yet to occur, then this process of transformation would be the physical events of "now". At our Δt and Δs of perception (Persinger, 1999) and measurement their probability of occurring could be discernable by measuring photon densities and their temporal patterns during the previous few days.

The experimental results pertain to the atomic level and relevance for virtual-to-matter determinism. The fluctuations of photons and the outcomes of randomly generated numbers from quantum tunneling electrons were detectable by photon fluctuations at a temporal distance of 41, 47, 48, and 71 hours. The concept of causation and influential intention upon events is complimented by the theory of Topological Geometrodynamics (TGD) (Pitkänen, 1988) and the TGD Inspired Theory of Consciousness (Pitkänen, 2003). If quantum events yet to be determined are detectable from prior background photon fluctuations emerging from the background vacuum, then the causal nature of random states of energy could be reduced to be the influence of pairs of future and past directed light-cones.

If there is superposition of states decoupled from the immediate environment, regardless of space or time but with many degrees of microscopic freedom, then the macroscopic system

could behave quantum mechanically. Assuming intentional actions produce energetic consequences the interpretation of the naturally occurring randomness necessarily resides within classical concepts (i.e., causation and determinism). The appropriate use of causal space-time descriptions would therefore depend upon the value and temporal direction of the quantum of action (Bohr, 1928).

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Addendum

The following comments were provided by the authors in response to a number of clarifications requested by one of the reviewers (Dr. Matti Pitkanen).

MP: I did not understand the theoretical considerations of the article completely and this motivated the following questions:

Question 1. I do not understand the motivation for the hypothesis that a phenomenon in spatial scale Δx is discernible in time scale Δt assuming $\Delta x/\Delta t \sim 1$ m/s. If one can bring in light velocity c meaning assumptions about what it is to be discernible, one has dimensionless scaling ratio $\Delta x/c\Delta t = 3.3 \times 10^7$. This would be fascinating but is there any empirical evidence for this claim?

Response: There is an apparent relationship between the increments of space and time pertaining to the perception of the phenomenon. If the increments are not aligned, the detection of processes which require successive temporal sequences would be summated arbitrarily and only averages could be achieved. This goes to the core argument and theme of the present investigation, which is that we are dealing with phenomena in totally different time scales, which accompany each other.

Question 2. The scale T = 2 days was derived as a ratio of two numbers. I did not understand the estimate: my version of the estimate gives the same number 1.6×10^5 but as a dimensionless number rather than having a unit of time (second). In more detail:

1. The first number, call it *X*, was the total energy flux for the fluctuation of background photons through a likely area of order micrometer squared of gap junction for electron tunnelling in RNG. This flux fluctuation occurred about 2 days before the RNG produced the sequence of samples of duration of 1 second containing sequence of 200 bits. The

criterion for a sample to be counted as an event was a deviation from mean of 100 1s (electron tunnelling) per second was more than 20 per cent. The unit of this quantity is power (J/s). About 20 such tunnelling events per hour were observed.

2. The second number, call it *Y*, was presumably kinetic energy of electron for lowest Bohr orbit in hydrogen atom multiplied by the number 20 of events per hour(!). Also this gives a quantity with unit of power (J/s). I did not understand why this choice was made and whether it relates to electron tunnelling. In any case, the ratio *X/Y* of these two quantities with dimension of power is *dimensionless* number $X/Y = 1.6 \times 10^5$ rather than 1.6×10^5 s or 44.4 hours.

Response: Yes, the timescale was computed as a ratio of two numbers. The first number was derived by taking the total energy of Bohr radius electron at the fine structure velocity 4.37×10^{-18} J. We looked at the number of occurrences of events that were of an absolute deviation from the mean by ±20 (i.e. 80 or 120) which by a mean of 100 and a standard deviation of approximately the square root of 50 is equal to a z-score of 2.86. Data was analyzed, and an average of 20.38 of these significant events occurred during a given hour, or approximately 20 of the 3600 randomly generated events. The randomly generated events are not directly representative of an individual electron, yet it was assumed that with the cascades of electrons, one would be sufficient to determine if an event was significantly deviated from the mean. So, with 20 out of a possible 3600 events being greater than an absolute deviation of z-score 2.86, multiplied by the total energy of an electron at the fine structure velocity 4.37×10^{-18} J, yields a value of 8.74×10^{-17} J as the total energy for significant deviations per hour.

The second number for the ratio was the photon variations per hour with the cross sectional area of the electron tunneling. Photon variations have a value of 4 to 5×10^{-12} W/m^2. Multiplying this value with the assumed cross sectional area of the electron tunneling at approximately 10^{-12} m^2, yields a value of 4 to 5×10^{-22} J/s.

The ratio between these two numbers is the representative temporal time scale of dispersion between the two devices. 8.47×10^{-17} J divided by 4.5×10^{-22} J/s results in 1.94×10^5 seconds or approximately 2.25 days which is within the predictor variable hours of 2 – 3 days. Assuming a distribution of electron tunneling and significant events, the orders of magnitude remain within the 2-3 day period.

Question 3. I do not understand how the kinetic energy on Bohr orbit of atom (hydrogen?) could relate to the functioning of RNG. How could it relate to tunneling? This would require a detailed explanation.

Response: The phenomenon occurs with fundamental quantum units of the electron (i.e. Bohr); hence the entire universe should be considered as involved. We would have involved Mach's principle of immanence of the universe but left this perspective for another time.

We had reasoned that if the product of the electron's mass (9.1×10^{-31} kg), fine structure velocity (2.18×10^{6} m/s) and neutral hydrogen line (1.42×10^{9} Hz, because of its immanence throughout the universe) as applied across the likely cross-sectional distance of the RNG functional tunneling width (10^{-6} m) is 2.82×10^{-21} J, it would facilitate the mechanism of an interactive representation of entropic information between the RNG and PMT devices. The energy value for a bit of information to dissipate into entropy or to appear from it according to Landauer's Limit is *kT ln2* or 1.38×10^{-23} J/T multiplied by 21 deg C (the local temperature) or 294 deg K multiplied by 0.69 is 2.82×10^{-21} J. In other words there is the potential (certainly not proof) for intercalation.

Relating, the time scale of sampling is 5 ms for 1 of the 200 randomly generated numbers. This sampling rate can also be manipulated with the software to collect up to 1000 numbers per second. Dr. Dotta has confirmed the analogue photomultiplier tube samples once per minute, from which the data was then used to calculate the hourly average for the statistical analysis. Verifying the duration of the photon flux fluctuation will require further investigations and has been identified as an important measure to be taken with this and future calculations.

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