

Acceleration of Radiative Decay of Photon Counts With Increasing Numbers of Measurement Units: A Potential Large Scale Negative Zeno Effect That Matches With Lorentz Contraction and Photon Acceleration Durations

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ABSTRACT

The reverse Zeno effect whereby an unstable quantum state associated with radiative decay is accelerated by frequent measurements was demonstrated experimentally for numbers of “spontaneous” photons in a 3 m³ hyperdark chamber during the 60 s following a burst of applied photons. Numbers of photon counts were measured from one digital photomultiplier unit when either 1 (the reference) or 2, 3, or 4 units were measuring simultaneously. There was a median decrease of 50 photons per s with the addition of each additional simultaneous measurement by another unit. The energy was ~ 10⁻¹⁷ J per s and is equivalent to a wavelength of 10 nm. This quantity is equivalent to the energy of one neuron in the human brain displaying its upper limit (~1 kHz). The results suggest that this increment of energy may be a standard quantity that reflects the numbers of measurements by similar photoelectric currents to the decay of a single photon burst. The approximately 30 to 40 s required for the decay of photons per unit to inflect towards asymptote is consistent with the solution for the Lorentz contraction for the shift in electron mass-energy (10⁻¹⁷ J) with a wavelength of ~10 nm. The 30 to 40 s value is a solution for several applications to novel calculations involving fundamental parameters within the structure of space-time.

Indexing terms/Keywords

Zeno Effect; photon radiative decay; multiple measurements; Lorentz contraction; negative Zeno effects

Academic Discipline And Sub-Disciplines

Physics; Unstable Quantum States; Physical Cosmology

SUBJECT CLASSIFICATION

Photon measurements; Radiative Decay; Space-Time Inflections

TYPE (METHOD/APPROACH)

Experimental Physics; Quantitative Analyses; Convergent Operations

INTRODUCTION

The manifestation of phenomena such as excess correlation (“entanglement”) that were presumably restricted to the spatial-temporal parameters of quantum mechanics within visible (macro) space has been demonstrated experimentally in solid-state spin ensembles by Klimov et al [1]. Dotta and his colleagues [2, 3] and Rouleau and his colleagues [4] have shown that two loci separated by non-traditional distances exhibit excess correlations between 1 m and 10 km when both share specific types of rotating (circular) magnetic fields with specific changes in angular velocity. When the excess correlation occurs the reactions within the two loci behave as they are superposed or superpositioned within the same space. Whereas scalar responses (such as the power densities of photon emissions) double in non-local space, subtle shifts in pH occur in the opposite direction than that induced in the local space by a proton donor. The effect was recently [5] demonstrated for specific and predicted properties of human cerebral fields as inferred by quantitative electroencephalographic measurements for pairs of cerebral volumes separated by over 6000 km.

We reasoned there should be other macroscopic equivalents of quantum effects that might not require facilitation by critical magnetic fields. The dynamics of radiative decay involves a special condition according to Basharov [6]. Diatomic systems following decoherence exhibit excess correlations if the two systems share a thermostat. The quantum Zeno effect is often defined as the inhibition of the decay of unstable quantum states if there are sufficiently frequent measurements. However, Kofman and Kurizki [7] found that disintegration processes can also be *accelerated* by frequent measurements due the energy spread incurred by the measurements. According to these authors “whereas the inhibitory quantum Zeno effect may be feasible in a limited class of systems, the opposite effect (accelerated decay) appears to be much more ubiquitous.” Here we present experimental evidence for this contention that is evident at the macroscopic level where the numbers of photons per second recorded from spontaneous photon emissions within a volume of about 3 cubic meters following a bright light pulse diminished proportionally as the number of photomultiplier units increased from 1 to 4.

METHODS AND MATERIALS

To discern the potency of the effect of the numbers of different instruments of measurement per unit time we employed digital photomultiplier units to record the numbers of spontaneous photon emissions in a hyperdark room ($<10^{-12}$ $\text{W}\cdot\text{m}^{-2}$). It had been constructed to measure the spectral power density profiles of photons emitted from human beings in order to discriminate normal and aberrant (malignant) body states. The chamber had been constructed to be 1.70 m in height, 1.27 m in width and 1.32 m in length. It was housed in a second room which was also darkened. Four photomultiplier tubes (3 DM0090c and 1 DM0080c) from Sens-Tech Sensor Technologies were permanently fixed within the chamber as indicated in Figure 1. The peak sensitivity for the units was ~ 490 nm. They had been positioned on a direct plane approximately 15 cm from where a participant would sit on a chair. The PMT known as the Front PMT (A) was located directly in front of the participant's torso. The Back PMT (B) was located directly behind the participant's torso. The Z-plane (or top) PMT (C) was located directly above the participant. The Head PMT (D) was located next to the right temporal lobe of the participant. To maintain a consistent background dark count, the entire chamber was draped with high stitch count fabric during data collection. In the present experiment there was no subject. Instead a green LED connected to a custom-constructed circuit [8] was placed on the seat of the chair (see Figure 1).

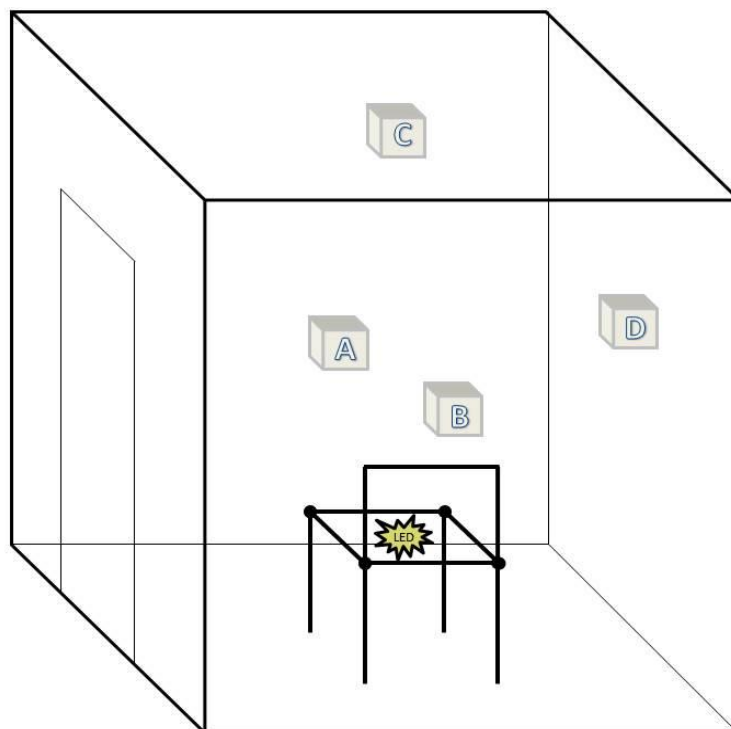


Figure 1. Positions of the apertures of the photomultiplier units (grey boxes) within the dark chamber. The chair indicates the position of the LED (covered with a cloth).

The measurements from the four sensors were obtained by a combination of the manufacturer's software and custom software so that the photon counts could be seen simultaneously on the screens of the laptop computers. The computers and experiments were outside of the dark chamber during the measurements. The small green LED that was placed inside the dark box was connected to a rectifying dial outside of the chamber. The dial was set at the lowest limit. The LED was covered with a laboratory coat and was located about 0.55 m from each of the sensors. The LED was activated for 30 s. Approximately 5 s after the light was extinguished the photon counts from either: 1, 2, 3, or 4 PMT units were measured simultaneously for 60 s with constant sampling rates of 50 Hz (time bins 20 ms) which was the upper limit of the software. Each experiment employing the different numbers of measurement units was completed 4 times. With each experiment the numbers of units activated per measurement was counterbalanced. The measurements, when the LED was activated, were about $8\cdot 10^6$ photons per s (saturation is likely $5.8\cdot 10^8$ counts per s). The dark counts for each PMT, a value which is unique for each unit, were subtracted from the average measurements for the 60 s segments.

RESULTS

The mean numbers of counts and the standard errors of the means (vertical bars) as a function of the numbers of photomultiplier units operating at the time of the measurements are shown in Figure 2. The mean values for the simultaneous measurement by 1 through 4 units were 236, 160, 118, and 68 photons per s, respectively. These measurements were the final measurements after the elevated counts associated with the pulse of green light approached asymptote and stabilized.

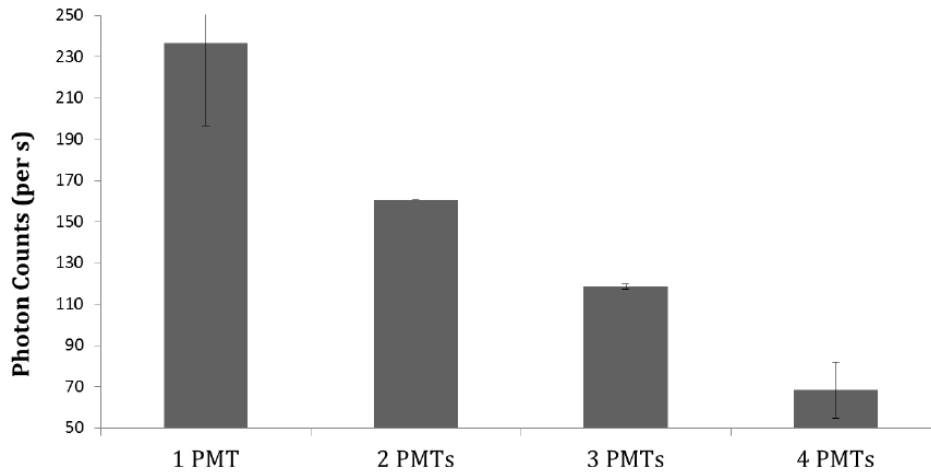


Figure 2. Numbers of photons per s recorded from one photomultiplier unit when the 1 (the unit) or 2, 3, or 4 units were recording simultaneously. Vertical bars indicate standard errors of the mean.

The net differences between 1 vs 2, 2 vs 3, and 3 vs 4 simultaneous measurements by photomultiplier units were 76, 42, and 50 photons per s. Assuming each photon displayed the median energy of 4×10^{-19} J and the average diminishment of photons per s as a function of numbers of measurement units was 50 photons (the median value), the energy would be $2.0 \cdot 10^{-17}$ J. The equivalent frequency (from dividing Planck's constant) would be $0.3 \cdot 10^{17}$ Hz and the corresponding wavelength assuming c (the velocity of light in a vacuum) would be about ~ 10 nm. The average decay times for all trials following the burst of photons when either 1, 2, 3, or 4 units were measuring are shown in Figure 3. Visual inspection of the graphs indicate that at least one qualitative inflection as asymptote is approached occurred around 30 to 40 seconds.

DISCUSSION

The results of this experiment involving the different numbers of photomultiplier units in measurement mode at any given 60 s interval while numbers of photons were recorded is consistent with Kofman and Kuriziki's [7] position that the energy spread that is incurred by frequent measurement accelerates the rate of disintegration of the system. We measured fewer background or spontaneous photon emissions as a function of the numbers of measurement units following the pulse of light energy into the volume around which the photomultiplier units were placed. The consistency of the effect between integers of instruments measuring at any given time indicates that the radiative decay was accelerated. Whether or not there is some equivalency between frequencies of observations or the numbers of units of single observations in the same space that accelerates rates of disintegration must still be determined.

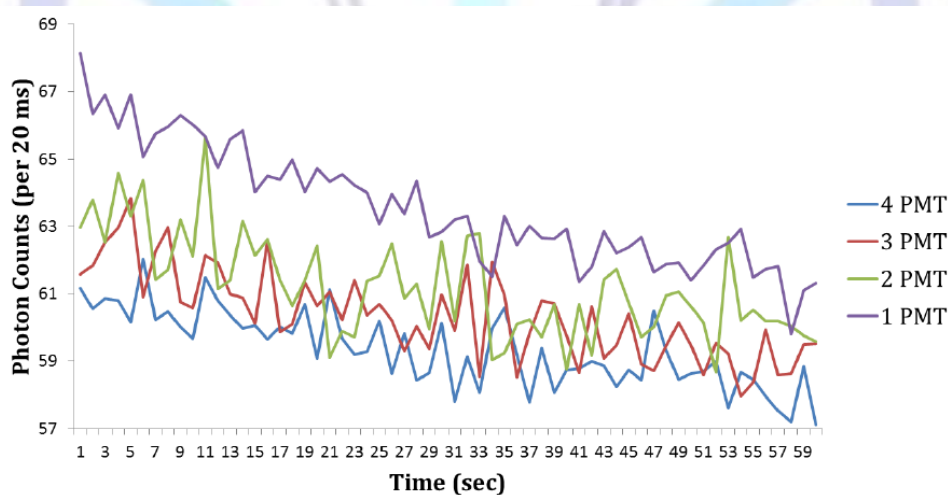


Figure 3. Averaged photon counts per 20 ms beginning 5 s after the offset of the LED during the subsequent 60 s from the reference photomultiplier unit when only the unit or 1, 2, or 3 additional units were measuring photon counts simultaneously.

The amount of energy from photons that was lost with incremental increases in the numbers of simultaneous measurements was about $2.0 \cdot 10^{-17}$ J per s at the aperture. That would be equivalent to $\sim 10^{-13}$ W·m⁻² and within the range of the flux density of cosmic ray (primarily protons) at the earth's surface. Assuming the typical $\sim 2 \cdot 10^{-20}$ J associated with each action potential from a neuron [9], the increments of energy diminishment with the addition of each measurement



would be equivalent to 10^3 action potentials per s. This is the upper boundary for the numbers of action potentials per s for a single neuron. Recent experimental results [10, 11] have demonstrated that a single neuron can change the state of the cerebral cortices and affect the occurrence or non-occurrence of an overt response. There is a long tradition in Science and Philosophy that observations or intentions involved with observations can affect dynamic phenomena such as radiative decay. If our results are applicable the coherent activity of 100 neurons discharging at 10 Hz or 1 neuron discharging at 1 kHz in a second would be the threshold to produce the negative Zeno effect.

We have considered the similarity of the time ($\sim 10^{-16}$ s) for a photon moving at the velocity of light to traverse a plasma membrane (10 nm) of a cell of and the time for an electron to complete one orbit of a Bohr magneton to be more than coincidence. The significance of this convergence is emphasized when one considers that the energy-equivalent associated with the mass of an electron moving at the square of the fine structure velocity for one orbit is remarkably similar to Planck's constant. The small discrepancy in coefficients is primarily the well known ratio between the electron's spin and orbital magnetic moment. The equivalence of that quantity of energy we measured with the addition of each photomultiplier unit to a wavelength of about ~ 10 nm suggests an alternative explanation for the persistence of this width as functional membrane spaces as well as distances between many cell boundaries. If the cell membrane or the separation between two membranes is considered a representation of multiple measurements units of unstable quantum states from incident photons, then these quantities might be required to quickly stabilize the intra-membrane environment.

The approximately 30 to 40 s that was required to inflect as the asymptote was approached may reveal mechanisms or processes. There are several potential origins for the time constant of the dynamic diminishment of photon detection. Locally, the first to examine would be the variant of a time constant based upon traditional approaches to RC circuits. If C (capacitance) for air (which is similar to a vacuum) is $8.85 \cdot 10^{-12}$ F·m⁻¹ then to obtain a time constant of ~ 30 to 40 s, the resistivity ($\Omega \cdot m$) must be in the order of 10^{11} to 10^{12} $\Omega \cdot m$. This well within the values occupied by the large range for glass and related silicate oxides.

However we suggest a more universal and exact solution can be derived from the Lorentz contraction. It is defined as $[\sqrt{1-(v^2/c^2)}]^{-1}$. For 30 to 40 s the required velocities would be between $2.9965 \cdot 10^8$ m·s⁻¹ to $2.997 \cdot 10^8$ m·s⁻¹ compared to c. The difference in energy equivalence for electron or a packet of energy with that mass equivalence with these upper and lower velocities is $2.7 \cdot 10^{-17}$ J. This is remarkably similar to the successive quantities that were recorded with the addition of each photomultiplier unit to the measurements. The equivalent wavelength would be ~ 10 nm. This is remarkably close to the equivalent wavelengths of the packet of energy that was diminished with the addition of each measurement unit. It may be relevant that the typical distance between the potassium ions frequently attributed to the average value resting membrane potential of mammalian cells is ~ 10 nm.

We would expect some convergence with a gravitational-inertial variable, considering the Lorentz contraction is reflective of alterations in inertial reference frames. It may relevant that the ratio of the rotational (angular) velocity of the earth at the latitude where our measurements were made and g (9.8 m·s⁻²) is 35 s which is within the 30 to 40 s range. In addition, the energy from the acceleration of a photon [12] at rest mass [$\sim 2 \cdot 10^{-52}$ kg] ($9 \cdot 10^{16}$ m²·s⁻²) is $1.8 \cdot 10^{-35}$ J. When divided into Planck's constant (the approximate energy from one orbit of an electron) the duration is 37 s [13].

CONCLUSIONS

The negative Zeno effect has been inferred within subatomic and quantum domains of space. In the present experiment the radiative decay of a burst of photons as measured by digital photon multiplier units was accelerated as a function of the numbers of simultaneous measurements. The calculated increment of energy diminishment as a function of the number of units measuring was equivalent to a wavelength of about 10 nm. The range of the asymptote which was about 30 to 40 s after the termination of the burst of photons solved for a range in Lorentz contractions that was effectively the same energy as the increments of diminishment. The results suggest that the energy quantity associated with the Zeno effect occurs within macro-space, may reflect an intrinsic feature of space-time, and could be simulated by a single neuron discharging at its upper boundary.

ACKNOWLEDGEMENTS

The authors thank Dr. W. E. Bosarge, Chairman, Quantlab LLC for the financial support to purchase and to build the equipment.

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Authors' Biographies with Photos



Blake T. Dotta, Ph.D. is associated with the Biophoton and Quantum Molecular Biology Laboratories at Laurentian University. His research is focused on the relationship between photon energies, cellular processes, and the photonic structure of space-time. He and his colleagues demonstrated the equivalence between specific biomolecular pathways in cancer cells and the specific wavelengths of photonic energy emitted by these pathways. He has demonstrated excess correlations (entanglement) between local and non-local spaces for photon emissions and shifts in pH in aqueous solutions when both loci are exposed to weak rotating magnetic fields whose phase and group velocities are dissociated. His goal is to relate realistic quantum effects to human cerebral function, particularly consciousness.



David A. E. Vares, is a Ph.D. student of the Interdisciplinary Human Studies Program and a Member of the Biophoton and Quantum Molecular Biology Laboratories at Laurentian University. He demonstrated the relationship between the paucity of 3.6 to 3.7 M quakes globally and their potential connection to Planck Length energies. He has applied basic physics to interpersonal distances as factors in cancer prevalence and the potential contributions of energies from small magnitude global seismicity to human group conflicts. Recently he and his colleagues demonstrated a strong (0.99) inverse correlation between global warming in the atmosphere and oceans, carbon dioxide increases, and the diminishing strength of the earth's magnetic dipole. The quantitative change in intermolecular magnetic energies converged with bulk changes in global temperature and CO₂.



Michael A. Persinger, Ph.D. is a Full Professor at Laurentian University in Sudbury, Ontario, Canada. He is affiliated with a number of different programs including Biomolecular Sciences, Behavioural Neuroscience and Human Studies as well as the Quantum Molecular Biology Laboratory where he is examining the relationship between 10^{-20} J events within the brain and complex functions. Dr. Persinger and his colleagues have experimentally demonstrated the validity of Cosic's Molecular Resonance Recognition Model, Bokkon's Cerebral Photon Field Hypothesis and the efficacy of proton driving patterned magnetic fields that inhibit the growth of cancer cells but not normal cells. He is an interdisciplinary scientist whose primary goal is to integrate the physical sciences, social sciences and humanities according to their fundamental operations. Within the last 50 years he has published more than 500 technical articles in variety of areas that range from Astronomy to Zoology. His present experiments are focused upon understanding the relationship between the structure of space and distribution of energy, the shared dimensional equivalence of quantized gravitational and electromagnetic fields, and the empirical demonstration of an intrinsic entanglement velocity.