

Noise Sources and Paranormal Investigation - Potentials for Detection

Donn Werrbach
Time Domain Laboratory Inc.
January 31, 2014

Abstract – I have postulated the existence of a “Metaphysical Boundary” and a discussion about that is presented on my blog site at www.timedomainlab.com/donns-blog.html. Hereinafter I will, for brevity, refer to the Metaphysical Boundary simply as “the boundary”. I have proposed that the boundary comprises a noisy structure, i.e., a structure of random energy that separates our known universe from a parallel universe, often called “The Other Side” or “The Other Dominion”. This paper builds upon that concept and delves into the various kinds of random noise that exist in our universe that may in fact comprise the boundary where we might start looking for paranormal energy that is bleeding through or trapped within.

If paranormal energies are impinging on the boundary, the most likely places to detect it would be at the verge of the boundary, in other words the lowest thresholds of the physical and electromagnetic domains where the quantum values are stochastic. This is where the random noise energies dominate the metrics of measurement and detection. It seems logical that paranormal energies would be detectable if they in any way upset the perfect randomness of the noise floor. We may be able to detect signaling codes or even voices coming from a parallel universe.

It is my belief that a survey of the commonly known random noise sources will lead to more successful paranormal investigation by focusing on the noise sources most likely to be influenced or infused by paranormal energy.

1. Self Organized Criticality

A key element of this study is the physical property of “Self Organized Criticality (SOC)^{1,2}”. Although there are many and various definitions given for SOC depending on what field (physics, human behavior, sand piles, etc.) to which it is applied, I can sum it up this way. Just about all things tend to find equilibrium at the verge of stability. In other words, natural systems settle only to the minimum point of stability and do not continue settling to a more stable state. If stability is disturbed by some event, the system will go out of stability for a time and settle back to the original state or another point of minimum stability. We can see examples of this wherever we look, and it is true down to the atomic level. It’s simple to understand when you realize that the forces acting upon each other eventually just balance out to a point of stability, and if one force changes, the other accommodates in some way. A simple example is water droplets laying on a table. If a second droplet rolls over to it, the two combine into one and just lay there. One droplet does not attempt to reach out and absorb more droplets in order to be “more stable” against future probabilities. A car rolling against a curb stops. If the car is given a push it may run over the curb but it will again stop as soon as it finds the next minimally stable state. How this applies to the present purpose is that all of the random noise sources exhibit SOC in some way. Observing SOC in a noise source can reveal events that force it to resettle which would be seen as a spike in the magnitude. This gives us a way to detect paranormal signaling at or near the boundary.

2. Colors of Noise

It is conventional to name spectrum characteristics with colors. It’s probably because of the interpretation of the eye to the spectral balance of visible light. We simply apply the color classifications to the spectral balance of any given

sound or EM frequency range of interest. The spectrum of interest (for paranormal investigation) in most of the noise systems I am writing about in this paper runs from the very low frequency spectrum, below 1Hz, up to a hundred megahertz or so.

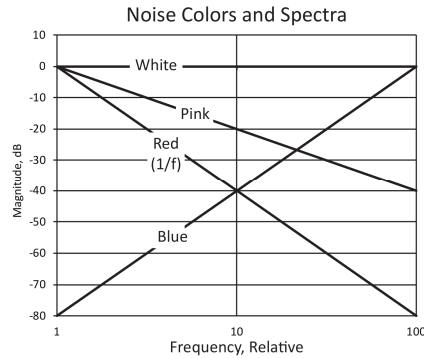


Figure 1 – Noise Colors

White Noise. This is a natural random noise that has a constant power at all frequencies. When measured with a constant bandwidth swept analyzer, the spectrum display will be flat. High-end laboratory spectrum analyzers provide constant bandwidth measurements but are often too expensive for practical applications. More practical (less expensive) analyzers for experimenters and certain professional applications such as acoustic testing do not have constant bandwidth capability. They are known as “constant – Q” analyzers. White noise measured by a constant-Q analyzer displays a 3dB per octave rising level for reasons I will explain. I point this out as a lead-in to “pink noise”.

Pink Noise. This is an unnatural noise type that is generated by passing white noise through a -3dB per octave electronic filter in order to have a noise source that will look flat to a constant-Q analyzer. We don’t find pink noise in nature.

The main use for Pink Noise is acoustic measurement where a less expensive fractional octave analyzer (constant-Q) can be employed to show a flat frequency response. I will now explain a little about this for the reader that is not intimately knowledgeable about signal analysis because I think it is important to know a little about how noise measurements are made.

Constant-Q swept filters or discrete band (i.e., octave, half octave, 1/3 octave, etc.) measurement filters are much easier to build than constant bandwidth filters for many reasons that are beyond the present scope. Suffice it to say a constant bandwidth lab analyzer costs \$40,000.00 while a constant-Q analyzer available to most experimenters may cost only a few hundred dollars. Before anyone starts writing me, I am aware that computer software is now available that can do credible constant bandwidth measurements at a low price. However, take into account that over past years that has not been the case. Take this treatment for its historical value. Also, bear in mind that constant-Q measurements may still be preferable because they gather results much faster than digital FFT or constant bandwidth swept analysis. If we are looking for paranormal phenomena, we want to have our instruments be as “real time” as possible to capture transient events. Here’s some very simple math:

$Q = f / bw$ - the definition for “quality factor”.

Where:

f = center frequency of the filter band

bw = bandwidth of the filter (traditionally at the -3dB limits relative to center gain)

For constant Q, bw increases proportional to frequency: double the f, double the bw.

White noise displays a 3dB per octave rising level because the admitting bandwidth of the filters is doubling for every octave. (3dB equals doubling of the noise power.) Pink noise compensates with half power every octave.

Red Noise. This is a naturally occurring noise type following the general (1/f) law. The frequency response is -6dB per octave (or -20dB per decade) when $\alpha = 1$. The general expression is:

$$V(n) = 1/f^\alpha$$

Where:

f = frequency

$\alpha = .5$ to 1.5, usually 1

The importance of red noise will become evident later in this paper.

Blue Noise. This is a naturally occurring noise found in FM radio receivers. It rises at the rate of 6dB per octave and can be very disagreeable for listening. A -6dB per octave de-emphasis filter is used in the audio circuits of FM receivers to reduce the overall noise level and make it white which is more tolerable for listening. To restore a flat broadcast frequency response, a pre-emphasis filter (+6dB per octave applied to the audio) is used in the FM transmitter to compensate for the receiver de-emphasis filters. The noise expression is:

$$V(n) = f$$

I am not sure how important this is to paranormal investigation, but since it is a physical part of FM radio we should at least understand that it exists since EVP recordings have been associated with FM radio sets. Maybe we can do better by removing or modifying the FM receiver's de-emphasis filter. That's a topic for later investigation.

3. Types of Noise

There are numerous types of random noise that exist in nature that can be easily detected and measured. These are separate and apart from non random noises like engine whine, crowd noises, someone babbling on a cell phone or an airplane going by. In this study, hereinafter the word "noise" will refer to random noise produced by some stochastic (randomizing) process.

Following is a list of the generally studied noise types:

- A. Thermal (Johnson) Noise
- B. Shot Noise
- C. Avalanche Noise
- D. Flicker Noise
- E. Burst (Popcorn) Noise
- F. Transit-time Noise
- G. Solar Noise
- H. Cosmic Noise
- I. Radioactive Decay
- J. Planet Generated Noise
- K. Generation-Recombination Noise

I will write a little about each of these, giving references should you wish to delve any deeper.

A. Johnson Noise⁴. All electrical conductors generate this noise whether carrying a current or not. It is purely a function of resistance, temperature, and the frequency bandwidth of interest. The expression for Johnson noise:

$$V(n) = \text{SQRT}(4*k*T*R*BW)$$

Where:

$V(n)$ = RMS noise voltage

k = Boltzmann's constant ($1.38 \text{ e-}23$)

T = Kelvin temperature

R = Resistance (Ohms)

BW = Bandwidth in Hertz

Johnson noise shows up in all electronic circuits. It is present in amplifiers due mostly to the high circuit resistances and to a negligible extent to wiring or conductors because of their relatively small resistance. It is a limiting factor in the signal to noise ratio of microphones and preamplifiers and many other types of sensors.

The origins of Johnson noise are at the atomic level where electrons are thermally agitated. In the agitated state, electrons jump quantum levels randomly but taken as a massive whole, as in a piece of metal, the sum of their energy creates white noise. Since current flow is not a factor in Johnson noise, magnetic induction fields and other disturbances have little or no effect on the noise power. For this reason, I predict that monitoring a Johnson Noise Generator will not yield much sensitivity in paranormal investigation. However I am not ruling it out for experimentation.

B. Shot Noise⁵. This noise is caused by electron current flow. It always exists in combination with Johnson Noise. Shot noise is independent of temperature and white in spectrum. It can exist in any current carrying object including wires, resistors, mosfet transistors and vacuum tubes. Shot Noise current and consequential noise voltage can be calculated quite easily as a function of conducting current and circuit resistance. The expression is:

$$I(n) = \text{SQRT}(2 * q * I * BW)$$

Where:

q = charge of an electron ($1.602 \text{ e-}19$)

I = amperes

BW = bandwidth (Hz)

Also,

$$V(n) = I(n) * R$$

Where R = ohms of resistance carrying the noise current

The measurement of Shot Noise is generally masked out by Johnson Noise. They are both white and add together as a single noise generator for all intents and purposes. Under normal circumstances Shot Noise is much smaller in voltage. However, in certain circumstances such as the current passing through a vacuum tube amplifier, Shot Noise can be detected and measured. I am thinking about constructing a tube amplifier optimized to generate shot noise for paranormal investigations. Unlike Johnson noise, shot noise can be influenced by external forces because it is current dependent. In a vacuum tube any magnetic or electric field can modulate the current density. This could turn out to be a sensitive enough detector to measure paranormal energy or obtain EVP's.

C. Avalanche Noise⁶. When a PN semiconductor junction is stressed by a sufficient reverse applied potential it will break down catastrophically in what is called "avalanche mode". In that condition it becomes a strong conductor and would self destruct if limits are not placed on the current flow. With a limit placed on the current flow, the diode will self regulate right at the threshold of its reverse breakdown voltage. Diodes that are made to operate in this mode are called Zener Diodes. Zeners are manufactured with varying doping levels to establish controlled breakdown voltages and are frequently used as cheap voltage regulators. While a Zener is regulating, it dithers about its breakdown voltage due to radical current carrier recombination in the PN junction. The result is relatively strong random noise generation over a very wide bandwidth extending well into the microwave frequencies with a white spectrum.

Bipolar transistor base-emitter junctions also exhibit avalanche breakdown. Small signal transistors generally break down at about 7 volts and can be used as very low impedance Zener diodes at low currents. I have used this property many times in precision circuits that I have designed. Avalanche noise is widely used to build random noise generators, and indeed the noise sources used in the Global Consciousness Project³ are avalanche based.

Unfortunately I have not been able to find a definitive equation for calculating avalanche noise. There is a wide disparity of noise magnitude among diodes and transistors so this noise must be process dependent and not reliably calculable. One simply needs to try a number of devices to obtain the best noise output.

It seems possible that external influences can alter the state of PN junction avalanche because it is dependent on starter voltage, operating current, temperature, and to some extent electric and magnetic fields. We must not forget that PN junctions are also responsive to photons, x-rays and cosmic rays. A transistor chip that is not encased may be a very sensitive paranormal detector. I intend to pursue that experimentally.

D. Flicker (1/f) Noise². This kind of noise is found in many natural systems both electrical and mechanical. Self-organized critical (SOC) dynamical systems give rise to 1/f noise for reasons that have been studied at great length. Since almost every dynamical system obeys SOC, they exhibit 1/f noise. Things like tectonic plates, sand piles, and human social behavior can be shown to exhibit 1/f noise. In electronics, 1/f noise is present in semiconductors. In most cases, this noise predominates over Johnson and shot noise at lower frequencies, generally below 1KHz and below 100Hz in so-called “low noise” devices where shot and Johnson noise have been minimized by optimal design. Since the origins of 1/f noise are with SOC dynamical processes, the entire environment can have an influence on the magnitude of the noise that is being generated. When a process is at critical stability, even small fluctuations in environmental variables can generate all sizes of noise spikes. For this reason, I believe that monitoring 1/f noises could be the most sensitive way of detecting paranormal energy. This would not be limited to electronic circuits, but to mechanical devices as well such as a building’s vibrations or even air pressure and sound. I am working on ideas to measure and analyze 1/f noise sources to detect the presence of paranormal energy but I expect it will not lead to EVP results since the detectable 1/f noise spectrum is at frequencies well below the voice frequency range. However, detecting abnormal spikes in the 1/f noise level could offer credible supporting evidence of the presence of paranormal energy when correlated with other indications such as EVP’s, apparitions or other suspected paranormal activity.

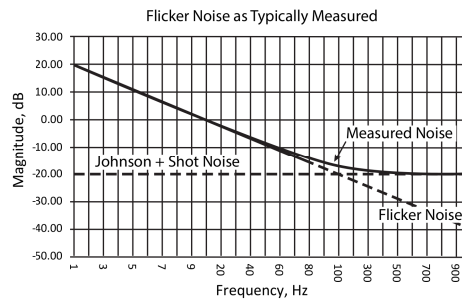


Figure 2 – Flicker Noise

E. Burst Noise⁷. This is a type of noise that occurs in semiconductors. It consists of impulses of fixed amplitude repeating at unpredictable times. The effect is a popping sound and it sometimes is called popcorn noise. There is no single source to explain this phenomenon but the usual explanation is the clumping and sudden releasing of charge carriers at the contact interfaces with imperfections in the bulk semiconductor. It is mostly associated with integrated circuits, possibly because of the many conducting layers and stratified doping that is present where there are many potential sites for charge carrier anomalies. However, burst noise can be observed in simple devices such as diodes and transistors. It has largely been eliminated in modern semiconductor fabrication by optimized wafer processing and semiconductor material purification.



Figure 3 – An Example of Burst (Popcorn) Noise

I think it is unlikely that monitoring burst noise will yield much sensitivity to paranormal energy partly because we would have to find semiconductor devices that exhibit burst noise which would entail hand selecting from a large quantity of devices to find the worst cases, and then tailoring a circuit to that specific device. Additionally, the baseline of burst noise varies unpredictably so it would be difficult to separate paranormal influence from random chance.

F. Transit Time Noise⁸. This type of noise occurs in radio-frequency transistors above the VHF frequency band. The noise level rises as a function of frequency (blue noise) and destroys the usefulness of devices at some limiting frequency. It is a function of the base-emitter thickness which determines the charge carrier transit time. That is why very high frequency bipolar transistors have thin structures and subsequently a relatively low breakdown voltage (only a few volts). Gallium arsenide field effect transistors are commonly used above a few hundred megahertz to avoid this issue in modern radio systems. TT noise is very difficult to experiment with and therefore I do not consider this type of noise to be practical in paranormal investigation at this time.

G. Solar Noise⁹. The sun radiates a huge amount of radio frequency noise that reaches the Earth. It can be received by radio receivers at all frequencies and can be strong enough to disrupt communications ranging from AM radio to satellite links. Solar noise varies greatly depending on sunspot activity and has a cyclical characteristic recurring every 11 years. Interestingly, we are now in the middle of “Cycle 24” (year 2014 as I am writing). This is the 24th cycle since 1755. You may have noticed how radio stations seem to be noisier in the weak reception areas. Satellite TV sometimes blanks out if your dish points towards the sun at any time of the day. EVP’s reportedly have been recorded off of radios so there might be some possibility that paranormal energies can “ride in” on Solar noise.

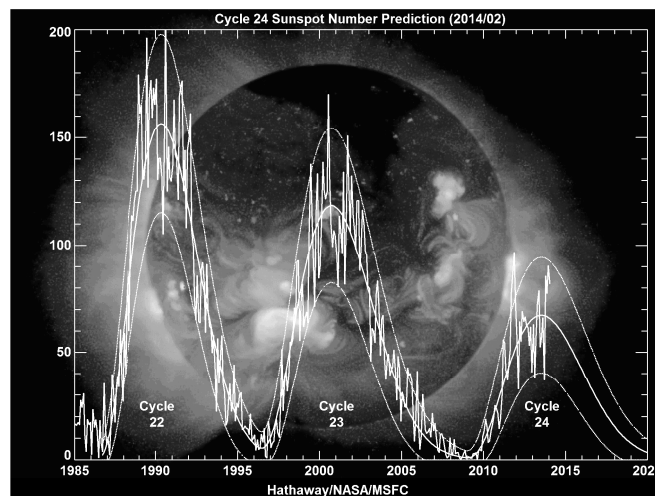


Figure 4 – Image Courtesy of NASA²⁸

H. Cosmic Noise¹⁰. Within our galaxy there are many radio noise sources – every star emits a spectrum of noise that speeds through space and reaches the Earth. Just as we can see the light they emit, we can also receive the radio spectrum noise. Granted it is very weak compared with solar noise.

A second classification of cosmic noise is **cosmic rays^{11, 29}** from outer space. These are high energy particles that can erase computer memory chips or even damage electronic devices on Earth. Cosmic rays hitting the Earth are fewer during sunspot peaks and more frequent during sunspot lulls. This suggests that the solar wind, which is stronger with sunspots, repels cosmic rays away from us. The origin of cosmic rays is one of the most puzzling mysteries of the universe. It has been found that cosmic rays come from all directions, and not mainly from the center of our galaxy as scientists once thought. In tracking down origins of cosmic rays, no remarkable features have yet been found at in deep space that has been triangulated by research satellites.

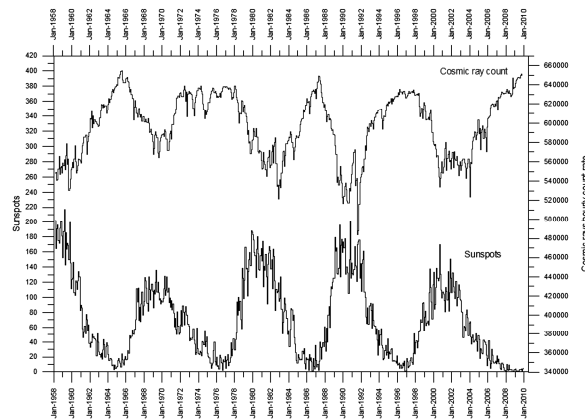


Figure 5 – Cosmic Ray Intensity –VS- Sunspot Cycles

It is possible to build cosmic ray detectors that can count events over time. This is certainly an interesting area to investigate – maybe paranormal energies inadvertently gather or occlude cosmic ray penetration. The problem is detecting cosmic rays with a reliable and practical device that can isolate cosmic rays from other forms of ionizing radiation (x-rays, radioactive isotopes, etc.) that exist in the natural environment. The cited reference describes some of the existing methods that are being used, but most are very esoteric.

I. Radioactive Decay¹². The decay of radioactive isotopes occurs randomly and can be considered a stochastic process because, although the rate of decay is constant, exactly when each atom will decay is unpredictable. The forces that bring a given atom to the point of decay describe a self organizing criticality. This is strongly suggested by the fact that radioactive decay generates a 1/f spectrum. Using a Geiger counter to measure background radiation may reveal paranormal energies if the 1/f noise can be seen to spike. I am considering a method to expose a weak isotope to a Geiger-Muller tube separated by some distance to see if a paranormal entity can be coaxed into upsetting the critical stability and spike the noise reading.

J. Planet Generated Noise^{13,14,15,16,17}. This is a nebulous area to deal with because there are so many mechanical and electromagnetic contributors. I have tried to provide the interested reader with adequate references for deeper study.

The Earth is not a static body. The process that causes tectonic motion is definitely SOC in nature and we continuously detect the rumbling noise of the subduction zones as they maintain critical stability. Measurements near fault lines turn up similar results as the disjointed bedrock layer scrapes together. Pressure keeps building up until enough pressure is gathered to cause a breakdown of one or both masses. This is classically a self-organized criticality. That’s why earthquakes eventually stop. The minimum critical stability is reached and the compressing

forces are no longer strong enough to sustain the breakdown. The greatest known perturber of the Earth's rumblings is the gravitational pull of the Moon. Think of the Earth as a giant ball of Jelly.

Other forces within the planet, some still mysterious to science, generate detectable mechanical and electrical waves. Given that the Earth's core is composed largely of iron, we can detect electromagnetic signals that are generated by movement and vibration deep beneath the surface. Interestingly, the spectrum of electrical Earth waves is 1/f. Whatever is going on within this planet is organizing its own criticality.

*Seismic Noise*¹⁸ has been described as "comprising a diversity of different, spatially distributed, mostly unrelated and often continuous sources" creating a stochastic process (random noise). Above 0.1 Hz, the noise spectrum that is typically measured follows the 1/f law as one would expect while there are some resonant peaks below 0.1 Hz, typically centered at (under .001 Hz), .075 Hz, and .2 Hz that are probably excited physical resonances of the Earth mass. Seismic noise has been intensely studied and you can find hundreds of books and papers that have been published.

EM wave phenomena emanate from the Earth continuously. At and directly below the surface are various densities of iron deposits that are clumped or gathered in formations that can be detected by aerial magnetometry. The magnetic anomalies of North America have been charted and can be viewed at reference [26].

As the Earth vibrates and churns, these magnetized domains emit EM waves. It is like taking two magnets and wiggling them against each other. If you had an antenna nearby you would receive an EM signal. We cannot usually detect these EM waves on our ELF meters because the frequencies are below the meter's cutoff frequency. However, if we are near a strong magnetic site, we could wave the ELF meter around and get a signal due only to our physical movement within the flux field. This is a good fact to know for paranormal investigators. If you only get indications when you wave the meter around it is probably you that is causing it.

*Schumann Resonance*²⁷ is widely considered to be the Earth's natural electromagnetic surface resonance. The surface of the Earth and the ionized layers of the upper atmosphere create a waveguide that carries (with substantial losses) EM waves at the fundamental Schumann frequency and its harmonics. That is why we find a rich mixture of EM signals that travel great distances around (not through) the Earth. Schumann resonant frequencies penetrate the ocean water and facilitate submarine communications albeit at a very low data rate. The resonance expression is:

$$f(n) = (c/(2*\pi*a))*SQRT(n*(n+1))$$

Where:

c = speed of light

a = Earth's radius

n = harmonic mode (1,2,3..)

It is usually given as 7.83Hz at the fundamental frequency (n=1).

I mention this because there can be a great deal of confusion when measuring anomalies in this frequency band. One of the biggest contributors is lightning which excites the Schumann resonance and propagates the EM wave for many thousands of miles. The Navy uses this frequency band for submarine communications and marine locator beacons. It would be fun to construct a receiver to pick up what can be found in this frequency band, but I don't yet see how to exploit it for paranormal investigation.

Piezoelectric Earth Rocks Are known to emit electric current when under great pressure. Think of the spark igniter in your cigar lighter (or gas range). That snapping spark comes from a piezo crystal that is struck by a tiny hammer. Thousands of volts can be generated by such a small crystal, so think of the enormous power that huge granite rocks and quartz veins underground can produce.

Since all rocks under the Earth's surface are under the pressure from their overburden, any change in stress can cause a piezoelectric reaction. Normal vibrations under the surface cause continuous piezoelectric output and, of course, any seismic shock can cause huge energy spikes. Hard rock mines often follow quartz veins where gold and silver are concentrated. An ELF meter operating inside the mine will frequently show a background level punctuated by sudden high spikes. Some explorers have associated this indication with ghosts or the paranormal. They didn't expect to see any indications so deep and away from manmade electric fields. However, one should always expect to get these indications in such places. Even while standing on the surface in a remote enough place, to avoid manmade interference, one can sometimes obtain ELF readings from natural electric impulses generated underground. Paranormal investigators have been regularly associating ELF spikes with hauntings, but I don't know whether the spikes are caused by paranormal energy or if the natural piezoelectricity has a way of channeling paranormal energy. This is a good topic for another paper.

For scientific interest, monitoring electromagnetic emissions from the Earth is becoming the next frontier for earthquake prediction^{21,22}. It has been discovered that unstable seismic locations emit relatively large EM waves just before earthquakes occur. The EM frequencies are usually below 1Hz where ELF meters don't register. I am thinking of building an ELF meter that can register in that super low frequency range just for general curiosity.

I have only scratched the surface about Earth generated noises, but I find this study very interesting from the standpoint of detecting paranormal energy. For one thing, on a macro level it seems most *unlikely* that we could observe paranormal energy interacting or modulating Earth noises simply because the strength of Earth noise is so great. It has been my postulation that we would most likely detect paranormal energy at very low noise thresholds closer to the molecular and atomic level. However, one must keep in mind that ghost hauntings are popularly paired with local ELF readings that are very likely attributable to piezoelectric phenomena within the Earth. It does seem possible that local piezoelectric fields could serve as a medium for paranormal energy diffusing into our universe. I intend to stay open minded about this.

Generation-Recombination Noise^{23,24,25}. This is a white noise associated with electronic photon detectors and other semiconductors. It is caused when electron charge carriers become trapped in a quantum state and then manage to jump to a second state. It happens in a random process causing unwanted noise. The SOC rule does not seem to apply, firstly because the noise spectrum is white, and secondly because the critical stability threshold is pretty binary. The trapped electron has only two predefined places to exist, so stability is not really self organizable.

Photon detectors are everywhere around us. Infrared remote controls use them, as well as motion detectors and smoke detectors. Digital cameras use photon detectors for imaging. If paranormal energy could cross into the photon detector noise, it could potentially be detected as a faint image or as a motion event in a motion detector.

I do not know if this is the mechanism for capturing paranormal images on cameras, but it may well be. By operating a photon detector at threshold levels using very hi gain amplification, we could maximize the noise level and perhaps create a sensitive paranormal energy detector. I plan to experiment with this.

4. Summary and Comments

The purpose of this paper has been to show the relevance of noise sources, not necessarily as electronic instruments, but as places to look for paranormal energy. I do believe that devices created to aid paranormal investigation can be made which detect anomalies in the molecular noise floor of our universe.

I predict the sources that exhibit 1/f spectrums are the most probable to yield results for paranormal energy detection because we can associate unexplainable abnormalities in the noise level with paranormal disturbances. That notwithstanding, many of the white noise sources may also have some potential. Devices where shot noise is predominant might offer sites for paranormal energies to exert influence. Operating a vacuum tube triode or

pentode at current that maximizes the shot noise with high voltage gain might be very useful, particularly if the tube has a primitive construction with minimal shielding of the cathode structure. Antique radio tubes may offer the best solutions.

In another direction, I envision an array of avalanche diodes, each with its own noise amplifier and LED indicator as a sort of imaging device. The array may be placed at a suspected location and individual lights would blink whenever the avalanche noise of the associated diode varies from normal. This would coarsely “image” a paranormal energy field passing through it. The array could be something like a 32 x 32 grid covering a square meter of area. How exciting would it be to see a blob shaped image as a spirit or ghost passes through it?

Simpler noise generators based on transistor junction or photon noise may also offer small and compact portable detection devices that could both signal a triggered event or continuously record signals from the other side. I think it is very likely that we can capture good EVP's with some of these devices.

5. References

- [1] http://en.wikipedia.org/wiki/Self-organized_criticality
- [2] http://www.scholarpedia.org/article/1/f_noise (section 3.2)
- [3] http://www.mpa-garching.mpg.de/~ensslin/Lectures/2011-1/SeminarTalks/f^1_noise Matthias Strauch.pdf
- [4] http://en.wikipedia.org/wiki/Johnson%E2%80%93Nyquist_noise
- [5] http://en.wikipedia.org/wiki/Shot_noise
- [6] <http://www.radio-electronics.com/info/rf-technology-design/noise/avalanche-noise-basics.php>
- [7] http://en.wikipedia.org/wiki/Burst_noise
- [8] [en.wikipedia.org/wiki/Noise_\(electronics\)#Transit-time_noise](http://en.wikipedia.org/wiki/Noise_(electronics)#Transit-time_noise)
- [9] http://www.vk3um.com/SunNoise_Measurements.pdf
- [10] http://en.wikipedia.org/wiki/Cosmic_noise
- [11] http://en.wikipedia.org/wiki/Cosmic_ray
- [12] http://en.wikipedia.org/wiki/Radioactive_decay
- [13] http://en.wikipedia.org/wiki/The_Hum
- [14] <http://pubs.usgs.gov/bul/0939b/report.pdf>
- [15] http://profile.usgs.gov/myscience/upload_folder/ci2010Nov2222285142871139.pdf
- [16] <http://piers.org/piersonline/download.php?file=MTAwNzE0MDU1MzI3fFZvbDdObzVQYWdlNDgxdG80ODUucGRm>
- [17] http://www.knmi.nl/cms/content/84005/ambient_earth_noise_and_instrumental_noise
- [18] <http://earthquake.usgs.gov/regional/asl/pubs/files/ofr93-322.pdf>
- [19] http://www.earth.northwestern.edu/people/seth/327/HV/Chapter_4_rev1.pdf
- [20] <http://www.ghosthuntingtheories.com/2013/12/piezoelectricity-and-hauntings.html>
- [21] http://profile.usgs.gov/myscience/upload_folder/ci2010Nov2222285142871139.pdf
- [22] http://www.phoenix-geophysics.com/applications/earthquake_research/taov15n3p329.pdf
- [23] http://en.wikipedia.org/wiki/Generation-recombination_noise
- [24] http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=10&ved=0CHAQFjAJ&url=http%3A%2F%2Fwww.researchgate.net%2Fpublication%2F236010280_Analysis_and_modelling_of_generationrecombination_noise_in_amorphous_semiconductors%2Ffile%2F50463515aa43d508d4.pdf&ei=Z6LrUozWL4eCogTJ7YCYAg&usq=AFQjCNFlr4kv0sc_k7WMu3nO5IWXE0vECg&bvm=bv.60444564,d.cGU&cad=rja
- [25] http://fp.optics.arizona.edu/detlab/Classes/Opti566/OPTI566_Spring12/Lecture-Notes/Lesson-04.pdf
- [26] http://pubs.usgs.gov/sm/mag_map/mag_s.pdf
- [27] http://en.wikipedia.org/wiki/Schumann_resonances
- [28] <http://solarscience.msfc.nasa.gov/predict.shtml>
- [29] <http://www-spf.gsfc.nasa.gov/Education/wenpart2.html>

END