The RetroComm Experiment -
Using Quantum Randomness to Send a Message Back in Time

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Abstract: In a simple electro-optical system, an agent attempts to influence a random number generator (RNG) based on quantum phenomena, and to use that influence to perform retrocausal signaling.

Introduction

> *"People like us, who believe in physics, know that the distinction between past, present, and future is only a stubbornly persistent illusion." – Albert Einstein*

Since the earliest days of quantum physics, a cornerstone of quantum theory has been its statistical nature -- the assumption that only probabilities, not actual outcomes, can be predicted. This assumption of fundamental randomness at the core of quantum mechanics (the so-called "random collapse of the wavefunction" due to measurement) has persisted and served well through decades of careful experimental tests (Peres, 1993).

However, in recent years there has also accumulated considerable evidence that this assumption may be incorrect. In a series of innovative experiments, Schmidt (1976, 1993) found that electronic random number generators could be significantly affected by conscious effort even if the data was recorded and played back at a later time. At Princeton, Robert Jahn and colleagues have conducted experiments over a 25-year period showing consistent small deviations in random bit streams apparently caused by conscious intention alone (Jahn et al, 1997; Radin, 1997). More recently, it was discovered that a global network of 35 RNGs was strongly perturbed during the events of September 11, 2001 (Nelson et al, 2002). See also Radin's overview of retrocausal experiments and a recent one utilizing a Markov chain of RNGs (Radin, 2000), and (Radin & Nelson, 1989).

The basic RNG experiment

Figure 1 shows a simple canonical experiment where the subject ("agent") tries to influence the output of a random number generator (RNG). The RNG bit stream is nominally unbiased, containing about 50% 0's and 50% 1's. The agent only observes the bit stream (via a suitable display such as lights or perhaps a visual representation of total 1's) and cannot directly influence it by any recognized physical means.

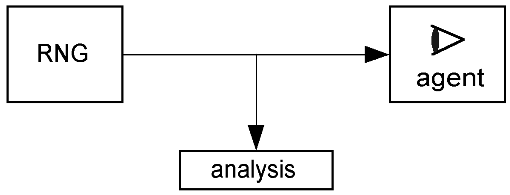


Figure 1. A simple RNG experiment.

The anomalous effects observed in these experiments are typically small but persistent, and can be statistically quite significant across a large number of trials and subjects (Jahn et al, 1997).[1] The protocol usually includes a randomly determined direction for each trial or group of trials of "more 1's", "more 0's", or neither (as a control), so as to avoid accumulation of any inherent first-order biases that might exist in the experimental situation.

Of course, it is a matter of some interest and controversy just how such anomalous RNG behavior might be explained without conflict with well-established physical principles (Schmidt, 1978; Etter, 1998 and 2001). In a recent paper (Shoup, 2002), we argue that if randomness were mutable, various so-called "psychic" phenomena would be readily explained and could be expected. This theory suggests that a quantum-random event is not fundamentally undetermined by physics, but instead emerges as a consequence of interactions of large numbers of particles dependent on that event.

The RetroComm Experiment

If quantum-random phenomena are indeed influenceable, this would allow backward-in-time signaling as a natural but perhaps startling consequence. This is because information produced by the random generator unavoidably requires some amount of time to travel to the supposed causal agent.

An experiment suggests itself to show this phenomenon in an unequivocal way. Consider a system like the one shown in Figure 2 that includes an RNG and an explicit delay.

[1] This phenomenon is sometimes referred to as *psychokinesis* (PK) or mind-over-matter, but these terms carry too many undesired connotations, and we prefer to focus on the observed anomalies in low-level randomness.

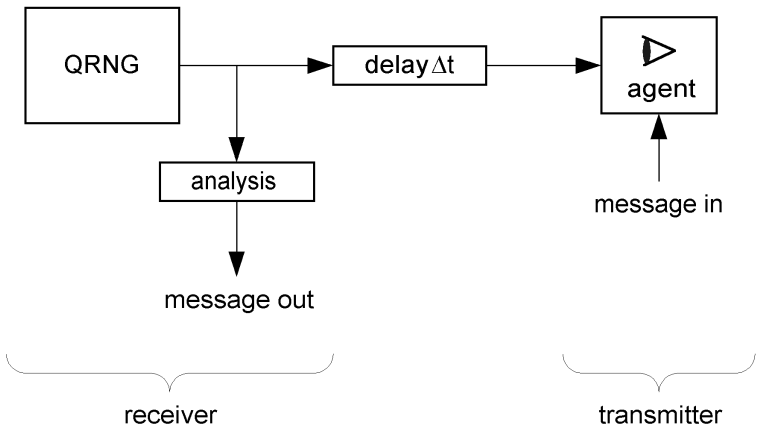


Figure 2. RetroComm system diagram.

In this system, a random generator based on quantum mechanical principles produces a stream of bits that are delayed somewhat and presented to the agent. The agent then observes the bit stream via a display and tries to influence it, imposing more 0's or more 1's in accordance with the bits of an intended message he has been given.

Back at the generator, the same random bits are examined immediately on emission for noticeable deviations from randomness. If these are seen, a suitable analysis can retrieve the sent message. Since an explicit delay has been inserted in the forward transmission path, the message will be received *prior to the time it was sent*.[2]

Of course, there is some concern that observation and analysis at the generator will "collapse" the random bits there, and prevent the agent from influencing them. We could perhaps mitigate this concern by inserting a data recorder between the RNG and the analysis box, and prevent anyone from looking at the data for a suitable period of time (the expected length of the message), as Schmidt (1976) did successfully.

The QRNG

In this experiment, it is required that the bit stream be generated by a process that is completely random and acausal according to standard quantum theory. This is accomplished by passing photons though a beam splitter (half-silvered mirror), as shown in Figure 3. Each individual photon is detected as 0 or 1 depending on whether it is

[2] In principle this advance could be quite large. Consider, for example the delay due to radio transmission from an RNG onboard a spacecraft on Mars, or even from a distant solar system.

reflected or passed, respectively, and an appropriate bit is then sent to the output bit stream.[3]

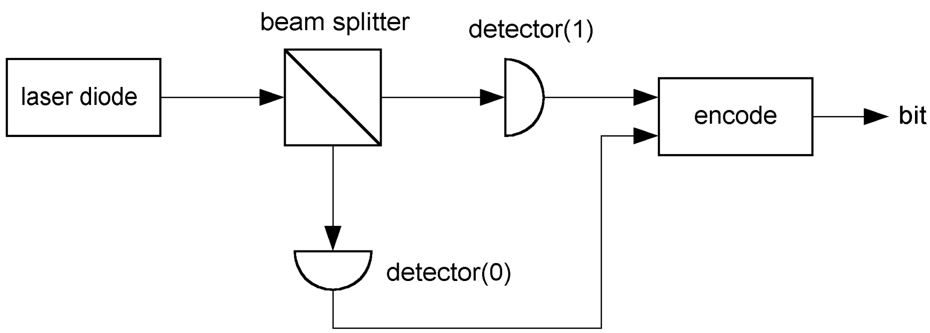
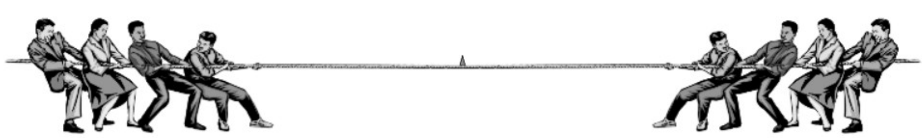


Figure 3. Quantum random bit generator

In practice, a large block of bits (1-10M or more) will be used to encode each bit of the intended message. Various encodings are possible, for example a majority vote with threshold (supermajority). In this case, significantly many 0's in the block would represent a 0, significantly many 1's would represent a 1, and blocks containing neither supermajority would simply be discarded.

The experiment will be implemented standalone on a dedicated machine, as well as being made available as part of the GotPsi suite of on-line psi tests. In both cases, an interesting interface will be created to make the task appealing to the user.



[3] A small number of bits (<1%) are generated by thermal noise in the detectors. Hardware processing also eliminates any first-order bias due to asymmetry of the mirror or detectors. The overall bit rate is about 1Mbit/sec (id Quantique, 2004).

Statistical analysis

If even small deviations from randomness are observed in the bit stream, a form of redundancy coding in a block of bits may be able to amplify this effect. In Figure 4, for example, suppose the probability of the desired bit is slightly elevated from 0.500 to .501 (square-dotted curve). A supermajority of 60% in a block of 1024 bits will yield the correct result about 85% of the time.

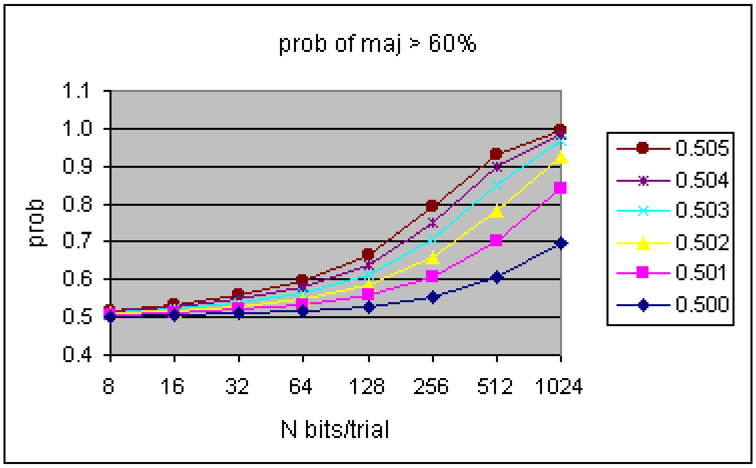


Figure 4. Effective probability by supermajority voting.

In practice, we expect a smaller effect -- perhaps on the order of 1 part in 10,000 -- but we can utilize blocks of 1-10 million bits or more to encode each bit of the intended message, and can require a greater supermajority to improve reliability. Other encodings can also be used, including higher-order biases or orthogonal random codes.

Implementation and protocol

This experiment will be arranged to run with a single dedicated agent, as well as with a potentially large number of subjects in the context of the Boundary Institute's "GotPsi?" suite of on-line psi tests, see http://www.gotpsi.org/ (Radin, 2002). These web-based tests have been in continuous operation since September 2000, with over 70 million experimental trials contributed thus far (March 2006) by over two hundred thousand users all over the globe.

As with the existing on-line tests, users will have the opportunity to compete, and to see their scores listed on the daily "Hall of Fame" -- a highly motivating factor for many. All data will be carefully time-stamped and recorded, with various consistency checks and monitors ongoing to avoid errors or tampering.

We can expect several thousand trials per day on the new proposed experiment once it is fully operational, and thus significant statistical power should be available with a few days or weeks of data gathering. Several encoding schemes, threshold parameter values, and other variations can be tried.

It is likely that some adjustment of parameters will be necessary to optimize any observed effect. If the desired effects are not seen or are too weak, it may be advantageous at first to simplify the experiment by removing the delay element, and to learn what is different about our experiment from others that have been successful at the basic task. This knowledge would itself be useful and important, even if the effect cannot be produced in a way that allows retro-communication.

Conclusion

If the experiment is successful in demonstrating influence on the randomly generated bit stream, this will represent significant evidence for the hypothesis of backwards causality, and a definitive challenge to the assumption of immutable randomness in QRNGs and thus in quantum mechanics itself. The simplicity of the experiment makes it relatively easy to replicate and to interpret the results.

If the experiment is completely successful and demonstrates signaling backwards in time, there are obvious significant implications for physics, for science as a whole, and for society at large.

References

Etter, Thomas, and Noyes, H. Pierre (1998). “Process, System, Causality, and Quantum Mechanics: A Psychoanalysis of Animal Faith”, Stanford Linear Accelerator Center Publication 7890, revised in Physics Essays, Vol. 12, No. 4, Dec. 1999. [*]

Etter, Thomas (2001a). “Reflections on PSCQM", in Noyes, H. Pierre (2001) *Bit-String Physics: A Finite and Discrete Approach to Natural Philosophy*, World Scientific [*]

id Quantique Corp. (2004). “Quantis Quantum Random Number Generator”, white paper, www.idquantique.com.

Jahn, R. G. et al (1997). “Correlations of random binary sequences with pre-stated operator intentions: A review of a 12-year program”, J. Scientific Exploration, Vol. 11, No. 3, pp. 345-367. See also http://www.princeton.edu/%7Epear/.

Nelson, R.D., Radin, D.I., Shoup, R., and Bancel, P.A. (2002). “Correlations of Continuous Random Data with Major World Events”, Foundations of Physics Letters, Vol. 15, No. 6., Dec. 2002. [*]

Peres, Asher (1993). *Quantum Theory: Concepts and Methods*, Kluwer Academic

Radin, Dean I. (1997). *The Conscious Universe*, HarperEdge.

Radin, Dean I. (2000). “Time-reversed human experience: Experimental evidence and implications”. [*]

Radin, Dean I. (2002), “Preliminary Analysis of a Suite of Informal Web-Based Psi Experiments”. [*]

Radin, D.I. & Nelson, R.D. (1989). “Evidence for Consciousness-Related Anomalies in Random Physical Systems”, Foundations of Physics, 19-12, pp. 1499-1514.

Schmidt, Helmut (1976). “PK Effect on Pre-Recorded Targets”, J. Amer. Soc. for Psychical Research, Vol. 70. [**]

Schmidt, Helmut (1978). "Can an Effect Precede Its Cause? A Model of a Noncausal World”, Foundations of Physics, 8 (5/6). [**]

Schmidt, Helmut (1993). "Observation of a Psychokinetic Effect Under Highly Controlled Conditions”, Journal of Parapsychology, Vol. 57. [**]

Shoup, Richard, and Etter, Thomas (1999). "Link Theory - From Computation to Quantum Physics, Parts I & II", in *Aspects II*, Proc. Alternative Natural Philosophy Assn. 20, ANPA. [*]

Shoup, Richard (2002). “Anomalies and Constraints”, J. Scientific Exploration, Vol. 16, No. 1, pp. 3-18. [*]

[*] Available on the Boundary Institute web site http://www.boundary.org.

[**] Available at http://www.fourmilab.ch/rpkp.