

Physics without Causality - Theory and Evidence

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Overview

- Introduction, the problem
- Quantum Entropy
- Unitary Measurement
- Randomness, RNG network
- Experiments, evidence
- Summary



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Q & A

- Unanswered Questions
 - Can the future influence the present?
 - Does God play dice?
 - How does Psi work?
- Unquestioned Answers
 - Cause-and-Effect principle?
 - Quantum Measurement “collapse”?
 - Fundamental randomness?

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Motivations

- Explain certain anomalous phenomena
 - Precognition, PK, RNG deviations, etc.
 - Implications for science, society
- Make sense of Quantum Mechanics
 - Interpretations, formalism
 - Reconsider “collapse”, fundamental randomness
- Arrow of time, time travel, free will, etc.

"I've got some grad student. He's thinking about the meaning of quantum mechanics. He's doomed." -- John McCarthy

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Psi Impossible??

"Your belief system is shot."



"Needless to say, [paranormal phenomena such as precognition] would be just as upsetting in quantum mechanics as in classical physics; If genuine, they would require a complete revamping of the laws of nature as we know them."

-- Murray Gell-Mann, The Quark and the Jaguar

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Hypothesis

- Complete time symmetry
 - Preparation is symmetric with measurement
 - Present can influence future and past "histories"
 - (But radioactive decay, black holes, kaons, ZPF?)
- All is unitary, including measurement
 - No "collapse" of the wavefunction
 - No fundamental randomness
 - Backward influence possible & necessary

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What About Causality?

- Common sense - cause *before* effect, unidirectional??
- Laws of physics are time-symmetric
 - Exception?: random "collapse" of the wavefunction
- Causality => *influence, dependence, correlation*
- Bidirectional *relations*, not functions
- Bidirectional connections (*links*), not inputs or outputs

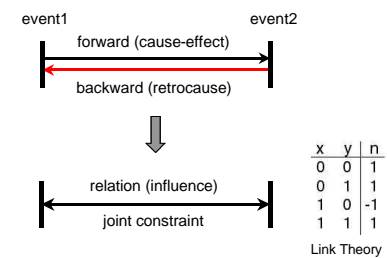
"All philosophers imagine that causation is one of the fundamental axioms of science, yet oddly enough, in advanced sciences ... the world 'cause' never occurs.... The law of causality, I believe, ... is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm."

-- Bertrand Russell, 1913

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Cause => Relation



"An elementary particle is not an independently existing, unanalyzable entity. It is, in essence, a set of relationships that reach outward to other things."

-- Henry Stapp

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Time Symmetry

Classical $E = \frac{1}{2}mv^2 = \frac{1}{2m}p^2$

substituting $E \rightarrow i\hbar \frac{\partial}{\partial t}$ and $p \rightarrow i\hbar \frac{\partial}{\partial x}$ gives

Quantum $i\hbar \frac{\partial \Psi(x,t)}{\partial t} = -\frac{\hbar^2}{2m} \frac{\partial^2 \Psi(x,t)}{\partial x^2}$

A solution for $+t$ is also a solution for $-t$.

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Quantum Dynamics

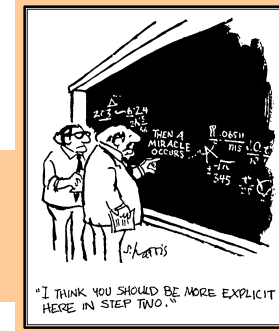
1. Unitary evolution

(Schrödinger equation)

- linear, unitary, conservative, reversible, deterministic

2. Measurement ("collapse" of the wavefunction)

- non-linear, non-unitary, non-conservative, non-reversible, random, unpredictable



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Entropy

Classical $H(A) = -\sum_a p(a) \log_2 p(a)$

Quantum $S(A) = -\text{Tr}_A[\tilde{\rho}_A \log_2 \tilde{\rho}_A]$

where $\tilde{\rho}_A$ is the density operator, and Tr_A is the trace over A.

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Quantum Entropy

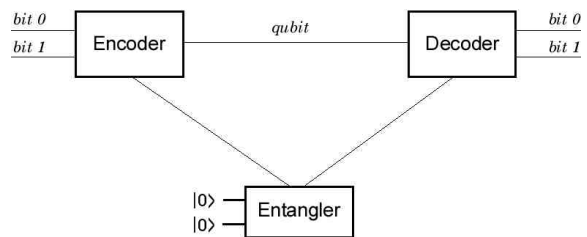
	$S_{A B}$	$S_{A:B}$	$S_{B A}$	$S_A=S_B$	S_{AB}
classical (independent)	1	0	1	1	2
classical (correlated)	0	1	0	1	1
quantum (entangled)	-1	2	-1	1	0

after Cerf & Adami, 1995

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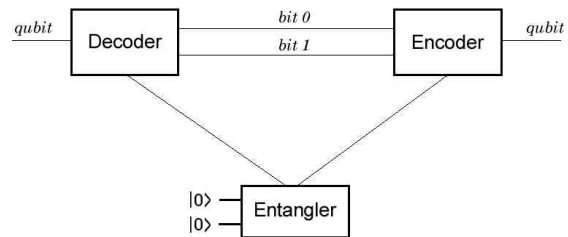
Quantum Dense Coding



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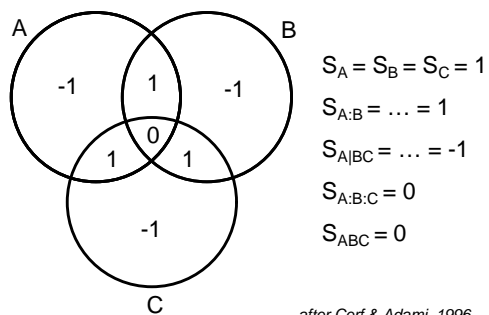
Quantum Teleportation



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Quantum Measurement

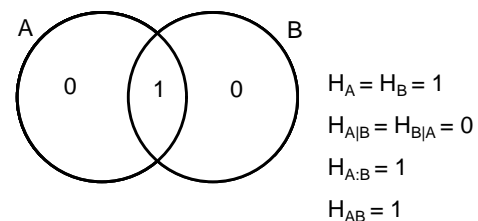


after Cerf & Adami, 1996

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Quantum Measurement

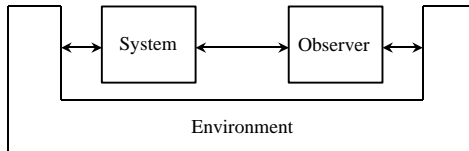


after Cerf & Adami, 1996

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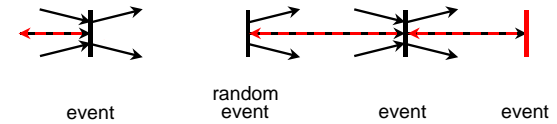
Measurement Interaction



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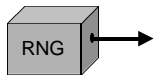
Randomness vs. Backward Influence



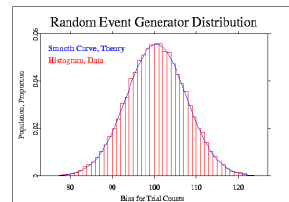
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REG/RNG: Uninfluenceable, Unpredictable



- No inputs
- No memory

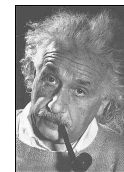


Tests: Diehard, NIST, Comscire, etc.

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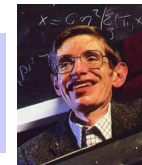
Is Nature Probabilistic?



"[QM] yields much, but it hardly brings us closer to the Old One's secrets. I, in any case, am convinced that He does not play dice."
- A. Einstein, letter to Max Born, 1924

"Not only does God definitely play dice, but He sometimes confuses us by throwing them where they can't be seen."

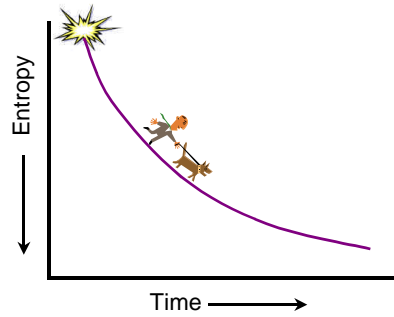
- S. Hawking, 1995



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What About the 2nd Law?



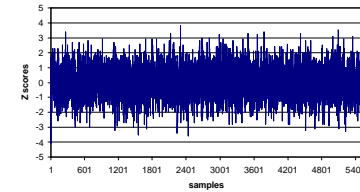
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Electronic Randomness



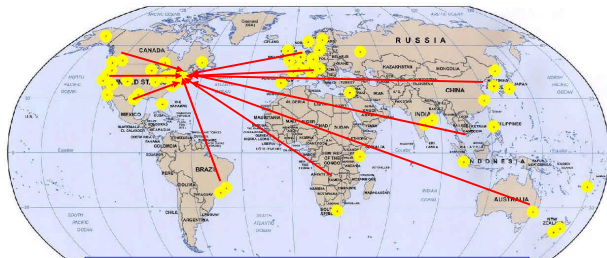
→ ... 0 1 1 0 1 0 0 1 0 0 0 1 1 1 ...



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Global Consciousness Project

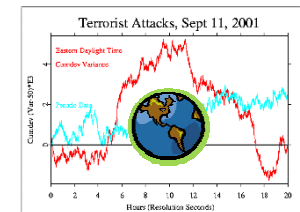


>70 true-random RNGs around the world
 200 bits / sec / RNG = >1 Gb / day
<http://noosphere.princeton.edu>

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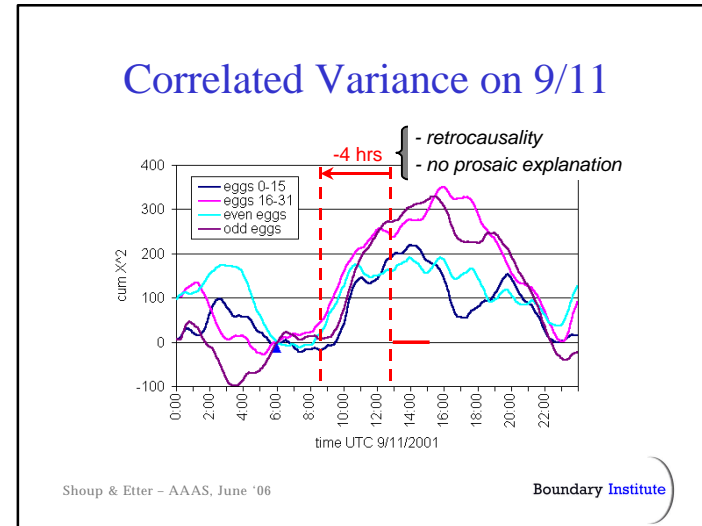
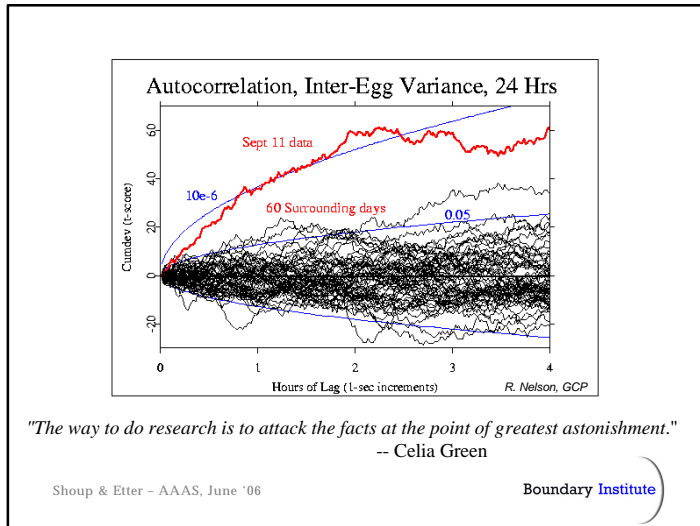
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Anomalous Behavior in the GCP network of Random Generators on September 11, 2001



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**CORRELATIONS OF CONTINUOUS RANDOM DATA
WITH MAJOR WORLD EVENTS**

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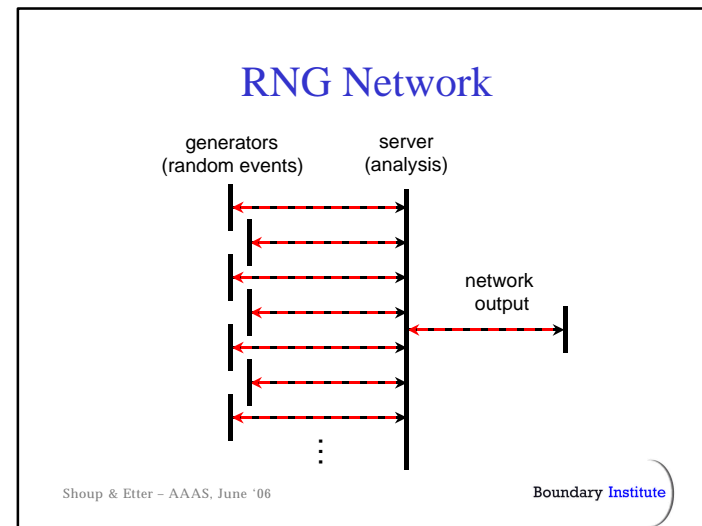
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Received 18 July 2002; revised 4 October 2002

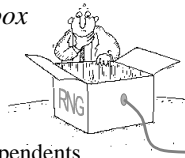
The interaction of consciousness and physical systems is most often discussed in theoretical terms, usually with reference to the epistemological and ontological challenges of quantum theory. Less well known is a growing literature reporting experiments that examine the mind-matter relationship empirically. Here we describe data from a global

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Origin of Randomness?

- RNG is best thought of as an *empty box*
 - Not a generator, but a *receiver*
 - No such thing as causeless action
 - Reflection of *outputs* connected to it
 - Output *appears* random due to many dependents
- Effects can be understood *without* a lot of new physics
 - Measurement is *unitary* -- no “collapse”
 - Influence forward and backward (*relational*)
 - Events are connected through *past* or *future* interactions



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Physics vs Parapsychology

- Parapsychology is a respectable science
 - Parapsychological Association - AAAS member since 1969
 - Peer-reviewed journals: JP, JASPR, JSPR, EJP, JSE, others
 - Controlled laboratory experiments, repeatable
 - telepathy, clairvoyance, precognition, psychokinesis
 - NOT fortune-telling, UFOs, bigfoot, etc, etc.
- But we're doing *physics*
 - Anomalies (cf. Michelson-Morley, perihelion of Mercury, etc, etc.)
 - New foundations of Quantum Mechanics, and more
 - New foundations for mathematics, computer science

"I like to keep an open mind, but not so open my brains fall out."
-- Arthur Sulzberger, Chairman, New York Times

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Key Anomaly: Psi

- Abundant evidence, yet little acceptance
 - Independent replications, peer-reviewed journals, etc.
 - Meaningful experiments and analysis are *very* difficult
 - Risk of ridicule, pseudo-skeptics, etc.
 - Disrepute due to “new age” wishful thinking about QM
- No adequate theory, phenomena *appear* to contradict physics
 - Really only our interpretations, misunderstandings?
 - New forces, fields, particles, dimensions, etc., required?
 - Cause-and-Effect thinking deeply ingrained
- Small statistical effects, not easily repeatable

"I shall not commit the fashionable stupidity of regarding everything I cannot explain as a fraud." -- C. G. Jung, 1919

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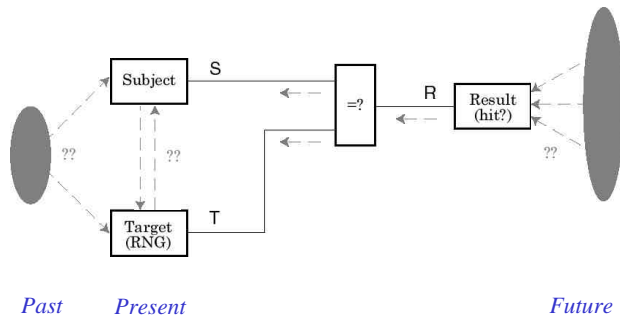
Key Anomaly: Psi - II

- Traditional taxonomy inappropriate, misleading
 - Telepathy, Clairvoyance, Precognition, Psychokinesis
 - Likely different aspects of the same natural phenomenon
- Important properties (*hints*), from the *evidence*
 - Time/order independence (clairvoyance vs precognition)
 - Complexity independence (goal orientation)
 - Selectivity problem (sensing & affecting)
 - Experimenter effect (belief, audience)
 - Effect small (in principle?), unavailable to evolution
- Real physical phenomena, poorly understood
 - Not poor technique or analysis, fraud, hallucination, etc.
 - Analogy to electromagnetism

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Simple Experiment



Past Present

Future

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Constraints on the Future

- Backwards influence from results
- Equivalent to regarding the outcome afterwards
- Not new – Etter, Schmidt, Bierman, von Lucadou, etc.
 - Etter, Thomas, and Noyes, H. Pierre, “Process, System, Causality, and Quantum Mechanics”, *Physics Essays*, 1999.
 - Schmidt, Helmut, “Can an Effect Precede Its Cause? A Model of a Noncausal World”, *Found. Physics*, 1978.
 - Etter, Thomas, “On the Occurrence of Some Familiar Processes Reversed in Time”, 1960.

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Welcome to the Boundary Institute's on-line psi tests



Card Test



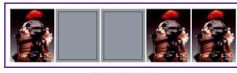
Remote Viewing Test



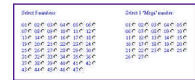
Sequential Card Test



Location Test



Card Draw Test



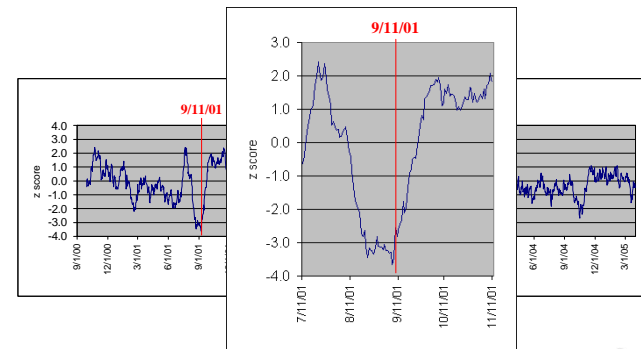
Lottery Test

www.boundarylab.org
www.gotpsi.org

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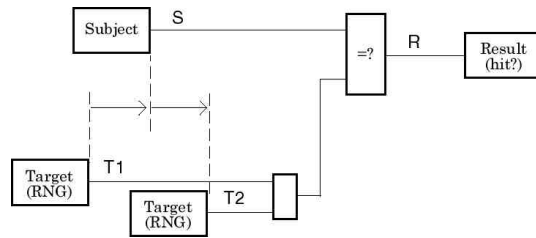
Card Guessing



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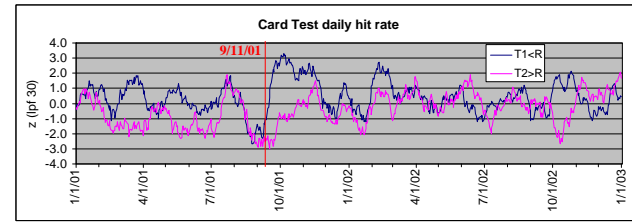
Simple Experiment w offsets



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Card Guessing - T1 vs T2

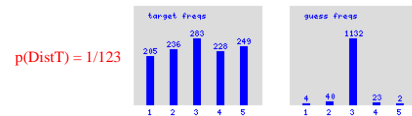


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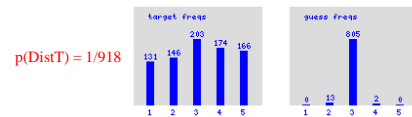
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Influencing the CT Targets?

Card Test - User AH, 1/14/06, total 1201 trials, 284 hits (23.6%), $p = 1/921$



Card Test - User AH, 3/23/06, total 820 trials, 204 hits (24.9%), $p = 1/2599$

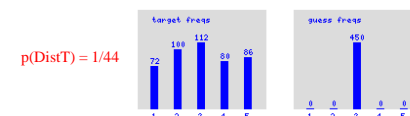


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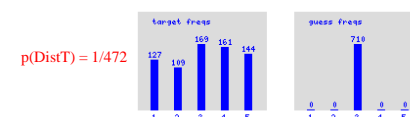
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Influencing the QRV Targets?

QRV Test - User AH, 8/26/05, total 450 trials, 112 hits (24.9%), $p = 1/150$



QRV Test - User AH, 9/11/05, total 710 trials, 169 hits (23.8%), $p = 1/136$



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Theory redux

- Allows backwards cause/influence
 - Modest changes to quantum theory formalism, simpler
- Good agreement/explanation for psi properties (hints)
 - Time/order independence (clairvoyance vs precognition)
 - Complexity independence (goal orientation)
 - Selectivity problem (sensing & affecting)
 - Experimenter effect (belief, audience)
 - Effect small (in principle?), unavailable to evolution, etc

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Summary Q & A

- Q: Is Quantum Measurement unitary & reversible?
A: Yes, if the environment is included.
- Q: Does the wavefunction really “collapse”?
A: No. It's all unitary evolution.
- Q: Are RNG outputs really random & causeless?
A: No. They are influenced by future dependencies.
- Q: Can Future events influence the Present?
A: Yes! But usually only in small ways.
- Q: Does God play dice?
A: No! Nothing is fundamentally “random”.

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Summary Q & A - II

- Q: Are psi phenomena possible/real?
A: Yes. The evidence is quite strong.
- Q: Does psi require rewriting physics?
A: No, just some modest changes to QM formalism.
- Q: Why isn't there more psi?
A: Because we're on a steep statistical slope.
- Q: Can “random” processes be influenced?
A: Yes. The evidence is strong & theory predicts it.
- Q: Can these effects be made large & controllable?
A: Yes, but it requires manipulating many particles.

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