Quantum Non-separability, Consciousness, Negentropy and a New Concept of Gravity

Arthur E. Pletcher

v5

Jan 16, 2024

https://doi.org/10.32388/0EQOTJ.5

Copyright: 2023 © the Author(s). Text is available under a Creative Commons Attribution 4.0 International license. More information in our Publishing Policy.

Quantum Non-separability, Consciousness, Negentropy and a New Concept of Gravity

January 16, 2024

Arthur E. Pletcher [1]
[1] *International Society for Philosophical Enquiry, Woodbridge, VA, USA*
artpletcher@ultrahighiq.org
© Pletcher 2022

Abstract

This article proposes a novel analogy between the escalating polarization which occurs between rational agents, and the emergence of spacetime in quantum decoherence. The former occurs within a framework of reinforcement loops of recursive information exchange between agents, and translates through scales (local, regional, national and international) of polarization. The latter occurs on a neurological scale within the split consciousness of the single observer, and thus a particle evolution becomes determined, as the particle becomes entangled with the polarized state of the observer and the observer's local environment. **The premise of this analogy is mathematically supported**. A modified Stern Gerlach experimental is proposed as a proof. A radical concept of gravity is a corollary.

Keywords: quantum entanglement; the measurement problem; quantum decoherence; entropic effects; quantum gravity

1 Introduction

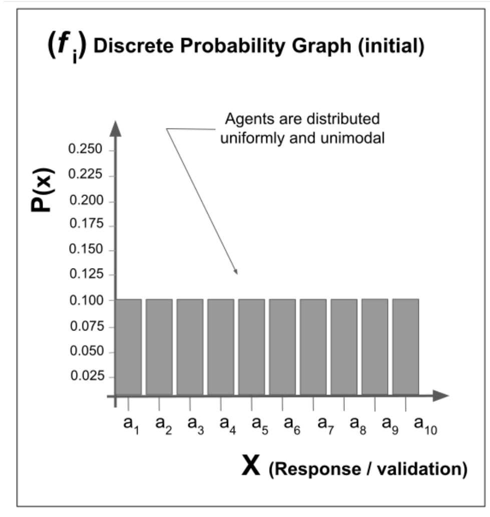
As recursive information exchange translates across scales of human conscious, ranging from neurological decision making to global information exchange, it's reasonable to assume that they also play a fundamental role in quantum decoherence. This article begins with an analysis of discrete probability graphs, over iterations of information exchange, within the framework of positive reinforcement loops, in the nature world of Classic Space. A flow chart and differential equation is presented to show the polarizing dynamics between agents, which are subsets of the universal set. Counter to the individual agent's bias, the developing polarization and orientation perspectives are shown to be subjectively validated. To be more precise, each iteration is shown to be self-validated. A summary of the emerging features (discreteness, polarization, locality, etc) in this Classic Space study is shown to be equivalent to emerging features in Quantum Mechanics. A Quantum Mechanics analysis of information as energy (the Jarzynski equality, free energy difference), along with a hypothesis of dual conscious polarization, suggests that the wave function [1] evolves deterministically, yet the eigenstate (λ) is subjectively validated in the dual conscious of the observer. An experiment is proposed, for empirical proof of observer self-validation in Quantum Mechanics. A novel paradigm of gravity is proposed as a repulsive force in $\mathbb{R}^4$ spacetime surface, from an interconnected $\mathbb{R}^5$ hyperspace.

2 An Analogy Between Polarization in Classic Space and Quantum Decoherence

Recursive Information Exchanges in Classic Space

Universal set U contains ten agents as noted: $U \mid \{a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8, a_9, a_{10}\} \in U$

figure 1 shows the discrete probability graph of set U at initial state f^i, along with it's associated information ($I(a_i)$) and Shannon entropy ($H(X)$): [2]

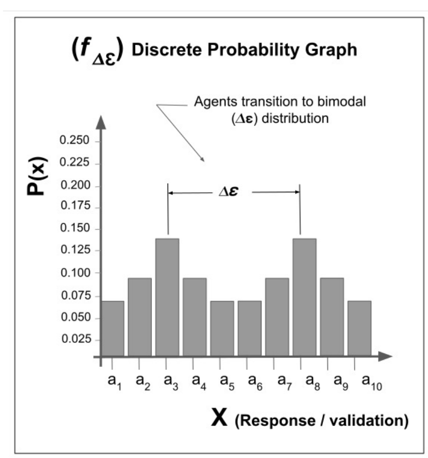


x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.100	3.322	0.332
a_2	0.100	3.322	0.332
a_3	0.100	3.322	0.332
a_4	0.100	3.322	0.332
a_5	0.100	3.322	0.332
a_6	0.100	3.322	0.332
a_7	0.100	3.322	0.332
a_8	0.100	3.322	0.332
a_9	0.100	3.322	0.332
a_{10}	0.100	3.322	0.332
	1.000		$H(x) = 3.322$

Figure 1: Discrete probability graph at initial state f^i

$$
\begin{aligned}
&H(X) = -\sum_i^n (p(x_i) * log_2[p(x_i))],\\
&Modified\ version\ of\ entropy\ equation:\\
&I(a_i) = -log_2(p(a_i)) \qquad (1)\\
&H(X) = \sum_i^{10} (I(a_i) * p(a_i)) \qquad (2)
\end{aligned}
$$

At initial iteration f^i, the distribution is uniform with high entropy of $H(x) = 3.322$.
However in the natural world, recursive information exchange tends to result in variance and division. Thus, subsequent iterations tend to transition to a bimodal distribution of two subsets A and B: $A\ and\ B \subseteq U$, and lower associated entropy (see figure 2).



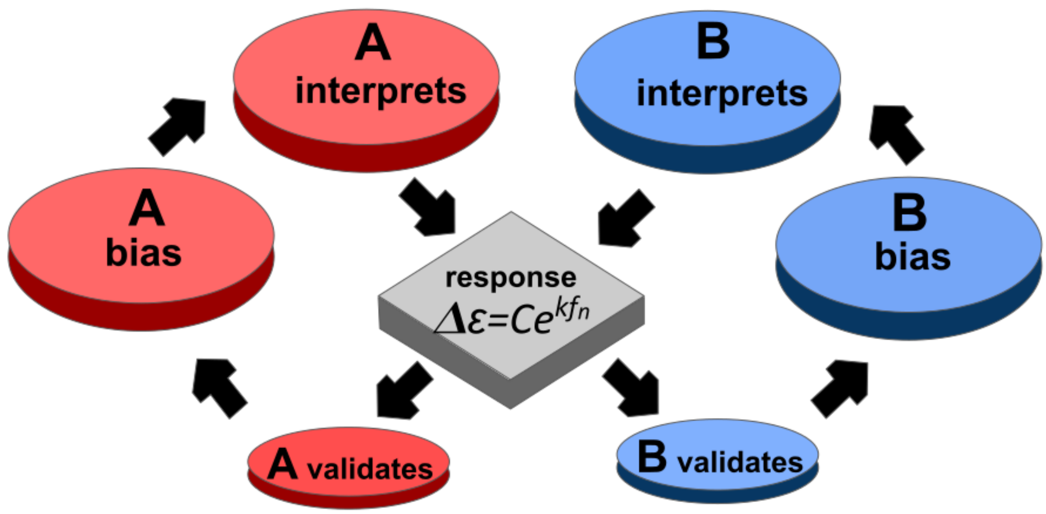
x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.075	3.737	0.280
a_2	0.100	3.322	0.332
a_3	0.150	2.737	0.411
a_4	0.100	3.322	0.332
a_5	0.075	3.737	0.280
a_6	0.075	3.737	0.280
a_7	0.100	3.322	0.332
a_8	0.150	2.737	0.411
a_9	0.100	3.322	0.332
a_{10}	0.075	3.737	0.280
	1.000		$H(x) = 3.271$

Figure 2: Discrete probability graph transitioning to a bimodal distribution

How Distributions Become Separated over Recursive Iterations of Information Exchange

The diagram in figure 3 shows the flow graph of incremental recursive information exchanges, within the framework of positive reinforcement loops. The components (bias, interpret, response and validation) are mutually mirrored between agents A and B, and follow a figure eight pattern. Tipically, the agent's disputes will tend to escalate over time, in this format. A real world example might be the polarization which occurs during dysfunctional political debates.

Positive Feedback Reinforcement Loop
of recursive exchanges, between A & B



f_n loops recursively

f_n iterations symbols with legend		
symbol	function	$\Delta\varepsilon$
A bias	Subset **A** perceives the response and information exchange of subset **B** with oppositional bias.	-
A interprets	Subset **A** inaccurately interprets the response and information exchange of subset **B,** due to bias.	-
A response	Subset **A** responds (proportionately) to his biased interpretation to subset **B**.	$\Delta\varepsilon=Ce^{kf_n}$
B validates	Subset **A's** response appears to validate subset **B's** biased interpretation from the previous iteration (**f_{n-1}**).	-
B bias	Subset **B** perceives the response and information exchange of subset **A** with oppositional bias.	-
B interprets	Subset **B** inaccurately interprets the response and information exchange of subset **A,** due to bias.	-
B response	Subset **B** responds (proportionately) to his biased interpretation to subset **A**.	$\Delta\varepsilon=Ce^{kf(n+1)}$
A validates	Subset **B's** response appears to validate subset **A's** biased interpretation from the previous iteration (**f_{n-1}**).	-

Figure 3: Division develops within positive feedback reinforcement loops, of recursive information exchange

The separation ϵ escalates between the agents in subsets A and B during each iteration, as a result of oppositional dynamics (misinterpretations and responses from opposing biased perspectives). Note that their mutual responses only seem to validate their opponents interpretation. However, **the outcome actually depends on their biased interpretation**. In other words, their biased observations are **self-validated**.

How Separation $\Delta\epsilon$ Increases over Iterations

Subsequent iterations follow the same sequence, and result in an incremental positive feedback loop. The separation escalates over iterations, as $\Delta\epsilon$ increases exponentially with each iteration (f^n), per the following differential equation and exponential solution. **Note,** that interpretations become increasingly distorted over iterations. This is demonstrated in the children's game "Chinese Whispers", [3] where an original message becomes unrecognizable, after multiple repetitions between players of the game,

$$\frac{d\epsilon}{df^n} = K\epsilon \tag{3}$$

$$\frac{1}{\epsilon} d\epsilon = k df^n \tag{4}$$

$$\int \frac{1}{\epsilon} d\epsilon = \int k df^n \tag{5}$$

$$ln|\epsilon| = kf^n + c \tag{6}$$

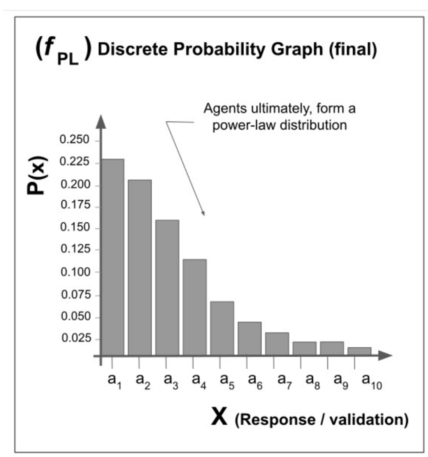
$$|\epsilon| = e^{kf^n + c} \tag{7}$$

$$\epsilon = Ce^{kf^n} \tag{8}$$

Critical Stage of Interation f_i Power-law Distributions

Per the law of preferential attachment, a power-law distribution (a functional relationship between two quantities, where a relative change in one quantity results in a relative change in the other quantity proportional to a power of the change, independent of the initial size of those quantities: one quantity varies as a power of another) will develop. Power-laws occur ubiquitously throughout nature. Some obvious real-world examples are: The largest trees tend to dominate to sun rays, and thus grow at proportionately higher rates. The most massive planets in a stellar system attract more space dust and debris, thus grow at proportionately higher rates.

The discrete probability graph in figure 4 is approaching a power-law distribution, with a much lower entropy of $H(x) = 2.818$. Of course, distributions of individual sets of agents will vary.



x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.250	2.000	0.500
a_2	0.225	2.152	0.484
a_3	0.175	2.515	0.440
a_4	0.125	3.000	0.375
a_5	0.075	3.737	0.280
a_6	0.050	4.322	0.216
a_7	0.038	4.737	0.178
a_8	0.025	5.322	0.133
a_9	0.025	5.322	0.133
a_{10}	6.322	3.322	0.079
	1.000		$H(x) = 2.818$

Figure 4: Discrete probability graph transitioning to a power-law distribution

Asymptotic Entropy of Open Systems with Power-law Distributions

At a critical shape point, power-law distributions tend to collapse and reform. Some real world examples include: The collapse of stars (capable of becoming nova) act as a catalyst to the birth of new stars in a nebula system. The sinusoidal economic cycles, between growth and recession. Note, that such systems tend to maintain their ordered state asymptotically in an open system, regardless of the universal direction of entropy. Also, the arrow of time can be gauged by the increasing complexity of such collapses over time. For example: The stages of fusion from hydrogen to helium, to lithium, and so on.

3 Collapse stage of f_i, as Analogous to Von Neumann Entropy

Again, per the law of preferential attachment, a power-law distribution will develop in the form of:

$$p(x) = C(x)^{-\alpha} \tag{9}$$

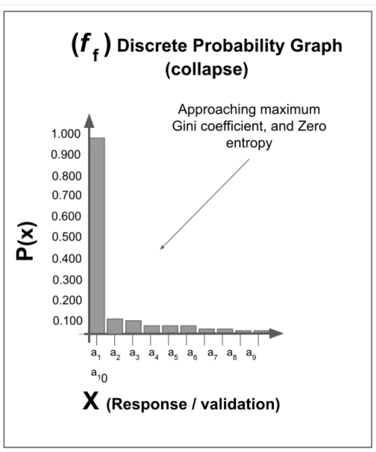
if we regard random information exchange to be connections between nodes,

$$\begin{aligned}
k &= connections \\
p &= the\ probability\ of\ a\ an\ isolated\ random\ connection \\
(1-p) &= the\ probability\ proportionate\ to\ accumulating\ connections \\
C &= fraction\ of\ nodes \\
L &= the\ fraction\ of\ nodes\ with\ connections \\
then, & \\
L &= Ck^{-\alpha}, \qquad (10) \\
where & \\
\alpha &= 1 + \frac{1}{1-p} \qquad (11)
\end{aligned}$$

As the Gini coefficient of a power-law distribution increases to maximum, the entropy approaches zero. This final stage can be regarded as a collapse, which is analogous to the transition from positive to the zero state in Von Neumann entropy.

$$as\ Gini\ coefficient \to max,\ H(X) \to 0 \tag{12}$$

Figure 5 shows a power-law distribution approaching maximum Gini coefficient.



x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.950	0.074	0.070
a_2	0.025	5.322	0.133
a_3	0.015	6.059	0.090
a_4	0.005	7.644	0.038
a_5	0.001	9.966	0.010
a_6	0.001	9.966	0.010
a_7	0.001	9.966	0.010
a_8	0.001	9.966	0.010
a_9	0.001	9.966	0.010
a_{10}	0.000	0.000	0.000
	1.000		$H(x) = 0.381$

Figure 5: As the Gini coefficient of a power-law distribution increases to maximum, the entropy approaches zero.

4 Polarization Emerges Between Sets of Agents

In figure 3, Polarization tends to emerges in the natural world (classic space) over iterations f_n. This orientation is analogous to a dipole magnet. This natural result is commonly observed between polar opposites (political, etc). **It's important to note that polarizations tend to escalate over scales (neurological decisions, local, regional, national, international) in the natural world**

The diagram in figure 6 shows how polarization emerges between sets of agents in the natural world.

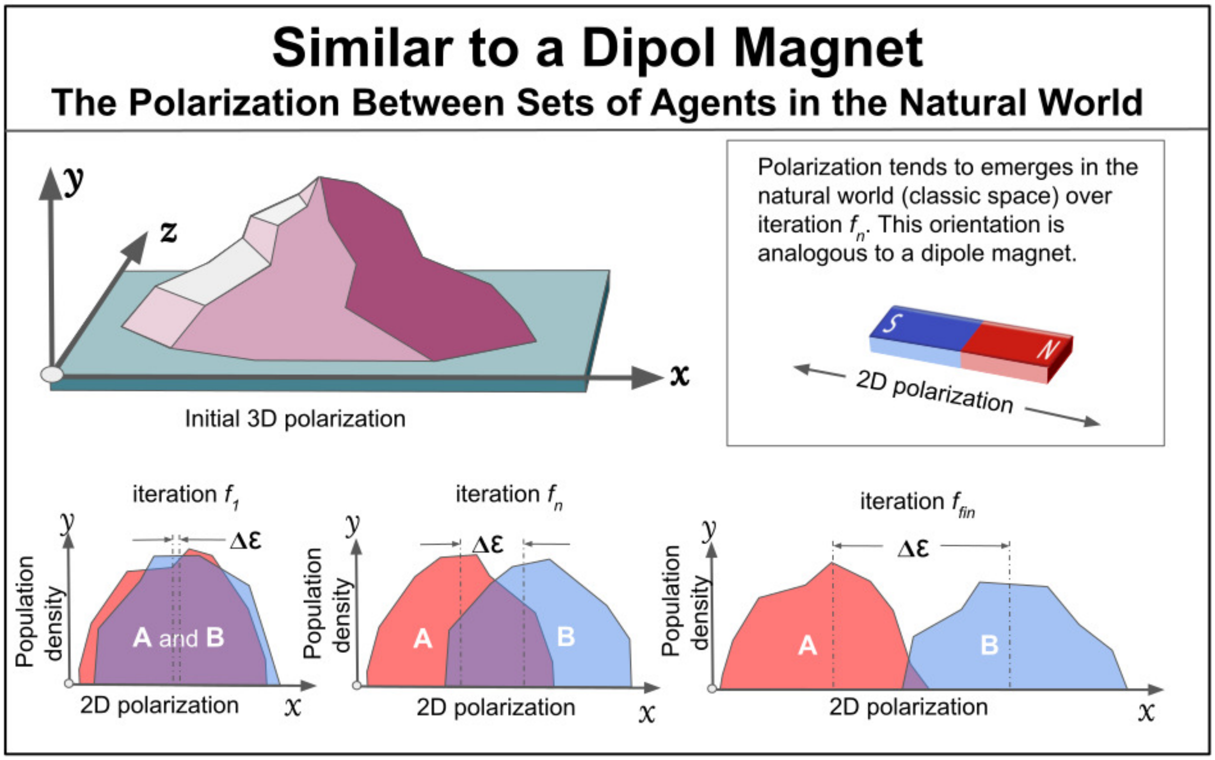


Figure 6: Polarization tends to emerges in the natural world (classic space) over iterations f_n

5 How Classic Recursive Information Exchange is Analogous to Quantum Decoherence

The following features, which emerge in this classic example, also emerge in quantum decoherence:

- **discreteness**
- **separation (locality)**
- **polarization**
- **orientation**
- **cascade to local environment**: Example: How local agents tend to become polarized, in correspondence to ideological or political conflicts
- **escalation over scales**: Example: conflicts tend to escalate for local to regional to National etc.
- **negentropy as potential energy**: The probability of negentropy $P(J)$ of a set is proportionate to it's polaraization $|\rightarrow\rangle$, over recursive information exchanges,

$$P(J) = k\,\frac{|\rightarrow\rangle}{f^n} \tag{13}$$

Where k is a constant or proportionality

6 Recursive Information Exchanges in Quantum Decoherence

Information as Energy

An experiment in 2010, by a team of Tokyo scientists, [4] demonstrated that a non-equilibrium feedback manipulation of a Brownian particle on the basis of information about its location achieves a Szilárd-type [5] information-to-energy conversion, using real-time feedback control. In thermodynamics, the Jarzynski equality [6] (free energy difference) $\Delta F = F_B - F_A \Delta F =$

$F_B - F_A$ between two states A and B is connected to the work W done on the system through the inequality: $\Delta F \leq W \Delta F \leq W$. In microscopic systems, thermodynamic quantities such as work, heat and internal energy do not remain constant but fluctuate. Nonetheless, the second law [7] still holds, on average, if the initial state is in thermal equilibrium: $\langle \Delta F - W \leq 0 \rangle$, where ΔF is the free-energy difference between states, W the work done on the system and $\langle * \rangle$ the ensemble average. However, the feedback control enables selective manipulation of specific fluctuations that cause $\Delta F - W > 0$, by using the information about the system. The feedback control can increase the likelihood of occurrence of such an event. This is the crux of the control in the thought experiment: "Maxwell's Demon". [8] Thus, it is concluded that the particle is driven by the 'information' gained by the measurement of the particle location.

The Measurement Problem

In quantum mechanics, a matter wave collapses as it interacts with a macroscopic photographic plate, seemingly at the point where an intelligent agent observes the plate. [9] This seems to defy a logical explanation, as the matter wave is in a superposition of several eigenstates and evolves deterministically, yet the resulting single eigenstate is determined by the state at the point of interaction (measurement). For any observable, the wave function is initially some linear combination of the eigenbasis $\{|\phi_i\rangle\}\{|\phi_i\rangle\}$ of that observable. When an external agency (an observer, experimenter) measures the observable associated with the eigenbasis $\{|\phi_i\rangle\}\{|\phi_i\rangle\}$, the wave function collapses from the full $|\psi\rangle|\psi\rangle$ to just one of the basis eigenstates, $|\phi_i\rangle|\phi_i\rangle$, that is: $|\psi\rangle \rightarrow |\phi_i\rangle.|\psi\rangle \rightarrow |\phi_i\rangle$.

The Key to the Measurement Problem: Two Minds of Observation in the Single Observer.

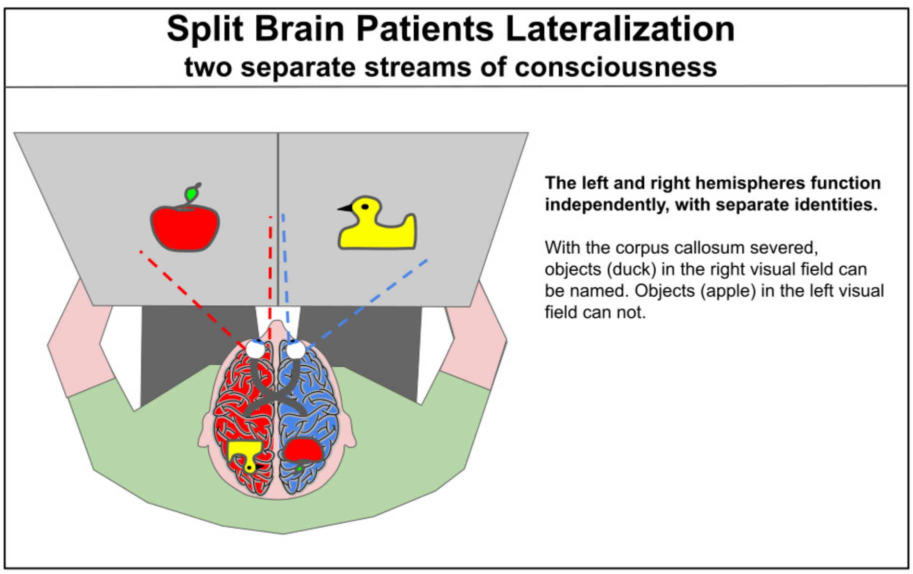


Figure 7: Split Brain Patients Lateralization two separate streams of consciousness

Neuroscience has theorized the duel (two minds) model of the human brain from research on post-surgery consciousness of split-brain patients. [10] Following surgery, these two minds are typically opposing, such that both minds simultaneously perform opposing functions (see figure 7).

This article proposes the following unique hypothesis: that during quantum decoherence (measuring of a particle) **a recursive oppositional dynamic occurs within the dual mind of the single observer, similar to the described flow chart**, in figure 3

7 Nonseparability and the Emergence of Spacetime

Hypothesis 1 *A dual consciousness exists within the mind of the single observer of a particle, which are opositional and seldom in equilibrium. During the process of observation, a positive feedback loop occurs between these dual and opposing conscious operations. This dynamic process follows a recurring flow of sequence (biased observation, interpretation, response and self-validation), resulting in the* ***polarization of the observer's dual consciousness****. Subsequently the particle, which exists in superposition becomes polarized / entangled in correspondence with the observer's polarizes state, along with the local environment. This emergence of a single polarized state (of spacetime), from an interconnected superposition state is the essential process which results in quantum decoherence.*

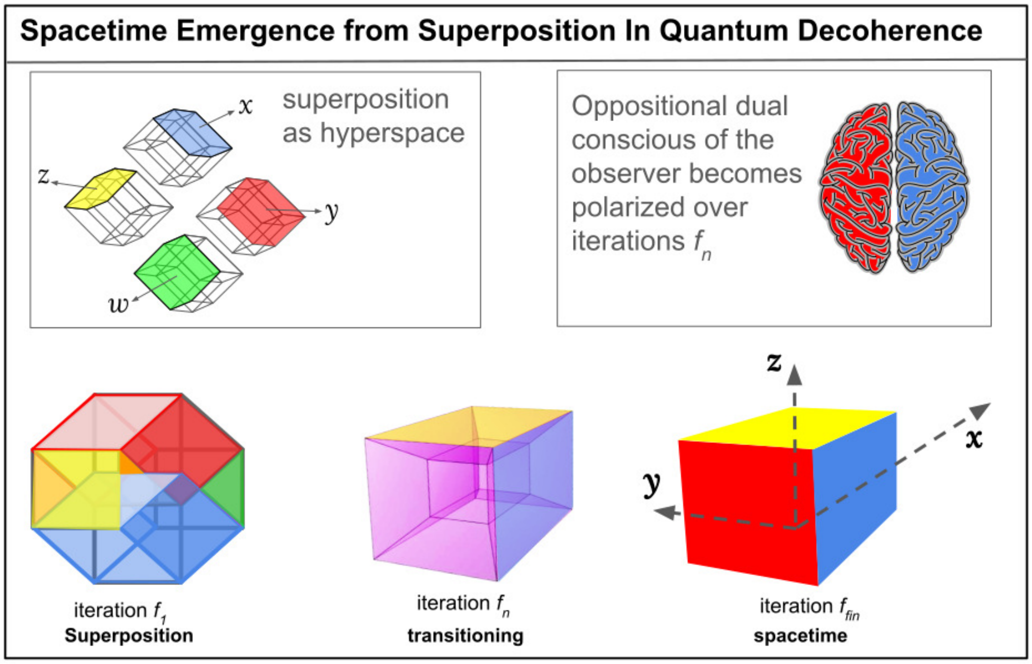


Figure 8: Particle 3D polarization emergence from 4D space

Thus, Hypothesis 1 implies the following, in the Measurement Problem,

- The evolution of a particle in the wave function is actually deterministic. However, the single measurable result (eigenvalue) λ_n is in correspondence with the polarized state of the observer's dual consciousness $|\circledless\rangle$, for the measurable $\hat{H}$ of of the measured state $|a_n\rangle$, in the Hermitian equation,

$$\hat{H}|a_n\rangle = \lambda_n|a_n\rangle \tag{14}$$

$$Such\ that\ the\ observer's\ polarized\ dual\ conscious\ is\ entangle\ with\ |a_n\rangle,$$

$$|\circledless_1\rangle \otimes |a_1\rangle + |\circledless_2\rangle \otimes |a_2\rangle \tag{15}$$

  This entanglement, between both the observer and particle, provides the missing deterministic feature, which Einstein objected to, as being "incomplete" in his equation, where he concludes that the entanglement of two particles, which are widely summed, can not be divided into two separated wave functions. Can be expressed as,

$$\Psi(x_1, x_2) = \sum_{n=1}^{\infty} \psi_n(x_2) U_n(x_1) \neq \chi(x)_1 \theta(x)_2 \tag{16}$$

- Hypothesis 1 can be experimentally verified, by demonstrating a correspondence between the observer's dual consciousness, the observer and the local environment, at any single moment. (See section 8).

8 Proposed Experiment to Prove that Decoherence is Influenced by the Polarized State of the Observer

An entanglement between the polarized observer's dual consciousness and the particular spin of an electron, implies a correspondence with the observer, particle and local environment, at any single moment. Thus, a statistical correlation can be demonstrated between two independent detector systems, as viewed by a single observer. The following experimental is proposed, as empirical evidence of observer influenced particle collapse, to a measurable state (figure 9),

- Two parallel Stern Gerlach [11] electron deflector systems ($a\ and\ b$) emit respective single unpaired electrons ($e_a\ and\ e_b$), at regular intervals through an inhomogeneous magnetic field, toward their respective detector screens ($d_a\ and\ d_b$).
- The two separated and parallel electrons ($e_a\ and\ e_b$) are emitted in sync, such that they strike their respective screens (virtually) simultaneous.

- A single observer is oriented to view both detector screens (d_a and d_b), with the following constraints,
- Detector d_a is viewed exclusively, by the observer's left field of vision, and detector d_b is viewed exclusively, by the observer's right field of vision.
- The null hypothesis would expect a weak correlation of $\pm \leq R$ 0.3, between the two systems spins. A reasonable sample size might be 500 unpaired electrons.
- A correlation value of $\geq \pm R$ 0.5 would demonstrate a **significant observer influenced particle bias. If proven, deterministic particle evolution would be of great benefit to science, and the field of Quantum Mechanics, in particular**.

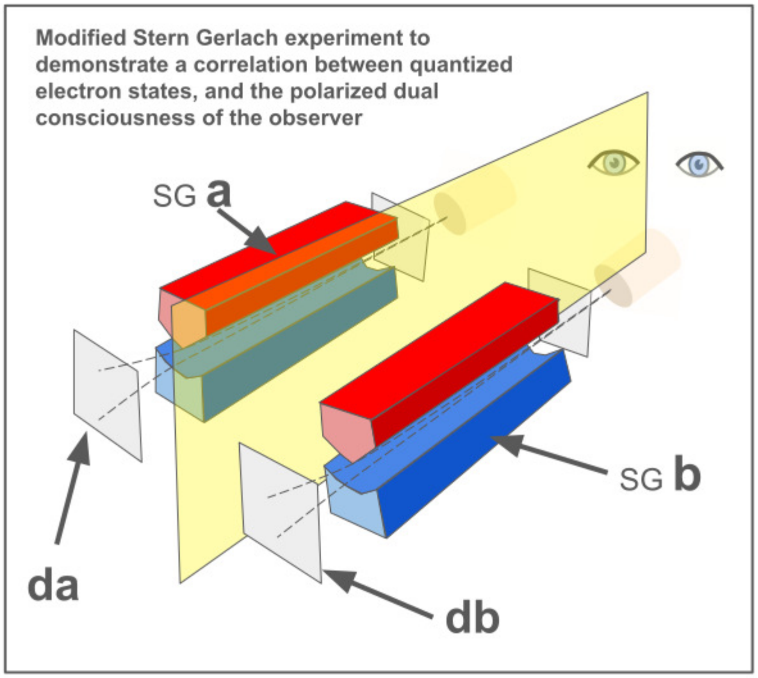


Figure 9: Modified Stern Gerlach experiment to demonstrate a correlation between quantized electron states, and the polarized dual consciousness of the observer.

9 Gravity

Hypothesis 2 *As hypothesis 1 implies,* ***all of matter remains connected in a higher dimensional space****. Thus, the fundamental interaction of gravity* ***does not result in an attraction****, rather the fundamental connection of all matter is separated and polarized to an $\mathbb{R}^4$ spacetime measurable state, as a result of a sequence of information exchange and negentropy.*

As hypothesis 2 describes gravity as an emergent $\mathbb{R}^4$ separation within a field of information, it can **crudely** be conceived of as a repulsive force from $\mathbb{R}^5$ connected matter, or the inverse of Newton's formula,

$$F_g \approx \frac{r^2}{Gm_1m_2} \tag{17}$$

This eliminates the need for factoring Dark energy, [12] as a repulsive force in empty space, to satisfy the Cosmological Constant Λ [13] (Of course, the mathematics of Newton [14] and Einstein, [15] elegantly describe the relationships of matter and space, and equally appy to this model).

10 Conclusion

Recursive information exchange and the resulting low-entropy power-law distributions, are ubiquitous in Classic Space. It's fair to say the we are swimming in the dynamics which maintain order and negentropy. **As RIE translate across scales of human conscious, ranging from neurological decision making to global information exchange, it's reasonable to assume that they**

also play a fundamental role in quantum decoherence. Hypothesis 1 suggests that matter which is separated in $\mathbb{R}^3$ spatial dimensions is actually connected in within a higher $\mathbb{R}^4$ dimensional space, which provides a basis for entanglement at a remote distance. Conceivably, it could provide a radically alternate model of gravity as a repellent force of separation.

References

[1] Aharonov Y. Meaning of the wave function. *Physical Review A, 1993;*, 47 (6): 46171.

[2] Shannon C. *A Mathematical Theory of Communication.* University of Illinois Press, Champaign, 1963.

[3] Blackmore S. *The Meme Machine.* Oxford University Press, P.X., 2000.

[4] Shoichi T. Experimental demonstration of information-to-energy conversion and validation of the generalized jarzynski equality. *Nature Physics 2010;*, 6: 988–992.

[5] Lanouette W. *Genius in the Shadows: A Biography of Leo Szilard.* Skyhorse Publishing, New York, 1992.

[6] Jarzynski C. Nonequilibrium equality for free energy differences. *Phys. Rev. Lett 2010;*, 78 (14): 2690.

[7] Jaffe R. *The Physics of Energy.* Cambridge University Press, Cambridge UK, 2018.

[8] Thomson W. Kinetic theory of the dissipation of energy. *Nature 1874;*, 8: pages441–444.

[9] Zurek W. Decoherence, einselection, and the quantum origins of the classical. *Reviews of Modern Physics 2003;*, 75 (3): 715-775.

[10] Gazzaniga M. *The Integrated Mind.* The Integrated Mind, New York, 1978.

[11] Gerlach W. Der experimentelle nachweis der richtungsquantelung im magnetfeld. *Zeitschrift für Physik 1922;*, 9 (1): 349-352.

[12] Peebles P. The cosmological constant and dark energy. *Reviews of Modern Physics 2003;*, 75 (2): 559–606.

[13] Dyson L. Disturbing implications of a cosmological constant. *Journal of High Energy Physics 2002;*, 2002 (10): 011.

[14] Newton I. *Philosophiæ Naturalis Principia Mathematica.* Imprimatur, Germany and Venice, 1728.

[15] Arnowitt R. Republication of: The dynamics of general relativity. *Springer. Gen Relativ Gravit 2008;*, 40: 1997–2027.

Declaration of Interests

The author declares that I have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

The author declares that no independent research data is included in this article.