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

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Preprint v1

July 13, 2023

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

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Abstract

This article provides a mathematical model of spacetime emergence from Nonseparability, as well as a determined particle evolution. An alternate paradigm of separability is proposed; Rather than spacetime as an illusion, spacetime is a limited $\mathbb{R}^4$ polarization from a higher dimensional space, with a fundamental connectivity. The process which results in this $\mathbb{R}^4$ polarization is very much analogous to the polarization which is ubiquitous throughout the natural world in classic space. Thus, we observe negentropy, polarization, separation and power-law distributions as natural consequences of recursive information exchange between agents within a format of reinforcement loops. A similar process of recursive information exchange is proposed to occur within the observer's oppositional dual consciousness during quantum decoherence. This cognitive process results in the entanglement between the observer's polarized consciousness, and the emerging particle. Contrary to conventional postulates, a particle's evolution is not undetermined, but rather emerges in conjunction with the polarized state of the observer. Thus, the observer, local environment and particle become polarized and entangled simultaneously. A modified Stern Gerlach experimental is proposed as proof. A radical concept of gravity is a corollary.

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

1 Introduction

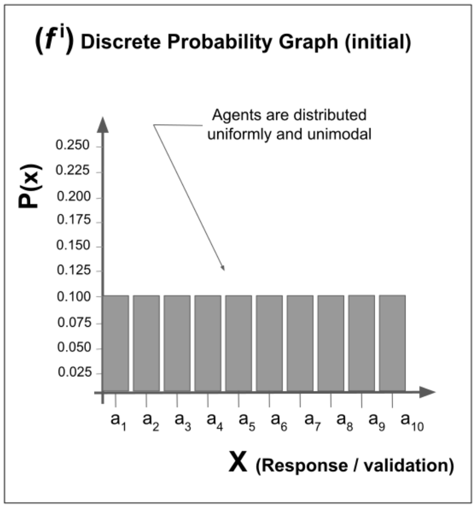
This article begins with an analysis of discrete probability graphs, over iterations of information exchange, within the framework of positive reinforcement loops, in the nature world of Classic Space. A flow chart and differential equation are presented to show the polarizing dynamics between agents, 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

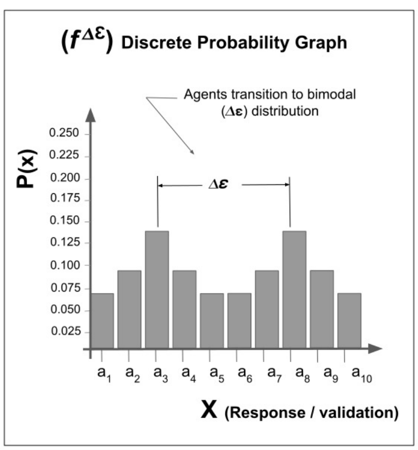
$$H(X) = -\sum_{i}^{n}(p(x_i) * log_2[p(x_i))],$$

$$Modified\ version\ of\ entropy\ equation:$$

$$I(a_i) = -log_2(p(a_i)) \tag{1}$$

$$H(X) = \sum_{i}^{10}(I(a_i) * p(a_i)) \tag{2}$$

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).

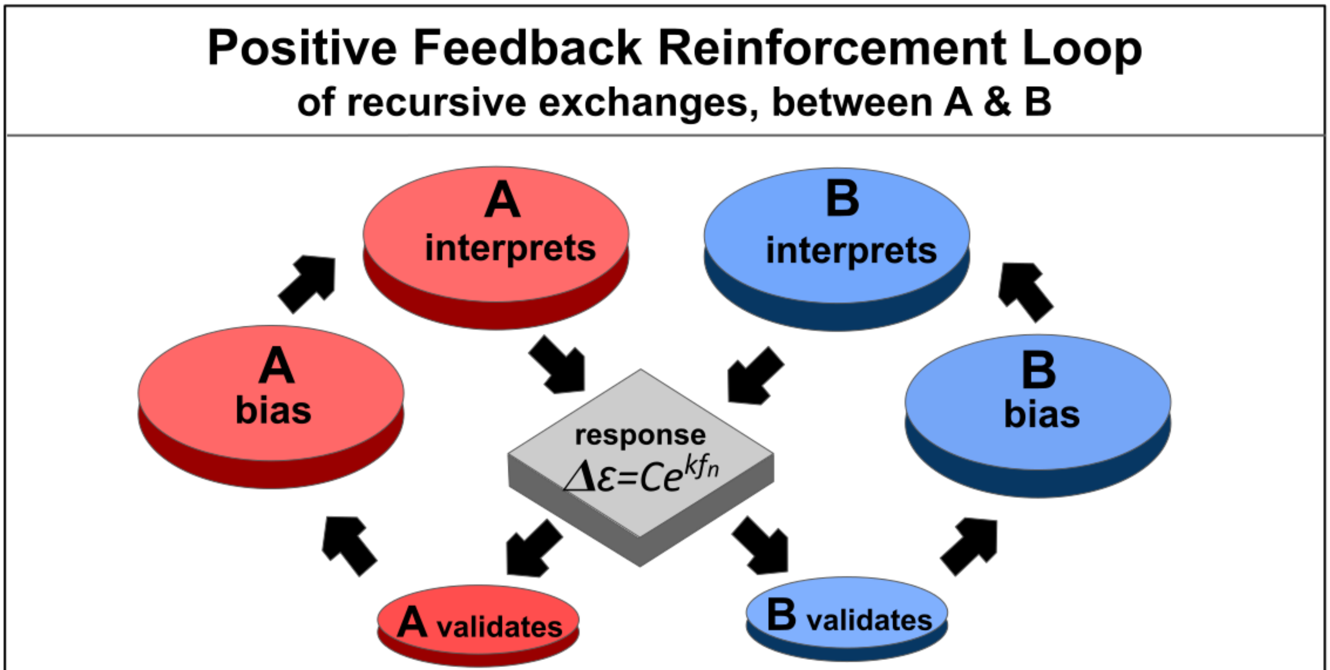


x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.075	3.737	0.280
a_2	0.100	3.322	0.332
a_3	0.150	2.737	0.411
a_4	0.100	3.322	0.332
a_5	0.075	3.737	0.280
a_6	0.075	3.737	0.280
a_7	0.100	3.322	0.332
a_8	0.150	2.737	0.411
a_9	0.100	3.322	0.332
a_{10}	0.075	3.737	0.280
	1.000		$H(x) = 3.271$

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. Disputes between agents tend to escalate over time, in this format. For example, the polarization which occurs during dysfunctional political debates.



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 diagram in figure 4 shows how $\mathbb{R}^2$ polarization emerges from $\mathbb{R}^3$ space.

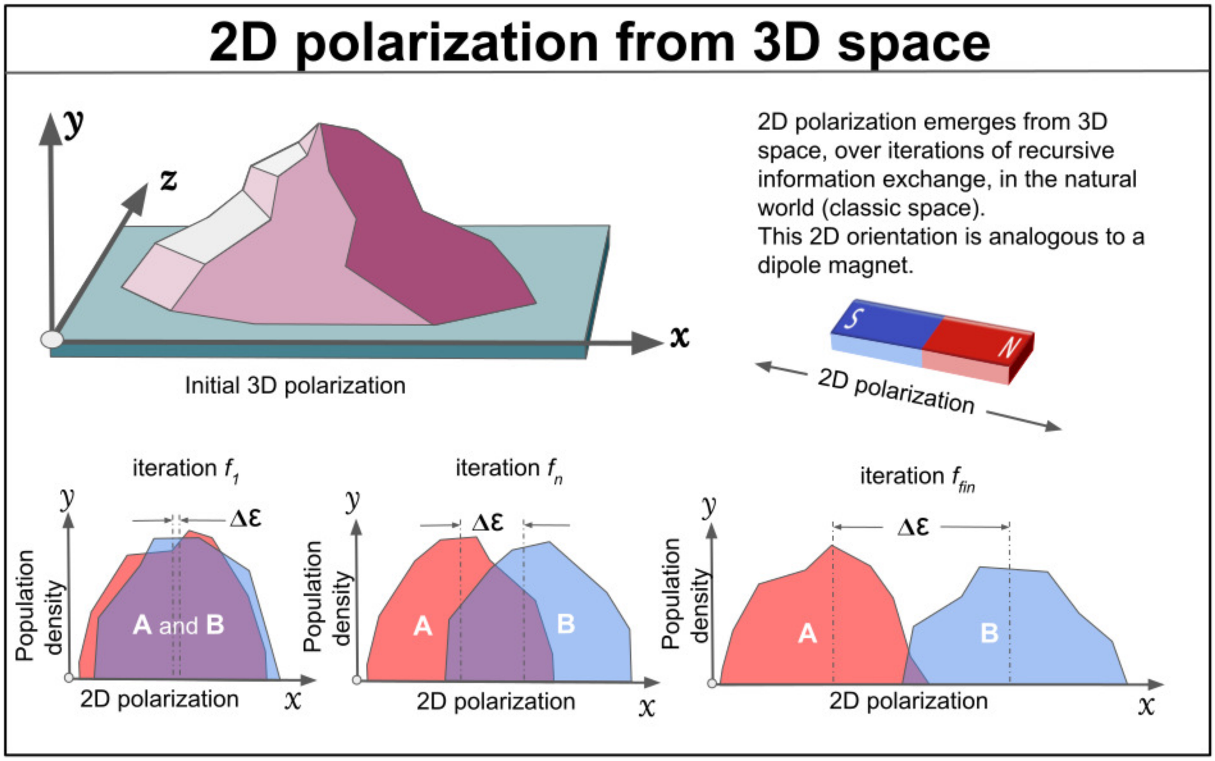


Figure 4: $\mathbb{R}^2$ polarization emerges from $\mathbb{R}^3$ space

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' interpretations. 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,

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

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

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

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

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

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

Final iteration f^{fin} (power-law distributions),

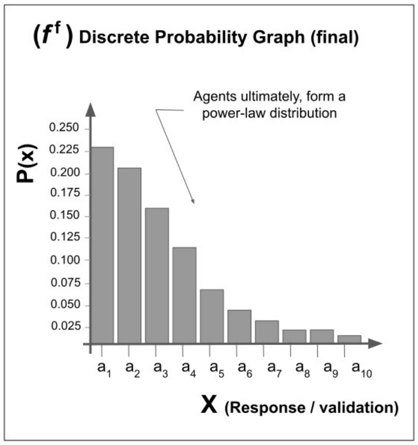
In the natural world, recursive oppositional exchange dynamics tend to result in Power-law distributions. [4] Zipf's law [4] and the principle of preferential attachment [5] are ubiquitous throughout nature. Some obvious real-world examples are: The largest trees tend to absorb more sunlight, and thus grow at proportionately higher rates. The most massive planets in a stellar system attract more space dust and debris, thus growing at proportionately higher rates.

The discrete probability graph in figure 5 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. However, the general form approaches a Zipf distribution of,

$$f(x) = \frac{c}{x^s} \tag{9}$$

$$Where\ c\ is\ a\ constant\ used\ to\ sum\ to\ 1$$

$$c = \left[\sum_{i=1}^{n} \left(\frac{1}{i}\right)^s \right]^{-1} \tag{10}$$



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 5: 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) acts 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.

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, from three spatial dimensions to two spatial dimensions**
- **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 polarization $|\rightarrow\rangle$, over recursive information exchanges,

$$P(J) = k\,\frac{|\rightarrow\rangle}{f^n} \tag{11}$$

Where k is a constant or proportionality

3 Recursive Information Exchanges in Quantum Decoherence

Information as Energy

An experiment in 2010, by a team of Tokyo scientists, [6] demonstrated that a non-equilibrium feedback manipulation of a Brownian particle on the basis of information about its location achieves a Szilárd-type [7] information-to-energy conversion, using real-time feedback control. In thermodynamics, the Jarzynski equality [8] (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 [9] 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. Feedback control can increase the likelihood of the occurrence of such an event. This is the crux of the control in the thought experiment: "Maxwell's Demon". [10] 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. [11] 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.

Neuroscience has theorized the dual (two minds) model of the human brain from research on post-surgery consciousness of split-brain patients. [12] Following surgery, these two minds are typically opposing, such that both minds simultaneously perform opposing functions (see figure 6).

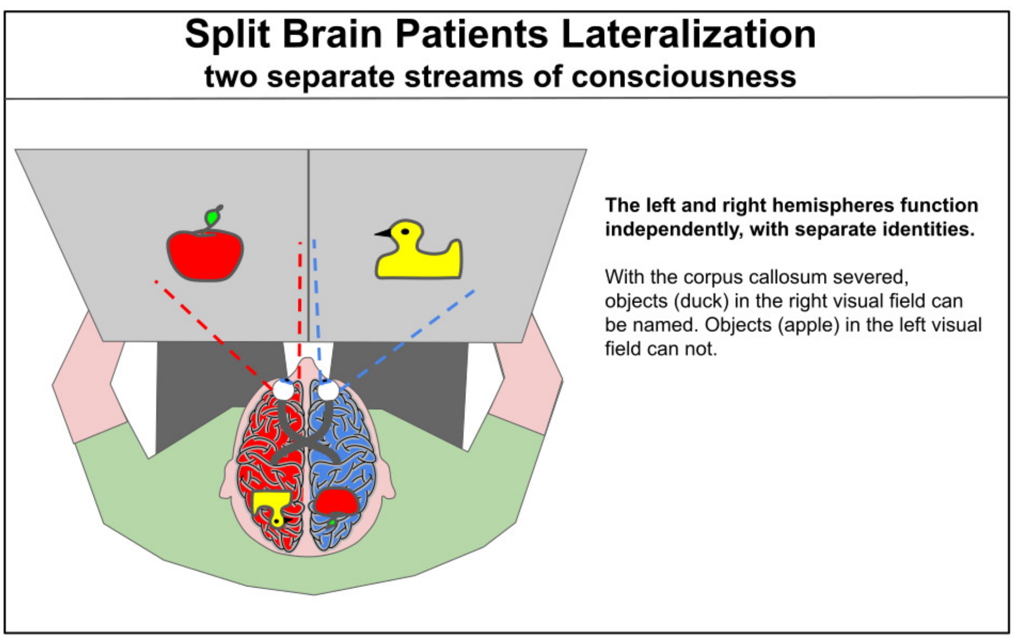


Figure 6: Split Brain Patients Lateralization two separate streams of consciousness

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

4 Nonseparability and the Emergence of Spacetime

Hypothesis 1 *A dual consciousness exists within the mind of the single observer of a particle, which is oppositional 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 biased observation, interpretation, response and self-validation, resulting in the* ***polarization of the observer's dual consciousness****. Subsequently, the particle, which exists in* $\mathbb{R}^5$ *hyperspace becomes polarized/entangled in* $\mathbb{R}^4$ *spacetime, in correspondence with the observer's polarizes state, along with the local environment. This* $\mathbb{R}^4$ *polarization separation and emergence from an interconnected* $\mathbb{R}^5$ *hyperspace is the essential process which results in quantum decoherence.*

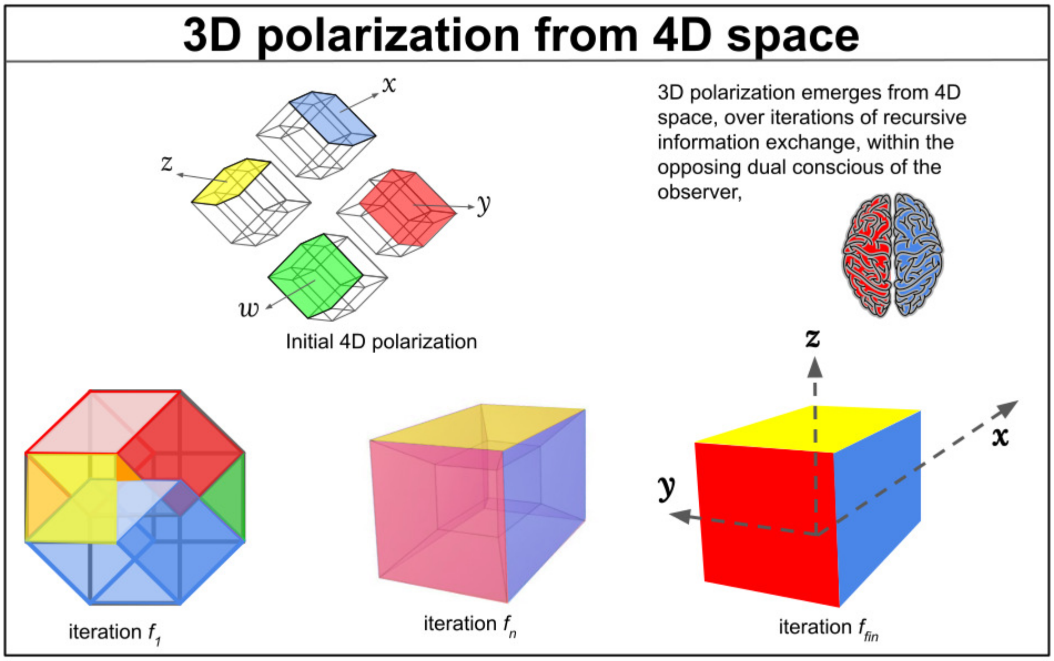


Figure 7: Particle 3D polarization emergence from 4D space

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 $|\olessthan\rangle$, for the measurable $\hat{H}$ of the measured state $|a_n\rangle$, in the Hermitian equation,

$$\hat{H}|a_n\rangle = \lambda_n|a_n\rangle \tag{12}$$

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

$$|\olessthan_1\rangle \otimes |a_1\rangle + |\olessthan_2\rangle \otimes |a_2\rangle \tag{13}$$

  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, cannot be divided into two separated wave functions. Can be expressed as,

$$\Psi(x_1, x_2) = \sum_{n=1}^{\infty} \psi_n(x_2) U_n(x_1) \neq \chi(x)_1 \theta(x)_2 \tag{14}$$

- 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 5).

5 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 (observational study) is proposed, as empirical evidence of observer-influenced particle collapse, to a measurable state,

- Two parallel Stern Gerlach [13] 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) simultaneously.
- 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**.

6 Gravity

Hypothesis 2 *As hypothesis 1 implies, **all of the 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,

$$F_g \approx \frac{r^2}{Gm_1 m_2} \tag{15}$$

This eliminates the need for factoring Dark energy, [14] as a repulsive force in empty space, to satisfy the Cosmological Constant Λ [15] (Of course, the mathematics of Newton [16] and Einstein, [17] elegantly describe the relationships of matter and space, and equally apply to this model).

7 Conclusion

Recursive information exchange and the resulting low-entropy power-law distributions, are ubiquitous in Classic Space. It's fair to say that we are swimming in the dynamics which maintain order and negentropy. Reasoning, by analogy to the dynamics of Quantum Mechanics, provides a logical explanation to the paradox of deterministic particle evolution, in the Measurement Problem. The key concept is that the observer's fundamental perspective is self-validated. Gaining awareness of our bias can elevate our perspectives in Physics, as well as in social conflict resolution. Hypothesis 1 suggests that matter which is separated in $\mathbb{R}^3$ spatial dimensions is actually connected 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.

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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.