Research Article

Particle Entanglement With the Observer's Polarized Dual Consciousness — A Modified Stern Gerlach Experiment, as Proof

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A profound and novel theory that particle observation is dual, involving two minds (per Post-corpus callosotomy experiments) and a mathematical model of consciousness as positive reinforcement loops, which ultimately collapse to a single state (in correspondence with the particle and subsequently the local environment). This concept is very much analogous to the classic space polarization (political and ideological) which we observe daily in society, as well as power distributions in nature.

The mathematical description of decreasing Shannon entropy, increasing potential energy, Jarzynski equality, and random information exchange probability is compared with Von Neuman entropy during Quantum Entanglement and collapse.

A simple and inexpensive proof of this theory is proposed (Section 5), using a modified Stern-Gerlach experiment.

The value of this model is how it eloquently explains the logical inconsistencies of the Two-State Experiments (Section 4), as the observer undergoes a profound change in each observed orientation.

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1. Introduction

As the polarization from recursive information exchange (RIE) translates across scales, ranging from neurological decision making to global information exchange, it is reasonable to assume that RIE also plays a fundamental role in quantum decoherence. To use a relevant example: What was the initial state which triggered World War 1? The general consensus would be: The ''Archduke Ferdinand moment'', and the literal pull of the assassin's trigger. However, I propose that the actual initial state and precursor to WW1 occurred at the **neurological scale**, within the dual and opposing mind of the assassin (see Section 3 for an explanation on Post-corpus callosotomy experiments). So, the nature of RIE is escalating positive reinforcement loops. In this example, the sequence of RIE **escalated through successive scales of: neurological, local, regional, national and global**.

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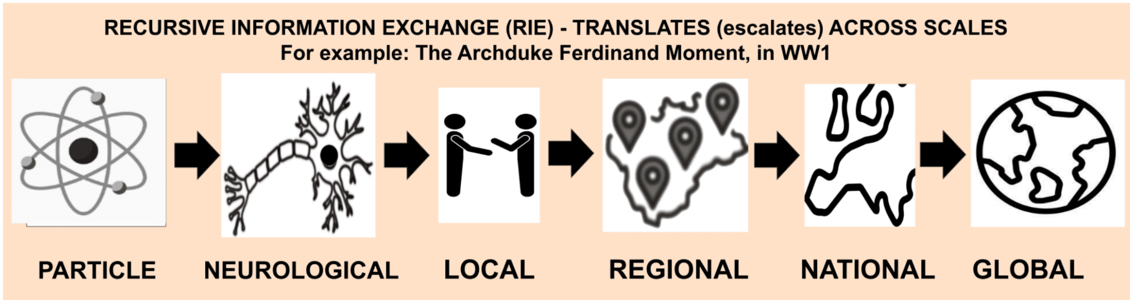

Figure 1. Recursive Information Exchange Translates Across Scales

2. Recursive Information Exchanges in Classic Space (Entropy Decreases and Potential Energy Increases)

Recursive information exchange (as positive reinforcement loops) over time ultimately results in a collapse. This is true at all scales, from subatomic space to Classic space. Regardless of the scale, a power law distribution leads to **a transition from high entropy / low potential energy states to low entropy / high potential energy states, and to the ultimate collapse into a single state**.

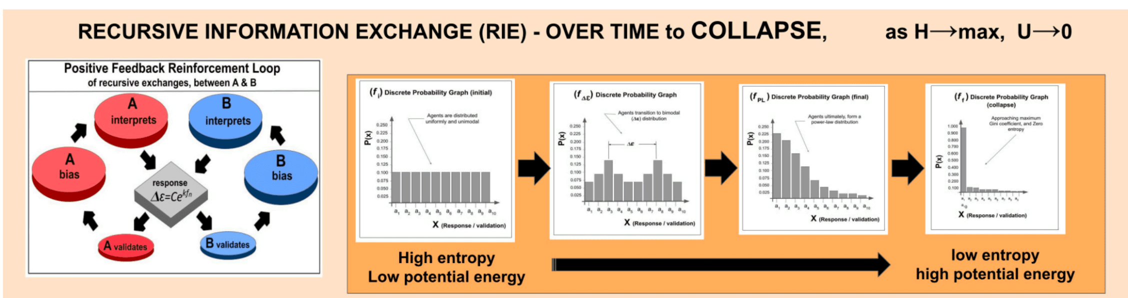

Figure 2. A transition from a high entropy/low potential energy state to a low entropy/high potential energy state, leads to the collapse into a single state.

An Analogy Between Polarization in Classic Space and Quantum Decoherence

Using a Classic Space analogue to Quantum Decoherence: Recursive information exchange (RIE), within the framework of reinforcement loops, between agents. From this dynamic system of information exchange, the resulting decreased Shannon entropy, increased potential energy, polarization and preferential growth (over scales) are compared with Von Neuman entropy during Quantum Entanglement and collapse.

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

Using a modified version of Shannon entropy for convenience,

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

Modified version of entropy equation:

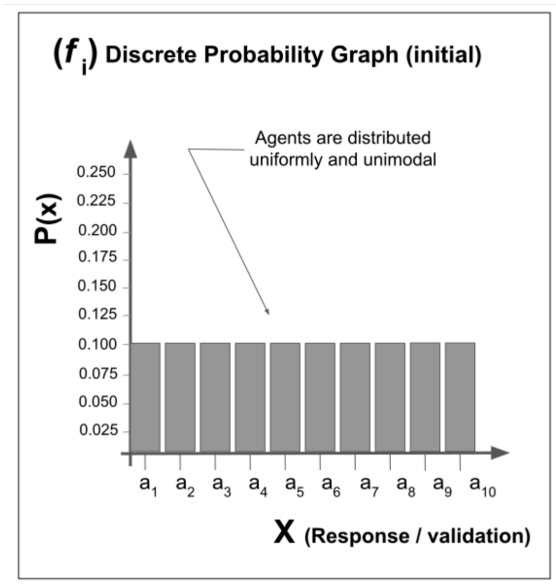
$$I(a_i) = -\,log_2(p(a_i)) \qquad (1)$$

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

figure 3 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 $(H(X))$[1]

Note: Entropy in the initial state is at maximum

$H(X) \rightarrow \max$



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 3. Discrete probability graph at initial state f^i

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 4).

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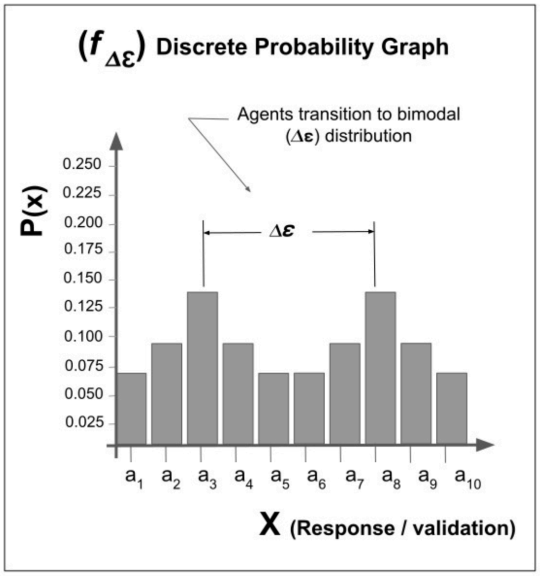

x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.075	3.737	0.280
a_2	0.100	3.322	0.332
a_3	0.150	2.737	0.411
a_4	0.100	3.322	0.332
a_5	0.075	3.737	0.280
a_6	0.075	3.737	0.280
a_7	0.100	3.322	0.332
a_8	0.150	2.737	0.411
a_9	0.100	3.322	0.332
a_{10}	0.075	3.737	0.280
	1.000		$H(x) = 3.271$

Figure 4. Discrete probability graph transitioning to a bimodal distribution

$$\textbf{Note: Entropy decreasing over iterations } f_n$$
$$H(X) = 3.271$$

How Distributions Become Separated over Recursive Iterations of Information Exchange. A Dialectical Development

The diagram in figure 5 shows the flow of incremental recursive information exchanges, within the framework of positive reinforcement loops. The observational components (of bias, interpret, response and validation) are mutually mirrored between agents A and B, and **follow a figure eight pattern**. Typically, divisions tend to escalate over time in this format. A real world example might be the polarization which occurs during dysfunctional political rivalry. Note the Dialectical Development

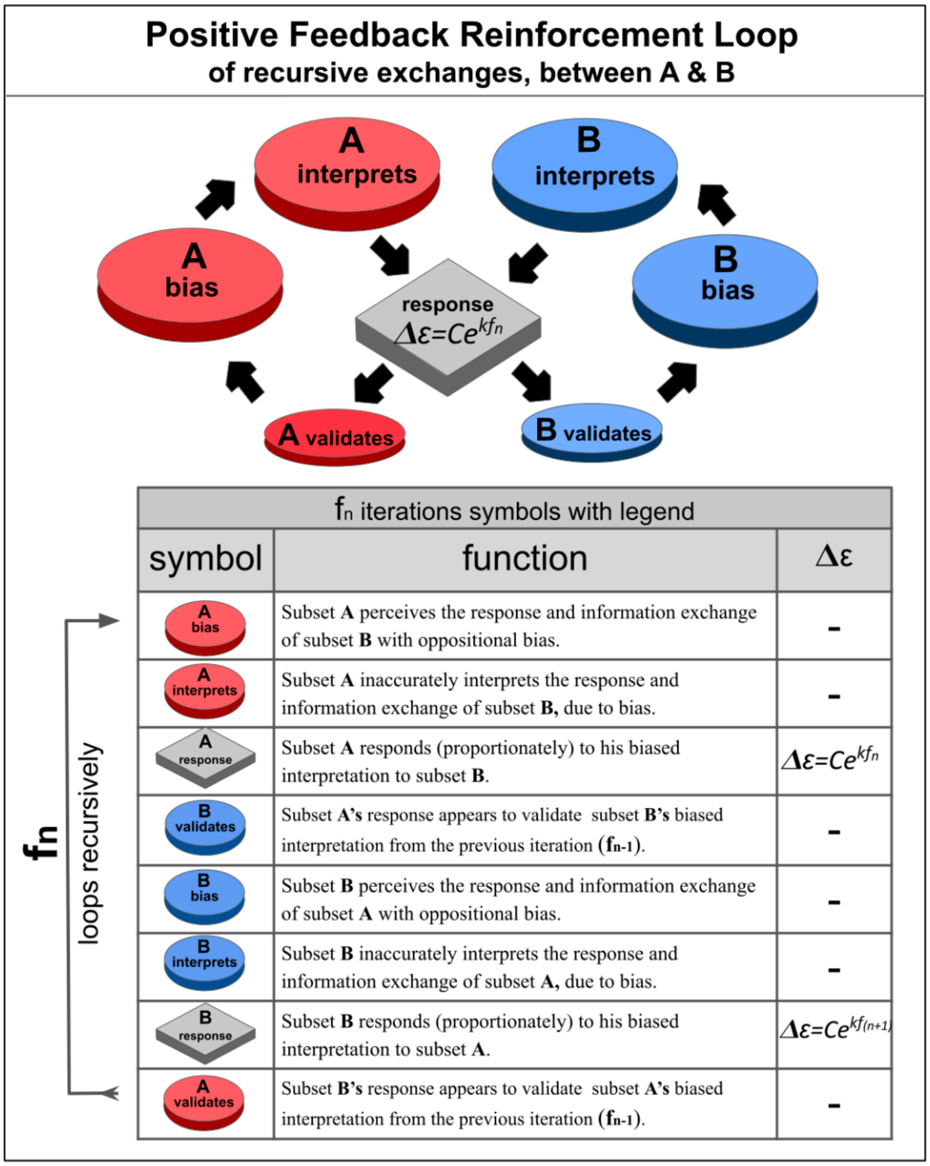

Figure 5. Division develops within positive feedback reinforcement loops, of recursive information exchange

Self-Validation of Subjective Observation,

The separation ϵ escalates between the agents in subsets A and B during each iteration, as a result of oppositional dynamics (biased interpretations and responses from opposing perspectives). Note that their mutual responses only seem to validate their interpretation. However, the outcome is merely confirmation bias. In other words, their subjective observations are **self-validated**. This concept of self-validation is referenced in section 4.3, as it relates to validation in Quantum Decoherence.

How Separation $\Delta\epsilon$ Increases over Iterations

Subsequent iterations follow the same sequence, and result in an incremental positive feedback loop. As separation escalates over iterations, $\Delta\epsilon$ increases exponentially with each iteration (f^n), per the following differential equation and exponential solution.

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Note, that interpretations become increasingly distorted over iterations. This is demonstrated in the children's game "Chinese Whispers"[2], where an original message becomes unrecognizable, after multiple recursive information exchanges between players of the game,

$$\frac{d\epsilon}{df^n} = K\epsilon \qquad (3)$$
$$\frac{1}{\epsilon}d\epsilon = kdf^n \qquad (4)$$
$$\int \frac{1}{\epsilon}d\epsilon = \int kdf^n \qquad (5)$$
$$ln|\epsilon| = kf^n + c \qquad (6)$$
$$|\epsilon| = e^{kf^n+c} \qquad (7)$$
$$\epsilon = Ce^{kf^n} \qquad (8)$$

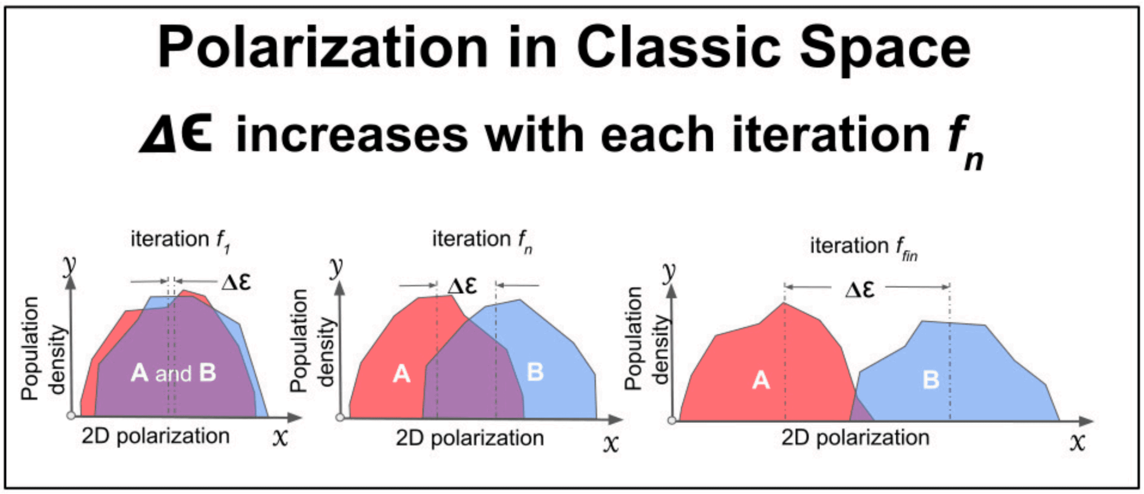

Figure 6. Polarization tends to emerges in the natural world (classic space) over iterations f_n

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 debris, and thus grow at proportionately higher rates.

The discrete probability graph in figure 7 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.

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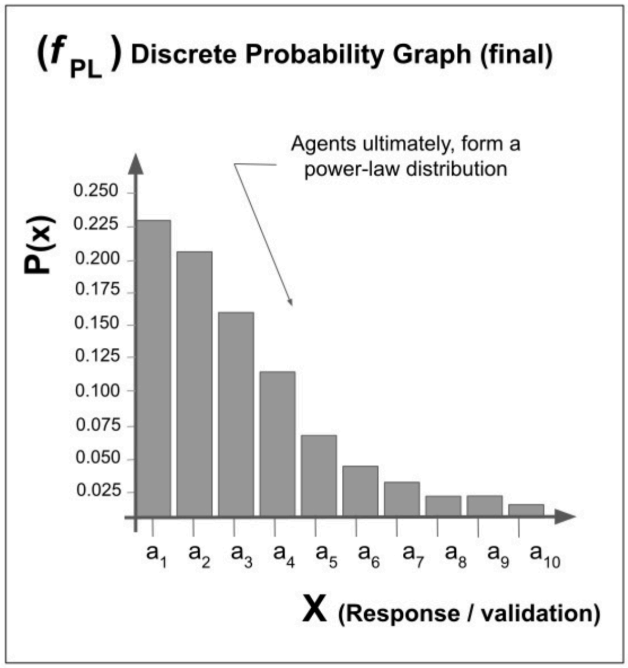

x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.250	2.000	0.500
a_2	0.225	2.152	0.484
a_3	0.175	2.515	0.440
a_4	0.125	3.000	0.375
a_5	0.075	3.737	0.280
a_6	0.050	4.322	0.216
a_7	0.038	4.737	0.178
a_8	0.025	5.322	0.133
a_9	0.025	5.322	0.133
a_{10}	6.322	3.322	0.079
	1.000		$H(x) = 2.818$

Figure 7. Discrete probability graph transitioning to a power-law distribution

$$\textbf{Note: Entropy decreasing over iterations } f_n$$
$$H(X) = 2.818$$

Asymptotic Entropy of Open Systems with Power-law Distributions

At a critical Gini coefficient, power-law distributions tend to collapse and then 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.

Collapse stage f_{fin}

Figure 8 shows a power-law distribution approaching maximum Gini coefficient.

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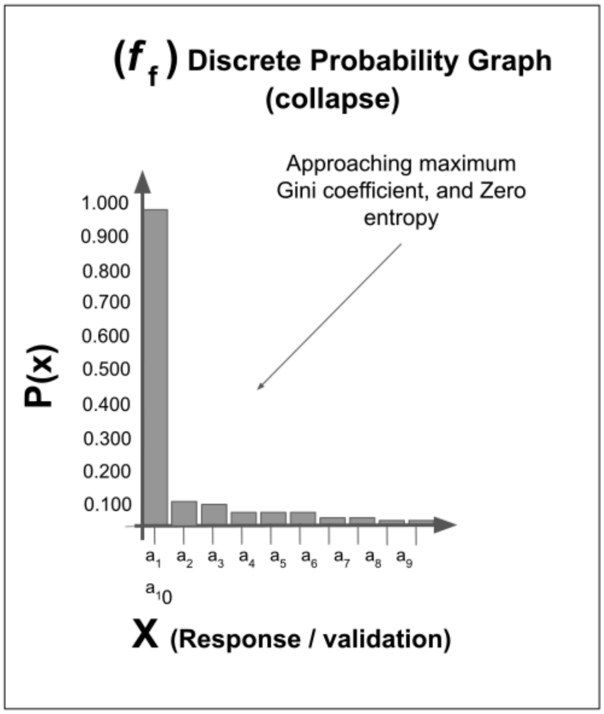

x_i	$P(x_i)$	$I(x_i)$	$P(x_i) * P(x_i)$
a_1	0.950	0.074	0.070
a_2	0.025	5.322	0.133
a_3	0.015	6.059	0.090
a_4	0.005	7.644	0.038
a_5	0.001	9.966	0.010
a_6	0.001	9.966	0.010
a_7	0.001	9.966	0.010
a_8	0.001	9.966	0.010
a_9	0.001	9.966	0.010
a_{10}	0.000	0.000	0.000
	1.000		$H(x) = 0.381$

Figure 8. As the Gini coefficient of a power-law distribution increases to maximum, the entropy approaches zero.

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.

$$H(X) \to 0\ as\ G \to max$$

Potential Energy Increases

Note: As entropy $H(x)$ goes to zero, potential energy U goes to maximum

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This gain of potential energy, from negentropy is real in classic space, if you consider how a Demagogue divides and polarizes a population, then uses the doped energy within this divided population to suit his own purposes

$$U \rightarrow \ max \ as \ H(X) \rightarrow 0$$

Negentropy as Potential Energy

The probability of negentropy $P(J)$ of a set is proportionate to it’s polarization $| \rightarrow \Big\rangle$, over recursive information exchanges,

$$P(J) = k \, \frac{| \rightarrow \Big\rangle}{f^n} \tag{12}$$

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[3] demonstrated that a non-equilibrium feedback manipulation of a Brownian particle on the basis of information about its location achieves a Szilárd-type[4] information-to-energy conversion, using real-time feedback control. In thermodynamics, the Jarzynski equality[5] (free energy difference) $\Delta F = F_B - F_A$ between two states A and B is connected to the work W done on the system through the inequality: $\Delta F \leq W$. In microscopic systems, thermodynamic quantities such as work, heat and internal energy do not remain constant but fluctuate. Nonetheless, the second law[6] 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".[7] 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.[8] 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 $\{|\phi_i\rangle\}$ of that observable. When an external agency (an observer, experimenter) measures the observable associated with the eigenbasis $\{|\phi_i\rangle\}$, the wave function collapses from the full $|\psi\rangle$ to just one of the basis eigenstates, $|\phi_i\rangle$, that is: $|\psi\rangle \rightarrow |\phi_i\rangle$.

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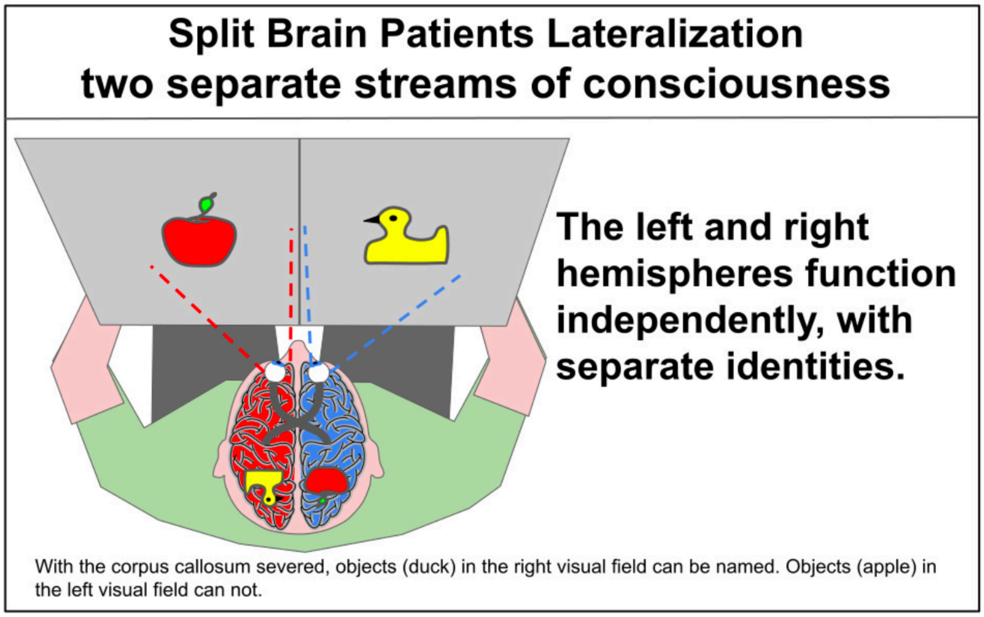

Figure 9. Split Brain Patients Lateralization two separate streams of consciousness

Neuroscience has theorized the duel (two minds) model of the human brain from research on post-surgery consciousness of split-brain patients.[9] Following surgery, **these two minds are typically opposing, such that both minds simultaneously perform opposing functions** (see figure 9).

Thus, Hypothesis [h-dual] implies the following, in the Measurement Problem,

- The observer's opposing dual consciousness exchange information about the particle being observed, and follow an essentially similar process (components of bias, interpret, response and validation) as the figure 8 flow diagram shown in figure 5.
- The two opposing observables ultimately collapse into one of two (polarized) states$|\psi\rangle \to |\phi_i\rangle$.
- The collapsed state corresponds to either a "spin up" or "spin down" state.

  ↑↓
- 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

$$|⧀\rangle$$

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

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

Such that the observer's polarized dual conscious is entangle with

$$|a_n\rangle, |⧀_1\rangle \otimes |a_1\rangle + |⧀_2\rangle \otimes |a_2\rangle$$

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- 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,

$$\Psi(x_1, x_2) = \sum_{n=1}^{\infty} \psi_n(x_2) U_n(x_1) \neq \chi(x)_1 \theta(x)_2 \tag{13}$$

- This process of exchange between the observer's dual consciousness **occurs instantaneously to the single observer, who is unaware of the subconscious dynamics**.
- Hypothesis [h-dual] 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).

4. The Two States Experiments are Explained by the Entanglement of Observer and Particle

The reason that the observer can not explain the logical inconsistencies of the "Two States Experiments" [10] is because the observer undergoes a profound change during each validation (I prefer to use validation, instead of "observation" or "measure", as it's more useful), such that the observer's opposing dual consciousness becomes polarized, through a sequence of recursive information exchange, that results in lower entropy, higher potential energy, and collapses to a single validated state (unconscious to the single observer). Subsequently, the particle becomes polarized and entangled with this single validated state (and subsequent local and remote environments). **Thus the observer becomes changed (polarized), in correspondence with the particle at each orientation.** Figure 10 shows the three stage sequence of $x \rightarrow y \rightarrow x$ axis orientations and resulting percentages of possible binary states of angular momentum.

Note: conjecture to follow

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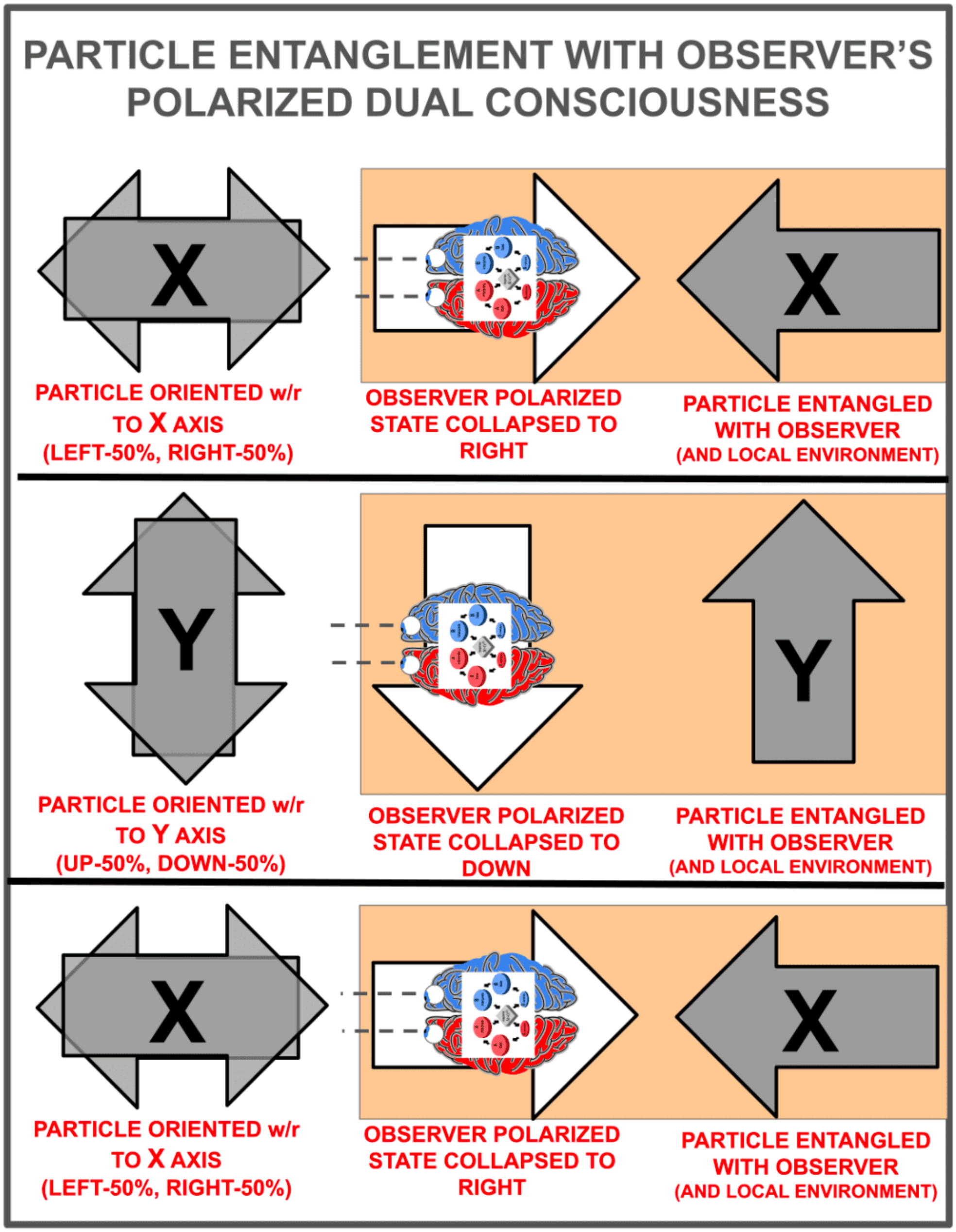

Figure 10. Two States Experiment, with three stages of x, y, x axis orientations and resulting percentages of possible binary states.

This model also explains the reason that repeated experiments tend to result in a 50 / 50 distribution of polarized particle orientations (to the tangent of the previous angle). The observer's dual mind naturally seeks balance over iterations. If this model is correct, a modified (two system) Stern-Gerlach experiment would provide proof of particle / observer entanglement.

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 angular momentum 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 11),

- 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**.

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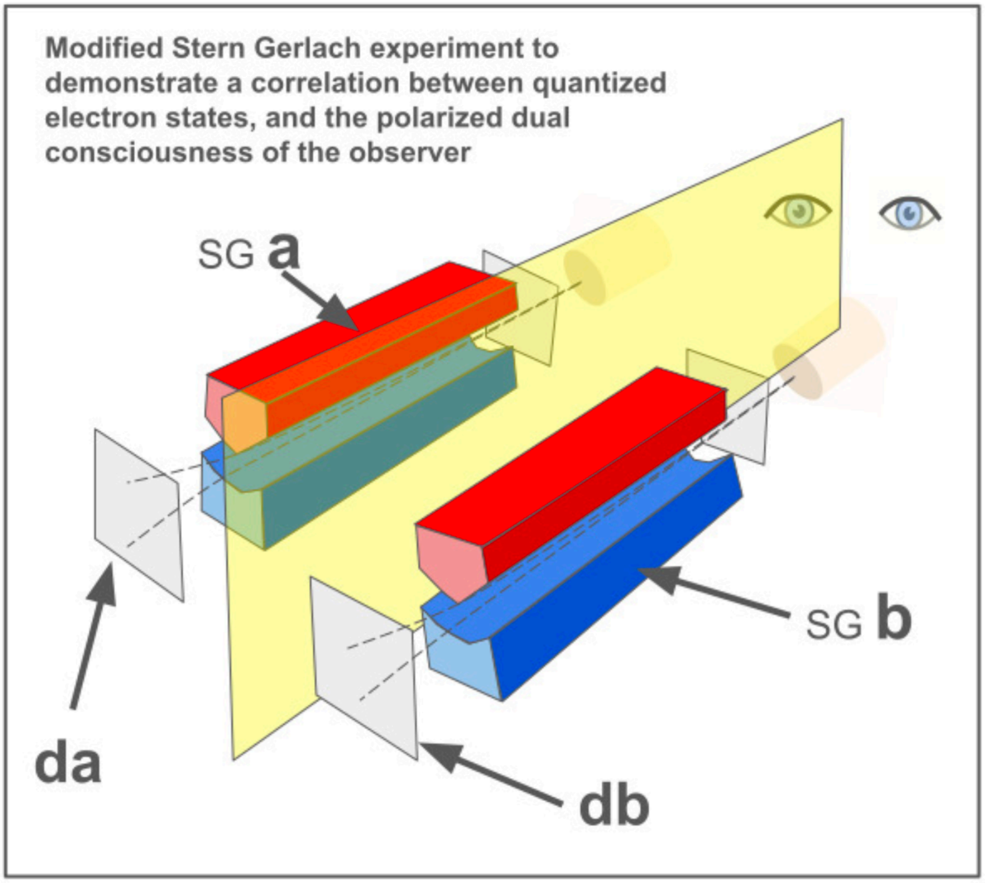

Figure 11. Modified Stern Gerlach experiment to demonstrate a correlation between quantized electron states, and the polarized dual consciousness of the observer.

6. Conclusion

Recursive information exchange and the resulting low-entropy power-law distributions, are ubiquitous in Classic Space. **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**. This model 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**.

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

Statements and Declarations

Conflicts of Interest

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.

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Data Availability

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

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