The Two Way Interaction Between the Wave Function of the Universe and the Wigner's Participators

Moninder Singh Modgil

Spiritual Applications Research Center (SpARC)
Gyansarovar, Mount Abu, Rajasthan, Pin 307501
India

Corresponding author: Moninder Singh Modgil - Email: msmodgil@gmail.com
Date: 30th September 2024

Abstract

We develop a formalism to describe the two way interaction between the universe and the "Participators" – a term introduced by Wigner, to replace the usual term "Observers". Role of biological aspects – brain and body in the "Quantum Measurement" or rather as we emphasize, "Perception", is discussed. We cite the experiments on perception of Necker's cube and confirmation of Quantum Zeno Effenct (QZE) within the brain. Our approach of interaction between the universe and the Participators is a Quantum Mechanical version of the approach in the book "Self and its Brain" by Ecclles and Popper, and is analogous to the Newton's third law of action and reaction.

1. Introduction.

von Neuman [1] and Eugene Wigner [2] were among the first physicists to identify an interaction between an observer and his/her environment – in a quantum measurement setting. Wigner introduced the term "Participator", which generalizes the term "Observer", for describing the two way interaction. Irwin, Fang and others [3,4,5], suggest that there is only one "Universal wave Function (UWF)" – with that of Wigner's Participants, being an Eigen Function of UWF. Here, they are aligned with Everett's Parallel Universes [6]. They put forth the concept of Trits [16,17,18], as a set, consisting of three entities, namely {0, 1, C(t)}, where C(t) is a choice function exercised at the time "*t*" of the Quantum Measurement. The UWF evolves with time and settles down to either 0 or 1, at Quantum measurement. This set is isomorphic to {{},{{}}, {!}}, where {} is the empty set (numerically equal to 0), {{}} is the set containing the empty set, (numerically equal to 1) and {!} is the Choice function.

Biological issues come to the fore, with the nervous system playing a major role. Penrose and Hameroff [7], identify microtubules in cytoskeleton, as the sites where quantum computation occurs, and plays a role in the collapse of the wave function. Schrodinger [8] examines "life" in a physical setting. Ecclles and Popper [9] in their celebrated book "Self and Its Brain", study the two way interaction between the body and the non-material consciousness. In this paper, we develop a formalism for the two way quantum measurement process occurring between the Wave Function of the Universe (WFU) and the Wigner's Participators. We also consider the biological aspects – brain and perception – which are essential for the Participator setting [10].

2. Formalism for the two way Interaction between Universe and Participators.

Let

$$\Phi = \{\varphi_1, \varphi_2, \varphi_3, \dots, \varphi_{n_1}\} \tag{1}$$

be the set of wave functions of the *n* Participators φ_i. Cardinalty of Φ at most, is a finite integer n_1 ; as the cardinality of any set of humans is countably finite. Let,

$$\Psi = \{\psi_1, \psi_2, \psi_3, \dots, \psi_{m_1}\} \tag{2}$$

be the set of eigenfunctions corresponding to the wave function of the universe $\varsigma_{Universe}$. What would be the cardinality of Ψ? Is it finite or countable infinity - $\aleph_0$(Cardinality of the set of Integers), or the uncountable infinity $\aleph_1$(Cardinality of set of real numbers). We need to elucidate certain additional properties of Ψ and ψ_i. For simplicity, we assume here in, that cardinality of Ψ is finite. Now we have -

$$\varsigma_{Universe} = \sum_{i=1}^{N} a_i \psi_i \tag{3}$$

where, a_i are the corresponding eigenvalues, forming the set *E*, given below –

$$E = \{a_1, a_2, a_3, \dots, a_N\} \tag{4}$$

Define a set $\wp$ of projection operators P_M^N, $N > M$ which project a *N* dimensional Hilbert space $\mathcal{H}$ onto the set of its *M* dimensional subspaces. The Projection operators can be expressed as a $N \times N$ Matrix -

$$\wp = \begin{bmatrix} P_N^N & P_{N-1}^N & \cdots & P_1^N \\ P_N^{N-1} & P_{N-1}^{N-1} & \square & P_1^{N-1} \\ & \square & \square & \vdots \\ \vdots & \square & \ddots \square & \square \\ & \square & \square \ddots & \square \\ P_N^1 & P_{N-1}^1 \cdots & \square & P_1^1 \end{bmatrix} \tag{5}$$

It is this collapse, in the last column, which completes the measurement process –

$$P_1^i(\varsigma_{Universe}) \xrightarrow{\square} \psi_i \tag{6}$$

Incorporating the role of participators, φ_i the process of the wave function collapse, denoted as $\mathfrak{H}$, by the Participator can now be expressed as follows–

$$\mathfrak{H}: P_1^n(\varsigma_{Universe}) \xrightarrow{f(\varphi_i)} \psi_n \in \mathcal{H}, n = 1, .., N, \tag{7}$$

where, $f(\varphi_i)$ represents the causal effect of the participator φ_i. Possible models for $f(\varphi_i)$ are that of Hepp [7], Fakuda [8] and others.

Corresponding to the matrix of Projection Operators of eq. (5), there exists another reciprocal Matrix of Hilbert Spaces, as follows –

$$\mathcal{H} = \begin{bmatrix} \mathcal{H}_N^N & \mathcal{H}_{M-1}^N & \cdots & \mathcal{H}_1^N \\ \mathcal{H}_N^{N-1} & \mathcal{H}_{N-1}^{N-1} & \square & \mathcal{H}_1^{N-1} \\ & \square & \square & \vdots \\ \vdots & \square & \ddots \square & \square \\ & \square & \square \ddots & \square \\ \mathcal{H}_N^1 & \mathcal{H}_{N-1}^1 \cdots & \square & \mathcal{H}_1^1 \end{bmatrix} \tag{8}$$

where in, we define the inverse operators Q_M^N , with the action,

$$P_m^n(\mathcal{H}) \otimes Q_n^m(\mathcal{H}) = \mathcal{H}, \quad n \geq m \tag{9}$$

Or more concisely,

$$P_m^n \otimes Q_n^m = I \tag{10}$$

where, I is the Identity Projection.

While P_m^n reduces the dimensionality, Q_n^m increases it. So the Q_n^m can be regarded as inverse of the Projection operators. We have -

$$\mathfrak{H}_{\square}^{-1} \otimes \mathfrak{H}: Q_n^1 \left(P_1^n (\varsigma_{Universe}^{\square}) \xrightarrow{f(\varphi_i^{\square})} \psi_n^{\square} \right) \xrightarrow{f_{\square}^{-1}(\varphi_i^{\square})} \varsigma_{Universe}^{\square} \quad , \quad n = 1, .., N \tag{11}$$

$\mathfrak{H}_{\square}^{-1}$ and $f_{\square}^{-1}(\varphi_i^{\square})$ are inverse of $\mathfrak{H}$ and $f(\varphi_i^{\square})$ respectively. It's the mutually inverse direction of $P_m^n \; and \; Q_n^m$, which allows the two way participator action – reminiscent of Newton's third law of action and reaction.

3. The Brain as the fulcrum.

We note that Participators have two special properties, namely – (1) Life, and (2) Consciousness; which are independent entities or processes. For instance plants have life but no (human like) consciousness. More examples of "life without consciousness", are Coma, and Deep Dreamless sleep – where in the EEG shows Delta waves. Consciousness is intimately connected with perception, i.e., - in coming information, from the universe which is processed by sense organs and brain - before coming into awareness. Reciprocally, there exist bodily actions which impact evolution of the universe. This underscores the role of biology, and specifically the brain, in the two way – " the Incoming Quantum Measurement" and "the Outgoing Participator's Reaction on the universe". In [11], we have posited that the participator/observer can be modelled as a Dirac Delta Function $\delta(x)$, where x is the position of Participator/Observer..

4. The Quantum Zeno Effect (QZE) and the Quantum Measurement in the Brain.

Experiments [12] based upon, the phenomenon of "Oscillating Stereoscopic Perception", of the Necker's cube, have shown existence of the Quantum Zeno Effect within the brain. The experiments were performed by [13], and based upon their result, Hepp [14] proposed existence of QZE in brain. Neuro-Biological Quantum Zeno Effect (NBQZE), was first introduced by Modgil [15].

References

1. von Neumann, J. : *Mathematical Theory of Quantum Mechanics*, Princeton University Press, (1955).

2. Wigner, E. P.: *The Place of Consciousness in Modern Physics,* The Collected Works of Eugene Paul Wigner, Book Series, Volume B/6.
3. Irwin, K., Fang, F., Amaral, M., Urekhchina : Private communication
4. Irwin, K., Fang, F. :
5. Irwin, K., Fang, F. :
6. Irwin, K., Fang, F. :
7. Penrose, R. and Hameroff, S. : *Consciousness in the Universe: Neuroscience, Quantum Space-Time Geometry and Orch OR Theory*, Journal of Cosmology, **14**, (2014).
8. Schrödinger, E. : *What is life?*, Cambridge University Press, (1944).
9. Sir Ecclles, J. C. and Popper, K. : *Self and Its Brain,* Routledge, (1984).
10. Modgil, M. S. : *Axioms for a Differential Geometric approach to the von Neumann's Theory of Quantum Measurement*, Quantum Speculations, Supplement to International Journal of Quantum Foundations, 5 (2023), 1-12.
11. Hepp, K. : Helv. *Phys. Acta.,* 45, 237 (1972).
12. Fakuda, R. : *Phys. Rev.,* A, 35, 8 (1987); 36, 3023 (1987).
13. Everett, H. : *Theory of the Universal Wavefunction*, Thesis, Princeton University, (1956).
14. Modgil, M. S. : *Axioms for a Differential Geometric Approach to von Neuman's Theory of Quantum Measurement*, Quantum Speculations.
15. Neckers cube
16. Experiments
17. Hepp
18. Modgil, M. S. : *Consciousness in Cyclic Time, Axiom of Choice and Neuro-Biological Quantum Zeno Effect*, Second International Conference on Consciousness, organized by Bhaktivedanta Institute, Calcutta, December 1996.