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RESEARCH ARTICLE

QUANTUM MECHANICS AND INDIAN PHILOSOPHIES: A CONTRIBUTION TO THE HISTORY AND PHILOSOPHY OF SCIENCE

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ABSTRACT

Since 1930, we have speculated among the "harmony" between Quantum Mechanics and the Philosophies of India, though there has not been many studies on this subject. This research article aims to be a contribution to this purpose, describing three Quantum Physics experiments and interpret their results through the perspective of Indian Philosophies.

INTRODUCTION

Currently, Physics has two main theories for the description of the Universe, namely the Theories of Relativity (for the macroscopic description of physical systems) and Quantum Physics (for the microscopic description of physical systems) (Goswami, 2011). The first physical theory is based on assumptions of strong objectivity (the Universe outside is independent of the mind of the observer), determinism (knowing the velocity and the initial position of the object, it is possible to predict the future movement), locality (the objects cannot travel faster than the speed of light, i.e., 300,000 Km/s) and continuity. The second theory is based on assumptions of weak objectivity (the mind of the observer interferes with the outer reality), Heisenberg uncertainty Principle (it is not possible to predict with equal accuracy, the position and speed of a quantum particle), non-locality (instant communication between two quantum objects) and quantum leap. However, the assumptions of these two physical theories are in opposition to each other, i.e. at the macroscopic level, physical reality is described by the characteristicsof "common sense," whereas at the microscopic level, the reality is described by totally different characteristics. In fact, there are four fundamental experiments of quantum physics that came to challenge the vision we have of the macroscopic Universe, and which have deep epistemological implications in the way we interpret the Universe. These four experiences are the double-split experiment, the delayed choice experiment, the non-locality experiment, the quantum leap experiment.

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METHODS

In this essay about Quantum Mechanics and the Philosophies of India, I collected and analyzed the main scientific books and technical articles, in this area of study, that area available in academic libraries. Thus, I selected the 28 most important items, based on the "impact factor" of the article and the "reference" books on this topic in order to be useful to the reader who aims to have just an idea of this subject, maintaining the scientific rigor of my research.

RESULTS AND DISCUSSION

In this section, I will present the results and the most relevant facts of my research work about the four experiments of Quantum Mechanics (the two–split experiment; the delayed-choice experiment; the non-locality experiment; the quantum leap experiment) and the epistemological interpretation made by Philosophies of India.

Quantum Mechanics experiments: four examples: All the following experiments on Quantum Mechanics are from the books *The Feynman Lectures on Phsyics* (Feynman and Sands, 1964) and *Quantum Mechanics* (Rae, 1992).

The two-split experiment: In this experiment, we have a source of electrons, a plate with two splits and a target (a photographic plate). Let´s suppose, we close the split 2, and open the split1 (or vice versa), we got a discrete phenomenon (in the sense that hits an electron here, another there, ...), and the arrival of electrons to a particular area of the plate, it is a random phenomenon. The electron behaves as a "particle".

If we open the two splits appears a figure of interference that are "quantum waves of probability". It is not possible to observe the movement of these "quantum waves of probability" in space-time, as these come into «collapse» when observed byan observer who detects the resultof this experiment in the target as a "point". All the points made up of a large number of electrons is called by a "interference wave pattern". However, if we send only a single electron into the system, we have a paradox, because a single electron, finding two open splits, it behaves as if it were a "wave sufficiently extensive" to pass simultaneously through two splits interfering with itself, being able to produce a "figure of interference", and appearing on the screen as a "located point". The electron behaves as a "wave". In summary, in the two split experiment, we could say that is impossible to observe, simultaneously, the wave-particle aspect of a "quantum wave of probability". This is the Complementary Principle.

The delayed choice experiment: This experiment is due to the scientist John Wheeler. In this experiment a beam of light is split into two beams of light of equal intensity, through a mirror, E1. Then these two beams are reflectedin order to meet at a point of intersection, P. At this point, the observer decides if he wants to see the wave or particle aspect of the beam of light. If he decides to see the particle aspect of the beam light, there are some detectors, D, after the point P, indicating which of the trajectories was followed by the particle. Alternatively, if the observer decides to see the wave aspect, there is another mirror of reflection, E2, next to the point P, so that such the two waves of the beam of light might interfere with each other. In this case we have to admit that the photon travelled at the same time through both paths, so as to have interference. If the wave aspect interfere constructively, the detector, D will sign the occurrence, while if the wave aspect interfere destructively, the detector, Dwill not sign anything. The particular aspect of this experiment is that the observer just decide if he wantsto see the particle aspect or wave aspect, at the last moment as possible (10^{-9}seconds), that is,if he is not going to put the mirror, E2, and then observe the particle aspect or if he is going to put the mirror, E2, and see the wave aspect. In summary, we must conclude that the photon travelled through just one path or both at the same time in, according to the choice of the observer.

The non-locality experiment: This experiment was performed by Alain Aspect and his collaborators and is the prove of Eistein, Poldolsky and Rosen paradox. In this experiment, subatomic particles, such as photons are entangled themselves and correlated by polarization. In this Aspect experiment, there is a source F, where are two-photon are excited. This experiment consisted in the measurement of polarization of these pairs of correlated photons that move in opposite directions. About 6 m of each side of the source F, there is a detector D of the polarization of each one the photons.The crucial aspect of this experience was the inclusion of a switch S that might change the direction of polarization, one of the detectors, each 10 nanoseconds (the speed of light takes 40 nanoseconds to travel the distance of 12 meters, between the polarizers). We can vary randomly the subsequent the path of photons, when they have already left the source F. Thus, the change of the direction of polarization in the detector D, it will change the measurement result in another location – exactly how quantum mechanics said that it should happen. In summary, in the non-locality experiment, there is an exchange of information, of a photon to the other correlated, but that has not occurred through local signals, because the "collapse of the wave function" of each of the photons is instantaneous (in space- time the maximum exchange of information is the speed of light, according to Theories of Relativity).

The quantum leap experiment: Continuity is a scientific assumption that claims any movement or any change is continuous. However, in quantum physics, the physicist Max Planck proposed the idea of *quantum*, that is, the minimum amount of energy that both bodies can change. Later, Niels Bohr maintained that the atom is stable because the quantum objects, in particular electrons, emits no light continuously, but only when they jump from one orbit to another bottom. In other words, the electron jumps from one orbit to another, without going into the space between them. This happens because the electrons, as the other quantum particles, are "quantum waves of probability". In summary, the atomic energies exist as discontinuous levels of energy and the electron cannot take values of energy between these discrete values.

Quantum Mechanics and Indian philosophies: an epistemological interpretation of the previous four experiments: In the first experiment, the wave-particle paradox happens because we consider that there is only a single level of reality – the physical level. At this level of reality we see separately, the wave aspect or particle aspect (but not both, simultaneously). However, if we consider several levels of Reality (which correspond to various levels of Perception), it is possible to see wave-particle together (the *quantum of energy*).This subject was approached by Werner Heinsenberg (Heinsenberg, **1998**) where he said «reality is the continuous fluctuation of the experience as capture by consciousness».In mathematical terms, this is in agreement with the open structure of the Universe and the unity of Reality levels proposed by the Theorem of Kurt Gödel (Nagel and Newman, 1958). This theorem states that «a sufficiently rich system of axioms inevitable gives results that are either undecidable or contradictory», that is, knowledge is "open".In this regard, Basarab Nicolescu (Nicolescu, 1985) says that "there are, in Nature and in our knowledge, different levels of Reality that correspond different levels of Perception.The passage from one level to another level of Reality is performed through the Logic of Hidden Third.

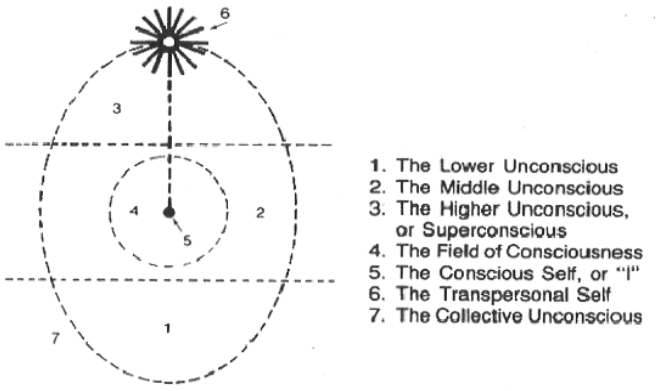

Figure 1. The areas of the consciousness in the human mind

For example, we could consider this antagonism in the study of the behavior of the human being. This description could be seen in Figure 1. This is the Assagioli Egg´s diagram. In this diagram, we could see the unconscious side of the human

being (number 1, 2, 3, 7), the field of conscious mind/perception of the human being (number 4), the self-perception field or "I" (number 5) that might establish a conscious link to the Soul/Real self (number 6). In the field of consciousness, it appears the mental and emotional patterns – Jung named them Archetypes (Jung, 1968) – that are "projected" as personal experiences in the physical world, such as, light/darkness, love/hate, grace/corruption (they are antagonic experiences in the physical reality). However, they are together in the field of conscious mind (the mind reality).
In this regard, the sage Indian Sri Aurobindo (Aurobindo, 1955) claims that Paramatman(named by religions as God or Conscious One) is the essence of all manifested world. This means that both goodness and evil are "quantum waves of possibilities"into Paramatmanthat conscious beings, like human being, should choose in order to manifest it into the physical world.This sage also claims that there is an *involutionary process of consciousness*, where the observer becomeconscious perception of the personality (physical, emotional, mental) – the "I" - and there is an *evolutionary process of consciousness*, where the observer become conscious of their qualities –the conscious of the Soul. Both are required for a complete realization of human life on Earth.

In the second experiment, I should refer that in the Cartesian Universe, the observer´s mind plays no role in the outer reality. However, the Indian physicist Amit Goswami (Goswami, 1988) claims that in the delayed choice experiment, until the observer makes the choice, there is no photon manifested in the space-time, but only "quantum waves of possibility". In mathematical terms, Feynman formulated the *paths integrals* (Feynman and Hibbs, 1965), that is, possible paths through which the photon travels, until pass the detector that indicates the path taken. The Euclidean quantum mechanics aims to apply the closest possible a probabilistic theory to regular quantum theory, so that we have an *imaginary time* in Scrödinger´s equation (Zambrini *et al.,* 2011). In fact, we have no *observable time* in quantum mechanics, but only a parameter (not an operator) as referred to by Pauli (1999). The difficulty to find the true role of time in Schrödinger´s equation might be a reflection of the lack of a theory of consciousness that might explain the entanglement between the observer´s mind and the physical world, when the observer makes a conscious choice (just at this moment arises an "arrow of time"). There is an huge unpublished correspondence between Pauli and Jung related with the relationship between mind and matter, the creative insight and biological evolution (Jung and Pauli, 1955). In this regard, the Indian sage Vivekananda (Vivekananda, 1988) defends that the cycle of birth and death is endless until Karma is ended. During lifetime, the change in creative focus (marriage, career) might be an opportunity to change the "fate" argued by a philosophical view, determinist, mechanist and materialist.

AmitGoswami (Goswami, 1988) adds that when the observer´s minddecideto see the wave aspect or the particle aspect (called by «collapse of wave function»)then it will be manifestedthe particular result according to the observer choice.This conclusion of Amit Goswami has many epistemological implications, particularly related withthe assumptions of strong objectivity and determinism. This Indian physicist claims that the observer´s mind has a responsibility in the manifestation of outer reality (is not a mere observer as claimed by Cartesian view). Moreover, the observer´s mind has free will to choose what will be manifested in the physical world, according to the "quantum possibilities" or archetypes that they are in the field of consciousness of the observer referred to in Figure 1. This description could be seen in Figure 2.

Figure 2. Young woman/old woman

This is a Gestaltic figure (young woman/old woman)that can be seen in two different ways according to observer´s mind.In fact, it is the observer´s mind that turns "quantum waves of possibility" into physical reality, that is, how we choose, so we are. This is in line with the "Anthropic Principle" (the Universe has a purpose) proposed by Barrow and Tipler (Barrow *et al.,* 1986). In this regard, Amit Goswami defends that the Universe is self-aware through self-conscious beings, such as human beings. In the third experiment about non-locality, we have seen that when there is an entanglement between quantum objects, such as photons, an instantaneous communication occurs between them, regardless of their distance, when there is an observation made by a conscious observer. In this regard, I should mention the Grinberg-Zylberbaumand colleagues experiment related with telepathic or instant communication between shamans. This description could be seen in Figure 3. In this experiment, there is an entanglement between two human brains of shamans that are "correlated" by meditation. There is also a control group which is not "correlated" between them. When some "flashes of light" are shown to one of the shaman and the other person of the control group, the "evoked potential" of both of them appeared in the electroencephalogram. However, the results are very different. The other shaman presents an equal "evoked potential" in his electroencephalogram, despite of being isolated and not having seen any "flashes of light". The other person of the control group does not present any "transferred potential". This non-local experiment is supported by the Mind-Brain theory (proposed by Stuart Hameroff and Roger Penrose) (Hameroff and Penrose, 1996) and Holographic Mind theory (proposed by Karl Pribam and David Bohm) (Pribam, 1993). The Mind-Brain theory argues that there is a *quantum component of the mind* (located in tubulins) which is responsible for self-perception (and the «collapse of the wave function») and creativity (such as, meditation) and a *classical componentof the mind* (located in dendritic membranes) which is responsible for trivial behaviour. The Holographic Mind theory claims that the mind (our thoughts and feelings) is an hologram. The brain converts the holographic mind (the Junguian archetypes referred to earlier Figure 2) in space-time reality.

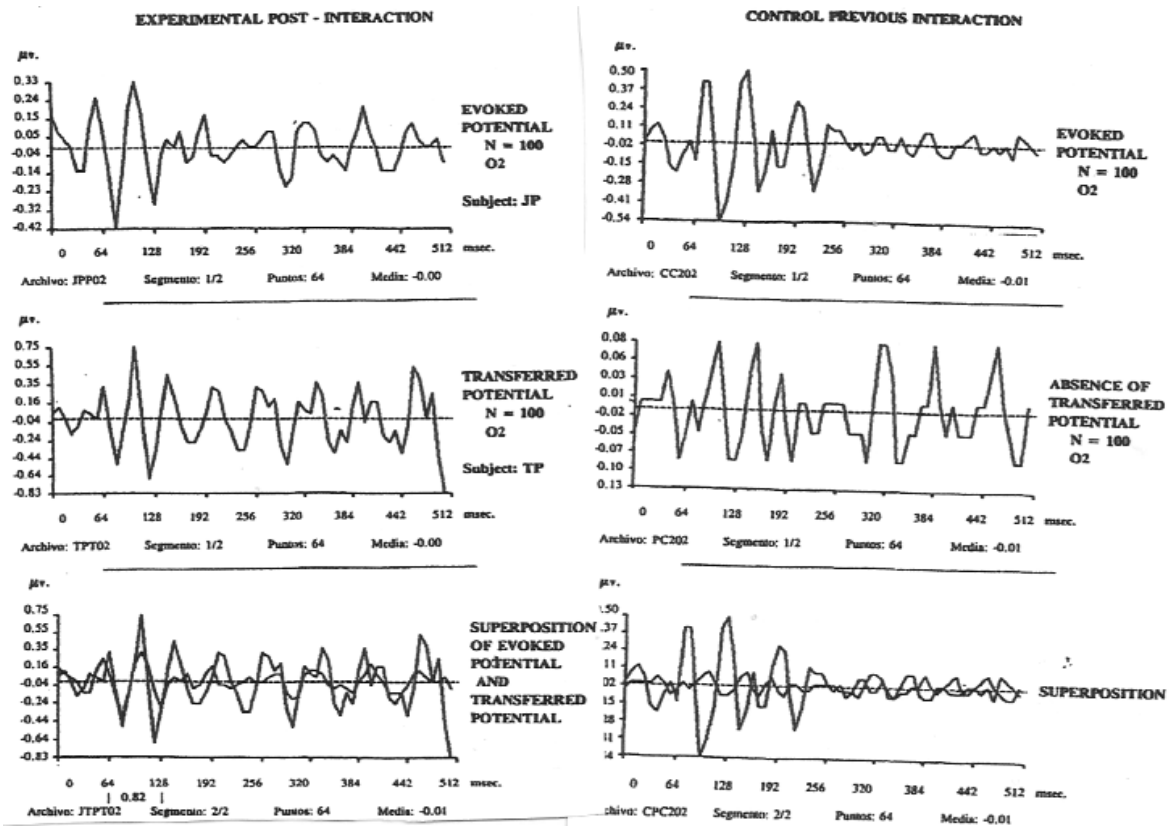

Figure 3. Evoked potentials for two cases: A- two shamans; B-control group

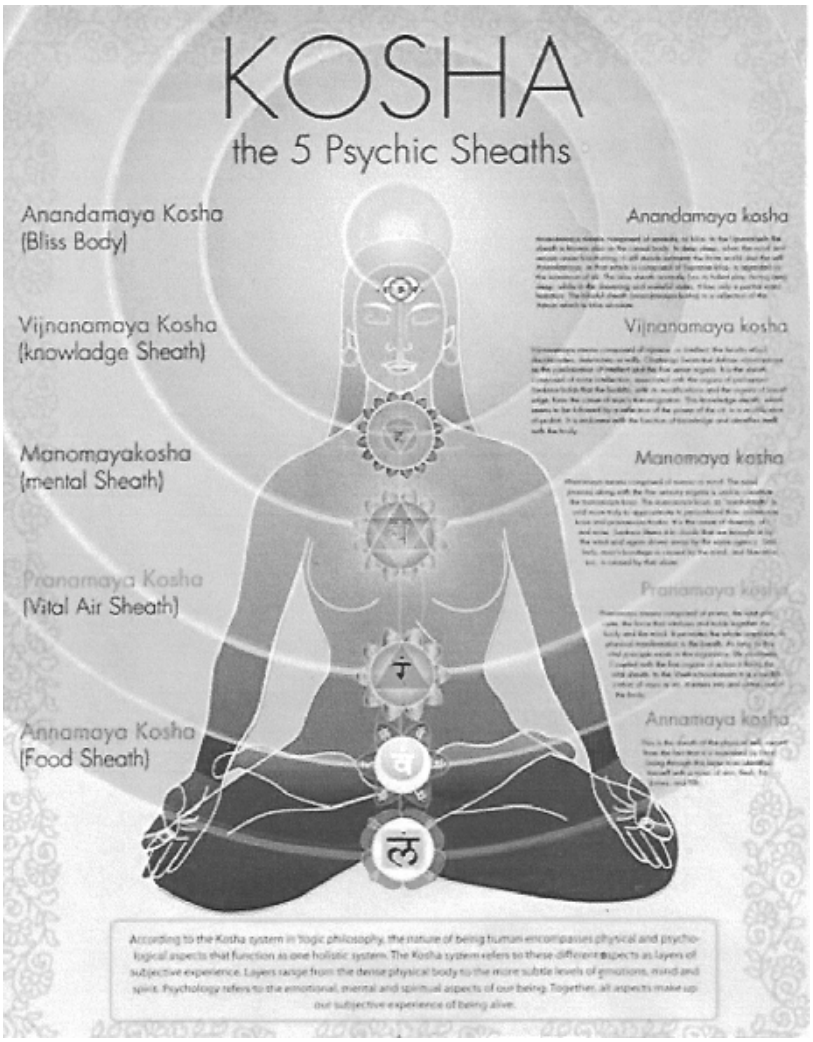

Figure 4. Schema of the consciousness planes in the human being

In this regard, Amit Goswami (Goswami, 1988) defends that the holographic mind might be described as "quantum waves of possibilities". He has said that the choice made by the observer´s mind turns the "quantum waves of possibility" into physical reality. In other words, at some deeper level of reality subatomic particles are not individual entities, but are holographic and indivisible/interconnected between them. In mathematical terms, the holographic mind theory is described by *Fourier transforms*. Moreover, the epistemological and philosophical implications of this experiment might be also applied to biological area because we're all made up by quantum particles. For example, the research works in the field of biology performed by Maturana and Varela, described by Capra (Capra, 1996), show us that biological systems also are self-aware and self-conscious and this characteristic determines the structure of web complexity. In this regard, I should mention the testimonies all over the world of several Thanks received by Divine intervention (for example, instant cures of an incurable disease, forgiveness of debts) that are made instantly and irreversibly (Olati, 2010). We must add, the Indian Sacred books, such as the Bhagavad-Gita (Anonymous, 2007), where there is description of a non-local "Divine message" transmitted between God and the Holy warrior, as is the case of Khrisna and Arjuna, respectively. In relation to the fourth experiment about quantum leap, I´m going to mention some ideas about Indian philosophies (Dasgupta, 1973), particularly the Samkhya school, states that the human being is constituted by soul, mind and body. During the evolution of consciousness in the human beings, it mighthappen some imbalance between Soul, mind and body. This process of evolution of consciousness is describedby the Indian philosophical theory called by Panchakoshas. This description could be seen in Figure 4. This theory claims that the "koshas" are sheaths that are removed during the evolution of consciousness in order to human being might witness his/her own real Self (or the Soul). The human being might experience five levels of perception (physical, pranic or energetic, feelings and thoughts (the mind), intuitive, bliss). This theory is in line with the Assagioli Egg´s diagram referred to earlier Figure 1. This is also in line with the theory of Punctuated Equilibrium proposed by Eldredge and Gould (Eldredge and Gould, 1972). This theory states that biological evolution is characterized both by continuous development (as Darwin perceived) and discontinuous periods of evolution or quantum leaps (called by «punctuation marks»).

Conclusion

In this paper we have study four quantum experiments that challenge the "common sense" of reality. In fact, in the 20th century, the emergence of Quantum Mechanics and Transpersonal Psychology have contributed to challenge our "common sense" about the vision of the world. It is true that scientific progress have allowed us an improvement in our day to day life, but the core of the questions that were raised in the Introduction of this paper, still remain to be answered by contemporary society, such as *What is the role of the human being in the Universe (the choice of the observer)? How we could explain the exceptional capabilities of the human brain (telepathic communication)?What is the purpose of Life (the perception of Life)?*.In this regard, Prigogine (Prigogine and Stengers, 1986). suggested "a new alliance" between science (physics, biology, chemistry) and humanities/social sciences (history, philosophy, psychology) in order to answer the previousquestions in a transdisciplinary and in a deeper way. The Indian philosopher Krishnamurti (Lutyens, 1980). also states that the resolution of the problems of contemporary society (war, environmental pollution, poverty, etc) depends of personal self-awareness. To achieve this aim it is critical that human being perform an inner process of transformation through meditation and inner creativity. Then, new archetypes of love, light and grace might be "born" in the heart of all human beings in order to contribute to the betterment of mankind on Earth.

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Conflict of Interests

There is no potential conflict of interests with regard to this research work. My research article does not involve the use of elements that may cause harm to the environment, plants, animals and humans. I had no funds from any scientific Foundation or private/commercial sources to perform this research article.

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