Essay

Reverse Quantum Mechanics: Ontological Path

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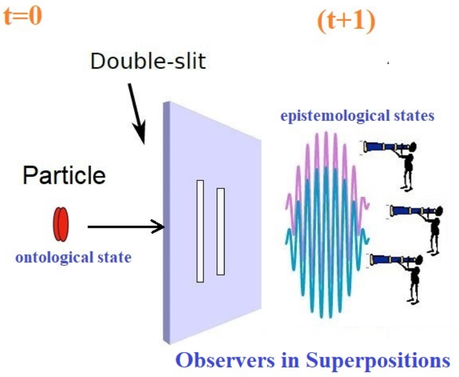
Abstract

This paper is essentially a quantum philosophical challenge: starting from simple assumptions, we argue about an ontological approach to quantum mechanics. In this paper, we will focus only on the assumptions. While these assumptions seems to solve the ontological aspect of theory many others epistemological problems arise. For these reasons, in order to prove these assumptions, we need to find a consistent mathematical context (i.e. time reverse problem, quantum entanglement, implications on quantum fields, Schrödinger cat states, the role of observer, the role of mind.

Keywords: Quantum mechanics, ontological path, quantum field, quantum entanglement.

1 Assumptions A, B, C, D

1) Assumption A. The particle is the only real object.
2) Assumption B. The particle has always a definite state..
3) Assumption C. Time reverse: the objective state of particle will occur at (t=0), we named this state ”Now”, the ontological state.
4) Assumption D. The process of measurement (observers) occur at t+1, we named this state ”After”,the epistemological states.
This simple assumptions are summarized in the following pictures:



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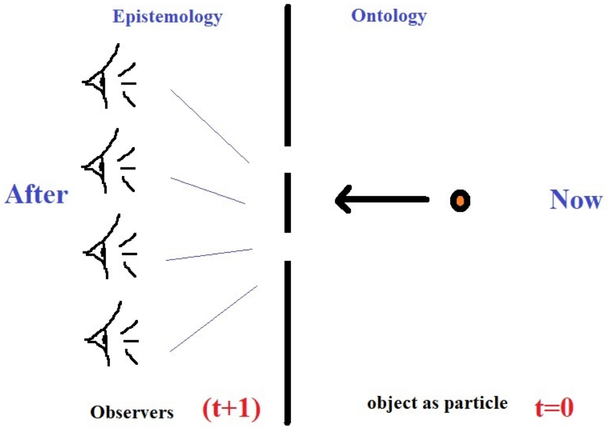

2 Consequences for assumption A, B, C and D

a) Superpositions states are an epistemological state of observers (not the particles).
b) **The delicate problem of collapse**: collapse occur at t=0, only then, the observer, at (t+1), is a able to record this phenomenon. So we can say that all observers are in superpositions states.
c) Superpositions description of states, in this framework, are epistemic states of observers.

3 Consequences for entangled states?

It is to hard find implications (according these assumptions) for Entangled states: we can say only that both observers are in entangled state at t+1 (not the particles)and in the same time, and that particles have a definite state at t=0 in the same time. New ideas and solutions on these delicate topics are welcome.

3.1 Quantum Entanglement: classical brief overview

From a phenomenological point of view, the phenomenon of entanglement is quite simple. When two or more physical systems form an interaction, some correlation of a quantum nature is generated between the two of them, which persists even when the interaction is switched off and the two systems are spatially separated. Quantum entanglement describes a non-separable state of two or more quantum objects and has certain properties which contradict common physical sense. While the concept of entanglement between two quantum systems, which was introduced by E. Schrödinger (1936) is well understood, its generation and analysis still represent a substantial challenge. Moreover, the problem of quantification of entangled states, is a long standing issue debated in quantum information theory. Today the bipartite entanglement (**two-level systems, i.e. qubits**) is well understood and has been prepared in many different physical systems. The mathematical definition of entanglement varies depending on whether we consider only pure states or a general set of mixed states. In the case of pure states, we say that a given a state $|\psi\rangle$ of n parties is *entangled* if it is not a tensor product of individual states for each one of the parties, that is,

$$|\psi\rangle \neq |v_1\rangle_1 \otimes |v_2\rangle_2 \otimes \cdots \otimes |v_n\rangle_n \ . \tag{3.1}$$

For instance, in the case of 2 qubits A and B (sometimes called "Alice" and "Bob") the quantum state

$$|\psi^+\rangle = \frac{1}{\sqrt{2}}[(|0\rangle_A \otimes |0\rangle_B + |1\rangle_A \otimes |1\rangle_B)] \tag{3.2}$$

is entangled since $|\psi^+\rangle \neq |v_A\rangle_A \otimes |v_B\rangle_B$. On the contrary, the state

$$|\phi\rangle = \frac{1}{2}[(|0\rangle_A \otimes |0\rangle_B + |1\rangle_A \otimes |0\rangle_B + |0\rangle_A \otimes |1\rangle_B + |1\rangle_A \otimes |1\rangle_B)] \tag{3.3}$$

is not entangled, since

$$|\phi\rangle = \left(\frac{1}{\sqrt{2}}\left(|0\rangle_A + |1\rangle_A\right)\right) \otimes \left(\frac{1}{\sqrt{2}}\left(|0\rangle_B + |1\rangle_B\right)\right) \ . \tag{3.4}$$

A pure state like the one from Eq.2 is called a *maximally entangled state of two qubits*, or a *Bell pair*, whereas a pure state like the one from Eq.4 is called *separable*. In the general case of mixed states, we say that a given state ρ of n constituent states is *entangled* if it is not a probabilistic sum of tensor products of individual states for each one of the subconstituents, that is,

$$\rho \neq \sum_k p_k \ \rho_1^k \otimes \rho_2^k \otimes \cdots \otimes \rho_n^k \ , \tag{3.5}$$

with $\{p_k\}$ being some probability distribution. Otherwise, the mixed state is called *separable*. The essence of the above definition of entanglement relies on the fact that entangled states of n constituents cannot be prepared by acting locally on each one of them, together with classical communication among them. Entanglement is a genuinely quantum-mechanical feature which does not exist in the classical world. It carries non-local correlations between the different systems in such a way that they cannot be described classically.

4 Conclusions: Philosophical implications

1)This approach try to save the ontological aspect of nature.

2)New epistemological problems arise:

2.1)to find a consistent mathematical context for these philosophical assumptions

2.2) the problem of epistemic states of observers

2.3) time reverse problems

2.4) the role of waves descriptions of quantum theory

2.5) the status of entangled states

2.6) the implications on quantum fields

2.7) the Schrödinger cat states.

2.8) the role of observer in this framework

2.9) the role of mind (observer)
New ideas and solutions on these delicate topics are welcomed.

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