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Extended Abstract

Questioning of quantum information

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Introduction

The quantum information theory began to rise in the end of 20th century. The EPR (relation) really is quantum entanglement, Consequently, it makes the concept of information in science expand from classical information theory to quantum information theory, and a new concept of quantum information formed. The primary concept of information faced to new challenges and produced some important philosophical questions. For example, can we set up the concept of quantum information? What is the nature of quantum information? The past common concept of information (the information is the elimination of uncertainty) could be used in quantum information? Whether does the emergence of quantum computation mean to eliminate no-boundaries between the quantum and the classical? My aim in this paper is to discuss these questions. My philosophical analysis focuses, however, on the basic quantum information theory.

Methods

The research method is analytical philosophy and logic that make quantum conception more clear and accurate.

Results and Discussion

The concept of information could be set up. fundamentally speaking, it did be supported by the Shannon information theory and further philosophical reflections.

According of information theory, (classical) information concept could be set up, and there are two necessary preconditions: (a) the premise is a set of possible events, and they can be described by the probability. (b) the information is the elimination of uncertainty.

Fundamentally, quantum information is also satisfied with the family-resemblance two preconditions:

(1)Quantum information describes the possibility of microscopic things, and quantum information is the expression of wave function. The wave function describes the state of microscopic particles, and presentation of the possibility of microscopic objects.

(2)On the aspect of eliminating the uncertainty, the quantum communication is same as classical communication. The signal receiver once received quantum signals transmitted, and the receiver eliminates the corresponding uncertainty of quantum. Therefore, the quantum information is the elimination of quantum uncertainty, and which is called ***quantum information*** I.

From two point of views, the possible events and eliminate uncertainty, the quantum information and classical information have family resemblance. Quantum information like Classical information way of transmission, it is delivered by the information source, and is received by recipient through the information channel.

Quantum Information is similar to classical information, but more essential difference between them, specifically in the following three aspects: (1) The probability directly describe the possibility of classic events, while wave function ψ (or probability amplitude) describes quantum events in the quantum world, and the absolute square of wave function $|\psi|^2$ is corresponded to classical probability. (2)There have the essential difference between qubits (quantum qits) and classical bits. (3) Classical information can be completely cloned or deleted. nevertheless, quantum information is neither cloned (no-cloning), nor removed completely.

To my point of view, through the analysis of the process of quantum teleportation, a quantum uncertainty can be divided into three categories: the first is the external uncertainties of microscopic particles; the second the uncertainty of the superposition state; the third the inherent uncertainty of microscopic particles. These three uncertainties can be eliminated by three different ways that are transmission of quantum information, accurate quantum transformations and the creations of quantum entanglement. Therefore we can give the general definition of certainty: a situation (the state of events, things) is of certainty, if they are satisfied with the following conditions: (a) a situation is entirely determined by *n* events parameters; (b) *n* parameters of events has an accurate values simultaneously.

The existences of quantum states form quantum facts. Quantum states show themselves, and therefore it releases the information to the outside world. For this reason, there have two aspects of quantum state which need to express: existence of quantum state is the quantum fact, here we emphasize "existence"; and quantum state can show to the external world, which is the quantum information, here we emphasize "Show". Hence, quantum information is the show(Zeigt) of quantum state, which is called ***quantum information Ⅱ***.

The nature of quantum information is the show of quantum events and their correlated ways. Quantum information is a kind of certainty and order. Quantum information can be divided into quantum information Ⅰ and quantum information Ⅱ.. Quantum Information Ⅰ just only a

phenomenonal definition, it does not go deeply into the nature of the information. Therefore, the elimination of uncertainty can not be seen as the nature of quantum information itself .

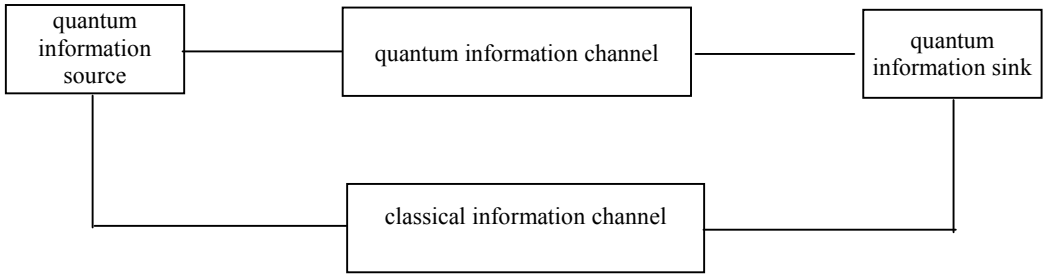
In the process of quantum teleportation, the source of quantum information (such as quantum state $|\psi>= a|0>+b|1>$, a and b are coefficients) is delivered to the receiver, what is the essence of quantum information? From the point of view of quantum information theory, quantum state represents quantum information, quantum state is the state of quantum system (or microscopic particles) or quantum events. in the quantum state $|\psi>$, what quantum states disclose the quantum information does not be the absolute size of quantum information, but the relationship, since the coefficients a and b satisfy the condition $|a|^2 + |b|^2 = 1$, and it do not be important numerical a and b, but between their relative size and relationship, which reflects the correlated ways between a and b.

The connotation of quantum Information Ⅰ and quantum information Ⅱ offers support for the common view of classical information concept. Which is more deeply to disclose the nature of quantum information for both of them? Obviously, quantum information Ⅱ reflects the nature of quantum information.

Quantum reality and quantum information are unified. What the wave function expresses is quantum reality. The wave function is unified of quantum information and quantum reality. There is no quantum reality, there is no quantum information. Because of the information and reality are unified, and quantum information different from classical information, so we can deduce that quantum reality is different from classical reality, and quantum computing differs from classical computing. In the classical parallel computing, the value calculated in different circuits respectively, but in parallel quantum computing the value calculated in one circuit, which is the essential difference between classical and quantum parallel computing.

Many worlds interpretation of quantum mechanics does not mean that the difference between quantum and classical disappears: (1) Superposition in the microscopic world is very different from classical macroscopic physical world, so it is impossible that the superposition principle is fit for quantum world used for the classical world; (2) "To perform a quantum measurement, quantum world can be split up numerous classical world" is not supported by any experience and evidence; (3) Each branches of quantum computing are in quantum states, and quantum states are coherent, holistic, and some even entangled. Nevertheless, it is impossible for classical computing to achieve the quantum computing's specific features; (4) The essential differences between quantum and the classical are decided by the development history of quantum mechanics and quantum information theory. The differences between quantum and the classical is really established by the quantum theory, concepts and their experiments that include Heisenberg's matrix mechanics of Schrodinger's wave equation, uncertainty principle of quantum mechanics and quantum entanglement phenomena and so on. They are completely different from the classical physical theories, concepts and experiments.

Figure 1. Quantum information processing



Conclusions

This fruitful work gives an discussion of quantum concept that is the quantum information is the elimination of quantum uncertainty, which is called ***quantum information Ⅰ*** and quantum information is the show (Zeigt) of quantum state, which is called ***quantum information Ⅱ***. Quantum information Ⅱ reflects the nature of quantum information. The nature of quantum information is the show of quantum events and their correlated ways.

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