

Quantum Motion

The Picture of Reality

Gao Shan

Abstract

I give a brief introduction of the book *Quantum Motion: Unveiling the Mysterious Quantum World*. This book presents a clear exposition of the intriguing idea of random discontinuous motion and its implications for quantum theory, relativity and consciousness etc. The ideas in the book come out of my lonely exploration in the past twenty years. A short recollection of my quantum exploration is also given.

Key Words: quantum motion, random discontinuous motion, discrete space-time, quantum theory, relativity, quantum mind

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Relativity and quantum theory brought two profound revolutions in 20th century physics. They have become the foundation stones of modern physics. However, these two theories are not only incomplete, but also incompatible. On the one hand, the conceptual foundations of quantum theory have not yet been firmly laid. For example, it is still unknown what on earth the wave function describes and whether or not the wave function really collapses. On the other hand, the existence of quantum nonlocality implies that the absolute validity of the principle of relativity will also be challenged. For example, a preferred Lorentz frame may be required for describing the quantum nonlocal processes. Moreover, general relativity and quantum theory also conflict with each other at the most fundamental level. These facts clearly

indicate that our present understandings of space-time and motion require a revolution profounder than that brought by relativity and quantum theory.

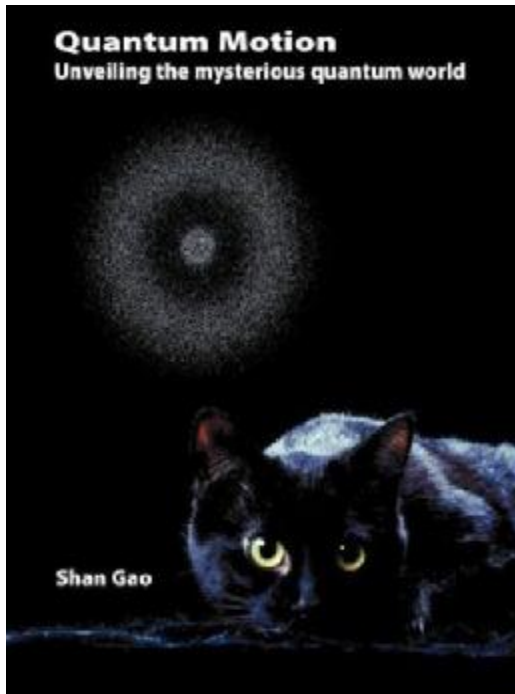
The book *Quantum Motion: Unveiling the Mysterious Quantum World* aims to provide a uniform basis for quantum theory and relativity. Such a basis is indispensable for a unified physical theory. As we know, the basic task of physics is to study the motion of matter in space and time. Then what is the real form of motion? Through a deep analysis of space-time and motion, it is demonstrated that the real motion is the random discontinuous motion of particles in discrete space and time, which is called quantum motion, and the microscopic and macroscopic motions are both displays of quantum motion. As a result, what the wave

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function describes is quantum motion, and the evolution of quantum motion naturally leads to the dynamical collapse of the wave function. This provides an ontological basis for quantum theory. In addition, it is argued that quantum motion may also explain the maximum and constancy of the speed of light in special relativity, and provide a consistent framework for the unification of quantum theory and general relativity. Consequently, quantum motion may be the uniform basis of quantum theory and relativity. In the second part of this book, the perplexing quantum nonlocality is analyzed in detail in terms of quantum motion. It is shown that the collapse of the wave function requires the existence of a preferred Lorentz frame. This provides a natural way to reconcile quantum nonlocality and special relativity. A principle of quantum superluminal communication is further introduced through considering the influence of the conscious observer. The analysis also leads to an interesting quantum theory of consciousness.



Reading this book requires a basic knowledge of both relativity and quantum theory. Advanced mastery of these subjects is not necessary. I appeal to the ability to reason rather than the mathematical ability of the reader. An open-minded reader may understand the new ideas in this book more easily. The quantum puzzle may be the most bewildering problem in the history of science; the reader must therefore be prepared to get

rid of some ingrained prejudices such as the prejudice of the uniqueness of continuous motion when reading this book. Once these implicit prejudices are rejected, everyone can understand quantum. Although quantum motion may be remote from or even contradict our everyday experience of motion, it is more natural in logic and closer to reality. It is intelligible to everyone. I hope that this book will appeal to all those who have been looking for a real understanding of nature.

The ideas of this book come out of my lonely exploration in the past twenty years. The following is a short recollection of my quantum exploration. It is well known that classical mechanics describes continuous motion. Then a natural question appears when we turn to quantum mechanics, i.e., that which motion does quantum mechanics describe? This is a question I frequently asked during my student times. However, no satisfying answer is given in textbooks. Later I learned that even Albert Einstein also admitted, "All these fifty years of conscious brooding have brought me no nearer to the answer to the question, 'What are light quanta?'" The meaning of quantum mechanics is still a mystery today. It is just this quantum puzzle that leads me to a strange picture of reality. The road of my quantum exploration is lonely but full of wonderful scenes. It eventually lets me find the real meaning of life.

On 22 August 1987, I wrote in my scientific diary: 'Is it really true that we have no way to describe the atom processes as processes happening in space and time?'² This year was the centennial of Erwin Schrödinger, the inventor of the wave function and its mechanics. Then I was at the age of 16. Yet, the seed of quantum reality had been put in my mind. When I was a sophomore, I was attracted by the mysteries of quantum theory more strongly, and began to muse its real meaning by myself. I read nearly all books about the foundations of quantum mechanics in library, and spent most of my spare time in studying the fundamental problems of quantum mechanics. However, the answer was still in the dark.

In a morning of October 1993 when I studied at the Institute of Electronics, Chinese Academy of Sciences, I suddenly had the idea of random discontinuous motion after long reflection in solitude and meditation. I realized that the microscopic particles described by the wave function may probably move in a random

² Personal diary, 22 August 1987.

and discontinuous way. For example, a single particle may pass through both slits discontinuously in the double-slit experiment. If quantum superpositions or indefinite states of a microscopic particle are objective states of the particle in space and time, then this discontinuous picture seems inevitable. The objective existence of quantum superpositions means that the property of a single particle in a superposition has an actual distribution of the different values in the superposition during an infinitesimal time interval. Considering a time interval consists of infinitely many instants, nature can indeed distribute the different values of property (e.g. different positions) at different instants in an infinitesimal time interval. Such a distributing way is evidently discontinuous. As a referee of *Foundations of Physics* later commented: 'The idea of using discontinuous motion as a realist interpretation of quantum mechanics is original. If it can be made to work, it would add an interesting new ontology to our stock of quantum mechanical interpretations.'³ From then on, I started on the lonely journey to make my idea work.

After graduating from the Institute of Electronics, Chinese Academy of Sciences in 1995, I had to make a living in a small firm. As Philip Pearle wrote, "there are very few places where Foundations of Quantum Theory are pursued..., it is like the binary code: either zero people (most often) or 1 person can be found in any institution."⁴ I continued my research on the meaning of quantum mechanics with greater passion during my spare time. I further developed and completed my idea of random discontinuous motion. Especially such motion was deeply studied in discrete space-time, which was called quantum motion from then on. I also tried to find the logical basis of quantum motion. To my surprise, the most familiar phenomenon of inertial motion actually implies that motion is random and discontinuous. Historically, Aristotle believed that force is the cause of motion, while Newton discovered that force is not the cause of motion, but the cause of the change of motion. Newton's discovery implies that motion has no cause. But it seems that nobody had noticed such a strange fact. Since motion has no cause, it must be random and discontinuous. This is just the basis of quantum motion. In addition, my research interests extended to other fields such as quantum nonlocality, superluminal communication and quantum consciousness

etc.

The results of my research were two Chinese books: one monograph *Quantum Motion and Superluminal Communication* (Gao 2000) and one popular book *Quantum* (Gao 2003). Besides, some of my research outcomes have also been published in journals such as *Foundations of Physics Letters* and *International Journal of Theoretical Physics* (Gao 2004, 2006). Last year, my ideas were integrally expounded in my new book *Quantum Motion: Unveiling the Mysterious Quantum World* (Gao 2006). The book was recommended for publication by Alwyn van der Merwe, the editor of *Foundations of Physics*. Bernard d'Espagnat gave a positive comment: 'I consider that its very existence is at any rate, an excellent illustration of the extent to which physical data force us to depart from commonsense ideas when we try to depict reality "as it really is".'⁵

I have engaged in the research of foundational problems of quantum physics for nearly twenty years. I spent much time in giving a cogent account of the physical reality that lies behind the mathematical formalism of quantum theory. I believe that quantum motion provides a convincing picture of reality. In this picture, space and time are discrete, and motion is discontinuous and random. Reality is a whole undergoing such quantum motion. Consciousness is a fundamental character of reality. Certainly, the theory of quantum motion still needs to be completed. This will be one of my major works in the remainder of my life.

Maybe I am an idealist. Once I fix on doing something, I will persist until I succeed or die. I want to understand the world where I live. Only after I understand it, can I obtain the inner serenity. Sometimes I think I just live for comprehending the mysterious but lonely universe, who creates me to talk with her, to understand her. Anyway, I will devote my whole life to the understanding of Ultimate Reality.

³ Referee report of *Foundations of Physics*, 15 March 2004.

⁴ Personal communication, 5 February 1999.

⁵ Personal communication, 11 August 2006.

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