

**On Indeterminacy Problem in  
Quantum Mechanics**

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# ON INDETERMINACY PROBLEM IN QUANTUM MECHANICS

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The main objectives of this Note are

- (1) *to demonstrate that the indeterminacy problem and its associated absurdities in interpretations of quantum mechanics are due to the wrong fundamental premise that there is no interference of other particles;*
- (2) *to reveal the fact that the Universe is filled with mediators, giving rise to the correct Mediator Sea Premise of quantum mechanics; and*
- (3) *to show that under the Mediator Sea Premise,*
  - (a) *causality holds true for the quantum-mechanical description of physical reality, removing the absurdities and confusions;*
  - (b) *the interference of the mediators to a moving particle is reminiscent to Brownian motion; and*
  - (c) *quantum mechanics is a correct and complete theory.*

## I. Classical Statistical Interpretation and Indeterminacy Problem

Two dominant views of the interpretation of quantum mechanics are the *realistic view*, advocated by Albert Einstein, and the orthodox view, also called the Copenhagen interpretation, which was mainly advocated by Niels Bohr and Werner Karl Heisenberg. The main characteristic for the Einstein realistic view is that causality must hold true in the quantum-mechanical description of physical reality, and quantum mechanics is an incomplete theory—the indeterminacy is caused by hidden variables. The key point for the Copenhagen interpretation is non-causality of quantum behavior of particles, leading to various absurdities; see among many others [3, 2, 1, 4].

## II. The Fundamental Premise of Indeterminacy Problem

All scientific theories and conclusions are built upon a fundamental premise. If the fundamental premise is true, then we would expect the conclusions are true as well. To understand the confusion caused by the indeterminacy as classically formulated, one needs to examine its fundamental premise.

In fact, the fundamental premise of the indeterminacy in quantum mechanics is that one assumes there is no interference of other particles. Our viewpoint is that such fundamental premise is in fact incorrect. Consequently, under an incorrect premise, confusions and misunderstandings arise, and more importantly

*the indeterminacy problem is a wrong question to be asked.*

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### III. Mediator Sea in the Background Space

One natural outcome of our field theory of fundamental interactions and the weakton theory of elementary particles suggests that our Universe is filled with mediators; see [5] and the reference by the authors therein. This clearly shows that the classical fundamental premise of the indeterminacy in the quantum-mechanical description of physical reality is a wrong assumption.

In other words, quantum mechanics should be understood under the following fundamental premise of the quantum-mechanical description of physical reality:

**Mediator Sea Premise:**

- (1) *The entire space is filled with a sea of mediators, including photons, gluons and the  $\nu$ -particles, as evidenced by the cosmic microwave background;*
- (2) *All mediators carry weak charges, participate the weak interaction, and consequently will interact with a moving particle in proper ranges.*

The interference of the mediator sea towards to a moving particle resembles similar features as the Brownian motion.

### IV. Causality

In essence, the heart of the debate between Einstein and Bohr is the causality of the quantum-mechanical description of physical reality. We believe what puzzled Einstein was the non-causality conclusion of the Copenhagen interpretation, rather than the randomness in the quantum mechanics.

With the new Mediator-Sea-Premise, it is clear that the principle of causality holds true, as Einstein believed. The randomness is caused by interference of the mediators as a particle moves in the mediator sea, leading to the indeterminacy of the precise position and momentum of the particle. Instead, in the Copenhagen interpretation, randomness is innate with no causality, resulting various spurious paradoxes in the interpretation of quantum mechanics.

Also, as in the Brownian motion, precise physical law expressed by the wave equation for the wave function offers complete information about the system. In other words, quantum mechanics is a correct and complete theory for describing the physical reality under the Mediator Sea Premise.

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