On Purported Physical Realizations of So-called Quantum Information Technologies

Guang-Liang Li
University of Hong Kong, China
glli@eee.hku.hk

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Abstract

Bell's inequality is derived by resorting to a hidden-variable theory devised for resolving the Einstein-Bohr debate on the conceptual foundations of quantum mechanics. The legitimacy of quantum superposition for describing the physical world is the essence of the debate. Einstein argued against the legitimacy of quantum superposition. Testing Bell's inequality by experiments with the experimental results explained by Bell's theorem opened the door to so-called quantum information technologies. In quantum information theory, "quantum bit" (or "qubit" for short) in a form of quantum superposition is supposed to represent quantum information. In the present paper, a new principle, the general principle of measurements, is introduced and proved as a mathematical theorem. Based on this principle, the experiments for testing Bell's inequality and so-called experimental evidence for physically realizable "qubit" are scrutinized. The findings are as follows. Although most physicists believe that Einstein's vision of the physical world contradicts the experimental results of testing Bell's inequality, actually Einstein's viewpoint is irrelevant to Bell's theorem. Bell's inequality failed to capture the essence of the Einstein-Bohr debate. The experimental results of testing Bell's inequality and the measurement outcomes of various experiments involving "qubit" are all erroneously explained. Without involving hidden variables, quantum mechanics can be completed based on the general principle of measurements by using disjunction ("or") as the logical relation between the orthonormal vectors that span an arbitrarily given Hilbert space, and the mathematical setting can remain essentially unchanged. All kinds of "qubit" violate the general principle of measurements and can only describe imaginary objects that do not exist in the real world. A very regrettable conclusion from the above findings is inevitable: Quantum information has no physical carriers, and all quantum information technologies are not physically realizable.

Keywords: Quantum superposition, Bell's inequality, Bell's theorem, Quantum information, Hilbert space in quantum mechanics

1 Introduction

Since the inception of quantum mechanics, its conceptual foundations have been controversial and are still debatable even today [1, 2, 3, 4, 5]. The legitimacy of the quantum-mechanical description of the physical world based on quantum superposition is the essence of the debate. Quantum superposition is the most troublesome and controversial notion in quantum mechanics. Random phenomena can always be observed in measurement outcomes of various experiments involving quantum superposition. Needless to say, probability can describe any observed random phenomenon[1]. But the observed random phenomenon deserves a reasonable explanation. However, quantum mechanics is claimed to be intrinsically probabilistic without explaining the observed random phenomena. This is why Einstein questioned the theory by calling it "the fundamental dice-game" [4]. The quantum-mechanical description denies the objective existence of definite properties of the physical world prior to measurements, which contradicts Einstein's vision of the physical world. According to Einstein's viewpoint in his debate with Bohr, before we can describe the physical world reasonably by observing its properties based on measurements, the properties must exist independently of human consciousness. In the sense above, Einstein considered the quantum-mechanical description incomplete. But he also considered that the theory might be completed [1].

Derived by resorting to a hidden-variable theory [6], Bell's inequality [7] used to be considered the only hope of completing quantum mechanics. But the hope has been shattered. Bell's inequality failed when tested by experiments [8, 9, 10, 11, 12, 13]. According to Bell's theorem [14, 15], quantum mechanics in its current form seems to have already been a complete theory, and Einstein's viewpoint seems to be wrong. Were Bell's theorem relevant to Einstein's vision of the physical world, the quantum-mechanical description would be legitimate, which implies that either or both of realism and locality, the two fundamental hypotheses underlying Einstein's viewpoint, should be abandoned. Renouncing either or both of the hypotheses opened the door to so-called quantum information technologies, such as quantum computation and quantum communication [16, 17, 18, 19, 20, 21, 22, 23]. In quantum information theory, "quantum bit" (or "qubit" for short) in a form of quantum superposition is supposed to represent quantum information. Consequently, quantum information technologies all stem from what Einstein called "the fundamental dice-game" [4].

In the present paper, a new principle, the general principle of measurements, is introduced and proved as a mathematical theorem. Based on this principle, the experiments for testing Bell's inequality and so-called experimental evidence for physically realizable "qubit" are scrutinized. The findings are as follows. Although most physicists believe that Einstein's vision of the physical world contradicts the experimental results of testing Bell's inequality, actually

[1] Roughly speaking, any observed random phenomenon can be considered as a collection of mutually exclusive events, such that the frequency of each event converges to a non-vanishing limit, which is the probability assigned to the event, and the sum of the probabilities of all the events in the collection equals unity.

Einstein's viewpoint is irrelevant to Bell's theorem. Bell's inequality failed to capture the essence of the Einstein-Bohr debate. The experimental results of testing Bell's inequality and the measurement outcomes of various experiments involving "qubit" are all erroneously explained. Without involving hidden variables, quantum mechanics can be completed based on the general principle of measurements by using disjunction ("or") as the logical relation between the orthonormal vectors that span an arbitrarily given Hilbert space, and the mathematical setting can remain essentially unchanged. All kinds of "qubit" violate the general principle of measurements and can only describe imaginary objects that do not exist in the real world. A very regrettable conclusion from the above findings is inevitable: Quantum information has no physical carriers, and all quantum information technologies are not physically realizable.

In Section 2, Einstein's vision of the physical world and Bell's theorem are revisited. In Section 3, the general principle of measurements is proved as a mathematical theorem for revealing scientific truth concealed by erroneously explained measurement outcomes of various experiments involving quantum superposition. In Section 4, completing quantum mechanics based on the general principle of measurements is demonstrated. In Section 5, so-called experimental evidence for physically realizable "qubit" is scrutinized. In Section 6, the results obtained in this study are briefly discussed. In Section 7, the paper is concluded with a summary of the reported findings.

2 Einstein's Instincts and Bell's Theorem

In a letter to Born, Einstein expressed clearly his vision of the physical world [4]:

"We have become Antipodean in our scientific expectations. You believe in the God who plays dice, and I in complete law and order in a world which objectively exists, and which I, in a wildly speculative way, am trying to capture. I firmly believe, but I hope that someone will discover a more realistic way, or rather a more tangible basis than it has been my lot to find. Even the great initial success of the quantum theory does not make me believe in the fundamental dice-game, although I am well aware that our younger colleagues interpret this as a consequence of senility. No doubt the day will come when we will see whose instinctive attitude was the correct one."

According to the explanation of the experimental invalidation of Bell's inequality [8, 9, 10, 11, 12, 13] given by Bell's theorem [14, 15], the day mentioned by Einstein has come. Nowadays most physicists consider the experimental invalidation of Bell's inequality as an experimental fact and believe that Einstein's vision of the physical world contradicts the experimental fact. However, neither the failure of Bell's inequality nor Bell's theorem is relevant to Einstein's vision of the physical world.

Bell's inequality [7] is derived by resorting to a hidden-variable theory [6] devised for resolving the Einstein-Bohr debate on the conceptual foundations of quantum mechanics [1, 2, 3, 4, 5]. But the supreme success of the quantum theory has prevented anyone from considering the theory entirely wrong. This is why Bell and his followers merely tried to reinterpret quantum mechanics and kept the theory in its current form intact [5]. Keeping current quantum theory intact presumes the legitimacy of quantum superposition. Consequently, Bell's inequality cannot capture the essence of the Einstein-Bohr debate and failed when tested by experiments.

In fact, the failure of Bell's inequality is unavoidable even before any actual experiment is performed to test it against quantum mechanics, no matter how the inequality is derived based on whatever hypotheses. In current quantum theory, quantum superposition plays two closely related roles in various experiments involving this notion. Consider an experiment with single microscopic objects of a given kind. A wave function ψ in a form of quantum superposition describes each of the objects. On the other hand, ψ is also used to calculate probabilities of the outcomes obtained by measuring the objects. In other words, ψ not only describes an arbitrarily given single object to be measured in the experiment but also serves to calculate the probability of the outcome measured. Because ψ presumes the legitimacy of quantum superposition, which amounts to assuming that the quantum-mechanical description of the physical world is legitimate, the fate of Bell's inequality is already predetermined. It is not surprising at all when Bell's inequality failed.

For instance, consider the optical experiment with single pairs of correlated photons for testing Bell's inequality generalized by Clauser, Horne, Shimony, and Holt [8]. In this optical experiment [9], one of the roles of quantum superposition is to describe each of the pairs by the so-called "entangled state" given in a specific form of quantum superposition that presumes the legitimacy of the quantum-mechanical description of the physical world; the other is to calculate, based on the same "entangled state", the probability of the outcome measured. Although this twofold role can guarantee that the quantum-mechanically calculated probabilities always agree with the corresponding results obtained by measurements, unfortunately, as a consequence of presuming the legitimacy of quantum superposition, the agreement between the quantum-mechanically calculated probabilities and the experimental results conceals the real scientific truth. In general, measurement outcomes of various experiments involving quantum superposition, including the experimental results of testing Bell's inequality, are all erroneously explained.

3 Experiments, Measurements, and Truth

As indicated in the previous section, experiments and measurements may not always reveal scientific truth; sometimes scientific truth is even concealed by erroneously explained measurement outcomes of experiments. By explaining random phenomena observed in measurement outcomes of various experiments involving quantum superposition, the general principle of measurements is helpful to reveal scientific truth concealed by the erroneously explained measurements outcomes.

Proving the general principle of measurements needs to review a few definitions in topology. A metric space is denoted by (X, d), where X is a set, and d is a metric on X. Let r be a positive real number. For $x \in X$, the open ball with center x and radius r is

$$B(x; r) = \{y \in X; d(x, y) < r\}.$$

Any open subset of X is a union of open balls. All open subsets of X constitute a metric topology for X. The set X and the metric topology form a metric topological space. Consider $x \in S$ where S is an open subset of X. If there exists $r > 0$ such that

$$B(x; r) \cap S = \{x\},$$

then x is an isolated point of S. Evidently, the metric on the corresponding metric topological space is necessary to define an isolated point.

The real world is the only place where physical quantities can be measured. Consequently, all physical quantities must be measured based on mathematical models of space and time of the real world, not anywhere else. The mathematical model of space of the real world is the three-dimensional Euclidean space $\mathbb{R}^3$ endowed with the metric given by the usual distance function between two points in the space. The mathematical model of time elapsed in the real world is the set of nonnegative real numbers R_0 equipped with the metric given by the usual distance function between two nonnegative real numbers. Points in $\mathbb{R}^3$ represent precise space coordinates; elements in R_0 are precise time coordinates. Measuring a point x in the space perfectly precisely requires x to be an isolated point of $\mathbb{R}^3$. Similarly, unless time t is an isolate point of R_0, it is impossible to measure t perfectly precisely.

If a set is not $\mathbb{R}^3$ or R_0, and if the metric on that set is not the usual distance function on $\mathbb{R}^3$ or the usual distance function on R_0, then the set and the metric are irrelevant to the mathematical models of space and time of the real world. A set consisting of singletons might be constructed in set theory, and one might claim "all points in a singleton set are isolated points." Based on this claim, one might further assert "measuring a coordinate of a physical system in a precise manner is possible." However, without specifying any metric on the singleton set, the claim and assertion are not meaningful. Even if a metric is specified on the singleton set, the set and the metric have nothing to do with the general principle of measurements proved below.

Theorem 3.1. *(***The General Principle of Measurements***) Neither $\mathbb{R}^3$ nor R_0 has isolated points, which means that precise space and time coordinates are practically unattainable by measurements.*

Proof. Consider first an arbitrarily given $x \in S$, where S is an arbitrary open subset of $\mathbb{R}^3$. Evidently, there is no $r > 0$ such that

$$B(x; r) \cap S = \{x\}.$$

This shows that $\mathbb{R}^3$ has no isolated point. Now consider $t \in S$, where S is an arbitrary open subset of R_0. An open "ball" now is an open interval

$$B(t; r) = (t - r, t + r).$$

There are two cases: $t = 0$, and $t > 0$. If $t = 0$, then R_0 is not a superset of any open interval centered at t, and R_0 has no open subset S such that $t \in S$. If $t > 0$, there is no $r > 0$ such that

$$S \cap B(t; r) = \{t\}.$$

The condition for t to be an isolated point is not satisfied in either case. Consequently, R_0 has no isolated point. This completes the proof of the general principle of measurements. $\square$

All issues about measurement instruments and accuracy of measurement outcomes in practice have nothing to do with the general principle of measurements. The following fact is helpful to understand the importance of the principle.

Remark 3.2. Any single measurement makes no sense statistically and cannot explain the random phenomenon observed in the corresponding experiment. The random phenomenon can only manifest itself in a large number of measurement outcomes obtained in different repetitions of the experiment under purported the same experimental conditions that depend on precisely specified space and time coordinates. A single measurement corresponds to only one outcome in one repetition. Because precisely specified space and time coordinates are unattainable by measurements, "the same experimental conditions" specified by such coordinates violate the general principle of measurements and hence do not exist in the real world.

Usually, measuring microscopic objects needs to specify directions (or orientations of apparatuses) in space. Any direction or orientation in space corresponds to a unique point on a unit sphere. The sphere is a subset of $\mathbb{R}^3$. The points on the unit sphere are irrelevant to spatial positions of microscopic objects.

Example 3.3. In quantum mechanics in its current form, a spin-1/2 particle is described by a form of quantum superposition with two eigenvectors spanning a Hilbert space. The eigenvectors correspond to possible outcomes obtained by performing a Stern-Gerlach experiment for measuring the spin of the particle in a specified direction. Neither time dependence of the superposed states nor spatial motion of the particle needs to be considered in this example. According to the quantum-mechanical description, the particle is claimed to be in two states along every direction simultaneously and hence has no definite spin in any direction. When a measure is performed in an arbitrarily given direction specified by a point on a unit sphere in $\mathbb{R}^3$, the outcome is either "spin up" or "spin down" with the corresponding probability, which is considered as evidence for the claim that quantum mechanics is intrinsically probabilistic. The random phenomenon observed in the experiment is not explained. By Theorem 3.1 and Remark 3.2, the claim is wrong. The random phenomenon observed in the experiment is due to lack of knowledge about precise space coordinates used to specify "the same experimental conditions" for detecting different particles measured in different repetitions.

Example 3.4. Consider a particle described by a time-dependent wave function given by a coherent superposition of energy eigenstates. Each of the energy states is assigned a quantum-mechanically calculated probability without explaining the observed random phenomenon. According to the quantum-mechanical description, before an experiment is performed to measure the energy, the particle is claimed to have more than one energy states at any given time. By Theorem 3.1 and Remark 3.2, the quantum-mechanical description makes no sense physically, and the quantum-mechanically described particle does not exist in the real world. The observed random phenomenon does not support the claim that quantum mechanics is intrinsically probabilistic. The random phenomenon observed in the experiment is due to lack of knowledge about precise time coordinates used to specify "the same experimental conditions" for measuring different particles in different repetitions.

Example 3.5. Consider the "entangled state" in the optical experiment for testing Bell's inequality [9]. Depending on "the same experimental conditions" specified by precise space coordinates, the "entangled state" is used not only to describe the single pairs but also to calculate the probabilities of the outcomes of measuring the pairs. The precise space coordinates are given by the corresponding points on a unit sphere in $\mathbb{R}^3$; some of the points on the sphere correspond to the polarizations and propagating directions of different photons detected in different repetitions of the experiment; the other points correspond to the orientations of the polarizers for measuring the photons. According to Theorem 3.1, the space coordinates are all unattainable by measurements and hence unknown. From Remark 3.2, "the same experimental conditions" specified by such coordinates violate the general principle of measurements and do not exist in the real world. Because the "entangled state" presumes the legitimacy of quantum superposition, which amounts to assuming that the quantum-mechanical description of the physical world is legitimate, Bell's inequality is doomed to failure. The "entangled state" is invalid and illegitimate, because it takes precise space coordinates for granted and violates the general principle of measurements. The random phenomenon observed in the experiment is due to lack of knowledge about precise space coordinates used to specify "the same experimental conditions" for detecting different photons measured in different repetitions.

As illustrated by the above examples, the scientific truth concealed by the erroneously explained measurement outcomes of various experiments involving quantum superposition now can be seen clearly: Quantum mechanics is not intrinsically probabilistic; Einstein's vision of the physical world is correct. In other words, Einstein's "instinctive attitude was the correct one." Quantum-mechanical description of the physical world denies the objective existence of definite properties of the physical world prior to measurements and hence cannot be considered complete. Nevertheless, Einstein never excluded the possibility of completing quantum mechanics.

4 Hilbert Space in Quantum Mechanics

The general principle of measurements paves the way towards completing quantum mechanics by replacing conjunction with disjunction as the logical relation between the orthonormal vectors that span an arbitrarily given Hilbert space. Using disjunction as the logical relation between the orthonormal vectors not only can be justified by the general principle of measurements; it is also consistent with the definition of a general Hilbert space. In fact, the concepts for defining a Hilbert space in general are all highly abstract and have no practical meanings. Orthogonality specified by an inner product is the most important concept to define a Hilbert space. The orthogonality for defining a Hilbert space in general is a purely mathematical concept without any practical meaning. Assigning practical meanings to the orthogonality is unnecessary.

Moreover, specifying the logical relation between orthogonal vectors is not a necessary condition to define a Hilbert space. In fact, the logical relation between orthogonal vectors that span a Hilbert space can even be neither conjunction nor disjunction. For a given application, practically meaningful concepts are necessary to define a specific Hilbert space for describing practically meaningful objects, and conjunction may serve as the logical relation between the orthogonal vectors in that space. But the orthogonal vectors must not correspond to mutually exclusive properties simultaneously belonging to the same object.

Example 4.1. The classical prototype of a Hilbert space was first studied by D. Hilbert with applications to the theory of integral equations. This Hilbert space consists of infinite sequences of complex numbers. The logical relation between the orthogonal vectors is neither conjunction nor disjunction. It is not necessary to specify the logical relation.

Example 4.2. With the inner product defined for the Euclidean vectors, $\mathbb{R}^3$ is a Hilbert space. For this Hilbert space, the orthogonal Euclidean vectors do not represent mutually exclusive properties simultaneously belonging to any geometric object, and the logical relation between the orthogonal vectors is conjunction.

Needless to say, the logical relation between the orthogonal vectors that span a specific Hilbert space can also be disjunction. For the Hilbert space in quantum mechanics, the logical relation between the orthonormal vectors must be disjunction as required by the general principle of measurements. Different outcomes corresponding to mutually exclusive properties are measured in different repetitions of the experiment in question. For instance, in different repetitions, different outcomes might be obtained by measuring the same "macroscopic" object described by quantum superposition, or by measuring different microscopic objects of the same kind. Each outcome yields a definite property of the physical reality belonging to the corresponding object. The definite property exists independently of human consciousness.

Consequently, a definite value corresponding to the outcome can be assigned to the object, even though the precise space and time coordinates for measuring it are unknown; the value can even be taken from a continuum and hence cannot be obtained by measurements, such as position and momentum of a particle moving in space. Therefore, by using disjunction as the logical relation between the orthonormal vectors, quantum mechanics can indeed be completed without changing the mathematical setting essentially! Hidden-variable theories are irrelevant to the real world.

On the other hand, violating the general principle of measurements can result in serious consequences. For instance, an imaginary microscopic object described by quantum superposition might be used to characterize different microscopic objects measured in different repetitions. No outcome is obtained by measuring the imaginary object described by quantum superposition. The imaginary object does not exist in the real world.

After completing quantum mechanics based on the general principle of measurements without involving hidden variables, there will be two entirely different notions of quantum superposition: one lies at the heart of current quantum theory, which will be referred to as "superposition (conjunction)", and the other uses disjunction to serve as the logical relation between the superposed orthonormal vectors, which will be denoted by "superposition (disjunction)" to avoid confusion.

Example 4.3. In current quantum theory, the notion of "commutator" used to prove uncertainty relations precludes simultaneous assignment of values to some physical quantities for a particle described by superposition (conjunction). The commutators and uncertainty relations serve to argue against Einstein's vision of the physical world and are hindrances of completing quantum mechanics. For instance, the commutator used to prove Heisenberg's uncertainty relation precludes simultaneous assignment of values to position and momentum of the same particle. Because superposition (conjunction) can only describe imaginary particles that do not exist in the real world, the arguments based on the commutators and uncertainty relations are not physically meaningful.

Example 4.4. Consider Example 3.5 again. In the optical experiment for testing Bell's inequality [8, 9], the single pairs of correlated photons are described by the "entangled state" in a form of superposition (conjunction). As shown in Example 3.5, the "entangled state" violates the general principle of measurements and hence is illegitimate for describing the single pairs of the correlated photons in the real world. Violating the general principle of measurements brings about using an imaginary pair to characterize different pairs measured in different repetitions of the experiment. No outcome is obtained by measuring the imaginary pair described by the "entangled state". The imaginary pair is claimed to have no definite polarizations before measurements [9]. By no means can such an imaginary pair exist in the real world. The measurement outcome corresponding to each single pair in the real world yields an element of the physical reality independent of human consciousness, even though the precise space coordinates required by "the same experimental conditions" for measuring the pairs are unattainable by measurements and unknown.

5 No Evidence for Physically Realizable "Qubit"

All kinds of "qubit" are expressed by physically meaningless superposition (conjunction). Because superposition (conjunction) violates the general principle of measurements and can only describe imaginary objects that do not exist in the physical world, no physical object can carry so-called quantum information. However, in quantum information theory, some popular experiments in quantum physics are considered as experimental evidence for physically realizable "qubit". Actually, as demonstrated by the following two examples, there is no such evidence. In each example, a popular experiment is scrutinized.

Example 5.1. Consider an experiment with single photons. In this experiment, a single photon is described by superposition (conjunction) with two superposed polarization states. The single photon is of course a physical system. But its quantum-mechanical description, i.e., superposition (conjunction), is physically meaningless. The explanation of the measurement outcomes of this experiment is incorrect, which violates the general principle of measurements by taking precise space coordinates for granted. The space coordinates are used to specify "the same experimental conditions" for measuring the photons. In the real world, the photons are measured in different repetitions of the experiment; each single photon can at most be detected only once. The experimental conditions for measuring different photons in different repetitions cannot be the same. An imaginary single photon described by physically meaningless superposition (conjunction) is used to characterize different photons. The imaginary photon does not exist in the real world and is not a physical carrier of so-call quantum information.

Example 5.2. In the Stern-Gerlach experiment considered in Example 3.3, a single spin-1/2 particle is described by superposition (conjunction) with two eigenvectors spanning a Hilbert space. Although the particle is a physical system, its quantum-mechanical description, namely, superposition (conjunction), is not physically meaningful and can only describe an imaginary particle. Just like the imaginary photon, the imaginary particle does not exist in the real world either and is not a physical carrier of so-call quantum information.

As demonstrated above, there is no evidence for physically realizable "qubit". The so-called physical realizations of quantum information processing systems, such as various quantum computers (including topological quantum computing systems) and various quantum communication networks, actually result from erroneously explained measurement outcomes of the corresponding experiments in quantum physics. In fact, quantum information has no physical carriers, and none of so-called quantum information technologies is physically realizable.

Quantum information theory stems from a mistaken belief, namely, quantum mechanics is a complete and correct description of the physical world. Based on this belief, it is claimed that quantum information processing cannot be precluded, unless quantum mechanics is wrong [17]. However, neither the belief nor the claim can stand the test of time. Quantum mechanics in its current form is indeed incomplete. But incompleteness is not incorrectness. Based on the general principle of measurements, quantum mechanics can be completed by replacing conjunction with disjunction as the logical relation between the orthonormal vectors that span an arbitrarily given Hilbert space. Therefore, the completed quantum theory will not change current quantum theory essentially, and completing quantum mechanics based on the general principle of measurements does not necessarily imply current quantum theory failing to be correct. After investing enormous amounts of time and money in the attempt to build "quantum information processing devices" that cannot be realized physically, now it is the time to stop wasting time and money in such hopeless attempt!

6 Discussion

Before the inception of quantum mechanics, the following statement reflects a commonsense held by all physicists then.

Statement 6.1. *For experiments with physical objects, the same experimental conditions always produce the same results.*

In the above statement, physical objects are studied by classical physics; precise space and time coordinates are also necessary to specify the experimental conditions. In outcomes of measuring physical objects studied by classical physics, random phenomena can also be observed. But the random phenomena are mainly due to lack of knowledge concerning the relevant physical situations that can be successfully explained by statistical physics. Therefore, the general principle of measurements is hardly noticeable and hence ignorable. In this sense, Statement 6.1 is approximately true.

The old commonsense is changed by quantum mechanics and replaced by the new one held by most physicists now. The new commonsense is characterized by the statement below [24].

Statement 6.2. *For experiments with physical objects studied by quantum physics, the same experimental conditions do not produce the same results.*

The experimental conditions mentioned in the two statements both need to be specified by precise space and time coordinates. Although Statement 6.1 is approximately true, Statement 6.2 is misleading, because random phenomena observed in outcomes of measuring physical objects studied by quantum physics are exactly due to lack of knowledge about precise space and time coordinates for specifying "the same experimental conditions"; statistical physics cannot explain such random phenomena. According to the general principle of measurements, "the same experimental conditions" specified by precise space and time coordinates do not exist in the real world. Statement 6.2 is largely responsible for erroneously explained experimental results in quantum physics.

7 Conclusion

In the present paper, the experiments for testing Bell's inequality and so-called experimental evidence for physically realizable "qubit" are scrutinized. The scrutiny is based on the general principle of measurements proved as a mathematical theorem and leads to the following findings. Einstein's vision of the physical world does not contradict the experimental results of testing Bell's inequality. Bell's inequality failed to capture the essence of the Einstein-Bohr debate, and Bell's theorem is actually irrelevant to Einstein's viewpoint. The experimental results of testing Bell's inequality and the measurement outcomes of various experiments involving "qubit" are all erroneously explained. Without involving hidden variables, quantum mechanics can be completed based on the general principle of measurements by using disjunction ("or") as the logical relation between the orthonormal vectors that span an arbitrarily given Hilbert space, and the mathematical setting can remain essentially unchanged. All kinds of "qubit" violate the general principle of measurements and can only describe imaginary objects that do not exist in the real world. A very regrettable conclusion from the above findings is inevitable: Quantum information has no physical carriers, and quantum information technologies are not physically realizable.

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