How to realize quantum superluminal communication?

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We deeply analyze the possibility to achieve quantum superluminal communication beyond the domain of special relativity and present quantum theory, and show that when using the conscious object as one part of the measuring device, quantum superluminal communication may be a natural thing.

I. INTRODUCTION

After having shown quantum superluminal communication must exist in our world [5], we will further study the possibility to realize such superluminal communication, this is undoubtedly a formidable task within the scope of our present knowledge about Nature, since the two foundation stones of modern physics—special relativity and quantum mechanics all reject superluminal communication, thus in order to achieve quantum superluminal communication, we must first revise them.

II. REVISING SPECIAL RELATIVITY

In order to admit quantum superluminal communication, special relativity needs to be changed only a little, and this does not limit its applicability in its previous territory at all, in fact, we only need to limit the scope of "natural phenomena" in the principle of relativity, which is the first assumption of special relativity, namely the natural phenomena satisfying the principle of relativity will no longer involve all natural phenomena, and the quantum nonlocal influence is just such an exception [4], we call the new principle quantum relativity principle.

In fact, there exists nothing compelling in both theoretical considerations and experimental confirmations to require the validity of the principle of relativity for all natural phenomena, just as Einstein, the founder of special relativity, demonstrated himself [3], "in view of the more recent development of electrodynamics and optics, it became more and more evident that classical mechanics affords an insufficient foundation for the physical description of all natural phenomena. At this juncture the question of the validity of the principle of relativity became ripe for discussion, and it did not appear impossible that the answer to this question might be in the negative." Indeed, his worries become true when considering the quantum nonlocal influence in quantum theory.

On the other hand, although we have demonstrated that the quantum nonlocal influence rejects the relativity principle owing to the resulting causal loop [4], the deeper reasons need to be given, as Einstein denoted [3], the relativity principle originates from classical mechanics, the precondition of its validity will be "all natural phenomena were capable of representation with the help of classical mechanics", while quantum phenomena are evidently not such natural phenomena, and classical mechanics can no longer afford an sufficient foundation for the physical description of such phenomena either, concretely speaking, the relativity principle will hold true for the continuous motion of the real objects including particles and fields, while for the quantum nonlocal influence in quantum space-like measurement, no real objects are transmitted in the process, and the process is also essentially discontinuous, thus there does not exist any real objects in continuous motion for the principle to apply in such process, and the earth beneath the feet indeed disappears, then it is by no means a surprising fact that the quantum nonlocal influence does reject the relativity principle [4].

Indeed, if one principle is valid for all natural phenomena, it will be too absolute to be true, the original relativity principle is just such a principle; on the other hand, its founder Einstein also ignored one subtle possibility, namely the invalidity of the relativity principle for some natural phenomena, say the quantum nonlocal influence, will not influence its validity for other natural phenomena, say classical phenomena.

At last, even though special relativity is revised so as to permit the existence of quantum superluminal communication, it provides nothing helpful for realizing such superluminal communication, since the origin lies in the quantum nonlocal influence itself, thus we must turn to the quantum theory.
III. REVISING QUANTUM MECHANICS

According to the demonstrations about the existence of quantum superluminal communication[1], we know that in order to find the preferred Lorentz frame, which existence is predicted in theory, the distinguishability of nonorthogonal single states is required, but present quantum theory uncompromisingly rejects this requirement[2], thus we need to revise present quantum theory.

First, as to the normal linear evolution equation of the wave function in present quantum theory, even though it has been confirmed very precisely, we can not exclude the possibility of its inaccuracy yet, and there may exist some kind of deterministic nonlinear correction, which will result in the different predictions from present quantum mechanics[17,10,16], then quantum superluminal communication can be achieved in such revised quantum theory.

Secondly, as to the evolution of the wave function during quantum measurement, present quantum theory is by no means a complete theory, and the projection postulate, from which the quantum nonlocal influence appears, is just a makeshift, while the concrete dynamical process of the projection, where the availability of quantum superluminal communication may hide, is undoubtedly one of the most important unsettled problems in quantum theory, and the resulting revised theories are deeply studied recently[1,6–8,11–14], in which the linear evolution equation of the wave function is replaced by stochastic linear or nonlinear equation; on the other hand, there exists no essential reason to prevent the revised quantum theory including dynamical collapse process from permitting the distinguishability of nonorthogonal single states, on the contrary, this kind of distinguishability will disclose the mysterious veiling of the wave function, say endow with reality to it, and eventually settle the notorious interpretation problem of quantum mechanics.

IV. HOW TO REALIZE QUANTUM SUPERLUMINAL COMMUNICATION?

Since no essential reason and experimental evidence can be found to revise the normal linear evolution equation of the wave function by some deterministic nonlinear correction, we will mainly analyze the possibility to achieve quantum superluminal communication by use of the revised quantum theory including dynamical collapse process.

First, even though present quantum theory, especially its projection postulate, is surely incomplete, but in case of its correctness it still imposes strong limitations for the availability of quantum superluminal communication, concretely speaking, once the quantum measurement process is completed, projection postulate will take effect, then little room is left for the possibility of quantum superluminal communication, thus the opportunity only exists in the quantum measurement process.

Secondly, since for any quantum measurement the measurement results undoubtedly need to be obtained by the observer, say our human being, or other conscious object, who wants to carry out such measurement, then the above opportunity requires that the state of the conscious object must be entangled with the measured state before the completion of the quantum measurement process, two essential advantages to resort to conscious are that, on the one hand, the conscious object will be the last identifier in the measurement process and its influence is inescapable before the dynamical collapse process is completed, on the other hand, only the conscious object may identify the intermediate process and state before the dynamical collapse process is completed owing to his self-conscious, and takes a different action from the action corresponding to one of the states in the superposition state.

Since the distinguishability of nonorthogonal single states is required to achieve quantum superluminal communication, here we assume what need to be measured and differentiated are the following nonorthogonal single states $\psi_1 + \psi_2$ and $\psi_1$, and the entangled state of the whole system including measured system, measuring device and conscious object is respectively $\psi_1 \varphi_1 \chi_1 + \psi_2 \varphi_2 \chi_2$ and $\psi_1 \varphi_1 \chi_1$, where $\varphi_1$ and $\varphi_2$ are the states of the measuring device, $\chi_1$ and $\chi_2$ are the conscious state of the conscious object, then it is evident that, in order to distinguish the above nonorthogonal single states, the only reasonable condition is the conscious time for the definite state $\psi_1 \varphi_1 \chi_1$ is shorter than the collapse time for the superposition state $\psi_1 \varphi_1 \chi_1 + \psi_2 \varphi_2 \chi_2$, and the time difference is long enough for the conscious object to identify[3].

In the following, we will mainly demonstrate that this condition is not irrational, and can be satisfied in essence, first, we can assume the conscious time of the conscious object in Nature is generally independent of the collapse process of the observed state, since during the formation and evolution of conscious the input states will be always classical definite states coming from the outside classical world, the conscious object can only be trained to adapt to these classical definite states, and there exists no collapse process for the observed classical state at all, furthermore,

1This condition may result in the conclusion that conscious can not be explained by present ( quantum ) physical theory.
with the natural selection the conscious time will turn shorter and shorter, while the universal collapse time formula is not changed, then it is reasonable that for some kind of conscious object the conscious time for the definite state $\psi_1\varphi_1\chi_1$ is shorter than the collapse time of the superposition state $\psi_1\varphi_1\chi_1 + \psi_2\varphi_2\chi_2$, and the time difference is long enough for the conscious object to identify, thus even if our human being can not satisfy this condition, other conscious objects may satisfy this condition.

On the other hand, if the above condition can not be satisfied in essence, then we must accept the following bizarre conclusion, namely the concrete collapse theory will limit both the mass, size of the conscious part and conscious time of any conscious object, this means that in case of a certain conscious time the mass and size of the conscious part of any conscious object can not be smaller than the minimal finite values, and in case of a certain mass and size the conscious time of any conscious object can not be shorter than the corresponding collapse time, these requirements are evidently irrational, since the above properties of any conscious object all originate from the natural selection in the environment of classical world, and even if the natural selection relating to the collapse process does take effect, then it is also more reasonable for the conscious object to be able to use quantum superluminal communication, since undoubtedly it will be useful for his existence and evolution.

V. A FEASIBLE EXPERIMENT

In this section, we will present a feasible experiment to confirm the above possibility of quantum superluminal communication.

The experiment is based on the fact that the visual perceptual apparatus of many creatures including our human being possesses an extreme sensitivity, and as we know, for hoptoad only one photon can trigger a definite visual perception, for our human being the number is about seven [15].

We first consider a simple case in which a bunch of 10 photons coming from a region A propagates towards the eye of a human observer [9], which has been analyzed by Ghirardi from a different point of view, the photons hit the retina of the observer and trigger the definite perception “a luminous spot at A”; in a similar way, the photons coming from a region B, spatially separated and perceptively distinct from A, will trigger the definite perception of the observer “a luminous spot at B”.

Now, we consider a different situation, in which a superposition state of the above two states of the photons is prepared and kept long enough for the experimental aim using present quantum optics technology, and again the photons propagate towards the eye of the same human observer, hit his retina and trigger his visual perception, then according to the above analysis the observer may have a different perception from any one of the above perceptions.

Certainly, due to the brevity of the perceptual process, it may be very difficult for the observe to perceive the difference of the above two situations, but as we think, it is by no means impossible some conscious object in nature.

On the other hand, the human observer may be replaced by a trained hoptoad, and the above experiment may contain only one photon, which can be easily realized presently, then we can observe the different reactions of the hoptoad for the above two situations, according to our analysis, for the superposition state situation the hoptoad may take a different reaction from any one of the reactions corresponding to the definite states in the superposition state.

VI. CONCLUSIONS

We show that special relativity and present quantum theory can be revised to permit quantum superluminal communication, and when using the conscious object as one part of the measuring device, quantum superluminal communication may be a natural thing.

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Acknowledgments

Thanks for helpful discussions with Dr S.X.Yu (Institute Of Theoretical Physics, Academia Sinica).