An intrinsic quantum state interpretation of quantum mechanics

Dean L. Mamasa)
4415 Clwr. Hr. Dr. N., Largo, Florida 33770, USA

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Abstract: The observation that distantly separated entangled particles exhibit correlations demands a new interpretation of quantum mechanics. In order to avoid a contradiction with relativity regarding the speed of light as a limiting velocity, the individual particles must be regarded as possessing intrinsic, fixed, and complementary quantum states even before an observer performs a measurement. There is no contradiction with quantum mechanics when calculated probabilities are viewed as purely statistical, applicable only to ensembles of identically prepared systems using the law of large numbers.© 2013 Physics Essays Publication. [http://dx.doi.org/10.4006/0836-1398-26.2.181]

I. INTRODUCTION

The subject of entangled particles has been the object of intense debate and confusion for nearly a century, beginning with Einstein’s disconcertment on the question. Einstein was so puzzled by entanglement that he rejected quantum mechanics and proposed the hypothetical existence of “hidden variables.”1 Enormous amounts of wasted debate have followed to this day, when the question of entanglement is actually trivial. The term “entangled” is misleading. A better term would be to describe the particles as simply being in a shared quantum state condition, as described in Section II. The term “entangled” gives the false impression that one particle can somehow “sense” the state of the other instantaneously and at an arbitrarily great distance; there is, however, no known mechanism in science that could explain any such instantaneous communication. The particles are rather simply in a shared quantum state condition by virtue of their having been simultaneously created as twins. That the particles are in a shared quantum state condition is verifiable by bringing the particles together and performing a suitable measurement; should one particle be then observed to be for example spin up, the other would be found to be spin down, the particles in a shared state as simultaneously created twins. There are numerous examples of “entangled” pairs of twin particles exhibiting correlations in their quantum states as shown for example in the work of Bell,2 or even for three or more such entangled particles as shown by GHZ.3

In the present article, it is maintained that simultaneously created “entangled” twin particles do indeed exhibit correlations, but without any instantaneous communication between the separated particles. There are no contradictions with quantum mechanics, nor with Bell’s Inequality, this inequality to date not decisively tested.4 The observed correlations are seen here as simply due to the twin particles having been simultaneously created in a fixed and common quantum state. There are no contradictions with quantum mechanics if quantum mechanical predictions are interpreted as purely statistical; there are no hidden variables and the particles still obey Schrödinger’s equation.

II. AN INTRINSIC QUANTUM STATE INTERPRETATION

Entangled particles are simultaneously created, and much as twins, it should come as no surprise that the particles possess complementary quantum states. When entangled particles A and B are separated, it should be expected from symmetry that should particle A be spin up, that particle B would then be spin down, or should particle A be right hand polarized one should expect particle B to be left hand polarized. Conservation symmetries are found throughout nature and to be expected, especially considering that the particles are simultaneously created as twins.

When the quantum state of particle A is measured and determined to be spin up, an observer can then expect particle B to be at any later time found to be spin down before

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a)deanmamas@yahoo.com
that later measurement is ever even performed, by reason of symmetry. There is no need nor reason to believe that there exists any instantaneous superluminal communication between the two separated particles, rather, the correlation of quantum states is simply seen here as a result of the situation that the two particles when simultaneously created as twins, are imparted upon their creation with intrinsic, fixed, complementary quantum states. Particle B separates and travels off from particle A already possessing an intrinsic and fixed quantum state that an observer at any later time could measure. By symmetry, particle A also was imparted upon its creation with an intrinsic and fixed quantum state, complementary to that of its twin particle B.

Particles A and B are thusly viewed as possessing intrinsic quantum states. There is no contradiction with quantum mechanics when the predictions of quantum mechanics are interpreted as purely statistical, applicable only to ensembles of identically prepared systems using the law of large numbers.

III. SCHRODINGER’S CAT

Given the above discussion, in the thought experiment of Schrödinger’s cat, a particular cat is simply in fact either alive or dead, whether or not a measurement is ever even performed. A particular system possesses an intrinsic quantum state where the particular cat is in actuality either dead or alive, with no contradictions with quantum mechanical probabilities which are purely statistical. Realism is preserved in this sense; any particular cat is in fact already dead or still alive, before one even performs an observation. The state of the cat is independent of an observer. The resolution of the thought experiment of Schrödinger’s cat is trivial. The question of Schrödinger’s cat is no more complicated than the question of the tree in the forest being standing or fallen; the tree is either standing or fallen, whether or not one goes into the forest to observe it.

IV. PARTICLE TRAJECTORIES

Particle trajectories viewed as quantum states are also fixed before an observer even performs an observation. In a single slit experiment, a particular particle emerging from the slit is viewed here as already headed towards a particular spot on the observation screen, before the scintillation is even observed. Trajectories are intrinsic and fixed with no contradictions with quantum mechanics; quantum mechanical predictions of where on the observation screen particles should fall are interpreted as purely statistical.

The view of the trajectory of a photon as intrinsic and fixed is consistent with a quantum mechanical wave model of a photon as a localized wave packet whose physical dimensions are restricted to only a few wavelengths, in both length and breadth. The effective length of a photon’s wave packet corresponds to the coherence length in a thin-film experiment, where the distance between the two surfaces cannot be more than a few wavelengths if a single photon is to reflect from both surfaces and exhibit an interference pattern. The effective breadth of a photon’s wave packet corresponds to the distance separating the slits in a double slit experiment, which cannot be more than a few wavelengths if a single photon is to pass through both slits and exhibit an interference pattern. The view of a photon as a wave diffracting through a slit is consistent with the view of the photon as a wave packet possessing a fixed trajectory, where the photon’s wave function is localized to a finite space whose dimensions are less than a few wavelengths.

V. CONCLUSIONS

In order to avoid a contradiction with relativity regarding the speed of light as a limiting velocity, the phenomenon of quantum entanglement needs be explained without superluminal communication between entangled particles. Correlations between entangled particles then must be attributed to the particles possessing intrinsic, fixed, complementary quantum states with which the particles are imparted upon their creation. Entanglement thusly demonstrates that quantum mechanical systems can possess intrinsic and fixed quantum states which are independent of an observer. An intrinsic and fixed quantum state of a particular quantum mechanical system is discovered upon measurement. There is no contradiction with quantum mechanics if quantum mechanical probabilities are viewed as purely statistical.

This new interpretation of quantum mechanics, where systems are viewed as possessing intrinsic quantum states independent of an observer, avoids the metaphysical problem of postulating instantaneous superluminal communication.

2J. S. Bell, Physics 1, 195 (1964).