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QUANTUM ENTANGLEMENT AND FUTURE

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Abstract- This paper contains details about quantum entanglement, connection between space and time and hope to find the way for quantum teletransportation. About the entanglement of particles and their behavioral connections and how that violates all the existing laws of physics,mainly Quantum Theory which defines Standard Model.

In 1935 Einstein, Podolsky and Rosen designed one thought experiment to demonstrate the incompleteness of quantum mechanics. The presented thought experiment assumed the principle of locality and reality of quantum mechanics. Einstein, Podolsky and Rosen came to the conclusion that some of quantum effects must travel faster than light,that is a contradiction to the theory of relativity. The presented thought experiment is called the EPR paradox. In response to the EPR paradox, Irish physicist John Stewart Bell performed a thought experiment showing that at least one of the quantum mechanics assumptions must be false. This paper mainly concentrates on this.

I. INTRODUCTION

Two particles are said to be entangled if their wave functions cannot be separated. Simply saying measurement of one particle affect the state of other. That is if we know the state of one particle then the state of other entangled particle can be predicted precisely. This violates the second postulate and widely accepted notion that speed of light in vacuum is a constant for all frame of references. Speed of light in vacuum also represents speed of causality. If one event is happening in a specific space-time, it will take a certain time for any other space-time to understand that one event has happened depending on how far these two space-time are separated. This speed of passing information is speed of causality which equals to speed of light in vacuum. Alternate way of saying this is that, no two separate space-time can ever pass information within a zero time interval. But quantum entanglement has practically proven that between two entangled particles kept at two different space-time can communicate with each other spontaneously. This is violating the famous second postulate in special theory of relativity.

QUANTUM ENTANGLEMENT

Let’s consider a thought experiment.2 elastic balls in outer space, held tightly together by some glue, can it apart if the glue fails. In this case we have no qualms about saying that, eg., one of the balls is flying upwards and the other down, and that one of them is spinning with its spin vector up (ie., +ve), and the other down (ie., -ve). One thing we are sure of is that each one of them is in some definite physical state. Moreover these states are distinct, and so are the balls - they have their own individual properties (they might, eg., have different colours).We can easily imagine it for some classical system.

Consider now the quantum-mechanical situation. The kind of classical system just described is very complicated, and so is its quantum counterpart. But we can start with a pair of 2-level systems; this makes things much simpler. Let's start with an example

Example: the Positronium System: We start with a system for which the kind of correlation described above is easy to arrange. The name "positronium" describes a system in which an electron and a positron (the 'anti-particle' of an electron) are bound closely together by their electrostatic attraction, with zero net angular momentum. After a short time they will mutually annihilate, leaving behind 2 very high energy photons, which must then fly off in opposite directions, each with opposite spin

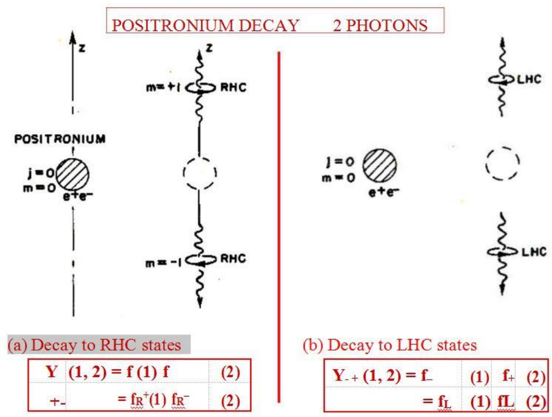

FIG:1 The decay of positronium to produce a pair of photon states. In (a) we see the decay products with the upward moving photon having spin m = +1, and the downward moving photon with spin m = ¡1. This is equivalent to 2 photons with right helicity (ie., right or 'clockwise' polarization). In (b) the polarizations are now both left, corresponding to spin m = ¡1 and m = +1 for upwards and downwards moving photons respectively. See text for more details.

we are making any one of them stop (by providing some energy field), spontaneously the other will stop even if the distance between them is in light years! This is not possible since relativistic concept doesnot allow speed of causality to be zero and the maximum possible speed of causality is speed of light in vaccum(exactly 299792458 m/s). Albert Einstein called this as a “spooky action” and questioned the completeness of most acclaimed Quantum Theory and developed a EPR Paradox.

Imagine there are two entangled electrons which are exact opposites. The spins and magnetisms are different (fig.1). Any change or movement to one of these electron will instantly make the other one change in the exact opposite fasion. The change of the ‘unaffected’ electron happens faster than the speed of life. This has been tested and proven with varying distances between the particles, and more than two electrons at a time. This solves the ‘impossible’ scenario of knowing both somethings speed and its location at the same time (violation of Heisenberg’s uncertainty principle).

Einsteins question of whether Quantum Mechanics is right was well answered by John Stewart Bell through his well-known Bell’s theorem. Bell's theorem is a "no-go theorem" that draws an important distinction between quantum mechanics (QM) and the world as described by classical mechanics.

”No physical theory of local hidden variables can ever reproduce all of the predictions of quantum mechanics.”

The theorem is usually proved by consideration of a quantum system of two entangled particles. The most common examples concern systems of particles that are entangled in spin or polarization. Quantum mechanics allows predictions of correlations that would be observed if these two particles have their spin or polarization measured in different directions. Bell showed that if a local hidden variable theory holds, then these correlations would have to satisfy certain constraints, called Bell inequalities. However, for the quantum correlations arising in the specific example considered, those constraints are not satisfied, hence the phenomenon being studied cannot be explained by a local hidden variables theory.

Following the argument in the Einstein–Podolsky–Rosen (EPR) paradox paper (but using the example of spin)Bell considered an experiment in which there are "a pair of spin one-half particles formed somehow in the singlet spin state and moving freely in opposite directions." The two particles travel away from each other to two distant locations, at which measurements of spin are performed, along axes that are independently chosen. Each measurement yields a result of either spin-up (+) or spin-down (−); it means, spin in the positive or negative direction of the chosen axis.

QUANTUM TELETRANSPORTATION

Using the concept of Quantum particle we can teletransport particles.

Here we are discussing about teletransporting photons. Firstly we have to create two entangled photons. Among which one photon stays in station-1 and the other one is sent to station-2 in our observational premises.

The distance between those entangled particles could be any value. Now we are introducing the third photon to be teletransported to the station-2. We make the third photon to interact with the photon in our statio-1. Interaction of these photons are studied comparing quantum states. Because of ‘spooking action’ we can transform the photon in station-2 into the third photon using the study of the interaction between photons in station-1. This is not just theory but scientists have teletransported millions of photons using Quantum Entanglement.

One day, we hope, if we could reconcile Quantum theory with general relativity then we could teletransport huge masses, say a man or sending the probe to other galaxies spontaneously rather easier than how now possible.

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