



Action at an Apparent Distance

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Abstract

When an atom simultaneously emits twin photons which travel off in different directions, if the first photon to be absorbed by another atom reveals itself to be an up-spin photon then the other photon will ultimately reveal itself to be a down-spin photon, and vice versa. It has been experimentally demonstrated that the spin of each atom is not determined at the time of its emission. Seemingly, the spins of both photons are determined in the instant that the first photon is absorbed by a second atom. Problematically, this seems to imply that the first photon must send a message to the second photon so it knows that it must manifest the opposite spin, and that such a message would have to travel faster than the speed of light, which is correctly forbidden by Relativity.

Current theories are based on the assumption that there can be no physical connection between the photons since nothing physical can travel any distance, faster than the speed of light. Therefore, these theories inherently cannot offer a physical explanation of what might be taking place. However, by applying the herein-proposed theory Spacetime Locality-based Entanglement, Einstein's Spooky Action At A Distance is reconciled with light-speed limitation considerations, by employing the Relativistic principle of Distance-Contraction. It is argued that the twin-photons, in their own stationary reference-frame maintain a Light-Speed-Contracted-Distance Separation of zero while at the same time, a stationary observer sees a potentially enormous, non-contracted separation-distance that can extend to intergalactic distances and endlessly beyond.

Keywords: Spooky Action At A Distance; Relativistic Entanglement; Locality; Non-locality; Spacetime; Time Dilation; Distance Contraction; Faster-than-light Prohibition

Introduction

Overall, this paper makes three claims:

- Spacetime Locality-based Entanglement provides a more sensible interpretation of well-known facts than current explanations provide.
- Casual scrutiny reveals that the notion of Non-Local Entanglement contradicts itself.
- Current theories of Non-Locality-based Entanglement do not really explain how anything actually works; instead, they merely restate the original question in the form of an assertion.

Newton was rightly horrified at the idea of Action At A Distance. The entire notion of objects gravitationally attracting each other across truly empty Space really is truly absurd. For him, there simply had to be some kind of material to convey the force across the distance between the objects. For example, one must actually throw a rock if he really wants to break a window. To be more specific, the rock must actually travel from the thrower, through space, to the window. He can't just wave the rock back and forth, make nasty faces and still get the job done! It was especially hard to describe forces of attraction—one starts imagining some kind of elaborate universal arrangement of invisible ropes and pulleys or interconnecting elastic bands! (Good luck with that, Newton!)

Throughout the Nineteenth Century, electromagnetic Action at a Distance was starting to be explained by electromagnetic fields. By the early 1900's photons were added into the mix. Nowadays, the Standard Model of Particle Physics describes three most-fundamental forces, different combinations of which comprise the electromagnetic force, the strong nuclear force and the weak nuclear force, but not Gravity. General Relativity explains Gravity as a kind of Curvature in Space; this potentially eliminates the need to regard Gravity as a fundamental force. (This is far less intuitively-sensible than is misleadingly-represented in popular explanations; nonetheless, for now, so far so good!) However, Relativity then goes on to bar any matter, energy or information from traveling faster than the speed of light. Spacetime Locality-based Entanglement complements the two theories of Relativity and is also based on the same prohibition of faster than light information transfer.

On the one hand, any interaction that does not require faster than light travel is called a Local Interaction and is said to exhibit Locality. For example, Newton's material-mediated gravitational force is considered a Local Interaction Theory. On the other hand, any interaction that would otherwise seem to require faster-than-light travel of Mass, Energy or Information is called a Non-Local Interaction and is said to exhibit Non-locality. For example, Quantum theory, and its associated experiments strongly suggest that an atom can simultaneously emit twin photons, so-called Entangled Photons, which fly off in different directions, yet in some non-physical, unspecified sense they remain somehow still-connected or "Entangled" even though they are separated by a considerable distance; but what does this even mean?

This is how this experiment works. In this paper, Twin Photons are so-called because they are born at the same time; that is they are emitted simultaneously from the same atom, but they fly off in different directions. As soon as the first twin photon is absorbed by a second atom, it may reveal itself to be an up-spin photon, if so, the other twin photon must later reveal itself to be a down-spin photon, and vice versa. Here's the rub. It has been experimentally demonstrated that the spin of each photon is not determined at the time of its emission. Seemingly, the spins of both photons are determined in the same instant that the first photon is absorbed by a second atom.

These experiments really can be legitimately construed to imply that the first photon to be absorbed must send a message to the

second photon so it can know which spin to manifest, and that this message must travel faster than the speed of light. However, Relativity is probably correct to forbid faster-than-light transfer of information. Certainly, less-prestigious theories would be falsified by such damning contrary evidence. Not so with Relativity. Relativity is dogmatically true. No mere mortal experiment could ever falsify any part of it!---

Make no mistake, At best, Relativity is on life-support and has been for nearly a century. Nonetheless, rather than prematurely pulling the plug, Spacetime Locality-based Entanglement is actually healing the patient. This skeptical theory is actually the World's first attempt to salvage Relativity without resorting to self-contradictory, grotesquely-tortured, psychologically-unhealthy rationalizations. The next paragraph details why such rude claims are being asserted.

It is usually claimed that there is no need for faster-than-light information-transfer because the twin-photons never lost their special twin-connection in the first place, even when they became spatially-separated! This is called "Entanglement." This is like saying, by lighting a candle, listening to soft music, and especially by closing one's eyes, and chanting the word "Entanglement" many, many times, one is thereby endowed with supernatural powers. All of a sudden, one can magically tickle one baby twin on one side of town and make the other baby twin giggle on the opposite side of town, without so much as a phone call, let alone a genuine explanation of how this actually works! (It's fun, you should try it!) Even though this is, in a certain limited sense, actually true, nonetheless, in the absence of an credible mechanism, this is crazy stuff!!!

This paper provides a completely organic, Locality-based explanation without making ad hoc, self-contradictory assertions. So-called Spooky Action at a Distance is reconciled with light-speed limitation considerations, using the Relativistic principle of Distance-Contraction. It is argued that so-called Entangled Photons, within their own stationary reference-frame, maintain a Light-Speed-Contracted-Distance-Separation of zero while at the same time, a stationary observer sees a potentially enormous, non-contracted separation-distance that can extend to intergalactic distances and endlessly beyond.

Materials and Methods

The journey of an astronaut who travels very close to the speed of light is compared with the journey of a photon that travels at the speed of light. This analysis suggests a Locality-based explanation for so-called Entanglement that is based upon Relativistic Distance-Contraction while at the same time explaining why this looks like Non-local Entanglement when making the usual observations from the stationary reference frame of the photon-emitting atom. Hence the title: Action At An Apparent Distance.

Results and Discussion

We look at the distance to the second-nearest Star and tend to view it as a more or less fixed quantity. However, this perspective only holds if we are traveling at sub-relativistic speeds. The Relativistic Astronaut Illustration is used to devise an analogy that will reveal the experience of a photon as it travels from the atom that emitted it to the atom that ultimately absorbs it. On the one hand, an Earthbound, stationary observer that witnesses a Spacecraft traveling close to the speed of light makes the usual sorts of Observations. In this example:

- The ship's internal clock slows to about one four-hundredth its usual pace.
- The length of the ship contracts by a factor of about four-hundred. A spherical ship would now appear to be disk-like—with a stem-to-stern distance that is now 400 times shorter.
- Traveling a little slower than the speed of light, it will appear to take a little more than four years for the spacecraft to cross a three-dimensional spatial distance of four light years to the second nearest Star.

On the other hand, the crew thinks:

- The ship's internal clock is completely normal.
- The ship still has its usual spherical shape.
- They arrive in a little more than 3.65 days.

The crew must either believe that they traveled four-hundred times faster than the Speed of light or else they must conclude that they traveled a distance, that was contracted or shortened by a factor of four-hundred, just as the Earth-bound observers thought that the ship was contracted or shortened by a factor of four-hundred.

Photons do not travel at close to the speed of light--they in fact, by definition, travel at the speed of light! (Really???) Therefore, from the perspective of the stationary atom that emits it:

- The internal clock of a photon does not merely slow down, it is absolutely stationary.
- The Photon either has no thickness, or perhaps the minimum-possible thickness of a Planck Length. (Perhaps this provides a physical reason for the prohibition on faster-than-light travel, since nothing can get any thinner than this.)
- The photon's journey begins when it is emitted from the first atom and it will end when the photon is finally absorbed by another atom. Perhaps this second atom is spatially located millions of light-years in the distance, at a point of time in history that is millions of years in the future.

On the other hand, the photon thinks:

- Its internal clock is completely normal.
- Its thickness remains unchanged.
- It is emitted by one atom and absorbed by a second atom after traveling zero distance in zero time. In other words, from the photon's perspective, the two atoms are so close that they passionately kiss, and the photon is transferred directly from one atom to the other atom as intimately as if they were sharing an electron.

Now we must consider the case of a first atom simultaneously emitting two photons. As described above, from their own reference frames, each photon remains zero-distance from the atom that emitted them, therefore they remain zero-distance from each other. In other words, they do indeed remain spatially-connected, not mysteriously "Entangled." There is nothing "Spooky" or "Distant" about the "Action".

Conclusion

Spacetime Locality-based Entanglement explains the appearance of Non-Local Quantum Entanglement in terms of a Locality-based Relativistic interpretation. This is accomplished by merely pointing out the necessary implications of Relativistic Distance Contraction as it relates to alleged instances of Non-local Entanglement. Thus, it is no longer necessary to resort to confusing claims

that spatially-disconnected twin-photons are somehow still connected, even though are not—or are they??? Merely, substituting the word “Entangled” for the word “Connected” does not negate the built-in contradiction.

Spacetime Locality-based Entanglement also presents a picture of a photon that acts as a sort of time-tunnel. In a single instant, this time tunnel not only simultaneously joins two or more atoms that exist at vastly separated points in Space, but the atom that emits a photon today is instantaneously connected across both time and Space to a distant future atom that is absorbing it, millions of years later. Thus, the photon is a kind of Stargate Time-Tunnel that instantaneously transmits information across vast distances and over long eons of future History using Relativistic Distance Contraction. Perhaps this can also be conceived as a phenomenon where Distance is contracted because, between or the two photons, Space is folded up.