Rev. 2 (2003)
Rev. 3 (2024)

Abstract
This paper explores the intersection of quantum mechanics and relativity theory in the context of superluminal communication, highlighting the paradoxes that arise when these theories are applied to Einstein-Podolsky-Rosen (EPR) kindred methodologies for temporally invariant information transfer. The authors propose a thought experiment involving two superluminal devices in different inertial reference frames and explore the implications within the framework of the Many Worlds hypothesis. It posits that a superluminal device might be linked to a closely related reality in the multiverse due to non-inertial effects as dictated by relativity. The paper concludes by emphasizing the necessity of careful consideration of the superluminal pipeline through which data flows, ensuring it represents the user's home reality and not an alternate one.

This exploration provides a compelling insight into the ongoing endeavor to reconcile quantum mechanics and relativity theory, and the potential implications for our understanding of the universe. This paper serves as a significant contribution to the discourse on the compatibility of quantum mechanics and relativity theory in the realm of superluminal communication.

Extract from a Focus Meeting of the FTL Working Group: How EPR Kindred Methodologies Show Disagreement Between Quantum and Relativity Theories

When identifying the problems and concerns of using EPR kindred methodologies to achieve temporally invariant information transfer, i.e., giving superluminal communications devices the ability to break the time-barrier and talk into the past, little concern is given for just how these schemes fit into the overall pictures dictated to us by both the Quantum theory and the Relativity theory. Actually, modern quantum theory is not hung up on time parity violations. For example, using two communication devices that are at some distance apart and using entangled states. The quantum theory simply says these devices are connected in such a way as to allow instantaneous information transfer to occur. The problem comes up when both devices are located in different inertial reference frames. Accelerating one device will put it into a different reference frame with respect to the other device. Accelerating one of the communicators relativistically will put it into a frame of reference that has experienced less time than the device at rest. A one-dimensional analysis of this experiment shows that it would then be possible to use these two devices to translate information past temporal barriers.

Examination of these kindred methodologies reveals an obvious error only when reapplied to the quantum application of simultaneity: the two communication devices are no longer identically simultaneous, which is mandatory for entangled systems under E-P-R conditions. Relativity destroys the reason behind entangled states. This example illustrates the incompatibility between quantum and relativity theory. So which concept is correct? We have had ample proofs of the success of both general and special relativity over the decades since its creation - from time dilation between atomic clocks in different strength

gravitational fields, to the dilation effects experienced by GPS satellites undergoing acceleration in orbit. Relativity is right. On the other hand, there has been stellar success in demonstrating Bell inequality violations as well, albeit for a lesser time period. Quantum theory is also right. How can relativity theory and quantum theory both be simultaneously correct, especially since the results of either interpretation is so different from one another? This is still an unanswered question, but it also shows why it would be desirous to perform relativistic EPR experiments. I am far from the first to have thought of this.

The basic question boils down to this: Are the two FTL communication devices fixed within inertial frames that are Lorentz invariant? Or, more generally, do there exist transformation equations that do not destroy the non-locality of quantum operators? If so, then non-locality can be preserved through relativistic changes. Unfortunately, this does not also mean causality may be preserved through quantum changes. This can be best described through the following example. The only assumption is instantaneous signaling is conserved, i.e. propagation time Δt = zero.

Before the experiment, superluminal communication devices A and B are linked and demonstrated to be functioning. When B transmits a signal, the indicator on A lights up. Clocks attached to both devices are synchronized and identical, such that $\Delta t = 0$. Then B undergoes acceleration such that upon its return to the rest frame, the clock in accelerated frame B is no longer in sync with the rest frame such that $\Delta t \neq 0$.

So, what happens to information sent through the active superluminal pipeline? Does the propagation time for information through the superluminal pipeline remain zero, i.e. where Δt is still zero? This is the result given by quantum theory. Or, will there be a detectable temporal parity violation, either into the past or future, such that $\Delta t \neq 0$, as would seem to be dictated by general relativity?

Presently, this Gedanken thought experiment is actually possible to be done today if a linked FTL communications device were placed in an orbital satellite. The Global Positioning (GPS) Satellites for example, regularly need to be corrected for the effects of both general and special relativity to the amount of 38 micro-seconds per day. This would amount to an accumulated time difference of 13.87 milliseconds per year. If this experiment is performed, a time lag of ≈ 14 milliseconds into the future or past would certainly seem to validate relativity theory. It would also seem to invalidate the results dictated by the quantum theory, meaning our experiment would disappear in a puff of logic as it depends on the correctness of quantum mechanics. On the other hand, if there were no time lag, showing quantum mechanics were correct, relativity would need to be re-written or thrown out. Unless both were right... so is there a way relativity theory and quantum mechanics can play well together?

In the decades since this paper was first prepared by the original FTL Working Group, a newer interpretation involving the many worlds hypothesis has risen to ascendency and provides a direct yet thought-provoking solution. The universe that your superluminal communications device is linked to through the afore-mentioned fourteen millisecond time shift, simply put, is not your own. It is a very close neighbor in the multiverse, time shifted 14 milliseconds into the future (or past depending on your perspective). To be clear, it is not the actual physical device that is in a different universe, but the superluminal pipeline they function through that is now linking to device B in another, closely related reality, due to the non-inertial effects described by relativity. Of course, if anyone finds this fact unsettling, all that need be done is to turn off the affected device and the link will break providing normalcy once more.

As long as both superluminal devices are connected to the same universe, there will never be a time shift, guaranteeing the results dictated by quantum mechanics remain valid, but only for our local universe. Because superluminal information is moving through a pipeline that is non-inertial, there exist no set of transformation equations that can be attached to its operation in a meaningfully valid way. Thus, the application of relativistic principles to active superluminal pipelines creates an interesting method to explore closely-spaced alternate realities, though one might assume the larger Δt is, the bigger the difference between target realities. In this way, Professor Einstein's relativity provides a stunning confirmation of the Many Worlds hypothesis.

This example clearly shows where the universe places its values. Quantum mechanics provides a process for transferring information faster than light, and relativity theory provides a method for investigating alternate realities. My suspicion is that causality, as we understand the term, is a more complex topic than we realize. At the least, great care must be taken to ensure that the superluminal pipeline through which your data flows is not corrupted by non-inertial effects, and actually represents your home reality and not someone else's.

Greysky

12 Feb. 2003

16 May, 2024

Note:

1) There were two links in the original revision that have been removed because they no longer worked.
2) An abstract has been added.
3) Some spelling and typos have been fixed, as well as some areas re-written and updated to reflect new insights, and the file resaved.