SUPERLUMINALS AND THE SPEED OF LIGHT

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Abstract: This brief paper was submitted as partial requirement for a Chemistry course. The topic was recommended to Dr. Kamala Sharma*.

Key Concepts: superluminals, locality/nonlocality, mechanistic/nonmechanistic, Smarandache Hypothsis.

Definitions:

Superluminals are phenomena capable of greater than light speed.

Locality is the assumption that change in physical systems requires presence of mechanistic links between cause and effect.

Nonlocality is that which is displayed by physical systems in which change evidently happens without such mechanical links.

Mechanistic is direct physical contact (push-and-pull interactions) between parts of dynamic systems characteristic of machines.

Nonmechanistic is nonphysical interaction between parts of a dynamic system characteristic of superluminals.

For more than a century, an argument has been carried on concerning which is a more accurate picture, or model, of the workings of the universe. Basic to this argument is the difference between the view of the world presented to us by classical (Newtonian) physics and quantum physics. Classical physics held sway on a macroscopic scale until Max Planck discovered that on the very small scale, quantum mechanics was more accurate than classical mechanics could provide. Central to this argument were

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physicists like Planck, Einstein, Hizenburg, Scheodinger, Bohr, Bohm, and a number of others. Most basic to this controversy is how action at a distance can occur, e.g., how does the sun hold the planets in place without any mechanical means of doing so. Einstein did not agree with Newton's theory of gravitation, because there was no evidence, and still isn't, of any force acting across space to hold the planets near the sun. Einstein developed his own theory of gravitation to give a much more mechanical view of gravitation. The sun influences the space, warps the space, near it, so that the planets roll around the sun much as marbles would roll around a tightly stretched sheet with some sort of indentation in the middle of it.

Einstein's theory of gravitation was as good or better than Newton's, however, on the subatomic level, motions could not be accounted for accurately without a new theory: Quantum Mechanics. With Quantum physics a new wrinkle was added to the discussion. It appeared that particles could communicate at a greater than light speed. Einstein thought this possibility absurd, and he and a couple of his assistants came up with a thought experiment (EPR) to refute the possibility that speeds greater than light could occur. Being convinced that the speed of light was the top speed of the universe, Einstein imagined two particles with opposite spins could change their relative spins only if somehow they communicated at greater than the speed of light. Since he had already absolutely accepted the speed of light as the maximum velocity in the universe, he had to conclude that this instantaneous communication between the spinning particles was absurd, or absolutely impossible. Seems like sort of a circular argument.

Paralleling this mechanistic/nonmechanistic debate was the concept of locality/ nonlocality. Local was used as synonymous with mechanical and nonlocality with non-mechanical. Bell argued that if we could show that the notion of "local" did not exist at the subatomic level, then speeds seemingly occurring at greater than light would be explainable. I.e., if some things in the universe are really nonlocal, then communication could occur instantly, because they would not involve time or space. These instantaneous messengers came to be called superluminals. Bell's experiments proved the existence of superluminals, and, hence, Bohr's view of mechanics was proven right, and Einstein's view wrong. There can be nonmechanistic action at a distance at the subatomic level, if you can show some sort of communication without regard for time and space.

In our macroscopic world we live in a universe of "locality" but on the subatomic, microscopic world, all localities can be taken as the same locality, and, therefore, non-local. On a large scale our world seems to be very mechanistic, i.e., things have to touch and move things through space and time for anything to happen, whereas, on the small scale, subatomic level, things are still capable of behaving as they did at the big bang, i.e.,

they all were at the same place at the same time: All places were one place and all times were one time. Therefore, if subatomic particles have retained their big bang behavior, and experiments are showing that they do, then these particles are communicating at faster than light velocities, because they don't have to traverse any time or space. Super-luminal communication does seem to be possible, i.e., communication unrelated to any particular velocity.

Dr. Florentin Smarandache argues in his paper, "There Is No Speed Barrier In The Universe," called "Smarandache Hypothesis," that paired entangled particles (photons) communicate instantly concerning their individual states, i.e., measuring one immediately determines the measurement of the other no matter how far separated. His conclusion had to be that this sort of subatomic particle behavior must be taken as sound evidence that, on the quantum level, there is no restraining finite speed. Even after Bell's inequality experiment, which extended the Einstein – Podolsky – Rosen (EPR) thought experiment, that has shown conclusively that there has to be phenomena interacting at greater than light speed, there is criticism of Dr. Smarandache's paradox. The criticisms go like this: "While it is true that modern experiments <u>have</u> demonstrated the existence of types of measurable superluminal phenomena, none of these experiments are in conflict with causality or special relativity since no information or physical object actually travels at speeds greater than light to produce the observed phenomena." It seems easy enough for these criticisms to say "no information" is moving from particle to particle or that these particles are not "physical objects," but, then, what is happening between them, and what are they. The point is that <u>something</u> is occurring at greater than light speed, called "superluminals," and it has been measured. It may be better for us to say that there is some sort of "interaction" between subatomic particles happening at greater than light speed, however, whatever we call it, it exists, and, therefore, we have to amend our view of light speed as the maximum universal velocity.

Various experimental apparatus were designed essentially with the same premise, that of splitting up certain qualities or characteristics of different kinds of particles. The results at the detector were startling and very difficult to explain unless at the quantum level one assumed communication, or some sort of interaction, between the particles at a greater than light speed. John Stewart Bell's experiments have swept away the assumption, on the microscopic level, because we now have proof. However, that has been an enormous, almost overwhelming discovery, because it shows us that nature can behave in a totally noncommonsensical manner. Things do work on one another without touching and without regard for time or space. This finding has been abhorrent to many physicists, including Einstein, however, he was wrong in his belief in a totally mechanistic world. A great deal of our world is quite concealed from us, and our lab work on it, and our mathematics, reveal that in the very small subatomic world, things behave according to laws and a logic very different from the laws and logic of the very large world of people, and, planets, and galaxies. This is difficult for many of us to accept, but assumptions were made about the operations of the universe, and some of these assumptions are being shown wrong. In a similar way we believed for a very long time, we assumed, that the earth was the center of our solar system. We now have to alter our thinking relative to another fundamental matter.

An even more crucial area of concern relative to the issue of superluminals, a much more fundamental area of physics that was illuminated by experiments developed for testing for the possibly of superluminals, is the ongoing debate over whether the universe is a totally mechanistic one (classical/Newtonian/local) or is it in some sense non-mechanistic (nonlocal). John Stewart Bell, an Irish physicist, worked out

experiments to test the classical assumption that nature works in a strictly "local," mechanistic way. The results of these experiments revealed that the classical assumption was wrong – nature is in some sense nonlocal (nonmechanistic), and, hence, the possibility of effects occurring between subatomic particles at a speed greater than light, is quite real. David Bohm, another physicist who spent much of his life studying this surprising side of nature, remarked near the end of his life, "Quantum strangeness is a keyhole through which we have caught a first glimpse of another side of nature, one in which the universe is neither deployed across vast reaches of space and time nor harbors many "things". Rather it is one, interwoven thing, which incorporates space and time but in some sense subordinates them (e.g. superluminals) perhaps by treating them as important but non-fundamental aspects of the interface between the universe and the observer who investigates it."

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