The Phenomenon of Quantum Nonlocality

Because the spin of a particle does not exist until a measurement is made, the act of making the measurement and determining the axis of spin of particle 1, will also determine the spin of particle 2, no matter how far apart it is from particle 1. Particle 2 will instantly respond to the state of particle 1, even if it is on the other side of the universe.

At the instant we perform our measurement on particle 1, particle 2, which may be thousands of miles away, will acquire a definite spin -- "up" or "down" if we have chosen a vertical axis, "left" or "right" if we have chosen a horizontal axis. How does particle 2 know which axis we have chosen? There is no time for it to receive that information by any conventional signal. (Capra, 1982, p. 85).

Quantum nonlocality, as suggested by Bell's theorem, is a fact of nature that has now been experimentally verified on many occasions. Alain Aspect's experiments in 1982 at the University of Paris-South proved the existence of quantum nonlocality. These experiments have been refined and repeated many times since.

The Implications of Quantum Nonlocality

At the quantum level, instantaneous actions occur at a distance. Two particles that are part of a single system continue to act in concert with one another no matter how far apart they appear to be separated by spacetime. Nonlocality or nonseparability is asking us to revise completely our ideas about objects, to remove a pervasive projection we have upon nature. We can no longer consider objects as independently existing entities that can be localized in well-defined regions of spacetime. They are interconnected in ways not even conceivable using ideas from classical physics, which is largely a refinement and extrapolation from our normal macroscopic sense of functioning. (Mansfield, 1995, p.122).

Nature has shown us that our concept of reality, consisting of units that can be considered as separate from each other, is fundamentally wrong. For this reason, Bell's theorem may be the most profound discovery of science. (Kafatos and Kafatou, 1991, 64-65).

Quantum nonlocality proves that "particles that were once together in an interaction remain in some sense parts of a single system which responds together to further interactions" (Gribbin, 1984). Since the entire universe originated in a flash of light known as the Big Bang, the existence of quantum nonlocality points toward a profound cosmological holism and suggests that: If everything that ever interacted in the Big Bang maintains its connection with everything it interacted with, then every particle in every star and galaxy that we can see "knows" about the existence of every other particle. (Gribbin, 1984).

Further Questions and Observations

•If every "particle" is in communication with every other "particle," could the phenomenon of quantum nonlocality help account in some way for the self-organizing, recurrent patterns of form that appear everywhere in the universe? Could such a theory contribute to our understanding of morphogenesis on a cosmological level?

•The Greek philosopher Plotinus believed that the metaphysical principle of Mind is nonlocal, and explained that, because it is not limited by time and space, it can be present everywhere. Similarly, Karl Pribram has demonstrated that memory is not localized in specific parts of the brain. Does quantum nonlocality support -- or help us understand -- noetic theories of the universe? Is the underlying structure of the universe essentially noetic in nature?

•What is the nature of the universal "laws of physics," which seem to be the same everywhere. Do the laws of physics presuppose some type of nonlocality? Does the very concept of "the universe" as one thing imply a form of cosmological holism and nonlocality?