The wacky world of

Quantum Mechanics

IF YOU STUDY SCIENCE LONG ENOUGH and seriously enough and dig deeply enough, if you don't come up feeling wacko about it, you haven't understood a thing, said Fred Alan Wolf in the movie, "What the Bleep."

The subatomic world does seem crazy. It defies all the natural laws as most people experience them. For starters, subatomic particles appear to travel backward in time. Also, a single particle can simultaneously be in two places at precisely the same moment. And, it seems clear that scientists influence the outcomes of experiments through the act of observing them.

How is all this possible? First, consider the vast amount of space within atoms. Take, for example, an ordinary apple. If it were inflated to the size of our planet, each atom in that Earth-sized apple would only be about as big as a cherry.

Now, take that cherry, representing an atom, and increase it to the dimensions of St. Peter's dome in Rome. The nucleus of that atom would be the size of a grain of salt, and the electron particles whizzing around it at 600 miles per second would be mere specks of dust. Clearly, atoms are made up primarily of "empty" space. Humans are composed of atoms and therefore made up almost entirely of empty space. If we were to pull out only the true density of all the nuclei in one person's body, we would have a lump the size of the head of a pin.

Then how do humans seem to be so solid? It's the combined result of the incredible speed at which subatomic particles travel, and the repulsive properties of electrons when they interact with each other, which give matter its seeming solidity. With all that empty space within our bodies, there is plenty of wiggle room for strange things to happen at the subatomic level.

And they do happen. As we go deeper, we find that the nucleus—the grain of salt in St. Peter's dome—of an atom is not solid either, but is made up of protons and neutrons moving at 40,000 miles per second. These protons and neutrons are composed of three quarks each.

But the quarks aren't solid, either. If a single atom—with its quarks—were enlarged to the size of our entire universe, we most likely would not find anything solid. Instead, many theorists hypothesize we would find vibrating energy strands the size of telephone poles. (Obviously, we aren't going to be seeing these strings anytime soon, so this idea remains a theory. However, the mathematics for the theory work elegantly.) These strings would be setting a sort of code for each quark, giving it a specific energy signature. According to theory, some strings would be open-ended, while others would be looped strands, like rubber bands.

There are five different theories about strings. Scientist Ed Witten, however, found a way to show that these seemingly contradictory theories could be seen as different aspects of a whole theory, much like the way a flower is part of a plant, just as a root and a leaf would be—different from each other, yet part of the whole. He called his idea *M-theory*. If M-theory is true, then all that exists is energy—energy that only appears to be solid.

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One radical hypothesis of M-theory is that we do not live in a world composed only of three dimensions of space and one dimension of time. Instead, for the mathematics of the idea to work, we need to accept that we live in a world of at least 11 dimensions. Scientists have postulated that the extra dimensions are so tiny and curled up, we don't notice them. An everyday example of a hidden dimension might be a basketball. While watching a basketball game from high up in the stands, the basketball appears to be flat, or two-dimensional (even though we know from experience that it is three-dimensional). But when we walk over and pick up a basketball, we see and feel that it is actually three-dimensional—it's curled around.

In the same way, a time dimension could be curled up. It might be possible, at a certain level of existence, to travel along a curled-up time dimension and arrive at a previous moment in time. This movement back in time appears to happen in some experiments with subatomic particles. Seems wacko, huh?

Other weird things happen with subatomic particles. They don't glide along their orbits in set patterns, like our planets move around the sun. Rather, they twang around the nucleus, like a tightly stretched rubber band that's been pulled and released. When trying to locate an electron, physicists can only predict where it will be or when it will appear. They cannot predict both at the same time. Electrons behave like the disappearing objects on a magician's table. The audience doesn't know when or where they will appear—people can only guess.

Yet scientists observing electrons are not just audiences. They are participants in the experiments. The results of studies with subatomic particles reflect the interactions of the observers, even if the observers didn't "do" anything except observe.

Take, for example, an electron. If a scientist sets up an experiment to see if the electron acts like a particle—not a tiny speck, but a location—then the experimental results will show that the electron is a particle. But if the same electron is run through an experiment to see if it is a wave of energy instead of a location, then the electron will appear to act as an energy wave pattern of influence. This means the physicists themselves are part of the experiment, and influence its outcome.

Electrons can twang from orbit to orbit, sort of smearing themselves along—seeming to be everywhere at once—and then blip into another position, without any time elapsing. It would be analogous to Earth suddenly popping in next to Jupiter, then next to Mercury, with no elapsing time between pops.

In an odd way, the universe itself appears to behave in a similar fashion. If two particles were together and then separated by great distances, scientists found that when one of the particles was affected, the other particle also would be immediately affected, with no elapsing time occurring.

To some scientists, everything in the universe appears to be connected in a vast quantum sea of energy. It seems all points in the universe are connected with all the other points in a vast and intricate web of energy that even permeates our own bodies and our thoughts.

Humans might feel separate and distinct from each other, just as subatomic particles can appear to be separate and distinct. Yet, just like particles can also behave like waves, humans have a wave aspect, an interconnectedness with all other aspects of the universe. Wacko? Maybe. But it resonates with what spiritual teachers have said for millennia.

About the author: Heidi Bright Parales, M.Div., is Director of Communications for St. Thomas Episcopal Church in Terrace Park, and is the author of Hidden Voices: Biblical Women and Our Christian Heritage *(Smyth & Helwys, 1998). Contact her at 513.774.9882.*

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