

Quantum Mechanics as a Science - Religion Bridge

By Stanley Klein

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Stanley Klein is professor of vision science, bioengineering and optometry at the University of California, Berkeley. His early research was in biology (co-authoring a paper with Richard Feynman) and particle physics (papers on S-matrix theory and topology of early string theory). He then switched research areas to study the visual system and physiological optics. Klein's vision research seeks to account for unusual perceptual effects and limits to vision in terms of underlying physiological mechanisms. Recently, he has been using evoked scalp brain waves and MRI in humans to learn about the role of different brain areas in constructing perceptions. His optics research is relevant to improving algorithms for laser refractive surgery and for fitting contact lenses. Klein's interest in quantum mechanics and brain research has led him to explore and write about how science can deal with consciousness and theology. His California auto license plate of more than 20 years, DUALITY, summarizes his theme that the duality of quantum mechanics provides an ideal framework for the science-religion duality. This framework provides a relativistic ontology that enables dialogue among the seemingly incompatible ontologies of different theistic and atheistic religions.

Our Future Vision conference assignment is to engage our scientific and spiritual imagination to chart a path for a better future. The world's environmental problems, unimaginable disparities between rich and poor, continuing conflicts based on differing worldviews, and continuing population growth make it clear that the world can use mending and transforming.

I am optimistic that increased dialogue between science and spirit can be a crucial step on the path to that better future. There is bridge-building dialogue among some scientists and theologians, but it is not broad enough. For science and religion to be a force in transforming society, the dialogue needs to be extended to mainstream scientists and people of faith.

Quantum mechanics (QM) is the formalism that physicists and chemists use to understand the workings of our universe. When applied to simple systems, it makes predictions that have been tested as being accurate to 12 decimal places, and there have been countless unsuccessful attempts to find spots where quantum predictions fail. The only problem with QM is that it violates intuition. I argue that QM and science/religion violate our intuitions in the same way.

Before setting theological issues of quantum ontology, I will briefly summarize the three steps associated with QM calculations:

- Step 1: Decide on which experiment to do (what question to ask of nature). This is known as the Heisenberg choice.
- Step 2: Calculate the sum of all possible Feynman diagrams from the initial state of the experiment to each possible outcome. There are numerous mathematical tricks for doing this calculation. This step violates classical materialism since the objects being studied become immaterial wave-like entities between observations. (For details, I recommend Feynman's thin, non-mathematical book QED.)
- Step 3: The outcome of the experiment is made real (converted from possible to actual) when an observation is made. The probability of observing a particular outcome is given by the square of the summed quantity calculated in step 2. This collapse from the multiplicity of possible outcomes to a single outcome is called the Dirac choice.

The implications of QM for the science-religion bridge are numerous.

While physicists agree that the above three steps are proper for calculating the outcome of experiments, there is less agreement on how to interpret what is behind the calculation. There are four categories of interpretations:

- The von Neumann/Stapp Collapse interpretation considers the collapse in Step 3 to literally occur.
- The Copenhagen interpretation considers the collapse metaphorical rather than literal.
- The Splitting Universe interpretation suggests that every time a measurement is made, each of the multiple outcomes produces a new universe, and the multiple universes all coexist.
- The Bohm interpretation suggests that there is an underlying, hidden reality that guides the evolution of the universe in a deterministic manner.

Many people view the ambiguity of multiple interpretations to be a negative aspect of the theory. They wait for a new metaphysics with a single interpretation to emerge. To me, the multiple, seemingly conflicting, interpretations are the beauty of the theory. The multiplicity of interpretations, all apparently correct in that they give identical predictions, preaches tolerance of divergent worldviews.

The most important feature of quantum metaphysics is that every interpretation of quantum mechanics is dualistic, with a duality between the observed and the observer. The quantum duality differs from previous dualities of Plato, Descartes and Kant in that it is mathematically formulated, self-consistent and tightly constrained.

Quantum dualism is central to the science-religion bridge I seek, which is much broader than the Spinoza-Einstein bridge. Einstein was clear that he did not believe in a personal god. Using the language of the Hebrew Scriptures, Einstein said he believed in Elohim (a god that can be identified with nature) but not YHVH (the God with whom one has a personal dialogue). A dualistic worldview with a blurring of the metaphor/literal distinction opens up a space for a personal god.

Quantum duality is a striking refutation of those objecting to a dualistic worldview. One must be careful, however, not to legitimize old-fashioned, discredited dualities with separate physical and mental/spiritual realms. Quantum duality is tightly constrained and, some argue, forbids some spiritual beliefs including paranormal phenomena such as intercessory prayer.

Quantum mechanics reverses the Galilean and Darwinian revolutions that removed us from being central to the operation of the universe. We the observers, in a sense, create the universe. Elevating each of us to an important position in the cosmos is relevant to New Age and classic theologies that give the individual a direct connection to God. QM may also provide a natural law explanation for the anthropic principle, whereby the laws governing our universe are especially suitable for the development of intelligent life. This is an anti-Copernican notion.

John Bell devised a class of experiments he thought would disprove QM. The experiments were done, and the quantum predictions were verified. Bell's theorem implies that there is an intrinsic non-locality in nature whereby the outcome of an experiment instantly influences what is true elsewhere in the universe.

Non-locality has spiritual relevance in reminding us that we are not separate from each other and

from nature. Our fundamental interconnectedness is a theme of many spiritual practices. Some people claim that interconnectedness allows paranormal phenomena to occur. However, careful calculations show that although entities are interconnected, paranormal influences among separated entities are not predicted. This outcome is wonderful for the science-religion bridge since it removes a potential obstacle for dialogue, while at the same time the interconnectedness adds strength to the bridge.

A successful science-religion dialogue is helped by the presence of a non-materialistic realm that is compatible with the scientific worldview. Quantum duality offers such a realm, because between observations all outcomes are ontological possibilities.

This freedom aids the spiritual dimension in several ways. It allows a true fundamental top-down free will to exist, not merely a weakened free will that is compatible with determinism. Henry Stapp (see Research News, February 2001) points out how the free choice of what question to ask (the Heisenberg choice) can affect the probability of the outcome.

This freedom is important in loosening the rigidity often associated with science. The collapse interpretations allow a non-deterministic framework (dear to theologians) to be compatible with reductionism (dear to scientists).

My rabbi says that half of our prayers can be summarized in the word, Wow! We need to be reminded about how amazing, awesome, surprising and mysterious the world is. I know of no more amazing and awesome and mysterious theory than QM.

A problem with many interpretations of QM is the question of where to put the dualistic split between the observer and observed. Are sentient animals the only possible observers? What are the possible effects of primitive animals, fetuses, robots or film on QM experiments?

The Copenhagen interpretation allows flexibility because von Neumann showed that the quantum split was moveable. Consider a double slit experiment where a single photon passes through two slits and makes a wave-like pattern on photographic film. Does the film become the observer producing the collapse, or is it the human viewing the film? Or is a second human viewing the first one the observer?

The moveability of the split that defines what is real introduces some relativism that causes displeasure among those who prefer a rigid worldview (ontology). Schrödinger used this example (with a cat replacing the film) as an argument pointing out the craziness of QM. I use it to demonstrate its flexibility.

The moveable split provides a method for connecting religions with seemingly incompatible worldviews. For example, Eastern and Native American religions where humans, animals and plants are all given reverent status would have the QM split placed low. Judeo-Christian religions, where humans are special, would have the QM split placed high.

The most important feature of the Copenhagen interpretation for the science-religion dialogue is that it blurs the line between a metaphorical and literal understanding of nature. Countless articles and books have been written on whether Bohr considered his Copenhagen interpretation to be an ontological theory of reality or an epistemological theory of our knowledge of the world.

Detractors claim it is not ontological because the shifting split would imply a shifting ontology, which is not a true understanding of reality. It is my belief that the fundamental nature of the

world is stranger than our old-fashioned ideas. Therefore, the strangeness associated with the Copenhagen ontology may be correct. There is a metaphorical quality to the Copenhagen interpretation. The saying, Quantum mechanics is the dreams that stuff is made of rings true for the Copenhagen interpretation.

I am discouraged by the rigidly literal belief in resurrection held by leading science-and-religion scholars. Theologians may fear that metaphorical interpretations cripple resurrection stories because metaphor is taken to be a weak substitute for the real thing. I suspect, however, that the status of metaphor will greatly escalate once it becomes clear that all of science is based on a theory in which the substance of the material world must be taken metaphorically. In other words, science may have a basis similar to that of the spiritual realm!

Some theologians and people of faith may have problems with the quantum constraints placed on God's power. However, history indicates this obstacle can be overcome.

Bridge-building theologians need to pull back from their faith in paranormal phenomena intercessory prayer, intelligent design and literal resurrection (and other miracles). Quantum duality offers a subtle solution, in that it allows absolutist statements of what is real for each observer, while allowing different observers to have a different set of equally valid beliefs. What applies to observers could be extended to theologies.

There are also obstacles for scientists to overcome. Most scientists think that science should be totally separate from religion. They fear scientific theories will be applied inappropriately as has happened with Darwinism.

Physicists, for instance, have seen many mangled versions of QM that have been used inappropriately. Alan Sokal's hoax is an excellent example how quantum language can be tuned into gibberish. (I recommend a quick Internet search of this topic to bring you up-to-date quickly.) Scientists also believe that their enterprise has a solid, not metaphorical, foundation.

The strange world of QM described above is not familiar to most scientists. Even though many have taken courses in QM, they have not dealt with its murky philosophical implications. Scientists have as hard a time as theologians in accepting the notion that their world has a shaky underpinning. Having both scientists and theologians on common, if not shaky, ground may be a good place to begin.