

NONDUAL QUANTUM DUALITY

1. Introduction

The first purpose of this talk is to explain how orthodox quantum mechanics is dualistic on the pragmatic, operational level but is essentially nondualistic on a deeper ontological level.

The second purpose is to reconcile a pertinent concept of human freedom with the principle of sufficient reason: the principle that nothing happens without a sufficient cause.

To lay the framework for addressing these issues I shall begin by reminding you of some contrasting ideas about the nature of reality advanced by three towering intellectual figures, Rene Descartes (1596-1650), Isaac Newton (1642-1727), and William James (1842-1910).

René Descartes is called the father of modern philosophy. He conceived nature to be divided into two parts: a mental part and a physical part. The mental part, called “res cogitans”, contains our thoughts, ideas, and feeling, whereas the physical part, called “res extensa”, will be defined here as being those aspects of nature that we can describe by assigning mathematical properties to space-time points. Descartes allowed the mental and physical aspects interact with each other, but only for those physical parts that are located inside human brains. Descartes’ view is the classic meaning of *duality*.

Isaac Newton, building upon the ideas of Descartes, Galileo, and Kepler, formulated laws of motion that accounted quite accurately for all of the directly observable planetary and terrestrial motions. Newton’s laws dealt exclusively with the physical aspects of nature: the mental parts were left completely out. Newton suggested that laws of this kind were universal, extending down to the atomic constituents out of which all physically describable systems were supposed to be composed. Such a universality would allow the mental realities to *know* about the physical aspects of nature, but be unable to affect those physical aspects in any way. Descartes’ duality was thereby replaced, insofar as the causally closed physical universe was concerned, to a physics-based *nonduality*; to *physical monism or physicalism*.

All of us doubt, intuitively, this physicalist claim that the our thoughts cannot affect our actions: we build our active lives and institutions around the apparently incessantly reconfirmed belief that one’s mental effort can influence one’s own physical actions.

William James, writing in 1892, also doubted this claimed impotence of our minds, but for reasons far more profound than mere felt intuitions. At the end of his book *Psychology: the Briefer Course* he reminded his readers that “the natural science assumptions with which we started are provisional and revisable things”. Eight years later a new constant of nature was discovered by Max Planck. That discovery led, in less than three decades, to the downfall of the precepts of Newtonian-based classical physics.

In the newer physics, called quantum mechanics, the mental aspects of nature that had been left out of classical dynamics re-emerge as the central focus of all of science:

Bohr: *“In our description of nature the purpose is not to disclose the real essence of phenomena but only to track down as far as possible relations between the multifold aspects of our experience”*. (*Atomic Theory and the Description of Nature: p.18*)

Bohr: *“The sole aim [of quantum mechanics] is the comprehension of observations... (Atomic Physics and Human Knowledge: p.90)*

Bohr: *The task of science is both to extend the range of our experience and reduce it to order. (Atomic Theory and the Description of Nature: p.1)*

Heisenberg: *“The conception of the objective reality of the elementary particles has evaporated not into the cloud of some new reality concept, but into the transparent clarity of a mathematics that represents no longer the behaviour of the particles but our knowledge of this behavior.”* (Daedalus, 1958: p. 95.)

The logician and mathematician John von Neumann rigorized quantum mechanics in a way that allowed it to be interpreted as a *dualistic* theory of reality in which mental realities interacted in specified ways with physically described human brains. This quantum ontology was in essential accord with the dualistic ideas of Descartes.

An objection often raised against Cartesian dualism is couched as the query: How can ontologically distinct aspects of nature ever interact? Must not nature consist ultimately of one fundamental kind of stuff in order for its varied components to be able to cohere.

This leads to a central question: What is the ontological nature of the physical aspect of quantum mechanics?

2. The ontological character of the physical aspect von Neumann’s quantum mechanics.

The physical aspect of the quantum conception of nature is the quantum state. This state is *physical*, in the defined sense that we can describe it by assigning mathematical properties to space-time points. But this physical aspect is *not a material substance*, in the sense in which the physical world of Newtonian or classical physics is a material substance. It does not always evolve in a continuous manner, but is subject to abrupt “quantum jumps”, sometimes called “collapses of the wave function”.

In accordance with the ontological ideas of Heisenberg, the quantum state has the ontological character not of “an actuality”, but rather of “a potentiality”: of an “objective tendency” for an “actual event to happen”. The actual event in the von Neumann

ontology is “The discontinuous change in the probability function [that] takes place with the act of registration...in the mind of the observer”.

The first main point of my talk is that the physical aspect of quantum mechanics, which is represented by the quantum state, has the ontological character of a *potentia*, of an *objective tendency* for an actual event to happen, and as such it is more mindlike than matter-like in character. This physical aspect of nature involves not only stored information about the past, but also tendencies pertaining to events that have not yet happened. They involve projections into the future. They involve elements that resemble imagined ideas of what might come to pass. The physical aspects are, in these ways, more like mental things than material things.

Also, a quantum state specifies *probabilities*. Probabilities are not matterlike. They are mathematical connections that exist outside the actual realities to which they pertain. They involve mindlike computations and evaluations: weights assigned by a mental or mindlike process.

Von Neumann (orthodox) quantum mechanics is thus dualistic in the pragmatic and operational sense that it involves aspects of nature that are described in physical terms and also aspects of nature that are described in psychological terms, and these two parts interact in human brains in accordance with laws specified by the theory. This is all in close accord with classic Cartesian dualism. On the other hand, and in contrast to the application to classical mechanics, in which the physically described aspect is ontologically matterlike, not mindlike, in quantum mechanics the physically described part is mindlike! So both parts of the quantum Cartesian duality are fundamentally mindlike. Thus quantum mechanics conforms at the *pragmatic/operational* level to the precepts of Cartesian duality, but reduces at a deep *ontological* level to a fundamentally mindlike nondual monism.

3. Natural Process, Sufficient Reason, and Human Freedom.

There are two ways to cope with the demands of the theory of relativity.

The first is the classical-physics-based Einsteinian idea of a *Block Universe*: the entire future is laid out beforehand, and our experiences take place in this **preordained** structure.

The second is the quantum-physics-based *Unfolding Universe* in which facts and truths become fixed and definite in the orderly way allowed by relativistic quantum field theory, with our experiences occurring in step with the coming into being of definite facts and truths.

I subscribe to the latter idea --- to the idea of an *unfolding reality*, marked by *actual events*, and in which each experienced increment of knowledge is associated with an actual event!

I also subscribe to the idea that this unfolding conforms to the principle of sufficient reason, which asserts that no fact or truth can simply “pop out of the blue”, with no sufficient reason to be what it turns out to be.

But I do not believe that this entails that all the facts and truths existing at one moment entail certainty about what is yet to unfold, or its corollary that human freedom is an illusion.

Laplace’s classical argument for the “certainty of the future” states (in condensed form):

“For a sufficiently powerful computing intellect that at a certain moment knew all the laws and all the positions, nothing would be uncertain, and the future, just like the past, would be present before its eyes”

This view argues for “certainty about the future” on the basis of information existing at a certain moment. It posits:

1. A computing intellect existing outside/beyond nature itself, able to “go” in thought where quantum (mind-based) nature has not yet gone.
2. Invariant causal laws.

However, nothing exists outside the whole of nature itself! Thus nature itself must make its own laws/habits. Even if there are *sufficient reasons* for every change in the laws, it is not evident that any intellect standing outside the evolving reality itself could compute what has not yet occurred. For the evolution of reason-based reasons may be intrinsically less computable than the evolution of physically described properties evolving via fixed physically describable mathematical laws.

The laws of *classical mechanics* are cast in a very special kind of mathematical form that allows a “mathematical computation” performed at an early time to *predict with certainty* the state that the universe will be in at a later. This is very special property. It is far from obvious that the (definitely nonclassical) real world will exhibit this wonderful ‘computability’ feature.

That a *reason-based* unfolding of the actual world is *computable* is an extrapolation from the classical-physics approximation that is far too dubious to provide the basis of a sound argument that, in a mind-based quantum universe evolving in accordance with the principles of both quantum mechanics and sufficient reason, the outcomes of human choices are *certain* prior to their actual occurrence. It is far from being proved that in that kind of universe my pressing now of the key, X, was certain already at the birth of the universe.