

## QUAESTIO DISPUTATA

QUANTUM ANTHROPOLOGY:  
REIMAGING THE HUMAN PERSON AS BODY/SPIRIT

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*Quantum anthropology looks to the image of particle/wave complementarity within the field of quantum mechanics as an analogy for body/spirit in Christian anthropology. Drawing on Karl Rahner's concept of human spirit and on quantum mechanics' concept of wave as probability, the author recasts the body/spirit relationship in terms of the self-actualization of infinite human potential, but a potential that is shaped by probability due to one's context, relationships, and history. Integral to this discussion are the concepts of freedom, choice, death, and resurrection.*

IN A POST-CARTESIAN, SCIENTIFIC WORLD, the perceived relationship between spirit and body in the human person is problematic. The question about the spirit in the dialogue between science, philosophy, and religion becomes this: To what extent the spirit is reducible to the body? A strict reductive physicalism or determinism reduces all functions traditionally attributed to the spirit to the biological processes of the body. Such an approach, in which the whole is no more than the sum of the parts, does not leave room for any dialogue between science and religion.<sup>1</sup> Wolfgang Vondey laments the fact that contemporary theology

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<sup>1</sup> While my focus here is on how developments in science can expand our theological concepts, I also recognize that theologians need to help scientists understand developments in theology. Scientists need to know that theology has

has not taken into account the paradigm shift from Newtonian physics to Einstein's theory of relativity, as Enlightenment theology did for the Copernican Revolution.<sup>2</sup> I would argue the same is true for the shift to a quantum worldview where matter is energy, and energy is field, and all things are both/neither particle/wave. How we talk about what it means to be human, what it means to be embodied spirit or enspirited body, must fundamentally shift in light of the quantum revolution in physics.

Today theologians must ask whether there is a way to move the body/spirit conversation beyond the impasses of reductionism and dualism. Is there a new analogy for defining what we mean when we talk about human spirit and when we talk about the relationship between spirit and matter in the human person? What does it mean to be embodied spirit?

Quantum physics offers a new paradigm of reality that can help us move beyond the impasse of reductionism versus dualism. Quantum theory has scientifically challenged the dominant model of either/or thinking found in much of Western science, philosophy, and theology. Neither the relationship of body/spirit nor the relationship of particle/wave can be directly observed. Scientists have developed conceptual models for the relationship of particle/wave that can be used analogously to gain new insights into the relationship of body/spirit, both of which encompass two aspects of one reality. Ian Barbour notes that "conceptual models and analogies are used to imagine what cannot be directly observed (God or a subatomic particle, let us say)" in both science and religion. One form of dialogue, he suggests, is to use an analogy from science as an analogy for a theological concept.<sup>3</sup> At the same time, one must heed John Polkinghorne's warning that "quantum theory is certainly strange and surprising, but it is not so odd that according to it 'anything goes.'"<sup>4</sup> He adds that wave/particle duality "does not afford us a license to indulge in embracing any pair of contradictory notions that take our fancy."<sup>5</sup> Nonetheless, there is a synchronicity

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moved beyond a substance dualism and a reified concept of spirit, as well as beyond a too-anthropomorphic image of God to a theology that sees God as mystery. This development should inform any theology-science dialogue. See Heidi A. Russell, "Sanctity and Science: The Mysticism of Theologically Engaging Science," *Theology and Science* 10 (2010) 249–58.

<sup>2</sup> Wolfgang Vondey, "The Holy Spirit and the Physical Universe: The Impact of Scientific Paradigm Shifts on Contemporary Pneumatology," *Theological Studies* 70 (2009) 3–36, at 3–4.

<sup>3</sup> Ian Barbour, *When Science Meets Religion: Enemies, Strangers, or Partners?* (New York: Harper Collins, 2000) 2–3.

<sup>4</sup> John Polkinghorne, *Quantum Theory: A Very Short Introduction* (New York: Oxford University, 2002) 92.

<sup>5</sup> *Ibid.*

between the analogies put forth to explain the phenomenon of particle/wave and new ways of thinking about what is meant by body/spirit.

When employing such a theological analogy, it is important to point out that all analogies are limited and eventually break down. Joseph Bracken writes:

First of all, given contemporary postmodern sensibilities, most of us are aware of the conceptual dangers in claiming that a single theoretical scheme provides all the answers for any given problem-situation. Metaphysical systems are models or symbolic representations of reality that are never fully adequate to their task. As Ian Barbour shrewdly commented several years ago, models in theology as well as in the natural sciences should be taken seriously but not literally; something is always missing in the description of reality.<sup>6</sup>

These cautions hold even truer when one uses an analogy from science as an analogy in theology, in the sense of using an analogy for an analogy. In other words, “particle” and “wave” are analogies for mathematical formulas in science. Furthermore, as will be seen in my scientific explanation below, the formulas do not describe the behavior of a single particle/wave in isolation, but describe the way the system operates as a whole; the parts cannot be separated from the whole. William Stoeger argues that particle and wave, as manifestations of different types of measurement, “are not simultaneously real, according to the standard interpretation, and are not properties that the underlying quantum reality possesses independently of the measurements.”<sup>7</sup> These images are inexact ways of trying to put into language what science can accurately portray only in terms of mathematical formulas. Barbara Brown Taylor quotes Niels Bohr as saying, “we must be clear [that], when it comes to atoms, language can be used only as in poetry.”<sup>8</sup> Paul Davies puts it this way: “By employing mathematics as a language, science can describe situations which are completely beyond the power of human beings to describe.”<sup>9</sup> Both science and theology use language and images to represent realities that are beyond words. Thus, when employing these scientific analogies as theological analogies, one

<sup>6</sup> Joseph A. Bracken, S.J., “The Body of Christ: An Intersubjective Interpretation,” *Horizons* 31 (2004) 7–21, at 7–8, citing Ian Barbour, *Religion and Science: Historical and Contemporary Issues* (San Francisco: HarperCollins, 1997) 119.

<sup>7</sup> William R. Stoeger, “Epistemological and Ontological Issues Arising from Quantum Theory,” in *Quantum Mechanics, Scientific Perspectives on Divine Action* 5, ed. Robert John Russell et al. (Berkeley CA: Center for Theology and the Natural Science, 2001) 81–98, at 89.

<sup>8</sup> Barbara Brown Taylor, *The Luminous Web: Essays on Science and Religion* (Cambridge, MA: Cowley, 2000) 34, citing George Johnson, *Fire in the Mind* (New York: Knopf, 1995) 146.

<sup>9</sup> P. C. W. Davies, *God and the New Physics* (New York: Simon & Schuster, 1983) 18.

operates in the realm of image and poetry, which allows for certain facets of the mystery to be glimpsed but will never provide an exact correspondence to reality.

In what follows, I introduce the concept of wave/particle complementarity in quantum physics and attempt to depict in some depth the scientific concepts involved. Working through the science and drawing on Karl Rahner's understanding of the relationship between spirit and matter enables us to apply these concepts and their interpretations in an analogous manner to body/spirit in the human person. In short, just as the wave function in the Copenhagen interpretation of quantum physics is a wave of probability of places in which the electron might be found, our spirit function is all of our potentiality, limited as probability by our historicity and interrelatedness. Likewise, as particle is understood as location in a specific position, and thus the actualization of one of the possible positions given by the wave function, our embodiment is the actualization of our potentiality in space and time.

Having laid out my basic theological analogy, I will return to the world of physics to further explore the implications of particle/wave complementarity for our understanding of what we mean by reality, specifically that reality always includes more than can be seen. Some physicists would argue that reality in quantum mechanics is not simply the material world but also includes the nonmaterial. This expanded notion of reality as having material and nonmaterial aspects resonates with a notion of the human person as embodied spirit. Appealing to the work of Lothar Schäfer, I then explore this analogy in a way that understands spirit as the realm of potentiality and body as the realm of actualization, emphasizing that potential or virtual states are just as much a part of reality as occupied states in quantum physics; thus analogously all our potential, including what is unfulfilled, remains part of the reality of who we are as persons. Furthermore the concept of freedom can be understood as self-actualization within God's infinite realm of potentiality. Finally I address the theological concept of the resurrection of the body analogously as the definitive and irrevocable collapse of the wave function, the point of total actualization, once again drawing on Rahner's thought. His understanding of death and the resurrection of the body as the definitive and eternal significance of one's history, interrelatedness, freedom, and self-actualization in space-time can be illustrated as the definitive and eternal collapse of the wave function, in which spirit (analogously as wave) is not eliminated but rather concretized and validated in union with God.

### **PARTICLE/WAVE COMPLEMENTARITY**

In order to use the image of particle/wave complementarity as an analogy, it is necessary to spend some time explicating the science that

has led to this paradigm shift in the understanding of particle physics. Once I have explained the scientific image, I will use it to describe spirit as our wave of potentiality and probability and body as our actualization of that potential. In the classical tradition, atoms have been described as miniature solar systems involving a solid nucleus of protons and neutrons orbited by a certain number of electrons.<sup>10</sup> In this classical understanding of the atomic world, everything was composed of tiny particles, and elements of the world were understood by breaking them down into their tiniest parts or particles and understanding how those particles interacted and related to one another.

Quantum physics, however, has engendered a huge paradigm shift in how reality is conceived. Everything that was known and understood about the so-called material world gets turned on its head, starting with the fact that what most people think of as matter—often imaged as particles or minute balls—is actually the manifestation of energy, what physicists call quanta or little packets of energy manifesting themselves out of an infinite field.<sup>11</sup> Polkinghorne concludes: “Today all theories of elementary particles (such as the quark theory of matter) are quantum field theories. Particles are thought of as energetic excitations of the underlying field.”<sup>12</sup> The road

<sup>10</sup> The solar system model was developed by Ernest Rutherford in 1911 (see Polkinghorne, *Quantum Theory* 10–11).

<sup>11</sup> Ibid. 73–75.

<sup>12</sup> Ibid. 75. According to Polkinghorne, “a field is an entity spread out in space and time” that has “an infinite number of degrees of freedom,” whereas a particle “has only a finite number of degrees of freedom” (ibid. 73). An example of a field that we experience in everyday life is an electromagnetic field. Brian Greene explains: “A magnetic field provides a magnet what an army provides a dictator and what auditors provide the IRS: influence beyond their physical boundaries, which allows force to be exerted out into a field” (*The Fabric of the Cosmos: Space, Time, and the Texture of Reality* [New York: Knopf, 2004] 40). He goes on to explain that there are force fields (electromagnetic, gravitational, strong nuclear, weak nuclear) and matter fields (electron, up-quark) in which particles are excitations of their respective fields (256, 518 n. 4). Quantum field theory (QFT) has led to many important developments in physics and, in combination with string theory, holds out hope for a grand unified theory that is able to unite the electromagnetic, strong nuclear, weak nuclear, and gravitational forces. QFT teaches us that there is no such thing as empty space, that even what we have called a vacuum is teeming with activity, albeit motion “in its lowest energy state” (Polkinghorne, *Quantum Theory* 74). QFT enables quantum mechanics to deal with systems with many particles. For an excellent description of QFT and its relation to both quantum mechanics and the theory of special relativity, as well as some of its philosophical implications for ontology, see Meinard Kuhlmann, “Quantum Field Theory,” *The Stanford Encyclopedia of Philosophy* (Winter 2012 Edition), ed. Edward N. Zalta, <http://plato.stanford.edu/archives/win2012/entries/quantum-field-theory/>. All URLs cited herein were accessed on August 20, 2013.

that brought scientists to this realization actually began with the debate about whether light is particle or wave, and their realization that light exhibits both wave-like and particle-like qualities. As Richard Feynman et al. observe, “Things on a very small scale behave like nothing that you have any direct experience about. They do not behave like waves, they do not behave like particles, they do not behave like clouds, or billiard balls, or weights on springs, or like anything that you have ever seen.”<sup>13</sup> The realization that light, which had been primarily understood to be waves, actually exhibited properties of what are called photons, little quanta or packets or lumps of energy, led other physicists to ask whether light can behave like particles; whether it is possible that particles can behave like waves. This question led to the famous double slit experiment with electrons.<sup>14</sup>

Imagine shooting a pellet gun at a wall, but placing a barrier between the gun and the wall with a slit in it. Clearly some pellets will go through the slit; others will be blocked by the barrier. The result on the wall behind the barrier is a band of hits roughly equivalent to the slit, heaviest in the exact center and tapering off on either side. Now imagine that we put two slits in the barrier. Again, not surprisingly, we end up with two bands on the wall, roughly corresponding to the place of the two slits, heaviest in the center and tapering off on either side.<sup>15</sup>

Now imagine that we repeat this experiment with water waves. Send a wave of water through one slit, and it will hit the wall with the most intensity at the point corresponding to the slit in the barrier, and taper off on either side. However, if we put two slits in the barrier, the wave going through both slits will form two new wave patterns that will interfere with each other. Brian Greene explains:

When a peak [the highest part of the wave] of one wave and a peak of the other cross, the height of the water is even greater, being the sum of the two peak heights. Similarly, when a trough [the lowest part of the wave] of one wave and a trough of the other cross, the depression in the water is even deeper, being the sum of the two depressions. And here is the most important combination: when a peak of one wave crosses the trough of another, they tend to cancel each other out, as the peak makes the water go up while the trough tries to drag it down. If the height of one wave's

<sup>13</sup> Richard Feynman, Robert Leighton, and Matthew Sands, *The Feynman Lectures on Physics*, 3 vols. (hereafter Feynman) (Reading, MA: Addison-Wesley, 1965) 3:1.1.

<sup>14</sup> For accounts of these experiments as well as pictures of the images and patterns described below and the mathematical equations involved, see *ibid.* 3:1.1–1.11; John Gribbin, *In Search of Schrödinger's Cat: Quantum Physics and Reality* (New York: Bantam, 1984) 163–76; Polkinghorne, *Quantum Theory* 22–38.

<sup>15</sup> Feynman clarifies: “The probabilities just add together. The effect with both holes open is the sum of the effects with each hole open alone. We shall call this result an observation of ‘no interference’” (3:1.3).

peak equals the depth of the other's trough, there will be perfect cancellation when they cross so that the water at that location will not move at all.<sup>16</sup>

When done with light waves, the pattern on the detector wall shows bands of light where the peaks coincide and where the troughs coincide, alternating with bands of darkness where they cancel each other out, resulting in a striped pattern on the wall.

This experiment was done by shooting electrons against a detection wall with a barrier in between. The expectation was that electrons, as particles, would behave as the pellets would; but when the experiment was performed, the pattern on the detection screen was one of interference (alternating bands of hits and nonhits), like waves. Scientists thought that perhaps the electrons were bouncing off one another to create the interference pattern, but when they shot the electrons out of the gun one at a time, they still found that over time, when enough electrons had been shot, they produced an interference pattern.<sup>17</sup> To figure out what was really happening, the scientists modified the experiment by putting a measuring device at the barrier so that they would be able to tell exactly which slit each electron passed through; however, when they did the experiment in this manner, the interference pattern disappeared, and the result over time was two bands of hits, roughly corresponding to the two slits in the barrier, exactly as if the electrons were indeed tiny pellets or particles.<sup>18</sup>

<sup>16</sup> Brian Greene, *The Fabric of the Cosmos* 85. Feynman describes this phenomenon as the waves interfering constructively and destructively (Feynman 3:1.3–1.4). In mathematical terms, the difference is that with the pellets, the end result is simply the sum of the two intensities of pellets being shot through each slit. For waves, the equation is different to account for the interference, and mathematically is the square of the sum of the two intensities found when done with the single slit (Feynman 3:1.3).

<sup>17</sup> See Brian Cox and Jeff Forshaw, *The Quantum Universe (And Why Anything That Can Happen, Does)* (Boston: Da Capo: 2011). The authors mention that the electron “doesn’t seem to behave *exactly* like a regular wave either because the pattern is not built up as a result of some smooth deposition of energy; rather it is built out of many tiny dots. We always detect Thomson senior’s [J.J. Thomson’s] single, point-like electrons” (24). In other words, the experiment cannot be done with a single electron. The pattern occurs with the accumulation of many electrons. Each single electron is still a single point on the detection screen, but the pattern over time with the accumulation of many electrons becomes one of interference (alternating bands across the entire screen) like waves, rather than the pattern of pellets (two bands directly behind the slits).

<sup>18</sup> For a more detailed account of this experiment, including a description of the use of light to detect which slit the electron passed through, see Feynman 3:1.6–1.9. Feynman concludes: “If one looks at the holes or, more accurately, if one has a piece of apparatus which is capable of determining whether the electrons go through hole 1 or hole 2, then one *can* say that it goes either through hole 1 or hole 2. *But*, when one does *not* try to tell which way the electron goes, when there is nothing in the experiment to disturb the electrons, then one may *not* say that an electron goes either through hole 1 or hole 2. If

Gribbin comments on how uncanny the results of this experiment are:

When we try to look at the spread-out electron wave, it collapses into a definite particle, but when we are not looking it keeps its options open. In terms of Born's probabilities, the electron is being forced by our measurement to choose one course of action out of an array of possibilities. There is a certain probability that it could go through one hole, and an equivalent probability that it may go through the other; probability interference produces the diffraction pattern at our detector. When we detect the electron, though, it can only be in one place, and that changes the probability pattern for its future behavior—for that electron, it is now certain which hole it went through. But unless someone looks, nature herself does not know which hole the electron is going through.<sup>19</sup>

Physicists understand the wave aspect or wave function of electrons to be a wave of probability that the electron will be found in a particular place. In theory, the electron could be found anywhere, including on the other side of the universe, but there is a higher probability that the electron will be found in certain places, and in the world of statistics, the most extreme possibilities tend to cancel one another out, while the most likely possibilities reinforce one another. Nonetheless, it is still impossible to know exactly where the electron will end up without looking, and once measured, the wave function has collapsed so that the electron is now only in one possible place.<sup>20</sup>

Niels Bohr called this particle/wave aspect of reality complementarity. If we find the notion of particle/wave complementarity difficult to grasp, we are in good company. Feynman famously quipped, "I think I can safely say that no one understands quantum mechanics."<sup>21</sup> Gribbin explains that in Bohr's theory

particle physics and wave physics, are equally valid, complementary descriptions of the same reality. Neither description is complete in itself, but there are circumstances when it is more appropriate to use the particle concept and circumstances

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one does say that, and starts to make any deductions from the statement, he will make errors in the analysis. This is the logical tightrope on which we must walk if we wish to describe nature successfully" (1.9).

<sup>19</sup> Gribbin, *Schrödinger's Cat* 171.

<sup>20</sup> See Feynman 3:2.2–2.4; and Polkinghorne, *Quantum Theory* 25–26, 36–38, 44–46. Cox and Foreshaw express this dilemma as follows: "The crucial point is that it makes no sense to say that 'the electron could have ventured along each of these routes, but really it went along only one of them.' To say that the electron really ventured along one particular path would be to give ourselves no more of a chance of explaining the interference pattern than if we had blocked up one of the slits in the water wave experiment. We need to allow the wave to go through both slits in order to get an interference pattern, and this means that we must allow all the possible paths for the electron to travel from source to screen. . . . We need to describe a spread-out wave that is also a point-like electron, and one possible way to achieve this is to say that the electron sweeps from source to screen following all possible paths at once. . . . This is what it means to be a quantum particle" (31–32). On the concept of probability see p. 44.

<sup>21</sup> Cited in Polkinghorne, *Quantum Theory*, on the dedication page.



where it is better to use the wave concept. A fundamental entity such as an electron is neither a particle nor a wave, but under some circumstances it behaves as if it were a wave, and under other circumstances it behaves as if it were a particle. . . . But under no circumstances can you invent an experiment that will show the electron behaving in both fashions at once. The idea of wave and particle being two complementary facets of the electron's complex personality is called complementarity.<sup>22</sup>

The idea that one can know either the position or the momentum of an object on a quantum level, but not both, is called Heisenberg's Uncertainty Principle.<sup>23</sup> If one measures the position, one is looking for a particle-like property; if one measures the momentum, one is looking for a wave-like property. Quantum physics has traditionally held that both position and momentum cannot be known at the same time, though even this concept is today being challenged in certain experiments.<sup>24</sup> Physicists observe that this complementary nature of reality is applicable not only to light or electrons but also to everything that exists.<sup>25</sup>

<sup>22</sup> Gribbin, *Schrödinger's Cat* 118.

<sup>23</sup> "It is impossible to design an apparatus to determine which hole the electron passes through, that will not at the same time disturb the electrons enough to destroy the interference pattern" (Feynman 3:1.9). C. N. Villars explains that the properties being measured are not properties of the microphysical object itself, but rather properties of the microphysical object interacting with the instrument of measurement. See C. N. Villars, "Observables, States and Measurements in Quantum Physics," *European Journal of Physics* 5 (1984) 177–83, at 180. In terms of the impossibility of knowing both position and momentum, he points out that, "position-defining and momentum-defining interactions are mutually exclusive because they require mutually exclusive apparatuses" (178). Polkinghorne states: "One can know where an electron is, but not what it is doing; or one can know what it is doing, but not where it is," and he concludes: "Observables come in pairs that epistemologically exclude each other" (*Quantum Theory* 33). For an explanation of the mathematics, see *ibid.* 106–7.

<sup>24</sup> John Gribbin, *Schrödinger's Kittens and the Search for Reality: Solving the Quantum Mysteries* (Boston: Little, Brown, 1995) 18. For a more recent example, see Lee A. Rozema et al., "Violation of Heisenberg's Measurement-Disturbance Relationship by Weak Measurements," *Physical Review Letters* 109.10 (2012) 100404–8. The importance of these new experiments is the question of whether the position and momentum of a microphysical object are by nature unknowable (epistemologically exclusive in Polkinghorne's terms) or whether science has simply not yet advanced enough to discover the way of knowing both position and momentum. For this reason, it is important to apply these concepts as analogies and not literally, lest we run the risk of developing a "God of the gaps" theology.

<sup>25</sup> In terms of the way we experience the world of everyday objects, the wave aspect of matter is negligible if the object is larger than Planck's constant, which is  $6.63 \times 10^{-34}$  joule-seconds (Feynman 3:1.11; Polkinghorne, *Quantum Theory* 48–50, 100), so we do not experience or "see" these quantum realities in our day-to-day lives.

Wave functions in quantum physics are not just the potentiality for finding the particle or manifestation at a certain point in time and space; wave function is probability. Probability also has to do with this concept of interdependence and interconnectedness. Quantum physics is teaching us that everything that exists is interconnected and affects everything else that exists. Reality by its very nature is interconnectedness. The famous experiment that demonstrates this interconnectedness or entanglement, as it is called in quantum physics, is EPR.<sup>26</sup> In its very simplest terms, this experiment sent two entangled electrons (that is, electrons that have interacted with each other) miles away from each other, and when one electron was observed, the measurement of the second electron miles away was instantaneously correlated to the observation of the first electron. Theoretically the same would hold true even if the electron were on the opposite side of the universe. Observing and measuring one electron allows us to instantaneously know the position and spin of the entangled electron regardless of the distance between them. While both results are random and are not determined until they are measured, they are nonetheless correlated, not because one has an effect on the other, but because they are inseparable parts of a whole.<sup>27</sup> Gribbin clarifies:

Once quantum entities are entangled in an interaction then they really do behave, ever afterwards, as if they are parts of a single system under the influence of Einstein's "spooky action at a distance." The whole is greater than the sum of its parts, and the parts of the whole are interconnected by feedbacks—feedbacks that seem to operate instantaneously.<sup>28</sup>

The earliest and most widely accepted school of interpretation of quantum mechanics is known as the Copenhagen interpretation, which focuses on the role of the observer or on the act of measurement. As Gribbin

<sup>26</sup> EPR is named after Einstein, Podolsky, and Rosen, the scientists who developed the thought experiment. Ironically, these scientists developed the experiment to disprove the very point that ended up being proven, the possibility of what Einstein called "spooky action at a distance." Years later experiments were carried out that confirmed the existence of this "spooky action at a distance" in the proof of Bell's theorem or nonlocality. Note again that physicists do not agree on the interpretation of these experiments. The major schools are the Copenhagen interpretation following Niels Bohr, the hidden variables interpretation following David Bohm, and the many-world interpretation following Hugh Everett.

<sup>27</sup> For a more detailed explanation, see Robert John Russell, "Quantum Physics in Philosophical and Theological Perspective," in *Physics, Philosophy, and Theology: A Common Quest for Understanding* (Vatican City: Vatican Observatory, 1988) 343–74.

<sup>28</sup> Gribbin, *Schrödinger's Kittens* 223.

concludes, "It is the act of observing the wave that made it 'collapse' to become a particle."<sup>29</sup> He goes on to explain that the wave is not a material wave at all, but rather a wave of probability.<sup>30</sup> In other words the wave function describes the probability of finding the so-called particle at a particular place. To use Gribbin's own words:

An electron that is not being observed literally does not exist in the form of a particle at all. There is a certain probability that you might find the electron here, and another probability that you might find it there, but in principle, it could turn up literally anywhere in the Universe. Some locations are very probable . . . and some are extremely unlikely. . . . Once the electron is observed, however, the odds change. The wave function collapses, . . . and at that moment it is 100 percent certain where the electron is. But once you stop looking, the probability starts leaking out from that location. The probability of finding the electron in the same place that you last looked decreases, and the probability of finding it somewhere else increases as the probability wave spreads out through the universe.<sup>31</sup>

Even within the Copenhagen school, there are different understandings about what qualifies as an observer. Is the observer simply the apparatus of measurement, or must the observer be conscious? Some will argue that reality only exists when there is a conscious mind observing it. Much to the dismay of many physicists, the Copenhagen interpretation has led to a certain degree of theological speculation about God as the conscious observer that ultimately is collapsing the wave function.

Today there are multiple interpretations of quantum mechanics competing with the Copenhagen interpretation, including the many-worlds interpretation the Bohmian interpretation, and the consistent histories interpretation. While it is beyond the scope of this article to explore these other interpretations, it is important to emphasize that the many-worlds interpretation is gaining prominence among physicists precisely because it avoids the necessity of collapsing the wave function.<sup>32</sup> Ultimately

<sup>29</sup> Ibid. 10.

<sup>30</sup> The "reality" of the wave aspect as material, potential, virtual, etc., is debated among the different schools of interpretation. No definitive answer has yet been experimentally demonstrated, and multiple theories work mathematically to explain the experimental results. See C. N. Villars, "Microphysical Objects as 'Potentiality Waves,'" *European Journal of Physics* 8 (1987) 148–49, for an explanation of waves as an aspect of reality rather than a mathematical probability.

<sup>31</sup> Gribbin, *Schrödinger's Kittens* 12.

<sup>32</sup> For an in-depth discussion of the Copenhagen interpretation versus many-worlds interpretation, see Max Tegmark, "The Interpretation of Quantum Mechanics: Many Worlds or Many Words?" *Fortschritte der Physik* 46 (1998) 855–62. Tegmark declares that "when environment-induced decoherence is taken into account, the experimental predictions of the MWI are identical to those of the Copenhagen interpretation except for an experiment involving a Byzantine form

there is no way to prove which of these interpretations is correct. In regard to the popularity of the many-worlds interpretation and its implication of a multiverse, Ellis, Kirchner, and Stoeger argue: “There is no evidence that the postulated physics is true in this universe, much less in some pre-existing metaspaces that might generate a multiverse. Thus, belief in the validity of the claimed physics that could lead to such consequences is just that, a belief—it is based on unproved extrapolation of established physics to vastly beyond where it has been tested.”<sup>33</sup> Furthermore, as Robert John Russell observes, when engaging in philosophical and theological conversations with quantum mechanics, one must make a decision about the “multiple interpretability and historical relativity” of quantum mechanics.<sup>34</sup> In other words, when using an analogy from the Copenhagen interpretation, of quantum mechanics, one must recognize that there are competing interpretations, and that in time this interpretation may be proved false, but one must nonetheless pick an interpretation with which to dialogue.

### THE HUMAN PERSON AS BODY/SPIRIT

The concept of particle/wave complementarity can provide a useful analogy in theological anthropology to talk about the relationship of body/spirit, using the concept of wave function as potential and probability and particle as the actualization of one of those probabilities. As Niels Bohr has pointed out, these two descriptions of reality, the one looking at potential<sup>35</sup>

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of ‘quantum suicide.’ This makes the choice between them purely a matter of taste, roughly equivalent to whether one believes mathematical language or human language to be more fundamental” (855).

<sup>33</sup> G. F. R. Ellis, U. Kirchner, and W. R. Stoeger, “Multiverses and Physical Cosmology,” *Monthly Notices of the Royal Astronomical Society* 347 (2004) 921–36, at 934. See also Stoeger, “Epistemological and Ontological Issues” 91–93. Stoeger comments on the hidden variables interpretation and the many-worlds interpretation, noting that “though we cannot rule out these approaches, I consider them less adequate than others, either because of the difficulties in meshing them with special relativity, their lack of fruitfulness (e.g., in quantum field theory) or the somewhat extreme and counterintuitive philosophical positions to which some seem to lead” (82).

<sup>34</sup> Robert John Russell, “Divine Action and Quantum Mechanics: A Fresh Assessment,” in *Philosophy, Science, and Divine Action*, ed. F. LeRon Shults, Nancy Murphy, and Robert John Russell (Leiden: Koninklijke Brill, 2009) 351–403, at 363 n. 28.

<sup>35</sup> Stoeger observes that when discussing wave function, “a number of authors, including Werner Heisenberg and [Abner] Shimony, invoke the concept of potentiality. They suggest that there are potentialities underlying all indefinite but probable events and properties of entities, with specific measurements or interactions servings actualize those potentialities. However, others would consider this language too realistic” (“Epistemological and Ontological Issues” 89).

and probability and the other looking at actualization, are complementary. In an analogous manner, spirit and body are complementary descriptions of the same reality, the human person, who is body/spirit.<sup>36</sup> To use Rahner's terminology, spirit and matter "though essentially different, are everywhere correlative constitutive moments of one reality."<sup>37</sup> As was mentioned above, when physicists speak of particle/wave complementarity, they are speaking of particles within a system, not individual particle/waves. The interference pattern appears only after a number of electrons have been shot at the detector screen over a prolonged period of time. Similarly, while the analogy is being used here to speak of individual human persons as body/spirit, our potentiality as human persons never exists in isolation. Human beings, like particles, exist within a system or ensemble of relationships. We are always part of larger systems—society, culture, history, indeed humanity itself—that affect and shape our potentialities into probabilities. These aspects of body/spirit are complementary facets of the human person, if one describes spirit as potentiality or probability and embodiment as actuality. Once probability has been actualized or embodied in space-time, the "spirit" function has been "collapsed" in the same way that, once an electron is observed in a particular position, the wave function is collapsed. Note that while the human person has agency and can actualize a potentiality in a conscious way, an electron or other particle does not "choose" its position the way a human person chooses a certain action. The position of the particle when measured is random. The electron does not choose its position; the system is nondeterministic. Once measured, the position of the electron is known in the moment it is observed, but there is also a wave of probability in terms of where it will appear next. Analogously, when one

<sup>36</sup> Again, recall that the limitation of this analogy is the fact that in physics, particle and wave are not simultaneously real and do not exist apart from being measured (Stoeger, "Epistemological and Ontological Issues" 89). Stoeger also declares, "Of course it is vital to stress that the wave function is not an objective reality. But, from a philosophical point of view, it certainly 'stands for' or represents some hidden underlying 'objective' reality. Since it gives the probabilities for outcomes of potential experiments on some system, it must in some way represent the system, however partially, indirectly, or inadequately" (94).

<sup>37</sup> Karl Rahner, "The Unity of Spirit and Matter in the Christian Understanding of Faith," in *Concerning Vatican Council II*, Theological Investigations (hereafter TI) 6, trans. Karl-H. and Boniface Kruger (Baltimore: Helicon, 1969) 153–77, at 171. See also Karl Rahner, *Hominization: The Evolutionary Origin of Man as a Theological Problem*, trans. W. J. O'Hara, (New York: Herder & Herder, 1965). Rahner refers to spirit and matter as correlated elements, inseparable, yet irreducible to each other. See Karl Rahner, *Foundations of Christian Faith: An Introduction to the Idea of Christianity* (New York: Seabury, 1978) 184; and "Christology within an Evolutionary View of the World," in *Later Writings*, TI 5, trans. Karl-H. Kruger (Baltimore: Helicon, 1966) 157–92, at 164.

actualizes a possibility in one's life (not randomly like the electron, but through one's agency of self-determination), all the other paths one could have taken—that manifold potential of possibilities—collapse into the one concrete, embodied act chosen in the process of becoming. By choosing one path, one simultaneously refuses others. A new wave of potential possibilities now emerges, spreading out from the new point in one's becoming that one has actualized. New potentiality exists, but has shifted. The process is dynamic, so that if you look at a single act, you catch only a snapshot of a single embodied moment; if you look at the potential, there is no way to know which possibility will be actualized.

Drawing on Rahner's concept of spirit, the term here means human transcendence, one's reaching beyond one's finiteness toward an infinite horizon or one's experiencing oneself as infinite possibility.<sup>38</sup> Spirit is the human capacity for the infinite or, in theological terms, for the incomprehensible and infinite mystery we call God, but this capacity manifests itself in our everyday lives as we actualize this potential in the here and now. Notice that when Rahner refers to the human capacity for the infinite, he is not referring to unlimitedness in regard to space-time per se, but rather to human openness to what is totally other, the incomprehensible mystery of God. However, for Rahner, this capacity for the infinite other—God—is always actualized in space-time. It is precisely this openness to God that creates the unlimited, unbounded potential of what it means to be human, and thus what it means to become within space-time. Rahner emphasizes this human capacity for the infinite in connecting anthropology to Christology. Humanity is created to be the potential for the infinite, in that humanity is created to be the potential for incarnation. The capacity for the infinite that is human nature is perfectly and fully actualized in space-time in and through the incarnation. In explicating this connection between anthropology and Christology, Rahner states that

only someone who forgets that the essence of man (although in a specifically human way, which is to say, in accordance with the point of departure, in terms of a point in space and time) is to be unbounded (thus in this sense, to be un-definable) can suppose that it is impossible for there to be a man, who, precisely by being man in the fullest sense (which we never attain), is God's Existence into the world.<sup>39</sup>

<sup>38</sup> Rahner, *Foundations of Christian Faith* 32.

<sup>39</sup> Karl Rahner, "Current Problems in Christology," in *God, Christ, Mary, and Grace*, TI 1, trans. Cornelius Ernst (Baltimore: Helicon, 1961) 149–200, at 184. See also Karl Rahner, "On the Theology of the Incarnation," in *More Recent Writings*, TI 4, trans. Kevin Smyth (Baltimore, MD: Helicon, 1966) 105–20, at 108–10; and *Foundations of Christian Faith* 216–18.

The essence of humanity is to be unbounded. Rahner elucidates: "The transcendence of man makes it clear that it would be wrong to define him, to delimit and put bounds to his possibilities. At least a hypothetical extension and culmination of the possibilities given with his transcendence are justified."<sup>40</sup> While Rahner declares that this capacity need not be fulfilled, it is unlimited as potential. Furthermore, because of the incarnation,

the finite itself has been given an infinite depth and is no longer a contrast to the infinite, but that which the infinite himself has become, to open a passage into the infinite for all the finite, within which he himself has become a part—to make himself the passage and the door, through whose existence God himself became the reality of nothingness.<sup>41</sup>

This capacity for the infinite is also what Rahner calls an obediential potency, as a potency for God that God is not under obligation to fulfill, but rather gratuitously fills through grace (and ultimately glory), and which can only be "obediently accepted" by the human person.<sup>42</sup> In his article on "Nature and Grace," Rahner expresses this concept of spirit as obediential potency:

Spirit, that is openness for God, freedom and conscious self-possession, is essentially impossible without a transcendence whose absolute fulfillment is grace. Still, a fulfillment of this sort is not owed to it, if we suppose that this conscious possession of self in freedom is meaningful in itself, and not just as a pure means and a mere stage on the way to the beatific vision.<sup>43</sup>

In other words, Rahner understands this potential of the human spirit to be ultimately intended for union with God—he calls it glory or the beatific vision. This union is, of course, ultimately due to grace, not human effort. Nonetheless, human dynamism, while ultimately intended for union with God after death, still has an intrinsic meaning in the becoming of the human person in this life through freedom and self-actualization of the person in space-time. The potential is for the infinite, but that potential is actualized in and through the finite. Furthermore, that potential is fully realized only in the incarnation. Spirit is the capacity for matter "becoming conscious of itself in transcendence toward absolute being."<sup>44</sup> Spirit as our analogous wave function is the infinite potential to

<sup>40</sup> Rahner, "Theology of the Incarnation" 110.

<sup>41</sup> Ibid 117; see also Rahner, *Foundations of Christian Faith* 226.

<sup>42</sup> Karl Rahner, "Potentia Obœdientialis," in *Sacramentum Mundi: An Encyclopedia of Theology*, 6 vols. (New York: Herder & Herder, 1970) 5: 65–67, at 65.

<sup>43</sup> Karl Rahner, "Nature and Grace," in *More Recent Writings*, TI 4, trans. Kevin Smyth (Baltimore: Helicon, 1966) 165–88, at 186.

<sup>44</sup> Rahner, "Unity of Spirit and Matter" 168. Although Rahner uses the term "matter," he means matter in its ultimacy, matter in the context of the unity of

actualize ourselves, albeit a potential that is limited by the finite world and our finite embodiment, and therefore a potential that involves different probabilities. Similarly, recall that an electron, while it could be anywhere once measured, will more probably be found in certain places than others, and that the most extreme probabilities cancel one another out. That is to say, not all our choices, options, and capacities have equal probability of being enacted.

Rahner defines matter as limited and frozen spirit, but it is created for the sake of spirit and has the potential to be spirit's own reality.<sup>45</sup> He states that matter is "the openness and the bringing itself-to-appear of the personal spirit in the finite world. . . . It is a moment in the spirit."<sup>46</sup> So spirit is the unlimiting of matter, and matter is the particularizing of spirit, the collapsing of the analogous wave function, the collapsing of potentiality and probability into actuality. While Rahner understands spirit as transcendence and matter as embodiment, like particle and wave, the two are correlative terms, so dualism is avoided. Spirit can only manifest itself in matter, and matter has its unlimiting potential in the transcendence of spirit. As the "bringing-itself-to-appear" of spirit, embodiment is analogously the particle aspect of the human person, the definite position in space-time in which the potential or probability of a choice or act becomes definitive. Embodiment is the manifestation of spirit, the finite manifestation of infinite potential. One must let go of historical biases that regarded embodiment as lower than or less than spirit. In this analogy, embodiment is the enactment of spirit, the particularization of potential and probability.

In "The Theology of Symbol," Rahner portrays the body as the symbol of the human person. He purports that human persons express the unity of their being, that is, their spirit, in a plurality, in a succession of moments in space-time, in other words, through history and embodiment.<sup>47</sup> Embodiment is the expression of who we are as persons in space-time. As our analogous particle behavior, embodiment is the way in which our infinite potentiality manifests and expresses itself in a concrete individualized and particularly unique manner. We as finite beings cannot

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all matter. In its ultimacy matter, for Rahner, is spiritual in and through the enspiriting of matter that is the human person and through the union of all matter with God in the incarnation. See Rahner, "Christology within an Evolutionary View of the World" 160–68. See also *Foundations of Christian Faith* 181–88.

<sup>45</sup> Rahner, "Unity of Spirit and Matter" 170.

<sup>46</sup> Ibid.

<sup>47</sup> Karl Rahner, "The Theology of Symbol," in *More Recent Writings* 221–52, at 227–28.



express or manifest our infinite potential in one given moment. We must do so, as Rahner emphasizes, in a succession of moments that is the history of our lives and our becoming as persons. That manifestation and expression of who we are in our infinite potential, that is, our embodiment, is what others experience of us; it is that aspect of our being that interacts with others.

Barbour remarks that for Heisenberg “tendencies in nature include *a range of possibilities*. The future is not simply unknown; it is ‘not decided.’ More than one alternative is open, and there is some opportunity for unpredictable novelty.”<sup>48</sup> In theology, we would call this “opportunity for unpredictable novelty” an opportunity for freedom. Rahner maintains that “when freedom is really understood, it is not the power to be able to do this or that, but the power to decide about oneself and to actualize oneself.”<sup>49</sup> Freedom is integral to God’s creation, both in nature and in the human person. Just as the wave of potentiality collapses into a concrete particle, so one’s human potential is collapsed into embodied actuality through choice, history, and act; and in the process one becomes who one is as a human person. Rahner explains this self-actualization in and through individual choices and acts:

We do not everlastingly do this or that, we do not constantly react to every new object and situations, but by doing what we do, we make ourselves, once and for all, despite the temporal sequence. Freedom is not the capacity for indefinite revision, for always doing something different, but the one capacity to create something final, irrevocable and eternal, the capacity of what by itself is everlasting. Freedom alone creates that which is final.<sup>50</sup>

No one act or choice determines who we are as persons, but we become who we are as persons only in and through the choices and acts of our everyday lives, through enacting our potentiality. Freedom is self-actualization—what Rahner calls “transcendental freedom.” But transcendental freedom is always actualized through individual choices in

<sup>48</sup> Barbour, *When Science Meets Religion* 69.

<sup>49</sup> Rahner, *Foundations of Christian Faith* 38. Rahner does not limit self-actualization and the realizing of one’s capacity for the infinite to volition. In fact, cognition is his primary category when speaking of self-transcendence. Human persons operate out of a triune consciousness that involves cognition, volition, and affect; thus self-actualization always involves all three aspects of human consciousness. For an in-depth account of the relationship of these three intentionalities in Rahner’s theology, see Heidi Russell, *The Heart of Rahner: The Theological Implications of Andrew Tallon’s Theory of Triune Consciousness* (Milwaukee: Marquette University, 2009).

<sup>50</sup> Karl Rahner, *Grace in Freedom*, trans. Hilda Graef (New York: Herder & Herder, 1969) 228.

time and space; this actualization Rahner calls “categorical freedom.”<sup>51</sup> Freedom always ensures that our future is open possibility. In that potentiality, freedom makes us able to be individualized, albeit always interconnected, beings, as we enact those potentialities in time and space.

Every human person as body/spirit has infinite potential, and yet not all possibilities in our lives have an equal probability of coming to be. In terms of quantum physics, Villars explains: “Though each electron has a wide range of possible interactions open to it, it has a different tendency, or inclination, towards each possibility. These tendencies are described by a weight, assigned to each possibility, corresponding to the probability that the electron will take up that possibility.”<sup>52</sup>

Analogously, each of our choices and opportunities can be described as having a certain “weight,” a certain probability that we will or will not take up that possibility. My past actions and decisions—the ways I have collapsed my spirit/wave function—shape and limit the probability of future courses of action. Thus my personal history limits my infinite potential, making certain courses of action highly probable and other courses of action extremely improbable. In this sense we can also correlate body/particle with the past (what has already been actualized) and spirit/wave with the future (the openness and unknowability of the future). We know our past but cannot know our future with certainty. The present is the interaction of our past and future; our past impacts the probability of current actions, our freedom plays a role in determining which future probabilities get actualized and how those actualizations impact our future probabilities.

Remember that one key difference from the analogy of particle/wave in quantum mechanics is that the position of the particle, once measured, is random, whereas the human person has agency and exercises freedom in choosing who to be as a person. Nonetheless, that freedom can be limited by external circumstances. Rahner observes: “Every free act of one person changes the objective possibilities of the free act of his neighbor, it enlarges, changes or limits the sphere of the other’s freedom before this latter can freely intervene.”<sup>53</sup> Thus we talk about spirit as not only potentiality but also probability.

<sup>51</sup> Rahner notes: “In this active freedom man decides his own destiny. Of course, the one free act of man in which he realizes himself once and for all is dispersed in space and time as many free actions, in which the one fundamental decision of the one man is enacted” (ibid).

<sup>52</sup> Villars, “Observables, States and Measurements” 179–80.

<sup>53</sup> Rahner, *Grace in Freedom* 233.

In quantum mechanics the idea of entanglement<sup>54</sup> gave physicists insight into the interconnected nature of microphysical reality. Particles exist only as part of a system; they are never isolated, individual particles. Analogously, we are not autonomous, individual beings, but we are interconnected. Individual human persons, like particles in quantum mechanics, operate as part of a larger system. The actions and decisions of others in both the present and the past shape and limit the probability of our future courses of action. Those interactions then influence both our potential and others' potential because of the ways we are interrelated, interconnected, and interdependent as spirit. Our spirit as a wave of potential becomes probability because we do not exist in isolation, but rather all our possibilities are impacted in their likelihood by our situatedness in a particular context (sociopolitical, historical, economic, racial, ethnic, gendered, etc.) and by our interrelationships with other human persons. Thus, we can understand the individual human person only as part of a larger system, while at the same time recognizing that the system does not ultimately define the individual. Rahner argues:

Despite its original subjectivity freedom is realized in common sphere of the unity of historical subjects. By realizing my own freedom I also partly determine the sphere of the freedom of others. True, I do not change their freedom, but [I do change] the sphere in which their freedom is realized, hence this affects the possibilities of their subjective freedom.<sup>55</sup>

While we have infinite potential, that potentiality becomes probability as it is affected by our interactions and interconnectedness with those around us. All options might be possible, but all are not equally probable.

### LOTHAR SCHÄFER AND VIRTUAL REALITY

Having laid down the basic concept of particle/wave complementarity and the analogy of body/spirit in terms of actualization and probability, I want to delve a bit deeper into the interpretation and the implications of this complementarity, using the articles Lothar Schäfer published in *Zygon* in 2006 and 2008.<sup>56</sup> Schäfer argues that through quantum physics we have learned that reality is not limited to the physical, material world. Rather reality has both empirical and nonempirical aspects, with the empirical being the material, visible, and actual elements, and the nonempirical being the hidden, nonmaterial and potential

<sup>54</sup> Also referred to as EPR or nonlocality; see above, p. 943 and n. 26.

<sup>55</sup> Rahner, *Grace in Freedom* 232–33.

<sup>56</sup> Note that once a physicist moves from mathematical equations and experimental results to interpretation, there is much more room for debate due to the speculative nature of such interpretations.

elements.<sup>57</sup> He depicts these domains as the realms of actuality and potentiality.<sup>58</sup> For Schäfer the nonempirical realm of potentiality makes up the transcendent cosmic order, and virtual states are the way that order expresses itself in the material world.<sup>59</sup> Schäfer makes the very important

<sup>57</sup> Lothar Schäfer, "Nonempirical Reality: Transcending the Physical and Spiritual in the Order of the One," *Zygon* 43 (2008) 329–52, at 329. Schäfer seems to want to leave the door open to dialogue with both followers of the Copenhagen interpretation, as indicated by his use of the words "non-material" and "potential," while depending more on the hidden variables interpretation from his own perspective. At stake is the ongoing debate among physicists about an ontological versus an epistemological interpretation of the wave function. For a detailed account of this debate, see Stoeger, "Epistemological and Ontological Issues." Schäfer is drawing on the work of Villars, who explains: "Potentiality waves differ from *probability waves* in that the latter are usually conceived as abstract, mathematical devices which represent, in a statistical way, the behaviour of *particles*. By contrast, potentiality waves, as their more concrete name suggests, are conceived as physically real waves which exist in their own right, not merely as representations of the behaviour of particles. Microphysical objects are not particles 'guided' in some mysterious way by 'waves of probability,' but, rather, microphysical objects *are* waves of potential observation interactions" (148, emphasis original). Similarly theology has struggled to define spirit as reality in a worldview that has typically defined reality in terms of physicality or substance, leading into the historical quagmire of substance dualism. The advantage of using Schäfer's concepts for our analogical purposes is that he does not insist that the wave is a physical object, but rather that nonphysical objects are no less a part of reality than physical objects. Such a shift in our concept of reality in an ontological sense can serve as an analogy for speaking about spirit and human potentiality as much a part of reality as the embodied actualization of that potential.

<sup>58</sup> Schäfer, "Nonempirical Reality" 329.

<sup>59</sup> Lothar Schäfer, "Quantum Reality and the Consciousness of the Universe: Quantum Reality, the Emergence of Complex Order from Virtual States, and the Importance of Consciousness in the Universe," *Zygon* 41 (2006) 505–32, at 512, 523. A number of articles in this issue of *Zygon* address Schäfer's theory of empty or virtual states. For instance, Ervin Lazlo suggests the wording of "potential states" rather than "virtual states" and asks what is meant by the terms "real" and "reality"; and Carl Helrich argues that wave functions have no physical reality, and that wave/particle complementarity is an epistemological clarification, not an ontological clarification (Ervin Lazlo, "Quantum and Consciousness: A New Paradigm" 533–41, at 536; and Carl Helrich, "On the Limitations and Promise of Quantum Theory for Comprehension of Human Knowledge and Consciousness" 543–66, at 562). Both authors charge that Schäfer's interpretation sets up a dualistic system of mind and matter, whereas they would propose a single system that has both physical and mental aspects. Schäfer, however, disputes the accuracy of this accusation ("Nonempirical Reality" 342). He replies: "Helrich takes me to task for giving virtual states too much reality, . . . while I am reprimanded by Ervin Laszlo for not granting virtual states enough of that precious commodity, reality" ("A Response to Carl Helrich: The Limitations and

point that empty or virtual states of an electron are part of quantum reality. He describes virtual states as more than mere mathematical formulas and uses Aristotle's concept of *potentia* to explain that these virtual states "are part of the realm of potentiality in physical reality because they contain the future empirical possibilities of the universe."<sup>60</sup> In other words, some of these virtual states will be actualized, therefore all their possibilities are part of reality. All the states in which the electron can possibly exist are an essential part of the overall system and continue to exist as empty or virtual after the wave function is collapsed. The "occupied states" (those actualized) form the visible part of reality, but the empty states (those not actualized) are also a part of reality, a reality that is nonactualized potentiality.

To translate this concept into my own analogy, all the possible choices or paths we could take because of our infinite potential of being spirit are part of what makes up our reality; and once we have actualized a certain choice or path, all the options we did not choose continue to exist as part of our being, part of what makes us who we are. Within the theological question of freedom versus determinism, this model allows us to take a perspective that all our potentiality exists in God; thus whatever choices we make or paths we actualize, all of our possibilities are always held within God as part of God's creation. To recall Rahner's words quoted above, "When freedom is really understood, it is not the power to be able to do this or that, but the power to decide about oneself and actualize oneself."<sup>61</sup>

For Schäfer, virtual states are part of a predetermined cosmic transcendent order. Thus nothing we do or choose puts us outside God, even when our choice is against God. Rahner maintains that even a choice to reject God is an actualization of one's freedom, and that freedom is grounded in God and borne by God.<sup>62</sup> All our potential or possible

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Promise of Quantum Theory" 583–91, at 587). This idea of a cosmic transcendent order is also controversial because it follows Bohm's hidden variables interpretation, an interpretation that is less accepted by many physicists, who prefer the Copenhagen interpretation.

<sup>60</sup> Schäfer "Nonempirical Reality" 334; see also Schäfer, "Quantum Reality" 510–11.

<sup>61</sup> Rahner, *Foundations of Christian Faith* 38.

<sup>62</sup> I am using this concept of a cosmic transcendent order differently from Schäfer. He applies this idea literally; I apply it analogously. Applying the concept literally puts much more weight on the side of determinism; Schäfer proposes that God's cosmic order is the hidden variable in the universe, which then manifests itself through the actualization of virtual states (Schäfer, "Nonempirical Reality" 342). My use of the idea analogously puts much more weight on the side of freedom. I am not suggesting, however, that there is a hidden predetermined order that manifests itself in the choices we make.

choices are part of a larger reality that is encompassed by God in the same way that all the virtual states of microphysical objects are part of a quantum reality that encompasses both potentiality and actuality.

Schäfer draws on the work of Villars to emphasize the fact that the virtual states are part of reality. Villars concludes that reality in quantum physics is not simply actuality as was the case in the classical system; rather, reality is both actuality and potentiality.<sup>63</sup> Similarly we can think of our spirit as our Aristotelian *potentia* that is actualized in and through our embodiment. Our reality is one of both potentiality and actuality, and so there can be no separation between the two. One does not exist without the other, and neither takes precedence over the other. Against the materialists, potentiality or nonmaterial reality gains legitimacy. Against the dualism of faculty psychology, embodiment cannot be denigrated as lower than and subordinate to spirit. Spirit cannot be actualized in human beings without embodiment.

The actualization of our potential occupies one possibility of our infinite potential. The probabilities of our future choices thus shift and change in response to the potentialities we actualize. Schäfer explains:

After each transition from “the possible to the factual,” as Heisenberg called it, the evolution of new “tendencies or possibilities” for future actual events starts anew, but now from a different starting point than before. There is a continuous flux from the evolution of tendencies to their actualizations—empirical events—and from empirical events to new tendencies. Each new state of potentiality carries in it, like a stamp, the memory of the last event.<sup>64</sup>

The human person is body/spirit, the continuous interplay between potentiality and actualization. Every actualization or collapse of the spirit≈wave function creates new potentiality. That interplay between actualization and potentiality is what it means for us to have an openness to the infinite while being limited by the finite, by space-time. We actualize this freedom and potential (≈ analogously collapsing these continuous wave functions) throughout the course of our lives as we become the person we will eventually be in all eternity in and through

<sup>63</sup> Villars, “Observables, States and Measurements” 181. Villars explains: “Probability waves evolve in a complex, infinite-dimensional vector space, called Hilbert space. Hilbert space is real. It is not merely an abstract, mathematical construction existing solely in the human mind, but rather, is an aspect of physical reality itself. Classical physics identified reality with actuality. In quantum physics, this concept is extended to include two aspects; actuality and potentiality. Hilbert space is the space of potentialities, i.e., the weighted possibilities alternative to what actually occurs, which encompasses and goes beyond the ordinary three-dimensional space of actualities” (181).

<sup>64</sup> Schäfer, “Nonempirical Reality” 343, citing Werner Heisenberg, *Physik und Philosophie* (1958; Stuttgart: Hirzel 2000) 80, 262.

the limits of time, space, and embodiment. Rahner depicts this relationship of freedom to the temporal and the eternal as follows:

Freedom is the event of something eternal. But since we ourselves are still coming to be in freedom, we do not exist with and behold this eternity, but in our passage through the multiplicity of the temporal we are performing this event of freedom, we are forming the eternity which we ourselves are becoming.<sup>65</sup>

Salvation then is the eternal validity of this person we have become.<sup>66</sup> The process of self-actualization culminates in the definitive collapse of the “wave function” that Christian theology calls the resurrection of the body.

### RESURRECTION OF THE BODY

The final theological concept I want to address is the idea of the resurrection of the body. First of all, on a literal rather than analogous level, quantum physics has huge implications for understanding the body and thus the resurrection of the body. If the so-called particles out of which we are made are in fact not particles but manifestations of fields of energy, quanta or little packets of energy, if you will, then this thing we call a body is not a thing at all! There is a falsity to the concept of object, matter, or body. There is really no such thing as particles or objects or matter, but rather only space and energy. What we call the material world is not a collection of physical objects, but rather occasions or processes, so scientists and theologians should be able to move beyond the debates about materialism.<sup>67</sup> The term “particle” simply denotes the collapse of the wave function and tells us position in time

<sup>65</sup> Rahner, *Foundations of Christian Faith* 96.

<sup>66</sup> Ibid.

<sup>67</sup> Philip Clayton notes, “From the standpoint of field theory, individual subatomic particles are expressed as ‘localizations’ of the quantum field at a particular place and time. Thus the famous French physicist Bernard d’Espagnat argues that it is no longer accurate to understand objects as objects; they should really be understood as properties of a field: ways in which the field is manifested at a particular place and time” (“Unsolved Dilemmas: The Concept of Matter in the History of Philosophy and in Contemporary Physics,” in *Information and the Nature of Reality: From Physics to Metaphysics*, ed. Paul Davies and Niels Henrik Gregersen [New York: Cambridge University, 2010] 55). Clayton explains: “No ‘primary matter’ serves as the basic stuff out of which all else is composed. Instead, the deeper one pursues the explanations, the more nonmateriality reveals itself in (or behind) the solid objects around us. Beginning with the oft-repeated observation that the solid object one touches is in fact composed mostly of space, one finds oneself confronted with as strange a world in physics as one will ever meet in the history of philosophy” (58). See also the related material on field theory above, pp. 937–38 and n. 12.

and space, creating a sense of history and individuality. Body is the collection of previous occasions, processes, and events that shape the probability waves of the future. This new understanding of body, however, should in no way denigrate the importance of our embodiment. Our bodies are the only way by which we actualize ourselves, our spirit, our potential. When we talk about the resurrected body, we must remember that matter as we experience it in this world is something of an illusion—not in that it is not real, but in that it is not what we experience it to be, that is, a world of solid, individual objects in which each of us is one separate individual object among others. People get stuck in the question of whether this body—understanding body to be this thing that I can touch—will exist in a “place” called heaven. If matter is not material, we need not conceive of the body as a thing so much as the actualization of who we are, and that history, that actualization and individuation, continues to have eternal significance after death in a way that is no longer limited by time and space.

Within the analogy of body/spirit as particle/wave, we can talk about this resurrection of the body as our definitive collapse of the wave function, the point when we have actualized our embodied potential. Our resurrection is united to the ultimate definitive and irrevocable actualization of the potential with which humankind was created in the incarnation, death, and resurrection of Jesus the Christ. Human potential is ultimately potential for union with God. That human potential is actualized first and foremost in the life of Jesus of Nazareth, a life that is validated in its eternal significance in the resurrection. Through our union with God in and through Christ, our lives also take on a final and irrevocable validity in resurrection.

Rahner defines death as “the supreme act of man in which his whole previous life is gathered up in the final decision of his freedom and mastered, so that he ripens for his eternity.”<sup>68</sup> For Rahner death is not one act among others, but rather the totality of one’s life, “the definitive act of [one’s] freedom, the complete integration of [one’s] time on earth with [one’s] human eternity.”<sup>69</sup> If we think of embodiment as the actualization of our infinite potential, albeit limited by probabilities, then this moment of death is the definitive actualization of our potential, culminating in union with the infinite God, and thus the definitive collapse of the wave function. For Rahner, death is necessary, because without death we can never achieve our definitive actualization, and an

<sup>68</sup> Karl Rahner, “Dogmatic Questions on Easter,” in *More Recent Writings* 121–33, at 129.

<sup>69</sup> *Ibid.*



endless existence of becoming would be absurdity, and ultimately damnation.<sup>70</sup> Furthermore, Rahner maintains that our entire lives are lived in this process of dying:

In reality we *are* dying all our lives through right up to this, the final point in the process of dying. Every moment of life is a stage on the way to this final goal, a stage which already carries this end within itself and derives its significance from it. . . . Dying takes place throughout life itself and death when it comes is only the ultimate and definitive completion of the process.<sup>71</sup>

Each time we collapse our spirit/wave function of potentiality into act, we die to all the potentialities that we do not enact. Rahner adds that each of these acts of dying is an act of faith or despair, culminating in the ultimate act of faith or despair that is death. Ultimately, do I believe that my existence has eternal and irrevocable validity in the eyes of God? That definitive collapse of the wave function of potentiality in which I am no longer becoming in time and space but now am who I am in union with God is the resurrection of the body. In this "collapse" spirit is not eliminated but rather actualized. The resurrection of the body is not the elimination of spirit but is rather the concretization of spirit. As beings that are embodied spirit, our existence after death cannot be purely spiritual or pure potentiality; rather, it is actualized potentiality. When we return to the original understanding of spirit as potential for God, in death that potential is actualized in union with God. In death, who we have become in our life, lived in the temporal moments of day to day becoming, is now taken up into the oneness and wholeness of God without in any way losing the uniqueness and individuality of that person we have become. This enduring existence and uniqueness of our actualization is what I mean by resurrection of the body.

In addressing the resurrection of the body, we must address the concept not only on a personal or individual level but also on a communal level. In tradition and Scripture we find the idea that the resurrection of the body is something that happens simultaneously to everyone at the end of the age when the dead shall be raised. Rahner would express this concept as nothing more nor less than the absolute interconnectedness of the individual with all humanity and all humanity with creation itself.

<sup>70</sup> Karl Rahner, "On Christian Dying," in *Further Theology of the Spiritual Life*, TI 7, trans. David Bourke (New York: Seabury, 1971) 285–93, at 288.

<sup>71</sup> *Ibid.* 290. On this concept that death is the summation of our existence and that this death takes place throughout our entire lives, see Karl Rahner, "Ideas for a Theology of Death," in *Theology, Anthropology, Christology*, TI 13, trans. David Bourke (New York: Seabury, 1975) 169–86; and "Christian Dying," in *God and Revelation*, TI 18, trans. Edward Quinn (New York: Crossroad, 1983) 226–56.

Thus Rahner argues that union with God and belonging to the material world are not concepts that can be thought of as being in inverse proportion.<sup>72</sup> Nearness to God does not mean remoteness from the world.<sup>73</sup> So for Rahner, in a sense, our final definitive actualization is bound up with the final definitive actualization of the entire world. Again, I would point to Schäfer's theory that

reality is a homogenous wholeness in which potentiality is entwined with actuality and matter is nothing but "coagulated potentiality" or "coagulated form." . . . It is only in relation to this, the limited human receptor, that the terms empirical and nonempirical, spiritual and physical, material and formal, are perceived like the characters of a dualistic reality.<sup>74</sup>

In other words, there is a wholeness, an interrelatedness and interconnectedness to reality, that supersedes both our individuality and the distinctions we make between part and whole, matter and spirit, individual and communal. In this sense, our embodiment as our actualized potential shapes not only our own wave function probabilities but also the probabilities of the potential of those who are interconnected with us and, as a result, the probabilities of those interconnected to them, on to infinity. Rahner states this sentiment more simply: "The history—which has remained within the framework of the world—of those who by their lives have already effected their personal finality, reaches its real completion and explicit expression together with the consummation of the world."<sup>75</sup> Each individual is connected to every other person who exists, has existed, and will exist. Therefore my personal finality, which is achieved in my death, continues to be intertwined with the lives of those who come after me, and thus my personal finality must ultimately come to a conclusion in a communal finality that we call the resurrection of the dead. Thus our ultimate realization, the playing out of our self-actualization, becomes definitive when the whole of creation has been actualized and God is all in all.

<sup>72</sup> Karl Rahner, "The Resurrection of the Body," in *Man in the Church*, TI 2, trans. Karl-H. Krueger (Baltimore: Helicon, 1963) 203–16, at 211.

<sup>73</sup> Ibid.

<sup>74</sup> Schäfer, "Nonempirical Reality" 342, citing Hans-Peter Dürr, *Auch die Wissenschaft spricht nur in Gleichnissen: Die neue Beziehung zwischen Religion und Naturwissenschaften* (Freiburg im Briesgau: Herder, 2004) 33. Note that Schäfer is here following David Bohm's hidden variables interpretation rather than the Copenhagen school of Niels Bohr et al. He also moves beyond the scientific to the philosophical and theological in developing his concept of cosmic consciousness. For my analogous purpose in this article, what is important is the understanding that nonempirical reality can be interpreted as the interconnectedness of empirical reality.

<sup>75</sup> Rahner, "Resurrection of the Body" 213–14.