The Quantum State Function, Platonic Forms, and the Ethereal Substance: Reflections on the Potential of Philosophy to Contribute to the Harmony of Science and Religion

VAHID RANJBAR

Abstract

Werner Heisenberg, one of the founders of quantum mechanics, argued that the quantum state function for elementary particles should be understood as belonging to the realm of Plato's idealized Forms. In this paper, I suggest that this connection between two concepts of fundamental importance in our understanding of reality, from science and philosophy respectively, can be plausibly further correlated to concepts from the knowledge system of religion, as described in the Bahá'í Writings. I argue here that ethereal substance (*maddiy-i-athiriyyih*) as described by 'Abdu'l-Bahá and alluded to by Bahá'u'lláh also belongs to Plato's idealized realm. Further, the description of ethereal substance in the Bahá'í Writings resonates with the modern understanding of a quantum field, which itself is derived from the concept of a quantum state function. The paper also considers the implications of apparent parallels drawn in the Bahá'í Writings between the ethereal substance and the human spirit, and concludes with reflections on the possible relationship between consciousness and quantum mechanics.

Résumé

Werner Heisenberg, l'un des fondateurs de la mécanique quantique, a soutenu que la fonction d'état quantique des particules élémentaires devait être comprise comme appartenant au domaine des formes idéalisées de Platon. Dans cet article, l'auteur suggère que ce lien entre deux concepts d'importance fondamentale dans notre compréhension de la réalité, issus respectivement de la science et de la philosophie, peut être plausiblement corrélé à des concepts du système de connaissances de la religion, tel que décrit dans les Écrits bahá'ís. L'auteur soutient ici que la substance éthérée (*maddiy-i-athiriyyih*) décrite par 'Abdu'l-Bahá et à laquelle Bahá'u'lláh fait allusion relève également du domaine des formes idéalisées de Platon. De plus, la description de la substance éthérée dans les Écrits bahá'ís concorde avec la compréhension moderne d'un champ quantique, lui-même dérivé du concept de fonction d'état quantique. L'auteur examine également les implications de parallèles apparents établis dans les Écrits bahá'ís entre la substance éthérée et l'esprit humain, et conclut l'article par des réflexions sur la relation possible entre la conscience et la mécanique quantique.

Resumen

Werner Heisenberg, uno de los fundadores de la mecánica cuántica, argumentó que la función del estado cuántico para las partículas elementales debe entenderse como perteneciente al campo de teoría de las formas de Platón. En este artículo, sugi-

ero que esta conexión entre los dos conceptos de fundamental importancia en nuestra comprensión de la realidad, de la ciencia y filosofía respectivamente, puede ser mayor y plausiblemente correlacionada a conceptos derivados del sistema de conocimiento de la religión, tal como se describe en los Escritos Bahá'is. Acá presento el argumento que la sustancia etérea (*maddiy-i-athiriyyih*) tal como lo describe Abdu'l-Bahá y alude a ella Bahá'u'lláh también pertenece al campo de teoría de las formas de Platón. Además, la descripción de la sustancia etérea en los Escritos Bahá'ís resuena con el entendimiento moderno de un campo cuántico, lo cual se deriva del concepto de función del estado cuántico. El artículo también considera las implicaciones de paralelas aparentes hechas en los Escritos Bahá'ís entre la sustancia etérea y el espíritu humano, y concluye con reflexiones sobre posible relación entre la conciencia y la mecánica cuántica.

Introduction

In this paper, I will discuss the possible interrelationships between Platonic Forms, our current models of fundamental physical reality, and certain concepts discussed by Bahá'u'lláh and 'Abdu'l-Bahá—in particular, the "ether" and the human spirit. In some respects, these interrelationships are fairly clear: the Central Figures of the Bahá'í Faith, for instance, speak directly about Plato, and it is not too difficult to see that they validate and build upon Platonic philosophical ideas in a number of respects as They translate Their privileged understanding of reality into terms that we can grasp. In other places, as is inevitable with work of this kind, I will be drawing connections that I believe are plausible, but whose validity we cannot definitively pronounce upon. At the end of the day, Platonic Forms, quantum fields, and the human spirit are at most discernable by their effects; the fact that we cannot hold them in our hands and compare them is a central part of how we define them. However, it is my hope that the threads I draw here between these various concepts may help, in whatever measure, to inspire those who believe not only in the harmony of science and religion, but in the fundamental oneness of a creation that is at once material and spiritual.

The paper begins with a brief discussion of how the Bahá'í Writings affirm and deploy certain Platonic concepts. This kind of affirmation of philosophical ideas in the Writings is important, not only because it marks the first time in history that many philosophical concepts have been engaged with on their own terms in revealed scripture, but also because the Writings clarify and correct tendencies in the development of theology in earlier dispensations, in which Platonic concepts were often rejected for reasons that contributed to the confusion of theology itself. I will then consider how, contra this trend in religion, some physicists have used the Platonic Forms to help understand the nature of reality. This will set the stage for the central argument of the paper, which proceeds in two parts.

In the first, I elaborate on why the quantum state function in particular can be understood in terms of Plato's

theory of the Forms. Since the birth of quantum mechanics, the ontological reality of the state function—the mathematical core of quantum mechanics—has been debated. One resolution proposed initially by Werner Heisenberg is to identify the state function as properly residing in the realm of Plato's Forms. Various aspects of the state function that support this identification will be explored: its non-physical nature, how it manifests its physicality via a mathematical process similar to how a shadow is cast, its probabilistic nature, and its strange and multi-faceted relationship with consciousness.

In the second part of the argument, I will suggest that further light can be shed on this explanation of fundamental physical reality by looking attentively at certain remarkable statements by 'Abdu'l-Bahá and Bahá'u'lláh. These statements, in my view, may not only affirm the relationship between Forms and fundamental material reality, but further connect both of these to *spiritual* reality, taking us fully out of the realm of physics and into the larger, metaphysical reality in which it is grounded. A reading of 'Abdu'l-Bahá's discussion of ether and fundamental particles appears to reinforce the connection of fundamental physics to the realm of Forms. He compares both ether—described in terms that resonate with our current understanding of a quantum field—and fundamental particles to the human spirit. He goes on to describe the ability to hold mutually exclusive states at once as an essential property of the human spirit; this quality maps onto the concept of superposition, which also happens to be a unique property of the quantum state function. 'Abdu'l-Bahá further describes ether as being a "sign of the Primal Will in the phenomenal world" (*Má'idiy-i-Ásmaní* 2:69, qtd. in Brown, "A Bahá'í Perspective" 28. Provisional translation). Finally, Bahá'u'lláh, in His Tablet of Wisdom, describes something that bears "the closest likeness to the human spirit" as underlying all things, in terms that are again suggestive of a quantum field (*Tablets* 146).

I conclude the paper with some thoughts on the implications of this apparent connection between fundamental physics, the Forms, and spiritual entities—specifically the human spirit—for the intriguing relationship between consciousness and the quantum state function.

Platonism and Theology

Historically, Platonism and its philosophical offshoots have had a complex relationship with theology. Platonic ideas often served as bridge between theology and rational science or philosophy in both classical Paganism and the Abrahamic religions; however, they also encountered resistance, particularly as theology became encrusted by literal and materialistic interpretations of scripture.

At the time of the birth of Christianity, Philo Judeaus (20 BCE-50 CE), a relatively minor Jewish theologian and philosopher from Alexandria, took the concept of *logos* which had been

developing during the middle Platonic period and applied it to Jewish theology. Decades prior to the development of analogous ideas in Christian theology, Philo identified Logos[1] with the thought of God, also described as His firstborn son, which acts as the vehicle for the creation of the world (Philo). Subsequently, the author of the Gospel of John would, in that text's opening passage, apply this same Platonic term—Logos—to Christ, in terms analogous to Philo (John 1:1).[2] In turn, this religious conception of the Logos, as an image or first emanation of the Absolute, mirrors[3] to a striking degree one of the key philosophical positions of Plotinus (204/5–270 C.E.), the founder of what is today known as Neoplatonic philosophy. Writing over a century after the Gospel of John, Plotinus argued that there exists an utterly transcendent "One" from whom Logos (also called "Nous" or intellect), emanates. It is this first mind from which successive levels of reality emanate in turn, giving rise to our universe (Plotinus).

Early Church fathers such as Justin Martyr (100-165 CE), Clement of Alexandria (150-215 CE) and Origen of Alexandria (185-253 CE) all actively tried to reconcile Platonic philosophy with Christian theology. They employed the Neoplatonic concept of Logos to attempt to resolve the confused question of the station of Christ relative to the Deity. However, following the First Council of Nicaea (325 CE), the dogma of the Trinity would cement its centrality in Christian thought; this dogma relied on the concept of *homoousios*, the idea that Christ was of the same "substance" as God the Father. Thus, God was implicitly materialized, in stark contrast to the very thrust of Platonism. This break between Platonism and theology is epitomized by the 399 CE riots in Alexandria, Egypt, sparked by Christian monks' denunciation of the early church father Origen's teaching that God was incorporeal (Harding).

In the modern age, Christian philosopher William Lane Craig has argued that Platonism is "potentially a dagger in the heart of the Christian doctrines of divine aseity [God's existence independent of any cause but Himself] and *creatio ex nihlo*" (441). This stance hinges on Craig's argument that objects that are co-eternal with God (which Platonism allows for) are necessarily uncreated.

This trajectory in Christianity has its parallel in Islam. Craig's objection to Platonism, for instance, is an old one, made by Islamic philosophers such as al- Ghazálí (d. 1111 CE) who saw the concept of the eternity of the universe

1 Logos is often capitalized when used in a religious sense.

2 The apostle Paul, for his part, refers in his letters to Christ as the "Image of God" (see for instance 2 Cor 4:4)—a phrase reminiscent of the mirror analogy used by Bahá'u'lláh to explain the station of the Manifestation (Kitáb-i-Íqán 2:102–109).

3 Plotinus makes no reference to Christian philosophical ideas—or indeed to Christianity—in his writings, leaving his possible influence by such ideas a matter of historical speculation.

proposed by Peripatetic philosophers such as Ibn Siná as heresy.[4] Indeed, al-Ghazálí's repudiation of the Platonic and Aristotelean influence on prior Islamic philosophy is commonly viewed as a turning point, marking the pivot in mainstream Islamic thought away from these philosophical foundations.[5]

Plato and Bahá'í Scripture

The disconnect between theology and Platonic philosophy that grew in Christianity and Islam makes the Bahá'í affirmation of philosophy generally, and a Platonic / Neoplatonic approach to reality specifically, all the more important, as it opens the door to a reconciliation between these two great systems of knowledge—religion and philosophy.

"[T]he divine Plato" is highly praised in Bahá'u'lláh's *Tablet of Wisdom*; his "wise, accomplished and righteous" teacher Socrates even more so (*Tablets* 147–48). But the engagement with Platonism in the Bahá'í Writings goes beyond mere acknowledgement of the virtue and wisdom of these philosophers: Bahá'í philosophy as described by 'Abdu'l-Bahá has deep roots in Platonic idealism, particularly in Neoplatonism as understood in the Islamic and Sufi traditions. Of particular note for the purposes of this paper is 'Abdu'l-Bahá's invocation of the Sufi view of creation, inspired by Neoplatonic philosophy, as a series of emanations which lead away from, and back to, God via descending and ascending arcs.[6] 'Abdu'l-Bahá explains that

> those who have thoroughly investigated the questions of divinity know of a certainty that the material worlds terminate at the end of the arc of descent; that the station of man lies at the end of the arc of descent and the beginning of the arc of ascent, which is opposite the Supreme Centre; and that from the beginning to the end of the arc of ascent the degrees of progress are of a spiritual nature. The arc of descent is called that of "bringing forth" and the arc of ascent that of "creating anew". The arc of descent ends in material realities and

4 Bahá'u'lláh resolves this issue using an approach reminiscent of that of Mullá Sadrá, who proposed that existence is created at every instant in time (Meisami). In the Tablet of Wisdom Bahá'u'lláh explains that creation can be eternal and yet still created: "the irresistible Word of God . . . is the Cause of the entire creation, while all else besides His Word are but the creatures and the effects thereof . . . It became manifest without any syllable or sound and is none but the Command of God which pervadeth all created things. It hath never been withheld from the world of being" (*Tablets* 9:9–10).

5 For a recent discussion of the influence of pre-Islamic philosophy on earlier Islamic philosophers, and Bahá'u'lláh's confirmation of significant elements of their approach, see Joshua Hall, "Bahá'u'lláh and the God of Avicenna."

6 Nader Saiedi discusses this concept at length in his *Logos and Civilization*.

> the arc of ascent in spiritual realities. (*Some Answered Questions* 81:9)

This overall framework for thinking about reality, and the place of the conscious human being within it, will be drawn on at intervals below to highlight how both the Platonic Forms and certain features of physical reality can be understood through a Bahá'í lens. Before considering their resonance with concepts in the Bahá'í Writings, however, the Forms must first be understood on their own terms, and their relevance to some of the most fundamental, if esoteric, findings of modern science reviewed.

Platonic Forms

In his theory of Forms, Plato claims that reality is most accurately understood by reference to non-physical, idealized Forms or ideas. It is from their relationship to these Forms that physical objects derive their "essence." The Forms are often described as models or templates, imperfect copies or projections of which exist in the physical world. The theory of Forms itself is rooted in Pythagorean ideas which place divine math at the center of reality. Whereas in the Pythagorean paradigm all things are considered as being composed of numbers, in Plato's hands this divine math is expressed as the Forms—geometrical expressions of mathematical relationships as well as more abstract things like "Truth" and "Beauty."

In *The Republic*, Plato uses the allegory of the cave to illustrate the relationship between Forms and the observed world. In the book, he has Socrates ask his interlocutor (Plato's brother, Glaucon) to imagine several prisoners trapped since birth in a cave deep underground. Their bodies and heads are chained so that they are forced to see only the wall in front of them, on which the shadows of various objects are projected, cast by a large fire behind them. The effect, as Socrates describes it, is the same as that of a shadow puppet show. The prisoners, however, are unaware of their situation and of what is going on behind them; they thus mistake the shadows they see projected on the wall for reality itself. Eventually one of the prisoners escapes, sees the real objects being projected, and slowly, through painful stages, realizes the nature of the deception. This freed prisoner represents the enlightened philosopher or, as we might say, a spiritually awakened person. The prisoners are all of humanity, and the shadows are what we call physical reality. We mistake these shadows for the totality of reality itself; the objects that cast them are the Forms.

Modern Pythagoreans and Platonists

In spite of its antiquity, the concept of the Forms remains relevant to contemporary philosophy. The Forms have, for example, been revisited by way of the concept of "abstract objects," coined by Willard Quine and later developed in the early 1980s by Edward

Zalta. Building on the work of Alexius Meinong and Ernst Mally, Zalta claims that there exist abstract objects which encode properties that we can observe exemplified in physical objects. Examples of abstract objects range from familiar concepts, such as numbers, to so-called nonexistent things like a round square. Whereas physical objects can be understood through empirical observation, abstract objects are knowable via axioms. He further argues that for every set of properties there is exactly one abstract object which encodes exactly that set of properties and no other (35). Thus, Zalta uses the concept of abstract objects to develop a formal ontology (a quasi-mathematical method to classify existent things).

This understanding of the Forms has also found purchase in science. In the physics community of the twentieth century, Platonism seemed inescapable—at least for those willing to ignore Richard Feynman's dictate to "shut up and calculate" and attempt to grasp the philosophical implications of what was being discovered. In 1960, Nobel laureate physicist Eugene Wigner penned an article entitled "The Unreasonable Effectiveness of Mathematics in the Natural Sciences." As suggested by the title, the article grappled with a question that had been surfacing even before the birth of quantum mechanics: how is it that the mathematics developed to describe one type of physical phenomena can be so easily used to explain other phenomena which have little to do with the one to which they were originally applied? Of course, from the viewpoint of Plato's theory, this would seem natural: developments in mathematics simply provided ever-better ways of representing Forms which are, at their core, mathematical. So, for example, while a perfect circle can be represented using a simple formula, more complex Platonic Forms or ideas could finally begin to be represented by using more complex forms of mathematics. Over time, mathematicians have learned to express ideas as abstract as different sorts of infinities, sets, or classes of motion. In other words, one might view mathematics in general as a means to unambiguously represent the Platonic Forms of the universe. It is due to this fact that some theoretical physicists, in an apparent return to Pythagorean philosophy, entertain the view that mathematics somehow represents the true nature of reality: the physical universe is not just *described* by mathematics, but *is* mathematics.

Semantically, to say that the universe is mathematical might be construed as simply meaning that what exists in our physical universe is measurable, and thus susceptible to mathematical inquiry. However, the philosophical position that the universe is ultimately mathematical is potentially more radical: it can imply that the *reality* of our universe is the quantifiable relationships between things. The logic behind this position is arguably compelling. Reality, in this view, consists of relational or semantic information, what a Platonist might call "Forms." The actual matter of our universe is both not knowable

and unimportant to our reality. For example, we can never "know" what an electron is; rather, an electron is defined by its charge, mass and spin (intrinsic angular momentum). These quantities are themselves only known relative to the mass, charge and spin of another thing—whatever we are using as the "metric." Thus, all that we can establish about a thing are its quantitative relationships relative to other things. The inaccessibility of a thing's matter in itself—as opposed to measurable, relational information about the thing—is affirmed by James C. Maxwell, the father of Electromagnetic theory: "It is only when we contemplate, not matter in itself, but the form in which it actually exists, that our mind finds something on which it can lay hold" (482). This distinction also maps on to 'Abdu'l-Bahá's clear differentiation between essence and attributes, which is fundamental to a Bahá'í approach to epistemology:

> When we consider the world of existence, we find that the essential reality underlying any given phenomenon is unknown. Phenomenal, or created, things are known to us only by their attributes. Man discerns only manifestations, or attributes, of objects, while the identity, or reality, of them remains hidden. (*Promulgation* 470)

A simple thought experiment can help illustrate this claim about reality. If tomorrow all the objects in the universe were to be replaced with other objects, and yet the exact same mathematical relationships that existed between the old objects were maintained between the new objects, there would be no way we could tell that the swap had occurred, because no measurement or experiment would allow us to distinguish the two universes. In fact, one could maintain that they are the same—that it is these unchanged mathematical relationships which determine what things are, and not any reference to a primal or elementary substance.[7] This view, known as Ontic Structural Realism (Ladyman), clearly resonates with Platonism: the relational information that gives reality to objects, when abstracted from those objects, maps precisely onto the concept of Platonic Forms.

7 It is worth noting that a version of this substitution of matter occurs in any digital simulation of a physical phenomenon, which represents an attempt to recreate the mathematical relationships of physical matter within the physics of a digital computer. When the concept of a digital simulation is taken to its logical extreme, as in the recently popularized simulation hypothesis put forward by the likes of Nick Bostrom, it amounts to a sort of retelling of Plato's cave analogy. Bostrom posits the possibility, based on extrapolation of existing technology and probabilistic arguments, that our human consciousnesses may represent agents in an advanced simulation (Bostrom). Bostrom's view, however, suffers from its failure to take the argument to its logical and seemingly obvious conclusion: the primacy of "Form" and the subversion of materialism which Plato's allegory makes clear.

The Ship of Theseus thought experiment, discussed by Heraclitus and related in Plutarch's *Theseus*, can be used to illustrate this same point. Here, a famous ship which was sailed by Theseus is preserved for over a century by replacing its various parts when they rot or break, until ultimately every part of the ship has been replaced. The thought experiment asks us to consider whether this is now the "same" ship which was sailed by Theseus. A Pythagorean could argue that it is indeed the same ship, to the degree that all its fundamental particles relate to each other in exactly the same way as in the original—that is, if the precise same relative positions of carbon, hydrogen, iron and other elements are maintained. This is because the ship's identity is defined by these relative relationships.[8]

Before turning to the relevance of Forms to quantum reality specifically, it is worth highlighting a particular consequence of conceiving of our reality as residing in these relationships: it obviates the need to ground the possibility of spiritual reality in classical Cartesian dualism, which conceives of matter and spirit as two utterly distinct substances. Instead, whatever we think of as "real" is actually relational information; i.e., its *reality* exists in the realm of Forms. The apparent or imagined dividing line between spirit and matter concerns our ability to perceive or measure these relationships, thereby deducing the Forms. The Forms that we observe in the ordinary course of our lives manifest the relationship inherent in composition and decomposition. However, with the advent of modern physics there is evidence for the existence of fundamental particles, or things which are not composite—*atoms* in the classical Greek understanding of that word. In the case of an electron, for example, physicists believe it is fundamental and not composed of even smaller units. While individual instances of electron can pop in and out of existence, they are all exactly the same ontological thing. Modern field theory postulates that there is an ever present "sea" of these fundamental particles everywhere in space—electrons, photons, quarks, etc.—which can at any point in time be summoned up, in the same way that the number five is the same ontological thing every time someone writes it down. Thus, the electron is an eternal Form without the usual properties of composition and decomposition to which we are accustomed.

These concepts are echoed by 'Abdu'l-Bahá, Who describes reality in a way that contradicts Cartesian dualism: "know ye that the world of existence is a single world, although its stations are various and distinct"

8 It is also worth noting that this kind of relational information on some level defines a "living" thing, which is considered living in so far as it is able to maintain these relative relationships. For example, a living organism will swap out countless cells during its lifetime, yet it maintains its identity by preserving the overall relationships between these "parts" even as they are replaced.

(*Selections* 320). Further, He explains that the essential characteristic of our physical world is given by the properties of composition and decomposition: "[n]ature is that condition or reality which outwardly is the source of the life and death, or, in other words, of the composition and decomposition, of all things" (*Some Answered Questions* 1:1). He also goes on to explain that elements (or fundamental particles) are eternal, stating that it is a "true and fundamental scientific principle . . . that an element itself never dies and cannot be destroyed for the reason that it is single and not composed. Therefore, it is not subject to decomposition" (*Promulgation* 470).

Non-composition is similarly described as a property of certain spiritual entities in the Bahá'í Writings, including the human soul.[9] On some level, then, if we are to hold to a dualistic understanding of reality, we might need to consider whether to put tables, stars, and human bodies on the material side of the ledger, while grouping the human soul and the electron together on the spiritual side. Dualism is arguably more usefully understood as an artificial dichotomy than as a truth about reality, arising from our limited perception and capacity to "measure" and deduce relationships in this world. In this sense, we can say that there is only one reality: the realm of Forms or spirit. What we commonly refer to as the material world is a subset of Forms that exhibit the properties of composition or decomposition. Within this conception, the "arc of descent" or "bringing forth" represents the appearance of higher and higher Platonic ideals in composed Forms, the final one being the human spirit in the form of man.

What is remarkable about the applicability of the concept of Forms to entities like electrons, is that physics here lends some support to the Forms including not only the entirely abstract entities Zalta focuses on, like numbers, but also things that we intuitively think of as necessarily concrete, like electrons. The electron is indisputably *real*, in a way that the abstract concept of "five" (as opposed to an actual group of five tangible *things*) may not seem, to us, to be. This is relevant when considering spiritual reality, and in particular the human soul, which can sometimes be dismissed as simply an abstract articulation of that essentially quiddity of a human being that is hard to describe in language, and thus not a *real* thing. As will be seen later in this paper, some of the ways in which the soul is described in the Bahá'í Writings are reminiscent of the electron or the quantum state function—entities not so easily dismissed as mere abstractions or mental constructs.

The Quantum State Function

Having reviewed some of the essentials of Plato's theory of the Forms,

9 See, for example, 'Abdu'l-Bahá, *The Promulgation of Universal Peace* 258–60.

and the general case for understanding physical reality as a whole in light of the Forms, I will now consider the extent to which a particular concept in modern physics—the quantum state function—can be understood in terms of those Forms. This first requires a review of our understanding of the quantum state function itself.

To understand what the quantum state function is, it is helpful to begin with the classic double-slit experiment, which hints at aspects of reality quite at odds with the "common sense" understanding of the universe that emerges from our interactions with the macroscopic world. In this experiment, a beam of electrons hits a plate pierced by two slits and reaches a second plate which registers the distribution of electrons that have passed through these slits. If the electrons behaved like simple particles (as classically defined) then two clear bands would appear on the second screen, corresponding to the two slits in the first screen (see Figure 1). However, the electrons instead behave like waves: they generate a series of high and low intensity bands appearing across the whole width of the second screen (see Figure 2). These bands are consistent with the electrons behaving like waves and interfering with each other and themselves or diffracting. Yet when the electron position is finally measured (when it hits the screen) it appears as a discrete particle. Thus, we say that the electron behaves with both wave-like and particle-like attributes. Interestingly, the same pattern appears—and wave behavior is manifested—even if single electrons are shot at the double slit and accumulate one-by-one (see Figure 3). So, in reality the electron—behaving as a wave—traverses both slits at the same time; it effectively exists in two locations at once.[10] This ability to exist in two locations at once is also known as the quantum mechanical property of *superposition*. As will be discussed later, superposition can exist for many other physical properties beyond merely position.

10 Note that physicists have developed different interpretations of this behavior. Physicists ascribing to the Copenhagen interpretation (a majority) are careful to make an important distinction between the empirical fact that the results of the experiments are *consistent* with the electron traversing both slits, and the claim that the electron actually *exists at the two locations at the same time*. They would say that there's no such thing as the electron passing through a particular slit unless a measurement device was placed in that slit. On the other hand, the idea of a particle existing in two places at once has been used frequently in reputable science journalism; see for example Rafi Letzter's "Giant Molecules Exist in Two Places at Once in Unprecedented Quantum Experiment." To be sure, the idea of "existing in two places at once" stretches the very concept of "existence" or "being," and begs the question: what category of being is something which is described by the state function but not yet measured? This of course is the very heart of this paper—the ontological status of the state function.

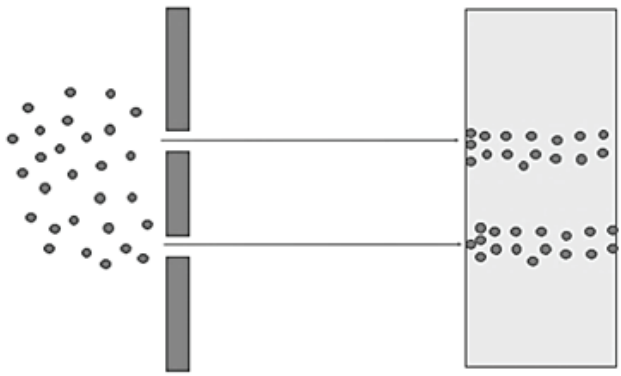

Figure 1: Expected results of Double Slit Experiment if electrons behaved like particles only.

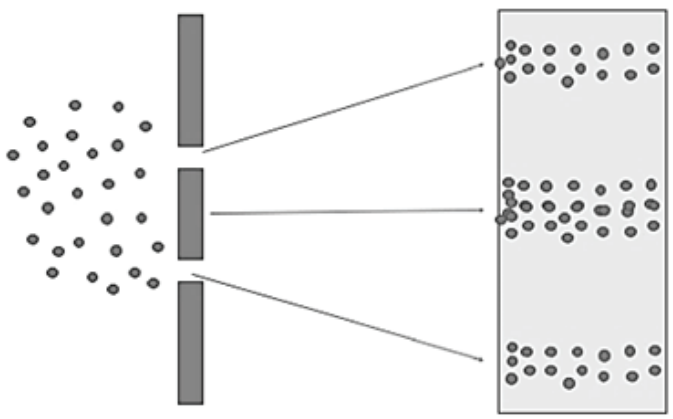

Figure 2: Actual result of Double Slit Experiment, showing that electrons behave like waves.

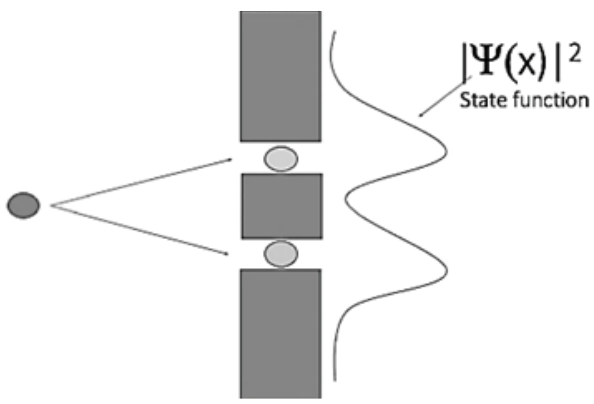

Figure 3: A single electron passing through the two slits, according to the interpretation by which it exists in both slits at once. The squared norm of the state function indicates the probability of locating the electron in a given place.

In the mid-1920s, both Erwin Schrödinger and Heisenberg developed a new approach to model the dynamics of electrons. Schrödinger's approach used a wave-like differential equation, while Heisenberg used an equivalent matrix method. The solutions to both these equations are known as the quantum state function.

There is no need, for the purposes of this paper, to delve into the details of why the quantum state function represented a breakthrough. Suffice it to say that its introduction solved many outstanding problems related to our understanding of how reality operates at the smallest scales. It allowed scientists, for example, to model how light is absorbed and emitted by atoms, and how electrons are bound about the nucleus of the atom giving rise to its distinct chemical properties (Ratner and Schatz). What is important to highlight, however, is that the quantum state function is, in mathematical terms, a complex or imaginary object. This means that it contains factors equal to the square root of -1. Since the square root of -1 is not a real number—i.e. there is no measurable quantity that, when squared, yields a result of -1—complex numbers cannot on their own represent a real measurable quantity. Physicists thus call the quantum state function "non-physical" in that it cannot correspond to a physical thing as commonly understood. The state function is used to generate measurable quantities, such as an expected value for an electron's position or momentum, only after it is *integrated* mathematically with the "operator" for the variable one is interested in measuring. Readers may be familiar with integration from calculus: it is a mathematical operation that allows one to calculate the area under a curve, by effectively "adding up" an infinite number of infinitesimally divided segments (see Figure 4). This can be likened to the process by which one can calculate the area of a shadow that a three-dimensional object will project onto a two-dimensional surface; in that case, one must also integrate or "add up" all the light rays over the object. In fact, the mathematical process of integration in certain contexts is referred to as a "projection operation."

Thus, when an observation is made in quantum mechanics, it represents a kind of shadow of the state function. The relationship between the state function and the physically measurable quantities in question is startlingly analogous to the relationship Plato described between the idealized Forms and the shadows they cast onto the "cave-wall" of our world to comprise the observed physical universe. It is also evocative of 'Abdu'l-Bahá's description of the physical world:

> Know thou that the Kingdom is the real world, and this nether place is only its shadow stretching out. A shadow hath no life of its own; its existence is only a fantasy, and nothing more; it is but images reflected in water, and seeming as pictures to the eye. (*Selections* 150)

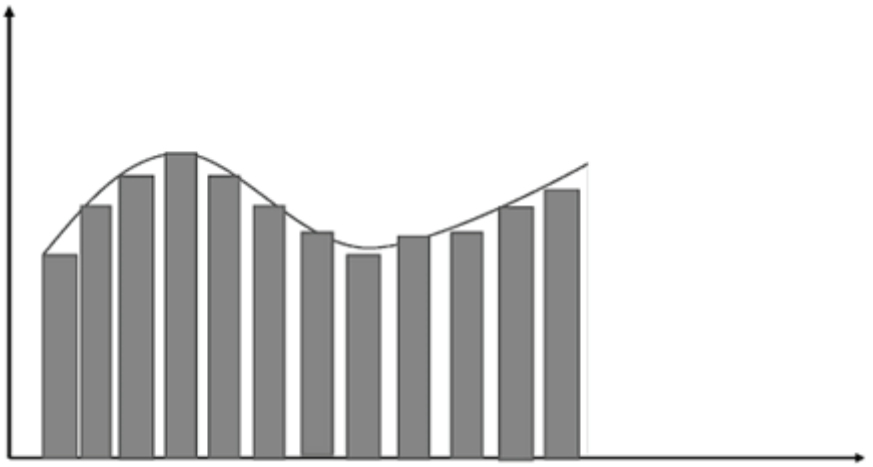

Figure 4: The area under the curve is approximated by the sum of the areas of the boxes.

Thus, from the moment of its discovery, the ontological reality of the quantum state function was debated; as an explicitly "non-physical," complex or imaginary mathematical object, in what sense could it be said to represent an actual, existing entity? Heisenberg argued from the outset that it should properly be identified with Plato's Forms, as it was not a "material" reality. He described elementary particles, like the electron whose dynamics the quantum state function was developed to model, as "comparable to the regular bodies of Plato's *Timaeus*. They are the original models, the ideas of matter" (*Physics and Beyond* 241).

Two further points about the state function bear mention. First is its probabilistic nature. When the state function is evaluated to produce a measurable quantity, it yields an "expectation value" which represents a probability, rather than a specific value. Returning to the case of the double slit experiment, if we were to predict where the electron will register on the screen using the state function, we would be able to obtain only a *probable* location in space. So, until we perform a measurement, we cannot say for certain where the electron will appear, *even if we account for its exact initial conditions and have perfect knowledge of the forces acting on it*. This, of course, is unlike the classical physics still used to predict the trajectories of macroscopic objects with great precision: here, the forces and initial conditions completely determine the object's trajectory. Given that quantum physics is now considered fundamental, with classical physics being a "special case" of quantum physics arising when objects are above a certain scale, physics as a whole appears to be statistical and non-deterministic at its core.

The second, related point is that an actual act of measurement causes the quantum state function to return a specific value (position, momentum, or whatever other physical quantity is

being measured), which it will now possess as it evolves in time. Thus, the state of "superposition"—recall the example of the electron existing in two places at once—is "collapsed" upon measurement. If, for example, we set up the double-slit experiment as before, but measure the position of the electron right before it traverses the double slit, our act of measurement "collapses" the electron's position to a singular location. Now the electron, existing in only one place, will either hit the barrier or traverse one of the slits (and not both of them). The interference pattern we would have observed on the screen had we not made the measurement does not appear; instead our results (if repeated) look like Figure 1.[11]

From a theistic, and specifically a Bahá'í, perspective, the apparent fundamental non-determinism of physics has very important implications. The late Dr. Dávúdí, for example, argues that this non-determinism casts doubt on any purely materialistic conception of existence and consciousness:

> The materialists consider "Matter" as the primary substance of human life and deny the existence of a non-material and non-physical soul. They consider man as purely physical being and reject the existence of will power. Therefore, if we dispute and disprove the concept of "determinism" we will have shaken the very foundation of materialist beliefs. (47)

The lack of determinism implies that a purely physical-causative perspective cannot fully account for what happens; as we observe in the non-deterministic trajectory of any given electron in the double-slit experiment, there is an element of *randomness*. That is, things can occur for which there is not only no known "physical" reason, but no hidden physical variable which, if known, would somehow remove the randomness or predict the behavior. When we say something is random, we are admitting a hard limit on knowledge, defined as the degree to which a set of information accessible to us corresponds to the facts of either the present, future or past state. Where no physical reason for something exists, it is rational to consider non-physical causes. In cases of human action, human free will can be posited, as Dávúdí highlights. In the case of non-determinism or apparently random behavior at the sub-atomic

11 John von Neumann in particular laid the groundwork for developing an understanding of the nature of the dynamics which quantum mechanics implied (von Neumann). He explained that there are two sorts of physics which are described by quantum mechanics. The first involves a non-deterministic process, caused by a "measurement" which he termed "non-causal". Here the "collapse" into a particular state is governed by probability. The second quantum mechanical process he termed causal, as it involves the deterministic and reversible physics which governs the evolution of the state function. The non-deterministic aspect of the state function can also be shown to support its identification with the Platonic Forms (see Appendix).

level, the principle, common to many religions, that nothing transpires without the permission of God may lead us to hypothesize that the non-physical cause at work is the Divine Will.

Ideas, Matter, and the State Function

The status of the state function was somewhat resolved with the Copenhagen interpretation thanks to the work of Werner Heisenberg, Niels Bohr, and Max Born (Wimmel). Born, in particular, proposed that the state function represents nothing more or less than a probability density function that, ontologically, existed only in the realm of mathematics. The implication was that there was no hidden "physics" or "realism" masked by the mathematical formalism—a theory that ran counter the beliefs of other prominent physicists.

In reaction to the apparent "non-realism" of the state function, physicists Albert Einstein, Boris Podolski, Nathan Rosen and others came up with a thought experiment (the now famous EPR paradox, after their initials) to expose what was considered an absurd consequence of quantum mechanics: the fact that two particles, after interacting and becoming "entangled" quantum-mechanically, could affect each other's measured properties even after being separated by a great distance. Without delving too deeply into the mathematics involved in the paradox, the idea is this: if the quantum state function exists only in the realm of mathematics, and has no physical correlate, then the quantum entanglement of two particles will also be due purely to the underlying mathematics of the state function. There will be no physical mechanism whatever connecting the two. Thus, unlike in the case of two macroscopic objects acting on each other through the physical force of gravity, for instance, the quantum-entangled particles will be able to produce a measurable difference in each other that is not reduced by great distance. Altering one will impact the other, without there being any physically-mediated connection between them. Although the EPR paradox—which Einstein derisively called "spooky action at a distance"—was intended to highlight an absurd consequence of the Copenhagen non-realist understanding of the quantum state function, it was actually subsequently demonstrated through many experiments. In fact, the notion of quantum entanglement is now not only accepted, but is used to develop new technologies. So far, experimental testing[12] has lent support to

12 Such tests, of what is known as the "Bell Inequality," were in fact the subject of the 2022 Nobel prize in physics. The non-local nature of quantum entanglement was couched in a famous theorem developed in 1964 by John Bell, which states that "[n]o physical theory of local hidden variables can ever reproduce all of the predictions of quantum mechanics" (Parker 542). Bell further proposed an inequality employing the EPR style of quantum entanglement, which if violated would prove his theorem. Bell's inequality was thus intended to prove that quantum mechanics required

the counterintuitive idea that the state function operates at the level of mathematics, yet dictates outcomes in the physical world—without any physical mechanism mediating this effect.

The Ontological Reality of the State Function

The Pythagorean view of physics was thus re-energized with the introduction of the state function in the 1920s. This was especially true after the experimental results of Bell's Theorem ruled out the existence of anything that can be termed "physical"—that is, something existing in a definite location in space and time—underlying the state function. Attempts to ground the state function in some kind of physicality—most notably David Bohm's non-local version of a hidden variable theory—require describing the hidden variable in a manner that does such violence to the very concept of "physicality" that it scarcely differs from how a Platonist might describe a Form, or a religious person might describe a spirit as something apart from space and time.[13]

This subversion of the standard concept of physicality is true for every viable interpretation of the quantum state function. The many worlds theory put forward by Hugh Everett, for example, postulates that at every measurement of the state function the universe bifurcates into multiple separate universes representing each probable outcome (Everett).[14] Finally, the more prevalent Copenhagen-inspired interpretations treat the state function as only a mathematical reality. In all these schools the traditional notion of what we call a "physical" thing is upended in various ways: by denying it properties of space and time, denying it a singular identity, or relegating it to the realm of mathematical abstraction. Thus, the state function for a particle presents itself as a strong candidate for being identified

non-locality. Experiments testing Bell's inequality in 1972, 1981, and 2015 (by Wehner, Taminiau, and Henson et al.) have so far laid to rest any theory of local hidden variables. In other words, there are, in fact, no local 'physical' mechanisms which can account for the correlated behavior seen in the case of quantum entangled objects.

13 Bohmian mechanics grew out of De Broglie's concept of a "pilot wave", which was thought to encode the behavior of the quantum state function (Goldstein). In Bohmian mechanics, this pilot wave or guiding equation is the non-local aspect of the quantum state function; it determines the velocity of each particle, and is itself determined by the configuration of the entire universe. In other words, Bohm's non-local guiding wave function exists everywhere and instantaneously connects all things. Thus, even though Bohmian mechanics has not been ruled out experimentally, the non-local physical properties required by this theory stretch the concept of "physical" almost beyond recognition. It is not surprising that Bohmian mechanics was quickly picked up by followers of various branches of eastern mysticism to validate their essentially spiritual views of reality (Horgan).

14 See Appendix for a discussion of a "level I multiverse," a concept with similar implications.

with a Platonic Form, particularly in the Copenhagen interpretation.

The impulse to identify the quantum state function with *anything*, physical or not, has not gone without considerable criticism from the philosophical community (Stenger, Lindsay, and Boghossian). Critics' central argument is that physicists are mistaking their model for reality. From a certain perspective, this is always an important caution: science involves the progressive construction and refinement of models to make better and better predictions, but such models should not be mistaken for reality itself, since they will no doubt be improved upon to produce more accurate approximations of reality. On this view, the quantum state function is simply a model that helps us make predictions about the actual physical universe; the mathematics in which it exists as itself are not an objectively existent underpinning of the physics, but only a tool. The counter-argument is that at some point, in some areas of science, models can no longer be improved upon: the mathematics encode all that is necessary to describe a particular phenomenon at a given scale. In a trivial example, the mathematical equation of the circumference of a circle will never be replaced by a better model.[15]

15 This view is made explicit in Renormalization Group Theory, developed in the early 1970s. Renormalization Group Theory provides a framework to address the limits of physical theories in a mathematically rigorous manner; it also addresses the role that scale and coherence play in the emergent physical attributes of nature—from charge, mass and magnetization, to the appearance of solid, liquid and gaseous states of matter (Ma). While no doubt better models will arise, which can capture more physics above a certain energy scale, the profound insight of Renormalization Group Theory is that at a given energy scale one can define exactly all observed physical phenomena using an "Effective Field." This Effective Field description will remain true regardless of what form the model ultimately assumes at a higher energy scale. Thus, the fact that concepts of physicality and locality will remain violated in all future models of quantum physics is certain; in the realm of quantum mechanics, the experimental validation of Bell's Theorem tells us definitely that we must abandon normal ideas of physicality, such as locality in space and time.

Renormalization Group Theory additionally provides further evidence for the Pythagorean argument that mathematical relationships, rather than the "stuff" of matter, primarily determine what is. The study of so-called critical phenomena in the context of Renormalization Group Theory has shown the existence of what are called universality-classes. These are a set of mathematical models which flow towards a single type of self-similar behavior as one changes the scale that is observed. That is, identical physical behavior can be observed across a diverse range of physical systems, implying that some phenomena are independent of the actual materials involved.

Ether and the Realm of Forms

Having made a plausible case that the quantum state function could belong to the realm of Platonic Forms, I will now explore how statements

by ‘Abdu’l-Bahá and Bahá’u’lláh can enrich this discussion, by not only potentially supporting this case, but by also possibly pointing to connections between the Forms, the quantum field, and spiritual reality. This goes beyond the identification of this world as a “shadow stretching out,” a concept intuitive to many religious worldviews, and gets into remarkably specific pronouncements. Of course, whenever an individual shares the meanings they find in the Bahá’í Writings, there is no claim to have found authoritative truth; readers are invited to reflect for themselves on the connections suggested below, and to decide whether they find them useful as working hypotheses in their own understandings of our reality.

At the outset, it is worth acknowledging that many academics, particularly those familiar with the historical and cultural context of Bahá’u’lláh’s Revelation, would hesitate to admit that Bahá’u’lláh could have possibly been describing any aspect of modern physics as we understand it. On this view, it is a mistake to attribute modern understandings to historical individuals; a proper understanding of a historical figure’s statements can only be arrived at by assessing the culture and modes of thought current at the time. Thus, it is only through this historical lens that an author’s intent can be deduced. While this approach is certainly reasonable when applied to ordinary humans, it may not apply when considering statements by the Manifestations of God, since Their understanding transcends any historical or cultural context. That is not to say that an understanding of this context cannot shed light on the meaning of Their words, but rather that neither culture, current knowledge, nor history can be argued to impose a hard limit on the potential meaning of their words. Bahá’í Scripture makes clear that the words of God transcend human conceptual limitations, and have meanings that are inexhaustible and unfold over time. Indeed, in His discussion of Socrates, Plato’s teacher, in the *Tablet of Wisdom*, Bahá’u’lláh purposely draws our attention to the fact that this philosopher’s perception of “a unique, a tempered, and a pervasive nature in things, bearing the closest likeness to the human spirit”—a statement which, as discussed below, can be connected to both the Forms and modern physics—also reflected an understanding that transcended the understanding of even a far later age: “Wert thou to ask from the worldly wise of this generation about this exposition, thou wouldst witness their incapacity to grasp it” (*Tablets* 146).

Of course, this principle also applies to our temptation to apply our current understanding of reality to the Words of the Manifestation, and assume that where we see some correlation we must have correctly—and even precisely—understood the Manifestation’s meaning. It is easy, in hindsight, to say that one sees affirmations of certain contemporary ideas in scripture. Individuals engaged in searching for these correlations often put a great deal of effort into fitting scripture into the current scientific narrative, or worse yet trying

to fit (and distort) current science to fit theology. While a certain amount of creative analogizing might be necessary as a starting point to discerning the meaning(s) of scriptural passages that appear obscure, one should always bear in mind that just about any theory can be made to fit our observations if we twist it enough. This is attested by the efforts of creationist "research" institutes that attempt to mold current scientific evidence to fit the narrative of a 6,000-year-old earth—here science is distorted to support a supposed "truth" of scripture. It is equally seen in those who divine all sorts of modern scientific concepts from scripture, or historical predictions from the numerology of the Bible or the Qur'án—here the temptation may be to skew one's reading of scripture in order to see in it reflections of empirical findings. Of course, the strongest evidence for the validity of any interpretation of scripture as a description of physical reality would be for it to produce a valid *prediction* about nature that is both novel and testable; that is, it should ideally generate new and useful knowledge about nature. I am unaware of any case where humans have divined any such new scientific knowledge from scripture prior to its discovery through scientific study itself.[16] In this respect, the current work is no exception, and makes no claim to uncover anything "new" and predictive in Bahá'í scripture relating to the natural sciences. All I have attempted is to read the two Books God has provided for us—that of Nature, and that of Revelation—in a spirit of humility and curiosity, and to point out correlations which seem reasonable based on my understandings of both.

A first point of correlation emerges from juxtaposing the ontological reality of the state function with that of the "ether," the hypothetical medium that, as late as the early twentieth century, was believed to be instrumental in the propagation of light. This conception of ether began to be questioned with the famous Michelson-Morley experiment (first performed in 1887, and subsequently repeated with increasing rigor), which failed to measure ether's expected effects. Once Einstein's special theory of relativity eliminated the need for a physical medium for the propagation of light, ether was duly discarded as both empirically unsupported and theoretically unnecessary. Einstein in fact built the whole of special relativity by assuming the non-existence of a physical ether against which relative motion could be measured (Griffiths). Light, like electrons, ultimately came to be represented by a quantum state function. Einstein also introduced the concept of light as modeled by discrete particles or photons. While photons, like electrons, do at times behave as

16 Indeed, while a Bahá'í understands the Manifestations to have access to all knowledge, it is also evident that the Revelations They bring are focused on imparting spiritual and social teachings, rather than the secrets of physical reality that human reason is itself able, over time, to uncover through science.

waves, and while waves require a medium in which to propagate, this medium could not have the properties of ordinary physical matter. Instead, this medium is represented using the state function or by employing the *quantum field* formalism.

The quantum field itself is a generalization of the quantum state function developed to account for the creation and annihilation of multiple particles and species of particles. After the development of the Schrödinger equation in 1925, Paul Dirac developed a version of this equation which obeyed special relativity, explained the origin of the electron's intrinsic magnetic field, and even predicted the existence of antimatter. However, it became clear that the Dirac equation necessitated a field approach to quantum phenomena. This is because when relativity is combined with quantum mechanics as in the Dirac equation, particles and energy now have the possibility of arbitrarily appearing from the vacuum and disappearing just as arbitrarily. The standard quantum mechanical state function, however, does not have a mechanism for a particle to be created or destroyed. The field theory approach solved this problem by including just such a mechanism. In the field theory view, all of space is permeated by various fields, the vibrations of which give rise to particles that interact with other fields, and cause vibrations or particles in those fields in turn. The energy of these particles corresponds to the frequency of the vibrations in their field, with higher frequency yielding higher energy particles (Zee, *Quantum Field Theory*).

Without going into too much technical detail, subsequent developments in quantum theory have helped flesh out the picture of how quantum fields relate to physical reality as a whole. Quantum electrodynamics showed that vibrations in quantum fields give rise to both light and matter (Feynman), while quantum chromodynamics and electroweak theory provided for the existence of quarks, gluons and other elementary particles and forces. These theories collectively comprise the Standard Model of Physics. The Standard Model requires the existence of multiple quantum fields, linked together through a patch work of continuous symmetries. The Standard Model is consistent with an enormous amount of experimental evidence; further theoretical models, attempting to expand the Standard Model to account for a broader swathe of forces and particles, have yet to receive experimental validation. Such theories include super symmetry, in which the multiple quantum fields of the Standard Model are reduced to a singular field with a single symmetry that permits the appearance of all particles and forces except gravity, and so-called unified field theories, like string theory, which aim to account for gravity as well. (Zee, "Gravity and Beyond")

Before any of these theoretical advances—or the idea of a quantum field upon which they are built—was conceived, 'Abdu'l-Bahá, in various Tablets, and in talks given in the early

1900s, discussed the then-current concept of the ether. However, a careful examination of His statements makes it clear that the ether which He was describing was a very different thing than what was commonly understood at the time; indeed, the ether as described by 'Abdu'l-Bahá seems to properly belong to the realm of Forms. 'Abdu'l-Bahá describes ether not as a physical reality—the medium for the propagation of light that Einstein invalidated—but an intellectual one, which He compares to the human spirit:

> Even the ether, the forces of which are said in natural philosophy to be heat, light, electricity, and magnetism, is an intelligible and not a sensible reality. Likewise, nature itself is an intelligible and not a sensible reality; the human spirit is an intelligible and not a sensible reality. (*Some Answered Questions* 16:3)

The consistency of this description of ether with the modern concept of the quantum field has been highlighted by a number of authors (Brown; Mihrshahi; Matthews).

Elsewhere, 'Abdu'l-Bahá elucidates the following verse from Bahá'u'lláh's *Tablet of Wisdom*: "The world of existence came into being through the heat generated from the interaction between the active force and that which is its recipient" (*Tablets* 141). Keven Brown provides a provisional translation of 'Abdu'l-Bahá's discussion of this verse, which describes ether as giving rise to both matter and electromagnetism:

> the substance and primary matter of contingent beings is the ethereal power, which is invisible and only known through its effects, such as electricity, heat, and light—these are vibrations of that power, and this is established and proven in natural philosophy and is known as the ethereal substance (*maddiy-i-athiriyyih*). This ethereal substance is itself both the active force and the recipient; in other words, it is the sign of the Primal Will in the phenomenal world . . . . The ethereal substance is, therefore, the cause since light, heat, and electricity appear from it. It is also the effect, for as vibrations take place in it, they become visible. For instance, light is a vibration occurring in that ethereal substance. (*Má'idiy-i-Ásmaní* 2:69, qtd. in Brown, "A Bahá'í Perspective" 28. Provisional translation)

There are two points to highlight here. First, 'Abdu'l-Bahá' identifies ether as the "sign of the Primal Will"; combined with the earlier quote's explanation that ether—like the human spirit—is intelligible, not sensible, this would seem to place it squarely in the spiritual realm, or at least in the realm of Plato's Forms.

Second, 'Abdu'l-Bahá's discussion is surprisingly prescient in its consistency with the thrust of modern theoretical

physics. Brown, in highlighting how this passage seems to elucidate Bahá'u'lláh's description of "the active force and its recipient as the same, yet different" notes that, for 'Abdu'l-Bahá, these two "are the polar aspects of the ethereal substance, which is both spirit and non-material matter" (qtd. in Brown, "A Bahá'í Perspective" 28. Provisional translation). Some physicists speculate that our universe might have come into existence as a consequence of the vacuum fluctuations of the quantum field.[17] These vacuum fluctuations arise due to the Heisenberg uncertainty principle, which places limits on the possibility of determining a particle's momentum and position simultaneously. While this is commonly (and mistakenly) understood as a statement about our capacity to measure reality, it in fact describes a property of quantum particles, one of whose consequences is that a particle cannot exist in an absolute state of rest: it must always have some non-zero momentum or, equivalently, must always have some finite temperature. This in turn ensures that the vacuum state must always contain a non-zero amount of energy; thus, a true vacuum cannot exist.[18] There is striking resonance between this modern scientific account of creation, in which these vacuum fluctuations or vibrations of the quantum field generate physical existence, and 'Abdu'l-Bahá's description in which vibrations of the field—the "ethereal substance"—generate particles and forces.

As mentioned earlier, in *Some Answered Questions* a comparison is made between ether and the human spirit. We thus know that the ether and the human spirit have at least this much in common, that each is "an intelligible, and not a sensible reality" (16:3). Remarkably, if we take 'Abdu'l-Bahá's to be using the term "ether" to refer to a quantum field, and compare such a field's characteristics as currently understood to those of the human spirit as elucidated elsewhere by 'Abdu'l-Bahá and Bahá'u'lláh, more similarities unfold. A detailed comparison of the known attributes of the quantum state function (and/or its generalization the quantum field) and the human spirit reveal several striking areas of commonality. These include the following:

1. Both are non-physical;
2. Both are pervasive;
3. Both give form to a measurable physical expression;
4. Both are simple, non-composite;

17 See for instance Lawrence Krauss, *A Universe from Nothing*, in which this account of the universe's origins is used to argue against theism.

18 'Abdu'l-Bahá's affirmations that "motion . . . is necessary to existence" (*Some Answered Questions* 63:2) and that "a void is impossible and inconceivable" (Tablet of the Universe ¶20; provisional translation) also resonate strongly with these findings of modern physics. The theory of constant motion is in fact an ancient one; according to Plato it goes back to Heraclitus: "Heracleitus [*sic*] is supposed to say that all things are in motion and nothing at rest" (*Cratylus*).

5. Both have the power of superposition;
6. Both are "the sign of the Primal Will in the phenomenal world."

The first and most obvious common characteristic is non-physicality. Both the human spirit and the state function are non-physical— at least by the classic understanding of "physicality." The second property follows from the first: they both are pervasive in that they both appear to transcend the strictures of space. For example, particles can be quantum mechanically entangled across the universe and affect each other instantaneously or in a non-local manner. As for the human spirit, 'Abdu'l-Bahá explains that "the spirit has no place: It is a placeless reality, and for the spirit earth and heaven are the same" (*Some Answered Questions* 67:2)

As to the third property, in *Some Answered Questions* 'Abdu'l-Bahá states: "The spirit is as the lamp, and the mind as the light that shines from it" (55:5). Thus, the physical expression of the mind acting in the world arises from the human spirit. Similarly, the quantum state function gives rise to the appearance of a physical elementary particle localized at particular point in space.

The fourth property is that each is simple and non-compounded. An electron, for example, is a fundamental particle, simple and uncompounded. Although it arises from a continuum or a field, its physical expression only occurs in indivisible units of matter. Similarly, in one of His talks, 'Abdu'l-Bahá states that the human spirit is like a fundamental particle (He uses the word "atom" in the ancient Greek and original sense of this word, meaning an indivisible particle) in that it is not composed: "It is self-evident that the human spirit is simple, single and not composed in order that it may come to immortality, and it is a philosophical axiom that the individual or indivisible atom is indestructible" (*Promulgation* 307). In the same talk, He provides support for the fifth property listed above, describing a capacity of the human spirit that parallels the quantum mechanical property of superposition. In doing so, He invokes exactly the same ontological category of abstract objects used in contemporary versions of Platonism (i.e., an object possessing two geometries simultaneously):

> The spirit of man, however, can manifest itself in all forms at the same time. For example, we say that a material body is either square or spherical, triangular or hexagonal. While it is triangular, it cannot be square; and while it is square, it is not triangular. Similarly, it cannot be spherical and hexagonal at the same time. These various forms or shapes cannot be manifest at the same instant in one material object. Therefore, the form of the physical body of man must be destroyed and abandoned before it can assume or take unto itself another. Mortality, therefore, means transference from one form

> to another—that is, transference from the human kingdom to the kingdom of the mineral. When the physical man is dead, he will return to dust; and this transference is equivalent to nonexistence. But the human spirit in itself contains all these forms, shapes and figures. It is not possible to break or destroy one form so that it may transfer itself into another. As an evidence of this, at the present moment in the human spirit you have the shape of a square and the figure of a triangle. Simultaneously also you can conceive a hexagonal form. All these can be conceived at the same moment in the human spirit, and not one of them needs to be destroyed or broken in order that the spirit of man may be transferred to another. There is no annihilation, no destruction; therefore, the human spirit is immortal because it is not transferred from one body into another body. (*Promulgation* 307)

This property of "superposition" of the human spirit is important enough that 'Abdu'l-Bahá discusses it in at least two other talks (see Appendix). Just as 'Abdu'l-Bahá describes the human spirit as able to conceive of multiple contradictory forms at the same time, the property of superposition in quantum mechanics permits a particle to maintain several contradictory properties at the same time. In the double-slit experiment, as seen, a single electron can pass through two slits in a screen at the same time, thus existing in two locations at once; however, this principle of superposition can apply to other states and properties beyond position.[19]

We can again note here a strong correlation with Platonic Forms. An entity—whether a quantum phenomenon or the human spirit—which contains contradictory states would explicitly qualify as one of Zalta's "abstract objects," discussed earlier as a modern philosophical take on the Platonic Forms. Indeed, the mythical "round-square" often used to exemplify an abstract object is not only directly alluded to in 'Abdu'l-Bahá's discussion of the human spirit's capacity to contain multiple geometric shapes; it is also a perfectly possible superposition in quantum mechanics, where a quantum state can exist in a superposition of

19 In the well-known thought experiment of Schrödinger's cat, the concept of superposition of states is taken to the extreme (and highly debatable) case where the release of a poison is triggered by a random quantum event (radioactive decay) which, until observed, is in a superposition of having occurred and not occurred; as a result, a cat kept in a box where the poison has / has not been released is kept in a superposition of life and death. The implausibility of this scenario suggests that, intuitively, superposition is unlikely to be a property of macroscopic systems—although, intriguingly, it may be too categorical to assert that no composite system can be in superposition, as recent experimental work seems to demonstrate that superposition of entire molecules is possible. Again, see for example, Letzter.

geometries that exhibit a round form and a square form simultaneously.[20]

The sixth common property is that they both are a sign of the Primal Will in the world. This is obviously true of the human spirit, which Bahá'u'lláh explains "is, in its essence, one of the signs of God, a mystery among His mysteries. It is one of the mighty signs of the Almighty, the harbinger that proclaimeth the reality of all the worlds of God" (*Gleanings* 82:6). 'Abdu'l-Bahá's, as we have seen, similarly describes ether as "the sign of the Primal Will in the phenomenal world" (*Ma'idiy-i-Asmanl* 2:69; provisional translation).

Of course, none of these correlations imply that the quantum state function is in any way *equivalent* to the human spirit, but it does suggest that they have properties similar to each other. This close similarity may find further support in a remarkable passage from Bahá'u'lláh in the *Tablet of Wisdom*. In His praise of Socrates in the *Tablet*, Bahá'u'lláh makes the following statement:

> What a penetrating vision into philosophy this eminent man had! He is the most distinguished of all philosophers . . . He [Socrates] it is who perceived a unique, a tempered, and a pervasive nature in things, bearing the closest likeness to the human spirit, and he discovered this nature to be distinct from the substance of things in their refined form. He hath a special pronouncement on this weighty theme. Wert thou to ask from the worldly wise of this generation about this exposition, thou wouldst witness their incapacity to grasp it. (*Tablets* 146)[21]

Keven Brown makes a convincing case that this quote should be properly understood in terms of Plato's Theory of Forms, and that the "unique . . . tempered, and . . . pervasive nature in things . . . distinct from the substance of things in their refined form" might well be a reference to "[t]he ethereal substance itself, which is the universal medium for . . . vibrations and motions;" in other words, what we today understand as the quantum field ("A Bahá'í Perspective" 30). Brown further suggests that the connection of "closest likeness" between this ether and the human spirit may be a reference to *Phaedo*, a dialogue of Plato in which Socrates presents an argument for the immortality of the Soul based on the concept of Forms. He argues

20 This is a so-called "cat-state," a quantum state composed of two diametrically opposed states, and named after the Schrödinger's cat thought experiment. "Cat-states" involving six atoms arranged in a superposition of two maximally different states have so far been achieved (Leibfried).

21 From the point of view of modern historical scholarship, the basis for the attribution of this statement to Socrates is unclear; readers may wish to refer to Keven Brown's discussion on this point in "A Bahá'í Perspective on the Origin of Matter."

that the soul or spirit of a human represents a type of idealized form; thus, like the Forms, it is immortal. This implies, of course, that other idealized Platonic Forms have a likeness to the human spirit. This concept is further reinforced in *Timaeus*, where the idea of "natural receptacle of all bodies" is presented as a "a kind of neutral plastic material on which changing impressions are stamped by the things which enter it, making it appear different at different times" (Plato, *Timaeus* 66). Brown elaborates on how this

> "natural receptacle of all bodies" corresponds to the passive pole of the ethereal substance mentioned by 'Abdu'l-Bahá. It is, as was already stated, an intellectual reality and therefore eternal and on the same plane as the human spirit . . . The active pole of the ethereal substance corresponds to . . . the Forms. ("A Bahá'í Perspective" 31)

Finally, in another reported statement, 'Abdu'l-Bahá appears to make this connection between spirit and the thing which underlies matter explicit. He is reported to have said that

> in philosophy the spirit is energy and all matter is endowed with energy; and this power is inseparable from matter, as in electricity. In other words, matter is a vehicle for spirit, but the transformation of matter does not involve the extinction of that power because transformation and transference are in the properties of matter…. The manifestation or appearance of the spirit varies due to changes in matter and bodies. (Zarqání 335)

Consciousness and the Quantum State Function

What has been discussed so far makes the case that the human spirit and the quantum state function can both be understood as being, on some level, ontologically similar, based on their shared properties and on their plausible categorization as Platonic Forms. It is worth considering the further possibility that these two entities—the human spirit and the quantum state function—have a particular relationship to each other. In this context, the growing suspicion among many physicists that there might be some correspondence between human consciousness and the nature of the quantum state function echoes the connections drawn in the Bahá'í Writings between the human spirit and the "ether".

One of the most startling facts about the quantum state function is that the expectation value it produces depends on the manner in which the phenomenon in question is observed. For example, one can observe either the particle nature of the quantum state function or its wave nature, depending on how one performs a given measurement. The crucial role of observation in quantum mechanics inspired the von Neumann–Wigner interpretation of

QM, according to which the relationship between consciousness and the state function is such that consciousness actually causes the collapse of the state function (Atmanspacher). This interpretation lends strong support to philosophical idealism, the idea that reality is founded upon consciousness or mind.

Despite the fact that this is favorite territory of those who unabashedly abuse and mis-represent science in order to peddle pseudo-science, there do exist many legitimate links between consciousness and quantum mechanics. In his article, "The Strange Link between the Human Mind and Quantum Physics," Philip Ball—the one-time editor for the journal *Nature*—lays out the fascinating and strange correspondence between the two. Ball mentions the von Neumann-Wigner interpretation, but also highlights the possibility that the relationship between quantum mechanics and consciousness may (also) work in the other direction.

Today some physicists suspect that, whether or not consciousness influences quantum mechanics, it might in fact arise because of it. They think that quantum theory might be needed to fully understand how the brain works. Might it be that, just as quantum objects can apparently be in two places at once, so a quantum brain can hold onto two mutually-exclusive ideas at the same time?

This line of reasoning rests, of course, on the very property of superposition that 'Abdu'l-Bahá points to as a characteristic of the human spirit.

Conclusion

On the second day of Genesis, God created what in the original Hebrew is termed *ráqîa'*. This word, translated as "firmament" by the authors of the King James Bible, might also be rendered "expanse"; it is a luminous interworld linking "heaven" and "earth." The Greeks similarly posited that the celestial spheres were composed of "quintessence" or "ether," a fifth element that was neither earth, air, water or fire. By the time of western medieval science, ether was believed to fill the heavens beyond the earth. Finally, by the seventeenth and eighteenth centuries, luminiferous ether was thought to be the medium for the propagation of light and later electromagnetism.

I have shown that in many respects the quantum field is the modern representation of the ancient concept of ether, and that in fact it can be identified with the ethereal substance (*maddiy-i-athiriyyih*) discussed in the Bahá'í Writings. This identification places it squarely in Plato's idealized realm. A careful consideration of the properties of the related concept of the quantum state function for elementary particles also supports the case for it belonging to the realm of Plato's idealized Forms. Like the expanse of *ráqîa'*, the quantum field conceptually links philosophical idealism with the material world, and perhaps even hints at a bridge over the growing gulf between science and religion. Those familiar with the Bahá'í Faith are generally aware of

its insistence on the harmony between these two great systems of knowledge; it may be that in further exploring the correlations between the Bahá'í Writings and the independent system of knowledge that is philosophy, we will gain an ever-richer understanding of just how coherent and interconnected all of reality, in its spiritual and material dimensions, truly is.

Appendix

Implications of Quantum Randomness

This probabilistic aspect of nature has very profound implications. If we assume that the universe is spatially infinite, we might further conclude that it constitutes a level I multiverse according to the often-used multiverse classification scheme developed by Max Tegmark. Such a multiverse is characterized by an infinitude of identical or "parallel" worlds. This is because probabilistic physics operating over any kind of infinity will "almost surely" yield all outcomes that have a non-zero probability of occurring, even if that probability is infinitesimally small. This means that, in a universe with infinite space, all these forms must not only exist, but have an infinite number of occurrences at any time. Furthermore if the universe is eternal, these forms will occur an infinite number of times; that is, all physical configurations are eternal (Tegmark).

This can perhaps most easily be understood by way of analogy. If we imagine that each possible physical configuration represents one side of a die with an extremely large yet still finite number of sides, and if we are free to roll that die an infinite number of times, then we "almost surely" will explore all the sides of that die not just once but an infinite number of times. The key concept here is that the number of sides or distinct physical configurations is finite. It is not clear from our current understanding of physics whether this is in fact the case (though there is some evidence to suggest that it is). In other words, space-time might not be infinitely divisible, and there may exist some finite division of space and time, thus placing a limit on the number of distinct physical configurations.

The existence of an infinitude of eternally repeating forms suggests that, in fact, all possible physical configurations are actually eternal and exist outside of space and time—that each represents a type of eternal Platonic Form, or as 'Abdu'l-Bahá explains in the Tablet of the Universe, "[j]ust as particulars are infinite in number, so also universals" (¶ 8; provisional translation). Similarly, in *Foundations of World Unity* He tells us:

> The apparent annihilation is this: that the form, the outward image, goes through all these changes and transformations. Let us again take the example of this flower. The flower is indestructible. The only thing that we can see, this outer form, is indeed destroyed, but the

> elements, the indivisible elements which have gone into the composition of this flower are eternal and changeless. Therefore the realities of all phenomena are immutable. Extinction or mortality is nothing but the transformation of pictures and images, so to speak—the reality back of these images is eternal. (52)

'Abdu'l-Bahá and Bahá'u'lláh also explain in numerous places that in fact creation is both eternal and infinite. It should be noted that They do not, to my knowledge, suggest that we do in fact live in a level I multiverse. Indeed, a possible escape from the infinite occurrences of human beings specifically is offered by the idea of the uniqueness of each human soul. Further, infinite occurrences of all physical forms may conceptually be avoided if there is a Divine Will behind creation: the existence of so-called parallel worlds it is not a foregone conclusion if one posits that apparent quantum randomness is actually a function of such a Will. Either way, death and decay would seem to be an illusion—a simple product of our limited sampling, if we exist in a multiverse, or if not then still negated by the existence of the idealized realm of the Forms, a reality more fundamental than the material one.

Talk at Green Acre Eliot, Maine, 16 August 1912

Therefore, it follows that no phenomenal organism can be possessed of two forms at the same time. If an object or phenomenon presents a triangular shape, it cannot simultaneously possess the shape of a square. If it is spherical, it cannot at the same time be pentagonal or hexagonal. In order to assume any given figure or form it must relinquish its previous shape or dimension. Thus the triangular must be abandoned to assume the square; the square must change to become a pentagon. These transformations or changes from one condition to another are equivalent to death. But the reality of man, the human spirit, is simultaneously possessed of all forms and figures without being bereft of any of them. It does not require transformation from one concept to another. Were it to be bereft of one or all figures, we would then say it has been transferred to another, and this would be equivalent to death. But as the human spirit possesses all the figures simultaneously, it has no transformation or death. ('Abdu'l-Bahá, *Promulgation* 260)

Talk to Theosophical Society, The Kensington Exeter and Boylston Streets, Boston, Massachusetts, 24 July 1912

Every being in the universe requires a unique form to be realized. For example, it may have the form of a triangle, or the form of a square, or the form of a pentagon, or the form of a hexagon, but all of these forms cannot exist simultaneously in the same material entity, and it is impossible for that entity to come into existence while possessing

multiple divergent forms. A being cannot have a triangular form at the same moment it has the shape of a square, nor can it possess the form of a square simultaneously with the form of a pentagon, nor the form of a pentagon with the form of a hexagon. Rather, that singular being is either triangular, square, or pentagonal. Consequently, when it is transferred from one shape to another, change and transformation result, and decomposition and inversion will appear. But if we reflect, we will perceive that the soul of man, unlike his body, can exist while simultaneously possessing endless forms. Whether it possesses the form of a triangle, the form of a square, the form of a pentagon, the form of a hexagon, or the form of an octagon, the soul exists with all of them, for it resides in the plane of the mind where translocation from one form to another does not occur. (‘Abdu’l-Bahá *Promulgation* 242)

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