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The Concept of God According to Quantum Theology

- K.Babu Joseph[1]

Abstract: *Quantum theology is defined as the application of quantum mechanics to theology. The principles of quantum mechanics are briefly reviewed and applied to the problem of conceptualizing God. We propose that God is an Infinite Energy Source. God is the creator of the universe which is of finite energy and is its constant Observer in the sense of quantum mechanics. The physical basis of our arguments is the observation that energy is simply the capacity for doing work and can be conceptualized even in a one dimensional time world.*

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Introduction

The one question that is of supreme importance to humans is the existence of God.[2] Theology purports to be the study of issues relating to God and God's relationship with the world. Many proofs for the existence of God from a Judaic-Christian point of view are available in classical theology. A cogent account of the relevant arguments is available in Hick.[3] God is visualized as the Supreme Being who is Eternal and Infinite in everything, including power, glory, goodness, holiness and love. God is the Creator or Designer of the universe, which has been supposed to be evolving according to the laws God has enjoined in the beginning - so goes a most popular line of argument. Traditional arguments for the existence of God include the ontological argument, the first cause and cosmological arguments, the design or teleological argument and the

moral argument. The ontological argument, first put forth by Anselm of Canterbury in his work *Proslogion*, proclaims God as the Most Perfect Being such that nothing more perfect can exist. Such a being, if it existed in the mind only, then a being greater than that which existed as an extra mental reality could be conceived.[4] Hence, the conclusion is that the Perfect Being must be an extra mental reality. Kant, among others, has criticized this argument on the ground that the concept of the Perfect Being does not necessarily entail its own existence, just as the definition of an arbitrary entity X does not necessarily entail the existence of X.[5] In fact philosophical arguments, both pro and contra, do not prove or disprove God's existence conclusively, leaving the existence of God ultimately as a matter of faith.

Quantum theology[6] constitutes a recent attempt to apply quantum mechanics, the physical theory of the world of atoms, molecules and quanta (of energy), which was developed in the 1920s. In the past many religious thinkers fashioned their reflection on God in a manner consistent with Newtonian mechanics[7] and classical determinism according to which, if the initial positions and velocities of all particles in a system are known, then its future behaviour is predictable. With the discovery of chaos in the latter half of the last century, this kind of certainty can be ensured only in the case of classical systems that are linear.[8]

That is, there is no guarantee of certainty if the system is nonlinear. In this sense, the long- term behaviour of the planets in the solar system is not predictable with absolute precision. The world of particles is governed by Heisenberg's principle of uncertainty[9] which states that certain pairs of physical quantities, called complementary observables, cannot be measured simultaneously with exactness. Position and momentum[10] form such a complementary pair. Quantum mechanics is an edifice built on the uncertainty principle. In the standard Copenhagen interpretation of quantum mechanics one can talk only about probabilities. For instance, from quantum mechanics one may compute the probability of finding an electron at any point, at any instant. Even if the probability of an electron being found here is one, it does not follow that the probability of finding it in New York the next moment is zero. In quantum theology the endeavour is to apply the foundational framework of standard quantum mechanics to the problems in natural theology.[11] In the present work we

follow the spirit of this emerging discipline and try to throw some light on a concept of God that is consistent with quantum theology. The fact is that quantum mechanics opens up a new worldview and our attempt is to seek a suitable formulation of the God concept.

In the next section the physical principles of quantum mechanics are summarized. Then I make some philosophical remarks based on these decisions. The next section takes up the problem of considering God to be the observer and the universe the observed, and suggest a way out from the puzzle of quantum Zero effect.[12] Finally, some concluding insights are offered.

The Principles of Quantum Mechanics

Quantum mechanics was developed in a series of papers by Planck, Bohr, De Broglie, Heisenberg, Schrödinger and Von Neumann.[13] The theory replaces the Newtonian mechanics of classical physics as the theory of the micro world. Having achieved the elegance of a mature theory quantum mechanics lends itself to a presentation in the form of five postulates.

i) The state of a system is represented by a vector in a mathematical space called Hilbert space. The vector is also called the wave function. It gives the probability (amplitude) of finding the system in the given state.

ii) The time development of the system is described by the Schrödinger wave equation which gives the time–rate of change of the wave function in terms of the total energy operator (called the Hamiltonian) acting on the wave function.

iii) An experimentally measured value which is precise (i.e. zero error) is given by an 'eigenvalue' of the corresponding physical quantity which is represented by the Hamiltonian operator. The physical quantity itself is known as an observable.

iv) The average value of an observable measured on a system whose wave function is known, can be calculated from it by applying a mathematical prescription.

v) The wave function of a system can be written as a superposition of the 'eigenfunctions, representing the eigenstates of the system corresponding to the eigenvalues that are associated with various measurement trials of an observable. The probability of getting any particular eigenvalue is obtained from the representation of the wave function as a superposition of eigenfunctions. This postulate is called the measurement postulate. Some mathematical aspects of these statements are sketched in the notes.[14]

Of all the postulates the measurement postulate is the least understood and the most controversial one. For the purposes of argument to be presented subsequently we shall focus our attention on the last three postulates, iii, iv, and v, all dealing with the distinguished act called measurement or observation. It is important to note that the term system is not defined in the theory. Sometimes the term particle, is used in its place, but its meaning, likewise, is left unclear. In classical mechanics a particle is identified as a geometrical point that is zero dimensional in physical space, but this equivalence need not apply in the case of a quantum particle because the latter can be assigned either a position or a velocity at a time but not both simultaneously. Moreover, a quantum particle is represented by its wave function, which can be defined at any instant, over all space or for all values of momenta (momentum components). All that we know is that the system is characterized by its Hamiltonian or energy operator. Even though zero can be an energy eigenvalue (i.e., number obtained in a measurement), it cannot be the only eigenvalue allowed for the system, for in such a case, the Hamiltonian operator H would be identically zero, the Schrödinger equation would be vacuous and there would not be any time evolution of the system, implying that the system does not exist! On the basis of these observations we propose that a system is an object[15] having energy (whose value may be negative, zero or positive).

The Schrödinger wave equation is what is called in mathematics a linear differential equation whose solutions are wave-like and hence, superposable. Physically a coherent superposition of waves gives rise to interference. Historically, the wave nature of matter had been predicted by De Broglie a couple of years before the systematic formulations of quantum mechanics began to appear.[16] Quantum effects

have come to mean some sort of coherence operating at the level of atoms and particles, and the emergence of classicality is ascribed to the loss of coherence or decoherence.[17] If as a result of measurement, an eigenstate of an observable is 'projected out' from a superposition, there is a temporary decoherence. There is an increasing appreciation these days, of the decoherence aspect of the mechanism of measurement. But the real mechanism of throwing up one particular number in the act of observation continues to baffle scientists, in spite of the hope recently pinned on the decoherence theory wherein friction between the system and the environment including the observer, is pointed out as the culprit behind decoherence.

Quantum mechanics has been eminently successful in countless applications dealing with matter in different states of aggregation as well as in the form of individual particles. It has also been applied to the cosmos as a whole in a bid to explain the earliest moments of its existence. Quantum cosmology is the field that investigates such applications.[18] To the outstanding credit of quantum mechanics, it must be said that there is not a single experiment that has falsified a quantum mechanical prediction. Nevertheless there are a number of gray areas in the foundations of quantum mechanics which call for resolution.

Some Physico-philosophical Remarks

The mathematical framework of quantum mechanics enables one to perform calculations that agree well with experiment. However there is considerable scope for innovation at the interpretational level. One of the obvious things is the novelty of the probability interpretation itself. In the classical probability theory the basic stuff is the space of events and probability is a positive definite number associated with each event. If an event A can be decomposed into special cases B and C, and all these events A,B,C belong to the space of events S, then the probability of A is the sum of the probabilities of B and C. By contrast, in quantum mechanics, there is the event space and one can define a probability amplitude which may be real or complex. Instead of the additivity of probabilities of mutually exclusive events, one speaks about the additivity of amplitudes of such events and the probability for the union of the two events is calculated from the resultant amplitude. This difference in approach between

classical and quantum probability theories is significant to the extent that the latter permits coherent interaction between otherwise independent events, producing interference effects. The superposition principle (Postulate v) epitomizes the addition law for probability amplitudes.

The projection postulate necessitates the presence of an observer, namely a classical system, for the emergence of an eigenvalue and hence an eigenstate through measurement. Referred to also as the postulate of the collapse of the wave function, it implies that there is a subjective element in the unraveling of quantum reality. Birkhoff and von Neumann[19] have argued that quantum mechanics is the realization of a new logic called quantum logic which is different from the ordinary logic, namely Boolean logic, the logic of human experience, namely Aristotlean logic. There are three constituents in a measuring situation: system (quantum), apparatus (classical) and observer (classical). Since quantum logic is not the logic of the human mind, a human obserever must project the structure of the quantum universe.[20] The wave function collapse, according to this view, marks a discontinuous transition from quantum logic (non Boolean) to classical logic (Boolean). The universe that we see around us, in Wheeler's words, is a "participatory universe." The observer and the observed, distinct as they are, together create the reality. London and Bauer[21] were the first to bring consciousness into the observation process. It is the observer's consciousness which is responsible for the wave function reduction which is not an objective process in itself. We may characterize it not as physical but logical or epistemological. Wigner[22] went one step further and suggested that some non- linear term is responsible for breaking the Schrödinger equation for living systems. According to him, wave function collapse and freedom of the will are a spontaneous activity of living systems.

God as the Observer

We now come to the central part of this paper where we take up the proposal that God is the Observer who collapses the wave function of the Universe. This idea has been around for some time, and recently Raymond Chiao [(9)] has revived it as a neo-Berkeleyan point of view. Herein we offer a reformulation of this concept of God in a novel way. To this end we start with the physical concept of energy as the capacity

for doing work. We wish to emphasize that energy can be defined as the ability or potentiality in a scenario where time exists as the only dimension. Energy and time according to quantum mechanics, constitute a 'complementary pair.' Measurement of energy necessarily involves the passage of time. As already discussed earlier, if we define a system as an object having energy, then it can exist (as an abstraction) in time, regardless of whether there is ambient space or not. This is a relativistically invariant view as well. What we do is to identify the corresponding frame of reference as the rest frame[23] of the system. For our purposes, it is sufficient to imagine a coordinate system with a single point, namely the origin, and an axis, namely time, which extends in both directions. The origin can be identified as a point in space– time under the assumption that the light-cone erected at the point has collapsed to a single point. In another paper[24] we have put forward a pre-creation scenario which is essentially non-relativistic, that is, one in which there is only time and no space. The modification that we introduce here is that of a one-point space-time which can be identified as the rest frame in the conventional sense of relativity theory.

Energy does not require space to exist. But we are accustomed to the manifestations of energy in space as motion, light, heat and so forth, because we are beings having extension in space. As argued in more detail in note 21, the Hamiltonian of a system is necessarily a constant when there is only time but no space. Similar remarks apply when the space is identified as a single point, namely the origin in a one dimensional temporal world. Since a space with a single space point can exist in a one dimensional temporal world, there cannot be any spatial manifestation of energy changes in such a scenario. For example, the conversion of potential energy to kinetic energy would be impossible in these circumstances. Nevertheless systems with constant energy can be located at this point which is their common rest frame. There is considerable evidence for believing that the universe was as small as a point some 12–15 billion years ago. Then came the big bang and the expansion scenario. What is seen is a mutual moving apart of galaxies so that the best we can speculate about is that all these must have been much closer initially. Since the unification scale for all the four fundamental forces is very small (10^{-33} cm), there is no harm in assuming

that the initial size of the universe was this small or, at the worst, point-like. An object of this size is very well pictured as a quantum system.

The standard explanation for the conservation of energy is time displacement symmetry. It follows that time is eternal. That is, there was time even before big bang. This is possible if we impose a periodicity condition on the wave function of the universe, as discussed elsewhere.[25] In order to maintain the constancy of energy of the universe before the expansion began, it must have been necessary to freeze it in that particular eigenstate (experimentally realizable state) by some mechanism. Contrary to the normal argument against quantum zero effect that it prohibits transitions and therefore time evolution of the universe, we speculate that it was precisely this effect which trapped the universe in the constant energy mode. For the collapse of the wave function of the universe its observation by an observer or agency, distinct from it, is necessary. We identify this agency as God and describe God as an Infinite Energy source. The universe represents a finite amount of energy released by the Infinite Energy Source which continues to be infinite still.

Theologically the account given here is satisfactory, because it is consistent with the vision of God as Infinite and caring which is a figurative way of referring to the constant collapsing process that is going on with God as the observer and the universe as the observed. In the standard quantum theory of measurement, even though there is an interaction between the observer and the observed, the observer (including the apparatus) is classical, that is, of a scale of size or energy much greater than that of the observed system. By imagining God to be of infinite energy, we are not only fulfilling this criterion but also allowing the possibility of creation by God of multiple universes. If one tentatively adopts the decoherence model of the wave function collapse, then one is constrained to look for an environment 'outside' the universe, an impossible task to accomplish. The act of Creation can be understood as the collapse of the wave function of the universe by the observation of God. In Wheeler's sense, God becomes the participator in the construction of the realty that is the universe. God's omnipresence perhaps means this. God is present everywhere at all times as the participator in the reality-unfolding of the universe.

Concluding Remarks

We have attempted to define God as an infinite energy source that acts as a constant observer of the universe. The most important physical idea that we have made use of here is that energy is simply the capacity for doing work. For manifestations of energy, of course, space is needed. Particles or systems are energy packets which do not necessarily need space for their existence. They do 'materialize' in space under observation by an observer. It is this sort of independence from space that is perhaps reflected in the probabilistic behaviour of quantum systems. If this were not the case, energy flow should have been continuous in space and particles would have had well defined paths.

God has been described as the Infinite Source of Energy. This is a figurative definition in the sense that God is designated by the quality of processing infinite energy. No doubt such a source is classical or super classical in the sense of physics and to identify it as a person is a flash of human genius, a stroke of artistic imagination. Theological concepts such as soul, after life, good, evil, sin, reward, punishment and so forth, do not directly depend on the physical science–inspired concept of God that we have proposed here. These are matters of revelation and faith which are beyond reason.

Notes

1. Dr. Babu K. Joseph was the former Vice Chancellor of Cochin University of Science and Technology. Currently he is the director of Rajagiri School of Engineering & Technology, Kakkanad, Cochin – 682 030, India.
2. Since it is absurd to talk about the sex of God, we refrain from using pronouns such as he, she and it. God will be always cited as God.
3. John H. Hick, *Philosophy of Religion,* Fourth Edition, (New Delhi: Prentice-Hall of India, 1990)
4. Here extra mental existence is taken as a perfection or one of the characteristics, which a being that exists in the mind only lacks.
5. For a brief review of Kant's criterion and related issues see Robert Audi, General Editor, *The Cambridge Dictionary of Philosophy* (Cambridge: Cambridge University Press, 1995), pp.607–611. For a modern exposition of arguments for and against the existence of God, see Terry Miethe and Antony Flew, *Does God Exist?* (New York: Harper Collins, 1991).

6 See Diamuid O' Murchu, *Quantum Theology* (New York: Cross Road Pulishing Company, 1998). For a recent formulation of Quantum Theology, see K. Babu Joseph, "Quantum Theology – A New Frontier," *Proceedings of CTNS – SRCP Workshop,* Dec 28-Jan2, 2002, edited by Job Kozhamthadam (Pune: ASSR Publications, 2002), Forthcoming.

7. This is the mechanics of planetary motion, motion of trains, cars and airplanes, the equilibrium of bridges and buildings and so on, developed by Issac Newton in the 17th century.

8. A linear system means that its behaviour can be represented by a straight-line graph.

9. W. Heisenberg, *Z Physik* 43, 172 (1927)

10. Momentum is defined as (mass x velocity) mass of a body multiplied by its velocity.

11. Babu Joseph, "Quantum Mechanics and Religion: A New Interface," *Contemporary Science & Religion in Dialogue: Challengers and Opportunities,* edited by Job Kozhamthadam (Pune: ASSR Publication, Jnana Deepa Vidyapeeth, 2002), pp. 81–97.

12. Raymond Chiao, "Quantum Non localities: Experimental Evidence," *Quantum Mechanics - Scientific Perspectives on Divine Action,* edited by Robert John Russell, Philip Clayton, Kirk Wegter–Mc Nelly and John Polkinghorne (Vatican City: Vatican Observatory Publications, 2001), p. 38. Quantum Zero effect is the circumstance where a system that is too frequently disturbed by observation fails to undergo decay or transition.

13. For an introduction to quantum mechanics, see any of the thousands of published text books on the subject or a standard one such as Leonard I. Schiff, *Quantum Mechanics,* Third Edition (Singapore: McGraw Hill, 1968).

14 A vector is a directed quantity in physical space. A Hilbert space is a generalized type of space which can be finite or infinite dimensional. The standard Greek symbol for the wave function of a system is ψ. The Schrödinger wave equation is $i\hbar\frac{\partial\psi}{\partial t}=H\psi$, where H is the Hamiltonian (energy) operator. A linear operator is a mathematical symbol for an operation on an object called the operand (which may be a function or a vector or something else) which produces another object of the same kind in such a way that an ordinary number is not affected by the operation. H is a Hermitian operator (a special kind of linear operator which produces the effect of simply multiplying a particular type of operand by a real number). $\hbar$ is Planck's constant divided by 2π.

A typical eigenvalue equation for a Hermitian operator Q is Qf = qf where q, a real number, is called an eigenvalue of Q corresponding to an eigenfunction f.

The essence of postulate (iii) is that if Q represents an observable then q is an experimentally determinable number and f a mathematical function which is 'acted upon' by the Hermitian operator Q. See also James Cushing, *Determinism Versus Indeterminism in Quantum Mechanics*, pp. 100 and 101.

15. Note that the term object is not defined either.

16. For a very beautiful presentation of the early history of the object, see P.M. Mathews and K. Venkatesan, *A Text book of Quantum Mechanics* (New Delhi: Tata McGraw–Hill, 1976).

17. For a discussion of decoherence see, for example, Roland Omnes, *Understanding Quantum Mechanics* (Princeton: Princeton University Press, 1999).

18. For a discussion of quantum cosmology and its relevance to religion see the relevant papers in Robert John Russell, Nancy Murphy and C.J. Isham (Editors), *Quantum Cosmology and the Laws of Nature - Scientific Perspective on Divine Action* (Vatican City: Vatican Observatory Publications, 1993).

19. G. Birkhoff and J. von Neumann, Ann. Math. 37 (1936), p 923.

20. A.A. Grib, "Quantum Cosmology – The Role of the Observer Quantum Logic," Russell et al., *Quantum Cosmology and the Laws of Nature - Scientific Perspectives on Divine Action,* op. cit., p. 165.

21. F. London and E. Bauer, *La Theorie de l' Observation en Mecnique Quantique* (Paris: Hermann, 1939).

22. E.P. Wigner, *The Scientist Speculates* (London: Heinemann, 1961).

23. In Einstein's theory of relativity a coordinate frame is a set of space axes (directions) and one time axis, all intersecting at a point called the origin at right angles to one another. We imagine such a frame to be attached to each moving system. This frame is called the rest frame of the system because it is at rest relative to the frame.

24. K. Babu Joseph, "Quantum Theology: A New Frontier," *Proceedings of the CTNS-SRCP Workshop on Science and Religion.*

25. K. Babu Joseph, *On Pre-big bang Cosmology* (under preparation).