# WHY STEPHEN HAWKING'S COSMOLOGY PRECLUDES A CREATOR

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**Abstract:** Atheists have tacitly conceded the field to theists in the area of philosophical cosmology, specifically, in the enterprise of explaining why the universe exists. The theistic hypothesis is that the reason the universe exists lies in God's creative choice, but atheists have not proposed any reason why the universe exists. I argue that quantum cosmology proposes such an atheistic reason, namely, that the universe exists because it has an unconditional probability of existing based on a functional law of nature. This law of nature ("the wave function of the universe") is inconsistent with theism and implies that God does not exist. I criticize the claims of Alston, Craig, Deltete and Guy, Oppy and Plantinga that theism is consistent with quantum cosmology.

## 1. EXPLAINING THE UNIVERSE

Atheists have traditionally conceded in advance the theoretical arena in cosmology to the theists. Atheists have offered no explanation of why the universe exists, and theists have offered an explanation. It can be argued that since theism has greater explanatory power, it is preferable according to this theoretical criterion. Atheists have traditionally taken a merely negative route, arguing that the theistic explanation is false, disconfirmed, or meaningless. But this seems to be a tacit admission that theism is prima facie theoretically superior to atheism, since theism at least purports to explain something that atheism does not even attempt to explain.

But I think this prima facie superiority of theism to atheism can be countered by showing that atheism offers an explanation of the universe, and a bet-

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ter explanation, than theism. I believe that contemporary physical cosmology *can* explain (in principle and in simplified models) the universe's existence. Quantum gravity cosmology, I believe, does show how the universe can be explained in atheistic terms.

In Fang and Wu's introduction to the book *Quantum Cosmology,* which collects the major technical papers by Stephen Hawking, James Hartle, John Wheeler, and others, they say quantum cosmology implies that "in principle, one can predict everything in the universe solely from physical laws. Thus, the long-standing 'first cause' problem intrinsic in cosmology has been finally dispelled."[1] This cosmology has eliminated the need to postulate (or even the possibility of postulating) a first cause (originating cause) of the universe's beginning. Stephen Hawking has famously said "there is no place for a Creator." However, there is little or no actual arguments to be found either in their technical or popular writings to support such "atheistic" claims. Apparently they want to leave to philosophers the task of figuring out how their mathematical equations both imply that there is no First Cause and that there is an atheistic explanation of the universe's existence. Some attempts to carry out this task in partial form will be made in this paper. I will also show that the very explanation of the universe offered by quantum cosmology implies that quantum cosmology is logically incompatible with theism, that is, implies that God does not exist.

## 2. The Unconditional Probability of the Existence of a Universe

I shall concentrate on the cosmology developed by Hawking[2] and Hartle and Hawking[3] and later elaborated upon by Hawking and other coauthors. The wave function of the universe in Hartle and Hawking's paper gives a probabilistic and noncausal explanation of why our universe exists. More precisely, it provides an unconditional probability for the existence of a universe of our sort (i.e., an expanding [and later contracting] universe with an early inflationary era and with matter that is evenly distributed on large scales). Given only their functional law of nature, there is a high probability that a universe of this sort begins to exist uncaused.

This can be explained more exactly. In their formalism, $\psi[h_{ij}, \phi]$ gives the probability amplitude for a certain three-dimensional space S that has the metric $h_{ij}$ and matter field $\phi$.

A *probability amplitude* $\psi$ gives a number that, when squared, is the probability that something exists. This is often put by saying that the square of the modulus of the amplitude gives the probability. The square of the modulus of the amplitude is $|\psi[h_{ij}, \phi]|^2$.

In the case at hand, the probability is for the existence of the three-dimensional spatial slice S (the "three-geometry S" in Hartle and Hawking's parlance), from which the probability of the other states of the universe can be calculated. The three-dimensional space S is the first state of the temporally evolving universe, i.e., the earliest state of the temporal length $10^{-43}$ second (the Planck length). S is the state of the universe that may be called the "big bang"; it precedes the inflationary epoch and gives rise to inflation.

The *metric* is the degree of curvature of spacetime; the metric $h_{ij}$ Hartle and Hawking derive is that of an approximately smooth sphere (like the earth) that is much smaller than the head of a pin.

The *matter field* $\phi$ is equivalent to an approximately homogeneous distribution of elementary particles throughout the small sphere S.

Hartle and Hawking derive the probability amplitude by adding up or summing over all the possible metrics and matter fields of all the possible, finite, four-dimensional spacetimes which have a three-dimensional space S with metric $h_{ij}$ and matter field $\phi$ as a boundary. The square of the modulus of the amplitude, $| \psi [h_{ij}, \phi] |^2$, gives the probability that a universe begins to exist with a three-dimensional space S that possesses this metric and matter field. The probabilities for the history of the rest of the universe can be calculated once we know the metric and matter field of the initial state S.

Since the wave function includes the three-dimensional space S as the boundary of all *merely possible* four dimensional, finite spacetimes, we can calculate the "unconditional probability" of the 3-space S, in the sense that we do not need to presuppose some *actually existent* earlier 3-space S* as the initial condition from which the probability of the final condition S is calculated. The probability of the existence of the 3-space S is not conditional upon the existence of any concrete object (body or mind) or concrete event (state of a body or mind) or even upon the existence of any quantum vacuum, empty space or time; the probability follows only from the mathematical properties of possible universes. The probability of S is conditional only upon certain abstract objects, numbers, operations, functions, matrices, and other mathematical entities, that comprise the wave-function equation. This gives us a probabilistic explanation of the universe's existence that is based solely on laws of nature, specifically the functional law of nature called "the wave function of the universe."

Robert Deltete and Reed Guy,[4] William Lane Craig,[5,6] Ned Markosian,[7] Graham Oppy,[8] Richard Swinburne,[9] and others have commented that my earlier explanation of this notion of "the unconditional probability" of a universe existing has no apparent sense and that this atheistic explanation of the universe's existence is therefore unviable. Their criticisms, however, can be shown to be unwarranted.

Oppy has successfully argued that a propensity or objective chance interpretation of the probability calculus does not provide a sensible conception of the relevant unconditional probability.[10] However, he mistakenly assumes I am adopting this "objective chance" interpretation in my paper "Stephen Hawking's Cosmology and Theism."[11] Oppy's misinterpretation may be due to the fact that he does not recognize that the configuration space and state space of quantum gravity cosmology are timeless abstract objects ("mathematical spaces") rather than physical existents.[12]

Other critics of my notion of unconditional probability have not provided much by way of argument. It seems to me there is a straightforward way to understand such probabilities. We do not appeal to the propensity (objective chance) interpretation of probability, the personalist interpretation, the logical interpretation, the actual finite frequency interpretation, or the limiting relative frequency interpretation. Rather, we need a possible-worlds interpretation, where possible worlds are understood as abstract objects (along the lines originally developed by Alvin Plantinga,[13] R. Adams,[14] and others); these theories are metaphysical interpretations of some version of the semantics for modal logic developed by Rudolph Carnap,[15, 16] Stig Kanger,[17] and especially Jaakko Hintikka[18, 19, 20, 21] and Saul Kripke.[22, 23, 24] (I give more details in my *Ethical and Religious Thought in Analytic Philosophy of Language* and in an article in *The New Theory of Reference.*[25, 26]) Carnap used possible worlds in his logical interpretation of probability.[27, 28] Plantinga has shown how possible worlds can be used in the frequency interpretation of probabilities and there have been other uses of possible worlds.[29, 30] However, there is a different interpretation of probability than the above-named ones and I shall call it "the possible-worlds interpretation"; it consists of the six axioms mentioned below.

I do not mean to say that (what I am calling) "the possible-worlds interpretation" of the probability calculus is the only valid one. I see no reason to deny that there are actual finite frequencies, limiting relativity frequencies, propensities, subjective probabilities, or even logical probabilities. My claim is merely that the possible-worlds interpretation of the probability calculus is sufficient to make sense of the unconditional probabilities implied by quantum-gravity cosmologies, whereas the familiar interpretations are insufficient and thus "outdated" in terms of the most recent advances in the physical sciences. Specifically, my thesis is not that each or any one of the following six axioms, taken by itself, is a new idea; rather, my thesis is that *the conjunction* of these six axioms ("the possible-worlds interpretation of probability"), even if unfamiliar, is sufficient to interpret the unconditional probabilities implied by quantum-gravity cosmologies.

I will say that a possible world is a mind-independent (and Fregean-like) maximal proposition W, such that for each proposition p, W entails p or W entails ~p. The one and only actual world is the one and only maximal proposition W′ that is true. The concrete, physical universe belongs to the *truth-maker* of this maximal proposition.

This requires a sort of "platonic realism," but such a realism is required by quantum-gravity cosmologies in any case (as most popular books by physicists on these cosmologies have recognized). Further, Michael Tooley[31] has given good arguments that a Platonic-realist theory of laws of nature is required by science in general; Tooley's natural laws are relations among universals and these universals need not be instantiated by anything. Our first axiom is thus that there are possible worlds in the above-specified sense and our second axiom is that there are Tooley-like laws of nature. (I do not mean to commit myself to all the specifics of Tooley's, Plantinga's, Adams's, etc., theories.)

The third axiom of our possible-worlds interpretation of probability is that probabilities are proportions between possible-worlds (or classes of possible worlds). Given our third axiom, if the functional law of nature provides a 0.99 probability that a universe of our sort begins to exist uncaused, this means that in 99 percent of the possible worlds in which this wave function is a law of nature, there exists a universe of our sort that begins to exist uncaused.

Since there are at least aleph-zero possible worlds in which this functional law obtains, we need to address Cantor's argument that there are no unique proportions (such as 99/100) among infinite sets. Cantor's line of thinking would suggest that since there are aleph-zero worlds in which a Hartle-Hawking type universe exists (a WH world) and aleph-zero worlds in which the wave function obtains, then there is no fixed .99 proportion between them since the worlds can be ordered as follows (where a WO world is a world in which the law obtains but in which there is no Hartle-Hawking universe):

WO1, WH1, WO2, WH2, WO3, WH3, WO4, WH4 . . .

This gives a 0.5 proportion of WH worlds to the worlds in which the Hartle-Hawking law obtains. The solution to this problem is to introduce a fourth axiom that proportionality among aleph-zero sets of worlds is defined in terms of a suitably ordered sequence of worlds. This means, in the present case, that there is an aleph-zero number of mutually exclusive, exhaustive, and finite sets of worlds in which the wave function obtains, such that each of these finite sets contains only 99 WH worlds and one WO world. (There are infinitely many logically possible worlds in which the wave function does not obtain, and all of these worlds are not included in our infinite set of worlds.)

However, there are more than aleph-zero worlds in which the wave function of the universe obtains and thus we need to characterize proportionality among worlds in terms of nondenumerable infinities. This requires a fifth axiom that proportionality can be defined in these cases in terms of a proportionally preserving, branching, treelike topological structure. This "tree" branches finitely and equally at each of an aleph-zero number of levels. Storrs McCall has worked out a convenient model in terms of a decennary tree (a tree that branches in ten at each level).[32] But we differ from McCall in that we do not regard possibilities as existent, concrete items but as abstract objects, propositions, and in that we do not view the treelike structure as a temporally evolving branching of the future possibilities of concrete particulars but as an abstract structural relation among possible worlds. We borrow from McCall his idea of a decennary tree, suitably redefined for our purposes. As I conceive it, a decennary tree is an abstract topological structure that branches in ten, such that each of these ten branches itself branches in ten branches, each of which in turn branches in ten, for each of an aleph-zero number of discrete nodes. (A node is a point where a tenfold branching occurs.) Such a decennary tree will contain a nondenumerable infinity of branches, specifically, $10^{\aleph_0}$ (ten to the power of aleph-zero). On our abstract tree, each world is represented by a branch of the tree; the branches are WH or WO worlds except that at each level of ten branches, one branch is "unlabeled." The unlabeled branch has a successor fan of branches that are labeled (as WO or WH worlds) at the next level. Let us suppose the 0.99 probability is a nonterminating and nonrepeating decimal, e.g., 0.99372 . . . and that the 0.1 probability of a WO world is the decimal 0.00627.

. . . The proportion between these two sets of worlds is specified by 9 of the branches on the first level being WH worlds and none being WO worlds. On the second level, 9 sets of branches (with each set having 10 members) are WH worlds and no set contains WO worlds; on the third level 3 sets of branches contain WH worlds and 6 sets contain WO worlds, on the fourth level there are 7 sets compared to 2 sets, and so on. This delineates the precise decimal value of the proportion of WH worlds to WO worlds and thus the proportion of WH worlds to all the worlds in which the Hartle-Hawking law obtains.

A sixth axiom of the possible worlds interpretation of probability requires the introduction of Robinson's[33] nonstandard real numbers to solve the problem that classical measure theory (which uses only standard real numbers) poses, viz., that there is a probability of zero for each particular WH or WO world. Bernstein and Wattenberg[34] were the first to introduce nonstandard reals into probability theory and Brian Skyrms[35] and David Lewis[36] were the first philosophers to do this; since this time Falk and others have also used nonstandard reals.[37, 38] Some nonstandard real numbers are infinitesimals; an infinitesimal is smaller than any real number but larger than zero. Others are hyperreals, which is a number that differs from a real number by an infinitesimal. The probability of each particular WH or WO world is not zero but is a standard or nonstandard real number. For example, if we suppose that the Lebesque measure of the unit set consisting of our world WH′ is zero, we may say that the infinitesimally small probability of WH′ existing is infinitely close to the Lebesque measure of the set {WH′}.

Note that the introduction of decennary trees and nonstandard reals allows there to be a definite probability for a particular world and we are thus not confined to probability densities when dealing with infinite worlds.

We need to emphasize at this juncture the distinction between the parts of the wave-function equation and the possible worlds in which this functional law obtains. The wave-function equation involves a summation over all the possible histories of finite universes that have the state S as a boundary. These possible histories are a part of the wave-function equation. Since this equation exists in each WH or WO possible world, the parts of this equation (and thus the possible histories summed over) also exist in each WH or WO world. If we consider the wave function of the universe to be a complex mathematical proposition p, then p will be a conjunct of each maximal proposition (possible world) WH or WO. The possible histories summed over are neither possible worlds (maximal propositions) nor physically existent histories. Rather, they are complex counterfactual propositions that are parts of the mathematical proposition p, which is itself a conjunct of each maximal proposition WH or WO.

These six axioms of the possible-worlds theory of probability are sufficient for our present purposes of explaining the unconditional probability of a Hartle-Hawking type of universe. If Oppy, Deltete and Guy, Swinburne, Markosian, and others have problems with this theory of probability, they cannot refute it by assuming without argument that nominalism is true, that a regularity (or non-Tooleyian) theory of natural laws is true, or that only a propensity (objective chance), actual frequency, or personalist theory of probability is true, for this would amount at best to a question-begging argument. Furthermore, these arguments would rule out *a priori* (as impossibly true) an entire branch of contemporary science, quantum gravity cosmology. Could there really be a self-evident *a priori* metaphysical truth that implies the falsity of a science, i.e., an application of inductive logic to observational evidence? Craig thinks so[39] but I doubt Oppy, Markosian, Swinburne, Deltete and Guy would want to go so far as to reject the application of inductive logic to observations in favor of an *a priori* "metaphysical intuition."

The extant arguments offered against the unconditional probability theory I stated are invalid. For example, Deltete and Guy endorse an invalid argument given by Drees, namely that: "A mathematical probability of getting a universe from [literally] nothing does not give a physical universe, but only the idea of a physical universe."[40] Contra these authors, what gives the (probable existence of an) idea of a universe is the mathematical probability of there existing an *idea of a universe.* But the mathematical probability of there existing *a universe* gives us (to a certain degree of probability) *a universe.* This is tautologically true and it is surprising that Deltete and Guy could endorse Drees's tautologically false statements as "plausible."

As I mentioned, some writers of popular physics books are aware that quantum-gravity cosmology requires a Platonic-realist theory of probabilistic laws of nature. (I exclude Hawking, whose philosophical musings in his popular writings have been widely and correctly criticized as confused and inconsistent.) One example is Heinz Pagels, who poetically grasps the relevant ideas in *Perfect Symmetry.*[41] He says Hawking and Hartle "calculate the probability for the universe to emerge from a state of 'nothing,' as in Alex Vilenkin's model, to the state of 'something.'"[42] Pagels earlier recounts Alex Vilenkin's account of "nothing" in Vilenkin's first quantum-gravity model.[43] Pagels says that in Alex Vilenkin's early model, "nothing" does not refer to a quantum-mechanical vacuum or empty space. "'Space is still something,' Alex once remarked to me, 'and I think the universe should really begin as nothing. No space, no time—nothing.'"[44] Pagels poetically grasps the need for a Platonic-realist theory of natural laws in the Hartle-Hawking model (and the early Vilenkin model) in this passage:

> The nothingness "before" the creation of the universe is the most complete void we can imagine—no space, time or matter existed. It is a world without place, without duration or eternity, without number—it is what the mathematicians call "the empty set." Yet this unthinkable void converts itself into the plenum of existence—a necessary consequence of physical laws. What are these laws written into that void? What "tells" the void that it is pregnant with a possible universe? It would seem that even the void is subject to law, a logic that exists prior to space and time.[45]

There is no constructive point in analytic philosophers engaging in the task of tearing apart Pagel's passage or his earlier quoted sentences as logically incoherent if taken literally. If we treat it as poetry, we can translate it into a precise philosophical passage. Like most other physicists, Pagels uses "creation" to mean the beginning to exist of something; he does not use this word in a theological sense. The first sentence (translated or conceptually transformed into literal and coherent philosophical language) means that it is not the case that there is space, time, or matter except at or after the beginning of the universe. The second sentence, apart from its exclusion of eternity and thus tacitly of an eternal god, is best ignored, if only for the reason that independently of the universe there timelessly exist numbers that belong to the wave-function equation. The third sentence needs "probabilist" to be substituted for "necessary," a phrase that is not pragmatically self-referentially incoherent to be substituted for "unthinkable void" and a noncausal term substituted for "converts," among other changes. Apart from the usage of "void," the last three sentences convey with a relative poetic clearness the fact that Vilenkin's, and Hartle and Hawking's, cosmologies require a Platonic-realist theory of laws of nature, since the wave function of the universe is a functional law of nature.

## 3. The Inconsistency of the Hartle-Hawking Model with Classical Theism

The Hartle-Hawking derivation of the unconditional probability of the existence of a universe of our sort is inconsistent with classical theism. The unconditional probability is very high, near to 1. For purposes of simplification, we are saying the probability is 99 percent; there is a 99 percent probability that a universe of our sort—I will call it a Hartle-Hawking universe—exists uncaused.

The universe exists uncaused since the probability amplitude is determined by a summation or path integral over all possible histories of a finite universe. That is, the probability that a Hartle-Hawking universe exists follows directly from the natural-mathematical properties of possible finite universes; there is no need for a cause, probabilistic or otherwise, for there to be a 99 percent probability that a Hartle-Hawking universe will exist.

This is not consistent with classical theism. According to classical theism, if a universe is to have any probability of existing, this probability is dependent on God's dispositions, beliefs, or choices. But the Hartle-Hawking probability is not dependent on any supernatural states or acts; Hartle and Hawking do not sum over anything supernatural in their path integral derivation of the probability amplitude.

Furthermore, according to classical theism, the probability that a universe exist without divine causation is 0, and the probability that if a universe exists, it is divinely caused, is 1. Thus, the probabilities that are implied by classical theism are inconsistent with the probabilities implied by the Hartle-Hawking wave function of the universe.

It may be said that God could will that the Hartle-Hawking wave function law obtain and leave it to chance, a 99 percent chance, that a Hartle-Hawking universe begin to exist uncaused. But then God is not the creator of the universe, and we no longer have the god of classical theism. According to traditional theism, it is a contradiction to suppose that the universe exists without being created by God.

Some may suggest a scenario where there is a 99 percent probability that God shall *create* a Hartle-Hawking universe. Ned Markosian has developed such a scenario.[46] Imagine there are 100 possible universes tied for best in intrinsic value-ranking, and 99 of them are Hartle-Hawking type universes. According to Markosian, since God is omnipotent, God could see to it that, for each of these universes, there is a 1 percent chance that she will create (on a whimsy) that universe. It follows, that there is a 99 percent probability that a Hartle-Hawking type universe will be created by God. As it happens, God *does* will that a Hartle-Hawking universe exist. Markosian thinks this scenario makes classical theism consistent with Hartle's and Hawking's cosmology.

But it does not, for the wave function states that the natural-mathematical properties of the possible universes make it 99 percent probable that a Hartle-Hawking universe exist uncaused. This probability statement is not consistent with the classical theist position that there is 0 percent probability that a Hartle-Hawking universe exist uncaused or with Markosian's scenario where the 99 percent probability obtains only because it is derived from supernatural considerations. Further, since God is omniscient, she knows by middle knowledge or foreknowledge which universe she will create and thus the probability of the Hartle-Hawking universe existing is not 99 percent but 100 percent.

Oppy says that if the Hartle-Hawking theory is true, the probability that a Hartle-Hawking universe exists is 100 percent since such a universe does exist.[47] But this *conditional* probability is not the one I am talking about. Given the condition that a Hartle-Hawking universe exists, the probability of its existing is 100 percent. But the unconditional probability of such a universe, i.e., its probability not conditional upon anything but the wave function of the universe, is 99 percent. It is this latter probability that allows for an atheistic and acausal explanation of why the universe exists.

## 4. William Craig's Claim that the Hartle-Hawking Probability Is Merely Conditional

William Lane Craig and many others (e.g., Deltete and Guy) argue that the probability implied by the wave function of the universe is not unconditional and is conditional in a way that allows for a divine creation of the universe *ex nihilo*. Their claim is that I have misunderstood the Hartle-Hawking model.[48, 49, 50, 51] According to Craig, the only probabilities that follow from their model are conditional in the sense that they are transition probabilities for one state of the universe to follow another state. He writes:

> Smith interprets Hawking's model as establishing a certain probability for the first three-dimensional slice of spacetime to appear uncaused out of nothing. But this is a mistake, for the probability of finding any three-dimensional cross-section of spacetime in such quantum models is only relative to some other cross-section given as one's point of departure.[52]

Craig does not refer to Hawking's articles in support of this claim, but to the quantum cosmologist Christopher Isham's article on the Hartle-Hawking theory. What shall we say about Craig's argument? Craig is wrong both about the Hartle-Hawking theory and about Isham's interpretation of it.

First, Hawking and Hartle do say the probability is unconditional; in their 1983 article, they write about an unconditional probability amplitude, a probability "amplitude for the Universe to appear from nothing."[53] More fully, they say:

> One can interpret the functional integral over all compact four-geometries bounded by a given three-geometry as giving the amplitude for that three-geometry to arise from a zero three-dimensional geometry, i.e., a single point. In other words, the ground state is the amplitude for the Universe to appear from nothing.[54]

Hartle has written to Grünbaum about the odd statement he and Hawking made that nothing is a "single point" and has rejected this identification; Hartle writes: "the 'nothing' is not realized as a physical state in the formalism"[55] and thus that the misleading statement about nothing being a physical state, a "single point," should be omitted.

Hawking also recently emphasizes that the universe "would quite literally be created out of nothing: not just out of the vacuum, but out of absolutely nothing at all, because there is nothing outside the universe."[56] By "be created" Hawking, like other physicists, means began to exist. The statement that universe is "created out of nothing" means (in the familiar terms of analytic philosophy) that the universe (a maximal spacetime containing mass-energy) began to exist and that it is not that the case that the universe is caused to exist or consists of anything that exists temporally prior to the universe or that there is time prior to the universe.

The only "single point" or zero three-geometry in the Hartle-Hawking model is one predicted with a certain degree of (unconditional) probability by the wave function, and thus is not an unexplained given or brute fact. Hartle and Hawking write in their original paper: "In the case of the Universe we would interpret the fact that the wave function [the probability amplitude] can be finite and nonzero at the zero three geometry as allowing the possibility of topological fluctuations of the three-geometry."[57] This predicted fluctuation to a zero three-geometry is not the referent of "nothing" in the "appear from nothing" phrase, since "nothing" has no referent (or, in Hartle's words, "the 'nothing' is not realized as a physical state in the formalism."[58]

As I said, Craig does not refer to the Hartle-Hawking article to support his contention about the probabilities being conditional, but to Christopher Isham's article. Did Isham get it wrong, or did Craig misread Isham?

Craig refers to pages 395–400 in Isham's "Creation as a Quantum Process."[59] On pages 395–97, Isham is talking about how the probability of one state of the universe can be predicted from another state. But on page 398 he starts talking about the Hartle-Hawking theory of the uncaused beginning of the universe and says the wave function that gives the probability amplitude for the beginning of the universe does *not* make reference to, or depend upon, any earlier configuration or time from which the first physical state has evolved. Isham writes about the Hartle-Hawking concept K(c,f), where K is the probability, c the curvature, and f the matter field of a certain three-dimensional space. Isham writes:

> Note that the "transition" probability [Isham puts "transition" in scare quotes, since there is no transition from anything else] associated with this state-function is $K(c,f) = |\psi(c,f)|^2$. . . . Hence, K(c,f) is a function of just a *single* configuration point (c,f) [i.e., a single point in superspace, where each point represents a 3-space]: there is no $(c_1,f_1)$ corresponding to an *earlier configuration and time* from which the system has "evolved." This is the precise sense in which the theory is said to predict the probability that the universe is created in various configurations "from nothing."[60]

So Craig misinterprets both Isham and Hawking; Hawking's theory does give us an unconditional probability that a Hawking-type universe begins to exist uncaused and Isham correctly recognizes and states this fact in his interpretation of Hawking's theory. This also shows that Deltete and Guy[61] are wrong when they say the Hartle-Hawking theory is analogous to ordinary quantum mechanics in that it is about merely "a transition between two real states" and thus that the "probability amplitude is conditional."[62]

## 5. Plantinga's Criticism of the Atheist Argument from Quantum Cosmology

Craig asserts that "Plantinga pointed out to Smith that since according to classical theism God exists in all possible worlds, the probability of the universe on the wave function cannot differ from its probability on the wave function plus theism."[63] Exactly what did Plantinga point out and how should we evaluate his argument? Plantinga states that the relevant unconditional probability is (to quote Plantinga's own words):

> the proportion of possible worlds in which the universe has the characteristics [specified by the H-H wave function]. (Of course the figure of proportions of possible worlds here is just that—a figure; we have no reason to think possible worlds occupy something like a space, and no reason to think that there are at most continuum many possible worlds.) So the absolute probability of there being such a universe is, say, .95. But according to theism, God's existence is a necessary truth; so the probability that there be such a universe on the existence of God is the same as its probability on any necessary truth, which is just its absolute probability. So where's the inconsistency [that Smith alleges]? Of course the probability that there is such a world, given that God wills that there be such a world, is 1. But that's not an absolute probability, but a probability conditional on the (contingent) truth that God wills there be such a world.[64]

I am sympathetic with the "possible-worlds" approach to probability sketched (but not endorsed) by Plantinga in this passage and I think Plantinga's ideas are more nearly in line with the probability theory required by quantum-gravity cosmology than are Deltete's and Guy's or Oppy's. However, I believe there are several ways to respond to Plantinga's argument that there is no inconsistency between classical theism and quantum cosmology.

To begin with, the argument that theism and quantum cosmology are consistent is invalid in relevance logic. Let $p$ be the complex proposition that states the Hartle-Hawking theory. For any conjunction of $p$ with any necessary truth $q$, $p$ by itself will *entail* (in the sense of relevance logic) the statement $r$ of the probability value. The proposition $r$ is:

($r$) The probability that a universe begins to exist with the matter field $\phi$ and metric $h_{ij}$ is .99.

However, if theism is true, $p$ does not entail $r$. There must be a theistic proposition $q_1$ that entails $r$, since the probability of a universe existing based solely on natural-mathematical truths and without divine causation is zero. Thus, quantum gravity cosmology and theism will differ as regards to which conjunct in the conjunctive proposition, $p$ *and* $q_1$, entails $r$, which prevents the two theories from being consistent in relevance logic.

Another problem is that there is no candidate for the theistic necessary truth $q_1$. Since the theist cannot allow that $p$, in the conjunction $p$ *and* $q_1$, entails $r$, the theist must find some necessary truth of theism that entails $r$. Plantinga's proposition, *God exists,* does not entail $r$, nor does the theistic necessary proposition *whatever universe that exists is created by God.* Contingent propositions about God's decision to create a universe are not candidates, precisely because they are not necessary truths.

In fact, there is even an inconsistency *in standard propositional logic* between theism and quantum cosmology. I have been using "conditional probability" to mean a probability that is dependent on the existence of some concrete things or events (bodies, minds, or events involving bodies or minds). I will now use "conditional probability" to refer instead to any probability of the form $c(h/e$ & $b)$, where $c$ is the probability value, $h$ a contingent hypothesis, $e$ a contingent evidence statement, and $b$ the "background knowledge" of necessary truths. An "unconditional probability" now refers to probabilities of the form $c(h/b)$, which can be abbreviated as $c(h)$ to highlight their unconditional nature (they are not conditional on any contingent proposition). I will assign the following values to these letters:

$h$ = *there exists a Hartle-Hawking universe.*
$e$ = *there obtains the wave function of the universe* $\psi[h_{ij}, \phi]$.
$b$ = *small houses are houses, and . . . , etc. (the conjunction of all necessary truths).*

The proposition $c(h/e \,\&\, b) = .99$ is true if Hawking's quantum cosmology is true and it is no part of Plantinga's argument to argue this cosmology is false. But if classical theism is true, *b* will include some truths that are incompatible with $c(h/e \,\&\, b) = .99$, since it is a necessary truth of classical theism that for any possible universe U, the conditional probability that U exists is zero unless the conditions include some positive, contingent truths about divine dispositions, states or acts. A positive, contingent truth about divine acts is any truth of the form, *God exists and contingently performs the act A*. If theism is true, $c(h/e \,\&\, b) = 0$, since *e* includes no positive, contingent truths about divine dispositions, states, or acts. Thus if quantum cosmology and theism are both true, it follows both that $c(h/e \,\&\, b) = .99$ and that it is not the case that $c(h/e \,\&\, b) = .99$. This shows that we need not rely on relevance logic to show that quantum cosmology and theism are logically inconsistent.

## 6. William Alston and the Problem of Conserving a Quantum Universe

God cannot conserve (in the sense of continuous creation) the successive states of the universe if the wave-function law is true.

It is part of quantum mechanics that any quantum-mechanical system Q is governed by a wave function, and that the wave function evolves in accordance with the Schrodinger equation *unless interfered with by an outside influence.* Now the evolution of the quantum mechanical system Q in quantum cosmology is governed by the gravitational Schrodinger equation (the Wheeler-DeWitt equation). Since the system Q that is the subject of quantum cosmology involves a physically closed system, the entire universe, there can be no outside influences. The evolution of the probabilities of the metric and matter field of the universe *cannot* be due to divine influence.

This argument can be presented more formally.

1a. The universe is a physically closed system that is described by the Hartle-Hawking "no-boundary" wave function of the universe.

2a. The probability distribution of the metrical and matter properties of any given three-dimensional spatial slice of the universe that has a preceding three-dimensional spatial slice, follow deterministically from the metrical and matter properties of the preceding 3-space in accordance with the "no-boundary" solution of the Wheeler-DeWitt equation.

Therefore,

3a. There are always sufficient conditions for the probabilistic evolution of the universe that are physical.

Therefore,

4a. There is no causal role for the god of classical theism to play in determining the probabilistic evolution of the universe.

Note that if we introduce at this point a theological *ceteris paribus* clause about divine conservation, we are introducing an argument that science is false, and are not showing how science is consistent with theism. Note, first, that there cannot be a theological *ceteris paribus* clause about divine conservation that is logically consistent with quantum cosmology, for such a clause would entail that the probabilities of the successive 3-spaces of the universe *never* evolve in accordance with initial conditions and the "no-boundary" solution of the Wheeler-DeWitt equation. But if they never evolve in this way, Hawking's "no-boundary" quantum cosmology is false.

If an alleged natural law L is never instantiated, despite the fact that its antecedent is instantiated (the antecedent referring to the initial conditions), then the alleged law is false. Consider this alleged law: "If there is a 3-space $S_1$ with the property F, then there is a subsequent 3-space $S_2$ that is probabilistically caused by $S_1$ in accordance with the probability distribution specified by the 'no-boundary' solution of the Wheeler-DeWitt equation." Now if the 3-space $S_1$ mentioned in the antecedent exists, but the subsequent 3-space $S_2$ is caused by God and is not probabilistically caused by $S_1$ in accordance with the Hartle-Hawking "no-boundary solution" of the Wheeler-DeWitt equation, then the quantum cosmological law is false.

William Alston states that quantum mechanics allows for divine intervention.[65] Divine intervention would be ruled out, Alston says, if "the universe as a whole [is] a closed system vis-à-vis our body of physical laws. That, in effect, is what envisaged by the Laplacean formulation of determinism."[66] If the universe is a closed system vis-à-vis our body of physical laws, then "the total state of the universe at one moment is a determinate function of its state at any other moment."[67] Alston regards quantum mechanics as refuting this view and allowing that "God designed the universe to operate in accordance with probabilistic laws so as to give room for God to enter the process as an agent."[68]

Thus, we would have it that the wave function of the 3-space S determines the probabilities for the next 3-space. Suppose the 3-space that actually occurs after S is $S_1$. We may suppose that the probability of S1, conditional upon S and the wave function, is 85 percent. But God wants to bring about a different 3-space $S_2$. Thus the probability of $S_1$ conditional upon S, the wave function, and God's volition that $S_2$ occur, is 0 percent. Let us suppose that this is true for each 3-space, so that the probability of a 3-space, $p(h/e \& b \& G)$, is 100 percent, where h is the hypothesis that the 3-space occurs, e is the evidence that the earlier 3-space occurred, b is the relevant background knowledge (in this case, the wave function), and G is God's willing that h be true.

But in this case quantum cosmology would be false. It never succeeds in giving us the correct probability for any hypothesis h. Quantum cosmology is false since it includes among its conditions e + b, and omits G. It is not the mere omission of G that renders quantum cosmology a false theory; it is the inclusion of probabilistically irrelevant conditions e and b as the conditions for h. Since $p(h/e \& b \& G) = p(h/G)$, it follows that e and b are probabilistically irrelevant. Quantum cosmology is thus false for two reasons; it omits a relevant condition of $p(h)$, and it includes only irrelevant conditions of $p(h)$.

The theist may respond to this that "science is true since it is only about the natural universe, and does not take into account supernatural activity." But this response is offered as a panacea to disguise the implication of theism, namely, that science is false. Theism implies that science gives us a false theory of the natural universe, since science asserts that probabilistically *irrelevant* conditions of natural occurrences are the only probabilistically *relevant* conditions. The reason the theist cannot admit this, I submit, is sociological. Anybody who says "science is false and religion is true" immediately puts themselves beyond the pale of academic respectability and is dismissed as a "religious kook." I submit the theist ought to brave this negative peer pressure and "come out of the closet" about the implications of her theism.

Thus, Alston is mistaken that quantum mechanics can allow divine activity in a way that classical determinism cannot. But Alston puts forth another line of argument, that no scientific law specifies "unqualifiedly" conditions for a natural occurrence, be these conditions sufficient or probabilistic. Alston writes: "The most we are ever justified in accepting is a law that specifies what will be the outcome of certain conditions in the absence of any relevant factor other than those specified in the law."[69] "None of our laws take account of all possible influences."[70] Thus, "it can hardly be claimed that such a law will be violated if a divine outside force intervenes."[71] But this does not solve the problem, since, if theism is true, the conditions mentioned in the law are probabilistically irrelevant to the outcome, and the law is false. If the law is true, then the conditions are probabilistically relevant; but in that case, God cannot intervene since his intervention, being omnipotent, makes any other conditions probabilistically irrelevant.

Now, does quantum cosmology bring any new twist to this argument? This argument holds for ordinary quantum mechanics as well as quantum cosmology, but what quantum cosmology adds to this is that the wave function of the universe is a unique sort of law in that it *does* take account of *all possible influences* and does offer *unqualified* conditions for occurrences of states of the universe and of the universe as a whole. The qualified laws are those that purport to describe some part of the universe, since they allow that some other part may be influential and thus change the outcome specified by the law. But the wave function of the universe is about the whole universe. It is the one law that incorporates the clause that there are no other possible outside influences. If it did not incorporate this clause, it would not be a wave function of the universe but a wave function of a subsystem of the universe.

The response that the law means no other "natural influences" is unsuccessful, since the law, as a universal generalization, does not have for its domain only some of the things that exist—God's creatures. The variable ranges over everything. The natural/supernatural distinction is not made by the wave function, but is invented by the theist, limiting the actually unlimited domain of quantification of the variables in the wave-function law. But this law in fact has no limits to its domain of quantification. For the theist to stipulate that it does not range over everything, but only some things—the things belonging to God's creation—is to change the law—or more exactly, is to say the law is false since it ranges over everything and thus over God and thus fails to account for God's activities in what it mentions.

This fact is illustrated by one point. As Hawking says in *A Brief History of Time,*[72] the wave function gives in principle the probabilities of the histories of intelligent organisms: "Each history in the sum over histories will describe not only the space-time but everything in it as well, including any complicated organisms like human beings who can observe the history of the universe." Some of these histories include, to borrow Alston's phrase, "the many occasions on which human beings take themselves to be in communication with God, receiving messages from God and speaking to God in turn, being aware of God's activity towards them. . . these events involve's God's doing something at a particular time and place to bring something about."[73] The histories of intelligent organisms not only include their interactions with other intelligent organisms, but also their interactions with God (or what they believe is a god). If they receive a message from God, the description of this event involves the description of the organism receiving the message from God and (as a part of this complex event) God giving the message. A complete wave function of the universe would thus include these human-divine interactions; otherwise, it would not be complete. Thus, the universal variables in the complete wave function do range over *all* events (which include, if theism is true, creaturely events and the Creator's events). Accordingly, a theist has to say that if a complete wave function does not incorporate reference to divine activity, it is not true. It is not a wave function that describes the complete histories of intelligent organisms; it has gaps in it, gaps at every moment when someone stoops to prayer or hears a message from God. But the complete wave function purports to have no gaps, and thus the theist must say that this complete wave function is false.

The moral of this story is that quantum cosmology and classical theism cannot both be true. One has two choices: become an atheist or else argue that science, in the form of quantum cosmology, is false. However, since Copernicus and Galileo, any time that religion has opposed science, religion has lost.

## REFERENCES

1. L. Z. Fang and Z. C. Wu, "An Overview of Quantum Cosmology," in *Quantum Cosmology*, ed. L. Z. Fang and Remo Ruffini (Singapore: World Scientific, 1986), p. 3.

2. Stephen W. Hawking, "The Boundary Conditions of the Universe," in *Astrophysical Cosmology* (Vatican City: Pontifica Academiae Scientarium, 1982) pp. 563–72.

3. J. Hartle and Stephen W. Hawking, "Wave Function of the Universe," *Physical Review D* 28 (1983): 2960–75.

4. R. Deltete and R. Guy, "Hartle-Hawking Cosmology and Unconditional Probabilities," *Analysis* 57 (1997): 304–15.

5. William Lane Craig, "The Caused Beginning of the Universe: A Reply to Quentin Smith," *British Journal for the Philosophy of Science* 44 (1993): 623–29.

6. William Lane Craig, "Hartle-Hawking Cosmology and Atheism," *Analysis* 57 (1997): 291–95.

7. Ned Markosian, "On the Argument from Quantum Cosmology against Atheism," *Analysis* 55 (1995): 247–51.

8. Graham Oppy, "Some Questions about 'The Hartle-Hawking Cosmology,'" *Sophia* 36 (1997): 84–95.

9. Richard Swinburne, review of *Theism, Atheism, and Big Bang Cosmology*, by William Craig and Quentin Smith, *Philosophical Review* 104 (1995): 337–39.

10. Oppy, "Some Questions about 'The Hartle-Hawking Cosmology.'"

11. Quentin Smith, "Stephen Hawking's Cosmology and Theism," *Analysis* 54 (1994): 263–43.

12. William Lane Craig and Quentin Smith, *Theism, Atheism and Big Bang Cosmology* (Oxford: Clarendon Press, 1993), pp. 307–10.

13. Alvin Plantinga, "World and Essence," *Philosophical Review* 79 (1970): 461–92.

14. R. Adams, "Theories of Actuality," *Nous* 8 (1974): 211–31.

15. Rudolph Carnap, "Modalities and Quantification," *Journal of Symbolic Logic* 11 (1946): 33–64.

16. Rudolph Carnap, *Meaning and Necessity* (Chicago: University of Chicago Press, 1947).

17. Stig Kanger, *Provability in Logic* (Stockholm: Almqvist & Wiksell, 1957).

18. Jaakko Hintikka, "Quantifiers in Deontic Logic," *Societa Scientariarum Fennica, Commentationes Human Litterarum* 23 (1957): 3–23.

19. Jaakko Hintikka, "Modality as Referential Multiplicity," *Ajatus* 20 (1957): 49–64.

20. Jaakko Hintikka, "Modality and Quantification," *Theoria* 27 (1961): 119–28.

21. Jaakko Hintikka, "The Modes of Modality," *Acta Philosophica Fennica* 16 (1963): 65–79.

22. Saul Kripke, "A Completeness Theorem in Modal Logic," *Journal of Symbolic Logic* 24 (1959): 1–14.

23. Saul Kripke, "Semantical Analysis of Modal Logic I: Normal Propositional Calculi," *Zeitschrift fur Mathematische Logik* 9 (1963): 67–96.

24. Saul Kripke, "Semantical Considerations on Modal Logic," *Acta Philosophica Fennica* 16 (1963): 83–94.

25. Quentin Smith, *Ethical and Religious Thought in Analytic Philosophy of Language* (New Haven: Yale University Press, 1997).

26. Quentin Smith, "A More Comprehensive History of the New Theory of Reference," in *The New Theory of Reference*, ed. James Fetzer and Paul Humphreys (Dordrecht: Kluwer Academic Press, 1998).

27. Rudolph Carnap, *Logical Foundations of Probability* (Chicago: University of Chicago Press, 1950).

28. Rudolph Carnap, "The Two Concepts of Probability," *Philosophy and Phenomenological Research* 5 (1945): 513–32.

29. Alvin Plantinga, "The Probabilistic Argument from Evil," *Philosophical Studies* 35 (1979): 1–53.

30. Arthur Falk, *The Joy of Deciding* (privately printed text for a course on decision theory, 1998).

31. Michael Tooley, *Causation: A Realist Approach* (Oxford: Clarendon Press, 1987).

32. Storrs McCall, *A Model of the Universe* (Oxford: Clarendon Press, 1994), pp. 86–94.

33. Abraham Robinson, *Non-Standard Analysis* (Amsterdam: North-Holland Pub. Co., 1966).

34. Allen Bernstein and Frank Wattenberg, "Nonstandard Measure Theory," in

*Applications of Model Theory to Algebra, Analysis and Probability*, ed. W. Luxemburg (New York: Holt, Rinehart and Winston, 1969).

35. Brian Skyrms, *Causal Necessity* (New Haven: Yale University Press, 1980).

36. David Lewis, "A Subjectivist's Guide to Objective Chance," in *Studies in Inductive Logic and Probability*, vol. 2, ed. R. Jeffrey (Berkeley: University of California Press, 1980).

37. McCall, *A Model of the Universe*.

38. Falk, *The Joy of Deciding*.

39. Craig and Smith, *Theism, Atheism and Big Bang Cosmology*.

40. Deltete and Guy, "Hartle-Hawking Cosmology and Unconditional Probabilities," p. 307.

41. Heinz Pagels, *Perfect Symmetry* (New York: Simon and Schuster, 1985).

42. Ibid., p. 347.

43. A. Vilenkin, "Creation of Universes from Nothing," *Physics Letters* 117B (1982): 25–28.

44. Pagels, *Perfect Symmetry*, p. 343.

45. Ibid., p. 347.

46. Markosian, "On the Arguments from Quantum Cosmology against Atheism."

47. Oppy, "Some Questions about 'The Hartle-Hawking Cosmology.'"

48. Craig, "The Caused Beginning of the Universe: A Reply to Quentin Smith."

49. Craig, "Hartle-Hawking Cosmology and Atheism."

50. R. Deltete and R. Guy, "Emerging from Imaginary Time," *Synthese* 108 (1996): 185–203.

51. Deltete and Guy, "Hartle-Hawking Cosmology and Unconditional Probabilities."

52. Craig, "The Caused Beginning of the Universe: A Reply to Quentin Smith," p. 637.

53. Hartle and Hawking, "Wave Function of the Universe," p. 2961.

54. Ibid.

55. Hartle, letter to Adolf Grünbaum, 1990.

56. Stephen Hawking and Roger Penrose, *The Nature of Space and Time* (Princeton, N.J.: Princeton University Press, 1996).

57. Hartle and Hawking, "Wave Function of the Universe," p. 2962.

58. Hartle, letter to Adolf Grünbaum.

59. Christopher Isham, "Creation of the Universe as a Quantum Tunneling Process," in *Physics, Philosophy and Theology*, ed. R. J. Russell et al. (Vatican City: Vatican Observatory, 1988).

60. Ibid., pp. 399–400.

61. Deltete and Guy, "Hartle-Hawking Cosmology and Unconditional Probabilities," p. 306.

62. Ibid.

63. Craig, "Hartle-Hawking Cosmology and Atheism," p. 292 n. 2.

64. Alvin Plantinga, quoted with permission from a private communication to Quentin Smith about quantum cosmology and theism, 1996.

65. William Alston, "Divine Action, Human Freedom, and the Laws of Nature," in *Quantum Cosmology and the Laws of Nature*, ed. R. Russell, N. Murphy, and C. Isham (Vatican City: Vatican Observatory, 1993).

66. Ibid., p. 190.

67. Ibid., p. 188.

68. Ibid., p. 189.

69. Ibid., p. 190.
70. Ibid.
71. Ibid.
72. Stephen W. Hawking, *A Brief History of Time* (New York: Bantam Books, 1988), p. 137.
73. Alston, "Divine Action, Human Freedom, and the Laws of Nature," pp. 186–87.

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