God and Spacetime

**Abstract**

In *The Divine Fractal*, Studtmann (2021) introduced a novel conception of God, what he calls the *symmetry conception*, and showed that such a conception not only can be formalized within extensional non-well-founded set theory but also entails the Thomistic view that God is identical to her essence. In this paper, I show that Studtmann’s symmetry conception of God can be integrated into a recent approach to quantum gravity, namely causal set theory. The theory that results has two significant consequences. First, God is the necessarily existing set of spacetime events. Second, the square root of the probability that a spacetime event randomly chosen from N spacetime events is uncaused is given by the following formula: . I conclude the paper by briefly discussing a connection between this formula and the cosmological constant.

One of the perennial problems concerning God is her relationship to space and time. In *The Divine Fractal*, Studtmann (2021) introduced a novel conception of God, what he calls the *symmetry conception*, and showed that such a conception not only can be formalized within extensional non-well-founded set theory but also entails the Thomistic view that God is identical to her essence. In this paper I show that the symmetry conception of God leads to a compelling view about God’s relationship to space and time. According to the view, God is the necessarily existing set of spacetime events. So stated, the view has a strong affinity to the Spinozistic conception of God. The view, however, goes beyond Spinoza in so far as it fits into a contemporary approach to foundational physics, namely causal set theory. It is the primary purpose of this paper to show that it is possible to construct an infinite number of causal sets from the sets in God’s mind in a way that is consistent with the sequential growth models in Rideout and Sorkin (1999) and Cortes and Smolin (2014, 2014).

 In the sequential growth models of causal set theory, time is understood as a process of sets coming into existence. In both the Rideout-Sorkin and Cortes-Smolin models, sets are ‘generated’ and then the causal predecessors of the set are chosen by way of some process. Here is Cortes and Smolin’s description of the process:

Principle A is incorporated here, in that each event is created as the result of a process acting on the prior set of events. That process is the activity of time. In the model we call it the *events generator*. The events generator must make two decisions each time it creates an event: First, which of the prior set of events are to be progenitors of the new event. Second, how are the properties of the new event determined from the properties of its progenitors.

And here is Rideout and Sorkin’s description:

The dynamics which we will derive can be regarded as a process of “cosmological accretion” or “growth”. At each step of this process an element of the causal set comes into being as the “offspring” of a definite set of the existing elements – the elements that form its past. The phenomenological passage of time is taken to be a manifestation of this continuing growth of the causet. Thus, we do not think of the process as happening “in time” but rather as “constituting time”.

According to both theories, the resulting causal structure, , must satisfy four axioms. (1) is irreflexive (or reflexive); (2) is anti-symmetric; (3) is transitive; and (4)is locally finite. A set, C, is locally finite with respect to if and only if for all x and all z , . The theories disagree insofar as Cortes and Smolin take the progression of time to be a fundamental and irreducible aspect of the universe while Rideout and Sorkin eliminate external time so as to avoid the effect of arbitrary labelling of sets on their dynamics.

 The theory in this paper conforms to the fundamental part of both these models. In the theory spacetime results from a three-step process: (1) a set is ‘generated’; (2) a set of possible causal predecessors for that set is chosen; and (3) a subset of the set of possible causal predecessors is chosen as the set of actual causal predecessors. Moreover, the causal relation that results from the process satisfies the four axioms that define a causal set. The theory in this paper agrees with Cortes and Smolin that time is a fundamental asymmetric process in the universe. But to the extent that Rideout and Sorkin want to avoid the effect of arbitrary labeling of sets, the theory in this paper also conforms to their theory. For, as shall become apparent, the order of the sets results from their internal structure, not an arbitrary labeling.

The theory in this paper differs from both the Rideout-Sorkin and Cortes-Smolin models, however, in three respects. First, the sets that are generated are chosen from sets that are contained by God. Because, as Studtmann proves in his previous paper, God is identical to her essence, she is the necessarily existing set of spacetime events. Second, the method of generation is by way of an explicitly set-theoretic operation, one that is linked to an important metaphysical concept, namely the concept of an essence. The operation is what I call the ‘essence-of’ operation, which takes a set, x, to the set of all and only those sets that contain x. Finally, and perhaps most importantly, the causal order is defined in terms of a random process that depends on the internal structure of the sets that God contains.

As a result of this last feature, the causal sets that are constructed from God’s mind have a structure that is absent from the causal sets that have been explored in the literature. Such an additional structure has both conceptual and physical significance. Its conceptual significance can be appreciated by considering a quotation from Fay Dowker (2005) about current approaches to causal set theory.

In causal set theory as currently conceived, the subject of the theory and the laws by which it is governed are different in kind. This is apparent in the Rideout-Sorkin models for example. The law of growth is given by a sequence of non-negative numbers. This law is not part of physical reality which is the causal set. To a materialist like myself, it would be more satisfying if the laws themselves were, somehow, physically real; then the physical universe, meaning everything that exists, would be “self-governing” and not subject to laws imposed on it from outside. Should these nebulous ideas find concrete expression it would represent perhaps the ultimate unity of physics.

Although I certainly don’t intend in this paper to unify physics, it will become clear that the causal sets defined from God’s mind get their order from a random process defined in terms of the internal structure of her members and so meet the desideratum that Fowker articulates.

 The physical significance of the internal structure of the sets in God’s mind comes from a particular detail of that structure. As will become apparent, the empty set, or what I will call *non-Being*, is one of the sets that can be chosen as containing the possible causal predecessors of some spacetime event. Because the empty set is empty, the theory entails that it is possible for spacetime events to be uncaused. Such a fact has theological significance insofar as the principle of sufficient reason has been a pillar of rationalistic theology (Melamed, Lin 2016). When applied to the causal domain, the principle of sufficient reason can be stated as the principle that every event has a cause. Such a principle has been used in the *Kalam Cosmological Argument* for the existence of God. (Craig, 1977) Unlike traditional rationalist theism, the theism in this paper is not only consistent with but entails the falsity of the principle of sufficient reason. Indeed, the theory in this paper goes beyond the mere possibility that there are uncaused spacetime events. For, it yields the following equation that expresses the square root of the probability that a spacetime event randomly chosen from N events is uncaused, where N is the number of spacetime events and Harmonic[N] is the Nth harmonic number.

The equation for Q expresses what might be considered a measure of the a-rationality of the universe. To the extent that an uncaused spacetime event is not rationally explainable, the probability that any spacetime event is uncaused is a measure of the extent to which the universe contains events that defy rational explanation. One of the distinctive features of the symmetry conception of God, therefore, is that it entails both a necessarily existent fundamental principle that sustains in existence all spacetime events as well as a degree of a-rationality in the universe.

Before proceeding to the substance of the paper, I want to address an objection that one might raise at this point. Addressing the objection should make clear the methodological stance I am taking. Using non-well-founded set theory to analyze the structure and assert the existence of God may seem to entail the view that God is a set. But here, someone might sensibly retort that whatever God is, she cannot be a set. How, after all, could the living God be a mathematical object? A similar sort of objection has been raised to certain theories of properties. (Bealer 1980) According to the objection, a property cannot be a function from possible worlds to sets, since that would entail that when I savor the taste of pineapple, I am savoring a function. But certainly, one might object, I cannot savor a function.

There are two plausible responses to this objection. (Oddie 2001) First, one might insist that the identification of properties with functions from possible worlds to sets is a proper reduction and hence that, appearances notwithstanding, one does savor a function when savoring the taste of pineapple. Although such a response is certainly possible with respect to the understanding of God in this paper – I could claim to have reduced God to a set – there is a second, less extreme, response to the objection that is, I believe, more plausible in the case of God. (Whether the second response is more plausible in the case of properties is not something I take a stand on.) Instead of claiming that one can reduce properties to functions, one might instead claim that appealing to such functions is a way of understanding the logical structure of properties, whatever properties end up being. So, for instance, one might claim that such an appeal can explain why extensions do not fix intensions. Analogous to such a response, one can use the axioms in this paper to illuminate the structure of God, whatever God ends up being. As in the case of properties, the appeal to a mathematical depiction of God can help illuminate God’s structure and thereby resolve some long-standing theological questions. In his previous paper, Studtmann showed that some traditional conceptions of God, which have both been proposed and objected to on the grounds of conceptual incoherence, pass at least a minimal test of coherence and that they all, surprisingly, revolve around the concept of symmetry. In this paper, I show that the symmetry conception of God can be incorporated into a current approach to spacetime.

 The remainder of the paper is structured as follows. In section I, I state the five axioms that Studtmann uses as the basis for his symmetry conception of God and then discuss the structure that is entailed by those axioms. In section II, I show how to construct causal sets from God’s mind in such a way that the equation for Q expresses the property just mentioned, namely the square root of the probability that a randomly chosen spacetime event is uncaused. I conclude by discussing a connection between the above equation for Q and the cosmological constant.

Section I

 Before turning to the details of Studtmann’s symmetry conception of God, it may prove worthwhile first to describe in general terms the axioms and the structure that they entail. For, the interest of the theory can be seen from a general description. One crucial aspect of the theory is that it is part of non-well-founded set theory. The most natural non-well-founded set theory in which to carry out the theory is positive set theory. Positive set theory has an explicitly topological motivation: it restricts its axiom schema to positive formulas, which thereby avoids the Russell paradox, and guarantees the existence of the topological sets. (Holmes 2017) Hence, the set theory in this paper finds a direct and easy application to topology.

One of the five axioms, the axiom of Extensionality, is fundamental to any set theory. Each of the other four axioms corresponds to a fundamentally important metaphysical concept. Ever since Parmenides championed Being and forbade inquiry into non-Being, those two concepts -- Being and non-Being – have been at the heart of metaphysical speculation. Two of Studtmann’s axioms assert the existence of Being and non-Being, which are better known by the names ‘the universal set’ and ‘the empty set’. The existence of non-Being is a standard part of well-founded set theories. The existence of Being, on the other hand, is not. The existence of a universal set leads to a contradiction in well-founded set theories but is easily proven within the two mathematically serviceable non-well-founded set theories, namely Quine’s NF and Positive Set Theory. (Holmes 2017) In addition to Being and non-Being, the concept of essence is fundamental to metaphysical speculation. Although the concept of essence is typically treated within a modal framework (Ishii, *et al.* 2018), it is possible to articulate a non-modal set theoretic notion of the essence of a set, x, in terms of the set that contains all the sets that contain x. If one were to think of an essence as the set of all the properties that an object has across all possible worlds, and if one were to restrict one’s attention to mathematical entities that have their properties necessarily, then such an extensional understanding of essence is entailed by the modal conception. Studtmann’s essence axiom asserts the existence of an essence for any set. Finally, Studtmann’s God axiom asserts the existence of a set that is a member of some set, x, if and only if x is a member of it. Because such an axiom asserts the existence of a set that is universally symmetrical with respect to the set-membership relation, Studtmann calls his conception of God the *symmetry conception*.

The five axioms characterize a structure that is homeomorphic to {-1/n | n is a positive integer} {0} { 1/n | n is a positive integer}. Such a homeomorphism, one might argue, makes the theory well suited to a study of discrete physical phenomena. But there is more to the structure than this homeomorphism, since the sets that make up the structure are composed of each other. As discussed in Studtmann’s previous paper, the sets that play the role of the positive numbers all contain themselves and each other, 0, and an infinite number of the sets that play the role of the negative numbers, which are discretely ordered as a result of their containing finite sequences of the sets in the positive part of the structure. Importantly, each set in the positive part of the structure is missing some initial finite segment of the series of sets in the negative part of the structure. Finally, 0 contains all and only those sets in the positive part of the structure. Zero in the structure corresponds to what I call *the God Set,* or more simply, *God.* The God set is defined by perfect set theoretic symmetry. In other words, (x)(x God God x). It is provable that any such set is identical to its essence and so is symmetrical in the topological sense of being invariant with respect to the operation used to construct the total order of spacetime events that is God’s mind. In addition, because God is a member of any member of her, the membership relation in God is infinitely descending; and so, God has a fractal-like structure.

 As will become apparent, the God set contains Being as well as those sets that result from applying the essence-of operation repeatedly to Being. As will also become apparent, God is totally ordered by the subset and superset relations and is locally finite with respect to those relations. Hence, God is a totally ordered locally finite set whose order is the result of the structure of the sets that she contains. Of course, a total order is not a partial order. And a causal set is locally finite and partially ordered. So, God is very close to a causal set, except that the order of sets in him is total. But there is a very natural way to construct partial orders from the sets in God’s mind. As will emerge, the method of construction involves three steps. First, a set is ‘generated’ by applying the essence-of operation to sets within God’s mind. The generation of sets begins with the first set in the total order, namely *Being*. Second, a set is randomly chosen from among the sets that are missing from the generated spacetime event. Third, some subset of the set chosen in the second step is chosen as the set that contains the actual immediate causal predecessors of the event in question.

 Here, then, are the five axioms that provide the basis for the symmetry conception of God.

1. Extensionality:
2. Being:
3. Non-Being:
4. Essence:
5. God:

These axioms serve to characterize the contents of God’s mind, i.e. the sets that God contains. To see the structure that is entailed it is helpful to begin with the first four axioms. The first thing to note is that the Essence axiom and the non-Being axiom entail an infinite progression of sets. Let ‘E(x)’ denote the essence of x and ‘∅’ denote non-Being. Then, the two axioms entail the existence of non-Being, ∅, the existence of the essence of non-Being, E(∅), the existence of the essence of the essence of non-Being, E(E(∅)), and so on. Likewise, the Essence axiom and the Being axiom entail an infinite progression of sets: Being, E(Being), E(E(Being), and so on. For the ease of expression, I will call any set that is part of the progression of essences stemming from non-Being a ‘non-Being essence’ and any set that is part of the progression of essences stemming from Being a ‘Being essence’. I will also employ the following notation – En(x) – to stand for the essence function applied n times repeatedly beginning with x. So, for instance, E3(∅) = E(E(E(∅))). In the limit when n=0, En(x)=x.

 There are six theorems that express the structure entailed by the four axioms so far discussed. Before looking at the theorems, it will be helpful to see a visual representation of it. Because the theory is first order, by the Löwenheim-Skolem theorem structures that are not isomorphic to the structure also make the axioms true. What follows can be considered a representation of the intended structure -- it stands to the axioms above as the intended structure of arithmetic stands to the axioms of Robinson’s Arithmetic.

In the intended structure the non-Being essences are all finite sets whose members are Being essences. Each non-Being essence, En(∅) contains all the Being essences Em(Being) such that . So, for instance, E1(∅) contains E0(Being), E2(∅) contains E0(Being) and E1(Being), and so on. The Being essences are all infinite sets. Each Being essence contains every Being essence. In addition, each Being essence Em(Being) contains every non-Being essence En(∅) such that . The following is a visual representation of the first several Being and non-Being essences.

E0(Being) = {E0(Being), E1(Being), E2(Being)… E0(∅), E1(∅), E2(∅), E3(∅)…}

E1(Being) = {E0(Being), E1(Being), E2(Being)… E1(∅), E2(∅), E3(∅)…}

E2(Being) = {E0(Being), E1(Being), E2(Being)… E2(∅), E3(∅)…}

E3(Being) = {E0(Being), E1(Being), E2(Being)… E3(∅)…}

E0(∅) = {}

E1(∅) = {E0(Being)}

E2(∅) = {E0(Being), E1(Being)}

E3(∅) = {E0(Being), E1(Being), E2(Being)}

E4(∅) = {E0(Being), E1(Being), E2(Being), E3(Being)}

In this structure, the Being Essences progressively lose more and more of the non-Being essences. So, for instance, E0(Being) contains everything, both all the Being essences and all the non-Being essences. E1(Being) contains all but one thing: It contains all the Being essences as well as all the non-Being essences except E0(∅). E2(Being) contains everything but two things. And so on. It is as if the progression of Being essences is progressively drained of the non-Being essences. Were one to take such a progression out to infinity, one would reach a set that contains all of the Being essences and none of the non-Being essences. In other words, Eω(Being)= {Em(Being) | m is a positive integer}.The progression of non-Being essences, on the other hand, does not consist in a successive loss of sets but rather a successive gaining of sets. E0(∅), i.e. non-Being, contains nothing, E1(∅) contains one set, namely E0(Being). E2(∅) contains two sets, namely E0(Being) and E1(Being). And so on. Were one to take such a progression out to infinity, one would again reach the set that contains all of the Being essences: Eω(∅)= {Em(Being) | m is a positive integer}. Hence, Eω(Being) = Eω(∅). What can be called ‘the point at infinity’ for both the Being and non-Being essences is the set that contains all the Being essences.

 The following six meta-theorems describe the intended structure. (Proofs of the theorems appear in the appendix.) Let A be the set of axioms above.

 *Theorem 1*: For all m≥0, all n≥0, A |- Em(Being) ∈ En(Being)

 *Theorem 2*: For all m≥0, all n≥0, A |- Em(∅) ∉ En(∅)

*Theorem 3*: For all m, all n such that 0≤m<n, A |- Em(Being) ∈ En(∅);

*Theorem 4*: For all m, all n such that 0≤n≤m A |- Em(Being) ∉ En(∅)

*Theorem 5*: For all m, all n such that 0≤m≤n, A |- En(∅) ∈ Em(Being);

*Theorem* 6: For all m, all n such that 0≤n<m, A |- En(∅) ∉ Em(Being).

This brings us to the fifth axiom above, the God axiom. There are three important theorems about God that serve to characterize her structure.

*Theorem 7*: T = E(T).

*Theorem 8*: For all n≥0 A |- En(Being) ∈ T

 *Theorem 9*: For all n≥0, A |- En(∅) ∉ T.

Theorem 7 shows that T is not only symmetrical (in the logical sense) with respect to the set-membership relation but is also symmetrical (in the sense of being invariant) with respect to the essence function. Just as Aquinas claimed, God is identical to her essence. Theorems 8 and 9 show that in the intended structure God = {Em(Being) | m is a positive integer}. In other words, God is the point at infinity for the progression of the Being and the non-Being essences.

The following is a visual representation of God and the first four Being essences that she contains.

 God = {

E0(Being) = {God, E0(Being), E1(Being), E2(Being)… E0(∅), E1(∅), E2(∅), E3(∅)…}

E1(Being) = {God, E0(Being), E1(Being), E2(Being)… E1(∅), E2(∅), E3(∅)…}

E2(Being) = {God, E0(Being), E1(Being), E2(Being)… E2(∅), E3(∅)…}

E3(Being) = {God, E0(Being), E1(Being), E2(Being)… E3(∅)…}

…}

It should be clear from this visual representation that God is totally ordered by the superset (and subset) relation and is locally finite. In order to see the potential relevance of such a set to quantum processes, one can suppose for the moment that the non-Being essences contain an amount of energy. As the sets progress from Being to the essence of Being and so on, they lose energy in a discretely ordered way. Each application of the essence of operation yields a set that has one less unit of energy that can be extracted from it. One can see this in terms of an increase in entropy: The entropy of the system increases step by step as the essence-of operation is applied. God represents the completion of that process, a point at infinity that contains no extractable energy. God provides the direction of the universe. The progression of sets is a progression of increasingly God-like sets. God is the end point. Being, the beginning.

Section II

 Causal set theory is a current approach to quantum gravity. (See Henson, 2006, for an overview.) According to it, a causal structure is the fundamental feature of the world. The mathematical basis of such an approach stems from the fact that of the ten numbers that are needed to define the spacetime structure of a manifold, nine of those numbers are fully specified by the causal structure of the light cone. The other number needed is volume, which in the causal set approach equals the number of causal sets. Within causal set theory a causal set is defined by a small set of axioms. The logical simplicity of the theory is one of its chief attractions. According to the axioms, a causal set is a set with a partial order, , that is irreflexive (or reflexive), anti-symmetric, transitive and locally finite.

 There are a number of outstanding issues within the causal set approach to quantum gravity. As so far developed, it has yet to be formulated as a full theory of quantum gravity and still faces a number of technical difficulties. It is not my intention to address any of the issues that it currently faces, since the contribution of this paper to the approach occurs at a more fundamental level, one that allows it to be incorporated into any of the various approaches to causal set theory. As I will I show it is possible to construct locally finite partially ordered sets from the totally ordered set in God’s mind. As I have already said, the main difference between the theory in this paper and other causal set theories lies in the fact that current approaches treat the elements of casuals sets as structureless. As should be clear by now, the elements of the causal sets that will be constructed from God’s mind have a great deal of structure.

 The method of construction is very simple and has been foreshadowed by the discussion so far. It occurs as follows. Sets are generated by repeated application of the essence of operation to the Being essences, beginning with Being itself. Each time a set is generated, one of its missing non-Being essences is chosen randomly as containing its possible immediate causal predecessors. Second, some non-empty subset of the sets contained in that non-Being essence are chosen as the actual causal predecessors (unless the non-Being essence is the empty-set in which case the spacetime event has no immediate casual predecessor.) Let us suppose, then, that Em(Being) En(Being) if and only if Em(Being) is chosen to be one of En(Being)’s immediate causal predecessors. And let be the transitive closure of . It is easy to see from the structure of the Being and non-Being essences that is irreflexive, anti-symmetric, transitive and locally finite. The fact that it is a partial order follows from the fact that the possible immediate causal predecessors of En(Being) are E0(Being)… En-2(Being). In other words, En-1(Being) cannot be a causal predecessor of En(Being). This follows from the fact that for any Em(Being), the missing non-Being essences progress only up to Em-1(∅) and those non-Being essences contain Being essences only up to Em-2(Being). Because En(Being) cannot be a causal predecessor of En-1(Being), is a partial order.

 For the purposes of deriving the equation for Q, it suffices to consider the class of causal sets that are constructed by requiring the first choice to be random. In other words, a missing non-Being essence is randomly chosen to contain a spacetime event’s possible causal predecessors. Because for any En(Being), the number of missing non-Being essences equals n, the probability that E0(∅) is chosen equals 1/n. As long as some set other than E0(∅) is chosen, En(Being) has at least one causal predecessor. Hence, for any such method of constructing a partial order, and for any N, the expected number of causal sets that have no causal predecessor is Harmonic[N]. Hence, for any such causal order, expresses the square root of the probability that a spacetime event randomly chosen from N spacetime events has no causal predecessor.

Conclusion

 I have so far argued that the symmetry conception of God can be incorporated into causal set theory in a way that has a significant physical implication, namely that there is a non-zero probability that a spacetime event randomly chosen from N events will be uncaused and a significant theological implication, namely that spacetime events are all contained by and all contain God. I want to conclude by discussing a connection between the equation that expresses the first of these facts and the cosmological constant, .

As is well-known, the very low value of the cosmological constant is one of the great mysteries in physics. To use Leonard Susskind’s phrase (2006), the cosmological constant problem is the ‘mother of all physics problems.’ It is therefore one of the significant sources of interest of causal set theory that it can predict the approximate value of the cosmological constant. Using a statistical argument, Sorkin (1990) argued that ~ , which is close to the currently measured value of . Sorkin estimated only the magnitude, not the sign, of the constant. Nonetheless, the ability to provide even an approximate estimate of the magnitude of a phenomenon that has baffled physicists is certainly a mark in favor of causal set theory.

As it turns out, there is a natural modification of the equation for Q and a natural assumption about the number of causal sets in the universe that allows one to predict the cosmological constant’s exact measured value. Such a fact no doubt raises many questions that I will not address here. In particular, it raises the question as to why and how such a modified equation would fit into Einstein’s Field Equation in the way that the cosmological constant does. But without trying to answer that question, we can nonetheless turn to the assumption and the modification.

 The assumption concerns the number of spacetime events. Because of the fundamentality of time in the theory, it is natural to suppose that the number of spacetime events in one dimension equals the number of Planck moments that have elapsed in the universe. With such an assumption, the number of total spacetime events is with t measured in Planck units. If one supposes that the age of the universe is 13.04 billion years old, which is within the margin of error from Planck 2015, then the number of spacetime events is , and the equation for Q reduces to the following.

It should be clear that this number is very close to the measured value of the cosmological constant. Indeed, it bears a natural relationship to the measured value. The cosmological constant is a curvature constant and so has units of . It is possible to introduce those units into the equation for Q in a natural way by dividing the expression on the right-hand side of the equation by the surface area of a sphere with a radius equal to one Planck length. With such a modification, one arrives at the following equation:

Plugging for N into this equation yields the following:

It should perhaps not be surprising that a theory of causal sets would yield an equation that predicts the cosmological constant, since Sorkin has already shown that causal set theory leads to an approximate prediction of its magnitude. Nonetheless, the fact that the above equation predicts the measured value is striking for at least two reasons. The first reason is the extreme simplicity of the equation. For, what kind of coincidence could it be that such a simple equation predicts the measured value of the cosmological constant?

The second reason is that the equation comes from a mathematical analysis of God’s mind. *Pace* many theologians, both past and present, God’s mind is not as inscrutable as one might have thought. Such a fact, one might reasonably contend, counts in favor of God’s existence. But it does so in a way that runs exactly counter to the way that some theists have tried to argue. Some theists have argued that the value of the physical constants is evidence that God fine-tuned the universe so as to allow for the possibility of life. (Plantinga 2007, McGrath 2009) As it turns out, however, although the fundamental expression on which the cosmological constant depends – Harmonic[N] – is related to God, it has nothing to do with God’s fine tuning the universe. Rather, the expression is a measure of the number of uncaused and hence unexplained events. Far from being the effect of fine-tuning, the cosmological constant is the result of those aspects of the universe that God does not explain, the absurd if you will. To the extent that the existence of the universe and life depend on the cosmological constant, the universe and life retain an element of the absurd.

**Appendix**

Theorems 1-6, 8 and 9 are meta-theorems. They all stem from the fact that some set, x, is in a set, y, if and only if y is in the essence of x. With an appropriate definition of the essence-of function, such a fact can be proven from the Essence axiom and extensionality. Call that fact ‘E’. Formally stated,

E: (∀x)(∀y)(x ∈ y ≡ y ∈ E(x)).

Completely rigorous proofs of the meta-theorems would require using induction on the syntax. Instead of complicating the presentation by formulating inductive proofs, I exhibit several iterations of the patterns involved and then use the informal phrase, ‘and so on’. It should be obvious in each case that an inductive proof could be supplied.

Proof of Theorem 1.

For n≥0, A |- En(Being) ∈ Being. By instantiation of E, for all n≥0, A |- En(Being) ∈ Being ≡ Being ∈ En+1(Being). Hence, for n≥0, A |- Being ∈ En+1(Being). By the Being axiom, A |- Being ∈ Being. So, for n≥0 A |- Being ∈ En(Being). By instantiation of E, for all n≥0, A |- Being ∈ En(Being) ≡ En(Being) ∈ E1(Being). So, for n≥0 A |- En(Being) ∈ E1(Being). By instantiation of E, for all n≥0, A |- En(Being) ∈ E1(Being) ≡ E1(Being) ∈ En+1(Being). Hence, for n≥0, A |- E1(Being) ∈ En+1(Being). By the Being axiom, A |- E1(Being) ∈ E0 (Being). Hence, for n≥0 A |- E1(Being) ∈ En(Being). By instantiation of E, for all n≥0, A |- E1(Being) ∈ En(Being) ≡ En(Being) ∈ E2(Being). So, for n≥0, A |- En(Being) ∈ E2(Being). By instantiation of E, for all n≥0, A |- En(Being) ∈ E2(Being) ≡ E2(Being) ∈ En+1(Being). Hence, for n≥0, A |- E2(Being) ∈ En+1(Being). By the Being axiom, A |- E2(Being) ∈ E0(Being). Hence, for n≥0, A |- E2(Being) ∈ En(Being). And so on. Hence, for all m≥0 and all n≥0, A |- Em(Being) ∈ En(Being).

Proof of Theorem 2.

Suppose that for arbitrary m≥0 and n≥0, A |- Em(∅) ∈ En(∅). By instantiation of E, A |- En-1(∅) ∈ Em(∅) ≡ Em(∅) ∈ En(∅), A |- Em-1(∅) ∈ En-1(∅) ≡ En-1(∅) ∈ Em(∅), A |- En-2(∅) ∈ Em-1(∅) ≡ Em-1(∅) ∈ En-1(∅), and so on. Hence, A |- Em-n(∅) ∈ En-n(∅) or A |- En-m(∅) ∈ Em-m(∅). Hence, A |- (∃x)(x ∈ ∅), which contradicts the empty set axiom. Hence for all m≥0, all n≥0, Em(∅) ∉ En(∅).

Proof of Theorem 3.

For all n≥0, A |- En(∅) ∈ Being. Hence, by instantiation of E, A |- En(∅) ∈ Being ≡ Being ∈ En+1(∅), A |- Being ∈ En+1(∅) ≡ En+1(∅) ∈ E(Being), A |- En+1(∅) ∈ E(Being) ≡ E(Being) ∈ En+2(∅), and so on. So, for all n≥0, all m ≥1, A |- En(∅) ∈ Being ≡ Em(Being) ∈ En+m(∅). Hence, For all m, all n such that 0≤m<n, A |- Em(Being) ∈ En(∅)

Proof of Theorem 4.

Assume that 0≤n≤m. By instantiation of E, A |- En-1(∅) ∈ Em(Being) ≡ Em(Being) ∈ En(∅), A |- Em-1(Being) ∈ En-1(∅) ≡ En-1(∅) ∈ Em(Being)…. A |-Em-n(Being) ∈ En-n(∅) ≡ En-1(∅) ∈ Em(Being). Hence, A |- Em(Being) ∈ En(∅) ⊃ Em-n(Being) ∈ En-n(∅). Hence, A |- Em(Being) ∈ En(∅) ⊃ (∃x)(x ∈ ∅). Hence, A |- Em(Being) ∉ En(∅).

Proof of Theorem 5.

For all n≥0, A |- En(∅) ∈ Being. By instantiation of E, A |- En(∅) ∈ Being ≡ Being ∈ En+1(∅), A |- Being ∈ En+1(∅) ≡ En+1(∅) ∈ E(Being), A |- En+1(∅) ∈ E(Being) ≡ E(Being) ∈ En+2(∅), A |- E(Being) ∈ En+2(∅) ≡ En+2(∅) ∈ E2 (Being), and so on. So, for all m, all n such that 0≤m≤n A |- En(∅) ∈ Being ≡ En+m (∅) ∈ Em(Being). Hence, for all m, all n such that 0≤m≤n A |- En+m (∅) ∈ Em(Being).

Proof of Theorem 6.

Assume that 0≤m<n. By instantiation of E, A |- Em-1(Being) ∈ En(∅) ≡ En(∅) ∈ Em(Being), A |- En-1(∅) ∈ Em-1(Being) ≡ Em-1(Being) ∈ En(∅)… A |- Em-n(Being) ∈ En-n(∅) ≡ En-n(∅) ∈ Em-n+1(Being). Hence, A |- En(∅) ∈ Em(Being) ⊃ Em-n(Being) ∈ En-n(∅). Hence, A |- Em(Being) ∈ En(∅) ⊃ (∃x)(x ∈ ∅). Hence, A |- Em(Being) ∉ En(∅).

Proof of Theorem 7.

Suppose x ∈ God. Then, by the symmetry of God, God ∈ x. Therefore, by the definition of an essence, x ∈ E(God). Suppose x ∈ E(God). Then, by the definition of an essence, God ∈ x. Therefore, by the symmetry of God, x ∈ God. Therefore, for any set, x, x ∈ God ≡ x ∈ E(God). Therefore, by extensionality, God = E(God).

Proof of Theorem 8.

By the Being axiom, A |- God ∈ Being. Hence, by the God axiom, A |- Being ∈ God. By instantiation of E, A |- Being ∈ God ≡ God ∈ E(Being). Hence, A |- God ∈ E(Being). By the God axiom, therefore, A |- E(Being) ∈ God. By instantiation of E, A |- E(Being) ∈ God ≡ God ∈ E2(Being). Hence, A |- God ∈ E2 (Being). By the God axiom, therefore, A |- E2(Being) ∈ God. And so on.

Proof of Theorem 9.

By the God axiom, for all n, A |- En(∅) ∈ God ⊃ God ∈ En(∅). By the fact E, A |- En-1(∅) ∈ God ≡ God ∈ En(∅). Hence, A |- En(∅) ∈ God ⊃ En-1(∅) ∈ God. Hence, by the God axiom, A |- En(∅) ∈ God ⊃ God ∈ Em-1(∅). By the fact E, A |- En-2(∅) ∈ God ≡ God ∈ En-1(∅). Hence, A |- En(∅) ∈ God ⊃ En-2(∅) ∈ God. Hence, by the God axiom, A |- En(∅) ∈ God ⊃ God ∈ En-2(∅). And so on, until A |- En(∅) ∈ God ⊃ God ∈ Em-m(∅). Hence, A |- En(∅) ∈ God ⊃ (∃x)(x ∈ ∅). Hence, A |- En(∅) ∉ God.

**Works Cited**

Cortes, M., Smolin, L., (2014) “The Universe as a Process of Unique Events”, *Physical Review D*, Volume 90.

Cortes, M., Smolin, L., (2014) “Quantum Energetic Causal Sets”, *Physical Review D*, Volume 90.

Craig, W., (1979) *The Kalam Cosmological Argument*, Wipf and Stock Publishers.

F. Dowker, (2005) “Causal Sets and the Deep Structure of Spacetime”, arXiv:gt-qc/0508109.

J. Henson, (2006) “The Causal Set Approach to Quantum Gravity”, arXiv:gr-qc/0601121.

Holmes, R, "Alternative Axiomatic Set Theories", The Stanford Encyclopedia of Philosophy (Winter 2017 Edition), Edward N. Zalta (ed.).

McGrath, A., (2009) *A Fine-Tuned Universe: the Quest for God in Science and Theology*, (1st ed.). Louisville, KY.: Westminster John Knox Press.

Rideout, D.P., Sorkin, R.D., (1999) “Classical sequential growth dynamics for causal sets”. *Physical Review D,* Volume 61.

Plantinga, A. (2007) “The Dawkins Confusion: Naturalism a*d absurdum*” *Christianity Today*.

Sorkin, R., (1990) “First Steps with Causal Sets”, in R. Cianci, R. de Ritis, M. Francaviglia, G. Marmo, C. Rubano, P. Scudellaro (eds.), *General Relativity and Gravitational Physics*, (Proceedings of the Ninth Italian Conference of General Relativity and Gravitational Physics, held Capri, Italy), pp. 68-90.

Studtmann, P., (2021) “The Divine Fractal”, *Philosophia,* forthcoming*.*

Susskind, L., (2006) *The Cosmic Landscape: String Theory and the Illusion of Intelligent Design*, Little, Brown and Co, New York.