

Evidence of the Design of the Universe through Anthropic Principles

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There is an abundant wealth of evidence from the workings of physics, chemistry, and properties of the universe, our solar system, and earth which indicate that life on earth did not happen by accident--it was planned. These arguments are typically called "anthropic principles," where physical properties or parameters seem to be "just right" or "fine-tuned" to allow for life--and not necessarily just for life as we know it. The existence of these principles is well recognized in the scientific literature, and is discussed by many physicists, cosmologists, and even the occasional cosmetologist.

In the Beginning...

Before discussing Anthropic Principles, it is important to note that contrary to public opinion, most astrophysicists believe that the universe itself is not infinite, and that it had a beginning. Einstein's general theory of relativity predicts that the universe must expand or contract if it contains any matter (which of course it does)¹, implying there was an "explosion" at the beginning of the universe.^{1,3} This explosion, often called the "Big Bang", began as an infinitely dense infinitesimal singularity which blew up, sending matter and energy flying in all directions.

Many predictions made by Einstein's theory of relativity and "Big Bang" cosmology have been observed¹--including relativity-related time-changes on satellite clocks, curvature of light around stars due to matter, predicted levels of background radiation in the universe, light elemental abundances, and observations that galaxies are receding from one another from some point of explosion.

Big Bang cosmology has been controversial from its beginning. Young-earth creationists have typically opposed the Big Bang theory as it implies the universe has an age on the order of billions of years. While the necessity of a young-universe interpretation of Genesis may be open to hermeneutical questioning, the options open to scientists are as follows: the universe was supernaturally created some 10 thousand years ago, or the universe was supernaturally created some 10 billion years ago. For this reason, many atheist cosmologists have also opposed Big Bang cosmology because, "[if there was] a beginning, then there must be a Beginner"³. Information theorist Hubert Yockey notes the results of these implications have been that, "[i]n spite of other successes of the general theory of relativity, the Big Bang, and in particular the idea that the universe had a beginning, was fought bitterly every step of the way"¹.

Einstein himself had trouble accepting his own theories with his worldview as they showed "the necessity for a beginning,"⁴ and "the presence of a superior reasoning power."⁵ To avoid the consequences of his own theory, Einstein added a "cosmological constant" to the equations to change its philosophical implications and avoid the necessity of a "beginning" to the universe. Decades later, after the cosmological constant was disproved, Einstein called his addition of the constant, "the biggest blunder of his life."⁶ Sir Arthur Eddington, an astronomer contemporary with Einstein, wrote, "Philosophically, the notion of a beginning of the present order of Nature is repugnant . . . I should like to find a genuine loophole"⁷ and admitted that "unscientifically I feel ... unwilling to accept the implied discontinuity in the divine nature [caused by the Big Bang creation event]"⁸. But loophole's weren't to be found, and cosmologists who once strongly held to an infinite universe without a beginning (mostly for philosophical reasons) today are few in number. This led scientists of Einstein's day, such as Nobel Prize winner Arthur Compton, to say:

"For myself, faith begins with the realization that a supreme intelligence brought the universe into being and created man. It is not difficult for me to have this faith, for it is incontrovertible that where there is a plan there is intelligence--an orderly, unfolding universe testifies to the truth of the most majestic statement ever uttered--'In the beginning God.'"⁹

Before the Beginning...

As seen in Compton's statement, many have explained the necessity for a beginning to the universe by the action of God. Objectors have said that, philosophically speaking, it isn't acceptable to invoke God as an explanation for the origin of the universe unless we can somehow explain where God came from. Of course for the Christian theist, this cannot be done¹⁰, for God is *by definition* a Being existing outside of space and time eternally in the past, present, and future¹¹, from Whom all things which were created have come¹², who has no origin¹³.

The problem for the person who uses this objection to belief in God is that in their own worldview they are also left with unknowns. When asked where God came from, the theist may answer, "I don't know", but when asked where the universe came from, the non-theist must also then answer, "I don't know".

Some non-theists may try to avoid this unknown through coming up with other theories. As evidence began to mount for the Big Bang beginning of the universe, other theories began to be suggested to avoid the implications. Some of these include the steady state model and the oscillating universe theory. The non-scientific motivation for the oscillating universe theory (not to mention the failure of the steady state model) is best captured by writings of John Gribbon:

"The biggest problem with the Big Bang theory of the origin of the Universe is philosophical - perhaps even theological - what was there before the bang? This problem alone was sufficient to give a great initial impetus to the Steady State theory; but with that theory now sadly in conflict with the observations, the best way round this initial difficulty is provided by a model in which the universe expands from a singularity, collapses back again, and repeats the cycle indefinitely."²⁸

Some have suggested a steady bouncing universe (i.e. the universe reaches the same maximum size and then contracts again), while others have suggested an ever increasing bouncing universe (i.e. the universe increases in size with each bounce). But all of these explanations still regress back to the question, "what started off the chain of events?" not to mention "what is the 'bounce' mechanism?". Let's take a look at the latter first.

There are three basic problems to speculating on the theory of a bouncing universe. First, the current state of expansion of the universe is such that the amount of mass (and, therefore gravity) is not sufficient to cause collapse.²⁹ In other words, the universe is expanding too quickly for the effects of gravity to overcome and reverse the expansion. Furthermore, there is now evidence that the universe is actually accelerating in its expansion.³⁰ The second reason why the oscillating universe is found wanting is based on entropy. With each bounce, the radius of the universe would increase because of energy loss with each bounce. An everyday example of this is a rubber ball (matter in the universe) on a rubber band (effect of gravity in universe supposedly causing the contraction) attached to a paddle. With each bounce, usable energy is "lost" (i.e. there's an increase in entropy) to the system as the rubber band heats up and the ball bounces further and further from the paddle. This leads into the third problem: the mechanical efficiency of the universe. When it comes to mechanical efficiency, the universe has been likened to a "wet lump of clay"²⁹ rather than a pumped up basketball.³¹ Based on these reasons, the oscillating universe is not a likely candidate for valid consideration for the origin of the universe.

To the question, "what started the universe?", the non-theist must answer, "I don't know", but the theist has an explanation for one more thing than the non-theist: the origin of the universe. We may not be able to understand the "origin" of "God", but we know that space-time and energy-matter can come from a superpowerful Being. Using God as an explanation for the origin of the universe is thus an acceptable philosophical inference which actually has a larger explanatory power than a model which doesn't invoke God and leaves the origin of the universe unexplained.

...After the Beginning...

It may be incredible that the universe had a beginning, but if that was the end of the story, then we wouldn't be here to talk about it. The fact is that a large number of physical constants must be "fine-tuned" or "just right" in order to allow for life. Physicist and author Paul Davies has said that it is highly unlikely to get life as we know it given the possibilities for physical laws:

"Taken together they [anthropic principles] provide impressive evidence that life as we know it depends very sensitively on the form of the laws of physics, and on some seemingly fortuitous accidents in the actual values that nature has chosen for various particle masses, force strengths, and so on. If we could play God,

and select values for these natural quantities at whim by twiddling a set of knobs, we would find that almost all knob settings would render the universe uninhabitable. Some knobs would have to be fine-tuned to enormous precision if life is to flourish in the universe" ¹⁴

If the Big Bang theory is correct, then these finely tuned parameters affected the nature of the universe from its earliest moments. The setting of various constants determined if our universe contained any protons, atoms, molecules, or any life, period:

"the Big Bang cooled just quickly enough to allow neutrons to become bound to protons inside atoms. Here the presence of electrons and the Pauli principle discouraged their decay, but even that would not prevent it were the mass difference slightly greater. And were it smaller--one third of what it is--then neutrons outside atoms would not decay. All protons would thus change irreversibly into neutrons during the Bang, whose violence produced frequent proton-to-neutron conversions. There could be no atoms: the universe would be neutron stars and black holes ... The mass of the electron enters the picture like this. If the neutron mass failed to exceed the proton mass by a little more than the electron's mass, then atoms would collapse, their electrons combining with their protons to yield neutrons ... As things are, the neutron is just enough heavier to ensure that the Bang yielded only about one neutron to every seven protons. The excess protons were available for making hydrogen of long-lived stable stars, water, and carbohydrates."²⁰

But the presence of matter isn't all that matters, and the fact of the matter is that the type of matter matters much in deciding whether life can even exist to ponder these matters. Physicist John Polkinghorne clarifies:

"In the first three minutes of cosmic history, the whole universe was the arena of nuclear reactions. When that era came to an end, through the cooling produced by expansion, the world was left, as it is today on the large scale, a mixture of three-quarters hydrogen and one-quarter helium. A little change in the balance between the strong and weak nuclear forces could have resulted in there being no hydrogen--and so ultimately no water, that fluid that seems so essential to life. A small increase (about 2 percent) in the strong nuclear force would bind two protons to form diprotons. There would then be no hydrogen-burning main-sequence stars, but only helium burners, which are far too fierce and rapid to be energy sources capable of sustaining the coming to be of planetary life. A decrease in the strong nuclear force by a similar amount would have unbound the deuteron and played havoc with fruitful nuclear physics."¹⁹

Though the Big Bang itself is said to have created mostly helium and hydrogen, nuclear physics says that other elements could have been produced in the nuclear reactions going on inside of stars. Carbon and oxygen, elements vital to life, are two such heavier elements which, due to their chemical bonding properties, appear to be vital for complex life-form metabolic chemistry. The only other element like carbon is silicon, but silicon is much heavier and has significantly different bonding properties (carbon bonds with many other elements to form mobile gas and liquid substances which are useful for allowing for complex organic chemical reactions. When silicon bonds, it typically forms solids, which makes it no surprise that it is the second most abundant element on earth--it comprises the bulk of rock!!). Oxygen is also useful in its bonding capabilities. However, if either carbon or oxygen are to be produced in stellar reactions, the resonance levels of atomic nuclei must match the levels of the processes which create them. Astrophysicist Hugh Ross notes that these levels are "fine-tuned":

"As you tune your radio, there are certain frequencies where the circuit has just the right resonance and you lock onto a station. The internal structure of an atomic nucleus is something like that, with specific energy or resonance levels. If two nuclear fragments collide with a resulting energy that just matches a resonance level, they will tend to stick and form a stable nucleus. Behold! Cosmic alchemy will occur! In the carbon atom, the resonance just happens to match the combined energy of the beryllium atom and a colliding helium nucleus. Without it, there would be relatively few carbon atoms. Similarly, the internal details of the oxygen nucleus play a critical role. Oxygen can be formed by combining helium and carbon nuclei, but the corresponding resonance level in the oxygen nucleus is half a percent too low for the combination to stay together easily. Had the resonance level in the carbon been 4 percent lower, there would be essentially no carbon. Had that level in the oxygen been only half a percent higher, virtually all the carbon would have been converted to oxygen. Without that carbon abundance, neither you nor I would be here."¹⁵

These observations led atheist Fred Hoyle to conclude that, "If you wanted to produce carbon and oxygen in roughly equal quantities by stellar nucleosynthesis ... your fixing would have to be just about where these [oxygen and carbon resonance] levels are actually found to be ... A common sense interpretation of the facts suggests that a superintellect has monkeyed with physics, as well as with chemistry and biology..."¹⁶

Living Water

Chemical laws present from the beginning of the universe also show that water, the basic molecule of life on

earth, has very unique properties which, if any different, wouldn't allow for life on earth. Liquid water is probably vital to any carbon-based life-form²³ and carbon is a great element to allow for complex chemical bonding reactions inherent to life. Water is also vital due to its properties as a liquid solvent, and the protective medium it provides as an environment for habitation. However, if water was just a little different, it couldn't be this powerful liquid. Hugh Ross notes that the rules of water chemistry are also fine-tuned, noting that, "polarity of the water molecule if greater: heat of fusion and vaporization would be too great for life to exist; if smaller: heat of fusion and vaporization would be too small for life's existence; liquid water would become too inferior a solvent for life chemistry to proceed ..."¹⁷

The fact that solid water can float on liquid water is also an important property for life on earth. Intuitively, we would expect the solid form of a substance to be more dense than its liquid form. However, due to its [pressure-temperature diagram](#), the [solid crystalline form of water](#) is actually less dense than its liquid phase. If this were not the case, polar ice caps would sink--not float--and would freeze the earth's oceans from the bottom up¹⁷. Astrophysicist John Barrow and Mathematician Frank Tipler explain that this property of water is highly uncommon:

"Water is actually one of the strangest substances known to science. This may seem a rather odd thing to say about a substance as familiar [as water,] but it is surely true. Its specific heat, its surface tension, and most of its other physical properties have values anomalously higher or lower than those of any other known material. The fact that its solid phase is less dense than its liquid phase (ice floats) is virtually a unique property. These aspects or the chemical and physical structure of water have been noted before, for instance by the authors of the Bridgewater Treatises in the 1830's and by Henderson in 1913, who also pointed out that these strange properties make water a uniquely useful liquid and the basis for living things."¹⁸

Barrow and Tipler go on to show how water has a much higher boiling point than other substances, which allow it to also condense to form a liquid. Water has properties which are generally "absent" in similar substances. However, all of these facts would be meaningless if the Earth was in a position relative to the sun that made surface temperatures too hot, or too cold to allow for liquid water. This, and other similar facts show that the solar system itself has been "fine-tuned" and that it seems that a Designer has influenced the fundamental properties of the universe, but also much smaller details like the origin of our solar system. This is discussed in the next section.

More than Just a First Cause

The Greeks attributed the origin of the universe to a "Prime Mover", or "First Cause" who set things in motion. "Rational thinkers" of the enlightenment took this idea further and found it popular for them to believe in a watchmaker God, who "wound up" the universe and left it to run on its own. This deistic view of the world saw God as an absentee father, who got things going, and then went on about his more important business. Big Bang theory says that the universe exploded, and over billions of years it cooled, and matter condensed forming galaxies, nebulae, stars, and solar systems. Our solar system is thought to be a "third-generation" solar system, which contains the left over parts of two previous star systems which "went nova." The formation of the solar system, and the earth, allegedly occurred long after the beginning of the universe. Thus, while God could have initially set physical properties of the universe and then gone fishing, the presence of similar "anthropic principles" for the solar system, the moon, and the earth itself indicate that the Designer was involved long after the beginning of the universe and had something to do with life on earth. Put in simple theological terms, one might say, God cares about life on earth.

First of all, the very position of the solar system in our galaxy is unique among stars, and allows for the existence of life. Astronomers Hugh Ross and Guillermo Gonzalez explain:

"The solar system occupies a position in the disk of the Milky Way approximately halfway to its edge and in-between two spiral arms. We now know enough about the structure of our galaxy to understand why our location should be preferred over others. If our solar system were closer to the center of the Milky Way or closer to one of its spiral arms, we would encounter harmful radiation from supernovae and perturbations from stars that would send Oort cloud comets careening into the inner solar system. If the solar system had formed farther out in the disk of the Milky Way, there would not have been sufficient heavy elements to build a planet capable of supporting life."²²

Not only is the position of our solar system important, but also the fact that our solar system's relative position remains constant within the galaxy. Richard Deem notes that, "the stability of our position is possible because

the sun is one of the rare stars that lies within the 'galactic co-rotation radius'²³ where, "most stars located between spiral arms do not remain there [within a galactic co-rotation radius] for long, but would eventually be swept inside a spiral arm [of the galaxy]. Only at a certain precise distance from the galaxy's center, the "co-rotation radius," can a star remain in its place between two spiral arms, orbiting at precisely the same rate as the galaxy arms rotate around the core"²³. But having a sun--or even a typical sun--isn't enough:

"While most textbooks discuss the Sun as if it were a typical star, it is a more massive star than 90 percent of the stars in the Milky Way. The Sun is anomalous in other ways, including its composition, brightness variation, and Galactic orbit. It can be plausibly argued that each of these characteristics must be exactly as it is for advanced life to exist on Earth."²²

As discussed above, liquid water is necessary at least for carbon based life²³, and probably for any life. Yet another parameter allowing for life on Earth is its position within the solar system which allows for liquid water. Nick Hoffman, Senior Research Scientist at La Trobe University, Melbourne Australia notes that if Earth was a bit closer to the sun, it would have a runaway greenhouse atmosphere vaporizing any chance for non-gaseous water to exist, like Venus. But, if it were a little further, it would have had no liquid water, as it all would have been frozen²⁴.

Earth's single large satellite, the Moon, is unique among the planets and greatly affects the geography of the earth. Hoffman again notes that, "it has become clear that our Moon is a rare celestial object and that few Earth-like planets could have produced such a chance outcome during their assembly"²⁶ and argues that without the moon, the earth most likely would have little to no exposure of continents²⁴. Similarly, Ross and Gonzalez note that the moon is vital for earth's continental geography:

"Removing the moon seems harmless enough at first. Of course, Solon [Earth without the moon] would differ from the earth. The tides would be lower without the moon, and it would lack eclipses and romantic, moonlit nights, but in the global scheme of things these changes seem trivial. As we dig deeper, we discover that lower tides, higher winds, and shorter days would greatly affect Solon's geography, its ability to evolve [could also read: support] life, and the quality of the life animals would have there. As the differences between Earth and Solon become more evident, it becomes clear that Solon would be a much less hospitable place in which to live."²¹

Finally, it has been argued that the size of the earth has prevented it from becoming either a total desert or a waterworld²³, that the large magnetic field protects life from harmful radiation²³, that our unique continental crust allows for plate tectonics and replenishes nutrient supplies for life²³, and even that the size and position of Jupiter is vital to the protection of life on earth from space debris²⁷. The bottom line is that a large number of parameters of the earth and solar system are finally tuned to keep it a stable, protected, nutrient and liquid-water bearing planet. This implies that design went into the origins of earth and the solar system, disallowing for a deistic worldview where God does not care about life on this planet.

Winning the Cosmic Lottery?

In light of this evidence for fine tuning, what are our options? So potent is the argument for design that one commentator stated that, "[t]his fine-tuning has two possible explanations. Either the Universe was designed specifically for us by a creator or there is a multitude of universes- a 'multiverse'"³² This common objection to these arguments basically goes like this:

"Sure, maybe it is unlikely that our universe would be 'just right' for life. But isn't it also really unlikely that one would win the lottery? We don't infer some divine coincidence there because we know that if you have enough tries, chances are even something very unlikely will occur. If there are 'infinite universes' out there, then perhaps the fact that ours is 'just right' for life isn't so unlikely!"

While this objection, if valid, would seem to make our universe less likely, the rejoinder to that is that we have no evidence of these "multiple universes" and this is complete philosophical speculation. This argument is unverifiable, and unfalsifiable. Additionally, Paul Davies notes that, "if the bio-friendliness of the natural world were the result of randomness, we might expect the observed universe to be minimally rather than optimally bio-friendly. But the degree of bio-friendliness we observe in the universe is far in excess of what is needed to give rise to a few observers to act as cosmic selectors."³³ Occam's Razor (the claim that simplest explanation is more often the right one) would seem to argue against postulating some complex cosmic lottery producing infinite universes.

However, the anthropic argument for design has something else much more powerful going for it. According to intelligent design theory, the ways that intelligent agents act can be observed in the natural world and

described. When intelligent agents act, it is observed that they produce high levels of "complex-specified information" (CSI). CSI is basically a scenario which is unlikely to happen (making it complex), and conforms to a pattern (making it specified). Language and machines are good examples of things with much CSI. From our understanding of the world, high levels of CSI are always the product of intelligent design. It may very well be that, through the fine-tuning of its laws, the universe contains this same CSI that we tend to find produced through intelligent design. The laws and properties of the universe are extremely complex, yet they are highly specified to match the very properties needed for life. Thus, we have a positive argument in favor of intelligent design of the universe. In essence, the universe has the same type of information we tend to find in intelligently designed machines. This strongly points to design.

The Meaning of it all

In contrast with strict intelligent design theory, Anthropic Principles reveal more about the Designer than simply the notion that it was, "intelligent." Anthropic Principles show that a Power outside of space and time (not extra-terrestrials) has had something do with life on earth. Anthropic Principles imply that there are Forces capable of providing all the energy for the universe, changing physical laws, manipulating a galaxy, precisely ordering a solar system, and controlling the geological history of Earth. The fact that anthropic principles are deduced all the way from the beginning of the universe to the last earthquake we had show that this Being must have had us in mind from the beginning, and that it is a single Power which did all this. To put it bluntly, the design of the universe imply there is a Creator God. The feelings provoked by these evidences is well typified by Professor of Astronomy George Greenstein:

"It was not for some time that I was able to place my finger on the source of my discomfort. It arises, I understand now, because the contention that we owe our existence to a stupendous series of coincidences strikes a responsive chord. That contention is far too close for comfort to notions such as: We are the center of the universe. God loves mankind more than all other creatures. The cosmos is watching over us. The universe has a plan; we are essential to that plan."²⁵

The very mathematical elegance of the universe is also a compelling observation. Physicist Paul Davies speaks for many scientists saying, "The temptation to believe that the Universe is the product of some sort of design, a manifestation of subtle aesthetic and mathematical judgement, is overwhelming. The belief that there is "something behind it all" is one that I personally share with, I suspect, a majority of physicists."²

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