Scientific Evidence for the Existence of God

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1. INTRODUCTION

Until about 1960, there was a general consensus in the scientific community that as we learned more about the physical universe through our investigation, we would be able to explain all that we observed and that this would render any belief in God unnecessary or irrelevant. However, just the opposite has happened. As our knowledge of the origin and complexity of the physical world has increased, we have come to realize that the universe is so intricate and well conceived, that a number of scientists have proposed that the universe must be the product of an intelligent designer.

Today, I want to present some scientific discoveries that have been made primarily during the last 40 years. In that time, we have made tremendous progress in understanding the origin and intricacy of the universe. These discoveries have initiated an active discussion among scientists regarding what conclusions about the existence of God can be inferred from the scientific evidence. These discussions have spawned a number of books and articles in popular magazines such as *Time*, *Newsweek*, *Discover,* and *Omni* that have discussed current scientific discoveries and what they may tell us about God.

What we have learned recently clearly suggests that the universe was designed and begun by an intelligent, transcendent Creator. I want to present some of that evidence for the design and the transcendent origin of the universe from science. I will show you that even agnostic and atheistic scientists have looked at the evidence and determined that there must be some kind of intelligent design to the universe. When we compare the required characteristics of that intelligence to the characteristics ascribed to the God of the Bible, we find that they are identical.

Although there is evidence for the existence of God from many disciplines of science, including chemistry and biology, I will limit my discussion today to evidence for God from the subjects of physics and astronomy. I will describe the scientific observations that have led to our current theories and then I want to show how these theories present evidence for God. The scientific evidence for God comes primarily from two sources: our understanding of the origin of the universe, and our understanding of the design in the universe.

2. THE ORIGIN OF THE UNIVERSE

2.1 Evidence for the Origin of the Universe

At the beginning of the twentieth century, most scientists believed that the universe had always existed, that it was infinite in both time and space. The idea that the universe has existed basically forever in its present configuration is known as the steady state model of the universe. This model is philosophically appealing to many scientists because an infinite universe allows infinite possibilities. An infinite universe does not require an origin, a cause, or a Creator since it has always existed. But over the last hundred years, all scientific discoveries have consistently pointed to an actual point in time when the universe began. Observations suggest that somewhere around 12-15 billion years ago, all of the matter in the universe was compressed into a very dense, very hot, and very small region of space and that from this original state, the universe has expanded outward, much like an explosion originates from a small region and expands outwards in all directions. When this "Big Bang" model of the universe was first proposed, it was not readily accepted by scientists who had always held that the universe existed

in a steady state. For instance, the British cosmologist Sir Authur Eddington said, "Philosophically, the notion of a beginning of the present order of Nature is repugnant.... I should like to find a genuine loophole."[1] It took an overwhelming amount of evidence for the Big Bang before it was accepted by the scientific community as the probable origin of the universe. There are three major experimental observations that have led scientists to the conclusion that the universe had its origin some 15 billion years ago. Those observations are the expanding universe, the cosmic background radiation, and the relative abundance of light elements.

2.1.1 THE EXPANDING UNIVERSE

The first hint that the universe might have actually had a beginning did not come from observational data, but from theoretical calculations. In the early 20th century, Albert Einstein developed the general theory of relativity, which describes how gravity works. The equations derived from general relativity indicated that the universe was both expanding and decelerating just as one would expect if the universe had its origin at some instant in time. If we were to witness an explosion we would see that immediately after the explosion all of the matter would be moving away from the epicenter of the explosion, so it would be expanding. Einstein realized that the equations of general relativity implied that the universe actually had a beginning, and possibly something or someone to cause the beginning. So in order to avoid this conclusion, Einstein introduced an *ad hoc* parameter, called the cosmological constant, which would cancel out these expansion and deceleration factors. As the experimental evidence that the universe was expanding became more compelling, Einstein discarded the idea of the cosmological constant. In fact, he later admitted that the introduction of the cosmological constant was the greatest mistake of his life.[2]

The first major piece of experimental evidence that the universe was expanding, and therefore had a beginning, came from the observations made by the astronomer Edwin Hubble around 1929.[3] In that year Hubble announced his famous observation regarding the distance and velocity of 40 galaxies. Hubble showed from measuring the red shift of galaxies that the farther away a galaxy is from us the faster it is moving away from us. This is what Einstein's theory of general relativity predicted, and what one would expect if the universe had a beginning from a singularity and was expanding.

I can illustrate this observation by blowing up a balloon. The surface of the balloon represents a two dimensional model of our three dimensional universe. We are sitting here at one location on the balloon. As the balloon expands, every point on the balloon moves farther away from every other point. All galaxies are moving away from each other. In addition, the farther a point is from another point, the greater their relative velocities are. The farther a galaxy is from us, the faster it is moving away from us. This is exactly what Hubble observed. Hubble's observation, coupled with Einstein's theory provided powerful evidence that the universe was at one time very tiny and very dense, and that it had a beginning long ago.

2.1.2 THE COSMIC BACKGROUND RADIATION

Physicists had realized from about 1920 that a universe expanding from a beginning would have initially been very dense and very hot. In 1948, the physicists Ralph Alpher and Robert Herman predicted that if the universe had begun in a hot Big Bang then there should be some residual heat, or radiation, left from that initial state.[4] If I were to heat an oven, then turned it off and open the door, the heat would radiate to warm the room until all that remained from the

hot oven was a warm glow in the room. Likewise, a universe that was once very hot would still exhibit a warm glow from long ago. Alpher and Herman estimated that this heat, or radiation, would appear to come from all directions in space and would have a very small temperature of about 5° Kelvin. In 1965, two scientists at Bell Labs, Robert Wilson and Arno Penzias, discovered that the earth was being bombarded equally from all directions with a 3° Kelvin radiation, exactly what would be predicted from an initial hot, dense universe.[5]

The most remarkable discoveries about this radiation occurred in the last few years. This background radiation should act like a blueprint which gives us a picture of the initial conditions in the Big Bang so that the radiation should look like what we observe when we observe the cosmos. When we look out in space, we see a very uniform distribution of galaxies. No matter which way we look the universe looks very much the same. But, the universe is not perfectly uniform, for we know that galaxies do exist and that they are separated by vast stretches of empty space. So in other words, the background radiation should look almost perfectly uniform, but not exactly uniform or galaxies could not exist.

In scientific language this blueprint translates into the prediction that the cosmic background radiation should follow a very smooth frequency spectrum characteristic of a perfect radiator, called a "black body." It should be close to a perfectly smooth black body spectrum, but not exactly. This type of signature for the black body radiation would guarantee that the universe could form galaxies, but that it would also look very much the same in all directions.

In 1990 and 1992 the Cosmic Background Explorer Satellite, called COBE made precise measurements of the background radiation.[6] The frequency spectrum of radiation followed a smooth and uniform black body spectral distribution which exhibited extremely small ripples. The nonuniform nature of the radiation is just large enough to account for the clumpiness of galaxies, and just smooth enough to account for the general uniformity of the universe.[7] It seems certain that the cosmic background radiation is the residual heat from the initial hot beginning of our universe. The leader of the COBE project, George Smoot said, "What we have found is evidence for the birth of the universe. If you are religious, it's like looking at God."[8]

In his book, *The Accidental Universe* , physicist Paul Davies writes, "It is hard to resist the impression of something—some influence capable of transcending spacetime and the confinements of relativistic causality—possessing an overview of the entire cosmos at the instant of its creation, and manipulating all the causally disconnected parts to go bang with almost exactly the same vigour at the same time, and yet not so exactly coordinated as to preclude the small scale, slight irregularities that eventually formed the galaxies, and us."[9]

Paul Davies says that there is a real temptation to attribute the origin of the universe to an influence that transcends space and time, that is not confined to either space or time and is able to manipulate the parts in just a way as to create us. This is exactly how the Bible describes God, yet Davies makes this claim only from the observable scientific data.

2.1.3 THE RELATIVE ABUNDANCE OF THE LIGHT ELEMENTS

The Big Bang model makes one more prediction. Because we understand most of the physical and chemical laws which have operated since shortly after the initial Big Bang, we can make calculations which describe the evolution of the universe from at least a second or two after the Big Bang. Calculations by scientists such as physicist George Gamow and cosmologist James Peebles predict that if the universe began with a Big Bang, then somewhat over 70% of the matter in the universe should be hydrogen, and about 25% of the matter should be helium. The amount of other light elements [such as deuterium (hydrogen with one neutron), ^{3}He, and

^{7}Li] can be predicted as well. Measurements show that the amount of these elements found throughout the universe precisely matches what is expected from the Big Bang.[10]

2.1.4 The Origin of Time

When Einstein originally made his calculations using general relativity, he showed that all of space had to be expanding from an initial point, but he didn't make any claims about the origin of time. From about 1966 until about 1970, three physicists, Stephen Hawking, George Ellis, and Roger Penrose extended the general theory of relativity to include both space and time. Their conclusions were astonishing. They discovered that their theory not only predicted that our three dimensions of space had a beginning, but also that time had originated in the same process as the origin of matter and energy.[11] In other words, the entire universe, everything that we know of, including matter, energy, and even space and time, all had a beginning in some cosmic singularity about 15 billion years ago. Both the observational evidence and the theoretical evidence is consistent in regards to this origin for our universe.

2.2 Proposed Alternatives to the Big Bang

As I stated earlier, opposition to the Big Bang emerged almost immediately after it was proposed. In fact, the name "Big Bang" itself was first used as a derogatory term by the physicist Fred Hoyle who didn't want to believe the universe had a beginning because of the philosophical and theological implications of that idea. A number of alternative theories to the Big Bang have been proposed and when these theories have been tested, they have been shown to be untrue.

2.2.1 Steady State Model

For instance, even after the evidence for a beginning of the universe began to pour in, many scientist continued to hold fast to the steady state model, the idea that the universe basically does not change. Yet apart from the evidence for the Big Bang itself, there is even more evidence against the steady state model. For instance, if the universe is infinite in space and time, then galaxies should continually be forming and dying and we should see a wide variety of ages in the observable galaxies. Some galaxies should be very old, and some should be quite new. However, almost every galaxy we observe is a galaxy in middle age, as if they all formed at just about the same time. We see no very old galaxies, and only a handful of possibly new galaxies which seem to be galaxies formed from the collision of two middle aged galaxies.

In addition, all of the stars we observe are relatively young, with ages less than about 16 billion years. Some stars can burn for more than eighty billion years, and if the universe were older than 20 billion years, we should see old stars, but we don't.

Finally, if the universe were infinitely large, as the steady state theory predicts, then the night sky would be as light as the sky during the day. If there were an infinite number of stars that had been out there for an infinite amount of time, then everywhere we looked, there would be some star at some distance from us. This would illuminate the night sky. The fact that the space is dark indicates that we do not live in an infinite steady state universe.

By about 1970, the idea of a steady state universe had been discounted due to the scientific observations.

2.2.2 OSCILLATING UNIVERSE

Still, many scientists were not ready to concede that the universe may have had an actual beginning, so a new idea was developed which gained popularity for a while. That was the idea of a bouncing, or oscillating universe. This is the idea that the universe expands and grows, then contracts to a point, and continues to repeat the cycle.

Physicist John Gribbin wrote in 1976, "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."[12] As with the steady state theory, the motivation for this theory appeared to be rooted more in philosophical bias than in scientific observation. The universe would, once again, be infinite and there would be no need to invoke an origin or Originator of the universe.

However, like the steady state model of the universe, the oscillating universe has been shown not to fit the observations or the theoretical calculations and is no longer considered a viable model. For instance, the second law of thermodynamics tells us that the entropy of the universe increases with time. This means that even if the universe did bounce, each successive oscillation would create a universe which must expand to a larger and larger size before it would begin to collapse. When the mathematics is worked out, it has been shown that the first bounce would have had to happen only a few trillion years ago, and that the universe would have still have had a beginning then.[13]

But even this model of the universe with a few bounces preceding our current universe is not a valid model. In 1983 and 1984 the American physicists, Marc Sher, Alan Guth, and Sidney Bludman demonstrated that if there were enough mass to cause the universe to collapse, it would not bounce back. Instead, it would collapse into oblivion with no bounce at all.[14]

The strongest indication that there were no previous universes or future universes is the experimental observations which have basically ruled out the oscillating model. If the universe is to oscillate, the galaxies must eventually stop expanding and collapse on each other because of their strong mutual gravitational attraction. Astronomical observations indicate that there does not seem to be enough mass in the universe to do this. We only observe about one tenth of the mass required to stop the expansion, and even though most astrophysicists believe there is more mass in the form of unobserved matter, there is a general consensus that there is not enough mass to stop the expansion.

Recent measurements of the cosmic background radiation by two experiments carried aloft in balloons have shown that the mass in the universe is insufficient to cause the universe to collapse. The experiments, MAXIMA (Millimeter Anisotropy eXperiment Imaging Array) and BOOMERANG (Balloon-borne Observations of Millimetric Extragalactic Radiation ANd Geophysics) indicate that the universe is "flat" which means that it will never collapse.[15] The experimental observations have ruled out the oscillating universe.

The observations and calculations all reveal a consistent picture of our universe. We live in a finite universe which seemed to begin from a singularity in space about 15 billion years ago. From that initial singularity the universe has expanded to its current size only this once. If the universe were to collapse it would never expand again. But the overwhelming experimental evidence now shows that the expansion will apparently go on forever. There are no oscillations.

2.2.3 SCIENCE AND SPECULATION

There continue to be hypotheses proposed from time to time that attempt to remove any necessary beginning to the universe, but these theories seem to be based more on speculation and philosophical bias, than on real science. Because we understand the evolution of the universe after about the first 10^{-33} seconds, just about the only place to find any loopholes in the idea of a beginning is during that first trillionth of a trillionth of a trillionth of a second, where observations and calculations are inconclusive. For instance, the brilliant physicist Stephen Hawking wrote a New York Times best selling book called *A Brief History of Time*.[16] The stated purpose of that book is to escape the philosophical implications of the Big Bang. Hawking describes a true scientific gap in our understanding of the laws of nature. That is, we currently have a very successful theory of gravity, Einstein's theory of general relativity, and a very successful theory of how the world works at the sub-atomic level, called quantum mechanics. However, we currently do not have a synthesis of the two, a theory of quantum gravity. So Hawking exploits this current lack of understanding to propose some speculative ideas about what a theory of quantum gravity might predict and then what might have happened during the first 10^{-43} seconds of the universe. Hawking believes that his speculations negate the necessity of some kind of Creator or God to initiate the Big Bang.

Actually, Hawking's proposal doesn't remove the necessity of a first cause and designer for the universe, but even more important, his hypotheses are not based on scientific observations. Ideas like Hawking's are pure speculation and conjecture. They are based on his philosophical bias, not on any scientific observation. They are an attempt to invoke non-science to explain the philosophical implications of good science. In contrast, my talk today is not about speculation and conjecture, but about concrete experimental observations and theoretical predictions. We may speculate all we want about unsubstantiated theories which might avoid the scientific evidence that the universe had a beginning, but those ideas are not science. They are simply opinion. The best science to date indicates that the universe had a beginning of both space and time

2.3 Theological Implications of the Origin of the Universe

As the evidence for the Big Bang became compelling, the astrophysicist and agnostic, Robert Jastrow wrote, "For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance; he is about to conquer the highest peak; as he pulls himself over the rock, he is greeted by a band of theologians who have been sitting there for centuries."[17]

Jastrow's statement is very insightful. The best scientific observations indicate that both space and time began about 15 billion years ago, and as Paul Davies said, that the influence that started the universe "is capable of transcending spacetime and the confinements of relativistic causality." So if science seems to indicate that the origin of the universe transcends space, time, and the laws of nature, where do we find such an "influence?"

I would like to propose that this influence is the God described in the Bible. The Bible stands apart from all religious writings in describing God as a transcendent Creator who can act entirely independent of the four dimensions of space and time. The Bible is entirely consistent and clear in describing a transcendent God who created both time and space but is bound by neither. These are exactly the characteristics that scientific investigation has independently determined are necessary for whatever influence began the universe. Let me show you that the

description of God in the Bible is identical to the transcendent cause proposed by Davies and other scientists who study the origin of the universe.

Take, for example, the first sentence in the Bible which describes this creation of space and time, "In the beginning, God created the heavens and the earth." There was a beginning of time, matter, and space, and in the beginning, God already existed, apart from the creation. The Hebrew word *bara*, which is translated "created" means to make something brand new and often has the connotation of creating *ex nihilo*, from nothing. In the book of Hebrews, chapter 11, verse 3 we read, "We understand that the universe was formed at God's command, so that what is seen was not made out of what was visible." Many other passages in the Bible describe God's action before the beginning of time and space. The idea that matter and time originated from something transcendent, or beyond the realm of the cosmos, is found in the Bible, and is also implied from scientific observation.

Of course the Bible does more than simply describe an impersonal influence that transcends space and time. The Bible says this Creator is personal and cares about you and me. For instance, the Bible declares that God had people in his mind, even before He created space and time. The apostle Paul writes in 2 Timothy 1:9, "This grace was given us in Christ Jesus before the beginning of time," and in Titus 1:2 he says, "[We have] eternal life, which God, who does not lie, promised before the beginning of time." The God of the Bible is not limited to space and time, but our universe is. It began with the creation of space and time.

Although God is not limited by space and time, he does choose to make himself known within our dimensions of space and time. In the first chapter of his gospel, the apostle John describes Jesus as God himself who "became flesh and made his dwelling among us." John says that Jesus did this so that we might have a personal relationship with this transcendent God. He describes this relationship as being children of God, and says, "To all who received him, to those who believed in his name, he gave the right to become children of God." The Bible alone describes a God who is beyond our four dimensions of space and time, but is also personal and knowable.

3. THE DESIGN OF THE UNIVERSE

So far, I have described the evidence for God from the origin of the universe. I now want to talk about the evidence for God from the design of the universe. A tremendous number of discoveries have been made which indicate that the universe shows intelligent design and precise composition which make the existence of life possible. These ideas about the biocentric design of the universe are often called the "anthropic principle."

3.1 The Fine Tuning of the Physical Constants

When we look at the physical laws that describe our universe, we see that they are precisely tuned to allow the possibility of life to exist. If the physical constants that describe the universe were changed just slightly, then the universe would be unsuitable for life of any kind. In their comprehensive book, *The Anthropic Cosmological Principle*, Astronomer John Barrow, and physicist Frank Tipler document over 100 examples of physical constants that have been finely tuned to allow life to exist in the universe. I will describe a few of them.

3.1.1 AMOUNT OF MATTER/ENERGY IN THE UNIVERSE

When the universe first began a certain amount of matter and energy was created. Although we don't know exactly how much matter is in the universe our estimates seem to be

correct to within a factor of 10 or so. The amount of matter in the universe is very important, for it must be precisely tuned for any life to exist. If there is too much matter, then the universe would have collapsed back in on itself shortly after the Big Bang because of the gravitational pull of the matter. If there is too little matter, then there would not be enough gravitational attractive force for matter to bunch together to form galaxies and solar systems. In other words, if the amount of matter in the universe is not precisely tuned then, we either don't have a universe for any appreciable amount of time, or we don't have any significant number of stars and galaxies in the universe. In order for the universe to maintain this precise balance the density of matter in the universe, referred to by the Greek symbol ρ, must be very close to some critical value, called ρ_{crit}. We know that when the universe was only 10^{-43} seconds old, the density did not vary from the critical density by more than 1 part in 10^{60}. This means that the actual density of the matter in the universe is exactly what it must be, not just to support life, but to have any universe at all.

Paul Davies writes, "To choose ρ so close to ρ_{crit}, fine-tuned to such stunning accuracy, is surely one of the great mysteries of cosmology.... If the crucial ratio had been 10^{-57} rather than $<10^{-60}$, the universe would not even exist, having collapsed to oblivion after just a few million years."[18]

In their book *Cosmic Coincidences*, cosmologist John Gribbin and astrophysicist Martin Rees discuss the fact that the matter density is so well tuned. They write "If this were a coincidence, then it would be a fluke so extraordinary as to make all other cosmic coincidences pale into insignificance."[19]

3.1.2 THE STRONG NUCLEAR FORCE

Shortly after the big bang, particles called quarks began to bind together to make neutrons and protons. The neutrons and protons then began to come together to make atomic nuclei. These nuclei eventually formed into gas and then stars which are the necessary fuel for life to exist. The force that holds neutrons and protons together is called the strong nuclear force. The strong nuclear force is exactly the necessary strength to allow the elements in our periodic table to exist. If the strong nuclear force were 5% weaker, then only hydrogen would be stable. We would have no elements other than hydrogen in the periodic table. The universe would not be able to create the molecular complexity necessary for the life functions of processing energy, storing information, and reproducing. In addition, deuterons, which consist of one proton and one neutron, would be unable to form in stellar interiors. This would be catastrophic for the nuclear chain reactions that power stars since the deuteron is a necessary intermediate in the fusion of hydrogen into helium.[20]

If the strong nuclear force were only 2% stronger, then protons and neutrons would bind together more readily to create very massive nuclei, which would have the potential of disrupting the chemistry of living systems. Also, stable hydrogen would be a very rare element, which means that there would be few long-lived stars, and few hydrogen containing compounds. Because heavy nuclei like iron are formed in stars, this would have vastly reduced the supply of these elements that are necessary for life.

3.1.3 CONVECTIVE STABILITY OF STARS

After the Big Bang had formed neutrons and protons, they began to coalesce together to form stars. In fact, if life is to exist in the universe, main sequence stars like our sun must be common. Only stars like our sun burn steady enough and bright enough for enough time to

allow life to flourish. The astronomer Brandon Carter pointed out that in order for typical stars like our sun to form in significant numbers, then the strength of the gravitational force must be precisely balanced with the strength of electromagnetic force. If I characterized the strength of the gravitational force by the gravitational coupling constant $\alpha_G = Gm_p^2/2hc \approx 5 \times 10^{-39}$, and the strength of the electromagnetic force is given by the electromagnetic coupling constant $\alpha = e^2/2\varepsilon_0 hc \approx 1/137$, then I can summarize Carter's conclusions with the following relationship. Carter showed that for stars like our sun to be formed in the universe, then we must have the equation

$$\alpha_G \geq \alpha^{12}(m_e/m_p)^4$$

satisfied, where m_e is the mass of the electron and m_p is the mass of the proton. When we insert numbers into this equation we get $5 \times 10^{-39} \geq 2.0 \times 10^{-39}$.

This is truly remarkable! Each side of this inequality is an extremely small number, yet the two sides are almost identical! If the left side were only a factor of 10 larger, then almost all stars would be blue giants that do not burn long enough and steady enough to allow life to exist as it has on our planet. If the right side of the inequality were a factor of 10 larger, then most stars would be red dwarfs that do not generate enough heat to support life. It is only because this equation is precisely balanced that stars like our sun exist in large numbers. If any of these physical constants changed by even a small amount, life would not exist in the universe.

3.1.4 The Formation of Carbon

Now we still can't have life even after we have stars forming. In order for life to exist we must have carbon, the basic building block of life in the universe. Most of the carbon in the universe has been formed in the interior of dying red giant stars billions of years ago. However, if it wasn't for a series of remarkable "coincidences" there would be no carbon at all in the universe, and hence, no life. Carbon is formed in stars when two helium nuclei fuse to produce a beryllium intermediate which then collides with another helium nuclei to create carbon. The lifetime of this beryllium intermediate is very important because if it decays too quickly, it will not react with another helium nucleus to form carbon. If it is more stable, then heavy element fusion would cause stellar explosions which would prevent the formation of heavier elements necessary for life. I won't go into all of the details of how carbon is formed from this beryllium intermediate, but it is a complicated process requiring the precise balance of three different nuclear resonance states,. These resonances are precisely tuned to create carbon. In a talk on cosmology, astronomer Owen Ginerich has said, "Had the resonance level in the carbon been four percent higher, 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 tonight."[21]

3.1.5 Fine Tuning Conclusions

The evidence that the universe is finely tuned so that it can, first, exist at all, and second, support life, is so overwhelming that many agnostic and atheistic scientists have come to the conclusion that there must be some intelligence responsible for the universe.

For instance, Sir Fred Hoyle, the British astronomer and agnostic, wrote in *The Intelligent Universe*, "Such properties seem to run through the fabric of the natural world like a happy

thread of coincidences. But there are so many odd coincidences essential to life that some explanation seems required to account for them."

Gribbin and Rees write in *Cosmic Coincidences*, "If we modify the value of one of the fundamental constants, something invariably goes wrong, leading to a universe that is inhospitable to life as we know it. When we adjust a second constant in an attempt to fix the problem(s), the result, generally, is to create three new problems for every one that we "solve." The conditions in our universe really do seem to be uniquely suitable for life forms like ourselves, and perhaps even for any form of organic complexity."[22]

Allan Sandage, who won the Crafoord prize in astronomy said, "I find it quite improbable that such order came out of chaos. There has to be some organizing principle. God to me is a mystery but is the explanation for the miracle of existence, why there is something instead of nothing."[23]

3.2 The Earth as a Fit Habitat

Not only is the universe, as a whole, finely tuned to support life, but also our planet earth seems to be in a very favorable, and very specialized location, both in space and time, to support higher life forms. If you are a Star Trek fan like I am, you may get the impression that the universe is full of so-called "M"-class planets that are capable of supporting highly developed life forms. Although, no one knows if there are other planets capable of supporting life in the universe, we can make some reasonable estimate of the probability of finding other earth-like planets in the universe. Our current scientific understanding of the environment necessary to support higher life forms shows further evidence of a specific design in the universe. Scientists are beginning to understand the conditions necessary to support intelligent life forms. In their book *Rare Earth*, geologist Peter Ward and Astronomer Donald Brownlee have attempted to catalog many of the criteria that are important in order for a planet to support higher life forms. We will look at a few of those criteria.

3.2.1 THE RIGHT GALAXY

We live in the right galaxy for supporting life. About 95% of all galaxies are either elliptical or irregular galaxies, but only 5% of galaxies are spiral galaxies like our Milky Way. In elliptical galaxies, star formation ceases before enough heavy elements are created to support life. Irregular galaxies have a large number of active nuclei which create an excessive amount of life-destroying radiation.

The number of supernovae explosions in our galaxy is just right for life to exist. Two physicists R.E. Davies, and R.H. Koch have determined that for a solar system to create enough heavy elements to form rocky planets and assist life chemistry, supernovae must erupt at the rate of one supernova every three years during the life of the galaxy. The current rate of supernova explosions in our galaxy seems to be about one every fifty years, so there must have been a much faster explosion rate when our galaxy was young. In contrast, the supernova rate must be low now, or the radiation from excessive supernova explosions could destroy life on earth.

The position of the sun in our galaxy is also extremely important. Our sun is located in one of the spiral arms of the Milky Way, far from the center of the galaxy. Radiation from supernova and other phenomena is more severe near the center of the galaxy, and could be life threatening. Also, fluorine, an essential element to life, is only known to be created at the surface of white dwarf stars. This implies that sometime in its evolution, our solar system must have encountered the remnants of a white dwarf star, and the fluorine produced at its surface. It

appears our sun is located in the right galaxy, and in the right part of the galaxy for supporting life.

3.2.2 THE RIGHT STAR

Not only are we in a galaxy favorable for supporting life, but also, our sun is just the right kind of star for supporting life. For higher life forms to exist, they must be on a planet that is orbiting a star that is a specific mass and of sufficient age. During the history of our galaxy, there have been about three generations of stars. The first two generations of stars are required to create the heavy elements necessary for rocky planets and life, and to create enough carbon for life to exist. A third generation star is the youngest star with a high probability of supporting life. Our sun is a third generation star. If you saw the movie *Contact*, it was suggested that there must be other life forms in the universe because there is so much space. The truth is that there is so much space because it takes about 15 billion years to create rocky planets with enough carbon for life to exist like on the earth. In that time the universe would have expanded to 15 billion light years in size. So actually, our universe is just about the smallest a universe could be and support any life, even on a single rocky planet orbiting one main sequence star.

In addition, life is most probable on a planet orbiting a bachelor star, a star with no companions. In a binary star system, the gravitational pull of the second star is extremely likely to perturb the orbit of a planet out of the temperate zone necessary for life. About seventy percent of stars are bachelor stars.

Other factors, like a star's luminosity must be just right to support life. The star must be middle aged and burning very stably like our sun.

3.2.3 THE RIGHT PLANET

Our planet is also specifically suited to support life. For instance, a change in the earth's distance from the sun of as little as 2% would disrupt the water cycle balance on the earth enough to destroy life. Factors like surface gravity and temperature must be tuned to a few percent to allow methane and ammonia, but not water vapor, to escape from the atmosphere. The period of rotation of the planet must be similar to the earth's to ensure even heating, and to minimize extreme winds that are created if the planet rotates too fast. Even our single, large moon seems to play an important role for life, for its gravitational pull stabilizer earth's planetary tile and creates the tides which tend to replenish nutrients in coastal waters.

3.2.4 THE PROBABILITY OF A PLANET LIKE THE EARTH

Ward and Brownlee discuss the improbability of producing an earth-like planet when they write, "If some god-like being could be given the opportunity to plan a sequence of events with the express purpose of duplicating our "Garden of Eden" that power would face a formidable task… It is unlikely that earth could ever truly be duplicated... The physical events that led to the formation and evolution of the physical earth also required a set of nearly irreproducible circumstances."[24]

The astrophysicist Hugh Ross has made a conservative calculation of the probability of an earth-like planet existing in the universe based on arguments similar to what I have just discussed. This chart has been reproduced from his book *The Creator and the Cosmos*. Some of these factors are known quite well and some are estimates. Ross encourages scientists to improve on these estimates in order to refine this number, as necessary. Correlations are not included so a dependency factor of 10^{21} has been added. Nevertheless, we see that the

probability of all 123 parameters being found in a single planet is one in 10^{162}. There are only 10^{22} possible planets in the universe. This estimate indicates that the earth itself has been specifically designed to support higher life forms.

3.3 Theological Implications of Design

So what are the implications of the design in the universe? One thing is certain. Those who have carefully studied the design in the universe have almost universally come to the same conclusion, that the universe is too precisely designed to be an accident. For instance, in the most comprehensive book on this subject, *The Anthropic Cosmological Principle* , Barrow and Tipler have concluded that the universe was definitely made by an intelligent designer and that it was definitely made for humans. Barrow and Tipler are two widely respected scientists who do not believe in God. So if the scientific evidence mandates an intelligent Creator, but there is no God, then who does the creating? Barrow and Tipler conclude that humans are the only intelligence in the universe, so humans must do the creating. They believe that mankind will one day evolve to a point where they encompass and fill the whole universe, where they have gained infinite knowledge, and where they are able to reach back in time and create the universe for themselves. Why would a well respected cosmologist and mathematical physicist come to such a bizarre conclusion, that mankind will someday reach back billions of years to create the universe in the past for themselves? Because they refuse to accept the possibility of an external Creator, so it is the only alternative they have based on the evidence. The design of the universe screams for an intelligent Creator, and unwilling to accept God as that creator, the only alternative Barrow and Tipler have is mankind.

Barrow and Tipler aren't the only ones who see the necessity for an intellect to create the universe, or for humanity to be part of the universal plan. In an article for *Engineering and Science*, agnostic physicist Fred Hoyle wrote, "A common sense interpretation of the facts suggests that a superintellect has monkeyed with physics, as well as with chemistry, and biology, and that there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me so overwhelming as to put this conclusion almost beyond question."[25] Even for an agnostic, it is common sense that there is a superintellect.

In his book, *Superforce*, Paul Davies wrote, "If physics is the product of design, the universe must have a purpose, and the evidence of modern physics suggests strongly to me that the purpose includes us."[26]

All of these agnostic and atheistic scientists who have carefully studied the origin and design of the universe recognize that current scientific discoveries require that there be a "superintellect" behind it all. The scientific evidence has driven them to the conclusion that the universe is designed and constructed precisely for humans, that we must be part of the plan or purpose behind the universe. Modern science is implying that humanity has some special place in the universe.

But unfortunately, many of these scientists have missed the most obvious candidate for the superintellect who cares about humanity. For millennia, long before science declared it, the Bible has declared that man does have a special place in the universe. Hoyle's "superintellect" and Davies' "purpose [that] includes us" perfectly describes the God of the Bible. The Bible states that God has prepared a world for people, and that he desires to have a relationship with individuals. Israel's ancient King David pondered this dramatic question when he wrote in Psalm 8, "When I consider the heavens, the work of your fingers, the moon and the stars which you have set in place, what is man that your are mindful of him, the son of man that you care for

him?" Could it really be true that the God who designed and made this universe cares for humans? The Bible makes it clear that he does. The prophet Zephaniah wrote, "[God] will take great delight in you, he will quiet you with his love, he will rejoice over you."

So we see that our scientific understanding of the origin of the universe implies a transcendent cause and our observations of the design in the universe points to an intellect who has a place for humanity. The characteristics required of this originator and designer are identical to those attributed to God in the Bible. Don't miss this point. Scientists who are agnostics or atheists themselves, have come to the conclusion that there must be a transcendent intelligence and designer involved in the universe that includes humanity as an intricate part of its purpose. This is exactly how the Bible describes God. This fact has driven some scientists to believe in God. The famous astronomer Allan Sandage was quoted in a recent Newsweek article saying, "It was my science that drove me to the conclusion that the world is much more complicated than science... It is only through the supernatural that I can understand the mystery of existence."[27] It is quite remarkable to me that observations of the natural world have led some scientists to believe in God, for the Bible actually predicts that the character of God is revealed by observing nature. King David wrote in Psalm 19:1 "The heavens declare the glory of God; the skies proclaim the work of his hands," and the Apostle Paul wrote in Romans 1:20, "For since the creation of the world [God's] invisible attributes, His eternal power and divine nature, have been clearly seen, being understood through what has been made." The Bible declares that God's attributes can be clearly seen through the physical universe. Scienctific study has certainly observed the transcendence, the power, and the intelligence of God, as well as the fact the he has a purpose for humanity.

4. CONCLUSION

There is abundant scientific evidence for the existence of an intelligent Creator. In today's talk, I have only discussed a little of the evidence from the scientific disciplines of physics and astronomy. I have not touched on the wealth of evidence from chemistry or biology. Although science will never prove the existence of God, the belief in a transcendent, intelligent, personal Creator is not only consistent with the scientific evidence, but may be the absolute best interpretation of the current evidence. I find it quite amazing that scientific inquiry itself has led to the prediction that the originator of the universe is transcendent, intelligent, and cares for humanity, which is exactly how the Bible describes God. In his book, *The Symbiotic Universe*, the physicist George Greenstein writes, "As we survey all the evidence, the thought insistently arises that some supernatural agency—or, rather Agency—must be involved. Is it possible that suddenly, without intending to, we have stumbled upon scientific proof of the existence of a Supreme Being?"[28] The evidence for the existence of the God described in the Bible from scientific inquiry is so compelling, that it makes such a conclusion perfectly reasonable and, perhaps, unavoidable. Current scientific observations give overwhelming evidence for the existence of God.

5. APPENDIX

Estimate of the Probability for Attaining the Necessary Parameters for Life Support.[29]

	PARAMETER	CHANCE PROB.
1	local abundance and distribution of dark matter	0.1
2	galaxy size	0.1
3	galaxy type	0.1
4	galaxy location	0.1
5	local dwarf galaxy absorption rate	0.1
6	star distance relative to galactic center	0.1
7	star distance from corotation circle of galaxy	0.005
8	star distance from closest spiral arm	0.1
9	z-axis extremes of star's orbit	0.1
10	proximity of solar nebula to a supernova eruption	0.01
11	timing of solar nebula formation	0.01

	relative to supernova eruption	
12	number of stars in system	0.7
13	distance/mass of nearby stars	0.1
14	star birth date	0.2
15	star age	0.4
16	star metallicity	0.02
17	star orbital eccentricity	0.1
18	star's distance from galactic plane	0.1
19	star mass	0.001
20	star luminosity change relative to speciation types & rates	0.00001
21	star color	0.4
22	star's carbon to oxygen ratio	0.01
23	star's space velocity relative to Local Standard of Rest	0.05
24	star's short term variability	0.05
25	star's long term variability	0.05
26	H3+ production	0.1
27	supernovae rates & locations	0.01
28	white dwarf binary types, rates, & locations	0.01
29	location, timing, and rate of stellar encounters	0.01
30	planetary distance from star	0.001
31	inclination of planetary orbit	0.5
32	axis tilt of planet	0.3
33	rate of change of axial tilt	0.01
34	period and size of axis tilt variation	0.1
35	planetary rotation period	0.1
36	rate of change in planetary rotation period	0.05
37	planetary orbit eccentricity	0.2
38	rate of change of planetary orbital eccentricity	0.1
39	rate of change of planetary inclination	0.5
40	period and size of eccentricity variation	0.1
41	period and size of inclination variation	0.1
42	number of moons	0.2
43	mass and distance of moon	0.01
44	surface gravity (escape velocity)	0.001
45	tidal force	0.1
46	magnetic field	0.01
47	rate of change & character of change in magnetic field	0.1
48	albedo	0.1
49	density	0.1
50	thickness of crust	0.01
51	oceans-to-continents ratio	0.2
52	rate of change in oceans to continents ratio	0.1
53	global distribution of continents	0.2
54	frequency, timing, & extent of ice ages	0.1
55	frequency, timing, & extent of global snowball events	0.1
56	asteroidal & cometary collision rate	0.1
57	change in asteroidal & cometary collision rates	0.1
58	rate of change in ast. & comet collision rate	0.1
59	mass of body colliding with primordial earth	0.002
60	timing of body colliding with primordial earth	0.05
61	location of body's collision on primordial earth	0.1
62	position & mass of Jupiter relative to Earth	0.01
63	major planet eccentricities	0.1
64	major planet orbital instabilities	0.1
65	drift and rate of drift in major planet distances	0.05
66	number & distribution of planets	0.01
67	atmospheric transparency	0.01
68	atmospheric pressure	0.01
69	atmospheric viscosity	0.1
70	atmospheric electric discharge rate	0.1
71	atmospheric temperature gradient	0.01
72	carbon dioxide level in atmosphere	0.01
73	rate of change in carbon dioxide level in atmosphere	0.1
74	rate of change in water vapor level in atmossphere	0.01
75	rate of change in methane level in early atmosphere	0.01
76	oxygen quantity in atmosphere	0.01
77	chlorine quantity in atmosphere	0.1

78	cobalt quantity in crust	0.1
79	arsenic quantity in crust	0.1
80	copper quantity in crust	0.1
81	boron quantity in crust	0.1
82	flourine quantity in crust	0.1
83	iodine quantity in crust	0.1
84	manganese quantity in crust	0.1
85	nickel quantity in crust	0.1
86	phosphorus quantity in crust	0.1
87	potassium quantity in crust	0.1
88	tin quantity in crust	0.1
89	zinc quantity in crust	0.1
90	molybdenum quantity in crust	0.05
91	vanadium quantity in crust	0.1
92	chromium quantity in crust	0.1
93	selenium quantity in crust	0.1
94	iron quantity in oceans	0.1
95	tropospheric ozone quantity	0.01
96	stratospheric ozone quantity	0.01
97	mesospheric ozone quantity	0.01
98	water vapor level in atmosphere	0.01
99	oxygen to nitrogen ratio in atmosphere	0.1
100	quantity of greenhouse gases in atmosphere	0.01
101	rate of change of greenhouse gases in atmosphere	0.01
102	quantity of forest & grass fires	0.01
103	quantity of sea salt aerosols	0.1
104	soil mineralization	0.1
105	quantity of decomposer bacteria in soil	0.01
106	quantity of mycorrhizal fungi in soil	0.01
107	quantity of nitrifying microbes in soil	0.01
108	quantity & timing of vascular plant introductions	0.01
109	quantity, timing, & placement of carbonate-producing animals	0.00001
110	quantity, timing, & placement of methanogens	0.00001
111	quantity of soil sulfur	0.1
112	quantity of sulfur in the life planet's core	0.1
113	quantity of silicon in the life planet's core	0.1
114	quantity of water at subduction zones	0.01
115	hydration rate of subducted minerals	0.1
116	tectonic activity	0.1
117	rate of decline in tectonic activity	0.1
118	volcanic activity	0.1
119	rate of decline in volcanic activity	0.1
120	viscosity at Earth core boundaries	0.01
121	viscosity of lithosphere	0.2
122	biomass to comet infall ratio	0.01
123	regularity of cometary infall	0.1

Dependency Factors Estimate: 10^{21}

Longevity Requirements Estimate: 10^{-6}

Probability for occurrence of all 123 parameters: ~10^{-161}

Maximum possible number of planets in universe: ~10^{22}

Probability of finding one earth-like planet formed by chance: ~10^{-139}

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