Executive Summary

Does God exist?

Many would like to believe that God does exist. Just as many others want to believe that there is no God. The best way to determine if God exists and is still active in this world today is to look back in time. By tracing the universe back to its very beginning, it is possible to determine if it came into existence by chance or was created.

How Did the Universe Begin?

Scientific evidence supports the theory that the universe began with a gigantic explosion called the big bang. As a result, the universe continues to expand even today. This miraculous explosion left behind clues that still reside in the universe. Background radiation in the cosmos is a clear indication that the big bang occurred. These big bang ripples scientifically substantiate the big bang model prediction. But what caused the big bang itself?

The Universe Had a Cause

There is no logical explanation outside of God the creator to suggest a cause for the big bang. The universe did not come into being on its own, God caused it to come into being. By studying the almost infinite number of constants in the universe such as the speed of light, gravity and nuclear forces, it is easy to see that the universe was carefully crafted and designed.

Superstring Theory

Superstring theory attempts to describe elemental particle physics using ‘strings’. By treating subatomic particle structures as strings, it is possible to see that different vibrations or ‘notes’ of these strings will produce different subatomic particles. This is the most accepted theory that explains the beginning of the universe and the underlying structure that is the building block for matter and energy. One aspect of superstring theory that is intriguing is the concept of extra-dimensionality. Extra dimensions consist of both space and time dimensions. Such extra-dimensionality explains how God can still be a part of the universe today, yet remain hidden from human senses.

God Does Exist

Through the study of scientific evidence, it is possible to draw only one conclusion. There is no logical explanation for the creation and formation of the universe outside of acknowledging God. The grand design of the universe with its intricate balance of billions of galaxies statistically happens one time in 10^{99}. This is virtually impossible. From these facts, it can be said without a doubt, God exists. God created our universe, and still resides here today.

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1 Introduction

> "*The universe is like a safe to which there is a combination – but the combination is locked up in the safe.*" (Peter DeVries).

How did the universe come into being? This is a question that cognoscente beings have grappled with since the beginning of time itself. The most recent theories that are widely accepted by the scientific community deal with the *big bang*. These theorize that the universe came into existence due to an intense explosion of incredibly dense energy. This gigantic explosion eventually resulted in our observable universe. But what, or who created this big bang? Where did it come from? Those questions can now be intelligently and scientifically answered with a high degree of certainty.

Scientific evidence for the big bang model is abundant. Two key areas that will be discussed are expansion of the universe and *big bang ripples*. Once the validity of the big bang model is introduced, we will delve into the inner workings of the universe to find out how it began. The main underlying theory that explains interaction between matter and energy is known as *superstring theory*. This theory will be described to give you a better understanding of the basic building blocks of the universe. By looking at the instant the big bang occurred, we are able to see how the universe formed.

Implications from superstring theory result in extra-dimensionality. These are other dimensions that are in our universe, but are imperceptible to our senses. Extra space and time dimensions explain how the creator of the universe can exist yet remain unseen. The next section will investigate the design of our universe. Supporting evidence and a statistical analysis for the big bang will be shown to rule out the possibility of the universe coming into existence by chance. Finally, conclusions will be drawn from the supplied evidence to answer the question “Does God exist?”

Any evidence that deals with the existence or absence of God must always go back to the creation of the universe. How did we get here? Where is the creator now if there ever was one? These broad questions can be answered by looking at the instant of creation, the big bang.

2 Evidence for the Big Bang

The creation of the universe only has two possible explanations. Either the universe has always existed, or it was created at some point in time. All credible scientists agree that the universe had a definite beginning. The second law of thermodynamics states that energy will continue to exit from a system in the form of heat. If the universe has existed for an infinite amount of time, then we can assume that there would be no heat left in the system. This is obviously not true, so the universe definitely had a beginning in the finite past. In this section we will examine the big bang theory that explains how the universe came into being.

2.1 How Did the Universe Begin?

The science of astronomy has determined the universe began approximately 12 billion years ago from an explosion of very dense matter and energy. There are many facts and much research that support this date estimation. The facts also state that the universe is still expanding. In the early years of Albert Einstein, he didn't believe that his own equations were right. He wanted to believe that the universe was stationary and the galaxies were not expanding away from each other. To counteract his equations, Einstein originally proposed a new gravitational force that would cancel out the expansion of the universe.

Einstein's view changed in 1929 when Edwin Hubble proved that the galaxies were expanding away from each other just as Einstein's original general relativity calculations predicted. With this evidence provided by Hubble, Einstein eventually acknowledged "the necessity for a beginning," [1:100] and "the presence of a superior reasoning power" [2:106].

The only model that fits all of the collected scientific data for the universe is an explosion. Only an explosion that occurred at some point in the finite past could produce the results that are visible today. This theory is known as the 'hot big bang' model.

2.2 The Hot Big Bang Model

The hot big bang model describes the initial explosion of matter and energy that created the universe. It also explains the effects that should be noticeable today if this model is accurate. George Gamow originally derived the hot big bang model in 1946, which is an extension of the original big bang model. This new model had little scientific evidence for support when the theory was introduced. In 1965, Bell labs found the first scientific data to come in defense of Gamow's theory. Their discovery of background radiation in the universe was a big step toward proving the accuracy of the hot big bang model. We will examine both expansion of the universe as well as background radiation to prove hot big bang model's legitimacy.

2.2.1 Expansion of the Universe

Just after the big bang, atoms and subatomic particles in a super-dense state were blasted apart from each other. Unless an outside force acts on these particles, they will continue to expand indefinitely. Even after billions of years, we can still see the effects of this explosion. In 1922, Alexander Friedman discovered the first evidence of an expanding universe. Edwin Hubble confirmed these findings in 1929 when he made use of the Doppler effect.

The Doppler effect states that traveling waves will have different frequencies depending on the direction of the object. This same basic principle can be applied to a speeding car. Imagine yourself standing at the side of a highway. A car coming toward you has a higher frequency sound than a car moving away from you. This has to do with the time it takes for the sound waves to travel from the car to your ear. The Doppler effect works the same way with light waves. Objects moving away will appear more 'red' since the light wavelengths are longer. An object moving toward you will appear more 'blue' since light wavelengths are shorter.

Hubble used this principle to develop the 'law of red shifts'. He found that galaxies are moving away from us in all directions. The conclusion that he came to was that the universe is expanding in a uniform fashion. When this process is reversed, it is evident that all galaxies in the universe converge to a single point. This is the main underlying evidence for the hot big bang.

2.2.2 Big Bang Ripples

One of the main predictions of the hot big bang model is a constant level of background radiation. We can compare this to a nuclear bomb explosion. Just after the initial blast there is a shockwave that spreads out and a mushroom cloud that forms at the blast center. After everything returns to a steady state following the initial explosion, there are still radioactive isotopes that exist for a very long time. You not only see the effects of the bomb, but you can measure the radiation it produces after the initial blast. In much the same way scientists can measure the background microwave radiation that is a result of the big bang.

The hot big bang model estimates the average temperature of space as well as a radiation constant that should be present. In 1964, Bell labs originally discovered cosmic background microwave radiation. A major breakthrough came in 1990 when the COBE (COsmic Background Explorer) satellite found ripples at the edge of the universe [3]. These signals originated when the universe was only 100 000 years old. They have been traveling toward us for almost 12 billion years before being discovered in 1990. Since signals can only travel at the speed of light (299 792 458 m/s), they take time to reach earth.

COBE found that the edge of the universe is very uniform and spherical in shape. The findings also revealed that galaxies are clumped together throughout our universe. Galaxies are not evenly distributed as you might think. As a result, the cosmic background radiation should show some bumpiness. This is analogous to airflow on the wing of a plane. When air is evenly distributed, the result is a very smooth flight. If you keep yourself from looking out the window, you might not even think you were flying. However, when the air is turbulent and not evenly distributed, the plane begins to buffet from the regions of high pressure to the regions of low pressure. This results in a very bumpy flight. The same can be said about cosmic background radiation.

The matter that we interact with every day is made of protons, neutrons and electrons. This is known as 'ordinary matter' that strongly interacts with radiation. Therefore, if radiation is smooth after traveling through this matter, the matter itself is likewise smooth and evenly distributed. However, the results that astronomers obtained from COBE were quite unexpected. In 1990, COBE recorded cosmic background radiation that fit the smooth model down to 0.0001% accuracy, even though galaxies in our universe are clumped together.

Why is this? These results are due to exotic matter. This matter very weakly interacts with radiation and has a way of smoothing cosmic radiation before reaching earth. Exotic matter is necessary for the big bang to be a plausible theory. The Hubble telescope further substantiated the results of COBE with the use of *gravitational lensing*. Exotic matter is difficult to detect, but the gravitational lens technique confirmed that the universe contains anywhere between two to ten times as much exotic matter as ordinary matter [4].

This confirms the hot big bang model, and allows the cosmic background radiation to be relatively smooth while the galaxies are clumped together throughout the universe. The results from COBE are shown in Figure 1. The graph is shown in waves per centimeter versus radiation intensity. The hot big bang model theoretical curve is shown as a solid line. Experimental results are shown as points. The experimental and theoretical results completely overlap, giving accurate experimental proof for the hot big bang model.

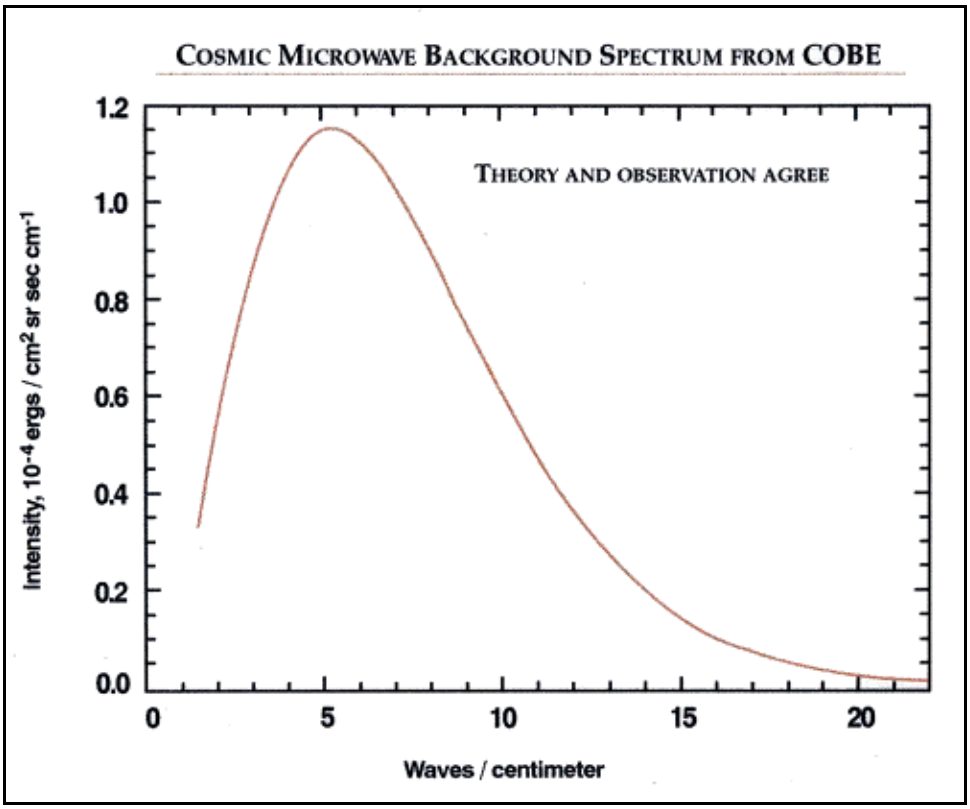

Figure 1 – Cosmic Microwave Background Spectrum Radiation from COBE [5]

From cosmic background radiation, it is possible to derive the current average temperature of the universe. COBE found that the average blackbody distribution had a temperature of -270.265 degrees Celsius (2.735 degrees Celsius above absolute zero). This directly corresponds to one of the hot big bang model predictions.

2.3 How Was the Big Bang Caused?

Current scientific evidence for the big bang can only account for what happens after the universe is 10^{-34} seconds old [6]. This presently represents the limit of research that today's enormous superconductors can perform. Quantum mechanics theories that try to explain what happened before that time are nothing more than guesses.

Now that we have established the hot big bang model's accuracy it is necessary to ask the question, "How was the big bang caused?" To answer this question, one must look at current theories describing what happened after the first 10^{-34} seconds of the universe. Superstring theory provides an intricate description of the big bang and its repercussions. Superstring theory gives a reasonable and logical explanation as to how the universe formed. By understanding the basic structure of the universe we can determine how the big bang was caused.

3 Superstring Theory

As science progresses, new theories are developed to explain our physical universe. Historical theories over the past century have given mankind a glimpse at the underlying structure of the universe. Building on theories created by Albert Einstein, a new breed of theories attempts to combine large and small physics into a single set of equations that will accurately describe all aspects of the universe. In this section, we will look at historical theories that brought us to where we are today. We will also look at current theories such as superstrings that are very close to providing a logical answer to the development and existence of the universe. This will lead into implications caused by superstrings and how they relate to the beginning of the universe.

3.1 Historical Theories

> "*If I have seen further than others, it is by standing on the shoulders of giants.*" (Sir Isaac Newton).

Each successive generation learns and advances from existing developmental theories. As Sir Isaac Newton noted, his work was only made possible because of those who came before him. As we take a look at existing theories that attempt to explain the universe, it is essential to look at historical scientific work that results in present day theories.

3.1.1 Relativity Theory

In 1905, Albert Einstein stunned the scientific community with his theory of special relativity. He worked 'outside the box' in four dimensions, treating time as an extra dimension in addition to height, width and depth. By 1915, Einstein expanded his calculations to produce the theory of general relativity.

When Einstein first introduced special relativity and later general relativity, the scientific community mocked him for even suggesting the notion. However, by 1928 Einstein's general relativity equations were already being experimentally substantiated. Scientists and mathematicians began to discover the far-reaching implications of his equations. The accuracy of general relativity is now known to within a trillionth of a percent, or 14 decimal places of precision [7:229-231]. These equations predict a universe that burst forth and is still expanding from its early infinitely dense state [8:42-49].

In 1966, astrophysicists George Ellis, Stephen Hawking and Roger Penrose expanded Einstein's relativity equations. They concluded that there must be a singular origin in the finite past for not only matter and energy, but space and time as well. This is now known as the space-time theorem of general relativity.

3.1.2 A Single Unifying Theory

The top scientific minds in our world still struggle with finding a single set of equations that explain both large and small operations of matter and energy. Major advancements were made in the last 100 years to produce mathematics and theories that would explain our physical universe, but we have yet to find the single unifying theory. Einstein worked on this problem for the last 25 years of his life. He tried to make the pieces of the puzzle fit together between quantum mechanics and general relativity.

Quantum mechanics explains the complex world of atomic and subatomic particles. It deals with electrons, protons, neutrons and their strange interaction with each other. *Quantum Field Theory* (QFT) goes deeper, looking at subatomic particles such as quarks, leptons, *tachyons*, *gravitons* and *antimatter*. With the standard model of particle physics, those subatomic particles are considered to be points with a specific mass (or lack thereof), electrical charge, velocity, vector and spin. These characteristics are used to show the four types of interactions between different particles.

The four types of particle interactions are:

- Electromagnetism
- Strong nuclear forces
- Weak nuclear forces
- Gravity

In the 1970s *quarks* and *leptons* were discovered. Quarks are always held together by 'strong' nuclear forces that are observable as larger particles such as protons and neutrons. The strong nuclear forces are dominant over electromagnetism at subnuclear distances and act only on quarks. There are also 'weak' nuclear forces that act on both quarks and leptons alike. Weak nuclear forces are responsible for holding electrons (consisting of leptons) in orbit around the core of an atom.

For QFT equations to work, electromagnetism in addition to strong and weak nuclear forces are taken into account. However, gravity is left out of the equation. When gravity is included in the QFT equations, the gravimetric force between two gravitons approaches infinity, which is impossible. When gravity is neglected, quantum mechanics works flawlessly and has been proven to be accurate. General relativity does account for gravity, but cannot adequately explain what happens at the atomic and subatomic levels.

It is still unknown how these forces interact with gravity to produce the physical world that we see and touch. The quest is on to find a viable set of equations that bring together both quantum mechanics and general relativity while including gravity in the equation.

3.2 Superstring Theory

To explain subatomic interactions properly, we must include gravity in the equation. Since quantum field theory does not account for gravity, string theory was developed to explain the composition of the universe, which later evolved into superstring theory. Physicists are hopeful that these will one day give birth to the *Unified Field Theory*.

3.2.1 String Theory

As we discussed earlier, all interactions between particles in the standard model of physics assumes that particles are points. This does not leave much flexibility when it comes to designing equations to explain the physical universe. In string theory, these particle points are replaced with a fundamental building block called a 'string'. You can think of this as the same type of string that you use to sew a button back onto a shirt. When you are working with strings, they can be either open or closed. As time progresses, these strings can either trace out a sheet or a tube, for open and closed strings respectively (Figure 2).

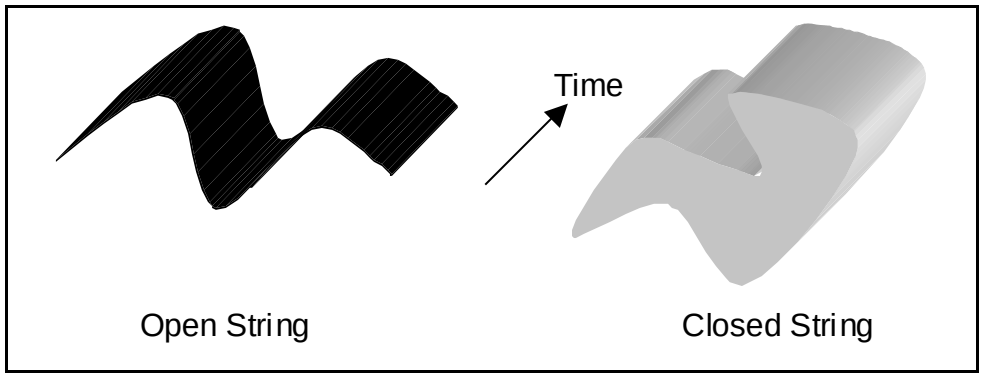

Figure 2 – Open and Closed Strings

These strings have different vibration levels that correspond to various particle types. Since different particles are seen as different masses or subatomic spins (integer and odd half integer spins), strings can be any type of subatomic particle. This idea is analogous to LEGO. You have a bunch of LEGO building blocks (strings) in front of you, and you can build different shapes and structures. Once the LEGO is snapped together into a shape, you cannot change that shaped unless you take it apart.

Now imagine each piece of LEGO contains a magnet. Once you snap different LEGO pieces together, it takes a lot of effort to take them apart again. The forces that hold an individual LEGO piece together are strong and weak nuclear forces. The forces between different LEGO pieces are electromagnetism and gravity. Just as in physics, only certain LEGO pieces can be fitted together with others. They need to have the right pegs to fit the holes of the next piece of LEGO.

Strings take on different characteristics depending on their vibration level, or 'note'. The strings on a guitar vibrate at different frequencies producing various notes. This can be thought of in the same way for string theory. Depending on the frequency vibration of the

string, it could appear as a quark, lepton, photon, graviton, or any other subatomic or elemental particle. These are the basic LEGO pieces that make up our universe. For a string particle state example, please refer to Appendix A.

String theory can only work when a graviton is used in the equations. This is of particular interest to physicists since the quantum field theory produces erroneous results when a graviton is introduced. String theory correctly uses all four types of particle interactions mentioned in Section 3.1.2.

As physicists developed string theory, they found that it only described the forces and energy that made up the universe, but did not describe matter. Superstring theory expands on string theory to create a better set of equations that include both matter and energy.

3.2.2 Superstring Theory

Superstring theory builds on string theory to include all matter and energy. Depending on whether a particle is matter or energy depends on the type of spin that particle exhibits. *Bosons* have an integer spin and consist of energy particles that carry forces. These forces are present in particles such as gravitons for gravity and gluons for strong nuclear forces. *Fermions* have an odd half integer spin and make up the physical matter that we can see and touch. Strings vibrate at certain frequencies to produce quarks and leptons, which in turn make up protons, neutrons, and electrons. These are the basics building blocks of matter. Bosons and fermions always occur in pairs, interacting to make up matter and the corresponding forces that act on our physical universe.

With the advancement of superstring theory came three different approaches. Two of these approaches used closed strings, while the third used open strings. All three theories were mathematically consistent, and none of them could be ruled out. As time progressed, physicists found that these three theories were all part of the same underlying theory.

Combining these three superstring theories gives us a set of equations that bring us closer to discovering the unified field theory. There are still many uncharted areas for superstrings. At present, trying to describe the unified field theory using existing superstring theory is like describing the intricacies of a car by looking at the engine through a microscope. You need to know about many areas of the car before you can know the larger picture of what it looks like.

Now that we have looked at strings and superstrings, we will discuss the main implications of these theories, and how they relate to the big bang.

3.3 What do Superstrings Prove?

Superstrings were briefly discussed, giving you a general understanding of the subject matter. Now we will build on the theory of superstrings, explaining how it relates to the big bang and the beginning of the universe.

We live in a universe with the following four dimensions:

- Height
- Width
- Depth
- Time

Any viable string theory must fit into these observable space-time dimensions. Current superstring theories only work in a universe with a minimum of ten dimensions. Fermionic strings (those that produce matter) also require a minimum of ten dimensions for their multidimensional equation to work [9:5]. How can there be ten or more dimensions, yet we can only see three dimensions and experience time? Any extra dimensions must be compacted so that we do not observe them in our four dimensions. These extra dimensions are curled up very tightly so that we are never aware of their existence. This dimensional compacting can be traced back to the very start of the big bang, before they were compacted.

Compact dimensions that we cannot see allow for degrees of freedom for fermions and bosons. For instance, the electric charge of an electron would simply be motion in a compacted dimension. This electric charge motion is there, except we cannot see it since it is in the other dimension. Rather, we measure the effects of that extra-dimensional motion as the charge of the electron. This theory dates back to the 1920s. New discoveries in both math and physics are bringing these old theories to life again.

By using these compact dimensions, physicists are better able to theorize what happened before the universe was 10^{-34} seconds old. At the instant the big bang started, there were ten dimensions. Once the universe was 10^{-34} seconds old, six of those ten dimensions are compacted, leaving us with the four dimensions that we know as our universe today.

But how did the initial big bang happen in the first place? Evidence suggests that this grand design did not come into existence on its own. The following section discusses the intricate design of our universe and the statistical probability that it came into existence purely by chance.

4 Our Universe by Design

> "*The further the spiritual evolution of mankind advances, the more certain it seems to me that the path to genuine religiosity does not lie through the fear of life, and the fear of death, and blind faith, but through striving after rational knowledge.*" (Albert Einstein).

It is difficult to deny the complexity of the universe in which we live. Trying to understand everything from strings and atoms to stars and galaxies is almost incomprehensible to the human mind. In previous sections, we dealt with scientific explanations to explain why the universe exists in its present form. In this section we will explore the results of the big bang,

as well as the statistical probability that such a design would be able to support life. This evidence will be used to reason if the universe had a creator, namely God.

4.1 Our Universe has a Cause

Any first year university philosophy student realizes that two true premises result in a true conclusion, as long as the conclusion is a result of the premises. This basic philosophical approach is used in Table 1 to reason that the universe has a cause.

Table 1 – Cause for the Universe

Premise 1:	Whatever begins to exist must have a cause.
Premise 2:	The Universe began to exist.
Conclusion:	Therefore the Universe has a cause. [10]

Is it more logical to believe that the universe simply came into existence out of nothing, or that it was created? Since the universe is finite and there was nothing before the beginning of the universe, something must have created it. Furthermore, that something must be outside of time, space, and matter to accomplish this task. Therefore, it logically follows that the universe had a cause. That cause was the creator, God, who created the universe.

4.2 Our Universe has Constants

For the universe to exist in its present form, there are almost an infinite number of cosmological constants needed to keep the universe stable. These constants control everything from the spin radius of an electron around the nucleus of an atom, to the speed of light. If there were no constants in this universe, it would cease to exist as we know it. Scientists have formed a group of 75 cosmological constants that are absolutely essential to the formation of life. These constants are listed in Appendix B, giving the statistical probability for the formation of our universe to sustain life.

Two of the constants listed in Appendix B are strong nuclear forces and the expansion rate of the universe. If strong nuclear forces are just two percent less, nuclei are destroyed. If strong nuclear forces are two percent more, matter is prevented from forming. The same results are true when looking at the expansion rate of the universe. When the expansion rate is less by one part in 10^{12}, the universe would collapse very early in its formation. If the expansion rate is greater by one part in 10^{6}, stars would never even get a chance to form [10].

Using the constants from Appendix B, the probability that the universe formed to support life is 10^{-99}. This is analogous to the probability of a tornado touching down in a junkyard, rearranging all of the parts, and leaving a fully operational Boeing 747 in its wake. This incomprehensible event wouldn't happen only once, it would happen a million times! Such an event is nearly impossible, and so is the creation of our universe without God.

4.3 Our Universe has a Creator

The evidence is overwhelming. To suggest that the universe formed completely by chance is statistically improbable. A much more logical answer is that God, the creator, carefully formed the universe so it could support life. Intelligent life is also a direct result of the creator. The topics discussed are much too complicated and precise to occur without a master designer. That master designer is God, the creator of the heavens and the earth.

5 God and Extra-Dimensionality

How could God exist before time began? Where could he exist before the universe started if there was no space? Where is God if we cannot see Him? These are questions that can be answered by looking at the extra-dimensionality of God to explain the big bang. We will look at extra space dimensions beyond height, width, and depth that we are familiar with. Additional time dimensions will also be examined and described to help you understand how the universe came into being in the first place. It is superstring theory that gives us this background to talk about extra-dimensionality.

At the instant of the big bang, there were ten dimensions. When the universe was 10^{-34} seconds old, six of those ten dimensions stopped expanding and never produced any matter. The remaining four dimensions continued expanding, eventually forming atoms, molecules, stars and galaxies. The six remaining dimensions still exist, but they are invisible to us since they are so tightly curled up in the space-time continuum. We will give you an understanding of these extra dimensions, and discuss the implications they have on the creation of our universe, as well as the creator.

5.1 Extra Space Dimensions

The world that we know exists in four dimensions; height, width, depth and time. The laws of physics require that all universal matter and energy be constrained to these dimensions [11:90-96]. Superstring theory suggests that there were at least 10 dimensions when the universe was created, and these dimensions still exist today.

5.1.1 Making the Jump to Four Dimensions

To help with the understanding of extra space dimensions, an example will be used to extend two dimensions into three dimensions. As shown in Figure 3, the two-dimensional people depicted live on a flat plane.

Imagine that 2D man wants to meet 2D woman. How is he going to do this? The line that separates them goes infinitely up and down. Since they are only in two-dimensional space, 2D man cannot go around the line. What should he do? If he could travel into 3D space, he would simply jump over the line and introduce himself to 2D woman.

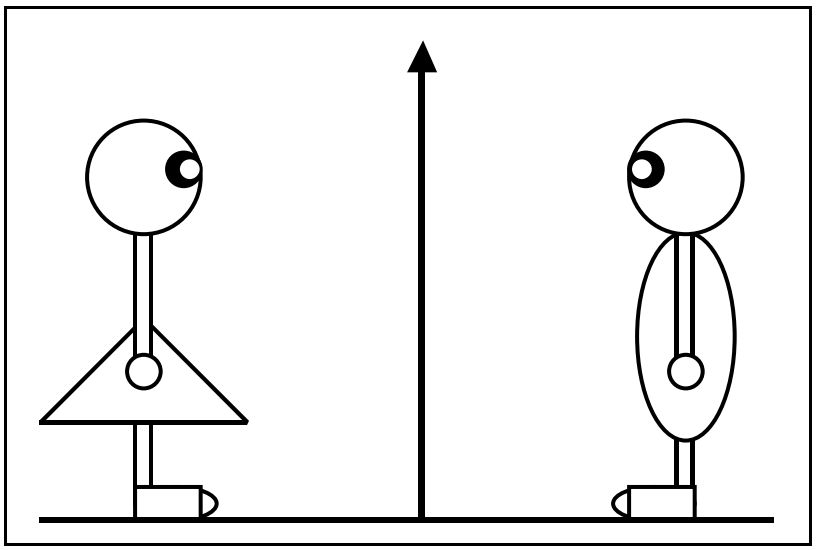

Figure 3 – Two Dimensional Man and Woman

We can use the same idea when going from three dimensions into four dimensions. In four dimensions it is possible to turn a basketball inside out without cutting it. You can also walk through a wall. You don't actually walk through it, but you walk around it into the fourth dimension. This is identical to jumping over a line on a flat two-dimensional plane by going into the third dimension.

God can reside in these extra dimensions to watch over us. He can do this without us ever seeing Him, yet He can always see us. This is analogous to us seeing the two-dimensional people in Figure 3, yet they can never see us. This would explain how the creator of the universe can be undetectable by our senses yet reside in our universe. He can also interact with our universe, just like you can interact with the two-dimensional plane in Figure 3.

5.1.2 Why are we Limited to Three Dimensions?

Since there are more dimensions than those we see, why did God limit us to only three space dimensions? Life cannot exist in any more or any less than three dimensions [12:32]. Gravity varies with the inverse square of the distance in three-dimensional space ($\text{Gravity} \propto [\text{distance}^2]^{-1}$). Only in three dimensions does gravity hold together solar systems and galaxies to sustain life. In four dimensions gravity varies with the inverse cubed distance. Gravity continues to have less of an effect when more dimensions are added. Only in three dimensions does the universe have the correct properties to prosper.

Electromagnetism is also completely dependant on our three dimensional space. If there were more than three dimensions, electrons would not be able to hold their orbit around an atom. They would spiral away from or into the atomic nuclei they are orbiting. This prohibits any complex atoms from forming. Therefore, it is only possible for our universe to exist in three-dimensional space.

All of these variables suggest that the universe did not simply come together as some chance event. Rather, the universe was intelligently designed, and continues to operate as it has since the beginning of time. Since there are additional space dimensions in our universe, it also goes to reason that there are additional time dimensions as well. These extra time dimensions will now be discussed and evaluated.

5.2 Extra Time Dimensions

How did time begin? Superstring theory states that neither space nor time existed before the big bang. After the big bang, 3 space dimensions and a single universal time line dimension began to exist in our observable universe. The remaining time dimensions are compressed just like the additional space dimensions. It is relatively easy to accept that space and matter can be created at the time of the big bang, but how could time be created?

5.2.1 How was Time Created?

The universe must have a cause (discussed in Section 4.1). For something to be created, it must have a creator. Hence, since the universe was created, it must have a creator. The question arises, 'Who created the creator God?' The answer is nobody. God has always existed and will always exist. This extends to provide the only logical explanation for the creation of time. Since God lives outside of time itself, he existed before time. When the big bang occurred, he created space and time dimensions. It was only then that time began. Before that point, according to superstring theory, there was no time.

Time as we know it moves along a straight line at a constant speed. It is not possible to move backward along this line, but it is possible to change the speed at which time passes. According to general relativity, time is variable. It is dependent on the curvature of space, which is in turn dependant on gravity as well as your speed relative to the speed of light. For example, the closer you get to the speed of light, the slower time will pass. What does this have to do with the creator?

Even though we may be able to alter the speed at which we travel through time, we cannot stop time from passing. God on the other hand can be anywhere in time, and everywhere in time with the addition of just one more time dimension.

5.2.2 Adding Time Dimensions

> "*For a thousand years in your sight are like a day that has just gone by, or like a watch in the night*." (Psalm 90:4, NIV) [13:876].

With the addition of just one more time dimension, God could travel anywhere or everywhere in time. Just as you can touch more than two points on the same line if you were in two-dimensional space, the creator of time can do the same thing. In this simple example of only one extra time dimension, it is possible to travel backward, forward, and even sideways in

time. Going sideways in time would allow God to spend an infinite amount of time in our timeline at one particular point. This concept of our universal timeline existing on a two-dimensional plane is illustrated in Figure 4.

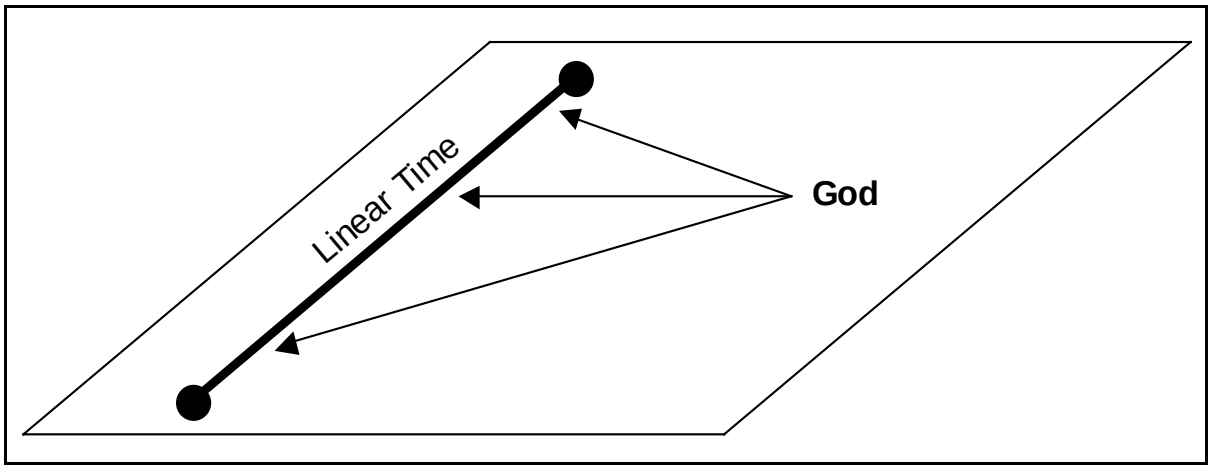

Figure 4 – Universal Timeline Along a 2D Plane

The two-dimensional plane in Figure 4 extends infinitely in all directions. The linear timeline has a definite starting point and end point. As you can see, God can be at all points on the time line simultaneously. He can exist outside of our time with the addition of just one more time dimension. What if time were three-dimensional for God? The possibilities are staggering.

Even with this simple example, it is possible to understand what a universe with more than one dimension of time would be like. The same question can be asked about time that was asked about space, 'Why are we limited to only one time dimension?' Superstrings, the theory of general relativity, and time-space itself are testaments that the observable universe could not exist if there were more than one time dimension.

With all of this scientific evidence and proof, conclusions can now be made about the creation of the universe. Does the big bang prove the existence of God?

6 Conclusion

> "*Fix reason firmly in her seat, and call on her tribunal for every fact, every opinion. Question with boldness even the existence of a God, because, if there be one, he must more approve of the homage of reason than that of blind faith.*" (Thomas Jefferson, 1785).

The creation of the universe from the big bang was not a chance event. There are many contributing factors such as universal constants, superstrings and extra-dimensionality. The statistical probability is 10^{-99} that these universal constants would all have the proper values to form a life-supporting universe. This is statistically improbable. Even if this statistically improbable event did happen to occur by chance, no scientific explanation can be formulated as to how the big bang was initiated in the first place. Nothing cannot create nothing. For something to come into being, there must be a cause. The only logical explanation for the cause of the universe is God.

God not only caused the big bang to occur, God also shaped the universal constants that determine matter and energy interactions. There are almost an infinite number of finely tuned values in our universe that allow for the existence of life. Strong nuclear forces, gravity and the speed of light are just a few of the constants that keep our universe functioning. All of these constants were determined the instant the big bang occurred.

Superstring theory has given mankind a deeper look into the intricacies of the universe, and how it was formed. Rather than providing all the answers, superstring theory brings us one step closer to understanding creation and God. God exists in dimensions that are imperceptible to our human senses. Extra space dimensions that are needed for superstring theory to work explain how God can be with us, yet we are not able to see Him. Additional time dimensions explain some claims of the bible that God's time is different than our linear timeline. Since the universe had a definite beginning, it can be concluded that God exists both inside and outside of time. Before the creation of the universe, there was no time or space, there was only God.

> "*In the beginning, God created the heavens and the earth.*"
> (Genesis 1:1, NIV) [13:6].

Such a simple statement encapsulates the incredibly complex creation event. All of this began nearly 12 billion years ago with collapsing superstrings and the big bang. Does it take more faith to believe that our universe came into existence as a cosmological accident, or that God created the universe? From a purely scientific standpoint, the only rational explanation is that God created our universe, and then created mankind in His image.

> "*When I consider your heavens, the work of your fingers, the moon and the stars, which you have set in place, what is man that you are mindful of him? O Lord, our Lord, how majestic your name in all the earth!*"
> (Psalm 8:3-4,9, NIV) [13:786].

Appendix A – Superstring Particle States

> "*In Mathematics, you don't understand things; you just get used to them.*" (Neumann).

The basis behind string theory is it can represent single particle states depending on the energy vibration level or more specifically, the tachyon emission from the string. Different tachyon emissions radiating from the string result in different particle states. Strings are capable of exhibiting all of the allowed string modes with its internal structure, but can only display one of those modes externally. Therefore, subatomic and atomic particles can now be thought of as strings that are capable of many states, rather than simply finite points.

To examine this phenomenon, a four-tachyon amplitude example is used to describe the closed-bosonic-string theory [14:269-289]. As shown in Figure 5, two boson-fermion pairs (k_1-k_2 and k_3-k_4) exchange a tachyon. Resulting from this exchange, energy levels are altered and the particle would change in some way since the resulting string vibration amplitude is now different.

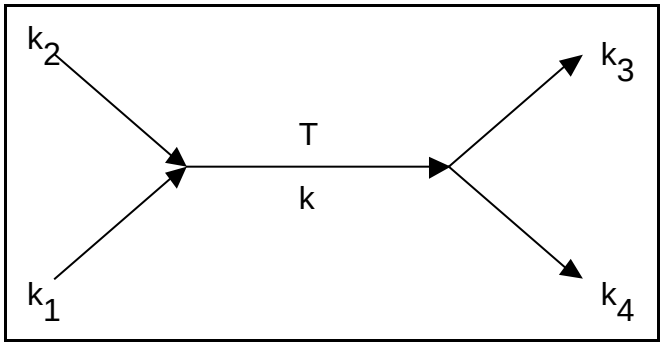

Figure 5 – Contribution to A4 from s-channel exchange

Equation 1 – String vibration amplitude

$$A_4 = \frac{g^2}{4} \cdot \frac{\Gamma(-1-\frac{s}{8})\Gamma(-1-\frac{t}{8})\Gamma(-1-\frac{u}{8})}{\Gamma(2+\frac{s}{8})\Gamma(2+\frac{t}{8})\Gamma(2+\frac{u}{8})}$$

where:
$$s = (k1+k2)^2 = 2k1\cdot 2k2 - 16$$
$$t = (k2+k3)^2 = 2k2\cdot k3 - 16$$
$$u = (k1+k3)^2 = 2k1\cdot k3 - 16$$

This is used to find the tachyon amplitude. The particle characteristics of this string will depend on the vibration amplitude of the resulting fermion, k_4.

Appendix B – Universal Formation Probability

Table 2 – Probability for Universal and Earth Formation to Support Life [15]

Number	Parameter	Probability
1	galaxy size	0.1
2	galaxy type	0.1
3	galaxy location	0.1
4	star location relative to galactic center	0.2
5	star distance from closest spiral arm	0.1
6	z-axis extremes of star's orbit	0.1
7	proximity of solar nebula to a supernova eruption	0.01
8	timing of solar nebula formation relative to supernova eruption	0.01
9	number of stars in system	0.2
10	star birth date	0.2
11	star age	0.4
12	star metallicity	0.05
13	star orbital eccentricity	0.1
14	star's distance from galactic plane	0.1
15	star mass	0.001
16	star luminosity relative to speciation	0.0001
17	star color	0.4
18	H^3+ production	0.1
19	supernovae rates & locations	0.01
20	white dwarf binary types, rates, & locations	0.01
21	planetary distance from star	0.001
22	inclination of planetary orbit	0.5
23	axis tilt of planet	0.3
24	rate of change of axial tilt	0.01
25	planetary rotation period	0.1
26	rate of change in planetary rotation period	0.05
27	planetary orbit eccentricity	0.3
28	surface gravity (escape velocity)	0.001
29	tidal force	0.1
30	magnetic field	0.01
31	albedo	0.1
32	density	0.1
33	thickness of crust	0.01
34	oceans-to-continents ratio	0.2
35	rate of change in oceans to continents ratio	0.1
36	global distribution of continents	0.3
37	frequency & extent of ice ages	0.1
38	asteroidal & cometary collision rate	0.1
39	change in asteroidal & cometary collision rates	0.1
40	mass of body colliding with primordial earth	0.002
41	timing of body colliding with primordial earth	0.05

42	rate of change in asteroid & comet collision rate	0.1
43	position & mass of Jupiter relative to Earth	0.01
44	major planet eccentricities	0.1
45	major planet orbital instabilities	0.1
46	drift and rate of drift in major planet distances	0.1
47	atmospheric transparency	0.01
48	atmospheric pressure	0.1
49	atmospheric electric discharge rate	0.1
50	atmospheric temperature gradient	0.01
51	carbon dioxide level in atmosphere	0.01
52	oxygen quantity in atmosphere	0.01
53	chlorine quantity in atmosphere	0.1
54	iron quantity in oceans	0.1
55	tropospheric ozone quantity	0.01
56	stratospheric ozone quantity	0.01
57	mesospheric ozone quantity	0.01
58	water vapor level in atmosphere	0.01
59	oxygen to nitrogen ratio in atmosphere	0.1
60	quantity of greenhouse gases in atmosphere	0.01
61	quantity of forest & grass fires	0.01
62	quantity of sea salt aerosols	0.1
63	soil mineralization	0.1
64	quantity of decomposer bacteria in soil	0.01
65	quantity of mycorrhizal fungi in soil	0.01
66	quantity of nitrifying microbes in soil	0.01
67	quantity of soil sulfur	0.1
68	quantity of sulfur in the life planet's core	0.1
69	tectonic activity	0.1
70	rate of decline in tectonic activity	0.1
71	volcanic activity	0.1
72	rate of decline in volcanic activity	0.1
73	viscosity at Earth core boundaries	0.01
74	biomass to minicomet infall ratio	0.01
75	regularity of minicometary infall	0.1
	Combined probability:	**10^{-99}**

Glossary

Antimatter – elementary particles such as protons, neutrons, and electrons that posses opposite charges than those of ordinary matter (i.e. e- is and electron, e+ is the antimatter positron).

Big bang – fundamental theory as to the origin of the universe. Predicts a large explosion from very dense matter and energy approximately 12 billion years ago.

Big bang ripples – microwave background radiation still measurable today from the big bang explosion. This phenomenon is predicted by the hot big bang model.

Boson – subatomic energy particles that carry forces. Found in gravitons for gravity, and gluons for strong nuclear forces. Always occur as a pair with a fermion.

Fermion – subatomic particles that include quarks and leptons. They make up the physical matter of our universe. Always occur as a pair with a boson.

Gravitational lensing – a technique to magnify cosmological images by capturing the image after light has been bent by a large gravitational source. Similar to light separating and spreading as it goes through a prism.

Graviton – a particle that has no charge and no mass but exerts forces on other particles through gravity.

Leptons – includes any particles that have an odd integer half spin and experience no strong nuclear forces.

Quarks – includes any particles with integer spin that interact with strong nuclear forces.

Quantum Field Theory (QFT) – physics principles that explain subatomic properties and relationships. QFT is the combination of quantum mechanics and relativity, but does not include gravity in the equations.

Superstring – a hypothetical subatomic string that follows supersymmetric rules. Vibration frequencies in strings determine what particle is produced. This particle exists in ten dimensions of which only four are evident in our physical universe

Tachyon – a hypothetical subatomic particle that has no known smaller parts. It always moves at speeds greater than the speed of light. “Tachyon” comes from the Greek word, meaning swift.

Unified Field Theory – attempt to find a single underlying framework of equations to describe all forces and matter in the universe and their relationships.