

DISCUSSION 6

THE
FINE-TUNED
UNIVERSE

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OUTLINE

- 1. The question**
- 2. The incredible universe**
- 3. Ideas about the origin of the universe**
- 4. What is the universe made of?**
- 5. Examples of fine-tuning**
- 6. Responses to the fine-tuned universe**
- 7. Conclusions**
- 8. Review questions**

1. THE QUESTION

1. THE QUESTION

Was the universe designed, or did it just happen to come into existence by itself?

The Bible strongly suggests that God is the creator of the universe. Two verses that imply this are:

1. THE QUESTION

GENESIS 1:16

Then God made two great lights: the greater light to rule the day, and the lesser light to rule the night. *He made* the stars also.

PSALMS 102:25-27

In the beginning you laid the foundations of the earth, and the heavens are the work of your hands.

1. THE QUESTION

A paradoxical incident tells us that some strongly disagree with what the Bible says about origins.

In 1959 some 1500 scientists from all over the world gathered at the University of Chicago for a five day celebration of 100 years since the publication of Darwin's famous book *The Origin of Species*. During that conference a special convocation was held at the University's famous Rockefeller Chapel. As the meeting began, the scientists bowed their heads in a prayer to "Almighty God." Then Sir Julian Huxley, -- the grandson of Darwin's valiant defender Thomas Huxley, who was often called "Darwin's bulldog,"-- got up and delivered an oration, pointing out that there is no God.

1. THE QUESTION

Huxley stated: “The earth was not created; it evolved. So did all the animals and plants that inhabit it, including our human selves, mind and soul as well as brain and body. So did religion. ...”

Furthermore, he elaborated: “Evolutionary man can no longer take refuge from his loneliness in the arms of a divinized father-figure, whom he himself has created, nor escape from the responsibility of making decisions by sheltering under the umbrella of Divine Authority, nor absolve himself from the hard task of meeting his present problems and planning his future by relying on the will of an omniscient, but unfortunately inscrutable, Providence.”

Simply stated: There is no God.

1. THE QUESTION

In the Bible, the apostle Paul completely disagrees with Sir Julian Huxley, pointing out that there is no excuse for not believing in God because the creation points to God's power. Speaking of God he states:

“For the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, even his eternal power and Godhead; so that they are **without excuse**: Because that, when they knew God, they glorified him not as God, neither were thankful; but became vain in their imaginations, and their foolish heart was darkened. Professing themselves to be wise, they became fools.” Romans 1:20-22.

As we look at the recent discoveries about the universe, we will be asking whether Huxley or Paul is right.

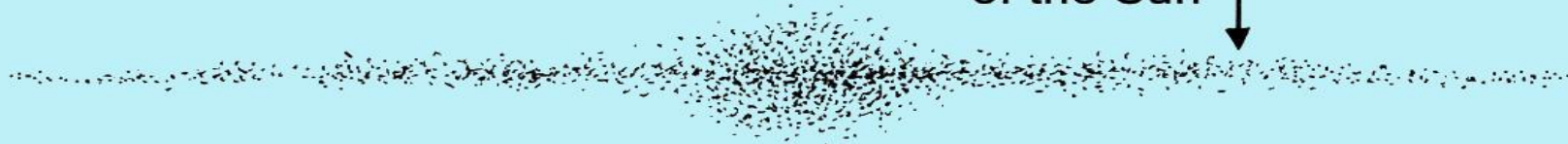
2. THE INCREDIBLE UNIVERSE

2. THE INCREDIBLE UNIVERSE

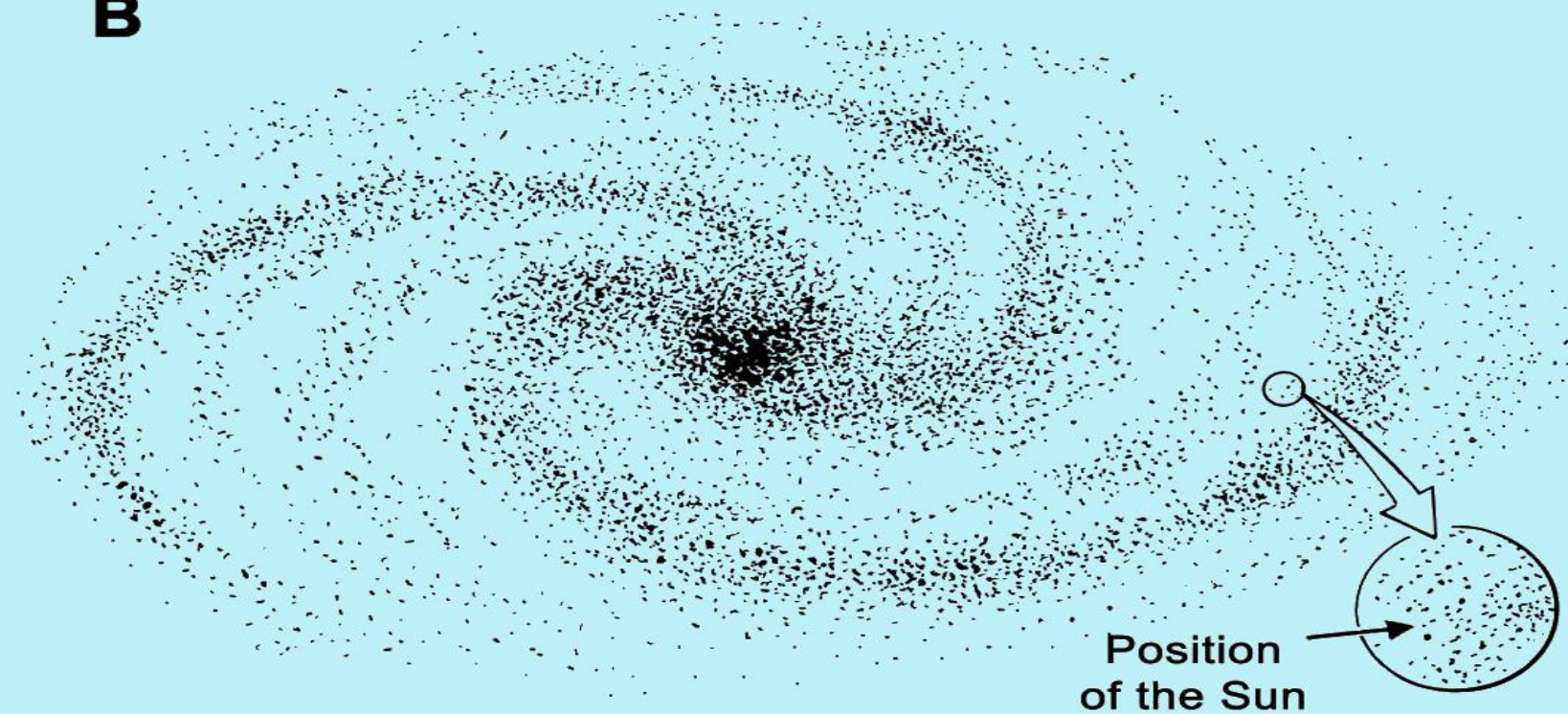
Our marvelous universe consists of all kinds of things from minute subatomic particles to an immensely huge array of stars. A useful unit for our discussion are the huge flat disc-shaped structures consisting of many stars that are called *galaxies*. The flat disc that we live in is called the Milky Way Galaxy and is illustrated in the next slide. In part **A**, which is a side view looking at the edge of the disc, note the thick bulge in the center. A dreaded black hole may be there. Part **B** is a nearly planar view showing the spiral arms and the approximate position of our Sun.

A

Position
of the Sun



B



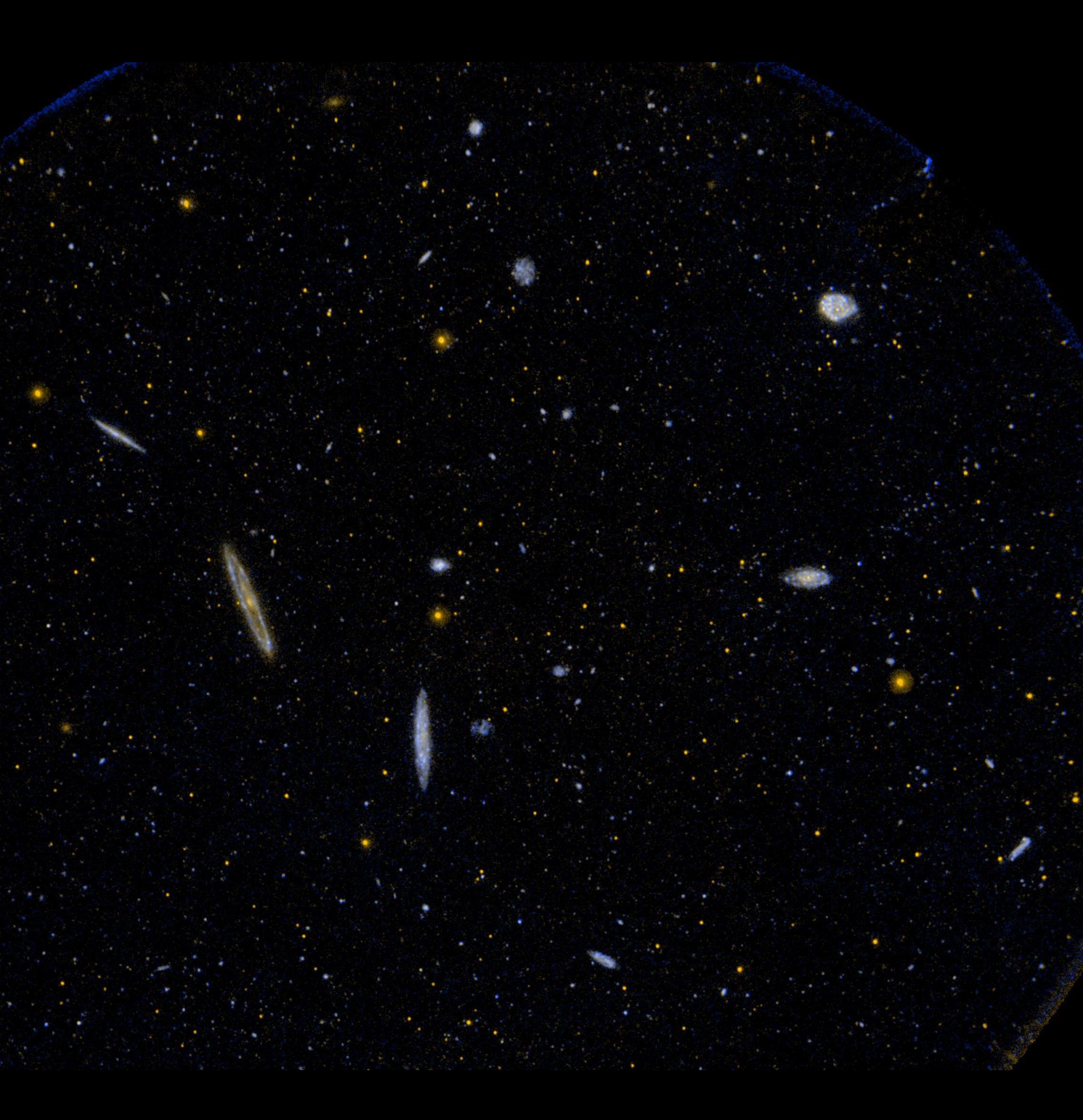
Position
of the Sun

THE MILKY WAY GALAXY. A: side view, B: nearly planar view

2. THE INCREDIBLE UNIVERSE

SOME VIEWS

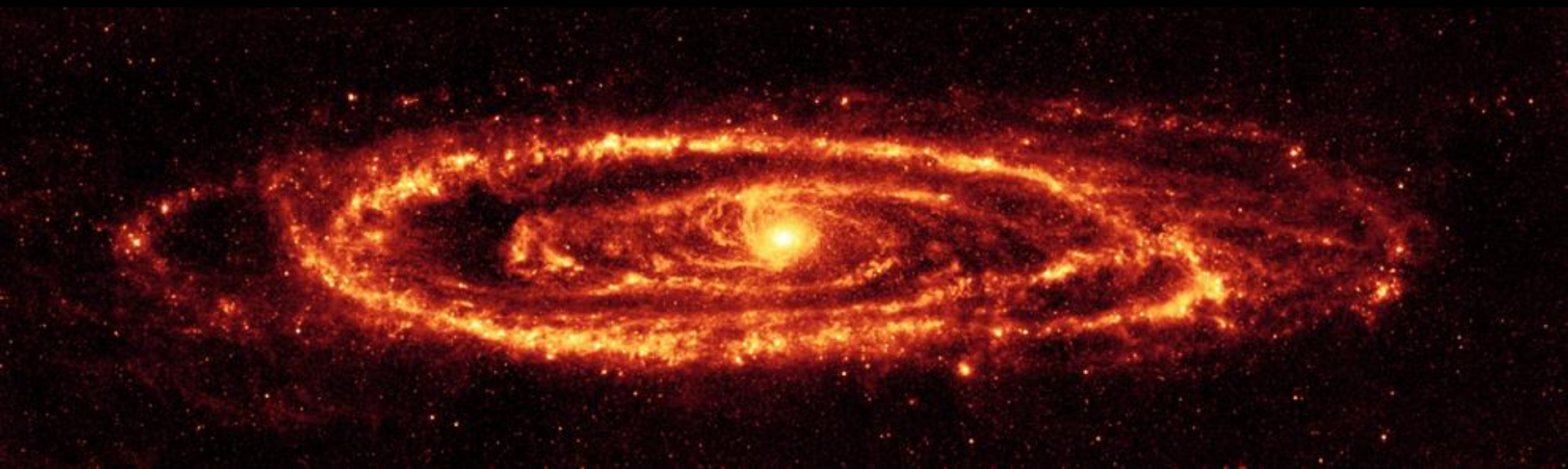
You may not be familiar with what we are finding in the universe. Below are a few illustrations of some of the more common features. Recent study indicates that the universe is very complicated and active. It also poses many mysteries and unanswered questions.



A few of the galaxies seen in the constellation Virgo.

The galaxies, that are of varied shape, are the large gray objects. They are located way beyond the many smaller stars of our Milky Way Galaxy that you can also see.

**Courtesy of
NASA/JPL-
Caltech/SSC**



Andromeda Galaxy. Courtesy NASA/JPL-Caltech



**An irregular
dwarf galaxy,
IC 1613.**

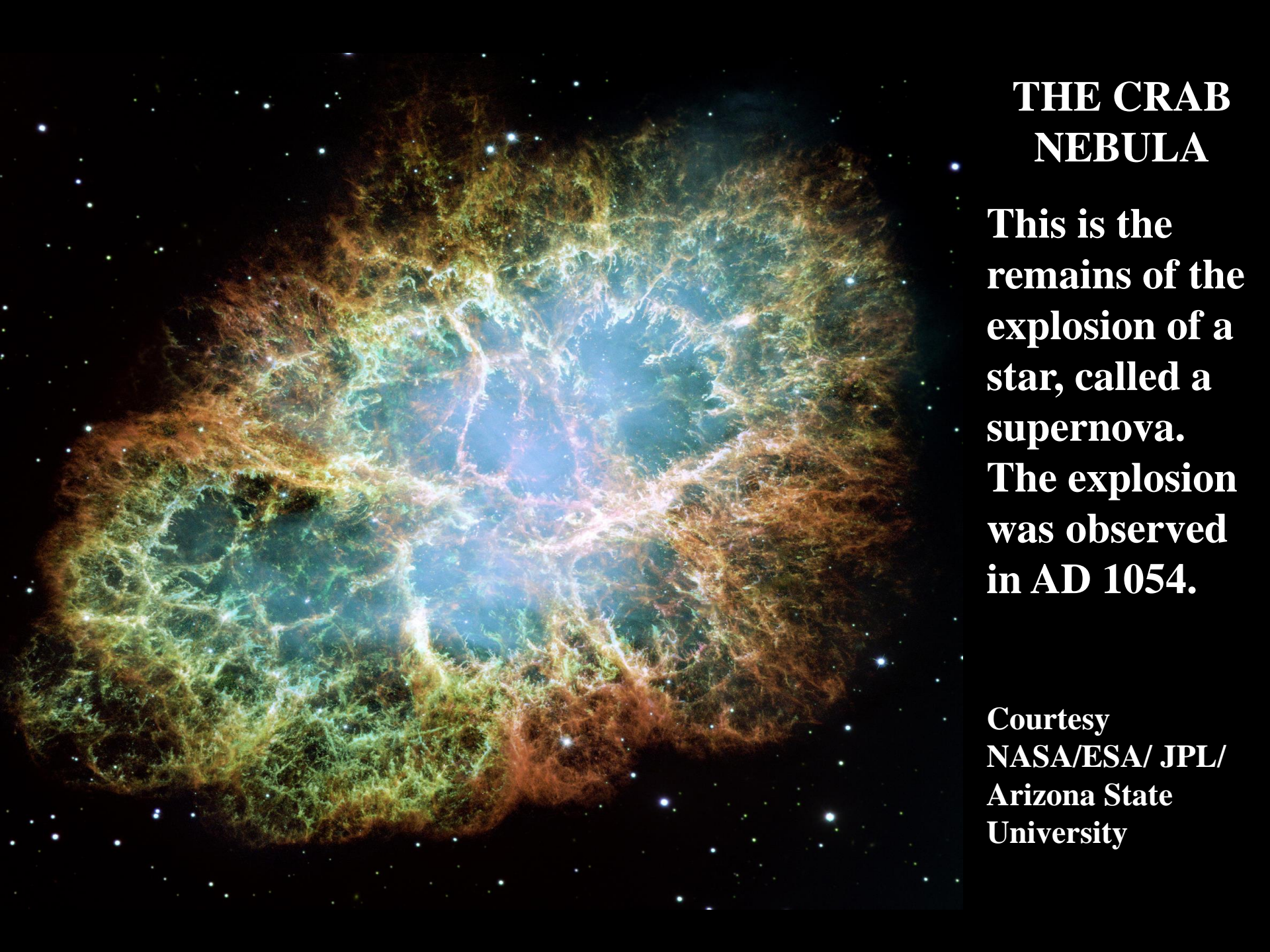
**Ultraviolet
image.**

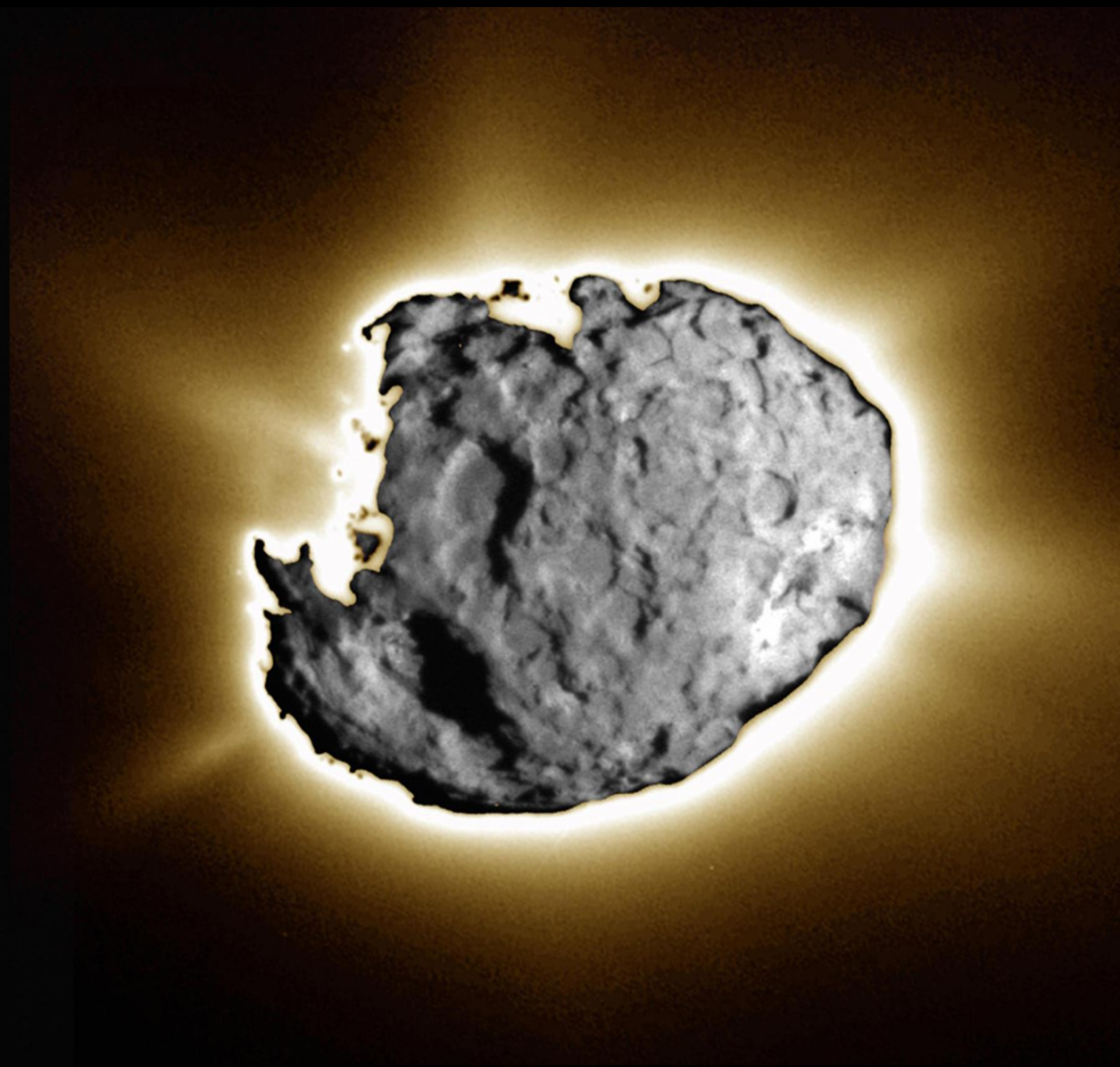
**Courtesy
NASA/JPL-
Caltech/SSC**

THE CRAB NEBULA

**This is the
remains of the
explosion of a
star, called a
supernova.
The explosion
was observed
in AD 1054.**

**Courtesy
NASA/ESA/ JPL/
Arizona State
University**





COMET WILD-2

This comet is about 5 kilometers (3 miles) in diameter. Note several large depressions.

Comets are made of ice and something like soot. Dust and gases stream into space as the comet streaks through space.

**Photo courtesy
NASA/JPL-Caltech**



THE PLANET JUPITER

This is a true color view of our solar system's largest planet. It is about 11 times the diameter of the Earth. It makes a complete rotation about every ten hours

All that you see is clouds that are likely hydrogen, and helium.

The famous rounded Great Red Spot is the reddish oval just below the middle of the picture. It has been observed for centuries. In the Great red spot the clouds circle around in around six Earth days.

Courtesy NASA/JPL-Caltech

2. THE INCREDIBLE UNIVERSE

FACTS ABOUT THE UNIVERSE

- There are around **100 billion stars** in a galaxy, and probably around **100 billion galaxies** in the universe
- Our galaxy is rotating slowly
- At its present rate of travel our Sun would take **250 million years** for one complete rotation in our galaxy
- To do this, our Sun has to travel at **225 kilometers per second, (505,000 miles per hour)**. Our Earth and we also travel around our galaxy with our sun at that rate.

2. THE INCREDIBLE UNIVERSE

THE EXTREME IMMENSITY OF THE UNIVERSE

1. Proportionately, if the Sun were the size of a room (3m, 10 feet diameter) the Earth would be the size of an apricot 0.4 kilometers ($\frac{1}{4}$ mile) away, and Pluto (no longer considered a planet) would be the size of a pea 13 kilometers (8 miles) out.
2. By commercial jetliner it would take **19 years** of continuous travel to get from Earth to the Sun.
3. Light from the Sun takes **8 minutes** to reach us.

2. THE INCREDIBLE UNIVERSE

THE EXTREME IMMENSITY OF THE UNIVERSE

4. Light travels around **9,461 billion km (6 trillion miles)** in one year (*light year*).
5. It takes light **100 thousand years** to travel across our galaxy.
6. Light coming from the Andromeda Galaxy, that lies close to our galaxy, takes **2 million years** to reach us.
7. The universe is considered by some to be **several dozen billion light years** across, with various assumptions providing varied conclusions.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

The Bible indicates that God created the universe.

There are many other ideas about how the universe came to be.

Some think that the universe has *always existed*. For those who believe this, the question of how the universe came to be is not valid, since the universe has always existed. During most of his life, famed physicist Albert Einstein believed that the universe always existed, but he eventually accepted the idea that it had a beginning.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

There are other ideas, such as the universe repeatedly expanding and contracting in a so called *oscillating universe*. Others believe in a *steady state* universe where new matter is continuously being created and destroyed. These latter views tend to avoid the question of the beginning of the universe.

A major shift in thinking took place almost a century ago when it was noted that many distant galaxies appear to be moving away from us, some at 50 thousand kilometers per second (100 million miles per hour). It was also noted that the farther away a galaxy was, the faster it was receding.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

The conclusion that the farther away a galaxy is, the faster it travels, has become known as **Hubble's Law**. It is named after the famous astronomer Edwin Hubble who studied this at the famous 100 inch telescope on Mount Wilson, California. A few disagree with this conclusion.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

One way astronomers determine how fast a galaxy is receding is to note how the characteristic light color pattern emanating from the excited atoms of stars is shifted towards the red end of the light color spectrum. This shift, called the *redshift*, is due to the stars receding so fast that the light waves are effectively stretched out, shifting them towards the red end of the light spectrum that has the longer light waves. It is somewhat similar, but not exactly like the **Doppler Effect** noted when a sound like a siren from a police car is high pitched as it comes towards us but drops in pitch when the source travels away from us. In the case of galaxies, the faster they are moving away from Earth, the greater the shift of the light pattern that comes from the atoms towards the red end of the visible spectrum, i.e. the *redshift*.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

Hubble first tried to estimate distances on the basis of how bright certain standard astronomical features were. This is somewhat the same as estimating how far away a candle is by how bright it is. This has not proved to be very accurate because not all stars shine with the same brightness, but some special stars (Cepheid) appear to be more reliable. Distance also poses a problem when you try to estimate the exact age of the universe by assuming it started very small and calculating how long it would take to expand to its present size. Recent estimates place the age of the universe at around 13 billion years.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

The idea that the universe is expanding has profound implications. It means that as you go **backwards in time** the universe gets smaller and smaller, and eventually you get to the point where you wonder how it all got started. **This suggests that the universe has not always been here,** and that opens the door for wondering how it started and if some master mind like God, whose own origin is a mystery, had to start things; and if not, how did anything ever get started? We have no good answers about ultimate beginnings, but the idea of an expanding universe points to it having a beginning.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

At present the generally accepted view is that the universe had a beginning and this has led to interesting ideas from leading scholars. The dominant scenario now is the *Big Bang*. The idea is that originally all the matter of the universe was compressed in an extremely hot and extremely dense particle smaller than the nucleus of an atom. This particle expanded very rapidly in a Big Bang and eventually produced the universe as we know it. At first we have a singularity which is a period when the laws of physics do not apply. Then there was a brief and especially rapid period of expansion; parts of atoms formed, followed by whole atoms that eventually formed stars and galaxies expanding to our present universe.

Some researchers suggest that the universe may eventually reverse its expansion and collapse into a huge catastrophic universal *big crunch*, or it may continue to expand into an eventually *featureless void*. However the Bible indicates that the universe will be habitable forever.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

It needs to be kept in perspective that while there is impressive scientific evidence that supports the Big Bang, there is also persistent evidence against it and also against the idea that the universe is expanding. Some have spoken about light getting tired over distances, thus giving the impression of expansion. While the Big Bang is presently the dominant view, we should keep in mind that we are dealing with past events that are difficult to test and caution is warranted. There is much that we don't know.

3. IDEAS ABOUT THE ORIGIN OF THE UNIVERSE

God could have used a form of the Big Bang in creating the universe. It is sometimes pointed out that there are at least five passages in the Bible that speak of God **stretching out the heavens** (Job 9:8, Psalms 104:2, Isaiah 40:22, Jeremiah 10:12, Zechariah 12:1) and that is interpreted by some as suggesting that God expanded the universe in a Big Bang type of activity. However we cannot at all be certain about that.

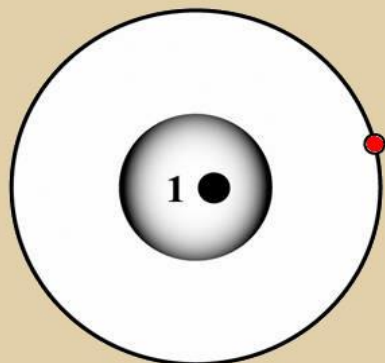
It is usually acknowledged that there is no plausible scenario for how the minute particle that is supposed to have started the Big Bang came to be. This leaves the model wide open for the **need for God's special action at that time**, and several cosmologists have pointed this out.

**4. WHAT IS THE
UNIVERSE MADE
OF?**

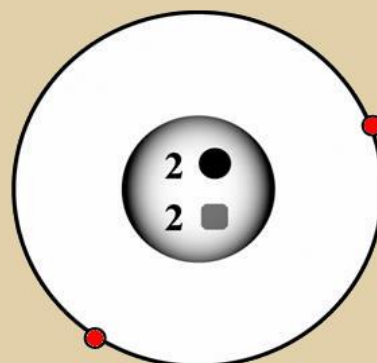
4. WHAT IS THE UNIVERSE MADE OF?

By studying the pattern of the color of light coming from the Sun, galaxies, etc., we have been able to determine that the universe is composed of the very same kind of tiny atoms that we find on Earth, but the proportions are very different. The Earth has an abundance of heavier elements like oxygen, silicon and aluminum which form 82 % of the Earth's crust, while 97 % of the universe appears to be made of the two lightest elements we know of, namely hydrogen and helium.

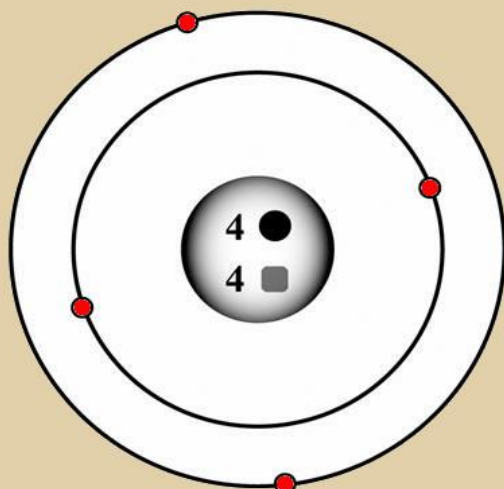
Atoms are extremely complicated, composed of dozens of different kinds of subatomic particles. A few simplified examples are illustrated below. Most of the mass of an atom is in the central nucleus, which is represented by the shaded spheres in the following frame.



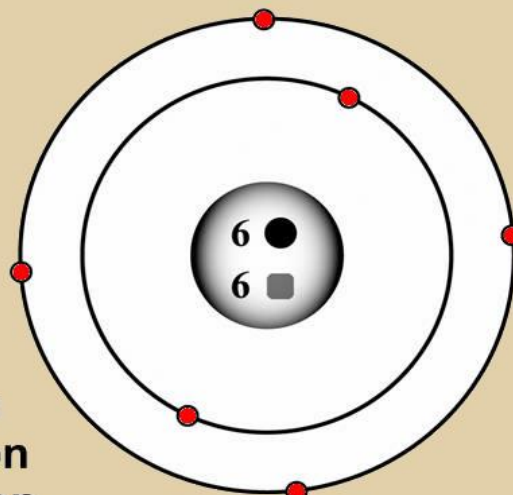
Hydrogen



Helium



Beryllium



Carbon

- Proton
- Neutron
- Electron

5. EXAMPLES OF FINE-TUNING

5. EXAMPLES OF FINE-TUNING

As we examine the universe from atoms to galaxies we discover a number of factors that just **happen to be exactly right** to permit a universe to exist and to be especially suitable for life to exist in it.

The question these factors raise is how did they all happen to be just right if there is no perceptive God who configured the universe? If they just happened by chance, as a few researchers suggest, we have to think of many cases of extremely precise good luck after many more others, etc.

We will examine a few of these factors. They very much address the question of whether or not there is a God.

5. EXAMPLES OF FINE-TUNING

a. WHY IS MATTER ORGANIZED?

Matter could just be a chaotic, disorganized blob of degenerate amorphous goo.

Instead, we find that matter is composed of highly organized **atoms** that are so versatile they can form anything from galaxies to fleas and you, and also provide light from the Sun as well as accommodate all kinds of chemical changes such as digesting food.

Atoms are composed of dozens of different kinds of **subatomic particles** that follow laws that permit the formation of over 100 different intricate elements.

5. EXAMPLES OF FINE-TUNING

a. WHY IS MATTER ORGANIZED?

Precision is important. For instance the relation of the mass (weight) of a proton to that of a neutron has to be very precise. If either varied by more than 1 part out of 1000, we would have no atoms, at least not the kinds that form the universe. There are several other similar relationships between subatomic particles.

5. EXAMPLES OF FINE-TUNING

a. WHY IS MATTER ORGANIZED?

Why do these particles happen to have such exact and useful properties? Could this all just happen by chance? It looks like a very perceptive designer would be necessary to provide such precision and such versatile atoms.

5. EXAMPLES OF FINE-TUNING

b. CARBON

The element carbon is the chemical backbone of living things, forming the basic structure of proteins, fats, carbohydrates and DNA. It is the most useful and suitable element for living things.

As we look at the various elements, we find that carbon has a privileged position. Its **resonance** very much favors its production from smaller atoms. The agreement of several factors, such as target mass and especially energy levels that favor formation and stability is called **resonance**.

5. EXAMPLES OF FINE-TUNING

b. CARBON

It is proposed that a carbon atom would originate by combining three helium atoms. It has been calculated that if the resonance level of carbon had been 4% lower, or if the resonance of oxygen, that would form from combining carbon and helium, had been 1% higher, it appears that there should be virtually no carbon. In the first case, little carbon would form, in the second case most of the carbon would be changed to oxygen. Carbon seems to have a special position in the scheme of the elements that facilitates its existence, stability, and ultimately the existence of life.

5. EXAMPLES OF FINE-TUNING

c. THE ORBIT OF THE EARTH

We take the Sun for granted, seldom appreciating its faithfulness in giving us warmth and light. The Sun produces its energy by combining hydrogen to form helium. This is the same kind of process that takes place when a hydrogen bomb explodes, and we can think of our Sun as a very well controlled hydrogen bomb explosion.

5. EXAMPLES OF FINE-TUNING

c. THE ORBIT OF THE EARTH

The orbit of the Earth seems to be in just the right place relative to the Sun so as to give the Earth the temperature and light that our carbon based life requires. If the earth were closer to or farther from the Sun we would very soon experience intolerable cold or heat. It has been estimated that if the Earth were only **5% closer or 1% farther** from the Sun, this would rid our planet of all life.

5. EXAMPLES OF FINE-TUNING

THE PRECISE FORCES OF PHYSICS

Recent advances in physics have revealed details about the four basic forces operating in our universe. Their strengths vary by a huge factor (10^{39}) from weakest (gravity) to strongest (strong nuclear force). It turns out that the basic strength constants of those forces have to be extremely precise in order for them to function, and they function in very specialized realms of operation.

5. EXAMPLES OF FINE-TUNING

d. STRONG NUCLEAR FORCE

The **strong nuclear force** binds parts of the nucleus of atoms; it has a short range action, operating only in the nucleus of atoms, and that is a good thing, otherwise it would scrunch everything together. If that force were **2% stronger**, we would have no hydrogen. If **5% weaker** we would have only hydrogen, and the universe would be very boring!

5. EXAMPLES OF FINE-TUNING

e. WEAK NUCLEAR FORCE

The **weak nuclear force** is thousands of times weaker than the strong force. It acts on certain particles in the nucleus of atoms and controls some forms of radioactive decay. If **slightly stronger**, helium would not form in the Sun, and that is the process that provides the sun's energy. If **slightly weaker** no hydrogen would be left in the Sun, and hydrogen is what is combined to form helium.

5. EXAMPLES OF FINE-TUNING

f. ELECTROMAGNETIC FORCE

The **electromagnetic force** guides electrons in orbit around the nucleus; it is involved in light and in chemical changes. It is a long range force. If it were **slightly stronger**, the Sun would be a cool red star, if **slightly weaker**, the Sun would be a hot blue star that would not last very long. Either way, we could not have life as we know it on Earth.

5. EXAMPLES OF FINE-TUNING

g. GRAVITY

Gravity is a weak, but very long range force. It is only $1/10^{39}$ as strong as the strong nuclear force, but it keeps galaxies together, water in the ocean basins, and our feet on the ground. It also keeps planets like the Earth together and in orbit.

5. EXAMPLES OF FINE-TUNING

A VERY PRECISE RELATIONSHIP

A hypothetical example may help you understand how exact this requirement is. Suppose you had a huge pile of wooden matchsticks, a very huge spherical pile, much larger than the entire volume of the Earth. In fact, the pile is not only a million times the volume of the Earth, it is more than a million times a million times the volume of the Earth. Such a pile is so large that it would barely fit between the Earth and the Sun. You may recall that it would take 19 years of continuous flight in a jetliner to travel from Earth to the Sun. Now only one of the matchsticks in the whole pile has a head on it, the rest are bare headless matchsticks, and you are very cold and you need that one matchstick with a head on it to start a fire. Your chance of picking the one matchstick with a head out of the pile, on the first try, without looking, is greater than one out of 10^{40} . There is a greater chance that you would pick the right matchstick than that gravity or the electromagnetic force would have the required value.

A BRIEF REVIEW OF PROBABILITY

PROBABILITY IS: The chance of an outcome occurring.

SOME FAMILIAR EXAMPLES:

- 1. TOSS A COIN:** 1 chance out of 2 to get “heads”
- 2. ROLL A DIE (DICE):** 1 chance out of 6 to get a “5”
- 3. PICKING ONE RED BEAN AMONG 99 BLACK ONES WITHOUT LOOKING:** 1 chance out of 100

A BRIEF REVIEW OF PROBABILITY

WHEN YOU COMBINE IMPROBABILITIES YOU HAVE TO MULTIPLY THE IMPROBABILITIES; WHEN YOU DO THIS, THINGS CAN BECOME VERY IMPROBABLE:

The chance of getting “5s” on 2 dice thrown at the same time is:

1 out of 36

For 3 dice it is 1 out of 216

For 4 dice it is 1 out of 1296

Combining improbabilities is how Roger Penrose (next slide) calculated the chance of the universe coming into existence all by itself.

5. EXAMPLES OF FINE-TUNING

COMBINING THE IMPROBABILITIES FOR THE FORMATION OF THE UNIVERSE

**THIS HAS BEEN CALCULATED AND IT GIVES AN
EXTREMELY IMPROBABLE FIGURE:**

**Oxford University physicist Roger Penrose in:
Penrose R. 1989. The Emperor's New Mind.
Oxford University Press, p 344, states:**

**“How big was the original phase-space volume... that the
Creator had to aim for in order to provide a universe compatible with
the second law of thermodynamics and with what we now observe? ...
The Creator's aim must have been: namely [precise] to an accuracy of
one part in $10^{10(123)}$.”**

**Without a creator, this is only one chance out of the number 1
followed by 10^{123} zeros that the universe would have the right
configuration. Each new zero multiplies the improbability ten times.
That is many times more zeros than there are atoms in the universe.**

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

Few deny the unusual nature of the fine-tuned universe data although some minimize it. The list of unusual features is much longer than the few examples given above. One cosmologist lists 74 of these and adds a number of other parameters necessary for life to exist.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

Does fine-tuning mean that there is a God who is the intelligent creator of the universe? Not necessarily, according to some authorities in the field, but their argumentation is patently unimpressive. The responses to the fine-tuning data have been varied, fascinating and instructive. We shall discuss the main ones under three subheadings.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

a. THE ANTHROPIC COSMOLOGICAL PRINCIPLE.

This is an ill defined concept that has several versions. It can be generalized as: *Any intelligent beings can find themselves only where intelligent life is possible.* This is a self evident statement that only indirectly addresses the question of why the universe is fine-tuned. The principle tries to emphasize our special privileged position as observers of the universe.

It needs to be kept in mind that our unusual observer privilege can just as well mean that the universe was designed by God, but that is not at all the usual interpretation of the anthropic cosmological principle.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

a. THE ANTHROPIC COSMOLOGICAL PRINCIPLE.

Sometimes the anthropic cosmological principle is elaborated on by pointing out that if the universe were not fine tuned we would not be here! This kind of answer is what is called a *non-sequitur*; the answer does not apply to the question of why the universe is fine-tuned. It is similar to being out in a desert and asking where the water in an oasis comes from and being told that if it were not there trees would not grow there. The anthropic principle does not give a direct answer as to why the universe is so fine-tuned. It distracts from the real question.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

b. THE MANY UNIVERSES EXPLANATION

Could there be other universes that we don't know about? Could there be different kinds of universes, and many of these (the “**multiverse**” concept)? This is possible, and by using the powerful force of numbers we could suggest that there are an almost infinite number of universes, and ours just happens by chance to have all the right characteristics for life to exist.

This idea has been given serious consideration by a number of scholars as an answer to the fine-tuned universe that we find ourselves in. We just happen to be in the right universe among many universes.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

b. THE MANY UNIVERSES EXPLANATION

However, this kind of logic tends to be unimpressive because it lacks any validation. **You can explain almost anything you want to by this kind of argumentation**, hence it is essentially a useless argument. This is not careful critical thinking. No matter what you happen to find, you just say that it just happened that way in one of billions and billions of universes.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

b. THE MANY UNIVERSES EXPLANATION

The real problem is where are all those other universes? Where is any scientific evidence that any exist? There seems to be none whatsoever. Postulating many universes is rampant speculation, not careful reasoning based on known facts. This is a desperate argument to try and explain fine-tuning.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

c. THE FINE-TUNED UNIVERSE INDICATES DESIGN BY GOD

The large number of examples of fine tuning and the incredible precision required for many of them make it extremely difficult to think that all of this is a case of just good luck after more and more good luck.

Furthermore the values for fine tuning are often intimately interrelated. The whole universe seems to be balanced on a knife edge. A very slight change in any of most of the fine-tuned factors, and the universe **instantly falls apart.**

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

c. THE FINE-TUNED UNIVERSE INDICATES DESIGN BY GOD

Also it needs to be kept in mind, as we illustrated with the dice example, that the correct mathematical answer in combining several improbabilities is obtained by **multiplying these values**. This makes the total probability for a fine-tuned universe very much smaller than any one of the separate improbabilities by themselves. The mathematics and science make it very much look like **there is a very perceptive creator God behind all this**.

6. RESPONSES TO THE FINE-TUNED UNIVERSE DATA

c. THE FINE-TUNED UNIVERSE INDICATES DESIGN BY GOD

This raises the specter of religion, and some scientists are uncomfortable mixing science and religion regardless of rather overwhelming evidence in favor of a Creator. However, if we are hoping to find truth, we may need to overlook the anti-religious prejudices of the scientific community, **approach data with an open mind**, and follow the evidence wherever it leads.

**7. CONCLUSIONS
FOR THE
FINE-TUNED
UNIVERSE**

7. CONCLUSIONS

From minute atoms to galaxies we see evidence of many factors that are exactly what they need to be to make a universe that can exist and sustain life.

Some have tried to attribute these factors to a *non-sequitur* type of anthropic principle, others to a multiplicity of imaginary universes. These suggestions are only distractions from the rather **overwhelming scientific data indicating that some very perceptive God must have fine-tuned the complexity of matter, including the exact structure of atoms and the precise forces of physics, so the universe would be suitable for life.** Any such God would surpass the universe He created.

8. REVIEW QUESTIONS

(Answers given later below)

8. REVIEW QUESTIONS – 1

(Answers given later below)

- 1. What is the significance of a fine-tuned universe for the conflict between secular science and the Bible? What would be the significance of a universe that was not fine-tuned?**
- 2. Explain what is meant by the statement in Romans 1:20: “are clearly seen, being understood by the things that are made,” with reference to the conflict between a secular scientific interpretation of origins and the biblical creation concept.**
- 3. What major conclusion about the history of the universe have scientists drawn from the evidence of an expanding universe?**
- 4. How precise does the mass of a proton or neutron have to be? What would be the consequences if that were not the case?**

REVIEW QUESTIONS – 2

- 5. Resonance is a combination of factors such as the right energy and target mass that favors the formation of some elements from smaller ones. What would probably be the consequence if the resonance of carbon were not so favorable, and why is carbon so important?**
- 6. It is estimated that the orbit of the Earth should not be more than 5% closer or 1% farther from the sun. What are the consequences of changing Earth's orbit beyond these limits?**
- 7. The four forces of physics are: the strong nuclear force, the weak nuclear force, the electromagnetic force, and the gravitation force. Give the main realm of action of each. How varied are the strengths of the forces (strength constants)? How precise does gravity have to be as it relates to the electromagnetic force?**
- 8. What is the anthropic cosmological principle? Why is it not an explanation for the fine-tuned universe?**

REVIEW QUESTIONS – 3

9. Why is the concept of many universes (multiverse) not a satisfactory answer to the question of why the universe is so fine-tuned?
10. What do all the special exact parts of atoms, our benevolent sun, and the realm of action and precision of the forces of physics, indicate about the origin of the universe?

REVIEW QUESTIONS AND ANSWERS – 1

1. What is the significance of a fine-tuned universe for the conflict between secular science and the Bible? What would be the significance of a universe that was not fine-tuned?

The fine-tuned universe raises the question of how did it get precisely fine-tuned in so many aspects. That suggests a tuner who would be God. If the universe were not fine-tuned, that suggests a random chaotic origin and not necessarily an intelligent designer.

2. Explain what is meant by the statement in Romans 1:20: “are clearly seen, being understood by the things that are made,” with reference to the conflict between a secular scientific interpretation of origins and the biblical creation concept.

Here the apostle Paul is clearly stating that the things that are made leave no excuse for not believing in God. Nature clearly points to God, and fine-tuning is part of that evidence.

REVIEW QUESTIONS AND ANSWERS - 2

3. What major conclusion regarding beginnings have many scientists drawn from the evidence of an expanding universe?

In the past the universe was smaller, and before that it was smaller yet, etc. Eventually you come to the point where the universe had a beginning, and thus it has not always been here. It must have had a start, and that raises the question of how it started. Many scientist believe that the universe started with an explosive “Big Bang,” and expanded from there. But what was before that to start things? Science has not provided any good answers. It seems reasonable to think God did it.

4. How precise does the mass of a proton or neutron have to be with reference to each other? What would be the consequences if that were not the case?

They have to be precise to at least one part out of a thousand. If not, we would not have any atoms.

REVIEW QUESTIONS AND ANSWERS - 3

5. Resonance is a combination of factors such as the right energy and target mass that favors the formation of some elements from smaller ones. What would probably be the consequence if the resonance of carbon were not so favorable, and why is carbon so important?

There would be very little or no carbon in the universe. Carbon is the element that forms the “backbone” of the many organic molecules of living things. Without it, very likely there would be no life.

6. It is estimated that the orbit of the Earth should not be more than 5% closer or 1% farther from the sun. What are the consequences of changing Earth's orbit beyond these limits?

If closer or farther from the sun, intolerable heat or cold, respectively, would result, and this would rid the Earth of all life.

REVIEW QUESTIONS AND ANSWERS - 4

7. The four forces of physics are: the strong nuclear force, the weak nuclear force, the electromagnetic force, and the gravitation force. Give the main realm of action of each. How varied are the strengths of the forces (strength constants)? How precise does gravity have to be as it relates to the electromagnetic force?

Strong nuclear force binds nuclei of atoms. Weak nuclear force deals with radioactive decay in the nuclei of atoms. Electromagnetic force deals with widespread light and chemical changes. Gravity binds planets, solar systems and galaxies. The four forces vary by a factor of 10^{39} from weakest to strongest. It appears that the strength of gravity has to relate to that of the electromagnetic force with a precision within 1 part out of 10^{40} .

8. What is the anthropic cosmological principle? Why is it not an explanation for the fine-tuned universe?

Intelligent beings can find themselves only where intelligent life is possible. The principle does not address the question of why the universe is so fine-tuned.

REVIEW QUESTIONS AND ANSWERS - 5

9. Why is the concept of many universes (multiverse) not a satisfactory answer to the question of why the universe is so fine-tuned?

Because you can explain almost anything you want with this kind of loose “reasoning.” No matter what is proposed, one just says this just happens to be a universe where that happened. Within this kind of “thinking” there is no way to test if the idea is true or false. This is essentially pure imagination. Besides that, where are all those extra universes? The evidence for them is essentially nonexistent.

10. What do all the special exact parts of atoms, our benevolent sun, and the realm of action and precision of the forces of physics, indicate about the origin of the universe?

It very much looks like a very intelligent and perceptive God had to design all these exact features so that the universe could exist and provide for our existence in it.

ADDITIONAL REFERENCES

For further discussions by the author (Ariel A. Roth) and many additional references, see the author's books titled:

1. **ORIGINS: LINKING SCIENCE AND SCRIPTURE.** Hagerstown, MD. Review and Herald Publishing Association.
2. **SCIENCE DISCOVERS GOD: Seven Convincing Lines of Evidence for His Existence.** Hagerstown, MD. Autumn House Publishing, an imprint of Review and Herald Publishing Association.

Additional information is available on the author's Web Page: Sciences and Scriptures. www.sciencesandscriptures.com. Also see many articles published by the author and others in the journal **ORIGINS** which the author edited for 23 years. For access see the Web Page of the Geoscience Research Institute www.grisda.org.

Highly Recommended URLs are:

Earth History Research Center <http://origins.swau.edu>

Theological Crossroads www.theox.org

Sean Pitman www.detectingdesign.com

Scientific Theology www.scientifictheology.com

Geoscience Research Institute www.grisda.org

Sciences and Scriptures www.sciencesandscriptures.com

Other Web Pages providing a variety of related answers are: Creation-Evolution Headlines, Creation Ministries International, Institute for Creation Research, and Answers in Genesis.

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