A Fine-Tuned Universe and Earth as Part of The Evidence for a Creator

By Raymond C. Faircloth

Most scientists now recognize that life can only exist when certain universal **fundamental physical constants** lie within a very narrow range. This means that if any one of these constants were only slightly different matter, elemental diversity, astronomical features, or life would not exist. Physicist Paul Davies stated that:

> There is now broad agreement among physicists and cosmologists that the universe is in several respects 'fine-tuned' for life

Stephen Hawking noted,

> The laws of science, as we know them at present, contain many fundamental numbers, like the size of the electric charge of the electron and the ratio of the masses of the proton and the electron. ... The remarkable fact is that the values of these numbers **seem to have been very finely adjusted** to make possible the development of life. *A Brief History of Time* p. 125.

THE ANTHROPIC PRINCIPLE

The anthropic principle states **that the conditions that are observed in the universe must allow the observer to exist** and so ***fundamental physical constants*** are actually a necessity because living observers on Earth could not exist so as to observe the universe if these laws and constants were not in effect. This principle is recognized because of its history of scientific observations, trials and errors, and inventions of necessary instrumentation. The anthropic principle is an answer to **the Copernican Principle** advocated by Carl Sagan and Frank Drake, which states that humans do not occupy a privileged position in the Universe.

The Constants for a Sustainable Universe

The deep-space structure the ***Eta Carinae Nebula*** could not form in a universe with significantly different physical constants.

The chances of all of the following factors occurring at the same time are 1/1,000,000,000,000,000. So planets that are capable of sustaining complex life must be extremely rare. In Chapter Fourteen of his book *The Creator and the Cosmos* titled *"Just Right" Universe* Hugh Ross tables 26 factors which must remain constant:

1. **Strong nuclear force** constant:
   If larger: no hydrogen; nuclei essential for life would be unstable.
   If smaller: no elements other than hydrogen.

2. **Weak nuclear force** constant:
   If larger: too much hydrogen converted to helium in big bang, hence too much heavy element material made by star burning; no expulsion of heavy elements from stars.
   If smaller: too little helium produced from big bang, hence too little heavy element material made by star burning; no expulsion of heavy elements from stars.

3. **Gravitational force** constant:
   If larger: stars would be too hot and would burn up too quickly and too unevenly.
   If smaller: stars would remain so cool that nuclear fusion would never ignite, hence no heavy element production.

4. **Electromagnetic force** constant:
   If larger: insufficient chemical bonding; elements more massive than boron would be too unstable for fission.
   If smaller: insufficient chemical bonding.

5. Ratio **of electromagnetic force** constant to **gravitational force** constant:

   If larger: no stars less than 1.4 solar masses hence short stellar life spans and uneven stellar luminosities.
   If smaller: no stars more than 0.8 solar masses, hence no heavy element production.

6. Ratio of **electron** to **proton** ***mass***
If larger: insufficient chemical bonding.
If smaller: insufficient chemical bonding.

7. Ratio of ***numbers*** **of protons to electrons**
If larger: electromagnetism would dominate gravity, preventing galaxy, star, and planet formation.
If smaller: electromagnetism would dominate gravity, preventing galaxy, star, and planet formation.

8. **Expansion rate of the universe**
If larger: no galaxy formation.
If smaller: universe would collapse prior to star formation.

9. **Entropy level of the universe**
If smaller: no proto-galaxy formation.
If larger: no star condensation within the proto-galaxies.

10. **Mass density of the universe**
If larger: too much deuterium from big bang hence stars burn too rapidly.
If smaller: insufficient helium from big bang, hence too few heavy elements forming.

11. **Velocity of light**
If faster: stars would be too luminous.
If slower: stars would not be luminous enough.

12. **Age of the universe**
If older: no solar-type stars in a stable burning phase in the right part of the galaxy.
If younger: solar-type stars in a stable burning phase would not yet have formed.

13. **Initial uniformity of radiation**
If smoother: stars, star clusters, and galaxies would not have formed.
If coarser: universe by now would be mostly black holes and empty space.

14. **Fine structure** constant (a number used to describe the fine structure splitting of spectral lines):
If larger: DNA would be unable to function; no stars more than 0.7 solar masses.
If smaller: DNA would be unable to function; no stars less than 1.8 solar masses.

15. **Average distance between galaxies**
if larger: insufficient gas would be infused into our galaxy to sustain star formation over an adequate time span.
if smaller: the sun[1]s orbit would be too radically disturbed.

16. **Average distance between stars**
if larger: heavy element density too thin for rocky planets to form.
if smaller: planetary orbits would become destabilized.

17. **Decay rate of the proton**
if greater: life would be exterminated by the release of radiation.
if smaller: insufficient matter in the universe for life.

18. **12 Carbon (12C) to 16Oxygen (16O) energy level ratio**
if larger: insufficient oxygen.
if smaller: insufficient carbon.

19. **Ground state energy level for 4Helium** (4He)
if larger: insufficient carbon and oxygen.
if smaller: insufficient carbon and oxygen.

20. **Decay rate of 8 Beryllium** (8Be)
if slower: heavy element fusion would generate catastrophic explosions in all the stars.
if faster: no element production beyond beryllium and, hence, no life chemistry possible.

21. **mass excess of the neutron over the proton**
    if greater: neutron decay would leave too few neutrons to form the heavy elements essential for life.
    if smaller: proton decay would cause all stars to collapse rapidly into neutron stars or black holes.

22. **initial excess of nucleons over anti-nucleons**
    if greater: too much radiation for planets to form.
    if smaller: not enough matter for galaxies or stars to form.

23. **polarity of the water molecule**
    if greater: heat of fusion and vaporization would be too great for life to exist.
    if smaller: heat of fusion and vaporization would be too small for life's existence; liquid water would become too inferior a solvent for life chemistry to proceed; ice would not float, leading to a runaway freeze-up.

24. **supernovae eruptions**
    if too close: radiation would exterminate life on the planet.
    if too far: not enough heavy element ashes for the formation of rocky planets.
    if too frequent: life on the planet would be exterminated.
    if too infrequent: not enough heavy element ashes for the formation of rocky planets.
    if too late: life on the planet would be exterminated by radiation.
    if too soon: not enough heavy element ashes for the formation of rocky planets.

25. **white dwarf binaries**
    if too few: insufficient fluorine produced for life chemistry to proceed.
    if too many: disruption of planetary orbits from stellar density; life on the planet would be exterminated.
    if too soon: not enough heavy elements made for efficient fluorine production.
    if too late: fluorine made too late for incorporation in proto-planet.

26. **ratio of exotic to ordinary matter**
    if smaller: galaxies would not form.
    if larger: universe would collapse before solar type stars could form.

If, for example, we expand on Ross' statement concerning the **strong nuclear force** so that it were 2% stronger than it actually is, while the other constants were left unchanged, **diprotons** would be stable and **hydrogen** would fuse into them instead of **deuterium** and **helium**. This would ***drastically alter the physics of stars***, so that life as we know it would not exist.

Our Solar System Is In the Galactic Habitable Zone

The location of a planetary system within a galaxy must also be favourable to the sustaining of life. This is called the galactic habitable zone where a sufficiently high level of heavy elements exist to favour the formation of rocky, or terrestrial, planets, which are needed to support life. Also these heavier elements in general become increasingly necessary for complex life on Earth. In contrast, the planetary system must be far enough from the galactic centre so that it would not be affected by dangerous high-frequency radiation, which would cause harmful alterations to the DNA of any carbon-based life.

Earth Is the only Planet in the Circumstellar Habitable Zone for Our Solar System

Within a planetary system, a planet must lie within the habitable zone in order to sustain life. The circumstellar habitable zone is a band of space surrounding stars where the **surface temperatures** of any planets present might maintain liquid water which is vital for carbon-based life because of its role as the solvent needed for biochemical reactions. Either side of this habitable zone and the water would either boil away or totally freeze.

Other Factors about Earth's Position

ORBITS A MAIN SEQUENCE G2 DWARF STAR

This is the only kind of star that would allow for complex life. Such stars are not common: G type stars such as the Sun comprise only 9% of the hydrogen-burning stars in the Milky Way. Yet life can only exist where there is complex chemistry, and such chemistry requires metals. The only known mechanism for creating and dispersing metals is a supernova explosion. Yet many, perhaps most, stars are poor in metals, other than stars in the larger spiral galaxies and only then in the quiet suburbs of the larger spiral galaxies. Such is the position of our sun.

EARTH IS PROTECTED BY THE GAS GIANT - JUPITER

Today, millions of **asteroids** circle the Sun in relatively stable orbits between Mars and Jupiter. Furthermore, **Comets** are found in two regions:

- Significantly past the orbit of Neptune, in an region known as the **Kuiper belt**
- On the very edge of the solar system as part of the **Oort cloud**

Because the mass of Jupiter is more than twice the mass of all the other planets of the solar system combined and so has an immense and powerful gravitational field which acts as a shield for Earth, protecting it from being overly bombarded by straying asteroids and comets.

HAS A NEARLY CIRCULAR ORBIT

This keeps earth within the habitable zone and s0 does not allow for extremes of temperature as are found in much of the solar system.

Unique Factors about Earth

1. *HAS AN OXYGEN RICH ATMOSPHERE*

   78% Nitrogen
   21% Oxygen
   1% Carbon dioxide

2. *EARTH'S MASS*

   If this was less, as with Mars, the earth would lose its atmosphere. If greater the earth would begin to resemble a gas giant and no life would survive.

3. *LARGE IRON CORE*

   This gives the optimum magnetic field. Such a field is required to protect life on earth from the solar winds.

4. *PLATE TECTONICS*

   In the solar system this phenomenon is now found **only on Earth** so that it is a living planet. Plate tectonics may be the most important of the unique features of Earth because the movement of the plates:

   - Recycles the carbon dioxide and so **acts as the planet's thermostat**. This and the other greenhouse gases of: water vapour, ozone, and methane are keys to the presence of fresh water on the planet. Without these **Earth's water would evaporate.**
   - Causes changes in sea level through mountain building. This is vital to the formation of minerals that keep the level of global **carbon dioxide balanced** for life.
   - Built the **continents**, without which Earth would be a water-world with only primitive sea life.
   - Makes it possible for earth to have its protective **magnetic field**.
   - Promotes high levels of **biodiversity**. As the continents have expanded the number and degree of separation of habitats has increased so as to cause geographic isolation and therefore greater variety within species.

The Large Moon Gives Unique Effects for the Earth

STABILIZER

A large moon stabilizes the rotation axis of Earth at 23.5 degrees. This varies only from 22.1 to 24.5 for seasonal fluctuations. If the moon were smaller these fluctuations would be dramatic—up to 30 degrees and so producing extreme seasons that would kill the population. If these fluctuations were smaller the mild seasons would prevent the essential wide distribution of rainfall.

TIDES

Without a moon of its size, the tides on earth would be so small as to fail to produce weather patterns that give equitable rainfall.

Earth-Moon-Sun Relationship

The sun is 400 times bigger than the moon, but it is 400 times farther away from earth than the moon is. Combined with the fact that the sun and the moon are the roundest objects in our solar system, these factors provide for occasions of perfect total eclipses so that, at that moment, the chromosphere of the sun can be studied by scientists. This is vital for ascertaining the construction of stars.

SUGGESTED READING FOR THE SCIENTIFICALLY MINDED

Rare Earth: Why Complex Life is Uncommon in the Universe by P. D. Ward and D. Brownlee.

A Fine-Tuned Universe: The Quest for God in Science and Theology by Alister McGrath.

Argument from the fine-tuning of the universe by Richard Swinburne.

The Anthropic Cosmological Principle by cosmologist John D. Barrow and mathematical physicist Frank J. Tipler.

The Privileged Planet: How Our Place In The Cosmos is Designed For Discovery by Guillermo Gonzalez and Jay W. Richards

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