FINE-TUNING OF THE UNIVERSE (PART 3 OF 8): FOUR EXAMPLES OF FINE-TUNING

Rating: 5.0

Description: Four examples[1] of fine-tuning are discussed: fine-tuning that allows life on planet earth, carbon resonance, the strong nuclear force, and the ratio of the strong nuclear force to electromagnetic force.

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1. Fine-Tuning to Allow a Habitable Planet

When we think of the specific conditions that are needed nearer home in our solar system and on earth, we find that there are a host of parameters that must be just right in order for life to be possible. A number of factors must be fine-tuned in order to have a planet that supports life:

·It must be a single star solar system, in order to support stable planetary orbits.

·The sun must have the right mass. If it was larger, its brightness would change too quickly and there would be too much high energy radiation. If it was smaller, the range of planetary distances able to support life would be too narrow; the right distance would be so close to the star that tidal forces would disrupt the planet's rotational period. Ultraviolet radiation would also be inadequate for photosynthesis.

·The distance from the earth to the sun must be just right. Too near and water would evaporate, too far and the earth would be too cold for life. A change of only 2% and all life would cease.

·Earth must have sufficient mass in order to retain an atmosphere.

·Surface gravity and temperature are also critical to within a few percent for the earth to have a life-sustaining atmosphere – retaining the right mix of gases necessary for life.

·Earth must rotate at the right speed: too slow and temperature differences between day and night would be too extreme, too fast and wind speeds would be disastrous.

- The earth’s gravity, axial tilt, rotation period, magnetic field, crust thickness, oxygen/nitrogen ratio, carbon dioxide, water vapor and ozone levels have to be just right.

Astrophysicist Hugh Ross[2] lists many such parameters that have to be fine-tuned for life to be possible, and makes a rough but conservative calculation that the chance of one such planet existing in the universe is about 1 in 10^{30}.

2. Fine-Tuning of Carbon ‘Resonance’

Life requires plenty of carbon that makes complex molecules. Carbon is formed either by combining three helium nuclei or by combining nuclei of helium and beryllium. Carbon is like the hub wheel in a tinker toy set: you can bind other elements together to more complicated molecules (carbon-based life), but the bonds are not so tight that they can’t be broken down again to make something else.

Eminent mathematician and astronomer Fred Hoyle, found that for this to happen, the nuclear ground state energy levels have to be fine-tuned with respect to each other. This phenomenon is called ‘resonance.’

The carbon resonance level is determined by two constants: the ‘strong force’ and ‘electromagnetic force’. If you mess with these forces even slightly, you either lose the carbon or the oxygen. If the variation were more than 1% either way, the universe could not sustain life.

Hoyle later confessed that nothing had shaken his atheism as much as this discovery.[3]

3. Fine-Tuning of the Strong Nuclear Force

The "strong force" is the force that binds protons and neutrons together in nucleus. If the strong force constant were 2% stronger, there would be no stable hydrogen, no long-lived stars, no hydrogen containing compounds. This is because the single proton in hydrogen would want to stick to something else so badly that there would be no hydrogen left!

If the strong force constant were 5% weaker, there would be no stable stars and few elements besides hydrogen. This is because you would not be able to build up the nuclei of the heavier elements, which contain more than 1 proton.

So, whether you adjust the strong force up or down, you lose stars that serve as source of energy or you lose complex chemistry which is necessary for life.

4. Ratio of Strong Nuclear Force to Electromagnetic Force

If the ratio of the strong nuclear force to the electromagnetic force had been different by 1 part in 10^{16}, no stars could have been formed. Increase it by only 1 part in 10^{40} and only small stars can exist, decrease it by the same amount and there will only be large stars. You must have both large and small stars in the universe. The large ones produce elements in their thermonuclear furnaces and it is only the small ones that burn long enough to sustain a planet with life.[4]

To put 10^{40} in perspective, having a precision of one part in 10^{30} (a much smaller number) is like firing a bullet and hitting an amoeba at the edge of the observable universe!

Arno Penzias, an American physicist and Nobel laureate who co-discovered the cosmic microwave background radiation which helped establish the Big Bang, sums up what he sees,

'Astronomy leads us to a unique event, a universe which was created out of nothing, one with the very delicate balance needed to provide exactly the right conditions required to permit life, and one which has an underlying (one might say 'supernatural') plan.'[5]

Footnotes:

1. Ross, Hugh. 2001. *The Creator and The Cosmos*. Colorado Springs, Co: NavPress. 145-157.
2. Bradley, Dr. Walter. Is There Scientific Evidence for the Existence of God? How the Recent Discoveries Support a Designed Universe. On-line. Available from Internet, http://www.leaderu.com/real/ri9403/evidence.html, accessed 10 March 2014
3. Spitzer, Robert. 2010. New Proofs for the Existence of God: Contributions of Contemporary Physics and Philosoph Grand Rapids/Cambridge: Wm.B. Eerdmans Publishing Co. 50-56.

[2] Davies, Paul. 1988. *The Cosmic Blueprint*. New York: Simon and Schuster. 138-139.

[3] Gingerich, Owen. 2000. "Do The Heavens Declare?" in *The Book of the Cosmos*, ed. Danielson, Richard Dennis. Cambridge, MA: Perseus Publishing. 524-525.

[4] Davies, Paul. 1983. *God and the New Physics*. London: J. M. Dent and Sons.

[5] Margenau and Varghese eds. 1992. *Cosmos, Bios, and Theos*. La Salle, IL: Open Court. 83.