FINE-TUNING OF THE UNIVERSE (PART 4 OF 8): EXTREME EXAMPLES OF FINE-TUNING

Rating: 5.0

Description: Three extreme examples of fine-tuning are given along with illustrations of just how big the numbers are and how fine-tuned our universe is.

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First, physicists identify four fundamental forces of nature. In terms of increasing strength, they are gravity (G_0), weak force (10^{31} G_0), electromagnetic force (10^{37} G_0), and the strong nuclear force ($10^{40}G_0$).

Second, since *extreme* examples of fine-tuning deal with extraordinarily large numbers, we need to have an idea of just how big they are. It will give us some perspective of how delicate fine-tuning is:

·average number of cells in a human body is 10^{13} (i.e. 10 trillion)

·age of the universe is roughly 10^{17}s

·number of sub-atomic particles in the known universe is estimated to be 10^{80}

Keeping these numbers in mind, consider the following three examples of fine-tuning:

1. Weak Nuclear Force

One of them, the 'weak nuclear force' which works inside the nucleus of an atom is so sensitive (finely-tuned) that even an alteration of one part in 10^{100} would prevent life in the universe![1]

2. Cosmological Constant

The cosmological constant is a term in Einstein's theory of gravity that has to do with acceleration of the universe's expansion. It is described as self-stretching property of space (or more accurately space-time).[2] Unless it is within an extremely narrow range around zero, the universe will either collapse or it will expand too rapidly for galaxies and stars to form. The constant is fine-tuned to an unimaginably precise degree. If it were changed by as little as one part in 10^{120}, the universe would have no life![3]

3. Penrose Number: The *Most* Extreme Example of Fine-Tuning

That is not it. According to standard cosmology model, the accepted model of the universe today, if you were to go back some 14 billion years, you can think of the universe as condensed to less than the size of a golf ball. The initial state of the space-time, and thus gravity, of the early universe had very low entropy[4]. This low entropy is required for a habitable universe in which high-entropy structures like stars are formed. The ‘mass-energy’ of the initial universe had to be precise to get galaxies, planets, and for us to exist. The most extreme example of fine-tuning has to do with the distribution of mass-energy at that time.

Just how precise?

Roger Penrose of Oxford University, and one of Britain’s leading theoretical physicists and cosmologists, has calculated that the odds of a low-entropy state to exist by chance alone are one out of $10^{10^{123}}$ - the Penrose number. He wrote in his book, ‘The Road to Reality,’ "Creation of the universe, a fanciful description! The Creator’s pin has to find a tiny box, just 1 part in $10^{10^{123}}$ of the entire phase-space volume, in order to create a universe with as special a Big Bang as that we actually find."[5]

In his other book, ‘The Emperor’s New Mind,’ he observed, "In order to produce a universe resembling the one in which we live, the Creator would have to aim for an absurdly tiny volume of the phase space of possible universes – about $1/10^{10^{123}}$ of the entire volume, for the situation under consideration."[6]

Let us try to get an idea of what type of a number are we talking about?

You don’t have enough particles in the universe (that we know of) to write down all the zeroes! It is like a ten raised to an exponent of:

10000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000.

This number is so large, that if every zero were 10 point type, it will fill up a large portion of our universe![7]

That is why we will explain it with four illustrations.

First, balancing a billion pencils all simultaneously positioned upright on their sharpened points on a smooth glass surface with no vertical supports does not even come close to describing an accuracy of one part in 10^{60}.[8]

Second, this is much more precision than would be required to toss a dart and hit a penny across the universe![9]

A third illustration suggested by astrophysicist Hugh Ross[10] may help. Cover America with coins in a column reaching to the moon (380,000 km or 236,000 miles away), then do the same for a billion other continents of the same size. Paint one coin red and put it somewhere in one billion of the piles. Blindfold a friend and ask her to pick the coin. The odds of her picking it are 1 in 10^{37}.

All these numbers are extremely small when compared to the precise fine-tuning of the Penrose number, the *most extreme* example of fine-tuning that we know of.

In summary, the fine-tuning of many constants of physics must fall into an exceedingly narrow range of values for life to exist. If they had slightly different values, no complex material systems could exist. This is a widely recognized fact.

Footnotes:

[1] Davies, Paul. 1980. *Other Worlds*. London: Dent. 160-61, 168-69.

[2] Ross, Hugh. 2001. *The Creator and The Cosmos*. Colorado Springs, Co: NavPress. 46.

[3] Krauss, Lawrence. 1998. *The Astrophysical Journal*. 501: 465

[4] Entropy is a measure of disorder.

[5] Penrose, Roger. 2004. The Road to Reality: A Complete Guide to the Laws of the Universe. London: Jonathan Cape 730.

[6] Penrose, Roger. 1991. *The Emperor's New Mind: Concerning Computers, Minds, and the Laws of Physics*. New York Penguin Books. 343.

[7] Spitzer, Robert. 2010. *New Proofs for the Existence of God: Contributions of Contemporary Physics and Philosophy*. Grand Rapids/Cambridge: Wm.B. Eerdmans Publishing Co. 59.

[8] Ross, Hugh. 2001. *The Creator and The Cosmos*. Colorado Springs, Co: NavPress. 151.

[9] Lecture at Pepperdine University titled '*Is [it] True?*' hosted by the Veritas Forum on Feb 18, 2013.

[10] Ross, Hugh. 2001. *The Creator and The Cosmos*. Colorado Springs, Co: NavPress. 150.

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