A HYPOTHESIS OF THE UNIVERSE'S ORIGIN THAT CAN BE FALSIFIED BY THE DISCOVERY OF ALIEN LIFE

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Abstract

Perhaps the most important scientific debate is the one over whether or not we are alone in the universe. For hundreds of years, the question of alien life has been argued over because of its significance in our place in the universe as a species, but, unfortunately, there is virtually no way of determining the answer to this question without going out and searching every corner of the universe for aliens. In this paper, a cosmological hypothesis is proposed which is incompatible with alien life and is, therefore, either valuable for offering an answer to whether evolved aliens exist, or valuable for being falsifiable in the case that evolved alien life is discovered.

This hypothesis supposes two premises: that there is a bubble multiverse and that quanta of mass have a multiversal probability of existing at the moment of each universe's big bang.

1. Set up for the intuitive hypothesis

1.1

Assume there are infinite bubble universes, and that the probability of each unit of mass forming in a big bang is a constant independent value in all universes. These two semi-intuitive assumptions create a hypothesis of the origin of the universe that is falsifiable by directly contradicting the existence of evolved extraterrestrial life, therefore, if evolved beings from another planet are contacted, the two assumptions upon which this hypothesis is based can't coexist. That is to say, once contact with evolved life is made, it is guaranteed that at least one of the assumptions under which this hypothesis operates is false.

Assume the probability of each universe at its formation (P_Ω) is a value determined by an exponential function represented by the equation

$$(1)\ P^{\Omega} = P_{\Omega}$$

and when finding the probability of one universe relative to another,

$$(2)\ P^{\Omega r} = P_{\Omega r}\ ,$$

with P being the individual probability of a given unit of mass exploding into existence, Ω being the mass of a universe in units corresponding with P, and r being the ratio of the universe's mass and the mass of Ω. Considering that r is the exponent of equation 2, universes with greater masses become exponentially less likely. If Ω is the mass of a single electron, and that mass has a P value of 0.5, for example, then a universe with our mass is twice as likely to form as a universe with our mass plus a single electron. If a universe has a mass equivalent to 10^{15} mass units, it has a P^(10^{15}) probability of forming. If the value of P for a given mass unit is 0.9, that is, a single mass unit has a 90% chance of existing at a universe's big bang, then the probability of a randomly selected universe out of the infinite multiverse having that mass is:

$$(3)\ 7.4918669 \times 10^{-45{,}757{,}490{,}560{,}676}\ .$$

There is nothing, on neither the atomic nor the cosmic scale, that can be used to put into perspective how astronomically tiny that value is. Approximately 1 in every *1.3347808 × 10^45,757,490,560,675* randomly selected universes will have the mass 10^{15} units when P is equal to 0.9.

Using this logic, smaller universes are many times more likely to form than larger ones (though all possible Ω values will exist in an infinite multiverse, no matter how large, because the probability is a function of Ω), because for every universe with a mass of 2 units, there are $1/P$ with a mass of 1. If P in this example is $1/10^9$, there will be 1,000,000,000 universes with a mass of 1 unit for every single universe with a mass of 2 units. This means that any universe with a specific trait is almost certainly the minimum size a universe can be while still containing that trait. The value P is not tied to any known physics, however, so this value is entirely speculative. However, if we assume that such a value does exist, and that there is a bubble multiverse, then this hypothesis is sensical.

1.2

With the assumptions made the probability of every universe in the multiverse can be calculated as a value equal to the probability of a specific unit of mass existing raised to the power of the mass of the universe in mass units of Ω.

If the probability of every universe is calculated in this way, then larger universes will be much less likely than smaller ones in accordance to their ratio (r) as an exponent of the probability of the smaller universe (see formula 2). If the assertion that larger universes are exponentially less likely is true, then a randomly selected universe with a specific trait will almost certainly have the minimum mass needed to contain that trait. For example, if one had access to all universes in the multiverse and they were to pick a single random hydrogen atom out of the infinite set of universes that contain hydrogen, then the universe they pick it from will likely contain the single atom they picked, or a few additional particles depending on the value of P. There may be exceptions, exceptions that are more or less likely to be stumbled across depending on the value of P, with lower values of P making additional matter less likely. The amount of mass in units of Ω (m) at which the number of universes with a mass greater than m is equal to the number of universes with a mass less than m in a large finite set is found with the formula:

$$(4)\ log_P\left(\tfrac{1}{2}\right) = m$$

If P=0.87, for example, then the value for m is about 5, or, in other words, the average mass of a universe in a multiverse with a P value of 0.87 will be 5 units. The sum of the likelihoods of all universes in the multiverse is limited at the value

$$(5)\ \lim_{P\to\infty} \frac{x}{x-y}\,,$$

where x is the numerator and y is the denominator of the value P represented as a fraction. For example, if P=0.87, then the sum of the value for P_{Ω} in every universe in an infinite set will be:

$$(6)\ \sum_{n=1}^{\infty}(0.87^{n}) = 87 \div (100-87) = 6.692307...$$

Using this value as a divisor of the individual probability of each universal mass, the sum of the new adjusted values will add up to 100% and be bisected at the mass predicted by formula 4, with the adjusted probabilities corresponding to values below and above m both adding up to 50% respectively. As an example, if P=0.2, then the number of universes in a large finite set with a mass between 0.43067656 and infinity units will tend to be equal to the number of universes with a mass between 0 and 0.43067656 units. If Ω is one kilogram, then half of the universes in a large finite set will have a mass smaller than 431 grams individually, and the remaining half of the set will have universes with a mass between 431 grams and unlimited mass.

Considering that universes with low mass would outweigh those with a large mass by ratio if $P < 1$, then a randomly selected universe out of the multiverse is more likely to have a mass tending towards 1 unit, rather than tending towards infinity, as you would see if the probability for every mass was equal. If you were to take the infinite set of universes with a specific trait and select a random one, then the one you pick will tend to have a mass that is the minimum for the likelihood of that trait existing in that universe as a function of its mass to be greater than the likelihood of more mass in that universe. If that trait is evolved life, then we can assume that evolved life will always find itself in a universe that has the minimum mass required for the probability of evolved life to be higher than the probability of a universe with a higher mass. If a certain amount of mass is needed for enough solar systems to form to have enough Earth-like planets for a planet with evolved life to occur once, then the mass of a universe with two planets with evolved life is predictably twice as large, because it would require twice as many solar systems for the probability of life existing in a given solar system (L) times the number of solar systems (S) to equal 2 rather than 1, meaning that the probability of a universe with two instances of evolved life is the probability of a universe with a single instance of life squared, therefore there will be P^-Ω universes with only one planet with evolved life for every universe with two.

One can think of life on Earth as a randomly selected instance of evolved life from the multiverse. If the assumptions of this paper are to be believed, then earthling life, as a randomly selected instance of evolved life, likely exists in a universe tending towards the minimum mass for a universe with something that can be considered evolved life.

2. Multiple Earth-like planets and the Weak Anthropic Principle

2.1

This brings the discussion to the Weak Anthropic Principle[1], which states that life will always find itself in a universe seemingly finely tuned for its existence, even if the conditions for its existence are extremely unlikely because life can never find itself in a universe that isn't perfectly balanced for its existence, even if that type of universe is infinitely more likely. This logic can be adapted to the hypothesis of the universe proposed by this paper. If life will inevitably find itself in a universe that can support it, regardless of how unlikely the conditions of that universe are, and that evolved life is a trait which will nearly always occur in as small a universe as possible, then we can conclude that our universe, despite its incredible mass, must be the minimum size a universe with evolved life can be under this hypothesis. The universe, under this hypothesis, must be as small as possible right down to the electron for evolved life to occur. Different instances of evolved life would tend to be alone in their universes, surrounded by the minimum amount of mass needed to form enough solar systems to make the probability of life emerging higher than the probability of every universe with a higher mass, rather than be contained in the same universe. The expression:

$$(7)\ P_{\Omega}^{\ x}$$

determines the probability of a given universe having x occurrences of a trait, with P_{Ω} representing the probability of a universe with the minimum mass needed for a single occurrence of said trait.

In a given universe, the emergence of evolved life relies on a balance between how accommodating the universe is for life (that is, how many solar systems with planets from which life could potentially emerge there are) and how likely the universe itself is to form, or P^Ω. If the universe is more accommodating then it stands to reason that it is less likely to form, because more mass is needed in a universe that has more star systems with planets that could potentially develop life. Life will more often find itself in internally unaccommodating circumstances than a universe large enough to be internally accommodating. That is to say, relating to the last paragraph, if 1 in 10 Earth-like planets bear evolved life, then those 10 planets will be spread across 10 universes rather than be contained in just one. One of the universes they are spread across will have evolved life which could look at every planet in its universe and conclude that, since no other planet besides theirs is earth-like, 100% of Earth-like planets will harbor life. In reality, only 10% would, but life will usually occur in a small universe where it is unlikely (one where there is only one earth-like planet), rather than a large universe

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[1] Abyss.uoregon.edu. "Anthropic Principle", 2020, http://abyss.uoregon.edu/~js/cosmo/lectures/lec24.html

where it is likely (one where there are 10 earth-like planets). The balance between the accommodability of the universe and the probability of the universe will nearly always be struck where there is only one occurrence of a planet with evolved life. Therefore, under this hypothesis, we can conclude that earth almost certainly be the only planet that bears evolved life in the universe.

If a universe has a great amount of mass, using our universe's example, then approximately 0.4%[2] of that mass will be contained within stars. There is about one planet for every star in the universe, so approximately 99.6% of the mass of a universe will be "waste mass", or additional mass that isn't contained within a solar system but is still necessary for the formation of solar systems. If one in *n* solar systems will bear evolved life, then 1-1/*n* % of the solar systems are waste mass and thus the total waste mass of the universe will be the universe's total mass minus the mass of the solar systems that contain evolved life. If the premises of this hypothesis are presumed, then the mass of a universe will tend to be the minimum value necessary for enough stars to form for the theoretical probability of evolved life emerging from a given solar system times the number of solar systems in the universe to be equal to that of a universe with a higher mass. This conclusion is denoted as:

$$(8)\ LS = P^{\Omega}$$

or, to solve for Ω,

$$(9)\ \log_P(LS) = \Omega.$$

There will of course be exceptions to this tendency, but the average mass of a universe that contains evolved life will be the value for *Ω* in equation 8.

3. Estimates for P^Ω

3.1

But how certain can we be? What is the probability of a universe with two Earth-like planets that bear evolved life versus a universe with just one? This is a difficult question to answer because the exact value for both *P* and *Ω* are unknown, but we can make estimates. Our universe's minimum possible mass, or the mass of the observable universe, is roughly 10^{53} kg, or about 5.586592×10^{82} MeV/c^2. If we assume that the probability of one MeV/c^2 of mass forming at the big bang is 1%, then the calculation for our universe's probability is 0.01^(5.586592×10^{82}). This value is equal to the number of universes with twice our universe's mass for every universe with a mass equal to ours, and

[2] Millis, John P., Ph.D. "The Composition of the Universe." ThoughtCo, Aug. 26, 2020, thoughtco.com/composition-of-the-universe-3072252.

presumably the number of universes bearing two instances of evolved life for every universe with just one instance, because the number of occurrences x (in this case the number of times a planet with evolved life emerges) is the exponent of P_Ω. In this example $x = 2$, therefore there are $P_\Omega{}^2$ universes with 2 instances of an evolved life-bearing planet for every P_Ω with just one. $P_\Omega{}^2 \div P_\Omega = P_\Omega$, therefore for every single universe with one planet that bears evolved life, there are P_Ω universes with two. P_Ω in this example is a fraction so impossibly tiny that it can not be put in terms of even the astronomically tiny example in section 1.1. With the assumptions made, there are:

$$(10)\ 10^{-1.1173184\times 10^{83}}$$

universes with 2 instances of evolved life for every universe with a single instance. With this calculation, with the assumptions made, there would be 10^(1.1173184 × 10^{83}) universes like ours, where there is only one earth-like planet bearing life, for every universe with 2. The value 10^(1.1173184 × 10^{83}), made with conservative estimates, is so large that it could not be written out in the base-10 format if every atom in the universe were converted into enough ink to write a single digit because you would run out of ink by the time you had completed 0.1% of the task.

For another estimate, once could use a more forgiving value for P. Assuming that P is equal to 0.99 and Ω is still equal to 5.586592 × 10^{82} MeV/c^2, then the mass of our universe will have a probability of 10^(-2.438439 × 10^{80}). This means that for every one universe with two earth-like planets bearing evolved life there are 10^(2.438439 × 10^{80}) universes with just one. Even with the assumptions that the universe is the minimum possible size our observations allow for and that every 1 MeV/c^2 of mass has a 99% chance of existing at the big bang, the value for the ratio of universes with one instance of life to universes with two instances of life is a value 30 sextillion times larger than the universe's age in Planck times. Of course, these values are just estimates, but they do justice to the main thesis which is that we are almost certainly alone in the universe under the hypothesis described. If evolved alien life were to be contacted, it would prove that the assumptions made in this hypothesis can not be simultaneously true.