Habitable Planets and Alien Civilizations in the Reciprocal System

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Abstract

The general public, as well as the scientific community, has enormous interest in the question of extraterrestrial life in our universe. The Reciprocal System provides the answers: yes, there are numerous habitable planets and numerous extraterrestrial cvilizations. Values are supplied for the variables of the Drake equation for our Galaxy.

keywords:

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Introduction

The Reciprocal System of physical theory is described in the books by Dewey B. Larson, such as Ref. [1] and Ref. [2]. The theory leads to the conclusion that there are numerous planets in our universe and that many of these are inhabited by intelligent hominids quite like us.

Nomenclature

f_e = fraction of intelligent civilizations that develop the ability and desire to communicate with other worlds

f_i = fraction of life-bearing planets on which intelligence emerges

f_l = fraction of suitable planets on which life actually appears

f_p = the fraction of stars with planets

L = longevity in years of each civilization in the communicative state

N = number of civilizations in our side of the Galaxy that are currently capable of communicating with other solar civilizations

N_{stars} = number of stars in the Milky Way

n_e = the number of planets, per solar system, with an environment suitable for lfie

R_{star} = rate per year at which new stars are formed on our side of the Galaxy during the period when the solar system itself was born

Note: A black square in the upper right of an equation means that the equation is disabled from running in *Mathcad*. This is done because not all variables in the equation have, as yet, been given numerical values.

1. Habitable Planets

Larson, Ref. [1], pp. 101-102, states the case very clearly:

"The contents of this chapter identify some of the factors that have a bearing on the question as to where planets are likely to exist, a question that excites a great deal of interest because it is a key element in any assessment of the possibility of the existence of life—particularly intelligent life—elsewhere in the universe. The B component of a binary system is *either* a star or a planetary system, not both. This eliminates all binary stars, and since all Class 1 stars [those that haven't gone through a supernova explosion yet] are automatically excluded, it confines the possibility of planets to single Class 2 stars (such as the Sun), or to single components of multiple systems (Class 3 and later). Inasmuch as a long period of reasonably stable conditions is probably required for the development of life—certainly for the emergence of any of the higher forms of life—the Class C stars of the second and later cycles, and the stars high on the main sequence, all of which are subject to relatively rapid change, can also be crossed off the list.

"This wholesale exclusion of so many different classes of stars may seem to limit the possibility of the existence of extra-terrestrial life very drastically, but in fact, these conspicuous and well-publicized stars constitute only a minor part of the total galactic population. The great majority of the stars of the Galaxy are small, and relatively cool, stars in the lower sections of the main sequence. As we will see in Chapter 12, there is a lower limit to the mass of a white dwarf star, and when the B component of a system is below this limit it cannot attain stellar status. This implies the existence of an immense number of planets among the smaller systems. Of course, there are requirements as to size, temperature, etc., that a planet must meet in order to be available as an abode for life, but there is a zone in each system within which a planet of an appropriate size is quite likely to meet the other requirements. Since Bode's Law (as revised) is applicable to all systems in which the conditions are favorable for planet formation (the small systems), it is probable that all of these systems have at least one planet in the habitable zone.

"The findings of this work thus increase the probability that there are a very large number of habitable planets—earth-like planets, let us say—in our own galaxy, as well as in other spiral galaxies. There are few, if any, in the galaxies smaller than the spirals—the ellipticals and the small irregulars—because they are composed almost entirely of Class 1 stars. The situation in the giant spheroidals is not yet clear. There are multitudes of lower main sequence systems in these giants, and these can be expected to have the usual proportion of planetary systems. However, the intense activity that, as we will see later, is taking place in the interior zones of these giants, no doubt rules out the existence of life. Whether enough of this activity carries over into the outer parts of these galaxies to exclude life in these areas as well is uncertain. The oldest of these giants are probably lifeless. As we will find in Chapter 19, there is a strong x-ray emission from these mature galaxies, and this is probably lethal. So far as we know at present, however, there may be outlying regions in some of the younger galaxies of this class in which the conditions are just as favorable for life as in the spirals.

"In today's science fiction, where life in other worlds is a favorite motif, the habitations of the alien civilizations are identified with familiar names, for reasons that are understandable. The thrilling action that the authors of these works describe takes place on planets that circle Sirius, or Arcturus, or some other well-known star. But according to our findings, few, if any, of these familiar stars are capable of having a habitable planet in orbit, and are also old enough to have developed complex forms of life. Sirius, for instance, has a white dwarf companion instead of a planetary system. Arcturus is a young Class C star. The astronomers do not make the mistake of identifying the environments of these stars as the abode of life, but they avoid it by making a different mistake. In selecting the target of their first systematic attempt at interplanetary communication (1974) they were misled by their current view of the evolutionary direction of the stars. This initial effort was directed at the globular cluster M 13, on the assumption that it is a very old structure in which the processes that lead to life have had ample time in which to operate. We now find that the globular clusters are relatively young structures which, aside from a few stray stars that have been picked up from the environment, are composed entirely of Class 1 stars. These cluster stars have not been through the explosion process, and therefore have no planetary companions at all. As matters now stand, the available information indicates that habitable planets are plentiful, but that the planets on which life probably exists are not located in any systems that we can call by name. The stars that they are orbiting are undistinguished, anonymous, and with few, if any, exceptions, unseen stars of the lower main sequence."

2. Alien Civilizations

Again, Larson, Ref. [2], pp. 92-93, states the case very clearly:

"We know that intelligence is favorable to survival and therefore we know that evolution *will* produce an intelligent organism if it *can*. We know that evolution *can* produce an intelligent biological organism uder the conditions prevailing on the earth, since it did so. And since these are, by definition, the *same* conditions that prevail on any earth-like planet, evolution can and will produce intelligent organisms on these planets. Furthermore, all other earth-like planets are, like earth itself, located in existence as a whole, and they are therefore subject to the same Sector 3 influences as human beings.

"There has been some opposition to the current efforts to open up radio communication with the inhabitants of extraterrestrial abodes of life, if there any within range, on the ground that these beings may be of a malevolent nature, and capable of doing us harm of some kind if we establish contact. Our findings indicate that these fears are groundless. The Sector 3 influences have more control over some individuals than others, but there is no reason to believe that their average effectiveness in application to any other large group of intelligent beings is any less than it is in application to the human race. If the inhabitants of a distant planet are far enough advanced technologically to enter into communications with us, they are also far enough advanced ethically to constitute no more of a threat to the nations of the earth than those nations are to each other.

"On the basis of the foregoing considerations, we can say that *Homo sapiens* is not unique; he is only one of many, a conclusion that has some very important implications for both science and religion."

3. Quantitative Estimates by Shapley and Drake

Larson, Ref. [2], p. 77, gives Harlow Shapley's quantitative estimate as follows:

"Harlow Shapley has made an interesting calculation in this connection, using figures which he considers very conservative, that is, figures which underestimate rather than overestimate the number of planets on which life exists. Assuming that only one star in a hundred is a single star, that only in a hundred of these has a system of planets, that only one in a hundred of these systems includes an earth-like planet, that only one in a hundred of these earth-like planets is neither too cold nor too hot, and that of them only one in a hundred has a chemical environment similar to ours, he says that 'we could still have, after all that eliminating, ten billion planets suitable for organic life something like that on earth.'"

Nowadays, most scientists use the Drake Equation, which is:

$$N := R_{star} \cdot f_p \cdot n_e \cdot f_l \cdot f_i \cdot f_e \cdot L \qquad (1)$$

where

N := "number of civilizations in our side of the Galaxy that are currently capable of communicating with other solar systems "

R_{star} := "rate per year at which stars are being formed in the Galaxy during the period when the solar system itself was born"

f_p := "the fraction of stars with planets"

n_e := "the number of planets, per solar system, with an environment suitable for life"

f_l := "the fraction of suitable planets on which life actually appears"

f_i := "the fraction of life-bearing planets on which intelligence emerges"

f_e := "the fraction of intelligent societies that develop the ability and desire to communicate with other worlds"

L := "longevity in years of each civilization in the communicative state"

The value of each of these variables is subject to a wide range of opinions, as can be seen by any of the many discussions on the Web.

R_{star} depends on the number of supernovae Type I per year in the Galaxy and the cycle Class of the star. This could be from a Class 1, 2, 3, 4, or even 5 star, but there are few stars above 3 in our Galaxy. Captured globular clusters (mature or immature) do not help, because the stars of these clusters are pre-explosion. The existing stars of the Galaxy accrete all of the available interstellar dust, and so no stars form *between* existing stars. An explosion of a Class 2, 3, or above star could wipe out an *existing* solar system. A conventional estimate for R_{star} is 7, but this seems way too high. It's more likely to be much smaller, say about 0.01--one net new solar system per 100 years in our side of the galaxy.

$R_{star} := .01$ new stars/year from SN explosion (2)

The next variable, f_p, the fraction of stars with planets, is easier to estimate. Either a Class 2 or higher Class star is binary or has planets. In our local environment, it's clear that approximately half of the stars are binary. The other half of Class 2 or higher Class stars must therefore have planets. Thus

$f_p := 0.5$ (3)

The next variable, n_e, the number of planets per solar system with an environment suitable for life, is also fairly easy to estimate. It's probably between 1 and 2, and so 1.5 seems approximately right.

$$n_e := 1.5 \qquad (4)$$

The next variable, n_L, the fraction of suitable planets on which life actually appears, is almost assuredly close to one, because life appears to be remarkable hardy.

$$n_L := 1 \qquad (5)$$

The next variable, fi, the fraction of life-bearing planets on which intelligence emerges, is also almost assuredly close to one, because biological evolution produces it!

$$n_i := 1 \qquad (6)$$

We have to assume that all intelligent hominids in our Galaxy are as curious about alien civilizations as we are, and so

$$f_e := 1 \qquad (7)$$

It takes approximately 5 billion years for an intelligent civilization to evolve, and since a given star cycle lasts approximately 10 billion years, this leaves 5 billion years as the maximum lifetime for a civilization. However, the last three billion years, when the star is high up on the main sequence, may make it difficult for a civilization to survive, and so the net *maximum* amount of time would probably be about 2 billion years.

$$L := 2 \cdot 10^9 \quad \text{years} \qquad (8)$$

Putting all of this together, we have

$$N := R_{star} \cdot f_p \cdot n_e \cdot n_L \cdot n_i \cdot f_e \cdot L \qquad N = 1.5 \times 10^7$$ planets with intelligent civilizations in our side of the Galaxy

An estimate in Wikipedia, Ref. [3], gives 3.64×10^7, or about twice ours.

Given that there are roughly 300 billion galaxies in our universe, of which perhaps 1/3 are spirals, this implies that there are

$$N \cdot 300 \cdot 10^9 \cdot \frac{1}{3} = 1.5 \times 10^{18}$$

intelligent civilizations in the universe--a staggering number. The giant spheroidal galaxies are probably devoid of life, except at their edges, and the small elliptical galaxies and globular cluster stars are mostly comprised of Class 1 stars. So this leaves spiral galaxies as having most of the intelligent life.

Given that there are 200 billion stars in our Galaxy, this means that

$N_{stars} := 200 \cdot 10^{9}$ stars in the Milky Way

$\frac{N}{N_{stars}} = 7.5 \times 10^{-5}$ of stars in our Galaxy have intelligent life

SETI has searched fewer than 20000 star systems to date. Thankfully, they are now looking at red dwarf stars on the lower main sequence, where the Reciprocal System says there should be planets!

4. Travel to or from Alien Civilizations

This is a very dubious proposition. In the Reciprocal System, space-time cannot be "warped" and so "warp drive" is not feasible! The maximum one-dimensional speed in space is c, which is unit speed in the Reciprocal System. Given that the Reciprocal System is a perfectly symmetrical theory, there are as many speeds above unity as there are below. But: the speeds above unity are in time! This means that the velocity equation, $v = s/t$, is flipped to $v = t/s$. Outward in coordinate time is equivalent to inward in coordinate space, so speeds above c mean that the objects get closer together, not further apart, in space! So all those supposed engineering designs for faster-than-light travel are destined to fail miserably. Sorry, Star Trek fans.

The above conclusion explains the Fermi Paradox: if there are so many alien civilizations out there, why cannot we see them or find them? Where are they? The answer is that we're all trapped in our solar systems. The probability of being able to leave a solar system and travel to another in a reasonable amount of time, with a reasonable amount of resources, is slim to none. Faster than light travel is impossible for us, and it is still impossible for a civilization even two billion years more advanced than us....

References

[1] D. Larson, *The Universe of Motion* (Portland, OR: North Pacific Publishers, 1984).

[2] D. Larson, *Beyond Space and Time* (Portland, OR: North Pacific Publishers, 1995).

[3] https://en.wikipedia.org/wiki/Drake_equation

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