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Number of Galactic Civilizations

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Abstract

A probabilistic assessment is made to determine the possible as well as most likely range of galactic civilizations with the help of a newly formulated probability equation. For any number of critical habitability criteria assumed, a minimum star and planet compliance ratio can be determined which is required for the existence of advanced civilizations in a galaxy of any given size. Detailed tables and figures are derived as partly illustrated in the abstract.

1. Introduction

An evaluation of the number of advanced civilizations in a galaxy has already been attempted in 1969 with the Drake probability equation [1],[3] which established a number of general principles. In this case a detailed analysis is provided of how differences in the number of critical habitability criteria will impact the number of habitable planets having advanced civilizations under conditions of differing compliance rates with these criteria. The calculations give a complete overview of all possible major habitability scenarios where the most likely zones can be readily identified. As the next step the issue of concurrent communicating civilizations has also been addressed.

1.1 Calculational Method

Ph Habitable planets with advanced civilizations
Sg Number of stars in the galaxy
n Number of critical habitability criteria

C1 to Cn are rates at which stars and planets meet the required criteria

$$Ph = Sg\,(C1xC2xC3\ldots\ xCn) \qquad (1)$$

C is the geometric mean of the product C1 to Cn

$$C = (C1xC2xC3\ldots\ xCn)^{1/n} \qquad (2)$$

$$Ph = SgC^{n} \qquad (3)$$

As an example, in case of a galaxy with 200 billion stars, assuming 11 critical habitability criteria [2],[4],[5],[6] and an average compliance rate of 1/5

$$Ph = (200x10^{9})\ x\ (1/5^{11}) = 4{,}096 \qquad (4)$$

will be the resulting number of habitable planets with advanced civilizations in the Galaxy. These civilizations have only very limited overlap.

In case of a compliance rate of 1/10

$$Ph = (200x10^{9})\ x\ (1/10^{11}) = 2 \qquad (5)$$

1.2 Communicating Civilizations

Detailed calculations indicate that for the most likely scenarios as far as number of habitable planets with advanced civilizations and assuming various durations for the civilizations, the number of concurrent civilizations at any given time is severely limited.

Lc average life span of an advanced civilization in years
Gt is the suitable period in the existence of a Galaxy in years
Sc are the number of concurrent sequential civilizations with the civilizations assumed to follow consecutively

$$Sc = (PhLc)/Gt \qquad (6)$$

Assuming as an example 11 criteria with 1/4 mean compliance and
Lc = 100,000 with Gt as 5 billion

$$Sc = (47{,}683x100{,}000)/(5x10^{9}) = 0.9536 \qquad (7)$$

Assuming Lc = 10,000

$$Sc = (47{,}683x10{,}000)/(5x10^{9}) = 0.0953 \qquad (8)$$

Which indicates substantial empty periods

2. Figures

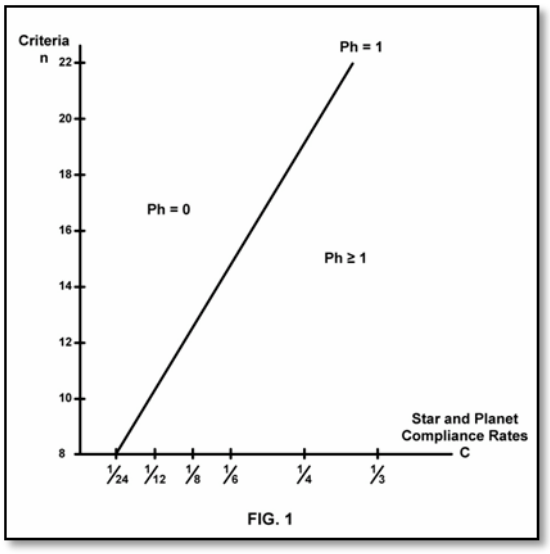

Figure 1. Galaxy habitability dividing line for 200 billion star Galaxy

3. Tables

Table 1 Minimum Compliance Ratio for Galaxy Habitability. (Eq.3) Sg is 200 billion

Criteria(n)	Ratio of Compliance(C)
16	1/5.08
15	1/5.67
14	1/6.42
13	1/7.40
12	1/8.75
11	1/10.65
10	1/13.49
9	1/18.01
8	1/25.86

Table 2 Galactic Habitability(Ph) (Eq.3) Sg is 200 billion

Criteria(n)	Mean Compliance Rate(C)		
	1/5	1/7	1/10
16	1	---	---
15	6	---	---
14	32	---	---
13	163	2	---
12	819	14	---
11	4096	101	2
10	20480	708	20
9	102400	4956	200
8	512000	34693	2000

4. Summary and Conclusions

Based on the planet habitability equation derived a probabilistic evaluation has been made to determine the possible number of habitable planets with advanced civilizations within a galaxy corresponding to a a range of critical habitability criteria as well as diverse geometric mean star and planet compliance rates with these criteria.

The calculations made provide a good overview of the possible range of planets with advanced civilizations which could be encountered in a galaxy in particular when the number of critical habitability criteria and their compliance range is narrowed down to the most probable ones.

As known the minimum compliance ratio has been attained and is probably exceeded in the Milky Way Galaxy.

The issue of communicating civilizations has also been examined. Due to the expected limited superposition of advanced civilizations, with a finite life span and the great distances involved, chances of interplanetary communications appear tentative.

Acknowledgement

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References

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