Disproof of the Fermi Paradox via the Thermodynamic Disprobability of Natural Abiogenesis

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Abstract

Using published values of ΔG°, we compute the cumulative probability of abiogenesis under prebiotic(before life) conditions. The result, $P < 10^{-260}$, exceeds the total amount of maximum chemical trials in the observable universe ($N \approx 10^{120}$) by 10^{140} orders of magnitude. This challenges the first assumption of the Fermi Paradox and makes it statistically improbable not just for intelligent life but life in general to exist. Summary: Life will likely never begin elsewhere and will not begin even in the distant future. We are a probabilistic anomaly.

1 Introduction

Fermi (1950): "Where is everybody?" Answer: **Step 1 aka LIFE getting produced by sheer probability failed.** Abiogenesis is not just rare — it is **orders of magnitudes above in improbability** even on cosmic scales.

2 (Im)Probability Chain

For each reaction $A \to B$:

$$P_i = e^{-\Delta G_i^\circ / RT}, \quad T = 298\,\text{K}, \quad R = 8.314\,\text{J/mol·K}$$

Using standard values [1, 2]:
With Gibbs Free Energy Equation:

$$\Delta G = \Delta H - T\Delta S$$

And since:

$$\ln \Omega = \frac{\Delta S}{R}$$

With Ω being the number of microstates (entropy in terms of probability).

- Amino acid formation (e.g., glycine): $\Delta G^\circ \approx +30\,\text{kJ/mol} \to P \approx 10^{-5}$
- 20-mere peptide (also correct chirality): $(10^{-2})^{20} = 10^{-40}$
- Functional enzyme (100 aa, folded): 10^{-130}
- Self-replicating RNA: 10^{-40}
- Lipid bilayer(double wrapped di-lipids) + metabolism: 10^{-50}

Cumulative: $P < 10^{-5} \times 10^{-40} \times \cdots =$ **lesser than 10^{-260}**

3 Maximum Amount Of Cosmic Trials

$$N = N_{\text{atoms}} \times r_{\text{rxn/s}} \times t_{\text{univ}} = 10^{80} \times 10^{23} \times 10^{17} \approx 10^{120}$$

Expected successes in one universe:

$$\mathbb{E}[\text{successes}] = P \cdot N < 10^{-260} \times 10^{120} = \mathbf{10^{-140}}$$

True probability of at least one success:

$$1 - (1 - P)^N \approx P \cdot N = \mathbf{10^{-140}}$$

Even in 10^{100} universes: still $\mathbf{10^{-40}}$ — **effectively zero.**

4 Conclusion

Life is not "rare." It is **statistically ZERO** until heat death. But we exist.

Therefore:

We are the exception. The Great Filter is at Step 1.

References

[1] Lehninger, A. L. (2017). *Principles of Biochemistry.*

[2] Voet, D. (2011). *Fundamentals of Biochemistry.*

[3] Miller, S. L. (1953). Science, 117(3046), 528–529.