Research Article

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The Inevitability of the Emergence of Life on Earth

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ABSTRACT

Dr. Fred Hoyle argues that the possibility of life arising on Earth is extremely low and impossible. However, this study demonstrates that even if Dr. Hoyle's claim is correct, life would still inevitably arise if branched universes exist. Furthermore, the existence of such branched universes is not merely hypothetical but is experimentally verifiable, and this study describes the specific methods for doing so. The existence of these branched structures makesrenders the emergence of habitable planets where life could arise virtually inevitable withinacross a multitude of universes, even if the probability of life arising on a single planet is extremely low, thusthereby providing a scientific explanation for the origin of life on Earth. Moreover, this study shows that the emergence of humankind was athe result of life arising by chance and, suggesting that the anthropic principle does not need to be assumed, and that no other extraterrestrial civilizations exist in the same universe as Earth.

Keywords
Life birth probability, Fermi's paradox, quantum entanglement, Branching universes.

Introduction

The mainstream hypothesis about life origin is the primordial soup theory, which suggests that various organic compounds randomly combined in the ancient Earth's oceans to create life building blocks. However, Dr. Hoyle strongly objected to the idea of "randomly" in this context. According to his calculations, the probability of all the enzymes necessary for life coming together correctly is an astonishing "1 in 10 to the power of 40,000"—an incredibly small "miraculous probability" compared to the number of atoms in the universe (approximately 10 to the power of 80). A typical analogy he uses is "the probability of a tornado passing through a junkyard and assembling a Boeing 747", which he claims is impossible. In reality, Earth's abundant life has prompted many scientists to challenge this claim.

Traditional hypotheses explaining the origin of life on Earth

1. The panspermia theory: It suggests that life forms come from outer space [1].
2. Issues with the RNA world hypothesis: No evidence supports the idea that various nucleic acid analogs adopt RNA's unique bonding patterns in their presence. RNA is less stable than DNA and is thus more susceptible to degradation. Self-replicating RNA molecules remain unidentified [2,3].
3. Issues with the protein world hypothesis: Peptides lack self-replicating capabilities. While proteins are not as unstable as RNA, their molecular structures remain unstable. The natural emergence of enzymes and conformationally specific molecules from random amino acid polymerization is difficult to accept [4].
4. Such theories abound; however, they remain hypothetical and lack sufficient empirical support. While panspermia theory has existed since ancient times and explorations of its possibilities continue, the steady-state cosmology remains unproven and untenable. Its acceptance therefore becomes difficult, particularly in light of Dr. Fred Hoyle's argument that aligning enzymes correctly would require more trials than the number of atoms in the universe.

Drake equation

As for the research on the probability of civilizations existing in the universe, the estimation using the Drake Equation is well-known: the equation proposed by astronomer Frank Drake (N =

$R* \times fp \times ne \times fl \times fi \times fc \times L$) attempts to calculate the number of communicative intelligent life forms in the Milky Way galaxy. Estimates based on this equation suggest the existence of anywhere from several dozens to several million intelligent civilizations in the Milky Way galaxy. Here, each parameter represents the following:
R*: The number of stars formed annually within the galaxy
fp: The fraction of stars that have planets
ne: The number of planets that could potentially support life
fl: The fraction of such planets where life actually arises
fi: The fraction of life that develops intelligence
fc: The fraction of intelligent life that develops technology capable of communication
L: The average lifespan (in years) of such civilizations

Exoplanet discoveries are rapidly advancing, with several Earth-like planets identified in habitable zones—temperature ranges that allow life-supporting conditions. Observations from the Kepler space telescope and others estimate billions of Earth-like planets within the galaxy alone. This suggests the presence of numerous celestial bodies with life emergence–favorable environments.

Chemical process of life origin: The 1953 Miller experiment demonstrated that amino acids form naturally under primitive Earth-like conditions, supporting the natural origin-of-life's molecular building blocks. In addition, samples from asteroid Ryugu contained fundamental building blocks of life—amino acids and uracil—supporting the thought that life-forming materials are widespread across the universe. Furthermore, experimental "RNA world" research has shown the plausibility of forming RNA systems with self-replication capabilities.

Place of life origin: Despite several theories about life origin, including "hot spring," "submarine hydrothermal vent," "tidal flats," and "space arrival (panspermia)" theories, definitive conclusion remains unestablished. However, the ubiquity of these environments throughout the universe suggests frequent opportunities for life emergence.

Fermi's paradox [5-10]

If life is widespread in the universe, numerous technologically advanced civilizations should exist; yet, the lack of evidence for their presence presents a well-known paradox. This question is often raised as an argument against the universality of life or intelligent life, and several possible answers have been proposed, including the "Great Filter" hypothesis (a barrier exists that wipes out intelligent life before it can advance into the universe) and the "Zoo Hypothesis" (an advanced civilization observes us but does not interfere).

The Many worlds interpretation

Everett initiated the many worlds interpretation. If this interpretation of the many worlds theory is correct, then the real world will split into many worlds, and so-called branched universes (parallel universes) will exist. In other words, this branching into many worlds has been occurring constantly since the universe's birth, whenever there were all possible options.

In other words, the universe we inhabit is only one among many; considering all parallel universes, the opportunities for life to emerge become extremely numerous—potentially approaching infinity.

Finely Tuned Universe

The origin of life in the universe is extremely sensitive to the values of certain fundamental dimensionless physical constants, and the observed values suggest that these constants may be extremely finely tuned. However, if branched universes exist, universes with such physical constants can be considered among the branching results. In other words, many universes exist with diverse physical constants; however, Earth exists in a branched universe with physical constants that make the emergence of life possible. In addition, diverse biochemical reactions are repeated on Earth, many branched universes corresponding to each chemical reaction are created, and life has arisen in some of these universes, albeit probabilistically rarely. In other words, the birth of humankind is a result of life arising and evolving on Earth, and the anthropic principle that "the universe is suitable for humans because otherwise humans would not be able to observe it" should not be assumed.

Time required for life emergence on Earth

The Earth was born 4.6 billion years ago, but the ocean is thought to have formed 4.0–4.3 billion years ago, and it is believed that the last universal common ancestor emerged 4.2 billion years ago. In other words, if life were born in the ocean, the necessary time for it to emerge would be about 500 million years.

Scenario for life birth if branching universes actually exist

Even if Dr. Fred Hoyle's calculations are correct and the probability that all enzymes required for life exist is 1 in 10 to the power of 40,000, the number of branching universes, including our own, is nearly infinite. For example, because the time of radioactive decay of atoms, as postulated in "Schrödinger's cat," experiment is uncertain, branching universes are created every time, resulting in numerous universes branching. The creation of various enzyme molecules also involves creating as many branching universes as the number of chemical reactions that occur in the ocean. Therefore, among the nearly infinite number of branching universes, cases exist in which all enzymes necessary for the birth of life are present. Therefore, life will begin in a certain branching universe and ultimately emerge within 500 million years. We exist in one of these rare branching universes, whereas no life exists in other branching universes.

Experimental methods to prove the existence of branching universes

Existence of branching universes may explain life's emergence; however, without experimental validation, the concept remains hypothetical, necessitating empirical proof.

The existence of nonlocal long-range interactions (quantum entanglement) has been proven by Wheeler's delayed choice experiment and Alan Aspect's violation of Bell's inequality [11,12] as well as by many other studies [13-16]. This phenomenon allows us to create pairs of photons using devices that convert high-frequency optical signals to low frequencies (downconverters), such as barium borate, a nonlinear crystal that realizes a semireflective mirror, or optical parametric oscillations, in which the behavior of one photon affects the other photon at a distance. In [17], we conducted experiments using photons in this quantum entangled state.

Experiment overview

Experiment 1

A photon travels along one of the paths, left or right, through the beam splitter, and then splits into two photons at the downconverter, but because the path has not been determined, interference fringes appear on screens A and B, respectively.

Experiment 2

The photon travels along one of two paths using a half mirror; then, in the downconverter, it becomes two photons, and one of those photons is observed by one of the particle detectors, so the path is determined and no interference pattern is seen on the screen.

Experiment 3

A photon travels along one of the left or right paths through the half mirror and becomes two photons in the downconverter. When an interference pattern is observed on screen A, an interference pattern also appears on screen B because the photon's path is undetermined. However, if screen B is removed immediately after observing the interference pattern on screen A, the photon whose path is undetermined will not be observed by either particle detector.

a) In this case, if no interference is detected at A and the interference detector at B is not removed, no interference will occur at the other interference detectors, contradicting the experiment in Figure 1.

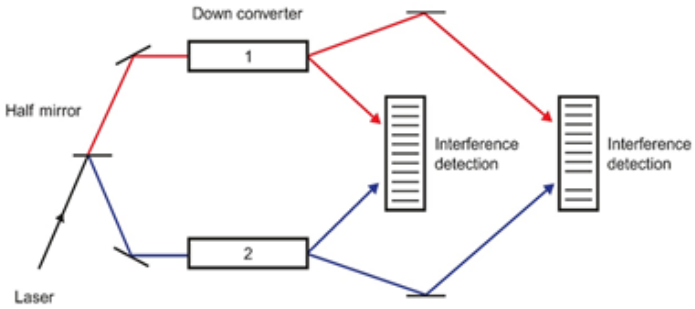

Figure 1: Schematic of interference fringe generation when a photon path through the half mirror and downconverters is undetermined.

b) Furthermore, if interference is actually detected at A and the interference detector at B is removed, the photon at B will be observed as a particle owing to the presence of the particle detector, resulting in a different result for the photon pair, contradicting the experiment in Figure 2. Therefore, simply installing an interference detector removal device will only produce inconsistent results in both cases.

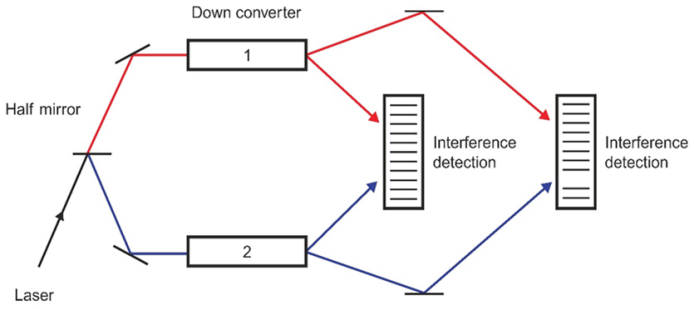

Figure 2: Schematic of interference fringe disappearance when the photon path through the downconverters becomes determined.

c) However, if a mirror is installed on a geostationary satellite, the particles may not reach the particle detector due to vibrations or air turbulence caused by the presence of the device in the environment. Therefore, even if we detect interference fringes at A as a preliminary experiment, we will perform multiple experiments without performing the interference fringe removal operation at B to determine the probability of observing interference fringes at B. By comparing this probability with the particle detection probability after the removal operation of the interference detector at B in the main experiment, the experimental validity can be confirmed.

Expected results

If the experiment reveals no contradictions, the expected outcome shown in Figure 3 is that interference detector B remains in place—either owing to equipment failure or the experiment is not conducted for another reason.

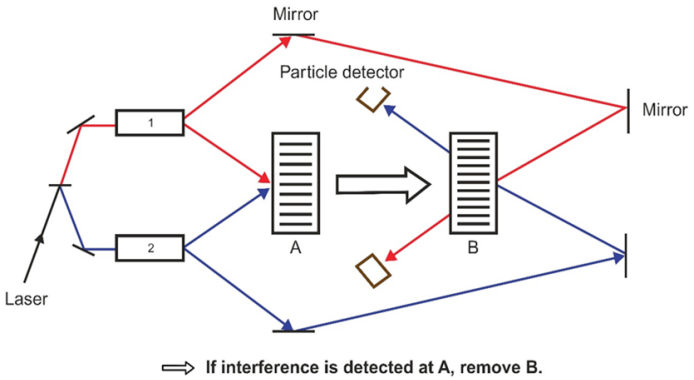

Figure 3: Schematic illustrating the dependence of interference fringes at A on the removal of screen B.

That is, interference fringes appear when interference detector B remains in place. However, in the experiment where the removal

of the interference detector is attempted, the particle detection probability at the particle detector along the photon path abruptly drops to zero owing to unknown environment-induced factors.

This always leads to the same result, no matter how many times it is repeated after confirming that the equipment is working properly.

If experiments (1) and (2) are confirmed, and experiment (3) yields the expected results, the most plausible explanation is that the failure of many previous attempts stems from macroscopic phenomena with extremely low probabilities. Such abnormal phenomena occur for a reason. The removal attempts of the interference detector are likely to induce events responsible for anomalous outcomes. Examples include truck-induced vibrations, unexpected power failures, or other disturbances presumed to accompany each experimental trial. That is, each universe has many branches in which observers exist, and experimenters can statistically prove the strange fact that these branching universes exist.

Conclusion

If this experiment proves the existence of branching universes, even if no one can refute Dr. Fred Hoyle's calculations, it means that among the countless branching universes, at least one universe exists that contains a planet where all enzymes necessary for the evolution of life have been produced. In other words, inhabit a universe in which life happened to originate on Earth. Unlike traditional hypotheses, this origin-of-life scenario is scientifically plausible and shows that the emergence of life is inevitable. By contrast, the very fact that life exists on Earth and we humans exist is proof that branched universes have existed since a long time. Furthermore, if life exists only in this scenario, then the answer to Fermi's paradox is obvious. In other words, life has not arisen on other planets and encounters with technologically advanced life will naturally cease.

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