

# Search for Life in Universe

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## Abstract

This article aims to define Life and discusses strategies for exploring Life in the Universe.

## Introduction

On Earth we are surrounded by great variety of living organisms, from bacteria and plants to large animals and humans. Life on Earth is organized in so-called ecosystems where various living organisms co-exist for mutual benefit.

Despite abundance of life on Earth, what Life actually is has never been clearly defined in scientific literature. Without a sufficiently coherent definition of Life it may be difficult, if not impossible, to find evidence of Life elsewhere in the Universe.

For this reason, discussion about Life in the Universe should begin with establishing the definition of Life.

## Definition of Life

Life can be considered a “process” as well as a “system”. What is the essence of this “process” and/or “system” that we call Life?

Ability to process information seems a common feature of all living organisms. Every living organism makes continuous choices what to do and what to avoid doing, what to eat and what to avoid eating.

Every living organism seems to have “preferences” that clearly distinguish dangers from pleasant and satisfying activities.

Inside any living organism various organs and cells have to communicate with one another continuously in order to maintain balance and sustain functionality of the entire organism.

Every living creature has tools of perception that allow it to perceive information from surrounding environment and communicate with other living organisms.

Ability to continuously process information actually distinguishes a living organism from a dead organism. A dead organism does not process information, does not make choices and its internal cells/organs do not communicate with one another to sustain their existence and functionality.

Clearly the essence of the “system” and/or “process” that we call Life is the ability to process information. Without the ability to process information - Life cannot actually exist.

The ability to process information seems so central to all Life that it is tempting to define Life as “a system of information processing”. Such a definition is likely to meet some criticism, because every computer is also a system of information processing.

We need to improve the above definition to distinguish Life from computers.

Living organisms are known for their survival strategy (so-called “fight” for survival) that manifests itself by adaptability and self-preservation. All living organisms from plants to animals seem to aim to survive in presence of adversity.

Self-preservation, self-repair, adaptation and consistent aim for survival, so universally observed in living organisms, can be interpreted as consequences of self-awareness.

In other words, we can say that self-awareness is a distinctive feature of information processing in living organisms. Every living organism has at least some degree of self-awareness, a feature that is critically important for its survival, self-preservation, its preferences, adaptability and an attitude of identifying and avoiding dangers.

So, we can define Life as “a system of information processing that is self-aware”.

Interestingly, we can adopt exactly the same definition to define Consciousness.

What we have just concluded is that the essential feature of Life is “consciousness”, defined as “a system of information processing that is self-aware”.

### **Necessary Condition for Information to exist**

Since the ability to process information is so central in all Life, we need to consider what conditions are necessary for information to actually exist.

Information cannot exist without being encoded. Information encoding cannot be random, because randomly encoded information is not retrievable. Encoding needs to be intelligent, systematic, coherent, reliable and durable.

So, a necessary condition for information to exist is coherent encoding.

### **Physics of Information Encoding**

Physical nature of consciousness can be established by determining the necessary requirements for the associated information encoding [1].

One of the most fundamental observable properties of our own consciousness is our privacy of thought: privacy of information processing in our consciousness. Our

thoughts simply cannot be intercepted. Hence, another necessary property of the information encoding in our consciousness is protected individuality of access.

What possible physical mechanisms for information encoding could facilitate the necessary requirements outlined above? Since our thoughts are easily reversible, at least several times per second, any chemical-molecular-DNA based mechanisms are highly unlikely, because they are not easily reversible.

The only plausible mechanisms of information encoding that our science today allows us to admit for consideration are of electromagnetic/electro-photonic nature. Of these, we have to exclude the possibility of any analog encoding, simply because it cannot meet the privacy requirement arising from Observable Reality.

The only possibility left seems to be some kind of digital electromagnetic/electro-photonic encoding. Experiments in quantum computing confirm that single elementary particles (electrons) can store quite large amount of information. Storing and retrieving information from electrons occurs by means of photons [5][6].

What is currently interpreted as “random”, “non-deterministic” and “unexplorable” behavior of elementary particles (the quantum world) [4] can simply be a manifestation of information processing.

It is very important to note, that digitally encoded transmissions will appear “random” to any observer who is unaware of their encoding details [2].

Quantum-digital encoding seems not only possible, but actually highly likely mechanism of information encoding in our consciousness.

Since quantum experiments confirm that elementary particles across the Universe

can interact and exchange information, the entire Universe should be considered as a gigantic system for information processing. People on Earth do not have access to this information not because they are not intelligent enough, but because they dismiss such a possibility.

### Expanding the context

Current efforts of exploring the Universe focus on matter (mass) and energy that, according to current scientific understanding, are proclaimed proportional to one another.

Mass and energy are integral parameters of the Universe that disregard information encoded in quantum oscillations. Information is lost in the integration process used in the process of mass and energy measurements.

Limitations associated with mass-energy approach can be illustrated using the following example.

Imagine a book. How much energy it contains? We can burn or otherwise disintegrate a book and find out how much energy we can obtain. Or we can determine the mass of the book and estimate the amount of energy using known mass-energy relationships. We can determine fractions of mass/energy that correspond to various atoms or molecules in the book and achieve quite a complex result.

However, no matter how impressive the mass/energy result appears – it disregards all information that the book contained, including the book's very purpose of existence.

Arguably, a policy of focusing on mass and energy in the Universe is no more advanced than a policy of burning books...

Since we determined that information processing is a key feature of Life, we need to expand the context of our considerations

of Life to include aspects of quantum-encoded information processing.

### Search for Life

Our first step should be admitting for consideration the possibility that quantum-encoded information may exist in Nature.

This step should be followed by development of tools and techniques to explore the above possibility.

Results of such explorations should provide more information about Life in the Universe and its purpose of existence than the overwhelming trend of constructing larger and more capable telescopes.

### Communication

One of the most interesting consequences of quantum-encoding of information is potential for communication on large distances across our planet, our Galaxy and potentially the Universe.

Measuring energy of the light that comes from distant parts of the Universe is not sufficient, even if we split this energy into finely resolved spectra.

More important in the light (and other electrophotonic radiation) that reaches us is not the energy, but the quantum-encoded information it can carry.

However, using direct carriers such as light is not the only way to communicate quantum-encoded information.

The most interesting communication possibility arises from quantum-entanglement of information-carrying particles such as electrons.

Quantum entanglement is an observable interaction between distant and seemingly unconnected quantum particles, which is not yet fully understood.

## Operating system

How could quantum-encoded information be organized in the Universe?

Necessity of both encoding and maintaining information can give us a good hint.

A set of quantum particles can sustain information when the following conditions are satisfied:

1. information encoding is compatible in all quantum particles involved in the set
2. there exists an “operating system” that oversees access and storage of information and enables one quantum particle to interface with others
3. there is a source of energy that sustains quantum oscillations to carry information

How large is the set involved in quantum-encoded information processing?

If oscillations of every electron and every other quantum “particle” exist in the entire Universe, it is quite likely the set may comprise the entire Universe.

From our experience we can also say that each and every living organism (defined earlier as a system of information processing that is self-aware) seems to be allocated a *subset* of quantum-encoded resources sufficient to sustain itself [2] and evolve [7].

The relationship between autonomous living organisms and the “operating system” could be similar to the relationship between autonomous computers and the network they are connected to.

Robust and reliable quantum-encoding seems a core and the necessary condition for existence of the entire operating system.

How did the possibility of quantum-encoding come to existence? Could the quantum encoding have some purpose to exist? [2].

If encoding has a purpose to exist, can the operating system be aware of itself?

If it is, it would mean that our Universe is alive...

## References

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