Habitability and Life Parameters in our Solar System *

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ABSTRACT
The whole spacetime i.e. cosmoverse is divided into various universes. Every universe is traveling due to habitability on its own motion and gravitational attraction towards the other universes similarly every planet travels in our Solar system. Planets are in motion due to their main source Sun. All universes are habitable due to stable cosmoverse. Our universe is habitable because of quantum fields for existing particles and forces. In other universes their quantum fields as well as particles and forces are different from our universe. So everything around us from subatomic particles to Planets of our solar system are structured and constituted according to the quantum state of our universe. It shows that at the time of origin of our Solar System, there would have been other solar systems existed and that was consequences of the gravitational interaction of natural forces outside our solar system. These natural forces are parameters for habitable zone to determine the energy, age and life of all motionary planets traveling within the solar system.

Ultimately the purpose of the Solar System is to give rise to intelligent life according to anthropic principle and fundamental physical constants set to ensure that life as we know it, will emerge and evolve on different planets.

Keywords: Spacetime, Fine-tuned universe, Fundamental physical constants, Habitability, Cosmoverse

1 INTRODUCTION

The whole spacetime i.e. cosmoverse is divided into various universes. Every universe is traveling with habitability in this cosmoverse due to its own motion and gravitational attraction towards the other universes like every planet in our Solar system. Planets are in motion due to their main source Sun. Sun travels due to its main source Milkyway. Similarly Milkyway exists due to its main source universe. In other words planets are in motion, sun travels and milkyway exists because of habitable universe. All universes are habitable due to stable cosmoverse. It means that all universes are habitable but not stable. Do you know on which main source our universe is habitable? Our universe is habitable (on specific limits and conditions) because of quantum fields for existing particles and forces. In other universes their quantum fields as well as particles and forces are different from our universe. So everything around us from subatomic particles to galaxies are structured and constituted according to the quantum state of our universe. According to Big bang theory, our universe came into existence due to explosion of cosmic egg like our sun came into existence due to explosion of supernova. It shows that at the time of origin of our universe, there were other universes existing and that was consequences of the gravitational interaction of natural forces outside our universe. Ultimately our universe was born and got the energy from the cosmoverse like earth got the energy from the Sun by way of natural forces. These natural forces are parameters to determine the energy, age and life of all motionary planets, traveling stars, existing galaxies, habitable universes in the stable cosmoverse.

Further our universe is divided into superclusters, these are again divided into clusters which appears to be collection of galaxies held together by mutual gravitational attraction towards individual galaxies and various solar systems. In other words, our solar system as well as Milkyway galaxy are also part of one supercluster. This is called the structural distribution of our universe. Beyond our universe, there are number of hyperclusters exists in other universes. Every galaxy has its galactic habitable zone to decide which regions are most likely to form solar system. Solar systems decide within star’s planetary habitable zones to provide stable environment for the life in which the life emerged from planet to planet according to the theory of energy distribution on a planet for life requirement. Ultimately sun is the last recipient in this race to get energy from the habitable universe. Gradually sun grew considerably since its initial formation like a child expanding its radius and energy ratio and came into prime phase of life known as the main sequence. Sun derive energy from the fusion of the hydrogen into helium. Like we derive energy from the fusion of oxygen into carbohydrates but as we grow we need more oxygen and consume more energy according to growth ratio. 6 Billion tones oxygen is consumed by humanity...
per year. In other words, fusion is a process by which sun attain and consume energy from the source house of its total energy. Accordingly we can calculate the total energy, age and life of all galaxies to superclusters even the whole universe.

Now the question is how we get energy and from where? Why the intelligent life exists in the universe? What are those properties which allow life to develop? We know that our universe was built by positive charged particles which attain energy from outside. So natural forces determine the total energy of our universe. The energy density is homogeneous and isotropic in every large volume of the space in all directions. According to topology all qualitative properties of the universe including three spatial dimensions are equal in length. So universe has a simply connected and compact topology. It is the reason that energy is proportionally distributed to all superclusters, cluster of galaxies, individual galaxies and solar systems. The purpose of the universe is to give rise to intelligent life with the laws of Nature and their fundamental physical constants set to ensure that life as we know it, will emerge and evolve.

We will study the habitability in our solar system from its formation to main sequence till red giant phase. We know our sun get energy from its main source field i.e. its galaxy – The Milky Way. Here the Sun behaves like particle and interact with its field. So interaction between sun and milky way is the subject matter of this study.

2 FINDINGS

Space is part of universe, whereas habitability relates to life. Life is habitable because galaxies exist, stars travel and planets are in motion. These are the properties of stable cosmoverse. It does not mean that if cosmoverse is stable then all are stable. Here stability is not a part of Relativity because cosmoverse is special and nothing can be compared with it. So is life. Life cannot be compared. It is structured according to the habitable state of our universe. Beyond our universe there may be different life properties, particles and forces.

There are only two types of particles travel in our universe. First is matter particle, the building block of the universe and the second is life particle permeated into all life forms. This is the reason that universe is habitable and hence the fundamental constants of the universe are ultimately the result of the anthropic principle. In other words, the universe we are in, is fine-tuned to permit intelligent life. No properties and characteristics are different from these two particles since the origin of the universe till date. Here the whole game is between the space and life. It is also noted that Natural Forces are not the subject of life particle and can not destroy it. All physical laws, universal theories and fundamental interaction of natural forces are the subject to understand and study the matter particle from sub-atomic level to super structure level and determine the total mass and energy of the universe. The life particle is bounded by the body. Life is the truth rests in the body but body does not know how to get this ultimate position because life is not a part of the body. It exists in the body without existence. Similarly habitability is the truth rests in the universe but universe does not know absolute position of the habitability because habitability is not a part of the universe. It is the study of life properties, life forms, and intelligent life.

Only habitability tell us how life emerges in different zones of solar systems and galaxies. Habitable zone is the region around stars within which planetary mass objects with commensurate atmospheric pressure could support liquid water at the surface. It is inferred from known requirements of Earth’s biosphere, the earth’s position in the solar system and the amount of radiant energy it receives from the sun.

According to theory of habitable zones, it is in the context of planetary habitability and extraterrestrial life. It covers circumsellar habitable zone as well as various other determinants of planetary habitability, eventually estimating the number of habitable planets in the Milky Way to be about 600 million. Afterwards it was introduced the concept of the term “Goldilocks Zone” through exploration of Space Colonization specifically a region around a star whose temperature is just right for water to be present in the liquid phase. Similarly the galactic habitable zones are the regions were life is most likely to emerge in a galaxy, encompasses whose regions close enough to a galactic center that stars there are enriched with heavier elements, but not so close that star systems, planetary orbits, and the emergence of life would be frequently disrupted by the intense radiation and enormous gravitational forces commonly found at galactic centres.

Whether a body is in the circumsellar habitable zone of its host star is dependent on both the radius of the planet’s orbit (for natural satellites, the host planet’s orbit) and the mass of the body itself. Large masses of planets with a circumsellar habitable zone life Super-Earth planets which can sustain thicker atmospheres and stronger magnetic fields than Earth. Lower mass planets like Earth or Venus can remain habitable, complemented by a larger extended habitable zone, in which super-earth planets, which have stronger greenhouse effects, more powerful geomagnetic dynamos, and greater amounts of plate tectonics, can have the right temperature for liquid water to exist at the surface.

3 ANALYSIS

In order to identify a location in the galaxy as being a part of the galactic habitable zone, a variety of factors must be accounted for. These include the distribution of stars and spiral arms, the presence or absence of an active galactic nucleus, the frequency of nearby supernovae that can threaten the existence of life, the metallicity of that location, and other factors. Without fulfilling these factors, a region of the galaxy cannot create or sustain life with efficiency. One of the most requirements for the existence of life around a star is the ability of that star to produce a terrestrial planet of sufficient mass to sustain it. Various elements, such as iron, magnesium, titaniu-
um, carbon, oxygen, silicon and others, are required to produce habitable planets, and the concentration and ratios of these vary throughout the galaxy.

One important elemental ratio is that of \([\text{Fe/H}]\), expressed using the logarithmic dex units. The galactic bulge, the region of the galaxy closest to the galactic center, has an \([\text{Fe/H}]\) distribution peaking at -0.2 dex; the thin disk, where the Sun is located, has an average metallicity of -0.02 dex at the orbital distance of the Sun around the galactic center, reducing by 0.07 dex for every additional kiloparsec of orbital distance. The extended thick disk has an average \([\text{F/\text{H}}]\) of -0.6 dex, while the halo, the region farthest from the galactic center, has the lowest \([\text{Fe/H}]\) distribution peak, at around -1.5 dex. In addition, ratios such as \([\text{C/\text{O}}]\), \([\text{Mg/Fe}]\), \([\text{Si/Fe}]\), and \([\text{S/Fe}]\) may be relevant to the ability of a region of a galaxy to form habitable terrestrial planets, and of these \([\text{Mg/Fe}]\) and \([\text{Si/Fe}]\) are slowly reducing over time, meaning that future terrestrial planets are more likely to possess later iron cores.

In addition to specific amounts of the various stable elements that comprise a terrestrial planet’s mass, an abundance of radionuclides such as 40K, 235U, 238U, and 232Th is required in order to heat the planet’s interior and power life-sustaining processes such as plate-tectonics, volcanism and a geomagnetic dynamo. The \([\text{U/\text{H}}]\) and \([\text{Th/H}]\) ratios are dependent on the \([\text{Fe/H}]\) ratio.

Even on a habitable planet with enough radioisotopes to power, various prebiotic molecules are required in order to produce life; therefore, the distribution of these molecules in the galaxy is important in determining the galactic habitable zone. A 2008 study by Samantha Blair and colleagues attempted to determine the outer edge of the galactic habitable zone by means of analyzing formaldehyde and carbon monoxide emissions from various giant molecular clouds (GMC) scattered throughout the Milky Way. While high metallicity is beneficial for the creation of terrestrial extrasolar planets, an excess amount can be harmful for life. Excess metallicity may lead to the formation of a large number of gas giant planets in a given system, which may subsequently migrate from beyond the system’s frost line and become hot Jupiters, disturbing planets that would otherwise have been located in the system’s circumstellar habitable zone. Thus, it was found that the Goldilocks principle applies to metallicity as well; low-metallicity systems have low probabilities of forming terrestrial-mass planets at all, while excessive metallicities cause a large number of gas giants to develop, disrupting the orbital dynamics of the system and altering the habitability of terrestrial planets in the system.

As well as being located in a region of the galaxy that is chemically advantageous for the development of life, a star must also avoid an excessive number of catastrophic cosmic events with the potential to damage life on its otherwise habitable planets. Nearby supernovae, for example, have the potential to severely harm life on a planet; with excessive frequency, such catastrophic outbursts have the potential to sterilize an entire region of a galaxy for billions of years. The galactic bulge, for example, experienced an initial wave of extremely rapid star formation, triggering a cascade of supernovae that for five billion years left that area almost completely unable to develop life. In addition to supernovae, gamma-ray bursts, excessive amounts of radiation and gravitational perturbations, various other events, controversially including such proposals as “galactic tides” and cold clumpy dark matter with the potential to induce cometary impacts, have been suggested as mechanisms that can hamper the emergence or evolution of life in the Universe. Various morphological features of galaxies can affect their potential for habitability. Spiral arms, for example, are the location of star formation, but they contain numerous giant molecular clouds and a high density of stars that can perturb a star’s Oort Cloud, sending avalanches of comets and asteroids toward any planets further in. Considering these factors, the Sun is advantageous placed within the galaxy because, in addition to being outside of a spiral arm, it orbits near the corotation radius, maximizing the interval between spiral-arm crossing.

Spiral arms also have the ability to cause climate changes on a planet. Passing through the dense molecular clouds of galactic spiral arms, stellar winds may be pushed back to the point that a reflective hydrogen layer accumulates in an orbiting planet’s atmosphere, perhaps leading to a snowball Earth scenario. A galactic bar also has the potential to affect the size of the galactic habitable zone. Galactic bars are thought to grow over time, eventually reaching the corotation radius of the galaxy and perturbing the orbits of the stars located these.

Early research on the galactic habitable zone, including the 2001 paper by Gonzalez, Brownlee, and Ward, did not demarcate any specific boundaries, merely stating that the zone was an annulus encompassing a region of the galaxy that was both enriched with metals and spared from excessive radiation, and that habitability would be more likely in the galaxy’s thin disk. However, later research conducted in 2004 by Lineweaver et al. did create boundaries for this annulus, in the case of the Milky Way ranging from 4 kpc to 10 kpc from the galactic center. The Lineweaver team also analyzed the evolution of the galactic habitable zone with respect to time finding for example that stars close to the galactic bulge had to form within a time window of about two billion years in order to have habitable planets.

A 2006 study by Milan Cirkovic and colleagues extended the notion of a time-dependent galactic habitable zone, analyzing various catastrophic events as well as the underlying secular evolution of galactic dynamics. The paper considers that the number of habitable planets may fluctuate wildly with time due to unpredictable timing of catastrophic events, thereby creating a punctuated equilibrium in which habitable planets are more likely at some times than at others. Based on the results of Monte Carlo simulations on a toy model of the Milky Way, the team found that the number of habitable planets is likely to increase with time. As per the research paper by Michael Gowanlock, who calculated the frequency of supernova-surviving planets as a function of their distance from the galactic center, their height above the galactic plane, and their...
age, ultimately discovering that about 0.3% of stars in the galaxy could today support complex life, or 1.2% if one does not consider the tidal locking of red dwarf planets as precluding the development of complex life.

4 CONCLUSION

Studies that have attempted to estimate the number of terrestrial planets within the circumstellar habitable zone tend to reflect the availability of scientific data. A 2013 study by Ravi Kumar Koppalapu put these at 0.08, meaning that there may be roughly 95-180 billion habitable planets in the Milky Way. Previous studies have been more conservative. In 2011 Seth Borenstein concluded that there are roughly 500 million habitable planets in the Milky Way. NASA’s Jet Propulsion Laboratory study based on observations from the Kepler mission, raised the number somewhat concluding that about “1.4 to 2.7 percent” of all sun-like stars are expected to have earthlike planets in the Milky Way. NASA’s Jet Propulsion Laboratory study based on observations from the Kepler mission, raised the number somewhat concluding that about “1.4 to 2.7 percent” of all sun-like stars are expected to have earthlike planets “within the habitable zones of their stars”, a figure about 2 billion habitable planets for the entire galaxy.

Estimates for the habitable zone within the Solar System range from 0.725 to 3.0 astronomical units, though arriving at these estimates has been challenging for a variety of reasons. Venus, for example, has an orbit whose aphelion touches the inner reaches of the Solar System’s habitable zone, but has an extremely thick carbon dioxide atmosphere which causes the surface temperature to reach 462°C. While the entire orbits of the Moon, Mars, and dwarf planet Ceres lie within various estimates of the habitable zone, and seasonal flows on warm Martian slopes have not yet been ruled out, the three bodies have atmospheric pressures that are far too low to create a strong greenhouse effect and sustain liquid water on their surfaces. Most estimates, therefore, are inferred on the effect that repositioned orbit would have on the habitability of Earth or Venus. According to extended habitable zone theory, however, a planet with a more dense atmosphere than Earth orbiting in the extended habitable zone, such as Gliese 667 Cd or Gliese 581 d, might theoretically possess liquid water.

Estimates of the circumstellar-habitable-zone boundaries of the Solar System

<table>
<thead>
<tr>
<th>Inner Edge (AU)</th>
<th>Outer Edge (AU)</th>
<th>Year</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.725</td>
<td>1.24</td>
<td>Dole 1964</td>
<td>Used optically thin atmospheres and fixed albedos. Places the aphelion of Venus just inside the zone.</td>
</tr>
<tr>
<td>0.88 - 0.912</td>
<td>Rasool and DeBurgh 1970</td>
<td>Based on studies f Venus’s atmosphere, Rasool and DeBurgh concluded that this is the minimum distance at which Earth would have formed stable oceans.</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Fogg 1992</td>
<td></td>
<td>Used the carbon cycle to estimate the outer edge of the circumstellar habitable zone.</td>
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Astronomers use stellar flux and the inverse-square law to extrapolate circumstellar-habitable zone models created for the Solar System to other stars. For example, while the Solar System has a circumstellar habitable zone centered at 1.34 AU from the Sun, a star with 0.25 times the luminosity of the sun would have a habitable zone centered at 0.5, the distance from the star, corresponding to a distance of 0.67 AU. The location of a star’s habitable zone depends upon its luminosity. Because a star’s luminosity increases with time, both the inner and outer boundaries of its habitable zone move outward. Thus, a planet that is in the habitable zone when a star is young may subsequently become too hot. Venus may have been such a planet; however, because it is geologically active, its current surface is too young to show any evidence that a more clement climate may have existed billions of years ago. Other planets could be too cold for liquid water to exist when their star is young but might warm up enough to have liquid water on their surface later as their star’s luminosity increases. This may happen to Mars a few billion years hence. Thus, the most promising region to find Earth-like life would be in a “continuously habitable zone”, where liquid water could have been present from early in the star’s life up to the current epoch. The continuously habitable zone of the Sun (from our billion years ago to the present) is from about 0.9 to 1.688 astronomical units. Beyond this, though, there are numerous roadblocks to a perfect extrasolar extrapolation of the circumstellar habitable zone concept. It is expected that the concept of a circumstellar habitable zone is actually limited to stars in certain types of systems or of certain spectral types. Binary systems, for example, have circumstellar habitable zones that differ from those of single-star planetary systems, in addition to the orbital-stability concerns inherent with a three-body configuration. If the Solar System were such a binary system, the outer limits of the resulting circumstellar habitable zone could extend as far as 2.4 AU.
Circumstellar habitable zones change over time with stellar evolution. For example, hot O-type stars, which may remain on the main sequence for fewer than 10 million years, would have rapidly changing habitable zones not conducive to the development of life. Red dwarf stars, on the other hand, which can live for hundreds of billions of years on the main sequence, would have planets with ample time for life to develop and evolve. Even while stars are on the main sequence, though, their energy output steadily increases, pushing their habitable zones farther and farther out; our Sun, for example, was only 75% as bright in the Archaean as it is now, and in the future continued increases in energy output will put Earth outside of the Sun’s habitable zone where water would be lost as a result of runaway greenhouse effect leading to the earth becoming hotter and hotter until the water boiled away.

5 RECOMMENDATIONS

The human population on the earth is about 7.0 billion. Therefore only about 0.5 m2 of the Sun’s surface is available to supply the needed energy for each person on earth. This limited supply is needed for the production of oxygen, food, heat, clothing, living space, vehicles etc. What about other species? It is estimated that currently only about 1% of Sun’s radiation is absorbed by the photosynthesizing organisms. The influx of the Sun’s energy will not be able to sustain our growing population and growing individual consumer demand. A closer look at the above numbers raises the question – Do we want to survive? Do we want a decent life? Afterall many species and plants have extinct due to human interaction with environment and biosphere. The need for the coming future is to search for the space colony to inhabit the population.

This paper provides the ground through exploration of space colonization and search for habitable zone. Scientists are searching life properties like water and oxygen on Moon. Gravitational and tidal forces on Moon may create the habitable environment by attracting comets and asteroids on the surface. As we know Earth is at the inner edge of the habitable zone and close to, but just outside of the runaway greenhouse limit, it affects the Moon and evaporate the water from the surface. It may be possible to make low atmospheric pressure on the Moon to create a strong greenhouse effect and sustain liquid water on the surface.

It has been observed that about four billion years ago, the sun was 40 percent less luminous than today. But due to the long distance from the sun, Earth and Mars may have been much cooler at that time. Venus may have been the first rocky inner planet to develop warm oceans and a mild climate because it is closer to the Sun. After a long time, sun’s luminosity was increased and the life on the Venus was extinct. As per the theory of Panspermia, it is even possible that life on Earth may have evolved from life forms ejected from Venus, because pieces of planets were blasted off of each other much more frequently in the early Solar System by asteroidal and cometary impacts and so microbes from Venus could easily have ended up landing on Earth. Afterwards due to the planet’s runaway greenhouse effect the life was transferred, emerged and evolved on the Earth for the last more than 2 billion years. Due to the increasing luminosity of the Sun, it will put earth outside of the sun’s habitable zone where water would be lost as a result of runaway greenhouse effect leading to the earth becoming hotter and hotter. Earth would become the dead planet like Mercury and Venus and the life would be emerged on the planet Mars.

REFERENCES