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Interstellar Molecular Species and the Existence of Life on Earth: A Mini-Review

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Abstract: *The pursuit for confirmation of interstellar life in our Astral System is presently shown by our understanding of earthly biology and its linked bio-signatures. Development and genesis of life must be intensely reliant on the condition or nature of the environment at which it exist. Formation of an atmosphere is one of the key significant procedures in the early Earth development. The genesis of life on earth centered on bimolecular homo-chirality which has been a great mystery whether or not life originates from both enantiomers and one of the enantiomer tends to degrades overtime or the formation of biomolecule is led by homo-chirality. The dust and grain creating stars and planetary system previously possesses a surplus of Dextro-rotatory sugars and Lavo-rotatory amino acids when fused into proteins and primeval organisms. As a result, the evolving life must certainly be chiral. Dust particles play a key role in life initiation in interstellar molecular mists. The interstellar space is not empty but filled with numerous simple and complex organic molecules which are believed to have been a helping hand to the formation of life on the earth rhyme.*

1. INTRODUCTION

Within the external galaxies and Milky Way, the space in-between the stars are packed with an interstellar medium (ISM) comprising of dust and gas. The Interstellar medium can be separated into diverse constituents with very diverse physical factors, alternating from a highly scorching temperature (106 K), diluted particles less than $10^{-2}cm^3$ heated by supernova detonations, which occupied greater than half (1/2) of its total volume, to molecular clouds having temperatures ranging from 10 to 100K and molecular hydrogen (gas) masses from a hundred to about 108 units (per cm^{-3}), which turned to be less than 1% by volume of the interstellar Medium. Interstellar dust is approximately 1% of ISM total mass (microscopic amount). Examination from infrared wavelength, radio, sub-millimeter, and millimeter resulted to the discovery of hundreds of several molecules in the circumstellar shell interstellar cloud. Diethyl ether and cyanopolyyn are largely detected also many others organic compounds with significant complexity have been discovered, Bell et al., (1999) and Kuan et al., (1999).

These organic molecules, whose abundance proportions comparative to molecular hydrogen of less, and in numerous circumstances much fewer than 10-4, are essential tracers of both the chemistry and physical condition of numerous kinds of circumstellar and interstellar environs. In spite of their comparatively low profusions, the complexity and variety of carbon-based (organic) compounds presently discovered in space designates a dynamic chemistry and omnipresent distribution, Ehrenfreund et al., (1998) and Van et al., (2000).

Celestial organics may perhaps have engaged in recreation role in the evolution and origin of life, Oro (2000) and Chyba et al., (1990).

The biogenesis of the lone chirality of numerous biomolecules is quiet a great mystery. The queries are: Does life begin by via both kind of chirality, and then later on one of the kind vanished? Or did the selection of homo-chirality dominate the creation of biomolecules that possibly will ensure duplication and information transference? Is the natural selection of D-sugars and L-amino acids on

which existence is centered deterministic or unsystematic? Was the handedness in our Cosmos present from the eras of the Big Bang? These mysterious posed enticing queries for generations of scientist, Mauksch et al., (2010).

2. Theory of Chirality

Alongside the problematic issues of trace element vitality, we should think through about a closely associated problem of chirality. A live being is a structured system of molecules possessing a specific handedness, called homochirality. Chiral molecules are labeled levorotatory (L) or dextrorotatory (D) in accordance to the left and right direction, correspondingly, by which the crystalline form the chiral molecules, rotates a beam of polarized light. Protein and nucleic acids (biological polymer) use virtually the entire Detro sugars and Lavo amino acids. Except glycine as it has two hydrogen atoms that cannot be distinguished linked to its alpha carbon. The synthesis done in the laboratory from optically none active precursors yield racemic mixture D and L isomer. The remaining 19 out of 20 amino acids that were used in the synthesis of proteins can occur as D- or L- enantiomers. The device that influenced the selection of enantiomers when life initiate is still a mystery. Several proposals has been given, such as the optically active, quartz diverged light and usual radioactivity. A new mechanism was proposed that could result in chirality surplus, supposing that amino acids were manufactured on dust bits in interstellar space. The bombardment by intergalactic beam of high-energy protons separated in magnetic fields. Kolokolova (2015).

Displaying that the evolution from interstellar molecular clouds to stars and the other planets offers an appropriate environs for nucleo-base production in space, we can assume that life started chiral because it was originated in the interstellar molecular clouds with a major role played by magnetic fields, dust particles and exposure to intergalactic rays. The opinions supporting the assumption are put forward based on several physics laws and astral observations carried out, Stolar (2020).

Chirality infiltrates much of present science, starting from the physics of fundamental particles through space science and then to chemistry of life. As known on Earth, life is a biochemical structure proficient in self-reproduction and development and is grounded on chiral molecules. Life has so many definition, for example, Pross (2013), suggested a new description of life: “a self-sustaining or sufficient kinetically unchanging self-motivated reaction system derived from a duplicating reaction”. Nevertheless, even according to the author, the word dynamic kinetic unchanging is moderately challenging to quantify, Pascal (2013). But, the query of why life is fabricated on homo-chiral biomolecules or the reason why it was not erected upon the mirror images of chirality is still one of the utmost mysteries regarding the genesis of life Riehl (2010).

3. Origin of Life in Space

As reported by (Greenberg 2002), the interstellar dust is combined to gas mists and, for that reason carried about the Milky Way. The clouds (mists) come in an extensive variety of temperature, shapes, densities, temperatures and sizes. Nevertheless, they can be qualitatively categorized into two elementary categories: interstellar molecular clouds and interstellar diffuse clouds.

The concurrent discovery of uracil, thymine and cytosine (pyrimidine) and adenine, hypoxanthine and xanthine (purine nucleo-bases) in interplanetary ice analogs consist of less molecule of complexity such as CO, H2O, CH3OH and NH_3 after disclosure to ultraviolet photons (radiation) accompanied by thermal heating (processes), similar circumstances that instigate the chemical processes resulting to star materialization (formation) from molecular mists. Their outcomes intensely propose that the progression from molecular clouds to the formation of stars and planets offers a suitable atmosphere for nucleo-base formation (synthesis) in space, Oba et al. (2019). As stated earlier by Wachtershuser (1994), Ancient organic molecules molded close to hydrothermal systems; the source of the energy necessary to moderate the carbon (iv) oxide might ought to have been delivered by the oxidative establishment of pyrite (FeS2), generated from iron hydrogen sulfide gas (H_2S) and sulfide (FeS). Pyrite possesses positively charged surface and links carbon (iv) oxide reduction product, resulting to the formation of a two-dimensional reaction structure, named a “surface metabolism.” Research laboratory examination has given support for this favorable new “metabolism-first” methodology. Iron sulfide, carbon (iv) oxide and hydrogen sulfide react under anaerobic (absence of air) conditions to yield a sequences of thiols, which includes methanethiol and hydrogen. Acetic acid and methanethiol have also been acquired from hydrogen, carbon (ii) oxide, iron sulfide and nickel

sulfides, and catalytic quantities of selenium. Under particular state, thioesters are produced that probably the trigger for the metabolic motivating dynamism of a "thioester world," according to de Duve (1998). Thioesters are sulfur-bearing organic compounds that presumably would have been present in a sulfur-rich, volcanic environment on the early Earth.

Celestial life, meaning life on a planetary body of a solar system apart from our own life on earth, will not be reachable to space operations in the anticipatable future. The difficult trial of discovering unsociable life must then be tackled by astrophysicists and radio starwatchers. The concurrent discovery of carbon (iv) oxide, hydrogen and ozone (an easy noticeable and significant monogram of oxygen) in space would constitute the greatest substantial biomarker but not entire evidence. Other irregularities in the space of telluric exo-planets (rocky Earth-like planetary body), for example the discovery of methane, could be the signature of a celestial life. Astrophysicists in the European nations are suggesting the creation of a flotilla of four free flying space ships, each of them constituting an infrared of 3m diameter telescope, to search for biomarker of life on solid rocky (terrestrial-like) planets. A mission, named Darwin-IRSI, is currently under research at ESA. In conclusion, the discovery of a definite electromagnetic indicator through the Search for Interstellar Intellect program would clearly be a stimulating event as stated by Andre (2014).

As discussed by Elpiner et al., (1964) that ultrasonic tremors (vibrations) can create organic compounds, comprising formaldehyde and hydro-cyanides contained in water flooded with Carbon (ii) oxide and Nitrogen. The reactions happen in cavitation foams where by on failing, generate extreme hydraulic vibration complemented by short-term but very great force and temperature rhythms. Anbar (1968) disclosed that cavitation take place in structures mimicking ocean waves and dropping water; amino acids are formed when the water enclosed methane and ammonia. In recent times Bar-Nun et al establish that amino acids are manufactured in gas blends by shock waves act out the entry of meteorites into the stratosphere Bar-Nun et al., (1970).

The space and ocean were created by outgassing starting from the molten inner of the earth. Carbon monoxide is steady at magmatic temperatures and also would have been the major system of outgassed carbon. The most stable state of carbon is methane in a reducing space at low temperatures, conversely, and would have been made sluggishly from carbon monoxide on cooling. The CO is also a component of the Martian space, and it is a main constituent of interstellar clouds. The process of reduction of carbon monoxide by Hydrogen gas is enhanced by numerous metallic catalysts, which has been foundation of the Fischer-Tropsch procedure for synthesizing hydrocarbons, Anders et al., (1973).

Steadiness of Ammonia in the embryonic space, ammonia is thermodynamically preferential state of nitrogen in a decreasing atmosphere at conventional temperatures Miller and Urey (1959). The absence of an ozone canopy in such an atmospheric environment would, nevertheless, license prompt photolysis of ammonia (into N_2 + H_2) by ultraviolet wavelengths smaller than 230 nm, Abelson (1966).

In time past, Bada and Miller (1968) made a resourceful evaluation of the minor limit of ammonium in the embryonic ocean centered on the point that NH_3 is essential to inhibit the deamination of an aspartate in solution, About 10^{-3}M was estimated, lead to a least possible pressure of approximately 10^{-6}atm ammonia in the outer space.

In recent theoretical studies, Ferris et al., 1974 and Nicodem et al., 1972 it was discovered that photolysis of ammonia is so quick that its lifespan would not have surpassed a small number of millions of years under settings usually measured convincing for the embryonic earth. The existence of hydrogen gas at higher pressure beyond 50 torr could have maintained ammonia gas by generating it continuously, which is more efficient compare to the release of ammonia through hydrolysis of uric acid (urea) by reacting carbon (ii) oxide and ammonia gas. Nevertheless, lack of these instruments, it give the idea that either ammonia had no part in the derivation (origin) of life, or its part was accomplished within few millions of years earlier in the history of the earth.

An interstellar genesis of life on Earth through celestial transfer of living entities, as suggested previously by Arrhenius in 1903, seems improbable. Certainly, some creatures (particularly their spores) are capable of surviving in environments of extreme radiant emission and temperature on Earth and it has been debated that such kinds could live interstellar space. Conversely, recent research

have revealed that the existence possibility for living beings entrenched in asteroids, comets and interstellar dust contributing on the young (early) Earth was insignificant as started by NRC Report Task Group (1998). In disparity, the conceivable conveyance of interstellar organic compounds through infilling asteroids and comets is a solemn likelihood as described by Chyba et al., (1990) and Oro (1961).

The very slight gap amid the end of the substantial bombardment stage and the proof for primitive creatures favors the notion that impacting prebiotic material probably could have been the first step to life. However it cannot be omitted that living beings and organic matters are established in the vicinity of protected areas of the seas/oceans or within the Earth's terrain, a significant portion of the Earth's prebiotic account of water and organic molecules may have been originated from interstellar space. Intensive examination revealed that certain minor particles can be mildly slowed by the atmosphere of the Earth and may have conveyed complete organic compounds to the earth at the early stage, Chyba (1992) and Anders (1989).

Development and genesis of life must be intensely reliant on the condition or nature of the environment at which it exist. Formation of an atmosphere is one of the utmost significant procedures in the early Earth development. The primeval atmosphere originating through the gathering of gases released out from the surface must be correlated with conformity to volcanic discharges and it alignment, in turn, rest on the inner structure of the earth such as the oxidative state of the higher layer. Present time proof intensely favors the scorching (hot) accretion model, by which the Earth fundamentally molded in a differentiated manner, Kasting (1993).

The premature atmosphere enclosed minute or no oxygen gas. The concentration of oxygen amplified significantly about 2.0 x 10^9 years ago as a result of photosynthetic action of microbes. Global warming caused as a result of slight release of methane gas into the outer space may have molded an organic cloud layer, which air-conditioned the environment and protected embryonic life from ultraviolet radiation about 3.5 to 2.5 x 10^9 years ago, Pavlov (2000). Currently analysis of Precambrian muddy (sedimentary) rocks have exposed an insightful modification in chemical reactions comprising oxygen and sulfur in the outer space that transpired in between 2.1 x 10^9 and 2.5 x 10^9 years back. For the duration of this exact period, the level of oxygen has greatly increased in the atmosphere. As a result of the rise of oxygen in the outer space, it is said to be the key step in the development and creation of life on earth, Pavlov (2000).

4. INTERSTELLAR BIOLOGY

In view of the potentials for life existence on other planets, it is anticipated that any of such a life is essentially be founded on chemistry. The unique property of carbon atom that is appropriate for the building of living matter (organism) has often been pronounced. There is no reliable alternative to life order than carbon based that has been document. The interstellar profusion of light (simple) elements, including carbon and its compounds add supplementary weight to the theory of existence of life on earth. If the prior postulate is accurate, therefore most of the physiques in the interstellar system can be eradicated as conceivable habitations of existence (life) on the basis of two consequences: Firstly, for the reason that carbon compounds of low molecular weight are typically volatile, objects that cannot hold them, will surely give room for them to be lost into the atmosphere. However it seems inevitable that such compounds would be manufactured from living organisms, would enter the outer space, and would in fact have a crucial part in the cycling of substance that must take place on whichever life supporting planet. It shows that bodies devoid of an atmosphere are incompatible for life existence. The second consequence is that planets with high temperatures (150°C) are absolutely unsuitable for life, because at such a temperature carbon compounds turn out to be unsteady based on geological time-scale. Inference can be drawn based on this fact that it is impossible for life to exist in the moon or the other satellites in the interstellar space neither in mercury because neither of them meets with the reasonable criteria that supports life existence. Conclusion has been made on the case of the moon by verifying with Apollo sample. The temperature of Venus ranges from 400 to 500ºC which is extremely too high to support the existence of life of any kind, (Horowitz et al., 1970; Etim *et al*., 2018, 2020, 2021).

About 4.5 x 10^9 year back, immediately after the creation of the Earth, the earth delivered a very unfriendly condition for existence. Volcanic discharges from the heated internal and exterior substantial bombardment by insignificant bodies may have quenched emergence of life on a quick

time scale. The evidence for life was first provides by microfossil about 300 million years ago, Schopf (1993). Today, investigation on the starting point of life is an interdisciplinary ground, which aside biologist it also includes chemists, geologists, physicists and astronomers. Various theories for the genesis of life exist which are centered either on earthly or an interstellar origin, McKay and Whittet (1997).

5. CHIRALITY IN INTERSTELLAR SPACE, A FACILITATING HAND TO LIFE ON EARTH

Every living organism on Earth make use of one and only single handedness of several kinds of chiral molecules. This attribute is known as homo-chirality; it is serious for life and has significant consequences for numerous genetic structures, including DNA's binary helix. Researchers are yet comprehend how biology came to depend on homo-chirality (one handedness) and not the other. The response, the scientists venture, may be establish in a manner, these molecules logically formed in intergalactic before being united into comets and asteroids then later was deposited on newly developed planets. "Meteorites in our Stellar System comprise chiral molecules that exist before the Earth itself, also chiral molecules have in recent times been discovered in comets," famous Carroll. "Such insignificant bodies could be what strapped life to the handedness we observe today." "By discerning a chiral molecule in interstellar, we in conclusion have an approach to study wherever and how these molecules produced before they proceeds into comets and meteorites, and to recognize the part they play in the genesis (origins) of life and homo-chirality," (McGuire *et al 2016)*.

6. ASTRONOMICAL MOLECULES

Rank (1971) and Buhl (1971) stated that microwave spectroscopy is been used by astronomers in the modern day to discover a huge number of molecules of genetic significance in interplanetary space. These molecules are established in relationship with dust clouds that transpire in diverse regions of the space, remarkably in the course of the pronounced nebula in Orion. It is usually thought that the dust particles have a catalytic part in the creation of the molecules from the esoteric intergalactic gas, and it is definite that they protection them from photolysis by astral ultraviolet radiation. Meanwhile there is purpose to reason that dust clouds are areas where planetary systems and stars are formed, the discovery of molecules that ought to have been identified in research laboratory experiments as prospective evolutionary starting materials of nucleotide and amino acids is a matter of rare interest. Almost twenty seven molecules have been discovered in interplanetary clouds, amongst the discovered, hydrogen cyanide, hydrogen gas, formamide, water, carbon (ii) oxide, methanol, ammonia, acetonitrile, hydrogen sulphide, cyano-acetylene, formic acid and acetaldehyde are biologically useful. Microwave spectroscopy was used to identify the entire aforementioned molecule excluding H_2, which was discovered by optical astrophysics (Etim and Arunan, 2015, 2016, 2017; Etim *et al*, 2016, 2017a, b,c). As reported earlier by Oro (1972), this list comprises of what are commonly deliberated to be the utmost significant prebiotic starting materials of purines, amino acids, sugar and pyrimidine.

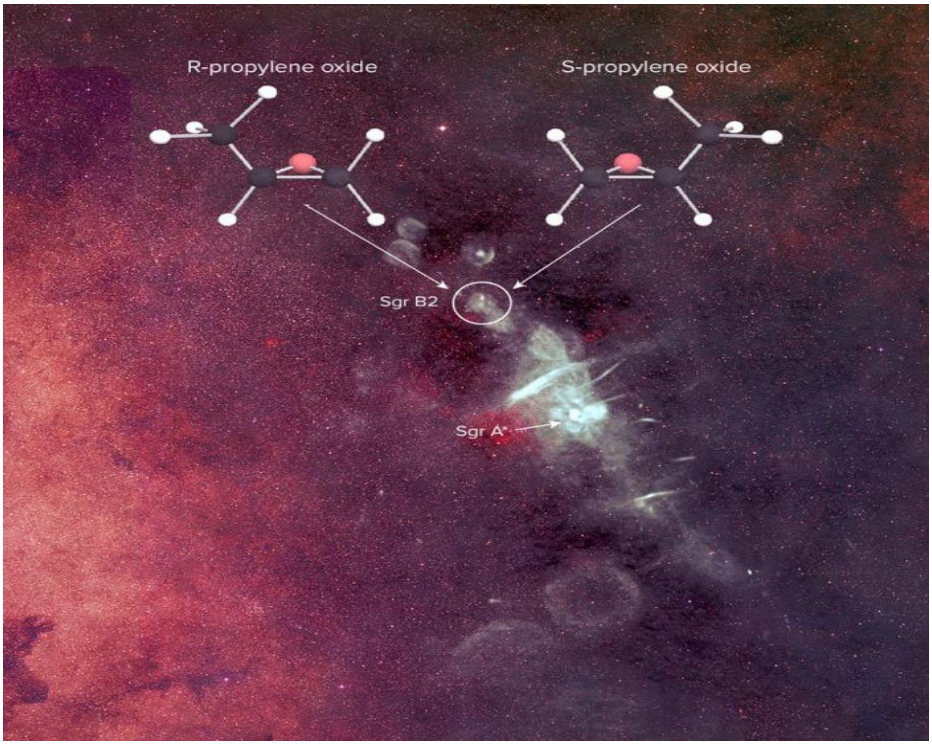
Most of the species were discovered at short radio wave-lengths, at appoint whereby they have pure rotational shift (transitions). The heterodyne modus operandi engaged allow elevated frequency resolution, reducing the possibility of unintended line coincidences, even though the fertility of the spectra can as well lead to misidentifications and misperception, Dickens et al (1997) an the misconception was recognized by Ellder et al., (1980).

Molecules that are non-polar, example ethyne, were observed through ro-vibrational shifts through Infrared spectroscopy, naturally in absorption against light background sources such as radiant young stars entrenched in the clouds. Chemical or biochemical processes in the gaseous phase in cold, inert clouds are mainly ionic molecule reactions, driven principally by interstellar ray ionization of molecular hydrogen. Premeditated abundances of experimental molecules match the opinions relatively well as reported by Dickens et al (2000) and Pratap et al (1997), even though the agreement hinge on a restricted range of parameters, for example longevity (age) of the cloud and the proportional abundance of oxygen gas and carbon in the stellar space.

Other physical factors such as density and temperature could directly be gotten from the molecular line radiation. The enormous values for the hydrogen cyanide and isocyanides abundance proportion have also been deliberated to be a typical pointer of ionic molecular chemistry, resulting in the discovery of hydrogen cyanide in comets of distinct curiosity as stated by Irvine et al (1998a). As icy

clouds develop, and mainly as cores breakdown as fragment of star formation, molecules froze onto the grains, developing cold layers over the original organics and silicates, Ehrenfreund and Schutte (2000).

As studied by Brown and Charnley 1990, active chemistry happens on grain planes and can result to the establishment of complex astronomical molecules. At the grains surfaces atoms such as oxygen, hydrogen, nitrogen and deuterium have efficient vigor to interact at temperature of 10 K. Simple thermodynamic (exothermic) reactions involving the addition of hydrogen can explain the formation process of light molecules such as ammonia, water, methane etc. Nevertheless slightly complex such as methanol and other organic compounds necessitates that it takes place at cold mantles.



The two enantiomers of propylene oxides. Tribute: B. Saxton, NRAO/AUI/NSF from information delivered by N.E. Kassim, Naval Research Laboratory, Sloan Digital Sky Survey "Meteorites in our Stellar System comprise chiral molecules that preexist Earth itself, and chiral fragments have in recent times been discovered in comets," (Mondal *et al*., 2021; Carroll *et al, 2016)*. "Such insignificant bodies may be what spring up life to the chirality we see today.

Year's back, acknowledgments to the speedy enlargement of radio-telescopes and interplanetary missions, the number of complex organic molecules discovered in space has been an unbelievable progression. In precise, the interstellar medium was found to be inhabited of diverse organic molecules, such as propylene Marcelino et al., (2007), cyanic or isocianic acids, Brunken et al., (2010) and Snyder and Buhl (1972), form-amide, Rubin et al., (1971), complex organic molecules glycolo-nitrile Zeng et al., (2019) and Z-cyanomethanimine Rivilla et al., (2019). Recently, the propylene oxide was discovered in Sagittarius B2 McGuire et al., (2016). Their spectral structures are produced by alterations of constituent electrons between diverse energy levels or by vibrational or rotational spectra. Discovery frequently occurs in infrared, radio or microwave portions of the spectra band, Pfalzner *et al, (2013*).

Intergalactic molecules are molded by biochemical reactions inside very sparse interplanetary or circumstellar gas, clouds and dust. Ordinarily this takes place once a molecule is ionized, habitually as a result of collaboration with celestial ray. These cationic charged molecules then attract a nearby neutral molecule's electron through electrostatic attraction. These molecules can be generated also by reactions between molecules and neutral atoms, even though this progression is usually slower, Ewen *et al, (1951*). The dust plays a vital part in protecting the molecules away from the ionizing influence of electromagnetic particle emitted by stars. (Weinreb *et al, 1963*).

7. CONCLUSION

The quest for absolute evidence of existence of life in our Astral System will necessitate a matching set of depths that concentrate on pinpointing the distinguishing features of life such as the prospective bio-signatures. The homo-chirality of sugars and amino acids is one among several unique features of existence on Earth which could be examined in the pursuit for chemical confirmation of interstellar life. The discovery of chiral asymmetry of many organic molecules with inclusion of amino acids will need to be cautiously understood and interpreted in the context of several other crucial interpretations. The previously proposed "Hierarchy of Life Discovery" starting point for biotic chemistry centered on the amount of asymmetry amino acid is inadequate based on our modern information of investigational evidence and prebiotic chemistry in meteorites for abiotic enantiomer enhancement processes that could yield much more enantiomeric excesses. The detection of a second origin of life is a systematic prerequisite for the investigation of the origin of life. It will validate that life does not come about as a black magic that is it does not come as a one-step route instead a stepwise systematic phenomenon. Numerous researchers are persuaded that microscopic life is not limited to the Earth, but such verdict now necessities to be sustained by evidences.

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