Proceedings of the 2023 International Conference on Mathematical Physics and Computational Simulation
DOI: 10.54254/2753-8818/10/20230344

Extraterrestrial creature's existing and planets' factors

Zizheng Yang[1, †], Liyuan Yu[2, †] and Yuhe Zhao[3, 4, †]

[1] A-Level Center of Jinan University Town Experimental High School, Lixia District, Jinan, 250000
[2] Farragut Academy, Heping District, Tianjin, 300000
[3] Traditional Chinese Medicine, Changsha Medical University, Changsha, 410000

[4] 1700210722@stu.sqxy.edu.cn
[†] These authors contributed equally.

Abstract. In order to explore the outer space and find the future of human development, this article aims to analyze the property of the extraterrestrial life's exist. Authors complete this investigation by talking about some different characteristics in and around the planets. First the authors will claim some characteristics (how this characteristic helps the extraterrestrial life survive), and then the authors will give some examples about some planets with these characteristics. Finally, the authors will analyze why these characteristics can be formed, the authors will analyze the conditions of the planets and set as examples. In fact, the authors will not just introduce the characteristics that helps extraterrestrial life survive, the authors will also discuss what environment in the universe can form planets with these properties. The authors discuss the liquid water, temperature and geographic elements in the first body paragraph, the authors discuss the atmosphere, satellites and the distance between fixed star and planet in the second body paragraph. In the third paragraph, the authors discuss the distinct that appropriate for planets to develop situation for creatures to survive.

Keywords: track shape, liquid water, atmosphere, geographic activity, dust cloud.

1. Introduction

1.1. Background information

Today's scientists are paying a lot of attention on exoplanets' exploring. Whether there's other lives on other planets has also piqued the curiosity of scientists. Some planets may be suitable for lives to survive and that means Something that often happens in science fiction will happen in the near future: interplanetary immigration. Analogy to earth, there are some key features about the exoplanets which lives can survive on it. Today's scientists applied some methods to explore a planet from a distance. According to the Professor Massomeh Mirrashid , scientists can observe the energy releasing by fixed star, using primary transit, to calculate some fundamental information for the planet, such as the size and temperature of the planet [1]. But for some specific characteristics for living creatures' survival, scientists need to apply more precise observing methods. In affirming the situation about a planet which similar to the earth, scientists also have many ways. According to Professor Nancy Y K , the exoplanet's exploring work is completed by building a model for this planet, scanning the atmosphere to know

DOI: 10.54254/2753-8818/10/20230344

ingredient about the gas on the planet and apply telescope to conduct some direct observation [2]. After hundreds of samples about planets which could be habitable for life entity, scientists detected many key features and our aim is to conclude these features. In fact, if there is a planet with these characteristics, it would be highly likely to be habitable for lives.

1.2. Preview

In this paper, the authors will show the characteristics suit for creatures to survive and they will list some evidences by analogy the similar situation on earth to show how these characteristics help creatures to survive. Finally, the authors will give some planets which have these characteristics as an example. At last, the authors will discuss which outside environmental conditions helps the formation about these characteristics. Finally, the authors will get a list of the criteria on and surround the planets which makes creatures maybe can survive. The quotient content takes up some length in this paper because it needs to quote evidences that mentioned in other people's paper. The authors will discuss from the planet itself and surrounding conditions separately for two body paragraphs(one paragraph maybe has 2~3 segments). After discussing these conditions, the authors will discuss which environment in the universe creates them and finally in the body paragraph 3 the authors will get a summing up for which district in our universe has the most property to produce a planet which is suitable for creatures to survive on it. Analogies and data analysis are the most commonly used methods in this article.

2. Main body

2.1. Heat

The first important characteristic of a planet which suitable for creatures to survive is temperature. The organic organism needs appropriate temperatures to make themselves metabolism and staying alive. The temperature first depends on how much heat absorbed from the fixed star. In fact, the planet's orbital trace has a far-reaching influence about the planet's temperature. The shorter the planet's orbit means the average radius of the planet's orbiting trace is shorter, so the planets can absorb more heats because of getting closer to the fixed star. In addition to measuring the average distance between fixed star and planet, it is requisite to measure out the entire orbit exactly. The orbit's shape most likes an ellipse so the radius of a planet's orbit is a variable value. This changing may cause temperature on the planet change intensifies.

2.2. Semi axis and tidal energy

Second, the rotation of a planet can also cause problems. An overlong rotating period can cause one side of a planet absorb too much energy from fixed stars and makes temperature peaking. Planets consist of fixed star clouds and these particles in dust clouds initially get an angular velocity, so the planet consisted of these particles will also carry an angular velocity. All the people know that gravitational force from the fixed star or other planets will change planetary rotation frequency, because these forces can inflict torques to the planet and change its planetary rotation frequency. But there are also many other factors for scholars to should consider. According to Stanton J. Peale's paper, Geographical activities on the planet which scientists want to observe makes a huge influence on the frequency of planetary rotation, especially some large-scale geographical activities, like tides and plate movements [3]. According to Jack Jonathan Lissauer's article, the collision caused by comets and other floating staffs in our university because the collision from other stuffs will also bring extra angular momentum to planet [4]. In Christian Bizouard's paper, even the planet's atmosphere can influence the frequency of the planetary rotation [5]. The or the atmosphere has a gravitational relationship with other celestial bodies, and that makes atmosphere gets an "Atmospheric angular momentum". According to the observed result, Earth's rotation frequency varies more than Mercury's because Earth has a thicker atmosphere than Mercury. The momentum of the atmosphere affects the rotation rate through the friction of the gases. In fact, to be more static, there should be less disturbing caused by collision of other stuffs in the space and gravitational torques of other planets. It will make a similar conclusion about how to form a planet with

DOI: 10.54254/2753-8818/10/20230344

static planetary rotation: the planet has a long semi-axis differ from a short semi-axis and it has a longer track length.

2.3. Greenhouse effect

Third, the ingredient of the atmosphere can also be an important factor of a planet (that means if there is a planet without an atmosphere, scientists can exclude it at first). According to Charlie Longmuir's paper, the original carbon dioxide gas in the Earth's early phase atmosphere slowed the dissipation of heat absorbed by the Earth [6]. The greenhouse gas in the atmosphere was crucial to form a favorable temperature for creatures occurred on Earth. So the researchers should make some accurate explorations about other planets' atmosphere ingredient. In Laura K. Schaefer's paper, the method to determine an atmosphere's ingredient is exploring a planet's spectrum and the composition of the atmosphere is explored by investigating the energy absorbed from light as when light passes through it [7]. Analogy to Earth, the brief greenhouse gas in ancient Earth's atmosphere is carbon dioxide. The quantity of carbon dioxide in atmosphere influenced the temperature's changing.

2.4. Cyanobacteria's suitable temperature

The authors use the analogy of cyanobacteria, early prokaryote on Earth. According to Richard D. Robarts's paper and Allan Konopka's paper, it's easy to find early Earth prokaryotes needed a suitable temperature (about 15 to 30 degrees) to revolve their body properly [8, 9]. To continue and thrive, the life needs a stable and comfortable temperature. Cyanobacteria, for example, have the highest survival rate when the temperature is between 15 and 30 degrees. This allows us to infer by analogy that the surface temperature of a planet with the right conditions for life should be constant or get an error on temperature range for no more than 10 degrees to ensure the most basic conditions for the life. When the temperature is lower than this range, the prokaryotes will enter hibernation mode or die, and when the temperature is higher than this range, the prokaryotes will die directly.

2.5. Water and gravity circulation

The liquid water is an imperative factor for creatures to survive. All known life forms are dependent on liquid water. The table below shows some typically planets to have water resources (included liquid water and solid water).

Table 1. Characteristics of some typical planets with water.

Planets' name	Average Temperature (degrees Celsius)	Atmosphere's Ingredient	Mass(kg)	Distance from the fixed star(km)	Liquid water or solid water
Earth	13.9	Nitrogen, oxygen, Carbon dioxide	5.97237 × 10^24	1.496×10^9	Liquid water
Ceres	-38	No atmosphere	9.43 ± 0.07 ×10^20	4.13×10^9	Solid water
Europa	-163	Thin oxygen	4.8×10^22	7.8 ± 0.0671 × 10^9	Solid water
Mimas	-178	DNE	3.84 × 10^19	1.2 × 10^9~1.59 × 10^9	Solid water
Planets' name	Average Temperature (degrees Celsius)	Atmosphere's Ingredient	Mass(kg)	Distance from the fixed star(km)	Liquid water or solid water

DOI: 10.54254/2753-8818/10/20230344

Table 1. (continued).

Pluto	-229	Nitrogen, Methane, Carbon monoxide	1.303 × 10^22	5.91×10^9	Solid water
Enceladus	-200	DNE	1.1×10^20	1.437 × 10^10-1.436×10^10	Liquid water
Titan	-179	Nitrogen	1.345 10^23	1.438 × 10^10-1.4358×10^10	Solid water

As making an analogy with the Earth, The Earth contains a lot of liquid water. First, the Earth's mass allows it to attract hydrogen and oxygen atoms, which not escape from the atmosphere. Second, the Earth is at an appropriate distance from the sun. The Earth has the right temperature to melt the ice on its surface, also didn't make its surface temperature be too high. Third, in the course of the Earth's development, there was once a comet with a lot of solid water hit the Earth, which replenished the Earth's water resources. It is obvious that in the top table. Some of them like Europa and Ceres and Titan don't have an appropriate temperature to melt the solid water on its surface, because they are too far from the fixed star. Some others like Mimas and Enceladus gets a low mass and this prevents them from attracting enough hydrogen and oxygen atoms to form a water system (Enceladus is an exception because the magma beneath it heats up groundwater so that the water spewing from its surface is liquid). So even if they had solid water resources on its surface, it would be hard for them to form a water cycle and give rise to life. The liquid water's formation's process, I would like to call it "the process of examining the conditions". First of all, if a planet doesn't have the right temperature, researchers should rule it out from having life, because the solid water can't melt and make creatures survive. Next, it's also important to test whether there's a sufficient mass. Heavier planets attract hydrogen and oxygen atoms around them. Now imagine a scenario which a planet has both two factors. The appropriate temperature makes water maintain liquid status and a lot of liquid water evaporates. But when it evaporates, the water vapor stays in the atmosphere because of the planet's massive mass. In Isaac M. Held's paper, even though he wrote that water vapor in the Earth's atmosphere caused a severe greenhouse effect that affected the survival of life on Earth, it is an obvious conclusion that water vapor is an important greenhouse gas [10]. Water vapor in the atmosphere is a good way to keep the planet's surface from losing heat to outer space, and maintaining the planet's temperature helps the water stay liquid. In fact, if a planet has a large quantity of liquid water, that liquid water will almost never change form, because it will be able to form a stable cycle I wrote above to maintain the water's liquid state.

2.6. Geological activity's fact on water ingredient

Whether the geology is active or not also play a role. To draw an analogy with the early Earth, too active a geology would not appropriate for life. According to the data. There have been five mass extinction events on Earth, and all five extinction events were associated with the sudden geographic activity. However, in these five mass extinction events, sufficient conditions have been prepared for the iterative renewal of life. The crustal activity changed the earth surface's relative flatness situation and created countless fissure, valley and peaks. During the crustal activity, due to the extrusion or tearing of plates, the surface of the planet which was squeezed up and higher than water level formed a certain living space for the possible emergence of terrestrial organisms and created conditions for the evolution of aquatic organisms in terrestrial organisms. In addition, the content and types of minerals (such as carbon, potassium, calcium, iron, etc.) In the Earth's crust are much higher than in the ocean, which can provide inorganic mineral ions that maintain the basic level of life for more complex organisms. Mineral resources on a planet can provide more sufficient conditions for the explanetary of exoplanetary life. Although it's not possible at current levels to detect whether an exoplanet has mineral ions that could support life, the authors.

DOI: 10.54254/2753-8818/10/20230344

2.7. Geological activity and environment

Geological activity is not just related to the changing of landform, but also influence a lot of the planet's climate. A very obvious example is about volcanos. The Figure 2 shows the structure of an erupting volcano.

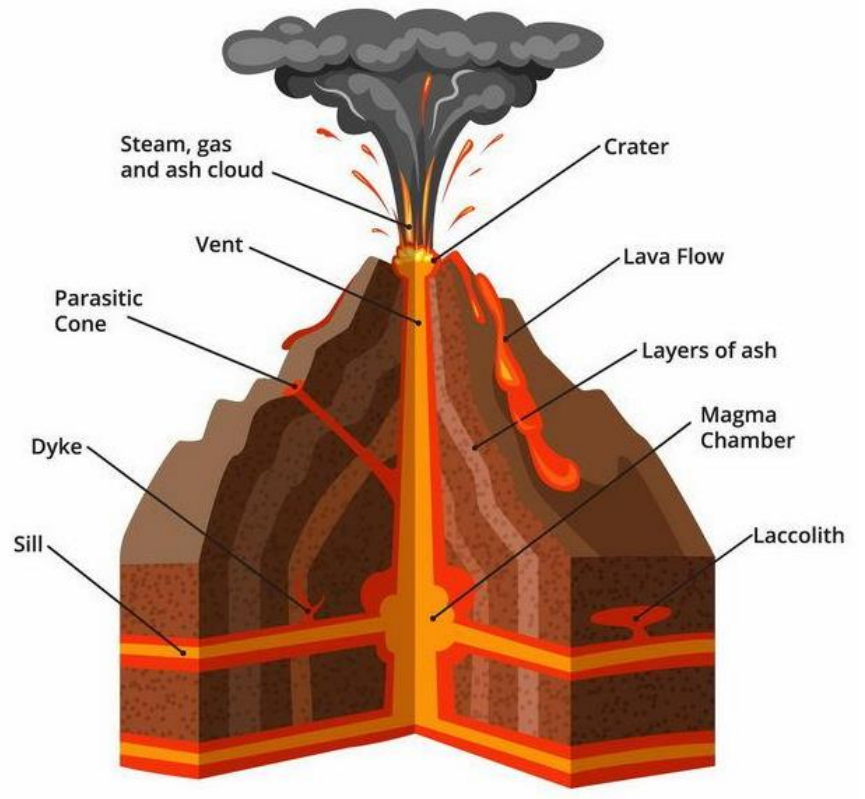

Figure 1. Volcano eruption's principle [15].

In Professor Tom Schils' paper, ash from a volcanic eruption falls into the sea and has a negative effect on the life in the sea [11]. Frequent geological activity usually made volcanic eruptions become a normal thing. Crustal movement extruded lava and form protruding peaks in the ground and finally the lava eruption happened. The frequent eruption of volcano means a large sum of toxic gas (like sulphide gases)'s emission and make the planet got appropriate for creatures to live. Also, the volcanic eruption will transfer the massive volcanic ash to atmosphere and these tiny fragments will remain at atmosphere for even several years. The floating volcanic ash will resist sunlight and makes the planet's temperature drop substantially.

2.8. Zones more possibly to have liveable planet

From subsections in body 1 and body 2, can sum up some elements about whether a planet is appropriate for creatures to live. Stable temperature and stable geographic activity give a planet a greater chance of having a life. The stable temperature is determined by the mass of the planet and the distance between fixed star and planet. The mass of the planet determines whether a planet can attract enough hydrogen and oxygen atoms to form water, and fixed star provides the keep to keep the planet warm. A steadier geographic activity can also make life easier to survive. So a habitable planet would first have to be closer to its fixed star. According to Ramses M. Ramirez's paper, a circle ring around the fixed star is called the habitable zone, planets in this zone can easier get a temperature suitable for life [12]. Figure 3 shows the structure of the habitable zone.

DOI: 10.54254/2753-8818/10/20230344

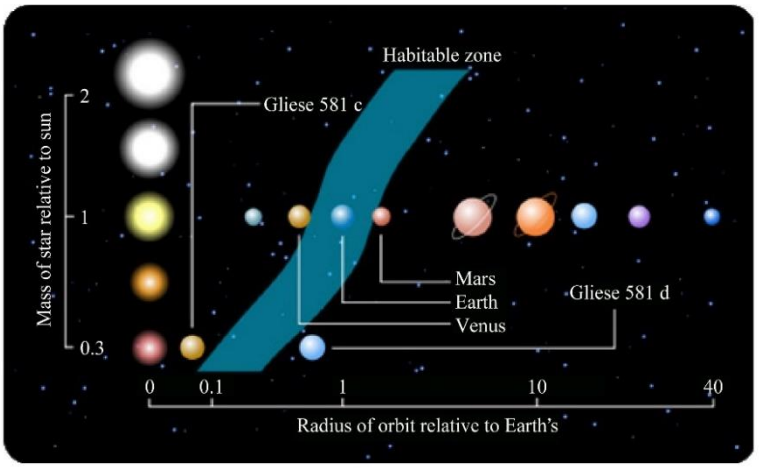

Figure 2. Habitable zone [16].

According to John C B Papaloizou's paper, the orbits trace of a planet and its rotation rate are determined by the dust clouds that made up the planet [13]. This suggests that the amount and motion way of the dust clouds determine the characteristics of the planet. Dust clouds with higher rotation speeds can form a fast-spinning planet. These dust clouds should not be too few. It takes more dust clouds to form a more massive planet. According to P. Woitke's paper, frequent large numbers of planets colliding in these regions of the universe, and these planets tend to form large clouds of dust as they break apart [14]. And the motion of these planets before decomposition often determines the motion and kinetic energy of the dust cloud, so it's indispensable to find places in the universe that are full of collisions of planets that move in particular ways before they break apart. Therefore, in places close to the fixed star and with a large number of planets, the probability of having habitable planets is higher than other places. It gets more possibility to find planets with creatures at these districts in our universe.

3. Conclusion

To summarize, this article's aim is to introduce a method of exploring extraterrestrial lives. This new method is supposed to be a good way to exclude planets without alien lives. From the previous description, in order to make alien life's exploration easier, the authors have described the basic characteristics of a planet to make life live on it. In the main body, authors analysed the situation by some different aspects: heat, static of orbital motion, geographic factors, liquid water's existing and position in the galaxy. Researchers can check out whether an exoplanet have creatures by checking the planet's heat and the position it placed. After reading, readers can exclude planets without alien lives more rapidly. But the authors also have some limitations with their study. Most evidences in this article are quoted from other scholars' article, and there is relatively lacking the authors' personal observation data. It's also a failure that the aspects of finding planets with creatures should combine with high-technology instruments. It's hard to find some useful result by only use methods mentioned in this article. Because of the lacking in professional technical instruments, most of the authors' verdicts are inferenced by themselves but not depend on rigorous data support. In fact, as technology develops, scientists will develop more efficient instruments to explore outer space planets more rapidly. With more efficient new technologies, this method can be used in rapid survey for outer space's creatures, so this method is hopefully to contribute more for astronomical in the future.

References

[1] Masoomeh Mirrashid, Hosein Naderpour 5 May 2022, Volume 7, June 2022, 100127Transit Search, an optimization alogorithm based on exoplanet Exploration - ScienceDirect.

[2] Nancy Y. Kiang, Shawn Domagal-Goldman, Mary N. Parenteau, David C. Catling, Yuka Fujii, Victoria S. Meadows, Edward W.Schwieterman, Sara I. Walker 1 Jun 2018, liebertpub Vol.

DOI: 10.54254/2753-8818/10/20230344

18, No. 6 Bioimprinting of Exoplanets: The dawn of a New era of planetary observation | astrobiology (liebertpub.com).

[3] Dynamics of planetary autobiography|Annual Review of Astronomy and Astrophysics (annualreviews.org) Peter Goldreich, Stanton J. Peale September 1968, Vol. 6:287-320(Volume publication date September 1968).

[4] The random component of planetary rotation - ScienceDirect Jack Jonathan Lissauer, Victor Sergeivich Safronov, Icarus Volume 93, Issue 2, October 1991, Pages 288-297.

[5] Influence Of The Atmosphere On Earth Rotation: What New Can Be Learned From The Recent Atmospheric Angular Momentum Estimates? (researchgate.net) Aleksander Brzeziniski, Christian Bizouard, Sergei D. Petrov 8 October 2001, Surveys in Geophysics, January 2002.

[6] Climate change and greenhouse gases(wiley.com) Charles Langmuir, Chair G, Eos, Vol. 80, No. 39, September 28, 199.

[7] The Air Over There: Exploring Exoplanet Atmospheres | Elements | GeoScienceWorld Laura K. Schaefer, Vivien Parmentier, Elements (2021) 17(4): 257-263.

[8] Temperature effects on photosynthetic capacity, respiration, and growth rates of bloom‐forming cyanobacteria: New Zealand Journal of Marine and Freshwater Research: Vol 21, No 3 (tandfonline.com) Richard D. Robarts, Tamar Zohary, Pages 391-399 | Received 19 Feb 1987, Accepted 21 Apr 1987, Published online: 30 Mar 2010.

[9] Effect of Temperature on Blue-Green Algae (Cyanobacteria) in Lake Mendota | Applied and Environmental Microbiology (asm.org) Allan Konopka, Thomas D. Brock, Research article, 1 October 1978.

[10] Water Vapor Feedback and Global Warming | Annual Review of Environment and Resources (annualreviews.org) Isaac M. Held, Brian J. Soden Vol. 25:441-475 (Volume publication date November 2000).

[11] Episodic Eruptions of Volcanic Ash Trigger a Reversible Cascade of Nuisance Species Outbreaks in Pristine Coral Habitats | PLOS ONE Tom Schils, October 4, 2012.

[12] Geosciences | Free Full-Text | A More Comprehensive Habitable Zone for Finding Life on Other Planets (mdpi.com) Ramses M. Ramirez, 28 July 2018, Geosciences 2018 8(8), 280.

[13] Planet formation and migration - IOPscience John C B Papaloizou, Caroline Terquem, 9 November 2006, Reports on Progress in Physics, Volume 69, Number 1, Stellar atmospheres.

[14] Dust cloud formation in stellar environments - II. Two-dimensional models for structure formation around AGB stars | Astronomy & Astrophysics (A&A) (aanda.org) P. Woitke, G. Niccolini, 29 March 2005, A&A Volume 433, Number 3, April 3, 2005, Stellar atmosphere.

[15] Figure 1 : Volcano structure - Bing images.

[16] Figure 2 : Habitable zone - Bing images.