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Review Article

The Future of Universe, Sun, Earth and Humanity

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Abstract

This article aims to present the origin and evolution of Universe, Sun and Earth as well as alternative solutions for the survival of humanity with the end of Earth planet, Sun and Universe.

Keywords: Future of humanity; Origin and evolution of universe; Sun and earth

Introduction

This article aims to present the origin and evolution of universe, sun and earth and their probable future as well as alternative solutions for the survival of humanity with the end of earth planet, sun and universe. This article presents alternative solutions for the survival of humanity when dealing with asteroids coming from outer space, the collision among the Andromeda and Milky Way galaxies, the increasing of distance of moon in relation to earth, the death of sun and the end of universe in which we live. This study was based on research of the existing on cosmology literature about the origin and evolution of universe, sun and earth planet. The methodology used in the execution of the work consisted of identifying how universe, sun and earth planet work, as well as the factors that would lead to the end of each one of them, besides identifying the alternative solutions for the survival of the human species and the technological breakthrough needed to achieve this goal.

The Origin and Evolution of the Universe and its Probable Future

The vast majority of scientists believe in the big bang theory, which would have started the universe we know. According to the theory, about 13.7 billion years ago all the matter that constitutes the universe was concentrated in a single point, which exploded, giving rise to everything we know. The big bang is proven by several scientific observations [1,2]. However, explaining what existed before the big bang is, however, a much more arduous task. This explanation attempts to unite Einstein's theory of gravitation with quantum mechanics, suggesting that there are universes parallel to ours. The big bang would be the result of the clash between two of these universes. This idea results from the superstring theory, which says that matter is formed by microscopic strings vibrating in space-time. It therefore represents the attempt to reconcile quantum mechanics with the theory of general relativity. Before our Universe existed, there would be another one before it, which also emerged from a supermassive point, expanded and began to shrink, reaching the singularity of the big bang [3].

The Theory of General Relativity is the basis of the current cosmological models of the universe. Combined with measurements of the quantity, type and distribution of matter in the universe, the equations of general relativity describe the evolution of the universe over time. The observable universe (Figure 1) depends on the location of the observer, who traveling, may encounter a larger region of space time than an observer who remains immobile. However, even the fastest traveler will not be able to interact with the entire space.

General relativity is Albert Einstein's theory published in 1915. General relativity generalizes Einstein's special relativity and Isaac Newton's law of universal gravitation providing a unified description of gravity as a geometric property of space and time. In general relativity, the distribution of matter and energy determines the geometry of space time. Therefore, the solutions of Einstein's field equations describe the evolution of the universe. Combined with measurements of the quantity, type and distribution of matter in the universe, the equations of general relativity describe the evolution of the universe over time.

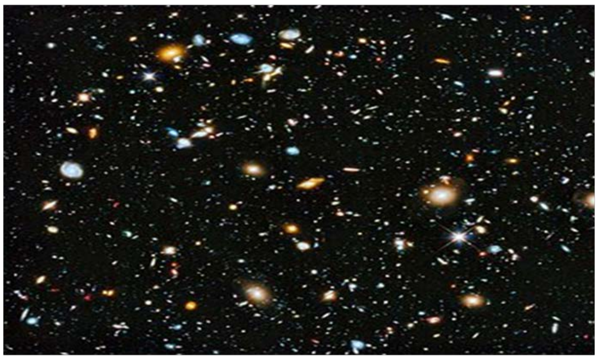

Figure 1: Observable universe.

This high-resolution image (Figure 1) captured by the Hubble space telescope, and known as the Hubble Ultra Deep Field, shows a wide variety of galaxies, each made up of billions of stars. The small reddish galaxies, approximately 100, are some of the most distant galaxies photographed by an optical telescope.

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The size of the universe is difficult to define. According to the theory of general relativity, some regions of space may never interact with us during their existence due to the finite speed of light and the continuous expansion of space. For example, radio messages sent from earth may never reach some regions of space because space can expand faster than light can pass through it. It is assumed that regions far from space exist and are part of reality, even though we can never interact with them. The space region that we can affect and be affected by is the observable universe. The observable universe depends on the location of the observer. When traveling, an observer may meet a larger region of space-time than an observer who remains motionless. However, even the fastest traveler will not be able to interact with the entire space. Typically, the observable universe means the portion of the universe that is observable from our observation point in the Milky Way [4] (Figure 2).

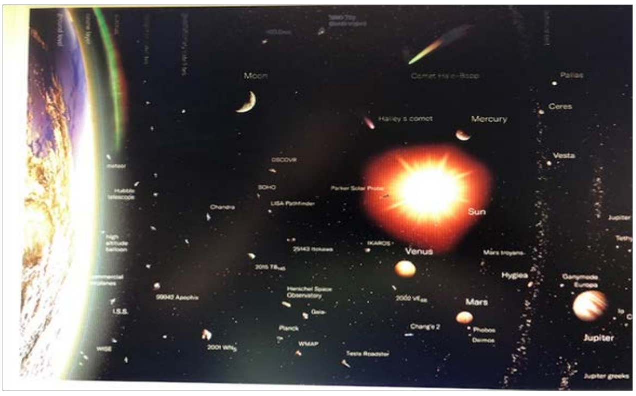

Figure 2: Universe seen from earth.

Map of the observable universe with some of the notable astronomical objects known today (Figure 2). The scale of length increases exponentially toward the right. Celestial bodies are shown enlarged in size to be able to appreciate their shapes.

The universe is 13.7 billion years old, with a margin of error of 0.2 billion more or less. To reach this figure, scientists have struggled for almost 80 years. The universe is made up of 73% dark matter and 23% dark energy, while the rest is made up of galaxies, stars, planets, etc. which corresponds to 4% of the entire universe [5]. The dark matter and energy hypothesis is a recent cosmological model, which came into play to break the paradigm related to the standard cosmological model, given that several observational results pointed to a major flaw in the predictions based on this model. The first of the two hypotheses to emerge was that of dark matter, with Fritz Zwicky, in 1933. For their results, the speed of galaxies was such that their gravitational attraction, calculated from their visible mass, was insufficient to form a system connected, as observed. Zwicky then proposed that there was a portion of extra matter that was not visible: "dark matter".

In 1970, a group of astronomers, led by astronomer Vera Rubin, made a series of very precise measures that shook the previous theoretical cosmological structures for good. Such measures indicated that the speed of rotation in the galaxies, after a certain point, was approximately constant and did not decrease with the inverse of the square root of the ray, as predicted by Newtonian physics. Therefore, the idea of dark matter came up with more vigor and seriousness, being a frontier research nowadays. In the 1990s, two independent teams of astrophysicists turned their eyes to distant supernovae (name given to the celestial bodies that emerged after the explosions of stars with more than 10 solar masses, which produce extremely bright objects, which decline until they become invisible, past weeks or months) to calculate the slowdown. To their surprise, they found that the expansion of the Universe was not slowing, but accelerating. Something must have been overcoming the force of gravity, which is a consequence of a new form of matter that scientists have called "dark energy" that has also not been detected until now and the current theory cannot explain. Dark matter attracts and dark energy repels, that is, dark matter is used to explain a greater than expected gravitational attraction, while dark energy is used to explain a negative gravitational attraction.

On the issue of energy and dark matter, there is the thesis that dark energy is eating dark matter. This means that the space can become emptier. A tantalizing suggestion that dark matter may be slowly shifting to dark energy has been discovered by a team of cosmologists in the United Kingdom and Italy. While the specific nature of the interaction that drives the conversion is not known, the process could be responsible for slowing the growth of galaxies and other large-scale structures in the universe over the past eight billion years. If the conversion continues at the current rate, the Universe's ultimate destination as a cold, dark and empty place could come sooner than expected. Cosmologists Valentina Salvatelli, Najla Said and Alessandro Melchiorri, from the University of Rome, together with David Wands and Marco Bruni at the University of Portsmouth reported that the conversion of dark matter into dark energy is very slow [6]. If it continues at its current rate, the entire universe will have declined in dark energy in about 100 billion years. If dark energy is growing and dark matter is evaporating, we will end up with a big, empty space in the universe with almost nothing in it.

The distance measured at a specific moment, including the present one between earth and the edge of the observable universe is 46 billion light years making the diameter of the observable universe to be about 91 billion light years. The distance that light from the edge of the observable universe is very close to the age of the universe times the speed of light, 13.8 billion light years, but this does not represent distance at any time because the edge of the observable universe and the earth have separated since then. As we cannot observe space beyond the edge of the observable universe, it is unknown whether the size of the universe is finite or infinite. Observations, such as those obtained by Cosmic Background Explorer (COBE), Wilkinson Microwave Anisotropy Probe (WMAP) and Planck maps of cosmic background radiation suggest that the universe is infinite in extent, but at a finite age, as described by Friedmann Lemaitre Robertson Walker (FLRW). These FLRW models thus support inflationary models describing a flat and homogeneous universe currently dominated by dark matter and dark energy [4].

According to the big bang model, the universe has expanded from an extremely dense and hot state and continues to expand today. Because of this expansion, scientists can observe the light of a galaxy thirty billion light years away even though that light has traveled for only thirteen billion years because the space between them has expanded.

This expansion is consistent with observations that indicate that spatial expansion is accelerating. There are dynamic forces that act on particles in the universe that affect their rate of expansion. Before 1998, it was expected that the rate of increase in the Hubble constant would be decreasing over time due to the influence of gravitational interactions in the universe and, therefore, there would be an additional observable amount in the universe called the deceleration parameter, that the cosmologists believed to be directly related to the density of matter in the universe. In 1998, the deceleration parameter was measured by two different groups which implied that the current growth rate of the Hubble constant is increasing over time. Despite advances in technology and research carried out in the areas of astronomy and astrophysics, it is still not possible to be sure of the exact size of the universe.

The universe appears to be a continuum of space time that consists of three spatial dimensions and a temporal dimension (time). On average, it is observed that the space is almost flat, meaning that Euclidean geometry is empirically true with high precision throughout most of the universe. Space time also appears to have a simply connected topology, in analogy to a sphere, at least on the observable universe's length scale. However, the present observations cannot exclude the possibilities that the universe has more dimensions and that its space-time may have a global topology connected in a multiple way, in analogy with the cylindrical or toroidal topologies of two-dimensional spaces [4].

For a long time, scientists considered the universe flat, but now a study published in the scientific journal nature astronomy has shown that, in fact, we live within a gigantic closed sphere. It was previously believed that in the vacuum of the universe, particles called photons, which carry energy from electromagnetic radiation, followed a straight line. Now, as the universe can be spherical, astronomers believe that these particles come and go where they came from. One fact that supports the sphere shape of the universe is the existence of a phenomenon in which gravity bends the path of light an effect predicted by the theory proposed by Albert Einstein [7].

Another clue is that gravity also bends the electromagnetic radiation left between galaxies and stars. This radiation is a remnant of the early period of the universe, when the big bang occurred and the first neutral atoms were formed those that have the same amount of positive and negative charges. In that research, the conclusion that the universe is spherical came when scientists saw that gravity was bending the path of light far more. They noticed using data from the European Space Agency's (ESA), from Planck Space Observatory, which show differences in concentration between dark matter and dark energy. Dark matter in the universe is a mass detectable by the gravitational force, which emits no light. Dark energy, on the other hand, has a negative pressure, which acts against gravity and which has accelerated the expansion of the universe for the last five billion years. The discrepancy between dark matter and dark energy causes the universe to collide with itself, creating a sphere shape. The discovery leader, Eleonora Di Valentino, from the University of Manchester in the United Kingdom, considered that the study could revolutionize what we know about the cosmos [7].

The fate of the universe is still unknown, because it depends critically on the curvature index k and the cosmological constant Λ. If the universe were sufficiently dense, k would equal +1, which means that its average curvature is positive and the universe will end up colliding in a Big Crunch (The universe contracts) possibly starting a new universe in a big bounce. On the other hand, if the universe were insufficiently dense, k would be equal to 0 or -1 and the universe would expand forever, cooling down and finally reaching the Big Freeze (The universe freezes in total darkness) with the thermal death of the universe. Recent data suggest that the expansion rate of the universe is not decreasing, as initially expected, but increasing. If this rate of expansion continues indefinitely, the universe may eventually reach a Big Rip (The universe will have expanded so much that even atoms that form planets and galaxies will start to disintegrate, generating the biggest apocalypse of all). By observations, the universe appears to be flat (k = 0), with an overall density that is very close to the critical value between collapse and eternal expansion [4].

The Origin and Evolution of the Sun and its Probable Future

The Sun appeared about 4.6 billion years ago, being one of the more than 100 billion stars in the Milky Way. The Sun orbits around the center of the galaxy called the Milky Way at a distance of about 24 to 26,000 light years from the galactic center (Figure 3). The Milky Way is one of the galaxies in the universe where the solar system is located, which gathers a set of planets like the Earth that revolves around the Sun.

Figure 3: The solar system in the milky way.

The sun and the rest of the solar system were formed from a rotating cloud of gas and giant dust known as the solar nebula. As soon as the nebula collapsed because of its gravity, spinning very fast and becoming flat as a disk, most of the material was pulled towards the center to form the sun. Like most other stars, the sun is composed mainly of hydrogen, followed by helium. Almost all the rest of the matter consists of seven other elements: oxygen, carbon, neon, nitrogen, magnesium, iron and silicon.

The sun is an almost perfect sphere. There is only a ten kilometer difference in its polar diameter compared to its equatorial diameter. Considering the vast extent of the sun, this means that it is the closest to a perfect sphere that has been observed in nature. Inside the sun there is the nucleus, the radiation zone and the convection zone. The atmosphere of the sun is formed by the photosphere, chromosphere, a transition region and the solar corona also called the white corona or Fraunhoffer corona. The outer part of the sun and visible (the photosphere) emanates a heat between 5,500 to 6,000°C, while temperatures in the core can reach more than 15 million degrees Celsius, this value being driven by nuclear reactions (Figure 4).

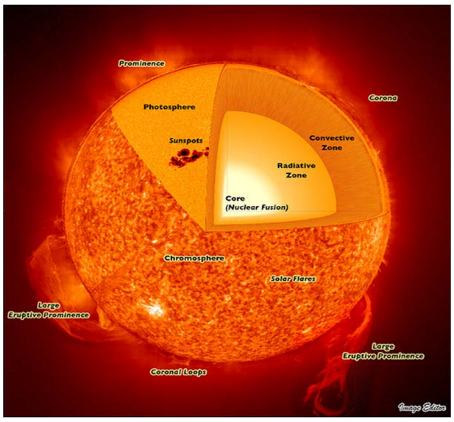

Figure 4: Internal structure of the sun.

Sunlight is the main source of energy for the earth. Only part of the solar radiation forms the light that is visible to our eyes, with wavelengths corresponding to the seven colors, in the following ascending order of energy: red, orange, yellow, green, blue, indigo and violet. Ultraviolet radiation from the sun is what promotes the tanning of our skin, but if we overexpose ourselves without protection, it can cause cancer. Infrared solar radiation, responsible for warming the earth, contributes to the greenhouse effect. Part of the infrared solar radiation that reaches the atmosphere returns to space, mainly reflected by clouds.

Infrared solar radiation reaching the earth's surface is largely absorbed by soil, water and living things. These heated surfaces emit infrared radiation back into the atmosphere, most of which is absorbed by greenhouse gases and trapped in the atmosphere. The atmosphere thus prevents heat from completely dissipating, thus preventing the earth from cooling. Only a small amount of infrared radiation returns to space.

According to Marine Benoit, unmatched resolution images show us the sun like never before. We owe these images to the Daniel K. Inouye terrestrial solar telescope, which is scheduled to officially enter service in Hawaii in the course of 2020 [8]. Figure 5 shows the surface of the sun photographed for the first time with such a level of precision.

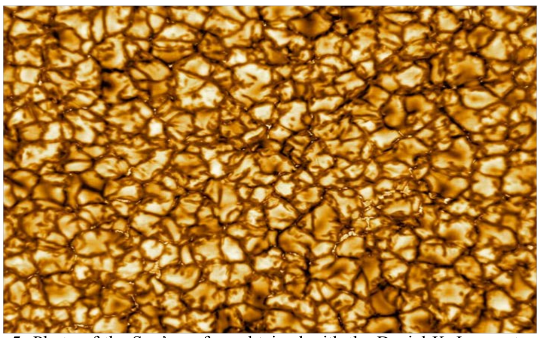

Figure 5: Photo of the Sun's surface obtained with the Daniel K. Inouye terrestrial solar telescope.

What exactly we see in the images of the terrestrial solar telescope, Daniel K. Inouye or DKIST (Solar Telescope Daniel K. Inouye), compiled in a short video of the National Solar Observatory (NSO) are convection cells, formed under the impulse of gas rising from the sun's core towards its surface. Releasing energy as it cools, the plasma dives inward, forming small, granular and mobile structures. It is possible to clearly see in these images the smallest, whose size barely reaches 30 kilometers. DKIST will enter service in the coming months and is expected to collect a very large amount of data about our closest star for five years (more than anything we have been able to learn about the Sun in all of human history). Video showing unparalleled resolution images of the Sun like never before can be accessed through the website <https://youtu.be/4nieF-e0OOs>.

The sun is responsible for giant eruptions of charged particles known as coronal mass ejections that are large eruptions of high temperature ionized gas from the solar corona. Most ejections originate from active regions of the solar surface. The expelled gas is part of the solar wind and when it hits the earth's magnetic field, it can cause geomagnetic storms causing the northern lights phenomenon, damaging the media and the electricity supply.

The sun is the center of the solar system. All other bodies in the solar system, such as planets, dwarf planets, asteroids, comets and dust, as well as all satellites associated with these bodies, rotate around the sun. The sun is responsible for 99.86% of the mass of the solar system, has a mass 332,900 times larger than earth's, and a volume 1,300,000 times larger than our planet's. The distance from earth to the sun is about 150 million kilometers. The Sun like the other stars has its own light. It is different from the moon that only reflects sunlight.

There are eight planets that are part of the solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Figure 6).

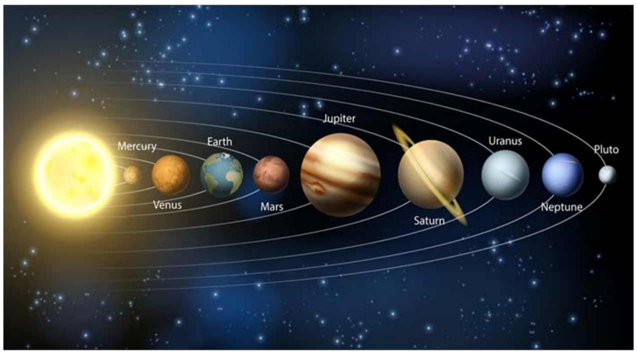

Figure 6: The solar system.

For decades, Pluto was considered one of the planets in the solar system, but in 2006, the International Astronomical Union (IAU) classified this celestial body as a "dwarf planet". Third planet from the sun, the earth has only one natural satellite, the moon, located about 380 thousand kilometers away from our planet. At each time of the year, the intensity of sunlight can vary a lot and, therefore, we have the seasons on earth. In autumn and winter, sunlight is less intense. At these two times of the year, the sun shines for less time and because of this we have the impression that the days are smaller and the nights bigger, because the sun rises later than usual and sets earlier as well. The opposite is true in summer and spring, that is, the sun gets brighter and brighter, rises earlier and sets later, so we have the impression that the days are longer and the nights shorter.

The sun is very important to us humans, not only because we need it to eat plants and animals, but also because it is responsible for making our bones stronger. Bones need vitamin D to get stronger and the only way we can get this vitamin is by being exposed to sunlight for a few minutes of the day. Without sunlight, our bones would become weak and break very easily. As research has progressed, it is now known that vitamin D from the sun can provide us with other health benefits, such as weight loss, strengthening our immunity, prevention of type 2 diabetes and hypertension, and be related to the formation of various hormones.

Solar energy is stored in glucose by living organisms through photosynthesis, a process on which, directly or indirectly, all living beings that inhabit our planet depend. A plant uses the energy supplied by the sun to boost photosynthesis and provide food for growth. As a byproduct, oxygen is released. Animals such as cows, for example, feed on plants and convert them into energy, nutrients, so they can grow. Solar energy is also responsible for weather phenomena and climate on earth.

There is a very important relationship between solar energy and the oceans, as they are very important for maintaining the thermal (temperature) balance on the planet. The warming of the oceans happens from the surface to the bottom by the convection process. Sunlight that reaches the oceans is partially transformed into heat, which is reflected or transmitted, mainly by wave generated turbulence, to the deepest water layers (up to about 100 m deep). In addition to the vertical distribution of heat to about 100 m depth, surface ocean currents redistribute absorbed heat and transfer this heat to the atmosphere, determining local changes in climate.

In the oceans, the daily variation in temperature is generally lower than on the continent. In addition, they retain more heat and heat more slowly than terrestrial soil. Because of this, the oceans contribute directly to climate moderation, as the heat reserve in the waters acquired in the warmer months is partly dissipated in the colder months. In addition to trapping and distributing heat, oceans also participate in controlling the planet's temperature because they remove about one-third of carbon dioxide from human activity from atmospheric air, which reduces the amount of this gas in the air and, consequently, diminishes its effect in global warming.

Fluctuations in solar activity have a noticeable effect on the earth's climate, discovered by a group of researchers from Switzerland, who managed to estimate for the first time the influence of the sun on the global warming of planet earth. Financed by the Swiss National Fund, scientists have found that, after a high solar intensity phase after 1950, the sun's activity will decline soon. The study predicts that weaker radiation from the star may contribute to a total reduction in earth's temperature of 0.5 degrees. This effect, however, will not compensate for the warming of planet earth induced by human activities, which caused an increase of approximately one centigrade degree in global temperature in comparison with the numbers recorded in the pre-industrial era. The discovery of this reduction in solar activity is "important" and can help to deal with the consequences of climate change. Precious time can be gained if the sun's activity decreases and if there is a slight reduction in the peak of terrestrial temperatures.

It is scientifically known that all life on earth will end when our sun reaches the end of its existence within 5 billion years by becoming a red giant that will swallow the earth. Astronomers' calculations indicate that when the sun becomes a red giant, the diameter of the sun in its equator line will overtake planet Mars, consuming all the rocky planets: Mercury, Venus, Earth, and Mars. And that will indeed be the end of planet earth. The red giants are stars that are already at an advanced stage of their life and considerably increase their mass due to the end of their hydrogen, usually reaching up to 8 times the mass of our sun. When this happens, the solar system becomes a chaos and the sun loses a tremendous amount of mass. As it grows, it loses mass, causing the planets to lose their orbits. The Sun will die and end our solar system.

An article published under the title "Distant future of the Sun and Earth revisited" using the most modern models of stellar evolution to revisit the distant future of the sun and earth [9]. According to the authors, when the sun becomes a red giant 7.59 billion years from now, it will begin to lose its mass rapidly. This will happen when the sun reaches its largest radius, which will be 256 times its current size and will be only 67% of its present mass. The sun will expand and this will happen relatively quickly when it depletes hydrogen in its core over a period of 5 million years. The sun will then enter its brief phase of helium burning, which will last another 130 million years. At this point it will be beyond mercury's orbit and then will reach venus's orbit. According to scientists, when the sun reaches the earth, it will have lost 4.9 × 1020 tons of mass for each year of this phase. That means about 8% of the earth's mass each year.

In fact, long before this stage of the sun, the habitable zone in which our planet is located will disappear completely. Astronomers predict that this will occur in about 1 billion years when the sun will migrate out of earth's orbit. The sun will be 10% brighter than we currently see and will evaporate the oceans of the earth. The earth's atmosphere will then be saturated with steam, some will rise to the stratosphere, and there ultraviolet solar radiation will separate the hydrogen present in the water, which, when free, will be much lighter and will be lost in space. It will be the end of the oceans and water on planet earth forever. Moreover, eventually it will turn into a globe of molten lava. The sun, in turn, will turn into a white dwarf which is the name given to this star after its death. After being a red giant, the Sun becomes a celestial body composed of a carbon core and still some helium and hydrogen melting in the crust.

All this means to say that we will face the death of our species with the disappearance of the sun and the earth unless humanity promotes sufficient technological advancement that makes it possible to leave the solar system and reach a new planet in another solar system that is habitable for the human beings.

The Origin and Evolution of the Earth and its Probable Future

Earth formation is estimated to have occurred approximately 4.56 billion years ago. The most accepted theory today about the origin of the solar system, and consequently of our planet, is the solar nebula theory. This theory admits that the planets in the solar system, including the earth, formed from the collapse of a cloud that was spinning at high speed and contracted. It is believed that the sun was formed from the concentration of the central part of the cloud, and the planets from the remaining particles. Some theories say that life appeared on earth a billion years after its formation [10].

Earth is one of the eight planets that make up the solar system, located in the Milky Way. It is considered the largest in diameter and density among the rocky planets (Mercury, Venus, Earth and Mars). Earth planet is one of the planets that are part of the solar system, being the third closest planet to the sun. Earth has the largest natural satellite in the solar system, moon. Based on geodesy, which is the science that makes the study about the dimensions, shape and gravity of the planet allows us to affirm that earth has a rounded shape. Of all the planets in the solar system, Earth is the one with favorable temperatures for the development and proliferation of life, because our planet is neither too hot nor too cold. Under normal circumstances, the average earth temperature is 15ºC.

Despite the great astronomical discoveries, it cannot be said that there is a planet with characteristics similar to those of the earth in the universe capable of providing the existence of living beings. The elements that favor life on earth are called the biosphere or "sphere of life" that is composed of the lithosphere, atmosphere and hydrosphere formed approximately 3.5 billion years ago. The mentioned elements interact with each other and with the living beings present on planet earth (animals, plants and man). In addition to presenting favorable conditions for the existence of life, the earth also has natural resources (renewable and non-renewable) that promote the maintenance of this existence. It is through these resources that living beings maintain themselves, as mineral resources, energy, food, among others are used. In the midst of evolutionary history, man adapted to the conditions presented by the earth and improved his skills, removing from it what was necessary for his survival.

As for its shape, the earth corresponds to a spheroid, having flat poles. The general data for planet earth are as follows:

Diameter - Approximately 12,756.2 km
Surface area - Approximately 510,072,000 km^2
Mass - 5.9722 x 10^{24} Kg
Distance from the Sun - About 149.6 million km
Natural Satellite - 1 (Moon)
Rotation period - 23 hours 56 minutes and 4 seconds
Translation period - 365 days 5 hours and 48 minutes
Average temperature - 15ºC
Terrestrial population - Approximately 7.722.522.000 inhabitants

Planet earth is composed of layers that go from the earth's surface to the core [11]. Different types of ores and gases form all of these layers, although the main ones are iron, oxygen, silicon, magnesium, nickel, sulfur and titanium. Planet earth has about 70% of its surface covered by water. The existence of water in its liquid state, together with the presence of oxygen and the ability to recycle carbon dioxide make the Earth a planet with unique characteristics. The earth has its internal structure divided into: earth's crust, mantle and core (Figure 7).

The earth's crust is also known as the lithosphere and corresponds to the outermost layer of earth, formed by rocks and minerals, such as silicon, magnesium, iron and aluminum. It has an average of 10 kilometers under the oceans and between 25 and 100 kilometers under the continents. It contains continents, islands and the ocean floor. In addition, it is observed that it is not a solid layer, as there are divisions that form large rock blocks known as tectonic plates, which move and can cause tremors on the earth's surface. The mantle is located between the earth's crust and the core. It is known as the intermediate layer, which is divided into an upper mantle and a lower mantle. It can have a depth of about 30 to 2,900 km below the crust and, unlike of the crust, the mantle is not solid. With an average temperature of up to 2,000°C, this layer is composed of magmatic material (in a pasty state) composed mainly of iron, magnesium and silicon. The movement of magma, known as convection currents, causes the movement of rock blocks that make up the earth's crust. The core is the innermost layer of Earth and is divided into outer and inner core. It is also the layer that has the highest temperature, which, according to scientists, can reach 6,000°C. It is formed by iron, silicon, nickel and, despite the high temperatures that should keep these compounds in a liquid state, the core presents high pressure, which ends up grouping these substances, keeping them solid.

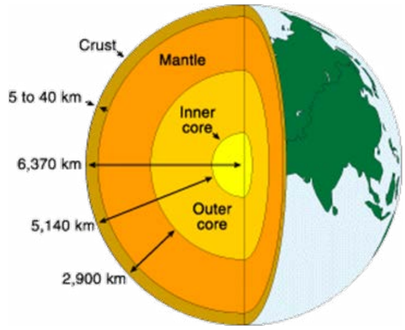

Figure 7: Internal structure of earth planet.

In addition to the internal structure, there is also the external structure that corresponds to the lithosphere, hydrosphere, biosphere and atmosphere that offer the conditions favorable to the existence of life on planet earth (Figure 8).

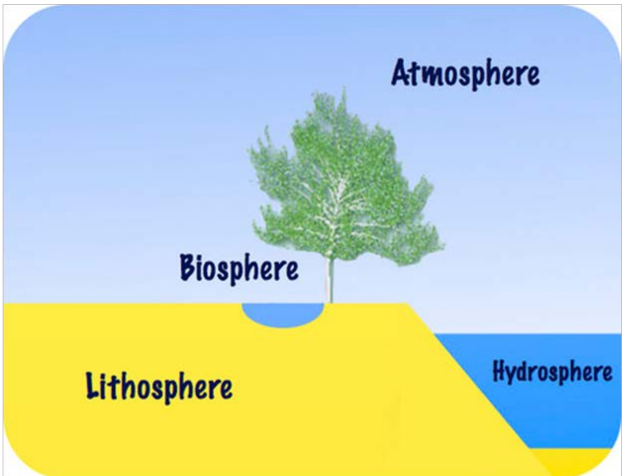

Figure 8: External structure of earth planet.

The outer layers of earth are biosphere, atmosphere, lithosphere and hydrosphere. Biosphere corresponds to the set of ecosystems that comprise earth. Basically, it concerns the groups of living beings that inhabit it. These ecosystems are found from the highest points on the planet to parts of the ocean floor. Atmosphere corresponds to a gaseous layer that surrounds the entire planet earth. It is formed by gases maintained by gravity, whose main function is to protect the planet from the emitted solar radiation, filtering it, in addition to maintaining the average temperature of the earth, making sure that there is no great thermal amplitude. Atmosphere prevents earth from being hit, too, by rock fragments coming from outer space. This layer has the division of the sub-layers: troposphere, stratosphere, mesosphere, thermosphere, and exosphere. Lithosphere is the outermost solid layer of a rocky planet and consists of rocks and soil. In the case of earth, it is formed by the earth's crust and part of the upper mantle. Hydrosphere corresponds to the layer that comprises the water bodies of Planet earth. It covers not only the oceans, but also the seas, rivers, lakes and groundwater.

One of humanity's greatest fears is that earth is on a collision course with some giant asteroid that has the potential to annihilate us completely. Fear is by no means unfounded because these monsters exist in space and can hit earth. In fact, the history of our planet is full of these impacts. While still in formation, the earth was bombed more frequently. According to NASA's Jet Propulsion Laboratory, 556 small asteroids crossed the atmosphere from 1994 to 2013. Most of them disintegrate, however some manage to reach the surface and cause damage, like the object that hit the city of Chelyabinsk, in Russia [12]. We must not forget that the extermination of the dinosaurs occurred between 208 and 144 million years ago due to an impact from an asteroid 10 km in diameter that generated an explosion similar to 100 trillion tons of TNT.

What would happen to our planet if it collided with a big asteroid? The discovery channel made a simulation that answers this question. The video shows an asteroid with a diameter of 500 kilometers hitting the pacific ocean and producing shock waves that travel at hypersonic speeds. Such an episode would decree the end of life on earth. The force of the impact would be such that it would completely disrupt the earth's crust in the region, sending debris into space. They would enter a low orbit and, as they fell, would destroy the entire surface. As if the scenario were not catastrophic enough, the destruction does not stop there: a firestorm would spread through the atmosphere and vaporize any form of life in its path. In just one day, the entire planet would become uninhabitable. Most shocking of all is the number of times that scientists believe that such an apocalypse has affected the earth throughout its history that is six times. Another threat from space concerns the explosions of supernovae, stars of greater mass than our sun, at the end of its existence that could exterminate life on Earth due to the release of enough gamma radiation and X-rays to heat the surface of our planet and make the atmosphere and the oceans evaporate.

In addition to the atmosphere that prevents the earth from being hit by rock fragments such as asteroids from outer space, Moon and Jupiter act as protectors of our planet. The moon has protected us from meteors and comets that could hit planet earth. The hidden side of the Moon has more craters than the visible side because it is more exposed to collisions with asteroids and comets coming from space. Our moon is, therefore, a true protective shield of the earth in terms of collision of celestial bodies. Another protector of earth is the jupiter planet at is known as the **"**cosmic attractor" of the solar system [13-15].

The mass of the jupiter planet is so large (318 times larger than earth) that it simply "attracts" by the force of gravity thousands of meteors that wander through our solar system, sucking on it several asteroids and celestial bodies that could hit against the earth or other planets, greatly reducing the number of impacts. Many astronomers believe that life would not have appeared and maintained on earth if jupiter did not exist. Before the complete formation of the solar system, earth was often bombarded by hundreds of asteroids and with the formation of jupiter, these asteroids were eventually attracted to the planet of greater mass, freeing earth from these lonely cosmic stones.

Earth performs several movements, but the main ones are those of rotation and translation. The first corresponds to a movement that earth performs around itself and that requires twenty-four hours to be accomplished and is responsible for the appearance of days and nights. The earth's rotation gradually decreases with the increase in the distance of the moon from our planet, however, almost imperceptibly to human beings. This decrease is approximately 17 milliseconds every 100 years and causes the length of the day to increase. The second corresponds to the translation movement that the earth performs around the Sun and it takes 365 days and 6 hours to complete it. In leap years, the six hours are added over four years, totaling 24 hours or one day. The translation movement is responsible for the appearance of the seasons; this variation in the climate corresponds to the closest or distant positions where earth is in relation to the Sun at certain times of the year. Moon strongly influences the tides on earth due to the gravitational force that exists between earth and moon. Because of the positioning of moon in relation to earth and the sun, it is possible to observe the four lunar phases (new, full, waning and growing).

According to english chemist James Lovelock, earth is a large living organism with mechanisms that help in the preservation of life forms within it. In 1969, NASA asked James Lovelock to investigate Venus and Mars to see if they had any form of life. Analyzing our neighbors in the solar system, Lovelock said there was nothing that could be considered alive there. But, looking at the earth itself, he concluded that, in addition to being the residence of several forms of life, it itself behaves like a great living being, with mechanisms that help to preserve the other living beings that it houses. In addition, he named earth of Gaia, after the Greek goddess of earth. At first, the theory was rejected by the scientific community. Nevertheless, the launch of satellites from the 1970s brought data on the planet earth that helped reinforce the central thesis of the Gaia Theory: the planet has an ability to control its temperature, atmosphere, salinity and other characteristics that keep it with conditions ideals for the existence of life [16].

According to Lovelock, before life on earth existed between 4.6 billion and 3.8 billion years ago, our atmosphere was probably similar to that of mars and venus. However, since life started, this composition has changed and remains completely different from that of our neighbors. For Gaia's theory, this is only possible because at some point the earth started to function as a self-regulating living being. Between 3.8 billion to 2.3 billion years ago, there were bacteria among the first living beings that consumed carbon dioxide (CO_2) and released gases such as methane and oxygen. Over time, the respiration of bacteria changed the composition of the atmosphere, injecting more O_2 that contributed to multi cellular beings to develop. When life begins to influence the evolution of the environment, and vice versa, it is a sign that Gaia was born. Alive, the earth also regulates its temperature. The concentration of methane in the air, for example, creates a greenhouse effect that guarantees heat on the planet.

By affirming that the planet earth functions as a living being, Lovelock demonstrates that it is a dynamic system. One of the evidences that the earth operates as a dynamic system is its ability to control its own composition and climate through response mechanisms between its organic (biosphere) and inorganic (air, rocks and seas) parts between 2.3 billion 200 years ago. The carbon cycle, for example, helps to control the concentration of CO_2 in the atmosphere. As a dynamic system, the earth also has its mechanisms to keep everything running. The balance between life, atmosphere, seas and rocks works through very complex cycles. From time to time, the balance breaks down, and mass extinctions occur. However, the surviving species form a new balance and everything starts to operate on new bases. The concentration of salt in the sea, for example, has been stable at 3.4% for thousands of years and is an indication, according to Gaia's theory, that the earth behaves as a self-stabilizing dynamic system. Bacteria that consume the product and salt lagoons composed of corals organize themselves in another cycle, to maintain the balance necessary for marine life.

For the first time in history, the balance of the dynamic system based on which earth planet operates was affected by humans since the 1st Industrial Revolution in the 18^{th} century. Humanity has been constituting a real threat to the existence of life on the planet with the development of economic activities that degrade the environment by exhausting, polluting and destroying natural resources, in addition to contributing to the growing emission of greenhouse gases that causes that there is a rise in temperature and consequent catastrophic climate change that can shorten life on earth planet. Regardless of the threat posed by humans, the habitable zone in which our planet is found will disappear completely when the Sun migrates out of earth's orbit in about 1 billion years. The Sun will be 10% brighter than we currently observe and will cause the earth's oceans to evaporate. The terrestrial atmosphere, then, will be saturated with steam and a part will rise to the stratosphere and there the ultraviolet solar radiation will separate the hydrogen present in the water, which, when free, will be much lighter, and will be lost in space. It will be the end of the oceans and water on planet earth, forever. Finally, the Earth will become a globe of molten lava.

The Birth and Importance of the Moon for Planet Earth

Moon is very important for the existence of life on earth planet. Earth was formed some 4.6 billion years ago, from the disk of gas and dust that formed the sun and the other bodies of the solar system. Moon formed, in turn, about 100 million years after earth, after a violent impact on earth by a body the size of Mars, called Theia. The huge impact tore off part of Earth, which at the time was a magma sphere, and placed it in Earth orbit. The fragments that resulted from the clash between earth and Theia formed the moon [17,18].

The earth-moon system that came into existence began to exert a mutual gravitational pull. Such attraction produced (and continues to produce) the dissipation of an enormous amount of energy due to the friction of the oceans with the seabed during the tides coming and going. As a consequence of such dissipation, the earth's rotation speed was reduced from about 6 hours that lasted the primitive earth day without moon until the current 24 hours. Today, Moon continues to slow earth's rotation at a rate of about 1.5 milliseconds every century. To compensate for this decrease in the speed of rotation of earth, the energy of the lunar rotation needs to increase which produces a gradual increased distance from Moon in relation to earth, at a speed of about 3.82 centimeters each year [19].

The increase in the distance from the moon in relation to the earth is due to the friction between the earth's surface and the huge mass of water that is on it and causes the earth to rotate a little more slowly on its axis over time. Earth and moon are joined by a kind of gravitational embrace. Then, as the movement of earth slows down, that of moon accelerates. And when something in orbit accelerates, that acceleration pushes it out. For each action there is an equal and opposite reaction, according to Newton's third law. The distance from moon affects our planet in several ways. To begin with, as earth spins more slowly, the days get longer. They are already longer, in two milliseconds every century.

What would happen to the earth if the moon moved away continuously? It would be catastrophic for earth planet because the days could be 48 times longer. During the night, temperatures would kill everyone in the cold. Throughout the day, no one could stand the heat. On the coast, there would be extremely violent winds of 200 km / h. In terms of life, there would be almost nothing left, except super-resistant bacteria and worms. All of this shows how the earth is dependent on this sterile ball of minerals that we call the moon. Just to give you an idea, before the satellite started to orbit our planet, one day lasted between six and eight hours. Since then, interaction with the moon has slowed the planet's rotation. By celestial mechanics, this happens as the moon moves away.

More than 4 billion years ago, it is estimated that moon was only 25,000 kilometers from earth. Today, the distance is 15 times greater. With this distance from moon in relation to earth, the speed of rotation of the planet gradually decreased. In about 3 billion years, the length of the day had already jumped to 18 hours. Following this trend, the 24-hour day that prevails today will not last forever. Moon will continue to distance itself now, at a faster rate than before, at a rate of 3.8 centimeters per year. This process should continue until the satellite is 560 thousand kilometers away. When this happens, the earth's rotation will stabilize, the days will have 1,152 hours and life on the planet will be unfeasible. This process will take at least 4 billion years to happen. Probably, in this chaotic scenario, there will be no human beings to witness it, because in the next billion years, Sun will be 10% hotter, which will be enough to make any form of life on earth unfeasible.

Many wonder: what would happen if the moon suddenly disappeared? Immediately, someone would say that we could enjoy the stars, the Milky Way and other wonders of the cosmos without being overshadowed by moonlight. Solar and lunar eclipses would also cease to exist. In addition, all the romanticism and mystery associated with our satellite, which inspired so many songs, poems, tales, novels, and so many artists, would disappear. But, only that would happen if the moon suddenly disappeared? Of course not!

The main consequences of the sudden disappearance of moon would be: 1) the disappearance of the tidal phenomenon; 2) the end of the stability of earth's axis of rotation; 3) the end of many terrestrial species and plants; and, 4) drastic and global climatic changes resulting from the disappearance of the tides and the destabilization of the Earth's axis of rotation. The disappearance of the tidal phenomenon resulting from moon's gravity would lead to the weakening of ocean currents whose waters would tend to stagnate. The shores of the seas would lose their drainage and natural cleaning system due to the advance and retreat of the waters. The ocean water would tend to redistribute itself, taking the course of the poles, and the sea level would rise in the coasts. The consequence of all this would be a drastic change in the earth's climate.

The end of the stability of the earth's axis of rotation would occur with the earth's precession that would become slower without the Moon and its axis may vary chaotically between 0 and 90 degrees. The axis of rotation of the earth is 23 degrees from the plane of its orbit caused by the orbital movement of the moon, which is responsible for the existence of the stations as we know them. The end of the stability of the earth's axis of rotation would result in climate change on a global scale, which could produce summers with temperatures exceeding 100 degrees, and winters with temperatures below minus 80 degrees. In the most extreme case, the terrestrial rotation axis could line up directly in the direction of the Sun, which would cause areas of the planet to be under permanent sunlight and others, in permanent darkness. The huge thermal differences between one half and the other of the earth would cause extreme winds, with speed of more than 300 kilometers per hour and other dramatic meteorological phenomena.

The end of many terrestrial species and plants would occur with the disappearance of the moon, which would also affect life on earth. The most immediate effect would be the disappearance of the sunlight reflected by the moon, which would alter the biological rhythms of many animal and plant species that have adapted and evolved under the cyclic presence of lunar light. Many species would need to adapt suddenly to the total darkness of moonless nights. The disappearance of lunar tides would mainly affect species adapted to marine flows and currents, such as those that live on the coasts to which the tidal flow takes nutrients, or those that inhabit seas and oceans, accustomed to the current patterns of marine currents.

The drastic and global climatic changes, resulting from the disappearance of the tides and the destabilization of the earth's axis of rotation, would be the factors that would produce the most terrible consequences on terrestrial life. The vital rhythms of all animal and plant species would be altered by these climatic changes: migrations, the season of heat, hibernation, etc. Plant growth would also be affected by extreme thermal variations. Many species would be unable to adapt and there would be massive extinction of plants and animals. In the extreme case, which we saw before, that the terrestrial axis of rotation ended up pointing towards the sun, life on earth as we know it would be impossible in either of the two hemispheres, and would only perhaps be viable at the equator, between the burning and frozen hemispheres on the planet.

The Future of Humanity

The survival of mankind depends on the ability of human beings to find scientific and technological solutions to deal with asteroids coming from outer space, the collision between the Andromeda and Milky Way galaxies, the increase of distance of moon in relation to earth, the death of the sun and the end of the universe in which we live [20]. Without the advancement of science and technology, humanity will not be able to survive all these threats. In summary, it means to say that humanity will face its end with the threats described above unless it promotes sufficient scientific and technological advancement to overcome them.

To avoid the collision of large asteroids coming from space toward earth planet, humanity should use powerful rockets to deflect them. Before the collision between the Andromeda and Milky Way galaxies, humanity would have to seek its escape to a planet in a closer galaxy like the Canis Major Dwarf Galaxy located 25,000 light years away. In order to face the problems resulting from the increased distance from Moon in relation to earth, humanity could seek its survival by implanting space colonies on mars, titan (saturn's moon), callisto (jupiter's moon) and the dwarf planet Pluto in the solar system possible escape locations, all of them with numerous obstacles that would require great technological advancement to overcome them. Before the death of the Sun, humanity should leave the solar system and reach a new planet in another planetary system that is habitable for human beings. This planet could be the "Proxima Centauri b" orbiting the closest star to the Sun that is part of the Alpha Centauri system. Before the end of the Universe in which we live, humanity should seek a way out, that is, a parallel universe, for humanity to escape and survive all the catastrophic scenarios predicted to the end of Universe.

Currently, humanity would be able to prevent the collision of large asteroids on the planet Earth because it has rockets capable of hitting them. However, it does not have the resources to implant space colonies on Mars, Titan (moon of Saturn), Callisto (moon of Jupiter) and on the dwarf planet Pluto. Humanity also lacks the scientific and technological resources to seek its escape to a planet in a closer galaxy such as the Canis Major Dwarf Galaxy, to reach another habitable planet, "Proxima Centauri b", orbiting the star closest to the Sun and member of the Alpha Centauri system, much less seek a way out to a parallel universe before the end of our universe.

If the scientific and technological challenge is immense to escape to a planet in a galaxy like the Canis Major Dwarf Galaxy located 25,000 light years away, reach a new planet in another planetary system that is habitable for humans like "Proxima Centauri b" orbiting the closest star to the sun that is part of the Alpha Centauri system, the challenge would be even greater in abandoning our universe and heading towards parallel universes. According to Michio Kaku, an American theoretical physicist, professor and co-creator of the string field theory, the main problem in abandoning our universe and going to parallel universes is whether we will have enough resources to build machines capable of accomplishing such a difficult feat and if the laws of physics allow the existence of these machines [21].

Kaku says that humanity will have billions of years ahead to find the solution that will allow us to abandon our universe towards parallel worlds. Kaku says that, for long-distance interplanetary missions, physicists will have to find more exotic forms of rocket propulsion if they expect to reach distances hundreds of light years away as current chemical rockets are limited by the maximum velocity of exhaust gases. He says that the development of a solar / ion engine could provide a new way of propelling rockets between the stars. One possible project would be to create a fusion reactor, a rocket that extracts hydrogen from interstellar space and liquefies it by releasing unlimited amounts of energy in the process.

For humanity to escape to parallel universes, Kaku says it is necessary to overcome a series of great obstacles. The first barrier would be to complete a theory of everything when we would be able to verify the consequences of using advanced technologies. In addition, Kaku proposes to find wormholes and white holes that are dimensional gates and cosmic strings that would make it possible to reach parallel universes, send probes through a black hole that would function as an emergency hatch to leave our universe, build a black hole for purposes experiments, create a baby universe with a false vacuum in the laboratory, create immense atom colliders despite major engineering problems, create implosion mechanisms using laser beams, build a bend-boosting machine with the ability to cross immense stellar distances, use the negative energy of the compressed states with the use of laser beams that can be used to generate negative matter to open and stabilize wormholes, wait for quantum transitions to escape to another universe and, finally, as a last hope, with fusion of our consciousness with our robotic creations uses and advanced DNA engineering, nanotechnology and robotics.

Regarding the existence of other universes, it is worth highlighting the latest research by physicist Stephen Hawking, who points out that our universe may be just one of many others similar to it. Hawking's theory indicates a path for astronomers looking for evidence of the existence of parallel universes. The study was sent for publication in the Journal of High-Energy Physics. Hartle and Hawking used quantum mechanics as a basis to explain how the Universe would have started from nothing. Scientists developed the idea and hypothesized that the Big Bang would not have created just one universe, but countless universes. Some of them, according to the Hartle-Hawking theory, would be very similar to ours - perhaps with Earth-like planets and societies and individuals like those existing in our universe. The other universes would have punctual differences - an earth where dinosaurs were not extinct, for example. And there would be totally different universes from our Universe, without a planet earth or perhaps without stars or galaxies and with different laws of physics. It may sound unlikely, but the equations developed in this theory make these scenarios possible (GHOSH, 2018).

A critical question arises from this: the existence of infinite types of universes with infinite variations in their laws of physics. Hawking collaborated with Thomas Hertog to try to resolve this paradox (GHOSH, 2018). Hawking's final work is the result of 20 years of research with Hertog and solved this puzzle by resorting to new mathematical techniques created to study another exotic branch of physics called string theory. These techniques allow researchers to view theories of physics in a different way. New elaboration by the Hartle-Hawking theory in the study gave an order to the hitherto chaotic multiverse. The work points out that there can only be universes with the same laws of physics as ours. This means that our Universe is a typical universe and that the observations made from our point of view will be useful in the development of our concepts about how other universes arose.

Artificial intelligence can make a decisive contribution to scientific and technological advances, aiming to provide humanity with the necessary resources to face its survival problems. There is the possibility of creating machines that are more intelligent than humans, called artificial super intelligences. If artificial brains ever surpass the intelligence of human brains, then this new super intelligence can become very powerful [22]. Humanity's fate would become dependent on the actions of these super intelligent machines. The idea is that everything that occurs in the brain, and even in the universe, comes from information and its transfer: matter only supports the storage and propagation of information. If that is the case, it may even be a matter of time before the first artificial super intelligence is created, perhaps even before 2045.

Everything that has just been exposed indicates the need for humanity to equip itself as urgently as possible with the instruments necessary to have control of its destiny with the implantation of a democratic world government. This is the only means of survival for the human species to face internal and external threats to planet earth. In addition to being an instrument for solving existing international conflicts and the problems of environmental degradation and global climate change, a global democratic government should adopt immediate strategies to avoid the collision of comets and asteroids with the earth, seeking to divert them with the use of space rockets, to mitigate the impact on earth of giant eruptions of charged particles known as coronal mass ejections from the Sun and to face the threats posed by the increasing of distance of the Moon in relation to earth, supernova explosions, the collision of the Andromeda and Milky Way galaxies, the death of the Sun and the end of the Universe in which we live. These strategies will only be successful if there is a global effort under the leadership of a global democratic government aimed at preparing human beings to face these threats and to promote scientific and technological development to support them [23-25].

Author

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