Space Islands in Orbit Around the Sun

Valentyn Halunko

Doctor of Law, Professor, President of Company "Science and Space" (Kyiv, Ukraine)
E-mail: scinspace@gmail.com
https://orcid.org/0000-0003-1619-5028

Oleksii Padun

Chief design engineer of Company "Science and Space" (Kyiv, Ukraine)
E-mail: justalexpa@gmail.com
https://orcid.org/0000-0003-1715-9942

Yevgen Rokytsky

Ph.D. (International Law), Senior Lecturer, National Aviation University (Kyiv, Ukraine),
Chairman of the Supervisory Board, Company "Science and Space" (Kyiv, Ukraine)
E-mail: tristar.ua@gmail.com
https://orcid.org/0000-0002-4832-0754

Halunko, Valentyn, Oleksii Padun and Yevgen Rokytsky (2021) Space Islands in Orbit Around the Sun. *Future Human Image*, Volume 15, 24-38. https://doi.org/10.29202/fhi/15/3

The article comprehensively reveals the concept of an autonomous space island constellation to be deployed in orbits in the solar system. This project will make the Earth a green and blue oasis without harmful production and give humanity a chance to survive in any cataclysm on Earth. The authors propose an original idea and calculations regarding the simulation of Earth's magnetic field and the system of magnetic simulators of artificial gravity. The concepts of an electric power supply system, the ozone layer, greening, water exchange and waste disposal are proposed. The article suggests that the construction of a space island constellation should be an international project of public organizations and private companies.

Keywords: cataclysms, space island, humanity, magnetic field of Earth, magnetic simulator of artificial gravity, oasis, ozone layer, rescue, public and private partnership

Received: 2 February 2021 / Accepted: 5 March 2021 / Published: 25 April 2021

Introduction

The article reveals the author's concept of a space island constellation. As standard, islands will be able to operate autonomously. In the long run, they will be able to survive almost without attracting resources from the Earth. The constellation will consist of islands, such as 1) residential, administrative, medical and recreational (tourist) which will be in the solar orbit between Earth and Mars; 2) *islands of supply*: solar power plants; water extraction from astronomical bodies in the solar system; agricultural production; burial and worship; waste disposal islands; 3) *production islands*: a) delivery and primary processing of useful resources from asteroids that will be in heliocentric orbit between Jupiter and Saturn; b) industrial production — in the heliocentric orbit between Mars and Jupiter.

As a result, the cradle of mankind — the Earth — will be relieved of the negative overload of the biosphere. It will be a green and blue oasis of the Solar System without harmful industries and with the optimal number of people to live on it on an ongoing basis. The autonomous space island constellation will be deployed in the heliocentric orbits between Earth to Saturn. In addition, they should be a guarantee of human survival in the event of natural or man-made disasters on the planet Earth.

The authors argue that natural space objects close to Earth, such as the Moon and Mars, are not adapted to human habitation. Safe and comfortable living on them requires colonists to address more challenges than on artificial spacecraft, originally designed for specific purposes. Furthermore, it should be stressed that the Moon and Mars' resources will become not sufficient to meet the needs of space-faring nations and their private space companies in a very short time. That will lead to international conflicts.

There are some scientific approaches to saving humanity beyond the Earth. In his works, Stephen Hawking strongly advises humanity to have a reserve for productive existence for the next 100 years. A number of space-faring nations have almost begun the previous colonization of the Moon. Entrepreneur Elon Musk and scientists hired by him are developing Mars colonization. However, we are critical of their efforts. Therefore, from the perspective of international space law, it is more promising and less conflicting to save humanity by designing and building a space island constellation with all the Earth conditions artificially modeled.

Therefore, our scientific novelty is the suggestion that the future of mankind is not in the adaptation of natural space bodies for human habitation and work, but in the construction of artificial space islands pre-programmed to simulate all basic conditions, existing on the planet Earth. After all, our solar system, and even more so, the Milky Way galaxy, has almost enormous mineral resources to provide everything necessary for safe and comfortable living on space islands for the number of people, thousands of times the current population of the Earth. We have developed a framework and some concrete actions for the design and construction of space islands.

At the beginning of the article, we make arguments: Why would humanity spend to design and build space islands? Next, we successively reveal the space island constellation mission in circumsolar orbits and problems to be solved by the first experimental space island.

The considerable and specific focus is on the author's developments on simulating Earth's magnetic field and the system of magnetic simulators of artificial gravity, calculation of other technical factors of the project. Finally, the article considers the ways and effects of the project. The authors argue that this should be an international project of hundreds of private companies and public organizations.

Why should humanity spend money on the design and construction of space islands?

Humanity is developing at an accelerated rate and is increasing in numbers. Today, the planet Earth is home to almost 8 billion people. According to the UN, by 2050, there will be 10 billion people (Our growing, 2019). This will further overload the Earth's biosphere. We advocate Stephen Hawking's opinion that in order to survive in the next hundred years, humanity in sufficient numbers should move to live autonomously in outer space (Hawking, 2011).

For example, a number of asteroids cross Earth's orbit. They have a probability of striking our planet and causing serious damage to humanity (Sluijs et al., 2015). There have been cases in the Earth's history when large asteroids destroyed most species of life on it (Chapman, 2004). In addition, the safety of human habitation on the Earth is affected by man-made socially dangerous factors, namely the probable nuclear war (Baum & Barrett, 2018), genetically modified viruses, global warming, etc., which can destroy human civilization.

Human development is characterized by social progress, which provides more and more opportunities for a comfortable life. Today, citizens of poor nations are gradually equalizing their standard of living with the "golden billion" in purchasing power parity terms. This will lead to a significant increase in the consumption of material resources per capita.

Furthermore, it should be noted that artificial restraint of childbearing has more negative than positive aspects. In developed democratic States governed by the rule of law, fertility is at a critically low level. The such States are already encouraging citizens to have more children. However, the pension system for persons unable to work has been exhausted and has become a factor in the financial crisis and social tension. Moreover, the solidarity pension system and the savings and private pension system have run their course. Who cares that a man has accumulated millions of old-age money in the course of long working life? If no able-bodied young people are providing the disabled with everything they need, millions in pension savings will become a mere number on the bank's computer. The real purchasing power of such savings would be negligible. In order to encourage citizens of developed States to give birth to several children, the pension of non-working parents must be linked to public contributions to public pension funds that are paid by their able-bodied children. Our formula is simple: the more successful children are raised by parents, the better they will live in old age (Halunko, 2017).

In this process, artificial intelligence and the resulting work will not help humanity. Indisputably, human labor simulators will be actively used in many sectors of public life. Moreover, the working minority will be able to provide a decent life for the non-working majority. However, robots must be intellectually restricted. In no case should they be allowed to think abstractly. In other words, at any level of robotization, there will always be professions that robots cannot replace because of dangerous effects on the very existence of mankind. For example, it is possible to replace waiters with robots, but robots cannot be entrusted to heal people or conduct legal proceedings.

Therefore, without an increase in the birth rate, it is impossible to solve the problems of mankind. Simultaneously, without the preservation of Earth's biosphere, humanity will die or degrade beyond recognition as a Man of Reason. In our view, the only way to further the development of humanity is to resettle most of it in medium and then in deep outer space. It has an unlimited resource to provide resources for the lives of trillions of people.

For humanity to choose the place of permanent residence outside the Earth, there are three basic options: 1) to arrange satisfactory conditions for people to live on large natural bodies and then colonize them. Such plans are now being actively lobbied with regard to the Moon and Mars; 2) to create medium- and large-sized artificial space islands, originally designed and built for comfortable living and work; 3) to find in the Milky Way galaxy the twin planet of the Earth, total or most biosphere parameters thereof correspond to the Earth's.

We advocate space islands for the following reasons. First, adjusting to something is thankless labor that never gets a good result. For example, Mars has no breathable atmosphere, low temperature, low gravity. However, the main challenge is soil-containing perchlorate compounds of chloric acid salts. They are a dangerous poison to humans and all living beings. Along with the constant dust storms, this will make human life on Mars extremely dangerous.

The search for the Earth's twin is considered utopian. This is even though basically our Earth is an ordinary stone-type planet as many others around stars neighboring the Sun. However, from the perspective of the biosphere, no other such planet could exist. In the formation of the planet Earth at every stage of its development, especially just before and after the birth of life, very specific accidents arose, which are virtually unique. If anyone wishes to object to us, let one give us to one proven existence of the Earth's twin with such a biosphere. All other exoplanets identified around stars with the so-called habitable zone have only potential water in liquid form. However, water in liquid form is a necessary but far from sufficient condition for life. All the phenomena of creating a unique biosphere on the planet Earth began not from the presence of water in liquid form on its surface, but from other, as yet unexplained, causes.

Therefore, we believe that the only way to save humanity from natural disasters and self-destruction as a result of the dangerous artificial activity of the immature society is a complex space island constellation, designed, tested, built, adapted to human life, and work by the human mind, the only being in the universe that has the gift of abstract thought.

The mission of a space island constellation in solar-centric orbits

Humanity is constantly growing in numbers and intellectually. Environmental scientists conclusively prove that humanity has already crossed the threshold of no return of the biosphere to its natural state (Weitzman, 1999; Reijnders, 2014). Today we are borrowing natural resources from future generations (Wada et al., 2010).

However, we argue that if Earth's biosphere is relieved from overload, it can return to a state of well-being. Then the cradle of mankind will fulfill its mission, up to billion years. Indeed, as a result of the gradual increase in the brightness of the Sun, 1% every 100,000 years, there will still be a tipping point when the greenhouse effect occurs, making the Earth so hot that it becomes uninhabitable (Schröder & Smith, 2008).

Therefore, from the perspective of astronomy and astrobiology, our star, the Sun, for a billion more years, can provide a satisfactory living environment for humans on Earth, provided that we take care of the latter, not overload the biosphere.

We believe that the only way to preserve Earth's biosphere is to resettle a significant number of people in space islands that will be placed in solar-centric orbits between Earth and Mars. All hazardous and harmful production should be transferred to space islands beyond Mars' orbit. We recommend a non-conflict, safe, and theoretically resource-unlimited way to move some people into outer space for permanent and temporary residence and production of industrial products.

This system of islands will serve various purposes: tourist, industrial, including food, medical, transit and permanent residence. When these islands are deployed and put into operation, they will mainly 'consume' natural resources from asteroids and comets, with minimal use of resources from the Earth.

As a result of such activities, the Earth, the cradle of mankind, will become a blue-green oasis — a nature reserve without any harmful production. However, the first experimental space island, which will provide the project's scientific and technical background under consideration, should be located at one of the Lagrange points L4/L5 In the Earth-Moon system.

Tasks to be fulfilled on an experimental space island

We plan to create the first space island at the Lagrange point L4 or L5 in the Earth-Moon gravitational interaction (Prado et al., 1996). However, the first comprehensive studies of the project will be carried out in Earth's hydrosphere, adapted for the purpose.

In addition, experiments on the artificial Earth's magnetic field and its magnetosphere, magnetic simulators of artificial gravity, and an ozone "sandwich" must be conducted. In these experiments, the leading factor should be the influence of the artificial factors considered on humans and other living beings (Blaber et al., 2010). These three studies will start on the Earth and be tested in laboratories on artificial satellites in outer space at distances from the Earth, with minimal impact of the natural protective factors considered. Finally, it is reasonable to implement the results of these studies on an experimental space island.

With regard to the extraction and processing of minerals from asteroids and meteorite water, several successful experiments are being carried out under present conditions (Volker et al., 2020), the legal framework is being developed, and specific business structures are being created (Glester, 2018). Accordingly, we will leave this problem outside the scope of our study.

However, from the space law perspective, it should be noted that the legal regulations guiding the extraction and use of minerals from space bodies are national. In particular, the United States, the United Kingdom, and Luxembourg have adopted such laws. For example, according to the US Space Act (2015), the private sector resident in the United States is granted significant preferences, such as releasing from strict government regulation of space activities and providing them with the rights to own everything extracted from asteroids (Oduntan, 2015). This is dangerous for the practical use of natural resources from celestial bodies by residents of other countries.

Indeed, national legislation does not correspond to one another. This will lead to space conflicts sooner or later. This issue needs to be resolved at the level of the United Nations through the adoption of the "Convention on the extraction, ownership, and use of natural resources from celestial bodies" by the international community or the creation of an authoritative international federation: "Extraction of resources from celestial bodies." The ratification of this convention by the major space-faring nations is the most difficult. Failure to do so will lead to inevitable military confrontations, raids, and other negative developments in outer space by order of magnitude more than the Wild West of the USA during the colonization period.

Therefore, the tasks to be fulfilled on an experimental space island are to test the performance of all systems and equipment of space islands, the effectiveness, and indisputability of the simulators of the Earth's magnetic field and artificial gravity, the ozone layer. Thousands

of tourists will have to be allowed to visit these islands. This is the way to make ordinary Earthlings believe in the safety and comfort of people living outside the Earth.

Thousands of normal ways for Earth people to rest and work required for permanent residence in outer space should be created. In particular, these include technologies for preparing "hot" food and its consumption, the operation of pipes of water and other liquids and gases, the discharge of sewage and its processing. Physical fitness equipment and methods of learning, medical protocols, crematorium for the deceased on the island who wish to be "buried" in space, methods of religious worship should be adopted. For Man of Reason to become Man of Reason in Space, thousands of different challenges must be addressed. It will not be possible to do so without the experimental island proposed.

General description of the experimental space island

We propose to locate the first experimental space island at the Lagrange point L4 or L5 in the Earth-Moon system. It will provide accommodation (rest, treatment) for 60 passengers to be served by 40 crew members.

The island will be an oval with a major axis of 30 meters and a minor axis of 20 meters. The oval will be constructed of titanium and composite materials. Inside there will be equipment simulating the Earth's magnetic field and technical equipment. Besides, the crew will live in cabins inside the island. The island's interior surface will be equipped with electromagnetic systems, which will simulate a gravity analog equal to Earth's in combination with the special shoes and clothing of passengers.

Two-thirds of the island's mid-sector surface will be covered with a transparent double dome at an altitude of 10 meters above the surface. Ozone will be pumped between the double surfaces. This will allow passengers to rest and be treated without protective means on the protected surface of the island.

On the outer surface of the island protected by the dome, there will be houses with an artificial analog of gravity for the accommodation and treatment of passengers. Many passengers will be disabled spinal cords, which can become more physically mobile under controlled artificial gravity. The greenery will decorate the protected surface of the island. Fountains will function due to the water magnetization.

The poles of the space island will be open and equipped with gateways for receiving spacecraft with cargo, passengers, and devices for connecting to external communications. The two fields of the solar panels will be located at a certain safe distance from the different poles of the island. The estimated mass of the island is 5,000 tonnes. The useful volume is 3,350 cubic metres, and the surface area is 2,700 square metres.

The basic layout of space islands linking

Space island constellation in circumsolar orbit between Earth and Mars, ideally, should be designed as independent from Earth's resources. However, the first experimental island does not set such an ambitious goal. The island, like the existing International Space Station, will be provided with Earth resources.

The space island is a very technologically complex and science-intensive facility and requires a well-functioning power supply and information exchange system. The power supply system consists of sources, wiring and current control units. The current control is implemented by specialized units and is essential for the stable and safe operation of the system (Ly &

Truong, 1999). The main sources of power on the island are solar panels. As noted above, the solar panels are in the form of banks extending into outer space from both poles of the island. The estimated area of the solar panels is 80,000 square meters and the mass is 630 tonnes. Solar panels are known to suffer significant damage from micrometeorites and free-floating debris, for which protection systems are applied, and repair and replacement of individual panels are provided (Christiansen et al., 2006). Optimum orientation (Yermoldina et al., 2019) is provided with movable joints. The solar panels are also duplicated by a backup source, a 2 Megawatt generator, which will be powered by the methane-powered internal combustion engine. These engines will be activated automatically in the event of a possible overload of the island or in the event of an unforeseen voltage drop from the solar panels.

The main purpose of the life-support system is the safety of the crew and passengers in conditions as close as possible to the ground ones. The atmosphere on the island consists of 79% nitrogen, 20% oxygen and 1% other gases. In the long run, the comets will produce water from which oxygen and hydrogen will be extracted using electrolysis. The air circulation is provided with a system of fans, heaters and monitoring sensors. Specialized subsystems control humidity, temperature and composition of air (Wieland, 1998).

As noted above, the space island constellation should be as autonomous as possible. Renewal and recycling is the main technological constraint to the space island's autonomy as a long-term manned space mission. For this reason, the optimally designed system of renewal and recycling of resources is decisive (Janik et al., 1989). We expect that 99% of the waste will be recycled and further processed cyclically on one of the islands in the constellation.

Spoiled food will be used as fertilizer in the gardens. Wastes that will not be recycled will be stored in containers and sent to heliocentric orbit so that they can be safely collected and disposed of in the future with more advanced technologies. The extraction of oxygen from comet water will release hydrogen, which can be used as fuel for incoming spacecraft, and the excess hydrogen will be vented.

Earth's magnetic field simulation

The study presents the author's original design of an electromagnet to protect a space island from such a negative space factor as the solar wind.

The solar wind is an extreme danger to the health of the crew and passengers and to the proper functioning of the island (Meyer-Vernet, 2007). An artificial magnetic field will be provided on the space island for primary protection against the dangerous solar wind and the creation of an electromagnetic background similar to Earth's.

Several options are considered in the design of the field construction system and a detailed analysis of preferences, disadvantages, mass and energy consumption enables to choose the electromagnet model as shown in Figure 1. With the characteristics specified in Table 1, this electromagnet generally satisfies the basic requirements for the magnetic field with the optimum mass of the system. The electromagnet is realized by placing the wire in the dielectric and non-magnetic housing. The fixings of the electromagnet to the island body should also be provided with dielectric and non-magnetic supports. Meeting these requirements will provide a near-calculated field.

It is known that the presence of a ferromagnetic core allows increasing its resulting characteristics. Nevertheless, the design of an electromagnet for an artificial magnetic field on a space island does not have a ferromagnetic core inside the winding. This decision is based on a

detailed study of mass parameters. The gain in power of the magnet due to the cores of various constructions has been analysed, but it turned out that the gain in power is offset by the increase in the mass of the magnet due to the ferromagnetic core. According to the study results, it will be more beneficial in terms of mass parameters to increase the mass of the magnet and the area of the solar panels than to place a ferromagnetic core inside the magnet. Ansys Maxwell© software enables to carry out calculations. The calculation has implied the finite element method.

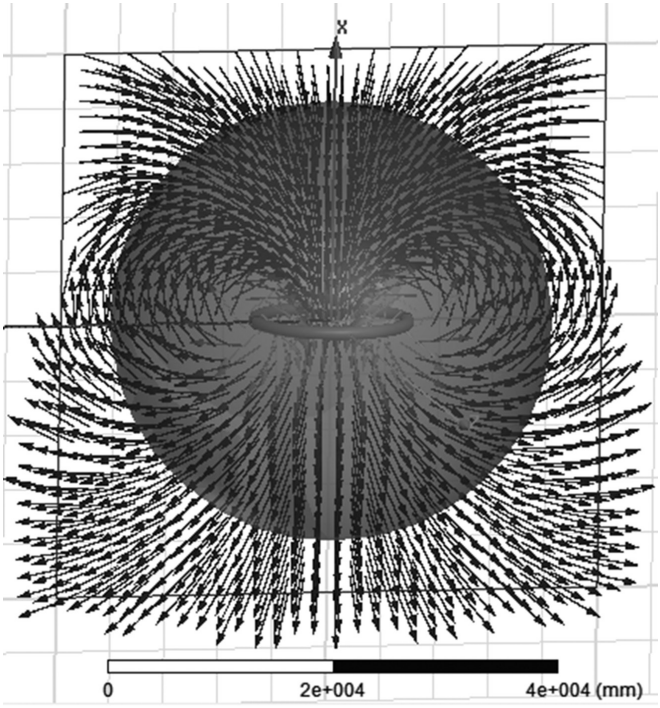

Fig. 1 Magnetic induction lines of an artificial magnetic field

Table 1 Characteristics of an artificial magnetic field

Magnetic induction modulus variation range, μT.	The radius of the magnet coils., meters.	Ampere-turns quantity, A.	Power, kW
35.9 — 45.9	6.4	16 000	20.753

Artificial gravity magnetic simulators

One of the dangerous factors of long space flight is the atrophy of the musculoskeletal system (Stein, 2013). In order to prevent this problem, causing the injury of astronauts, an artificial analogue system of gravity will be installed in the island's residential areas. At present, there are several generally accepted concepts for system implementation. They are all based on the use of centrifugal force in rotation to simulate gravity.

However, this concept has several significant drawbacks. First, it is not possible to control the force in different zones if there is only a rotation of one part, or the whole station. A space island requires the possibility to introduce varying gravity in different zones for the rehabilitation of spinal cords. Second, it is complex mechanical rotation systems, as the island is large in size. For these reasons, on a space island, the artificial analog system of gravity is based on the electromagnetic interaction of specialized clothing with the floor. Simulators are implemented by placing powerful electromagnets under the floor of residential zones to attract electromagnets in the shoes and clothes of passengers and crew.

A critical factor in the functioning of the system is feedback, which regulates the interaction power gradient, that is, the stable movement of a person. This electromagnet control system will make the human gait as close as possible to Earth conditions and prevent the user from falling. For system design in the first approximation, finite element simulations in the software Ansys Maxwell are applied. An analogy of interaction power and earth gravity force has been developed to calculate the power of the electromagnet. Comparative characteristics are in Table 2.

Table 2 Comparative characteristics of magnetic field and gravity criteria

Distance from the magnet, meters	Overload, G	The module of magnetic induction (B-field), μT
0.001	2.9	35 000
0.601	0.0758	1 790
1.201	0.02502	5 210
1.8	0.01216	1 380

The greatest engineering challenge is the rapid drop of interaction power with distance from the electromagnet, illustrated by Fig. 2 as an example for human use.

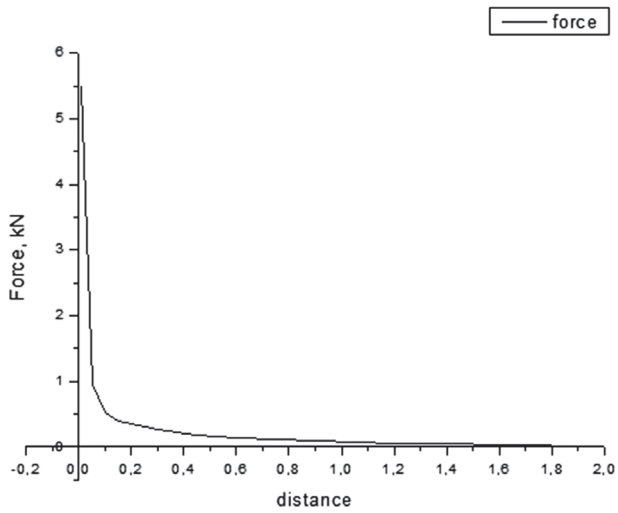

Fig. 2 The diagram of interaction power of space clothing with an electromagnet

The solution to this problem is the above-mentioned system of control of the power of electromagnets in different parts of space clothing.

The data are obtained by varying the distance to the main electromagnet, one of the calculated positions is shown in Figure 3.

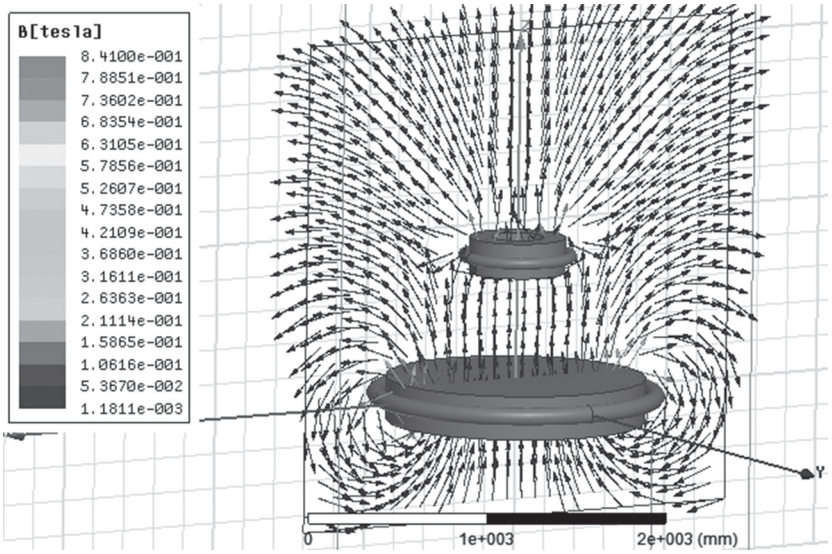

Fig. 3 Magnetic induction lines during interaction of the electromagnet, placed in the floor of the island, with an element of space clothing.

Moreover, the results of the simulation enable to draw certain conclusions for the design of cosmic clothing in the first approximation. Since the magnetic field needed to attract the space clothing is significantly more than the value of the Earth's magnetic field, in order to provide a normal human magnetic background under artificial gravity, the mesh shielding structure should be integrated into space clothing.

Another conclusion is that in order to reduce the required power of space clothing, the interaction power will be applied only to the lower part of the system, the legs. This will reduce the power of the electromagnet in space clothes to 400 W and the electromagnet on the floor to 1.6 kW. All mathematical models and simulations of this power distribution correspond to the above. This solution will allow the space clothing to be powered by a portable battery. The floor magnet will be powered by solar panels or the island's backup power supply on methane engines.

Delivery of components and passengers to the experimental island

The Lagrange point L4/L5 in the Earth-Moon system has been chosen to locate the first island for 100 people. The Lagrange points are the points where all the gravitational forces are balanced.

Namely, the island at the Lagrange point will remain stationary relative to Earth and Moon. The most stable points of the system are L4 and L5; even with small deviations, the resultant

force will return the island back to the Lagrange point, meaning there will be no need to spend the fuel to stabilize the orbital position.

The position of the Lagrange points in the Earth-Moon system is shown in Fig. 4.

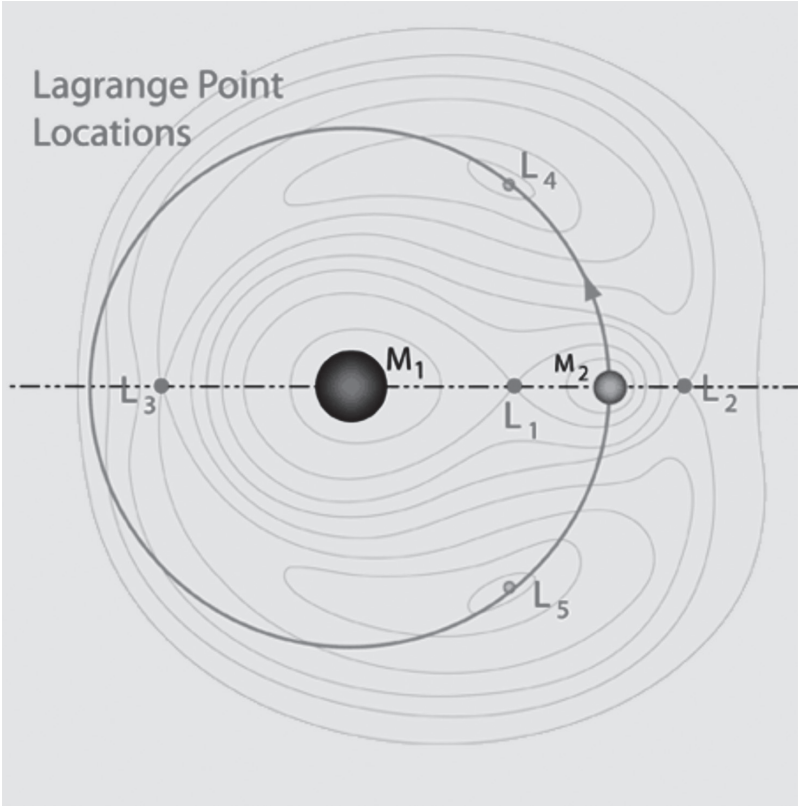

Fig. 4. Lagrange points in the Earth-Moon system

The flight follows the Hohmann trajectory from low Earth orbit (408 km) to the Lagrange point L4 (distance 384400, deviation from the Moon by 60°), as this is the most energy-efficient way to reach the Lagrange point and, in the case of a space island, requiring to move large masses, the energy factor is crucial.

The trajectory calculated is elliptical and crosses the Moon's orbit and low Earth orbit in the apses. The orbital flight maneuver consists of two engine starts. The maneuver pattern is shown in Figure 5.

According to the calculation results, the total characteristic velocity of the orbital maneuver is 3.88 km/s. This maneuver takes approximately 123 hours to complete. It is planned to use a heavy reusable launch vehicle, whose prototypes are now being actively tested.

The following is a diagram of the Lagrange launch using an orbital refuelling system (Richard Lawler, 2019). The starting point is the moment when the rocket with useful cargo is launched from the starting table. Half an hour after the launch of a useful cargo missile, a similar tanker missile will launch into orbit exclusively with fuel. Three hours after the

beginning of the count, the tanker missile joins with the cargo missile then transfers the fuel in orbit from the tanker to the cargo missile. After this stage, the orbital maneuver begins; the cargo missile makes the first start of the engine, with a relative velocity of 3.051 km/s. Then, in 119 hours, 34 minutes after the first start of the engine, the second one starts in the opposite direction. The second launch provides a relative velocity of 0.8332 km/s.

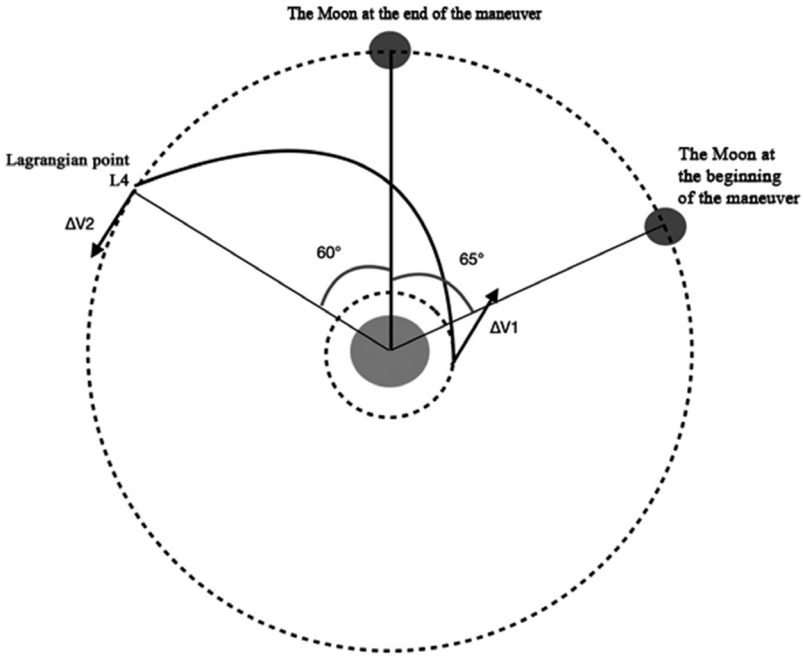

Fig. 5 The orbital maneuver pattern of delivery of components and passengers to the island

Therefore, one flight takes about 123 hours and allows moving about 100 tons of cargo to the Lagrange point L4 or L5.

Mass calculation concept, solutions to island compilation and cost challenges

To estimate the mass of the island, an equivalent sphere with a radius of 20 meters is used. Taking into account current trends in mechanical fixing designs, it is estimated that the primary structure will cover 10 percent of the space island. Further mass calculations take into account innovative coefficients. An innovative coefficient is a promising reduction parameter of mass, power consumption and price that are available to modern technologies in the medium term of 5-7 years using “Earth” technologies in outer space.

The coefficients are calculated on the basis of historical trends and the law of accelerating returns of science, technology and social relations. The result is an estimated island mass of

about 4.5 thousand tons, but it may increase as the area of the solar panels increases to increase the island's energy capacity.

The construction of the space island is interrelated to the lack of human experience in the design of large but not standardized systems in outer space orbit. It is known that modern space stations have a modular structure, which greatly simplifies assemblage, as the modules have standard docking blocks. However, a space island is an oval that supports the subsystems of the island described above. To assemble it, specialized space tugs and a space crane should be launched to carry the elements of the island and to fix them accordingly.

Means and impact of the project

The space island constellation project is ambitious, both in terms of courage and cost. No State alone, no businessman can realize it — it is necessary to unite State-space agencies, public organizations involved in space activities and entrepreneurs, with investments from many countries. We believe that the project under consideration should be implemented with the help of private investors from a dozen sovereign States, with their governments' support. In other words, we are planning to establish a private joint-stock company, a transnational company with a parent legal entity registration in one of the stable States with the rule of law, liberal tax and banking laws and which is a member of the Space Club, that is part of the Missile Technology Control Regime. Such a transnational corporation could be called "Intercosmos II."

Then distribute the privileges among the investors. The first is the right to choose in which enterprises and in which States to invest regarding the design and production of the project's components. In other words, the investments of investors in the project will develop their business, or (if the investor is not a businessman), at the investor's choice, will be sold in those states and in those enterprises capable of producing them. Moreover, there will be an exchange of technologies within the corporation enabling non-spacefaring nations to become such through their entrepreneurs. However, this sector implies limitations. Businessmen who are residents of States outside the space club will not be able to receive and produce missile technologies. However, given the scale of the project, there will be more than enough work for all actors.

The realization of such an ambitious project will attract thousands of investors from a dozen States to the exploration and use of outer space and will actively develop and positively affect the economies of the States in which they are residents. Indeed, space activities today are not the right of a few developed countries. It is a common opportunity for any creative businessperson or investor from any State to engage in it. Business activities in the space industry are becoming routine, however, one of the most profitable.

Conclusions

Therefore, as long as theoretical physicists and mathematicians solve the equations "Accessible Universe," humanity can and must master the Solar System Cosmos for living, production, recreation and treatment. It is a matter of human survival. Stephen Hawking argues that it is only a matter of time before the planet Earth is destroyed. The part of humanity needs to leave the Earth because it is becoming too small for us, and our physical resources are disappearing at an appalling rate.

We offer the concept of space island constellation to the scientific community, statesmen, businessmen and investors. It is designed on the basis of available laws of physics and industrial technologies practically mastered. All we offer for an experimental island construction either has already been produced by national businessmen from different countries or can be done by them. Considering the high cost of the project, it should be international, involving businessmen and investors from a dozen countries. This will have a positive impact on the economies of the participating States and on the world economy as a whole.

🕮 References

Baum, Seth and Anthony Barrett (2018) A Model for the Impacts of Nuclear War. *Global Catastrophic Risk Institute Working Paper*.

Blaber, Elizabeth, Helder Marçal, and Brendan P. Burns (2010) Bioastronautics: The Influence of Microgravity on Astronaut Health. *Astrobiology*, 10:5, 463-473. https://doi.org/10.1089/ast.2009.0415

Chapman, Clark R. (2004) *The hazard of near-Earth asteroid impacts on Earth.* Earth and Planetary Science Letters. Available online: https://www.sciencedirect.com/science/article/abs/pii/S0012821X04001761?via%3Dihub

Christiansen, Eric L., Kornel Nagy, Dana M. Lear and Thomas G. Prior (2006) Space Station MMOD Shielding, AIAA 2006-B6.3.05. *57th International Astronautical Congress*. October 2006.

Glester, Andrew (2018) The asteroid trillionaires. *Physics World*. Available online: https://physicsworld.com/a/the-asteroid-trillionaires/

Janik, D., Crump, W., Macler, B., Wydeven, T. et al. (1989) Problems in Water Recycling for Space Station Freedom and Long Duration Life Support. *SAE Technical Paper* 891539. https://doi.org/10.4271/891539

Halunko, Valentyn (2017) *Pension as Factor of Legal Interaction Between Children and Parents.* Scientific Institute of Public Law. Available online: http://sipl.com.ua/?p=4776

Hawking, Stephen (2011) *The Universe in a Nutshell*. Available online: https://www.goodreads.com/book/show/2095.The_Universe_in_a_Nutshell

Ly, J. H. and C. Truong (1999) Stability analysis of the International Space Station electrical power system,. In *Proceedings of the 1999 IEEE International Conference on Control Applications* (Cat. No.99CH36328), Kohala Coast, HI, USA, 1999, pp. 628-633 vol. 1, https://doi.org/10.1109/CCA.1999.806725

Meyer-Vernet, Nicole (2007) *Basics of the Solar Wind*. Cambridge University Press.

Oduntan, Gbenga (2015) *Who owns space? US asteroid-mining act is dangerous and potentially illegal*. Available online: https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073

Our growing population (2019) UN. Available online: https://www.un.org/en/sections/issues-depth//

Prado, de Almeida, Antonio Fernando Bertachini, and Roger Broucke (1996) Transfer orbits in the Earth-moon system using a regularized model. *Journal of Guidance, Control, and Dynamics*. https://arc.aiaa.org/doi/pdfplus/10.2514/3.21720

Reijnders, L. (2014) Phosphorus resources, their depletion and conservation, a review. *Resources, Conservation and Recycling.* Volume 93, December 2014, 32-49. http://doi.org/10.1016/j.resconrec.2014.09.006

Schröder, K.-P. and Robert Connon Smith (2008) Distant future of the Sun and Earth revisited. *Monthly Notices of the Royal Astronomical Society*, Volume 386, Issue 1, May 2008, 155–163. https://doi.org/10.1111/j.1365-2966.2008.13022.x

Sluijs, Lennart van, Charlotte Brand, Dennis Vaendel, Dominique Petit dit de la Roche (2015) The lightcurve of an asteroid. *Semantic scholar*. Available online: https://home.strw.leidenuniv.nl/~jarle/Teaching/Practicum2015/assets/2015-04-19-asteroid-lightcurve.pdf

Stein, T.P. (2013) Weight, muscle and bone loss during space flight: Another perspective. *Eur J Appl Physiol* 113, 2171–2181. https://doi.org/10.1007/s00421-012-2548-9

Volker, Hessel, Nghiep Tran Nam, and Sanaz, Orandi (2020) *Continuous-Flow Extraction of Adjacent Metals—A Disruptive Economic Window for In Situ Resource Utilization of Asteroids*? Volume 60, Issue 7, 2021, 3368-3388. Available online: https://onlinelibrary.wiley.com/doi/abs/10.1002/anie.201912205

Wada, Yoshihide, Ludovicus P. H. van Beek, Chery M. van Kempen, Josef W. T. M. Reckman, Slavek Vasak, and Marc F. P. Bierkens (2010) Global depletion of groundwater resources Global depletion of groundwater resources. *Geophysical Research Letters*, Volume 37, Issue 20. https://doi.org/10.1029/2010GL044571

Weitzman, Martin L. (1999) Pricing the Limits to Growth from Minerals Depletion. *The Quarterly Journal of Economics*. Volume 114, Issue 2, May 1999, 691–706.

Wieland, P. (1998) *Living Together in Space: The Design and Operation of the Life Support Systems on the International Space Station*.

Yermoldina, G.T., Suimenbayev, B. T., Sysoev, V.K., and Suimenbayeva, Zh.B. (2019) Features of space solar power station control system. *Acta Astronautica*, Volume 158, 111-120. https://doi.org/10.1016/j.actaastro.2018.04.001