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The Europa Clipper Mission and Space Tourism Through The Lens of Maqasid Al-Shariʿah

[1,] *Fahima Nazihah Binti Mohamad Hussaini

[1]Faculty of Syariah and Law, Universiti Sains Islam Malaysia (USIM), 71800, Nilai, Negeri Sembilan, Malaysia

*Corresponding author. E-mail: fahimanazihah@raudah.usim.edu.my

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ABSTRACT

This study examines the idea of space exploration with the principles of *Maqāsid al-Shariʿah*, with emphasis on NASA's Europa Clipper mission and space tourism. In addition to examining the various implications from Islamic viewpoint, and the ethical, environmental, and socioeconomic standpoint, this study analyses secondary data to show the benefits of space exploration, including the economic and scientific advancements, as well as the drawbacks, like resource allocation, environmental risks, and socioeconomic disparity. To guarantee adherence to *Maqāsid al-Sharīʿah*, this study proposes a balanced approach between scientific advancements and economic benefits in space exploration with Islamic principles. This research thus aims to suggest a framework that supports Islamic values and promotes fair and sustainable space exploration. This research contributes to the emerging field of Islamic astroethics by providing a structured approach to evaluating space exploration activities through the Maqāsid framework. The findings have significant implications for Muslim-majority countries developing space programs and for international space policy discussions, offering a unique perspective that balances technological progress with ethical responsibility. The study ultimately argues that space exploration, when properly regulated and guided by Islamic principles, can be a means of fulfilling humanity's role as *khalifat fi al-ardh* while advancing beneficial knowledge for all humankind.

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Introduction

Previously, humans can only gaze to the skies, making speculations on the nature of the night skies' objects. Through the developments of rockets and other technology and electronics in the 20th century, it became feasible to not only send machines, but humans beyond the atmosphere of the Earth into outer space (Logsdon, 2024). These rapid advancements in space exploration, especially the space tourism industry and the recent NASA's Europa Clipper mission raises relevant questions on related issues like safety concerns, impacts on the environment and socio-economic justice and quite the most important one is considerations from the Islamic perspective.

There is therefore a need to examine these recent developments in space exploration from the standpoint of *Maqāsid al-Shariʿah*. It is important to identify whether space exploration and its related activities are in accordance with Islamic values. One question to be answered in this study is how space exploration, particularly space tourism and the Europa Clipper mission, and their implications align with the principles of *Maqāsid al-Sharīʿah*—specifically the preservation of religion or *hifz al-din*, preserving life or *hifz al-nafs*, preservation of intellect (*hifz al-aql*), and wealth (*hifz al-mal*)?

Another relevant question is the available methods to balance or harmonize space exploration, through its challenges and benefits with principles of *Maqāsid al-Sharīʿah*. This study therefore will look into the considerations revolving space exploration, particularly focusing on space tourism and the Europa Clipper mission. This study proposes that while space exploration provides significant value and potential for advancements in science and economy, to ensure its alignment with Islamic principles, a balanced approach that prioritizes *Maqāsid al-Sharīʿah* is required.

Literature Review

Space Tourism: Definition and History

Space tourism, an aspect of space exploration, involves commercial travel to outer space for the various purposes such as recreational, leisure, or business. While government agencies such as NASA have historically been in charge of space exploration, there is an increase of private space companies. The commercial space businesses have also developed and has opened the door to civilians' space flight (Tinelmis, 2024). Space tourism now takes two forms: suborbital and orbital. Suborbital space tourism involves a brief duration in zero gravity in addition to viewing Earth from space (Thomas, 2023). Suborbital space missions will try to reach an altitude that counts as reaching space, although will not complete a full orbit. Virgin Galactic and Blue Origins are the two companies controlling the industry of suborbital space tourism (Calimanu, 2023).

Meanwhile, orbital space trips reach heights of nearly 400 kilometres, and orbital space travellers typically spend days, if not weeks, in space. In comparison to suborbital space flights, orbital space flights are more costly thanks to the increased time, speed and distance (Calimanu, 2023). The idea of space tourism started to emerge in the 1970s with early designs for Space Shuttle program's passenger cabins, albeit these were never developed. In 2001, Dennis Tito, an American businessman's visit to the International Space Station (ISS) on a Russian Soyuz spacecraft also

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marked a major milestone in space tourism as this paved the way for other private individuals to travel to space (Stimac, 2024).

Current Trends and Future Prospects

Much work still remains to be done as space tourism in early stages. Existing suborbital companies are continually modifying launch vehicles and boosting launch cadence to approach regularity, while new ones are waiting for FAA license to commence operations (Waldek, 2022). Currently, there are several active companies in the space tourism market which are selling tickets and planning future flights, such as Virgin Galactic, Jeff Bezos' Blue Origin, SpaceX led by Elon Musk and also Space Perspective. All these companies are making significant strides in making space tourism a reality (Lindbergh, R., 2020).

SpaceX is said to be testing reusable rocket technology to make spaceflight more affordable while other companies (for instance, Virgin Galactic and Blue Origin) are investing in suborbital space tourism (Taylor, 2021). While seemingly in the short term, space tourism is only accessible to extremely wealthy individuals, but it has long-term potential for regular people (Taylor, 2021). The International Space Station is currently the only habitable structure in space although companies are venturing beyond this as space hotels are likely to be the next venture.

The Europa Clipper Mission

Europa Clipper project was officially launched in 2015 by NASA (Pappalardo et al., 2024). The mission is aimed at examining Europa, Jupiter's moon to discover whether its subsurface ocean is habitable. Jupiter contains hundreds of moons, the four biggest of which are known as the Galileans. In the year 2030, on April 11, Europa Clipper will make its approach to Jupiter. Europa Clipper will circle Jupiter rather than Europa due to radiation concerns (*Overview | Mission – NASA's Europa Clipper*, n.d.). The goal of the mission according to NASA's postdoctoral scholar working on the project (Marshall Styczinski) is learning more about Europa, especially on whether the ocean is livable (Cooper, 2024).

To understand the ice shell's characteristics and the ocean underneath it, as well as the composition and geology of the moon, are three primary scientific goals of the mission. NASA's Europa Clipper mission will make many close flybys of Jupiter's moon Europa in order to gather accurate data for the moon's research. Each flyby will take the spacecraft over a new spot, scanning almost the whole moon. Including its enormous radar antennas and solay arrays, Europa Clipper is the largest spacecraft NASA has ever constructed for a planetary mission. Operating in the Jupiter system, the spacecraft requires huge solar arrays to gather enough light for its power requirements. Under its frozen surface, there is compelling evidence of a liquid water ocean (*Overview | Mission – NASA's Europa Clipper*, n.d.).

One of the most promising places outside of Earth where people could find habitable conditions is said to be Europa. A source of energy, certain specific chemical components and temperatures at which liquid water may exist are necessary for life. Scientists has described Europa as an "ocean world" because there is a strong suggestion of an ocean of liquid water beneath the its surface (*Overview | Mission – NASA's Europa Clipper*, n.d.). Strong evidence of a salty ocean with

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720 million cubic miles of water, which is double the size of our seas was found by NASA's Galileo probe (Evans, 2024).

Space Exploration: Ethical Considerations

Environmental Impact

The industry of space tourism is expected to negatively affect the environment on earth as there are claims that one day the space vehicles will be the world's biggest source of carbon dioxide emissions (*Want to Be a Space Tourist? Here Are 6 Things to Consider First*, 2024). Due to the requirement for high energy, spacecraft and rocket launches can result in air and noise pollution which subsequently can contribute to climate change and damage to atmosphere (EVONA, 2023). Emissions such as black carbon can harm the ecosystem, inducing various illnesses and even impacting agricultural practices. Thus, space tourism can pose a serious threat to the environment (Safdie, 2024).

Large volumes of carbon dioxide, nitrogen oxides, and other contaminants released by launch and re-entry of rockets and spacecraft could have long-term effects on the ecosystem (Armeen Farzad, 2022). Additionally, there is also the issue of space junk or space debris, contributed by these rockets. Space debris happen when scientific objects that are launched into space float in space instead of returning to, where they continuously exposed to excess emissions and harmful substances that are released back to our own atmosphere (Safdie, 2024).

It is known that every time a spacecraft launches, space debris is produced and can remain in orbit for years and as these frequency of launches increases, the amount of space debris that can harm other spacecraft is also increased, as even tiny particles can be damaging (EVONA, 2023). Other satellites and spacecraft in orbit around the Earth may be in danger due to the debris produced by space tourism activities, and increased space tourism could make this issue worse and raise the possibility of space collisions (Armeen Farzad, 2022).

Safety Concerns

As space travel is a risky endeavour, mishaps or accidents can occur as even with safety precautions, there is always a chance tha something could go wrong, and the repercussions of a mishap could be a disaster (EVONA, 2023). Researchers have studied spaceflight's health effect and known issues include bone loss and higher cancer risk, and there are also signs of vision problems, reduced brain tissue, weakened immunity, and changes in gene activity or DNA damage (Mann, 2024). Space travel poses significant radiation risks. A recent study found that space weather events could expose them to radiation levels far above the recommended limits. Higher levels of ionizing radiation in space can damage DNA, increasing the risk of health issues, including cancer (Rees, 2024).

NASA's Human Research Program has identified five main hazards astronauts will face. First is space radiation which is one of the biggest threats. Second, isolation and confinement. Being in a small space for a long time, far from Earth can potentially affect behaviour. Third, distance from earth will make it more difficult to get new supplies, medical help and instructions

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(NASA, 2024). Fourth, gravity fields as astronauts must adapt to different gravity levels on the space station, Moon, Mars, and back on Earth. Last is hostile or closed environments as to ensure a safe environment inside the spacecraft is challenging, including managing temperature, pressure, lighting, noise, and microbes. These hazards can interact and worsen their effects on the human body (NASA, 2024).

Resources and Accessibility

Due to the high cost involved in space travel, especially space tourism, which is currently available to the wealthy, many people are unable to experience space flight, which according to some can lead elitism and inequality (EVONA, 2023). Because only a small portion of the world's population can pay the expenses, space tourism is likely to be an exclusive sector. This might make already-existing socioeconomic injustices worse and result in a situation where only the wealthy privileged have access to space (Armeen Farzad, 2022). Critics believe that the massive resources being invested in space tourism may be better spent on poverty, healthcare, and climate change (Barnes, 2024).

Currently, billionaires who benefit from capitalism is said to be the ones controlling space tourism (Chin, 2021). Space exploration offers valuable knowledge and the potential to solve Earth's problems, but its costs may deter some. Some argue that the knowledge gained is invaluable, leading to the discovery of new technologies and potentially preventing human extinction in the face of unsustainable Earth conditions (*Space Exploration Pros and Cons: A Waste of Money?*, n.d.). The space industry, valued at over $400 billion, significantly impacts materials science and telecommunications sectors, generating direct economic output and job creation (Episodes, 2024).

Maqāsid al-Shariʿah and Space Exploration

Maqāsid al-Shariʿah: An Overview

According to Al-Zuhayli (2003) as cited by Rosidi et al. (2022), maqasid is the ultimate goal, intention and outcome regulated by *Shari'ah* through its rules, which must always be accomplished, demonstrated and attained. *Maqāsid* in its literal interpretation means objective, purpose and goal (Mulhim, 2005, as cited in Baharuddin et al., 2019). Everything that Allah SWT has mandated in various religious affairs is known as *Shari'ah*, including the recommended and the required acts such as zakat, praying, fasting, pilgrimage and other righteous, noble actions (Al-Qaradawi, 1996).

According to Al-Raysuni (2015), *Maqāṣid al-Shari'ah* refers to the aim of fostering human welfare. While Al-Zuhaili (1986) defines it as the Shariah's goals and principles that are contained in its provisions. According to Nor Azlina et al. (2023), these goals and purposes are considered the fundamental principles of Shariah, as established by Allah SWT. With the aim of safeguarding the wellbeing or people in this life as well as the next, *Shariʿah* is a comprehensive manual to guide the humanity as a way of life. Al-Ghazali (2013) used the expression *al-Dharuriyyat al-Khamsah*:

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"*And the purposes of Shari'ah are five, which are: to protect religion, life, intellect, lineage, and their property*".

According to Husna Ahmad Khalid et al. (2021), the fundamental principle of *Maqāsid al-Shariʿah*, which is removing harm or *mafsadah* and preserving benefit or *maslahah* is in line with al-Ghazali's approach. *Maslahah* simply means public interest, whereas mafsadah refers to everything that might have an impact on both human and non-human, including the environment. According to Al-Shatibi (2004), *maqāṣid* for all humankind is realized by *shari'ah*. Its purpose is to secure rewards (*maslahah*) and avert harm (*mafsadah*), both in this life and the next. Al-Ghazali (1971) distinguishes three types of *maṣlaḥah*: necessities (*al-Darūriyat*), complements (*al-Hajiyāt*), and embellishments (*at-Tahsiniyāt*). *Al-Darūriyat* (necessity) involves components or factors that are essential for both the Deen and the Dunya and cannot be disregarded, the absence of which will result in chaos.

Al-Ghazali also emphasized on the need of preserving the five important components: religion, life, intellect, offspring, and property. Any act that upholds the preservation of these five fundamental components are considered in the *maslahah* category and any act which contradicts the preservation of these five fundamental components is considered as *mafsadah*. Meanwhile, *al-Hajiyāt* is something that people need to overcome difficulties or without it, people will struggle in following the commands of Allah, but society is not going to end up in chaos without it unlike *al-Darūriyat*. As emphasized by Al-Shatibi (2004), the loss of *al-Hajiyāt* may lead to some difficulties, but it will not significantly affect the five vital aspects.

Finally, *at-Tahsiniyāt* (embellishments) are an improvement (Al-Ghazali, 1971), things that will contribute to advancing or perfecting life although its absence will not result in difficulties like the other other two categories (Rosidi et al., 2022). For the purposes of this study, the most relevant out of the five important components are *Hifz al-din, Hifz al-nafs, Hifz al-aql* & *Hifz al-mal*. *Hifz al-din*, according to Ibn Ashur (1998), is protection a Muslim's faith. While to defend life under Hifz al-Nafs, Islam condemns killing ourselves or others, as the failure to save lies will lead to destruction and loss of peace (Rosidi et al., 2022).

Al-Razi (1986) emphasized that protection of life, based on Islamic scholars, has two aspects: physical dimension and spiritual dimension. According to al-Khadimi in *'Ilm al-Maqasid al-Syar'iyyah*, *hifz al-din* is preventing any kind of harm to life and ensuring the continuity of life. While Al-Shatibi (2013) in *Al-Muwafaqat* emphasized that for the *al-wujud* dimension, examples are sanctioning of *iman* or belief, pillars of worship which include obligatory acts such as prayer, fasting and many others. For *hifz al-aql*, according to Ibn Ashur (1998), keeping the intellect entails safeguarding the mind against everything that might cause harm to it. He goes on to suggest that intellectual disturbances will have a big negative impact on society.

According to Al-Shatibi (2013) also, mind preservation entails keeping it safe from any harm (Rosidi et al., 2022). Islam urges its followers to use their intellect to contemplate the manifestation of Allah's majesty (Muhammad Ismail, 2014), and one way to do so is through travelling. To maintain mental well-being when traveling, there are variety of approaches including *tafakkur* to promote mental health in people with an emphasis on intellect preservation

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(Nor Azlina et al, 2023). To ensure that *hifz al-aql* can be carried out during travel, the traveling must be for the purpose of seeking and increasing knowledge (Nor Azlina et al, 2019). For *hifz al-mal*, Al-Ghazali (1971) defines this as protecting people's property (Rosidi et al., 2022).

According to Al-Raysuni (2015), the classical views emphasize on the protection of people's belongings under the preservation of wealth, whereas Al-Shatibi (2013) illustrate it as prohibiting forms of injustice, wastefulness and corruption. Mankind ought to conserve and be responsible in administering resources without causing any detrimental consequences on the world by encouraging *ihsan* (mutual kindness) and '*adl* (socioeconomic fairness) (Muhammad Nooraiman et al., 2022). Clearly, Islam forbids wastefulness, extravagance and greed, (Ahmad Musadik et al., 2020).

Space Travel and Exploration in Islam

According to some scholars, space travel is acceptable so long as it will not endanger the creation of Allah SWT or go against Islamic law. On the other hand, some other scholars believe that certain space activities are prohibited (*haram*) activities involving space are said to be equivalent to harming oneself. Shaykh 'Abd al-'Aziz al-Shaykh, Muftī al-Akbar of Saudi Arabia has stated that space tourism is not allowed due to the risk and expenses involved (Kalhoro, 2023). According to a fatwa published in Islamweb.net, there is no harm in Islam going to and landing on the Moon or other planets, if it leads to achieving benefits and does not cause considerable harm or neglect of what is more appropriate or contradict with Islamic principles.

While Sheikh Al-Habib Ali Al-Jifri viewed that that space tourism is transgress the sacredness of life and resources are wasted, and these resources could be used to beneift humanity. In Islam, individuals are encouraged to research and explore the world, increasing their knowledge. "*And He has subjected for you the night and day and the sun and moon, and the stars are subjected by His command. Indeed, in that are signs for people who reason*" (Quran 16:12). This verse highlights the importance of utilizing human reasoning and reflective skills to obtain a deeper understanding of the cosmos. In deciding and issuing a ruling on space travel, Islamic scholars consider a number of factors. First, the intent behind the journey, the benefits and disadvantages for the individual, adherence to Islamic practises and principles in outer space, and to appreciate Allah's creation and his manifestations (Kalhoro, 2023).

Meanwhile, according to Sheikh Muhammed Salih Al-Munajjid, there is no prevention in Islam for man to explore the space its wonders, or to look for Allah's dominion and what He has created, as Allah has commanded us to do so. Although, Muslims should also measure the effort, time and money spent against the expected (*Islamic View of Space Exploration - Islam Question & Answer*, n.d.). In Malaysia, ANGKASA and JAKIM jointly hosted a two-day "Seminar on Islam and Life in Outer Space" in April 2006 and at the end of the seminar a guideline was adopted (Fischer, 2008). This is before the event of Malaysia sending its first astronaut, Sheikh Muszaphar Shukor to the ISS in 2007. A guideline by the Department of Islamic Development Malaysia's '*Guideline for Performing Islamic Rites at The International Space Station* (ISS)'.

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The conference approved space travel although there are ethics that must be observed by a Muslim astronaut in regard to the maintenance of relationship with Allah SWT, observation of peace with other beings also ensures the sustainability of the space environment (*Muslims in Outer Space*, n.d.). It was also stated in JAKIM's guideline that space exploration is an advancement in the history of civilisation as there will be further exploration in the, and that no matter where a Muslim is and no matter how technology evolves, his or her religious rites remain an obligation which must be performed. It was also stated that appreciating the greatness of Allah and giving priority to the interest of the ummah must be the ultimate goal.

Clearly, human expeditions and explorations into space have begun. Aside from ISS, it is not impossible that in the future there will be human expeditions to Mars as planned by the United States Space Agency (NASA) and Muslims may join the expedition, therefore at that time a new formulation of *fiqh* is required, related to the qibla of prayer, prayer time, fasting period and so on (*Pejabat Mufti Wilayah Persekutuan*, 2020). The International Space Station, which orbits at a high height of 254 miles, is firmly under our planet's gravitational pull. But Mars is a totally other story. At its closest approach, the Red Planet remains an astonishing 140 million miles away from Earth (Tokel, 2024) Space tourism has made significant progress in commercial spaceflight. However, ethical concerns such as environmental impact, safety, access, and socio-economic disparities persist.

The Europa Clipper mission, aside from the similar implications of space exploration, also requires ethical deliberation, particularly regarding resource distribution. The currently available literature discussed on the benefits of space exploration from the technological and scientific perspective. One significant gap in current existing research is related to the application of *Maqāsid al-Sharīʿah* principles in space exploration, particularly on the weighing and balancing the benefits against the harm. Future research initiatives should focus on how Islamic values may be integrated into space exploration to enable the long-term growth of space tourism and missions.

Methodology

This research evaluated space exploration, particularly space tourism and the Europa Clipper project, from the framework of *Maqāsid al-Sharīʿah*, through data gathered from secondary sources such as Islamic jurisprudential writings and industrial publications to provide insight into the religious, technological, environmental, and socioeconomic aspects of space exploration. Space exploration activities are evaluated based on fundamental principles of *Maqāsid al-Sharīʿah*, including the preservation of life, intellect, wealth, religion, and lineage.

Discussion

In answering the first research question on how space exploration (particularly space tourism and the Europa Clipper mission) align with *Maqāsid al-Sharīʿah*, in terms of the preservation of life, space travel or exploration involve significant risks, including harmful effects to the human body, life and negative environmental effects, raising concerns from the perspective of *hifz al-nafs*. For preservation of religion, Muslims are required to adhere to their religious obligations, and this is

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included even during the space exploration. If there is neglection of one's religious duties while in space or if the time, attention and effort spent can take away a person from his or her religious responsibilities, it can be argued that space exploration does not support the preservation of religion. Additionally,

Although in the context of the Europa Clipper, the mission itself might not endanger human life directly, as the spacecraft is unmanned. For preservation of property, as Islam forbids wastefulness, people must handle resources sensibly while having regards to socioeconomic fairness and charity. Space exploration in general requires high cost or financial resources. Although some may argue that space industry will create new economic and employment opportunities related to space travel and space technology, subsequently leading to economic growth, this raise concerns on whether there is imprudent use of financial resources, especially as there are more serious issues on earth to be addressed. Especially for space tourism which its purposes are recreational in nature.

Moreover, *Maqāsid al-Sharīʿah* puts much importance on the protection of human intellect, under *hifz al-aql*. Space exploration in will advance human's scientific knowledge and contribute to scientific research and technological advancements or innovations. In Islam, the pursuit of knowledge and exploration is encouraged. In response to the second research question, which is concerned on balancing space exploration with the principles of *Maqāsid al-Sharīʿah*, several important suggestions centre on safety, intellectual development, wealth preservation, and moral behaviour. First, to ensure the preservation of religion (*hifz al-din*), creation of detailed rules and guidelines for Muslim astronauts to follow in order to fulfil their religious obligations in space are necessary. The integration of Islamic principles into space policies will ensure space exploration that is in line with Islamic principles.

Using such methods, space exploration can develop in a way that strikes a balance between Islamic belief and scientific and economic advancements, guaranteeing that knowledge acquisition benefits humanity without sacrificing fundamental religious and moral principles. Next, for preservation of life (*hifz al-nafs*), suggested ways would be improving safety protocols for astronauts, to minimize as much as possible dangerous risks to the health and life. However, uncrewed missions like the Europa Clipper should be given priority to reduce risks involving human life and putting environmental stewardship into practice to lessen the ecological impact of space activities.

In addition, the implementation of research in useful technologies, and also encouraging collaborative thinking and cooperation between Islamic scholars and scientists for the development of clear and comprehensive frameworks which integrate Islamic and ethical principles especially for Muslims are some of the ways to promote the preservation of intellect (*hifz al-aql*). Moreover, the preservation of wealth (*hifz al-mal*) can be accomplished by supporting the creation of policies that will make space exploration's benefits more accessible to marginalized groups and concentrating on investments on technologies that provide humanitarian benefits and making sure that resources are allocated wisely to prevent waste.

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Conclusion

To conclude, it is essential to weigh the benefits against the harm, as the underlying aims of *Maqāsid al-Sharīʿah* is to prevent or remove *mafsadah* and to secure or preserve *maslahah*. Weighing between the two while considering established principles in Islam is important in considering whether it is in line with *Maqāsid al-Sharīʿah.* While space exploration holds significant potential for scientific and economic advancements, to ensure its alignment with Islamic principles, a balanced approach is required.

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