Cislunar Security: U.S. and Chinese Activities in Cislunar Space and Future Issues*

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Abstract

Discussions focusing on cislunar security have started to gather momentum. It is due to the increasing potential for cislunar space to evolve into a location of continuous human activity and both the United States and China see implications here beyond science and technology. In this context, the U.S. Department of Defense is establishing technology demonstration programs as well as a unit associated with cislunar space, with a focus on space domain awareness. China's People's Liberation Army has indicated in one of its current textbooks that it believes the military domain will extend into deep space, and it has been suggested that the military may have been already assigned related missions. In preliminary considerations of future cislunar security, three issues can be raised for possible military activities: support of military activities on Earth and inside geosynchronous orbit, protection of national interests in cislunar space, and the defense of lines of communication and relay stations to deep space. Concerns to be discussed regarding the governance of cislunar space include space debris, space situational awareness, space traffic management, lunar resource development, and the activities of military organizations and personnel on the Moon.

Introduction

In recent years interest in cislunar space has grown for the first time since humans first landed on the Moon about half a century ago. Cislunar space literally means the space on this side of the Moon (in Latin, "cis" means "on this side of"). This includes the area of space from the Earth to geosynchronous orbit (GEO), but generally, the area within GEO is excluded when discussing cislunar space.[1] On the other hand, definitions of cislunar space often include the five Earth-Moon

* Originally published in Japanese in *Anzenhosho Senryaku Kenkyu* [Security & Strategy], vol. 3, no. 2 (March 2023). Some parts have been updated.

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1 In many cases, GEO refers to geostationary orbit, about 36,000 km from the Earth's equator. For a definition of cislunar space, see the examples below. Office of Science and Technology Policy, The White House, *National Cislunar Science and Technology Strategy*, November 2022, p. 3, https://www.whitehouse.gov/wp-content/uploads/2022/11/11-2022-NSTC-National-Cislunar-ST-Strategy.pdf; Steve Parr and Emma Rainey, eds. "Cislunar Security National Technical Vision," Johns Hopkins University Applied Physics Laboratory, November 2022, pp. 1-2, https://www.jhuapl.edu/Content/documents/CislunarSecurityNationalTechnicalVision.pdf.

Lagrange points (EMLs), their nearby orbits, and the Moon.[2] The discussions here are based on that definition.

Cislunar space is attracting renewed attention due to the fact that there has been a significant increase in human activity related to this space in recent years, and the trend is expected to continue. In particular, both the U.S. and China have been focusing on cislunar space through the Artemis and the Chang'e programs, respectively. Both countries intend to continue relevant activities, and the implications are not limited to science and technology.

In this context, discussions about cislunar security have become more spirited. Within space security, cislunar security can be seen as a specialized concept for cislunar space. Therefore, just as space security has two aspects ("space for security" and "security for space"),[3] cislunar security covers how cislunar space can be used for military purposes and how to ensure the stable use of aforementioned space.

With these points in mind, this paper will review the current state of and plans for initiatives by the U.S. and China, the world leaders in cislunar space activities, and analyze the implications of these activities for each country. In addition, it will provide preliminary consideration of possible military activities and governance in cislunar space.

The study of cislunar security is significant in that it broadens the horizons of security studies, especially military and governance research. At the end of the 1950s, humans began launching artificial satellites, a paradigm shift which extended the field of security studies into outer space. However, its scope was essentially limited to within GEO. Cislunar security will greatly expand this scope.

Discussions and research on cislunar security are primarily conducted by American researchers and practitioners. In 2020, the Johns Hopkins University Applied Physics Laboratory founded the Cislunar Security Conference, which has been held every year since. In the three years leading up to 2022, more than 1,100 people attended the conference.[4] In addition, discussions of cislunar security have begun to take place in the Space Force Association's publication *Space Force Journal* and other media. In the journal, David Buehler and others at the Air Force Research Laboratory (AFRL) have suggested that the expansion of the U.S.'s space activities beyond geostationary orbit (XGEO) will create a need to protect the national interest, and based on that, the U.S. should begin the studies and technology development necessary for military activities in XGEO.[5] Laura Duffy and James Lake have also used *Space Force Journal* as a forum to argue that

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2 The White House, *National Cislunar Science and Technology Strategy*, p. 3. An EML is "a place where the gravitational pull of the Earth and the Moon is equal to the centrifugal force of an orbiting spacecraft," allowing the spacecraft to stay put while using very little energy. Okuda Yui, "The Orbit Control of Ultrasmall Probes Aiming for the Lagrange point and Communications Technology (EQUULEUS Technology: Part 1): The Japanese Cubesat Piggybacking Artemis I (3)," *Minna no Shisaku Hiroba*, December 9, 2021, https://minsaku.com/articles/post828/.

3 See below for more information. Fukushima Yasuhito, *Order and Disorder in Space Security: Past, Present, and Future* (Tokyo: Chikura Shobo, 2020), Introduction.

4 Johns Hopkins University Applied Physics Laboratory, "Cislunar Security Conference 2023," https://events.jhuapl.edu/event/8c1f0789-6780-4485-bcd6-c0d807461184/summary.

5 All titles in this paper are as they were when presented and announced. David Buehler, Eric Felt, Charles Finley, Peter Garretson, Jaime Stearns, and Andy Williams, "Posturing Space Forces for Operations Beyond GEO," *Space Force Journal*, issue 1 (January 31, 2021), https://spaceforcejournal.org/posturing-space-forces-for-operations-beyond-geo/.

the U.S. should at minimum acquire the capability to observe activities in cislunar space, pointing out that there are strategically important areas in cislunar space.[6]

Meanwhile, the unique approach of this paper is to analyze the activities of both the U.S. and China in cislunar space and their implications from multiple angles, and consider cislunar security from both military and governance perspectives.

Cislunar security research is of growing policy significance in Japan.[7] In October 2019, the Japanese government announced its participation in the Artemis program. At the time, the Strategic Headquarters for Space Development, headed by the Prime Minister, issued the Policy of Japan on the Participation in International Space Exploration under the Proposal of the United States, which cited foreign policy and security as a key reason for participation. The following year, the Basic Plan on Space Policy established by the Cabinet indicated that, based on the fact that the Artemis program has substantially different characteristics from conventional space science and exploration from the perspective of aiming for sustainable activities on the Moon, the government as a whole will promote discussions, including engagement from view points other than space science and exploration, such as economic activities, diplomacy, and security to ensure that Japan's participation in the program is proactive. In this way, cislunar space became a security policy issue for Japan.

Sections 1 and 2 will analyze the current state of U.S. and Chinese cislunar activity and the implications for each country. Section 3 will provide preliminary consideration of possible military activities and global governance in cislunar space.

Fukushima Yasuhito is the corresponding author of this paper and was responsible for writing everything except Section 2. Yatsuzuka Masaaki was responsible for writing Section 2.

1. U.S. Activities in Cislunar Space and Their Implications

(1) The Activities of the National Aeronautics and Space Administration (NASA)

(A) The Current State of the Artemis Program and its Future

The U.S. was the first (and currently the only) country in the world to successfully land humans on the Moon. The first successful manned lunar landing was Apollo 11 in 1969, and there have been six landings up to Apollo 17 in 1972; a total of 12 astronauts have been on the lunar surface.

However, the U.S. has not made any crewed lunar landings since then. The Barack Obama administration canceled the crewed lunar landing program announced by the George W. Bush administration. President Obama's reasoning was that the U.S. had already achieved manned Moon landings, and he endorsed a policy of sending humans further than the Moon—to asteroids and even to Mars orbit.[8]

In this context, Space Policy Directive-1 (SPD-1), signed by President Donald Trump in December 2017, put a renewed emphasis on a crewed lunar exploration program. Through the

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6 Laura Duffy and James Lake, "Cislunar Spacepower The New Frontier," *Space Force Journal,* issue 2 (December 31, 2021), https://spaceforcejournal.org/3859-2/.

7 Discussions focusing on cislunar security are very limited in Japan; the symposium below is an exception. Science, Technology, and Innovation Governance Program, Graduate School of Public Policy, The University of Tokyo, "[Report] International Symposium on the Future of Lunar and Cislunar Activities: Commercial, Governance and Security Challenges," January 14, 2022, https://stig.pp.u-tokyo.ac.jp/?p=4401.

8 Brian Berger, "Obama Pledges 2025 Mission to Asteroid," *SpaceNews*, April 15, 2010, https://spacenews.com/obama-pledges-2025-mission-asteroid/.

document, President Trump announced that humans would return to the Moon for long-term exploration and use, and then be sent to Mars and other locations. He clarified that these initiatives would be undertaken in cooperation with commercial and international partners. During the SPD-1 signing ceremony, President Trump further indicated the idea of not only making a mark by planting the American flag on the Moon, but also establishing a base for the ultimate mission of going to Mars.[9] As explained below, there were motivations behind the Trump administration's policy shift that went beyond the perspective of science and technology. At the signing ceremony, Vice President Michael Pence stated that reestablishing an American presence on the Moon was critical to strategic objectives and that pursuing these objectives would enhance the country's national security, spur innovation, and create jobs.[10]

Under President Trump's policy, NASA established a plan for a crewed lunar landing by 2028, but in March 2019, Vice President Pence significantly accelerated this goal, announcing that it would be achieved by 2024.[11] In May 2019, NASA Administrator James Bridenstine announced that the associated missions would be called the Artemis program.[12]

The Joseph Biden administration did not reverse the previous administration's policy as the Obama administration did, but continued to pursue a crewed Moon landing agenda. However, in November 2021, Clarence William Nelson who was appointed the new NASA Administrator, announced that a crewed Moon landing would take place after 2025. One of Nelson's reasons was that the Trump administration's goal of 2024 was not technically feasible.[13]

NASA is taking incremental steps toward a crewed Moon landing. In November 2022, it launched a new rocket, the Space Launch System (SLS), as Artemis I. The uncrewed Orion spacecraft aboard this rocket orbited the Moon and returned to Earth the following month. In 2024, NASA will launch the SLS with a crewed Orion spacecraft aboard, which will orbit the Moon as Artemis II. That same year, construction will begin on Gateway, a crewed station orbiting the Moon. NASA will use Gateway as a relay station to travel to the lunar surface and later to Mars. In addition, the U.S. plans to conduct a crewed Moon landing with Artemis III in 2025. This landing will occur after astronauts transfer from the Orion spacecraft to the Human Landing System (HLS) while orbiting the Moon.[14]

Following the first crewed Moon landing since the Apollo program, Artemis IV will launch the Gateway International Habitat (I-HAB) using SLS and land astronauts on the Moon. Next, Artemis V will launch Gateway's European System Providing Refueling Infrastructure

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9 The White House, "Remarks by President Trump and Vice President Pence at Signing Ceremony for Space Policy Directive – 1," December 11, 2017, https://trumpwhitehouse.archives.gov/briefings-statements/remarks-president-trump-vice-president-pence-signing-ceremony-space-policy-directive-1/.

10 Ibid.

11 The White House, "Remarks by Vice President Pence at the Fifth Meeting of the National Space Council | Huntsville, AL," March 26, 2019, https://trumpwhitehouse.archives.gov/briefings-statements/remarks-vice-president-pence-fifth-meeting-national-space-council-huntsville-al/.

12 Robert Z. Pearlman, "NASA Names New Moon Landing Program Artemis After Apollo's Sister," *Space.com*, May 14, 2019, https://www.space.com/nasa-names-moon-landing-program-artemis.html.

13 National Aeronautics and Space Administration, "NASA Outlines Challenges, Progress for Artemis Moon Missions," November 10, 2021, https://www.nasa.gov/press-release/nasa-outlines-challenges-progress-forartemis-moon-missions.

14 National Aeronautics and Space Administration, "About Human Landing Systems Development," https://www.nasa.gov/content/about-human-landing-systems-development.

and Telecommunication (ESPRIT), a robotic arm, and a lunar rover. Beyond this, NASA's goals include establishing the Artemis Base Camp near the lunar South Pole and human exploration of Mars.[15]

(B) The Characteristics of the Artemis Program

One of the characteristics of the Artemis program is its persistence. The main goal of the Apollo program was to achieve a manned Moon landing before the Soviet Union, so the crewed Moon landing mission was canceled after three years having accomplished its primary objective. The Artemis program, on the other hand, aims to make cislunar space a new area of human activity. Gateway and the Artemis Base Camp are the precursors.[16]

Another characteristic of the Artemis program is a strong emphasis on partnerships. The Apollo program was essentially a U.S. government effort,[17] but the Artemis program has assumed from the beginning that it will work with commercial and international partners. In the same way that private services are used to transport astronauts and cargo to the International Space Station, the Artemis program will purchase the transportation of astronauts and cargo from companies as a service. The abovementioned HLS will not be developed and operated by NASA itself; it will be outsourced as a service from companies. In addition, NASA plans to purchase Gateway Logistics Services, which will transport cargo to Gateway, and Lunar Exploration Transportation Services, which will transport astronauts from Gateway to the lunar surface.[18]

NASA also emphasizes international collaboration, and the Artemis program is being carried out in cooperation with the European Space Agency (ESA), which includes 22 countries, Canada, Japan, and others. Gateway's I-HAB is being developed and manufactured by ESA and the Japan Aerospace Exploration Agency (JAXA), while ESPRIT is being developed and manufactured by ESA. Similarly, Gateway's robotic arm is being developed and manufactured by the Canadian Space Agency, while discussions are underway for JAXA to take responsibility for transportation of some of the cargo to Gateway.[19]

(2) Department of Defense Activities

(A) An Expanding Sphere of Interest

In the past, the activities of the U.S. Department of Defense were basically limited to the domain within GEO, but it has now begun to expand its horizons to XGEO. The U.S. Space Force

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15 Alex Fox, "Four Things We've Learned About NASA's Planned Base Camp on the Moon," *Smithsonian Magazine*, August 29, 2022, https://www.smithsonianmag.com/science-nature/four-things-weve-learned-about-nasas-planned-base-camp-on-the-moon-180980589/.

16 Ibid.; National Aeronautics and Space Administration, "Gateway," https://www.nasa.gov/gateway.

17 Note that Australia cooperated in providing sites for NASA ground stations. Department of Industry, Science, Energy and Resources, Australian Government, "Australia and the First Moon Landing," July 18, 2019, https://www.industry.gov.au/news/australia-and-the-first-moon-landing.

18 National Aeronautics and Space Administration, "NASA Awards Artemis Contract for Gateway Logistics Services," March 28, 2020, https://www.nasa.gov/press-release/nasa-awards-artemis-contract-for-gateway-logistics-services; National Aeronautics and Space Administration, "NASA Gauges Industry Interest for Long-Term Moon Landing Services," April 30, 2021, https://www.nasa.gov/feature/nasa-gauges-industry-interest-for-long-term-moon-landing-services.

19 Japan Aerospace Exploration Agency, "The Lunar Orbit Manned Base GATEWAY," https://www.exploration.jaxa.jp/program/.

(USSF), established in December 2019 as a military service dedicated to space forces, signed a Memorandum of Understanding (MOU) with NASA the following September. This updated the MOU signed in 2006 between NASA and the Air Force Space Command, the predecessor of the USSF. It specifies that as U.S. public and private activities reach cislunar space, the USSF's sphere of interest will expand to 272,000 miles (about 438,000 km) and beyond.[20] This is the distance to cislunar space on the far side of the Moon. Regarding specific areas of cooperation in cislunar space, this MOU lists space domain awareness (SDA), communications, navigation, space structure servicing/assembly/manufacturing, ride shares, hosted payloads, and more.[21]

(B) Technology Demonstration Programs and the Establishment of a Unit

In addition to expanding its sphere of interest, the Department of Defense has initiated technology demonstration programs. AFRL has begun to consider the capabilities needed for satellite operations and SDA in cislunar space. In 2019, AFRL launched a project called the Defense Deep Space Sentinel.[22] This project will launch a small satellite to demonstrate electric propulsion mobility and an SDA sensor in cislunar space.

In 2020, AFRL also announced the Cislunar Highway Patrol System (CHPS) program (the program name was later changed to Oracle). CHPS (Oracle) will primarily test technology for detecting and tracking objects around the Moon. In the second half of 2025, AFRL is expected to launch Oracle, position it at EML-1 between Earth and the Moon, and conduct orbital testing for two years.[23]

Moreover, recognizing the need for significant improvements in propulsion technology for cislunar SDA, the Defense Advanced Research Projects Agency (DARPA) is pursuing the development of the Demonstration Rocket for Agile Cislunar Operations (DRACO).[24] DRACO is a nuclear-powered rocket that aims to achieve high-speed maneuverability through nuclear thermal propulsion. DARPA estimates that the thrust-to-weight ratio of nuclear thermal propulsion is about 10,000 times that of electric propulsion, and its specific impulse is 2 to 5 times that of chemical propulsion. DARPA's goal is to conduct a demonstration experiment of DRACO above low-Earth orbit in 2025.[25]

In February 2021, DARPA also announced the Novel Orbital and Moon Manufacturing, Materials, and Mass-efficient Design (NOM4D) program, and began researching methods for

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20 NASA.gov, "Memorandum of Understanding Between the National Aeronautics and Space Administration and the United States Space Force, September 21, 2020," p. 2, https://www.nasa.gov/sites/default/files/atoms/files/nasa_ussf_mou_21_sep_20.pdf.

21 Ibid., p. 3.

22 Theresa Hitchens, "Space Force, AFRL to Demo Mobile Lunar Spy Sat," *Breaking Defense*, November 30, 2020, https://breakingdefense.com/2020/11/space-force-afrl-to-demo-mobile-lunar-spy-sat/.

23 Jeanne Dailey, "AFRL Awards Contract for Pioneering Spacecraft in Region of Moon," Air Force Research Laboratory, U.S. Air Force, November 10, 2022, https://www.afrl.af.mil/News/Article-Display/Article/3216493/afrl-awards-contract-for-pioneering-spacecraft-in-region-of-moon/.

24 Defense Advanced Research Projects Agency, U.S. Department of Defense, "Demonstration Rocket for Agile Cislunar Operations (DRACO)," https://www.darpa.mil/program/demonstration-rocket-for-agile-cislunar-operations.

25 Defense Advanced Research Projects Agency, U.S. Department of Defense, "DARPA Selects Performers for Phase 1 of Demonstration Rocket for Agile Cislunar Operations (DRACO) Program," April 12, 2021, https://www.darpa.mil/news-events/2021-04-12.

fabricating large-scale structures in space and on the lunar surface.[26] It is considering the use of lunar resources as part of this effort.

The Defense Innovation Unit (DIU) has in addition initiated programs related to cislunar space. One of these focuses on nuclear propulsion and power sources, with the goal of enabling a small spacecraft to maneuver at will in cislunar space, and to operate payloads that require large amounts of electrical power.[27] DIU plans to launch a demonstration spacecraft in 2027.

At the end of 2022, DIU also launched a program to deliver a spacecraft to XGEO within a time frame of only a few months based on need.[28] DIU requires the companies selected in 2023 to demonstrate their capabilities within 12 to 18 months of signing a contract.

It is worth noting that in April 2022, the USSF announced that it would establish a unit responsible for XGEO SDA. Specifically, it established the 19th Space Defense Squadron.[29] In 2022, together with other units under Space Delta 2, this squadron supported NASA's Artemis I mission and conducted tests of cislunar SDA.[30]

(3) Political, Economic, and Security Implications

It is clear from the foregoing discussion that the U.S. government sees implications beyond science and technology in its activities in cislunar space. The Artemis program has significant political implications. For the U.S., cislunar space is a new stage in the great power competition with China. In Vice President Pence's speech above, which announced the acceleration of the human lunar landing, he noted that what is needed for a human Moon landing is a sense of urgency, and that the U.S. is in the midst of a space race, as it was in the 1960s.[31] In this speech, Vice President Pence stated that China has revealed its ambition to gain strategic high ground on the Moon through the first ever landing on the far side of the Moon.[32] In May 2021, Nelson, who was appointed NASA Administrator by the Biden administration, asserted that China is an aggressive competitor, as well as the need to return Americans to the Moon before China.[33] In an interview published in early 2023, he contended that there was the possibility of China claiming territorial

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26 Defense Advanced Research Projects Agency, U.S. Department of Defense, "Orbital Construction: DARPA Pursues Plan for Robust Manufacturing in Space," February 5, 2021, https://www.darpa.mil/news-events/2021-02-05.

27 Defense Innovation Unit, U.S. Department of Defense, "Powering the Future of Space Exploration: DIU Launching Next-Generation Nuclear Propulsion and Power," May 17, 2022, https://www.diu.mil/latest/powering-the-future-of-space-exploration-diu-launching-next-generation.

28 Garrett Reim, "DIU Wants Fast Ride for Small Spacecraft Beyond GEO Space," *Aviation Week Network*, December 9, 2022, https://aviationweek.com/aerospace/commercial-space/diu-wants-fast-ride-small-spacecraft-beyond-geo-space.

29 Space Base Delta 1, "Space Delta 2 - Space Domain Awareness," https://www.spacebasedelta1.spaceforce.mil/SpaceDelta2/.

30 Hillary Gibson, "Delta 2 Leverages Space Domain Awareness in Support of Artemis I," Space Operations Command, U.S. Space Force, December 12, 2022, https://www.spacecom.mil/newsroom/news/Article/3243172/delta-2-leverages-space-domain-awareness-in-support-of-artemis-i/.

31 The White House, "Remarks by Vice President Pence at the Fifth Meeting of the National Space Council | Huntsville, AL."

32 Ibid.

33 Marcia Smith, "Nelson: 'Watch the Chinese'," *SpacePolicyOnline.com*, Posted: May 25, 2021, Last Updated: May 26, 2021, https://spacepolicyonline.com/news/nelson-watch-the-chinese/.

rights over the Moon, citing the Spratly Islands in the South China Sea as an example.[34]

There are significant economic implications as well, as is evident from the fact that the characteristics of the Artemis program include making cislunar space a place for continuous activities and conducting these activities in partnership with commercial organizations. NASA's launch of the Artemis program is creating new business opportunities for American companies. It is estimated that by fiscal year 2025, NASA will have spent $86 billion on the Artemis program,[35] and spending is expected to continue beyond that. A wide range of companies, from those traditionally associated with space to start-ups, are working on related projects with diverse business content, including communications, positioning and navigation, transportation, and resource development.

The U.S. government also expects economic benefits from the development of lunar resources. In 2015, Congress passed the Commercial Space Launch Competitiveness Act, which allows individuals to own, possess, transport, use, and sell space resources.[36] In a September 2020 webinar, NASA Administrator Bridenstine posited that, in the long term, NASA hopes to discover and collect rare earths on the Moon, suggesting that if there were an entity that could exploit ore deposits of types of platinum worth trillions or tens of trillions of dollars buried on the Moon, it could change the balance of power on Earth.[37]

The U.S. government recognizes that it may become necessary to protect such national interests generated through cislunar space from a security and military perspective. The MOU signed between the USSF and NASA made it clear that as American public and private activities expand into cislunar space, the USSF's sphere of interest will also expand into this area. In a webinar when that MOU was released, NASA Administrator Bridenstine disclosed that the reason for emphasizing cooperation with the USSF was to ensure the security of sustained activity on the Moon.[38]

Furthermore, the USSF's first doctrine, *Spacepower*, released in August 2020, indicates that the national interest in space could expand to cislunar space and beyond in the near future through commercial investment and new technologies, and the idea that it will be necessary to protect, defend, and maintain these strategic interests.[39] This document includes transfer paths to cislunar space and beyond in lines of communication in the space domain.[40]

The area of responsibility for the U.S. Space Command (USSPACECOM), established in

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34 Bryan Bender, "'We Better Watch Out': NASA Boss Sounds Alarm on Chinese Moon Ambitions," *POLITICO*, January 1, 2023, https://www.politico.com/news/2023/01/01/we-better-watch-out-nasa-boss-sounds-alarm-on-chinese-moon-ambitions-00075803. It has also been suggested that Nelson has created a sense of crisis to gain congressional support for the Artemis program. John B. Sheldon, "The Lunapolitics of U.S.-China Lunar Rivalry: Rhetoric and Reality," *Lunapolitics*, January 6, 2023, https://lunapolitics.com/2023/01/06/the-lunapolitics-of-u-s-china-lunar-rivalry-rhetoric-and-reality/.

35 Marcia Smith, "NASA IG: Artemis Will Cost $86 Billion Through FY2025, Launch Dates 'Highly Unlikely'," *SpacePolicyOnline.com*, April 19, 2021, https://spacepolicyonline.com/news/nasa-ig-artemis-will-cost-86-billion-through-fy2025-launch-dates-highly-unlikely/.

36 Nakamura Shinya, "Lunar Exploration in the Present: The Trends Surrounding Space Resources," *Chosa to Joho*, vol. 1169 (January 27, 2022), p. 12.

37 Theresa Hitchens, "Space Force-NASA Accord Highlights Cooperation Beyond Earth Orbit," *Breaking Defense*, September 22, 2020, https://breakingdefense.com/2020/09/space-force-nasa-accord-highlights-cooperation-beyond-earth-orbit/.

38 Ibid.

39 U.S. Space Force, *Spacepower*, Space Capstone Publication, June 2020, p. 14.

40 Ibid., p. 24.

August 2019, is only specified as being more than 100 km above mean sea level and is not limited to within GEO. USSPACECOM Commander James Dickinson articulated in a speech in August 2021 that the EMLs, strategic way stations, will be included in its area of operations.[41]

2. China's Activities in Cislunar Space and Their Implications

(1) The Background to Lunar Exploration and Projects

(A) The Details and Current State of Projects

The China Lunar Exploration Program was approved by the Chinese government in January 2004 as the Chang'e (嫦娥) Project.[42] This project comprises three phases (three great steps), "Exploration," which aims to explore the Moon using unmanned craft; "Ascension," which targets manned exploration of the Moon; and "Staying," which intends to construct a base on the lunar surface.[43] The first stage, "Exploration," is further divided into three phases (three small steps): (1) "Orbiting," which aims to go around the Moon; (2) "Landing," which proposes to land a space probe; and (3) "Returning," which plans to return with samples from the Moon.[44] At the end of 2020, Vice Administrator of the China National Space Administration, Wu Yanhua, announced that the three small steps were complete with Chang'e 5's return bringing lunar samples.[45] Based on this, the project should now have entered the second stage of the three great steps, "Ascension," but the Chinese government has announced the current status to be in the fourth phase.[46]

A prime opportunity for China's Lunar Exploration Program to attract international attention was in January 2019, when Chang'e 4 successfully landed on the far side of the Moon. In addition to the project being a world first, the fact that China sent the relay satellite Queqiao (鵲桥) into a halo orbit around EML-2 to relay communications between Chang'e 4 and Earth attracted notice. It is possible for a spacecraft to remain in this orbit while using very little fuel, and also, it has the advantages of enabling communication with Earth and observation of the far side of the Moon.[47]

(B) Lunar Exploration Program

The fourth phase of the Lunar Exploration Program, which entered its implementation stage at the end of 2021, will be carried out via the launch of lunar probes on three occasions (Chang'e 6, 7, and 8), and is expected to be completed by 2030.[48]

This fourth phase program will focus on two areas: investigating the South Pole of the

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41 Theresa Hitchens, "SPACECOM Head Touts Space, High Seas Parallels," *Breaking Defense*, August 3, 2021, https://breakingdefense.com/2021/08/spacecom-head-touts-space-high-seas-parallels/.

42 *60 Year of China's Aerospace Industry* [中国航天事业的60年], Compiled by the Editorial Board of "60 Year of China's Aerospace Industry" (Beijing: Peking University Press, 2016), p. 299.

43 "The 'Three Great Steps' and 'Three Small Steps' of China's Chang'e Project" [中国嫦娥工程的"大三步"和"小三步"], *Ecns.cn* [中国新闻网], December 1, 2013.

44 Hayashi Yukihide, *China's Space Development* (Tokyo: Adthree, 2019), p. 144.

45 "Chang'e-5 Mission Completed Successfully as a Perfect End to the Three-step Plan of China's Lunar Exploration Project" [嫦娥五号任务圆满成功中国探月工程三步走规划完美收官], December 17, 2020, http://www.scio.gov.cn/xwfbh/xwbfbh/wqfbh/42311/44497/zy44501/Document/1694835/1694835.htm,

46 "Three Missions to be Implemented in Phase IV of the Lunar Exploration Project" [探月工程四期还将实施3此任务], *People's Daily* [人民日报], March 10, 2022.

47 Michael Byers and Aaron Boley, "Cis-Lunar Space and the Security Dilemma," *Bulletin of the Atomic Scientists*, January 17, 2022, https://thebulletin.org/premium/2022-01/cis-lunar-space-and-the-security-dilemma/.

48 "Three Missions to be Implemented in Phase IV of the Lunar Exploration Project" [探月工程四期还将实施3此任务], *People's Daily* [人民日报], March 10, 2022.

Moon and building a scientific research base on the lunar surface. In the program, Chang'e 7 will land on the South Pole of the Moon, Chang'e 6 will return from the South Pole of the Moon with samples, and Chang'e 8 will be launched to establish a research base on the lunar surface.[49] As it is being constructed in cooperation with Russia and others, the lunar research base will be named the International Lunar Research Station (ILRS). China signed an MOU concerning the ILRS with Russia in March 2021.[50]

Exploration of the lunar South Pole is attracting attention because it has perpetually shadowed craters that the sunlight does not reach, and researchers have pointed out the possibility that there is water (ice) in that location. The Chang'e 7 mission is to land on the lunar South Pole and carry out a highly precise investigation of the perpetually shadowed craters, and it is conceivable that this is linked to the existence of water resources.[51] Wu Weiren, the chief designer of the China Lunar Exploration Program, points out that the ILRS is to be situated at the South Pole because the lunar South Pole can ensure long hours of activity thanks to its good sunlight exposure, and because it is possible that there is water (ice) in the perpetually shadowed craters.[52]

According to the China National Space Administration's Lunar Probe and Space Project Center, the ILRS will serve as a base for comprehensive science experiments that will make long-term autonomous operation possible on the lunar surface and in lunar orbit; it will carry out scientific research activities in diverse fields with a variety of objectives, including lunar exploration and development, observation of the lunar surface, fundamental scientific experiments, and technological demonstrations.[53] Together with Russia, China is creating a roadmap for the construction of the ILRS, and collaborating on the ILRS building plan, demonstrations, design, development, implementation, and operation, including opening the initiative to the international space and aviation community.[54]

(2) Roles of the Private Sector in Space Development

(A) The Rise of Private Companies in the Space Industry

Since the Xi Jinping administration adopted military-civil fusion as a national strategy in March 2015, private Chinese companies have actively joined the space industry in concert with this

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49 China Aerospace Science and Technology Corporation [中国航天科技集团有限公司], "Phase IV Missions of the Lunar Exploration Project Approved" [探月工程四期任务获批复], December 29, 2021, http://www.spacechina.com/n25/n2014789/n2014804/c3421712/content.html.

50 "China and Russia Signing a Memorandum of Understanding on Joint Construction of an International Lunar Research Station" [中俄两国签署合作建设国际月球科研站了解备忘录], China's Lunar and Deep Space Exploration [中国探月与深空探测网], March 9, 2021, http://www.clep.org.cn/n5982341/c6811379/content.html.

51 Andrew Jones, "China Targets Permanently Shadowed Regions at Lunar South Pole," *SpaceNews*, May 27, 2022, https://spacenews.com/china-targets-permanently-shadowed-regions-at-lunar-south-pole/.

52 "Phase IV of the Lunar Exploration Project Fully Rolled out" [中国探月工程四期开始全面实施], *Science and Technology Daily* [科技日报], March 8, 2022.

53 "Guide for International Lunar Research Station Partners" [国际月球科研站合作伙伴指南], China's Lunar and Deep Space Exploration [中国探月与深空探测网], June 16, 2021, http://www.clep.org.cn/n5982341/c6812147/content.html.

54 The Central People's Government of the People's Republic of China [中华人民共和国中央人民政府], "A Press Conference concerning the Chang'e-4 Mission of the Lunar Exploration Project held by the State Council Information Office [新闻办就探月工程嫦娥四号任务有关情况举行发布会], January 14, 2019, http://www.gov.cn/xinwen/2019-01/14/content_5357776.htm#3.

directive.[55] To date, state-owned companies and research institutions under the China Aerospace Science and Industry Corporation and China Aerospace Science and Technology Corporation (CASC) are almost exclusively responsible for rocket launch technology, but start-up space companies have also begun to get involved. Reportedly, One Space, which was founded in around 2015, had already realized four rocket launches by the end of August 2021.[56] Furthermore, in December 2021, Galactic Energy, created in 2018, was the first Chinese private rocket company to have solid-fuel rockets reach space orbit twice and succeeded in sending five satellites into sun-synchronous orbit.[57]

China's start-up space companies are also referred to as the Chinese version of "New Space," compared to U.S. companies such as SpaceX.[58] It was said that, as of November 2020, over 160 privately operated companies already existed in the space field, including those involved in rocket launches and satellite creation.[59] In March 2021, the Chinese government announced its 14th Five-Year Plan for National Economic and Social Development and the Long-range Objectives Through the Year 2035. In this document, it indicated that the area of aerospace would be a field that would see the exploration of collaborative innovation in military-civil science and technology, and hinted that start-up space companies would participate in the Chinese space industry.[60] Meanwhile, many of the founders and researchers of start-up space companies are from, or also working for research organizations connected to the People's Liberation Army; in some cases, they receive financial assistance from the State Administration for Science, Technology and Industry for National Defence (SASTIND, the organization responsible for supervising munitions companies) so they clearly have close ties to the military and/or the government.[61]

The rise of China's start-up space companies is not directly linked to the military use of space but can be seen as contributing to improving China's space security capabilities through the provision of technology and services to the military. It has also been pointed out that these companies have benefited from the government's industrial policies; they have an advantage at the low end of the market, and so can compete with the U.S. commercial space sector.[62]

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55 The Central People's Government of the People's Republic of China [中华人民共和国人民政府], "Opinions of the General Office of the State Council on Promoting Closer Civil-Military Integration in the National Defense Science and Technology Industry" [国务院办公厅推动国防科技工业军民融合深度发展的意见], December 4, 2017.

56 "Product Services" [产品服务], One Space [零壹空间], http://www.onespacechina.com/productDetailL.

57 Andrew Jones, "China's Galactic Energy Raises $200 Million for Reusable Launch Vehicle Development," *SpaceNews*, January 24, 2022, https://spacenews.com/chinas-galactic-energy-raises-200-million-for-reusable-launch-vehicle-development/.

58 Fukushima Yasuhito, "China's Military Use of Space," *NIDS China Security Report 2021* (2021), p. 49.

59 "Over 160 Commercial Aerospace Enterprises in China" [我国商业航天企业已超160家], *Xinhuanet* [新华网], November 24, 2020, http://www.xinhuanet.com/tech/2020-11/24/c_1126781273.htm.

60 "Outline of the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China" [中华人民共和国国民经济和社会发展第十四个五年计划和2035年远景目标纲要], March 2021, p. 27.

61 Lorand Laskai, "Building China's SpaceX: Military-Civil Fusion and the Future of China's Space Industry," Testimony Before the U.S.-China Economic and Security Review Commission Hearing on China in Space: Strategic Competition? April 25, 2019.

62 Kevin Pollpeter, "China's Role in Making Outer Space More Congested, Contested, and Competitive," China Aerospace Studies Institute, October 2021, https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/CASI%20Articles/2021-09-27%20Congested%20Contested.pdf?ver=-AfhmnFJ0XDNnLxxG626bw%3d%3d.

(B) Private Companies in Lunar Exploration

Since the military-civil fusion development strategy was posited, a trend of private companies getting involved in lunar and deep space exploration has been evident. In March 2015, SASTIND announced that it considered Chang'e 4 to be an experimental project for the involvement of private capital, and that it would make use of technology verification / product equipping / data application from private capital.[63] It is expected that the involvement of private finance will have the effect of accelerating technological innovation for aerospace, effectively reducing technology costs, and increasing investment efficiency.[64]

There is a tendency towards the further expansion of private companies and space businesses in lunar exploration and deep space exploration. Vice Administrator of the China National Space Administration, Wu Yanhua, prefaced an announcement with "Lunar exploration and deep space exploration are mainly national acts," and went on to say that (1) the success of China's Lunar Exploration Program will inspire private companies to develop and commercialize space-related technology, and that the Chinese government will welcome the involvement of Chinese and foreign private companies; (2) space-related technology transfer and commercialization will be encouraged; and (3) China is considering a variety of approaches through which private and foreign companies can participate in missions to explore Mars and deep space, which are the next steps after lunar exploration.[65]

Moreover, as unmanned technology and AI become more important in space missions worldwide, there is a bias for the increased participation of start-up companies that possess the technology; China is no exception to the trend. In December 2021, Chang'E Aerospace Technology [Beijing] LLC., which has cooperative relations with the China National Space Administration Lunar Probe and Space Project Center, announced it had signed an agreement with Baidu to become the global strategic partner for AI in Chinese lunar exploration projects.[66] The scope of this cooperation concerns space technology and AI technology in the deep space exploration field. Baidu has already engaged in technological cooperation with the Zhurong Mars exploration rover in 2021. Wang Haifeng, Chief Technology Officer of Baidu, has stated that it is possible to make wider use of AI technology in fields such as spaceship failure analysis, mission design and planning, autonomous decision-making, intelligent robots, and cluster analysis.[67] Wu Weiren, who participated in the signing ceremony of this agreement, demonstrated an affirmative viewpoint regarding the future participation of private companies in space exploration ventures, in which AI technology is becoming increasingly important.[68]

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63 The Central People's Government of the People's Republic of China [中华人民共和国中央人民政府], March 12, 2015, http://www.gov.cn/xinwen/2015-03/12/content_2833073.htm.

64 Ibid.

65 The Central People's Government of the People's Republic of China [中华人民共和国中央人民政府], "A Press Conference concerning the Chang'e-4 Mission of the Lunar Exploration Project held by the State Council Information Office [新闻办就探月工程嫦娥四号任务有关情况举行发布会].

66 "Baidu Becoming a 'Global AI Strategic Partner for China's Lunar Exploration and Space Engineering Project'" [百度成为"中国探月航天工程人工智能全球战略合作伙伴"], Baidu Brain [百度大脑], December 2, 2021, https://ai.baidu.com/support/news?action=detail&id=2703.

67 Ibid.

68 "Baidu to Cooperate in AI with China's Lunar Exploration and Space Engineering Project to Boost Deep Space Exploration" [助力探空探测 百度将于中国探月航天工程开展人工智能相关合作], *Ecns.cn* [中国新闻网], December 18, 2021.

(3) Political, Economic, and Security Implications

The political implications of China's lunar exploration will likely consist of both external and internal components. Securing international predominance by obtaining scientific and technological capabilities, financial strength, and even lunar resources through the lunar exploration project can be considered an external implication. For example, possessing samples from the lunar South Pole and building the ILRS there, as planned in future lunar exploration projects, will both become assets that will promote international cooperation, and mean that China possesses limited resources.

It is likely that the construction of the ILRS will contribute to China creating a preponderant position in international relations. China and Russia have deepened their collaborative relationship significantly through the construction of the ILRS, but the ILRS plan has not been renewed following Russia's invasion of Ukraine. From China's perspective, having a long-term relationship with Russia has political risks, and, on top of this, there is less to gain technically through joint ventures with Russia; some believe that there are greater advantages in finding partners in Europe or elsewhere.[69] The ESA, Sweden, Italy, France, and others are expected to participate in Chang'e 6.[70] The 2021 white paper on space also states China will "work with other countries, international organizations and partners" on the Chang'e 8 mission, so Russia will not necessarily be China's only partner for the ILRS.[71]

In terms of U.S.-China relations, China indicated that its stance regarding the possibilities of collaboration with America through the ILRS plan or of providing lunar samples to NASA "depends on the attitude of the U.S. government."[72] Moreover, while China has avoided directly criticizing the American-led Artemis Accords, it has shown no intentions of signing them. This may be connected to the memorandum of understanding on lunar and deep space exploration (June 2018) already agreed with Russia. When asked for a comment on the Artemis Accords, a spokesperson from China's Ministry of Foreign Affairs said it supported "the discussion of a body of laws for the development of space resources within the framework of existing regulations on space and via the platform of the UN," and would "continue international exchange and cooperation with all parties involved in the lunar exploration process," but while it avoided direct criticism—"Space is not a place for competition between great powers, it is an important domain for cooperation and reciprocity"—it exuded a sense of wariness toward the Artemis Accords as the

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69 Andrew Jones, "China Seeks New Partners for Lunar and Deep Space Exploration," *SpaceNews*, September 28, 2022, https://spacenews.com/china-seeks-new-partners-for-lunar-and-deep-space-exploration/.

70 Chen Sijia [陈思佳], "To Launch Tianwen-4, and Visit Jupiter and Uranus around 2030" [计划2030年前后发射, 天问四号要去木星和天王星], *Guancha.cn* [观察者], September 28, 2022, https://www.guancha.cn/internation/2022_09_28_659825.shtml.

71 The State Council Information Office of the People's Republic of China [中华人民共和国国务院新闻办公室], "China's Space Program: A 2021 Perspective" [2021中国的航天], January 2022, http://www.scio.gov.cn/zfbps/32832/Document/1719689/1719689.htm.

72 For example, Yicai [第一财经], December 17, 2020, https://www.yicai.com/news/100880936.html and Shanghai Observer [上观新闻], September 22, 2021, https://web.shobserver.com/wx/detail.do?id=407720.

number of signatories increased under American leadership.[73]

The internal implications likely concern the Chinese Communist Party ensuring its legitimacy as the ruling party by creating an impression of the great rejuvenation of the Chinese nation in terms of science and technology. Xi Jinping, General Secretary of the Party, stated that the Central Committee had established the Lunar Exploration Program in February 2019 "to realize the Chinese dream of 'embracing ideals and challenging high targets (飞天蓝月)'."[74] The execution of the Lunar Exploration Program will be proof of China's steps toward becoming a scientifically and technologically great power and strengthen the legitimacy of the Party's rulership.

China's lunar exploration projects also have economic implications as well as political aims. The 2021 white paper on space noted that the general development of space technology will encourage economic development for the people,[75] and China's space experts have also demonstrated a long-term outlook on the cislunar economic sphere. For example, Bao Weimin, Director of the CASC Science and Technology Commission, has pointed out the great economic potential of cislunar space in a forum hosted by his organization.[76] He asserted that "China should complete research on fundamental questions and make key technological breakthroughs by 2030, construct a highly safe, low-cost space transportation system by 2040, and establish a cislunar economic sphere by the middle of this century."[77] The CASC Science and Technology Commission is predicting that the production value of Chinese cislunar space will reach a scale of over 1 billion dollars in around 2050.[78] In 2021, the Chinese Academy of Sciences established research groups for cislunar space exploration and development strategy as an organization studying such development strategies for cislunar space.[79]

There were no facts or articles to be found that reference the security or military implications of lunar exploration by Chinese government authorities. At a press conference in November 2007, Pei Zhaoyu, spokesperson of the China National Space Administration, mentioned that "China has consistently adhered to the rules on the Peaceful Uses of Outer Space, and the aims of all space activities carried out by China, including lunar exploration and deep space exploration

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73 Ministry of Foreign Affairs of the People's Republic of China [中国外交部], "A Regular Press Conference Hosted by Foreign Ministry Spokesperson Zhao Lijian on October 15, 2020" [2020年10月15日外交部发言人赵立坚主持例行记者会], October 15, 2020, https://www.fmprc.gov.cn/web/wjdt_674879/fyrbt_674889/202010/t20201015_7816734.shtml; Ministry of Foreign Affairs of the People's Republic of China [中国外交部], "A Regular Press Conference Hosted by Foreign Ministry Spokesperson Zhao Lijian on August 29, 2022" [2022年8月29日外交部发言人赵立坚主持例行记者会], August 29, 2022, https://www.mfa.gov.cn/fyrbt_673021/202208/t20220829_10757191.shtml.

74 The Central People's Government of the People's Republic of China [中华人民共和国中央人民政府], "Xi Jinping Meeting with Representative of the Research and Testing Participants of the Chang'e-4 Mission of the Lunar Exploration Project" [习近平会见探月工程嫦娥四号任务参演参试人员代表], February 20, 2019, http://www.gov.cn/xinwen/2019-02/20/content_5367237.htm.

75 The State Council Information Office of the People's Republic of China [中华人民共和国国务院新闻办公室], "China's Space Program: A 2021 Perspective" [2021中国的航天].

76 "China to Build a Cislunar Space Economic Zone by the Middle of this Century" [我国力争本世纪中叶建成地月空间经济区], *Xinhuanet* [新华网], November 1, 2019, http://www.xinhuanet.com/politics/2019-11/01/c_1125179024.htm.

77 Ibid.

78 "Insights into the New Material Industry I: Opening up a Great Space Age" [新材料产业深度之一:开启大航天时代], Sealand Securities Research Institute [国海证券研究所], November 10, 2022, p. 46, http://pg.jrj.com.cn/acc/Res/CN_RES/INDUS/2022/11/10/9ae2e9fd-7fa7-424c-8909-89d13850e14b.pdf.

79 Ibid.

activities, are the joint exploration of space and the creation of happiness for humanity. The project objectives and scientific objectives which China has set out do not include any factors associated with military affairs."[80] There are no statements from the Chinese authorities that significantly deviate from the official opinion.

However, this does not mean that the Chinese government finds no military significance in lunar exploration or cislunar space. In fact, the expansion of the military domain in space is evident in the opinions of people connected to the People's Liberation Army. The Army's textbook, the *Science of Military Strategy* 2020 edition (战略学 2020年修订), indicates the viewpoint that the future military domain in space will expand into near space and deep space, and the possibility of the People's Liberation Army being given some kind of mission has also been pointed out.[81] Moreover, the perspective of Chinese opinion journals is to sound the alarm that the competition between countries over space, including the U.S. military, is expanding into cislunar space, and a new trend of space militarization is emerging.[82]

3. Preliminary Cislunar Security Consideration

(1) Possible Military Activities

The following three issues can be raised when considering military activities in cislunar space. The first is the support of military activities on Earth and in space within GEO from cislunar space. Specifically, this could include information support such as intelligence, surveillance, reconnaissance, and SDA; improving mission assurance, e.g., by deploying backup satellites; attacking satellites within GEO; and attacking targets on Earth.

Among these, there is a precedent for information support: the Vela nuclear explosion detection satellites launched by the U.S. from 1963 to 1965 to verify the Partial Test Ban Treaty.[83] These satellites were placed at an altitude of about 100,000 km. Moreover, Project Horizon, developed by the U.S. Army in 1959, was a plan to build an outpost base on the lunar surface and use it for space and Earth surveillance.[84] In terms of SDA, one can consider detecting indications of attacks from XGEO on satellites within GEO and, if enemy standby satellites are positioned in XGEO, monitoring their movements.

In terms of mission assurance, it is conceivable that spares for satellites operating within

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80 "China National Space Administration: China's Lunar Exploration Project Involving no Military Factor" [航天局:中国探月工程不含任何军事因素], *Ecns.cn* [中国新闻网], November 1, 2007, http://mil.news.sina.com.cn/2007-11-01/1648470133.html.

81 Kristin Burke, "Chinese Military Thinking on Orbits Beyond GEO," China Aerospace Studies Institute, August 2022, https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/CASI%20Articles/2022-09-06%20Chinese%20Military%20Thinking%20On%20Orbits%20Beyond%20GEO.pdf.

82 Yang Leping and Peng Wangqiong [杨乐平, 彭望琼], "Trends and Impacts of Space Security for Future 30 Years" [未来30年太空安全发展趋势及影响], *National Defense Technology* [国防科技] vol. 42, no. 6 (December 2021), pp. 1-14; "These New Trends Presented in Space Militarization Highly Noteworthy" [太空军事化呈现出的这些新动向, 值得高度关注], *PLA Daily* [解放军报], April 7, 2022.

83 Clementine G. Starling, Mark J. Massa, Christopher P. Mulder, and Julia T. Siegel, "The Future of Security in Space: A Thirty-Year US Strategy," *Atlantic Council Strategy Papers*, April 2021, p. 70, https://www.atlanticcouncil.org/wp-content/uploads/2021/04/TheFutureofSecurityinSpace.pdf.

84 Jeffrey T. Richelson, ed. "Soldiers, Spies and the Moon: Secret U.S. and Soviet Plans from the 1950s and 1960s," *National Security Archive Electronic Briefing Book*, no. 479 (July 20, 2014), https://nsarchive2.gwu.edu/NSAEBB/NSAEBB479/.

GEO could be placed in cislunar space.[85] A U.S. Defense Intelligence Agency report published in 2022 notes the possibility of adversaries positioning standby satellites in deep space.[86]

Regarding anti-satellite attacks, a U.S. defense official has expressed concern about GEO satellites being attacked from the side of the Moon.[87] As for anti-Earth attacks, the U.S. Air Force came up with the concept of the Lunar Based Earth Bombardment System in 1961.[88]

The second conceivable military activity is the protection of national interests in cislunar space from a military perspective. The capabilities and activities required for this mission are thought to include cislunar SDA; lunar intelligence (LUNINT); communications; positioning, navigation, and timing; on-orbit services; transportation; control of cislunar space (defensive and offensive); attacks on the Moon; and the exercise of the right of self-defense on the Moon.

The third plausible military activity is the defense of lines of communication and relay stations to deep space, including Mars. Everett Dolman's *Astropolitik* is a useful reference in this regard.[89] Dolman divides the solar system into Terra or Earth, Terran or Earth space, Lunar or Moon space, and Solar space, then he presents the idea that whoever controls Solar space, which has vast amounts of resources, will control the solar system. In addition, he points out the importance of obtaining and maintaining lines of communication, their chokepoints, and relay stations to Solar space. Moon space is part of a route to Solar space, and facilities in low lunar orbit (LLO) and on the lunar surface would serve as relay bases.

Of the three conceivable military activities outlined above, the first and second could be the focus in the near future, with cislunar SDA related to both. Chief of Space Operations John Raymond of the USSF has already stated that at the very least domain awareness capabilities will be needed in five to ten years.[90] Capabilities may also be developed for communications; positioning, navigation, and timing; on-orbit services such as refueling; and access to cislunar space from Earth, which are necessary to operate cislunar SDA satellites.

Furthermore, with the exception of the establishment of military bases on the Moon, the military activities discussed are not explicitly prohibited by the Outer Space Treaty. The establishment of a military base was made illegal when this treaty came into force in 1967.

(2) Governance of Cislunar Space

The main international law governing activities in cislunar space is the Outer Space Treaty of 1967. It has been ratified by 112 countries (as of January 1, 2022), including all major space-faring

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85 Brian Bauer and Eric Klatt, "Use of Cislunar Space for Reconstitution of Space-Based Capabilities," Steve Parr and Emma Rainey, eds., *Cislunar Security National Technical Vision*, Johns Hopkins University Applied Physics Laboratory, November 2022, pp. 4-1-4-7.

86 Defense Intelligence Agency, U.S. Department of Defense, *Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion*, March 2022, p. 36.

87 Patrick Tucker, "China's Moon Missions Could Threaten US Satellites: Pentagon," *Defense One*, October 16, 2018, https://www.defenseone.com/technology/2018/10/chinas-moon-missions-could-threaten-us-satellites-pentagon/152084/.

88 Richelson, ed. "Soldiers, Spies and the Moon."

89 Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (London: Routledge, 2001)

90 Amanda Miller, "Space Force Foresees Need for Cislunar Space Domain Awareness Within Decade," *Air Force Magazine*, January 19, 2022, https://www.airforcemag.com/space-force-foresees-need-for-cislunar-space-domain-awareness-within-decade/.

nations such as the U.S. and China.[91] Article II of this treaty prohibits the possession of celestial bodies, including the Moon.[92] In addition, Article IV prohibits the placement of weapons of mass destruction on celestial bodies or in space, as well as the establishment of military bases, the conducting of weapons tests, and the conducting of military exercises on celestial bodies.[93] Thus, the placement and deployment of weapons of mass destruction in cislunar space, including on the Moon, are prohibited, and the placement of military bases, weapons testing, and military exercises on the Moon can be construed as prohibited.

However, not all activities by military personnel on the Moon are prohibited by the Outer Space Treaty. Article IV explicitly states that the use of military personnel for scientific research or any other peaceful purposes, and any equipment or facilities necessary for the peaceful exploration of the Moon or any other celestial body, are not prohibited.[94]

International law governing activities in cislunar space also includes the Moon Agreement, which entered into force in 1984. The first article of this agreement states that the reference to the Moon includes orbits around or any other trajectories to or around the Moon.[95] Thus, the provisions of Article 3, which include prohibitions on the establishment of military bases, weapons testing, and military maneuvers on the Moon, could be applied to cislunar space other than the Moon.[96] Furthermore, Article 11 states that the Moon and its natural resources are the common heritage of mankind, that "Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person," and that should it become possible to develop the natural resources of the Moon, "States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon."[97] Because the Moon Agreement precludes free economic activity, only 18 countries have ratified the treaty (as of January 1, 2022), and none of the major space-faring nations have ratified it.[98] Moreover, Saudi Arabia, currently one of the 18 parties, will officially withdraw from the Moon Agreement

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91 Office for Outer Space Affairs, United Nations, *Status of International Agreements Relating to Activities in Outer Space as of 1 January 2022*, May 28, 2022, pp. 5-10, https://www.unoosa.org/res/oosadoc/data/documents/2022/aac_105c_22022crp/aac_105c_22022crp_10_0_html/AAC105_C2_2022_CRP10E.pdf.

92 Japan Aerospace Exploration Agency, "(5) TREATY ON PRINCIPLES GOVERNING THE ACTIVITIES OF STATES IN THE EXPLORATION AND USE OF OUTER SPACE, INCLUDING THE MOON AND OTHER CELESTIAL BODIES (Adopted on December 13, 1966, Resolution 2222 by the UN General Assembly 21st Session, Proclaimed October 10, 1967)," https://www.jaxa.jp/library/space_law/chapter_1/1-2-2-5_j.html.

93 Ibid.

94 Ibid.

95 Japan Aerospace Exploration Agency, "(20) AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES (Adopted on December 14, 1979, Resolution A/34/68 by the UN General Assembly 34th Session, Proclaimed July 11, 1984)," https://www.jaxa.jp/library/space_law/chapter_2/2-2-2-20_j.html.

96 Aoki Setsuko, "The Basic Rules of Space Activities," in *Introduction to Space Law for Entrepreneurs*, 2nd edition, Kozuka Souichirou and Sato Masahiko, eds. (Tokyo: Yuhikaku Publishing, 2018), p. 43.

97 Japan Aerospace Exploration Agency "(20) AGREEMENT GOVERNING THE ACTIVITIES OF STATES ON THE MOON AND OTHER CELESTIAL BODIES (Adopted on December 14, 1979, Resolution A/34/68 by the UN General Assembly 34th Session, Proclaimed July 11, 1984)."

98 Aoki Setsuko, "The Basic Rules of Space Activities," p. 39; Office for Outer Space Affairs, *Status of International Agreements Relating to Activities in Outer Space as of 1 January 2022*, pp. 5-10.

in January 2024.[99]

Although not legally binding, the Artemis Accords could play an important role in the governance of the Moon and other cislunar space.[100] The Accords set out principles to be applied to civil space activities by civil space agencies in order to facilitate the Artemis program. Specifically, they list principles concerning peaceful purposes, transparency, interoperability, emergency assistance, registration of space objects, release of scientific data, preserving space heritage, space resources, deconfliction of space activities, and orbital debris. The Accords are a series of bilateral agreements between the U.S. and (initially) seven countries signed in October 2020.[101] The number of signatories has since grown to 23 countries, including the U.S., as of December 2022.

Future issues concerning the governance of cislunar space could include the following. The first is the issue of space debris in cislunar space.[102] Because the Moon has no atmosphere, space debris does not burn up in the atmosphere as it does on Earth; it simply hits the lunar surface. Furthermore, there is some concern that the regolith whirled up by space debris hitting the lunar surface will cause mechanical failures and interfere with lunar activities. As missions to cislunar space increase worldwide in the future, the amount of space debris in cislunar space will also increase. On top of this, as activity on the Moon increases and becomes continuous, the risk of falling space debris hitting lunar facilities or personnel could become a major concern.

Another issue is that if cislunar space utilization becomes more active, the sharing of space situational awareness (SSA) and space traffic management will be necessary.[103] There are only four inclinations at which a stable orbit around the Moon is possible in LLO (27°, 50°, 76°, 86°).[104] Moreover, since it is possible that areas around EMLs can be used as relay ports between the Earth and the Moon,[105] various countries and companies may seek to use them. In this case, in addition to the development of cislunar SSA capabilities and the sharing of that data, traffic management will be required. Concerning this issue, the National Cislunar Science & Technology Strategy announced by the U.S. government in November 2022 sets out a policy to pursue SSA sharing among nations and between the public and private sectors.[106]

How to use the Moon will be a concern of future governance. There are valuable and finite

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99 John B. Sheldon, "Saudi Arabia's Moon Ambitions," *Middle East Space Monitor*, January 11, 2023, https://mideastspace.substack.com/p/saudi-arabias-moon-ambitions.

100 National Aeronautics and Space Administration, "The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes," October 13, 2020, https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf.

101 National Aeronautics and Space Administration, "NASA, International Partners Advance Cooperation with First Signings of Artemis Accords," October 14, 2020, https://www.nasa.gov/press-release/nasa-international-partners-advance-cooperation-with-first-signings-of-artemis-accords.

102 Adam Mann, "The Moon Could Soon Have a Space Junk Problem," *Science*, February 22, 2022, https://www.science.org/content/article/moon-could-soon-have-space-junk-problem.

103 SDA is a term that the U.S. Department of Defense began using to emphasize the importance of understanding intentional threats, so the more general term SSA has been used here.

104 Spencer Kaplan, "Eyes on the Prize: The Strategic Implications of Cislunar Space and the Moon," Center for Strategic and International Studies, July 13, 2020, p. 2, http://aerospace.csis.org/wp-content/uploads/2020/07/20200714_Kaplan_Cislunar_FINAL.pdf.

105 Ibid., p. 7.

106 Office of Science and Technology Policy, The White House, *National Cislunar Science and Technology Strategy*, p. 11.

locations on the Moon, such as areas with high sunshine rates suitable for solar power generation, and perpetually shaded areas containing ice that can be used for water to sustain human life or for oxidizer/fuel for rockets.[107] In particular, the lunar poles have both high sunshine and perpetually shadowed areas and are thought to be highly valuable. While water on the North Pole is thinly distributed over a wide area, water on the South Pole is expected to be concentrated in craters.[108] Based on this, the U.S. plans to establish an Artemis Base Camp near the lunar South Pole. China too, plans to return to Earth with samples from the lunar South Pole. Coordination between countries concerning the use of the lunar poles will likely be necessary.

How to develop lunar resources is also an important issue. The Outer Space Treaty has no provisions on space resources, so different countries have different views on whether the commercial collection and use of space resources is acceptable in light of the Treaty. The U.S., Luxembourg, the United Arab Emirates, and Japan have enacted relevant domestic legislation based on the position that it is within the scope of the Outer Space Treaty. At a symposium in September 2020, NASA Administrator Bridenstine said that just as it is acceptable to catch tuna swimming in international waters, it is possible to collect and use lunar resources, even though the acquisition of the Moon is prohibited by the Outer Space Treaty.[109] Meanwhile, Russia believes a new treaty is needed.[110] In 2019, the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space agreed to hold informal consultations in 2020 on potential legal models for activities in the exploration, exploitation, and utilization of space resources.[111] The informal consultations were canceled in 2020 due to the global spread of COVID-19, but an agreement was made to establish a working group in 2021.

Finally, the activities of military organizations and personnel on the Moon may become an issue in the future. As noted above, the use of military personnel for scientific research and other peaceful purposes and the use of any equipment or facilities necessary for peaceful exploration are permitted by the Outer Space Treaty. Is it permissible for military personnel to operate a space observation facility on the lunar surface, or for military personnel to guard a lunar facility in the same way that soldiers guard embassies? Moreover, while the use of conventional weapons on the Moon for self-defense is permissible,[112] under what specific circumstances is it appropriate to exercise the right of self-defense? These points may need to be considered in the future.

Conclusion

This paper has focused on cislunar security, first reviewing the current state of and plans for American and Chinese activities and analyzing their implications. It has also provided preliminary

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107 Saiki Kazuto, *The Moon is Amazing: Resources, Development, Migration* (Tokyo: Chuokoron-Shinsha, 2019), pp. 115-116.

108 Kaplan, "Eyes on the Prize," p. 6.

109 Secure World Foundation, "Keynote: NASA Administrator Jim Bridenstine," Second Summit for Space Sustainability, September 10, 2020, pp. 2-3, https://swfound.org/media/207210/bridenstine-keynote.pdf.

110 Valerie Oosterveld and Anne Campbell, "Space Resource Discussions in the UN Committee on the Peaceful Uses of Outer Space," *Opinio Juris*, July 11, 2021, http://opiniojuris.org/2021/07/11/space-resource-discussions-in-the-un-committee-on-the-peaceful-uses-of-outer-space/.

111 Ibid.

112 Sato Masahiko, "Moon Agreement," in *Disarmament Dictionary*, Japan Association of Disarmament Studies, ed. (Tokyo: Shinzansha Publisher, 2015), p. 335.

consideration of possible military activities in cislunar space, and its governance.

At present, there is no confirmation that any nation is conducting military activities in cislunar space. The U.S. has begun to consider the military implications of China's growing presence in cislunar space. However, there is no concrete information that China is planning military activities in cislunar space. Nor have U.S. defense officials provided any analysis that China is conducting or plans to conduct such activities.

It is conceivable that initiatives by the U.S. Department of Defense are not attempting to respond to an imminent threat or one that will materialize shortly.[113] The actuality is that they are beginning to acquire SDA capabilities preemptively because they lack the ability to understand what other countries are doing in cislunar space in the first place. In addition, satellite operations in cislunar space require different expertise than satellite operations within GEO, so it will take time to develop the appropriate competences.[114] Recognizing these realities, the U.S. defense authorities have begun to develop relevant capabilities in advance.

As this paper has shown, cislunar space has increasing potential to become a new area of continuous human activity, so it is necessary to study the various activities, from economic to military, envisioned for the area and the governance that will be required in conjunction with these activities.

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[113] Fukushima Yasuhito, "Trends in the Military Use of Space and Implications for Japan's Defense Policy," *NIDS Commentary*, no. 235 (August 18, 2022), p. 3, http://www.nids.mod.go.jp/publication/commentary/pdf/commentary235.pdf.

[114] Buehler, Felt, Finley, Garretson, Stearns, and Williams, "Posturing Space Forces for Operations Beyond GEO."