The Sino-American Battle for the Moon

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Abstract
The leading spacefaring powers have recently focused on the Moon as the closest target with which to begin extraterrestrial expansion. The U.S. and China have launched ambitious programs to build lunar bases. Large international blocs are forming around these initiatives as space exploration becomes increasingly politicized after a period of global cooperation. There are plans for the exploitation of lunar resources, albeit with a slow return on investment. To defend future acquisitions, the first military programs have been commenced, and the U.S. Space Force has doctrinally proclaimed the Moon an area of its responsibility. Although many plans will be delayed, and

the most optimistic ideas probably never realized, humanity is taking its first steps beyond near-Earth orbit. But it does so, carrying the residue of many earthly problems and contradictions.

Keywords: space, the Moon, Marce, U.S., China, Russia, foreign relations, military, geopolitics.

> "The universe is the ocean, the moon is the Diaoyu Islands, Mars is Huangyan Island. If we don't go there now, even though we're capable of doing so, then we will be blamed by our descendants. If others go there, then they will take over, and you won't be able to go even if you want to."
>
> Ye Peijia, Head of the Chinese Lunar Exploration Program (Hong, 2018)

The Second Moon Race is already underway. The leading spacefaring powers are accelerating their programs, increasing the quantity and complexity of automated stations and preparing for manned missions. Unlike the Soviet-American race of the 1960s, these programs seek to not just plant the flag on the Moon, but to stay there, developing it scientifically, economically, and militarily. The main contestants are the U.S. and China, with the Moon acting as just another front of the New Cold War between them. But other countries—including Russia, Japan, India, and Pakistan—and 'NewSpace' private players are also increasingly active.

SISTER OF APOLLO

The current U.S. lunar program harks back to the early 21st century. After the Space Shuttle Columbia disaster on 1 February 2003, it became clear that further "procrastination" in space exploration was no longer tolerable. The shock, and the need to develop a new manned spacecraft and restore prestige, emboldened the U.S. political leadership and NASA, which had previously limited themselves to vague theoretical discussions of "someday" flying "somewhere" (probably Mars, maybe the Moon).

In January 2004, George W. Bush announced a new space research strategy, which was subsequently named Constellation (NASA, 2004). It sought nothing less than human expansion into the Solar System, first via probes, then with a return to the Moon by 2020, and eventually, drawing on the lunar base experience, with a flight to Mars. Unmanned probes would focus on Jupiter's moons and on Saturn's moon Titan, which might be suitable for future colonization. Although the manned Mars mission has remained at the planning stage, some of Constellation's lunar ideas have come to fruition.

These include, principally, the Orion spacecraft, which first appeared in the Bush administration's program and suffered from some troubles before undergoing unmanned tests, including a Moon flyby in November 2022. The first manned flight is preliminarily scheduled for 2025. Constellation planned for Orion to ferry crews to the ISS, the Moon, and Mars. (In the case of the Moon, the Altair lander would bring crews to and from the actual surface. In the case of Mars, Orion would be docked with a much larger ship, about the size of a space station.)

The lunar program required the development of a new family of Ares launch vehicles. The light Ares-I would put Orion into Earth's orbit, and the heavy Ares-V could carry a lunar lander with its own propulsion system and other large payloads. To minimize costs, they were supposed to utilize Space Shuttle components: Ares-I and the first stage of Ares-V would use the liquid-propellant rocket engines and solid-fuel boosters of the Space Shuttle orbiter. However, by keeping the production base, infrastructure, jobs, and contracts safe for the sector's leading firms, the government opted for an inefficient, costly, commercially nonviable rocket. For instance, the single-use Ares-V would have required more engines than the Space Shuttle used repeatedly. Problems were compounded by the Apollo program's abrupt termination, leading to mass layoffs and the loss of expertise.

By Barack Obama's inauguration, Constellation programs had run over their schedules and budgets. While officially abandoning the

Moon and Mars would have unacceptably harmed U.S. prestige, the new administration did call for a radical revision of plans. Yet no clear roadmap was presented during Obama's two terms. Instead, the White House proposed a Flexible Path (which became the tentative name for Obama's space program) that would somehow lead to the Moon and Mars through a series of rather strange and often unrelated missions (American Presidency Project, 2010). For example, one widely discussed proposal was to tow a small asteroid to the Moon's orbit and land an astronaut on it.

But there were successful undertakings as well: principally, support for the 'NewSpace' private players in launch services and space technology more generally. Plans to rely more on commercial services included Orion's replacement with private alternatives for crew delivery to the ISS, created under the Commercial Crew Program and hired by NASA. This allowed the U.S. to resume its own manned flights aboard SpaceX's Crew Dragon ships in 2020.

The current lunar program retains the idea of a manned station orbiting the Moon. This dates back to the Deep Space Habitat (DSH) program, which planned manned modules for long flights beyond Earth's orbit: a flyby of Mars or Venus and a permanent station at a stable Lagrangian point or above the Moon. The latter option was selected and named the Deep Space Gateway (DSG). The DSG would be placed in an unusual seven-Earth-day near-rectilinear halo orbit (NRHO), permitting constant radio contact with Earth, near-constant contact with a surface station at the Moon's south pole, and flights to the Moon's surface within a short window once a week. Additionally, interplanetary missions can be launched from the NRHO at a low cost in energy, hence the DSG's name: it should become a gateway not just to the Moon but to deep space.

Another Flexible Path legacy that has survived to this day is the Space Launch System (SLS) launch vehicle. Although presented as a replacement for the overly expensive and constantly delayed Ares rocket, it is a lightweight manned version of Ares-V (a modification of Ares IV planned under the Constellation program). With Ares-I abandoned, and Orion no longer used for low-Earth-orbit missions, the SLS will deliver manned spacecraft and payloads (such as DSG modules) to the Moon.

The current U.S. lunar program took its final shape during Trump's presidency, which also saw the establishment of the U.S. Space Force (USSF) as an independent military service. In December 2017, Trump signed Space Policy Directive 1, which replaced the Flexible Path with low-Earth-orbit flights, lunar missions, the construction of a permanent lunar base, and eventual missions to Mars. In March 2019, Vice President Mike Pence announced that the program's first Moon landing would be moved up from 2028 to 2024. The SLS would deliver the Orion, with a crew of four, to the DSG, from which two astronauts would take a lander to the Moon's South Pole. This mission would be preceded by two flybys of the Moon, one unmanned and the other manned. In May 2019, the program was named Artemis, after the sister of Apollo. DSG was also later renamed the Lunar Gateway to more specify their role.

Given the intensifying confrontation with China, the Biden administration maintained the Artemis program without major amendments. In April 2021, NASA chose SpaceX to create the Human Landing System (HLS), to ferry astronauts from the Moon's orbit to its surface. SpaceX's design, based on its Starship, has a towering height of 50 meters and appears to greatly exceed the program's initial requirements (including the declared ability to ferry not only astronauts, but up to a hundred tons of cargo, which is unlikely to be necessary in the near future). The new ship should deliver astronauts from the Moon's orbit to its surface and back.

The Starship HLS is to be refueled in low Earth orbit from Starship's tanker, which has yet to be created and which itself will get the fuel from Starship spacecraft over at least a dozen flights. The Artemis program has been significantly delayed by its dependence on SpaceX's ability to create both a lander and the Starship-Super Heavy system. In 2019, the first Moon landing was scheduled for 2024, but that year actually saw Starship only learning to fly to low Earth orbit. According to the latest GAO report, the Starship HLS is not likely to be ready before 2028 (Foust, 2024a). Given SpaceX's module problems, in May 2023, Blue Origin received a contract to create an alternative, lighter module, which is to be ready for manned landing even later—by 2029. Another cause of chronic postponements is the SLS launch vehicle, suffering from cost overruns and delays.

The current Artemis program schedule is as follows:

- Artemis II, fall 2025: Manned lunar flyby. Given the success of the Artemis I unmanned mission at the end of 2022, Artemis II is likely to be completed on time.
- Artemis III, fall 2026: This is the official deadline, but the Starship HLS is unlikely to be created, let alone tested, by that time. The manned landing may therefore be postponed, replaced in 2026 by a flight to the Lunar Gateway, or by Starship HLS testing in Earth orbit.
- Lunar Gateway, end of 2026 or in 2027.
- Artemis IV, fall 2028: The first full-profile flight, with a more powerful SLS configuration, the delivery of additional modules to the Lunar Gateway, docking with the station and transfer to the HLS.
- Artemis V and subsequent modifications: Starting in 2030, annual flights to expand the orbital and surface lunar stations.

Further adjustments to the schedule are inevitable, likely with new presidential administrations. At the current tempo, the U.S. is likely to make at least one landing, and begin deployment of orbital and surface unmanned infrastructure, by the end of the decade.

ARTEMIS ACCORDS

Artemis differs from previous international space programs in that it has been politicized from the outset.

The U.S. is seeking to increase the number of program participants, but conditioned on the signing of the 'Artemis Accords' (NASA, 2020) regarding civilian activity in space. The Artemis Accords apply on the "Moon, Mars, comets, and asteroids, including their surfaces and subsurfaces, as well as in orbit of the Moon or Mars, in the Lagrangian points for the Earth-Moon system, and in transit between these celestial bodies and locations" (Ibid).

The Accords are based on the 1967 Outer Space Treaty, but with some modifications. Most importantly, signatories not only agree that "extraction of space resources does not inherently constitute national appropriation under Article II of the Outer Space Treaty" but also proclaim that "utilization of space resources can benefit humankind by providing critical support for safe and sustainable operations" (NASA, 2020). The use of resources, not so much by states as by private firms, is endorsed by the signatories. Another significant distinction is the attention paid to the problem of space debris. While important and relevant, it could provide convenient cover for the development and deployment of anti-satellite weapons.

Unlike the Outer Space Treaty and other space law agreements concluded within the UN framework, the Artemis Accords are a system of bilateral agreements between the governments of the signatory countries and the U.S. government, and between the space agencies of these countries and NASA. A copy of the Artemis Accords has been transmitted to the UN Secretary General, but it has been separately stipulated that they are not subject to registration under Article 102 of the UN Charter and are not to be considered by the UN as an official international treaty. However, outwardly, the Artemis Accords are framed as a UN agreement, not only by their structure and vocabulary, but also by their official translation into the UN working languages, including Russian (NASA, 2020). Since their signing, concerns have been voiced that the U.S. is seeking to replace the Outer Space Treaty to "enable the U.S. interpretation of international space law to prevail" (Boley and Byers, 2020). The Artemis Accords, and recent U.S. space diplomacy as a whole, have generally been characterized as explicitly aimed at creating advantages for American companies in economic space exploration (Uvarov, 2024).

Such accentuated "America-centricity" of the Artemis Accords obviously, and probably intentionally, makes it impossible for China and Russia to join the agreement for reasons of national prestige. This is also true of other countries that have strained relations with Washington. As a result, a club of countries standing "on the right side of space expansion" is forming (Vorontsov, 2022). The club encourages the use of space resources, which is criticized by other countries, in particular Russia and China, as an overly free interpretation of the Outer Space Treaty (Ji, Cerny, and Piliero, 2020; MID, 2020). At the same time, it is unclear whether the members of the Artemis Accords will be just as positive in the future about such activities by countries that are not participating in the agreement, or will they consider it "poaching?"

As of September 2024, 43 countries had joined the Artemis Accords, including almost all those with significant space programs, except Russia, China, Iran, and the DPRK. While the participation of the entire "collective West" was probably inevitable, India's 2023 accession was a significant achievement by the U.S. If Washington sought to create an alternative to the Outer Space Treaty to be complied with by all the club members recognizing its space leadership (at least in matters of lunar exploration), then it has achieved its goal. In the future, the club members are likely to create institutions that regulate the economic use of celestial bodies.

NEW HIGH GROUND

Another interesting aspect of the Artemis Accords is that they concern "civil space activities conducted by the civil space agencies." Thus, "military space activities" are deliberately put aside, but interest in them outside near-Earth orbit is growing.

Discussion of military interests requires clarification of the term 'cislunar space,' which is a region of near-Earth space with special conditions for spacecraft maneuvering. Its lower boundary is twice as far from Earth's surface as geostationary orbit is (that is, about 70,000 km), and its upper boundary is located near the L2 Lagrangian point in the Earth-Moon system (that is, at a distance of about 61,500 km from the far side of the Moon). In this region, spacecraft are strongly affected by the Moon's gravity, which creates complex orbital dynamics—the 'cislunar regime'—that differ significantly from those of the near-Earth region. This interferes with the establishment of stable orbits, and makes impossible almost all permanent ultra-high Earth orbits.

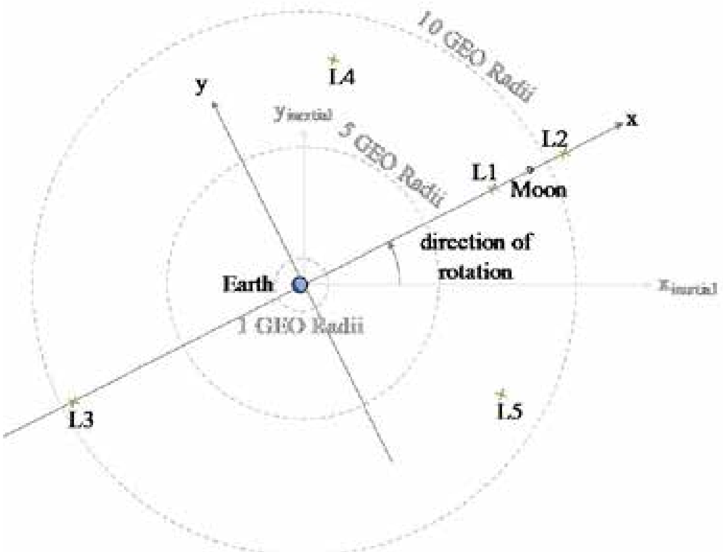
In this region, spacecraft must remain "tethered" to either the Moon or the five Lagrangian points (where the gravitational influences of

Earth and the Moon are more or less balanced). A spacecraft can remain at those points, or in certain orbits around them, for a long time using little fuel. A detailed analysis of flight mechanics under the conditions of the 'restricted 3-Body problem' goes far beyond the scope of this article. The interested reader is encouraged to consult a fairly simple and illustrative work published by the Air Force Research Laboratory—its authorship clearly testifies to the military's constant interest in this topic (Holzinger, Chow, and Garretson, 2021).

The L1 Lagrangian point lies between Earth and the Moon and would be perfect for a refueling and servicing station. The L2 point is an important location for relay satellites providing communication between Earth and the far side of the Moon. And the closest part of cislunar space can be used for the deployment of assets to permanently monitor geostationary satellites, and potentially attack them (see Graph 1.)

Graph 1.

Location of the Lagrangian points in the Cislunar space



Source: Holzinger, Chow, and Garretson, 2021.

China has already proposed using a gravity assist maneuver near the Moon to put inspector satellites into retrograde geostationary Earth orbit, allowing them to pass all other satellites in regular geostationary Earth orbit within 12 hours (He, Ma, and Li, 2021).

So, although cislunar space is a huge area, almost two thousand times larger than the well-traveled space within geostationary orbit (Holzinger, Chow, and Garretson, 2021), control of several key points would be enough to dominate it. This immediately raised interest within the U.S. military. Published in July 2023, the USSF Space Operations Doctrine reads: "Current United States military space operations occur in a set of defined orbits within the geocentric regime. Guardians [i.e. USSF personnel] are preparing to move beyond the geocentric regime to provide space domain awareness (SDA) in all regimes as commercial and government entities reach new milestones and potential threats arise" (STARCOM, 2023). Earlier, in 2020, USSF and NASA signed a Memorial of Understanding, reading, *inter alia*: "… USSF was tasked with defending and protecting U.S. interests in space. Until now, the limits of that mission have been in near Earth, out to approximately geostationary range. With new U.S. public and private operations extending into cislunar space, the reach of USSF's sphere of influence will extend to 272,000 miles and beyond…" (SpaceRef Editor, 2020).

USSF wants to first focus on reconnaissance and surveillance of foreign spacecraft in cislunar space. To this end, a number of programs have already been launched, including the development of two types of Oracle spacecraft (until 2022 known as the Cislunar Highway Patrol System, CHPS) by the Air Force Research Laboratory. Oracle-M (Mobility) will be the first to practice active maneuvering in cislunar space, and is scheduled to take its maiden flight in 2027, becoming the first military spacecraft designed to operate beyond Earth's orbit (Erwin S., 2023). Oracle-P (Prime) will be created based on Oracle-M's experience and is intended mainly for detecting and monitoring objects near the Moon. Probably to emphasize the importance of this task, recent months have seen expressions of concern about several automated lunar stations coming dangerously close to one another (Foust, 2024b). Interestingly, Oracle spacecraft are expected to be equipped with refueling units for longer operation.

To ensure even greater mobility within cislunar space, a new type of propulsion system is needed, and for this purpose the U.S. is developing a nuclear thermal propulsion engine, which heats liquid fuel into gas. DARPA and NASA are jointly implementing the Demonstration Rocket for Agile Cislunar Operations (DRACO) program using such an engine. Lockheed Martin and BWX Advanced Technologies have been selected as the lead contractors for DRACO, with the first flight scheduled for 2027 (Hitchens, 2023).

A NEW EL DORADO?

However, is this not sheer paranoia afflicting the military? Is there something of value on the Moon or in cislunar space that needs to be taken and protected?

Although it provides profit opportunities to specific actors in the aeronautics sector, the Moon will likely have no actual economic value for the near future. But it does contain valuable resources.

First of all, helium-3, which may see future use as fuel for thermonuclear power plants. (It is already used in very narrow capacities, such as in heavy-duty cooling systems.) There is much more helium-3 on the Moon than on Earth, potentially justifying its extraction from Moon soil (regolith). However, this would require a robust infrastructure to mine, process, and deliver the isotope to Earth. In fact, any significant amount of helium-3 would require sifting through thousands of tons of surface regolith (Borowitz, Noonan, and El Ghazal, 2023). But the larger problem is that nuclear plants using helium-3 do not currently—and may not ever—exist. But if such nuclear power plants become a reality, the practical impossibility of extracting helium-3 from Earth's natural sources (helium-3 results from the radioactive decay of tritium produced in nuclear reactors) can make lunar mining operations profitable. Anyway, the prospect is frequently mentioned in the media (e.g., *Gunpowder Moon, Iron Sky*, and *For All Mankind*) and has attracted investment (e.g., the startup Interlune is planning to demonstrate helium-3 mining technology before the end of the current decade (Davenport, 2024)).

The Moon also contains more less speculative mundane and useful resources, such as rare-earth minerals. Yet, although some of them may be in abundance on the Moon, their extraction there will for the foreseeable future be much more expensive than the terrestrial alternative (Borowitz, Noonan, and El Ghazal, 2023). The situation can probably change only if demand skyrockets and/or Earth's supply of resources is exhausted.

There are significant reserves of water ice in the Moon's polar regions; hence such keen interest in these areas and the plans to build the Artemis's base camp on the South Pole. Water ice is not only a source of water and oxygen for humans, but also a source of oxygen and hydrogen that are a raw material for rocket fuel—a mixture of oxygen and hydrogen alone is sufficient to fuel all by itself a liquid-propellant rocket.

There are also even more exotic ideas, such as generating electricity on the Moon or at Lagrangian points, or even building secure data centers on Earth's natural satellite (Werner, 2023). But 'trivial' things, such as tourism, mining novelty lunar rocks, and Moon burials, appear to be more reliable sources of income in the near future (Borowitz, Noonan, and El Ghazal, 2023). Even if the "lunar economy" does materialize in the coming decades, it will most likely be subsidized.

Yet optimists argue that "a 'space economic zone' … could produce $10 trillion a year by 2050" (Jones, 2020) and that it is time to "stake a claim" as a trailblazer using military means (Goswami, Bowen, and Wilson, 2024), because it is the first "colonizer" who will set the rules and norms (Borowitz, Noonan, and El Ghazal, 2023). As Scott Pace, former Executive Officer of the U.S. National Space Council, and director of the U.S. Space Policy Institute at George Washington University, said, "rules on frontiers and shared domains are made by those who show up, not those who stay behind" (Evans, 2021) The latter is illustrated by U.S. plans to create Coordinated Lunar Time, whose implementation "will require international agreements… through existing standards bodies and among the 36 nations that have signed a pact called the Artemis" (Roulette and Dunham, 2024).

Additionally, the U.S. Department of Commerce is planning a Traffic Coordination System for Space (TraCSS)—a service available to private players (naturally, from the "right" countries) to coordinate flight paths and prevent possible collisions (Uvarov, 2023), albeit so far only in near-Earth orbit.

GODDESS FROM THE EAST

The U.S. has competitors. Over the past decade, China has made great strides in automated Moon missions under the Chang'e program, named after the lunar goddess. (The name was first used for the Chang'e-1 lunar orbiter, launched in 2007, and thus might have influenced the U.S.'s selection of 'Artemis' a decade later.)

The Chang'e program has featured the most complex and consistently successful Moon missions of recent years. They do not copy Soviet or American flights of the 1960s and the 1970s, but instead use cislunar maneuvering and complex, long, energy-efficient routes, accompanied by the deployment of spacecraft at Lagrangian points. China has carried out orbital mapping missions, landed two probes with rovers, and twice brought lunar soil samples to Earth. China is the third country to accomplish the latter and the second, after the USSR, to do it using automated probes. Two probes—Chang'e-4 and Chang'e-6—landed on the far side of the Moon for the first time ever. During these missions, China used Queqiao relay satellites navigating complex orbits, including around the L2 point. Chang'e-7, to be launched in 2026, is expected to land in the South Pole region and deploy not only a lunar rover but also a small flying probe. Subsequent missions are planned to test lunar-base-building technology, including 3D printing with regolith.

The U.S. is clearly lagging behind in automated missions. The Artemis program relies on of NewSpace experience of contracting private companies and giving them a free hand in delivering equipment and cargo to the Moon, but U.S. companies have so far been more successful in near-Earth orbit, managing only one partial success beyond that: the Odysseus mission, whose lander fell on its side. However, many missions have already been contracted for the future:

the U.S. is pursuing a quantitative advantage, gaining experience and creating a "lunar NewSpace" by trial and error.

Far less is known about China's manned lunar program than about Artemis, although some more information has recently become available. Mockups have been displayed of the Mengzhou spaceship and Lanyue lander, which look more like Apollo or Constellation than Artemis and its huge Starship HLS. China is planning two launches of the future-generation Long March-10 rocket to deliver a spacecraft, the mothership, and landers. Unmanned tests, including Lanyue's landing with a payload, will be carried out before the manned mission. A manned landing was initially planned before 2030 (Xiaoci, 2023), but this is hardly possible, as even the future launch vehicle has not been flight tested yet. However, if the Americans keep delaying and postponing its projects, China may as well vie for leadership in performing the first manned landing on the Moon in the 21st century.

Russia and the U.S. once considered the possibility of further cooperation between Roscosmos and NASA, after the ISS, on the Moon. In the early 2010s, Boeing even came up with the rather bizarre idea of moving some of the ISS modules to the L1 point and building an inexpensive cislunar station with them. When priority was given to the Gateway, it was assumed that Russia would build a docking module for it, compatible with its future manned spacecraft.

However, the need for significant financial investment, uncertainty about the readiness of the spaceship and the heavy launch vehicle, and most importantly, Russia's unwillingness to play a secondary role in the American project made it clear even before the current dramatic confrontation between Washington and Moscow that "there will be no deal."

Russia's insistence on equal status—as had been the case with the ISS, essentially a joint Russo-American project—was unacceptable to the Americans, as there now was no consideration of equal financial participation, there was uncertainty regarding Russia's development of a new spaceship and a new heavy launch vehicle (which could be of interest as backup options), and the U.S. lacked the unique experience that Russia had to offer regarding orbital stations. The possibility of cooperation was thus largely foreclosed even before the current crisis in relations. The Artemis Accords have now made cooperation even less plausible—which may indeed have been one of their objectives in requiring signatories to accept the primacy of American space law over international treaties. (Canadians authors have written more about the danger of establishing American norms above international ones in connection with the Accords (see Boley and Byers, 2020). Borowitz, Noonan, and El Ghazal (2023) state: "The United States is engaging with international partners and actively seeking to influence global space norms with the development and continued promotion of the Artemis Accords, principles for responsible behavior on the Moon."

Although NASA keeps reiterating its desire to cooperate with Roscosmos in manned space exploration, it is difficult to imagine new major joint programs being approved by U.S. lawmakers (who attacked even the ISS project in the past), regardless of Russia's position. China is in a similar situation—in 2011, Congress legally banned NASA from cooperating with China without obtaining special permission (Foust, 2023).

Finding themselves in the position of natural allies, Moscow and Beijing began cooperating in lunar exploration. In March 2021, they announced plans to create an International Lunar Research Station (ILRS), with automated systems that will lay the groundwork for an inhabited camp (CNSA, 2021). Since then, 11 countries have joined the ILRS, mostly those friendly with Russia and/or China. Unlike the Artemis Accords, China and Russia do not require compliance with any "rules" or anything else other than basic international space treaties. Although most participants are unlikely to be able to contribute directly to space activities, countries such as Venezuela, Senegal, or South Africa can host additional ground-based communication systems, and Kazakhstan's participation will provide access to the Baikonur spaceport (Jones, 2024).

Russia's contribution is an open question, depending largely on the priority given by Moscow to scientific rather than military space activity. Recently, the ILRS seems to have received top-level attention, an agreement on it with China was ratified in June 2024 after President Putin's visit to China. If Russia succeeds in creating a heavy launch vehicle and the new manned spacecraft Oryol (Eagle), these will certainly be employed as alternatives.

Roscosmos has its own lunar exploration program with automated probes, but so far has only launched the Luna-25 station, which crashed into the Moon during a pre-landing orbit correction. New orbital and landing craft are scheduled to be launched in 2027-2028, but could be postponed as was repeatedly the case with Luna-25.

Russia probably has the most to offer in the field of aeronautic nuclear power, if it manages to realize the longstanding project of a nuclear interorbital tugboat or builds a miniature nuclear power plant for powering a lunar base. The latter is quite desirable given the long lunar night, and similar work is underway in the U.S. and the UK. Roscosmos chief Yuri Borisov has repeatedly spoken of such plans in Russia and China. The first lunar nuclear power plant is expected to go online in 2033-2035 (Reuters, 2024).

The Second Moon Race features diminished funding compared to the 1960s, resulting in slower progress and delays. However, as the geopolitical confrontation between Washington and Beijing intensifies, politicians are keen to win the race, encouraged by the growing interest of private business and the general public in space exploration, and inspired by NewSpace's successes. Militaries seek a foothold—just in case—on this new 'high ground' or 'first island chain'. Even the hint of an adversary holding certain plans is enough to justify competing efforts. Future historians will likely define our time as a transition from geopolitics to astropolitics.

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