Revista Mexicana de Ciencias Políticas y Sociales | Universidad Nacional Autónoma de México
Nueva Época, Año LXX, núm. 253 | enero-abril de 2025 | pp. 129-159 | ISSN-2448-492X
DOI: http://dx.doi.org/10.22201/fcpys.2448492xe.2025.253.81553

The Silk Road in Space? China, Strategic Restraint and Space Security

¿La ruta espacial de la seda? China, moderación estratégica y seguridad espacial

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Received: January 9th, 2022
Accepted: November 21st, 2022

DOSSIER

ABSTRACT

This article analyzes the entry of the People's Republic of China into the space race and the short time it has required to become a space power compared to the Soviet Union and the United States. Unlike Washington and Moscow, however, China's space developments have proceeded without the strategic restraint required to mitigate their impact. As a result, its activities are highly polluting, generating space debris, threatening space and international security by testing directed-energy weapons, and expanding its influence within the space agendas of several developing countries. Throughout the space race, the United States and the Soviet Union/Russia have agreed to certain rules limiting militarization and promoting the sustainability of space activities. While current geopolitical tensions between Washington and Moscow hinder effective governance of outer space, the People's Republic of China has a disruptive effect on space security by prioritizing its national interests without fully considering the regulatory framework of space law.

RESUMEN

En el presente artículo se analiza la incursión de la República Popular China a la carrera espacial y el corto tiempo que —en comparación con la Unión Soviética y Estados Unidos— ha requerido para convertirse en potencia espacial. Sin embargo, a diferencia de Washington y Moscú, los desarrollos espaciales chinos han procedido sin la moderación estratégica requerida, de manera que sus actividades son altamente contaminantes, generan basura espacial, amenazan a la seguridad espacial e internacional con el ensayo de armas de energía dirigida y, además, se posiciona en las agendas espaciales de diversos países en desarrollo, donde reafirma su presencia. Estados Unidos y la Unión Soviética/Rusia, a lo largo de la carrera espacial, han aceptado reglas para limitar la militarización y buscar la sostenibilidad de las actividades espaciales. Si bien hoy las tensiones geopolíticas entre Washington y Moscú impiden una cabal gobernanza del espacio ultraterrestre, la República Popular China tiene un efecto disruptivo en la seguridad espacial al hacer prevalecer sus intereses nacionales sin considerar la normatividad del derecho espacial.

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Keywords: space security; People's Republic of China; Russia; United States; strategic moderation; Chinese space program.

Palabras clave: seguridad espacial; República Popular China; Rusia; Estados Unidos; moderación estratégica; programa espacial chino.

Introduction

In 1957, when the Union of Soviet Socialist Republics (USSR) launched the first artificial Earth satellite, *Sputnik*, Chinese leader Mao Zedong addressed his people, proclaiming: "We too will build satellites!" (Swissinfo, 2020). At that time, it seemed a mere political statement. Today, 65 years later, the People's Republic of China (PRC) has indisputably established itself as a high-flying power in outer space. However, this rise presents challenges regarding the sustainability of space activities —increasingly carried out by a growing number of countries and private actors— the ongoing militarization of space, commercial considerations, the generation of space debris, and, ultimately, space governance.

The space race has changed drastically. In its early days, dominated by the Cold War, only the most technologically advanced countries could aspire to space exploration, and the funding of space activities was primarily the responsibility of governments. In contrast, today's so-called "Second Space Race" involves multiple actors, not only countries but also universities, private companies, civil society organizations, and even individuals who participate in space activities. Still, it is important to note that states remain significant players and central figures. Ideally, their conduct should foster actions, rules, codes of conduct, and dialogue mechanisms that uphold the spirit of the 1967 treaty in terms of non-appropriation, demilitarization, and the development of space activities for the benefit of humanity. However, the opposite outcome is also possible. Space technologies are dual-use, and their development is closely linked to the arms race. While the multitude of non-state actors engaging in space activities has raised concerns among the academic, scientific, and legal communities due to legal gaps that hinder regulation, there is also growing apprehension about the perceived militarization of outer space, largely driven by states, as evidenced by the recurrent use of anti-satellite (ASAT) weapons. The *strategic restraint* that enabled Cold War negotiations between the United States (U.S.) and the USSR to "protect" their space assets is now in question, given the emergence of governmental and non-governmental space actors who view outer space as an unexplored domain offering numerous geopolitical —and certainly economic— advantages.

Within this context, the PRC's space program is a key element of its development and the expansion of its national power (Hilborne, 2020). The advancement of technological capacities —such as those enabling satellites, rockets, launch platforms, and related products— allows the state to protect itself, whether from natural disasters, armed con-

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flicts, or issues of border security in a turbulent region, as well as to monitor treaties and international commitments. Space technology also enables Beijing to strengthen its international standing by promoting international cooperation that allows it, on the one hand, to access needed resources —particularly raw materials and minerals— and, on the other, to develop human resources and monitor the countries with which it establishes agreements and the regions they inhabit. This has led to discussions about extending the New Silk Road into outer space. As is known, this initiative aims to enable countries included in the Belt and Road route and others, as is visibly occurring in Latin America, to receive support from Beijing to promote their economic development under the conditions set by the PRC (Raffaini, 2021).

A brief history of the "other" space race: anti-satellite systems

An anti-satellite weapon is a space-based device capable of destroying satellites. At the dawn of the space race, the USSR took the first steps toward creating "satellite killers" aimed at U.S. intelligence satellites. In 1963, Moscow launched its prototype missile, called *Polyot 1*. Sergei Korolev, known as the father of the Soviet space program, proposed the idea of creating manned aircraft equipped with intercontinental ballistic missiles (ICBMS) to destroy enemy satellites (Harford, 1999; Cadbury, 2007). However, this idea was not well received by the Kremlin, which opted instead to support an unmanned system proposed by Vladimir Myasishchev and Vladimir Chelomei, based on orbital space planes, an audacious concept for the time. Thus, in 1962, the *Istrebitel Sputnikov* (*Истребитель спутников*) or "satellite destroyer" was born, which underwent several experimental phases during the 1970s and 1980s before becoming operational (Reichil, 2019). By the end of the Cold War, a more refined anti-satellite system, the *IS-MU*, was declared operational; however, the collapse of the Soviet Union delayed its further development. The USSR's advances in ASAT weaponry are a key factor that prompted the U.S., under President Ronald Reagan, to accelerate the development of the famous Strategic Defense Initiative (SDI), which aimed to create an anti-missile shield to counter the Soviet threat (Dietl, 2018; Zak, 2013).

During the Cold War, ASAT testing and development were dominated by the two major space powers. Both were willing to limit this development at various points due to the immense material costs involved. Strategic restraint also seemed necessary because of the costly space infrastructure deployed by both powers, which could be destroyed with severe consequences for each. This reasoning likely motivated Washington and Moscow to engage in various binding negotiations between 1967 and 1979 to ensure that space activities would remain peaceful and that neither the Moon nor any other celestial body would be subject to appropriation. However, this did not end the development of anti-satellite weapons.

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In the 1950s and 1960s, the U.S. and the Soviet Union developed ASAT capabilities as residual products of systems initially designed for other purposes. For example, the R7 rocket, used to launch *Sputnik*, was also a vector capable of carrying intercontinental ballistic missiles, thus necessitating a countermeasure system (Stares, 2022). During these years, Washington gradually altered its stance on space militarization regulations. Initially, it promoted initiatives the USSR interpreted to hinder Soviet space developments. Nevertheless, in 1967, the two powers reached an understanding to establish a foundation for space governance. For the U.S., this was a way to legitimize its space program, while for the USSR, limiting space-based weapons was seen as a positive step. Thus, in that year, the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" came into force, although it does not prohibit the deliberate targeting of satellites or anti-satellite missiles. While it excludes nuclear and mass-destruction weapons, it does not impose the same restrictions on conventional or other types of weapons in space activities (Stares, 2022; Grego, 2012: 3).

Between the 1960s and 1970s, the USSR developed co-orbital anti-satellite weapons equipped with conventional warheads to destroy satellites in orbits between 230 and 1 000 km in altitude. This system was successfully tested and became operational in 1973. As is well known, the "Anti-Ballistic Missile Treaty" (ABM treaty) was signed in 1972, prohibiting countries from interfering with national technical means of verification and recognition. By accepting these terms, the USSR implicitly endorsed the legitimacy of U.S. satellite reconnaissance systems (Stares, 2022; Greco, 2012: 3; Stützle, Jasani & Cowen, 1987).

Later, in the 1980s, the U.S. decided to develop a new type of ASAT weapon, and in 1983, the SDI was announced. While this initiative primarily involved ground-based missile systems, some parts funded smaller research projects for space-based missile systems that continue today. In 1985, the American ASAT weapon ASM-135 ASAT destroyed the *Solwind* research satellite, or *P78-1*, which stirred controversy within the U.S. scientific community as the satellite was still operational and provided valuable data on the solar corona. Criticism focused on the destruction of a scientific laboratory transmitting extremely useful information about the Sun instead of selecting a "zombie" satellite or another non-operational space object for ASAT testing (Eberhart, 1985). More importantly, the destruction of the satellite generated space debris, including traceable parts and smaller fragments. The last traceable pieces left Earth's orbit in 2002 (Grego, 2012). Nevertheless, this test demonstrated the advancements of U.S. satellite-destroying capabilities. In response, in 1987, the USSR sought to deploy a test platform to counter its rival's space-based missile defense systems; however, the platform failed to achieve its objective, and Soviet leader Mikhail Gorbachev canceled the initiative (Grego, 2012; Stares, 2022).

From the 1980s to the 1990s, there was a surge in anti-satellite systems using lasers, electromagnetic energy, and kinetic energy. These weapons serve various purposes; for example,

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directed electromagnetic energy weapons, such as lasers and microwave weapons, have limited range and are weather-dependent, making them more "environmentally friendly" by generating less space debris and complicating attacker identification (Deng, 2021). Low-intensity lasers can temporarily "dazzle" or "blind" satellite sensors, while high-intensity lasers can damage or destroy them. The U.S. Navy developed a ground-based system called the *Mid-Infrared Advanced Chemical Laser* (MIRACL), initially intended to destroy anti-ship cruise missiles but later repurposed for ballistic missile testing and ASAT laser trials. This was a byproduct of Reagan's SDI, motivated by concerns that the USSR had developed high-power lasers, which was later found not to be the case. The U.S. tested the MIRACL system in 1997, targeting a Navy satellite, which Russia viewed as violating the ABM treaty (Petersen, 2005). The U.S. military also accelerated the development of a ground-based kinetic energy ASAT system, the KE-ASAT. However, the Air Force, responsible for operating military satellites, has shown limited support for this system due to concerns that its benefits are outweighed by the potential harm posed by space debris to U.S. satellite infrastructure (Rosas, 2021). The U.S. Congress has intermittently authorized funding for its development (Stares, 2022).

End of the Cold War and the Second Space Race

In the present century, driven by the remilitarization spurred by the terrorist attacks of September 11, 2001, the U.S. has shown renewed interest in developing ASAT systems and space-based platforms. Russia, somewhat recovered from the Soviet collapse, continues investing in space but focuses on commercial rather than military activities. Until 2008, Russia agreed to cooperate with the U.S. on missile defense; however, this collaboration was abruptly interrupted when Washington destroyed one of its own satellites with an ASAT missile in 2008 (Stares, 2022). What happened? It appears that the action taken by George W. Bush's administration was a response to the initiatives launched by a new player in the space domain: the PRC.

In early 2007, the PRC destroyed one of its own aging weather satellites, *Fengyun 1-C*, with a ballistic missile, receiving strong international criticism as this was perceived as an open challenge to the peaceful use of outer space (Reinoso, 2007a). It was the first ASAT attack in 20 years. The operation was also criticized for the enormous number of debris and contamination it generated: an estimated 2 500 traceable fragments and over 150 000 smaller pieces (Raju, 2021a: 4). The United States condemned Beijing's actions, yet subsequently, in February 2008, destroyed a malfunctioning spy satellite with an ASAT, though the scientific community dismissed the U.S. arguments. Washington claimed that the decision was made because the spy satellite was damaged and posed a risk of releasing its toxic hydrazine fuel if it fell to Earth, potentially harming populated areas. However, scientists speculated that

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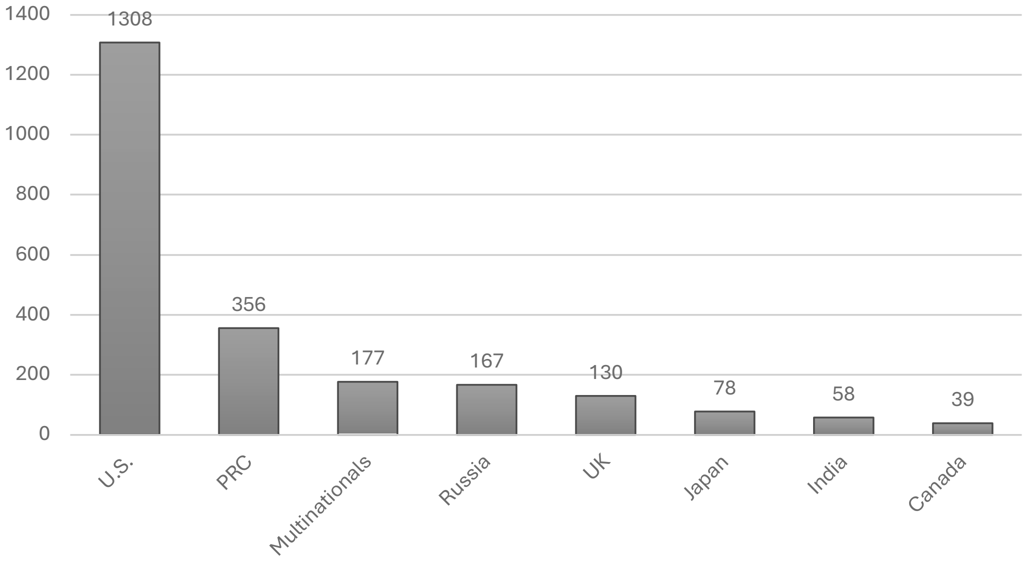
the real concern was that the malfunctioning satellite might fall into Chinese or Russian hands, potentially revealing U.S. secrets (Bowman, 2008; Raju, 2021a).

In its defense, the U.S. argued that the satellite was destroyed at low orbit —at an altitude of 247 km (Wolf, 2008)— which hastened the destruction and disintegration of the resulting debris in the atmosphere, in contrast to the PRC's action. By destroying its obsolete satellite at high orbit —at an altitude of 850 km, where both the U.S. and Japan have their intelligence satellites— the PRC created hard-to-degrade debris that still threatens the space infrastructure of various countries and private companies (Moriyasu, 2021).

Figure 1
"Satellites: the other race of the 21st century"
Countries with the most satellites in orbit (as of April 2020)



Source: Union of Concerned Scientists Satellite Database, Statista.

The PRC's entry into the exclusive club of countries with ASAT capabilities holds strategic implications for international security (Kuo, 2021). Prior to the PRC's 2007 ASAT test, the U.S. and Russia held a monopoly on military activities in space, applying principles of caution and strategic restraint to varying degrees, based on the understanding that any other approach could harm their own satellite infrastructure. However, the PRC's actions must be viewed in the context of its rapid ascent, particularly in 21st century international relations, where it has chosen to expand into outer space as part of an ambitious extension of the Belt and Road Initiative, positioning itself as a major power (Fedorova & Novosyolova, 2022: 1).

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This so-called second space race differs from Cold War-era space activities in several aspects, including:

- The reduced costs of space technologies.
- The emergence of new space powers accelerating technological developments for both military and civilian purposes (as previously discussed, space activities are often dual-use).
- The increase in countries with space capabilities and agencies.
- The involvement of private actors in developing technologies and vehicles, and engaging in other space activities (La Vanguardia, 2021).
- The rise in objects launched into space, as well as an increase in debris and space junk (Yagües, 2018: 180).

Table 1
"Who wants to be a millionaire?"
The richest people in the world in 2021*

Position	Name	Nationality	Companies	Personal fortune
1	Jeff Bezos	American	Amazon**, Blue Origin	177 MMD
2	Elon Musk	American/South African	Tesla, Space X	151 MMD
3	Bernard Arnauldt	American	Louis Vuitton, Sephora	150 MMD
4	Bill Gates	American	Microsoft	124 MMD
5	Mark Zuckerberg	American	Facebook	97 MMD
6	Warren Buffet	American	Berkshire Hathaway	96 MMD
7	Larry Ellison	American	Oracle	93 MMD
8	Larry Page	American	Alphabet	91. 5 MMD
9	Sergey Brin	American	Alphabet ***	89 MMD
10	Mukesh Ambani	Indian	Reliance Industries	84. 5 MMD

* Mexican tycoon Carlos Slim is ranked 16th.
** Jeff Bezos resigned as CEO of Amazon, although he will remain chairman of the company's board of directors.
*** Sergey Brin retired from the company, although he retains shares in it.
Data from Forbes (n.d.).

In this regard, this second space race indicates that the hegemony once held by the U.S. and the USSR/Russia in space activities is now being challenged by new participants (see figure 1). While these emerging players have less experience in space governance, they are also less inclined to comply with existing space law, perceived by many as an obstacle. They bring accelerated technological innovation, investment, and asset development capabilities.

Moreover, the growing importance of the private sector cannot be overlooked, which, to some extent, emerged from the 2008-2009 financial crisis when governments were forced to cut budgets and implement austerity measures that affected the space sector. This shift opened the doors to non-state actors. Today, the so-called space barons —billionaires who amassed their fortunes in areas such as e-commerce (Jeff Bezos), commercial aviation (Richard Branson), and new technologies (Elon Musk)— are now leveraging their vast wealth to enter the space industry with diverse ventures, including reusable and non-reusable vehicles for various missions, cargo and supply shipments to the International Space Station (ISS), and even space tourism (Davenport, 2018; Berger, 2021; Fernholtz, 2018; Nadis, 2020). The fortunes of these figures have multiplied significantly. The private sector has excelled in four main areas within the space industry: the commercialization of satellite applications, space launch services (see Figure 2), space tourism, and the exploration and exploitation of the Moon and other celestial bodies (Yagües, 2018: 193-195).

Thus, in a new international division of labor and scientific-technological innovation, the private sector seems increasingly engaged in operational and commercial tasks, while space agencies, armed forces, and other government bodies focus on strategic and space security matters (Ansede, 2021).

Strategic moderation, political realism, or technonationalism?

During the Cold War, the U.S. and the USSR reached an understanding that James Clay Moltz (2019) refers to as *strategic restraint*, a form of self-imposed limitation on space activities with military purposes that favored dialogue and cooperation between the two powers. This restraint was based on their awareness that unchecked ambitions could lead to the destruction of costly assets positioned in outer space, leading to the signing of various legally binding international space treaties between 1967 and 1979, for which Washington and Moscow were key architects (Moltz, 2010; Naciones Unidas, 2002).[1] Likewise, the two superpowers promoted the ban on atmospheric nuclear tests (1963) and ABM treaty (1972),[2]

[1] These international instruments include the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967); the Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space (1968); the Convention on International Liability for Damage Caused by Space Objects (1972); the Convention on Registration of Objects Launched into Outer Space (1975); and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (1979).

[2] This treaty had a validity of 30 years. In 2002, the U.S. government under President George W. Bush announced the country's withdrawal from the treaty, which cleared the path for Washington to pursue the development of a missile defense shield. The stated rationale was that withdrawing from the treaty was necessary to prepare missile defense systems to protect the U.S. from potential attacks by a so-called "rogue state".

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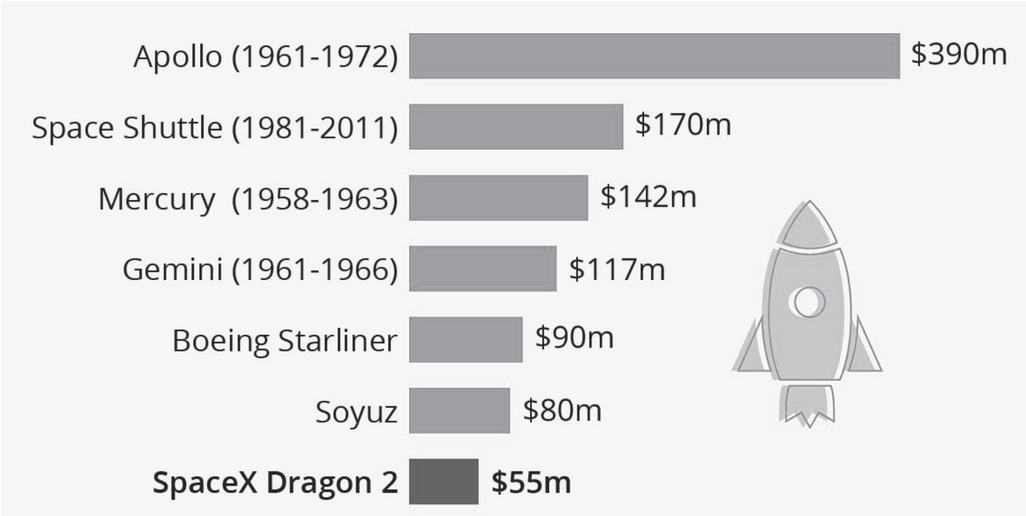
which, according to scholars of strategic restraint, clearly demonstrated that containing military activities in space helped mitigate strategic, political, and even economic tensions between the two powers (Blinder, 2012; Moltz, 2003).

Figure 2
The reduction in the cost per seat
for travel to outer space*



* Estimated costs adjusted for inflation. For Soyuz, the cost refers to the price per seat under a 12-seat contract as of 2017.
Data from Statista, NASA, Planetary Society.

Strategic restraint served as the foundation for cooperation between the U.S. and the USSR, as despite the political and ideological confrontation between these powers, they showed a willingness to hold consultations and even, as Moscow did, to unilaterally suspend its ASAT tests in the 1980s (Moltz, 2011b). U.S.-Soviet cooperation continued even into the 1990s, allowing for Soviet participation in the ISS. When the U.S. space shuttle program was terminated, Russia monopolized transporting astronauts to the ISS using its Soyuz capsules. However, this changed in 2020, with the successful launch of astronauts by Elon Musk's company, SpaceX, in its Dragon capsules at more competitive rates than those offered by the Russian government (see figure 2).

Nevertheless, not all agree that strategic restraint was the main mechanism ensuring the sustainability of space activities by the U.S. and the USSR during the Cold War. According to Everet C. Dolman (2002), the 1967 Outer Space Treaty was not a product of superpower co-

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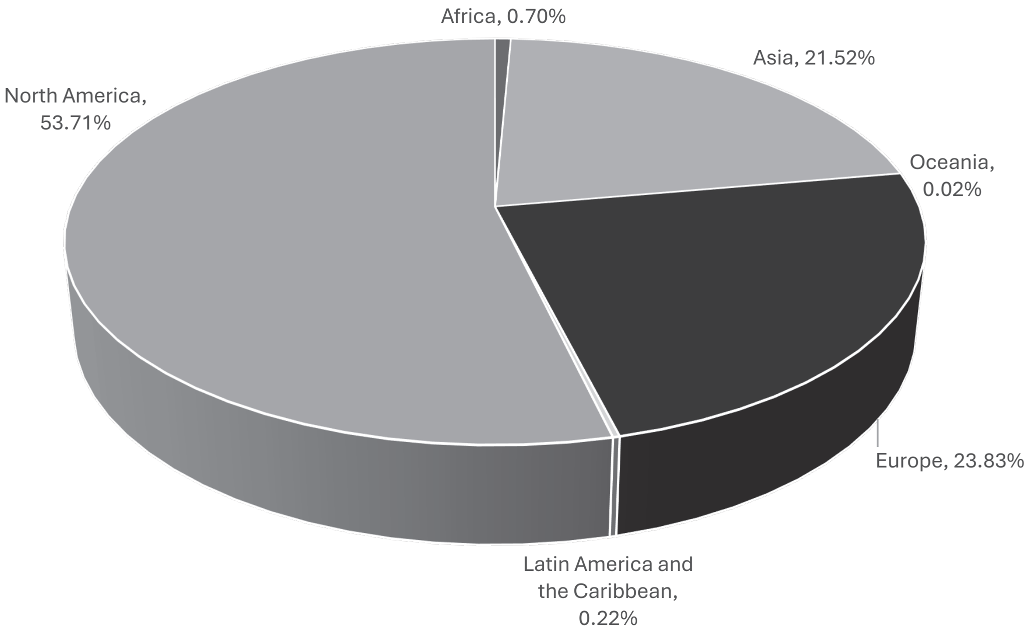
operation and restraint but rather a reaffirmation of Cold War realism and national rivalry, a diplomatic maneuver in which both superpowers bought time or simply displayed "common sense." Dolman bases his argument on the prevalence of space nationalism (Dolman, 2002: 125; Kallen, 2019), which has not only limited international collaboration —contradicting the 1967 treaty's assertion that space activities should benefit all humanity— but has also intensified competition between countries, driven by the premise that national power is strengthened by space power. In 1959, then-Senator Lyndon B. Johnson put it plainly: "men who have worked together to reach the stars are unlikely to descend together into the depths of war and desolation" (Shackelford, 2019).

The debate between Moltz and Dolman is particularly relevant today: if space powers and non-state actors do not accept creating a governance structure for outer space, the lack of sustainability in space activities is likely to threaten space and international security. Part of the problem lies in that the existing governance framework was crafted with the principles of Cold War-era strategic stability, a time when only two key players were at the *space table*, along with some U.S. allies.

Figure 3
Contribution of regions to the global space budget in 2020
(in percentages)



Data from Space in Africa (2021).

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Today, the space race extends beyond military concerns: state actors' investments in space activities have significant civilian applications, such as national security, disaster risk management, remote education and healthcare, environmental monitoring, natural resource protection, combating organized crime, border control, and more (Yagües, 2018: 181; Economic and Social Council, 2020).

Map 1
Satellite launch sites of the PRC

Chinese Space Launch Sites and Key Satellite Control Centers

China has four launch sites. The newest, Wenchang on Hainan Island, has a launch latitude closer to the Equator, which provides a more efficient path to launch satellites into GEO. China's main satellite control center is in Xian and its primary control center for human spaceflight and lunar missions is in Beijing.[77]

Visualization: DIA, D3 Design • 1811-19969

Reproduced from Erickson (2019).

Certainly, nationalism and prestige are factors in the equation. Andrew Erickson argues that the development of space programs is closely tied to recognition as a great power. The PRC, along with India, Brazil, the United Arab Emirates (UAE), and other countries, are

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joining the select club of space powers, contributing to their leadership projection and repositioning nations previously considered backward or problematic (Erickson, 2016). Take the case of the UAE's space program: with an ambitious agenda that includes the development of its own commercial space sector, sending probes and robots to the Moon and the asteroid belt, and building human resources with astronauts like Hazzaa Al Mansoori, Sultan Al Neyadi, Nora Matrooshi, and Mohammed Al Mulla. Additionally, the UAE appointed a woman, Sarah Al Amiri, as the Minister of State for Advanced Science (Ramesh, 2021), thereby presenting itself to the world as a technological power, distancing itself from the barbaric and misogynistic image with which the international community often views the region, while also reaping multiple economic and political benefits (Whittington, 2021). In this way, technological nationalism, or technonationalism, is an element that does not easily fit into the "two-player framework" of strategic restraint (Johnson-Freese, 2007). Figure 3 confirms that while more than half of the global space budget still rests in North America —primarily the U.S.— Europe accounts for another quarter, and Asia is emerging as a significant player, with the PRC as the focal point.

The Chinese space race

As mentioned earlier, space activities are dual-use: they have civilian applications but are also driven by strategic-military imperatives. Similarly to the U.S. and the USSR, the PRC's space program emerged as a byproduct of its military-industrial complex established in the 1960s, when the country sought a prominent position in a bipolar world (Beens, 2018: 12-29; Harvey, 2019). Previously, in 1956, despite being predominantly rural and still reeling from the devastation of World War II and the Chinese Revolution, Beijing opened its first research institute for missile development (New Scientist, 2005; Salla, 2020; Mineiro, 2012). In 1960, with Soviet assistance, the PRC developed its first *Long March* (*Changzheng* or *CZ*) series rocket (New Scientist, 2005; Fedorova & Novosyolova, 2022; Jüris, 2022: 185-202).

On July 19, 1964 —the year the country successfully detonated its first atomic bomb— the PRC launched and successfully recovered a rocket sent into space, carrying four albino mice as passengers (El Periódico, 2018). In 1968, Beijing inaugurated a medical and space engineering institute to advance its human spaceflight program (Chandrashekar, 2022). On April 24, 1970, the PRC launched the *Dong Fang Hong I* satellite from its launch center in Jiuquan, Gansu Province, becoming the fifth country to put satellites into orbit, following the USSR, the U.S., France, and Japan. Plans for manned space missions existed in that decade, but the project was apparently shelved for budgetary and political reasons. Nonetheless, in the 1980s, several launch centers were established in the country, and after the Cold War, the PRC developed a growing partnership with Russia in space activities (Jüris, 2022). In 1996,

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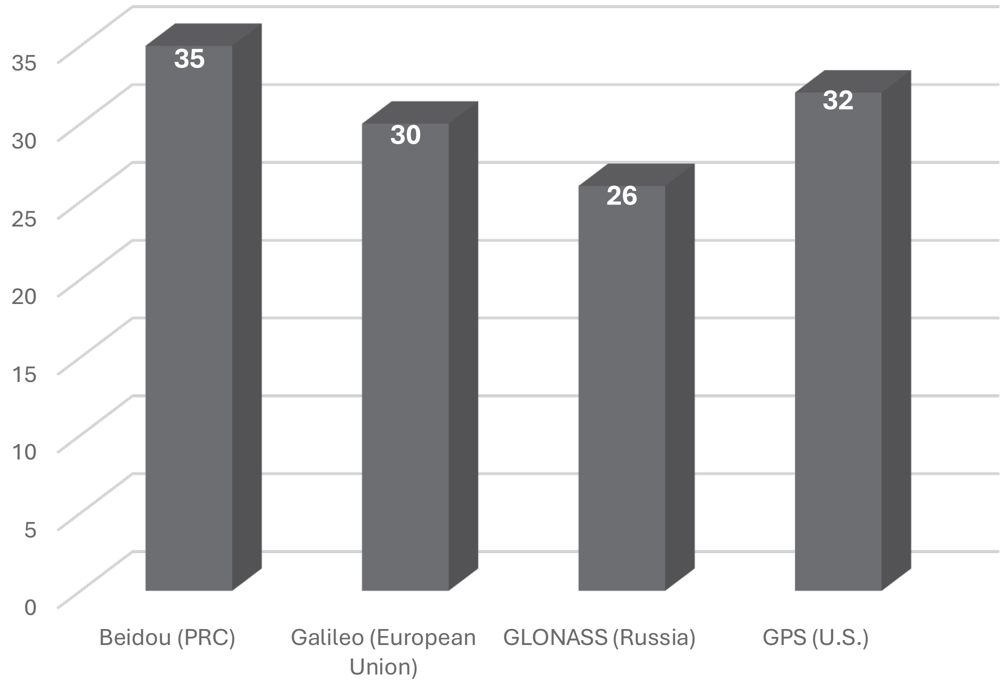
Beijing signed an agreement to acquire Russian technology. In 1997, Wu Jie and Li Jinlong completed a year of training at the Russian Star City, becoming certified as flight instructors (New Scientist, 2005).

Figure 4
Satellite navigation systems
Operational satellites by global system in 2020



Data from Information and Analysis Centre, European GNSS Agency.

As a result of collaboration between Beijing and Moscow, on November 20, 1999, the PRC successfully launched the *Shenzhou* or "Divine Vessel", followed by three more launches in 2001 and 2002 in preparation for the highly anticipated manned mission.[3] Thus, on October 15, 2003, the PRC became the third country, after the U.S. and Russia, to send a person

[3] It is worth noting that the ISS, whose first components began to be installed in 1998, involves the participation of five space agencies: the National Aeronautics and Space Administration (NASA); the Russian Space Agency (ROSCOSMOS); the Canadian Space Agency (CSA); the Japan Aerospace Exploration Agency (JAXA); and the European Space Agency (ESA). Likewise, the Italian Space Agency (ASI) and the Brazilian Space Agency (AEB) have made technological contributions to the ISS. Sixteen countries are involved, but the PRC was excluded from the project, which has prompted it to accelerate efforts to establish its own space station by 2022.

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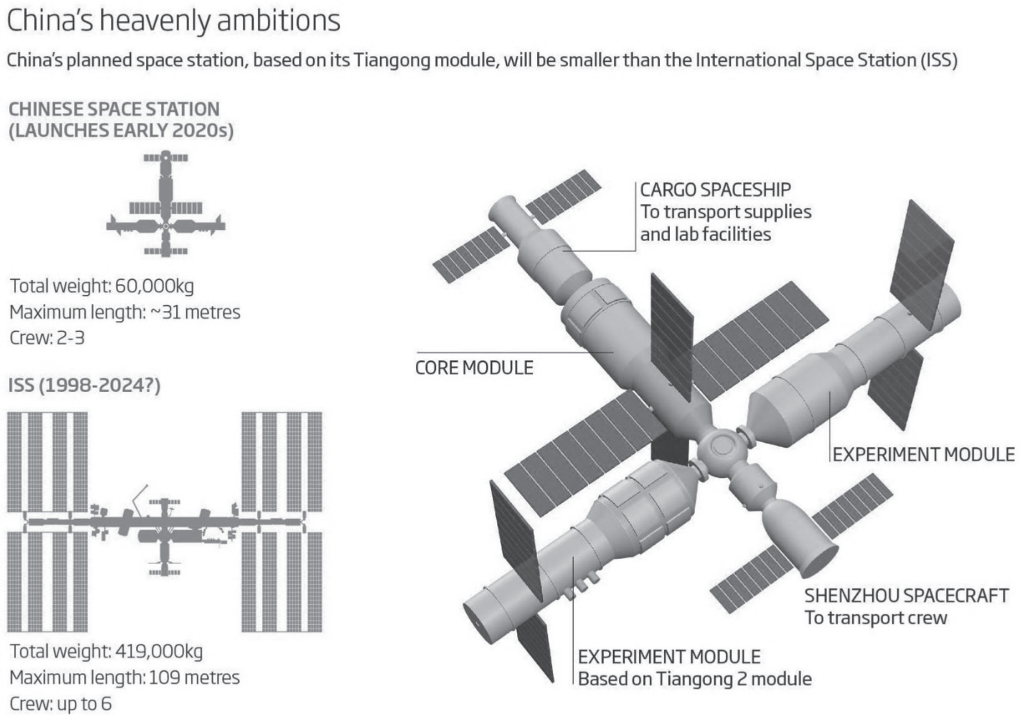
into space on its own rocket; taikonaut Yang Liwei spent 21 hours aboard *Shenzhou-5*. On October 12, 2005, two more taikonauts traveled into space aboard *Shenzhou-6*. In 2007, the *Chang'e I*[4] probe entered lunar orbit, and in 2008, the PRC's third manned mission aboard Shenzhou-7 included the country's first spacewalk by 41-year-old taikonaut Zhai Zhigang (El País, 2008). In 2010, a second lunar exploration mission, Chang'e II, was launched. In 2011, the PRC launched its first space lab, *Tiangong-1*, followed by *Tiangong-2* in 2016, part of the plan to establish a permanently manned space station by 2022.

Figure 5
The *Tiangong-2* Space Station



Reproduced from Aron (2016).

On December 14, 2013, the PRC achieved a historic milestone in its space program, successfully landing an unmanned spacecraft on the Moon, a feat previously accomplished only by the U.S. and the USSR and for the first time since 1976. Two probes, *Chang'e 3* and

[4] *Chang'e* is the Chinese goddess of the Moon.

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Chang'e 4, were responsible for these lunar landings. On January 3, 2019, *Chang'e 4* successfully landed on the far side of the Moon, Earth's natural satellite. The *Chang'e 4* mission carried the *Yutu* or "Jade Rabbit 2" rover, tasked with analyzing the lunar surface on its hidden side and transmitting millions of data points to Earth, which will be crucial for future missions and the potential establishment of human colonies (Jones, 2021). More recently, on June 23, 2020, the PRC launched the *Beidou* or "Big Dipper" satellite (BDS), which, following years of intense technological development (Jakhar, 2018), now competes with the United States' Global Positioning System (GPS), the European Galileo, and the Soviet/Russian GLONASS global navigation system (see figure 4).[5] Ten days later, on July 23, the PRC sent a probe to Mars, *Tianwen-1*, or "Questions to Heaven", in its first independent mission to another planet. Notably, since 2007, Beijing and Moscow had been collaborating on a joint exploration program for the red planet (Reinoso, 2007b). A product of this collaboration was the attempt in 2011 to send the *Yinghou-1* or "Firefly" probe alongside Russia's *Fobos-Grunt* probe to the fourth planet of the solar system; however, both were lost in Earth's atmosphere after the launcher failed to enter orbit (Bankinter Innovation Foundation, 2020).

On November 24, 2007, the *Chang'e-5* was launched, followed by the April 29, 2021, launch of the *Tianhe* or "Heavenly Harmony" module, designed to house Chinese taikonauts in the *Tiangong-2* space station (AFP, 2021). What lies ahead for the PRC's stellar ambitions? Plans include a proprietary space station projected to begin operations in 2022, a program to collect samples from a near-Earth asteroid by 2024, a Mars sample return mission in 2028, a probe to Jupiter in 2029, and the establishment of a manned lunar station within the next 10 to 15 years (Bankinter Innovation Foundation, 2020; Yeung & Jiang, 2021; The State Council Information Office of the People's Republic of China, 2022).

Characteristics of the Chinese space program

Although space infrastructure can have both military and civilian applications, the PRC's program exhibits a deliberate ambiguity. The China National Space Administration (CNSA) was founded on April 22, 1993, but the embryonic phase of China's space program dates to the Cold War era. The Korean War, during which the U.S. even considered using nuclear weapons to end the conflict, incentivized Mao Zedong's government to pursue the development of such weapons of mass destruction, a process that accelerated as relations with the USSR soured following Stalin's death in October 1952.

[5] Unlike the American GPS, the Chinese BDS has a constellation of 35 satellites —the GPS has 32— with a location accuracy of 10 centimeters compared to 30 centimeters for the U.S. GPS. It also enjoys greater bandwidth, as well as autonomy and security in accessing the network, as it does not depend on third parties for this (BBC News Mundo, 2020).

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The father of China's space program is Qian Xuesen, a scientist from a well-educated and politically influential Chinese family who, after completing his studies in the PRC, received a scholarship to enroll at the Massachusetts Institute of Technology (MIT) in Boston, where he excelled. Qian later became a researcher at the California Institute of Technology (Caltech) in Pasadena, working on classified U.S. government projects to develop Caltech's Jet Propulsion Laboratory (Fedorova & Novosyolova, 2022: 1-2). After the revolution that brought Mao Zedong to power in the PRC, the FBI monitored Qian to determine if he was spying on behalf of the Chinese communist regime. This was during the era of anti-communist hysteria and McCarthyism, with the Korean War further fueling racist and hostile reactions against the scientist. Consequently, in June 1950, Qian's security clearance was revoked, preventing him from continuing work on secret programs. Media at the time portrayed Qian as the "sinister genius" aiding the Chinese government in developing its missile program. Unable to work further, Qian announced his decision to return to the PRC, leading to his detention by U.S. authorities. Qian spent five years with restricted activities in the U.S. while Washington and Beijing engaged in intense negotiations for his deportation to the PRC, which took place in 1955 (Rodríguez, 2021; Cong, 2012).

Upon his return to the PRC, he was celebrated as a hero, and after joining the Chinese Communist Party (CCP), he worked on developing the country's space and missile programs, areas in which the PRC had limited prior knowledge. It is important to recall that the space technology used at that time was of Soviet origin, and Qian's arrival allowed the PRC to integrate U.S. technological advances into its missile and space exploration program (Cong, 2012). Notably, in 1960, when the political and ideological rift between Moscow and Beijing emerged, technological collaboration between the two nations ceased. Qian also promoted the training of new scientists and engineers in the PRC, and over time, the technological developments resulting from his work were even used against the nation that deported him. For example, during the First Gulf War, Chinese "Silkworm" missiles developed by Qian were used by Saddam Hussein against the U.S.-led multinational coalition (Puri, 2020; Chang, 1996; Greshko, 2019; Harvey, 2019).

The CNSA was established following the division of the Ministry of Aerospace Industry and the China Aerospace Science and Technology Corporation (CASC). The CNSA operates under the State Administration for Science, Technology, and Industry for National Defense (SASTIND), which, in turn, is directed by the Ministry of Industry and Information Technology. The CNSA oversees the country's space policy, while CASC serves as the operational body. CASC has undergone subsequent reforms and is comprised of companies focused on developing space products and technologies. The CNSA is responsible for deep-space exploration, manned missions, launching a manned space station, and advancements in technology, materials, robotics, and artificial intelligence. With an annual budget estimated at $11 billion —an increase of 37.5 % from the 2018 budget— it ranks as the second-highest funded space

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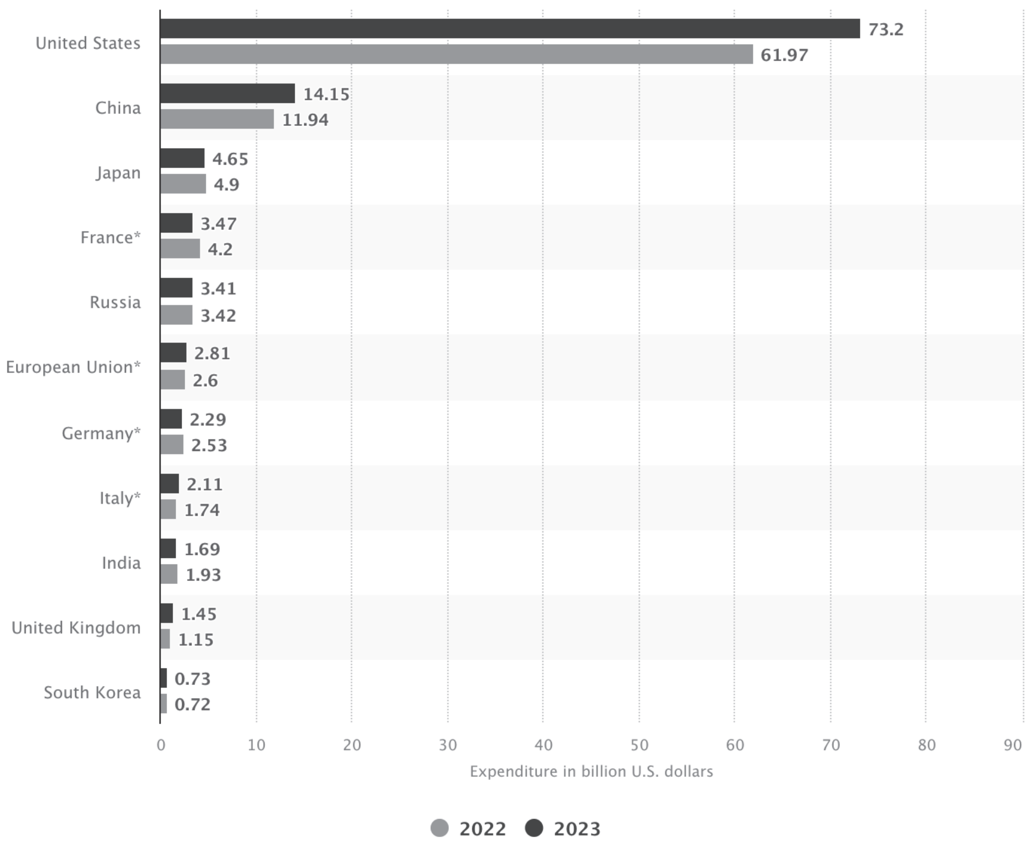
agency globally, behind the U.S. In 2021, NASA received $23.2 billion; the European Space Agency (ESA) $6.4 billion; the Russian Federation's Space Agency (ROSCOSMOS) $1.7 billion; the Japanese Aerospace Exploration Agency (JAXA) $1.7 billion; and the Indian Space Research Organization (ISRO) $1.9 billion (Solar Mems, 2021). It is important to note that CNSA's budget supports both civilian and military activities. Additionally, the PRC's space budget represents 69.35 % of Asia's total spending in this sector (Space in Africa, 2021: 18).

Figure 6
Government spending on space programs in 2022 and 2023 by leading countries in the sector (billions of dollars)



Data from Statista.

The PRC has been collaborating with various countries on space-related activities such as satellite launches, particularly in Africa and Europe. This, along with cooperation with Russia, has led more countries to seek closer ties with the Asian giant in space endeavors, as

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seen in Latin America with Argentina, Bolivia, Brazil, Venezuela, Chile, Ecuador, Peru, and Uruguay. Although Latin American countries were not part of the original design of the Belt and Road Initiative (BRI), Argentina's then-president, Alberto Fernández, announced his country's participation in the BRI during his visit to Beijing for the Winter Olympics (Urien, 2022). In Argentina, for instance, the PRC has operated a space station in Neuquén, Patagonia, since 2014 (Frenkel & Blinder, 2019).

Elsewhere, in 2018, the PRC and Cambodia signed an agreement to launch telecommunications satellites as part of the various agreements and projects under the BRI (Henry, 2018). The Asia-Pacific Space Cooperation Organization (APSCO), founded in 2005 and led by Beijing, includes members such as Bangladesh, Iran, Mongolia, Pakistan, Peru, Thailand, and Turkey, now functioning as an extension of the Belt and Road Initiative (Staiano, Bogado & Caubet, 2019). The PRC's commercial sector and startups, which are developing technologies for rocket reuse, present highly attractive advancements that are expected to solidify the country's position as a leader in global space activities and as a critical component of a "Space Silk Road" (Space in Africa, 2021: 20).

Governance of outer space in the 21st century

On May 13, 2013, the PRC launched a rocket into space from the Xichang Satellite Launch Center southwest of the country (Goswami, 2018). Chinese authorities stated that this launch aimed to research the space environment at different altitudes (Pollpeter, Ditter, Miller, and Waidelich, n.d.). However, U.S. authorities concluded that Beijing was testing an ASAT (anti-satellite) missile system launched from a mobile ballistic missile platform. According to Washington, the system appeared to be designed to position a kinetic-energy satellite killer on a trajectory toward deep space, capable of reaching medium, high, and geostationary altitudes, a significant development in the PRC's anti-satellite capabilities (Keck, 2014).

The PRC's development of ASATs has sparked similar actions from other countries (Major, 2018; Gallagher, 2015). In 2019, India, the "new kid on the space block" (Kumar, 2017), conducted its own ASAT test, Mission Shakti, which involved destroying one of its own satellites (BBC News Mundo, 2019). India's test was conducted at an altitude of approximately 285 km, also creating space debris (Raju, 2021b).

More recently, on November 15, 2021, Russia launched an ASAT missile to destroy its own inactive satellite, *Cosmos 1408*, a device weighing approximately 2,200 kg that was once part of the Soviet-era *Tselina D* electronic intelligence system. The satellite was struck in low Earth orbit at an altitude of 480 km (Raju, 2021b), generating much debris that threatens the sustainability of space activities and the infrastructure that countries and companies, including Russia, have in place. The test was harshly criticized by the U.S., NATO, Japan, and

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South Korea, as it is estimated to have endangered various space assets, including the ISS. Notably, neither the PRC nor India publicly commented on or criticized Moscow. Concern over the Russian test is heightened by the decision to physically destroy a satellite rather than merely deactivate it, suggesting that Moscow may have intended to reassert its space capabilities in response to similar displays by other actors, including its allies, the PRC, and India.

The fact that the U.S., Russia, India, and the PRC are conducting ASAT tests is worrisome not only due to the resulting space debris but also because it fuels the space arms race, especially as non-state actors now occupy leading roles in the exploration, exploitation, and commercialization of space activities with their own infrastructure, which further complicates space security challenges (Raju, 2020; Moltz, 2011a; David, 2021).[6]

In addition to using ASATs to destroy satellites, major space powers have also focused on developing high-powered lasers and directed-energy weapons to turn off satellites. In 2008, the United States used an SM-3 missile —originally developed for ballistic missile interception— employed by the U.S. Navy to destroy a weather satellite. A similar approach was used in Mission Shakti, where India deployed a missile from its *Prithvi Defense Vehicle* anti-ballistic system (George, 2019). This "repurposing" of anti-ballistic missile capabilities for satellite destruction keeps space powers vigilant as they work to enhance their defensive or offensive capabilities in outer space, undoubtedly posing a serious threat to space and international security.

Unfortunately, to date, no international treaty prohibits the deployment and/or use of weapons in space (Rosas & López Salas, 2019; Gestión, 2017). The 1967 treaty applies only to weapons of mass destruction, but as noted, it does not address the militarization of space. The last legally binding treaty in this area, the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, does explicitly prohibit in Article 3, paragraph 3, the placement of weapons in outer space. However, the problem with this treaty is that only 18 countries have ratified it, preventing its full implementation (Wright, 2019; Moltz & Marshall, 2009).

In 2008, the European Union proposed a voluntary code of conduct for regulating space activities, which in 2014 was renamed the International Code of Conduct for Outer Space Activities (Moltz, 2014). Initially, developing countries claimed they felt excluded from the proposed provisions, which seemed to be designed mainly for European countries. The U.S., for its part, stated that it would not sign the code, deeming it "too restrictive" (Raju, 2021a: 9-10). Also, in 2008, the PRC and Russia proposed a draft treaty to the United Nations Conference on Disarmament aimed at preventing the deployment of weapons in outer space and the threat or use of force against objects in space. On June 10, 2014, the two countries presented an updated ver-

[6] Elon Musk's company, SpaceX, plans to launch a megaconstellation of some 12 000 Starlink satellites into orbit over the next few years. With similar plans from companies such as Amazon and OneWeb, the sustainability of space activities is at risk, since the possibilities of collision, interference in the signals of various devices and saturation of the radio spectrum of countries are very high (Raju, 2020b).

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sion of this initiative. If realized, the Sino-Russian proposal would be legally binding, a prospect that currently holds little appeal for major space actors, such as the U.S. and the private sector.

The Sino-Russian proposal has been criticized by some legal experts who argue that it lacks language to prevent the development, testing, or deployment of Earth-based ASAT weapons. Others believe the proposed treaty outlines crucial aspects, such as the legal protection of nuclear-powered satellites and systems in outer space. The U.S. contends that the text is insufficient to address existing challenges and that Beijing and Moscow are seeking to gain strategic advantages (Raju, 2021a).

In 2018, the United Nations Institute for Disarmament Research (UNIDIR) published guidelines for those conducting ASAT tests. The proposal suggests that any actor conducting an ASAT test should avoid generating space debris. If debris is generated, the test should be conducted at a low altitude to minimize potential harm. It also proposes that a country planning an ASAT test should notify others to prevent misunderstandings (UNIDIR, 2018: 11-12; Deudney, 2020). The problem with this proposal is that it indirectly encourages countries to continue ASAT testing.

The U.S. has favored voluntary agreements and norms that promote responsible conduct in outer space, which, according to American officials, could be more easily adapted to future technological changes (McCall, 2021). Consequently, it seems unlikely to support legally binding proposals (Office of the Secretary of Defense, 2021). Commercial considerations and pressures from the private sector cannot be ignored: both Luxembourg and the U.S. have laws allowing the private sector to profit directly from activities conducted in outer space, such as space mining, which violates the provisions of the 1967 treaty. The fine line between a militarized space —where space powers conduct intelligence activities— and an armed space, where weapons are deployed and used, is becoming increasingly blurred (Hernández, 2021: 11).

Final considerations

To date, only the United States (U.S.), Russia, and the People's Republic of China (PRC) have conducted anti-satellite (ASAT) attacks, and these have been few. This does not imply that the issue is minor, as other risks concerning space security also deserve attention. For instance, through denial-of-service attacks, cyber warfare can render satellites inoperable. Additionally, the possibility of a celestial body colliding with Earth is another concern that should encourage greater cooperation among space powers, considering that asteroids have impacted the planet in the past. Approximately 65 million years ago, the asteroid that struck Chicxulub led to the extinction of much of life on Earth, including the dinosaurs. Currently, the Double Asteroid Redirection Test (DART), developed by NASA and the Johns Hopkins University Applied Physics Laboratory, with the support of European and Japa-

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nese space agencies and the Italian Space Agency (ISA), aims to "push" the moon of a double asteroid, *Didymos*, to modify its trajectory. The DART spacecraft was launched on November 24, 2021, and is expected to collide with its target between September 26 and October 2, 2022 (BBC News, 2021b). This experiment is crucial for initiatives regarding planetary security and defense.

The sustainability of space activities must also consider accidents. The *Changzheng 5B* (Long March) rocket, which the PRC placed into orbit in April 2021 with a future Chinese space station component, was supposed to return to Earth. However, its uncontrolled reentry raised concerns in the U.S. and Europe due to the object's size, which, according to Chinese authorities, partially disintegrated in the atmosphere while another part fell into the Indian Ocean (BBC News Mundo, 2021a). As early as 2018, the world had also witnessed with alarm the uncontrolled reentry of the RPC's first space laboratory, *Tiangong-1* ("Celestial Palace") (Clarín, 2018).

In December 2019, then-President Donald Trump announced the creation of the Space Force, a new command that adds to the air, maritime, land, and cyberspace commands to safeguard U.S. national security. In March of the same year, Trump announced that the U.S. would return to the Moon within the next five years and send a new astronaut (RTVE, 2019). The renewed interest of the U.S. in space activities is explained by the events that have taken place during the second space race, where there are many players, each with their own needs and appetites.

Countries recognize the significant dependence that their daily activities have on space systems. While there is a consensus on the need to establish effective governance in this area, deep disagreements persist regarding how to achieve it. Developing countries argue that the topic is monopolized by the permanent members of the United Nations Security Council, and they are not without reason. They also lament the slow pace at which other relevant forums within the international organization, such as the Conference on Disarmament or the Committee on the Peaceful Uses of Outer Space (PAROS), address the issue. Therefore, it seems that the roadmap should begin with a moratorium on ASAT tests that is adhered to by the four countries capable of conducting them. However, space security does not end there.

The concept of *space security* has undergone significant transformation since the end of the Cold War. Focused on militarization and the threat posed by weapon systems to the world —especially weapons of mass destruction— it has ceded since the late 20th century and throughout the current one to growing environmental concerns, which in outer space have centered on space debris. However, a broad perspective on space security is needed, one that adequately addresses not only ASAT tests and the generation of debris but also solar storms, large celestial bodies that could collide with Earth, potential extraterrestrial life that might disrupt terrestrial life, as well as aspects such as cyber warfare, pollutant emissions responsible for greenhouse effects, and the increasingly uncontrolled ambitions of billionaires who view space activities as sources of profit. Space activities are intended to

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serve nations' security and prosperity, not endanger them. The PRC's role in this framework will undoubtedly be decisive in the years to come.

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doi: http://dx.doi.org/10.22201/fcpys.2448492xe.2025.253.81553

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