



THE SECURITY IMPACT OF THE MILITARIZATION OF OUTER SPACE

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The competition for the military conquest of outer space dominated the public agenda during the Cold War. It was the spatial side of the geopolitical competition between the capitalist West and the communist East. It started with the researches for the development of strategic armaments and it ended with the military space programs launched by the great powers of the post-war era, which transformed the outer space into a real theater of operations. A theater currently relieved, by the Cosmic Space Treaty, of weapons of mass destruction. However, the unregulated military action in outer space, and especially the problems of defining the boundary between outer space and atmospheric space, can become explosive at any time. This article aims to present the main space powers, the space military programs they run and the potential security impact of the militarization of outer space.

Keywords: space militarization; Star Wars Program; reconnaissance satellites; Russian orbital service station; Artemis Accords; Outer Space Treaty.

Motto: "A new space race has begun [...]. This race is not [about] political prestige or military power. This new race involves the whole human species in a contest against time".

*Ben Bova (1932-2020),
science-fiction american writer*

During the 65 years from the launch of *Sputnik 1*, the first artificial satellite of Earth, mankind has transformed space into a theater of military operations, in which space forces operate, in which military exercises take place, and in which technological advancement is more visible than anywhere else. How widespread is the militarization of outer space? What are the main space military powers and what military programs have they developed? And, most importantly, what could be the security impact of the militarization of outer space?

"Star Wars Program"

In October 1949, US President Harry S. Truman (1884-1972) established the *Joint Long Range Proving Grounds* at Cape Canaveral, Florida, a range for testing intermediate and intercontinental ballistic missiles. Two years later, in 1951, in its immediate vicinity, the Air Force transformed *Banana River Naval Air Station* into

the headquarters of the Air Force Missile Test Center. In 1964, the two facilities were renamed the *Air Force Eastern Test Range*, which in 1977 became the *Detachment 1, Space and Missile Test Center*, and in 1979 the Detachment 1, Space and Missile Test Center was renamed *Eastern Space and Missile Center* (NASA 1972).

In the mid-1950's, rocket technology in the United States reached the stage where Earth satellites could be launched. The opportunity arose in July 1955, when President Dwight D. Eisenhower (1890-1969) announced that the United States would put a satellite into orbit as part of the American contribution to *The International Geophysical Year* (IGY) 1957-1958. The American *Explorer-1* satellite was successfully launched on February 1, 1958, three months after the Soviets placed Earth's first low-orbit artificial satellite, *Sputnik-1*, on October 4, 1957.

The success of placing artificial satellites on Earth low-orbit led to the creation, on July 29, 1958, of the *National Aeronautics and Space Administration* (NASA), through the *Space Act* adopted by the United States Congress. And, on December 13, 1958, it led to the establishment of

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the *United Nations Office for Outer Space Affairs* (UNOOSA n.d.), the first international body dedicated to peaceful international cooperation in outer space.

NASA took over the laboratories of the *National Advisory Committee for Aeronautics*, including the *Wallops Station* in Virginia and four research centers: *Langley Memorial Aeronautical Laboratory* (renamed *Langley Research Center*), Hampton, Virginia; *Lewis Flight Propulsion Laboratory* (renamed *Lewis Research Center*), Cleveland, Ohio; *Ames Aeronautical Laboratory* (renamed the *Ames Research Center*), Moffett Field, California; and the *High Speed Flight Station* (later the *Dryden Flight Research Facility*), Edwards, California. Later, in 1959, the *Beltsville Space Center* (renamed *Goddard Space Flight Center*) was established in Greenbelt, Maryland, and the Vanguard operations group in Cape Canaveral, renamed the *Goddard Space Flight Center's Field Projects Branch* officially became NASA's first launch team, responsible for launching most pioneering satellite programs, including lunar and planetary probes, and the world's first meteorological and communications satellites (NASA 1972).

In December 1959, the *George C. Marshall Space Flight Center* was established in Huntsville, Alabama, with the mission of launching heavy spacecraft, subordinated to *Marshall's Launch Operations Directorate* from Cape Canaveral – the organization that would create the *John F. Kennedy Space Center* three and a half years later. In December 1964, the launching elements of the *Houston Crew Space Crew Center* (now the *Johnson Space Center*) were transferred to the *Kennedy Space Center* (NASA 1972). In May 1961, astronaut Alan Shepard (1923-1998) became the first American to make a suborbital flight, and at the same time, President John F. Kennedy (1917-1963) announced the launch of the *Apollo Space Program*, through which the United States would transport people to the Moon and back. On December 24-25, 1968, the *Apollo 8* manned mission made its first lunar orbit flight, and on July 20, 1969, the *Apollo 11* manned mission made its first landing on the moon, opening a new stage in human history.

On the other hand, in the late 1950s, during the administration of President Dwight D. Eisenhower,

the American scientific circles launched the *Ballistic Missile Boost Intercepts Project* (BAMBI). It was to deploy satellites in Earth orbit to carry interceptor missiles capable of attacking Soviet intercontinental ballistic missiles (ICBMs) shortly after their launch. This interception in the boost phase of multiple independently targetable reentry vehicles (MIRVs), usually with multiple thermonuclear warheads, could have successfully neutralized all warheads. But, the project was abandoned due to the enormous costs involved (Broad 1986).

A decade later, however, the project was revitalized as *High Frontier*. This time, it aimed to create a multi-layered surface-to-air missile shield, which could track, intercept, and destroy enemy ballistic missiles. These issues were included in the report entitled *High Frontier: A New National Strategy*, published in 1982 by Daniel O. Graham, former head of the US Defence Intelligence Agency. As stated on the website of this project, "the foundation of High Frontier concepts was the abandonment of the suicidal and immoral strategy of Mutual Assured Destruction (MAD) for the concept of Assured Survival through the creation of effective defences against ballistic missiles" (High Frontier n.d.).

On the other hand, in 1972, the two hegemonic powers of the Cold War signed *The Anti-Ballistic Missile Treaty* (ABM or ABMT), which remained into force from 1972 to 2002. Under the terms of the treaty, each party was limited to two ABM complexes, consisting of 100 anti-ballistic missiles. This was followed by the signing in 1972 and 1979 of the *Strategic Arms Limitation Talks* (SALT) I and II and then, in 1991, of the *Strategic Arms Limitation Treaty* START 1. All these documents prohibit the placing of nuclear weapons or any other type of weapons of mass destruction in Earth orbit, including split orbital missiles.

Around the same time, in the late 1970s, another group of researchers, led by physicist Edward Teller (1908-2003) – "the father of the hydrogen bomb", proposed the *Excalibur Project* – which aimed to develop a space-based laser (SBL) able to shoot down dozens of missiles in one fell swoop (DARPA n.d.).

Briefed about the new defence projects, on March 23, 1983, US President Ronald Reagan (1911-2004) announced the launch of a military program called the *Strategic Defence Initiative* (SDI).



The project was intended to ensure the defence of US territory through a shield against strategic ballistic nuclear weapons (intercontinental ballistic missiles and ballistic missiles launched from the submarine), which could have been launched by an enemy state. The missile defence system, which included the installation of space launcher batteries equipped with radars and lasers in outer space, was nicknamed the *Star Wars Program* (SDIO 1984). In 1984, the *Organization of the Strategic Defence Initiative* was established, with the mission of coordinating the research program. And in 1985, within the United States Armed Forces, the *United States Space Command* (USSPACECOM) was created.

In the meantime, many of the research directions targeted by the program failed. The Excalibur Project proved to be unviable, being limited to anti-satellite defence, and the High Frontier, renamed the *Strategic Defence System* (SDS), *Phase I Architecture*, did not gain much confidence. In the late 1980s, researchers at *Lawrence Livermore National Laboratory* introduced the concept of *Brilliant Pebbles*, a swarm of space sensors, which became the basic model for SDS Phase 1.

But the year 1991 radically changed the paradigm. The dismemberment of the USSR made the Brilliant Pebbles concept, designed to counteract widespread nuclear attacks, useless. It was replaced by *Global Protection Against Limited Strikes* (GPALS) – a combined system of mobile ground missiles, numerous low-orbit satellites – *Brilliant Eyes* and the *Pebbles System*. Later, the Brilliant Eyes Satellite System was renamed the *Space and Missile Tracking System* (SMTS), and in the late 1990s it became a low-orbit component of the *Air Force's Space Based Infrared System* (Global Security.org n.d.).

Amid East-West relaxation in 1993, the Bill Clinton administration shut down SDIO and established *The Ballistic Missile Defence Organization* (BMDO), later renamed the *George W. Bush Missile Defence Agency*. On November 20, 1998, *The International Space Station*, the largest space object, was launched into orbit. It was the result of the collaboration of five major space agencies in the United States, the Russian Federation, Japan, Canada and Europe (Howell 2021). Also in 2017, NASA launched the *Artemis Program*, an international program that, by 2025,

aims to resume human transport to the Moon, on the lunar South Pole, and then to Mars (NASA n.d.).

In the following years, the *Star Wars / High Frontier Program* – heavily criticized by some (Edward M. 1986), strongly supported by others (Lardner 1992) – though it was not officially mentioned in US documents, continued to develop, in one form or another, without being, however, fully materialized¹. Theater missile systems such as Patriot and THAAD, Alaska and California ground ICBM interceptors, Iron Dome, Aegis system, Global Positioning System (GPS) satellite navigation are the results of this program (High Frontier n.d.).

In 2018, US President Donald Trump announced the establishment of the US Space Force, publicly stating that "space is the world's newest war-fighting domain" (Kennedy 2019). In 2019, Pentagon officials requested funding for researches into space lasers, particle beams and other new forms of missile defence, so that in 2023 they will be able to test the first such weapons systems in space (Tucker 2019). The first meeting of the National Space Council (NSC) took place on December 1, 2021. On this occasion, Vice President Kamala Harris stressed that "space planners should look down at their home planet as well as out into the cosmos" (Wall 2021). A sign that the US space program has not been interrupted, on the contrary, it has entered into the next stage, of the state policy and the Grand Strategy.

Russian military space program

Unlike the Americans, who developed the space program as a result of the collaboration between the US Army and civilian institutions such as NASA, the Russians devoted this area exclusively to the

¹ Over time, Star Wars Program has been structured into the following researches categories: 1. *Ground Programs*: Extended Range Interceptor (ERINT); Homing Overlay Experiment (HOE); Exoatmospheric Reentry-vehicle Interceptor Subsystem and High Endoatmospheric Defence Interceptor, Ground-Based Interceptor; 2. *Directed Weapons Systems Development Programs (DEW)*: X-ray lasers powered by nuclear explosions; Deuterium fluoride chemical lasers; Neutral particle beam accelerators; Relay mirrors placed in space to direct laser beams; 3. *Space programs*: Space interceptors; Brilliant pebbles; 4. *Sensor development programs*: Boost Surveillance and Tracking System (BSTS); Space Surveillance and Tracking System (SSTS); Brilliant Eyes. See: About High Frontier – Past, Present, Future, op.cit.



military factor.

Between 1947 and 1956, a ballistic and meteorological missile launch pad was built at *Kapustin Yar* in the Astrakhan region (SOROKINA 2021). On February 12, 1955, the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the Soviet Union issued a joint executive order, codenamed *The Tayga Installation*, to establish the domain of scientific research into outer space (Tayga 1957).

On June 2, 1955, the space military base near the town of Tyuratam, in the Kyzylorda region of the Kazakh Soviet Socialist Republic, now the Republic of Kazakhstan, was established. Subordinate to the Soviet Strategic Missile Forces, the 6700 km² polygon, the world's first and largest spaceport, is also known as the Baikonur Cosmodrome (Sorokina 2021). In 1957, the *Plesetsk Cosmodrome* was built in the Arkhangelsk region. It was intended for launching smaller spacecraft (such as meteorological satellites) as well as for testing missile complexes (Sorokina 2021).

On October 4, 1957, the Soviet Union successfully launched *Sputnik 1*, the first artificial satellite in a low-elliptical orbit of the Earth. In 1959, the Soviets launched the space program *Luna*, which aimed at the production and placement of satellites and lunar robots for scientific purposes. On January 2, 1959, *Luna 1* was launched, the first man-made object to reach heliocentric orbit (NASA 1959). On September 12, 1959, *Luna 2* landed on the Moon, and less than a month later, *Luna 3* took its first photos of the dark side of the Moon.

Then, in August 1960, the Soviets recovered a spacecraft that carried animals in Earth orbit, and in February 1961 launched a space probe that measured the atmosphere of Venus. On April 12, 1961, Russian cosmonaut Yuri Gagarin (1934-1968) became the first person to travel in space. In the 1960s, the Soviets launched another two other manned space programs. The first one aimed at launching, with a Proton-K missile, a monthly *Soyuz 7K-L1* (Zond) flight mission. The second one aimed at launching, with the *NI missile*, Moon-landing manned-missions using *Soyuz 7K-LOK* and *LK spacecrafts*. Both programs were unsuccessful (Zak 2020). And on April 19, 1971, the Soviets launched into low Earth orbit *Salyut 1* (DOS-1), the world's first space station. Other seven stations were launched as part of the program. The final

module of the program, *Zvezda* (DOS-8), became the core of the Russian segment of the International Space Station and remained into the Earth orbit until 2001 (Tillman 2012). *Mir* was the first modular spacecraft with a larger mass than any previous spacecraft (NASA 2001).

On July 13, 1962, the Soviets made the first launch of an *R-16U ICBM* from an underground shaft (Astronautix 2005). The same ICBMs that were the subject of the *Cuban Missile Crisis* in the fall of the same year, 1962. Also, in the 1960s, they developed the first research in the field of laser weapons and the *R-36ORB Fractional Orbital Bombardment System* (FOBS) (NextSpacelight 1966), banned in 1979 by the SALT II Agreement. In 1962, the Soviets began construction of the *A-35 anti-ballistic missile system*, equipped with A350 exo-atmospheric interceptor missiles with a thermonuclear warhead, a system covered in 1972 by the ABM Treaty (Astronautix 2005). In 1970, the Soviets created a high-powered space laser system (GadsdenTimes 1984), which was combined with an orbiting *Kaskad anti-satellite missile platform* (Teitel 2013), and deployed *R-23M Kartech cannons* on the Salyut 3 space station, as part of the *Almaz – Diamond space project* (Zak 2015). In the 1980s, they were developing the *Polyus – Skif orbital weapon system project* (Teitel 2013), designed to provide defence against anti-satellite weapons. And in 1982, the independent Soviet Space Forces were established within the Ministry of Defence.

The geopolitical collapse of the 1990s, subsequent to the break-up of the Soviet Empire, brought the temporary decline of Russian space programs. The Russian Space Forces were created on August 10, 1992, with the establishment of the Armed Forces of the Russian Federation (Politika 1990). After several reconfigurations, on August 1, 2015, the Russian Federation Aerospace Forces were founded, with independent status (AerospaceForce 2006) comprising the cosmodromes of Baikonur, Plesetsk, Yasni (Orenburg area, Urals), Svobodny (closed), Kapustin Yar training ground (Sorokina 2021), Yuri Gagarin cosmonaut training center in the Moscow region, etc.

On February 25, 1992, the *Russian Space Agency* was established. In 2004 it was transformed into the *Federal Space Agency* (Roscosmos), which in 2015 became the *Roscosmos State Corporation*



by merging with the *United Rockets and Space Corporation* (Pandey 2015). Roscosmos is based in Moscow, but its *Main Mission Control Center* is located in Korolyov. Roscosmos works closely with the *Russian Federation Air Force Command*, including the control of the Baikonur, Plesetsk and Yuri Gagarin Center cosmodromes. It is currently developing space science research programs targeting the Moon, Mars and Venus.

Russia has been part of the *Soyuz Project* since 2003, in collaboration with the European Space Agency. "Spacecraft are launched at the Kourou/Sinnamary cosmodrome in French Guiana. The first launch of the 'Soyuz-ST-B' launch vehicle was carried out in 2011: two of Europe's 'Galileo' satellites were taken into orbit. A total of 20 launches have taken place in the meantime, resulting in some 60 satellites in orbit" (Sorokina 2021). Also worth mentioning is the *Morskoy Start Project* – the only floating cosmodrome in the world, built in the 1990s by the California-based Sea Launch Company, whose shares were split among Russian Federation, Ukraine, the United States and Norway. Currently, the company belongs to the Russian group S7 (which also operates one of the main airlines in the Russian Federation). The first launch took place in 1999 on a mobile platform in the Pacific, near the Equator. The *Zenit-3SL launch vehicle* and a former offshore oil rig were used. A total of 30 spacecraft launches and various cargoes were successfully carried out (Sorokina 2021).

In March 2021, Roscosmos signed a memorandum of understanding with the China National Space Administration (CNSA) for the construction of a permanent base on the Moon. The International Lunar Research Station (ILRS) is described as a future base of comprehensive scientific experiments, which will be built on the surface of the Moon or in the orbit of the Moon and will conduct multidisciplinary scientific research activities, including exploration, use and observation of the Moon, technical checks and long-term autonomous operation (Jones 2021). One month later, in April 2021, Roscosmos announced that it would leave the *ISS International Space Station program* after 2024, and would build a new *Russian Orbital Service Station* in 2025 (Reuters 2021).

Chinese military space program

The Chinese space program began with the

development of ballistic missile systems, which later became the starting point for launchers. In the mid-1950s, the Chinese ballistic missile industry developed with the help of Soviet engineers, with the two states sharing the same Marxist ideology. Moreover, the two Eastern bloc partners believed that the newly launched space race between the two systems, Western and Soviet, was the perfect opportunity to demonstrate to the whole world the superiority of Communism over Capitalism.

In 1956, the leadership of the Chinese Communist Party (CCP) adopted the "*Two Weapons and a Satellite*" *Development Plan for Science and Technology*, established for the period 1956-1967. Communist leader Mao Zedong (1893-1976) announced that the Chinese Academy of Sciences had launched *Research Project 581*, aiming to place a satellite in orbit by 1959, to celebrate the 10th anniversary of the People's Republic of China (PRC) (Astronautix 1958).

The project was not successful, but it was followed by two other satellite space programs: *Dong Fang Hong* and *Fanhui Shi Weixing*. In June 1965, the Central Committee of the Communist Party of China decided to develop a launch vehicle, the *Long March 1 missile*. On April 24, 1970, China successfully launched its first satellite, *Dong Fang Hong I (Mao-1)*, the heaviest satellite placed by a nation in the low orbit of the Earth (Matignon 2019), part of a space program with similar name. The program also initiated the construction of the *Jiuquan Satellite Launch Center (JSLC)* in the Gobi Desert of Inner Mongolia – the first of China's four space ports, and the construction of the *Dongfeng Aerospace City* (Matignon 2019).

At the same time, in 1966, the Beijing authorities launched the *Fanhui Shi Weixing Satellite Program*, through which, by 2006, 25 recoverable reconnaissance satellites had been built and used for military and civilian missions. The first satellite was launched on November 26, 1975, and returned safely to Earth on November 29, 1975, making China the third country to recover a satellite after the space mission, after the United States and the USSR (FSW, astronautix). There were four models of *Fanhui Shi Weixing (FSW)* satellites, all launched into *Long March rocket orbit* (Astronautix).

Also on July 14, 1967, the party leadership announced the launch of China's Manned Space



Program (Internet Archive 2005) "Codename Mission 714", the project aimed to build the *Shuguang-1 spacecraft* and selected the first astronauts. On April 1, 1968, the *Chinese Institute of Space Medicine* was established, and in 1968, construction began on a space center called *Base 27* in the Xichang Mountain Region of Sichuan Province.

The first *Yuanwang-class spacecraft* for tracking and supporting intercontinental ballistic missiles and satellites was launched in 1979 (followed by five more models) (Internet Archive 2007) and the first full-range ICBM DF-5 test was conducted on May 18, 1980. In 1986, Chinese leaders approved the *National High-Tech Research and Development Program*, also known as the *863 Program*, which was implemented over three successive five-year plans (Ministry of Foreign Affairs of the People's Republic of China 2010). The program initially focused on the development of seven priority strategic areas: laser technology, space, biotechnology, information technology, automation and manufacturing technology, energy and advanced materials (Raska 2013). China has now expanded these areas in size, scope and importance to cutting-edge technology products and processes. This program resulted in the *Loongson* family of *computer processors* (Designing Quad-Core Loongson-3 Processor 2009), *Tianhe supercomputers* (Raska 2013) and the *Shenzhou spacecraft* (Shenzhou 2017).

On July 5, 1988, the *Ministry of Aerospace Industry* was established. In June 1993, the *China Aerospace Corporation* was founded, in 1999 it became the *China Aerospace Science and Technology Corporation*, and on April 22, 1993, the *China National Space Administration (CNSA)* was established.

In November 1999, on the occasion of the 50th anniversary of the PRC, China launched the *Shenzhou 1 spacecraft*, which was recovered after a 21-hour flight. It was China's first unmanned spaceflight test (Shenzhou 2005). It was followed by ten other successfully launched models. Since *Shengzhou 5*, launched in 2003, flights have included human crews, with China becoming the third country capable of conducting independent human spaceflight (Space.com 2005). On September 29, 2011, China launched *Tiangong-1*, the first prototype of the Chinese space station (Wall 2018), replaced in 2016 by *Tiangong-2*. On

April 29, 2021, *Tianhe*, the 22-tonne central module of the *Tiangong space station*, was successfully launched into the low orbit of Earth, indicating the Chinese intention to build a permanent national space station (Jones 2021).

On October 31, 2000, China launched the first *BeiDou-1 regional satellite navigation system* (BeiDou-1) in which China began building its own compass satellite navigation system as an alternative to GPS. On June 23, 2020, the last *BeiDou satellite* was launched, and on July 31, 2020, Chinese leader Xi Jinping officially announced the launch of *China's BeiDou Navigation Satellite System (BDS-3)* (China.org.cn. 2020).

In 2004, Beijing officials approved the *Moon Exploration Program*. This led to the production of the *Chang'e Moon orbiters*, launched on May 1, 2009 (Dooling n.d.). Currently, the number of such missions has increased to five. According to planning by Chinese officials, *Chang'e 6* will be launched in 2024, and will land in the South Pole-Aitken Basin near the lunar South Pole (Jones 2021). *Chang'e 7* will also be launched in 2024, and will perform an in-depth exploration of the lunar South Pole to search for mineral resources (Jones 2021). And *Chang'e 8* will be launched in 2027 and will help establish a *Permanent International Moon Research Station (ILRS)*, in collaboration with Russia and other potential partners (Jones 2021). The ILRS plan includes the development of a robotic base that can be further expanded in the 2030s to allow astronauts to make long-term stays on the lunar surface. Since 2019, China has been operating the *Chang'e 4 landing gear* and the *Yutu 2 rover* on the dark side of the Moon (Jones 2021).

In January 2007, China successfully conducted an anti-satellite rocket test, and in 2011, China made its first attempt to send a *Yinghuo-1 class orbiter* to Mars on a joint mission with Russia. Despite the failure, the Chinese persevered in the Mars exploration project, so on July 23, 2020, China successfully launched *Tianwen-1* to Mars. On May 14, 2021, China became the third state to establish communication on the Martian surface, after the Soviet Union and the United States (Planetary Society n.d.). And on January 30, 2022, *Xihe-1*, China's first solar exploration satellite, photographed the H-alpha solar spectral line from orbit (DIGI24 2022)

In December 2015, the *Strategic Support Force*



of the Chinese People's Liberation Army (PLA) was established. It represents the fifth category of Chinese Army forces, with space, cyber, psychological, electronic and strategic intelligence warfare missions (Ni and Gill 2019).

It should also be noted that in 2006, China adopted the *National Medium and Long-Term Plan for Science and Technology Development* (MLP), considered to be its most ambitious national science and technology plan, with a total funding of \$ 75 billion. MLP targets 16 national megaprojects in areas such as electronics, semiconductors, telecommunications, aerospace, pharmaceuticals, clean energy and oil and gas exploration. Among the projects developed by MLP are:

- *The Shenguang Laser Project*, which explores inertial fusion (ICF) as an alternative approach to obtaining inertial fusion energy (IFE) - a controllable and sustained nuclear fusion reaction, aided by a series of high-power lasers;

- *BeiDou satellite navigation system - 2*;

- *The technological design of hypersonic vehicles* capable of maneuvering at Mach 5 speeds (6,150+ km/h) and flying at altitudes close to space (Raska 2013).

French military space program

The French space program is the third oldest national space program in the world and the largest in Europe. It made its debut in 1946, when the *Ballistics and Aerodynamics Research Laboratory* was established, followed in 1959 by the *Space Studies Committee* and in 1961 by the *National Center for Space Studies* (CNES).

On November 26, 1965, France successfully launched *Asterix 1*, its first satellite, using the *Diamant A in-house missile* (the first French exclusive launch system and at the same time the first satellite launcher) (Astronautix n.d.). The launch was made from the *Hammaguir base* in Algeria (Varnoteaux 2017). Subsequently, the launches were made with *Ariane rockets*, currently used by the member countries of the European Space Agency (The European Space Agency n.d.).

In 1964, construction began on the *Kourou Space Center* in French Guiana. As stated on the Aerospace Technology website: "situated close to the Equator, at 5.3° North latitude, the Spaceport is well situated for missions into geostationary orbit. Launching near the equator reduces the energy required for orbit plane change maneuvers.

This saves fuel, enabling an increased operational lifetime for Ariane's satellite payloads, and, in turn, an improved return on investment for the spacecraft operators. The French Guiana coastline's shape allows for launches into all useful orbits from northward launches to -10.5° through eastward missions to -93.5°" (Aerospace Technology n.d.).

In 1973, France participated in the creation of the *European Space Agency* (ESA) and became its first and main contributor, with 24.5% of the budget of 4.810 billion Euros in 2022 (The European Space Agency n.d.). The Agency's programs are, to date, exclusively civil.

In July 2019, France created the Space Command, which brings together the air and space forces, and in March 2021, it began the first military exercises in space, codenamed AsterX, aiming to test its ability to defend its satellites. According to France 24, "the French government accuses Russia of bringing its Olymp-K intelligence gathering satellite, also known as Louch, near the Franco-Italian military satellite Athena-Fidus in 2017, in what the Minister of Defence, Florence Parly called «an act of espionage»" (France 24 2021).

On 16 November 2021, France launched its first operational constellation of information satellites (SIGINT), communications satellites (COMINT) and electronic intelligence satellites (ELINT), known as CERES (Capacité de Renseignement Électromagnétique Spatiale). This constellation is in addition to the *Syracuse* communications satellites. The *CERES program* is a successor to the previous *ESSAIM COMINT* and *ELISA ELINT micro-satellite programs*. The *ESSAIM Project* explored the use of several micro-satellites arranged in formation, the constellation being launched in 2004. The flight of intelligence satellites arranged in formation, at a certain distance from each other, allows a user to triangulate on a transmitter, regardless of voice or radio frequency. The *ELISA* demonstrator, who followed the *ESSAIM* project in 2011, explored the same approach for the role of *ELINT* (Le Breton 2021).

Israeli space program

Institutionally, the Israeli space program began in 1960, when the National Committee for Space Research was established, which after 1983 was transformed into the Israel Space Agency (ISA).

The country's spaceport is located at the



Palmachim military base on the Mediterranean coast. Palmachim serves as the main test site for *Jericho II* ballistic missiles and *Arrow* missile defence systems (NTI n.d.).

Israel is one of the seven global space powers with autonomy in the production of satellites and launch vectors. Israel's space autonomy is ensured by *Shavit*, the indigenous launch vehicle capable of sending payload into low Earth orbit (*Logsdon*), and by the *space program*, which focuses on the production and launch of telescopes and satellites in the following categories:

- *Ofeq* series of reconnaissance satellites (Astronautix n.d.);
- *Amos* series of communication satellites (IAI n.d.);
- the constellation of high-resolution surveillance satellites, class *EROS* (Earth Remote Observation System) (eoPortal n.d.), with applications in the field of information and national security;
- *TechSAR* space mini-radar satellites (eoPortal n.d.) for military use;
- *Techsat/Gurwin* series micro-research satellites (GlobalSecurity.org);
- *ULTRASAT* (Ultraviolet Transient Astronomy Satellite), micro-satellite for detecting and monitoring transient astronomical events in the near ultraviolet spectral region (Spacewatch.global n.d.);
- *VEN μ S* class micro-satellites for Earth observation (eoPortal n.d.);
- Multifunctional high resolution optical observation *OPSAT* (OPERational SATellite Uplink), used by *Fourth Echelon* agents. It was originally a device used by *Third Echelon Splinter Cell* agents, but following the disbandment of *Third Echelon* in 2011, the *OPSAT* system is now used by *Fourth Echelon* as standard equipment (Splinter Cell n.d.);
- *SHALOM* type hyperspectral satellites (Spaceborne Hyperspectral Applicative Land and Ocean Mission), developed in collaboration with the Italian Space Agency, which will integrate radar observations with visible infrared and ultraviolet observations (*SHALOM* – satellite);
- *SAMSON* (Space Autonomous Mission of Swarming & Geolocating Nano-Satellites) nano-satellites for geo-location.

These major research directions were added the *Matroshka/Phantom AstroRad radiation experiment*, a space testing of the mobile high-radiation radiation shielding vest, developed in collaboration with NASA, the German Space

Agency, Lockheed Martin Corp. (NASA 2020), as well as the *Israel Network for Lunar Science and Exploration Program* (INLSE), which focuses on laser communications, robotics, remote sensing and other technologies for lunar missions, through which Israel became a member of the *NASA Center for Moon Research* (Howell and SERVI).

Indian space program

Institutionally, the Indian space program began with the establishment, in 1962, of the Indian National Space Research Committee (INCOSPAR) within the Department of Atomic Energy. In 1969, it was replaced by the Indian Space Research Organization (ISRO). Then, in 1972, it was subordinated to the Department of Space and the Space Commission of the Indian Govern (Space Programs of India).

From the very beginning, the Indian space program sought to ensure space autonomy by creating launch vehicles and technology products to be launched into space, especially satellites for communications and remote sensing.

The country's main spaceport was established in Thumba, near Thiruvananthapuram, a location beyond the Earth's geomagnetic Equator. The *Thumba Equatorial Missile Launch Station* (TERLS) was built there. The first homemade rocket, *RH-75*, was launched on November 20, 1967. The first Indian satellite, *Aryabhata*, was launched on April 19, 1975, with Soviet support. On July 18, 1980, India launched the *Rohini* satellite into orbit using an indigenous launch vehicle, the *Satellite Launch Vehicle-3* (SLV-3), joining the "club" of the seven space launch powers (Vikaspedia n.d.).

Since then, research programs have focused on developing:

- *Indian National Satellite System* (INSAT) for telecommunications, television transmissions and meteorological services, launched on April 10, 1982 (eoPortal n.d.);
- *Satellite Remote Sensing System* (IRS) for Natural Resources Monitoring and Management and Disaster Management Assistance, launched in 1988 (Vikaspedia n.d.);
- *Polar Satellite Launch Vehicle* (PSLV) launch vehicles with IRS (Indian Remote Sensing Satellite) observation satellites on board and Geosynchronous Satellite Launch Vehicle (GSLV) class vehicles with GSAT geosynchronous satellites



(Vikaspedia n.d.);

- *CHANDRAYAAN* investigative satellites of the Moon and the Orbiter Mission (Mangalyaan) spacecraft for missions to Mars. The Chandrayaan-2 mission, launched on 22 July 2019, includes an orbiter, a Vikram lander and a Pragyan rover of entirely indigenous production (Vikaspedia n.d.);

- *Cartosat*, *NovaSAR* and *SI-4* satellites for optical observation of the Earth and the constellation of *NavIC* navigation satellites;

- *Hyper spectral Imaging Satellite* (HysIS) (Space Programs of India);

- *Gaganyaan* program for human space exploration of the lower orbit of the Earth and the planets of the solar system (Indian Space Research Organisation Department of Space n.d.);

- *The Indian Ballistic Missile Defence Program* (BMD), launched in 1999, which included the development of *anti-satellite weapons* (ASAT): exo-atmospheric radars and interceptors and exo-atmospheric destruction vehicles (Strategic Frontier Research Foundation 2017).

Subsequently, the program expanded to the production of energy-directed ASAT weapons, coorbital ASAT weapons, lasers and ASAT weapons based on electromagnetic pulses (EMPs) and space shields against electronic and physical attacks (Pandit, 2019). On March 27, 2019, India successfully tested an anti-satellite weapon – *the Shakti Mission*.

The Space Defence Agency was created in 2018, with the mission of conducting space warfare and satellite intelligence gathering missions (Sanjeev Miglani; Krishna N. Das, 2019). The agency reports to the *Defence Image Processing and Analysis Center* (DIPAC) in Delhi and the *Defence Satellite Control Center* in Bhopal, representing the growing integration of India's space capabilities (Rajagopalan, 2019).

In March 2019, India conducted an anti-satellite weapon (ASAT) test. Also, on July 25-26, 2019, India conducted its first simulated space warfare exercise, codenamed *IndSpaceEx* (Rajagopalan, 2019).

Japanese space program

Japan is the seventh most powerful space-producing and launch space satellite with positioning, navigation, and timing satellites, which it can launch independently into higher orbits (Wilson, 2020).

Institutionally, the Japanese space program

began in the 1950s, when the first structures with responsibilities in the field were created. Following successive transformations in 2003, the merger between the *Institute of Space and Astronautical Sciences* (ISAS) at the University of Tokyo, the *Japan National Space Development Agency* (NASDA) and the *Japan National Aerospace Laboratory* (NAL) created the *Unified Japan Aerospace Exploration Agency* (JAXA). Like other space powers, Japan has developed its space program from the ballistic program. In this sense, the *Pencil Rocket project*, initiated in the 1950s, which aimed at the development of rocket-propelled aircraft (Pencil Rocket), bears witness to this. On February 11, 1970, Japan successfully launched its first satellite, *Ohsumi 1*, with an unguided American *L-4S 5 rocket* (University of Tokyo n.d.). In the 1970s, *Mu/M class rockets*, used in the successful launch of domestically produced satellites (Astronautix n.d.), went into production. This family of missiles also includes the *M-3SII*, the first solid-propelled rocket to leave Earth's gravity carrying the *Halley Armada Sakigake* and *Swiss satellites* (Astronautix n.d.). In parallel, the *H-1 rocket engine* was produced for Delta-type launch vehicles with liquid hydrogen fuel and re-ignition oxygen propellant capable of launching objects in excess of 500 kg (Astronautix n.d.) into geostationary orbit engine. It was followed by the *H-II rocket*, completely indigenous, successfully launched in February 1994 (JAXA n.d.).

Currently, the main research directions are:

- development of the *Epsilon* family of solid fuel rockets for the launch of micro-satellites (JAXA n.d.);

- *MTSAT* (Multi-Functional Transport Satellite), meteorological and aviation control satellites (eoPortal n.d.);

- *JAXA Engineering Test Satellite ETS-VIII* (Kiku 8) communications satellites (eoPortal n.d.);

- Military Intelligence Gathering Satellites *IGS Optical* (Spacewatch.global n.d.);

- *Minerva Hayabusa/MUSES-C* robotic asteroid exploration spacecraft with detachable mini-lander (Dooling n.d.);

- Projects on unmanned flights, manned missions to Mars and long-term establishment on the Moon.

In 2020, the Space Operations Squadron was established within the Japan Air Defence Force,

based at Fuchu Air Base, Tokyo (Johnston 2020).

Other space players

Apart from the mentioned powers, there are other space players such as: Great Britain, Germany, European Union, Arab League, South Africa, Brazil, etc. They all develop civilian programs of scientific research of cosmos. However, some of them are also developing military programs, which are mainly aimed at the satellite communications and intelligence gathering sectors.

For example, in the case of Great Britain:

- on April 1, 2021, it established the *UK Space Command* (Royal Air Force n.d.);
- it developed the *Skynet military satellite communications program*, which provides coverage to almost the entire globe (Ministry of Defence 2021);

The *OneWeb satellite constellation* was entered in the *UK Register of Outer Space Objects* following the acquisition (along with an Indian company) in July 2020 of 45% plus a gold share of the shares of the bankrupt *OneWeb company* (BBC 2020). The acquisition was made in order to extract the UK from the EU's *Galileo satellite navigation system*, aiming to further implement the *Independent Global Navigation Satellite System* (UKGNSS). The future constellation of satellites will be incorporated into the *Skynet 6 military communications architecture*. The *OneWeb project* aims to launch about 2,000 satellites into low Earth orbit, to provide Internet services to "everyone, everywhere" (Amos 2017).

British National Space Center (BNSC) was the second largest financial contributor to the European Space Agency's general budget under *Aurora – Earth Observation Program-3, Global Monitoring for Environment and Security* (GMES) *Phase 1* and *Advanced Research in Telecommunications Systems* (ARTES) (BNSC n.d.).

Instead of conclusions: The security impact of the militarization of the outer space

On October 10, 1967, the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, also known as the *Outer Space Treaty*, came into force. It was signed in London, Moscow and Washington DC on January 27, 1967.

The treaty prohibits the stationing of weapons of mass destruction (ANM) in the orbits of Earth or other celestial bodies, prohibits military activities

on celestial bodies – from establishing permanent military bases or installations, to testing "any type of weapon" or deploying military exercises on the Moon and other celestial bodies, and details legally binding rules governing the peaceful exploration and use of space (Arms Control Association 2020).

However, the treaty does not prohibit the launch of ballistic missiles from space and, very importantly, does not establish exactly the boundary between atmospheric and extra-atmospheric space, nor does it regulate military activities in outer space – potentially explosive topics in the coming years, when more and more players will develop spatial capabilities.

Cosmic space, also known as extra-atmospheric space represents the area located outside the Earth's atmosphere. As the planet's atmosphere gradually becomes thinner, there is no clear boundary between cosmos and outer space. For this reason, there is no unanimously accepted line between the atmosphere and the cosmos.

However, the *International Aviation Federation* (IAF) has accepted an arbitrary separation of the two spaces, unrecognized in international law, but intended to differentiate aeronautics from astronautics. This boundary is called the *Kármán Line* and is represented by the sky segment that begins 62 miles - 100 kilometers above average sea level. It was established in the 1960s and is the area where orbital dynamic forces² become stronger than aerodynamic forces (Drake 2018).

Another perspective on the limits of outer space belongs to the United States Army (US), which lowered the limit of this space as the lowest perigee reached by a spacecraft in orbit, without specifying, however, an altitude (National Security Space Institute). As stated in a document issued by the US National Space Security Institute, "the Earth's atmosphere does not end abruptly at a certain altitude and space begins. In fact, the Earth's atmosphere continues to erupt more than 1,000 miles into space. In practical terms, the lowest altitude for a satellite in a circular orbit is about 93 miles - 150 km, but without propulsion the satellite would quickly lose speed and fall back to Earth" (National Security Space Institute). There are other opinions on the boundary between the terrestrial

² The orbit is the trajectory through outer space under the effect of gravity followed by a celestial body around another larger celestial body or a set of celestial bodies.



and the cosmic. Among them there is a study published in 2009 by a group of researchers at the University of Calgary in Canada, who claimed to have built the *Supra-Thermal Ion Imager*, a device able of determining the edge of outer space based on the speed of ions. In his opinion, the Earth's atmosphere ends 118 kilometers away from Earth (Thompson 2009), which is the boundary between Earth's space – where ions move more slowly, and outer space – where ions can reach speeds of over 1000 km/h.

Under these conditions, the question arises, where does the national air territory end and where does the low orbit of the Earth begin? How much sovereignty do states have over the atmospheric columns of their national territories? And if espionage is considered a hostile act, how can one categorize the process of "information gathering" by satellites placed in orbit, above or within the national territory of a state?

On the other hand, as it can be seen from all the case studies presented, space programs, even if they had indisputable civilian scientific objectives, were born of military research, always related to the field of ballistic missiles. Subsequently, the development of satellites automatically involved military applications, and orbital stations also served to military missions. Therefore, the global space program is essentially military. In these circumstances, is it natural to wonder how long a treaty that came into force 54 years ago could still be effective, when the race to conquer space was just at the beginning? Or, in other words, how long will it take for the first permanent military base to be placed on the Moon? Or for the first WMDs to be placed in space – given that military exercises are already taking place in Earth orbit and the Treaty does not prohibit the launch of ballistic missile armed with ANM warheads (Arms Control Association 2020). Of course, the provisions of the Treaty have been reiterated by legal documents such as the *ABM Treaty*, the *SALT I and II* agreements, the *START I Treaty*. However, all these documents prohibiting the placing of nuclear weapons or any other type of weapons of mass destruction in Earth orbit, including split orbital missiles, have been signed between the US and the USSR, without involving other space powers such as China, India, France, etc.

At the same time, in the absence of international

regulations on space capabilities, humanity is facing a new and major security challenge – the spiral of space arming. Which, given the current technological sprint, is automatically linked to the concept of *Massive Attack of Disruption* and the risk of huge losses. And not only that. How will a space crisis caused by an accidental or intentional destruction by a competing power of military or civilian equipment placed in orbit or on another celestial body of some space power be handled? What implications could such an incident have? What types of weapons could be used in the clashes among the space powers involved, given that there is no ban on the use of these weapons on Earth?

Launched in the 1950s, the space race had an intense geopolitical and ideological connotation. Practically, with every success registered by the politico-military blocs of the Cold War, the enslaved propaganda celebrated the victory of one ideology over the other. At present, the terrestrial geopolitical game is faithfully reflected in space, where the new technological blocs express terrestrial alliances. On the one hand there is the Russian-Chinese technology alliance, which has just "cemented" the base of a future permanent lunar station and invited India to join it (Lele 2021). And, on the other side, there are NASA and the *Artemis Agreements: Principles for Cooperation in Civilian Exploration and the Peaceful Use of the Moon, Mars, Comets and Asteroids*, which it launched in 2020 with six other space agencies in Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates and the United Kingdom (NASA 2020). The agreements, which reiterate the principles set out in the *Outer Space Treaty*, were subsequently signed by space agencies in Ukraine, South Korea, New Zealand, Brazil, Poland, Mexico and Israel. For this instance, the European Space Agency has only signed a memorandum of understanding with NASA on the agreements, with Europeans also participating in the *US Agency's Artemis Program* (ESA n.d.). It is becoming clear that we are witnessing the emergence of two space blocks that express a very clear reality: the international system is moving towards a new power architecture. An architecture in which Asia, united in the Russian-Chinese mainland bloc, is in competition with an American-British and Japanese maritime bloc, to which a large part of the European states has only partially adhered.

This is a new and extremely dangerous situation and an increasingly obvious return to the paradigm of global domination, with the mention that now the pivotal zone is made up of the huge Russian-Chinese bloc.

In conclusion, we can say that we are witnessing an extensive militarization of Earth orbit, which engages the seven main space powers in a spiral of space arming. This is all the more worrying because there are no international regulations that address extremely sensitive issues such as: sovereignty over the atmosphere, satellite espionage, the extent of the military presence in outer space, how to resolve space crises caused by space accidents or incidents, the right to use space weapons in outer space, etc. A situation that risks getting out of control in the context of the increasingly obvious reconfiguration of the global power architecture, in which space technology blocks describe a return to the Cold War paradigm, with its "assured mutual destruction".

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