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The transformation of outer space into a warfighting domain in the 21st century

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Abstract: The article deals with the process of the transformation of outer space into a warfighting domain in the 21st century. During the Cold War, outer space was a place of understanding and peaceful competition between superpowers. Militarization has existed since the beginning of the Space Age, excluding the weaponization of space until the beginning of the 21st century. The absence of an international regime to prevent the weaponization of space and technological advances opens up new opportunities for states in their quest to increase power. The theoretical paradigm is a realistic perspective of international institutions as a reflection of the most powerful state's minimum consensus on a mechanism for reducing their costs. Successfully tested anti-satellite weapons open new questions about the defense of vulnerable space installations from enemy attacks. The author's prognostic thesis refers to the new race in space weapons and the matter of time when lasers, plasma weapons, kinetic bombardment, and other types of space weapons will see the light of day. The strategic balance will remain untouched until the invention of a superior space weapon able to neutralize the existing offensive capacities of the states and erase the second strike capability appears. The author concludes that international institutions cannot limit the ambitions of states in conquering space because they do not want to give up that potential, but that a limited space war is unlikely.

Keywords: outer space, warfighting domain, militarization, weaponization, satellites, space weapons, strategic stability.

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Militarization and strategic stability of outer space in the 20th century

During the Cold War era, outer space was an arena where superpowers fought for prestige by demonstrating scientific and technological superiority. However, in a period known for numerous crises, proxy wars and situations on the brink of open US-Soviet conflict, space has not been an arena in which military power was measured. The fact that space weapons were then in the domain of science fiction, the unprofitability of opening a new battlefield for superpowers, as well as physical limitations, made outer space a relatively peaceful domain throughout the Cold War period. Also, cooperation in space served to reduce tensions between superpowers and relieve the relationship in some other spheres of competition. The symbolic handshake in space in 1975 between American and Soviet cosmonauts within the joint Apollo-Soyuz project is an illustrative example of peaceful cooperation (Peter 2016, 146). In addition to being non-military by its nature, the Cold War-era space race was bipolar with only two states capable of space activities (the United States and the Soviet Union). The end of the Cold War did not lead to a rapid process of militarization of space, but in the 1990s appeared some new states capable of space activities, such as China, Japan, India and the European Union. The peacefulness of human action in space continued throughout the 20th century, and the culmination of the cooperation was the launch of the International Space Station in 1998 (ISS 2021). The project to launch and maintain the International Space Station is probably one of the most ambitious but also the most successful joint technological ventures of several countries. Apart from the USA and Russia, countries like Japan, Canada and the European Union took participation in this project (ISS 2021).

Less than a week after the launching Sputnik-1, first human-made object in the outer space, the Eisenhower administration created political proposal for the United Nations to promote outer space exclusively for scientific and peaceful purposes (Grunert 2021). At that time, the Soviet Union was one step ahead as the only spacefaring country in the world, which led to the rejection of the starting offer. The year 1957 marked the beginning of the space age, but it probably remained the first and only moment to prevent a future rush towards the militarization of space. The Cold War period was full of mutual hostilities and tensions between superpowers but the domain of space activities remained relatively peaceful until the collapse of the Soviet Union in 1991. The problems of weaponization and militarization of the outer space at its core carry a number of issues such as the limitation of state sovereignty and protecting the public good of humanity. The key question is whether states are allowed to place weapons in

space and wage future wars „from“ space or „in“ space. The peaceful period during the Cold War left behind several important international agreements which partially regulated the rights and obligations of states in this field but with great shortcomings. The first and to this day the most important international agreement in this area was adopted in 1967 under its official name Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, colloquially known as The Outer Space Treaty (OST 1967). This agreement is the result of relative cooperation and the basic consensus on the newly created arena of superpowers competition. The Outer Space Treaty promoted the non-sovereign status of space, which cannot be any kind of state's property.

It is important to mention Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water from August 1963 which bans testing of nuclear weapons in space (PTBT 1963). Also, international treaties regulating certain activities in space are Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space signed in 1968 (Rescue Agreement 1967), Convention on International Liability for Damage Caused by Space Objects signed in 1972 (SLC 1971) and Convention on Registration of Object Launched into Outer Space signed in 1975 (Registration Convention 1974). Agreement Governing the Activities of States on the Moon and Other Celestial Bodies created in 1979 legally prohibits commercial activities on the Moon and other celestial bodies, unlike the before mentioned has not been signed by spacefaring nations (Moon Treaty 1979).

Although prescribing very important provisions, Moon Treaty is inapplicable in practice because it has not been signed by any country that independently performs space launches - primarily the United States, Russia, China, Japan and India. Observing the beginning and evolution of space activities throughout the Cold War, space was a relatively peaceful field of action, with the exception of the ambitious and practically non-conductive Ronald Reagan's project entitled the Strategic Defense Initiative but popularly known as the Star Wars program (Williams 2010, 785). Observing the past and present activities in space, John Mearsheimer's claim that states strive for international cooperation and the establishment of control mechanisms only as long as it reduces their costs and while it is in their interest, turned out to be correct (Mearsheimer 1994/95). By limiting expensive and technologically difficult activities in space, powerful states prevented overstrain by codifying prohibitions on something they probably weren't even able to do. Modern technological advances in informatics, rocket and satellite technology especially in 21st century, made military strategists to think again about scenarios from Hollywood sci-fi movies.

Space wars, laser guns and energetic weapons have been described in movies and video games, but now technology enabled such things to enter reality. But there is still no offensive space weapons in operative use although during the Cold War and throughout the 20th century space was militarized. Difference between weaponization and militarization is a special topic of analysis, but it is important to point out that militarization still does not mean the transformation of outer space into the warfighting domain. Many types of satellites were sent into space for military use but for now, still no weapons were stationed in Earth orbit or on the celestial body. It seems that superpowers consensus behind non-weaponization of outer space has been caused by high cost of space weapon projects, and that in a situation of spending huge amounts of money on nuclear weapons, airplanes, submarines, financing the overthrow of disobedient regimes, proxy wars and all other activities during the Cold War. Also, there was a technological impossibility to develop sophisticated weapon systems in space in 20th century. All experiments attempted by the US and the USSR remained either in the domain of theory or at the experimental level. Some projects that could be realized would cost a fabulous amount of money and were unprofitable because the same resources could strengthen the nuclear arsenals and constantly developing missile systems. Space weapons development projects in the 20th century were simply too adventurous and did not offer great success in practical application guided by cost-benefit analysis. The basic consensus of maintaining the peacefulness of space between superpowers is the result of common interests to avoid unnecessary overstrain in a situation of strategic balance that has already enabled by nuclear weapons with a triad of transmitters to the target (missiles, bombers and submarines). At that time, some primitive space weapon would not even be able to disrupt the strategic balance, so outer space with the agreement of superpowers (also some formal international treaties), left this field not only for peaceful activities, but also for cooperation to decrease general tensions. The era of complete digitalization of society and reliance on satellite infrastructure, which is crucial for the overall functioning of states and people, has changed the matrix of thinking about space as an exclusively peaceful domain. States maintained the neutrality of the outer space until arose interests in overthrowing such a status and turning it into warfighting domain. Therefore, the peacefulness of space in the 20th century is not the result of cooperation and the strength of international arrangements, but solely a desire to reduce the irrational costs and technological weaknesses of states (Mearsheimer 1994/95). Technological advances in weapons systems, on the one hand, and the importance of space objects for daily life on Earth, on the other, have made the transformation. Analysis of the praxis and the lack of will of the states to prevent the space arms race with

an international agreement, speaks of a „false promise of international institutions“ (Mearsheimer 1994/95). All agreements regulating space activities are designed to meet a minimum of common interest at the time, but not to prevent any future changes in that field. Legal norms related to space are obviously obsolete but that is not a sufficient reason for states to resort to adoption of a new joint agreement. This is another indicator of the reluctance to limit state’s enormous potential offered by the development of space weapons.

The militarization of space during the Cold War introduced even a dose of stability into the relationship between the superpowers. In terms of great-power war, nuclear deterrence was the main reason why the Cold War was era of “the Long Peace” (Gaddis 1986). Reconnaissance and early warning spacecraft were means of checking and verification of the other side’s capabilities. Navigation satellites made nuclear targeting more accurate and later became crucial for precision of conventional weapons (Neufeld 2021, 45–46). In 21st century the opposite scenario is possible, because some future omnipotent space weapon could disrupt strategic balance. Imagine a combination of weapons that destroy all the enemy’s satellites on which not only the army relies but the whole life of the ordinary people and a space-based defensive system that shoots down all enemy’s rockets that would be launched in retaliation. With such weapons would be possible to neutralize the second-strike capability of the opponent. Second-strike capability lies at the core of nuclear deterrence and strategic stability even today. In short, the militarization of space during the Cold War period had positive impact on the global strategic stability while in the 21st century weaponization and transformation of space into warfighting domain could have negative effect on the strategic stability, especially in a situation of monopolization of space weapons by one or a small number of states. We are still far away from such a weapon, but the gap between space fiction and space reality in the military context has narrowed.

Lack of Global Prohibition Regime

The lack of consensus on the boundary of the outer space is not as problematic as the question of what kind of space actions are allowed. An altitude of 100 km above sea level, so called Karman line, is usually marked for the space boundary (Bille and Lishock 2004, 59). Unlike space, airspace is under jurisdiction of nation states as a part of their sovereignty. The issue of outer space status is relatively undefined. The most famous human objects orbiting the planet are artificial

satellites for various purposes (also military). Lagrangian points where the force of gravity is strong enough for objects not to escape into the space but weak enough not to pull the object to the ground, have the potential to station a future space military base (Bille and Lishock 2004, 59). There are numerous natural obstacles for man to tame the outer space, but over time, technological advances will definitely enable the creation of space weapons. The main obstacles which human technology must overcome before the submission of space are the lack of gravity, vacuum, dangerous objects, solar and galactic radiation. A potential space arms race will definitely be reserved for a small number of states that have the necessary capacity for such endeavors. One of the reasons for the lack of an adequate prohibition regime that would prescribe the rules in space is the relatively insufficient technological ability of states to dominate outer space (Nadelman 1990). Although there is no comprehensive and effective international mechanism that would prohibit the militarization and weaponization of space, does not mean that this field is completely unregulated.

The more than half a century old Outer Space Treaty from 1967 is still the basic legal mechanism for regulating the space activities of states. The most important provisions regarding the militarization and weaponization of space are contained in Article IV, which states that

(...) the signatories are obliged not to place into orbit any objects carrying nuclear weapons or other weapons of mass destruction, not to install such weapons on celestial bodies or station them in any way in deep space (OST 1967, Article IV).

Thus, international legal norms prohibit only the arming of the outer space with weapons of mass destruction, while for conventional weapons such a prohibition does not exist. The same article states that “the Moon and other celestial bodies will be used exclusively for peaceful purposes” (OST 1967, Article IV). The agreement does not prohibit the use of military equipment and personnel on the Moon and other celestial bodies, although it does prohibit the formation of military bases (OST 1967, Article IV). There is also the possibility for a broad interpretation of the provision of “peaceful purpose”, which can be interpreted as excluding only aggressive types of weapons, while defensive space weapons in that sense would be allowed. The signatories seem to have left the possibility for future installation of all kinds of space weapons, as well as the use of resources of other planets. Peaceful use of space facilities can mean the installation of defensive military equipment under the pretext of maintaining peace. Legal uncertainty also exists in the field of extraction of raw materials and ownership of some future space mines on celestial bodies. The current norms in the most general terms proclaim the well-being of humanity and the peaceful use of outer

space, without clearly defined rules related to the ore extraction. Mines on the Moon, asteroids and other planets could be the most profitable business ever. The National Aeronautics and Space Administration (NASA) estimates the value of currently available asteroids at USD 700 quintillion, which is roughly USD 95 billion per capita on the Earth (Mallick and Rajagopalan 2019). The existing legal norms do not prohibit militarization, and even the weaponization of the space, with the exception of weapons of mass destruction. Also, a topic for discussion can be how weapon of mass destruction is defined and whether Outer Space Treaty prohibits low-yield nuclear warheads or kinetic bombardment.

The debate on agreement called Prevention of an Arms Race in Outer Space began in 1985 with the establishment of a committee that was supposed to propose an international agreement on space armaments conference within the United Nations (FAS 2021). The United States was the only country, along with the restrained Israel, that opposed the adoption of such agreement, emphasizing the needlessness of prescribing the prevention of something that does not exist, alluding to space weapons (FAS 2021). In 2008, China and Russia proposed an draft agreement that would ban any type of weapon in Earth orbit, the installation of weapons on celestial bodies, or the threat of force in space (FAS 2021). This agreement will hardly ever be adopted because countries, such as the United States, which have made the greatest progress in space exploration and exploitation, do not want to limit themselves even a millimeter more than prescribed by the Outer Space Treaty. In the 21st century and the era of rapid development of technology, the desire to ban the space weapons by some comprehensive international agreement is becoming less realistic option. However, the absence of legal obstacles does not automatically mean arming the space, because weaponization of space will largely depend on technological achievements. It is difficult to expect signing of an agreement that would prevent any nation from gaining a military advantage in outer space.

Militarization and weaponization of the outer space in the 21st century

Significant difference between the processes of militarization and weaponization of space was already mentioned. Militarization implies space operations aimed at increasing the military power of the state, but without direct attack on the enemy's space-based facilities or attack from space (Lele 2013, 182). Weaponization includes destroying enemy targets in space such as satellites,

installation of space-to-ground weapons, but also ground-to-space weapons (Lele 2013, 182). Johnson-Freese gave the most adequate definition of space weapons (excluding satellites), defining the space weapon as “a system that has the direct goal of destroying space installations from land or space or a system that targets enemy targets on Earth from space” (Johnson-Freese 2016, 67).

Militarization has existed for decades including use of space objects for military purposes, primarily in the form of support for air and ground weapons systems. The active militarization of space primarily refers to navigation, communication and surveillance for military purposes. For these activities are in charge numerous satellites. As many as 1,100 active systems and 21,000 pieces of inactive parts (space debris) are circling in Earth’s orbit (Al-Rodhan 2012, 2). Of course, not all satellites are used for military purposes, but their application in the military activities of countries today is so great that would be unthinkable without navigation, communication and monitoring systems. Any type of technology that has dual use, in its essence is additionally more difficult to control and limit exclusively to the civilian domain. Like the use of nuclear fission process, which today supplies humanity with electricity but at the same time could put an end to human existence in a potential nuclear war. So existing space objects can find their purpose in both, the civilian and military domains. Since the end of Cold War, particularly in the 21st century, space-based military systems are more important for terrestrial activities than ever before. Navigational systems from space allow aircrafts, ships, submarines and ground units to be precise and more efficient. Best example of domination of space-based military support is initial American invasion on Iraq in 2003. In 2002 the Bush administration formally left the Anti-Ballistic Missile Treaty which prohibited space-based anti-missile systems (Boese 2002). In the 21st century United States seek effective missile defence system which raised the question of weaponization of space.

Many countries are present in space today, but only couple of them have the capacity to develop offensive space weapons, so future weaponization of space should be considered in this triangle (Race 2018, 383). The United States took an organizational step towards comprehension space as a warfighting domain by creating new branch of the United States Armed Forces (Stojanović 2020). The United States Space Force (USSF) was formed in December 2019 as the first newly created service branch since the formation of the United States Air Force in 1947 (Browne 2019). Also, United States Space Command (SPACECOM) is reactivated in August 2019 after it was shut down in 2002 (Erwin 2019). SPACECOM is the newest of the eleven unified commands in the Department of Defence (USSC 2021). Mission of this unified command is to “conducts operations in, from, and to space to deter conflict, and if necessary, defeat aggression, deliver space

combat power for the Joint force, and defend U.S. vital interests with allies and partners” (USSC 2021). In fact formation of operational command capable of waging the future space wars means recognition of space as a warfighting domain. After taking office of the American president, in his speech Donald Trump underlined the outer space as a warfighting domain (Billings 2018, 385). Creation of the Space Force and the reactivation of the Space Command imply the use of American military force in space.

In 2018, the United States promoted its first National Strategy for Space which designated outer space as a warfighting domain (The White House 2018). Military use of space began with the launching of the first human-made object in space in October 1957. Yet the use of space for military purposes was reduced to the role of supporting military actions on land, water, and airspace, without perception that space is a warfighting domain. Therefore, the universe has enjoyed the status of a peaceful arena for decades, regardless of the fact that it had a certain military purpose. The twenty-first century is a century of a different perception which is not only visible in American strategic documents, but also among other spacefaring nations. Number of countries that use space for military purposes is growing, and pioneering ventures in the field of space weapons are also visible.

In 2007, China conducted an anti-satellite weapon test destroying its own weather satellite and sending space debris into the Earth orbit (Kan 2007). In low Earth orbit, up to 2,000 km altitude, reconnaissance and weather satellites, and manned space missions (including the International Space Station) are vulnerable to the increase in space debris resulting from China’s satellite destruction (Kan 2007). This debris cloud (estimated at 950 pieces 4 inches or bigger plus thousands of smaller pieces) threatens space assets in low Earth orbit (Kan 2007). The fact that the destruction of relatively insignificant weather satellite could jeopardize state’s activities in the outer space shows that some future sophisticated space weapons could make huge damage to the state’s infrastructure. Chinese test of an anti-satellite weapon was actually start of the new era in the practical understanding the outer space as a warfighting domain. Although outer space was used for military purposes for decades during the Cold War, both superpowers abstained from weapon tests in space (Fukushima 2020, 105). China with its strategy of asymmetric warfare in a way desecrated the sanctuary of the inviolability of the outer space which was recognized by both Cold War superpowers (Colby 2016, 7). China is not the only state with successful anti-satellite weapon test. In March 2019 India carried out the Mission Shakti, an anti-satellite weapons test (Urrutia 2019). Indian Prime Minister Narendra Modi officially confirmed that Indian missile turned the satellite into debris in low Earth orbit (Urrutia 2019).

Russia is the most advanced country when it comes to anti-satellite weapons. Russia conducted three tests in 2020, last one in december when successfully tested direct-ascent anti-satellite missile (Weaitering 2020). "Russia publicly claims it is working to prevent the transformation of outer space into a battlefield, yet at the same time Moscow continues to weaponize space by developing and fielding on-orbit and ground-based capabilities that seek to exploit U.S. reliance on space-based systems", said U.S. Army General James Dickinson, U.S. Space Command commander (USSC 2020). The United States publicly accused Russia for weaponizing the space and developing of several types of ground-based and space-based anti-satellite weapons (USSC 2020). "Russia has made space a warfighting domain by testing space-based and ground-based weapons intended to target and destroy satellites", Dickinson added. According to U.S. Space Command Russia tested two different types od anti-satellite weapons. First type is kinetic weapon (DA-ASAT system) capable of destroying satellites in low Earth orbit which Russia tested several times. Second type is co-orbital anti-satelite space-based weapon which tested in 2017 and again in 2020 (USSC 2020). But the greatest fear of Russian space weapon in the U.S. lies in the announced development of ground-based laser system for use by the Russian Space Forces (USSC 2020). In 2020 U.S. Defense Space Strategy China and Russia are designated as biggest threats to the American interests in outer space and are countries who have weaponized space creating new warfighting domain (DSS 2020, 3).

In the complex system of international relations, it is ungrateful to draw conclusions as to whether China was the first country to launch "space weapons race" in 2007, or whether the United States and the Soviet Union started race much earlier with pioneering projects during the Cold War. The United States is the most advanced in terms of technology and organization of space conquest. United States is the only country that has officially legalized the exploration and mining of ores in space by its own regulations, more precisely by Commercial Space Launch Competitiveness Act in 2015 (Mallick and Rajagopalan 2019). Irrefutable conclusion can be reported, that states are largely developing and testing weapons systems operational from or toward space targets.

Space weapons in the new warfighting domain

Anti-satellite weapons are the current reality, but also the only type of offensive space weapon that has been successfully tested operationally. There is no consensus which categories of weapons could be classified as "space weapons".

The basic principles that guide us in determining the category of space weapons are related to three operational models: space to earth, earth to space and space to space. For instance, intercontinental ballistic missile could not be in category of “space weapons” because it is launched from the ground, water or airspace and its target is not in space. Exclusively weapons that have targets in space, or weapons that act from space towards targets in the air, at sea and on land could be categorized as “space weapons”. Space weapon is always space-based or has space infrastructure as a main target. Many types of space weapons are still in the domain of theory or on experimental level of use such as laser weapons, plasma weapons, kinetic bombardment, electromagnetic weapons, particle beams, heliobeam or other types of orbital weapons. In the group of space weapons are also many forms of defensive systems based in outer space such as conceived model in Strategic Defense Initiative, military research program launched by president Ronald Reagan (Duric 2003). These systems potentially could destroy intercontinental ballistic missiles or other objects from the outer space but for now such expansive programs are still in the domain of theory.

The question is how realistic is the future Hollywood sci-fi movies scenario about interstellar travel, military bases on other planets or intergalactic war. However, in the foreseeable future, it is possible to discuss about weaponization of space, and even bases on the Moon and other celestial bodies. As explained, international legal norms do not prohibit weaponization of space (except for weapons of mass destruction). At the same time observable intentions of the most powerful countries in the world go in the direction of recognition space as a new warfighting domain. Space is definitely becoming a less stable environment and transforming into warfighting domain caused by overall progress in weapon technology mixed with the aspirations for power. Developments in offensive military capability have outbalanced developments in defensive capabilities, specially systems of ballistic missile defence.

US President George W. Bush said in 2002 that Anti-Ballistic Missile Treaty is now “behind us” and that it is necessary to develop a missile shield “as soon as possible” to protect from “growing missile threats” (Boese 2002). Russia’s response to the American development of the anti-ballistic shield was the development of hypersonic weapons that can easily break through any defense, thus ensuring a “second strike” in a possible military conflict. In March 2018, Russian President Vladimir Putin announced new types of Russian weapons, marking the entry into a new era in warfare technology (Putin 2018). With a new air-to-ground ballistic missile “Kinzhal”, a new intercontinental ballistic missile “Sarmat”, the first nuclear-powered cruise missiles of unlimited range codenamed “Burevestnik”, a submarine-powered drone “Poseidon”, and naval hypersonic

missiles “Zircon”, Russia has pushed the boundaries of modern warfare (Putin 2018). But the greatest attention was attracted by a new type of hypersonic weapon codenamed “Avangard”, which flies 20 times faster than the speed of sound using “zig-zag” trajectory completely elusive for missile defenses (Putin 2018). A striking sentence in the above-mentioned speech: “You did not listen to us, but from now on you will have to”, was addressed to the former Cold War opponent (Putin 2018). More than 20 months after the speech of the Russian president, Russia became the first country to officially introduce hypersonic weapons into its operational military arsenal, more precisely the Avangard system (Al Jazeera 2019). Thus, it made all ground missile defense systems meaningless and created new technological challenges in the global arms race. The U.S. response included rethinking the development of space defense systems from the Strategic Defense Initiative program. Reagan’s project should make nuclear weapons impotent with effective large-scale space and ground based defense system imagined to neutralize any nuclear strike. But this project has never come to life and the fear of collapsing the strategic balance soon disappeared. All activities aimed at developing new offensive and defensive weapons systems are the result of mutual mistrust between the most powerful countries in the world and the weakness of international institutions to limit these activities (Maersheimer 1994/95). In that mistrust, states use all possible suitable tools to create an advantage in the military power. Outer space offers completely new possibilities and encourages innovative solutions in the development of weapons. Today, about 60 countries around the world are present in space, at least with weather forecasting satellite or astronauts in the International Space Station, but several countries are capable of developing offensive space weapons (Moore 2011). Back in 1957, when Sputnik was launched, Lyndon Johnson, senator and later president of the United States, said that “whoever controls the universe controls the world” (BBC News 2007).

Although space weaponization has only just begun, there have been experimental attempts to create space weapons during the Cold War. The most famous Soviet project was the secret program code-named “Almaz” begun in 1964 (ESA 2021). Almaz was orbital piloted station for a three-person crew and an operational life of one or two years. Three missions were launched in the timeframe 1973-1976 before program was cancelled in 1978 (ESA 2021). The early Soviet space station carried the first ever weapon in space. This was 23-millimeter cannon that could fire using an optical sight but pilot had to turn the entire station to focus the target (Zak 2015). Only after the collapse of the Soviet Union, Russian sources revealed that the cannon had fired in orbit in 1975 (Zak 2015). Till today the Almaz pilot station was the only armed military spacecraft ever flown in space.

United States also had its own experiments of creating space weapons. There was an sci-fi idea conceived by Jerry Pournelle in the 1950s for kinetic bombardment (Larson 2020). Large rods of high-density tungsten sent in space via rocket should be thrown away from space on the Earth, literally falling down and make damage just by kinetic power (Larson 2020). So-called “rods from God” would travel at hypersonic speed and make stronger impact than conventional explosives. But this ambitious project never “saw the light of day” thanks to high price (Larson 2020). In the 21st century as process of transforming space into warfighting domain heats up there were many known and not well known secret project of space weapons. In addition to anti-satellite weapons, which is already a reality in the 21st century, there are other space weapons projects worth mentioning.

In 2004, the US Boeing X-37 spacecraft project was transferred from the NASA to the Defense Advanced Research Projects Agency (DARPA) which is well-known section of the US Department of Defense dealing with the development of advanced military technologies (Wall 2020). The first test of this mysterious spacecraft was conducted in 2010, since when as many as six test flights were conducted, and the last in May 2020 (Wall 2020). This plane could do bombing from space, destroy satellites or enemy’s spacecrafts but U.S. Air Force officials have always denied that X-37 is a space weapon.

Recently, General Jay Raymond, the head of the Space Force gave official statement in U.S. Congress that the United States is developing directed-energy weapons to maintain superiority in space (Strout 2021). Raymond stated that Russia and China already work on directed energy capabilities and publicly confirmed for the first time that U.S. is also developing such systems, although details remained classified (Strout 2021). United States often designates Russia and China as justification for creation its own space weapons. Although still under development directed energy space weapons mean potentially deploying of space-based interceptors based on lasers or other energetic technology. This is officially confirmed. France had stated that will also defend themselves with lasers in the outer space (Strout 2021). Laser or neutral particle beams in space could shoot down enemy missiles much more efficient than kinetic interceptors. In theory such weapon could destabilize strategic balance between nuclear powers and potentially diminish second-strike capability. In March 2019 former U.S. President Donald Trump issued an executive order on Coordinating National Resilience to Electromagnetic Pulses (Wilson 2019). In this act electromagnetic pulses (EMP) are recognized as potential threat to critical infrastructure, and “the federal government must foster sustainable, efficient and cost-effective approaches to improving the nation’s resilience to the effects of EMPs” (Wilson 2019). This also means “green light” to create their own EMP weapons in all

warfighting domains. In this kind of research are involved U.S. Defence Advanced Research Projects Agency (DARPA), Air Force Research Lab (AFRL), Naval Research Lab (NRL) and Army Research Lab (ARL) (Wilson 2019). Electromagnetic non-nuclear space weapon could disable communication and navigation systems, command and control line and completely blind the enemy. Executive director of the EMP Task Force on National and Homeland Security, Dr. Peter Pry, announced that China already has EMP weapon and protocol to conduct first-strike attack (Conca 2020). He added that China has created a network of satellites, missiles and electromagnetic pulse weapons that could completely destroy electric grid, communication systems and even shut down ability to respond of all aircraft carriers (Conca 2020).

Although there are many unknowns due to the nature of super-secret projects, the fact is that some countries have successfully tested anti-satellite weapons as first operative space weapon ever. It is impossible to deny that some nations already have space weapons and also are diligently working on other space weapons projects.

Future projections of waging space wars

The development of space weapons does not necessarily mean waging a space war. This is best seen in the example of nuclear weapons, which were used only once in history in the war, at the time of the United States nuclear monopoly. Nuclear deterrence functioned almost flawlessly by deterring direct armed conflicts between the possessors of nuclear arsenals. A similar scenario is possible with space weapons, which can be an upgrade to the still existing nuclear strategic balance. The problem can arise if some future space weapon, such as a space-based defensive missile system, could neutralize the opponent's ability for a second strike. This would lead to more unstable mutual relations between the most powerful countries in the world.

There are four main activities of spacefaring nations in the outer space: space support, force enhancement, space control and space force (Rabkin and Yoo 2017, 61–62). As the first one, space support means ability to launch missiles and satellites in orbit and maintain them. Second, force enhancement includes the use of space for surveillance, reconnaissance and support of military operations on Earth (land, sea and airspace). Spy satellites replaced airplanes for surveillance such as U-2 with much more survivability and capacity to reduce miscalculations about the intentions of other state (Rabkin and Yoo 2017, 61–62). Force

enhancement also means space-based guidance of attacking and defensive missions, deployment of units, communication network and the synchronization of different military branches. Third, space control refers to use space for its own and prevent interference of others or for their benefits (Rabkin and Yoo 2017, 61–62). Fourth and the most important is space force which includes defensive and offensive weapon systems (Rabkin and Yoo 2017, 61–62). Last activity is actually weaponization of space with potential of the space wars outbreak. Spacefaring nations will seek to make offensive and defensive weapon systems. Special attention is occupied by program of space-based lasers that could destroy ballistic missiles in their boost phase when they are the most vulnerable. But reliance on space-based systems could be difficult because it is hard to defend them from attack. Technology that can destroy satellites or other artificial objects in space already exists. Future space-based anti-missile system would be primary target of any space war. Another natural problem of waging space wars could be the debris from an explosion or destroying space-based objects. Just one Chinese test of anti-satellite weapon produced thousands of particles speeding along (Kan 2007). If we imagine the exchange of hundreds of rocket attacks in space, there will undoubtedly be a huge cloud of particles that will further destroy other objects or prevent their operational efficiency. Technology for destroying space object is much more accessible and cheaper than the development of defensive space-based systems. Mostly of complex space weapons have decades to go before come to reality. First step would be development of such sophisticated weapon, but second step relates to its vulnerability to attack.

Although space wars will remain a distant future for these reasons, we may wonder what would be their purpose. Everett Dolman confirms Mearsheimer's realistic perspective and applies it to the outer space. States strive to maximize power and space will be used for that purpose if offers leverage (Dolman 2002, 15). Space is just one new warfighting arena in the struggle for dominance on Earth. Essentially there is no difference from other geopolitical arenas like land, sea or air (Dolman 2002, 15). Dolman's "space nationalism" thesis includes realistic perspective for international arrangements solely used of reducing costs, proves to be correct observing the activities of states in outer space. There is no space regime like the nuclear non-proliferation regime that would more severely limit the activities of states in terms of weaponization because still there are not enough accumulated common interests to establish such a regime (Davis 1993, 82). The activities of spacefaring nations in the 21st century do not inspire optimism that such a regime will be established. From the perspective of realism, considered the most objective for the story of outer space weaponization, such a regime could be established in a situation of "stalemate" of several different states that have

mastered space weapons. Stalemate could establish relations similar to the “mutual assured destruction” relationship between nuclear weapon states.

Possible monopoly on space weapons, which could neutralize enemy missile attacks, would cause the desire of the monopolist to establish a space regime to keep *status quo*. However, this would not be accepted by other non-possessors with their intention to ensure strategic parity. Is space war possible in the future? It is difficult to isolate exclusively the relationship of states in the field of outer space because relations spill over all other warfighting domains. Some limited space war would be difficult to imagine, and given the fact that spacefaring nations are mostly nuclear powers, deterrence would still work. Only the emergence of a superior space weapon capable to prevent nuclear strike could be used in a war as a “blitzkrieg” tool. No one can ignore the extreme vulnerability of existing space systems to attacks. Superior space weapon would have to develop effective self-defense mechanisms. From a technological point of view, humanity is still far from creating such a weapon, but that possibility must not be ruled out. Meanwhile, the race to develop space weapons will continue and most likely gain momentum.

Concluding remarks

Analyzing the transformation of outer space into a war domain is not simple but it is possible to draw several conclusions. First, the outer space has a decades-long history of a peaceful arena while its recognition as a warfighting domain has only just begun. Civil and peaceful exploration of the space will continue alongside its militarization and weaponization. This means that space will not only be reserved for states, but also for private actors who perceive new research and business opportunities.

Second, there is a lack of international norms governing the field of action in space. The Outer Space Treaty is the main source of rights and obligations even today, although it was created in the midst of the Cold War as a minimum of common interests of superpowers. There is no will of spacefaring nations to establish an international regime similar to non-proliferation regime and limit or even prevent future weaponization of space. The assumption of realism that states will not give up the possibility of increasing their own power seems completely correct. Weakness of international institutions in restraining these desires is obvious and hard to overcome. From this perspective, it seems impossible for nations to agree and adopt a new international treaty that would ban the placing of weapons in space. The existing provisions of the Outer Space Treaty leave too

much for different interpretations, and at best only prevent the placement of weapons of mass destruction in space.

Third, our knowledge of space is evolving. The insurmountability of technological obstacles is diminishing, and something that until a few decades ago was in the domain of science fiction movies, is now achievable in reality. However, the technological limitations are still great today, given that the space is a hostile environment that requires the most sophisticated and the most expensive innovations. Only a small number of the richest and most advanced countries will be able to participate in the space race. We can expect more and more space missions, orbital flight, tests of new space weapons, and even the installation of some military facilities in the future. Observing the current technological development, it is most realistic that the only type of “space weapons” in the near future will be anti-satellite weapons, already been successfully tested by the United States, China, Russia and India. The directed-energy weapons will come a little later but in the foreseeable future.

Fourth, space wars will not be waged as limited wars, but exclusively as one segment of some broader conflict. This does not exclude tensions and perhaps some future “space Cuban crisis” with the world on the brink of conflict. The strategic balance between the nuclear powers will not be endangered in the foreseeable future, and in order for that to happen, it is necessary to create an indestructible and maximum efficient space-based anti-missile system. Such a technological endeavor is still in the domain of theory, and the United States is the country that strives for its creation the most. Nuclear deterrence with efficient missile systems, even new hypersonic weapons, will continue to maintain a “cold peace” between the possessors.

Finally, the space will continue to militarize and weaponize. Mankind is increasingly relying on space installations in everyday life and some space military intervention could leave unforeseeable consequences for life on Earth. It will no longer be questionable whether the space has been transformed into a warfighting domain, given that all indicators speak in favor of that thesis. There are no legal barriers, technological ones are shrinking and states are striving for power with strong desire to use outer space. There are all the conditions for a new space race. But this time with more than two players and not so peaceful. Creativity in the conceptualization of futuristic space weapons is not lacking. Space has been transformed into a warfighting domain and its militarization and weaponization will continue in the future. When lasers, plasma weapons, particle beams and other types of orbital weapons will become a reality remains just a matter of time.

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TRANSFORMACIJA SVEMIRA U RATNI DOMEN U 21. VEKU

Apstrakt: Rad razmatra proces transformacije svemira u ratni domen u 21. veku. Tokom Hladnog rata svemir je bio mesto razumevanja i miroljubivog takmičenja između supersila. Militarizacija je postojala od početka kosmičke ere, isključujući naoružavanje svemira sve do početka 21. veka. Nepostojanje međunarodnog režima koji bi sprečio naoružavanje svemira i tehnološki napredak otvaraju nove mogućnosti državama u njihovoj težnji za uvećanjem moći. Teorijsku paradigmu čini realistička perspektiva da su međunarodne institucije odraz minimalnog konsenzusa najmoćnijih država i mehanizam umanjivanja njihovih troškova. Svemir je samo jedna od arena ratovanja, ali sve važnija s obzirom da svakodnevni život, infrastruktura i komunikacija počivaju na svemirskim objektima. Uspešno testirano antisatelitsko oružje otvara nova pitanja odbrane ranjivih svemirskih instalacija od napada protivnika. Prognostička teza autora se odnosi na novu trku u svemirskom naoružanju i pitanje momenta kada će laseri, plazma oružje, kinetičko bombardovanje i drugi tipovi svemirskog oružja ugledati svetlost dana. Strateški balans će ostati netaknut sve dok se ne izume superiorno svemirsko sposobno da neutrališe postojeće ofanzivne kapacitete država i izbriše sposobnost za drugi udar. Autor zaključuje da međunarodne institucije ne mogu ograničiti ambicije država u osvajanju svemira jer one ne žele da se odreknu tog potencijala, da je svemir nesumnjivo postao nova arena ratovanja, ali i da je ograničeni svemirski rat malo verovatan.

Ključne reči: svemir, ratni domen, militarizacija, naoružavanje, sateliti, svemirsko oružje, strateška stabilnost.