



**Strengthening the Outer Space Treaty:
Addressing Emerging Security Concerns in the Age of Technological Advancements**

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JCSP 49 DL

Exercise Solo Flight

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Strengthening the Outer Space Treaty: Addressing Emerging Security Concerns in the Age of Technological Advancements

The fact that some nations have not been acting congruent to the Western led rules based international order should not be a surprise, but recent news articles have highlighted alarming developments regarding Russia's activities in space, particularly concerning the development of nuclear weapons in space for the purposes of being employed in a co-orbital anti-satellite (ASAT) role¹. Nuclear weapons employed in space are an indiscriminate area weapon that cannot differentiate between legitimate military targets and commercial or civil satellites and could render low earth orbit unusable for upwards of one year because of the residual radiation. This would be in addition to the countless, non-hardened, satellites that would be damaged or destroyed by any debris resulting from the detonation, or by the ensuing electromagnetic pulse.² The fact that a nuclear weapon in space is in violation of international laws and Article 4 of the Outer Space Treaty (OST) notwithstanding, pundits agree that terrestrially the world is not at risk as nuclear weapons in space provide no advantage.³ Arguably, a space-based nuclear weapon employed in a co-orbital ASAT role would be ineffective as it would threaten an adversary's own satellites as much as our own. The greater risk to space-based assets would be a nuclear-powered satellite as it would provide an adversary with an immediate advantage, which will be discussed later in this paper.⁴ When addressing the issues of the placement of nuclear weapons in space, the OST must be at the centre of all discussions, as it is the primary international framework governing arms control in space. Conceived during the Cold War era, its inception was motivated by the need to prevent space exploration from devolving into an arms race. However, recent events demonstrate that the treaty is failing to address emerging security concerns effectively.⁵ The OST is no longer fulfilling its original intent, and technological advancements have exposed loopholes that leave adherents to the rules-based international order vulnerable from a defense and security (to include economic, food, transportation, and infrastructure⁶) perspective. Consequently, this paper will show there is a pressing need to amend the OST to include the implementation of controls over the use of nuclear power and other dual use technologies in space

The introduction of the Truman Doctrine in 1947 is credited as being the start of the cold war, and consequently one could argue the start of the nuclear arms race between the United States and the Soviet Union (which will be referred to as Russia from this point forward). The space race started with Russia launching of Sputnik 1, the first artificial satellite, in October 1957 and then quickly followed up with the first animal in space a month later. Russia then put the

¹ DeLuce, Dan. 2024. "Pentagon official warns Russian anti-satellite nuclear weapon could be devastating." *NBC News*, May 1.

² *ibid*

³ Harrison, Todd, and Clayton Swope. 2024. "Russia Is a Serious Threat in Space, But There's No Need to Panic." *The National Interest*, February 27. Accessed May 2024.

⁴ *Ibid*.

⁵ 2024. *Center For Arms Control and Non-Proliferation*. Accessed May 21, 2024. <https://armscontrolcenter.org/outer-space-treaty/>

⁶ Stiles, Charles W. 2024. "Perspective: The Threat of Weapons in Space." *Homeland Security Today*. April 8. Accessed May 13, 2024.

first human in space in April 1961, which drove President, John F. Kennedy to declare the US would put a man on the moon by 1970.

During the cold war, both superpowers saw developments in rocketry and nuclear weaponry that allowed for the testing of nuclear weapons in space.⁷ Following concerns over these developments and the potential for the arms race to extend into space, the US proposed a treaty for the verification of testing space objects in 1957 but Russia was on the cusp of launching Sputnik 1 and declined. With the space race now making the cold war's arms race expansion into space a legitimate possibility the West put forth multiple arms control treaty proposals until eventually what is referred to as the OST was ratified unanimously by the United Nations (UN) General Assembly on October 17, 1963, aiming to regulate the exploration and use of outer space to ensure it benefits all humanity.⁸

Besides declaring that the exploration and use of space was for the benefit of all, and that member states shall conduct space activities in accordance with international law, the OST has four provisions particularly germane to this discussion. Those provisions are Article 4 which bans the placing of nuclear weapons or weapons of mass destruction in space, Article 7 which declares that the launching state is liable for any damages caused to another state party, Article 8 which defines ownership of space objects, and Article 9 which declares that the activities of one state party may not infringe upon the free access to space of another state party.⁹

The OST was designed to promote international cooperation in space exploration as a means of contributing to the development of mutual understanding with the hope of avoiding an arms race in space. Furthermore, the UN viewed an OST as means of extending of UN General Assembly Resolution 110 (II), which was aimed at avoiding provocation or encouragement of any threat to the peace, breach of peace, or act of aggression, to space.¹⁰ At the time, the US was supportive of the treaty as they saw it as a means to bar the militarization of space and prevent an arms race in space.¹¹

Since the treaty's signing, significant technological advancements have occurred, including the development of co-orbital weapons such as radiofrequency jammers, lasers, high power microwaves, kinetic kill vehicles, and other sophisticated capabilities.¹² These capabilities did not exist in 1967 and provide a state party with the potential ability to adversely affect another state party's space-based capabilities. The impact of that potential ability becomes even greater when assessed against dual-purpose Global Navigation Satellite Systems (GNSS) capabilities such as the US' GPS or Europe's Galileo constellations. For the most part these

⁷ Howells, Kate. 2024. "What is the Outer Space Treaty." *The Planetary Society*. May 14. Accessed May 18, 2024. <https://www.planetary.org/articles/what-is-the-outer-space-treaty>.

⁸ 2017. "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies." *U.S. DEPARTMENT of STATE*. January 20. Accessed May 13, 2024.

⁹ 1966. "The Outer Space Treaty." *United Nations Office for Outer Space Affairs*. December 19. Accessed May 18, 2024. <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html>

¹⁰ Ibid.

¹¹ US DoS, Treaty on Principles. . .

¹² Stiles, "Perspective: The Threat of Weapons in Space. . .

technological advancements are not in contravention of international law, or Article 4 of the OST, and can obfuscate Articles 7 and 9 enough so as to render them useless.

Furthermore, in developing these technological advancements the financial barriers to entry into space have been lowered. Space is no longer the sole domain of nation states and the proliferation of space-faring nations, including power-houses like China and India, “rogue states” such as North Korea and Iran, along with the involvement of private entities such as SpaceX and Blue Origin, has expanded the landscape of space exploration and introduced new complexities as these space actors act in their own national or financial best interests; which aren’t always aligned with the rules based international order.

There are growing concerns about the potential exploitation and weaponization of space by both state and non-state actors. While traditional adversaries like Russia and China pose significant threats, they can reasonably be expected to conduct themselves in a consistent manner, while rogue nations and failing states could exacerbate the risks further. Regardless of the adversary, their potentially injurious actions were mitigated by size, weight, and power issues onboard their satellites. More specifically, size and weight restrictions for the solar panels onboard satellites limit their power output and therefore limit the impact of those co-orbital weapons.

Technological advancements have exposed loopholes in the OST, particularly regarding Article 4 and the prohibition of nuclear weapons or weapons of mass destruction in space. GNSS, micro-chips and other advanced technologies have enabled states to develop co-orbital offensive capabilities that are more precise and focused than traditional nuclear weapons, or weapons of mass destruction and do not contravene Article 4.

The Article 4 loophole is cut and dry. A weapon in space is either a nuclear weapon or a weapon of mass destruction, or it is not. Given that technology has advanced so far since 1967, and the variety of options that an adversary has available to them to impact our operations in space the more concerning loophole created by these advances in technology is Article 7 of the OST; liability on the part of one state party to the treaty for damages caused to another state party to the treaty’s objects in outer space. In order to understand why this is potentially a far greater loophole for concern one must look at the Convention on International Liability. Article 1 of the convention defines damage as including the loss of or damage to property. In addition, Article 12 of the convention states that the liability is limited to that necessary to restore the damaged item back to “the condition which would have existed if the damage had not occurred.”¹³ In the case of those co-orbital threats such as lasers, or radio frequency jammers the effects are reversible, so any effect would not be permanent meaning that even if any loss (and therefore damage) of capability could be proven as soon as those reversible attacks ceased the affected satellites would be returned to their original state and the offending state party would have been able to advance their national interests while suffering no consequences for their actions. This leads us to the next vulnerability in the convention, attribution. Article 3 of the convention says liability only exists if the damage is due to the fault of the launching state. The fact that the launching state can be one or more state parties notwithstanding, the critical component is that the affected state party needs

¹³ 1971. "Convention on International Liability for Damage Caused by Space Objects." *United Nations Office for Outer Space Affairs*. November 29. Accessed May 18, 2024.

to be able to attribute the damage to the launching state. Article 10 of the convention provides the final piece to this liability and attribution puzzle. Article 10 gives state parties one year from the date of the occurrence of damage, from the identification of the launching state which is liable, or one year following that point in which the state party could have reasonably been expected to have learned the facts to submit their claims for compensation. When Articles 3 and 10 are considered together the so what is that the affected state party has one year to prove that damage to their space object was caused by the space object of another launching state and submit a claim which suggests the ability to attribute damage to a launching state is paramount. Reversible effects can be applied intermittently, and impacted systems return to normal operations when the effect is no longer being applied which makes the proving of damage, and the attribution to a launching state exceedingly difficult. This difficulty is exacerbated when there are multiple launching states, and the offender must be identified.

The Convention on International Liability also contains one other article that provides another loophole in the OST. Article 6 of the convention exonerates launching states from liability if the launching state can establish the damage was caused in whole, or in part, by “gross negligence or from an act or omission with the intent to cause damage on the part of the claimant state...”¹⁴ The Article goes on to state that exoneration will not be granted in those instances where the launching state was acting contrary to international law and particularly, the OST. The placement of defensive measures in space is not contrary to the OST, and even though Article 2(4) of the United Nations Charter states members shall refrain from use of force against another state, Article 51 states nothing in the charter impairs a state’s right to individual or collective self-defence.¹⁵ Pre-emptive self-defence (i.e. in advance of the armed attack stated in Article 51) is an accepted principle of international law if the threat is imminent. If we then refer back to Article 1 of the OST, outer space shall be free for the exploration and use by all states, then and adversary could place a satellite in orbit and employ any of the reversible or irreversible co-orbital technological advances previously mentioned to disable or destroy another satellite and then argue pre-emptive self-defence was required as the result of gross negligence on the part of the claimant state party. While this argument may not stand up in international court the OST, by being almost sixty years old and having not accounted for advances in technology, creates a large enough loophole that an adversary, even if they were not able to avoid liability, could put off the assessment for years.

The security implications of these advancements are significant on their own. Given society’s dependence upon space-based enablers any one of the technological advances mentioned in this paper could have significant impact upon the national, financial, or agricultural security of a state party yet the placement of these capabilities in space is not in contravention of international law or the OST. The only saving grace is that the impact of many of these capabilities is mitigated by the power limitations resulting from the use of solar energy. Furthermore, capabilities such as radiofrequency jammers are limited terrestrially in the impact they can have because of the earth’s curvature. Once deployed in space they no longer face such limitations and can deliver effects over far greater ranges if their power supply permits.

¹⁴ 1971. "Convention on International Liability. . .

¹⁵ n.d. "United Nations Charter." *United Nations*. Accessed May 18, 2024. <https://www.un.org/en/about-us/un-charter>.

Nuclear weapons in space are not a new idea, nor are they a particularly useful idea because they pose little threat to humans on earth and provide little to no advantage in space because they will equally disadvantage all state parties in low earth orbit, and because they are explicitly forbidden under the OST; which then makes the offending state party subject to international condemnation and repercussions. Nuclear powered satellites, on the other hand, would provide an adversary with an immediate advantage, whilst being in accordance with the OST. Whereas the amount of energy created by solar panels is a function of their size, and panel size is dictated by satellite size, weight, and power considerations, nuclear powered satellites have no such limitations. Therefore, any sort of satellite employing directed energy weapons such as lasers, high power microwaves, or radiofrequency jammers powered by a nuclear generator would be able to do so indefinitely. For the more kinetic, irreversible, capabilities such as kinetic kill vehicles or robotic mechanisms a nuclear-powered space object would be able to travel faster and for longer than a conventional chemical powered space object with the same amount of propellant.¹⁶

Thus far, much of the threat has been focused on low earth orbit, which would suggest that the GNSS satellites in medium earth orbit upon which the banking industry, agricultural sector, and our supply chains rely upon are safe, but that is not the case. China's experimental satellites, Shijian 17, and Shijian 21 were launched into geosynchronous orbits with the stated purpose as being for research and development of debris mitigation techniques. Since their launch China has proven a capability to remove other space objects from their orbits using robotic grapples. ¹⁷ The placement of these satellites in outer space is not contrary to the OST. Furthermore, the OST, in establishing that the use of space shall be free for all but in not placing any obligation upon launching states to remove space debris leaves enough ambiguity for a state party such as China to argue that their removal of a "non-responsive" space object is in keeping with Article 1 of the treaty as it fits the definition of debris that is interfering in their free exploration and use of space. Given that the OST makes no mention of how issues such as space debris infringing upon a state party's free use of space should be handled, I would suggest that an attempt to assess liability against China for its actions would be the only recourse, but Article 6 of the Convention on International Liability would give China the counter-argument of gross negligence by omission on the part of the claimant state party. Whether or not this claim and counterclaim would stand up in international court is irrelevant as China's national interests would have been achieved in the interim and repercussions would take years to materialize, if ever. Shijian satellites coupled with a nuclear power source would become an exponentially greater threat.

Nuclear power sources, in and of themselves, also serve a dual purpose. A nuclear power source detonated in space would achieve the same effect as a nuclear weapon but would be entirely legal. Yes, liability could be assessed against the launching state(s) that either owned the

¹⁶ Corfield, Richard. 2024. *Physics World*. February 1. Accessed 05 19, 2024

¹⁷ 2022. "China's SJ-21 'tugs' dead satellite out of GEO belt: Trackers." *Breaking Defense*. March 10. Accessed May 19, 2024.; Jones, Andrew. 2022. "China's Shijian-21 towed dead satellite to a high graveyard." *Space News*. January 27. Accessed May 19, 2024.; Tingley, Brett. 2022. "A Chinese Satellite Just Grappled Another And Pulled It Out Of Orbit." *The War Zone*, September 01. Accessed May 18, 2024.

satellite or allowed it to be launched from within their territorial boundaries, but the actions of the launching state would not have been in contravention of international laws or the OST.

The rapid pace of technological advancement necessitates the modernization of the OST in order to address emerging security challenges effectively. There is no singular way to close the loopholes created by these advancements, but closing those loopholes is essential to maintaining stability and security in not only in outer space, but terrestrially as well. Here are three ways in which the loopholes in the OST could be mitigated in order to reduce the overall risk.

Firstly, there is no need to go so far as to do away with the OST and start over fresh. Though advancements in technology were not written into the OST the potential for such was realized and Article 15 was included. This article allows for any state party to the treaty to submit proposals for amendments and those amendments would enter into force upon acceptance by a majority of the state parties. This would allow state parties to bypass many of the partisan obstacles we see in other bodies such as the United Nations Security Council (UNSC). Rather than submitting resolutions to through the UNSC, amendments to the OST should be submitted in accordance with the OST articles, so that the partisan actions of one state cannot derail the process.

Secondly, dual use capabilities such as nuclear-powered satellites or China's Shijian series of satellites with their grapples may develop to the point of being economically and operationally viable. Not contravening the OST, but merely having the potential to act in a manner that would be in contravention of the OST does not mean controls or protective measures should not be put in place to ensure their safe operations and mitigate the potential for widespread misuse and abuse. That is not to suggest that they should be declared illegal, but more stringent controls related, but not limited to, liability for space debris, obligation on the part of the launching state to deorbit their defunct space objects and remove space any debris caused by their space object within strict timelines, etc. would put limitations on how these capabilities could be used to exploit loopholes in the OST.

Thirdly, akin to traffic separation schemes utilized in both the terrestrial air and maritime domains, language could be added to the OST to clearly define safety distances required between non-space debris space objects. The OST may not be able to outlaw the positioning of directed energy weapons, etc. in space, but measures such as a separation scheme could reduce the likelihood of their employment by eliminating the ability to claim such things as their Article 1 freedoms were being violated, or pre-emptive self-defence.

As it currently stands the OST can no longer achieve what it was originally created to achieve; a space arms race is once again possible. What has changed is the nature of the weaponry and the competition is no longer confined to only those nuclear capable superpowers. By implementing stricter controls over nuclear power in space and shoring up those areas that allow other technologies to be exploited to the detriment of humanity, the international community can strengthen the treaty and uphold the principles of peaceful cooperation and exploration in outer space.

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