



Militarization of Outer Space: Legal Limits under International Humanitarian Law

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Abstract:

The militarization of outer space has accelerated dramatically in the twenty-first century, driven by the proliferation of anti-satellite weapons, dual-use satellite constellations, directed-energy systems, and the emerging integration of artificial intelligence into space-based military operations. This paper critically examines the legal limits imposed on the militarization of outer space under international humanitarian law (IHL) and the broader corpus of international space law. It analyses the foundational treaty framework centred on the Outer Space Treaty (1967) and its cognate instruments identifying the critical gap between the prohibition on weapons of mass destruction and the absence of any prohibition on conventional military operations in space. The paper examines the applicability of IHL's core principles distinction, proportionality, precaution, and the prohibition on unnecessary suffering to space warfare scenarios, with particular focus on the targeting of dual-use satellites, anti-satellite weapons testing, and cyber operations in space. Drawing on the landmark Woomera Manual on the International Law of Military Space Activities and Operations (2024) and recent developments in the United Nations Open-Ended Working Group on the Prevention of an Arms Race in Outer Space, the paper assesses the normative adequacy of the existing legal framework. It concludes that while space is not a lawless domain, it is a law-deficient one, and proposes a framework for a new legally binding instrument to address the most critical regulatory gaps.

Keywords: Outer Space Treaty, International Humanitarian Law, Anti-Satellite Weapons, Dual-Use Satellites, Prevention of an Arms Race in Outer Space.

1. Introduction

1.1 The Strategic Stakes of Space

In October 1957, the Soviet Union's launch of Sputnik 1 inaugurated the space age and simultaneously revealed, for the first time, that the physical domain above Earth's atmosphere had strategic military dimensions that no existing legal instrument was prepared to address. Within a decade, the United States and the Soviet Union had negotiated the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies universally known as the Outer Space Treaty (OST, 1967) establishing the first and still the foundational legal architecture for human activity beyond the atmosphere. The OST's drafters confronted a fundamentally bipolar strategic environment in which the primary threat was the placement of nuclear weapons in orbit; they could not have anticipated the twenty-first century's proliferating cast of spacefaring states, the privatisation of launch and satellite infrastructure, the emergence of anti-satellite weapons as routine instruments of strategic competition, or the integration of space-based services so thoroughly into civilian life that virtually every dimension of the modern global economy communications, navigation, financial settlement, weather forecasting, and agricultural monitoring is now dependent on satellite systems that have no dedicated legal protection in the event of armed conflict.

The contemporary strategic reality of space is dramatically different from that which animated the OST. As of 2024, the United States Space Force was budgeted at approximately \$30 billion annually nearly



double the 2023 figure and its leadership has declared explicitly that "space is not just a support function. It's a war-fighting domain. We have to be prepared to fight, deter, and win" (Harvard National Security Journal, 2025). Russia maintains several conventional anti-satellite weapons already in orbit, conducted a destructive direct-ascent ASAT test in November 2021 that generated at least 1,500 trackable debris pieces and endangered the International Space Station, and continues to develop a space-based nuclear payload according to United States intelligence assessments (United Nations General Assembly, 2024; Arms Control Association, 2024). China has demonstrated direct-ascent ASAT capabilities, is developing co-orbital weapons capable of physically manipulating or disabling adversary satellites, and continues to invest in ground-based directed-energy systems (IJIRL, 2025). India conducted a successful ASAT test in 2019 under Mission Shakti. Four major spacefaring nations the United States, Russia, China, and India have either demonstrated or are developing capabilities for offensive space warfare, creating a technological and strategic reality that the legal framework of the 1960s was not designed to govern (Harvard National Security Journal, 2025).

This paper examines the legal limits that international humanitarian law, in conjunction with the existing space law treaty regime, imposes on the militarization and weaponization of outer space. The analysis proceeds from a foundational premise established by the International Court of Justice in its Nuclear Weapons Advisory Opinion (1996): IHL "applies to all forms of warfare and to all kinds of weapons, those of the past, those of the present, and those of the future" a proposition that, combined with the OST's status as binding treaty law, means that space is decidedly not a law-free zone, even if it is, as Koplow (2024) has described it, undeniably "law-deficient."

1.2 Definitional Distinctions

The paper employs three analytically distinct concepts that are often conflated in public discourse. *Militarization* refers to the use of space for military support functions reconnaissance, surveillance, navigation, communication, and early warning that do not themselves involve the deployment or use of weapons. This category has been a feature of space activity since the early 1960s and has never been prohibited under international law, implicitly or explicitly. *Weaponization* refers to the deployment or use of weapons in or through outer space placing weapons systems in orbit, deploying ground-based weapons designed to attack space objects, or using space-based platforms to deliver kinetic or non-kinetic attacks on terrestrial targets. This category is partially constrained by the OST's prohibition on weapons of mass destruction but is otherwise unaddressed by treaty law. *Space warfare* refers to the active use of weapons against space objects or through space in the context of armed conflict the operational application of weaponized space capabilities. This category is governed primarily by IHL, supplemented by the OST and the United Nations Charter's jus ad bellum framework.

2. The International Legal Framework: Space Law and Its Limits

2.1 The Outer Space Treaty: Text, Scope, and Structural Gaps

The OST, which entered into force on October 10, 1967, and had 115 States Parties as of June 2024, is the constitutional foundation of international space law (Arms Control Association, 2024). Its provisions most directly relevant to militarization are contained in Articles I, IV, and IX. Article I establishes that outer space "shall be the province of all mankind" and declares that space shall be "free for exploration and use by all States" a principle of non-exclusivity that has been interpreted as permitting military use of space provided it does not infringe on the freedom of access of other states. Article IV contains the Treaty's most operationally significant arms control provisions: it prohibits States Parties from placing in orbit around Earth, or on celestial bodies, "any objects carrying nuclear weapons or any other kinds of weapons of mass destruction." It further mandates that the Moon and other celestial bodies be used exclusively for peaceful purposes, prohibiting military bases, weapons testing, and military exercises on celestial bodies (OST, 1967, Art. IV).

The structural limitations of Article IV are profound and have been consistently identified by legal scholars as the central weakness of the space law arms control regime. First, the WMD prohibition applies only to weapons placed in orbit or stationed on celestial bodies it does not prohibit the launching of ballistic missiles, which pass through space while carrying nuclear warheads, a deliberate gap reflecting the strategic interests of the nuclear powers at the time of negotiation (Arms Control Association, 2024; Defence Industry, 2024). Second, the prohibition covers only weapons of mass destruction; conventional weapons directed-energy systems, kinetic kill vehicles, co-orbital interceptors, jamming systems, and cyberweapons are entirely unregulated by Article IV, a gap that has grown increasingly consequential as conventional ASAT capabilities have proliferated (IJIRL, 2025; Finabel, 2023). Third, the Treaty's concept of "peaceful purposes" has never been definitively interpreted: the United States has consistently maintained that "peaceful" means "non-aggressive" rather than "non-military," thereby permitting reconnaissance satellites and military support systems as consistent with the Treaty (Finabel, 2023; Defence Industry, 2024).

Article IX imposes an obligation on States to conduct activities "with due regard to the corresponding interests of all other States Parties" and to avoid "harmful contamination of space." The Woomera Manual extensively analysed the negotiating history of this provision and concluded that no definitive legal standard can be derived from state practice regarding what constitutes unlawful "harmful interference" ASAT tests, for example, have been broadly condemned as dangerous and irresponsible without generating any finding of a treaty violation (Beard & Stephens, 2024; Lieber Institute, 2024). This interpretive indeterminacy means that Article IX functions more as a diplomatic norm of responsible behaviour than as an enforceable legal constraint with specific, adjudicable content.

2.2 The Supporting Treaty Instruments

Four additional treaties supplement the OST in ways relevant to militarization. The Liability Convention (1972) establishes a compensation regime for damage caused by space objects, including damage to other space objects a provision that, in theory, creates financial liability for states that conduct ASAT tests generating debris that damages other satellites. The Registration Convention (1976) requires states to register space objects with the United Nations, a transparency measure that has been widely circumvented, with significant numbers of military satellites described in vague or misleading terms that prevent other states from assessing their capabilities (Beard & Stephens, 2024). The Rescue Agreement (1968) is relevant to military space activities in that astronauts who engage in hostilities lose their protected status under the Agreement and instead become subject to prisoner-of-war treatment under IHL an early textual acknowledgement that IHL norms can penetrate the space law regime (Defence Industry, 2024). The Moon Agreement (1979) ratified by only eighteen states and not by any of the major spacefaring nations extends the prohibition on military activities to the Moon, prohibiting weapons testing and threatening force against other states' lunar activities; its limited ratification renders it effectively without normative force for the most relevant actors (European Journal of Law and Political Science, 2026).

2.3 PAROS and the Multilateral Deadlock

The United Nations General Assembly has addressed the prevention of an arms race in outer space (PAROS) through annual resolutions since 1981, and the Conference on Disarmament has had PAROS on its agenda for decades without producing any binding outcome. The most significant recent multilateral effort was the Open-Ended Working Group (OEWG) on PAROS, which convened four sessions between 2022 and 2023, tasked with making recommendations on reducing space threats through norms, rules, and principles of responsible behaviour (ICRC, 2023). The OEWG produced a report that identified norms including a moratorium on destructive ASAT testing, notification of potentially dangerous space activities, and registration transparency but did not achieve consensus on legally binding instruments, reflecting the



fundamental disagreement between the United States and its allies on one side and Russia and China on the other about the appropriate legal architecture for space arms control (UNGA, 2024).

This geopolitical deadlock was starkly illustrated in April 2024, when Russia vetoed a United States and Japan-sponsored Security Council resolution reaffirming that parties to the OST shall not place nuclear weapons or WMDs in orbit a text that merely restated existing treaty obligations. Russia's veto was widely interpreted as signalling its intent to preserve operational flexibility for a space-based nuclear capability (UNGA, 2024; Just Security, 2025). China abstained. The episode illustrated the extent to which PAROS multilateralism has become paralysed by great-power competition, leaving the existing treaty framework with all its gaps as the operative legal environment for the foreseeable future.

3. IHL in Outer Space: Applicability and Core Principles

3.1 The Applicability Question

International humanitarian law the law of armed conflict or *jus in bello* was not drafted with outer space in mind. The four Geneva Conventions (1949) and their Additional Protocols (1977) address the conduct of hostilities in international and non-international armed conflicts without any specific reference to the spatial domain in which hostilities occur. The foundational question whether IHL applies to armed conflict that involves or occurs in outer space was for many years treated as unresolved in the legal literature. It is now the subject of strong convergence across major spacefaring states and among international legal experts.

The ICJ's conclusion in the Nuclear Weapons Advisory Opinion (1996) that IHL applies to "all forms of warfare and all kinds of weapons, those of the past, those of the present, and those of the future" provides the authoritative judicial foundation for the applicability of IHL to space warfare. This position has been affirmed by the United States Department of Defense Law of War Manual, which explicitly acknowledges IHL's application to military space operations; by the European Union States in a joint contribution to the OEWG; and by the Australian position paper submitted during the OEWG process (Lieber Institute, 2024). The Woomera Manual published by Oxford University Press in 2024 as the first comprehensive examination of the international law of military space activities across all three phases (peacetime, tension and crisis, and armed conflict) takes as one of its core conclusions that "the general targeting principles of LOAC do apply to space in a time of armed conflict," a position it derives from treaty interpretation, state practice, and the ICJ's advisory opinion (Beard & Stephens, 2024; Lieber Institute, 2024).

This conclusion has significant practical implications: once an armed conflict exists and involves attacks on or through space assets, the full corpus of IHL distinction, proportionality, precaution, the prohibition on unnecessary suffering, and the duty to protect the natural environment applies to those operations. IHL does not, however, govern peacetime military activities such as ASAT tests or the deployment of co-orbital weapons systems conducted short of armed conflict a critical gap addressed in Part 4 below.

3.2 The Principle of Distinction

The principle of distinction requiring belligerents to distinguish at all times between civilians and combatants, and between civilian objects and military objectives, and to direct attacks only against the latter is the bedrock of IHL (Additional Protocol I, 1977, Arts. 48, 51, 52). Its application to space operations raises immediate and practically significant challenges arising from the predominantly dual-use character of space infrastructure.

A dual-use satellite is one that simultaneously performs military and civilian functions providing navigation services to both military and civilian users, relaying communications for both commercial and defence networks, or collecting imagery used by both intelligence agencies and humanitarian organisations. The Starlink constellation, operated by SpaceX and providing communications to Ukrainian

military forces as well as civilians across Europe and globally, is the most prominent contemporary example (Harvard National Security Journal, 2025; Case Western Reserve Journal of International Law, 2025). Whether such a satellite constitutes a "civilian object" or a "military objective" for IHL targeting purposes is determined by whether it "by its nature, location, purpose or use makes an effective contribution to military action" and whether its "total or partial destruction, capture or neutralisation, in the circumstances ruling at the time, offers a definite military advantage" (Additional Protocol I, 1977, Art. 52(2)).

The Woomera Manual addressed the dual-use problem directly and with significant practical consequence. It concluded that where a satellite is used to provide support to military operations even partially it may qualify as a military objective and may therefore lawfully be attacked, subject to the proportionality constraint (Beard & Stephens, 2024; Lieber Institute, 2024). This conclusion is legally sound but raises profound concerns about the structural incentive it creates for states to design satellites as exclusively civilian or exclusively military. Professor Koplow of Georgetown University one of the Woomera editors had previously argued that the United States' practice of relying on "dual-use" commercial satellites for military support may itself create targeting risk for those satellites under IHL distinction analysis, a concern that the Manual acknowledged but did not resolve (Duke Law, 2025). The proliferation of commercial satellite constellations performing military communications functions Starlink being the most prominent but far from the only example means that the distinction principle creates both an accountability framework for attackers and a significant legal vulnerability for commercially operated systems that have been integrated into military logistics.

3.3 The Principle of Proportionality and the Space Debris Problem

The proportionality principle requires that an attack not be launched if the expected incidental civilian casualties or damage to civilian objects would be excessive in relation to the concrete and direct military advantage anticipated (Additional Protocol I, 1977, Art. 51(5)(b)). In the space domain, the proportionality calculus is uniquely complicated by the problem of orbital debris the clouds of fragmented metal, at velocities of up to 28,000 kilometres per hour, generated by kinetic ASAT attacks on satellites in orbit. Russia's November 2021 direct-ascent ASAT test, which destroyed the defunct Cosmos 1408 satellite and generated at least 1,500 trackable debris pieces and hundreds of thousands of smaller fragments, illustrates the proportionality problem in vivid practical terms (Case Western Reserve Journal of International Law, 2025; ICRC, 2023). The debris cloud endangered the International Space Station requiring crew shelter manoeuvres and continues to threaten other operational satellites in Low Earth Orbit. In an armed conflict scenario, a state contemplating a similar strike would be required under IHL to estimate whether the expected collateral damage debris threatening civilian satellites, including communications and broadcasting systems serving civilian populations, and potentially endangering astronauts aboard the ISS or China's Tiangong space station is excessive relative to the military advantage of destroying the target (Case Western Reserve Journal of International Law, 2025). The Woomera Manual noted that destroyed satellites, unlike warships that sink or aircraft that fall to earth, create debris that persists in orbit, creating "significant" and potentially enduring hazard for other space users a factor that must weigh heavily in any proportionality assessment for kinetic ASAT attacks (Lieber Institute, 2024).

The Manual further concluded that the precaution obligation requiring attackers to take all feasible measures to avoid or minimise incidental damage would require appropriate selection of means and methods to neutralise enemy satellites, noting that many non-kinetic options jamming, spoofing, cyber interference, directed-energy dazzling may achieve the military objective with significantly less collateral damage than kinetic destruction (Beard & Stephens, 2024; Lieber Institute, 2024). This conclusion has direct bearing on the legality of destructive ASAT testing: even where a state could argue that a kinetic

strike on an adversary satellite is proportionate in terms of the military advantage gained, the availability of less destructive alternatives creates a feasibility obligation to consider those alternatives first.

3.4 Prohibition on Unnecessary Suffering and Indiscriminate Weapons

IHL prohibits weapons of a nature to cause superfluous injury or unnecessary suffering to combatants, and attacks of a nature that cannot be directed at a specific military objective or that have disproportionate effects (Additional Protocol I, 1977, Arts. 35, 51). The Woomera Manual applied these norms to several categories of emerging space weapons with significant analytical results. Electromagnetic pulse (EMP) weapons capable of disabling electronic systems across entire orbital bands rather than targeting specific satellites were assessed as potentially indiscriminate given their inability to discriminate between military and civilian space objects within their effect radius (Duke Law, 2025). Nuclear weapons detonated in space the most extreme form of EMP generation would generate electromagnetic effects capable of permanently destroying large numbers of satellites across multiple orbital regimes, effectively eliminating civilian communications, navigation, and environmental monitoring services for extended periods, and would clearly violate the prohibition on indiscriminate attacks in addition to the OST's WMD prohibition (Case Western Reserve Journal of International Law, 2025).

3.5 Cyber Operations in Space

Cyber operations targeting space assets occupy an increasingly important position in the military space domain, and their regulation under IHL raises novel questions to which neither the OST nor the Geneva Conventions provide clear answers. The Woomera Manual concluded that electromagnetic jamming of satellites temporary interference with satellite signals is unlikely to constitute a "use of force" or "attack" under IHL, given the reversibility of the effect and the absence of physical damage (Lieber Institute, 2024). This conclusion has significant implications: jamming, which Russia has extensively employed against Ukrainian and Western navigation and communications satellites in connection with the conflict in Ukraine, falls outside the threshold of armed force that triggers IHL obligations a gap that allows significant operational interference with space systems without legal accountability under the laws of war (UNGA, 2024).

Cyber operations that cause physical damage to space objects for example, by corrupting satellite software to cause loss of orbit control and re-entry would cross the threshold of an "attack" under IHL and trigger the full proportionality and distinction analysis discussed above (Harvard National Security Journal, 2025). The Harvard National Security Journal's 2025 analysis of IHL in space concluded that a cyber attack permanently disabling a satellite used by non-state actors for military purposes would likely comply with IHL principles it would not cause superfluous injury, necessity would be satisfied if it is the minimum necessary level of force, and proportionality would be assessed against the civilian functions simultaneously performed by the satellite (Harvard National Security Journal, 2025).

4. Critical Regulatory Gaps and Emerging Challenges

4.1 The Peacetime Gap: ASAT Tests and the Absence of a Specific Prohibition

The most critical structural gap in the legal framework is the absence of any specific prohibition on anti-satellite weapons testing in peacetime the domain in which ASAT activities most directly threaten the long-term sustainability of the space environment and the security of civilian space infrastructure. IHL, by definition, applies only during armed conflict; the OST's Article IX "due regard" and "harmful interference" provisions impose only vague obligations whose content cannot be determined from state practice; and no treaty specifically bans or regulates ASAT testing outside the context of armed conflict (Just Security, 2025; ICRC, 2023). The consequences of this peacetime gap are illustrated by the fact that Russia (2021), China (2007), India (2019), and the United States (2008) have all conducted destructive ASAT tests without facing any legal finding of treaty violation, even where as with Russia's 2021 test the



international community broadly condemned the activity as dangerous and irresponsible (ICRC, 2023; Case Western Reserve Journal of International Law, 2025).

The United States committed unilaterally in 2022 not to conduct destructive direct-ascent ASAT tests and called on other nations to follow suit a norm-building exercise that remains hortatory rather than binding, and has not been matched by Russia or China (Arms Control Association, 2024). The OEWG process has identified a moratorium on destructive ASAT testing as one of the most achievable near-term norms, but consensus on even this limited measure has been blocked by great-power competition (UNGA, 2024).

4.2 Autonomous Weapons Systems and AI in Space

The integration of artificial intelligence and autonomous systems into space-based military operations creates a set of legal challenges that neither the OST nor IHL was designed to address. The Woomera Manual's foundational analysis of OST Article VIII which assigns jurisdiction and control over space objects to the state of registry did not specifically address the question of whether the "control" requirement is satisfied when a space object is governed by an autonomous AI system rather than direct human intervention (ScienceDirect, 2025). For IHL purposes, the central concern is whether autonomous weapons systems in space can satisfy the distinction and proportionality requirements which require human-like judgment about the nature of targets and the expected incidental effects of attacks when operating faster than human decision-making cycles allow and in a domain where environmental conditions, sensor reliability, and the dual-use status of targets are all highly uncertain (ScienceDirect, 2025).

The European AI Act's express exclusion of military AI applications from its scope means that the EU's own regulatory framework for AI does not constrain the development of autonomous military space systems, creating a legal void at precisely the point where civilian AI governance and military law intersect (ScienceDirect, 2025). The Woomera Manual recommended establishing a future legal framework specifically addressing autonomous weapons in space a recommendation that has not yet generated traction in the multilateral system.

5. Conclusion and Recommendations

The legal analysis presented in this paper yields a set of conclusions that are simultaneously normatively significant and practically urgent. Space is not a lawless domain: the OST's prohibition on orbital WMDs, the Geneva Conventions' applicability to all forms of warfare including space warfare, and the application of IHL's core targeting principles as confirmed by state practice, the ICJ, and the Woomera Manual establish a legal framework that imposes meaningful constraints on the most extreme forms of space-based military activity. Yet the framework is profoundly inadequate to the strategic reality of twenty-first century space competition. Its gaps the absence of prohibition on conventional weapons in orbit, the peacetime regulatory vacuum for ASAT testing, the unresolved dual-use satellite problem, the inadequate treatment of cyber operations, the absence of any governance framework for autonomous weapons are not technical deficiencies amenable to interpretive correction. They are fundamental structural lacunae that require new legal instruments.

The following recommendations address the most critical gaps.

First, the international community should negotiate a Treaty on the Prevention of Placement of Weapons in Outer Space (PPWT) a proposal that Russia and China have repeatedly advanced but which has been blocked by the United States' insistence on verification safeguards and definitional clarity. A politically viable path forward may involve a more modest initial instrument: a multilateral moratorium on destructive ASAT testing, open for universal signature, building on the United States' 2022 unilateral commitment. This would not resolve the broader weaponization problem but would address the most



immediately threatening activity debris-generating kinetic ASAT tests through a legally binding rather than hortatory mechanism.

Second, the dual-use satellite problem requires a dedicated legal protocol clarifying the criteria for determining when a commercially operated satellite loses civilian object protection under IHL. The Woomera Manual's contribution is valuable but not sufficient: a binding instrument establishing notification requirements for the military use of commercial satellite systems, analogous to the civilian protection provisions for dual-use infrastructure in Additional Protocol I's Articles 54 and 56, would provide the operational clarity that targeting decisions require.

Third, the UN Committee on Peaceful Uses of Outer Space (UNCOPUOS), in collaboration with the International Committee of the Red Cross which has engaged extensively with the space security governance question should develop a set of Norms of Responsible Behaviour for Military Space Operations, analogous to the Tallinn Manual process for cyber operations. These norms, while not binding, could establish a consensus baseline for state behaviour across the full spectrum of military space activities from peacetime through armed conflict, building on the Woomera Manual's 48 rules and providing a foundation for eventual treaty codification.

Fourth, the regulation of autonomous weapons systems in space requires immediate multilateral attention, given the speed at which AI-enabled space military capabilities are being developed. A group of governmental experts under the Convention on Certain Conventional Weapons should be tasked with examining the compatibility of autonomous space weapons with the core IHL principles of distinction and proportionality, with a mandate to recommend specific legal constraints by 2028.

Fifth, UNCOPUOS's registration transparency regime must be substantially strengthened to ensure that all military satellites including those operated by commercial entities under government contracts are accurately described in terms of their capabilities and missions, reducing the strategic uncertainty that fuels worst-case threat assessments and accelerates arms racing dynamics.

The most important conclusion of this analysis is that the legal limits on the militarization of outer space, while real, are structurally insufficient to prevent the scenarios destructive debris-generating ASAT attacks, blinding of civilian navigation and communications infrastructure, autonomous weapons operating faster than human decision cycles that most threaten the long-term sustainability of the space environment and the security of the billions of civilians whose daily lives depend on it. As the Woomera Manual's editors observed, space is not "law-free" but it is "law-deficient" and the world community's demonstrated willingness to supplement the important general principles with sufficient implementing specifics has been, so far, catastrophically inadequate to the challenge. The window for preventive legal architecture is narrowing as military space capabilities proliferate. The time for new law is now, before the first great-power space conflict makes its inadequacy tragically apparent.

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