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Great Power Rivalry and the Militarization of Space: Strategic Competition in the 21st Century

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Abstract

Anti-satellite (ASAT) weaponry and their associated controversies have transformed the militarization of space into a foundational component of global rivalries in the twenty-first century. This paper examines the ASAT systems and the space military doctrines and related policies of the United States, China, India, and Russia—perhaps the world's leading challengers in this arena. Using the international relations theory of realism and the empirical methodology focusing on documented ASAT tests, this research explains the complexity of the deterrence problem, the effects on space debris, and the collision of arms control with the ASAT tests and the development of potential ASAT technologies. This analysis argues that the space militarization process manifests an increasing threat to the global order and the environment of space. By analyzing the national doctrines as well as the global order in a multipolar condition, this research identifies the governance gaps and outlines a set of policies, including technical resilience, confidence-building, tailored arms control, and the preservation of legitimate security interests to reduce the risk of escalating threats, to construct governance models for the identified gaps.

Keywords: Space Militarization, Anti-Satellite Weapons, ASAT, Great Power Competition, Strategic Stability, Space Security, Deterrence Theory.

1. Introduction

1.1 The Strategic Significance of Space

The incorporation of outer space for scientific as well as military, economic, and civilian uses has transformed space domains from scientific frontiers to contested strategic environments. Modern space command systems provide command, control, communication, computers, intelligence, surveillance, and reconnaissance (C4ISR), as well as early missile warning, precise navigation and timing, and weather forecasting (Gouveia, 2005). This dependency constitutes strategic weaknesses that space military counter operators may exploit. This is why space militarization has become an important topic in today's security studies.

The aspects of anti-satellite (ASAT) demonstration by the major powers are an indication of a paradigm shift in the nature of space competition. Four countries the United States, Russia, China, and India, have intentionally destroyed orbiting satellites with a kinetic intercept, in a select group of states with a proved capability to use hard-kill ASAT (Lauer, 2022). The 2007 destruction of its Fengyun-1C weather satellite by China was a precursor of a turning point in that it created an international buzz on the issue of space debris as well as an indication of Beijing being ready to create its own asymmetric space countermeasures to U.S. space dominance (Gill & Kleiber, 2007). This incident triggered the re-embracing of space security and the expedited counterspace programs amongst the leading nations.

1.2 Defining Anti-Satellite Weapons

The anti-satellite weapons comprise a wide range of technologies that are aimed at denying, degrading, disrupting, or destroying space-based capabilities. This paper adopts a comprehensive taxonomy that includes:

1. **Kinetic physical weapons**: Direct-ascent missiles and co-orbital interceptors that physically destroy satellites through collision, creating debris fields (Gouveia, 2005)
2. **Directed-energy weapons**: Lasers and high-power microwave systems capable of temporary disruption (soft-kill) or permanent component damage (hard-kill) depending on power levels and dwell time (Summers, 2012)
3. **Co-orbital and rendezvous-proximity operations (RPO)**: Spacecraft designed to approach, inspect, or interfere with satellites through on-orbit maneuvers (Prentice & Waite, 2020)
4. **Electronic and cyber warfare**: Non-kinetic attacks targeting satellite command links, ground control systems, or data transmissions to achieve denial or manipulation effects (Gouveia, 2005)

This broad definition recognizes that space warfare extends beyond dramatic kinetic intercepts to include subtle, reversible, and difficult-to-attribute capabilities that may be more operationally relevant in actual conflicts (Berge & Hiim, 2024).

1.3 Theoretical Frameworks

To comprehend the militarization of outer space, we must combine several theoretical perspectives from the field of the international relations. For offensive realism, the state pursues relative advantages in space capabilities due to the view that counterspace weapons are tools for offsetting the technological superiority of adversaries (Mearsheimer, 2001). The security dilemma model clarifies why defensive space capabilities like RPO satellite servicing may be seen as an offensive behavior, triggering response escalations (Herz, 1950). Analysis of ASAT capabilities impact on crisis stability within the scope of deterrence theory outlines what is classified as deterrence by denial (one's asset protection) and deterrence by punishment (retaliatory threat) (Bahney et al., 2019).

Classical deterrence logic must factor in the complexities of the space domain. Traditional offense-defense boundaries are complicated by the difficulty of attribution (Bahney et al., 2019). Retaliation can escalate in different domains. Due to the potential for attacking space systems to impact other domains simultaneously – including nuclear early warning, conventional precision strike, and civilian infrastructure – decision-makers innately face unpredictable control challenges during crises. (Morgan et al., 2008).

1.4 Research Questions

This paper addresses three central questions:

1. What anti-satellite (ASAT) technological abilities have great powers established, and how do these abilities stack up against one another down the kinetic and non-kinetic spectrum?
2. How do national strategic doctrines affect counterspace postures, and what impact do differences in doctrine have on crisis stability and the escalation of a conflict?
3. What policy frameworks and governance mechanisms might reduce escalation risks while accommodating legitimate security concerns in an era of intensifying space competition?

2. Technical Capabilities: A Comparative Assessment

2.1 Kinetic Direct-Ascent Systems

Kinetic direct-ascent ASAT systems rely on air or ground-launched missiles to intercept and destroy target satellites through a high-velocity impact. Such systems deploy current technologies used in the interception of missiles and therefore remain low-hanging fruit for states in possession of sophisticated missile capabilities. However, the resultant kinetically destroyed satellites create a cloud of lethal debris which remains a threat to all users of space, including the attacking state (Mackey, 2009).

United States: In February 2008, the United States showed a mature kinetic ASAT capability when a modified SM-3 missile, during Operation Burnt Frost, destroyed the malfunctioning USA-193 reconnaissance satellite which was at an altitude of 247 kilometers (Mackey, 2009). While the operation was officially justified on safety grounds, as the satellite contained hydrazine fuel that was toxic, the operation also exhibited US capabilities following China's test in 2007. The US has several systems that can conduct ASAT missions, such as US Ground-Based Midcourse Defense (GMD) interceptors, Aegis SM-3 variants, but official policy advocates restraint in such tests due to the proliferation of debris (Prentice & Waite, 2020).

China: The most impactful demonstration of kinetic ASAT destruction occurred in January of 2007 in China. A modified DF-21 medium-range ballistic missile removed the Fengyun-1C weather satellite at an altitude of 865 km – resulting in the formation of 3,000 collidable pieces of large debris, among other untrackable fragments, which remain dangerous for decades (Gill & Kleiber, 2007). In addition to the satellite destruction test, China also demonstrated the ability to endanger United States reconnaissance and communication satellites which furthered the implementation of asymmetric deterrence strategies to curb American space domination. Following evaluations, the Chinese military has reportedly continued the development and testing of direct ascent ASAT systems with documented successful interceptions through 2025

(Stefanovich & Porras, 2022).

India: India performed their first and only kinetic ASAT test on March 27, 2019, called Mission Shakti, where a Prithvi Defense Vehicle Mark-II interceptor destroyed the Microsat-R satellite at around 300 kilometers in altitude, resulting in about 250 debris fragments (Thompson, 2020). To avoid long-lived debris, Indian officials stated the altitude was selected purposely; however, while most fragments are likely to decay in weeks or months, some debris will require years before complete degradation. The test served multiple strategic purposes, including demonstrating technological capabilities, enhancing mitigation credentials amid China and Pakistan, and demonstrating Indian status in the global arena (Samson, 2011).

Russia: Russia's development of Anti-Satellite (ASAT) systems through co-orbital technology has its roots in the Soviet Union, as it conducted research on ASAT systems throughout the Cold War. Although there have been no direct-ascent kinetic tests in recent decades, it has the ability to perform such tests; Russia has modernized its counterspace systems (Chapman, 2008). Within its military doctrine, Russia places great emphasis on the fusion of electronic warfare with kinetic capabilities, as well as the non-kinetic options incorporated into a broader counterspace strategy (Stefanovich & Porras, 2022).

2.2 Directed-Energy Weapons

The alternative to kinetic intercept is directed-energy weapons (DEW), in which lasers or high-power microwaves can be used in disrupted or damaged parts of the satellites without producing debris. The magnitude of effects imposed by DEWs can vary, including temporary dazzling of optical sensors (soft-kill) to more severe methods (breakage of solar panels or electronics) (hard-kill) as provided the power levels and the quality of the beam meet the target hardening (Summers, 2012).

A major technical difficulty in ground-based lasers is that the lasers are vulnerable to atmospheric absorptions, turbulence, and require accurate systems of tracking and pointing. However, some of the leading powers have taken action on DEW research and development. Experimental laser systems that are run by the United States have the ability to track and light up satellites, although what is publicly available creates the perception that these are done by space situational awareness rather than offensive capability (Gouveia, 2005). China has also been reported to develop ground-based laser equipped to dazzle or blind satellite sensors, which can potentially pose a threat to the U.S. reconnaissance (Berge & Hiim, 2024). Russia also has its programs of laser dating back to Soviet times and has also proclaimed producing of the mobile laser programs to launch at the counter space (Chapman, 2008).

DEWs are more appealing to the strategy of their reversibility, scalability as well as an ability to produce less debris than kinetic weapons do. The brief laser blinding of an enemy reconnaissance data may be an indicator of resolution in a crisis that does not create the line of permanent annihilation. Nevertheless, this ambiguity is simultaneously the thorn in the flesh of deterrent and escalation management, as the targets might not be able to tell whether they were violently shaken or actually damaged (Summers, 2012).

2.3 Co-Orbital Systems and Rendezvous-Proximity Operations

Co-orbital ASAT systems involve spacecraft that maneuver close to target satellites to conduct inspection, interference, or attack missions. These systems exploit the same technologies used for legitimate satellite servicing, debris removal, and on-orbit assembly, creating significant attribution and arms control challenges (Prentice & Waite, 2020).

Russia has demonstrated advanced co-orbital capabilities through several high-profile incidents. In 2020, Russia tested a projectile release from a satellite in close proximity to another Russian satellite, demonstrating a capability that could threaten adversary spacecraft (Stefanovich & Porras, 2022). China has performed several RPO test, including the Shijian-17 satellite which displayed satellite grappling technology which may be used in militarized co-orbital operations (Berge & Hiim, 2024). Implementation of RPO skills within the U.S. remains within the confines of military and intelligence operations, though information remains classified (Prentice & Waite, 2020).

The dual-use of RPO related technologies generates a problem of arms controlling regulation. Understanding operational context, trajectory patterns, and behavioral indicators is essential for differentiating peaceful satellite servicing from hostile intent; however, such information is not likely to be available to all observers. This ambiguity allows states to develop counterspace capabilities under the guise of civilian or commercial programs, complicating verification and confidence-building (Lauer, 2022).

2.4 Electronic Warfare and Cyber Capabilities

Cyber attacks and electronic warfare (EW) are the most operationally relevant counterspace threats in the modern-day conflicts. These non-kinetic capabilities are able to deny, degrade or manipulate satellite communications and control links without leaving debris or even surpassing evident escalation limits (Gouveia, 2005).

Jamming attacks involve radio frequency interference to interfere with the uplinks or downlinks between the satellites and the ground stations, preventing communication between spacecraft and the ground stations. The attacks of spoofing manipulate fraudulent messages that can mislead receivers possibly with effects of deviant navigation or executing instructions. The ground control systems are targeted by cyber intrusion, where the system idles on software program vulnerabilities to infiltrate the satellite operations (Prentice and Waite, 2020).

The EW and cyber counterspace capabilities are held by all the major space powers, although the level of sophistication and their doctrine of operation is different. Three main areas that Russia has showcased EW usage include the GPS jam in Syria and Ukraine and communications disruption (Stefanovich and Porras, 2022). The military modernization in China involves the large-scale investment in the information warfare and cyber capabilities that can be applied to space systems (Berge & Hiim, 2024). The focus of the United States on resilience against EW and cyber threats is built on encryption, diversity of frequency, and distributed architectures (Prentice and Waite, 2020).

Strategic implication of the EW and cyber counter space operations is radically different compared to the kinetic attacks. They are not very appealing in terms of signaling or coercion unless armed conflict is involved because they are reversible and can be scaled. Nonetheless, the risks of escalation because of attribution and due to cascading effects pose a risk to decision-makers that can be underestimated in case of a crisis (Bahney et al., 2019).

2.5 Comparative Capability Matrix

Table 1 describes the counterspace capabilities of dominant space actors within four categories capturing the varied technological methodologies related to space warfare.

Table 1: *Comparative ASAT Capabilities by State and Type*

State	Kinetic Direct-Ascent	Co-Orbital/RPO	Directed Energy	Electronic/Cyber
United States	Demonstrated (2008); multiple systems capable of ASAT missions; policy restraint on debris-generating tests	Active R&D and operational capabilities; counter-RPO doctrine development	Significant R&D programs; ground and airborne laser systems under development	Advanced capabilities; emphasis on resilience and attribution
China	Demonstrated (2007); continued development and testing; extensive debris generation	Developing capabilities; multiple RPO demonstrations; dual-use programs	Investment in soft-kill systems; ground-based laser facilities reported	Growing capabilities; soft-kill preference in doctrine
Russia	Soviet-era heritage; modernization programs; no recent kinetic tests	Historical co-orbital programs; recent demonstrations of projectile release	Laser programs; mobile systems announced; Soviet-era facilities modernized	Extensive EW capabilities; demonstrated in regional conflicts
India	Demonstrated (2019); low-altitude test with mitigation measures	Developing surveillance and RPO capabilities; limited public information	R&D interest; no confirmed operational DEW systems	Building cyber/EW capabilities; focus on resilience

This comparative analysis shows numerous trends. First, despite the lowering of technical barriers, the possession of kinetic ASAT capabilities is still confined to a handful of states. Second, there is a widespread operational relevance of non-kinetic capabilities, especially electronic warfare (EW) and cyber — and these are more present in modern warfare. Third, the entwined and unique applications of co-orbital and directed-energy systems for military use makes it difficult to implement arms control and build trust. Fourth, there is a considerable 'counterspace' ASAT and non-kinetic capabilities' complementarity, signifying a more diversified strategic culture and a range of operational choices of the states.

3. Strategic Doctrines and Multipolar Dynamics

3.1 United States: From Sanctuary to Warfighting Domain

The U.S. space strategy has transitioned from treating space as a sanctuary with no threats, to viewing it as a domain of active warfare with both defensive and offensive capabilities. This change in doctrine has to do with greater concerns regarding the space counter-programs of both Russia and China, as well as the growing exposure of U.S. military operations to space disruptions (Morgan & Goldizen, 2007).

The establishment of the U.S. Space Force in December 2019 officially recognized space as a separate domain of warfare, resulting in the prioritization of organizational attention and the allocation of resources toward space operations. The current U.S. doctrine is characterized by three distinct elements: (1) resilience through distributed architectures and proliferated low-Earth orbit constellations; (2) space situational awareness and attribution capabilities to detect and characterize threats; and (3) defensive and offensive counterspace options to deter aggression and respond to attacks (Prentice & Waite, 2020).

The United States policy looks to balance competition with collaboration by fostering partnerships with allies, promoting norms of responsible behavior, and building the capacity to win military conflicts in space. In the United States 2020 Defense Space Strategy, space is termed, “a warfighting domain” and the U.S. is required to “maintain space superiority” through the full capabilities of military space power (Kruppa et al., 2021). This competitive posture is in conjunction with the U.S. diplomatic efforts around debris mitigation, transparency, and other confidence building measures. This reflects the dual nature of the U.S. position, balancing the need for security with the need for sustainability (Prentice & Waite, 2020).

Domestically and internationally, critics of the U.S. doctrine suggest that prioritizing space supremacy, offensive military capabilities, and the doctrine in its entirety will contribute to an escalation in the arms race and a decline in strategic stability. Some factions advocate that the U.S. doctrine perspective would be better placed in the domain of arms control, mutual constraints, and international treaties to prevent the weaponization of space (Thompson, 2020). These discussions illustrate the continuing conflict in the U.S. National Security Strategy between what might be termed as \`competitive realism\`, on the one hand, and \`cooperative institutionalism\`, on the other.

3.2 China: Asymmetric Deterrence and Strategic Ambiguity

China's strategy regarding space involves advocating for the peaceful use of space while simultaneously developing nuanced, comprehensive counterspace capabilities. The focus of their public diplomacy is not focused on what many consider to be a glaring contradiction but on what the authors (Gill & Kleiber, 2007) call asymmetric deterrence, or the seeming paradox of public advocacy for space arms control while seeking to develop deterrent capabilities that target the space assets of the United States.

The Chinese military literature focuses on the so-called counter-intervention and anti-access/area denial (A2/AD) tactics, which focus on the U.S. power projection capacities (space-based C4ISR systems) (Berge & Hiim, 2024). The 2007 ASAT test was an indication that China is ready to build and show competencies that could question U.S. space superiority at the expense of international reproach and the production of debris. Nevertheless, a later depiction of Chinese counterspace has focused on non-kinetic capability, specifically, electronic warfare, cyber assaults, and directed-energy weapons, which provide greater operational oftentimes and lessen debris hazards and could heighten jeopardy (Berge & Hiim, 2024).

The diplomatic position of China is the Prevention of an Arms Race in Outer Space (PAROS) program at the United Nations that aims to create treaties outlawing spaces weapons. This stance, critics say, is hypocritical considering that China is also undertaking counterspace, and the Chinese authorities claim that they are acting in self-defense against U.S. space militarization (Gill & Kleiber, 2007). This strategic ambiguity has several functions, limiting the capability of the U.S. with arms control and conserving Chinese options, influencing the international norms to support Chinese interests, and making the management of alliances of the U.S. in Asia-Pacific region difficult.

According to the latest studies, China adopts the focus on the use of soft-kill counterspace options reversible, non-debris-producing capabilities, rather than kinetic intercepts to use in practice (Berge & Hiim, 2024). This choice is based on the lessons of the international response to the 2007 test, the worry of debris striking Chinese space resources, and that soft-kill capabilities provide a superior capability of maintaining escalation in a conflict. However, China also has kinetic ASAT capability which is used as a strategic deterrence and coercive measure during extreme crises.

3.3 Russia: Legacy Systems and Asymmetric Options

Russia's counterspace posture reflects both Soviet-era heritage and post-Cold War adaptation to resource constraints and technological change. The Soviet Union developed extensive ASAT programs during the Cold War, including co-orbital interceptors and directed-energy weapons, establishing technical foundations that Russia continues to exploit (Chapman, 2008).

Contemporary Russian military doctrine emphasizes information warfare, electronic attack, and non-kinetic counterspace operations as asymmetric responses to U.S. and NATO technological superiority. In the course of various regional conflicts, Russia has demonstrated advanced military capabilities, such as GPS jamming and communications disruption; these actions reveal the military doctrines operationalized by Russia for the use of counterspace and conventional warfare integrated operational strategies (Stefanovich & Porras, 2022).

Russian counterspace activities emphasize updating Soviet-era capabilities and creating deployable, resilient systems that can threaten and protect against pre-emptive attacks on enemy space assets. Russia continues to develop both kinetic and non-kinetic approaches, demonstrated by the 2020 test of a co-orbital anti-satellite weapon system (Stefanovich & Porras, 2022). Framing these developments as defensive measures prompted by U.S. missile defense and space weaponization, Russian officials contrast sharply with the Western depiction of these systems as offensive strategies undermining international order (Chapman, 2008).

Russia's diplomatic position on space security resembles China's: supporting arms control initiatives that would constrain U.S. capabilities while preserving Russian options. Russia and China jointly proposed a draft Treaty on the Prevention of the Placement of Weapons in Outer Space (PPWT) at the Conference on Disarmament, though the United States and its allies rejected the proposal as inadequately addressing ground-based ASATs and lacking verification mechanisms (Stefanovich & Porras, 2022).

3.4 India: Emerging Capabilities and Strategic Autonomy

The March 2019 ASAT test by India became the first of the countries with proven kinetic counterspace capability, with larger aims of developing full space power and increasing deterrence credibility (Thompson, 2020). The test had various strategic purposes; it was an indication that India had attained technological success, it was used to enhance deterrence against China and Pakistan, and a way of asserting their status in the international governance bodies as a key space power (Samson, 2011).

The space security environment in India is based on strategic autonomy, which involves having independent capabilities although it seeks the partnership of all the major powers, especially the United States. Institutionalization of space as a security domain can be seen by the establishment of the Defence Space Agency in 2019, and space operations becoming a part of military planning (Samson, 2011). Indian officials emphasize responsible behavior and mitigation of debris, which is not the case as the low-altitude test of the Mission Shakti occurred and high-altitude intercept by China in 2007 produced long-lived debris (Thompson, 2020).

India has its own way of strategic issues in space security. The increasing reliance on space resources to support economic growth and military activities is exposed to weak points that can be manipulated by the enemies. The high level of counterspace capabilities in China is a direct threat to the Indian satellites especially in the Sino-Indian border conflicts. The developing space program of Pakistan and the possible avenue of Chinese counterspace technologies give regional dimensions to the threat calculus of India (Samson, 2011).

The space doctrine of India is still evolving, between the need to deter and diplomatic missions. India does not wish to enter a arms race, but to have credible counterspace capability which is difficult to achieve because of perceptions of the threat in the region and limited resources. Alliances with the United States such as the 2023 Space Situational Awareness agreement provide a way to improve capacity via collaboration without compromising on strategic independence (Samson, 2011).

3.5 Alliance Dynamics and Secondary Actors

Secondary players in great power space rivalry will continue to forge partnerships and develop new capabilities, affecting the geometry of strategic balance. U.S. space partnerships with NATO, Japan, South Korea, and Australia develop distributed architectures and integrated situational awareness which increases protection against counter-space attacks (Prentice & Waite 2020). These partnerships also serve to politically binding the U.S. allies and complicate targeting assumptions of adversaries.

European space powers, particularly France, Germany, and the United Kingdom, are progressively developing their own independent space security capabilities, all the while closely aligned with the United States. France stood up a Space Command in 2019 and has since announced the development of “active defense” systems which include counterspace capabilities (Stefanovich & Porras, 2022). This is a divergence from the norm in the European space players and reflects a desire to avoid over reliance on the U.S. and obtain a measure of strategic autonomy, but limited resources will require less independent action.

Japan's space security policy has changed from a pacifist orientation to include military objectives, and especially space situational awareness and counterspace capabilities. The establishment in 2020 of the Japan Space Operations Group actives within the Air Self-Defense Force signifies the institutionalization of military-space operations, assisted, at least in part, by the close U.S.-Japan security cooperation (Samson 2011).

The activities of private commercial actors further complicate the balance of power. Companies such as SpaceX, OneWeb, and Amazon's Project Kuiper build and operate constellations of thousands of satellites, creating new channels of dependency and new weaknesses. The commercial nature of these activities is in stark contrast to the military nature of SpaceX's decision to provide Starlink terminals to Ukraine in the course of the Ukraine-Russia war of 2022-2025, which blurs distinctions between civilian and military space assets, and may expand the scope of space targeting in future wars (Stefanovich & Porras, 2022).

4. Strategic Implications: Stability, Deterrence, and Escalation

4.1 Space Debris and Long-Term Sustainability

The use of kinetic ASAT tests creates a significant number of debris that poses a ‘tragedy of the commons’ situation. The ASAT test that China conducted in 2007 created over 3,000 pieces of debris that are still a danger today (Gill & Kleiber, 2007). Even the 2019 test that India conducted at a lower altitude created 250 pieces of debris. Although the debris quickly decayed, the atmosphere still poses a threat (Thompson, 2020).

One of the most significant of these threats is the Kessler syndrome. It describes a situation in which debris from one collision in space creates a cascading chain reaction. This phenomenon creates the possibility of an entire orbital region (including several satellites in the same belt) becoming unusable for decades (Mackey, 2009). This is also the source of self-destructive incentives for kinetic warfare. During a crisis, a warring state might decide to use ASAT weapons to degrade an adversary’s space capabilities before the debris created from the attack limits future military operations (Thompson, 2020).

Debris mitigation is a risk that must be accepted. India’s decision to conduct ASAT test Mission Shakti at a lower altitude recognized the consequences of debris accumulation and reflected a willingness to accept operational constraints to lower potential long terms danger (Thompson, 2020). However, in a real situation, the military might decide to override the restraint in the operational environment if ASAT kinetic operations are viewed as critical to operational success or strategic deterrence.

The debris issue also poses common concerns which may foster arms control or confidence-building measures. All space-faring nations benefit from maintaining usable orbital zones, indicating opportunities for treaties limiting debris-generating ASAT test firings, or barring kinetic intercepts above certain altitudes (Thompson, 2020). Yet, transforming these common concerns into legally-binding regulations continues to encounter significant challenges in terms of verification and enforcement.

4.2 Deterrence Instability and Crisis Dynamics

The expected capabilities of counter-space technologies disrupt the conventional and nuclear deterrence balance by endangering the command systems and communications of strategic stability. Destruction of early warning satellites disrupts and abstracts the missile launch detection capability, thus compressing the time available for decision-making and elevating the likelihood of false alarms in crises (Bahney et al, 2019). Deletion of satellites disrupting communications nuclear command and control and increases the fears of decapitation strikes along with erosion of confidence in the second strikes capability (Morgan et al, 2008).

Classical deterrence theory rests on a foundational assumption of a separation between conventional and nuclear domains at the conventional and nuclear thresholds of escalation which provide firebreaks guarding against escalation of a conflict. This changes with attacks on space as conventional and nuclear domain operations are conducted in support of space assets simultaneously. The ambiguity of intent and appropriate response from an attack on a dual-use satellite which provides early warning of nuclear and conventional missile launches (Bahney et al. 2019) is particularly concerning.

The non-kinetic counterspace attacks added problems regarding deterrence due to their reversibility and scalability. During a crisis, a target counterspace jamming attack or isolated cyber intrusion may be intended to signal limited activity, but it may instead be interpreted as signals laying the groundwork for more extensive attacks, leading to a pre-emptive attack (Berge & Hiim, 2024). If policymakers struggle with attribution regarding disruptions to an adversary's use of space, they may misattribute attacks or their responses may be insufficient, thereby undermining the credibility of deterrence and compounding the problem.

Cross-domain deterrence—retaliating in other domains (cyber, conventional, economic) for space attacks—offers possible routes for stability while also increasing complexity. When states threaten terrestrial retaliation for space attacks, adversaries may pre-emptively strike terrestrial targets to mitigate that retaliation, thereby expanding, rather than containing conflicts (Bahney et al., 2019). Furthermore, calibrating proportional cross-domain responses during crises requires advanced escalation management that may eclipse decision-makers' abilities under stress.

4.3 Escalation Pathways and War Termination

The one-of-a-kind attributes pertaining to outer space warfare have created course of escalation that are unlike any found in war on land. Having space attacks on adversary's satellites can have instantaneous and widespread impacts on military operations in all combat theaters and can pose opportunities for escalatory military actions to avoid operational stagnation. The "use it or lose it" paradigm, where states are incentivized to attack adversary satellites at the onset of conflicts to gain and maintain space combat advantage before their satellites are destroyed, can snap escalatory spirals (Morgan et al, 2008).

No kinetic kill, or 'soft-kill' counterspace options of jamming, cyber, dazzling, and directed-energy are still kill options, however, do provide range of escalation opportunities that could provide for crisis management and alternatively create complicated scenarios for de-escalation (Berge and Hiim, 2024). Soft-kill attacks viewed as threshold strikes and reversible are not likely to be viewed as crossing the line of war, possibly incentivize their use in war. The preference for soft kill options shown in the Chinese military doctrine demonstrates their recognition of space-related debris, in addition to their belief that soft kill attacks provide greater control on escalation (Berge & Hiim, 2024).

War termination in conflicts involving space strikes pose specific obstacles. Unlike land, where borders and territories can be given, traded, or occupied, destroyed satellites leave imbalances as they cannot be replaced and potential weaknesses remain even after active hostilities. Space debris for instance will remain damaging for all space operations long after the war is over which makes closing such conflicts even more complicated (Mackey, 2009). Taken altogether, these issues space wars will be unlikely to conclude. This in turn will prolong wider conflicts.

4.4 Nuclear Stability and Strategic Warning

The convergence of counterspace capabilities and nuclear deterrence creates extreme stability dilemmas. Space-based early warning systems, such as SBIRS and Russian equivalents, provide valuable warning time (minutes) critical to evaluating threats and responses (Bahney et al., 2019). Blindness to threats during critical nuclear crises increases pre-emption by nuclear powers as aggressors, and systems that blind opponents to threats are used to enable pre-emptive aggression, otherwise nuclear powers are forced to use systems with lower reliability.

The communications satellites that provide support for nuclear command and control represent another critical area of soft target vulnerability. The disruption of these command-and-control systems could impact the ability to authorize, transmit, and execute nuclear orders which would amplify the concerns of decapitation and undermine confidence in the ability to assure retaliation (Morgan et al., 2008). While nuclear states have redundant communications in other terrestrial domains and airborne systems, the space communications systems have particular soft target advantages in coverage, survivability and speed that terrestrial systems cannot replicate.

The integration of conventional and nuclear activities, with the use of the same space infrastructure, poses increased risk of collateral escalations. An assault aimed at degrading the conventional military capabilities by attacking reconnaissance and/or communications satellites may also result in the disabling of systems utilized for nuclear early warning and nuclear command and control, thereby unintententionally and disproportionately prompting a nuclear response (Bahney et al., 2019). This coupling suggests that space attacks, even if intended as limited conventional operations, carry inherent risks of nuclear escalation that decision-makers may underestimate.

Resilience measures—such as proliferated satellite constellations, protected communications, and diverse sensor architectures—can reduce vulnerabilities and enhance crisis stability. The U.S. shift toward distributed, proliferated architectures in low Earth orbit reflects recognition that resilience through numbers and diversity offers better protection than hardening individual high-value satellites (Prentice & Waite, 2020). However, proliferation creates new challenges for arms control verification and may simply shift competition toward capabilities that can attack distributed systems efficiently.

5. Policy Frameworks and Governance Challenges

5.1 International Space Law and Its Limitations

Specifically, from the Cold War, the contemporary international legal framework on space activities provides some key principles, but fails to address counterspace weapons specifically. Consider the Outer Space Treaty from 1967, which proscribes the placing of nuclear and other weapons of mass destruction in orbit, and the carrying out of military activities on celestial bodies; but fails to prohibit other conventional weapons or ASATs (Thompson, 2020).

The prohibition on 'weapons of mass destruction' in Article IV of the Outer Space Treaty is interpreted narrowly, such that conventional ASATs are excluded. Additionally, Article IV requires that space activities are to be conducted "for the benefit and in the interests of all Countries" and that space is the "province of all mankind." While this ideationally creates norms of the peaceful use of space, lack of enforcement and clear definitions on what activities are prohibited means that these principles will be ineffective (Thompson, 2020).

Other treaties and agreements—such as the 1968 Rescue Agreement, 1972 Liability Convention, and 1975 Registration Convention—deal with different aspects of space activities, but do not restrict counterspace weapons. The absence of verification provisions in these treaties reflects the political realities of the Cold War, along with the technical limitations of arms control agreements today (Gill & Kleiber, 2007).

International law and norms of responsible behavior provide additional options for governance. The UN Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities Recommended voluntary guidelines on debris mitigation, pre-launch notifications, and data sharing (Lauer, 2022). But voluntary norms are non-binding and rely on cooperation of states, even though cooperation may clash with their perceived security interests.

5.2 Arms Control Proposals and Verification Challenges

While many arms control initiatives have attempted to limit counterspace weapons, there is still no agreement from major space powers on any proposals. Preventing an Arms Race in Outer Space, PAROS, from China and Russia is an initiative at the Conference on Disarmament that seeks to stop the placement of weapons in outer space, however, it does not cover ASATs that are land based; the most advanced and widely used counterspace capability in existence (Thompson, 2020). The United States and allies have routinely rejected PAROS proposals on the basis that they do not cover the scope of counterspace threats, and do not provide an adequate means for verification.

Alternative proposals entail: (1) bans on kinetic ASAT testing that creates long-lived debris; (2) 'no first use' pledges for counterspace weapons; (3) exclusion areas around satellites to avert close approaches; and (4) transparency measures that include prior notification of space activities and sharing of orbital data (Lauer, 2022). All proposals, however, have their difficulties. Test bans would leave unbounded development of new, untested systems and would not constrain capabilities. No first use pledges lack significant credibility in their absence of meaningful verification. Exclusion zones could obstruct legitimate satellite servicing and removal of orbital debris. Transparency measures would entail trust and reciprocity that are likely absent in any such competition.

Verification presents the most fundamental challenge to space arms control. The prevalence of dual-use technologies– satellites that serve benign purposes, but are capable of hostile actions – complicates the identification of legitimate activities versus activities that breach the treaty. Ground based ASATs, as implemented and deployed, can be developed and disguised as ballistic missile defense systems, or space launch vehicles, complicating ASAT verification (Thompson, 2020). There is little to distinguish virtuously co-orbital systems meant for satellite servicing from co-orbital ASATs until the hostile actions that would trigger a verification gap that would destroy confidence in compliance.

Technical approaches to verification include national technical means (satellites and ground-based sensors), on-site inspections, data exchanges, and cooperative monitoring mechanisms. However, each method faces limitations. Satellites cannot reliably determine the internal characteristics or intent of observed objects. On-site inspections may be politically unacceptable and technically inadequate for mobile or concealed systems. Data exchanges depend on states' willingness to share sensitive information. Cooperative monitoring requires trust that may be absent among competitors (Lauer, 2022).

5.3 Confidence-Building Measures and Norms

Due to the lack of global arms control treaties, international CBMs may help alleviate the reduction of mistaken perceptions and the unintended escalation of CBMs. Proposed CBMs include:

1. **Pre-launch notifications**: Prentice and Waite (2020) argued that states would notify others prior to performing activities in space such that these activities might be construed as hostile to mitigate any possibility of surprises and to allow monitoring.
2. **Space situational awareness data sharing**: The ability of all states to avoid collisions and

assign appropriate activities would improve with the shared collaboration around the tracking data of satellites and debris (Stefanovich & Porras, 2022).

3. **Debris mitigation best practices**: Willingness to follow guidelines minimizing debris generation from everyday business and testing operations would sustain space's long-term usefulness (Thompson, 2020).
4. **Consultation mechanisms**: Hotlines or liaison systems would facilitate real-time communication in times of crisis in order to elucidate intent and avoid escalation born of misperception (Morgan et al., 2008).
5. **Behavioral norms**: Tensions could be mitigated even in the absence of formal treaties by the avoidance of close approaches to other's satellites without communicating in advance (Lauer, 2022).

The effectiveness of CBMs depend on the principles of reciprocity, transparency, and the presence of political will. States must feel that there is a benefit to collaborating and trust that there will be compliance from the partners regarding the informal agreements. Historical experience with CBMs in other fields, like the Incidents at Sea Agreement between the U.S. and the Soviet Union, indicates that, despite wider political contests, concentrated, technically tailored arrangements can mitigate operational risks (Stefanovich & Porras, 2022).

Critics argue that CBMs may provide false confidence or enable adversaries to gather intelligence while appearing cooperative. Moreover, CBMs do not constrain capabilities or prevent their use during conflicts when security interests override cooperative norms. These limitations suggest CBMs should complement rather than substitute for binding arms control agreements and technical resilience measures (Thompson, 2020).

5.4 National Policies and Regulatory Approaches

Counterspace threats and military operations in outer space have increasingly become a staple in a nation's space policy. Accordingly, given the strategic importance of the outer space domain, it is understandable why space policy in the U.S. prioritizes resilience, cooperation with allies, and superior control of space with the support of responsible behavior and debris mitigation (Prentice & Waite, 2020). The U.S. Space Force and U.S. Space Command are together institutionalizing the doctrine and capabilities for warfare in space.

China's space policy tends to civilian and military functions within a single administrative framework, as China integrates counterspace capabilities into its military modernization. In theory, China's policy for space is peaceful and endorses the suspension of the arms race in outer space. In practice, however, writings in military strategy view space control and counterspace operations as a requisite to modern warfare (Gill & Kleiber, 2007). The duality of China's policy tends to critique military weakness to adapt and strategically influences the behavior of other nations, thereby providing China with a certain veneer of strategic ambiguity.

India's developing space policy is centered on balancing deterrence with restraint. Following its 2019 ASAT test, India highlighted the importance of debris mitigation and self-restraint, highlighting its capability to defend its space assets (Thompson, 2020). The partnerships that India is forming with the United States and other nations, as well as its participation in international governance of space, are indicative of the norms that India is trying to establish.

The specific Russian space policy emphasizes territorial sovereignty, countering US hegemony, and the construction of operationally effective asymmetric counterspace capabilities. Russian counterparts justify the counterspace programs as defensive on the U.S. militarization of outer space while endorsing arms control proposals that would limit U.S. advantages (Stefanovich & Porras, 2022).

Regulatory strategies directed at commercial space activities now consider dual-use technologies and national security concerns. Balancing security and stimulating commercial activities are reflected in export controls on space technologies, licensing obligations for satellite operations, and institutional cooperation between civil and military space agencies. Nevertheless, the proliferation of space-faring nations and the global character of space commerce challenge unilateral regulatory strategies (Lauer, 2022).

When it comes to commercial space activities, regulatory regimes begin to focus on dual-use technologies, and on a more granular level, on technological aspects of national security. While trying to give more `space` to commercial innovations, export controls on space technologies, regulations on licensing spacecraft, and the fragmentation of control mechanisms of civilian and military space sectors try to contain security risks. Yet, unilaterally, the widespread phenomena of space commerce, and of space-faring states, dissolve the above efforts (Lauer, 2022).

6. Conclusion: Pathways to Space Security

6.1 Summary of Key Findings

This analysis has examined the militarization of space through the lens of great power competition, focusing on anti-satellite weapons as the most visible manifestation of counterspace rivalry. Several key findings emerge:

ASAT systems and technologies have spread beyond the original Cold War Super Powers to include both China and India with varying degrees and types of technologies, including kinetic direct ascent kill interceptors and soft kill non kinetic systems. The comparison suggests that even though kinetic systems are limited to a few units of states, the non kinetic systems—especially those pertaining to electronic warfare and cyber—are of greater availability and are of increasing operational relevance.

Moreover, national strategic doctrines have also integrated different approaches to space security, which are shaped by strategic cultures, threat perceptions, and resource constrains. For the US, the focus is on resilience and space supremacy; China opts for asymmetric deterrence with a soft-kill preference; Russia adopts a legacy systems and asymmetric approaches; whereas India is trying to find an equilibrium of deterrence and norm of responsible behavior. Such differences in doctrines open both the possibility of misinterpretation and the prospects of building confidence.

Thirdly, the generation of space debris, which also poses a threat to long-term space sustainability, destabilizes strategic stability through multiple geoeconomic space deterrence mechanisms, which also destabilizes deterrence through the attacks on command systems and early warning. Space also incorporates multiple systems soft-kill ambiguity escalation, crisis dynamics, and use-it-or-lose-it incentives. The integration of space infrastructure with conventional and nuclear operations deepens the threat of unintentional escalation.

Fourth, existing governance frameworks—such as the Outer Space Treaty and self-regulatory principles—remain insufficient in constraining counterspace weaponry. Proposals aimed at controlling the arms face dual-use verification challenges, while confidence-building measures provide slow increment steps without substitution for legal frameworks and systemic technical resiliency.

Fifth, multipolar dynamics are increasingly configuring the competitive environment in space, particularly with respect to alliance systems and the roles of secondary state and commercial actors in the competition. The U.S.-China rivalry constitutes the primary axis of the competition in spacecraft systems, while Russia, India and other actors exploit and complicate the bilateral dynamics with their own strategies.

6.2 Policy Recommendations

Addressing the challenges of space militarization requires integrated approaches combining technical resilience, diplomatic engagement, and selective arms control:

Near-term priorities (1-5 years):

1. **Enhance resilience**: Accelerate development of proliferated, distributed satellite architectures in low Earth orbit that reduce vulnerability to counterspace attacks through redundancy and diversity (Prentice & Waite, 2020).
2. **Improve attribution**: Invest in space situational awareness capabilities and forensic analysis tools to reliably identify sources of counterspace attacks, enabling appropriate responses and deterrence (Stefanovich & Porras, 2022).
3. **Establish crisis communications**: Create bilateral and multilateral hotlines for space incidents to enable rapid clarification of intent during crises and prevent escalation based on misperception (Morgan et al., 2008).
4. **Adopt debris mitigation norms**: Implement voluntary restraint on kinetic ASAT tests that generate long-lived debris, building on recent U.S. and Indian commitments to responsible behavior (Thompson, 2020).

Medium-term objectives (5-10 years):

1. **Negotiate limited arms control**: Pursue focused agreements on specific issues where verification is feasible and interests align, such as bans on kinetic ASAT tests above certain altitudes or keep-out zones around critical satellites (Lauer, 2022).
2. **Develop confidence-building measures**: Establish data-sharing arrangements for space situational awareness, pre-notification requirements for close approaches and maneuvers, and consultation mechanisms for ambiguous incidents (Stefanovich & Porras, 2022).
3. **Strengthen alliance cooperation**: Deepen partnerships with allies and partners on space security through combined exercises, integrated architectures, and shared doctrine development (Prentice & Waite, 2020).
4. **Regulate dual-use technologies**: Develop international frameworks for responsible development and use of satellite servicing, debris removal, and on-orbit manufacturing technologies that have both beneficial and hostile applications (Lauer, 2022).

Long-term goals (10+ years):

1. **Comprehensive space governance**: Work toward multilateral treaties establishing rules for space activities, including verification mechanisms, enforcement procedures, and dispute resolution processes that reflect contemporary technological and political realities (Thompson, 2020).
2. **Space traffic management**: Create international systems for coordinating satellite operations, preventing collisions, and managing the growing congestion in popular orbital

regimes (Stefanovich & Porras, 2022).

3. **Norm development**: Build international consensus on acceptable and unacceptable space behaviors through practice, dialogue, and incremental agreements that establish customary international law (Lauer, 2022).

6.3 Final Reflections

The 21st century confronts an unprecedented challenge in the international sphere with the militarization of space. The spheres of economics, military engagement, and civilian activities increasingly rely on space assets and their strategic risks. The current trajectory of strategic instability and the long-term mitigation of the effects of militarization in outer space is influenced by the proliferation of competitive space negation technologies and the absence of governance and controlling structures.

The challenge of space is balanced by its potential for international co-operation, even in the face of military and economic rivalry. The challenge for scholars and policy makers is to identify the spheres of competing interests capable of achieving even limited agreements and complex interdependence such that resilience, deterrence and crisis management defines the remaining unmanageable strategic conflict.

Future efforts must combine an understanding of competitive realities as well as the limitations of cooperation. Technical resilience through distributed architectures and protected communications can minimize weaknesses even without the cooperation of the adversary. Risk of misperception can be mitigated through competitive resilience preserving transparency initiatives and confidence-building. In the face of contentious issues at the margins, targeted arms control can manage acute threats, e.g. bans on kinetic ASAT tests, while other contentious issues can be deferred.

In the end, space security stems from understanding that, all the space-faring states are stakeholders in a shared environment, the degradation of which is detrimental to all. Constructing governance mechanisms that incorporate this fact and that also consider the spectrum of rightful security concerns is the most important task for the coming decades. The alternative—untrammeled rivalry culminating in debris-producing skirmishes and chronic environmental degradation—advances no one's interests and endangers the future of all of humanity in outer space.

Conflict of Interest

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