Testimony before the U.S.-China Economic and Security Review Commission

Hearing on China in Space: A Strategic Competition?

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Executive Summary

There is a growing recognition among many countries that the existing space governance framework is not sufficient to deal with current trends and challenges: namely the democratization of space capabilities and technologies, the burgeoning commercial space sector, and the proliferation of military space and counterspace capabilities. Specifically related to the topic of today's hearing, there are active debates underway about how the space governance framework should be updated or modified to deal with national sovereignty, extraction and utilization of space resources, and potential for future conflict in space.

As the 2018 National Defense Strategy laid out, the United States and China are engaged in a long-term strategic competition across diplomatic, information, military, and economic dimensions. Far too much of the domestic U.S. debate has focused on the military aspects of the competition with China and correspondingly there has been far too little consideration of the diplomatic aspects. This part of the competition matters greatly, as it will help determine the future of the space governance framework and whether it continues to support U.S. national interests.

This testimony addresses outer space governance and China's views on space law, norms of behavior, and security-related topics such as the weaponization of space. It focuses on China's own views and interests in the multilateral space diplomacy fora, discusses whether those views conflict with the interests of the United States, and provides policy recommendations for Congress to address these issues.

My oral and written testimony today reflects the aggregate knowledge and insights from across Secure World Foundation's staff. Our perspective on this matter is informed by two main bodies of evidence. The first is China's actions and statements in multilateral diplomatic space fora, primarily the United Nations Committee on the Peaceful Uses of Outer Space (COPOUS) and the Conference on Disarmament (CD). In our role as an NGO, SWF has been an observer and participant at many of these discussions over the last decade, giving us first-hand perspective on how China views issues related to space law and norms. We also have had direct experience partnering with Chinese academic institutions and NGOs to organize workshops and discussions on topics ranging from space debris to commercial space.

The second body of evidence we drew from is China's activities on orbit, and specifically their recent testing and development of counterspace technologies over the last fifteen years. Our experience in this area draws heavily from the research done to support our recently updated annual report on Global Counterspace Capabilities, which is entirely based on open sources.

To the best of our knowledge, China has complied with the existing legal principles and norms stemming from all four main space treaties, at least to the same extent that the United States and other major powers have. While it is possible that China may choose to break from those legal principles and norms in the future, we do not see strong evidence to support that conclusion and doing so would contradict the diplomatic positions China has established over the last few decades.

In orbit, China has conducted multiple tests and demonstrations of rendezvous and proximity operations (RPO) capabilities in both low Earth orbit (LEO) and geosynchronous Earth orbit (GEO) since 2010. There are no publicly-known cases of Chinese satellites approaching U.S. or other foreign satellites. While some of these Chinese RPO activities may be precursors to co-orbital anti-satellite capabilities, they are entirely consistent with existing international laws and norms of behavior for space and similar space activities and testing and demonstrations being conducted by the United States and Russia.

China has been an active participant within the major multilateral bodies and discussions on space governance. In COPUOS, which focuses mainly on peaceful uses of outer space, China's statements and positions have been generally constructive to U.S. aims and interests, particularly in comparison to the recent behavior of Russia within COPUOS. For example, China was supportive of the effort to develop guidelines for the long-term sustainability of space and played an important role in COPUOS reaching consensus on 21 such guidelines in June of 2018.

On the topic of sovereignty in space and utilization of space resources, China has consistently echoed the perspective of developing countries that space is the common heritage of all humankind and any extraction and use of space resources should be done in an equitable manner and consistent with an international framework. Chinese legal experts have actively participated in multi-stakeholder discussions to develop governance frameworks.

Within the Conference on Disarmament (CD), the main body focused on space arms control, China's main efforts have been to push for a new treaty on space weapons. China and Russia were co-authors of the Treaty on the Prevention of the Placement of Weapons in Outer Space (PPWT), originally submitted in 2008 and updated in 2014, and continue to push for its adoption today. China has also voiced strong support for the Russian proposal for No First Placement of Weapons in Outer Space pledge and has consistently highlighted the actions of the United States as detrimental to outer space security.

China's statements and actions in multilateral space fora and on-orbit activities lead us to conclude that China is largely complying with international norms and law on space while also pushing for changes to better suit its national interests. China sees outer space governance as an underdeveloped area in transition where it can play a role to actively shape the outcomes rather than a framework hostile to its interests. Within the existing space governance framework, China is taking full advantage of the freedom of action provided by the existing legal and normative framework for space.

To date, we have not witnessed any major gains for China in advancing its own interests over those of the United States in influencing or developing international space law or norms. What smalls gains China has realized in this area have been more the result of inaction or self-defeating actions by the United States more than Chinese successes. For example, China, along with Russia, have successfully characterized the Trump Administration's rhetoric on "dominating space" and the Space Force as further evidence that the United States is a major threat to peaceful uses of outer space. This propaganda effort damages the ability of the United States to marshal its diplomatic allies and advance its own interests in space governance discussions.

Our main policy proposal is to urge the United States to take a stronger leadership role in space governance discussions and help shape their development in a way that suits U.S. national interests. The United States did so successfully during the dawn of the Space Age and was able to enshrine American national interests at the core of the existing space legal framework, resulting in significant political, economic, and national security benefits to the United States. For the last several decades, however, the United States has either "led from behind" or worked to actively block further progress, particularly on space security-related issues, despite growing international clamor for progress. This lack of U.S. leadership has given China and Russia the opportunity to advance their own agendas and interests.

To become an active leader in space diplomacy, the United States needs to be willing to make substantive proposals on current space governance challenges and mobilize support among its allies to push the proposals within international fora. Congressional support is critical for this to happen; ten years ago, Congressional resistance hamstrung the Obama Administration's efforts to support the voluntary, non-binding International Code of Conduct for Space that would have provided some minimal progress on these issues. Congress also plays an important role in ensuring the Department of State is properly resourced, staffed, and empowered to advance the United States' interests in space diplomacy.

Retaking this leadership role would create an opportunity for the United States to help shape the future direction of space governance to suit its interests and those of its allies and private sector. The United States should also be willing to engage in dialogue with both allies and competitors - including China - to better understand the context for the competition and avoid direct military conflict.

China's Participation and Activities in Multilateral Space Fora

China has been an active participant in the major multilateral fora for discussion on space governance issues for several decades. The two major fora are the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), where the original space treaties were negotiated and discussions on peaceful and civil space continue today, and the Conference on Disarmament (CD), where several arms control treaties have been negotiated and the weaponization and security-related aspects of space are actively discussed today. There are also independent Groups of Governmental Experts (GGEs) that are occasionally formed by the UN to create ideas or proposals on specific issues over a short period of time.

Although there are four main treaties establishing core principles of international space law and several decades of space activities, the outer space governance regime itself is still largely undeveloped compared to international law in the terrestrial, air, and maritime domains. There are still significant debates about the interpretation of key space law principles and no international court cases or decisions to draw upon for insight. Key issues under active debate include the authorization and oversight of private sector space activities, sovereignty and utilization of space resources, and the weaponization of space and potential for conflict in space. The diplomatic environment for these debates is influenced by national policies and legislation as well as diplomatic statements and positions in the key international fora.

This testimony addresses each of these three areas and China's position and proposals on major issues related to space law and norms and proposals in each in the following sections.

United Nations Fourth Committee and COPUOS

The major treaties forming the foundation of international space law were drafted and negotiated at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) during the 1960s to the 1970s. Established as an *ad hoc* committee in 1958 and as a permanent UN committee in 1959,[1] COPUOS is a committee under the United Nations General Assembly, and is currently one of the largest UN Committees. COPUOS is currently the main multilateral forum for discussing issues related to the peaceful uses of outer space. COPUOS currently has 92 member countries and 41 non-governmental organizations as observers, including Secure World Foundation.[2]

COPUOS has two subcommittees, the Scientific and Technical Subcommittee, and the Legal Subcommittee. Both Subcommittees meet for two weeks each spring in Vienna, Austria, and their reports are considered and adopted by the full COPUOS Committee (or "plenary") each summer, also in Vienna. Those reports are then sent on to the Fourth Committee of the United Nations General Assembly on Special Political and Decolonization Issues.

China was granted admittance to COPUOS in 1980 under UN General Assembly Resolution 35/16.[3] Additionally, China often makes statements concerning these basic principles of space law within this

[1] G.A. Res. 1472 (XIV) (Dec. 12, 1959), *available at* http://www.unoosa.org/pdf/gares/ARES_14_1472E.pdf.
[2] *Members of the Committee on the Peaceful Uses of Outer Space*, United Nations Off. of Outer Space Aff., http://www.unoosa.org/oosa/en/members/index.html (last visited Apr. 15, 2019).
[3] G.A. Res. 35/16 (Nov. 3, 1980), *available at* https://www.un.org/documents/ga/res/35/a35r16e.pdf.

Committee and has been an active participant in several of the COPUOS Working Groups on specific topics.

China's Adherence to Existing International Space Treaties

Along with numerous other nations, the Republic of China (Taiwan) signed the Outer Space Treaty on January 27, 1967, the first day it was opened for signature.[4] Subsequently, the People's Republic of China (PRC) became a successor State Party to the Outer Space Treaty. The Outer Space Treaty is the foundational international treaty regulating the activities of states in the access, exploration, and use of outer space, including the Moon and other celestial bodies, and establishes for states basic international legal rights and obligations pertaining to space activities. Many provisions of this treaty were subsequently expanded upon by later UN treaties on outer space, including the 1968 Astronaut Rescue and Return Agreement,[5] the 1972 Liability Convention,[6] and the 1975 Registration Convention,[7] all of which both the US and China are parties to. However, neither the United States nor China are parties to the 1979 Moon Agreement.[8]

In brief, states parties to the Outer Space Treaty enjoy the right to access, use, and explore outer space, including both 'void' space and celestial bodies.[9] The treaty establishes that these rights to access, explore, and use are not contingent upon permission of other states parties to the treaty, nor of the international community as a whole. Freedoms of access and use are therefore foundational norms of law applicable to outer space. Next, the treaty balances these broad freedoms with various obligations regulating state behavior (and the behavior of those they are responsible for). A main obligation is the prohibition on the placement of nuclear weapons or other weapons of mass destruction into orbit, or the placement of them on celestial bodies. Additionally, states are restricted from asserting territorial sovereignty over space, including over celestial bodies.

A number of obligations requiring states to take particular actions are also contained in the Outer Space Treaty. States bear international responsibility for national activities in outer space, whether such activities are carried on by governmental agencies or by non-governmental entities. They are additionally required that all these national activities are carried out in conformity with the Outer Space Treaty and with international law in general. States are also required to provide "authorization and continuing supervision" for space activities conducted by their non-governmental entities. This means that states are ultimately responsible for what their private entities (such as commercial entities) do in outer space and must ensure that these private entities observe international law. This is noteworthy because it is unique in

[4] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty], *available at* https://www.state.gov/t/isn/5181.htm//signatory..
[5] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Apr. 22, 1968, 19 U.S.T. 7570, 672 U.N.T.S. 119 [hereinafter Rescue and Return Agreement].
[6] Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].
[7] Convention on Registration of Objects Launched into Outer Space, Jan. 14, 1975, 28 U.S.T. 695, 1023 U.N.T.S. 15 [hereinafter Registration Convention]..
[8] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 5, 1979, 1363 U.N.T.S. 3) [hereinafter Moon Treaty].
[9] Outer Space Treaty, Art. I.

international law that the activities of commercial companies could implicate the international responsibility and potential liability of their authorizing government.

While China, like many other countries, lacks a comprehensive and uniform national space legislation, China has enacted two administrative regulations addressing the issues of launching and registration of space objects: the 2001 *Measures for the Administration of Registration of Objects Launched into Outer Space* (Registration Measures) and the 2002 *Interim Measures on the Administration of Licensing the Project of Launching Civil Space* (Licensing Measures).[10] Additionally, China has also enacted the *Interim Instrument of Space Debris Mitigation and Management* (Space Debris Interim Instrument). The Registration and Licensing Measures have been enacted in the form of departmental regulations, which constitute one of the lowest level of laws in China.

Over the past twelve years, China has issued a series of policy documents, the "white papers" on space activities, to complement the existing regulatory framework. The white papers are issued every five years by the Information Office of the State Council, and while they are not legally binding, they are significant because they reflect the growing size of Chinese space activities and the more active role played by China at the international level. The importance of the white papers is threefold: 1) they promote transparency over the nature of the Chinese space program and facilitate acceptance of China as a reliable partner for international projects; 2) they reinforce China's position of promoting the peaceful uses of outer space and respecting international obligations; and 3) they demonstrate that Chinese authorities are aware of the importance of giving a formal and consistent framework to the Chinese space program. Relatedly, Chinese authorities appear to be aware of the need for a structured national as; as stated by the Secretary-General of the CNSA in 2014, national space law has been listed in the national legislation plan, and the CNSA is directly engaged in the process of working towards enacting the legislation.

In cases where physical damage results from space activities, states bear potential international liability for any physical damage which is caused by space objects of which they are the launching state. These provisions found in Article VII of the Outer Space Treaty were expanded upon in the 1972 Liability Convention, of which both the United States and China are Parties to.[11] However, to date, there has never been a liability case brought to court under these treaties and there remain significant ambiguity as to what constitutes negligence in determining liability for damage to other space objects.

The Outer Space Treaty also requires that states treat astronauts from other states with considerable care, as 'envoys of mankind,' and that any personal or space objects from other states which land in a state's territory, or which they discover, shall receive assistance and returned to the original launching state.[12] These provisions where expanded upon by the 1968 Astronaut Rescue and Return Agreement, of which both the United States and China are parties to.

[10] Fabio Tronchetti, Space Law and China, Oxford Res. Encyclopedia of Planetary Sci. (2016), available at http://oxfordre.com/planetaryscience/view/10.1093/acrefore/9780190647926.001.0001/acrefore-9780190647926-e-66
[11] Liability Convention, *supra* note 6.
[12] Outer Space Treaty, Art. V.

The international registration of space objects, first called for in a UNGA Resolution in 1961,[13] was also subsequently expanded by the 1975 Registration Convention.[14] The United Nations Office for Outer Space Affairs (UNOOSA) keeps and regularly updates an online index of launched space objects, which contain basic orbital parameters and other identifying information. This information is supplied by states on a regular and voluntary basis. UNOOSA does not verify this data and posts it online for the purposes of having a publicly-accessible basic and centralized registry of space objects. The China National Space Administration (CNSA) maintains the Chinese registry, which was established in 2001.[15] China notifies UNOOSA of its space launches on a rolling basis. The UNOOSA online registry lists 23 such submission letters from China to UNOOSA since 1990.[16] As of April 1, 2019, the UNOOSA online registry lists 307 space objects as China's.[17] It is common practice for all States, including the United States, to register payloads and large rocket bodies but not small pieces of orbital debris.

China's Role in Developing Guidelines on the Long-Term Sustainability of Outer Space Activities

In 2010, the COPUOS Scientific and Technical Subcommittee created a Working Group on the Long-term Sustainability of Space Activities.[18] The goal of this effort was to expand upon the success of the international space debris mitigation guidelines to focus more broadly on effort to promote and enhance the long-term sustainability of space. The long-term sustainability guidelines ("LTS guidelines") generated from this Working Group were to be a compilation of existing best practices and focused on four main topics: sustainable space utilization supporting sustainable development on Earth; space debris, space operations and tools to support collaborative space situational awareness; space weather; and regulatory regimes and guidance for actors in the space arena.[19] For the purpose of transparency, SWF's current Executive Director, Dr. Peter Martinez, was the chair of this Working Group prior to coming to SWF.

China and the United States were both active participants in the LTS effort, with experts serving in each of the Expert Groups that began the process and then the subsequent political discussions. In general, China was a constructive participant in the discussions, particularly in contrast to Russia. From 2014 until the end of the LTS effort, Russia sought to undermine, delay, and obstruct the LTS discussions in response to the U.S. and European sanctions following Russia's aggression in Crimea and Ukraine. Notably, China (along with Brazil) broke from Russia during a key moment in the LTS discussions when Russia tried to halt the entire effort. China reaffirmed its support for the LTS discussions and in doing so assured their continuation despite Russian objections.

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[13] G.A. Res. 1721 B (Dec. 20, 1961).
[14] Registration Convention, *supra* note 7.
[15] United Nations Committee on the Peaceful Uses of Outer Space, Information furnished in conformity with the Convention on Registration of Objects Launched into Outer Space, Note verbale dated 8 June 2005 from the Permanent Mission of China to the United Nations (Vienna) addressed to the Secretary General, UN Doc. ST/SG/SER.E/INF.17, available at http://www.unoosa.org/pdf/reports/regdocs/SER_INF_017E.pdf.
[16] United Nations Office of Outer Space Affairs, Notifications from States & Organizations: China, http://www.unoosa.org/oosa/en/spaceobjectregister/submissions/china.html.
[17] United Nations Office of Outer Space Affairs, Online Index of Objects Launched Into Outer Space, http://www.unoosa.org/oosa/en/spaceobjectregister/submissions/list/china.html.
[18] Committee on the Peaceful Uses of Outer Space, Report of the Committee on the Peaceful Uses of Outer Space, Fifty-third session, 150-168, U.N. Doc. A/65/20 (2010), *available at*: http://www.unoosa.org/pdf/gadocs/A_65_20E.pdf.
[19] Josh Wolny, *The UN COPUOS Guidelines on the Long-term Sustainability of Outer Space Activities – A Secure World Foundation Factsheet*, Aug. 2018, https://swfound.org/media/206227/swf_un_copuos_lts_guidelines_fact_sheet_august_2018.pdf.

The LTS Working Group was largely successful. In 2016, the first set of 12 guidelines were agreed to by a consensus of all the members of COPUOS and the mandate of the LTS Working Group was extended through 2018.[20] In 2018, the LTS Working Group reached consensus on nine more guidelines and the preamble text, bringing the total to 21, as well as agreeing to review their implementation and potentially update them.[21] However, last minute blocking actions by Russia prevented COPUOS from agreeing on a final report that could be submitted to the United Nations General Assembly. Despite this lack of a final report, many countries, including the United States and China, continue to regard the LTS effort as a success and discussed their national implementation of the LTS guidelines during the most recent STSC meeting in February 2019.[22]

China's Views on Space Mineral Resources and Sovereignty

Over the last few years, the topic of sovereignty in space and utilization of space resources, such as water or minerals, has become an increasingly salient topic in COPUOS. Concerns over the unequitable exploitation of space resources led to the negotiation and drafting of the Moon Treaty, which was opened for signature in 1979. However, the Moon Treaty failed to gain traction among most countries, with very few signatories compared to the other four main space treaties. The topic of space resources has been rekindled in recent years due to the rise of private sector entities planning to harvest asteroids or explore the Moon.

Governance of space resources remains an undecided issue. A few countries have taken steps to update their national regulations regimes to support such activities, notably the United States[23] and Luxembourg,[24] but most remain uncertain about the path forward. A minority of countries at COPUOS consider space resource utilization incompatible with the Outer Space Treaty's prohibition on national appropriation, or at least illegal without the sort of international governing framework outlined in the Moon Treaty. However, a majority of countries believe that it is possible to extract and use resources such as water, minerals, or regolith without running afoul of appropriation, but are not sure what the framework should be for doing so or what the constraints should be.

Chinese statements in COPUOS on sovereignty and utilization of space resources have generally been in line with the G77 voting bloc of developing countries. Specific statements were made by the G77 since 2017 emphasize equitable access and space as the province of all humankind and reinforce the need for an international coordinated framework for governance of space resource utilization to avoid gaps or

[20] United Nations, "Guidelines for the long-term sustainability of outer space activities," 10 October 2017, http://www.unoosa.org/res/oosadoc/data/documents/2017/aac_105c_1l/aac_105c_1l_362rev_1_0_html/AC105_C1_L362Rev01E.pdf
[21] United Nations, "Working Group on the Long-term Sustainability of Outer Space Activities: Preambular Text and Nine Guidelines," 8 February 2018, http://www.unoosa.org/res/oosadoc/data/documents/2018/aac_105c_12018crp/aac_105c_12018crp_18rev_1_0_html/AC105_C1_2018_CRP18Rev01E.pdf
[22] Secure World Foundation, "SWF Highlights Implementation of Sustainability Guidelines and Commercial Satellite Servicing Standards at UN," 18 February 2019, https://swfound.org/news/all-news/2019/02/swf-highlights-implementation-of-sustainability-guidelines-and-commercial-satellite-servicing-standards-at-un
[23] Jeff Foust, "House Passes Commercial Space Bill," *SpaceNews*, 16 November 2015, https://spacenews.com/house-passes-commercial-space-bill/.
[24] Andrew Zaleski, "Luxembourg leads the trillion-dollar race to become the Silicon Valley of asteroid mining," *CNBC*, 16 April 2018, https://www.cnbc.com/2018/04/16/luxembourg-vies-to-become-the-silicon-valley-of-asteroid-mining.html.

contradictions from domestic regimes.[25,26,27] Thus, China has positioned itself firmly in the camp of most developing countries who are concerned about "rich" States being able to access space resources to the exclusion of less advanced states..

At the same time, China is also open to governance frameworks for space resource utilization other than the Moon Treaty and has experts actively participating in such discussions. Since 2014, the main forum for these discussions has been the Hague International Space Resources Governance Working Group ("the Hague Group"), a multi-stakeholder group of companies, universities, governments, and non-government organizations.[28] The main purpose of the Hague Group is to identify and develop building blocks for the governance of space resource activities, which might form the basis of a common legal framework to enable space resources development in a manner consistent with the established treaty regime governing space activities at the international level. SWF was one of the founding partners in the Hague Group. The Chinese Ministry of Foreign Affairs is an observer organization to the Hague Group and an academic scholar from the Beijing Institute of Technology has been an active participant in the discussions.

United Nations First Committee and the CD

The United Nations General Assembly's First Committee focuses on disarmament and international security issues. It is the primary multilateral body where space security issues, including the militarization and weaponization of space, are discussed. The Conference on Disarmament (CD) is not an official body of the United Nations but is a major forum where security and arms control issues are discussed. Created in 1980 as a forum directly purposed on international disarmament negotiations, the CD meets in Geneva, Switzerland.[29] The CD and its predecessors were instrumental in drafting numerous arms control agreements, including the Treaty on the Non-Proliferation of Nuclear Weapons (1968), the Biological Weapons Convention (1972), the Chemical Weapons Convention (1993) and the Comprehensive Nuclear-Test-Ban Treaty (1996).

In 1985, the CD established an ad hoc committee to identify and examine issues related to the Prevention of an Arms Race in Outer Space (PAROS) due to strong concerns from many States about the weaponization of space.[30] The United States opposed giving the committee a negotiating mandate. The committee convened each year through 1994, with no further meetings occurring as a result of the objections made by the United States. Since 1994, the CD has co-mingled PAROS with the elimination of

[25] Statement of the G-77 and China during the Fifty-sixth session of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, 27 March - 7 April 2017, delivered by H.E. Ambassador Pilar Saborío de Rocafort, Permanent Representative of Costa Rica, https://www.g77.org/vienna/OOSAAPR17.htm.
[26] G-77 and China statement during the Fifty-seventh session of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, from 9-20 April 2018, delivered by H.E. Ambassador H.E. Ms. Vivian N.R. OKEKE, Permanent Representative of Nigeria, https://www.g77.org/vienna/OOSAAPR18.htm.
[27] G-77 and China Statement during the Fifty-eighth session of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space, from 1-12 April 2019, delivered by H.E. Mr. Omar Amer Youssef, Ambassador, Permanent Representative of Egypt, https://www.g77.org/vienna/OOSAAPR19.htm.
[28] International Institute of Air and Space Law, The Hague International Space Resources Governance Working Group https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-for-air-space-law/the-hague-space-resources-governance-working-group.
[29] Conference on Disarmament, https://www.unog.ch/cd.
[30] *Proposed Prevention of an Arms Race in Space (PAROS) Treaty*, Nuclear Threat Initiative, https://www.nti.org/learn/treaties-and-regimes/proposed-prevention-arms-race-space-paros-treaty/ (last updated Sept. 29, 2017) [hereinafter NTI].

nuclear weapons, fissile material controls, and negative security guarantees and struggled to reach consensus on an agenda of work due to objections from one or more countries on at least one of those topics.

The Russia–China Draft PPWT

In 2008, China and Russia presented a draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT) to the CD.[31] The PPWT sought to define "space weapons' and to prohibit their deployment into outer space, but was silent on the development, testing, and deployment of ground-based anti-satellite weapons.[32] In addition, the PPWT sought to establish a dispute resolution mechanism and an "Executive Organization" that oversees and enforces the PPWT.[33] The United States dismissed this proposal and characterized it as "a diplomatic ploy by the two nations to gain a military advantage."[34]

In 2014, Russia introduced to the CD an updated draft PPWT it had worked on with China.[35] There were many changes, including but not limited to changes to the definitions of many core terms, language regarding states' right of self-defense, the role of the Executive Organization of the PPWT, the dispute resolution mechanism of the PPWT, and the requirement needed to amend the PPWT.[36]

Also in 2014, Ambassador Robert Wood, the U.S. representative to the Conference in Geneva, said that the United States had completed an in-depth review of the PPWT and that the U.S. analysis concluded the new draft PPWT remained fundamentally flawed.[37] Reasons given include the lack of a definition of space weapon, lack of a verification mechanism, and no restrictions on the development and stockpiling of anti-satellite (ASAT) weapons on the ground. This, Woods said, would allow a nation to develop a readily deployable space-based weapons break-out capability should it decide to withdraw from the PPWT. Further, Ambassador Wood stated that terrestrially-based ASAT systems, not weapons in space, are the most pressing current threat to outer space systems, and the PPWT does not ban any of them.[38]

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[31] *Id.*

[32] The placement into space of nuclear weapons and other Weapons of Mass Destruction (WMDs) are already outlined in Article IV of the Outer Space Treaty. Likewise, the 1963 Partial Test Ban Treaty prohibits the testing of nuclear weapons in the upper atmosphere, or in outer space. The transit of WMDs through space, such as ICBMs, is not currently impermissible under international law.

[33] NTI, *supra* note 28.

[34] Id.

[35] Permanent Reps. of the Russian Federation and China to the Conference on Disarmament, Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects, U.N. Doc. CD/1985 (June 12, 2014) [hereinafter PPWT].

[36] *Id.*; Specifically, the changes included: the omission of the definition of "outer space." *Id.* at Art. I; a simplified and broader definition of "outer space object." *Id.*; a more expansive definition of "weapon in outer space," including component parts of the definition and allowing infliction of damage "by using any principles of physics." *Id.*; broadening the definition of "placed in outer space." *Id.*; separating and giving individual definitions for "use of force" and "threat of force." *Id.*; clarifying language with respect to recognizing that the PPWT does not affect States' rights to self-defense. *Id.* at Art. IV; expanding the role of the Executive Organization of the PPWT, which would consider matters related to the operation and implementation of the PPWT. *Id.* at Art. VI; clarifying that the dispute resolution mechanism in the PPWT is not obligatory unless a State decides to request another State clarify alleged failures to fulfill obligations under the PPWT. *Id.* at Art. VII; clarifying that the PPWT's dispute resolution mechanism does not override any issues that are subject to the Liability Convention. *Id.*; raising the requirement needed for an amendment to the PPWT from "majority vote" to "consensus." *Id.* at Art. XI.

[37] Jeff Foust, *U.S. Dismisses Space Weapons Treaty Proposal As "Fundamentally Flawed"*, SpaceNews (Sept. 11, 2014), https://spacenews.com/41842us-dismisses-space-weapons-treaty-proposal-as-fundamentally-flawed/.

[38] Id.

In 2015, Ambassador Fu Cong, Head of the Chinese Delegation at the Geneva Space Security Conference, made statements that the PPWT does in fact prohibit terrestrially-based ASAT weapons.[39] The Chinese ambassador then emphasized that the draft PPWT was open to further improvement and that they looked forward to any specific proposals for its amendment.[40] However, in 2017, Counsel Ji Haojun, at the working group on the "Way Ahead," stated a different interpretation that said the treaty does not prohibit land, sea, or air-based ASAT weapons outright, but that banning the use or threat of force against objects in outer space discourages the development of such weapons systems at exorbitant cost.[41] The counselor also stated that the national measures, consultations, and TCBMs in the PPWT were an effective means of ensuring compliance and verification.[42]

Over the last decade, China's statements and contributions in space security discussions have been remarkably consistent in promoting the PPWT and linking it to the broad concerns of the international community over the weaponization of space. In a panel discussion during an Outer Space Conference in Geneva in April 2017, Second Secretary of the Chinese Ministry of Foreign Affairs Mr. Li Zhang emphasized the role of the PPWT in fulfilling the peaceful purposes principle of the Outer Space Treaty and remarked how the notion had "broad international support."[43] During the 2018 iteration of this event, China's Ambassador to the UN in Geneva, Mr. Fu Cong, described China's approach to space security as driven by concerns over space debris and the risk of space becoming a battlefield.[44] These are just two of dozens of such examples of the consistent messaging by China on this issue.

No First Placement of Weapons in Space Initiative

In 2014, Russia was a lead sponsor of draft UNGA Resolution 69/32 proposing an agreement on "No first placement of weapons in space" (NFP) within the UN First Committee.[45] This resolution was adopted with a vote of 126 in favor, 4 against, and 46 abstentions in the General Assembly, with the US one of four the states voting 'no'.[46] In the explanation of its vote, the United States stressed that the NFP pledge was problematic, ineffective, and irrelevant to real issues in space security, because it was prone to the same flaws of the PPWT – namely, that space weapons are not defined, compliance with the NFP would be unverifiable, and that this pledge is again focused on space-based threats, rather than ground-based

[39] *Statement by Ambassador FU Cong, Head of Chinese Delegation at the Geneva Space Security Conf.*, Permanent Mission of China to the United Nations Off. at Geneva and other Int'l Org. in Switz., http://www.china-un.ch/eng/hom/t1291114.htm (last visited Apr. 12, 2019).
[40] Id.
[41] *Statement by Counselor Ji Haojun on the PPWT at the Working Group on the 'Way Ahead'*, Permanent Mission of China to the United Nations Off. at Geneva and other Int'l Org. in Switz., http://www.china-un.ch/eng/hom/t1472400.htm (last visited Apr. 12, 2019).
[42] Id.
[43] Li Zhang, "Remarks on the PPWT at the Outer Space Conference 2017," United Nations Institute for Disarmament Research, 21 April 2017, http://www.unidir.ch/files/conferences/pdfs/prevention-of-the-placement-of-weapons-in-outer-space-the-threat-or-use-of-force-against-outer-space-objects-ppwt-en-1-1238.pdf
[44] "UNIDIR Space Security Conference 2018: Conference Report," United Nations Institute for Disarmament Research, May 2018, http://www.unidir.ch/files/publications/pdfs/space-security-conference-2018-space-security-the-next-chapter-en-714.pdf
[45] United Nations General Assembly Resolution 69/32, No first placement of weapons in space, UN Doc. A/Res/69/32, Dec. 14, 2014, *available at*: https://undocs.org/A/RES/69/32.
[46] The US was joined by three other States (Georgia, Israel, and Ukraine) in voting against this resolution. UNGA Official Records, A/69/PV.62 pgs. 6-7, *available at*: https://www.un.org/en/ga/search/view_doc.asp?symbol=A/69/PV.62.

ASATs and other pressing threats to space security.[47] They also stressed that the NFPs flaws additionally did not meet the criteria for effective TCBMs on space security.[48] Nevertheless, the No First Placement Resolution was adopted by the UN General Assembly in 2014, and has been subsequently adopted in following years.

Although Russia has taken the lead in proposing and promoting the NFP concept within the First Committee, China has voiced strong support for the issue.

Groups of Governmental Experts on Space Security Topics

Occasionally, the United Nations will create an ad hoc group of experts to study a topic, known as a Group of Governmental Experts (GGE). This is generally done by the Secretary General to undertake a study on issues of concern and report findings at the UN General Assembly and may be directed or recommended by the UNGA resolution. A GGE is formed with a specific mandate to examine a topic for a relatively short period of time, usually one to two years, and attempts to reach consensus among its members before the end of that period. GGEs often include up to two dozen experts representing the socioeconomic and geographic diversity of UN member states. The experts are appointed by member states and expected to serve in an individual capacity, but often have instructions from their home governments about national positions.

Over the last decade, there have been two major GGEs convened to study space security topics. Both of the GGEs were driven by the on-going deadlock in the CD and failure of that body to make any progress on PAROS or space security issues. The GGEs were convened to try and find ways around the deadlock and reach consensus on ideas for enhancing space security that could be acceptable to a broad array of States. China and the United States were active contributors to both. One GGE was successful in reaching agreement, but the other was not.

2012-2013 GGE on Transparency and Confidence-building Measures (TCBMs) on Outer Space

UNGA Resolution 65/68 of December 5, 2010, "Transparency and confidence-building measures in outer space activities," (TCBMs) called for UN Secretary General Ban Ki-moon to establish a GGE on transparency and confidence-building measures on outer space activities.[49] TCBMs are means by which governments can share information with an aim of creating mutual understanding and trust, reducing misperceptions and miscalculations and thereby helping both to prevent military confrontation and to foster regional and global stability. The resolution was sponsored by Russia and China and while the United States publicly declared its support for the process, it abstained from voting on the resolution due to its mention of the PPWT. The resolution passed with strong support from the international community.

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[47] Sixty-Ninth UNGA First Committee Explanation of Vote Before the Vote on: L.14, Agenda Item 94(b): "No First Placement of Weapons in Outer Space" by Ambassador Robert A. Wood Alternate Representative Delegation of the United States of America October 30, 2014, *available at*: http://reachingcriticalwill.org/images/documents/Disarmament-fora/1com/1com14/eov/L14_US.pdf.

[48] Hao Liu & Fabio Tronchetti, United Nations Resolution 69/32 on the 'No first placement of weapons in space': A step forward in the prevention of an arms race in outer space?, 38 Space Policy 64 (2016), available at https://www.sciencedirect.com/science/article/abs/pii/S0265964616300121.

[49] Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities, U.N. GAOR, 68th Sess. U.N. Doc A/68/189*, July 29, 2013, *available at:* http://www.un.org/ga/search/view_doc.asp?symbol=A/68/189.

The GGE on TCBMs in Outer Space consisted of 15 international experts nominated by Member States. The permanent members of the UN Security Council (China, France, Russia, the United Kingdom, and the United States) were guaranteed five of these 15 spots. The remaining spots were filled by countries selected by the UN based on State applications and on fair geographic representation. They were (in alphabetical order): Brazil, Chile, Italy, Kazakhstan, Nigeria, Romania, South Africa, South Korea, Sri Lanka, and Ukraine. The Russian expert was chair of the GGE.

The GGE on TCBMs in Outer Space met three times between July 2012 and July 2013 and managed to reach consensus on a set of voluntary TCBMs for enhancing space security. The GGEs recommendations included information exchange on national space policy and goals, and exchange of information on military space expenditures; information exchange on activities in outer space, including orbital parameters, possible conjunctions, natural space hazards, and planned launches; notifications on risk reductions such as scheduled maneuvers, uncontrolled high-risk re-entries, emergency situations, intentional orbital breakups; and voluntary visits to launch sites and command and control centers, and demonstrations of space and rocket technologies.[50]

The GGE on TCBMs in Outer Space was largely considered a success. It remains the only time in the last two decades that the United States, Russia, and China all agreed on a space security-related resolution within the UN. However, implementation of the recommendations from the GGE has been lacking.

2018-2019 GGE on PAROS

More recently, the UNGA convened a second GGE focused on space security-related issues. UNGA Resolution 72/250 of December 24, 2017, "Further practical measures for the prevention of an arms race in outer space", called for the UN to establish a GGE on PAROS, and specifically to consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, inter alia, on the prevention of the placement of weapons in outer space.[51] Any recommendations from the GGE were to be sent to the CD for inclusion in their deliberations.

The GGE on PAROS received strong international support, although the United States voted against it.[52] In explaining their vote, the United States expressed concern about China's use of the draft PPWT concepts in the GGE forum and reiterated its long-standing concern to use the PPWT as the basis for a legally-binding agreement. The US also stated "[i]t is also worth noting that this resolution offers an example of China's attempts to impose its national view of multilateralism and world geopolitics on the international system. Our countries cannot agree to this language but look forward to working with China

[50] *See also* Christopher Johnson, *The UN Group of Governmental Experts on Space TCBMs - A Secure World Foundation Fact Sheet*, *available at*: https://swfound.org/media/109311/swf_gge_on_space_tcbms_fact_sheet_april_2014.pdf.
[51] *Further practical measures for the prevention of an arms race in outer space*, UNGA Res. 72/250, Dec. 24, 2017, https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/72/250.
[52] United Nations General Assembly, 76th plenary meeting Saturday, 23 December 2017, 11.30 p.m. New York, pg. 12, *available at*: https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/72/250; *See also* United States Mission to the United Nations, Explanation of Vote in the First Committee on Resolution L.54: Further Practical Measures for the Prevention of an Arms Race in Outer Space, Oct. 20, 2017, https://usun.state.gov/remarks/8085.

and others in the months and years ahead to sustain and strengthen the international norms on which the global system is based."[53]

Nevertheless, the GGE on PAROS was established. The governmental Experts were from Algeria, Argentina, Australia, Belarus, Brazil, Canada, Chile, China, Egypt, France, Germany, Iran, Italy, Japan, Kazakhstan, Malaysia, Nigeria, Pakistan, Republic of Korea, Romania, Russian Federation, South Africa, United Arab Emirates, United Kingdom, and the United States. The GGE on PAROS was chaired by Ambassador Guilherme de Aguiar Patriota, Special Representative of Brazil to the Conference on Disarmament.

In addition to the official meetings of the GGE on PAROS, there were informal discussions both prior and during its work. Prior to its first official meeting in Geneva, a preparatory meeting was held in Beijing, convened by the United Nations Office for Disarmament Affairs (UNODA), together with the Ministry of Foreign Affairs of China, and the Ministry of Foreign Affairs of the Russian Federation. SWF Space Law Advisor Christopher Johnson was invited to serve as expert speaker at this meeting, and his presentation discussed the underpinnings of international obligations fostering collective security measures, gaps and insufficiency in existing international legal regime for outer space.[54] The Draft PPWT was mentioned numerous times by the Chinese and Russian experts present at this meeting, but it appeared that other GGE experts were not convinced that borrowing directly from the PPWT text was the desirable path forward. During the GGE on PAROS process, informative consultative meetings were held with non-governmental organizations who were also invited to provide written inputs. SWF was one of several organizations that submitted written suggestions for the GGE and PAROS in general.[55]

However, at the final GGE on PAROS meeting in March 2019, consensus on the final report was not reached. As the UNGA Resolution recommending the GGE mandated that its final report be adopted by consensus, and no consensus was reached, no final report will be released, and the GGE meeting ended without any deliverable.

Manuals on International Law and Military Activities in Space

Apart from the formal discussions on weaponization and space security in the First Committee and CD, there are also two informal efforts, led by universities, underway to try and define how international law applies to military activities in space. The Manual on International Law Applicable to Military Activities in Space (MILAMOS) Project[56] is led by McGill University in Canada, and the Woomera Manual is led by the University of Adelaide and the University of New South Wales-Canberra in Australia, the

[53] United states Mission to the United Nations, Explanation of Vote in the First Committee on Resolution L.54: Further Practical Measures for the Prevention of an Arms Race in Outer Space, Oct. 20, 2017, https://usun.state.gov/remarks/8085.
[54] Christopher Johnson, The Status of Norms Applicable to International Security and the Prevention of an Arms Race in Outer Space, International Workshop for the Prevention of an Arms Race in Outer Space, https://swfound.org/media/206199/cjohnson_gge_beijing_jul2018.pdf.
[55] Group of Governmental Experts on Further Practical Measures for the Prevention of an Arms Race in Outer Space, Working paper submitted by the Secure World Foundation, UN Doc. GE-PAROS/2019/WP.5, March 18, 2019, *available at*: https://undocs.org/pdf?symbol=en/GE-PAROS/2019/WP.5.
[56] McGill University, Manual on International Law Applicable to Military Activities in Outer Space (MILAMOS), https://www.mcgill.ca/milamos/.

University of Exeter in the United Kingdom, and the University of Nebraska at Lincoln in the United States.[57] SWF staff participate as experts in both projects.

Both projects bring together legal scholars and practitioners from militaries, universities, and non-governmental organizations to discuss how international law applies to military activities in space, both in peacetime and armed conflict. The Beijing Institute of Technology (BIT) is a partner institution in MILAMOS and a Chinese legal scholar participates in an individual capacity in the Woomera project.

Implications of China's Diplomatic Activities for Space Governance

China's activities outlined above show an overall support for, and compliance with, the existing international legal and normative framework for space. China is a party to the four main treaties establishing international law and principles for outer space and is complying with them, at least to the same extent as other spacefaring nations, including the United States. Like the United States, China is more than willing to exploit the lack of specificity or gaps in the existing legal framework to suit its national security interests.

While working within the existing space governance framework, China's activities in the international diplomatic environment also indicate that China wants to shape the future space governance framework to suit its national interests. Part of China's focus in this regard is to be seen as a major space power and playing a positive role in shaping space governance. This can be seen in China's constructive participation in the COPUOS LTS Working Group and China's role in pushing the LTS effort towards a mostly successful conclusion. On this topic, and most of the topics addressed in COPUOS, China's interests are either aligned with those of the United States or at least not in direct opposition.

The situation is different in the diplomatic fora addressing space security, such as the First Committee and the CD, where China is actively pushing proposals that are contradictory to U.S. interests. China, along with Russia, is an active proponent of the PPWT and NFP, which are largely constructed to position Russia and China as active defenders of peace and security in space. While the PPWT and NFP have not gained significant traction with the vast majority of countries, they are dominating the discussions because of the lack of any alternative proposals. There is a strong desire from many countries to address weaponization and space security topics, and the PPWT and NFP are designed to capture that interest.

China, along with Russia, has also been able to effectively frame the actions and policies of the United States as undermining space security while masking its own military space activities. This is due in large part to consistent and effective messaging and public diplomacy that leverages the United States' own domestic political rhetoric on space domination and warfighting.[58] However, it is also enabled by the lack of alternative proposals from the United States that address space security issues, the reluctance of the United States to discuss Russian and Chinese development of counterspace capabilities, and internal U.S. bureaucratic resistance to a stronger public diplomacy campaign of its own on space governance.

[57] "The Woomera Manual," *University of Adelaide*, retrieved from https://law.adelaide.edu.au/woomera/home.
[58] For example, see "Beijing: U.S. should stop weaponizing outer space, work with China, Russia," *China Global Television Network*, 10 April 2019, https://news.cgtn.com/news/3d3d414e3351544f33457a6333566d54/index.html

Chinese Rendezvous and Proximity Operations on Orbit

Another key source of information on what China believes about norms of behavior and space law is their actual activities on orbit. Actions and activities by a state in a domain can serve as evidence of state practice, which in turn can help create norms of behavior or even customary international law.

Recently, there has been a lot of concern about activities of Chinese satellites getting close to or interacting with other space objects. The formal term for these activities is rendezvous and proximity operations (RPO) and they generally involve on space object altering its trajectory to come close to another space object. RPO are not new to space; they have been around since the Gemini 8 mission in 1966 and used extensively for human spaceflight since then. Over the last 15 years, the technology for doing RPO between robotic spacecraft has improved significantly and is now being explored and demonstrated on orbit by commercial firms, civil government organizations, and militaries for a wide variety of applications. Chief among these are the emerging field of on-orbit satellite servicing (OOS), which includes the capability to approach, grasp, manipulate, modify, repair, refuel, integrate, and build completely new platforms and spacecraft on orbit. Some of these RPO capabilities and technologies could also be used to support national security space activities such as surveillance, intelligence collection, and even co-orbital anti-satellite weapons.

As a result of this dual-use nature, China's recent RPO activities have prompted significant speculation about the intent of these activities, whether they are co-orbital anti-satellite tests, and the degree of threat they pose to U.S. national security space capabilities. However, the actual details and nature of these activities are often far removed from their description in the media and by pundits. The following paragraphs provide summaries and relevant details about some of the recent Chinese RPO activities. Further details can be found in the recent SWF report on global counterspace capabilities.[59]

Chinese RPO Activities in LEO

The first known Chinese robotic RPO occurred in LEO in the summer of 2010 and involved the Chinese satellites Shi Jian-12 (SJ-12, 2010-027A, 36596), and the SJ-06F (2008-053B, 33409). The SJ-06F was launched on October 25, 2008, and the SJ-12 was launched on June 15, 2010. Both satellites were reportedly built by the Shanghai Academy of Spaceflight Technology (SAST) under contract to the China Aerospace Science and Technology Corporation (CASC).

In the summer of 2010, the SJ-12 initiated a series of deliberate changes in its orbital trajectory to approach and rendezvous with the SJ-06F satellite.[60] The maneuvers occurred over several weeks between June 12, 2010, and August 16, 2010, and indicated a very slow and methodical approach. On August 19, the two satellites had their closest approach, which was estimated to be less than 300 meters. A change in the orbital trajectory for the SJ-06F around that same time indicates that the two satellites may have bumped into each other, although at a very slow relative speed of a few meters per second. There were no external indications of damage to either satellite, nor any debris created by the incident.

[59] Brian Weeden and Victoria Samson, "Global Counterspace Capabilities: An Open Source Assessment," *Secure World Foundation*, April 2018, https://swfound.org/counterspace

[60] A more detailed technical analysis of this event can be found in Brian Weeden, "Dancing in the Dark; The Orbital Rendezvous of SJ-12 and SJ06F," *The Space Review*, August 30, 2010, http://www.thespacereview.com/article/1689/1.

The incident appears to have been similar to the bumping that occurred during the autonomous rendezvous attempt between NASA's Demonstration for Autonomous Rendezvous Technology (DART) satellite and the U.S. Navy's Multiple Path Beyond Line of Site Communication (MUBLCOM) satellite in April 2005.[61]

Another rendezvous between two Chinese satellites in LEO occurred in 2013. On July 19, 2013, China placed three payloads into roughly similar orbits around 670 kilometers altitude and 98 degrees inclination from the same launch: Shiyan 7 (SY-7, 2013-037A, 39208), Chuangxin 3 (CX-3, 2013-037B, 39209), and Shijian 15 (SJ-15, 2013-037C, 39210). The mission was publicly described by the Chinese government as "conducting scientific experiments on space maintenance technologies."[62] Public information at the time indicated the SY-7 was built by the DFH Satellite Corporation on behalf of the Chinese Academy of Space Technology (CAST), and likely carried a robotic arm being developed to support China's space station program, perhaps similar to the Canadian robotic arm used on the International Space Station. SJ-15 was built by the SAST and was reportedly an optical space tracking satellite similar to, but likely much less capable than, the U.S. Air Force's Space-Based Surveillance System (SBSS) satellite. CX-3 was built by the Chinese Academy of Sciences and was likely a small store-and-forward communications satellite that was the most recent in a series of such satellites.

More than a year later, in October 2014, an internet code repository was discovered that supported earlier claims that the three satellites were engaged in capture and surveillance activities. What was known publicly as SY-4 had an internal codename of Tansuo-4 and was designed with a teleoperated robotic arm that interacted with the separating subsatellite. CX-3 was known internally as Tansuo-3 and was designed to provide optical surveillance of space objects in geostationary and low Earth orbits. The SJ-15 was known internally as Tansuo-5 and was designed to maneuver and conduct proximity operations with other space objects.

In August 2013, the SJ-15 initiated a series of maneuvers to alter its orbit and bring it close to two other satellites. On August 9, the SJ-15 altered its altitude by a few tens of kilometers, which meant it passed above the CX-3 at a distance of a few kilometers before returning largely to its original orbit. On August 16, the SJ-15 altered its altitude by more than 100 km and its inclination by 0.3 degrees, which eventually led to a close approach of Shi Jian 7 (SJ-7), a Chinese satellite launched in 2005 (2005-024A, 28737), to within a few kilometers. Anonymous U.S. officials claimed that the rendezvous was part of a "covert anti-satellite weapons development program," and that one of the satellites "grabbed" another,[63] although the satellite with the arm, SY-7, was not involved in this particular RPO.

On October 18, 2013, the SY-7 initiated a small maneuver to raise its orbit by several hundred meters, and shortly thereafter released another object, which the U.S. military labeled Payload A Debris (2013-037J, 39357). The SY-7 and Payload A debris orbited in relatively close proximity to each other for several days, ranging between a few kilometers and several hundred meters, with some reports claiming

[61] Overview of the DART Mishap Investigation Results," NASA, accessed April 7, 2019. http://www.nasa.gov/pdf/148072main_DART_mishap_overview.pdf.
[62] Jonathan McDowell, posting on the NASAspaceflight.com forums, July 20, 2013, http://forum.nasaspaceflight.com/index.php?topic=30486.msg1076481#msg1076481.
[63] Bill Gertz, "China Testing New Space Weapons," *The Washington Free Beacon*, October 2, 2013, http://freebeacon.com/national-security/china-testing-new-space-weapons/.

the two objects may have physically joined with each other. However, the publicly available tracking is not accurate enough to confirm those claims. Both objects occasionally conducted small maneuvers throughout 2014 and 2015, although the separation distance between them never exceeded more than a few kilometers. This appears to be similar to the 2007 DARPA Orbital Express experiment, which involved two satellites, one with a robotic arm, separating and conducting a series of RPO with each other.[64]

In 2016, another Chinese satellite was launched that again created concerns about on-orbit grappling. The Aolong-1 (AL-1, 2016-042F, 41629), also known as the Advanced Debris Removal Vehicle (ADRV) or "Roaming Dragon," was a small satellite developed by Harbin Institute of Technology under contract to CALT to reportedly demonstrate using a robotic arm to capture a small piece of space debris for removal from orbit. Aolong-1 was placed into orbit on the first launch of China's new Long March 7 (LM-7) rocket on June 25, 2016, along with a scaled-down test version of China's next human spacecraft, a ballast mass, and a few small rideshare cubesats.

Although only a small part of the overall mission, the debris removal experiment generated significant press outside of China due to concerns over dual-use technology. Stories included an inflammatory report that quoted a researcher from the National Astronomical Observatories in Beijing talking about the potential for Aolong-1 to be used as a weapon system.[65] However, it is unclear whether the researcher was truly convinced that was indeed the motive for Aolong-1, or whether he was hypothesizing about military applications for debris removal technology in general, much as American scientists and officials often do.[66] The reality is that, according to U.S. military tracking data, the Aolong-1 did indeed separate into a 380 km by 200 km orbit but did not rendezvous with any other objects. The debris capture experiment appears to have been simulated, and the Aolong-1 does not appear to have altered its orbit during its short two months on orbit.

Chinese RPO Activities in GEO

China has also conducted RPO experiments in the GEO region. On November 3, 2016, China lofted the SJ-17 satellite (2016-065A, 41838) to GEO on the maiden launch of its new Long March 5 (LM-5) space launch vehicle. The SJ-17 was reportedly designed to test advanced technologies such as environmentally friendly chemical propellant, ion propulsion, quad-junction gallium arsenide solar panels, and an on-board optical surveillance sensor.[67]

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[64] Lt Col Fred Kennedy, "Orbital Express Space Operations Architecture," DARPA Tactical Technology Office, accessed April 7, 2019, http://archive.darpa.mil/orbitalexpress/index.html.
[65] "Is China militarising space? Experts say new junk collector could be used as anti-satellite weapon," *South China Morning Post*, updated June 12, 2017, http://www.scmp.com/news/china/diplomacy-defence/article/1982526/china-militarising-space-experts-say-new-junk-collector.
[66] During a 2011 workshop organized by the National Research Council as part of a study of NASA's space debris program, participants stated that a Department of Defense plan to remove space debris did not go forward in part due to concerns that "most of the proposals had a weapons-like character about them". See National Research Council, *Limiting Future Collision Risk to Spacecraft: An Assessment of NASA's Meteoroid and Orbital Debris Programs*, Washington, DC: National Academies Press, 2011, https://doi.org/10.17226/13244, pg. 143.
[67] "China's Shijian-17 Satellite settles in Geostationary Orbit for Experimental Mission," *Spaceflight101*, November 24, 2016, http://spaceflight101.com/shijian-17-settles-in-geostationary-orbit/.

Several days after reaching GEO, the SJ-17 began maneuvering to place itself into the active GEO belt close to another Chinese satellite. It began with a maneuver on November 10 to lower its orbit and reduce its westward drift, and then a pair of maneuvers on November 11 to fully stabilize within the active GEO belt at a longitude of 162.9 E. This placed the SJ-17 relatively close to another Chinese satellite, Chinasat 5A (1998-033A, 25354). Chinasat 5A was originally built by Lockheed Martin under contract to the Chinese Communications Ministry and launched in 1998 under the name Zongwei 1 to provide commercial satellite communications services for southeast Asia. The SJ-17 made several small maneuvers to circumnavigate Chinasat 5A at a distance of between 100 and 50 km for several days, slowly closing in to within a few km on November 30, and then returning to a 100 to 50 km standoff distance.[68] The two satellite remained close until December 29, when commercial tracking networks reported that Chinasat 5A had begun drifting away.[69]

Since April 2017, the SJ-17 has been relatively active in the GEO region and demonstrated significant maneuvering capability. Between April and June it drifted to 215E and remained there until late when it drifted to 118 E. In January 2018, the SJ-17 began a rapid eastward drift at two degrees per day, followed by a rapid drift westward at four degrees per day starting on February 9. On March 20, the SJ-17 lowered its orbit to reverse its drift, indicating that it is doing fast survey of the GEO region. In January the SJ-17 also raised its inclination from 0.43 to roughly four degrees, before reversing back to zero in July.[70] This was unusual as most operational satellites in GEO are used to provide communication services and are station-kept to remain close to zero degrees inclination for optimal service. Additionally, the relatively sudden change in inclination suggests significant delta-vee capability as plane change maneuvers are among the most energy intensive.

On December 23, 2018, China launched another mission to GEO that has also exhibited unusual behavior. Like its predecessors, the Tongxin Jishu Shiyan (TJS)-3 satellite was launched from Xichang Space Launch Center into an elliptical geosynchronous transfer orbit (GTO). Few details are known publicly about the TJS series, the first of which was launched in early 2017. Chinese official media has described them as communications technology test satellites but observers believe they may also be testing missile warning sensors, deployable antennas, or other technology.[71] TJS-3 appeared to be similar in nature, and the U.S. military ended up cataloging two objects from the launch in GEO: the TJS-3 satellite (43874, 2018-110A) and a second object (43917, 2018-110C) that was assumed to be an apogee kick motor(AKM), a detachable rocket engine often used to circularize a satellite in GEO, as it was slowly drifting westward.

While the modern practice is to separate and dispose of AKMs above GEO for space debris mitigation, it is not uncommon for them to be in GEO. However, shortly after the separation, object 43874 did a series

[68] "In-Space Eavesdropping? – China's Shijian-17 completes High-Altitude Link-Up," *Spaceflight101* December 9, 2016, http://spaceflight101.com/cz-5-maiden-flight/shijian-17-rendezvous-with-chinasat-5a/.
[69] Analytical Graphics (@AGItweets), "ComSpOC has detected that #Chinasat 5A has departed SJ-17 & is drifting 0.9 deg/day westward. SJ-17 remains @ 163 deg," Tweet, December 29, 2016, https://twitter.com/AGItweets/status/814513003798364161.
[70] Jonathan McDowell, "Jonathan's Space Report," No. 754, October 8, 2018, http://planet4589.org/space/jsr/back/news.754.txt; Verified by data compiled from the public U.S. military satellite catalog at https://space-track.org.
[71] "China opens 2017 with obscure communications satellite launch," *Spaceflight101*, January 5, 2017, http://spaceflight101.com/long-march-3b-tjs-2-launch/.

of maneuvers to place it into a GEO slot at 59.07E, near TJS-3.[72] Object 43874 slowly drifted toward TJS-3 and according to Analytic Graphics exhibited photometry consistent with a stabilized object and not one that was tumbling. Thus object 43917 appears to be a subsatellite and not an AKM and maintaining a relatively close distance (100 to 200 km) from TJS-3.

Implications of China's RPO Activities for Space Governance

The activities of the SJ-12, SJ-15, SJ-17, and TJS-3 AKM are consistent with the demonstration of RPO technologies for the purpose of satellite servicing, space situational awareness, and inspection. Notably, it appears the U.S. intelligence community agrees with this assessment. A counterspace assessment released by the Defense Intelligence Agency (DIA) in February 2019 stated that China is developing capabilities for inspection, repair, and space debris removal that may also be used as a weapon but did not specifically state that any Chinese RPO activities was a weapons test.[73]

Based on the public evidence to date, China's RPO activities in LEO and GEO appear to be in line with similar activities conducted by multiple countries, including the United States. This includes the U.S. Air Force's XSS-10 satellite, which was used to do inspections of satellites in LEO in 2005 and 2006[74]; the Swedish Mango (2010-028B, 36599) and Tango (2010-028F, 36827) cubesats that were part of the Prototype Research Instruments and Space Mission technology Advancement (PRISMA) mission, which demonstrated cooperative rendezvous and proximity operations and formation flying in 2010[75]; and the U.S. Air Force's Micro-satellite Technology Experiment (MiTEx) satellites and Geosynchronous Space Situational Awareness (GSSAP) satellites, which have been conducting close-up inspections of U.S. and foreign satellites in the GEO region since 2016;[76] in addition to the other U.S. missions mentioned earlier.

It is also worth noting that no country has called out China's RPO activities, or similar RPO activities done by other States, as illegal or violating any norm of behavior. In fact, China's RPO activities in nearly every case have been preceded by similar or the same activities being conducted by the United States or other countries years, sometimes decades, earlier.

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[72] See discussion of this in the following thread on the NASASpaceflight.com forums: https://forum.nasaspaceflight.com/index.php?topic=46903.0;all.
[73] Defense Intelligence Agency, "Challenges to Security in Space," February, 2019, http://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.
[74] Thomas M. Davis and David Melanson, "Xss-10 Micro-Satellite Flight Demonstration," Smartech.GATech.edu, https://smartech.gatech.edu/bitstream/handle/1853/8036/SSEC_SD3_doc.pdf;jsessionid=906BB52FE69F848048883B704DB20F07.smart2.
[75] "Prisma," OHB Sweden, accessed April 7, 2018, http://www.ohb-sweden.se/space-missions/prisma/.
[76] Brian Weeden and Victoria Samson, Global Counterspace Capabilities: An Open Source Assessment, *Secure World Foundation*, April 2019, section 3-1, https://swfound.org/counterspace.

Appendix

Table 1 - Recent Chinese Rendezvous and Proximity Operations

Date(s)	System(s)	Orbital Parameters	Notes
June – Aug. 2010	SJ-O6F, SJ-12	570-600 km; 97.6°	SJ-12 maneuvered to rendezvous with SJ-06F. Satellites may have bumped into each other.
July 2013 – May 2016	SY-7, CX-3, SJ-15	Approx. 670 km; 98°	SY-7 released an additional object that it performed maneuvers with and may have had a telerobotic arm. CX-3 performed optical surveillance of other in-space objects. SJ-15 Demonstrated altitude and inclination changes to approach other satellites.
Nov. 2016 – Feb. 2018	SJ-17, YZ-2 upper stage	35,600 km; 0°	YZ-2 upper stage failed to burn to the graveyard orbit and stayed near GEO. SJ-17 demonstrated maneuverability around the GEO belt and circumnavigated Chinasat 5A.
Jan. 2019	TJS-3, TJS-3 AGM	35,600 km; 0°	TJS-3 AKM separated from the TJS-3 in the GEO belt and both performed small maneuvers to maintain relatively close orbital slots.