VI. Developments in space security

NIVEDITA RAJU

Developments in space security in 2021 were defined by the proliferation of counterspace technologies, reported weapon tests and growing lunar ambitions. Space security also received dedicated focus at the national level, as evidenced by new space commands established by the German and British governments.[1] The need for stronger governance to curb threats to space activities further encouraged states to move towards concrete action in the United Nations General Assembly.

This section outlines three key issues in space security in 2021. First, overall stability continued to be unsettled by the development and demonstration of offensive counterspace capabilities.[2] Reported weapon tests in space by China and Russia were particularly controversial. Second, the year saw rising interest in lunar activities. Several states expressed lunar ambitions through the formation and development of two distinct international partnerships: one led by the United States and the other led by China and Russia. The absence of any dedicated cooperation mechanism between these two partnerships is potentially destabilizing. In addition, US military interests in lunar activities expanded. Third, and more positively, 2021 witnessed widespread support for new measures on space security in the General Assembly. States, international organizations and civil society representatives contributed to discussions on norms, rules and responsible behaviour, which were summarized in a report by the UN secretary-general. A consensus-based open-ended working group (OEWG) will be convened to move discussions forward.

Reports of weapon tests by China and Russia

'Counterspace' refers to capabilities or techniques used to gain an advantage over a rival in space. These can include offensive and defensive elements. In recent years there has been a surge in the development of different types of counterspace capability, principally by China, Russia and the USA.[3] In 2021 reported weapon tests in space by China and Russia drew international criticism, especially from the USA.

[1] Siebold, S., 'New German space command to tackle Russian, Chinese threat, overcrowding', Reuters, 13 July 2021; and British Ministry of Defence, 'UK Space Command officially launched', 30 July 2021.

[2] Weeden, B. and Samson, V. (eds), *Global Counterspace Capabilities: An Open Source Assessment* (Secure World Foundation: Washington, DC, Apr. 2019). On developments in 2019 and 2020 see Porras, D., 'Creeping towards an arms race in outer space', *SIPRI Yearbook 2020*, pp. 513–18; and Raju, N., 'Developments in space security, 2020', *SIPRI Yearbook 2021*, pp. 531–36.

[3] eds Weeden and Samson (note 2).

China's fractional orbital bombardment system test

A fractional orbital bombardment system (FOBS) is a weapon-delivery system that partially enters into orbit and then, rather than completing a full rotation, deorbits to reach its target. In October 2021 the *Financial Times* reported that in August China had conducted a test of a FOBS that deployed a hypersonic glide vehicle.[4] China maintained that the test only involved a reusable space launch vehicle.[5] Subsequent reports suggested that two tests had occurred, in July and August.[6] The reports were based on limited information released by US sources. In the absence of verified open-source information, these reports fuelled speculation and exaggerated claims, including those from US officials, that the test was close to a 'Sputnik moment'.[7]

FOBS are not new. The technology was developed and deployed by the Soviet Union in the 1960s and 1970s.[8] However, more recently, alarmist views have arisen about the new hybrid technology of FOBS paired with hypersonic glide vehicles. FOBS were designed by the Soviet Union to bypass the US network of radar systems in the north and instead attack targets through the South Pole undetected.[9] The principal advantages were overcoming anti-ballistic missile (ABM) systems and challenging the adversary's ability to predict the intended target.[10] However, some have questioned the military effectiveness of FOBS.[11] Others state that FOBS cannot be used to conduct a surprise nuclear attack on the USA due to the latter's sophisticated space situational awareness (SSA) capabilities.[12] Experts also note that US vulnerability to Chinese attacks existed prior to this FOBS test, given China's existing nuclear and conventional arsenal.[13]

There are different views on whether FOBS violate Article IV of the 1967 Outer Space Treaty, which prohibits the placement of weapons of mass

[4] Sevastapulo, D., 'China tests new space capability with hypersonic missile', *Financial Times*, 16 Oct. 2021.

[5] Tian, Y. L., 'China denies report of hypersonic missile test, says tested space vehicle', Reuters, 18 Oct. 2021.

[6] Sevastapulo, D., 'China conducted two hypersonic weapons tests this summer', *Financial Times*, 21 Oct. 2021.

[7] Martin, P., 'US general likens China's hypersonic test to a "Sputnik moment"', Bloomberg, 27 Oct. 2021.

[8] Jasani, B., 'Military satellites', *SIPRI Yearbook 1977*, table 5.17, p. 170.

[9] Siddiqi, A. A., 'The Soviet fractional orbiting bombardment system (FOBS): A short technical history', *Quest, The History of Spaceflight Quarterly*, vol. 7, no. 4 (2000); and Bowen, B. and Hunter, C., 'Chinese fractional orbital bombardment', Asia-Pacific Leadership Network, Policy Brief no. 78, 1 Nov. 2021.

[10] Siddiqi (note 9).

[11] Siddiqi (note 9).

[12] Bowen and Hunter (note 9).

[13] Grego, L., 'A nuclear arms race is unavoidable without serious intervention', *Financial Times*, 27 Oct. 2021; and Bowen and Hunter (note 9).

destruction (WMD) in orbit around the Earth.[14] It largely depends on the interpretation of 'orbiting' and whether FOBS can be considered to have been 'placed in orbit' even when they do not complete a full rotation in orbit. Nonetheless, China's test is expected to further widen mistrust between China and the USA, propel the cycle of weapon proliferation and accelerate the pace at which states are moving into an arms race. Statements from US officials support this bleak outlook.[15] These developments further highlight the complex relationship between nuclear weapons, missile defence and space security.

Russia's direct-ascent anti-satellite weapon test

In November 2021 Russia conducted a direct-ascent anti-satellite (ASAT) weapon test using the PL-19 Nudol ABM system to intercept one of its own defunct satellites in orbit, Cosmos-1408. Although Russia had tested the Nudol on several occasions, this was the first instance of a collision with a target.[16]

The intercept took place at an altitude of approximately 480 kilometres in low-Earth orbit, creating significant debris in what is the busiest environment for space activities. The debris created was initially estimated by US Space Command to comprise 1500 trackable fragments.[17] Based on these figures, 904 fragments have been publicly catalogued.[18] This count will fluctuate due to various actors' ability to track and observe the debris and due to fragments gradually re-entering the Earth's atmosphere.

The test was a stark reminder of how space debris endangers the space activities of all states. The hazards of space debris were evident soon after the test, when the US National Aeronautics and Space Administration (NASA) reported that the International Space Station (ISS) had to take emergency measures to avoid the risk of collision with the debris from Russia's test.[19] A study by commercial firm COMSPOC (based on estimates from US Space Command) suggests that the Russian test posed direct risks to spacecraft of other states as well as the ISS.[20] However, the official Russian statement denied that the test posed 'any obstacles or difficulties to the functioning of

[14] For a summary and other details on the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) see annex A, section I, in this volume.

[15] Erwin, S., 'Mike Griffin critical of US response to China's advances in hypersonic weapons', SpaceNews, 30 Nov. 2021.

[16] eds Weeden and Samson (note 2), pp. 2–16; and McDowell, J., 'Space activities in 2021', 3 Jan. 2022, p. 54.

[17] United States Space Command, 'Russian direct-ascent anti-satellite missile test creates significant, long-lasting space debris', SpaceRef, 15 Nov. 2021.

[18] Hitchens, T., 'Russian ASAT debris imperils DOD, NRO sats, while ISS risks increase: COMSPOC', Breaking Defense, 4 Jan. 2022.

[19] NASA, 'NASA administrator statement on Russian ASAT test', 15 Nov. 2021.

[20] COMSPOC, 'COMSPOC's latest analyses of the Russian ASAT event', 29 Dec. 2021.

orbital stations and spacecraft, or to other space activities'. The statement also claimed that the test was conducted 'in strict conformity with international law'.[21]

Arguments can be made that the intentional creation of large amounts of debris violates elements of the Outer Space Treaty. Article IX of the treaty provides a series of obligations for states to follow.[22] These include the duty to 'avoid . . . harmful contamination' of outer space and 'where necessary, . . . adopt appropriate measures' to carry out this duty; and a requirement that states conduct activities with 'due regard to the corresponding interests of all other States Parties to the Treaty'. Furthermore, Article IX states,

> If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space . . . would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space . . . it shall undertake appropriate international consultations before proceeding with any such activity or experiment.

Russia's failure to consult can arguably be an additional violation of the treaty.

Several actors, including states, companies and civil society, have condemned ASAT tests as irresponsible and called for them to be prohibited.[23] These public reactions reflect the nascent movements towards an instrument prohibiting debris-creating kinetic ASAT tests. Indeed, earlier in 2021 an international open letter had proposed a multilateral treaty to ban kinetic ASAT tests.[24] US officials also expressed support for such a ban.[25] Russia's test revived the urgency of agreeing new measures regarding these tests.[26]

Growing interest in lunar activities

The legal regime for lunar activities is distinct from activities elsewhere in outer space under international law. States are legally obligated by the Outer Space Treaty to use the Moon and other celestial bodies 'exclusively' for peaceful purposes.[27] There are also blanket prohibitions on certain activities: 'The establishment of military bases, installations and fortifications, the

[21] Russian Ministry of Foreign Affairs, 'Comment by Foreign Ministry Spokeswoman Maria Zakharova on aspects of the space activities of Russia and other states', 16 Nov. 2021.

[22] Outer Space Treaty (note 14), Article IX.

[23] Raju, N., 'Russia's anti-satellite test should lead to a multilateral ban', Commentary, SIPRI, 7 Dec. 2021.

[24] Raju (note 23); and Byers, M. et al., 'Kinetic ASAT test ban treaty', Open letter, Outer Space Institute, 2 Sep. 2021.

[25] Smith, M., 'Space Council condemns Russian ASAT test: DOD calls for end to debris-creating tests', Space Policy Online, 1 Dec. 2021; and Hitchens, T., 'Biden's space policy nominee backs ban on destructive ASAT testing, pushes norms', 13 Jan. 2022, Breaking Defense.

[26] Byers et al. (note 24).

[27] Outer Space Treaty (note 14), Article IV.

testing of any type of weapons and the conduct of military manoeuvres on celestial bodies'.[28] The Moon therefore has a special legal status, with a higher standard of non-militarization than the rest of outer space.[29] This legal standard requires emphasis in the light of renewed lunar exploration ambitions and growing military focus in 2021.

International partnerships

In 2021 two distinct international partnerships for lunar exploration and resource utilization developed. The first is the Artemis Accords, which is led by the USA and by the end of 2021 included 14 other states.[30] The second involves a memorandum of understanding (MOU) announced by China and Russia in May 2021 for a joint international lunar research station, which invites other states to collaborate on this venture.[31] China and Russia have reportedly approached the European Space Agency (ESA) to join.[32]

With similar timelines and purposes, it is unclear how these two initiatives can be conducted simultaneously without any dedicated coordination mechanisms between the states leading them. For example, lunar resource utilization is a key objective for both partnerships. Yet, the Moon does not have plentiful, evenly distributed resources, and states are therefore likely to direct activities to a few resource-rich regions, or to specific areas that offer observational advantages.[33] As a result, new protocols will be required between participating states to ensure that no conflict arises out of competition for these locations and resources. Such cooperation, even involving rival states, is not unimaginable: NASA and the China National Space Administration (CNSA) have previously cooperated to exchange data and even provide monitoring and observational support.[34] However, in the absence of these dedicated mechanisms, the potential for miscommunication and magnified tensions leading to conflict on the Moon is likely to grow.

[28] Outer Space Treaty (note 14), Article IV.

[29] See Porras (note 2). See also Raju, N., 'Trends in lunar exploration: Examining the governance challenges', eds T. Ray and R. P. Rajagopalan, *Digital Debates: Cyfy Journal 2021* (Observer Research Foundation and Global Policy Journal: New Delhi, 2021).

[30] The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, opened for signature 13 Oct. 2020.

[31] Joint statement between China National Space Administration and the State Space Corporation 'Roscosmos' regarding cooperation for the construction of the International Lunar Research Station, 9 Apr. 2021.

[32] TASS, 'ESA mulls joining Russian–Chinese lunar station project', 27 Oct. 2021.

[33] Elvis, M., Krolikowski, A. and Milligan T., 'Concentrated lunar resources: Imminent implications for governance and justice', *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, vol. 379, no. 2188 (2021), p. 7.

[34] Foust, J., 'NASA exchanged data with China on Mars orbiters', SpaceNews, 30 Mar. 2021. Also see Xinhua, 'NASA's lunar orbiter has its third, overhead look on China's Chang'e-4 probe', 15 Feb. 2019.

Military interest in lunar activities

In May 2021 the US Air Force Research Laboratory released a primer on cislunar security, which was 'targeted at military space professionals . . . to develop plans, capabilities, expertise, and operational concepts'.[35] The primer refers to the MOU signed in September 2020 between NASA and the US Space Force (USSF), in particular quoting,

> As NASA's human presence extends beyond ISS to the lunar surface, cislunar, and interplanetary destinations, and as USSF organizes, trains, and equips to provide the resources necessary to protect and defend vital US interests in and beyond Earth-orbit, new collaborations will be key to operating safely and securely on these distant frontiers.[36]

It then addresses the scope for the detection and surveillance of activities in cislunar space.[37] The primer indicates an expansion of US military interest in lunar activities, in particular the USSF's drive for enhanced surveillance and monitoring in cislunar space.[38]

Growing military interest in lunar activities was again evidenced when the Defense Advanced Research Projects Agency (DARPA), the research and development arm of the US Department of Defense (DOD), announced the intent to commence manufacturing processes on the Moon.[39] As the Outer Space Treaty requires that the Moon be used 'exclusively for peaceful purposes', DARPA's announcement was immediately questioned by experts in the space sector as possibly violating international law.[40] As a result, some experts recommended the termination of these USSF and DARPA ventures in cislunar space, and alternatively suggest that these programmes be reassigned to NASA for civilian uses only.[41] This would ensure that the non-militarization standard for the Moon continues to be strictly maintained. Clarifications regarding intent in cislunar space, in addition to limitation of military interests, are therefore needed.

[35] Holzinger, M. J., Chow, C. C. and Garretson, P., *A Primer on Cislunar Security* (Air Force Research Laboratory: Kirtland AFB, NM, May 2021), p. 3.
[36] Holzinger et al. (note 35), p. 3.
[37] Holzinger et al. (note 35) pp. 13–18.
[38] Hitchens, T., 'AFRL jumpstarts early research on cislunar monitoring, satellite servicing', Breaking Defense, 17 Dec. 2021.
[39] Erwin, S., 'DARPA to survey private sector capabilities to build factories on the Moon', SpaceNews, 7 Feb. 2021.
[40] Hitchens, T., 'DARPA space manufacturing project sparks controversy', Breaking Defense, 12 Feb. 2021.
[41] Byers, M. and Boley, A., 'Cis-lunar space and the security dilemma', *Bulletin of the Atomic Scientists*, 17 Jan. 2022.

Other states have also expressed interest in cislunar space, such as China.[42] Amid unclear rhetoric and military interest, there is a need for clarity on permissible activities in the lunar environment.

Looking ahead: Discussions on responsible behaviour in space

The need to prevent an arms race in outer space was acknowledged at the Conference on Disarmament (CD) in 2021, although no further measures were adopted.[43] The UN Committee on the Peaceful Uses of Outer Space (COPUOS) also convened its 64th session, where delegations exchanged views on ways to maintain peaceful uses of space.[44] These included discussions on the continued implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities, adopted by the committee in 2019.[45] However, at the multilateral level, it was developments through the United Kingdom-sponsored resolution at the UN General Assembly that made the most substantive progress. This approach may hold the key to overcoming the current impasse in space security governance.[46]

In December 2020 the General Assembly adopted a resolution on 'Reducing space threats through norms, rules and principles of responsible behaviours'. This resolution invited states to

> study existing and potential threats and security risks to space systems . . . characterize actions and activities that could be considered responsible, irresponsible or threatening . . . and share their ideas on the further development and implementation of norms, rules and principles of responsible behaviours and on the reduction of the risks of misunderstanding and miscalculations with respect to outer space.[47]

The resolution aims to advance space security discussions on the prevention of an arms race in outer space (PAROS), which has been a priority for the CD for decades, but has made little progress due to political and technical hurdles.[48] It adopts a fresh approach that focuses on behaviour rather than capabilities and hardware. The resolution invited states to submit their views, which were then summarized in a report by the UN secretary-

[42] Chinese State Council, *China's Space Program: A 2021 Perspective*, White paper (State Council Information Office: Beijing, Jan. 2022).

[43] United Nations, General Assembly, Report of the Conference on Disarmament, 2021 session, A/76/27, 14 Sep. 2021.

[44] United Nations, General Assembly, Report of the Committee on the Peaceful Uses of Outer Space, 64th session, A/76/20, 21 Oct. 2021.

[45] United Nations, A/76/20 (note 46), annex II.

[46] Porras (note 2).

[47] UN General Assembly Resolution 75/36, 'Reducing space threats through norms, rules and principles of responsible behaviours', 7 Dec. 2020, para. 5.

[48] Porras (note 2).

general.[49] Thirty states, the European Union (EU) and several international and non-governmental organizations submitted responses. The submissions exhibit common concerns: the shared importance of space for all states and the risks posed by the proliferation of counterspace technologies, including both kinetic capabilities (which rely on motion-based destruction to destroy targets) and non-kinetic capabilities (such as lasers and electronic interference).

Most submissions referred to the hazards of space debris, with a few expressly proposing a ban on kinetic ASAT tests that generate debris. Some submissions also raised the need to specifically regulate non-cooperative rendezvous and proximity operations, which is when space objects come into contact with, or in close proximity to, each other. The submissions also contain recommendations for SSA data-sharing and increased transparency.

The secretary-general's report was followed by a resolution in the General Assembly in December 2021 to convene an open-ended working group to 'make recommendations on possible norms, rules and principles of responsible behaviours relating to threats by States to space systems, including . . . how they would contribute to the negotiation of legally binding instruments, including on the prevention of an arms race in outer space'.[50] The OEWG will convene in 2022 and 2023 over four sessions and, working by consensus, will submit a report to the General Assembly at its 78th session.[51]

Continuing to build the momentum to enhance the security of outer space through norms of behaviour, in July 2021 the US Secretary of Defense published a formal memorandum stating that the DOD would, unless otherwise directed, follow five 'Tenets of responsible behavior in space': (*a*) operating with due regard, (*b*) limiting 'long-lived debris', (*c*) avoiding creation of harmful interference, (*d*) maintaining safe separation and safe trajectory, and (*e*) communicating and notifying to enhance safety and stability.[52] While this declassified memorandum is a positive starting point for discussions on responsible behaviour in space, many of these concepts require legal and technical clarification as well as consensus-building among states as to their common understanding. The OEWG provides the ideal forum for these discussions.

With the potential to overcome the ongoing space security stalemate, this resolution and the OEWG could evolve space security governance at a time when transparency and cooperation are urgently needed.

[49] United Nations, Report of the Secretary-General, 'Reducing space threats through norms, rules and principles of responsible behaviours', A/76/77, 13 July 2021.

[50] UN General Assembly Resolution 76/231, 'Reducing space threats through norms, rules and principles of responsible behaviours', 30 Dec. 2021, para 5(c).

[51] UN General Assembly Resolution 76/231 (note 52), para. 5(d).

[52] US Secretary of Defense, 'Tenets of responsible behavior in space', Memorandum, 7 July 2021.