DID EXCLUSION IGNITE CHINA'S DRIVE TO COMPETE IN SPACE STATION TECHNOLOGY? AN ANALYSIS OF THE TECHNO-LEGAL IMPLICATIONS OF THE WOLF AMENDMENT (2011)

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Abstract

China has been excluded from participation in the International Space Station (ISS) since 2011. The exclusion was codified into law by the Wolf Amendment (2011), which was passed in Congress to restrict extensively, based on financial constraints, the National Aeronautics and Space Administration (NASA) and the Office of Science and Technology Policy (OSTP) from cooperating with China at all levels. Ten years later, in the absence of American collaboration, China successfully launched its permanent space station in June 2021. It may be the appropriate time to revisit the Wolf Amendment to assess its long-term impact on China's progress in space station technology.

This article traces and analyzes the ostensible reasons and underlying rationale why Congress passed the Wolf Amendment in 2011. It further discusses the response of the Chinese authority in space station technology after being excluded from the ISS. This will provide a platform to discuss the justification and effectiveness of the Wolf Amendment in protecting the integrity of American space technology, based on the concerns about the national pride, rather than national security, of the United States. This article concludes that excluding China from international cooperation in space exploration is a fruitless and unwarranted endeavor.

Keywords

Space program, International Space Station, Wolf Amendment, Artemis Accords

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TABLE OF CONTENTS

"Our policy of excluding China from human spaceflight and exploration missions to the Moon and beyond has not slowed its rise as a space power. Worse, it may create an incentive for China to build an alternative coalition for space exploration that could undermine our traditional leadership role in this arena."

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INTRODUCTION

Space station technology has become considerably well-developed after the launch of the International Space Station (ISS), a multinational cooperative project jointly organized by the national space agencies of a number of countries (including Canada, Europe, Japan, Russia, and the United States) to provide a platform for scientific exploration in a space environment and a possible staging base for outer space missions.[2] Its first component was launched and staged at the low Earth orbit (LEO)[3] on November 15, 1998. In 2007, China expressed its interest in participating in the ISS.[4] This request was approved by the European Space Agency in 2010 but was rejected by the United States in 2011 when Congress passed the Wolf Amendment.[5]

Is exclusion an effective way to stop or weaken China's development of space station technology? Though the amendment does not directly prohibit all collaboration between the United States and China, its effects have proven to be a significant obstacle to bilaterally cooperative civil space projects.[6] Yet, China commenced its own space station program in the absence of American cooperation in space technology. While being effective in stopping bilateral cooperation, the exclusion measures of the Wolf Amendment to impair the Chinese technological progress in space station appears to be ineffectual.[7]

1. *China in Space: A Strategic Competition? Hearing Before the U.S.-China Econ. & Sec. Rev. Comm'n,* 116th Cong. (2019), https://www.uscc.gov/hearings/china-space-strategic-competition [hereinafter China in Space Hearing].

2. GARY KITMACHER, REFERENCE GUIDE TO THE INTERNATIONAL SPACE STATION 38 (2006).

3. *See* J. C. Sampaio et al., *Resonant Orbital Dynamics in LEO Region: Space Debris in Focus*, 2014 MATHEMATICAL PROBLEMS IN ENGINEERING 1 (2014) (explaining a low Earth orbit (LEO) is an Earth-centered orbit with a circulation period of 128 minutes or less around the Earth).

4. Loretta Hidalgo Whitesides, *China Wants to Partner on the International Space Station*, WIRED (Oct. 10, 2007, 8:40 AM), https://www.wired.com/2007/10/china-wants-t-1/ (covering Chinese officials stated desires to cooperate with the ISS).

5. Wolf Amendment, Pub. L. No. 112-10, § 1340.

6. Makena Young, *Bad Idea: The Wolf Amendment (Limiting Collaboration with China in Space)*, DEFENSE360 (Dec. 4, 2019), https://defense360.csis.org/bad-idea-the-wolf-amendment-limiting-collaboration-with-china-in-space.

7. *Id*. ("However, in the eight years since the first iteration of this amendment, the U.S. has not seen the desired changes in Chinese human rights policies that the Wolf Amendment was intended to spur. And during that time, China's economy, global influence, and space capabilities have continued to grow.").

A decade after being excluded from the ISS, China successfully launched its own space station, Tiangong under Project 921,[8] in 2021. Tiangong will soon become the only space station in operation when the ISS retires in the next decade, after serving for more than twenty years.[9] By that time, the United States will need to request permission to participate in China's space station if any space-related experiments are to be conducted by American scientists in a microgravity environment.[10]

Moreover, in March 2021, China and Russia announced the development of cooperative plans to build and stage a lunar space station.[11] Unless the United States can build and launch its own space stations in the orbits of the earth and the moon, American scientists will have much fewer chances to conduct space-related experiments in the next few decades.[12] Since the development of China's space station project appears to be much faster than expected, some observers argue that the Wolf Amendment may have humiliated China and thus ignited its drive to compete in space station technology.[13] This article proposes that although humiliation may be a contributing factor, China's pre-determined policy in technological progress determines the pace of its achievement in space exploration.

While there were several significant incidents in the 2000s that triggered the perceived need to exclude Chinese scientists in the sharing of American knowledge in space technology, the Wolf Amendment is a milestone in the United States' Chinese exclusion policy in space technology.[14] This exclusion policy persists because the issue of pursuing global space leadership and military-civil fusion in China's space ambitions has become a primary concern of the United States.[15]

From a historical perspective, some Chinese scholars argue that the Wolf Amendment can be regarded as a space-technology-based reinstatement of America's Chinese exclusion policy that prevailed in the late nineteenth and early twentieth centuries, lasting for sixty-one years. The Chinese Exclusion Act, which explicitly prohibited the migration of all Chinese skilled and unskilled laborers, was passed in 1882, renewed in 1892, made permanent in

8. *What's Driving China's Race to Build a Space Station?*, CSIS: CHINA POWER PROJECT (Dec. 7, 2016), https://chinapower.csis.org/chinese-space-station.

9. Thomas Hayden, *Beijing's Heavenly Debut*, 135 U.S. NEWS & WORLD REP. (Sept. 2003) at 37, 37–38.

10. *See* Young, *supra* note 6 ("With the ISS slated for retirement in 2024, other countries that want a long-term human presence in low Earth orbit may be lured into partnering with China on the CSS.").

11. *China and Russia to Build Lunar Space Station*, BBC (Mar. 10, 2021), https://www.bbc.com/news/world-asia-china-56342311.

12. *See* Young, *supra* note 6 (further discussing China's position as the ideal partner of choice for future space exploration missions).

13. *See id.* ("Being left out of U.S.-led international missions has not deterred China in space, but instead has pushed China to develop parallel capabilities on its own.").

14. William Pentland, *Congress Bans Scientific Collaboration with China, Cites High Espionage Risks*, FORBES (May 7, 2011), https://www.forbes.com/sites/williampentland/2011/05/07/congress-bans-scientific-collaboration-with-china-cites-high-espionage-risks/?sh=14f35f174562 (discussing the reasons the Wolf Amendment came to pass and the changes it spurred at the time of its passing).

15. China in Space Hearing, *supra* note 1.

1902, and repealed in 1943.[16] However, the linkage to what happened more than a century ago does not seem to provide a plausible justification for the current situation of the space station development.[17] This historical perspective will be further explored and discussed in the following sections.

This article traces and analyzes the ostensible reasons and underlying rationale for why Congress passed the Wolf Amendment in 2011.[18] It further discusses the response of the Chinese authority in space station technology after being excluded from the ISS. This will provide a platform to understand and analyze the justification and effectiveness of the Wolf Amendment in protecting the integrity of American space technology as well as issues related to national security. This article also argues that although the Wolf Amendment could not have stopped or weakened the progress of China's space station technology, it did not ignite China's drive to start to compete in such technology. This is due to the observation that there have been well-placed and designed plans formulated by the Chinese authority to develop its space technology since 1992. This article supports the view that excluding China from international cooperation in space exploration is a fruitless and unwarranted endeavor.

I. A Historical Review of Space Stations

The idea of space exploration has been the dream of scientists since the seventeenth century. In a letter to Galileo Galilei in 1610, Johannes Kepler wrote of building ships or sails adapted to heavenly breezes by future explorers who would no longer shy away from the vast space.[19] A number of foreign scientists have contributed to the development of space technology in the United States. One of the prominent scientists is Konstantin Tsiolkovsky (1857–1935), a Russian rocket scientist who pioneered the astronautic theory.[20] Another leading scientist is Wernher von Braun (1912–1977), a German aerospace engineer who was one of the leading scientists in rocket technology in Nazi Germany and the United States.[21] These two non-American scientists had significant contributions to the space programs in the United States.[22]

One of the most important steps in space exploration is the anchoring of space stations in Earth's orbits. Taking up a significant role in space technology

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16. *See generally* JOHN SOENNICHSEN, THE CHINESE EXCLUSION ACT OF 1882 xiv (2011) (providing a background on the 19th and early 20th century United States policies towards China).

17. *See* Zhihui Zhang & Bruce Seeley, *A Historical Review of China-U.S. Cooperation in Space: Launching Commercial Satellites and Technology Transfer, 1978–2000*, 50 SPACE POL'Y. 1, 1 (describing periods of cooperation between China and the U.S. in the past regarding space technology).

18. China in Space Hearing, *supra* note 1.

19. Anton Postl, *Correspondence Between Kepler and Galileo*, 21 VISTAS IN ASTRONOMY 325, 327 (1977).

20. *See generally* A. KOSMODEMYANSKY, KONSTANTIN TSIOLKOVSKY: HIS LIFE AND WORK 1 (2000) (providing further background on Tsiolkovsky).

21. *See generally* ERIK BERGAUST, WERNHER VON BRAUN 1 (2017) (providing further background on Von Braun).

22. *Konstantin E. Tsiolkovsky*, NASA (Sept. 22, 2010), https://www.nasa.gov/audience/foreducators/rocketry/home/konstantin-tsiolkovsky.html (detailing Tsiolkovsky's contributions); *Biography of Wernher von Braun*, NASA (last updated Aug. 3, 2017), https://www.nasa.gov/centers/marshall/history/vonbraun/bio.html (detailing von Braun's contributions).

development, a space station is an artificial structure staged in Earth's orbit equipped with a pressurized enclosure and the necessary power, supplies, and installations to support human habitation for scientific exploration for extended periods.[23] From 1971 to 2021, a total of thirteen space stations have been launched into low Earth orbit (LEO), with different lifespans ranging from a few weeks to more than twenty years.[24]

Both the United States and the USSR (Union of Soviet Socialist Republics) are pioneers in space station technology.[25] Nine stations have been developed and launched by the United States or USSR (and later, Russia), the two primary developers of space stations from the 1970s onwards.[26] In chronological order, they are USSR's Salyut program (Salyut-1 to Salyut-7, 1971–1986), United States' Skylab (1971–1979),[27] followed by USSR's Mir (1986–2000).[28] The individual efforts of the United States and USSR were later consolidated to produce the project of the International Space Station (ISS) (through multinational efforts), which was launched in 1998.[29] As of October 5, 2021, a total of 246 individuals from nineteen countries have visited the ISS.[30] None of them are from China nor India, two of the major players in the space exploration exercise in the new millennium.[31]

In addition to the American-Russian versions of space stations, three space stations have been launched by China. Tiangong-1 (2011–2018) and Tiangong-2 (2016–2019) were China's first and second temporary space stations,[32] placed in Earth's orbits to serve as a crewed laboratory to test key space technologies. A permanent station named Tiangong (or heavenly palace in Chinese), the size of which is about a fifth of the ISS, was successfully launched in 2021.[33] The following paragraphs will outline the history and background of the space stations developed by the USSR, the United States, and China.

A. Space Stations of the USSR and Russia

The USSR was one of the pioneers in space technology development. It projected the world's first intercontinental ballistic missile in August 1957 and

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23. David M. Harland, *Space Station*, BRITANNICA (last edited June 23, 2021), https://www.britannica.com/technology/space-station.

24. *Id*.

25. *See id.* (providing information that until 2011, all space stations ever launched were from the USSR or the United States).

26. *Id*.

27. *Id*.; *see also* Sylvia Doughty Fries & Frederick I. Ordway III, *The Space Station From Concept to Evolving Reality*, 12 INTERDISC. SCI. REV. 143–59 (1987) (offering further background on the origins of space stations).

28. Harland, *supra* note 23; *see also*, DAVID M. HARLAND, THE STORY OF SPACE STATION MIR (2005) (providing further background on the MIR space station).

29. Jennifer Gebelein & Dean Eppler, *How Earth Remote Sensing from the International Space Station Complements Current Satellite-Based Sensors*, 27 INT'L J. REMOTE SENSING 2613, 2613–29 (2006).

30. Mark Garcia, *Visitors to the Station by Country*, NASA (Dec. 8, 2021), https://www.nasa.gov/feature/visitors-to-the-station-by-country.

31. *Id*.

32. Harland, *supra* note 23.

33. *Id*.

its first artificial satellite, Sputnik I, in October 1957.[34] Later the USSR lifted off the first human, Yuri Gagarin, to travel in space, completing a full orbit of Earth on April 12, 1961.[35]

A series of the USSR's first-generation uncrewed space stations was launched in the early 1970s, with the first one, Salyut-1, being projected in April 1971.[36] The early Soviet stations were all designated "Salyut," with two distinct types: civilian and military.[37] These space stations had only one docking port and could not be re-supplied or refueled, restricting their life spans to only a few months.[38] There were also a number of casualties of Soviet astronauts traveling to and from the early versions of space stations.[39] Despite these failures, the USSR's new space stations, Salyut-3, Salyut-4, and Salyut-5, also known as Almaz stations, were supported by a total of five astronauts, arriving at different times.[40] They performed numerous tests and experiments to help develop and improve the second-generation space stations.[41]

The USSR's second-generation space stations have a much longer life span by having more than one docking port, allowing refueling and resupply from subsequent spacecraft coming from the home base on earth.[42] This concept was gradually expanded and applied to Salyut-6 and Salyut-7. These are civilian stations built with two docking ports, allowing more astronauts to visit and stay at space stations continually.[43] These stations could also receive astronauts from countries other than the USSR. Vladimir Remek of Czechoslovakia, the first space traveler not from the U.S. or the USSR, visited Salyut 6 in 1978.[44] Later versions of Salyut's served as a transition between the second-and third-generation space stations, paving the way for the introduction of Mir, the first third-generation space station.[45]

Mir (1986–2001), launched by the USSR in 1986, was the first permanent space station in orbit lasting fifteen years.[46] It weighs more than 100 tons and measures more than 107 feet long, with the capacity to support a crew of three

34. Andrew Chatzky, Anshu Siripurapu & Steven J. Markovich, *Space Exploration and U.S. Competitiveness*, COUNCIL FOREIGN REL. (Sept. 23, 2021, 11:15 AM), https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness.

35. *Id*.

36. Cameron Wade, *Suspension of Disbelief: The Real History of Spaceships*, PASTE MAG. (Mar. 21, 2017), https://www.pastemagazine.com/science/spaceships/suspension-of-disbelief-the-real-history-of-spaces.

37. *Russian Space Stations,* NASA, (Jan. 1997) https://er.jsc.nasa.gov/seh/russian.pdf (describing the Soviet space programs).

38. *Id*.

39. *Id*.

40. *Id*.

41. *Id*.

42. *Id*.

43. *Id*.

44. *Id*.

45. John Uri, *50 Years Ago: Launch of Salyut, the World's First Space Station,* NASA (Apr. 19, 2021), https://www.nasa.gov/feature/50-years-ago-launch-of-salyut-the-world-s-first-space-station.

46. *Id*. ("Despite highly publicized incidents late in its orbital life, Mir secured its place in history as the first modular space station that enabled semi-permanent human habitation in low-Earth orbit.").

or more astronauts for extended visits.[47] It consists of the Mir core, connected to seven modules (1987–1996).[48]

In 1987, the modular approach proved effective when the Kvant module was first added to the Mir core station.[49] Six more modules have been developed based on the design and capabilities of Mir.[50] After being in operation well exceeding its design life and with its funding being cut off, the Mir space station was de-orbited ending its mission on March 23, 2001.[51] Instead of working alone, the USSR's (and after 1991, Russia's) exploration in space station technology has evolved to become an active partner of the ISS project starting in the 1990s.[52]

B. American Space Station: Skylab

Despite the outstanding achievement in landing human beings on the surface of the Moon from 1969 to 1972,[53] the United States appeared to be lagging behind the USSR in the launching and anchoring of space stations. Skylab (1973–1979), the first experimental space station of the United States, was launched by NASA in May 1973,[54] two years after the USSR's Salyut-1 had been staged in Earth's low orbit. Being one of the pioneering projects in the second-generation space station technology, Skylab was designed for extended duration missions to conduct experiments to prove that humans could live and work in space for a long time and explore the knowledge of scientific research on the basis of zero-gravity beyond Earth-based observations.[55]

Skylab was equipped with two docking ports, allowing spacecraft to dock and connect to the station to bring supplies for long-duration missions. Yet, it disintegrated and fell to the surface of Earth on July 11, 1979,[56] lasting only about six years in orbits. The planned replacement, Skylab B, with similar but improved design and operations compared to its predecessor, was never launched due to funding issues.[57] As a result of funding reallocation, NASA started the Space Shuttle program instead of continuing the space station

47. *Russian Space Stations*, *supra* note 37.

48. *Id*.

49. *Mir Space Station*, HISTORIC SPACECRAFT, https://historicspacecraft.com/Mir.html (last visited Mar. 3, 2022).

50. *35 Years Ago: Launch of Mir Space Station's First Module*, NASA (Feb. 22, 2021), https://www.nasa.gov/feature/35-years-ago-launch-of-mir-space-station-s-first-module (explaining the subsequent history of Mir Space Station).

51. DAVID M. HARLAND, THE STORY OF SPACE STATION MIR (Springer Science & Business Media, 2007).

52. Mark Garcia, *International Space Station: International Cooperation*, NASA, https://www.nasa.gov/mission_pages/station/cooperation/index.html (last updated Oct. 2020).

53. Roger D. Launius, *Interpreting the Moon Landings: Project Apollo and the Historians*, 22 HIST. & TECH. 225–55 (Aug. 20, 2006).

54. David M. Harland, *Skylab*, BRITANNICA, https://www.britannica.com/topic/Skylab (last visited Mar. 3, 2022).

55. *Id.*

56. *Id.*

57. DAVID J. SHAYLER, SKYLAB: AMERICA'S SPACE STATION 301 (Springer Science & Business Media, 2001).

program in 1981[58] Later, the United States initiated the ISS program in 1989 to conduct space-based tests and experiments with international partners on a cost-sharing basis.[59]

Space exploration is always an expensive task. NASA's budget for 2021 was $23.3 billion, with $4 billion allocated to the operations of the ISS.[60] The financial constraints restrict the scope of NASA's operations and its ambition to a great extent.[61] The Apollo program cost the United States about $26 billion between 1960 and 1973, based on the estimation of the Planetary Society.[62] After being adjusted for inflation, the figure becomes $283.8 billion (expressed in the dollar value in 2020).[63] Although the space exploration of the United States, especially the moon-landing project, has inspired more than one generation of scientists, researchers, and students, its role has diminished in recent years, given the trend that competition and costs involved in space programs have grown significantly.

NASA's plan to build and maintain a space station is restricted by its budget and impending political issues.[64] Since China and Russia are both planning actively to launch space stations in Moon's orbits, Former President Trump pushed for an American moon landing by 2024, which happened to be a costly exercise.[65] The target was later moved to 2028 by President Biden, in accordance with the schedule of the Artemis Project, to establish a sustainable presence on the surface of the Moon to prepare for Mars exploration.[66] As the launch of an all-American space station is unlikely in the next few years, NASA will maintain the ISS until an alternative replacement project materializes in the near future.

C. International Space Station

The unilateral efforts of both American and Russian space station programs seem to be overly expensive and uneconomical.[67] Initiated by the United States, the International Space Station (ISS) is a milestone of space exploration based on a cooperative global effort to extend scientific knowledge to outer space, with

58. David Collingridge, *Technology Organizations and Incrementalism: The Space Shuttle*, 2 TECH. ANALYSIS & STRATEGIC MGMT. 181–200 (1990).

59. Garcia *supra* note 52.

60. *Nasa's FY 2021 Budget*, THE PLANETARY SOCIETY, https://www.planetary.org/space-policy/nasas-fy-2021-budget (last visited Mar. 3, 2022).

61. *Id.*

62. *How Much Did the Apollo Program Cost?*, THE PLANETARY SOCIETY, https://www.planetary.org/space-policy/cost-of-apollo (last visited Mar. 3, 2022).

63. Shaina Mishkin, *The Apollo Moon Landing Cost the Equivalent of $600 Billion. Here's Why That Was a Bargain*, MONEY.COM (July 19, 2019), https://money.com/apollo-11-moon-mission-cost.

64. Brad Plumer, *NASA wants to keep the International Space Station going until 2024. Is That a Good Idea?* WASH. POST (Jan. 9, 2014) https://www.washingtonpost.com/news/wonk/wp/2014/01/09/nasa-plans-to-keep-the-international-space-station-going-until-2024-is-that-a-good-idea.

65. Christian Davenport, *Trump Pushed for a Moon Landing in 2024. It's Not Going to Happen*, WASH. POST, (Jan. 13, 2021), https://www.washingtonpost.com/technology/2021/01/13/trump-nasa-moon-2024.

66. *Artemis Program*, NASA, https://www.nasa.gov/artemisprogram (last visited Mar. 3, 2022).

67. Andrew Chatzky et al., *Space Exploration and U.S. Competitiveness*, COUNCIL ON FOREIGN RELS. (Sept. 23, 2021), https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness.

the purpose of reaching out to the moon and Mars and beyond.[68] It evolved from a combination of space stations proposals based on the drawing boards of the Space Station Freedom (United States) and Mir-2 (USSR/Russia).[69] The American proposal is based on President Ronald Reagan's State of the Union Address delivered on January 25, 1984, to direct NASA to build an international space station within the next ten years.[70] In the early 1980s, several countries started some active space travel programs in the hope of developing some breakthroughs in space technology. This includes the Space Shuttle program developed by the United States, Buran (USSR), Hermes (Europe), and Hope (Japan).[71]

The ISS is a third-generation modular-based, permanent, crewed facility (about 110 meters in length and 75 meters in width) placed in low Earth orbit (LEO) as a habitable artificial satellite at an altitude of 400 kilometers to support scientific research in space and future outer space exploration.[72] These scientific research projects include space observation, space communication, zero-gravity experiments, and the testing of materials and pharmaceuticals to be conducted in the ISS within its expandable and multipurpose compartments.[73] The ISS is an international collaborative project involving five participating space agencies: NASA (United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada).[74]

The ISS is the ninth space station inhabited by crews, following the USSR's Salyut and Mir stations, and the American Skylab. It is the largest artificial object in low Earth orbit (LEO).[75] It can complete 15.5 orbits every day.[76] Most ISS modules have been launched primarily by American and Russian spacecraft such as Russia's Proton and Soyuz rockets and U.S. Space Shuttles.[77] Other spacecraft have also been sent by Europe and Japan.[78]

The characteristics of modular systems and the durability of the ISS allow it to continue the expansion of operations for a long time. Its lifespan can last

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68. Garcia, *supra* note 52.

69. Jason Roberts, *Celebrating the International Space Station (ISS)*, NASA (June 19, 2020), https://www.nasa.gov/image-feature/celebrating-the-international-space-station-iss-0.

70. *History and Timeline of The ISS*, ISS NAT. LAB'Y, https://www.issnationallab.org/about/iss-timeline (last visited Mar. 3, 2022).

71. *History of Space Shuttles: Remembering the fleet of U.S. space planes – 181–2011*, SPACE TODAY, http://www.spacetoday.org/SpcShtls/ShuttleHistory/Space_Shuttle_history_1981_2012.html (last visited Mar. 3, 2022).

72. Julie A. Robinson et al., *NASA Utilization of the International Space Station and the Vision for Space Exploration*, 61 ACTA ASTRONAUTICA 176–84 (2007).

73. *Space Station Research & Technology: Space Station Research Experiments*, NASA, https://www.nasa.gov/mission_pages/station/research/experiments_category (last visited Mar. 3, 2022).

74. Garcia, *supra* note 52.

75. Esther Fleming, *Is the ISS the Biggest Man Made Object in Space?*, SIDEMARTINBIO (July 26, 2019), https://www.sidmartinbio.org/is-the-iss-the-biggest-man-made-object-in-space.

76. *Gateway to Astronaut Photography of Earth Space Station Orbit Tutorial*, NASA, https://eol.jsc.nasa.gov/Tools/orbitTutorial.htm (last visited Mar. 3, 2022).

77. JOHN E. CATCHPOLE, THE INTERNATIONAL SPACE STATION: BUILDING FOR THE FUTURE 1–5 (Springer Science & Business Media, 2008).

78. *International Space Station Legal Framework*, EUR. SPACE AGENCY, https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station/International_Space_Station_legal_framework (last visited Mar. 3, 2022).

beyond 2030 if participating nations agree to maintain the current support services.[79] However, as the major provider in spacecraft service to carry astronauts and supplies to the ISS, Russia has expressed its intention to halt participation after 2024.[80] It seems likely that the ISS will stop operations by 2030, after serving for more than three decades.

The ISS is composed of seventeen detachable and expandable modules, with six sent from Russia (Zarya, Pirs, Zvezda, Poisk, Rassvet, and Nauka), eight from the United States (BEAM, Leonardo, Harmony, Quest, Tranquility, Unity, Cupola, and Destiny), two from Japan (the JEM-ELM-PS and JEM-PM) and one from Europe (Columbus).[81] The ISS required a total of $150 billion to develop and build, with the cost covered mainly by the United States.[82] It also costs NASA about $4 billion a year to operate and maintain.[83]

As of October 5, 2021, nineteen different nations have visited the space station multiple times, including 153 Americans, 50 from Russia, 9 from Japan, 8 from Canada, 5 from Italy, 4 from France, 3 from Germany, and 1 each from Brazil, Denmark, Kazakhstan, Spain, Malaysia, South Africa, South Korea, United Arab Emirates, and the United Kingdom.[84] Countries with advanced technology in space exploration, such as China and India, have never been allowed to send any astronauts to the ISS.[85]

Russia's passenger vehicle, Soyuz, has been used to serve as the only means to carry astronauts to the ISS after the U.S. retired its Space Shuttle Program in 2011.[86] In 2020, the United States started to use the SpaceX system, which was developed and built by Elon Musk, reducing the reliance on Russian spacecraft.[87] This is why in September 2021, Russia announced that it would withdraw from the International Space Station in 2025 and intended to build and manage its own space laboratory to be launched into orbit by 2030.[88]

D. China's Space Station

China space exploration commenced with the announcement of Project 921 in 1992 for its space program. After two decades, the first Chinese space station,

79. Meghan Bartels, *The International Space Station Will Eventually Die by Fire*, SPACE.COM (Feb. 4, 2022), https://www.space.com/how-to-destroy-a-space-station-safely.

80. Quirin Schiermeier, *Russia Aims to Revive Science After Era of Stagnation*, 579 NATURE 332–37 (Mar. 2020).

81. *History and Timeline of The ISS, supra* note 70.

82. Michael Sheetz, *NASA Wants Companies to Develop and Build New Space Stations, with up to $400 Million up for Grabs*, CNBC (Mar. 27, 2021 9:11 AM) https://www.cnbc.com/2021/03/27/nasa-commercial-leo-destinations-project-for-private-space-stations.html.

83. *Id.*

84. *Visitors to the Station by Country*, NASA (Dec. 8, 2021), https://www.nasa.gov/feature/visitors-to-the-station-by-country.

85. *Id.*

86. Elizabeth Howell, *Soyuz Rocket: Russia's Venerable Booster*, SPACE.COM (Apr. 11, 2018), https://www.space.com/40282-soyuz-rocket.html.

87. Om Marathe, *Explained: Why Does Russia Want to Leave the International Space Station?*, INDIAN EXPRESS (May 6, 2021), https://indianexpress.com/article/explained/explained-why-russia-wants-to-leave-the-international-space-station-7288790.

88. *Id.*

Tiangong-1,[89] being merely temporary for very short-term missions, was launched in September 2011, just a few months after the passing of the Wolf Amendment in April 2011,[90] The short time gap suggests that the Wolf Amendment could not have significantly sped up the advancement of China's space station technology. After five years, communication with Tiangong-1 was lost in March 2016, and it disintegrated on April 2, 2018.[91]

Based on the lessons learned from Tiangong-1's failure, China managed to launch an improved station, Tiangong-2, in September 2016.[92] It is intended to be a temporary station to serve as a platform to offer critical capabilities, such as docking and berthing of spacecraft for the transportation of crews and supplies, to prepare for the operations of a permanent space station.[93] It was de-orbited in July 2019.[94] China built and launched Tianhe-1, the core module of Tiangong, intended to be China's first permanent space station on April 29, 2021.

Three astronauts were sent to Tiangong in October 2021 to carry out a series of space experiments.[95] More modules will be sent to the space station by the end of 2022.[96]

II. THE EXCLUSION OF CHINESE PARTICIPATION IN THE ISS BY THE WOLF AMENDMENT (2011)

China is currently advancing along the path of integrating into the global economy by placing more emphasis on its power in science and technology. In 2003, China became the third country to send crewed spacecraft into Earth's orbits.[97] In 2007, Li Xueyong, a vice minister of China's Ministry of Science and Technology, said, "We hope to take part in activities related to the international space station . . . . If I am not mistaken, this program has sixteen countries currently involved, and we hope to be the seventeenth partner."[98] Despite China's interest in the ISS, its request was rejected by the United States based on the threat of the theft of American technology, national security of the

89. The word "Tiangong" means "heavenly palace" in Chinese. Andrew Jones, *China's Tiangong Space Station*, SPACE.COM (Aug. 24, 2021), https://space.com/tiangong-space-station.

90. Xueke Li et al., *Evaluation of the Chinese fine Spatial Resolution Hyperspectral Satellite TianGong-1 in Urban Land-Cover Classification*, 8 REMOTE SENSING 438–96.

91. *What's Driving China's Race to Build a Space Station?*, CHINA POWER, https://chinapower.csis.org/chinese-space-station (last visited Mar. 3, 2022).

92. *Id.*

93. Jun-Jun Wu et al., *Estimation for Sparse Vegetation Information in Desertification Region Based on Tiangong-1 Hyperspectral Image*, 34 SPECTROSCOPY AND SPECTRAL ANALYSIS 751–56.

94. *Id.*

95. Sammy Westfall, *China Sends Three Astronauts to New Space*, WASH. POST (Oct. 15, 2021, 10:10 AM), https://www.washingtonpost.com/world/2021/10/15/china-space-station-launch-tiangong.

96. Zachary Snowdon Smith, *China Plans to Launch 140 Spacecraft, Complete Space Station in 2022*, FORBES (Feb. 9, 2022, 3:27 PM), https://www.forbes.com/sites/zacharysmith/2022/02/09/china-plans-to-launch-140-spacecraft-complete-space-station-in-2022/?sh=455b8e0e5707.

97. Bill Keeter, *Space Flight 2003—Asian Space Activities*, NASA (Oct. 8, 2009), https://www.nasa.gov/directorates/somd/reports/2003/asia.html.

98. *China Wants Role in Space Station*, CNN (Oct. 16, 2007, 3:39 PM), https://web.archive.org/web/20080314104006/http:/www.cnn.com/2007/TECH/space/10/16/china.space.ap/index.html.

United States and China's human rights issues.[99] The exclusion of China's participation in the international cooperation of space technology was formalized by the passage of the Wolf Amendment.

Congress passed the Wolf Amendment as an integral part of the Department of Defense and Full-Year Continuing Appropriations Act in 2011.[100] It prohibits the National Aeronautics and Space Administration (NASA) from using government funds to engage in bilateral cooperation with the Chinese government and China-affiliated organizations from its activities without explicit authorization from the Federal Bureau of Investigation and the U.S. Congress.[101]

China responded to the exclusion by launching the Tiangong-01 space station in September 2011. Just two years later, China successfully launched the lander and rover of Chang'e 3 on the moon's surface in December 2013.[102] After a succession of launches, China eventually managed to collect 1,731 grams of moon samples back to earth in 2020.[103] In 2021, China successfully launched its permanent space station to the LEO,[104] about a decade after the passing of the Wolf Amendment. The exclusion of Chinese participation in the ISS with a view to weakening China's space technology does not seem to be effectual.

A. National Space Policy of the U.S.

In terms of general principles such as openness, transparency, and predictability, Former President Donald Trump's version of the National Space Policy specified four crucial issues—the promotion of a commercial space industry, the returns of Americans to the Moon and the landing on Mars, the continuation of American leadership in space exploration, and the need to defeat possible threats in the space domain that are hostile to the national interests of the United States.[105] This National Space Policy also recognizes that an innovative and competitive commercial space sector is imperative to the continuous growth and support for sustaining American leadership in space technology.[106]

In a report submitted to the U.S.-China Economic and Security Review Commission on March 30, 2020, the following observation and recommendations were made:

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99. Jeffrey Kluger, *The Silly Reason the Chinese Aren't Allowed on the Space Station*, TIME (May 29, 2015, 5:48 PM), https://time.com/3901419/space-station-no-chinese.

100. Department of Defense and Full-Year Continuing Appropriations Act of 2011, H.R. 1473, 112th Cong. § 1340(a) (2011).

101. *Id.*

102. *Chang'e 3*, NASA, https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=2013-070A (Jan. 7, 2022).

103. *China's Chang'e-5 Retrieves 1,731 Grams of Moon Samples*, CHINA NAT'L SPACE ADMIN. (Dec. 19, 2020), http://www.cnsa.gov.cn/english/n6465652/n6465653/c6810963/content.html

104. Scott Alan Johnston, *China Launches the Core Module of Its New Space Station*, UNIVERSE TODAY (Apr. 30, 2021), https://www.universetoday.com/151047/china-launches-the-core-module-of-its-new-space-station.

105. NATIONAL SPACE POLICY OF THE UNITED STATES OF AMERICA, TRUMP WHITE HOUSE, 5–6 (Dec. 9, 2020), https://Trumpwhitehouse.Archives.Gov/Wp-Content/Uploads/2020/12/National-Space-Policy.pdf.

106. *Id.* at 1.

> The Chinese Communist Party (CCP) is executing a long-term strategy to exploit U.S. technology, talent, and capital to build up its military space and counter space programs and advance its strategic interests at the expense of the U.S.-China's zero-sum pursuit of space superiority harms U.S. economic competitiveness, weakens U.S. military advantages, and undermines strategic stability. In short, it represents a threat to U.S. national security. Barring significant action to counter China's space-related programs and activities of concern, it is likely that this strategic competitor's efforts will continue to adversely affect U.S. interests . . . . Therefore, the U.S. government should work to reassess export control waivers for Hong Kong to ensure the protection of critical U.S. technology.[107]

These comments provide a clear profile of America's prevailing policy of excluding China from space technology. Based on this perspective, China is considered a serious threat to the United States concerning its space superiority, economic competitiveness, military advantages, and strategic stability. Therefore, China's space programs are going to affect American interests adversely.

B. The Wolf Amendment (2011)[108]

In April 2011, the 112th Congress of the United States restricted NASA from engaging in bilateral agreements and coordination with China unless prior approval was given by Congress and Central Intelligence Agency (CIA). This is known as the Wolf Amendment and is stated under Public Law 112-10, Section 1340 of the 2011 Department of Defense and Full-Year Continuing Appropriations Act:

> (a) None of the funds made available by this division may be used for the National Aeronautics and Space Administration or the Office of Science and Technology Policy to develop, design, plan, promulgate, implement, or execute a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or any Chinese-owned company unless such activities are expressly authorized by a law enacted after the date of enactment of this division.
>
> (b) The limitation in subsection (a) shall also apply to any funds used to effectuate the hosting of official Chinese visitors at facilities belonging to or utilized by the National Aeronautics and Space Administration.[109]

107. MARK STOKES ET AL., CHINA'S SPACE AND COUNTERSPACE CAPABILITIES AND ACTIVITIES 3 (2020), https://permanent.fdlp.gov/gpo154588/China_Space_and_Counterspace_Activities.pdf.

108. Department of Defense and Full-Year Continuing Appropriations Act of 2011, H.R. 1473, 112th Cong. § 1340(a) (2011).

109. *Id.*

Later, additional clauses were passed in Congress to supplement the Wolf Amendment[110]:

> (c) The limitations described in subsections (a) and (b) shall not apply to activities which NASA, OSTP, or NSC, after consultation with the Federal Bureau of Investigation, have certified—
>
> > (1) pose no risk of resulting in the transfer of technology, data, or other information with national security or economic security implications to China or a Chinese-owned company; and (2) will not involve knowing interactions with officials who have been determined by the United States to have direct involvement with violations of human rights.
>
> (d) Any certification made under subsection (c) shall be submitted to the Committees on Appropriations of the House of Representatives and the Senate, and the Federal Bureau of Investigation, no later than 30 days prior to the activity in question and shall include a description of the purpose of the activity, its agenda, its major participants, and its location and timing.[111]

These additional clauses provide a certain level of flexibility for the possible cooperation between the scientists from China and the United States. According to Mike Gold, chair of the FAA's Commercial Space Transportation Advisory Committee (COMSTAC), the Wolf Amendment would not prohibit cooperation between China and the United States, and NASA could engage with China under its auspices.[112] Along this line of thinking, the Wolf Amendment is believed to take up the role of a safety value, protecting significant American scientific knowledge from being stolen by foreign powers. Nevertheless, it officially barred any American contact with the Chinese space agency for fear of "national security" unless Congress and the FBI approved. This includes not only direct collaboration but also the trading or exchanges of space-related commodities[113]

C. Immediate Causes of the Wolf Amendment

The immediate causes of America's latest Chinese exclusion policy related to technological issues can be traced back to the allegations by a U.S. Congressional Commission in 1998 that the technical information American

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110. *See* Jeff Foust, *Defanging the Wolf Amendment*, THE SPACE REV. (June 3, 2019), https://www.thespacereview.com/article/3725/1 ("Making appropriations for the Departments of Commerce and Justice, Science, and Related Agencies" for the fiscal year ending September 30, 2020, and for other purposes.").

111. Department of Defense and Full-Year Continuing Appropriations Act of 2011, H.R. 1473, 112th Cong. § 1340(a) (2011).

112. Foust, *supra* note 110.

113. Patricia L. Bellia, *The Lone Wolf Amendment and the Future of Foreign Intelligence Surveillance Law*, 50 VILL. L. REV. 50, 425 (2005).

companies provided China for its commercial satellite improved Chinese intercontinental ballistic missile technology.[114]

The Select Committee on U.S. National Security and Military/Commercial Concerns with China, also known as the Cox Commission (being named after Rep. Christopher Cox), was established in June 1998 to investigate allegations that China stole sensitive U.S. missile and space technology to launch U.S. civilian satellites in China.[115] The full report of the Cox Commission was released on May 25, 1999 alleging that technical information provided by American commercial satellite manufacturers to China concerning satellite launches could be used to improve Chinese intercontinental ballistic missile technology.[116]

The Cox Report alleged that China stole design information regarding some of the most advanced American thermonuclear weapons, enabling the Chinese military authority to accelerate its design, development, and nuclear weapons testing.[117] It also claimed that China's next-generation nuclear weapons would contain elements of stolen American state-of-the-art design information.[118] These thefts were the results of decades of intelligence operations against American weapons laboratories conducted by the Ministry of State Security and would persist even if new security measures were implemented.[119] An assessment report published in 1999 by Stanford University's Center for International Security and Cooperation commented that a certain part of the Cox report "was inflammatory and some allegations did not seem to be well supported," and "the language of the report, particularly its Overview, was inflammatory, and some allegations did not seem to be well supported."[120]

In September 2013, Ji Wang, a Chinese postdoctoral candidate in astrophysics at Yale University, received a message from NASA that he could not attend Kepler Science Conference II because of the Wolf Amendment passed in Congress in 2011.[121] The conference was supposed to be a meeting of scientists from all over the world gathering at NASA's Ames Research Center in California to discuss new results from the Kepler mission.[122] Having heard of Wang's rejection from the conference, several prominent scientists boycotted the meeting, and some even withdrew from the research groups.[123] Rep. Frank

114. Daniel Oberhaus, *Will NASA Ever Work With China?*, POPULAR MECHANICS (Oct. 18, 2016), https://www.popularmechanics.com/space/a23402/will-nasa-ever-work-with-china/.

115. ALASTAIR JOHNSTON ET AL., THE COX COMMITTEE REPORT 5 (M.M. May ed. 1999).

116. *Id*.

117. *Id*. at 27.

118. *Id.* at 11.

119. *Id*. at 12.

120. *Id.* at 2.

121. Department of Defense and Full-Year Continuing Appropriations Act of 2011, H.R. 1473, 112th Cong. § 1340(a) (2011).; *see also* Michael D. Lemonick, *'No Chinese Allowed.' NASA's Short-Lived Rule*, TIME (Oct. 23, 2013), https://science.time.com/2013/10/23/no-chinese-allowed-nasas-short-lived-rule/; Jeffrey Mervis, *Legislator Blasts NASA's Explanation for Excluding Chinese Students from Meeting*, Science (Oct. 8, 2013), https://www.science.org/content/article/legislator-blasts-nasas-explanation-excluding-chinese-students-meeting.

122. Lemonick, *supra* note 121.

123. Mervis, *supra* note 121.

Wolf wrote to NASA Administrator, claiming that the restriction only applied to bilateral meetings between NASA and Chinese public and private stakeholders.[124] Kepler Science Conference II was supposed to be a multilateral event.[125] This interpretation is interesting because China has been rejected from participation in the ISS, which is obviously a "multilateral" international cooperative project.[126]

D. Historical Causes of the Wolf Amendment

The policy of excluding Chinese from mainstream American society can be traced back to America's history in the nineteenth century. The Chinese Exclusion Act of 1882 was a historic act of legislation that demonstrated how racism had prevailed in this era.[127] The Act was repealed in 1943.[128] It should be noted that the linkage to what happened more than a century ago does not seem to provide a plausible justification to explain the current situation of the space station development. The prohibition of Chinese participants in the Kepler Science Conference in 2013 showed how unpopular this form of exclusion was among American scientists in space technology.[129] The historical causes of the amendment can be related to the national pride of the United States and China and the history of Chinese exclusion in the United States.

1. National Pride of the United States and China

To some extent, the Wolf Amendment is sometimes considered a consequence of the competition of the national pride of the United States and China.[130] National pride is the sense of esteem that people derive from their national identity.[131] Countries need to maintain unity and cohesiveness among their people and it is why Xi Jinping, political leader of China, and Donald Trump, former president of the United States, both promised to make their countries "great again."[132]

From the perspective of the United States, leadership in space exploration is considered a natural and obvious outcome of America's supremacy in the global economy and technology. The United States has dominated space technology for more than five decades since its moon landing in 1969.[133]

124. Letter from Rep. Wolf to NASA Administrator Bolden Regarding China and ISS (Mar. 5, 2012), http://www.spaceref.com/news/viewsr.html?pid=40171.

125. Lemonick, *supra* note 121.

126. *Id.*

127. JOHN SOENNICHSEN, THE CHINESE EXCLUSION ACT OF 1882 156 (2011).

128. *Id.* at 149.

129. Lemonick, *supra* note 121.

130. BRIAN WEEDEN & XIAO HE, U.S.-CHINA STRATEGIC RELATIONS IN SPACE, *in* Dong Wang & Travis Turner, *Avoiding the 'Thucydides Trap': U.S.-China Relations in Strategic Domains*, (forthcoming June 24, 2022).

131. Matt Schiavenza, *How Humiliation Drove Modern Chinese History*, THE ATLANTIC (Oct. 26, 2013), https://www.theatlantic.com/china/archive/2013/10/how-humiliation-drove-modern-chinese-history/280878.

132. DONALD J. TRUMP, CRIPPLED AMERICA. HOW TO MAKE AMERICA GREAT AGAIN 1 (2015).

133. Matthew Donovan, *It's Important America Preserve Its Space Power Advantage*, DEFENSE NEWS (Apr. 27, 2021), https://www.defensenews.com/opinion/commentary/2021/04/27/its-imperative-america-preserve-its-space-power-advantage/.

Through education and socialization, most Americans have been taught that the United States has been, and will always be, perpetually the undisputable leader in space exploration. It seems that national pride, rather than national security, is the primary concern of the politicians in Washington to win elections. Space technology is one of the key issues in protecting the national pride of the United States.

Viewed from the Chinese lens, national pride is closely related to China's rising patriotism after suffering from a "century of humiliation," which is a narrative framework used by some scholars to describe China's history from the mid-nineteenth to mid-twentieth centuries, starting from the first opium war in 1839 to the founding of the People's Republic of China in 1949.[134] During this long period, China, having experienced the chaos of the continuous aggression of Western powers and the emerging Japan, had to surrender at least a quarter of its territory, was forced to sign a series of unequal treaties, and paid a huge amount of compensation, mainly in silver, to foreign powers.[135]

A specific incident illustrates how humiliation is perceived and addressed by the Chinese government. During the second opium war in 1860, Yuanmingyuan, the summer palace built in the Qing Dynasty, was burned and destroyed as a "solemn act of retribution" by the British military force in order to crush the Chinese emperor's "pride as well as his feelings."[136] Today, the Chinese government never intends to rebuild the devastated summer palace and instead preserves its ruined remains as a reminder of China's national humiliation.[137]

Preoccupied with the "century of humiliation," the Chinese government seems obsessed with the drive to reestablish China to become a world power by developing massive technological and economic power.[138] Space exploration has become a prominent instrument to restore China's national pride, and all available resources are utilized to achieve this objective.[139]

The contradiction and conflicts arising from the differences in the perspectives of the United States and China have given rise to the description of "Thucydides Trap," which is an impending question of whether or not China and the United States are destined to fall into this trap.[140] The competition in

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134. Alison Adcock Kaufman, *The 'Century of Humiliation,' Then and Now: Chinese Perceptions of the International Order*, 25 PAC. FOCUS: INHA J. INT'L STUD. 1 (2010), https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1976-5118.2010.01039.x.

135. DAVID SCOTT, CHINA AND THE INTERNATIONAL SYSTEM, 1840–949 (2008).

136. JAMES HEVIA, ENGLISH LESSONS: THE PEDAGOGY OF IMPERIALISM IN NINETEENTH-CENTURY CHINA 107 (2003).

137. Greg James, *Culture Heritage Officials Reject Proposals for Yuanmingyuan Reconstruction*, SUPCHINA (Nov. 13, 2020), https://supchina.com/2020/11/13/culture-heritage-officials-reject-proposals-for-yuanmingyuan-reconstruction/.

138. ORVILLE SCHELL & JOHN DELURY, WEALTH AND POWER: CHINA'S LONG MARCH TO THE TWENTY-FIRST CENTURY 1 (2013).

139. Tom Harper, *How the Century of Humiliation Influences China's Ambitions Today*, CIGH EXETER (July 11, 2019), https://imperialglobalexeter.com/2019/07/11/how-the-century-of-humiliation-influences-chinas-ambitions-today/.

140. DONG WANG & TRAVIS TANNER, AVOIDING THE 'THUCYDIDES TRAP': U.S.-CHINA RELATIONS IN STRATEGIC DOMAINS 1 (2021).

space technology between these two nations will inevitably continue in the next few decades.

2. *History of Chinese Exclusion*

To some Chinese historians, the Wolf Amendment reminds them of the discriminatory Chinese Exclusion Act of 1882, which the Senate redressed in 2012.[141]

History shows that, since the nineteenth century, the policy of excluding Chinese from the United States has been plagued by racism. This is evidenced by the verdict of Chief Justice Hugh Murray,[142] in the 1854 case *People v. Hall*:

> "[Chinese are] a race of people whom nature has marked as inferior, and who are incapable of progress or intellectual development beyond a certain point, as their history has shown; differing in language, opinions, color, and physical conformation; between whom and ourselves nature has placed an impassable difference, is now presented, and for them is claimed, not only the right to swear away the life of a citizen, but the further privilege of participating with us in administering the affairs of our Government."[143]

Murray's comments reflected the prevailing American sentiment against the Chinese in the late nineteenth century. Subsequently, the Chinese Exclusion Act was passed in 1882, renewed in 1892, and made permanent in 1902.[144] After the Exclusion Act was passed, further limitations of Asians in America, such as the Scott Act of 1888[145] and the Geary Act of 1892,[146] were imposed during the late nineteenth century. The enactment of the Chinese Exclusion Act increased hatred and violence against Chinese people based on the misguided perception that they were to blame for depressed wage levels and unemployment among white citizens.[147]

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141. Shen Zhourong, *Scientific Exploration at Its Best When There's Cooperation*, CGTN.COM (Dec. 8, 2020), https://news.cgtn.com/news/2020-12-08/Scientific-exploration-at-its-best-when-there-s-cooperation-W26EfmWnJe/index.html.

142. *See* Edgar Whittlesey Camp, *Hugh C. Murray: California's Youngest Chief Justice*, 20 CAL. HIST. SOC'Y Q. 365, 367 (1941) (noting that Hugh Campbell Murray (1825–1857) was the third Chief Justice of California (1852–1857)).

143. People v. Hall, 4 Cal. 399, 405 (Cal. 1854) (Murray, C.J.) (holding the testimony of a Chinese man who witnessed a murder by a white man was not admissible, denying the right of Chinese, along with Native and African Americans, to testy in courts against white people).

144. JOHN SOENNICHSEN, THE CHINESE EXCLUSION ACT OF 1882 xiii–xiv (2011); *see also* Li Chen, *Chinese Crusaders' Lawfare Against Chines Exclusion Laws*, 36 UCLA PAC. BASIN L.J. 139, 151 n. 94 (2019) (describing the history of the Chinese Exclusion Act and its extension in 1902).

145. *See* SOENNICHSEN, *supra* note 144, at xiv (noting the Scott Act, passed in 1888, invalidating the reentry permits of more than 20,000 Chinese Laborers).

146. *See id.* (noting the Geary Act, passed in 1892, added ten years to the Chinese Exclusion Act and forced all Chinese residents to carry permits).

147. *See generally*, CHARLES J. MCCLAIN, IN SEARCH OF EQUALITY: THE CHINESE STRUGGLE AGAINST DISCRIMINATION IN THE NINETEENTH-CENTURY AMERICA (1994) (documenting Chinese efforts to battle discrimination in housing, employment, and education, in nineteenth-century America); SHIH-SHAN HENRY

The Chinese Exclusion Act was officially repealed in 1943,[148] indicating an end to over a century of racial discrimination against Chinese people. Yet, the establishment of the People's Republic of China and its communist ideology have created concerns in the United States about a potential hostile enemy in global politics. In the 1990s, Congressional worries about China's missiles and space programs led to strict export control restrictions for space technologies against China, which inevitably led to the passing of the Wolf Amendment.[149]

E. Persistence of the Wolf Amendment

Although Representative Frank Wolf, the Wolf Amendment's proponent, retired in 2014, the Wolf Amendment persists and is still good law.[150] Keeping the Wolf Amendment is, in every sense, not a good idea for a modern democratic society. It has not made a significant contribution to the promotion of human rights, and it cannot weaken the progress of space technology in China.

If the ISS stops operations in the next decade, countries intending to perform space-based experiments will need to partner with China on its space station. For other space projects, such as the Artemis and Luna Gateway, the United States acts as the leader and provides funding and technology for their operations.[151] Yet it is unlikely that China will be allowed to participate in these projects, which will likely be a concern for American scientists who wish to do experiments in China's space station. After launching its first astronaut to the Earth's orbit in 2003, China has conducted a series of space programs, orbiting a core module of its own space station in 2021,[152] and has sent numerous spacecraft to the moon and Mars. Most of these accomplishments have been achieved without cooperation with the United States.

The Wolf Amendment was sustained by a series of reports and hearings that reinforced the claim that China is a hostile competitor of the United States in space technology and, more importantly, the United States needs to be an invincible leader in military and space power.[153]

In 2012, the U.S.-China Economic and Security Review Commission issued a report "China's Evolving Space Capabilities: Implications for U.S. Interests," claiming that China regarded space power as an indicator of its

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TSAI, THE CHINESE EXPERIENCE IN AMERICA (1986) (examining the nineteenth-century immigration experience, the development of early Chinese communities, American exclusion and the difficulties of living in the shadow of exclusion).

148. Paul Yin, *The Narratives of Chinese-American Litigation During the Chinese Exclusion Era*, 19 ASIAN AM. L.J. 145, 168 (2012).

149. Mercy A. Kuo, *China in Space: Impact on China-US Competition*, DIPLOMAT (June 23, 2021), https://thediplomat.com/2021/06/china-in-space-impact-on-china-us-competition.

150. Department of Defense and Full-Year Continuing Appropriations Act, H.R. 1473, 112th Cong. § 1340(a).

151. Michael Hua, *What the U.S. Can Do to Prevent a New Sino-U.S. Space Race*, INT'L POL'Y DIG.: THE PLATFORM (Nov. 1, 2021), https://intpolicydigest.org/the-platform/what-the-u-s-can-do-to-prevent-a-new-sino-u-s-space-race.

152. Jones, *supra* note 89.

153. Kluger, *supra* note 99.

national strength in science and technology.[154] In 2015, another report, "China Dream, Space Dream," prepared by the Institute on Global Conflict and Cooperation of the University of California, San Diego, proposed that China's ultimate goal in science and technology was to become a space power on par with the United States.[155] In this report, the word "leadership" appears nineteen times, indicating the significance of being a leader in space technology and similar areas.[156]

A hearing on the topic "China in Space: A Strategic Competition?" was conducted by the U.S.-China Economic and Security Review Commission in 2019.[157] The issues of China's pursuit of global space leadership and the military-civil fusion in its space ambitions were highlighted, indicating how these two issues would be primary concerns of the United States.[158]

The United States' mainstream perception is that China continues to exploit American technology for its space program. This contradicts the reality that China can develop its own space technology, without help from the United States. In fact, the United States has slowed the pace of its space exploration due to a funding shortage. For instance, the U.S. canceled the 2010 Constellation program, which aimed to return U.S. astronauts to the Moon[159] and will likely have to delay a similar mission scheduled for 2024. The U.S. Space Force was established in 2019 by President Donald Trump and would likely take up a significant portion of the funding allocation for space exploration.[160] It appears that the U.S. is planning to rely on its private sector to conduct space programs, such as SpaceX, Blue Origin, and Virgin Galactic.[161]

III. SPACE TECHNOLOGIES FOR MILITARY USE

The most critical factor for space exploration is space technology. The United States started to utilize space technology for possible military purposes in the 1950's, a few years after WWII.[162] Later, NASA was established in 1958

154. MARK A. STOKES & DEAN CHENG, PROJECT 2049 INST., CHINA'S EVOLVING SPACE CAPABILITIES: IMPLICATIONS FOR U.S. INTERESTS 4 (2012), https://www.uscc.gov/research/chinas-evolving-space-capabilities-implications-us-interests.

155. *See* KEVIN POLLPETER ET AL., INST. GLOB. CONFLICT & COOP., CHINA DREAM, SPACE DREAM: CHINA'S PROGRESS IN SPACE TECHNOLOGIES AND IMPLICATIONS FOR THE UNITED STATES 1 (2015), https://www.uscc.gov/sites/default/files/Research/China%20Dream%20Space%20Dream_Report.pdf (examining China's space programs and how they "advance [China's] national security, economic, and diplomatic interests").

156. *Id.* at iii, 1–2, 6–7, 12, 24, 41, 87, 94, 108, 114.

157. China in Space Hearing, *supra* note 1.

158. *Id.*

159. Tariq Malik, *NASA Grieves over Canceled Program*, NBC NEWS (Feb. 2, 2010, 9:12 PM), https://www.nbcnews.com/id/wbna35209628.

160. Leonard David, *Trump Officially Establishes US Space Force with 2020 Defense Bill Signing*, SPACE.COM (Dec. 21, 2019), https://www.space.com/trump-creates-space-force-2020-defense-bill.html.

161. Deb Pfaff, *Spacing Out: Will We Allow the Privatization of Space to Eclipse NASA and NRO?*, THE HILL (Dec. 23, 2021, 12:00 PM), https://thehill.com/opinion/national-security/585675-spacing-out-will-we-allow-the-privatization-of-space-to-eclipse-nasa.

162. GLEN R. ASNER & STEPHEN J. GARBER, NAT'L AERONAUTICS & SPACE ADMIN., ORIGINS OF 21ST-CENTURY SPACE TRAVEL: A HISTORY OF NASA'S DECADAL PLANNING TEAM AND THE VISION FOR SPACE EXPLORATION, 1999–2004 17 (2021).

to commence space exploration.[163] A series of space missions, including the Apollo project, was launched by NASA from the 1960's to the 1980's.[164]

In 1982, President Ronald Reagan reinstated the discussion of creating a military space service.[165] The 2001 Space Commission proposed to set up a Space Corps by 2007, creating the U.S. Space Force, which would be commanded under the U.S. Air Force.[166] In December 2019, the Space Force Act was passed as part of the National Defense Authorization Act proposed by Former President Donald Trump, formally establishing the new independent military service called the "United States Space Force (USSF)."[167]

In September 2020, a memorandum of understanding between NASA and USSF was signed, just one month before the issuance of the Artemis Accords, unambiguously indicating the United States has an explicit determination to share all information obtained by NASA with USSF.[168]

A. Technologies Used in Space Station

In terms of technical structure, first-generation space stations (1964–1977), such as the Salyut 1 (USSR), were constructed and launched in a single piece, housing all supplies and equipment.[169] One or two astronauts would join the station and perform research and experiments within this monolithic structure, facing the challenge of abandoning the station when all supplies were consumed.[170] The second-generation stations (1977–1985) had two to four docking ports, allowing refueling and resupply by spacecraft.[171] These stations can last much longer in the LEO with additional supplies than the first-generation monolithic design.[172]

The third-generation space stations, including the Mir (USSR) and all subsequent stations, have adopted a different approach by taking on a modular design, which is still currently being used.[173] It is composed of a core unit constructed to accommodate its connection to a number of additional modules.[174] This design allows greater flexibility in operations and does not need the launch of a single immensely large station at the outset. The third-generation space stations reached a relatively mature stage when the ISS was launched in

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163. *Id.* at 18.
164. *Id.* at 18–22.
165. Howell Raines, *Reagan Affirms Support for U.S. Space Program*, N.Y. TIMES (July 5, 1982), https://www.nytimes.com/1982/07/05/us/reagan-affirms-support-for-us-space-program.html.
166. John A. Tirpak, *The Space Commission Reports*, AIR FORCE MAG. (Mar. 1, 2001), https://www.airforcemag.com/article/0301space.
167. David, *supra* note 160.
168. Memorandum of Understanding between Nat'l Aeronautics and Space Admin. (NASA) and U.S. Space Force (USSF) (Sept. 21, 2020), https://www.nasa.gov/sites/default/files/atoms/files/nasa_ussf_mou_21_sep_20.pdf [hereinafter NASA-Space Force MOU].
169. John Uri, *50 Years Ago: Launch of Salyut, the World's First Space Station*, NASA (Apr. 19, 2021), https://www.nasa.gov/feature/50-years-ago-launch-of-salyut-the-world-s-first-space-station.
170. *Id.*
171. Tom Chao, *Space Station Evolution: 6 Amazing Orbital Outposts*, SPACE.COM (May 12, 2013), https://www.space.com/21051-space-station-evolution-history.html.
172. *Id.*
173. *Id.*
174. *Id.*

1998, allowing many countries to participate in the space exploration program.[175]

The ISS project was initiated in 1984 by President Ronald Reagan to sustain the leadership of the United States to compete with the USSR's space station program.[176] Europe, Japan, and Canada were co-opted as partners of the ISS.[177] ISS construction was completed in 2011, and the utilization period was extended to 2024.[178] It is expected that funding will be suspended in 2025, and private participation will be introduced.[179] The Chinese space station, Tiangong, was launched in 2021, adopting a combination of the technologies used in Mir and the ISS.[180]

A space station's operations, such as the ISS and Tiangong, require at least four essential technologies:[181] the orbital architecture of the space station, the communication between the station and its mission controller on earth through satellites, transportation of humans and supplies to and from the station, and the connection, docking, and the facilitation of scientific experiments to be done inside a space station.[182]

1. The Orbital Architecture of a Space Station

The idea of staging a space station is an unprecedented achievement in scientific endeavors to plan and operate a research platform in space. The use of large panels of solar cells and batteries as their source of electrical power provides opportunities to supply energy for sustainable space-based experiments using a flexible, high-efficiency gallium arsenide battery board.[183]

The experience obtained from Mir (USSR) operations suggested that the pressurized module segment or building block structure is a valid technology.[184] The ISS adopts more advanced technology, the Integrated Truss Structure (ITS).[185] It consists of a linear arranged sequence of connected trusses on which various unpressurized components are mounted, such as logistics carriers and radiators, solar arrays, and other equipment.[186] It supplies the ISS with a bus

175. *Id.*

176. W. Henry Lambright, *Administrative Leadership and Long-Term Technology: NASA and the International Space Station*, 47 SPACE POL'Y 85, 85 (2019).

177. *Id.*

178. *Id.*

179. *Id.*

180. Jones, *supra* note 89.

181. Alvar Saenz-Otero, Design Principles for the Development of Space Technology Maturation Laboratories Aboard the International Space Station (2005) (Ph.D. dissertation, Massachusetts Institute of Technology), https://www.mit.edu/~alvarso/thesis-phd/ThesisBook.pdf.

182. *Id.*

183. Lewis M. Fraas et al., Space Mirror Development for Solar Electric Power and the International Space Station (Institute of Electrical and Electronics Engineers 43rd Photovoltaic Specialists Conference (PVSC), 2016), https://www.academia.edu/27443984/Space_Mirror_Development_for_Solar_Electric_Power_And_the_International_Space_Station?auto=citations&from=cover_page.

184. James A. Van Allen, *Space Science, Space Technology, and the Space Station*, 254 SCI. AM. 32, 32 (1986).

185. Mary Bowden & Max Benton, Design of Deployable-Truss Masts for Space Station (Aerospace Design Conference, February 1993), https://arc.aiaa.org/doi/abs/10.2514/6.1993-975.

186. *Id.*

architecture.[187] The Chinese space station does not fully utilize the truss structure of the ISS and instead adopted a modular (building block) structure, same as the Mir (USSR), and solved the problem of various segments of the battery board covering each other through large flexible solar panels that can be shifted,[188] thus becoming a more flexible version of the truss-based space station.

As a latecomer in space station technology, the Chinese space station adopts several optimization designs, such as integrated docking and airlock modules and foldable exposure platforms.[189] The space station can be developed into a spaceship if needed.[190] Its core module has the facilities to cater to incoming spacecraft and allow for docking, repairing, and maintaining spacecraft.[191] Following the technical structure of the ISS, the Chinese space station has installed several facilities such as semi-automatic robotic arms, experimental cabinets based on the standard of the ISS, high-voltage power supply, and the use of electric propulsion system to maintain orbital anchoring.[192]

2. The Communication Between a Space Station and its Mission Controller on Earth Through Satellites

Advanced communications technologies are critical for exploring space and the advancement of space-based experiments. A space station employs geostationary relay satellites for continuous communication with mission controllers on the ground.[193] It also uses positioning systems based on satellites for control and navigation with the use of laser communications enabling extensive space communication and expanding broadband on Earth.[194]

The development in global positioning systems (GPS) for navigation and location identification, building smart tools for the Internet of Things (IoT), and connectivity devices for worldwide internet access requires technologies designed and adopted for space exploration to improve bandwidth and signal processing capabilities.[195]

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187. *Id.*

188. *Flexible Solar Panel Wings Applied in China Launched 'Tianhe' Core Module of Space Station*, DS NEW ENERGY (Apr. 30, 2021), https://www.dsneg.com/info/flexible-solar-panel-wings-applied-in-china-la-56912342.html.

189. Yan Gong et al., *Cosmology from the Chinese Space Station Optical Survey (CSS-OS)*, 833 ASTROPHYSICAL J. 203 (2019).

190. *Id.*

191. *Id.*

192. Z.Y. Huang et al., *Online LSSVM Model to Predict Temperatures of Furnace System in Chinese Space Station*, 16 J. INSTRUMENTATION P07005 (2021).

193. Natalie M. Kintz, *Impact of Communication Delays to and from the International Space Station on Self-Reported Individual and Team Behavior and Performance: A Mixed-Methods Study*, 129 ACTA ASTRONAUTICA 193, 193 (2016).

194. *Id.*

195. *Cf.* Madeleine Hillyer, *How Has Technology Changed – and Changed Us – in the Past 20 Years?*, WORLD ECON. F. (Nov. 18, 2020), https://www.weforum.org/agenda/2020/11/heres-how-technology-has-changed-and-changed-us-over-the-past-20-years (discussing the advancement of technology).

3. The Transportation of Humans and Supplies to and from the Space Station

The technology required to build appropriate spacecraft can become a robust platform and help construct permanent vehicles and satellites in the LEO. There are many examples of spaceflight initiatives in technology development and demonstration that promise to improve the utilization of space stations. The most prominent one is testing the compatibility of individual components and modules based on advanced computing technologies.[196] Moreover, testing the use of larger spacecraft for improved reliability in navigation and re-entry of transport vehicles will support the future utilization of LEO by enhancing the delivery and return capabilities available to users of space-based platforms.[197]

The improvement in the docking and berthing technologies can help the safe and efficient delivery of astronauts and supplies to and from a space station.[198] The use of the ISS National Lab to demonstrate the utility and success of new spaceflight technologies for innovative R&D not only maximizes utilization of the ISS but also paves the way for next-generation space platforms enabling more advanced research and development.[199] This will help in-orbit research keep pace with terrestrial technology advancements in laboratory equipment and capabilities.

4. The Facilitation of Scientific Experiments to be Done Inside a Space Station

A space station, for instance, the ISS, supports a variety of satellite testing and demonstration initiatives for research, communications, and Earth-observation purposes.[200] The utilization of the National Laboratory of the ISS as a test bed also makes it a valuable platform to support the advancement and operational improvements of new technologies toward the success of future orbiting platforms.[201]

U.S. National Laboratory on the ISS provides a platform for research, development, and education that inspires innovation and provides opportunities for new scientific discovery.[202] The ISS offers technology development opportunities encompassing a broad range of initiatives, from testing satellite

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196. *Cf.* Press Release, NASA, Space Station Elements Successfully Complete Testing (Sept. 17, 2003), https://www.nasa.gov/home/hqnews/2003/sep/HQ_03298_station_elements.html (reporting on an example of the successful testing of space station components).

197. *Id.*

198. Justin McFatter et al., *NASA Docking System Block 1: NASA's New Direct Electric Docking System Supporting ISS and Future Human Space Exploration*, *in 44th* AEROSPACE MECHANISMS SYMP. (2018), https://esmats.eu/amspapers/pastpapers/pdfs/2018/mcfatter.pdf.

199. *Id.*

200. Tariq Malik, *NASA Astronaut Tests Microsatellite Aboard Space Station*, SPACE.COM (May 23, 2006), https://www.space.com/2429-nasa-astronaut-tests-microsatellite-aboard-space-station.html.

201. Press Release, SpaceRef, Six Projects Selected by NSF and CASIS to Advance Transport Phenomena Through ISS National Lab Utilitzation (Sept. 14, 2021), http://www.spaceref.com/news/viewpr.html?pid=58222.

202. Mark Uhran, *Status of US National Laboratory on the ISS*, 23 GRAVITATIONAL & SPACE RSCH. 67 (2010).

components and sensors to in-orbit manufacturing to operationalizing new facilities for advanced space research and supporting the optimization of new remote sensing technologies to facilitate decision support tools.[203]

Space stations can be a powerful platform for observing and imaging Earth and space. It can also test the energy efficiency of fuel cells and other fluids-based systems for energy generation and storage under radiation environment in space.[204] Other examples of spaceflight initiatives in technology development and demonstration include material testing and in-orbit manufacturing.[205] Optimizing materials and robotics to withstand the harsh space environment will provide a new set of building blocks for new versions of satellites, spacecraft, and space stations. The unique fluid movement in microgravity enables the study of materials, semiconductors, and nanoscale systems with a high level of accuracy.[206]

B. Weaponization of Space[207]

Space technology is closely related to the possibility of its weaponization. The discussion on the issue of space weaponization is often centered around how countries actively pursue the advancement of their space technology on a path toward the militarization of space.[208] Back in 1957, the launch of Sputnik by the USSR was perceived by the Western world as a threat to space safety.[209] As the space race intensified in the 1960s, the Outer Space Treaty was signed in 1967 to prevent the development and use of space weapons.[210] It seems clear that the advancement of technology has made space weaponization possible and is deemed necessary for national safety. The basic approach of the U.S. regarding space weapons is that it has to be the sole superpower to command and control the space battlefield in order to maintain world peace.[211] Unfortunately, maintaining a leading position in space technology is not only challenging but also expensive. In January 2007, China successfully launched a missile from earth to destroy an obsolete Chinese satellite by using a ground-based Kinetic-Energy Anti-Satellite (KE-ASAT) weapon,[212] which gave a clear signal of its

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203. *Id.*

204. Saenz-Otero, *supra* note 181.

205. *Id.*

206. *Id.*

207. *See generally* Adam G. Quinn, *The New Age of Space Law: The Outer Space Treaty and the Weaponization of Space*, 17 MINN. J. INT'L L. 475 (2008) (providing a background on space law and the potential weaponization of space).

208. *See generally* Joan Johnson-Freese & David Burbach, *The Outer Space Treaty and the Weaponization of Space*, 75 BULL. ATOMIC SCIENTISTS 137 (2019) (discussing several countries' pursuits of space weaponization and how those pursuits might be curbed).

209. Karl P. Mueller, *Totem and Taboo: Depolarizing the Space Weaponization Debate*, 1 ASTROPOLITICS 4, 4 (2003).

210. Loren Grush, *How an International Treaty Signed 50 Years Ago Became the Backbone for Space Law*, THE VERGE (Jan. 27, 2017), https://www.theverge.com/2017/1/27/14398492/outer-space-treaty-50-anniversary-exploration-guidelines.

211. Sterling Michael Pavelec, *The Inevitability of the Weaponization of Space: Technological Constructivism Versus Determinism*, 10 ASTROPOLITICS 39, 39 (2012).

212. Marek Thee, *Militarism and Militarization in Contemporary International Relations*, 8 BULL. PEACE PROPOSALS 296, 296 (1977).

ability to destroy specific and targeted objects in Earth's orbits.[213] In November 2021, just a few months after launching a space station to LEO, China efficaciously tested a nuclear-capable hypersonic missile.[214]

These alarming incidents have given a wake-up signal that American military supremacy in the technology related to the weaponization of space is under threat, especially about the possible proliferation of the space technology to hostile countries such as North Korea and Iran.[215]

C. The Memorandum of Understanding Between NASA and USSF

While the United States has always been worried about the Chinese application of dual-use space technology for military purposes,[216] NASA declared that it would share space technology with USSF.[217] The memorandum of understanding between NASA and USSF was signed in September 2020, just one month before the issuance of the Artemis Accords, indicating undisguisedly that the United States has a clear and explicit determination to share all information obtained by NASA from all possible sources to USSF concerning national securities, international discoveries, and technologies that have military value.[218]

It is interesting to note that the Artemis Accords require participating nations to agree on certain principles of safety, transparency, interoperability, and release of scientific data in their international space operations.[219] Therefore, these participating nations in the Accords will have to prepare for the possibility that their space technologies and technical know-how will be made known and utilized ultimately by the USSF for military purposes.[220]

The issue of techno-militarization of American space technology requires some specific attention.[221] Techno-nationalism is about how technology affects the social and cultural aspects of a nation.[222] One typical example is the use of technology to advance nationalist agendas to promote connectedness and a

213. Joseph Kahn, *A New Player at Star Wars: China Shows Assertiveness in Reported Weapons Test*, N.Y. TIMES (Jan. 20, 2007), https://www.nytimes.com/2007/01/20/world/asia/20china.html. Both the United States and the USSR successfully destroyed satellites in orbit in the 1980s.

214. Mercy A. Kuo, *China in Space: Impact on China-US Competition*, THE DIPLOMAT (June 23, 2021), https://thediplomat.com/2021/06/china-in-space-impact-on-china-us-competition.

215. David Brennan, *China's Shock Hypersonic Missile Test Alarms U.S. Lawmakers: 'National Security Crisis'*, NEWSWEEK (November 10, 2021), https://www.newsweek.com/china-shock-hypersonic-nuke-test-alarms-us-lawmakers-national-security-crisis-1647879.

216. EMILIAN KAVALSKI, THE ASHGATE RESEARCH COMPANION TO CHINESE FOREIGN POLICY 404 (2017).

217. David A. Koplow, *Reverse Distinction: A US Violation of the Law of Armed Conflict in Space*, 13 HARV. NAT'L SEC. J. 25 (2021).

218. NASA-Space Force MOU, *supra* note 168.

219. *The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of The Moon, Mars, Comets, and Asteroids for Peaceful Purpose*, NASA (Oct. 13, 2020), https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf

220. Jeremy Grunet, *Uncut Gems: The Laws of Outer Space in an Age of Expanding Space Security Threats*, *in* CONFERENCE PROCEEDINGS FOR 2021 ISOMA 149, 149 (2021).

221. Jon Evans, *The Techno-Militarization of America*, TECHCRUNCH (Jan. 18, 2014), https://techcrunch.com/2014/01/18/the-techno-militarization-of-america.

222. *Id.*

stronger national identity.[223] In the case of aerospace technology, it is even more prominent in the promotion of nationalism.[224]

IV. CAN THE U.S. AND CHINA COOPERATE IN SPACE?

After Congress passed the Wolf Amendment in 2011, a high-ranking NASA employee told his colleagues, "If my Chinese counterpart comes here," he said, "I'm forbidden to even buy him a cup of coffee."[225] The all-exclusion policy as exhibited by Wolf Amendment reflects the concerns of the United States about Chinese ambitions in space, which can be traced back to the 1960s. Qian Xuesen (1911–2009), one of the creators of the "Carmen-Qian formula,"[226] used to work on the Manhattan Project that helped produce the first-generation nuclear weapons but returned to China in 1955 to help develop China's missiles and nuclear bombs in the 1960s.[227] As the Cold War began in 1950, with McCarthyism prevailing in the United States and anti-communist ideology rising, Qian was forced to stop all his research in the United States and returned to China.[228] Subsequently, Qian helped develop nuclear weapons and missiles in China.[229] This seems to be an illustrative case of how an exclusion policy can stimulate technological development in China.

The United States relied on Russia's rockets and Soyuz capsules for many years to carry American astronauts to the ISS.[230] In the absence of Russia's participation, the United States can still send astronauts into space in Space X Dragon 2.[231] However, the ISS is becoming obsolete and will likely retire within the next decade.[232] It seems the United States has no plan to launch its own space station into the LEO. Soon, China's Tiangong Space Station will be the only available microgravity and space environment laboratory to conduct scientific research. However, there were rare occasions that the United States managed to collaborate with China. For instance, during China's 2019 Chang'e 4 mission,

223. Joan Johnson-Freese, *The Geostrategic, Techno-Nationalist Push into Space*, OASIS (Dec. 19, 2014), https://revistas.uexternado.edu.co/index.php/oasis/article/view/4006.

224. W. Henry Lambright, *Administrative Leadership and Long-Term Technology: NASA and the International Space Station*, 47 SPACE POL'Y 85, 85 (2019).

225. Zach Rosenberg, *This Congressman Kept the U.S. and China from Exploring Space Together*, FOREIGN POL'Y (Dec. 17, 2013), https://foreignpolicy.com/2013/12/17/this-congressman-kept-the-u-s-and-china-from-exploring-space-together/#.

226. Zhengping Zou et al., *Numerical Modeling of Steady State Errors for Shielded Thermocouples Based on Conjugate Heat Transfer Analysis*, 119 INT'L J. HEAT & MASS TRANSFER 624, 624 (2018).

227. Jane Qiu, *Qian Xuesen (1911–2009)*, NATURE (Dec. 9, 2009), https://www.nature.com/articles/462735a.

228. Ning Wang, *The Making of an Intellectual Hero: Chinese Narratives of Qian Xuesen*, 206 CHINA Q. 352 (June 20, 2011).

229. *Qian Xuesen: The Man the US Deported—Who then Helped China into Space*, BBC NEWS (Oct. 27, 2020), https://www.bbc.com/news/stories-54695598.

230. G.F., *Why Does America Still Use Soyuz Rockets to Put Its Astronauts in Space?*, THE ECONOMIST (Oct. 16, 2018), https://www.economist.com/the-economist-explains/2018/10/16/why-does-america-still-use-soyuz-rockets-to-put-its-astronauts-in-space.

231. Jason Costa, *NASA's SpaceX Crew-4 Trains for Upcoming Mission*, NASA BLOGS (Mar. 3, 2022), https://blogs.nasa.gov/spacex.

232. Meghan Bartels, *The International Space Station Will Eventually Die by Fire*, SPACE.COM (Feb. 4, 2022), https://www.space.com/how-to-destroy-a-space-station-safely.

NASA collaborated with China to monitor the moon lander.[233] In the future, the possible cooperation between the United States and China will be an important issue to be handled with cautious thinking.

A. China as the New "World Power"

As discussed in the earlier section, the persistence of the Wolf Amendment, irrespective of its shortcoming in cutting off the possibility of America's collaboration with China in space technology, reflects the mainstream perspective of how Americans perceive the undesirable effects of the uprising power of China and how the United States should respond to the challenge.

Ever since Congress passed the Wolf Amendment, the discussion on the possible repeal of the amendment has become a legitimate issue for policy debate of a hawkish approach to portray and treat China as a dangerous adversary in space technology versus a dove's stance to collaborate with China in all aspects.[234] It seems that a restrictive policy is much more popular than a cooperative one.

For the past few years, China's space exploration has made significant progress. In 2019, it became the first country to land on the far side of the moon.[235] In 2020, China successfully completed its staging of the Beidou satellite,[236] challenging the Global Positioning System (GPS) of the United States.[237] In 2021, it landed on Mars and launched the space station, Tiangong.[238] In this way, China presents a promising profile of a potential superpower, and as the gap between the United States and China decreases, the conflict increases.[239] After the collapse of the USSR, the United States has enjoyed three decades of unparalleled leadership in space.[240] As things have changed, China's fast-growing capability in space exploration challenges the dominance of the United States.

Some scholars choose to analyze and interpret the competition or conflicts between China and the United States[241] through the lens of the "Thucydides

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233. Yingzhuo Jia et al., *The Scientific Objectives and Payloads of Chang'E− 4 Mission*, 162 PLANETARY & SPACE SCI. 207, 207 (2018).

234. Hannah Kohler, *The Eagle and the Hare: US-Chinese Relations, The Wolf Amendment, and the Future of International Cooperation in Space*, 103 GEO. L.J. 1135, 1135 (2014).

235. Matthew S. Schwartz, *China Becomes First Country to Land On Far Side Of Moon, State Media Announce*, NPR (Jan. 3, 2019, 3:00 AM), https://www.npr.org/2019/01/03/681825762/china-becomes-first-country-to-land-on-far-side-of-moon-state-media-announces.

236. Andrew Jones, *Successful Launch Takes China a Step Closer to Completing Beidou Navigation Constellation*, SPACENEWS (Mar. 2020), https://spacenews.com/successful-launch-takes-china-a-step-closer-to-completing-beidou-navigation-constellation.

237. *Id.*

238. Agence France-Presse, *Chinese Astronauts Arrive at Space Station for Longest Mission*, THE GUARDIAN (Oct. 15, 2021, 6:58 PM), https://www.theguardian.com/science/2021/oct/16/chinese-astronauts-arrive-at-space-station-for-longest-mission.

239. BARRY BUZAN, THE UNITED STATES AND THE GREAT POWERS: WORLD POLITICS IN THE TWENTY-FIRST CENTURY (2004).

240. Nectar Gan & Ben Westcott, *US-China Rivalry Is Extending From Earth Into Space. That Poses a Challenge to American Dominance*, CNN (June 21, 2021, 6:49 AM) https://edition.cnn.com/2021/06/21/china/china-us-space-race-mic-intl-hnk/index.html.

241. *Id.*

Trap," which is a destructive pattern of structural conflict that will inevitably result when a rising power, such as China, challenges an existing ruling one, such as the United States.[242] Yet, this approach ignores the possibility of transposing destructive competition into constructive cooperation, especially when the concern for economic welfare and development is becoming more important than the power struggle. Apparently, the implications of the Thucydides Trap are more relevant to monarchies rather than modern democratic societies. The use of economic or legal sanctions, in the form of American traps, will be more cost-effective than raging wars in modern economies.

B. The American Traps: How the U.S. Handles Competition

In as early as 1967, Jean-Jacques Servan-Schreiber, a French writer who published The American Challenge (*Le Défi Américain*), warned that Europe was on the way to becoming an economic colony of the United States.[243] To maintain leadership in global technology, since the 1960s, the United States has been enforcing its own competition rules not only on hostile countries but also on national allies such as Japan and France, based on allegations such as threats to national security and bribery.[244] The American traps are put in place by the United States authority to use its influence to protect and extend the power of American multinational corporations by legal measures such as anti-bribery or anti-corruption laws as part of the effort to consolidate its hegemony.[245]

In the 1980s, chips manufactured in Japan were much cheaper than those made in the United States.[246] This cost advantage swiftly allowed Japanese firms like Toshiba and Fujitsu to dominate the global market.[247] The United States responded by accusing Japanese companies, especially Toshiba, of committing industrial espionage, violating American export rules by trading with its enemies, and engaging in unfair trade practices in 2015.[248] Toshiba was thus seen as a threat to the development of the tech firms in the United States. The United States achieved its goal of protecting the domestic chip industry by suppressing its most prominent rival with some high-sounding excuses. In the end, Toshiba had to sell its chip business to Bain Capital, an American

242. GRAHAM ALLISON, DESTINED FOR WAR: CAN AMERICA AND CHINA ESCAPE THUCYDIDES'S TRAP? (2017).

243. *Jean-Jacques Servan-Schreiber*, ENCYCLOPEDIA BRITANNICA (Feb. 9, 2022), https://www.britannica.com/biography/Jean-Jacques-Servan-Schreiber.

244. Huang Lanlan & Li Qiao, *Lessons from Toshiba, Alstom: How US Suppresses Foreign Rival Companies to Maintain Tech Hegemony*, GLOBAL TIMES (Sept. 28, 2020, 9:07 PM), https://www.globaltimes.cn/page/202009/1202395.shtml.

245. ROBERT GILPIN, THE POLITICAL ECONOMY OF INTERNATIONAL RELATIONS (1987).

246. Bryan Johnson, *The U.S.-Japan Semiconductor Agreement: Keeping Up the Managed Trade Agenda*, HERITAGE FOUND. (Jan. 24, 1991), https://www.heritage.org/asia/report/the-us-japan-semiconductor-agreement-keeping-the-managedtrade-agenda.

247. Mario Daniels & John Krige, *The Fight Over High-Tech Supremacy Isn't New. We Just Haven't Learned Our Lesson*, FORTUNE (Feb. 12, 2019, 9:07 AM), https://fortune.com/2019/02/12/trump-china-trade-war-tech.

248. *Id.*

corporation, at $18 billion in 2018,[249] withdrawing from the chipmaking industry.

In the French case, Frédéric Pierucci was a senior executive of Alstom, which was one of the major French suppliers of nuclear power plants.[250] It built power generation stations, transmission lines, railways, and was a formidable competitor of the U.S.-based giant General Electric (GE) in many countries and regions in the early 2010s.[251] In April 2013, Frédéric Pierucci was arrested in New York by the FBI for an alleged crime of bribery, based on the unilateral extraterritorial enforcement of the Foreign Corrupt Practices Act (FCPA).[252] After being imprisoned for more than two years, he was released after his company agreed to pay a huge amount of financial penalty ($772 million) and, at the same time, he gave up major business areas of control to its American competitor, General Electric, all under the coerced force of the United States.[253] Pierucci later wrote a book "The American Trap" to describe his perception of the American conspiracy.[254] After being translated into Chinese, the book has become one of the best-sellers in China,[255] indicating how Chinese businessmen have become more aware of the American trap.

Both the Japanese and French cases tell how the United States uses legal sanction and prosecution as a weapon against its own allies.[256] Being accused of bribery and threats to national security, these companies have to pay a massive penalty in lieu of imprisonment of their senior executives and are later required to disarm and disempower their core businesses.[257]

In the case of competing with China, a similar approach was adopted against Huawei, the principal 5G technology provider in China and an archenemy of the American telecommunication industry in the global telecommunication market.[258] In 2019, the United States imposed sanctions on Huawei by cutting it off from key technologies and telecommunication markets in the United States and Europe.[259] But this is not enough. Following the pattern

249. *Toshiba Completes $18 Billion Sale of Chip Unit to Bain Consortium*, REUTERS (June 1, 2018, 12:44 AM), https://www.reuters.com/article/us-toshiba-chips/toshiba-completes-18-billion-sale-of-chip-unit-to-bain-consortium-idUSKCN1IX3O5.

250. Will Dunn, *Frédéric Pierucci's The American Trap: a Memoir of Theft on an Industrial Scale,* NEW STATESMAN (June 8, 2021, 11:31 AM), https://www.newstatesman.com/culture/2015/03/the-american-trap-federic-pierucci-reivew.

251. Huang & Li, *supra* note 244.

252. *Id.*

253. *Id.*

254. FRÉDÉRIC PIERUCCI & MATTHIEU ARON, THE AMERICAN TRAP: MY BATTLE TO EXPOSE AMERICA'S SECRET ECONOMIC WAR AGAINST THE REST OF THE WORLD (2019).

255. Adam Taylor & Liu Yang, *An Unlikely Winner in the China-U.S. Trade War? A French Businessman's Book About His Battle With the DOJ,* THE WASHINGTON POST (June 8, 2019), https://www.washingtonpost.com/world/2019/06/07/an-unlikely-winner-china-us-trade-war-french-businessmans-book-about-his-battle-with-doj.

256. Huang & Li, *supra* note 244.

257. *Id.*

258. David Sacks, *China's Huawei Is Winning the 5G Race. Here's What the United States Should Do to Respond,* COUNCIL ON FOREIGN RELATIONS (Mar. 29, 2021, 3:00 AM), https://www.cfr.org/blog/china-huawei-5g.

259. Gordon Corera, *Huawei's Meng Wanzhou Flies Back to China After Deal with US*, BBC (Sept. 25, 2021), https://www.bbc.com/news/world-us-canada-58682998.

of the American trap, Meng Wanzhou, the chief financial officer of Huawei, was detained in Canada on fraud charges in December 2018 at the request of the United States.[260] Meng's arrest was not made on American soil but in the Vancouver Airport on a transit flight to Brazil.[261] After being detained for almost three years, Meng was released when the Department of Justice dropped an extradition request for her after signing a Deferred Prosecution Agreement (DPA) in 2021.[262]

In the Huawei case, the American trap is ineffective in achieving the same level of success as in the Japanese and French cases, attributing mainly to the much shorter power distance between the United States and China than the corresponding distance between the United States and Japan and France.[263] It presents proof that the American trap is only effective when the United States is facing relatively weak competitors.

Due to the multiple-use nature of space technologies, including digital communications to navigation, the United States and China have to compete for supremacy in economic, technological, geopolitical, and even ideological superiority on Earth. Space has become a crucial frontier in the global power game. The Patriot Act passed in 2003 boosted the extraterritoriality, providing agencies in the United States (National Security Agency, Central Intelligence Agency, Federal Bureau of Investigation) the power to investigate foreign companies on a massive scale.[264] By the end of 2019, 30 non-U.S. multinational corporations had been fined by American prosecutors.[265] This includes fines of 398 million for Total, 800 million for Siemens, and 8.9 billion for BNP Paribas.[266] The extraterritoriality is technically unilateral, as most countries have neither the means nor the political will to enact extraterritorial laws.

Unlike the cases of Alstom in 2003, Toshiba in 2015, and Huawei in 2019, there is no direct financial penalty involved in the sanctions and exclusion as in the case of the adoption of the Wolf Amendment to exclude Chinese participation in space exploration. Nevertheless, the technological hegemony of the United States, as illustrated by these cases, has taught Chinese authority in space station technology a valuable lesson—in order to avoid being trapped in the U.S.-China competition in space technology, space exploration in China must reduce dependence on technology and expertise of the United States.

260. *Id.*

261. *Id.*

262. Twinkle Ghosh & David Lao, *Here Are the Key Events Leading to the Release of Meng Wanzhou, 'Two Michaels'*, GLOBAL NEWS (Sept. 25, 2021, 12:21 AM), https://globalnews.ca/news/8218811/meng-wanzhou-release-two-michaels-timeline.

263. *Id.*

264. *Myths and Realities About the Patriot Act*, ACLU, https://www.aclu.org/other/myths-and-realities-about-patriot-act (last visited Mar. 6, 2022).

265. Giorgio Schutte, *The American Trap*, SCI. ELEC. LIBR. ONLINE BRAZIL (2021) (reviewing FRÉDÉRIC, PIERUCCI, THE AMERICAN TRAP: MY BATTLE TO EXPOSE AMERICA'S SECRET ECONOMIC WAR AGAINST THE REST OF THE WORLD (2019)), https://www.scielo.br/j/cint/a/pjmPcVNy4Lj3djS7sVqgjkp/?lang=en.

266. *Id.*; Nate Raymond, *BNP Paribas Sentenced in $8.9 Billion Accord Over Sanctions Violations*, REUTERS (May 1, 2015, 10:32 AM), https://www.reuters.com/article/us-bnp-paribas-settlement-sentencing-idUSKBN0NM41K20150501.

C. Private Sector Involvement

It is sometimes suggested that the United States can beat China in the new space race by relying on its private sector to be the silver bullet against China's quest for leadership in space exploration.[267] In the early days, private companies sold components of spacecraft to NASA.[268] Later, SpaceX and other companies can create a market to substitute partially the current government-led space exploration.[269]

In May 2020, Elon Musk's SpaceX became the first private company to send humans into space.[270] This marks not only a technological achievement but also a clear indication that a new commercial space industry, in which goods and services designed to supply space-based customers, are emerging. While it is crucial to maintain a partnership between the public and the private, it is also important to be aware of the possible shortcoming of overly relying on private companies. As illustrated by SpaceX, private companies have the desire and the ability to send people into space. In terms of efficiency, private space companies are performing much better than NASA in terms, and at a much cheaper cost.[271] However, NASA is still needed to manage risk and safety and coordinate the major space plans.[272]

Private spaceflight accomplishments include flying suborbital spaceplanes (SpaceShipOne and SpaceShipTwo), launching orbital rockets, flying two orbital expandable test modules (Genesis I and II), and launching astronauts to the International Space Station (ISS).[273] But space exploration is expensive, and the outcome of such ventures cannot generate attractive financial returns, even with the promotion of space tourism.[274] The related business opportunities available in private space travel are pre-flight training, pre-flight and post-flight adaption, and data analysis, which can become a new business opportunity for affluent space tourists. However, it also bears the risk of information leakage when private companies are involved in such technology.[275]

D. Artemis Accords and International Cooperation

International space law is supposedly developed through the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations (UN) and

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267. Brandon J. Weichert, *The Future of Space Exploration Depends on the Private Sector*, NAT'L L. REV (July 5, 2021, 6:30 AM), https://www.nationalreview.com/2021/07/the-future-of-space-exploration-depends-on-the-private-sector.
268. *Id.*
269. Matt Weinzierl & Mehak Sarang, *The Commercial Space Age Is Here*, HARV. BUS. REV. (Feb. 12, 2021), https://www.hbs.edu/faculty/Pages/item.aspx?num=60004.
270. *Id.*
271. Hua, *supra* note 151.
272. David Szondy, *SpaceX Dragon's Ultimate Mission is Mars Colonization,* NEW ATLAS (Feb. 5, 2012), https://newatlas.com/date-set-for-spacex-dragon-launch/20810.
273. Mikhail Kokorich, *Private Space Industrialization is Here*, TECHCRUNCH (Aug. 18, 2020, 3:47 PM), https://techcrunch.com/2020/08/18/private-space-industrialization-is-here/?guccounter=1.
274. Eva Yi-Wei Chang, *From Aviation Tourism to Suborbital Space Tourism: A Study on Passenger Screening and Business Opportunities*, 177 ACTA ASTRONAUTICA 410, 410–20 (2020).
275. *Id.*

multilateral treaties with nations.[276] The Outer Space Treaty (1967) laid down the basic principles for international space exploration by emphasizing peaceful use of resources gained from such exploration to benefit all human beings instead of individual nations.[277] The Moon Agreement of 1979 aimed at sanctioning commercial exploitation of outer-space resources, but only a small number of states have ratified.[278] Unfortunately, three major nations in space exploration, the United States, China, and Russia, did not agree.[279]

Instead of adopting the international space law and related agreements initiated and led by the UN, it seems that the United States wishes to develop its own version of legal control of space exploration. The Artemis Accords are an international agreement led by the United States signed between governments participating in the Artemis Program, aiming to return humans to the Moon by 2024 to extend space exploration.[280] The Artemis Accords are guided by key principles of peaceful exploration, transparency, interoperability, emergency assistance, objects registration, scientific data release, preserving outer space heritage, preventing harmful interference, and safe disposal of space debris.[281]

The Artemis Accords portray a shared vision for principles grounded in the Outer Space Treaty of 1967 by creating a safe and transparent environment that facilitates exploration, science, and commercial activities on the moon. Previous attempts to govern space have been through painstakingly negotiated international treaties.[282] As of December 30, 2020, only twelve countries have signed the Artemis Accords: Australia, Brazil, Canada, Italy, Japan, Luxembourg, New Zealand, the Republic of Korea, Ukraine, the United Arab Emirates, and the United Kingdom.[283]

Many countries, such as France and Germany, have serious concerns about the Accords and have so far refused to sign them.[284] While all are traditional allies of the United States, Russia has already stated that the Artemis Program is overly "U.S.-centric" to sign in its present form.[285] China's absence is explained by the United States congressional prohibition on collaboration with the country. Concerns that this is a power grab by the United States and its allies are fueled by the lack of African or South American countries amongst the founding

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276. Jack Wright Nelson, *The Artemis Accords and the Future of International Space Law*, 24 AM. SOC'Y OF INT'L L., 1, 1 (2020).

277. Biswanath Gupta & Ekta Rathore, *United Nations General Assembly Resolutions in the Formation of the Outer Space Treaty of 1967*, 17 ASTROPOLITICS 77, 77–88 (2019).

278. *Nelson*, *supra* note 276, at 2–3.

279. Ram Jakhu & Maria Buzdugan, *Development of the Natural Resources of the Moon and Other Celestial Bodies: Economic and Legal Aspects,* 3 ASTROPOLITICS 201, 201–50 (2008).

280. Melissa de Zwart, *To the Moon and Beyond: The Artemis Accords and the Evolution of Space Law,* 65, 65–80 (2021).

281. Antonino Salmeri, *One Size to Fit Them All: Interoperability, the Artemis Accords and the Future of Space Exploration*, SPACEWATCH GLOBAL (2020), https://spacewatch.global/2020/11/spacewatchgl-opinion-one-size-to-fit-them-all-interoperability-the-artemis-accords-and-the-future-of-space-exploration/.

282. Jason Krause, *5 United Nations Treaties in Outer Space*, AMERICAN BAR ASS'N J. (Apr. 1, 2017, 4:45 AM), https://www.abajournal.com/magazine/article/space_law.

283. Jack Wright Nelson, *The Artemis Accords and the Future of International Space Law*, 24 INSIGHTS 1, 3–4 (2020).

284. *Id.* at 5.

285. Jeff Foust, *Russia Skeptical about Participating in Lunar Gateway*, SPACENEWS (OCT. 12, 2020), https://spacenews.com/russia-skeptical-about-participating-in-lunar-gateway/.

partner states.[286] Although several European Space Agency (ESA) member states have signed on to the Accords, the ESA has not.[287] While it is possible that countries such as Germany, France, and India with well-developed space programs would undoubtedly benefit from being involved in Project Artemis, these countries refused to sign the Accords. Neither have most developing countries in Eastern Europe, South and Central America, Africa, and South-East and Central Asia. It seems that most countries in the Global South do not welcome the Artemis Accords.[288]

The signing of the Accords represents a significant political attempt to codify key principles of space law and apply them to the program based on American rules. Although the Accords are bilateral agreements and not binding instruments of international law,[289] they can establish the practice in the area and influence subsequent governance frameworks for exploration on the Moon, Mars and beyond. Section 10(4) of the Accords commits to ongoing discussions at the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations about developing a relevant legal framework based on international law.[290] However, given the passing of the Space Act 2015 that puts the right to use and trade space resources under American domestic law, the jurisdiction of the United States, rather than international law, will be more relevant to settle any possible disputes under the governance of the Accords. With Russia and China opposing them, the Accords will likely meet diplomatic resistance that may provoke resentment in UN meetings and forums.

E. China's Master Plan for Space Exploration

The fast pace of China's development of space stations has triggered the use of the term "Sputnik moment" to describe the situation. It is the time when a country or a society suddenly becomes aware that it needs to catch up with its perceived technological lag behind some other countries and put more investment efforts into research, development, and education.[291]

China's space exploration program can be traced back to the early 1950s and late 1960s when there was an impending national need to develop ballistic missiles capability during the Korean and Vietnam wars.[292] The subsequent

286. Christopher Newman, *Artemis Accords: Why Many Countries are Refusing to Sign Moon Exploration Agreement*, THE CONVERSATION (Oct. 19, 2020, 7:45 AM), https://theconversation.com/artemis-accords-why-many-countries-are-refusing-to-sign-moon-exploration-agreement-148134.

287. *Id.*

288. Sarah Hartley et al., *A Retrospective Analysis of Responsible Innovation for Low-Technology Innovation in the Global South*, 6 J. RESP. INNOVATION 143, 143–62 (2019).

289. Many researchers argued that Artemis Accords cannot be regarded as a binding agreement. *See, e.g.*, Rossana Deplano, *The Artemis Accords: Evolution or Revolution in International Space Law?*, 70 INT. & COMP. L.Q. 799, 799–819 (2021).

290. *See Committee on the Peaceful Uses of Outer Space*, UN OFF. FOR OUTER SPACE AFF. (2021), https://www.unoosa.org/oosa/en/ourwork/copuos/index.html (explaining the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations was set up by the General Assembly in 1959 to govern the exploration and use of space for the benefit of all humanity: for peace, security, and development).

291. Sean Kay, *America's Sputnik Moments*, 55 SURVIVAL 123, 125 (2013).

292. James Clay Moltz, *Asia's Space Race*, COMMENT (Dec. 7, 2011), https://www.nature.com/articles/480171a.

development of the Dongfeng and Long March missile series has facilitated the launch of spacecraft.[293] China's space exploration breakthrough happened on April 24, 1970, when China launched its first satellite, Dongfanghong-1, into space.[294] This important date, April 24, was designated as China's Space Day to mark this milestone in its journey into space.[295]

When the Sino-American relationships started to improve in the 1970s, China's *de facto* leader Deng Xiaoping (also known as "Teng Hsiao-ping" in some media), Time Magazine's Man of the Year in 1978,[296] visited the United States on January 28, 1979.[297] After several stops in Washington, Philadelphia, and Atlanta, Deng landed in Houston on February 2, 1979, and was greeted by Mayor Jim McCann and Governor Bill Clements.[298] Immediately following Deng's visit, China established the first Chinese Consulate in Houston,[299] a clear recognition of the importance that Deng gave to energy and space technology available in this city, signaling the future direction of the ambition of China.

Following Deng's ambition and aspiration, China's plan to stride into the boundaryless realm of space exploration was officially formulated in the 1980s. In 1986, China launched the 863 Plan, also known as the State High Tech Research and Development Plan.[300] Within this plan, a crewed spaceflight program code-named Project 863-204 paved the way for the development of Project 921, commonly known as the Shenzhou space program.[301]

On September 21, 1992, Jiang Zemin, then General Secretary of the Communist Party of China (CPC) Central Committee, chaired a meeting of the Standing Committee of the Political Bureau of the CPC Central Committee to decide on the implementation of China's crewed space program (code-named Project 921) by defining China's "three-step" development strategy for crewed spaceflight.[302] In 1993, China National Space Administration (CNSA) was established as China's national space agency, governed by the Commission of Science, Technology and Industry for National Defense (CSTIND), which has been superseded by the State Administration of Science, Technology and

293. *Timeline: Major Milestones in Chinese Space Exploration*, REUTERS (Dec. 1, 2020, 9:41 AM), https://www.reuters.com/article/us-space-exploration-china-moon-timeline/timeline-major-milestones-in-chinese-space-exploration-idINKBN28B5GE.

294. *Id.*

295. *See id.* (describing events of Space Day).

296. Reuters, *Teng Named by Time Magazine as Its 'Man of the Year' for 1978*, N.Y. TIMES (Dec. 24, 1978), https://www.nytimes.com/1978/12/24/archives/teng-named-by-time-magazine-as-its-man-of-the-year-for-1978.html.

297. Johnathan Steele, *America Puts the Flag out for Deng*, THE GUARDIAN (Jan. 30, 1979, 5:35 PM), https://www.theguardian.com/world/1979/jan/30/china.usa.

298. Fox Butterfield, *Teng Speaks of Plans for Imports in Billions*, N.Y. TIMES (Feb. 4, 1979), https://www.nytimes.com/1979/02/04/archives/teng-speaks-of-plans-for-imports-in-billions-teng-tells-texans.html.

299. *How a Houston-Area Tour Stop Helped Heal US-China Relations in 1979*, ABC 13 (Jul. 22, 2020), https://abc13.com/fire-chinese-consulate-documents-being-burned-houston-us-and-china-tensions/6328863.

300. *National High-Tech R&D Program (863 Program*), EMBASSY OF THE PEOPLE'S REPUBLIC OF CHINA IN THE KINGDOM OF NORWAY, (Sept. 7, 2010), https://www.fmprc.gov.cn/ce/ceno/eng/kj/program/t715317.htm.

301. Joe McDonald, *Project 91*, SMITHSONIAN MAG. (Nov. 2002), https://www.smithsonianmag.com/air-space-magazine/project-921-35507272.

302. Li Junxia, *China's Manned Space Program and the "Three-Step" Strategy*, CHINA NEWS SERVICE (Apr. 27, 2021, 9:20 PM), http://www.stdaily.com/zhuanti/rwjs/2021-04/27/content_1127986.shtml.

Industry for National Defense (SASTIND) in 2008,[303] under the auspices of the Ministry of Industry and Information Technology (MIIT). It is responsible for the planning and development of space exploration.[304]

Since 1992, China has been operating its space station program based on this three-step strategy—critical technology validation, modular set-up, and space operations.[305]

1. *First Step: Critical Technology Validation*

In the 1990s, China's technology in the exploration of outer space was decades behind the West. In the early 1990s, China had developed significant launch capabilities.[306] The Long March 2 and 4 derivates could launch several tons into Earth's orbits.[307] The later version, Long March 3 (and 2E), had paved the way for the launch of geostationary satellites. The first step of critical technology validation was important because it could test whether China's existing space technology could send astronauts into space and return to earth safely, allowing experiments to be conducted in space applications.

This technical know-how was validated by the successful launches of Shenzhou-5 in 2003 and Shenzhou-6 in 2005, making China the third country in the world, after the U.S. and USSR, to achieve crewed spaceflight.

2. *Second Step: Modular Set-Up*

The next step was to test key technologies required to stage a permanent space station in low Earth orbit (LEO), including installing space laboratories, in-orbit propellant refueling, extra-vehicular activity, as well as conjunction and docking technology of crewed spacecraft and space vehicles. This has been validated by the successful launch of eleven crewed spacecraft, sending two temporary space stations, Tiangong-1 (launched in 2011) and Tiangong-2 (launched in 2016). These two launches provided a breakthrough of the technology in the conjunction and docking of crewed spacecraft and space vehicles, laying an important milestone in the "three-step" strategy of China's space technology development.

3. *Third Step: Space Operations*

The third step is to launch, assemble, and operate a permanently crewed space station, staging a new landmark of China's state-of-the-art space

303. *State Administration for Science, Technology and Industry for National Defense*, STATE COUNCIL PEOPLE'S REPUBLIC OF CHINA (Oct. 6, 2014, 11:45 AM), https://english.www.gov.cn/state_council/2014/10/06/content_281474992893468.htm.

304. Larysa Soroka, *Space Doctrine and the Future of the Space Industry*, 26 PHIL. & COSMOLOGY 25, 25–34 (2021).

305. Huaxia, *China Launches Space Station Core Module Tianhe*, XINHUANET (Apr. 29, 2021, 1:12 PM), http://www.xinhuanet.com/english/2021-04/29/c_139914564.htm.

306. Zhengyu Song et al., *Reviews and Challenges in Reliability Design of Long March Launcher Control Systems*, 60 AEROSPACE R. CENT. 537, 538 (2021).

307. *Id.* at 539–40.

technology. This will allow scientists to address the long-term applications of space experiments. The Tiangong Space Station, which literally means "Heavenly Palace," was launched and staged at LEO on April 29, 2021.[308] By the end of 2022, the station is expected to be fully assembled, becoming a 60-ton modular space station after eleven launches of crewed spacecraft carrying astronauts, cargoes, and space station modules.[309]

After the successful launch of its permanent space station, China plans to expand the station with more modules to become a massive "ultra-large spacecraft" with the size of a small town up to the length of one kilometer.[310] By contrast, the International Space Station (ISS) is only 361 feet (110 meters) long.[311] On October 16, 2021, China launched three astronauts to its space station.[312]

Over the past two decades, China's "three-step" development strategy for crewed space station technology has been put in place since 1992. Through the works of the China National Space Administration (CNSA), China has made significant progress in space exploration. In 2019, China completed the installation of the Five-Hundred-Meter Aperture Spherical Telescope (FAST), the largest telescope on Earth.[313] In December 2020, China brought back rock samples from the far side of the Moon in the Chang'e 4 space mission.[314] The creation of the BeiDou Navigation Satellite System, capable of linking up to 70% of all Chinese smartphones, means that China will soon no longer depend on the U.S.-based GPS.[315] China launched its own Tiangong space station in 2021, becoming the only space station once the International Space Station is de-orbited.[316] A new crew of three astronauts was launched into space on October 16, 2021, commencing a six-month trip to the space station.[317] More modules have been scheduled to be sent to Tiangong, and its construction is expected to be completed in 2022.[318] In the near future, Beijing's ambitious space program will take further steps in various space technologies such as space stations, moon-landing, and Mars exploration. With relatively lower costs, faster

308. Andrew Hones, *China's Tiangong Space Station*, SPACE.COM (Aug. 24, 2021), https://www.space.com/tiangong-space-station.

309. Mike Wall, *China Plans to Launch Core Module of Space Station This Year*, SPACE.COM (Jan. 07, 2021), https://www.space.com/china-space-station-core-module-launch-spring-2021.

310. Eric Mack, *China May Build a Massive Space Station the Size of a Small Town*, FORBES (Aug. 26, 2021, 11:40 AM), https://www.forbes.com/sites/ericmack/2021/08/26/china-may-build-a-massive-space-station-the-size-of-a-small-town/?sh=6158c5192087.

311. Edd Gent, *China Wants to Build a Mega Spaceship That's Nearly a Mile Long*, SCI. AM. (Sept. 2, 2021), https://www.scientificamerican.com/article/china-wants-to-build-a-mega-spaceship-thats-nearly-a-mile-long/.

312. Steven Lee Myers, *The Moon, Mars and Beyond: China's Ambitious Plans in Space*, N.Y. TIMES, (Oct. 15, 2021), https://www.nytimes.com/article/china-mars-space.html.

313. B. Peng et al., *Five-Hundred-Meter Aperture Spherical Telescope Project*, 182 INT'L ASTRONOMICAL UNION COLLOQUIUM 219–24 (2001).

314. Yingzhuo Jia et al., *The Scientific Objectives and Payloads of Chang'E-4 Mission*, 162 PLANETARY & SPACE SCI. 207, 207–15 (2018).

315. Chunhao Han et al., *BeiDou Navigation Satellite System and Its Time Scales*, 48 METROLOGIA 213, 214 (2011).

316. Stephen McDonell, *China Launches First Module of New Space Station*, BBC NEWS (Apr. 29, 2021), https://www.bbc.com/news/world-asia-china-56924370.

317. Myers, *supra* note 312.

318. *Id.*

construction speeds, and a group of aggressive Chinese scientists, China has set strategic, long-term goals to achieve the objective of becoming a great space power.[319]

Based on the above analysis, it seems evident that China has been preparing itself for space exploration independently since the 1950s and formally announced its space program, Project 921, in 1992. Space exploration is an important part of China's overall development strategy for extracting and utilizing outer space resources.[320] The master plan of the development of space programs has been in place for three decades. Since the establishment of China's space program in 1956, China has attained significant achievements, including developing nuclear bombs, missiles, artificial satellites, crewed spaceflight, and the landing on the Moon and Mars. This form of amazing technological progress is something that the United States cannot ignore. The impact of the Wolf Amendment could only serve as a stimulus that was playing a minor role in the pace of China's space technology development. Given the progress of space technology in China, the continuous existence of the Wolf Amendment needs to be reconsidered carefully.

CONCLUSION AND RECOMMENDATION

While the ISS is a joint American-Russian venture representing the end of the Cold War, China's Tiangong space station signifies the start of a new cold war.[321] The establishment of the joint Apollo-Soyuz program by the United States and the USSR in 1975 ended the space race, which lasted for more than two decades. If the United States can work with the USSR, there is no reason why the United States cannot collaborate with China to explore space. For the past few decades, the United States has dominated the arena of space technology. It is interesting to note that, for the ISS project, the United States has chosen to work with Russia but restricted the participation of China, despite the reality that the ISS is supposed to be a "multilateral" project among many nations. However, as China is catching up quickly, it is time for the United States to reconsider its space strategy.

Is China willing to scale back its fast-paced economic and technological progress, or is the United States ready to accept the idea of becoming number two? The future of Sino-American relations, to a great extent, depends on how the struggle for supremacy in space technology is to be formulated. Both countries are considering space as a domain crucial to their national pride and security. While China is developing its own space program, the United States is trying to recapitalize its space capabilities and secure continuous success in this

319. Ahmad Khan, *Book Review*, 18 ASTROPOLITICS 92 (2020) (reviewing BRIAN HARVEY, CHINA IN SPACE: THE GREAT LEAP FORWARD (2d ed. 2019)).

320. *White Paper on China's Space Activities in 2016*, SPACEREF (Dec. 27, 2016), http://www.spaceref.com/news/viewsr.html?pid=49722.

321. Robert Jay Ronci, Dividing Heaven: Investigating the Influence of the U.S. Ban on Cooperation with China on the Development of Global Outer Space Governance (2018) (Master's Thesis, Norwegian University of Life Sciences), https://nmbu.brage.unit.no/nmbu-xmlui/bitstream/handle/11250/2567759/RRonci%202018.pdf?sequence=1.

domain. Faced with these realities, what can the United States do? Instead of an exclusion policy, a better solution for the United States is to collaborate with China and provide more funding to NASA to cooperate with private companies. Exploration of the limitless space needs to avoid duplication of efforts of all competing nations in this arena, and collaboration, cooperation, as well as coordination will be the key success factor for all space programs, irrespective of their nationalities.

Being the leaders in the global economy and space technology, both the United States and China have the power to bolster space governance and develop responsible norms of space technology. Since with great power comes great responsibility, both nations need to look for ways to cooperate in space activities to create a positive realm of their space relationship that can minimize the threats of military competition in the space domain. A cooperative rather than a hostile relationship between the United States and China is essential to progress and peace in the coming decades, not for these two countries but for the whole world. This relationship needs to be based on a realistic, informed view of each side of the other's economic and socio-political situations, in addition to the endowment and development of technologies.

Insofar as possible, it should also be based on a realistic view of how China and others view the United States. Over the past few years, academics and practitioners have started to pay more attention to a new perspective of the optimization of competition and cooperation called "co-opetition."[322] The concept of co-opetition first appeared in 1996 to explore the possibilities of cooperation among competitors for mutual benefits.[323] This mode of relationship has become common in a number of hi-tech business relationships such as between Apple and Samsung and between Google and Yahoo.[324] It is also applicable in space exploration, and the cooperation between Russia and the United States in operating the ISS is a good example. There are many reasons for a co-opetition strategy to work well in space station technology. It allows cost-saving by avoiding any possible duplication of efforts of parties involved. It also provides room for a better division of labor and expertise among participating nations in space exploration.[325] In this way, new business models can be better defined based on technology-related ecosystem platforms that focus on symbiosis and mutual benefits rather than isolationism. A co-opetition strategy, a combination of competition and cooperation, is also consistent with the idea of "smart competition" in the testimony of Samm Sacks, who testified on March 7, 2019, before the House Foreign Affairs Committee about

322. Paul Chiambaretto & Herve Dumez, *Toward a Typology of Coopetition: A Multilevel Approach*, 46 INT'L STUD. MGMT. & ORG. 110, 124 (2016).

323. ADAM M. BRANDENBURGER & BARRY J. NALEBUFF, CO-OPETITION (1st ed. 1997).

324. *See, e.g.*, Adam Brandeburger & Barry Nalebuff, *The Rules of Co-opetition*, HAR. BUS. R. (Jan. 2021), https://hbr.org/2021/01/the-rules-of-co-opetition (discussing the use of co-opetition).

325. *Id.*

competing with China.[326] In the context of the conflict between the United States and China, co-opetition is indeed a blessed form of smart competition.

In conclusion, the United States needs a more effective, consistent, and long-term strategy to sustain the American leadership in space technology by changing from the current state of restricting the cooperation only with its allies (and Russia) to align with a worldwide trend of multipolarity.[327] It is the strategies, rather than legislative or budgetary measures (such as the Wolf Amendment), that really matter to the progress of the space technology of the United States.

Unilateral exclusion of China's participation in international space programs is a double-edged sword. It will inevitably expel and force not only China to develop its own space programs in the short run. In the long run, it will give away the possible benefits from the uprising of Chinese technology by adopting a nativist and isolationist approach to protect the endangering global leadership of the United States, which unfortunately is unwise and detrimental to the development of space technology in the United States. Based on the worldwide cooperation in tackling terrorism, climate change, and the COVID-19 pandemic, multilateral collaboration is the only way forward for all nations on this small and densely populated planet.[328]

326. *China: Challenges for U.S. Commerce: Hearing Before the Subcomm. on Sec'y & S. Comm. on Com., Sci., & Transp.*, 116th Cong. (Mar. 7, 2019) (testimony of Samm Sacks, Cybersecurity Policy and China Digital Economy Fellow, New America), https://www.commerce.senate.gov/services/files/7109ED0E-7D00-4DDC-998E-B99B2D19449A.

327. Muhammad Muzaffar et al., *Changing Dynamics of Global Politics: Transition from Unipolar to Multipolar World*, 1 LIBERAL ARTS & SOC. SCIS. INT'L J. 49, 51 (2017).

328. Shen Zhourong, *Scientific Exploration at its Best When There's Cooperation,* CGTN (Dec. 8, 2020, 7:39 AM), https://news.cgtn.com/news/2020-12-08/Scientific-exploration-at-its-best-when-there-s-cooperation-W26EfmWnJe/index.html.