STRATEGIC STUDIES QUARTERLY

China in Space: Ambitions and Possible Conflict

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To explore the vast cosmos, develop the space industry and build China into a space power is a dream we pursue unremittingly.

—"China's Space Activities in 2016"

Abstract

Major powers like China are viewing space less concerned with "securing the high ground" for espionage and nuclear deterrence and more for access to the vast material and energy resources of the inner solar system. China aims to establish a manned space station by 2020–22 and a space-based solar power station by 2050 to meet its burgeoning economic and energy needs, develop space science and technology, explore outer space, and land on Mars. This article examines China's vision and the end it foresees for its contemporary space activities (grand visions), which might lead to and determine the imagined shape of governance in space. It identifies strains of nationalism and internationalism and specifically discusses Chinese policy attitudes and aspirations related to space-based solar power (SBSP), lunar and asteroid mining, space settlement, and planetary defense.[1]

Our contemporary space age is moving toward the prospect of harvesting space-based resources for long-term national economic development. For instance, asteroids are rich in minerals like platinum, gold, titanium, iron, nickel, and, most importantly, water. Precious metals like titanium and gold sell for anything between US $30,000 to $50,000 per kilogram.

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Scientists infer that a small asteroid 200 meters in length and rich in platinum could be worth $30 billion.[2] Asteroid 2011 UW158, worth $5 trillion in platinum, sailed at a distance of 1.5 million miles from Earth in July 2015.[3] Waking up to the potential of billions of dollars' worth of minerals that can be mined from asteroids, the US Congress passed the 2015 US Commercial Space Launch Competitive Act that aims to encourage and propel private-sector investments and entrepreneurship in space as well as establish better regulatory mechanisms for such activities.[4] Private companies like Planetary Resources are focused on asteroid mining, along with others like Deep Space Industries, Bigelow, and SpaceX.[5] Luxemburg is the first in Europe to announce a government initiative to develop regulatory and legal frameworks to establish ownership of minerals extracted from asteroids.[6] The 1967 Outer Space Treaty (OST) states the following:

- "the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind;
- "outer space shall be free for exploration and use by all States;
- "outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[7]

However, since the OST does not specify how space-based resources will be allocated, ambiguity with regard to ownership of space-based resources could result in conflict. Two reasons exist for this: the absence of a regulatory mechanism that factors in the entry of commercial enterprises into the business of space as well as states starting to look to space for resources for their own economic development.

China's attitudes and aspirations towards expansionism, territoriality, and resource nationalism in space is of paramount significance to future space governance. China is a major spacefaring nation with specific future ambitions in space.[8] Over the past several decades, China has witnessed rapid and observable progress with regard to its space activities. It began space research and development as early as the 1950s. Twenty years later, on 24 April 1970, China successfully launched its first satellite (*Dong Fang Hong I*) into space, utilizing its indigenously built rocket, the *Long March 1*.[9] Established in 1968, the Chinese Academy of Space Technology (CAST) was instrumental in realizing this ambition.[10] Zhou Enlai, China's first premier, believed that China's accomplishments in space would result in global prestige. Over the next 20 years, China's space activities accelerated, with growing focus on geosynchronous communication satellites vital for military command, control, and intelligence. In 1999, China launched its first unmanned spacecraft *Shenzhou I*, followed in 2001 and 2002 by *Shenzhou II* and *Shenzhou III,* respectively.[11] In 2003, China sent its first manned spacecraft (*Shenzhou V*) into space.[12] In 2007, China carried out its first antisatellite missile test.[13] In 2010, it both orbited an unmanned spacecraft around the moon and landed a rover on its surface. On 30 October 2015, China tested the *Dong Neng-3* exoatmospheric vehicle capable of ramming US satellites and destroying them.[14] Added to this space capability are the *Tiangong 1* and *Tiangong 2* space labs and the indigenously built *Tianzhou* cargo ship capable of on-orbit refueling that extends access and logistics lines. Autonomous cargo delivery and on-orbit refueling are critical building blocks of an end-to-end supply chain for space presence and space resources or the construction of on-orbit power stations.[15]

According to its white papers on space, China essentially views exploration of outer space as part of its overall national development. China takes pride in its indigenous capacity building in space technology, including the development of its manned space program, lunar probe, and development of space industry. China aims to pursue independent innovation in space and reform its institutions for further creativity as well as cement international cooperation in outer space.[16] Moreover, China aims to improve the *Beidou 2* navigation system, with an aim to provide for regional coverage (especially to those countries along the One Belt, One Road initiative) by 2018, and offer global coverage by 2020.[17] Recently, China Aerospace Science and Technology Corporation issued a report claiming that China will achieve a major breakthrough by 2040 with regard to "nuclear-powered space shuttles." This breakthrough will enable mining of space-based resources, including from asteroids, and the establishment of solar power stations. The report also specified that by 2035, China will possess fully reusable launch vehicles.[18] China aims to establish a manned space station by 2020–22 and a space-based solar power station by 2050, develop science and technology to protect China's national core interests, and land on Mars.

It is in this context that this article examines China's ambition and aspirations related to space-based solar power, lunar and asteroid mining, space settlement, and planetary defense. It identifies strains of nationalism and internationalism and specifically discusses Chinese policy attitudes and scenarios that might lead to and determine the imagined shape of conflict.

China's Space Ambitions

China's space ambitions are unique and have the full backing of the Communist Party of China (CPC). Pres. Xi Jinping views China's space program as enhancing a climate of scientific innovation, especially in the field of robotics, artificial intelligence, and aviation.[19] Towards this end, the CPC aims for China's space program to result in enormous economic dividends. Investment in space technology is perceived as a means to revive state-owned enterprises as well as inspire private start-ups in line with SpaceX and Blue Origin. China is estimated to spend $6 billion annually on its space program.[20] Compared to NASA's $18.5 billion annual budget in 2016,[21] China's space budget appears diminutive. Its space science budget increased from zero a decade ago to $695 million between 2011 and 2015. But, given its low costs in labor and other added services, the country may enjoy an advantage. Private start-ups like One Space, Expace, and Land Space are being encouraged to develop launch capabilities and enter the thriving market for commercial space companies.[22]

The question that arises for the international community in this context is: what is driving China's space ambitions? There are concerns that a South China Sea–like scenario may unfold in outer space compelled by resource nationalism, defined as "anti-competitive behaviour designed to restrict the international supply of a natural resource."[23] Population growth, the uneven worldwide distribution of resources, and governance issues can lead to resource nationalism.[24] While Chinese experts largely dismiss these concerns, a reason to link these comes from Chinese Long March designer, Wang XiJi, who offered the following lens of occupation: Wang warned that if it did not act quickly, other countries, in particular the US and Japan, would take the lead and occupy strategically important locations in space.[25] In 2002, Ouyang Ziyuan, chief scientist of China's Moon exploration program, stated, "The Moon could serve as a new and tremendous supplier of energy and resources for human beings. . . . This is crucial to sustainable development of human beings on Earth. . . . Whoever first conquers the Moon will benefit first."[26]

Chinese strategic and space experts express discomfort with the idea of "resource-nationalism" in space, insisting that China's strategic culture does not support such expansionist behavior.[27] For instance, the idea of *he* (harmony), written in ancient Chinese texts inspired by Daoism and Confucianism, and the ideal aspiration of "harmonization" attest to this.[28] However, a divergent perspective on the concept of harmony is offered by Wei Xiaohong and Li Qingyuan, from Sichuan Agricultural University, China. They argue that while harmony is a fundamental guiding principle for social interactions in China, there are two types of harmony: genuine and surface harmony. Genuine harmony is sincere and holistic, while surface harmony is strategic tolerance, hiding conflicts under the surface.[29] For better or worse, surface harmony is preferred to direct confrontations. This idea of surface harmony creates suspicions regarding China's overall intent with regard to its strategic behavior. Given China's assertive behavior with regard to "lost territories" intertwined with the idea of national resources, it is likely China's quest for space-based resources would be informed by a similar logic.[30] However, Chinese space experts maintain that while enhancing national prestige and international status remain prime motivating factors with regard to China's space goals, China views space from a completely different perspective, namely a "global commons" perspective.[31] Consequently, how China conducts itself with regard to its core interests of sovereignty and territorial integrity cannot be generalized into its space behavior—at the grand strategic level, China may continue to utilize nationalism to create legitimacy for the CPC and to invest heavily in space.[32]

There are others who indicated that acquiring high-end technology and investing in space science that benefits China commercially from its space program appears to be taking center stage.[33] For instance, the China Great Wall Industry Corporation offers the Long March rocket for commercial launches internationally in collaboration with the China Academy of Launch Vehicle Technology (CALT), the Shanghai Academy of Spaceflight Technology (SAST) and the China Satellite Launch, Tracking and Control General (CLTC).[34] The China Great Wall Industry Corporation is the prime contractor for commercial contracts, while CALT, SAST, and CLTC are subcontractors. As mentioned earlier, China is starting to witness purely commercial private companies showing keen interest in investing in outer space. Liu Ruopeng, founder of Hong Kong–based Kuang-Chi Science Ltd.,[35] stated that commercial activity and innovation will grow exponentially in outer space in China in the next 10 years.[36] Ruopeng is aiming at entering the space tourism race, competing with companies like SpaceX, to offer space tourists a chance to travel to suborbital space, enjoy zero gravity, and re-enter earth. That said, the role of the Chinese state in space investment has not diminished. Speaking to astronauts from the *Shenzhou 11* mission in December 2016,[37] Pres. Xi Jinping expressed his commitment to turn China into a major space power.[38] "Space Day" was declared 24 April 2016, memorializing the day China launched its first satellite in 1970.[39]

The institutions within China tasked with developing China's space explorations are many and varied. While the CPC's Central Committee of the Political Bureau, comprising President Xi and Premier Li Keqiang, has ultimate power and authority, several institutions have been established to formulate and carry out the country's space activities. Foremost among the plans laid out was the 863 plan,[40] established to kick-start technological development for space exploration. Led by the Science and Technology Leading Small Group under the State Council that provided the policy guidance and overall framework, the importance of the 863 plan can be gauged from the fact that Deng Xiaoping personally approved it and Premier Zhao Ziyang led it.[41] Besides CAST, State Administration on Science, Technology, and Industry for National Defense (SASTIND), which functions under the direction of the Ministry of Industry and Information Technology, oversees the vital link between space technology and nuclear power and communicates this aspect with other countries and international organizations.[42] SASTIND is tasked with managing and coordinating China's space activities.[43] Under SASTIND is the China National Space Administration (CNSA), established in 1993. The CNSA is responsible for articulating China's space policies, directing its manned space mission, the lunar mission, the *Tiangong* space station, and the Long March series of rockets.[44] While the State Council issues the "White Paper on Space" outlining the medium- to long-term space goals, CNSA is responsible for articulating and publicizing China's space policy and directs its civilian space program.[45] At the space symposium in Colorado Springs in April 2017, CNSA secretary general Yulong Tian stated that China's major space goals in the next five years are to launch robotic missions to the moon, outline a policy for commercial space activities, conduct an automated Mars sample return mission by 2030, and launch deep space exploration of Jupiter, Venus, and asteroids.[46] Other institutions tasked with space technology are China Aerospace Science and Technology Corporation[47] (which includes under it CALT), the China Aerospace Science and Industry Corporation, and Chinese Academy of Sciences (CAS). Interestingly, the China Satellite Launch, Tracking and Control General is run by the Central Military Commission.[48] The CLTC serves as a command-and-control center for PLA's space-related operations. This direct interlinkage resulted in very close supervision by the commission, specifically its General Armament Department (GAD), now merged into the Strategic Support Force (SSF), which influenced space policy as well as how goals were set in the long term. In collaboration with SASTIND, GAD (now SSF) issued regulations for defense industry procurements as well as identified institutions that would deal with space technology. On 31 December 2015, China set up the PLA SSF that would now be in charge of both cyber and space assets. The SSF is responsible for managing the human spaceflight program.[49] According to Maj Gen Du Wenlong, from the PLA Academy of Military Science, "as for the Strategic Support Force, it better coordinates the cooperation between forces on the battlefield and logistic support."[50] Interestingly, what this implies is that the PLA and not the Chinese Air Force will have control over space, unlike in the United States, where space is the domain of the Air Force.[51] The SSF has two distinct space-related organizations, the Space System Department and the Military Space Force.[52]

As per policy statements from these leading space institutions, particularly CAST, CNSA, and SASTIND, three unique Chinese space goals come to light: (1) space-based solar power, (2) lunar and asteroid mining, and (3) establishing its own space station.[53] These goals are unique as they indicate a completely different view of space. Rather than just an arena for conquest and showing off, China views space as an environment in which to live, work, and create wealth through habitation and resource extraction. This different view of what space is directly affects policy. In its 2016 white paper on space, China specifically linked its space exploration to long-term economic developmental goals. This includes bringing back samples from Mars for research as well as asteroid exploration.[54] Below is a detailed analysis of these three unique space goals.

Space-Based Solar Power

China's space solar ambitions were outlined in a 2010 report by its leading space agency, CAST. The report stated, "In 2010, CAST will finish the concept design; in 2020, we will finish the industrial level testing of in-orbit construction and wireless transmissions. In 2025, we will complete the first 100kW [solar power station (SPS)] demonstration at [low Earth orbit (LEO)]; and in 2035, the 100mW SPS will have electric generating capacity. Finally in 2050, the first commercial-level SPS system will be in operation at [geosynchronous Earth orbit (GEO)]."[55]

In 2015, China expressed its intention to build a space solar station 36,000 kilometers above the earth. This power station will be placed in geosynchronous orbit and equipped with huge solar panels, and the solar electricity that will be generated will be sent via microwaves or lasers to Earth. One of the biggest advocates of space-based solar power in China is Wang Xiji, the chief designer of China's first rocket, the *Long March 1*.[56] Wang believes that "the world will panic when the fossil fuels can no longer sustain human development. We must acquire space solar power technology before then. . . . Whoever obtains the technology first could occupy the future energy market. So it's of great strategic significance."[57] According to Duan Baoyan of the Chinese Academy of Engineering, "If we have space solar power technology, hopefull (sic) we could solve the energy crisis on Earth."[58] These views are supported by senior vice president of CAST, Li Ming, who believes that "China will build a space station in around 2020, which will open an opportunity to develop space solar power technology."[59] Li indicates that once the space station is in place, China would then carry out experiments on developing an SBSP station.[60] In a presentation for the 2016 International Astronautical Congress in Mexico, Li further elaborated on the SBSP concept by suggesting that in-situ resource utilization and on-orbit 3-D printing could be applied using resources from asteroids to build SBSP satellites on a lunar base instead of having to lift them from Earth to space. This will bring down manufacturing costs from $536 trillion ($50,000 per kilogram) to $170 billion ($250 per kilogram). Materials present on the lunar surface and asteroids include silicon and aluminum, required for solar panel production.[61] Li points out that the low gravity of some asteroids or near Earth objects (NEO) makes it easier for spacecraft to dock, park, or separate, requiring less propulsion. NEOs are attractive as they are rich in resources required for SBSP purposes. More recently, Lt Gen Zhang Yuilin, the Central Military Commission's deputy chief of GAD (now SSF) stated that solar power generation in space was more efficient than Earth solar, indicating that China would start developing technology for an industrial-scale solar power station once it completes work on its permanent space station by 2020.[62] China has invested in developing a blueprint within a timeline of 2050 for its SBSP program. The CAST design by Hou Xinbin for SBSP satellites took the first position at the 2015 SunSat Design Competition.[63] Given CAST's timelines of completing the first 100kW SPS demonstration at LEO by 2025 and the first commercial-level SPS system to be in operation at GEO by 2050, these could turn into China's own Sputnik moments.

So, what exactly is SBSP? It is an orbital technology concept that traps the sun's rays to deliver clean, renewable power wirelessly to Earth.[64] What is more, given space has no atmosphere and is never cloudy, and when the satellite is in geosynchronous orbit with Earth there is no night, the power generated by a SBSP satellite will be constant. SBSP locates satellites in the geosynchronous orbit, which are far enough from the Earth that they do not fall under our planet's shadow except for very brief periods (spring and fall equinoxes) of less than an hour. Placed high above the atmosphere at a distance of about 35,800 kilometers above the Earth's equator,[65] the SBSP satellites can intercept rays 35 to 70 percent more powerful than the midday sun on Earth. This means the space-based photovoltaic cell will generate 40 times more power annually than an Earth-based solar cell.[66] Once generated, the electric current can be transmitted back to receiving antennas on Earth either through an infrared laser beam or as microwaves that can easily pass through cloud cover. While an individual satellite can actually only see a little less than half of the Earth, a system of satellites can provide power anywhere on the globe with a receiving antenna. By 2100, the world will require about 70 terawatts of energy, and the geostationary belt alone has the capacity to generate 332 terawatts of energy, which will facilitate a developed world with zero carbon energy emissions.[67]

Technological hurdles that exist for an SBSP station are its weight (10,000 tons) compared to what rockets can lift today (100 tons), transferring energy from space via microwaves, and precise attitude control as well as on-orbit manufacture/assembly/integration. Significantly, China has recognized that in order to ensure seamless energy flow for future generations, investing in SBSP research and development is to think big long term and start working on building space solar infrastructure in orbit, especially in LEO and GEO—22,000 miles above Earth. CALT has started work on the super heavy *Long March 9* rocket, for China's future deep space exploration, to be completed by 2028. Li Tongyu, head of aerospace products at CALT, believed that the *Long March 9*'s "specifications will mostly be determined by a host of factors, including the government's space plan and the nation's overall industrial capability, as well as its engine's development."[68] This focus on SBSP has practical outcomes for China. China's energy consumption has grown from 18 quadrillion Btu in 1980 to 37.1 quadrillion Btu in 1996. It is projected to be 98.3 quadrillion Btu by 2020.[69] China's economy is projected to become the largest economy by 2028,[70] both in purchasing power parity and market exchange rate, and its energy demands have to sustain its economy. It is in this context that Lt Gen Zhang Yulin's remarks assume significance. He stated, "The Earth-moon space will be strategically important for the great rejuvenation of the Chinese nation."[71] He suggested that "China would next begin to exploit Earth-moon space for industrial development. The goal would be the construction of space-based solar power satellites that would beam energy back to Earth."[72]

Within China, those who study security and those who are space scientists have divergent perspectives on space-based resources. In general, Chinese experts on China's missile defense, nuclear, and regional security studies are pessimists when it comes to China's capability to achieve long-term space goals like SBSP or asteroid mining.[73] They believe that long-term space goals articulated by Chinese space policy makers or scientists are aimed mostly at procuring state funding for their projects.[74] On the other hand, long-term space investment is a high priority for China's leadership.[75] The commitment of the highest levels of PRC leadership is demonstrated by the close personal association of its highest leaders to space activities. In 1999, Chinese Premier Jiang Zemin personally named China's first unmanned space-craft, *Shenzhou* (*Our Divine Land*), and wrote the calligraphy imprinted on the side of the spacecraft.[76] China, via its space program, is aspiring to use its space technology, both for its development needs and the peaceful use of space and to reap economic dividends.[77] CAST, one of China's leading space agencies, views SBSP as meeting several important goals for China, namely, "sustainable economic and social development, disaster prevention and mitigation, and the retaining of qualified personnel and the cultivating of innovative talents."[78] CAST submitted a feasibility report on SBSP, which was approved by the Ministry of Industry and Information Technology.[79] While the acquisition of technology for SBSP will require the development of cutting-edge technologies including ultra-thin arrays, revolutionary launch capabilities, and on-orbit manufacture/assembly/integration, China views its investments in developing SBSP technologies for energy as equivalent to the Apollo program that resulted in the US lead in science and technology.[80]

Lunar Exploration and Asteroid Mining

In its 2016 white paper on space activities, China identified asteroid exploration as one of its fundamental future space goals. In his presentation at the 2016 International Astronautical Congress in Mexico, Li Ming specifically identified mining resources from the moon and asteroids as a priority. China is focusing on exploiting resources like titanium, helium 3, and water from the far side of the moon. Its *Chang'e* lunar exploration program, launched on Long March rockets, is an ongoing robotic mission to the moon led by the CNSA. Besides discovering titanium and helium 3, discovering water on the lunar: on the lunar surface is going to be vital for any ambitions for a human settlement. Water is vital for creating propulsion, necessary for space crafts. In an interview with the BBC, Wu Weirin, the head designer of China's lunar missions, revealed that China aims for long-term exploration and a research base on the lunar surface.[81] By 2018, China aims to launch the *Chang'e-4* lunar probe to achieve a soft landing on the far side of the moon, to carry out topographic and geological survey of lunar samples.[82] By 2036, China aims to send a manned mission to the moon.[83]

It is interesting to understand the linkage drawn between the lunar base, asteroid mining and exploration, and SBSP. What can be inferred is that Chinese policy makers and space scientists have a long-term plan that has two distinct phases. The first phase is to succeed in developing its permanent space station by 2020–2022. In this, the *Tiangong 1* and *Tiangong 2* space labs are preliminary testing of technologies. The 20 April 2017 successful launch of its cargo space ship *Tianzhou 1* to test its docking with *Tiangong 2* will be ultimately utilized for supplying the six astronauts that will live in its permanent space station. Dr. Yang Yuguang, secretary general of the International Space Transport Association, stated that "this is the ultimate reason why China is building up a cargo fleet."[84] Chinese scientists involved with the building of the *Tianzhou 1*, namely Bai Mingsheng, its chief designer, and Zhou Jianping, chief designer of China's manned space program, believed that the success of *Tianzhou 1* meant that they could now start work on the permanent space station as the supply and on-orbit refueling issues have been solved.[85]

The second phase is deep space and asteroid exploration. Ye Peijian, who leads deep space exploration at CAST, stated that China is investing in both Mars and asteroid exploration. Asteroid exploration, specifically, will be carried out between 2020 and 2025.[86] He said that "the detailed schedule and the target asteroid have yet to be determined, but we are working on them. We want to explore asteroids because their resources will be important to mankind's development in the future."[87] CNSA has scheduled the time period 2017–2022 to begin feasibility studies to develop the capability to exploit asteroids.[88] The ultimate aim is to land on asteroid 1996 FG3,[89] begin research probes on samples of minerals like titanium and platinum that could be worth billions, and establish a lunar presence to carry out manufacturing in space.

Hexi Baoyin, Yang Chen, and Junfeng Li at Tsinghua University in Beijing have published findings on how to nudge an asteroid into Earth's orbit.[90] The idea is to capture a NEO or asteroid with a low energy orbit and place it in Earth's orbit temporarily in order to develop the capacity and technology to extract resources from NEOs. On 13 December 2015, China's *Chang'e 2* flew as close as 3.2 kilometers past asteroid Toutatis, which is about 7 million kilometers away from the Earth. It managed to capture close pictures of the asteroid, making China the fourth country—after the United States, the European Union, and Japan—to examine an asteroid from an unmanned spacecraft.[91] Such probes require extreme precision.

One skill China intends to cultivate is planetary defense. In this, the asteroid Apophis, discovered in 2004 and 394 meters in length, is China's focus of study. In 2029, Apophis will fly near earth, missing it by 30,000 kilometers. In assessing the threat asteroids may pose to earth, CAS' Purple Mountain Observatory plays a significant role. In January 2017, the observatory discovered three NEOs, and one among them, 2017 BL3, poses a risk to Earth. In building towards these space technologies, China aims to establish a more permanent presence in space.

Permanent Space Station

China's ambitions to develop SBSP and exploit resources from asteroids are planned for after it completes building its permanent space station by 2020–22. The idea is to use permanent presence to then explore deep space and unravel some of the mysteries of space. In this, the work on developing capacity started nearly a decade ago. Named *Tiangong* ("*Heavenly Palace*"), China launched the *Tiangon*g *1* on 29 September 2011 on the Long March 2F/G.[92] The *Tiangon*g *1* was an experimental space laboratory aimed at carrying out docking and creating expertise on construction and operation of a space station. On 31 October 2011, the unmanned *Shenzhou 8* was launched via *Long March 2F (Y8)* launch vehicle and successfully docked with *Tiangong 1*.[93] The *Shenzhou 8* registered the first international collaboration for China's manned space program with SIMBOX, a joint project between China and Germany in the field of biomedicine.[94] In July 2012, China concluded the first successful crewed docking with the *Shenzhou 9*, the next stage in its plan to develop a manned space presence.[95] This was followed by the *Shenzhou 10*, the longest manned Chinese mission with three astronauts. The mission goals were to further enhance docking capabilities and build knowledge of living and working in space.[96] The *Tiangong 1* was planned to stay in orbit for two years and then fall back to Earth but is now expected to burn up in Earth's atmosphere in March 2018.[97]

On 15 September 2016, the *Tiangong 2* was launched and was visited by two Chinese astronauts aboard the *Shenzhou 11* for a month on 16 October 2016.[98] This is further progress toward establishment of the space station by 2022. Wu Ping, deputy director of China's manned space engineering office, stated that "the launch of *Tiangong-2* will lay a solid foundation for the building and operation of a permanent space station in the future."[99] On 20 April 2017, China launched the space cargo ship *Tianzhou 1* to refuel the *Tiangong 2*.[100] The *Tianzhou 1* successfully docked with the *Tiangong 2*.[101] This boosted China's path to its permanent space station, as the *Tianzhou 1* can carry about six tons of cargo and two tons of fuel and has the capacity to fly unmanned for three months.[102] The *Tianzhou 1* will be carrying out experiments on how weak gravity affects the development of human embryonic stem cells while in space.[103] The lead researcher for this project from Tsinghua University, Beijing, Kehkooi Kee, specifies that "the research is expected to provide a theoretical basis and technical support to solve the possible problems of human reproduction caused by the space environment,"[104] especially the impact of microgravity. From this, we can surmise that China has ambitions for human settlement in space. According to Wu Weiren, chief designer of its moon missions, "our long term goal is to explore, land, and settle" on the lunar surface.[105] The *Tiangong 3* launch is planned by 2020.

The *Tiangong* orbital space station will support up to six astronauts for a long-term stay and consist of a 20-ton core module as well as two research modules. Given the International Space Station (ISS) is scheduled to retire by 2025, the *Tiangong* may be the only human space station remaining.[106] Significantly, Chinese astronauts are debarred from participating on the ISS as per 2011 US Congressional legislation.[107] Interestingly, Chinese experts assert that this prohibition has had a positive impact on China's space development. Lack of high-technology cooperation with the US has encouraged indigenous space capacity building and helped develop local expertise, with the CPC further motivated to invest heavily on China's space program.[108] Chinese experts on security and space matters go on to state that once China achieves high-end indigenous space technology, the US will have no other choice but to cooperate. Moreover, it will, by default, address the US congressional concern of space technology theft.[109] Once China has the knowledge and proven space capacity of its own, international cooperation with the US would become the new normal.

Serious Ambition Timelines

China's stated future space goals of developing a SBSP station and beaming that energy wirelessly back to Earth, establishing a manned lunar presence, landing on the dark side of the moon, exploring and mining asteroids, utilizing these resources for in-situ manufacturing, and building a permanent space station are technologically ambitious to achieve in the 20–30 year time span. The skeptics would argue that such goals are not achievable or feasible given the absence of proven technology or that China may rhetorically state these ambitions, but it remains to be seen if these goals are achievable.

To answer whether we need to take these future Chinese space goals seriously, let us examine the pattern of stated Chinese space ambitions in the past and whether it met the goals within the specific timeline set. In the 1950s China announced its ambitions for space along with its nuclear ambitions under Mao Tse-tung. This was a result of threatened nuclear weapons use by the United States in the Korean War and Mao's decision to develop China's own nuclear arsenal as a deterrent against future vulnerabilities. To shore up international prestige for China, Mao aimed to place a satellite in orbit by 1959 under Project 581. When Soviet technical assistance was withdrawn, there was realization that this aim for a satellite was not possible, and consequently, Project 581 was abandoned.[110] This did not, however, completely eliminate the space program. Work continued for the next two decades to build the foundations for a long-term program, and finally, in 1970, China's first satellite *Dong Fang Hong 1* was launched on 25 April broadcasting the song "East Is Red" from orbit. Following that successful launch, and after Deng Xiaoping took over as premier of China, the space scientist community received a further boost to lay down specific aims for China's future space program. These were as follows.

In the late 1980s, China declared that it aimed to send a manned spaceflight in the next two decades. While it actually sent its first manned space mission, *Shenzhou V*, in 2003, its first unmanned space mission was successfully launched in 1999. While some argue that China's success in its unmanned and manned mission is due to its 1996 agreement with Russia on space technology acquisition, reengineering of Russian space technology simply does not mean the same technology but added-on technology fitted by Chinese engineers and scientists. In 2004, Wang Yongzhi, the chief designer of China's space program, stated that China plans to have a permanent crewed space station in the next 15 years.[111] That aim was reiterated in its 2016 white paper on space activities. The plans to establish a space station incrementally have been met, again as per stated schedule. In 1992, China established Project 921-2, whose mission was to launch a manned spaceflight in 10 years (mission accomplished 2003), an orbiting station by 2010 (mission accomplished 2011), and finally a permanent space station by 2020–22.[112] In 2007, China announced that between 2008 and 2010, the Shenzhou unmanned and manned spaceflights will be launched to dock with *Tiangong 1* (also mission accomplished).[113] In 2011, China declared its intentions to launch *Tiangong 2* by 2015, later postponed to 2016, followed by the *Shenzhou 11* manned spaceflight to dock with it, to be followed by the Chinese space cargo ship in 2017.[114] All these stated goals have been accomplished, including the successful launch and docking of the indigenously built Chinese space cargo ship, the *Tianzhou 1*. The success in not only building the technology but also successfully meeting stated timelines gives enormous credibility to China's future stated goals of a 2018 landing on the dark side of the moon, a 2036 manned mission to the moon, SBSP space station by 2050, asteroid mining, and so forth. These goals would require enormous indigenous technology innovation and if successful would establish the independent innovation potential of China's space enterprise. The *Tianzhou 1* is a great example of the growing indigeneity of China's space program. Even with the PRC's delayed record of accomplishing its stated space goals, those who dismiss or ignore China's announced roadmaps for space should consider the fact that achievements in space are directly connected to the CPC's legitimacy and are not taken lightly. The high levels of political engagement with the space program are also grounds for possible conflict.

Conclusion

China's investments certainly suggest a desire to exploit space resources and pursue space settlement. Surely the ability of any nation to gain an advantage in accessing the vast wealth of the inner solar system could have an effect on the balance of power in the international system. Such access and mobility are likewise likely to provide certain military advantages as is true in any domain. However, quite aside from general concerns of changes in the distribution of economic and military power are the specific concerns of how such resources themselves are allocated and whether this can lead to conflict. It remains to be seen whether the shift in China's space goals, as articulated by its scientists and space policy makers, to acquire space-based resources and a permanent space station lead to resource nationalism, territoriality, and expansionism. Furthermore, will Chinese space ambitions result in a scenario of land grabs based on historical claims and counterclaims?

Will Chinese territorial assertion be replicated with regard to space resources? Once China reaches somewhere in space first—for instance, the far side of the moon or an asteroid—will it recreate a similar argument of owning a resource by being there first as it does with regard to the South China Sea and East China Sea? Will similar arguments with regard to being the first to use navigational charts in the South China Sea or issue first historical records with regard to the East China Sea be replicated on the lunar surface, where, by 2018, China aims to carry out topographic and geological survey of lunar samples?[115] What will be the likely strategic impact if China declares a "Zone of Non-Interference," similar to an air defense identification zone, on the moon once it establishes a permanent base there? And if China passes an act similar to the 2015 US Asteroid Act that favors "first come, first served" with regard to mining rights and ownership of the mined resources, what would transpire if a US private company applies for landing and mining rights on an asteroid, but China rushes in and establishes its base first?[116] What if both US and Chinese companies want to mine the same asteroid? Are there mechanisms that would help peacefully create shared rights?

If the South China Sea is taken as a precedence, to date, China and its fellow disputants have not succeeded in establishing a code of conduct. The absence of a regulatory framework reflects the consequential absence of a standard of behavior that is acceptable to all and thereby leaves room for variable interpretations. This situation could get reflected in space once the technology to mine resources becomes cost effective and on-orbit manufacturing becomes commonplace.

China's ambitions in space over the coming 20–30 year time span show all indications of being successful. Chinese scholars on strategy and space indicate that China would prefer the "global commons" or internationalist perspective when it comes to space resources. None asserted any nationalist vision for celestial bodies or space resources, and all were firmly attached to playing as a "responsible stakeholder" within the existing global governance framework.[117] Nevertheless, China's strategic behavior with regard to the South China Sea and East China Sea, both rich in resources and both claimed by China, is based on a "first presence" argument. Consequently, Chinese behavior during a conflict in space would likely depend to a large extent on the kind of international regulatory regime in place, the ability of the regime to mitigate conflicts, and whether China considers itself to be in a superior or inferior position. China's strategic culture indicates it opts for peaceful conflict resolution when it is inferior to its adversaries but prefers use of force when it is in a superior position. Only those nations that keep up with China with regard to space access and industrial exploitation are likely to have any meaningful rule-making power. Chinese scholars specializing in space law insist that there is no international regulatory mechanism or law to adjudicate space property issues.[118] Given the potential increase in space-related resource activities, including China's officially stated ambitions to exploit asteroids for resources, build an SBSP, and establish a lunar base, those in the international community who desire a peaceful future in space should promptly craft an international regulatory framework tuned to the realities of the twenty-first–century space ambitions. SSQ

Notes

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