THE CHINESE SPACE PROGRAM

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Abstract: The origins or the Chinese Space Program can be traced to the Cold War and the establishment of the missile program by Mao. The Chinese National Space Agency (CNSA) was established in 1993 to help China boost its civil and commercial use of the space sector. In broad terms, the Chinese Space Program is characterized by effective rapid improvement, concentration on transformation, optimization and automation of all digital aspects allowing China to become a leader in the Information Age, with the help of its recently established space structures. The effective investment in technology over the last thirty years has allowed the tech sector to grow exponentially and in turn help China develop a more advanced society, based on that same space technology. Ultimately the Chinese Space Program will continue to improve itself and enhance the stature of China in Space, whilst acknowledging the necessary common effort to conquer the final frontier and let humanity reach the stars.

Keywords: CNSA; space technology; space defense; satellites; deterrence; determinism; international relations; security; space race

Historical retrospective

The Space Race was born during the Cold War. The power struggle between the USA and USSR saw some of the greatest accomplishments humans have ever performed. The ultimate contest for aerospace superiority, technological progress and ideological strife allowed humanity to enter the Information Age, as a result of the Space Age. Yet one must remember that the only nation-states guaranteed to participate in such an expensive race, are the superpowers possessing the resources, manpower and technology. Although China possessed neither the technology nor the expertise, they possessed other valuable factors at their disposal such as: resources and manpower. Facilitation to the entrance of the Space Race became possible only ten years after WWII and the Korean War in 1950, where US projected militarism in East Asia and forced China to respond by mobilizing and developing their own first ballistic missile program, Project 02 (Li 2007, 151)[1]. Following Project 02, Project 581

[1] Li, X. A History of the Modern Chinese Army, University Press of Kentucky, 2007, pp.150 – 151

was initiated, China's first space program (CAS 2007)[2]. During the Korean War the People's Republic of China, proved to be a worthy adversary, by repulsing American forces back in South Korea. As a consequence, Eisenhower coerced China, with their newly developed nuclear deterrent and tensions eventually halted on the 46° parallel (Norris & Kristensen 2006)[3]. To avoid such future possibilities, Chairman Mao decided the only way to be able to avoid nuclear blackmail, would be to also possess nuclear technology. On the 15th of January '55, China designated their nuclear arms program "02". The first ballistic missile program developed as a nuclear deterrent became the cornerstone for the Chinese Space program. In 1956, the Fifth Academy of the National Defense Ministry was established and became the main organization responsible for research and development of the first ballistic missiles. The father of Chinese Rocketry and director of the Space program was Qian Xuesen. In 1935, Xuesen left China on a scholarship, to study at MIT. Shortly after arriving in the States, the young scholar became fascinated with rockets, and transferred to California Institute of Technology. There along with other fellow scientists they gave the name of the Jet Propulsion Laboratory, which eventually became NASA's main laboratory (Cheek 2015, 153)[4]. In 1949, Xuesen was named director at the Jet Propulsion Laboratory at CALTECH, the same year McCarthyism started. The Chinese scientist was withheld in custody and deported back to China in 1955 (Wines 2009)[5]. Through twenty years of studying and researching aeronautical engineering, Xuesen had obtained the needed rocketry expertise to direct and develop the first Chinese ballistic missile program under the Fifth Academy. Xuesen was given the responsibility for the establishment of China's first missile and rocket research institute, the Fifth Research Institute of the State Ministry of Defense (Goh 2017)[6]. He was in charge of the program for "jet and rocket technology building", supervised and directed the development of ballistic missiles as well as China's first artificial earth satellite. The short-range missiles technology would become the cornerstone for the whole Dongfeng series. In

[2] CAS, Zhao Jiuzhang and China Satellite, Chinese Academy of Sciences, 2007, <https://web.archive.org/web/20080314030932/http://www.cas.ac.cn/html/Dir/2007/10/16/15/33/09.htm>

[3] Norris, R. & Kristensen, H. U.S. nuclear threats: Then and now, Bulletin of the Atomic Scientists. 62 (5), 2006, pp. 69 – 71.

[4] Cheek, T. The Intellectual in Modern Chinese History, Cambridge, Cambridge University Press, 2015 p. 153.

[5] Wines, M. Qian Xuesen, Father of China's Space Program, Dies at 98, New York, NY Times, 2009 <https://www.nytimes.com/2009/11/04/world/asia/04qian.html>

[6] Goh, D. The life of Qian Xuesen, father of China's space programme, SpaceTech Asia, 2017, <https://www.spacetechasia.com/qian-xuesen-father-of-the-chinese-space-programme/>

essence the technology in the DF-1 was a licensed copy of the SRBM Soviet S-2. The first medium-range, China came up with, were also Russian designed, and resembled greatly R-5 Pobeda. The DF-3, the first intermediate-range missile, also greatly derived from R-14 Chusovaya (Lewis & Di 1992)[7]. Besides rocketry, Xuesen contributed greatly to the fields of aerodynamics, aviation engineering, jet propulsion, engineering cybernetics and physical mechanics. Additionally he was the founder and initiator of mechanics, systems engineering theory and applied research in the modern Chinese educational system (Sullivan & Liu-Sullivan 2015)[8]. In 1957, with the launch of Sputnik in Space, Mao reaffirmed China's determination to become a superpower, by setting a deadline to launch an artificial satellite in space by 1959, dubbed Project 581. The completion of the launch of the satellite, meant to serve as celebration for the tenth anniversary of Peoples Republic of China, nevertheless it was only launched eleven years later, in 1970, making China, the fifth nation in the world to launch own satellite into space (McDowell 2020)[9]. In the years to come China further improved their missile capability and launched numerous of commercial satellites in space, by developing their Long March series of rockets. Moreover there were a number of proposed crewed space programs between 1970 and 2000, but only on the 15th of October 2003, China sent Yang Liwei in space, making them the third nation to launch a human in space on their own and officially entering the contest for the final frontier (People's Daily 2003)[10]. The advancements within the Chinese technological sector really began with Deng Xiaoping's ascension to power and the state shifting focus to help sciences, research and technology. Various projects were set in motion, which brought about sending eventually Yang Liwei to space and paving way for current and future missions beyond Earth. Chunsi writes in his works "Deng Xiaoping regarded science and technology as the chief productive force. The present Chinese leadership under Hu Jintao stresses the scientific outlook on development and the need to pursue an indigenous program for the devel-

[7] Lewis, J. & Di, H. China's Ballistic Missile Programs – Technologies, Strategies, Goals, International Security, Fall, vol. 17 no. 2, 1992, <https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/china%27s_ballistic_missile_programs.pdf>

[8] Sullivan, L. & Liu-Sullivan, N. Historical Dictionary of Science and Technology in Modern China, Rowman & Littlefield, 2015, pp. 283 – 342, <https://archive.org/details/rocketmanstoryof00stre/page/n7>

[9] McDowell, J. "Satellite Catalog", Jonathan's Space Page, 2020, <http://planet4589.org/space/log/satcat.txt>

[10] President Hu hails successful launch of Shenzhou V, People's Daily Online, 2003, <http://en.people.cn/200310/15/eng20031015_126054.shtml>

opment of science and technology" (Chunsi 2008, 622)[11]. Such improvements in science are best exemplified by the initiation of "Program 863" in March 1986, focusing on the development of bio-technology, telecommunications, information and laser technology, new materials, automation, space and energy. Initiated in 1986, "Project 863" was the direct response to the defense missile system, SDI, initiated by Ronald Reagan (Chunsi 2008, 623)[12]. One of the projects that came out of "Project 863" was "Project 921", Chinas first official manned space program, established in 1992. The 921 program was meant to show that China had developed the capability to send Taikonauts to space and contest the traditional space faring nations. The program evolved into the Shenzhou program, and on the fifth mission in 2003, Yang Liwei went to space. China's aspirations to the space realm are also well summarized within the words of Drozhaschchikh „In reflecting upon the "means" of fulfilling the Chinese Dream, Xi Jinping raised the issue of aerospace innovations to contribute to the nation's rejuvenation in economic welfare and international influence… The space dream is part of the dream to make China stronger. With the development of space programs, the Chinese people will take bigger strides to explore further into space" (Drozhaschchikh 2018, 176)[13]. China seeks to gain a great lot from space, in all aspects and not only economically or diplomatically but also: power, prestige, strategic advantage, knowledge, access to outer space resources and the usage of space based technology to enhance all of the latter mentioned. The ability to conduct science in space, to have a self-sustained navigation system, to have a higher ground when it comes to strategic defense, are only a small amount of the activities that a nation can perform in space, if they have a space program. Nation states fortunate enough to possess the capability to build up a comprehensive space program directly enter the outer space contest and can compete for global dominance in the international realm. An ample space program can only be successfully defined by a clear policy, widespread strategy and an organized structure, which China has steadily developed since the 1990's. The end of the Cold War marked the beginning for the Chinese Space sector to begin reorganizing itself, restructuring and augmenting their technological base, to be able to challenge the present space dominant, USA.

[11] Chunsi, W. China's Outer Space Activities: Motivations, Goals, and Policy, Strategic Analysis 32:4, 2008, p. 622 – 623.

[12] Chunsi, China's Outer Space Activities: Motivations, Goals, and Policy, p. 623.

[13] Drozhashchikh, E. China's National Space Program and the "China Dream", Astropolitics, 16:3, 2018 pp. 175 – 186.

Structural organization of the Chinese Space Program

The Chinese Space Program is defined by a complex relationship between state, military, civil and commercial structures. Originally the space program was under the command of the Second Artillery Corps of the PLA for many years, until the 1990's. However, with the end of the Cold War, the Chinese Communist Party decided that structural changes were needed to the national defense industry, in order to make it resemble more like the western models and other traditional space powers with well-established structures. By reorganizing the structure of the Chinese space program and industrial technology base, the CCP began making a clear distinction between their civil and military, both space activities and technology. Christine Edwards from the Business Insider reports "The current organization of China's defense industrial base is pretty simple – two competing corporations face one at other in the five key divisions through shipbuilding, aviation, nuclear, ordnance and missile/aerospace. These include China North Industries Group Corporation (CNIGC) and China South Industries Group Corporation (CSIGC). Each with friendlier subordinate import/export set ups – China North Industries Corporation and China Great Wall Industries Corporation – which facilitate import and sales of commercial and military goods for profit" (Edwards 2019)[14]. This setup allows for continuous competition like in a free market; bring about innovation and improvements constantly to the space technology. With the advancement of technology and the ever-growing usage of satellites in the information age for the civil society, it is only natural to allocate civilian missions and space activities to a civilian organization. Consequently the civil part of the space program came under the authority of the Chinese National Space Administration – CNSA, based in Haidian District, Beijing. The CNSA is the main organization responsible for the planning and development of space activities. As the organization best describes itself "…fulfills the corresponding management responsibilities of the government. Implement industry management of aerospace activities, so that they can develop in a stable, orderly, healthy and coordinated manner. It is also representing the Chinese government in organizing or leading foreign exchange and cooperation activities in the aerospace field" (CNSA 2020)[15]. Positing along with the words of Logan „The People's Liberation Army also manages the military and civilian manned space programs, while the China National Space Adminis-

[14] Edwards, C. State-owned media is pitching China's latest hypersonic missiles and laser weapons to the global arms market, Business Insider, 2019, <https://www.businessinsider.com/chinas-latest-laser-weapons-are-ready-for-the-arms-market-state-media-2019-1>

[15] CNSA – Institutional functions, Chinese National Space Agency, 2020, <http://www.cnsa.gov.cn/n6758821/index.html#w_two>

tration (CNSA) directs – unmanned scientific projects and international collaboration" (Logan 2007)[16]. There are four departments which operate within the CNSA, Department of General Planning, Department of System Engineering, Department of Science, Technology and Quality Control, and Department of Foreign Affairs. In addition to operate missions, CNSA uses four launch sites, which are also supervised by the PLA: the Jiuquan Satellite Launch Center, the Taiyuan Satellite Launch Center, the Xichang Satellite Launch Center and the Wenchang Satellite Launch Center, completed in 2014. It was built closest to the equator as to gain advantage of the location and is intended to launch China's heaviest rockets Long March 5 and Long March 7 into the geosynchronous orbit (NTI 2013)[17]. The expansion of the launching capability allows China to have flexibility when it comes to diversity of locations as well as launch window of opportunity, especially with the growing space debris and the decrease in the time available for a space launches (Al-Rodhan 2018)[18]. The Chinese National Space Administration falls under the authority of the State Administration for Science, Technology and Industry for National Defense (SASTIND), which is under the governance of the MIIT – Ministry of Industry and Information Technology. Besides CNSA, three further entities fall under SASTIND, the China Aerospace Science and Technology Corporation (CASC) and the Chinese Electronics Technology Group Corporation (CETC) and the China Aerospace Science & Industry Corporation Limited (CASIC). The latter is practically the 5th Academy, originally established in 1956 and directed by Qian Xuesen. CASIC is China's biggest missile manufacturer and in their words "has established a complete technology research and development (R&D) and production system for air defense missile weapon system, aerodynamic missile weapon system, solid launch vehicle and space technology products" (CASIC 2020)[19]. The other big space technology manufacturer in Chinas is CASC, and also traces its origin back to the 5th Institute of Defense. CASC's profile states „CASC is dedicating itself to building China into a space power, continuously carrying out the national major scientific and technical programs such as Manned Spaceflight, Lunar Exploration, Beidou Navigation and High-Resolution Earth Observation

[16] Logan, J. China's Space Program: Options for U.S.-China Cooperation, ResearchGate, 2007, <https://www.researchgate.net/publication/235194510_China's_Space_Program_Options_for_US-China_Cooperation>

[17] NTI, Facilities, China, the Nuclear Threat Initiative, 2013, <https://www.nti.org/learn/countries/china/facilities/>

[18] Al-Rodhan, N. Space traffic control: technological means and governance implications, 2018, <https://www.thespacereview.com/article/3473/1>

[19] CASIC, Introduction of CASIC, Chinese Aerospace Science and Industry Corporation, 2020, <http://www.casic.com/n189298/n189314/index.html>

System; initiating a number of new major programs and projects such as heavy launch vehicle, Mars exploration, asteroid exploration, space vehicle in-orbit service and maintenance, and space-ground integrated information network; and actively conducting international exchanges and cooperation, thus making new contributions to peaceful use of outer space and benefiting mankind as a whole" (CASC 2020)[20]. The organization itself has many institutes and sub entities, which all focus on various aspects in the space R&D. The biggest of these is the China Great Wall Industry Corporation (CGWIS), which is essentially CASC's dedicated export management and international contracting entity. According to CGWIS's profile "CGWIS is the sole commercial organization authorized by the Chinese government to provide commercial launch services, satellite systems and to carry out space technology cooperation" (CGWIS 2020)[21]. In addition to the civil changes, in 2016 the People's Liberation Army, was also reformed, and the Second Artillery Corps, became the PLA Rocket Force, which remains responsible for any ballistics and missiles. Supplementary to the Rocket Force, a new branch was created, the PLA's Strategic Support Force (PLASFF), responsible for overseeing the cyber, electronic and space services of China. The establishment of the PLASSF aims to unify and facilitate many operations, which previously were performed by various parties within the space program. Additionally PLASSF reports directly to the Central Military Commission, rather than the Rocket Force or any other branch, which means China, starts to recognize the importance of the space domain, and is beginning to set a military structure, to support any Chinese efforts in aerospace. With advances in the space supremacy, as well as development of counter-space capabilities, China highlights the value space holds for them, and its integration as key element to their national defense (CASI 2017, 31)[22]. Within the PLASSF, is the Information Engineering University which oversees the following sub entities: S&T Research Department, Training Department, Command Information Systems Academy, Electronic Technology Academy, Encryption Engineering Academy, Luoyang Foreign Language Academy, Geospatial Information Academy, Cyberspace Security Academy, Navigation and Aerospace Target Engineering Academy, Command Officer Basic Education Academy and Blockchain

[20] CASC, About CASC, Company profile, Chinese Aerospace Science and Technology Corporation, 2020 <http://english.spacechina.com/n16421/n17138/n17229/index.html>

[21] CGWIS, Company Profile, About us, China Great Wall Industry Corporation, 2020, <http://www.cgwic.com/About/index.html>

[22] CASI, PLA Aerospace Power – A primer's trend on Chinese Military Air, Space and Missile Forces, 2020, <https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/PLAAF/CASI_Primer%202017.pdf>

Academy (Burton & Stokes 2018)[23]. All of these facilities educate and train the brightest space minds of China and help support the already established structure and allow China to compete technologically in space. R&D support of the military and civilian structures also derives from universities and commercial companies. The main universities associated with the development of the space sector are: the College of Aerospace Science and Engineering at the National University of Defense Technology, the School of Astronautics at Beihang University, the School of Aerospace at the Tsinghua University, the School of Astronautics at Northwestern Polytechnical University, School of Aeronautics and Astronautics at Zhejiang University, the Institute of Aerospace Science and Technology at the Shanghai Jiaotong University, the College of Aeronautics at Harbin Institute of Technology and the School of Automation Science and Electrical Engineering at the Beihang University (Stokes, Alvarado, Weinstein & Easton 2020, 67)[24]. All of these academia organizations participate actively in the development of new satellites, launching systems and spacecraft technology. Focusing on space tech education and intertwining it with the main space program, gives chance to China to improve on the already previously state developed technology. The head organization responsible for overseeing the science and technology in China is the Chinese Academy of Sciences (CAS). Originally established in 1949, as posited on their website „CAS is a think tank delivering Science and Technology advice and a community for training young science and technology (S&T) talent" (CAS 2020)[25]. Complimenting CAS and the numerous of academies and universities, there are also a number of commercial companies, which work with the PLA and CNSA, to launch satellites into space as well as create new launching capabilities. These companies are relatively new to the space scene, and mostly developed in the last five years, but have still allowed for a private growth of the Chinese space industry. Beijing One Space Technology Co. referred to as One Space; was found in 2015 and focuses mainly on three sectors: its M-series commercial launch vehicle, its X-series flight test platforms, and electrical and propellant products. Some of its products include missile control and measurement control communications, unmanned aerial vehicle inte-

[23] Burton, R. & Stokes, M. "The People's Liberation Army Strategic Support Force Leadership and Structure", Project 2049 Institute, 2018, <https://project2049.net/wp-content/uploads/2018/09/180925_PLA_SSF_Leadership-and-Structure_Stokes_Burton.pdf>

[24] Stokes, M. Alvarado, G. Weinstein, E. & Easton, I. China's Space and Counterspace Capabilities and Activities, 2020, p. 67, <https://www.uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf>

[25] CAS, Introduction – About us, Profile, Chinese Academy of Sciences, Chinese Academy of Sciences, 2020, <http://english.cas.cn/about_us/introduction/201501/t20150114_135284.shtml>

grated avionics, ground monitoring and control communications and satellite and microsatellite measurement and control communications (Goh 2018)[26]. The other private company, which has dealt with launching capabilities is, Land-Space Technology Corporation, also referred to as Blue Arrow. It was found in 2015 and is engaged in the R&D and operation of launch vehicles. It focuses on the development of liquid-fuel rocket engines and low-cost commercial launch vehicles with (Stokes, Alvarado, Weinstein & Easton 2020, 77)[27]. "In addition to these two, there is the Chang Guang Satellite Technology Co. (CGSTL); found in December 2014, and deals exclusively with commercial remote sensing satellites. Its satellites are being used to track foreign military assets. CGSTL asserts that the company's main business scope comprises R&D and sales for satellite and UAV systems as well as their components, loading systems, monitoring and tracking systems, and other relevant services" (Stokes, Alvarado, Weinstein & Easton 2020, 78)[28]. The other commercial satellite manufacturer is Beijing PieSat Information Technology Co., established in 2008. The Chinese high-tech commercial firm specializes in the development of remote sensing satellite technology. The company website states that PieSat independently developed its Pixel Information Expert (PIE) software that can be used for analyzing remote sensing imagery and data using advanced information extraction techniques and artificial intelligence. „Its PIEMap software provides map navigation and geographic information system GIS services for the government, army, enterprises, and other clients" (PieSAT 2020)[29]. Dwelling on the private entrepreneurship, the PRC looks to challenge other western, traditionally strong in the space sector, companies: Boeing, Lockheed Martin, and SpaceX. The 2016 State Council White Paper on Space Activity only affirms that, by acknowledging the need for a commercial space industry and even introducing various new ways of funding private companies in order to promote commercial growth in the space sector (SCIO 2016)[30]. Additionally, Robin Li, co-founder of Baidu, the Chinese equivalent of Google, has also spoken in favor of more government support in the private sector to enhance the competitiveness of China within the international

[26] Goh, D. Interview: One Space CEO on its progress, plans, and China's space industry, SpaceTech.com, 2018, <https://www.spacetechasia.com/interview-one-space-ceo-on-its-progress-plans-and-chinas-space-industry/>

[27] Stokes, M. Alvarado, G. Weinstein, E. & Easton, I. China's Space and Counterspace Capabilities and Activities, p. 77.

[28] Ibid, p. 78.

[29] PieSAT, Company Profile, About us, PieSAT Information Technology, 2020, <http://www.piesat.cn/en/ABOUTUS.html>

[30] The State Council The People's Republic of China, White Paper on Chinese Space Activities, 2016, <http://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm>

aerospace industry (Curcio & Lan, 2018)[31]. All these advances highlight Chinese aspirations for space control. Having the proper organization and structures in place, civil, military and commercial allows also for a comprehensive approach towards a vital future sector regardless of its nature. Ultimately the CCP decides the course of the space program would go, and all of the substructures help, enable, and perform the space activities.

China's Missions and Ambitions

The Chinese space program has several important goals which it pursues. Foremost the CNSA seeks improve their standing in the world of space science, with a continuous technological innovation. More specifically in the near future, the Chinese space program seeks to: establish an orbital crewed space station, a lunar base and send robotic probes to Mars. In an interview with BBC, the head designer of the lunar missions, Wu Weiren, explains the Chinese strategy in approaching space. The plan has a near-term and long-term goal. The near-term goal is to fly to the moon, orbit, land and take samples, which would be than brought back for studies. The long-term goal is to explore, land, and settle. The first step would be establishing a lunar research base, with the hope of finding water on the dark side of the moon, due to the lack of sunlight. In terms of plans for Mars, Weiren states that the Central Party has finally approved the Martian mission, and CNSA will orbit, land and deploy a rover on Mars (Weiren 2016)[32]. As of January 2019, China successfully landed on the dark side of the moon, with the Chang'e-4 mission. The name derives from the Chinese Moon goddess. The successor Chang'e-5 was launched on November 23rd 2020, with the objective to bring back samples gathered from Chang'e-4 (Bridges 2020)[33]. Some elements found on the Moon include: titanium, manganese, aluminium, silicon, magnesium and iron (Taylor 1975, 64)[34]. Such resources would be welcomed to the expanding Chinese economy, and will surely provide an important advantage in deep space travel. Besides obvious economic gains, a lunar base gives China a strategic edge in the high ground. A base on the moon would mean better space logistics, enhanced orbital control and an ensured tactical

[31] Curcio, B.& Lan, T. Analysis | The rise of China's private space industry, Space News, 2018, <https://spacenews.com/analysis-the-rise-of-chinas-private-space-industry/>

[32] Weiren, W. China's plans for the Moon, Mars and beyond, BBC News, 2016, <https://www.bbc.com/news/av/world-asia-36085659/china-s-plans-for-the-moon-mars-and-beyond>

[33] Bridges, J., Chang'e 5: China launches sample return mission to the moon – is it winning the new space race?, SpaceNews.com, 2020, <https://www.space.com/change-5-china-moon-sample-return-mission-to-the-moon-winning-new-space-race>

[34] Taylor, S., "Lunar Science: a Post-Apollo View", Oxford: Pergamon Press. 1975, p. 64.

advantage over adversaries. In terms of Mars, CNSA launched the "Tianwen 1" mission on the 23rd of July 2020 (Wall 2020)[35]. The Martian rover will seek to study the soil, geological structure, environment and atmosphere of Mars. The name of the mission means "quest for heavenly truth" (Woodyatt 2020)[36]. Landing on Mars would make China the third country in the world to do so after USA and Russia. Furthermore a landing on Mars would symbolize that China is not playing catch-up anymore, but rather are on the same level of technical proficiency and space capability as the traditional space powers. Chinese overall economic stability will be critical to maintaining funding for the space missions. As mentioned previously, space exploration is the most expensive endeavor, and any nation seeking to pursue it, must ensure the needed requirements are met. That is mostly why, the traditional space powers, are also world superpowers and vice versa. Just like the Soviet Union had the Mir space station, the USA shares the ISS with other nations, China will also needed to gain access to a space laboratory, which consequently will be upgraded to a Chinese Space Station. The "Tiangong" space station project is the final phase of Project 921, launched in 1992. The original date set for a Chinese Space Station was 2020, but there have been delays along the years, and the assembly is now set to take place between 2020 and 2022 (Futron Corporation 2003, 7)[37]. So far "Tiangong 1" and "Tiangong 2" were tested throughout 2011 and 2018 as viable modules for a habitat module and a space laboratory. The completion of an independent Chinese Space Station is a notion of technological determinism, which stems from the necessity to counter and leverage foreign space dominance. In addition to the prestige and scientific knowledge that a space station can bring, China has expressed interest in working with other nations on its space station. China strongly believes in space cooperation, and looks to build ties with other nations interested in space exploration. Jiang Guohua, a professor and engineer at the China Astronaut Research and Training Center has stated "We think some space scientific experiment items will be collected and selected from countries of the world which will promote international exchanges and cooperation. Scientists of all countries are welcome to participate in space science experimental

[35] Wall, M. Chinas launches ambitious Tianwen-1 Mars rover mission, SpaceNews.com, 2020 <https://www.space.com/china-tianwen-1-mars-mission-launch.html>

[36] Woodyatt, A. China reveals name of Mars mission, which will take place in 'coming months', CNN News, 2020, <https://edition.cnn.com/2020/04/24/china/china-mars-mission-intl-scli-scn/index.html>

[37] Futron Corporation, China and the Second Space Age, 2020 p. 7 <https://web.archive.org/web/20120419165427/http://www.futron.com/upload/wysiwyg/Resources/Whitepapers/China_n_%20Second_Space_Age_1003.pdf>

research on China's space station" (David 2011)[38]. The technological lifespan of the International Space Station is not infinite, and repairs are required all the time to maintain the station operational. In addition the project is international, and largely depends on the willingness of all participating nations to help extend the lifespan of the International Space Station. China's new space station could offer a cheaper alternative with Tiangong, whereby other countries can only benefit from such partnership. As of 2019, CNSA and UN announced that nine international scientific experiments from seventeen countries will be held on board of the Chinese Space Station (Yuandan 2019)[39]. On top of benefiting scientifically, China can create better diplomatic relationships with other countries and collaborate on projects, which would be harder to implement on their own. Completing the given set of objectives above, will allow China to both compete and cooperate with any given set of nations interested in the Space Race.

Space Realism

Chinese expansion of counter space capabilities clearly demonstrates the technological determinism behind the realist notion of a new space race. Although China wishes to cooperate in outer space, the continuous research and development in the range of: laser, kinetic, electronic and ballistic space capabilities, is a necessary prerequisite should China also need to defend their space assets. Concurring with realist scholars, projecting power is vital for a nation state should it wish to grow or control. Space-based technology both with defensive and offensive capacity is a clear sign of such power and its capability. Generally, Chinese military space policy has undergone two phases since the last century. Concurring with Tang Shipping, we can divide the periods into two: the first portrayed by offensive realism strategy, during the reign of Mao, and the second as defensive realism strategy, which substituted the former, with the newly appointed Deng Xiaoping. The two schools of thought in the realism camp differ in such ways that offensive realism refers to the inevitability of a conflict. Mao regarded the States as the ultimate adversary and continuously prepared PRC to retaliate if it was required. Defensive realism on the hand highlights that besides a conflict, cooperation can take place between rivaling nation states (Shipping 2008, 12)[40]. Both schools of thought emphasize a realistic viewpoint,

[38] David, L. "China Details Ambitious Space Station Goals", 2011, <https://www.space.com/11048-china-space-station-plans-details.html>

[39] Yuandan, G. "Nine international scientific projects to board China Space Station, 2019, <http://www.globaltimes.cn/content/1154057.shtml>

[40] Shipping. T. From Offensive to Defensive Realism: A Social Evolutionary Interpretation of China's Security Strategy", in China's Ascent: Power, Security, and the Future of International Politics, ed. by Robert S. Ross and Feng Zhu, Cornell University Press, 2008, p. 12, <http://www3.ntu.edu.sg/rsis/publications/SSIS/SSIS003.pdf>

under which Chinese scholars recognize China's trailing position compared to the other space powers, USA and Russia. Furthermore it is noted how Chinese perception of counter measures goes from symmetrical to asymmetrical, as defensive realism shifts. An example would be: during Mao's reign, China obtained nuclear weapons in order to avoid any future nuclear blackmail. When the Soviet Union and USA launched satellites, the People's Republic of China, also launched their own satellites to respond accordingly. Those two reactions are a clear indication of symmetrical measures taken to balance the power. However, asymmetrical measures also have begun to be explored and developed alongside the symmetrical one's, especially with the shift towards defensive realism. Asymmetrical measures are researched and developed in the areas of laser, kinetic, electronic weapons, besides constructing Tiangong. Developing ingenious ways of projecting power, whether soft or hard, China expands their influence and international standing on a global scale. As previously stated, a space program is an expensive project and requires a lot of factors for a single nation put together and execute it properly. China has displayed in the last thirty years the ability to create, innovate and enhance space technologies in capabilities comparable to and beyond the traditional space powers. The United States and the Russian Federation very much remain relevant in the Space Race, but the rise of private corporations brings new actors to the space scene. Companies such as SpaceX, Blue Origin and Virgin are incentivized not by ideology or social support, rather than business profit and power expansion. Individual nation states which are related to space, have their own space legislation, but the main legal frame of the outer space was loosely established by the United Nation in 1967, with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (UN 2020)[41]. Conversely, this treaty is outdated in today's information age and scope of participants in the space race. It will be essential for any future international space relations, that new legal framework is codified and agreed to by all space faring nations. This would pave way for the cooperative way of exploring the outer space and allowing humanity to eventually pro-create life on other planets. However, should we fail to establish such legal structure; there is the real danger of turning space into the Wild West and the Gold Rush of the 1850's in North America. In 2015, the US Congress passed bill HR2262, to the Finders Keep-

[41] United Nations, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, UN Office for Outer Space Affairs, 2020, <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html>

ers law, which allows private companies to retain any resources found in outer space (US Congress 2015)[42]. Such national legalities exemplify and promote the competitive scenario in space. Even though cooperation and diplomacy are the idealistic way of exploring space, competition has always been the main driving factor behind the progress of humanity. Recognizing the importance space will play in the future of our civilization, there are private space companies being established every year. More nations are adopting cooperative mechanisms to also reach the stars with the help of traditional space faring actors or already well established commercial launchers. The outer space international relations setting, is becoming more complex and competitive every day. In order for China to continue gaining new heights through its Space program, it needs to continue showing flexibility and ingenuity when creating new technologies and implementing new policies. So far the model used by China has worked successfully, nevertheless the future will be different and this is why resilience is essential in space. In the long run, a mix of cooperation and competition will probably be the future of space relations. Smaller nation states and newly established private companies will look for partnership, whilst the traditional space nations and big space corporations will look for competition to maximize their power and resources. In any event, only time will tell how the space scene develops.

Bibliography

Al-Rodhan 2018: Al-Rodhan, Nayef. Space traffic control: technological means and governance implications, 2018, <https://www.thespacereview.com/article/3473/1>

Bridges 2020: Bridges, John. Chang'e 5: China launches sample return mission to the moon – is it winning the new space race?, SpaceNews.com, 2020, <https://www.space.com/change-5-china-moon-sample-return-mission-to-the-moon-winning-new-space-race>

Burton & Stokes 2018: Burton Rachael & Stokes, Mark. The People's Liberation Army Strategic Support Force Leadership and Structure, Project 2049 Institute, 2018, <https://project2049.net/wp-content/uploads/2018/09/180925_PLA_SSF_Leadership-and-Structure_Stokes_Burton.pdf>

CAS 2007: Chinese Academy of Sciences, Zhao Jiuzhang and China Satellite, CAS, 2007 <https://web.archive.org/web/20080314030932/http://www.cas.ac.cn/html/Dir/2007/10/16/15/33/09.htm>

[42] US Congress, H.R.2262 – U.S. Commercial Space Launch Competitiveness Act, 2015 <https://www.congress.gov/bill/114th-congress/house-bill/2262>

CAS 2020: Chinese Academy of Sciences, Introduction – About us, Profile, 2020, <http://english.cas.cn/about_us/introduction/201501/t20150114_135284.shtml>

CASC 2020: Chinese Aerospace Science and Technology Corporation, About CASC, Company profile, 2020, <http://english.spacechina.com/n16421/n17138/n17229/index.html>

CASI 2020: China Aerospace Studies Institute. PLA Aerospace Power – A primer's trend on Chinese Military Air, Space and Missile Forces, 2020, <https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/PLAAF/CASI_Primer%202017.pdf>

CASIC 2020: Chinese Aerospace Science and Industry Corporation. Introduction of CASIC, 2020, <http://www.casic.com/n189298/n189314/index.html>

Chunsi 2008: Chunsi, Wu. China's Outer Space Activities: Motivations, Goals, and Policy, Strategic Analysis 32:4, 2008, pp. 622 – 623.

CGWIS 2020: China Great Wall Industry Corporation, Company Profile, About us, 2020, <http://www.cgwic.com/About/index.html>

CNSA 2020: Chinese National Space Agency, Institutional functions, 2020, <http://www.cnsa.gov.cn/n6758821/index.html#w_two>

Cheek 2015: Cheek, Timothy. The Intellectual in Modern Chinese History, Cambridge University Press, Cambridge, 2015, p. 153.

Curcio & Lan 2018: Curcio, Blaine & Lan, Tianyi. Analysis | The rise of China's private space industry, Space News, 2018, <https://spacenews.com/analysis-the-rise-of-chinas-private-space-industry/>

David 2011: David, Leonard. China Details Ambitious Space Station Goals, 2011, <https://www.space.com/11048-china-space-station-plans-details.html>

Drozhaschchikh 2018: Drozhaschchikh, Evgeniia. China's National Space Program and the "China Dream", Astropolitics, 16:3, 2018, pp. 175 – 186.

Edwards 2019: Edwards, Christian. State-owned media is pitching China's latest hypersonic missiles and laser weapons to the global arms market, Business Insider, 2019, <https://www.businessinsider.com/chinas-latest-laser-weapons-are-ready-for-the-arms-market-state-media-2019-1>

Futron 2003: Futron Corporation, China and the Second Space Age, 2003 p. 7 <https://web.archive.org/web/20120419165427/http://www.futron.com/upload/wysiwyg/Resources/Whitepapers/China_n_%20Second_Space_Age_1003.pdf>

Goh 2017: Goh, Deyana. The life of Qian Xuesen, father of China's space programme, SpaceTech Asia, 2017, <https://www.spacetechasia.com/qian-xuesen-father-of-the-chinese-space-programme/>

Goh 2018: Goh, Deyana. Interview: One Space CEO on its progress, plans, and China's space industry, SpaceTech.com, 2018, <https://www.spacetechasia.com/interview-one-space-ceo-on-its-progress-plans-and-chinas-space-industry/>

Li 2007: Li, Xiaobing. A History of the Modern Chinese Army, University Press of Kentucky, 2007, pp. 150 – 151.

Lewis & Di 1992: Lewis, John Wilson & Di, Hua. China's Ballistic Missile Programs – Technologies, Strategies, Goals, International Security, Fall, vol. 17 no. 2, 1992, <https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/china%27s_ballistic_missile_programs.pdf>

Logan 2007: Logan, Jeffrey. China's Space Program: Options for U.S.-China Cooperation, ResearchGate, 2007, <https://www.researchgate.net/publication/235194510_China's_Space_Program_Options_for_US-China_Cooperation>

McDowell 2020: McDowell, Jonathan. "Satellite Catalog", Jonathan's Space Page, 2020, <http://planet4589.org/space/log/satcat.txt>

Norris & Kristensen 2006: Norris, Robert. & Kristensen, Hans. U.S. nuclear threats: Then and Now, Bulletin of the Atomic Scientists. 62 (5), 2006, pp. 69 – 71.

NTI 2013: Nuclear Threat Initiative, Facilities, China, 2013, <https://www.nti.org/learn/countries/china/facilities/>

PieSAT 2020: PieSAT. Company Profile, About us, PieSAT Information Technology, 2020, <http://www.piesat.cn/en/ABOUTUS.html>

SCIO 2016: State Council The People's Republic of China, White Paper on Chinese Space Activities, Information Office of the State Council, 2016, <http://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm>

Shipping 2008: Shipping. Tang. From Offensive to Defensive Realism: A Social Evolutionary Interpretation of China's Security Strategy", in China's Ascent: Power, Security, and the Future of International Politics, ed. by Robert S. Ross and Feng Zhu, Cornell University Press, 2008, p. 12, <http://www3.ntu.edu.sg/rsis/publications/SSIS/SSIS003.pdf>

Stokes, Alvarado, Weinstein, & Easton 2020: Stokes, Mark. Alvarado, Gabriel. Weinstein, Emily. & Easton, Ian. China's Space and Counterspace Capabilities and Activities, 2020, p. 67, <https://www.uscc.gov/sites/default/files/2020-05/China_Space_and_Counterspace_Activities.pdf>

Sullivan & Liu-Sullivan 2015: Sullivan, Lawrence. & Liu-Sullivan, Nancy. Historical Dictionary of Science and Technology in Modern China, Rowman & Littlefield, 2015, pp. 283 – 342, <https://archive.org/details/rocketmanstoryof00stre/page/n7>

Taylor 1975: Taylor, Stuart. Lunar Science: a Post-Apollo View, Oxford: Pergamon Press. 1975, p. 64.

People's Daily 2003: President Hu hails successful launch of Shenzhou V, People's Daily Online, 2003, <http://en.people.cn/200310/15/eng20031015_126054.shtml>

Wall 2020: Wall, Mike. Chinas launches ambitious Tianwen – 1 Mars rover mission, SpaceNews.com, 2020 <https://www.space.com/china-tianwen-1-mars-mission-launch.html>

Weiren 2016: Weiren, Wu. China's plans for the Moon, Mars and beyond, BBC News, 2016, <https://www.bbc.com/news/av/world-asia-36085659/china-s-plans-for-the-moon-mars-and-beyond>

Wines 2009: Wines, Michael. Qian Xuesen, Father of China's Space Program, Dies at 98, New York, NY Times, 2009, <https://www.nytimes.com/2009/11/04/world/asia/04qian.html>

Woodyatt 2020: Woodyatt, Amy. China reveals name of Mars mission, which will take place in 'coming months', CNN News, 2020, <https://edition.cnn.com/2020/04/24/china/china-mars-mission-intl-scli-scn/index.html>

Yuandan 2019: Yuandan, Guo. Nine international scientific projects to board China Space Station, 2019, <http://www.globaltimes.cn/content/1154057.shtml>

UN 1967: United Nations, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1975, <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html>

US Congress 2015: United States Congress, H.R.2262 – U.S. Commercial Space Launch Competitiveness Act, 2015 <https://www.congress.gov/bill/114th-congress/house-bill/2262>