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CHINA'S AMBITIONS IN SPACE

The Sky's the Limit

Marc JULIENNE

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Initiative on "European space governance"

This tripartite initiative (Ifri, DGAP, IAI) is intended to provide analysis pertaining to the international space competition and its impact on the European space industry as well as its governance. Through a series of publications and public events, the goal of the initiative is to raise awareness among stakeholders in the European Union on the challenges presented by the transformation of the global space industry. It is coordinated by **Éric-André Martin**, General Secretary of the Study Committee on French-German relations (CERFA) at Ifri.

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Executive Summary

From the dawn of China's space program in the mid-1950s to the ability to build, launch and operate satellites in low Earth and geosynchronous orbits from the 1980s, the People's Republic of China (PRC) is in 2021 a complete space power with autonomous access to outer space and to deep-space exploration.

Today, China is on the verge of building its own space lab in low Earth orbit (LEO), possibly the only orbiting lab in a few years from now. During summer 2020, it launched an ambitious mission to Mars, which could help it catch up with other powers in the exploration of the Red Planet. It is also making rapid progress in its Moon explorations. In January 2019, Beijing achieved its "first world first" by landing a rover on the far side of the Moon, and in December 2020, it succeeded a most delicate mission in recovering lunar samples and returning them to Earth. Its plans are now to establish a lunar base by 2030. Closer to Earth, in the LEO, there are several Chinese projects of space-based internet constellations, albeit at a relatively early stage. Hence, the PRC is no longer an outsider, but an actual challenger to the great powers in space, including the United States (US), although it still lags behind in terms of technology and means, both quantitatively and qualitatively.

China's space doctrine is based on three pillars: national development, military empowerment, and great-power competition. The former two drove China's development in space from the beginning of the program, while the latter is a characteristic that has been particularly intensified in the last few decades. Under President Xi Jinping, outer space is fully integrated in the "China dream of the great rejuvenation of the Chinese nation", whereby outer space must contribute to make the PRC the number one "technological great power" by 2049.

These ambitions, which are presented as peaceful and to the benefit of all mankind, also have their darker side. China's military activities in outer space are mostly unknown, causing anxiety abroad, especially since Beijing destroyed one of its own satellites in 2007, spreading thousands of pieces of debris in space and putting its reliability into question.

China's space institutional landscape is interesting to study, especially because it is not as it appears. The Chinese space agency, the China National Space Administration (CNSA), is in fact a store front for international cooperation. The actual decision-making is to be found in the State Administration for Science, Technology and Industry for National Defense (SASTIND), as well as within the People's Liberation Army (PLA), and especially

the Strategic Support Force. Other actors are instrumental, such as the state-owned aerospace conglomerates (China Aerospace Science and Technology Corporation – CASC – and China Aeropace Science and Industry Corporation – CASIC), as well as the Chinese Academy of Science (CAS) and academia.

The commercial space industry has been a very dynamic sector for the past five years in China, prompting many to call it "new space", as in the US. The Chinese commercial space industry intends to stimulate innovation and create new financing channels; however, the Communist Party (CPC) maintains strict control over aerospace activities. The liberalization of the sector is rather limited and private actors are barely competing with the giant state conglomerates. Looking closely at these new Chinese aerospace entrepreneurs, it appears that most of them come from the traditional aerospace industries or from the military.

Finally, there is a field where Beijing is increasingly active: international forums of space governance. Indeed, now that China is a major space power, it intends to make the most of international space law, while the US seems to have given up this path and gone on its own unilateral way.

We focus in this paper on two case studies. First is the exploitation of space resources, where China holds a wait-and-see position, detached from the opposition between Russia and the US. Russia strongly advocates the opening of negotiations for a new set of regulations, while the US is taking its own unilateral path, signing bilateral agreements with foreign countries to exploit Moon resources, in the framework of the Artemis program. Indeed, China has its own ambitions for the Moon and acknowledges that international law is at a dead end.

Second is the ban on placing weapons in outer space. On this case, Beijing and Moscow – with many supporting countries at the UN – are jointly pressuring Washington to sign a new treaty, which the US has always opposed, along with several Western allies. One side is accused of maintaining strategic hegemony in outer space and threatening other powers in space and on the ground. The other side is accused of trying to hinder the American technological advantage, while in the meantime catching up in the mastering of these technologies and stockpiling ground-based weapons.

Hence, political conflicts on Earth concerning the outer space domain are likely to intensify in the coming years. Besides building national pride and international prestige, space is a strategic field where Beijing needs to fill the technological gap with the US, and where it is searching for US vulnerabilities. The question remains: Where does Europe stand in this strategic landscape?

Résumé

Après plus de 60 ans de recherche et d'innovation erratiques, la République populaire de Chine (RPC) est aujourd'hui une puissance spatiale complète, disposant d'un accès autonome à l'espace extra-atmosphérique et à l'exploration de l'espace lointain.

La Chine est actuellement sur le point de construire son propre laboratoire spatial en orbite basse, potentiellement le seul opérationnel dans quelques années. Au cours de l'été 2020, elle a lancé une ambitieuse mission vers Mars, qui devrait lui permettre de rattraper les autres pays dans l'exploration de la Planète rouge. Elle fait également de rapides progrès dans son programme d'exploration lunaire. En janvier 2019, Pékin a réalisé sa « première première mondiale » en alunissant une astromobile sur la face cachée de la Lune. Et en décembre 2020, elle a réussi une mission des plus délicates en prélevant des échantillons lunaires et en les rapportant sur Terre. Ses ambitions sont maintenant d'établir une base sur la Lune à l'horizon 2030. Plus près de la Terre, bien qu'à un stade encore relativement précoce, plusieurs projets chinois de constellations de satellites en orbite basse sont en développement, pour étendre la couverture Internet mondiale. Ainsi, la RPC n'est plus un *outsider* dans le domaine spatial, mais un véritable compétiteur des grandes puissances établies, y compris les États-Unis, bien qu'elle accuse encore un certain retard en termes de technologies et de moyens.

La doctrine spatiale chinoise repose sur trois piliers principaux : le développement national, l'autonomisation militaire et la compétition entre grandes puissances. Les deux premiers ont guidé le développement spatial de la Chine dès le début du programme, tandis que le troisième est une caractéristique qui s'est particulièrement intensifiée au cours de la dernière décennie. L'espace a été pleinement intégré dans le « rêve chinois de grande renaissance de la nation chinoise », cher au secrétaire général Xi Jinping. Il doit contribuer à faire de la RPC la « grande puissance technologique » mondiale d'ici 2049.

Le paysage institutionnel du spatial en Chine est intéressant à étudier, notamment parce qu'il n'est pas tout à fait ce qu'il paraît. L'agence spatiale chinoise (China National Space Administration – CNSA) est en réalité une vitrine pour la coopération internationale, tandis que la prise de décision proprement dite se trouve au sein de la State Administration for Science,

Technology and Industry for National Defense (SASTIND), ainsi qu'au sein de l'Armée populaire de libération, et en particulier de la Force de soutien stratégique. C'est cette dernière qui opère la plupart des systèmes spatiaux en Chine (centres de lancement, stations de surveillance de l'espace…). D'autres acteurs jouent un rôle déterminant, tels que les industries aérospatiales d'État, la China Aerospace Science and Technology Corporation (CASC) et la China Aeropace Science and Industry Corporation (CASIC), ainsi que l'Académie chinoise des sciences et le monde universitaire plus largement.

Le secteur commercial de l'espace est très dynamique en Chine depuis ces cinq dernières années, ce qui pousse nombre d'observateurs à l'appeler « *new space* », sur le modèle américain. L'industrie spatiale commerciale chinoise cherche à stimuler l'innovation et créer de nouveaux canaux de financement. Cependant, le Parti communiste conserve un contrôle strict sur toutes ces activités. Aussi, la « libéralisation » du secteur est plutôt limitée et la concurrence entre les petits acteurs privés et les géants étatiques est toute relative.

Enfin, un domaine dans lequel Pékin est de plus en plus actif sont les forums internationaux de la gouvernance de l'espace. Maintenant que la Chine est une puissance spatiale majeure, elle entend peser dans les négociations et tirer le meilleur parti du droit international régulant l'espace extra-atmosphérique. Deux sujets l'intéressent particulièrement : l'exploitation des ressources dans l'espace et l'arsenalisation de l'espace.

Les conflits politiques sur Terre concernant le domaine spatial ont tout lieu de s'intensifier dans les années à venir. Outre le renforcement de la fierté nationale et du prestige international, l'espace est un domaine stratégique où Pékin doit combler le fossé technologique avec les États-Unis et où il recherche les vulnérabilités américaines. Dans ce contexte de rivalité croissante, une question demeure : quel rôle jouera l'Europe dans le paysage spatial de demain ?

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Introduction[1]

In January 2019, China achieved global media coverage with the successful landing of the rover Yutu-2 on the far side of the Moon, where no-one had ever landed before. In December 2020, China recovered lunar samples thanks to the *Chang'e 5* robotic mission, the first time a country has succeeded in doing so since the Americans and Soviets in the 1970s. And, in July 2020, China launched the ambitious *Tianwen-1* mission to Mars, expecting to succeed – on the first attempt – in orbiting the "red planet", land on it, and deploy a rover. Clearly, China is today one of the major powers in space. This is precisely why it is so essential to better understand the nature and ambitions of the Chinese space program.

In this paper, we intend, first, to study China's space doctrine in order to identify the main political guidelines that drive the program. Secondly, to better understand the organization of Chinese space activities, it is worth exploring the institutional landscape of the Chinese space sector, identifying the role of traditional civilian and military actors, and also the role of new private stakeholders in the rising field of commercial space. It appears that, whatever the sector or the nature of the stakeholders, the Communist Party of China (CPC) is key in the decision-making and orientation of the program. Thirdly, we will review some of the major technical and scientific achievements China has demonstrated in these past twenty years, from low Earth orbit to deep-space exploration. Finally, back on Earth, we will examine China's desire to influence international space regulations, to better preserve its interests and ambitions in outer space, especially in terms of resources exploitation and placement of weapons in orbit.

Outer space is (again) increasingly important in the political, economic and military competition among the great powers down on Earth. Therefore, it is a domain to be watched closely, and towards which powers are building up their own strategy – including, hopefully, Europe.

1. The author warmly thanks Isabelle Sourbès-Verger, Lucie Sénéchal-Perrouault and Jean Deville for enriching discussions and comments. He extends his thanks to Sophie Hanck for the precious help in the research work.

China's Space Policy: The Path to Power

China's space program was born in the mid-1950s, originally motivated by the development of a nuclear weapon and a ballistic missile. What was later called the "Two Bombs, One Satellite" (两弹一星) project was achieved with the atomic bomb (1964), the hydrogen bomb (1967) and the first satellite launched in April 1970, the Dong Fang Hong 1 (DFH-1) or East Is Red 1, aboard the first civilian launcher, the Chang Zheng-1 (CZ-1 or Long March 1). China thus became the fifth country capable of putting a satellite into orbit, after the USSR, the US, France and Japan.

By the 1980s, the People's Republic of China (PRC) had gained the ability to independently build, launch and operate satellites in low Earth and geosynchronous orbits, as well as to recover a satellite after atmospheric reentry. Although China's troubled history during the Mao era slowed down parts of the program, the Communist Party (CPC) leadership was always determined that China would become a major space power, for three main reasons.

The three pillars of China's space doctrine: national development, military empowerment, great-power competition

As long as China was trying to catch up with the great powers in space, the two main drivers of the space program were national development and military empowerment. Programs were selected, and (limited) budgets dedicated, according to their social or military fallouts, which were expected to be significant. This is why, for instance, ballistic missile and satellite development was favored over human space flight in the late 1970s – as China's white paper on Space Activities implied in 2000: "The aims and principles of China's space activities are determined by their important status and function in protecting China's national interests and implementing the state's development strategy".[2] Therefore, China had to select a "limited number of projects that [were] of vital significance to the

2. China's white paper on Space Activities, 2000.

national economy and social development" and "explore a more economical and efficient development road for its space activities".[3]

In this first white paper on Space Activities, China set out the main principles of its space policy, in accordance with international treaties' principles of the peaceful use of space. These principles are that space activities support the national "comprehensive development strategy" and serve "peaceful purposes and benefit the whole of mankind".[4] China's aims in space are defined as follow: "to promote mankind's civilization and social progress, to meet the growing demands of economic construction, national security, science and technology development and social progress, to protect China's national interests and build up the comprehensive national strength".[5]

It is interesting to note the constant twofold argument that space activities are to be used to both enhance national security and military capability and to contribute to the "peace of "the whole of mankind". This is a narrative that we find in other components of China's rising power, such as navy build-up and cyber capacity development. This rhetorical effort, labeled "peaceful rise" under Hu Jintao's presidency, attempts to obviate any fears that China's rise may provoke in other countries.

Such concerns are particularly present in the space domain because of the high duality of space technology for civilian and military use. This is reinforced by the substantial role played by the military in managing space activities.

Less officially promoted, China uses space achievement as a benchmark of prestige and power on the international stage. Space capabilities have always been an asset of great-power competition, especially between the US and the USSR during the Cold War. While this was always true in China as well, this dimension took a more decisive role from the 1990s on, when investment in the space industry and the number of scientists and engineers engaged in space activities grew rapidly. Consequently, China has been able to be less selective and work on many different programs at the same time, and progress faster than in the previous decades. This materialized into greater focus on science and space exploration (manned spaceflight, Moon, Mars, deep-space observation). Today, China is no longer an outsider in these domains, but an actual challenger to the other great powers for space dominance.

President Xi Jinping has pushed this feature forward since his took over in late 2012. His signature concept upon his arrival was the "China dream of the great rejuvenation of the Chinese nation". In his view, science, and

3. *Ibid.*
4. *Ibid.*
5. *Ibid.*

especially space science, have laid "an important foundation for China as a major country with world influence".[6] Xi believes that China must become a "technological great power" (科技强国), and "must lead the world in terms of technological innovation": "We must try hard to catch up, catch up, and strive to surpass".

The dark side of Chinese space activities

China remains very secretive about its military activities in space. White papers never detail military programs, although China does not deny having these. In the 2015 white paper on Military Strategy, China attributed the "weaponization" of space to the US. It stated that China intended to "deal with security threats and challenges in that domain, and secure its space assets to serve its national economic and social development, and maintain outer space security".[7] Beijing does not exclude any technology that can guarantee its national security in the context of this "weaponization".

China, indeed, has many space military programs, such as intelligence satellites, an early-warning constellation, and several counterspace technologies. In this latter field, China is working on different destructive and non-destructive approaches, such as kinetic antisatellite interceptors, electronic warfare, cyber warfare, directed energy, and co-orbital operations.[8]

In January 2007, China demonstrated its capability in terms of kinetic antisatellite interceptors, by shooting down one of its own satellites in low Earth orbit (LEO). From this successful test, about which the international space community was not informed, resulted thousands of pieces of debris, endangering every object orbiting in LEO. China has conducted at least two more antisatellite tests since then, although non-destructive, in 2013 and 2014.

China is not the only country to have conducted destructive antisatellite (ASAT) tests. The US (which has mastered this technology since the 1960s) conducted such a test exactly one year after China, while India did so in March 2019, the last one to date. The US ASAT test was often seen as a way for Washington to show Beijing that it was still fully capable of and ready for such an operation. The main difference between the Chinese test and those of the US and India is altitude: 850 km for the Chinese satellite, around 250 km for

6. Xi Jinping, "Speech at the 17th Academician Conference of the Chinese Academy of Sciences and the 12th Academician Conference of the Chinese Academy of Engineering" (在中国科学院第十七次院士大会、中国工程院第十二次院士大会上的讲话), *People's Daily*, 9 June 2014, available at: http://politics.people.com.cn.
7. China's Military Strategy, 2015.
8. See B. Weeden, "Current and Future Trends in Chinese Counterspace Capabilities", *Proliferation Papers*, No. 62, Ifri, November 2020.

the other two. As a result, debris created by the Chinese test will keep orbiting around Earth for several decades, while the American and Indian debris would have reentered the atmosphere within a couple of months.[9] China thus seriously undermined international confidence in its behavior in space.

Interestingly, in the white paper on Space Activities that followed the ASAT test (published in 2011), China reiterated, with even more emphasis, its responsible behavior in space and the peaceful use of outer space: "The country develops and utilizes space resources in a prudent manner and takes effective measures to protect the space environment, ensuring that its space activities benefit the whole of mankind". For the first time in this kind of document, China "oppose[d] weaponization or any arms race in outer space".[10] Furthermore, it gave unprecedented attention to debris management, with 18 occurrences in 2011, compared to 3 and 5 occurrences in 2000 and 2006 respectively.

Debris management has indeed become another topic of suspicion, since China has effectively enhanced the development of co-orbital technologies, in the perspective of conducting space debris removal missions. It conducted five tests of co-orbital operations between 2010 and 2019, consisting of the maneuver of a satellite closer to another orbiting object, with the purpose of inspecting, seizing or removing it from its orbit with the help of a robotic arm. Although it is useful to clean up LEO (for rather large pieces of debris only, however), it is a *de facto* dual technology, as it may well be used to destroy, spy on or sabotage foreign satellites. This, of course, is also true for any other space power. The placement of weapons in outer space, the development of ground-based counterspace weapons and dual-use orbiting technologies are today among the main sources of tensions between major space powers. It is, therefore, one of the core stumbling blocks in the UN work on legislating space, as we will examine in the last section of the paper.

9. J. Mackey, "Recent US and Chinese Antisatellite Activities", *Air & Space Power Journal*, No. 155, 2009.
10. "Weaponization of Outer Space" was mentioned for the first time in 2011 in the White Paper on Space Activities, but it has been regularly referred to in Defense white papers since the early 2000's.

Chinese Space Institutional Landscape

The Chinese space landscape is at the same time heterogeneous and homogeneous. It is heterogeneous because it includes civilian and military institutions, public and private actors. It is homogeneous because people from different backgrounds work together and often move from one sector to another. For instance, it is common for a Chinese engineer to be trained in a military engineering school, to start his career in a defense SOE, then be transferred to a state administration position; and, for some, it is even possible to eventually enter politics at the municipality, provincial or national level. The relationship between the civilian and military sectors has always been very tight, and this trend is expanding today with the ongoing "civil-military fusion" policy.

In China, ministries and state agencies supervise the sound fulfillment of science and technology orientations, the management of specific space programs, international cooperation in space, and the financial management of aerospace state-owned enterprises (SOEs). Research and development (R&D) is undertaken by the China Academy of Science (CAS), academia, the SOEs, and the People's Liberation Army (PLA), which is also the main end user. Indeed, the PLA is the main operator of space assets, such as the launching sites and space tracking and telemetry centers. Above all, it is the CPC Standing Committee and the Central Military Commission (CMC), both headed by Secretary General Xi Jinping, who ultimately decide the strategic orientations of China's space program.

CNSA: the storefront of China's space program

The Chinese space agency is the China National Space Administration (CNSA, 国家航天局), established in 1993. It is self-presented as the country's "governmental organization responsible for the management of space activities for civilian use and international space cooperation with other countries".[11]

11. CNSA website: www.cnsa.gov.cn.

The main purpose of the CNSA is to become the equivalent to the American NASA, the French CNES or the European Space Agency (ESA), in order to facilitate and promote inter-agency dialogue and cooperation.[12] But, contrary to other space agencies, the CNSA has little policy leverage on the space program; it is rather intended for space diplomacy, to promote China's achievements, emphasize the peaceful means of its program, and seek for new partners and customers. Certainly, the CNSA is rather low in the bureaucratic hierarchy. It is placed under the supervision of the State Administration for Science, Technology and Industry for National Defense (SASTIND), which is itself under the control of the Ministry of Industry and Information Technology (MIIT).[13] Nonetheless, the director of the CNSA is also director of SASTIND, currently Zhang Kejian.

State Administration for Science, Technology and Industry for National Defense (SASTIND)

The State Administration for Science, Technology and Industry for National Defense (SASTIND, 国防科工局) is the nerve center of the China space program. It has its origins in the early years of the China space program. Its ancestor was the Committee on Science and Technology for National Defense (CSTND), created in April 1956 at Zhou Enlai's initiative. It was tasked to supervise the aerospace and nuclear industries, and later on, all defense industries. It became the COSTIND (Commission on Science, Technology and Industry for National Defense) in 1982, and was fully civilianized in 1998, as the PLA General Armaments Department (GAD) was established and took over military procurement and science and technology (S&T). In 2008, a new reform established the MIIT under the State Council, and the COSTIND became the SASTIND. Its responsibility remains significant, however, in overseeing S&T development in the defense industry, including aerospace.

It is important to note that the SASTIND is headed by people who are all engineers with substantial experience in defense SOEs. For example, the current director, Zhang Kejian, is a nuclear physicist, who was trained at the National University of Defense Technology (under the PLA), and spent most of his career within the nuclear arms development industry, the China Academy of Engineering Physics (CAEP), which he headed from 2007 to

12. I. Sourbès-Verger and D. Borel, *Un empire très celeste. La Chine à la conquête de l'espace*, Paris: Dunod, 2008, pp. 115-116.
13. F. Gaillard-Sborowsky, E. Puig and I. Sourbès-Verger, "Analyse comparée de la stratégie spatiale des pays émergents : Brésil, Inde, Chine", *Étude de l'IRSEM*, No. 15, 2012, pp.94-99.

2015. He then joined SASTIND, taking up various positions, before becoming director in 2018, being concurrently vice-minister of the MIIT and director of the China Atomic Energy Agency (CAEA). It is likely that he will pursue his career in politics, like his predecessors Chen Qiufa (2008-2013), Ma Xingrui (2013-2014) and Xu Dazhe (2014-2016). All of them are today heading provinces (Liaoning, Guangdong and Hunan, respectively). SASTIND deputy directors are similarly trained in NUDT or other civilian engineering schools; they made their career in the aerospace, aeronautical or ordnance industries, ascending towards higher managerial positions, before joining SASTIND (or COSTIND before 2008).

The People's Liberation Army (PLA)

The People's Liberation Army (PLA) remains a crucial actor within the Chinese space program, and its role seems to have even grown these past few years. Indeed, resulting from the major reform of the PLA in late 2015, the Strategic Support Force (PLASSF), which took over space activities, was established, under the direct leadership of the CMC.

According to Mark Stokes *et al.*, the PLASSF has gathered all space activities, from S&T and procurement in close relations with the SASTIND and the industries, to operations and training.[14] It seems, however, that the new CMC Equipment Development Department and the CMC S&T Committee, both established on the remains of the former GAD, maintain a significant supervising role over military S&T and procurement.

More exactly, within the PLASSF, the Space Systems Department is commanding space activities. While the CSNA is the storefront of the China space program, the PLASSF Space Systems Department (SSD) is now the main operator of Chinese space systems. The SSD controls China's four launching sites, the China Launch and Tracking Control General (CLTC), the Xi'an Satellite Tracking and Control Center, the Beijing Space Flight Command and Control Center, most of the other land-based space tracking and control stations in China and abroad, as well as the fleet of four Yuanwang-class space tracking and telemetry ships.[15]

14. M. Stokes, G. Alvaro, E. Weinstein and I. Easton, *China's Space and Counterspace Capabilities and Activities*, Report to the US-China Economic and Security Review Commission (USCC), 30 March 2020, p. 21.

15. "Three Yuanwang Survey Ships Jointly Escorted the 'Tianwen' Fire Detection in the Pacific" (3艘远望号测量船太平洋上联手护送"天问"探火), *Xinhua*, 23 July 2020, available at: www.xinhuanet.com; "The Yuanwang 7 Ship Went to the Atlantic for the First Time to Perform Maritime Measurement and Control Missions" (远望7号船首次赴大西洋执行海上测控任务), *Xinhua*, 28 February 2020, available at: www.xinhuanet.com.

The PLA also has the upper hand when it comes to the manned space program. The current head of the China Manned Space Engineering (CMS), the agency that leads the program, is General Li Shangfu (李尚福), who is also the director of the CMC Equipment Development Department, the PLA procurement entity.[16] One of the deputy directors of the CMS is Lieutenant General Shang Hong (尚宏), Commander of the PLASSF SSD.

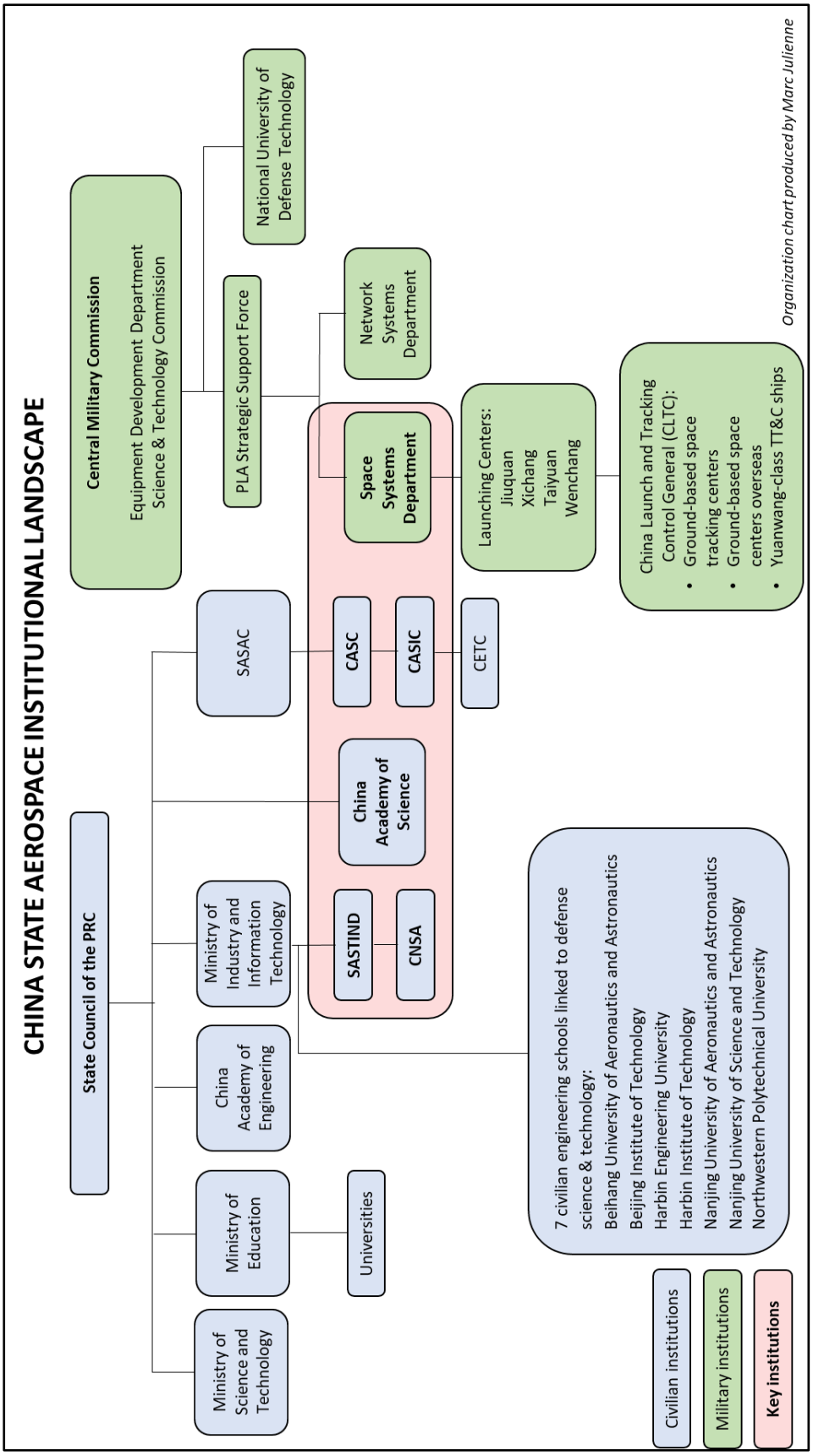
The two pillars of China's space industry: CASC & CASIC

China's aerospace SOEs are the backbone of the space program. All political aspirations in space are framed by the industry technological and production capabilities. In this domain, China is well endowed, with two giant state-owned aerospace groups: the China Aerospace Science and Technology Corporation (CASC) and China Aerospace Science and Industry Corporation (CASIC). Like any other state-owned enterprises, both conglomerates are under the leadership of the State-owned Assets Supervision and Administration Commission (SASAC) of the State Council.

CASC is the main constructor of launchers (especially heavyweight ones). It produces the entire Long March series, all Chinese spacecraft and most Chinese satellites. It also operates on the international space market. Its commercial subsidiary, China Great Wall Industry Corporation (CGWIC), sells satellites and has provided launch services to private companies and foreign countries since the late 1980s. Its catalogue includes the telecommunication satellite DFH-4 and the Earth observation satellite CAST 2000. Its clients are mainly developing countries, such as Belarus, Bolivia, Brazil, Cambodia, Ethiopia, Laos, Nigeria, Pakistan, Sri Lanka, Turkey and Venezuela.

CASIC, for its part, produces the Kuaizhou light launcher series, as well as various satellites. It is currently expanding its catalogue with several LEO telecommunication satellite programs (see infra). CASIC doesn't have a specific commercial subsidiary for space systems and services,[17] but has established a commercial subsidiary, ExPace, to develop light launchers, which leads us to what one might call the Chinese "New Space".

16. For CMS leadership see: www.cmse.gov.cn.
17. CASIC has a commercial subsidiary – China Precision Machinery Import Export Corporation (CMPIEC) – but only for arms export.


CHINA STATE AEROSPACE INSTITUTIONAL LANDSCAPE
State Council of the PRC
Central Military Commission
Equipment Development Department
Science & Technology Commission
National University of Defense Technology
PLA Strategic Support Force
Network Systems Department
Space Systems Department
Launching Centers:
Jiuquan
Xichang
Taiyuan
Wenchang
China Launch and Tracking Control General (CLTC):
• Ground-based space tracking centers
• Ground-based space centers overseas
• Yuanwang-class TT&C ships
SASAC
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CASIC
CETC
China Academy of Science
SASTIND
CNSA
Ministry of Industry and Information Technology
China Academy of Engineering
Ministry of Education
Universities
Ministry of Science and Technology
7 civilian engineering schools linked to defense science & technology:
Beihang University of Aeronautics and Astronautics
Beijing Institute of Technology
Harbin Engineering University
Harbin Institute of Technology
Nanjing University of Aeronautics and Astronautics
Nanjing University of Science and Technology
Northwestern Polytechnical University
Civilian institutions
Military institutions
Key institutions
Organization chart produced by Marc Julienne

Commercial space: the "New Space" with Chinese characteristics

The concept of New Space that arose in the US in the 2000s[18] is now often used to talk about the emergence of private companies in the space sector in China. To what extent does the comparison hold? China's commercial space sector is both an old and a new phenomenon. It is an old phenomenon because, as mentioned above, the CGWIC has been operating since the 1980s, and also because the COSTIND released the "Interim Measures for the Administration of Licenses for Civil Space Launch Projects" in December 2002, in order to grant access to civilian companies.[19] Hence, as early as the late 1990s and early 2000's, Chinese private companies were established to provide Earth observation data analytics, satellite and components manufacturing (Zhuhai Orbita, 21AT, Space Eye). The new trend in the Chinese space sector is the entrance of many start-ups in recent years on the upstream segment: launcher and satellite manufacturing. Among them the most notorious ones are LinkSpace (2014), One Space (2015), Land Space (2015) and iSpace (2016).

This trend was made possible thanks to the firm support of the central government. Indeed, the "Guiding Opinion of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment" (also called Document 60), published in November 2014, aimed at modernizing the financing channels into strategic sectors, such as environment protection, agriculture, transportation, energy, and space. Article 24 provides that the government: "Encourages private capital to participate in the construction of national civil space infrastructure".[20] This encouragement was reiterated in China's 2016 white paper on Space Activities: "Nongovernmental capital and other social sectors are encouraged to participate in space-related activities, including scientific research and production, space infrastructure, space information products and services, and use of satellites to increase the level of commercialization of the space industry."[21]

According to a report by the American IDA Science and Technology Policy Institute in 2019, there are 78 commercial space companies in China

18. See X. Pasco, *Le nouvel âge spatial, de la guerre froide au New Space*, Paris : CNRS Éditions, 2017.
19. Interim Measures for the Administration of Licenses for Civil Space Launch Projects (民用航天发射项目许可证管理暂行办法), COSTIND, 21 December 2002, available at: www.miit.gov.cn.
20. Guiding Opinion of the State Council on Innovating the Investment and Financing Mechanisms in Key Areas and Encouraging Social Investment (国务院关于创新重点领域投融资机制鼓励社会投资的指导意见), State Council of the PRC, 26 November 2014, available at: www.gov.cn.
21. China's White Paper on Space Activities in 2016.

involved in satellite manufacturing, launch, remote-sensing operation, communication, ground stations, and downstream analytics. Among them 49 were established after 2014, illustrating the reality of this new trend. Most Chinese commercial space companies are privately owned (71% are start-ups or subsidiaries of private companies), the rest are CAS or university spin-offs, or SOEs subsidiaries.[22]

Private companies and traditional SOEs on the Chinese space market are hardly in competition. First, private companies usually develop one or two specific technologies with rather limited budgets. The risk is therefore very high because their middle-term business model is to rely on market demand. Many of these start-ups may well collapse in the years to come, for not being profitable. On the contrary, SOEs benefit from significant state budgets, regardless of their profits. Secondly, whether it be SOEs, CAS spin-offs, private companies' subsidiaries or start-ups, their activity is always authorized and controlled by the central government through the SASTIND. The Chinese central government supports the development of commercial companies in order to try new ways of attracting investments and stimulating innovation for the benefit of the entire nation. That is why Shu Chang, founder and chairman of One Space, talks about "differentiated competition",[23] which in fact means no real competition because start-ups don't work on the same segment as SOEs, and with very different financial capacity.

This "differentiated competition" is even more important in the context of the civil-military fusion policy, promoted by Xi Jinping. Space was clearly referred to in the "Opinion on Promoting the Deep Development of Military-Civilian Integration in National Defense Technology Industry" published by the State Council in November 2017. It called for the speeding-up of "the coordinated construction of space infrastructure, meeting military and civilian needs", as well as the promotion of exports of aerospace equipment and enhancing of international cooperation through the CNSA.[24]

What is more, private space companies may be seen as outsiders in the Chinese market for launchers, but their leadership and engineer teams are true insiders. Most of them come from the inner circle of the aerospace industry. For example, iSpace founder and CEO, Peng Xiaobo (彭小波), is a former director of R&D at the China Academy of Launch Vehicle Technology (CALT), CASC's first academy. His vice-president is Yao Bowen (姚博文),

22. I. Liu *et al.*, *Evaluation of China's Commercial Space Sector*, Institute for Defense Analysis, Science & Technology Policy Institute, September 2019, pp. 28-40.
23. Quoted in L. Sénéchal Perrouault and C. Liffran, "Lanceurs commerciaux chinois : nouveaux acteurs, cadre, dynamiques", Asia Centre, 28 October 2019.
24. "Opinion on Promoting the Deep Development of Military-Civilian Integration in National Defense Technology Industry" (关于推动国防科技工业军民融合深度发展的意见), Information Office of the State Council, 23 November 2017, available at: www.gov.cn.

former engineer at CALT, son of a CALT engineer and married to a CALT engineer.[25] Liu Baiqi (刘百奇), founder of Galactic Energy, a launch-provider private company established in 2018, received his PhD from Beijing University of Aeronautics and Astronautics (BUAA) where he taught for a few years before joining CALT.[26] The founder of Deep Blue Aerospace, Huo Liang (霍亮), received his PhD from Tsinghua and worked at CASIC.

Two of the major Chinese commercial start-ups, Land Space and One Space, present a slightly different profile in that their founders have management and financial backgrounds instead of full aerospace engineering training. Land Space's Zhang Changwu (张昌武) received an MBA from Tsinghua and worked for HSBC and the Spanish bank Santander.[27] He is, however, assisted by Wu Shufan (吴树范), a PhD from Nanjing University of Aeronautics and Astronautics (NUAA) with 15-year experience at the European Space Agency (ESA), as well as Wang Jianmeng (王建蒙), a space launch veteran from the PLA who contributed to the construction of the Xichang launch site and who worked at the Beijing satellite launch command center.[28] One Space's founder, Shu Chang (舒畅), has a bachelor's in aircraft design from BUAA and a master's degree in Economics from Beijing University. He worked for CASC's investment funds, as well as for Legend Holding, before establishing One Space, together with Ma Chao (马超), a PhD from BUAA and a former CALT engineer.[29]

Liang Jianjun (梁建军), the founding chairman of Space Trek, has worked for 20 years at the Academy of Equipment Research of the PLA Second Artillery Force (now the PLA Rocket Army), responsible for conventional and nuclear ballistic missiles.[30] Aside from a couple of civilian launchers, his company also produces and sells two types of ballistic missiles (D140 and D200) – even though it is rather uncommon for a private company to produce and sell weapons.

In this rather mainstream ecosystem, Link Space, founded in January 2014 as the first private rocket company, holds a very special position. Its

25. "Exclusive Interview. Yao Bowen: Entering Interstellar Glory Orbit" (独家访谈. 姚博文：入轨的星际荣耀), *Caijing Times*, 6 June 2019, available at: https://tfcaijing.com.
26. "Interview with Liu Baiqi: Providing Reliable and Cheap Commercial Rockets for Orbiting 6G Space Internet" (专访刘百奇：围绕6G太空互联网提供可靠廉价的商业火箭), *The Paper*, 21 July 2019, available at: www.thepaper.cn.
27. IT Tangerine (IT桔子): www.itjuzi.com.
28. "Wang Jianmeng: Finding Ways to Learn More" (王建蒙：想方设法多学知识), *Tsinghua News*, 24 April 2018, available at: https://news.tsinghua.edu.cn.
29. "Shu Chang: The 'post-85' Kid Who Builds Rockets" (舒畅：造火箭的"85后"小伙儿), *Qianlong.com*, 12 June 2018, available at: http://beijing.qianlong.com.
30. "Space Trek's Liang Jianjun: Using the Aerospace Backbone Talent Echelon to Build a High-Level Commercial Launch Vehicle" (星途探索梁建军：用航天骨干型人才梯队，打造高水准商业运载火箭), *OFweek*, 15 January 2020, available at: https://mp.ofweek.com.

founder Hu Zhenyu (胡振宇) was born in 1993. The "Genius Rocket Boy", as the media call him, did not graduate from one of the top Chinese engineering schools, but from the South China University of Technology in Guangzhou. He founded Link Space together with Yan Chengyi (嚴成義), a PhD Candidate at Tsinghua University at that time, and Wu Xiaofei (吴小飞), a senior mechanical engineer with no university degree but with extensive experience in liquid fuel rocket engines.[31] The three of them were born in the 1990s.[32] This very uncommon business profile may explain the change of leadership in May 2019, when Hu Zhenyu stepped down from CEO to COO, and left his chair to Chu Longfei (楚龙飞), a PhD from BUAA and a former engineer from CALT.[33]

Aerospace startups	Founders & board members	Institution of origin
iSPACE	PENG Xiaobo	CASC
	YAO Bowen	CASC
星河动力 GALACTIC ENERGY	LIU Baiqi	Beihang University - CASC
深蓝航天	HUO Liang	Tsinghua University - CASIC
LANDSPACE	ZHANG Changwu	Tsinghua University
	WU Shufan	Nanjing University of Aeronautics and Astronautics
	WANG Jianmeng	PLA
ONE SPACE	SHU Chang	Beihang University - CASC
	MA Chao	Beihang University - CASC
SPACE TRUS	LIANG Jianjun	PLA
LINK SPACE AEROSPACE TECHNOLOGY GROUP	HU Zhenyu	South China University of Technology
	YAN Chengyi	Tsinghua University
	WU Xiaofei	N/A
	CHU Lengfei	Beihang University - CASC

31. "A 1990s-Born Young Man Who Builds Rockets: Did Not Go to College and Built a Reusable Rocket with His Team" (造火箭的90后少年：没上过大学 和团队造出可回收火箭), *Sohu*, 25 April 2019, available at: www.sohu.com.
32. "China's First Private Rocket Firm Aims for Market", *Space Daily*, 19 August 2014, available at: www.spacedaily.com.
33. "Behind the Ups and Downs of the "Genius Rocket Boy": There Is No 'Superhero' in China's Private Space" ("天才火箭少年"的浮沉背后：中国民营航天没有"超级英雄"), *Caijing Times*, 11 June 2020, available at: www.tfcaijing.com.

The Chinese landscape of commercial space has been highly dynamic over the past five years. Yet, it remains very different from the US New Space ecosystem, led by SpaceX and Blue Origin. The capitalization of private Chinese companies in the space sector is significantly lower than that of the American counterparts, to the point of no comparison, and their ambitions are still rather limited. Elon Musk and Jeff Bezos have their personal ambitions in space – the conquest of Mars for the former, and the exploitation of space resources for the latter –, while Chinese commercial space companies aim at producing and selling launchers and satellites, as well as launching satellite constellations. Indeed, in CPC-led China, wherein state capitalism is officially described by the motto "the government leads, the market operates" (政府引导，市场运作), it is very unlikely to witness the development of a free and autonomous private space sector.

China's Achievements and Ambitions in Space: The Great Catch-Up

China expanded and modernized its space infrastructure and space carriers, allowing it to broaden its ambitions in space exploration towards manned missions, the Moon and Mars. Back on Earth, space also provides solutions for national development and Internet coverage.

Manned missions: from the first taikonaut to the space station

In order to catch up with the great space powers, China officially launched its own manned space program in September 1992, under Project 921. The central government approved the "Three Steps" development strategy for manned spaceflight (三步走"的发展战略). Step one was to build a spaceship. Step two was to put in orbit a manned space lab, which includes mastering the technology of extra-vehicular activity (EVA), rendezvous and docking, as well as the launch of the space lab. And step three is the space station.[34] The China Manned Space Engineering Office (CMSE) was established to supervise the program.

Between 1999 and 2003, four unmanned flight tests of the Shenzhou spaceship were conducted, and, in October 2003, China successfully put its first taikonaut, Yang Liwei, in orbit, on board Shenzhou 5. China thus became the third country to put a human in orbit (while it was the fifth to put a satellite in orbit), although it was achieved roughly four decades after the USSR and the US. Exactly two years later, in October 2005, China launched its second manned mission, with two taikonauts. Then again in September 2008, three taikonauts boarded Shenzhou 7, and two of them engaged in the first extra-vehicular activity (EVA). The following mission in November 2011 was a big step forward on China's path to permanent space lab. The unmanned Shenzhou 8 spacecraft automatically proceeded to rendezvous and docking with Tiangong-1, China's first space module. Two crews boarded the station for a few days in 2012 and 2013, before it was

34. Official Document from CMSEO.

decommissioned. The Chinese second space lab, Tiangong-2, launched in September 2016, has helped develop the Tianzhou-1 cargo ship, necessary for long-term manned missions.

China has thus successfully accomplished the first two steps of its strategy for manned spaceflight. The third step ahead is to launch and assemble the three modules of the future Chinese space station, the Tiangong-3. According to the CMSE, the station will be completed around 2022, now that the Long March-5B (LM-5B) launcher is operational after several setbacks.[35] Tiangong-3 is planned to have a ten-year lifespan and to permanently host crews for scientific experiments.

In the quest for power in space, the Tiangong-3 space lab could become a turning point for China, considering the more than uncertain future of the aging International Space Station (ISS) after 2025. Neither the Americans nor the Russians show any interest in paying the high cost of maintaining it in operational condition. On the other hand, deorbiting a structure of over 400 tons is no less of a technical and costly challenge.[36] In any case, it is most likely that the ISS will no longer be an international scientific space-based station before 2030. Consequently, the Tiangong-3, which is already presented as an international cooperation space lab, could provide China with a *de facto* leading position in space-based scientific cooperation.

The race to the Moon

Beyond low Earth orbit, China extended space exploration to the Moon in 2004, with the Chinese Lunar Exploration Program (CLEP), or Project Chang'e. The program is organized in three phases: orbiting, Moon landing and return (绕落回). The probes Chang'e 1 and Chang'e 2 completed the first phase of the program in 2007 and 2010. Their observations and data collection helped prepare the second phase by Chang'e 3 and 4, which successfully landed on the Moon in December 2013 and January 2019. In particular, the *Chang'e 4* mission and its rover Yutu-2 made history by landing on the far side of the Moon.

The third phase was achieved in December 2020 with *Chang'e 5*, which successfully recovered lunar samples and returned them to Earth, the third country to do so since the Americans and the Soviets in the 1970s. The mission consisted of a Moon orbiter, a landing module, a takeoff and rendezvous and docking module, and a reentry vehicle. The mission was initially scheduled in 2017 but had to be postponed due to the LM-5B

35. "China Focus: More Details of China's Space Station Unveiled", *Xinhua*, 18 May 2020, available at: www.xinhuanet.com.
36. Interview with Isabelle Sourbès-Verger.

setbacks, the only Chinese launchers with the thrust and payload capacity needed for such a mission.

China plans several more robotic missions to the Moon and aspires to settle a manned scientific lunar base after 2030, which would welcome international cooperation. Beijing has already launched its own initiative, the "International Lunar Research Station" (ILRS), an alternative project to the "space village" proposed by ESA and a similar one by Russia.[37] Hence, China's ambition to become a world-leading power in space by 2030 is no mystery.

Destination Mars

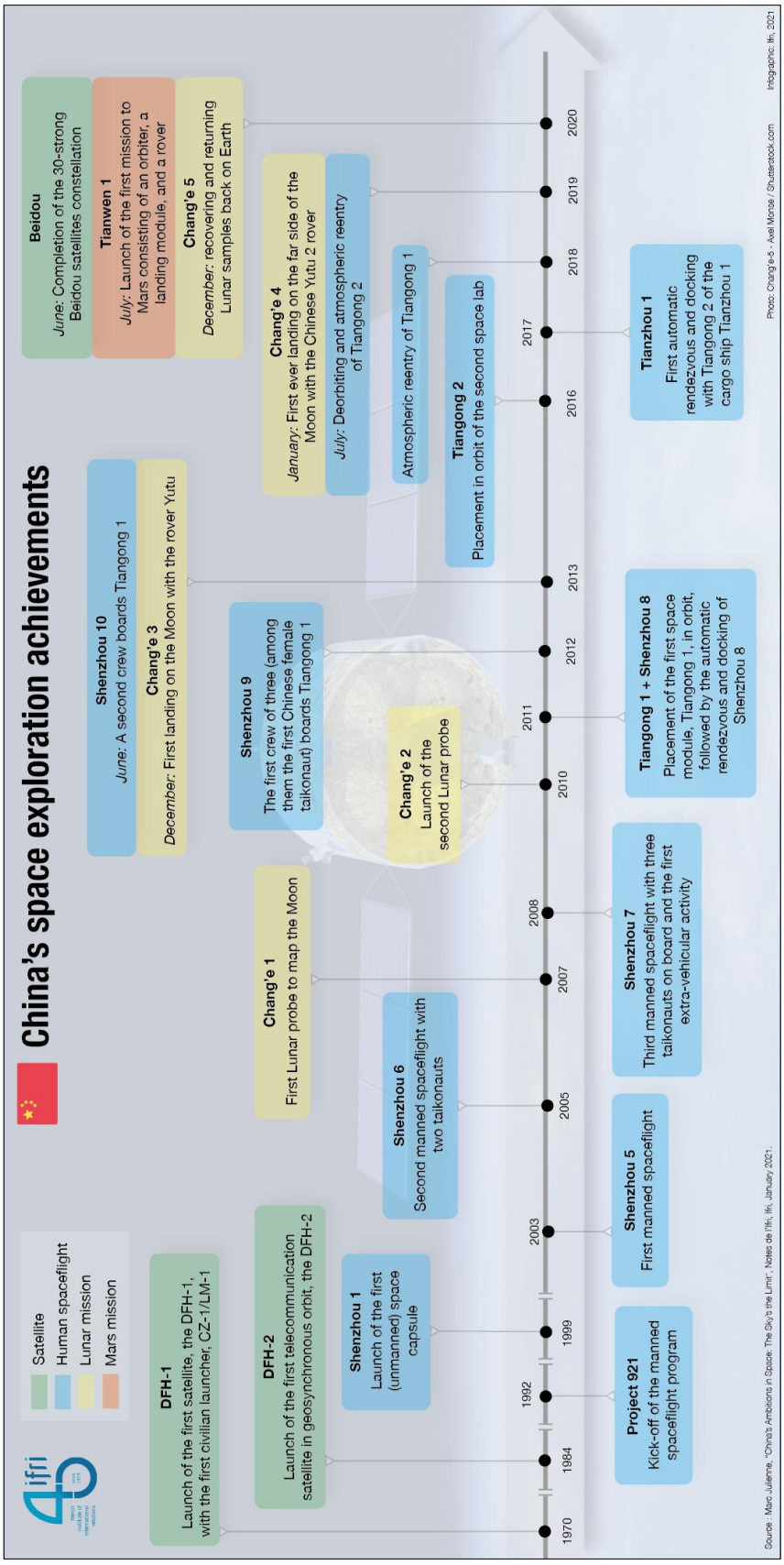
In addition to the space station and the lunar exploration programs, China has embarked on the exploration of Mars. In July 2020, it launched its first mission to Mars, the *Tianwen-1*, which consists of an orbiter, a landing module, and a rover. *Tianwen-1* comes roughly 40 years after the first probes and landings on Mars by the US and Soviet Union. However, if successful, China would catch up with the other space powers on its first attempt. China sent its Mars mission during the same launching window as the Emirati Martian mission *Hope* (an orbiter) and the American *Mars 2020 Perseverance* (a rover).[38]

In China, it seems that Mars exploration is a source of frustration. Ye Peijian, a Chinese academic and head of the CLEP, has publicly blamed "government administration" for missing the launching windows in 2013 and 2015, even though scientists were ready to go.[39] India successfully launched its own probe to Mars orbit in 2013, becoming the fourth power to do so, and the first in Asia. In Ye Peijian's view, the *Tianwen-1* mission is a way to catch up, and most importantly surpass India and other countries.

From sky to Earth: Beidou and space-based Internet

Since national development and military empowerment are among the three main objectives of the Chinese space program, the PRC is also strengthening its satellite constellations for civil and military applications.

37. Song J., "China Emphasizes International Cooperation in Future Lunar and Deep Space Exploration", *Bulletin of the Chinese Academy of Sciences*, Vol. 33, No. 2, 2019.
38. "Why Is Mankind Interested in Exploring Mars? What Is China's Level?" (人类为何对探测火星兴致盎然？中国处于什么水平？), *Xinhua*, 23 July 2020, available at: www.xinhuanet.com.
39. "Long Keduo: Mars Is Not the Diaoyu Islands, It Can Accommodate China and Foreign Countries" (龙科多：火星不是钓鱼岛，容得下中国和外国), *Guancha*, 10 March 2017, available at: www.guancha.cn.


China's space exploration achievements
Satellite
Human spaceflight
Lunar mission
Mars mission
DFH-1
Launch of the first satellite, the DFH-1, with the first civilian launcher, CZ-1/LM-1
DFH-2
Launch of the first telecommunication satellite in geosynchronous orbit, the DFH-2
Shenzhou 1
Launch of the first (unmanned) space capsule
Project 921
Kick-off of the manned spaceflight program
Shenzhou 5
First manned spaceflight
Shenzhou 6
Second manned spaceflight with two taikonauts
Chang'e 1
First Lunar probe to map the Moon
Shenzhou 7
Third manned spaceflight with three taikonauts on board and the first extra-vehicular activity
Chang'e 2
Launch of the second Lunar probe
Shenzhou 9
The first crew of three (among them the first Chinese female taikonaut) boards Tiangong 1
Tiangong 1 + Shenzhou 8
Placement of the first space module, Tiangong 1, in orbit, followed by the automatic rendezvous and docking of Shenzhou 8
Shenzhou 10
June: A second crew boards Tiangong 1
Chang'e 3
December: First landing on the Moon with the rover Yutu
Tiangong 2
Placement in orbit of the second space lab
Atmospheric reentry of Tiangong 1
Chang'e 4
January: First ever landing on the far side of the Moon with the Chinese Yutu 2 rover
July: Deorbiting and atmospheric reentry of Tiangong 2
Tianzhou 1
First automatic rendezvous and docking with Tiangong 2 of the cargo ship Tianzhou 1
Beidou
June: Completion of the 30-strong Beidou satellites constellation
Tianwen 1
July: Launch of the first mission to Mars consisting of an orbiter, a landing module, and a rover
Chang'e 5
December: recovering and returning Lunar samples back on Earth
1970
1984
1992
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2013
2016
2017
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2019
2020
Source : Marc Julienne, "China's Ambitions in Space: The Sky's the Limit", Notes de l'Ifri, Ifri, January 2021.
Photo: Chang'e-5 - Axel Monse / Shutterstock.com
Infographic: Ifri, 2021

In June 2020, China put in orbit the final satellite to complete the 30-strong Beidou-3 satellite constellation, the Chinese indigenous Global Navigation Satellite System. It took more than twenty years for China to develop and deploy its own system, but now it is self-reliant in terms of satellite positioning for its military (guided missiles, aircraft, vessels and troops) at home and globally. Hence, it will no longer depend on the US-owned GPS or be vulnerable to any signal disruption. In terms of civilian applications, Beidou will help improve public transport, maritime and air traffic, agriculture, and many other fields, in China and also overseas. Beidou is already in use in Indonesia, Cambodia, Thailand, Myanmar, the Maldives, Kuwait and Uganda,[40] while Pakistan also uses it for specific military devices.[41]

China aims to develop space-based commercial solutions for overseas. That is why Beidou is at the forefront of what Beijing labeled in 2016 "the Belt and Road Initiative Space Information Corridor" (BRISIC). It was officially detailed in the "Guiding Opinion on Accelerating the Construction and Application of 'One Belt One Road' Space Information Corridor" in November 2016.[42] According to the "Opinion", the BRISIC "will help promote cooperation between China and countries along the BRI in the high-tech sector, and improve the level of industrial cooperation with countries along the road".[43]

In addition to international cooperation, the BRISIC aims to open up opportunities for China and Chinese companies. It will help to "shape China's image as a responsible major country". And it is expected to help develop the national aerospace commercial industry. To do so, Beijing "supports a new model of commercial aerospace development, with enterprises as the main body and the market as the direction". It encourages aerospace companies (SOEs or privately owned) to "go out" (走出去), meaning to internationalize by targeting foreign markets. Here again, the role of space in national economic development, as well as in China's ambition to become a global great power, is very clear.

40. L. Sénéchal-Perrouault, "Des utilisations commerciales de la constellation Beidou (½)", *East Is Red*, 9 August 2020.
41. A. Halappanavar, "China's Answer to GPS Is Now Fully Complete", *The Diplomat*, 26 June 2020, available at: https://thediplomat.com.
42. On this "Opinion", see the analysis by L. Sénéchal-Perrouault, "Le couloir d'information spatiale des nouvelles routes de la soie : ambitions et réalités", Asia Centre, 18 August 2020, available at: https://centreasia.eu.
43. "Guiding Opinion on Accelerating the Construction and Application of 'One Belt One Road' Space Information Corridor" (关于加快推进"一带一路"空间信息走廊建设与应用的指导意见), SASTIND and NDRC, 23 November 2016, available at: www.ndrc.gov.cn.

In addition to Beidou, China is developing several other programs that would add to BRISIC, especially satellite constellations providing mobile Internet coverage to remote areas. CASC is working on the Hongyan constellation, which would eventually include 320 LEO satellites. However, CASC has so far launched only one experimental satellite – in December 2018.[44] In December 2019, a company was established by CASC, China Telecom, China Electronic Corporation and others, to manage the program: East is Red Satellite Mobile Communication Company. Official reports stated that the Hongyan constellation has benefited from the largest investment for a commercial aerospace project, with RMB 20 billion (roughly USD 3 billion) for the first phase of 60 satellites to 2022. The whole constellation is expected to be completed by 2025.[45]

CASIC has its own Internet satellite project: the Hongyun constellation. As with its CASC counterpart, the first experimental satellite was launched in December 2018. With a total of 156 satellites in LEO, it is supposed to be completed by 2022, which seems already quite ambitious. According to the SASAC: "users will be able to enjoy the same Internet speed and service in a desert, on an ocean or in a plane as they can at home".[46] This is at least the objective; the first satellite is still being tested.[47] CASIC is developing another Internet constellation, the "Xingyun Engineering", dedicated to the Internet of Things (IoT). This would consist of 80 LEO satellites, including two that were launched in May 2020, and is expected to be completed by 2023.[48] To mass-produce these satellites, CASIC (specifically, the Second Academy) established in 2019 the "Satellite Industrial Park" in the Wuhan National Aerospace Industry Base, with a claimed production capacity of 100 satellites a year.[49]

The private sector has also got into this market. The privately owned start-up GalaxySpace, founded in 2018, aims to mass-produce small LEO broadband satellites to provide global 5G coverage. It launched an experimental payload in October 2018, and its first 5G communication

44. "Report on the Launch of the First Experimental Satellite of the Hongyan Constellation of CASC", CASC, 1 February 2019, available at: www.spacechina.com.
45. "Many Central Companies Join Forces: National Commercial Aerospace Project 'Hongyan Constellation' Put into Operation" (多家央企联手国 家级商业航天项目"鸿雁星座"投入运营), SASAC, 23 December 2019, available at: www.sasac.gov.cn.
46. "CASIC Launches First Satellite in Hongyun Project", SASAC, 27 December 2018, available at: http://en.sasac.gov.cn.
47. "The First Satellite of China Hongyun Project Operates Stably in Orbit" (中国虹云工程首发卫星在轨运行稳定), CASIC, 21 May 2020, available at: www.casic.com.cn.
48. "La Chine lance les premiers satellites d'un projet IoT spatial de nouvelle génération", *Le Quotidien du peuple*, 13 May 2020, available at: http://french.peopledaily.com.cn.
49. "This Is Serious! In 2020, an Industrial Park with an Annual Output of 100 Satellites Will Be Completed" (重磅！2020年，年产百颗卫星的产业园即将建成), CASIC, 26 April 2019, available at: www.casic.com.cn.

satellite in January 2020.[50] Many other companies entered the market with more or less different constellation projects, such as Laserfleet, LinkSure, Commsat, and HorizonX. However, according to Jean Deville, a China aerospace expert, these companies seem to have revised or "pivoted away" from their initial ambitions. The reasons may be the cost, the profitability, regulation issues and competition with powerful SOEs.[51] Another structural obstacle is that it is unlikely that the Chinese central government would allow private companies to operate in the Internet sector, traditionally the exclusive domain of the state and SOEs.[52] Technical and production issues may also come as a challenge, considering that the CASC and CASIC constellation projects do not seem to be progressing well either.

Chinese constellation programs remain much smaller – one might say more reasonable – than the American ones. SpaceX's plans for its Internet mega-constellation Starlink, for instance, are as high as 42,000 satellites (although it was authorized to launched 12,000 so far), and it has already launched over 700. Beijing may not want to be left behind, and a rather mysterious SOE is said to have been established, in early 2020, to take charge of the future LEO communication satellite constellations.[53] The new company, China Satellite Network Communications Corporation, would be headed by Zhang Dongchen (张冬辰), the current CEO of China Electronic Corporation (CEC) and Wu Yanhua (吴艳华), deputy director of SASTIND and CNSA.[54] To conclude, there is definitely more to come in the next months on the front of Chinese Internet satellite constellations.

50. "GalaxySpace's Xu Ming: China's Opportunities for Internet Satellite" (银河航天徐鸣：卫星互联网的中国机遇), *TMTPost*, 10 August 2020, available on GalaxySpace website: www.yinhe.ht.
51. J. Deville, "Chinese Private Constellations and the Art of the Pivot", *The China Aerospace Blog*, 6 October 2020, available at: https://china-aerospace.blog.
52. Interview with Jean Deville.
53. Interview with Jean Deville.
54. "The Four Major Operators Are about to Establish the 'China Satellite Network Communications Group Corporation', Referred to as Xingwang" (四大运营商即将成立"中国卫星网络通信集团公司"，简称星网公司), *TianYanCha*, 22 April 2020, available at: https://news.tianyancha.com.

Space Governance: China as an Aspiring Rulemaker

As an aspiring space power, China became a member state of the Committee on the Peaceful Uses of Outer Space (COPUOS) within the UN Office for Outer Space Affairs (UNOOSA) in November 1980, and ratified most of the space-related treaties between 1983 and 1988, except for the Moon Agreement, like the US, Russia and many other countries.[55]

China is increasingly active within the COPUOS, but also very pragmatic in opposing or promoting certain policies, in a context where any progress in international space regulations seems stuck. Two of the main issues discussed these past few years are the legal regime of the exploitation of space resources, and the placement of weapons in outer space. On these two issues, China holds different stances, one of wait-and-see, and one of active opposition.

The exploitation of space resources

On the exploitation of space resources, Russia and the United States hold conflicting approaches, while China remains passive. Russia wants to reopen international negotiations to produce a new treaty to regulate the exploitation of resources in outer space and freezing any attempt to do so in the meantime. The US, on the contrary, assessed long ago that international space law was at a dead end, and that it could not wait for an unlikely treaty to pursue space exploration and resource exploitation.[56]

In 2015, the US Congress voted the "SPACE Act", authorizing "commercial exploration for and commercial recovery of space resources"[57] – a euphemism for exploitation – by private companies. In October 2020, in the framework of the Artemis Program to return to the Moon by 2024 and establish a Moon base by 2030, the US signed bilateral agreements, the Artemis Accords, with seven countries, "to establish a common vision via a

55. To name a few: Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies; Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space; Convention on International Liability for Damage Caused by Space Objects; Convention on Registration of Objects Launched into Outer Space

56. Interview with Julien Mariez, Head of Legal Department at the CNES (French Space Agency).

57. Commercial Space Launch Competitiveness Act: www.congress.gov

practical set of principles, guidelines, and best practices to enhance the governance of the civil exploration and use of outer space".[58] Despite the US claim that it respects the Outer Space Treaty, many countries, including Russia, consider these national and bilateral initiatives as an attempt to bypass international law and build parallel US-centric legislation which might eventually transform into custom.[59] China has remained particularly silent on these matters.[60] The reason for that is that Beijing has similar ambitions as Washington on the Moon, and shares the same assessment that it cannot afford to wait for a hypothetical international treaty. The parallel method of the US to advance its Moon ambitions is therefore a spur for China. Washington is somehow showing the way to Beijing, and it is more than likely that China will follow the same unilateral path to advance its conquest of the Moon.[61]

No first placement of weapons in outer space

On the issue of the placement of weapons in space, the PRC holds a much more active position. China has joined Russia in its longstanding campaign to promote a treaty on the "Prevention of an Arms Race in Outer Space" (PAROS). In 2008, Russia and China drafted the "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects" (PPWT), which they submitted to the Disarmament Conference in Geneva. The treaty is aimed at forbidding any "weaponization" of space, and at establishing a litigation resolution mechanism and an executive body. The US strongly opposed the draft, in a similar way as it has opposed the PAROS initiative since the 1980s. In 2014, China and Russia submitted a revised draft to the Conference, which was blocked again.

In the UN General Assembly (UNGA), however, China and Russia manage, almost every year, to pass resolutions on issues related to security in space: on "International cooperation in the peaceful uses of outer space" (since 2000), on the "Prevention of an arms race in outer space" (since

58. The seven countries are: Australia, Canada, Italy, Japan, the UAE, and the UK. The Artemis Accords: www.nasa.gov.
59. C. Newman, "Artemis Accords: Why Many Countries Are Refusing to Sign Moon Exploration Agreement", *The Conversation*, 19 October 2020, available at: https://theconversation.com.
60. E. Ji, M. B. Cerny and R. J. Piliero, "What Does China Think About NASA's Artemis Accords?", *The Diplomat*, 17 September 2020, available at: https://thediplomat.com.
61. One might argue that this is an international trend since Luxembourg and the United Arab Emirates have also passed their own national space laws.

2000), and on "Transparency and confidence building measures in outer space" (since 2005).

Along with the 2014 draft treaty, China and Russia also submitted a new resolution on "No first placement (NFP) of weapons in outer space" (69/32), which was largely adopted, with 127 votes in favor, four against (Georgia, Israel, Ukraine and the US), and 46 abstentions.[62] This resolution has been slightly amended and submitted to the UNGA every year since 2014. In 2017, they promoted an additional resolution, "Further practical measures for the prevention of an arms race in outer space" (72/250).[63] It was adopted with 108 votes in favor, five against (France, Israel, UK, Ukraine, and the US), and 47 abstentions. This resolution, as well, is put on the UNGA agenda every year, with slight modifications. Getting these five resolutions voted on repeatedly is a way for China and Russia to re-emphasize their position and press the US to open discussions on a treaty on weapons in space.[64]

The opponents to the resolution – the US, UK and France among others[65] – argue that the notion of "weapon" in space is not adequately defined, since any maneuverable object in orbit can be used for offensive purposes. They also see a risk in that the draft treaty does not include ground-based counterspace weapons, like ASATs. They criticize the Sino-Russian approach for being willing to ban the placement of weapons in orbit, while at the same time developing ground-based counterspace capabilities. Thus, many observers believe that the NFP initiative by China and Russia is a strategy to constrain the technological advantage of the US and prevent it from placing weapons in space, while in the meantime enabling them to catch up in the mastering of these technologies and stockpiling ground-based weapons.

Furthermore, the draft treaty does not provide any verification mechanism, as do other arms-control regulations. The sound implementation of the treaty is thus impossible to control, as well as the good faith of states.

Finally, those who oppose the NFP resolutions object to the introduction, since 2017 (res. 72/27), of the Chinese concept of "community of shared future for humankind". They see this as a domestic ideological

62. UNGA Resolution 69/32, available at: https://undocs.org.
63. UNGA Resolution 72/250, available at: https://undocs.org.
64. Interview with Jérémie Ayadi, French legal expert on space issues.
65. Albania, Australia, Estonia, France, Georgia, Haiti, Israel, Latvia, Lithuania, Poland, Romania, Ukraine, United Kingdom, United States of America.

concept that reflects a conflicting vision of multilateralism and that should not be introduced into UN resolutions.[66]

The exploitation of space resources and weaponization of space are two illustrations of how international space regulations are deadlocked. China holds a highly pragmatic position by opposing the US when not able to compete, and adopting a wait-and-see and interested attitude when the US decides to pursue its own path in terms of space legislation.

Between the dead end at the UN and the unilateral path of several countries, the EU has been putting forward a third way: the International Code of Conduct for Outer Space Activities. This is certainly an interesting path to explore, in order to preserve the multilateral management of outer space.

66. "Explication de vote du représentant permanent de la France auprès de la conférence du désarmement", 74th UNGA, 4 November 2019, available at: https://cd-geneve.delegfrance.org.

Conclusion

There are a lot of unknowns in the Chinese space program – among them, budgets and military programs. However, the Chinese authorities are quite explicit about their objectives and ambitions in space. Considering the history of the space program and the contemporary doctrine, it is clear that China's main drivers are domestic economic development, military buildup, and great-power competition – which, compared to other major space powers, is hardly original.

A specificity of China's space program is the high degree of political centralization under the leadership of the CPC. Whether it is the state (SASTIND), the military (PLA), the SOEs, or even the private sector, the Party leads and arbitrates the whole process. We have also noted the endogamous nature of the space community in China, and the close relations between the different sectors, including the opportunity for high-level scientists to conduct a political career at the national level, in order to acquire legitimacy and ascend within the Party-state apparatus.

This does not mean, however, that there is no debate, dispute or confrontation within the space community on the priority or relevance of programs, or on the policy orientation to give to space ambitions. One example is leading scientist Ye Peijian's controversial statement, in 2017, on his vision of China's space exploration: "The universe is an ocean, the Moon is the Diaoyu Islands, and Mars is the Huangyan Island [Scarborough Shoal]. We can go now, but we don't, and the next generations will blame us for that. If other people go there and settle down, you will not be able to go there anymore".[67] This very "zero sum game" approach is not necessarily widely shared in China. It is contradictory to the official doctrine of peaceful and cooperative use of space, but also consistent with the explicit ambition to become a dominant power in space.

Overall, China's achievements in space over the past two decades have been truly impressive, from the first taikonaut in orbit to the lunar exploration, and the launch of the Mars mission. In addition, China now aims to become a leading power in space cooperation. Since Beijing has been excluded from any space cooperation that includes the US for decades, it is planning to challenge Washington and to become a gravitational center itself

67. "Long Keduo: Mars Is Not the Diaoyu Islands, It Can Accommodate China and Foreign Countries" (龙科多：火星不是钓鱼岛，容得下中国和外国), *Guancha*, *op. cit.*

for other space powers. China certainly has more and more assets to do so, but the US remains far ahead, with its advanced technology, dynamic innovation ecosystem, and huge budgets. The rising conflict between China and the US will increase the importance of space in the coming years. Besides building national pride and international prestige, space is a strategic field where Beijing needs to fill the technological gap with the US, and where it is searching for US vulnerabilities.

Where does Europe stand in this rising competition and friction? It is undoubtedly in a rather difficult position to compete with the US and China, considering its means and ambitions. It is nonetheless a coveted partner in space for scientific and political reasons, and must leverage this to play a decisive role among the other space powers. As a normative power, Europe should keep promoting a rule-based order in space, through the International Code of Conduct for Outer Space Activities, for instance. It should also maintain the longstanding cooperation it has with the US, China and Russia in order to remain a trusted and reliable partner (albeit demanding) for all of them.

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