

China's Space Activities

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Introduction

The scope of mankind's activities has experienced expansion from land to ocean, from ocean to atmosphere, and from atmosphere to outer space. Space technology, which emerged in the 1950s, opened up a new era of man's exploration of outer space.

Having developed rapidly for about half a century, mankind's space activities have scored remarkable achievements, greatly promoted the development of social productivity and progress, and produced profound and far-reaching effects. Space technology has turned out to be one field of high technology that exerts the most profound influence on modern society. The continuous development and application of space technology has become an important endeavor in the modernization drive of countries all over the world.

The Chinese nation created a glorious civilization in the early stage of mankind's history. The gunpowder "rocket" invented by ancient Chinese was the embryo of modern space rockets. After the People's Republic of China was founded in 1949, China carried out space activities on its own, and succeeded in developing and launching its first man-made satellite in 1970. China has made eye-catching achievements, and now ranks among the world's most advanced countries in some important fields of space technology. In the 21st century, China will continue to promote the development of its space industry in the light of its national situation, and make due contributions to the peaceful use of outer space, and to the civilization and progress of mankind.

At the turn of the century, it is of significance to give a brief introduction to the aims and principles, present situation, future development and international cooperation concerning China's space activities.

I. Aims and Principles

The Chinese government has all along regarded the space industry as an integral part of the state's comprehensive development strategy, and upheld that the exploration and utilization of outer space should be for peaceful purposes and benefit the whole of mankind. As a developing country, China's fundamental tasks are developing its economy and continuously pushing forward its modernization drive. 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.

The aims of China's space activities are: to explore outer space, and learn more about the cosmos and the Earth; to utilize outer space for peaceful purposes, promote mankind's civilization and social progress, and benefit the whole of mankind; and to meet the growing demands of economic construction, national security, science and technology development and social progress, protect China's national interests and build up the comprehensive national strength.

China carries out its space activities in accordance with the following principles:

- Adhering to the principle of long-term, stable and sustainable development and making the development of space activities cater to and serve the state's comprehensive development strategy. The Chinese government attaches great importance to the significant role of space activities in implementing the strategy of revitalizing the country with science and education and that of sustainable development, as well as in economic construction, national security, science and technology development and social progress. The development of space activities is encouraged and supported by the government as an integral part of the state's comprehensive development strategy.
- Upholding the principle of independence, self-reliance and self-renovation and actively promoting international exchanges and cooperation. China shall rely on its own strength to tackle key problems and make breakthroughs in space technology. Meanwhile, due attention shall be given to international cooperation and exchanges in the field of space technology, and self-renovation in space technology shall be combined organically with technology import on the principles of mutual benefit and reciprocity.
- Selecting a limited number of targets and making breakthroughs in key areas according to the national situation and strength. China carries out its space activities for the purpose of satisfying the fundamental demands of its modernization drive. A limited number of projects that are of vital significance to the national economy and social development are selected so as to concentrate strength to tackle major difficulties and achieve breakthroughs in key fields.
- Enhancing the social and economic returns of space activities and paying attention to the motivation of technological progress. China strives to explore a more economical and efficient development road for its space activities so as to achieve the integration of technological advance and economic rationality.
- Sticking to integrated planning, combination of long-term development and short-term development, combination of spacecraft and ground equipment, and coordinated development. The Chinese government develops space technology, application and science through integrated planning and rational arrangement in the aim of promoting the comprehensive and coordinated development of China's space activities.

II. Present Situation

Since its birth in 1956, China's space program has gone through several important stages of development: arduous pioneering, overall development in all related fields, reform and revitalization, and international cooperation. Now it has reached a considerable scale and level. A comprehensive system of research, design, production and testing has been formed. Space centers capable of launching satellites of various types and manned spacecraft as well as a TT&C (Telemetry Tracking and Command) network consisting of ground stations across the country and tracking and telemetry ships are in place. A number of satellite application systems have been established and have yielded remarkable social and economic benefits. A space science research system of a fairly high level has been set up and many innovative achievements have been made. And a contingent of qualified space scientists and technicians has come to the fore.

China's space industry was developed on the basis of weak infrastructure industries and a relatively backward scientific and technological level, under special national and historical conditions. In the process of carrying out space activities independently, China has opened a road of development unique to its national situation and scored a series of important achievements with relatively small input and within a relatively short span of time. Now, China ranks among the most advanced countries in the world in many important technological fields, such as satellite recovery, multi-satellite launch with a single rocket, rockets with cryogenic fuel, strap-on rockets, launch of geo-stationary satellites and TT&C. Significant achievements have also been gained in the development and application of remote-sensing satellites and telecommunications satellites, and in manned spacecraft testing and space micro-gravity experiments.

Space Technology

1. **Man-made Satellites:** China's first man-made satellite, the "Dongfanghong-I" was successfully developed and launched on April 24, 1970, making China the fifth country in the world with such capability. By October 2000, China had developed and launched 47 satellites of various types, with a flight success rate of over 90%. Altogether, four satellite series have been initially developed in China, namely, recoverable remote-sensing satellites, "DFH (Dongfanghong)" telecommunications satellites, "FY (Fengyun)" meteorological satellites and "SJ (Shijian)" scientific research and technological experiment satellites. The "ZY (Ziyuan)" earth resource satellite series will come into being soon. China is the 3rd country in the world to have mastered the technology of satellite recovery, with the success rate reaching the advanced international level, and the 5th country capable of developing and launching geo-stationary telecommunications satellites independently. The major technological index of China's meteorological and earth resource satellites has reached the international level of the early 1990s. The six telecommunications, earth resources and meteorological satellites developed and launched by China in the past few years are in stable operation, and have generated remarkable social and economic returns.
2. **Launching Vehicles:** China has independently developed the "Long-March" rocket group, containing 12 types of launching vehicles capable of launching satellites to near-earth, geo-stationary and sun-synchronous orbits. The largest launching capacity of the "Long-March" rockets has reached 9,200 kg for near-earth orbit, and 5,100 kg

for geo-stationary transfer orbit, able to basically meet the demands of customers of all kinds. Since 1985, when the Chinese government announced to put the "Long-March" rockets into the international commercial launching market, China has launched 27 foreign-made satellites into space, thus acquiring a share of the international commercial launching market. Up to now, the "Long-March" rockets have accomplished 63 launches, and made 21 consecutive successful flights from October 1996 to October 2000.

3. **Launching Sites:** China has set up three launching sites – in Jiuquan, Xichang and Taiyuan – which have successfully accomplished various kinds of test flights of launching vehicles and launches of a variety of satellites and experimental spacecraft. China's spacecraft launching sites are capable of making both domestic satellite launches and international commercial launches, and carrying out international space cooperation in other fields.
4. **TT&C:** China has established an integrated TT&C network comprising TT&C ground stations and ships, which has successfully accomplished TT&C missions for near-earth orbit and geo-stationary orbit satellites, and experimental spacecraft. This network has acquired the capability of sharing TT&C resources with international network, and its technology has reached the international advanced level.
5. **Manned Spaceflight:** Initiating its manned spaceflight program in 1992, China has developed a manned spacecraft and high-reliability launching vehicle, carried out engineering studies in aerospace medicine and aerospace life science, selected reserve astronauts and developed equipment for aerospace remote-sensing and aerospace scientific experiments. China's first unmanned experimental spacecraft – "Shenzhou" – was successfully launched and recovered November 20-21, 1999, symbolizing a breakthrough in the basic technologies of manned spacecraft and a significant step forward in the field of manned spaceflight.

Space Applications

China attaches importance to developing all kinds of application satellites and satellite application technology, and has made great progress in satellite remote-sensing, satellite telecom and satellite navigation. Remote-sensing and telecommunications satellites account for about 71% of the total number of satellites developed and launched by China. These satellites have been widely utilized in all aspects of economy, science and technology, culture, and national defense, and yielded remarkable social and economic returns. Related departments of the state have also made active use of foreign application satellites for application technology studies, with satisfactory results.

1. **Satellite Remote-Sensing:** China began to use domestic and foreign remote-sensing satellites in the early 1970s, and eventually carried out studies, development and promotion of satellite remote-sensing application technology, which has been widely applied in meteorology, mining, surveying, agriculture, forestry, water conservancy, oceanography, seismology and urban planning. To date, China has established the National Remote-Sensing Center, National Satellite Meteorology Center, China Resources Satellite Application Center, Satellite Oceanic Application Center and China Remote-Sensing Satellite Ground Station, as well as satellite remote-sensing application institutes under related ministries of the State Council, some provinces and municipalities and the Chinese Academy of Sciences. These institutions have made use of both domestic and foreign remote-sensing satellites to carry out application studies in

weather forecasting, territorial survey, agricultural output assessment, forest survey, natural disaster monitoring, maritime forecasting, urban planning and mapping. The regular operation of the meteorological satellite ground application system, in particular, has greatly improved the accuracy of forecasting disastrous weather and significantly reduced the economic losses of the state and people from such weather.

2. **Satellite Telecommunications:** In the mid-1980s, China began to utilize domestic and foreign telecommunications satellites, and developed related technology to meet the increasing demands of the development of telecommunications, broadcasting and education. In the field of fixed telecom service, China has built scores of large and medium-sized satellite telecom earth stations, with more than 27,000 international satellite telephone channels connected to more than 180 countries and regions worldwide. The establishment of the domestic satellite public communication network, with more than 70,000 satellite telephone channels, has initially solved the problem of communication in remote areas. The VSAT (Very Small Aperture Terminal) communication service has developed very rapidly in recent years. There are now in the country 30 domestic VSAT communication service providers and 15,000 small station users, including over 6,300 two-way users. More than 80 specialized communication networks for dozens of departments like finance, meteorology, transportation, oil, water resources, civil aviation, power, public health and the media have been built, with over 10,000 VSAT. A satellite TV broadcasting system covering the whole world and a satellite TV education system covering the whole country have been established. China started to use satellites for TV broadcasting in 1985, and has formed a satellite transmission network with 33 telecommunications satellite transponders responsible for transmitting 47 TV programs and educational TV programs of CCTV (China Central Television) and local TV stations throughout the country, 32 programs of the Central Broadcasting Station domestically and abroad, and about 40 local broadcasting programs. Ever since the opening of satellite education TV broadcasting programs over a dozen years ago, more than 30 million people have got college or technical secondary school education and training through it. China has also set up a satellite direct broadcasting experimental platform to transmit CCTV and local satellite TV programs by digital compression to the vast rural areas which wireless TV broadcasting cannot cover. In this way, China's TV broadcasting coverage has been greatly increased. China has about 189,000 satellite TV broadcasting receiving stations. The China broad-band multi-media education satellite transmission network has also been established on the satellite direct broadcasting experimental platform to provide comprehensive remote education and information technology services.
3. **Satellite Navigation:** In the early 1980s, China began to utilize other countries' navigation satellites and develop the application technology of satellite navigation and positioning, which is now widely used in many fields including land survey, ship navigation, aircraft navigation, earthquake monitoring, geological calamity monitoring, forest fire prevention and control, and urban traffic control. After joining the COSPAS-SARSAT in 1992, China established the Chinese Mission Control Center, thus greatly improving the capability of the emergency alarm service for ships, aircraft and vehicles.

Space Science

China started to explore the upper atmosphere using rockets and balloons in the early 1960s. In the early 1970s, China began to utilize the scientific exploration and technological testing

satellites of the "SJ" group in a series of space explorations and studies, and acquired a large amount of valuable data about the space environment. Research on space weather forecasting and related international cooperation have also been carried out in recent years. In the late 1980s, recoverable remote-sensing satellites were employed for various kinds of aerospace scientific experiments, and have yielded satisfactory achievements in crystal and protein growth, cell cultivation and crop breeding. Innovative achievements have been scored in the study of basic theory of space science. The establishment of advanced and open state-level laboratories specializing in space physics, micro-gravity and space life science, and the founding of the Space Payload Application Center provide the country with the basic ability to support aerospace scientific experiments. The "SJ" group has been used in recent years to detect charged particles in terrestrial space and their effects. In addition, the first micro-gravity space experiment on double-layer fluid was accomplished, in which remote operation of space experiments was realized.

With the establishment and improvement of China's socialist market economic mechanism, the state guides the development of space activities through macro-control, makes overall plans for the development of space technology, space application and space science, promotes the R&D and system integration of important space technologies and the application of space science and technology in the fields of economy, science and technology, culture, and national defense. The state has also carried out reforms in the space science and technology industry to achieve sustainable development of the space industry. The state has strengthened legislation work and policy management, enacted laws and regulations and promulgated industrial policies for the space industry to ensure orderly and standardized development of space activities. Research institutions, industrial enterprises, commercial enterprises and institutions of higher learning are encouraged to make full use of their advantages and participate in space activities under the guidance of the state's space policies. The state supports renovation in space technology and the establishment of a space technological renovation system with Chinese characteristics, in the aim to improve the self-renovation capability and industrialization of space activities. Space activities for public welfare and R&D work with commercial prospects are also supported by the state, and the state's supervision over space activities is being continuously strengthened. The China National Space Administration (CNSA) is China's governmental organization responsible for the management of satellites for civilian use and inter-governmental space cooperation with other countries.

III. Future Development

The 21st century will witness vigorous development of space activities across the world. China is drafting a space development strategy and plans oriented to the 21st century according to the actual demands and long-term target of national development to spur the growth of the space industry.

Development Targets

The short-term development targets (for the next decade) are:

- To build up an earth observation system for long-term stable operation. The meteorological satellites, resource satellites, oceanic satellites and disaster monitoring satellites can develop into an earth observation system for long-term stable operation to conduct stereoscopic observation and dynamic monitoring of the land, atmosphere, and oceanic environments of the country, the peripheral regions and even the whole globe;
- To set up an independently operated satellite broadcasting and telecommunications system. Positive support will be given to the development of commercial broadcasting and telecommunications satellites such as geo-stationary telecom satellites and TV direct broadcasting satellites with long operating life, high reliability and large capacity, so as to form China's satellite telecom industry;
- To establish an independent satellite navigation and positioning system. This will be achieved by setting up a navigation and positioning satellite group step by step and developing a relevant application system, which will eventually bring into being China's satellite navigation and positioning industry;
- To upgrade the overall level and capacity of China's launch vehicles. This will be achieved by improving the performance and reliability of the "Long-March" group, developing the next generation of launch vehicles with non-toxic, non-polluting, high-performance and low-cost qualities, forming a new group of launch vehicles and strengthening the capability of providing international commercial launching services;
- To realize manned spaceflight and establish an initially complete R&D and testing system for manned space projects;
- To establish a coordinated and complete national satellite remote-sensing application system by building various related ground application systems through overall planning, setting up a remote-sensing data receiving, processing and distributing system covering the whole country for data sharing, and forming a fairly complete application system in major application fields of satellite remote-sensing; and
- To develop space science and explore outer space by developing a scientific research and technological experiment satellite group of the next generation, strengthening studies of space micro-gravity, space material science, space life science, space environment and space astronomy, and carrying out pre-study for outer space exploration centering on the exploration of the moon.

The long-term development targets (for the next 20 years or more) are as follows:

- To achieve industrialization and marketization of space technology and space applications. The exploration and utilization of space resources shall meet a wide range of

demands of economic construction, state security, science and technology development and social progress, and contribute to the strengthening of the comprehensive national strength;

- To establish a multi-function and multi-orbit space infrastructure composed of various satellite systems and set up a satellite ground application system that harmonizes spacecraft and ground equipment to form an integrated ground-space network system in full, constant and long-term operation in accordance with the overall planning of the state;
- To establish China's own manned spaceflight system and carry out manned spaceflight scientific research and technological experiments on a certain scale; and
- To obtain a more important place in the world in the field of space science with more achievements and carry out explorations and studies of outer space.

Development Concepts

China develops its space activities with the following approaches:

- Accelerating the industrialization of space technology and its application. Enterprises engaged in space science and technology are guided and encouraged to renovate institutions and technology, and establish an operational mechanism geared toward both the domestic and international markets, so as to speed up the industrialization of space technology and its applications step by step, with the stress on telecom satellites and satellite telecom and launching vehicles.
- Deploying space activities rationally. Space science, technology and application shall be developed in a well-coordinated manner through overall planning. The work in these three fields will be given differentiated importance from "preferential arrangement," "active support" and "proper development" to "follow-up studies," so as to ensure the comprehensive and coordinated development of China's space industry.
- Strengthening pre-study and technological infrastructure construction. Efforts will be concentrated on tackling key technological problems to grasp core technology and attain independent intellectual property rights. At the same time, technological infrastructure construction will be strengthened in the three aspects of space activities, and international cooperation will be broadened to sustain the development momentum of China's space industry.
- Speeding up the development of talented people in the space industry and forming advantages in this regard. Special policies will be adopted to promote space education and train qualified personnel to foster a contingent of young and highly qualified space scientists and engineers. Efforts will be made to publicize space knowledge, and motivate all sectors of society to support the development of the space industry.
- Improving scientific management for better quality and benefits. Since space activities involve huge investments, high risks, sophisticated technology and complicated systems, systems engineering and other modern management tools shall be applied to promote scientific management, increase system quality, lower system risks and enhance comprehensive benefits.

IV. International Cooperation

China persistently supports activities involving the peaceful use of outer space, and maintains that international space cooperation shall be promoted and strengthened on the basis of equality and mutual benefit, mutual complementarity and common development.

Guiding Principles

The Chinese government holds that international space cooperation should follow the fundamental principles listed in the "Deceleration [Declaration] on International Cooperation on Exploring and Utilizing Outer Space for the Benefits and Interests of All Countries, Especially in Consideration of Developing Countries' Demands," which was approved by the 51st General Assembly of the United Nations in 1996. China adheres to the following principles while carrying out international space cooperation:

- The aim of international space cooperation is to peacefully develop and use space resources for the benefit of all mankind.
- International space cooperation should be carried out on the basis of equality and mutual benefit, mutual complementarity and common development, and the generally accepted principles of international law.
- The priority aim of international space cooperation is to simultaneously increase the capability of space development of all countries, particularly the developing countries, and enable all countries to enjoy the benefits of space technology.
- Necessary measures should be adopted to protect the space environment and space resources in the course of international space cooperation.
- The function of the United Nations Office of Outer Space Affairs (OOSA) should be consolidated and the outer space application programs of the United Nations should be backed up.

Fundamental Policies

- The Chinese government adopts the following policies in developing international space cooperation:
- Persisting in the independence and self-reliance policy, carrying out active and pragmatic international space cooperation to meet the needs of the national modernization drive and the demands of the domestic and international markets for space science and technology.
- Supporting multilateral international cooperation on the peaceful use of outer space within the framework of the United Nations.
- Attaching importance to the Asian-Pacific regional space cooperation and supporting space cooperation in other regions of the world.
- Attaching importance to space cooperation with both developed and developing countries.
- Enhancing and supporting research institutions, industrial enterprises and universities and colleges to develop international space exchanges and cooperation in different

forms and at different levels under the guidance of relevant state policies, laws and regulations.

Important Events

China's participation in international space cooperation started in the mid-1970s. During the last two decades or more, China has joined bilateral, regional, multilateral and international space cooperation in different forms, such as commercial launching service, which have yielded extensive achievements.

1. **Bilateral Cooperation:** Since 1985, China has successively signed inter-governmental or inter-agency cooperative agreements, protocols or memorandums, and established long-term cooperative relations with a dozen countries, including the United States, Italy, Germany, Britain, France, Japan, Sweden, Argentina, Brazil, Russia, Ukraine and Chile. Bilateral space cooperation is implemented in various forms, from making reciprocal space programs and exchanges of scholars and specialists, and sponsoring symposiums, to jointly developing satellite or satellite parts, and providing satellite piggyback service and commercial launching service.

In 1993, a Sino-German joint venture - EurasSpace GmbH - was established, and a contract on the development and manufacture of Sinosat-1 was signed with DASA and Aerospeciale in 1995. Sinosat-1, which was successfully launched in 1998, was the first cooperative project on satellite development between the Chinese and European aerospace industries.

The collaboration between China and Brazil on the project of an earth resources satellite is making good progress, and the first such satellite was successfully launched by China on October 14, 1999. In addition to cooperation on complete satellites, China and Brazil are cooperating in the areas of satellite technology, satellite application and satellite components. The cooperation between China and Brazil in the space sector has set a good example for the developing countries in "South-South Cooperation" in the high-tech field.

2. **Regional Cooperation:** China attaches great importance to space cooperation in the Asia-Pacific region. In 1992, China, Thailand, Pakistan and some other countries jointly sponsored the "Asian-Pacific Multilateral Space Technology Cooperation Symposium." Thanks to the impetus of such regional cooperation, the governments of China, Iran, the Republic of Korea, Mongolia, Pakistan and Thailand signed the "Memorandum of Understanding on Cooperation in Small Multi-Mission Satellite and Related Activities" in Thailand in April, 1998. Besides the signatory countries, other countries in the Asia-Pacific region may also join the cooperative project, which has helped to enhance the progress of space technology and space application in the Asia-Pacific region.
3. **Multilateral Cooperation:** In June 1980, China dispatched an observer delegation to the 23rd Meeting of UN COPUOS for the first time, and on November 3, 1980, China became a member country of the committee. Since then, China has participated in all the meetings of UN COPUOS and the annual meetings held by its Science, Technology and Law Sub-committee. In 1983 and 1988, China acceded to the "Treaty on Princi-

ples 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," and "Convention on Registration of Objects Launched into Outer Space," and has strictly performed its responsibilities and obligations.

China supports and has participated in the UN space applications program. Since 1988, China has provided other developing countries every year with scholarships for long-term space technology training. In 1994, together with ESCAP, China hosted in Beijing the first Asian-Pacific regional "Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific," and the "Beijing Declaration" issued after the conference has had a far-reaching influence. In September 1999, in collaboration with the UN and ESA, the Chinese government held in Beijing the "Symposium on Promoting Sustainable Agricultural Development with Space Applications." From July to August 2000, together with the OOSA of the UN and ESCAP, relevant departments of the Chinese government opened the Short-term Training Course for Asia-Pacific Multilateral Cooperation in Space Technology and Applications. Trainees from ten developing countries in the Asia-Pacific region attended the course.

The issue of space debris is a big challenge to further expansion of space activities. The relevant departments in China pay great attention to the problem, and have carried out research on this issue with related countries since the beginning of the 1980s. In June 1995, CNSA acceded to the Inter-Agency Space Debris Coordination Committee. China will continuously make efforts to explore, together with other countries, ways and means to mitigate and reduce space debris, and promote international cooperation on this issue.

In addition, China has participated in multilateral cooperative projects, such as "Committee on Earth Observation Satellites," "World Weather Monitoring," "UN Decade of Disaster Mitigation," and "International Solar-Terrestrial Physics."

4. Commercial Launching Service: Ever since the Chinese government made the declaration in 1985 that China's "Long March" launching vehicles would serve the international market and provide international satellite launching service, up to October 2000, China had successfully launched 27 foreign-made satellites for users in Pakistan, Australia, Sweden, the United States, the Philippines, as well as domestic users. The service of "Long March" launching vehicles in the international satellite launching market is a beneficial supplement to international commercial satellite launching services, and it has provided foreign clients with new options.

Priority Cooperation Areas

The Chinese government will continuously render support to international exchanges and cooperation in space technology, space applications and space science, with priority being given to cooperation in the following areas:

- Actively enhancing multilateral cooperation in space technology and applications in the Asian-Pacific region, and promoting regional economic growth and environmental and natural calamity monitoring with space technology.
- Supporting Chinese space enterprises to participate in international space commercial launching services in line with the principles of equality, equity and reciprocity.
- Giving support to using China's mature space technology and space application technology to carry out cooperation with other developing countries and provide services to cooperating countries on the basis of mutual benefit.
- Supporting international exchanges and cooperation in earth environment monitoring, space environmental exploration, and studies of micro-gravity science, space physics and space astronomy, particularly international exchanges and cooperation in micro-gravity fluid physics, space materials science, space life science and space biology.