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China's Space Program: An Overview

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Summary

The People's Republic of China launched its first astronaut, or "taikonaut," Lt. Col. Yang Liwei, on October 15, 2003 Beijing time (October 16 Eastern Daylight Time). China thus became only the third country, after Russia and the United States, able to launch humans into orbit. Lt. Col. Yang landed on October 16 Beijing time (October 15 EDT) after making 14 orbits (21 hours and 23 minutes). The launch is raising congressional interest in the nature and scope of the Chinese space program. The implications of China's entry into the field of human space flight is unclear. Some may welcome a new entrant in the human exploration of space, some may view it as an indicator of Chinese technological advancements that could pose a threat, and others may find the event unremarkable, coming as it does 42 years after the Soviet Union and United States accomplished the same feat. This report will not be updated.

Introduction

China launched its first satellite in 1970. By October 16, 2003, it had conducted 79 launches. Of those, 67 were successes, 8 were complete failures, and 4 were partial failures placing satellites into incorrect orbits. Most of the launches were of Chinese communications, weather, remote sensing, navigation, or scientific satellites. Some of those satellites may be for military applications, or are dual use. Four test spacecraft related to China's human spaceflight program were launched, followed by the first Chinese "taikonaut" (see below). Some launches were conducted on a commercial basis for foreign countries or companies, primarily placing communications satellites into orbit.

China has three space launch sites: Jiuquan (also called Shuang Cheng-tzu) in the Gobi desert; Xichang, in southeastern China (near Chengdu); and Taiyuan, south of Beijing. Jiuquan was China's first launch site, and is used for launches of a variety of spacecraft, including those related to the human spaceflight program. Xichang, inaugurated in 1984, is used for launches into geostationary orbit (above the equator), primarily communications satellites. Taiyuan, opened in 1988, is used for launches into polar orbits (that circle the Earth's poles), primarily weather and other Earth observation satellites. China has several different launch vehicles; most are called Chang Zheng (CZ, meaning Long March). Versions of the CZ 2 are used at Jiuquan; the CZ 2F is used for

launches associated with its human spaceflight program. Versions of the CZ 3 and some CZ 2 variants are used at Xichang. CZ 4 is used at Taiyuan. China is developing a new family of launch vehicles, called Kaituozhe (KT, meaning Pioneer). A test launch of the first of these, KT-1, for small satellites, was conducted at Taiyuan in September 2003.

In a 1991 article, Dr. Yanping Chen reviewed the evolution of the Chinese space program, dividing it into four periods: 1956-1966, when the space program was first established despite a number of "traumatic political events" including the Great Leap Forward and the withdrawal of Soviet support for Chinese science and technology; 1966-1976, during which the space program was able to maintain its course even though "virtually all sectors of Chinese society were torn apart" by the Cultural Revolution; 1976-1986, a period when the space program was put on the back burner, but survived, while the country recovered from the Cultural Revolution; and 1986 forward, which Dr. Chen describes as the "heyday" of the program as the government made space a "cornerstone of the national science and technology development effort."[1]

China's Human Spaceflight Program

China's First "Taikonaut"[2]. On October 15, 2003, at 09:00 Beijing time (01:00 GMT, or October 14, 2003, 21:00 Eastern Daylight Time), China launched its first taikonaut—People's Liberation Army Lt. Col. **Yang Liwei**—into space aboard the Shenzhou 5 (Divine Vessel) spacecraft. Lt. Col. Yang landed on October 16, 2003 at 06:23 Beijing time (October 15, 18:23 EDT), after 14 orbits (21 hours 23 minutes).

China's current effort to launch humans into space started in 1992 and is designated by the Chinese as "Project 921" (an earlier effort was discontinued due to economic pressures). Two Chinese specialists trained at Russia's cosmonaut training facility in Star City (near Moscow) in 1997. According to several Chinese press reports, the current taikonaut corps consists of 12 trainees and two trainers, all fighter pilots.

Shenzhou Design. The Shenzhou spacecraft design is patterned after Russia's Soyuz spacecraft, although the Chinese insist that the spacecraft are made entirely in China. Shenzhou consists of three modules: the descent module, a service module, and an orbital module. At the end of the primary mission, the descent module and service module detach from the orbital module. The service module positions the descent module correctly for reentry and fires its engines to initiate descent. It detaches from the descent module and disintegrates in the atmosphere as the descent module returns to Earth. The orbital module remains in orbit for several months. It has its own propulsion system, allowing it to make maneuvers. On some of the test flights, experiments were carried on the orbital module in addition to those in the descent module.

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[1] Chen, Yanping. China's Space Policy—a Historical Review. Space Policy, May 1991: 116-128.

[2] The term "taikonaut" for Chinese astronaut was popularized by an independent Chinese space analyst, Chen Lan, who operates the "Go Taikonauts" unofficial Chinese space Web site [http://www.geocities.com/CapeCanaveral/Launchpad/1921/index.htm]. According to Mr. Chen, other Chinese terms for astronaut are "yahangyuan,""hangtianyuan," and "taikogren."

Test Flights. Four orbital test flights of the Shenzhou spacecraft were conducted without crews. As described above, each spacecraft consists of three modules, one of which—the descent module—is designed to return to Earth. The descent modules are not reusable. Shenzhou 1 was launched on November 20, 1999 and the descent module remained in orbit for 21 hours. According to Chinese accounts, this version of the spacecraft did not include many of the systems (such as life support) needed for an actual human space flight. The flight was not announced by the Chinese government until after its successful landing, an event accompanied by significant Chinese press coverage. Shenzhou 2 was launched on January 10, 2001, and, according to a Chinese press report, carried unspecified animals.[3] Unlike Shenzhou 1, no photographs were released of the capsule once it returned to Earth after 7 days in orbit, leading many in the West to conclude that the landing was unsuccessful. Shenzhou 3 (launched March 25, 2002) and Shenzhou 4 (launched December 30, 2002) each carried "dummy" astronauts and their descent modules returned after 7 days. The orbital module for Shenzhou 1 reentered after a week; the others remained in orbit for 7-8 months.[4] The Shenzhou 5 descent module, carrying Lt. Col. Yang, returned after 21 hours; the orbital module is still in orbit.

Future Plans. Chinese sources said the next human spaceflight would occur in 1-2 years. Chinese officials often are quoted discussing a three-step human spaceflight plan: send humans into Earth orbit, dock spacecraft together to form a small laboratory, and ultimately build a large space station.[5] A Chinese journal mentioned a three step plan to send humans to the Moon, beginning with Earth-orbiting space laboratories, followed by robotic probes, and ultimately a human landing on the Moon.[6] Conflicting estimates of when (between 3-20 years) the first robotic probe might be launched have been made.

China has expressed interest in participating in the International Space Station (ISS) program (see CRS Issue Brief IB93017 for more on ISS). The United States has declined to bring China into the program, although one experiment—the Alpha Magnetic Spectrometer—that includes Chinese hardware is scheduled to be placed aboard the space station (it flew on the space shuttle in 1998), although the launch date is uncertain.

Guiding Principles and Funding

The Chinese government published a "White Paper" in November 2000 outlining its goals and guiding principles for the space program. The first principle is —

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[3] Reuters reported that a monkey, a dog, a rabbit, and snails were carried (Snails Blaze Space Trail for 1st China Astronaut, January 17, 2001, 23:55:35, via Newsedge), but no mention of these specifics could be found in Chinese sources used for this report. Xinhua, however, did state that animals were aboard (Beijing Xinhua in English, January 9, 2001, 1845 GMT, via FBIS).

[4] For a summary of these four flights, see: Clark, Phillip S. The First Flights of China's Shen Zhou Spacecraft. Journal of the British Interplanetary Society, Vol. 56, 2003: 160-174. (The Shenzhou 4 orbital module reentered on September 9, 2003, after that article was published.)

[5] Lu Pi. Manned Space Flights: A Foreseeable Goal. Beijing Review (Internet Version-WWW) in English, May 9, 2002 (via Foreign Broadcast Information Service, hereafter "FBIS").

[6] Wang Qian. China to Land on Moon by 2010. Beijing Zhongguo Wang WWW-Text in English, October 26, 2002 (via FBIS, which describes the source as an official PRC Internet site).

> — 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.[7]

Xie Mingbao, director of the China Manned Space Engineering Office, was quoted by Xinhua, China's official news service, as saying that China spent "18 billion yuan (about 2.2 billion US dollars) on the five spacecraft of the Shenzhou series that have been launched so far."[8] Annual spending on the total Chinese space program is difficult to ascertain. Dr. Joan Johnson-Freese, chair of the Department of National Security Studies at the Naval War College, estimates that China spends $1.4 billion-$2.2 billion annually on space, but cautions against direct comparisons with U.S. space spending because of currency conversion issues, China's command economy, and "deliberate over-employment."[9]

Commercial Space Launch Activities

China announced its intention to enter the commercial space launch business in 1986. (Commercial space launch competition is discussed in CRS Issue Brief IB93062.) Chinese launch services are marketed through China Great Wall Industries Corporation (CGWIC). Virtually all communications satellites requiring commercial launch services are built in the United States or include U.S. components, so U.S. export licenses must be granted to send the satellites to China for launch. The United States thus has played a key role in the evolution of the Chinese commercial launch services business. In 1988, the Reagan Administration approved the first export licenses for three satellites to be sent to China on the condition that China sign three international treaties concerning, among other things, liability for damage from space launches; negotiate a fair trade agreement with the United States regarding launch services; and reach agreement on protecting technology from being transferred while satellites are in China. All conditions were met by January 1989. At that time, commercial communications satellites were on the U.S. Munitions List and export license requests were handled by the State Department. Following the Tiananmen Square uprising in June 1989, the Bush Administration suspended all export licenses for items on the Munitions List, including the three satellites. The suspension was ultimately lifted, and the satellites were launched by China.

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[7] White Paper: "Full Text" of 'China's Space Activities.' Beijing Xinhua in English, November 22, 2000, 0211 GMT (via FBIS).

[8] Quoted in: PRC Space Official Says China To Launch Next Shenzhou in 1-2 Years. Beijing Xinhua in English, October 16, 2003, 0752 GMT (via FBIS).

[9] Johnson-Freese, Joan. September 29, 2003 presentation to Center for Strategic and International Studies. Available at [http://www.csis.org/china/030929johnson-freese.pdf]. Dr. Freese is the author of *The Chinese Space Program: Mystery Within a Maze*, Malaber, Florida, Kreiger Publishing Co., 1998.

The incident underscored the coupling of commercial communications satellites export licenses and overall relationships between the United States and China. The 1990s witnessed repeated instances where export licenses would be granted, suspended, and reinstated, depending on the political situation. In 1997, allegations surfaced that China was obtaining militarily useful information by launching U.S. satellites. The charges concerned investigations into launch failures involving U.S.-built satellites where two U.S. companies (Loral and Hughes) allegedly assisted China in understanding the cause of the accidents and how to remedy them. By that time, responsibility for commercial communications satellite exports had been shifted from the State Department to the Commerce Department. In response to the allegations, Congress returned export responsibility to the State Department as of March 15, 1999. The State Department has not granted any export licenses for sending communications satellites to China since then, and Chinese commercial space launch operations consequently have been suspended. (See CRS Issue Brief IB93062 for more details on the Loral/Hughes controversy and the financial penalties imposed on the companies in settlements with the U.S. government.)

Military Space Activities

Chinese officials routinely call for using space for peaceful purposes, and argue against the militarization of space in settings such as the U.N. Conference on Disarmament. However, the November 2000 White Paper includes national security as one of the purposes served by the space program, and China's remote sensing, communications, and navigation satellites presumably satisfy both military and civilian objectives. Two Chinese satellites (ZY-2 and ZY-2B) are widely considered in the West to be for military reconnaissance. The Chinese space program is conducted by the China Aerospace Science and Technology Corporation (abbreviated CASC by the Chinese), a state-owned enterprise that develops and manufactures strategic and tactical missiles in addition to spacecraft, launch vehicles, and other aerospace products. CGWIC (see above) is a part of CASC. CASC's Web site is [http://www.spacechina.com].

The U.S. Department of Defense (DOD) publishes an annual report on "Military Power of the People's Republic of China." The current edition, available at [http://www.defenselink.mil/pubs/20030730chinaex.pdf], discusses China's efforts to develop new space launch vehicles, "counterspace" systems, and to send humans into space. DOD asserts that the human spaceflight effort eventually could aid Chinese military space capabilities. "While one of the strongest immediate motivations for this program appears to be political prestige, China's manned space efforts almost certainly will contribute to improved military space systems in the 2010-2020 timeframe." (p. 37) Regarding counterspace systems, the DOD report suggests that China may be developing a direct-ascent antisatellite (ASAT) weapon, systems to jam U.S. navigation satellite signals, and ground-based lasers to damage optical sensors on satellites (p. 36).

International Cooperation

China is very interested in international cooperation in space. The 2000 White Paper discusses it extensively, and China has cooperative arrangements with several countries, including Russia, Brazil, and Europe (see below). There is no government-to-government level cooperation between China and the United States, although the National Aeronautics and Space Administration (NASA) has reported in the past that it has engaged in low level

scientific cooperation, data exchanges, and participation in multilateral coordination groups with China. China inaugurated use of a receiving station for acquiring data from U.S. Landsat Earth remote sensing satellites in 1986. The U.S. trade magazine *Aviation Week & Space Technology* reported in its April 1, 2002 edition (p. 27) that NASA and the State Department were exploring "whether and how to bring China into close cooperation with the U.S. in space," but there has been no public announcement of new cooperative agreements since then. President Bush congratulated Chinese President Hu in an October 19, 2003 letter [http://www.whitehouse.gov/news/releases/2003/10/20031019-5.html], and wished China continued success in its human spaceflight program. NASA Administrator O'Keefe called Shenzhou 5 an "important achievement in human exploration" and wished China "a continued safe human space flight program."[10]

Russia. Russia[11] signed a bilateral space cooperation agreement with China in 1994, including cooperation in robotic missions to Mars and human spaceflight. Then-President Yeltsin signed a "joint understanding" in 1996 that included training two Chinese specialists at Russia's cosmonaut training facility. The Chinese reportedly use Russian spacesuits, and Russia provided technical assistance to China in the development of the Shenzhou spacecraft. A Russian space agency official was quoted as saying the design is 100% Russian,[12] but Chinese officials insist the spacecraft are built entirely in China, and some Western experts cite differences in specific features of Shenzhou versus Soyuz (for example, the Shenzhou orbital module has its own propulsion system, while the Soyuz orbital module does not).[13]

Europe. China has cooperated with several individual European countries. For example, Sweden launched its Freja satellite on a Chinese launch vehicle from Jiuquan in 1992. China also is cooperating with the European Space Agency (ESA). ESA and China are developing scientific research satellites called Double Star for magnetospheric studies. The two Chinese-built satellites will carry five ESA sensors. China and the European Union (EU) signed a cooperative agreement in September 2003 for China to participate in the EU-ESA Galileo navigation satellite system, which will be similar to the U.S. Global Positioning System (GPS).[14] Russia and Canada also are participating.

Brazil. China and Brazil are jointly developing remote sensing satellites under the CBERS (China-Brazil Earth Remote Sensing) program. The first satellite was launched in 1999; the second in October 2003. Two more are planned.

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[10] NASA press release 03-333, October 14, 2003.

[11] The Soviet Union was instrumental in assisting China's space program in the late 1950s, but political relationships between the two countries deteriorated soon thereafter and Soviet technical assistance ended in 1960. See Yanping Chen, op. cit., p. 117.

[12] Russia: First Chinese Astronaut Trained in Star City, Russia. Moscow Interfax in English, October 1, 2003, 1155 GMT (via FBIS)

[13] See Clark, op. cit., pp. 161, 164.

[14] China, EU Sign Cooperative Agreement to Jointly Develop Galileo Project. Beijing, Xinhua in English, September 19, 2003, 0940 GMT (via FBIS). China's existing navigation satellite system, Beidou, uses satellites in geostationary orbit. It is a different technical approach than that used by GPS and Galileo (and Russia's GLONASS), and provides only regional, rather than global, coverage.