Cute companions

Young adults turn to plush toys to seek comfort, lift their spirits

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ROK president courts fresh controversy

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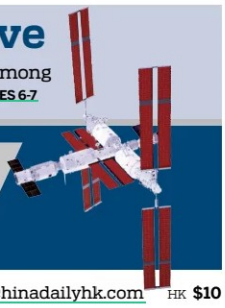
Up, up and above

Lunar, solar, Martian explorations among highlights of space journey CHINA, PAGES 6-7



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CHINA

Spectators observe the retrieval of a lunar soil sample on the Chang'e 6 mission, displayed at the 15th China International Aviation and Aerospace Exhibition in Zhuhai, Guangdong province, last month.
HONG ZEHUA / XINHUA

14 The number of crewed spaceflights made by China since the country's first manned mission in 2003

24 The number of Chinese astronauts who have taken part in spaceflight

The lander-ascender of the Chang'e 6 mission. XINHUA

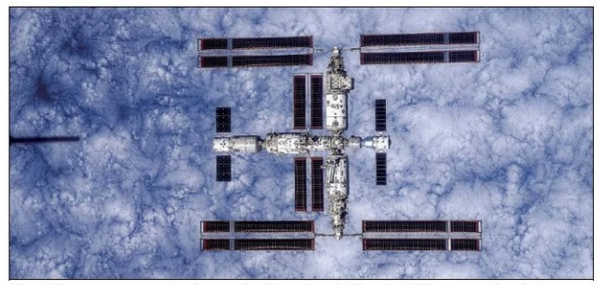
1,000 Estimated number Chinese satellites working in Earth's orbit

26 The number of carrier rocket models in service in China, 16 of which are members of the Long March family

NATION'S SPACE JOURNEY CONTINUES APACE

Lunar, solar, Martian explorations among latest moves as State, private sectors advance side by side

The Shenzhou XVIII manned spaceship atop a Long March 2F carrier rocket is transported to its launch pad at the Jiuquan Satellite Launch Center on April 17. WANG JIANGBO / FOR CHINA DAILY



China's Tiangong space station photographed from above by Shenzhou XVI crew members last year.
PROVIDED TO CHINA DAILY

By ZHAO LEI
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The first-ever samples retrieved from the moon's far side, an iconic feat achieved by China's most recent lunar expedition, Chang'e 6, were on display at the 15th China International Aviation and Aerospace Exhibition, which took place in Zhuhai, Guangdong province, from Nov 12 to 17.

This was the first time the valuable lunar substances had been shown to the public since they were brought back to Earth in June.

The Chang'e 6 mission, representing the world's first attempt to bring back samples from the far side of the moon, was launched on May 3 from the Wenchang Space Launch Center in Hainan province.

After a series of complex maneuvers, the lander of the Chang'e 6 probe touched down at the South Pole-Aitken Basin on the lunar far side on June 2, and then began to collect surface and underground samples.

It was the second-ever landing of a spacecraft on the lunar far side. The vast region had never been reached by any spacecraft until January 2019, when the Chang'e 4 probe landed in the South Pole-Aitken Basin. Chang'e 4 surveyed areas surrounding its landing site, but did not collect samples.

The lander worked for 49 hours on the far side, using a mechanical arm and a drill to collect surface and underground materials.

The unmanned mission successfully concluded on June 25 with a total of 1,935.3 grams of samples from the far side retrieved.

The samples have unique scientific value and will further expand knowledge about the moon's history and help to gear up the exploration and exploitation of lunar resources, according to the China National Space Administration.

Previously, 10 lunar sample-return missions were undertaken by the United States, the former Soviet Union and China, but all these samples were collected from the moon's near side.

Before Chang'e 6, China had fulfilled a lunar sample-return mission — the Chang'e 5 in the winter of 2020, which landed on the moon's near side and recovered 1,731 grams of samples, the first lunar substances obtained since the Apollo era. It made China the third nation, after the US and the former Soviet Union, to have retrieved lunar samples.

So far, Chang'e 5 samples have enabled Chinese researchers to make a number of academic advancements, including the discovery of the sixth new lunar mineral, named Changesite-(Y).

Changesite-(Y), which falls in the category of lunar merrillite, is the first lunar mineral discovered and identified by Chinese scientists.

So far, China has conducted six robotic missions to explore the moon.

Besides the sample-collection endeavors, China has also deployed two rovers on the moon through the Chang'e 3 and Chang'e 4 missions.

The Yutu 2 rover, the central part of the Chang'e 4 mission, has worked on the moon for nearly six years, far exceeding its designed life of three months, and has traveled more than 1,600 meters, continuing to extend its lead as the longest-working robot on the moon.

In the coming years, China plans to continue to send unmanned probes to the moon and use the next two missions — Chang'e 7 and Chang'e 8 — to establish a prototype for the International Lunar Research Station, an ambitious multinational science project initiated by China.

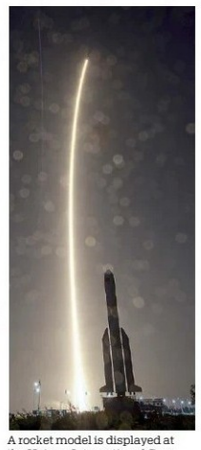
Crew landing roadmap

Having gathered rich experience through robotic adventures, China is moving progressively toward its goal of sending astronauts to the moon before the end of this decade, according to a key figure in this ambitious endeavor.

Zhou Jianping, chief designer of China's manned space program, told a crewed spaceflight forum in late November in Shenzhen, Guangdong province, that all of the preparatory research work for the nation's first manned lunar mission has finished, with essential technologies and implementation plans already in place.

Mission planners, scientists and engineers have started to design and build prototypes of necessary hardware, he said.

"Currently, prototypes of the Long March 10 heavy-lift carrier rocket, the Mengzhou crew spaceship, the Lanyue lunar lander, as well as the crew rover and other hardware needed in a manned mission to the moon are under research and development. Some of their components have been made and are being tested," Zhou said at the forum, hosted by the China Manned Space Agency.



A rocket model is displayed at the Hainan International Commercial Aerospace Launch Center, as a rocket is launched at its adjacent Wenchang Space Launch Center in Hainan province, on June 29. PU XIAOXU /XINHUA

75 years on

China's roadmap for its first manned lunar expedition involves two Long March 10 launches from the Wenchang Space Launch Center in Hainan province to transport a Lanyue lunar lander and a Mengzhou manned spacecraft to lunar orbit.

After reaching their preset orbital positions, the Lanyue lander and the Mengzhou vessel will rendezvous and dock with each other. Two crew members will enter the lander, which will then undock and descend toward the lunar surface for an engine-assisted soft landing.

On the moon, the astronauts will drive a rover to carry out scientific tasks and collect samples. Upon completion of their assignments, they will return to the Lanyue module, which will fly them back to their spaceship waiting in lunar orbit.

Finally, the astronauts will carry the samples into their Mengzhou spacecraft, which will then undock and carry the crew back to Earth.

To prepare for the challenging adventure, China has selected its fourth group of astronauts, who are learning knowledge and skills to be used in lunar operations.

If everything goes according to plan, China will become the second nation in the world, after the US, to have sent humans to the moon. The US made six Apollo crewed missions in the 1960s and 1970s, taking 12 Americans to the silver celestial neighbor.

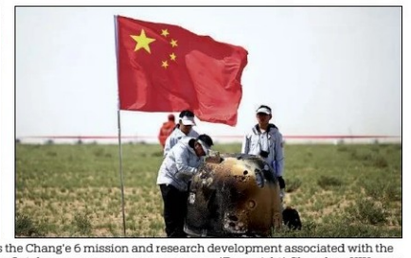
In the long term, the country intends to construct a lunar scientific outpost to conduct extended explorations and technology demonstration operations, according to Zhang Hailian, deputy chief planner at the China Manned Space Agency.

"The moon is the nearest extraterrestrial body that humans can reach based on current technologies. Manned missions to the moon will be a realistic and practical step ... to start with (in order) to expand our exploration endeavors in deep space. Meanwhile, it is scientifically meaningful for us to continue to explore the moon because it will help scientists better understand the origin and the evolution of the solar system as well as the composition of planets," he said.

Deep-space adventures

Beyond the moon, China has left its mark on another extraterrestrial body in the solar system — Mars — via the Tianwen 1 mission, which was launched in July 2020 as the country's first independent interplanetary expedition.

The landing craft of Tianwen 1 touched down on the Martian surface in May 2021 after traveling more than 470 million kilometers and going through an extremely challenging landing process. Soon after landing, it released a rover named Zhurong to perform scientific tasks.



From left: Guan Feng, director of the Lunar Exploration and Space Engineering Center of the China National Space Administration, introduces the Chang'e 6 mission and research development associated with the lunar soil sample the mission had retrieved from the far side of the moon during the 75th International Astronautical Congress in Milan, Italy, in October. DE YONGJIAN / CHINA NEWS SERVICE (From right) Shenzhou XIX crew members Cai Xuzhe, Song Lingdong and Wang Haoze salute the crowd at the Jiuquan Satellite Launch Center on Oct 30 before the mission. LI ZHIPENG / XINHUA The returner of the Chang'e 6 mission, containing lunar soil samples, successfully lands in Siziwang Banner, Inner Mongolia autonomous region, on June 25. BEI HE / XINHUA

Before Tianwen 1, no country had ever tried to send an orbiter, a lander and a rover in one single flight to Mars.

Zhurong, the sixth rover deployed on the Red Planet, following five predecessors from the US, traveled more than 1,900 meters in its yearlong journey and obtained much data and many images en route to its destination — an ancient coastal area on Utopia Planitia, a vast Martian plain.

China plans to collect Martian samples and bring them back to Earth in around 2028 via another historic mission named Tianwen 3.

The main scientific goal of this mission is to look for traces of life on Mars, according to Liu Jizhong, chief planner of the Martian soil-return project.

He said in September that Chinese researchers "are working on essential technologies to be used in the robotic expedition such as sampling and liftoff on the Martian surface".

Chinese scientists have also placed two solar observation satellites in orbit. The spacecraft have achieved major scientific and technological feats that have helped scientists to deepen their knowledge of our nearest star.

The Chinese H-Alpha Solar Explorer, known as Xihe, was launched in October 2021 from the Taiyuan Satellite Launch Center in Shanxi province to become the nation's first space-based solar telescope. Its scientific payload is an H-Alpha imaging spectrograph that can, for the first time, acquire full-disk spectroscopic solar observations in the H-Alpha waveband.

Its primary task is to investigate the dynamics of solar activity in the lower atmosphere, namely the photosphere and chromosphere, and to understand the physical mechanisms of solar eruptions. The mission is very meaningful to the nation's space exploration and satellite technology, mission planners said.

One year later, the second solar explorer, the Advanced Space-based Solar Observatory, or Kuafu 1, was launched from the Jiuquan Satellite Launch Center in Northwest China.

Carrying cutting-edge apparatus such as a full-disc vector magnetograph and a hard X-ray imager, the Kuafu 1 aims at exploring connections among solar magnetic fields, solar flares and coronal mass ejections.

Orbital outpost

In a low-Earth orbit about 400 km above the ground, China's Tiangong space station has been traveling around the mother planet for about three years and seven months.

The origin of China's aspirations to operate its own space station can be traced back to the mid-1980s when a group of distinguished space scientists started calling for government support to open manned space programs so that China would not lag behind in the global arena of space exploration.

In 1986, the government launched what later became known as Project 863. The national high-tech project covered seven major fields, ranging from biology to new energy. It set two major goals for China's space sector: one was to build large carrier rockets and reusable aerospace vehicles; the other was to construct a space station.

In September 1992, a massive plan made by scientists for crewed spaceflights and a permanent space station was approved by the top leadership, officially beginning the nation's manned space program.

Since then, the Chinese space community has made specific plans and taken a systematic approach, advancing patiently from simple, multi-day missions to sophisticated, monthlong flights involving several spacecraft.

After nearly 30 years of preparations that included five unmanned flights and six crewed missions, China launched the first, and central, component of its space station, the Tianhe core module, in April 2021, and began to send astronauts to fly with it to perform trial operations and prepare for the arrival of other parts.

In the second half of 2022, the Wentian and Mengtian science modules were launched to dock with Tiangong, completing the space station's construction phase.

The Tiangong is one of the largest and most advanced structures ever deployed in Earth's orbit and is the only operating space station independently built by a single nation.

So far, eight crews have been sent to man the space station, including the incumbent Shenzhou XIX team, who arrived at the outpost in late October.

Private power rising

Besides State-funded projects, China's private enterprises have become serious players in the space circle.

So far, five private companies — Space Pioneer, i-Space, LandSpace, Galactic Energy and Orienspace — have used their own rockets to conduct orbital missions, which refer to powered flights that place satellites or other kinds of payloads in orbit in outer space.

Among the privately developed rocket models, LandSpace's ZQ-2 and Orienspace's Gravity 1 are most known because they set records in the global space sector.

In July last year, the ZQ-2 became the first methane-fueled rocket to successfully complete an orbital mission.

The rocket model's main propulsion system — the TQ-12 — is the first methane engine in China. Before LandSpace, only a handful of companies in the US had developed such engines.

Compared with traditional types of rocket engines that can function only once, a methane engine is reusable and more environmentally friendly.

In January, the Gravity 1 conducted its debut flight from a launch service ship off the coast of Haiyang in Shandong province, becoming the most powerful solid-propellant launch vehicle in the world and also the mightiest of all of Chinese private rocket types.

Private players have also come of age in the satellite field to become a flourishing seedbed for technological innovation and creativity.

GalaxySpace, a leading private satellite maker, built China's first satellite equipped with a flexible solar array and deployed it into space in July last year.

The satellite, Lingxi 03, is a plate-shaped communications satellite. It has a millimeter-wave multibeam digital payload, which features a transmission capacity of tens of gigabits per second.

In May, GalaxySpace cooperated with the Mahanakorn University of Technology in Thailand to establish a ground test station at the Thai university, marking the first trial of a low-orbit broadband internet communication network in the Southeast Asian country.

Private industry holds keys to China's cosmic success

ZHAO LEI
Reporter's log

As a reporter covering China's space programs, I have witnessed dozens of liftoffs when a gigantic rocket soars into the skies. I have talked with many Chinese astronauts and seen capsules and samples returned from the moon. I am proud of the accomplishments made by Chinese scientists and engineers.

However, being proud is not equal to being complacent or even arrogant. I know clearly that China still lags behind the superpower in the global space arena — the United States — in many aspects. And I am convinced that only attention, support and funds from the government alone are no longer enough to ensure that China can continue to keep pace with the US in terms of developing orbital resources or establishing a human presence on the moon or even on Mars.

To achieve our goals and maintain our competitiveness, we must go full speed on a roadmap that has been laid out for several years yet is still restricted by institutional obstacles in policies and State-funded programs. The core essence of the roadmap is commercialization.

I am not calling for weakening State-owned contractors' roles in the space sector — they have actually excelled in national projects ranging from building a space station to putting a rover on Mars. I am urging more attention, fair opportunities and unbiased policies for private players.

For example, look at what SpaceX has achieved: it has made reusable rockets including a gigantic type even bigger than the Saturn V used in the Apollo missions, and has formed a massive network of more than 7,000 satellites — and the number continues to grow.

The success of SpaceX has testified to a truth that has been corroborated in many other circles: fair competition and diversification, together with appropriate management and supervision from authorities, lead to a robust market and business prosperity, and consequently improve a country's overall capability in that field.

It is true that our space authorities have been striving to bolster commercialization by encouraging private companies to take part in State programs and giving more resources to such enterprises, and that Chinese private companies have made remarkable progress such as fulfilling the world's first orbital flight of a methane-fueled rocket.

However, Zhang Shijie, a senior spacecraft researcher and chief scientist at GalaxySpace, a leading private satellite maker in Beijing, told me that more efforts are needed, such as providing a higher level of market access for private companies and removing outdated constraints that hinder private players' growth.

Zhang was apparently restraining himself from making complaints in front of me. As far as I know, it is not uncommon for private enterprises to have difficulties getting access to State-owned spacecraft research, testing and telemetry infrastructure, or receiving opportunities to take part in national space programs.

Therefore, I hope that space authorities and State-owned conglomerates can offer more favorable policies and support to our private enterprises to help them become stronger, thus improving China's overall capability in the global space arena.

China's land-based launch centers

Milestones in China's space sector

Oct 8, 1956
The Fifth Academy of the Ministry of National Defense — China's first rocket research body — is founded in Beijing. The date is now recognized as the birthday of the country's space industry.

April 24, 1970
China launches its first carrier rocket — a Long March 1, which is a de facto modified long-range ballistic missile, from the Jiuquan Satellite Launch Center in Inner Mongolia to place the country's first satellite, the Dongfanghong 1, into orbit. This mission makes China the fifth nation capable of launching its own spacecraft into orbit.

Nov 26, 1975
China deploys a recoverable remote-sensing satellite in orbit for the first time. The satellite, named Jianbing 1, or Scout 1, is launched by a Long March 2 rocket from the Jiuquan center, and is used for optical reconnaissance.

Sept 20, 1981
China launches a Fengbao 1, or Storm 1, rocket to deploy three satellites into space, becoming the fourth country able to place multiple satellites via a single launch.

April 8, 1984
China's first experimental communications satellite — Dongfanghong 2-0B — is lifted by a Long March 3 rocket from the Xichang Satellite Launch Center in Sichuan province, marking the completion of a decade-long endeavor to develop a Chinese communications satellite.

Sept 7, 1988
China launches its first weather satellite, Fengyun 1A, from the Taiyuan Satellite Launch Center in Shanxi province. Since, it has deployed 21 Fengyun meteorological satellites into space.

April 7, 1990
China uses a Long March 3 rocket at the Xichang center to place the AsiaSat 1 communications satellite into a geostationary transfer orbit. The spacecraft is built by the Hughes Aircraft in the United States and operated by Hong Kong-based Asia Satellite Telecommunications. The launch marks the first time for China to lift a foreign satellite.

Nov 20, 1999
China launches the first prototype of its Shenzhou crewed spaceship from the Jiuquan center for technology demonstration and systems tests. The unmanned craft circles Earth 14 times before returning. The mission officially unveils the country's manned space program.

Oct 15, 2003
China's first manned spaceflight, the Shenzhou V mission, is launched from the Jiuquan center, sending astronaut Yang Liwei on a 21-hour journey around the planet. China becomes the third nation, following the former Soviet Union and the United States, capable of independent manned spaceflight.

Oct 24, 2007
China's first lunar explorer, the Chang'e 1 is launched by a Long March 3A rocket. It successfully verifies the country's lunar probe technologies.

Sept 27, 2008
Astronauts Zhai Zhigang and Liu Boming complete the country's first extravehicular activity, commonly known as a spacewalk, during the three-day Shenzhou VII mission. Their short adventure makes China the third nation, following the former Soviet Union and the US, tha can independently conduct a spacewall

Sept 29, 2011
China launches a Long March 2F rock from the Jiuquan center to place the country's first prototype space station Tiangong 1. The experimental station an the Shenzhou VIII unmanned spaceship complete the first orbital docking betwe any Chinese spacecraft on Nov 3, 2011.

April 26, 2013
The first satellite in China's space-based high-resolution Earth observatio system, Gaofen 1, is sent into space aboard a Long March 2D rocket.

Dec 2, 2013
The Chang'e 3 mission begins, with the aim of sending a robotic probe to the moon. After a 12-day flight, the probe lands on the silver sphere, becoming the first Chinese spacecraft to do so and the first craft from any country to achieve the goal in nearly four decades. Yutu, the first Chinese lunar rover, moves onto lunar soil on Dec 15 and begins operations.

Nov 3, 2016
The Long March 5 rocket makes its debut flight at the Wenchang center, becoming the biggest, heaviest and mightiest in China's launch vehicle family. The 57-meter rocket has a liftoff weight of 869 tons.

Dec 8, 2018
China's fourth lunar probe, Chang'e 4, is launched from the Xichang center toward the far side of the moon. After a 26-day journey, the robotic spacecraft lands in the Von Karman Crater, beginning humanity's first close observation of the lunar far side. The Yutu 2 rover has worked on the moon for nearly 2,200 days and traveled more than 1,600 meters on the lunar soil, making it the longest-working rover ever.

June 5, 2019
A Long March 11 solid-propellant carrier rocket is used for China's first seaborne space launch in its territorial waters. Prior to the mission, the country had conducted more than 310 carrier rocket launches at its four land-based space launch centers.

July 25, 2019
Beijing startup i-Space becomes China's first private enterprise to successfully conduct an orbital mission. The company launches its SQX-1 carrier rocket from the Jiuquan center, sending two satellites and three experimental payloads into space.

July 31, 2020
The domestically developed Beidou Navigation Satellite System is completed and starts providing full-scale global services. Beidou is now one of the two space-based navigation networks with global coverage, the other is GPS operated by the US.

Nov 24, 2020
The Chang'e 5 robotic moon mission is launched from the Wenchang center. After landing on Dec 1, it brings 1,731 grams of lunar rock and soil back to the Earth. The 23-day mission makes China the third country to retrieve lunar samples.

July 23, 2020
The Tianwen 1 mission, the nation's first independent interplanetary exploration, is launched from the Wenchang spaceport. It travels more than 470 million kilometers before entering Mars' orbit in February 2021. Its rover named Zhurong touches down on the planet on May 15, 2021, and begins work on the surface a week later.

April 29, 2021
In-orbit construction of the Tiangong space station begins as the Tianhe core module — the first and central component — is launched. The module has three parts: a connection section; a life-support and control section; and a resources section.

Dec 31, 2022
President Xi Jinping announces the completion of the Tiangong space station in his New Year address, marking the realization of a grand aspiration pursued by Chinese scientists and space industry workers for three decades. The Tiangong consists of three major components: a core module and two science lab modules and is regularly connected with visiting spaceships.

May 3, 2024
The Chang'e 6 mission, representing the world's first attempt to bring samples from the far side of the moon, is launched from the Wenchang center. Its lander touches down at the South Pole-Aitken Basin on the lunar far side on June 2. The robotic mission successfully concludes on June 25 as a total of 1,935.3 grams of samples from the lunar far side are brought back.

ZHAO LEI