# Shenzhou 15 Completes All Scheduled Tasks in Space for Half a Year

**The Shenzhou 15 mission is the sixth mission of China's manned space program in 2022, and it is also the last mission during the construction phase of China's space station. The crew will work and live in orbit for 6 months. The main purpose of the mission is to verify that the space station supports crew rotation capabilities, realizing the first on-orbit rotation of astronaut crews; carrying out the installation and commissioning of equipment inside and outside the space station and space application mission-related facilities and equipment, conducting space science experiments and technical tests; performing daily maintenance and repair of the space station which is the normal operation mode of the cabin assembly. Aerospace members are Fei Junlong, Deng Qingming and Zhang Lu.**

The two crews of Shenzhou 15 and Shenzhou 14 will meet in space for an on-orbit handover, which is the primary highlight of this mission. On-orbit handover will be the main task handover mode during the operation of China's space station in the future, which is more efficient and reliable than ground handover.

The crew of Shenzhou 15, as the first crew to visit after the completion of the space station's in-orbit construction, will carry out the long-term residency verification work for the status of the third cabin of the space station; the astronauts will complete the

unlocking, installation and testing of 15 scientific experiment cabinets, and carry out covering more than 40 space science experiments and technical experiments in the fields of space science research and application, aerospace medicine, and aerospace technology; 3 to 4 out-of-cabin activities are planned to be carried out, and the cargo airlock of the Mengtian experimental cabin will be used to transfer items for the first time.

During the space flight mission, the two manned spacecraft, Shen XIV and Shen XV, docked at the space station at the same time for the first time. Shenzhou 15 docked at the forward port of the Tianhe core module, and the two spacecraft simultaneously carried out normal operations with the space station, such as information transmission, ventilation and heat exchange, and grid-connected power supply.

During the Shenzhou 15 flight mission, the Shenzhou 15 crew will focus on six aspects of work:

The first is to carry out the long-term residency verification of the status of the third cabin of the space station; the second is to complete the unlocking, installation and testing of 15 scientific experiment cabinets, and carry out more than 40 space science experiments and technologies in the fields of space science research and application, space medicine, space technology, etc. test; the third is to implement 3 to 4 out-of-cabin activities, and complete the installation of the Mengtian cabin expansion pump set and the load exposure platform equipment; the fourth is to verify the cargo airlock cabin out-of-cabin working mode, and cooperate with the ground to complete 6 times of cargo out-of-cabin; the fifth is to carry out normalized platform testing, maintenance and station management; the sixth is to carry out on-orbit health protection exercises, on-orbit training and drills, etc.

On February 9, 2023, the crew of Shenzhou 15 astronauts ushered in the first "space walk". At 0:16 on the 10th, after about 7 hours of out-of-vehicle activities, Shenzhou 15 astronauts Fei Junlong, Deng Qingming, and Zhang Lu cooperated to complete all the scheduled tasks for out-of-vehicle activities. First outing. In this mission, the activities of astronauts going out of the cabin covered three sections of the space station, the Tianhe Core Module, the Wentian Experimental Module and the Mengtian Experimental Module.

On March 2, 2023, with the cooperation of the ground staff and astronaut Deng Qingming, the two crew members of Shenzhou 15, Fei Junlong and Zhang Lu, went out of the cabin for the second time. Complete all the scheduled work tasks and return to the Wentian Experimental Cabin safely.

On November 29, 2022, samples and experimental units of two scientific experiments nicknamed "Little Cube" of life sciences, led by the Chinese Academy of Sciences, are responsible for the development of China's manned spaceflight engineering space application system - "Space Radiation Measurement and Biological Damage Evaluation Technology" and "Research on Molecular Networks of Plant Cell Structure and Function Regulated by Space Microgravity Environment", took the successfully launched Shenzhou 15 manned spacecraft into space, and went to the Chinese space station to carry out space science research.

The "Space Radiation Measurement and Biological Damage Assessment Technology" experiment will be carried out in the small general-purpose cultivation experiment module of the life ecology experiment cabinet in the Wentian Experimental Cabin of the Chinese Space Station, and a single nematode will be cultivated and optically monitored through the fluid control of the microfluidic chip and analysis technology, realize on-orbit detection of radiation damage markers, establish a method for space radiation measurement and biological damage assessment, and provide important support for space radiation damage assessment and medical diagnosis and protection; through systematic biological analysis of returned nematode samples , to reveal the molecular mechanism of space radiation on radiation damage and repair of nematodes, and to study the synergistic mechanism of space radiation and microgravity biological effects.

The experiment of "Study on Molecular Networks of Plant Cell Structure and Function Regulated by Space Microgravity Environment" will be carried out in the general biological cultivation experiment module of

**The Shenzhou 15 flight mission is the last item in the construction phase of China's space station, and it is also the first project in the application and development phase of the space station. It plays an important role in linking the past and the future**

the Life Ecology Experiment Cabinet in Wentian Experiment Cabin, through the study of space microgravity environment to regulate plant cell structure and function to reveal the signal transduction mechanism and regulatory network of plants feeling the microgravity environment; to study the mechanism of hormone transport system involved in plant response to microgravity, the mechanism of microgravity-induced transcription factors regulating plant cell wall formation, and to clarify the plant's response to space microgravity mechanisms of environmental adaptation.

Six hours before the launch of Shenzhou 15, the cabin door of the spacecraft was opened, and the operator installed some "fresh" materials in the orbital cabin of the spacecraft. They will set off with the astronauts and take the "express train" to the Chinese space station. In this batch of temporarily boarded materials, there are nematodes and plants required for biological experiment projects, which have high requirements on the environment. For this reason, the researchers artificially created a transportation "Cold Chain" to quickly load the goods before launch to ensure that the experiment timeliness of items. Fresh fruits enjoy similar treatment. As one of the most popular foods for astronauts in the space station, seasonal fresh fruits such as apples and grapes will also arrive at the space station in the freshest and

On January 12, 2023, the China Manned Space Project officially announced the list of space breeding experiment projects for the Shenzhou 14 and Shenzhou 15 manned spacecraft. It is reported that the Shenzhou 14 and Shenzhou 15 manned spacecraft carried more than 1,300 copies of space breeding materials such as crop seeds and microbial strains from 112 units.

On June 4, 2023, the fourth batch of space science experiment samples of the Chinese Space Station returned to the ground with the return capsule of the Shenzhou 15 spacecraft, and delivered the space application system led by the Chinese Academy of Sciences at the Dongfeng Landing Field. At around 14:00 on the 4th, some experimental samples arrived at the Space Application Engineering and Technology Center of the Chinese Academy of Sciences in Beijing.

The space application system went down with the return module of the Shenzhou 15 spacecraft for experimental samples of 15 scientific projects, including life experimental samples such as cells, nematodes, Arabidopsis, and ratooned rice, as well as various alloy materials, new infrared detector materials, amorphous material experimental samples such as thin film materials. The total weight of downlink experimental samples is more than 20 kg.

The manned flight mission of Shenzhou 15 is the last flight mission in the construction stage of China's space station. After the rendezvous and docking of the spacecraft and the space station assembly, the Chinese space station will have a unique shape, namely, the core module of Tianhe, the experimental module of Wentian, and the experimental module of Mengtian. module, two manned spacecraft and Tianzhou-5 cargo spacecraft to form a combination of "three cabins and three ships".

The flight of Shenzhou 15 is the 27th mission since the establishment and implementation of China's manned space program, and it is also the fourth manned mission after entering the space station stage. The success of this launch marks the successful completion of all 12 launch missions planned for the key technology verification and construction stages of the space station. Since the launch of the Tianhe core module at the end of April 2021, China Aerospace has successfully organized 3 space station modules, 4 manned spacecraft and 4 cargo spacecraft at the two launch sites of Wenchang and Jiuquan in less than 20 months. Launch, the shortest interval between two missions at the same launch site is only 12 days. The 30-year-old manned spaceflight project has achieved the "acceleration" of China's aerospace industry on the new journey of exploring the vast universe with an excellent record of successive victories and missions

## Shenzhou 15 completes all scheduled tasks

During its in-orbit period, the crew of Shenzhou 15 completed 4 out-of-cabin activities, 8 human factors engineering technology research, 28 aerospace medical experiments, 38 space science experiments and experiments, and long-term residence verification of the status of the third cabin of the space station, etc. The work in 6 aspects has successfully completed all the established tasks and obtained valuable experimental data.

Extravehicular activities are a very important task for astronauts during their orbit. The three astronauts of "God Fifteen" worked closely together. From February 10 to April 15 this year, they completed four out-of-vehicle missions in two months. This not only enabled completion of the first out-of-vehicle activities of astronauts after the completion of the Chinese space station, but also refreshed Records of Chinese astronauts' single crew out-of-vehicle activities.

## Shenzhou Fifteen has achieved fruitful scientific research

During the in-orbit period, the crew of Shenzhou 15 astronauts used the space station two-photon microscope independently developed by China to carry out on-orbit verification experiments and achieved success. This is the world's first known use of a two-photon microscope to obtain three-dimensional images of the epidermis and superficial dermis of an astronaut's skin during a space flight, providing a new tool for future on-orbit health monitoring research on astronauts.

During the in-orbit period, the astronaut crew of Shenzhou 15 also completed the on-orbit test of the space-efficient free-piston stirling thermoelectric conversion test device, which is also the first time that China has realized the on-orbit verification of this technology. Stirling thermoelectric conversion is one of the key technologies for space new energy. It can efficiently convert heat energy into electrical energy, and has the advantages of simple structure, light weight, and fast start-up. It can reduce the dependence on traditional solar energy and manned the moon in the future. It has broad application prospects in space missions such as deep space exploration and so on.

In March of this year, with the cooperation of ground researchers and astronauts, the experimental system in the Mengtiancai combustion science cabinet successfully performed the first on-orbit ignition test. The ignition experiment used Methane as fuel, and the high-speed camera clearly captured the entire ignition and combustion process. This experiment verified the completeness of the functions of the space station combustion science experiment system, as well as the accuracy and scientificity of the overall experiment process.

In May of this year, the three astronauts also realized the on-orbit observation of the generation process of conductive ring wear debris and the phenomenon of clusters for the first time. A good foundation has been laid.

On June 3, 2023, the Shenzhou 15 manned spacecraft and the space station assembly were successfully separated. Before the separation, the astronaut crew of Shenzhou 15, with the cooperation of the ground personnel, completed various tasks before the evacuation, such as setting the status of the space station assembly, sorting and downloading experimental data, cleaning and transferring materials left in orbit, and cooperated with the crew of Shenzhou 16. The group completed the work handover.

On June 4, 2023, the return capsule of the Shenzhou 15 manned spacecraft successfully landed at the Dongfeng Landing Field, and the Shenzhou 15 manned flight mission was a complete success.

From top to bottom, the astronauts Fei Junlong, Zhang Lu, and Deng Qingming left the warehouse safely

The picture on the left shows that the manned spacecraft is separated from the space station and is about to return to Earth. From left to right are Zhang Lu, Fei Junlong and Deng Qingming