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Left: Astronaut Nie Haisheng undergoes a training session in a pool that mimics weightlessness in January. **MING FANGZHOU / XINHUA**



Right: Astronauts Nie Haisheng (center), Liu Boming (right) and Tang Hongbo greet onlookers after they landed in the reentry capsule of the Shenzhou XIII mission in the Inner Mongolia autonomous region last month. **LIAN ZHEN / XINHUA**

Building a home in the sky

After initial solid steps, upcoming missions will ensure operation of China's Tiangong space station, **Zhao Lei** reports.

China plans to conduct its Shenzhou XIII manned space flight this month, sending three astronauts to stay six months inside the country's Tiangong space station. During their mission, the astronauts, whose names have yet to be disclosed, will be mainly tasked with demonstrating and testing key technologies involved in the assembly and future operations of the Chinese space station, according to Zhou Yangfang, a chief designer at the China Manned Space Agency's Technical Bureau.

Specifically speaking, they will verify the equipment and technologies for longtime flight with the station. Like their peers in the Shenzhou XII mission, they will carry out spacewalks to test the robotic arm and other instruments for extravehicular activities, and will also conduct scientific experiments to accumulate experience for the station's construction and operations, Zhou said.

Shenzhou XIII will be the fourth spacecraft to visit China's permanent space station, named Tiangong, or Heavenly Palace, and also the second crewed ship to transport astronauts to the orbiting outpost.

The first astronauts inside Tiangong — Major General Nie Haisheng, Major General Liu Boming and Senior Colonel Tang Hongbo — finished their 92-day Shenzhou XII mission in mid-September.

They flew 90 days with Tiangong and made two spacewalks to use a large robotic arm and other equipment to install and adjust devices outside the station. They also performed a number of scientific experiments and technological tests, and made video calls with President Xi Jinping and hundreds of researchers, teachers and students in Hong Kong.

Their work was expected to enable the China Manned Space Agency to accumulate experience and check the capability, performance and compatibility of systems involved in the Tiangong space station program to prepare for the next steps in its construction.

One of China's most challenging and sophisticated space endeavors, Tiangong will consist of three main components — a core module attached to two space labs — with a combined weight of nearly 70 met-

ric tons. The entire station is set to work for about 15 years in a low-Earth orbit about 400 kilometers above the planet.

The station's core module — Tianhe, or Harmony of Heavens, was lifted by a Long March 5B heavy-lift rocket at the Wenchang Space Launch Center in Hainan province in late April.

The biggest and heaviest spacecraft China has ever constructed, Tianhe is 16.6 meters long and has a diameter of 4.2 meters. The craft's weight, at 22.5 tons, is equal to the combined weight of 15 standard-size automobiles. It has three parts: a connecting section, a life-support and control section, and a resource section.

The craft is now connected with the Tianzhou 2 robotic cargo ship that was launched from the Wenchang facility in late May and the Tianzhou 3, which was lifted from Tiangong last month.

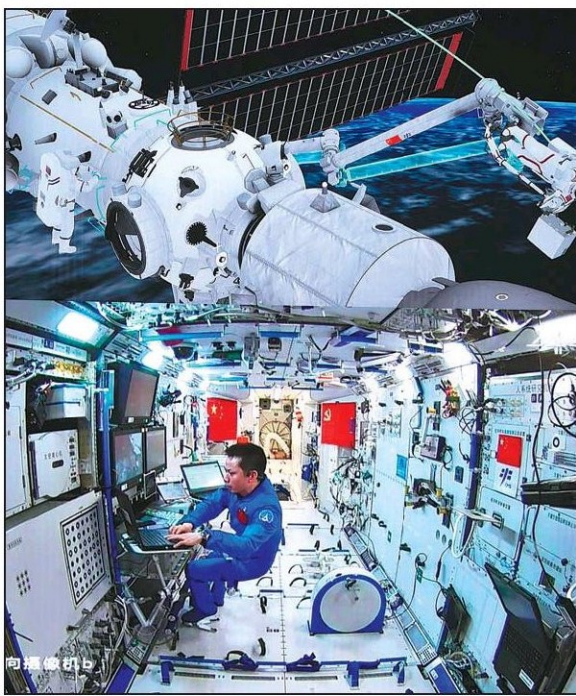
In 2022, two large space labs will be launched to connect with the core module. Moreover, two manned missions and two robotic cargo flights will be made that year to continue construction of the Tiangong station, which is scheduled to become complete and start formal operation around the end of 2022.

Upon its completion, Tiangong will be manned regularly by groups of three astronauts in periods lasting several months. During handovers to new three-astronaut groups, the station will accommodate up to six astronauts.

In April 1971, the former Soviet Union became the first in the world to operate a space station with the deployment of its Salyut 1 station in a low-Earth orbit. Since then, 10 space stations have been launched and most of them were built by the Soviet Union.

Before Tiangong, the only operational station was the International Space Station, a joint effort by several national space agencies including the United States' NASA and Russia's Roscosmos. However, China has been excluded from the project since its very beginning mainly because of US objections.

The first part of the 419-ton ISS, the largest and heaviest spacecraft mankind has ever built, was launched in 1998 by a Russian rocket, and since then the station has gradually taken shape as more com-



A dual image captured from inside the command center shows Tang Hongbo (below) working inside the core module of China's Tiangong space station (above) in August. **TIAN DONGYU / XINHUA**

ponents were lifted and assembled. The station was completed in 2011 and is reportedly set to retire by the end of the decade, which will likely leave the Tiangong as the only operational station until the next station is constructed in orbit.

Scientific platform

Hao Chun, director of the China Manned Space Agency, has said his

agency will strive to ensure that it makes the best use of the Tiangong to advance space science, technology and application.

He said scientists will be able to take advantage of the facility's unique environment to perform mutation breeding experiments, produce special medicines and create new materials, thus generating scientific, technological and economic benefits.

In addition, the agency has signed agreements with the United Nations Office for Outer Space Affairs on space station cooperation. The two organizations have jointly issued a statement inviting scientists from around the world to submit their research proposals for an opportunity to conduct their own experiments aboard the Chinese station.

"As of now, 17 nations have confirmed their participation in nine scientific tasks on our station, with related work proceeding well," Hao told China Daily in an earlier interview. "We will continue working with the UN's outer space office to solicit proposals for future scientific collaborations."

The official said there will be more than 20 cabins aboard the station reserved for scientific instruments that were designed in accordance with international standards, adding that they will be available for collaborators.

Moreover, Hao said there def-

nately will be foreign astronauts on the Chinese station.

Zhao Lijian, a spokesman for the Foreign Ministry, said at a daily briefing after the Shenzhou XII crew returned to Earth that China's manned space programs have contributed greatly to mankind's peaceful development of outer space, and the country will continue broadening and deepening its cooperation and communication with the international community to build the Chinese space station into a shared laboratory to bring benefits to all people on the globe.

Continuous efforts

To support the Tiangong program, the Astronaut Center of China has been training the third group of Chinese astronauts since October 2020.

The 18 new astronauts — 17 men and one woman — are in three groups: seven will become spacecraft pilots, another seven will be space flight engineers and the last four mission payload specialists, according to the China Manned Space Agency.

They are undergoing systematic and sophisticated training before qualifying for space missions, it said.

Before them, China had 21 astronauts from two generations. Among them, 12 have taken part in space flights during seven missions. Sever-

al in the two generations who had not taken part in any space flight during their service have retired.

The selection for the third-generation team began in May 2018 and finished in September 2020, involving three rounds of tests. About 2,500 applicants participated in the process.

The new spaceship pilots were chosen from aviators from the People's Liberation Army Air Force. The space flight engineers are former researchers or technicians in aerodynamics, astronautics and other related fields, while mission payload specialists were selected from those involved in space science and applications for China's manned space program.

In addition, Chinese engineers are developing a next-generation crewed vehicle that is expected to feature world-class designs and technologies, high reliability and flexibility, reusability and multiple functions.

It will be tasked with serving Tiangong's future operations as well as the country's manned lunar missions that are being planned by scientists.

The new craft will consist of two major parts — a reentry module that will house astronauts and serve as the control center for the entire craft during a space flight, and a service module that will contain power and propulsion systems.

The vehicle will have a length of nearly 9 meters, a diameter of 4.5 meters and a weight of 22 tons.

Long history

As a major symbol of the space age, manned space flight first emerged in China's space plans in the mid-1960s.

Chinese scientists and engineers soon began research and development in space technology and started training a small group of astronaut candidates selected from elite Air Force pilots. All of their work was kept secret.

However, the endeavor had to be stopped in the mid-1970s due to financing and technological obstacles.

From the mid-1980s, Chinese scientists began to urge the government to consider reopening the manned space program as they were convinced that it would be crucial to the future of the country's space industry.

In August 1992, a special government committee decided that China will develop manned spacecraft and train astronauts and the ultimate goal is to assemble and operate a space station in the near future. The plan was approved in September that year by the Standing Committee of the Political Bureau of the Communist Party of China Central Committee, officially unfolding the nation's manned space program that involves hundreds of thousands of researchers, engineers and technicians.

On Oct 15, 2003, the country carried out its first manned space flight, sending Yang Liwei on a 21-hour journey around the mother planet in the Shenzhou I spacecraft. Since then, China has conducted seven manned space flights, which totaled 160 days and sent 12 Chinese astronauts into orbit.

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