



President Xi Jinping, who is also general secretary of the Communist Party of China Central Committee and chairman of the Central Military Commission, congratulates (from left to right) Tang Hongbo, Nie Haisheng and Liu Boming, astronauts orbiting Earth in China's space station core module Tianhe, and talks with them from the Beijing Aerospace Control Center on Wednesday. PHOTOS BY JU PENG AND YUE YUEWEI / XINHUA

## President greets orbiting astronauts

Space station's construction 'a milestone' for nation, he tells mission's 3-man crew

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President Xi Jinping encouraged the astronauts on board the core module of China's space station to work closely to accomplish their tasks, as he spoke with the crew members on Wednesday morning via video link.

Speaking from the Beijing Aerospace Control Center in a northwestern suburb of the capital, Xi said it was a delight to see that the three astronauts on board the module — Major General Nie Haisheng as mission commander, Major General Liu Boming and Senior Colonel Tang Hongbo — were in good condition and the work was progressing well.

The president, who is also general secretary of the Communist Party of China Central Committee and chairman of the Central Military Commission, extended greetings on behalf of the top authorities and the

Chinese people. "We all care about you very much," Xi said.

"The construction of the space station is a milestone in China's space industry, which will make pioneering contributions to the peaceful use of space by humanity," the president told the astronauts. "You are the representatives of those who are striving and climbing in China's space industry in the new era. I hope you will work closely with each other and complete the upcoming tasks."

Xi added: "We wish you a successful mission and a comfortable journey. We will wait for your triumphant return to Beijing."

Nie, noting that this is his third space mission, told Xi that "the conditions are getting better and better" and Chinese astronauts now have "a permanent home operating in orbit". "We, in distant space, are very proud of our great Party and motherland," the veteran astronaut said. "We will follow your instructions

and honor our duties and commitments."

Liu, who is on his second space trip, said it is a great honor and responsibility to participate in this significant mission.

"Later, we will carry out a series of technological verification experiments, including two extravehicular activities and robotic arm operations. We will carry out the operations carefully to ensure the success of all tests," he added.

Tang, who is making his first spaceflight, told Xi that he has adapted to the weightless environment in space. "I eat, live and work well, and I can make video calls with my family. Our home in space is very cozy and comfortable, and we have full confidence in completing the upcoming tasks," he added.

Before the televised conversation, Xi and a host of high-ranking officials watched livestreams of Nie practicing operating a mechanical arm and Liu and Tang researching a spacesuit designed for extravehicular activity.

A Chinese national flag and a Party flag are tied to the walls of

the core module, which is named Tianhe, or Harmony of Heavens.

Pang Zhihao, a spaceflight researcher in Beijing with knowledge of China's manned space program, said the call took place as Tianhe flew over China as the result of careful arrangement to ensure the smooth transmission of video signals between the Beijing center and the module.

"There was a double-insurance mechanism that involved a relay satellite network and ground-based tracking stations, which was intended to make sure the signal transmission would be stable and reliable," he said. "Actually, our Tianlian-series relay satellites alone are capable of realizing such a ground-spacecraft video call."

The country now operates a space-based relay network consisting of four Tianlian satellites in geostationary orbit that are able to transmit signals between spacecraft and anywhere in the world, Pang said.

The three astronauts entered Tianhe on June 17 after their Shenzhou XII spacecraft docked

with the module earlier in the day, becoming the first occupants of the module, the first and central component of the Chinese station, which is called Tiangong, or Heavenly Palace. They are scheduled to stay there for three months for a wide variety of tasks.

Their spacebus was launched on a Long March 2F carrier rocket that blasted off on June 17 from the Jiuquan Satellite Launch Center in northwestern China.

Shenzhou XII, the nation's seventh manned space mission, is part of the Tiangong station program, which aims to complete a three-component station in a low-Earth orbit about 400 kilometers above the ground before the end of 2022.

In the near future, three manned missions and three robotic cargo flights will be conducted for the station's construction. Two large space labs will also be lifted to link up with the station.

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# Robotic arm utilizes top technologies

Mechanism will assist operations, connect modules for space station

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A robotic arm mounted on the core module of China's space station has world-class technologies and capabilities, according to a researcher with knowledge of the station program.

Pang Zhihao, a retired spaceflight researcher at the China Academy of Space Technology, said on Wednesday that the robotic arm on the Tianhe module is the most advanced and sophisticated of its kind ever developed by China.

"The arm is 10 meters long when fully extended. It has several motorized joints, which allow it to act like a human arm to the maximum extent possible," he said.

Pang said the robot is self-relocatable and can reach many parts of the module through an inchworm-like movement. It is able to handle payloads with a weight of 25 metric tons.

The arm is critical to the construction and operation of the Chinese station, called Tiangong, or Heavenly Palace, as it will be used to connect two space labs – scheduled to be launched next year – with the Tianhe module to form the entire station, carry packages from cargo spacecrafts, capture visiting spacecraft and assist astronauts in their spacewalks, Pang explained.

It can also execute a wide range of other tasks such as examining Tiangong's external condition and monitoring the environment outside the spacecraft, he said.

When the space labs dock with Tianhe, the machine can connect with smaller arms to have a longer reach and heavier capacity, Pang added.

## 10 meters

Length of the robotic arm on the Tianhe module of the Tiangong space station when fully extended

During their three-month mission, the three Chinese astronauts – mission commander Major General Nie Haisheng, Major General Liu Boming and Senior Colonel Tang Hongbo – are scheduled to conduct two spacewalks, during which they will use the robotic arm to install equipment and check Tianhe's external condition.

One maneuver will involve Liu standing on the arm to fulfill some operations, he told reporters on June 16, a day before their mission was launched from the Jiuquan Satellite Launch Center in northwestern China's Gobi Desert. He added that astronauts will wear a new-generation, domestically developed extravehicular suit during the spacewalks.

The most well-known robotic arm on a spacecraft is the Mobile Servicing System on the International Space Station. Its core component is the Space Station Remote Manipulator System, commonly known as Canadarm2, as it was designed and built by Canada.

The large robot has played an irreplaceable role in the assembly and maintenance of the ISS, the largest and most complex space-based facility, as it moves equipment and supplies around the station, supports astronauts working in space, and assists in external maintenance.