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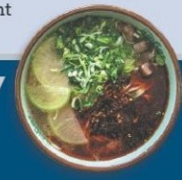

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Tianzhou 6 launched with cargo for manned missions

By ZHAO LEI in Wenchang, Hainan
zhaolei@chinadaily.com.cn

The Tianzhou 6 robotic cargo ship — the first spacecraft to visit China's Tiangong space station this year — was launched on Wednesday night to transport packages for the next two manned missions.

With Tianzhou 6 atop, the Long March 7-Y7 carrier rocket — the seventh of its kind — blasted off at 9:22 pm from the coastal Wenchang Space Launch Center in the country's southernmost island province of Hainan.

After a short flight, the rocket placed Tianzhou 6 into a low-Earth orbit. The three-story-tall cargo ship will travel for several hours to rendezvous with the Tiangong station and then dock with the massive outpost.

The cargo vehicle is the ninth spaceship to visit the Chinese space station and the first to do so since the station was completed at the end of 2022.

Tianzhou 6 is carrying about 260 packages with a combined weight of nearly 5.8 metric tons, including living necessities enough for a three-member crew for 280 days. In the food packages, there are about 70 kilograms of fresh fruit, double the quantity carried by Tianzhou 5.

There are 98 packages of science payloads, with a combined weight of 714 kg. These contain new equipment, spare parts and experiment-related materials. The payloads will be used in 29 scientific experiments and technological tests in disciplines such as life sciences, biology and fluid physics in microgravity, as well as combustion and material sciences.

With a designed life span of more than a year, a Tianzhou cargo craft has two parts — a cargo cabin and a propulsion section. Such vehicles are 10.6 meters long and 3.35 meters wide. It is the world's best space cargo transporter when it comes to carrying capacity, as more than half of its liftoff weight can be used for payloads, according to its designers.

Li Zhihui, deputy project manager of Tianzhou 6, said that compared with its predecessors, Tianzhou 6 has a remarkable improvement — it has more space in the airtight payload containers because engineers have redesigned its interiors and moved some devices from the cargo cabin to the propulsion section.

After the modifications, the cargo ship is capable of holding 7.4 tons of mission supplies, according to Li.

Pang Zhihao, an expert on space exploration and manned spaceflights, said the new version of the cargo craft features stronger transport capability and higher efficiency.

"The new model's loading ratio — the proportion of mission payloads in its overall weight — is as much as 53 percent, the best of its kind in the world. It means we could use, say, three of these craft to carry materials that would have originally required four," he said.

In addition, Pang said the new spacecraft model has an improved communication system — a phased array antenna that has good capacity and is lower in cost.

Last week, the Tianzhou 5 cargo craft undocked from the Tiangong space station and started a period of solo flight. Its connection hatch will be used by Tianzhou 6.

Tianzhou 5 is scheduled to re-dock with the space station in the coming weeks after the departure of the Shenzhou XV crew, who will return to Earth after their six-month journey ends, according to the China Manned Space Agency.

Around the end of May, the crew of the Shenzhou XVI mission is expected to arrive at the Tiangong station to take over from the Shenzhou XV team.

A Long March 7-Y7 carrier rocket — with the Tianzhou 6 robotic cargo ship atop — lifts off at 9:22 pm on Wednesday from the Wenchang Space Launch Center in Hainan province. YANG GUANYU / XINHUA

Plateau observatory to advance knowledge of universe

By ZHANG ZHIHAO
zhangzhihao@chinadaily.com.cn

China's Large High-Altitude Air Shower Observatory, one of the world's most advanced cosmic ray observatories, passed national appraisal on Wednesday. The facility will help scientists uncover the origins of high-energy cosmic rays and expand humanity's knowledge of the universe.

Cosmic rays are high-energy particles consisting mainly of protons and atomic nuclei that travel through space at nearly the speed of light. Since their discovery in 1912, such rays have fascinated scientists because their electric charge, energy, speed and other properties can contain critical scientific information about their origins and that of the universe.

The facility, also known as LHAASO, sits at an altitude of 4,410 meters on Haizi Mountain in Daocheng county, Sichuan province.

The observatory is comprised of 5,216 electromagnetic particle detectors, 1,188 muon detectors, a 78,000-square-meter Cherenkov water detector array and 18 wide-field-of-view Cherenkov telescopes. Construction began in 2017 and was completed in 2021.

A muon is a type of elementary particle that serves as one of the basic building blocks of the universe. The water detector array is used to detect Cherenkov radiation, which is the form of energy that one can perceive as blue light emitted when charged particles move faster than light in a specific medium, such as water.

Cao Zhen, chief scientist of LHAASO and a researcher at the Institute of High Energy Physics of the Chinese Academy of Sciences, said the facility is one of China's key national science and technology infrastructures and one of the most advanced observatories in the world for researching high-energy cosmic rays.

"It represents the cutting-edge of China's science infrastructure engineering, and we hope it can make groundbreaking discoveries and contribute to human civilization's understanding of the universe," he said.

"Studying cosmic rays is vital for understanding the universe's origins, the evolution of stellar bodies, solar activities and other major scientific questions. They are like the couriers of the universe."

By researching cosmic rays, scientists have discovered numerous fundamental particles, including muons and positrons — the antiparticle of electrons with a positive charge. It led to the creation of particle physics, and five Nobel Prizes were given to scientists working in this field.

However, Cao said that despite over a century of research, scientists still know little about the origins of cosmic rays and how some of them can accelerate to such mind-blowing energy levels.

Some cosmic rays that hit Earth had energies thousands of times greater than those produced by the largest human-made particle accelerator, the Large Hadron Collider in Geneva, Switzerland. Scientists have hypothesized certain celestial phenomena, such as black holes or supernovas, as origins, but no one has confirmed this conclusively.

One of the reasons is that these cosmic particles carried electric charges and were susceptible to alteration by magnetic forces as they passed through space. So when they finally reached Earth, scientists had difficulty tracing their source, Cao said.

Another reason is that the higher the energy, the rarer and more challenging the cosmic ray is to detect. Moreover, the Earth's atmosphere can absorb most cosmic rays upon entering.

The ideal way to catch high-energy cosmic rays is in outer space, but creating a massive detector in space is unfeasible, so scientists opted for the next best option: mountain tops.

He Huihai, chief technician of LHAASO, said when an ultrahigh-energy particle hits the atmosphere, it can produce an extensive cascade of ionized particles that fall to the ground in a phenomenon called cosmic ray air shower.

"By capturing and studying these secondary particles, we can piece together information about the energy and direction of the original particle," he said. "This is why we need to pack so many different types of detectors across a large area so that we can collect as much data from the air shower as we can before the secondary particles decay to much lower energies."

He said the location, size and design of LHAASO give it an "unprecedented ability to detect ultrahigh-energy cosmic rays and will open a new window for scientists to study the most energetic particles in the universe."

Even when LHAASO was partially operational in 2019, it made major discoveries that were later published in top scientific journals such as Nature and Science, He said.

Dong Yuhui, deputy director of the Institute of High Energy Physics of the Chinese Academy of Sciences, said LHAASO has cemented China's position as one of the global leaders in high-energy astrophysics.

"It will facilitate China's development in particle physics, leading to more original breakthroughs and spearheading interdisciplinary and international research," he said.

Scientists to explore lunar construction materials, tech

The Beijing Institute of Technology recently received 500 milligrams of the lunar samples brought back by the Chang'e 5 mission.

BIT's research team will study the material characteristics of these samples and related manufacturing technology, with the building of a future lunar research station in mind.

Shen Jun, a professor with the School of Mechanical Engineering at BIT, noted that both international and domestic plans have been laid out for the construction of lunar research stations, and her team will focus on related preliminary research.

"Building a lunar research station is like building a house on the moon. Due to current rocket carrying capacity limitations and the high cost of transportation between the Earth and the moon, it is essential to make use of indigenous materials on the moon during lunar research station construction. That means lunar soil will serve as the main material," Shen said.

The professor said that the scientific research is scheduled to be conducted in two phases. First, the basic physical properties of the samples, including optical and electromagnetic features, will be studied.

Then, the team will explore lunar soil particle surface properties, and search for the most suitable 3D printing techniques and materials that can be printed in appropriate shapes when mixed with lunar soil.

"If we compare lunar soil to cement, what we will do first is study the characteristics of the cement, then find suitable materials such as sand and adhesives for mixing with the cement, and ultimately ensure that we have the technology to make bricks from the cement and sand mixture," Shen added.

Lunar soil molding technology faces a slew of challenges such as material compatibility, mixture stability and printing reliability.

The lunar samples will not be used for the construction experiments. Instead, the team plans to develop simulated lunar soil with existing materials on Earth and continuously optimize the development methods and construction techniques based on analysis data from the lunar samples.

"BIT will make full use of these valuable lunar samples and is committed to providing a theoretical basis and technical support for the future construction of lunar research stations," said Zhang Jun, an academician of the Chinese Academy of Engineering and Party chief of BIT.

He added that the university will collaborate with relevant organizations in scientific research and personnel training, and contribute to the exploitation of lunar resources as well as the peaceful use of space by mankind.

Chang'e 5, comprising an orbiter, a lander, an ascender and a returner, was launched in November 2020 and returned to Earth the following month. It retrieved a total of 1,731 grams of lunar samples, mainly rocks and soil from the moon's surface.

Five batches of lunar samples have been issued to 98 research teams since July 12, 2021. As of now, more than 60 new related findings have been published in academic journals.

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