# China's Giant Step Into Manned Space Exploration

by Marsha Freeman

For 40 years, although people of many nations have ventured into space, only two have had the ability to take them there. On Oct. 14, China successfully sent its first astronaut, 38-year-old Yang Liwei, into Earth orbit, joining the United States and Russia in manned space exploration. China's Shenzhou V mission had been widely anticipated, following four unmanned tests of similar spacecraft since 1999; but that did not diminish the excitement in China, or the impact the accomplishment will have on space programs around the world. Like Yuri Gagarin and Alan Shepherd before him, Yang, when he returned to Earth the following day, after 14 orbits and 21 hours in space, was an instant national hero.

Political pundits and science commentators have searched for months for answers to the question, why would China, still a developing nation, commit such extensive resources to put human beings into space? The answers have ranged from national prestige, advancing military capabilities, and showing itself a world-class technology player, to shoring up control of the ruling Communist Party. For the most part, the key is not so mysterious.

In the 1960s, the political leadership of both the United States and the Soviet Union knew that manned space missions would drive the development of technologies for advancements in science, military applications, and the civilian economy. A nation that could meet the challenge of space flight could do just about anything, everyone believed. Optimistic young people would be motivated to study science and engineering. Scientists knew that taking man off the Earth, with his own capabilities supplemented by scientific instruments and robotic systems, would allow the search for new universal principles.

## Not Why, But Why Not?

For China, an additional motivation is a dream of spaceflight that extends back a millennium, to when the first ancient Chinese fire dragon rockets were used to ward off invaders; and to lessons learned from the burning of the ocean fleet by a Ming Dynasty which did not want to venture outside its own shores in the 16th Century, during the first age of exploration.

But the pundits are asking the wrong question. The real issue is not why China has created a manned space program, but why all of the other space-faring nations have nearly abandoned theirs. The Europeans and Japanese, who were both on the verge of doing so in the 1980s, and had the industrial and technical base, cancelled their programs. At that time, Germany was developing the Sänger and France the Hermes space planes. But they succumbed to self-destructive economic policies based on so-called free-market principles, abandoned state-sponsored great infrastructure projects, and gave way to a pessimistic culture that deprecated science and technology.

These same policies have more recently crippled the magnificent Russian space program, mothballing both the Buran space shuttle and the massive Energia booster. The United States, with a chronically underfunded, and currently grounded Shuttle program, now finds itself dependent upon Russia, and in the future, perhaps China, just to keep the International Space Station operational.

China, on the other hand, has embarked on an overall multi-decade infrastructure development plan to leap-frog today's technologies: through advanced fission and nuclear fusion energy; magnetically levitated transport systems; massive projects for water management; and space flight. Its leaders well know that no linear extension of today's technology will allow China to sustain an economic growth rate that will meet the needs of its 1.3 billion people.

The technical community in China worked systematically for ten years to send Yang Liwei into space. They were not aiming for a specific launch date or political event, but waited until they were ready. This accomplishment is not a "spectacular' for China, but one giant step in a well-planned, multi-decade progression of space exploration milestones that will meet, and possibly surpass, what the other space-faring nations have accomplished.

## A Technical Leap

The Shenzhou program was not China's first plan for manned space flight. Although they have only now reached this milestone, in 1967, during the heat of the Soviet-U.S. "space race," Chinese experts conducted a systems concept study for a manned spacecraft. The Autumn 2003 issue of *Aerospace China* reports that by 1971, after China had succeeded in launching its first satellite the year before, more than 400 experts from over 80 organizations and departments in the government discussed the concept that had been developed. A full-scale model of the spacecraft, named Shuguang, was created.

Shuguang was a two-module craft, similar to the American Gemini spacecraft, but "due to a weak economical foundation and relatively low technical and manufacturing and process level, and some political reasons, Shuguang-1 just remained as a draft' program.

By 1989, the magazine reports, experts determined that manned spacecraft development was possible under China's economic conditions, and work began. In January 1992, the Chinese government formally approved the project, and the next three years were spent in concept definition. A prototype was developed, and extensive ground testing and system inte-

*With "1990s, not 1960s technology," China's Shenzhou rocket launches cosmonaut Yang Liwei into 14-orbit flight on Oct. 14. The question is not why China is making the effort, but why Europe, Japan, and other nations have dropped manned space flight or scaled it back? China's proposal to cooperate on the International Space Station is now on the table.*

gration tests were completed. On Nov. 20, 1999, China launched its first experimental Shenzhou spacecraft, and three more of the unmanned versions followed, each with increasing sophistication, successively approaching what would be required to sustain a man in space.

When the first unmanned Shenzhou test spacecraft was launched in 1999, skeptics described it as just a copy of the Russian Soyuz. And when Shenzhou V launched on October 14th, comedians jeered that the Chinese had finally succeeded in doing what the United States and Soviet Union had done—in 1961. In fact, China had no intention of reinventing the wheel, or repeating the first steps of manned space flight history. Shenzhou bears little resemblance to humanity's first, tentative steps in space.

In contrast to the Vostok that carried Yuri Gagarin into one orbit; and the Mercury capsule that took Alan Shepherd on America's first suborbital trip, both in 1961; Shenzhou is actually 1990s, rather than 1960s technology. Both the Vostok and Mercury capsules had room for one crew member; Shenzhou can accommodate three. When Gagarin and Shepherd returned to Earth, their mission was over. But Shenzhou is made up of three modules: one for in-orbit propulsion; a descent module that brings the crew back to Earth; and an orbital module that has stayed in space, in previous unmanned test flights, for up to six months.

The Gagarin and Shepherd trips were necessarily brief, relying on internal batteries for power. Shenzhou has two pairs of solar arrays that continuously produce electricity, allowing for a longer manned mission, and extended stays for the orbital module. And the propulsion module allowed for the on-orbit maneuvering of Shenzhou V, laying the basis for rendezvous and docking with future spacecraft—the first steps to assembling a space station.

Zhang Qingwei, president of China Aerospace Science & Technology Corporation, which builds spacecraft and the Long March rocket, explained in an interview with China's *People's Daily* on Oct. 17th, that Shenzhou's orbital module is "highly adaptable." It can stay in space making observations of the Earth and carrying out microgravity experiments, and can also be prepared to rendezvous and dock with spacecraft in the future. "In foreign countries," Zhang explained, to practice docking, "two space ships are launched successively for one time; but in China, one is launched first, and its orbital module stays, to dock with the next one."

Shenzhou can more accurately be compared to the three-man Russian Soyuz spacecraft which has been transporting crews back and forth to the International Space Station. Even there, Shenzhou is larger, weighs nearly a ton more, and has a higher degree of precision navigation, allowing more precise landing.

To carry the 7.8 ton Shenzhou, China had to develop and then man-rate a launch vehicle, achieving a reliability as close to 100% as possible. The Long March II-F rocket has been developed for that purpose, incorporating 55 new technologies, among which are an automatic malfunction detection system, an escape system for the astronaut during launch, and redundancy in critical systems such as navigation and stability control. The development of the Long March II-F was begun in 1992, along with the Shenzhou orbiter.

Chinese experts are rightly proud of the technological developments they have incorporated into their space program. "The 13 key technologies applied in making the spacecraft," Zhang stated, "were all developed on our own, and they are comparable with the most advanced in the world." According to the chief designer of China's manned space program, Wang Yongzhi, 70% of the people in China's space sector are under the age of 35. As was the case in the United States, China's program is creating the human capital for the advancement of the entire nation, as well as its next steps in space.

## To the Moon, and Beyond

In November 2000, for the first time in English, the Information Office of the State Council of China released an eight-page white paper titled, "China's Space Activities." It outlined a 20-year program of overall goals, without specific dates, to be carried out when each program is ready. It described China's space program as based on the principle that

exploration is an "integral part of the state's comprehensive development strategy.' The goals included manned space flights, as well as "studies of space microgravity, space materials science, space life sciences, the space environment, and space astronomy." China would also carry out a "pre-study for outer space exploration, centering on the exploration of the Moon." More recent material from China has been more specific.

The most recent issue of *Aerospace China* reported that the next steps in China's manned space program are "basically similar to those of the U.S. and Russia," but undoubtedly on a more compressed time table.

The next goal will be to develop orbital rendezvous and docking technology, and to carry out extravehicular activity—space walks—both of which are necessary for orbital construction. Manned spacecraft and a "spacelab" will be launched, in order to expand working space, and provide the ability for astronauts to live, and conduct research. At the same time, heavier, economical, and reliable launch vehicles will be developed to launch a space station, for long-term stays in orbit and as a critical part of China's low-Earth-orbit infrastructure. This will "lay the foundation for deep space exploration, and provide an operational platform" as the point of departure for destinations beyond.

The day after the Shenzhou V landed, Xie Mingbao, director of the China Manned Space Engineering Office, told reporters that he expects that "the country will send its next Shenzhou craft in one or two years." Most observers believe that, at that time, China may launch a second craft close behind the first, and attempt to link up the two vehicles. Of utmost concern, Xie stressed, is the safety of the astronaut.

At the same time that China is pursuing its manned space program, a parallel lunar effort is underway. The first phase of lunar study, described as the Chang'e Program—after the Chinese legend about a young fairy who flew to the Moon—will be the launch of an orbiter, expected around 2008. It will conduct a year-long mission, deploying cameras for photographs; a laser altimeter to measure topography; gamma, X-ray, and microwave instruments to observe the Moon's environmental and chemical make-up; and high- and low-energy particle detectors to measure the effects of the Sun.

China expects to follow its polar-orbital mission with a lunar lander, and then a spacecraft to land and return samples of the Moon to the Earth. Within the next decade and a half, China plans to send its own astronauts to the surface of the Moon. While science is a strong motivation, Chinese scientists have stressed that the resources on the Moon, such as the rare isotope Helium-3, which can be used as a fuel for nuclear fusion, will be an important element in lunar exploration.

Such a long-range program for space exploration should surprise no one—it is the same path followed by its predecessors.

## Alone or Together?

The reaction to the success of the Shenzhou mission by Washington think-tankers, neo-cons, and political pundits has been somewhat schizophrenic. On the one hand, they have downplayed its significance, or called it a stunt; while on the other, they have proposed it represents a potential military threat against the security of the United States.

But leaving such extremists aside, the response to this joyful event by those who have some knowledge of both past and future history, has been congratulations and calls for cooperation with China.

James Oberg, a former NASA engineer and long-time highly critical observer of the Soviet, Russian, and Chinese space programs, wrote in a *USA Today* op-ed on Oct. 15th: "China is not racing us to establish a manned military station on the Moon. Nor is it assembling an orbiting battle fleet. . . . To imagine such threats is to fear shadows. To respond as if they were real, would be folly." Instead, Oberg recommends that China be welcomed into the space community, suggesting it could, for example, use its manned vehicles to provide emergency support to the International Space Station. "If there is a challenge involved," he states, "it is for the United States and other space-faring nations to live up to their ideals and potentials in space."

The official U.S. government response has been to congratulate China and wish them well. Chinese-American astronaut Ed Lu, living aboard the space station, simply told Yang, in Chinese, "Welcome to space."

American astronauts, on the whole, have tried to nudge the United States to cooperate with China in space. Four days before the Shenzhou V launch, former Apollo astronaut Buzz Aldrin warned the United States not to have a "knee-jerk" reaction to the feat, but instead to consider rolling out the welcome mat at the space station. "We should offer to work out some mutually attractive means of advancing both our interests," he counseled.

China is already partnering with other nations in space. The China National Space Administration announced last Summer that it is readying the launch of the second China Brazil Earth Remote Sensing satellite. The first was launched by China in 1999. The two nations share the cost of developing and launching the satellites. China has also teamed up with the European Space Agency in the Double Star program, consisting of two spacecraft to study the interaction of the Sun with the Earth. China and Russia have an on-going series of discussions on space cooperation, as part of the regular meetings of the Prime Ministers of both nations.

When George W. Bush entered the White House, the Chinese government sent a request to the new Administration for a meeting to discuss China's particpation in the International Space Station. They are still waiting for a reply. Hopefully, the recent successful mission of Shenzhou V will provide a much-needed kick in the pants.