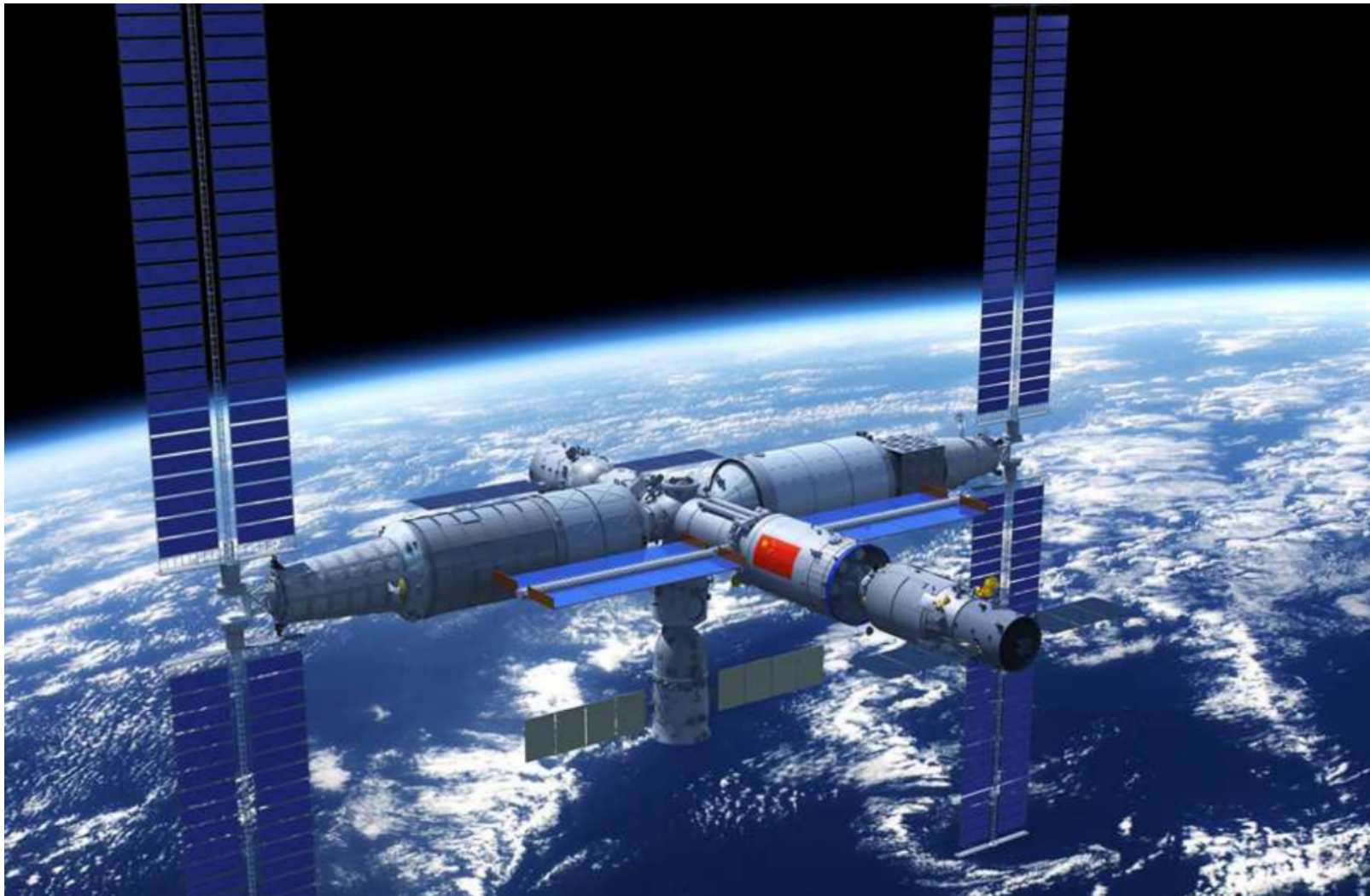


What we know about China's space station: modules, crew, launch plans and more

by **Andrew Jones** | May 31, 2018 10:58 | **BEIJING** **UNITED STATES** **CHINA'S SPACE PROGRAM**



Depiction of the China Space Station in low Earth orbit, with two docked Shenzhou crewed spacecraft (bottom, rear centre) and Tianzhou cargo craft (left in foreground).

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China last week opened up its planned space station to international cooperation, with the first module set to launch in 2020. The road to this point has been long, requiring serious resources and innovation.

China officially approved its space station programme way back in 1992, when the country's economy was around 26 times smaller in GDP terms than today.

The ambitious three-step plan, named Project 921, involved first developing a human-rated rocket and spacecraft, orbiting Tiangong space labs as test beds and, with new, large rockets, constructing a 60-100 metric tonne modular space station in low Earth orbit.

China launched the first Long March 2F rocket with an uncrewed test Shenzhou spacecraft in November 1999. In October 2003, Yang Liwei became first Chinese astronaut in space aboard Shenzhou 5. Tiangong-1, which recently **met a fiery end**, was launched in 2011 and visited by two crews in 2012 and 2013, proving lift support and docking systems. Tiangong-2, Shenzhou-11 and Tianzhou-1 further verified systems, and China is now looking to begin constructing the Chinese Space Station (CSS) starting around 2020.

Tianhe core module

The core module, **Tianhe** (天合, or "harmony of the heavens"), is first of three 20 metric tonne modules that will make up the CSS.

Tianhe includes the living quarters for the crew and control compartment and will be the first into orbit. It will have the capability to recycle a high rate of water from respiration and excretion.

It is expected to launch around **2020**, after which it will be joined by two experiment modules, Wentian and Mengtian to be used for a range of science objectives.

Tianhe was developed by the China Academy of Space Technology (CAST), a subsidiary of the country's main space contractor, the China Aerospace Science and Technology Group (CASC) and is by far the largest and most complex spacecraft yet.

Also see: **[Tianhe: A look at the core module of the Chinese Space Station](#)**





A view of the Tianhe living compartment, with five Control Moment Gyroscopes (CMGs) visible. CCTV/framegrab

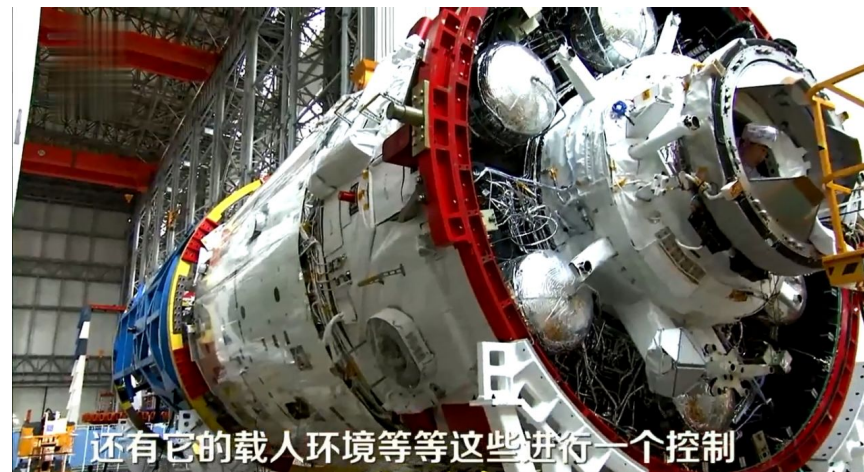


Experiment modules

Two experiment modules, named Wentian (问天), or "quest for the heavens," and Mengtian (梦天), or "dreaming of the heavens,") will complete the basic T-shaped CSS, joined by a **docking hub**.

The experiment modules will be equipped with an array of science racks for experiments in space life sciences and biotechnology, microgravity fluid physics and combustion, material science in space, fundamental physics in microgravity and other areas.

The two modules have science experiment racks inside within its pressurised sections, and external racks.



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More like Mir than ISS

Once completed, the 60-tonne CSS is expected to be operational for at least 10 years.

It will somewhat resemble the [Mir space station](#), while there are apparent similarities between the Tianhe and Russian [Zvezda module](#) of the International Space Station. The China Manned Space Agency (CMSA) has also released a [handbook](#) for the CSS.

China's space station: What you need to know

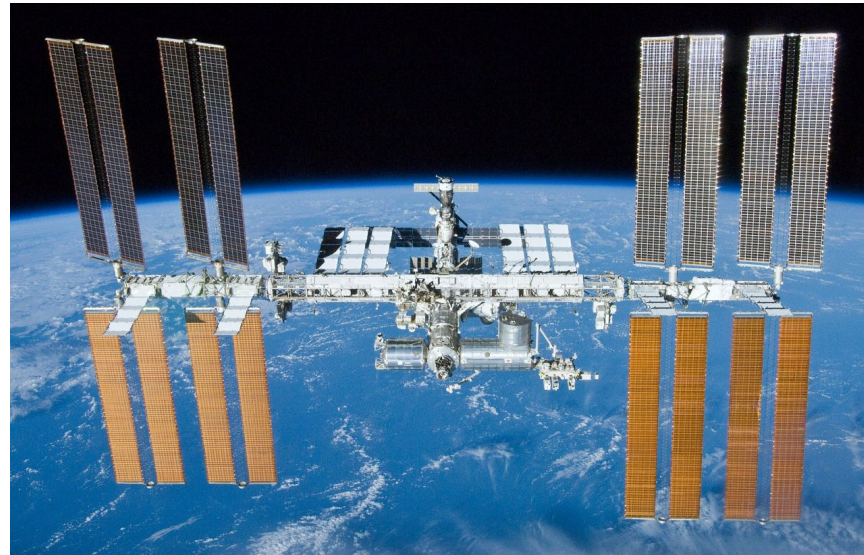


China's space station: What you need to know



Overall the ISS is much larger, at around 420 metric tonnes, but with construction beginning in 1998, the much older facility could be

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The International Space Station is featured in this image photographed by an STS-132 crew member on board the Space Shuttle Atlantis after the station and shuttle began their post-docking relative separation. *NASA/Crew of STS-132 NASA/Crew of STS-132*

'Arms and wings'

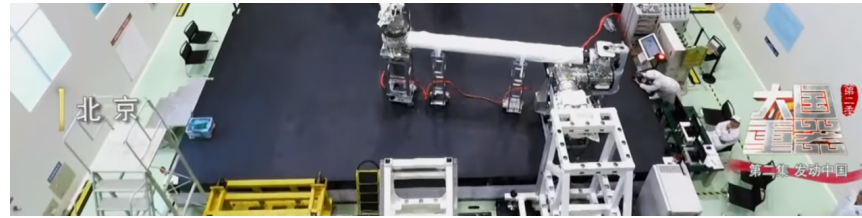
The CSS will be aided by **two robotic arms** and two flexible solar arrays, or 'wings', each with a 30-metre wingspan.

"Together with biaxial sun pointing mechanisms and high-efficient lithium ion batteries, they constitute a sophisticated and powerful space station power system," Zhou Jianping, a senior space official, said in 2016.

The station will also have two robotic arms, with a total length of 15 metres, Zhou added, noting that human-machine coordination will make the building and maintaining of the Space Station possible. The arms will also be used for installing experiments.



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The large mechanical arm for the Chinese Space Station, undergoing testing.
Framegrab/CCTV



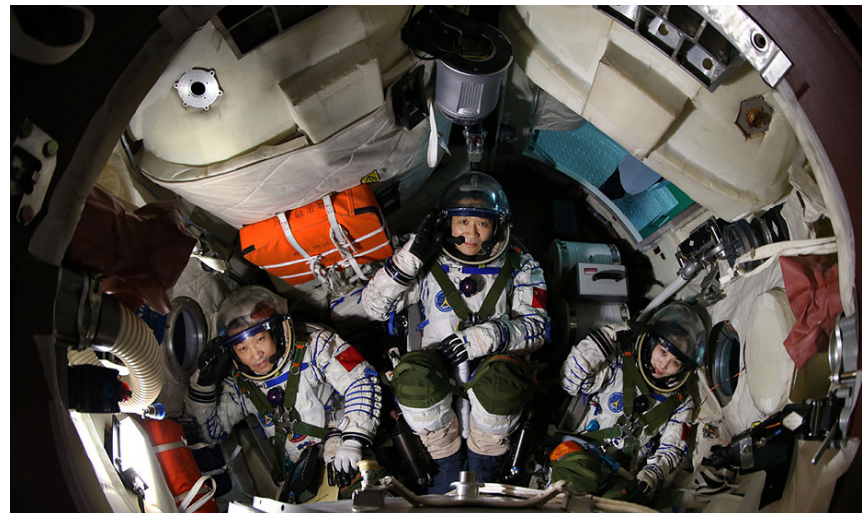
Orbit and launch schedule

The CSS will orbit with an inclination of between 41 and 43 degrees, closely matching the latitude of the Jiuquan Satellite Launch Centre, from which the Long March 2F rocket will launch astronauts to the space station.

The Tianhe module will be launched after a successful test flight of the Long March 5B, a 1.5 stage variant of the 2.5 stage **Long March 5** developed for missions to geostationary transfer orbit, the **Moon** and **Mars**.

The Long March 5B is set to **debut in June 2019** from Wenchang. If successful, the following launch would then carry the Tianhe module to an orbit of around 390 kilometres above the Earth, **around 2020**.

Once in orbit, Tianhe is then set to be visited by the Tianzhou-2 cargo spacecraft in order to deliver supplies and propellant, and then by the first crew, aboard **Shenzhou-12**.



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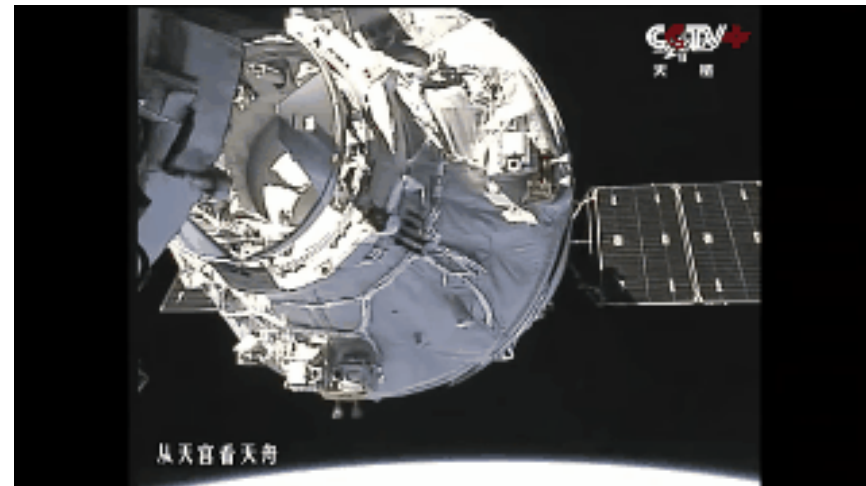
The crew of Shenzhou-10 in preparation for launch in June 2013. *CNS*



The Wentian and Mengtian experiment modules, along with further Tianzhou and crewed Shenzhou missions, will then follow, to be joined by a docking hub, with the orbital outpost to be completed around 2022, orbiting at an altitude between 340-450 kilometres above the Earth.



The CSS will be supported by **Tianlian** data relay satellites, much like the tracking and Data Relay Satellite System (TDRSS) the United States uses for communications satellites, and the Beijing Aerospace Control Center (BACC).



The first docking of Tiangong-2 space lab and the approaching Tianzhou-1 cargo spacecraft in April 2017. *Youtube/CCTV+*



Xuntian telescope

It is also planned that the CSS will be joined by a co-orbiting optical module,

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able to dock with it for maintenance, repairs and propellant supply.

Xuntian will have a mirror around 2 metres in diameter, similar to that of Hubble, but with a field of view 200 times greater, according to latest announcements.



A rendering of the Xuntian space telescope, or Chinese Space Station optical module, in a presentation from the China Manned Space Agency. *Sina Weibo/Lin Xiaoyi*

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Launch, supply and support

To construct, maintain and send crew to the CSS, China will use three different launch vehicles, which will lift off from two different launch centres, Jiuquan in the northwest of the country for orbiting astronauts, and Wenchang in the south for launching the modules and sending cargo craft to dock with the CSS.

The 20-metric-tonne CSS modules will be launched from the specially developed coastal Wenchang Space Launch Centre by the Long March 5B.

The original Long March 5 suffered a **failure** on its second flight in July last year, prompting an investigation and subsequent redesign of the first stage engines. It will make a return to flight around November, and if all goes well, the Long March 5B will have its own test flight in June 2019.



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The first Long March 5 rocket being rolled out for launch at Wenchang in late October 2016. *Su Dong China Daily*

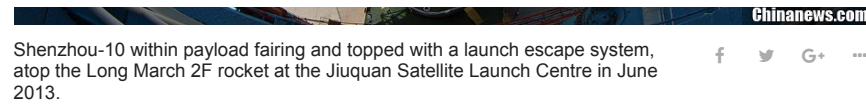


The **Long March 7** is, similar to the Long March 5, a new generation of cryogenic rocket powered by kerosene and liquid oxygen. It was designed for launching specially designed **Tianzhou cargo spacecraft** to send supplies and experiments to the CSS. Tianzhou craft can carry nearly 6.5 tonnes of cargo, including 2.5 tonnes of fuel into orbit.

The Long March 2F – an older, hypergolic rocket developed in the 1990s – is China's only human-rated launch vehicle and is launched from Jiuquan in the Gobi Desert. It can launch the 8-tonne Shenzhou spacecraft with three astronauts aboard. The rocket is distinctive for the launch escape tower, which can carry astronauts away from the rest of the rocket body in the event of an emergency during launch.



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Space station crew

China has 16 active astronauts, selected in two rounds in 1998 and 2010. 11 of these have flown to space, starting in October 2003 with Yang Liwei aboard Shenzhou 5, which made China only the third country to achievement independent human spaceflight.

In the near 15 years since, China has only flown five further human spaceflight missions, most recently **Shenzhou-11** in 2016. This was by far the longest at 33 days.

Stays on the CSS will be around 3-6 months at different stages of construction and development, requiring China's astronauts to both launch more often, but also adapt to much longer stays in space. Astronauts will be able to perform extravehicular activities thanks to module airlocks.



Liu Yang, China's first woman in space, in front of the charred Shenzhou-9 return capsule after spending two weeks aboard Tiangong-1. CNS

In April China also opened a **third selection round** of astronauts, with the requirements changing to reflect the new CSS era. While the previous two rounds drew only from air force pilots. this time civilians are welcome to

The current astronauts have been in **training for extravehicular activities and field survival**.



Yang Liwei, who became China's first astronaut in space in 2003, in the Badain Jaran desert for field training in May 2018. *Huang Siyu China Daily*

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International cooperation

In May China **announced** the first opportunity for all United Nations countries to apply to be involved in science missions aboard the CSS.

The move is one **that aims** to put China's space activities in a positive light, boosting the country's space and soft power, while also providing developing nations with access to space.

China is also collaborating with the European Space Agency with a view to ESA astronauts potentially flying with Chinese counterparts.

Last August Sam Cristoforetti and **Matthias Maurer** joined 16 Chinese colleagues for **joint sea survival training** off the coast of Shandong, as part of CSS mission training. These early stages of cooperation could bloom into European visitors to the CSS.



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ESA astronaut Matthias Maurer joined Chinese colleagues Liu Boming and Ye Guangfu in Yantai, China to take part in their sea survival training, on 19 August 2017. *ESA—Stephane Corvaja*

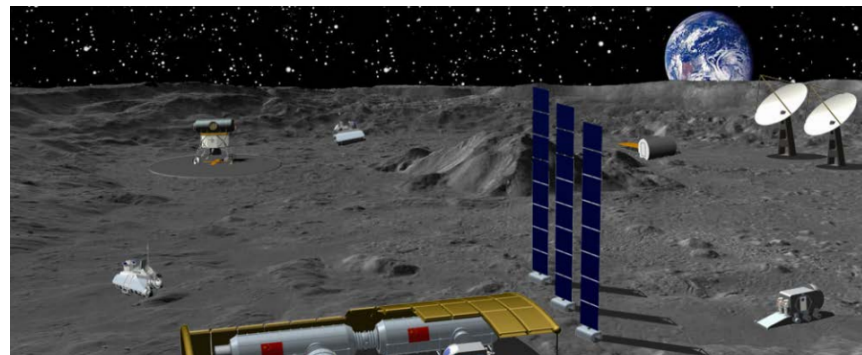


Stepping stone

The CSS is not the final point in Chinese ambitions for human spaceflight and space exploration. The orbital platform will, along with its own objectives, provide experience that will be useful for ventures beyond low Earth orbit.

With early work on a **super heavy-lift launch vehicle**, similar to the Saturn V rocket that took NASA astronauts to the Moon, and a **new generation crewed spacecraft** ongoing, China is signalling that it is eyeing up human missions to the Moon, which could begin in the early 2030s.

This would be no flags-and-footprints endeavour, and is likely to involve establishing a **human lunar outpost**.



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A conceptual Chinese lunar base on Sinus Iridum. *CAST*

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Andrew Jones covers the growing Chinese space programme, including exploration, space science, politics, launches, human spaceflight and more.

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