**Webb telescope goes into space**

_Webb telescope goes into space_, Ling Xin*

The Innovation Editorial Team, China

*Correspondence: lxin2015@yahoo.com

Received: November 9, 2021; Accepted: December 14, 2021; Published Online: December 17, 2021; https://doi.org/10.1016/j.xinn.2021.100198

© 2021 The Author(s). This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Citation: Xin L. (2022). Webb telescope goes into space. The Innovation 3(1), 100198.

As Hubble’s successor, it will look deeper into the past than ever before

The James Webb Space Telescope (JWST), the world’s largest and most powerful space science observatory, lifted off aboard an Ariane 5 rocket from Kourou, French Guiana at 9:20 a.m. local time on December 25, 2021. The $10-billion mission will enable scientists to look at the oldest stars and galaxies to better understand cosmic history and search for evidence of life outside our solar system, among other goals.

After three decades of hard work since its original conception, the long-awaited telescope will finally take us over 13.5 billion years back in time to see how the first bright objects formed in the Universe. Theories have it that the post-Big Bang world started like a hot, obscure soup made of particles such as protons, neutrons, and electrons. When the Universe gradually cooled down, these particles combined into neutral atoms so that light particles could travel freely, and the first source of light is expected to appear a few hundred million years after the Big Bang. The JWST is tasked to find out what that first light looked like, how the first stars were born, and how the first galaxies were assembled—as those galaxies seemed small and clumsy and very different from our Milky Way galaxy.

JWST is also going to revolutionize our understanding of exoplanets. Astronomer Johanna Teske from the Carnegie Institution for Science in Washington, D.C., says she is super excited about the launch. Teske is co-Principal Investigator of a proposal that has won 141.6 hours of observing time with the telescope. The plan is to observe 11 selected exoplanets transiting in front of their stars to measure their atmospheric compositions, to find out how diverse their atmospheres are, and shed light on how those exoplanets may have formed.

“Winning such a proposal still feels like a dream to me,” says Teske. Just a few years ago, she was using ground-based telescopes to measure the masses of so-called super-Earth and sub-Neptune planets in our galaxy. These planets typically have radii about 1–3 times of the Earth’s, and seem to bridge the gap between gas giants and terrestrial planets in the solar system. She then met up with Natasha Batalha, who specializes in planetary atmospheres and now works for NASA Ames Research Center, and the two started developing the idea that turned into the largest General Observer proposal in exoplanet research with JWST. “Our proposal was successful due to the creative, collaborative effort between team members with expertise in different aspects of planet theory and observations. Much of my excitement comes from getting to work with these world-class experts,” Teske notes.

Scientists in China also show great enthusiasm for the launch. “I first heard of JWST about 13 years ago, when I was still an undergraduate student at the University of Science and Technology of China,” says Cai Zheng, now an...
astrophysicist at Tsinghua University in Beijing who is leading a research team on high redshift galaxies and the intergalactic medium in the early Universe. “JWST will bring human beings to the edge of the Universe and present a spectacular view of the first light, first stars, and first galaxies,” he says.

Cai had lots of experience using the Hubble Space Telescope (HST), JWST’s predecessor, during his doctoral study in the U.S., and he worked as a Hubble Fellow for three years before joining Tsinghua. Launched in 1990, HST has revolutionized our understanding of the Universe and is one of the most successful space science projects in history. For instance, thanks to Hubble, we now have solid evidence that the Universe is expanding faster and faster, and that gigantic black holes are everywhere, especially at the heart of galaxies. So far HST has inspired over 18,000 research papers, which in turn motivated the science goals of JWST.

While HST primarily works in the visible and ultraviolet wavelengths, JWST will mainly look at the Universe in infrared. Infrared waves can slip through the gas and dust in the intergalactic medium, and offer information on the most remote stars and galaxies, which is otherwise unavailable. “I’m really impressed by JWST’s large aperture and wavelength coverage into the middle infrared band, which is impossible to probe from the ground,” says Cai.

As a joint venture between NASA, the European Space Agency, and the Canadian Space Agency, JWST is equipped with four science instruments, namely a near-infrared camera, a near-infrared spectrograph, a near-infrared imager and slitless spectrograph, which aims to detect the first light and exoplanets, as well as a mid-infrared instrument to take amazing pictures of distant objects like HST has done. Compared to HST’s 2.4-meter-diameter primary mirror, JWST’s main mirror is 6.5 meters across, the largest of its kind ever put into space, and it is coated with a very thin layer of gold to help with the reflection of infrared light. The telescope also features a five-layer sunshield about the size of a tennis court to block out heat from the Sun, the Earth, and the Moon and keep the mirrors and instruments as cold as –220°C as required by infrared observations.

It will take JWST about a month to reach its destination, a gravitationally stable spot called the second Sun-Earth Lagrange point 1.5 million kilometers away from the Earth. From there the telescope will orbit the Sun and stay in line with the Earth, with its main mirror facing the deep space for planned observations. If everything goes smoothly, the first high quality images can be expected in six months, and the telescope will work for at least 10 years before it runs out of propellant.

DECLARATION OF INTERESTS

The authors declare no competing interests.