UAE and Chinese spacecraft safely enter Martian orbit

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Two missions to Mars successfully entered orbit around the fourth planet in the solar system this week: the Hope spacecraft built by the United Arab Emirates and launched by Japan from the Tanegashima Space Center, on February 9, and the Tianwen-1 ("heavenly questions") launched by China from the country's Wenchang Spacecraft Launch Site, on February 10.

A third mission will reach Mars next Thursday, the Mars 2020 rover and helicopter pair, named Perseverance and Ingenuity, respectively, launched by the US National Aeronautics and Space Administration (NASA).

All three missions took advantage of the favorable conjunction between Earth and Mars, which occurs about every 26 months, when the two planets reach their closest approach to each other. The "launch window" varies slightly depending on the exact path taken to get to Mars, but it allowed all three spacecraft to arrive a mere seven months after launch, after a relatively short journey of about 493 million kilometers.

Once the spacecraft arrive in the vicinity of Mars, they must undertake an orbital insertion maneuver, one of the most difficult operations in space exploration. Spacecraft travel to Mars (and the other planets) at speeds of tens of kilometers per second, and must brake sharply and precisely to be captured by the planet's gravity and enter orbit. The gravitational attraction of Mars is also much weaker, about 62 percent less than Earth's. Moreover, the 22-minute round-trip required for radio signals between Earth and Mars means the entire process must be automated.

These challenges have meant that, since the Soviet Union first exploited this launch window 61 years ago, more than half of the 49 Mars missions have failed. Only in the last 25 years have successes overtaken failures.

Of course, many lessons on space travel have been learned in this arduous process. The Hope mission, in close collaboration with NASA, is the second time a country's first mission to Mars safely entered orbit, following the success of India's Mangalyaan probe in 2014. Tianwen-1 is only China's second attempt to reach Mars, and the first time the country built and launched the spacecraft mostly on its own (a previous joint mission with Russia failed to escape Earth orbit).

Satellites deployed in earlier missions are also informing the scientific objectives of each craft. Hope is designed to study the daily and seasonal weather cycles on Mars, and is slated to carefully analyze the red planet's atmosphere for a full Martian year (about two Earth years). The primary mission is to understand why Mars lost so much of its atmosphere to space, a process that still continues today. Secondary objectives include mapping out a more complete picture of the more inclement weather cycles, such as the planet's many dust storms.

Hope has three instruments in addition to its communications suite. The Emirates eXploration Imager (EXI) is a high-resolution camera designed to image water, ice, dust and aerosols in the Martian atmosphere at six different wavelengths. The Emirates Mars Infrared Spectrometer (EMIRS) will study the temperature characteristics of ice, water vapor and dust. The Emirates Mars Ultraviolet Spectrometer (EMUS) will use ultraviolet light to provide a better understanding of Mars thermosphere, as well as the planet's oxygen and hydrogen content.

While these instruments are relatively commonplace, they will be filling a gap in the understanding of the Martian atmosphere, which has never been analyzed in such a complete manner. The mission objectives were decided in consultation with the Mars Exploration Program Analysis Group, a NASA-led international team which coordinates Mars missions from multiple countries.

The Hope team also received assistance in designing and making the spacecraft and its instruments from the Laboratory for Atmospheric and Space Physics at the University of Colorado Boulder, Arizona State University, and the University of California, Berkeley. They received further aid from the Indian Space Research Organization, which shared its experiences with the Mangalyaan mission.

Sarah bint Yousef Al Amiri, deputy project manager for the mission, commented to CNN's Becky Anderson on the success of the orbital insertion that, "I am grateful for the performance of the spacecraft, and what has made this mission remarkable, Becky, it is not only the 200 Emiratis working on this, but it is the 450 people from different continents, and from different backgrounds and beliefs. This is truly an international endeavor, and this is what science needs to be. This is what exploration is all about."

Tianwen-1 is a more sophisticated spacecraft, which includes

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a Mars orbiter, lander and rover. The lander and rover are set to deploy in May or June of this year after a close approach of the orbiter of about 265 kilometers to map the landing site in Utopia Planitia. The high resolution camera on board Tianwen-1 is capable of achieving a resolution of better than two meters at that height.

If the rover successfully lands, China will be the third country to achieve a soft landing on Mars, following the Soviet Union and the United States.

Other instruments on board the Tianwen-1 orbiter include a medium resolution camera, a magnetometer, a spectrometer, a subsurface radar, and two different particle analyzers. One of the particle analyzers, the Mars Energetic Particle Analyzer, has been operating since six days after the spacecraft's launch last July to study the environment between Earth and Mars, and how that changes in Martian orbit. This is similar to the role of the Radiation Assessment Detector on board NASA's Curiosity rover.

The rover has its own suite of instruments, including ground-penetrating radar, another magnetic field detector, a weather station, a navigation camera and two tools to study planetary geology. The solar panel-powered rover is slated to use these platforms to chemically analyze the Martian soil, looking for potential signs of past and (less likely) present life. It will add to the growing body of knowledge about the past and potential habitability of the red planet.

As part of its scheduled 90-day mission, the rover will also cache rock and soil samples for a future sample-return mission, which China has slated for the 2030s. If this 90-day mission is anything like the Spirit and Opportunity rovers, the rover will still be taking data and doing science even then.

Even if the rover does not land, both the Tianwen-1 and Hope are already successes, joining the constellation of satellites that have been studying Mars continuously for the past 20 years. These include the still operational Mars Odyssey and Mars Express, launched in 2001 and 2003 respectively, the Mars Reconnaissance Orbiter, Mangalyaan, MAVEN and ExoMars.

If the rover does make it to the surface, it will be joining the Curiosity rover and InSight lander as part of the ongoing surface exploration of the planet, which has been ongoing since 2004. The whole mission is being supported by teams in Argentina, France and Austria.

Of course, the international collaboration necessary for each mission has not stopped a spate of nationalism from the governments of both China and the UAE. In contrast to the comments from Al Amiri, Vice President and Prime Minister of the UAE and Ruler of Dubai, Sheikh Mohammed bin Rashid Al Maktoum, proclaimed that the Hope mission was solely a triumph for "Arab civilization."

Moreover, this spacecraft as a whole was designed to reach Mars around the time of the country's 50th anniversary. And the success was projected onto the side of the Burj Khalifa, the skyscraper which is a symbol of the crushing social and economic inequality in the region and around the world, and which had construction costs more than seven times higher than the paltry $200 million expended on the Hope mission.

Similar comments were issued at the time of Tianwen-1's launch by Chinese officials. Bao Weimin, a senior director at the state-owned China Aerospace Science and Technology Corporation declared that the exploration of Mars by China is "a manifestation of the country's scientific and technological strength."

It is also a measure of China's military capacity, which think tanks and the Pentagon in the US are painfully aware of. If a country can thread a spacecraft to orbit Mars and even land on it, it is more than capable of launching missiles with pinpoint accuracy against targets on its own planet. A great scientific achievement at the same time exacerbates international rivalries and extends them into outer space.

Such rivalries also limited the Chinese mission. There is no reason that a second rover on the scale of Perseverance, which is many times the mass and complexity of the Tianwen-1 rover, could not have been sent on the rocket launched from Wenchang, except that NASA workers are barred from such close collaboration with their Chinese counterparts. It has meant that, both for its Moon and Mars rovers, China has had to literally reinvent wheels to drive on those other worlds.

That the UAE launched spacecraft with the support of the United States and Japan is another indication of international tensions, this time US aggression against Iran. The UAE has traditionally been used by Iran, a few miles across the Strait of Hormuz, to send and receive goods that have been embargoed by other nations, usually the US. The close collaboration between the United States and UAE is no doubt concerning for Iranian ruling circles, further encircling the already isolated country.

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