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Mars science is expanding internationally

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Editorial

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July 2020 marked the beginning of a busy year of Mars Exploration, that will culminate with the arrival of three spacecraft at Mars in February 2021. The three spacecraft, from the United Arab Emirates, China and the United States are all primarily robotic missions that will join a busy group of exploration spacecraft either in orbit or on the planet's surface.

The Emirati Hope orbiter, the first deep space explorer of the UAE, will be the first to arrive on February 9th. The orbiter was developed through a partnership between Mohamed bin Rashid Space Centre (MBRSC), Laboratory for Atmospheric and Space Physics at the University of Colorado-Boulder, and Arizona State University (ASU). Hope has three instruments, two spectrometers and one exploration imager (high-resolution camera). One spectrometer will determine the temperature of the planet through the Martian year, the other will measure the oxygen and hydrogen levels at ~40,000 kilometers from the surface of Mars. The imager will also provide information on the ozone levels on the Red Planet. The orbiter will be active through one Martian year (two Earth years).

Next will be China's Tianwen-1 mission scheduled to arrive at Mars on February 10th. After orbiting the planet, it will send a lander containing a rover to the surface in May. The main task of Tianwen-1 is to perform an extensive survey of the entire planet using the orbiter, and to send the rover to surface locations of scientific interest to conduct detailed investigations. Specifically, the scientific objectives of Tianwen-1 are (1) to map the morphology and geological structure, (2) to investigate the surface soil characteristics and water-ice distribution, (3) to analyze the surface material composition, (4) to measure the ionosphere and the characteristics of the Martian climate and environment at the surface, and (5) to perceive the physical fields (electromagnetic, gravitational) and internal structure of Mars. There are 13 scientific payloads in the Tianwen-1 mission in total. The seven instruments on board the orbiter comprise two cameras, the Mars-Orbiting Subsurface Exploration Radar, Mars Mineralogy Spectrometer, Mars Magnetometer, Mars Ion and Neutral Particle Analyzer, and Mars Energetic Particle Analyzer. The six instruments installed on the rover include the Multispectral Camera, Terrain Camera, Mars-Rover Subsurface Exploration Radar, Mars Surface Composition Detector, Mars Magnetic Field Detector, and Mars Meteorology Monitor.

Soon after, on February 18th, NASA's Perseverance rover will arrive and immediately head toward the Martian surface. The primary objective of the mission is to seek signs of extinct life. But first it will deploy Ingenuity, a small helicopter. That device has its own mission of carrying out the first powered flight from the surface of another planet. Perseverance will collect samples for eventual return to Earth. The Mars Perseverance rover introduces a drill that can collect core samples of rocks and soils that show promise for signs of extinct life and set them aside in a "cache" on the surface of Mars. The mission also provides opportunities to gather knowledge and demonstrate technologies that address the challenges of future human expeditions to Mars. These include testing a method for producing oxygen from the Martian atmosphere, identifying other resources (such as subsurface water), improving landing techniques, and characterizing weather, dust, and other potential environmental conditions that could affect future astronauts living and working on Mars. Perseverance will carry seven instruments:

1) Mastcam-Z, an advanced camera system with panoramic and stereoscopic imaging capability with the ability to zoom. The instrument also will determine mineralogy of the Martian surface and assist with rover operations.
2) SuperCam, an instrument that can provide imaging, chemical composition analysis, and mineralogy at a distance.
3) Planetary Instrument for X-ray Lithochemistry (PIXL), an X-ray fluorescence spectrometer and high-resolution imager to map the fine-scale elemental composition of Martian surface materials. PIXL will provide capabilities that permit more detailed detection and analysis of chemical elements than ever before.
4) Scanning Habitable Environments with Raman & Luminescence for Organics and Chemicals (SHERLOC), a spectrometer that will provide fine-scale imaging and uses an ultraviolet (UV) laser to map mineralogy and organic compounds. SHERLOC will be the first UV Raman spectrometer to fly to the surface of Mars and will provide

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complementary measurements with other instruments in the payload. SHERLOC includes a high-resolution color camera for microscopic imaging of Mars' surface.

5) The Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE), a technology demonstration that will produce oxygen from Martian atmospheric carbon dioxide. If successful, MOXIE's technology could be used by future astronauts on Mars to burn rocket fuel for returning to Earth.
6) Mars Environmental Dynamics Analyzer (MEDA), a set of sensors that will provide measurements of temperature, wind speed and direction, pressure, relative humidity, and dust size and shape.
7) The Radar Imager for Mars' Subsurface Experiment (RIMFAX), a ground-penetrating radar that will provide centimeter-scale resolution of the geologic structure of the subsurface.

This cadre of missions will advance our knowledge of the of the Martian environment and its potential for harboring life extant or extinct, that is, a true advance in the science of Astrobiology.

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