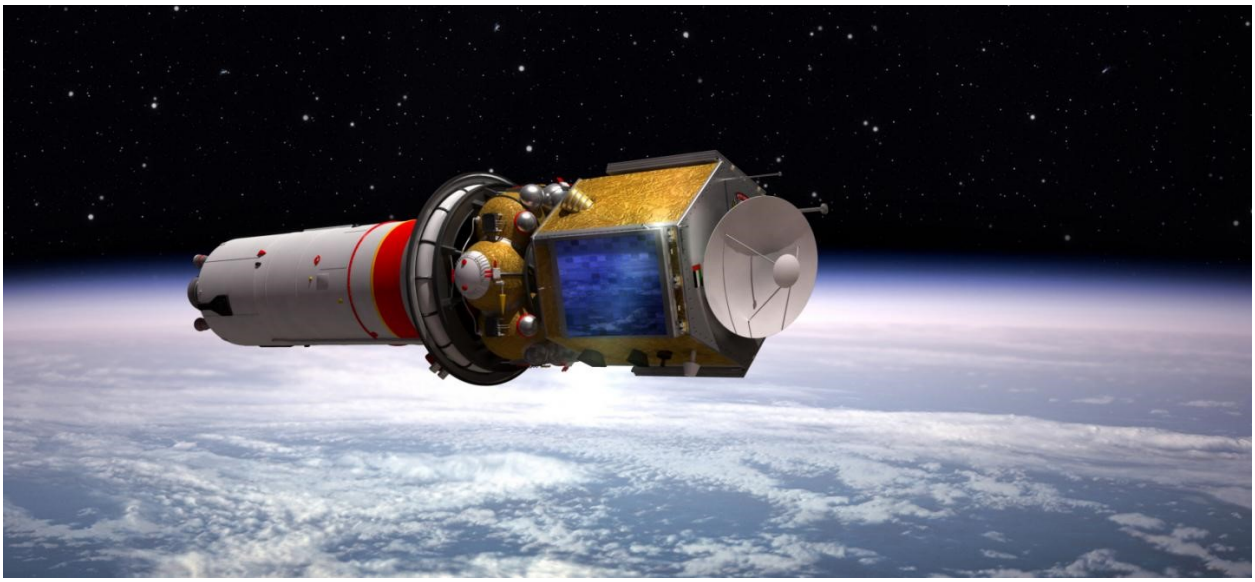


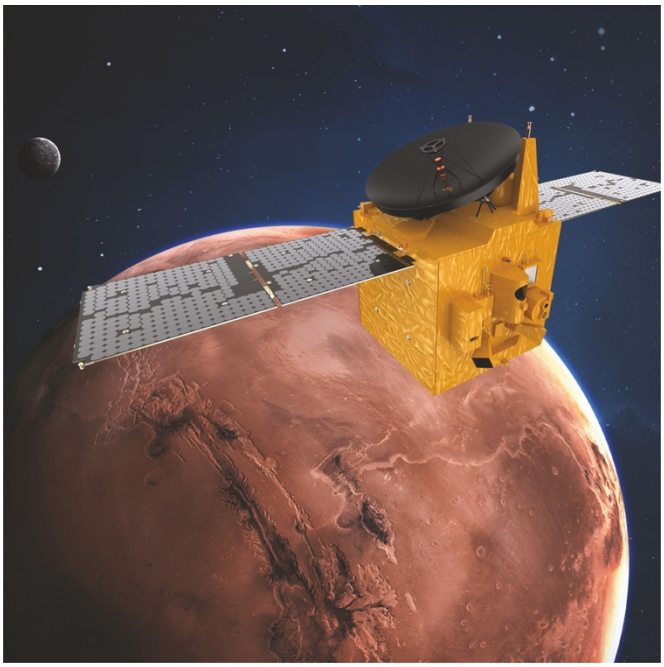
U.A.E. Launches First Arab Interplanetary Mission

In yet another milestone for the U.A.E. Space Program, the Emirates Mars Mission "Hope Probe" launched on July 20th 2020 for a 7-month journey to the Red Planet, where it will arrive in February 2021 to coincide with the 50th Anniversary of the U.A.E. as a country. This strategic initiative, which was first announced by U.A.E. President His Highness Sheikh Khalifa Bin Zayed Al Nahyan and U.A.E. Vice President and Prime Minister His Highness Sheikh Mohammed Bin Rashid Al Maktoum in 2014, is meant to not just achieve important scientific objectives by furthering understanding of the Martian atmosphere but also accelerate the U.A.E.'s development of a knowledge economy and inspire a generation of Emirati and Arab Youth to "dream for the stars." This impressive feat for a space program in its relative infancy is a testament to the U.A.E.'s visionary leadership, its rapid advances in the field, and the power of partnerships, particularly with the United States.

Goals and Objectives

Scientists consider Mars a significant target for further exploration given its proximity to Earth and a variety of features that could potentially sustain life, such as soil containing water, a relatively tolerable climate, and gravity levels to which the human body can adapt. As such,

there are currently eight active Mars missions, some orbiting the planet and some on its surface. Two more missions, one led by the United States and the other by China, will launch in the next month, when Mars and the Earth draw close, as they do every 26 months, thus minimizing travel time and fuel use. Only the U.S., Russia, Europe, and India have thus far succeeded in reaching Mars with China and the U.A.E. seeking to join this exclusive club.



Now that the U.A.E.'s Hope Probe (pictured at right) has successfully launched into space, it will embark on a 307-million-mile journey over the next 7 months to Mars. There, the 2,970 pound probe, which is 24 feet wide and 9 feet tall when its solar panels are deployed, will spend a Martian year (687 days) orbiting the planet from a large, oval-shaped high orbit varying from 12,400 miles to 27,000 miles above the surface.

From this orbit, three instruments mounted on the probe will improve scientific understanding of Mars by providing the first complete picture of the Martian atmosphere across the globe, at all times of day, and throughout a full seasonal cycle. It should help scientists better understand extreme weather events on Mars, such as global dust storms that sometimes engulf the planet. Moreover, the data the probe collects, which it will share freely with the scientific community, should help answer important questions about the loss of Mars' atmosphere to space and how processes in the lower atmosphere contribute to that escape.

The significance of this should not be understated. Understanding the atmosphere of Mars should help facilitate future exploration of Mars, including potentially by crewed missions, and explain the story of the planet, which was once much warmer and wetter, with a thicker atmosphere, than at present. This, in turn, could help us better understand not just the workings of Mars but the workings of Earth and other planets in the universe.

Beyond achieving these purely scientific objectives, this probe should propel forward the U.A.E.'s nascent space program. Indeed, by endeavoring to accomplish a task many times harder than anything previously attempted by the U.A.E. space program, the probe has already built the capabilities of Emirati engineers and scientists in the field of space exploration. It has also positioned the U.A.E. for further advances in this field by helping establish and reify mutually beneficial partnerships with international entities.

The impact of this mission, however, should not just be limited to space exploration. This mission promises to help develop the U.A.E.'s science and technology sectors more generally

through the transfer of knowledge and skills beyond the space program and by inspiring Emirati children to enter STEM (science, technology, engineering, and math) fields. It may even spur innovations with broad applications here on Earth in areas such as energy conservation or food security. This would all help the U.A.E. further diversify its economic base, create a knowledge economy, and prepare for a post-oil future.

Finally, as the Arab World's first interplanetary mission, this mission can inspire the next generation of Arab youth. Referencing President John Kennedy's famous "moon shot speech" that "captured the imagination of the world," U.A.E. Ambassador to the United States His Excellency Yousef Al Otaiba remarked, "Today in the U.A.E., that same energy and wonderment exists as the Hope probe is set to launch. The Emirates Mars Mission is inspiring a new generation of Arab youth to explore careers in science and technology, and opening up new frontiers of possibility for our region."

Evolution of U.A.E. Space Program

The Emirates Mars Mission Hope Probe is a joint initiative between the Mohammed bin Rashid Space Centre (MBRSC) and the U.A.E. Space Agency. The U.A.E. Government assigned the MBRSC to manage, develop, and execute all phases of the program, while the U.A.E. Space Agency funded and supervised procedures and necessary details for the implementation of this project. The relative youth of both of these institutions, not to mention the relative youth of the U.A.E. itself, makes the U.A.E.'s achievement all the more remarkable.

The MBRSC and its predecessor organization first began developing earth-sensing satellites in 2006, with ever-increasing contributions from Emirati engineers. It launched DubaiSat-1 in 2009 from Kazakhstan, DubaiSat-2 in 2013 from Russia, and KhalifaSat in 2018 from Japan. KhalifaSat was notably the first satellite to be wholly designed and developed in the U.A.E. The MBRSC also launched Nayef-1, the first Emirati Nanosatellite, in early 2017 from India. In sending these satellites into orbit during the first two decades of the 21st century, the MBRSC mirrored the accomplishments of its Emirati peers in Abu Dhabi, Thuraya Communications Company and Al Yah Satellite Communications Company (Yahsat). The U.A.E. currently has ten functioning satellites in orbit with plans to launch another eight in the coming years (including two more in 2020).

In addition to launching satellites into space, the MBRSC has also been responsible for the U.A.E. Astronaut Program. Since its inception in 2017, this program has already seen the September 2019 launch of the U.A.E.'s first astronaut, former F16 pilot Hazza Al Mansouri

(pictured above), to the International Space Station, where he spent eight days conducting science experiments. Al Mansouri was the first Arab to travel to space in three decades.

The MBRSC is also responsible for the development of the Mars 2117 vision to build a human colony on Mars. In line with this vision, the U.A.E. is building a domed Mars Science City, which will simulate Mars' terrain and environment so as to help test the various technologies needed for humans to eventually settle the planet.

In pursuing these endeavors, the MBRSC has grown to a staff of over 200 Emirati employees. In total, more than 150 Emirati engineers, scientists, and researchers spent six years working on the Emirates Mars Mission, at a reported cost of nearly $208 million (765 million AED).

Notably, the majority of the Emirates Mars mission team is under the age of 35, with an average age (as of 2019) of just 27. Moreover, 34% of the Emirates Mars Mission team, 80% of the science team, and half of the leadership team are female, including Her Excellency Sara Al Amiri, who is the Deputy Project Manager and Science Lead for the Emirates Mars Mission. In July 2020, as part of an important U.A.E. government reshuffle, Her Excellency, who is 33 years old and was then serving as U.A.E. Minister of State for Advanced Sciences, was appointed Minister of State for Advanced Technology as well as head of the U.A.E. Space Agency.

This appointment reflects the degree to which the MBRSC works hand in hand with the U.A.E. Space Agency, which was established by federal decree in 2014 with the aim of developing the U.A.E.'s national space sector. The agency is responsible for assisting academic programs, advancing national and regional space exploration, and investing in research, development, and commercial space projects as well as expanding international partnerships.

Power of International Partnerships

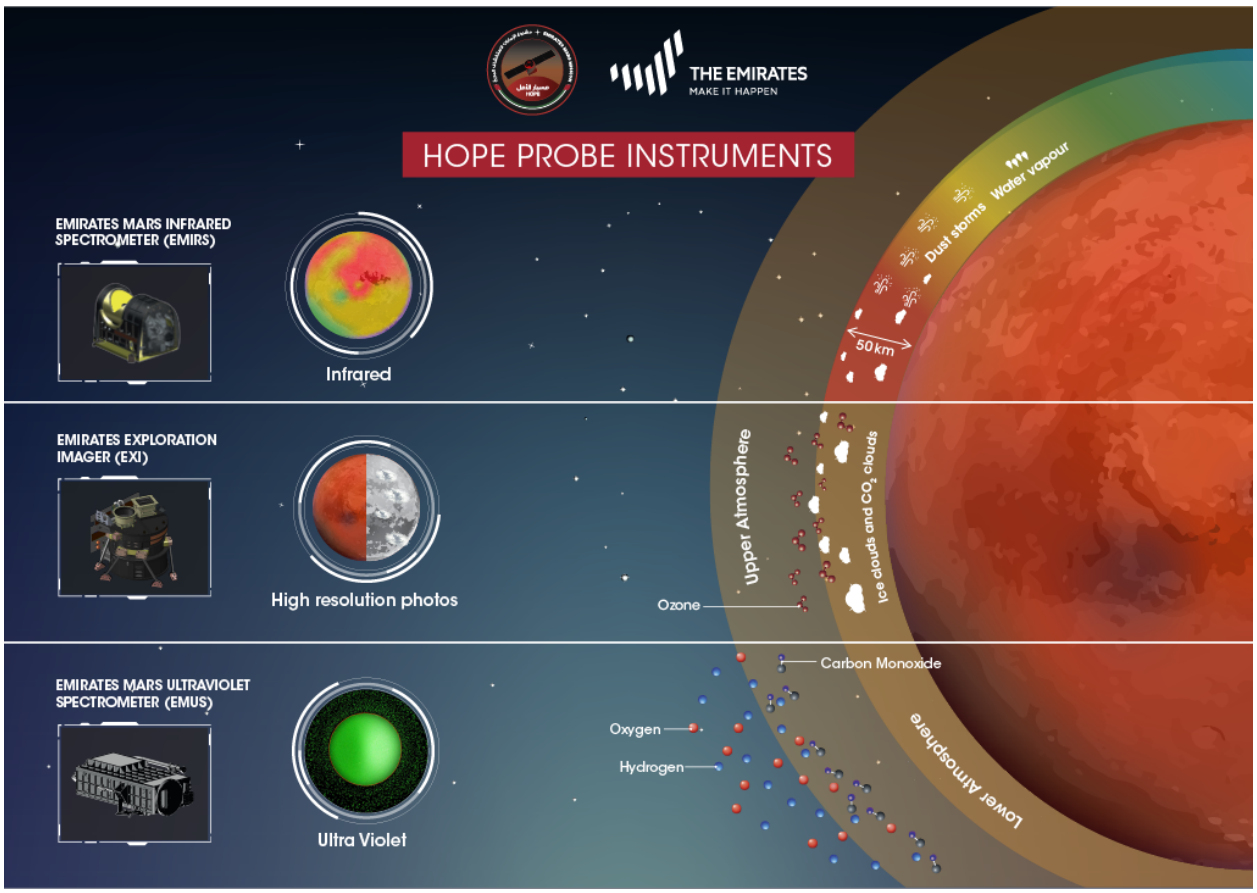
In order to so quickly achieve its goals and objectives in space, the U.A.E. has harnessed the power of international partnerships, particularly with the United States.

Indeed, the Hope Probe was designed and developed by the Emirates Mars Mission team in close partnership with "Knowledge Transfer partners" at three U.S. universities: the University of Colorado Boulder, Arizona State University, and the University of California Berkeley.

- The Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado Boulder, which houses the science team of NASA's Mars Atmosphere and Volatile Evolution (MAVEN) mission, was involved in the Emirates Mars Mission's design, spacecraft, testing, and operations as well as the development of two of the probe's three major instruments:
    - The Emirates eXploration Imager (EXI), which is a high-resolution multiband (visible and UV) digital camera that will capture high-resolution images of Mars along with measuring water ice and ozone in the lower Martian atmosphere.

- The Emirates Mars Ultraviolet Spectrometer (EMUS), which is a far-UV imaging spectrograph that will measure oxygen and carbon monoxide in Mars's thermosphere and the variability of hydrogen and oxygen in its upper atmosphere.

- Arizona State University was involved in the development of the probe's third major instrument, The Emirates Mars InfraRed Spectrometer (EMIRS), which will measure global distribution of dust, ice clouds, and water vapor in the lower Martian atmosphere.
- The University of California, Berkeley Space Sciences Lab (SSL) was involved in the development of EMUS detectors.



At the same time it has drawn on partnerships with key American universities, the Emirates Mars Mission has leveraged its relationships with The National Aeronautics and Space Administration (NASA). For instance:

- When designing the mission, the U.A.E. consulted a NASA advisory committee called the Mars Exploration Program Analysis Group (MEPAG) to determine what research a U.A.E. probe could usefully add to the current state of knowledge, thereby framing Hope's ultimate objectives.
- Throughout its voyage to Mars, communications will be routed through NASA's Deep Space Network (DSN) to the Emirates control center in Dubai. Managed out of the Jet Propulsion Laboratory (JPL) in Pasadena, California, the DSN is responsible for scheduling the station

contacts, transmitting commands to the spacecraft, acquiring telemetry data from the spacecraft, and recording radiometric tracking data.

This collaboration with NASA is just part of a much larger partnership between NASA and the U.A.E. Space Program and the U.A.E, as formalized by key agreements. In July 2018, the U.A.E. Space Agency and NASA signed an implementing arrangement for cooperation on manned spaceflight. The agreement strengthened an overarching framework agreement between the two parties signed in 2016 to collaborate on the exploration of outer space for peaceful purposes.

Taken as a whole, U.S.-U.A.E. partnerships have not just helped enable the success of the Emirates Mars Mission, but they have planted the seeds for further bilateral cooperation in space exploration as the U.S.-U.A.E. relationship expands beyond the Earth to the stars.