NEIGHBORS

UAEU celebrates World Space Week

Praise for mission to explore Venus, asteroid belt

This week the United Arab Emirates University celebrates World Space Week, the annual event designated by the United Nations in 1999 to mark the contribution of science and technology to improvements in human life.

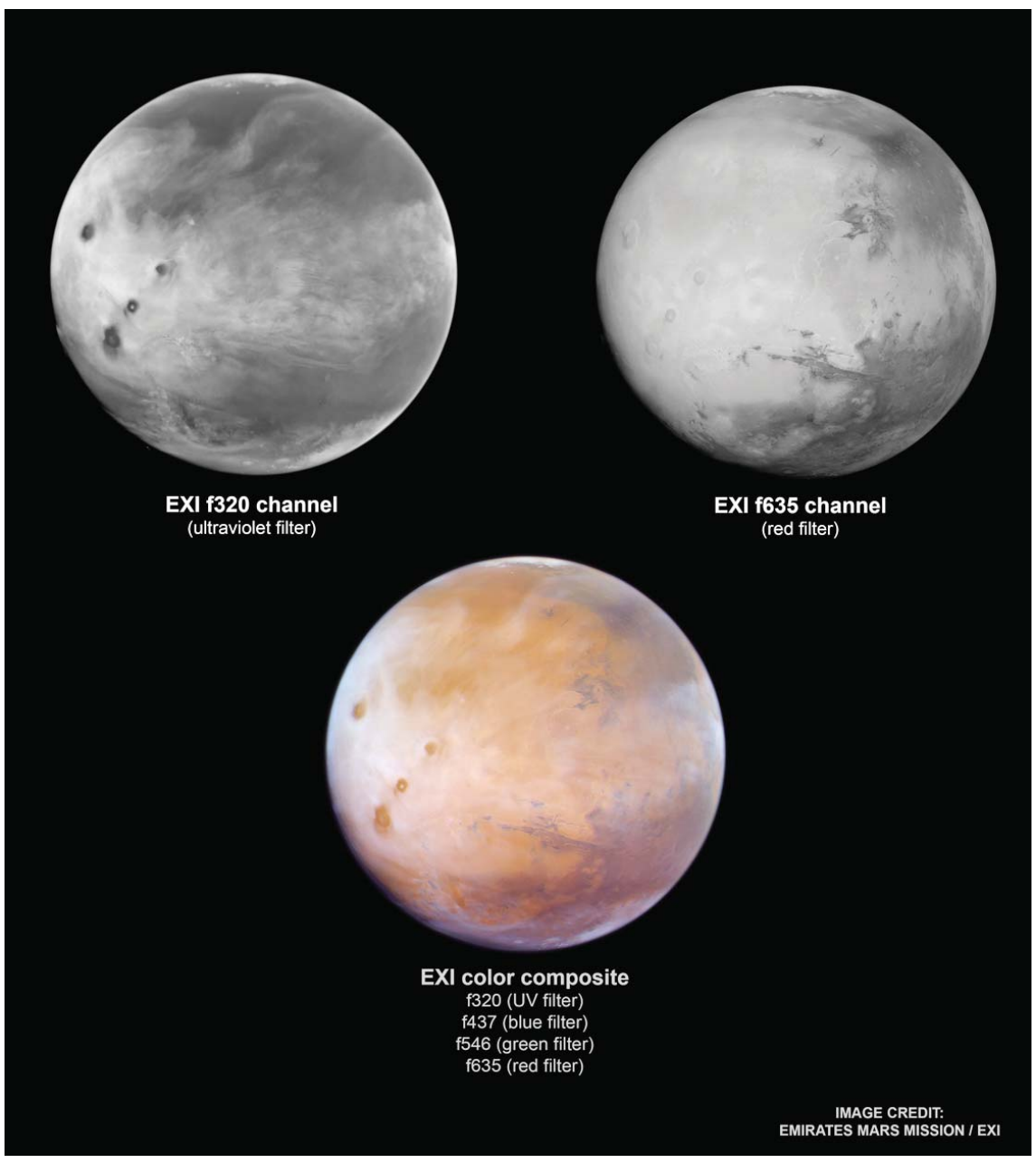
His Excellency Zaki Anwar Nusseibeh, University Chancellor and Cultural Adviser to His Highness the President used the occasion to praise the UAE leadership for their announcement of an Emirati mission to explore Venus and the solar system's asteroid belt and achieve the first Arab vehicle landing. He said, "This unprecedented initiative will be an historic achievement, adding a jewel to the UAE's pioneering crown".

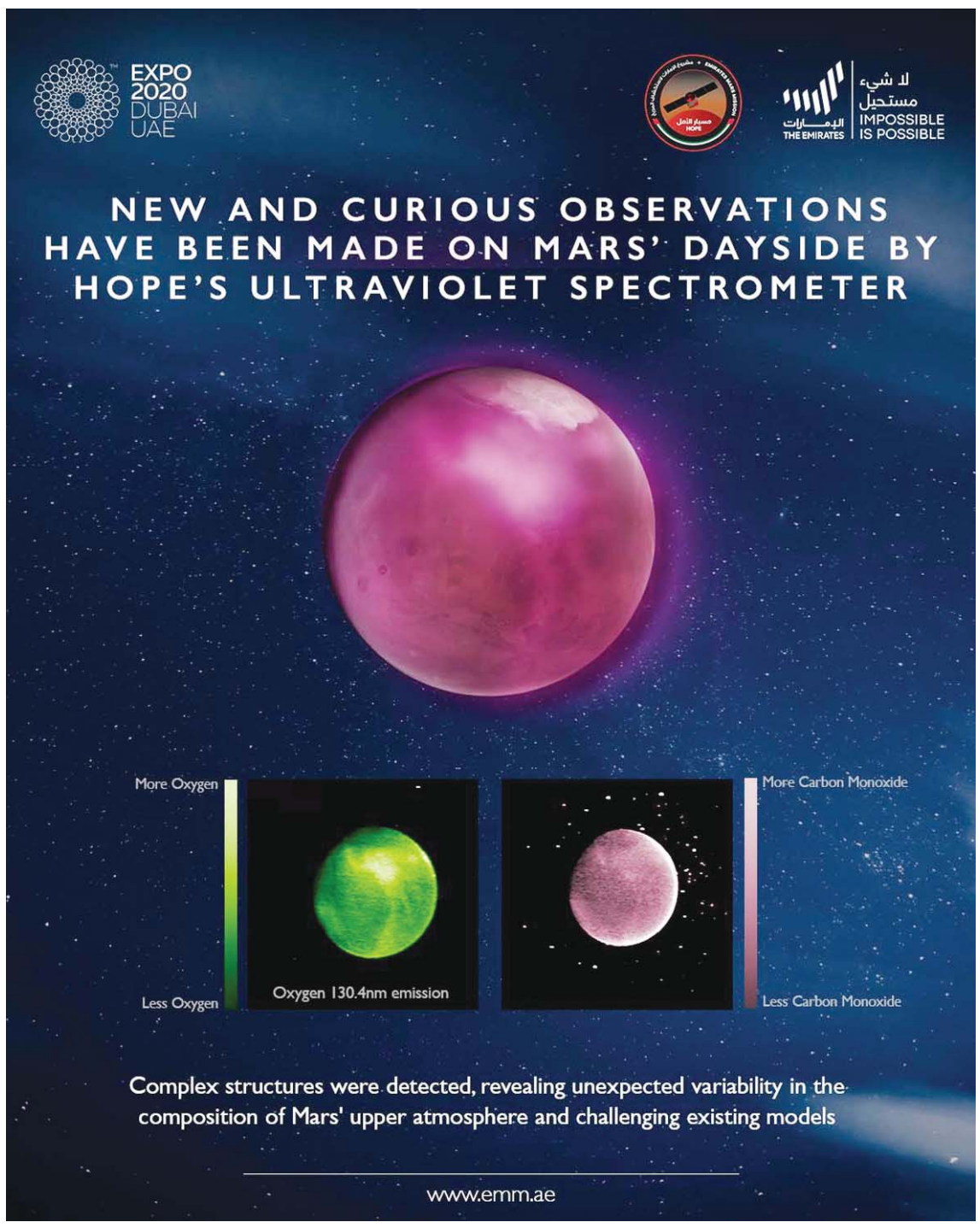
H.E. described this initiative as an expression of the great confidence placed in the UAEU by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President, Prime Minister and Ruler of Dubai and His Highness Sheikh Mohammed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the Armed Forces. "I am grateful to them for their recognition of the university's scientific expertise and research capacity, and our ability to conduct experiments and tests necessary to this pioneering national project. I thank them for their faith in the capability of the nation to push boundaries in the fields of space science and to use advanced technology to innovate and explore new horizons. They hold a deep belief in the UAE's potential to enhance its global competitiveness and achieve its aspirations in the space sector.


Nusseibeh

The theme of the 2021 celebration is 'Women in Space'. Dr. Reem Fares, Assistant Professor in the Department of Physics of the College of Science said that Emirati women have leading positions in the country, and at the forefront is the mother of the nation, Her Highness Sheikha Fatima bint Mubarak, President of the General Women's Union. Dr. Reem expressed the UAEU's pride that its alumnus Noura Al Matrooshi is one of the first Emirati astronauts. She said, "This highlights the university's objective to foster students' capability in scientific research by providing an innovative educational experience of the highest international standards. This year we have coordinated with the UAE Space Agency to organize our celebrations, which will be run by the College of Science, the National Center for Space Science and Technology, and student clubs. We hope the events motivate women to participate and encourage them to choose to study science, informatics, and engineering".

Dr. Reem described the confidence felt by the university because the UAE leadership has chosen it to participate in the mission to explore Venus and the asteroids of the solar system. "It demonstrates the integrity of the university's objectives to provide excellent education in pure and applied science and research and to empower all its students to achieve distinction in their studies. The university aligns its work to the nation's strategic vision for the next fifty years. This vision includes using scientific research and study to build the strength and potential of the nation and to prepare young people to support our progress towards leadership in all fields of endeavor".





EXI Multispectral Image of Mars, showing volcanoes poking through the cloud layer

On 18 July 2021, the EXI camera system onboard the Hope probe obtained a set of multispectral images of a fully-illuminated hemisphere of Mars – which looks very similar to observations routinely carried out by weather satellites orbiting Earth. At the time the images were taken, the Hope spacecraft was at an altitude of about 20,260 kilometers above the surface; with the view centered at 11.0°N latitude, -79.4°E longitude, North is toward the top. In terms of the Martian season, it was late spring in the northern hemisphere.

In the EXI 635 nanometer (red) image presented here, surface features are very distinct while atmospheric hazes and clouds are quite subtle; in the EXI 320 nanometer (ultraviolet) image, the Martian surface is dark but atmospheric water-ice clouds and hazes are bright and distinct. By combining the individual images into a single colour image, one can view the notable surface and atmospheric features at the same time. This colour composite was assembled from images taken through EXI's blue, green, and red filters (437, 546, and 635 nanometers) overlaid with an ultraviolet image (320 nanometers). These images have been "calibrated" to remove several types of artefacts introduced by the camera system. The contrast has been adjusted to enhance the visibility of surface and atmospheric features.

It is late spring in the northern hemisphere, the time of year when Mars reaches the maximum distance from the Sun (aphelion) in its elliptical orbit. This is also when atmospheric temperatures reach their minimum for the year, leading to widespread condensation of atmospheric water vapor and the formation of a band of water-ice clouds between the equator and about 30°N latitude. This so-called Aphelion Cloud Belt (ACB) is very distinct in the 320 nanometer and colour-composite images. Below the center in these images, the Valles Marineris canyon system stretches nearly 4000 kilometers across the surface. To the west, the upper slopes and summits of the massive Tharsis Montes volcanoes extend up through the clouds, forming four "dark spots". The leftmost of these – Olympus Mons – at 600 km across and nearly 22 km tall, is the largest known mountain in the Solar System.

EMUS 130.4 nm – Dramatic variation in concentrations of Atomic Oxygen on Mars

This observation from the EMUS instrument (Emirates Mars Ultraviolet Spectrometer) was acquired on 24 April 2021 and shows vast structures in the airglow emitted by atomic oxygen from the dayside of Mars at a wavelength of 130.4 nm. This oxygen is produced when sunlight splits carbon dioxide molecules in the upper atmosphere at altitudes above 100 km. These measurements show higher than expected variations in the density of atomic oxygen and point to unusual levels of atmospheric turbulence.

One of three instruments on board the Mars Hope Probe, EMUS' principal science goal is the measurement of oxygen and carbon monoxide in Mars' upper atmosphere and the variability of hydrogen and oxygen in the exosphere. EMUS (Emirates Mars Ultraviolet Spectrometer) is the most sensitive ultraviolet instrument yet to orbit Mars.

EMUS 137-150 nm – Equally dramatic dayside variations in carbon monoxide

This observation from the EMUS instrument (Emirates Mars Ultraviolet Spectrometer) was acquired on 24 April 2021 and shows vast structures in the airglow emitted by carbon monoxide from the dayside of Mars at wavelengths of 137-150 nm. Along with atomic oxygen, this carbon monoxide (CO) is produced when sunlight splits carbon dioxide (CO2) in the upper atmosphere of Mars. Understanding the chemistry of carbon monoxide in the Martian atmosphere is a long-standing problem in planetary science, and these observations by EMM promise new avenues for progress.

New observations show unexpected behaviors

New insights into turbulent Martian atmosphere revealed

The Emirates Mars Mission, the first interplanetary exploration undertaken by an Arab nation, today released unique new images of Mars that challenge our existing conception of how the planet's atmospheric gases behave and interact. Taken by the Mars Hope probe's EMUS instrument, the observations show dramatic variations in the concentrations of both atomic oxygen and carbon monoxide in the dayside atmosphere of Mars.


Al Matroushi

"These observations contain features that were completely unexpected and we believe will have far-reaching consequences for our existing models of the Martian atmosphere and our understanding of its behaviour. We simply hadn't anticipated structures of this magnitude and complexity," said Emirates Mars Mission Science Lead, Hessa Al Matroushi.

The new findings are included in the first data release from the Mission, which was opened up to public access on 1 October 2021, and follow on from the Mission's revolutionary observations of the Martian discrete aurora. Both new observations come early in the Mission's lifetime and have significant implications for our understanding of the Martian atmosphere and its interaction with solar radiation.

The observations confound scientist's preconceptions of the distribution of ultraviolet light emitted from the upper atmosphere of Mars, showing vast structures at a range of wavelengths suggesting a higher than expected variation in the density of atomic oxygen and pointing to unusual levels of atmospheric turbulence. Taken at a time when Mars was near the aphelion of its orbit (furthest from the Sun) and when solar activity was low, the images are at their most striking and remarkable in emissions from oxygen at the 130.4 nm wavelength.

"It was so unexpected that we initially thought the structures might be artefacts in the image, caused by contaminating light from longer wavelengths that the instrument is designed to reject," said EMM Deputy Science Lead Justin Deighan. "We had expected to observe a relatively uniform emission from oxygen at 130.4 nm across the planet and yet here we are, faced with unpredicted variations of 50% or more in the brightness. The science team is currently refining their models to come up with a robust interpretation of these findings. It's very exciting to be challenged this way; this is exactly the type of science the mission was designed to pursue."

One of three instruments on board the Mars Hope Probe, EMUS' principal science goal is the measurement of oxygen and carbon monoxide in Mars' upper atmosphere and the variability of hydrogen and oxygen in the exosphere. EMUS (Emirates Mars Ultraviolet Spectrometer) is the most sensitive ultraviolet instrument yet to orbit Mars.

"We have been refining our processing pipeline, readying for our first science data release to the global science community, which took place as scheduled on the first of October," commented Al Matroushi. "these observations, and our previously announced observations of Mars' discrete aurora, will form part of that initial data release, which includes observations made by Hope between 9 February to 22 May 2021. From now onwards, we will be releasing new data sets every three months without embargo and free for use to the community."

The Emirates Mars Mission is studying the relationship between the upper layer and lower regions of the Martian atmosphere, giving the international science community full access to a holistic view of the Martian atmosphere at different times of the day, through different seasons.

The Mission's Hope Probe is following its planned 20,000 – 43,000 km elliptical science orbit, with an inclination to Mars of 25 degrees, giving it a unique ability to complete one orbit of the planet every 55 hours and capture a full planetary data sample every nine days throughout its one Martian year (two Earth year) mission to map Mar's atmospheric dynamics.

EMM and the Hope probe are the culmination of a knowledge transfer and development effort started in 2006, which has seen Emirati engineers working with partners around the world to develop the UAE's spacecraft design, engineering and manufacturing capabilities. Hope is a fully autonomous spacecraft, carrying three instruments to measure Mars' atmosphere. Weighing some 1,350 kg, and approximately the size of a small SUV, the spacecraft was designed and developed by MBRSC engineers working with academic partners, including LASP at the University of Colorado, Boulder; Arizona State University and the University of California, Berkeley.

The Hope Probe's historic journey to the Red Planet coincides with a year of celebrations to mark the UAE's Golden Jubilee.

editor's choice