News in focus

MITSUBISHI HEAVY INDUSTRIES/EPA-EFE/SHUTTERSTOCK

The Hope orbiter launched at 6.58 a.m. local time on 20 July from the Tanegashima Space Center in Japan.

EXCITEMENT AS ARAB WORLD'S FIRST MARS PROBE LIFTS OFF

The United Arab Emirates' US$200-million spacecraft has embarked on a 7-month odyssey to produce the first global map of Martian weather.

By Elizabeth Gibney

The United Arab Emirates' Hope orbiter is on its way to Mars after launching successfully from the Tanegashima Space Center near Minamitane, Japan. The probe, built by the United Arab Emirates (UAE) and US partners, is the first interplanetary mission from any Arab state.

The car-sized craft was lifted into Earth's orbit on a Mitsubishi H-IIA rocket at 6.58 a.m. local time on 20 July. After the launch, a second stage of the rocket fired, putting the craft on its Mars trajectory.

Two hours later, engineers at mission control at Mohammed bin Rashid Space Centre (MBRSC) in Dubai declared the launch a success, having established communication with the craft.

"The Hope probe has performed perfectly so far and we're in great shape," the mission's project manager, Omran Sharaf, said in a statement. "The team at MBRSC are delighted and celebrating, obviously, but there's a lot of work yet to go," he said.

Mission controllers now face a 7-month wait as Hope travels the 493 million kilometres to the red planet. It will enter Martian orbit in February 2021, ahead of the UAE's 50th birthday. Hope is one of three missions to Mars this year, with launches from the United States and China due over the coming weeks.

For many scientists involved with Hope, entering orbit will be the real crunch point. "What I'm dreading more is the Mars orbital insertion," says Sarah Al Amiri, the mission's deputy project manager and science lead. Although the launch was out of the mission team's hands, orbital insertion will be a direct test of whether the spacecraft they built works as planned, she says.

After insertion, Al Amiri's team will turn its attention to the science. Hope will study the Martian atmosphere from an unusual elliptical orbit that allows it to observe almost the

entire planet, across both night and day, in each 55-hour cycle. It will produce the first global map of the Martian weather, over days and seasons, says Al Amiri. The team hopes that the data will reveal how atmospheric processes cause Mars to lose hydrogen and oxygen into space – a process that is thought to have contributed to the once-lush planet becoming barren. "This allows us to have a more holistic understanding of the planet and how it lost its atmosphere, and also the dynamics of the atmosphere as a whole," says Al Amiri.

The small Gulf state's route to becoming an emerging space power has been short and unusually fast. The mission began just six years ago, alongside the creation of a national space agency, when the UAE had only recently begun to design and build Earth-observation satellites. Hope was designed as a catalyst for science more broadly in the region, and to promote research careers in a region whose oil wealth is on the wane.

Without experience of its own in interplanetary missions, the UAE Space Agency hired US collaborators – mainly from the University of Colorado Boulder – to guide it through the process and build up science and engineering capacity within the UAE.

"This marks a historic moment for the United Arab Emirates and the entire Arab world, and I could not be more honoured to be a part of this incredible day," says Brett Landin, an engineer at the University of Colorado Boulder, who leads the mission's spacecraft team. "As much as I'd like for our team to be able to celebrate and take a well-deserved break, the difficult work of operating the spacecraft has now just begun." Construction took place mostly in the United States, but with the involvement of 75 Emirati scientists and engineers from the MBRSC who were dedicated full-time to the mission. Operations for Hope will be run out of mission control.

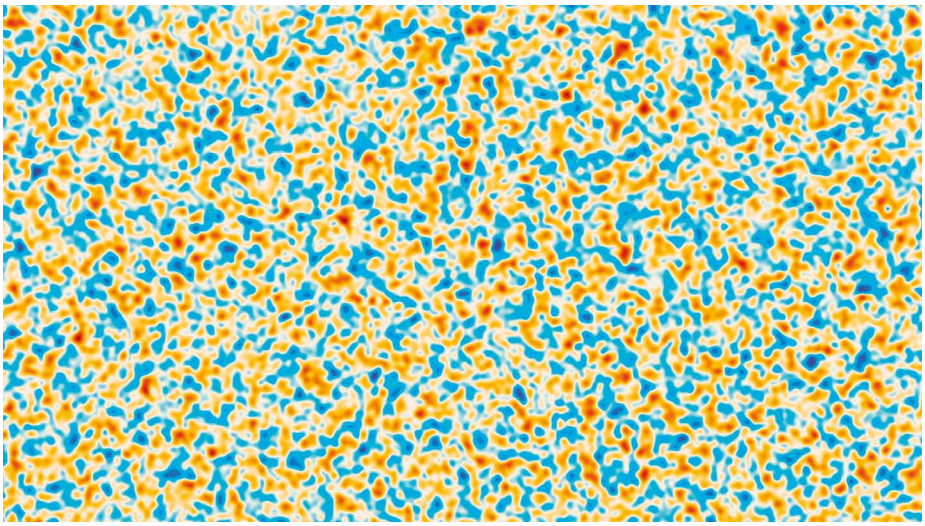
Value for money

According to the UAE's minister of cabinet affairs, Mohammad bin Abdullah Al Gergawi, the mission's cost came in at a relatively cheap US$200 million. This includes spacecraft development, launch and ground operation, a spokesperson confirmed to *Nature*. This is more expensive than India's Mangalyaan mission, which cost around US$75 million, but is cheaper than fully fledged NASA missions, such as the US$720-million Mars Reconnaissance Orbiter. The UAE Space Agency had declined to release the cost until now.

Although the mission was on time and within budget, COVID-19 presented a final challenge. International travel restrictions, including a mandatory 14-day quarantine period for all those entering Japan, meant that the mission had to be shipped earlier than planned, at the expense of some last-minute tests. Groups of engineers, travelling two weeks apart, had to tag-team to make sure the craft was always in expert hands while they adhered to quarantine rules. The accelerated schedule meant the second team was still able to make it to the launch site in time for preparations.

Back at mission control, celebrations continued into the early hours. "There is an accumulation of many emotions," says Fatma Lootah, a member of the mission's science team at the MBRSC. "We are excited and we are ready, and, by we, I mean the entire nation," she says, adding that pictures of the probe cover the country's billboards and screens.

The mission's success is not only about launching successfully, or even getting to Mars, but about the ripple effects on the UAE's education and economy, says Al Amiri. "The impact we have is something I'm looking forward to seeing over the next few years."



ACT COLLABORATION

A portion of the new map of the Universe's cosmic microwave background radiation.

MYSTERY OF UNIVERSE'S EXPANSION DEEPENS WITH FRESH DATA

A long-awaited map of the Big Bang's afterglow fails to settle debate over how fast the Universe is expanding.

By Davide Castelvecchi

A new map of the early Universe has reinforced a long-running conundrum in astronomy over how fast the cosmos is expanding. The data – collected using a telescope in Chile's Atacama Desert – back up previous estimates of the Universe's age, geometry and evolution. But the findings clash with measurements of how fast galaxies are flying apart from each other, and predict that the Universe should be expanding at a significantly slower pace than is currently observed.

The Atacama Cosmology Telescope (ACT) mapped the cosmic microwave background (CMB), the radiation 'afterglow' of the Big Bang. The findings, based on data collected from 2013 to 2016, were released on 15 July (S. K. Choi *et al.* Preprint at https://arxiv.org/abs/2007.07289 (2020); S. Naess *et al.* Preprint at https://arxiv.org/abs/2007.07290 (2020)).

CMB radiation comes from all directions of space, but it is not perfectly uniform: its variations across the sky reveal that regions of the early Universe differed slightly in temperature. Over the past two decades, cosmologists have used those minute variations – together with an established theory called the standard model – to calculate key features of the Universe's structure and evolution, including its age and the density of matter. Cosmologists also use the variations to predict the rate at which the Universe is currently expanding, a measure known as the Hubble constant.

The European Space Agency's Planck telescope mapped the entire CMB sky from 2009 to 2013 with unprecedented precision, and its observations are considered the gold standard of CMB cosmology. The ACT data