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News

Space exploration

A new Hope for Mars

The United Arab Emirates's orbiter aims to chart the Martian atmosphere in detail

Leah Crane

MARS is getting an injection of Hope. An uncrewed craft of that name is the United Arab Emirates' first mission to another world and, as *New Scientist* went to press, was due to enter orbit around the planet on 9 February. The mission aims to build the most complete picture of the Martian atmosphere so far.

"The team has prepared as well as they can... to reach orbit," said Sarah Al Amiri, chair of the UAE space agency and the science lead for the mission, during a press conference late last month.

That preparation is crucial – it takes 11 minutes for a signal from Hope to reach Earth, so the entire operation to enter orbit will be on autopilot. If anything goes wrong, the probe can deal with various problems by itself during the 27 minutes in which the thrusters will fire to put it into a stable orbit.

"By the time we see the start of the burn, it's already almost halfway complete," said Pete Withnell at the University of Colorado Boulder, a programme manager for the mission, during the press conference. "We are observers, and we get to see what's happening, but we do not interact in real time."

The spacecraft's delayed signals make the mission nerve-wracking, says Omran Sharaf at the Mohammed Bin Rashid Space Centre in Dubai, another programme manager. "Firing the thrusters for 27 minutes non-stop is something we haven't done before," he says. "We couldn't test it on Earth because if we did, we could have damaged the spacecraft, so we could only test it for a few seconds." Even the small manoeuvres that the craft has performed on its way to Mars only required the thrusters to fire for a minute or less.

Once in orbit, Hope will provide us with an unprecedented view of Mars. The six other active craft orbiting the planet follow paths around the equator which line up with its rotation in such a way that they can only see any particular area of the surface at one time of day. Hope, on the other hand, will circle in a way that allows it to get a total picture of the planet every nine Martian days – including every spot on the surface at every time of day.

The Hope spacecraft should give us a new way to observe Mars

ALEXANDER MCNABB/MBRSC

The spacecraft carries three main scientific instruments that will allow it to observe Mars's atmosphere in wavelengths from the infrared into the far-ultraviolet. "For the first time, the world will receive a holistic view of the atmosphere," says Sharaf.

The goal is to study how layers of Martian air interact with one another at different times of day and year. This will help us answer the long-standing question of how gas escapes from Mars's atmosphere into space, a process that keeps the planet cold and dry, rather than warm and damp as it may once have been.

If Hope enters orbit safely, the team will spend two months testing the craft and its scientific instruments before starting to take measurements. "Hopefully by September 2021 we will have science data that we can share," says Sharaf. ▮

Chemistry

Making molecules go splat results in precision reactions

BREAKING the chemical bonds in large molecules to form a desired substance can be a fiddly task, but simply chucking molecules at a wall can get the job done.

Stephan Rauschenbach at the University of Oxford and his colleagues made the discovery, which they call "splat chemistry", after accidentally firing a complex molecule called Reichardt's dye at a copper surface.

The team expected the collision to have enough energy to break all the molecule's bonds, but that didn't happen, says Rauschenbach. "Despite this huge energy, it wasn't just chaos, it was very selective."

Using a microscope to investigate the collision scene, the researchers noticed that the result was a systematic crash. The molecule had "fractured" at a specific carbon-nitrogen bond, creating a more spread-out structure. After running the experiment again, they found that the molecule split entirely at this bond to form two separate fragments (*Physical Review Letters*, doi.org/ftjg).

The team created computer simulations of the collision and found that the molecule's final state is based on its orientation as it hits the surface. Striking at a particular angle puts a strain on a particular bond and forces it to break. In contrast, during typical chemical reactions, molecules are heated, randomly distributing the energy without targeting specific bonds.

"Control the geometry of the molecule as it collides and you get controlled chemistry"

"We realised that molecular-surface collisions will divert energy to certain areas, and here we're just exploiting it for a new type of mechanochemistry," says team member Kelvin Anggara at the Max Planck Institute for Solid State Research in Germany.

This technique could create new molecules that can't be made using conventional heating methods. "If someone could control the geometry of the molecule as it collides, you can get a controlled chemistry, and this is the dream for all chemists," says Anggara. ▮

Ibrahim Sawal