

What 2022 holds for space travel

From lunar missions to anti-asteroid defence systems

ROBIN MCKIE

This year promises to be important for space exploration, with several major programs reaching the launch pad over the next 12 months. The US is to return to the moon, undertaking a set of missions intended to establish a lunar colony there in a few years. China is expected to complete its Tiangong space station while Europe and Russia will attempt to land spacecraft on Mars, having failed at every previous attempt. India, South Korea and Japan are also scheduled to put a number of missions into space.

Rockets

Particular interest is going to focus on NASA's mighty new space launch system (SLS). This is the most powerful rocket it has ever designed and has been built to carry astronauts to the moon and beyond as part of the agency's Artemis deep space exploration program. With these missions, NASA hopes to reopen the solar system to investigation by humans – rather than robot probes – and regularly carry astronauts to the lunar surface.

The program's first launch is scheduled for February when an SLS rocket – standing more than 300ft high – will carry an unmanned Orion capsule on a trajectory that will enter a highly elliptical orbit round the moon. At its closest, the spaceship will sweep within 62 miles of the lunar surface before soaring 40,000 miles above it, a distance that will take it further from Earth than any spacecraft built for humans has ever flown.

Crucially, Orion – designed to carry between four and six astronauts when fully operational – will be fitted with a European service module that will provide the capsule's power and propulsion for manoeuvring in orbit. This will give its manufacturer – the European Space Agency – the opportunity to become a key partner in future Artemis missions. If February's mission succeeds, a crewed trip around the moon will take place in 2024 and this will be followed by a lunar landing in 2025 – a gap of 53 years since Apollo 17, the last crewed moon mission, touched down on the Taurus-Littrow valley in December 1972.

This time the crew will include at least one woman and the mission will mark the begin-



Landers built by private companies with NASA's backing will carry science and technology missions to the lunar surface.

ning of a program aimed at establishing a lunar colony where astronauts would work on months-long missions and develop technologies that could be used by future colonies on Mars. A prime target for the first lunar outpost is Shackleton crater, near the moon's south pole, which is believed to hold reservoirs of ice. Water will not only provide precious sustenance for astronauts, it can be exploited as a source of hydrogen and oxygen – by electrolysis – that can be combined as rocket fuel.

As part of its preparations to establish a lunar colony, Nasa will also start a massive program of robot missions through the agency's \$2.6bn commercial lunar payload services (CLPS) initiative. This will involve sending a flotilla of robot spacecraft to the moon, with the first missions beginning this year. Built by private companies with Nasa backing, these probes will attempt to map underground water deposits, study the moon's deep interior and release robot rovers to investigate the lunar surface. Fledgling space company Astrobotics will send its newly designed Peregrine lander to Lacus Mortis – “the lake of death” – a plain of basaltic rock in the north-eastern part of the moon. It will carry 11 different payloads of instruments and will be followed by another US

company, Intuitive Machines, which is sending a spacecraft carrying six payloads to Oceanus Procellarum, the Ocean of Storms.

A further 12 CLPS missions are scheduled for the next three years, though head of Nasa science, Thomas Zurbuchen, has warned that these privately funded efforts each face a high risk of failure. As many as half could go wrong, he said recently.

For good measure, Russia and India are both planning to launch their own lunar landers next year, while South Korea is scheduled to place a satellite in moon orbit to study its mineral composition.

The hunt for alien life will take a step further this year with the launch of the joint European-Russian ExoMars mission, which will land a robot rover on the Oxia Planum, a 125-mile-wide clay-bearing plain in the planet's northern hemisphere. The rover – named after Rosalind Franklin, the British chemist and DNA pioneer – will be fitted with a drill capable of probing several feet below the Martian surface, where it is hoped primitive lifeforms may survive or at least the remnants of extinct organisms. The 660lb rover was built by Airbus Defence and Space, at the company's UK facility in Stevenage. Launch is scheduled for September 22

and touchdown is expected on 10 June 2023.

Hopes of success for the mission are guarded, however, as neither Russia nor Europe has had any luck in landing on Mars. Nineteen Russian and Soviet missions and two European bids to land on the red planet have all failed – including Europe's Schiaparelli lander, which was intended to be a trial run for the current ExoMars mission but which crashed on the planet in 2016.

Asteroids

Easily the most spectacular mission to the asteroids will be NASA's bid to test an anti-asteroid defence system for Earth. Launched last year, the double asteroid redirection test (Dart) spacecraft will crash into the moonlet Dimorphos in September. Hurling into its target at 15,000mph, the 1,340lb probe – the size of a small car – will try to change the orbit of Dimorphos, a lump of rock the size of a football stadium, around its parent asteroid, Didymos.

If successful, NASA and other space agencies will be encouraged to follow up the mission by developing craft that could deflect a larger asteroid heading towards Earth – and so avert an Armageddon-style impact, say astronomers. Should an asteroid the size of Dimorphos crash on Earth, it would trigger an explosion equivalent to 400-600 megatonnes of TNT. “A city like Manhattan would be completely obliterated,” Elena Adams, Dart's systems engineer, told the journal Science. “This is to demonstrate a technique to save the world.”

NASA has plans for several other asteroid missions next year, including the launch of the probe Psyche. Scheduled for lift-off in August, the spacecraft will visit an asteroid called 16 Psyche that is thought to be the leftover core of a planet. This vast chunk of nickel and iron is the remains of a violent collision with another astronomical object that stripped off the planet's outer layers and left its metallic innards exposed. Studying 16 Psyche will give scientists an unprecedented opportunity to examine a planetary core. It will also afford them a chance to explore a new type of world – one that is made of metal.

Human spaceflight

Boeing will attempt to get its Starliner crew capsule into orbit so that it can begin to ferry

astronauts to and from the International Space Station (ISS). A 2019 flight failed to reach the station and another attempt last year was called off at the last minute when fuel valves failed to open. Boeing now plans to launch a crewless Starliner in early 2022, followed by a test flight with astronauts later in the year. The capsule will then be used – along with SpaceX's Crew Dragon spaceship – on a rota to ferry astronauts to the ISS.

For its part, China is expected to complete its space station Tiangong – Heavenly Palace – after launching the first of its three main modules, Tianhe, in April. Modules Mengtian and Wentian will be added this year. China has said it hopes to keep its space station – which is considerably smaller than the ISS – inhabited continuously by three astronauts for at least a decade. A key task for crewmen will be to service the Xuntian space telescope, which will be launched in 2024 and which will orbit in formation with the Tiangong station. Fitted with a mirror roughly the same size as the Hubble space telescope, Xuntian's tasks will include investigations of dark matter and dark energy as well as galaxy formation and evolution.

Blue Origin (founded by Jeff Bezos) and Virgin Galactic (set up by Richard Branson) both succeeded in launching maiden sub-orbital flights last year and both say they expect to begin regular missions in 2022, offering groups of tourists a few minutes of weightlessness before returning to Earth

