BBC

25 WINTER TARGETS FOR URBAN OBSERVERS

#212 JANUARY 2023

Sky at Night

THE UK'S BEST-SELLING ASTRONOMY MAGAZINE

STARGAZING IN 2023

Discover the year's best sights

PLUS Space mission launches

NEW YEAR NEW COMET

Where to find 2023's first bright comet this month

FAMILY-FRIENDLY ASTRONOMY TIPS

VAONIS VESPERA OBSERVATION STATION ON TEST

UK'S LAUNCH FACILITIES GET READY FOR LIFT-OFF

WHAT HAPPENS WHEN EARTH'S MAGNETIC FIELD REVERSES?

COSMOLOGY EXPLAINED WITH OUR NEW SERIES

Spaceflight takes off in the UK

As the first-ever UK space launch draws near, **Shaoni Bhattacharya** takes a deeper look at Britain's spaceflight industry

This is the year that the UK hopes to demonstrate it is a serious player in space. It already has established expertise in space science and satellite production, but 2023 will see it become a launch-capable nation. According to the UK Space Agency, our nation offers the right mix of regulations, environment, business and geography for commercial launch services, with the aim of attracting business in an industry worth $20 billion globally. With the UK due to host its first rocket launch (and the first from European soil) in late 2022 from Spaceport Cornwall, and two more sites hoping to begin operations in 2023, these hopes may not be unfounded. Meanwhile, the UK is also building its relationships with private companies and spacefaring nations, and is already involved with several major projects that could see UK-built tech touching down on the surface of the Moon. It's an exciting time to take a deeper dive into the world of UK spaceflight. ▸

MARK GARLICK

LauncherOne leads the way in the race to establish the UK as a world-class launch site

ILLUSTRATION

ILLUSTRATION

The repurposed Boeing 747 Virgin Orbit will send satellites into space

From Cornwall to orbital

The first UK space launch will depart not from a launch pad, but a runway

Based at Newquay Airport, Spaceport Cornwall is able to host horizontal launches, which involve a carrier aircraft taking off from a runway to reach the desired launch altitude and releasing a rocket in mid-air. Virgin Orbit's modified Boeing 747, called Cosmic Girl, will release the LauncherOne rocket at an altitude of around 35,000 feet (10,700 metres). The system can transport up to 300kg of cargo into orbit.

The 'Start Me Up' mission from Spaceport Cornwall is due to launch by the end of 2022, and was granted a licence to fly by the Civil Aviation Authority on 16 November, though a launch date was yet to be announced at time of writing. It will deploy seven payloads into low-Earth orbit. These will be a range of satellites, with five from the UK, including the IOD-3 Amber satellite developed by the Satellite Applications Catapult and Horizon Technologies, and built by AAC Clyde Space. It is the first of more than 20 satellites that will be in the Amber constellation, designed to provide governments and customers with maritime data to help combat problems like illegal fishing, smuggling and trafficking.

Notably, among the UK payloads is the test launch of the world's first returnable and reusable space-manufacturing platform, called ForgeStar-0. Made by Welsh company Space Forge, this platform eventually aims to harness space to make materials off-Earth in microgravity conditions.

Also on board, in another first, is the Sultanate of Oman's first-ever satellite, AMAN, for Earth observation. A further Polish satellite is also to be deployed as part of SatRev's STORK constellation for Earth observation.

▲ Once at altitude, the plane will release its satellite-bearing rocket

▲ Melissa Thorpe, head of Spaceport Cornwall, with the LauncherOne

The Scottish Space Race

A pair of spaceports are vying to stage the first vertical launch from UK soil

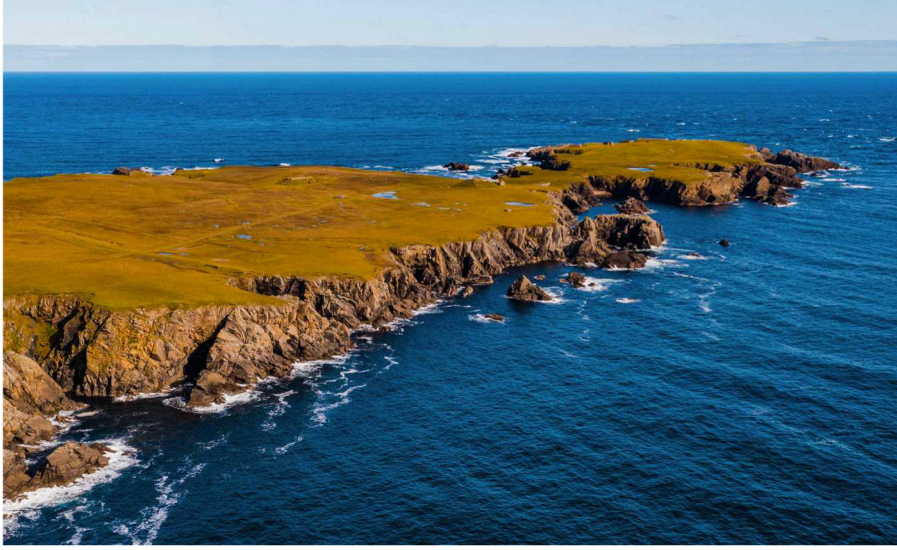
With the first horizontal launch on its way, the race is now on between SaxaVord on Unst in the Shetland Islands, the most northerly point of the UK, and Sutherland on the northwest Scottish coast to stage the UK's first vertical rocket launch. These two facilities will launch satellites using traditional rockets taking off directly from a launchpad on the ground.

SaxaVord aims to be a multi-use spaceport supporting launches by several operators, but Lockheed Martin is keen to be the first to launch there as part of the UK Space Agency's Pathfinder launch. It is bringing over a new rocket from the US called RS1, by ABL Space Systems, that can carry payloads up to 1,350kg. The launch will carry up to six CubeSats into low-Earth orbit, deployed by a free-flying Orbital Manoeuvring Vehicle built by Moog, currently in production in Reading.

"They've started to pour the concrete [in SaxaVord] and put in the bits of infrastructure needed to support this," says Nik Smith, regional director for Lockheed Martin UK. "From a space perspective, they've got a great location. It's fantastic for polar orbits where a lot of low-Earth orbit communications satellites will be operating."

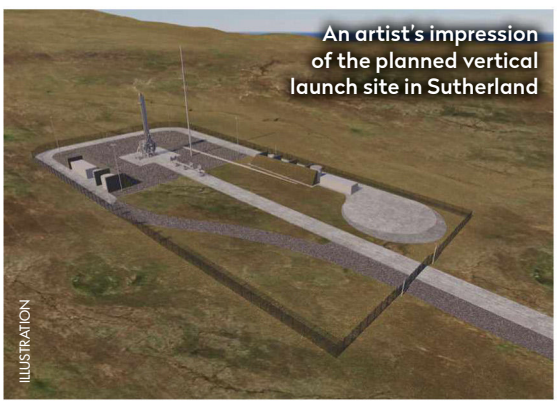
Sutherland Spaceport, on the A' Mhòine peninsula on the northern coast of the Highlands, offers similar benefits for reaching these orbits. Both Scottish locations also offer remote flight paths that do not traverse populated areas, but rather vast expanses of sea. British rocket company Orbex is planning to launch its rocket vertically from Sutherland, and last November signed a 50-year sub-lease on the spaceport with the development agency Highlands and Islands Enterprise. It plans to launch up to 12 vertical rockets a year from Sutherland to carry satellites to low-Earth orbit.

While the UK Space Agency has invested most in these three spaceports, four other sites have also been under consideration. These include three more in Scotland: North Uist in the Outer Hebrides, Spaceport Machrihanish in Argyll, Prestwick Spaceport in South Ayrshire; and Spaceport Snowdonia in Wales. ▸



▲ Skaw in Unst, the northernmost settlement in the UK and the most direct route to orbit from Europe

► One of three launch pads being built by SaxaVord in Skaw to send small rockets into low-Earth orbit



An artist's impression of the planned vertical launch site in Sutherland

▼ Orbex's Prime rocket: the Scottish company is to build and run Sutherland spaceport

Q&A

with Ian Annett of the UK Space Agency

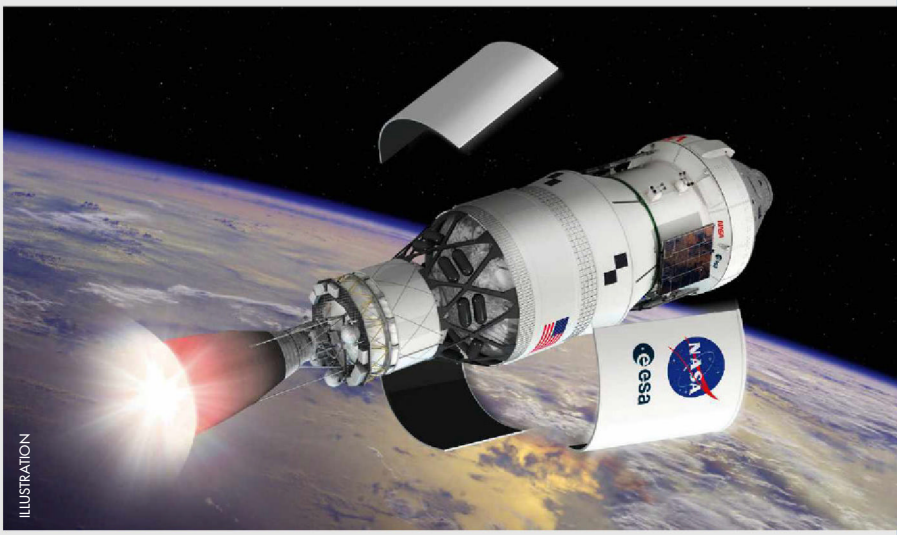
The UK Space Agency has been instrumental in guiding the developing British space sector

It feels like there's a lot going on in spaceflight in the UK. Are we on the cusp of something?
There is an immense amount going on. I think we're in the most exciting decade for space since the 1960s. It's gripped the world, not only for its inspiration but because it's got real economic benefits globally and certainly nationally for the UK.

We want to establish a commercial vertical and horizontal satellite launch capability from the UK. Really what we're aiming at is the economy in low-Earth orbit (LEO) – that's burgeoning. Back in 2012, something like 50 satellites launched into LEO, and by 2019 I think it was 900; but last year, there were 1,900 launches into space, 1,700 of which were satellites into LEO. So it's a rapidly growing economic opportunity for the UK, whether that be for telecommunications, Earth observation or indeed in more normal technologies like manufacturing interfaces, we can grow crystalline structures in a much better and more efficient manner [in space]. You're only really limited by your imagination.

Why the UK? Are there advantages geographically, politically or legally that make the UK a good place for spaceflight?
I think all of the above. The UK is a good place to do business. It's got a stable legal framework. Under the Space Industry Act in 2020 we have introduced the most forward-leading and flexible set of space regulations. If you look at the insurance market for satellites and launches, you'll find the vast majority of them come to London.

But more fundamentally, our space industry has an immense amount of skill, from designing satellites to building them. More small satellites are built in Glasgow than anywhere else in Europe. Global businesses like Inmarsat and OneWeb have their operation centres here. The UK is a great place to come to for developing applications that can exploit that data [from space], whether it be Earth observation or navigational data. The one thing that was really missing in that full spectrum of capability is launch. And if you can deliver that from a single nation, it makes it really, really attractive. That's why we've put £40 million into the launch programme.



ILLUSTRATION

▲ Tech on board Artemis's Orion module has had UK involvement via the European Space Agency

What about human spaceflight and the UK's role in the Artemis programme?
The UK is very forward-leaning in terms of being involved in the global human spaceflight projects, but we very much do that through our partnership with the European Space Agency (ESA). Through its association with ESA the UK will make critical contributions towards Artemis: whether it's through parts of the Lunar Gateway that's being built, or the European Service Module as part of the Orion capsule – there's a lot of UK technology within that, and also some UK academic thinking through the likes of Imperial College.

What are you looking forward to in 2023 in terms of spaceflight in the UK?
One of the key things that keeps me driving forward with launch, and I hope I can reflect on in 2023, will be how many thousands of youngsters we have inspired to look up at the stars, get involved in the space sector, and be part of something that can improve our lives here in the UK, and also help to develop us economically.

Ian Annett is the Deputy CEO for Programme Delivery, responsible for national space programmes across the UK Space Agency

ESA/D. DUCROS, UNIVERSITY OF LEICESTER, SPACEBIT, CHRIS ALAN WILTON/ALAMY STOCK PHOTO, AIRBUS, GETTY

Space hubs, companies and bridges

The UK is growing as a centre for spaceflight innovation

▲ **Space Park Leicester, where university research and business expertise meet**

As well as spaceports, other initiatives are helping to bolster the UK spaceflight sector, one example of which is Space Park Leicester, which officially opened in March 2022.

"It's a university-owned space facility, built around the idea that we host space businesses in the same facility as the researchers work," says Martin Barstow, their director of strategic partnerships and a professor of astrophysics and space science at the University of Leicester. "Space is expensive. In terms of building things like clean rooms, they're costly. They're beyond the means of small companies."

Making such facilities available in the Space Park reduces the cost of access for small and medium-sized enterprises and start-ups, he adds. They are also able to lean on the academic expertise in space that already exists at the university, which has some 300 people working in the area.

As well as small companies, start-ups and university spin-offs, some aerospace giants such as Lockheed Martin and Northrop Grumman have also joined, setting up small groups that work alongside their larger UK facilities.

"Space is an obvious next step for us for the ambitions that the UK has put in place," says Lockheed Martin's Nik Smith, noting that the UK government has put in "very strong structures around a broad space strategy". These include the UK's Space Strategy and Spaceflight Programme which, combined with capital coming into the country for space, is creating a strong environment for innovation.

The UK's work on building strong international relationships also makes it an attractive hub to reach into new markets. The UK has already signed several partnerships – such as the UK–Australia Space Bridge and a Memorandum of Cooperation with the Japanese Aerospace Exploration Agency – with the aim of increasing international cooperation into the future, and cementing our position as a space power on the international stage.

Shaoni Bhattacharya is a science writer and editor, as well as a short fiction author

Best of British

We highlight three of the dozens of space projects currently underway in the UK

▲ Spacebit

A UK–Ukrainian company that hopes to send the first walking rover to the Moon, on board the Peregrine lander (see **page 32** for more details).

Goonhilly Earth Station ▶

The radio communication site has been operating from Cornwall since 1962, but is getting renewed interest for communicating with lunar missions.

▲ Ariel

Led by University College London and mainly being built by Airbus in Stevenage, Ariel is an ESA mission to characterise 1,000 exoplanets, due to launch in 2029.