New space funding paves the way for pioneering approaches to energy, communication and resources

Science and Innovation Minister George Freeman announced the £2 million boost for 13 new projects during British Science Week (11-20th March), which aims to inspire interest in and celebrate science, engineering, technology and maths for people of all ages.

The projects include Rolls-Royce developing a power station for space that could power the generation of water, breathable oxygen and fuels for solar exploration.

Another will develop new imaging technology which can withstand the high radiation levels on Mars, while a third will build a communications tool for astronauts to tackle the delay in conversations between Mars and Earth. Engineers will also develop a robot that will search for resources such as oxygen and water in Moon rocks.

Science and Innovation Minister George Freeman said:

> As we celebrate British Science Week, I am pleased to announce this £2 million package to support 13 new projects for the UK's brilliant scientists and engineers to help us take significant strides in space exploration and discovery.
>
> In addition to discovery breakthroughs, these projects will also ensure that people here on Earth benefit from new technology, including micro-reactor technology with the potential to support our Net Zero commitments.

Abi Clayton, Future Programmes Director, Rolls-Royce said:

> The support of the UK Space Agency has been instrumental in enabling the continued progress of the Rolls-Royce Micro-Reactor development programme.
>
> This shows the true value of public and private partnership as we bring together the space domain experience of the UK Space Agency with our own unique nuclear expertise. Together we can achieve ambitious technological firsts for the UK as we develop the power systems of the future.

The UK has a leading role in space exploration and invested £180 million over five years in the European Space Agency's global exploration programme in

2019.

The UK, through Airbus, is leading on the Sample Fetch Rover, which will play a key role in the joint NASA/ESA Mars Sample Return mission – the first mission aiming to bring back samples of Mars to Earth.

The UK is also supporting international efforts to return humans to the Moon, with industry expected to build parts of the Lunar Gateway – a new space station that will orbit the Moon and provide a key stepping stone for human and robotic expeditions to the lunar surface.

The Power to Explore – Rolls-Royce Space Reactor Programme

Lead: Rolls-Royce

Funding: £249,000

Rolls-Royce will continue the development of Space Reactor technology. Utilising its 60-year nuclear expertise, the British engineering firm is developing a uniquely deployable, safe, and autonomous Micro-Reactor for use in the space domain. The technology being developed is equally suited for use on Earth, supporting the government's Net Zero Strategy. The high-power Space Reactor will accelerate human exploration of the Moon, Mars and beyond, providing continuity of power for critical operations. Additionally, the technology will power the generation of water, breathable oxygen and rocket fuels from human Lunar and Martian exploration missions.

Plasma Water Purification System for In Situ Resource

Lead: University of Southampton

Funding: £100,000

One of the technical challenges in long-term crewed space missions is having safe drinking water as it is not feasible to carry all required amounts of water for the entire mission duration. The only practical option for surface expeditionary crews and future par-point outposts is in-situ resource utilisation and recycle/reuse of onboard water. However, recycled system water or extracted water from extra-terrestrial bodies can contain organic contaminants, bacteria, and viruses of known and unknown origins. In this project they will explore the feasibility of a novel non-thermal plasma water purification method to remove biological and chemical contaminants in water.

Advancing deep space communications technology to improve crew health and performance in exploration class missions

Lead: Braided Communications, Glasgow

Funding: £100,000

On future missions to Mars the crew will face some obvious hazards – for example microgravity and radiation – and some less obvious ones, including

communication delays. A radio signal takes many minutes to reach Mars so you cannot have a normal conversation with someone on Earth. Braided Communications has invented a tool to address this issue. They cannot remove the delay – that is down to a fundamental law of physics – but they can make it feel as if the delay has gone. They are working with Thymia Ltd and The UCL Centre for Space Medicine to study how this tool can help astronauts on those missions.

Moon-RISE: Moon Robotic Inspection

Lead: GMV, Harwell Space Cluster

Funding: £222,000

Water, other elements that would evaporate in sunlight and lunar materials present potential resources that can support sustainable human and robotic exploration of the Moon and the Solar System beyond. The first step is to identify and characterise resource potential of the Moon through prospecting and mapping. In the Moon-RISE project GMV are proving the concept of autonomous prospecting using a mobile robot, robot arm and instrumentation suitable for prospecting and mapping. The robot will use a combination of cameras and LIDAR for mapping during exploration and a Laser Induced Breakdown Spectrometer (LIBS) will be used to analyse mineral composition. The robot will demonstrate navigation, mapping and prospecting both on the surface and underground mines as an analogue for lunar lava tube caves that are a key subject of future exploration mission.

Augers Not Included: A new deep-drilling concept

Lead: University of Glasgow

Funding: £85,000

When exploring the surface of another planet, it may be necessary to drill into the soil. However, this has always required the use of a rotating drill string, which uses a lot of power and involves heavy rotating equipment. This project seeks to determine if a new approach, based on vibration, can be used to extract material from the bottom of the hole without rotation. This would reduce the mass of future landers, which would in turn mean that they could be deployed more quickly and more cheaply than before.

Dynamic Radioisotope Power Conversion Technology Feasibility Study for Lunar Surface Applications

Lead: University of Leicester

Funding: £50,000

This project will focus on developing a dynamic radioisotope power conversion concept design that uses the standard baseline European Large Heat Source (a 200 W radioisotope heat source). Adopting a system engineering approach, the design will be backed up by analytical models and will be a building block

for further Leicester led work. The ELHS could be the heat source for a much larger set radioisotope power generators both within and outside Europe, thus transforming access to challenging regions in the solar system, enabling a host of new mission types and opening bilateral and multilateral collaboration opportunities.

Radiation characterisation of infrared detectors for future Mars exploration

Lead: Open University

Funding: £91,000

The Open University (OU) is investigating the suitability of a new UK-based imaging technology for use in future Mars exploration missions. Researchers at the OU are subjecting newly developed infrared detectors, provided by Teledyne e2v based in Chelmsford, to radiation levels like those experienced during a mission to Mars. By investigating how well the detectors cope with the damage caused by radiation, this exciting new technology may provide a new avenue for remote observations of Mars in the infrared band and commercial applications in the UK technology market.

Development of a Deeply Throttleable Pintle Injector for Lander Applications

Lead: Protolaunch, Westcott

Funding: £194,000

This project will further advance Protolaunch’s deeply throttleable pintle injector technology, with a particular focus on lander applications.

Protolaunch is a chemical propulsion start-up company developing engines for NewSpace applications that are throttleable, reliable, and don’t need a turbopump.

This project builds upon previous hot-fire engine tests and will be one of the first test campaigns to take place at the newly opened and state-of-the-art Protolaunch Propulsion Test Facility situated at Westcott Venture Park in Buckinghamshire. The project is well-aligned with Protolaunch’s technology roadmap as the company rapidly advances the technology readiness of engine sub-systems as they bring their family of propulsion system products to market.

Developing In Situ Resource Utilisation Production Technology (DISRUPT)

Lead: TAS-UK

Funding: £ 218,000

This project will establish an end-to-end demonstration capability in the UK

which would contribute significantly to the de-risking of technology used for In Situ Resource Utilisation (ISRU). This end-to-end demonstration capability would allow many of the uncertainties present in the process chain to be understood and characterised; especially the effect of the regolith (Moon soil) collection and pre-processing of the feedstock for the Metalysis-FFC process reactor. This activity will be conducted in partnership with Metalysis, AVS, URA Thrusters and the Open University.

Microwave Heating Demonstrator (MHD) payload –Develop hardware of 250W Microwave Generator and oxygen/water extraction subsystem

Lead: Open University

Funding: £174,000

This project will work on a Microwave Heating Demonstrator (MHD) payload concept which has been developed to investigate the potential of the microwave heating method for lunar construction and resource extraction such as oxygen and water from lunar soil through a series of experiments on the Moon surface.

NEBULASS –Nuclear Energy research at Bangor University and Leicester for Advanced Space Systems

Lead: Bangor University

Funding: £50,000

Nuclear reactors for space will require extremely robust fuels and to enable efficient launch and operation. Properties such as density and mass are far more important than for terrestrial nuclear applications. The work being led by Bangor University’s Nuclear Futures Institute (https://nubu.nu) is aiming to model the behaviour and operation of a range of space reactor concepts and tailor the fuels to be fit for purpose, enabling specific missions to the Moon, Mars and beyond. A combination of theoretical modelling and practical fuel manufacture capabilities are being targeted and extended with the help of the collaborating team at the University of Leicester, providing a new nuclear power capability for the UK Space Agency.

LEIA Hybrid Qualification

Lead: MDA UK, Harwell Space Cluster

Funding: £421,000

This grant will support the qualification of the company’s LEIA LIDAR, which is used to provide a 3D map for spacecraft landing on the Moon and well as spacecraft rendezvous and docking in LEO and GEO. LEIA has been designed specifically to meet the needs of the emerging commercial space market and will be a key component for a new generation of companies providing payload delivery services to the Moon over the next few years. At the end of the project LEIA will have undergone a suite of environmental and functional

tests design to raise the technology readiness level and test the unit in the field to optimise and improve performance.

An architectural feasibility study for the Curation and Analysis Facility for Extra-terrestrial Samples.

Lead: Science and Technology Facilities Council (STFC), part of UK Research and Innovation

Funding: £40,000

An architectural feasibility study will develop the construction process for the UK’s first bespoke, dedicated facility for the preparation, characterisation and analysis of pristine extraterrestrial samples. There are at least eight missions planning to return samples from asteroids and Mars over the coming decade. These missions will move planetary science from analysis by space instrumentation to analysis using more sophisticated techniques on Earth.