Mars mission boost welcomed by scientists

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University of Leicester scientists, who are closely involved in the European mission to Mars –ExoMars- have welcomed support from the Government for the project.

Following the Chancellor's Autumn statement, the UK will play a lead role in Europe's ExoMars mission to the Red Planet. The ExoMars mission is one of the key missions under the remit of the UK Space Agency.

The Government's new commitment to the ExoMars programme amounts to £47.7m, alongside a similar amount for the International Space Station (ISS). This more than triples the sum offered as a "one-off" payment to the ISS two years ago. Also among the UK's increased commitments to the European Space Agency (ESA) was £130m to be spent on satellite telecommunications projects.

ExoMars is a robotic mission developed by ESA, with two mission components - an orbiter and landing demonstrator which are due for launch in 2016, and a scientific rover that will be launched in 2018. The rover will explore the planet, paying particular attention to its geochemistry and possible evidence of biology.

The University of Leicester has a strong involvement with the rover mission through the development of one of the key instruments, a Raman spectrometer, which is being built by a number of European partners, including Spain (lead), France and Germany. RAL Space and UK industry will also be involved in the development of the instrument

Raman Spectrometer

The scientific aims of the Raman instrument are:

- to identify organic compounds in mineral matrices and search for life
- to identify the mineral products and indicators of biological activity
- to characterise mineral phases produced by water related processes, and
- to characterise igneous minerals and their alteration products.

Professor Martin Barstow, Pro-Vice-Chancellor, Head of the College of Science & Engineering, Professor of Astrophysics & Space Science and President of the Royal Astronomical Society said: "The Autumn statement is a welcome demonstration of the Government's commitment to science investment. The decision to contribute an additional £47.7m to the ESA ExoMars programme is particularly important for the role of this University and wider UK involvement in the exploration of the Red Planet."

Professor Mark Sims, Professor of Astrobiology and Space Instrumentation at the University of Leicester said: "The announcement of £47.7m commitment to the ExoMars Programme from the Chancellor in his Autumn statement will help secure the 2018 rover mission in which University of Leicester plays a significant technical and scientific role in developing the Raman spectrometer for this mission.

"The ExoMars programme has struggled to raise funding for the two missions from the ESA member states and the UK's additional commitment reinforces other additional contributions to secure the mission, allowing the instrument and programme development to proceed towards the 2018 launch."

University of Leicester Involvement

The ExoMars rover, which houses the Raman spectrometer, will explore the surface of the planet, drilling up to 2m below the surface. The Raman instrument will investigate the resulting drill samples, determining the mineralogy and searching for organics including those that might be associated with life.

Dr. Ian Hutchinson, a lecturer in the Department of Physics & Astronomy, leads the ExoMars instrument activities at Leicester. The team, which also includes Professor Howell Edwards and Dr. Richard Ingley are currently working on the development of a camera system for the Raman instrument and lead the science activities related to the detection of organics. The Raman camera incorporates Charge Coupled Devices (CCDs) from e2v and electronics from RAL Space. The Raman spectrometer utilises laser light to probe molecular bonds within the sample and generates characteristic patterns (molecular 'fingerprints') that can be used to identify particular minerals and organic compounds in mineral matrices.

Professor Howell Edwards is also a member of the ExoMars Landing Site Selection Working Group and will work with an international team of scientists and engineers to determine where on the surface of Mars the rover should be deployed. In response to the positive news, Professor Edwards, who is an acknowledged international expert on the applications of Raman spectroscopy and has 1200 research papers in the literature, confirms the key analytical role of Raman spectroscopy as a first pass non-destructive technique on the ExoMars rover for the interrogation of Martian regolith specimens. The detection of molecular biomarkers in protective geological niche environments using the Raman laser spectrometer (RLS) on the ExoMars mission will be the prime target for the search for extinct or extant life on Mars in this mission. In this context, the research work currently being undertaken by members

of Dr Hutchinson's group at Leicester on the characterisation of biomarker Raman spectral signatures from extremophilic organisms in terrestrial Mars analogue sites in hot and cold deserts is critically important for the future spectral interpretation of ExoMars mission data from the planetary surface and subsurface.

Also involved in the ExoMars project is Dr John Bridges, Reader in Planetary Science at the University of Leicester. Along with Professor Edwards, Dr Bridges is set to follow up his key role with the Mars Curiosity mission by helping to choose the target destination of the next red planet rover and will lead on gathering of the data.

There are a large number of engineering and scientific constraints to be considered in the selection of the 2018 site and over the next few years the scientists will gather a lot of data and consider which of the 4 shortlisted sites is best suited to the science aims of ExoMars. This is where the expertise of Professor Edwards and Dr Bridges comes in. Dr. Bridges has already been integral to NASA's Mars Curiosity mission, since its launch in November 2011 and landing on August 2012.

He is part of a team from the Space Research Centre at the University of Leicester, the Open University and CNRS France, who are analysing data to determine the conditions associated with the presence of water and assess the past Habitability of Mars for microbial life.

As a result, he has gained invaluable insights into the most effective target areas for drilling. In a recent blog post, John says:

"One of the key things we are learning from MSL is about the importance of drilling and the preservation of organics in relation to the surrounding terrain. ExoMars should be able to drill down to 2m depth, helping our chances of avoiding the full effects of radiation from solar and galactic sources.

"However, results from Curiosity also show the likely importance of identifying sampling sites which have been protected by overlying rocks for most of their history, with only relatively recent exposure by wind erosion on the Martian surface."

Along with Professor Edwards, he will help to assess suggestions from the scientific community of possible landing sites for the ExoMars Rover mission which is proceeding via a series of workshops.

The suggested sites must meet a range of criteria laid out by ESA. For instance, the site must be ancient (more than 3.6 billion years old) and must show lots of evidence of longstanding or re-occurring water activity.

Background information

ExoMars (Exobiology on Mars) is a European-led robotic mission to Mars, developed by the European Space Agency (ESA) and NASA. It is part of ESA's Aurora programme for robotic exploration of the Solar System and its aim is to further characterise the chemical, geological and possible biological environment on Mars in preparation for robotic missions and then human exploration. Data from the mission will also provide invaluable input for broader studies of exobiology - the search for life on other planets.

The mission to Mars also has enormous Earth-bound applications with spin-offs in collaboration with industry bringing environmental benefits as well as technologies that can be applied in the fields of health and crime detection.

Professor Mark Sims said: "ExoMars is a key mission in exploration of the planet Mars. It will attempt to gather samples from a depth 1-2m below the surface where they are protected from radiation and oxidants

thought to exist on the surface – both of which would destroy/heavily degrade complex organic compounds.

"The mission gives the University, and the Department of Physics and Astronomy team in particular, the opportunity to explore the chemistry and mineralogy of Mars as well as look at the possibility of life on Mars in the distant past, or even today, and at the same time create world-class science. Because of its innovative work in space instrumentation, which builds upon the expertise in imaging detectors and its interdisciplinary work on sensor systems, the University is helping to provide an instrument for the mission.

"This is a truly exciting opportunity to explore Mars and look for extra-terrestrial life."

Professor Howell Edwards said: "The Raman Laser Spectrometer will play a key role in the first pass analytical study of the samples acquired by the drill. The instrument's ability to recognise molecular biomarkers in protective geological niche environments will be a particularly important element in the missions search for extinct or extant life on Mars.

"A large amount of preparatory work still needs to be completed before the rover arrives on Mars in order to ensure that the samples are analysed accurately and effectively. We have already spent several years investigating a range of analogue samples retrieved from various extreme environments on Earth using flight-like prototype instruments so that the spectrometer design can be optimised.

"In a recent issue of the *Philosophical Transactions of the Royal Society*, the oldest scientific journal now celebrating its 350th anniversary from foundation in 1665, the Leicester team contributed nine original research papers in collaboration with international colleagues on the theme of

Raman spectra of extremophiles and preparations for the ExoMars mission."

Professor Sims added: "The University of Leicester and the UK has a major international role in this key mission. The work associated with the ExoMars mission will be a major part of the University's Space research programme until launch of the mission in 2018 and after that, with operations and 'new science' on the surface of Mars from 2019.

"For the last 50 years at the University of Leicester, we have been exploring the Universe via astronomy; since 1993 the Earth and since 1995 the planets and Mars in particular. In 2018 the University will contribute an instrument to the ExoMars mission that will attempt to answer the question of past or present life on Mars."

Professor Sims added that the University of Leicester's space research fed directly into postgraduate research as well as impacting on undergraduate education and on outreach programmes in schools, colleges and the wider community. The pioneering work of the University in Physics and Astronomy also led to the creation of the National Space Centre in Leicester.

Professor Sims said: "Given its major roles in the Mercury Bepi-Colombo mission and ExoMars Leicester is becoming known as one of the European leaders in planetary instrumentation. We now have thriving postgraduate research in planetary science and particularly Mars. There is an indirect link to undergraduate courses e.g. Space and Planetary Instrumentation, Life in the Universe."

Provided by University of Leicester