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100-year mission into interstellar space

A pioneering interstellar space mission could continue to send data back to earth for 100 years, giving mankind crucial information about the conditions in deep space, thanks to a new, ultra-reliable power source.

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Scientists in France are getting ready to make a prototype of a highly efficient nuclear-powered electricity generator which has no moving parts, making it much more reliable than current technology.

It is one of a handful of European research projects that are pushing forward the boundaries of space exploration technology, from computer models that can predict the effect of solar radiation, to technology that provides enough power for a mission into deep space, or landing on and exploring the surface of an alien world.

‘We are at the beginning of a new technology, a technological breakthrough,’ said Professor Maurice-Xavier François, coordinator of the SPACE TRIPS research project.

‘We envisage at the moment probe (missions) of a hundred years … but that's not possible today. It will be possible tomorrow,’ he said.

By comparison Voyager 1, the furthest spacecraft from earth, will stop sending data back by around 2020 as it runs out of power, some 40 years after its launch in 1977.

To achieve the levels of extended power foreseen by Prof. François, scientists at SPACE TRIPS are developing a highly efficient generator that uses a conductive fluid that moves into a magnetic chamber. That means it has no moving parts and is therefore less likely to malfunction than the piston-driven system being developed in similar highly efficient nuclear generators in the United States, he said.

The fact that the SPACE TRIPS generator is so reliable means it could be scaled up, and even used to power a colony on Mars, for example. ‘We could think of much bigger systems for electricity on Mars,’ said Prof.

François.

Robot teams

A colony on Mars could be pre-prepared by teams of collaborating robots before humans arrive, or robots could work together to safely explore the surface of a planet while humans remain in orbit overhead, according to Dr Thomas Vögele, coordinator of FASTER, a project which is developing a system of two coordinating space rovers.

‘I am convinced that robotic exploration will be the solution of the future,’ he said, because of the difficulty of landing an astronaut on a planet and bringing the astronaut back afterwards. He believes that one robot would not be versatile enough for a complex mission such as one to bring samples back from another planet.

He works at the Robotics Innovation Center of the German Research Center for Artificial Intelligence, which specialises in robot development and robot cooperation. ‘We developed a feasibility study for a robot team, a larger rover that can carry a linked, smaller rover to the edge of a moon crater, for example, so the smaller rover can walk down in the moon crater, get a sample and come up.’

The FASTER project is working on a ‘scout’ system equipped with miniaturized soil-testing sensors where a smaller planetary rover checks the ground ahead of a main mission rover.

‘The scout rover is not a mission-critical component, so even if the scout rover gets lost, the other rover can go ahead as planned,’ said Dr Vögele, a geologist and computer scientist.

The scout rover works because it is much lighter, and has specially developed wheels which are similar to the spokes of an old-style cartwheel with the rim removed. That means the rover has less chance of getting stuck while crossing the rocky terrain of a planet like Mars.

It’s a significant problem for scientists - NASA’s Mars rover Spirit got stuck in late 2009, and scientists lost communication with it a few months later.

> An artists’s impression of the scout rover being developed by FASTER. Image courtesy of FASTER, background image
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The FASTER project plans to have a prototype of the scout rover and sensor system ready for testing by the end of next year.

The technology could be included in ExoMars, a planned European robotic mission to look for signs of life on Mars which could launch a rover mission in 2018.

Real-time models

One of the most important parts of a space mission is the planning, and much of that is done by using computer models which can predict things like the effects of the solar wind on the magnetic field of planets.

The European research programme IMPEx is working on an integrated tool that will allow comparatively simple analytic models to be run in real time, but also complicated models to be stored in a repository so that users can look through a library of modelled scenarios.

‘If you need to make a technological decision or mission management decision, you need a really fast model,’ said Dr Maxim Khodachenko, coordinator of the IMPEx project, which is developing a way to integrate data from different computer models with observational data from space missions.

‘The model will be able to predict how the overall environment changes in response to the change in the solar wind parameters, for example if a magnetic cloud comes and collides with the planet,’ said Dr Khodachenko.

However, mission managers on earth can't always take direct control of a spacecraft as it can take too long for the signal to arrive. It would take nearly 16 hours for a signal from Voyager 1 to reach earth, for example, meaning that 100-year interstellar missions would need to be able to make autonomous decisions, as would a team of rovers on a planetary surface.

'The question of course is how much autonomy these robots will have in the future and how much will be remote controlled from a control station,' said FASTER's Dr Vögele.

Snake robot on Mars

Researchers at the Norwegian SINTEF research organisation have developed a snake robot to see if it would work as part of a mission to Mars.

The idea is that the robot operates alongside a rover vehicle – collecting samples from hard-to-reach locations and even coiling around a rock to act as an anchor if the rover needs to pull itself free.

'One option is to make the robot into one of the vehicle's arms, with the ability to disconnect and reconnect itself, so that it can be lowered to the ground, where it can crawl about independently,' said Aksel Transeth, a researcher at SINTEF who was involved in developing the robot.

For more information, watch the video courtesy of ROBOTNOR.

More info

SPACE TRIPS

FASTER

IMPEx