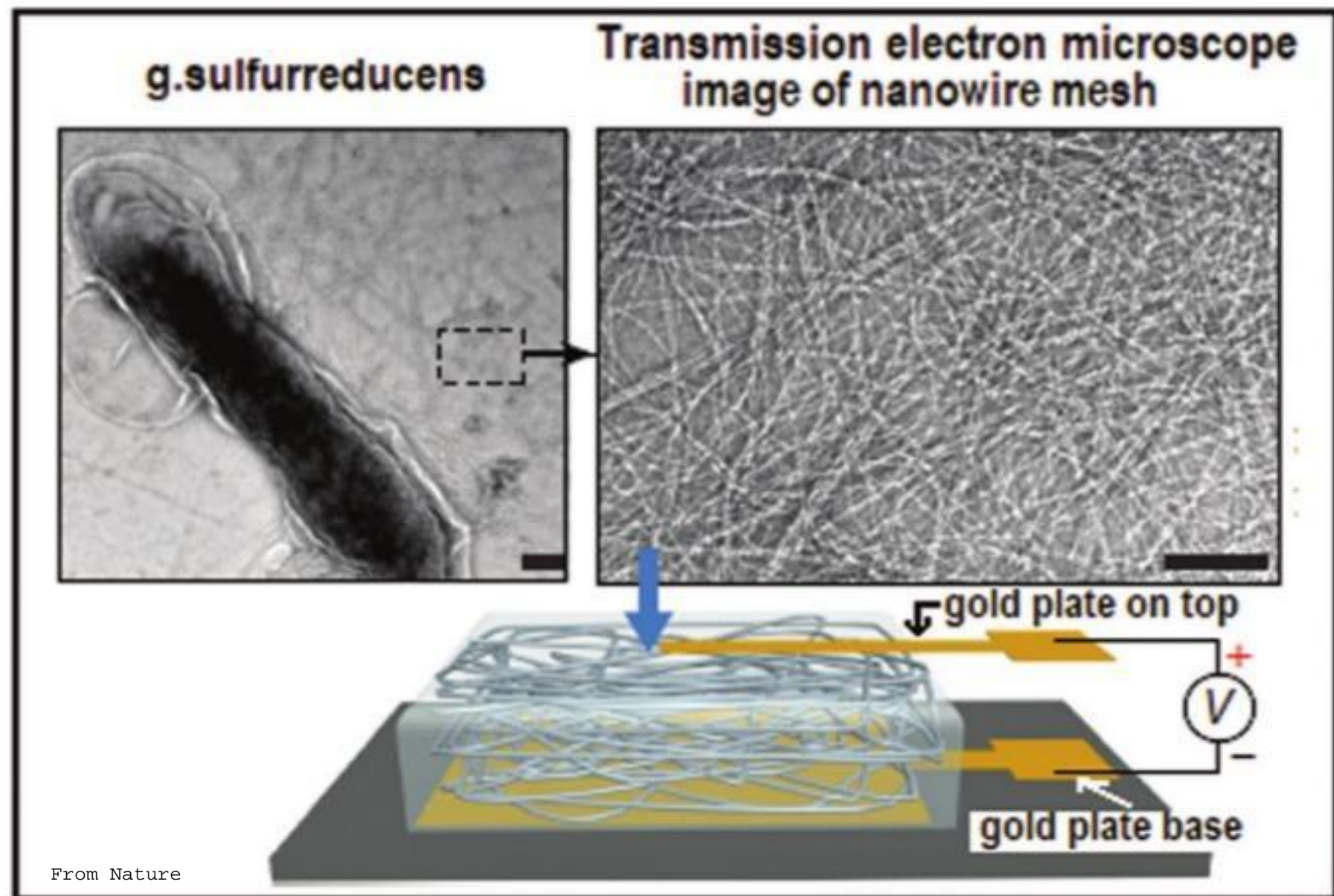


Electricity from the air



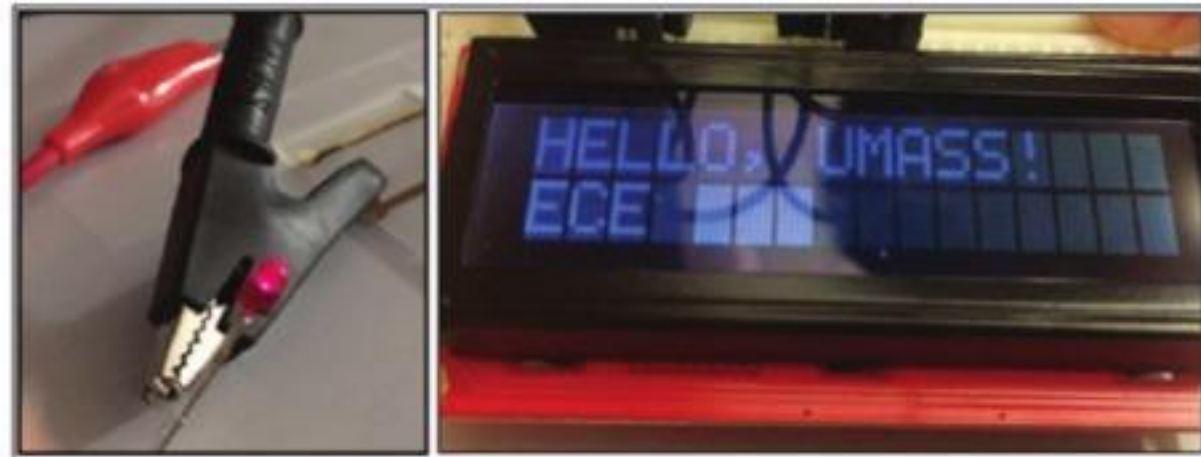
moisture levels in the air around us can be used to generate electricity to power simple devices

ANANTHANARAYANAN

The current imperative is that sources of power be carbon neutral. This limits the truly green sources to wind-power, solar power and hydropower. These three sources, unfortunately, share the features of being intermittent or limited to geographical locations.

ionizes or induces atoms within the film material to ionize, or split into positively and negatively charge components. And, as there is a gradient in the quantity of moisture, a gradient develops in the charges induced, which can be used to drive an electric current. In one report that the paper cites, a power generator and a respiratory monitor are energised by human breath. In other reports, harvesting energy from ambient moisture is suggested as a power source for "wearable electronics".

been possible are short, less than 50 second bursts of current, followed by a recharging phase of more than 100 seconds, the paper says. In contrast, authors present an arrangement, based on a film of electrically conducting biological material, in the form of a nanowire mesh, which outperforms predecessors both in the current output as well as in the length of time it keeps working. At least 20 hours at a time and output as high as four milliwatts, against the earlier 30 microwatts, for one cubic cm of material, the paper says. At four milliwatts a cubic cm, a one inch cube device, which is about 15 cubic cm, could charge a cell phone, just from the moisture in the air!



Protein nanowire mesh devices power an LCD (left) or an LED panel (right) (pic: Nature)

conducting. G. sulfurreducens, in fact, is known to create electric currents, has been studied, and is being used in microbial fuel cells. The nanowires, or protein material from the electrically active species, are sandwiched between the gold foil base and smaller, just 1mm x 1mm, electrode placed above. The distribution of moisture, through the 7-micron film, creates a voltage difference between the two faces of the conducting film. The voltage, when no current is drawn, is about 0.5Volts and when the gold plates are connected, the current is about 250 nano Amperes.

Where does the power come from?

All power comes from some system at a higher energy state falling to a lower energy state. Coal based power arises from coal and oxygen becoming CO2, hydropower from water falling from a height, and so on. When humidity in the air is the source, the energy comes from the energy stored in the water vapour in the atmosphere. The nano film creates a gradient, with a potential difference, which is drawn off as electricity. This results in flattening the gradient, which needs to be renewed, from the ambient atmosphere, which gets its humidity thanks to sources of water and the sun.

The behaviour did not change with the illumination of the device, which showed that light had nothing to do with the effect. The voltage and current lasted for more than 12 hours, which showed that the effect was not caused by transient charging. And, as both electrodes were gold, it was not some metal-metal effect that was in play. Even with carbon as the electrodes, the paper says, the voltages were of the same order. Chemical tests eliminated any decomposition of the nanowires as being the source of electricity and even removing nitrogen or oxygen from the surrounding air had no effect.

It was found that current could flow, through a load, continuously for as long as 20 hours. In the course of 20 hours, the voltage fell from 0.5V to 0.35V, but could regenerate and reach 0.5V in just 5 hours. Over a longer time span, the voltage remained at 0.4V - 0.6V for more than two months of cycles of regeneration. The fluctuation of the voltage was associated with changes in the relative humidity of the ambient air. The best voltage output was at 40 to 50 per cent relative humidity, which may be typical on a fine day in Mumbai or Kolkata. But substantial voltages were still generated at relative humidity as low as 20 per cent (desert) or 100 per cent (soaking, wet day), the paper says. The authors clearly identified the moisture as the source of electricity by sealing the top face of the film -

which led to disappearance of the voltage - which reappeared when the seal was removed. And then, of course, the dependence of the voltage on the relative humidity. It was seen that the moisture content at the surface of the thin film was some 27 per cent, against about 3 per cent at the bottom face for an 8-micron film. And the voltage generated increased with thickness of the film, till a plateau of about 0.55V at about 10 microns. The device can be made as small as desired, the paper says, and devices can be connected in series or in parallel, to provide higher voltage or to deliver more power. It is practical to think of power density, when films are stacked, of over kilowatt per cubic metre, the paper says. In one trial, the authors achieved output at 10V by connecting 17 devices in series.

The writer can be contacted at response@simplescience.in

PLUS POINTS

Before you eat junk



Eating a western-style diet for a week can slightly impair brain function and encourage healthy young people to overeat, according to a new study. After consuming a high fat, high added sugar diet, volunteers performed worse on memory tests and had a desire to eat junk food following a meal. The research suggests eating a western-style diet causes some disruption in the hippocampus region of the brain, the region involving memory and appetite control, making it more difficult for people to regulate their appetite. "After a week on a western-style diet, palatable food such as snacks and chocolate becomes more desirable when you are full," Richard Stevenson, professor of Psychology at Macquarie University in Sydney and one of the co-authors of the study, told The Guardian. "This will make it harder to resist, leading you to eat more, which in turn generates more damage to the hippocampus and a vicious cycle of overeating." Scientists enlisted 110 healthy participants aged between 20 and 23 years of age in their investigation, splitting them into a control group who ate a good diet, and another who consumed a high energy western diet including a heavy portion of Belgian waffles and fast food. Both groups ate breakfast at the beginning and end of the week, completing word memory tests and rating their desire and enjoyment of high-sugar foods such as Cocom Pops, before and after the meal.



"The more desirable people find the palatable food when full, following the western-style diet, the more impaired they were on the test of hippocampal function," said Professor Stevenson. He said when the hippocampus functions less efficiently; there is a flood of memories to the brain which make food more appealing. The findings mimic earlier research done in animals, which showed junk food impairs the hippocampus. There are no concrete reasons as to why this happens, but the hippocampus is considered to block or weaken memories about food when we are full. These initial subtle impairments caused by the western-style diet may lead to long-term decline in other areas such as obesity and diabetes —both of which have links to developing dementia and declines in brain performance, Stevenson said. He believes the government will eventually be forced to restrict the consumption of junk food in the same way it has done smoking. He said, "Demonstrating that processed foods can lead to subtle cognitive impairments that affect appetite and serve to promote overeating in otherwise healthy young people should be a worrying finding for everyone." The study, published in the journal Royal Society Open Science, is one of the first studies, which looks into whether the western diet impairs memory and appetite control in humans.

The independent

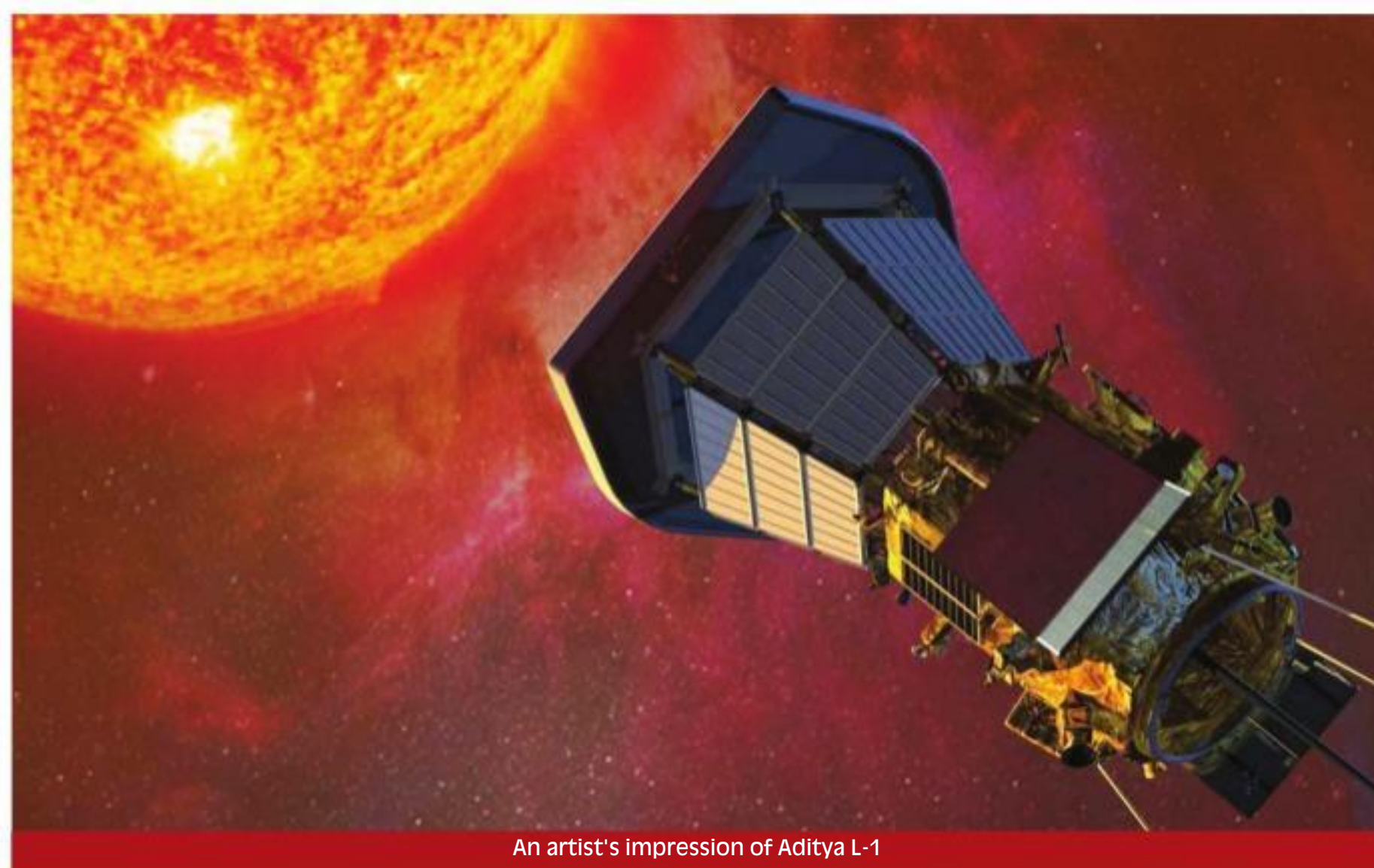
Innovative indeed



An image from video footage showing violinist Dagmar Turner playing the violin as doctors monitored her movements on screens during her brain surgery on 31 January has gone viral. She helped surgeons avoid damage to her brain during the operation to remove a tumour by playing her instrument, said the British hospital where she underwent the innovative procedure. Consultant neurosurgeon Keyoumars Ashkan of King's College Hospital in London hit on the plan to ensure that areas of Turner's brain responsible for intricate hand movements were not affected during the precision procedure. The medical team proposed that Turner be woken up midway through the procedure so she could play and be monitored to make sure her coordination was not being affected.

The straits times/ann

Aditya-L1's date with the Sun



An artist's impression of Aditya L1

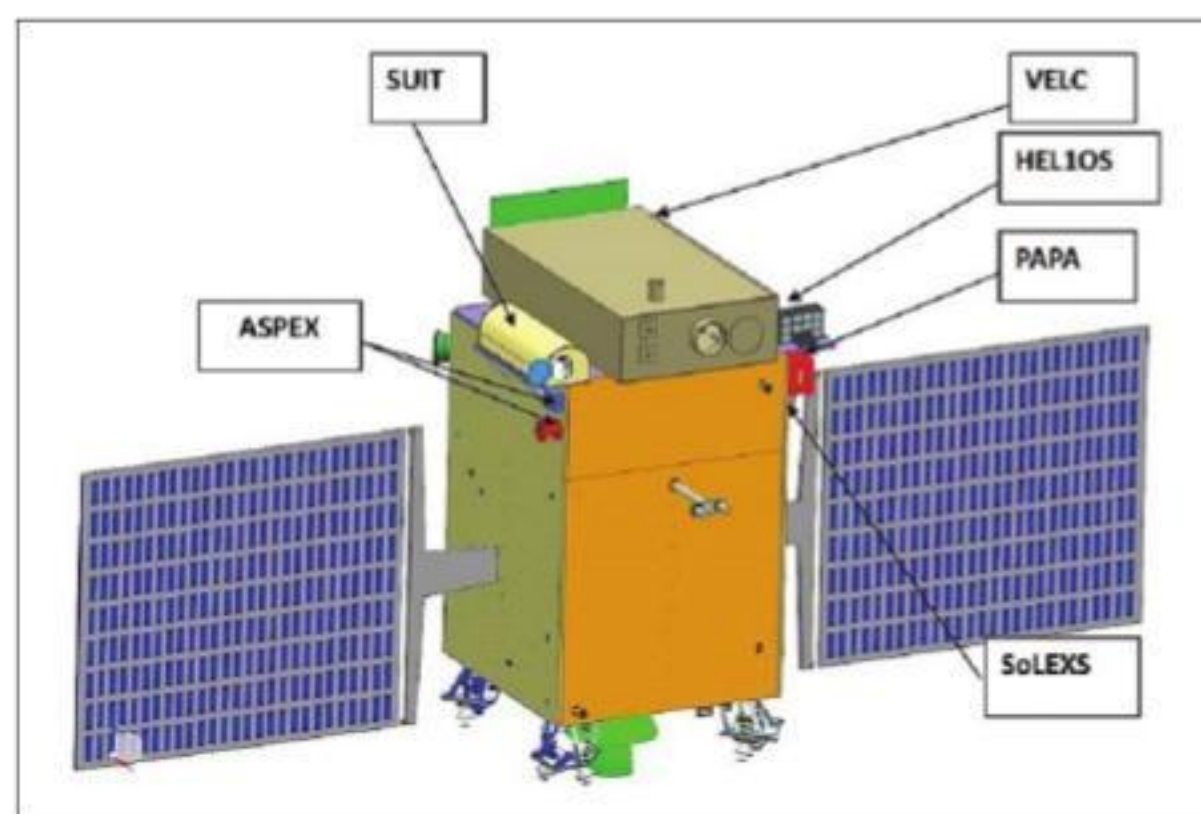
The Indian Space Research Organisation's maiden solar mission, which is expected to launch by the end of this year, will seek to unravel some long-standing mysteries of solar physics

BINAY MALAKAR

After two Chandrayaan missions, it's now the Sun's turn. The Indian Space Research Organisation will launch its maiden solar mission, called Aditya-L1, by the end of 2020 from the Satish Dhawan Space Centre in Sriharikota using the PSLV-XL rocket. It may not be possible to penetrate the Fire Ring of the Sun but it will try to go to its vicinity to study the solar corona closely. This ambitious plan of Isro will put India at the frontier of cutting edge research. It will carry out vigilance in the secret haunt of the Sun to find out its mysterious actions, and send information and photographs back to the Blue Planet. Aditya L-1 was conceptualised in

2008 by Isro for space research. It was initially envisaged as a 400 kg-class Low Earth Orbiting mini-satellite with only one payload to study the solar corona. The scope of the mission has since been expanded and it is now planned to be a comprehensive solar and space environment observatory to be placed at the first Lagrangian point or "L1". The main payload, Variable Emission Line Coronagraph, can provide observations of different layers of the Sun including the solar corona. The Aditya-L1 mission will be inserted in a halo orbit around the L1 point — about 1.5 million kms from Earth and 147.5 million kms from the Sun. The 1,500 kg satellite will take about 100 days from the date of launch to

start orbiting around L1. There will be a total of seven payloads with different objectives and it is the first Indian space mission to be placed at the Lagrangian point L1. Variable Emission Line Coronagraph (Velc): The coronagraph creates an artificial total solar eclipse in space by blocking sunlight with an occulter. This coronagraph will study the diagnostic parameters of the solar corona, the origin of coronal mass ejection and magnetic field measurement of solar corona. Solar Ultraviolet Imaging Telescope (Suit): This telescope will image the photosphere and chromosphere in the near ultraviolet (200-400



The various payloads on the satellite

nm) region.

- Aditya Solar Wind Particle Experiment (Aspex): It will study the variation of solar wind properties as well as its distribution and spectral characteristics. Plasma Analyser Package for Aditya (Papa): To understand the composition of solar wind and its energy distribution. Solar Low Energy X-ray Spectrometer (Solexis): This spectrometer will monitor the X-ray flares for studying the heating mechanism of the solar corona. High Energy L1 Orbiting X-ray Spectrometer (Helios): This spectrometer will provide an estimate of the energy used to accelerate the particles during the eruptive events. Magnetometer: It will measure the magnitude and nature of the interplanetary magnetic field. The main aim of this mission is to study the solar corona, and the two outer layers—photosphere and chromosphere—with the help of the Velc. In the core of the Sun, due to thermonuclear reactions called fusion, hydrogen gets converted into helium continuously and thus we get light and heat energy. The temperature in the core is about 15 million Kelvin

and that of the inner most layer is about 6,000 Kelvin. However, the temperature of the corona, which is nearly at a distance of 10 times that of the photosphere from the core, is about 1 million Kelvin. Further, temperature of the corona is not the same everywhere — it is too low at some places and too high at others. Why is temperature of the corona so high? Why is corona so mysterious? These are two of the unanswered questions in solar physics. Other important issues which Aditya-L1 will try to resolve are — dynamics of the coronal mass ejection, route of the solar storm to Earth, and from where the Sun ejects its harmful UV rays. Scientists believe that Aditya-L1 will be able to unlock the mystery of the Sun, the object we observe everyday in the sky from morning to evening and due to which water can exist in liquid form only on this planet. If this mission comes out with flying colours, then India will definitely be in a strong position in the field of space research. The Aditya-L1 mission is expected to provide a multi-pronged holistic approach for the understanding of some of the long-standing problems of solar physics. The writer is associate professor and head, department of physics, Netaji Mahavidyalaya, Arambagh, West Bengal