CAPSULE

Strong smell
It is well known that elephants have a fine sense of smell. An experiment on Asian elephants that controlled for alternative interpretations found that they could differentiate a bucket containing a lot of sunflower seeds from those with far fewer seeds, purely using their sense of smell. This study addresses bias in tests of animal perception and cognition.

Climate change guide
Dendrochronology, the analysis of tree rings to infer things about the past, can now be used to understand the future. A study, published in *Nature Communications*, of tree rings of living and dead conifers suggested that slowly growing trees sequester more carbon than fast-growing ones. This finding can inform environmental policies that rely on plantations of fast growing trees to mitigate global warming.

A fine tuning
Scientists at Massachusetts Institute of Technology have found a way to convert molecular structures of proteins into audible sounds resembling musical notes. Once the conversion is done, they can alter some of the notes and then reconvert the notes back into proteins to produce proteins that have never been seen in nature. The method translates the 20 types of amino acids into a 20-tone scale.

Malaria reaching out
A slight rise in temperature may increase the risk of malaria to hundreds of thousands of people in areas currently too cold for malaria parasites to complete their development, according a study. This is because the parasites develop much faster at these lower temperatures than has been previously estimated, according to the researchers from Penn State University

IIT Hyderabad fabricates device for early diagnosis of heart attack

The microfluidic device can detect the biomarker even at low concentrations

R. PRASAD

A cardiac biomarker – cardiac troponin I – that is widely used for early diagnosis of acute heart attack can now be detected in about three minutes and even when present at very low concentration. And the detection can be done at bedside. This has become possible with the development of a microfluidic device by a team of researchers from the Indian Institute of Technology (IIT) Hyderabad.

The heart cells that get damaged during heart attack cause the expression of cardiac muscle proteins such as the biomarker cardiac troponin I, which get released into the blood. Detecting the biomaker in the blood serum helps in early diagnosis of heart attack.

Early indicator: Heart cells damaged during heart attack cause the release of the biomarker into the blood. ▪ V. SREENIVASA MURTHY

Superior performance
Commercially available assays have limitations in terms of both sensitivity and time taken for detection. These assays cannot detect when the biomarker is present at concentrations below 0.02 nanogram per ml and take a long time for detection. In contrast, the microfluidic device developed by the team led by Renu John from the Department of Biomedical Engineering at IIT Hyderabad can detect the biomarker even when the concentration is as low as 0.005 nanogram per ml.

"Our device can detect the biomarker over a wide range – from 0.005-100 nanogram per ml," says Prof. John. Serum samples from patients were used for testing the device. The results were published in the *Journal of Materials Chemistry B*.

Commercially available assays as well the microfluidic device use the same antibody to bind to the biomarker. But the way the device has been constructed makes the difference in terms of better sensitivity and rapid detection.

Rapid detection
The researchers have successfully integrated the microfluidic device with chitosan-coated nickel vanadate nanospheres to enable rapid detection and better sensitivity.

The outer surface of the nanospheres is first coated (functionalised) with the antibody that binds to the biomarker. Since the nanospheres have greater surface area, more antibodies are present on the surface thus increasing the chances and ability to bind to the biomarker. The functionalised nanospheres are then coated on the working electrode that is present in the microfluid device chip.

"The integration of the nanospheres which detect the biomarker with the compact microfluidic device speeds up the detection process," says Nawab Singh from IIT Hyderabad and first author of the paper.

"When the patient's serum is introduced into the microfluidic device, the biomarker present in the serum binds to the antibodies present on the nanospheres. This causes a change in the current flow at a microamphere level," explains Prof. John. "The electrochemical response of the sensor changes in response to a change in the concentration of the troponin I biomarker causing a change in the current flow."

Bedside device
Since the microfluidic device can be made tiny, detection of the biomaker can be made right at bedside.

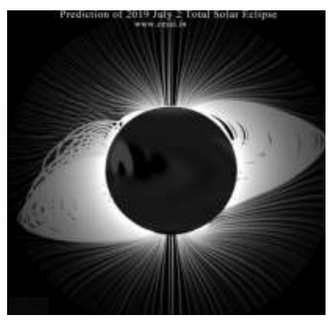
"This is a proof-of-concept work. We have to undertake large trials involving many patient samples before it can be used commercially," says Prof. John.

IISER Kolkata takes a step towards predicting space weather

The team has predicted the shape of the Sun's atmosphere that the eclipse will reveal

SHUBASHREE DESIKAN

July 2, this year, is a special day for a team of researchers from the Indian Insititute of Science Education and Research (IISER) Kolkata as a total solar eclipse becomes visible in parts of Chile and Argentina. The team has given out a computer model-based prediction of the shape of the Sun's atmosphere that the eclipse will reveal. Many Indian and international solar physicists will be gathering in Argentina to observe the eclipse and discuss the Sun's influence on our space environment. If the Indian prediction works, it will help us forecast how the Sun's temperament can affect space weather. This, in turn, can help monitor the safety of the electronic sensors in satellites, astronauts' well-being and even the impact on Earth.



Prediction: Occulted Sun will show two petal-like formations on either side. ▪ CESSI

The corona
The Sun's corona, which is like the Sun's atmosphere, although hotter than its interior, is less dense and therefore emits fewer photons. Therefore, in normal times, the Sun's surface shines so brightly that it obscures the corona. Only when there is a total solar eclipse does the solar disc get 'occulted' by the moon, exposing the corona to our view, albeit using instruments for photographing it.

The Sun's magnetic field lines stretch out from the surface and permeate the corona. Solar plasma wind and storms including flares and coronal mass ejections are born in coronal magnetic field. Emergence of magnetic field from below the Sun's surface and dynamic restructuring in the outer layers changes the shape of the corona. Now a team of researchers from IISER Kolkata, has found a way to predict the shape of the corona well in advance.

Two-step process
The team uses a two-step process to predict the shape of the corona. Using a model for the way the magnetic fields emerge as sunspots and evolve on the sun's surface, they first predict what will be the form of the sun's surface magnetic field on the day of the eclipse. Then, they use another model to extrapolate this to reveal what the corona will look like.

The coronal brightness and structure are determined by the magnetic fields of the Sun, which emerge out of the surface and spread out into the corona. "Using computational models, we have predicted the Sun's surface magnetic field on the day of the eclipse. We used this as input to generate the prediction for the coronal field," says Dibyendu Nandi from Center of Excellence in Space Sciences and IISER, Kolkata, who led the research.

Coronal regions which have more intense, closed petal-like loop structures appear brighter because the underlying magnetic fields heat the corona and control its emission. "Observations of these bright and dark structures in the corona during the eclipse can tell us whether our underlying computational models are correct or need more refinement," Prof. Nandi adds.

According to their calculation, the occulted Sun will show two petal-like formations on either side of the corona with extended plume like structures stretching out into the solar system from their tips. It is to be noted that while solar north points upwards on paper, the eastern side is to the left and western side is to the right, unlike the conventions for geographical maps.

The eclipse will last for four minutes and 33 seconds. It will be visible during sunset in parts of Chile and Argentina.

Nipah virus: Experimental antiviral drug shows promise

Remdesivir drug used for Ebola treatment can stop Nipah virus from making new copies of its genome

ASWATHI PACHA

In a new study published last month, researchers from the National Institutes of Health, U.S., have shown that Remdesivir was able to treat four African green monkeys which were given a lethal dose of Nipah virus.

Remdesivir is a broad-spectrum antiviral drug which is currently in phase 2 clinical trial for the treatment of Ebola.

Eight monkeys were inoculated with a lethal dose of Nipah virus Bangladesh strain, and, 24 hours later, four of them were treated intravenously with the drug for 12 consecutive days.

Response in monkeys
The ones that did not receive the drug developed respiratory problems with the disease rapidly progressing in about a week. Two of these were sacrificed on day seven due to disease severity, and the remaining two were sacrificed on the eighth day when they reached the humane endpoint criteria (when the experimental animal is in pain and/or distress and the experiment is terminated).

Connection: The virus that caused Nipah in India belongs to the same genotype as that from Bangladesh used i n the study. ▪ G. RAMAKRISHNA

The four animals which were treated with the drug survived. They did not show any clinical signs up to 92 days and the experiment was terminated.

Though parameters such as body weight and temperature remained unchanged in the two groups, an increased respiration rate and decreased oxygen saturation (oxygen-saturated haemoglobin versus total haemoglobin in the blood) were seen in the non-drug group.

When asked if these results hold true for Indian Nipah strain, Emmie de Wit, the first author of the study said in an email to *The Hindu:* "The Nipah virus that caused the outbreak in India belongs to the same genotype as the Nipah virus from Bangladesh that we used in our study. So although there are some small genetic differences between the two viruses they are very similar. It is always good to confirm, but we are confident that the drug will be effective against Indian Nipah viruses as well."

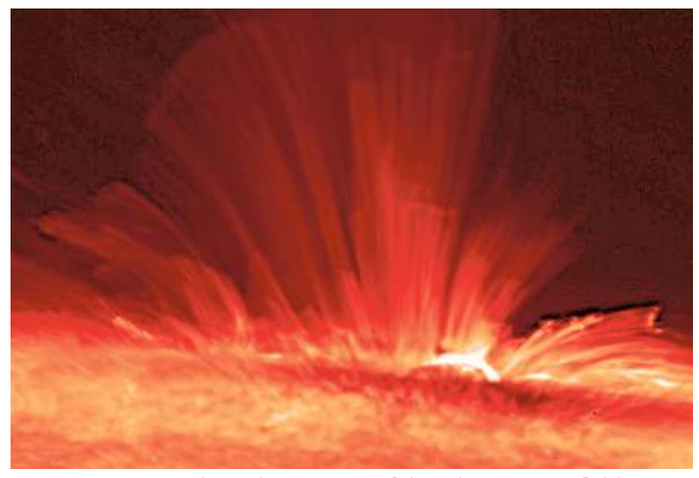
> **It is always good to confirm, but we are confident that the drug will be effective against Indian Nipah viruses as well.**
>
> EMMIE DE WIT
> National Institute of Health

During the course of the study, the researchers found that one of the drug-treated animals exhibited inflammation of the brain tissues.

Dr. de Wit explains, "We know from patients with Nipah virus that they also often develop this disease of the brain when they are infected. There are also patients in Malaysia who were infected with Nipah virus, survived and then got encephalitis caused by Nipah virus several months or years later." This is most likely because the Nipah virus easily enters the brain and then slowly replicates until it causes disease. "In the animal treated with the drug that had histologic evidence of meningoencephalitis, we did not observe any signs of neurological disease at the time the experiment ended, so we were very surprised to see this meningoencephalitis in a small part of the brain," she adds.

Mode of action
When asked about the mode of action of the drug, Dr. de Wit writes "Remdesivir can stop the virus from making new copies of its genome. Because the genome is an essential part of the virus, the virus cannot replicate itself very well in the presence of the drug, and there is less damage to organs and thus less severe disease."

"Right now, there are two promising antiviral treatments against Nipah virus that could be used in humans soon. The first is a monoclonal antibody developed by Chris Broder and colleagues at the Uniformed Services University in the U.S. The second promising treatment is Remdesivir. Both treatments are available as clinical grade material and have been safety tested in humans. These two treatments could thus be tested in Nipah virus patients in the context of a clinical trial," explains Dr de Wit.



Coronal eruptions: This is the structure of the solar magnetic field rising vertically from a sunspot, into the solar atmosphere. ▪ AP/NASA

Indian scientist to be Co-I for NASA's PUNCH mission

The mission will study the Sun using four suitcase-sized microsats

SHUBASHREE DESIKAN

NASA has selected Texas-based Southwest Research Institute to lead its PUNCH mission which will image the Sun. This is a landmark mission that will image regions beyond the Sun's outer corona. Dipankar Banerjee, solar physicist from Indian Institute of Astrophysics is also a Co-Investigator of the PUNCH mission. PUNCH, which stands for "Polarimeter to Unify the Corona and Heliosphere," is focused on understanding the transition of particles from the Sun's outer corona to the solar wind that fills interplanetary space.

"The Sun and the solar wind are one interconnected system, but [these] have until recently been studied using entirely different technologies and scientific approaches," explains Prof. Banerjee in an email to *The Hindu*.

Focus on polar regions
Commenting on his role as Co-Investigator in the PUNCH mission, Prof. Banerjee said, "I will be working to study how the solar wind is accelerated. I will focus on the polar regions of the Sun." The team also plans to observe the Sun using joint observations from PUNCH and Indian mission Aditya, which is underway.

India is planning to send up its own satellite Aditya-L1, a mission to study the Sun's corona, and Prof. Banerjee is the co-Chair of the Science Working Group. "We expect co-ordinated observations of Aditya and PUNCH in order to understand our space weather environment," he says.

Constellation of satellites
PUNCH will consist of a 'constellation' of four suitcase-sized microsats that will orbit the Earth in formation and study how the corona, which is the atmosphere of the Sun, connects with the interplanetary medium. The mission is expected to be launched in 2022.

The mission will image and track the solar wind and also the coronal mass ejections - which are huge masses of plasma that get thrown out of the Sun's atmosphere. The coronal mass ejections can affect and drive space weather events near the Earth.

Other probes
Other missions such as NASA's Parker Solar Probe and the ESA-NASA joint project, Solar Orbiter, which is due to be launched in 2020, can study the structures of the Sun's atmosphere. The PUNCH mission enhances these by tracking these structures in real time. Since the Sun's corona is much fainter than its surface layers, it cannot be viewed by the instruments directly. So PUNCH will block out the light from the Sun to view its corona and the structures in it.

New approach proposed for post-stroke rehabilitation

Existing methods ignore diversity of lesions and variability of individual responses

PRESS TRUST OF INDIA

The existing approach for brain stimulation to rehabilitate patients after a stroke does not take into account the diversity of lesions and the individual characteristics of patients' brains, a study has found.

In recent decades, non-invasive neuromodulation methods such as electric and magnetic stimulation of various parts of the nervous system have been increasingly used to rehabilitate patients after a stroke.

Stimulation selectively affects different parts of the brain, which allows you to functionally enhance activity in some areas while suppressing unwanted processes in others that impede the restoration of brain functions.

This is a promising mean of rehabilitation after a stroke. However, its results in patients remain highly variable.

Authors of the study, which was published in the journal *Frontiers in Neurology,* argued that the main reason for the lack of effectiveness in neuromodulation approaches after a stroke is an inadequate selection of patients for the application of a particular brain stimulation technique.

They said the existing approach does not take into account the diversity of lesions after a stroke and the variability of individual responses to brain stimulation as a whole.

The researchers have proposed two criteria for selecting the optimal brain stimulation strategy.

The first is an analysis of the interactions between the hemispheres.

Now, all patients, regardless of the severity of injury after a stroke, are offered a relatively standard treatment regimen. This approach relies on the idea of interhemispheric competition.

"For a long time, it was believed that when one hemisphere is bad, the second, instead of helping it, suppresses it even more," said Maria Nazarova, researcher at the HSE Institute of Cognitive Neurosciences.

"In this regard, the suppression of the activity of the 'unaffected' hemisphere should help restore the affected side of the brain. However, the fact is that this particular scheme does not work in many patients after a stroke. Each time it is necessary to check what the impact of the unaffected hemisphere is - whether it is suppressive or activating," she said.

According to the researchers, the second criterion is the neuronal phenotype.

This is an individual characteristic of the activity of the brain, which is 'unique to each person like their fingerprints'

Such a phenotype is determined, firstly, by the ability of the brain to build effective structural and functional connections between different areas (connectivity).

Secondly, the individual characteristics of neuronal dynamics, including its ability to reach a critical state. This is the state of the neuronal system in which it is the most plastic and capable of change.

Wrong approach: Now, all patients, regardless of the severity of injury after a stroke, are offered a relatively standard treatment regimen. ▪ AFP