Flare of radio emission from a binary star in our galaxy detected by MeerKAT

MANCHESTER: The MeerKAT radio telescope in the Northern Cape of South Africa has discovered an object which rapidly brightened by more than a factor of three over a period of three weeks. This is the first new transient source discovered with MeerKAT and scientists hope it is the tip of an iceberg of transient events to be discovered with the telescope.

Astronomers call an astronomical event "transient" when it appears or disappears, or becomes fainter or brighter over seconds, days, or even years. These events are important as they provide a glimpse of how stars live, evolve, and die. Using an assortment of telescopes around the globe, the researchers determined that the source of the flare is a binary system, where two objects orbit each other approximately every 22 days.

While the cause of the flaring and the exact nature of the stars that make up the system is still uncertain, it is thought to be associated with an active corona – the hot outermost part of the brighter star.

The source of the observed activity is located in the Southern constellation of Ara and was found to be coincident with a giant star about two times as massive as the Sun. The orbital period was determined using optical observations with the Southern African Large Telescope (SALT). Fortuitously, the star is sufficiently bright to have also been monitored by optical telescopes for the last 18 years and is seen to vary in brightness every three weeks, matching the orbital period. "This source was discovered just a couple of weeks after I joined the team, it was amazing that the first MeerKAT images I worked on had such an interesting source in them. Once we found out that the radio flares coincided with a star, we discovered that the star emits across almost the entire electromagnetic spectrum from X-ray to UV to radio wavelengths," said Laura Driessen, a Ph.D. student at The University of Manchester who led this work.

Patrick Woudt, Professor and Head of the Astronomy Department at The University of Cape Town said: "Since the inauguration in July 2018 of the South African MeerKAT radio telescope, the ThunderKAT project on MeerKAT has been monitoring parts of the southern skies to study the variable radio emission from known compact binary stars, such as accreting black holes.

"The excellent sensitivity and the wide field of view of the MeerKAT telescope, combined with the repeat ThunderKAT observations of various parts of the southern skies, allows us to search the skies for new celestial phenomena that exhibit variable or short-lived radio emission." Professor Ben Stappers from The University of Manchester said: "The properties of this system don't easily fit into our current knowledge of binary or flaring stars and so may represent an entirely new source class." The MeerKAT telescope is sweeping the sky for sources that vary on timescales from milliseconds to years, and will significantly improve human understanding of the variable radio sky.—**AFP**

A surprising substance may be key in capturing CO2 in the atmosphere

NEW YORK: Climate worries go hand in hand with CO2 emissions concerns. Emissions hit an all-time high last year. The CO2 level in the atmosphere may be higher than it's been in 3 million years. Carbon capture will most likely be necessary to reduce the level of CO2 in the atmosphere. To accomplish that we need the technology and materials to do the job. Recently a promising and surprising new candidate has emerged.

"The results are first and foremost important in terms of climate change," says Professor Liyuan Deng at NTNU's Department of Chemical Engineering.

Professor Deng is leading the work of the membrane research group at NTNU, and their results are gaining attention.

Water altered the material

Power plants that use fossil fuels require a membrane that can filter the emissions and separate out the carbon. These membranes need to be both permeable for CO2 and also separate the CO2 from the other gases, such as nitrogen.

"We didn't think this membrane material was going to be suitable," says Deng.

TESET, before and after water treatment. The water has changed the structure in the material. Credit: Kenneth P. Mineart, NCSU

But a simple move changed that. The hopeless membrane candidate needed another substance to work properly. This second substance was simply – water.

By lowering the membrane into water and then drying it out again, the membrane underwent a change. CO2 penetrated the membrane much more efficiently, and the membrane was somewhat better at filtering out nitrogen.

NPG Asia Materials, a journal in the Nature group, recently published an article on the NTNU research, which stated that "these nanostructured membranes constitute promising candidates for gas separation technologies aimed at CO2 capture."

The material in question is a polymer. Polymers are relatively inexpensive and easy to make. Many researchers therefore regard them as promising candidates for separating different gases on the large scale that will be needed. The membranes must also be stable and durable.

A polymer is a substance composed of long-chain molecules. Many plastics are polymers, but they are also found in nature as proteins, cellulose and glass, for example.

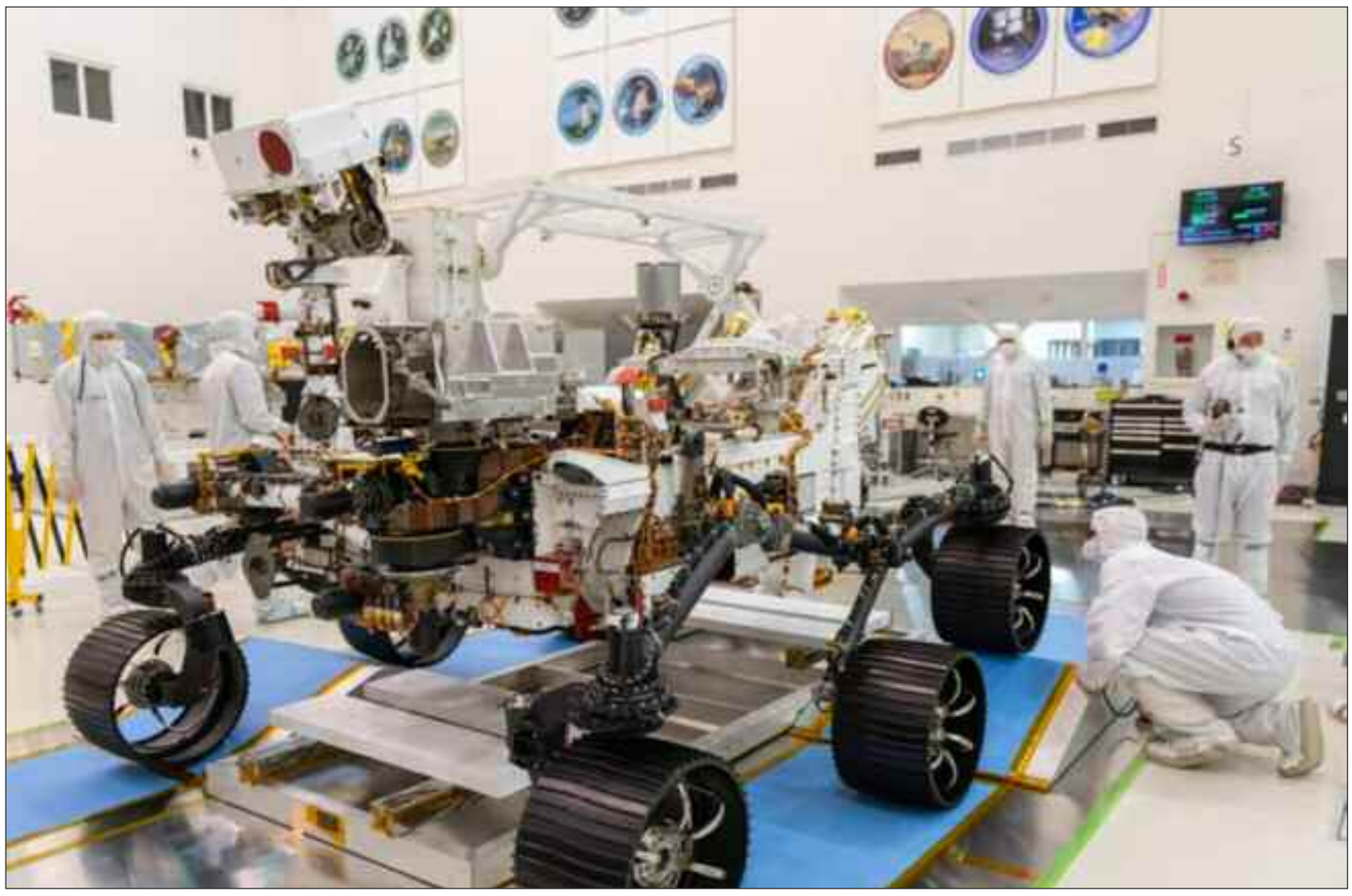
The membrane research group is looking for materials that can help filter out carbon dioxide. Credit: NTNU

Fortunately, someone gave it the nickname TESET instead. The material is already in commercial use and is therefore readily available. "The company holding the patent is interested in this new field of application," says Deng.

The Membrane Research Laboratory at NTNU hosts the only group in Norway that is researching membranes from polymers that can be used to filter CO2 from the air. Some individual scientists are working with the same materials, while other groups are looking at inorganic membranes. The research on membranes in Norway as a whole is quite advanced, and perhaps even cutting edge, according to the professor.

This particular research is part of Horizon 2020, the EU's Framework Programme for Research and Innovation. The group is also working on other promising candidates for CO2 filtration. Among these are membranes made of graphene oxide.

Graphene is the world's thinnest and strongest material. It consists of one layer of carbon atoms organized in a hexagonal pattern. The material has many exciting properties, and several groups at NTNU are looking at the practical fields of application for it.—**AFP**



NASA takes mars 2020 rover for spin in first drive test

NASA's next Mars rover has passed its first driving test. A preliminary assessment of its activities on December 17, 2019, found that the rover checked all the necessary boxes as it rolled forward and backward and pirouetted in a clean room at NASA's Jet Propulsion Laboratory in Pasadena, California. The next time the Mars 2020 rover drives, it will be rolling over Martian soil.

"Mars 2020 has earned its driver's license," said Rich Rieber, the lead mobility systems engineer for Mars 2020. "The test unambiguously proved that the rover can operate under its own weight and demonstrated many of the autonomous-navigation functions for the first time. This is a major milestone for Mars 2020."

On December 17, 2019, engineers took NASA's next Mars rover for its first spin. The test took place in the Spacecraft Assembly Facility clean room at NASA's Jet Propulsion Laboratory in Pasadena, California. This was the first drive test for the new rover, which will move to Cape Canaveral, Florida, in the beginning of next year to prepare for its launch to Mars in the summer. Engineers are checking that all the systems are working together properly, the rover can operate under its own weight, and the rover can demonstrate many of its autonomous navigation functions.

The launch window for Mars 2020 opens on July 17, 2020. The rover will land at Mars' Jezero Crater on February 18, 2021.

Scheduled to launch in July or August 2020, the Mars 2020 mission will search for signs of past microbial life, characterize Mars' climate and geology, collect samples for future return to Earth, and pave the way for human exploration of the Red Planet. It is scheduled to land in an area of Mars known as Jezero Crater on February 18, 2021.

"To fulfill the mission's ambitious science goals, we need the Mars 2020 rover to cover a lot of ground," said Katie Stack Morgan, Mars 2020 deputy project scientist.

Mars 2020 is designed to make more driving decisions for itself than any previous rover. It is equipped with higher-resolution, wide-field-of-view color navigation cameras, an extra computer "brain" for processing images and making maps, and more sophisticated auto-navigation software. It also has wheels that have been redesigned for added durability.

On December 17, 2019, engineers took NASA's next Mars rover for its first spin. The test took place in the Spacecraft Assembly Facility clean room at NASA's Jet Propulsion Laboratory in Pasadena, California. Credit: NASA/JPL-Caltech

All these upgrades allow the rover to average about 650 feet (200 meters) per Martian day. To put that into perspective, the longest drive in a single Martian day was 702 feet (214 meters), a record set by NASA's Opportunity rover. Mars 2020 is designed to average the current planetwide record drive distance.

In a 10-plus-hour marathon on Tuesday that demonstrated all the systems working in concert, the rover steered, turned and drove in 3-foot (1-meter) increments over small ramps covered with special static-control mats. Since these systems performed well under Earth's gravity, engineers expect them to perform well under Mars' gravity, which is only three-eighths as strong. The rover was also able to gather data with the Radar Imager for Mars' Subsurface Experiment (RIMFAX).

"A rover needs to rove, and Mars 2020 did that yesterday," said John McNamee, Mars 2020 project manager. "We can't wait to put some red Martian dirt under its wheels." JPL is building and will manage operations of the Mars 2020 rover for NASA. NASA's Launch Services Program, based at the agency's Kennedy Space Center in Florida, is responsible for launch management. Mars 2020 is part of a larger program that includes missions to the Moon as a way to prepare for human exploration of the Red Planet. Charged with returning astronauts to the Moon by 2024, NASA will establish a sustained human presence on and around the Moon by 2028 through NASA's Artemis lunar exploration plans.

Beyond moore's law: 3D silicon circuits take transistor arrays into the third dimension

LANSING: Silicon integrated circuits, which are used in computer processors, are approaching the maximum feasible density of transistors on a single chip—at least, in two-dimensional arrays.

Now, a team of engineers at the University of Michigan have stacked a second layer of transistors directly atop a state-of-the-art silicon chip.

They propose that their design could remove the need for a second chip that converts between high- and-low voltage signals, which currently stands between the low-voltage processing chips and the higher-voltage user interfaces.

"Our approach can achieve better performance in a smaller, lighter package," said Becky Peterson, an associate professor of electrical engineering and computer science and project leader.

Moore's Law holds that computing power per dollar doubles roughly every two years. As silicon transistors have shrunk in size to become more affordable and power efficient, the voltages at which they operate have also fallen.

Higher voltages would damage the increasingly small transistors. Because of this, state-of-the-art processing chips aren't compatible with higher-voltage user interface components, such as touchpads and display drivers. These need to run at higher voltages to avoid effects such as false touch signals or too-low brightness settings.

"To solve this problem, we're integrating different types of devices with silicon circuits in 3D, and those devices allow you to do things that the silicon transistors can't do," Peterson said.

Because the second layer of transistors can handle higher voltages, they essentially give each silicon transistor its own interpreter for talking to the outside world. This gets around the current trade-off of using state-of-the-art processors with an extra chip to convert signals between the processor and interface devices—or using a lower-grade processor that runs at a higher voltage.

"This enables a more compact chip with more functionality than what is possible with only silicon," said Youngbae Son, the first author of the paper and recent doctoral graduate in electrical and computer engineering at U-M.

Peterson's team managed this by using a different kind of semiconductor, known as an amorphous metal oxide. To apply this semiconductor layer to the silicon chip without damaging it, they covered the chip with a solution containing zinc and tin and spun it to create an even coat. Next, they baked the chip briefly to dry it. They repeated this process to make a layer of zinc-tin-oxide about 75 nanometers thick—about one-thousandth the thickness of a human hair. During a final bake, the metals bonded to oxygen in the air, creating a layer of zinc-tin-oxide.

The team used the zinc-tin-oxide film to make thin film transistors. These transistors could handle higher voltages than the silicon beneath. Then, the team tested the underlying silicon chip and confirmed that it still worked. To make useful circuits with the silicon chip, the zinc-tin-oxide transistors needed to fully communicate with the underlying silicon transistors. The team accomplished this by adding two more circuit elements using the zinc-tin-oxide: a vertical thin film diode and a Schottky-gated transistor. The two kinds of zinc-tin-oxide transistors are connected together to make an inverter, converting between the low voltage used by the sili-