

CAPSULE



Black hole puzzle

The Hubble space telescope revealed the presence of a black hole at the centre of the galaxy NGC 3147 which is 130 million light years away that behaves differently from what is expected. While traditional theories postulated that its accretion disc would puff up like a doughnut, it was in fact flattened like that surrounding a more massive black hole.



Insects feel chronic pain

New research published in *Science Advances* reveals that insects feel chronic pain after injury. The researchers injured one leg of fruitflies (*Drosophila* species) and found that other legs became hypersensitive, trying to protect themselves from injury. They inferred that the fruit flies experienced long-lasting pain in the injured leg.

TIFR desalinates seawater without electricity

Alternatively, gold nanoparticles can be used to convert carbon dioxide into methane

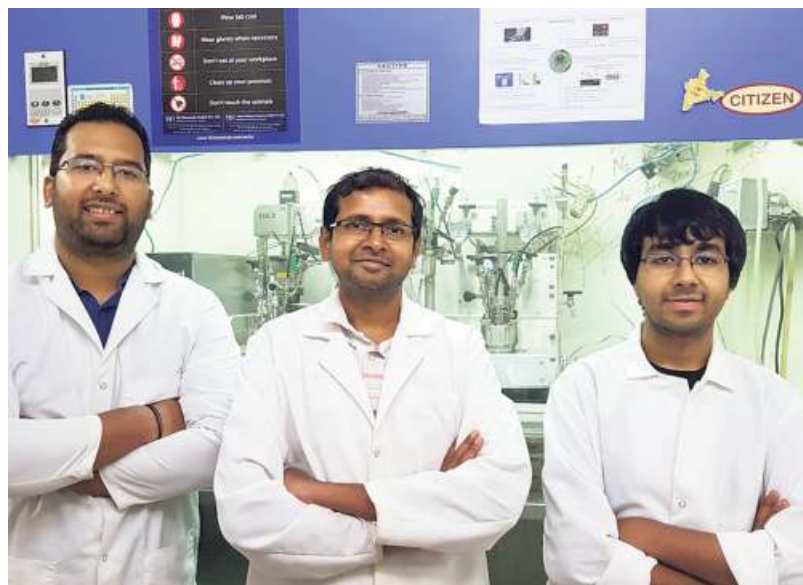
R. PRASAD

Using gold nanoparticles that absorb sunlight over the entire visible region and even the near infrared light, researchers at the Tata Institute of Fundamental Research (TIFR), Mumbai, have been able to desalinate seawater to produce drinking water. Unlike the conventional reverse osmosis that is energy intensive, the gold nanoparticles require no external energy to produce potable water from seawater.

Using 2.5 mg of gold nanoparticles, the team led by Vivek Polshettiwar from TIFR's Department of Chemical Sciences was able to use sunlight to heat the water to 85 degree C and generate steam to produce drinking water from seawater. Since the temperature reached is high, about 10% of seawater becomes steam (and hence drinking water) in about 30 minutes.

Alternatively, the gold nanoparticles can be used to convert carbon dioxide into methane. This happens when the light absorbed by the gold nanoparticles excites the electrons, and the excited electrons when transferred into carbon dioxide converts it into methane in the presence of hydrogen. The hydrogen comes from the water that is used as a reaction solvent.

"At present, the conversion of carbon dioxide to methane is low – about 1.5 micromole per gram. It is desirable to increase the conversion one-fold to millimole range. We are finding ways to improve the conversion rate," says



Alternative metal: The next step after this preliminary study is to replace gold with some inexpensive metal to make it sustainable, say (from left) Mahak Dhiman, Vivek Polshettiwar and Ayan Maity. •SPECIAL ARRANGEMENT

Prof. Polshettiwar. The results of the study were published in the journal *Chemical Science*.

The gold nanoparticles decorate the surface of 3D fibrous silica nanosphere structure. The silica nanospheres measuring 400-500 nanometres are first functionalised with amines. In the presence of a reducing agent, the gold chloride gets deposited on the silica nanospheres. The gold nanoparticles were made bigger through cycles of deposition.

"We used a different reducing agent

that allows the gold to get deposited only on already formed nanospheres and not form new nanoparticles," says Prof. Polshettiwar. "A weak reducing agent does not allow gold to reach a critical concentration for it to form new nanoparticles. But in certain channels of the fibrous material, the concentration of the gold precursors was sufficient to form new nuclei leading to the formation of new nanoparticles."

The formation of smaller gold nanoparticles allows variation in size,

which is essential for harvesting light. Each gold nanoparticle has an electron cloud on the surface that resonates with light. As the gold nanoparticles come closer when they grow bigger, the resonating electron cloud starts coupling together. This allows the gold nanoparticles to absorb light of different wavelength – visible and near infrared light.

While gold takes on different colours including red at nanometre size, it is not possible to make it black by simply changing the size of the nanoparticle. "By changing the size and shape of gold nanoparticles we can tune the light absorption characteristic in the visible region. When we have plenty of gold nanoparticles in the vicinity of each other we can achieve completely absorption of visible light leading to black colour," says Mahak Dhiman from TIFR and one of the first authors of the paper.

"There is huge electromagnetic field and thermal heat produced about 1 nanometre around the gold nanoparticle. This is called a hotspot. Such hotspots are present only when there is a gap between the gold nanoparticles. The gaps provide higher surface area," says Ayan Maity from TIFR and the other first author. So more number of nanoparticles with gaps in between them are needed to generate more thermal hotspots.

"This is only a preliminary study. The next step should be to replace gold with some inexpensive metal to make it sustainable," says Dhiman.



•Uday Khankhoje

IIT-M's model detects cancer with deep learning, microwave

The method offers a portable, low-cost and safe alternative to X-ray and MRI scans

SHUBASHREE DESIKAN

Uday Khankhoje's team at IIT Madras is interested in developing a way of detecting breast cancer using microwaves - or radio frequency (RF) waves, as they are called. While several groups have worked on this in Europe and the US, and even made working hardware for this purpose, Dr Khankhoje's group uses the very popular method of "deep learning" for this. The method not only addresses a mathematical challenge, it also increases the range of the permittivity observed, where permittivity, the square of the refractive index of a material, is the characteristic that distinguishes cancer tissue from normal tissue. Further, this offers a portable, low-cost and safe alternative to X-ray and MRI scans already available for detecting cancer tissue.

In their method, what Dr. Khankhoje's team would do is to surround the patient with RF transmitters and receivers and collect the waves that bounce off the tissues. Analysing the waves reflected by the tissue, they would reconstruct the type of tissue, or the permittivities of the tissues, that scattered the waves.

This is a classic example of what are known as inverse scattering problems. Other examples of inverse scattering problems are the following: detecting buried landmines using ground penetrating radars; archaeological missions for detecting buried artefacts and so on. These are "inverse" problems because you observe the way waves scatter off an unknown object and reconstruct what it is made of, its shape and other characteristics. The innovation used by this group in solving the inverse scattering problem is "deep learning," which is a popular technique involving neural networks. Their article has been published in the journal *IEEE Transactions on Computational Imaging*.

"A neural network is something that learns a relation between input and output just by looking at data," explains Dr Khankhoje. If you have pairs of numbers (1,1), (2,4), (3,9), (4,16) and so on, a human intelligence would guess that this is a series of numbers and their squares. A machine, on the other hand, "learns" this series, and when given a number as input can produce an output that is the square of that number without having figured out that the relation between them is "square of". Deep learning, simply, is such a learning process made up of a huge number of "neurons."

A neural network thus has to be "trained" on data. "We generate our own input or output training data because we know the physics of the problem. This data is used to train the network for inputs it is yet to see," says Yash Sanghvi the first author of the paper.

He further explains that by this learning, the algorithm positions the analysis approximately in the correct region of the solution. Then existing physics-based algorithms take over, refine the result and arrive at the correct answer. "This exciting new framework of combining physics and machine learning has a very bright future, and in my opinion, it is important to do both," he adds.

The group is yet to work with the actual biological data. "More work needs to be done, including getting biological samples, building a hardware setup and running trials. That is the direction in which we are heading," says Dr. Khankhoje.

Humans drive all-male elephant grouping

These elephants remained solitary or associated in mixed-age and mixed-sex groups within the forested areas.

ILAVENIL I T ASWATHI PACHA

Environmental and anthropogenic factors have not just degraded elephant habitats and left them stressed, but also changed their social behaviour, notes a recent study conducted by the National Institute of Advanced Studies (NIAS), Bengaluru.

The study revealed that there has been an increase in all-male elephant groups in the regions where landscape have been modified by humans. However, these elephants remained solitary or associated in mixed-age and mixed-sex groups within the forested areas.

From February 2016 to December 2017, the researchers observed Asian elephants in a large area of nearly 10,000 sq. km, encompassing protected forested areas and human-use habitations including crop fields in Karnataka and Tamil Nadu.

Using camera traps, they monitored the elephants that visit the nearby agricultural areas and those that stayed largely within the forests. Mature male elephants are known to move out from their herd to find nutritious forage to im-



Pack protection: All-male elephant grouping has become a behavioural necessity for young males in high-risk, high-resource landscape. •SPECIAL ARRANGEMENT

prove their reproductive health and also find a mate. But usually they roam around solo.

The study found that in recent times the male elephants have started to form small groups. "Since the landscape around them is changing drastically and not necessarily favourable – more roads, more electrical lines have come up – it becomes risky for the young males to be alone. So they have started associating with other male elephants and this helps them in multiple ways," says Nishant Srinivasaiah, PhD

Scholar at NIAS and the corresponding author of the research paper published in *Scientific Reports*.

Individuals familiar with the landscape help the group navigate better, find nutritious foraging sites and survive in the human-inhabited area. This has become a "behavioural necessity for the young males in high-risk, high-resource landscape," notes the study.

The researchers found that these groups comprised of mixed age male elephants and their number also varied. The smallest was two and the lar-

gest male group comprised of 25 individuals.

Dominance

Some of these elephants have been together for over 10 years. When asked if there has been any homosexual behaviour, Srinivasaiah explains that though they have observed few sexual interactions among the males, they were not aimed at mating but mostly to establish dominance or bonding. It was also observed that musth elephants from these groups moved long-distances into the forested areas and associated with females for reproduction and returned to the original male-group later. "Similar all-male groups are found in baboons, Asiatic and African lions. But this owes mostly to affiliations and establishing domination over mating. But in elephants it's more about security or escaping the risk-areas," he adds.

He adds that these changes are purely environmental and not biologically influenced. More studies are needed to fully understand such emerging behaviours. Decoding them may help frame new strategies to manage human-elephant conflict.

High-fibre diet may promote healthy pregnancy: study

PTI

Consuming a healthy diet rich in fibre during pregnancy may promote the wellbeing of both the mother and child, and reduce the risk of preeclampsia, according to a study published in the journal *Nature Communications*. Plant-based fibre is broken down in the gut by bacteria into factors that influence the immune system, said researchers from the University of Sydney in Australia.

Gut microbiome

The researchers investigated the role of these metabolic products of gut bacteria during pregnancy. They noted the simple recommendation to 'eat real food, mostly plants, and not too much' might be the most effective primary prevention strategy for some of the most serious conditions of our time. "The mother's gut bacteria and diet appear to be crucial to promoting a healthy pregnancy," said Professor Ralph Nanan, from the University of Sydney.

The study found that in humans, reduced levels of acetate, which is mainly produced by fibre fermenta-

tion in the gut, is associated with the common and serious pregnancy-related condition preeclampsia. Preeclampsia occurs in up to 10 per cent of pregnancies and is characterised by high blood pressure, protein in the urine and severe swelling in the mother.

Immunity

It also interferes with the child's immune development whilst in the womb, with some evidence suggesting a link to higher rates of allergies and autoimmune disease later in life. The study found that preeclampsia affected the development of an important foetal immune organ, the thymus, which sits just behind the breastbone.

These results showed that promoting specific metabolic products of gut bacteria during pregnancy might be an effective way to maintain a healthy pregnancy and to prevent allergies and autoimmune conditions later in life. They may also, in part, explain the rapid increase of allergies, autoimmune conditions as Western diets are increasingly dominated by highly processed foods, which are very low in fibre.

127 papers from India retracted for image duplication, manipulation

Since 2011 and particularly in the last three-four years more papers are getting flagged and retracted for problematic images

R. PRASAD

Unlike plagiarism in papers published in scientific journals, image duplication in the same paper or in different papers and image manipulation have hardly received any attention. Fortunately, this is beginning to change. Since 2011 and particularly in the last three-four years more papers are getting flagged for problematic images. And the number of papers with questionable images getting retracted is also growing suddenly.

A searchable database of retracted papers launched in October last year by Retraction Watch blog has about 18,000 papers since the 1970s. The database was screened for retracted papers from India. Of the 982 papers that have been retracted so far from India, 330 have been for plagiarism. Surprisingly, 118 papers from India have been retracted for image duplication and/or manipulation.

Of the 118, 54 papers have been retracted for image manipulation and the remaining for image duplication. There are a few papers that contain

both image duplication and manipulation. However, nine retracted papers that did not figure in the database have been added taking the total number of papers retracted for image duplication and/or manipulation to 127.

The number of papers retracted has suddenly increased since 2016, with 18 papers retracted in 2019, 37 papers in 2018, 15 papers in 2015 and 21 papers in 2016. At 20, Dr. Rashmi Madhuri and Prashant Sharma of IIT Dhanbad have the most number of retracted papers. They are co-authors in all papers.

While 127 papers retracted might be a fraction of the number of papers published each year from India, it is still a huge number considering how reluctant journal publishers are in retraction.

"Journals are not very responsive [in retracting or correcting papers with problematic images]," Dr. Elisabeth Bik who is a Science Consultant at Harbers-Bik LLC, San Francisco, California and an expert in identifying duplication and manipulation in images says in an email to *The Hindu*. "Of the 782 papers that I reported in 2014 and

2015 [for image duplication and manipulation], 44 have been retracted, two have an expression of concern, and 196 have a corrigendum or erratum. The remaining 540 papers have not been corrected, as far as I know. That means that five years after problematic papers have been reported, only one third of them have been corrected or retracted. That number is much too low, in my opinion, and it means that journals are not very willing to take any action." The reluctance becomes all the more glaring as at least 50% of papers had images suggestive of deliberate manipulation.

Dr. Bik along with two other authors found 782 papers with problematic images from a dataset of 20,000 papers published by researchers from many countries in 40 journals from 1995 to 2014. The study was published in 2016 in the journal *mBio*. The authors reported the problematic papers to the respective journals.

Compared with the US and China, there are relatively fewer papers from India that gets published. But Bik's



Leading the pack: At 20, Dr. Rashmi Madhuri and Prashant Sharma of IIT Dhanbad have the most number of retracted papers. •SPECIAL ARRANGEMENT

study found India had 1.93 higher-than-predicted ratio of papers containing image duplication. In 2018, Dr. Bik and others analyzed 960 papers published in *Molecular and Cellular Biology* from 2009 to 2016. They found 59 papers contained duplicated images leading to corrections for 41 papers and five retractions. "The majority of inappropriate image duplications result from errors during figure preparation

that can be remedied by correction," they write. The journal instituted a pilot program where all the accepted papers were screened for images prior to publication. In just two months, the journal identified image concerns in 12 of the 83 papers. "Image screening can identify papers with problematic images prior to publication... and requires an average of 30 minutes of staff time per problematic paper," they write.

According to a small study of 200 papers that were about to be accepted for publication in *The Journal of Clinical Investigation*, 21% (42 of 200) of papers had issues with Western blots and 27.5% (55 of 200) of papers had problems with images. The study was carried out between July 2018 and first week of February 2019. They found 49 of 55 papers with image issues were "minor transgressions".

"The absolute number of retractions has risen over the past few decades, from fewer than 100 annually before 2000 to nearly 1,000 in 2014. But retractions remain relatively rare: Only about four of every 10,000 papers are now retracted," says an article in the journal *Science*.

Shift of opinion

The good news is that journals are beginning to shed their reluctance to retract papers involving problematic images. "There appears to be a trend towards a faster response time; perhaps under the influence of social media discussions or a shift of opinion of the general audience that these cases should be

handled faster," Dr. Bik says.

Unlike in the case of plagiarism where there are software available to detect it and almost all journals routinely use them, no such software or system is available for detecting image duplication and manipulation. But that shortcoming is to a small extent getting addressed in a completely different way. The *Journal of Clinical Investigation* is relying on Dr. Corinne L. Williams, an editor who has an "excellent eye for image duplication", to find such faulty papers. "The *Journal of Biological Chemistry* has been a pioneer though, screening images after acceptances very carefully and asking for originals if there was any doubt. But only if they suspected something," says Dr. Bik. The *Molecular and Cellular Biology* "instituted a program to analyze the figures in all accepted manuscripts before publication, modeled after a similar program used by the *Journal of Cell Biology*" Dr. Bik and others write in the 2018 paper. Now, more and more journals have started demanding for unedited, raw image data from authors at

some stage of the publication process.

A catalyst that is bringing about this change is the PubPeer website, which allows independent researchers to publish post-publication review of scientific papers. The independent researchers are "increasingly making use of PubPeer or social media to describe papers of concern," says Dr. Bik. "Almost all remarks about problematic images on PubPeer appear correct, and there is an active community who will comment if they do not agree," she adds. The popularity of PubPeer can be gauged by the regular mention of the website in articles on science misconduct. "So we can assume that more and more people are becoming familiar with PubPeer," Dr. Bik says.

And the results are showing. At least one paper from India with questionable image gets posted on PubPeer at least once in two days. With *The Hindu* reporting on papers with problematic images from half a dozen institutions, there is a sudden rush by Indian researchers to post their responses on PubPeer.