

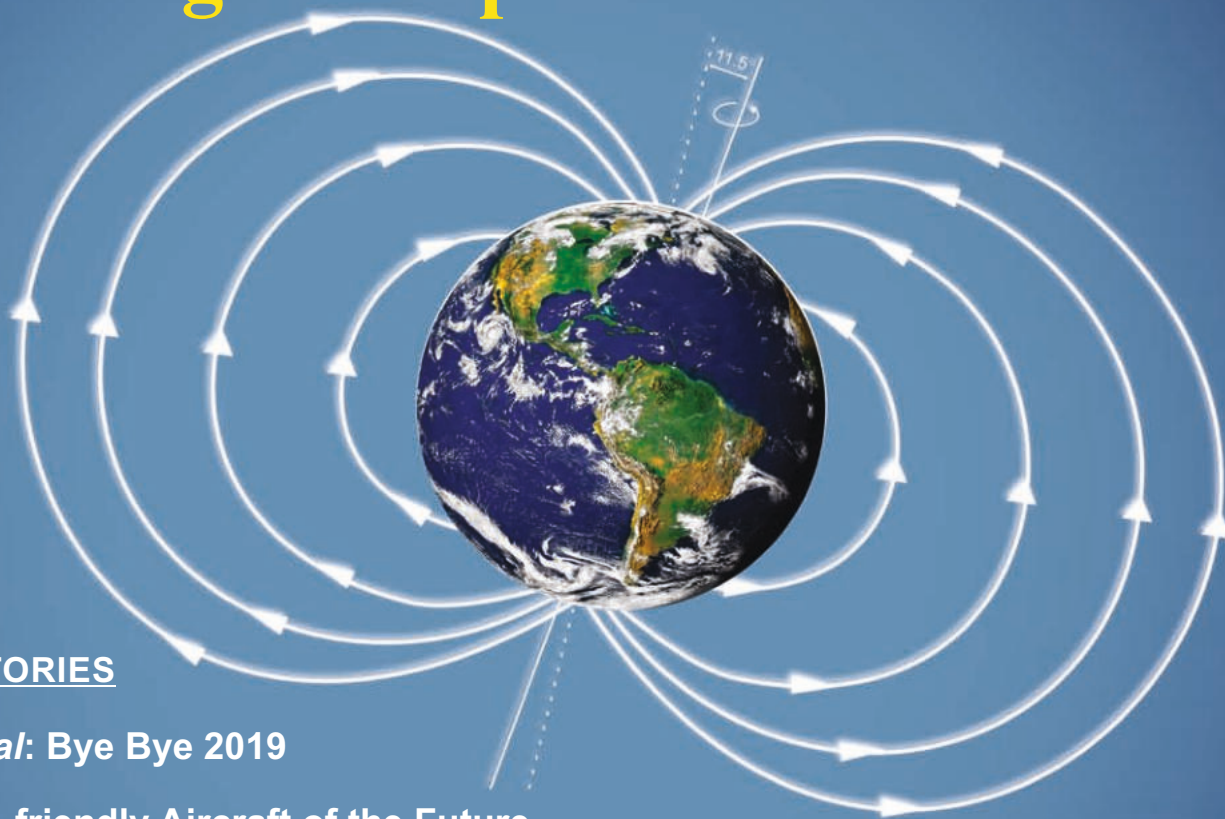
VIGYAN PRASAR

# DREAM

## 2047

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## The curious case of wandering north pole



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# Bye Bye 2019

While the sun sets on 2019, the year leaves behind a number of discoveries, milestones, events, and happenings.

But before the year ends, most parts of southern India will witness an annular solar eclipse on 26 December this year. Coimbatore will be one of the major cities that will fall in the path of the event. Speaking about the outside world in the sky, 11 November this year witnessed the rare transit of mercury.

Continuing with space, most of us have heard about Kepler, an exoplanet. An exoplanet or extrasolar planet is a planet outside the solar system. The first mission dedicated to search for exoplanetary transits named as CHEOPS – Characterising ExOPlanet Satellite starts its work in the last part of 2019. This is an initiative led by the European Space Agency (ESA).

I hope that you wouldn't have forgotten that on 10 April this year, astronomers had released the first-ever image of the black hole.

It was on 22 April this year that scientists reported the discovery of the famous buckyballs ( $C_{60}$ ) or Buckminsterfullerenes in the interstellar medium by the Hubble Space Telescope.

Then, it was on 22 July this year when *Chandrayaan 2* was launched with an orbiter, lander, and rover. Rest, of course is history.

Back on Earth, palaeontologists discovered *Avimaia Schweitzerae*, the first fossil bird in Northwest China with an unlaidd egg that existed 115 million years ago. This discovery was reported, again this year on 20 March.

On the advancement in health sciences, researchers at the Duke University Health System were able to find a mechanism for cartilage repair in human beings, which could allow joints and possibly entire limbs to regenerate. This news was made public on 8 October.

In the field of supercomputing, 2019 would always be remembered as a milestone year because Google announced its 53-qubit Sycamore processor. This processor has achieved quantum supremacy in performing a specific task. Reports say that Google went on to claim what Sycamore can do, the world's best supercomputer today would take more than 9,999 years to complete. Surprising isn't it.

For us, at Vigyan Prasar too, 2019 was a year full of activities, hustle and bustle.

DD Science, a Doordarshan channel dedicated to Science and Technology was launched in mid-January, this year. IndiaScience.in, a dedicated OTT channel was also launched simultaneously at that point in time. Interestingly, Vigyan Prasar supported a number of projects related to science communication and popularisation that were coordinated and implemented by a number of non-government agencies. Pune Vidyapeeth, Vigyan Bharati, and Vigyan Prasar came together to organise a very interesting two-day conference on Science in Performing Arts in January 2019. Vigyan Prasar's annual tryst with Science Films at a grandeur level – 9th India International Science Film Festival happened successfully in Chandigarh University in January. From films to languages, Vigyan Prasar traversed a



**Nakul Parashar**

big path this year, opening up avenues for science communication, popularisation, and extension in many Indian languages. Beginning with Bangla, moving on to Urdu, and then Tamil, Malayalam, Kannada and Gujarati, 2019 augmented Vigyan Prasar's role manifold.

The list seems to be growing rapidly – Vidyarthi Vigyan Manthan, the nation-level school-student-level talent search examination witnessed its annual award ceremony where more than 700 students converged for the grand finale in Hyderabad.

Amidst all this, Vigyan Prasar was also given the opportunity to conduct the fifth edition of India International Science Festival at Kolkata. From views and reviews received, I'm told that it was well taken by the participants and organisers alike.

Yet, the journey of 2019 is still awaiting its finals milestone – the 26 December Annular Solar Eclipse. Please come to Coimbatore to witness this event – a lifetime one.

However, before we bid farewell to 2019, on behalf of the team of Vigyan Prasar, I wish that we were able to meet most of your expectations and thus, assure to strive for getting more closer to your wishful list of 2020.

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# An Eco-friendly Aircraft of the Future



*Vishnu Hariharan and Debi Prasad Mishra*

*Aviation pollution is increasing day by day as flights are becoming more affordable. Flying aircrafts produce two types of pollution mainly noise and air pollution. The main pollution from aircraft is nitrogen dioxide formed from nitrogen oxide. Moreover, greenhouse gas emissions have a greater effect on climate change at higher altitudes than at lower altitudes. The noise from aircraft and airport operations causes harm to people living around the area. Solar powered aircraft is devoid of all these problems. Being eco-friendly and one of the cleanest technologies, it can be used to power aircraft without the fear of air or noise pollution.*

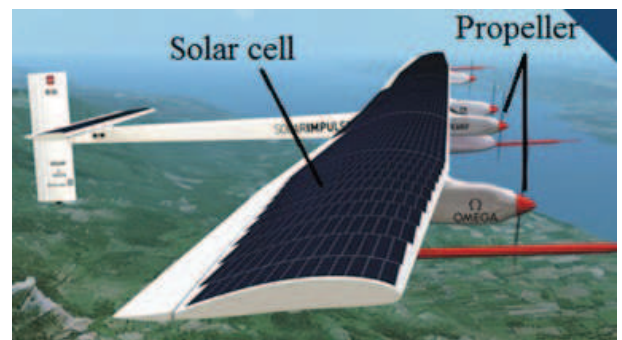
“When I was flying around the world in my solar airplane, I remember looking at the Sun that was giving energy to my four electric motors and their huge propellers. There was no noise, no pollution, no fuel... and I could fly forever. *At a certain moment I thought ‘this is science fiction, I’m in the future.’* And then I realised, ‘no it’s wrong, I’m in the present; this is what the technologies of today already allow me to do. It’s the rest of the world that is in the past, with old inefficient devices.’” These are the words of Bertrand Piccard, the man who flew the first experimental solar-powered aircraft, the *Solar Impulse-1* in 2010.

The amount of Sun’s energy reaching the Earth’s surface is almost twice as much the energy generated from all other renewable resources. If put to use, it could solve all of the world’s energy demands. India has already raised its solar power capacity to 25.21GW by 31 December 2018. Taking an average of about 300 sunny days per year, and a land area 3.287 million square kilometres, the average output of power from sunlight could be about 5,000 trillion kilowatts per year. Solar power is one of the cleanest technologies.

The use of solar power for propulsion was first tested in Swiss experimental aircraft called *Solar Impulse*. There are two prototypes for this

aircraft – *Solar Impulse-1*, *Solar Impulse-2*. The first one is single-seater monoplane that is designed to be airborne for up to 36 hours. The second one is a double-seater and two pilots Bertrand Piccard and André Borschberg circumnavigated the Earth with it in 2016. It travelled about 40,000 km from Abu Dhabi to India, Myanmar, China, Japan, U.S.A. and back to Europe and Abu Dhabi. Strategies had to be designed from scratch to allow *Solar Impulse-2* to fly across the pacific for five consecutive days and nights and become first solar aircraft to accomplish oceanic crossing and thereby proving that clean technologies can accomplish what was once considered impossible.

*Solar Impulse-2* has a wingspan of 72 metres, weighs 2,300 kg and carries four propellers and batteries. It has a maximum flight time of 117 hours 52 minutes and can fly at a maximum altitude of 28,000 feet (8,534 metres). The *Solar Impulse* is not only the first solar-powered airplane but also



*Fig.1. A representative photograph of Solar Impulse (Credit: wiki/Solar Impulse)*

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the first to take a flight at night. During the daytime, solar cells in the plane trap the rays from the Sun to generate electricity which is stored in lithium-ion batteries. At night, it uses this reserve of energy to power the aircraft. The *Solar Impulse* has more than 17,000, or precisely 17,248 solar cells mounted on wings, fuselage and horizontal tailplane to collect the energy from the Sun which amounts up to 340 kWh of energy from just about 269.5 m<sup>2</sup> of area.

### Design of Solar Impulse

The *Solar Impulse* uses four propellers, each two metres long and weighing just five kilograms. The propellers run based on 'teeter system', a popular technology used in wind turbines. This teeter system adjusts the pitch of the propeller blades according to the movement of the air and thereby reducing the effect of wind gusts or persistent air making the system more efficient. Moreover, the teeter system reduces vibrations on the whole structure. The propellers are made of a foam core inside a carbon fibre structure to withstand high centrifugal forces.

To save energy, the aircraft is made as light as possible. It uses a combination of ultralight materials like carbon fibre weighing 25 g/m<sup>2</sup> and alveolate foam in the form of a honeycomb. Solar cells are fixed on the upper wing surface with a high-strength adhesive. The aircraft also needed to be resistant to wind, water and large temperature variations. Light insulating materials like rigid polyurethane foam are used for protecting the cockpit and the housing of the motors and batteries; high-performance polycarbonate sheets are used for the windows.

The single-seater cockpit has a volume of just about 3.8 square metres and provides the pilot enough space for food and oxygen supplies. It is provided with a multipurpose seat that can be converted into a bed, a toilet and can be reclined to do physical exercises. In the back of the seat is a survival kit consisting of a parachute and life rack for use in case of emergency. The cockpit

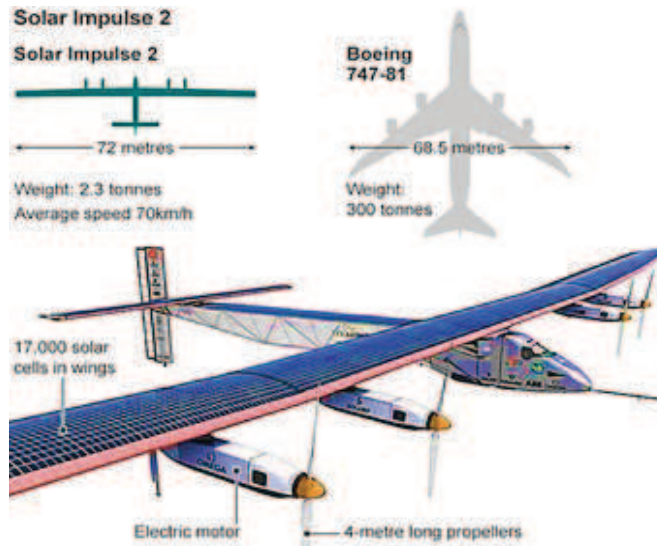


Fig.2. A representative photograph of Solar Impulse-2 (Credit: [bbc.com/news/science-environment](http://bbc.com/news/science-environment))

constitutes flying controls, flight display screens, the single seat and food supply for the pilot. To reduce weight, the cockpit is not pressurised but there is complete oxygen supply and backup system. To protect from extreme cold at high altitudes the cockpit shell is made of high-density thermal insulation. The pilot stays in touch with the mission control centre which keeps a record of the vital signs of the pilot.

### Solar UAV

Though *Solar Impulse* is the first solar-powered aircraft with humans on board, there are other unmanned vehicles powered with solar power. An unmanned aircraft called *Zephyr* HAPS (High Altitude Pseudo-Satellite) flew for a record of 26 days on solar power. It had a wingspan of 28 metres, flew at an altitude of about 21,000 (6,400 metres) with a cruising speed of 55 km/hr. Boeing's Phantom Works (research division of Boeing) was developing the *SolarEagle*, a solar/electric-powered high-altitude long-endurance unmanned aerial

vehicle system that could provide persistent intelligence, surveillance, reconnaissance and communications. It was designed to stay aloft for up to five years at altitudes above 60,000 feet (18,300 metres). However, the *SolarEagle* project was cancelled in 2012.

The Indian Institute of Technology Kanpur has developed a solar UAV (Unmanned Aerial Vehicle) under the project MARAAL, which is the first Indian solar-powered UAV. Some of the major features are inflight destination updating capability, fully autonomous operations, low IR and radar signature, and intelligent power management system. MARAAL-2 weighs 12 kg with ability to carry payload of 7 kg with 18-hr endurance.

Under NASA's Environmental Research Aircraft and Sensor Technology (ERAST) programme, a solar-powered UAV, *Helios* has been under development to carry scientific instruments or telecommunications relay equipment. The approximately 730-kg aircraft can reach cruising speeds of 8.5-12 m/s with the use of fourteen 1.5 kW motors that drive two-blade propellers. The wingspan of 75.3 m, with a wing area of 183.6 m<sup>2</sup> (wing thickness of 0.3 m) is covered with solar cells that are approximately 19% efficient. *Helios* is able to perform during daylight hours plus an additional five hours at night and is designed to fly at an altitude of 15,000-21,000 m (4,572-6400 m).

### An eco-friendly aircraft

Aviation pollution is increasing day by day as flights are becoming more affordable. Flying aircrafts produce two types of pollution mainly noise and air pollution. The main pollution from aircraft is nitrogen dioxide formed from nitrogen oxide. Nitrogen oxide in lower atmosphere produces ozone and this ozone in the lower part of the atmosphere acts as a pollutant contributing to global warming. Nitrogen oxides (NO<sub>x</sub>) from high-altitude supersonic aircraft damages the stratospheric ozone. Aviation fuel is also a significant source

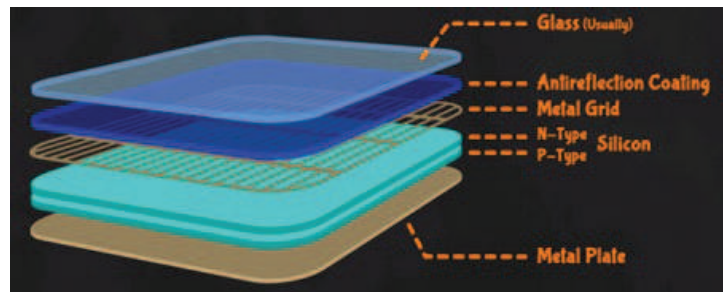


Fig.3. Representative image of photovoltaic cell

(Continued on page 28)

# Coin-tossing explains activity of opposite motors on phagosomes



*Dr. Paulomi Sanghavi*

“Augmenting Writing Skills for Articulating Research (AWSAR)” is an initiative of the Department of Science and Technology, Govt. of India. It aims to disseminate Indian research stories among the masses in an easy-to-understand and interesting format. Under this initiative, PhD scholars and Post-Doctoral Fellows in science and technology are encouraged to write at least one popular science article during the tenancy of their fellowship and to participate in a national competition. For Ph.D. researcher, the top three essays are awarded a cash prize of ₹1,00,000, ₹50,000 and ₹25,000 respectively. For Post-Doctoral Fellows, the best essay is awarded the cash prize of ₹1,00,000. Apart from these, top 100 entries from Ph.D. and top 25 entries from Post-Doctoral Fellows are awarded ₹10,000 each, along with Certificate of Appreciation. For more information log-on to <https://www.awsar-dst.in/>

The article “Coin-tossing explains activity of opposite motors on phagosomes” written by Dr Paulomi Sanghavi was awarded outstanding story prize in Post-Doctoral Fellow category in AWSAR 2018.

Cellular environment is extremely crowded and busy. Cells have several smaller compartments called organelles and various biomolecules, each of varying shapes and sizes. If we put a live cell under a microscope, we see that there is constant exchange and movement of material from one part of the cell to the other. This transportation of biomolecules, or “cargoes” as we call them, is required for various life processes, such as cell division, uptake of nutrients, and migration of cells to the site of wound

healing, for example. Defects in transport of key molecules can often result in death or it can manifest in a number of diseases such as Alzheimer’s and Huntington’s.

We studied the transport process with respect to infection. In our day-to-day life, we encounter a variety of infectious agents. Our body has developed defence mechanisms to fight disease-causing agents without affecting our normal functions. When a foreign particle infects our body, our immune cells ingest these particles and

trap them in a double-layered membrane structure, which is called a phagosome. This process is called phagocytosis. Phagosomes eventually move to the centre of the cell for degradation. Motion of a phagosome from the site of engulfment to its site of killing is extremely important for effective clearance of the pathogen.

How does this motion of phagosome or other cargoes occur in the cell? This is brought about by the action of cellular “motors”. Motor proteins walk along pre-

Dr. Paulomi Sanghavi is a Post-Doctoral researcher from Tata Institute of Fundamental Research, Mumbai in the field of Cell Biology and Biophysics. The article “Coin tossing explains activity of opposite motors on phagosomes” was awarded first prize in Post-Doctoral Fellows category in AWSAR 2018. Email: polsi.bs@gmail.com

existing roads to deliver cargoes at their required locations. For simplicity, let us imagine the cargo as a cart, which requires a motor – say a horse, to drive it in one direction. There are two main types of cellular motors that carry out long-distance transport namely Kinesin and Dynein – both proteins – which can be compared to the horse and the bullock, to simplify it. Microtubules serve as tracks for the two classes of motor proteins. Both Kinesin and Dynein motors walk on same kind of tracks, however, they are quite different in their size, structure, as well as the direction in which they move. Kinesin motors move cargoes towards cell periphery (a horse-cart moving in one direction) while Dynein generally moves them towards the centre (a bullock-cart in the opposite direction).

To add to the cellular complexity, a large number of cargoes have both kinds of motors and actually move back and forth. So, we now imagine a cart with horses on the one end and bullocks on the other, both pulling back and forth to drive its motion in opposite directions. How these opposite motors work together to bring molecules to the right place at the right time is hotly debated. We have recently addressed this question in our work published in *Current Biology* in May 2018.

In our study, we examined the motion of phagosomes in the early stages of phagocytosis. These Early Phagosomes (EPs) display bidirectional back-and-forth motion due to presence of both Kinesin and Dynein motors. To study motor function on EPs, we extracted them from immune cells using well-established protocols and made them walk on artificially constructed tracks. We analysed their motion outside the cell using a special kind of microscopy called optical trapping. This technique provides tremendous amount of information as to how far motors can walk; the forces exerted by each motor type, and their speed. Such experiments allow us to decipher properties

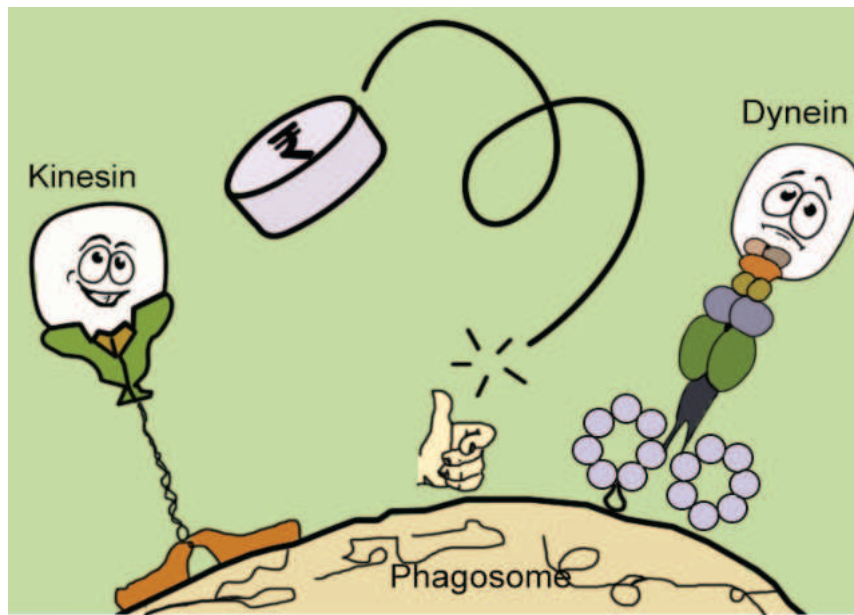
of motors at a single phagosome level, a resolution that cannot be achieved when looking at an entire cell.

We investigated how we could explain the back-and-forth motion of EPs. Do opposite motors depend on each other or do they pull against each other as in a tug of war? To make sense of how opposite motors behave on an EP, we specifically removed Dynein motors from the EP membrane. Surprisingly, upon Dynein removal, Kinesin neither performed better nor did it become worse. This suggested that both types of motors act independent of each other and do not require the opposite motor

This suggests that all four types of event are equally likely to occur. This is similar to tossing of a coin where the probabilities of getting two heads (HH) or one head and then a tail (HT) or two tails (TT) or one tail and then a head (TH) are more or less equal. Thus, once a pulling event occurs, the choice between Dynein and Kinesin for the next event is a random process. The system does not have any memory of the first event and thus, activation by either type of motor is equally likely.

We next asked whether this random choice of active motor explains bidirectional EP motion. If this is random, can we simulate this motion using modelling? Interestingly, we found that the back-and-forth EP motion is accurately explained by mathematical modelling when we consider motor numbers on EP, their binding and unbinding rates and the geometry of phagosome where motors bind the track. These parameters somehow ensure that both Dynein and Kinesin events are equally possible resulting in back-and-forth EP motion. Such motion allows EPs to sample more intracellular space and interact with other organelles for exchange of components.

Thus, from our studies we have obtained basic parameters that make choice of motors a fair process. This may also be true for many other cellular cargoes. Further levels of regulation such as change in membrane composition, motor numbers or organisation can bias this fair coin and accordingly change motion properties of phagosomes in the later stages. Our work, in general, addresses some fundamental questions by using a variety of approaches – we employ biological methods, biophysical force measurement techniques as well as mathematical modelling. Our work provides a holistic view in understanding of bidirectional cargo transport during early stages of phagosome motion as well as in situations when things go awry and result in infections.



*Cartoon depicting a coin toss between Kinesin and Dynein motors on the phagosome*

for their function. If the motors function independently, then what governs the choice of active motor – when do horses pull and when do bullocks pull the cart? Is there a pattern these motors follow to bring about motion?

To answer this, we analysed a number of events where pulling force was generated by Kinesin (horses) and Dynein (bullocks) motors. We focussed on even pairs, for instance, a KK pair where Kinesin was followed by another Kinesin event, or KD pair where a Kinesin was followed by a Dynein event, DK pair where Dynein was followed by Kinesin event and DD pair where Dynein was followed by another Dynein event. On performing statistical analysis of these pairs, we found that the number of each type of event pair is more or less similar.

# Wearable Devices: Has it changed your life yet?



*Dr. Ritika Singh*

*Generations of men have come together to put the wearable technology in its present form. The technologies presented in science fiction are now becoming a reality. The opportunity is right here for all of us to experience them. Wearable devices can provide preventive interventions in the domain of healthcare. They can help to quit smoking, signal asthma situation, and detect breast cancer. Recently, researchers are finding out various utilities of wearable devices for cardiological and urological patients.*

## Introduction

Leading a Digital Life! Not yet? *Star Trek*, an American space opera television series based on the science fiction debuted in 1966 gave the concept of wearable devices (Fig. 1). *Shaktimaan* a man in the series aired on DD National has a wearable costume which can make him fly, allow him to pick up heaviest of heavy objects (Fig. 2), break walls and thus bring him powers unimaginable to a normal human being. Wearable devices are smart electronic or mechanical devices that can be incorporated into clothing or worn on the body as implants or accessories. These have long been engraved in our imaginations with their powers.

Generations of men have come together to put the wearable technology in its present form. The technologies presented in science fiction are now becoming a reality. Creations long fantasised by mankind have come to our doorsteps. The opportunity is right here for all of us to experience them. Would you not like to have a lifestyle partner that takes the responsibility of your health, makes your connection with the world more fun, accessorises and clothes you to make a fashion statement?

Would younger generation not grow up in a culture of wearables? Would not Education Systems and working organisations be able to



*Fig. 1. Star Trek wearable (Source: <https://www.ifsecglobal.com/access-control/5-ways-wearable-tech-will-change-security-industry/>)*



*Fig. 2. Shaktimaan wearable (Source: <https://medium.com/@karthikpasupathy/nostalgic-90s-parle-g-and-shaktimaan-f6f28de50b68>)*

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do micro-management? Would not Governments around the world have an inclusive growth of the global economy?

Microelectronics and microfabrication with which very small designs and components are feasible; wireless communication which entails the possibility of connecting two or more devices without wires; sensors which can detect and respond to signals such as temperature, blood pressure, humidity, speed, etc.; computational modelling making possible the mathematical modelling of complex systems; machine learning which help the devices to learn from the behaviour; artificial intelligence – the intelligence demonstrated by machines – have captured the imagination of scientists and researchers. With the technology growth in these areas, wearable devices have gained acceptance as a solution to the day-to-day challenges. These domains have led to better designs and high-powered resolution to societal challenges.

## Applications

Wearable devices can provide preventive interventions in the domain of healthcare. They can help to quit smoking, signal asthma situation, and detect breast cancer. Recently, researchers are finding out various utilities of wearable devices for cardiological and urological patients. Wearables are also being used as activity trackers which measure heart rate, fat loss, and monitor room condition during sleep. Apart from accessories there are smart socks, fitness pants, and training clothes that provide various functionalities from normal walking to hip, knee, ankle movement, muscle effort, and breathing parameters for various diagnostics.

Other wearables such as virtual reality headsets for entertainment, and virtual reality and head-mounted wearable devices allow doctors performing surgery to simultaneously monitor a patient's vital signs and react to changes without having to take their eyes off the patient. Google glass for digital information, Hololens headsets for flight attendants service are some of the latest uses.



Fig. 3 Exoskeleton device

## Demand in India

Globally, while the technology is in its infancy, analysts at Morgan Stanley believe it will become a \$1.6 trillion business in the near future. According to a group of Morgan Stanley analysts, “Wearable devices will far surpass market expectations, and become the fastest ramping consumer technology device to date”. The analysts add that wearable devices will have “far-reaching” impacts by creating a new category and disrupting or even accelerating change within industries outside of technology.

The wearable market in India, observed total shipments of 2.5 million units in 2016 according to a survey. The breakdown for various devices reflected 80, 76, and 74 per cent in the fitness monitoring, smart watch, and eyeglass segments respectively. In terms of price, 73% of the market is captured by devices with price less than Rs 3,250 in 2016. This basic wearable accounted for almost 90% of total wearable shipments in the March 2017 quarter. The basic models provide features like calories burnt, distance covered, steps taken, inbuilt sleep detection capabilities, heart rate, detailed micro and macro nutrient breakdown of food. This entry level segment is dominated by fitness trackers from vendors like GoQii and Xiaomi. In terms of share, 15% market of wearable devices is with GoQii, 13% is with Xaomi and 8% with Fitbit. A few new vendors, primarily China-based, are expected to make inroads into the Indian

market. Among Indian firms Titan is aggressively targeting this segment along with the smart watches. Majority of shipments continue to sell through online platform.

GoQii has the highest share in the Indian market and it is a start-up by an Indian. It is a California-based fitness technology venture founded in 2014 by Vishal Gondal. It offers a wearable fitness band which collects users’ (called players) activity and sleep data. A personal coach is assigned to a player who reviews this data and communicates via mobile app to guide them towards their health and fitness goals. A

player pays a subscription fee for personalised coaching with a wearable device, which has an OLED display and hum vibration module, tracks steps, distance, time, calories, active time, and sleep.

## Scenario of Indian research

DEBEL (Defence Bioengineering and Electromedical Laboratory), a DRDO lab, and IIT Madras have developed a Smart-Vest which monitors physiological signals and produces overall picture of wearer’s health. IIT Madras has developed a wearable for deriving vitals in a non-invasive manner including pulse-rate, oxygen saturation, respiratory rate, skin temperature and blood pressure. IIT Delhi in collaboration with AIIMS has developed wearable nasal device which restricts the entry of air pollutants into lungs.

Council of Scientific & Industrial Research-Central Scientific Instruments Organisation (CSIR-CSIO) has the wearable technologies developed in its Cognitive and Virtual Rehabilitation (CARE) Lab of Biomedical Division such as Ligament Injury Assessment and Therapy Devices “L-GEAR” for motor-rehabilitation of soldiers or sports persons suffering from disabilities due to strenuous working style. It has training tasks for the shoulders which are evaluated and recorded for the performance. L-GEAR is for correcting the shoulder movement hindered because of pain or injury based on the principles of speed and range of motion.

It has accelerometer sensors and it is in the form of a watch linked with a smart phone. It can also be used for sports to check whether the exercises are being performed correctly or not; posture taken while playing is static or has the required bend can all be tested for different kinds of sports. Another such device developed by the lab is exoskeleton device (Fig. 3). An exoskeleton is an external structural mechanism with joints and links corresponding to those of the human body. The exoskeleton device can be used as a capability magnifier or assisting device for rehabilitation of spinal cord injury and stroke patients, elderly population, etc.

### Future of wearable devices

Manufacturers should focus not only on well-differentiated functionality and high compatibility but also on attractive design and brand name. Wearable devices which integrate fashion and customisation are the hottest things to come to the market in a generation.

Privacy and data security in wearable devices are the growing concern. New devices can help physicians monitor patients' vital signs; sleep patterns and heart rhythms remotely, transforming the face of medicine as we know it. These developments in technology will help detect early signs of diseases and aid in diagnosing medical conditions. Essentially, these devices are minicomputers that send and receive data

which can be used for further analysis. The data that these incredibly powerful devices collect can be stolen, which raises concerns for data safety and encryption. Furthermore, there is a valid concern that companies will use large amounts of personal healthcare data for marketing and insurance purposes.

In future, there is widespread potential in transforming fitness tracking devices into applications and deliverable devices in which useful medical information can be tracked and acted upon.

Along with this, a recent survey pointed out that only five per cent of the wearables in the markets are validated. This may lead to inconsistent medical analysis based on the self-gathered data. The wearables made are very generic and do not consider individuals characteristics. So, the technology can never replace the trained medical professional. Therefore, it is strongly suggested by the medical practitioners that there must be government regulations around this industry.

### Conclusion

The demand for wearable devices is on a rise in India and the Indian research organisations are working towards it. But the industry, research organisations and Government interventions are still required to take us to the age where *Star Trek* and *Shaktimaan* are a reality.

## An Eco-friendly Aircraft of the Future

(Continued from page 33)

of carbon dioxide emission. Moreover, greenhouse gas emissions have a greater effect on climate change at higher altitudes than at lower altitudes. The International Civil Aviation Organisation (ICAO) has set international standards for smoke and certain gaseous pollutants in airports. The noise from aircraft and airport operations causes harm to people living around the area. Solar powered aircraft is devoid of all these problems. Being eco-friendly and one of the cleanest technologies, it can be used to power aircraft without the fear of air or noise pollution.


### Conclusion

Being one of the tropical countries with sunlight available on most days of the year, India has tremendous potential in using solar energy. Several Indian companies are already involved in the manufacture of solar cells and solar photovoltaic modules. Solar UAVs developed in India can pave the way to the development of solar aircraft in near future. Let us hope for a day when India's solar aircraft will be a dream come true. ■

Dream 2047

Articles invited

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# The curious case of wandering north pole



*Dr. P. K. Mukherjee*

*As Earth spins on its axis, both the inner and outer cores also spin along with it. But, the inner and outer cores spin at different rates. This produces what is known as 'dynamo effect', leading to the creation of convection currents in the outer molten core and thus Earth's magnetic field is generated. It is like an electric current flowing through a coil producing a magnetic field. Turbulence in the outer core affects the Earth's magnetic field, which in turn impacts the location of the magnetic north pole. In addition to the shifting position of the magnetic north pole, the Earth's magnetic field is also getting weaker which may ultimately lead to the flipping of the magnetic poles of the Earth.*

Like a bar magnet, Earth's magnetic field has also north and south poles. However, unlike the poles of a bar magnet, the poles of Earth's magnetic field are not static. According to scientists, the intensity of Earth's magnetic field has also been weakening. As a result, these poles may also flip in future, as has happened numerous times in the past, but not in the last 7,80,000 years. In case the Earth's magnetic poles flip, what are going to be its consequences? Before delving into all this, let us first discuss the case of drifting magnetic north pole of Earth's magnetic field.

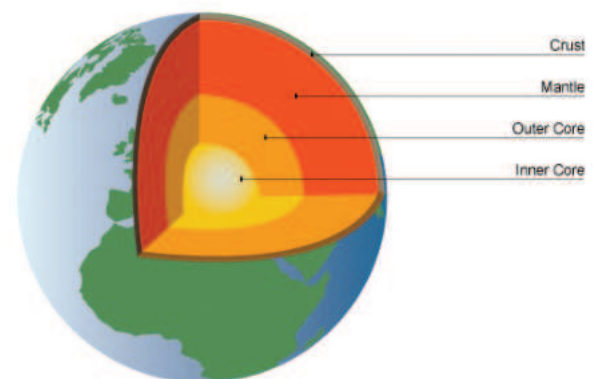
The movement of the magnetic north pole has been the object of study since 1831 when in June that year British Royal Navy explorer James Clark Ross discovered it in the Canadian Arctic. Since then, it has been constantly on the move and has covered about 2,300 kilometres, its speed jumping from 15 kilometres per year to 55 kilometres per year since 2000. It crossed the international date line in 2017 and is heading towards Siberia.

The precise location of the magnetic north pole is very important for navigation systems, both military and civilian, as well as

some smart phones and some consumer electronic devices. That is the reason why its location is updated every five years in December. Its position was to be updated on 31 December 2019. However, in view of the pole's faster movement, this time the update was done nearly a year ahead of schedule, on 31 January 2019.

## Who updates the position of magnetic north pole?

The updating of the location of magnetic north pole is done on the basis of a standard model called World Magnetic Model (WMM). The updating work is done jointly by the US-based national Centres for Environmental Information (NCEI) and the UK-based British Geological Survey (BGS),



*Earth's internal structure (Credit: pinterest.com)*

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who were involved with the development of the model.

Calling the fast shifting of the magnetic north pole a problem for compasses in smart phones and some consumer electronic devices, University of Colorado geophysicist Arnaud Chulliat, who is also the head author of the newly issued World magnetic model, said, "The location of the magnetic north pole is updated every five years in December, but this update came early because of the pole's faster movement."

### What causes the shift?

Why does the location of the magnetic north pole shift? Does magnetic south pole also shift its position? According to scientists, changes occurring in the magnetic field of the Earth are responsible for the shifting position of the magnetic north pole. The location of the magnetic south pole also changes but the rate of its movement is far slower compared to the north pole

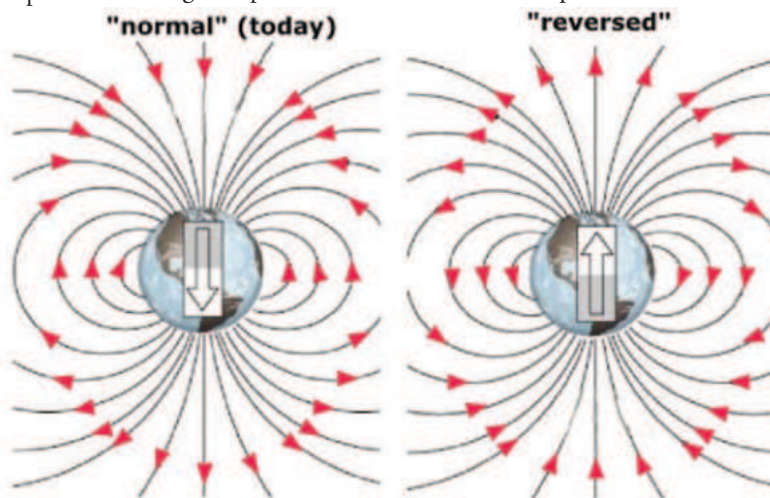
Let us now understand how the Earth's magnetic field is produced. For this, we need to know about the inner structure of the Earth. It has an iron core, about 1,270 kilometres thick, made of solid iron. Surrounding the inner core is a molten outer core of thickness 2,200 kilometres. In this outer core, iron and nickel are present in molten form. The next layer out, the mantle, has a thickness of about 2,850 kilometres. It is solid but malleable like plastic. Finally, comes the outermost layer that makes the surface of the Earth, called the crust. It is brittle and has a thickness ranging from 0-100 kilometres. Beneath the oceans, the crust generally extends to about 5 kilometres. The thickness of the crust beneath continents averages about 30 kilometres, while under large mountain ranges, such as Alps or Sierra Nevada, the base of the crust can be as deep as 100 kilometres. The crust beneath the Himalayas is between 60 and 780 kilometres thick.

As Earth spins on its axis, both the inner and outer cores also spin along with it. But, the inner and outer cores spin at different rates. This produces what is known

as 'dynamo effect', leading to the creation of convection currents in the outer molten core. These convection currents are responsible for the production of Earth's magnetic field. It is like an electric current flowing through a coil producing a magnetic field.

It is the turbulence in the outer core that affects the Earth's magnetic field, which in turn impacts the location of the magnetic north pole. In addition to turbulence, irregularities where the core and mantle meet and changes in the Earth's crust, like earthquakes of large magnitude, can also change the Earth's magnetic field and hence the location of the magnetic north pole.

In addition to the shifting position of the magnetic north pole, the Earth's magnetic field is also getting weaker which may ultimately lead to the flipping of the magnetic poles of the Earth. This is not quite



*Reversal of Earth's magnetic poles might cause its magnetic field to flip in future (Credit: all-geo.com)*

well understood by the scientists. However, according to the University of Colorado geophysicist Daniel Lathrop, "It (Earth's magnetic field) has changes akin to weather. We might call it magnetic weather."

Had we got some means to get information about this magnetic 'weather', we would have found out what is going to happen with the Earth's magnetic field. However, it is difficult to predict the 'weather' of the central core of Earth because it is buried deep below 3,000 kilometres under the surface of Earth. Hence, it is difficult to 'sense' the core from above.

However, recent technological advances have made possible to take observations of the central core of Earth using geomagnetic observations on Earth

### BOX: Know about three other north poles

Besides the magnetic north pole, there are three other north poles – geographic north pole, instantaneous north pole and geomagnetic north pole. However, of these the more familiar or well-known are the magnetic north pole and geographic north pole. Let us know about all the four north poles in a little more detail

and by satellites in space. These observations along with computer modelling and simulation techniques have greatly enhanced our knowledge about the central core of the Earth. A jet stream was discovered in the core a couple of years back. Thanks

to recent advancements, it has become possible to predict fairly accurately the behaviour of the central core of Earth and its magnetism.

The implication of the Earth's magnetic field getting weaker, say the scientists, is that it would eventually flip which, in effect, would mean field reversal. During the course of Earth's history, such field reversals have happened many times, typically every 2,00,000 to 3,00,000 years. Field reversal means that the magnetic north and south poles would change polarity

with north pole slipping towards the bottom of the planet and the south pole moving towards the top. The last time Earth's field reversal happened was around 7,80,000 years ago; an incomplete or temporary field reversal occurred about 41,000 years back. The poles may again flip in future but it may take a few thousand years to happen. If a field reversal happens in future, the situation will last for nearly 1,000 years which means the poles will attain their original position only after 1,000 years. The temporary flip that happened 41,000 years ago lasted for 250 years only.

The question is, if field reversal happens in some future point of time, how would it affect life on Earth. Actually, the Earth's magnetic field is like an invisible

sheet enveloping our planet that protects us from the harmful radiations and charged particles coming from the Sun and space. If a reversal of poles takes place in future, our protective shield would weaken, and we would lose protection from damaging radiation and charged particles. This will directly impact our artificial satellites which would greatly hamper our communication system, aviation and power distribution system. According to scientists, our electronic equipment might also be affected by the field reversal, but how actually they would be affected cannot be predicted in exact terms.

It is difficult to predict what will be the impact of the field reversal on life forms on Earth because last time when this happened, some 7,80,000 years ago, no studies were carried out. However, it may be predicted that some migratory birds who, on their long voyages, use Earth's magnetic field for their flight guidance, might be affected.

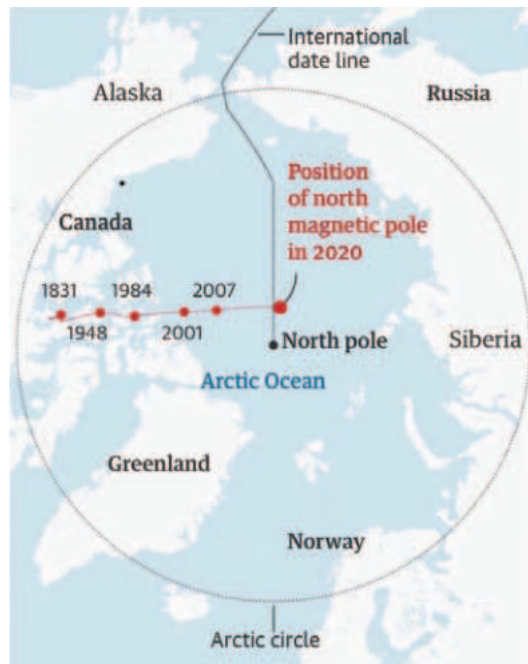
## Magnetic north pole

The magnetic north pole is actually the north pole of the Earth's (real) magnetic field. It represents a point on the Northern Hemisphere where earth's magnetic field points vertically downwards. If you are sitting over the north magnetic pole with a compass, the needle would dip and point straight downward – hence the other name magnetic dip pole. However, over the south magnetic pole, your compass needle would point straight upward.

The magnetic north pole is not just important in precise navigation, it is also responsible for the phenomena of picturesque and dramatic lights, called *aurora borealis*, observed in the Northern Hemisphere. This is due to the solar radiations bouncing off the Earth's magnetic field. This phenomena takes place at the Southern Hemisphere also where these spectacular lights are called *aurora australis*.

## Geographic north pole

The geographical north pole is a spot in the Arctic Ocean



*The magnetic north pole is on the move (Credit: twitter.com)*

where man-made line of longitude, known as meridians, converge. This is actually the “True North”, which is also known as “Terrestrial North Pole” and “Geodesic North Pole.”

## Instantaneous north pole

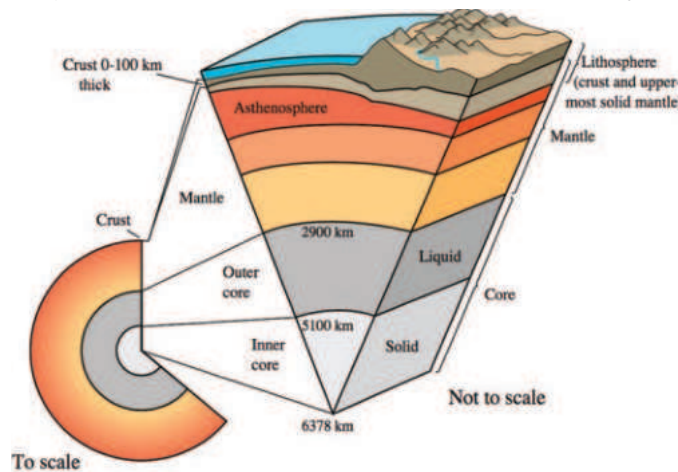
As the name suggests, the instantaneous north pole is not a static or fixed point. It represents the point where the rotational axis of the Earth meets its surface and the Celestial North Pole – the point around which all the heavenly bodies of the North Hemisphere can be seen to rotate clockwise. Although instantaneous north

pole is close to the geographic north pole, unlike the latter whose position is fixed, it tends to move in an irregular fashion around a circle. Called the Chandler circle, its diameter varies from a few centimetres to a few metres. This circle is named after an American astronomer Seth Carlo Chandler who in 1891 discovered that the Earth wobbles as it rotates about its axis. It is this wobble, known as Chandler wobble, which makes the radius of the Chandler circle irregular. It takes about 14 months for the instantaneous north pole to complete one revolution of the Chandler circle. The average of the positions of the instantaneous north pole is called the ‘north pole of balance.’ It lies at the centre of the Chandler circle. Strictly, the point, called ‘north pole of balance’, is not fixed. It is gradually moving towards North America at around 15 centimetres per year.

## Geomagnetic north pole

We may regard the Earth's complex and varied magnetic field as a big bar magnet or magnetic dipole. The north pole of this bar magnet or magnetic dipole is actually the geomagnetic north pole. However, geomagnetic north pole is totally different from magnetic north pole. While the magnetic north pole lies in Northern Canada, the location of the geomagnetic north pole is roughly off the northwest coast of Greenland.

The magnetic north pole has an important role in navigation, smart phones and some other applications. But, does geomagnetic north pole also have some important role? Commenting on this, Jeffrey J. Love, a U. S. Geophysical Survey geophysicist, said, “But, the geomagnetic pole is useful, if you're in space. The farther away from Earth you get, the more its magnetic field actually does act like a dipole or a bar magnet – even if in reality there is no such thing.” Love further added, “A space physicist usually thinks in terms of the tilted dipole that the Earth has, whereas a navigator would probably be more interested in the magnetic north pole.”



*Composition of Earth (Credit: science4fun.info)*

# Recent Developments in Science and Technology



*Biman Basu*

*It is well-known that failing bee populations can cripple the crops and wild plants they help to pollinate. Around three fourths of the earth's flowering plants and crops benefit from animal pollinators, including 87 of the 115 leading global food crops. The 20,000 species of bees in the world are not the only animals that pollinate, but they are top pollinators for many staples.*

## Water vapour found on exoplanet

For the first time, two teams of astronomers have almost simultaneously reported the discovery of water vapour and possibly even liquid water clouds that rain in the atmosphere of a strange exoplanet that lies in the habitable zone of its host star, about 110 light-years from Earth, in the constellation of Leo. The exoplanet, dubbed K2-18b, was discovered by NASA's Kepler Space Telescope in 2015 and orbits a red dwarf star named K2-18.

The host star of K2-18b shines with less than 3 per cent the luminosity of our own Sun, but because K2-18b orbits so close to it, the planet receives just 5 per cent

more starlight than our own. And because the planet transits, some of that starlight passes through its upper atmosphere *en route* to telescopes on Earth, picking up and transmitting information about the cocktail of gases in K2-18b's atmosphere which revealed the presence of water.

The first report by an international team led by Björn Benneke, a professor at the Institute for Research on Exoplanets at the University of Montreal in Canada, was published online on 10 September 2019 on pre-print site arXiv.org, where scientists can share studies before they are released in peer-reviewed journals (arXiv:1909.04642). The second report by a team led by Angelos Tsiaras, an astronomer at the University



*An artist's impression of the planet K2-18 b, its red dwarf host star, and another accompanying planet in the system. (Credit: ESA/Hubble, M. Kornmesser)*

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College London, was published on 11 September in the journal *Nature Astronomy* (doi.org/10.1038/s41550-019-0878-9).

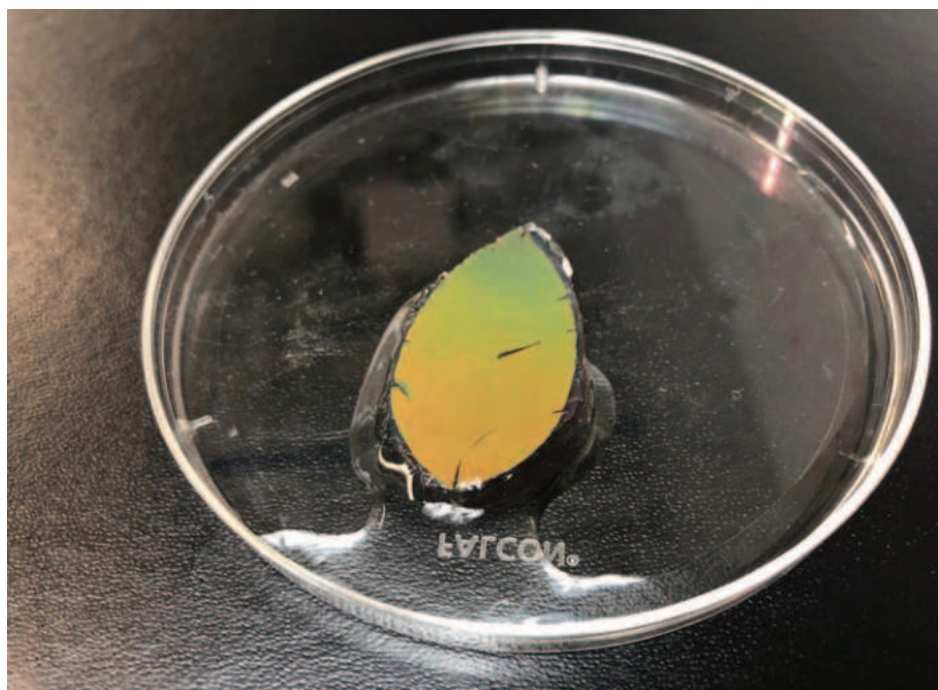
Both the reports suggest the presence of water vapour on K2-18b, while only the Montreal team provides evidence of a liquid water cloud deck in the atmosphere of the exoplanet. Both the teams worked on Hubble Space Telescope data to arrive at their conclusions.

During their study, Benneke and his team measured the transits of K2-18b at eight different times between 2016 and 2018, with the Hubble Space Telescope, as well as with Kepler and the Spitzer Space Telescope. Analysis by Benneke's team suggested the existence of a statistically significant fraction of water vapour in K2-18b's upper atmosphere, but more significantly, what the team argued were hints of liquid-water droplets condensing deeper down. In other words, Benneke and his colleagues report evidence of clouds – and of rain.

Tsiaras and his colleagues used sophisticated computer models to tease out signs of water vapour on K2-18b from data gathered by the Hubble Space Telescope, making the planet, they say, “the best candidate for habitability” presently known. They suggest the water vapour could make up anywhere between a hundredth of a per cent to half of K2-18b's atmosphere.

Before this discovery, astronomers had discovered gas giants that have water vapour in their atmospheres, but this is the first time that water vapours have been found in the atmosphere of a much smaller exoplanet. The new exoplanet is just over twice the size of Earth – in a planet category known as a “super Earth” – and Earth and nearly nine times as massive, likely with a solid core of rock or ice surrounded by a thick envelope of hydrogen – and other gases, apparently including water vapour. It has a temperature cool enough to have liquid water, between zero and 40°C. According to the researchers, with a 33-day orbit around a cool M3 dwarf star, K2-18b receives virtually the same amount of total radiation from its host star as the Earth receives from the Sun, making it a good candidate to host liquid water clouds.

The similarities between the exoplanet K2-18b and the Earth suggest to astronomers that the exoplanet may potentially have a water cycle possibly allowing water to condense into clouds and liquid water rain to fall.



*A leaf-shaped sample of the photonic crystal-based “smart” skin, during changeover from yellow orange to green. (Credit: Emory University)*

The recent findings can be considered a milestone in the search for alien life. According to the researchers, the result portends a near future in which astronomers will use new, advanced telescopes on the ground and in space to more deeply study the most promising planets around our Sun's neighbouring stars.

### Smart skin that changes colour developed.

The chameleon is a unique animal. It can change the colour of its skin at will to either blend into the background to hide or stand out to defend its territory and attract a mate. Besides chameleons, many other creatures have evolved the ability to change colour. The stripes on a neon tetra fish, for example, turn from deep indigo to blue-green when they swim into sunlight.

The skin coloration in these organisms is not based on pigments, as most coloured objects are, but on tiny particles in a repeating pattern. The skin cells of these animals contain tiny crystals crammed together that are called photonic crystals. Unlike pigments, which have an intrinsic hue, these crystals reflect, and scatter light differently based on their size, chemical makeup, and arrangement – creating colour. Photonic

crystals are periodic optical nanostructures that affect the motion of photons in much the same way that ionic lattices affect electrons in solids. The periodicity in these particles causes the material to interfere with wavelengths of light. Although the particles themselves are colourless, the precise spacing between them allows certain light waves to undergo interference and get reflected thus producing different colours. The visible colours produced keep changing depending on factors such as lighting conditions or shifts in the distance between the particles. The iridescence of some butterfly wings and the feathers of peacocks are among many other examples of photonic crystals in nature.

The chameleon skin and butterfly wings contain natural photonic crystals, but scientists have struggled to make an artificial photonic crystal “smart” skin that changes colour in response to the environment. They have spent decades unravelling the chameleon's colour-changing secrets in the lab, and their years of work have now yielded a new smart skin that changes colour when exposed to the Sun. Chemists at Emory University, Georgia, USA have developed a flexible smart skin that reacts to heat and sunlight while maintaining a near constant volume (*ACS Nano*, 11 September

2019 | DOI: 10.1021/acsnano.9b04231). The research was led by Yixiao Dong, a PhD candidate in Emory's Department of Chemistry.

To develop the new smart skin, the researchers experimented with embedding photonic crystal arrays into flexible, water-containing polymers, or hydrogels. They found that the colour change could be produced by varying the spacing between the arrays by expanding or contracting the hydrogel. The problem, however, was that the accordion-like action needed to generate a visible change in colour caused the hydrogel to significantly grow or shrink in size, leading to structural instability and buckling of the material

Dong used close-up, time-lapsed images of the chameleon changing hues and noticed that the arrays of photonic crystals did not cover the entire skin but were spread out within a dark matrix. As the photonic crystals turned different colours, these patches of colour remained the same distance apart. Based on these observations, Dong hypothesised that the skin cells making up the dark matrix somehow adjusted to compensate for the shifts in the photonic crystals.

The researchers used magnets to arrange patterns of photonic crystals containing iron oxide within a hydrogel. They then embedded these arrays into a second, non-colour-changing hydrogel. The second, springy hydrogel was mechanically matched to the first hydrogel to compensate for shifts in distances between the photonic crystals. When heated, this strain-accommodating smart skin changed colour but maintained a near-constant size. Dong also tested the material in sunlight, fabricating strain-accommodating smart skin films into the shape of a leaf. When exposed to natural sunlight for 10 minutes, the leaf colour shifted from orange to green, without changing in size.

## Bees are meat eaters

Many of us may have experienced a bee sting and know how painful it can be. A bee sting is not a bite but a defence mechanism to protect their hives or themselves from attack by humans. Normally bees sustain on nectar and pollen and are an efficient agent of pollination so essential for production of fruits and vegetables we eat, and seeds that



*Mason bee larva eating pollen (Credit: shutterstock.com)*

create more plants. Female bees deliberately collect pollen, along with nectar, to feed their babes.

Till now, bees have been widely thought to derive all protein directly from floral resources – nectar and pollens. But recent findings suggest this is largely untrue. Studies have revealed that bee larvae feed extensively on pollen-borne prey – mainly microbes – as well as on the pollen, itself. This larval food choice is part of what defines a bee. When a larval bee consumes aged pollen, the bee is consuming both ‘microbial meat’ and plant biomass, assimilating the amino acids of microbial prey as well as those of the plant material – analogous to “eating bacon bits in a salad”.

Prarthana Dharampal of the University of Wisconsin-Madison and Shawn Steffan, who works jointly at the university and the U.S. Department of Agriculture's Agricultural Research Service (ARS), assessed 14 different bee species in six of the seven bee families. They found that bees eat substantial amounts of microbes, enough to change how they fit within food webs (*Proceedings of the Royal Society B*, 12 June 2019 | doi.org/10.1098/rspb.2018.2894).

Steffan and his colleagues have shown that microbial meat is a necessary part of bees' diet. In a study with a species of mason bee (so named for their habit of using mud or other “masonry” products in constructing their nests), they sterilised half of the pollen and then fed different mixes of sterilised and unsterilised pollen to the groups. As

the percentage of sterilised pollen in the food increased, so did the larvae's likelihood of dying. The larvae also weighed less and took longer to mature. “Microbes are a very important source of nutrients for these bees,” Dharampal says. “If you take away this critical source, or portion, of their diet, they suffer tremendously.”

The mason bee results suggest that bees could suffer or starve if certain microbes disappear from their diet. Scientists have attributed the declines of both managed and wild bees to various combinations of habitat loss and degradation, pests and pathogens, pesticide exposure and climate change. They have largely focussed on how such factors impact bees directly. The next step is to look at whether the stressors may affect the pollen-borne microbes. Steffan says any stressor that throws the external rumen out of whack could be “an indirect, but no less lethal” way of killing bees.

It is well-known that failing bee populations can cripple the crops and wild plants they help to pollinate. Around three fourths of the earth's flowering plants and crops benefit from animal pollinators, including 87 of the 115 leading global food crops. The 20,000 species of bees in the world are not the only animals that pollinate, but they are top pollinators for many staples. According to the researchers, knowing the role of pollen microbes may eventually help solve conservation challenges by, for example, directing flower choices for habitat restoration. ■

# 5th India International Science Festival

The India International Science Festival (IISF) is the largest science festival in the world. The 5th IISF was held in Kolkata from 5-8 November 2019. The theme for this year's festival was RISEN India – Research, Innovation and Science Empowering the Nation. In IISF-2019 a total of 28 events were organised. The event was attended by nearly 20,000 participants including leaders from different countries, Science and Technology Ministers from different States of India, government officials, representatives from NGOs, scientists, technocrats, science writers, teachers, journalists, students, craftsmen, farmers, and others.

Prime Minister Narendra Modi inaugurated the IISF-2019 in Kolkata via video conference on 5 November 2019. Speaking on the occasion, he said the theme of the festival “RISEN: Research, Innovation and Science Empowering the Nation” reflects the aspirations of 21st century India.

He said, “We need to think as to how science can be helpful in making our living easy. And that's why science for society has a great relevance. When every scientist and citizen think and act on these lines, then the country would advance.” The Prime Minister urged everyone to focus on the long-term solutions and long-term benefits that science can provide us. He said, “There are no failures in science. There are only efforts, experiments and successes. If you keep this in mind while working, then you would not face any difficulties either in your scientific investigation or in your life.”

Inaugurating the Mega Science Exposition, a part of the IISF, in Kolkata on 5 November,



*The Prime Minister, Shri Narendra Modi addressing the gathering at the inauguration of the 5th India International Science Festival via video conferencing, on November 05, 2019.*

the Union Minister for Science and Technology, Earth Sciences and Health and Family Welfare, Dr. Harsh Vardhan said that a platform like the IISF is an opportunity to bridge the gap and bring science and technology nearer to the public for wider awareness.



*The Governor of West Bengal, Shri Jagdeep Dhankhar and the Union Minister for Health & Family Welfare, Science & Technology and Earth Sciences, Dr. Harsh Vardhan displaying a Guinness World Record Certificate achieved, during the closing ceremony of the four-day-long 5th India International Science Festival (IISF), in Kolkata on November 08, 2019.*

Three Guinness World Records were set during the course of the 5th IISF. The first record was set on the opening day when 1,598 school students attended a class on astrophysics and assembled working models of spectroscopes using nothing but discarded CDs and ordinary cardboard boxes. The second record was set when 268 students successfully assembled radio kits from scratch. In all, 490 students participated, 280 kits were evaluated, and 268 were found to be assembled properly. The feat was accomplished in two hours. It was dedicated to

eminent scientist Jagadish Chandra Bose.

The third record was set when a group of 415 school students came together arranged themselves to form the largest ever shape of a chromosome. In the nucleus of every cell, the DNA molecule is packaged into chromosomes, which are thread-like structures. Each chromosome is made up of DNA tightly coiled many times around proteins called histones that support its structure. The events were designed to inculcate the spirit of discovery in young minds to start their own explorations in the world of science and technology.

## Connecting science and literature

“Confluence of science and literature will go a long way in taking science to the masses”, said Shri Jayant Sahasrabudhe, Organising Secretary, Vijnana Bharti. Shri Sahasrabudhe presided over the inaugural function of the International Science

Literature Festival in Kolkata on 5 November. Organised by CSIR-National Institute of Science Communication and Information Resources (NISCAIR) and Vigyan Prasar, the inaugural function of the International Science Literature Festival was attended by nearly 200 invitees, researchers and scientists.

Vigyanika reached out to visitors through four components of science communication: *Vigyan Manthan* or discussions on challenges and opportunities in communication of contemporary scientific issues, *Vigyan Spandan* through debates, papers and abstracts from experts, communicators, *Vigyan Manchan* or 'staging' science through drama, poetry and other art forms, and *Vigyan Prakashan*, which showcased science publications through a book fair.

The dignitaries released Vigyanika's theme book during the inaugural function. The International Science Book Fair that had nearly 30 publishers displaying their books, was also inaugurated.

Six books published by Vigyan Prasar were released in one of the Vigyanika events.

## Overseas Ministers' and Diplomats' Conclave

Addressing delegates from different countries in Kolkata during the Overseas Ministers' and Diplomats' Conclave as part



*The Union Minister for Health & Family Welfare, Science & Technology and Earth Sciences, Dr. Harsh Vardhan with the foreign delegates, during the Overseas Ministers and Diplomats Conclave, a part of the India International Science Festival (IISF), in Kolkata on November 05, 2019. The Secretary, Department of Science and Technology, Prof. Ashutosh Sharma is also seen.*

of the IISF-2019, the Union Minister for Science and Technology, Earth Sciences and Health and Family Welfare, Dr. Harsh Vardhan emphasised the need to harness the soft prowess of science and technology as an important pillar of the cooperation in the knowledge economy of the 21st century. He said India shares a common past and future goal with many of its close neighbours and other partner countries that has served to forge an unbreakable association with India.

## Women Scientists' & Entrepreneurs' Conclave inspires young talents to science

The Women Scientists' & Entrepreneurs' Conclave, which was inaugurated as a part of IISF 2019 in

Kolkata on 6 November, highlighted the importance of networking to enhance the representation of women in science and research.

Speaking on the occasion, Professor Ashutosh Sharma, Secretary, Department of Science & Technology, referred to entrepreneurship efforts supported by organisations like the Women Entrepreneurship and Empowerment (WEE) Foundation, supported by DST, and said that one needs absolute clarity about problems and solutions instead of just talking about the problems. Stressing on the need of interventions by different stakeholders to improve the participation of women in research, he highlighted DST's schemes like Vigyan Jyoti which targets to

increase representation of women in reputed institutions like IITs. The Vigyan Jyoti scheme brings holistic science camp which imparts training to get into IITs and has many science institutions to partner in it.

Secretary, Department of Scientific & Industrial Research and Director General CSIR, Dr Shekhar C. Mande also inspired the audience with his address.

The festival was jointly organised by Ministry of Science and Technology, Ministry of Earth Sciences and Ministry of Health and Family Welfare and Vijnana Bharati. Vigyan Prasar, an autonomous organisation of the Department of Science and Technology, was the nodal agency to coordinate IISF-2019.

(Compilation: Navneet Kumar Gupta) ■



*Members of the organisation committee and delegates of the National Science Teachers Congress.*

# National workshop on cyber-security and cryptology

A two-day national workshop on the current state of affairs in cyber-security and cryptology was held at NIT-Durgapur during 13-14 September 2019. The workshop was jointly organised by Vigyan Prasar, NIT-Durgapur, and Vivekananda Vijnan Mission. About 80 undergraduate and post-graduate students attended the workshop. Dr. A.K. Himanshu, convenor, Vivekananda Vijnan Mission, welcomed all the dignitaries and briefed the participants about the workshop. In his welcome address, Dr. Anupam Basu, Director, NIT- Durgapur, stressed the need for cyber-security and cryptology in today's internet dominated world. Professor Bimal Roy, Chairman, National Statistical Commission, briefed the participants about the objectives of the workshop. As organising secretary of the workshop, Professor Tandra Pal of NIT-Durgapur welcomed all the participants. Dr. Jaydeep Howlader of NIT- Durgapur gave a vote of thanks.

Professor Bimal Roy conducted the first technical session of the workshop and interacted with students. He discussed the notion of ideal secured system, generation of keys for ciphertext, stream cipher, public-key



*Release of the souvenir in the inaugural function*



*Dr. Nakul Parashar, Director, Vigyan Prasar delivering a talk in the valedictory session*

cryptography, and many other concepts of cryptology and cyber-security. He explained many concepts with examples from his own experience.

In technical session II, day 1, Professor Abhishek Adhikari of Presidency University, Kolkata gave a talk “Various

aspects of secret sharing – few open issues.” Professor Debdeep Mukhopadhyay of IIT Kharagpur gave an overview of cyber-security research and discussed on-going research problems.

In the first technical session of day 2, Shri Rintu Nath, Scientist F, Vigyan Prasar delivered a lecture on block cipher techniques and Message Authentication Code (MAC). Professor Kannana Sreenathan of International Institute of Information Technology (IIIT) Hyderabad discussed different cryptographic protocols.

In technical session II, day 2, Dr. Shion Samadder Chaudhury of Indian Statistical Institute, Calcutta, delivered a lecture on information theory, secret sharing, and matroids. Professor Dhiren Patel, Director of VJTI, Mumbai, gave a talk “Understanding Attack Campaigns and Threat Actors on Cyber Landscape.” The discussion encompassed malware families, various cyber threats, and mitigation strategies.

In the valedictory session, Dr. Nakul Parashar, Director, Vigyan Prasar explained the importance of cyber-security in everyday life. He suggested that similar workshops in different parts of the country may be conducted to increase understanding and awareness among various stakeholders. ■

## Pune Book Fair-2019

The 18th edition of the annual Pune Book Fair was organised by Marathi Sahitya Parishad, Pune Granthalay and Marathi Library Pune at the Ganesh Kala Krida Manch from 28 September to 2 October 2019. More than 50 publishers from across the country participated. The Book Fair was inaugurated by Dr. Deepak Mahiskar, Divisional Commissioner, Pune.

Vigyan Prasar participated in the Pune Book Fair in a big way. Almost all the titles including recently published books were available at the book fair. Special interest was seen among children, science club coordinators, subscribers of *Dream 2047* magazine, and researchers towards science fiction books. During this fair, around 3,000 visitors, including scientists, research scholars, professors and schoolteachers from universities and research institutes came and bought books. Ganesh Dattu Kalghuge represented Vigyan Prasar at the Pune Book Fair 2019.



*Reported by Ganesh Dattu Kalghuge*