



# WAVES

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*A newsletter that embodies the ripples of thought that can shake our very foundations*

Issued by the Department of Physics of Ethiraj College for Women, Chennai

## A Leap Into the Unexplored: Chandrayaan II

ISRO's second lunar mission, Chandrayaan II, marked India's first endeavour to make a soft landing on the lunar surface, with the aim of better understanding the origin and evolution of our moon and exploring the yet-unexplored south pole of the moon.

Chandrayaan II had three components—an Orbiter, a Lander “Vikram”, named after the Father of Indian Space Research Programme Dr. Vikram A Sarabhai, and a Rover “Pragyan”, which means wisdom in Sanskrit. It carried 13 different payloads distributed across the three modules.

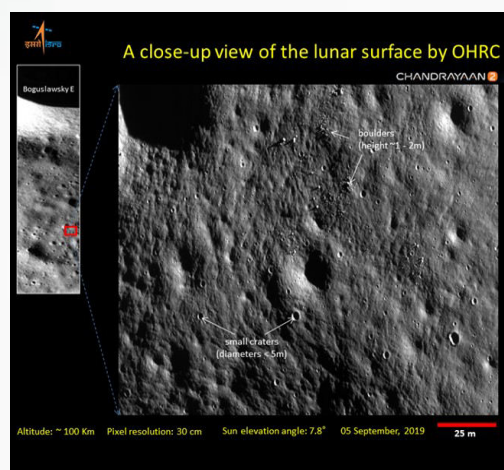
Chandrayaan II was launched successfully into space on July 22 2019 using the Geosynchronous Satellite Launch Vehicle (GSLV) MK-III from ISRO's Satish Dhawan Space Centre in Sriharikota.



*The lander*

The spacecraft reached lunar orbit on August 19th. During the Sept. 6 (Sept. 7 IST) moon landing attempt by Lander Vikram, ISRO officials lost contact with the moon lander when the probe was just 1.3 miles above the lunar surface. Officials have been unable to re-establish communication with the lander since then. Recently, the Chandrayaan-2 orbiter located the lander on the lunar surface and beamed its first picture back to ISRO. Despite the last-stage snag, Chandrayaan 2 is not a

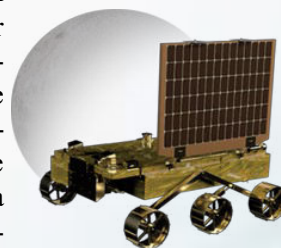
lost cause, but is an additional feather in India's cap. It has been reported by an ISRO official that only 5 percent of the mission has been lost. It is safe to say that the remaining 95 per cent- the orbiter, is orbiting the moon successfully. Great discoveries can still be expected from it.



India will try yet again to land on the moon with the next ISRO mission, Chandrayaan 3, which will have almost the same mission aims as its predecessor. It has been reported that ISRO has already begun designing the mission and the launch may take place in late 2020, or early 2021.



*The orbiter*



*The rover*

### *Inside this issue...*

*Detective's Corner* Pg 2

*The Physics Nobel Prize 2019* Pg 2

*Econophysics* Pg 3

*Association Report* Pg 4

*Comics and Crossword* Pg 5

*The Black Hole Image* Pg 6

*Why so few? (Women in STEM)* Pg 7

*Physics Bookshelf and Movie Rack* Pg 8

*-M S Pavithra, II BSc Physics*

## Destination Moon: Gaganyaan

In the year 2022, India will touch the moon. In a mission of great national pride, three Indian astronauts will travel in an indigeneous space module and carry out experiments on the lunar surface. Though the deadline is quite challenging to meet, ISRO already has a launch vehicle, GSLV Mark III, which has systems proven to ensure recovery of the crew module. In the next nine months, a half humanoid named ‘Vyommitra’ will be sent in the test flight, and will provide information about actual conditions in the crew module. Four astronauts have been selected from the Indian Air Force, after almost 25 IAF pilots went through several rounds of intense physical and psychological tests. These astronauts will receive module-specific training in India after undergoing a nine-month training process in Russia. An ‘Indian Data Relay Satellite System’, IDRSS, is also being developed, which will ensure unbroken communication links between the crew and the ground station. The Defence Food Research Laboratory, Mysore, is preparing food items and containers for the astronauts.

*- Thamarai Priya, III BSc Physics*

*Not only is the Universe stranger than we think, it is stranger than we can think -Werner Heisenberg*

## Detective's Corner

Mr Schrodinger's pet cat Whiskers got wind of his thought experiment and was scared he'd find a way to try it out on her in real life. So she decided to run away.

Mr Schrodinger, who loved his cat very much, was heartbroken.

Bobo, his dog, knew that his master was too kind-hearted to try it out on a real cat even if it was possible. So he made sure that Whiskers left a trail of clues leading to her hiding spot!

*The trail is scattered throughout this newsletter. Look out for the paw-prints, and help Mr Schrodinger find his cat!*

## Nobel Prize 2019- For A New Understanding of the Universe

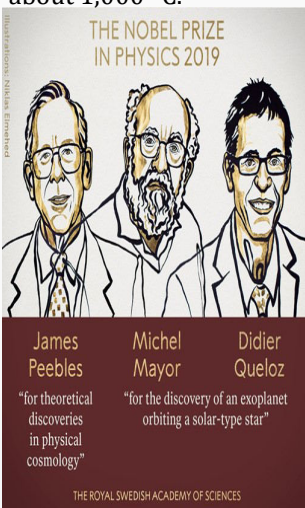
The Nobel Prize for Physics in 2019 was awarded to three people whose contributions led to path-breaking discoveries about the evolution of the universe and our Earth's place within it.

On October 8 2019, the Royal Swedish Academy of Sciences awarded the Nobel Prize to cosmology and exoplanet researchers. One half of the prize went to astrophysicist **James Peebles** of Princeton University, USA, who set the foundations for modern cosmology with his work on the big bang, dark matter and dark energy. He is also credited with developing the theoretical tools that ena-

bled scientists to create a cosmic inventory of what the universe is made from, showing that ordinary matter makes up just 5% of its known content, the rest being dark matter and dark energy.

The other half was then jointly awarded to two astronomers, **Michel Mayor** of University of Geneva, Switzerland, and **Didier Queloz** of University of Geneva, Switzerland, University of Cambridge, UK for the discovery of an exoplanet named 51 Pegasi b, orbiting a solar-type star. They have been recognized for their joint discovery of the same in 1995. This first discovered exoplan-

et is 50 light years away in the constellation of Pegasus. The planet is a gaseous ball about 150 times more massive than Earth and has a scorching surface temperature of about 1,000 °C.



- Gayathri J, II MSc Physics

## Everyday-Life Physics

*(Snippets from Chris Woodford's book 'Atoms Under the Floorboards')*

### Why Does Your Leather Shoe Shine?

Regular leather has very tiny scrapes and scratches on it, which scatter whatever light hits the leather. Thus, it appears dull. When a leather shoe is polished, it is coated in a fine layer of wax which fills in those crevices. Because the surface is now smoother and more uniform, light bounces back towards the eye more evenly, making your leather shoe shiny.

-Mary Shajina, II BSc Physics

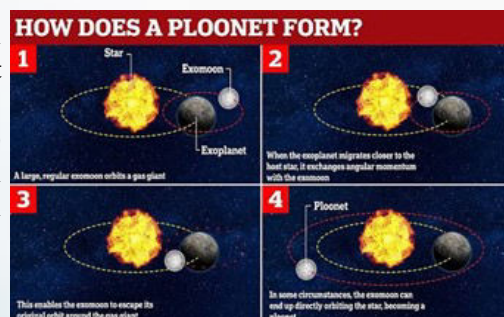
## Ploonets: Runaway Moons

'Ploonet' is a new word the astronomers have coined to describe a moon that becomes a planet. Yes, you read that right. A moon can leave the orbit of its parent planet, and start moving in its own stable orbit around a star. At this point, this orbiting rock can be called neither a moon nor a planet. Hence, the name 'Ploonet'.

This idea explains why astronomers have been unable to find moons that orbit exoplanets (planets outside our solar system). The team involved in this study was interested particularly in the moons of 'Hot Jupiters', which are gas giants that lie very close to their stars. Many astronomers believe that these giants reach this proximity

by moving towards their stars from their original orbits. The moon that tags along is disturbed by this motion. Its orbit gains higher energy due to the strong gravitational pull between its parent Hot Jupiter and the star, and it detaches itself, forming its own orbit.

The researchers, who used simulations to explain the same, found that the simulated Ploonets were quite short-lived, crashing into the star or their parent planet in 0.5-1 million years. This may explain certain astronomical phenomena like ring systems around some exoplanets- the rings could be made of debris from crashed Ploonets.



They also found that 48% of moons detach to form ploonets, which could be a reason why we haven't found any exomoons yet.

Scientists say that even our beloved Moon is moving away from the Earth at the rate of 3-4 centimeters every year due to the Earth's tidal strength. But at that rate, it will take many billion years to actually leave us. By that time, our Sun itself will be on its last legs.

What do you think will happen if our planet loses its moon? A Moon-less Earth....Unthinkable!

- Varsha M, III BSc Physics

*If one became two and two became one, the first three numbers of Sherlock Holmes' starting address would become ?*

## Shifting Paradigms: Econophysics

Econophysics, as the reader may have guessed, is an interdisciplinary and wildly interesting branch of science that combines physics and economics.

This field involves the application of physics concepts to explain economic phenomena and analyse economic trends.

It became increasingly obvious over the years that conventional economic models were insufficient to predict and analyse trends in world markets.

This may primarily be due to two factors. First, traditional economic theory mainly derives its predictions from ideal models and assumptions rather than empirical observations and available data, as is mentioned in a paper by Sinha and Chakrabarti.

Second, these models are based on the assumption that human beings have absolute free will and make completely rational decisions to maximise profit after analysing all information available (for example, while buying a car). How-

ever, this is far from the truth. Readers would agree that a person rarely possesses all available information in a particular case. Even if so, it is very likely that the final choice would rest on emotional and behavioural factors as well.

This wide gap between theory and reality is being bridged to some extent by Econophysics.

Physics is used to analysing the behaviour of non-rational objects, thus relieving theorists of having to depend on the very fallible "human rationality". Thus, for instance, the idea of trying to predict the behaviour of a group of electrons or water molecules in a particular scenario is extended to economic systems where wealth, poverty, investments and human choices are the variables.

Also, markets display properties of complex, non-linear systems with elements of uncertainty, the studies of which are rather well-framed in Physics thanks to developments in the last century.

These advantages have led to increasing

collaboration between specialists from the two areas, and India is one of the forerunners in the same. In fact, the very term Econophysics was coined by Eugene Stanley at a 1995 Kolkata conference. Seminars and meetings regarding addressing problems which can be solved by Econophysics have been held by the Indian Statistical Institute, Kolkata, and the Institute of Mathematical Physics, Chennai, which have been pioneers in promoting research in Econophysics along with universities like Delhi University and Pondicherry University. Several papers on the subject have been published as well.

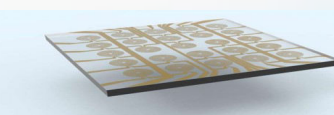
Thus Econophysics is a fast-growing area which pushes the boundaries between subjects. It is a field that attempts to make sense of a world complex in more than one sense—a world in which myriad factors changing even slightly can throw a global system into 'chaos'. Econophysics after college, anyone?

-L S Nivedita, III BSc Physics

## Towards Better Mobile Photos on Thinner Phones: 'SmartLens'

In this era of foldable and ultrathin smart phones, the need to have superior camera quality on thinner smartphones is a great motivator to finding new camera technologies. This goal has pushed manufactures to increase the number of cameras in order to provide better zoom, portrait settings and other modifications on phones. But adding more lenses to a miniature configuration isn't an easy task. The current requirements are complex lenses that can handle the full optical spectrum and be reshaped electrically within milliseconds. Until now, a class of soft materials known as liquid crystal spatial light modulators were used for high-resolution light shaping, but their implementation had limitations related to performance, bulkiness and cost. In a recent study, researchers have demon-

strated a technique to manipulate light without any mechanical movement. 'Smartlens' is an approach where current is passed through a micrometre-scale resistor, and the small



local heating changes the optical properties of the transparent polymer plate holding the resistor. This microscale hot region deviates light, similar to the way a mirage bends light passing through hot air to create illusions of the presence of water. Within milliseconds, a simple slab of polymer can be turned into a lens. These lenses heat up and cool down quickly with minimal power consumption. They can even be fabricated in an array. By modelling heat diffusion and light propa-

gation, along with inclusion of algorithms, a properly engineered resistor can have a highly controlled light shaping capability with which we can achieve wide variety of optical functions. For instance, if the right resistor is imprinted on the polymer, it could be activated or deactivated at will to generate a given "freeform" and correct specific defects in our eyesight, or even aberrations of an optical instrument.

The Smartlens technology is said to be cost effective and scalable, and has proven to have the potential to be applied to high-end technological systems as well as simple end-user-oriented devices like cameras.

-Shanmuga Priya, II BSc Physics

**The greatest question of all time: Why did the chicken cross the road?**

**Einstein:** Well, if you look at it from the chicken's point of view, it was the road that was actually moving beneath it.

**Pauli:** It's quite simple. There already was a similar chicken on this side of the road.

## The Blackest Black

A black material reported to be 10 times blacker than anything that has been previously reported was recently formulated by MIT engineers. When coated with this material, a bright diamond dramatically took on the look of a dark void. The material is made from vertically aligned carbon nanotubes (microscopic filaments of carbon) resembling a fuzzy forest of tiny trees, that the team grew on a surface of chlorine-etched aluminum foil. This foil captures more than 99.96 percent of any incoming light, which makes it the blackest material on record. It has various optical, artistic and space science applications. However, one of the researchers, Brian Wardle, feels that "the blackest black is a constantly evolving concept", and someone will find a blacker material one day which will hopefully help scientists engineer the 'ultimate black'.

-Vasundhara A, III BSc Physics

The first letter of the second part of the location is the first letter of the last name of the man who thought of an energetic demon.

## Report: Ripples 2019

Ripples, the annual intercollegiate fest of the Physics Department of Ethiraj College for Women which acts as the inaugural event of the Physics Association's activities, was held this year on the 21st of August 2019.

Ripples 2019 saw a total of 15 colleges and their teams, consisting of 128 students, participate in various events that were held throughout the day. The inaugural ceremony was graced by various dignitaries including Dr. S Kothai, Principal and Secretary, Ethiraj College for Women, Dr. Usha Rani, Vice Principal and Head, Department of Economics, Ethiraj College for Women, and retired faculty members of the Department. The Chief Guest of the day was Dr. Shrihari Gopalakrishna, Professor of Theoretical Physics, IMSc, who gave the inaugural address on the topic, 'Cosmology, Particle Physics and Dark Matter'. The address was followed by an energetic question- and- answer session.

The various events held during the day were Potpourri, Quiz, Story-Telling, Best of Waste, Adzap and Meme Creation. The events were judged by two-judge benches, each consisting of a judge from the Physics department and a judge from various other departments of the college. The inter-collegiate quiz Scintillations witnessed students from Madras Christian College (Shift 1) winning the Scintillations Shield after several rounds of intense competition. The annual inter-departmental quiz, which is a part of Ripples, was held earlier on the 19th of August 2019 and saw the active participation of 8 departments of the College. The trophy for the same was bagged by the team from the Chemistry Department.

The day came to a close with the Valedictory ceremony, with Dr. Caroling, Head of the Department of Chemistry and Dean of Academics, Ethiraj College for Women, giving away prizes to the winners of various events. The much coveted overall trophy of Ripples 2019 was received by MCC Shift 2 amidst much applause.

The audience then rose for the College Song, and, following refreshments, dispersed after an eventful, intellectually stimulating day.

### This Year in The Physics Department...

This year the Department of Physics witnessed, as it does every year, a host of achievements by its student body and exciting events in its calendar. The year's activities were kicked off with *Ripples*, Ethiraj's annual intercollegiate Physics Association event in August. In September, the Ethiraj Team won the Overall Trophy in *Symban* – the intercollegiate Physics Association event conducted by Madras Christian College. The month of October saw two Astronomy Club events being held. The first was an Introduction to Night Sky Watching, an interactive session by R K Paavai and Lekha R – the Secretary and Joint Secretary of the Club. The second was a fun-filled learning trip to the B.M Birla Planetarium in accordance with Dr. APJ Abdul Kalam's birthday. In December, a guest lecture by Dr. Sohan Jeetha on 'Astrophysics and the Biochemical Evolution of Life' was organised by the Astronomy Club. Also in December, the students of III UG and II PG travelled to the Indian Institute of Astrophysics' radio Observatory at Gauribidanur, Karnataka. This educational trip saw the students learn about Radio Telescopes and their working, and gave them a peep into the daily lives of the scientists there. In the same month, Ethiraj bagged the Overall Trophy in *Spectran*, Gurunanak College's intercollegiate Physics Association event.

The new year began with the students walking into a newly renovated laboratory, welcomed by gleaming tables and walls. Ethibandhan, Ethiraj's Alumni Day which coincides with the Republic Day, welcomed several Department alumni from the batches of the '70s, enabling them to relive a little of their student days. The students of the Department won laurels in many other intercollegiate events held by the city colleges. A host of events are planned for February and beyond, and the Department looks forward to an interesting couple of months preceding the close of the academic year.



At the Gauribidanur Radio Observatory, Gauribidanur

The second and fifth letters are the same! They are the first letter of the surname of everyone's favourite fizzy-haired scientist.

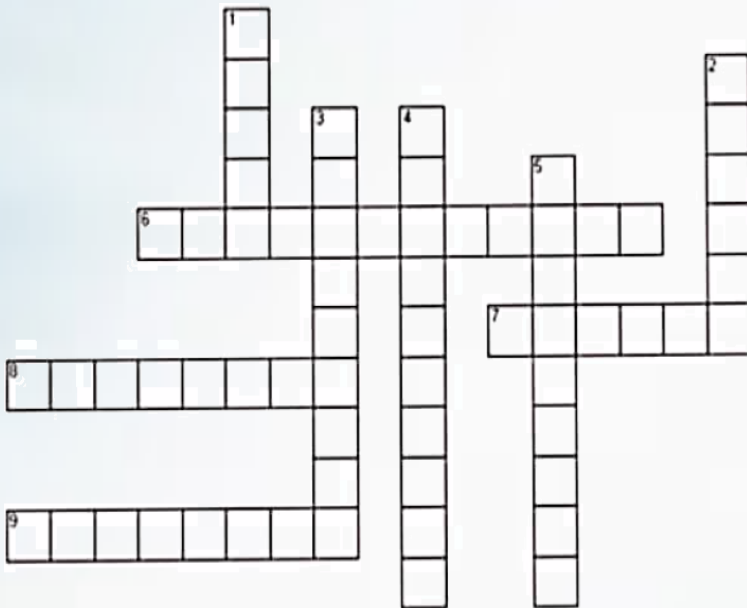
# It's Crossword Time!

*This time, it's all things bright and beautiful*

- S S Akshaya, II BSc Physics

**Down :**

1. An icy space object that forms a ball when it passes near the Sun
2. A large, bowl shaped cavity on the surface of a planet or moon caused by a meteorite impact
3. A sphere of meteoroids and comets beyond Pluto
4. A region beyond Neptune containing many asteroids and comets



5. A piece of rock that has fallen to the ground from outer space

**Across :**

6. A region between Mars and Jupiter where many small and large meteoroids are found
7. A space rock that enters Earth's atmosphere
8. The name given to a very bright meteor
9. A large space rock orbiting the Sun

		<p><b>3, 6, 9: Tesla Numbers!</b></p> <p>Though there is a lot of controversy surrounding this, some say that Nicola Tesla claimed that the numbers 3, 6 and 9 represent the key to the universe. These numbers, absent in the vortex sequence, are supposedly the link to higher dimensions. Despite there being almost no historical proof of Tesla's statement, the Tesla Numbers idea does make for fun reading.</p> <p>-Idea by Shunmugi, I BSc Physics &amp; Art by G Mathangi, II BSc Physics</p>

**How Do Our Ball-Point Pens Work?**

We are able to write on paper by ball point pen because of gravity. There is a ball at the tip of the pen which rolls as we press down to write on a piece of paper. Inside the pen is ink that sits on top of the ball. Gravity pulls the ink down towards the paper, and the ball rolls in the ink as we write, taking a controlled amount of it from inside the pen to the paper surface as it turns. If the ball holding back the ink is removed, gravity would pull all the ink down and on to the paper.

- Preethika A, III BSc Physics

The third and sixth letters are also the same... They're the first letter of the first name of the physicist in this picture.

(Hint: He's the one we all thought was "surely joking")



## The Black Hole Image

Black holes have been capturing collective human imagination ever since their existence was first conceived in the 18th century. The year 2019 will go down in history as the year in which humans first set sight on this entity, which lets no light escape it.

On April 10 2019, the world was awed by the first ever image of a black hole. The image was that of M87, a super-massive black hole 55 million light years away from Earth. The picture was not of the black hole itself, but rather of its accretion disc.

Stars that come close to the black hole's event horizon (the point of no-return for light) orbit it and slowly fall inside. Thus gases falling into the black hole slowly spiral around it, creating an 'accretion disc'. Since they are outside the event horizon at this point, their light is still visible. Due to the massive gravitational pull exerted on it, light from the accretion disc *bends* as if the entire black hole was a lens. It is this light that was captured.

This powerful picture hides behind it a mountain-load of toil by many scientists across the world. To image a black hole, a telescope the size of the Earth was needed. Instead of attempt-



The Image Released by NASA in April

ing the near-impossible task of constructing such a telescope, scientists came up with an ingenious solution. They coordinated data from 8 radio telescopes across the globe, thus creating a virtual observatory roughly 12,000 kilometres in width. The telescopes were focused on two candidates - Sagittarius A\*, which is our resident black hole at the centre of the Milky Way, and M87. Sagittarius A\* was too active for us to capture a proper image, hence M87 is what we saw in the end.

Scientists co-ordinated the telescopes over a range of several dates in April 2017. Clear visibility was imperative for every single telescope. The data had to then arrive from each telescope, and data from the telescope at the

South Pole arrived only in the December of that year due to extreme weather conditions in that area. All of the information from these telescopes totalled to 10 lakh GB of data.

One of the anxieties that plagued scientists was whether the weak signals from M87 could actually be elicited from this huge amount of data, a large part of which would contain other electromagnetic radiations from the remaining parts of space. The task of doing so took more than a year, and to be absolutely sure, this work was done four different times by four different teams. Each team produced the exact same image.

And then, on April 10, 2019, at six simultaneous press conferences held around the globe, the image from the virtual Event Horizon Telescope was unveiled to the world. Newspapers and magazines, TV Channels and websites carried the amazing news. The historic image of fiery glow and inky blackness will find its place in the annals of time - a record of humanity's constant endeavour to understand and *know* the unfathomable depths and mysteries of the Universe.

-L S Nivedita, III BSc Physics

## We Now Know How Friction Causes Static Electricity

*Triboelectricity* is the concept of electricity being produced by rubbing two objects together. When Greek philosopher Thales of Miletus first found that fur attracted dust particles after rubbing it with amber, it became clear that rubbing (friction) induces static electricity. *But how does friction cause static electricity?* After so many years, we now know.

A phenomenon called *Flexoelectric effect* comes into play. This is the phenomenon in which deformations on surfaces are responsible for separation of charges, which in turn produces voltages that ultimately cause static charging.

The fourth letter is the one we use to denote the speed of light!



*By now, you should've figured out the first two parts of Whiskers' location! You're almost there... Look for a final clue on the next page!*

Scientist Laurence Marks' team from the United States introduced a connection between the effects of Triboelectricity and Flexoelectricity. On rubbing two surfaces together, deformations such as the bending of protrusions (which are present in the rough surface of all materials) occur. Hence, charge separation is produced.

Thus Triboelectricity, Flexoelectricity and Friction are all inter-linked with each other. This discovery will have a great impact on new technologies, and in addition shows us how fundamental research in one field can give rise to unexpected advances in another field.

- Varsha K, III BSc Physics

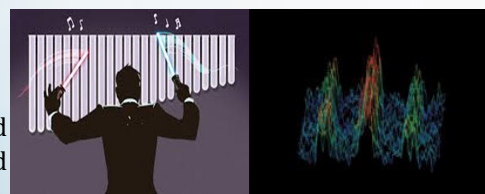
## Rydberg Atoms: The Future of Quality Radio?

The Atomic Radio is a newly invented concept that relies on Rydberg atoms - atoms whose outermost electrons are excited to higher quantum states by methods such as irradiation.

These atoms exhibit the property of Electromagnetically Induced Transparency - a gas made of these atoms can be made optically transparent to a particular narrow frequency range. In recent experiments, a cell of excited Cesium atoms was so taken and rendered transparent. A laser was then shone through it, and a photodiode placed to detect the

same.

The transparency of the gas changed when the Rydberg atoms interacted with passing EM radiations (in this case, radio waves), which in turn changed the level of intensity of the second laser detected by the photodiode. This enabled us to figure out the state of modulation of the radio wave. The highly minute spacing between electron levels far from the nucleus makes it is easy to perturb electrons and make them change states, which ensures that the system is highly sensitive to even small changes.



Thus just as today's radio antennas operate electromagnetically, atomic radios detect radio waves optically. Atomic radios don't need bulky contraptions like antennas, and stages of a traditional radio which usually pick up interference are also not present, resulting in lesser noise. Let's hope for atomic radios in the near future!

- M A Nusrath Ruhaiyah, III BSc Physics

## Why So Few?

Women have made tremendous progress in education and in the workplace during the past 50 years. Even in traditionally “male” fields such as business, law and medicine, women have made impressive gains. In scientific areas, however, women’s educational gains have been less dramatic, and their progress in the workplaces is still slower. In an era when women are becoming increasingly prominent in medicine, law, and business, why are so few women becoming scientists and engineers?

When we witness so many women achievers like Malala Yousafzai, Hima Das, Kiran Bedi, why do only few women, compared to men, pursue the majors of STEM (Science, Technology, Engineering, and Mathematics)?

Most people associate science and math fields with the “male” tag and humanities and arts fields with the “female” tag. Implicit bias is common, even among individuals who actively reject these stereotypes. This bias not only affects individuals’ attitudes toward others but may also influence girls’ and women’s likelihood of cultivating their own interests in math and science.

Attracting and retaining more women in the STEM workforce will maximize innovation, creativity, and competitiveness. With a more diverse workforce, scientific and technological products, services, and solutions are likely to be better designed and more likely to represent all users, as has been seen by the inclusion of women in other fields.

To diversify the STEM fields we must take a hard look at the stereotypes and biases that still pervade our culture. Encouraging the entry of more girls and women in these vital fields will require careful attention to the environment in our schools and colleges, and the showcasing of strong examples of women who have already made strides in STEM at par with men, to children in schools.

- S Haashika Raj, I BSc Physics

### Say it Right!

*The difference between a scientific fact, hypothesis, law and theory*

When we get into a huddle with friends debating a plot twist in a favourite series, it’s a pretty sure bet that at some point, one of us would start, “Hey, I have a theory...”

Little do most of us know what weight the word ‘theory’ carries in scientific circles. In this article, we set straight for you the difference between a scientific fact, hypothesis, law and theory.

A scientific *fact* is “an observation that has been repeatedly confirmed”. For example, ‘a dropped cake falls to the ground’ is a fact (and a disaster, but let’s leave that angle for now). It is thus something that is taken as true. However, we must remember that a fact is a ‘fact’ only until a contradictory observation pops up.

We come next to a *hypothesis*. A hypothesis is an idea that attempts to explain the observations or facts. For example, ‘the cake falls to the ground because of an attractive force from the ground’, or, ‘because ants on the ground pull it down with invisible ropes’ are both hypotheses. Hypotheses are ideas which have not been confirmed- they are starting points, which must be confirmed through experiments and evidences.

Now let’s look at laws. We have the facts, and let’s say we have a hypothesis that holds up. We can then formulate a *law*- which is a statement, usually supported by a mathematical expression, which covers the details of *how* a process works in detail. An example is Newton’s law of gravitation, which gives a precise explanation as to how two masses would behave near each other.

We finally come to the grand finale- a *theory*. A theory wraps in itself the *why* of the *how*. It ties up the facts, hypothesis and laws regarding a phenomenon in neat(ish) bundle, with a ribbon on the top. For example, Einstein’s General Theory of Relativity, which says gravitation is a consequence of the curvature of space-time, is a theory that covers the known facts, hypotheses and laws regarding the same (it falls apart in quantum mechanical scenarios, though- hence the use of the word neat ‘ish’).

So there we are! So next time we have a heated discussion, let’s get those words right. Maybe we’ll formulate a law regarding the phenomenon of certain stories leaving us off with cliff-hangers. (Yep, it’s worth spending time on- it leaves readers dying of suspense. And that’s a fact!)

### Everyday-Life Physics

**Sticky notes fall off easily after some time. Wondered why?**

Sticky notes feature a plastic adhesive spread as small capsules on them. When you slap a sticky note onto a bulletin board, only some of these touch the surface to keep the note stuck to it. After several times of re-using the note, eventually, all the capsules of glue will get used up or clogged with dirt, and the sticky note won’t stick anymore.

**Can you imagine heating the room with just people?**

Humans radiate 100-200 watts of heat normally. In coherence to this, 70 people in motion, or 140 people standing still, can heat a house which uses four electric storage heaters! If only we could get human coolers. Sigh...

*Our lengths each measure around 540 in the nanometer scale! Pick us out and we’ll lead you to a path...*

**“Physics is really nothing more than a search for ultimate simplicity, but so far all we have is a kind of elegant messiness.”**

-Bill Bryson

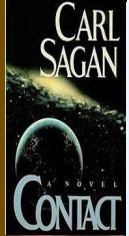
Science and the fascinations it hints at have always captured our imaginations— made us wonder how far we can breach the boundaries of ‘reality’, and what would happen if we do. Science Fiction over the years has grappled with the question of what situations such enterprises could land us in, and how humanity’s innate qualities— both good and bad, would respond to changing realities. And how our very sentience could be under question. We put before you a selection of books and movies cutting across a host of genres, that explore these questions in ways you’ll remember for a long time.

BOOKSHELF / MOVIE RACK



**The Time Machine, H G Wells**

A timeless classic, ‘The Time Machine’ features a traveller who journeys into the future and narrates to his friends his harrowing experiences. The future is seen to reflect the ramifications of class divides in the author’s present, and this social narrative is as interesting as the travel itself.



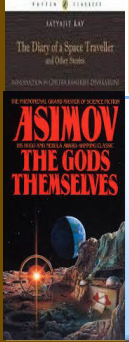
**Contact, Carl Sagan**

A scientist working in a remote observatory receives a signal from somewhere beyond our solar system. What follows is a multinational human effort to work with the ramifications of what it holds. *Contact* is undoubtedly a bold mixture of science and adventure.



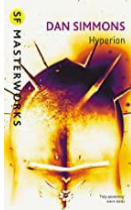
**The Diary of a Space Traveller and Other Stories, Satyajit Ray**

This beautiful translated collection of stories enables the reader to make her acquaintance with Professor Shonku— a scientist who has a cat called Newton, a manservant named Prahlad, and a nosy neighbour-Avinash Babu. Written in Ray’s inimitable style, this collection will take you on several unforgettable adventures, and will find a place in your heart.



**The Gods Themselves, Isaac Asimov**

Any Sci-Fi list would be incomplete without a mention of Asimov. *The Gods Themselves* is a Hugo award winning novel set in the twenty second century, when humans are provided free energy by a dubious source from a parallel universe. The few outliers who realise that this energy is causing the destruction of our own Sun, must ensure Earth’s survival.



**Hyperion, Dan Simmons**

The first book of the series Hyperion Cantos, *Hyperion* is a stunning novel weaving in the stories of seven ‘pilgrims’. These seven travel to the world of Hyperion where a mythological monster, Shrike, awaits in the midst of the foreboding Time Tombs. Their pasts may hold the key to saving all of humanity.



**Solaris, Stanislaw Lem**

This novel by Polish writer Lem explores philosophy and human understanding. Psychologist Kris Kelvin arrives at the planet Solaris to study its vast ocean, only to find painful memories churn up in his mind. He soon discovers that he is not alone in this experience, and along with others begins to suspect that the “ocean” may not be just that...



**Back to The Future, Dir. Steven Spielberg**

This funny tale takes us along a ride through time with Marty McFly, who travels to the past in Doc Brown’s time machine. There he meets his parents as youngsters, and accidentally sets into motion events which may erase his very existence. This film and its two sequels guarantee some truly delightful movie-time.



**The Matrix, Dir. Lana and Lilly Wachowski**

This gripping film introduces us to Neo (Keanu Reeves), who learns that his reality may not be real after all. He is then pulled into a battle to destroy the intelligence that holds humanity captives in an illusory world. Despite the existence of sequels, this film holds its own as a stand-alone classic.



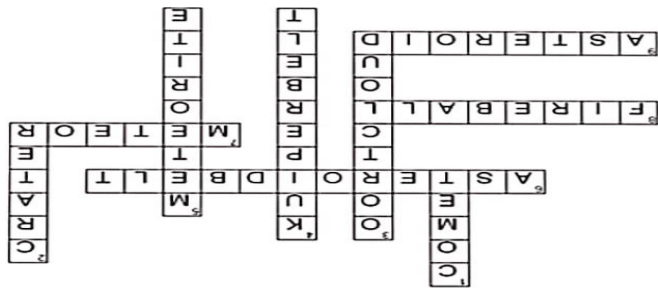
**Alien, Dir. Ridley Scott**

Set in the future, *Alien* is a horror-cum-Sci Fi film. A crew of humans returning to Earth are side-tracked by what seems to be a signal for help from another planet. Instead of finding distressed beings, they find themselves the victims of a horrifying attack.



**Close Encounters of the Third Kind, Dir. Steven Spielberg**

In this film, considered one of the best involving extra-terrestrial communication, a repairman encounters a UFO and becomes obsessed with the same, eventually finding a group of those with similar experiences. *And while we’re on the subject of aliens, the heart-warming ‘ET’ is not to be missed!*



Crossword Solution

That’s right! Whiskers ran away to Albert Einstein’s home! With your help, we were able to get her back. Great job, detective!  
 Pg 2– 112 (Holmes’ address is 221 B, Baker Street); Pg 3– M (Maxwell— his thought experiment—Maxwell’s Demon); Pg 4– E (Einstein); Pg 5– R (Richard Feynman— author of ‘Surely You’re Joking, Mr. Feynman’); Pg 6– c; Pg 8– Street (540 nm corresponds to the colour green. The green letters s,r,e,t in the given quote make up the word *street*—a synonym for *path*).

Whiskers’ Location!

**Editors’ Note**

*It is an indisputable truth that Physics is all around us. It is also an indisputable truth that not all recognise it to be so, and hence fail to fully embrace the excitement, wonder and beauty of it all. Through ‘Waves’, we endeavour to bring to you the small but poignant joys words and science woven together can give. The year 2019 is the year we glimpsed a black hole, attempted to send a lander to the moon, and made breakthroughs in creating atomic radios. And that’s just the tip of the iceberg. To say we’re honoured to have covered these events would be a massive understatement. We sincerely hope you laugh, wonder and enjoy yourselves while reading this issue, as much as we did creating it.*

*It goes without saying that this edition of Waves would not have reached your hands if not for the support we received from the Heads of the UG and PG Departments— Dr. A.V Jhone Verjhula and Mrs. S Abirami, the guidance of our association in-charges- Dr. S Mahalakshmi and Dr. Rajeswari Gangadharan and the encouragement given by the rest of the faculty members. We thank them from the bottom of our hearts for having given us this wonderful opportunity. We also extend our deep gratitude to the non– teaching staff and our fellow students for their support.*

*-The Editorial Team, 2019-2020 (L.S. Nivedita-III UG, K. Varsha- III UG, G. Mathangi- II UG, J. Gayathri- II PG, V. Krithika- II PG) .*

\* All related web sources and newspapers have been freely referred to during the writing of the articles in this newsletter\*