PHYSIK'23

DEPARTMENT OF PHYSICS

Beyond Atoms...

STELLA MARIS COLLEGE(AUTONOMOUS)
CHENNAI - 600086

A Note From the Editors' Desk

" SOMEWHERE, SOMETHING INCREDIBLE IS WAITING TO BE KNOWN"
-Carl Sagan

To the inquisitive minds,

From the quantum state of an atom to the incomprehensible vastness of the universe, physics is everywhere. As aspiring physicists and members of the editorial board, we take great pride in releasing this year's edition of the annual department magazine **PHYSIK'23** on 9th March 2023. This year's magazine has been the culmination of efforts from the students and faculty of the Physics Department.

Physik'23 is an amalgamation of informative articles and stimulating puzzles on recent technological advances in Physics. This year, our magazine features articles spanning various streams of Physics, namely, Astronomy and Astrophysics, Quantum Physics, Interdisciplinary Physics and Nanoscience.

We extend our heartfelt gratitude to our Principal, Dr. Sr. Rosy Joseph fmm, Secretary, Sr. Judith Anita Gonzalvez, Provincial and General Counsellor, Dr. Sr. Francisco Nirmala Gnanapragasam fmm, and Vice-Principals, Dr. Shiny John Vairamon, Dr. Regi Manimegala and Dr. Sr. Stella Mary fmm, for their support. We sincerely thank our Head of the Department, Dr. Belina Xavier, and the faculty of the Department of Physics for their constant support and encouragement in leading this endeavour to fruition.

We are grateful to the faculty advisors, Dr. C. Stella and Ms. M. Asisi Janifer, for their guidance and creative inputs in helping shape this magazine. The editorial board renders its appreciation to the students of UG and PG studies in the department of Physics who have contributed to the magazine with their ingenious features.

We hope this magazine educates its readers on the magnificence of Physics and ignites scientific temper in them.

STELLA MARIS COLLEGE
(AUTONOMOUS)
17, CATHEDRAL ROAD
CHENNAI - 600 086.

Foreword

PHYSIK 2023 brings to the discerning reader a plethora of articles in such interdisciplinary fields as Astrophysics, Quantum Physics and Nano science. The articles, by postgraduate and undergraduate students of the Department cover a range of content modes, spanning informative, explanatory and information based narratives, fusing theory and applications and with appropriate illustrations for clarity.

The interdisciplinary nature of the evolving discipline of Physics in the 21st century has generated much interest among scientists, scholars and the teaching community. New areas of study and research, conflating a number of varied disciplines continues to erase borders between scientific disciplines, thought and practice. The students of the Department have grasped these new directions while also retaining interest in older fields such as Time Travel.

I congratulate the Department for the compilation of student articles for their magazine.

I wish them every success in future endeavours.

Dr. Sr. Rosy Joseph fmm
Principal
Stella Maris College (Autonomous)
Chennai 600086
February 17, 2023

Phone : 044 - 2811 1951 / 2811 1987 Fax : 044 - 2811 1129 email : principal@stellamariscollege.edu.in
website : www.stellamariscollege.edu.in

STELLA MARIS COLLEGE
(AUTONOMOUS)
17, CATHEDRAL ROAD
CHENNAI - 600 086.

Foreword

Dear readers,

It is my pleasure to welcome you to the latest edition of our physics magazine PHYSIK'23. In this issue, we delve into some of the most exciting and thought-provoking topics that are currently being explored in the world of physics.

Physics is a fascinating and diverse field that touches on many aspects of our day-to-day lives, from the way that we see and hear, to the technology that we use to communicate and travel. It is also a field that challenges us to think deeply and creatively about the nature of reality and the fundamental laws that govern it.

In this magazine, we aim to showcase some of the most innovative and exciting features in Astrophysics, Quantum Physics, Nanoscience and also Interdisciplinary Physics. But we also hope to inspire a sense of wonder and curiosity in our readers, inviting you to explore the world of physics with us and to discover the beauty and mystery that lies at the heart of this fascinating discipline.

I would like to extend my thanks to all of the contributors and editors who have helped to make this magazine possible. Their hard work and dedication are evident on every page, and I am sure that you will find their articles and insights to be both engaging and informative.

So without further ado, I invite you to immerse yourself in the world of physics and to join us on a journey of discovery that promises to be both exciting and enlightening.

Sincerely,

Sr. Anita Gonsalvez

Sr. Judith Anita Gonsalvez
Secretary
Stella Maris College (Autonomous)
Chennai 600086

Phone : 044 - 2811 1951 / 2811 1987 Fax : 044 - 2811 1129 email : principal@stellamariscollege.edu.in
website : www.stellamariscollege.edu.in

STELLA MARIS COLLEGE
(AUTONOMOUS)
17, CATHEDRAL ROAD
CHENNAI - 600 086.

Dear Readers,

I am delighted to introduce the annual Department magazine Physik 2023. This year the students have compiled articles on Astrophysics, Computational Physics and Applied Physics. This compilation helps us to know the present research status in these areas and draws new perspectives on these areas of Physics. The magazine is an annual activity of the Department to nurture curiosity and scientific thinking among students. It lays emphasis on developing effective writing skills and learning beyond the classroom. This year the student editors along with the faculty advisors have worked hard to present to you articles on the latest breakthroughs in Physics.

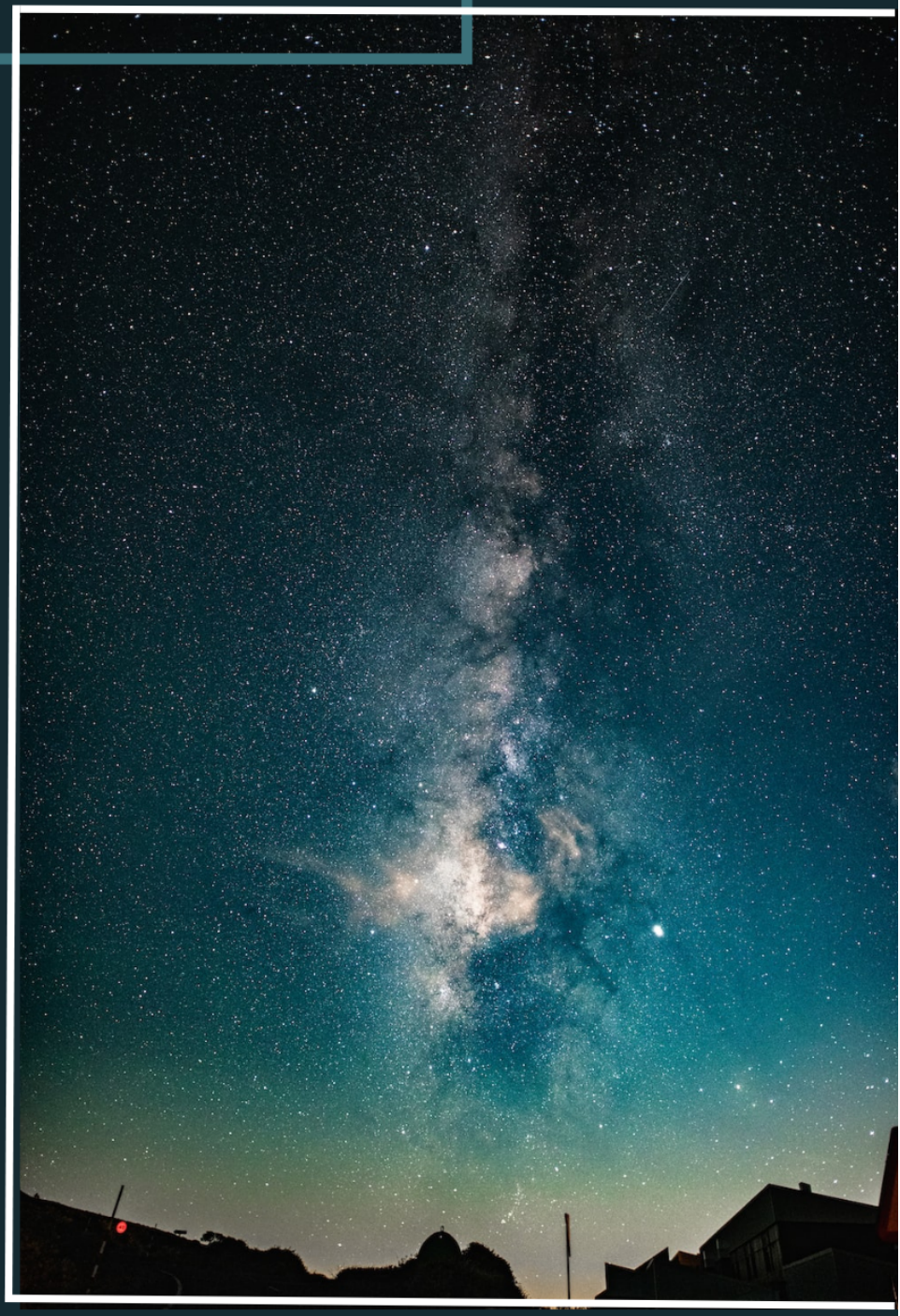
I extend my gratitude to Dr. C. Stella and Ms. M. Asisi Janifer for supporting this student-led initiative. I also would like to congratulate the student community for their contributions and efforts in bringing about Physik 2023. I hope this activity will motivate and help them prepare for a productive career in Physics.

Dr. Belina Xavier
Head and Associate Professor
Department of Physics
Stella Maris College (Autonomous)
Chennai

Phone : 044 - 2811 1951 / 2811 1987 Fax : 044 - 2811 1129 email : principal@stellamariscollege.edu.in
website : www.stellamariscollege.edu.in

LET THE EXPLORATION BEGIN!

Astrophysics and Astronomy



"Man must rise above the Earth to the top of the atmosphere and beyond for only thus will he fully understand the world in which he lives."

Socrates

CHINA HATCHES EARTH 2.0

The Kepler spacecraft was launched by NASA to discover Earth-like planets orbiting other stars. Kepler is an Exoplanet. Exoplanets are called extrasolar planets that lie outside the solar system. There are 2600 planets in Kepler. One of the planets is Kepler-452b. It is reckoned that Earth existed only for the past 4.54 billion years while Kepler-452b is estimated to have an age of 6 billion. Do people believe that there's an Exoplanet named Earth 2.0? Are they actually present? Yes, there are possibilities. In 2026, China will be launching a new mission named 'Earth 2.0'. Its objective is to find an Exoplanet with conditions that tend to assist and support alien life. Most astronomers believe that the planets which are similar to Earth support alien life and so they focus on it. Initially, the mission starts with the launch of Earth 2.0 spacecraft to the L2 point, the gravitational pull of the Sun and Earth forms an equilibrium, which keeps the smaller objects L2 in orbit. It is believed that this mission would be brought off fortuitously and it would dispense a cluster of Exoplanet samples for future research. With the use of NASA's Kepler telescope, 5000 planets have been brought to light in the Milky Way. This Chinese mission will be accomplished and funds will be provided by the Chinese Academy of Sciences. The team plans to launch this spacecraft before the end of 2026.

The Earth 2.0 is designed in a manner that it will be able to carry 7 telescopes which have the potential to observe the Sky for 4 years. Jian Ge, The Astronomer leading the mission Earth 2.0 says that "The Kepler field is a low-hanging fruit because we have very good data from there". Hopefully, Mission Earth 2.0 will be made successful in the year 2026.

SAHANA RV
22/UPHA/001

CONSTELLATION MYSTERY

Thousands of years ago, astronomers divided the stars into groups and drew imaginary pictures around them, such as that of a hunter or a bear. This made it easier for them to remember the star patterns. Such a group of stars is called a 'constellation'. The shape of a constellation always remains the same. Constellations appear to move from east to west. As of Today, about 88 Constellations are found by astronomers. However, the stars in a constellation are unrelated. They are at widely varying distances from the Earth. However, when viewed from the Earth, they appear to be at the same distance and form a group. As

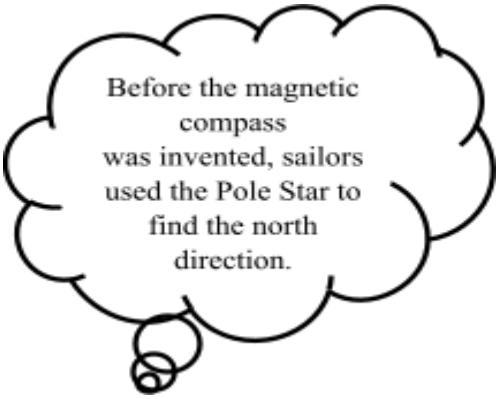
already said, there are 88 constellations found by astronomers as of today and some of them are discussed here.

Ursa Major

It contains seven bright stars arranged in the form of a big spoon. It is called the Big Dipper. This name is derived from the word 'dipper' which in the olden days meant a large spoon used for drinking water. It is also called the Great Bear because, along with several other faint stars, it forms the picture of a bear. Its Indian name is Saptarishi.

You can locate the Pole Star (Dhruv Tara) with the help of Ursa Major. This star can be seen towards the north and it is the only star that stands stationary in the sky with respect to earth. Before the magnetic compass was invented, sailors used the Pole Star to find the north direction.

Orion



Orion is also called THE HUNTER. Its Indian name is Mriga. It has seven bright stars and several faint ones. Four bright stars mark the shoulder and legs of the hunter and three stars mark its belt. Other faint stars complete the picture. Betelgeuse and Rigel are the two bright stars of this constellation. This constellation is visible in the winter season and is easy to locate.

You can locate Sirius, the brightest star in the sky with the help of Orion. A straight line through the three middle stars of Orion leads to Sirius.

Cassiopeia

This constellation is visible in the northern sky during winter in the early part of the night. The five prominent stars form a distorted W or M. All the stars in the constellation are supposed to form an image of the Egyptian queen Cassiopeia.

KAROLINE MARY ANGELENE A
22/UPHA/002

SPACE SOLAR

Scientists around the world say harvesting the Sun's energy in space can turn out to be a cost-effective way of delivering the world's need for power in as little as 30 years. This is done by building up a satellite that could collect energy from the sun and beam it back down

to the Earth, which is then added to the electrical grid. Several groups of scientists across the world dreamed of building such a satellite over several decades, but no one came up with a design with all the constraints until last summer.

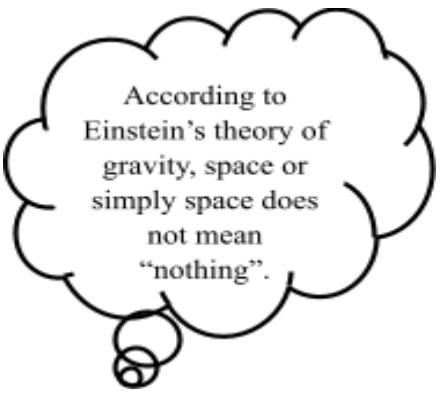
John Mankins, a NASA engineer, put forth this idea in reality. This idea is a bio-mimetic approach, meaning it is based on a way something in nature goes about handling a similar situation. His idea is this: there is something like flowers whose petals collect solar energy and reflect into Earth. These petals are built up of an array of small mirrors that would direct the solar rays to solar cells and this energy is then converted to microwaves. These microwaves are collected in the receiving station on Earth, where electricity would be generated from the energy of microwaves. The mirrors and solar cells should be small and lightweight so that they could be easily transported into space using conventional transport vehicles.

NASA is working on a cheaper version of this project which will orbit closer to earth. It works out well; a full-scale satellite would be built and sent up, which would perhaps become a game-changing theory of energy production. It is said that this idea could double the amount of solar power collected, compared with the amount of earth-bound technology Another advantage is that space solar power can occur without worry about adverse weather conditions and the cost of energy storage.

VARSHA M
22/UPHA/006

DARKNESS OF THE COSMOS

The observable universe, the galaxies and stars are just 5% of the whole universe. Can you believe that? Also, the universe is still expanding even after years after the Big Bang. What causes this continuous expansion? These questions made physicists sleepless.



During the early 1990s theorists predicted that the universe must have low energy density to stop expansion and again form a singularity or it must have high energy density and that density is then slowed by gravity. Theoretically, the universe must slow down expansion. But by observations (from Hubble Space Telescope) the universe is not slowing down but the expansion is accelerating. What causes this acceleration? It is known as dark energy. Roughly about 68% of the universe is made out of dark energy and about 27% is made up of dark matter. According to Einstein's theory of gravity, space or simply space does not mean "nothing". Space has its energy. In simple words, if space increases energy increases as well. Einstein named it a "cosmological constant". But the cosmos is not constant. On the other hand, in the quantum theory of matter, space has

virtual particles that produce their energy. By observations, the energy produced is tremendous that it could not be ever so. Dark energy is a dynamic energy fluid or field. If all the known theories fail to explain cosmic expansion then do we need a new theory? Also, dark energy is not detectable by today's instruments. Because it does not emit or absorb radiation.

This energy comes from particles that are not visible and so-called dark matter. Dark matter does not contain baryonic particles. Dark matter is not an antimatter. Because it does not produce gamma radiation and no destruction when facing matter. You cannot imagine a universe with equal amounts of matter and antimatter or antimatter existing predominantly.

If the puzzles of dark energy are solved then science and humankind reach new heights that are unimaginable and will become reality.

SUGANYA G
22/UPHA/022

THE SPACETIME

Is time travel possible? Is time real or just an illusion? What is space-time? These are some of the many questions that have been pondered by scientists across the globe. Time is not a fixed quantity. Time is relative to space. Space and time are not separate but rather a single entity. The speed of light is constant. If a person at rest and a person in motion are both observing light from the same source, the speed at which they both perceive the light remains the same. For the speed of light to be constant for both moving and stationary objects, the time varies. This may seem absurd for objects at a closer distance but for objects of larger size and distance, there is a vast difference in time. This is called time dilation. Thus, time is an uncertain quantity.

There is no specific direction for the flow of time. In our galaxy, we feel time flowing in a forward direction. But does time only move forward as per the Arrow of Time concept? The Universe is full of interactions. Interactions between various subatomic particles resulted in the formation of our Universe. Our Universe keeps expanding and thus moving from a less disorderliness to a more disordered state. There is an increase in entropy. Time also keeps moving from past to present and from present to future. Entropy is also a factor affecting time. Time flows in our three-dimensional Earth but according to the Block Universe Theory, that is not the case. According to this

theory, time just exists but doesn't flow. The past, present, and future all coexist together in their respective coordinates in this four-dimensional space. Time is an infinite loop. Thus, the Deja vu feeling that many of us feel may be real if this is the case, for we may have experienced the exact incident before at a different point in time. If the block universe concept is real then time travel may not just be imaginary. Time is variable. For objects that move at a lesser velocity than the velocity of light, time flows faster and for objects that move at a higher velocity than that of light, time flows slower.

The proverb reads ‘Time waits for none’. Well, time does stop if an object can move at the speed of light. Time is illusionary at the quantum level but has to be real at macroscopic levels to be practical. There is no specific order for the flow of spacetime. The past for one person may seem to be the future for another person. Space-time is not an objective reality. Space-time varies prospectively but the space-time interval between different events is the same for everyone. Time is the result of causality. Time is a flipbook on the four-dimensional block universe where all our past, present and future events exist. There is no sense in this four-dimensional space thus no specific time order. There are several space-time with different geometries and not just one.

DHEEPTHI D
22/ UPHA /032

THE EXPANDING UNIVERSE

In our universe, which is filled with incredible and wondrous bodies like black holes, pulsars, and supernovae, one of the most intriguing mysteries is the mysterious force that drives our universe. The birth of our universe is widely accepted to be the Big Bang a huge explosion resulting in the birth of our existing universe. The major theories of how the universe will end are also put forth by physicists and cosmologists a few being the Big Freeze, where the universe will reach absolute zero temperature; the Big Rip, where the constituents of the universe are torn apart; and the Big Crunch, where the universe contracts and eventually collapse into a single point.

There are many theories behind the reason for the accelerating expansion of the universe. Hubble measured the rate of expansion of the universe in the 1920s and termed the rate of expansion as H or Hubble’s constant. The well-known theory is the concept of dark energy being the driving force in this expansion, although the existence of dark energy is still theoretical in nature. Cosmologists all over the world are eager to discover and prove the reason for this expansion - for it would give rise to, but also solve many other mysteries regarding our enormous home.

MARIZA FLORENCE
21/UPHA/003

WHAT WOULD HAPPEN IF THE SUN EXPLODED

Our Sun is one of the lower stars in the Milky Way galaxy. The Sun is comparatively a youthful star, at only 4.6 billion times old. Without the Sun we cannot survive on Earth. Plants use light from the sun to induce the veritable oxygen we breathe. If the Sun decides to up and explodes one day, the resulting blast is named a supernova. A change in the core would affect the Sun launching the utmost of its mass into space in the most massive explosion we have ever seen.

Although a long way out, the Sun will go through a metamorphosis as it nears the end of its life. As it uses up the last bits of hydrogen in its core, the Sun's mass will begin to collapse into itself. This pressure will heat its centre, pushing all its face layers outward. The performing expansion will beget the Sun to grow so large it'll fully consume our Earth.

The Sun will remain a red mammoth for a hundred million times as it burns and fuses its helium to survive. Eventually, the Sun will have nothing left to give and expel its external layers into the breadth of space. This planetary nebula will remain roughly 10,000 times and may form new stars and globes. After the Sun creates a planetary nebula of gas, only a condensed core of carbon and oxygen will remain. This core remnant is known as a white dwarf. The white dwarf will still emit residual heat and light at first but on a much lower scale. It will take numerous billion times for the white dwarf that was formerly our Sun will cool completely, leaving nothing but a cold surge, black sphere.

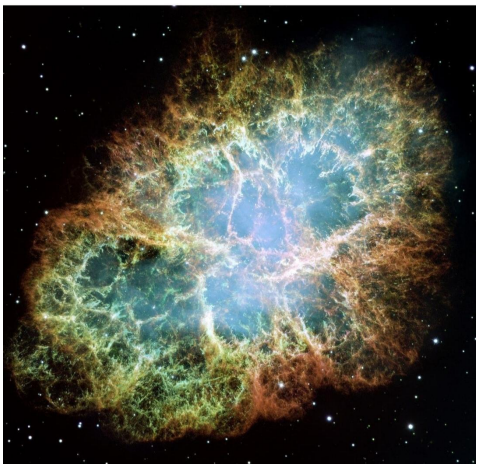
MAGDALENE S
20/UPHA/002

NEBULA

Nebula is a Latin word meaning" cloud", but in an astronomical environment, it refers to any celestial object which appears cloud-like when viewed through a telescope.

Nebulas are frequently set up in the space between stars, known as the Interstellar medium. On an average, this region contains only around one snippet per boxy centimetre. Still, in certain places, the viscosity can be significantly advanced than this grandly enough to come visible through a telescope. The result is what we call a nebula, and they're among the most

spectacular sights in astronomy. In fact, numerous of the most iconic Hubble telescope images, similar to the" Pillars of Creation", are images of nebulae.



There are several different types of nebulas, depending on how they form and their composition. The utmost nebula is primarily made of gas, which is suitable to glow with its own light, creating the various displays with which we're familiar. But other nebulae similar to the so-called" dark nebula" are important in their composition, and rather than glowing this dust has the effect of blocking the light from further distant objects beyond it. Nebula plays a crucial part in the life cycle of stars, both at their birth and death. Stars are born in thick clumps of gas, dust, and other material inside verbose emigration nebulae, also constantly pertained to as" astral nurseries". Hubble's Pillars of Creation is in this order, as is the notorious Orion Nebula, which you may well have seen for yourself through binoculars or a small telescope. The top force at work then's graveness, which causes the tenuous astral medium to condense into a nebula and graveness causes clumps inside the nebula to collapse down into stars.

At the other end of a star's life, we encounter a different type of emigration nebula. Stars like the sun end their lives as largely compact white dwarfs, but as they shrink down into this phase they release shadows of gas that form a so-called" planetary nebula". This is a rather deceiving name because a similar nebula has nothing to do with globes. Unlike verbose emigration nebulae, these have a more easily defined appearance, generally indirect in shape, which reminded William Herschel of the earth when he first observed them in the 1780s. Not all stars end their days in the relative serenity of a planetary nebula. A star that's much more massive than the sun will ultimately explode as a winner and the debris slung out from that explosion forms yet another kind of nebula called a winner remnant. The most notorious of these is the grouser Nebula, which is all that remains of a spectacular winner that was observed by Chinese astronomers in 1054.

This nebula has everything Cosmic clouds, hot young stars and butterfly-shaped regions of nebulosity all make up this stellar nursery. Located in the large Magellanic cloud - a satellite galaxy to our own - this nursery lies 160000 light years away from the earth, just south of Tarantula Nebula. Also, this photo was captured by the Hubble space telescope. New stars emit intense bouts of ultraviolet light, causing hydrogen gas to glow blue. The blackness of space gives way to bright blue wisps of hydrogen gas mixing with red, yellow and orange dust.

In the 19th century, astronomer William Parsons sketched the nebula and produced a drawing that resembled a crab, giving the supernova its common name – the crab nebula. Civilizations around the world marked the arrival of a "guest star" in 1054C.E which appeared bright in the daytime sky for nearly a month. This star was a stellar explosion 6500

light-years away in the direction of the constellation Taurus. Edwin Hubble first associated the supernova remnant with the ”guest star” and this image was captured by his namesake Hubble. In this image, the orange and the green is ionized sulphur and the red is doubly ionised oxygen. The blackness of space surrounds an amorphous nebula with veins of orange, blue, green and red that extend toward the centre of the supernova remnant.

These prominent pillars of semi-opaque gas and dust in between shades of rust-brown and grey-blue start at the bottom left and towards the top right. From left to right, each pillar is consequently smaller. The background blends from dark blue in the bottom left corner to bright orange–red in the upper right. The predominant bright orange hues dip into v shape at the top centre. Multiple tips of the pillars appear to have eight points of yellow and blue stars littering them. There are also tiny orange-red dots at the edges of the pillars, which are newly born stars.

ANTONY TRINITA B
20/UPHA/027

IS SPACE REALLY SPACIOUS?

Space is a continuous area that is free or unoccupied. Every single human would be fascinated about the night sky. The night view is so adorable that it takes us to another world. And that makes everyone curious about outer space and the outer world. Is our outer space really free, or vacant?

Actually, the space is a fantastic playground filled with knowledge and many other things. We can use space travel to support or refute scientific hypotheses that were formed on Earth. Due to the lack of molecules positioned close enough to one another, sound cannot travel over space. Bits of gas, dust and other matter float in the “emptier” (but not quite empty) parts of the universe, while planets, stars and galaxies can be found in the more congested parts.

The Kármán line, which is located about 62 miles (100 kilometres) above sea level, is where we on Earth typically think that outer space starts. No one knows exactly how big the space is! We came to know only a very little % of this space using our resources and technology. To measure long distance we use light years which is the distance travelled by light in 1 year. We have mapped galaxies almost as far back as the Big Bang, which is thought to have begun our universe around 13.8 billion years ago, from the light that is visible in our telescopes.

There are other types of radiation present in the “emptier” regions of space in addition to the debris fragments that strike them. Charged particles streaming from the sun in our own solar system, known as the solar wind, can cause auroras to appear close to Earth’s poles. Furthermore, cosmic rays from supernovae outside of our solar system pass through our neighbourhood. Another thing to note is that our Universe is ‘overwhelmed’ with Cosmic Microwave Background (CMB), which is believed to be the leftover radiations from the great explosion, the Big Bang and CMB is the oldest radiation which can be detected or traced by our instruments. Then comes the two great mysteries of the Universe- Dark Matter and Dark Energy. Even though their existence has been proved, they are still under the tag ‘mysteries’ because only their effects have been observed, not directly observed. The names seem to resemble each other, but they are totally different entities.

Scientists believe that 80% of all the mass of the Universe is made up of the so-called Dark Matter. Although dark matter emits no light or energy and is therefore not directly observable, scientists have found compelling evidence that it makes up most of the matter in the universe. It is believed that Dark Energy is responsible for the ongoing expansion of Our Universe and makes up about 75% of the Universe.

Asteroids are rocks that are not large enough to be dwarf planets. Their small size often leads to the conclusion that they are remnants from the formation of the solar system. Comets are cosmic snowballs which are made up of dust and ice that orbit the Sun. When it approaches the Sun, the ices sublime, producing coma and sometimes gases and dust blown out from this coma.

We know that there are an enormous number of stars in Our Universe and a small fraction of them can be seen during the night sky. Stars are huge gas balls which can produce radiation on its own. When the core of the star is deprived of elements for fusion, starbursts generate a lot of gas and dust particles to outer space. Then comes the planets, which revolve around the Sun assumed to have a nearly round shape. As we know, among the planets in our solar system, Earth is the only one known to support life so far.

Among the large comic structures, we will be able to see the Galaxies, which are a huge collection of stars. Galaxies often have supermassive black holes embedded in their centres and can only be seen through the radiation each black hole emits and its gravitational interactions with other celestial bodies. So an empty space is not empty. A point in space is filled with dust and gas, light from stars, cosmic rays and the other radiations left over from the great Big Bang, electric and magnetic fields, neutrinos from nuclear reactions, planets and many more. But our Universe is expanding and thereby becoming spacious and spacious!

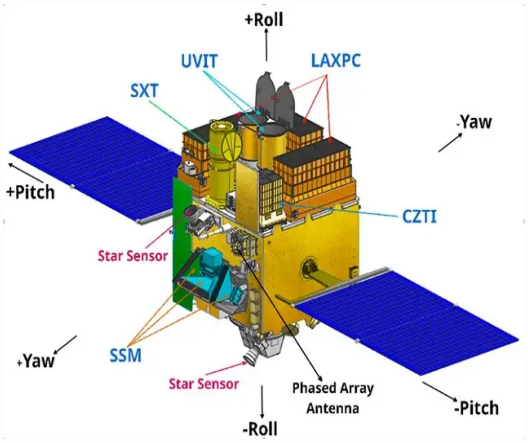
DARIA TESSA JEEN
22/PPHA/122

MULTI-WAVELENGTH ASTRONOMY SATELLITE : ASTROSAT

AstroSat is the first dedicated Indian astronomy mission aimed at studying celestial sources in X-ray, optical and UV spectral bands. AstroSat is India's Space Astronomy Observatory launched into a 650-km, 6-degree inclination orbit on September 28,2015 , with a lift-off mass of 1515 kg, by PSLV-C30 (XL) rocket from Satish Dhawan Space Centre Sriharikota. AstroSat carries a total of five scientific payloads enabling imaging, studying temporary and spectral properties of galactic and extragalactic cosmic sources in a wide range of wavelengths on a common platform.

The unique feature of this observatory is its capability for carrying out broadband simultaneous multiwavelength observation going from far ultraviolet to gamma rays. UVIT has the highest angular resolution of 1.5 arc second which is 3 times better than the next best UV telescope (GALEX-Galaxy evolution explorer) operational today. LAXPC has the highest collecting area in comparison to any other X-ray detector till today. The unique capability of measuring X-ray polarisation is done using an astrosat and also acts as an open detector beyond 100 keV.

AstroSat is operated as a proposal-based observatory. The proposals for AstroSat data are solicited through the announcement of the regular base.



AstroSat has the following five payloads:

ULTRAVIOLET IMAGING TELESCOPE (UVIT)

It was developed by IIA and consists of two identical telescopes of aperture 380 mm. One telescope covers the FUV (130-180 nm) band and the other covers the NUV (200-300 nm) and visible band (320-550 nm). The hyperbolic mirrors are super polished.

LARGE ARE X-RAY PROPORTIONAL COUNTERS (LAXPC)

It was developed by TIFR which has three identical gas detectors. LAXPC has a total effective area of 8000 cm^2.

CADMIUM-ZINC-TELLURIDE IMAGER (CZTI)

It was developed by TIFR which works in 20-100 keV. The imaging capability is achieved with a coded mask. CZTI also has the capability of making X-ray polarisation measurements.

SOFT X-RAY TELESCOPE (SXT)

It was developed by TIFR which uses X-ray reflecting mirrors and X-ray for imaging and spectral studies in 0.3-8 keV.

SCANNING SKY MONITOR (SSM)

It was developed by ISRO which is an all-sky monitor for detecting and monitoring transient sources and for follow-up studies of known X-ray sources in 2.5-10 keV regions.

TREFILLA MISSIER S
21/PPHA/101

FEEDING BLACK HOLE BLOWS COSMIC BUBBLES

The explosive outflow from a distant supermassive black hole is one of the most energetic outbursts. The effect of a distant feeding black hole that is burping out massive amounts of energy and blowing huge cosmic bubbles in its surrounding material. A cosmic bubble is a cavity of low-density, high-temperature plasma surrounded by a shell of cold, neutral gas and dust.

The galactic cluster MS0735 located in the constellation Camelopardalis, 2.6 billion light-years away, reveals new information about mysterious cavities or radio bubbles small-scale energy bursts that, over millions of years, fuel much larger explosions, creating vast, high-energy clouds that surround the black hole. The most energetic outbursts ever observed from a supermassive black hole. This happens when you feed a black hole and it violently burps out a giant amount of energy.

Supermassive black holes are found at the heart of most massive galaxies including the Milky Way with the supermassive black hole Sagittarius A at its centre. The galaxies and their supermassive black hole inhabitants are often found together in groupings of hundreds or thousands, gatherings called galactic clusters. These clusters are atmospheres that fill the space between galaxies with incredibly hot gas or plasma at temperatures as great as around 90 million degrees Fahrenheit. This plasma can cool over time and allow cold dense gas to form and eventually collapse to form new stars, feeding black holes can work against the process.

Supermassive black holes can reheat this gas through explosive outbursts of material. These outflows occur when some of the matter is not swallowed by the black hole but instead dragged to its poles from where it is blasted out at near the speed of light. This process is known as feedback and quenches the formation of new stars with the jets of material and

shapes out cavities in the surrounding gas. As this gas is pushed away from the centre of galactic clusters it is replaced by bubbles that emit radio waves.

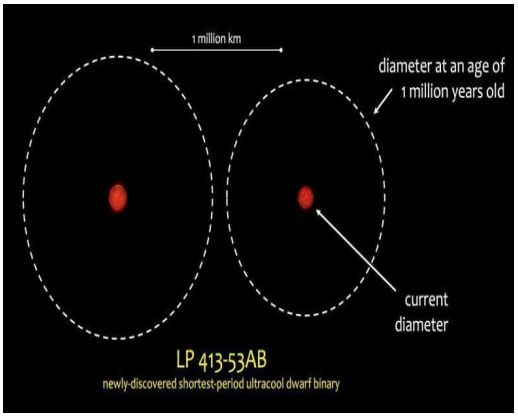
The shifting of huge volumes of gas requires a large amount of energy in turn and a subtle distortion effect that rapidly moving electrons in the hot cluster gas have on the Cosmic Microwave Background is microwave radiation that fills all space. This effect on fossil radiation was emitted 380,000 years after the beginning of the universe. When the cosmos had increased in size and cooled to allow electrons to bond with protons creating the first atoms thus allowing photons to travel freely creating the first light is called the Sunyaev Zeldovich effect.

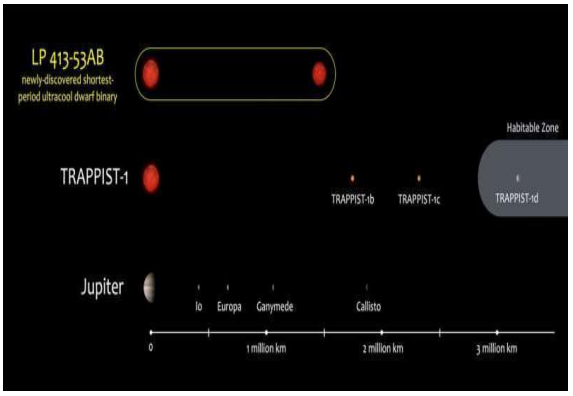
Cavities from collapsing come from things other than heat with these non-thermal sources including particles travelling at near-light speed, high-speed charged particles called cosmic rays, and turbulence. They found a small contribution comes from magnetic fields.

NIRAJA
21/PPHA/109

ULTRACOOL DWARF BINARY STARS BREAK RECORDS

The two stars are so close that it takes them less than one Earth day to revolve around each other. In other words, each star "year" lasts and has just 20.5 hours.





The newly discovered system, named LP 413-53AB, has been composed of a pair of ultracool dwarfs and a class of very low-mass stars that are so cool that they emit their light primarily in the infrared and make them completely invisible to the human eye. It is one of the most common types of stars in the universe.

Previously, astronomers only detected three short-period ultracool dwarf binary systems, all of which were relatively young up to 40 million years ago. (LP 413-53AB) It is estimated to be billions of years old, similar age to our sun but it has an orbital period that is at least three times shorter than all the ultracool dwarf binaries discovered so far.

At the 241st Meeting of the American Astronomical Society in place of Seattle. The "Discovery of the shortest-period ultracool dwarf binary" will take place on the day of Tuesday, Jan. 10, as part of a session on the "Stars and Their Activity."

The team first discovered a strange binary system while exploring archival data. Scientist Hsu developed an algorithm that can be a model of a star based on its spectral data. By analysing the spectrum of light which is emitted from a star, astrophysicists can determine the star's chemical composition, temperature, gravity and rotation. This analysis also shows the star's motion as it moves toward and away from the observer, which is known as radial velocity.

When examining the spectral data of the LP 413-53AB, Scientist Hsu noticed something strange. Early observations caught the system when the stars are roughly aligned and their spectral lines overlapped, leading Hsu to believe it was just one star. But as the stars moved in their orbits, the spectral lines shifted in opposite directions, splitting into pairs into later spectral data. Scientist Hsu realised there were two stars locked into an incredibly tight binary.

"When we people were making this measurement, we can see the things changing over a couple of minutes of observations," Burgasser said. Most of the binaries we follow have orbit periods of years. So, we get a measurement every few months. Then, after a while, we can piece together the puzzle. With this system, we can see the spectral lines moving apart in real time. It is amazing to see something that is happening in the universe on a human time scale.

The observations confirmed what Scientist Hsu's model predicted. The distance between two stars is about 1% of the distance between the Earth and the sun. "This is remarkable because when they were young, something like that 1 million years ago, those stars would have been on top of each other," said Burgasser. The team speculates that stars either migrated toward each other as they evolved, or they could have come together after the ejection of a third now lost stellar member. More observations were needed to test these ideas.

Scientist Hsu also said that by studying similar star systems researchers can learn more about potentially habitable planets beyond Earth. Ultracool dwarfs are fainter and dimmer than the sun, so any worlds with liquid water on their surfaces—a crucial ingredient to form and sustain life—would need to be closer to the star. However, for the named LP 413-53AB, the habitable zone distance happens to be the same as stellar orbit, making it impossible to form habitable planets in this system.

"These are the ultracool dwarfs that are neighbours of our sun," Scientist Hsu said. To identify the potentially habitable hosts, it is helpful to start with the nearby neighbours. But if close to binaries are common among ultracool dwarfs, there may be few habitable worlds to be found. To fully explore all these scenarios, Hsu, Burgasser and their collaborators hope to pinpoint more ultracool dwarf binary systems to create a full data sample. New observational

data can help us to strengthen the theoretical models for binary star formation and evolution. Until now, however, finding ultracool binary stars has remained a rare feat. "These systems are rare," said Chris Theissen, study co-author and a Chancellor's Postdoctoral Fellow at UC San Diego. "But don't know whether they are rare because they rarely exist or because we just don't find them. That's an open-end question. Now that we have only one data point that we can start building on. This data has been sitting in the archive for a long time. Dino's tool will enable us to look for more binaries and binaries like this."

NIHER N
21/PPHA/112

PLUTO IS ALIVE!

In 2006, NASA launched the New Horizons probe to explore the then-ninth planet of the solar system Pluto. After travelling for nine years, New Horizons reached Pluto and became the first spacecraft to visit the far-flung world. Today, the probe has crossed the mark of 50 astronomical units from Earth. That is more than 7.5 billion kilometres or 4.6 billion miles. But data from the Pluto flyby are still being analysed by astronomers. In 2022 studies suggested that Pluto is alive and isn't as calm as it seems. The images of Pluto's surface have shown many bumpy volcanos raised to different heights. Unlike the other planets there were no impact craters from asteroids or meteors nor was there any evidence of plate tectonic activities that play a crucial role in the formation of mountains on Earth. All these factors hinted that this surface was formed after a geological disturbance, possibly a volcanic eruption. Scientists carefully studied two volcanic peaks on Pluto named Wright Mons and Piccard Mons. After analysing the images captured by New Horizons, researchers speculate that the formation of such a terrain might have been fueled by multiple eruption sites located near each other. The material ejected during the resultant cryovolcanic eruptions coated the entire region with layers of ice.

So, from where does Pluto get heat for the volcano? Pluto does not have much rocky material in its core to generate enough heat from radioactivity like the Earth. It does not have massive neighbouring objects that exert a gravitational pull on it, like in the case of Jupiter's moon, IO. Thus, the only possible way is that Pluto will still have some unused heat from its formation trapped within it, which is highly likely in a deep-water ocean beneath its icy crust. If cryovolcanism is still active on Pluto today, it will strengthen the possibility of finding a liquid ocean there and maybe life too.

SHARLIN SHAJU
21/PPHA/114

DWARF GALAXIES

What are they?

Dwarf galaxies are a small portion of the size of the Milky Way, despite the fact that they have the potential to hold billions of stars. The most prevalent type of galaxy in the universe is known as a **"dwarf galaxy,"** but because they are far less brilliant than larger galaxies, they are harder to see. The bulk of dwarf galaxies, often referred to as **"satellite galaxies,"** are found in galaxy clusters and as partners to larger galaxies. It may be crucial to understand how these dwarf galaxies form and how they interact with larger galaxies like the Milky Way.

Dwarf Galaxy: Forms and Dimensions

Dwarf galaxies are thought to be formed by the gravitational pull of larger galaxies either during their formation or when two larger galaxies collide, as will happen in billions of years when our galaxy, the Milky Way and its neighbour, the Andromeda galaxy, collide.The colliding galaxies are torn apart by these encounters, releasing jets of gas, dust and even stars. A significant portion of material continues to be reincorporated into the galaxy formed by the collision, although some of it might produce dwarf galaxies that continue to circle this galaxy. The quantity of stars in each of these corresponding groups of stellar objects, gas, dust and dark matter is what distinguishes dwarf galaxies from ordinary galaxies.

Dwarf galaxies can have a few billion stars or many fewer stars than full-size galaxies like the Milky Way, which can have hundreds of billions of stars. Segue 2, one of the tiniest dwarf galaxies, has as few as 1,000 stars. It is one of the most faint dwarf galaxies. Segue 2 is 20 billion times less brilliant than the Milky Way, yet it is 900 times as bright as the sun. However, dwarf galaxies are not only restricted in terms of star populations. They have a restricted spectrum of shapes, despite having shapes that are comparable to those of their larger counterparts.

There are three main types of dwarf galaxies

Even though they are smaller, dwarf elliptical galaxies share many characteristics with larger elliptical galaxies.

These dwarf galaxies lack recent star formation because they have relatively little gas, which is the building block for star formation. Stars in dwarf elliptical galaxies have a total mass that ranges from 10 million to a billion times that of the sun. These dwarf galaxies range in size from 3,000 to 30,000 light-years. The Milky Way, by contrast, has a diameter of roughly 106,000 light years. Astronomers refer to the reduced proportion of heavy elements in elliptical dwarf galaxies' stars as **"metallicity."** Elliptical dwarf galaxies must be quite old because each new generation of stars contains more **"metals,"** elements heavier than hydrogen and helium. They are therefore effectively **"fossilised"** leftovers of the early universe, making them an ideal location for astronomers to look for the first star-forming generations.

Dwarf spheroidal galaxies are at the very bottom of the brightness spectrum for dwarf elliptical galaxies. Since they are so faint, we have only so far been able to find them in the Milky Way's immediate neighbourhood of about 20 galaxies. These dwarf galaxies are also far smaller than most dwarf elliptical galaxies, while having a more spherical form than elliptical dwarf galaxies. Dwarf spherical galaxies appear to range in size from 320 to 1600 light-years. The number of stars found in these dwarf galaxies is limited by their size. Most of them contain stellar matter that is equivalent to 10–100 million times the mass of the sun. Another prominent form that dwarf galaxies can adopt is that of irregular dwarf galaxies.

Smaller than 16,000 light-years in diameter, spiral dwarf galaxies have low luminosities. In comparison to dwarf elliptical galaxies and dwarf irregular galaxies, they are likewise rather few. Many astronomers believe that spiral dwarf galaxies undergo a transformation into dwarf elliptical galaxies, especially in compact galactic clusters.

SINDHUJA S
22/PPHA/114

THE ARROW OF TIME

"Time and tide wait for no man," says Geoffrey Chaucer.

Time never stops, the clock is always ticking, the future is a mystery, and once time is gone, it never comes back, and many more. Most of us have probably heard these phrases at some point in our lives. What if the clock ticks backward and takes us to the first day of our summer vacation, or our childhood fantasy of knowing the future comes true? Do you think it is possible? I have no idea, but here is a brief glimpse into the direction of time that I grasped after reading Stephen Hawking's book, "A Brief History of Time."

People used to believe that time was absolute and that every event could be measured in terms of units of time. Later, time became a more personal concept, relative to the observer who measured it from his or her point of reference. With the unification of gravity with quantum mechanics, the idea of imaginary time, which had no difference between the forward and backward directions, came into existence, but there is still a huge difference from real time, where time is not the same in both directions.

Here comes a question: why do we remember the past but not the future when the law of science does not distinguish between past and future?

Suppose there is a glass vase on the table; accidentally, it fell to the ground and broke. After a period of time, it gathers back together and jumps back onto the table. Have you ever seen it? If it really happens, the shopkeeper might run out of business. In reality, a glass vase breaking and not coming back is stopped by the second law of thermodynamics, according to which entropy increases with time. That is to say that one can go from a state of high order in the past when the vase was intact to a state of disorder in the future, not the other way around.

The increase in entropy with time is one of the examples of the direction of time, or, in other words, the arrow of time. There are three arrows that help us to distinguish the past from the future. They are the thermodynamic arrows that show how entropy increases over time. psychological arrow, the direction in which we feel time passes; in other words, we remember the past but not the future. At last, the cosmological arrow, the direction in which the universe is expanding.

Let’s begin with the thermodynamic arrow of time that follows the second law of thermodynamics. This arrow of time influences the other arrows of time.

The psychological arrow of time follows the direction of the thermodynamic arrow. It can be explained by storing data in a computer's memory. Initially, the memory is in a disordered state, but after receiving a command from an external source, it jumps to an ordered state. It goes from a disordered state to an ordered state. To ensure that the memory is accurate, a certain amount of energy is used up and it is dissipated in the form of heat, which is cooled down using the fans. The amount of disorder caused in the universe by heat dissipation is greater than the increase in order. In the end, entropy increases with time.

Coming to the cosmological arrow's direction, consider a scenario in which the universe begins to contract due to the presence of a weak thermodynamic arrow of time. It might lead to all sorts of science fiction-like possibilities; wouldn’t it be so exciting to see the future or see the broken vase jump back to the table, among many others? But in reality, a strong thermodynamic arrow is required for intelligent life to operate. In order to survive, we living beings need to consume food, which is an ordered form of energy and convert it into heat, which is a disordered form of energy. Thus, intelligent life could not survive in the contracting phase of the universe. Thereby, we can conclude that both the thermodynamic and cosmological arrows of time point in the same direction and the universe is expanding. It is not the expansion of the universe that causes disorder to increase; rather, the lack of a boundary condition causes disorder to increase.

After knowing about various arrows of time, it’s time to think further and explore the switch that can control the time that waits for no man.

MERCIA ROLEIN. R
22/PPHA/102

DARK MATTER & DARK ENERGY

So, the cosmological theory says dark matter is a non-luminous material that is believed to exist in space and that it could take any of its own forms, including weakly interacting particles, which is cold dark matter, or the high-energy randomly moving particles created soon after the big bang, which is hot dark matter. Dark energy is even more peculiar and strange, as it exists as the complete opposite of gravity and exerts a negative, repulsive pressure. In the 20th century, astronomers learned that the universe is expanding. To the

contrary, this mysterious force causes the expansion of the universe. And we can't detect it or measure it.Surely, dark matter is not a part of a black hole, a compact mass that vigorously disturbs its surroundings rather than being dispersed all over the place. The universe is made up of 67% dark energy, 28% dark matter and the rest 5% regular matter like stars, galaxies, atoms, trees, etc.

To be precise, we have never known what dark matter and dark energy are about, but what we do know is that something else exists that is more powerful and that it can even expand our universe. Dark matter does not interact with electromagnetic forces, which means it does not observe, reflect, or emit light. This much information is brought to our attention solely by the attractive force known as gravity.In the 1930s, Swiss-American astronomer Fritz Zwicky researched the galaxy cluster called the "Coma Galaxy Cluster." While calculating the mass of the stars, he found some changes where the mass should be 400 times more than the calculated one. So, he was puzzled and began researching further into it. He said that there is something invisible that is driving these clusters and named this unknown phenomenon "DARK MATTER." Gravitational lensing confirms the existence of dark matter. In 1917, Einstein also hinted at the existence of dark matter. He said that the empty space is not nothing; it has amazing properties.

This empty space creates some kind of energy, which creates a temporary virtual particle and destroys it at the exact same moment. And the after-effect of this process of energy is the reason for our universe expansion. And thus, it is believed that this energy could be dark energy**.** All these theories about dark matter and dark energy remain nothing but theories. There are no proven facts that support these theories. We still have a lot to learn in this wide-ranging universe.

PRINCY NADALYA A
22/PPHA/124

PHYSICS IN OCEAN AND ITS SURFACE

The study of the physical and biological features of the ocean is known as oceanography or oceanology. It is a significant branch of earth science that deals with a variety of subjects. These interdisciplinary subjects include astronomy, biology, chemistry, climatology, geology, hydrology, meteorology, and physics. Oceanographers combine these fields to learn more about the ocean environment and its processes. One of humankind's oldest fields of study is marine science. Physical oceanography is the study of the physical conditions and physical processes that occur inside the ocean, particularly the movements and physical characteristics of ocean waters. Descriptive and dynamic oceanography are two types of physical oceanography.

The science of physical oceanography examines the dynamical and physical characteristics of the oceans. It also covers the physical motions and processes that take place within the waters. One of the many subdomains that make up oceanography is physical

oceanography. An important component of oceanographic analysis is physical oceanography. It is the study of the physical factors that influence the seasons and oceans. It deals with all large-scale physical processes occurring inside the waters as well as their repercussions. The processes' nature is quite dynamic. They involve water masses with a range of sizes and proportions. Additionally, space and timing affect how water masers behave. All these factors are taken into account when predicting the oceans by physical oceanography. This branch has expanded as a result of past oceanographic research and predictions made by numerous academics from practically every country in the world. Physical oceanographers investigate the atmosphere, the ocean's ability to retain and release heat, the physical characteristics of water across the ocean, the development and motion of currents, and coastal dynamics. Researchers at NASA analyse ocean surface topography, sea surface temperature, the speed and direction of winds over the ocean, and soon sea surface salinity in order to better understand these phenomena. Scientists can better analyse current and sea ice using this data. Physical characteristics of the oceans and seas are always included in physical oceanography.

Application and Scope

The oceans are a key indication of climate change since they are both impacted by and contribute to it. AUVs are used by physical oceanographers to examine these changes and evaluate how they will affect humans in the future, even in the toughest conditions on Earth, such as the poles and the deep ocean. The AUVs offer technology and capabilities that can reach these previously inaccessible places and gather the highest-quality data.

Ocean observatories are platforms created to investigate the ocean and provide answers to fundamental queries regarding the functioning of the planet. These observatories give researchers the chance to gather data passively over extended periods of time to monitor changes in the ocean, atmosphere, and Earth. One of the most technically difficult applications for an AUV is in ocean observatories, which need vehicles that can regularly dock and undock, recharge their batteries, collect and download data, and change mission patterns while submerged for extended periods of time. For all of these needs, the REMUS 100 and 600 AUVs are ideal.

DASLIMA NAZREEN R
21/PPHA/125

ANECDOTE OF BLACK HOLE

There is a forest called “UNIVERSE” which looks dark, filled with its inhabitants such as the solar system, galaxies, wonders and mysteries, quasars, supernovas, exoplanets, and possibly other forms of life. Visitors (scientists) even considered that the beginning of the Universe was the big bang. An Eagle called “Black Hole 1” is there in a forest. Like other Eagles Black Hole 1 is ferocious but unlike others, it is greedy and is also very intensive and aggressive but it was loved by the inhabitants. It loves deer. Once there came a new deer named Star to the Universe. Its naughtiness and charmingness attracted all the forest members and all liked it. Even Black Hole 1 was enjoying its presence. But the greedy Black Hole 1 who didn’t like the deer after a point, had a vengeance on it and wanted to put it down. Black Hole 1 was not allowed near the star. But when no one noticed, as Black Hole 1 was very hungry it got tempted and ate up the Star. First, it had its yummy hydrogen layer and its stomach was filled. The bone termed as ‘core’ was the only part left. It wanted it for a later time. The left-out core turned into a state called a white dwarf. If Black Hole 1 leaves it somewhere it might get caught red-handed so it carried the white dwarf along with it. It didn’t eat the left-over part. The white dwarf travelled wherever Black Hole 1 went. The white dwarf’s movement almost formed a spirograph pattern in two days. If this continues it would even get converted to a Planet, to be more specific a planet of the size of the largest planet Jupiter, a member of the solar system. The species who lived in the Universe have seen many animal species in their lifetime. But for a white dwarf to get converted to a planet may take more than 70 times greater than the life of the forest. So, this conversion may not take place. There are many Eagles like Black Hole 1 in the forest. They all love eating deer. This Black Hole 1 eats very much every day. Black Hole 1 seems to look small but as per the idiom “Looks can be deceptive” it takes in everything both mentally and physically. So Black Hole 1 survived by eating massive deer.

[All characters and comparisons in the given story are only for imagination and to make the plot engrossing. It is not meant to humiliate nature and inventions.]

JENCY IMMACULATE A
22/UPHA/003

DISCOVERING THE BEYOND!

E	H	L	S	Y	A	R	T	E	L	O	I	V	A	R	T	L	U	T	P	U
T	L	A	T	U	L	T	R	O	I	D	H	S	M	A	X	E	M	R	H	T
A	I	P	A	T	P	K	S	U	I	E	S	L	H	A	K	M	G	H	S	I
T	P	T	I	U	I	E	G	O	C	L	I	I	L	F	I	G	I	T	C	S
S	E	E	T	C	M	F	R	J	I	P	M	L	K	L	H	A	T	R	I	C
M	L	T	I	N	N	E	H	N	K	H	A	O	K	L	L	U	P	E	S	I
U	O	E	C	A	T	I	O	G	O	R	F	Y	S	H	S	U	P	L	Y	T
U	H	J	K	S	W	A	R	T	A	V	W	V	A	R	S	H	F	A	H	I
C	K	G	A	P	L	E	D	P	S	A	A	L	B	E	D	O	A	T	P	R
A	C	O	S	M	O	L	O	G	Y	T	I	V	A	R	G	L	U	I	T	O
V	A	N	D	E	R	O	F	R	K	T	S	A	D	G	L	E	R	V	F	E
N	L	A	N	O	I	T	A	L	F	N	I	D	Y	N	A	M	O	I	I	T
O	B	N	O	I	T	A	L	L	E	T	S	N	O	C	E	H	R	T	H	E
I	G	I	R	A	E	Y	T	H	G	I	L	R	I	A	R	R	A	Y	S	M
L	N	J	S	D	Z	H	P	D	Y	O	R	T	S	A	R	E	H	T	D	E
E	A	T	C	E	S	R	A	P	L	D	Q	L	Q	K	T	F	K	R	E	C
H	B	B	U	S	A	G	O	U	A	U	R	U	H	G	S	R	G	K	R	H
I	G	D	J	X	G	F	R	L	A	G	D	O	A	X	R	K	E	G	N	A
R	I	Q	X	V	B	G	T	S	K	K	Q	Y	G	R	T	A	H	C	A	N
E	B	C	F	Y	H	K	A	A	S	A	F	U	L	E	K	A	R	O	N	I

ANSWERS

ALBEDO
BLACKHOLE
CONSTELLATION
ARRAY
BIG BANG
COSMOLOGY
ASTEROID
AURORA

SUPERNOVA
ULTRAVIOLET
MILKY WAY
INFLATION
HYDROGEN
METEORITICS
LIGHT YEAR
GRAVITY

PULSAR
PARSEC
PARALLAX
PERIHELION
RELATIVITY
RED SHIFT
UNCERTAINTY PRINCIPLE
QUARKS
QUASAR

SANDHIYA S
22/UPHA/008

ASTROPHYSICS

14	4	6	6	10	17	7	11	15	2	3	10	12	13	9	1		
12	1	18	8	2	7	5	10	2	8	2							
5	8	8	2														

I. Process that power stars: ____ ____ ____ ____ ____ ____ ____

2	4	18	17	1	10	11
20	4	12	15	8	2	

II. A theoretical tube connecting two different points in space and time:

3	8	11	5	9	8	17	1

III. _____ is a star at the eastern end of Orion's belt

6	1	13	10	8	11	15	8	2	15	12		

IV. Who first proposed the theory that the galaxy was expanding?

9	4	14	14	17	1

V. _____ is when two spacecraft join together in space.

7	8	18	19	15	2	16

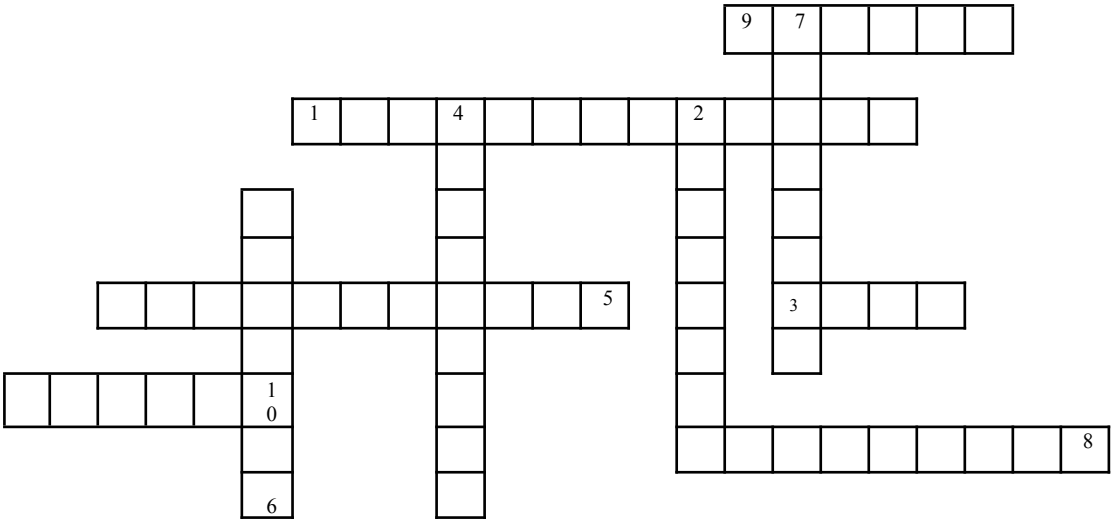
Answer:

(Buzz Aldrin was the second man on the moon.)

I. Nuclear fusion.
II. Wormhole.
III. Zeta Orionis.
IV. Hubble.
V. Docking.

SHODARHOR VASHUM
20/UPHA/050

THINK ABOUT SPACE AND PUZZLE!



Right to Left

1. A group of stars in the sky and they are often named after an animal, object, or a person (13)

9. A type of galaxy (6)

Left to Right

3. A ball of shining gas which is mostly of hydrogen and helium, which are held together by its gravity (4)

5. Objects that are round and orbit the sun like planets do (11)

8. It is a spherical shell around our solar system and it has more than a trillion icy bodies (9)

10. A collection of thousands to billions of stars (6)

Top to Down

2. It's a kind of Rocks, floating all around in space (8)

4. A starburst, which is brighter than the whole galaxy (9)

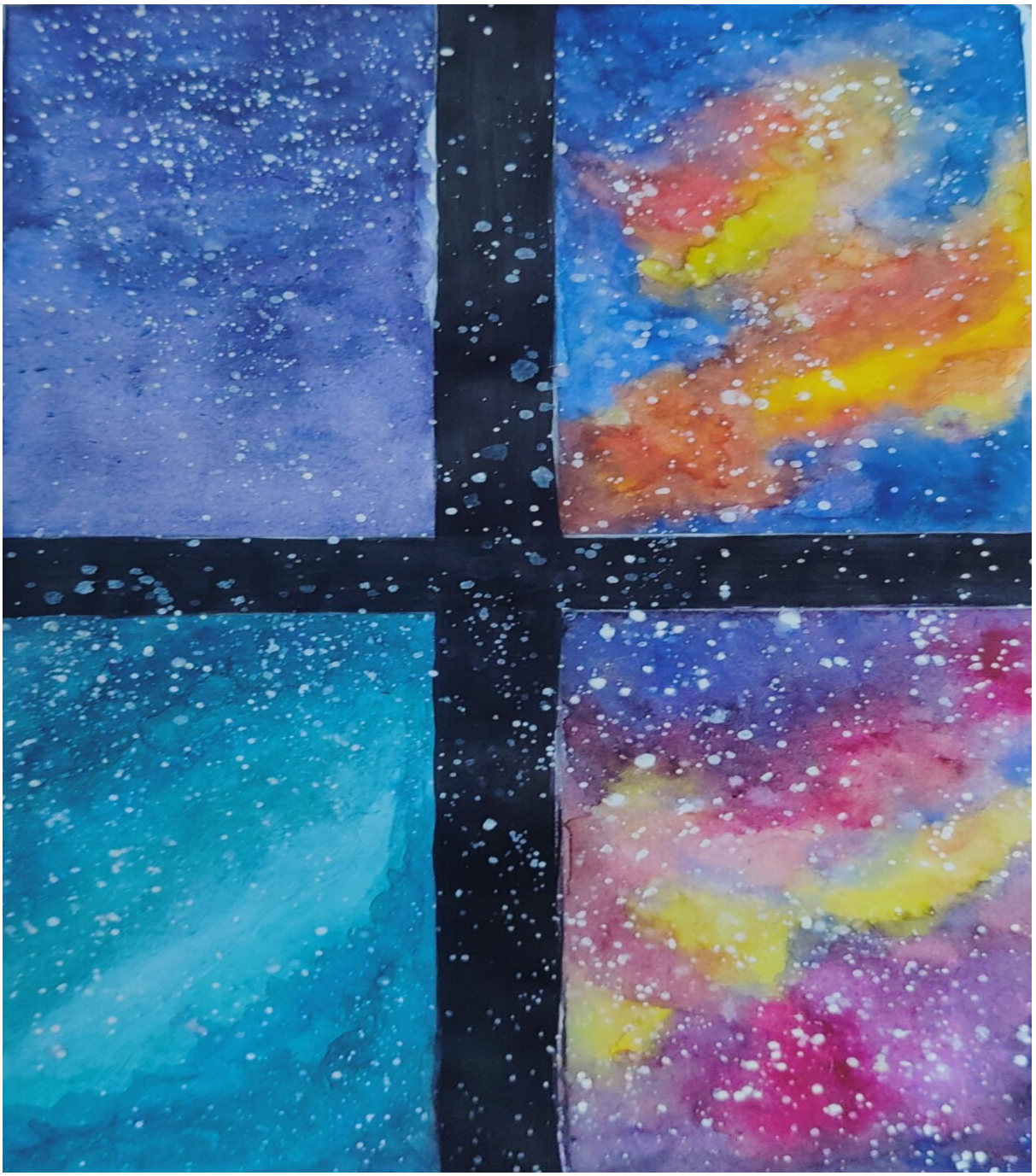
7. Includes everything like space, matter, energy, and even time (8)

Down to Top

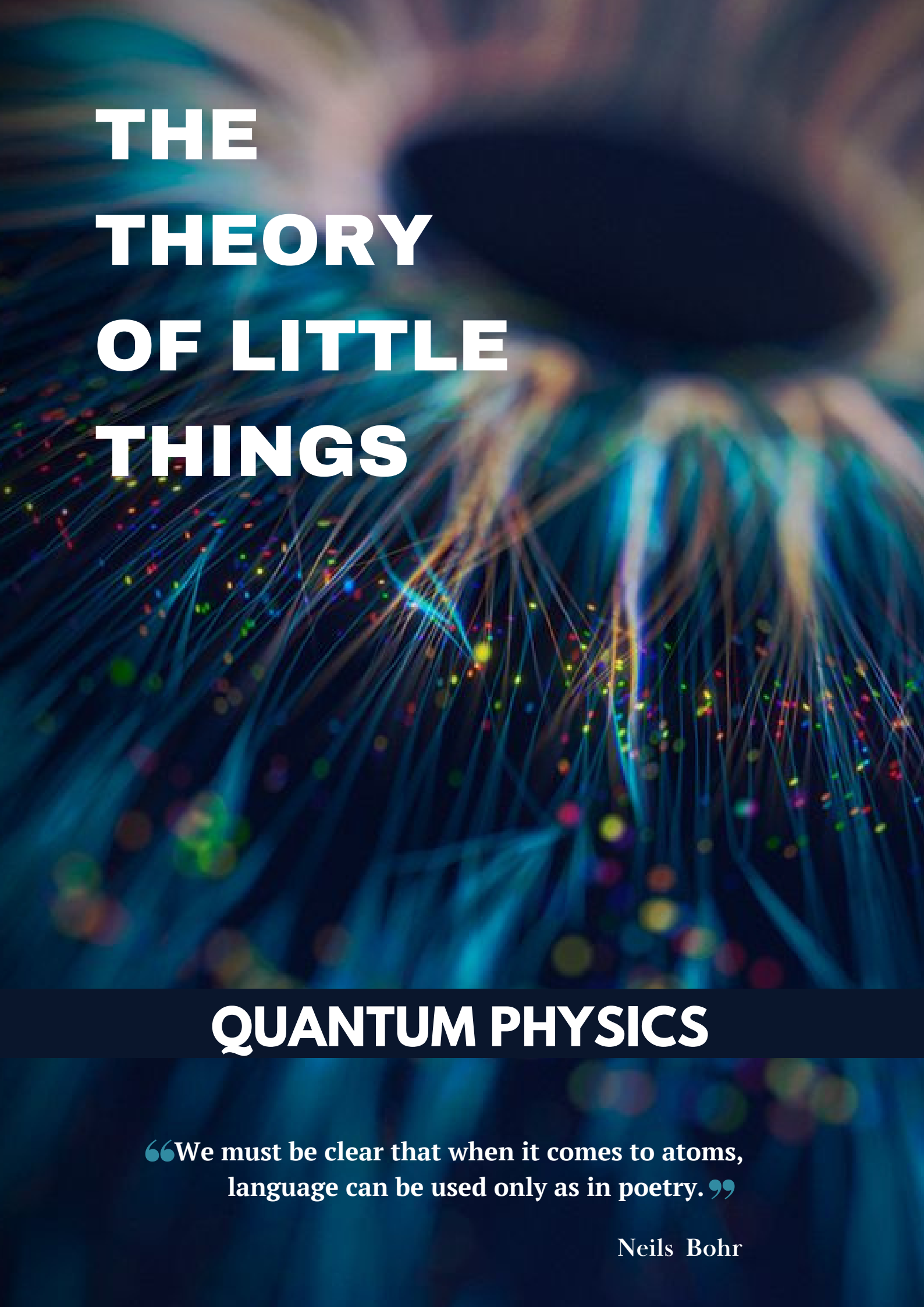
6. How astronomers explain the way the universe began as a single point, then expanded (7)

Answer: 1) Constellation. 2) Asteroid. 3) Star. 4) Supernova. 5) Dwarf planet.
6) Big bang. 7) Universe. 8) Oort cloud. 9) Quasar. 10) Galaxy

D THUTHINISA
21/PPHA/105



ZAIBA HADIYA
22/UPHA/024



THE THEORY OF LITTLE THINGS

QUANTUM PHYSICS

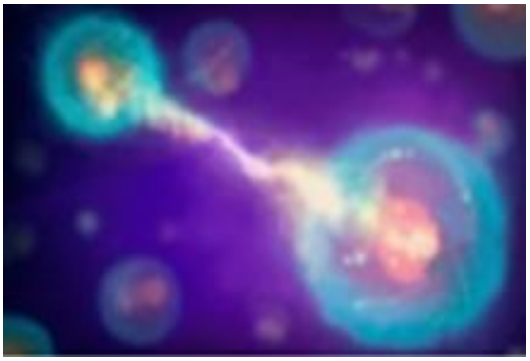
"We must be clear that when it comes to atoms, language can be used only as in poetry."

Neils Bohr

QUANTUM ENTANGLEMENT

What is it?

Quantum entanglement is one of the most intriguing and mysterious phenomena in the field of quantum mechanics. It refers to the phenomenon where two or more particles become correlated in such a way that the state of one particle can be instantaneously determined by the state of the other particle, regardless of the distance separating them.



The concept of quantum entanglement was first introduced by Albert Einstein, Boris Podolsky, and Nathan Rosen in their 1935 paper "Can Quantum-Mechanical Description of Physical Reality be Considered Complete?". In this paper, they showed that the predictions of quantum mechanics were incompatible with the idea of local realism, which states that the physical properties of a particle exist independently of measurement and can be described locally.

Quantum entanglement is a result of wave-particle duality, where particles can exhibit both wave-like and particle-like behaviour. According to the principles of quantum mechanics, particles can exist in multiple states simultaneously, known as superposition. When two particles become entangled, their states become correlated; meaning that the state of one particle affects the state of the other particle.

EPR Paradox

One of the most famous examples of quantum entanglement is the Einstein-Podolsky-Rosen (EPR) paradox. In this paradox, two entangled particles are moved in opposite directions and their states are measured. According to quantum mechanics, the measurement of one particle instantly determines the state of the other particle, regardless of the distance separating them. This apparent instant communication between particles violates the principle of locality, which states that information cannot be transmitted faster than the speed of light.

Applications

Quantum entanglement has necessary implications in the fields of quantum cryptography and quantum computing. In quantum cryptography, entangled particles can be used to securely transmit information. Because the state of one particle determines the state of the other particle, any attempt to eavesdrop on the transmission would immediately alter

the state of the particles and alert the sender and receiver.

In quantum computing, entangled particles can be used to perform certain computations much faster than classical computers. By manipulating the states of entangled Z particles, quantum computers can perform many operations simultaneously, allowing for the solution of certain problems much faster than classical computers.

How to Measure Entanglement?

By the 1930s, it was clear that Bohr, Schrödinger and the other quantum pioneers were onto something; the theory described experiments with atoms and subatomic particles more accurately than any other theory. The debate was about how far one could trust it.

Einstein, for instance, held out hope that the bizarre theory was just a stepping stone to a more complete picture that would align with classical physics. He suspected that two entangled electrons took on opposing spins because some "hidden variable" caused their spins to point in opposite directions in the first place. In other words, what looked like a random measurement outcome in quantum mechanics was the result of some as-yet unappreciated deterministic description that created an illusory connection between the particles.

In 1964, John Stewart Bell proposed some details that involved the general idea to measure the spins of entangled particles along different axes: not just up and down but sometimes, randomly, left and right or in other directions. If Einstein was right, and the particles secretly had predetermined spins all along, then the act of switching the axis of measurement should not affect the outcome. Bell calculated that if the universe was truly quantum mechanical, and entanglement was as spooky as it seemed, the axis-switching would lead to correlated spin measurements more often than would be possible in classical theories like relativity.

"John Bell translated the philosophical debate into science and provided testable predictions that launched experimental work," said Olsson.

TIMELINE

1935
Albert Einstein, Boris Podolsky and Nathan Rosen argue that quantum physics misses some "hidden variables" that would explain apparent quantum paradoxes.

1964
John Bell devises a thought experiment that suggests that the states of entangled particles are too correlated to be explained by hidden variables.

1969
The American physicist John Clauser and colleagues refine Bell's theorem and propose an experiment to test it against real-world data.

1972
Clauser and a colleague observe a violation of Bell's inequality for the first time in an experiment.

1982
Alain Aspect of France carries out a series of experiments that confirm the violations of Bell's theorem, but a few loopholes remain.

2017
The Austrian physicist Anton Zeilinger and colleagues demonstrate a loophole-free test that finally closes the door on Einstein, Podolsky and Rosen's hidden-variables theory.

2022
The Nobel Prize in Physics is awarded to Clauser, Aspect and Zeilinger for their explorations of quantum entanglement.

Bell's Experiment

Initially, physicists, including Richard Feynman, discouraged Clauser from pursuing the experiment, arguing that quantum mechanics needed no further experimental proof. But, Bell personally encouraged Clauser to see the research through, and in 1972 Clauser and Freedman succeeded in seeing Bell's experiment. They generated pairs of entangled photons and used lenses to measure their polarisation directions. Unsure what he would find, Clauser had placed a $2 bet that his experiment would prove Einstein right. To his surprise, his results inclined Bell's prediction over Einstein's. The photons' states appeared correlated in a way that precluded any hidden-variable theory. Clauser's lost bet was a huge victory for quantum mechanics. "I was very sad to see that my experiment had proved Einstein wrong," he said years later in an interview.

Nobel Prize in Physics 2022

Alain Aspect carried out a series of increasingly stringent Bell tests in Paris, culminating in a sophisticated experiment in 1982. In that test, the orientation of the lenses would randomly change during the billionths of a second that the photons spent flying from the emitter to the lens. In this way, the initial lens configuration was erased and could not influence any secret process setting the polarisation at the moment of their emission. Once more, the experiment was found in favour of Bell and quantum mechanics. Only the slimmest of loopholes remained. Could a secret and nonrandom process that was somehow set in motion at the beginning of the experiment determine how the lenses would update? Anton Zeilinger's research at the University of Vienna further narrowed this remaining small doubt.

But most researchers take the work of Bell, Clauser, Aspect, Zeilinger and their teams at face value. Entanglement is what it seems: The pair of particles is one unified system. For each particle, properties like spin and polarisation are undefined until the moment of measurement. In other words, reality has no fixed and predetermined state until you measure it. It's a dramatic conclusion that most researchers accept but still struggle to fully grasp. "The very fundamental question — what does this mean in a basic way? — is unanswered, and is an avenue for new research," said Zeilinger.

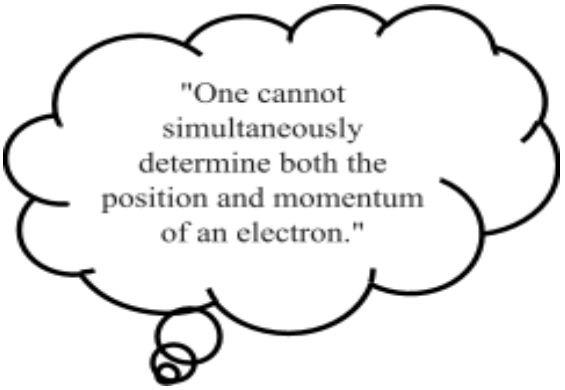
HARITHRA R
21/UPHA/011

HEISENBERG'S UNCERTAINTY PRINCIPLE

Everything in the universe exists as both particles and waves. A particle can have a specific location in space. Whereas, a wave exists in multiple locations in space due to its shape. Then, how can we determine the exact position of the wave?

Have you ever thought "What if I don't exist in this world?". Well, maybe you don't.

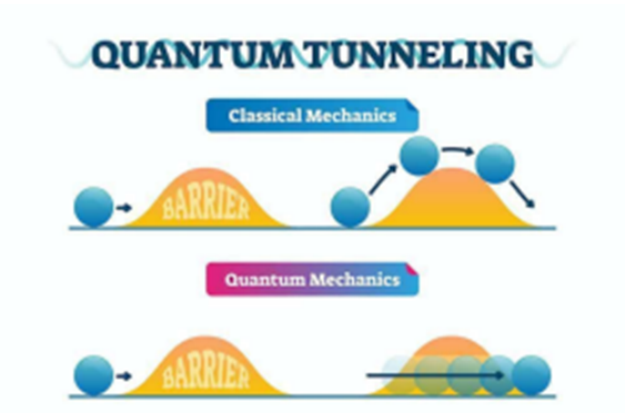
By adding many waves together, the regions where the peaks match becomes narrower indicating the presence of the wave in that region and the regions where the troughs add up indicate the absence of the wave. This suggests the probability of the position of the wave. The wave nature of a particle depends on its momentum. The larger the momentum of an object the shorter the wavelength and more prominent its position. That is why we cannot see the wave nature of humans, plants and every other object. Because they are too big and have too much momentum (mass x velocity). This is not the case for an electron. Its size is very small so its wave nature is prominent. Hence, its position can only be determined by adding a few waves together to form a wave packet. That's why the position of an electron is given by orbitals - a probability of where they exist. When we measure the location of the electron, its velocity becomes uncertain and vice-versa. Hence, Werner Heisenberg in 1927 suggested that "One cannot simultaneously determine both the position and momentum of an electron".



This paved the way for a lot of applications in the field of quantum mechanics. It raised many questions on the quantum theory of light including the famous discussion between Albert Einstein and Neils Bohr that a particle does not exist until it is observed.

SHAZA FATHIMA A
21/UPHA/007

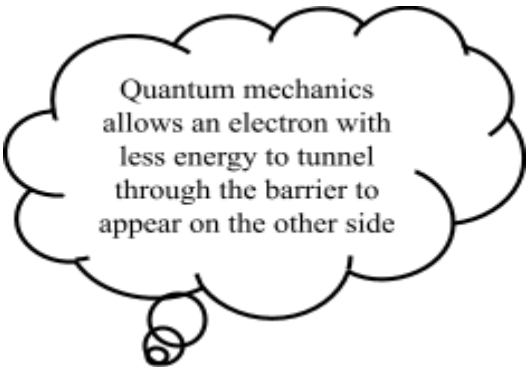
QUANTUM TUNNELLING



About 150 million kilometres away from us, there is a huge sphere of hot plasma, which we call the sun. Just like any other star, the sun makes its energy by colliding with lighter atomic nuclei to form a heavier element. This process, called nuclear fusion, is crucial for the existence of every single star in the universe.

However, there is a problem. The colliding nuclei are all positively charged, which means that they repel each other electrically. How do the nuclei fuse, then? There is another force – the strong nuclear force – which brings them together, but only when they are close to each other, to begin with. Therefore, the nuclei must have huge energy (and thus velocity) to approach each other to the point where the attractive nuclear strong force surpasses the repulsive electrical force for nuclear fusion to occur. But when the temperature of the sun was ascertained by its spectrum, it came to light that it does not even remotely reach the values necessary for nuclear fusion. In other words, the sun simply should not shine whatsoever. This conclusion is wrong – the sun shines, for which we owe to a peculiar phenomenon of quantum physics – quantum tunnelling.

Quantum tunnelling is a phenomenon wherein particles or even whole atoms have a certain probability of surpassing a barrier, even though they do not have enough energy to surpass it, which is unambiguously against the principles of classical physics. This phenomenon may not seem that peculiar at first sight, but the opposite is true. It would probably be quite strange if a person who ran up against a wall appeared on the other side of the wall or even inside the wall. However incredible it may sound, this is essentially what happens to objects from the microworld during quantum tunnelling.



Quantum tunnelling can be explained using the principle of quantum superposition and the uncertainty principle. How? According to classical physics, the sun does not have sufficient temperature for atomic nuclei to approach each other enough for fusion to occur. However, the principle of quantum superposition states that the nuclei can be in more places at once (due to their wave nature). So there is a certain probability of them approaching enough and fusing. According to Heisenberg's uncertainty principle, on the other hand, there is always some uncertainty regarding the momentum of an object, so from time to

time, one or both nuclei obtain an immense velocity (momentum) and fuse.

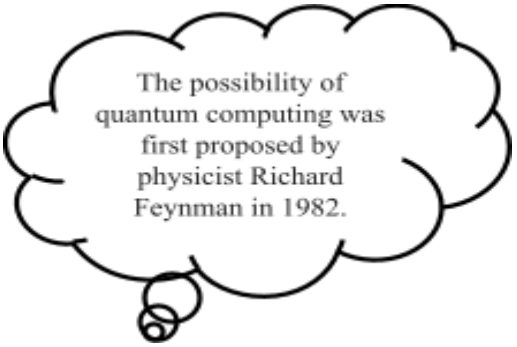
Quantum tunnelling is one of a few phenomena of quantum mechanics whose consequences we can hugely feel in the microworld as well. The structure of our own bodies, for instance, is determined by the DNA molecule. However, it has been theorised that the protons within the molecule can experience quantum tunnelling and therefore change our genetic makeup! These random genetic mutations caused by quantum tunnelling may even be linked to the existence of cancer, but more research is needed. Tunnelling also occurs during radioactive decay or in flash discs.

SHARON NOBLE A
21/UPHA/001

QUANTUM RESISTANT CRYPTOGRAPHY

Cryptography is the practice used to secure information. Generally, cryptography is about constructing and analysing protocols that prevent third parties from reading private messages.

Most of the internet in today's world uses non-quantum cryptography. The cryptographic codes that are currently used online are for public key systems. The word 'key' refers to a method that is being used to encrypt a message. It is an algorithm that converts readable text or data into a mess but it is created in a way that should be predictable. If the key is public everybody knows how to encrypt a message but only the recipient knows how to decrypt it and everybody knows how to scramble up a message and then they also know how to unscramble it. It does not seem to be very secure, but the clever part of public key cryptography is that the user should use a method that is easy to do but hard to undo.



Various methods are being used in cryptographic protocols for locking the treasure chest. The best one is the factorization of large numbers into prime numbers. This method is used by the algorithm known as RSA named after its inventors, Rivest, Shamir, and Adleman. The idea behind RSA is that if there are two large prime numbers it is easy to multiply them but if the product of the two prime numbers is known it is difficult to find out its prime factors. Computers may take some longer time to solve it.

Quantum computers can speed up this process. They can break cryptographic protocols such as RSA in a short time. And this is a big security risk. This is a problem that not only affects credit card numbers but it affects everything from trade to national security. So the physicist came up with better protocols that cannot be broken by quantum computers. This is possible by using protocols that rely on math problems for which quantum computers

cannot bring an advantage. This cryptography which is safe from quantum computers is called quantum-resistant cryptography or post-quantum cryptography.

NIVETHITHA A P
21/UPHA/034

QUANTUM COMMUNICATION

Introduction

The deployment of the Fifth Generation (5G) dispatches and service architectures has formally started. The vacuity of ultra-broadband fixed-mobile connectivity at ultra-low quiescence, deep integration of Artificial Intelligence with the network and service platforms, and increased inflexibility and programmability, as enabled by Software Defined Network (SDN)and Network Function Virtualization(NFV) are the major characteristics of 5G. Also, 5G leverages the integration of the network structure with Cloud and Edge Computing for enabling services scripts similar to the Internet of effects, Assiduity 4.0, stoked/ virtual reality, multimedia interactive gaming, unmanned mobility, smart metropolises, etc. Lately, the exploration and invention conditioning on the coming generations of networks and services architectures (e.g., 6G) has demurred off the deployment target as previsioned in 2030. Innovation will continue to drive global frugality into the coming decade. Over the last many times, we've witnessed an emotional growth of data business accompanied by a progressive Digital Transformation of Industry and Society. These trends are anticipated to accelerate in the coming decades; thus, unborn networks and services architectures, e.g., 6G, will be facing similar business challenges in the environment of ever-growing network complexity and dynamicity, where veritably advanced services scripts are anticipated (e.g. ultra-massive scale dispatches for ambient intelligence, holographic telepresence, tactile Internet, new paradigms for brain computer relations, innovative forms of dispatches, etc.)

Scope

Quantum communications is a rapidly evolving research area with imminent practical applications. Quantum Key Distribution (QKD) is one of the most important and successful applications in this research field, with a rapid evolution from theoretical proposals to commercial products. Besides that, there exist other relevant challenges, where the laws of quantum physics can offer new functionalities to communication systems. Practical deployment of Quantum communication systems and networks still demands a large scientific bid to further develop optic quantum technologies for generating, manipulating, transmitting and detecting quantum states. New Amount protocols should also be developed

to explore these new functionalities. Their integration into communication systems and networks is another area of intense research. This special issue gathers international experts to discuss the latest research advances and trends in the field of quantum communications.

Methods of quantum communication

1. Multi-step transmission: if we have an entangled quantum system, we can transmit the system from one user to another in multiple steps. Because it's entangled, measurement on one part of an entangled quantum system does not provide all the information about the quantum system. It provides a novel way of constructing quantum communication protocols and has been used extensively in various protocol designs of quantum communications.
2. Block transmission: Block transmission is essential for QSDC. In block transmission, the information carriers are transmitted in a block. For instance, the two ordered particle sequences are transmitted in a block of N particles. Security is guaranteed by checking on the block of N particles which are chosen randomly and measured to give an estimated error rate.
3. Order Rearrangement: Similar to the conjugate-basis method, where an eavesdropper doesn't know which conjugate-basis the legal users are using, one can reorder the orders of the particles within a block. The order number of a particle is unknown to the eavesdropper. The eavesdropper can only guess the order number of the particle. The order rearrangement method was called the CORE protocol. This method has been used extensively.

HARITHAA P S
21/UPHA/013

QUANTUM EFFECTS IN THE BRAIN

In the mid-1990s, it was proposed that quantum effects in proteins known as microtubules play a role in the nature of consciousness. The theory was largely dismissed since quantum effects were thought unlikely to occur in biological systems, which are warm and wet and subject to decoherence.

Quantum effects have been implicated in photosynthesis, a process fundamental to life on earth. They are also possibly at play in other biological processes such as avian migration and olfaction. The microtubule mechanism of quantum consciousness has been joined by other theories of quantum cognition. It has been proposed that general anaesthetic, which switches off consciousness, does this through quantum means, measured by changes in electron spin. The tunnelling hypothesis developed in the context of olfaction has been applied to the action of neurotransmitters.

A recent theory outlines how quantum entanglement between phosphorus nuclei might influence the firing of neurons. These, and other theories, have contributed to a growing field of research that investigates whether quantum effects might contribute to

neural processing. This review aims to investigate the current state of this research and how fully the theory is supported by convincing experimental evidence. It also aims to clarify the biological sites of these proposed quantum effects and how progress made in the wider field of quantum biology might be relevant to the specific case of the brain.

SHALINI M
21/UPHA/058

DEEP SPACE ATOMIC CLOCK: A REVOLUTIONARY TOOL FOR SPACE EXPLORATION

On Earth, we rely on GPS to find our way around. However, spacecraft need to receive signals from navigators which then return to Earth. The time required for the signals to come back is measured by a ground-based atomic clock. Scientists can calculate the spacecraft's distance from Earth knowing that those signals travel at the speed of light. Though this method seems quite complete and precise, we should note that the further the spacecraft is, the longer the time for the signals to reach Earth. Therefore, the calculations get delayed, making the data uncertain. With an onboard atomic clock, the spacecraft would acquire enough autonomy to calculate its speed.

Let's look at how the ground-based atomic clock works. This type of clock depends on an oscillator, like a pendulum or a quartz crystal, as we have in our wristwatches. Clocks tick according to the number of oscillations or the frequency of the quartz oscillator's vibration. The major problem lies with stability with the frequency that degrades over time. For an hour, the best of the quartz oscillator will be off by a nanosecond. After a few weeks, it can be by a millisecond or an imprecision of 185 miles.

An atomic clock pairs an oscillator with a collection of atoms to keep the frequency stable. A specific amount of energy needs to be given to a particular atom to get it excited, thus creating a vibration. Knowing the nature of the atom, scientists can monitor the stability of their atomic clock by measuring the unchangeable frequency, hence achieving a decent level of accuracy. A "correction" can be applied to the quartz oscillator to guide it back to its correct frequency. Such correction is applied every few seconds to the Deep Space Atomic Clock's quartz oscillator.

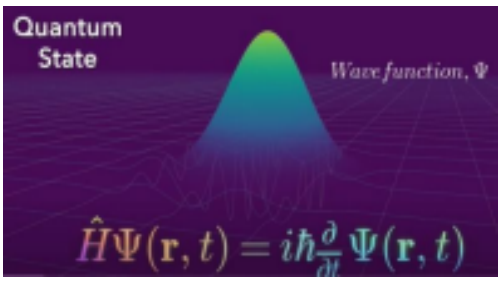
Built by NASA's Jet Propulsion Laboratory and launched in June 2019, this ultra-precise, mercury-ion Deep Space Atomic Clock encased in a small box is a monumental upgrade to the satellite-based atomic clock. This invention is roughly the size of a toaster compared to a refrigerator-sized ground-based atomic clock making it small enough to fit in a spacecraft. This type of clock can either have its atoms contained in a vacuum chamber or interact with the chamber walls. However, environmental changes such as temperature can lead to frequency errors. This Deep Space Atomic Clock has its electrically charged mercury ions contained in an electromagnetic "trap". Thus, reaching a new level of precision.

Sending updates twice a day to this onboard GPS atomic clock, Ely and Burt, the leaders of this project, have reported that their clock has an extremely low drift, corresponding to a deviation of fewer than four billionths of a second over 23 days. At the same rate, it would lose a second in 1000 years, which is considerably better compared to other atomic clocks in space which would be off by a second in 90 years.

The spacecraft will receive an initial signal from Earth to measure its position and direction from a constant point of reference. But, there's no need for the signal to bounce back, making it possible for the calculations to be made onboard. The team is planning to send an even smaller version of their clock on NASA's VERITAS mission which will head to Venus near the end of the decade. This Deep Space Atomic Clock enables new operational capabilities for NASA's human and robotic exploration missions.

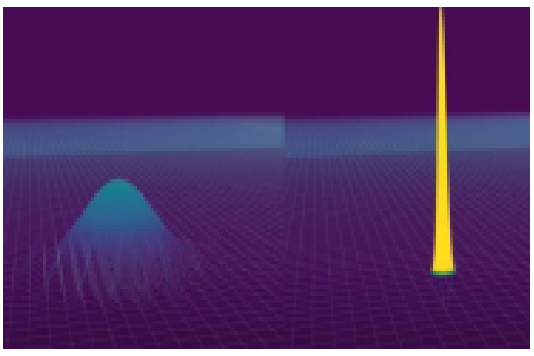
ANDRE SNEHA MARIE ANELLA
22/UPHA/012

ARE PARALLEL UNIVERSES REAL?



In classical mechanics, if you know the state of a system, say the position and velocity of a particle, then you can use an equation like Newton's second law to calculate what that particle will do in the future. In quantum mechanics, if you know the quantum state of a particle, that is, its wave function then you can use the Schrodinger equation to calculate what that particle will do in the future.

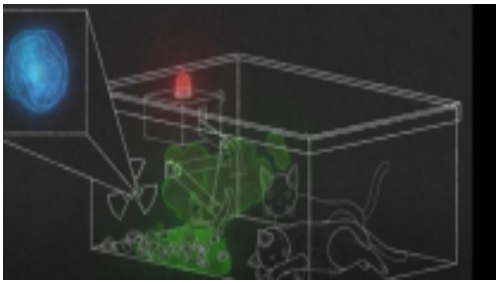
If you know its initial state, you can use an equation to evolve that state smoothly and continuously into the future. The problem is, in quantum mechanics, we never actually observe the wave function like in the image. Instead, when we measure it we find the particle at a single point in space. So how are we to reconcile the spread-out wave function evolving smoothly under the Schrodinger equation from this particle?



One way quantum mechanics came to be understood is that there are two sets of rules: when you're not observing the particle, the wave function simply evolves according to Schrodinger's equation. But, when you are observing it, when you make a measurement, the wave function collapses suddenly and irreversibly and the probability of measuring any particular outcome is given by the amplitude of the wave function associated with that outcome squared.

Now, Schrodinger himself hated this formulation, which is actually why he invented

the famous Schrodinger's cat thought experiment. The experiment goes as: put a cat in a box with a radioactive atom. Add a radiation detector that triggers the release of poisonous cyanide gas. Although it was only meant as a thought experiment, Schrodinger helpfully notes that this device must be secured against direct interference by the cat. If the atom decays, the detector detects radiation, releases the poison and the cat dies .If the atom doesn't decay , the detector doesn't detect radiation, poison is not released and the cat remains alive.



Since the state of the cat and detector apparatus are directly tied to the state of the atom, we say that they are entangled. According to quantum mechanics, the state of the atom does not have to be either decayed or not decayed. Generally, it's in a superposition of both decayed and not decayed at the same time assuming no measurements have been made. This superposition state of the atom gets entangled with the detector and then the cat. So, according to quantum mechanics, the cat really is both alive and dead at the same time only when we open the box and make a measurement does the wave function collapse and the cat actually becomes either dead or alive.

These days, Schrodinger's cat is often used as a way to show how weird quantum mechanics is. But that wasn't Schrodinger's point; he wanted to show that quantum mechanics, as formulated, was wrong. But, there is a better way to think about Schrodinger's cat.

Let’s examine the three essential components of Schrödinger’s cat: superposition entanglement and measurement. The superposition is the idea that quantum objects can be in two different states at the same time. After interaction, quantum objects do not have separate wave functions at all. They are described by a single wave function and this is what it means to be entangled. Measurement is just the interaction of one quantum system with another quantum system and we simply evolve their wave functions.

Remember, we are made of electrons and atoms that obey the laws of quantum mechanics. So, we are quantum mechanical. That is, when we open the box, there is no measurement and no wave function collapses. We simply get entangled with the state of everything inside the box. So, we see the cat alive and we see the cat dead. But how is that possible? The solution is that the alive cat and the dead cat, actually inhabit separate worlds, that is, they exist in their complete realities and those realities will never interact! But where did these separate worlds come from?

When a quantum object in a superposition gets entangled with the environment, it is said to undergo environmental decoherence which branches the wave function of the universe, essentially splitting the universe into two slightly different copies. So, a more realistic account of Schrodinger's cat goes like this:

The radioactive atom evolves from a 100% undecayed into a quantum superposition of decayed and undecayed. The detector becomes entangled with this superposition state of the atom.

The detector is being bombarded by all these air molecules and photons in the box which would bounce off differently. So, the detector becomes entangled with the state of the environment. This branches the wave function to split into two identical copies. Each outcome of the experiment continues to be identical until the box is opened.

This interpretation of quantum mechanics is called 'many worlds' and it was formulated by Hugh Everett. If it's true, then the branching of the wave function is happening all the time and so frequently that the rate may well be infinite.

SUBBULAKSHMI C T
21/UPHA/042

SPINTRONICS AND SPINTRONIC DEVICES

Generally, in electronics, we use the flow of electrons to produce charges used in electronic devices to store and transfer information. But, when we use the spin of the electrons as the basis to produce electronic devices, then the field of interest becomes spintronics. Spintronics, also known as spin electronics, is a field of study that combines the principles of quantum mechanics and electronics to manipulate the spin of electrons rather than their charge. As spintronics is based on spin, we must first comprehend the concept of spin in electrons. Electrons are subatomic particles that have both mass and charge. The spin of an electron refers to its intrinsic angular momentum, which is the direction in which it is spinning. The electron spin can either be up or down. In spintronics, we use these up-and-down spins to represent the binary digit or a bit of information. In this way, the spin of an electron can be used to store and transfer information through spintronic devices.

One of the most significant advantages of these devices is that they consume less energy than standard electronic devices. This is because we use the fundamental property of the electron, i.e., the spin, to store information, which does not require any movement of charges. These spins can be achieved using magnets and magnetic fields. Despite its advantages, the development of practical spintronic devices is challenging because the materials used here are complex to work with and because it is difficult to develop materials with the required spin properties. Another challenge is that it requires an extremely low temperature to manipulate the spin properties. Since spintronics is a relatively new field of study, researchers are developing new techniques to overcome these challenges. Spintronic devices have a lot of applications, out of which, "magnetic memory devices," where we use

the spin of the electron to store information, and "spin-based sensors," where using the spin property of the electron will make the sensors more accurate and sensitive, are promising. Thus, soon, spintronics will be a promising field of study where we can develop faster, smaller, and more energy-efficient devices with larger storage capacities.

JENY MARK X R
22/PPHA/110

HIGGS BOSON

Firstly, I need to discuss this material's family: The Higgs boson In the early 1990s, scientist Leon Lederman coined the term "immortal atom" and used it as the title of his book on the subject.I'm sure he thought it was just a cute name. This period material is commonly used for three sizing courses.This period of macroscopic material commonly relates to molecules, which are often bigger than atoms and particles. Examples of macroscopic particles include power, dust, sand, or even objects as big as the stars of a galaxy. Lederman claims his publisher rejected his original idea of the goddamn particle, but the media went crazy with the name, and now it's hard to disentangle the real physics of the Higgs from the hype. This word is also used in the same way by many other scientists, including Stephen Hawking.

The current hypothesis about the fundamental components of matter depends on the Higgs mechanism. According to Higgs and his associates, there is some kind of charge present in space. This interaction between elementary particles and charge gives mass.

Particles make up both you and your surroundings. But when the universe first started, there were no particles with mass; they were all moving at the speed of light. Only because of the fundamental field connected to the Higgs boson could stars, planets, and life begin to form. The discovery of the Higgs boson particle at CERN in 2012 provided further evidence of the existence of this field that provides mass. Particles gain mass by interacting with the Higgs field; they do not have their own mass. The stronger a particle interacts with the Higgs field, the heavier it becomes. Photons, for example, have no mass because they do not interact with this field. Other elementary particles, such as electrons, quarks, and bosons, do interact and thus have different masses. The Brout-Englert Higgs mechanism, proposed by theorists Robert Brout, Francois Englert, and Peter Higgs, is responsible for this mass-giving interaction with the Higgs field.

The Higgs boson cannot be discovered by chance but must be created in a particle collision. Once formed, it transforms or decays into other particles detectable by particle detectors. The discovery of the Higgs boson was only the beginning. In the ten years since, physicists have studied how strongly it interacts with other particles to see if theoretical predictions are correct. The Higgs boson has had and will continue to have an impact on our lives in ways we could never have predicted. It contributes to our understanding of why we and everything we interact with have mass, as well as to our natural human curiosity about

our universe and how it evolved. Accelerator and detector technologies were pushed to their limits in the search for this particle, leading to advances in healthcare, aerospace, and other fields.

JEYA PRIYA
22/PPHA/118

WAVE PARTICLE DUALITY

Wave-particle duality as embodied in Bohr's Principle of Complementarity (BPC) has been a cornerstone in the interpretation of quantum mechanics and quantum measurement theory since its inception. The celebrated Bohr-Einstein debate revolved around this issue and was the starting point for many of the illuminating experiments conducted during the past few decades. Bohr strongly advocated that "the unambiguous interpretation of any measurement must be essentially framed in terms of the classical physical theories" This insistence on the primacy of classical concept and logic in describing experiments led him to the introduction of his controversial principle of Complementarity as embodied in the following quotation: "Here it is presented with a choice of either tracing the path of the particle, or observing interference effects to do with a typical example of how the complementary phenomena appear under mutually exclusive experimental arrangements"

In the context of the double-slit welterweight experiments, the original formulation of the BPC dictates that in a particular experimental con- figuration, "the observation of an interference pattern and the acquisition of which-way information are mutually exclusive" Experiments have revealed the possibility of partial fringe visibility and partial which-way-information within strict limitations, and many experiments have backed this validation of BPC. What these experiments have in common, however, is the fact that they provide information by measurement techniques which ultimately perturb the wavefunction.

Now the presence of sharp interference and highly reliable which-way information in the same experimental arrangement for the same photons using non-perturbative measurement techniques at separate spacetime coordinates, both of which refer back to the behaviour of the photon at the same event, i.e., the passage through the pin- holes.

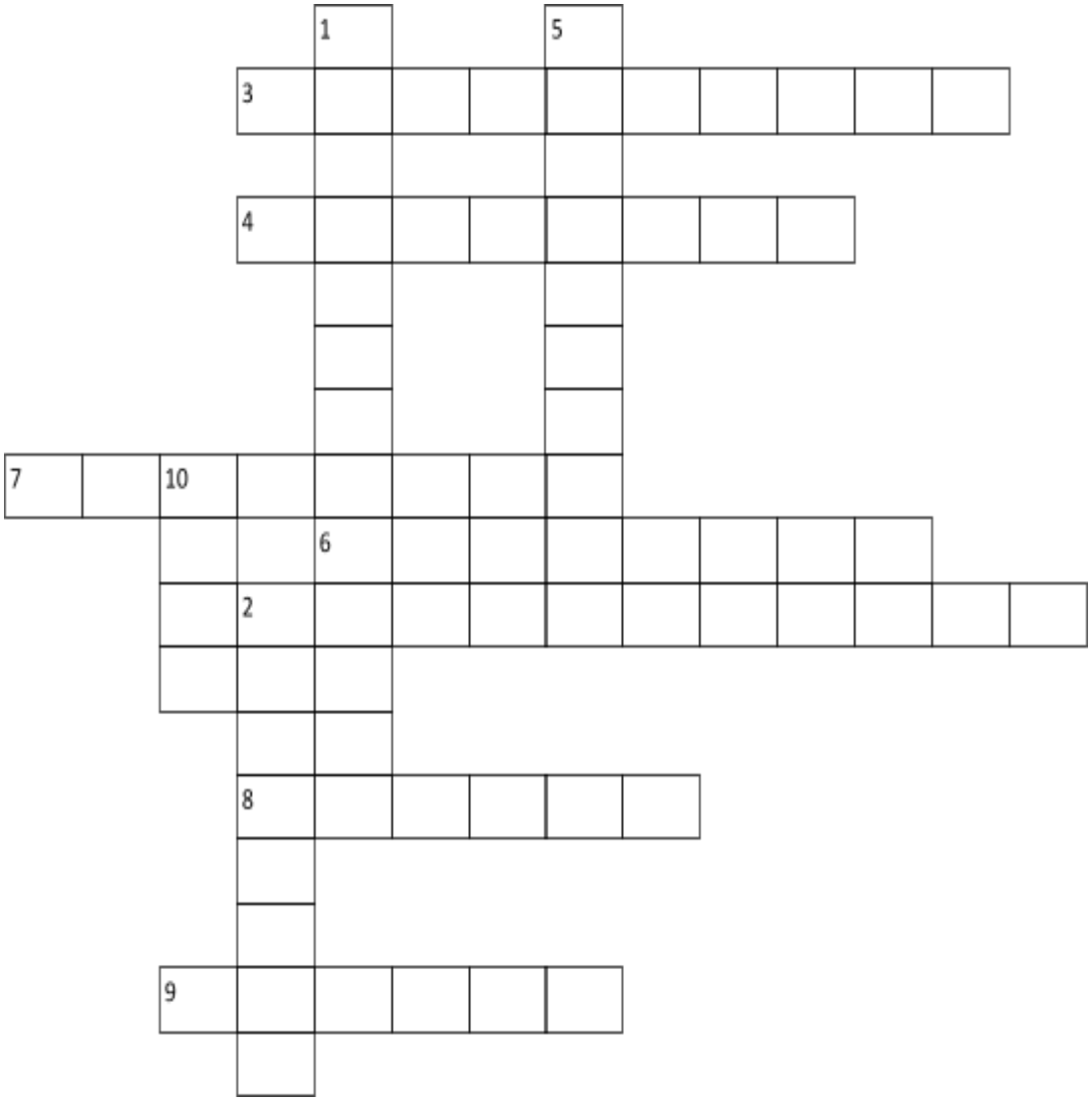
The full fringe visibility from the observation that the total photon flux was only slightly decreased when thin wires were placed exactly at the minima of the presumed interference pattern. Which-way information was obtained further downstream through the known imaging capabilities of a lens system. In the framework of classical logic, by making statements about the which-way information of the photon as it passes the plane of the pinholes.

With respect to the mutual exclusivity of complementary wave and particle natures as expressed in BPC, the applied technique appears to allows to circumvent the limitations imposed by Heisenberg's uncertainty principle and the entanglement between the which-way marker and the interfering quantum object as employed in some welterweight experiments

Afshar's non-perturbative measurement technique used in this work is conceptually different from quantum non-demolition or non-destructive techniques which do not destroy, but perturb the photon wave function directly. The observation that the presence of the wire grid decreases the photon count only negligibly, characterises a confirmation null result. Such a null result represents affirmation measurement in quantum mechanics, which verifies the expectation of a vanishing wave function at particular positions, in this case at wire grid.

MONICA NANCY T
21/PPHA/110

QUANTUM PUZZLE

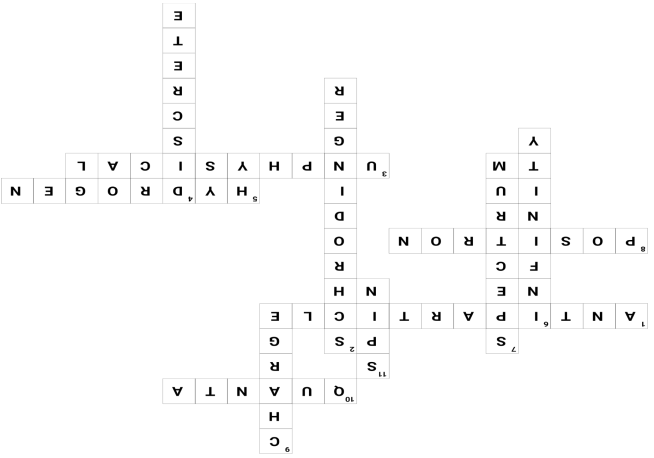


Across

2. The Quantum Mechanical model of the atom was proposed by
3. Quantum mechanics are
4. The energy spectra of a bound state are
6. The bound state occurs when a particle cannot move
7. The first antiparticle to be discovered
8. The wavelength of the matter waves is independent of
9. Radiation energy is emitted in packets called as

Down

1. The Dirac equation shows that every particle has
5. Bhor used quantum physics to describe which element
2. The graph between energy and frequency is called
10. The rotation of an electron about its axis



JESSIKA VALENCIA A
21/UPHA/023

QUANTUM ELECTRODYNAMICS

H	Y	D	R	O	G	E	N	D	E	G	A
S	O	R	E	Y	N	W	R	I	L	U	K
T	O	J	H	U	S	A	Z	A	E	L	I
A	R	O	J	K	H	I	X	N	C	T	M
N	E	Y	P	C	P	U	Y	J	T	P	T
D	L	T	I	M	E	L	H	A	R	H	H
P	E	R	T	U	R	B	A	T	I	O	N
Y	L	I	G	H	T	J	K	K	C	T	E
M	E	C	H	A	N	I	C	S	A	O	V
H	V	E	T	H	S	Y	Q	C	L	N	S
U	E	U	Y	K	C	F	U	Y	L	S	V
C	N	T	H	R	E	E	X	Z	Y	W	U

Questions

1. QED can be described as_____theory.
2. Who called it "the jewel of physics" for its extremely accurate predictions of quantities?
3. The predictions of QED regarding the scattering of photons and electrons are accurate to _____ decimal places?
4. Quantum Electrodynamics (QED) is the study of how electrons and _____ interact.
5. QED mathematically describes all phenomena involving _____ charged particles
6. The first theory where full agreement between quantum _____and special relativity is achieved.
7. Extremely accurate predictions of quantities like the anomalous magnetic moment of the electron and the Lamb shift of the energy levels of_____.
8. QED describes how _____and matter interacts.
9. In QED, an electron emits or absorbs a photon at a certain place and _____?

10. QED is based on the assumption that complex interactions of many electrons and photons can be represented by fitting together a suitable collection of the above _____ building blocks and then using the probability amplitudes to calculate the probability of any such complex interaction.

Answers

1.Perturbation
2.Richard
3.Eleven
4.Photons
5.Electrically
6.Mechanics
7.Hydrogen
8.Light
9.Time
10.Three

KELINA SHARON S
21/UPHA/015

CROSSWORD PUZZLE

Q	A	I	N	T	H	G	V	S	W	C	H	J	H	F	V	M	F	B	G
Q	U	B	A	C	D	L	A	S	D	A	N	V	T	T	C	A	L	K	N
Z	U	A	Z	V	B	V	T	T	K	T	M	T	S	T	O	T	O	M	A
X	C	A	N	N	E	C	O	V	I	O	T	V	T	T	G	O	J	K	N
V	G	P	N	T	N	F	M	H	J	M	T	H	O	M	T	M	O	O	O
N	Q	K	H	T	O	C	B	V	K	I	J	H	C	K	F	O	N	K	P
U	W	K	V	O	U	I	H	D	L	C	T	H	H	U	T	L	N	O	A
C	E	L	I	M	T	M	M	V	R	S	F	T	A	I	T	O	F	T	R
L	R	I	Q	N	V	O	P	T	D	K	F	G	S	E	H	G	T	T	T
E	T	N	S	Q	E	L	N	H	E	G	B	H	T	T	E	Y	V	V	I
O	Y	E	F	K	D	T	L	S	Y	B	W	E	I	D	E	X	L	V	C
N	U	A	J	K	C	S	I	F	H	S	H	S	C	D	A	A	O	F	L
I	I	R	B	M	W	H	T	C	B	T	I	D	S	G	V	H	G	S	E
C	O	B	M	D	K	O	G	I	H	O	J	C	T	E	T	N	I	I	S
S	P	F	N	E	L	S	K	H	L	C	L	R	S	J	F	C	C	T	L
S	A	R	O	Y	M	H	O	J	E	H	H	T	K	G	X	G	T	J	Y
Z	S	J	P	C	O	O	C	I	I	A	R	G	H	X	V	N	S	B	S
C	B	F	R	Y	I	I	V	M	L	S	V	J	K	C	O	S	M	I	C
H	J	K	D	U	M	L	W	I	K	T	H	N	I	F	E	L	N	M	M
P	A	R	T	I	C	L	E	P	H	Y	S	I	C	S	U	K	P	B	O

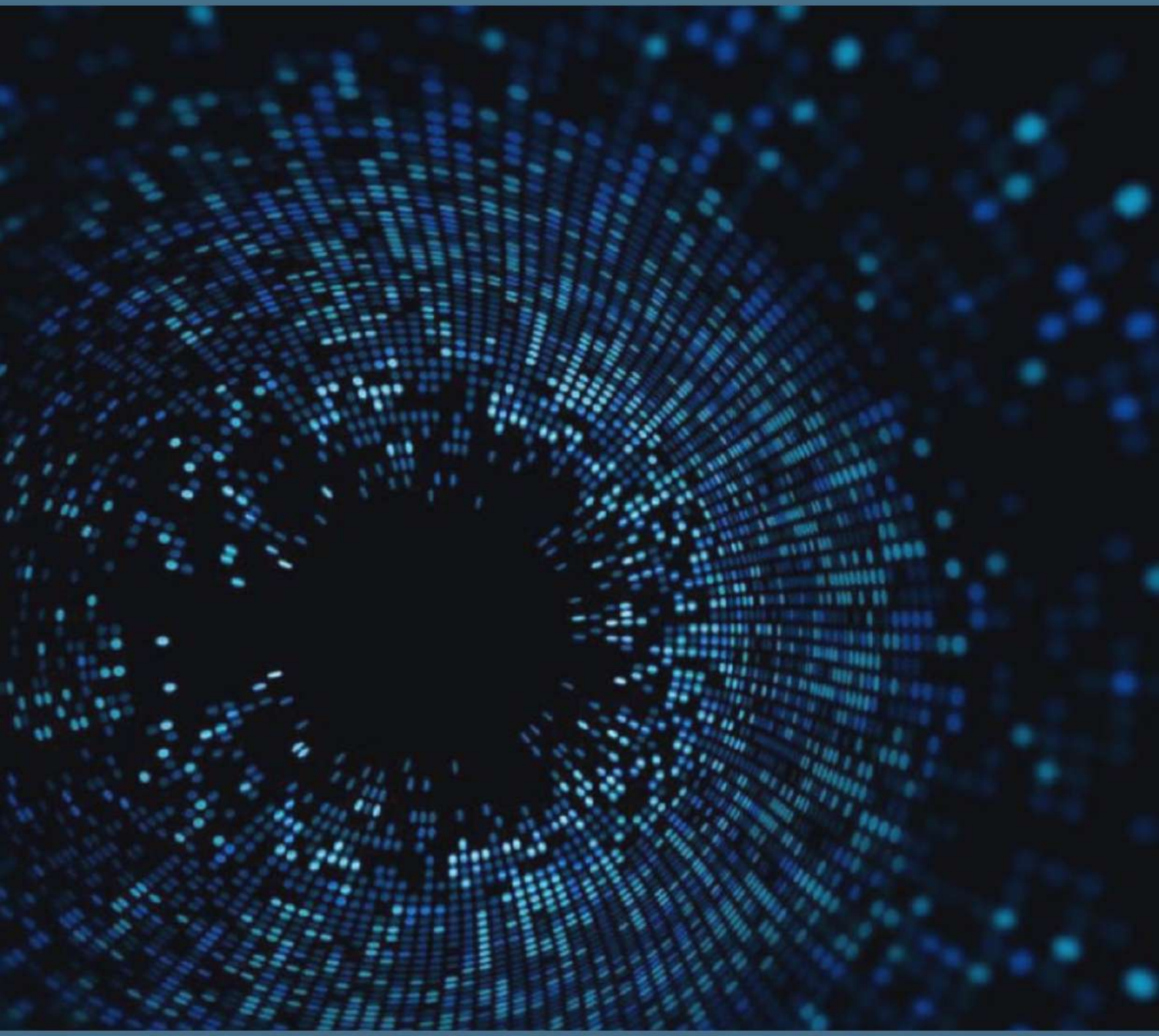
Answers

1.Quantum physics
2.Atomics
3.Atomology
4.Nucleonics
5. Particle physics
6. Nano physics
7.Stochastic
8.Linear
9.Kinetic
10.Logic
11.Photon
12.Atom
13.Cosmic

BENOLIN J
21/UPHA/053

THE ERA OF NANOTECHNOLOGY

THINK BIG BY THINKING SMALL



" NANOTECHNOLOGY IS AN IDEA THAT MOST PEOPLE SIMPLY DIDN'T BELIEVE "

-RALPH MERKLE

QUANTUM DOTS

Quantum Dots (QDs) are one of the possible fluorescent nanoparticles for diagnostic applications. QDs are crystalline clumps of a few hundred atoms, coated with an insulating outer shell of a different material.

Shape and size

They are spherical nanocrystals in 1-10 nm diameter. They are composed of atoms from group II-VI or III- V of the periodic table and are defined as particles with dimensions smaller than the excitation Bohr radius.

The QDs absorb light at a wide range of wavelengths but emit almost monochromatic light of a wavelength that depends on the size of the crystals. Larger QDs emit red light, whereas smaller crystals emit light at the blue end of the spectrum. QDs fluorescence is so bright that it is possible to detect a cell carrying a single crystal. Quantum dots of semiconductor particles such as CdS and CdSe, whose electronic properties vary according to their particle size, are used as bio labels and biomarkers. Their water soluble nature and ability to conjugate with biological molecules make them a good choice as Nano sensors.

These Quantum dots can be tuned in size and composition to exhibit emission ranging from ultraviolet through visible region to near infrared. It is possible that by altering the size and chemical composition of the quantum dots, a broad emission wavelength range of 400 - 2000 nm can be achieved. Hence, they can probe a variety of biological molecules. Quantum dots are advantageous over traditional dyes in terms of their stability.

Quantum dots can withstand for a longer time, hence they can be used for long term observation of biological cells when compared to the traditional dyes. Several properties of quantum dots (QDs) make them suitable choices as fluorescent labels.

Comparing organic dyes and biomolecules

1. QDs exhibit narrow and symmetric emission peaks whereas organic dyes show broad and unsymmetrical emission peaks. Hence, QDs are suitable materials when simultaneous labelling and detection of multiple analytes are desired.

2. QDs have large molar absorptivity and high quantum yield

3. Quantum dots can withstand for a longer time, hence they can be used for long term observation of biological cells when compared to the traditional dyes. The rate of photodegradation is low for QDs.

Advantages of Quantum Dot Technology

1. Better Energy Efficiency

2. Longer Lifespan and

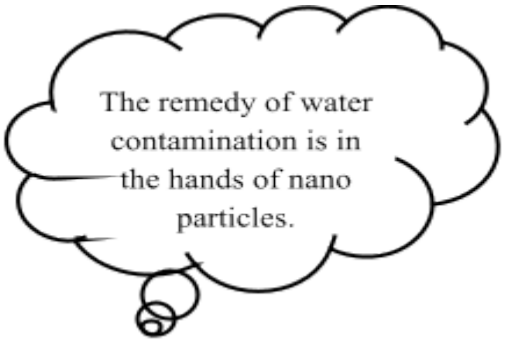
3. Versatile sizes and Thinner Panels

PUSHPARANI L
21/UPHA/012

NANOTECHNOLOGY IN TREATING WATER POLLUTION

Water is the main component for the existence of human life. 97% of earth's surface is covered with water. Out of which just 3% is freshwater. And of these 3%, 0.08% of water is clean water. To be precise, we have an analogy of 1 teaspoon of water versus 5 litre of polluted water. This data makes clear about the high risk of water pollution and that its remedies are one of the main topics to be discussed today.

Water pollution is one of the main problems today. There are several technological ways created to treat water pollution. But most of those techniques are time consuming as well as costly methods. Hence nanotechnological methods of treating polluted water are preferred over other techniques as it is cost-effective.



Iron based nanoparticles can disperse throughout the water bodies easily and can decompose the organic solvents present in it. Especially zero valent iron is used to treat contaminated water. Zero valent iron is a reducing agent used for groundwater remediation. It has a size of about less than 20 nm composed of iron with a valency of zero. It can be exposed directly to environmental substances like soil, water or solid waste. By injecting it into the affected area, it can dechlorinate organic solvent, pesticides and fertilizers. Hence it is considered as a rapidly emerging technological method with great efficiency to reduce the amount of toxicants present in the water.

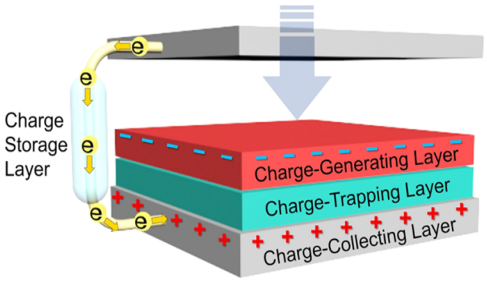
Zero valent iron could be synthesized under laboratory conditions and their effectiveness is proved for detoxifying hexavalent Chromium (Cr (VI)) from aqueous solution. It was found that 99% of toxic Chromium (VI) was removed from the contaminant water. Besides cobalt, copper, nickel, arsenic and nitrate was also removed from the water surface using zerovalent iron. Arsenic (III) which is highly toxic and Arsenic (V) which is another pollutant in water has been removed from groundwater using ZVI. ZVI combined with a metal catalyst (mainly Pd) has been shown to be one of the promising materials for

reductive degradation of chlorinated solvents due to its moderately strong reducing potential. The potential use of zero valent iron nanoparticles is found mainly for the treatment of toxic metal ions, phosphates and nitrates from wastewater mainly by adsorption mechanisms and photocatalytic degradation.

There are several other nanotechnological methods to be used for water treatment. But iron based nanoparticles are considered as best as they are stable, and have high reducing ability, and above all the nanosized iron used for water treatment is recyclable and hence can be used over and over again.

MICHELLE G ALANI
20/UPHA/013

TRIBOELECTRIC NANOGENERATORS



The most important energy conversion in human history has been combustion, which is typically inefficient and causes serious environmental problems. An eco-friendly and efficient technique to increase energy efficiency is to collect and use the energy wasted through friction. Triboelectric nanogenerator (TENG) has made many breakthroughs in the basic mechanism and self-driving system of TENG. TENG has many advantages in micro-nano energy harvesting and can be widely used in sensors, portable devices, etc.

The basic principle behind TENG is when two materials come into contact, chemical bonds are established at some interface locations, and charges are transported between the interfaces to balance the electrochemical potential, resulting in the generation of triboelectric charges. Some applications of these TENGs in day to day life is, it can be used as a switch sensor for smart home lighting fixtures.

Currently, there are two types of smart house light switches: voice control switches and light control switches. However, the smart home's two switches that control the lamps must also automatically turn the lights down for a while after they are switched on, using and wasting energy. The mechanical energy of people walking can be captured and turned into electrical energy using TENG, which eliminates the requirement for a light switch if it is incorporated into a wooden floor as a switch sensor.

It can efficiently prevent the issue of illumination that lasts longer than it should and conserve energy. Triboelectric nanogenerators are used in home floors as a pressure sensor due to friction, the magnitude of the voltage generated by the nanogenerator, and the magnitude and frequency of the externally applied force rate-related features. The recent advancements are in 3-d printing where the nanogenerators can be printed using additive manufacturing techniques in which it is an added advantage in low cost, facile and efficient

self - powered systems. The 3-d printed TENGs are used in vast areas listed as sensing application and integration with advanced technologies in IOT, AL, CNN.

MANVIZHI S
22/PPHA/123

WHAT ABOUT QUANTUM DOTS AT ROOM TEMPERATURE?

Quantum dots are semiconductor particles of a few nanometers in size. The optical and electrical characteristics of quantum dots (QDs) differ from those of bigger particles due to the laws of quantum mechanics. They are a key subject in materials science and nanotechnology. Drug delivery, solar cells, LEDs, quantum computing are a few potential uses for quantum dots. Some QDs can be suspended in solutions due to their small size, which may enable their usage in spin-coating and inkjet printing. In Lang muir-Blodgett thin films, they have been employed. These processing approaches produce semiconductor production processes that are less expensive and time-consuming.

The normal method for creating quantum dots uses industrial settings, high temperatures, and expensive, toxic solvents. This method is neither cost-effective nor environment friendly. However, scientists have now successfully completed the procedure on a lab bench using water as a solvent, producing an end product that is stable at ambient temperature. Their discovery demonstrates that protein sequences not found in nature can be utilized to create useful materials, opening the door to producing nanomaterials in a more environmentally friendly manner.

But what happens when nature doesn't choose the sequences? What opportunities exist in creating wholly new sequences to create unique proteins that have little relation to anything found in nature? The first new protein *de novo* that is known to promote the creation of quantum dots was found by Princeton University researchers. The method developed by the scientists allows for fine-tuning of nanoparticle size, which affects the color that quantum dots fluorescence. This opens up opportunities for labeling chemicals present in biological systems, such as in vivo staining of cancer cells. From amino acid sequences that bear only a passing resemblance to those that have evolved in nature, combinatorial libraries of novel proteins can be created. These novel proteins are a rich source of variety for the isolation of new proteins capable of performing roles not found in biology because they were not chosen to conduct life-sustaining functions. Here, we demonstrate how a protein (ConK) identified from one of these combinatorial libraries promotes the synthesis of cadmium sulphide quantum dots by accelerating the synthesis of a reactive sulphur species from the amino acid cysteine. These findings show that proteins not obtained from biology can be utilized to create useful materials that, while not employed to support living things, have a wide range of applications in a variety of technologies.

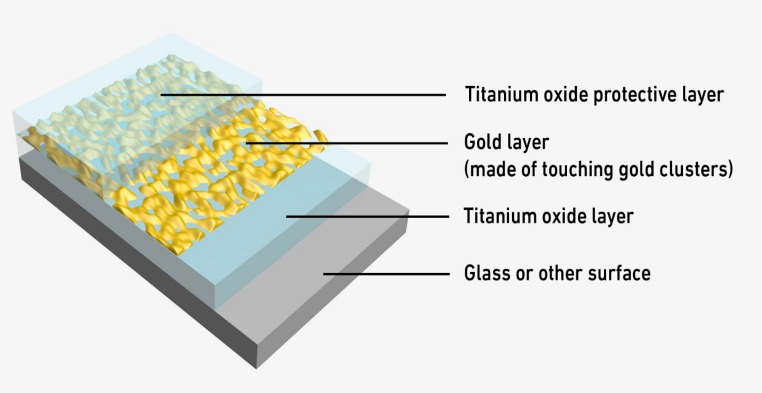
De novo proteins are distinct from proteins that have developed in nature because they are made from brand-new amino acid sequences. Escherichia coli is saved from toxic copper concentrations by ConK, a *de novo* generated protein with a binary pattern. Recently, it was discovered that ConK binds to the cofactor PLP (pyridoxal phosphate, the active form of vitamin B6). Here, we demonstrate that ConK catalyses cysteine's desulfurization to HOkay now you can finishS, which may be exploited to make CdS nanocrystals in solution. The optical characteristics of the CdS nanocrystals, which have a size of about 3 nm according to a transmission electron microscopy measurement, are comparable to those of chemically produced quantum dots.

Two advantageous characteristics of CdS nanocrystals that were not seen during biomineralization utilising native proteins are produced by the slower development rate. In contrast to normal biomineralization processes, which result in a mixture of the Zinc Blende and wurtzite phases of CdS, CdS nanocrystals are primarily of the Zinc Blende crystal phase. Second, the CdS nanocrystals created by ConK are stable at a final size, in contrast to the growth and eventual precipitation seen in natural biomineralization systems. By enabling the synthesis of more stable, high-quality quantum dots at room temperature, future optimization of CdS nanocrystal development utilizing ConK—or other de novo proteins—may help to overcome the limitations on nanocrystal quality normally found from natural biomineralization.

Professor Michael Hecht and his research group at Princeton have made a significant discovery by creating the first known de novo protein that catalyzes the synthesis of quantum dots.

MERRIN ANN JOJO
21/PPHA/102

A ‘GOLD’EN SOLUTION TO FOGGY GLASSES



Researchers from the ETH Zurich University have developed an ultra-thin, gold-based transparent coating that has the ability to convert sunlight into heat. This coating when applied to glass and other surfaces can prevent them from fogging and can be used in eyewear and car

windshields. The gold-based coating is fabricated with methods that are used extensively in manufacturing. Miniscule amounts of gold are deposited onto the surface using vapor deposition under vacuum.

Conventional glass surfaces are coated with hydrophilic (water-attracting) molecules, which results in an even spread of condensation. But in the new method, the surface gets heated, thus preventing humidity-induced condensation from forming in the first place. The principle is the same as used in a car's rear window. But electric heating is inefficient and energy wasteful. In contrast, the new coating is heated passively and requires no additional energy source during daytime. One speciality of the new coating is that it absorbs solar radiation selectively. Half of the energy contained in sunlight lies in the infrared spectrum and the other half in visible light and UV radiation spectrum. The coating absorbs a large proportion of the infrared radiation, which causes it to heat up by up to 8 degrees Celsius. It absorbs only a minor fraction of the radiation in the visible range, which makes the coating transparent.

SAMIYA FIRDAUS S M
21/PPHA/103

AGRO-NANOTECHNOLOGY

In agriculture, nanotechnology can be defined as the manipulation of nanoparticles, which measure 1 to 100 nm to increase agricultural production. Nanotechnology has recently gained popularity in the field of agriculture due to its effectiveness. Through nanotechnology, scientists made little things that are too small to see with our eyes that can kill bugs and help plants grow. Those who grow food and animals are using nanomaterials to help them.

Nanomaterials are researched to stop bad side effects on plants, animals, and humans. By using nanotools, scientists can solve problems in agriculture. This allows farmers to plant crops without harming the plants. When something is really small (nano), it can do new things because it is different from larger particles. This special size made it possible for scientists to do new things for plants and animals on farms.

History of Nanotechnology in Agriculture

Many poor countries earn a lot of their money from their agricultural production. Scientists are trying to increase their food production by using nanotechnology. This will help feed the world and save farmers more money. In the old days, scientists couldn’t see very well with microscopes because they could only see big things.

In 1981, scientists started to be able to see small things, like atoms. They did it with new microscopes. Nanotechnology has been used in many different fields, including agriculture. In the past years, nanotechnology changed how food is

grown, and it keeps getting better. Nanoparticles are tiny particles that you can't see, but they are in our food. They are used to make some foods safer and to make other foods easier to package.

Benefits of Nanotechnology in Agriculture

Nanotechnology has a huge benefit in agriculture or farming.

1. Nano-based Agrochemicals – Nanotechnology is a new and better way to get plants the nutrients they need. We can use nanotechnology to make fertilizer that is easier for plants to use. Nano copper is a good fertilizer as it gives plants nutrition and protects them from disease. Farmers can use nanotechnology to kill weeds without hurting the crops.

2. Nanotechnology for genetic plant engineering – Scientists have made flowers and plants stronger by using genetic reprogramming. They have done this so the plants can be resistant to things that hurt them. Bits of DNA from plants with good traits could make plants more productive. It would help plants to live in different conditions.

3. Plant disease diagnosis – Some molecules can be used to help find plant diseases before they spread to other plants. They help scientists by detecting plant diseases and letting farmers know what to do about them. Scientists are using tiny machines to help doctors find plant diseases. Special machines can also tell if foods are bad before we eat them.

4. Nanotechnology in post-harvest management – Using nanomaterials, scientists are trying to make seeds last longer. This will help farmers after they have harvested their crops. New nanotechnology can help us keep food fresher longer which could save people money or stop them from throwing away food.

5. Nanotechnology in animal breeding and animal health – Scientists use nanotechnology to make sick animals better and to find diseases in animals. The old way was to try out different medicine on different animals and that was hard and expensive. The new method is to use nanoparticles which are easier and cheaper. Someday it might be possible to use nanotools in chicken. Nanomaterials used experimentally in chickens make them stronger and healthier.

Disadvantages of Nanotechnology in Agriculture

As much as nanotechnology has positively impacted agriculture, some concerns need to be addressed. Besides the application of nanotech concepts, agriculture is still in the experimental stages.

1. Bioaccumulation – Metal particles can build up in the bodies of animals that eat plants. This process is called bioaccumulation. It happens because animals don't get off things they eat fast enough. With time, it can cause health problems in animals.

2. Unpredictability – The long-term effects of most nanoparticles are still unknown. We need more research to better understand nano-based materials used in agriculture.
3. Phyto-toxicity – It describes any condition that can inhibit plant growth. The engineered nanoparticles can cause toxicity in plants if they are used improperly.

Nanotechnology provides Sustainable Agriculture

Nanotechnology applications can increase crop productivity while reducing environmental pollution. The use of nanotech concepts in farming and livestock keeping can improve food security in the world. Nonetheless, more research needs to be done on nanoparticles. This will help scientists avoid possible complications that may result from the use of nanomaterials.

ALPHONSA MARIA CYRIAC
21/PPHA/113

PERSISTENT LUMINESCENCE

Persistent luminescence, also known as afterglow, is a phenomenon in which a material continues to emit light after being exposed to a light source and then removed from the source. This can last for a few seconds to several hours depending on the material and conditions.

The persistent luminescence effect is typically observed in phosphorescent materials, which are materials that have a long-lived excited state. When a phosphorescent material is excited by light, the electrons in the material absorb energy and move to a higher energy level. When the light source is removed, the electrons slowly return to their lower energy state and emit light as they do so.

Persistent luminescent materials have potential applications in a variety of fields, including medical imaging, sensors, and lighting. In medical imaging, they can be used to track the movement of drugs in the body, while in sensors they can be used to detect changes in temperature or pressure. In lighting, they can be used to create energy-efficient lighting that does not require a constant power source.

To improve the efficiency of persistent luminescent materials, researchers have been exploring new types of materials and developing methods to control their properties. For example, some recent research has focused on using nanomaterials to improve the brightness and duration of the afterglow effect. As such, the study of persistent luminescence continues to be an active area of research with potential for a range of exciting applications.

LAVANYA S
21/PPHA/118

NANO-MAGNETS TO RESTORE DAMAGED NERVE CELL

They produced three-dimensional "mini-brains" using magnetic manipulations, which are functional, multi-layered neural networks that resemble parts of a mammal's brain. The cells held their position by the remotely administered magnetic fields when the collagen solution hardened into a gel. The cells quickly transformed into mature neurons, established extensions and connections, displayed electrical activity, and flourished in the collagen within a few days. The cells developed in the collagen gel for at least 21 days after a few days of development into adult neurons with extensions, connections, and electrical activity.

Future medical uses may not be safe if magnetic particles are introduced into cells, particularly nerve cells. Prof. Orit Shefi notes that “The subject of safety is crucial, and we have committed much thought and research into it. In the first step, we examined how various particles affected cell health in culture. In addition, we added a biocompatible protein coating to the magnetic particles.”

The coating facilitates the penetration of the nanoparticles by acting as a barrier between the magnetic element and the cell. Importantly, iron, the component of the nanoparticle, is a substance that is found in the body naturally and is not outside. The same gel with magnetic particles has also been examined in our lab and proven to be safe for using animal models.

The basic building blocks of the brain and nervous system are neurons. They are the cells that receive sensory information from the outside world, send control signals to our muscles, and transform and relay electrical signals at each stage along the way. The three primary components of neurons, also known as nerve cells, are the cell body, dendrites, and the axon, a long, thin projection that facilitates cell-to-cell communication.

Neurons have very little, if any, capacity for self-healing when they are harmed by degenerative illness or injury. Therefore, a fundamental difficulty in the field of tissue engineering is the restoration of neuronal networks and their typical function.

One of the most cutting-edge methods for developing neural networks, Prof. Orit Shefi and Ph.D. student Reut Plen from the Kofkin Faculty of Engineering at Bar-Ilan University have created a revolutionary methodology to address this difficulty.

The researchers introduced magnetic iron oxide nanoparticles into neural progenitor cells, transforming the cells into autonomous magnetic units, which enabled the creation of neural networks. They next subjected the progenitor cells, which are known to mature into neurons, to a range of magnetic fields that had been previously modified before they were

remotely commanded to travel within a three-dimensional, multi-layered collagen substrate that simulates the properties of bodily tissue.

SANDHYA S
21/PPHA/119

NANOTECHNOLOGY IN SPACE

Space Flight

To reduce the cost of sending cargo into orbit, the space elevator device is used. Like any elevator the space elevator will have a cable, it needs to be stronger than the existing cable. The carbon nanotube is used to make a cable whereas the material made from carbon nanotubes reduces the weight of spaceships even increasing the structural strength. This device will eliminate the need to use rocket fuel.

Spaceships can be propelled by light from the sun reflected off of solar sails while traveling through space, just as sailboats are propelled by the wind while on the seas. Carbon nanotubes were used in solar sails however the solar sails will be very large, spreading for kilometers, and very thin to keep their weight low carbon nanotubes are used to make thin, lightweight sheets that may replace the polymer sheets which have great potential for reducing the amount of fuel.

Nanosensor

Scientists built nanosensors by coating carbon nanotubes with different polymers that react with various chemicals or by doping the carbon nanotube and nanowire with different catalytic metal particles that act as the sensing material. Various nanostructured materials, carbon nanotubes, and metal oxide nanowires coated or uncoated are in each channel. There are 32 sensing channels on the chip depending on the chemical that was detected. It triggers a reaction when a small amount of the targeted chemical touches sensing materials that cause the current flow through the sensor to increase or decrease.

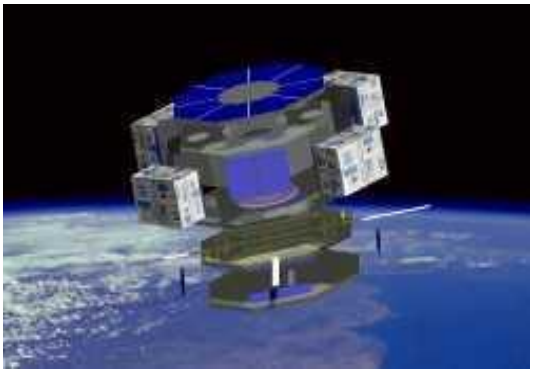
The sensor used to identify a gas will form a pattern depending on different responses. Using carbon nanotubes to sense chemicals for one, the nanostructure material increases surface area to volume ratio allowing the material to absorb more gas, and thus it will improve sensitivity. Other advantages of nanosensors include low power use and durability.

Nano-robotics

Robots can perform well in space technology; they are designed to handle weather and tough terrains in space and carry weight. To repair damaged parts of the international space station remotely operated by technologies from the earth. There are new ideas that play out when nanorobots work in space technology. The bio nanorobots were employed greatly in space suits. It can respond to damages to space suits. These bio nanorobots respond if the astronaut is in trouble. For example, they will provide the drug in a medical emergency. In the upcoming years, the Design, Manufacturing, Programming, and control of nanoscale robots

for the application of space. Nanorobots are smart structures capable of actuation, sensing, signaling, information, intelligence, and swarm behavior at the nanoscale.

Recent Advancements



There is a significant thermal issue from the radiation of the sun. Traditional quartz tiles were used as solar reflectors. Solar reflectors provide excellent thermal properties for heat from spacecraft and reflecting heat from the sun. The use of aluminum-doped ZnO metamaterial is used as a coating for satellite and rocket exterior which reduces the mass burden and is easy to apply. It combines infrared plasmonics and high transparency for a spectral response. For the enhancement of cooling the nanosystem developed paint that dries with nanoscale. Aerospace has a potential application, for substantial investment from the high-cost low volume application.

As with any conventional satellite, nanosatellites are weighing less than 10 kilograms and they also have a controlling factor compared to conventional satellites, Nanosatellites are less in size, low in price, and have shortened development. At the same time, it increases the sophistication of each satellite. Because of the scale, it increases the advancement in the current and future generations of the satellite.

BRINDHA M
21/PPHA/120

BIOINSPIRED NANOMATERIALS FOR SUSTAINABLE AGRICULTURE

The sustainable growth of agriculture depends on new techniques like nanotechnology. Nanomaterials produced from plants are highly preferable. Green nanotechnology is an energy-efficient, safe process and also it reduces green gas emissions. The agricultural science moves toward the use of nanomaterial has increased food production as eco-friendly and opened up new avenues in agriculture. Green nano agro science has great potential to develop the strong foundations of green chemistry.

The Nano fertilizers formulation synthesized by the green methods supplied a balanced supply of minerals with less intervention. Zinc is the main micronutrient for crop yield. ZnO nanoparticles at three different concentrations of 40, 80,120 ppm on the wheat

farms benefit the height of the plant. Nano fertilizers such as N, P, K, Fe, Mn, Zn, Cu, Mo, and carbon nanotubes show better release and targeted delivery efficiency.

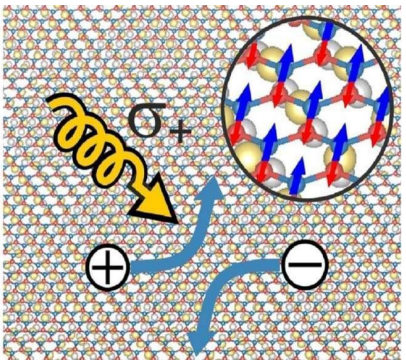
Nano-pesticides are becoming the most prominent part of agriculture due to their ability to solve problems related to pesticide toxicity. Graphene oxide is used as a nanocarrier for revolutionizing the application of pyrethroid pesticides against spider mites. It is a phytophagous mite pest. ZnO nanoparticles are used against twig blight disease in crops. The nano pesticide formulations can increase water solubility, and bioavailability and protect agrochemicals against environmental degradation, revolutionizing the control of pathogens, weeds, and insects in the crops.

Nanosensors are extremely small devices capable of detecting and responding to physical stimuli with dimensions in the order of one billion a meter. It can be used to determine the time of crop harvest, crop health detection, and chemical or microbial contamination of crops. Chitosan is a naturally available polycationic linear polysaccharide originating from chitin and is used widely in the area of nanosensors. Propyl hydroxylase domain (PHD) proteins serve as oxygen sensors and may regulate oxygen delivery. Nanotechnology holds many promises in agricultural technology, these compounds being extremely small and highly soluble.

ANANDHI M
21/PPHA/122

TWO- DIMENSIONAL FERRIMAGNETISM IN GRAPHENE

Graphene is bi-dimensional material made of a honeycomb of carbon titles. They're available in different sizes from many nanometers(graphene amount blotches) to large flakes of several microns inside. It's an extremely electrically conductive form of essential carbon.



That's composed of a single flat distance of carbon titles arranged in a repetitious hexagonal chassis. Graphene, a two- dimensional revision of carbon, is the lightest and strongest of all two- dimensional accouterments available at the moment and is also largely conductive.

In 2018, experimenters from St. Petersburg University and their associates from Tomsk State University and German and Spanish scientists were the first in the world to modify graphene and give it the parcels of cobalt and gold-captivation and spin-route commerce (between the moving electron in graphene and its glamorous moment). When interacting with cobalt and gold, graphene retains its unique characteristics and incompletely takes on the parcels of these essences. The scientists synthesized a graphene system with a ferrimagnetic state as part of the new work. It's a unique state in which the substance has magnetization in the absence of an external glamorous field.

The physicists used an analogous substrate made from a thin subcaste of cobalt and an amalgamation of gold on its face. During face alloying, disturbance circles were formed under graphene. These circles are triangular regions with a lower viscosity of cobalt titles to which the gold titles have moved closer. Until now, it was known that single-subcaste graphene could only be completely bewitched in an invariant way. Still, studies by scientists from St. Petersburg University have shown that it's possible to control the magnetization of the titles of individual sublattices through picky commerce with the structural blights of the substrate. " This is a significant discovery, as all electronic bias uses electrical charges and involves heat generation when current overflows.

Our exploration will ultimately allow information to be transmitted in the form of spin currents. This is a new generation of electronics, an unnaturally different sense, and a new approach to technology development that reduces power consumption and increases the speed of information transfer," which was explained by Artem Rybkin, top investigator of the exploration, Leading Research Associate in the Laboratory of Electronic and Spin Structure of Nanosystems it. Petersburg University. The alternate important specific of the graphene synthesized by physicists is the strong spin-route commerce. In this structure, the strengthening of this commerce is explained by the presence of Gold titles under graphene. At a certain rate of the glamorous and spin-route commerce parameters, it's possible to move from the trivial, i.e., state of graphene to a novel, topological bone.

SAVITHA U
21/PPHA/128

NANOTECHNOLOGY TO IMPROVE GENE THERAPY FOR BLINDNESS

Using nanotechnology that enabled mRNA-based COVID-19 vaccines, a new approach to gene therapy may improve how blindness is being treated.

A Team of Oregon Health & Science University and Oregon State University researchers has developed an approach that uses tiny lipid nanoparticles, lab-made balls of fat to deliver strands of messenger ribonucleic acid, or mRNA, inside the eye. To treat blindness, the mRNA has been designed to create proteins that edit the vision-harming gene hormones.

A study was published where the team demonstrated how the lipid nanoparticle delivery system targets light-sensitive cells called photo-receptors and modifies them. The Nanoparticles are then coated with a peptide that has been identified as being attracted to photoreceptors.

The researchers compare the nano-peptide being put inside the eye to sending the mail where the gene therapy is sent in with an envelope-like structure to attract the photo-receptors. The study’s corresponding head Dr. Gaurav Sahay Ph.D., an associate professor at the OSU college of pharmacy who also has a joint research department at the

OHSU Casey eye hospital. The peptide ensures that the mRNA is delivered precisely to the photo-receptors cells which were not able to target before the usage of these nanoparticles.

He further explains that almost 250 gene mutations are a cause of inherited retinal diseases. but for now, only one gene mutation therapy has been tested and allowed. The study's co-author Renee Ryals, Ph.D. an assistant professor of ophthalmology at the OHSU School of Medicine and a scientist at the OHSU Casey Eye Institute. She says that "Improving the technologies used for gene therapy can provide more treatment options to prevent blindness. Our study's findings show that the nanoparticles could help us do just that."

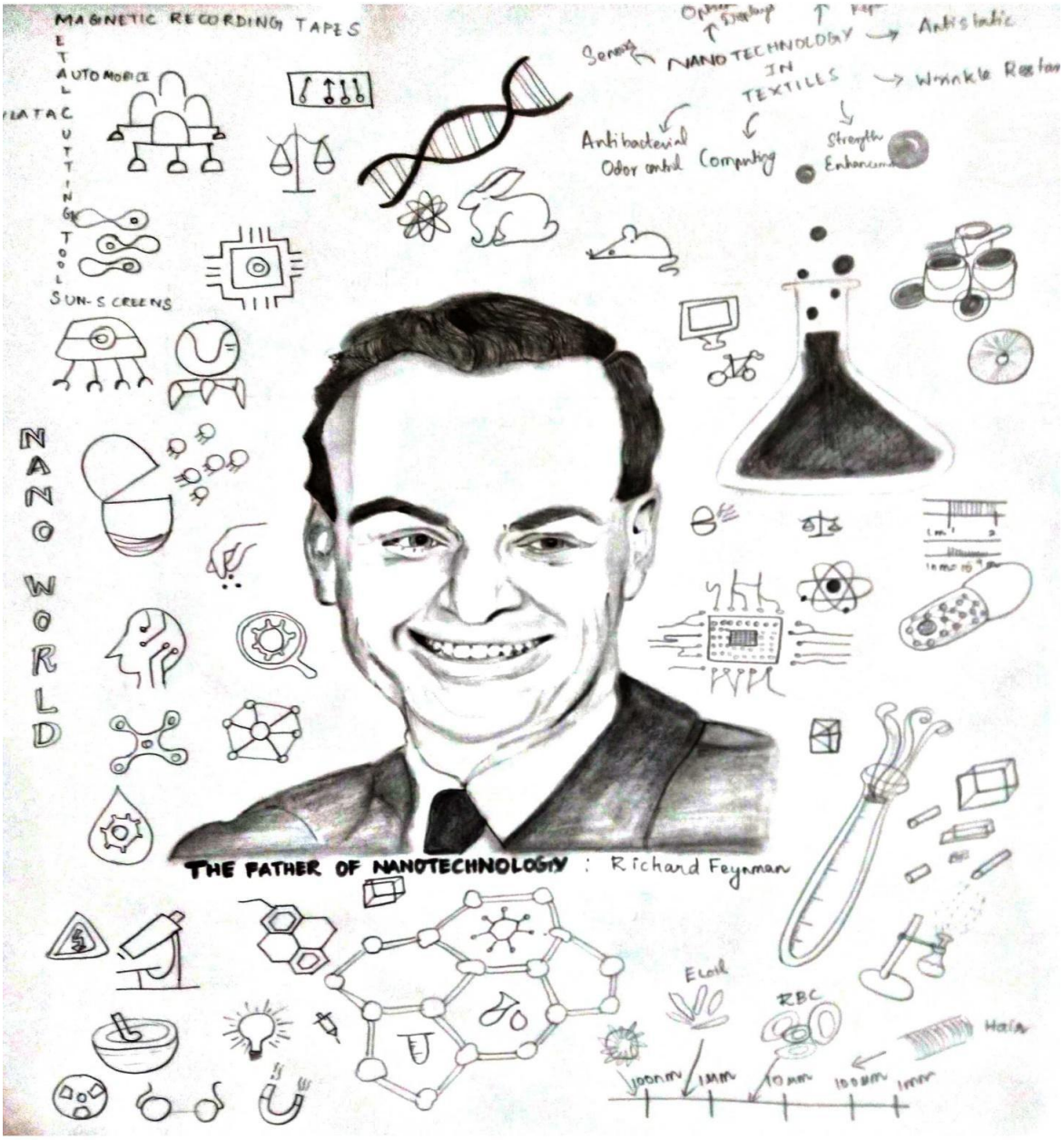
In 2017, the Food and Drug Administration (FDA) approved the first gene therapy to treat an inherited form of blindness. Many patients have experienced an improvement in their vision and have less blindness after receiving the therapy. The brand Luxturna has recently modified the version of the adeno-associated virus, or AAV, to deliver gene-revising molecules.

When compared with AAV, Lipid nanoparticles are a promising alternative because they do not have size constraints like AAV. Additionally, lipid nanoparticles can deliver mRNA, which only keeps gene-editing machinery active for a short period, so could prevent off-target edits. The potential of these nanoparticles was further proved by the success of mRNA-based COVID-19 vaccines, which also use lipid nanoparticles to deliver mRNA they also were the first vaccines to be authorized for COVID-19 in the United States, due to the speed and volume at which they can be manufactured.

Sahay and Ryals found that a peptide-covered lipid nanoparticle shell can be directed toward photoreceptor cells in the retina, in the back of the eye that enables vision. mRNA with instructions to make green fluorescent protein was placed inside nanoparticles to see the process of the mutation.After injecting this nanoparticle-based gene into the eyes of mice and animals, the team used a variety of imaging techniques to examine the treated eyes. The mice's retinal tissue glowed green, showing that the lipid nanoparticle shell reached photoreceptors and that the mRNA it delivered successfully entered the retina and created green fluorescent protein. This research marks the first time that lipid nanoparticles are known to have targeted photoreceptors in a nonhuman primate.

Scientists are currently working on furthering a way to quantify how much of the green fluorescent protein is expressed in animal retinal models. Researchers are currently working to develop a therapy with mRNA that carries the code for gene-editing molecules.

YASHWANTHY A
21/PPHA/129



JANEETA PRIYA P
21/PPHA/123

INTEGRATED
இயற்பியல்

"In the longer run and for wide reaching issues , more creative solutions tend to come from imaginative interdisciplinary collaboration"
- Robert J.shiller

INVENTIONS IN AGROPHYSICS

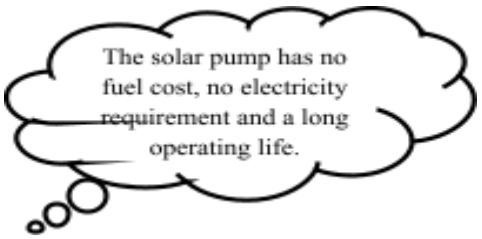
Solar water pumping system

In the past decades, farmers have used water pumps which require manual labour or electricity for moving the water to the field and water pumps with the help of fuel have become a great success in agriculture as it requires less human labour. The solar water pumping system uses the sun's energy to pump water which supplies water to the agricultural field. As we know, the amount of power the sun strikes the earth in a year in a single hour is more than the entire world consumes in a year.

The system operates on power generated using a solar PV (photovoltaic) system. The photovoltaic array uses electricity to run the motor pump set by converting solar energy into electrical energy. The open well, bore well, stream, pond, canal, and other sources are all utilized by the pumping system. For the solar panel to be installed, the system needs a location free of shadows. A system with an 1800-watts PV array capacity and a 2 HP pump can give a water discharge of 1.4 lakh litres per day from a depth of 6 to 7 meters. This quantity of water is considered adequate for irrigating about 5-8 acres of land held for several crops. The advantages of the solar pump are that it is eco-friendly, has no fuel cost, no electricity requirement and a long operating life. More than 50% of Indians are farmers in agricultural fields. Due to non-availability of electricity in many areas, even though the field is fertile, farmers cannot do cultivation, so the solar water pumping system can make agriculture possible even in remote areas.

Laser scarecrow

It has been found that birds can destroy up to 75% of the crops within 48 hours of harvesting, which results in severe financial loss for the farmers. The laser scarecrow was invented by Rebbeca Brown. The laser scarecrow emits a green laser which people cannot see in the sun and this works on birds, since birds are sensitive to green light, it moves back and forth scanning the birds. In the last two decades, these laser techniques are being used in enclosed spaces such as warehouses.



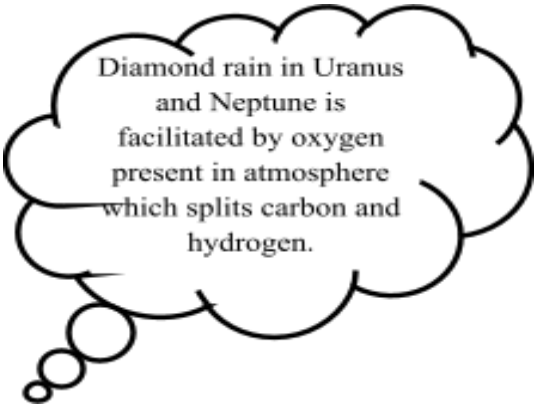
LED-based lasers are less expensive these days. The beams are also considered to be a safe deterrent and it is also found out that long wavelength lasers can disperse birds in low-light conditions while presenting "no threat to the animal or the environment." Lasers are an effective, long-lasting, and humane way to deter birds from growing crops and planting seeds with proven results.

JOY SALETH DHARSHINI A
21/UPHA/035

DIAMONDS FROM PLASTIC?!

It has been common knowledge that extreme conditions exist in the ice giants (Neptune and Uranus) in our solar system. Extremely high pressures and temperatures lead to a phenomena called “diamond rain” in these planets facilitated by the oxygen present in the atmosphere which splits the carbon and hydrogen in the atmosphere, thus giving rise to what we know as nano diamonds.

Now, research shows that such states can be recreated in a laboratory by using lasers. This research was carried out by a team of scientists from Germany’s HZDR, the university of Rostock and France’s Ecole Polytechnique.



The material used in this research was PET, which is a commonly available resin. The reason for choosing this material is that PET contains a favourable mix of carbon, hydrogen and oxygen in its composition which mimics the composition of the atmosphere of icy giants. During the experiment an X-ray laser called the Linac Coherent Light Source (LCLS) was made to fire flashes on the PET film. Due to this, nano diamonds were created because of the shock wave which compressed the matter to a high extent. The nano diamonds were then collected in a large tank filled with water where they were decelerated. After this they were filtered and harvested.

This research not only supports the assumption that it rains diamonds in Uranus and Neptune, but also provides a cleaner way to produce nano diamonds which have various applications in quantum sensors, polishing agents and abrasives among many more.

MAYURAKSHEE MOOKERJEE
20/UPHA/001

THE PHYSICS OF MUSIC

Physics is everywhere, and without physics there would be no principles behind everyday activities. At the same time, music is a universal language with structures, patterns, repetitions and other characteristics that make it easy for the human ear to recognize. Ultimately, music is a science and the physics behind it is simply fascinating. The whole process of creating music is a matter of physics. Let's look at musical instruments, which can produce sound because of standing waves, which result from constructive interference between waves traveling in two directions along a string or a tube.

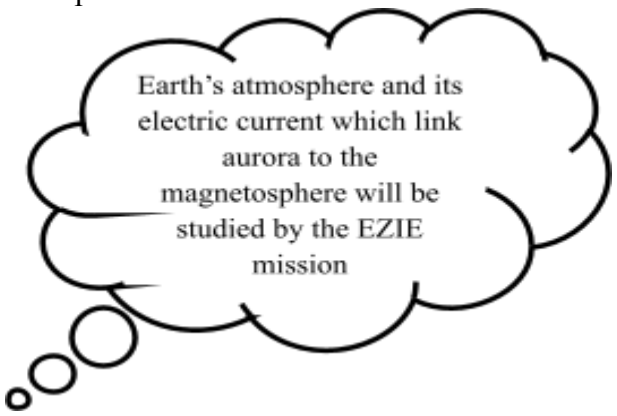
A guitar has a total of 6 strings, but all guitar strings are the same length. Now everyone will think, how can strings of the same length produce sounds of

different frequencies. If we take a closer look, they are actually made of different sizes, so all the strings are of different quality and length. The bottom one has the least mass and length, so it has the highest frequency. As you go up, the strings increase in mass and length, so the heaviest, tallest string has the lowest frequency. Likewise, the operation of the organ is the same as that of the guitar, the only difference being that the strings are connected at both ends, while the ends of the organ are free.This type of instrument produces harmonic frequencies.

SNEHA V
20/UPHA/015

HELIOPHYSICS

The integrated study of the Sun, its planets, and the space environment as a dynamic system is known as heliophysics. It focuses on the turbulent magnetic activity of the Sun and how it affects Earth's upper atmosphere, other planets in the solar system, and the heliosphere that surrounds them. The changing conditions in space and the effects of the Sun on Earth and other planets in the Solar System are the primary topics of heliophysics. The magnetosphere, ionosphere, thermosphere, mesosphere, and upper atmosphere of the Earth and other planets are its primary focus. The Science Mission Directorate's Heliophysics Division investigates the Sun's nature and the ways in which it affects space, including planets' atmospheres and technology. Contrary to popular belief, space is not completely empty; We, on the other hand, live in the massive atmosphere of a moving star. The solar wind, a constant outpouring of particles and energy, and the magnetic system, which is always writhing, emanate from our Sun. The Sun, Earth, and the planets are surrounded by this vast, dynamic solar atmosphere that extends far out into the solar system.



This system's study not only helps us comprehend fundamental information about how the universe works, but it also helps safeguard our spacecraft and technology. Because extreme space weather can disrupt our communications, satellites, and power grids, NASA seeks knowledge of near-Earth space. We can learn more about how stars influence the habitability of planets all over the universe by studying the Sun and space.

A comprehensive investigation of the Sun's influence on space, Earth, and other planets is necessary for mapping out this interconnected system. From the Parker Solar Probe at the Sun, which is observing the very beginning of the solar wind, to satellites around Earth, NASA has a fleet of spacecraft strategically placed throughout our heliosphere. The farthest human-made object, Voyager, is sending back observations on interstellar space. In order to observe and comprehend the flow of energy and particles throughout the solar system, each

mission is positioned at a crucial, well-thought-out vantage point, all of which contribute to our understanding of the effects of the star we live with.

Two heliophysics missions have been approved by the US space agency National Aeronautics and Space Administration (NASA). The Earth's atmosphere and its electric currents, which link the aurora to the magnetosphere, will be studied by NASA's EZIE mission. The magnetosphere is a complicated space weather system that reacts to a number of things, like solar activity. Despite the fact that scientists do not yet comprehend the specifics of the structure of the currents, the Auroral Electrojet (AE) index is commonly used to measure the levels of geomagnetic activity.The mission is slated to launch in June 2024, according to NASA.

The EUVST, a solar telescope operated by JAXA and designated as the Solar-C EUVST Mission, would investigate both the mechanisms by which the solar atmosphere drives material eruption and the solar wind that is produced there. Because of their influence on the space radiation environment throughout the solar system, studying them is important. The mission's launch is planned for 2026.

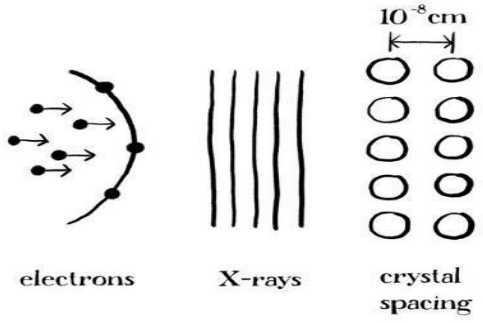
CELCIA
20/UPHA/019

X-RAYS ON CRYSTALS

On November 8, 1895, Wilhelm Conrad Rontgen produced an electron beam inside a glass tube that had been evacuated, and as a result, he unintentionally discovered some “rays’’ that had spread past the tube’s end. Rays appeared to travel in a straight line and exposed a photographic plate, he discovered. He also discovered that these kinds of rays only pass through flesh, not bones, therefore he used them to take a picture of his wife’s hand bone. He then referred to this ray as an x-ray. The X-rays developed by Röntgen were instantly heralded as a breakthrough in photography. He grumbled that he couldn’t identify his own work in the reports and wasn’t happy with the notoriety. X-rays were electromagnetic waves with an extremely high frequency and short wavelength. High-speed electrons crash with the end of an evacuated glass tube after being accelerated. Electromagnetic waves of short wavelength, or X-rays, which are produced in a collision transports the electron’s; energy and momentum onward. However, not everyone was persuaded. Some people still thought that X-rays were particles.

The year was 1912, and I was listening to a student in the research class describe his investigation into how long-wavelength electromagnetic waves interact with the atoms or molecules that make up a crystal. Since the usual crystal’s atom or molecule spacing (10-8 cm) is barely greater than the expected X-ray wavelength (10-9 cm), X-ray waves should form an interference pattern, or a pattern of waves that are superimposed both constructively and destructively, after passing through the crystal. This interference pattern ought to resemble what happens when visible light travels through a diffraction grating, which is a

regular grid of parallel slit-shaped apertures. The interference pattern created in both scenarios are dependent on a wave feature known as diffraction, which is a deviation. The two scenarios are physically very distinct, despite the fact that X-ray interference is, in its geometry, a smaller-scale variation of visible light interference. By causing the charged particles in the atoms (or molecules) that make up a crystal to vibrate, X-rays can flow through it. These atoms then emit additional waves that are transmitted from atom to atom, interaction after interaction, until the final atoms on the opposite side of the crystal emit like a series of evenly spaced radio beacons.



On the other hand, visible light is absorbed or reflected by the material surrounding the slits of a diffraction grating while passing freely through the slits. Paul Knipping and Walter Friedrich, two co-workers, were persuaded by Von Laue to try out his hypothesis. The X-ray interference pattern seen to the right was recorded on film during their initial experiment using the materials and equipment they had on hand. A single, bigger dark patch, denoting the remnants of the original ray, is surrounded by multiple smaller dark blotches that each represent the constructive interference of diffracted X-rays. This image garnered positive attention and helped gain money for additional thorough tests that amply supported von Laue's thorough analysis. In June 1912, Von Laue, Friedrich, and Knipping reported their initial findings. His concept was excellent, and everything supported it. He had "suddenly... recognised the approach which afterwards proved to be the shortest path to" rather than spending years pursuing one idea. The 1914 Physics Nobel Prize in Physics was to Von Laue for "his discovery of the diffraction of X-rays by crystals" Less than three years separated Von Laue's rise from privatdozent to Nobel winner.

Von Laue endured long enough to experience the raging flames of the Nazi regime and World War II. Because Einstein was Jewish, he actively opposed the promotion of a "German science" that, for example, disregarded relativity. He also publicly opposed the persecution of Jews. He remained in Germany throughout the war, openly denouncing the Nazis while secretly assisting his Jewish co-workers in emigrating and ultimately escaping.

Von Laue assisted in the post-war reconstruction of Germany's scientific organizations. Then, in 1960, a motorcycle crashed into the automobile he was driving to work and turned it over. Von Laue wrote his own funeral tribute within the few time he had left, writing, "He died trusting in God's mercy."

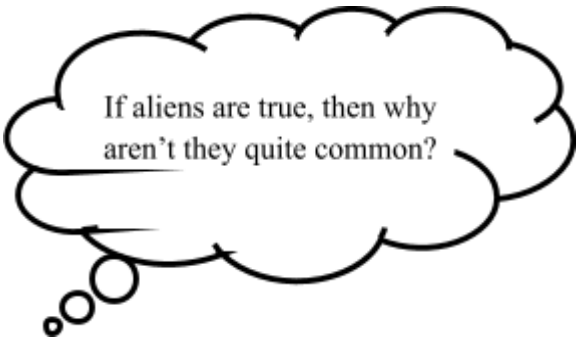
MARINA
20/UPHA/022

ARE WE ALONE???

In this modern world we wonder how Big Bang Theory started and how living beings started being created and there is various research that is still ongoing in this topic but we also think about other living forms who are still unknown and remain a mystery to the human eye. We always want to know more about others than ourselves. That's technically the human mentality. We were curious,we are curious and we will be curious in the upcoming future too. And that is also the reason why we try to analyse and think more about new things and we try to learn more about one's working process especially physicists are one among them. As the famous physicist and a remarkable person, Richard Feynman once had a little talk that was said to be, " There's plenty of room at the bottom". Likewise we literally know nothing about everything. We couldn't possibly just learn everything everywhere all at once and we are not robots too.

As we dig deeper, we're still researching and analyzing like it's an endless cycle that couldn't be completed, rather gets deeper and we have to think harder than we ever could imagine. Since our curiosity is the key to knowledge as well as creativity and that creativity further led to the thinking of living forms in other planets, solar systems, galaxies etc., and those foreign creatures generally called "aliens" are yet to be found by us.

The article wholly focuses on astrobiology which is nothing but the study of the universe where we all learn existential life forms in different parts of the universe and in some unexplainable theories and hypotheses we say as "multiverse". Multiverse is a totally mind-blowing huge topic that has its own beauty in it. So talking about the aliens in this world, we mainly consider the "Rare Earth Hypothesis". It speaks about some improbable conditions and combinations of astrophysical and geological situations where the origin of life and evolution has been taking place. So when talking about extraterrestrial life, people still believe we're truly connected with the foreign life forms somehow in an unimaginable way despite its low probability in this universe. Extraterrestrial life seems impossible but one cannot just assume that this can be always true and this might become true and there will be a transition of believing that the aliens are also in real life and this could become a universal fact and this might be a very tremendous discovery in the history of mankind. One might believe everything that others say but scientists and physicists will only accept the hypothesis and consider them as a theory and will believe only after making it or proving the condition to be "a fact".



The accommodation of complex life on earth is typical and quite surprising to the fact that we're still living on this rocky planet without knowing that we might be living with some stranger in the nearest possible galaxies without knowing anything as we don't have much properties and knowledge to research about time travel and aliens and stuff. Another theory

that could be a contradiction and speaks against the rare earth hypothesis is “Fermi paradox” where there is no clear evidence or testimony that there is any existence of aliens in this world and there is not much anything observed about the extraterrestrial beings.

There are some other possible theories which say that there are many earth-like planets where there might be aliens but one could raise a question as “If aliens are true, then why aren’t they quite common and can’t be seen?”.

Few answers state that those planets with those living forms cannot be found as they are unidentifiable or couldn’t be recognized as they are situated very far away and because of being many light years away, we couldn’t achieve and find out the existence of other kinds of life who are most super realistic. But the main reasons for the non-existent nature of aliens according to Fermi paradox can be said as

1. Insufficient elements for the formation of terrestrial planets
2. Dead zones in galaxy
3. Gravitational perturbation which leads to the many collisions which may lead to the major cause and becomes a drawback for the formation of planets for life existence
4. Planet size, distance from the star
5. Atmosphere
6. Tectonic movements of the plates
7. Immense moon size
8. A unique timing for evolutionary triggering for life creation and much more

Lastly, I would like to talk about the “Galactic habitable zone”. This is a one of a kind region in the galaxy or in space where the existence or creation of the species is started or most likely said to be developed.

Once we get to know more about space and life, it gets deeper and better but also difficult to understand as we have infinite possible answers for infinite unanswerable questions.

P. JANICE VALENTINA
20/UPHA/024

RELATION BETWEEN PHYSICS AND ARCHAEOLOGY

Interdisciplinary physics refers to a category of physics that applies the fundamentals of physics to subjects in other disciplines, thereby providing a new perspective. Given that it entails applying physics to other fields, this is sometimes referred to as applied physics. The term ‘‘interdisciplinary’’ is taking on more significance for the next generation researchers and educators as multidisciplinary techniques constitute the foundation of all modern scientific approaches. Sciences in general explore several perspectives and features of the

material, people today combine many viewpoints from other disciplines. To produce more fruitful research. One such interdisciplinary approach is physics applied in the field of Archaeology.

Archaeology is the study of human history through the collection and examination of physical remains. Archaeological artefacts are the source of historical evidence. These artefacts are used to learn how people lived in specific times and places.

Archaeology comprises techniques like microscopic analysis, excavation, and landscape mapping. However, the authenticity of these remains or artefacts can only be justified when they are researched in a systematic and scientific manner. Science, and particularly physics, can provide answers to several questions like the age of the artefacts. What's the composition? Where did it originate? etc.

Scientific techniques such as Carbon-14, Potassium-Argon, Thermoluminescence, Fission Track, Archaeomagnetism, Muon imaging etc use the fundamentals of physics and enable the process of establishing the age of the artefact thus playing a crucial role in reconstructing the archaeological record.

For example, Archaeomagnetism as the name suggests ties magnetism and archaeology. It has been the most popular geophysical tool used for archaeological prospection since its introduction in 1957 in England. This dating technique is based on changes in the earth's magnetic field throughout time.

These physics-related techniques have proven to be quite beneficial for archaeological studies because

- They are quite feasible.
- It minimizes the influence on cultural assets as the preservation of the artefact is the main objective. Sites can be evaluated with minimal intrusive exploration to conduct subsurface research
- Data gathering - High-quality data is unquestionably essential and can adjust to occasionally unforeseen ground circumstances.
- Site-specific methods - Methodologies and interpretations that are tailored to the particular cultural and environmental circumstances of each site are essential for success.
- Cost efficiency - In addition to providing specific data, a scientific survey can also help keep research costs down. Survey results can be strategically used to focus data recovery operations.

In conclusion, it is undeniable that historical events are shaped by the scientific interpretation of archaeological data. The tendency of analysing archaeological data is very advanced today, and this is only due to research methodologies. The contemporary methods

of physics on their thorough analysis and consistent application at sites are a reliable and effective tool for archaeological remain searching as they decrease the volume of exhausting excavations and increase productivity. Through this relationship between physics and archaeology, it offers the possibility of correlation of the conceptual contents and methodological and practical application of theoretical knowledge.

RAMYA MARY KOSHY
20/UPHA/026

GEOTHERMAL ENERGY

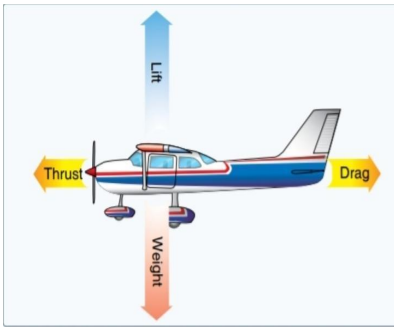
Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. The geothermal energy of the Earth's crust originates from the original formation of the planet and from radioactive decay of minerals. The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface. Earth's internal heat is thermal energy generated from radioactive decay and continual heat loss from Earth's formation. Temperature at the core-mantle boundary may reach over 4000 degrees.

The high temperature and pressure in Earth's interior cause some rock to melt and solid mantle to behave plastically, resulting in portions of mantle convicting upwards since it is lighter than the surrounding rock. Rock and water is heated in crust, sometimes up to 370 Degrees. From hot springs, geothermal energy has been used for bathing since Paleolithic times and for space heating since ancient Roman times, but it is now better known for electricity generation Worldwide, 11,400 MW of geothermal power was online in 24 countries in 2012. An additional 28 GW of direct geothermal heating capacity is installed for district heating, space heating, spas, industrial processes, desalination and agricultural applications in 2010.Geothermal power is cost effective, reliable, sustainable and environmentally friendly, but has historically been limited to areas near tectonic plate boundaries. Recent technological advances have dramatically expanded the range and size of viable resources especially for applications such as home heating,opening a potential for widespread exploitation. Geothermal wells release greenhouse gases trapped deep within the earth ,but these emissions are much lower per energy unit than those of fossil fuels. As a result geothermal power has the potential to help mitigate global warming if widely deployed in place of fossil fuels.

The Earth's geothermal resources are theoretically more than adequate to supply humanity's energy needs, but only a very small fraction may be profitably exploited. Drilling and exploration for deep resources is very expensive. Forecasts for the future of geothermal power depend on assumptions about technology, energy prices, subsidies and interest rates.

NEHA MARIAN JOVITTA. A
20/UPHA/033

THE PHYSICS OF FLIGHT



Aviation is a branch of science that involves the study of aircraft, its design and maintenance. Physics allows us to learn about how engines (piston and gas turbine) work; how helicopters and airplanes fly and hence it is important for people who maintain and repair aircrafts to know some basic Physics. The four forces acting on an airplane are Lift, Weight, Thrust and Drag.

Principles of a Flight

The principles of flight are Newton's third law of motion and Bernoulli's principle.

1.Newton's Third Law of Motion

Newton's third law states that every action has an equal and opposite reaction. In an airplane, the action-reaction pair is the moving air and engine's thrust which makes it possible for airplanes to fly. For an airplane to go up, the lift has to be stronger than the downward gravitational force (weight).

2.Bernoulli's Principle

Bernoulli's Principle states that, when the velocity of a fluid increases, its pressure decreases by an equivalent amount. The wings of an aircraft are designed in such a way that the air passing over the top of the wing travels faster than the air moving under the wing in the same period but the energy associated with the air remains constant according to conservation of energy. The consequence of this is that the air above the wing has a lower pressure than the air below below the wing and this net pressure creates a lift.

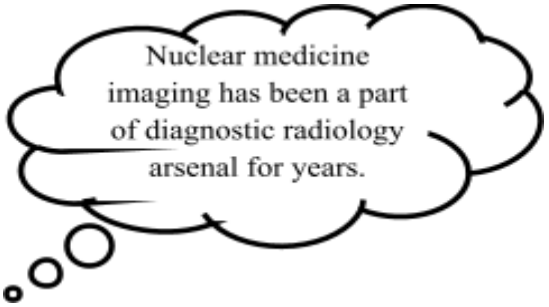
Falcon Solar with its curved wings

The wings and tail of the aircraft are covered with solar cells which convert solar radiation to electrical energy. The electricity thus generated is used for propelling the aircraft and onboard electronics. The excess energy is utilised to recharge the batteries which are used in the absence of sunlight. During flight, a solar powered aircraft switches automatically between battery and solar power. A circuit with a configurable microprocessor handles the power transmission output. Solar-powered airplanes have a significant potential for High Altitude and Long-Endurance (HALE) missions owing to the inexhaustible supply of solar electricity.

BERTLEJA
20/UPHA/055

AN EXCITING ARRAY OF NUCLEAR MEDICINE

Nuclear medicine is a branch of radiology that examines the structure and function of organs using very small quantities of radioactive substances, called radiopharmaceuticals. Imaging in nuclear medicine combines several distinct fields of study. These include biology, physics, math, computer science, and chemistry. This area of radiography is frequently used to identify and treat anomalies that first appear relatively early in the course of a disease, like thyroid cancer. Without the use of a contrast agent, soft tissues like the intestines, muscles, and blood vessels are difficult to see on a typical X-ray because X-rays flow through them. The tissue may now be seen more clearly as a result. The structure and function of organs and tissues can be seen by nuclear imaging.



Since molecular imaging and genomes are now the hottest research areas, nuclear medicine imaging is experiencing a resurgence in prominence. Nuclear medicine imaging has been a crucial part of the diagnostic radiology arsenal for many years. Nuclear medicine has always been molecular in nature and will continue to do so. It also provides information on metabolism and physiology, as those interested in nuclear diagnostic medicine are aware. Nuclear medicine treatments fall short of X-ray projection imaging, CT, and MRI in terms of spatial resolution and anatomical detail, though. Dual-modality imaging is necessary to achieve the finest structural and functional imaging results because it enables correct registration of anatomy and physiology, the capacity to see biological differences between diseased and healthy tissues, and other benefits.

This is especially important for oncologic diagnosis, staging, designing therapies, and outcomes evaluation. It should come as no surprise that there is a great deal of interest in dual-modality imaging, particularly when it comes to combined PET and CT. As a result, dedicated PET/CT and SPECT/CT imagers have been implemented and adopted in clinics across the country, not only in diagnostic radiology but also in oncology and nuclear medicine. Therefore, an increasing future for those participating in and eager to participate in dual-modality imaging will include new expectations, responsibilities, educational needs, and opportunities for the nuclear medicine technologist. The nuclear medicine technician should have a basic understanding of X-ray imaging physics.

NAYANA JOSE
20/UPHA/012

IMPROVING BIOMEDICAL IMAGING

Image segmentation is one of the prime research areas which is being addressed by many researchers of various domains. Digital image processing has varied applications in distinct domains which includes agriculture, security, medical domain, industrial applications, etc. Image segmentation is a preliminary step in most of the applications of digital image processing. Hence it is believed as one of the challenging steps in the area of computer vision. The primitive job is to automatically segregate an image into its constituent regions based on their grey level intensity or the red, green, and blue channels (if a coloured image) values. The segregation should be such that the integration of the segments produces the complete image. The segmented regions possess similarities. These similarities can be calculated on different grounds like colour, texture, and intensity. The similarities can also be computed by means of some mathematical functions. Biomedical image segmentation is a primal step in computer-aided diagnosis. This segmentation is helpful for the precise and quick investigations of different parts of the body and it is also helpful in diagnosing numerous ambiguities such as infections, abnormal tissue growth, foreign objects, etc. Automated image segmentation helps in studying anatomical structures with ease. Segmentation plays a vital role in various other medical applications such as the simulation of various biological mechanisms, disease analysis, tracking progress, assessing the condition and the requirement of surgery, pathological investigations, and many more. However, biomedical images suffer from numerous issues including poor quality and correlation, ambiguous overlapping regions, noise, etc. and these obviously make the job of physicians more difficult.

For the numerous inherent problems accompanying biomedical images, a single solution is not applicable to all types of images. Many times, it has been observed that crisp segmentation cannot precisely determine the segmented regions from images. The primary goal thus is to develop a fuzzy method that can fruitfully and reliably segment the biomedical images of different modalities with the assistance of the EMO approach.

The basic theory is that a singular point belongs to more than one cluster with some degree of membership. The sum of these membership values for a point must be unity. This type of membership is defined as PARTIAL MEMBERSHIP. The degree of membership is determined by the fuzzy membership functions and based on this theory many issues are solved. Image segmentation exploits this concept of fuzzy set theory to determine various regions of an image. Using this concept of fuzzy set theory, the popular Fuzzy C-Means Clustering Method has been developed and its application is widespread, not only in image segmentation but in many other domains also employing this concept.

S HARIPRIYA
20/UPHA/017

WHAT IS THE PHYSICS BEHIND FOOD?

Cooking a food, isn't pretty much being an, suave chef—it’s approximately expertise in the technology of phase transitions. Food and physics, certainly for plenty physicists any such mixture seems strange. The normal affiliation with meals could be very different, taste, meals chemistry and technology. Nevertheless, meals wish to be tackled inside the mouth, that means that it could be processed with the aid of using small forces. Food is specifically dependent on smooth matter, or difficult matter, which melts inside the mouth or dissolves inside with the saliva. The applicable energies of metal structures want to be of the order of the thermal electricity k_BT. Indeed, all meals comprise polymers, proteins, polyelectrolytes and carbohydrates and the selective solvents water and oil. Together with (natural) emulsifiers, the meals shape is partially described with the aid of using self-organization (in nature) and molecular pushed non-equilibrium throughout meals processing.

In this unique trouble, some essential factors within the bodily factors of meals from global main studies companies are collected. Important subjects are for instance the physics of fit to be eaten hydrogels, structuring oils, foams, the function of sugars in cacao butter crystal structures, or the biophysics of perception.

At the give up meals wishes to taste, to have first-rate textures, processed inside the mouth and to be digested throughout the gastrointestinal passage. All those approaches are strongly linked with the breakdown of colloidal, polymeric, and molecular structures, robotically within the mouth, with the aid of using pH brought about interplay adjustments with inside the belly and enzymatically with inside the intestine. Food incorporates physics, in all respects.

We all love eating ice cream. The first thing of making an ice cream is that you have to cool down the milk and the cream so they freeze and we will get a perfect ice cream. Ice doesn’t belong in ice cream. If you need to make an additional lick able treat, you want to limit the ice part. “The first factor in making ice cream is that you need to settle down the milk and the cream so that they freeze,” It is normal, however when, “You don’t need it to shape ice, but you need it to grow to be very, very cold and thick.” how one aspect (say, water) transforms into something else (ice). The path covers the physics of tender materials, The concepts of thermodynamics, molecular physics, and a sprint of molecular biology. this isn't a clear view however its “a higher appreciation of what’s taking place while they’re cooking.” And additionally, whether or not the ice cream they’re scooping is sufficient to justify the calories it’ll cost.

The usage of liquid nitrogen "cooking"

Before the existence of contemporary-day ice cream machines, glaciers (the French word for such professionals) might churn the liquid elements in a bucket coated with salt and ice. Salt brings down water’s freezing point, making sure that the bucket is particularly cold and that the ice cream hardens as quickly as possible, which reduces the possibility for massive ice crystals to shape. Modern physics, however, can do one higher than a bucket.

“The quality manner to make ice cream is, palms down, with liquid nitrogen,” right here we do the experiment with specific manufacturing methods, from shaking substances in a bag to pouring liquid nitrogen on them. They additionally must quantitatively degree the results.

Liquid nitrogen is so cold that it boils at minus 320 Fahrenheit, meaning “the entirety that comes into contact with it freezes extra or much less instantaneously the water molecules don’t have time to absolutely form ice, they simply solidify anywhere they are.” Pour it right into a bowl of combined cream, milk, and sugar and it freezes in seconds, generating ice cream with microscopic ice crystals, a smoother texture, and no wait.

For people who don’t have a liquid nitrogen canister tucked at the back of their saucepans, it’s critical to preserve stirring the mixture. It'll assist push back those ice crystals and to paste to cream (Gelatin and condensed milk won’t reduce it).

“Ice cream is each a foam and an emulsion,” so the name of the game to desirable, self-made ice cream is “to preserve the dimensions of the ice crystals to a totally small, microscopic size, get the emulsion of fats droplets to the proper consistency via way of means of the usage of cream, and get the proper quantity of air with inside the foam.”

KARAL MOZHI K
20/UPHA/045

HOW FINANCE AND PHYSICS ARE RELATED

Finance and physics may seem unrelated at first glance, but they are actually connected in several ways. One of the main ways that finance and physics are related is through the use of mathematical models. Financial models are used to predict and understand the behavior of financial markets, while physical models are used to understand and predict the behavior of physical systems.

Another way that finance and physics are related is through the concept of risk. Both finance and physics deal with the uncertainty of future events and the impact they will have. For example, a financial investor must consider the risk of a stock price falling, while a physicist must consider the risk of a particular experiment not yielding the desired results.

Finally, both finance and physics are impacted by the laws of supply and demand. In finance, the laws of supply and demand dictate the prices of stocks, bonds, and other financial instruments. In physics, the laws of supply and demand dictate the price of certain resources, such as energy. Understanding these laws is important for both financial investors and physicists. Overall, while finance and physics may seem unrelated at first glance, they are actually connected through the use of mathematical models, the consideration of risk, and the impact of the laws of supply and demand.

In finance, risk management is a crucial component. In order to effectively manage risk, financial professionals need to understand basic principles of physics such as probability and statistics. These principles help them assess the likelihood of certain events occurring and make informed decisions about investments.

In addition, finance and physics share a common goal of analyzing and predicting patterns. Financial models use mathematical formulas to determine the probability of future market trends, just as physicists use mathematical models to predict and explain the behavior of physical systems.

Finally, finance and physics are both concerned with the efficient allocation of resources. In finance, this refers to the allocation of financial resources to maximize returns, while in physics, this refers to the allocation of energy and materials to achieve a desired outcome. Thus, while finance and physics may seem like two very different disciplines, they actually share a number of important similarities and are connected in many ways.

KARISHMA LOURDES V
20/UPHA/025

PHYSICS BEHIND ORGANOLOGY

Organology is the study of musical instruments and the physics behind them. It studies the physical properties of musical instruments, such as their sound, structure, and acoustics, and how these properties affect the sound produced. Organology also examines the design and fabrication of musical instruments, as well as the history of their use and evolution. The physics of organology is based on the basic principles of acoustics. Acoustics is the science of sound, which includes the study of vibrations, waveforms, and resonance. Acousticians measure and analyze the properties of sound waves and their behavior in different types of environments. The physics of organology is concerned with the ways in which musical instruments produce sound, and how they interact with the environment.

The first step in understanding the physics of sound production is to understand how sound waves are produced. Sound is created when something vibrates, creating waves that travel through the air. The frequency of these waves determines the pitch of the sound. When an instrument is played, the vibrating strings, reeds, or other components create sound waves that travel through the air and are heard by the listener.The sound produced by a musical instrument is the result of various physical phenomena, such as air pressure, air flow, and vibration. Air pressure is the force that pushes air through the instrument, while airflow is the movement of air through the instrument. Vibration is the physical motion of the instrument's components, such as strings, membranes, and reeds. These physical phenomena interact with each other and the environment to produce the sound of the instrument.

DEENA RAKSHI
20/UPHA/035

PHYSICS BEHIND DRONES

Introductory drugs similar as delineations of instigation work kinetic and implicit energy power and Newton's laws of stir tells us how drones work, without knowing any aerodynamics. Newton's laws are simply stated; they're correct but interpreting them in the environment can be the tricky part. Aeronautic masterminds have got to get all the details exactly right. I 'd just like to get a feeling for what's going on and estimate some 'ball demesne' numbers for the power demanded for different aspects of light swimming, climbing and travelling horizontally though estimate is an important qualification. There's also the effectiveness of motors and batteries, etc..None of which I will go into 'going where angels sweat to tread' is an expression that comes to mind but nevertheless the power numbers deduced latterly are at an estimate of the minimal power demanded.

The flight of a quadrangle helicopter drone readily available as a toy is analysed using simple drugs generalities. A smartphone with erected - in accelerometer and gyroscope was attached to the drone to register the accelerations and angular rapidity along the three spatial axes while the drone is taking off wharf or rotating. The perpendicular speed, the height and one of the angular equals are attained through numerical integration of the acceleration values and compared with information handed by the manufacturer. The analysis of these amounts provides an occasion to gain sapience into important drug generalities involving Newton's laws and conservation principles in a stimulating terrain. Drones have no ailerons. The angular variables of pitch roll and yaw determine the exposure of the drone in the air and that fixes its direction of trip. Four motors are the minimal demand to control these four variables.

There's a good bit more drugs associated with drone flying similar to how cock and gyration are produced by controlling the relative pets of the counter-rotating propellers in different ways. It's the need to balance ropes as well as forces that dictates the use of dyads of counter-rotating rotors. However it is 'game over'. If one rotor fails while flying a 4 – rotor drone similar to my illustration. Although the remaining rotors can produce enough force to sustain the drone in the air and in principle you could immolate control of yaw so the drone spun freely around like a top, in practice the unstable ropes aren't controlled enough to allow the drone to maintain a roughly level station and descend safely. Anecdotal reports say the drone will crash land with serious damage at least to itself.

PRINCY G
20/UPHA/038

ROLE OF HYDROGEN AS A FUEL IN ROCKETS

Cryogenic engines are the most prestigious rocket engine technology due to their design and operational complexity. A simple rocket propels itself high into the sky using Newton's third law or in other words when the rocket engine ejects a high amount of mass at high speed the rocket gains an equal amount of momentum in the opposite direction. To eject

a high amount of fuel at high speed, rocket engines have to burn highly combustible fuel. Liquid fuel-based rocket engines are the most versatile engines for space propulsion with these rockets it is possible to efficiently control fuel injection. A rocket has to carry oxygen with it and the fuel oxidizer together and they are called propellant.

The first design challenge is to select the right fuel, when selecting fuel for a rocket engine specific impulse is the most crucial term. Specific impulse is the amount of push the rocket gets by burning per unit propellant so rockets clearly need high specific impulse fuels. Based on these criteria the obvious choice is hydrogen as it has a very low molecular weight and a high calorific value resulting in a high specific impulse. In addition to these factors hydrogen does not corrode engine parts and is not toxic to the atmosphere when burned with oxygen.

Challenge with hydrogen

The main challenge with hydrogen is that at room temperature it takes a gaseous form therefore carrying hydrogen gas in huge tanks would make the space rocket bulky the only solution is to liquefy the hydrogen. Here the cryogenics role comes into play, liquefaction of hydrogen is a more complicated process thus compressors condensers and throttling devices work together to bring the temperature down to -253C by this we can achieve the conversion of gaseous hydrogen to liquid hydrogen. Oxygen gas also undergoes the same process by this we can transfer the oxidizer and fuel to a composite which is made up of highly durable aluminium lithium alloy additional to this a yellowish material shrouding the outer tank, this material is in fact a 25 mm thick layer of thermally insulating polyurethane that has been applied with a spray foam technique its purpose is to protect the outer tank which has to face extreme heat while passing through earth's atmosphere.

We have stored the cryogenic propellants LH2 and LOX safely. A device called an injector plate is used to mix hydrogen and oxygen thoroughly in the combustion chamber where the propellants get atomized after the atomization the propellant is burned efficiently using a pyrotechnic igniter. The temperature inside the cryogenic engine combustion chamber can reach as high as 3000 degree celsius which can cause material damage however the circulating liquid hydrogen around the combustion chamber helps to maintain the material temperature within the allowable limit. The high pressure gases which are expelled from the combustion chamber are accelerated to higher velocities via a converging nozzle.

R. SWETHA
20/UPHA/041

EARTHQUAKE STUDY

An earthquake is any sudden shaking of the earth caused by the passage of seismic waves through the earth's rocks. Seismic waves occur when some form of energy stored in the Earth's crust is suddenly released, usually when masses of rock that are straining against each other suddenly break and "slide." Earthquakes most often occur along geological faults, narrow zones where rock masses move in relation to each other. Seismology, which involves the scientific study of all aspects of earthquakes, has provided answers to such long-standing questions as why and how earthquakes occur.

The Nature Of The Earthquake

Natural forces

Earthquakes are caused by a sudden release of energy in a certain limited area of the Earth's rocks. Energy can be released by elastic stress, gravity, chemical reactions, or even the motion of massive bodies. Earthquakes associated with this type of energy release are called tectonic earthquakes.

Tectonics

Tectonic earthquakes are explained by the so-called elastic rebound theory, which was formulated by the American geologist Harry Fielding Reid after the San Andreas Fault ruptured in 1906.

In 1906, for example, the San Andreas fault slid along a plane 430 km (270 mi) long. Along this line, the ground was shifted horizontally by up to 6 meters (20 ft).As the crack progresses along the fault or up, the rock masses are thrown in opposite directions and thus return to a position of less stress. At any given point, this movement may occur not all at once, but rather in irregular steps; these sudden decelerations and restarts create vibrations that travel like seismic waves.

Types of faults in tectonic earthquakes

Earthquakes have different characteristics depending on the type of fault slip that causes them. A common fault model has a "strike" (that is, the direction from north taken by a horizontal line in the plane of the fault) and a "dip" (the angle from the horizontal that shows the steepest slope of the fault). The lower wall of an oblique fault is called the footwall. Above the footboard lies a wall of hangers. When rock masses slide past each other parallel to strike, the movement is known as a strike-slip. Movement parallel to the dip is called dip-slip faulting. If in strike-slip faults, the hanging wall block slides downward relative to the footwall block, it is called a "normal" fault; the opposite motion, where the hanging wall moves upward relative to the foot, creates a backswing or thrust interruption.

Volcanism

A separate type of earthquake is associated with volcanic activity and is called a volcanic earthquake. Nevertheless, it is likely that even in such cases the fault is the result of a sudden landslide of rock massifs in the vicinity of the volcano and the subsequent release of elastic deformation energy. However, the stored energy may be partially hydrodynamic in origin due to heat provided by magma moving in reservoirs beneath the volcano or by the release of gas under pressure.

Artificial induction

Earthquakes are sometimes caused by human activity, including the injection of fluids into deep wells, the detonation of large underground nuclear explosions, the excavation of mines, and the filling of large reservoirs. In the case of underground mining, the removal of rock causes changes in the voltage around the tunnels.

Slip-on adjacent preexisting faults may occur, or the rock may break outward into new cavities. In fluid injection, slip is assumed to be induced by premature release of elastic stress, as in tectonic earthquakes, after fault surfaces are lubricated by fluid. Large underground nuclear explosions are known to cause slip on already stressed faults near test facilities.

Seismology and nuclear explosions

In 1958, representatives of several countries, including the United States and the Soviet Union, met to discuss the technical basis for the Nuclear Test Ban Treaty. Among the matters under consideration was the feasibility of developing effective means of detecting underground nuclear explosions and seismically distinguishing them from earthquakes.

Recent contract verification seismological work has included the use of high-resolution seismographs in a worldwide network, the estimation of explosion yields, the study of ground wave attenuation, the determination of amplitude and frequency discriminants of spectra, and the application of seismic fields. The results of such research have shown that, compared to natural earthquakes, underground nuclear explosions typically generate seismic waves through the Earth's body that are much larger in amplitude than surface waves.

ANGEL JOSE
20/UPHA/011

LASERS IN SURGERY AND MEDICINE

Has the laser matured after 60 years?

A big yes, for this question.

Lasers have become the main component of many devices that we use daily. In our day-to-day use, we use it in DVD players, barcode scanners. They are used in specific fields like surgery and manufacturing industries. The uses are listed as follows:Used in ophthalmic surgical procedures like LASIK to repair holes in the retina and other functions, also used to remove tumours, prostate and gall bladder and kidney stones In industry it is the commonly used device for cutting and drilling. Laser is used in spectroscopy and holographic imaging.

Laser Surgery

Laser surgery is a type of surgery that cuts tissue using a laser rather than a scalpel. On the eye, laser surgery is often employed. LASIK, a surgery that permanently reshapes the cornea using an excimer laser to remove a tiny amount of human tissue, and photorefractive keratectomy, a procedure that permanently reshapes the cornea using an excimer laser to remove a little quantity of human tissue, are among the techniques employed. Carbon dioxide, argon, Nd: YAG lasers and potassium titanyl phosphate lasers are examples of surgical lasers.

Laser surgery uses an intensely hot, precisely focused beam of light to remove or vaporise tissue and control bleeding in a wide variety of non-invasive and minimally invasive procedures. Laser surgery is used to cut or destroy tissue that is abnormal or diseased without harming healthy, normal tissue, shrink or destroy tumours and lesions and cauterise blood vessels to prevent excessive bleeding.

LASER (Light Amplification by Stimulated Emission of Radiation) surgery uses an intensely hot, precisely focused beam of light to remove or vaporise tissue and control bleeding in a wide variety of non-invasive and minimally invasive procedures. Laser therapy is minimally-invasive and painless.

What Cancers May Be Treated With Laser Therapy?

Lasers are used in surgery for the following types of cancer because they often have a special requirement that only lasers can meet—such as the ability to reach a hard to treat location, apply heat, or cut only a very small area:

- Vocal cord
- Cervical
- Skin
- Lung
- Vaginal
- Vulvar

- Penile
- Palliative surgery

The future of lasers will be magical!!!

MONITA REGY. P
22/PPHA/103

SUPER CONDUCTIVITY AND FERROELECTRICITY FOUND IN THE SAME MATERIAL

There are two important phenomena in physics which we have learnt in our lower grades. One is superconductivity and the other one is ferroelectricity. We can remember those phenomena now. As we all know superconductivity is the ability of certain materials to conduct electricity with no resistance and also low temperature is required for the materials to behave as superconductors.

Some dielectric materials exhibit a spontaneous polarization in the absence of an applied field which can be reversed by an externally applied electric field. This behavior is the ferroelectric effect. Superconductivity is a property of electricity conducting metals whereas ferroelectricity occurs at insulating materials. From this we can know they are two competing phenomena . But can you believe these two phenomena take place in a single material ? Yes, it is possible now.

Researchers at Columbia have found evidence that these two phenomena occur in a single material called Molybdenum ditelluride($MoTe_2$). It is a semiconductor. Rhodes, now an assistant professor at the University of Wisconsin had interest in growing High-quality crystals by peeling them into atom-thin layers to explore the unusual properties that can arise in two dimensions. In a single layer of $MoTe_2$ they have found initial evidence of superconductivity.

The atoms between the layers are not aligned, which should inherently create an internal electric field known as ferroelectricity, explains lead author Apoorv Jindal, a PhD student in Columbia physics, who continued Rhodes work on the material after he moved to Madison in 2019.

Initial evidence of ferroelectric metal was found in WTe_2 which has the same structure as $MoTe_2$ It was already confirmed that superconductivity takes place in $MoTe_2$, the researchers wondered whether ferroelectricity would take place in the same material. When they applied the electric field in $MoTe_2$, they found that $MoTe_2$ also had the property of ferroelectricity with immense happiness. They wondered whether a ferroelectric superconductor could exist.

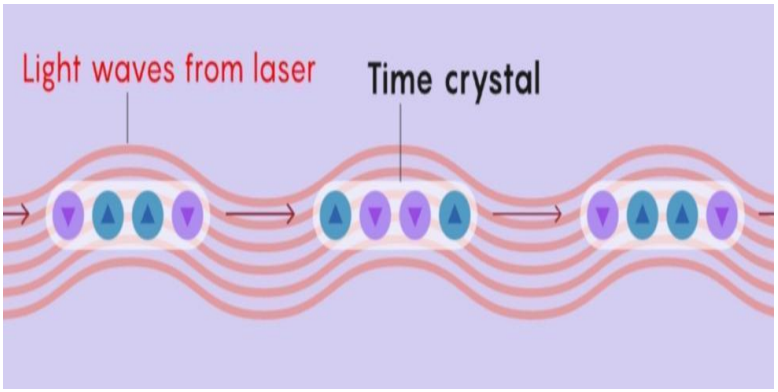
The team made additional measurements on temperature, magnetic field, and electrostatic doping to discover operable transitions between superconducting and ferroelectric states within $MoTe_2$. They said finding these two properties is magical. They have plans to explore why these two properties exist and how they can be controlled. There are still fundamental scientific questions to ask, but we didn't have the system to study them before, now we do," said Rhode.

THILAGAPRAGASINI C K
22/PPHA/108

TIME CRYSTALS- A NEW STATE OF MATTER

As far as we know, matter exists in five states: solid, liquid, gas, plasma, and bose-Einstein condensed matter. Scientists have been in the process of discovering and classifying new states of matter, and there are more than a few possible states of matter under study currently. Time crystals have been under consideration as a new state of matter since 2012, when the theory of time crystals was first proposed by Frank Wilczek in his article "Quantum Time Crystals" that same year. However, the idea remained a theory because there wasn't any practical proof. But thanks to the recent advancement in quantum physics and quantum computing, this theory has been proved using the quantum computer created by Google.

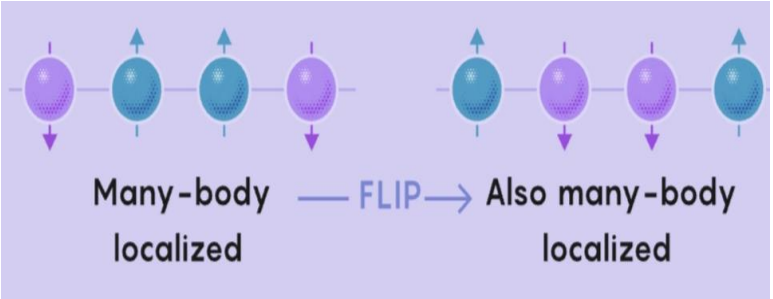
What are time crystals?



A crystal, as we know, is a structure in which the atoms are arranged in a regular pattern that repeats itself in all three dimensions. However, a time crystal doesn't repeat in three dimensions but does so in time. They aren't actual crystals, but they are "qubits" or "quantum bits" that arrange themselves over time. For this to make sense, we need to know the basics of how a quantum computer works. In a normal computer, all the computing is done in the form of bits, which are either 1 or 0, or a combination of both. Whereas in a quantum computer, the computing is done with the help of "qubits." Qubits are nothing but particles at the quantum level that possess a spin. It can be an electron, a neutron, or any other quantum particle that possesses spin. The qubits can either have an up spin or a down spin, or a superposition of both states. Quantum computers cannot be used in the same way that traditional computers can, such as sending emails; rather, quantum computers are used to stimulate specific quantum conditions by manipulating the qubits, allowing us to learn more about the quantum system under study.

In 2021, scientists at Stanford and Google collaborated to demonstrate a quantum time crystal using the quantum computer at Google. In this study, 20 qubits were taken and their initial spins were fixed; for example, if up spin is considered 1 and down spin is considered 0, then the qubits are initially in the state 1010101010101010. They are now rotated through an angle "g" (g = 1 for a 180-degree rotation) by passing a small laser pulse. After rotation, the qubits were flipped from how they were initially to 0101010101010101. However, after a few moments, they came back to their initial state. No matter how many degrees the qubits were rotated, they always got back to their initial state on their own. The time taken for them to come back to their initial state after being rotated was found to be an integral multiple of the length of the laser pulse used to rotate them.

Why is the existence of time crystals significant?



According to the second law of thermodynamics, the entropy, or disorderliness, of a system can only increase with time. whereas in the qubits observed, we can see that they go back to an orderly fashion after being rotated, as if they possess an innate memory that brings them back to order after being disturbed from their initial states. This defies the second law of thermodynamics, which clearly states that it is impossible for a system to return to order after being disordered without the help of an external energy source. Therefore, they break the symmetry of time translation, according to which the laws of physics remain unchanged throughout time. Therefore, this forms a state of matter in which quantum particles can exist in a state that repeats itself in time.

How are time crystals almost like a perpetual motion machine?

The laws of physics firmly state that a perpetual motion machine that runs forever with no energy input is impossible to construct. However, time crystals are almost as close to a perpetual motion machine because of the following reason: As previously stated, they used a laser pulse to rotate the qubits from their initial position; however, it was noted that the energy from the laser pulse was not used for rotating, only the qubits. While the rotation cannot be done without the help of lasers, it is important to note that there was no energy transfer from the laser pulse to the qubits or vice versa. Therefore, the rotations happened due to the interaction with the laser pulse without involving its energy.

PUVATHARINI S
22/PPHA/109

E-VEHICLE

E: Vehicles are either partially or fully powered by electricity. The short acronym of "e-vehicle" is "E-V." It is available at a low cost, and it is environmentally friendly because it uses little or no fossil fuels. There are four types of electric vehicles: Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), Plug-in hybrid electric vehicle (PHEV), FCEV (Fuel Cell Electric Vehicle).

The workings of the e-vehicle

In an electric car, the engine is powered by an electric motor instead of a gasoline engine. The electric motor gets energy from a controller, which regulates its usage based on the driver‘s use of an accelerator pedal. In electric and hybrid vehicles, we don‘t have gears. The electric motor is powered by the rotation of wheels, and it stores electricity in a rechargeable battery. It doesn't produce any sort of emissions or harmful gases.

Advantage

They don't produce any pollutants, hence they are environmentally friendly. We can save money if there is no need for fuel. Driving is easy and relaxed. Enhanced performance. Home charging is more practical.

Disadvantage

The most frequent excuses given by motorists for not using EVs are "range anxiety," or the worry that there won’t be enough charging stations and greater initial outlay requirements.

Discovery of lithium

India discovered a sizable lithium resource on February 9 in the Reasi district of Jammu and Kashmir. The Geological Survey of India (GSI) discovered 5.9 million metric tonnes of lithium deposits in Jammu and Kashmir. The non-ferrous metal lithium is one of the essential elements in the batteries of electric vehicles (EVs). It is possible to reduce the battery size while maintaining the same storage capacity since lithium and ion batteries have higher energy densities than lead-acid batteries or nickel-metal hydride batteries.The element has become extremely important in the production of these vehicles as a result of the global drive towards EVs by governments. Lithium, according to Live Science, is a light metal used in a variety of applications, including the treatment of bipolar disorder, where it aids in the control of the illness's erratic mood swings.

ASHMITHA T
22/PPHA/126

BIODEGRADABLE POLYMER

The trend to develop technologies based on non-renewable, life-essential resources is causing dangerous pollution and prompting scientists around the world to discover and invent new materials that are both biodegradable and recyclable. This move away from non-renewable materials then led to the production of agricultural composites made from natural fibres such as jute and coir. These materials are in turn used to create a wide range of essential items, from textiles and towels to modern aviation packaging and tech devices.

The main benefit of these biodegradable materials is ease of disposal. Biopolymers have many advantages over fossil polymers. Some of them are non-toxic, recyclable, renewable, biodegradable, cheaper, more readily available, easier to use, and much more environmentally friendly. Also, physically, biopolymers have more flexibility, a lower density, and are much safer to use. For these reasons, biopolymers are in high demand in various industries such as biomedical, packaging, aerospace, construction, defense, sports, and many more. They are also used for a variety of applications and are considered by many to be a much more desirable alternative material.

Polylactic Acid (PLA) has been identified as one of the key man-made and natural biopolymers to replace traditional plastics derived from petroleum by-products. PLA is renewable and biodegradable and is derived from agricultural crops such as sugar beets, corn, etc. In addition, it has exceptional structural strength and hardness and can be shaped using traditional manufacturing processes. In addition, PLA requires only a tenth as much resin as man-made, fossil-based polymers. These factors make PLA an ideal choice for a biodegradable polymer.

SOWMIYA RJ
22/PPHA/121

CAN LASER THERAPY BE CONSIDERED SAFE?

Laser beams in surgeries are greatly considered for their ability to cut tissues and small vessels while simultaneously coagulating the blood, which gives the name "the bloodless knife." It is regarded as a boon in neurosurgery because it places minimal mechanical strain on the tissue while also providing numerous benefits such as its sterile, contactless nature, which reduces the risk of infection, and during cutting tissues, they seal the bleeding, causing less damage to the surrounding tissues. Even the time duration for laser therapy is less compared to others. But one cannot be considered good in every aspect; laser therapy also has its own black dot.

To perform laser therapy, a doctor must have been through special training before they can perform surgery, and they must also follow very strict safety measures. In terms of side effects, lasers are commonly used in eye surgeries and Laser therapy can cause extreme or

misdirected burns accompanied by bleeding from the choriocapillaris. The choriocapillaris is densest in the macular area, where it is the sole blood supply for a small region of the retina.

Laser therapy can result in the breaking of Bruch's membrane. Bruch's membrane, an extracellular matrix located between the retinal pigment epithelium and the choroid, plays a vital role as structural and functional support for the retinal pigment epithelium. Although there are some drawbacks, the benefits far outweigh the drawbacks, and because laser therapy is widely used, it can be considered an alternative to other surgeries if given the choice.

BERNADINE SHRUTHI G
22/PPHA/115

ROBOTICS IN DEFENSE

One of the newest fields is robotics, which deals with the creation, maintenance, and use of robots in a variety of industries like defense, medicine, and industry. Robotics are used in the military and have been developed for more than ten years. With its sophisticated functionalities, robotics has revolutionised the military and defence industries globally. In our military and defence sector, wearable robotics are driving innovation to make it easier for human soldiers to carry large burdens with ease.

Artificial intelligence and robotics work together to move large amounts of weight from one location to another, which lessens the labour of human soldiers. For this industry, a well-secured monitoring system is highly valued. The ground-based systems make use of high-sensor cameras and surveillance robots with adequate weapons. Without sending in troops, these infrared or night vision cameras make it possible to monitor the entire military and defence complex. In the military and defence sector, mobile robots can be used for everything from bomb defusing to patrols. These mobile robots are equipped with cutting-edge sensors that enable them to carry out various tasks quickly and effectively while supplying the necessary video and photos.

Robotic arms are also employed to deactivate bombs and suspicious objects, ensuring that no human soldiers are harmed in the process. These might function on wheels, tracks, both, or batteries with a strong communication system. One of the most practical military robotics is used for search and rescue missions to save human soldiers from dangerous situations.Robotics has made it possible to find, track, and save soldiers in a variety of hazardous settings, including chemical, nuclear, radioactive, and biological ones. It can be controlled from a command center, allowing soldiers to be rescued from combat zones without further risk.

EOD robots, also known as "explosive ordnance disposal" robots, are frequently used in this field to locate and deactivate dangerous traps, makeshift explosive devices, and pyrotechnics, among other tasks. EOD robots can be integrated into bomb detection systems in closed areas, vehicles, or building complexes. These have immense potential in the near

future to carry a lot of major responsibilities in future missions. The military and defence industry are ready to invest millions of dollars in drones for observation. These are small surveillance drones with a long battery life and high-tech cameras. For this industry to observe activities and identify potential combat threats, an aerial view is absolutely necessary. These medium-sized robots can hold and fire weapons as well as disarm bombs and weapons. They also have features that look like machine guns, giving the impression that they are small armies. As a result, it is possible to see how robotics can contribute to enhancing the capabilities of the military and defence industry in the near future. Families of human soldiers may be relieved because they no longer have to worry about neutralising bombs or losing lives on the battlefield.

NANCY SELINA
22/PPHA/104

BIOSENSOR

The term "biological sensor," which is commonly known as "biosensor," is a self-contained, integrated analytical device that converts a biological response into quantifiable and processable signals. Biosensors are mainly used in checking ecological pollution control, agricultural fields, and food industries. The biosensor has three parts, namely, the sensor, the transducer, and the associated electrons. In the first part, the sensor is a responsive biological part; the second part is the detector part that changes the resulting signal from the contact with the analyte, and for the results, it displays them in an accessible way. The final part has an amplifier, which is known as a "signal conditioning circuit," a display unit, and the processor.

A specific enzyme or preferred biological material is deactivated by some of the usual methods. The deactivated biological material is in near contact with the transducer. The analyte connects to the biological object to give a clear analyte, which in turn gives the electronic reaction, which can be calculated. In some cases, the analyte is changed to a device that may be connected to heat, gas discharge, electron ions, or hydrogen ions. The transducer can assist in changing the linked device and converting it into electrical signals.The electrical signal of the transducer is frequently low and overlays a high baseline. The signal processed includes deducing a position baseline signal, which is obtained from a related transducer without any biocatalyst covering.

The electrical noise filtration problem is somewhat alleviated by the biosensor reaction's relative slowness. The direct output will be an analogue signal during this stage, but it is converted to digital form and accepted to a microprocessor phase where the information is progressed and accordingly to preferred units, and o/p to a data store.Physical biosensors are the most fundamental and widely used sensors.

Magnetic biosensors detect biological interactions by using paramagnetic or superparamagnetic particles or crystals and monitoring changes in coil inductance, resistance,

or magneto-optical characteristics, which are magnetically induced effects. Nanometers to microns in diameter are the sizes of the particles employed in magnetic biosensors. They have a bio-receptor coating, such as an antibody or nucleic acid strand.

MARGILIN JOHN
22/PPHA/106

3-D PRINTING

Additive manufacturing, or 3D printing, has been receiving some attention lately as an efficient method to use natural fibres in the production of PLA-based composites Fused Deposition Modelling (FDM) is the form of 3D printing favoured for such applications due to its ability to work with a variety of polymers such as PLA, ABS, and nylon.

The procedure consists of feeding PLA filament into a heated nozzle managed by a feeding roller, and the hot melt created is positioned on a heated bed one layer at a time, thus binding the partially liquefied layer to the previous layer as the material solidifies.There are numerous parameters that need to be considered for manufacturing the product through 3D printing, such as print speed,nozzle diameter, nozzle temperature, layer thickness, bed temperature, raster orientation, infill patterns, infill density, infill orientation, atmospheric temperature, printing time, and more. Plastic additive manufacturing (AM) is emerging as a low-cost manufacturing method. effective, lightweight alternative to established manufacturing techniques, such as injection moulding and compression molding. This novel process, with its ability to create porous structures boasting enhanced mechanical properties, shows great potential.

However, Further research is required to further understand, optimize, and harness its capabilities. Essentials such as nozzle diameter and nozzle temperature, layer thickness, bed temperature, raster orientation, and infill patterns, infill density, infill orientation, and atmospheric temperature are critical parameters that need to be manipulated and tested to achieve the desired results.

USHA NANDHINI G
22/PPHA/119

QUIZ TIME!

1) Geophysics is the study of:
a) Earth science that involves investigation of the solid and molten Earth using physical principles.
b) Biological systems and biological processes using physical principles.
c) The materials, processes, products, physical nature and history of earth.
d) Physics of clouds, how they form, their evolution, falling and dissipation.

2) Geophysical studies are:
a) Qualitative
b) Quantitative
c) Both
d) None of the above

3) _____ is the branch of geophysics which studies the materials that erect the interior of any planet.
a) Mineral
b) Geo-dynamics
c) Seismology
d) bio-geophysics

4) The geophysical techniques are not used in the inspection of a diamond.
a) True
b) False

5) _____ is the branch of geophysics that deals with the study of heat flow, rock deformation, various modes of transport deformation and lithosphere dynamics.
a) Geophysical fluid dynamics
b) Geomagnetism
c) Geo-dynamics
d) Paleo-magnetism

6) The advantages of geophysics:
a) Non-destructive
b) Cost-effective
c) Comprehensiveness
d) All of the above

7) Geophysics was discovered by

a) Richard Feynman
b) Walter Kertz
c) Raymond A. Serway
d) John W. Jewett

8) Geophysics can be used in the application of:
a) Seismology
b) Geodesy
c) Mineral physics
d) All of the above

ROCHELLE G ALANI
20/UPHA/008

LIFE OF A PHYSICIST

A typical man says, 'a' for apple, 'b' for ball, 'c' for cat, 'd' for doll;

But for us (physicists), 'a' for acceleration, 'b' for magnetic field,'c' for coulomb, 'd' for delta.

Physics has given a lot of lessons for our lives if you may realise or may not!

When you hit us we don't go crying sad! because

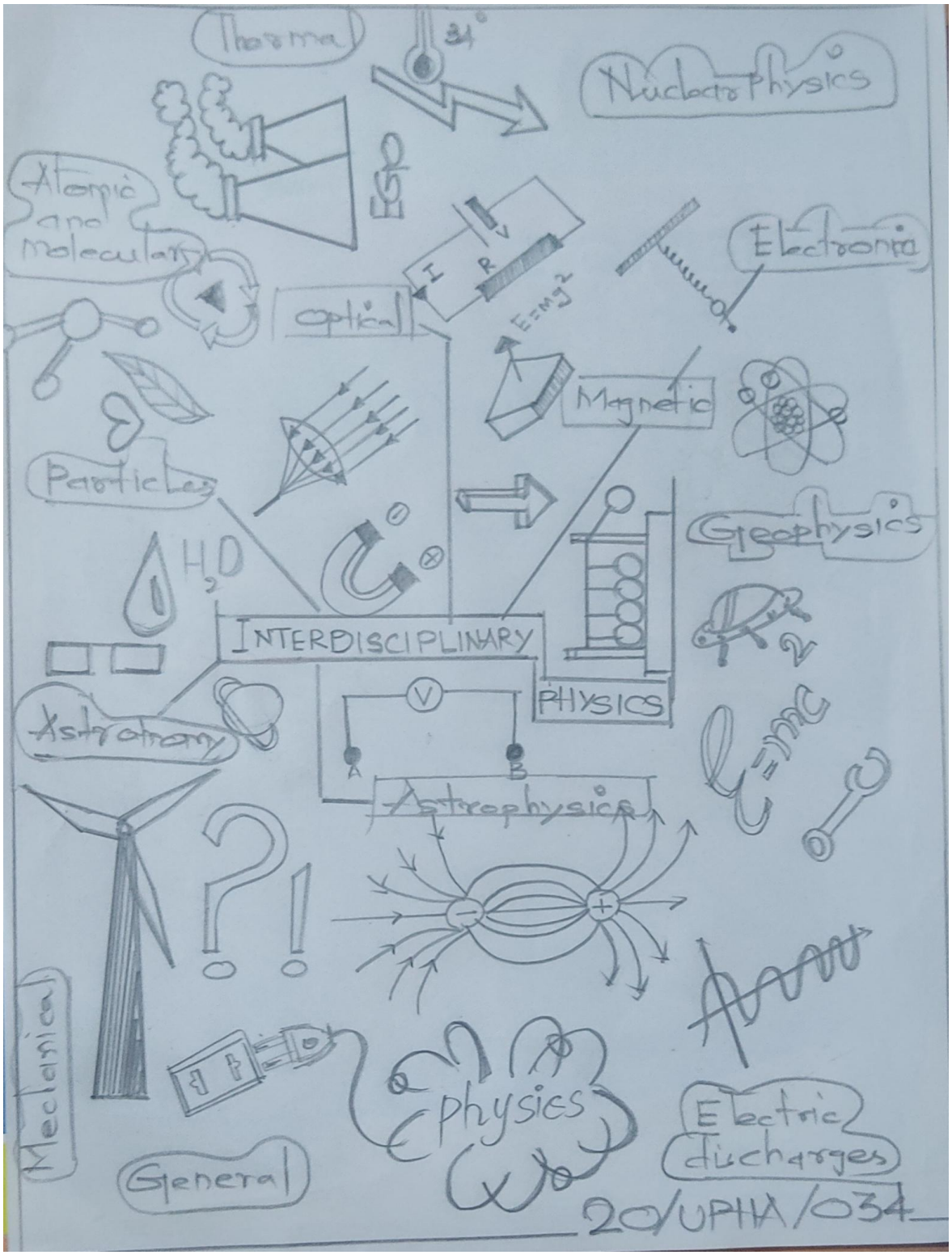
"For every action there is an equal and opposite reaction"

We don't fear failure, because,

We know that;

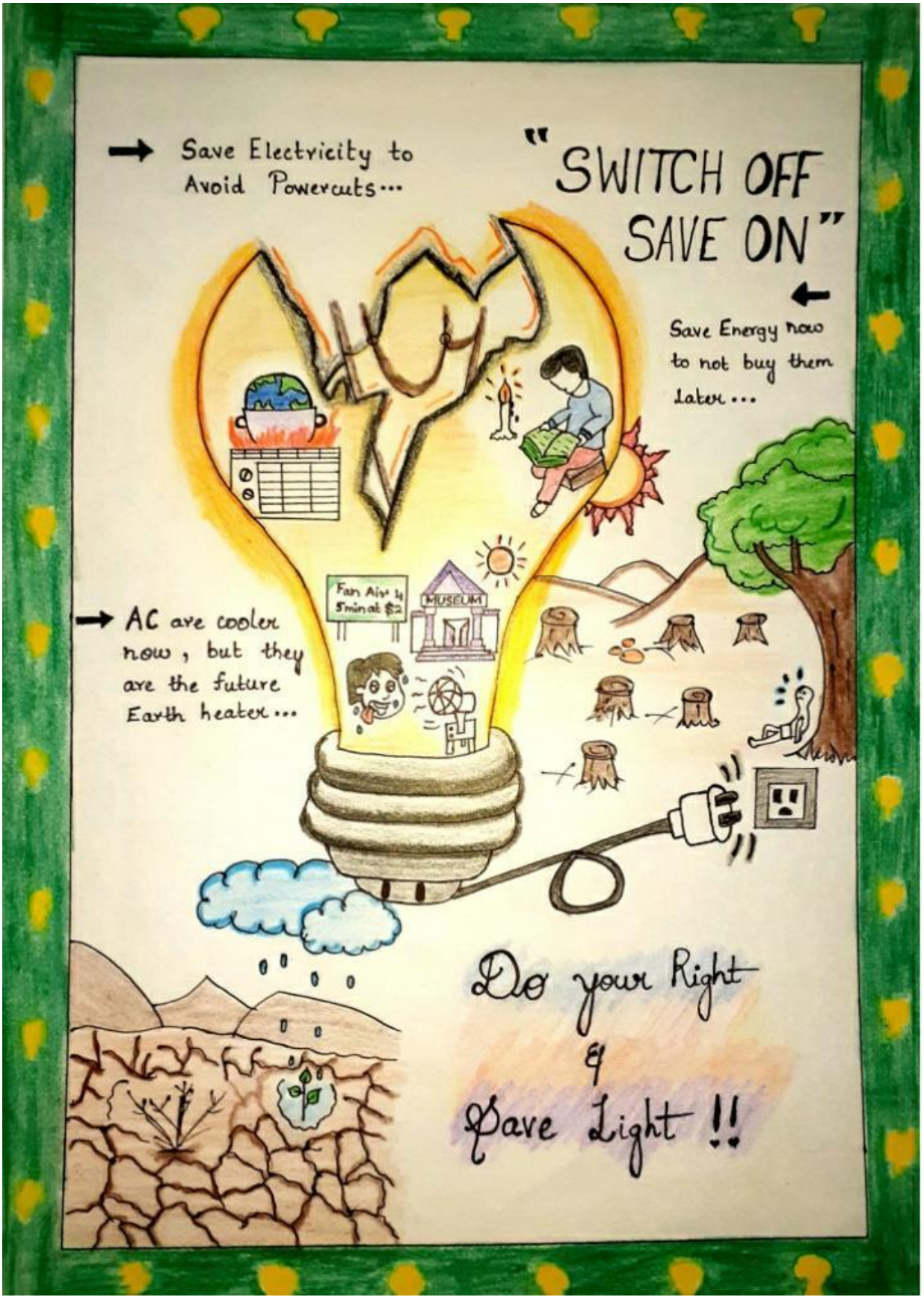
"Attaining absolute zero is impossible"

SRUTHISHA J M
20/UPHA/007



JAICY KAVIYA
20/UPHA/034

MINCY LUDS C
20/UPHA/010



THANA BRITNEY T
22/PPHA/116

LAURELS OF THE DEPARTMENT 2022-2023

NAME	PRIZE/AWARD	EVENT	INSTITUTE
AAFRIN FATHIMA 22/PPHA/101	Second Price	Pot Painting	Stella Maris College
	Recognition as 'Citizen scientist' and team member in the project	Project of IASC, collaborator of NASA	International Astronomical Search Collaboration
T SHANMUGA PRIYA 22/PPHA/112	First Prize	ADZAP - Interyear cultural competition	Stella Maris College
PRIYADHARSHINI. L - 22/PPHA/ 113	First Prize	ADZAP - Interyear cultural competition	Stella Maris College
THANA BRITNEY T 22/PPHA/116	First Prize	ADZAP - Interyear cultural competition	Stella Maris College
USHA NANDHINI G 22/PPHA/119	First Prize	ADZAP - Interyear cultural competition	Stella Maris College
MANVIZHI S 22/PPHA/123	First Prize	ADZAP - Interyear cultural competition	Stella Maris College

MAYURAKSHEE 20/UPHA/001	UG Research	Development of rocket propellants used in various launch vehicles in ISRO	Stella Maris College
	Participant	National Seminar on atomic and nuclear spectroscopy.	Justice Basheer Ahmed Sayeed College
	Third Prize	Madame Curie intercollegiate quiz competition by Physics department	Queens Mary College

SRUTHISHA 20/UPHA/007	First Place	Caption Writing	Women's Christian College
ROCHELLE G ALLANI 20/UPHA/008	UG Research	Photovoltaic design and energy efficiency	Stella Maris College
	Enrolled in a course	Water quality; testing, analysis, mapping	ICCW,IIT Madras Research Park
	Second Prize	Potpourri Competition	Women's Christian College
	UG Research	Review on pure and doped iron oxide	Stella Maris College
MINCY LUDS C 20/UPHA/010	Master of Ceremony	Popular lecture series on smart decision for environment and climate change	Stella Maris College
	Participant	IQAC workshop on future ready : outcome based performance appraisal.	Stella Maris College
ANGEL JOSE 20/UPHA/011	First Place	Debate	Madras Christian College
	Second Place	Potpourri Competition	Women's Christian College
NAYANA JOSE 20/UPHA/012	Third Place	Madame Curie intercollegiate quiz competition by Physics department	Queen's Mary College
	Silver Medal	NPTEL	NPTEL
MICHELLE G ALANI 20/UPHA/013	Enrolled in a course	Water quality testing, analysis and mapping	ICCW, IIT Madras Research Park
	UG Research	Environmental Nanotechnology	Stella Maris College
HARIPRIYA S 20/UPHA/017	UG Research	Study on Nano sensors for the trace detection of Nitroaromatic explosives	Stella Maris College

CELCIA 20/UPHA/019	Participant	National seminar on atomic and nuclear spectroscopy	Justice Basheer Ahmed Sayeed College
	UG Research	Enhanced semiconductor performance of nickel oxide-zinc oxide nanocomposites synthesised by facile chemical co-precipitation method	Stella Maris College
	Internship	Subject matter expert and quality analysis	Solvitude Solutions
	Presented a Paper	International Conference on Emerging Materials and Its Applications (ICEMA – 2022)	St. Xavier's College
KARISHMA LOURDES 20/UPHA/025	Participant	National Essay Competition	B K Birla College (Autonomous)
	Participant	Trends in public relation for entertainment	Stella Maris College
RAMYA MARY KOSHY 20/UPHA/026	First Place	Debate	Madras Christian College
	UG Research	Physics techniques applied to Archeology	Stella Maris College
	Second Place	Potpourri Competition	Women's Christian College
	First Place	Photo Exhibition	YMCA Nandanam
ANTONY TRINITA 20/UPHA/027	Successful training completion	First Aid and Basic Life Support Organised	Apollo Hospitals
	Internship	Finance Intern	Youth India Foundation

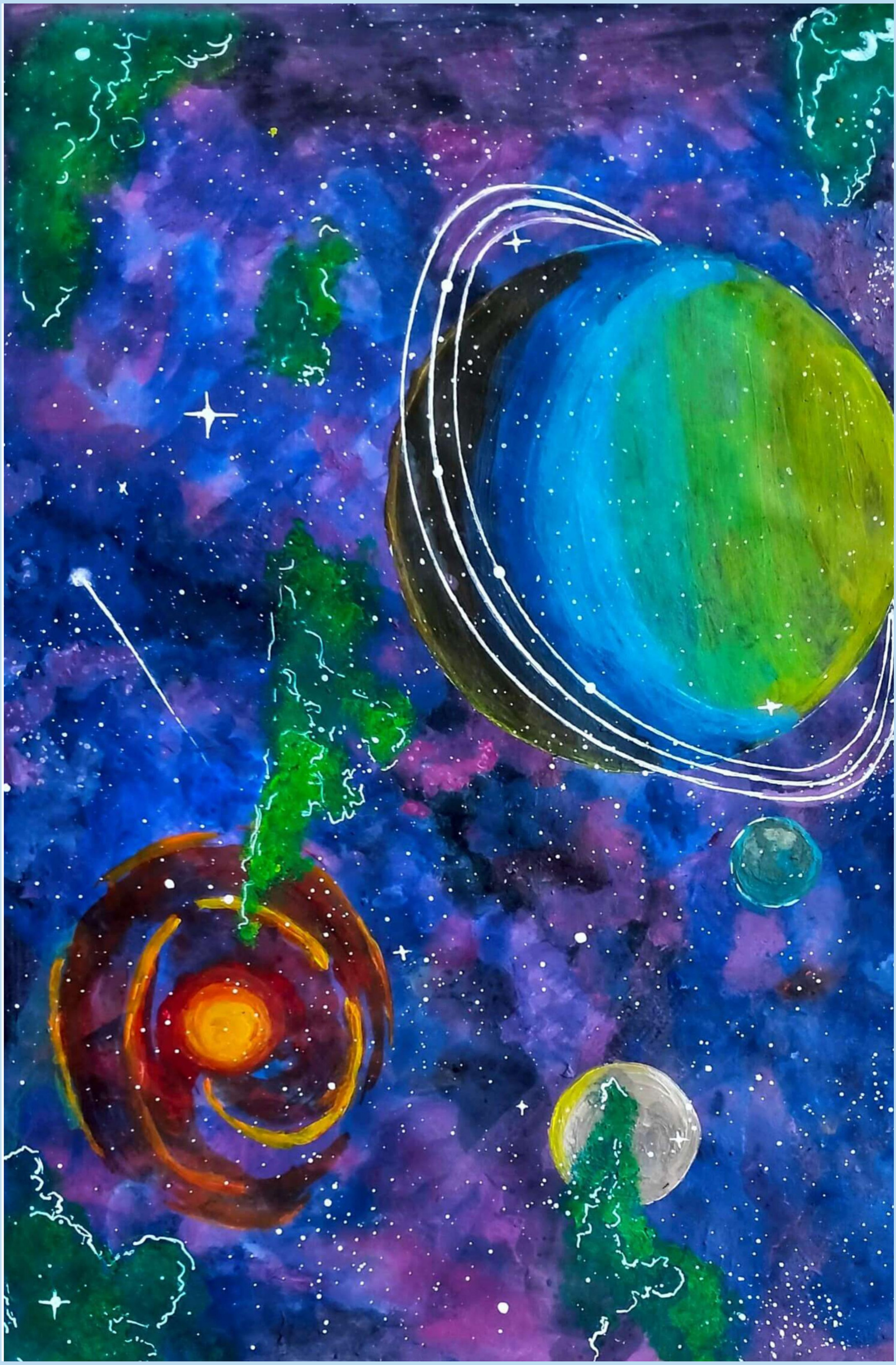
DURGA 20/UPHA/037	Volunteer	Wondering Minds Cultural event	Kalaivanar Arangam
	First Place	Intercollegiate chess tournament VASPO	DG Vaishnav College
	First Place	Chess Match	Women's Christian College
	First Place	Chess Match	M. Mallika Mahal, Pudur
	First Place	Russian house TN Chess tournament	Jawaharlal Nehru Stadium
	Second Place	International fide rating chess tournament	Gurunanak College
	Sixth Place	Chess match on silver jubilee celebration	Kavi Bharathi Vidyalaya School
EZHIL BHARATHI 20/UPHA/042	Certificate Course	Water quality testing, mapping and analysis - Chemistry department	Stella Maris College
	Certificate Course	C++ programming -Maths department	Stella Maris College
	UG Research	Review on different types of removal of nano material and techniques in the removal of heavy metals	Stella Maris College
KARAL MOZHI 20/UPHA/045	UG Research	Study on cobalt ferrite nanoparticles synthesised by co-precipitation technique for photocatalytic application.	Stella Maris College
BERTLEJA 20/UPHA/055	UG Research	Review on Boron Nitride Nanotube as an effective space radiation shielding material	Stella Maris College

	Certificate course	Water quality testing, mapping and analysis - Chemistry department	ICCW,IIT Madras Research Park
	Certificate course	C++ programming - Maths department	Stella Maris College
	Participant	National seminar on atomic and nuclear spectroscopy	Justice Basheer Ahmed Sayeed College
SHARON NOBLE 21/UPHA001	First Place	Quiz Competition by Rotary Club	Stella Maris College
I MANJUSHREE 21/UPHA/002	Gold Medal	Radio Control AM Flying	NCC CATC/IGC-VSC CAMP-2022
	First Place	Jodhpur AC Aeromodelling	NCC Aero Modellers Association
SHAZA FATHIMA A 21/UPHA007	First Place	Quiz Competition in Interstellar culturals	Stella Maris College
KELINA SHARON S 21/UPHA/015	Second Place	Inter-collegiate Chess Tournament	MOP Vaishnav College for Women Vaspo 2022-2023
	First Place	Trophy Chess Tournament	Women's Christian College
MARY IMMACULATE 21/UPHA/024	First Place	Shipwreck in Interstellar culturals	Stella Marise College
	Third Place	WCC Festeve '23 Why fight when you can negotiate? Event	Women's Christian College
CYRIL BRIJITH J 22/UPHA/009	Second Place	Poem competition - Campus ministry, Department of value education, Star of the Sea Group	Stella Maris College
ANDRE SNEHA MARIE ANELLA 22/UPHA/012	Participant	Popular lecture series - Physics Department	Stella Maris College
	Participant	Leading together international conference	Stella Maris College

	Enrolled in a course	Research methodology in natural sciences	NPTEL
	First Place	Dance Group Competition - Interstellar	Stella Maris College
	Participant	Workshop on Entrepreneurial Insights	Stella Maris College
ZAIBA HADIYA 22/UPHA/024	Participant	YIF - Stella Maris Event Become a Young India Fellow	Stella Maris College
	Participant	7th Annual International Leadership Conference in Collaboration with Trinity Western University Canada	Stella Maris College
DHARSHITHA Y 22/UPHA/028	Third Place and cash prize	District level Tamil speech competition - Tamil development department	Tamil development department, Chennai district
	Second Place	Solo singing competition - Campus ministry, Department of value education, Star of the Sea Group at Stella Maris College	Stella Maris College
AMALA THERESE JOM 22/UPHA/033	First Place	Solo singing competition conducted by Stella Maris NCC COY	Stella Maris College
	First Place	Cherry blossom competition conducted by Stella Maris NCC COY	Stella Maris College
	Second Place	Individual drill competition conducted by Stella Maris NCC COY	Stella Maris College

CHRISTY S 22/UPHA/036	Second Place	Short story competition - Campus ministry, Department of value education, Star of the Sea Group	Stella Maris College

DISCOVERING THE BEYOND



R. AAFRIN FATHIMA
22/PPHA/101

2020 - 2023

2021 - 2023