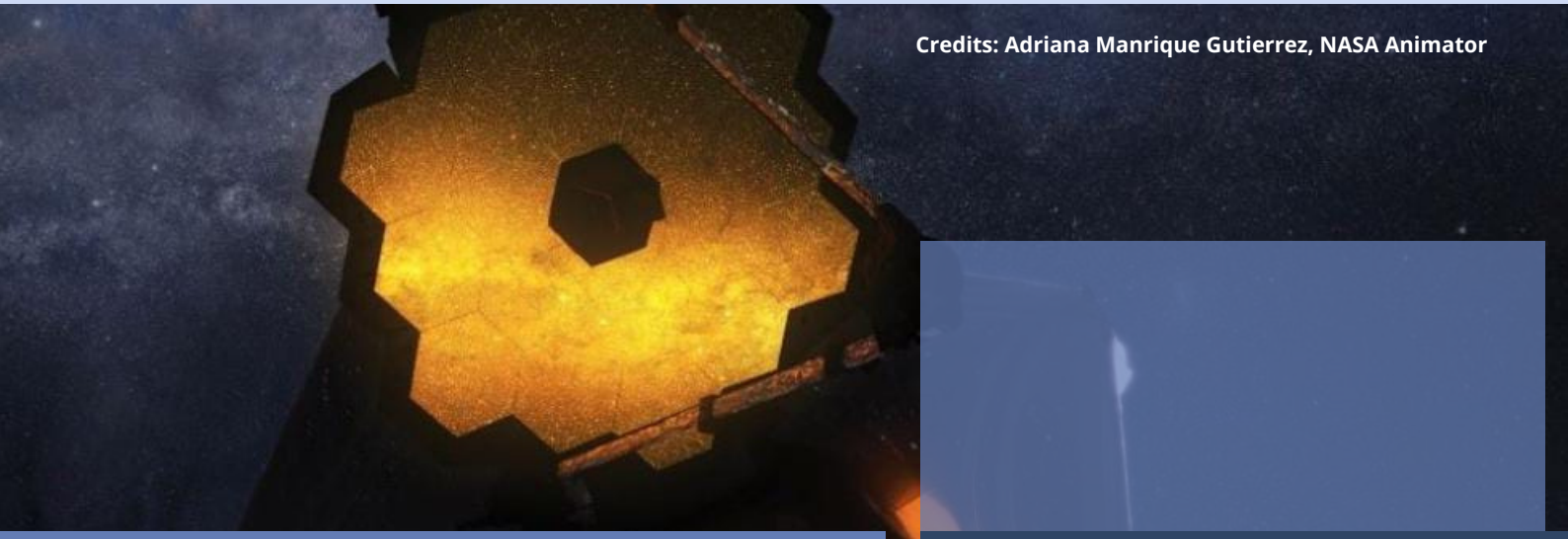
VOL. 4, ISSUE 1 | JANUARY 2022

IMPEDANCE

THE OFFICIAL E- NEWSLETTER OF VIDYUT, THE PHYSICS SOCIETY



Credits: Adriana Manrique Gutierrez, NASA Animator

Multiverse Explanation for Small Higgs Mass

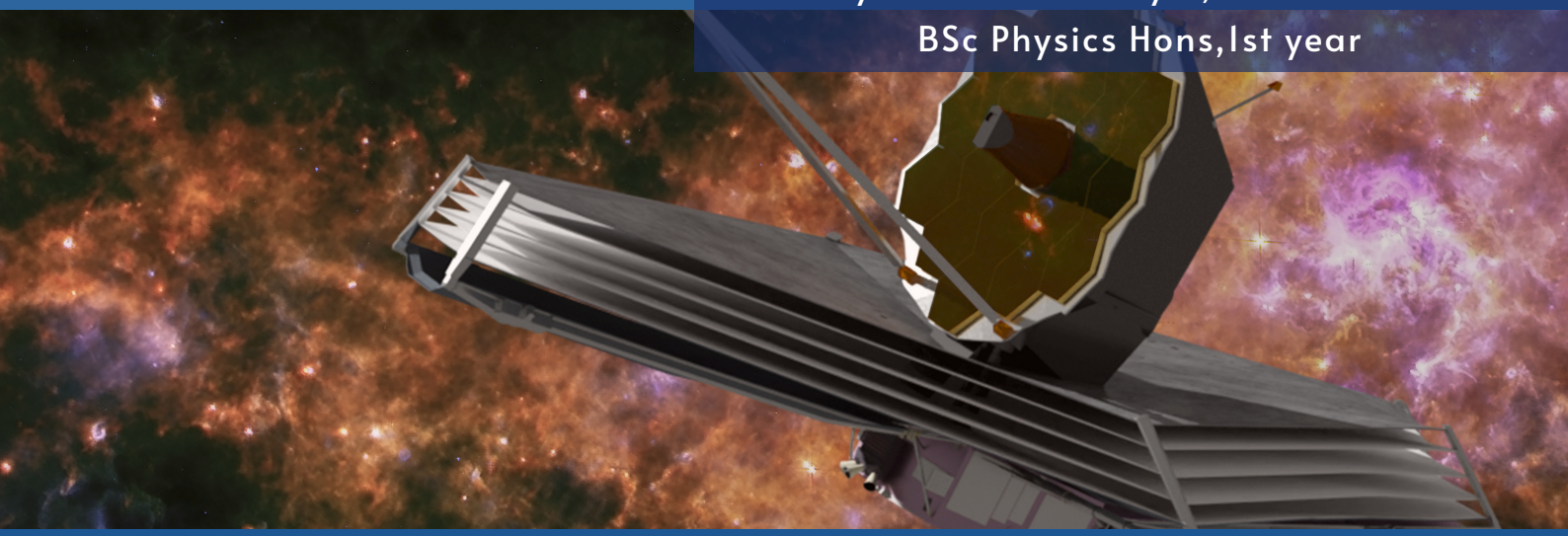
Read more at :
https://physics.aps.org/articles/v15/s6?utm_campaign=weekly&utm_medium=email&utm_source=emailalert

A new model that assumes that a multitude of universes existed when our Universe first formed may explain why the Higgs mass is smaller than traditional models predict.
(SOURCE : sakkmesterke/stock.adobe.com)

IN THIS VOLUME:

JAMES WEBB SPACE TELESCOPE

-By Kanika Palsaniya , Harleen kaur
BSc Physics Hons,1st year



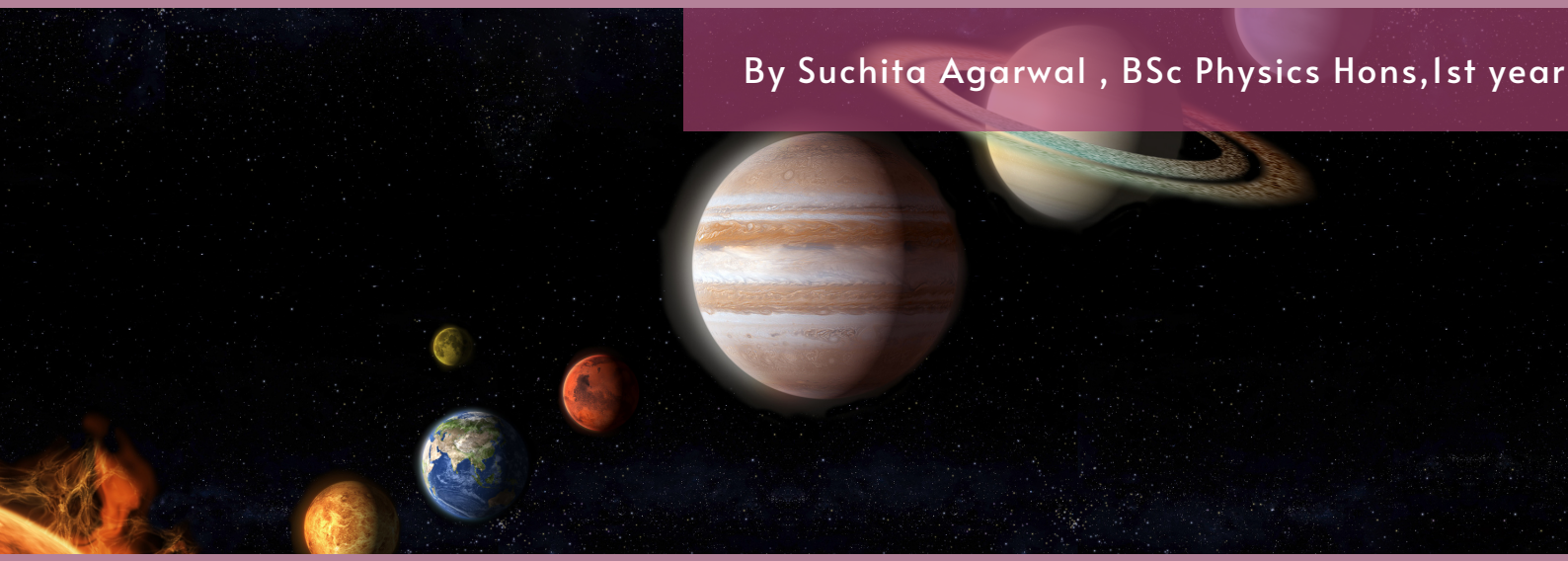
Our universe has expanded so much since it's beginning so is the human civilization. Technological changes have given a tremendous outlook to our society. Everyday a new invention makes our world a different place.
With continuous efforts of scientists and engineer, we have reached to a state that we can even travel back to time ..isn't that crazy?
The launch of JAMES WEBB SPACE TELESCOPE aims to make this statement possible.
Recently, NASA has launched a telescope on 24 December 2021. It's name is James Webb Space Telescope. It is named after a NASA's administrator James E. Webb(from 1961 to 1968). This telescope is important because it will not only orbit earth but through it we will explore universe. We can guess it's strength by this, but by considering Hubble telescope, How much helpful was it in exploring the universe? and it is expected by the experts that Webb telescope is 100 times more powerful than Hubble telescope. It is designed to capture extremely faint radiation emission from the old galaxies and distant stars. This will be helpful to get information about the far distant objects in universe. Astronomers are excepting that with this we will be able to unfold the mystery of how the universe begun? It has ability to view the infrared light and it's gathering capacity of light is seven times more than Hubble telescope.

HOW IS JAMES WEBB TELESCOPE DIFFFERENT FROM HUBBLE?

It will not be wrong to say that Webb is scientific successor of Hubble. But it is considerable to know that capabilities of both of them are not identical. Hubble worked over studying optical and ultraviolet wavelength whereas Webb would work over studying infrared wavelengths. Studying infrared wavelengths helps to identify the far across galaxies and stars as the light from far distance gets red shifted so the light of wavelength of ultraviolet or optical falls to infrared due to red shift which makes it difficult for Hubble to detect them, so here in the play comes Webb which detects this.
Webb is definitely larger in size from Hubble which helps it to gather light more than Hubble. The crazy idea of travelling back to time comes from the analogy that Webb can detect baby galaxies whereas Hubble can detect toddler galaxies. This is even considerable to know that Hubble was orbiting close to earth where Webb is deployed at second Lagrange point(L2) which is 1.5 million kilometers away from earth. So in case any problem occurs in its functioning, it can not have any manual help whereas Hubble was helped 5 times. The construction of Webb was so complex that NASA detected there can be around 300 practical ways this project can fail.
But despite of facts, this launch of JAMES WEBB can prove to be a revolutionary step in our understanding for the fate of universe.

ASTRONOMERS DISCOVER THE LARGEST GROUP OF 'ROGUE PLANETS' YET.

By Suchita Agarwal , BSc Physics Hons,1st year



A rogue planet is an interstellar object between 3 times the size of Earth to 12 times the size of Jupiter and does not have a host planetary system. These bodies do not orbit a star instead, they roam freely on their own, hence also known as free-floating (FFP), unbound or wandering planets. Such planets have either been kicked out from their solar system or have never been gravitationally bound to any star. Some astronomers also believe that these planets could also have been formed from collapsing gas clouds that are too small to lead to the formation of a new star.

Scientists use a technique known as microlensing to detect rogue planets by their effect on starlight. However, the fleeting nature of micro-lensing events averts any follow-up observations and individual characterization.

In September 2020, astronomers detected an Earth-mass rogue planet, for the first time, using microlensing. In December 2021, the largest group of rogue planets was discovered in our galaxy by a team of astronomers, with the help of data from the European Southern Observatory (ESO). The 70 or more rogue planets discovered were located in a star-forming region, in the Scorpius and Ophiuchus constellations with masses comparable to Jupiter's and age around 3 to 10 million years. It is the largest such group ever found which is a significant step towards understanding the origins and characteristics of these cosmic nomads.

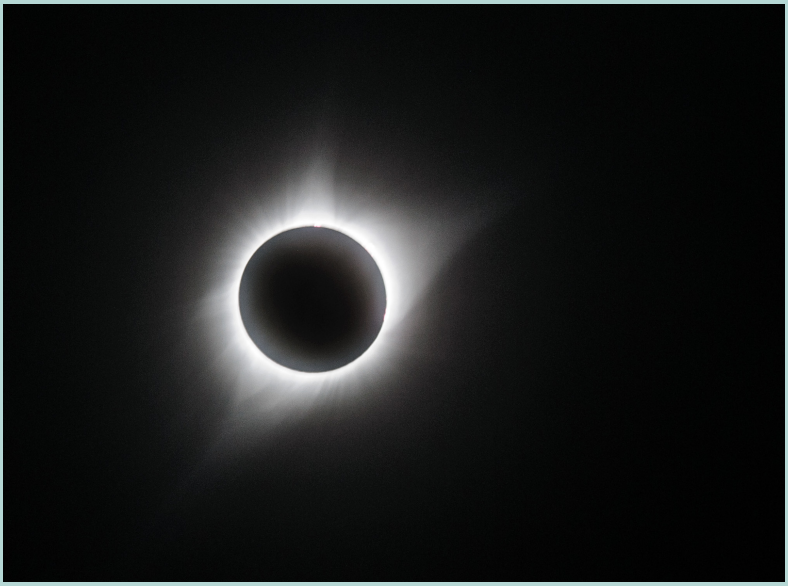
Normally, rogue planets are difficult to image because they aren't close to any star illuminating them. However, Núria Miret-Roig (an astronomer at the Laboratoire d'Astrophysique de Bordeaux, France and the University of Vienna, Austria) and her team used data spanning 20 years using a range of telescopes on both land and space and acted on the fact that, in a few million years after their formation, these planets are still hot enough to glow, thus can be identified by sensitive cameras on large telescopes. "We measured the small movements, colors and brightness of tens of millions of sources over a large part of the sky," explained Miret-Roig. "These measurements allowed us to safely identify the weakest objects in this region, the rogue planets."

Despite the record-breaking observation, their discovery suggests that many more of these mysterious objects are out there waiting to be discovered. Scientists are waiting for the completion of ESO's forthcoming Extremely Large Telescope (ELT), currently under construction in the Chilean Atacama Desert which will help the scientists to study these elusive cosmic objects in greater detail.

THE SUN IS NO LONGER THE LIMIT

~NASA's exultant Parker embarks For its peregrination into the sun's corona.

By Pragya Dobhal, BSc Physics Hons, 1st year



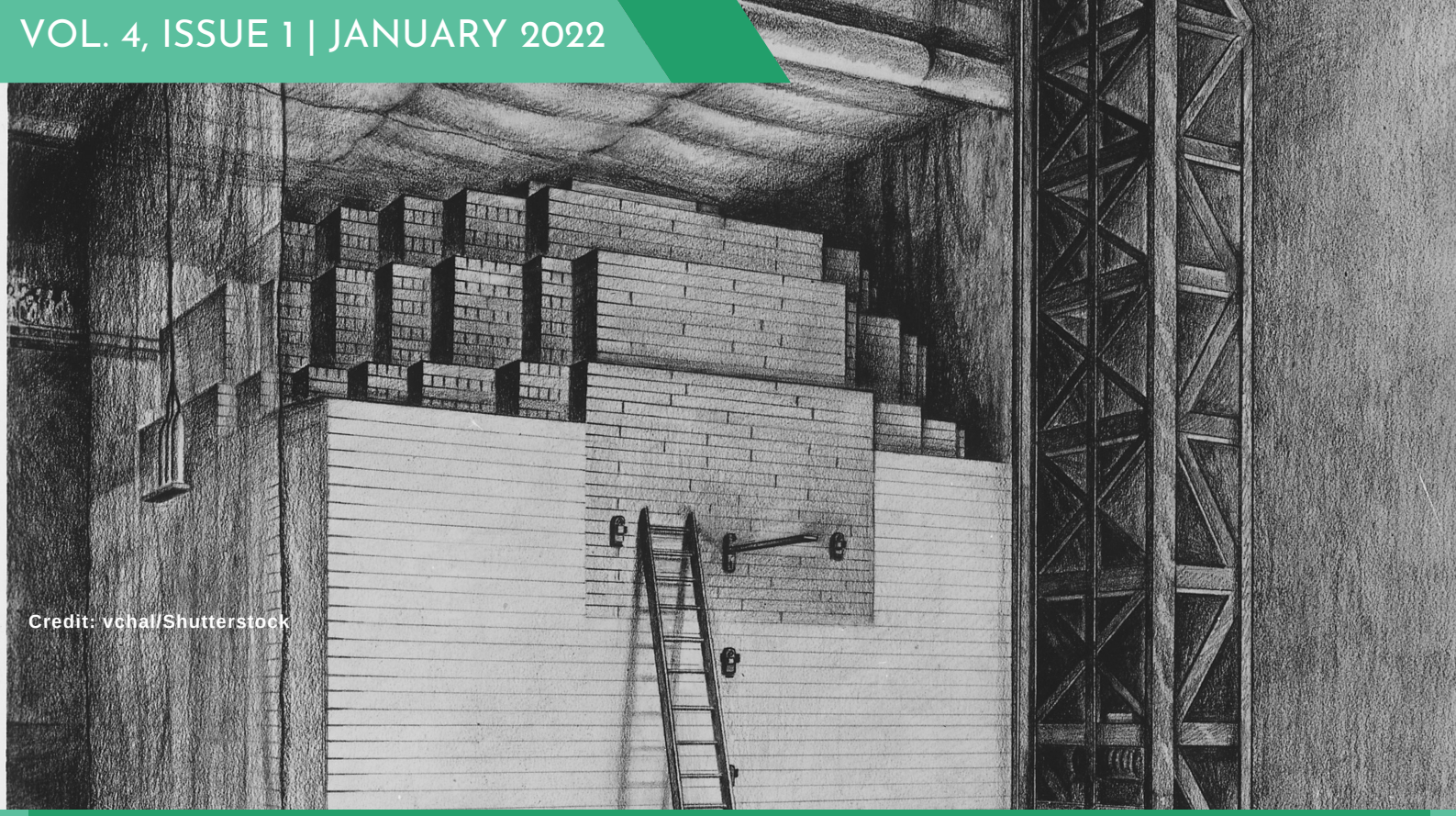
Living in Close Proximity to a Supermassive Black Hole Of course, there would be dangers—but it could also be entertaining!

The year 2021 ended with some "corona" positive news for all the space enthusiasts around the globe. NASA's long term solar mission named "Parker" finally found its way through the sun's corona. Launched in August 2018 from Cape Canaveral, Florida, the mission advanced with the sole motive to study our closest star and the phenomena associated with it.

Unlike earth and its neighbouring terrestrial planets, the sun doesn't have a terrene surface. Plasma forms the major component of the sun's exterior which is held together by the sun's gravitational forces. The solar material flowing out of the sun's surface is bound together by the sun's gravity and its magnetic field. Thus, forming the sun's atmosphere-corona. Since this part of the sun's atmosphere was only visible during total solar eclipses, scientists incorporated eclipses as a dominant part of their study about it. While the corona remained an inexplicable mystery for scientists on earth, NASA made it its chief goal to dive further into its unknown oblivion. In the words of Nour Roufai, the project scientist, "Two of the most challenging scientific mysteries in astrophysics occur in the region we call solar corona." Hence, the advent of Parker reiterates its significance while paving the way towards groundbreaking discoveries of our closest star. Parker became the maiden space probe of its kind to traverse through the Alfvén Critical Surface, the lowest point where the solar wind is under the direct control of the sun's gravity and magnetic field. This ambitious mission entered the corona three times on 28 April 2021 and stayed there for five hours, hence etching its name in history.

The giant fireball's surface has a temperature of 5700 degrees Celsius. As you move outwards into the corona, there is a peculiar and sharp rise in the temperature, ascending as high as a million degrees Celsius. Henceforth, the mammoth question is, how was Parker competent to such scabrous temperature conditions? The answer lies in its impeccable and virtuous engineering. It is instated with a white heat shield to reflect off heat emitted by the sun to maintain an optimum temperature at the back. It is intricately composed of two materials,carbon-carbon and carbon foams. The probe also boasts of a solar limb, whose primary function is to modify and administer the movements of the shield. It keeps the heat shield in the correct configuration. The water circulation within the probe inhibits the solar cells from overheating. However, the feeble density of the corona emerges as a significant factor. The corona, scorching at a million degrees, has a meagre particle density. Consequently, the probability of the high energy particles devastating the probe gets reduced substantially.Parker was successful in unfurling crucial information about the sun's upper atmosphere. Fluctuations in its magnetic field were also ascertained. As Parker traversed further, its WISPR(The Wide-Field Imager for Solar Probe) took several images of plasma streams that encompassed the probe. Due to the strong magnetic forces within the corona, the solar material moves slower. The solar material outside the corona remains unstirred by these forces. Thus, creating a frontier between the two, known as the Alfvén Critical Surface. The theory of this boundary being smooth was denounced by Parker's discoveries. It was found out to be a ubiquitous wrinkled frontier composed of bumpy ridges. This distortion of the Alfvén Critical Surface was the consequence of the plasma that flew out of the corona in copious quantities. As Parker traverses ahead, more clues are on the lines of getting excavated.

Embarking on this solar adventure of seven years, Parker will make 26 close approaches to the sun. As Parker travels farther into the abyss, scientists gear themselves up for more groundbreaking and incredible information from the only star we can study up close.



Credit: vchal/Shutterstock

FERMI PARADOX AND IT'S SOLUTIONS

-By Babita Rani, BSc Physics Hons, 1st Year

You might wonder about the line that Earth is the only planet that sustains life. But, what if other civilisations are also present on other planets.Till date, we can't say anything. We don't know the edges of the universe. In this universe, there are trillions of planets in which it is said that billions of habitable planets are present. In our galaxy milky way only, we have a great number. Guess what, if in those planets life is present. We normally refer to them as alien civilizations. We are even in search of them. Space stations have been sending signals from last 100 years, but they have decayed into an unreadable noise. It means our universe seems empty, devoid of any life. This is termed as FERMI PARADOX.

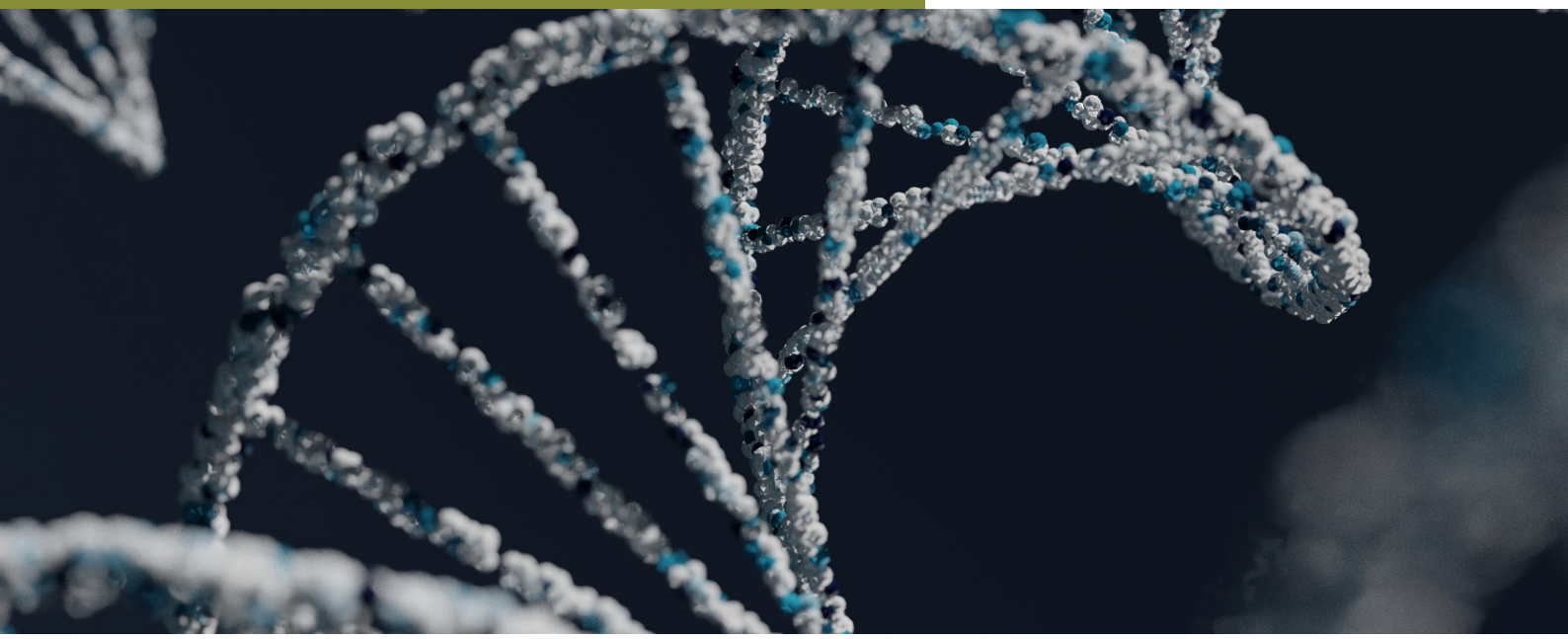
Yet it seems to be nothing in the universe, but, as humans we always face a dilemma. What if other civilisations are present? Maybe our galaxy is not empty, it's just a matter of time that we haven't detected anything. As humans, we are considered to be the most advanced species and also dangerous. We often extend our hand in space to get more resources and there we find that there are more such signals in the universe. So, can we conclude that there are other civilisations also? We often heard in the news that on earth, UFO's were found in a completely destroyed form. Is this the signal that the alien civilization already knew about life on earth or is this just the rumour? Till time, what can we do? We are safe for the time being, as we haven't found any traces of life on other planets. We just have to keep our focus on signals and disturbances in space. This is nothing but a sort of solution to the Fermi paradox.

But we can't fully deny that alien civilization is present. If we meet them in future, how we and they are going to behave. What will happen-attack or welcome? If there is an attack, then we don't know the limits of technology and how worse it can be. But on the other hand, there is a possibility that a welcoming and friendly civilisation is present.

So my dear readers, what can be the possible scenario. Is there any other civilisation present? If yes, how will they behave?

EVOLUTION AND ENTROPY

By Mahak Poonia,BSc Physics Hons, 2nd year



S=kln(W)
Entropy of the Universe always increases.
The above written equation and law are familiar to every physics student and contain the crux of Thermodynamics, a vast field with millions of physical and theoretical applications. Thermodynamics is known to be one the most 'physical'(in the sense of its many varied and important applications) and one the most abstract of all scientific disciplines. We know the laws and engineers apply them. The father of Thermodynamics is, after all, a brilliant Engineer, Nicolas Léonard Sadi Carnot. At the same time, Thermodynamics intrigues many minds because of its abstractness, the many laws it has and how much they reveal and obscure about our world. One of the most fascinating of these topics is that of Entropy.
Entropy has a hundred definitions, and each one of us likes to think of it in our own different way. We know it is a state function, we know its change is zero over a Reversible cycle and we know it contains its own definition of the Second Law. It is the measure of disorder in a system, it is the measure of the lack of information in a system, it defines the arrow of time. Entropy change has a clean formula for the Carnot Engine and finds many applications, principally those of determining whether a process is possible or not. The question of what Entropy is is impossible to answer to everyone's satisfaction, so let's not focus on that. Let's instead try to understand one particular definition of it and how it leads to natural processes being as they are.

For us, Entropy is a measure of the disorder in a system and mathematically, S=kln(W), where, W= the total no. of ways the particles in a system can exist together, k is the Boltzmann constant and S is entropy.
Consider a cuboid, divided into 2 halves by a removable partition. Let one half contain blue and the other orange gas molecules. Right now, the particles have a certain number of ways in which they can exist, say x1. Now, remove the partition. Gases, being as wiggly as they are, mix up and now the box contains a mix of blue and orange gas molecules. The total no. of ways the particles can now exist with one another are x2. Clearly x2>x1, which implies, according to our equation, that Entropy after the partition was removed is more than when the blue and orange gas molecules were separated. And, clearly, the order which existed with the molecules separated has been lost.
So, as disorder increases, Entropy increases. And the second law states that Entropy of the universe must always increase. This implies that the disorder of the universe should always increase. But then, why and how did organisms become gradually more ordered? From unicellular to multicellular and as we go up the evolution ladder, a clear organization of living beings have been going on. And how did planets form then? Why did debris scattered around the universe decide to come together? Doesn't that defy our law?

There are a lot of names and theories and concepts which come up in trying to answer these questions. Here I'll be focusing on the first of these questions.Life, many would agree, is a baffling phenomenon. The greatest mystery life presents us with is life itself, the greatest trick nature plays with us is its own manifestation, the greatest magician is the mystery. How do you start making sense of it? We have discovered our laws, we have established our principles. The beauty is the continuation of this quest of understanding, the fact that it is never ending.

The mystery of the existence of life becomes even more notorious when we understand the principle that, simply stated, contradicts it. This is what was thought when the Second Law of Thermodynamics and what it implies for our world were first understood. But nature, unsurprisingly, has more in store than just the law of entropy.

The Law, of course, is deduced from extensive experiments and painstaking amounts of work by scientists and engineers and is true in every system we can observe; this is true for life as well, because life exists and the Universe's entropy is increasing. The only problem is the manifestation of this law and the 'how' part of it. Many scientists have tried to understand it but here we'll focus on the work of two, Erwin Schrodinger and Jeremy England. In 1944, Erwin published a short classic, entitled "What is life?", considered one of the most important texts of the last century, both for the validity of the question it explores, and for its multidisciplinary approach, when a physicist tried to answer a question concerning all existing scientific and intellectual disciplines, a very courageous and humble attempt.

The book talks about everything from the size of atoms to the various laws of biology and physics in the living organism and about Entropy. The chapter 6 of this book, titled "Order, Disorder and Entropy", is the most relevant to our question. Since W in our equation of S is a measure of disorder, Erwin proposes that 1/W is a measure of order and putting this into our equation gives, $S=-k \ln(W)$ or $-S = k \ln(W)$.

This is Erwin's negative entropy and forms the basis of his explanation. He proposes that we take this negative entropy from the universe and create order, dissipating a large amount of heat in the process, thus greatly increasing the Universe's entropy, in agreement with the Second Law. What we take as food is nothing but a highly ordered organic substance, containing a lot of energy and 'Negative entropy', i.e. order. The food we take gives us the energy we need for carrying out the various metabolic processes and provides us with the negative entropy needed to maintain order in ourselves and thus, stay alive. Life works continuously to avoid its rapid decay into the state of thermodynamic equilibrium i.e. of maximum entropy. The massive amount of heat(and hence entropy) generated as a result of these processes and existence is more than this factor of negative entropy.
Quoting from Erwin's book, "That we give off heat is not accidental, but essential. For this is precisely the manner in which we dispose of the surplus entropy we continually produce in our physical life process".
In fact, the amount of entropy we generate due to the fact that we are alive is much more than what an unordered group of carbon atoms would. Could this be why we're alive? Does nature need life to achieve its state of maximum entropy?

Erwin talks about two ways of creating order, either from disorder or, as in the case of life, from order itself. He states, "We witness the event that existing order displays the power of maintaining itself and of producing orderly events". What we gain from Erwin's book is brilliant insight into how things might be happening and a possible way in which life manifests one of its million facets. What if we went back in time? When life as we know it didn't exist. This is where the work of Jeremy England exists.

Taking ideas from Time Reversal symmetry, the extended second law and scientists before him, Jeremy England has tried to put forth ideas and theories to help scientists and engineers understand the mechanisms of life. He argues, like many physicists before him, that Thermodynamics is fundamental to our understanding of life and its existence. He proposes to establish that unlike the common belief of the Second Law being against Life, it is actually very much in its favor and, in many ways, enables it.

Through the use of a formula on Time reversal symmetry discovered by Gavin Crooks in 1999, he has proposed that for a system driven by an external drive the likely paths carrying the system from an initial to a final state will have exceptionally positive values of the heat released during them. The more irreversible a process is, the more heat it will dissipate and the more work it will absorb. Over time, the system increasingly adopts shapes that resemble those in its history when dissipation occurred . In the end, the structures under consideration will appear to have organized themselves in a state which is well adapted to the environmental conditions; the more likely outcomes of evolution are going to be those systems which absorbed and dissipated more and more energy from their surroundings. This is called dissipative adaptation.

This theory supports life, since the complex order it consists of is capable of dissipating more heat than what an unordered cluster of atoms would do. This suggests that life, instead of being in contradiction to thermodynamic laws, might be a consequence of them.
Stated briefly, formulae derived by England state that taking a group of atoms, an energy source which drives them and a heat reservoir, chances are high that these atoms will come together and form structures which will dissipate increasingly more energy. Considering nascent earth, its energy source being sun and the oceans and atmosphere being its heat reservoirs, it could have happened that the atoms existing in their very disordered forms came together and formed structures; England's work states that this happens because of the Second Law. The Law drives atoms into forming more and more ordered and complex structures because that would lead to a much greater dissipation of energy and hence a greater increase in entropy and absorption of work compared to disordered bunch of atoms. Compared with Erwin's proposal, England's work is about order being created from disorder.

A very simple example would be that of the difference between a group of carbon atoms and the leaf of a living plant. The leaf is able to assimilate energy from the sun and create food for itself, the sunlight after reflecting from its surface is infrared, a much more dispersed form of energy than sunlight. Because of this dispersion of sunlight, photosynthesis leads to an increase in the Universe's entropy, despite creating and maintaining ordered systems within itself. According to England, this is why the universe favors life and seeks to create order from sheer disorder.
England's work is pioneering for it tries to account the Second Law for all of life. Computer simulations based on his model affirm his results and push us to dig deeper into how much the Law is about and how much it is responsible for. It doesn't just define the arrow of time, it is what possibly makes life happen.
But their two theories go in the same direction: order and therefore life. Quoting again from Erwin's book, "Life appears as an orderly and legitimate behavior of matter, not based solely on its tendency to move from order to disorder, but based in part on the existing order which is maintained".

We started with a question of how is life possible when the second law 'contradicts' it; what we end with is the insight that this is a misconception. There are thousands of scientists working on understanding 'the how's of life' and the knowledge they gain is beneficial both for the practical world and for our inherent curiosity. Something as real as life takes an abstract stand sometimes and raises more and more questions with every new bit of knowledge gained. Many of the answers we are looking for are hidden around us and sometimes require excellent scientific caliber and insight to be discovered. Since ages, life continues to elude us. Since ages, life continues to crave its understanding.

ARTIFICIAL INTELLIGENCE AND THE INDIAN DEFENCE SECTOR

By Namashya Gogoi, BSc Physics Hons, 1st year

American futurist, Jacque Fresco once rightly said, "The intelligent use of science and technology are the tools with which to achieve a new direction".

We live in an era of scientific and technological growth.Be it the pen with which I am writing this article or the LED which is lighting up my room- everything is a resultant of Science and Technology.In the recent times we have become familiar with the term "Artificial Intelligence"(AI) which is an ideal contribution and product of extensive scientific research and technological manifestations.

Artificial Intelligence is playing a very vital role in all advanced technical fields like aerospace and defence applications.Popularly dubbed as INDUSTRIAL REVOLUTION 4.0, AI is a dual use technology and have very intersting implications on the distribution of military power in the future.In January 2019,Late Army Chief General,Bipin Rawat said, "India will be too late if the armed forces do not embrace Aretificial Intelligence soon enough."

AI,if made possible in the defence sector of India,the traditional and conventional military capabilities will matter much less with time.To put in other words,human intervention will utterly reduce and the wars fought in the battle ground will be replaced by "digital wars".

In February 2018,The Ministry of Defence (MoD) constituted a multistakeholder task force for strategic implementation of AI and defence.The taskforce submitted its report in June 2019 with certain subtle recommendations which were accepted to be put into effect by the MoD by laying the foundation of an institutional framework for policy implementation,releasing guidelines to the defence organization and laying out a vision for capacity building.

The Defence Ministry in February 2019 formed a high level, Defence Artificial Intelligence Council(DAIC) under the chairmanship of the then Defence Minister,Smt Nirmala Sitharaman.It was assigned with the task of providing strategic direction towards the adoption of AI in defence.It also looks forward for the creation of an executive body- "DEFENCE AI PROJECT AGENCY"(which is analogus to USA's DARPA model).There has been legitimate fundings to AI related research work since then to the defence sector.

The Centre of AI and Robotics(CAIR) in DRDO has also developed autonomous, technology based products like snake robots,hexa-bots,sentries etc.It has a comprehansive library for AI based algoroithms and data-mining toolkits which can be potentially use for image/video recognition, Natural Language Processing (NLP), swarm artificial intelligence etc.

However in India,without efficient hardware systems and infrastructure to hold such gigantic data,the data-based approach to AI can serve a limited purpose only.Despite the limitation of resources our country faces,we are a home to some excellent educators, engineers, scientists and technocrates in the field of Computer Science and AI hailing from various IITs,IIITs,NITs,IISCs,IISERs and various state and central Universities .A good integration of such healthy scientific minds can bring about strategic , societal and cultural implications of AI in the Defence Sector of India.

NASA'S JOURNEY TO MARS

By Chanchal, BSc Physics Hons, 1st year

NASA (National Aeronautics and Space Administration) is an independent agency of U.S federal government mainly responsible for the civilian space program as well as aeronautics and space research.

NASA 'S JOURNEY TO MARS as NASA is an independent agency and also this agency plays a vital role in exploring the RED PLANET ; MARS and it also helps to enhance the potential of humans to go in the Mars planet in 2030. As the planet Mars is rich source of human exploration and also there are various things like atmosphere , existence and surface of mars that we need to explore .

Mars is known as "RED PLANET" ,it is 4th planet of solar system from the sun and it have two moons – Deimos and phobos . But there a lot of thing to explore in Mars the most arising question is that "Whether life exist in Mars or not? " and to know this answer NASA is exploring the Mars.

Generally, to explore Mars more there are three phases taken by NASA :-

1. EARTH RELIANT

NASA'S current human exploration occurs in earth reliant frame. Reliant means to depend on , so in exploration in Mars we consider Earth as very important because Mars is next planet after Earth so s the formation and exploration is somewhere comparable to Earth .

2. PROVIDING GROUND

NASA'S also lays stress on providing ground . Providing ground means to create a area or situation in which a person or thing is tested . NASA'S powerful and efficient space launch system helps a lot to create this providing ground to explore something new in Mars planet.

3. EARTH INDEPENDENT

NASA'S also plans to work with this idea of making Earth independent. This idea helps to reduce future dependency on Earth to import goods from Earth for the purpose of survival.

With the help of ISS (International Space Station) NASA is doing a lot of effort to explore Mars. Astronauts on the orbiting laboratory are also help us a lot through many technologies and systems related to communication that is needed to explore human missions. Living and working in space definitely require to accept risk but the space station is to make us understand what the changes body faces in space and how to protect or safeguard the life of an astronaut.

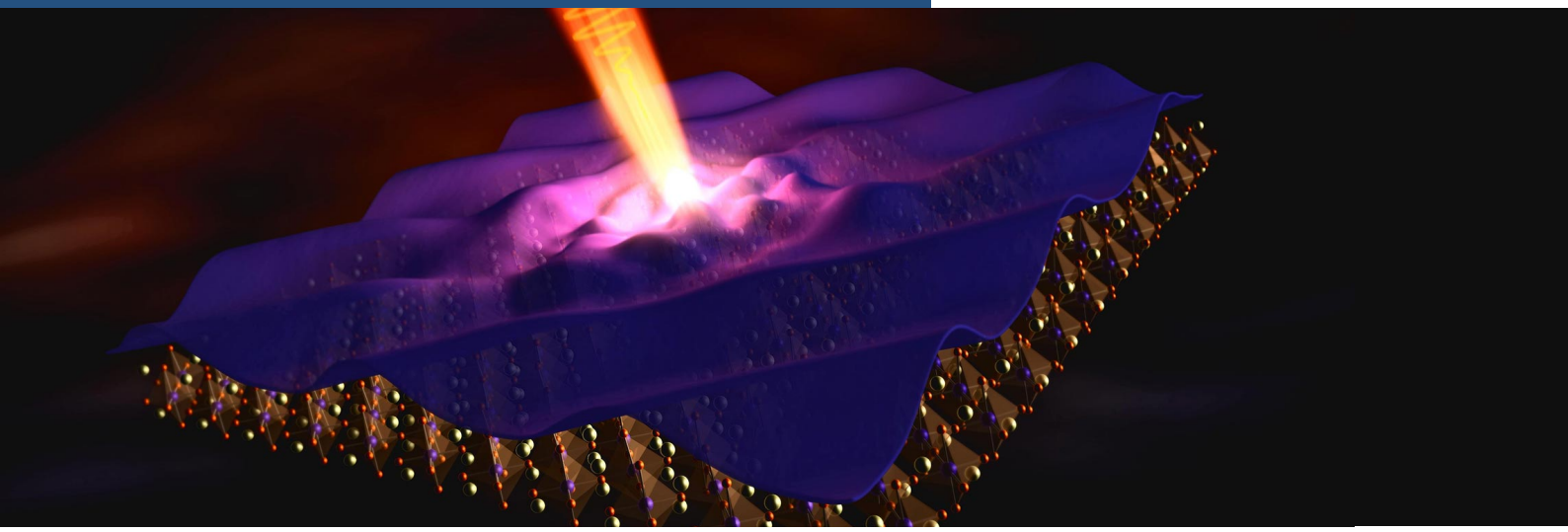
Also with the help of ORION spacecraft, some experiences are gained by NASA that are human spaceflight beyond low earth orbit , by the NASA explore some new system and capabilities such as Solar Electric Propulsion which helps to send cargo(essential goods) as part of human mission to Mars. As technology increases , Robotic spacecraft already set in the Mars to explore and also with this spacecraft NASA take some beginning steps to explore human existence and also laboratories related to Mars tells about radiations present in Mars and definitely these laboratories ensures how to protect the life of an astronaut.

As the scientists and engineers work day night to develop technologies at that extent so that this will help to explore live , inner environment of Mars and also create the next home for human in Mars.

Presently, NASA is participating in MARS EXPRESS , a mission planned by the European Space Agency (ESA) and Italian Space Agency(ISA) ; the mission is about to explore atmosphere and surface of Mars from polar orbit.

DISCOVERY OF THE INTERACTION BETWEEN DISORDER AND FLUCTUATIONS IN PHYSICAL SYSTEMS FROM THE ATOMIC SCALE TO THE PLANETARY SCALE BY GIORGIO PARISI

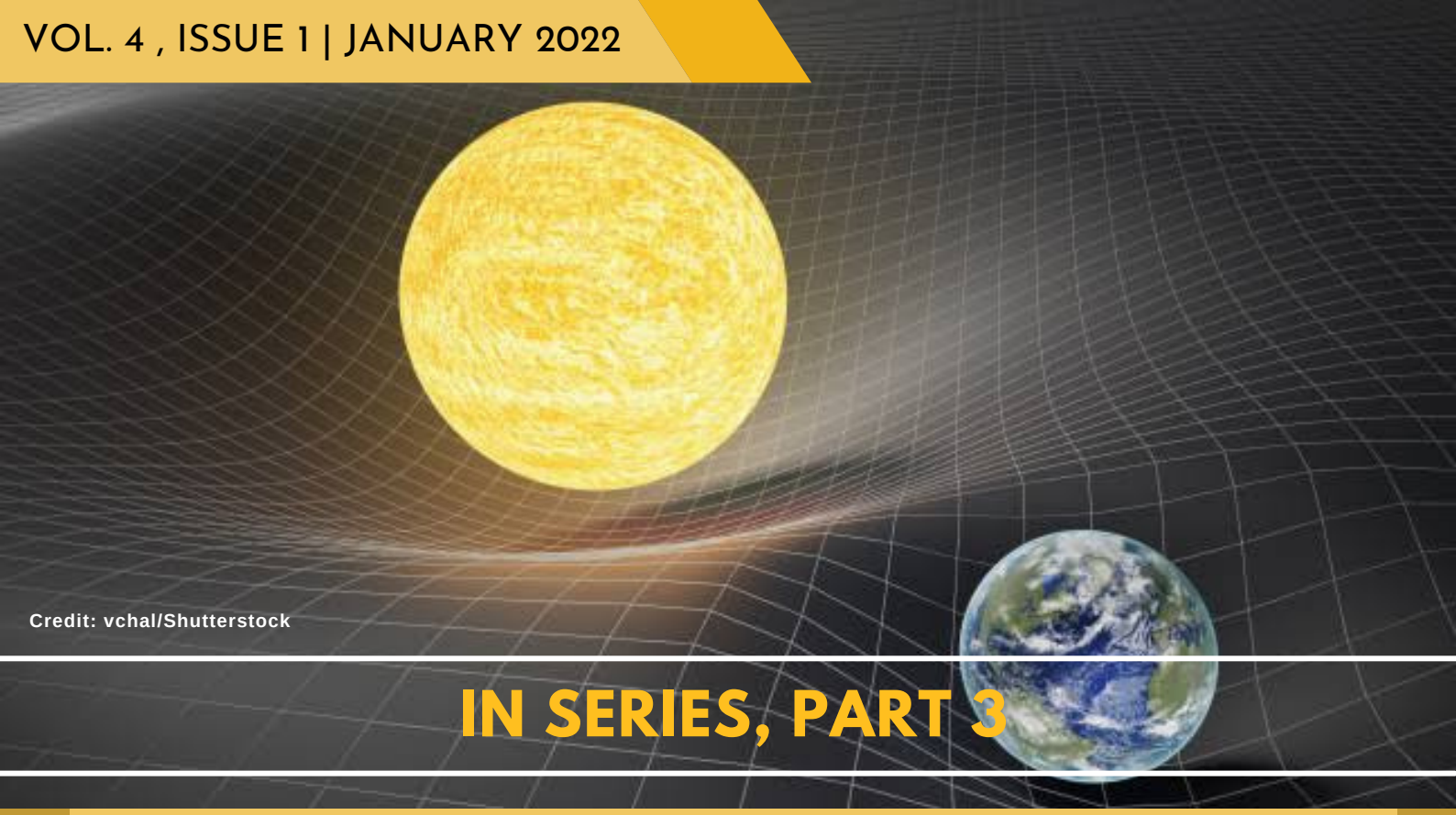
By Komal Bhatt,BSc Physics Hons, 1st year



A physicist strongly inclined to Mathematics from an early age gave us a very important solution, purely mathematically, which can be applied not just only in physics but also in various subjects & fields. The great, Italien theoretical physicist, named Dr. Giorgio Parisi, is mostly known for his contributions in statistical mechanics, spin glasses & complex systems. He recently received the Nobel Prize (2021) in Physics for his great contribution in complex systems, speaking more specifically for the Discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales.

For understanding his work we would first require to understand his interests (complex system, spin glasses, statistical mechanics) in short. Firstly, we try to understand what the field of statistical mechanics is. It basically deals with each and every particle, it is based on statistics (central tendencies & all), probability theory which is applied to large groups of microscopic entities wherein the state of the system is said to be uncertain or unpredictable. The Complex system comes basically from statistical mechanics, a set of elements (related to each other), which follows some kind of laws but we cannot predict what will happen after some moment of time. For e.g. suppose I am driving with a particular speed so using Newton's laws I can predict my exact position after a particular time. The laws will be applied to complex systems also but here we can't predict what will happen. Eg. – Disordered system, frustrated system. Now, coming to spin glass, let's understand the frustrated system first. Suppose three atoms in the three corners of a triangle and the first atom have spin let's say upwards then second may have downwards then now what about third one's spin? What will be the orientation of the third atom? Should it have upwards or downwards spin? Such a system is supposed to be frustrated. Spin glass is among such systems. Spin glass is an alloy of a non-magnetic metal having a small amount of magnetic atoms (e.g. iron) in it. So iron particles show ferromagnetism thus will have spin. Spin glass can be said to be a disordered magnetic state wherein spins are aligned randomly, irregularly. Complex systems sometimes show very chaotic behaviour. The questions above are tackled by Giorgio Parisi. His work is to describe what will be the optimal situation for this kind of disordered system. He was just dealing with spin glass. In his research he found there is not as such an equilibrium state. There is something intermediate. He developed a theory of disordered, frustrated & random phenomena and gave a solution (replica trick) that covers many other complex systems. It is useful in other fields also such as mathematics, biology, machine learning, etc. Now, if we have any random phenomenon that is happening, we can apply the solution given by Parisi & we can get the answer about that system.

Hats off to Parisi! :)



Credit: vchal/Shutterstock

IN SERIES, PART 3

TALKS ON RELATIVITY

-By Mahak Poonia , BSc Physics Hons, 2nd Year

So where were we?

Ah yes, relativity and Newton. But, as I said before, much happened before and in between this. It was Galileo Galilei who is credited with formulating the Principle of Relativity. The significance of the debate between the Copernican point of view, which Galileo supported and wrote volumes about, and the Ptolemaic view of the Earth being the Universe's center, is of the two points of views, or frames of reference it presents. What Galileo wrote about in his 2 volumes about his views did not prove the Copernican view as superior to the Ptolemic one, but stated the possibility of the former view and the equivalence of these two. Years later, the significance of this debate was not lost to Sir Isaac Newton, who borrowed a lot from Galilean ideas of relativity, reference frames and Inertial frames building extensively on them.

The principle of Galilean relativity states that: mechanical experiments will have the same results in a system in uniform motion that they have in a system at rest. This principle was first developed when Galileo was trying to establish his world view of the Sun as our solar system's center. Countering the argument given by Ptolemy supporters that if Earth is revolving, why does a stone thrown down from the Tower of Pisa fall straight down?, he said that mechanical observations were the same when carried out within a body at rest and within one moving at a constant velocity, presenting his famed Ship thought experiments and carrying out similar ones to prove his claims.

Galileo is credited with having started a revolution in Science, and it can be argued that he did. His principle of Relativity was, however, flawed. He assumed, for example, that a body rotating with a constant velocity is equivalent to one at rest in terms of mechanical experiments carried in/on them. However, Galileo understood the significance of composition of motion, understanding how motion of a body is related to the motion of the body it exists in, paving the way for the likes of Huygens and Newton to dig deeper into the significance of inertia, Relativity and frames of reference.

VOL. 4, ISSUE 1 | JANUARY 2022

DSKC SQUARE

BRINGING NATURE INSIDE

Materials used in the indoor structure of a house to improve Air Quality

-By Hashima Sherin, Hrudya Prasanth, Krishna S Nair ,
B.Sc(Hons.)Physics
Mentors – Dr.Rashmi Rakshit, Dr. Sandhya, Dr. Vandana Verma

In recent decades, indoor air quality has become paramount due to its effects on human health. The closing of natural openings in buildings for energy saving purposes, the use of new untested materials and poor air exchange significantly affect indoor air quality. Sometimes, the polluted air concentration is higher in indoor than outdoor. We can maintain our indoor environment clean by some techniques. The purpose of our work is to study "Materials used in the structure of the houses to improve air quality". Through this study we found what are the best construction materials for a good indoor environment, efficiency, availability, cost and sustainable aspects of these materials. So, that we can make every house's indoor, a good environment.

Description of Study:

Pollution Absorbing Bricks (Breathe Bricks) is a very good innovation to be used in the structure of the house. Especially considering the present health conditions, it is very essential to breathe fresh and clean air. There are different ventilation systems that can be constructed in buildings so that the use of Air conditioners, which leads to harmful gaseous emission, can be limited. Air filters can be installed on the ventilations to ensure the entering air is clean and devoid of VOCs (Volatile Organic Compounds) and dust particles. Conducting a flush out of air thoroughly in buildings, before occupancy, will help replacing dirty indoor air with fresh outdoor air and removing all the contaminants that accumulated so far. Installing carbon monoxide monitors will help in regulating the amount of CO2 in the house by controlling the opening of the air filters thereby managing air movement.

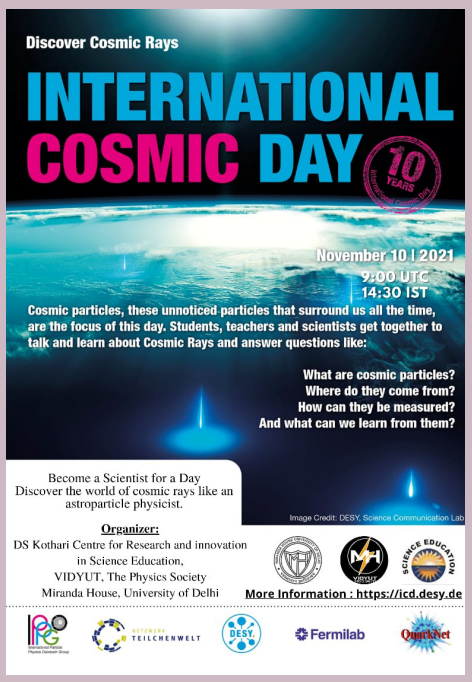
There are so many simple ideas that are great designs on buildings as well as natural alternatives to all the materials that are used in construction so far. Green roofs and walls, where plants are planted on the roof and the walls respectively, helps to improve air quality, make local air better to breathe and gives a beautiful look to the building. Coating the roof of a building by materials that have high reflectivity and high emissivity keeps the buildings cooler and comfortable. Nowadays, wood is used as flooring in most buildings because of its satisfying appearance and it can create a cool atmosphere wherever it is constructed. Straw

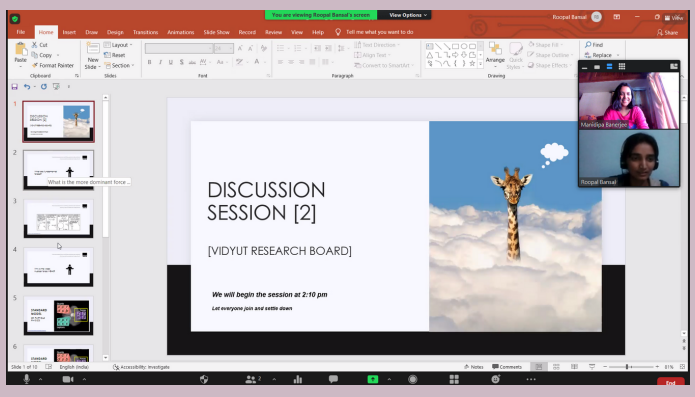
bales (a natural material) can be used as soundproof material because of its good insulation properties. Low VOC content paints emit extremely less amount of chemicals, Low Emission glass windows minimises the amount of harmful rays entering houses and buildings and the use of materials that have low VOC content for indoor carpets, sub-floor materials, ceramics, sealants, adhesives, etc, have to be encouraged so that the indoor environment becomes healthier.

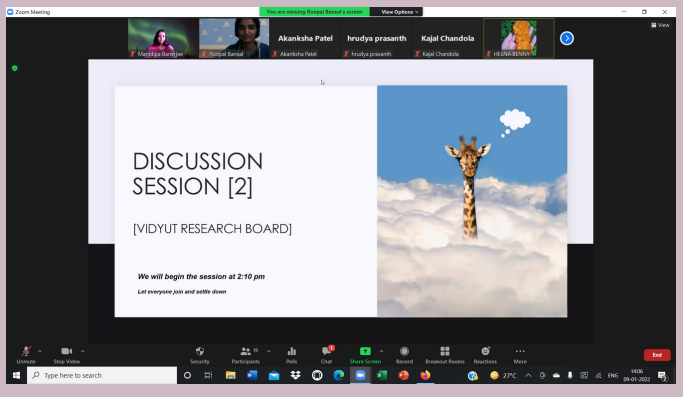
Finally, The natural products market has exploded. No matter what material you want, there's a less hazardous, more sustainable alternative out there.

You just have to look for it.

EVENTS HELD IN PREVIOUS MONTHS







EVENTS HELD IN PREVIOUS MONTHS

CLOCK BY PROFESSOR POORNENDU CHATURVEDI

A report by Anandita Sangwan,BSc Physics Hons, 1st year

The Department of Physics, Miranda House organized a webinar on the topic "CLOCK" on 15th January 2022 from 4 PM onwards by the constant encouragement of our respected Principal ma'am Dr. BijayalakshmiNanda and our Physics Department professors.

Dr. Poornendu Chaturvedi who is currently working as head of Centre of Advanced Semiconductor Technology in Solid State Physics Laboratory in DRDO, Delhi was invited as the speaker of the session.

The Webinar Session began precisely at 4 PM which included the welcome address by Gauri Patti, the President of Vidyut introducing the speaker and explaining the main aim of the webinar.

Dr Poornendu started the session in a fun and interactive way by asking all participants to tell the exact time on their digital devices and clock at their home. The webinar was made not just a lecture givenby the professor, rather an interactive session where students answered various questions which seemed easy but ironically made everyone ponder, giving their full active participation throughout the session.

The lecture started with simplest basic conceptseveryone knew of and the level was gradually takenhigher defining these concepts with a bit of specifications and practical ideas. From giving definition of time, a year, a day and a second with the emergence of astronomical observations and physical metrology to the concept of atomic clock with it's new recent innovations and accuracy and also it's use in our everyday life, the whole session was scholarly enlightening.

At last various queries from students were responded by sir and the session was concluded with the Vote of Thanks by Manidipa Banerjee, the General Secretary of Vidyut.

INTERNATIONAL COSMIC DAY

A report by Manidipa Banerjee, BSc Physics Hons, 2nd year

On International Cosmic Day ICD, more than 60 institutions such as schools, universities, and research institutes in over 13 countries participate to perform experiments on cosmic particles. The D.S. Kothari Centre for Research and Innovation in Science Education, Miranda House in collaboration with Vidyut, The Physics Society of Miranda House, University of Delhi provided the students with the opportunity to get involved in performing experiments on cosmic particles with the help of Quarknet and Cosmic Ray Muon Detector and the students from Miranda House participated in the video conference organised by DESY, Germany (10/11/2021,6:30 PM onwards) on the occasion of International Cosmic Day Event and discussed the results of their experiments with other participants around the world.

Under the guidance of Dr. S N Sandhya and Dr. Raishma Krishnan, students in Miranda House enthusiastically performed various experiments on Cosmic Particles such as :

1. Cosmic shower detector studies (Performed by ISHIKA KUMAR, ANJU SHARMA, MANASVI GAUTAM, ANUSKA BHUYAN, MEENAKSHI S HARI)
2. Dependence of accuracy in speed of muon on different factors (Performed by HARSHA P, PREETY)
3. Detection of muons near Earth's surface proves Einstein's theory of special relativity (Performed by Manidipa Banerjee, Roopal Bansal)
4. Influence of sun in muon flux (Performed by Aikya Banerjee, Priyajit Jana, Hardik Kuralkar *External students, DSKC interns 2021*)

The conference was really interesting and at the end of the day, all the participants had a lively exchange about their new findings on cosmic particles.

COSMIC RAY MUON DETECTOR & EQUILIBRIUM TIDAL THEORY

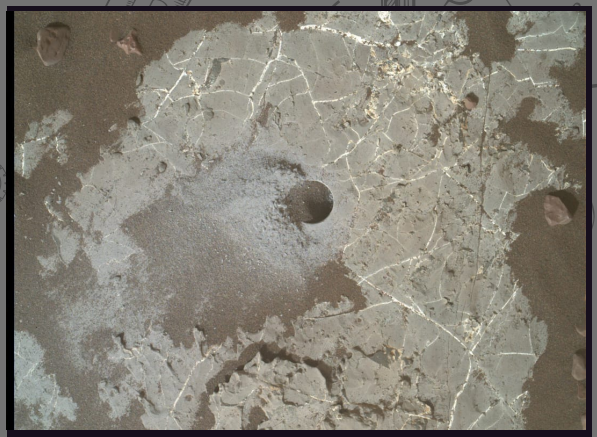
A report by Muskan, BSc Physics Hons, 2nd year

The department of Physics, Miranda House organized webinar on the topic 'Cosmic Ray Muon Detector and Equilibrium Tidal Theory' on 19th November, 2021 from 5:00 PM onwards with persistent encouragements from our respected Principal Ma'am Bijayalaxmi Nanda and Professors from our Physics Department.
Ms. Shivani Yadav, an alumnus of Miranda House, who is currently pursuing MSc Physics, JNU, Delhi was invited as a speaker to articulate her knowledge and experience at Cosmic Ray Muon Detector and Equilibrium Tidal Theory at DSKC summer workshop organized by Miranda House, University of Delhi. For this webinar, online posters, registration links, zoom meeting ID, links and password were created and were circulated among the students and faculties of different departments of various universities and institutions. This event was open for all.
Ms. Shivani Yadav started the session with the picturesque images of Aurora phenomenon and linked it with the cosmic rays. She began with topic 'cosmic ray muon detector'.
She engaged the audience more by referring a comic named, 'We have no Idea- A guide to the Universe', which one should go through to induce interest in the topic. Then at first, she discussed the cosmic ray energy spectrum, describing its various features including knee and ankle. Then she moved forward explaining Cosmic shower containing electrons, γ-rays, π-ions and muons. By discussing various properties of muons, she described how they can be detected by the detector available in the labs. She explained how they used scintillation detectors for their project i.e., they used plastic scintillators because of fast emission, its flexible detector design, better time resolution and good light. She talked about the software they used for their project. She showed the Flux Study indicating that the same number of muons per unit time per unit area is received by us from both the directions of space. And Lunar Eclipse has no effect on muon flux. Other things which have been explained by her included Time of Flight study and Shower study.

Then some interesting questions asked by audiences were taken by Ms. Shivani, which included detection of muons by the scintillators, possibility of cosmic rays from Moon and effect of gravity on muons.
Then she introduced everyone with the second topic, 'The Equilibrium Tidal Theory'. To provoke everyone's thoughts, she began by stating that tides are more of a gravitational phenomenon rather than a water phenomenon as it seems. She elaborated that tidal theory can be viewed from two aspects-
1. Equilibrium Theory
2. Dynamic Theory
She explained all the phenomena based on Equilibrium Theory. She described how the Lunar tides play a more prominent role than Solar tides depending on the masses and the distance between The Sun, Moon and the Earth. She discussed how the superposition principle acts in describing the actual movement of water at the surface of the earth.
Audiences found the webinar very informative as some really intriguing questions were put up about effect of gravity on atmosphere, effect of other planets on tides and about diurnal and mixed tides.
Finally, a vote of thanks was delivered by Gauri, President of The Physics Society of Miranda House, University of Delhi.

IMAGES OF MONTH

'Supernova Remnant Simeis 147'
https://apod.nasa.gov/apod/ap220113.html



"Drilling Holes on the Red Planet'
https://www.nasa.gov/image-feature/drilling-holes-on-the-red-planet

'A Year of Sunrises'
https://apod.nasa.gov/apod/ap220105.html

'Young Star Jet MHO 2147'
https://apod.nasa.gov/apod/ap220121.html

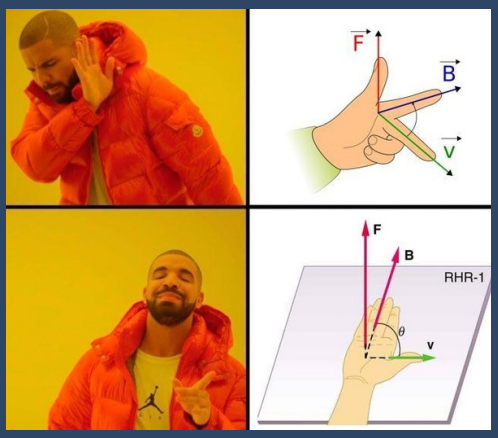
"NGC 7822 in Cepheus'
https://apod.nasa.gov/apod/ap220120.html

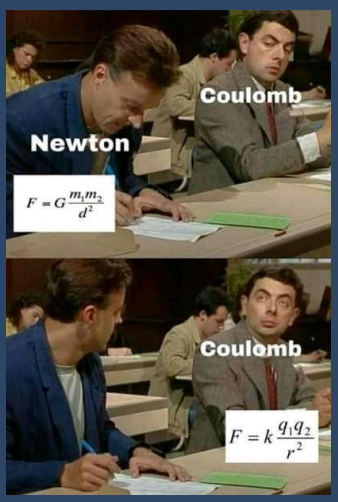
EXTRA DIMENSIONS

"Caught in the webb"
Source: Ulrik Falk-Peterson
@daily_hopper

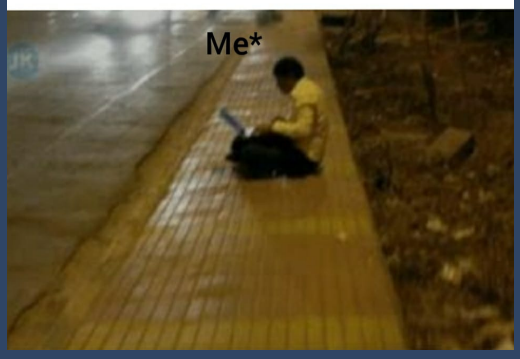
'Galaxies Collision' by Rashmi Sarwal, BSc Physical Science with Computer Science

PHY-EMES

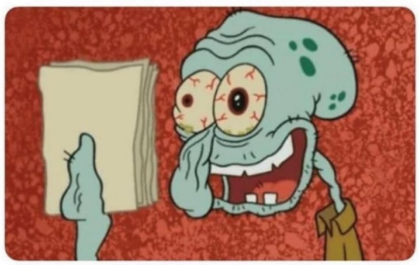




When tomorrow is the last date of assignment submission



Me when i finally finish the assignment



logic: *exists*

quantum physics:

OBE exists

Le camscanner*

FOR MORE INFO:-

AI and the Indian Defence Sector
- https://www.google.com/amp/s/www.orfonline.org/expert-speak/artificial-intelligence-military-operations-where-does-india-stand-54030/

Bringing Nature Inside
- http://www.ecomena.org/indoor-air-quality/
- http://www.rethinkingthefuture.com/

Fermi Paradox and its solutions
- https://youtu.be/xAUJYP8tnRE

James Webb Space Telescope
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Discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales by Giorgio Parisi
- https://www.nobelprize.org/uploads/2021/10/popular-physicsprize2021-2.pdf
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The Sun is no longer the limit, NASA's exultant Parker embarks for its peregrination into the Sun's corona
- https://www.nasa.gov.in
- YouTube channel ki place pr ye link lagana
- https://www.nasa.gov/feature/goddard/2021/nasa-enters-the-solar-atmosphere-for-the-first-time-bringing-new-discoveries

DEPARTMENT OF PHYSICS | MIRANDA HOUSE

EDITOR: SHRADDHA SINGH
CO-EDITORS: SHALLY YADAV, GAURI PATTI, HRUDYA PRASANTH, MANIDIPA BANERJEE, AYUSHI LENKA, ROOPAL BANSAL, RONAK
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