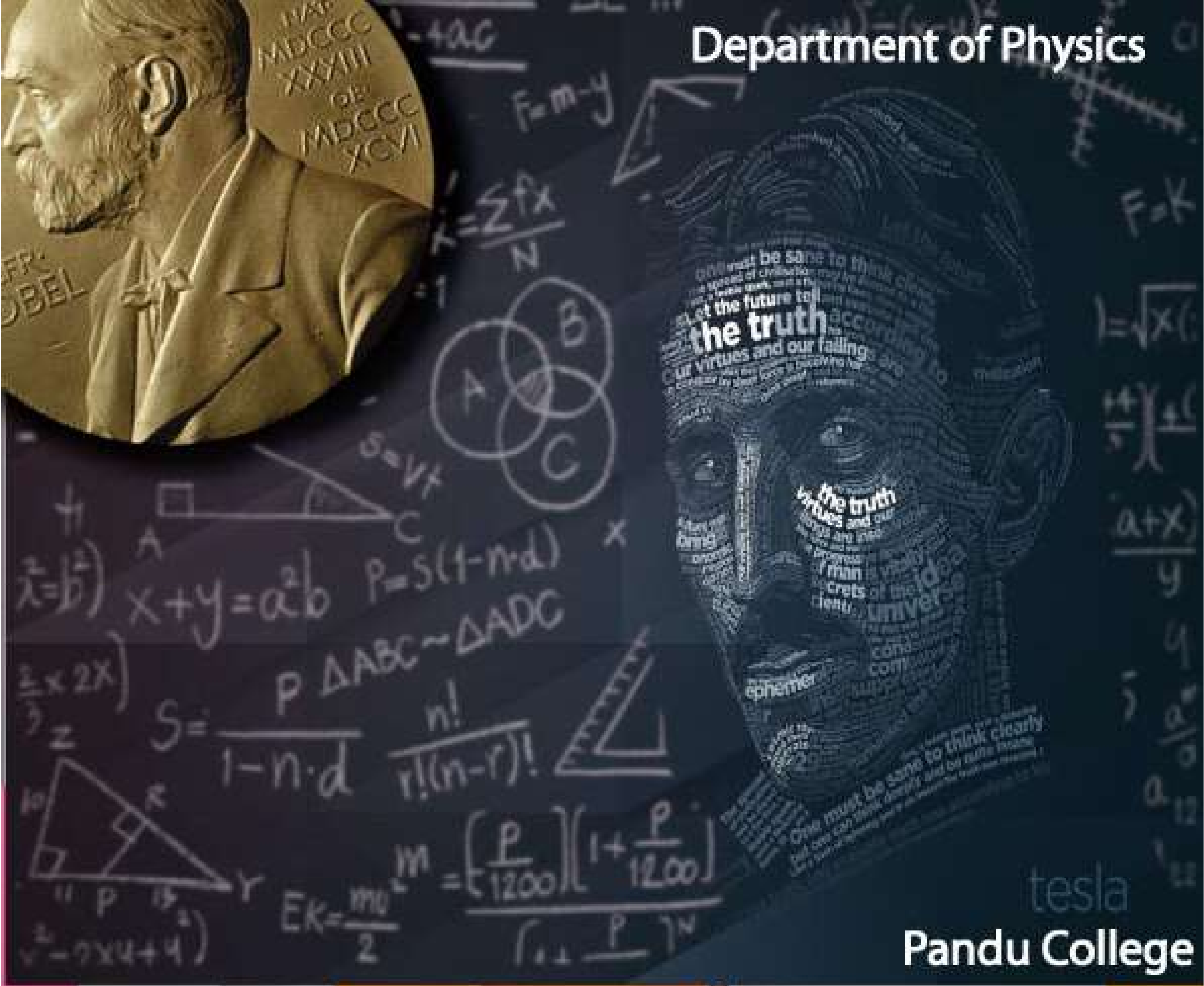
Department of Physics



Pandu College

Spectrum

16th Edition

2022-23

Glimpses of our Department

SPECTRUM

16^{th} Edition

2022 – 23

DEPARTMENT OF PHYSICS
PANDU COLLEGE

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From the Editor's Desk

(From left to right : Manjit Ray, Kankan Das, Partha Sarathi Das, Shiva Prasad Medhi)

We on the behalf of the editorial board of SPECTRUM – 16 would like to offer heartiest gratitude to the Department of Physics, Pandu College, all the authors and readers & pray to god that all of us have a wonderful feature ahead.

We have tried to introduce some of the new concepts in our departmental yearly magazine such as sections of Achievements of our Physics department, Revisiting our Department and Glimpses of our Department. For the first time we have tried to list our Departmental magazine to be published in online medium having our own website & domain and not listing it directly on Google site. We even created some other provisions in our website which will enhance your reading experience of e-Spectrum.

We would like to extend special thanks to Dr. Bandana Das, HOD of Physics department and all the professors of our department to give us the opportunity to publish the spectrum magazine and guiding us all the way.

We want to thank all the students of our department since they provided the article during Durga Pooja vacation and we were able to complete the work of our magazine within 9 days.

Lastly, with apologies for any error or unseen mistakes from our part, the editorial board of Spectrum – 16 wishes all the readers a Happy New Year, 2023 in advance and wish a wonderful year ahead.

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Word from Head of the Department

It is indeed a great pleasure to hear that the 16th issue of our departmental yearly Bulletin "Spectrum" is going to publish. A departmental Bulletin can be the mirror of imagination of creative minds which can explore some unknown facts. I hope this magazine will inspire the students to put down something new and exciting things and create a wonderful atmosphere of reading writing exercises.

Dr. Bandana Das
Head of the Department
Physics Department
Pandu College - 12

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Achievements of our Physics Department

1. Abhisekh Deb (Batch 2018 – 21) of our Physics Department had been awarded as the best Science graduate student from our college.

2. This year our department got 2nd position in the Best Department category

3. Pushpita Bhattacharjee (Batch 2021 – 24) of our Physics Department had secured 2nd position in Western genre and 3rd position in Lokgeet during Gauhati University Inter – College Youth Festival, 2021 - 22.

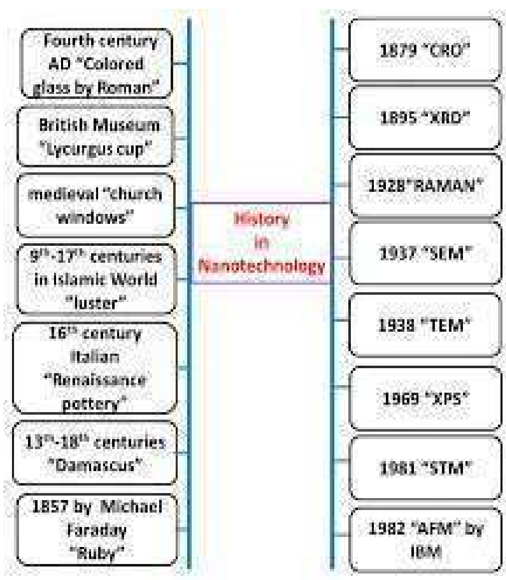
4. 12 students of our Physics Department got admission in Post Graduate this Year (2022).

Journey from Coloured glasses to Nanoelectronics

- **Dr. Bandana Das (Faculty, Department of Physics)**

The history of science and technology reveals that these two interconnected domains always move forward parallel. Such coordination between science and technology has made every century in the past characterized by some unique achievements. Keeping this trend, the present century may be characterized by achievements in the nanoscale domain (one billion times smaller than a meter) and hence we may term the 21^{st} century as the nanoscience and nanotechnology century.

Nanotechnology (Norio Taniguchi, a Japanese scientist was the first to use and define the term “nanotechnology” in 1974) refers to any technology which is based on science of nanoscale structures or devices. In the fourth century, AD Roman glass makers fabricated colourful glasses utilizing metal nanoparticles. The Lycurgus cup, made from soda lime glass doped with silver & gold nanoparticles and preserved in the British museum in London, is an example of this. When a light source is placed inside the cup, the colour of the cup changes



CRO: Cathode Ray Oscilloscope
XRD: X-Ray Diffraction
SEM: Scanning Electron Microscope
TEM: Transmission Electron Microscope
XPS: X-Ray Photoelectron Spectroscopy
STM: Scanning Tunnelling Microscopy
AFM: Atomic Force Microscope

from green to a deep red creating a magnificent scene. The presence of metal nanoparticles in the window glasses of medieval cathedrals makes the glasses colourful. There are numerous examples of such ancient technology in nanoscale domain which were, however, not assisted by proper scientific base at that time.

The ancient nanotechnology took its turn to the proper technology based on basic science i.e. modern nanotechnology after the revolutionary talk of Nobel Laureate Richard Feynman. On 29th December 1959, he delivered a visionary and prophetic lecture in the annual general body meeting of the American Physical Society, entitled ***"There is plenty of Room at the Bottom,"*** where he speculated on the possibility and potential of Nano sized materials. Since Feynman's remarkable scientific implications, nanoscience and nanotechnology have emerged as a revolutionary area of technology based research, opening up the new era of precise engineering on the atomic scale and covering every field from healthcare to the environment. Since all natural materials and systems exist at a nanoscale level, nanotechnology covers a large area and wide variety of scientific disciplines including physics, chemistry, material science, biology, medicine, electronics, engineering and computer simulation etc.

In 1996, the National Science Foundation of US along with a number of government agencies commissioned a study for assessing the current global status of trends, research and development in nanoscience and nanotechnology. Two general findings of the study are: firstly, materials have been and can be nanostructured for new properties and hence for novel performance. This encouraged the material scientists to investigate on semiconductor materials of Nano dimension. This ultimately turned towards interests in studies of semiconductor devices of Nano dimension. Accelerating progress achieved in semiconductor/ metal nanodevices has paved the way for a transition from electronics based on bulk material (i.e. microelectronics) to electronics based on nanomaterial (i.e. nanoelectronics). The second general observation of the US government study was recognition of the wide spectrum of disciplines as contributors to the development in the nanoscience and nanotechnology.

In 2006, a team of Korean researchers from the Korea Advanced Institute of Science and Technology (KAIST) and the National Nano Fab Centre developed a 3 nm MOSFET, the world's smallest nanoelectronics device. The journey from Coloured glasses to Nanoelectronics continues till present with the commercial production of nanoelectronics semiconductor devices started in the year 2010.

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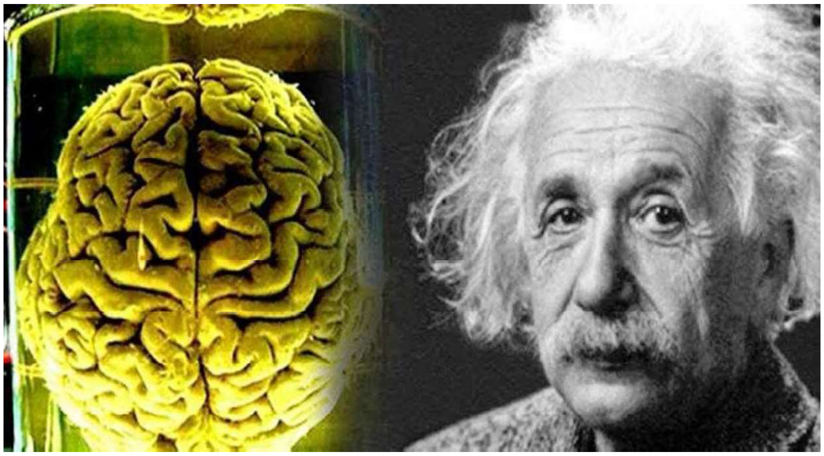
Albert Einstein's Brain after death: A Strange Story

- **Dr. Jhuma Biswas (Faculty, Department of Physics)**



Albert Einstein is considered one of the most important scientists in world history and best known for developing the theory of Relativity and Photoelectric Effects. He was born in Ulm, Wurttemberg, Germany in March 14, 1879 where he grew up. His birthday, 14th March, is also known as "Pi" day because 3/14 makes up the first three digits of the number pi (3.14). He attended grade school in Germany and later on, he moved to Switzerland where he attended university. In 1896, he went to the Swiss Federal Polytechnic School in Zurich where he was trained as a teacher in physics and mathematics. Max Talmud, introducing Einstein to higher mathematics and philosophy had important influence on Einstein's life. He had introduced Einstein to a children's science series, in which the author imagined riding alongside electricity that was traveling inside wire of a telegraph. Then, Einstein asked himself the question that would dominate his thoughts for the next 10 years. At that time, Einstein also wrote his first scientific paper "The Investigation of the State of Aether in Magnetic Fields". After graduation in 1900, Einstein faced one of the greatest crises in his life. Because he studied advanced subjects on his own, frequently did not attend his classes; which earned him the enmity of some professors, mainly Heinrich Weber. In 1901, Albert gained his diploma and acquired Swiss citizenship. He gained his doctor's degree in 1905.

Einstein was subsequently turned down for every academic position that he applied to. The decisive moment came afterward, when father of his friend Marcel Grossmann was capable to recommend him for a position as a clerk in the Swiss Patent Office in Bern. While working at the patent office, Einstein found he could get his daily job done in just a few hours. This left the rest of the day open for him to work on his own scientific theories. He would quickly finish analyzing patent applications, leaving him time to day dream about the vision that had obsessed him since he was 16: "What would happen if you raced alongside a light beam?". While Einstein was in polytechnic school, he had studied Maxwell's equations, which describe the nature of light, and discovered a fact unknown to James Clerk Maxwell himself-namely, that the speed of light remains the same no matter how fast one moves. This violates Newton's laws of motion, even if, because there is no absolute velocity in Isaac Newton's theory. This insight led Einstein to formulate the famous Principle of Relativity: "the speed of light is a constant in any inertial frame". The year 1905 is called the "miracle year" in the history of physics. In this year, Einstein published 4 numbers of papers in the *Annalen der Physik*, each of which would modify the course of Modern Physics. He was appointed Privatdozent in Berne in 1908. He became Professor Extraordinary at Zurich in 1909 and Professor of Theoretical Physics at Prague in 1911. He was as well appointed Director of the Kaiser Wilhelm Physical Institute in 1914 and Professor at the University of Berlin. In 1940, he became a United States citizen and retired from his post in 1945. After gaining fame for his "Miracle Year" papers, he eventually returned to Germany as a professor until Hitler gained power in 1933. His discoveries changed the course of Modern Physics establishing the field of Special Theory of Relativity and also contributing in the area of Quantum Mechanics. He is most famous for his Theory of General Relativity and the equation "$E=mc^2$." Albert Einstein won the Nobel Prize for Physics in 1921 for his explanation of the Photoelectric Effect.

Einstein obviously had a special brain. He did not want his brain or body to be studied or worshipped after his death. "He had left behind specific instructions regarding his remains: cremate them, and scatter the ashes secretly in order to discourage idolaters," writes Brian Burrell in his book, Postcards from the Brain Museum in 2005.

When he died as a result of a fatal aneurysm in Princeton Hospital, New Jersey on April 18, 1955, the chief pathologist of the Hospital on call, Thomas Harvey, stole it within seven and a half hours of his death. But Harvey took the brain anyway, without permission from Einstein or his family. "When the fact came to light a few days later, Harvey managed to solicit a reluctant and retroactive blessing from Einstein's son, Hans Albert, with the now-familiar stipulation that any investigation would be conducted solely in the interest of Science," Burrell writes. Harvey immediately lost his job at the Princeton hospital and took the brain to Philadelphia, where it was carved into 240 pieces and preserved in Celloidin, a hard and rubbery form of cellulose. He divided up the pieces into two jars and stored them in his basement. After Harvey's wife threatened to dispose of the brain, he returned to retrieve it and took it with him to the Midwest. During this time he worked as a medical supervisor in a Biological testing lab in Wichita, Kansas, keeping the brain in a cider box stashed under a beer cooler. He moved again, to Weston, Missouri, and practiced medicine while trying to study the brain in his spare time. He then relocated to Lawrence, Kansas, took an assembly-line job in a plastic-extrusion factory. Harvey would tell stories to the poet William Burroughs about the brain, that cutting off chunks to send to researchers around the world. Later on in 1985, Harvey and collaborators in California published the first study of Einstein's brain, claiming that it had an abnormal proportion of two types of cells, Neurons and Glia. That study was followed by five others, reporting extra differences in individual cells or in particular structures in Einstein's brain. The researchers after these studies say studying Einstein's brain could facilitate uncover the neurological underpinnings of intelligence. In the original 1985 report, Harvey and his collaborators found that in Brodmann Area 39 - a region where the temporal, parietal, and occipital lobes meet - Einstein's Neuron-to-Glia ratio was significantly smaller than it was in the same area in 11 control brains. But the control group was not all that well controlled: the brains came from people age 47 to 80 years old, whereas Einstein died at age 76. The controls brains were also fresh, whereas Einstein's had been languishing in basements and beer coolers for three decades. A study led by Florida State University evolutionary anthropologist Dean Falk had revealed that portions of the brain of Albert Einstein are unlike those of most people. Falk's team used photographs of Einstein's brain, taken shortly after his death, but not earlier analyzed in detail. The photographs showed that Einstein's brain had an unusually complex pattern of convolutions in the *prefrontal cortex,* which is important for abstract thinking. Falk and her team published their work on November 16, 2012 in the journal *"Brain"*.

In 1996, Harvey partnered with a scientist from Alabama and counted neurons in Einstein's Brodmann Area 9 **-** part of the frontal cortex **-** and those of five controls. There were no differences in the number of neurons or the size of neurons, the study found, but Einstein's tissue was thinner than controls. More densely packed neurons, the authors speculated, means that cell-to-cell messages travel shorter differences, which might mean faster processing speed overall. As Hines calls out in his poster, the finding was based on just one square millimeter of Einstein's brain. In 1999, Harvey and Canadian collaborators got Einstein's brain into one of the world's most prestigious medical journals, "The Lancet". Based on old photographs that had been taken of Einstein's brain before it was cut up, the researchers claimed that Einstein had an abnormal folding pattern in part of his parietal lobe, a region that has been linked to mathematical ability. They also reported that his parietal lobes were 15 % wider, and more symmetrical, than those of control brains. Finally, in 1998, Harvey**-**who died in 2007**-** donated the remaining brain samples to the University Medical Center of Princeton, where it remains today.

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Unsung Indian Physicists who deserved Nobel Prize

- **Shiva Prasad Medhi, B.Sc 5th sem (Physics Honours)**

1. ***Meghnad Saha (1893-1956)***

He born in undivided Bengal of British India. He introduced the world to thermal ionization equation (known as Saha equation) which demonstrated the relationship between the element's ionisation state to the temperature and pressure. The equation helped his science successor to perform accurate spectral classification of stars.

In 1930, 1951 and 1955 Saha was nominated for the Nobel prize in Physics by Dabendra Mohan Bose and Sisir Kumar Mitra. In 1937 and 1940, Noble Laureute Arthur H Comton also nominated Saha's name. However despite seven nomination Saha was never awarded the prize.

2. ***Debandra Mohan Bose (1985-1975)***

Debandra Mohan Bose was the nephew of famous Indian Physicist Jagadish Chandra Bose who was born in Bengal. Debandra Mohan Bose contributed in the field of cosmic rays, artificial radioactivity and neutron physics. He and his colleague Bibha Choudri to study cosmic rays using photographic plate. Since particle accelerators were not at that time, high energy subatomic particles were only obtainable from atmospheric cosmic rays. Walther Bothe gave the duo the idea of photographic emulsion but due to restriction of world war II full tone photographic plate were not available in India. Later Cencil Frank Powell independently used the same method and was awarded Nobel prize in Physics in 1950.

3. ***Bibha Chowdhuri (1913 – 1991) :***

Bibha Chowdhuri was an Indian physicist. International astronomical has a star named after her. She is considered as first discoverer of Pi-Mesons (Pions), the first subatomic particle she identified new particle by studying their track in cloud chamber and on photographic plate. She is also known for KGF (Kolar Fold Field) experiments: Energetic muons (Emln=150 GeV) experiments at kolare gold. She left India in 1945 to work with Patrick Backket who won the Nobel Prize in 1948.

4. ***G. N. Ramachandram (1922-2001)***

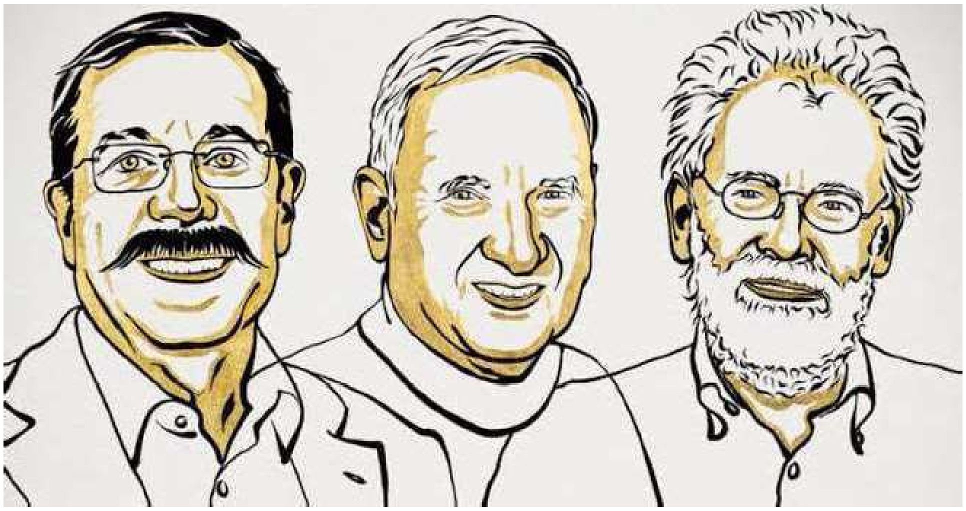
He was known for Ramachandram plot for understanding peptide structure. His field of research was biophysics. He along with Gopinath Kartha had proposed triple Helix structure of collagen. He was nominated for Noble Prize for his fundamental contribution in protein structure and function. Leading science prof. Linus Pauling and prof. Francls Circk regarded G.N. Ramachandran as Nobel prize calibre scientist.

5. ***Emackal chandy George Sudarshan (1931 – 2018)***

E.C.G. Sudarsham was Indian theoretical physicists. He contributed in many things of Physics. He was popularly known for Glauber – Sudarshan representation for which R . J. Glauber won Nobel Prize in Physics but not E. C. G. Sudarshan. Many physicist wrote letter to Noble committee to give him share of Nobel Prize.

The Nobel Prize in Physics 2022

- **Prabal Baishya, B.Sc 5th sem (Physics Honours)**



The Royal Swedish Academy of Science had awarded Nobel prize in physics to Alain Aspect , John F. Clauser , Anton Zeilinger this year 2022 for their experiments with entangled photons , establishing the violation of Bell inequalities and pioneering quantum information science. They have been working for a long time on quantum physics and have successfully setup a base for further research on 'entanglement' phenomenon. Their experiments have conclusively established that the entanglement phenomenon observed in quantum particles was real not a result of any unknown forces. It could be utilised to make transformative technological advances in computing ,hack free communications and science fiction.

The three conducted a series of experiments on entangled quantum states , where two separate particles behaves like a single unit. In simple words, before the experiments of these three scientists almost all scientists are thinking that the correlation between particles which are far away from each other is because of an unknown force but they have conclusively established that this is wrong concept .

Moreover, teleportation which is a fiction till now may also be possible in future because of this research.

Aditya L-1, India's first mission to study the Sun

- **Romanchita Choudhury, B. Sc 1st sem (Physics Honours)**

Aditya L1 is a coronagraph spacecraft, currently being designed and developed by Indian Space Research Organisation (ISRO) and other Indian research institutes. It is planned to be launched in January 2023 from one of the ISRO launching centre at Sriharikota, a boarding a PSLV-XL (Polar Satellite Launch Vehicle XL) to study the solar atmosphere. The launching of Aditya L1 has been delayed due to COVID 19 pandemic. The Aditya L1 was originally announced in 2008 as India's first solar mission aimed to study the sun's corona. Earlier it was named as Aditya 1 and was aimed to be launched in the Lower Orbital of Earth (LEO) about 800km. Later it was changed to be launched for Lagrangian point for its various advantages and hence renamed as Aditya L1.

Aditya L1 will be placed in the halo orbit around the Lagrangian point 1 between the Sun and Earth and will continuously study the Sun without any eclipses. Lagrange Points are basically the points that are positioned in space, where gravitational forces of a two celestial body system are equal and opposite, i.e. a body at that point tends to stay put. It's about 1.5 million km from Earth which poses a set of new challenges to ISRO. It will study coronal heating, solar wind acceleration, coronal magnetometry, origin and monitoring of near UV solar radiation and continuously observe photosphere, chromosphere, corona, solar energetic particles and magnetic field of the Sun. This mission will also obtain near simultaneous images of the different layers of the Sun's atmosphere, which can reveal the ways in which the energy may be channelled and transferred from one layer to another.

Its main mission is to track the solar magnetic storm directed to the earth and its impact on earth's environment. As of July 2019, the mission has an allocated cost of ₹378.53 crore Indian value excluding launch costs. It's quite important for ISRO to strike a good deal out of Aditya L1 as it has many future aspects for space weather studies from the data gathered by it. Those data can help reduce the variations of solar storms that lead to changes in satellite's orbit damage onboard electronics, and can also lead to power cut - offs here on Earth. The Aditya-L1 mission will take around 109 Earth days after launch to reach the halo orbit around the L1 point and will have a weight of 400kg. This satellite will carry seven science payloads each having different objectives. These payloads of Aditya L1 are :-

● Visible Emission Line Coronagraph (VELC)
● Solar Ultraviolet Imaging Telescope (SUIT)
● Aditya Solar wind Particle Experiment (ASPEX)

● Plasma Analyser Package for Aditya
● Solar Low Energy X-ray Spectrometer (SoLEXS)
● High Energy L1 Orbiting X-ray Spectrometer (HEL1OS)
● Magnetometer

Apart from India's Aditya L1 by ISRO, many sun specific missions have been launched by various countries like NASA's Parker Solar Probe, NASA's Living With a Star, NASA's Helios 2 etc. However, the Aditya L1 solar mission by ISRO is different from any other solar mission, as it will take continuous observation and measurement of the coronal magnetic field from the Lagarian point without any eclipse. The payload VELC of Aditya L1 will play an important role in studying the coronal magnetic field.

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369 code : Nikola Tesla's secret Code

- **Bornali Dey, B. Sc 3rd Sem (Physics Honours)**

Nikola Tesla was not just an inventor but also a man with secrets and mysteries we could never imagine of. One of his most floated theory is Tesla 369 number theory. Nikola Tesla was obsessed with these numbers. He wanted the world to know the significance of the number 36 . In mathematics,

1+1= 2
2+2=4
4+4=8
8+8=16 ; 1+6=5
16+16=32 ; 3+2=5
32+32=64 ; 6+4=10 ; 1+0=1

These patterns only returns 1,2,4,5,6,7,8 and the numbers 3,6,9 are always missing.

In his life, Tesla manifested his obsession in numerous ways. He would walk three times around the block before entering the building. Tesla would wash his dishes with 18 napkins (18 is divisible by 9, 6, and 3). The inventor would also only stay in hotel rooms that had a room number divisible by three.

When we study the circles we know a Circle will have 360 degrees. As we divide a circle many times, we will get 3, 6 on 9 numbers only. If we cut a quarter of a circle, we will get 90 degrees, now that quarter will be multiple of 3, 6 and 9, Remaining 3 quarters angle total degree will be 210 degrees, which are the multiples of 3 , 6, 9.

3 6 9 with AUM :
AUM means nothing and it also means everything.
AUM is the most mysterious word in the Universe.
AUM has three sounds A...U....M.
A **-** Signifies the beginning of the universe,
U **-** Signifies the life period of universe and
M **-** Signifies the destruction of the Universe

The synchronicity of these particular numbers are in direct correlation with the Universe. The number three is significant because is it the direct link to Universe. Six represents the deepest strength we have within ourselves. Nine is in accordance with moving on from the past, and helps release any feelings of self-doubt or negativity. These numbers 3,6 and 9 are very special, with their use, we can easily open the secret door of the universe, But we should have faith in it.

The Einstein-Podolsky-Rosen Paradox

- **Hrishikesh Sarma, B. Sc 3rd Sem (Physics Honours)**

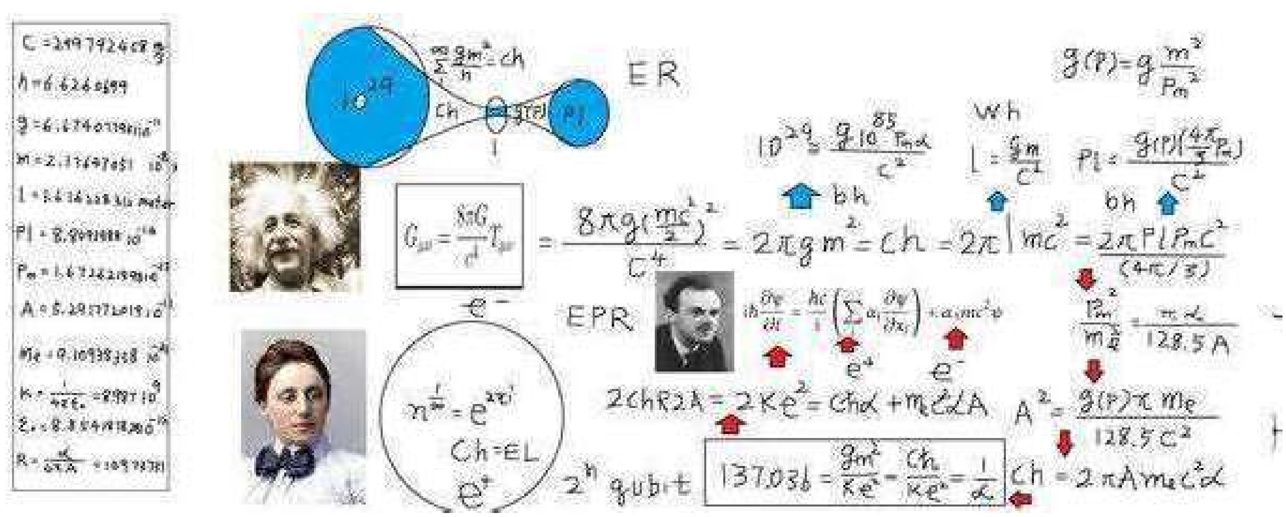
Einstein, Podolsky and Rosen (EPR), in their famous paper, argued that the quantum-mechanical description of physical reality is incomplete. They showed that one can envisage physical situations whereby 'an element of physical reality' can be located such that it does not have a counterpart in quantum theory. A simple description of the EPR paradox is presented in this article, using the example of two spin-l/2 particles.

Consider an entangled state, like the following "singlet state" of two spin-1/21/2 particle. Let the two particles be labelled A and B. Measuring Sz on A collapses the system into a two-particle state that is unentangled, where each particle has a definite spin. If the measurement outcome is $+\hbar/2$, the new state is $|+z\rangle|-z\rangle$, whereas if the outcome is $-\hbar/2$, the new state is $|-z\rangle|+z\rangle$.

$$|\psi\rangle=12\text{–}\sqrt{}(|-z\rangle|+z\rangle-|+z\rangle|-z\rangle)$$

The postulates of quantum theory seem to indicate that the state collapse happens instantaneously, regardless of the distance separating the particles. Imagine that we prepare the two-particle state in a laboratory on Earth. Particle A is then transported to the laboratory of Alice, in the Alpha Centauri star system, and particle B is transported to the laboratory of Bob, in the Betelgeuse system, separated by ~640 light years. In principle, this can be done carefully enough to avoid disturbing the two-particle quantum state.

Alice measures Sz on particle A, which induces an instantaneous collapse of the two-particle state. Immediately afterwards, Bob measures Sz on particle B, and obtains—with 100% certainty—the opposite spin. During the time interval between these two measurements, no classical signal could have travelled between the two-star systems, not even at the speed of light. Yet the state collapse induced by Alice's measurement has a definite effect on the result of Bob's measurement.



This phenomenon had three noteworthy aspects :-

a) Firstly, it dispels some commonsensical but mistaken “explanations” for quantum state collapse in terms of perturbative effects. For instance, it is sometimes explained that if we want to measure a particle’s position, we need to shine a light beam on it, or disturb it in some way, and this disturbance generates an uncertainty in the particle’s momentum. The EPR paradox shows that such stories don’t capture the full weirdness of quantum state collapse, for we can collapse the state of a particle by doing a measurement on *another* particle far away.

b) Secondly, our experimentalists have a certain amount of control over the state collapse, due to the choice of what measurement to perform. So far, we have considered Sz measurements performed by Alice on particle A. But Alice can choose to measure the spin of A along another axis, say Sx. In the basis of spin-up and spin-down states, the operator Sx has matrix representation

$$S\hat{}x=\hbar/2\begin{bmatrix}0 & 1\\ 0 & 1\end{bmatrix}$$

The eigenvalues and eigenvectors are

$$Sx=\hbar/2,\ |+x\rangle=1/\sqrt{2}(|+z\rangle+|-z\rangle)$$

$$Sx=-\hbar/2,\ |-x\rangle=1/\sqrt{2}(|+z\rangle-|-z\rangle).$$

Conversely, we can write the S^z eigenstates in the $\{|+x\rangle,|-x\rangle\}$ basis:

$$|+z\rangle=1/\sqrt{2}(|+x\rangle+|-x\rangle)$$

$$|-z\rangle=1/\sqrt{2}(|+x\rangle-|-x\rangle).$$

This allows us to write the two-particle entangled state in the S^x basis:

$$|\psi\rangle=12-\sqrt{}(|-x\rangle|+x\rangle-|+x\rangle|-x\rangle)$$

Alice’s measurement still collapses the particles into definite spin states with opposite spins—but now spin states of Sx rather than Sz.

c) Third, this ability to choose the measurement axis *does not* allow for superluminal communication. Alice can choose whether to- (i) measure Sz or (ii) measure Sx, and this choice instantaneously affects the quantum state of particle B. If Bob can find a way to distinguish between the cases (i) and (ii), even statistically, this would serve as a method for instantaneous communication, violating the theory of relativity. Yet this turns out to be impossible. The key problem is that quantum states themselves cannot be measured; only observables can be measured. Suppose Alice’s measurement is S^z, which collapses B to either $|+z\rangle|+z\rangle$ or $|-z\rangle|-z\rangle$, each with probability 1/2. Bob must now choose which measurement to perform. If he measures Sz, the outcome is $+\hbar/2$ or $-\hbar/2$ with equal probabilities. If he measures Sx, the probabilities are:

$$P(Sx=+\hbar/2) = 1/2|\langle +x|+z\rangle|^2$$

$$P(Sx=-\hbar/2) = 1/2|\langle -x|+z\rangle|^2$$

The probabilities are still equal! Repeating this analysis for any other choice of spin axis, we find that the two possible outcomes always have equal probability. Thus, Bob's measurement does not yield any information about Alice's choice of measurement axis.

Since quantum state collapse does not allow for superluminal communication, it is consistent *in practice* with the theory of relativity. However, state collapse is still nonlocal, in the sense that unobservable ingredients of the theory (quantum states) can change faster than light can travel between two points. For this reason, EPR argued that quantum theory is *philosophically* inconsistent with relativity.

EPR suggested an alternative, maybe quantum mechanics is an approximation of some deeper theory, whose details are currently unknown, but which is deterministic and local. Such a "hidden variable theory" may give the appearance of quantum state collapse in the following way. Suppose each particle has a definite but "hidden" value of Sz, either $Sz=+\hbar/2$ or $Sz=-\hbar/2$; let us denote these as [+] or [−]. We can hypothesize that the two-particle quantum state $|\psi\rangle|\psi\rangle$ is not an actual description of reality; rather, it corresponds to a *statistical* distribution of "hidden variable" states, denoted by [+; −] (i.e., $Sz=+\hbar/2$ for particle A and $Sz=-\hbar/2$ for particle B), and [−; +] (the other way around).

When Alice measures Sz, the value of the hidden variable is revealed. A result of +z implies [+; −], whereas −z implies [−; +]. When bob subsequently measures Sz, the result obtained is the opposite of Alice's result. But those were simply the values all along—there is no instantaneous physical influence traveling between their two laboratories.

Clearly, there are many missing details in this hypothetical description. Any actual hidden variable theory would also need to replicate the huge list of successful predictions made by quantum theory. Trying to come up with a suitable theory of this sort seems difficult, but with enough hard work, one might imagine that it is doable.

Plant grown in Moon's soil for the very first time

- Kankan das, B. Sc 5th sem (Physics Honours)

From 1969 to 1972 NASA launched total six Apollo missions. During the missions they carried almost 382 kg of lunar rocks, core samples, pebbles, sand and dusts which are collectively known as lunar regolith from moon surface. They brought them to study with state-of—the-art equipment and saved for future research with advanced equipment.

Almost 50 years later scientists have made a breakthrough discovery with the lunar regolith. For the very first time scientists have grown plant in lunar soil. Bill Nelson, head of US space agency said, "This research is critical to NASA's long term human exploration goals." Robert Ferl and Anna Lisa Paul, professors of horticulture science University of Florida applied three times over the course of 11 years for a chance to work with lunar regolith. Finally they get a chance and the University of Florida researchers loaned 12 gram of regolith from NASA.

Researchers used thimble sized wells to in plastic plates normally used to cultured cells. Arabidopsis plant was used for the experiment. This plant is the member of mustard family which includes cultivated species such as cabbage and radish. The main reason of the use of this plant was its genetic code was fully mapped. Growing Arabidopsis in lunar soil allowed the researchers more insight into how the soil affected the plants, down to the level of gene expression.

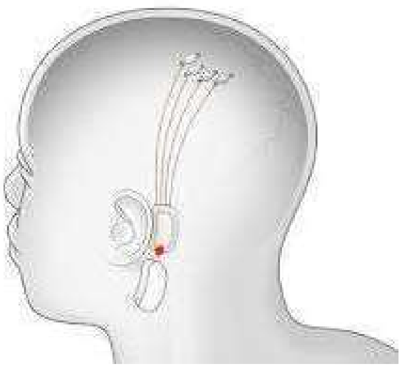
They used only one gram of sample brought during Apollo 11, 12 and 17 for each plant. They also took sample of soil from different places of earth and volcanic ash to simulate the lunar soil. The team added water and then seeds to the samples. The samples were kept in a clean room and added nutrients daily. After two days seeds started to sprout. After 6 days the team noticed that lunar soil plants were not as robust as the plants growing in volcanic ash and the plants were growing differently depending on which type of sample they were in. The plants of lunar soil grew more slowly as compared to terrestrial soil and had stunted roots, additionally some had stunted leaves with reddish pigmentation.

After a period of 20 days, researchers ground up the plants so that they could study their biological structure. After the study of their RNA, researchers found that the plants grown in lunar soil were under stressed conditions in relation to the controls. But the study was still deemed a success.

Neuralink

- **Pushpita Bhattacharjee, B. Sc 3rd Sem (Physics Honours)**

Neuralink is a neurotechnology company co-found by Elon Musk, Max Hodak and Paul Merolla in July, 2016. It develops implantable brain–machine interfaces (BMI). Since Neuralink is established, it has been hiring well known neuro-scientists across the globe.



In a report of 2018, Gizmodo (a science news website) reported that Neuralink remained highly secretive about its work and project, although it was revealed through public records that the company is planning to start an animal testing facility in San Francisco, which subsequently initiated to carry out researches at the University of California. The Neuralink team revealed to the public the technology of the first prototype they had been working on. It is a system that involves ultra-thin probes that will be inserted into the brain, a neurological robot that will perform the operations and a high-density electronic system capable of processing information from neurons. It is based on technology developed at UCSF. The probes are generally made of polyimide a biocompatible material with a thin gold or platinum conductor, are implanted in the brain through an automated process performed by a surgical robot. Each probe consists of an area of wires that contains electrodes capable of locating electrical signals in the brain, and a sensory area where the wire interacts with an electronic system that allows amplification and acquisition of the brain signal. Each probe contains 48 or 96 wires, each of which contains 32 independent electrodes, making a system of up to 3072 electrodes per formation. Neuralink also claims to have robot capable of inserting many flexible probes into the brain avoiding problems like tissue damage.

In order to study the neural function inside the brain and simulate these neurons back, Neuralink has developed an Application-Specific Integrated Circuit (ASIC) to create a 1,536-channel recording system. This system consists of 256 amplifiers capable of being individually programmed (analog pixels), analog-to-digital converters within the chip (ADCs) and a peripheral circuit control to serialize the digitized information obtained. ASIC aims to convert information obtained from neurons into an understandable binary code to understand neural activity. In July 2020, according to Musk, Neuralink obtained a FDA breakthrough device designation which allows limited human testing under the FDA guidelines for medical devices.

Neuralink has done some innovational works recently but there are a lots of technical challenges cited by some of the honoured scientists and institutions. Performing brain surgery and implanting devices into the brain is a high risk process, which to be modified in their future works.

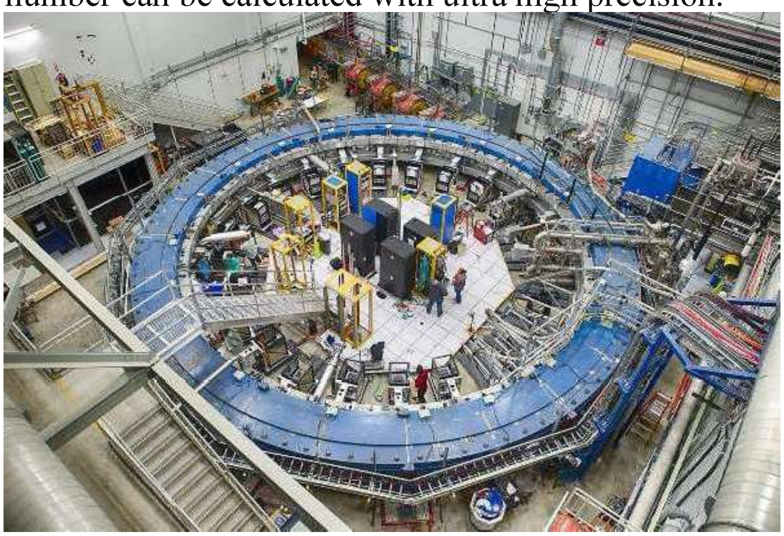
The first result of Muon g-2 Experiment

- **Anjan Bhowmik, B.Sc 1st sem (Physics Honours)**

The long-awaited first results of Muon g-2 experiment at the U.S. department of energy`s Fermi National Accelerator Laboratory show fundamental particles called muons behaving in a way that is not predicted by scientist`s best theory , the standard model of particle physics. This landmark result, made with unprecedented precision , confirms a discrepancy that has been gnawing at researchers for decades .

The strong evidence that muons deviate from standard model calculation might hint at exciting new physics. Muons act as a window into the subatomic world and could be interacting with yet undiscovered particles or forces.

A muon is a charged particle and about 200 times massive than electron. Muons occur naturally when cosmic rays strike earth's atmosphere, and particle accelerator at Fermilab can produce them in large numbers. Like electron , muons act as if they have a tiny internal magnet. The strength of internal magnet determines the rate that the muon percusses in an external magnetic field and is described by a number that physicists call the g-factor. This number can be calculated with ultra high precision.



As the muons circulate in the muon g-2 magnet, they also interact with a quantum foam of subatomic particles popping in and out of existence . Interactions with these short-lived particles affect the value of g- factor , causing the muons precession to speed up or slow down very slightly. The standard model predicts this so called anomalous magnetic moment extremely precisely. But if the quantum foam contains additional forces or particles not accounted for by Standard model, that would tweak the muon g-factor further .

"This quantity we measure reflects the interactions of muon with everything else in the universe . But when the theorists calculate the same quantity , using all the known forces and particles in standard model, we don't get the same answer," said Renee Fatemi, at the university of Kentucky and the stimulations manager for the muon g-2 experiment .

The first result from the muon g-2 experiment at Fermilab confirms the result from experiment performed at Brookhaven National Lab two decades ago. Together, the two results show strong evidence that muons diverge from the Standard Model prediction.

The accepted theoretical values for muon are :-

g-factor : 2.00233183620(86)

anomalous magnetic moment : 0.00116591810(43)

The new experimental world average results announced by the muon g-2 collaboration today are :-

g-factor :2.0023318422(82)

anomalous magnetic moment : 0.00116592061(41)

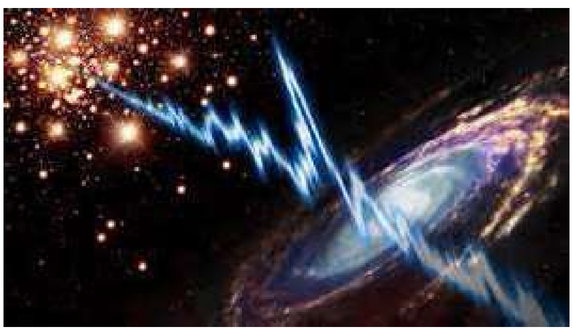
the combined results from Fermilab and Brookhaven show a difference with theory at a significance of 4.2 sigma, a little shy of the 5 sigma (or standard deviations) that scientists require to claim a discovery but still compelling evidence of new physics .

Fast Radio Burst

- **Piyush Kumar Sharma, B.Sc 3rd Sem (Physics Honours)**

Fast radio bursts are intense bursts of radio emission that have durations of milliseconds and exhibit the characteristic dispersion sweep of radio pulsars. It can also be said as bright flashes of light that appear for a few milliseconds and then vanish. It is claimed to be the second mysterious radio signal detected by scientists. There was no pre knowledge of when and where it is going to occur so they were hard to discover, the first one was thus reported in 2007 by an American astronomer Duncan Lorimer. Only a handful of emission have been traced too specific areas of the sky, most indicating in other galaxies.

As of today, their origin is unknown. They are believed to be produced by unidentified sources in the distant cosmos. In 2020, a source within the Milky Way – most likely belonging to a type of neutron star called a magnetar- was confirmed to be a fast radio buster.

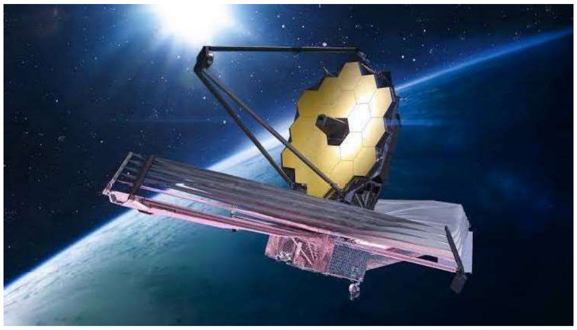


The flash of these radio waves is incredibly bright, if distant, comparable to the power released by hundreds of millions of suns in just a few milliseconds. The intensity suggests powerful objects like black holes and neutron stars could be involved, with highly dense bodies such as magnetars as likely culprits. The events were once considered to be transient i.e., they were seemed to be happen once, without obvious signs of repeated emission. Surprisingly, in 2016 that the astronomers found evidence of multiple bursts and that too from the same source. Since then, a good number of such events has been recorded. The plasma that lies between stars and galaxies causes all light- including radio waves- to slow down, but lower frequencies feel this effect more strongly and slow down more than higher frequencies. FRBs contain a range of frequencies, so the higher frequency light in the burst hits Earth before the lower frequencies, causing dispersion. This allows researchers to use dispersion to estimate far from Earth an FRM originated. The more stretched out an FRB is, the more plasma the signal must have passed through, the farther away the source must be.

There is more yet to be discovered about this mind flattering FRBs. We are just at the coast of it.

JAMES WEB SPACE TELESCOPE

- Saheb Dutta B.Sc 3rd sem (Physics Honours)



The James Web Space Telescope (JWST) is a space telescope designed primarily to conduct infrared astronomy, is the largest optical telescope in space high infrared resolution and sensitivity allow it to view objects too early, distant, or faint for the Hubble Space Telescope. This is expected to enable a broad range of investigations across the fields of astronomy and cosmology, such as observation of the first stars and the formation of the first galaxies, and detailed atmosphere Characterization of potentially habitable exoplanets.

The James Web Space Telescope was launched on 25 December 2021. on an Ariane 5 rocket from Kourou, and aroused at the Sun- Earth in January 2022. The first image captured by JWST was released to the public 1 July, 2022 by press conference .

FEATURES OF JWST

JWST'S primary mirror consist of 18 hexagonal mirror sergeants made up of gold plated beryllium, which combined create a 6.5 meter diameter mirror, compared with Hubble's 2.4 m. This gives JWST a light collecting area of about 25 sqm & about 6 times that of Hubble Telescope. The mirror has a gold coating to provide infrared reflectivity and this is covered by a thin layer of glass for durability.

JWST is designed primarily for near infrared Astronomy but can also see orange and red visible light as well as the mid infrared region depending on as well as the instrument. It can detect objects up to 100 times fainter than Hubble can, and objects much earlier in the history of the universe. JWST can also observe objects in the Solar System at an angle of more than 85° from the sun & having an apparent angular rate of motion less than 0.3arc per sec. This includes mars, Jupiter, Saturn, Uranus, Neptune, Pluto, comets, asteroids and minor planets at or beyond the orbit of Mars.

JWST operates in a halo orbit circling around a point in space known as the Son-Earth L2 Lagrange point approx. 1,500,000 km beyond Earth orbit.

Schrodinger Equation is almost impossible to solve!

- **Manjit Ray, B.Sc 5th sem (Physics Honours)**

Let's have a quick look what the Schrodinger Equation actually say. It governs how a particular system's wave function changes over time. The wave function is quite simply mathematical function that is directly related how likely we are to find an electron in different region of space when we try to measure its position. Specifically if we take the wave function and we square it or rather we takes its square modulus that directly related to the probability of finding the electron. If we take a look in the Schrodinger equation in little bit more details.

$$\hat{H}\,|\psi\rangle = E\,|\psi\rangle$$

We see that in a very simplified way all it all it saying is that the systems kinetic energy and its potential energy added together to give total energy i.e., in this case.

$$\left(-\hbar^2/2m\ \nabla^2 - qe/4\pi\epsilon_o r\right)|\psi\rangle = E\,|\psi\rangle$$

Let we have a single helium atom in empty space in order to keep things simple. It has two proton and two neutrons in the nucleus. Mass of the nucleus is much bigger than the mass of either of electrons surrounding the nucleus. We will treat the nucleus as if stationary basically while electrons are free to move around it because the nucleus is so massive in comparison. The truth is a bit different in reality both the nucleus and electrons move about their common centre of mass. We will treat the nucleus as one object with the charge of two protons and mass of two protons and neutrons. Now the Schrodinger's equation will be.

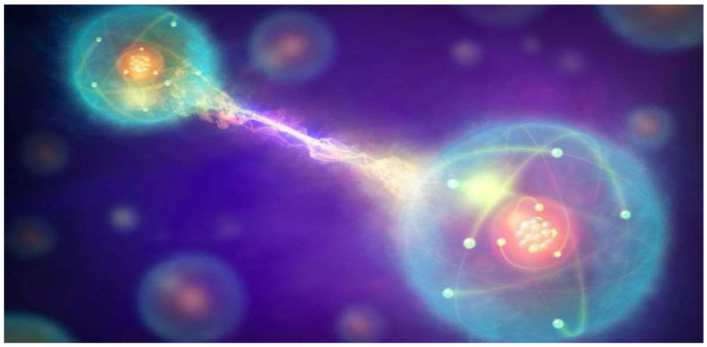
$$\left(-\hbar^2/2m_e\ \nabla^2 i_1 - \hbar^2/2m_e\ \nabla^2 i_2 - 2e^2/4\pi\epsilon_o r_1 - 2e^2/4\pi\epsilon_o r_2 + e^2/4\pi\epsilon_o r_2\right)|\psi\rangle = E\,|\psi\rangle$$

Finding a solution to this meaning finding the wave function that work for the system is actually very difficult. What we got here is differential equation and we don't really have any good mathematical technique to easily find the allowed wave function. We do have technique for solving differential equation but not necessarily ones as complicated as this. The Schrodinger equation that we derived for Helium atom is stupidly hard to solve. We don't really have any analytical technique to find psi. We can use numerical method such as when computer go through lots of possible different versions of PSI based on educated guesses and essentially just tries to see if they fit the equation or if we want to consider this equation in cases where one of the terms is very small compared the others and we can then use perturbation theory. We don't have any technique that easily allows us to solve for PSI. If we account all the situations then the Schrodinger equation we built would be way more challenging to solve. On top of that this is just a Helium atom the second smallest and second simplest kind of atom we found in the universe. We can build the Schrodinger equation quite easily but trying to solve it that is another matter entirely.

Quantum Entanglement

- **Sneha sen, B.Sc 1st Sem (Physics Honours)**

Quantum entanglement is a physical resource like energy, it is possible in between the quantum system. When a pair of electron share or interact spatial proximity, their spin states can get entangled, this is known as quantum entanglement of electrons.



Quantum entanglement was first recognised by Einstein, Podolsky, Rosen and Schrodinger. In 1935 and 1936, Schrodinger published a two part article in the proceedings of the Cambridge Philosophical Society in which he discussed and extended an argument by Einstein, Podolsky, Rosen. The Einstein, Podolsky, Rosen (EPR) argument was, in many ways, the culmination of Einstein's critique of the orthodox Copenhagen interpretation of quantum mechanics and was designed to show that the theory is incomplete. Physicists have observed that quantum entanglement among "billions of billions" of flowing electrons in a quantum critical materials. The study provides us the strongest direct evidence to date of entanglement's role in bringing about quantum criticality.

Quantum entanglement enables particles to affect each other across any distance. The particles remain connected even if they were in the opposite side of the universe. Einstein himself referred it as "Spooky Action at a Distance", though it is known as "Quantum Entanglement. An example of entanglement is a subatomic particles decay into an entangled pairs of other particles. The decay event obey, various conservation law, as a result the measurement outcomes of the other particles. Quantum entanglement has demonstrated experimentally with photons, electrons, neutrinos, as large as Bucky balls, molecules and small diamonds. The measurements of physical properties such as position, spin and polarization performed on an entangled particles can be found to be perfectly collated. Entanglement get broken when the entangled particles decohere through the interaction with environment. The utilization of entanglement in communication, computation and quantum Rader is very active area of research and development.

Quantum Mechanics in Brain

- **Namrata Saikia, B.Sc 1st Sem (Physics Honours)**

Quantum mechanics is a subfield of physics that describes the behaviour of particles — atoms, electrons, photons and almost everything in the molecular and sub molecular realm. it refers to a narrow field of the operation of quantum physics in the nervous system such as the emergence of higher cognitive functions like consciousness, memory, internal experiences, and the processes of choice and decision making.

Specific molecular machines and proteins have been proposed to implement quantum computations. The best known of such proposals is Penrose and Hameroff's hypothesis that the tubulin components of microtubules, filamentous protein polymers that form the cytoskeleton of cells, implement quantum computations.

Two key biophysical operations underlie information processing in the brain: chemical transmission across the synaptic cleft, and the generation of action potentials. These both involve thousands of ions and neurotransmitter molecules, coupled by diffusion or by the membrane potential that extends across tens of micrometres. Both processes will destroy any coherent quantum states. Thus, spiking neurons can only receive and send classical, rather than quantum, information. It follows that a neuron either spikes at a particular point in time or it does not, but is not in a superposition of spike and non-spike states.

The power of quantum mechanics is often invoked for problems that brains solve efficiently. Computational neuroscience is a young field and theories of complex neural systems, with all the variability of living matter, will never reach the precision of physical laws of well-isolated simple systems. It has already been demonstrated, however, that many previously mysterious aspects of perception and action are explainable in terms of conventional neuronal processing.

Say an observer is looking at a super-imposed quantum system, such as Schrödinger's box with the live and dead cat, with one eye while his other eye sees a succession of faces (see figure). Under the appropriate circumstances, the subject is only conscious of the rapidly changing faces, while the cat in the box remains invisible to him. What happens to the cat? The conventional prediction would be that as soon as the photons from this quantum system encounter a classical object, such as the retina of the observer, quantum superposition is lost and the cat is either dead or alive.

This is true no matter whether the observer consciously saw the cat in the box or not. If, however, consciousness is truly necessary to resolve the measurement problem, the animal's fate would remain undecided until that point in time when the cat in the box becomes perceptually dominant to the observer. This seems unlikely but could, at least in principle, be empirically verified.

The empirical demonstration of slowly decoherent and controllable quantum bits in neurons connected by electrical or chemical synapses, or the discovery of an efficient quantum algorithm for computations performed by the brain, would do much to bring these speculations from the ‘far-out’ to the mere ‘very unlikely’. Until such progress has been made, there is little reason to appeal to quantum mechanics to explain higher brain functions, including consciousness.

Unknown inventions of Great Nicola Tesla

- **Partha Sarathi Das, B.Sc 5th Sem (Physics Honours)**

1. Tesla Coil

The Tesla coil is one of Nikola Tesla's most famous inventions. It is essentially a high-frequency air-core transformer. It takes the output from a 120vAC to several kilovolt transformer & driver circuit and steps it up to an extremely high voltage. Voltages can get to be well above 1,000,000 volts and are discharged in the form of electrical arcs. Tesla himself got arcs up to 100,000,000 volts, but I don't think that has been duplicated by anybody else. Tesla coils are unique in the fact that they create extremely powerful electrical fields. Large coils have been known to wirelessly light up florescent lights up to 50 feet away, and because of the fact that it is an electric field that goes directly into the light and doesn't use the electrodes, even burned-out florescent lights will glow.

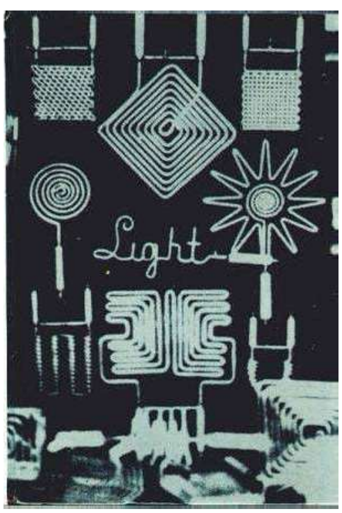
2. The Magnifying Transmitter

Tesla became obsessed with transferring power without wires and thought it was possible to do it at higher altitudes, so after securing funding he set up a lab in Colorado Springs in 1899. There, he built the largest and most powerful Tesla Coil, called the Magnifying Transmitter. The Magnifying Transmitter had three coils and was 52 feet in diameter. It generated millions of volts of electricity and shot lightning bolts that were 130 feet long – the biggest man-made lightning at the time. The problem was that Tesla was a bit too ambitious for the era, and wireless electricity wouldn't be developed until the mid-2010s, and as of 2015, it's still not yet common in households. While this specific project didn't pan out, the vision and scope are still quite impressive. The Magnifying Transmitter was the predecessor to Tesla's Wardenclyffe Tower, which was supposed to provide free electricity and communications to the world. Tesla started working on the project in 1901, but after financial backers pulled out the project fell apart and in 1915 the site went into foreclosure. The project also ruined Tesla, who had to file for bankruptcy and had a nervous break down.

3. Radio

The inventor of radio is a point of contention. In 1895, Tesla was getting ready to transmit a radio signal a distance of 50 miles but before he could do that, his lab burned down, delaying the test. Meanwhile in England, an Italian man named Guglielmo Marconi was working on wireless telegraphy, and was granted a patent in 1896 for his device. His system was much different than the one Tesla built, using only two circuits but unable to transmit over long distances. Tesla's invention would use multiple circuits, which would make it much stronger. Tesla submitted his patent in 1897 in the United States, and it was granted in 1900. When Marconi submitted his radio patent in 1900 to the U.S. Patent Office, it was turned down because it was too similar to Tesla's. Undeterred, Marconi opened his own company that had powerful backers, including Andrew Carnegie and Thomas Edison. In 1901, while using a number of Tesla's patents, including a Tesla oscillator, Marconi was able to transmit a signal across the Atlantic. In 1904, without giving a clear reason, the patent office reversed their decision and said that Marconi's patent was valid, making him the inventor of the radio. Marconi won the Nobel Prize in 1911 and in 1915, Tesla sued Marconi's corporation. Unfortunately at that point in his life, Tesla was too poor to take on a major corporation. The case wasn't settled until a few months after Tesla's death in 1943, when the Supreme Court upheld Tesla's patent.

4. The Neon Lamp



While fluorescent and neon lights weren't discovered by Tesla, he did make many contributions to the advancement of both. What's interesting is that no one working with cathode rays, which are the electrons observed in vacuum tubes like neon lights, really came up with a practical application for the technology. Tesla saw an opportunity and experimented with running electrical particles through gases, developing four different types of lighting. For example, he converted black light into visible light using a phosphorescent substance (which he created), and also found a practical use for such a technology when he created lamps and neon signs. At the World's Columbian Exposition, otherwise known as the 1893 Chicago World's Fair, at his personal exhibit Tesla had neon signs that were unique designs and written words. The idea gained popularity and now neon lights and signs light up major cities around the world.

5. *The Adams Power plant transfer House*

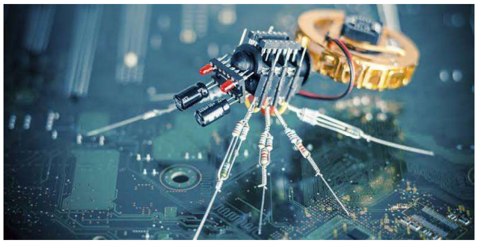
The Niagara Falls Commission was looking for a company to build a hydroelectric plant that would harness the mighty power of the falls for years. At first, they considered Thomas Edison's direct current plant, but after witnessing Tesla's alternating current that was offered by Westinghouse Electric, Westinghouse was offered the contract in 1893. Westinghouse used designs from Tesla but a big hurdle remained on the front of getting and keeping funding for such an ambitious task that a lot of people doubted would work. Yet when the switch was flipped on November 16, 1896, the Adams Power Plant Transformer House worked and started powering the city of Buffalo, New York. Ten more generators were built, and helped power New York City. The plant was considered revolutionary and set the standard for modern hydroelectric power plants.

6. *Tele Automation*

In 1898, at the Electrical Exhibition at Madison Square Garden, Tesla showed off an invention he called "tele automaton", which was a boat controlled by radio waves. He didn't even have a patent because the patent office didn't want to issue one on something that they didn't think was feasible, but he proved them wrong at the exhibition. Tesla controlled the battery operated boat, operating the propeller and lights through the radio waves. This invention was a big first in three different areas. The first was remote controls, influencing the development of objects like television remotes and garage door openers. Secondly, the boat was also one of the earliest robots, as it was a mechanical object that could be controlled without a human physically touching it. Finally, the combination of robotics and radio control technology makes Tesla's boat the great grandfather of drones.

Nanoscience and Nanotechnology

- **Bishal Banset, B.Sc 3rd sem (Physics Honours)**



Nanoscience is the study of phenomena on a nanometre scale. The word Nano is taken from Greek word 'Nanos' meaning 'dwarf' or something very small. The technology that utilized it in practical application such as electronics devices is called nanotechnology. Nanotechnology is about to affect almost every field of human life. this technology will revolutionize world by changing the current using materials in durability and reactivity. This will make things smaller in size, lightened in weight and strong. The nanoworld provides scientists with a rich set of materials useful for probing the fundamental nature of matter. These materials have unique structure and tenable properties. This make them many different real world application. Nanotechnology is currently in very infantile stage. It is basically the creation of useful material devices and system through control of matter at the nanometre length scale. There are mainly two major approaches to get nanomaterials one is Bottom Up and the other is Top Down. Bottom up manufacturing would provide components made of single molecules which are held together by covalent forces. Top down method for manufacturing involves the construction of parts through methods such as cutting, carving and moulding. methods such as cutting, carving and moulding.

Applications of Nanotechnology in different fields :

1) Electronics :- Nanotechnology have already reached the electronics industry with features in microprocessor now less than 100 nm in size

2) Health and medicine :- Nanotechnology ha also it's application in health and medicine called nanomedicine. It includes nanomaterials to nanoelectronics and even further possible application of molecular nanotechnology.

3) Transportation :- The transportation industry will experience many enhancement from nanotechnology. It will allow cars and planes to becomes safer and cheaper. Financially feasible by reducing the weight of heavy structural materials.

4) Space exploration :- Nanotechnology can make the structure of space planes much lighter thus can greatly improve viability.

Extra-terrestrial life

- **Dhiman Sarmah, B.Sc 1st sem (Physics Honours)**

Extra-terrestrial life is the life that may Occur outside Eco Earth and which did not originate on Earth. This is referred as Alien life and the beings that may occur outside earth are referred as Alien. Although we don’t have any clue of their existence but efforts are underway. Such life might go range from simple forms like prokaryotes to intelligent beings, possibly bringing forth civilization that might be far more advanced than humankind. The science of extra-terrestrial life in all its forms is known as astrobiology. Since the mid-20s 20th century, active research had taken place to look for signs of Extra-terrestrial life, encompassing searches for current and historic extra-terrestrial life and Search for extra-terrestrial intelligent life.

Biochemical Basis

The first basic requirement for life is an environment with non-equilibrium thermodynamics, which means that the thermodynamic equilibrium must be broken by a source of energy. Life on earth on requires water in a liquid state as a solvent in which biochemical reaction takes place. It is highly unlikely that an abiogenesis process can start within an Gaseous or Solid medium. Sufficient quantities of carbon and other elements, along with water, might enable the formation of living organism on terrestrial planets with chemical makeup and temperature range similar to that of Earth. Life on earth started with RNA world and later evolved to its current form, where some of the RNA tasks were transferred to the DNA and protein. Extra-terrestrial life may still be stuck on the RNA world or evolve into other configuration.

Planetary habitability in the Solar System

Mars may have niche subsurface environments where microbial life exists. A subsurface marine environment on Jupiter's moon Europa might be the most likely habitat in the solar system, outside Earth for extremophile microorganisms. Liquid water is widely thought to have existed on Mars in the past, and now can occasionally be found as low the volume liquid brines in shallow Martial soil.

Extrasolar Planets

Some astronomers search for extrasolar planets that may be conducive to life. There at least one planet on average per star. About 1 in 5 stars have an Earth sized planet in the habitable zone, with nearest expected to be within 12 lightyears distance from Earth. Assuming 200 billion stars in the milky way, that would be 11 billion potentially habitable Earth sized planets in the milky way. Yet there is not such planets found where life is guaranteed.

Unidentified Flying Objects

Some people believes that some extra-terrestrials are more advance than human and they often visits our planet earth. There are many claims that some people saw flying objects in sky. Some mysterious objects seen in the sky for which it is claimed no orthodox Scientific explanation can be found. They are often supposed to be a vehicle carrying Extra-terrestrials.

Anti Gravity

- **Borad Sengra Daimari, B. Sc 3rd sem (Physics Honours)**

Anti gravity is an idea of creating a place or object that is free from the force of gravity. Gravity is directly proportional to the mass. According to GRECE data, gravitation variation is likely due to the convention occurring in the earth mass (55% - 75%). It does not refer to the lack of weight under gravity experienced in the free fall or orbit, or to balancing the force of gravity with some other force, such as electromagnetism or aerodynamic.

Anti- Gravity device :

Anti gravity devices produced a force when twisted that operates “out of plane and can appear to lift themselves against gravity. A device is invited by Henry Wallace this device is consist of super conducting ceramic ring and solenoid. He claims that by passing current through solenoid results in creating a gravitomagnetic field which shows anti gravity effect.

NASA Anti-gravity machine :

Quantum levitation is another way to succeed in anti-gravity. Quantum Levitation as it is called is a process where scientists use the properties of quantum physics to levitate an object over a magnetic source. The reason this work is called the Meissner Effect and Magnetic flux pinning. The Meissner effects dictates that a superconductor in a magnetic field will always expel the magnetic field inside of it and thus bend the magnetic field around it.

Applications :

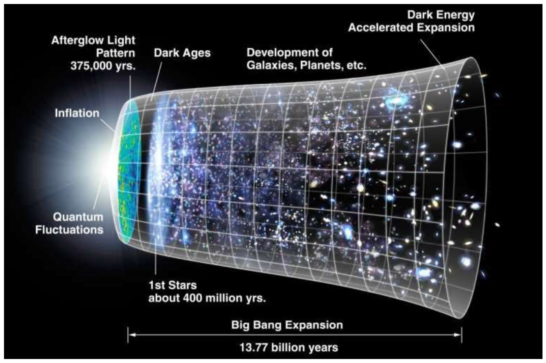
a) Cheap engine can be produced without burning any fossil fuel.
b) Human space travel will be possible at low cost and very high velocity of space ship can be obtained.
c) Antigravity technology would revolutionize space exploration.
d) Bearings can be manufactured with zero friction as there is no contact with the moving parts.
e) Land transport can be improved but for this magnetic tracks are required.

Conclusion :

With the help of anti-gravity we can easily explore the solar energy and outer space.

The Big Bang Theory

- Piyush Biswas, B.Sc 1st sem (Physics Honours)



(THE BIRTH OF THE UNIVERSE) The Big Bang hypothesis states that all of the current and past matter in the Universe came into existence at the same time, roughly 13.7 billion years ago. At this time, all matter was compacted into a very small ball with infinite density and intense heat called a Singularity. Suddenly, the Singularity began expanding, and the universe as we know it began.

Working backwards from the current state of the Universe, scientists have theorized that it must have originated at a single point of infinite density and finite time that began to expand. After the initial expansion, the theory maintains that Universe cooled sufficiently to allow the formation of subatomic particles, and later simple atoms. Giant clouds of these primordial elements later came together to form one mass through gravity to form stars and galaxies.

Planck Epoch (or Planck Era) was the earliest known period of the Universe. At this time, all matter was condensed on a single point of infinite density and extreme heat. During this period, it is believed that the quantum effects of gravity dominated physical interactions and that no other physical forces were of equal strength to gravitation

This Planck period of time extends from point 0 to approximately 10-43 seconds, and is so named because it can only be measured in Planck time. Due to the extreme heat and density of matter, the state of the universe was highly unstable. It thus began to expand and cool, leading to the manifestation of the fundamental forces of physics.

From approximately 10-43 second and 10-36, the universe began to cross transition temperatures. It is here that the fundamental forces that govern the Universe are believed to have began separating from each other. The first step in this was the force of gravitation separating from gauge forces, which account for strong and weak nuclear forces and electromagnetism.

Then, from 10-36 to 10-32 seconds after the Big Bang, the temperature of the universe was low enough (1028 K) that the forces of electromagnetism (strong force) and weak nuclear forces (weak interaction) were able to separate as well, forming two distinct forces.

With the creation of the first fundamental forces of the universe, the Inflation Epoch began, lasting from 10-32 seconds in Planck time to an unknown point. Most cosmological models suggest that the Universe at this point was filled homogeneously with a high-energy density, and that the incredibly high temperatures and pressure gave rise to rapid expansion and cooling.

This began at 10-37 seconds, where the phase transition that caused for the separation of forces also led to a period where the universe grew exponentially. It was also at this point in time that baryogenesis occurred, which refers to a hypothetical event where temperatures were so high that the random motions of particles occurred at relativistic speeds.

As a result of this, particle–antiparticle pairs of all kinds were being continuously created and destroyed in collisions, which is believed to have led to the predominance of matter over antimatter in the present universe. After inflation stopped, the universe consisted of a quark– gluon plasma, as well as all other elementary particles. From this point onward, the Universe began to cool and matter coalesced and formed.

As the universe continued to decrease in density and temperature, the energy of each particle began to decrease and phase transitions continued until the fundamental forces of physics and elementary particles changed into their present form. Since particle energies would have dropped to values that can be obtained by particle physics experiments, this period onward is subject to less speculation.

For example, scientists believe that about 10-11 seconds after the Big Bang, particle energies dropped considerably. At about 10-6 seconds, quarks and gluons combined to form baryons such as protons and neutrons, and a small excess of quarks over antiquarks led to a small excess of baryons over antibaryons.

Since temperatures were not high enough to create new proton-antiproton pairs (or neutron- antineutron pairs), mass annihilation immediately followed, leaving just one in 1010 of the original protons and neutrons and none of their antiparticles. A similar process happened at about 1 second after the Big Bang for electrons and positrons. After these annihilations, the remaining protons, neutrons and electrons were no longer moving relativistically and the energy density of the universe was dominated by photons – and to a lesser extent, neutrinos.

A few minutes into the expansion, the period known as Big Bang nucleosynthesis also began. Thanks to temperatures dropping to 1 billion kelvin and the energy densities dropping to about the equivalent of air, neutrons and protons began to combine to form the universe's first deuterium (a stable isotope of Hydrogen) and helium atoms. However, most of the Universe's protons remained uncombined as hydrogen nuclei.

After about 379,000 years, electrons combined with these nuclei to form atoms (again, mostly hydrogen), while the radiation decoupled from matter and continued to expand through space, largely unimpeded. This radiation is now known to be what constitutes the Cosmic Microwave Background (CMB), which today is the oldest light in the Universe.

As the CMB expanded, it gradually lost density and energy, and is currently estimated to have a temperature of 2.7260 ± 0.0013 K (-270.424 °C/ -454.763 °F) and an energy density of 0.25 eV/cm3 (or 4.005×10-14 J/m3; 400–500 photons/cm3). The CMB can be seen in all directions at a distance of roughly 13.7 billion light years, but estimates of its actual distance place it at about 46 billion light years from the centre of the Universe.

Over the course of the several billion years that followed, the slightly denser regions of the almost uniformly distributed matter of the Universe began to become gravitationally attracted to each other. They therefore grew even denser, forming gas clouds, stars, galaxies, and the other astronomical structures that we regularly observe today.

This is what is known as the Structure Epoch, since it was during this time that the modern Universe began to take shape. This consists of visible matter distributed in structures of various sizes, ranging from stars and planets to galaxies, galaxy clusters, and super clusters – where matter is concentrated – that are separated by enormous gulfs containing few galaxies.

The details of this process depend on the amount and type of matter in the universe, with cold dark matter, warm dark matter, hot dark matter, and baryonic matter being the four suggested types. However, the Lambda-Cold Dark Matter model (Lambda-CDM), in which the dark matter particles moved slowly compared to the speed of light, is the considered to be the standard model of Big Bang cosmology.

In this model, cold dark matter is estimated to make up about 23% of the matter/energy of the universe, while baryonic matter makes up about 4.6%. The Lambda refers to the Cosmological Constant, a theory originally proposed by Albert Einstein that attempted to show that the balance of mass-energy in the universe was static. In this case, it is associated with Dark Energy, which served to accelerate the expansion of the universe and keep its large-scale structure largely uniform.

Super conductivity

- **Puja Boro, B. Sc 3rd Sem (Physics Honours)**

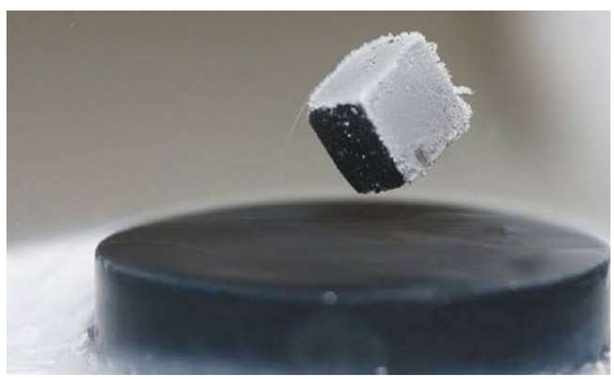
Superconductivity is a phenomenon observed in several metals and ceramic materials. When these materials are cooled to temperatures ranging from near absolute zero (0 degrees Kelvin, -273 degrees Celsius) to liquid nitrogen temperatures (77 K, -196 C), their electrical resistance drops with a jump down to zero.

The phenomenon of superconductivity was first observed by Kamerlingh Onnes in Leiden in 1911. In the superconducting state the dc electrical resistivity is zero.

When the Dutch physicist Heike Kamerlingh Onnes discovered that mercury wire lost all electrical resistance at an extremely frosty 4.2 kelvin, or 4.2 degrees above absolute zero (-273.15°C), the lowest temperature possible. The next year, tin and lead were discovered to become superconductors at 3.8K and 7.2K, respectively, followed by other metals, often as alloys such as niobium-tin.

In 1933, while looking for an explanation for superconductivity, Walter Meissner and Robert Ochsenfeld discovered that superconductors also exhibit a magnetic phenomenon, which is now known as the Meissner effect. The discovery of the Meissner effect was also an experimental observation and lacked a theoretical explanation. In 1957, John Bardeen, Leon Cooper, and John Schrieffer proposed an adequate theoretical explanation for both the electrical and magnetic behaviour of superconductors called the BCS theory. They received the Nobel Prize in Physics in 1972 for this theory.

MEISSNER EFFECT:-When a normal conductor is placed in a magnetic field, it produces current via electromagnetic induction, but a material under the transition from the normal to the superconducting state actively excludes magnetic fields from its interior; this is called the Meissner effect.



There are two types of superconductors :-

1. TYPE 1 SUPERCONDUCTORS :- The superconductors classified into this category are also known as “soft” superconductors. Type-I materials remain in the superconducting state only for relatively weak applied magnetic fields. Above a given threshold, the field abruptly penetrates the material, shattering the superconducting state. There are around 30 elements in the periodic table that fall under the category of Type – 1 superconductors. The common examples of type-I superconductors are pure metals, such as aluminium, lead, mercury, and some covalent aggregates such as heavily doped silicon carbide with boron, SiC:B.
2. TYPE 2 SUPERCONDUCTORS:-This category of superconductors is commonly referred to as “hard” superconductors or “high-temperature superconductors. Along

with certain metal alloys (e.g. niobium-titanium and niobium-tin), niobium, vanadium, and technetium are few examples of type-II superconductors. Type II superconductors exist in a mixed state of normal regions surrounded by areas of superconducting current called the vortex state, which makes them more versatile. Type II can withstand much stronger magnetic fields and still retain its superconductive properties in comparison to Type I.

BCS Theory : Bardeen-Cooper-Schrieffer theory of superconductivity, based on the notion that electrons with opposite momentum and spin are paired as a result of forces arising from lattice vibrations. The theory explains the existence of temperature dependence of the superconducting energy gap, the isotope effect, and many of the electromagnetic properties of superconductors.

Dhubri's teacher featured in Stanford's list of world's top 2% scientists.

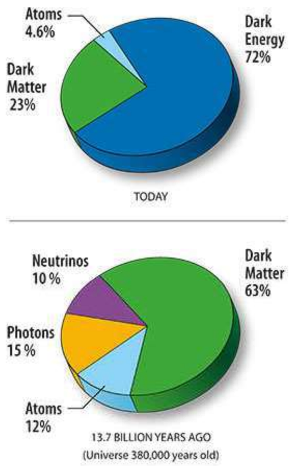
- **Shushanka Das, B.Sc 1st Sem (Physics Honours)**

A PhD-holder teacher in western Assam's Dhubri district, Dr Faizuddin Ahmed, has been featured among the top 200 scientists in the world in a list prepared by United State's Stanford University. . Every year, Stanford University makes a list of 1,000 scientists in each field of science of which, Ahmed, featured among the top 200 — the two percent , with 60 other Indian physicists.

Ahmed completed his graduation with honours in Physics from Bhola Nath College in 2006 and then to Assam capital Guwahati where after postgraduation, he earned his PhD in Theoretical Physics from Gauhati University in 2016.

After his doctorate, financial crisis gripped him and compelled him to return home where he started writing his research papers in Theoretical Physics (General Theory of Relativity and Quantum Mechanics) along with his teaching job simultaneously. His research interests is on Black Holes Physics, Naked Singularity models, Exact Solutions of Field Equations, Closed Causal Curves (Time Machine Models), Naked Singularity, Quantum Mechanics (Relativistic Wave-Equations), Kaluza-Klein Theory etc.

Dark matter and Dark energy



- Raj Mohan Dey, B.Sc 1st sem (Physics Honours)

Our universe is hidden in plain view. We can't see or touch it, although most astronomers say that the majority of cosmos comprises of dark matter and dark energy. The dark matter slows down the expansion of universe but the dark energy speeds it up. Here the dark matter acts like an attractive force or a kind of cosmic cement which holds the universe together. It does not reflect ,absorb or emit light . While dark energy acts like a repulsive force or a kind of anti-gravity which drives the universe ever expanding acceleration.

Dark energy comprises of roughly 68% of universe's total mass and energy .where Dark matter makes up 27% and rest 5% , are all regular matter we see and interact everyday. During the 1930s Fritz Zwicky a Swiss-born astronomer studied the images of approx. 1000 galaxies which make up the Coma Cluster and found something interesting about their behaviour. The galaxies moved so fast that they would fly apart . He guessed that some kind of 'Dark matter' would held them together .A decades later, astronomers Vera Rubin and Kent ford found similar phenomenon while studying the rotation of individual galaxies.

The stars located at the galaxy's outer edge should circle slower than the stars near the centre. Which is the way the planets in our solar system orbit around the sun. But they noticed that stars on a galaxy's outer edge orbit faster as the stars closer in . Further Rubin and Ford found evidence that some invisible form of matter apparently holds the universe together. There should be a lot of mass to make the stars orbit rapidly , but it's not visible . We call it 'the dark matter' . Nowadays astronomers have many evidences which suggest the dark matter is real . It has now become the part of standard model of cosmology , which the scientists use to study the universe birth and evolution . Physicist from all over the world have tried using high tech instruments to detect dark matter . But they've no signs of it .

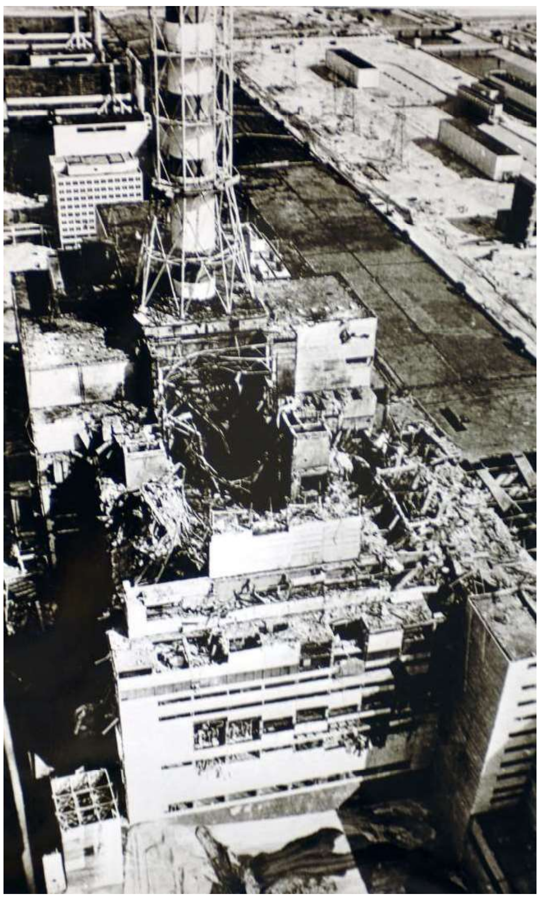
Astronomers know that our universe is expanding for about a century . The observations from telescope shows that most galaxies are moving away from each other , which shows that galaxies were closer to each other in past . Which implies the big bang theory . Though astronomers made an assumption that gravitational pull of the cosmos , stars and galaxies should be slowing the universe expansion. Perhaps it would collapse in itself as big crunch. But that theory was discarded in the late 1990s . While studying supernovas in the most distance galaxies researchers discovered that the distant galaxies were moving away from us faster than the nearby galaxies .

Observations have made the concept of dark energy tough. But researchers can define the role of dark energy in our universe. With use of Einstein's equation a new space came into existence . This idea allowed space itself to have energy. However , dark matter and dark energy seem to have playing a tug of war with the universe.

Chernobyl Nuclear power plant accident

- **Partha Sarathi Das, B. Sc 5th Sem (Physics Honours)**

The accident at the Chernobyl nuclear reactor that occurred on 26 April 1986 was the most serious accident ever to occur in the nuclear power industry. The reactor was destroyed in the accident and considerable amounts of radioactive material were released to the environment. The accident caused the deaths, within a few weeks, of 30 workers and radiation injuries to over a hundred others. In response, the authorities evacuated, in 1986,about 115,000 people from areas surrounding the reactor and subsequently relocated, after 1986, about 220,000 people from Belarus, the Russian Federation and Ukraine. The accident caused serious social and psychological disruption in the lives of those affected and vast economic losses over the entire region. Large areas of the three countries were contaminated with radioactive materials, and radionuclides from the Chernobyl release were measurable in all countries of the northern hemisphere.



Among the residents of Belarus, the Russian Federation and Ukraine, there had been up to the year 2005 more than 6,000 cases of thyroid cancer reported in children and adolescents who were exposed at the time of the accident, and more cases can be expected during the next decades. Notwithstanding the influence of enhanced screening regimes, many of those cancers were most likely caused by radiation exposures shortly after the accident. Apart from this increase, there is no evidence of a major public health impact attributable to radiation exposure two decades after the accident. There is no scientific evidence of increases in overall cancer incidence or mortality rates or in rates of non-malignant disorders that could be related to radiation exposure. The incidence of leukaemia in the general population, one of the main concerns owing to the shorter time expected between exposure and its occurrence compared with solid cancers, does not appear to be elevated. Although those most highly exposed individuals are at an increased risk of radiation-associated effects, the great majority of the population is not likely to experience serious health consequences as a result of radiation from the Chernobyl accident. Many other health problems have been noted in the populations that are not related to radiation exposure.

The Chernobyl accident caused many severe radiation effects almost immediately. Of 600 workers present on the site during the early morning of 26 April 1986, 134 received high doses (0.8-16 Gy) and suffered from radiation sickness. Of these, 28 died in the first three months and another 19 died in 1987-2004 of various causes not necessarily associated with radiation exposure. In addition, according to the UNSCEAR 2008 Report, the majority of the 530,000 registered recovery operation workers received doses of between 0.02 Gy and 0.5 Gy between 1986 and 1990. That cohort is still at potential risk of late consequences such as cancer and other diseases and their health will be followed closely.

The accident at the Chernobyl nuclear power plant in 1986 was a tragic event for its victims, and those most affected suffered major hardship. Some of the people who dealt with the emergency lost their lives. Although those exposed as children and the emergency and recovery workers are at increased risk of radiation-induced effects, the vast majority of the population need not live in fear of serious health consequences due to the radiation from the Chernobyl accident. For the most part, they were exposed to radiation levels comparable to or a few times higher than annual levels of natural background, and future exposures continue to slowly diminish as the radionuclides decay. Lives have been seriously disrupted by the Chernobyl accident, but from the radiological point of view, generally positive prospects for the future health of most individuals should prevail.

Gravitational Lensing from AGEL survey

- **Romanchita Choudhury, B.Sc 1st Sem (Physics Honours)**

Gravitational lenses are astronomical phenomena that occur when a massive celestial body like a Galactic cluster, stars, remnants, brown dwarfs, planets etc creates a gravitational field strong enough to create a distortion in the space time curvature for the path of light to visibly bend like that of in a lens. This effect is known as gravitational lensing. It was identified as a phenomenon by Albert Einstein that light bends around massive objects in space in the same way that light bends when going through a lens. This phenomenon helps in magnifying images of distant galaxies and other celestial bodies that are not generally visible to us solely through present day equipment.

Though this phenomenon is highly useful to observe distant galaxies, finding these cosmic lenses in the universe is like finding a needle in a haystack. However earlier this year 2022, a machine learning algorithm (AL) has identified upto 5000 potential gravitational lens in the universe that can help us understand evolutions of ancient galaxies and dark matter. Astronomer Kim-Vy Tran from ASTRO 3D and UNSW Sydney and colleagues have assessed 77 of these lenses using the Keck Observatory in Hawai'i and very large telescope in Chile and have confirmed that 68 out of the 77 are strong gravitational lenses spanning at vast cosmic distances. This work is part of the ASTRO 3D Galaxy Evolution with Lenses (AGEL) survey. This survey is made to confirm the existence of and find the gravitational lens through 3D mapping. This survey suggests that the success rate of the machine learning algorithm is 88% as of now which is quite reliable for astrophysics. The main goal of AGEL survey for now, is to spectroscopically confirm around 100 strong gravitational lenses that can be observed from both the Northern and Southern hemispheres throughout the year.

Gravitational lenses can provide magnification of distant objects close even to the timeline of the Big Bang. Having many such cosmic lenses at different distances in the cosmic timeline can provide us information of different events happening in different timelines i.e., the evolution and changes over time between the objects of the early universe and the present universe. This cosmic lens also helps the study of the nature of dark matter, a hypothetical invisible matter thought to exist for about 85% of the mass of the universe. By using gravitational lenses, astrophysicist can measure the masses of the dark matter by measuring the bending of the light by the gravitational lense. Apart from these Gravitational lenses being pretty objects, they help us understand the mass distribution in distant galaxies.

This algorithm (AL) was developed by Dr Colin Jacobs at Swinburne. He sifted through tens of millions of galaxy images to prune the sample down to 5,000. The images of those Gravitational Lenses are presently collected by the Hubble Space Telescope. Hence the AEGL survey and the algorithm developed by Dr Colin Jacobs, is an important achievement in the history of astrophysics that can unreveal the nature of Dark matter and the evolution of the early universe i.e., Big Bang.

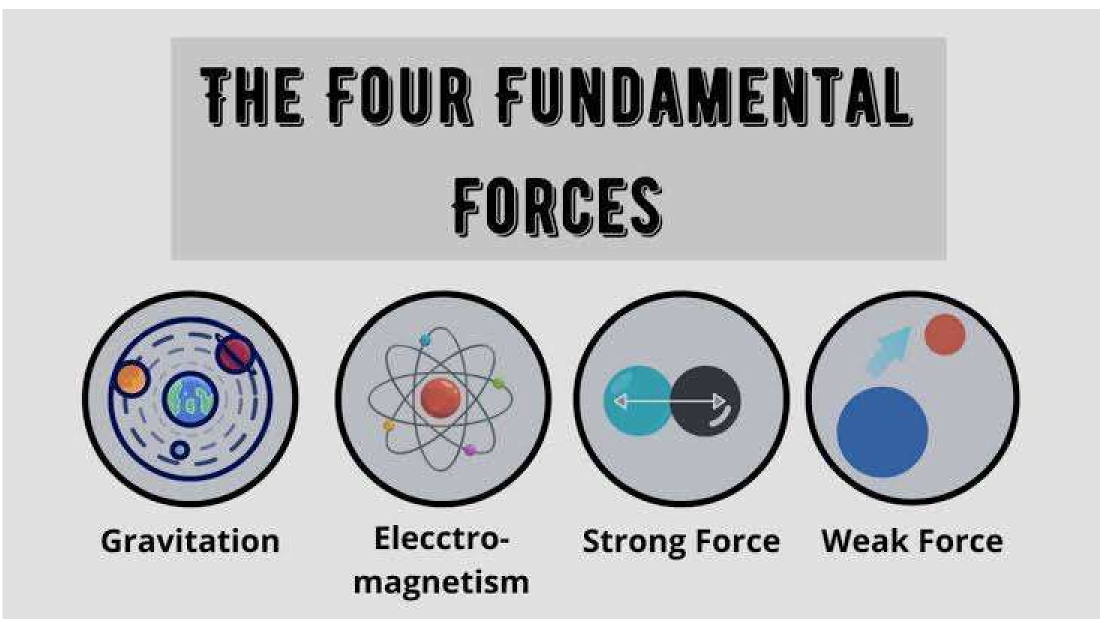
Unification of Four fundamental forces

- **Shiva Prasad Medhi, B.Sc 5th Sem (Physics Honours)**

Over the centuries physicists have tried in a great extent to understand and predict the physical world by connecting phenomena that look very different from each other. One of the successful stories of unification of forces is that of electricity and magnetism and now it is popularly known as electromagnetism. Experiments have shown that electric current could deflect the magnetic compass needle and that moving magnet could produce currents.

Then physicists linked another force, the weak force, with that electromagnetic force, forming a theory of electroweak interactions. Some physicists think the logical next step is merging all four fundamental forces—gravity, electromagnetism, the weak force and the strong force—into a single mathematical framework: a theory of everything.

Those four fundamental forces of nature are radically different in strength and behaviour. And while reality has cooperated with the human habit of finding patterns so far, creating a theory of everything is perhaps the most difficult endeavour in physics. Despite having difficulty in unifying the four fundamental forces there are great rewards such as in the path of unification of four fundamental forces they have discovered may new things.



It's hard to unify all of the forces when we can't even get all of them to work at the same scale. Gravity in particular tends to be a tricky force, and no one has come up with a way of describing the force at the smallest (quantum) level. Physicists such as Albert Einstein thought seriously about whether gravity could be unified with the electromagnetic force. After all, general relativity had shown that electric and magnetic fields produce gravity and that gravity should also make electromagnetic waves, or light. But combining gravity and electromagnetism, a mission called unified field theory, turned out to be far more complicated than making the electromagnetic theory work. This was partly because there was (and is) no good theory of quantum gravity, but also because physicists needed to incorporate the strong and weak forces.

The best-known candidate for a theory of everything is string theory, in which the fundamental objects are not particles but strings that stretch out in one dimension. Strings were proposed in the 1970s to try to explain the strong force. This first string theory proved to be unnecessary, but physicists realized it could be joined to the another theory called Kaluza-Klein theory as a possible explanation of quantum gravity. String theory expresses quantum gravity in two dimensions rather than the four, bypassing all the problems of the quantum field theory approach but introducing other complications, namely an extra six dimensions that must be curled up on a scale too small to detect. Unfortunately, string theory has yet to reproduce the well-tested predictions of the Standard Model.

Another well-known idea is the sci-fi-sounding "loop quantum gravity," in which space-time on the smallest scales is made of tiny loops in a flexible mesh that produces gravity as we know it. The idea that space-time is made up of smaller objects, just as matter is made of particles, is not unique to the theory. There are many others with equally Jabberwockian names: twistors, causal set theory, quantum graphity and so on. Granular space-time might even explain why our universe has four dimensions rather than some other number. Loop quantum gravity's trouble is that it can't replicate gravity at large scales, such as the size of the solar system, as described by general relativity.

None of these theories has yet succeeded in producing a theory of everything, in part because it's so hard to test them.

Revisiting our Department

Inauguration of Spectrum – 15 (2021 -22)

Two Days workshop on Computational Physics (2021-22)

Exhibition (2020 – 21)

Inauguration of Wall Magazine (2021 -22)

Inauguration of Spectrum – 14 (2020 - 21)

Two days workshop on Laboratory Practices (2022 – 23)

Visit to G.U. Observatory (2022 -23)

Freshers cum Farewell (2021 – 22)

Freshers (2022 – 23)

B.Sc 3rd Semester (2023 - 24 Batch)

B.Sc 1st Semester (2024 - 25 Batch)

Faculty Members of Department of Physics

Laboratory Assistants

B.Sc 5th Semester (2022-23 Batch)