fiziks

... The Bhoutik Glimpse of Pragjyotish College

Volume 2 Issue 1 Deccember 2020

Physics pronounced as 'fiziks' comes from the Greek word 'phusika', which means nature or natural things. Human beings from thousands of years or we can say since the beginning, had a strong desire to learn and to explore the world around them, and felt the urge to know how mother nature works. 'Bhoutik' is the Sanskrit word for Physics, means 'the study of matter and its motion with related concepts such as energy and force'.

From the desk of the Editor-

Since its establishment in 1958, the department of Physics has been an integral part of Pragjyotish College. The department has always been working for the all-round development of the students. The department has been organising seminar talks, institutional visits and other activities on a regular basis. This year Covid-19 has hit each and every one of us very hard. Because of this pandemic situation department's activities has been restricted to a certain limit but it couldn't bound the spirits of the free souls of the department. Amidst this pandemic, the professors of the department have given their best to keep the spirit high and uplift the morale of the students through the online classes. In this volume, we have tried to highlight some of the events and activities along with a number of articles from our enthusiast students. This newsletter will surely encourage each and every member of the department and keep the spirit alive.

Lastly, the job of editing and publishing a newsletter is an intricate one and it would've been impossible without the guidance of the advisors. We would also like to acknowledge our Principal Dr. Manoj Kr. Mahanta for his constant support and guidance.

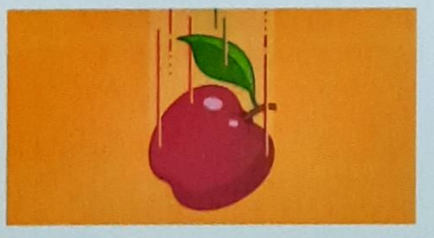
Correspondance
Email at:
physics@pragjyotishcollege.ac.in

IS GRAVITY REAL OR AN ILLUSION

Shahiduz Zaman
1st Semester
Department of Physics

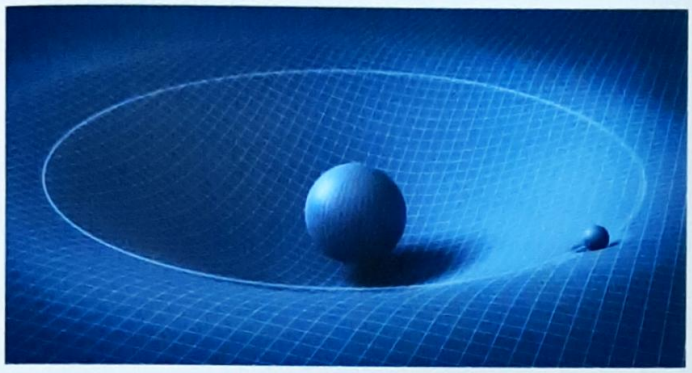
From years, physicists are trying to make a unified theory of everything and one of the greatest obstacles in making such a theory is 'gravity'. For Einstein's 'General Theory of Relativity' gravity is a curvature of space-time while according to 'Quantum Field Theory' and 'Standard Model of particle physics' gravity is exchange of the particle, named "graviton". Different physicist and scientists have their different theories and opinions. No one has been able to make a fully-fledged unified theory of gravity.

It all started from that one apple that fell into the head of Sir Isaac Newton from the top of the tree he was sitting under. From there he started wondering that how and why everything that goes up has to fall back on earth. From there he discovered gravity and made his universal law of gravity that everything in this universe attracts one another by a force called "gravity". This was one of the greatest breakthroughs in the world of physics.



Years later, one man realized that though Newton's mechanics defines planetary motion, the motion of satellites, etc. pretty well but, he had no idea what is it that causes the force of gravity. In simple words, he defined how the motion of planets, moons, etc. using gravity but, he himself didn't know what gravity is. Newton only said gravity is a force but, what is this force, how it is produced he certainly had no idea. This was realized by one of the greatest scientists of the 20th century named "Albert Einstein". This realization of Einstein leads to his theory of "General Relativity" based on gravity.

To understand it, imagine a trampoline whose cloth is made of rubber. Now if you throw a heavy object such as a bowling ball on it, the cloth of the trampoline gets stretched and curves the rubber cloth. Now, if you throw some marbles around it with a certain velocity it will move around it for some time near the bowling ball in a circular motion. This is what gratuity is according to general relativity, the rubber cloth is the fabric of space-time which exists in the 4th dimension. And the bowling ball and marbles could be considered as stellar objects such as the sun, stars, planets etc. Mass warps or bends the fabric of space-time which makes things fall on each other so it is not some kind of force rather than it depends on the curvature of space-time.



$$R_{\mu\nu} - \frac{1}{2} R\, g_{\mu\nu} + \Lambda\, g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Einstein's Equation of General Relativity

This was another breakthrough that changed people's perception towards gravity. But, even this theory breaks down at the edge of the black hole whose curvature is shown as infinity by its equation which is not a valid result according to physicists. Then physicists started looking for alternative theories which could define gravity at both larger and smaller scales, as General Relativity couldn't define gravity at smaller scales. From there rise of Advanced Quantum Field Theories (AQ FT) and Grand Unified Theory (GUT) started to begin defying gravity.
So, according to 'Standard Model of Particle Physics' there exist only two types of subatomic particles: Fermions, one's that gives mass to other particles such as protons, neutrons etc. (particularly matter) and the second type is Bosons, these force carriers are responsible for electromagnetic (carried by photons), weak and strong nuclear force (carried by W+ and Z bosons). Similarly, physicists predicted a particle(boson) for gravity also, named "graviton" for carrying gravitational force. This particle is still undiscovered.

This idea of particle physics contradicts the idea of General Relativity which says gravity is a curvature of space-time. Both theories work well in their own domain but contradict each other.

Scientists are trying to combine these two theories and to make a unified theory of gravity. This results in several theories and one of the famous theories which is known as the Theory of Everything is called "String Theory".

It says that every fundamental particle is made out of indivisible strings that vibrate in different frequencies producing different elementary particles. It also explains why gravity is weaker at the quantum level. But, it's major drawback is that it doesn't have any kind of experimental proof, till date it is only a hypothesis.

But, the question still remained unanswered, what is gravity? A force, curvature or just an illusion. Or the idea of the existence of gravity is just our imagination and in reality, there exists something else that binds things together in this universe and we are just getting misled by the term gravity. The more we try to find out answers the less we get to know about it.

We cannot solve problems with the same thinking we used to create them. – Albert Einstein

A SKY FULL OF STARS!

Nilotpal Saikia
1st Semester
Department of Physics

Hey!

Have you ever looked up in the sky when the sky is full of stars? What do you feel? Do you feel very tiny in comparison to this humongous universe? Do you wonder about the various possible things we might explore out there?

Every time I look up to the stars I wonder how huge this whole universe is and how much time it would take for us to travel all of it!!!!!!

It's crazy right! It's literally "beyond our imagination".

I wonder what if we can create the technology to travel those extremely huge distances. What if we could disprove relativity and travel faster than light! Or what if we could create a wormhole and travel to any part of the universe we want. Wouldn't you like to go on a vacation to the Andromeda Galaxy!

Now let me bring you back to reality.

What do you see around yourself? How many people you see are excited to build a future like that? How many people are really crazy to change the future, to find something new, to create the impossible?

We are a type of generation that believes development will occur automatically. But earlier things were different. During the cold war era space exploration and other innovations were at boom.

Saturn V – the rocket of the Apollo mission.

Many rich people in America funded the Apollo mission to the moon. Because so much emotion was attached to that mission. Ironically that was humanity's first and the only flight to our nearest celestial body, our own moon.

What is the reason!?

People during 50's and 60's were not like us. They knew in order to develop as a civilization we need a mindset for innovation. They knew we need to build; we need to create things.

But the people born in that era saw their entire childhood and teenage years that development is taking place every day without their efforts. When these teenagers finally became adults they had that same mindset.

People became indefinitely optimistic towards their future. They thought things would get better automatically without their efforts. And since then we are having this mindset. You have the choice to make a shift of your mindset. To believe that the future will be better only if we take action to make it better.

Peter Thiel

Peter Thiel, the co-founder of PayPal, wrote in his book "Zero to One " that there are 3 types of secrets in the world around us - Easy, Difficult and Impossible.

Our generation feels like there are not much new things to discover, because most of the easy secrets are already found out by our ancestors.

Now we are left with the impossible and the difficult ones. Some things like proving string theory, travelling faster than light are impossible at this stage.

But there are a lot of different secrets to discover, lots of different things to create that are difficult but not impossible. We don't put any effort in finding out those secrets.

People in the 50's and 60's believed that we'll go on trips to the moon, we'll have flying cars, teleportation and lots of crazy stuff. But the only things that are advanced are computers and the internet. And everybody is completely happy and satisfied with it!

You need to remind yourself that there's a lot, in the world, to do than just becoming a doctor, lawyer or a banker. There's a lot more to create than just creating apps like Tik-Tok. There's a real world outside the internet and real problems to solve.

We need more people like Elon Musk.

Elon Musk

Elon musk worked hard and started a private space organization named SpaceX. He's also the founder of the electric car company, Tesla.

We need real Tony Starks to advance as a civilization. We want flying cars in everyone's garage. We want Jetpacks that everyone can afford. We want technological companies crazy enough to build an amazing future.

I want you to look up at the stars tonight and see for yourself how much we still can do!

The future is ours if we have optimism and the desire to create something new, something extraordinary!

Dream big and Innovate!

BLACK HOLES - A MYSTERY

Papery Pawl
3rd Semester
Department of Physics

According to the theory of relativity a black region in the space from which nothing can be escaped including light. Black hole like a black body is a region of space-time from which nothing can escape, even light. Black holes are just like a dungeon or dark cell in a prison. There are a lot of black holes in the universe. Black holes are of three types: stellar black holes, supermassive black holes and intermediate black holes.

It is impossible to see a black hole directly because no light can escape from them; and as they are black. When a large star has burnt all its fuel it explodes into supernova. A supernova occurs in our galaxy once every 300 years, and in neighbouring galaxies over 500 neutron stars have identified. Therefore, it is an evident that there also should be some black holes.

Black holes have three layers – the outer and inner event horizon and the singularity. Once a particle crosses the event horizon, it cannot leave. Gravity is constant across the event horizon. The inner region of a black hole, where the mass of a black hole is concentrated is known as singularity.

Black holes are filling of wonder and mystery. It remains terrific fodder for science fiction books and movies. Scientists are still working to understand the equations by which black holes function.

I can calculate the motion of heavenly bodies but not the madness of people.
– Sir Isaac Newton

Civilization

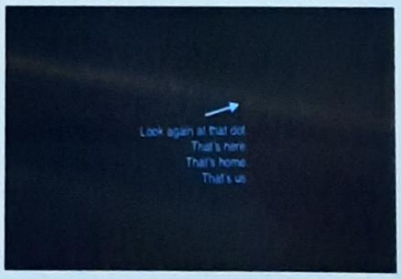
Tonmoy Deka
5th Semester
Department of Physics

Modern humans evolved only about 200,000 years ago. Civilization as we know it is only about 6000 years old and industrialization started only in the 1800s. So, we are a species which is at its initial stage compared to the other species that lived on this blue planet. So if we don't put an end to our civilization with our own hands then we still have a chance to become a great civilization and one day we may become a galactic one. And if referring to the 'Kardashev scale', then the humans have not even reached a TYPE-1 civilization. The Kardashev scales can be stated as follows-----

- A type-1 civilization or the planetary civilization can use and store all of the energy available on its planet. If humans increase their energy consumption at an average rate of 3 percent each year, then we may attain a type-1 status in 100-200 years (currently we are at 0.73 on the scale).
- A type-2 civilization also called a stellar civilization can use and control energy at the scale of its planetary system.
- A type-3 civilization also called a galactic civilization can control energy at the scale of its entire host galaxy. And this type of civilization is very hard and rare to attain.

The following are the quotes of visionary astronomer Carl Sagan----

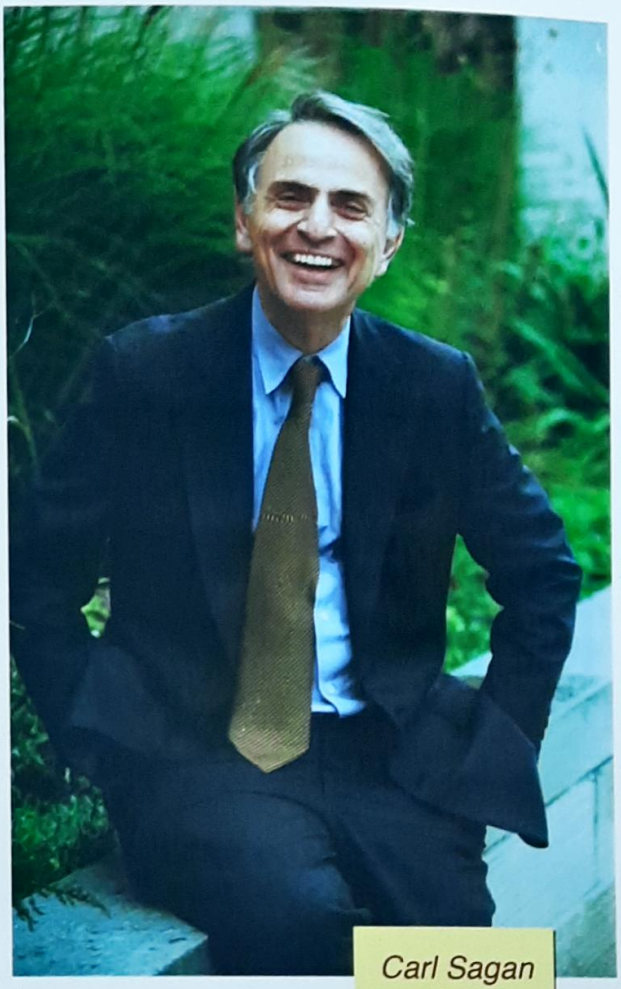
- Somewhere something incredible is waiting to be known.
- Science is not only compatible with spirituality; it is a profound source of spirituality.
- Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child ,inventor and explorer, every teacher of morals, every corrupt politician, every superstar, every supreme leader, every saint and sinner in the history of our species, lived there-on a mote of dust suspended in a sunbeam.



The first quote signifies the driving force; this is the thought that makes a simple person to a great researcher or an explorer of this universe.

The second quote can be interpreted differently for different persons. For me, spirituality, is not about following any religion or god, it's about respecting earth and accepting as nature really is, and not winding up with human made rituals and superstitions.

And the third quote was quoted, when Voyager-1, on February 14,1990, took a photograph of earth from 6 billion kilometres. This quote actually defines our civilization as a whole. All the love, sorrow, happiness, violence and rivers of blood flowed on this tiny pale blue dot, suspended in the vast cosmos. People praying one god or the other, claiming one religion to be greater than the other, to forgive them, to make them wealthier and to make them happy. These are nothing more than just illusions of life. After all, we must question the things around us, we must accept them on adequate evidence, we must question of our beliefs and find the answers step by step.



Carl Sagan

Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less. – Marie Curie

Fate of humanity

Ganesh Rai
1st Semester
Department of Physics

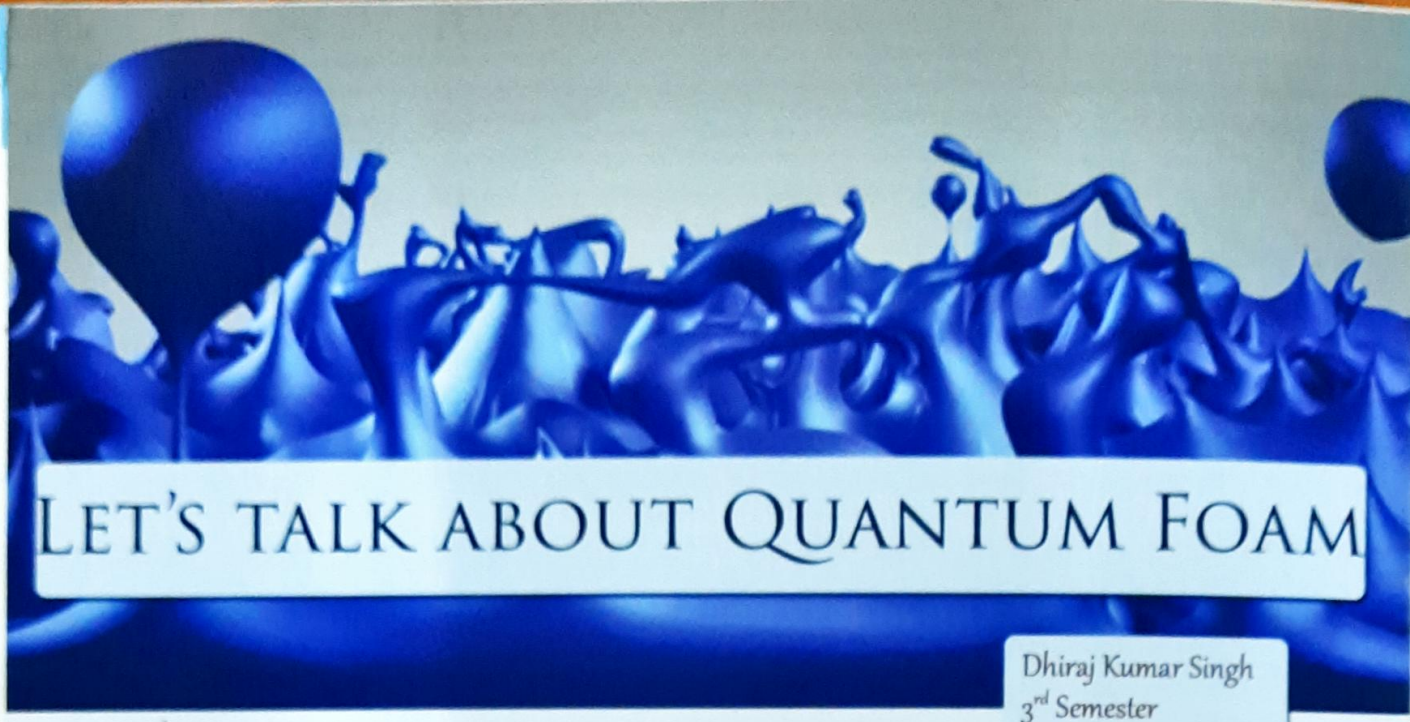
Who are WE? We were known to be a species of explorers since the very beginning of our time or a remnant of stars and massive explosions in the galaxies. Our primitive ancestors laid the foundation to the path of our civilization and some of our great minds in history on their journey for the quest on how the physical world function.

From the Newtonian era to a world of quantum mechanics, prejudice overhauled humanity. Starting of an epoch of atomic physics with the discovery of radioactivity by Henri Becquerel to the development of first nuclear weapons by the Manhattan Project team led by ***Robert Oppenheimer*** in 1945 to the bombing of first nuclear bombs on Hiroshima and Nagasaki (JAPAN) by the USA which claimed more than 3,50,000 lives eventually brought an end to World War-II, due to which more than 70 Million lives were gone. And finally ended the reign of egoistic *Adolf Hitler.*

It demonstrated for the first time how devastating a nuclear fission could be! The fate of humanity is to make progress in the scientific field and Revolutionizing the world. However, it shouldn't be distorted for personal gain by putting innocent lives into stake. We belong to the same descendant and our primitive ancestors had struggled to survive in the early

world until some great thinkers paved the way to modern civilization and modernized humanity in the context of scientific revolution without compromising.

Some of our great minds in the history of science have always seen the world from a different perspective and provided us with assets that have made our world what it is today. But, nowadays, the conditions aren't the same. We have turned against one another in terms of race, colour, religion, etc. And if it goes this way, humanity will cease to exist. Remember, we're just a stardust and we still have a lot to unravel about the mystery of the ***cosmos..... rather than quarreling among ourselves***



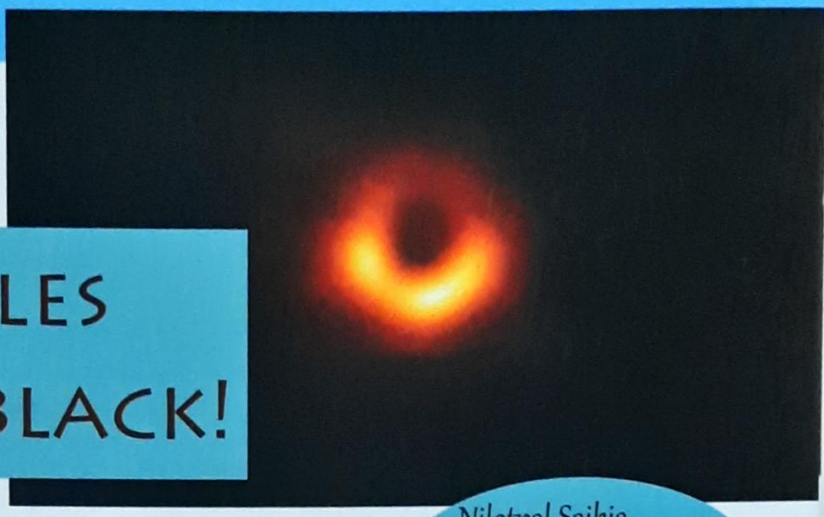
Let's talk about Quantum Foam

Dhiraj Kumar Singh
3rd Semester
Department of Physics

Generally, we all think that empty space as empty. But in Quantum level, empty space is not truly empty.

We see vacuum as complete absence of something because there is no energy or matter that we can measure. But Physicist believe that beyond this measure, there exists a Quantum vacuum. In this Quantum vacuum, virtual particles are probably formed, exists on very (very very) tiny borrowed energy from quantum, and pop away again, and that is something which called Quantum foam.

So, the seemingly empty space isn't empty and is formed from small virtual particles that live for infinitely small time and pop again into nowhere. And since, these particles define their existence in empty space. So, we consider them as empty space.



BLACK HOLES AIN'T THAT BLACK!

Nilotpal Saikia
1st Semester
Department of Physics

What would happen if a star runs out of its fuel and it shrinks into its own gravitation ?

What would happen if the earth becomes about 18 millimetres with the same mass ?

The answer to the above questions is the same . It is a Black Hole !

What is a black hole?

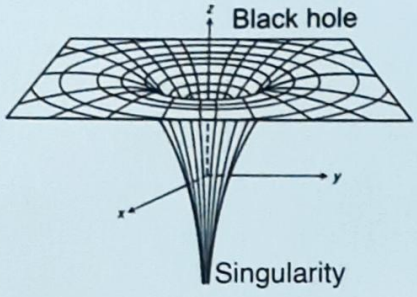
A black hole is an object in outer space which is very attractive.

Black holes attract everything in the universe. If something falls into the black hole it cannot escape . Not even light ! Although light is the fastest object in the universe!

Creation of black holes

Black holes are created when massive stars run out of fuel and they crush into their own mass , their own gravitational pull .

As from the theory of general relativity we know that empty space is like a fabric, called the space-time fabric. Mass bends the space-time fabric.



Since the dying star crushes in itself , its density (mass per unit volume) increases. Which means a large mass is concentrated at a very small volume.

This bends the space-time fabric to a huge extent . Hence a black hole is created with a strong gravitational pull . Damn ! It's really attractive !

Event horizon

The boundary of a black hole is called the event horizon . It is the outer surface of the black hole. In simpler words, it is the extent to which a black hole can attract a body .

If you cross the event horizon , you fall into the center of the black hole.

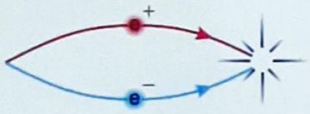
Temperature

A black hole has temperature. Anything having temperature radiates energy. When an iron is heated it becomes red hot and it radiates energy in the form of heat and light .

So black holes also have radiation. This radiation is called Hawking's radiation. We will talk about that later !

Empty space

Virtual Particles



--Uncertainty principle (in energy & time) allows production of matter-antimatter particle pairs

--But particles must annihilate in an undetectably short period of time.

The empty space in our universe is not that empty actually !

There are pairs of virtual particles that are continuously forming. They are annihilating each other as energy cannot be formed from nothing.

When this phenomenon occurs at the event horizon , one of the virtual particles falls back into the black hole . The other particle goes into outer space and becomes a real particle.

So what effect would the falling particle have on the black hole ?

Let's find out!

Hawking's radiation

Stephen with his wife

The particle that falls back into the black hole would have some negative energy (pure mathematics don't worry). Due to this negative energy our attractive guy would lose his mass !

The black hole would lose its mass in the form of radiation. This phenomenon is the famous Hawking's radiation!

Stephen Hawking discovered this in 1974.

So if the black hole doesn't eat anything , doesn't engulf planets it will eventually die .

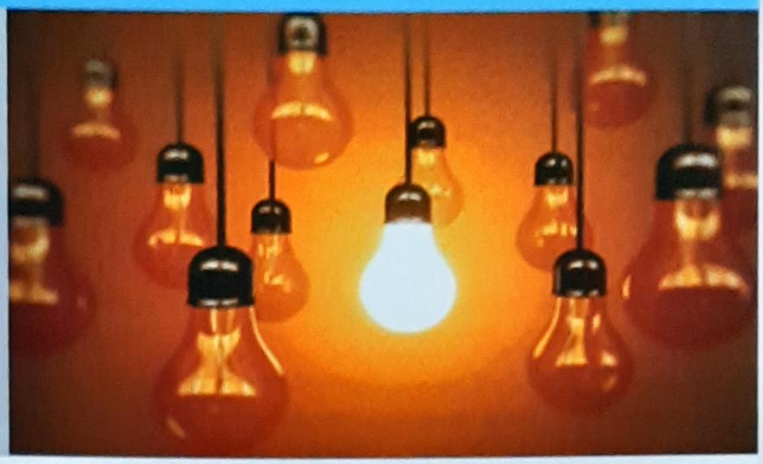
So one day all the black holes in the universe will die ! As no planets , particles or stars would be left to be eaten !

This is the theory of Hawking's Radiation.

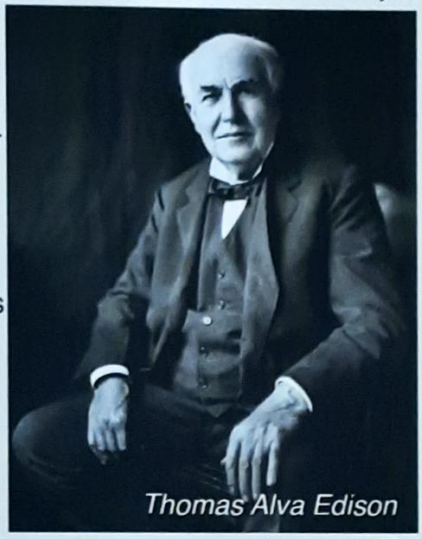
Since they radiate energy they aren't that black !

INVENTION OF THE BULB

Mainumoni Choudhury
1st Semester
Department of Physics



The electric light, one of the everyday conveniences that most affects our lives, was not "invented" in the traditional sense in 1879 by Thomas Alva Edison, although he could be said to have created the first commercially practical incandescent light. He was neither the first nor the only person trying to invent an incandescent light bulb. In fact, some historians claim there were over 20 inventors of incandescent lamps prior to Edison's version. However, Edison is often credited with the invention because his version was able to outstrip the earlier versions because of a combination of three factors: an effective incandescent material, a higher vacuum than others were able to achieve and a high resistance that made power distribution from a centralized source economically viable.



Thomas Alva Edison

Thomas Edison was born in Ohio, America, as a child he had hearing problems from the illness scarlet fever. His mother was a teacher, so he did not go to school but was taught at home. He got his first job by accident. He saved a 3 year- old boy from being hit by a train and the boy's father was so grateful that he gave Thomas a job as a telegraph operator. At the age of 19 Thomas got a new job. He wanted to work at night so that he could carry on with his experiments.

On January 27, 1880, Thomas Alva Edison was granted a patent for the electric light bulb, and for the first time in human history, man could conquer the night with the flip of a switch. Although over a hundred years has passed since that day, modern incandescent light bulbs are very similar to Edison's groundbreaking model. The same basic formula applies to both; Isolate a filament from oxygen and pass electric current through it to produce light.

The invention of the incandescent light bulb is a huge turning point in our life and industries. The light bulb changed uncountable things. Entertainment, mining, manufacturing, street lamp, lighting, industries, war etc. The greatest lighting sources by far is the light bulb.

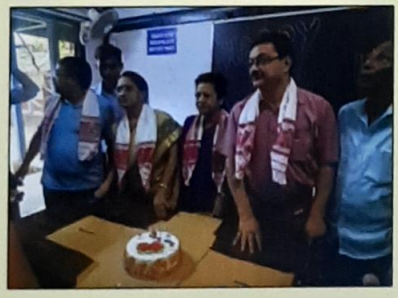
DEPARTMENTAL ACTIVITIES

Seminar Talk(Sept, 2019)

Resource person : Professor Sourabh Basu, IIT Guwahati

On 14th September the Department of Physics invited Professor Saurabh Basu, IIT Ghy to give a talk on the topic "How to crack JAM (Physics/Chemistry)" and motivate the students. It was an inspiring talk for the JAM aspirants.

Teachers' Day celebration (5th Sept, 2019)



On 5th September 2019 students of the Department of Physics celebrated Teachers' day.

The celebration started with lighting a lamp to pay tribute to Dr. Sarvepalli Radhakrishnan. This was followed by the felicitation ceremony; students of the department felicitated the teachers by a Phoolam Gamocha as a gesture of love and gratitude. As a part of the celebration, the students also had a cake which was cut by the Head of the Department Mr. Saumar Rajkhowa. Later on the teachers inspired the students by their motivational talk and sharing their experiences. This was a morale boosting experience for the students.

Teaching should be such that what is offered is perceived as a valuable gift and not as a hard duty.

- Albert Einstein

Vishwakarma Puja, 2019

On 17th September 2019, Department of Physics organised Vishwakarma puja in the departmental premises. Everyone attended the puja in their traditional attires and seeked the blessings from the Lord Vishwakarma.

Organising the Vishwakarma puja gives an excellent opportunity to the students to learn how to organise an event, raise funds and most importantly how to work as a team.

Inauguration of the annual Wall Magazine "SPECTRUM"

The annual issue of the Wall Magazine, SPECTRUM was also inaugurated by the Principal, Dr. Manoj Kr. Mahanta on 17th of September 2019 in presence of the entire department.

Seminar talk(Nov, 2019)

Resource person: Dr. Kishore Baruah

On 30th November 2019, Department of Physics, Pragjyotish College invited Dr. Kishore Baruah to give a talk on "Concept of Time" & "How to observe the Sky" to the students

Sapling plantation(Oct, 2019)

On 5th October 2019 Department of Physics organised a sapling plantation programme in front of the new departmental building. Along with the academics a student should learn the Ecological and Environmental values, this has been always one of the prime objective of the department.

Science is not only a disciple of reason but also one of romance and passion.
– Stephen Hawking

Prize distribution ceremony (Jan, 2020)

Prize distribution ceremony for the winners of an H.S level exam organised by the Department of Physics in collaboration with the Assam Physical Society was held on 22nd January of 2020.

Celebration of National Science Day (Feb, 2020)

National Science Day was celebrated in the department on 28th of February 2020 in the RUSA auditorium. A science quiz also organised by the department to celebrate the special day. Quiz enthusiasts from various departments took part in the competition.

National Graduate Physics Exam

National Graduate Physics Exam organised by IAPT- RC 17 was held in the department on 20th January 2020. Students from various colleges of Assam appeared in the examination.

Retirement of Dr. Mrinalini Das Chutia

Dr. Mrinalini Das Chutia, Former Head of the department retired on 31st August, 2019. She served in the Department since 1991. She was an integral part of our Physics Department. A very sincere and efficient teacher, she mesmerized students with her novel ways of instruction. She contributed a lot to the overall development of the Department, be it academic or any other matter. For students, she was like a mother. She always extended her help and support in career related and other matters. We are thankful to her& wish her a happy & healthy life...

Parents-Teachers Meet

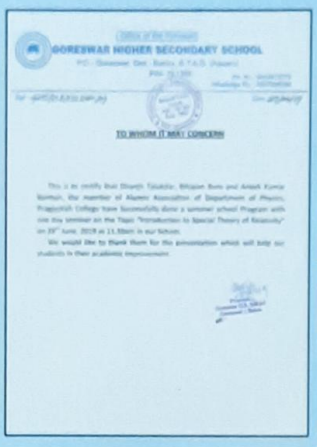
On 29th February 2020 annual parents-teacher meet was held in the presence of the faculties of the Department.

Farewell 2019

Bidding adieu is the hardest part for a student after a journey of three consecutive years in the department. But students' life is all about making progress and achieving more. On 15th June 2019 the Department of Physics held the farewell ceremony for the batch of 2016-2019. The teachers of the Department congratulated the students on completing the graduation and showered them with blessings for their future endeavours.

Activities of the Alumni Association of Department of Physics

On 29th June, 2019 three members of the Alumni Association of the department Dhanjit Talukdar, Bitopan Boro and Aneek Kr. Barman successfully did a summer school program with one-day seminar on the topic "Introduction to Special Theory of Relativity" at Goreshwar Higher Secondary School, Goreshwar, Baksa. Physics is an important element in the education of future chemists, engineers and computer scientists, as well as practitioners of the physical and other biochemical sciences and the Alumni Association of our department strongly believes that if we can inspire and motivate the students at their root level they can grow into a strong tree in near future.



GORESHWAR HIGHER SECONDARY SCHOOL

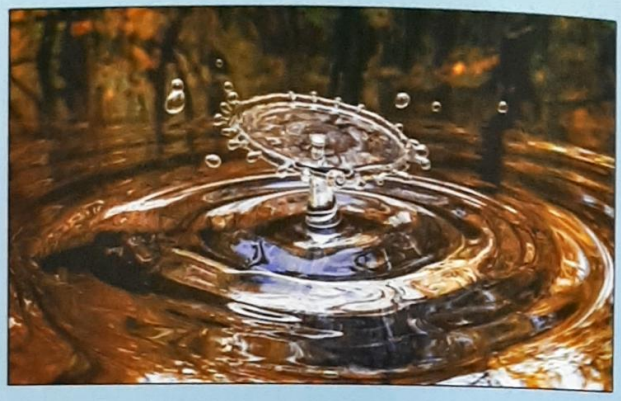
TO WHOM IT MAY CONCERN

If your hate could be turned into electricity, it would light up the whole world.
- Nikola Tesla

The important thing is to never stop questioning [or learning]. – Albert Einstein

WHAT'S NEW

1) Using x-ray lasers, researchers at Stockholm University have been able to follow the transformation between two distinct different liquid states of water, both being made of H2O molecules. At around -63 Centigrade the two liquids exist at different pressure regimes with a density difference of 20%. By rapidly varying the pressure before the sample could freeze, it was possible to observe one liquid changing into the other in real time. Their findings are published in the journal Science.



2) Light travels at a speed of about 300,000,000 meters per second as light particles, photons, or equivalently as electromagnetic field waves. Experiments led by Hrvoje Petek, an R.K. Mellon professor in the Department of Physics and Astronomy examined ideas surrounding the origins of light, taking snapshots of light, stopping light and using it to change properties of matter.

Petek worked with students and collaborators Prof. Chen-Bin (Robin) Huang of the National Tsing Hua University in Taiwan, and Atsushi Kubo of the Tsukuba University of Japan on the experiments. Their findings were reported in the paper, "Plasmonic topological quasiparticle on the nanometre and femtosecond scales," which was published in the December 24, 2020, issue of Nature magazine.

3) Astronomers studying a distant galaxy cluster discovered the biggest explosion in history, at least since the Big Bang that got the universe started. This recent bang was so big that astronomers were initially sceptical that it was possible. The explosion occurred in the Ophiuchus galaxy cluster, about 390 million light-years from Earth.

The greatest enemy of knowledge is not ignorance; it is the illusion of knowledge.
–Stephen Hawking

WHAT'S NEW

4) An international team from Germany, Sweden, Russia and the USA, led by scientists from European XFEL, has published the results of an experiment that could provide a blueprint for the analysis of transitions states in atoms and molecules. This would open up new opportunities to gain insights into important processes such as photocatalysis, elementary steps in photosynthesis, and radiation damage.

It was the very first user experiment carried out at European XFEL's Small Quantum System (SQS) instrument. The scientists used high-resolution electron spectroscopy to capture a snapshot of the short-lived transient state produced when X-rays punch a hole in the very core of the atomic electron cloud. The results of the study, which was carried out on neon atoms, are the starting point for the analysis of transient states and have been published in Physical Review X.

5) A new study identified 37 recently active volcanic structures on Venus, providing some of the best evidence yet that Venus is still a geologically active planet.Evidence of a warm interior and geologic activity dots the surface of the planet in the form of ring-like structures known as coronae, which form when plumes of hot material deep inside the planet rise through the mantle layer and crust.This is similar to the way mantle plumes formed the volcanic Hawaiian Islands.

There are those who reason well, but they are greatly outnumbered by those who reason badly. –Galileo Galilei

Our virtues and our failures are inseparable, like force and matter. When they separate, man is no more. – Nikola Tesla

6) A new study out of the Belgrade Astronomical Observatory in Serbia charts the paths of cosmic "superhighways" that could accelerate the movement of objects through space, providing an opportunity for human space exploration to reach science fiction distances.These "superhighways" — also called "celestial autobahns" or "celestial highways" — are formed as a result of different planets' gravitational forces, mainly that of Jupiter, the largest, densest planet and therefore the one with the most gravitational force. Jupiter's force creates space manifolds, within which a series of long arches or pathways make up a network of superhighways — some of which stretch all the way to Neptune. These superhighways use Jupiter's gravitational force to speed up space objects travelling inside.

This year Royal Swedish Academy of Sciences decided to award one half of the 2020 Nobel Prize in physics to Roger Penrose and the other half jointly to Reinhard Genzel and Andrea Ghez for furthering the understanding of black holes, the most "enigmatic" objects in the universe.