AUGUST 2020, ISSUE 1

THE NEUTRINO BREW

OFFICIAL NEWSLETTER OF THE NEUTRINO CLUB

INTRODUCTION

Dear Reader,

Physics is a fascinating amalgamation of diverse and exciting theories, shrouded by complex equations that cause the general viewer to shy away from this wondrous subject. Through this magazine, we not only want to rekindle the student's interest in physics outside of textbooks but also provide them with articles that entertain and impart knowledge. From the hidden simplicity of black holes to the twisted tales of time, we hope this magazine will be intriguing and exciting for all ages.

This year, Club Neutrino will be led forward by Kartikeya Tomar (Club President), Shantanu Misra (Vice President), along with a team of members ranging from grades nine to twelve. The teachers in charge of the club are Ms Shampa Biswas and Ms Ripple Mehta, Vrinda ma'am and Nidhi ma'am, without whose support and interest none of our work would have been possible.

We hope that you enjoy this issue of the magazine and want to extend heartfelt gratitude towards each and every one of our readers.

Yours Sincerely
Arya Abhisri
(Editor in Chief)

Club Neutrino

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LETTER FROM THE PRESIDENT

Dear Reader,

We hope that you are keeping safe!

It brings every one of us at Club Neutrino immense joy in launching the very first edition of the Neutrino Brew, a platform for one to express their thoughts and debate on the various aspect of sciences, physics in particular. The Neutrino Brew is a continuation of the Neutrino Journal series, launched back in 2018. It presents a brief yet diverse view of the amazing world of Physics, taking you through a breathtaking journey through the various domains. As we sail through the Neutron star to the neutrino particles, our motto is to present a holistic view of the subject and encourage young innovators to discover and discuss beyond what is mentioned in their school textbooks. This journal is our humble effort to bring you a piece of this vast field of knowledge, in the hope that it will awaken in you a desire to be drawn further into the subject.

It has been almost a decade long journey since the recognition of Club Neutrino as a formal institution harbouring young scientists and celebrating the spirit of Physics. Since then, we have travelled a memorable journey achieving new heights and learning together. The activities undertaken by the club include the club days, Cosmic 350 or the general brainstorming sessions have been great memories for the club members. Of late, the club started hosting annual trips to The National Physics Laboratory, New Delhi. It gives me immense pleasure to serve as the President of the Club for this academic session, 2020-2021.

In the wake of the Covid-19 pandemic, all of the institutions are adopting online applications to conduct various activities. Club Neutrino is also looking forward to seeking such methods to ensure that we can provide you with an amazing year filled with new surprises. However, none of them would be worthy without active participation from your side.

Hence, we look forward to innovations in these unprecedented times. Hope to see you soon after we have successfully dealt with the pandemic!

Until then, keep exploring.

Yours sincerely
Kartikeya Tomar
(President)

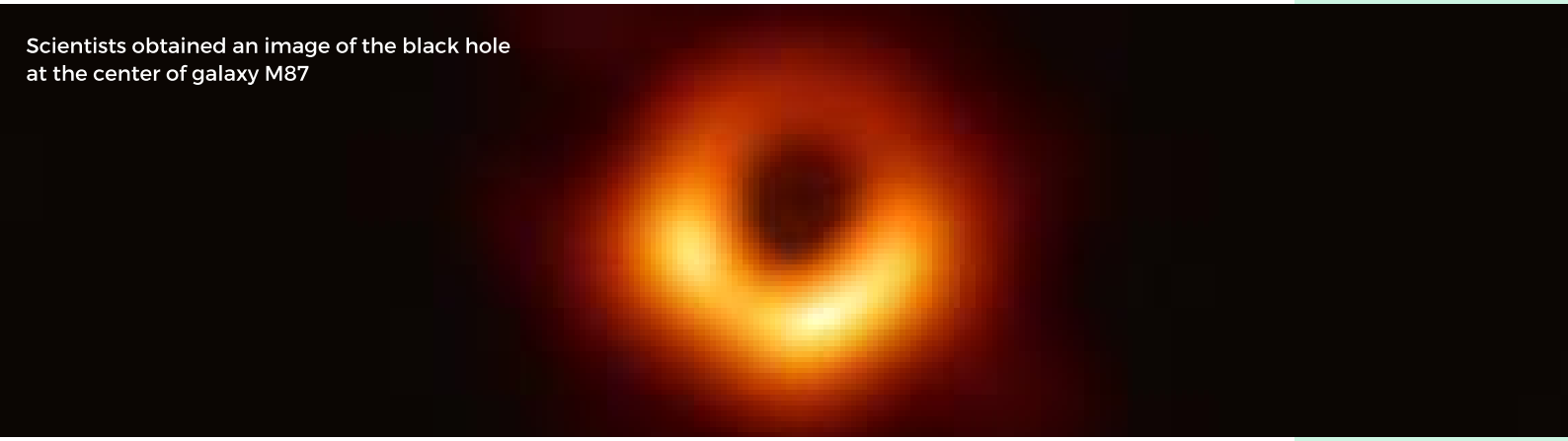
THE BLACK HOLE; AN ENIGMA

BY AVI ARYAN VIII A

In the 1990s, Stephen Hawking devised a way to explain the everlasting and the inexplicable. An irreplaceable aspect of the universe, which is born every few minutes but dies after millions of years, the black hole is a fundamental part of our universe and probably the most long-lasting too. The idea of a black hole seems very complicated, but when grasped fully it is extremely simple. The enigma of the black hole is hidden in its simplicity.

It is a really small densely packed star. A tablespoon of it would weigh around 1 billion metric tons. But, if the star is bigger, it becomes a black hole; a super-dense object in a really small volume with such a large gravitational pull that light cannot escape it. That is why it appears black and from far away, spotting it is visually is virtually impossible except its silhouette which is a bright light.

The fabric of spacetime is curved and distorted by matter, be it a celestial body, a star, or even a tiny bacterium, their influence will warp and create dents in spacetime. These warps in spacetime tells matter and radiation how to move and behave, this manifests itself to us as the force of gravity.



Scientists obtained an image of the black hole at the center of galaxy M87

Humongous stars die to give birth to the black holes. A black hole is formed after a star exhausts all of its fuel and explodes in a blinding blast of light called the supernova. After this, depending on the size of the star either a super-dense neutron star forms or an even denser black hole. Neutron stars form when the stars that are 10 to 25 times the mass of the sun go supernova.

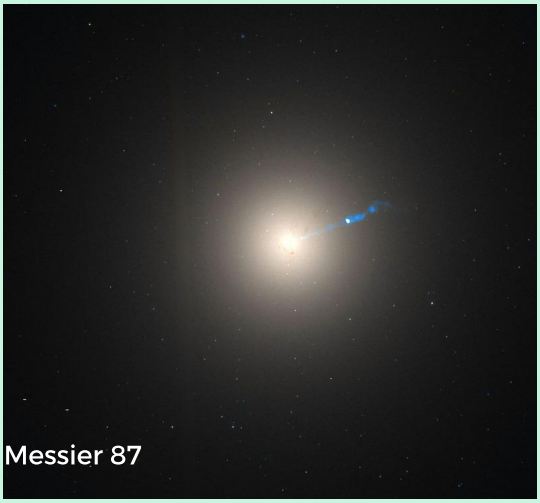
There are a few crucial parts of a black hole. One is the singularity, which is the point at the center of the black holes. The other is called the event horizon: the point of no return. The event horizon is the region around the black hole, where space and time have no practical meaning. Time and space are warped creating a wonderful sight, probably only seen before certain doom.

So, to explain the event horizon, let's take the example of a satellite hurtling through space. When it crosses the event horizon, nothing can save it. After the event horizon is crossed, even if the satellite tries accelerating away, it will just reach the singularity faster.

There are four major types of black holes: miniature, stellar-mass, intermediate, and the supermassive. Stellar-mass black holes are formed when stars that are at least 25 times the mas of the sun, end their life in a spectacular supernova. The biggest types of black holes are supermassive black holes, which are present at the centers of galaxies, whose immense gravitational pull keeps a whole galaxy in orbit. Huge nebulae orbit these supermassive black holes and form stars, but stars are also destroyed by the gravitational pull of black holes. So, in a way black holes are both the creators and the destroyers of stars.

Astronomers are still not sure how these supermassive black holes form. Stellar black holes result from the collapse of massive stars, and some have suggested that supermassive black holes formed out of the collapse of massive clouds of gas during the early stages of the formation of the galaxy. Another idea is that a stellar black hole consumes enormous amounts of material over millions of years, growing to supermassive black hole proportions. Yet another, is that a cluster of stellar black holes form and eventually merge into a supermassive black hole.

Despite their humble origins, black holes are fascinating creations, that play a quintessential role in helping us understand the beginnings and the workings of the universe. More research on the subject of black holes will help our species attain knowledge that we could only dream of right now.



Messier 87

Did you know ?

Time passes faster as you move away from Earth. Einstein's theory of relativity dictates that the closer you are to the centre of the Earth, the slower time goes – and this has been measured. At the top of Mount Everest, a year would be about 15 microseconds shorter than at sea level.

THE ENIGMA OF TIME TRAVEL

BY VANI TYAGI X F

Time travel is one of the most fun tropes to read about, it is almost as old as science fiction itself. Some of the most notable works of fiction include 'The Time Machine' by H.G. Wells, 'The First Fifteen Lives of Harry August' by Claire North, 'The End of Eternity' by Isaac Asimov and many others. Each book takes you on a breath-taking journey through a distinctive and slightly eccentric universe. What's common is the fact that they leave you with one question, "Is time travel simply a figment of the author's imagination or does it have any basis in reality?". The answer is yes, well sort of. Time travel is possible but it isn't quite like jumping into a time machine, rotating some dials and ending up in the time when dinosaurs lived. Here is how time travel is possible according to the laws of physics.

Newton believed that time was like an arrow, once you fired it, it went in a straight direction, never in reverse and was constant for everyone, anywhere in the universe irrespective of what they were doing. Einstein, on the other hand believed time to be like a river that meanders around, slows down and speeds up. It may even fork into two rivers or have whirlpools.

Time, according to him, was an illusion. It was relative and would vary for different observers depending on the speed by which they were moving. Compared to an observer moving slowly, a fast moving observer would measure time pass more slowly for everything and everyone around him, but his clock will tick normally. This is called Time Dilation. The mechanism for travelling into the future will use this effect of Special Relativity which has already been tested and verified by several experiments.

For example, extremely accurate atomic clocks were flown on aircrafts. When compared to identical clocks at rest, with which they were in perfect synchronization before they made the journey, there was a difference found in their readings which proved Einstein's predictions. The clocks in motion showed a slightly slow passage of time than the ones at rest.

This effect will be the same for all clocks including biological aging. But time travelling hundreds or even thousands of years into the future will not be straightforward

You would need to build a vehicle that could travel at speeds near to that of light (299,792 kilometres per second), you could never truly reach the speed of light but something around 99.99% of it should be possible and necessary (If you want to live to see the future and not age too much!). If you travelled at this speed, time would virtually stop for you.

So, you return in maybe one year but a thousand years might have gone by for the people on earth. But, there is a catch. The amount of energy required to make this round trip is monstrous (like that from an exploding star) and it is not yet technologically feasible. Time travelling into the future is definitely theoretically possible, but to actually try it out, we need to become much more technologically advanced than we currently are.

Time travelling into the future was the easy part, well relatively easy one at least. Time travel to the past, not so much.

"Nothing is as far away as one minute ago"

This simple line said by Jim Bishop is indeed true. Now, who wouldn't want to travel back in time and correct their mistakes or stop their past selves from doing something they would later regret? But is this a mere element used in science fiction or is it too possible? The answer to that is a very uncertain maybe. Einstein told us that gravity is a consequence of mass warping the fabric of space-time.

The Space-time continuum is a four dimensional continuum, with three spatial coordinates and one temporal one, in which our physical reality is located. The more mass that is squeezed into a small region of space, the more space-time gets warped and the slower time passes. One of the ways to travel back in time would be to use a transversable wormhole, which would warp space-time to close back in on itself.

But, along with this, we would also need to produce enough negative energy to stabilize it and prevent it from collapsing. There are also many blueprints of devices which are compatible with Einstein's theories that would allow this, like giant spinning cylinders, which will allow you to go back in time if you move in a spiral path around them or colliding cosmic strings where you move around them to go back before you left. This is still uncertain and based on a lot of hypotheses, and even if we could solve all the theoretical inconsistencies there would still be the issue of the energy required which would be massive and the technology which is nowhere near humanity's reach right now.

But not to worry, we still travel through time every day with our minds - relieving childhood memories or imagining ourselves in the future. And for those of you who are not satisfied with this, we are still travelling through time every moment of our lives, at the rate of one second per second into the future. It is not exactly what you wanted but still, just hang around for a couple of thousand years and you might just become the first time traveller.

AN ENTANGLED UNDERSTANDING OF SCHRÖDINGER'S CAT

BY RANAV SETHI X E

It is the year 1935 and Erwin Schrödinger has just told Quanta Magazine of a new thought experiment he has devised, while commenting on other discoveries on the quantum scale. He tells the reporter to imagine a feline in a box, along with a device that has a fifty percent chance of killing it.

The logical conclusion everyone comes to, is that the cat is either lying dead or alive in the box moments before it is opened. However, to their astonishment - Schrödinger explains that the cat is both dead and alive at the same time and exists in a probability state. When the box is opened, and the occurrence is measured by the viewer - the probability collapses and assumes one form (as the cat being dead or alive).

This bewildering phenomenon is now termed superposition and has also managed to explain how waves amplify or diminish each other -and how wave interference works. It's almost been a century since this thought experiment brought us onto the track, that is Quantum Mechanics. Being one of the greatest works of mankind, it attempts to explain some of the most bizarre phenomena in our world. Another exciting theory, called Quantum Entanglement explains how two particles share information with each other - and can perform tasks opposite to each other simultaneously, whether they are a few centimetres apart or are at the ends of the universe. The way it is explained is using the popular feline discussed a few lines ago.

Did You Know ?

If you forced all the atoms together, removing the space between them and making them as dense as the nucleus in the centre. A single teaspoon or sugar cube of the resulting mass would weigh five billion tons; about ten times the weight of all the humans who are currently alive.

Imagine two boxes, both with cats and both with the dreadful devices. Probability may have told you by now, that there are four possible occurrences. Let us call one cat A and the other one B. The cats are either both dead, both alive, A is alive with B being dead, or B is alive with A dead.

However, the principle of entanglement helps you disregard two cases in which they both share the same fate.What that means is, is that for each time such a case occurs - the cats will never be both dead or alive; one will always be alive and the other dead.

This staggering revelation still taunts scientists, as the speed of the information shared between the atoms that make up the devices (wherein they communicate with each other and express information about their own states) may somehow exceed light speed, violating many aspects of our current understanding of physics.

Entanglement is now at the very center of Quantum Information Science, an emerging field which understands the ways such peculiar laws apply to our larger world, whether it be quantum cryptography (securing data) or quantum computing. As work continues to establish and we continue to wrap our heads around both of these foundational and revolutionary concepts, there is no doubt that the future of physics will indeed be a bright one. It's also probably time for the cats to start working on their wills.

A WORLD WITHOUT FRICTION

by Manaswin Singh Kakran VI E

Increase in wear and tear
On road the car that we steer
Friction affects speed and efficiency
Be it in normal times or an emergency
Touching the finish line becomes unpredictable
Running errands too become uncomfortable
They say the difficulty that you face
Is actually friction on the surface
Is Friction a necessary evil?
Oh! How I want to solve that puzzle
To think of a world without friction
I paused and posed with my imagination
Seamlessly floated many questions
Topsy-turvy a world of reciprocal functions
How will we hold on to the ground?
Every action will become out of bound
Pencils will slip, on the paper ink will spill
Buildings will fall whether in the plains or on the hills
Objects on the slope will all lose balance
A bullet fired will travel a longer distance
No roll, neither the kick to the ball
Lack of the push, gone will be the pull
Open shoelaces and the stumble and the fall
Bygone will be all the meticulous control
Shaking hands and legs rickety
How to hold the glass when thirsty
And now with eyes at the metaphorical vantage point
Piercing through the microscopic bonds
I sit and think, should friction bid us adieu, what we will do?

A SAD INTRODUCTION TO GENERAL RELATIVITY

BY SHANTANU MISRA XI B

Sir Isaac Newton's theory of gravity reigned supreme for over two hundred years before its faults were finally exposed. Scientists had exhausted all their creativity, to come up with experiments to test Newton's laws in surprising scenarios. Newton's laws were effectively used to calculate the orbits of planets, comets and moons with breathtaking accuracy and precision. He was able to explain all of Kepler's Laws of Planetary Motion with his simple laws.

Let's start at the very beginning. The first time when people suspected that Newton's law of gravitation was flawed was when an anomaly was detected in the orbit of Uranus.

The anomaly could be explained in two ways: either Newton's laws had to be tweaked slightly or there was an undiscovered planet with a specific mass and a specific distance beyond Uranus. Putting their faith completely in Newton, a few mathematicians (independently) calculated the orbit of this planet and wrote a letter to their local observatory saying:
"Point your telescopes at this point in space at this time, and you'll find a planet". And lo and behold Neptune was discovered! Hooray for Newton!

Even today, Newton's Law of Gravitation is all you need (in addition to A LOT of money) to launch spaceships and land rovers on other worlds. So what went wrong? Why did Einstein have to come up with a radically new theory of gravity? What are its implications? How was it tested? Is it the end or is something more to come? And the most important question of all, why on Earth does space-time have to be curved?

Then, a few years later a man named Urbain Le Verrier (the same mathematician who "discovered" Neptune) described a peculiarity in the orbit of Mercury. Le Verrier found that the perihelion (the point in the orbit of a planet at which it is closest to the sun) of Mercury was changing, in a way that could not be explained by Newton's Laws. Ah, history repeats itself (or so they thought). People assumed that the anomaly in the orbit of Mercury was caused by an undiscovered planet, which they called Vulcan.

And so the hunt for Vulcan began and ended with excitement. The hunt ended, not because the planet was found, but because it WAS NOT found.

Newton's Laws had finally reached their breaking point, and it was finally known that the Universal Law of Gravitation wasn't so universal after all. Another problem with Newton's Laws is that they assume that the speed of light was infinite and time was absolute. These ideas were later dismantled by Einstein in his Special Theory of Relativity and were simply wrong ideas that Newton had accepted.

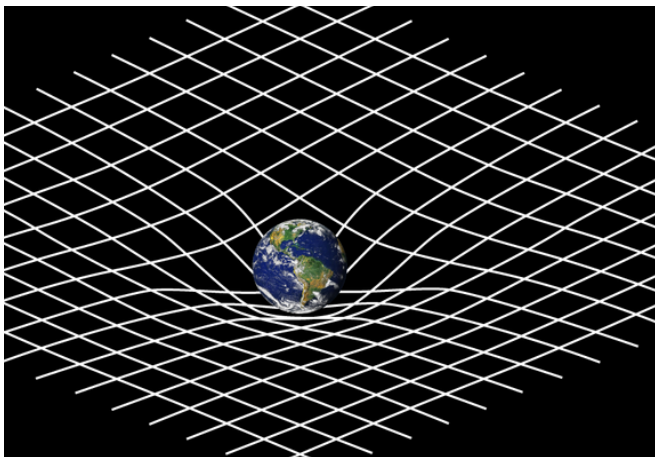
We, the inhabitants of the future with the power of hindsight must remember, however, not to be harsh on Newton. He reasoned his way to a mathematical formulation of gravity that works well in most aspects of life and united the notions of falling apples and orbiting planets with one simple equation. All this, in addition to him creating a design of the telescope that's still in use today, revolutionising optics, casually inventing calculus and developing the laws of motion. Oh and by the way, after doing all that he turned 26.

Before diving into General Relativity, we must explore the concept of an inertial frame of reference. An inertial frame of reference is a fancy phrase which simply means a non-accelerating frame of reference. Newton's Second Law of Motion, F=ma, is only valid when the observer is in an inertial frame. Let's think about this with an example:

Imagine yourself on a train. If the train begins to undergo uniform acceleration, relative to the train's interior you will accelerate backward, even though you can't identify any horizontal forces on you. So inside the train, F is not equal to ma. From the perspective of an observer on the ground, you don't accelerate at all. Instead, the train car accelerates forward to meet you, and hence F=ma.

All acceleration is measured with respect to inertial frames, and by definition, inertial frames of references do not accelerate with respect to one another. There's a quick and dirty test that you can do to check if your reference frame is inertial or not: pick up an object, and let go of it. If it stays in the place where you left it, your reference frame is inertial.

Now that we know about the limitations of Newtonian gravity and inertial frames, let us take a look at a debate that transcends time itself, a debate between Newton and Einstein, a fight for the validity of inertial frames of references.



Einstein: Newton, if we put a cup of coffee, a piano and a jaguar in a train which begins to accelerate forward, from the perspective of someone within the train, everything would accelerate backward at the same rate. And what other phenomenon are we aware of that makes things accelerate at the same rate? Yes, exactly! Gravity makes everything accelerate uniformly.

The forward acceleration of the train is identical to a gravitational field that points backward. If we consider the acceleration due to the train's motion, a 'fake' gravitational field and add it to Earth's 'real' gravitational field, we get a net gravitational field that points diagonally downward.

In fact, if we attach a helium balloon to the floor of a train undergoing uniform acceleration, we see that the balloon aligns itself in the direction provided by the vector sum of the accelerations of the 'real' and 'fake' gravitational fields. I thus propose that the acceleration due to Earth's gravitational field is also 'fake', a side effect caused by the Earth's acceleration upwards.

Newton: You're perfectly right in your analysis Einstein, however, I must remind you to bring to your attention a few things. First of all, thinking of the acceleration directed backwards due to the train's motion forward as a gravitational field is nothing more than a calculation trick, you must not lay the foundations of your bold claims with such hacks. Second of all, inertial frames are the standard for measuring true acceleration. So unless you can provide me with an inertial frame relative to which the Earth is accelerating upwards, it simply isn't.

Einstein: Not so fast, Newton. How about a reference frame that's in free fall? Now hear me out. If I put you and a few objects in a box and throw you off a cliff, you would see everything in the box just float. For all you know, you're in the middle of intergalactic space floating for no reason. This frame of reference even passes the quick and dirty test that YOU set up for an inertial reference frame. I can confidently say that the falling frame of the box behaves like a stationary inertial frame. And relative to this inertial reference frame, the Earth is accelerating upwards. So there you have it, an inertial frame relative to which the Earth is accelerating upwards.

Newton: I'd congratulate you, Einstein, if there weren't two fatal flaws in your argument. First of all, down isn't down, it's radially inward. Two objects in free fall are falling toward the Earth on two non-parallel radial lines, directed inward towards the Earth. So from the perspective of an observer within the box, the distance between two objects inside the box will not remain constant, they will accelerate toward each other. Second of all, by your criteria, orbiting frames of reference should also be considered inertial. But an orbiting reference frame accelerates relative to a reference frame in free fall, but inertial frames cannot, by definition, accelerate relative to each other.

Einstein: Well, huh.....that's a good point

So, it looks like Einstein's viewpoint was shot down by Newton with beautiful reasoning and logic, doesn't it? Well not so fast. Einstein was a very persistent man. He hated seeing two identical phenomena (over here 'regular' acceleration and acceleration due to gravity) given two very different explanations. His patience (for 7 years!) with the question led him to a counter-argument.

He realised that the rule that inertial reference frames can't accelerate relative to one another is only applicable if the world has a 'flat' geometry. If, however, the world is a non-Euclidian AND curved spacetime, then inertial reference frames can basically do whatever they want. In a non-Euclidian and curved spacetime, our intuitions about "basic" and "obvious" things like straight and parallel lines break down.

This was the loophole that Einstein found, he assumed that the world has a non-Euclidean geometry and built his theory up from there. If you accept Einstein's picture of reality, gravity is really not a force but emerges from geometry.

Just like the jolt that you feel in a uniformly accelerating train is not due to a force, acceleration due to gravity is not due to a force but due to you, dear reader, inhabiting an accelerating frame of reference (assuming of course that you are not in free fall or in space as you read this article).

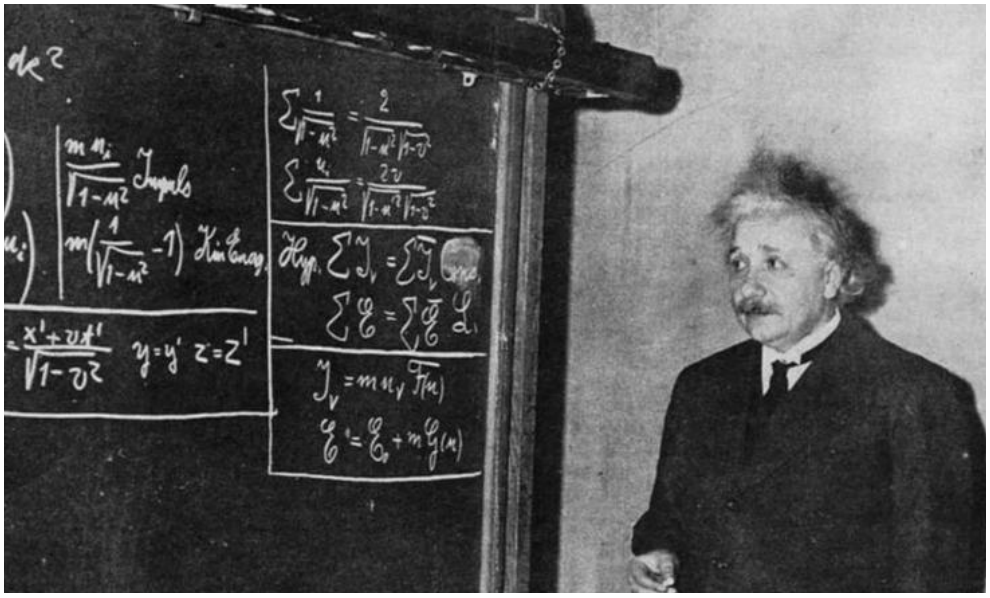
This theory, that has come to be known as General Relativity, paints a beautiful picture of the world. It's passed every single test that's been thrown at it, and most of its predictions about the world, have been tested and verified. Solving the equations of General Relativity alone, physicists were able to predict the existence of black holes, gravitational waves, and even correct their calculations for the orbit of Mercury.

Einstein's worldview has been confirmed several times over, the most recent confirmation being the detection of gravitational waves.

Despite the success of General relativity, it's far from complete. General Relativity is still a classical theory and completely ignores the uncertainty principle of quantum mechanics. We still do not know what gravity at the quantum scale would look like, but there's good work in that direction. Years of sweat and desperation lead physicists to the theory of Quantum Gravity that reigns supreme today: String Theory.

When physicists take on the colossal task of solving the maths of String Theory, the equations of General Relativity pop out almost like magic (if they didn't people would've just added a couple of extra dimensions to the maths until they did!). String Theory, however, is far from complete and is still in its infancy.

After playing with Einstein's equations, physicists were able to discover real-world objects and phenomena and were not experimentally confirmed for decades after their theoretical birth. Einstein united geometry with gravity, showed how gravity is nothing but an illusion and blew the collective mind of all of humanity with his groundbreaking theory that continues to seduce us with its simplicity, beauty and elegance.



Rare picture of Einstein fearing his intellect

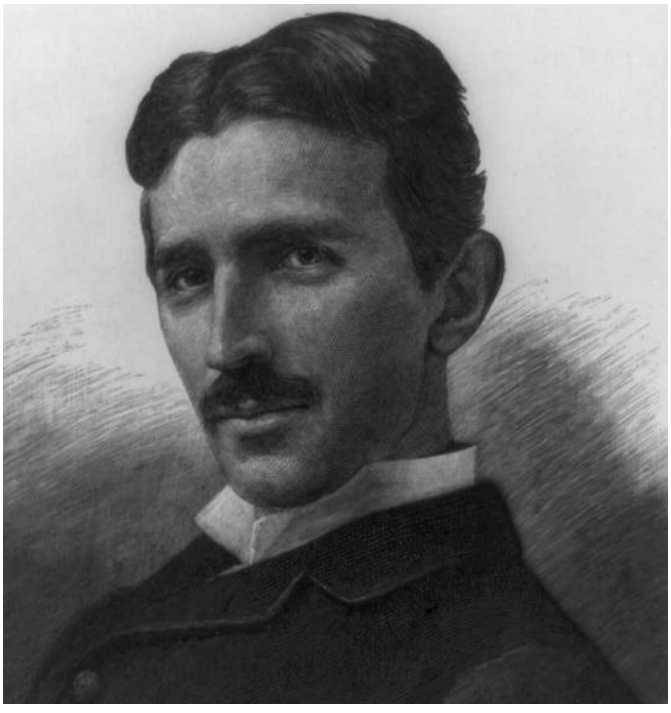
NIKOLA TESLA

BY ANANYA SINHA XII D

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

This well-known quote by one of the world's most erudite physicists, Nikola Tesla succeeds in portraying his ingenious, sapient self. He was a Serbian-American engineer, physicist and inventor born on the 10th of July in 1856 and raised in the Austrian Empire who made dozens of breakthroughs in the production, transmission and application of electric power. Nikola Tesla changed the world by inventing the machinery and processes needed to safely bring electricity into people's homes and workplaces. He helped "light-up" people's lives :)

He studied engineering and physics in the 1870s without receiving a degree. Tesla gained practical experience in the early 1880s working in telephony and at Continental Edison in the new electric power industry based in Paris.



DID YOU KNOW?

A telephone repeater is an electronics device that transmits the signal received in telecommunications. These devices are used to extend transmissions such that the signal can cover large distances and can be received on the other side of an obstruction

A magnetic field that has moving polarities in which the opposite poles rotate about a central point or axis. The rotation changes direction at a constant angular rate. This is the key principle of the alternating current motor.

“I don't care that they stole my idea, I care that they don't have any of their own.” Tesla said on the plagiarism by Thomas Edison."

Tesla was invited to work in the U.S.A. by Edison, after receiving a glowing recommendation from Tesla’s supervisor in Paris; which stated that Tesla was a genius and was as capable as Edison. Edison did hire Tesla, he also believed that his ideas were great, but he thought of them as impractical since they could not be implemented in real life. Edison and Tesla had different ways of working; Edison relied heavily on experimentation, for his discoveries (some historians put the reliance on experimentation, down to the fact of Edison’s lack of formal education). Tesla was emotionally driven; he was a dreamer and had his years of engineering training behind him. This enabled him to picture any problems with a relevant theory and to resolve the problem before it posed a threat to the actual building-up of the device. Later in their lives, both men publicly criticised each other’s work.

Edison and Tesla had a clash of lifestyles, Tesla was a germaphobe, he is meant to have told the “New York Times”; that Edison had no hobbies, cared for no amusement of any kind and lived in utter disregard of the most elementary rules of hygiene.

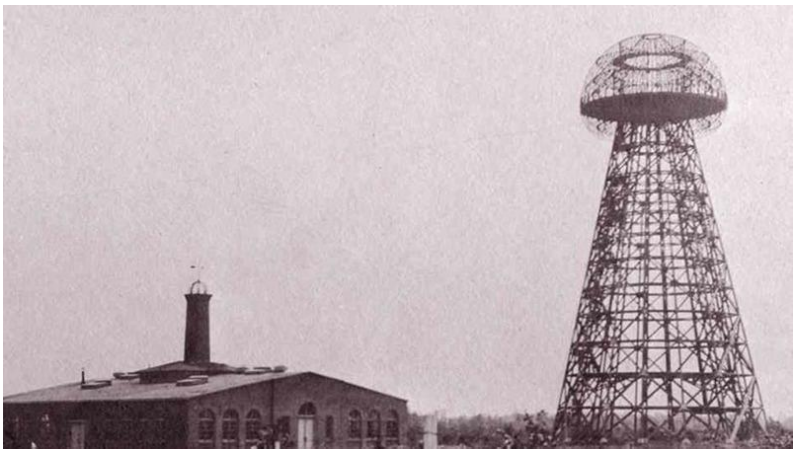
The clash that caused the most controversy between them, was over currents. Edison thought Tesla’s idea of AC (alternating current) technology to bring electricity to the population was unsuitable and dangerous, Edison thought his idea of DC (direct current) was superior and safer.

But what finally destroyed their partnership and made them go separate ways, was the ‘bet’. Tesla insisted that he could improve the efficiency of Edison’s prototypical dynamos. He worked diligently for months on the project and he was successful in improving the dynamos. When he demanded the reward, Edison claimed he was only joking. He only offered Tesla a raise of $10 a week, instead of the $50,000 he promised him if he succeeded.
After this exchange, Tesla quit. He spent months in New York, picking up odd jobs to survive. He saved his pennies, so he could build the “Tesla Electric Light Company”. He later developed several successful patents, including AC generators, wires, transformers, lights and 100 horsepower AC motors. Tesla beat Edison in the battle of the currents. He received backing from Westinghouse, J.P. Morgan and Astor. Westinghouse fulfilled Tesla’s dream of building a power plant at Niagara Falls, which powered New York City.

Tesla was a visionary, not a businessman, so he sold most of his patents for $1 million to George Westinghouse, an inventor, entrepreneur and engineer. He set up laboratories and companies in New York to develop a range of electrical and mechanical devices with the help of partners to finance and market his ideas.

Nikola Tesla is known for his scientific achievements in every corner of the globe. He made his first electrical invention, a telephone repeater and conceived the idea of the rotating magnetic field, which later made him world-famous. Nikola’s alternating current (AC) induction motor and related polyphase AC patents, licensed by Westinghouse Electric in 1888, earned him a considerable amount of money and became the cornerstone of the polyphase system which that company eventually marketed.

By the end of his brilliant and tortured life, Nikola Tesla was impecunious and was living in a small New York City hotel room. Tesla lost his money while building the Wardenclyffe Tower, a wireless, transmission station, which was foreclosed on twice. He worked on new inventions in his last decades even as his energy and mental health faded. He spent sleepless nights working over mathematical equations and scientific problems in his head. Tesla even had to sell off his assets to pay down his debts. In 1917, the U.S. government blew up the tower, fearing that German spies were using it in World War I.
He spent his final years feeding and as he claimed 'communicating' with the city's pigeons. Tesla died a sad death in his isolated hotel room on the 7th of January in 1943. Later, the U.S. Supreme Court voided four of Guglielmo Marconi's key (radio) patents, belatedly acknowledging Tesla's innovations in radio. The AC system he worked on and improved remains the global standard for transmission of power.

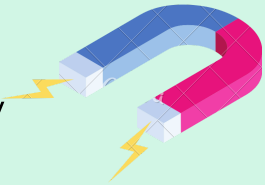


The Wardenclyffe Tower

To honour the legendary scientist, the IEEE (Institute of Electrical and Electronics Engineers) established an award in 1975: The IEEE Nikola Tesla Award. It is awarded annually for contributions made to power generation and utilization. There are enterprises, organisations, schools, ships, airports, streets and planets in his name. Holidays, events and songs have been dedicated to him. There are various memorials and museums built to commemorate the exceptional works of Dr. Nikola Tesla.
Tesla received several awards and medals during his lifetime for his extraordinary inventions and theories.

He penned numerous articles for magazines as well as journals and books. A few of his famous literary works are: My Inventions- The Autobiography of Nikola Tesla; The Fantastic Inventions of Nikola Tesla; The Tesla Papers and Inventions, Researches and Writings of Nikola Tesla.Tesla's death has not just deprived the world of a phenomenal scientist but has also deprived science of an inventive mind.

PAUSE AND PONDER



If atoms have no net charge, how do they respond to a magnetic field?

If nothing can escape a black hole, how does it have a gravitational influence on its surrounding?

Photons lose energy during cosmological redshift. Where does this energy go? Doesn't it violate conservation of energy?

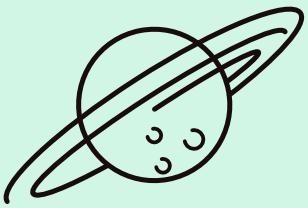
What would happen to a helicopter if there are no tail rotors? Why?

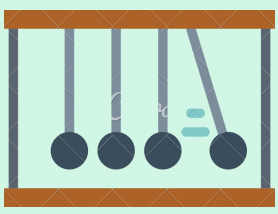
Could black holes really lead to alternate universes?

How would a world where entropy decreases with time work?

Where is the antimatter that the Big Bang should have also created?

If acceleration is absolute how is motion relative?





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Teachers in Charge
Ripple ma'am
Shampa ma'am
Nidhi ma'am
Vrinda ma'am

The articles in this magazine were primarily written by the members of the physics club, however you (yes, you!) can also have your articles published. ***You don't need to be a member of the physics club in order to submit articles, nor do you have to be in senior school.*** *Articles can be about various topics like: recent discoveries and inventions, experimental physics, black holes, scientists, light, electronics, or anything under the sun that's related to physics. Just be sure to send your articles to:* ***neutrinoeditorial@gmail.com.*** *We look forward to reading your articles.*

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