NOVEMBER 2020, ISSUE 3

THE NEUTRINO BREW

OFFICIAL NEWSLETTER OF THE NEUTRINO CLUB

INTRODUCTION

Dear reader,

Amid the current pandemic and subsequent chaos, all of us are looking for peace and methods of escaping this reality. We understand how in these times, trying to hold onto your passion for subjects, particularly physics may prove to be difficult.

While it is imperative for us to look for sources of comfort to improve our lifestyle in this pandemic, physics can offer a way to help ground ourselves. The exploration into the field and looking past the lines of our textbooks can give us a better understanding of its true nature and provide comfort in its beauty. Through this magazine, we hope to 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.

The Neutrino Editorial team brings to you, articles ranging from the violent vampire stars to the ever-elusive neutrinos, this time also containing a preview to a research paper written by two of our classmates.

Anyone interested in submitting articles for the subsequent issues of the magazine can send their articles at neutrinoeditorial@gmail.com or contact any of the board members (all contact information is available at the final page).

We sincerely hope that you enjoy reading the articles put together by the Neutrino club and again, would like to extend our heartfelt gratitude towards our readers.

Keep healthy!
Yours Sincerely
Arya Abhisri
(Editor in Chief)

Club Neutrino

TABLE OF CONTENTS

MARTIAN WHEELS

BY ARNAV GARG VIII B

On 30th July 2020, NASA's fifth rover to mars, Perseverance, was launched. Let's take a look at all of NASA's rovers till now:

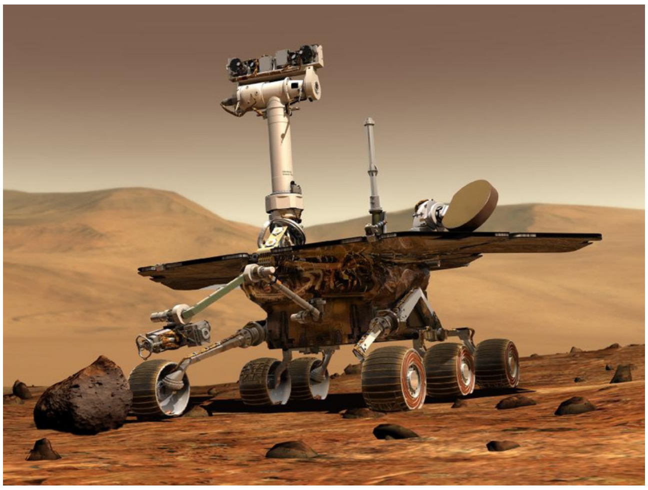
Sojourner

SOJOURNER

On July 4th, 1997, while the US was celebrating its 221st independence Day, Sojourner became the first rover to land on Mars. It was only as big as a microwave and weighed only 23 lbs (10 kgs). That's only as heavy as two cats! NASA chose Ares Vallis as the landing spot as it had a large collection of rocks. This meant that the rover wouldn't need to travel much. Ares Vallis was also very flat, making it an ideal landing area. Sojourner drove and took over 550 pictures to send to scientists at NASA. It also examined rocks and recorded the winds and weather. It was operational for only 83 days and carried just two scientific instruments. Humans thought Mars was cold and dry, but Sojourner helped prove that Mars used to be a warmer and wet place.

SPIRIT AND OPPORTUNITY

Spirit and Opportunity, two very optimistic rovers, landed on Mars in July 2004. They landed at different positions but had the same mission: to learn as much as they could about Mars. They were twins, which meant they carried the same equipment and were the same size - about as big as a golf cart.



Spirit and Opportunity

The two rovers set new records by lasting 6 and 14 years respectively. Spirit found several signs of volcanic activity and hot springs while Opportunity did research that suggested it had landed on an ocean shoreline. The two rovers found evidence that at some point, Mars used to have water like Earth does (in rivers, lakes, and oceans).

CURIOSITY

In August 2012, a month after my fifth birthday, Curiosity landed in the Gale Crater on Mars. This crater has a tall mountain in it, made up of many layers, and each layer in turn is made up of different materials from different time periods. NASA scientists believed that studying these minerals could help shed light on if there was water on Mars. Curiosity was as big as a small car and was much faster than the older rovers (a whopping 4 cm/s). It carried 10 scientific instruments, the most by any rover. It used 17 cameras for photos and to use some as its eyes. In fact, one of its cameras is attached to its 7-foot long robotic arm, which can be used as a selfie stick!

PERSEVERANCE

Finally, coming to the star of this article, representing Mission Mars 2020, we have Perseverance! Launched on the 30th of July 2020, it is very similar to Curiosity and hopes to find out if life ever started on Mars. Landing in February 2021, It will do extensive research in the Jezero Crater. It is the size of a small SUV and weighs more than 2000 lbs (907 kgs)! The rover will also try to convert carbon dioxide into oxygen. If this can be done, sending astronauts and humans to space will be much easier and cheaper. The cost of food supplies could also be cut down by farming on other planets. Rocket fuel also needs oxygen. In fact, rocket fuel is one of the costliest parts of a space mission! Perseverance can answer many questions and could be the stepping stone into a new age of space exploration.

Perseverance

Curiosity

Humans have always been intrigued by the Red Planet. The Greeks were the first to learn about it, and they named it ‘Ares’, after their god of war. They did so as they believed that the red color was due to blood. When the Romans came, they did the same, except, their god of war was Mars.

NASA is not the only one to send missions to Mars. In fact, Saudi Arabia launched the Hope orbiter on 19 July this year and the Chinese Tianwen-1 was launched on July 23.

Many believe that humans are very close to discovering the history of life on Mars. There has been a lot of interest in the planet as it is very similar to Earth in size and lies at a distance from the Sun that is ideal for life. Opportunity proved that there used to be giant bodies of water on Mars, and maybe there still is. Though we don’t know everything yet, we are definitely on the right track.

THERMODYNAMICS

BY SHREEYA MISHRA IX F

Introduction

The study of changes in energy, associated with physical and chemical reactions is called thermodynamics.The study of changes in energy and chemical reactions are based on four principles, called laws of thermodynamics. These are known as zeroth, first, second and third law of thermodynamics. The laws, in simple terms are as follows:

Nicolas Léonard Sadi Carnot, often described as the "Father of Thermodynamics" :

His concept of the idealized heat engine led to the development of a thermodynamic system that could be quantified, a key success that enabled many of the future discoveries that lay ahead.

The Zeroth Law states that if two bodies are in thermal equilibrium with some third body, then they are also in equilibrium with each other. This establishes temperature as a fundamental and measurable property of matter. In other words, if system A is in thermal equilibrium with system C and system B is also in thermal equilibrium with system C, system A and system B are in thermal equilibrium with each other.

The First Law states that heat is a form of energy, and thermodynamic processes are therefore subject to the principle of conservation of energy. This means that heat energy cannot be created or destroyed. It can be transferred from one object to another. For example, steam turbines convert heat energy into kinetic energy to run generators.

The Second Law states that heat energy cannot be transferred from a body at a lower temperature to a body at a higher temperature without the addition of energy. This is why it costs money to run an air conditioner.

The Third Law states that the entropy of a pure crystal at absolute zero is zero. Entropy is sometimes called "waste energy," that is energy which is unable to do work; and since there is no heat energy whatsoever at absolute zero, there can be no waste energy. . There can be no physical system with lower entropy, so entropy always has a positive value. Entropy is also a measure of the disorder in a system, any positive value of temperature means there is motion within the crystal, which causes disorder.

Fun Facts

Extending the second law to its logical conclusion, it's evident that someday, all of the usable energy in the universe will be converted to energy heat. This state has been suggested as one possible fate of the universe, and it's sometimes called the “heat death of the universe.” However, it’s not clear to physicists that this would actually happen.

Earlier, thermodynamics was studied to make steam engines work better. Now, ideas from thermodynamics are used in everything, from making engines to studying black holes.

Scientists use thermodynamics for many reasons. One is to make better engines and refrigerators. Another is to understand the properties of everyday materials so that they can make them stronger in the future. It’s also used in chemistry to explain which reactions will work and which will not. It’s powerful because simple models for atoms work well in explaining the properties of large systems like bricks (supporting the claim that phenomena in the other branches of science can be explained by the core principles of physics).

The second law of thermodynamics leads us to one of the most important implications of any of the laws in thermodynamics, the arrow of time. There is a famous documentary narrated by one of the most influential physicists of current times where they explain the concept of the arrow of time using an example of sand castles (the documentary is called Wonders of the universe, time and entropy).

Even cooling machines, such as refrigerators and air conditioners, actually use heat, simply reversing the usual process by which particles are heated. The refrigerator pulls heat from its inner compartment—the area where food and other perishables are stored—and transfers it to the region outside. This is why the back of a refrigerator is warm.

Imagine yourself being in a small crowded room with lots of other people. In all likelihood, you'll start to feel very warm and will start sweating. This is the process your body uses to cool itself off. Heat from your body is transferred to the sweat. As the sweat absorbs more and more heat, it evaporates from your body, becoming more disordered and transferring heat to the air, which heats up the air temperature of the room.

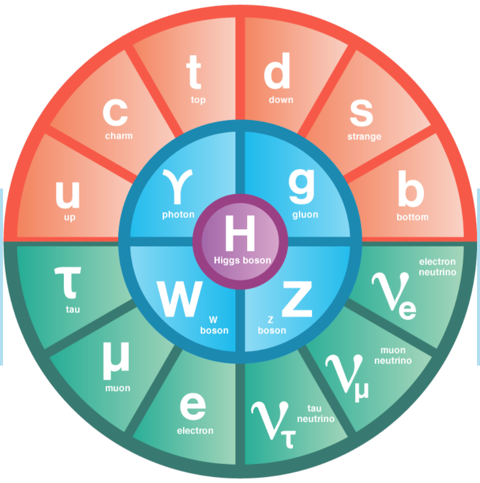
Thermodynamics may sound very exhausting or boring but this may help us to get a brief idea of the concept and relate it to our daily lives along with some fun facts.

NEUTRINOS

BY SHANTANU MISRA XI B

There's always so little said about the magnificence of neutrinos and the intriguing mystery behind them. The physics club was given the name Neutrino to shed some light on this particle and make people more aware of the impact that they've had on modern physics. In this article, I will attempt to do justice to these particles (and waves, I guess).

The problem was that when the mass of the original nucleus was compared to that of the sum of the daughter nucleus and the emitted particle (either electron or positron), the masses did not equate. After the decay, some mass was missing.



Types of neutrinos and the Standard Model of particle physics

Neutrinos are often called 'Nature's Ghosts', and that's one of the few things in physics that's not a misnomer. They interact less than any of the other known particles, only interacting via the weak force and gravity. Even though around 650 trillion (that's 650 followed by 12 zeros!) of them pass through you every second, it took decades to prove that they exist at all.

So if Neutrinos are so hard to detect, how did we discover them? Well, I'm glad you asked.

In the 1930s, scientists were bothered about a particular type of decay called Beta Decay, which seemed to violate the law of conservation of mass. Beta Decay is a process in which an atomic nucleus emits an electron or a positron which converts either a proton into a neutron or a neutron into a proton. Thich changes the atom from one element to another (micro alchemy!).

Lots of ideas were put forth to explain this, including abandoning the Law of Conservation of Mass in the quantum world. Wolfgang Pauli came up with the idea that the mass was missing because an unobserved particle was being emitted and carrying the missing mass away with it.

There are four known fundamental forces: the strong force, electromagnetism, weak force and gravity. Neutrinos have no colour or charge and thus interact only through the weak interaction and gravity. The mass of an individual neutrino is so less that, for the longest time physicists did not know if they had any mass at all. Even today we haven't been able to assign a mass to neutrinos, only a range.

Let us try to understand how hard it is to detect a neutron.Let's say you were allergic to neutrinos and you wanted to get away from as many of them as you could. Neutrinos are produced in nuclear reactions, and the biggest nuclear reactor around is the Sun. About 650 trillion neutrinos from the Sum go through you every second. To have a good chance of blocking half of these neutrinos you would need to get behind a solid block of lead five light-years in length. And of course, by the time you go five light-years away from the sun with your block of lead, you'll likely get closer to another neutrino source and all your efforts will be in vain.

So what are neutrinos anyway? Neutrinos belong to a class of particles known as the leptons.
The three charged leptons are:
- Electron
- Muon
- Tau

The muon and tau particles have the same properties as the electron, except they're much much heavier. For each charged lepton there is a neutrino, and they have been very creatively named:
- Electron neutrino
- Muon neutrino
- Tau neutrino

When a neutrino interacts, its partner particle often shows up. That helps physicists identify what flavour neutrino they're dealing with. Physicists never actually see the neutrino itself; instead, they see the other particles that are made when a neutrino interacts in a detector

The reasons why physicists are so intrigued by neutrinos are too many to cover in one tiny article; however, what this article is capable of doing is inspiring you to go and read more about it yourself.

One of the reasons why physicists are interested in neutrinos is because of their mass. All particles get their intrinsic mass from the Higgs Mechanism (perhaps a topic for another day), but the masses of the known neutrinos are so incredibly low that it made people think that maybe neutrinos get their mass from a different mechanism altogether.

Neutrinos are so hard to observe and study that we don't even know if they're their antiparticles

If that was true, it could explain one of the most deeply philosophical questions of physics:

Why is there something rather than nothing? Look around you, do you see any antimatter particles?

Probability says you don't.

One of the predictions of The Big Bang Theory is that equal numbers of matter and antimatter particles were created. This is a very exciting prediction it seems false at first sight. If neutrinos are Majorana (the technical jargon for a particle being its own antiparticle) then we may get one step closer to explaining the matter-antimatter discrepancy that we see around us.

The reason why neutrinos are so famous (or infamous) is because of a phenomenon called neutrino oscillations. Experiments have revealed that neutrinos change their flavour after propagating some distance. If you hand a particle physicist an electron neutrino, a muon neutrino and a tau neutrino and ask him which one is the electron neutrino, the answer will be an eye-opening "yes". The reason for this (as always) is quantum mechanics.

It turns out that the electron neutrino is all three of the neutrinos you handed the physicist at the same time, but all three of the neutrinos are muon and tau neutrinos also. You tell them apart by the way they oscillate (remember they're waves too). Electron, muon and tau neutrinos all oscillate (vibrate) differently. If in the wild you find a neutrino doing something weird, like oscillating both like an electron and tau neutrino, then the neutrino is sort of a mixture os the two and it has a probability of being an electron neutrino or a tau neutrino.

After producing, say an electron neutrino, at point A and observing it at point B you will notice that the neutrino will be oscillating with a different frequency and will now have some probability of being either an electron, muon or tau neutrino.

Now, why was that so important?

Remember how I said neutrinos have such little mass that for the longest time it was thought that they were massless? It turns out that massless neutrinos cannot oscillate. So if we observe neutrino oscillations, it follows that neutrinos must have mass.

You're probably sick and tired of me saying that neutrinos react with matter very weakly. But did you ask yourself why?

Force	Particles Experiencing	Force Carrier Particle	Range	Relative Strength*
Gravity acts between objects with mass	all particles with mass	graviton (not yet observed)	infinity	much weaker
Weak Force governs particle decay	quarks and leptons	W^+, W^-, Z^0 (W and Z)	short range	
Electromagnetism acts between electrically charged particles	electrically charged	γ (photon)	infinity	
Strong Force** binds quarks together	quarks and gluons	g (gluon)	short range	much stronger

The four fundamental forces of nature

As I have mentioned, they only experience the weak nuclear force and gravity. Their masses are small enough for gravity to be ignored. To interact with other types of matter, particles need to emit carriers of forces: photons for electromagnetism, gluons for the strong nuclear force, the W or Z bosons for the weak nuclear force and the hypothetical graviton for gravity.

So, the lesser the time that the emitted virtual boson exists, the more energy it can steal from the uncertainty principle.

The catch here is that the bosons of the weak force are massive, unlike the massless photon or gluons. To simply exist, the bosons emitted by the neutrinos need to have a lot of energy, and thus the bosons can only exist for a very brief period, meaning they can travel very small distances.

To interact with the nucleus that we mentioned, it needs to be inside the nucleus. This happens a stupidly rare number of times, and therefore neutrinos are very hard to detect. This is the reason, by the way, why the weak force is called weak.

The weak force is not a force in the traditional sense that you might think, it does not push or pull, instead, it's responsible for changing the flavour of particles and all types of radioactive decay. The only reason why it's called weak is that it's very rare (in certain interactions, it does not happen rarely at all, but is the first force to act).

That's why a more appropriate term would be the 'uncommon' force.

The final thing that I want to touch upon is some experimental physics. Neutrinos are one of the hardest things to detect in all of physics, figuring out ways to detect them requires creativity, ingenuity and a whole lot of money.

The weakly interacting nature of the neutrino makes them extremely difficult to study, but to have a chance at spotting even a single neutrino, a truly enormous number need to reach the detector.

To do that neutrinos need to be channelled into a concentrated beam. Because neutrinos react so weakly, they cannot be directly channelled into a beam, doing this requires some ingenious hacks, one of which is:

Accelerate protons around 3 to 4-kilometre circumference ring, using giant electromagnets to around 99.99% the speed of light. Easy right? Smash these protons into a graphite barrier, and as they collide with nuclei they produce all sorts of amazing subatomic particles. More electromagnets are then used to sort the positively charged pions from the others and focus them into a beam.

These pions quickly decay into muons and muon neutrinos.

This beam then passes through several hundred meters of pure solid rock, which removes the muons from the bream. And voila!

You have your very own beam of muon neutrinos. Bon appetit!

After we have the beam of neutrinos, all we have to do is detect them. One method is to take a giant tank of liquid argon and shoot around 10 trillion neutrinos at it per second. This huge number of neutrinos ensures that at least a few will interact with the argon atoms and be detected.

If a neutrino interacts with an argon atom, it will break it apart and release charged particles (in our example pions and muons), these charged particles will then travel through the liquid argon and knock the electrons free from the atoms.

The sides of the detector are charged, so a giant electric field fills the tank. This electric field attracts the free electrons, which allows us to trace the path of the particles. These paths have the potential to teach us everything about neutrino oscillations.

This article does not even dip its toes into the vast ocean of physics that is concerned with neutrinos. I can hardly believe that I wrote a whole article about neutrinos without elaborating on sterile neutrinos, the role that neutrinos play is supersymmetric theories, extremely interesting neutrino experiments like DUNE (Deep Underground Neutrino Experiment), ANITA (Antarctic Impulsive Transient Antenna), The Ice Cube Observatory and the T2K experiment. Those topics I guess, are for you to explore on your own

VAMPIRE STARS AND ZOMBIE STARS; UNIRONICALLY

BY ARYA ABHISRI XII A

While we may be most familiar with star systems containing a single star, such as our solar system, there are a staggering number of star systems that involve binary stars, which are a pair of stars revolving around each other. Among these, is a remarkable star species known for its particularly violent nature.

Vampire stars, found in certain binary star systems, show a parasitic nature of existence. In this relationship, the vampire star sucks fuel(hydrogen) from its companion and rejuvenates itself. To create a better understanding of the working of vampire stars, let's take a look at how we discovered these strange stars.

The universe is composed of many star clusters, which are groups of stars birthed from the same nebula. What this means is that the star clusters are born at the same time, implying that all-stars should be of the same age. Star clusters begin as an array of colours, with stars ranging from blue to yellow to deep red. The blue stars are the first to burn out, then the yellows; as time passes, star clusters are known to mature into a deep red colour. This gradual shift in colour helps astronomers in determining the age of the star cluster.

Due to the size of blue stars and how quickly they run out of fuel, it is highly unlikely to find any semblance of blue stars in an old cluster. But in the 1950s, astronomers found, amongst the old red stars of the cluster, brightly shining blue stars. Since it is impossible for new stars to be born in an old star cluster, the only possible explanation was that the stars were somehow getting younger. These stars came to be known as 'Blue Stragglers', a reference to the lagging in their ageing process.

DID YOU KNOW?

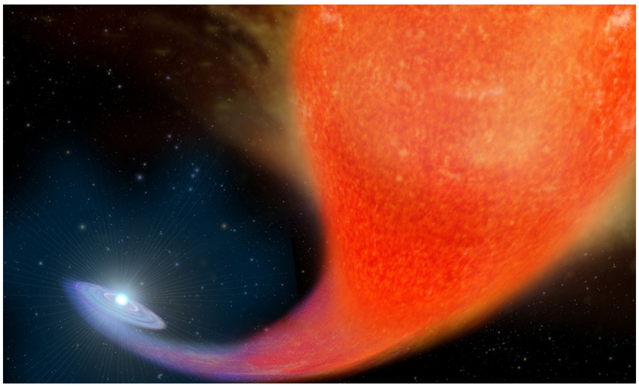
Nuclear fussion, the process which provides energy to stars, has the potential to provide vitually endless, free and clean energy to humanity, liberating us from fossil fuels for good.

The one thing that was common among all these stars was that they were all in a binary relationship with a white dwarf. After astronomers observed gas being sucked from the white dwarf stars, they hypothesised that the blue straggler had been using the fuel of the smaller star to stay perpetually youthful.

The theory suggests that these relationships took their origin in a close orbiting binary pair, with one star being substantially larger in size. We know that more massive stars tend to age faster, leading us to the conclusion that the star would also age quicker in this relationship.

As the star ages, it would start swelling up. As the star grows in size, the smaller star is able to come in contact with its outer layer of gas. The smaller star then becomes a 'Vampire Star', sucking fuel and energy out of its partner until it becomes nothing more than a dead white dwarf.

But this is not the end of the story.



Artist's depiction of a Vampire star

At some point in its life, the blue straggler would swell so much that its outer layer comes in the dead white dwarf's vicinity. This is when the white dwarf would try to steal back some of its fuel. Since it is impossible for the dead star to become alive again and restart fusion reactions, the fuel that the star sucks, starts to pile up.

As the piling of the gas continues, the star becomes a concentrated area of high energy hydrogen gas, and it meets its inevitable fate: an explosion. An explosion large enough to take out both the Vampire star and itself.

These stars are known as 'Zombie Stars'. And no, I'm not joking. These are, unironically the official names of these stars. So, to recap what we have gone through till now, there is the violent (and frankly, extremely abusive) relationship between two stars: the blue straggler/vampire stars and the later coined zombie star.

While 2020 has been a year equivalent to a rollercoaster on fire, it has started out well for the scientific community. To recount an actual spotting of the vampire star:

"NASA's Kepler spacecraft was designed to find exoplanets by looking for stars that dim as a planet crosses the star's face. A new search of Kepler archival data has uncovered an unusual super-outburst from a previously unknown dwarf nova. The system brightened by a factor of 1,600 over less than a day before slowly fading away.

The star system in question consists of a white dwarf star with a brown dwarf companion about one-tenth as massive as the white dwarf. A white dwarf is the leftover core of an ageing Sun-like star and contains about a Sun's worth of material in a globe the size of Earth (a brown dwarf is an object with a mass between 10 and 80 Jupiters that is too small to initiate nuclear fusion). "

This is an excerpt from the article published by NASA on the spotting of this Vampire star. To further read up on how the star was spotted and what the binary consisted of, you can go to this link.

PHYSICS AND ECONOMICS: IS THERE A NODAL CORRELATION?

BY RAGHAV SARANGI (XII B) & ISHAAN KANUDIA (XII F)

Abstract

The fields of Physics and Economics have mostly been viewed as isolated practices, and the rationale behind this convention is based on the fundamentals of each of these fields. While Physics is based on the research of the existing mechanisms of the universe, Economics is a conceptualisation of mankind. However, the monumental importance of these two fields and their ability to define the understanding of our society and surrounding compels us to analyze their roles in our lives. The series of articles which will follow would use the fundamentals of Econophysics and the evident concurrence between the subjects in an effort to demonstrate a possibility of rekindling an interest in the relationship between Economics and Physics.

Introduction

The importance of interdisciplinary research between Physics and Economics was realised in the 1990s when Physicists started exploring the application of 'Statistical Mechanics' to Economic theories. However, in recent years, the discipline of Econophysics has seen a gradual decline. With these articles, we attempt to collate and reintroduce Econophysics research at a grassroots level, and demonstrate the existing similarities between the two fields. In an effort to spur awareness of the field, we hope that this paper is successful in aiding further research.

Economics as an Imagined Reality

Economics is a discipline that significantly affects the structure of our society. It defines the interactions that consumers and producers are most likely to undergo, the investments that different members of the society will make and even the manner in which governments will structure their policies for the benefit of the country. In short, it directs the socio-political landscape using very simple assumptions of human nature.

However, one key characteristic of Economics is that it deals with entities that don't really exist anywhere except as a figment of an inter-subjective belief. An easy way to understand this is to think about money in terms of face value: It is nothing but a piece of printed paper made of wood pulp and a distinct composition of cotton and linen. It only has worth because we confer value upon it. Similarly, if we consider Apple as a corporeal establishment, is there anything that gives it a solid grounding? Of course, it has products, consumers and employees. However, all of these function under a particular brand name and there is nothing that separates them from the products, consumers or employees of another company. In other words, Apple only exists because we all choose to believe that there is a trillion-dollar corporation named Apple.

This idea of an “imagined reality” can also be extended to larger concepts such as nations and political boundaries. This isn’t to say, however, that Economics only deals with the virtual. The foundation of Economics are the principles of demand and supply. These are derived from human psychology and tangible factors such as the scarcity of resources. This paper acknowledges Economics as a field that, while predominantly concerned with systems that are more man-made than natural, has managed to transform the world entirely. (Harari 2011)

Physics: The Science of Understanding

Physics has long been considered an esoteric field, full of complex formulae and obscure concepts. However, its basis has always been extremely simple: the thirst for knowledge. The earliest physicists weren’t people that revelled in expressing the laws of the universe in concise mathematical equations. They were simply fascinated by natural phenomena, and curious enough to unravel the mystery. Physics, as a subject, seeks to understand the idiosyncrasies of our world. It also requires one to do so in an absolute manner, and this is why it has chosen its foundation to be mathematics, “the language with which God has written the Universe” as per Galileo.

The development of Physics can be traced across millenia, from Aristotle’s propositions of the various elements of nature to Newton’s revolutionary laws on gravity and his pioneering work in formally establishing the area of Mechanics. It has brought about several paradigm changes, ushering in the technological age at an unprecedented rate with its inventions of semiconductor chips and computing systems. While most concepts in Physics have a well-defined, concrete footing that can be seen in everyday life, such as the falling and rolling of footballs and the transmission of electromagnetic signals, it also deals with fey ideas, such as miniscule quantum fluctuations or the famous string theory.

Existing Econophysics Research

Econophysics is an interdisciplinary field of study that aims to utilize the tools learnt in Physics and apply them to economic problems of the real world. The term was first introduced by H. Eugene Stanley during a 1995 conference on statistical physics in Kolkata, India. Several Physicists have conformed to the practice of using their proficient mathematical and reasoning abilities to prepare analytical models of various economic and social situations. Notable examples include Daniel Bernoulli, Irving Fisher and Jan Tinbergen.

In the following editions of this series, we hope to present analyses of two examples which show the scope of Econophysics research.

TEACHERS' REMARKS THAT CHANGED THE HISTORY OF PHYSICS

BY ANANYA SINHA XII D

Archimedes: "You are late again. Don’t tell me you were locked again in the bathroom."

Copernicus: "When will you understand that you are not the centre of the world?"

Galileo: "If you will drop stones from the top of the tower one more time, you'll be dismissed forever."

Kepler: "Till when will you stare at the sky?"

Newton: "Will you please stop idling away under the apple tree?"

Volta: "I can see you have a lot of potential."

Heisenberg: "When will you be sure of yourself?"

Ohm: "Must you resist Ampere's (Empire's) opinions on current events?"

Nikola Tesla: "I see that everyone is attracted to your magnetic personality."

Einstein: "A crocodile is greener or wider?"

Schrodinger: "Stop abusing cats!!"

PAUSE AND PONDER

Q1 Why is the Earth round but the Milky Way flat?

Q2 Why do astronauts aboard the ISS feel weightless?

Q3 Why is the area of a rectangle its length times its width?

Q4 Is mathematics a science? Why or why not?

Q5 Why does the entropy of a closed system always increase?

Q6 Why are some quantities conserved and others not?

Q7 Why does light travel in a straight line?

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