

# PHYSICA

Annual Departmental E-Magazine

Vol.03

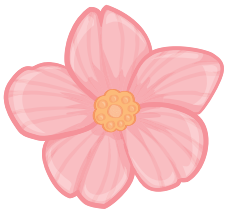
March 2026

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R$$

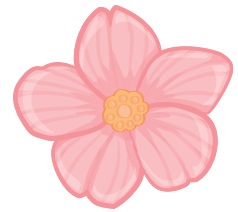
$$G_{\mu\nu} + \Lambda g_{\mu\nu} = (8\pi G / c^4) T_{\mu\nu}$$



DEPARTMENT OF PHYSICS  
ARYA VIDYAPEETH COLLEGE  
(AUTONOMOUS)



# In Loving Memory of



## **Bibha Chowdhuri**

(1913 - 1991)

### **Her Contributions to Science**

- One of the first Indian women experimental physicists.
- Specialized in Cosmic Ray Physics.
- Worked closely with D. M. Bose on high-energy particle research.
- Her early research contributed to the understanding of the pion (meson) particle in particle physics.
- Played an important role in developing experimental physics research in India.

### **Tribute**

**"Her dedication to science broke barriers and inspired generations of women in physics.**

**Her legacy continues to shine in the world of scientific discovery."**

## MESSAGE FROM THE PRINCIPAL DESK



It gives me great pleasure to present this e-magazine published by the Department of Physics. This initiative reflects the department's commitment to academic excellence, scientific curiosity, and creative expression. Physics plays a vital role in shaping analytical thinking and technological progress. This e-magazine provides a valuable platform for students to explore ideas, share knowledge, and showcase their intellectual potential beyond the classroom. I congratulate the editorial team, faculty members, and students for their dedicated efforts. I wish the Department of Physics continued success and hope this publication inspires young minds to pursue science with passion and purpose.

**Dr. Pradip Kr. Bhattacharyya**  
**Principal**  
**Arya Vidyapeeth College (Autonomous)**  
**Guwahati - 16**

## MESSAGE FROM THE HOD DESK



I am really very proud with our students that they are going express their ideas in Physica. The students of our Physics Department are very alert about the recent development of science and technology and literature. They try to give their ideas artistically in departmental E- magazine. I hope that the effort of students will reflect in the E- magazine and will spread awareness in the society as well the young generation.

I offer my heartiest greetings and congratulation to all the members of the Editorial Board. I wish them to continue their spirits in coming future.

**Dr. Apurba Kr. Das**  
**Associate Professor,**  
**Head of the Department,**  
**Department of Physics**  
**Arya Vidyapeeth College (Autonomous)**  
**Guwahati-16**

## MESSAGE FROM THE FACULTY IN CHARGE



It is a matter of great pleasure to present PHYSICA, the e-magazine of the Department of Physics. This magazine reflects the scientific curiosity, creativity, and academic enthusiasm of our students and faculty members. PHYSICA serves as a platform for sharing knowledge, ideas, and innovative thoughts beyond the classroom.

I appreciate the sincere efforts of the editorial team and contributors for bringing out this edition successfully. I hope PHYSICA inspires readers to explore, question, and develop a deeper understanding of physics.

I wish the magazine continued success in the years to come.

**Dr. Dipak Mazumdar**  
**Faculty In-Charge**  
**Department of Physics**

## MESSAGE FROM THE INAUGURATOR



It is really very appreciable that the Department of Physics, Arya Vidyapeeth College, Guwahati has come out with this year's, that is 2026, issue of the departmental magazine PHYSICA. I congratulate the faculty, students, supporting staff of the college, and all others behind the successful launch of this issue of the magazine. It will surely be a wonderful item to collect and preserve.

**Prof. Gazi Ameen Ahmed**  
**Department of Physics**  
**Tezpur University**  
**Tezpur, Assam.**

# MESSAGE FROM THE EDITOR

It gives me immense pleasure to welcome you to this edition of our Physics e-Magazine. Physics is not merely a collection of formulas and laws; it is a way of thinking, questioning, and understanding the universe around us. From the motion of the smallest particles to the evolution of vast galaxies, physics connects curiosity with creativity and logic with imagination.

This e-magazine is a humble effort to bring together ideas, insights, and innovations from the fascinating world of physics. Through articles, features, and student contributions, we aim to inspire young minds, encourage scientific temper, and showcase how physics continues to shape modern technology and human progress. Each page reflects the enthusiasm, hard work, and intellectual curiosity of our contributors.

I extend my sincere gratitude to the writers, editors, designers, and reviewers who worked tirelessly to make this publication possible. I also thank our readers for their continued support and interest in science. Your curiosity is the true driving force behind such initiatives.

I hope this issue sparks new questions, deepens understanding, and motivates you to explore physics beyond textbooks. Let us continue to learn, innovate, and look at the universe with wonder and reason.

Happy Reading!

**Raja Sharma**  
**Editor E-magazine**  
**PHYSICA**

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***A Legacy of Excellence:  
The Enduring Journey of the Department of Physics,  
Arya Vidyapeeth College (Autonomous)***



Since its establishment in 1962 under the foundational leadership of Prof. Biswanath Bhattacharjee, the Department of Physics at Arya Vidyapeeth College (Autonomous) has been a beacon of scientific education in the region. Over the decades, it has cultivated a distinguished legacy of academic rigor and scholarly contribution.

The department boasts a well-developed academic infrastructure to support both teaching, learning and innovation. In addition to the central college library, it maintains an independent, resource-rich departmental library with indigenous digitally monitored “ECLIPSE” system, developed by the students. Students also benefit from access to a dedicated computer lab and a digital classroom, ensuring a technologically enhanced learning environment.

Academically, the department has consistently performed with distinction, maintaining an average success rate of over 80%. Its alumni have gone on to excel across a broad spectrum of fields, holding esteemed positions in universities, colleges, schools, and multinational corporations—a testament to the quality and relevance of the education imparted.

Research and innovation remain at the core of the department’s mission. Faculty members are actively engaged in advanced research across diverse domains, including High Energy Physics, Nuclear Physics, Condensed Matter Physics, Nano Science and Technology, Computational Physics, and Astrophysics. Their scholarly output includes numerous research papers published in internationally recognized journals, and they have successfully completed several major research projects funded by national agencies.

The department’s distinguished history is further enriched by its faculty’s achievements. Dr. P. K. Dhar, a former faculty member, has been invited as a visiting scientist to premier institutions such as SINP, PRL, HRI, and IISER-Kolkata. The department also proudly counts among its former faculty the celebrated litterateur Dr. Sivanath Barman. In a remarkable testament to their academic leadership, four former faculty members—Dr. Amar Saikia, Dr. Suren Sarma, Dr. Amulya Choudhury, and Dr. Manoj Kumar Mahanta—have served as Principals at various colleges across Assam.

In recognition of its sustained excellence and significant contributions to science education, the department was honoured as a 'Star Department' by the Department of Biotechnology, Ministry of Science and Technology, Government of India, in 2018.

This accolade stands as a proud milestone in its ongoing journey of academic distinction.

## **FACULTY MEMBERS OF PHYSICS DEPARTMENT**



-->From left to right:-->

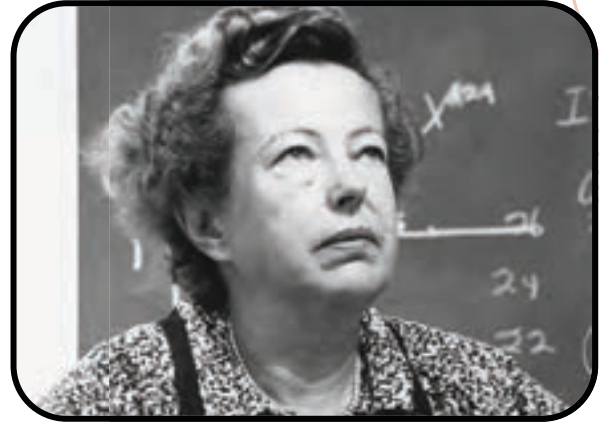
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Mr. Nayan Narayan Das (Assistant Professor)



## Woman Who Won Nobel Prize in Physics



**Marie Curie**  
(1903)



**Maria Goeppert Mayer**  
(1963)



**Donna Strickland**  
(2018)



**Andrea Ghez**  
(2020)



**Anne L'Huillier**  
(2023)

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IMAGINATION  
IS MORE  
IMPORTANT  
THAN  
KNOWLEDGE.

$$\frac{1}{2} \rho v$$

$$p v$$

$$= \int$$

$$x$$

$$F = m \cdot a$$

$$E = mc^2$$

# ARTICLE SECTION



"TIME IS AN

# Architect and the Defiant Genius behind the LED Age

## SHUJI NAKAMURA

Dr. Dipak Majumdar

Assistant Professor

In the annals of technological revolution, few stories are as compelling as that of the blue light-emitting diode (LED). For three decades, this component represented the final, elusive piece in a puzzle that, once solved, would redefine illumination and connectivity for humanity. While the 2014 Nobel Prize in Physics celebrated a trio of pioneers—Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura—it is Nakamura’s path that reads like a manifesto for disruptive innovation. His journey from an underfunded researcher at a small chemical firm to the architect of modern light challenges conventional narratives about where and how ground-breaking science happens.

The quest for the blue LED was more than an academic curiosity; it was a critical engineering bottleneck. Red and green LEDs had been commercially viable since the 1960s and 70s, but without an efficient blue source, it was impossible to synthesize the white light essential for general lighting and full-colour displays. The scientific community had largely settled on gallium nitride (GaN) as the ideal semiconductor material due to its wide bandgap. However, GaN was notoriously difficult to work with, earning it the nickname “garbage material” in labs. Growing high-quality, single-crystal GaN layers on affordable substrates like sapphire seemed insurmountable, leading giants like Sony and Philips to abandon the pursuit. The prevailing consensus was one of resigned impossibility.

Into this landscape of skepticism stepped Shuji Nakamura, a young engineer at Nichia Chemical, a company in rural Tokushima, Japan, specializing in phosphors for cathode-ray tubes. Lacking a PhD and operating far from Japan’s elite research universities, Nakamura was an improbable protagonist.



Photo Courtesy of Ladislav Markuš

His initial mandate was to improve existing red LEDs, but he became fixated on the blue problem. His first critical move was not technical, but entrepreneurial. He secured funding from Nichia’s president with a stark, all-or-nothing pledge: “Give me the budget. If I fail, I’ll resign.” This gamble freed him to pursue a parallel path to the academic work of Akasaki and Amano at Nagoya University, who had made foundational but impractical prototypes.

Nakamura’s genius was characterized by pragmatic, hands-on ingenuity. Confronted with the prohibitive cost of commercial crystal growth systems, he designed and built his own novel two-flow metalorganic chemical vapor deposition (MOCVD) reactor. This bespoke equipment allowed for unprecedented control over the GaN growth process, yielding crystals of exceptional quality. His second major breakthrough solved the “p-type doping” problem—making GaN layers conductive in a way essential for an LED to function. While Akasaki and Amano used a complex electron beam treatment, Nakamura discovered that simply thermal annealing (heating) the material in a furnace achieved the same results

## Architect and the Defiant Genius behind the LED Age SHUJI NAKAMURA

solution of elegant simplicity tailor-made for mass production.

Perhaps his most profound contribution was the strategic use of indium gallium nitride (InGaN) as the active layer in the LED. This alloy allowed precise tuning of the light's wavelength. More importantly, it possessed a miraculous property: its efficiency at emitting light was remarkably tolerant of the crystal defects that still plagued GaN films. This defied established semiconductor physics, where defects typically kill performance, and it became the key to achieving breath-taking brightness.

The moment of validation came in 1993 at a major conference in Japan. When Nakamura, the unknown engineer from a small company, presented a blue LED 100 times brighter than any previous device, the reaction was one of stunned disbelief. He had not merely replicated academic research; he had surpassed it with a robust, manufacturable product. This single presentation transformed the blue LED from a laboratory specimen into the cornerstone of a global industry.

The immediate application was the creation of white light. By coating the intense blue LED with a yellow phosphor, a portion of the blue light is converted, mixing to produce a clean, bright white. This simple method became the foundation for the global solid-state lighting revolution. Nakamura's subsequent departure from Nichia in 1999 and the landmark legal battle that followed further cemented his legacy as a champion for inventors' rights. The historic 2005

settlement, awarding him approximately \$800 million, was a recognition that individual intellect could generate value surpassing that of the corporation itself.

Today, the impact of Nakamura's work is omnipresent and profound. Over 80% of global LED lighting relies on his GaN-based technology, driving unprecedented energy savings and reductions in carbon emissions. The vivid, efficient screens of our smartphones, tablets, and televisions are direct descendants of his blue LED. Furthermore, it enabled transformative technologies like Blu-ray data storage and advanced water purification and sterilization systems. While Akasaki and Amano proved the fundamental possibility, Nakamura engineered the practical reality that now illuminates our world.

Shuji Nakamura's legacy, therefore, transcends the diode itself. It is a powerful case study in resilient ingenuity, strategic risk-taking, and the challenge to scientific dogma. For students in engineering, physics, and entrepreneurship, his story is a compelling reminder that transformative innovation often emerges from the periphery, driven by individuals willing to bet everything on a vision that the establishment has written off. He is not merely a Nobel laureate; he is the defiant maverick who taught the world to see in a new light.

*"The whole of science is nothing more than a refinement of everyday thinking."*

— ALBERT EINSTEIN

## Why Could Abhimanyu Not Escape the Chakravyuha? *A Simple Scientific Way of Thinking*

Krishna Kingkar Pathak

Associate Professor

### Introduction

The Mahābhārata describes many extraordinary battle formations, but none is as famous or as intriguing as the Chakravyūha. This formation, arranged in a spiral pattern, allowed warriors to enter with relative ease while making escape increasingly difficult. Once inside, movement toward the center involved continuous combat, confusion, and exhaustion. According to the traditional account, Abhimanyu knew how to enter the Chakravyūha but did not know the method of exit, a fact often cited as the primary reason for his tragic end.

However, complex situations in real life are rarely explained by a single factor. Modern science teaches us that outcomes are often shaped not only by knowledge and intention, but also by physical limits such as fatigue, energy loss, and coordination. A person may know the correct path or solution, yet be unable to act upon it once strength is depleted.

This article does not attempt to reinterpret history or challenge traditional understandings of the Mahābhārata. Instead, it explores how **modern scientific ideas offer an additional way of thinking** about the Chakravyūha episode. By drawing on simple concepts related to energy, movement, and human limitations, we ask a different question: was the real trap created by lack of knowledge, or by the gradual loss of the ability to act?

Seen in this light, the Chakravyūha becomes more than a clever military formation. It becomes an example of how situations can be designed to drain energy first, so that escape fails naturally.

### The Chakravyūha as a Trap of Fatigue

Imagine being inside a crowded spiral passage where people are constantly pushing inward. You may know where the exit lies, but escaping is not simply a matter of direction. It requires calm movement, coordination, balance, and above all, physical strength. If you are injured, surrounded, or exhausted, your body may no longer respond to what your mind intends.



Figure 1: A conceptual illustration of the Chakravyūha as a spiral trap. Entry into the formation is relatively easy, but escape requires sustained energy, precise timing, and coordinated sideways movement. As exhaustion increases, controlled angular motion becomes difficult, effectively trapping the individual near the center.

## Why Could Abhimanyu Not Escape the Chakravyūha? *A Simple Scientific Way of Thinking*

The Chakravyūha can be imagined in a similar way. Once inside the formation, movement was not free in all directions. Instead, different directions demanded very different levels of effort:

- *Moving inward involved continuous fighting and intense physical strain.*
- *Escaping required careful sideways movement, precise timing, and coordination amid chaos.*

As long as strength and control remained, such movement may have been possible. But with every moment of combat, energy was steadily drained. Modern science teaches us a simple but powerful lesson: knowing a path is not enough if the energy required to follow it is no longer available. When exhaustion sets in, options that once existed quietly disappear.

### A Sanskrit Reflection on Courage and Limits

The Mahābhārata repeatedly emphasizes Abhimanyu's courage and sense of duty. One verse describes him as unwavering in battle:

*Abhimanyus tu dharmātmā na yuddhād vyaticakrame*

### Simple meaning:

Abhimanyu, devoted to righteousness, never turned away from battle. This verse reminds us that Abhimanyu's fate was not the result of fear, hesitation, or lack of resolve. His courage was unquestionable. A modern scientific perspective offers a complementary insight: even the bravest warrior is bound by physical and mental limits.

Strength, coordination, and endurance are not infinite, and once they are depleted, control over one's actions begins to fade.

### Energy Matters More Than Knowledge

In many real-life situations, success or escape does not depend on strength alone, nor on knowledge alone, but on the ability to exercise fine control. Such control allows a person to move carefully, judge timing, and respond intelligently to changing conditions. All of this, however, requires energy.

*As long as a person has sufficient energy:*

- Small, careful movements remain possible.
- Coordination, balance, and timing can be maintained.
- Decisions can be translated into effective action.

*With continued effort and mounting fatigue, a critical point is eventually reached. Beyond this point:*

- *Fine control over movement begins to disappear.*
- *Reactions become slower and less precise.*
- *Only desperate, energy-draining actions remain available.*

At this stage, escape may still exist in theory, but it becomes impossible in practice. Paths that were once open can no longer be followed, not because they are blocked, but because the body and mind no longer have the strength to act on them. This distinction between *knowing what to do and being able to do it* lies at the heart of many human failures under extreme stress.

## Why Could Abhimanyu Not Escape the Chakravyuha? *A Simple Scientific Way of Thinking*

### Illustration: The Chakravyūha Trap

The illustration helps us understand why the Chakravyūha was such an effective formation. Its power did not lie only in its geometric shape, but in how that shape interacted with human limits. Entry into the spiral was relatively easy, but each step toward the center demanded continuous effort, combat, and attention.

Over time, this constant engagement drained physical and mental energy. By the time escape could be considered, the strength required for calm, coordinated movement was already diminished. In this way, the Chakravyūha functioned as a system that exhausted the individual first, ensuring that escape would fail naturally. The trap worked not by blocking paths, but by quietly removing the ability to follow them.

### Another Sanskrit Insight

Indian philosophical thought has long emphasized the connection between action and physical condition. This idea is beautifully expressed in a well-known Sanskrit verse:

*Śarīram ādyam khalu dharma-sādhanam*

### Simple meaning:

*The body is the primary instrument for performing one's duty.*

This verse reminds us that all action, however noble or well-intentioned, ultimately depends on the condition of the body. Courage, knowledge, and moral resolve are essential, but they can be expressed only through physical and mental capacity. Modern science echoes this in sight: when

energy is depleted, control fades, and choices that once seemed available quietly disappear.

### A Modern Scientific Perspective

Modern physics and control science study many systems in which movement and choice are possible in principle, but limited in practice by energy and fatigue. In such systems, not all directions of action are equal. Some actions can be taken with little effort, while others demand sustained energy and precise control.

Researchers have found that:

- Movement may be possible in many directions, but not all are equally easy.
- Certain directions require far more energy than others.
- Once energy drops below a critical level, practical choices begin to disappear.

Viewed through this lens, the Chakravyūha can be understood not merely as a clever formation, but as a system designed to exhaust an individual before escape could even be attempted. The trap succeeds because it drains strength first, ensuring that options vanish naturally rather than being forcibly blocked.

### Why This Matters Today

This way of thinking is not limited to ancient battlefields. Similar situations arise frequently in modern life, wherever people must act under pressure and limited energy. Examples include:

- Competitive sports, where endurance often determines the final outcome.
- Emergency situations, where exhaustion can

## Why Could Abhimanyu Not Escape the Chakravyuha? *A Simple Scientific Way of Thinking*

- High-pressure workplaces, where fatigue reduces judgment and creativity.
- Emergency situations, where exhaustion can narrow available choices.
- Team dynamics and leadership, where sustained effort is required to guide others effectively.

In all these cases, success depends not only on strategy, intelligence, or planning, but also on managing energy and fatigue. Recognizing this connection helps us understand why some situations become impossible to escape, even when solutions appear obvious in hindsight.

### Conclusion

The story of Abhimanyu reminds us that courage, intelligence, and determination are powerful qualities, but they are not limitless. Modern science offers a complementary insight: when energy is gradually drained, the ability to act with precision and control begins to fade. At that point, even paths that remain theoretically open can become effectively closed in practice. Viewing the Chakravyūha through a scientific lens does not diminish the depth or dignity of the original narrative. Instead, it enriches our understanding by connecting an ancient story to universal human experiences of fatigue, pressure, and limitation. The episode illustrates how exhaustion, rather than ignorance, can determine outcomes in complex situations. In this way, the Chakravyūha continues to speak to the present. It reminds us that managing energy is as important as acquiring knowledge and that wisdom lies not only in knowing what to do, but in preserving the strength required to do it.

*"A physicist is just an atom's way of looking at itself."*

— NEILS BOHR

## The Ghost In the *Machine*

*Why Our Lab Errors are secretly Genius*

Borsha Sharma

|

FYUGP 6<sup>th</sup> Semester

The fluorescent lights of the UG lab have a specific hum, a low-frequency buzz that seems to get louder when our experiment is failing. We've been standing over a "Resonance Column" for two hours. We strike the tuning fork and hold it over the tube, eyes fixed on the water level. We are searching for that one elusive frequency where the air column finally sings back to us. But the lab is too loud. Someone laughs in the corner; a chair scrapes across the floor. The resonance is lost. We demand pin-drop silence, not because we're being sensitive, but because we are trying to catch a whisper from the laws of physics.

"Still nothing."

In that moment, it's easy to feel like a failure. But in the grand tradition of Physics, we are exactly where we need to be.

### THE MYTH OF THE "CLEAN" DISCOVERY

As 6th Semester students, we are often haunted by the "Ideal Gas" or the "Frictionless Plane". We enter the lab chasing 'A Ghost: the Correct Value'. We think success is a straight line on a graph, a perfect  $R^2 = 0.999$  correlation. "But Physics is rarely that polite"

A parallax error while reading the water level isn't just a mistake; it is a reminder that the observer is part of the system. A temperature fluctuation that changes the speed of sound in the room isn't an "annoyance", it is a physical reality that demands us account for the entire environment.



### The Lab is a Silent Teacher

When the tuning fork seems to go mute or the vernier scale refuses to cooperate, we aren't just measuring sound or distance. We are practicing Methodological Rigor.

We learn to: —

- Measure twice: Not because of a rule, but out of a profound respect for the sensitivity of nature.
- Trust logic over guesswork: Because while a "guessed" resonance point might get us a signature in our record book today but it leaves our mind empty tomorrow.
- Question the default: If the graph isn't straight, maybe the law isn't "broken", maybe we've just discovered a systematic bias, like the end correction of the tube that we previously ignored.

## The Ghost In the *Machine*

*Why Our Lab Errors are secretly Genius*

### The Alchemist's Transformation

Physics does not reward the fast. It rewards the sincere. The student, who waits in total silence, striking the fork again and again to find the exact peak of a standing wave, isn't "slow."

They are becoming a Thinker. They are developing the resilience that defines a scientist. They are learning that a flawed result backed by deep, honest reasoning, accounting for the humidity and the room pressure is infinitely more valuable than a "perfect" result copied from a senior's old record.

One day, maybe not today, but soon the readings will align. The sound will swell into a clear, vibrating hum that fills the silence. In that moment, we'll realize the thrill wasn't the number we wrote in the observation table. The thrill was the version of us that didn't give up when the environment was chaotic.

### The Ultimate Equation

We learn the most important equation of all that

*Effort + Methodological Patience = Intellectual Evolution*

In physics, every error carries a hidden truth, and every failure brings us one step closer to understanding the universe.

*"I have broken the machine (the atom) and touched the ghost of matter."*

— ERNEST RUTHERFORD

## A Known Mystery: Blackhole

Manash Pratim Das

|

FYUGP 6<sup>th</sup> Semester

**B**lack holes are one of the most fascinating and mysterious objects in the universe. Even though scientists have studied them for many years, black holes still remain a topic full of unanswered questions. They are called a “known mystery” because we know they exist, but we do not completely understand what happens inside them

A blackhole is formed when a very massive star reaches the end of its life. When the fuel inside the star is exhausted, it collapses under its own gravity. This collapse becomes so strong that nothing can escape from it—not even light. Because light cannot come out, we cannot see a black hole directly. Instead, we detect its presence by observing the effect it has on nearby stars and matter.

One of the most interesting parts of a black hole is the event horizon. This is the boundary beyond which nothing can return. Once an object crosses this limit, it is permanently trapped. Scientists believe that at the centre of a black hole lies a point called the singularity, where gravity becomes infinitely strong. The laws of physics as we know them stop working there, which makes black holes even more mysterious.

Black holes are not dangerous to Earth, as they are located very faraway in space. In fact, they play an important role in shaping galaxies. Many galaxies, including our own Milky Way, are believed to have a super massive blackhole at their centre. These giant blackhole help control the movement of stars and gas within the galaxy.



Despite their fearsome reputation, black holes are not cosmic vacuum cleaners. They do not suck in everything around them unless an object comes very close. Most of the time, they remain quiet and invisible, silently existing in space.

In recent years, scientists have made great progress in studying black holes. The first image of a black hole was captured in 2019, which was a historic achievement. Even today, research continues, and black holes remain one of the greatest puzzles of modern science.

In conclusion, black holes are truly a known mystery. They challenge our understanding of space, time, and gravity. As technology improves, we may one day uncover more secrets about these strange and powerful objects that exist in the depths of our universe .

*“Somewhere, something incredible is waiting to be known”*

– CARL SAGAN

## The Hidden Physics In Music & Sound

Dikshya Chakaravarty

| FYUGP 6<sup>th</sup> Semester



**M**usic feels like emotion in motion; the quiet order behind it. Music blends into daily life so naturally that we rarely stop to question it. It fills silent rooms, keeps us company during long hours, helps us to heal and expresses feelings that words often fail to capture. On the surface, music feels spontaneous and free. Yet beneath this emotional experience lies a carefully structured physical process. Every sound we hear follows well defined laws of motion and energy, turning something invisible into something deeply meaningful.

At the core of all musical sound is vibration. When a string is plucked, a drum is struck, or air is pushed through an instrument, oscillations are produced. These vibrations travel through the air as longitudinal waves, moving in alternating regions of compression and rarefaction. As explained in Fundamentals of Acoustics, this basic wave motion is responsible for transforming physical movement into audible sound.

What makes music rich and expressive is the fact

that instruments never produce just one frequency. Along with the main note, several additional frequencies known as harmonics or overtones are generated. These combine to create timbre, the unique quality of sound that allows us to recognize different instruments instantly. A piano and a flute may play the same note, but their harmonic structures differ, giving each its own sonic identity. This idea is explored in detail in The Physics of Sound.

Hidden beneath these sounds is a powerful mathematical idea: Fourier analysis. It shows that even the most complex musical tone can be broken down into a set of simpler wave components. While this concept is often introduced mathematically, its impact is very real. Sound recording, audio compression, and digital music platforms all rely on Fourier principles to analyze and reproduce sound without losing its character.

Music is shaped not only by physical waves but also by how humans perceive them. Our ears do not respond equally to all frequencies, and changes in loudness are sensed logarithmically rather than linearly. This is why certain sounds feel comfortable and pleasing, while others feel sharp or unsettling. Music exists in a space where physics meets human perception, making it both a scientific and emotional experience.

The environment in which music is heard also plays a major role. Concert halls and auditoriums are carefully designed to control

## The Hidden Physics In Music & Sound

how sound waves reflect, spread, and fade. Proper acoustics can enhance clarity and depth, while poor design can distort even the best performance. As discussed in Music, Physics and Engineering, architecture and physics work together to shape the way sound reaches an audience.

Understanding the physics behind music adds a deeper meaning to the way we listen. Songs are no longer just background sounds; they become living examples of resonance, wave motion, and energy transfer at work. The hidden physics in music and sound reminds us that science is not distant or abstract, it exists quietly within everyday experiences. In every melody we enjoy, physics is present, shaping emotions through motion and turning invisible in waves into something we can truly feel.

*“Songs are living example of resonance, wave motion and energy transfer at work”*

**340 m/s**

Speed of sound in air at room temperature

**20 Hz to 20 kHz**

Human hearing range

*“If you want to understand function, study structure.”*

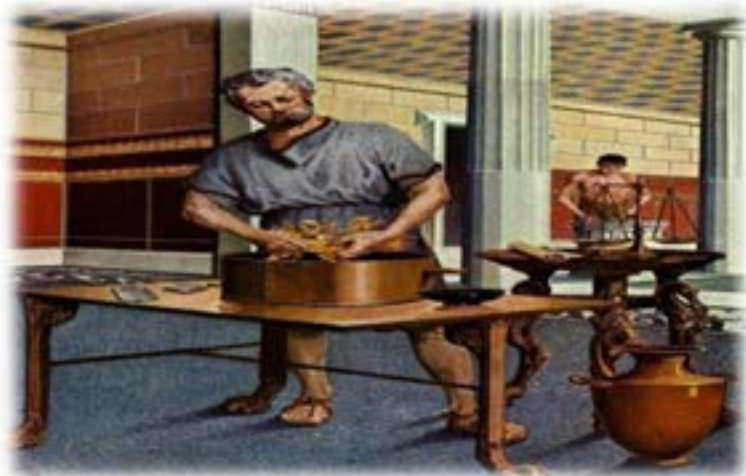
- FRANCIS CRICK

## ARCHIMEDES AND THE GOLDEN CROWN BUOYANCY

Tisha Sahani

|

FYUGP 6<sup>th</sup> Semester



### The Problem

In the 3rd century BC, King Hiero II of Syracuse suspected his goldsmith had cheated him. The King had provided pure gold for a votive crown, but he feared the smith had swapped in some cheaper silver and kept the rest of the gold. The crown weighed the correct amount, but was it pure gold? He asked Archimedes to solve it without damaging the crown.

### The "Eureka" Moment

Archimedes knew that gold is denser than silver. If the crown had silver in it, it would take up more space (volume) than a lump of pure gold of the same weight. But how do you measure the volume of an irregularly shaped crown?

Legend has it that Archimedes stepped into a bathtub filled to the brim. He noticed that the water spilled over the edge as he sank in.

He realized that the volume of water displaced was equal to the volume of the part of his body submerged.

He was so excited by this realization that he reportedly leaped out of the bath and ran naked through the streets of Syracuse shouting "Eureka!" ("I have found it!").

### The Result

He dunked the crown in water and measured the displacement. It displaced more water than an equal mass of pure gold, proving it was less dense (and thus contained silver). The goldsmith was caught, and the Archimedes' Principle was born. Something we can truly feel.

**19.3 g/cm<sup>3</sup>**

Density of pure Gold

**10.5 g/cm<sup>3</sup>**

Density of Silver

### ARCHIMEDES PRINCIPLE

Any object submerged in a fluid experiences an upward buoyant force equal to the fluid displaced by the object.

*"The only way to learn science is by doing science."*

- JAMES WATSON

## Can We *Freeze* a Ray of Light?

Sahil Sarkar

| FYUGP 6<sup>th</sup> semester



*“When too many photons are brought together, they start behaving in an unusual way — forming a “supersolid.”*  
Bose-Einstein Condensate Research · Italian Science Team

### Introduction

As we look around ourselves, we see many things around us— plants, animals and humans. But the most abundant thing that exists on the Earth is “water” which constitutes about 71% of the surface. Arguably it is also the most important of all elements for survival of all nature.

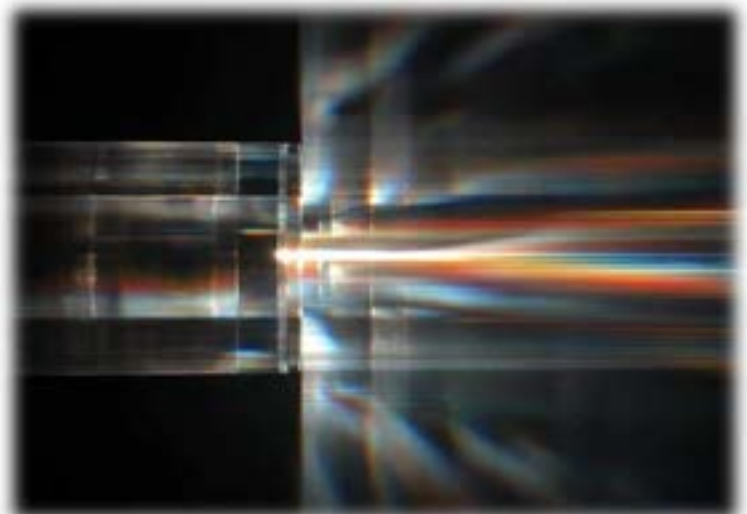
One of the interesting properties of this substance is that it can undergo changes of state and appear to be totally indistinguishable yet mutually recoverable substances, viz liquid ↔solid ↔gas. If we especially talk about freezing, it is simply when the atoms are made to cease their inherent motion so that they form a crystalline solid structure.

#### **Bose-Einstein Condensate**

A quantum state where particles move as one unit at extremely low temperatures, exhibiting unusual collective behaviour.

### Is it the same as Freezing Water?

Freezing a light ray is not the same as freezing water, mainly because light is not the same as ordinary matter. According to “quantum mechanics”, light is indeed made up of particles of energy called photons, but those particles don’t carry any mass and are just discrete units of energy which is light. So, the process used to freeze matter cannot be used to do the same with light.



## Can We *Freeze* a Ray of Light?

### How Do You Freeze A Ray of Light?

In an experiment, a group of Italian scientists worked with light at temperatures near absolute zero, where quantum effects dominate. Absolute zero or 0 kelvin is defined as that temperature where molecular motions cease altogether. Although, it is not practically possible to reach that temperature, it is still possible to get close approximately close to that.

The study is based on a concept called Bose-Einstein Condensate (BEC), where particles move together as one unit at extremely low temperatures. When too many photons are brought together they start behaving in an unusual way, forming a “supersolid”.

A supersolid is an exotic, quantum state of matter which exhibits the property of ordinary solids, thus forming a crystal structure with the property of very low viscosity thus flowing like a superfluid.

### Practical Applications

The discovery of supersolid has novel applications as listed below.

- ❖ Supersolid light could enhance the stability of qubits—the fundamental units of quantum computation. Additionally, this breakthrough could revolutionize the development of optical devices, photonic circuits, and further fundamental research in quantum mechanics.
- ❖ The ability to manipulate light in this way offers new possibilities in precision measurement secure communication, and advanced materials science. This discovery gives scientists anew way to study light and could lead to advances in quantum physics and technology.

*“I, a universe of atoms, an atom in the universe”*

- RICHARD FEYNMAN

## THE INDIAN

## PHOENIX

A 5,000-Year Journey of Scientific Brilliance

Anup Das | FYUGP 6<sup>th</sup> Semester

From the zero that defines our digital world to the satellites currently orbiting the Moon, India's scientific identity has never been just about survival—it has been about pioneering the impossible. As we stand in 2026, the nation is no longer just a participant in the global tech race; it is setting the pace.

India's scientific and technological legacy is a continuum of innovation that spans millennia, from ancient philosophical foundations to 21st-century space exploration.

## Ancient Era: The Foundations of Knowledge Mathematics

**Aryabhata (5th Century CE):** Often called the "Father of Indian Mathematics," he introduced the concept of zero as both a numeral and a symbol. He also calculated the value of pi ( $\pi$ ) to 3.1416 and proposed that the Earth rotates on its axis.

**Boudhayan (8th Century BCE):** Described the principles of the Pythagorean Theorem long before Pythagoras and was one of the first to calculate the value of pi.

**Brahmagupta (7th Century CE):** Established formal rules for operations with zero and introduced a multiplication method similar to modern techniques.

## Medicine &amp; Surgery

**Sushruta (ca. 600 BCE):** Known as the "Father of Plastic Surgery," his treatise Sushruta Samhita detailed rhinoplasty (nose reconstruction), cataract surgery, and the use of over 120 surgical instruments.

**Charaka (ca. 300 BCE):** Regarded as the "Father of Indian Medicine," he authored the Charaka Samhita, the foundational text of Ayurveda, and was an early researcher into digestion, metabolism, and immunity.

## Physics

**Acharya Kanada (ca. 600 BCE):** Developed the atomic theory (Vaisheshika school) nearly 2,500 years before John Dalton, proposing that all matter is composed of indivisible particles called Anu.

## The Modern Pioneers (Pre-Independence) :

**Jagdish Chandra Bose:** A polymath who demonstrated wireless communication in 1895, two years before Marconi. He also invented the Crescograph to prove that plants are living beings sensitive to stimuli.

**C.V. Raman:** Discovered the Raman Effect (light scattering) in 1928, becoming the first Asian to win a Nobel Prize in Physics (1930).

## THE INDIAN PHOENIX

**Srinivasa Ramanujan:** A self-taught mathematical genius who made extraordinary contributions to number theory, infinite series, and continued fractions despite no formal training.

**Satyendra Nath Bose:** Collaborated with Albert Einstein to develop the Bose-Einstein statistics, leading to the discovery of the "God Particle" (Higgs Boson) and the concept of bosons.

### Contemporary Excellence (Post-1947 to 2026):

#### *Space & Nuclear Science*

**Vikram Sarabhai:** The "Father of the Indian Space Program," he founded ISRO in 1969, envisioning space technology as a tool for societal development.

**Homi J. Bhabha:** Known as the "Father of India's Nuclear Program," he established institutions like TIFR and BARC to lead India toward nuclear self-reliance.

**A.P.J. Abdul Kalam:** Known as the "Missile Man of India," he led the development of indigenous ballistic missiles (Agni and Prithvi) and played a key role in the Pokhran-II nuclear tests.

### Leading 2026 Achievements

**Space Exploration:** India remains a global leader in space, with active missions including Chandrayaan-3 (lunar soft landing) and the Gaganyaan human spaceflight program.

### Defense & Healthcare

Breakthroughs include indigenous aircraft carriers like INS Vikrant and global leadership in vaccine

### Digital Innovation

India has achieved one of the fastest global rollouts of 5G technology and continues to lead in digital public infrastructure through initiatives like the Digital India mission.

*"Science is about being curious."*

- KARY MULLIS

## The Physics Behind 5G

5G is not merely a software upgrade, it is a triumph of wave physics, antenna engineering, and electromagnetic theory made practical at scale  
 .Ritisha Kalita | FYUGP 6<sup>th</sup> Semester



**W**hen we think about 5G, we usually imagine faster internet, smoother video calls, and better connectivity. But behind this technology is a lot of physics. Without understanding waves, energy, and electromagnetic behavior, 5G would not be possible.

5G or fifth-generation wireless technology, is the latest iteration of mobile networks, succeeding 4G LTE. It is designed to deliver higher data speeds, support massive device connectivity, and reduce latency. Unlike previous generations, 5G operates on multiple spectrum bands, including low-band, mid band, and high-band (millimeter wave or mm

Wave) frequencies, making it significantly more efficient and capable. 5G uses a wider range of the electromagnetic spectrum, including higher frequencies known as millimeter waves (mm Wave). These waves can carry more data, but they behave differently from lower-frequency waves. Physics explains why these waves:

- Travel shorter distances
- Get blocked easily by walls and buildings
- Need more towers placed closer together

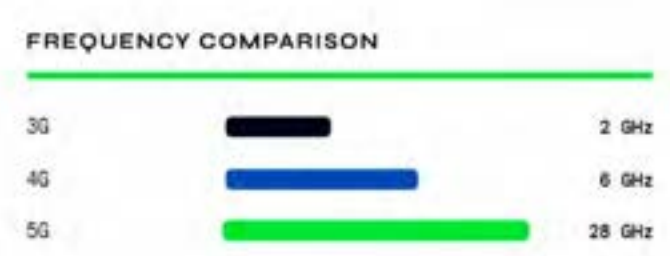
Without wave physics, engineers would not know how to design networks that handle these problems.

### BEAMFORMING

A signal processing technique that directs electromagnetic waves toward specific users using constructive and destructive wave interference — a direct application of superposition principles.

Without physics, fast and reliable communication like 5G would simply not exist.

## The Physics Behind 5G



### Frequency Comparison

Physics tells us that frequency and wavelength are closely related. Higher frequency waves have shorter wavelengths. 5G uses higher frequencies to increase data speed, but shorter wavelengths mean the signal is more sensitive to obstacles. Understanding this relationship helps scientists decide:

- Which frequency bands are best for cities or rural areas.
- How antennas should be designed
- How to reduce signal loss.

With previous technologies, the network sends the signal indiscriminately over a large area in all directions (umbrella broadcasting); the active antennas deployed with 5G allow to restrict the signal to the user's area of presence only. They also allow users to be spatially orthogonal and thus increase capacity. Antennas are not just metal rods. Their shape, size, and arrangement are designed using physics principles. 5G uses a technique called beamforming, where signals are directed toward specific users instead of spreading in all directions.

Beam forming is based on wave interference and superposition, both core ideas of physics. 5G has introduced mechanisms to put the infrastructure on standby to reduce energy consumption in off-peak periods (night or sparsely populated areas) physics helps manage energy use in 5G networks. 5G is not just an upgrade in software. It is deeply connected to physical laws. From wave propagation and frequency selection to antenna design and signal processing, physics plays a central role at every step. Without physics, fast and reliable communication like 5G would simply not exist.

# *If God* is Silent what are we??

Didwm Daimary

6<sup>th</sup> semester

*I have often wondered whether human life is a mistake we are too afraid to name. We are born into a world already in motion, already demanding. Before we understand what existence is, we are required to participate in it. To survive. To obey. To strive. No one asks whether we want this burden. Life simply begins, and from that moment onward, struggle is non-negotiable.*

No one asks whether we want this burden. Life simply begins, and from that moment onward, struggle is non-negotiable.

What troubles me most is not suffering itself, but its consistency. Pain is not an exception it is the structure. Every human life, regardless of privilege, bends eventually toward loss: of youth, of certainty, of people, of the body, and finally of the self.

*“We spend our years earning things that time quietly prepares to confiscate.”*

Children suffer before they can sin. Good people break while the cruel endure. Prayers are answered randomly, if at all. This randomness does not resemble justice, it resembles chance.

And so a disturbing idea forms, one that religion discourages but reason allows.

*“What if we are not the purpose of creation, but a byproduct of it?  
Or worse, what if we are an experiment? A spectacle?”*

## ***The Question of God!!***

If God exists, His presence is strangely incompatible with the world as it is.

A creator who is all-powerful yet permits meaningless suffering is either unwilling to intervene or uninterested in doing so. Neither possibility is comforting. Faith asks us to call this mystery. Reason calls it neglect.

*“I do not deny God out of arrogance. I question Him out of observation.”*

Perhaps the gods, if they exist, do not intervene because intervention would ruin the authenticity of the drama. Suffering must be real to be interesting. Hope must exist so it can be denied.

## ***A Lifetime Reduced to Nothing***

Humans exhaust themselves accumulating meaning through work, love, belief, and legacy. Yet death treats all of it with equal indifference.

When a person dies, their ambitions do not follow them. Their regrets do not either. Everything they fought for remains behind, instantly ownerless. A lifetime of effort becomes irrelevant in a matter of hours.

*This is not tragic in a poetic sense. It is tragic in a banal one.*

*The universe does not acknowledge our struggle. It does not pause. It does not remember.*

## ***If God is Silent what are we??***

### *Why then Continue?*

Perhaps the hardest truth is this: We continue not because life is meaningful, but because stopping requires certainty and humans rarely have it. We live because instinct is stronger than logic. Because hope, even when irrational, is persuasive. Because admitting that none of this matters feels heavier than continuing the illusion that it might.

*“Maybe philosophy exists not to answer these questions, but to make them bearable.”*

---

### *A Quiet Conclusion*

*I do not know whether God exists.*

*I do know that if He does, He has chosen silence over clarity.*

*And I do not know whether life has inherent meaning.*

*I only know that humans behave as though it must perhaps because accepting otherwise would paralyze us.*

*So we live. We struggle. We pretend.*

*And one day, we disappear.*

*Not as heroes. Not as sinners.*

*Just as beings who asked too many questions in a universe that never intended to answer them.*

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## Bibha Chowdhuri: A Trailblazer in Particle Physics

Raghunandan Rajbongshi

FYUGP 4<sup>th</sup> Semester

Bibha Chowdhuri (3 July 1913 – 2 June 1991) was a pioneering Indian **particle physicist** whose research on cosmic rays and subatomic particles placed her at the forefront of high-energy physics in the mid-20th century. Although her work was internationally significant and even acknowledged by Nobel laureates, she remained under-recognized throughout her life.

### Early Life and Passion for Physics

She was born in Kolkata into a well-educated Bengali family, she displayed an early aptitude for science. In 1936 she earned an **M.Sc. in physics from the University of Calcutta**, and notably she **was the only woman in her graduating class**. After her master's, she joined the **Bose Institute** in Kolkata working with physicist **Debendra Mohan Bose**, a leading figure in cosmic-ray research. She immersed herself in experiments using **photographic nuclear emulsions** to detect high-energy particles coming from cosmic rays — a cutting-edge technique before particle accelerators became widespread.

### Groundbreaking Research on Mesons and Cosmic Rays

Around the late 1930s and early 1940s, Chowdhuri and Bose conducted experiments in diverse and challenging environments — including high-altitude Himalayan stations — exposing photographic plates to cosmic rays observe particle tracks. These experiments helped them **identify mesotron showers and subatomic particles** that would later be classified as **mesons** (including pions and muons). Their results were published in **Nature** one of the most prestigious scientific journals, between **1940 and 1942**, marking some of the earliest experimental observations of these particles. However, disruption from **World War II** — which cut off the supply of sensitive emulsion plates - hindered

their ability to continue and refine this work. Later, **British physicist Cecil F. Powell** continued similar research and won the **Nobel Prize in Physics (1950) for discovering the pion using advanced emulsions, acknowledging Bibha and Bose's prior contributions in his citations.**

### Ph.D. at the University of Manchester

In **1945**, She went to the **University of Manchester** to pursue doctoral research under **Sir Patrick M.S. Blackett**, a Nobel laureate known for his work on cloud chambers and cosmic ray detection. During her Ph.D., she focused on “**Extensive Air Showers Associated with Penetrating Particles,**” studying how cosmic rays interacted with Earth's atmosphere to produce cascades of secondary particles. She completed and defended her thesis in **1949**, earning her Ph.D. in 1952. Remarkably, her examiners were impressed enough with her work to recommend her to **Dr. Homi J. Bhabha — the founder of the Tata Institute of Fundamental Research.**

## Bibha Chowdhuri: A Trailblazer in Particle Physics

### Return to India: TIFR and Leadership in Cosmic-Ray Physics

She returned to India in 1949 and was handpicked by Homi Bhabha as the first woman researcher at the Tata Institute of Fundamental Research (TIFR) in Mumbai — a historic milestone. At TIFR, she led the **Cloud Chamber Group**, continuing her research on cosmic rays and helping identify **K-mesons** particles that further expanded the understanding of subatomic physics. She also represented Indian physics internationally, including at the 2nd International Conference on Elementary Particles (Pisa, Italy, 1955)— an important global forum for cutting-edge particle research.

### Final Years: A Life of Scientific Dedication

After PRL, Bibha moved back to Kolkata and continued research with institutions like the **Saha Institute of Nuclear Physics (SINP)**, the **Indian Association for the Cultivation of Science (IACS)**, and occasionally with the **Variable Energy Cyclotron Centre (VECC)**. She remained engaged in high-energy physics and continued publishing scientific work — her last paper appeared in 1990, just a year before her death.

### Selected Scientific Contributions & Publications

Her research spanned cosmic rays, particle detection, and extensive air showers. Some key publications include:

- **Photographic Plates as Detectors of Mesotron Showers** (Nature, 1940) — early identification of meson events.
- **A Photographic Method of Estimating the Mass of the Mesotron** (Nature, 1941) — further particle measurements.
- **Extensive Air Showers Associated with Penetrating Particles** (Ph.D. thesis, Manchester, 1949) — foundational work on cosmic ray air showers.
- Later studies on muon events and underground showers published in the **Proceedings of the Indian Academy of Science**.

*"Imagination is more important than knowledge."*

— ALBERT EINSTEIN

## CLASSICAL PHYSICS AS COMMON SENSE OF UNIVERSE

Rajib Biswas

| FYUGP 4<sup>th</sup> Semester

**F**irst, there's the rule that nothing moves for free. If you're in a car that slams on the brakes, your body keeps going because of inertia ( $F=ma$ ). It's simple, brutal, and the reason we have airbags.

Then, thermodynamics is the reason your cold drinks bottle has moistures on it when taken out from freezer and why your coffee eventually turns lukewarm. It's the universe's way of saying you can't get something for nothing; energy always spreads out.

Finally, there's Electromagnetism. We don't think about force that turned magnets and static electricity it much, but it's the only reason you're able to read this on a phone screen right now. It's the invisible into the global power grid.

Modern physics might be more "mind-bending," but classical physics is the reason the bridge stays up and your car starts in the morning. It's the physics of the world we actually live in.

*Disclosure - example and reference are taken from NCERT BOOKS and Google Gemini (AI) used for grammatically error correction.*

$$\mathbf{F=ma}$$

NEWTON'S 2<sup>nd</sup> LAW

$$\mathbf{E=mc^2}$$

MASS-ENERGY EQUIVALENCE

### Three Pillars of Classical Physics

- **Mechanics** — Newton's laws, inertia,  $F = ma$
- **Thermodynamics** — Energy transfer, entropy, heat
- **Electromagnetism** — Charges, fields, power grid

*"What we observe is not nature itself, but nature exposed to our method of questioning"*

— WERNER HEISENBERG

## SPACE-X: FROM A BOLD IDEA TO SPACE REVOLUTION

Pritam Choudhury

| FYUGP 4<sup>th</sup> Semester

*"Its ultimate mission is to ensure the continuation of the human species by turning it into a multi-planet species through the colonization of Mars."*

SPACE X MISSION STATEMENT

Space Exploration Technologies Corporation or SpaceX for short was started in 2002 by businessman Elon Musk. It was based on just one simple but daring idea: travelling to space should be less costly, quicker and available to more people. When Musk saw that launching rockets was a very costly and that was the main reason why there were so few rockets were launched so he decided that innovation and smart engineering would completely change the way things were done.

At first, for Space X the journey was not so smooth, the company had a series of rocket failures and in 2008 it came close to shutting down but the successful launch of the Falcon 1 and the NASA contract that came at the right moment helped SpaceX to continue and even grow. After that SpaceX has managed to hit astounding milestones such as the invention of reusable rockets and the development of spacecraft that are capable of carrying astronauts to the International Space Station.



Now, SpaceX intends to surpass these achievements. Its ultimate mission is to ensure the continuation of the human species by turning it into a multi, planet species through the colonization of Mars. With its Starship project and others, SpaceX is not merely sending rockets into the sky but it is also determining the future trajectory of space exploration.

*"The whole of science is nothing more than a refinement of everyday thinking."*

— ALBERT EINSTEIN

## What If Gravity Disappeared For 10 Seconds?

Nabajit Kumar Gogoi

FYUGP 4<sup>th</sup> Semester

**G**ravity is the force of attraction that keeps us on earth, holds planets in orbit and shapes galaxies. But have you ever considered so as to what would happen if gravity were to suddenly vanish for just 10 seconds?

The moment gravity disappears anything and everything that is not firmly attached to earth would begin to float. Walking would be impossible and instead of falling, we would drift upward like astronauts in space. At the same time building, roads and mountains would stay in the same place because they are fixed to the earth's crust.

Without gravity to hold the air close to the surface, earth's atmosphere would slowly start to escape into the space. Now even though it will only happen for 10 seconds and the loss would be small, it will have significant consequences like violent air movement, dangerous pressure changes etc.

The oceans would also react dramatically; water would rise to form massive floating blobs. Birds in flight would continue moving in straight lines while airplanes could lose control due to sudden absence of downward force.

In zero gravity, the blood in our body would rush towards our head causing pressure and discomfort similar to what astronauts would experience, they even might feel dizzy, confused and disoriented.

Now when it comes to outer space, our satellites and moon wouldn't just suddenly fly away but their orbits will be disturbed, as gravity is what keeps moving the celestial bodies in space in a curved path. Without it everything would move in a straight line due to inertia, following Newton's first law of motion.

*But what would happen after 10 seconds of having no gravity?*

And this is where the real danger would begin. Since gravity has returned, everything that had floated upwards would fall back down at the same time. People and object crashing into the ground and massive waves would hit the coastlines. The atmosphere and oceans, would rush back creating powerful storms and shockwaves and this level of impact could cause serious injuries, destruction of property and wildlife and worst-case scenario, loss of life.

**9.8**  
M/S<sup>2</sup> ON EARTH

**10s**  
THOUGHT EXPERIMENT

**∞**  
RANGE OF GRAVITY

## What If Gravity Disappeared For 10 Seconds?

This thought experiment aims to show that how essential gravity is to our existence. It is the foundation of life on earth. It not only keeps our planets air and water in place but also maintains the motion of the planets. Gravity shapes our universe in ways we often take for granted.

So, while 10 seconds without gravity might sound like a fun idea, the reality would be far more dangerous. Gravity may be invisible, but without it our world would literally fall apart.

*"Science is the process that takes us from confusion to understanding."*

— BRIANE GREENE

## COMPUTATIONAL PHYSICS

Prakriti Gupta

|

FYUGP 4<sup>th</sup> Semester

### What is it?

Computational physics is basically about using computers to solve physics problems. Often, trying to figure out certain systems with just math formulas gets really complicated—especially when the system has lots of variables or moving parts. That’s where computers come in. They help us find approximate solutions using numerical methods, which is a fancy way of saying breaking the problem into manageable pieces a computer can handle.

The cool thing about computational physics is that it turns big, messy problems into small, manageable steps. Computers follow these steps quickly and accurately, which saves us from hours of tedious calculations. It’s kind of like giving the computer a recipe and letting it do the cooking, while we watch the results unfold.

### Seeing is Believing

One of the best parts of this field is being able to visualize data. Graphs, simulations, and animations make it so much easier to understand what’s really happening. Numbers alone can be boring and confusing, but watching a system in motion makes physics much more tangible and honestly, a lot more fun.

### Real-World Uses

Computational physics shows up in all sorts of places. Scientists use it to track planets, predict storms, or figure out the properties of new materials. Some of these things are too dangerous, expensive, or just plain impossible to test in a lab, so computer models give us a sneak peek into the otherwise invisible.

### Getting Started

To begin with computational physics, you need to connect what you learn in theory with how it works on a computer. A good understanding of calculus and basic mechanics is important, but programming is what helps you actually apply those ideas. Python is usually the first choice because it’s easy to read and learn, while C is useful when programs need to run faster for large calculations.

At first, turning physics formulas into computer code can feel confusing and time-consuming. There are moments when the logic doesn’t work the way you expect, and you have to try again. But with practice, coding starts to feel more natural, almost like testing ideas in a virtual lab. Along the way, you don’t just learn physics—you also develop stronger problem-solving and logical thinking skills that stay useful beyond this subject.

All in all, computational physics is a bridge connecting theory, experiments, and computer simulations. For students, it’s a hands-on, practical way to see how the physical world works and maybe even have some fun while doing it.

## The Physics Behind Music

### Why Some Voices Touch Us Deeply

Amit Upadhyay

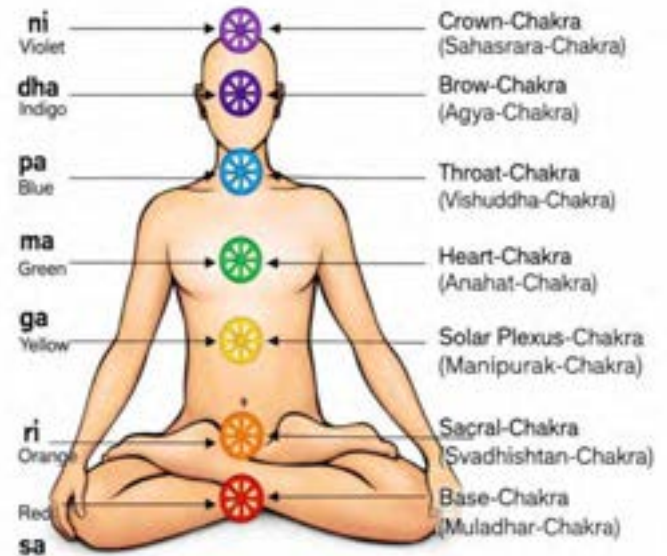
| FYUGP 4<sup>th</sup> Semester

**M**usic feels emotional, but it is deeply rooted in physics. Sound is produced when an object vibrates and creates waves in the air. These sound waves travel to our ears and are described by three main physical properties: frequency, amplitude, and timbre. Frequency decides the pitch of sound, amplitude decides loudness, and timbre defines the quality of sound. Timbre is the key reason why different people sound different even when singing the same note.

The human voice works like a natural sound system. Air from the lungs passes through the vocal cords, causing them to vibrate and produce sound. This sound is shaped by the throat, mouth, chest, and nasal cavity, which act as resonators. These resonators strengthen certain frequencies and reduce others, giving every human voice a unique tone and character.

Our brain reacts differently to various sound patterns. Smooth pitch movements feel pleasant, steady loudness feels calm, and rich harmonics make a voice sound warm and full. Because of this physical balance, some voices feel emotionally touching even without powerful lyrics.

A strong example is Arijit Singh. His singing shows smooth pitch transitions, controlled loudness, and strong resonance. He avoids forcing high notes and maintains balance in his voice. From a physics point of view, his voice contains well-balanced harmonics, making it easy to listen to and emotionally soothing.



In conclusion, music touches us deeply because of how sound waves interact with the human brain. Physics helps us understand why some voices feel special without reducing the beauty of music.

*"Doubt is the origin of wisdom."*

— RENE DESCARTES

# The First Super Fluid Molecule

## A Quiet Revolution in Physics (2025)

Nishanta Das

| FYUGP 4<sup>th</sup> Semester

For nearly a century, super fluidity has occupied a rare and almost mythical place in physics. It is the strange state of matter where a substance flows without friction, climbing walls, leaking through microscopic cracks, and defying our everyday intuition. Until now, this phenomenon had been confined to a short and exclusive list: liquid helium and ultra-cold atomic gases. In 2025, that list gained an unexpected new member, a molecule.

In a landmark experiment, researchers from the University of British Columbia and RIKEN successfully observed super fluidity in a molecule for the first time. This achievement is more than a technical milestone. It reshapes how scientists think about collective quantum behaviour in complex systems.

Super fluidity is a macroscopic manifestation of quantum mechanics. At extremely low temperatures, particles can lose their individual identities and behave as a single quantum entity. When this happens, resistance vanishes. No energy is lost to friction, and motion becomes eerily perfect.

### Why super fluidity matters?

Historically, super fluidity has been associated with simple systems. Helium atoms, for example, are spherical and interact weakly with one another, making them ideal candidates for collective quantum states. Later, physicists demonstrated super fluidity in ultra-cold atomic gases, where individual atoms are carefully controlled using lasers and magnetic fields.

**Molecules, however, are a different story.**

### Why molecules were thought impossible?

Unlike atoms, molecules have internal structure. They can rotate, vibrate, and stretch. These extra degrees of freedom introduce complexity and instability, making it far more difficult for molecules to synchronize into a single quantum state. For decades, this complexity led many physicists to assume that molecular super fluidity was either impossible or so fragile that it would never be observed experimentally.

### The 2025 Discovery

By cooling specially prepared molecules to ultralow temperatures, mere fractions of a degree above absolute zero, the researchers managed to coax them into a collective state where frictionless flow emerged. Despite their internal motion, the molecules locked into shared quantum behaviour, moving as one.

# The First Super Fluid Molecule

## A Quiet Revolution in Physics (2025)

Nishanta Das

|

FYUGP 4<sup>th</sup> Semester

### *What Makes This Discovery Different?*

This is not just super fluidity again but smaller. Molecular super fluidity opens an entirely new regime of quantum matter. Molecules interact with one another in richer and more tuneable ways than atoms. They possess electric dipoles, anisotropic shapes, and internal energy levels that can be controlled with remarkable precision.

The fact that such complex objects can still enter a super fluid state suggests that quantum coherence is more robust than previously believed. It also hints that other, even more intricate systems might exhibit similar collective behaviour under the right conditions.

### *A Quiet Turning Point*

Scientific revolutions are not always loud. Sometimes they arrive quietly, in a laboratory cooled to near absolute zero, where a handful of molecules begin to flow without resistance. The first observation of a super fluid molecule is one such moment, a subtle yet powerful reminder that nature still holds surprises, even in realms physicists thought they understood.

*In 2025, super fluidity became molecular. And with that, the quantum world grew a little larger.*

### **Potential implications**

While immediate applications are not the goal of this research, the long term implications are profound. Molecular super fluids could become powerful platforms for studying quantum chemistry, many body physics, and exotic phases of matter. They may help scientists simulate materials that are otherwise impossible to probe directly, including those relevant to superconductivity and quantum magnetism.

In the broader picture, this discovery pushes the boundary between the quantum and classical worlds. It shows that quantum effects are not limited to the simplest building blocks of nature, but can emerge even in systems with rich internal structure.

# THE PHYSICS OF MUSIC

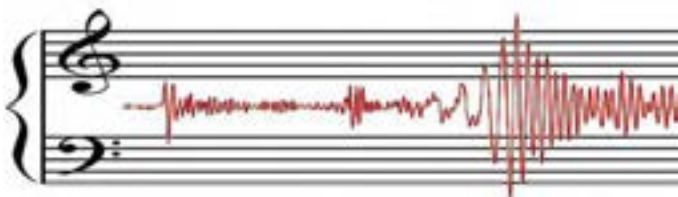
## Abstract

This journal explores the intersection of physical laws and auditory art. By analyzing sound as a mechanical wave, we investigate how frequency, resonance, and harmonic series dictate the structure of musical scales and the unique “voice” (timbre) of different instruments.

## Fundamental Wave Mechanics

Sound is a longitudinal wave that requires a medium (air, water, or solids) to travel. In music, we define three primary physical characteristics:

- **Pitch (Frequency):** Calculated as  $f = 1/T$ , where  $T$  is the period.
- **Volume (Amplitude):** The magnitude of pressure change in the wave.
- **Timbre (Waveform):** The shape of the wave created by the presence of overtones.



## String Theory and Air Columns

Musical instruments create sound through **Standing Waves**. These occur when a wave reflects back on itself, creating stationary points called **nodes** and vibrating areas called **antinodes**.

## A. Stringed Instruments (Violin, Guitar)

The frequency depends on the length ( $l$ ), tension ( $T$ ), and linear density ( $\mu$ ) of the string

$$f = \frac{1}{2l} \sqrt{\frac{T}{\mu}}$$

**B. Wind Instruments (Flutes, Trumpets)** these function as open or closed tubes. In an open-pipe resonator, the wavelength of the fundamental frequency is twice the length of the tube.

## The Harmonic Series

When a note is played, we hear the fundamental frequency, but the instrument also produces Harmonics (integer multiples of the fundamental).

- 1st Harmonic:  $f$  (The root note)
- 2nd Harmonic:  $2f$  (One octave higher)
- 3rd Harmonic:  $3f$  (A perfect fifth above the octave)

The specific mix of these harmonics is what allows a listener to distinguish a  $C_4$  played on a piano from a  $C_4$  played on a saxophone.

## Mathematical Harmony (Consonance vs. Dissonance)

The human ear perceives “harmony” based on simple mathematical ratios.

- Unison: 1:1 ratio.

## THE PHYSICS OF MUSIC

- Octave: 2:1 ratio (perfectly aligned peaks).
- Dissonance: Occurs when ratios are complex (e.g., 16:15), causing a physical phenomenon known as Beats, where the waves collide and create a “pulsing” sensation.

### Electronic Music and Synthesis

In the digital and electronic age, music is no longer limited to physical resonators like strings or air columns. We can now generate sound through oscillators and digital processing.

#### A. Waveform Geometry

Unlike acoustic instruments, which produce complex, irregular waveforms, electronic synthesizers often start with basic geometric shapes. Each shape has a distinct physical and auditory property:

- Sine Wave: A single, pure frequency with no overtones. It sounds smooth and “round”.
- Square Wave: Contains only odd harmonics (1f, 3f, 5f...). It sounds “hollow” or “woody,” similar to a clarinet.
- Saw tooth Wave: Contains every harmonic. It sounds “bright” and “buzzy,” making it the richest starting point for sound design.

#### B. Subtractive Synthesis and Filtering

The physics of synthesis often involves Subtractive Synthesis. In this process, a “rich” wave (like a Sawtooth) is passed through a Filter.

- Low-Pass Filter (LPF): Removes high-frequency energy (overtones), making the sound “darker” or “muffled.”
- Cutoff Frequency: The specific frequency where the filter begins to dampen the wave.

### B. Digital Sampling and Nyquist’s Law

When sound is converted to a digital format, the continuous wave is “sampled” at specific intervals. To perfectly reconstruct a sound wave, the Sampling Rate must be at least twice the highest frequency present in the sound.

$$f_s > 2 \times f_{max}$$

This is why standard audio is sampled at 44.1 kHz—it is slightly more than double the maximum frequency human ears can hear (20 kHz).

### Conclusion

Music is effectively the human interpretation of mathematical physics. By manipulating the physical properties of matter—length, tension, and air pressure—we create controlled vibrations that the brain translates into melody and emotion.

## Zodiac Sign

### An Introspection Analysis Through Physics

Bhumika Mahanta

|

FYUGP 4<sup>th</sup> Semester

**Y**es, one may wonder how zodiac signs can be related to physics, or what the reality behind zodiac signs actually is. After all, physics is not confined by symbolic boundaries. It exists within us and around us, in motion, in energy, in time and space. Wherever change occurs, physics is already at work.

Zodiac signs, often viewed as tools for predicting personality or destiny, originated from careful human observation of the sky. Long before modern instruments and equations, ancient civilizations noticed that the Sun appeared to travel along a fixed path across the sky throughout the year. In astronomy and physics, this apparent path is known as the ecliptic plane.

To understand this, one must consider Earth's motion. The Sun does not move through zodiac signs; instead, Earth revolves around the Sun. Because of this relative motion, (a fundamental concept in physics) the Sun appears to shift its position against different star backgrounds over the course of a year. The zodiac signs are simply twelve imaginary divisions of this observed path, created to track seasons, time cycles, and agricultural rhythms.

A common belief is that planets or stars influence human behaviour or destiny. Physics, however, provides a clear explanation. According to Newton's law of gravitation, every object exerts a gravitational force on every other object. The key factor is its magnitude.

The gravitational pull of distant planets or stars on a human body is extremely negligible. Even nearby buildings, vehicles, or mountains have a stronger gravitational influence on us than any planet in the solar system. From a measurable scientific perspective, no known physical force links zodiac signs to personality, emotions, or fate.

Another crucial concept is axial precession. Earth's axis slowly changes its orientation over approximately 26,000 years, much like a spinning top that wobbles as it spins. Because of this gradual shift, the positions of constellations relative to Earth have changed significantly over time. As a result, the zodiac signs commonly used today no longer align with the actual constellations in the sky. This alone highlights the difference between traditional belief systems and continuously updated scientific understanding.

Many people argue that quantum physics might leave room for astrology. This is a common misconception. Quantum mechanics describes the behaviour of particles at atomic and subatomic scales, where uncertainty, probability, and wave-particle duality dominate. However, quantum effects do not scale up to macroscopic systems like planets, stars, or human brains in any meaningful way.

## Zodiac Sign

### An Introspection Analysis Through Physics

There is no quantum mechanism by which planetary positions could encode personal information, influence neural activity, or shape human destiny. Invoking quantum physics to justify astrology is not scientific; it is a misuse of scientific terminology to give symbolic beliefs a false sense of legitimacy.

So why do zodiac descriptions feel accurate to many people? The answer lies not in physics, but in psychology - specifically the Barnum effect, where broad, general statements feel personally meaningful. When descriptions are vague enough, the human mind naturally fills in the details. What feels cosmic is often cognitive.

From a scientific viewpoint, zodiac signs are best understood as cultural astronomy, early human attempts to organize the universe using observation, pattern recognition, and logic. They were intellectual stepping stones that eventually led to modern astronomy, astrophysics, and our deeper understanding of the cosmos.

### Final Thought

Zodiac signs do not control human destiny through physical or quantum forces. Physics reveals a universe governed by measurable laws, testable theories, and evidence—not symbolic divisions of the sky. Yet zodiac systems remain valuable, not as predictors of fate, but as reflections of humanity's early curiosity and desire to understand the universe.

The stars do not define us-but they remind us to observe, question, and seek understanding.

Astrophysics does not "deny" astrology in an emotional or cultural sense, but it clearly rejects astrology as a science.

*"However difficult life may seem, there is always something you can do and succeed at."*

— STEPHEN HAWKING

## Superconductivity

Sourav Das

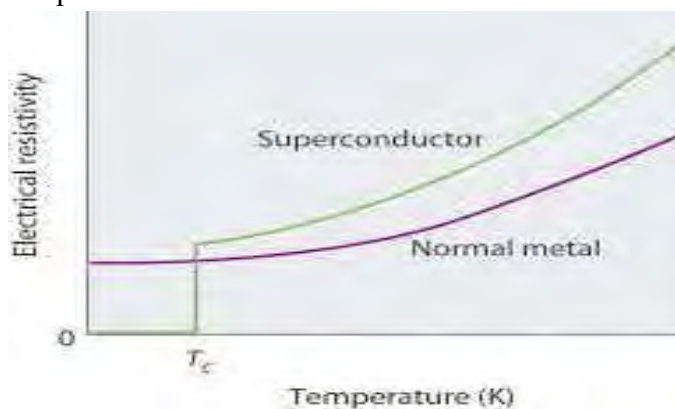
FYUGP 4<sup>th</sup> Semester

### Abstract

Superconductivity is a remarkable physical phenomenon in which certain materials exhibit zero electrical resistance and perfect diamagnetism when cooled below a characteristic critical temperature. Since its discovery in 1911, superconductivity has attracted immense scientific and technological interest due to its wide applications in power transmission, medical imaging, particle accelerators, and quantum computing. This article discusses the basic concept, properties, types, theoretical explanations, and applications of superconductivity.

### Introduction

In ordinary conductors, electrical resistance causes energy loss in the form of heat. However, in 1911, Dutch physicist Heike Kamerlingh Onnes discovered that mercury, when cooled to about 4.2 K, suddenly lost all electrical resistance. This phenomenon was later named superconductivity. Since then, many materials have been found to exhibit superconducting behavior at low temperatures.



Source: [www.saylordotorg.com](http://www.saylordotorg.com)

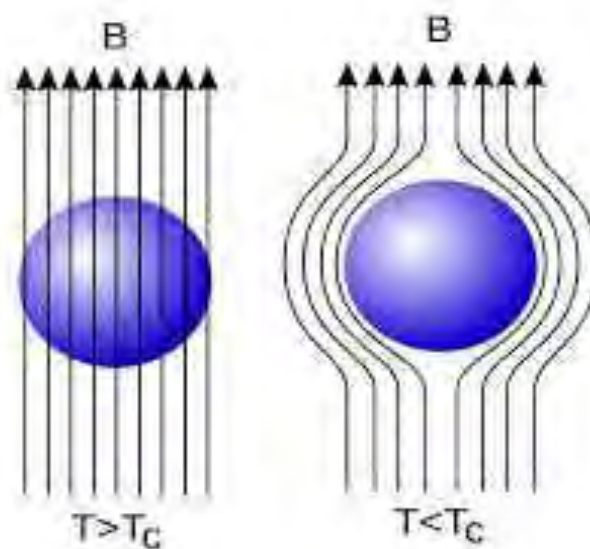
### Fundamental Properties of Superconductors

#### 1. Zero Electrical Resistance

The most striking property of a superconductor is that its electrical resistance becomes exactly zero below a certain temperature known as the critical temperature ( $T_c$ ). As a result, electric current can flow indefinitely without any loss of energy.

#### 2. Meissner Effect

In 1933, Meissner and Ochsenfeld discovered that a superconductor expels magnetic fields from its interior when it transitions into the superconducting state. This effect is called the Meissner effect and proves that superconductivity is not merely perfect conductivity but a distinct thermodynamic phase.



Source: [www.wikipedia.com](http://www.wikipedia.com)

## Superconductivity

### 3. Critical Parameters

Superconductivity exists only within certain limits:

- Critical temperature ( $T_c$ )
- Critical magnetic field ( $H_c$ )
- Critical current density ( $J_c$ )

Exceeding any of these destroys the superconducting state.

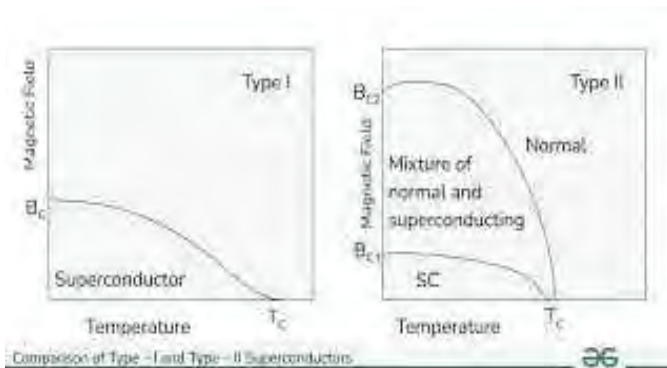
### Types of Superconductors

#### 1. Type I Superconductors

These are usually pure metals such as mercury, lead, and aluminum. They show complete Meissner effect and have a single critical magnetic field. Their practical applications are limited due to low critical temperatures and magnetic fields.

#### 2. Type II Superconductors

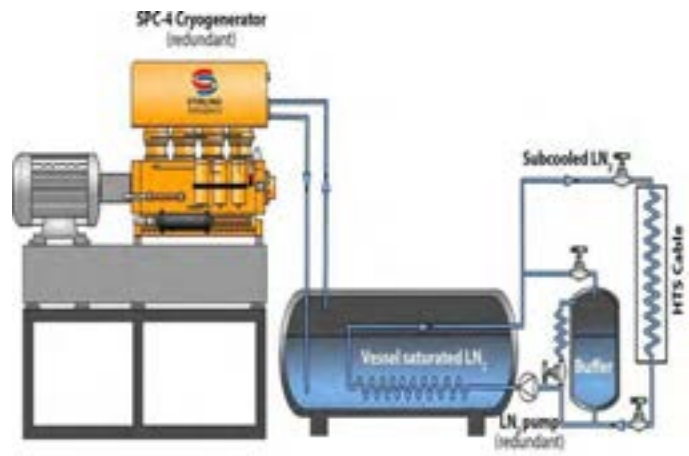
These include alloys and ceramic compounds. They exhibit two critical magnetic fields and allow partial penetration of magnetic flux in the form of vortices. Type II superconductors are widely used in technological applications due to their high critical fields.



Source: [www.GeeksForGeeks.com](http://www.GeeksForGeeks.com)

### High-Temperature Superconductors

In 1986, Bednorz and Müller discovered ceramic materials that become superconducting above 77 K, the boiling point of liquid nitrogen. These are called high-temperature superconductors (HTS). Common examples include copper oxide (cuprate) superconductors. Their discovery revolutionized superconductivity research by reducing cooling costs.



Source: [www.cryogenics.com](http://www.cryogenics.com)

### Theory of Superconductivity

The microscopic explanation of superconductivity in conventional superconductors is provided by the BCS theory (Bardeen–Cooper–Schrieffer theory). According to this theory:

- Electrons form weakly bound pairs known as Cooper pairs.
- These pairs move through the lattice without scattering, resulting in zero resistance.
- However, the exact mechanism behind high-temperature superconductivity is still not completely understood.

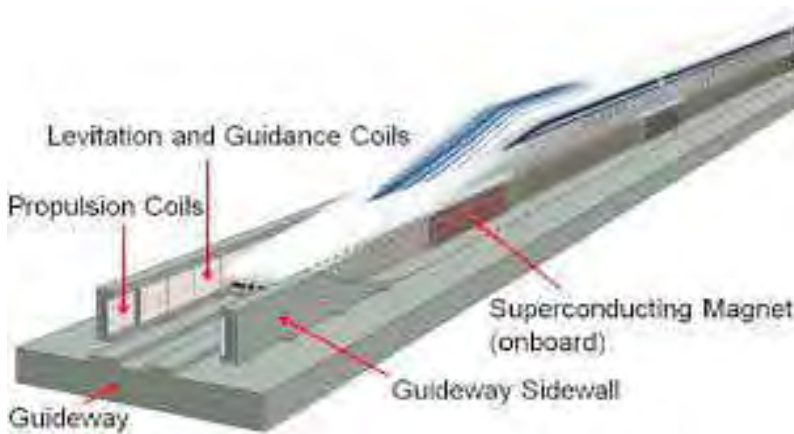
## Superconductivity

### Applications of Superconductivity

Superconductors have numerous important applications:

- Magnetic Resonance Imaging (MRI) in medical diagnostics
- Superconducting magnets in particle accelerators
- Maglev trains for frictionless transportation
- Power transmission cables with minimal energy loss

### *Quantum computing and ultra-sensitive sensors*



**Source:** [www.research.com](http://www.research.com)

### Advantages and Limitations

Advantages:

- Zero energy loss
- High efficiency
- Strong magnetic fields

### Limitations:

- Requirement of very low temperatures
- High material and maintenance costs
- Brittle nature of ceramic superconductors

### Conclusion

Superconductivity is one of the most fascinating phenomena in modern physics. Despite challenges related to cost and temperature requirements, continuous research is bringing us closer to room-temperature superconductors. Such a breakthrough would revolutionize energy transmission, transportation, and electronic technologies, making superconductivity a cornerstone of future scientific advancement.

*“The present is theirs; the future for which I really worked, is mine”*

- NIKOLA TESLA

## The Force that Shapes *Everything*

Dipankar Haldar

|

FYUGP 2<sup>nd</sup> Semester

**G**ravitation commonly called gravity is the quiet architect of the cosmos. It holds planets in orbit, shapes galaxies, guides the motion of stars, forms black holes, and even influences the passage of time. Though invisible, its power is everywhere. In this special issue, we explore gravity from its ancient origins to future discoveries.



### *Earth's gravity-the force*

Gravity gives us weight. It keeps oceans from drifting into space. It guides rain to the ground. It allows birds, planes, and rockets to find their rhythm. Earth's gravity is not constant everywhere. It is slightly stronger at the poles and weaker at the equator because Earth is not a perfect sphere.

### Newton – the apple, the insight, the revolution

The legend goes: Isaac Newton saw an apple fall and wondered why it fell straight down. From that question came Newton's Law of Universal Gravitation: Every mass in the universe attracts every other mass with a force that decreases with the square of the distance between them. This was the first time anyone understood that the same force that makes an apple fall also keeps the Moon in orbit.

### Einstein – gravity is not a force

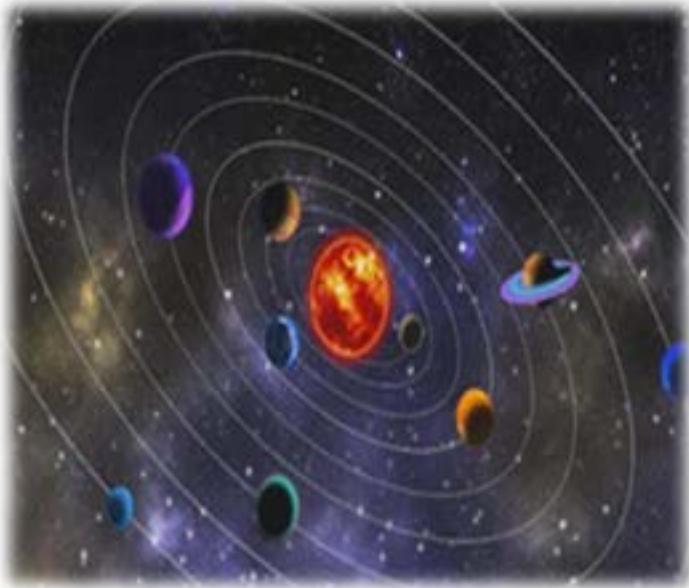
Albert Einstein shattered the Newtonian picture. His theory of General Relativity states: Gravity is not a force; it is the curvature of space-time caused by mass. Think of a heavy bowling ball on a stretched sheet. The sheet dents. A smaller ball placed near it rolls inward, not because it is pulled but because the

### *What exactly is gravitation ?*

Gravitation is the natural force by which every mass attracts every other mass. This attraction depends on two things: a. the mass of the objects and b. the distance between them. The farther apart they are, the weaker the pull. The larger the mass, the stronger the pull. Even your body attracts the Earth but Earth is so massive that its pull dominates.

## The Force that Shapes *Everything*

sheet is curved. This changed everything from predicting black holes to understanding cosmic expansion.



### GRAVITY ACROSS THE UNIVERSE

Stars Are Born Because of Gravity. Clouds of gas collapse under gravitational attraction, forming stars. Galaxies form due to gravity. Gravity gathers billions of stars into majestic spirals and elliptical forms.

Black Holes - Gravity at Maximum

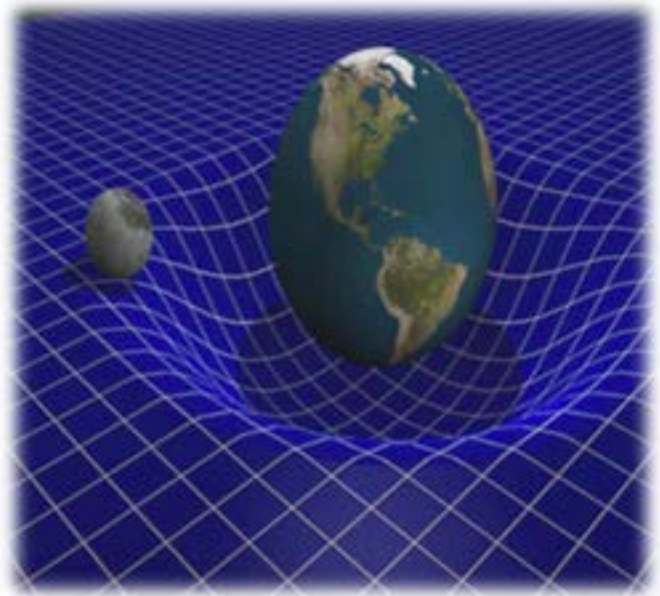
If enough mass collapses into a tiny region, gravity becomes so strong that even light can't escape.

Orbits: The Cosmic Dance

Planets orbit stars; moons orbit planets; stars orbit galactic centers -all due to gravity.

### GRAVITY AND SPACE TRAVEL

To leave Earth, rockets must escape its gravitational pull, requiring a speed of: 11.2 km/s (escape velocity). Gravity also helps spacecraft through gravitational slingshots, using the gravity of planets for acceleration.



### MODERN GRAVITY RESEARCH

- Gravitational Waves- Predicted by Einstein, detected in 2015 ripples in spacetime caused by massive cosmic collisions.
- Dark Matter & Dark Energy- Galaxies rotate too fast for their visible mass implying invisible matter held by gravity.
- Quantum Gravity (The Ultimate Mystery)- Scientists still don't know how gravity fits with quantum physics. String theory, loop quantum gravity, and other models attempt to solve this grand puzzle.

## The Force that Shapes Everything

### *FUN FACTS ABOUT GRAVITY*

Gravity is weak compared to other forces your magnet can lift a paperclip against the entire mass of the Earth. On the Moon, you weigh only 1/6 of your Earth weight. Black holes significantly slow down time due to extreme gravity. Without gravity, we would lose our atmosphere.

### WHAT IF THERE WAS NOGRAVITY?

Everything would float away.  
Earth would break apart.  
Planets would lose orbit.  
Stars would never form.  
The universe would be a cold, sparse cloud of particles.  
Gravity is not just important it is essential for existence.

### CONCLUSION: GRAVITY – THE UNSEEN ARCHITECT

From an apple to a galaxy, gravity shapes the universe in silence. It is the beginning of stars, the maker of orbits, the keeper of time, and the sculptor of space itself. As science evolves, gravity remains a deep mystery waiting to be fully understood. Including our own Milky Way, are believed to have a spermassive blackhole at their centre. These giant blackhole help control the movement of stars and gas within the galaxy.



*“A theory that explains everything, explains nothing”*

– KARL POPPER

## Time travel during the birth of Parikshit (Womb of Uttara)

*Myth meets Quantum mystery*

Jagyashini Kalita

| FYUGP 2<sup>nd</sup> Semester



**A**ncient Indian epics are often read as spiritual and moral guides, yet many of their narratives spark profound scientific curiosity. One such episode is the birth of king Parikshit, protected in the womb of Uttara by Lord Krishna during the devastating weapon Brahmastra. The birth of Parikshit, the last heir of the Pandavas dynasty, is one of the most scientifically intriguing episodes in the Mahabharata. It involves the intersection of high-energy weaponry, biological preservation, and what modern theorists might describe as quantum intervention or time dilation.

Modern physics describes spacetime as a fabric that can be curved, stretched, and influenced by energy. Krishna shrinks to atomic scale, enters the womb, and absorbs the Brahmastra's fury, reviving the stillborn child who emerges alive and named "Parikshit". Texts say he grants the infant a divine vision, marking him as Vishnu-rata, protected by the

preserver god himself. This evokes quantum superposition, where a system exists in multiple states (alive/dead) simultaneously until measurement collapses it. Krishna acts as the "observer" or stabilizer, maintaining the fetus in its viable state amid destructive interference, much like entanglement links distant particles to share fate instantaneously.

Alternatively, it hints at retro causality future protection influencing the past where Krishna's timeless presence "travels back" to rewrite the outcome, avoiding paradoxes via parallel timelines.

The story of Parikshit's birth serves as an ancient precursor to several modern scientific concepts. Krishna's intervention acts as radiation shielding, protecting delicate biological life here, and the unborn child from the Brahmastra's subatomic, lineage-erasing energy blast, much like modern materials block ionizing radiation to preserve DNA integrity. It evokes quantum superposition, where the protector exists simultaneously "inside" the microscopic womb environment and "outside" on the macroscopic battlefield, mirroring how particles can occupy multiple states until observed.

Finally, it hints at time travel of information, as Parikshit later "remembers" Krishna's face from the womb, suggesting fetal consciousness can record and retain data even when physical time warps under extreme energy, akin to retro causal quantum effects preserving memories across timelines.

## Time travel during the birth of Pariksit (Womb of Uttara)

*Myth meets Quantum mystery*

This womb rescue transcends myth, encoding insights into time's fluidity and life's fragility. Quantum mechanics challenges linear causality, proposing superposition's and entangled histories where interventions can "save" outcomes retroactively much like Krishna preserving dharma amid war's chaos.

## YUG SAHASRA YOJAN PAR BHANU

### An astronomical *interpretation*

Bhargab Mahanta

| FYUGP 2<sup>nd</sup>Semester

**T**he Hanuman chalisa, is one of the most significant and revered devotional hymns in Hindu Tradition. While it is primarily a spiritual and poetic work glorifying Lord Hanuman, one particular verse has drawn significant attention for what many believe is an astonishing reference to astronomical knowledge, centuries before modern science formally calculated it. The verse is:

**“YUGA SAHASRA YOJANA PAR BHANU, LEELYO TAAHI MADHUR PHAL JAANU”**

#### *Translation*

“At a distance of Yuga-Sahasra yojanas was the Sun, which Hanuman swallowed, thinking it to be a sweet fruit.” This line poetically describes the childhood episode of Hanuman, where he mistook the rising sun for a fruit and leapt toward it.

#### *Lateral meaning:*

- Yuga - Age,
- Sahasra - Thousand,
- Yojana - An ancient unit of distance,
- Bhanu - Sun,
- Leelyo - Swallowed,
- Madhur Phal - Sweet fruit



#### Numerical Representation of “Yuga Sahasra Yojana”

In traditional Indian cosmology 1 Yuga (in this context) is often taken as 12000 years and Sahasra means 1000. For interpretative purposes, many scholars use: 1 Yojana = 8 miles (13 km). So,  $yuga - sahasra = 12000 \times 1000 = 12000000$  yojanas. If 1 Yojana = 8 miles, then  $12000000$  yojana =  $12000000 \times 8$  miles = 96000000 miles.

*“Education is not the learning of facts, but the training of the mind to think”*

## YUG SAHASRA YOJAN PAR BHANU

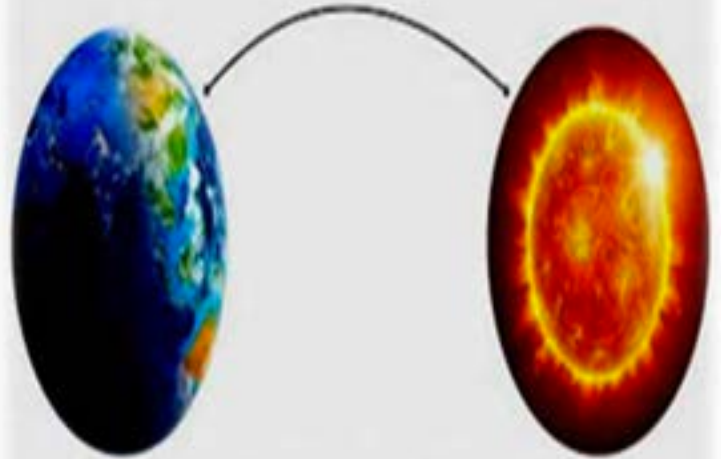
### An astronomical *interpretation*

#### Comparison with Modern Science

As of 2026, modern astronomical data (such as that of NASA) places the average distance between the Earth and the Sun at approximately 149.6 million kilometers (92.9 million miles). Because the Earth orbit is elliptical, this distance varies between 147 million km (perihelion) and 152 million km (aphelion).

The calculation from the Hanuman Chalisa (153.6 million km) has an error rate of roughly 1% to 3%. Supporters of this theory highlight that Tulsidas recorded this value nearly 200 years before Western scientists such as Johannes Kepler or 17th century astronomers using telescopes began to calculate these distances accurately. This closeness between 96 million miles (scriptural calculation) and 93 million miles (modern astronomy) has amazed devotees, scholars and scientists alike. Faith, Poetry and Knowledge Ancient Indian texts often combined spiritual wisdom, natural observation, Symbolic storytelling, rather than separating science and spirituality, they wove them together. Whether the distance mentioned is a coincidence, symbolic alignment, or inherited traditional knowledge remains a subject of interpretation.

**EARTH-SUN DISTANCE:  $\approx$  93-96 MILLION MILES  
(DUE TO EARTH'S ELLIPTICAL ORBIT)**



**"Yuga Sahasra Yojana Para Bhānu"**

**YUGA = 12,000  
SAHASRA = 1,000  
YOJANA  $\approx$  8 MILES**

**$12,000 \times 1,000 \times \sim 8$   
 $\approx$  96 MILLION MILES**

**1 mile  $\approx$  1.6 km  
 $96,000,000$  miles  $\times$  1.6  
 $=$  153.6 million km ( $\approx$  15 crore 36 lakh km)**

## Sudarshana Chakra Meets *Konark Wheels*: *Spinning Cycles of Time and Cosmos*

Jagyashini Kalita

| FYUGP 2<sup>nd</sup>Semester

**T**he Konark Sun Temple in Odisha is a site where ancient mythology, engineering, and legendary physics intersect. While the temple is primarily dedicated to the Sun God (Surya), it has deep roots in the story of Lord Krishna's family and is famously associated with mysterious magnetic properties that parallel the "cosmic wheel" of the Sudarshana Chakra. Built in the 13th century as Surya's massive Ratha (chariot), Konark's wheels double as sundials, while the chakra Vishnu's iconic spinning disc represents cosmic order and time's eternal wheel. Beyond its architectural brilliance, Konark is deeply connected to Hindu mythology, particularly the legend of Shri Krishna's Sudarshan Chakra, and also reflects advanced scientific and physical principles that continue to amaze modern scholars.

Konark's temple chariot, drawn by seven horses across 24 wheels, mirrors Vedic imagery of solar and divine vehicles navigating the heavens. The Sudarshana Chakra, often depicted as a radiant wheel hurled from Vishnu's hand, propels dharma's chariot against chaos, slicing through adharma like a blade. Puranas connect both to Vishwakarma, the divine architect: he forged the chakra, and Konark's builders channeled similar precision into stone "wheels" that track celestial motion. Each Konark wheel master's rotational physics for solar timekeeping.

Major spokes divide the 24-hour day into eight 3-hour prahars; minor spokes halve them to 90 minutes; 30 rim beads mark 2 minutes each, yielding accuracy within seconds via gnomon shadows. This leverages basic optics the sun's rays as parallel light beams



projecting angular position anticipating mechanical clocks by centuries. The chakra embodies angular momentum conservation: once spun, it maintains lethal velocity in perfect circles, defying drag through divine physics. In epics, it returns like a boomerang, homing on targets with gyroscopic stability principles of torque and precession that modern gyroscopes replicate. As kalachakra (wheel of time), its spin governs cosmic cycles, paralleling Konark's wheels as kalachakra mandalas dividing eternity into measurable instants.

Both systems exploit circular symmetry: Konark wheels model Earth's 360° rotation (15° per hour); the chakra symbolizes spacetime curvature and eternal recurrence. Ancient texts equate Surya (sun) with Vishnu's solar aspect, linking temple wheels to chakra spokes as fractals of universal motion quantum-like cycles where micro (minutes) mirrors macro (yugas). This reveals India's insight into

## **Sudarshana Chakra Meets *Konark Wheels:*** *Spinning Cycles of Time and Cosmos*



rotational invariance, predating Newtonian mechanics, where spinning forms preserve order amid chaos. Konark stands as a timeless reminder that ancient Indian civilization perceived science and spirituality not as separate entities, but as complementary forces governing the universe.

*"However difficult life may seem, there is always something you can do and succeed at."*

— STEPHEN HAWKING

## Quantum Computing From Classical Bits to *Quantum Brilliance*

Bikram Sharma

| FYUGP 2<sup>nd</sup>Semester

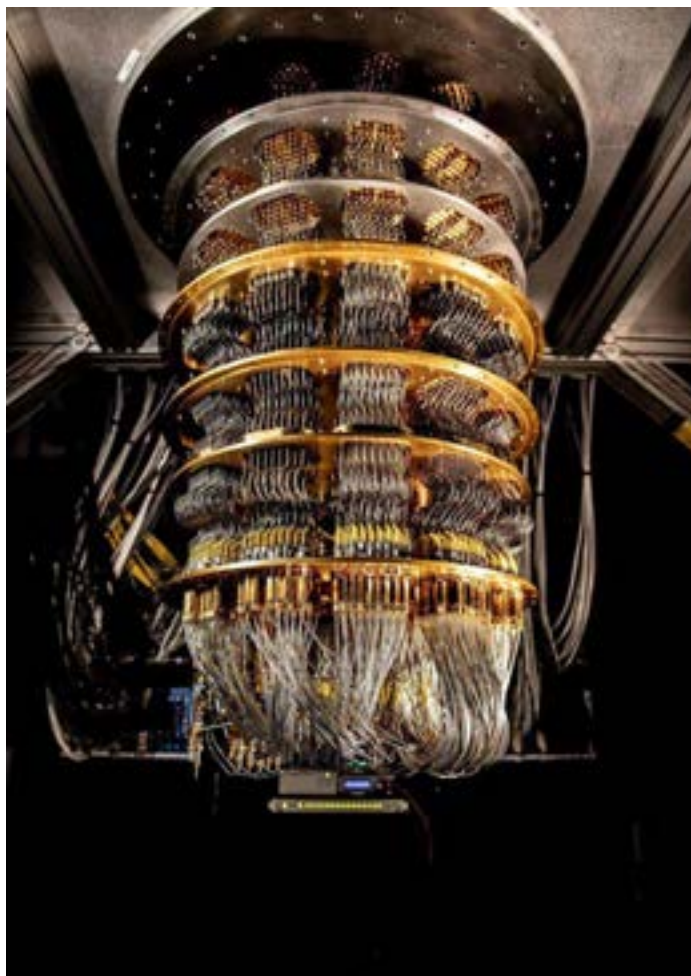
**Q**uantum computers harness the unique behavior of quantum physics – such as superposition, entanglement and quantum interference and apply it to computing. This introduces new concepts to traditional programming methods.

So to know quantum computing better we need to know about quantum, superposition, entanglement and quantum interference but first we need to know about qubit.

**Qubit** - A qubit is the basics unit of information in quantum computing. Qubits play a similar role in quantum computing, but they behave very differently. Classical bits are binary and can hold only a position of) 0 or 1 , but qubits can hold a superposition of all possible states.

**Quantum**- The quantum is “quantum computing” refers to the quantum mechanics that the system uses to calculate outputs. In physics, a quantum is the smallest possible discrete unit of any physical property. It usually refers to properties of atomic or subatomic particles, such as electrons, neutrons and photons.

**Superposition**- In superposition, quantum particles are a combination of all possible states. They fluctuate until they’re observed and measured. One way to picture the difference between binary position and superposition is to imagine a coin. Classical bits are measured by “flipping the coin” and getting heads or tails. However, if you were able to look at the coin and see both heads and tails at the same time, as well as every state in between, the coin would be in superposition.



## Quantum Computing From Classical Bits to *Quantum Brilliance*

Bikram Sharma

| FYUGP 2<sup>nd</sup> Semester

**Entanglement** - Entanglement is the ability of quantum particles to correlate their measurement results with each other. When qubits are entangled, they form a single system and influence each other. We can use the measurements from one qubit to draw conclusions about the others, By adding and entangling more qubits in a system, quantum computers can calculate exponentially more information and solve more complicated problems.

**QUANTUM INTERFERENCE**- Quantum interference is the intrinsic behavior of a qubit, due to superposition, to influence the probability of its collapsing one way or another. Quantum computers are designed and built to reduce interference as much as possible and ensure the most accurate results. To this end, Microsoft uses topological qubits, which are stabilized by manipulating their structure and surroundings them with chemical compounds that protect this from outside interference.

### QUANTUM COMPUTER USES AND APPLICATION AREAS

A quantum computer can't do everything faster than a classical computer, but there are a few areas where quantum computers have the potential to make a big impact.

#### FOR EXAMPLE

##### 1. Cryptography

Classical cryptography- such as the Rivest Shamir-Adleman(RSA) algorithm that widely used to secure data transmission relies on the intractability of problems such as integer factorization or discrete logarithms. Many of these problems can be solved more efficiently using quantum computers.

##### 2. Search

A quantum algorithm developed in 1996 dramatically speed up the solution to unsorted data search, running the search in fewer steps than any classical algorithm could.

Etc are example of this.

*"However difficult life may seem, there is always something you can do and succeed at."*

— STEPHEN HAWKING

## The Clock that Lied

### When **Time** Refused to Tick the Same

Rahul Bezbaruah

|

FYUGP 2<sup>nd</sup> Semester

#### WHEN TIME REFUSED TO FLOW EQUALLY

Time feels simple. Every second passes quietly, evenly, and without question. From the ticking of a classroom clock to the countdown of a rocket launch, we trust time as the most reliable quantity in nature. We assume that one second for you is the same as one second for someone else, no matter where they are.

But physics tells a different story. Under extreme conditions of high speed and strong gravity, time does not behave as we expect. Some clocks slow down. Some run faster. And the universe allows this without breaking any laws. This strange behavior gives rise to the idea of “The Clock That Lied.”

#### THE CLASSICAL IDEA OF TIME

In classical mechanics, developed by Isaac Newton, time was considered absolute. According to Newton, time flows uniformly everywhere in the universe, independent of motion or position. This idea worked perfectly for everyday life and remained unchallenged for centuries. For slow moving objects and weak gravitational fields, Newton’s view of time is an excellent approximation. However, as science progressed and experiments became more precise, cracks began to appear in this simple picture.



#### EINSTEIN CHANGES EVERYTHING

The revolution came in 1905, when Albert Einstein proposed the Special Theory of Relativity. One of its most radical ideas was that the speed of light in vacuum is constant for all observers, regardless of their motion. This single statement had shocking consequences. To keep the speed of light constant, time itself must adjust.

#### TIME DILATION DUE TO MOTION

*Einstein showed that:*

A moving clock ticks more slowly compared to stationary clock.

This phenomenon is called time dilation.

If two identical clocks are synchronized and one is in motion at a very high speed, the moving clock will lag behind when they are compared again. Importantly, the clock does not malfunction; it measures time correctly in its own frame. It only appears slow when observed from another frame.

## The Clock that Lied When **Time** Refused to Tick the Same

At everyday speeds, this effect is extremely small. But as the speed approaches the speed of light ( $3 \times 10^8$  m/s), time dilation becomes significant.

### A THOUGHT EXPERIMENT : THE SPACE TRAVELLER

Imagine an astronaut travelling in a spaceship at near-light speed while another person stays on Earth. Forth astronaut, life feels normal heartbeat, breathing, and thinking proceed as usual. However, when the astronaut returns, they find that more time has passed on Earth than for them.

This means the travelling astronaut has aged less. Time itself has slowed down for them relative to Earth.

This is not science fiction. It is a direct consequence of special relativity.

- ***Gravity and the Flow of Time***

In 1915, Einstein extended his ideas through the General Theory of Relativity, introducing another surprising effect: gravity affects time.

- ***According to general relativity:***

A clock in a stronger gravitational field runs slower than a clock in a weaker gravitational field.

This means: clock on Earth runs slightly slower than a clock on a mountain. A clock near a massive object runs slower than one faraway. Gravity bends space-time, and time slows down as space becomes more curved.

### THE GPS SYSTEM : PROOF IN YOUR POCKET

One of the most convincing real-life examples of time dilation is the Global Positioning System (GPS). GPS satellites orbit Earth at high speeds and at large altitudes.

Due to:

- High speed → time slows down (special relativity)
- Weaker gravity → time speeds up (general relativity)

The net effect is that satellite clocks run about 38 microseconds faster per day than clocks on Earth.

Though this difference seems tiny, without correction it would cause navigation errors of several kilometers per day. Therefore, engineers must apply Einstein's relativistic corrections to GPS clocks.

So when your phone accurately shows your location, it is because physics fixed a lying clock.

### EXPERIMENTAL EVIDENCE :

Time dilation is not just theoretical. It has been verified experimentally through:

*Atomic clocks flown on aircraft*

Precise clock comparisons on satellites

Observation of fast-moving particles like muons, which live longer when moving at high speeds.

## The Clock that Lied When **Time** Refused to Tick the Same

All these experiments confirm Einstein's predictions with remarkable accuracy.

### PHILOSOPHICAL IMPACT

The discovery that time is relative changed not only physics but also philosophy. Time is no longer an independent background; it is a dynamic quantity linked with space, motion, and gravity.

There is no single universal clock ticking for the entire universe. Each observer carries their own version of time.

### CONCLUSION

The "clock that lied" was not defective it was honest. It revealed a deeper truth about nature. Time inflexible, affected by motion and gravity, and woven into the fabric of space-time itself.

What once seemed impossible is now essential to modern technology. From satellites to space travel, our understanding of time has reshaped the world.

In physics, even time can no longer be taken for granted

*"However difficult life may seem, there is always something you can do and succeed at."*

— STEPHEN HAWKING

## The Orbit of Genius : *Aryabhata's Heliocentric Paradigm*

Mrinmoy Jyoti Deka

|

FYUGP 2<sup>nd</sup> Semester

**I**n 499 CE, the polymath Aryabhata codified a radical reimagining of the cosmos in his seminal treatise, the *Aryabhatiya*. At a time when the world adhered to geocentric dogmas, Aryabhata decoupled physical observation from theological projection, introducing a universe governed by kinematic motion and geometric precision.

**Axial Rotation and Relative Motion** Aryabhata's most profound departure from antiquity was his assertion of terrestrial rotation. He identified the perceived westward drift of the firmament as a mere optical byproduct of the Earth's rotation on its own axis. He articulated this through a sophisticated grasp of relative motion, observing that just as a traveler in a boat perceives stationary trees on a riverbank to be moving backward, an observer on Earth perceives the fixed stars as moving in the opposite direction. This insight anticipated the foundations of Newtonian mechanics by over a millennium.

**Proto-Heliocentric Undercurrents** While Aryabhata utilized a geocentric frame for terrestrial coordinate calculations; his underlying mathematical constants reveal a proto-heliocentric intuition. He correctly identified the Sun as the primary source of luminosity, noting that the Moon and planets do not possess intrinsic light but are "bathed in the Sun's luster." By treating the Sun as the system's anchor, he calculated planetary sidereal periods with startling accuracy, explaining erratic "retrograde" loops as a byproduct of the Earth's own orbital velocity.



**Secularizing the Eclipse** Aryabhata dismantled the prevailing mythology of celestial demons, utilizing geometric optics to explain eclipses as a predictable intersection of spheres. He calculated the Earth's shadow as a precise cone of darkness extending into space, demonstrating that a lunar eclipse occurs when the Moon intercepts this shadow, while a solar eclipse is a localized shadow cast by the Moon upon the Earth.

**Empirical Rigor** The integrity of Aryabhata's cosmos rested on unprecedented numerical precision:

- **The Sidereal Day:** Calculated at 23h 56m 4.1s, accurate to within a fraction of a second of modern values.
- **The Value of  $\pi$ :** Defined as an irrational approximation of 3.1416, allowing him to estimate the Earth's circumference with a margin of error under 1%.

## **The Orbit of Genius :** *Aryabhata's* **Heliocentric Paradigm**

Aryabhata transformed the sky from a realm of gods into a laboratory of geometry. His work eventually migrated through the Islamic Golden Age to Europe, providing the mathematical bedrock for the modern scientific era.

*"However difficult life may seem, there is always something you can do and succeed at."*

— STEPHEN HAWKING

## BEYOND THE NAKED EYE : A Journey through the Evolution of Telescope

Rituraj Dutta

|

FYUGP 2<sup>nd</sup> Semester

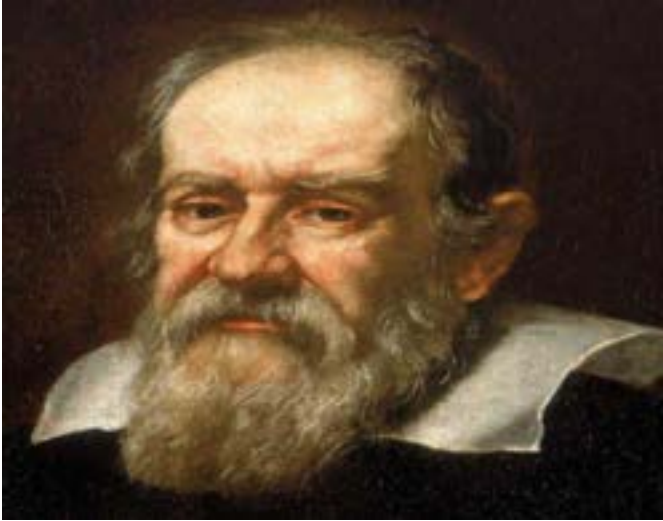
**T**he story of astronomy is, in many ways, the story of telescope. From a simple tube of lenses to a billion-dollar space observatory peering into the earliest epochs of the universe, telescopes have continuously reshaped humanity's understanding of cosmos. This journey, stretching from Galileo Galilei to the James Webb Space telescopes, reflects not only technological progress but also the ever-expanding curiosity of the human mind. Over centuries, telescopes have evolved in design, size and capabilities, allowing us to observe distant galaxies, uncover the laws of nature, and explore the origins of space and time. This evolution reflects the continuous growth of science and technology driven by human curiosity.

**Early Astronomical Observations (Before Telescopes):** Before the invention of telescopes, ancient civilizations closely observed the night sky. Indian, Babylonian, Egyptian and Greek astronomers studied the motion of stars and planets, predicted eclipses and developed calendars. Although their observations lacked precision, they laid the foundation of astronomy and inspired the development of instruments to see farther into space.

**Invention of the Refracting Telescope:** The first telescope was developed in the early 17th century when Dutch lens makers discovered that a combination of lenses could magnify distant objects. Galileo Galilei improved this device in 1609 and used it to observe the heavens.



## BEYOND THE NAKED EYE : A Journey through the Evolution of Telescope

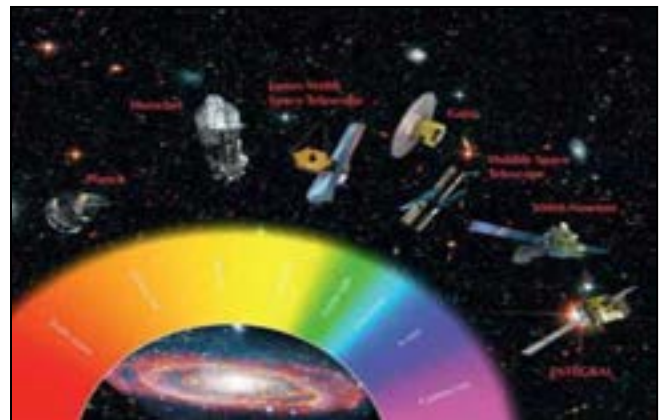


Galileo's discoveries, including craters on the Moon, the phases of Venus, sunspots and the moons of Jupiter, challenged the Earth-centered model of the universe and supported the heliocentric theory. However, early refracting telescopes suffered from chromatic aberration, which reduced image clarity.

### Reflecting Telescope (Overcoming Optical Limitation):

To solve the problems of refracting telescopes Issac Newton introduced the reflecting telescope in 1668. By using mirrors instead of lenses, reflecting telescopes eliminated chromatic aberration and allowed larger instruments to be built.

Reflecting telescopes become the foundation of modern astronomy. Continuous improvements in mirror polishing, coatings and telescope mounts significantly enhanced image quality and observational power.



## BEYOND THE NAKED EYE : A Journey through the Evolution of Telescope



### Giant Ground-Based Telescopes and the Expanding Universe:

The 18th and 19th centuries witnessed the construction of massive telescopes. William Herschel used large reflectors to discover Uranus and study nebulae and clusters. In the 20th century, telescopes like the 100inch Hooker telescope enabled Edwin Hubble to demonstrate that galaxies exist beyond the Milky Way and that the universe is expanding. This discovery revolutionized cosmology and introduced the concept of an expanding universe.

### Beyond Visible light (Multi-Wavelength Astronomy):

Astronomers later realized that celestial objects emit radiation across the entire electromagnetic spectrum. This led to the development of radio, infrared, ultraviolet, X-ray and gamma-ray telescopes. Radio telescopes revealed pulsars and cosmic microwave background radiation, infrared telescope uncovered star-forming regions hidden by dust, and X-ray as black holes and neutron stars. Each wavelength

telescopes exposed extreme cosmic phenomena such as black holes and neutron stars. Each wavelength provided new insights into the universe.

### Space Telescope (Escaping Earth's Atmosphere):

Earth's atmosphere distorts incoming light and blocks many wavelengths. To overcome this limitation, telescopes were placed in space. The launch of the Hubble Space telescope in 1990 marked a turning point of astronomy. Hubble delivered breathtaking images and precise measurements, helping scientists determine the age of the universe, study dark energy and observe distant galaxies and nebulae. It proved the immense value of space based observations.

### The James Webb Space Telescope, a New Era of Discovery:

The James Webb Space Telescope (JWST) launched in 2021. It represents the most advanced space telescope ever built. Unlike Hubble telescope, which primarily observes visible and ultraviolet light, JWST is designed to observe the universe in infrared wavelengths.

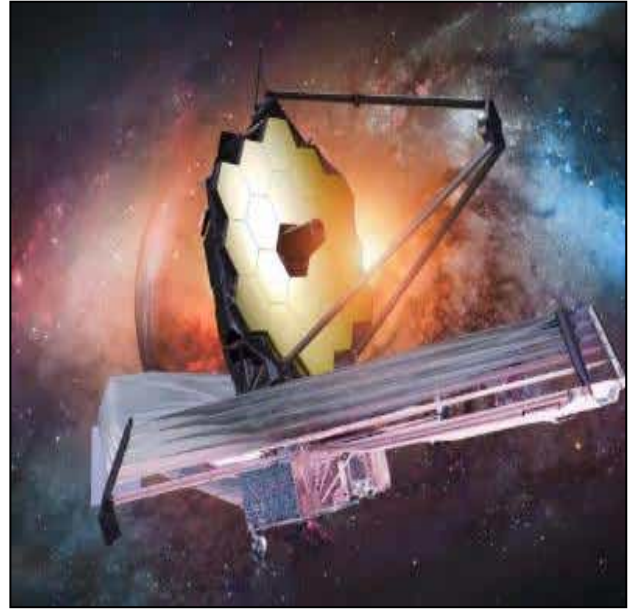
With its large segmented mirror and highly sensitive instruments, JWST can see deeper into space and further back in time than any previous telescope. It studies the formation of first galaxies after the Big Bang, explores star and planet formation and analyzes the atmosphere of exoplanets for signs for habitability. Positioned far from Earth to avoid heat interference, JWST has opened an entirely new window into the early universe.

## BEYOND THE NAKED EYE : A Journey through the Evolution of **Telescope**



Modern and Future Telescopes: Today's use cutting-edge technologies such as adaptive optics, computer control systems, and interferometry. Ground based and space telescopes work together to study dark matter, dark energy, gravitational waves and cosmic evolution.

Future telescopes aim to detect Earth-like exoplanets, search for extraterrestrial life and probe the earliest moments of the universe. The evolution of telescopes continues as a symbol of humanity's quest for knowledge.



The evolution of the telescope is a remarkable journey of scientific innovation. From simple optical lenses to powerful observatories like James Webb Space Telescope, each advancement has expanded understanding of the universe. As technology advances, telescopes will continue to reveal the mysteries of space and inspire future generations to explore the cosmos.

## THE DISCOVERY AND EXPERIMENTAL PROOF OF THE PHOTOELECTRIC EFFECT INTRODUCTION

Bhargab Mahanta

FYUGP 2<sup>nd</sup>Semester

The photoelectric effect is a physical phenomenon in which electrons are emitted from a material when light of sufficient frequency shines on it. This effect played a crucial role in the development of quantum mechanics, fundamentally changing our understanding of light and matter. Although the effect was first observed in the late 19th century, its correct explanation came decades later, leading to one of the most important scientific breakthroughs of the 20th century.

### *Early Observations: Heinrich Hertz (1887) Discovery of the effect*

The photoelectric effect was first discovered in 1887 by Heinrich Hertz, a German Physicist best known for confirming the existence of electromagnetic waves predicted by James Clerk Maxwell. While conducting experiments on radio waves, Hertz noticed something unexpected:

- He used spark gaps to detect electromagnetic waves.
- When ultraviolet (UV) light shone on the metal electrodes of the spark gap, sparks occurred more easily.
- Without UV light, a higher voltage was required to produce the same spark.

### *Significance of Hertz's Observation*

Hertz did not fully understand the cause, but his experiment demonstrated that:

- Light could influence the electrical properties of metals.
- This was the first recorded observation of the photoelectric effect.



However, Hertz did not pursue a detailed explanation, as his primary focus was on electromagnetic waves.

### *Systematic Investigation*

Wilhelm Hallwachs (1888) experimental confirmation in 1888, Wilhelm Hallwachs, a student of Hertz, conducted more controlled experiments and confirmed the effect more clearly.

### *Hallwachs observed that*

- A clean Zinc plate lost its negative charge when exposed to ultraviolet light.
- Positively charged plates were unaffected.

## THE DISCOVERY AND EXPERIMENTAL PROOF OF THE PHOTOELECTRIC EFFECT INTRODUCTION

### *Contribution*

Hallwachs concluded that:

- UV light causes negatively charged particles (electrons) to leave the metal surface.
- This supported the idea that light could remove electric charge from metals.

However, the nature of light and the mechanism behind this process remained unexplained.

### *Detailed Experimental Proof: Philipp Lenard (1902)*

Lenard's Experiments the most important experimental work was carried out by Philipp Lenard, who designed experiments specifically to study the emitted electrons. He made several key observations:

#### **1. Immediate Emission**

- Electrons were emitted instantaneously, even at very low light intensity.
- This contradicted classical wave theory, which predicted a time delay.

#### **2. Frequency Dependence**

- Below a certain Threshold frequency, no electrons were emitted, regardless of light intensity.
- Above this frequency, emission occurred.



#### **3. Energy of electrons**

- The kinetic energy of emitted electrons depended on the frequency, not the intensity of light.
- Increasing intensity increased the number of electrons, not their energy.

### *Why this was a problem?*

According to classical physics:

- Light was a wave and energy should depend on intensity.
- Any frequency should work if intensity were high enough.

Lenard's results clearly contradicted classical wave theory, creating a major scientific crisis.

## THE DISCOVERY AND EXPERIMENTAL PROOF OF THE PHOTOELECTRIC EFFECT INTRODUCTION

Bhargab Mahanta

| FYUGP 2<sup>nd</sup>Semester

### *Theoretical Explanation:*

Albert Einstein (1905) Einstein's Revolutionary Insight in 1900, Max Planck had introduced the idea that energy exchange occurs in discrete units (quanta). However, Planck believed this applied only to matter, not light itself. Einstein took a bold step further. In 1905, He provided the correct explanation using Max Planck's quantum hypothesis.

### *Einstein proposed that*

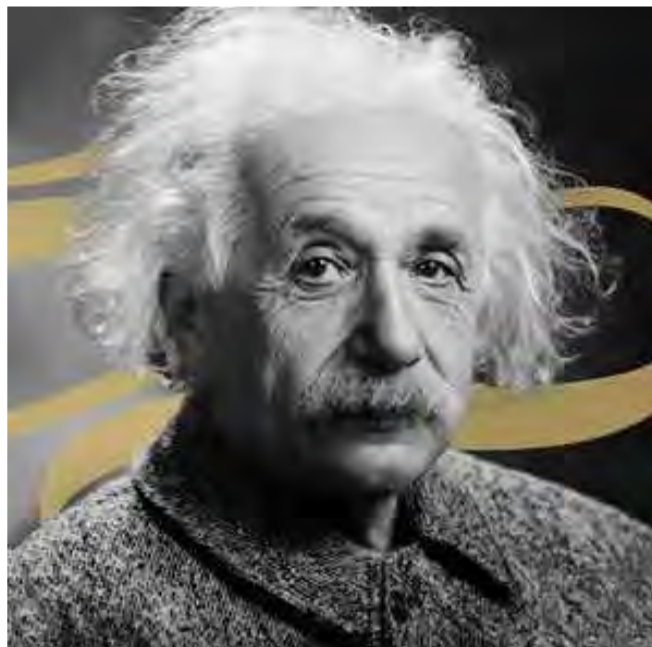
- *Light consists of discrete packets of energy, later called photons.*
- *Each photon has energy given by:  $E = h\nu$*

Where,  $h$  is Planck's constant and  $\nu$  is frequency of light. This was a direct challenge to the well-established wave theory of light.

### *Explanation of the Observations*

Einstein explained Lenard's results as follows:

- **Threshold Frequency:** the minimum photon energy is required to remove an electron from the metal.
- **Instantaneous Emission:** One photon transfers its energy to one electron instantly.
- **Kinetic Energy Dependence:** Excess energy becomes the kinetic energy of the electron:  $ax = h\nu - \phi$ , where  $\phi$  is the work function of the metal.



### *Importance*

Einstein's explanation showed that:

- Light behaves as both a wave and a particle.
- Classical physics was incomplete.

In 1921, Albert Einstein was awarded the Nobel Prize in Physics for this work (not for relativity). This recognition underscored the fundamental importance of Einstein's contribution to quantum theory.

### *Final Experimental Verification: Robert Millikan (1914-1916)*

*Testing Einstein's theory* - Although initially skeptical, Robert A. Millikan conducted highly precise experiments to test Einstein's photoelectric equation.

## THE DISCOVERY AND EXPERIMENTAL PROOF OF THE PHOTOELECTRIC EFFECT INTRODUCTION

Bhargab Mahanta

FYUGP 2<sup>nd</sup>Semester

Millikan:

- Measured stopping potentials for different frequencies.
- Verified the linear relationship between electron kinetic energy and frequency.
- Accurately determined Planck's constant from photoelectric data.

### Outcome

Millikan's Experiments:

- Confirmed Einstein's Theory experimentally.
- Left no doubt about the quantum nature of light.

Ironically, Millikan's work convinced the scientific community of Einstein's correctness.

### Impact and Applications

Scientific Importance of the Photoelectric effect:

- Provided strong evidence for quantum mechanics.

- Marked the end of classical explanations of light
- Introduced the concept of wave-particle duality

### Practical or Technological Applications

Today, the photoelectric effect is used in Solar Cells, Photodiodes, Light sensors, Automatic doors, Television camera tubes, Spacecraft power systems etc.

### CONCLUSION

The photoelectric effect was:

- Discovered experimentally by Heinrich Hertz (1887)
- Studied systematically by Hallwachs and Lenard
- Explained theoretically by Albert Einstein (1905)
- Experimentally verified by Robert Millikan (1916)

This journey transformed physics and laid the foundation of modern quantum theory, making this photoelectric effect one of the most important discoveries in scientific history.

*Education is not the learning of facts, but the training of the mind to think*

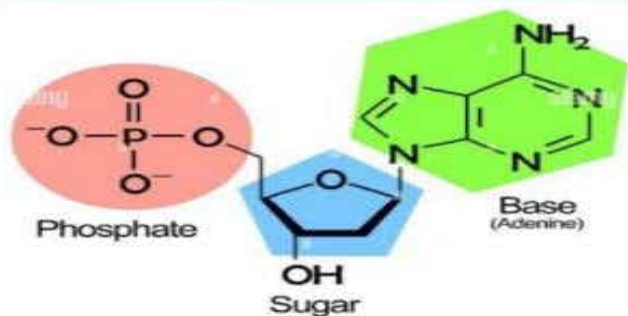
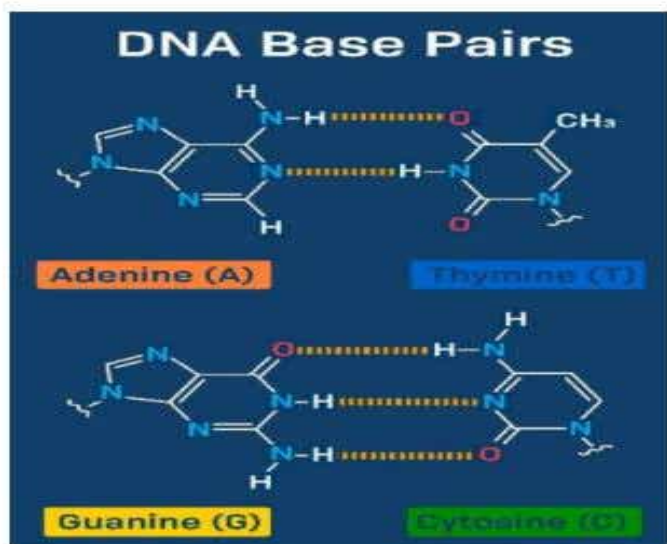
## DNA Biophysics : Physical Principles Governing the Molecule of Life

Dipangkar Nath

FYUGP 2<sup>nd</sup> Semester

**B**iophysics is an interdisciplinary branch of science that applies the principles and methods of Physics to understand biological systems. It seeks to explain life processes—ranging from the structure of molecules to the functioning of cells, tissues, and organisms—through physical laws such as mechanics, thermodynamics, electromagnetism, and statistical physics. By combining the quantitative rigor of physics with the complexity of biology, biophysics provides deep insights into how biological structures are formed, how they function, and how they respond to internal and external forces.

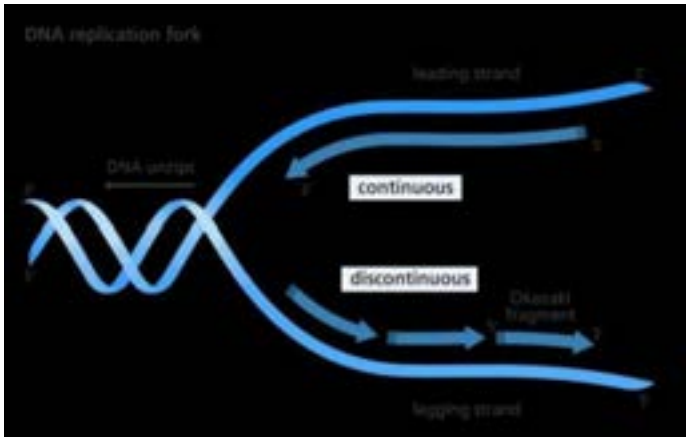
DNA is composed of two long chains called polynucleotide strands. Each strand is made up of repeating units known as nucleotides. Every nucleotide consists of three components: a deoxyribose sugar, a phosphate group, a nitrogenous base. There are four types of nitrogenous bases in DNA: adenine (A), thymine (T), guanine (G), and cytosine (C). These bases pair specifically through hydrogen bonds—adenine pairs with thymine via two hydrogen bonds, while guanine pairs with cytosine via three hydrogen bonds. This specific pairing is called complementary base pairing and is essential of DNA replication and stability. The two DNA strands run in opposite directions, a feature known as antiparallel orientation (one strand runs 5'→3' and the other 3'→5'). The sugar and phosphate groups form the outer backbone of the molecule, while the paired bases lie on the inside, like the rungs of a twisted ladder.



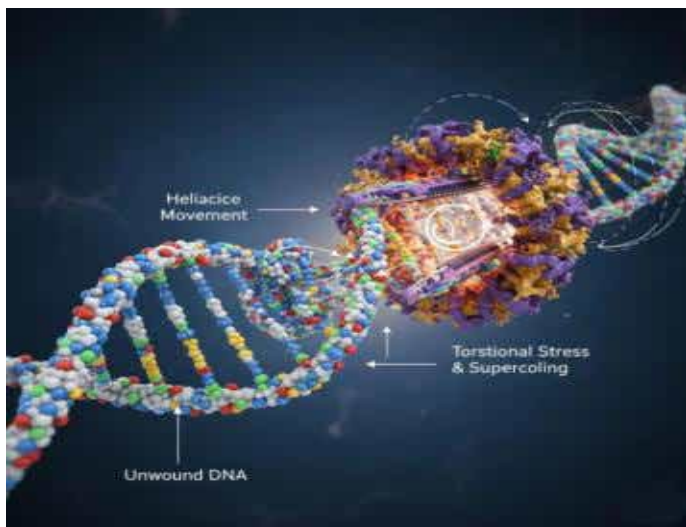
DNA replication is the fundamental biological process by which a cell makes an exact copy of its DNA before cell division. It is a semi-conservative process, meaning each newly formed DNA molecule contains one original (parental) strand and one newly synthesized strand. Replication occurs during the S phase of the cell cycle and ensures the faithful transmission of genetic information to daughter cells.

DNA replication is not only biochemical processes but also deeply mechanical phenomena governed by forces, motion, and deformation of the DNA molecule. During DNA replication, the double helix must be unwound to allow each strand to

## DNA Biophysics: Physical Principles Governing the **Molecule** of Life

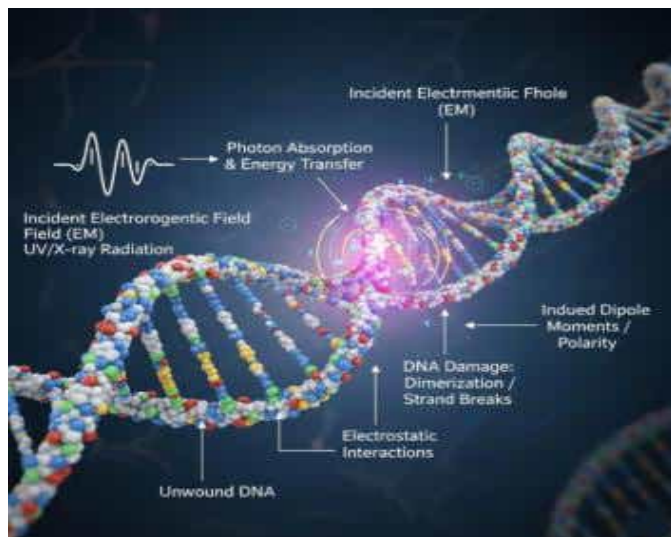


serve as a template. This unwinding is carried out by helicase enzymes, which apply mechanical stress, leading to over winding (positive supercoiling) ahead of the replication fork and under winding behind it. To relieve this stress, topoisomerase enzymes cut, rotate, and rejoin DNA strands, acting as mechanical regulators. The replication machinery itself exerts tensile forces that stretch DNA, while DNA polymerase advances in a stepwise mechanical motion as it adds nucleotides, converting chemical energy into directed movement.



DNA replication is fundamentally thermodynamic processes driven by changes in energy, entropy, and free energy. Although these processes appear highly ordered, they proceed spontaneously in cells because they are carefully coupled to favorable energy changes, mainly through nucleotide chemistry and ATP hydrolysis. In DNA replication, the separation of the double helix requires breaking hydrogen bonds between complementary base pairs. This strand separation is enthalpically unfavorable because energy is needed to disrupt these interactions. However, it is compensated by a favorable increase in entropy, as the ordered double helix transitions into more flexible single strands. The overall spontaneity of replication is ensured by coupling strand separation with energetically favorable reactions, such as the formation of new phosphodiester bonds during nucleotide incorporation. DNA polymerase uses the free energy released from deoxynucleotide triphosphate (dNTP) hydrolysis, making the overall Gibbs free energy change ( $\Delta G$ ) negative and driving replication forward in a highly directional manner.

## DNA Biophysics: Physical Principles Governing the **Molecule** of Life

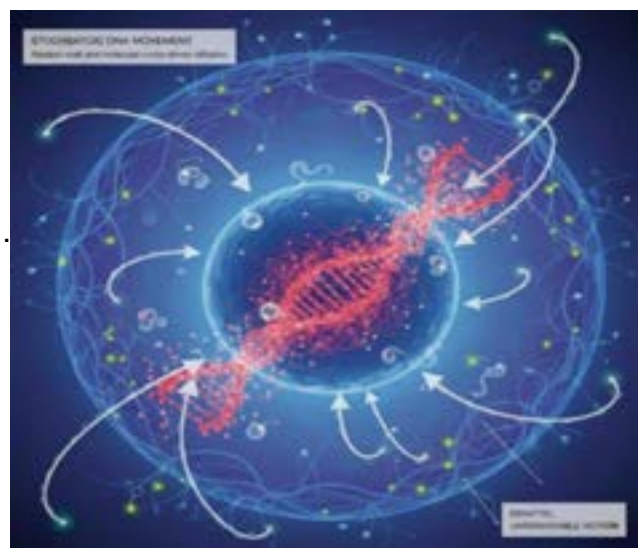


Electromagnetic interactions play a fundamental role in DNA replication because DNA and the proteins that process it are charged and polar molecules. These processes are governed largely by electrostatic forces, hydrogen bonding, and interactions mediated by ions in the cellular environment. DNA carries a strong negative electric charge due to its phosphate backbone. This charge creates long-range electrostatic fields that influence how DNA folds, interacts with proteins, and moves within the nucleus. During replication, enzymes such as helicase and DNA polymerase recognize and bind to DNA primarily through electrostatic attraction between positively charged amino acid residues (like lysine and arginine) and the negatively charged DNA backbone. These interactions stabilize the replication complex and guide enzymes accurately along the DNA strand.

DNA replication occurs in a stochastic (probabilistic) cellular environment, where molecular events are influenced by thermal

fluctuations, random collisions, and varying concentrations of biomolecules. Because these processes involve a large number of microscopic interactions, their behavior is best understood using statistical physics and statistical analysis, rather than purely deterministic models. In DNA replication, the binding of DNA polymerase, the opening of the replication fork, and the incorporation of nucleotides are all probabilistic events. Base pairing follows statistical rules governed by Boltzmann distributions, where correct nucleotide incorporation is energetically favored but errors can still occur with low probability.

The high fidelity of replication arises from statistical bias correct base pairs have much lower free energy than mismatches combined with proofreading mechanisms that further reduce error rates. Statistical models help quantify mutation frequencies, replication speed variations, and error probabilities across the genome.



## DNA Biophysics: Physical Principles Governing the **Molecule** of Life

In conclusion, the biophysics of DNA replication provides a fundamental bridge between physical laws and biological function, revealing how forces, energies, and molecular dynamics govern the faithful duplication of genetic information. By integrating principles such as thermodynamics, elasticity, hydrodynamics, and statistical mechanics, biophysics explains how DNA strands are unwound, stabilized, copied, and reassembled with remarkable speed and accuracy inside the crowded cellular environment. The scope of DNA replication biophysics continues to expand with advances in single-molecule techniques,

computational modeling, and high-resolution imaging, enabling scientists to observe replication processes in real time and at nanometer scales. This knowledge has profound applications in biotechnology, including the design of improved DNA polymerases, optimization of PCR and sequencing technologies, development of novel gene-editing tools, and targeted cancer therapies that exploit replication stress. Ultimately, understanding DNA replication through a biophysical lens not only deepens our insight into life's molecular foundations but also drives innovation across medicine, genetics, and synthetic biology.

*"However difficult life may seem, there is always something you can do and succeed at."*

— STEPHEN HAWKING

## Quantum Supremacy : *Reforming the Future of Physics*

Sudipta Sarkar

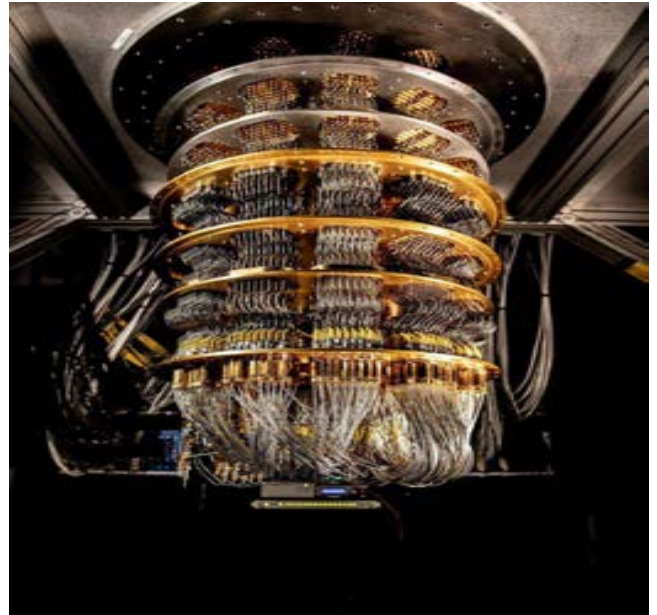
| FYUGP 2<sup>nd</sup> Semester

### INTRODUCTION

Quantum computing is no longer just a theoretical concept; it has become a reality. In 2025-26, we are witnessing a transition where quantum computers are solving problems that would take traditional supercomputers thousands of years. This milestone is known as “Quantum Supremacy”

### THE CORE CONCEPT

Unlike classical computers that use ‘bits’ (0 or 1), quantum computers use ‘qubits’. These qubits can exist in multiple states simultaneously, a phenomenon called superposition. This allows quantum machines to process vast amounts of data at an unimaginable speed.



### MAJOR BREAKTHROUGHS OF 2025

- Stable Qubits: scientists have finally developed a method to keep qubits stable at slightly higher temperatures, reducing the need for extreme cooling.
- Complex simulations: researchers used a quantum processor to simulate the exact behavior of a complex molecule, which could lead to revolution in medicine and natural science.

### GRAVITY ACROSS THE UNIVERSE

Quantum computing is bridge between theoretical physics and practical technology. As we move forward, it will continue to redefine our understanding of law of nature an power of innovation.

## JOURNEY TO THE DAWN OF TIME

Sudipta Sarkar

|

FYUGP 2<sup>nd</sup> Semester



### The Discovery of the Earliest Super massive Black Hole

#### *THE BREAKTHROUGH*

In a monumental leap for cosmological Astrophysics in 2025, astronomers have officially discovered the most distant and earliest super massive blackhole ever recorded. This celestial giant dates back to, a time when the universe was in its absolute influence, providing a rare “time-capsule” looks at the conditions shortly after the Big Bang.

#### *Why it matters:*

- REVISITING HISTORY- it proves that black hole grow much faster than we once thought.
- GALACTIC ORIGIN- it helps us understand how the first stars and galaxies were born.

#### *CONCLUSION*

This discovery is not just about a black hole, it’s about revisiting the history of our universe.

#### KEY FACTS-

- Oldest blackhole ever found.
- Millions of time larger than the Sun.

## LANDING ON *MARS*:

### *The Physics behind the Impossible*

Risha Barman

|

FYUGP 2<sup>nd</sup> Semester

**F**or centuries, Mars has fascinated humanity, growing like a distant ruby in the night sky. Today, robotic explorers land there successfully, captures images, conducting experiments, and sending back invaluable data. Yet behind every successful landing lies a story of precision, physics, and hidden calculations. One of the most crucial yet often overlooked tools in this story is dimensional analysis—a method that ensures all physical quantities, forces, and timings involved in a spacecraft's journey remain consistent and correctly scaled. Without it, even a perfect understanding of physics could fail to save a mission.

As a spacecraft approaches Mars, it enters the planet's thin atmosphere at speeds exceeding 5 kilometers per second. Friction with the sparse air begins to slow it down while generating intense heat, but the effect is limited. Mars' atmosphere is only about 1% as dense as Earth's, offering very little resistance. At this stage, engineers rely on dimensional analysis to understand how mass, velocity, atmospheric density, and force interact. By checking that equations remain dimensionally consistent, they ensure that simulations tested on Earth remain valid under Martian conditions.



Without this step, calculations could underestimate forces, misjudge timing, or predict parachute sizes that simply would not work—where even a small error could mean complete mission failure.

As the descent continues, parachutes deploy, but their role on Mars is very different from that on Earth. They are not meant to bring the spacecraft to a halt. Instead, they perform three critical functions: stabilizing the spacecraft's orientation, reducing velocity to manageable levels, and preparing the craft for rocket-assisted deceleration. Because drag depends on factors such as air density, velocity, and parachute area, dimensional analysis becomes essential here. It allows engineers to compare these variables correctly and ensure the parachute generates sufficient resistance. Without dimensional reasoning, a parachute could be wrongly scaled—too small to slow the craft or too large to remain stable—leading to tumbling, over speed, or loss of control.

## LANDING ON *MARS*:

### *The Physics behind the Impossible*

Risha Barman

| FYUGP 2<sup>nd</sup> Semester



Even after parachute deployment, the spacecraft is still descending far too fast for a safe landing. At this point, retro-rockets ignite, producing thrust to counter the remaining velocity and the pull of Martian gravity. The margin for error is extremely small. If the rockets fire too early, fuel is wasted and deceleration becomes inefficient; if they fire too late, the risk of impact rises dramatically. Dimensional analysis ensures that thrust calculations correctly match the spacecraft's mass, speed, and gravitational environment. It acts as a final consistency check, confirming that the force produced by the rockets is neither too weak nor too strong, but precisely what is required at that moment.

Some missions, such as NASA's Perseverance rover, use an even more complex system known as the sky crane. In this maneuver, rockets hover above the surface while the rover is lowered gently on cables. This stage requires a delicate balance between multiple forces—rocket thrust, rover mass, cable tension, and descent speed. Dimensional analysis allows engineers to scale these parameters accurately from simulations to real conditions on Mars, ensuring the rover touches down softly. Without this careful scaling, even slight mismatches in force or timing could cause the

entire system to fail.

History shows how unforgiving Mars can be when dimensional consistency is ignored. The Mars Climate Orbiter (1999) was lost due to a mismatch between metric and imperial units—a simple error in dimensional reasoning that destroyed a multi-million-dollar mission. Earlier Mars landers also failed after misjudging drag, gravity, or descent speed. These failures highlight a crucial lesson: knowing the laws of physics is not enough; they must be applied with dimensional precision.

Throughout the entire landing process, dimensional analysis acts as a silent guardian. It confirms that equations make physical sense, ensures that mass, velocity, gravity, and air density are scaled correctly, validates that Earth-based simulations can predict Martian behavior, and helps engineers detect errors long before they become *ca ta strop hic*.

Landing on Mars is not magic. It is the result of centuries of physics combined with careful engineering and the quiet power of dimensional analysis, ensuring every calculation speaks the same physical language. Parachutes stabilize and slow the descent, rockets provide controlled deceleration, and dimensional reasoning binds every stage together into a successful landing. Each touchdown on the Red Planet stands as proof that what once seemed impossible becomes achievable when science is applied with precision.

## BRIDGING THE INFINITY: *Physics, Vedanta and Cosmic Symphony*

Shreyash Dutta

| FYUGP 2<sup>nd</sup> Semester

**C**hicago in 1893, a young monk in saffron robes stood before the Parliament of the World's Religions. Swami Vivekananda did not just speak of faith; he spoke of a bridge. He proposed that the ancient insights of Vedanta were not relics of the past but premonitions of a future science. Today, as we delve into the subatomic world and the vastness of the cosmos, that bridge has become a highway of understanding, where the vibrations of a Bihu drum meet the complex equations of Quantum Mechanics.

### *The Loom of Space-Time: Akasha and Prana*

Vivekananda's core thesis rested on two pillars: Akasha (the primordial space/matter) and Prana (the cosmic energy). He described how Prana acts upon Akasha to create everything from the smallest atom to the grandest galaxy.

Decades later, Albert Einstein unified these concepts in the elegant equation.

$$E = mc^2$$

This was the scientific proof that matter is simply "frozen energy." In this light, the entire universe is not a collection of solid objects, but a shimmering, vibrating field. The "Akash" is the field, and the "Prana" is the energy that ripples through it.

### *The Oneness of the Boson: Vedanta in the Lab*

At the heart of Indian philosophy lies Advaita—the concept of Non-Duality, where the observer and the observed are one. This found its mathematical echo in

the work of Satyendra Nath Bose.

His Bose-Einstein Statistics described a world where particles lose their individual identity and behave as a single, harmonious unit. When Bose showed that particles (Bosons) could occupy the same state simultaneously, he provided the physical blueprint for the Vedantic "Brahman"—the single reality underlying all diversity. As Rabindranath Tagore noted, Bose was a "Poetic Scientist," finding the rhythm of unity in the chaos of particles.

### *The Rhythm of the Land: Bihu as Wave Mechanics*

This cosmic science is not hidden in laboratories; it is alive in the red soil of Assam. Consider the Bihu Dhol. When the drummer strikes the hide, he creates a series of Standing Waves. These are governed by the physics of harmonics:

$$f_n = nf_1$$

## BRIDGING THE INFINITY: *Physics, Vedanta and Cosmic Symphony*

The pulse of the Bihu drum is the "Prana" of Assam, vibrating through the "Akasha" of its valleys. Similarly, in the delicate Meend (glissando) of a Hindustani Khayal performance or the rhythmic precision of the Sattriya Taal, we find the sonic equivalent of the Schrödinger Equation

Reality is a wave of probability until it is observed, just as a Raga is a wave of potential until it is sung, "collapsing" into the heart of the listener as Rasa (emotion).

$$\widehat{H}\varphi = i\hbar \frac{\partial \varphi}{\partial t}$$

### *The Tandava of the Quantum Foam*

Modern physics suggests that "empty space" is never truly empty. It is a bubbling cauldron of energy known as Quantum Foam. Due to Heisenberg's Uncertainty Principle energy constantly fluctuates.

$$\Delta x \cdot \Delta p \geq \hbar/2$$

This is the Tandava of Shiva—the dance of creation, maintenance, and destruction. In the Tantric traditions of Kamakhya, this "Spanda" (vibration) is recognized as the source of life. The universe is not a machine; it is a song. From the black hole horizons (reminiscent of the Rigvedic descriptions of the void) to the pulse of a plant captured by Jagadish Chandra Bose's crescograph, everything is "Alive" and "One."

### *The Living Application: From Lab to Life*

How does this bridge serve us today? It reminds us that we are not isolated points in a cold universe.

### *Karma Yoga as a Stationary State*

In the frantic traffic of a modern city, one can remain internally still while externally active—a living example of the Stationary State equation

$$\widehat{H}\varphi = E\varphi$$

### *Entanglement as Compassion*

Quantum Entanglement proves that particles, once linked, affect

each other regardless of distance. This is the scientific basis for empathy: if everything is connected, to hurt another is to hurt oneself.

Vivekananda's call—"Arise, Awake!"—is a call to recognize our cosmic nature. In the resonance of the Dhol, in the math of the Boson, and in the silence of meditation, the message is the same. We are the architects of our own reality.

As the sun sets over the Brahmaputra, we realize that the "Infinite" is not far away. It is in the vibration of the air, the rhythm of our hearts, and the logic of our equations. We are the symphony, and the bridge is finally complete.

## **BRIDGING THE INFINITY :** *Physics, Vedanta and Cosmic Symphony*

### **The Resonance of Vedanta in the Pulse of Science: From Vivekananda to Quantum.**

When Swami Vivekananda addressed the world at the Parliament of the World's Religions in Chicago in 1893, he did not merely speak of Hinduism; rather, he presented the very foundations of modern science through the lens of spirituality. He declared that while Vedanta is ancient, it is fundamentally modern—grounded in logic and experimentation much like science itself. Today, twenty-first-century physics is re-validating those very words of Vivekananda through the language of mathematical equations.

## STORIES BEHIND

## THE GREATEST DISCOVERIES IN PHYSICS

Dhriti Raj Saha

|

FYUGP 2<sup>nd</sup>Semester



### Newton and the falling apple: birth of Gravitation (1687)

In the mid 17<sup>th</sup> century, the motion of planets and objects seemed like unrelated phenomena. According to legend, Issac Newton observed an apple fall from a tree and wondered why it always fell straight down instead of sideways or upward. This simple question led him to a revolutionary idea. the same force that pulls apple to earth governs the motion of noon and planets.

After years of intense mathematical work, Newton published Philosophies Naturalis Principia Mathematica (1687), where he introduced the law of universal gravitation.

$$F = G \frac{m_1 m_2}{r^2}$$

### Faraday's Invisible lines: Discovery of electromagnetic Induction (1831)

Michael faraday had little formal education and began his carrier as bookbinder's apprentice. Fascinated by science, he attended lecture and performed historic discovery: a changing magnetic field can induced an electric current in a wire. This principle now known as electromagnetic induction is mathematically expressed by Faraday's law:

$$\epsilon = -\frac{d\phi}{dt}$$



## STORIES BEHIND *THE GREATEST DISCOVERIES IN PHYSICS*



### Rontgen's Accidental rays: Discovery of X rays(1895)

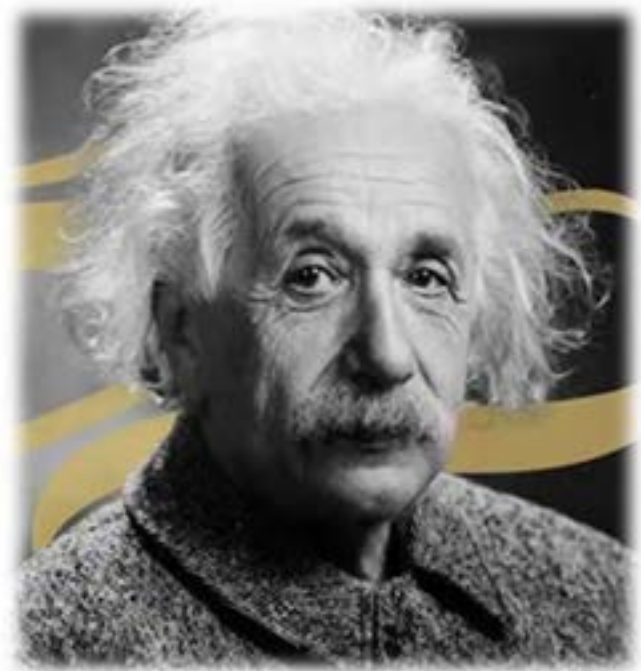
In 1895, Wilhelm Conrad Röntgen was experimenting with cathode ray tubes wrapped in black cardboard when he noticed a fluorescent screen glowing across the room. Something invisible was penetrating the cardboard and exciting the screen. He called the mysterious radiation X rays.

### Einstein's miracle year: Relativity and Quantum Photon (1905)

In 1905, Albert Einstein, then a patent clerk in Bern, published four papers that transformed physics. Two of the most revolutionary were:

Photoelectric Effect  $E = h\nu$

Special relativity  $E = mc^2$



## THE DISCOVERY OF GRAVITY AND NEWTON'S LAW OF *GRAVITATION*

Banadip Barman

| FYUGP 2<sup>nd</sup> Semester

One of the most important discoveries in the history of physics in the law of universal gravitation, formulated by Sir Isaac Newton in the 17th century, this discovery explained why objects fall to the ground and how planets move in their orbits, unifying earthly and celestial motion under a single law.

### The famous Apple story:

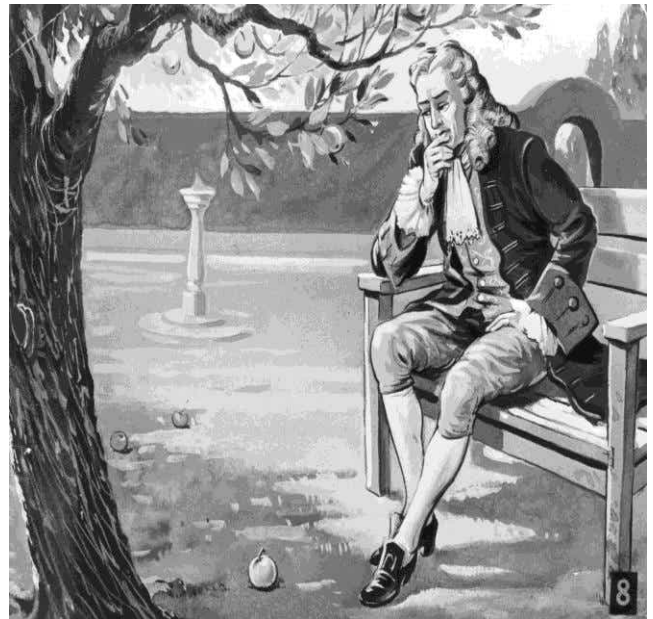
According to popular tradition, in 1665-1666 during the outbreak of the Great Plague, Isaac Newton returned to his home in Woolsthorpe, England, after the University of Cambridge was closed. While sitting in his garden, Newton observed an apple falling from a tree.

This simple observation led him to ask a profound question:

*“Why do objects always fall straight down towards the earth?” instead of thinking the apple fell due to chance, Newton reasoned that the earth must be exerting an attractive force on the apple. He then wondered whether this same force could extend beyond the earth – perhaps even reaching the moon.*

### From Falling Apples to Orbiting Moons:

Newton compared the falling of an apple with the motion of the Moon around the Earth. He realized that the Moon does not fly off in a straight line because it is constantly being pulled toward the Earth by the same force that pulls the apple downward. This insight helped him connect terrestrial motion (objects on Earth) with celestial motion (planets and moons).



### Development of the Law of Gravitation:

After years of careful thinking and mathematical calculations, Newton formulated the law of universal gravitation, which states:

Every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

Mathematically, the law is expressed as:

$$F = G \frac{m_1 m_2}{r^2}$$

Where:

F is the gravitational force  $m_1$  and  $m_2$  are the masses of the two objects  $r$  is the distance between their centres, and  $G$  is the universal gravitational constant.

## THE DISCOVERY OF GRAVITY AND NEWTON'S LAW OF *GRAVITATION*

### Publication and Impact

Newton published this law in 1687 in his famous book *Philosophiæ Naturalis Principia Mathematica* (commonly known as the *Principia*). This work laid the foundation of classical mechanics and remained the most accurate description of gravity for more than two centuries.

Importance of the Discovery: Newton's law of gravitation: Explained the motion of planets and satellites Helped predict eclipses and planetary positions Laid the groundwork for

space science and astronomy Unified the laws governing the Earth and the heavens space science and astronomy Unified the laws governing the Earth and the heavens

### Conclusion:

The discovery of gravity was not a sudden event but the result of deep observation, imagination, and mathematical reasoning. The falling apple may have inspired Newton, but it was his genius that transformed a simple event into one of the greatest scientific laws ever discovered.

# BIG BANG THEORY THE ORIGIN AND EVOLUTION OF OUR UNIVERSE

Banadip Barman

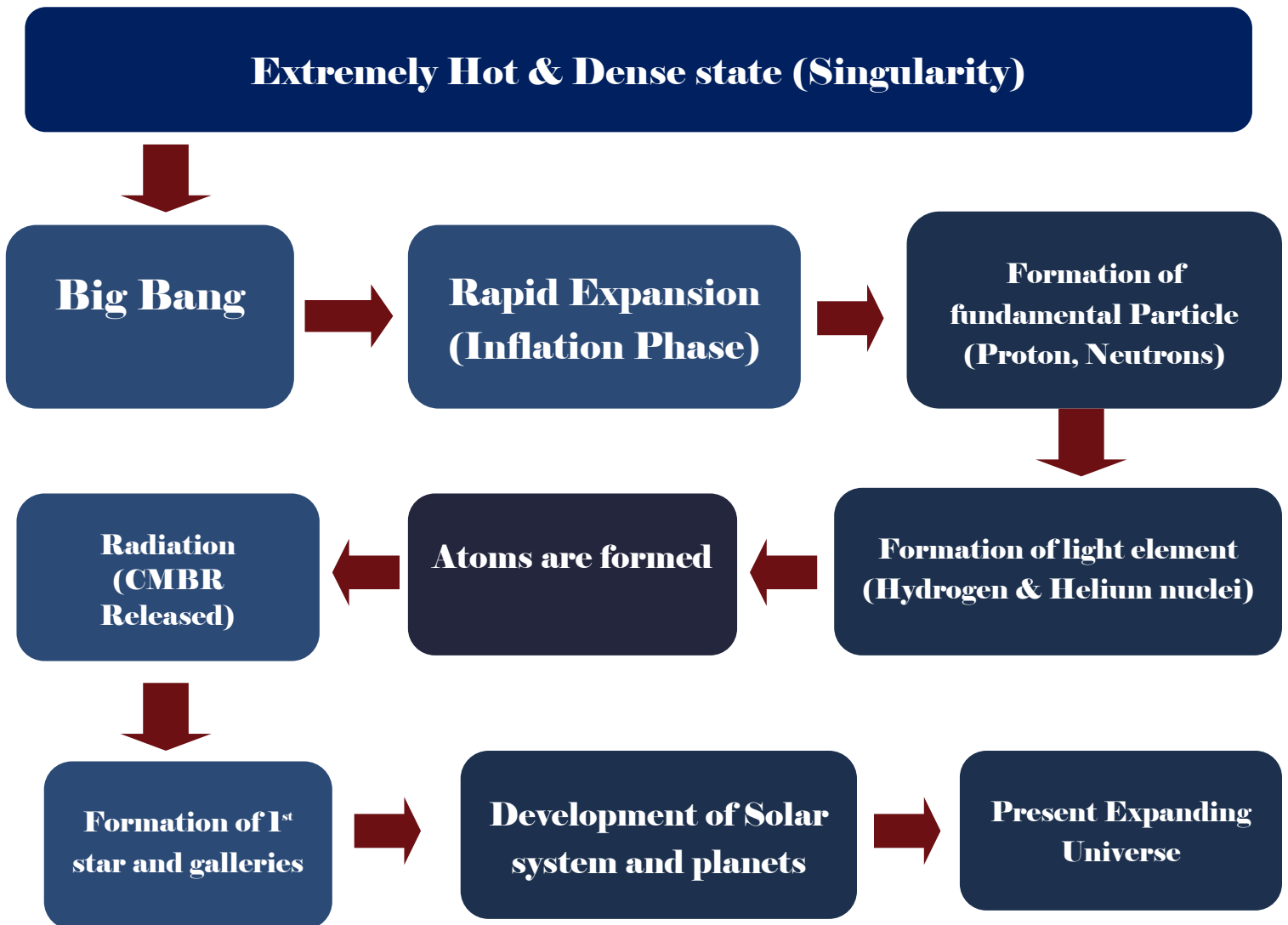
| FYUGP 2<sup>nd</sup> Semester

Have you ever wondered how everything we see today stars, galaxies, plants and even time itself came into existence?

About 18.8 billion years ago, the universe began from an extremely hot and dense state in an event known as the Big bang.

This theory explains only the origin of the universe but also continuous expansion.

## BIG BANG THEORY- FLOWCHART



“Stages in the Evolution of the universe according to big bang theory”

## THE DISCOVERY OF MAGNET

### *A Greek Shepherd's Story*

Dhanjit Kalita

| FYUGP 2<sup>nd</sup> Semester



u - shaped magnet



bar magnet



ring magnet



horseshoe magnet

Long ago in ancient Greece, there lived a shepherd named Magnes. One day, he was walking on a mountain called Mount Ida with his flock of sheep. Magnes was wearing iron shoes and carrying a stick with an iron tip.

Suddenly, he felt that his shoes were getting stuck to the ground. When he tried to move, it became difficult to lift his feet. He was surprised and confused. Then he noticed that his iron shoes and the iron tip of his stick were being attracted by some black stones present on the ground.

This simple observation by a shepherd changed the future of science and technology. It shows how great discoveries can begin from small and accidental moments.

Out of curiosity, Magnes picked up one of those stones and observed that it could attract small pieces of iron. This mysterious stone was later called lodestone, a naturally occurring magnet.

This discovery became the foundation of magnetism. The word “magnet” is believed to have come from the name “Magnesia,” a region in Greece where these stones were found. Over time, scientists studied this property and developed artificial magnets which are now used in motors, speakers, generators, compasses, and many modern devices.

# Henri Becquerel's Lazy Discovery of Radioactivity (1896)

Raghunandan Rajbongshi | FYUGP 4<sup>th</sup> Semester

Becquerel was studying phosphorescent materials and thought sunlight was necessary for them to emit radiation.

He planned an experiment but then...Paris became cloudy. So he said: "Fine, I'll do it later." He shoved uranium salts and photographic plates into a drawer.

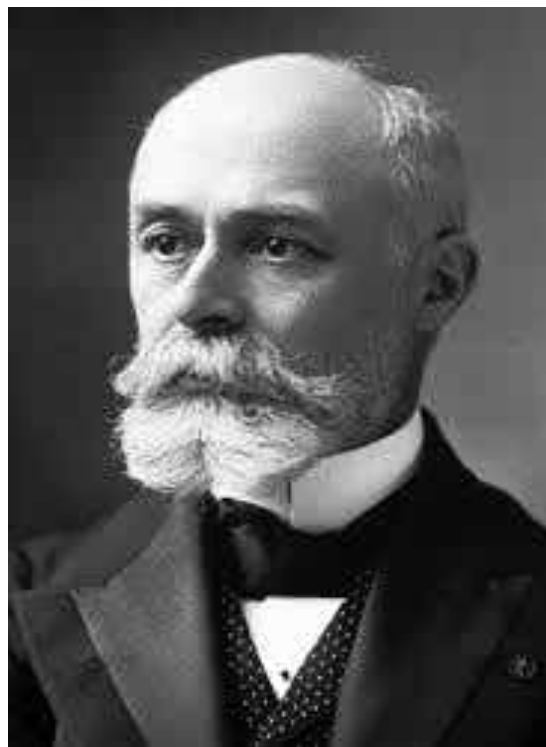
Days later, he developed the plates.

Result: Perfect images. No sunlight involved.

The radiation had exposed the plates inside a dark drawer.

So, radioactivity was discovered because: The weather was bad. The scientist was lazy Uranium didn't care about theory.

Physics lesson: Nature doesn't wait for your schedule.



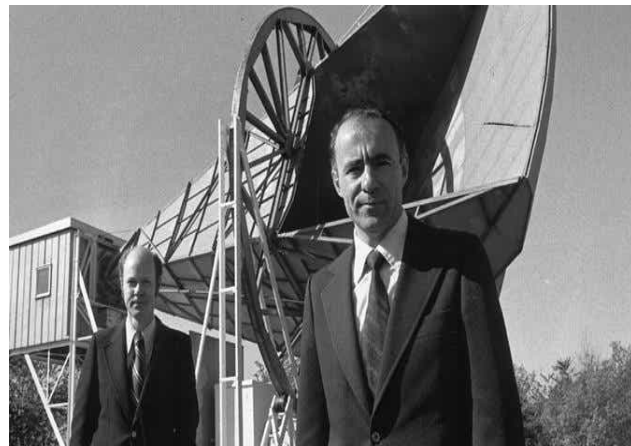
*"One never notices what has been done; one can only see what remains to be done."*  
**Pierre Curie**

## Bell Labs and the Pigeon Problem (Cosmic Microwave Background, 1964)

Raghunandan Rajbongshi | FYUGP 4<sup>th</sup> Semester

Two physicists, Arno Penzias and Robert Wilson, were working with a giant radio antenna. They kept hearing a constant background noise. They tried everything adjusted electronics, checked circuits, changed orientation, swore at the equipment, still there, then they found the culprit were Pigeons nesting inside the antenna and worse Pigeon had dropped their excreta (they politely called it “white dielectric material”). They cleaned it thoroughly. Even after that the noise was still there.

Turns out: They had accidentally discovered the Cosmic Microwave Background Radiation, the afterglow of the Big Bang. Because the pigeons were never the real cause. The remaining noise was : Cosmic Microwave Background Radiation (CMB) Leftover radiation from the Big Bang, about 13.8 billion years old, uniformly filling the entire universe. So no matter how clean the antenna was, it was still “listening” to the birth cry of the universe.



**Thomas Tredgold** – *“Engineering is the art of directing the great sources of power in nature for the use and convenience of man.”*

## মহাবিশ্বৰ আদি কথা: বিগ বেং আৰু সৌৰজগতৰ সৃষ্টি

~বৰষা অধিকাৰী, ৪র্থ ষান্মাসিক

আমাৰ এই বিশাল মহাবিশ্বখন কেনেকৈ সৃষ্টি হ'ল, সেই প্ৰশ্নই মানুহক যুগ যুগ ধৰি আচৰিত কৰি আহিছে। আজিৰ পৰা প্ৰায় ১৪০০ কোটি বছৰ আগতে সমগ্ৰ মহাবিশ্ব এক বিন্দুৰ দৰে অতি ক্ষুদ্ৰ আৰু প্ৰচণ্ড উত্তপ্ত অৱস্থাত আছিল। এক মুহূৰ্তৰ প্ৰচণ্ড বিস্ফোৰণৰ ফলত সেই বিন্দুৰ পৰাই স্থান, কাল আৰু পদাৰ্থৰ সৃষ্টি হয়। ইয়াকে বিজ্ঞানৰ ভাষাত 'বিগ বেং' বা মহাবিস্ফোৰণ (Big Bang Theory) বুলি কোৱা হয়। এই বিস্ফোৰণৰ পিছৰ পৰাই মহাবিশ্বখন ক্ৰমান্বয়ে প্ৰসাৰিত হ'বলৈ ধৰে আৰু ইয়াৰ উত্তাপ কমি আহে। এই বিশাল প্ৰক্ৰিয়াৰ বহুত পিছত, অৰ্থাৎ প্ৰায় ৪৫০ কোটি বছৰ আগতে আমাৰ সৌৰজগতখনে এক নিৰ্দিষ্ট ৰূপ ল'বলৈ আৰম্ভ কৰে।

সৌৰজগতৰ সৃষ্টিৰ ৰহস্য সম্পৰ্কে ১৭৫৫ চনত জাৰ্মান দাৰ্শনিক ইমানুৱেল কাণ্টে প্ৰথম এটা বৈজ্ঞানিক ধাৰণা আগবঢ়াইছিল। কাণ্টৰ মতে, মহাকাশত থকা গেছ আৰু ধূলিকণাৰ এক বিশাল ঘূৰ্ণায়মান নীহাৰিকাৰ (Nebula) পৰাই আমাৰ এই সৌৰজগতখনৰ জন্ম হৈছিল। পৰৱৰ্তী সময়ত ১৭৯৬ চনত ফৰাচী গণিতজ্ঞ পিয়েরী-চাইমন লাপলাচে কাণ্টৰ এই তত্ত্বটো কিছু সংশোধন কৰি এক নতুন ৰূপ দিয়ে। ইয়াকে বৰ্তমান 'নীহাৰিকা তত্ত্ব' (Nebula Hypothesis) বুলি জনা যায়। এই মতবাদ অনুসৰি, মহাকাশত থকা এটা বিশাল উত্তপ্ত গেছীয় পিণ্ড দ্ৰুতবেগে নিজৰ কেন্দ্ৰক প্ৰদক্ষিণ কৰি থাকোঁতে লাহে লাহে সংকুচিত হ'বলৈ ধৰে। ইয়াৰ ফলত কেন্দ্ৰীয় অংশৰ উত্তাপ বহুত বৃদ্ধি পায় আৰু কালক্ৰমত ই সূৰ্যৰ ৰূপ লয়। সূৰ্যৰ চাৰিওফালে বৈ যোৱা গেছীয় পদাৰ্থবোৰৰ পৰাই একো একোটা গ্ৰহৰ জন্ম হয়।

অৱশ্যে, এই তত্ত্বটোৱে সকলো দিশ ব্যাখ্যা কৰিব নোৱাৰাৰ বাবে ১৯০৫ চনত চিকাগো বিশ্ববিদ্যালয়ৰ বিজ্ঞানী টি.চি. চেম্বাৰলিন আৰু এফ.আৰ. মউল্টনে 'গ্ৰহাণু মতবাদ' (Planetesimal Hypothesis) আগবঢ়ায়। এই মতবাদ অনুসৰি, সৌৰজগত সৃষ্টিৰ আগতে আমাৰ সূৰ্যৰ অতি কাষেৰে এটা বিশাল নক্ষত্ৰ পাৰ হৈ গৈছিল। সেই নক্ষত্ৰটোৰ প্ৰচণ্ড মহাকৰ্ষণ শক্তিৰ ফলত সূৰ্যৰ দেহৰ পৰা জোৱাৰৰ দৰে কিছু গেছীয় পদাৰ্থ বাহিৰলৈ ওলাই আহে। নক্ষত্ৰটো আঁতৰি যোৱাৰ পিছত এই অংশবোৰ সূৰ্যৰ চাৰিওফালে ঘূৰিবলৈ ধৰে আৰু কালক্ৰমত শীতল হৈ কঠিন গ্ৰহাণুৰ ৰূপ লয়। এই গ্ৰহাণুবোৰেই পৰৱৰ্তী সময়ত ইটোৱে সিটোৰ লগত লগ লাগি বৰ্তমানৰ গ্ৰহসমূহৰ সৃষ্টি কৰিছে।

একেদৰেই ১৯১৯ চনত জেমছ জিনচ আৰু হেৰল্ড জেফ্ৰিছে 'জোৱাৰ তত্ত্ব' (Tidal Theory) আগবঢ়ায়। তেওঁলোকৰ মতে, সূৰ্যৰ পৰা ওলাই অহা পদাৰ্থখিনি এটা দীঘলীয়া 'ফিলামেণ্ট' বা চিগাৰৰ দৰে আছিল। এই গেছীয় পদাৰ্থখিনিয়েই পিছলৈ চেঁচা হৈ বিভিন্ন আকাৰৰ গ্ৰহবোৰৰ সৃষ্টি কৰে। সূৰ্যৰ নিকটৱৰ্তী গ্ৰহসমূহ— যেনে বুধ, শুক্ৰ, পৃথিৱী আৰু মঙ্গল— কিয় আকাৰত সৰু আৰু কঠিন, তাৰ উত্তৰো পদাৰ্থ বিজ্ঞানে দিছে। সূৰ্যৰ অতিপাত উত্তাপৰ বাবে এই ওচৰৰ গ্ৰহবোৰত পাতল গেছবোৰ স্থিৰ হৈ থাকিব নোৱাৰি দূৰলৈ উৰি গৈছিল। আনহাতে, সূৰ্যৰ পৰা বহুত দূৰত থকা বৃহস্পতি বা শনিৰ দৰে গ্ৰহবোৰত উত্তাপ কম হোৱা বাবে সেইবোৰে গেছীয় অৱস্থাতে থাকি বিশাল আকাৰ ধাৰণ কৰিলে।

আধুনিক জ্যোতিৰ্বিজ্ঞানৰ এক গুৰুত্বপূৰ্ণ ধাৰণা অনুসৰি, সৌৰজগত সৃষ্টিৰ অন্তৰালত এটা 'ছুপাৰনোভা' (Supernova) বা নক্ষত্ৰৰ বিস্ফোৰণৰো ডাঙৰ ভূমিকা আছিল। এই বিস্ফোৰণৰ পৰা অহা তীব্ৰ জোকাৰণিয়ে মহাকাশৰ সেই প্ৰাচীন ধূলিকণাৰ মেঘটোক সংকুচিত হ'বলৈ বাধ্য কৰিছিল। আশ্চৰ্যজনক কথা এয়ে যে আমাৰ শৰীৰত থকা প্ৰতিটো মৌলই এদিন কোনোবা এটা নক্ষত্ৰৰ বিস্ফোৰণৰ ফলত সৃষ্টি হৈছিল।

সামৰণিত ক'ব পাৰি যে বিগ বেংৰ পৰা আৰম্ভ হোৱা এই যাত্ৰাই আমাক বুজাই দিয়ে যে মহাবিশ্বৰ প্ৰতিটো বস্তু ইটো সিটোৰ লগত জড়িত। আজিৰ এই সুশৃংখল সৌৰজগতখন কোটি কোটি বছৰ ধৰি চলা মহাকৰ্ষণ শক্তি আৰু পদাৰ্থ বিজ্ঞানৰ এক অপূৰ্ব বিৱৰ্তনৰ ফলাফল। যিমানেই নতুন গৱেষণা হ'ব, সিমানেই আমাৰ এই মহাজাগতিক ইতিহাস অধিক স্পষ্ট হৈ পৰিব।

## TIME:

# FROM KALA TO *RELATIVITY*

Bishal Sharma

| Alumini

**T**ime has fascinated humans for millennium is still a puzzle for physicists. In Vedic science, time (Kala) is cyclic, unfolding in vast cosmic scales—Yuga, Kalpa, Maha-Kalpa—where one day of Brahma can equal billions of human years. Time also flows differently for gods, humans, and cosmic beings, reflecting an early intuition of relative experience of time.

Modern physics, too, challenges the idea of absolute, uniform time. Einstein’s theory of relativity shows that time depends on the observer’s velocity and gravitational field. High speeds or strong gravity can dilate time, much like the Vedic notion of cosmic and earthly time flowing differently.



Both systems link time with change and evolution. In Vedic thought, all phenomena are transient (Anitya), while in physics, time’s arrow is defined by entropy and irreversible processes. Measurement of time, whether via astronomical cycles in Vedic texts or atomic clocks today, relies on repetitive natural processes.

While Vedic science and modern physics differ in methodology, their concepts converge in emphasizing that time is dynamic, relational, and intimately tied to the structure of the universe. This dialogue between ancient intuition and contemporary theory highlights humanity’s enduring quest to understand the cosmos.



*“The distinction between past, present and future is only a stubbornly persistent illusion.”*

**Albert Einstein**

## ORDER, TIME, EPISTEMIC LIMITS

### *Vedic Thoughts in Dialogue with Modern Physics*

Pratiksha Biswas

| Alumini

Modern cosmology is often portrayed as the replacement of ancient myth by mathematical precision, yet at the foundation of modern physics, it deals with questions that lie beyond observation and experiment. Before any equation can be written, physics assumes that the universe is intelligible, that its behavior is not arbitrary, and that stable patterns exist which can be discovered and described. This assumption mirrors one of the earliest cosmological insights found in the *Rig Veda*: the idea of *Rita*. It denotes the underlying order that sustains the cosmos like the regularity of celestial motion, the reliability of natural cycles, and ponders about the rationality of existence itself. Importantly, *Rita* is not depicted as a command imposed by a deity, but as a principle which even the gods are subjected to. In this sense, it functions less like divine law and more like a cosmic constraint. On the other hand, modern physics adopts a parallel stance through the concept of physical law, which is expressed via symmetries and conservation principles. These laws do not cause events, instead they define what can occur.

Modern physics, like the Vedic thinkers, does not yet explain why such order exists, instead it simply presumes it as a condition or an axiom for understanding. Physics can describe how laws operate, relate laws to systems and unify laws under deeper frameworks, but it cannot exactly answer why there are laws at all rather than chaos. The Vedic thinkers were aware of the same issue, and they named this assumed order as *Rita* and treated it as a fundamental feature of reality, which is not justified by argument or experiment, rather it is recognized as the condition that

that allows the cosmos to be comprehensible in the first place. In that sense, *Rita* plays the same role that the assumption of lawfulness plays in physics.



Once order is acknowledged, the next unavoidable question concerns change: *how does this ordered universe evolve in time?* In answer to that, Vedic cosmology gives us an image of time that is fundamentally cyclic where creation, preservation, and dissolution unfold repeatedly across immense temporal scales. This view renders beginnings and endings to be conditional rather than absolute. It states time to not be an irreversible unidirectional arrow but rather a recurring process, which is a rhythm that is embedded in the cosmos itself.

## ORDER, TIME, EPISTEMIC LIMITS

### *Vedic Thoughts in Dialogue with Modern Physics*

Modern cosmology, despite its common association with a singular Big Bang, has not yet ruled out similar possibilities like the Oscillating Universe Theory. The fundamental equations of physics are largely time-symmetric, and current models explore oscillatory universes, bouncing cosmologies, and cyclic inflation. In these frameworks, the unidirectional arrow of time may emerge from thermodynamic conditions rather than being a fundamental feature of reality. The convergence here is not ideological but instead conceptual, as both traditions resist the idea that time must originate from a single, unrepeatable event. This naturally shifts the attention from the question of when the universe began to the deeper question of what, if anything, underlies its repeated transformations.

In Vedic thought, this underlying ground is expressed as *Brahma*. *Brahma* is not a creator in the anthropomorphic sense, nor is it an object within the universe but rather the reality from which space, time, and causation themselves arise. *Brahma* is not defined by activity as it does not ‘act’ upon the universe in the way a cause acts upon an effect. Rather, it is the condition for the possibility of anything to manifest itself. Just as the laws of physics do not push particles around but constrain how motion can occur, *Brahma* is understood as that which allows phenomena to appear, persist, and dissolve without itself undergoing change.

Modern physics also encounters a similar problem when it probes the foundations of reality beneath particles and fields. The Quantum vacuum, which is far from being empty, is a structured state with dormant potential, governed by laws that permit the spontaneous emergence of particles and, in some speculative models, entire universes. Yet the

similarity must not be overstated as *Brahma* is a metaphysical claim about what ultimately exists, whereas the quantum vacuum is a theoretical scientific construct within a specific mathematical framework. Equating the two would be a semantic error but we see that both are an attempt by the human mind to articulate a level of reality that is not directly observable but without which observable phenomena cannot be coherently explained.

If it is possible for reality to emerge from such a ground repeatedly, it becomes reasonable to question whether it does so uniquely. Vedic cosmology challenges human world centrality by proposing multiple *lokas*, which are described as hierarchically ordered realms or planes of existence rather than regions separated by spatial distance. These are not parallel universes in the modern sense, but this concept challenges the assumption that the cosmos is just limited to what humans can perceive.



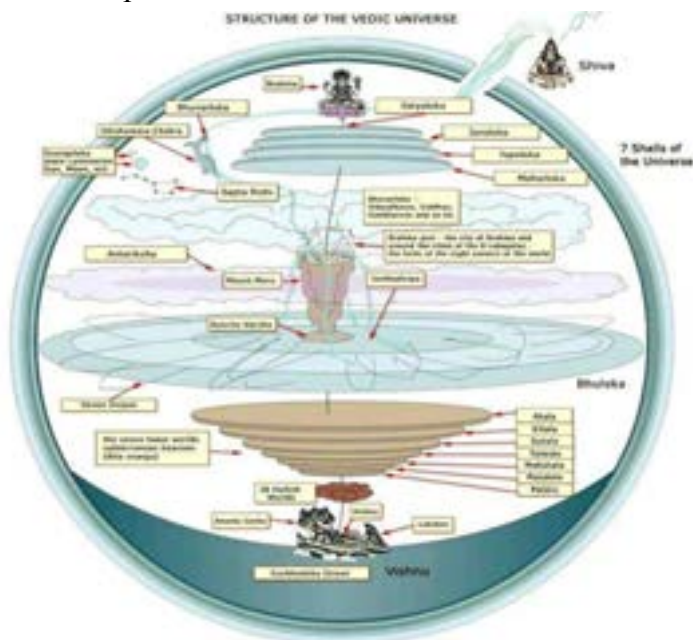
## ORDER, TIME, EPISTEMIC LIMITS

### *Vedic Thoughts in Dialogue with Modern Physics*

Modern cosmology also arrives at a similar destabilization of uniqueness but through very different means. Inflationary theory, string theory, and the many-worlds interpretations of quantum mechanics suggest that our universe may be only one realization among many permitted by deeper laws. In both cases, the implication is the recognition of the limits of human knowledge such that what we observe may be a typical, rare, or an entirely unreliable version of reality, but the difference between Vedic ideas and modern physics lies in their interpretation. *Lokas* are described as experiential and metaphysical constructs, while multiverses arise from mathematical consequences of physical theories, yet both undermine the idea that human experience occupies a privileged or central position in the vast cosmos.

questions whether anyone, regardless of being human or divine, can truly know the origin of existence. It suggests that even the highest overseer may be uncertain and shows a rare example amongst ancient literature of cosmological skepticism. This stance is remarkable not because of what it claims but because it shows acknowledgement of a boundary beyond which human explanation fails. Modern cosmology, despite its sophistication, also ends at a similar boundary such as scientific observations being unable to go past the Planck epoch, scenarios where initial conditions remain underdetermined, and the origin of physical laws themselves lying outside of current scientific explanation. At the deepest level, both Vedic and scientific ways converge on the acceptance that uncertainty is not a failure of curiosity and knowledge but rather an honest outcome of pushing that curiosity to its limits.

When viewed together, these ideas form a comprehensible progression rather than a collection of ideas with isolated parallels. Both Vedic thought and modern physics begin by assuming order to be fundamental, then deal with the structure of time itself, theorize an underlying but unreachable ground of reality and multiple worlds, and finally arrive at an acknowledgment of the limits of human understanding and discovery in their own ways. Their convergence is not supposed to be one that only gives answers but also questions. The eventual lesson that we arrive at is that the deeper our inquiry into the fabric of reality goes from either perspectives, the more essential intellectual humility becomes as it is not resignation or failure, but rather a constant endeavor despite limitations.



This trajectory of thought brings us to a striking moment of limitation found in the *Nasadiya Sukta* of the *Rig Veda* 10.129, where rather than offering a definitive account of creation, the hymn openly

## YOU CAN NEVER TOUCH ANYTHING

Abhi Sarkar

|

Alumini

**W**hen you touch a table, your hand never actually touches it. The atoms in your hand repel the atoms in the table due to electric forces between electrons. What you feel as “touch” is actually electromagnetic repulsion, not physical contact.



## The Dance of Shiva and Particle Physics

Abhi Sarkar

|

Alumini

**S**hiva's cosmic dance—Tandava—symbolizes creation, preservation, and destruction. In particle physics, particles constantly emerge and annihilate, forming and dissolving in a dynamic cosmic dance.

The universe is not static. It is a rhythm of change, where energy becomes matter, matter becomes energy, and everything flows in cycles—an eternal dance that echoes the ancient symbolism of Shiva.



**Carl Sagan**—“*The Cosmos is within us. We are made of star- stuff.*”

## Fractals: Nature's Infinite Canvas

Shrijana Sharma | Alumini

Let us think of something simple: a tree. Start with the trunk. It splits into branches. Each branch splits again into smaller ones, and those into even finer twigs. Now if we look closely, each small branch resembles the entire tree (Fig.1). The same pattern repeats again and again, at different scales, each one called a self-similar piece.

This is the essence of a *fractal*.

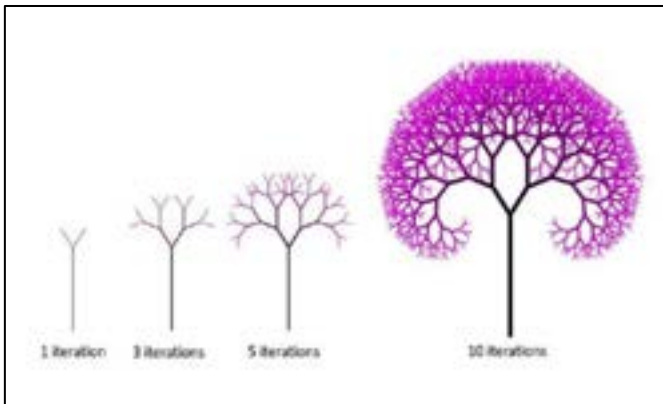


Figure 1: Fractals in a Tree

Fractals are structures defined by self-similarity, where parts resemble the whole across different scales. This is not merely visual repetition but a mathematical property arising from simple rules applied iteratively.

The departure from classical geometry is captured through the idea of **fractal dimension**. Unlike lines (dimension 1) or planes (dimension 2), fractals often exist in fractional dimensions, reflecting how detail scales with magnification.

For a self-similar object, the dimension is given by

$$D = \frac{\log N}{\log (1/r)}$$

For a self-similar object, the dimension is given by

$$D = \frac{\log N}{\log (1/r)}$$

where (N) is the number of self-similar pieces and (r) is the scaling factor. A coastline, for instance, may possess a dimension between 1 and 2 dimensions more complex than a line, yet not fully occupying a plane.

Perhaps the most striking example of fractal emergence arises from a simple iterative equation in the complex plane:

$$z_{n+1} = z^2 + c$$

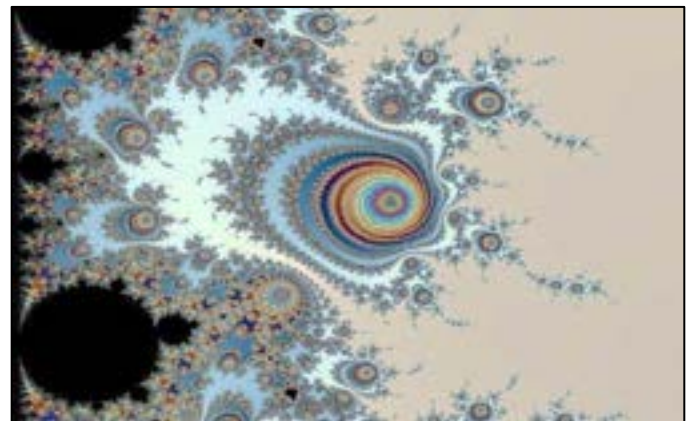


Figure 2: Mandelbrot set

The set of values for which this sequence remains bounded forms the Mandelbrot set (Fig.2). At first glance, it is just a shape in the complex plane. But zoom into its boundary and you fall into an endless descent. Spirals within spirals. Structures repeating, mutating, reappearing. No matter how far you go, the pattern never resolves into simplicity. It is not just complex. It is *infinitely unfinished*.

## Fractals: Nature's Infinite Canvas

Shrijana Sharma | Alumini

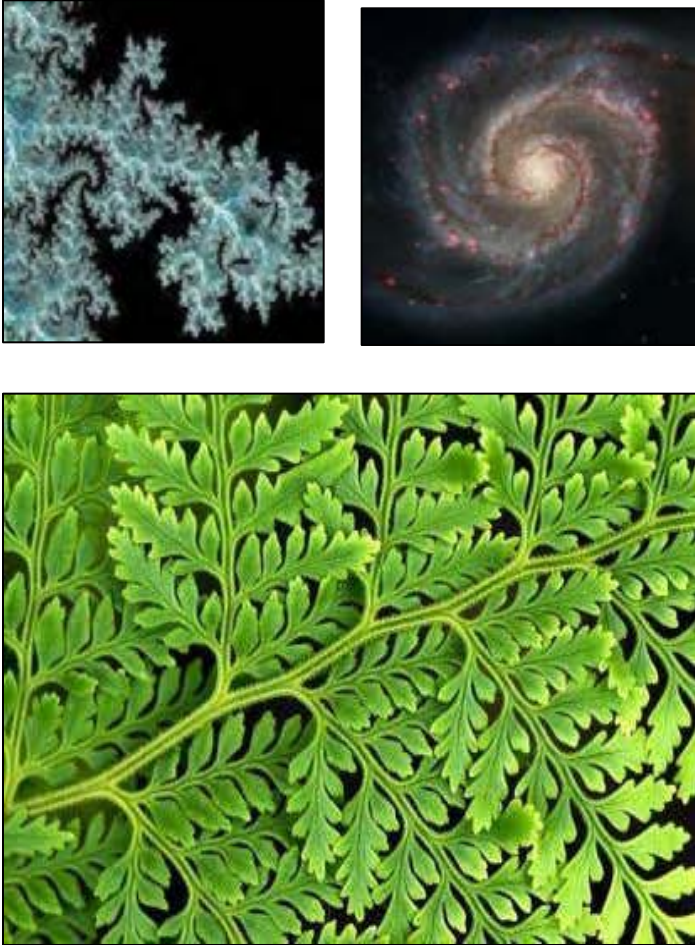


Figure 3: Fractals in Nature (Ice crystal, galaxies, Leaves)

Fractals are not confined to mathematical abstraction. They are deeply embedded in the natural world. The branching of trees and blood vessels, the structure of lungs, ice crystals, the formation of river networks, and even the jagged paths of lightning all exhibit fractal characteristics. These systems evolve through growth and division, guided by simple local rules that produce globally complex patterns.

Their relevance extends into technology and science. In computer graphics, fractals are used to generate realistic terrains and textures that mimic natural irregularity. In telecommunications, fractal antennas exploit self-similar geometries to operate efficiently across multiple frequency bands. In medicine, fractal analysis helps quantify irregular biological structures, from tumor growth to neural networks. Even in data compression, fractal-based algorithms encode images using recursive patterns, reducing storage without significant loss of detail.

Fractals ultimately challenge a long-held intuition that complexity requires complicated laws. Instead, they reveal a deeper principle: simplicity, when repeated across scales, gives rise to structures of immense richness. They blur the boundary between order and chaos, between the finite and the infinite.

## Throwing Darts at the Universe

Sourav Talukdar

| Alumini

**I**magine you're asked to calculate the value of  $\pi$ —but you're not allowed to use any formulas.

No geometry, no trigonometry, nothing. Just randomness.

So, you take a square, draw a quarter circle inside it, and start throwing darts blindly at the square (Fig.1). Some land inside the curve, some outside. At first, it feels pointless—completely chaotic. But then something strange happens. As you throw more and more darts, a pattern begins to emerge. The fraction of points inside the curve stabilizes. And from that ratio,  $\pi$  quietly reveals itself.

At first, this feels almost like cheating. Mathematics is supposed to be exact, deterministic. You follow steps, and you arrive at a precise result. But here, we're doing the opposite. We're giving up control, allowing randomness to take over—and somehow, we still arrive at truth.

Now imagine you're not estimating  $\pi$ , but trying to calculate something far more complicated—like how light behaves in a realistic scene. Every ray of light bounces, scatters, and interacts in countless ways. Writing exact equations becomes impossible. Instead, computers simulate millions of random light paths and average the results.

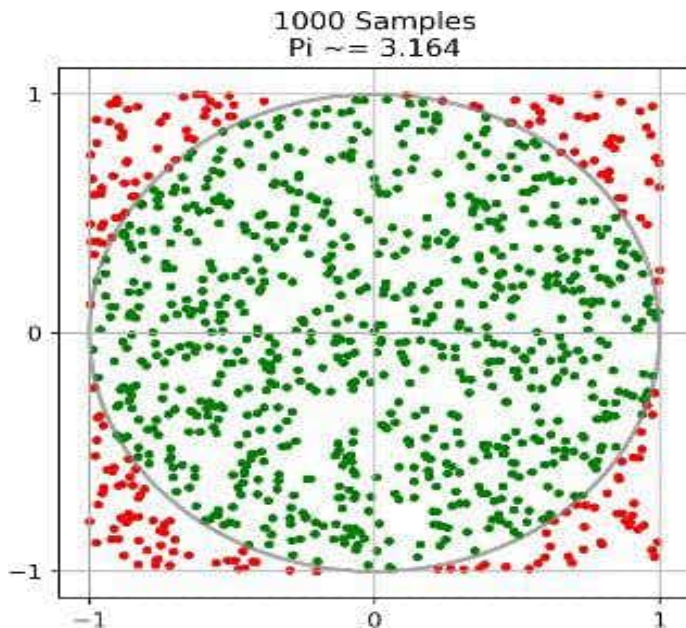


Figure 1: Darts at a square

This is the Monte Carlo method: solving problems not by direct calculation, but by letting **randomness explore the answer for you.**

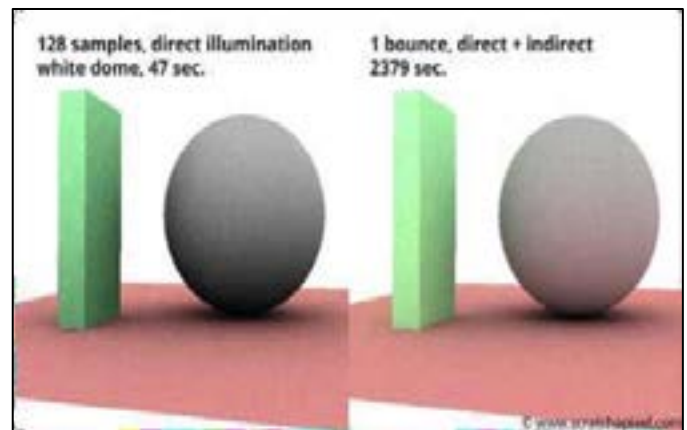


Figure 2: Simulating illumination of a white dome

This is how modern graphics works. The soft shadows in movies, the reflections in video games, the realism in animated films – all of it comes from controlled randomness. What looks like perfect realism is actually built on millions of random guesses.

# Throwing Darts at the Universe

Sourav Talukdar

| Alumini

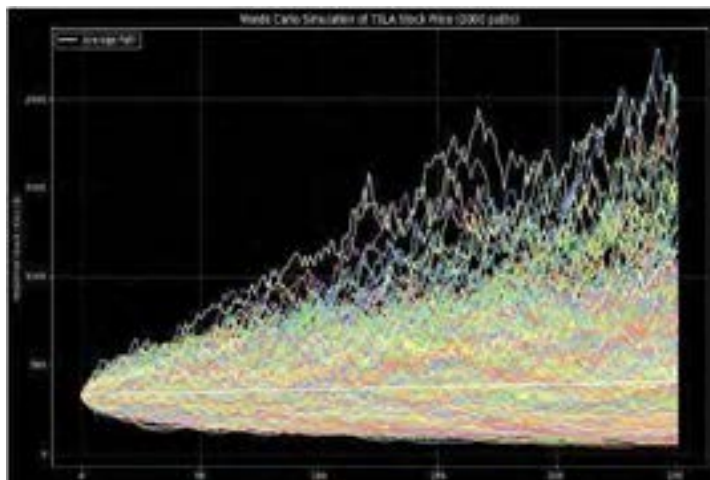


Figure 3: Monte Carlo Simulation of TSLA Stock Price

The same idea quietly runs through finance. Markets are unpredictable, influenced by countless factors. Instead of trying to predict one exact outcome, analysts simulate thousands of possible futures interstates rising, stocks falling, and unexpected shocks and observe the distribution of outcomes (Fig.3).

Each line represents a possible future. No single one is “correct,” but together they reveal risk, stability, and probability. Again, randomness is not noise—it is insight.

Then there is physics, where this idea becomes indispensable. Consider a system with trillions of particles. Tracking each one is impossible. But by randomly sampling configurations, physicists can predict macroscopic properties such as temperature and energy.

Techniques like **variance reduction** help mitigate statistical uncertainty, while methods such as **Markov Chain Monte Carlo (MCMC)** and **Quantum Monte Carlo (QMC)** facilitate sampling from complex probability distributions and simulating quantum systems. Monte Carlo methods also come in handy for predicting the **Icing model**, calculating the area under a curve, analysing Markov chains, and many other applications.

What is remarkable is that all these vastly different problems—geometry, graphics, finance, and physics—share the same strategy. At first, this may feel like surrender. But it is not. It is a shift in perspective. Rather than fighting uncertainty, we use it. Rather than avoiding randomness, we harness it.

And perhaps that is the most surprising lesson of all: sometimes, the best way to solve a problem is to stop trying to solve it directly.

# POETRY SECTION

**Step  
into a  
realm  
of  
verses  
and  
dreams**



POEM 01

# My Love Called Physics

By Ananya Khatanair

2<sup>nd</sup> SEMESTER

---

Physics is not just a subject to me. It feels like a universe I'm trapped inside – willingly.

Sometimes I sit and stare at the sky and think,  
How can something so vast still follow rules?  
How can stars burn silently,  
yet scream in equations only few understand?

They tell me physics is about numbers, formulas,  
and logic.  
But to me, it feels like poetry written in the  
language of the cosmos.

Light travels millions of years just to reach my  
eyes, and I wonder-  
did it travel just so I could exist in this moment?  
Or am I just another tiny speck in its journey?

Gravity pulls everything toward the Earth,  
but my thoughts keep floating beyond it.  
I feel small, yet strangely infinite.

Every atom inside me once belonged to a star.  
That means I am made of the same stuff as the universe.  
So am I separate from it – or am I the universe  
trying to understand itself?

When I solve a physics problem,  
It's not just math –  
it feels like unlocking a secret of existence.

Physics doesn't just explain the world.  
It makes me feel like I belong to something far greater  
than myself.

And honestly...  
That thought is both terrifying and beautiful.

# JUST ANOTHER APPLE

Shraddhashree Chakraborty  
FYUGP 2<sup>nd</sup> Semester

---

I slipped from a branch on a lazy noon,  
bonked someone's head, how dull, how soon.

Just another man beneath the tree,  
a random fate, or so it seemed to me.

Yet thought ran deep behind his gaze,  
questions bloomed in quiet ways.

A young man stood there in awe,  
and with my fall came the gravitational law.

# *Who am I, Physics?*

By Ranbir Langthasa

2<sup>ND</sup> SEMESTER

## *Physics?*

My journey started before the birth of Christ,  
When people did not know who I was.  
They stared in wonder when I arrived.

Ancient Greece — A place where knowledge grew,  
A man named Aristotle, do you know who?  
When science had no name of its own.  
His loom of philosophy wove my garment,  
Stitched in beliefs and thoughts alone.

I walked a mile, reached a new town,  
“Eureka! Eureka!”  
Shouted a man, running naked brown,  
Drenched in the streets of Syracuse, he gives me a book.  
On the measurement of Circle, the book reads.  
The Father of Mathematics says, “I am Archimedes.”

As the sun set, my foot touched Italy, Padua.  
A man sat on his roof — using telescope, aimed at the sky above Mantua.  
The Pendulum in his lawn, mimicked my heartbeat,  
“Arghh!” Two stones struck my head, at exact same beat.  
Galileo laughed, “That’s science for you, Thief!”

The sun rose — rural Woolsthorpe blazed.  
Cool wind led me through a garden mazed.  
I sat beside a man beneath an apple tree,

Soon an apple fell on my dreamin-head.  
I heard him say,  
“Something must’ve pulled it tight — Gravity!”

He laughed and pointed behind a bunch of trees.  
We went into his house — filled with theories,

# *Who am I, Physics?*

My face couldn't settle down — I remained starstruck.  
 I could only say,  
 "Newton, Truth is ever to be found in you, not luck."

I stumbled across a man, standing in the streets of France.  
 He said, "Hello, young boy — wanna know how fibres dance?"  
 I nodded happily, he showed me his Torsion balance in glow.  
 A silver wire twisting inside, I asked, "Why does it move so?"  
 He smirked, "That's written in my name — Coulomb's Law."

Coulomb bid me off — I reached Great Britain.  
 Few steps in, I heard people whisper, "Is he sane?"  
 How can these forces of nature be the same, the crowd laughed aloud.  
 Yet the man remained calm, his explanation didn't ring a bell,  
 Goats didn't know they were questioning Lord Maxwell.

My sights set — on the jungle red.  
 The sun reflected through the leaves it bred.  
 A train whistled, echoing through the trees,  
 They say it is a steam train — A human marvel.  
 But I say, it is thermodynamics on wheels.

Crossed the jungle, met a sign reading, "Dead end"  
 Below, a dark, small puddle — where even the light bend.  
 But I knew beneath lay a grave of larger reality,  
 An unknown abyss of endless possibility.

I hesitated, my foot trembled.  
 Soon my eyes woke up to a probabilistic gleam.  
 Even I didn't know — How I slipped into Quantum realm.

My journey didn't end last day nor will it today.  
 Even the Immortals follow what I say.

Though I have grown through the my journey,  
 Meeting great minds in the streets of settled town.  
 I am a great riddle, where countless answers can be found.  
 But If you think I have aged — You are a clown.

# Where Certainty Breaks

Sayani Chakraborty  
FYUGP 4<sup>th</sup> Semester

The universe did not begin  
with formulas.  
It began by happening—  
stars burning without explanation,  
stones falling without permission,  
time moving forward  
without asking if we were ready.

Much later,  
we started naming things.

Motion first.  
Then force.  
We learned that change obeys patterns,  
that paths can be predicted,  
that nature repeats itself  
if we listen carefully enough.  
For a while,  
certainty felt earned.

But light refused simplicity.  
It moved too fast,  
crossed empty space  
as if distance meant nothing.  
Some tried to slow it down with logic,  
others tried to trap it in waves.  
It escaped both,  
leaving behind equations  
that worked  
even when understanding did not.

Before equations learned how to speak,  
there were only questions—  
heavy, unanswered,  
sometimes ignored.

A boy once watched apples fall.  
Not just one, Many.  
And he wondered not why they fell—  
everyone knew they did—  
but why they never missed the Earth.

Newton was not chasing fruit.  
He was chasing something invisible,  
something stubborn.  
In quiet rooms and unfinished thoughts,  
motion slowly became law,  
force began to make sense,  
and the universe, reluctantly,  
accepted mathematics as its grammar.

Even then, certainty was weak.

Maxwell joined electricity and magnetism  
almost by accident,  
with equations so balanced  
that light had no option  
but to reveal itself as a wave.

For a moment,  
nature hesitated—  
as if it had spoken too clearly.

Time did not remain well-behaved.

Einstein trusted doubt  
more than tradition.  
Gravity was no longer a pull—  
it became a curve,  
a slow bending of space itself,  
where mass and geometry  
learned to speak to one another.

# Where Certainty Breaks

At smaller scales,  
particles refused to behave like objects.  
Electrons stopped choosing paths.  
Probabilities replaced answers.  
Observation itself began to interfere.

Physics grew careful.  
And humble.

No great theory arrived complete.  
They were assembled slowly—  
from wrong turns,  
half-finished notebooks,  
arguments between colleagues,  
and the courage to admit,  
“I don’t understand this yet.”

What textbooks now compress into  
chapters, was once confusion.  
What we solve in exams  
once kept brilliant minds awake at night.

So when we write symbols on a page,  
do not think of them as answers.  
Think of them as attempts—  
marks left by people  
trying to understand the world  
with honesty and patience.

Physics is not waiting for perfection.  
It is waiting for curiosity—  
quiet, persistent,  
and brave enough  
to keep asking  
even when the answer is unclear.

# Closed System

Hiya Moni Kalita  
FYUGP 4th Semester

We began in equilibrium--  
equal forces,  
no net loss.

You were gravity,  
I stayed in orbit  
without question.

Then mass shifted.  
You called it distance.  
I called it drift.

I kept supplying energy,  
you conserved yourself.

Friction did the rest.

This wasn't decay--  
it was design.

A closed system,  
where one body worked  
until failure  
was inevitable.

# Life a Lesson

By Nishant Paul

6<sup>th</sup> semester

Life is a lie unless you can prove yourself  
A shadow that dances with nobody else.  
We wander through echoes, hoping they stay,  
But silence replies when dreams drift away.  
The mirror reflects who we claim to be,  
But only the soul holds the truest key.

Beneath every smile, a battle is worn,  
A heart stitched up, still weathering scorn.  
They'll doubt your fire, they'll dim your light,  
Until you rise and burn through the night.  
No borrowed words, no borrowed grace  
You forge your worth in your own space.

So speak with your steps, not just your tongue,  
Let deeds declare where you belong.  
Life is a stage, but truth won't pretend,  
It waits in choices you made till the end.  
A lie it remains, the world and its shelf  
Life is a lie... unless you can prove yourself.

# পদাৰ্থৰ সংগীত

ৰিয়ামনি খাটনিয়াৰ

| ৪ৰ্থ ষাণ্মাসিক

নিষ্কন্ধ অন্ধকাৰত জ্বলি উঠে  
এটা ক্ষুদ্ৰ কণাৰ আলোক  
ইলেক্ট্ৰনৰ নৃত্যতেই  
জন্ম লৈ পৃথিৱীৰ গতি- চাণ্ড।

সময় বৈ যায় আপেক্ষিকতাত,  
আইনষ্টানৰ চিন্তাৰ পাখি মেলি,  
স্থান আৰু কাল একেডাল সূতাত  
ব্ৰহ্মাণ্ডখন গতি কৰে ধীৰে-ধীৰে চলি।

নিউটনৰ আপেল মাটিলে নামিলে  
প্ৰশ্ন এটাই জন্ম ল'লে মনে- মনে,  
বল আৰু ভৰৰ বন্ধনেতই  
নিয়ম গঢ়িলে প্ৰকৃতিৰ কোণে-কোণে।

তৰংগ হৈ আহে শব্দ আৰু পোহৰ,  
কণাও হয় - দুয়োটাই একে সঁচা,  
কোৱান্টামৰ বহস্যই ক'লে-  
নিশ্চয়তা মাথোঁ ভ্ৰম, সম্ভাৱনাই ইয়াৰ উক্তি।

উৰ্জা নাশ নহয়, ৰূপ সলাই চলে,  
আগুন, বিদ্যুত, জীৱনৰ স্পন্দন,  
পদাৰ্থ বিজ্ঞানেই শিকালে আমাক  
পৰিবৰ্তনেই চিৰন্তন সৃজন।

সৰল সমীকৰণৰ মাজেতই লুকাই  
ব্ৰহ্মাণ্ডৰ গভীৰ কাব্য,  
বিজ্ঞান মাথোঁ এক সূত্ৰ নহয় -  
ইয়ে চিন্তাক দিয়ে অসীম সাধ্য।

# কোলাহল

~ ড° ভূপালী শৰ্মা  
সহযোগী অধ্যাপক

প্ৰভাতী সূৰ্য্যৰ সেন্দূৰীয়া আভা,  
নিৰ্মল অনুভূতি মনোমুগ্ধকৰ ।  
ছেঃ !  
ক'ৰ পৰা আহিছে এই শব্দবোৰ ?  
উপভোগ কৰিব যে পৰা নাই মই,  
প্ৰকৃতিৰ অনুপম এই সৌন্দৰ্য্য ।  
ব্যাঘাত জন্মাইছে মোৰ সুখানুভূতিত,  
কি এই শব্দ ?  
পিৰালীতে বহি ভাবি ব'লো মই ।  
মোৰ শ্ৰৱণ শক্তি আছেনে ঠিকেই?  
কিন্তু মইচোন বুজি পোৱা নাই,  
উৎস কি এই শব্দৰ ?  
যেন কোলাহল কিহবাৰ ।  
অ' বুজিছো এতিয়া, আন একো নহয়,  
এয়া মোৰ অন্তৰাত্মাৰ কোলাহল ।

## **EVENTS IN OUR DEPARTMENT**



Alumini Meet



Cultural Rally Team  
2025



Wall Magazine 2025  
Theme: Medi-Physica



Society Connect Program 2025



Students attending  
Gauhati University Foundation Day  
2025



Einstein's Day Celebration  
2025

## **EVENTS IN OUR DEPARTMENT**



Kalavatika 2025



Farewell of 2022-2025 Batch



Celebration of Vikram Sarabhai Birthday with a Guest Lecture by Dr. Sanjeev Kalita, Assistant Professor, Dept. of Physics, G.U.



Celebration of National Space Day 2025



Teachers' Day Celebration 2025



Departmental Freshmen Social 2025

## **EVENTS IN OUR DEPARTMENT**



Vishwakarma Puja  
2025



**Popular Talk** on Quantum Tunneling and  
Nobel Prize by Prof. Prabin Kumar Saharia



Wall Magazine 2026  
Theme: Veda-Physica



Cultural Rally 2026



Students attending  
Gauhati University Foundation Day  
2026



Society Connect Program 2026

## ***EVENTS IN OUR DEPARTMENT***



Workshop on Design Thinking and IPR  
by Prof. Krishna Kingkar Pathak



Popular talk on " Raw Ideas and IPR " on  
the occasion of National Science Day  
Celebration.



Biweekly Students Seminar Talk  
by the First Group From 2nd Sem

## **DEPARTMENT ACHIEVEMENTS**

RESEARCH PUBLICATION IN THE DEPARTMENT:  
APRIL 2025 ---- MARCH 2026

PHYSICAL REVIEW B **112**, 214432 (2025)

### **Evidence of Griffiths-like clustered phase and nonuniversal critical behavior in the double perovskite $\text{Er}_2\text{NiMnO}_6$**

Dipak Mazumdar<sup>1,\*,†</sup> and I. Das<sup>2</sup>

<sup>1</sup>Department of Physics, Arya Vidyapeeth College (Autonomous), Arya Nagar, Guwahati 781016, Assam, India

<sup>2</sup>Condensed Matter Physics Division, Saha Institute of Nuclear Physics, HAF Bidhannagar, Kolkata 700064, India

 (Received 23 June 2025; revised 14 November 2025; accepted 21 November 2025; published 15 December 2025)

The Griffiths phase (GP), a state of magnetic disorder persisting above the Curie temperature ( $T_C$ ), is frequently observed in rare-earth and transition-metal oxides, often leading to anomalous quantum critical fluctuations near  $T_C$ . In this study, we investigate the ordered double perovskite  $\text{Er}_2\text{NiMnO}_6$  (ENMO), uncovering similar critical instabilities through detailed magnetic, magnetocaloric, and heat capacity measurements and analysis. The derived critical exponents near the critical region,  $T_C$  [ $\alpha = -0.942(1)$ ,  $\beta = 1.081(8)$ ,  $\gamma = 0.765(6)$ , and  $\delta = 1.731(7)$ ] deviate significantly from all known universality classes of magnetism, yet they satisfy the

Chaos, Solitons and Fractals 214 (2025) 117727



Contents lists available at ScienceDirect

**Chaos, Solitons and Fractals**

journal homepage: [www.elsevier.com/locate/chaos](http://www.elsevier.com/locate/chaos)



### **Universal nonlinear scaling of quantum tunneling with isotope mass**

Krishna Kingkar Pathak<sup>✉</sup>

Department of Physics, Arya Vidyapeeth College, Guwahati 781016, India

## **DEPARTMENT ACHIEVEMENTS**

RESEARCH PUBLICATION IN THE DEPARTMENT:  
APRIL 2025 ---- MARCH 2026

Eur. Phys. J. Plus (2025) 140:1069  
<https://doi.org/10.1140/epjp/s13360-025-07031-3>

THE EUROPEAN  
PHYSICAL JOURNAL PLUS

Regular Article



### Hyperfine structure of *B* and *D* mesons in a QCD-inspired potential model

Krishna Kingkar Pathak<sup>\*</sup>

Department of Physics, Arya Vidyapeeth College, Guwahati 781016, India

Received: 29 September 2025 / Accepted: 4 November 2025

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Journal of Magnetism and Magnetic Materials 626 (2025) 273143

Contents lists available at ScienceDirect



Journal of Magnetism and Magnetic Materials

journal homepage: [www.elsevier.com/locate/jmmm](http://www.elsevier.com/locate/jmmm)



Research article

### Study of magnetic and magnetocaloric properties of polycrystalline $\text{Pr}_{0.6}\text{Ca}_{0.4}\text{MnO}_3$ compound

Kalipada Das<sup>\*,1</sup>, Amanulla Karikar<sup>2</sup>, Dipak Mazumdar<sup>3</sup>, I. Das<sup>3</sup>

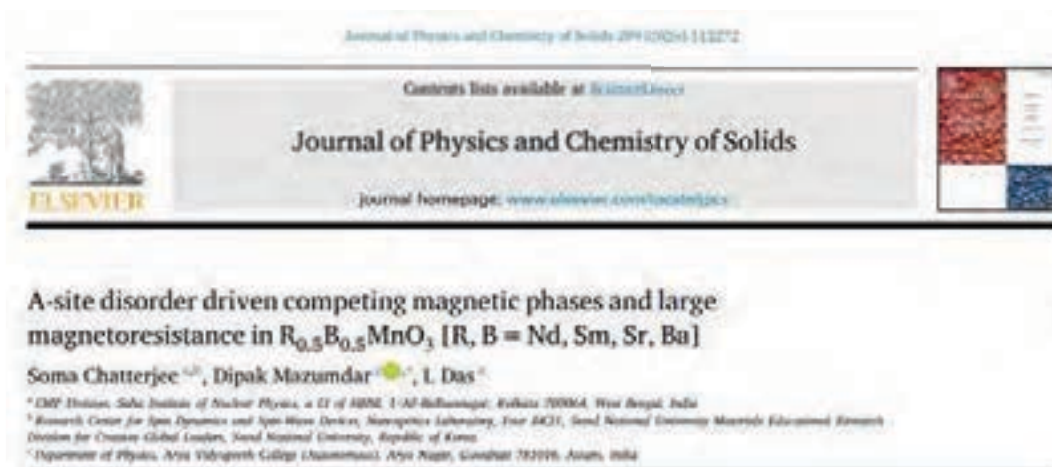
<sup>\*</sup> Department of Physics, Seth Anandram Jaisuria College, 10 Raja Subodhchandra Street, Kolkata 700005, India

<sup>1</sup> Indian Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India

<sup>2</sup> Department of Physics, Arya Vidyapeeth College (Chowmahalla), Arya Nagar, Guwahati 781036, Assam, India

## **DEPARTMENT ACHIEVEMENTS**

RESEARCH PUBLICATION IN THE DEPARTMENT:  
APRIL 2025 ---- MARCH 2026



# **DEPARTMENT ACHIEVEMENTS**

## **PATENT PUBLICATION IN THE DEPARTMENT:**

**APRIL 2025 ---- MARCH 2026**

1. MODULAR SOLAR POWERED PHONE CHARGING STATION  
DESIGN NO. 465797-001




# **DEPARTMENT ACHIEVEMENTS**

**PATENT PUBLICATION IN THE DEPARTMENT:**  
**APRIL 2025 ---- MARCH 2026**

## **2. BIOCHAR DISPENSING DEVICE DESIGN NO. 484033-001**



Design Number	484033-001	
Class	15-03	
<p>I. Dr. Krishna Kingkar Pathak Assistant Professor (III), Department of Physics, Arya Vidyapeeth College, Gowahati – 781 006 Dist: Kamrup (M), Assam, India 2. Dr. Roshmi Boruah Assistant Professor, The Assam Royal Global University, Bokoachi, Opp. Tirupati Balaji Temple/ ISBT, NH-37, Gowahati-35, Dist- Kamrup (Metro), Assam, India 3. Er. Mehedi Alam Assistant Manager, The Assam Royal Global University, Bokoachi, Opp. Tirupati Balaji Temple/ ISBT, NH-37, Gowahati-35, Dist- Kamrup(Metro), Assam, India 4. Dr. Sankar Barman Associate Professor, The Assam Royal Global University, Bokoachi, Opp. Tirupati Balaji Temple/ ISBT, NH-37, Gowahati-35, Dist- Kamrup (Metro), Assam, India</p>		
Date of Registration	16/12/2025	
Title	BIOCHAR DISPENSING DEVICE	
Priority NA		



## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



#### *Eclipse: A Digital Automated Library Management System*

Eclipse is a smart library system developed to modernize and simplify library operations. It uses a Raspberry Pi 4, Arduino microcontroller, touch LCD display, barcode scanner, and RFID scanner to automate book borrowing and returning. Books are identified through barcodes, while users log in using RFID cards, ensuring quick and secure access. The system was developed by Moyukh Surjya Basistha, Hrishikesh Mahanta, Emmanuel Hrangkol, and Samarjyoti Das, reflecting the department's effort toward smart and efficient digital infrastructure.

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



Bishal Sharma joined IIT(BHU), Varanasi with a JAM rank of 396. Also got a JEST rank of 153.



3rd Price in Wall Painting Competition

During College Week

(Awardee: Sitotpal Mukherjee,  
Shibom Das,  
Pratiksha Biswas,  
Richika Bujarbaruah,  
Jyotiprasad Barman,  
Bhumika Mahanta)

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



Best Poster Prize in Competition  
held at Gauhati University,  
Department of Physics

(Awardee:

Sahill Sarkar,  
Jyotiprasad Barman,  
Samriddha Sharma)



1st Price in Extempore Speech  
(Awardee: Pratiksha  
Biswas)



3rd Price in Extempore Speech  
(Awardee: Samriddha  
Sharma)

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



3rd Prize in the District -Level Essay Competition (Category C) held in honour of Deshbhakta Tarun Ram Phookun (Awardee: Jakir Hussain)



Consolation Price For Best Eco Sensitive Celebration  
of Departmental Fresher's Social

# **DEPARTMENT ACHIEVEMENTS**

## ACHIEVEMENT BY STUDENTS



Aditya Raj, a 3rd year student achieved 1st rank in the Pharma Track and 8th rank in Sales & Marketing Track of Naukri Campus Young Turks 2025.



Risha Barman from 2nd Semester got Gold Medal in "2nd All India Open Wadokai Karate Championship 2025"

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



From Right to Left:

Talk Presentation Competition

1st Prize (Raja Sharma, Didwm Daimary and Ankita Borah)

3rd Prize (Raghunandan Rajbongshi)

2nd Prize (Tisha Sahani, Sneha Roy and Diya Paul)



Prakriti Gupta and Dipangkar Nath got 3<sup>rd</sup> Position in  
Wall Painting Competition During College Week

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



Riyamoni Khataniar got 1<sup>st</sup> Position in  
Self -composed poem recitation Competition  
(Birth anniversary celebration of Jnanpith Awardee Nilmani Phookan).



Bhumika Mahanta got 1<sup>st</sup> Position in  
B.R.Ambedkar essay writing competition college level.



Namrita Gupta got 2<sup>nd</sup> Position in Essay  
writing Competition.

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



Bhumika Mahanta got 2<sup>nd</sup> Position in  
Trash to Treasure ( College week)



Hiya Moni Kalita got 2<sup>nd</sup> Position in  
On spot picture based Story writing ( College week)



Sudipta Sarkar got 2<sup>nd</sup> Position in  
State Level poster making competition  
(on the occasion of women's day)

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



Dhritanshu Bayan got 1<sup>st</sup> Position in Chess Competition during College Week



Hema Prabha Boro got  
Position 1<sup>st</sup> in Khokho  
Position 1<sup>st</sup> in Kabaddi  
Position 2<sup>nd</sup> in Volleyball  
Position 3<sup>rd</sup> in Relay Race  
Position 1<sup>st</sup> in Cricket  
Position 2<sup>nd</sup> in Arm Wrestling  
Position 3<sup>rd</sup> Tug of War  
Position 1<sup>st</sup> in Football  
(During College Week)



Jyotiprasad Barman got  
Position 2<sup>nd</sup> in Khokho  
(During College Week)

## **DEPARTMENT ACHIEVEMENTS**

### ACHIEVEMENT BY STUDENTS



Anup Das got 1<sup>st</sup> Prize in (Assamese Category ) Essay writing competition on the occasion of National Technology Day



Prakriti Gupta, Tushar Majumdar, Sourav Das got 3rd prize in poster making competition on the occasion of Foundation day at Gauhati University.

## **GLORY OF DEPARTMENT**

**PASSED OUT BATCH: 2022 - 2025**



**Bishal Kumar Sarma**  
Indian Institute of Technology (BHU) Varanasi  
M.Sc (Physics)



**Moyukh Surjya Basistha**  
Gauhati University  
M.Sc in Instrumentation and Applied Physics



**Hrishikesh Mahanta**  
Gauhati University  
M.Sc. (Physics)



**S.K Sahil Alam**  
Gauhati University  
M.Sc. (Physics)



**Shrijana Sharma**  
Gauhati University  
MSc in Radiological Physics



**Sourav Talukdar**  
Gauhati University  
M.Sc. (Physics)

## **GLORY OF DEPARTMENT**

**PASSED OUT BATCH: 2022 - 2025**



Hussain Md Shohel  
Mizoram university  
M.Sc. (Physics)



Emmanuel Hrangkhoh  
Gauhati University  
MSc in Radiological Physics



Darshan Shrawarna  
Gauhati University  
M.Sc in Instrumentation and Applied Physics



Ainu Bhaswati  
Gauhati University  
M.Sc in Instrumentation and Applied Physics

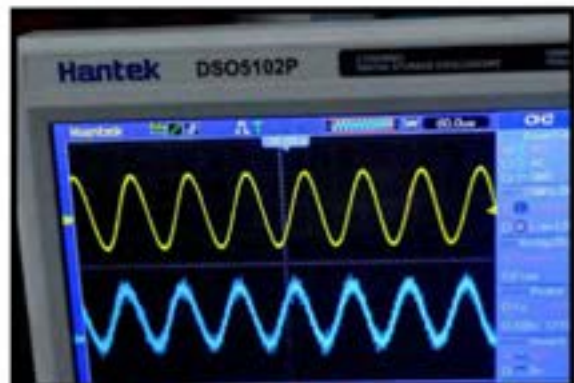


Samarjyoti Das  
Tezpur University  
M.Sc. (Physics)



Debasruti Gope  
Christ University, Pune, Lavasa  
M.Sc in Data Science

# MEMORIES OF 2025



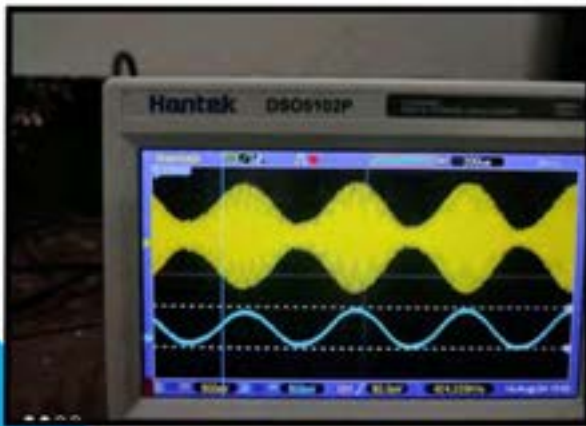
# MEMORIES OF 2025



# MEMORIES OF 2025



## MEMORIES OF 2025



# MEMORIES OF 2025



## **SOME POPULAR BOOKS ON PHYSICS**

1. Roger Penrose - The Road to Reality
2. Brian Greene- The Elegant Universe
3. Michio Kaku-The God Equation
4. Stephen Hawking - The Theory of Everything
5. Stephen Hawking - A Brief History of Time
6. George Gamow- One,Two, Three... Infinity
7. Carl Sagan- Cosmos
8. Richard Feynman- Surely you're joking, Mr Feynman
9. Carlo Rovelli- Seven Brief Lessons on Physics
10. Carlo Rovelli-The Order of Time
11. Richard Feynman-Six Easy Pieces
12. Brian Greene- The Fabric of the Cosmos
13. David Deutsch-The Fabric of Reality
14. David Deutsch-The Beginning of Infinity
15. Neil deGrasse Tyson- Astrophysics for People in a Hurry
16. Stephen Hawking- The Grand Design
17. Stephen Hawking- The Universe in a Nutshell
18. Lawrence M.Krauss- The Universe from Nothing
19. Richard Feynman - The Feynman Lectures Series
20. Albert Einstein - Relativity
21. Leonard Susskind- The Theoretical Minimum Series

