



# Physics Pulse

IIT (ISM) DHANBAD

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PHYSICS NEWSLETTER\*

## FROM HoD's DESK

By PROF. BOBBY ANTONY

Dear Students, Staff, Faculty, Alumni, and Friends of the Department of Physics:



Welcome to the first edition of "*Physics Pulse*", our new department newsletter! With great joy, I introduce this platform, which seeks to connect, inform, and inspire all members of the physics community at IIT(ISM).

As we begin this attempt, I'd like to underline our department's strong research and academic culture.

*Physics* aims to understand nature, from subatomic particles to galaxies, so that we can feel the *pulse* of our universe! This inaugural edition of "*Physics Pulse*" highlights our most recent research, profiles of faculty members, articles from the physics community, and important departmental activities. We want to highlight the outstanding research undertaken in our laboratories, as well as the dynamic student life within our department. Throughout our trip, I wish to highlight our department's strong culture of research and collaboration. Improving interdisciplinary teamwork is the main goal this year. Recognizing physics' interdisciplinary nature, we prioritize collabora-

tion with other departments and institutes. We may tackle complex situations by narrowing gaps and consolidating strengths.

Furthermore, we promote community inclusivity. Diverse perspectives improve knowledge of physics and make the learning process more engaging. Our department welcomes students and potential faculty from various backgrounds. To broaden and deepen our perspective, we participate in discussions with peers, mentors, and other experts in the field.

In conclusion, I appreciate everyone's dedication and effort. Your zeal and curiosity have converted our department into a center of discovery. Let us commemorate physics and inspire future generations to explore the universe.

Join "Physics Pulse"! Join us in this incredible adventure. We rely on your articles, news, and critiques to accurately represent our department. Let us celebrate our accomplishments, share our problems, and support one another in our search for excellence.

Thank you all.

## Spotlight



**Prof. Avijit Misra** joined on 9<sup>th</sup> September as an Assistant Professor.

[Read more »](#)

## Physics News

### A new method to 'split' electrons?

A surprising new research by our colleague shows that a weird feature of quantum mechanics can be used to produce objects that behave like half of an electron.

### C/2023: A Celestial Visitor Painting our Skies

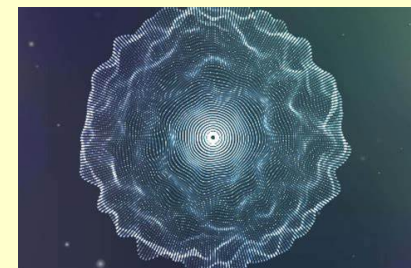


Bangalore sky seen on September 30th 2024

### Lighting Bengaluru's sky

The comet C/2023, aka Tsuchinshan-ATLAS, made a spectacular appearance in our skies at the end of September.

### Most Powerful Sound Laser, a breakthrough in phonon technology



Scientists have unveiled the world's most powerful "sound laser" to date, developed at the University of Vienna on September 28, 2024.

### A rare particle decay observed!

The CERN reports the ultra-rare decay of a positively charged kaon!

[Read more »](#)

\*Send your feedback to: [physicspulse@iitism.ac.in](mailto:physicspulse@iitism.ac.in)

## Achievements

- Dr. Kumar Swetabh, a former Ph.D. student received **RSC Advances Outstanding Student Paper Awards 2023** in Analytical Chemistry.
- Pubasha Shome (MSc 2023), got selected for PhD position in Stony Brook University, USA.
- Shantanu Sahay (MSc 2023), got selected for PhD position at Dartmouth College, USA.
- Akshat Prakash (B.Tech. 2024), got selected for Master of Science in Physics–Quantum Computing (MSPQC) at the University of Wisconsin, USA.
- Aditya Swamy (B.Tech. 2024), got selected for Master of Science in Astrophysics and Cosmology at the University of Padova, Italy.
- Sahil Yadav (B.Tech. 2024), got selected for Master's Programme in Theoretical Physics at Stockholm University, Sweden.
- Satvik Arya (B.Tech. 2024), got selected for Master's Programme in Quantum Technology at Uppsala University, Sweden.

## Spotlight

Prof. Avijit Misra graduated with a Bachelor in Physics from Ramakrishna Mission Vidyamandira, Belur Math, in 2009. Then, in 2016, he completed integrated MSc-PhD degree at Harish Chandra Research Institute (HRI), under the supervision of Prof. Arun K. Pati. He was a postdoctoral fellow at the Institute of Mathematical Sciences (IMSc) from January 2017 to September 2018. Later, he joined Prof. Gershon Kurizki's group at the Weizmann Institute of Science (WIS), Israel, in October 2018 as a PDF. He was a visiting scientist at TCG CREST, Kolkata, from December 2023 until he joined our department.

During his PhD, he mainly worked

on quantum information processing, especially the study of quantum resources for information processing and their energetic cost. During his postdoc, he worked on energy-efficient quantum technologies based on quantum optical platforms, hybrid quantum technologies, quantum metrology, and light-matter interaction-based quantum technologies.

He is currently interested in quantum information processing and communication networks based on the interaction between atoms and photons, quantum metrology in hybrid and many-body quantum systems, fixing quantum errors, and reversing and controlling the effects of decoherence when noises happen in real life. He has closely collaborated with experimentalists working with optical, atomic, and superconducting qubit facilities in his recent and ongoing research works.

## Book Editor

**Prof. Sk Riyajuddin** served as an editor of the book "Futuristic Trends in Chemical Material Sciences & Nano Technology" Vol 3, Book 20. He was adjudged Outstanding Editor for this work.

## Physics News

### A new method to 'split' electrons?

Electrons can be 'split' using quantum interference Scientists have long known that electrons are indivisible fundamental particles. Yet surprising new research shows that a weird feature of quantum mechanics can be used to produce objects that behave like half of an electron. The discovery was made by Professor Andrew Mitchell at University College Dublin in Ireland, and Dr Sudeshna Sen at the Indian Institute of Technology in Dhanbad, who are theoretical physicists studying the quantum properties of nano-scale electronic circuits. "The miniaturization of electronics has reached the point now where circuit components are just nanometers across. At that scale, the rules of the game are set by quantum mechanics, and you have

to give up your intuition about the way things work," said Dr Sen. "A current flowing through a wire is actually made up of lots of electrons, and as you make the wire smaller and smaller, you can watch the electrons go through one-by-one. We can now even make transistors which work with just a single electron.

Check out the highlighted work in the prestigious [phys.org](https://www.phys.org).

### C/2023: A celestial visitor painting our skies

Scientists estimate that C/2023 last visited Earth around 80,000 years ago, seen last by our ancestors as they were migrating from Africa! Comets, like C/2023, are essentially icy bodies composed of dust and rocks originating from the Oort Cloud, with materials that date back 4.6 billion years. As they get closer to the sun, they heat up, releasing gas and dust that create a glowing coma and a tail that streams away from the sun, producing stunning patterns in the sky.

### Most powerful sound laser, a breakthrough in phonon technology

This groundbreaking device uses a reflective cavity, a microscopic bead, and an electrode to produce a laser beam of sound particles (phonons) that is ten times more powerful and significantly narrower than previous designs. The enhanced precision could revolutionize imaging and quantum technology, allowing unparalleled control over sound at the microscopic scale.

### A rare particle decay discovered at CERN



In CERN's NA62 experiment, kaons are produced by colliding a high-intensity proton beam from the Super Proton Synchrotron (SPS) with a stationary target, generating nearly a billion particles per second. Of these, 6% are kaons, which

decay in the NA62 detector. The detector, upgraded in 2021-22, now operates at 30% higher beam intensity and collects data 50% faster. These upgrades enabled the precise detection of the ultra-rare kaon decay ( $K \rightarrow \pi\nu\nu$ ), which occurs in fewer than one in 10 billion kaons, confirmed with 5 sigma certainty.

### NQM landmark: T-Hubs announced

India's National Quantum Mission aims to position the country as a leader in quantum technology. Recently, NQM has announced the establishment of four Thematic Hubs at IISc Bengaluru, IIT Madras, IIT Bombay, and IIT Delhi to advance quantum research across key areas like computing, communication, sensing and metrology, and materials and devices.

## Events

- Mr. Saurav Lahiri successfully defended his Ph.D. thesis "Theoretical Insights on Electronic and Magnetic Properties of 2D Transition Metal Dichalcogenides and Alkaline Earth Metal Halide for Spintronics Application with Synthesis of VS<sub>2</sub> and MoS<sub>2</sub>/VS<sub>2</sub> Heterostructure" on 2<sup>nd</sup> September.
- Teacher's Day was celebrated on 5<sup>th</sup> September.
- A talk on "What are physical resources that allow exponential speed-ups in quantum computers?" was delivered by Mr. Chandan Mahato, final year Ph.D. student at IISER, Thiruvananthapuram, on 10<sup>th</sup> September.
- Director visited the department and interacted with faculty members on 19<sup>th</sup> September.

**Dr. Salam Jimkely Singh** (Ph.D. from NIT Nagaland) joined as Post Doctoral fellow with Prof. Asit Kumar Kar. His research is centered on the photocatalytic treatment of contaminated wastewater using magnetically recoverable NiFe<sub>2</sub>O<sub>4</sub>/TiO<sub>2</sub>/MWCNT ternary nanocomposite.

## Physics in History

- October is a month of atomic and nuclear physics since the pioneers of the field were born this month: James Chadwick (20<sup>th</sup> 1891), who discovered neutrons, Niels Bohr (7<sup>th</sup> 1885), who proposed the Bohr atomic model; and Homi Jehangir Bhabha (30<sup>th</sup> 1909) the father of India's nuclear program.
- It is also the Birth-month of another two great Indian scientists: Subrahmanyan Chandrasekhar, and A.P.J Abdul Kalam.
- Nuclear fission was discovered by Otto Hahn, Lise Meitner, and Fritz Strassmann. Now we know why October and Orbital starts with an 'O'!
- If you feel empty at heart this month, it's because in 1644, Torricelli demonstrated the existence of a vacuum or maybe you are missing your friend who went home for 'Durga Puja'.
- On the occasion of Dussehra (4 Oct 1957), the Soviet Union lit up the rocket to launch Sputnik 1.
- Discovery of the antiproton was announced this month in 1955 by Chamberlain and Segre.

## THE NUCLEUS FAMILY: A STRONG BOND

By **BAJARANGI SAHOO, M.SC. II YEAR**

Inside the heart of every atom, there's a strong family called the Nucleus Family, made up of protons and neutrons. They all live together in a tiny, cramped space at the center of the atom, but despite the tight quarters, they get along pretty well—most of the time. You see, protons are a bit complicated! They are positively charged. If you've ever tried to push the same sides of two magnets together, you know that positive charges

don't like being near each other! The protons, full of energy, are always trying to push each other away. It's like having siblings who keep bickering, saying, "Stay away from me!" But thankfully, there's a peacemaker in the family: the mighty, strong nuclear force! This invisible force is way stronger than the proton's desire to repel each other. It works like superglue, pulling the protons together and keeping them tightly bonded. Alongside the protons, the neutrons are the calm members of the family. They don't have any charge, so they act as peacekeepers, helping to keep things balanced and stopping the protons from arguing too much.



As long as the strong force is around, the Nucleus Family stays together. The protons might grumble from time to time, but they can't break free, no matter how hard they try to push apart. The neutrons, with their cool heads, help keep the family stable and make sure everyone stays close. Sometimes, when there are too many protons or neutrons, the nucleus starts to feel a bit crowded and stressed. The strong nuclear force can only hold so much! The nucleus might start to get a little shaky in big, heavy atoms, like uranium. When that happens, the Nucleus Family might break up in a process called radioactive decay. But don't worry—it's all part of the circle of life for atoms. At the end of the day, the Nucleus Family shows us that even though things get a bit tense and chaotic at times, the strong nuclear force is always there to keep everything together. It's what makes atoms stable and allows the universe to exist as we know it! And that's how the tiny, unseen bonds inside every atom help hold the entire universe together!

## Conference Announcement

The first announcement of 24<sup>th</sup> National Conference on Atomic and Molecular Physics was published, which will be held during 8<sup>th</sup> to 11<sup>th</sup> January 2025 at IIT(ISM) Dhanbad.

Convenor: Prof. Bobby K. Antony

Co-convenors: Prof. Sarun P. M., Prof. R. P. John, Prof. Soumya Bagchi, and Prof. Tusharkanti Dey.

Visit the [NCAMP2025 website](#) for further information, registration and submission of abstracts.

## Research Publications

1. Sapna Mahla and Bobby Antony, Photoionization of hydrogen halides using the R-matrix method, *Monthly Notices of the Royal Astronomical Society*
2. Himani Tomer, Nafees Uddin, and Bobby Antony, Ionization of sulfur clusters,  $S_n$  ( $n = 2-8$ ) by electron collisions, *Radiation Physics and Chemistry*
3. Sudeshna Sen and Andrew K Mitchell, Many-Body Quantum Interference Route to the Two-Channel Kondo Effect: Inverse Design for Molecular Junctions and Quantum Dot Devices, *Physical Review Letters*

## Physics Openings

1. **IBM research India offers research internship in quantum computing.**
2. **IIT Bombay offers internship designed to be an educational and research experience.**
3. **CERN calls for International Internship at Geneva.**
4. **Internship, Ph.D., Postdoc - Light-Matter Interactions for Quantum Technologies**
5. **Postdoc in quantum algorithms at University of Galway, Ireland**
6. **PhD Position in molecular-ion quantum technologies at the University of Basel, Switzerland**
7. **PhD Studentship in non-equilibrium quantum many-body theory at SUNY Buffalo, USA**

## Editorial Board

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